APPENDIX C – AREAS 1 AND 2 EXCAVATION OPTIMIZATION

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APPENDIX C – AREAS 1 AND 2 EXCAVATION OPTIMIZATION WEST LAKE LANDFILL SUPERFUND SITE OPERABLE UNIT 1

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JULY 2023

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LIST OF ACRONYMS

ACRONYM	Definition
BDID	below Design Investigation datum
Ci	Curie(s)
cm^3	cubic centimeter
cy	cubic yards
DI	Design Investigation
DID	Design Investigation datum
DIER	Design Investigation Evaluation Report
DOE	U.S. Department of Energy
ft	foot/feet
g	gram(s)
OU	Operable Unit
pCi	picocurie(s)
Ra-226	radium-226
Ra-228	radium-228
RD	Remedial Design
REP	Revised Excavation Plan
RIM	radiologically impacted material
RODA	Record of Decision Amendment
Site	West Lake Landfill Superfund Site
SOW	Modified Statement of Work
Th-230	thorium-230
Th-232	thorium-232
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

1.1 Purpose

This appendix to the Revised Excavation Plan (REP) has been prepared on behalf of West Lake Landfill Operable Unit 1 (OU-1) Respondents (Bridgeton Landfill, LLC, Cotter Corporation (N.S.L.), and the U.S. Department of Energy [DOE] [collectively, Respondents]) for the design of the selected Amended Remedy for OU-1 of the West Lake Landfill Superfund Site (Site), which is presented in the OU-1 Record of Decision Amendment (RODA) signed by the United States Environmental Protection Agency (USEPA) in September 2018. The RODA describes the OU-1 remedy that requires partial excavation of radiologically impacted material (RIM) containing greater than 52.9 picocuries per gram (>52.9 pCi/g) of combined thorium (thorium-230 [Th-230] plus thorium-232 [Th-232]) or combined radium (radium-226 [Ra-226] and radium-228 [Ra-228]) from Areas 1 and 2. The specific requirements are detailed below in Section 1.2 and include optimization based on depth.

The remainder of this section provides background information on the RODA requirements for optimization of the excavation, and the rest of this document is organized as follows:

- Section 2 describes the optimization for Areas 1 and 2;
- Section 3 presents the results of this evaluation and the conclusions; and
- Section 4 contains the references.

1.2 OU-1 RODA Requirements for Excavation

The requirements for the REP are provided in the Modified Statement of Work (SOW) dated July 2022 (USEPA 2022). As summarized in Section 1.3 of the SOW, the RODA (USEPA 2018) requires the following for the excavation of RIM >52.9 pCi/g to be disposed off-site:

- "Excavation of RIM from the Areas 1 and 2 of OU-1 that contains combined radium or combined thorium activities greater than 52.9 pCi/g that is located generally within 12 feet of the 2005 topographic surface." The depths are defined with respect to the 2005 topographical surface (defined as the Design Investigation [DI] datum in the Design Investigation Evaluation Report (DIER) [Parsons et al. 2023]);
- "Optimization of RIM removal above and below the 12-foot target depth (excavation as deep as 20 feet or as shallow as 8 feet) will be performed during the remedial design (RD) based on criteria set forth in Section 12.0 of the ROD[A] as discussed below:
  - If RIM greater than 52.9 pCi/g occurs between 12 and 20 feet below the surface, then evaluate and excavate where necessary to achieve long-term effectiveness and permanence objective;
  - The EPA places a priority on focusing the excavation on the higher activity occurrences of RIM. Therefore, the EPA expects the areas between 12 and 16 feet will be excavated if they are greater than 1,000 pCi/g;
  - The EPA also expects to focus the excavation in the areas between 16 to 20 feet on the higher activity occurrences of RIM (greater than 1,000 pCi/g) if it does not add significant excavation of non-RIM waste;
  - Data show that isolated pockets of RIM between 8 and 12 feet only occur in a limited number of areas; and
  - Not excavating isolated pockets of RIM between 8 and 12 feet will minimize the short-term impacts by reducing the volume of overburden and setback."

In addition, Section 3.8 of the SOW indicates the REP will include "final design-level delineation and supporting evaluation of the optimized excavation locations considering such factors as:

- Isolated pockets between 8 and 12 feet that, if excavated, would require large volumes of non-RIM waste as overburden and setback; and
- Higher concentrations of RIM>12 feet and <20 feet to be excavated in order to remove the activity represented by RIM greater than 52.9 pCi/g between the surface and 16 feet".

These requirements are the basis of the evaluation presented in this appendix for Areas 1 and 2.

2.0 OPTIMIZATION

As described in Appendix B of the REP, the total activity of RIM >52.9 pCi/g in Areas 1 and 2 from 0 to 16 feet below DI datum (ft BDID) is 61.7 Curies (Ci) and is considered the baseline amount of activity for removal throughout this appendix. The extent and depth (to 20 ft BDID) of the RIM >52.9 pCi/g are also presented in Appendix B of the REP. Section 12.2 of the RODA lists the following objectives for optimizing excavations of RIM >52.9 pCi/g:

- "Minimize total volume of landfill waste to be excavated to reduce short-term impacts (e.g., worker risk, odors, construction time, fugitive dust, bird and wildlife attractants, potential for impacted stormwater, potential to cause impacts to groundwater during excavation);
- The excavation strategy will be focused on removing higher radioactivity occurrences of RIM; and
- Maintain the same level of long-term effectiveness and permanence associated with the Proposed Plan Preferred Remedy [i.e., total activity present in the 0- to 16-ft BDID interval] by removal of the same total amount of radioactivity."

From a practical standpoint, these objectives have the following implications in terms of developing the engineering design and implementing the construction:

- Minimizing the area of disturbance minimizes the landfill waste to be excavated and reduces the secondary short-term impacts mentioned above. In addition, a minimized area reduces site preparation and the overall duration of remedial action. Therefore, whenever possible, deeper excavations should be directly under shallower excavations to minimize the area of disturbance.
- As excavations get deeper, the excavation efficiency decreases and execution time increases (e.g., equipment cycle times increase due to longer reaches); therefore, deeper excavations should be focused on areas of higher radioactivity.

In accordance with the objectives and practical considerations discussed above, the following general approach was used to develop an optimized excavation plan for Areas 1 and 2:

- Assume RIM >52.9 pCi/g within 0 to 8 ft BDID will be excavated and disposed off-site.
- Assume RIM >52.9 pCi/g at depths of 8 to 12 ft and 12 to 16 ft BDID that generally coincides with the 0- to 8-ft BDID excavation footprint will be excavated and disposed off-site.
  - For RIM >52.9 pCi/g being left in place from 8 to 12 ft and/or 12 to 16 ft BDID based on this evaluation, check for RIM >1,000 pCi/g within these depths. If present, consider including it in the excavation, depending on its location relative to other excavations.
  - Estimate the activity being removed and disposed off-site from 8 to 16 ft BDID based on this evaluation and compare it to the total activity present between 8 and 16 ft BDID.
- Identify sub-areas of RIM >52.9 pCi/g within 16 to 20 ft BDID that are located within the general excavation footprint of the 0- to 16-ft BDID removals and estimate the activity present in each sub-area. Select sub-areas or portions of sub-areas for excavation and disposal based on amount of activity that needs to be offset because of material being left in place from 8 to 16 ft BDID, as estimated in the previous bullet.
  - Preference should be given to sub-areas with higher activity (i.e., >1,000 pCi/g). If activity cannot be offset, re-evaluate including RIM >52.9 pCi/g at 8 to 12 ft and 12 to 16 ft BDID that is outside the footprint of the 0- to 8-ft BDID excavation.
  - Preferably continue 0- to 16-ft BDID side slope angle down into the 16- to 20-ft BDID excavation to avoid increasing overburden removal by maintaining the original 0- to 16-ft BDID frustum shape.
  - Select deeper 16- to 20-ft BDID high-activity zone excavations to coincide, to the extent practicable, with adjacent excavations where overburden removal is already occurring.

The optimization process described herein involved a collaborative effort between the engineering design team and the geostatistics team. The methods for estimating total activity of RIM >52.9 pCi/g are presented in Appendix B of the REP. During optimization, the engineering team requested activity calculations for specific polygons or lobes that contained RIM >52.9 pCi/g within 0 to 20 ft BDID. These calculations were performed using the same methods as presented in Appendix B of the REP but with smaller, polygon-specific subsetting of the activity model. This subsetting included evaluating small depth intervals and/or bisecting areas of RIM >52.9 pCi/g based on what RIM >52.9 pCi/g was being considered for excavation or to remain in place.

The process of subsetting and calculating activity was iterative. Revisions to excavation extents based on including and excluding lobes of RIM >52.9 pCi/g (in accordance with the RODA required the geostatistics team to re-evaluate the total activity of the modified area(s). This process was considered complete when the estimated total activity of the optimized excavation balanced the baseline amount of radioactivity to be removed (i.e., the radioactivity present from 0 to 16 ft BDID in Areas 1 and 2, which is the RODA requirement).

The optimization of RIM >52.9 pCi/g excavation and off-site disposal for Areas 1 and 2 is described in the following subsections. It includes offsetting RIM >52.9 pCi/g that will remain in place in Area 1 from 8 to 16 ft BDID with material that will be excavated from 16 to 20 ft BDID in Area 2.

2.1 Area 1 Optimization

The extent of RIM >52.9 pCi/g by depth interval (0 to 8 ft, 8 to 12 ft, and 12 to 16 ft BDID) in Area 1, as defined by the geostatistical model in Appendix B of the REP, is depicted on Figure 2.1a. Each of the pdfs included in this appendix are layered; therefore, layers showing individual depth intervals can be turned on or off. Figures showing where RIM >52.9 pCi/g is present in each individual depth interval are also provided separately as Figures 2.1b through 2.1d. Volumes and activities of RIM >52.9 pCi/g for the 0- to 16-ft BDID interval and the optimized excavation for Area 1 are summarized in Tables 2.1 and 2.2. Figure 2.2a depicts the extent of the Area 1 optimized excavation to remove RIM >52.9 pCi/g.

In accordance with the approach described above, the Area 1 excavation was optimized as follows:

- RIM >52.9 pCi/g within 0 to 8 ft BDID will be excavated and disposed off-site (see Figure 2.2b).
- RIM >52.9 pCi/g at 8 to 12 ft and/or 12 to 16 ft BDID within the general 0- to 8-ft BDID excavation footprint will be excavated and disposed off-site (see Figure 2.2c for 8 to 12 ft and Figure 2.2d for 12 to 16 ft).
- Sub-areas with RIM >1,000 pCi/g were also considered as potential priorities for removal. The extent of deeper RIM >52.9 pCi/g (i.e., between 8 and 16 ft BDID) was evaluated to identify specific sub-areas that could potentially be left in place to minimize the area of disturbance and excavation and handling of significant volumes of overburden, non-RIM waste material, and RIM <52.9 pCi/g.
  - Figure 2.2d depicts the locations of targeted excavations at 12 to 16 ft BDID to remove RIM >1,000 pCi/g (i.e., Sub-Areas U and V). These sub-areas will be excavated and disposed off-site since they are within the planned lateral extent of 0- to 12-ft BDID excavations in Area 1, and the removal of these sub-areas will not require the excavation of significant amounts of additional overburden, non-RIM waste material, or RIM <52.9 pCi/g beyond what is necessary to remediate the 0- to 12-ft BDID interval.
  - Figures 2.3a and 2.3b depict the sub-areas of deeper RIM >52.9 pCi/g (i.e., Sub-Areas A through G) that were considered for optimization in Area 1 based on their locations relative to shallower excavations and/or the limited amount of activity present.
    - Sub-Areas A and B from 12 to 16 ft BDID will remain in place because they contain a minimal amount of activity; therefore, it is not efficient to remove them at that depth.

- Sub-Areas C through G at 8 to 12 or 12 to 16 ft BDID will remain in place since RIM >52.9 pCi/g is not present in the overlying materials and excavation of RIM >52.9 pCi/g would require removal of significant overburden, non-RIM waste material and RIM <52.9 pCi/g. For example, Sub-Area C would require excavation of 520 cubic yards (cy) of overburden, non-RIM waste material, and RIM <52.9 pCi/g (see Attachment 1) for the removal of 10 cy containing 0.001 Ci; therefore, the total volume to activity ratio is approximately 530,000 cy/Ci, which is significantly higher than the 3,500 cy/Ci ratio for the overall excavation (see Table 2.2 for total volume and activity of optimized excavation).

Figure 2.4 presents a comparison of the extent of RIM >52.9 pCi/g present in Area 1 from 0 to 16 ft BDID to the optimized RIM >52.9 pCi/g excavation extent. Table 2.2 summarizes the total volumes and activities of RIM >52.9 pCi/g present in the 0 to 16 ft BDID interval and in the optimized excavation.

As shown in Table 2.2, when compared to the total volume and activity of RIM >52.9 pCi/g present from 0 to 16 ft BDID in Area 1, the optimization described above results in a reduction in total excavation volume from 42,700 cy to 28,900 cy with only a slight reduction in total activity removed (i.e., 8.3 Ci instead of 8.5 Ci). Although there is RIM >52.9 pCi/g present at 16 to 20 ft BDID in Area 1 (see Appendix B of REP for details), it would require removal of significantly more overburden, non-RIM waste material, and RIM <52.9 pCi/g to reach such pockets; therefore, the 0.2 Ci that will not be removed from Area 1 will be offset through the excavation of additional activity from deeper excavations in Area 2, as described in Section 2.2.

2.2 Area 2 Optimization

The extent of RIM >52.9 pCi/g by depth interval (0 to 8 ft, 8 to 12 ft, 12 to 16 ft, and 16 to 20 ft BDID) in Area 2, as defined by the geostatistical model in Appendix B of the REP, is depicted on Figure 2.5a. Each of the pdfs included in this appendix are layered; therefore, layers showing individual depth intervals can be turned on or off. Figures showing where RIM >52.9 pCi/g is present in each individual depth interval are also provided separately as Figures 2.5b through 2.5e. Volumes and activities of RIM >52.9 pCi/g for the 0- to 16-ft BDID interval and the optimized excavation for Area 2 are summarized in Tables 2.3 and 2.4. Figure 2.6a depicts the extent of the Area 2 optimized excavation to remove RIM >52.9 pCi/g from 0 to 18 ft BDID.

In accordance with the approach described above, the Area 2 excavation was optimized as follows:

- RIM >52.9 pCi/g within 0 to 8 ft BDID will be excavated and disposed off-site (see Figure 2.6b).
- RIM >52.9 pCi/g at 8 to 12 ft and/or 12 to 16 ft BDID within the general 0- to 8-ft BDID excavation footprint will be excavated and disposed off-site (see Figure 2.6c for 8 to 12 ft BDID and Figure 2.6d for 12 to 16 ft BDID).
- Sub-areas with RIM >1,000 pCi/g deeper than 16 ft BDID were also evaluated and prioritized for removal to offset RIM >52.9 pCi/g that will be left in place resulting from optimization in both Areas 1 and 2.
  - Figure 2.6e depicts the locations of targeted excavations at 16 to 18 ft BDID to remove RIM >1,000 pCi/g (i.e., Sub-Areas W, X, Y, and Z) to offset activity that will be left in place in the 8- to 16-ft BDID interval in both Areas 1 and 2. These sub-areas were selected for excavation and off-site disposal because they are located within planned 0- to 16-ft BDID excavations, and they will not require excavating significant additional overburden beyond what is necessary to remediate the 0- to 16-ft BDID interval.
- The extent of deeper RIM >52.9 pCi/g (i.e., between 8 and 16 ft BDID) was evaluated to identify specific sub-areas that could potentially be left in place to minimize the excavation and handling of significant volumes of overburden, non-RIM waste material, and RIM <52.9 pCi/g.

- Figures 2.7a and 2.7b depict the identified sub-areas of deeper RIM >52.9 pCi/g (Sub-Areas H through N) that were considered for optimization in Area 2 based on their locations relative to the 0- to 8-ft BDID excavation.
- Sub-Area H at 12 to 16 ft BDID (see Figures 2.7a and 2.7b) will remain in place since it represents a limited volume of RIM >52.9 pCi/g (12 cy) and activity (0.001 Ci); therefore, it is not efficient to remove it for disposal off-site.
- Sub-Areas I through N (see Figures 2.7a and 2.7b) at 8 to 12 and 12 to 16 ft BDID will remain in place since these sub-areas are located in areas where RIM >52.9 pCi/g is not present in the overlying materials, and excavation of RIM >52.9 pCi/g would require removal of significant overburden, non-RIM waste material, and RIM <52.9 pCi/g.
  - For Sub-Areas I and J, approximately 22,000 cy of overburden, non-RIM waste material, and RIM <52.9 pCi/g (see Attachment 1) would need to be excavated to access approximately 1,300 cy of RIM >52.9 pCi/g (see Figure 2.7a). The total volume to activity ratio would be about 72,000 cy/Ci, which is significantly higher than the 3,700 cy/Ci ratio for the overall excavation (see Table 2.4 for total volume and activity of optimized excavation); therefore, these sub-areas will remain in place.
  - The volumes of Sub-Areas K, L, and M are very small with minimal estimated activity (i.e., less than or equal to 0.001 Ci) present. In addition, to excavate Sub-Areas L and M, approximately 660 cy of overburden, non-RIM waste material, and RIM <52.9 pCi/g (see Attachment 1) would need to be excavated to access approximately 24 cy of RIM >52.9 pCi/g (see Figures 2.7a and 2.7b). The total volume to activity ratio would be about 342,000 cy/Ci, which is significantly higher than the 3,700 cy/Ci ratio for the overall Area 2 excavation (see Table 2.4 for total volume and activity of optimized excavation); therefore, these sub-areas will remain in place.
  - For Sub-Area N, approximately 1,600 cy of overburden, non-RIM waste material, and RIM <52.9 pCi/g (see Attachment 1) would need to be excavated to access approximately 60 cy of RIM >52.9 pCi/g (see Figure 2.7a). The total volume to activity ratio would be about 550,000 cy/Ci, which is significantly higher than the 3,700 cy/Ci ratio for the overall excavation (see Table 2.4 for total volume and activity of optimized excavation); therefore, Sub-area N will remain in place.

Figure 2.8 presents a comparison of the extent of RIM >52.9 pCi/g present in Area 2 from 0 to 16 ft BDID to the optimized RIM >52.9 pCi/g excavation extent. Table 2.4 summarizes the total volumes and activities of RIM >52.9 pCi/g present in the 0 to 16 ft BDID interval and in the optimized excavation to 18 ft BDID.

As shown in Table 2.4, when compared to the total volume and activity of RIM >52.9 pCi/g present from 0 to 16 ft BDID in Area 2, the optimization described above results in a reduction in total excavation volume from approximately 222,200 cy to 197,200 cy with a slight increase in total activity removed (i.e., 53.5 Ci instead of 53.2 Ci). The excavation of the additional 0.3 Ci from Area 2 will offset the 0.2 Ci deficit from Area 1 with a buffer of 0.1 Ci.

3.0 RESULTS AND CONCLUSIONS

Table 3.1 below summarizes the results from Section 2. Specifically, it provides the volume and activity of RIM >52.9 pCi/g and volume of overburden/non-RIM waste material/RIM <52.9 pCi/g that would require removal under the following two scenarios:

- If RIM >52.9 pCi/g present from 0 to 16 ft BDID in Areas 1 and 2 were to be excavated (i.e., the baseline scenario in accordance with the RODA).
- If the removal of RIM >52.9 pCi/g in Areas 1 and 2 was optimized based on the requirements in the RODA that are specified in Sections 1.2 and 2, above.

Figures 2.4 and 2.8 provide comparisons of the extent of RIM >52.9 pCi/g from 0 to 16 ft BDID and the optimized RIM >52.9 pCi/g excavation extents for Areas 1 and 2, respectively. Optimization performed for Area 1 and 2 results in the following:

- Removal of 61.8 Ci of activity, which is slightly higher than the total activity of 61.7 Ci estimated for RIM >52.9 pCi/g in the 0- to 16-ft BDID interval in Areas 1 and 2 (i.e., the baseline scenario).
- Removal in Areas 1 and 2 of 143,100 cy of overburden/non-RIM waste material/RIM <52.9 pCi/g to access 83,000 cy of RIM >52.9 pCi/g, as compared to the baseline that requires removal of 180,300 cy of overburden/non-RIM waste material/RIM <52.9 pCi/g to access 84,600 cy of RIM >52.9 pCi/g. This equates to a reduction of approximately 21 percent (%) in overburden volume and approximately 2% in RIM >52.9 pCi/g volume as compared to the baseline scenario.
- The area of disturbance of the optimized excavation is reduced by approximately 87,200 sf (2 acres) as compared to the baseline scenario (see Attachment 1 for areas).

Based on these results, the optimization achieves the RODA requirements by balancing the baseline and optimized activity and reducing the short-term impacts through less removal volume and area of disturbance.

4.0 REFERENCES

Parsons et al., 2023. *Design Investigation Evaluation Report: West Lake Landfill Superfund Site Operable Unit 1*. Prepared on behalf of the West Lake Landfill OU-1 Respondents by Parsons, Feezor Engineering, Inc., and Ameriphysics. January 31, 2023.

USEPA, 2018. *Record of Decision Amendment, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1*, September 2018.

USEPA, 2022. *Remedial Design Modified Statement of Work (SOW) Operable Unit 1, West Lake Landfill Superfund Site, City of Bridgeton, St. Louis County, State of Missouri,* July 2022.

TABLES

TABLE 2.1 AREA 1 RIM >52.9 pCi/g VOLUMES AND ACTIVITIES

	Area 1 RIM >52.9 pCi/g 0 to 16 ft BDID		Area 1 Optimized RIM >52.9 pCi/g Excavation	
Depth Intervals (ft BDID)	RIM Volume[1] (cubic yards)	Total Activity[2] (Ci)	RIM Volume[1] (cubic yards)	Total Activity[2] (Ci)
0 to 8	6,500	6.4	6,500	6.4
8 to 12	1,900	1.4	1,800	1.4
12 to 16	1,300	0.7	380	0.5
Total 0 to 16	9,700	8.5	8,700	8.3
		Difference:	- 1,000	-0.2

[1] RIM >52.9 pCi/g volume in this table is a neat (or bank) volume from the geostatistical model (see Appendix A of REP).
[2] Activities were estimated using a bulk density of 1.47 gram/cubic centimeter (g/cm^3)(see Section 2.2 of REP).

TABLE 2.2 AREA 1 VOLUMES AND ACTIVITIES SUMMARY

Area 1 – Excavation of RIM >52.9 pCi/g 0 to 16 ft BDID	
Total Volume (cubic yards)	42,700
Volume of RIM >52.9 pCi/g[1]	9,700
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[2,3]	33,000
Total Activity (Ci)	**8.5**
Area 1 – Optimized RIM >52.9 pCi/g Excavation	
Total Optimized Excavation Volume (cubic yards)	28,900
Volume of RIM >52.9 pCi/g[1]	8,700
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[1,3]	20,200
Total Activity (Ci)	**8.3**

[1] RIM >52.9 pCi/g volume in this table is a neat (or bank) volume from the geostatistical model. Volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g include excavation slopes of 1.5 horizontal to 1 vertical (based on 29 CFR Part 1926 Subpart P – Occupational Safety and Health Administration excavation requirements), and were estimated using the Blender software that was used to develop the design drawings, as discussed in the main text of the REP.
[2] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g for sub-areas to remain in place were estimated as shown in Attachment 1.
[3] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g were estimated from the existing surface, not the DID.

TABLE 2.3 AREA 2 RIM >52.9 pCi/g VOLUMES AND ACTIVITIES

	Area 2 RIM >52.9 pCi/g 0 to 16 ft BDID		Area 2 Optimized RIM >52.9 pCi/g Excavation	
Depth Intervals (ft BDID)	RIM Volume[1] (cubic yards)	Total Activity[3] (Ci)	RIM Volume[1] (cubic yards)	Total Activity[3] (Ci)
0 to 8	51,600	39.8	51,600	39.8
8 to 12	17,300	11.4	17,000	11.4
12 to 16	6,000	2.0	4,800	1.7
Total (0 to 16)	74,900	53.2	73,400	52.9
16 to 20	Not Applicable	Not Applicable	920	0.6
RIM Excavation	74,900	53.2	74,300	53.5
		Difference:	-580	+0.3

[1] RIM >52.9 pCi/g volume in this table is a neat (or bank) volume from the geostatistical model (see Appendix A of REP).
[2] Excavation from 16 to 20 ft BDID is not applicable because the basis of comparison is Area 2 from 0 to 16 ft BDID.
[3] Activities were estimated using a bulk density of 1.47 g/cm^3 (see Section 2.2 of REP).

TABLE 2.4 AREA 2 VOLUMES AND ACTIVITIES SUMMARY

Area 2 – Excavation of RIM >52.9 pCi/g 0 to 16 ft BDID	
Total Volume (cubic yards)	222,200
Volume of RIM >52.9 pCi/g[1]	74,900
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[2,3]	147,300
Total Activity (Ci)	**53.2**
Area 2 – Optimized RIM >52.9 pCi/g Excavation	
Total Optimized Excavation Volume (cubic yards)	197,200
Volume of RIM >52.9 pCi/g[1]	74,300
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[1,3]	122,900
Total Activity (Ci)	**53.5**

[1] RIM >52.9 pCi/g volume in this table is a neat (or bank) volume from the geostatistical model. Volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g include excavation slopes of 1.5 horizontal to 1 vertical (based on 29 CFR Part 1926 Subpart P – Occupational Safety and Health Administration excavation requirements), and were estimated using the Blender software that was used to develop the design drawings, as discussed in the main text of the REP.
[2] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g for sub-areas to remain in place were estimated as shown in Attachment 1.
[3] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g were estimated from the existing surface, not the DID.

TABLE 3.1 SUMMARY OF AREA 1 AND 2 VOLUMES AND ACTIVITIES

RIM >52.9 pCi/g 0 to 16 ft BDID (Baseline)			
	Area 1	**Area 2**	**Total Area 1 and 2**
Total Volume (cubic yards)	42,700	222,200	264,900
Volume of RIM >52.9 pCi/g[1]	9,700	74,900	84,600
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[2,3]	33,000	147,300	180,300
Total Activity (Ci)	**8.5**	**53.2**	**61.7**
Optimized RIM >52.9 pCi/g Excavation			
	Area 1	**Area 2**	**Total Area 1 and 2**
Total Optimized Excavation Volume (cubic yards)	28,900	197,200	226,100
Volume of RIM >52.9 pCi/g[1]	8,700	74,300	83,000
Volume of Overburden, Non-RIM material, and RIM Material <52.9 pCi/g[1,3]	20,200	122,900	143,100
Total Activity (Ci)	**8.3**	**53.5**	**61.8**

[1] RIM >52.9 pCi/g volume in this table is a neat (or bank) volume from the geostatistical model (see Appendix A of REP). Volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g include excavation slopes of 1.5 horizontal to 1 vertical (based on 29 CFR Part 1926 Subpart P – Occupational Safety and Health Administration excavation requirements), and were calculated using the Blender software that was used to develop the design drawings, as discussed in the main text of the REP.

[2] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g for sub-areas to remain in place were estimated as shown in Attachment 1.

[3] The volumes of overburden, non-RIM material, and RIM material <52.9 pCi/g were estimated from the existing surface, not the DID.

FIGURES

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PREPARED FOR

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REGION VII

ON BEHALF OF

WEST LAKE LANDFILL OU-1
RESPONDENTS

FIGURE 2.1a

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PARSONS

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Syracuse, NY 13212
Ph: 315-451-9560

Area 1 Extent of RIM >52.9 pCi/g 0-16 feet BDID

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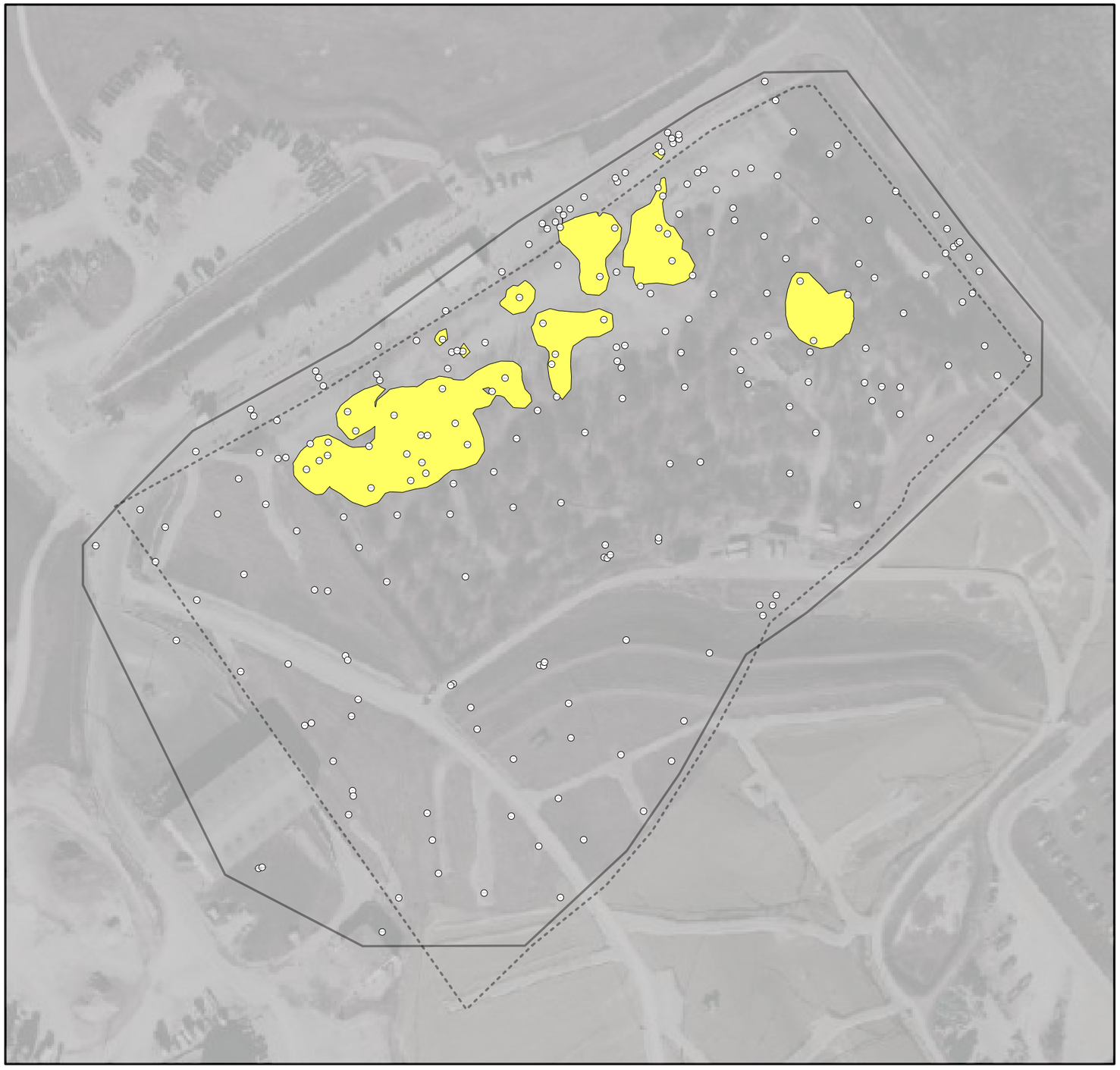

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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OU-1 REMEDIAL DESIGN
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FIGURE 2.1b

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PARSONS

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Area 1 Extent of RIM >52.9 pCi/g 0-8 feet BDID

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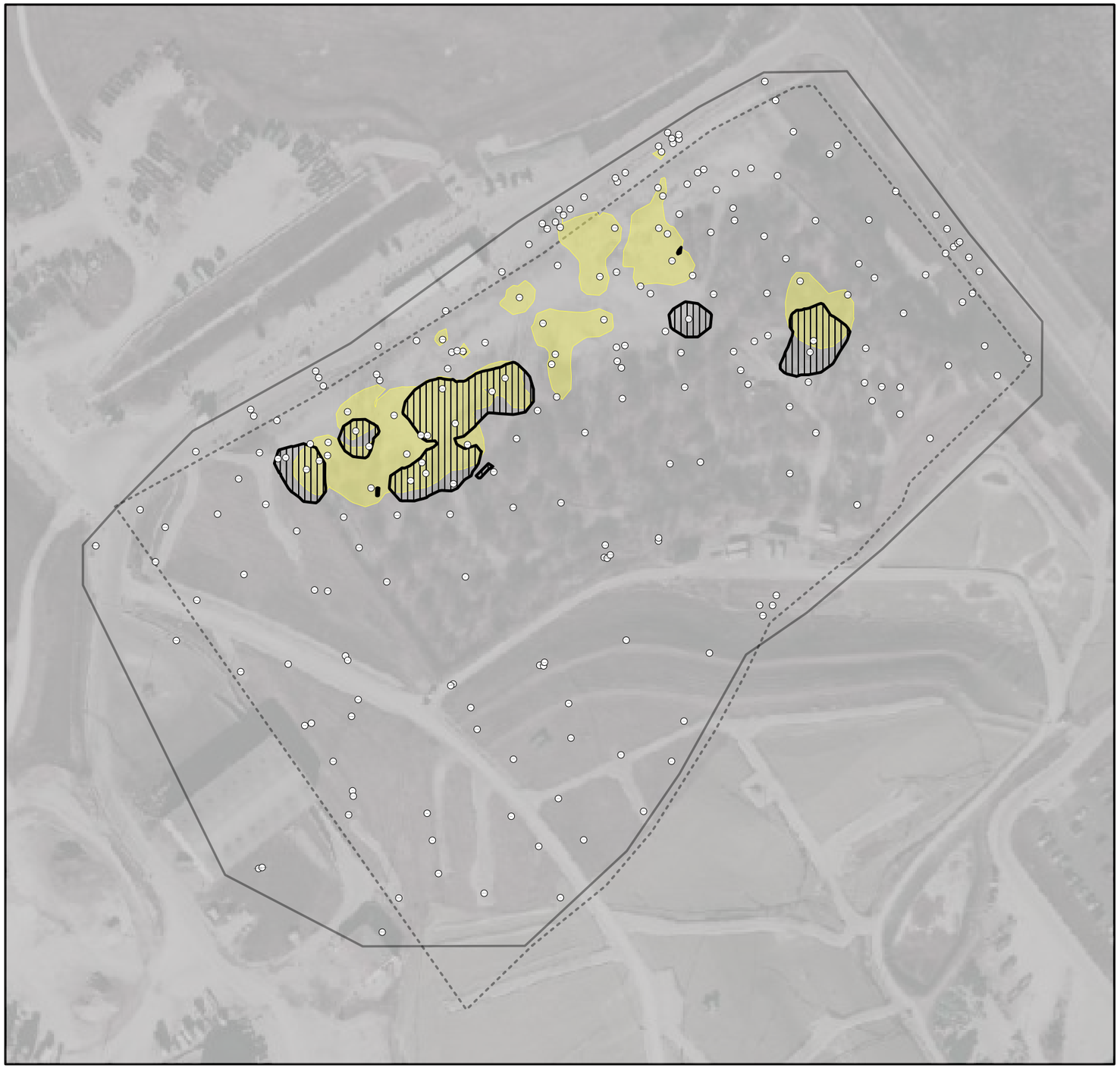

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

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FIGURE 2.1c

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Area 1 Extent of RIM >52.9 pCi/g 8-12 feet BDID

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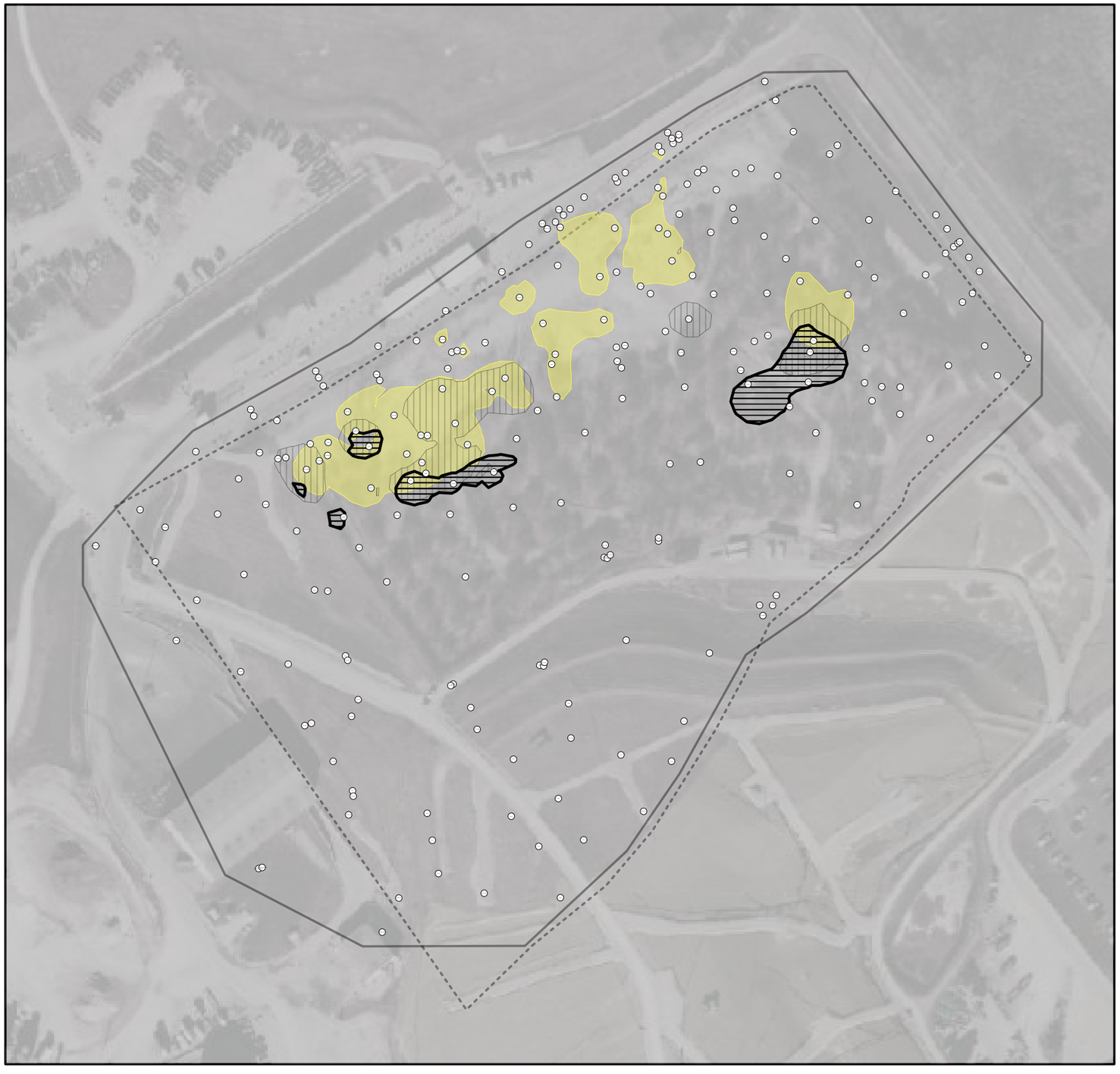

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.1d

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Area 1 Extent of RIM >52.9 pCi/g 12-16 feet BDID

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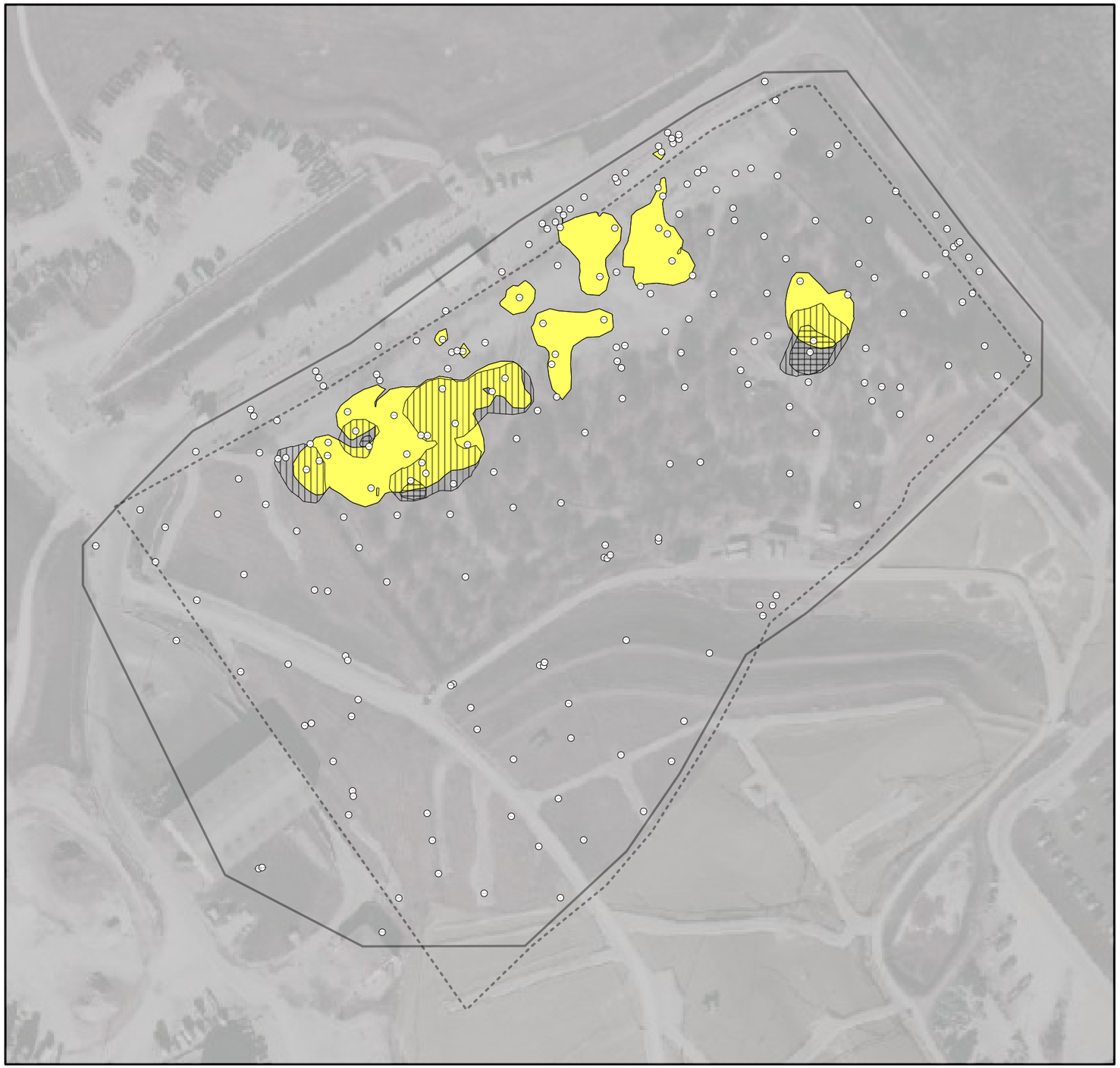

N

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.2a

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Area 1 RIM >52.9 pCi/g to be Excavated from 0-16 feet BDID

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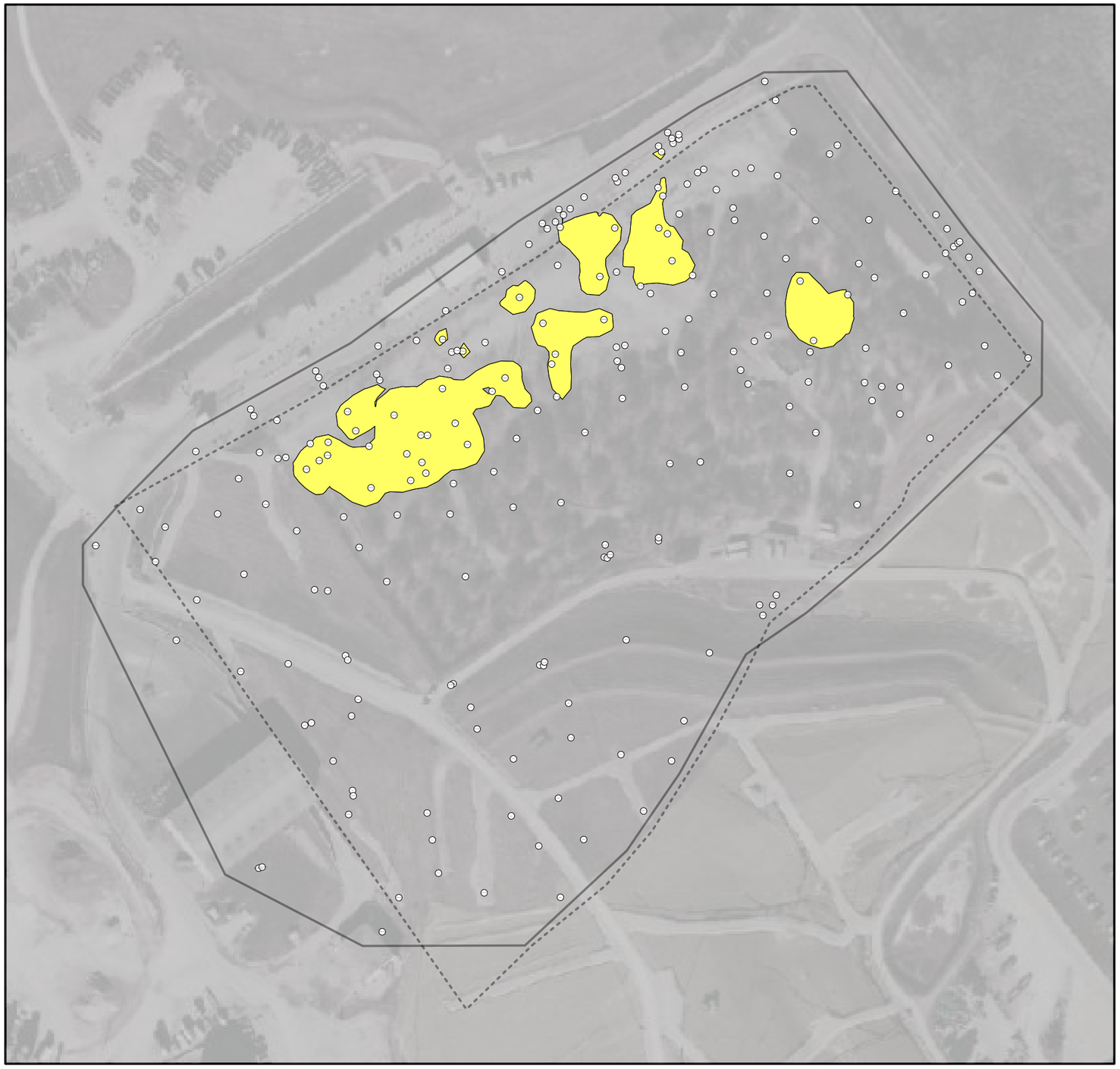

N

Legend

RIM Extent 0-8 ft BDID
(March 2023, Non-Zero Nugget)

Area Boundary

Geostatistical Model Boundary

A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.2b

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Area 1 RIM >52.9 pCi/g to be Excavated from 0-8 feet BDID

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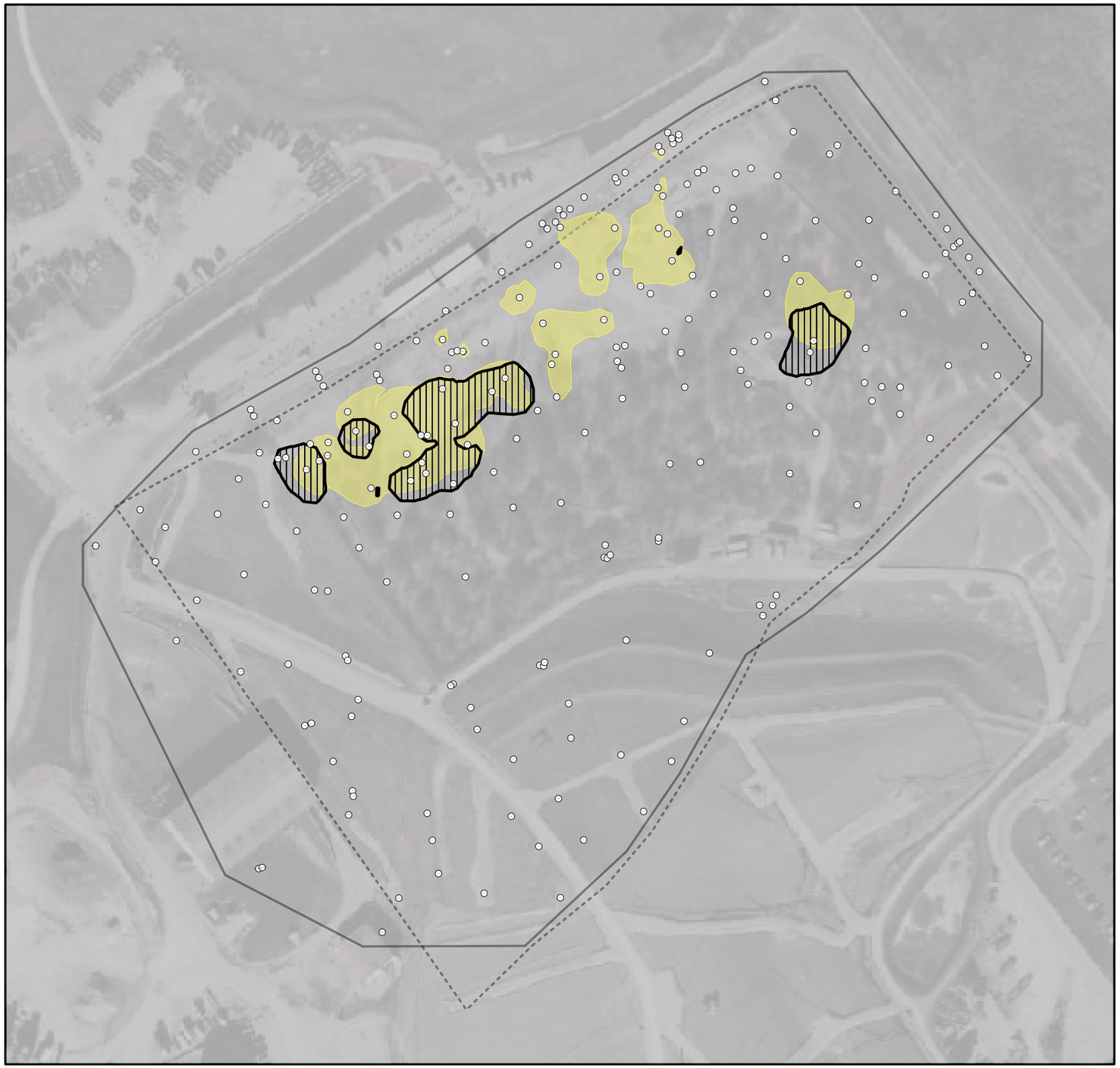

N

Legend

RIM Extent 0-8 ft BDID
(March 2023, Non-Zero Nugget)

RIM Extent 8-12 ft BDID
(March 2023, Non-Zero Nugget)

Area Boundary

Geostatistical Model Boundary

A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.2c

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Area 1 RIM >52.9 pCi/g to be Excavated from 8-12 feet BDID

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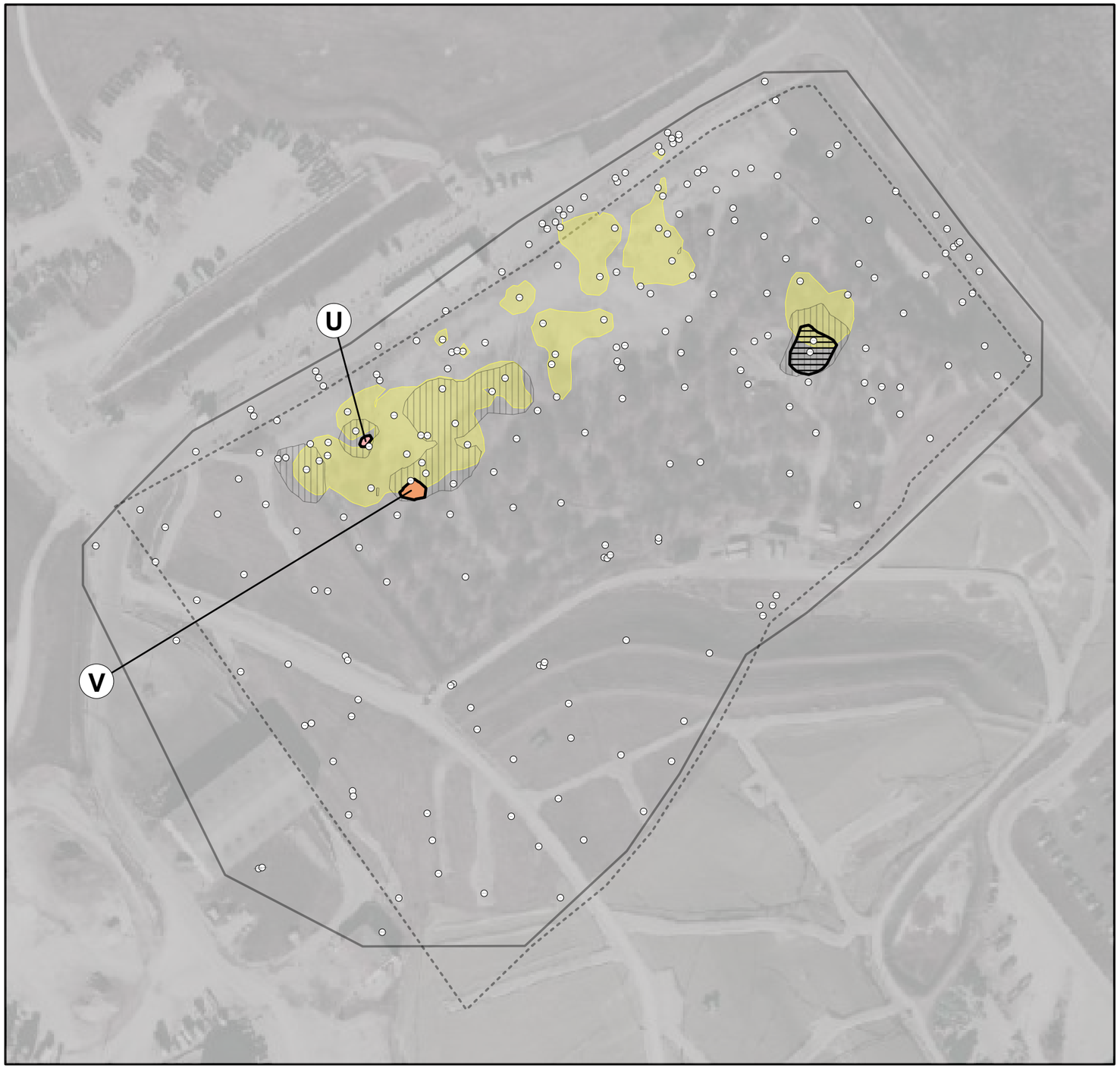

Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
U	12-13	2	0.002
V	12-14	20	0.039

N

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- RIM >1000 pCi/g 12-13 ft BDID
- RIM >1000 pCi/g 12-14 ft BDID
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.2d

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Area 1 RIM >52.9 pCi/g to be Excavated from 12-16 feet BDID

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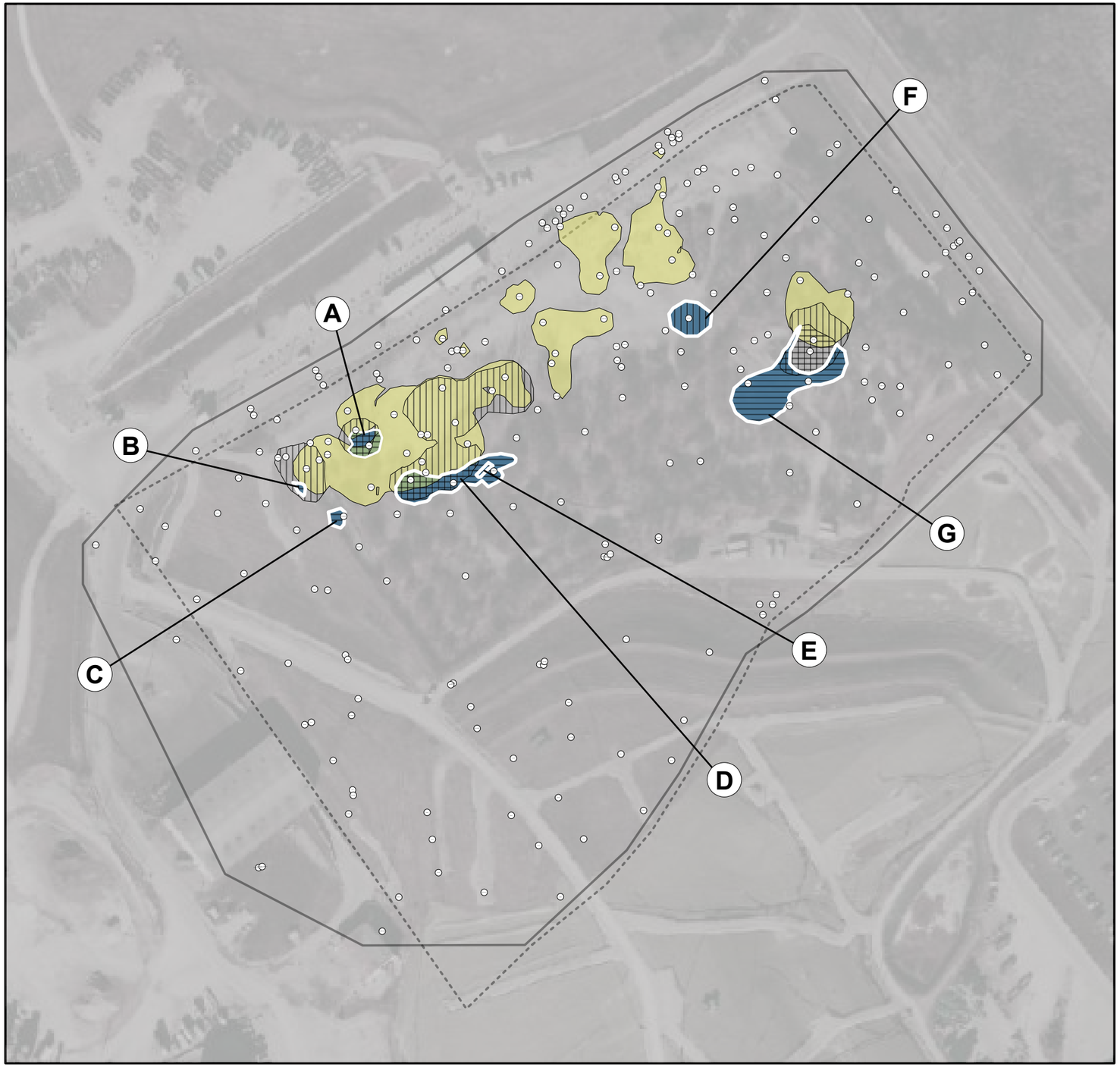

Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
A	12-16	45	0.015
B	12-16	1	<0.001
C	12-16	10	0.001
D	12-16	254	0.065
E	8-12	1	<0.001
F	8-12	122	0.017
G	12-16	580	0.151

Legend

- **RIM Extent 0-8 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 8-12 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 12-16 ft BDID** (March 2023, Non-Zero Nugget)
- **Area Boundary**
- **Geostatistical Model Boundary**
- **RIM to Remain in Place**
- A1-01 **Boring Location**

Note: "RIM" refers to RIM >52.9 pCi/g.

N

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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FIGURE 2.3a

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Area 1 RIM >52.9 pCi/g to Remain in Place

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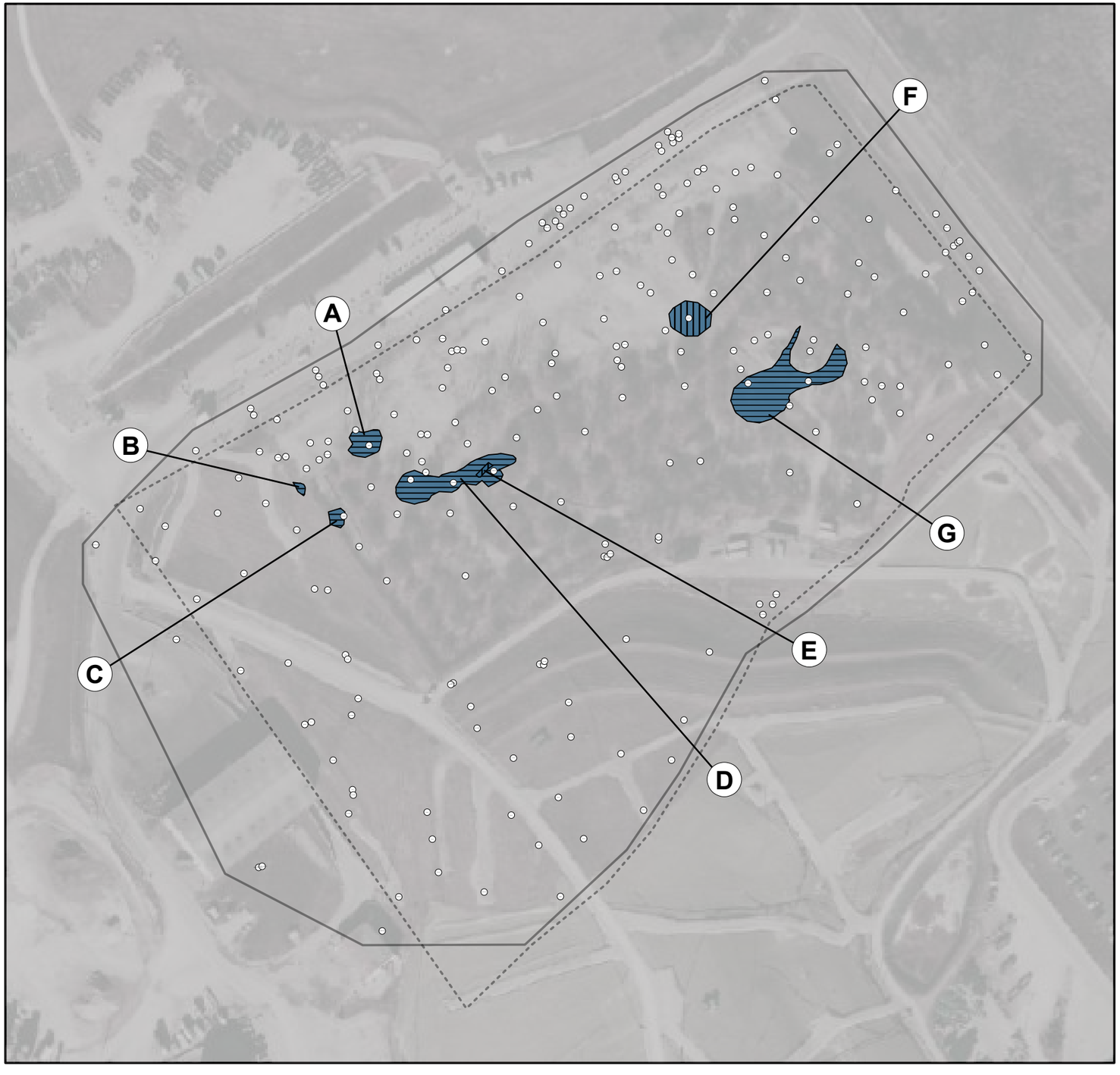

Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
A	12-16	45	0.015
B	12-16	1	<0.001
C	12-16	10	0.001
D	12-16	254	0.065
E	8-12	1	<0.001
F	8-12	122	0.017
G	12-16	580	0.151

N

Legend

- RIM to Remain in Place
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
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FIGURE 2.3b

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Area 1 RIM >52.9 pCi/g to Remain in Place

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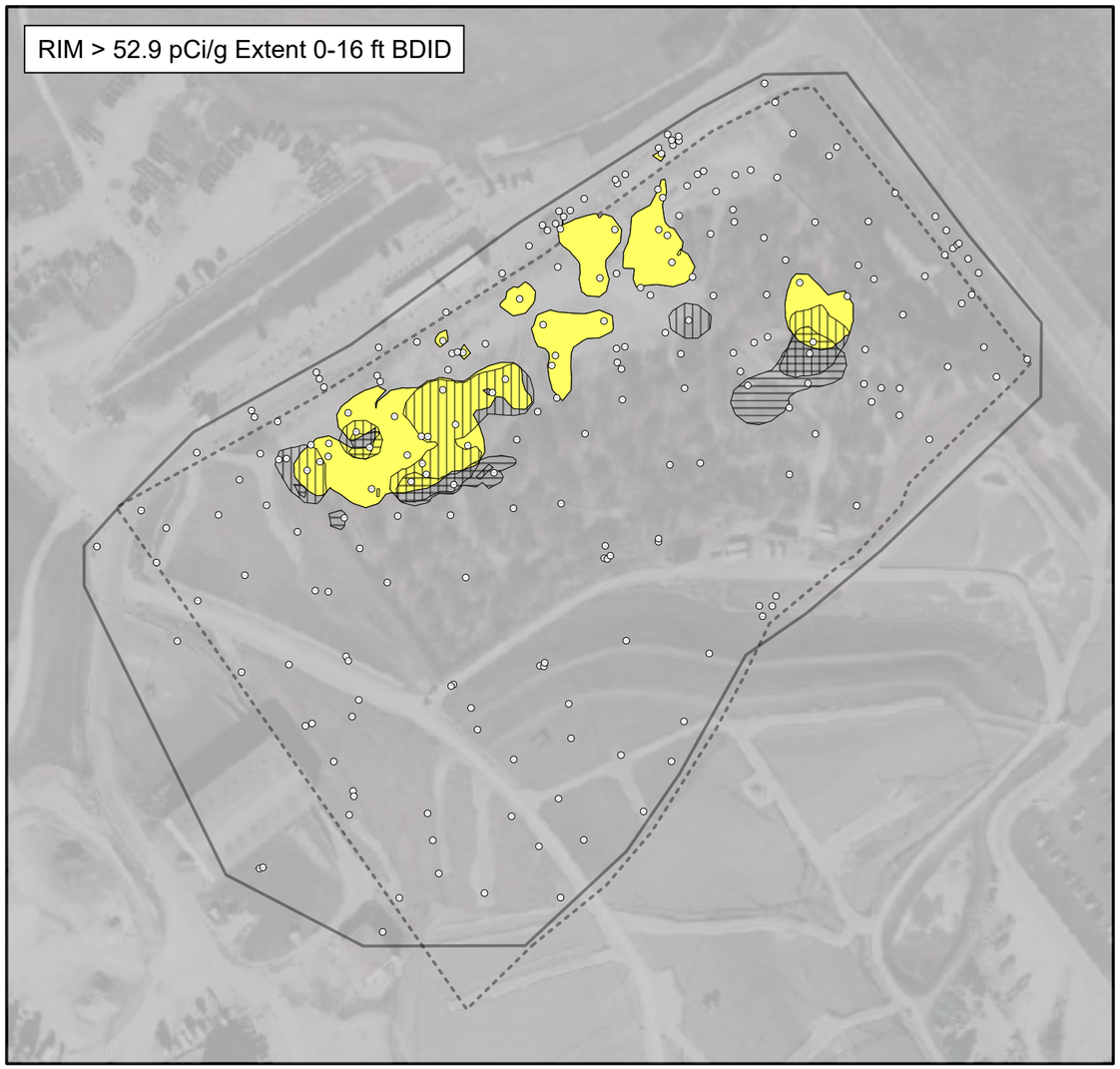

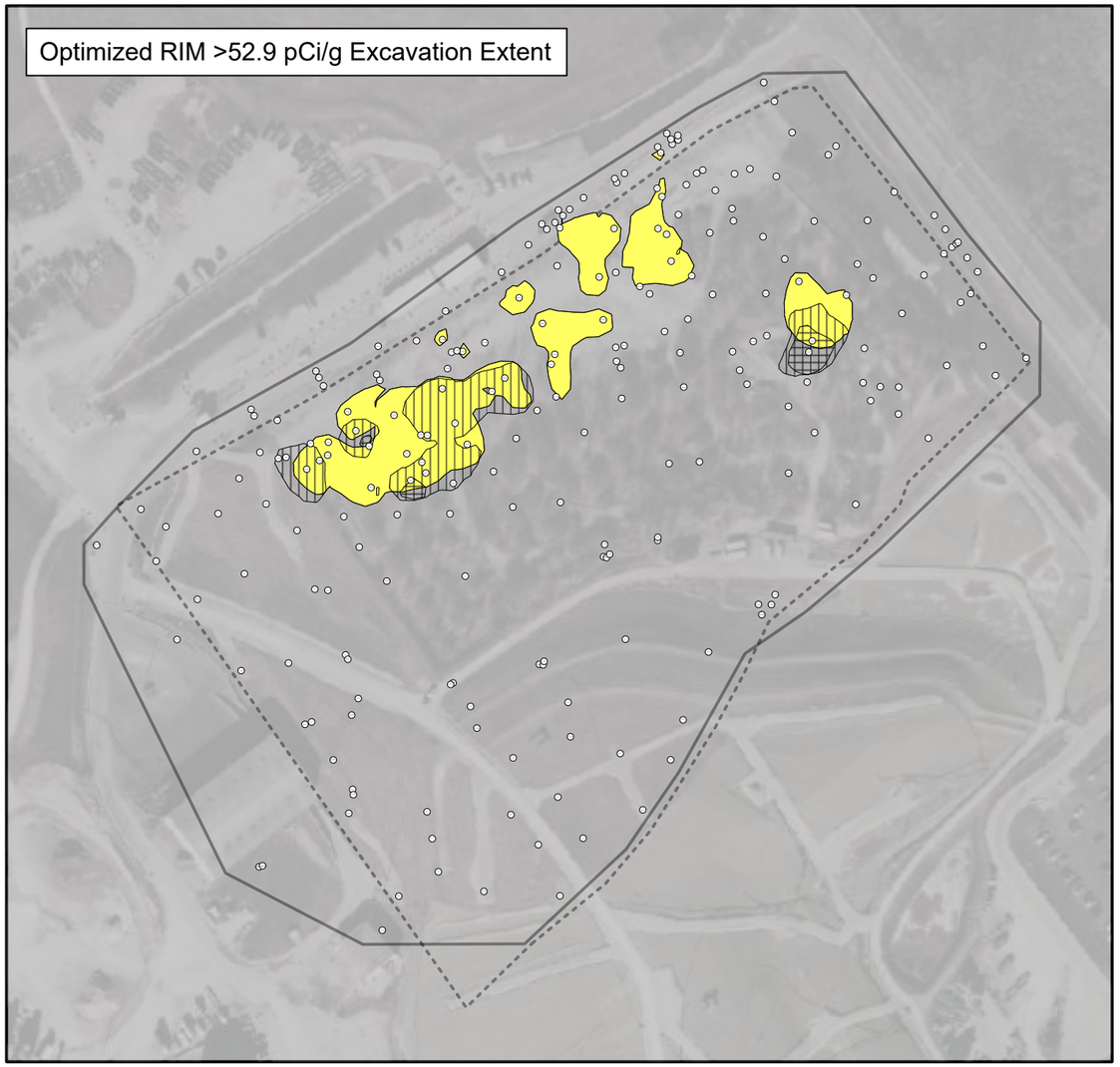

N

Legend

- **RIM Extent 0-8 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 8-12 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 12-16 ft BDID** (March 2023, Non-Zero Nugget)
- **Area Boundary**
- **Boring Location** (A1-01)
- **Geostatistical Model Boundary**

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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FIGURE 2.4

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PARSONS

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Syracuse, NY 13212
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Area 1 Comparison of RIM >52.9 pCi/g Extent 0-16 feet BDID and Optimized RIM >52.9 pCi/g Excavation Extent

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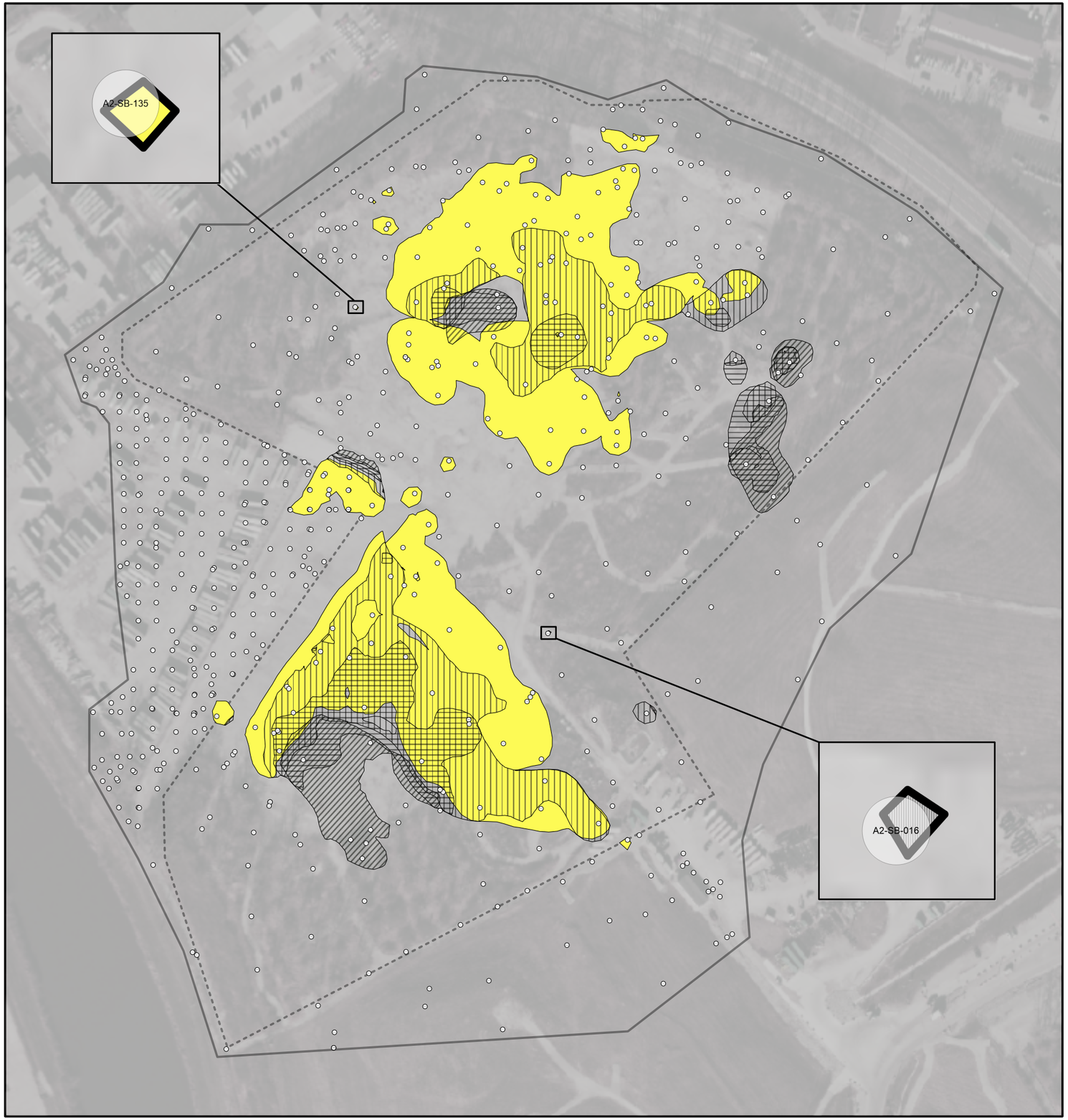

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 16-20 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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FIGURE 2.5a

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Area 2 Extent of RIM >52.9 pCi/g 0-20 feet BDID

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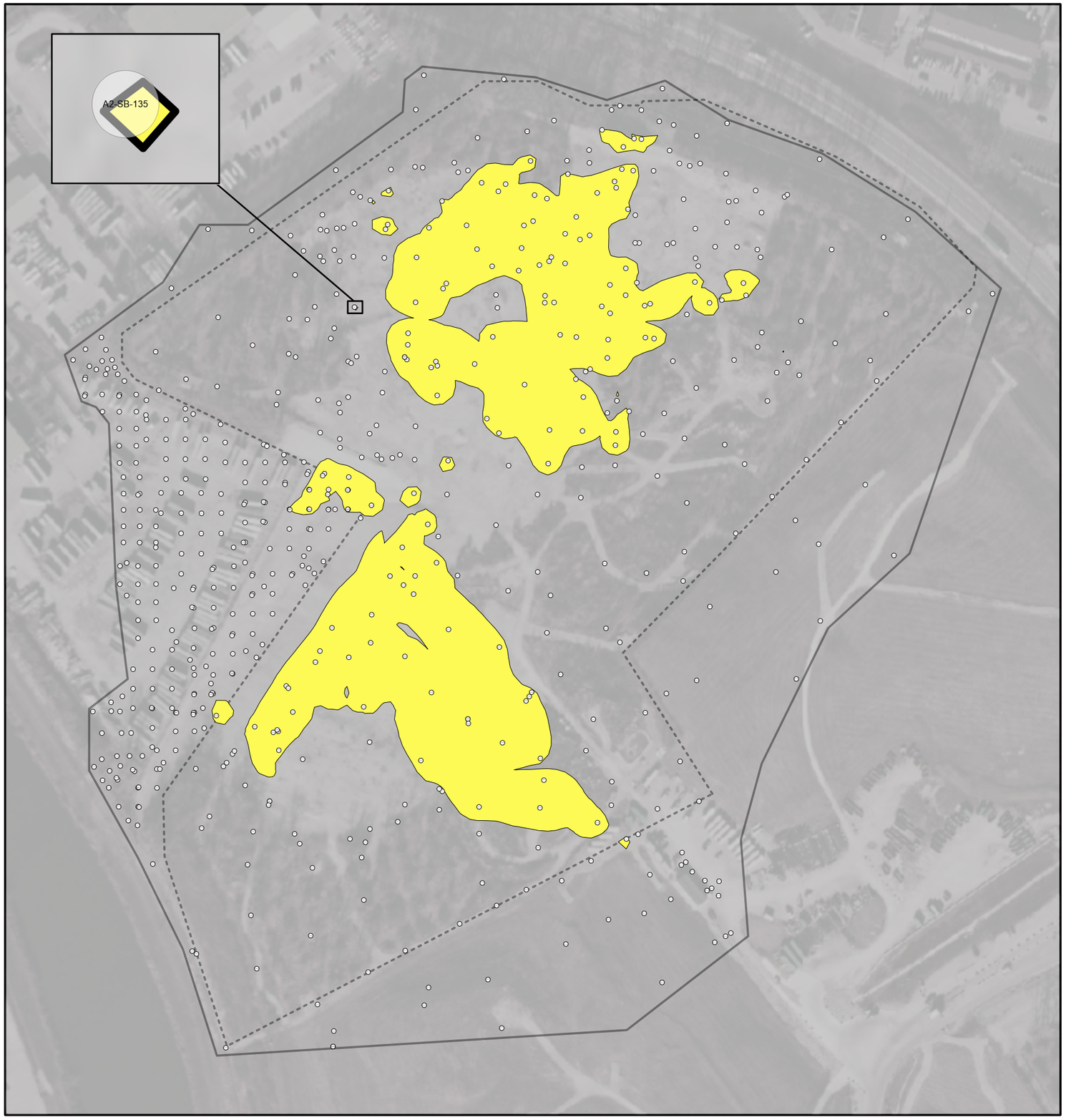

N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

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PROTECTION AGENCY
REGION VII

ON BEHALF OF

WEST LAKE LANDFILL OU-1
RESPONDENTS

FIGURE 2.5b

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DATE: 7/21/2023

PARSONS

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Syracuse, NY 13212
Ph: 315-451-9560

Area 2 Extent of RIM >52.9 pCi/g 0-8 feet BDID

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N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

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FIGURE 2.5c

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PARSONS

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Syracuse, NY 13212
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Area 2 Extent of RIM >52.9 pCi/g 8-12 feet BDID

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N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

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FIGURE 2.5d

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PARSONS

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Syracuse, NY 13212
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Area 2 Extent of RIM >52.9 pCi/g 12-16 feet BDID

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N

Legend

- Boring Location (A1-01)
- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 16-20 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.5e

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PARSONS

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Area 2 Extent of RIM >52.9 pCi/g 16-20 feet BDID

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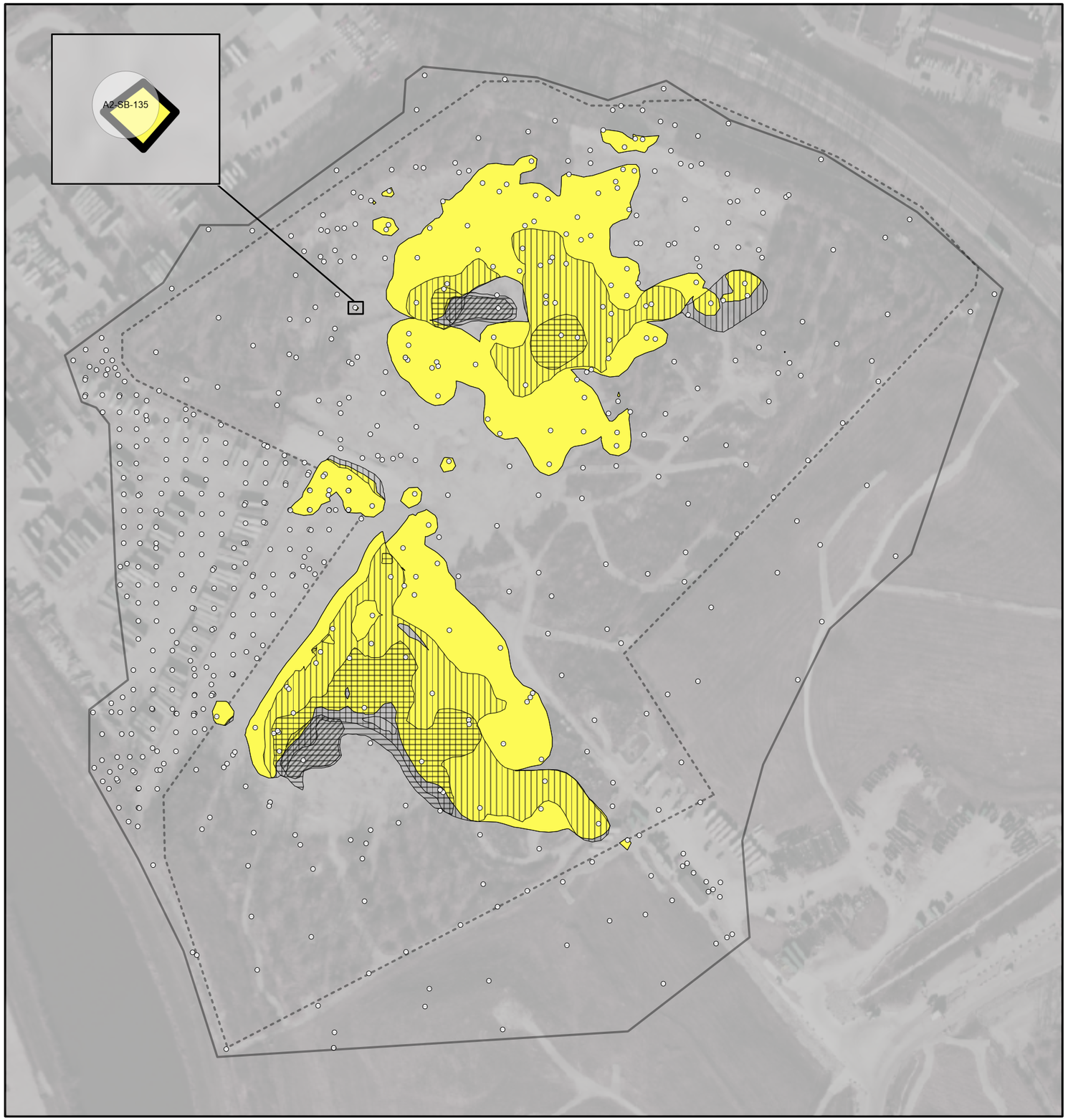

N

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 16-18 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

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FIGURE 2.6a

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Area 2 RIM >52.9 pCi/g to be Excavated from 0-18 feet BDID

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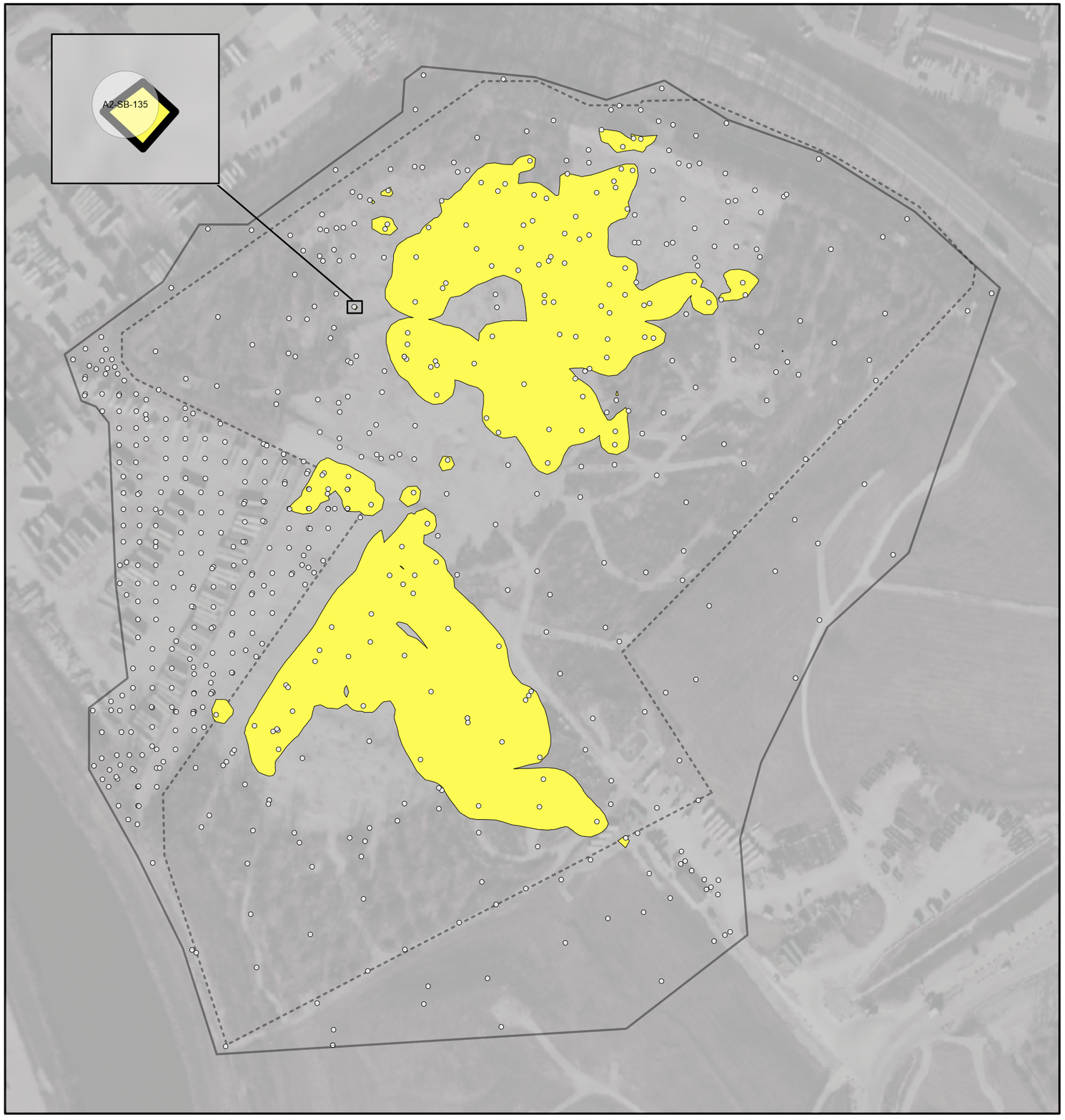

N

Legend

RIM Extent 0-8 ft BDID
(March 2023, Non-Zero Nugget)

Area Boundary

Geostatistical Model Boundary

A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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FIGURE 2.6b

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PARSONS

301 Plainfield Rd, 350
Syracuse, NY 13212
Ph: 315-451-9560

Area 2 RIM >52.9 pCi/g to be Excavated from 0-8 feet BDID

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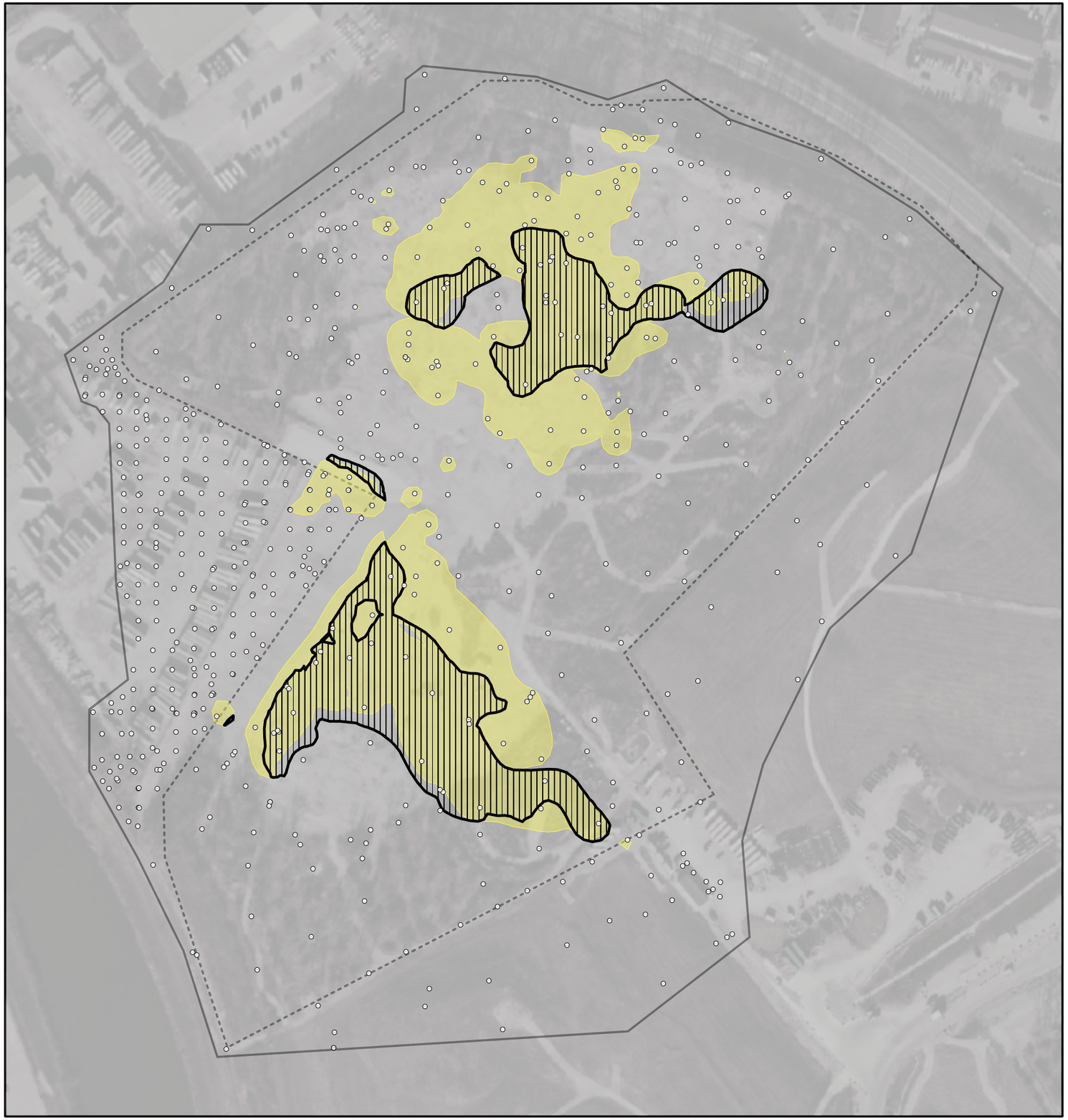

N

Legend

RIM Extent 0-8 ft BDID
(March 2023, Non-Zero Nugget)

RIM Extent 8-12 ft BDID
(March 2023, Non-Zero Nugget)

Area Boundary

Geostatistical Model Boundary

A1-01 **Boring Location**

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
OU-1 REMEDIAL DESIGN
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FIGURE 2.6c

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PARSONS

301 Plainfield Rd, 350
Syracuse, NY 13212
Ph: 315-451-9560

Area 2 RIM >52.9 pCi/g to be Excavated from 8-12 feet BDID

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N

Legend

- **RIM Extent 0-8 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 8-12 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 12-16 ft BDID** (March 2023, Non-Zero Nugget)
- **Area Boundary**
- **Geostatistical Model Boundary**
- A1-01 **Boring Location**

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

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OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

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FIGURE 2.6d

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PARSONS

301 Plainfield Rd, 350
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Area 2 RIM >52.9 pCi/g to be Excavated from 12-16 feet BDID

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Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
W	16-17	198	0.075
X	17-18	120	0.101
Y	16-17	335	0.250
Z	17-18	262	0.179

N

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- RIM Extent 16-18 ft BDID (March 2023, Non-Zero Nugget)
- Make Up RIM 16-17 ft BDID
- Make Up RIM 16-18 ft BDID
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
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FIGURE 2.6e

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PARSONS
301 Plainfield Rd, 350
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Area 2 RIM >52.9 pCi/g to be Excavated from 16-18 feet BDID

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Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
H	12-16	12	0.001
I	8-12	211	0.022
J	12-16	1060	0.303
K	8-12	<1	<0.001
L	8-12	23	0.001
M	12-16	<1	<0.001
N	12-16	62	0.003

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 16-18 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- RIM to Remain in Place
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PREPARED FOR

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION VII

ON BEHALF OF

WEST LAKE LANDFILL OU-1 RESPONDENTS

FIGURE 2.7a

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PARSONS

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Area 2 RIM >52.9 pCi/g to Remain in Place

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Sub-Area (Letter)	Depth (ft bDID)	Volume (cu yds)	Total Activity (Ci)
H	12-16	12	0.001
I	8-12	211	0.022
J	12-16	1060	0.303
K	8-12	<1	<0.001
L	8-12	23	0.001
M	12-16	<1	<0.001
N	12-16	62	0.003

Legend

- **RIM Extent 8-12 ft BDID** (March 2023, Non-Zero Nugget)
- **RIM Extent 12-16 ft BDID** (March 2023, Non-Zero Nugget)
- **Area Boundary**
- **Geostatistical Model Boundary**
- **RIM to Remain in Place**
- **Boring Location** (A1-01)

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
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FIGURE 2.7b

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PARSONS

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Syracuse, NY 13212
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Area 2 RIM >52.9 pCi/g to Remain in Place

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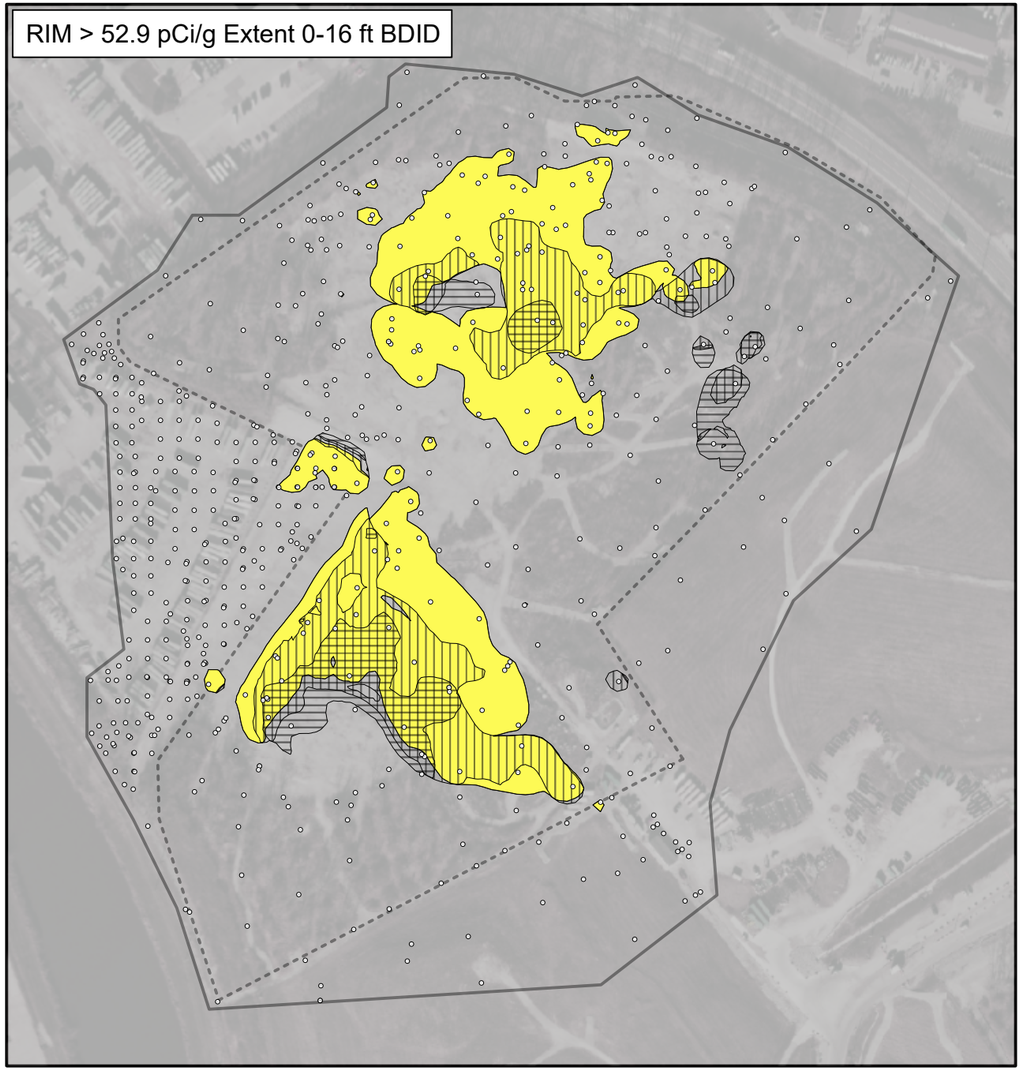

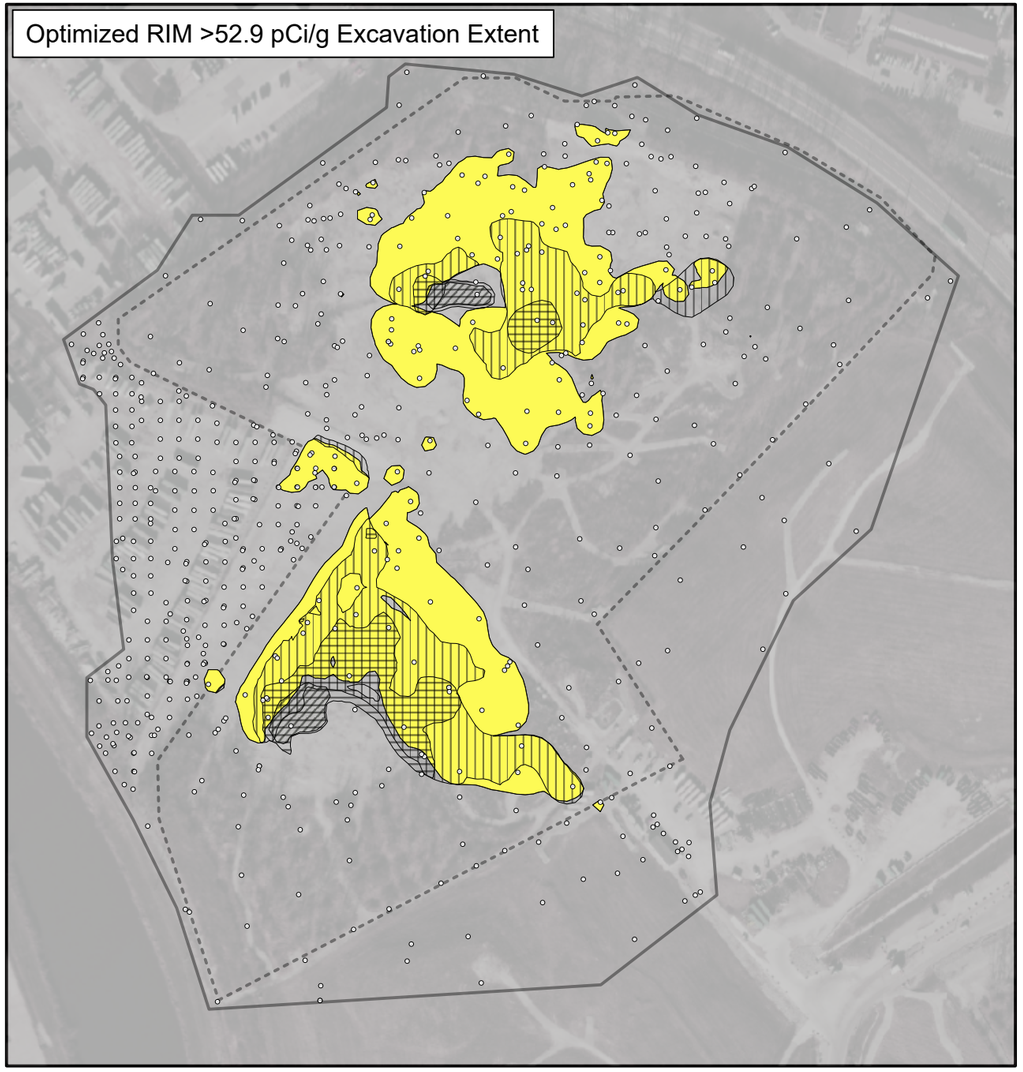

N

Legend

- RIM Extent 0-8 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 8-12 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 12-16 ft BDID (March 2023, Non-Zero Nugget)
- RIM Extent 16-18 ft BDID (March 2023, Non-Zero Nugget)
- Area Boundary
- Geostatistical Model Boundary
- A1-01 Boring Location

Note: "RIM" refers to RIM >52.9 pCi/g.

0 250 500 feet

PROJECT

WEST LAKE LANDFILL
SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

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FIGURE 2.8

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PARSONS

301 Plainfield Rd, 350
Syracuse, NY 13212
Ph: 315-451-9560

Area 2 Comparison of RIM >52.9 pCi/g Extent 0-16 feet BDID and Optimized RIM >52.9 pCi/g Excavation Extent

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ATTACHMENTS

ATTACHMENT 1: ESTIMATION OF OVERBURDEN FOR SUB-AREAS TO REMAIN IN PLACE

This attachment to Appendix C presents the procedure for estimating the volume of overburden[1] associated with the sub-areas of radiologically impacted material (RIM) >52.9 pCi/g that will be left in place because of optimization (see Section 2 of Appendix C for details). The procedure included the following:

- Determining the area and perimeter of each sub-area with RIM >52.9 pCi/g to be left in place.
- Estimating the thickness of overburden overlying the sub-areas to be left in place.
- Calculating the volume of overburden overlying the sub-areas to be left in place.
- Calculating the volume of overburden that will be excavated as setback assuming 1.5-feet (ft) horizontal to 1-ft vertical (1.5H:1V) side slopes for the excavation based on 29 CFR Part 1926 Subpart P – Occupational Safety and Health Administration excavation requirements.

Area and Perimeter Measurement

The area and perimeter of each sub-area that will remain in place due to optimization were estimated using the Adobe Acrobat *Measure* tool. Area and perimeter measurements are presented in Table 1.

Overburden Thickness Estimation

The thicknesses of overburden between the 2005 ground surface (defined as the Design Investigation (DI) datum[2] [DID] in the *Design Investigation Evaluation Report* [DIER] [Parsons et al. 2023]) and the top of RIM >52.9 pCi/g to be left in place were based on the RIM depth intervals established using the geostatistical model. For example, RIM >52.9 pCi/g in Sub-Area C is at a depth of 12 to 16 ft below DID; therefore, an overburden thickness of 12 ft was assumed.

The thickness of material placed on top of the DID surface was estimated by calculating the difference between the existing ground surface elevation and the DID within the footprint of the sub-areas to be left in place. Both components of the overburden thicknesses are presented in Table 1.

Overburden Volume Estimation

The volume of overburden within the footprint of the sub-area to be left in place was calculated by multiplying the area of each sub-area by the overburden thickness estimated for each sub-area.

The volume of setback was calculated assuming the excavations will have a 1.5H:1V side slope. The setback volume can be estimated by calculating the area of a "triangle" with a height equal to the overburden thickness and a base equal to 1.5 times the overburden thickness and multiplying the area of the "triangle" by the perimeter of the sub-area.

Overburden volume calculations are presented in Table 1.

[1] For purposes of this calculation the term overburden includes the non-combustible cover, non-RIM waste material, and RIM <52.9 pCi/g.
[2] The DI datum is discussed in the DIER (Parsons et al. 2023) and Appendix A of the Revised Excavation Plan.

TABLES

TABLE 1: OVERBURDEN CALCULATION SUMMARY

OU-1 Area	Sub-Area	SUB-AREA FOOTPRINT VOLUME CALCULATIONS						SETBACK VOLUME CALCULATIONS					Sub-Area and Setback Area (sf)	Overburden Volume (cu yd)
		Area (sf)	Thickness[2] (ft) (Existing GS to DID)	Thickness (ft) (DID to Top of RIM)	Total Overburden Thickness[1] (ft)	Volume (cu ft)	Volume (cu yd)	Perimeter (ft)	Cross-Sectional Area (sf)	Setback Area (sf)	Setback Volume (cu ft)	Setback volume (cu yd)		
1	C	460	0	12	12	5,520	204	80	108	1,440	8,640	320	**1,900**	**520**
1	D	1,900	0	12	12	22,800	844	215	108	3,870	23,220	860	**5,770**	**1,700**
1	F	2,180	0	8	8	17,440	646	170	48	2,040	8,160	302	**4,220**	**950**
1	G	6,645	7	12	19	126,255	4,676	495	271	14,108	134,021	4,964	**20,753**	**9,640**
												Area 1 Total	**32,643**	**12,810**
2	I-J 1	2,200	12	12	24	52,800	1,956	173	432	6,228	74,736	2,768	**8,428**	**4,720**
2	I-J 2	2,400	0	12	12	28,800	1,067	194	108	3,492	20,952	776	**5,892**	**1,840**
2	I-J 3	15,400	6	12	18	277,200	10,267	598	243	16,146	145,314	5,382	**31,546**	**15,650**
2	L	1,350	0	8	8	10,800	400	144	48	1,728	6,912	256	**3,078**	**660**
2	N	1,400	0	12	12	16,800	622	235	108	4,230	25,380	940	**5,630**	**1,560**
												Area 2 Total	**54,574**	**24,430**
												TOTAL	**87,200**	**37,200**

Notes:

1. Overburden thickness represents thickness of material between existing ground surface and top of RIM >52.9 pCi/g remaining in place.
2. A "0" for thickness between Existing GS and DID indicates DID coincides with the existing ground surface.
3. Overburden for Sub-Areas A, B, E, H, K, and M is not estimated here because it is either associated with another sub-area or planned excavation.
4. sf – square feet; ft – feet; GS – ground surface; DID – Design Investigation Datum; RIM – radiologically impacted material; cu – cubic; yd – yard

APPENDIX D – ACTIVITY ESTIMATES AND OPTIMIZATION FOR THE CLOSED DEMOLITION LANDFILL EXCAVATION

APPENDIX D – ACTIVITY ESTIMATES AND OPTIMIZATION FOR THE CLOSED DEMOLITION LANDFILL EXCAVATION WEST LAKE LANDFILL SUPERFUND SITE OPERABLE UNIT 1

Prepared For:

The United States Environmental Protection Agency Region VII

Prepared on Behalf of:

The West Lake Landfill OU-1 Respondents

Prepared By:

PARSONS

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Syracuse, New York 13212

In Association With:

Engineering for a Better World
FEEZOR ENGINEERING, INC.

3377 Hollenberg Drive
Bridgeton, Missouri 63044

And

AMERIPHYSICS

9111 Cross Park Drive, Suite D200
Knoxville, TN 37923

JULY 2023

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Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

LIST OF ACRONYMS

ACRONYM	Definition
CDL	Closed Demolition Landfill
Ci	Curie(s)
DI	Design Investigation
DIER	Design Investigation Evaluation Report
DOE	U.S. Department of Energy
EMSI	Engineering Management Support, Inc.
ft	foot/feet
g	gram(s)
m	meter(s)
MOE	Missouri East Zone
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
OU	Operable Unit
pCi	picocurie(s)
Ra-226	radium-226
Ra-228	radium-228
RD	remedial design
REP	Revised Excavation Plan
RIM	radiologically impacted material
RODA	Record of Decision Amendment
Site	West Lake Landfill Superfund Site
SOW	Modified Statement of Work
SPC	state plane coordinates
Th-230	thorium-230
Th-232	thorium-232
USEPA	United States Environmental Protection Agency

1.0 PURPOSE AND BACKGROUND

1.1 Purpose

This appendix to the Revised Excavation Plan (REP) has been prepared on behalf of West Lake Landfill Operable Unit 1 (OU-1) Respondents (Bridgeton Landfill, LLC, Cotter Corporation (N.S.L.), and the U.S. Department of Energy [DOE] [collectively, Respondents]) for the design of the selected Amended Remedy for OU-1 of the West Lake Landfill Superfund Site (Site), which is presented in the OU-1 Record of Decision Amendment (RODA) signed by the United States Environmental Protection Agency (USEPA) in September 2018. The RODA describes the OU-1 remedy that requires partial excavation of radiologically impacted material (RIM) containing greater than 52.9 picocuries per gram (>52.9 pCi/g) of combined thorium (thorium-230 [Th-230] plus thorium-232 [Th-232]) or combined radium (radium-226 [Ra-226] and radium-228 [Ra-228]) from Areas 1 and 2. The specific requirements are detailed below in Section 1.2 and include optimization based on depth.

This evaluation assumes that the RODA excavation requirements for Areas 1 and 2 also apply to the Closed Demolition Landfill (CDL) (see Figure 1.1). This appendix describes the procedure for defining the excavation extent and depth in the CDL based on the RODA requirements and the combined thorium and combined radium data previously presented in the Design Investigation Evaluation Report (DIER) (Parsons et al. 2023). In addition, this appendix estimates the total activities of combined thorium and combined radium and provides an optimized excavation with proposed excavation depths within portions of the CDL.

The remainder of this section provides background information on the RODA requirements for excavation, assumptions for the evaluation, and the method of analysis. The rest of this document is organized as follows:

- Section 2 describes how base data files were created for this evaluation;
- Section 3 explains the procedure for creating Thiessen polygon figures using the base data files;
- Section 4 describes the procedure for estimating total activities and optimizing the excavation;
- Section 5 presents the results of this evaluation and the conclusions; and
- Section 6 includes references.

1.2 OU-1 RODA Requirements for Excavation

The requirements for the REP are provided in the Modified Statement of Work (SOW) dated July 2022 (USEPA 2022). As summarized in Section 1.3 of the SOW, the RODA (USEPA 2018) requires the following for the excavation of RIM >52.9 pCi/g:

- "Excavation of RIM from the Areas 1 and 2 of OU-1 that contains combined radium or combined thorium activities greater than 52.9 pCi/g that is located generally within 12 feet of the 2005 topographic surface." As discussed above, this appendix assumes that the CDL will be required to be addressed in the same manner as Areas 1 and 2 for purposes of RIM excavation. The depths are defined with respect to the 2005 topographical surface (defined as the Design Investigation [DI] datum in the DIER [Parsons et al. 2023]);
- "Optimization of RIM removal above and below the 12-foot target depth (excavation as deep as 20 feet or as shallow as 8 feet) will be performed during the remedial design (RD) based on criteria set forth in Section 12.0 of the ROD[A] as discussed below:
  - If RIM greater than 52.9 pCi/g occurs between 12 and 20 feet below the surface, then evaluate and excavate where necessary to achieve long-term effectiveness and permanence objective;

- The EPA places a priority on focusing the excavation on the higher activity occurrences of RIM. Therefore, the EPA expects the areas between 12 and 16 feet will be excavated if they are greater than 1,000 pCi/g;
- The EPA also expects to focus the excavation in the areas between 16 to 20 feet on the higher activity occurrences of RIM (greater than 1,000 pCi/g) if it does not add significant excavation of non-RIM waste;
- Data show that isolated pockets of RIM between 8 and 12 feet only occur in a limited number of areas; and
- Not excavating isolated pockets of RIM between 8 and 12 feet will minimize the short-term impacts by reducing the volume of overburden and setback."

These requirements are the basis of the evaluation presented in this appendix for the CDL.

1.3 Lateral Extent Assumptions

Based on the RODA excavation requirements, this appendix evaluates the area within the CDL estimated to contain RIM >52.9 pCi/g in the top 16 feet (ft) below DI datum. As part of the optimization process, RIM >1,000 pCi/g in the top 20 ft below DI datum was also considered.

The boundary of RIM >52.9 pCi/g in this evaluation is based on the "estimated extent of RIM >52.9 pCi/g at depth <20 ft below DI datum" presented in Figure 5.1H of the DIER (Parsons et al. 2023), which is described in Table 5.1E of the DIER (Parsons et al. 2023). Specifically, the >52.9 pCi/g boundary was placed between borings with RIM >52.9 pCi/g and borings without RIM exceeding 52.9 pCi/g at depths less than 20 ft below DI datum. The boundary from Figure 5.1H of the DIER (Parsons et al. 2023) was refined in this evaluation to include RIM >52.9 pCi/g within the top 16 ft, as described in Section 1.5. Confirmation borings will be performed in this area to further refine the lateral extent of RIM >52.9 pCi/g within the top 16 ft.

1.4 Background on Analysis Method

Area-weighted (or spatially-weighted) averaging was selected for estimating representative activities of combined thorium and combined radium within the estimated 52.9 pCi/g RIM boundary of the CDL. Area-weighted average activities were estimated using Thiessen polygons, a common geostatistical tool used to spatially represent data points as non-equal areas within a defined boundary. Each polygon is associated with a sampling point and is defined such that any location inside the polygon is closer to its sample point than any other sampling points. Further support for selection of Thiessen polygons for this analysis is provided in Section 3.2 of the REP. The Thiessen polygons used for this analysis are shown in Figure 1.2. As described in Section 3.0, the *Create Thiessen Polygon* tool in ArcMap 10.8.1 was used for this evaluation.

1.5 Layer Thickness Assumptions

As shown in Figure 1.2, RIM >52.9 pCi/g was at a depth of less than 16 ft below DI datum in the following borings: CD-EA-208, CD-EA-199, CD-EA-199-C, CD-EA-200-D, CD-EA-200-B, CD-EA-175, CD-EA-175-A, CD-EA-190-C, CD-EA-190-R, CD-EA-190-B, CD-EA-174, CD-EA-200, and CD-EA-199-B. CD-EA-200-A and CD-EA-200-C were also included in this extent based on the following rationale:

- For CD-EA-200-A, recovery was only 20% for the 12 to 16 ft sample, and the grab sample in that interval was less than 7.9 pCi/g for combined radium and combined thorium; however, the result for the 16 to 20 ft sample was >52.9 pCi/g.
- For CD-EA-200-C, sample results from 16 to 20 ft were >1,000 pCi/g. In addition, it is adjacent to borings that include RIM >52.9 pCi/g in the top 16 ft below DI datum; therefore, it was included for consideration during optimization, since overburden over some of CD-EA-200-C may be excavated during the removal process for RIM associated with the adjacent borings.

As shown in Figure 1.3, ten subsurface layers were defined for purposes of this evaluation. Table 1.1 summarizes the thickness and depth of each layer. These layer thicknesses were developed based on considerations such as quantity of data available and potential excavation depths within CDL. Specifically, based on the Amended Remedy defined in the RODA, data collection activities during the DI focused on the top 20 ft below DI datum. To adequately represent potentially excavatable materials, a 2-ft thickness was assigned to each layer within the top 20 ft of the DI datum. This 2-ft thickness is also appropriate given the excavation requirements discussed in Section 1.2.

2.0 BASE DATA FILE CREATION

Base data files were created for import into ArcMap 10.8.1 and included the following soil boring information:

- Soil boring identifier (e.g., CD-EA-175)
- Boring Northing (North American Datum of 1983 [NAD83], specifically State Plane Coordinates [SPC] Missouri East [MOE], ft)
- Boring Easting (NAD83 SPC MOE, ft)
- Combined thorium and combined radium activity (pCi/g)
- Activity relative to 52.9 pCi/g, 500 pCi/g, 1,000 pCi/g, or 5,000 pCi/g combined thorium and combined radium

To prepare these base data files, the following steps were performed:

1. Analytical data were compiled in a spreadsheet with separate tabs per layer.
2. Samples were included in Layers 1 through 10 based on depth.
3. Length-weighted average combined thorium and combined radium activities were calculated on a per boring basis for each layer.

The following subsections provide more details regarding each of these steps.

2.1 Analytical Data

Sample locations were recorded in NAD83 and North American Vertical Datum of 1988 (NAVD88). The dataset used in this evaluation is provided in Attachment 1 and includes a subset of combined thorium and combined radium soil data collected during the DI and reported in the DIER (Parsons et al. 2023), as described in Section 1.0 above. Samples collected with a start depth greater than or equal to 20 ft below DI datum were not considered. Consistent with Appendix B of the REP (i.e., Revised Ordinary Kriging Model Technical Memorandum), select DI sample depth data were adjusted to account for core scan and downhole peak matching.

As previously indicated, combined thorium is the sum of Th-230 and Th-232 and combined radium is the sum of Ra-226 and Ra-228. For these individual radionuclides, data with "U" qualifiers (i.e., not detected above the detection limit) were included as their U-qualified values, and negative results were included as 0 pCi/g. In addition, only normal (i.e., parent) samples were included; duplicate samples were not included in this evaluation.

2.2 Layer Thicknesses and Number Assignments

As indicated previously, ten subsurface layers were defined for purposes of this evaluation, as shown in Table 1.1 and Figure 1.3. Each discrete and composite sample was assigned to one or more layers based on depth. Sample depths were defined as the depth below DI datum. For example, samples between 0 and 2 ft below DI datum were assigned to Layer 1. If a sample fell within multiple layers, the sample was assigned to each of those layers (e.g., a composite sample from 0 to 5 ft would be assigned to Layers 1, 2, and 3).

2.3 Sample Averages per Layer per Boring

Since only one combined thorium or combined radium analytical value (in pCi/g) was allowed per layer to create a Thiessen polygon at a boring location, samples within the same boring and layer were averaged to provide one data point per boring per layer. Specifically, a length-weighted average was calculated for each boring per layer based on the length of each sample in a given layer relative to the total length sampled in that layer using the following equation:

$$LWA = \sum_{i=1}^{n} activity_i \times \frac{sample\ length_i}{total\ sampled\ length\ in\ layer}$$

Where

LWA = the length-weighted average for each layer for each boring (pCi/g);

n = the total number of samples per layer per boring (dimensionless); and

i = sample number.

After the length-weighted average combined thorium and combined radium activities were calculated for each layer, base data files were created. One base file was created for each of the ten layers, resulting in a total of 10 base files (see Attachment 2). As indicated previously, borings were included or excluded as shown in Figure 1.2.

The following three borings had areas of no recovery within the top 16 ft of the DI datum, resulting in no or limited (composite only) available data in particular layers:

- CD-EA-175-A in Layer 8;
- CD-EA-200-A in Layers 4 and 8; and
- CD-EA-200-C in Layers 4 and 6.

Since no elevated downhole gamma peaks existed in the missing intervals, the analytical concentrations from above and below the area of no recovery were averaged, and the calculated average concentration values were assigned to the missing interval.

3.0 THIESSEN POLYGON GENERATION

This section describes how ArcMap 10.8.1 was used to generate Thiessen polygons using each base data file defined in Section 2.0 and the perimeter boundary file for the lateral extent of RIM >52.9 pCi/g in the CDL in the top 16 ft below DI datum (see Figure 1.2). The following steps were performed to generate Thiessen polygons from each base file using ArcMap 10.8.1:

1. One shapefile was imported into ArcMap 10.8.1 using the *Add Data* function as shown in Figure 3.1. The shapefile was plotted on a map which appears in the *Layout View* window. The lateral extent of RIM >52.9 pCi/g in the CDL in the top 16 ft below DI datum is shown in Figure 3.2.

Figure 3.1 Importing Shapefile into ArcMap 10.8.1

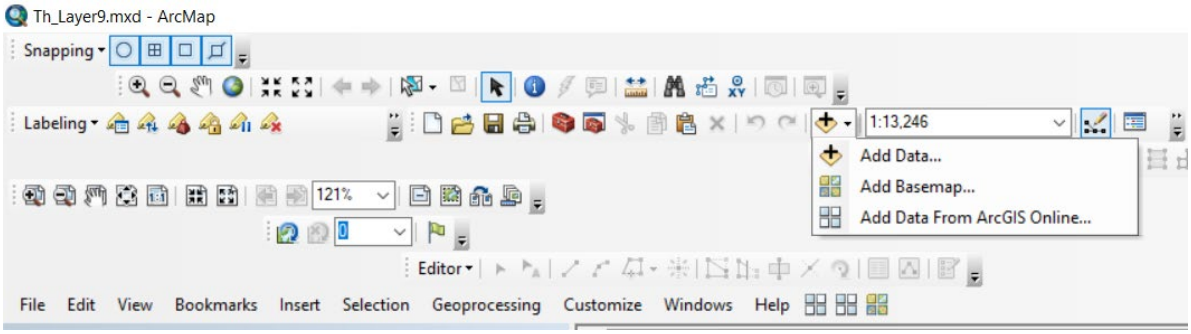
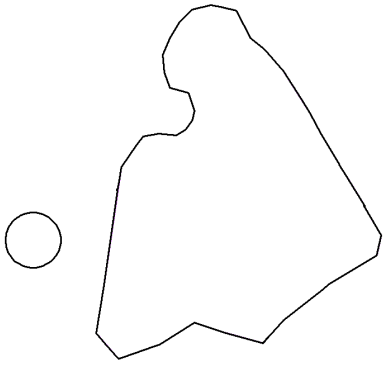


Figure 3.2 Plot of Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum



2. A base data file (Excel format) was imported into ArcMap 10.8.1 by selecting *ArcToolbox,* then *Conversion Tools, Excel, Excel to Table*, as shown in Figure 3.3. Within the *Excel to Table* dialog box, the base data file was selected as the *Input Excel File* (Figure 3.4). Converting the Excel base data file into a table in ArcMap 10.8.1 generated an attribute table, viewable by right-clicking the layer and selecting *Open Attribute Table* (Figure 3.5). The boring northing and boring easting in the table were plotted on a map which appears in the *Layout View* window (Figure 3.6). Only borings shown within the area of interest (i.e., lateral extent of RIM >52.9 pCi/g in the CDL in the top 16 ft below DI datum) figure were considered when developing the Thiessen polygons that are discussed in subsequent steps. Borings outside the perimeter boundary of the area of interest were removed by selecting the ArcToolbox, then

Editing Tools and Erase Point. Within the Erase Point dialogue box, the base data file was selected as the Input Features, the area of interest was selected under Remove Features, and "OUTSIDE" was selected from the Operation Type drop-down menu (Figure 3.7).

Figure 3.3 Importing Base Data File into ArcMap 10.8.1

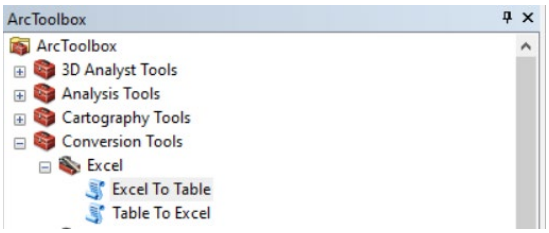


Figure 3.4 Selection of Base Data File

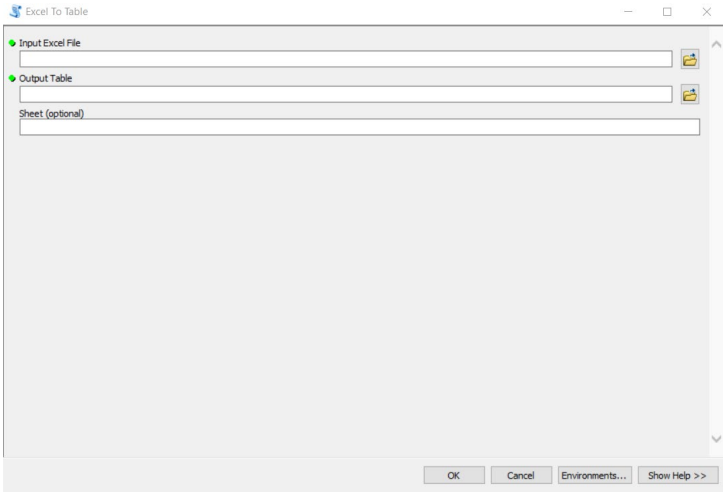


Figure 3.5 Example Attribute Table

Table

CDExcav_Layer1_ExcelToTable31

Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	BORINGS IN LAYER	Combined Ra Average pCi/g
835925.578	1069536.038	CD-EA-200	2.09
835923.065	1069400.292	CD-EA-190-B	5.88
835957.19	1069621.183	CD-EA-200-B	1.773333
835780.058	1069369.66	CD-EA-208	2.336667
835686.34	1069491.195	CD-EA-199-B	2.07
835797.913	1069548.224	CD-EA-199-C	1.89
835876.462	1069592.606	CD-EA-200-C	2.26
835802.602	1069473.477	CD-EA-199	1.83
835957.593	1069452.157	CD-EA-190-R	2.566667
835854.774	1069420.545	CD-EA-174	1.98
835999.19	1069452.697	CD-EA-190-C	13.8
836055.699	1069489.883	CD-EA-175-A	2.773333
835976.26	1069563.391	CD-EA-200-A	0.981
836004.133	1069525.25	CD-EA-175	7.408
835897.854	1069679.576	CD-EA-200-D	1.85

Figure 3.6 Plot for the Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

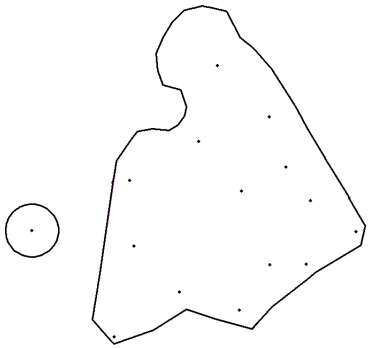
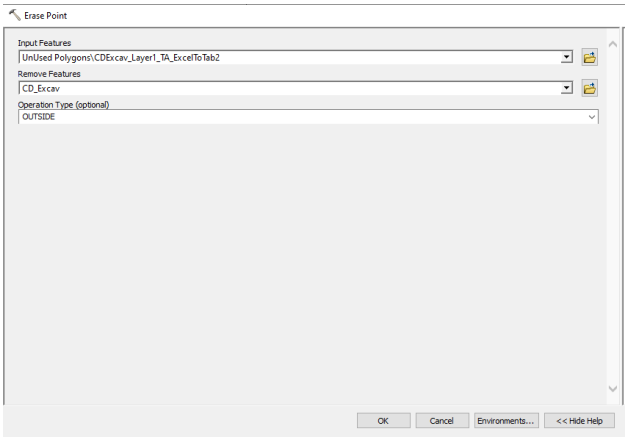


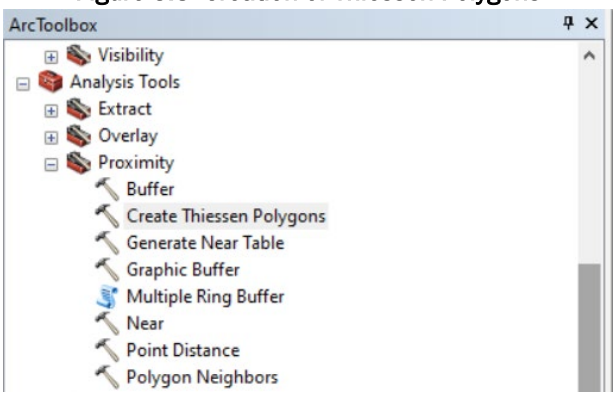
Figure 3.7 Removing Borings Outside the Area of Interest



3. Thiessen polygons were created by selecting *ArcToolbox*, then *Analysis Tools*, *Proximity*, *Create Thiessen Polygons,* as shown in Figure 3.8. In ArcMap 10.8.1, Thiessen polygons are constructed as follows (ArcGIS 2023):

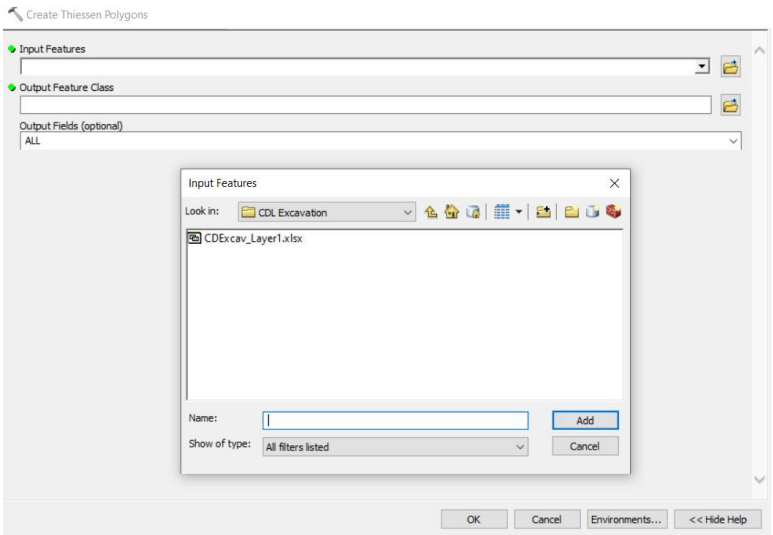
a. All points are triangulated into a triangulated irregular network that meets the Delaunay criterion.
b. The perpendicular bisectors for each triangle edge are generated, forming the edges of the Thiessen polygons. The location at which the bisectors intersect determines the locations of the Thiessen polygon vertices.

Figure 3.8 Creation of Thiessen Polygons



4. Within the *Create Thiessen Polygons* dialog box (Figure 3.9), the base data file was selected as the *Input Features*. Each base data file includes the following data:
   a. Soil boring Identifier (e.g., CD-EA-175)
   b. Boring Northing (SPC MOE NAD83)
   c. Boring Easting (SPC MOE NAD83)
   d. Total combined thorium and total combined radium activity (pCi/g)
   e. Activity relative to 52.9 pCi/g, 500 pCi/g, 1,000 pCi/g, or 5,000 pCi/g

Figure 3.9 Selection of Base Data File for Creating Thiessen Polygons



5. The extent of the Thiessen polygon analysis was set by selecting *Environments* from the *Create Thiessen Polygon* dialog box. This action opens the *Environmental Settings* dialog box (Figure 3.10), where the extent of the Thiessen polygon analysis was chosen by selecting *Processing Extent* and the appropriate shapefile (i.e., lateral extent of RIM >52.9 pCi/g in the top 16 ft of the CDL boundary shapefile). The

Create Thiessen Polygon tool then plotted Thiessen polygons on a map (Figure 3.11) in the *Layout View* window. By default, ArcMap 10.8.1 expands the polygons, as shown in Figure 3.11.

Figure 3.10 Defining the Extent of Thiessen Polygon Analysis

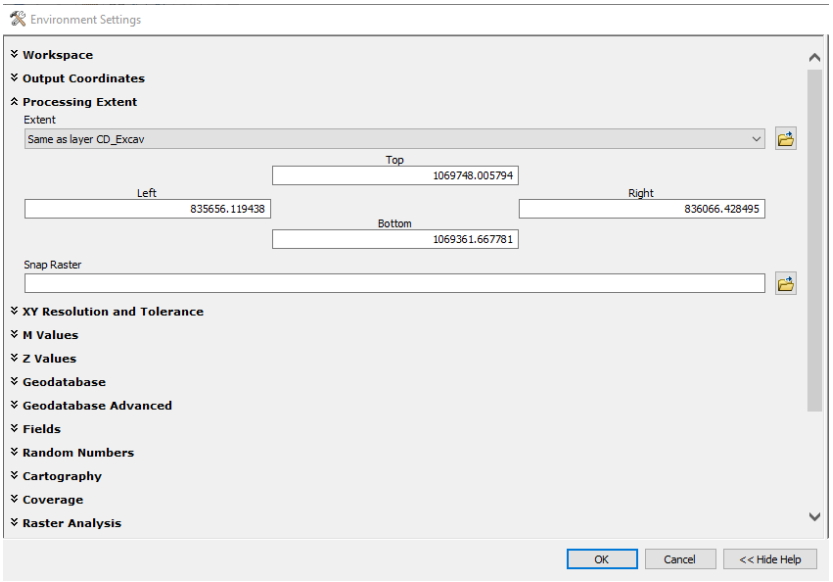
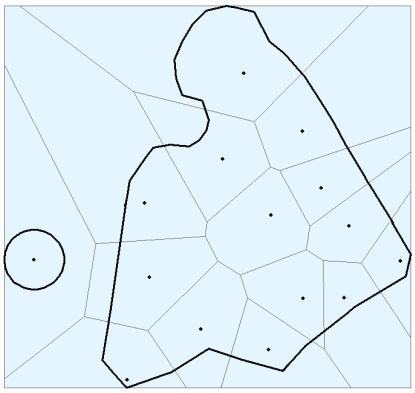


Figure 3.11 Plot of Thiessen Polygons for the Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum



6. The Thiessen polygon layer, generated from the *Create Thiessen Polygon* tool, was clipped to the area of interest (i.e., lateral extent of RIM >52.9 pCi/g in the CDL in the top 16 ft below DI datum) by selecting *ArcToolbox*, then *Analysis Tools*, *Extract*, *Clip,* as shown in Figure 3.12. This action opened the *Clip* dialog box (Figure 3.13) where the Thiessen polygon layer was selected from the *Input Features* drop-down. Running the *Clip* tool created a version of the Thiessen polygon layer that was clipped to the area of interest. The layer was plotted on the map (Figure 3.14) in the *Layout View* window.

Figure 3.12 Clipping of Thiessen Polygon Area – Step 1

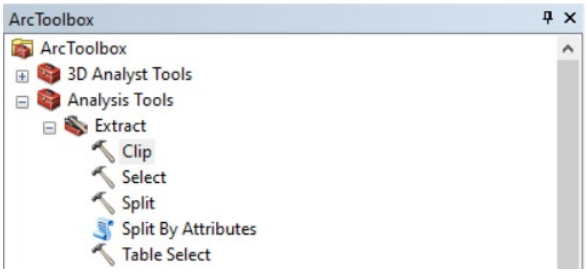


Figure 3.13 Clipping of Thiessen Polygon Area – Step 2

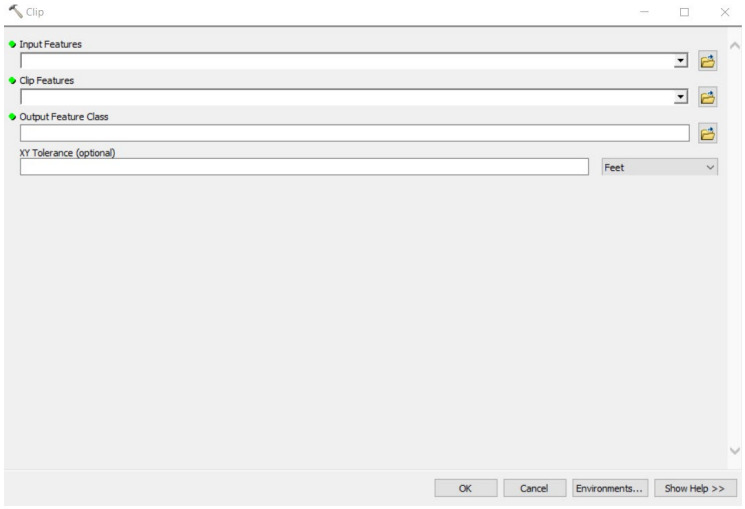
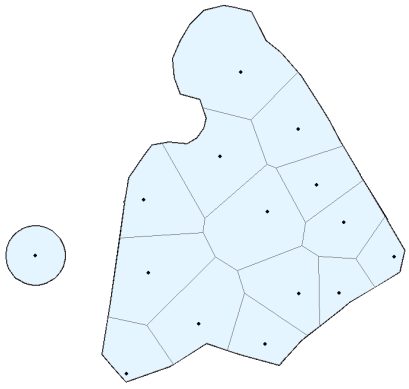


Figure 3.14 Example Plot of Clipped Thiessen Polygons for the Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum



7. To prepare the figures, the symbology of the layer was added to reflect the combined thorium or combined radium activity in each Thiessen polygon by selecting *Properties* (right-clicking the layer). This action opens the *Layer Properties* dialog box. The *Symbology* tab was selected (Figure 3.15), then *Unique Values* was selected from the *Show* column (listed under *Categories*). The *Analytical data range* was selected from the *Value Field* dropdown menu (Figure 3.16). The *Add All Values* button was selected, and symbology was adjusted using the *Symbology Selector.* Finally, a legend was created with color-coding that indicates the combined thorium or combined radium activity of each polygon relative to 52.9 pCi/g, 500 pCi/g, 1,000 pCi/g, or 5,000 pCi/g.

Figure 3.15 Selecting Symbology for Legend

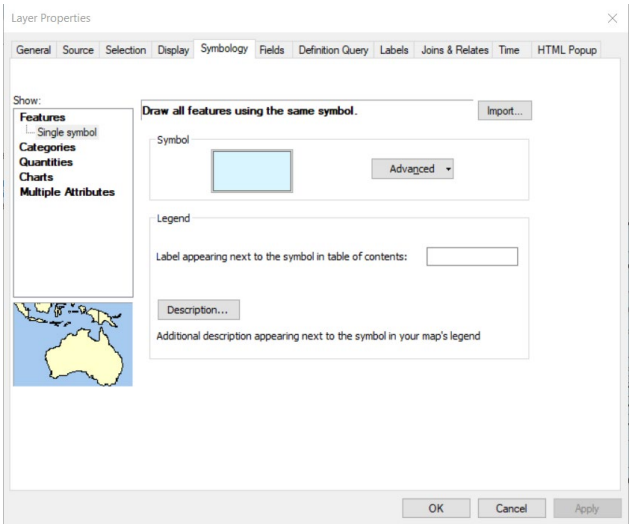
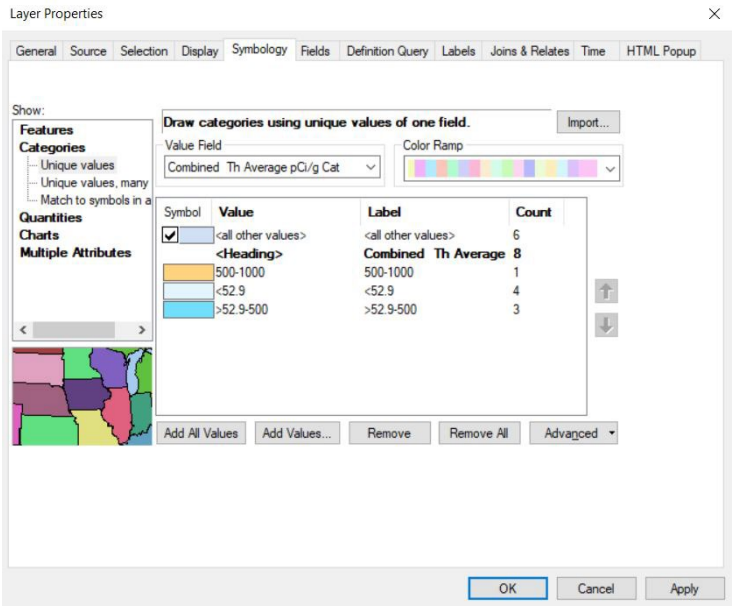


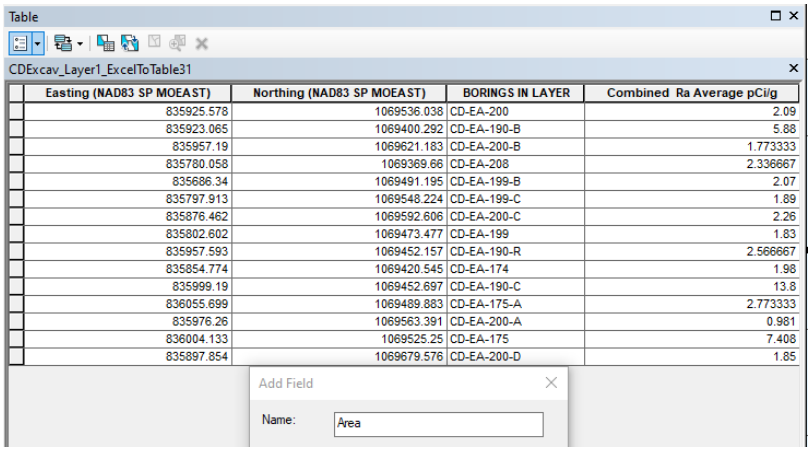
Figure 3.16 Selecting Analytical Range for Legend



8. Two figures (i.e., one for combined thorium and one for combined radium) were created for each base file. Attachments 3 and 4 contain Thiessen polygon figures for each layer for the combined thorium and combined radium activity[1], respectively. Based on these data, a summary of RIM >52.9 pCi/g to a depth of 20 ft below DI datum is provided in Figure 3.17 (see figures section at end of document). The polygon numbers shown on this figure match the numbering provided in Attachments 3 and 4.

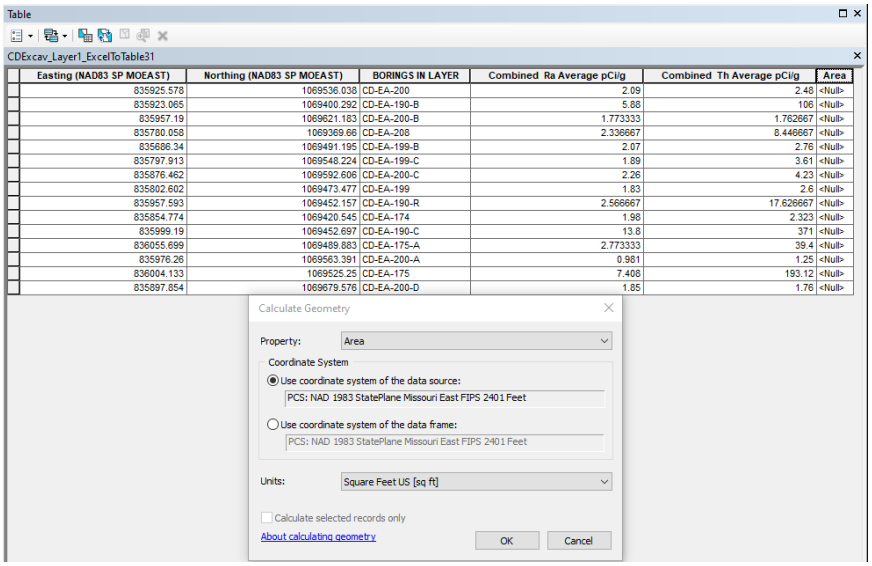
9. The area of each Thiessen polygon was calculated by adding a new field (i.e., Area) to the attribute table (Figure 3.18) and selecting *Calculate Geometry* function from the drop-down menu by right clicking the new field heading (Figure 3.19).

Figure 3.18 Adding a New Field to the Attribute Table



Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	BORINGS IN LAYER	Combined Ra Average pCi/g
835925.578	1069536.038	CD-EA-200	2.09
835923.065	1069400.292	CD-EA-190-B	5.88
835957.19	1069621.183	CD-EA-200-B	1.773333
835780.058	1069369.66	CD-EA-208	2.336667
835686.34	1069491.195	CD-EA-199-B	2.07
835797.913	1069548.224	CD-EA-199-C	1.89
835876.462	1069592.606	CD-EA-200-C	2.26
835802.602	1069473.477	CD-EA-199	1.83
835957.593	1069452.157	CD-EA-190-R	2.566667
835854.774	1069420.545	CD-EA-174	1.98
835999.19	1069452.697	CD-EA-190-C	13.8
836055.699	1069489.883	CD-EA-175-A	2.773333
835976.26	1069563.391	CD-EA-200-A	0.981
836004.133	1069525.25	CD-EA-175	7.408
835897.854	1069679.576	CD-EA-200-D	1.85

Figure 3.19 Calculating the Thiessen Polygon Areas



Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	BORINGS IN LAYER	Combined Ra Average pCi/g	Combined Th Average pCi/g	Area
835925.578	1069536.038	CD-EA-200	2.09	2.48	<Null>
835923.065	1069400.292	CD-EA-190-B	5.88	106	<Null>
835957.19	1069621.183	CD-EA-200-B	1.773333	1.762667	<Null>
835780.058	1069369.66	CD-EA-208	2.336667	8.446667	<Null>
835686.34	1069491.195	CD-EA-199-B	2.07	2.76	<Null>
835797.913	1069548.224	CD-EA-199-C	1.89	3.61	<Null>
835876.462	1069592.606	CD-EA-200-C	2.26	4.23	<Null>
835802.602	1069473.477	CD-EA-199	1.83	2.6	<Null>
835957.593	1069452.157	CD-EA-190-R	2.566667	17.626667	<Null>
835854.774	1069420.545	CD-EA-174	1.98	2.323	<Null>
835999.19	1069452.697	CD-EA-190-C	13.8	371	<Null>
836055.699	1069489.883	CD-EA-175-A	2.773333	39.4	<Null>
835976.26	1069563.391	CD-EA-200-A	0.981	1.25	<Null>
836004.133	1069525.25	CD-EA-175	7.408	193.12	<Null>
835897.854	1069679.576	CD-EA-200-D	1.85	1.76	<Null>

[1] In cases where sample data are not available for a boring within a layer (e.g., CD-EA-200-C for Layer 4), combined thorium and radium activities were estimated by calculating the arithmetic mean of the values from the layer above and below. For example, The combined thorium activity for CD-EA-200-C for Layer 4 was estimated by averaging the values from Layers 3 and 5.

10. After polygon areas were calculated, the attribute tables were exported from ArcMap 10.8.1 into Excel files by selecting *ArcToolbox,* then *Conversion Tools, Excel, Table to Excel,* as shown in Figure 3.20. The attribute tables exported from ArcMap 10.8.1 for each figure are provided in Attachment 5. Within the *Table to Excel* dialog box (Figure 3.21), the clipped Thiessen polygon layer (linked to the attribute table) was selected as the *Input Table*. The desired location of the saved Excel file was selected from the *Output Excel File* drop-down menu. The following data were exported from ArcMap 10.8.1 for each clipped Thiessen polygon analysis:

    a. Polygon ID
    b. Boring Northing (SPC MOE NAD83)
    c. Boring Easting (SPC MOE NAD83)
    d. Boring Identifier
    e. Polygon Activity (pCi/g)
    f. Polygon Area (square ft)

Figure 3.20 Exporting Attribute Table – Step 1

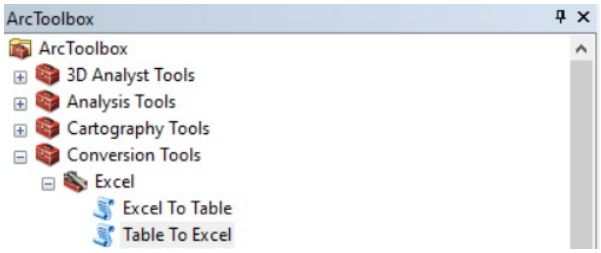
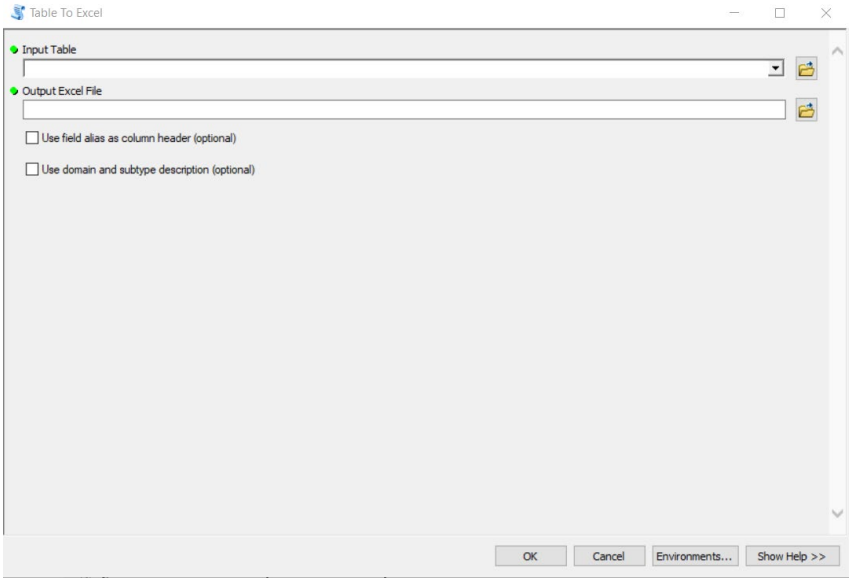


Figure 3.21 Exporting Attribute Table – Step 2



4.0 ACTIVITY ESTIMATES AND EXCAVATION OPTIMIZATION PROCEDURES

The procedure for estimating total activity of combined thorium and combined radium within the lateral extent of RIM >52.9 pCi/g in the CDL and within the top 16 ft below DI datum is described below. The optimization process is also described. This focuses on offsetting RIM >52.9 pCi/g that will remain in place within the top 16 ft of DI datum by removing RIM >52.9 pCi/g from depths greater than 16 ft below DI datum, as described in the RODA. These procedures included the following tasks:

- Developing a governing equation to estimate total activity of material >52.9 pCi/g combined thorium or combined radium in a layer;
- Using the governing equation to estimate the total activity from 0 to 16 ft below DI datum; and
- Optimizing the excavation by offsetting the activity in RIM >52.9 pCi/g from 8 to 16 ft of the DI datum that is left in place with RIM >52.9 pCi/g at depths greater than 16 ft, with a preference for RIM >1,000 pCi/g.

4.1 Total Activity Estimate

Total activity is estimated using the volume (area multiplied by layer thickness), average activity concentration, and density of the material. The total activity[2] in each layer (depth layer z_1 to z_2) is the sum of activities from each polygon with an average combined thorium or combined radium activity concentration >52.9 pCi/g, as defined in Equation 1.

Equation 1:

$$Act_{z_1-z_2} = \sum_{i=1}^{n}[(A_i x_i T_i)\rho_B + (A_i x_i R_i)\rho_B]$$

Where

$\boldsymbol{Act_{z_1-z_2}}$	= Activity in each layer over the depth interval z_1 to z_2 (pCi);
$\boldsymbol{A_i}$	= Area of polygon i (ft^2);
$\boldsymbol{x_i}$	= Thickness of each layer (see Table 1.1) for depth interval z_1 to z_2 (ft);
$\boldsymbol{T_i}$	= Average activity concentration of combined thorium for polygon i within depth interval z_1 to z_2;
$\boldsymbol{R_i}$	= Average activity concentration of combined radium for polygon i within depth interval z_1 to z_2;
$\boldsymbol{\rho_B}$	= Soil bulk density (weight of the dry soil/total soil volume) (g/ft^3); and
$\boldsymbol{n}$	= Number of polygons with combined thorium or combined radium >52.9 pCi/g within depth interval z_1 to z_2.

[2] The units for activity used in this evaluation are picocuries (pCi) and Curies (Ci). One Ci equals 1x10^{12} pCi. This conversion is used in this evaluation. Picocuries (pCi) are typically used for the activity concentration (pCi/g) which is how the laboratory data are reported, while the total activity is typically reported as Curies (Ci).

For this evaluation, the bulk density of the excavatable material within CDL, ρ_B, is assumed to be a constant value of 1.47 g/cm^3 (41,626 g/ft^3 or 91.9 pounds per cubic ft) based on the bulk density data collected during the DI. The data used for this estimate and a brief explanation of the calculations are provided in Appendix E to the REP.

It is noted that the material density does not affect the outcome of the optimization because optimization is an activity-balancing calculation that depends on relative quantities of total activity. This appendix assumes soil bulk density, ρ_B, is a constant value (as opposed to a variable value represented by a function that changes based on one or more inputs) for each layer within the lateral extent of RIM >52.9 pCi/g in the CDL. Therefore, when estimating the total activity for each Thiessen polygon area and layer, the $A_i x_i T_i$ and $A_i x_i R_i$ terms are always multiplied by the same value.

4.2 Estimating Total Activity between 0 and 16 Feet

As previously discussed, the estimated total activity to be removed is intended to approximately equal the total activity between 0 to 16 ft below DI datum within the boundary shown in Figure 1.2. The governing equation (Equation 1) can be used for individual depth ranges (or layers) and then summed together as appropriate. For this evaluation, depths were discretized in 2-ft intervals (or layers) (see Figure 1.3) from 0 to 16 ft below DI datum, as shown in Equation 2.

Equation 2:

$$TAct_{0-16} = Act_{0-2} + Act_{2-4} + Act_{4-6} + Act_{6-8} + Act_{8-10} + Act_{10-12} + Act_{12-14} + Act_{14-16}$$

Where

$\mathbf{TAct_{0-16}}$ = Activity (pCi) within 0 to 16 ft, i.e., Layers 1 to 8; and
$\mathbf{Act_{0-2}, Act_{2-4}}$ = Activity (pCi) within 0 to 2 ft (or Layer 1), 2 to 4 ft (or Layer 2), etc.

4.3 Excavation Optimization Approach

As discussed in Section 1.2, the RODA has specific excavation requirements associated with the removal of the estimated total activity in the top 16 ft below DI datum. To address these requirements, material >52.9 pCi/g in the top 8 ft below DI datum must be excavated, and the total activity in material >52.9 pCi/g that is allowed to remain between 8 and 16 ft below DI datum must be offset through excavation of an equivalent amount of activity deeper than 16 ft, with a preference for removal of material >1,000 pCi/g. This relationship is shown in Equation 3.

Equation 3:

$$Act_{UR\ 8-16} \leq Act_{OPT}$$

Where

$\mathbf{Act_{UR\ 8-16}}$ = Total activity (pCi) of unexcavated RIM >52.9 pCi/g between 8 and 16 ft; and
$\mathbf{Act_{OPT}}$ = Total activity (pCi) of RIM >52.9 pCi/g excavated between 16 and 20 ft for optimization.

Another way to express this is shown in Equation 4.

Equation 4:

$$TAct_{0-16} \leq Act_{0-16\ (excavated)} + Act_{OPT}$$

Where

$\boldsymbol{Act_{0-16\ (excavated)}}$ = Total activity (pCi) of excavated RIM within 0 to 16 ft below DI datum (i.e., not including material >52.9 pCi/g that remains in place between 8 and 16 ft).

5.0 RESULTS AND CONCLUSIONS

For Layers 1 through 10, Equation 1 was used to estimate the total activities of combined thorium and combined radium within the portion of the CDL that is being considered as part of this evaluation. The calculations are provided in Attachment 6, and the results are provided on a per layer basis in Table 5.1. The columns in the tables are not in numerical order of the polygons, but instead follow the layout of the polygons on the figures in a clockwise pattern (see Figure 5.1). As indicated in Table 5.1, aside from three exceptions described in the notes, activities are included only for those polygon layers where the average combined thorium or combined radium is >52.9 pCi/g.

Using the values in Table 5.1 and Equation 2, the estimated total combined thorium and combined radium activities between 0 and 16 ft below DI datum are 2.90 and 0.772 Curies (Ci), respectively. The estimated total activity is 3.67 Ci, as shown in Table 5.2.

Using the relationships defined in Equations 3 and 4, Table 5.3 provides a summary of the optimization and a proposed maximum excavation depth for each polygon, including the interval containing RIM >52.9 pCi/g to be removed. Table 5.4 presents a simplified version of the optimization results. Consistent with Table 5.3, Figure 5.1 shows the proposed excavation requirements for each polygon, and Figure 5.2 illustrates the extent of RIM >52.9 pCi/g to remain after excavation and the location of make-up RIM. Based on these results, the RODA optimization process requirements are met as follows:

- The material in each polygon and layer with combined thorium or combined radium >52.9 pCi/g within the top 8 ft of DI datum will be removed for a total activity of 1.01 Ci. A total activity of 2.32 Ci is proposed to be removed from the top 16 ft of DI datum.
- RIM >52.9 pCi/g left in place between 8 and 16 ft has a total activity of 1.35 Ci (i.e., 3.67 Ci minus 2.32 Ci), and the proposed additional excavation from the CD-EA-200 polygon from 16 to 18 ft below DI datum will remove 1.43 Ci. Therefore, the RODA requirement will be met since more activity will be removed from 16 to 18 ft than will be left in place between 8 and 16 ft.
- The material from CD-EA-200 from 16 to 18 ft below DI datum has an average combined radium of >1,000 pCi/g, which is preferred for material that is being used to offset RIM >52.9 pCi/g left in place between 8 and 16 ft below DI datum.
- As shown in Table 5.3, RIM >52.9 pCi/g to remain in place has at least 8 ft of material above it that does not require removal (CD-EA-199-C), but most cases have 12 ft (CD-EA-200-D, CD-EA-190-R, and CD-EA-199-B) or 14 ft (CD-EA-200-B and CD-EA-200-A) above them.
- As shown in Table 5.3, the proposed excavations in polygons CD-EA-174 and CD-EA-175 are optimized such that RIM >52.9 pCi/g within 12 ft below DI datum will be removed.
- Overall, as shown on Table 5.4, 3.75 Ci of activity will be removed. This value is greater than 3.67 Ci, which is the total activity estimated within 0 to 16 ft below DI datum.

This optimization substantially reduces the area of ground disturbance and volume of overburden removal, thus reducing the associated risks as compared to excavating all RIM >52.9 pCi/g within the top 16 ft below DI datum. Therefore, the optimization for the CDL excavation provided in this appendix fulfills the intent of the RODA optimization process.

6.0 REFERENCES

ArcGIS, 2023. "ArcMap: Create Thiessen Polygons." ArcMap Version 10.8. Retrieved on March 20, 2023 from https://desktop.arcgis.com/en/arcmap/latest/tools/analysis-toolbox/create-thiessen-polygons.htm.

Parsons et al., 2023. *Design Investigation Evaluation Report: West Lake Landfill Superfund Site Operable Unit 1*. Prepared on behalf of the West Lake Landfill OU-1 Respondents by Parsons, Feezor Engineering, Inc., and Ameriphysics. January 31, 2023.

USEPA, 2018. *Record of Decision Amendment, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1*, September 2018.

USEPA, 2022. *Remedial Design Modified Statement of Work (SOW) Operable Unit 1, West Lake Landfill Superfund Site, City of Bridgeton, St. Louis County, State of Missouri,* July 2022.

TABLES

TABLE 1.1 LAYER THICKNESSES

Layer Number	Depth Interval (ft)	Thickness (ft)
1 (top)	0 to 2	2
2	2 to 4	2
3	4 to 6	2
4	6 to 8	2
5	8 to 10	2
6	10 to 12	2
7	12 to 14	2
8	14 to 16	2
9	16 to 18	2
10 (bottom)	18 to 20	2

Note: Layer 1 starts at the DI datum.

PARSONS

TABLE 5.1 COMBINED THORIUM AND COMBINED RADIUM ACTIVITIES PER BORING PER LAYER

		Boring[1,2,3] (Polygon Number)															
Layer (Depth)	Activity	CD-EA-208[4] (4)	CD-EA-199 (8)	CD-EA-199-C (6)	CD-EA-200-C (7)	CD-EA-200-D (15)	CD-EA-200-B[5] (3)	CD-EA-200-A (13)	CD-EA-175 (14)	CD-EA-175-A[6] (12)	CD-EA-190-C (11)	CD-EA-190-R (9)	CD-EA-190-B (2)	CD-EA-174 (10)	CD-EA-200 (1)	CD-EA-199-B (5)	Total Activity (Ci)
1 (0-2 ft)	Combined Radium (Ci)	NA	NA	NA	NA	NA	NA	NA	0.003	NA	0.003	NA	0.002	NA	NA	NA	0.007
	Combined Thorium (Ci)	NA	NA	NA	NA	NA	NA	NA	0.067	NA	0.078	NA	0.029	NA	NA	NA	0.174
2 (2-4 ft)	Combined Radium (Ci)	0.001	NA	NA	NA	NA	NA	NA	0.003	0.001	0.005	NA	0.002	NA	NA	NA	0.011
	Combined Thorium (Ci)	0.007	NA	NA	NA	NA	NA	NA	0.067	0.011	0.120	NA	0.029	NA	NA	NA	0.234
3 (4-6 ft)	Combined Radium (Ci)	NA	0.003	NA	NA	NA	NA	NA	0.002	0.014	NA	NA	NA	0.002	NA	NA	0.021
	Combined Thorium (Ci)	NA	0.040	NA	NA	NA	NA	NA	0.034	0.209	NA	NA	NA	0.041	NA	NA	0.324
4 (6-8 ft)	Combined Radium (Ci)	NA	0.003	NA	NA	NA	NA	NA	NA	0.010	NA	NA	NA	0.004	NA	NA	0.016
	Combined Thorium (Ci)	NA	0.040	NA	NA	NA	NA	NA	NA	0.107	NA	NA	NA	0.080	NA	NA	0.227
5 (8-10 ft)	Combined Radium (Ci)	NA	0.003	0.003	NA	NA	NA	NA	NA	0.0002	NA	NA	NA	0.004	NA	NA	0.010
	Combined Thorium (Ci)	NA	0.043	0.083	NA	NA	NA	NA	NA	0.005	NA	NA	NA	0.080	NA	NA	0.211
6 (10-12 ft)	Combined Radium (Ci)	NA	0.003	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.005	0.003	NA	0.013
	Combined Thorium (Ci)	NA	0.043	0.083	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.289	0.043	NA	0.458
7 (12-14 ft)	Combined Radium (Ci)	NA	NA	NA	NA	0.002	NA	NA	NA	NA	NA	0.007	NA	0.005	0.003	0.001	0.018
	Combined Thorium (Ci)	NA	NA	NA	NA	0.281	NA	NA	NA	NA	NA	0.027	NA	0.289	0.043	0.021	0.660
8 (14-16 ft)	Combined Radium (Ci)	NA	NA	NA	NA	0.014	0.001	0.001	0.014	NA	NA	NA	NA	0.003	0.643	0.001	0.677
	Combined Thorium (Ci)	NA	NA	NA	NA	0.267	0.017	0.029	0.034	NA	NA	NA	NA	0.145	0.095	0.021	0.608
9 (16-18 ft)	Combined Radium (Ci)	NA	NA	NA	1.49	-	0.098	0.002	0.049	NA	NA	NA	-	NA	1.28	NA	2.92
	Combined Thorium (Ci)	NA	NA	NA	0.311	-	1.83	0.058	0.288	NA	NA	NA	-	NA	0.147	NA	2.63
10 (18-20 ft)	Combined Radium (Ci)	NA	NA	-	1.51	-	-	0.002	0.028	NA	NA	NA	-	NA	1.43	NA	2.97
	Combined Thorium (Ci)	NA	NA	-	0.516	-	-	0.058	0.068	NA	NA	NA	-	NA	1.09	NA	1.74

Notes:

1. Gray highlighting indicates a combined thorium or combined radium sample result from the boring exceeds 52.9 pCi/g, as shown in Attachments 3 and 4.
2. NA indicates "Not Applicable" since neither the combined thorium nor combined radium result exceeds 52.9 pCi/g, as shown in Attachments 3 and 4. Therefore, excavation is not required, and it does not contribute to the total activity in that layer for purposes of this calculation.
3. "-" indicates neither combined thorium nor combined radium data are available within a layer for a boring.
4. As shown in Attachment 3, Figure 2, CD-EA-208 has an average combined thorium value less than 52.9 pCi/g; however, Layer 2 for boring CD-EA-208 is highlighted gray in this evaluation because the sample interval from 3 to 3.4 ft below DI datum has a total thorium result of 236 pCi/g.
5. As shown in Attachment 3, Figure 8, CD-EA-200-B has an average combined thorium value less than 52.9 pCi/g; however, Layer 8 for boring CD-EA-200-B is highlighted gray in this evaluation because the sample interval from 14 to 15 ft below DI datum has a total thorium result of 75.8 pCi/g.
6. As shown in Attachment 3, Figure 5, CD-EA-175-A has an average combined thorium value less than 52.9 pCi/g; however, Layer 5 for boring CD-EA-175-A is highlighted gray in this evaluation because the sample interval from 8 to 9 ft below DI datum has a total thorium result of 81.1 pCi/g.

TABLE 5.2 TOTAL ACTIVITY IN THE CDL IN THE TOP 16 FT BELOW DI DATUM

Layer Number	Depth Interval (ft)	Combined Radium Activity (Ci)	Combined Thorium Activity (Ci)	Total Activity (Ci)
1 (top)	0 to 2	0.007	0.174	0.181
2	2 to 4	0.011	0.234	0.245
3	4 to 6	0.021	0.324	0.345
4	6 to 8	0.016	0.227	0.243
5	8 to 10	0.010	0.211	0.221
6	10 to 12	0.013	0.458	0.471
7	12 to 14	0.018	0.660	0.678
8	14 to 16	0.677	0.608	1.28
Total (Layers 1 through 8)	0 to 16	0.772	2.90	**3.67**

TABLE 5.3 TOTAL ACTIVITY IN PROPOSED EXCAVATION AND RIM >52.9 pCi/g TO REMAIN PER BORING PER LAYER

Layer (Depth)	Boring[1,2,3,4,5] (Polygon Number)														
	CD-EA-208[6] (4)	CD-EA-199 (8)	CD-EA-199-C (6)	CD-EA-200-C (7)	CD-EA-200-D (15)	CD-EA-200-B (3)	CD-EA-200-A (13)	CD-EA-175 (14)	CD-EA-175-A[7] (12)	CD-EA-190-C (11)	CD-EA-190-R (9)	CD-EA-190-B (2)	CD-EA-174 (10)	CD-EA-200 (1)	CD-EA-199-B (5)
	Activity (Ci)														
1 (0-2 ft)	NA	NA	NA	NA	NA	NA	NA	0.070	NA	0.081	NA	0.031	NA	NA	NA
2 (2-4 ft)	0.008	NA	NA	NA	NA	NA	NA	0.070	0.012	0.125	NA	0.031	NA	NA	NA
3 (4-6 ft)	NA	0.043	NA	NA	NA	NA	NA	0.036	0.223	NA	NA	NA	0.043	NA	NA
4 (6-8 ft)	NA	0.043	NA	NA	NA	NA	NA	NA	0.116	NA	NA	NA	0.084	NA	NA
5 (8-10 ft)	NA	0.046	0.087	NA	NA	NA	NA	NA	0.005	NA	NA	NA	0.084	NA	NA
6 (10-12 ft)	NA	0.046	0.087	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.293	0.046	NA
7 (12-14 ft)	NA	NA	NA	NA	0.283	NA	NA	NA	NA	NA	0.034	NA	0.293	0.046	0.022
8 (14-16 ft)	NA	NA	NA	NA	0.281	0.019	0.031	0.048	NA	NA	NA	NA	0.147	0.737	0.022
Total Activity of RIM >52.9 pCi/g to Remain from Layers 5 to 8 (8-16 ft)	NA	NA	0.173	NA	0.563	0.019	0.031	0.048	NA	NA	0.034	NA	0.441	NA	0.044
9 (16-18 ft)	NA	NA	NA	1.80	-	1.92	0.060	0.338	NA	NA	NA	-	NA	1.43	NA
10 (18-20 ft)	NA	NA	-	2.03	-	-	0.060	0.096	NA	NA	NA	-	NA	2.52	NA
	Proposed Maximum Excavation Depth (Interval of RIM >52.9 pCi/g to be Removed)														
	4 ft (2-4 ft)	12 ft (4-12 ft)	0 ft	0 ft	0 ft	0 ft	0 ft	6 ft (0-6 ft)	10 ft (2-10 ft)	4 ft (0-4 ft)	0 ft	4 ft (0-4 ft)	12 ft (4-12 ft)	18 ft (10-18 ft)	0 ft

Notes:

1. Gray highlighteding indicates a combined thorium or combined radium sample result from the boring exceeds 52.9 pCi/g, and it will be excavated.
2. Peach highlighting indicates RIM >52.9 pCi/g to remain within 8 to 16 ft below the DI datum.
3. Green highlighting is the RIM >52.9 pCi/g that will be excavated from 16 to 18 ft below the DI datum to offset RIM >52.9 pCi/g that will not be excavated between 8 and 16 ft below the DI datum.
4. NA indicates "Not Applicable" since neither the combined thorium nor combined radium result exceeds 52.9 pCi/g; therefore, it will not be excavated and does not contribute to the total activity for purposes of this calculation. NA also indicates "Not Applicable" when a boring does not have RIM >52.9 pCi/g to remain between 8 and 16 ft.
5. "-" indicates neither combined thorium nor combined radium data are available within a layer for a boring.
6. As shown in Attachment 3, Figure 2, Polygon Number 4 has an average combined thorium value less than 52.9 pCi/g; however, Layer 2 for boring CD-EA-208 is highlighted gray in this evaluation because the sample interval from 3 to 3.4 ft below DI datum has a total thorium result of 236 pCi/g.
7. As shown in Attachment 3, Figure 5, Polygon Number 12 has an average combined thorium value less than 52.9 pCi/g; however, Layer 5 for boring CD-EA-175-A is highlighted gray in this evaluation because the sample interval from 8 to 9 ft below DI datum has a total thorium result of 81.1 pCi/g.

TABLE 5.4 SUMMARY OF OPTIMIZATION RESULTS

	Total Activity (Ci)
Proposed Excavation in Layers 1 to 4 (0-8 ft)	1.01
Total Activity in Layers 1 to 8 (0-16 ft)	**3.67**
Proposed Excavation in Layers 1 to 8 (0-16 ft)	2.32
Required Make-up Activity	**1.35**
Proposed Excavation in Layer 9 (16-18 ft) as Make-up Activity	1.43
Excess Activity Proposed to be Excavated	**0.08**
Total Proposed Optimized Excavation in Layers 1 to 9 (0-18 ft)	**3.75**

FIGURES

0 250 500 1,000 Feet

Legend

Closed Demolition Landfill

FIGURE 1.1
CLOSED DEMOLITION LANDFILL AREA

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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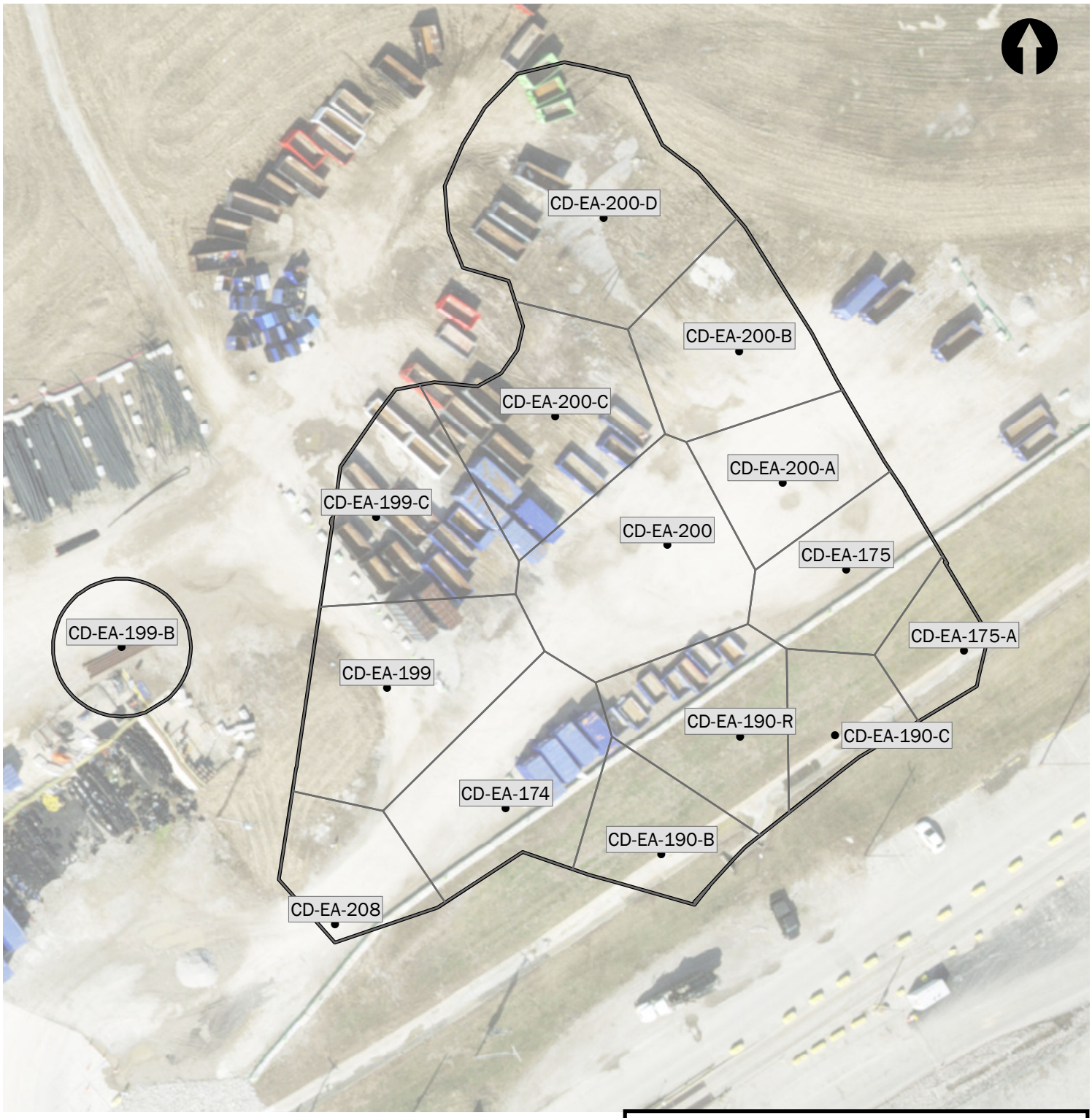

0 50 100 200 Feet

Legend

- Boring

Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

FIGURE 1.2
BORINGS EVALUATED IN THE CLOSED DEMOLITION LANDFILL AREA

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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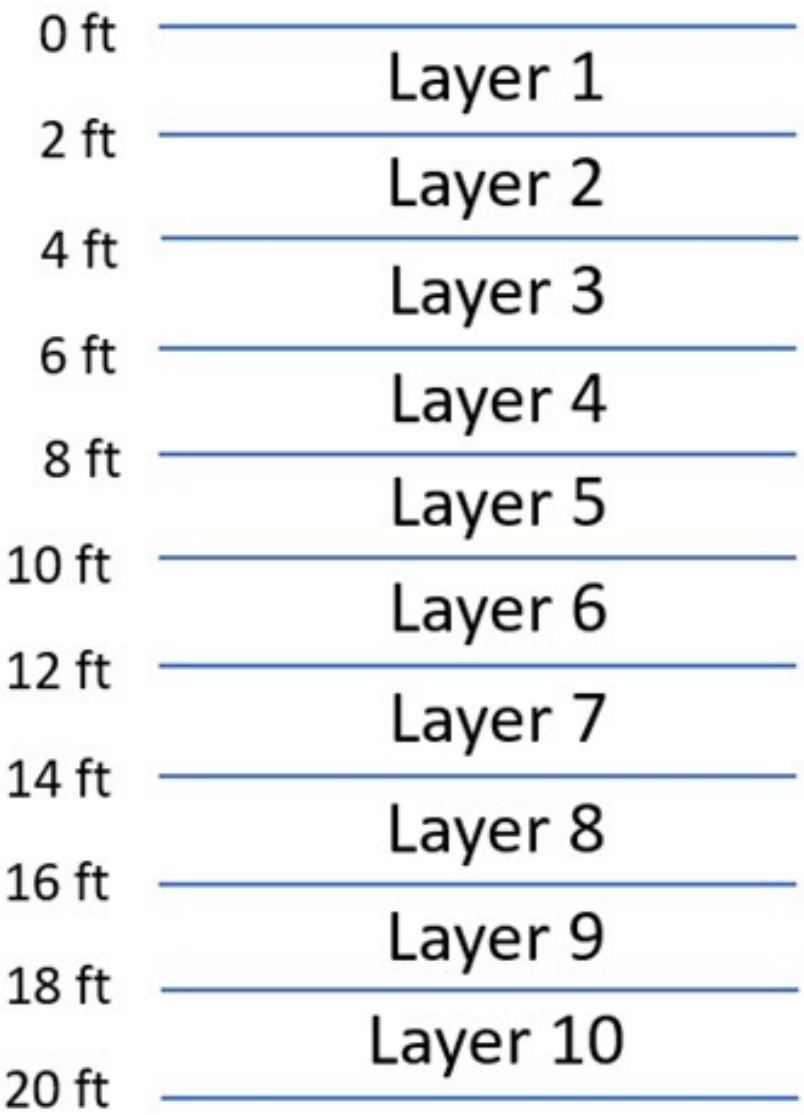

NOT TO SCALE

FIGURE 1.3
TEN LAYERS

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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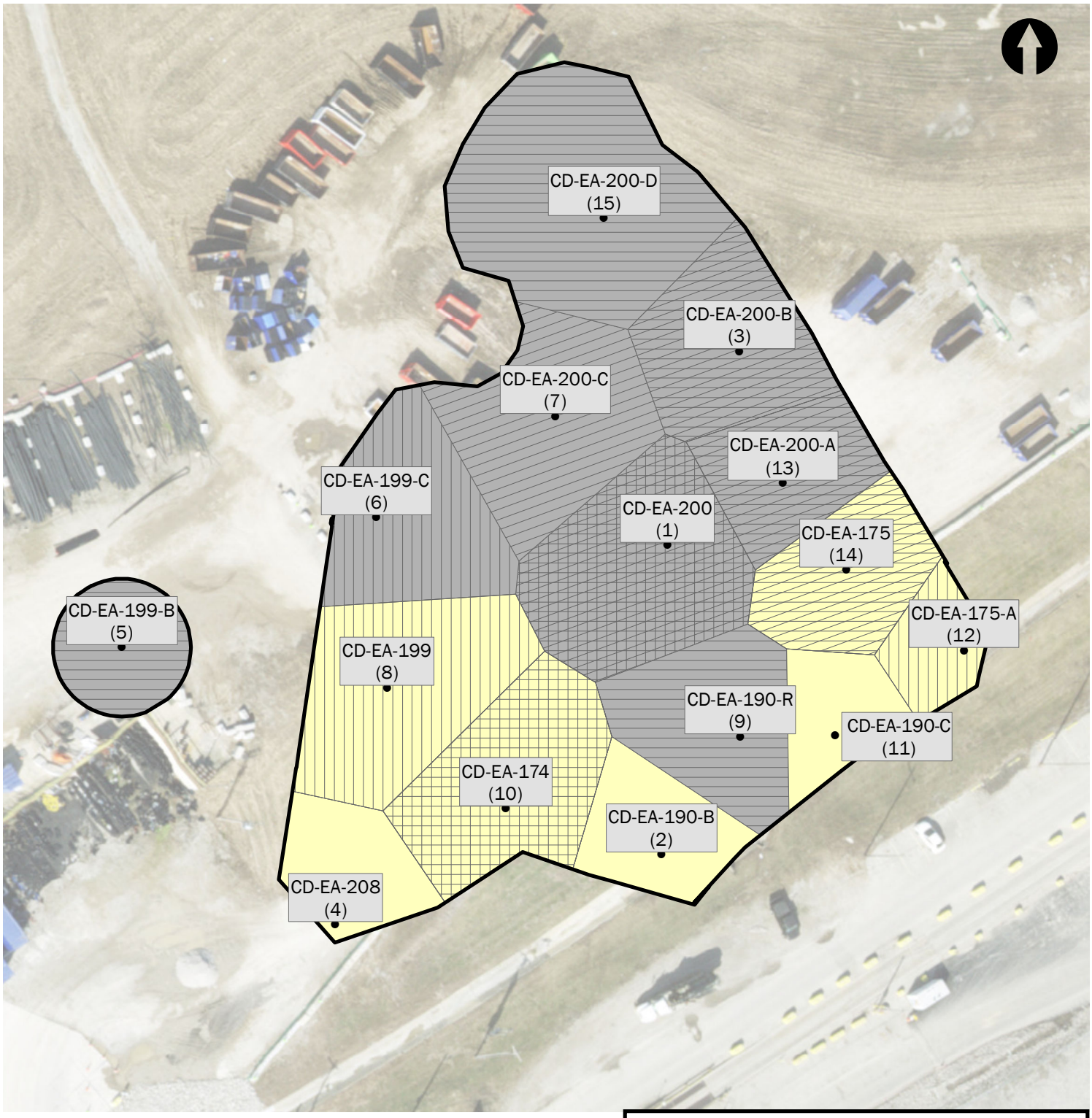

0 50 100 200 Feet

Legend

- Boring (Thiessen Polygon Numbers)
- Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum
- 0-8' RIM >52.9 pCi/g
- 8-12' RIM >52.9 pCi/g
- 12-16' RIM >52.9 pCi/g
- 16-20' RIM >52.9 pCi/g

FIGURE 3.17
EXTENT OF RIM >52.9 pCi/g WITH DEPTH
CLOSED DEMOLITION LANDFILL AREA

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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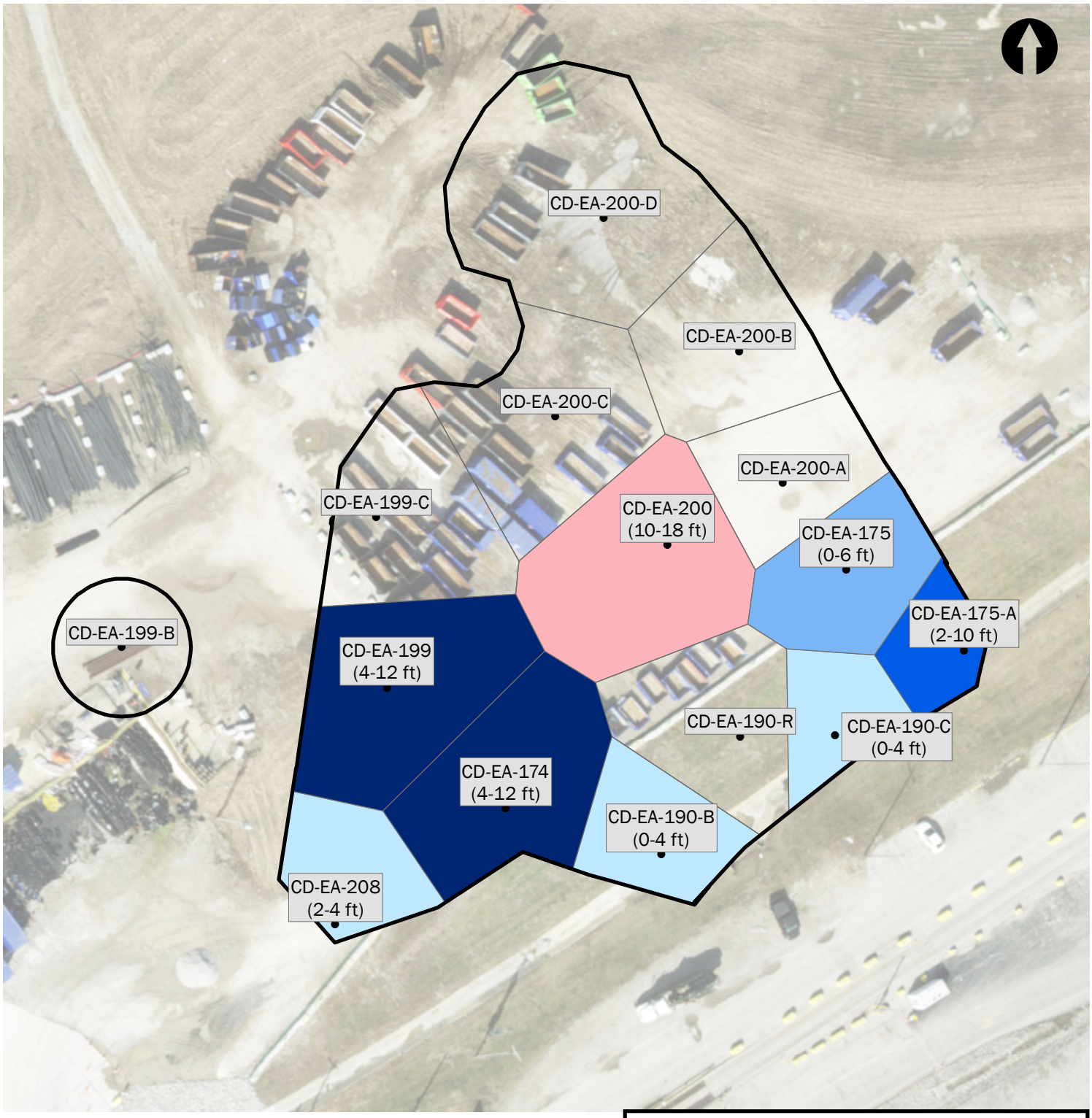

0 50 100 200 Feet

Legend

- Boring (RIM >52.9 pCi/g to be Removed)
- Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum
- No Excavation
- 4' Excavation
- 6' Excavation
- 10' Excavation
- 12' Excavation
- 18' Excavation

FIGURE 5.1
PROPOSED EXCAVATION IN THE CLOSED DEMOLITION LANDFILL AREA

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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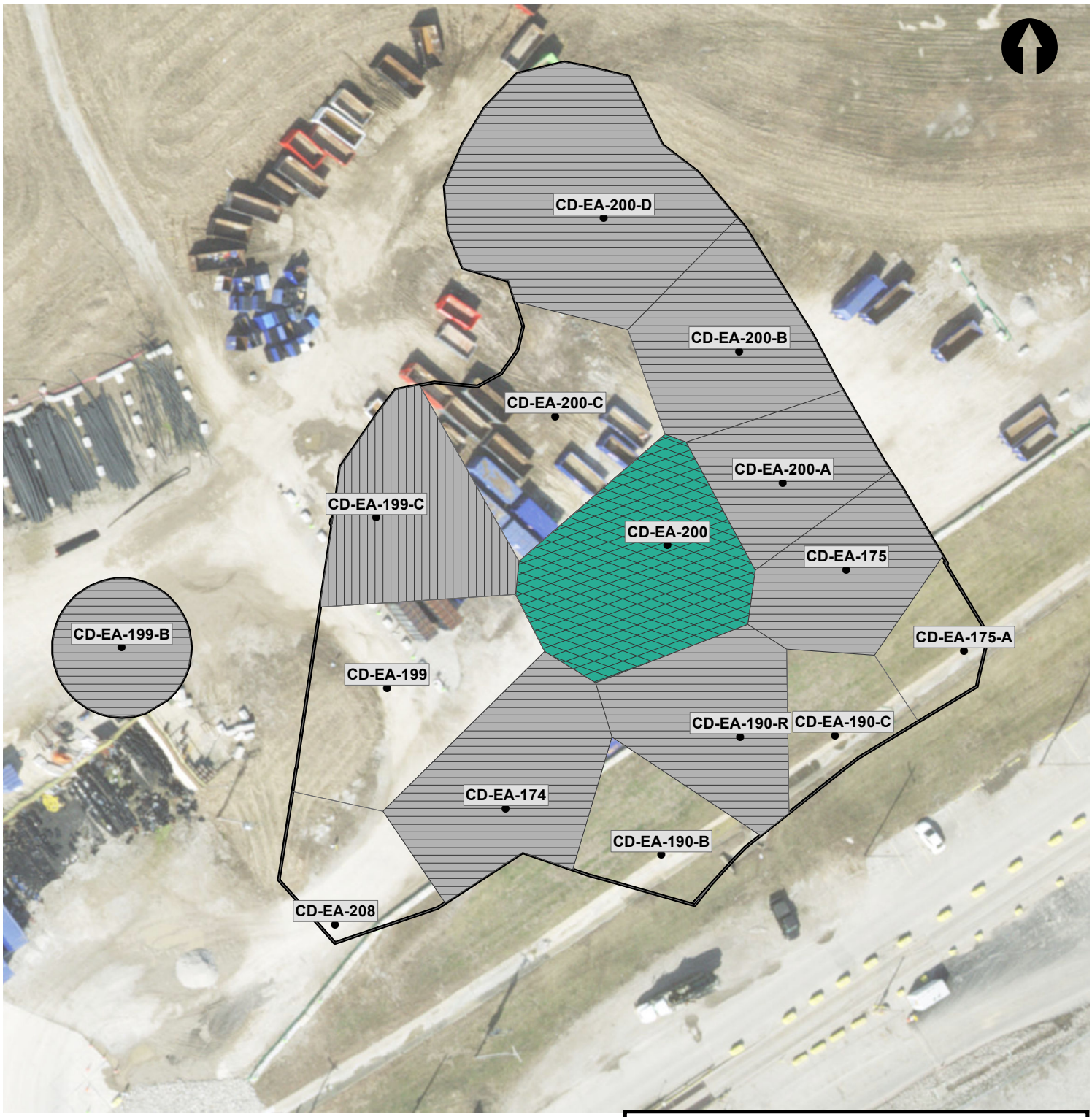

0 50 100 200 Feet

Legend

- Boring
- Lateral Extent of RIM >52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum
- RIM >52.9 pCi/g to Remain from 8-12'
- RIM >52.9 pCi/g to Remain from 12-16'
- Make-Up RIM from 16-18'

FIGURE 5.2
EXTENT OF RIM >52.9 pCi/g TO REMAIN POST EXCAVATION AND MAKE-UP RIM IN THE CLOSED DEMOLITION LANDFILL AREA

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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ATTACHMENTS

ATTACHMENT 1 DATASET USED FOR ANALYSIS

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 1

Attachment 1 - Dataset Used for Analysis
Layer 1

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-0-5-N	1.506	1.77	835674.578	1070167.657	-0.8	4.2	5
CD-EA-164	CD-EA-164-0-5-N	2.198	2.176	835766.253	1070284.033	-0.7	4.3	5
CD-EA-165	CD-EA-165-0-5-N	1.406	2	835957.091	1070343.454	0	5	5
CD-EA-166	CD-EA-166-0-5-N	2.32	1.948	835822.607	1070145.558	0	5	5
CD-EA-167	CD-EA-167-0-5-N	1.399	0.806	835677.832	1070017.51	0	5	5
CD-EA-174	CD-EA-174-0-5-N	1.98	2.323	835854.774	1069420.545	0	5	5
CD-EA-174-A	CD-EA-174-A-0-1-N	1.65	7.89	835870.315	1069368.608	0	1	1
CD-EA-174-A	CD-EA-174-A-0-4-N	2.46	12.9	835870.315	1069368.608	0	4	4
CD-EA-174-A	CD-EA-174-A-1-2-N	1.69	15.8	835870.315	1069368.608	1	2	1
CD-EA-175	CD-EA-175-0-5-N	7.408	193.12	836004.133	1069525.25	0	5	5
CD-EA-175-A	CD-EA-175-A-0-1-N	2.33	23.1	836055.699	1069489.883	0	1	1
CD-EA-175-A	CD-EA-175-A-0-4-N	3.64	65.9	836055.699	1069489.883	0	4	4
CD-EA-175-A	CD-EA-175-A-1-2-N	2.35	29.2	836055.699	1069489.883	1	2	1
CD-EA-176	CD-EA-176-0-5-N	1.692	2.791	835876.708	1069785.257	0	5	5
CD-EA-188	CD-EA-188-0-5-N	1.59	2.145	835695.068	1069300.601	0	5	5
CD-EA-189	CD-EA-189-0-5-N	1.461	2.112	835910.156	1069321.009	0	5	5
CD-EA-190-A	CD-EA-190-A-0-1-N	2.53	14.9	835988.91	1069406.468	0	1	1
CD-EA-190-A	CD-EA-190-A-0-4-N	2.2	7.53	835988.91	1069406.468	0	4	4
CD-EA-190-A	CD-EA-190-A-1-2-N	2.58	29.6	835988.91	1069406.468	1	2	1
CD-EA-190-B	CD-EA-190-B-0-4-N	5.88	106	835923.065	1069400.292	0	4	4
CD-EA-190-C	CD-EA-190-C-0-4-N	13.8	371	835999.19	1069452.697	0	4	4
CD-EA-190-R	CD-EA-190-R-0-1-N	2.77	30.6	835957.593	1069452.157	0	1	1
CD-EA-190-R	CD-EA-190-R-0-4-N	2.51	5.48	835957.593	1069452.157	0	4	4
CD-EA-190-R	CD-EA-190-R-1-2-N	2.42	16.8	835957.593	1069452.157	1	2	1
CD-EA-191	CD-EA-191-0-4-N	2.37	7.81	836055.288	1069442.664	0	4	4
CD-EA-191	CD-EA-191-0-1-N	2.03	13.4	836055.288	1069442.664	0	1	1
CD-EA-191	CD-EA-191-1-2-N	2.41	12.5	836055.288	1069442.664	1	2	1
CD-EA-191-A	CD-EA-191-A-0.5-1-N	1.55	2.28	836096.405	1069363.796	0.5	1	0.5
CD-EA-191-A	CD-EA-191-A-0-0.5-N	1.48	1.92	836096.405	1069363.796	0	0.5	0.5
CD-EA-191-A	CD-EA-191-A-1.5-2-N	2.21	2.36	836096.405	1069363.796	1.5	2	0.5
CD-EA-191-A	CD-EA-191-A-1-1.5-N	2.04	2.63	836096.405	1069363.796	1	1.5	0.5
CD-EA-192	CD-EA-192-0-1-N	0.808	1	836159.876	1069624.308	0	1	1
CD-EA-192	CD-EA-192-0-5-N	1.221	0.772	836159.876	1069624.308	0	5	5
CD-EA-192	CD-EA-192-1-2-N	1.13	1.61	836159.876	1069624.308	1	2	1
CD-EA-193	CD-EA-193-0-5-N	1.711	2.211	836076.433	1069887.925	0	5	5
CD-EA-193-A	CD-EA-193-A-0-5-N	1.15	1.15	836253.439	1069833.78	0	5	5
CD-EA-194	CD-EA-194-0-5-N	2.11	2.228	835915.311	1070071.563	0	5	5
CD-EA-195	CD-EA-195-0-5-N	1.933	1.835	835989.766	1070221.031	0	5	5
CD-EA-196	CD-EA-196-0-5-N	1.92	2.74	835402.189	1069742.298	0	5	5
CD-EA-197	CD-EA-197-0-4-N	2.09	1.9	835630.668	1069903.765	0	4	4
CD-EA-198-R	CD-EA-198-R-0-1-N	1.81	1.45	835680.595	1069590.029	0	1	1
CD-EA-198-R	CD-EA-198-R-0-5-N	1.686	2.23	835680.595	1069590.029	0	5	5
CD-EA-198-R	CD-EA-198-R-1-2-N	1.8	2.19	835680.595	1069590.029	1	2	1
CD-EA-199	CD-EA-199-0-4-N	1.83	2.6	835802.602	1069473.477	0	4	4
CD-EA-199-A	CD-EA-199-A-0-1-N	1.84	2.93	835754.076	1069445.503	0	1	1
CD-EA-199-A	CD-EA-199-A-0-4-N	1.76	3.05	835754.076	1069445.503	0	4	4
CD-EA-199-A	CD-EA-199-A-1-2-N	1.7	2.17	835754.076	1069445.503	1	2	1

Attachment 1 - Dataset Used for Analysis
Layer 1

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-199-B	CD-EA-199-B-0-4-N	2.07	2.76	835686.34	1069491.195	0	4	4
CD-EA-199-C	CD-EA-199-C-0-4-N	1.89	3.61	835797.913	1069548.224	0	4	4
CD-EA-199-D	CD-EA-199-D-0-4-N	1.72	2.28	835798.79	1069621.255	0	4	4
CD-EA-199-E	CD-EA-199-E-0-4-N	1.7	2.19	835615.56	1069493.96	0	4	4
CD-EA-199-E	CD-EA-199-E-0-1-N	1.96	2.15	835615.56	1069493.96	0	1	1
CD-EA-199-E	CD-EA-199-E-1-2-N	2.24	1.66	835615.56	1069493.96	1	2	1
CD-EA-200	CD-EA-200-0-5-N	2.09	2.48	835925.578	1069536.038	0	5	5
CD-EA-200-A	CD-EA-200-A-0-4-N	0.981	1.25	835976.26	1069563.391	0	4	4
CD-EA-200-B	CD-EA-200-B-0-1-N	1.06	0.918	835957.19	1069621.183	0	1	1
CD-EA-200-B	CD-EA-200-B-0-4-N	2.13	2.39	835957.19	1069621.183	0	4	4
CD-EA-200-B	CD-EA-200-B-1-2-N	2.13	1.98	835957.19	1069621.183	1	2	1
CD-EA-200-C	CD-EA-200-C-0-4-N	2.26	4.23	835876.462	1069592.606	0	4	4
CD-EA-200-D	CD-EA-200-D-0-4-N	1.85	1.76	835897.854	1069679.576	0	4	4
CD-EA-200-E	CD-EA-200-E-0-4-N	0.937	1.12	835979.81	1069760.76	0	4	4
CD-EA-201	CD-EA-201-0-4-N	0.815	2.61	836026.627	1069591.617	0	4	4
CD-EA-201-A	CD-EA-201-A-0-4-N	1.81	2.04	836022.568	1069685.44	0	4	4
CD-EA-202	CD-EA-202-0-5-N	0.926	0.924	836136.252	1070035.553	0	5	5
CD-EA-202-A	CD-EA-202-A-0-5-N	1.62	2.74	836302.06	1070017.559	0	5	5
CD-EA-202-B	CD-EA-202-B-0-5-N	0	2.3	836177.004	1070238.015	0	5	5
CD-EA-203	CD-EA-203-0.5-0.9-N	1.446	1.774	836401.952	1069798.383	0.5	0.9	0.4
CD-EA-208	CD-EA-208-0-1-N	2.13	8.82	835780.058	1069369.66	0	1	1
CD-EA-208	CD-EA-208-0-4-N	2.73	13.7	835780.058	1069369.66	0	4	4
CD-EA-208	CD-EA-208-1-2-N	2.15	2.82	835780.058	1069369.66	1	2	1
CD-EA-208-A	CD-EA-208-A-0-4-N	1.18	2.92	835729.129	1069329.541	0	4	4
CD-EA-208-B	CD-EA-208-B-0-4-N	2.18	10.3	835804.048	1069338.567	0	4	4
CD-EA-208-C	CD-EA-208-C-0-4-N	1.33	1.89	835687.09	1069360.47	0	4	4
CD-EA-209-A	CD-EA-209-A-0.5-1-N	1.93	2.2	836152.902	1069489.179	0.5	1	0.5
CD-EA-209-A	CD-EA-209-A-0-0.5-N	1.86	1.73	836152.902	1069489.179	0	0.5	0.5
CD-EA-209-A	CD-EA-209-A-1.5-2-N	1.76	2.09	836152.902	1069489.179	1.5	2	0.5
CD-EA-209-A	CD-EA-209-A-1-1.5-N	1.38	1.45	836152.902	1069489.179	1	1.5	0.5
CD-EA-209-R	CD-EA-209-R-0-1-N	1.84	10.7	836067.787	1069525.393	0	1	1
CD-EA-209-R	CD-EA-209-R-0-4-N	1.95	11.4	836067.787	1069525.393	0	4	4
CD-EA-209-R	CD-EA-209-R-1-2-N	2.17	8.18	836067.787	1069525.393	1	2	1
CD-EA-210	CD-EA-210-0-4-N	1.92	4.54	835781.7	1069252.78	0	4	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 2

Attachment 1 - Dataset Used for Analysis
Layer 2

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-0-5-N	1.506	1.77	835674.578	1070167.657	-0.8	4.2	5
CD-EA-164	CD-EA-164-0-5-N	2.198	2.176	835766.253	1070284.033	-0.7	4.3	5
CD-EA-165	CD-EA-165-0-5-N	1.406	2	835957.091	1070343.454	0	5	5
CD-EA-166	CD-EA-166-0-5-N	2.32	1.948	835822.607	1070145.558	0	5	5
CD-EA-167	CD-EA-167-0-5-N	1.399	0.806	835677.832	1070017.51	0	5	5
CD-EA-174	CD-EA-174-0-5-N	1.98	2.323	835854.774	1069420.545	0	5	5
CD-EA-174-A	CD-EA-174-A-0-4-N	2.46	12.9	835870.315	1069368.608	0	4	4
CD-EA-174-A	CD-EA-174-A-2-3-N	2.15	25.4	835870.315	1069368.608	2	3	1
CD-EA-174-A	CD-EA-174-A-3-4-N	2.39	3.7	835870.315	1069368.608	3	4	1
CD-EA-175	CD-EA-175-0-5-N	7.408	193.12	836004.133	1069525.25	0	5	5
CD-EA-175-A	CD-EA-175-A-0-4-N	3.64	65.9	836055.699	1069489.883	0	4	4
CD-EA-175-A	CD-EA-175-A-2-3-N	3.67	73	836055.699	1069489.883	2	3	1
CD-EA-175-A	CD-EA-175-A-3-4-N	4.85	62	836055.699	1069489.883	3	4	1
CD-EA-176	CD-EA-176-0-5-N	1.692	2.791	835876.708	1069785.257	0	5	5
CD-EA-188	CD-EA-188-0-5-N	1.59	2.145	835695.068	1069300.601	0	5	5
CD-EA-189	CD-EA-189-0-5-N	1.461	2.112	835910.156	1069321.009	0	5	5
CD-EA-190-A	CD-EA-190-A-0-4-N	2.2	7.53	835988.91	1069406.468	0	4	4
CD-EA-190-A	CD-EA-190-A-2-3-N	1.93	8.11	835988.91	1069406.468	2	3	1
CD-EA-190-B	CD-EA-190-B-0-4-N	5.88	106	835923.065	1069400.292	0	4	4
CD-EA-190-C	CD-EA-190-C-0-4-N	13.8	371	835999.19	1069452.697	0	4	4
CD-EA-190-C	CD-EA-190-C-2.5-3-N	119	2170	835999.19	1069452.697	2.5	3	0.5
CD-EA-190-R	CD-EA-190-R-0-4-N	2.51	5.48	835957.593	1069452.157	0	4	4
CD-EA-190-R	CD-EA-190-R-2-3-N	2.03	2.76	835957.593	1069452.157	2	3	1
CD-EA-190-R	CD-EA-190-R-3-4-N	2.29	2.7	835957.593	1069452.157	3	4	1
CD-EA-191	CD-EA-191-0-4-N	2.37	7.81	836055.288	1069442.664	0	4	4
CD-EA-191	CD-EA-191-2-3-N	2.29	7.28	836055.288	1069442.664	2	3	1
CD-EA-191	CD-EA-191-3-3.4-N	2.17	4.55	836055.288	1069442.664	3	3.4	0.4
CD-EA-191-A	CD-EA-191-A-2-3-N	2.12	2.62	836096.405	1069363.796	2	3	1
CD-EA-191-A	CD-EA-191-A-3-4-N	2.06	2.92	836096.405	1069363.796	3	4	1
CD-EA-192	CD-EA-192-0-5-N	1.221	0.772	836159.876	1069624.308	0	5	5
CD-EA-192	CD-EA-192-2-3-N	0.676	1.17	836159.876	1069624.308	2	3	1
CD-EA-192	CD-EA-192-3-4-N	0.528	1.24	836159.876	1069624.308	3	4	1
CD-EA-193	CD-EA-193-0-5-N	1.711	2.211	836076.433	1069887.925	0	5	5
CD-EA-193-A	CD-EA-193-A-0-5-N	1.15	1.15	836253.439	1069833.78	0	5	5
CD-EA-194	CD-EA-194-0-5-N	2.11	2.228	835915.311	1070071.563	0	5	5
CD-EA-195	CD-EA-195-0-5-N	1.933	1.835	835989.766	1070221.031	0	5	5
CD-EA-196	CD-EA-196-0-5-N	1.92	2.74	835402.189	1069742.298	0	5	5
CD-EA-197	CD-EA-197-0-4-N	2.09	1.9	835630.668	1069903.765	0	4	4
CD-EA-198-R	CD-EA-198-R-0-5-N	1.686	2.23	835680.595	1069590.029	0	5	5
CD-EA-198-R	CD-EA-198-R-2-3-N	2.18	2.23	835680.595	1069590.029	2	3	1
CD-EA-198-R	CD-EA-198-R-3-4-N	2	2.05	835680.595	1069590.029	3	4	1
CD-EA-199	CD-EA-199-0-4-N	1.83	2.6	835802.602	1069473.477	0	4	4
CD-EA-199-A	CD-EA-199-A-0-4-N	1.76	3.05	835754.076	1069445.503	0	4	4
CD-EA-199-A	CD-EA-199-A-2-3-N	1.9	2.54	835754.076	1069445.503	2	3	1
CD-EA-199-A	CD-EA-199-A-3-4-N	1.83	4.28	835754.076	1069445.503	3	4	1
CD-EA-199-B	CD-EA-199-B-0-4-N	2.07	2.76	835686.34	1069491.195	0	4	4
CD-EA-199-C	CD-EA-199-C-0-4-N	1.89	3.61	835797.913	1069548.224	0	4	4

Attachment 1 - Dataset Used for Analysis
Layer 2

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-199-D	CD-EA-199-D-0-4-N	1.72	2.28	835798.79	1069621.255	0	4	4
CD-EA-199-E	CD-EA-199-E-0-4-N	1.7	2.19	835615.56	1069493.96	0	4	4
CD-EA-199-E	CD-EA-199-E-2-3-N	3.27	2.49	835615.56	1069493.96	2	3	1
CD-EA-199-E	CD-EA-199-E-3-4-N	1.77	1.95	835615.56	1069493.96	3	4	1
CD-EA-200	CD-EA-200-0-5-N	2.09	2.48	835925.578	1069536.038	0	5	5
CD-EA-200-A	CD-EA-200-A-0-4-N	0.981	1.25	835976.26	1069563.391	0	4	4
CD-EA-200-B	CD-EA-200-B-0-4-N	2.13	2.39	835957.19	1069621.183	0	4	4
CD-EA-200-B	CD-EA-200-B-2-3-N	2.02	1.62	835957.19	1069621.183	2	3	1
CD-EA-200-B	CD-EA-200-B-3-4-N	2.36	1.7	835957.19	1069621.183	3	4	1
CD-EA-200-C	CD-EA-200-C-0-4-N	2.26	4.23	835876.462	1069592.606	0	4	4
CD-EA-200-D	CD-EA-200-D-0-4-N	1.85	1.76	835897.854	1069679.576	0	4	4
CD-EA-200-E	CD-EA-200-E-0-4-N	0.937	1.12	835979.81	1069760.76	0	4	4
CD-EA-201	CD-EA-201-0-4-N	0.815	2.61	836026.627	1069591.617	0	4	4
CD-EA-201-A	CD-EA-201-A-0-4-N	1.81	2.04	836022.568	1069685.44	0	4	4
CD-EA-202	CD-EA-202-0-5-N	0.926	0.924	836136.252	1070035.553	0	5	5
CD-EA-202-A	CD-EA-202-A-0-5-N	1.62	2.74	836302.06	1070017.559	0	5	5
CD-EA-202-B	CD-EA-202-B-0-5-N	0	2.3	836177.004	1070238.015	0	5	5
CD-EA-208	CD-EA-208-0-4-N	2.73	13.7	835780.058	1069369.66	0	4	4
CD-EA-208	CD-EA-208-2-3-N	2.61	2.85	835780.058	1069369.66	2	3	1
CD-EA-208	CD-EA-208-3-3.4-N	9.31	236	835780.058	1069369.66	3	3.4	0.4
CD-EA-208-A	CD-EA-208-A-0-4-N	1.18	2.92	835729.129	1069329.541	0	4	4
CD-EA-208-B	CD-EA-208-B-0-4-N	2.18	10.3	835804.048	1069338.567	0	4	4
CD-EA-208-C	CD-EA-208-C-0-4-N	1.33	1.89	835687.09	1069360.47	0	4	4
CD-EA-209-A	CD-EA-209-A-2-4-N	2.09	2.33	836152.902	1069489.179	2	4	2
CD-EA-209-R	CD-EA-209-R-0-4-N	1.95	11.4	836067.787	1069525.393	0	4	4
CD-EA-209-R	CD-EA-209-R-2-3-N	1.47	7.02	836067.787	1069525.393	2	3	1
CD-EA-209-R	CD-EA-209-R-3-3.5-N	2.15	10.9	836067.787	1069525.393	3	3.5	0.5
CD-EA-210	CD-EA-210-0-4-N	1.92	4.54	835781.7	1069252.78	0	4	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 3

Attachment 1 - Dataset Used for Analysis
Layer 3

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-0-5-N	1.506	1.77	835674.578	1070167.657	-0.8	4.2	5
CD-EA-163	CD-EA-163-5-10-N	1.633	1.854	835674.578	1070167.657	4.2	9.2	5
CD-EA-164	CD-EA-164-0-5-N	2.198	2.176	835766.253	1070284.033	-0.7	4.3	5
CD-EA-164	CD-EA-164-5-10-N	1.72	1.871	835766.253	1070284.033	4.3	9.3	5
CD-EA-165	CD-EA-165-0-5-N	1.406	2	835957.091	1070343.454	0	5	5
CD-EA-165	CD-EA-165-5-10-N	1.899	3.034	835957.091	1070343.454	5	10	5
CD-EA-166	CD-EA-166-0-5-N	2.32	1.948	835822.607	1070145.558	0	5	5
CD-EA-166	CD-EA-166-5-10-N	1.753	1.753	835822.607	1070145.558	5	10	5
CD-EA-167	CD-EA-167-0-5-N	1.399	0.806	835677.832	1070017.51	0	5	5
CD-EA-167	CD-EA-167-5-10-N	1.604	1.579	835677.832	1070017.51	5	10	5
CD-EA-174	CD-EA-174-0-5-N	1.98	2.323	835854.774	1069420.545	0	5	5
CD-EA-174	CD-EA-174-5-10-N	7.221	155.873	835854.774	1069420.545	5	10	5
CD-EA-174-A	CD-EA-174-A-4-5-N	2.2	3.98	835870.315	1069368.608	4	5	1
CD-EA-174-A	CD-EA-174-A-4-8-N	1.13	4.12	835870.315	1069368.608	4	8	4
CD-EA-174-A	CD-EA-174-A-5-6-N	0.784	4.69	835870.315	1069368.608	5	6	1
CD-EA-175	CD-EA-175-0-5-N	7.408	193.12	836004.133	1069525.25	0	5	5
CD-EA-175	CD-EA-175-5-10-N	2.41	2.53	836004.133	1069525.25	5	10	5
CD-EA-175-A	CD-EA-175-A-4.5-5-N	193	1400	836055.699	1069489.883	4.5	5	0.5
CD-EA-175-A	CD-EA-175-A-4-5-N	115	3310	836055.699	1069489.883	4	5	1
CD-EA-175-A	CD-EA-175-A-4-8-N	62.8	590	836055.699	1069489.883	4	8	4
CD-EA-175-A	CD-EA-175-A-5-6-N	69.4	1780	836055.699	1069489.883	5	6	1
CD-EA-176	CD-EA-176-0-5-N	1.692	2.791	835876.708	1069785.257	0	5	5
CD-EA-176	CD-EA-176-5-10-N	2.036	2.972	835876.708	1069785.257	5	10	5
CD-EA-188	CD-EA-188-0-5-N	1.59	2.145	835695.068	1069300.601	0	5	5
CD-EA-188	CD-EA-188-5-10-N	2.083	2.083	835695.068	1069300.601	5	10	5
CD-EA-189	CD-EA-189-0-5-N	1.461	2.112	835910.156	1069321.009	0	5	5
CD-EA-189	CD-EA-189-5-10-N	1.41	1.478	835910.156	1069321.009	5	10	5
CD-EA-190-A	CD-EA-190-A-4-8-N	1.28	5.48	835988.91	1069406.468	4	8	4
CD-EA-190-B	CD-EA-190-B-4-8-N	2.58	19.8	835923.065	1069400.292	4	8	4
CD-EA-190-C	CD-EA-190-C-4-8-N	1.66	16	835999.19	1069452.697	4	8	4
CD-EA-190-R	CD-EA-190-R-4-5-N	2.16	2.82	835957.593	1069452.157	4	5	1
CD-EA-190-R	CD-EA-190-R-4-8-N	2.19	5.29	835957.593	1069452.157	4	8	4
CD-EA-190-R	CD-EA-190-R-5-6-N	1.16	2.41	835957.593	1069452.157	5	6	1
CD-EA-192	CD-EA-192-0-5-N	1.221	0.772	836159.876	1069624.308	0	5	5
CD-EA-192	CD-EA-192-4-5-N	2.2	4.22	836159.876	1069624.308	4	5	1
CD-EA-192	CD-EA-192-5-10-N	1.8	1.878	836159.876	1069624.308	5	10	5
CD-EA-192	CD-EA-192-5-6-N	2.17	2.38	836159.876	1069624.308	5	6	1
CD-EA-193	CD-EA-193-0-5-N	1.711	2.211	836076.433	1069887.925	0	5	5
CD-EA-193	CD-EA-193-5-10-N	1.569	1.735	836076.433	1069887.925	5	10	5
CD-EA-193-A	CD-EA-193-A-0-5-N	1.15	1.15	836253.439	1069833.78	0	5	5
CD-EA-193-A	CD-EA-193-A-5-10-N	1.91	3.38	836253.439	1069833.78	5	10	5
CD-EA-194	CD-EA-194-0-5-N	2.11	2.228	835915.311	1070071.563	0	5	5
CD-EA-194	CD-EA-194-5-10-N	1.878	1.99	835915.311	1070071.563	5	10	5
CD-EA-195	CD-EA-195-0-5-N	1.933	1.835	835989.766	1070221.031	0	5	5
CD-EA-195	CD-EA-195-5-10-N	1.831	1.917	835989.766	1070221.031	5	10	5
CD-EA-196	CD-EA-196-0-5-N	1.92	2.74	835402.189	1069742.298	0	5	5
CD-EA-196	CD-EA-196-5-10-N	2.24	2.46	835402.189	1069742.298	5	10	5

Attachment 1 - Dataset Used for Analysis
Layer 3

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-197	CD-EA-197-4-9-N	1.57	1.78	835630.668	1069903.765	4	9	5
CD-EA-198-R	CD-EA-198-R-0-5-N	1.686	2.23	835680.595	1069590.029	0	5	5
CD-EA-198-R	CD-EA-198-R-4-5-N	1.06	3.72	835680.595	1069590.029	4	5	1
CD-EA-198-R	CD-EA-198-R-5.5-6-N	1.301	2.188	835680.595	1069590.029	5.5	6	0.5
CD-EA-198-R	CD-EA-198-R-5-6-N	1.6	2.21	835680.595	1069590.029	5	6	1
CD-EA-199	CD-EA-199-4-8-N	4.88	70.1	835802.602	1069473.477	4	8	4
CD-EA-199-A	CD-EA-199-A-4-5-N	2.18	7.64	835754.076	1069445.503	4	5	1
CD-EA-199-A	CD-EA-199-A-4-8-N	1.56	10.4	835754.076	1069445.503	4	8	4
CD-EA-199-A	CD-EA-199-A-5-6-N	1.49	9.56	835754.076	1069445.503	5	6	1
CD-EA-199-B	CD-EA-199-B-4-8-N	1.51	10.1	835686.34	1069491.195	4	8	4
CD-EA-199-C	CD-EA-199-C-4-8-N	2.02	2.2	835797.913	1069548.224	4	8	4
CD-EA-199-D	CD-EA-199-D-4.5-5-N	2	3.89	835798.79	1069621.255	4.5	5	0.5
CD-EA-199-E	CD-EA-199-E-4-8-N	2.34	1.96	835615.56	1069493.96	4	8	4
CD-EA-199-E	CD-EA-199-E-4-5-N	2.34	2.04	835615.56	1069493.96	4	5	1
CD-EA-199-E	CD-EA-199-E-5-6-N	2.1	2.06	835615.56	1069493.96	5	6	1
CD-EA-200	CD-EA-200-0-5-N	2.09	2.48	835925.578	1069536.038	0	5	5
CD-EA-200	CD-EA-200-5-10-N	1.59	3.15	835925.578	1069536.038	5	10	5
CD-EA-200-A	CD-EA-200-A-4-8-N	1.97	2.39	835976.26	1069563.391	4	8	4
CD-EA-200-B	CD-EA-200-B-4-5-N	1.52	1.75	835957.19	1069621.183	4	5	1
CD-EA-200-B	CD-EA-200-B-4-8-N	1.6	2.66	835957.19	1069621.183	4	8	4
CD-EA-200-B	CD-EA-200-B-5-6-N	2.53	1.84	835957.19	1069621.183	5	6	1
CD-EA-200-C	CD-EA-200-C-4-4.5-N	1.28	3.41	835876.462	1069592.606	4	4.5	0.5
CD-EA-200-D	CD-EA-200-D-4-8-N	2.02	2.34	835897.854	1069679.576	4	8	4
CD-EA-200-E	CD-EA-200-E-4-8-N	2.07	2.15	835979.81	1069760.76	4	8	4
CD-EA-201	CD-EA-201-4-8-N	2.29	2.32	836026.627	1069591.617	4	8	4
CD-EA-201-A	CD-EA-201-A-4-8-N	2.26	2.37	836022.568	1069685.44	4	8	4
CD-EA-202	CD-EA-202-0-5-N	0.926	0.924	836136.252	1070035.553	0	5	5
CD-EA-202	CD-EA-202-5-10-N	2.008	5.496	836136.252	1070035.553	5	10	5
CD-EA-202-A	CD-EA-202-A-0-5-N	1.62	2.74	836302.06	1070017.559	0	5	5
CD-EA-202-A	CD-EA-202-A-5-10-N	2.19	2.24	836302.06	1070017.559	5	10	5
CD-EA-202-B	CD-EA-202-B-0-5-N	0	2.3	836177.004	1070238.015	0	5	5
CD-EA-202-B	CD-EA-202-B-5-10-N	2.07	2.31	836177.004	1070238.015	5	10	5
CD-EA-203	CD-EA-203-5-10-N	2.171	3.074	836401.952	1069798.383	5	10	5
CD-EA-208	CD-EA-208-4-5-N	0.91	4.48	835780.058	1069369.66	4	5	1
CD-EA-208	CD-EA-208-4-8-N	2.88	38.5	835780.058	1069369.66	4	8	4
CD-EA-208	CD-EA-208-5-6-N	0.98	1.65	835780.058	1069369.66	5	6	1
CD-EA-208-A	CD-EA-208-A-4-8-N	2.03	2.35	835729.129	1069329.541	4	8	4
CD-EA-208-B	CD-EA-208-B-4-8-N	1.44	2.6	835804.048	1069338.567	4	8	4
CD-EA-208-C	CD-EA-208-C-4-8-N	2.62	2.19	835687.09	1069360.47	4	8	4
CD-EA-209-A	CD-EA-209-A-4-6-N	1.95	2.2	836152.902	1069489.179	4	6	2
CD-EA-209-R	CD-EA-209-R-4-5-N	1.83	4.88	836067.787	1069525.393	4	5	1
CD-EA-209-R	CD-EA-209-R-4-8-N	1.69	6.71	836067.787	1069525.393	4	8	4
CD-EA-209-R	CD-EA-209-R-5-6-N	1.83	2.58	836067.787	1069525.393	5	6	1
CD-EA-210	CD-EA-210-4-8-N	2.31	2.08	835781.7	1069252.78	4	8	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 4

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-5-10-N	1.633	1.854	835674.578	1070167.657	4.2	9.2	5
CD-EA-164	CD-EA-164-5-10-N	1.72	1.871	835766.253	1070284.033	4.3	9.3	5
CD-EA-165	CD-EA-165-5-10-N	1.899	3.034	835957.091	1070343.454	5	10	5
CD-EA-166	CD-EA-166-5-10-N	1.753	1.753	835822.607	1070145.558	5	10	5
CD-EA-167	CD-EA-167-5-10-N	1.604	1.579	835677.832	1070017.51	5	10	5
CD-EA-174	CD-EA-174-5-10-N	7.221	155.873	835854.774	1069420.545	5	10	5
CD-EA-174-A	CD-EA-174-A-4-8-N	1.13	4.12	835870.315	1069368.608	4	8	4
CD-EA-175	CD-EA-175-5-10-N	2.41	2.53	836004.133	1069525.25	5	10	5
CD-EA-175-A	CD-EA-175-A-4-8-N	62.8	590	836055.699	1069489.883	4	8	4
CD-EA-175-A	CD-EA-175-A-6-7-N	37.1	828	836055.699	1069489.883	6	7	1
CD-EA-176	CD-EA-176-5-10-N	2.036	2.972	835876.708	1069785.257	5	10	5
CD-EA-188	CD-EA-188-5-10-N	2.083	2.083	835695.068	1069300.601	5	10	5
CD-EA-189	CD-EA-189-5-10-N	1.41	1.478	835910.156	1069321.009	5	10	5
CD-EA-190-A	CD-EA-190-A-4-8-N	1.28	5.48	835988.91	1069406.468	4	8	4
CD-EA-190-B	CD-EA-190-B-4-8-N	2.58	19.8	835923.065	1069400.292	4	8	4
CD-EA-190-C	CD-EA-190-C-4-8-N	1.66	16	835999.19	1069452.697	4	8	4
CD-EA-190-R	CD-EA-190-R-4-8-N	2.19	5.29	835957.593	1069452.157	4	8	4
CD-EA-190-R	CD-EA-190-R-6-7-N	3.59	52.4	835957.593	1069452.157	6	7	1
CD-EA-192	CD-EA-192-5-10-N	1.8	1.878	836159.876	1069624.308	5	10	5
CD-EA-192	CD-EA-192-6-7-N	2.15	1.98	836159.876	1069624.308	6	7	1
CD-EA-192	CD-EA-192-7-8-N	0.493	0.52	836159.876	1069624.308	7	8	1
CD-EA-193	CD-EA-193-5-10-N	1.569	1.735	836076.433	1069887.925	5	10	5
CD-EA-193-A	CD-EA-193-A-5-10-N	1.91	3.38	836253.439	1069833.78	5	10	5
CD-EA-194	CD-EA-194-5-10-N	1.878	1.99	835915.311	1070071.563	5	10	5
CD-EA-195	CD-EA-195-5-10-N	1.831	1.917	835989.766	1070221.031	5	10	5
CD-EA-196	CD-EA-196-5-10-N	2.24	2.46	835402.189	1069742.298	5	10	5
CD-EA-197	CD-EA-197-4-9-N	1.57	1.78	835630.668	1069903.765	4	9	5
CD-EA-199	CD-EA-199-4-8-N	4.88	70.1	835802.602	1069473.477	4	8	4
CD-EA-199-A	CD-EA-199-A-4-8-N	1.56	10.4	835754.076	1069445.503	4	8	4
CD-EA-199-A	CD-EA-199-A-6-7-N	1.86	13.5	835754.076	1069445.503	6	7	1
CD-EA-199-A	CD-EA-199-A-7-7.5-N	2.61	13.2	835754.076	1069445.503	7	7.5	0.5
CD-EA-199-B	CD-EA-199-B-4-8-N	1.51	10.1	835686.34	1069491.195	4	8	4
CD-EA-199-C	CD-EA-199-C-4-8-N	2.02	2.2	835797.913	1069548.224	4	8	4
CD-EA-199-E	CD-EA-199-E-4-8-N	2.34	1.96	835615.56	1069493.96	4	8	4
CD-EA-199-E	CD-EA-199-E-6-6.5-N	2.29	1.55	835615.56	1069493.96	6	6.5	0.5
CD-EA-200	CD-EA-200-5-10-N	1.59	3.15	835925.578	1069536.038	5	10	5
CD-EA-200-A	CD-EA-200-A-4-8-N	1.97	2.39	835976.26	1069563.391	4	8	4
CD-EA-200-B	CD-EA-200-B-4-8-N	1.6	2.66	835957.19	1069621.183	4	8	4
CD-EA-200-B	CD-EA-200-B-6-7-N	1.55	5.06	835957.19	1069621.183	6	7	1
CD-EA-200-B	CD-EA-200-B-7-8-N	0.281	1.09	835957.19	1069621.183	7	8	1
CD-EA-200-D	CD-EA-200-D-4-8-N	2.02	2.34	835897.854	1069679.576	4	8	4
CD-EA-200-E	CD-EA-200-E-4-8-N	2.07	2.15	835979.81	1069760.76	4	8	4
CD-EA-201	CD-EA-201-4-8-N	2.29	2.32	836026.627	1069591.617	4	8	4
CD-EA-201-A	CD-EA-201-A-4-8-N	2.26	2.37	836022.568	1069685.44	4	8	4
CD-EA-202	CD-EA-202-5-10-N	2.008	5.496	836136.252	1070035.553	5	10	5
CD-EA-202-A	CD-EA-202-A-5-10-N	2.19	2.24	836302.06	1070017.559	5	10	5
CD-EA-202-B	CD-EA-202-B-5-10-N	2.07	2.31	836177.004	1070238.015	5	10	5
CD-EA-203	CD-EA-203-5-10-N	2.171	3.074	836401.952	1069798.383	5	10	5
CD-EA-208	CD-EA-208-4-8-N	2.88	38.5	835780.058	1069369.66	4	8	4
CD-EA-208	CD-EA-208-6-7-N	1.71	2.03	835780.058	1069369.66	6	7	1
CD-EA-208	CD-EA-208-7-8-N	2.1	2.23	835780.058	1069369.66	7	8	1
CD-EA-208-A	CD-EA-208-A-4-8-N	2.03	2.35	835729.129	1069329.541	4	8	4
CD-EA-208-B	CD-EA-208-B-4-8-N	1.44	2.6	835804.048	1069338.567	4	8	4
CD-EA-208-C	CD-EA-208-C-4-8-N	2.62	2.19	835687.09	1069360.47	4	8	4
CD-EA-209-A	CD-EA-209-A-6-8-N	2.31	2.15	836152.902	1069489.179	6	8	2
CD-EA-209-R	CD-EA-209-R-4-8-N	1.69	6.71	836067.787	1069525.393	4	8	4
CD-EA-209-R	CD-EA-209-R-6-7-N	2.3	4.3	836067.787	1069525.393	6	7	1
CD-EA-210	CD-EA-210-4-8-N	2.31	2.08	835781.7	1069252.78	4	8	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 5

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-10-15-N	1.943	1.553	835674.578	1070167.657	9.2	14.2	5
CD-EA-163	CD-EA-163-5-10-N	1.633	1.854	835674.578	1070167.657	4.2	9.2	5
CD-EA-164	CD-EA-164-10-15-N	1.448	1.533	835766.253	1070284.033	9.3	14.3	5
CD-EA-164	CD-EA-164-5-10-N	1.72	1.871	835766.253	1070284.033	4.3	9.3	5
CD-EA-165	CD-EA-165-5-10-N	1.899	3.034	835957.091	1070343.454	5	10	5
CD-EA-166	CD-EA-166-5-10-N	1.753	1.753	835822.607	1070145.558	5	10	5
CD-EA-167	CD-EA-167-5-10-N	1.604	1.579	835677.832	1070017.51	5	10	5
CD-EA-174	CD-EA-174-5-10-N	7.221	155.873	835854.774	1069420.545	5	10	5
CD-EA-174-A	CD-EA-174-A-8.5-8.8-N	2.75	37.1	835870.315	1069368.608	8.5	8.8	0.3
CD-EA-174-A	CD-EA-174-A-8-9-N	2.05	22.6	835870.315	1069368.608	8	9	1
CD-EA-175	CD-EA-175-5-10-N	2.41	2.53	836004.133	1069525.25	5	10	5
CD-EA-175-A	CD-EA-175-A-8-12-N	0.857	22.7	836055.699	1069489.883	8	12	4
CD-EA-175-A	CD-EA-175-A-8-9-N	2.8	81.1	836055.699	1069489.883	8	9	1
CD-EA-175-A	CD-EA-175-A-9-10-N	0.741	4.34	836055.699	1069489.883	9	10	1
CD-EA-176	CD-EA-176-5-10-N	2.036	2.972	835876.708	1069785.257	5	10	5
CD-EA-188	CD-EA-188-5-10-N	2.083	2.083	835695.068	1069300.601	5	10	5
CD-EA-189	CD-EA-189-5-10-N	1.41	1.478	835910.156	1069321.009	5	10	5
CD-EA-190-A	CD-EA-190-A-8-12-N	1.26	1.89	835988.91	1069406.468	8	12	4
CD-EA-190-B	CD-EA-190-B-8-12-N	1.53	1.73	835923.065	1069400.292	8	12	4
CD-EA-190-C	CD-EA-190-C-8-12-N	0.765	4.21	835999.19	1069452.697	8	12	4
CD-EA-190-R	CD-EA-190-R-8-12-N	2.33	24.1	835957.593	1069452.157	8	12	4
CD-EA-190-R	CD-EA-190-R-8-9-N	2.85	21.8	835957.593	1069452.157	8	9	1
CD-EA-190-R	CD-EA-190-R-9-10-N	0.996	9.35	835957.593	1069452.157	9	10	1
CD-EA-192	CD-EA-192-5-10-N	1.8	1.878	836159.876	1069624.308	5	10	5
CD-EA-193	CD-EA-193-5-10-N	1.569	1.735	836076.433	1069887.925	5	10	5
CD-EA-193-A	CD-EA-193-A-5-10-N	1.91	3.38	836253.439	1069833.78	5	10	5
CD-EA-194	CD-EA-194-5-10-N	1.878	1.99	835915.311	1070071.563	5	10	5
CD-EA-195	CD-EA-195-5-10-N	1.831	1.917	835989.766	1070221.031	5	10	5
CD-EA-196	CD-EA-196-5-10-N	2.24	2.46	835402.189	1069742.298	5	10	5
CD-EA-197	CD-EA-197-4-9-N	1.57	1.78	835630.668	1069903.765	4	9	5
CD-EA-197	CD-EA-197-9-14-N	1.73	1.99	835630.668	1069903.765	9	14	5
CD-EA-199	CD-EA-199-8-12-N	4.54	74.7	835802.602	1069473.477	8	12	4
CD-EA-199-A	CD-EA-199-A-8-12-N	2.03	3.06	835754.076	1069445.503	8	12	4
CD-EA-199-A	CD-EA-199-A-8-9-N	2.2	2.87	835754.076	1069445.503	8	9	1
CD-EA-199-A	CD-EA-199-A-9-10-N	1.65	2.43	835754.076	1069445.503	9	10	1
CD-EA-199-B	CD-EA-199-B-8-12-N	2.26	8.31	835686.34	1069491.195	8	12	4
CD-EA-199-C	CD-EA-199-C-8-12-N	7.3	182	835797.913	1069548.224	8	12	4
CD-EA-199-D	CD-EA-199-D-8.5-9-N	0.414	1.03	835798.79	1069621.255	8.5	9	0.5
CD-EA-200	CD-EA-200-5-10-N	1.59	3.15	835925.578	1069536.038	5	10	5
CD-EA-200-A	CD-EA-200-A-8-12-N	1.78	2.87	835976.26	1069563.391	8	12	4
CD-EA-200-B	CD-EA-200-B-8-12-N	1.71	2.53	835957.19	1069621.183	8	12	4
CD-EA-200-B	CD-EA-200-B-8-9-N	0.0639	0.392	835957.19	1069621.183	8	9	1
CD-EA-200-B	CD-EA-200-B-9-10-N	2.24	2.84	835957.19	1069621.183	9	10	1
CD-EA-200-C	CD-EA-200-C-8-12-N	1.91	4.33	835876.462	1069592.606	8	12	4
CD-EA-200-D	CD-EA-200-D-8-12-N	1.34	0.968	835897.854	1069679.576	8	12	4
CD-EA-200-E	CD-EA-200-E-8-12-N	2.19	1.95	835979.81	1069760.76	8	12	4
CD-EA-201	CD-EA-201-8-12-N	2.02	2.49	836026.627	1069591.617	8	12	4
CD-EA-201-A	CD-EA-201-A-8-12-N	1.96	2.29	836022.568	1069685.44	8	12	4
CD-EA-202	CD-EA-202-5-10-N	2.008	5.496	836136.252	1070035.553	5	10	5
CD-EA-202-A	CD-EA-202-A-5-10-N	2.19	2.24	836302.06	1070017.559	5	10	5
CD-EA-202-B	CD-EA-202-B-5-10-N	2.07	2.31	836177.004	1070238.015	5	10	5
CD-EA-203	CD-EA-203-5-10-N	2.171	3.074	836401.952	1069798.383	5	10	5
CD-EA-208	CD-EA-208-8-12-N	1.97	2.63	835780.058	1069369.66	8	12	4
CD-EA-208	CD-EA-208-8-9-N	2.49	3.71	835780.058	1069369.66	8	9	1
CD-EA-208	CD-EA-208-9-10-N	1.7	2.47	835780.058	1069369.66	9	10	1
CD-EA-208-A	CD-EA-208-A-8-12-N	1.93	2.22	835729.129	1069329.541	8	12	4
CD-EA-208-B	CD-EA-208-B-8-12-N	1.7	2.44	835804.048	1069338.567	8	12	4
CD-EA-208-C	CD-EA-208-C-8-12-N	1.95	2.06	835687.09	1069360.47	8	12	4
CD-EA-209-A	CD-EA-209-A-8-10-N	2.23	3.48	836152.902	1069489.179	8	10	2
CD-EA-209-R	CD-EA-209-R-8-12-N	1.67	9.72	836067.787	1069525.393	8	12	4
CD-EA-209-R	CD-EA-209-R-8-9-N	2.42	34.6	836067.787	1069525.393	8	9	1
CD-EA-209-R	CD-EA-209-R-9-10-N	2.02	16.5	836067.787	1069525.393	9	10	1
CD-EA-210	CD-EA-210-8-12-N	2.14	2.09	835781.7	1069252.78	8	12	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 6

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-10-15-N	1.943	1.553	835674.578	1070167.657	9.2	14.2	5
CD-EA-164	CD-EA-164-10-15-N	1.448	1.533	835766.253	1070284.033	9.3	14.3	5
CD-EA-165	CD-EA-165-10-15-N	1.84	2.826	835957.091	1070343.454	10	15	5
CD-EA-166	CD-EA-166-10-15-N	2.03	3.39	835822.607	1070145.558	10	15	5
CD-EA-167	CD-EA-167-10-15-N	1.758	1.872	835677.832	1070017.51	10	15	5
CD-EA-174	CD-EA-174-10-15-N	8.961	562.17	835854.774	1069420.545	10	15	5
CD-EA-175	CD-EA-175-10-15-N	0.781	0.48	836004.133	1069525.25	10	15	5
CD-EA-175-A	CD-EA-175-A-10-11-N	0.685	2.39	836055.699	1069489.883	10	11	1
CD-EA-175-A	CD-EA-175-A-11-12-N	0.661	1.39	836055.699	1069489.883	11	12	1
CD-EA-175-A	CD-EA-175-A-8-12-N	0.857	22.7	836055.699	1069489.883	8	12	4
CD-EA-176	CD-EA-176-10.7-11.2-N	1.434	1.849	835876.708	1069785.257	10.7	11.2	0.5
CD-EA-188	CD-EA-188-10-15-N	1.818	1.643	835695.068	1069300.601	10	15	5
CD-EA-189	CD-EA-189-10-15-N	1.302	1.493	835910.156	1069321.009	10	15	5
CD-EA-190-A	CD-EA-190-A-8-12-N	1.26	1.89	835988.91	1069406.468	8	12	4
CD-EA-190-B	CD-EA-190-B-8-12-N	1.53	1.73	835923.065	1069400.292	8	12	4
CD-EA-190-C	CD-EA-190-C-8-12-N	0.765	4.21	835999.19	1069452.697	8	12	4
CD-EA-190-R	CD-EA-190-R-10-11-N	1.33	2.55	835957.593	1069452.157	10	11	1
CD-EA-190-R	CD-EA-190-R-8-12-N	2.33	24.1	835957.593	1069452.157	8	12	4
CD-EA-191	CD-EA-191-10-15-N	1.933	3.536	836055.288	1069442.664	10	15	5
CD-EA-192	CD-EA-192-10-11-N	2.05	2.44	836159.876	1069624.308	10	11	1
CD-EA-192	CD-EA-192-10-15-N	1.619	1.579	836159.876	1069624.308	10	15	5
CD-EA-192	CD-EA-192-11-12-N	1.93	2.17	836159.876	1069624.308	11	12	1
CD-EA-193	CD-EA-193-10-15-N	1.518	2.037	836076.433	1069887.925	10	15	5
CD-EA-193-A	CD-EA-193-A-10-15-N	1.78	2.27	836253.439	1069833.78	10	15	5
CD-EA-194	CD-EA-194-10-15-N	1.689	1.868	835915.311	1070071.563	10	15	5
CD-EA-195	CD-EA-195-10-15-N	1.586	1.742	835989.766	1070221.031	10	15	5
CD-EA-196	CD-EA-196-10-15-N	1.69	1.95	835402.189	1069742.298	10	15	5
CD-EA-197	CD-EA-197-9-14-N	1.73	1.99	835630.668	1069903.765	9	14	5
CD-EA-198-R	CD-EA-198-R-10-11-N	1.66	2.29	835680.595	1069590.029	10	11	1
CD-EA-198-R	CD-EA-198-R-10-15-N	2.102	2.434	835680.595	1069590.029	10	15	5
CD-EA-198-R	CD-EA-198-R-11-12-N	2.59	2.89	835680.595	1069590.029	11	12	1
CD-EA-199	CD-EA-199-8-12-N	4.54	74.7	835802.602	1069473.477	8	12	4
CD-EA-199-A	CD-EA-199-A-10-10.5-N	2.57	3.86	835754.076	1069445.503	10	10.5	0.5
CD-EA-199-A	CD-EA-199-A-8-12-N	2.03	3.06	835754.076	1069445.503	8	12	4
CD-EA-199-B	CD-EA-199-B-8-12-N	2.26	8.31	835686.34	1069491.195	8	12	4
CD-EA-199-C	CD-EA-199-C-8-12-N	7.3	182	835797.913	1069548.224	8	12	4
CD-EA-200	CD-EA-200-10-15-N	4.39	72.3	835925.578	1069536.038	10	15	5
CD-EA-200-A	CD-EA-200-A-8-12-N	1.78	2.87	835976.26	1069563.391	8	12	4
CD-EA-200-B	CD-EA-200-B-10-11-N	1.86	2.26	835957.19	1069621.183	10	11	1
CD-EA-200-B	CD-EA-200-B-8-12-N	1.71	2.53	835957.19	1069621.183	8	12	4
CD-EA-200-C	CD-EA-200-C-8-12-N	1.91	4.33	835876.462	1069592.606	8	12	4
CD-EA-200-D	CD-EA-200-D-8-12-N	1.34	0.968	835897.854	1069679.576	8	12	4
CD-EA-200-E	CD-EA-200-E-8-12-N	2.19	1.95	835979.81	1069760.76	8	12	4
CD-EA-201	CD-EA-201-8-12-N	2.02	2.49	836026.627	1069591.617	8	12	4
CD-EA-201-A	CD-EA-201-A-8-12-N	1.96	2.29	836022.568	1069685.44	8	12	4
CD-EA-202	CD-EA-202-10-15-N	2.659	25.899	836136.252	1070035.553	10	15	5
CD-EA-202-A	CD-EA-202-A-10-15-N	2.21	2.5	836302.06	1070017.559	10	15	5
CD-EA-202-B	CD-EA-202-B-10-15-N	0.957	1.5	836177.004	1070238.015	10	15	5
CD-EA-203	CD-EA-203-10-15-N	2.083	2.58	836401.952	1069798.383	10	15	5
CD-EA-208	CD-EA-208-10-11-N	1.08	1.42	835780.058	1069369.66	10	11	1
CD-EA-208	CD-EA-208-8-12-N	1.97	2.63	835780.058	1069369.66	8	12	4
CD-EA-208-A	CD-EA-208-A-8-12-N	1.93	2.22	835729.129	1069329.541	8	12	4
CD-EA-208-B	CD-EA-208-B-8-12-N	1.7	2.44	835804.048	1069338.567	8	12	4
CD-EA-208-C	CD-EA-208-C-8-12-N	1.95	2.06	835687.09	1069360.47	8	12	4
CD-EA-209-A	CD-EA-209-A-10-12-N	2.62	2.52	836152.902	1069489.179	10	12	2
CD-EA-209-R	CD-EA-209-R-10-11-N	1.39	1.73	836067.787	1069525.393	10	11	1
CD-EA-209-R	CD-EA-209-R-8-12-N	1.67	9.72	836067.787	1069525.393	8	12	4
CD-EA-210	CD-EA-210-8-12-N	2.14	2.09	835781.7	1069252.78	8	12	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 7

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-10-15-N	1.943	1.553	835674.578	1070167.657	9.2	14.2	5
CD-EA-164	CD-EA-164-10-15-N	1.448	1.533	835766.253	1070284.033	9.3	14.3	5
CD-EA-165	CD-EA-165-10-15-N	1.84	2.826	835957.091	1070343.454	10	15	5
CD-EA-166	CD-EA-166-10-15-N	2.03	3.39	835822.607	1070145.558	10	15	5
CD-EA-167	CD-EA-167-10-15-N	1.758	1.872	835677.832	1070017.51	10	15	5
CD-EA-174	CD-EA-174-10-15-N	8.961	562.17	835854.774	1069420.545	10	15	5
CD-EA-175	CD-EA-175-10-15-N	0.781	0.48	836004.133	1069525.25	10	15	5
CD-EA-175-A	CD-EA-175-A-12.5-13-N	0.655	1.61	836055.699	1069489.883	12.5	13	0.5
CD-EA-175-A	CD-EA-175-A-12-13-N	1.44	20.3	836055.699	1069489.883	12	13	1
CD-EA-188	CD-EA-188-10-15-N	1.818	1.643	835695.068	1069300.601	10	15	5
CD-EA-189	CD-EA-189-10-15-N	1.302	1.493	835910.156	1069321.009	10	15	5
CD-EA-190-A	CD-EA-190-A-12-16-N	1.6	1.77	835988.91	1069406.468	12	16	4
CD-EA-190-B	CD-EA-190-B-12-16-N	1.54	1.28	835923.065	1069400.292	12	16	4
CD-EA-190-C	CD-EA-190-C-12-16-N	1.19	1.85	835999.19	1069452.697	12	16	4
CD-EA-190-R	CD-EA-190-R-12.5-13-N	138	191	835957.593	1069452.157	12.5	13	0.5
CD-EA-190-R	CD-EA-190-R-12-13-N	13.7	111	835957.593	1069452.157	12	13	1
CD-EA-190-R	CD-EA-190-R-12-16-N	5.94	47.9	835957.593	1069452.157	12	16	4
CD-EA-190-R	CD-EA-190-R-13-14-N	10	19.3	835957.593	1069452.157	13	14	1
CD-EA-191	CD-EA-191-10-15-N	1.933	3.536	836055.288	1069442.664	10	15	5
CD-EA-192	CD-EA-192-10-15-N	1.619	1.579	836159.876	1069624.308	10	15	5
CD-EA-192	CD-EA-192-12-13-N	0.942	1.07	836159.876	1069624.308	12	13	1
CD-EA-193	CD-EA-193-10-15-N	1.518	2.037	836076.433	1069887.925	10	15	5
CD-EA-193-A	CD-EA-193-A-10-15-N	1.78	2.27	836253.439	1069833.78	10	15	5
CD-EA-194	CD-EA-194-10-15-N	1.689	1.868	835915.311	1070071.563	10	15	5
CD-EA-195	CD-EA-195-10-15-N	1.586	1.742	835989.766	1070221.031	10	15	5
CD-EA-196	CD-EA-196-10-15-N	1.69	1.95	835402.189	1069742.298	10	15	5
CD-EA-197	CD-EA-197-9-14-N	1.73	1.99	835630.668	1069903.765	9	14	5
CD-EA-198-R	CD-EA-198-R-10-15-N	2.102	2.434	835680.595	1069590.029	10	15	5
CD-EA-198-R	CD-EA-198-R-12-13-N	1.88	1.63	835680.595	1069590.029	12	13	1
CD-EA-198-R	CD-EA-198-R-13-14-N	1.83	1.86	835680.595	1069590.029	13	14	1
CD-EA-199	CD-EA-199-12-16-N	1.83	7.92	835802.602	1069473.477	12	16	4
CD-EA-199-A	CD-EA-199-A-12-13-N	2.31	2.52	835754.076	1069445.503	12	13	1
CD-EA-199-A	CD-EA-199-A-12-16-N	2.65	2.89	835754.076	1069445.503	12	16	4
CD-EA-199-A	CD-EA-199-A-13-14-N	5.93	6.46	835754.076	1069445.503	13	14	1
CD-EA-199-B	CD-EA-199-B-12-16-N	4.1	87.9	835686.34	1069491.195	12	16	4
CD-EA-199-C	CD-EA-199-C-12-16-N	1.58	2.96	835797.913	1069548.224	12	16	4
CD-EA-199-D	CD-EA-199-D-12-16-N	2.23	1.87	835798.79	1069621.255	12	16	4
CD-EA-199-E	CD-EA-199-E-12-16-N	3.32	3.12	835615.56	1069493.96	12	16	4
CD-EA-199-E	CD-EA-199-E-12-13-N	3.51	3.07	835615.56	1069493.96	12	13	1
CD-EA-199-E	CD-EA-199-E-13-14-N	2.96	2.52	835615.56	1069493.96	13	14	1
CD-EA-200	CD-EA-200-10-15-N	4.39	72.3	835925.578	1069536.038	10	15	5
CD-EA-200-A	CD-EA-200-A-12.5-12.9-N	1	2.19	835976.26	1069563.391	12.5	12.9	0.4
CD-EA-200-B	CD-EA-200-B-12-13-N	0.728	1.53	835957.19	1069621.183	12	13	1
CD-EA-200-B	CD-EA-200-B-12-16-N	2.92	30.9	835957.19	1069621.183	12	16	4
CD-EA-200-B	CD-EA-200-B-13-14-N	3.01	29.4	835957.19	1069621.183	13	14	1
CD-EA-200-C	CD-EA-200-C-12-16-N	0.829	26	835876.462	1069592.606	12	16	4
CD-EA-200-D	CD-EA-200-D-12-16-N	2.47	344	835897.854	1069679.576	12	16	4
CD-EA-200-E	CD-EA-200-E-12-16-N	2.17	2.19	835979.81	1069760.76	12	16	4
CD-EA-201	CD-EA-201-12-16-N	1.54	3.02	836026.627	1069591.617	12	16	4
CD-EA-201-A	CD-EA-201-A-12-16-N	1.85	2.14	836022.568	1069685.44	12	16	4
CD-EA-202	CD-EA-202-10-15-N	2.659	25.899	836136.252	1070035.553	10	15	5
CD-EA-202-A	CD-EA-202-A-10-15-N	2.21	2.5	836302.06	1070017.559	10	15	5
CD-EA-202-B	CD-EA-202-B-10-15-N	0.957	1.5	836177.004	1070238.015	10	15	5
CD-EA-203	CD-EA-203-10-15-N	2.083	2.58	836401.952	1069798.383	10	15	5
CD-EA-208	CD-EA-208-12-13-N	0.847	0.944	835780.058	1069369.66	12	13	1
CD-EA-208	CD-EA-208-12-16-N	1.52	1.94	835780.058	1069369.66	12	16	4
CD-EA-208	CD-EA-208-13-13.5-N	1.61	1.69	835780.058	1069369.66	13	13.5	0.5
CD-EA-208-A	CD-EA-208-A-12-16-N	2.13	2.4	835729.129	1069329.541	12	16	4
CD-EA-208-B	CD-EA-208-B-12-16-N	2.09	2.36	835804.048	1069338.567	12	16	4
CD-EA-208-C	CD-EA-208-C-12-16-N	2.44	2.4	835687.09	1069360.47	12	16	4
CD-EA-209-A	CD-EA-209-A-12-14-N	2.68	3.12	836152.902	1069489.179	12	14	2
CD-EA-209-R	CD-EA-209-R-12-13-N	1.43	5.64	836067.787	1069525.393	12	13	1
CD-EA-209-R	CD-EA-209-R-12-16-N	1.28	4.3	836067.787	1069525.393	12	16	4
CD-EA-209-R	CD-EA-209-R-13-14-N	0.197	0.796	836067.787	1069525.393	13	14	1

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 8

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-10-15-N	1.943	1.553	835674.578	1070167.657	9.2	14.2	5
CD-EA-163	CD-EA-163-15-20-N	1.847	1.97	835674.578	1070167.657	14.2	19.2	5
CD-EA-164	CD-EA-164-10-15-N	1.448	1.533	835766.253	1070284.033	9.3	14.3	5
CD-EA-164	CD-EA-164-15-20-N	1.724	1.716	835766.253	1070284.033	14.3	19.3	5
CD-EA-165	CD-EA-165-10-15-N	1.84	2.826	835957.091	1070343.454	10	15	5
CD-EA-165	CD-EA-165-15-20-N	1.686	1.629	835957.091	1070343.454	15	20	5
CD-EA-166	CD-EA-166-10-15-N	2.03	3.39	835822.607	1070145.558	10	15	5
CD-EA-166	CD-EA-166-15-20-N	1.341	0.5449	835822.607	1070145.558	15	20	5
CD-EA-167	CD-EA-167-10-15-N	1.758	1.872	835677.832	1070017.51	10	15	5
CD-EA-167	CD-EA-167-15-20-N	0.899	1.469	835677.832	1070017.51	15	20	5
CD-EA-174	CD-EA-174-10-15-N	8.961	562.17	835854.774	1069420.545	10	15	5
CD-EA-174	CD-EA-174-15-20-N	0.847	1.146	835854.774	1069420.545	15	20	5
CD-EA-175	CD-EA-175-10-15-N	0.781	0.48	836004.133	1069525.25	10	15	5
CD-EA-175	CD-EA-175-15-20-N	80.8828	195.447	836004.133	1069525.25	15	20	5
CD-EA-176	CD-EA-176-15-20-N	1.014	7.29	835876.708	1069785.257	15	20	5
CD-EA-188	CD-EA-188-10-15-N	1.818	1.643	835695.068	1069300.601	10	15	5
CD-EA-188	CD-EA-188-15-20-N	1.57	2.288	835695.068	1069300.601	15	20	5
CD-EA-189	CD-EA-189-10-15-N	1.302	1.493	835910.156	1069321.009	10	15	5
CD-EA-189	CD-EA-189-15-20-N	2.117	7.65	835910.156	1069321.009	15	20	5
CD-EA-189	CD-EA-189-15-16-N	1.6	2.11	835910.156	1069321.009	15	16	1
CD-EA-190-A	CD-EA-190-A-12-16-N	1.6	1.77	835988.91	1069406.468	12	16	4
CD-EA-190-B	CD-EA-190-B-12-16-N	1.54	1.28	835923.065	1069400.292	12	16	4
CD-EA-190-C	CD-EA-190-C-12-16-N	1.19	1.85	835999.19	1069452.697	12	16	4
CD-EA-190-R	CD-EA-190-R-12-16-N	5.94	47.9	835957.593	1069452.157	12	16	4
CD-EA-190-R	CD-EA-190-R-14-14.4-N	1.73	2.48	835957.593	1069452.157	14	14.4	0.4
CD-EA-191	CD-EA-191-10-15-N	1.933	3.536	836055.288	1069442.664	10	15	5
CD-EA-191	CD-EA-191-15-20-N	2.54	3.11	836055.288	1069442.664	15	20	5
CD-EA-192	CD-EA-192-10-15-N	1.619	1.579	836159.876	1069624.308	10	15	5
CD-EA-192	CD-EA-192-15.5-16-N	1.216	1.588	836159.876	1069624.308	15.5	16	0.5
CD-EA-192	CD-EA-192-15-16-N	1.38	1.19	836159.876	1069624.308	15	16	1
CD-EA-193	CD-EA-193-10-15-N	1.518	2.037	836076.433	1069887.925	10	15	5
CD-EA-193	CD-EA-193-15-20-N	1.464	2.111	836076.433	1069887.925	15	20	5
CD-EA-193-A	CD-EA-193-A-10-15-N	1.78	2.27	836253.439	1069833.78	10	15	5
CD-EA-193-A	CD-EA-193-A-15-20-N	1.13	1.07	836253.439	1069833.78	15	20	5
CD-EA-194	CD-EA-194-10-15-N	1.689	1.868	835915.311	1070071.563	10	15	5
CD-EA-194	CD-EA-194-15-20-N	1.329	2.187	835915.311	1070071.563	15	20	5
CD-EA-195	CD-EA-195-10-15-N	1.586	1.742	835989.766	1070221.031	10	15	5
CD-EA-195	CD-EA-195-15-20-N	1	1.405	835989.766	1070221.031	15	20	5
CD-EA-196	CD-EA-196-10-15-N	1.69	1.95	835402.189	1069742.298	10	15	5
CD-EA-196	CD-EA-196-15-20-N	1.9	1.46	835402.189	1069742.298	15	20	5
CD-EA-197	CD-EA-197-14-19-N	1.46	1.71	835630.668	1069903.765	14	19	5
CD-EA-198-R	CD-EA-198-R-10-15-N	2.102	2.434	835680.595	1069590.029	10	15	5
CD-EA-198-R	CD-EA-198-R-14-15-N	1.44	1.85	835680.595	1069590.029	14	15	1
CD-EA-198-R	CD-EA-198-R-15-16-N	1.21	1.77	835680.595	1069590.029	15	16	1
CD-EA-198-R	CD-EA-198-R-15-20-N	1.677	3.467	835680.595	1069590.029	15	20	5
CD-EA-199	CD-EA-199-12-16-N	1.83	7.92	835802.602	1069473.477	12	16	4
CD-EA-199-A	CD-EA-199-A-12-16-N	2.65	2.89	835754.076	1069445.503	12	16	4
CD-EA-199-A	CD-EA-199-A-14-15-N	1.49	1.93	835754.076	1069445.503	14	15	1
CD-EA-199-A	CD-EA-199-A-15-15.5-N	1.19	2.14	835754.076	1069445.503	15	15.5	0.5

Attachment 1 - Dataset Used for Analysis
Layer 8

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-199-B	CD-EA-199-B-12-16-N	4.1	87.9	835686.34	1069491.195	12	16	4
CD-EA-199-C	CD-EA-199-C-12-16-N	1.58	2.96	835797.913	1069548.224	12	16	4
CD-EA-199-D	CD-EA-199-D-12-16-N	2.23	1.87	835798.79	1069621.255	12	16	4
CD-EA-199-E	CD-EA-199-E-12-16-N	3.32	3.12	835615.56	1069493.96	12	16	4
CD-EA-199-E	CD-EA-199-E-14-14.5-N	1.98	1.68	835615.56	1069493.96	14	14.5	0.5
CD-EA-200	CD-EA-200-10-15-N	4.39	72.3	835925.578	1069536.038	10	15	5
CD-EA-200	CD-EA-200-15-20-N	2160	247	835925.578	1069536.038	15	20	5
CD-EA-200-B	CD-EA-200-B-12-16-N	2.92	30.9	835957.19	1069621.183	12	16	4
CD-EA-200-B	CD-EA-200-B-14-15-N	4.08	75.8	835957.19	1069621.183	14	15	1
CD-EA-200-C	CD-EA-200-C-12-16-N	0.829	26	835876.462	1069592.606	12	16	4
CD-EA-200-D	CD-EA-200-D-12-16-N	2.47	344	835897.854	1069679.576	12	16	4
CD-EA-200-D	CD-EA-200-D-15-15.5-N	133	190	835897.854	1069679.576	15	15.5	0.5
CD-EA-200-E	CD-EA-200-E-12-16-N	2.17	2.19	835979.81	1069760.76	12	16	4
CD-EA-201	CD-EA-201-12-16-N	1.54	3.02	836026.627	1069591.617	12	16	4
CD-EA-201-A	CD-EA-201-A-12-16-N	1.85	2.14	836022.568	1069685.44	12	16	4
CD-EA-202	CD-EA-202-10-15-N	2.659	25.899	836136.252	1070035.553	10	15	5
CD-EA-202	CD-EA-202-15-20-N	1.606	1.783	836136.252	1070035.553	15	20	5
CD-EA-202-A	CD-EA-202-A-10-15-N	2.21	2.5	836302.06	1070017.559	10	15	5
CD-EA-202-A	CD-EA-202-A-15-20-N	1.09	1.37	836302.06	1070017.559	15	20	5
CD-EA-202-B	CD-EA-202-B-10-15-N	0.957	1.5	836177.004	1070238.015	10	15	5
CD-EA-202-B	CD-EA-202-B-15.5-16-N	1.41	2.09	836177.004	1070238.015	15.5	16	0.5
CD-EA-203	CD-EA-203-10-15-N	2.083	2.58	836401.952	1069798.383	10	15	5
CD-EA-203	CD-EA-203-15-20-N	2.18	2.634	836401.952	1069798.383	15	20	5
CD-EA-208	CD-EA-208-12-16-N	1.52	1.94	835780.058	1069369.66	12	16	4
CD-EA-208-A	CD-EA-208-A-12-16-N	2.13	2.4	835729.129	1069329.541	12	16	4
CD-EA-208-B	CD-EA-208-B-12-16-N	2.09	2.36	835804.048	1069338.567	12	16	4
CD-EA-208-C	CD-EA-208-C-12-16-N	2.44	2.4	835687.09	1069360.47	12	16	4
CD-EA-209-A	CD-EA-209-A-14-16-N	2.58	2.99	836152.902	1069489.179	14	16	2
CD-EA-209-R	CD-EA-209-R-12-16-N	1.28	4.3	836067.787	1069525.393	12	16	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 9

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-15-20-N	1.847	1.97	835674.578	1070167.657	14.2	19.2	5
CD-EA-164	CD-EA-164-15-20-N	1.724	1.716	835766.253	1070284.033	14.3	19.3	5
CD-EA-165	CD-EA-165-15-20-N	1.686	1.629	835957.091	1070343.454	15	20	5
CD-EA-166	CD-EA-166-15-20-N	1.341	0.5449	835822.607	1070145.558	15	20	5
CD-EA-167	CD-EA-167-15-20-N	0.899	1.469	835677.832	1070017.51	15	20	5
CD-EA-174	CD-EA-174-15-20-N	0.847	1.146	835854.774	1069420.545	15	20	5
CD-EA-174-A	CD-EA-174-A-16-17-N	2.67	3.86	835870.315	1069368.608	16	17	1
CD-EA-174-A	CD-EA-174-A-16-20-N	2.18	3.27	835870.315	1069368.608	16	20	4
CD-EA-174-A	CD-EA-174-A-17-18-N	2.32	2.98	835870.315	1069368.608	17	18	1
CD-EA-175	CD-EA-175-15-20-N	80.8828	195.447	836004.133	1069525.25	15	20	5
CD-EA-175	CD-EA-175-16.5-17-N	752.28	7170.3	836004.133	1069525.25	16.5	17	0.5
CD-EA-175-A	CD-EA-175-A-16-17-N	0.935	1.52	836055.699	1069489.883	16	17	1
CD-EA-175-A	CD-EA-175-A-16-20-N	0.609	2.66	836055.699	1069489.883	16	20	4
CD-EA-175-A	CD-EA-175-A-17-18-N	1.17	13.6	836055.699	1069489.883	17	18	1
CD-EA-176	CD-EA-176-15-20-N	1.014	7.29	835876.708	1069785.257	15	20	5
CD-EA-188	CD-EA-188-15-20-N	1.57	2.288	835695.068	1069300.601	15	20	5
CD-EA-189	CD-EA-189-15-20-N	2.117	7.65	835910.156	1069321.009	15	20	5
CD-EA-189	CD-EA-189-16-17-N	1.79	1.96	835910.156	1069321.009	16	17	1
CD-EA-189	CD-EA-189-17-18-N	2.42	2.56	835910.156	1069321.009	17	18	1
CD-EA-190-A	CD-EA-190-A-16-20-N	1.59	1.91	835988.91	1069406.468	16	20	4
CD-EA-190-C	CD-EA-190-C-16-20-N	1.35	1.29	835999.19	1069452.697	16	20	4
CD-EA-190-R	CD-EA-190-R-16-17-N	1.35	1.95	835957.593	1069452.157	16	17	1
CD-EA-190-R	CD-EA-190-R-16-20-N	1.59	1.35	835957.593	1069452.157	16	20	4
CD-EA-190-R	CD-EA-190-R-17-18-N	1.52	1.72	835957.593	1069452.157	17	18	1
CD-EA-191	CD-EA-191-15-20-N	2.54	3.11	836055.288	1069442.664	15	20	5
CD-EA-193	CD-EA-193-15-20-N	1.464	2.111	836076.433	1069887.925	15	20	5
CD-EA-193-A	CD-EA-193-A-15-20-N	1.13	1.07	836253.439	1069833.78	15	20	5
CD-EA-194	CD-EA-194-15-20-N	1.329	2.187	835915.311	1070071.563	15	20	5
CD-EA-195	CD-EA-195-15-20-N	1	1.405	835989.766	1070221.031	15	20	5
CD-EA-196	CD-EA-196-15-20-N	1.9	1.46	835402.189	1069742.298	15	20	5
CD-EA-197	CD-EA-197-14-19-N	1.46	1.71	835630.668	1069903.765	14	19	5
CD-EA-198-R	CD-EA-198-R-15-20-N	1.677	3.467	835680.595	1069590.029	15	20	5
CD-EA-198-R	CD-EA-198-R-16-17-N	2.06	4.03	835680.595	1069590.029	16	17	1
CD-EA-198-R	CD-EA-198-R-17-18-N	1.93	1.83	835680.595	1069590.029	17	18	1
CD-EA-199	CD-EA-199-16-20-N	2.15	1.89	835802.602	1069473.477	16	20	4
CD-EA-199-A	CD-EA-199-A-16-17-N	1.48	1.78	835754.076	1069445.503	16	17	1
CD-EA-199-A	CD-EA-199-A-16-20-N	1.83	2.03	835754.076	1069445.503	16	20	4
CD-EA-199-A	CD-EA-199-A-17-18-N	1.77	2.38	835754.076	1069445.503	17	18	1
CD-EA-199-B	CD-EA-199-B-16-20-N	3.01	3.58	835686.34	1069491.195	16	20	4
CD-EA-199-C	CD-EA-199-C-17-17.5-N	1.82	1.81	835797.913	1069548.224	17	17.5	0.5
CD-EA-199-D	CD-EA-199-D-17-17.5-N	1.21	1.31	835798.79	1069621.255	17	17.5	0.5
CD-EA-199-E	CD-EA-199-E-16-20-N	4.97	4.82	835615.56	1069493.96	16	20	4
CD-EA-199-E	CD-EA-199-E-16-17-N	8.26	7.37	835615.56	1069493.96	16	17	1
CD-EA-199-E	CD-EA-199-E-17-18-N	9.37	10.8	835615.56	1069493.96	17	18	1
CD-EA-200	CD-EA-200-15-20-N	2160	247	835925.578	1069536.038	15	20	5
CD-EA-200-A	CD-EA-200-A-16-20-N	6.96	185	835976.26	1069563.391	16	20	4
CD-EA-200-B	CD-EA-200-B-16-17.5-N	364	4090	835957.19	1069621.183	16	17.5	1.5
CD-EA-200-B	CD-EA-200-B-16-17-N	32.6	959	835957.19	1069621.183	16	17	1
CD-EA-200-B	CD-EA-200-B-17-17.5-N	179	1750	835957.19	1069621.183	17	17.5	0.5
CD-EA-200-B	CD-EA-200-B-17-18-N	234	8920	835957.19	1069621.183	17	18	1
CD-EA-200-C	CD-EA-200-C-16-20-N	2770	580	835876.462	1069592.606	16	20	4
CD-EA-200-E	CD-EA-200-E-16-20-N	2.01	2.12	835979.81	1069760.76	16	20	4
CD-EA-201	CD-EA-201-16-20-N	32.3	67.2	836026.627	1069591.617	16	20	4
CD-EA-201	CD-EA-201-17-17.5-N	70.7	89.1	836026.627	1069591.617	17	17.5	0.5
CD-EA-201-A	CD-EA-201-A-16-20-N	2.3	22.7	836022.568	1069685.44	16	20	4
CD-EA-202	CD-EA-202-15-20-N	1.606	1.783	836136.252	1070035.553	15	20	5
CD-EA-202-A	CD-EA-202-A-15-20-N	1.09	1.37	836302.06	1070017.559	15	20	5
CD-EA-203	CD-EA-203-15-20-N	2.18	2.634	836401.952	1069798.383	15	20	5
CD-EA-208	CD-EA-208-16-17-N	1.94	1.92	835780.058	1069369.66	16	17	1
CD-EA-208	CD-EA-208-16-20-N	1.71	1.97	835780.058	1069369.66	16	20	4
CD-EA-208	CD-EA-208-17-18-N	1.58	1.77	835780.058	1069369.66	17	18	1
CD-EA-208-A	CD-EA-208-A-16-20-N	1.47	1.92	835729.129	1069329.541	16	20	4
CD-EA-208-B	CD-EA-208-B-16-20-N	2	2.37	835804.048	1069338.567	16	20	4
CD-EA-208-C	CD-EA-208-C-16-20-N	2.29	2.03	835687.09	1069360.47	16	20	4
CD-EA-209-A	CD-EA-209-A-16-18-N	2.04	2.19	836152.902	1069489.179	16	18	2
CD-EA-209-R	CD-EA-209-R-16-17-N	0.763	4.5	836067.787	1069525.393	16	17	1
CD-EA-209-R	CD-EA-209-R-17-17.3-N	0.457	2.77	836067.787	1069525.393	17	17.3	0.3
CD-EA-209-R	CD-EA-209-R-17-17.3-NR	0.454	3.91	836067.787	1069525.393	17	17.3	0.3
CD-EA-210	CD-EA-210-16-20-N	1.39	1.5	835781.7	1069252.78	16	20	4

Attachment 1 – Dataset Used for Analysis

Dataset Used for Layer 10

Location ID	SYS_SAMPLE_CODE	Combined Radium Result (pCi/g)	Combined Thorium Result (pCi/g)	Easting (NAD83 SP MOEAST)	Northing (NAD83 SP MOEAST)	Start Depth DI-Datum-Adjusted (feet)	End Depth DI-Datum-Adjusted (feet)	Sample Length (feet)
CD-EA-163	CD-EA-163-15-20-N	1.847	1.97	835674.578	1070167.657	14.2	19.2	5
CD-EA-163	CD-EA-163-20-25-N	2.055	2.123	835674.578	1070167.657	19.2	24.2	5
CD-EA-164	CD-EA-164-15-20-N	1.724	1.716	835766.253	1070284.033	14.3	19.3	5
CD-EA-164	CD-EA-164-20-25-N	1.145	1.569	835766.253	1070284.033	19.3	24.3	5
CD-EA-165	CD-EA-165-15-20-N	1.686	1.629	835957.091	1070343.454	15	20	5
CD-EA-166	CD-EA-166-15-20-N	1.341	0.5449	835822.607	1070145.558	15	20	5
CD-EA-167	CD-EA-167-15-20-N	0.899	1.469	835677.832	1070017.51	15	20	5
CD-EA-174	CD-EA-174-15-20-N	0.847	1.146	835854.774	1069420.545	15	20	5
CD-EA-174-A	CD-EA-174-A-16-20-N	2.18	3.27	835870.315	1069368.608	16	20	4
CD-EA-175	CD-EA-175-15-20-N	80.8828	195.447	836004.133	1069525.25	15	20	5
CD-EA-175-A	CD-EA-175-A-16-20-N	0.609	2.66	836055.699	1069489.883	16	20	4
CD-EA-175-A	CD-EA-175-A-18-19-N	0.754	1.05	836055.699	1069489.883	18	19	1
CD-EA-175-A	CD-EA-175-A-19-19.5-N	0.824	1.25	836055.699	1069489.883	19	19.5	0.5
CD-EA-176	CD-EA-176-15-20-N	1.014	7.29	835876.708	1069785.257	15	20	5
CD-EA-188	CD-EA-188-15-20-N	1.57	2.288	835695.068	1069300.601	15	20	5
CD-EA-189	CD-EA-189-15-20-N	2.117	7.65	835910.156	1069321.009	15	20	5
CD-EA-189	CD-EA-189-18-18.5-N	2.25	2.36	835910.156	1069321.009	18	18.5	0.5
CD-EA-190-A	CD-EA-190-A-16-20-N	1.59	1.91	835988.91	1069406.468	16	20	4
CD-EA-190-C	CD-EA-190-C-16-20-N	1.35	1.29	835999.19	1069452.697	16	20	4
CD-EA-190-R	CD-EA-190-R-16-20-N	1.59	1.35	835957.593	1069452.157	16	20	4
CD-EA-190-R	CD-EA-190-R-18-18.5-N	2.9	3.92	835957.593	1069452.157	18	18.5	0.5
CD-EA-191	CD-EA-191-15-20-N	2.54	3.11	836055.288	1069442.664	15	20	5
CD-EA-193	CD-EA-193-15-20-N	1.464	2.111	836076.433	1069887.925	15	20	5
CD-EA-193-A	CD-EA-193-A-15-20-N	1.13	1.07	836253.439	1069833.78	15	20	5
CD-EA-194	CD-EA-194-15-20-N	1.329	2.187	835915.311	1070071.563	15	20	5
CD-EA-195	CD-EA-195-15-20-N	1	1.405	835989.766	1070221.031	15	20	5
CD-EA-196	CD-EA-196-15-20-N	1.9	1.46	835402.189	1069742.298	15	20	5
CD-EA-197	CD-EA-197-14-19-N	1.46	1.71	835630.668	1069903.765	14	19	5
CD-EA-197	CD-EA-197-19-24-N	2.01	3.11	835630.668	1069903.765	19	24	5
CD-EA-198-R	CD-EA-198-R-15-20-N	1.677	3.467	835680.595	1069590.029	15	20	5
CD-EA-198-R	CD-EA-198-R-18-19-N	1.9	1.88	835680.595	1069590.029	18	19	1
CD-EA-198-R	CD-EA-198-R-19-20-N	1.96	1.84	835680.595	1069590.029	19	20	1
CD-EA-199	CD-EA-199-16-20-N	2.15	1.89	835802.602	1069473.477	16	20	4
CD-EA-199-A	CD-EA-199-A-16-20-N	1.83	2.03	835754.076	1069445.503	16	20	4
CD-EA-199-A	CD-EA-199-A-18-19-N	2	2.51	835754.076	1069445.503	18	19	1
CD-EA-199-B	CD-EA-199-B-16-20-N	3.01	3.58	835686.34	1069491.195	16	20	4
CD-EA-199-E	CD-EA-199-E-16-20-N	4.97	4.82	835615.56	1069493.96	16	20	4
CD-EA-199-E	CD-EA-199-E-18-19-N	5.29	4.87	835615.56	1069493.96	18	19	1
CD-EA-200	CD-EA-200-15-20-N	2160	247	835925.578	1069536.038	15	20	5
CD-EA-200	CD-EA-200-18-18.5-N	4860	17800	835925.578	1069536.038	18	18.5	0.5
CD-EA-200-A	CD-EA-200-A-16-20-N	6.96	185	835976.26	1069563.391	16	20	4
CD-EA-200-C	CD-EA-200-C-16-20-N	2770	580	835876.462	1069592.606	16	20	4
CD-EA-200-C	CD-EA-200-C-19-19.5-N	3260	4020	835876.462	1069592.606	19	19.5	0.5
CD-EA-200-E	CD-EA-200-E-16-20-N	2.01	2.12	835979.81	1069760.76	16	20	4
CD-EA-201	CD-EA-201-16-20-N	32.3	67.2	836026.627	1069591.617	16	20	4
CD-EA-201-A	CD-EA-201-A-16-20-N	2.3	22.7	836022.568	1069685.44	16	20	4
CD-EA-202	CD-EA-202-15-20-N	1.606	1.783	836136.252	1070035.553	15	20	5
CD-EA-202-A	CD-EA-202-A-15-20-N	1.09	1.37	836302.06	1070017.559	15	20	5
CD-EA-203	CD-EA-203-15-20-N	2.18	2.634	836401.952	1069798.383	15	20	5
CD-EA-208	CD-EA-208-16-20-N	1.71	1.97	835780.058	1069369.66	16	20	4
CD-EA-208-A	CD-EA-208-A-16-20-N	1.47	1.92	835729.129	1069329.541	16	20	4
CD-EA-208-B	CD-EA-208-B-16-20-N	2	2.37	835804.048	1069338.567	16	20	4
CD-EA-208-C	CD-EA-208-C-16-20-N	2.29	2.03	835687.09	1069360.47	16	20	4
CD-EA-209-A	CD-EA-209-A-18-20-N	2.62	3.46	836152.902	1069489.179	18	20	2
CD-EA-210	CD-EA-210-16-20-N	1.39	1.5	835781.7	1069252.78	16	20	4

ATTACHMENT 2 BASE FILES

Attachment 2 – Base Files

Layer 1 Base File

Attachment 2 - Base Files
Layer 1

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	1.980	<52.9	2.323	<52.9
836004.133	1069525.25	CD-EA-175	7.408	<52.9	193.120	>52.9 - 500
836055.699	1069489.883	CD-EA-175-A	3.207	<52.9	52.650	<52.9
835923.065	1069400.292	CD-EA-190-B	5.880	<52.9	106.000	>52.9 - 500
835999.19	1069452.697	CD-EA-190-C	13.800	<52.9	371.000	>52.9 - 500
835957.593	1069452.157	CD-EA-190-R	2.538	<52.9	11.553	<52.9
835802.602	1069473.477	CD-EA-199	1.830	<52.9	2.600	<52.9
835797.913	1069548.224	CD-EA-199-C	1.890	<52.9	3.610	<52.9
835925.578	1069536.038	CD-EA-200	2.090	<52.9	2.480	<52.9
835976.26	1069563.391	CD-EA-200-A	0.981	<52.9	1.250	<52.9
835957.19	1069621.183	CD-EA-200-B	1.952	<52.9	2.076	<52.9
835897.854	1069679.576	CD-EA-200-D	1.850	<52.9	1.760	<52.9
835780.058	1069369.66	CD-EA-208	2.533	<52.9	11.073	<52.9
835876.462	1069592.606	CD-EA-200-C	2.260	<52.9	4.230	<52.9
835686.34	1069491.195	CD-EA-199-B	2.070	<52.9	2.760	<52.9

Attachment 2 – Base Files

Layer 2 Base File

Attachment 2 - Base Files
Layer 2

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	1.980	<52.9	2.323	<52.9
836004.133	1069525.25	CD-EA-175	7.408	<52.9	193.120	>52.9 - 500
836055.699	1069489.883	CD-EA-175-A	3.847	<52.9	66.433	>52.9 - 500
835923.065	1069400.292	CD-EA-190-B	5.880	<52.9	106.000	>52.9 - 500
835999.19	1069452.697	CD-EA-190-C	25.489	<52.9	570.889	500 - <1000
835957.593	1069452.157	CD-EA-190-R	2.393	<52.9	4.563	<52.9
835802.602	1069473.477	CD-EA-199	1.830	<52.9	2.600	<52.9
835797.913	1069548.224	CD-EA-199-C	1.890	<52.9	3.610	<52.9
835925.578	1069536.038	CD-EA-200	2.090	<52.9	2.480	<52.9
835976.26	1069563.391	CD-EA-200-A	0.981	<52.9	1.250	<52.9
835957.19	1069621.183	CD-EA-200-B	2.150	<52.9	2.147	<52.9
835897.854	1069679.576	CD-EA-200-D	1.850	<52.9	1.760	<52.9
835780.058	1069369.66	CD-EA-208	3.195	<52.9	28.157	<52.9
835876.462	1069592.606	CD-EA-200-C	2.260	<52.9	4.230	<52.9
835686.34	1069491.195	CD-EA-199-B	2.070	<52.9	2.760	<52.9

Attachment 2 – Base Files

Layer 3 Base File

Attachment 2 - Base Files
Layer 3

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	4.601	<52.9	79.098	>52.9 - 500
836004.133	1069525.25	CD-EA-175	4.909	<52.9	97.825	>52.9 - 500
836055.699	1069489.883	CD-EA-175-A	81.862	>52.9 - 500	1253.85	1000 – <5000
835923.065	1069400.292	CD-EA-190-B	2.580	<52.9	19.800	<52.9
835999.19	1069452.697	CD-EA-190-C	1.660	<52.9	16.000	<52.9
835957.593	1069452.157	CD-EA-190-R	2.013	<52.9	4.398	<52.9
835802.602	1069473.477	CD-EA-199	4.880	<52.9	70.100	>52.9 - 500
835797.913	1069548.224	CD-EA-199-C	2.020	<52.9	2.200	<52.9
835925.578	1069536.038	CD-EA-200	1.840	<52.9	2.815	<52.9
835976.26	1069563.391	CD-EA-200-A	1.970	<52.9	2.390	<52.9
835957.19	1069621.183	CD-EA-200-B	1.742	<52.9	2.372	<52.9
835897.854	1069679.576	CD-EA-200-D	2.020	<52.9	2.340	<52.9
835780.058	1069369.66	CD-EA-208	2.235	<52.9	26.688	<52.9
835876.462	1069592.606	CD-EA-200-C	1.280	<52.9	3.410	<52.9
835686.34	1069491.195	CD-EA-199-B	2.070	<52.9	2.760	<52.9

Attachment 2 – Base Files

Layer 4 Base File

Attachment 2 - Base Files
Layer 4

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	7.221	<52.9	155.873	>52.9 - 500
836004.133	1069525.25	CD-EA-175	2.410	<52.9	2.530	<52.9
836055.699	1069489.883	CD-EA-175-A	57.660	>52.9 - 500	637.600	500 - <1000
835923.065	1069400.292	CD-EA-190-B	2.580	<52.9	19.800	<52.9
835999.19	1069452.697	CD-EA-190-C	1.660	<52.9	16.000	<52.9
835957.593	1069452.157	CD-EA-190-R	2.470	<52.9	14.712	<52.9
835802.602	1069473.477	CD-EA-199	4.880	<52.9	70.100	>52.9 - 500
835797.913	1069548.224	CD-EA-199-C	2.020	<52.9	2.200	<52.9
835925.578	1069536.038	CD-EA-200	1.590	<52.9	3.150	<52.9
835976.26	1069563.391	CD-EA-200-A	1.970	<52.9	2.390	<52.9
835957.19	1069621.183	CD-EA-200-B	1.372	<52.9	2.798	<52.9
835897.854	1069679.576	CD-EA-200-D	2.020	<52.9	2.340	<52.9
835780.058	1069369.66	CD-EA-208	2.555	<52.9	26.377	<52.9
835876.462	1069592.606	CD-EA-200-C	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835686.34	1069491.195	CD-EA-199-B	1.510	<52.9	10.100	<52.9

Attachment 2 – Base Files

Layer 5 Base File

Attachment 2 - Base Files
Layer 5

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	7.221	<52.9	155.87	>52.9 - 500
836004.133	1069525.25	CD-EA-175	2.410	<52.9	2.530	<52.9
836055.699	1069489.883	CD-EA-175-A	1.162	<52.9	29.373	<52.9
835923.065	1069400.292	CD-EA-190-B	1.530	<52.9	1.730	<52.9
835999.19	1069452.697	CD-EA-190-C	0.765	<52.9	4.210	<52.9
835957.593	1069452.157	CD-EA-190-R	2.194	<52.9	21.258	<52.9
835802.602	1069473.477	CD-EA-199	4.540	<52.9	74.700	>52.9 - 500
835797.913	1069548.224	CD-EA-199-C	7.300	<52.9	182	>52.9 - 500
835925.578	1069536.038	CD-EA-200	1.590	<52.9	3.150	<52.9
835976.26	1069563.391	CD-EA-200-A	1.780	<52.9	2.870	<52.9
835957.19	1069621.183	CD-EA-200-B	1.524	<52.9	2.225	<52.9
835897.854	1069679.576	CD-EA-200-D	1.340	<52.9	0.968	<52.9
835780.058	1069369.66	CD-EA-208	2.012	<52.9	2.783	<52.9
835876.462	1069592.606	CD-EA-200-C	1.910	<52.9	4.330	<52.9
835686.34	1069491.195	CD-EA-199-B	2.260	<52.9	8.310	<52.9

Attachment 2 – Base Files

Layer 6 Base File

Attachment 2 - Base Files
Layer 6

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	8.961	<52.9	562.17	500 - <1000
836004.133	1069525.25	CD-EA-175	0.781	<52.9	0.480	<52.9
836055.699	1069489.883	CD-EA-175-A	0.796	<52.9	15.763	<52.9
835923.065	1069400.292	CD-EA-190-B	1.530	<52.9	1.730	<52.9
835999.19	1069452.697	CD-EA-190-C	0.765	<52.9	4.210	<52.9
835957.593	1069452.157	CD-EA-190-R	2.130	<52.9	19.790	<52.9
835802.602	1069473.477	CD-EA-199	4.540	<52.9	74.70	>52.9 - 500
835797.913	1069548.224	CD-EA-199-C	7.300	<52.9	182	>52.9 - 500
835925.578	1069536.038	CD-EA-200	4.390	<52.9	72.300	>52.9 - 500
835976.26	1069563.391	CD-EA-200-A	1.780	<52.9	2.870	<52.9
835957.19	1069621.183	CD-EA-200-B	1.740	<52.9	2.476	<52.9
835897.854	1069679.576	CD-EA-200-D	1.340	<52.9	0.968	<52.9
835780.058	1069369.66	CD-EA-208	1.792	<52.9	2.388	<52.9
835876.462	1069592.606	CD-EA-200-C	1.910	<52.9	4.330	<52.9
835686.34	1069491.195	CD-EA-199-B	2.260	<52.9	8.310	<52.9

Attachment 2 – Base Files

Layer 7 Base File

Attachment 2 - Base Files
Layer 7

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	8.961	<52.9	562.170	500 - <1000
836004.133	1069525.25	CD-EA-175	0.781	<52.9	0.480	<52.9
836055.699	1069489.883	CD-EA-175-A	1.178	<52.9	14.070	<52.9
835923.065	1069400.292	CD-EA-190-B	1.540	<52.9	1.280	<52.9
835999.19	1069452.697	CD-EA-190-C	1.190	<52.9	1.850	<52.9
835957.593	1069452.157	CD-EA-190-R	17.917	<52.9	64.215	>52.9 - 500
835802.602	1069473.477	CD-EA-199	1.830	<52.9	7.920	<52.9
835797.913	1069548.224	CD-EA-199-C	1.580	<52.9	2.960	<52.9
835925.578	1069536.038	CD-EA-200	4.390	<52.9	72.300	>52.9 - 500
835976.26	1069563.391	CD-EA-200-A	1.000	<52.9	2.190	<52.9
835957.19	1069621.183	CD-EA-200-B	2.570	<52.9	25.755	<52.9
835897.854	1069679.576	CD-EA-200-D	2.470	<52.9	344	>52.9 - 500
835780.058	1069369.66	CD-EA-208	1.406	<52.9	1.736	<52.9
835876.462	1069592.606	CD-EA-200-C	0.829	<52.9	26.000	<52.9
835686.34	1069491.195	CD-EA-199-B	4.100	<52.9	87.900	>52.9 - 500

Attachment 2 – Base Files

Layer 8 Base File

Attachment 2 - Base Files
Layer 8

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	4.904	<52.9	281.658	>52.9 - 500
836004.133	1069525.25	CD-EA-175	40.832	<52.9	97.964	>52.9 - 500
836055.699	1069489.883	CD-EA-175-A	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835923.065	1069400.292	CD-EA-190-B	1.540	<52.9	1.280	<52.9
835999.19	1069452.697	CD-EA-190-C	1.190	<52.9	1.850	<52.9
835957.593	1069452.157	CD-EA-190-R	5.557	<52.9	43.771	<52.9
835802.602	1069473.477	CD-EA-199	1.830	<52.9	7.920	<52.9
835797.913	1069548.224	CD-EA-199-C	1.580	<52.9	2.960	<52.9
835925.578	1069536.038	CD-EA-200	1082.195	1000 – <5000	159.650	>52.9 - 500
835976.26	1069563.391	CD-EA-200-A	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835957.19	1069621.183	CD-EA-200-B	3.152	<52.9	39.880	<52.9
835897.854	1069679.576	CD-EA-200-D	16.973	<52.9	326.889	>52.9 - 500
835780.058	1069369.66	CD-EA-208	1.520	<52.9	1.940	<52.9
835876.462	1069592.606	CD-EA-200-C	0.829	<52.9	26.000	<52.9
835686.34	1069491.195	CD-EA-199-B	4.100	<52.9	87.900	>52.9 - 500

Attachment 2 – Base Files

Layer 9 Base File

Attachment 2 - Base Files
Layer 9

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	0.847	<52.9	1.146	<52.9
836004.133	1069525.25	CD-EA-175	141.919	>52.9 - 500	829.525	500 - <1000
836055.699	1069489.883	CD-EA-175-A	0.757	<52.9	4.293	<52.9
835923.065	1069400.292	CD-EA-190-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835999.19	1069452.697	CD-EA-190-C	1.350	<52.9	1.290	<52.9
835957.593	1069452.157	CD-EA-190-R	1.538	<52.9	1.512	<52.9
835802.602	1069473.477	CD-EA-199	2.150	<52.9	1.890	<52.9
835797.913	1069548.224	CD-EA-199-C	1.820	<52.9	1.810	<52.9
835925.578	1069536.038	CD-EA-200	2160	1000 – <5000	247	>52.9 - 500
835976.26	1069563.391	CD-EA-200-A	6.960	<52.9	185	>52.9 - 500
835957.19	1069621.183	CD-EA-200-B	225.525	>52.9 - 500	4222.25	1000 – <5000
835897.854	1069679.576	CD-EA-200-D	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835780.058	1069369.66	CD-EA-208	1.727	<52.9	1.928	<52.9
835876.462	1069592.606	CD-EA-200-C	2770	1000 – <5000	580	500 - <1000
835686.34	1069491.195	CD-EA-199-B	3.010	<52.9	3.580	<52.9

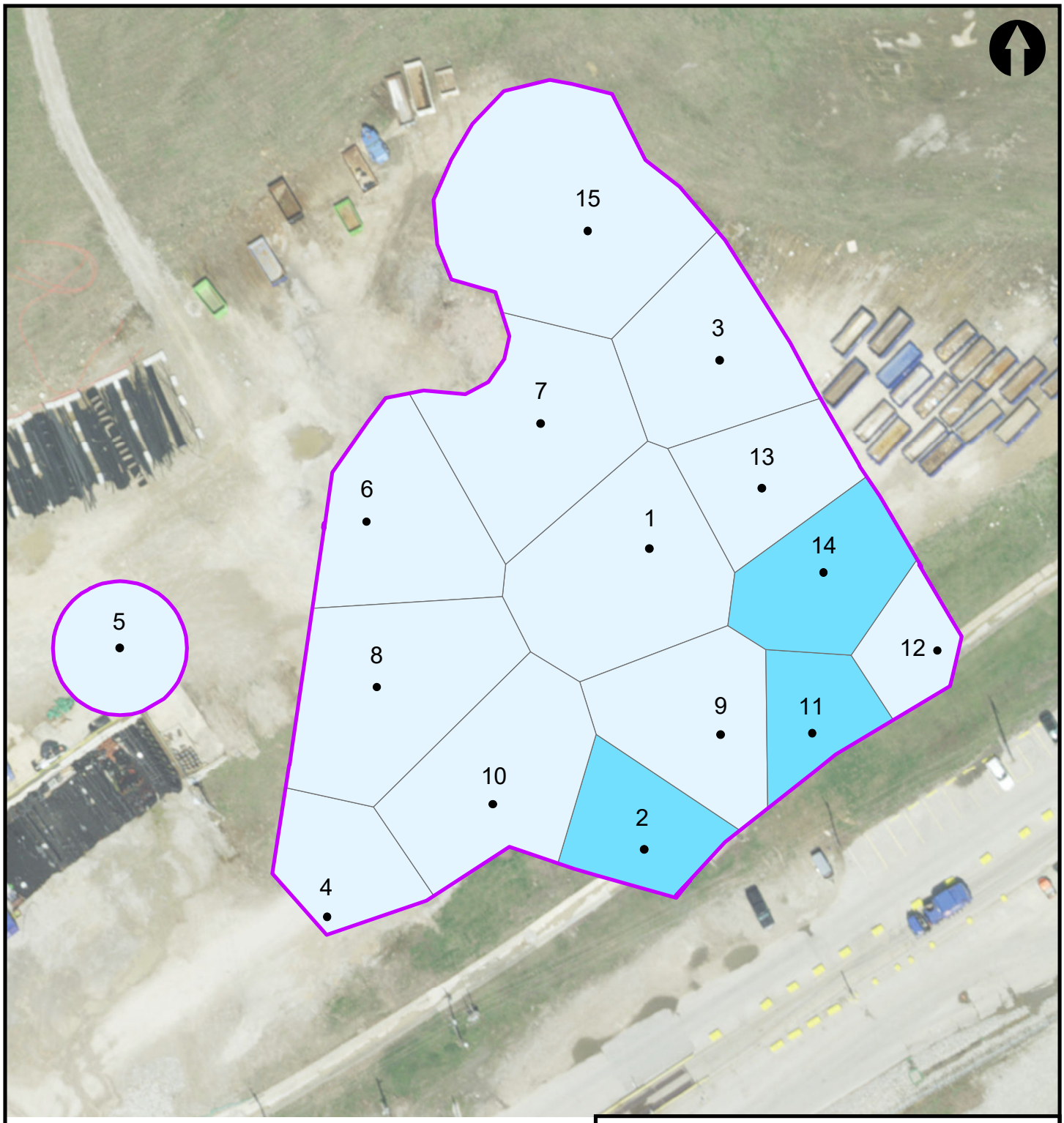
Attachment 2 – Base Files

Layer 10 Base File

Attachment 2 - Base Files
Layer 10

Easting (NAD83 State Plane MO East)	Northing (NAD83 State Plane MO East)	Borings in Layer	Length-Weighted Average of Combined Ra (pCi/g)	Combined Ra Length-Weighted Average Category (pCi/g)	Length-Weighted Average of Combined Th (pCi/g)	Combined Th Length-Weighted Average Category (pCi/g)
835854.774	1069420.545	CD-EA-174	0.847	<52.9	1.146	<52.9
836004.133	1069525.25	CD-EA-175	80.883	>52.9 - 500	195.447	>52.9 - 500
836055.699	1069489.883	CD-EA-175-A	0.655	<52.9	2.239	<52.9
835923.065	1069400.292	CD-EA-190-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835999.19	1069452.697	CD-EA-190-C	1.350	<52.9	1.290	<52.9
835957.593	1069452.157	CD-EA-190-R	1.736	<52.9	1.636	<52.9
835802.602	1069473.477	CD-EA-199	2.150	<52.9	1.890	<52.9
835797.913	1069548.224	CD-EA-199-C	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835925.578	1069536.038	CD-EA-200	2405.455	1000 – <5000	1842.727	1000 – <5000
835976.26	1069563.391	CD-EA-200-A	6.960	<52.9	185	>52.9 - 500
835957.19	1069621.183	CD-EA-200-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835897.854	1069679.576	CD-EA-200-D	Not Sampled	Not Sampled	Not Sampled	Not Sampled
835780.058	1069369.66	CD-EA-208	1.710	<52.9	1.970	<52.9
835876.462	1069592.606	CD-EA-200-C	2824.444	1000 – <5000	962.222	500 - <1000
835686.34	1069491.195	CD-EA-199-B	3.010	<52.9	3.580	<52.9

ATTACHMENT 3 COMBINED THORIUM THIESSEN POLYGON FIGURES



Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 1

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 1 (0-2')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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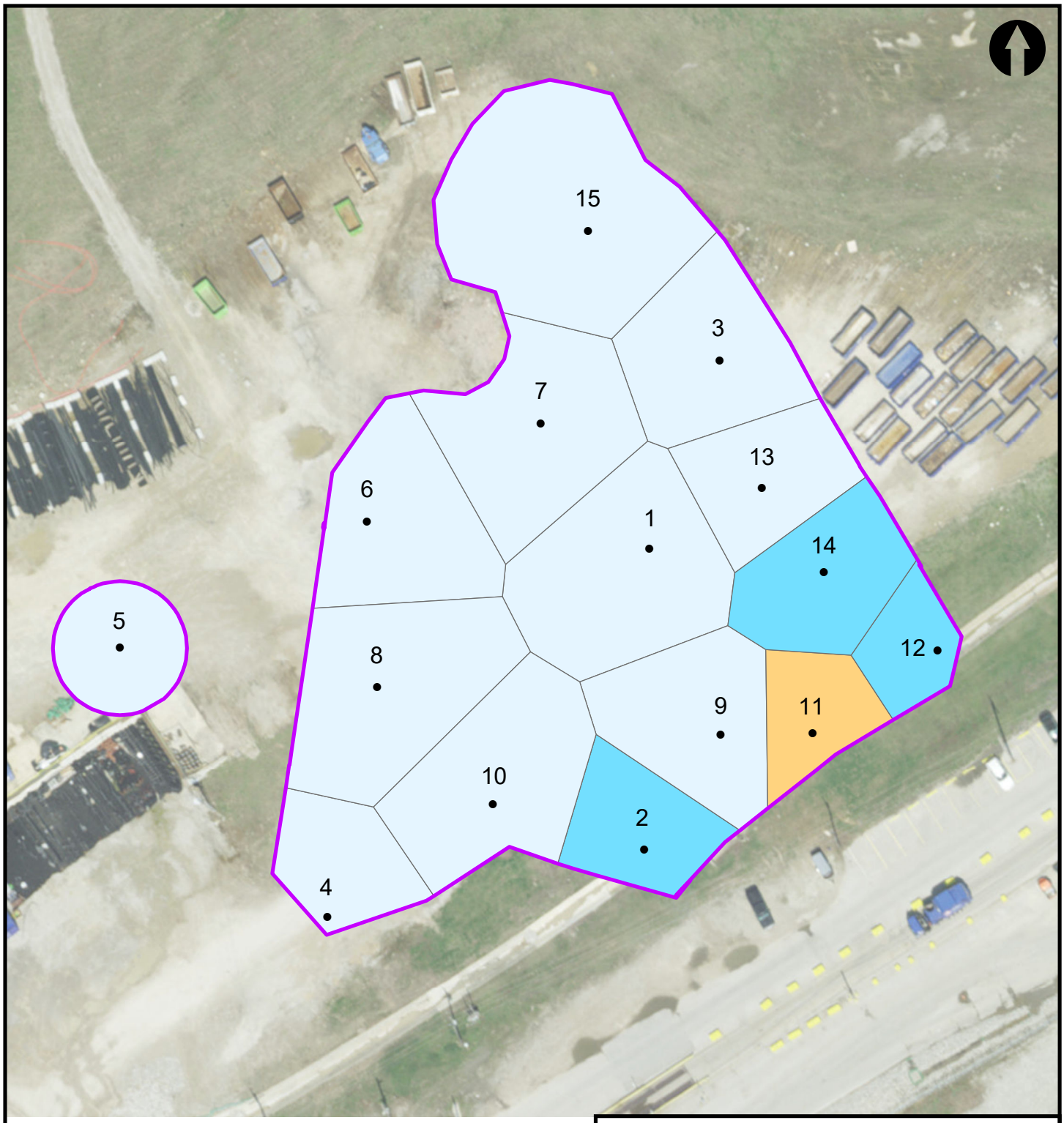

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 2

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 2 (2-4')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

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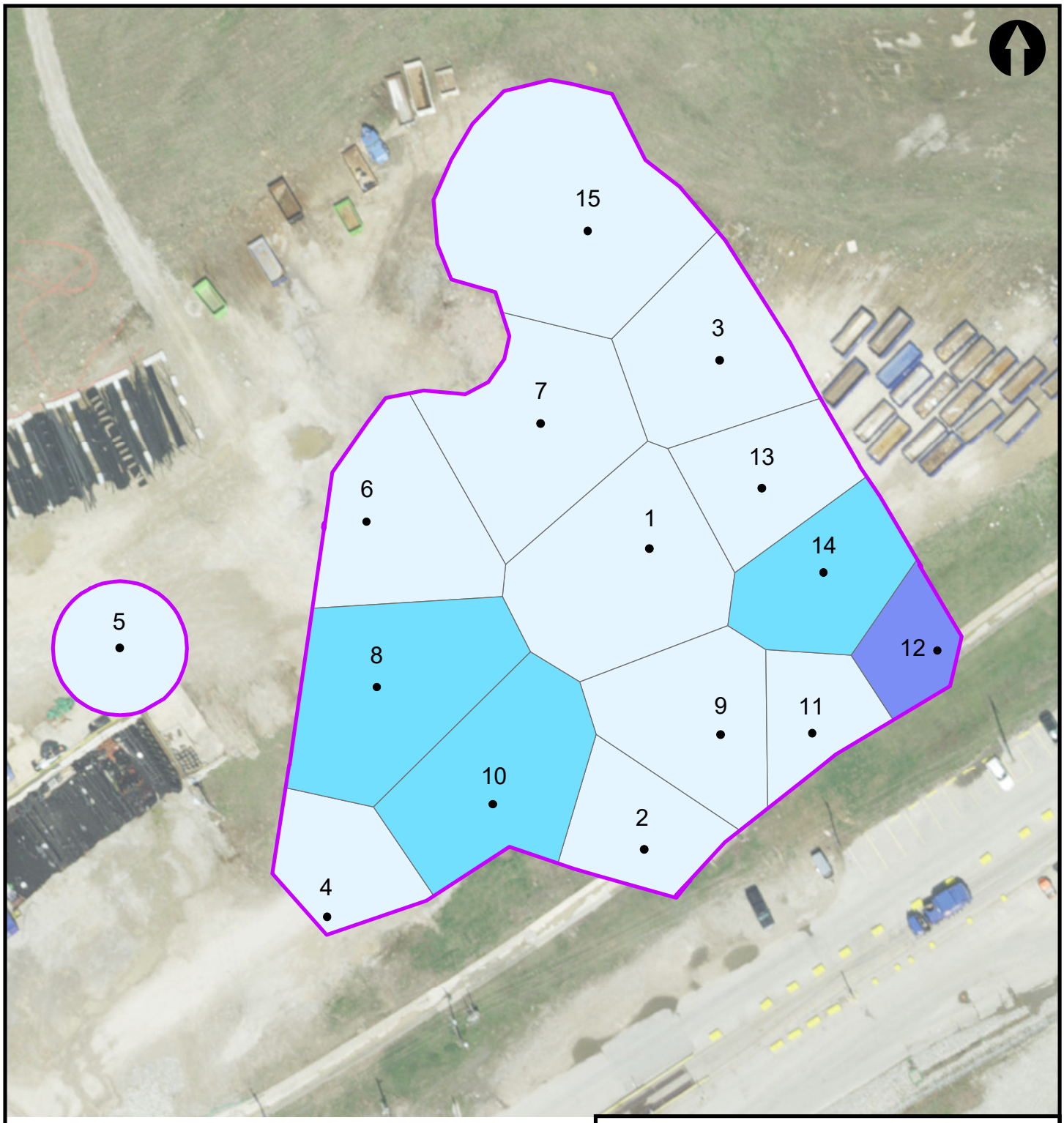

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 3

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 3 (4-6')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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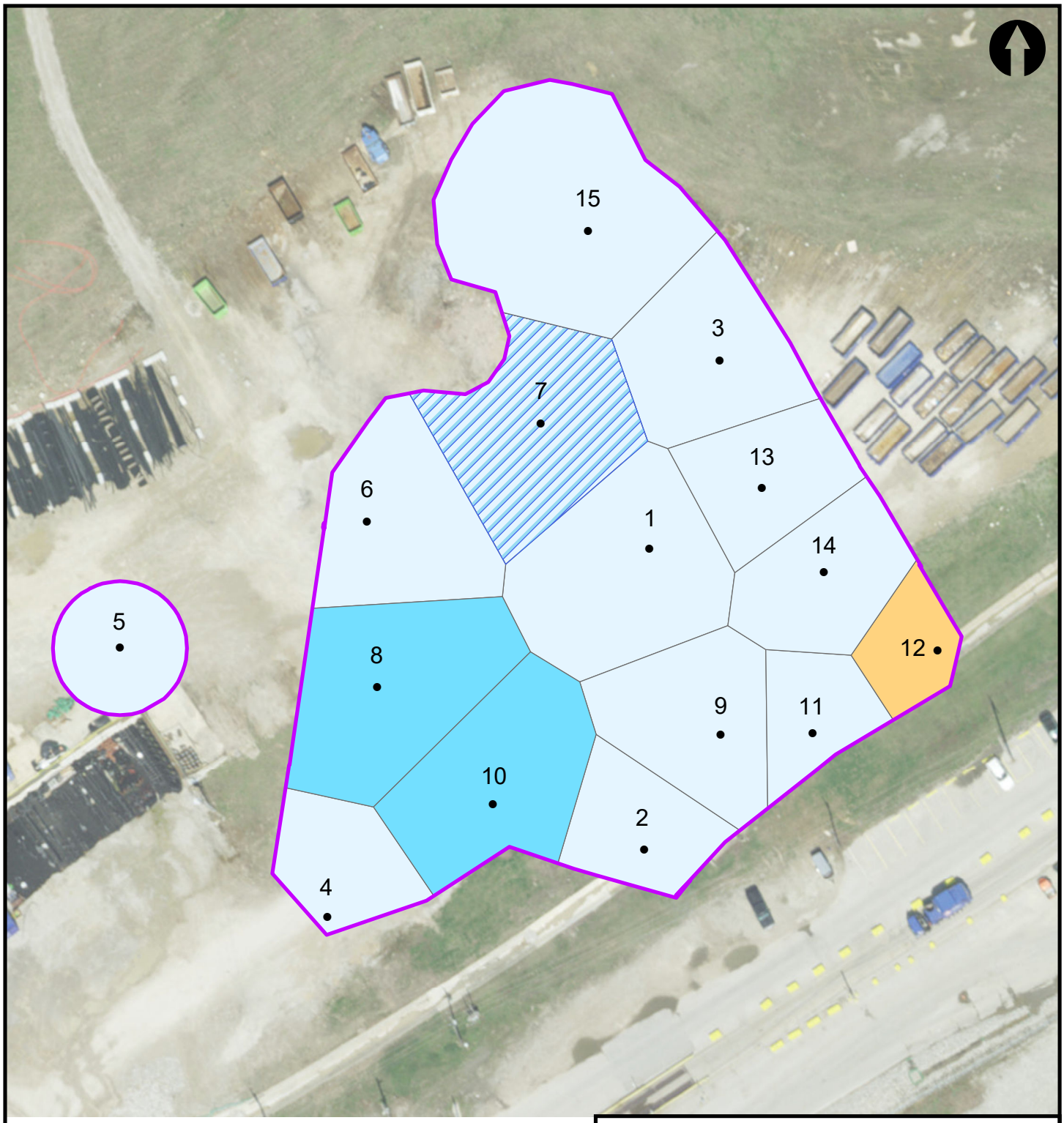

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 4

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 4 (6-8')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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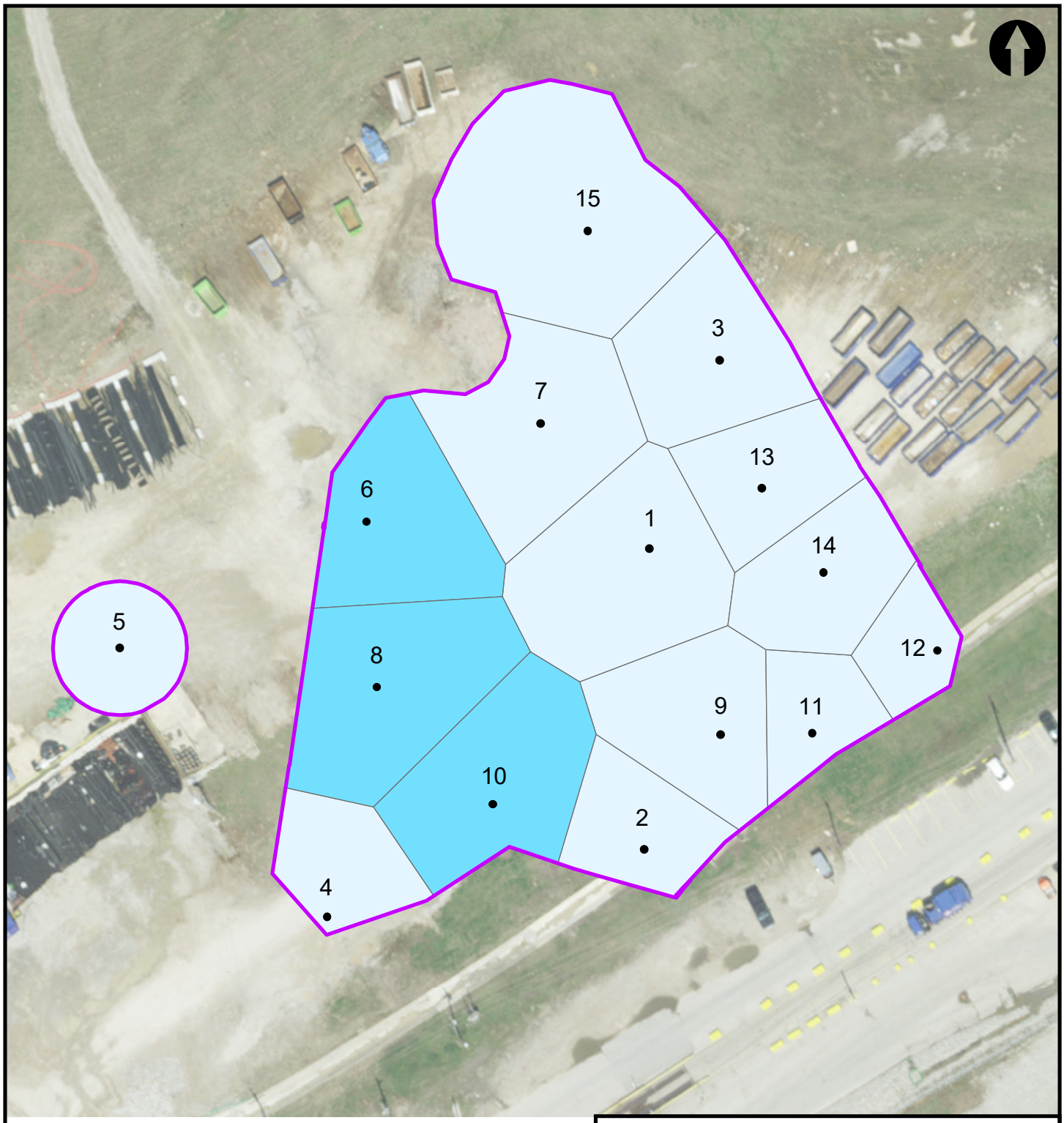

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 5

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 5 (8-10')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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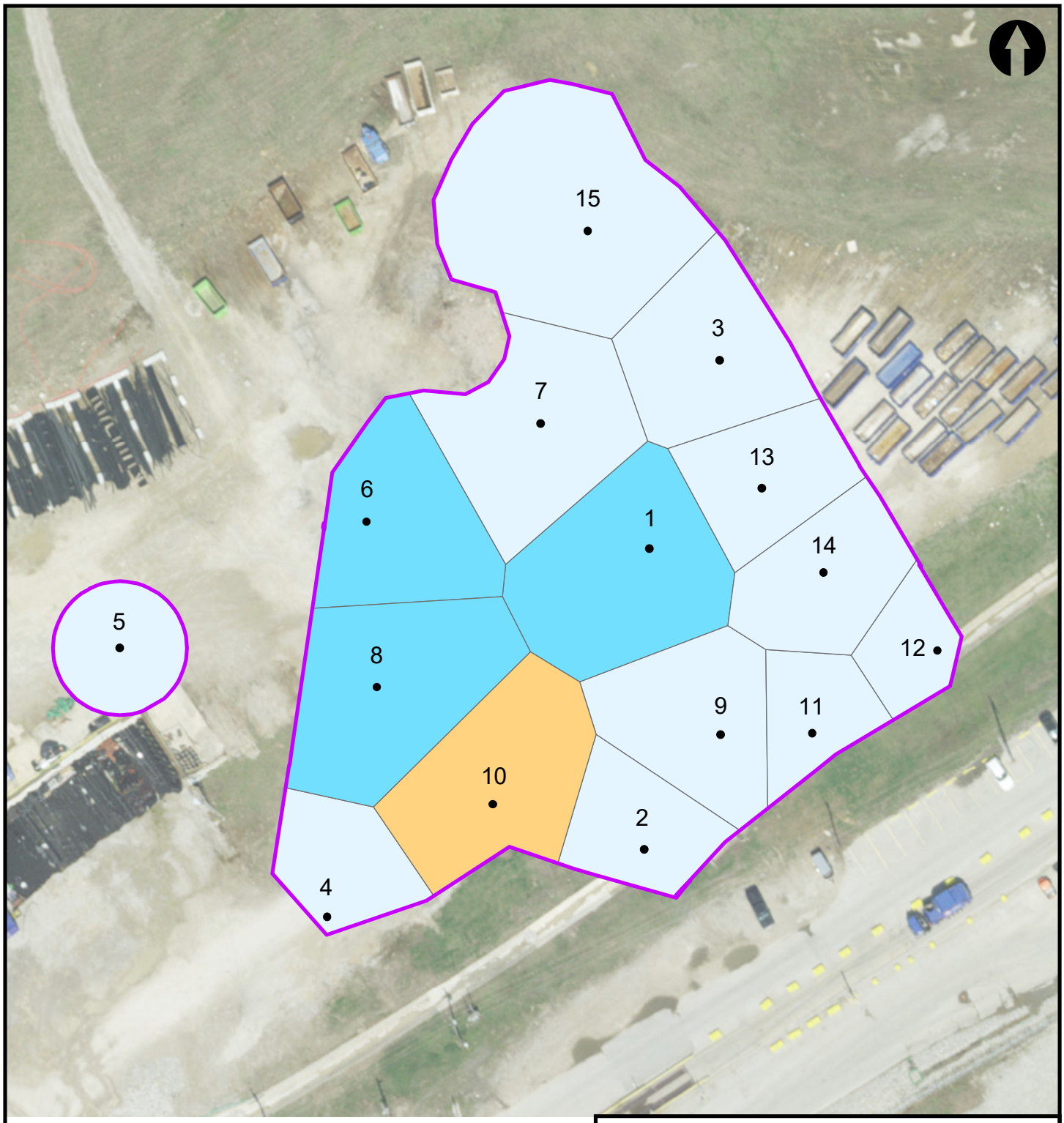

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 6

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 6 (10-12')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

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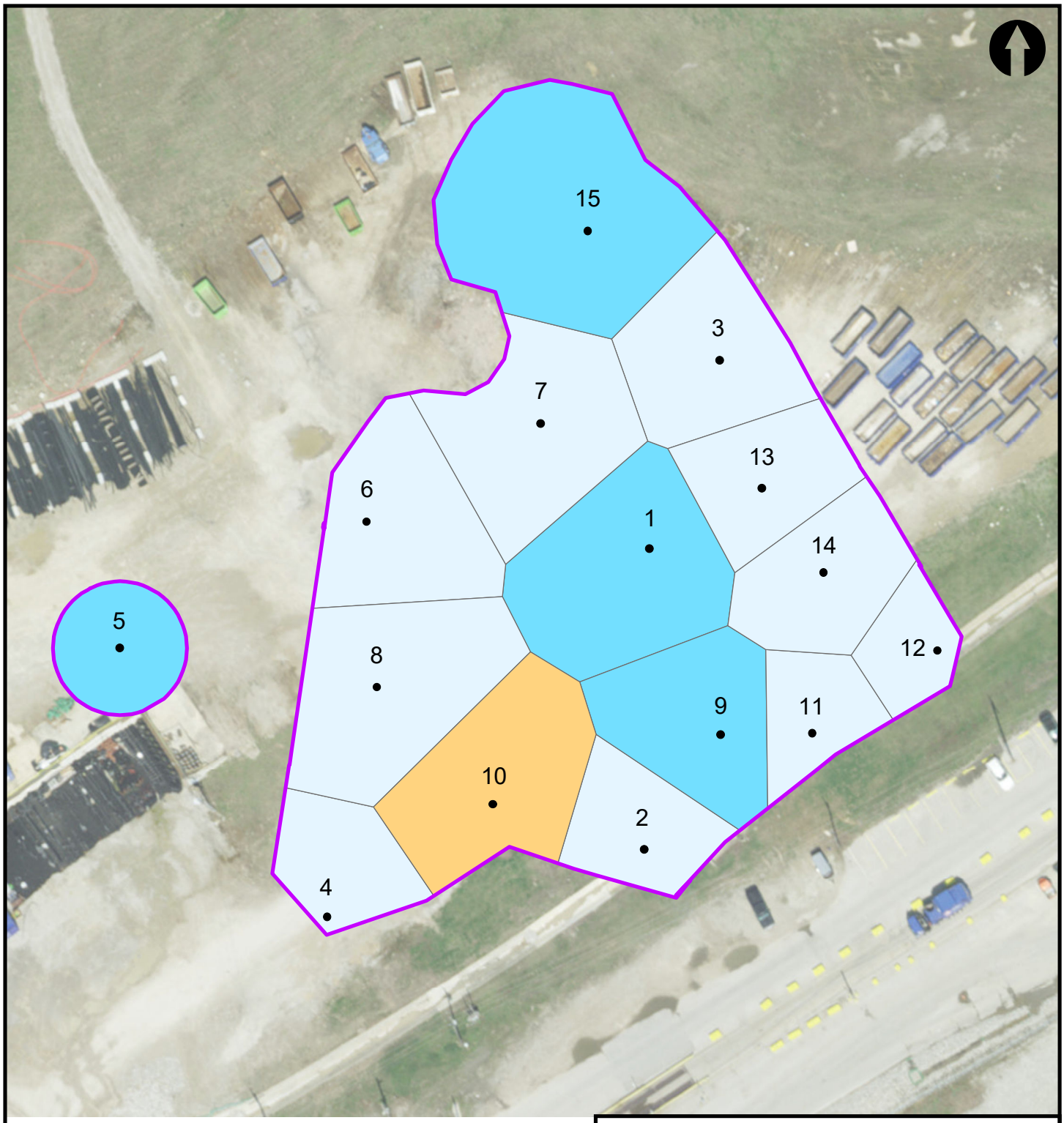

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 7

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 7 (12-14')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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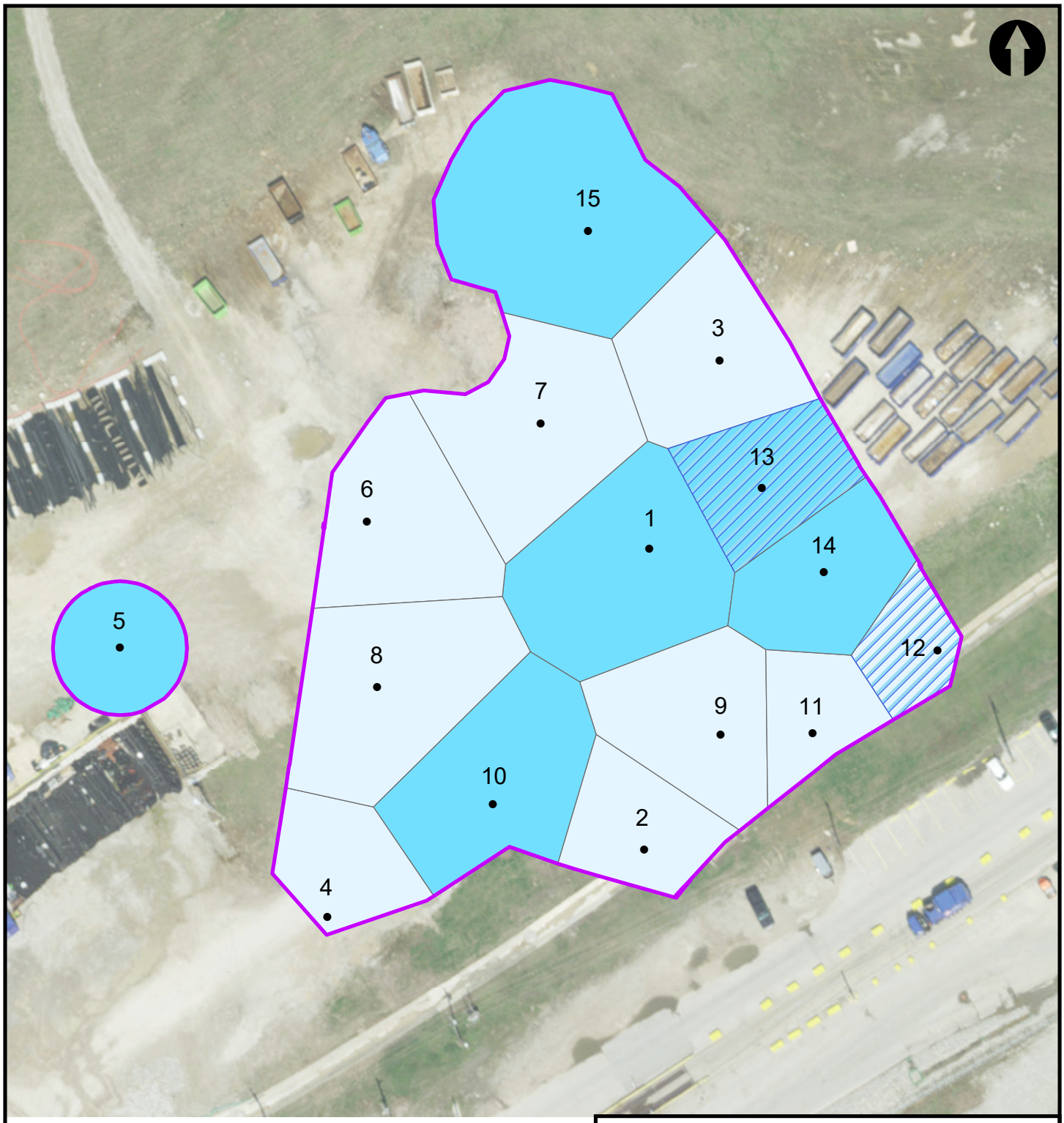

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 8

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 8 (14-16')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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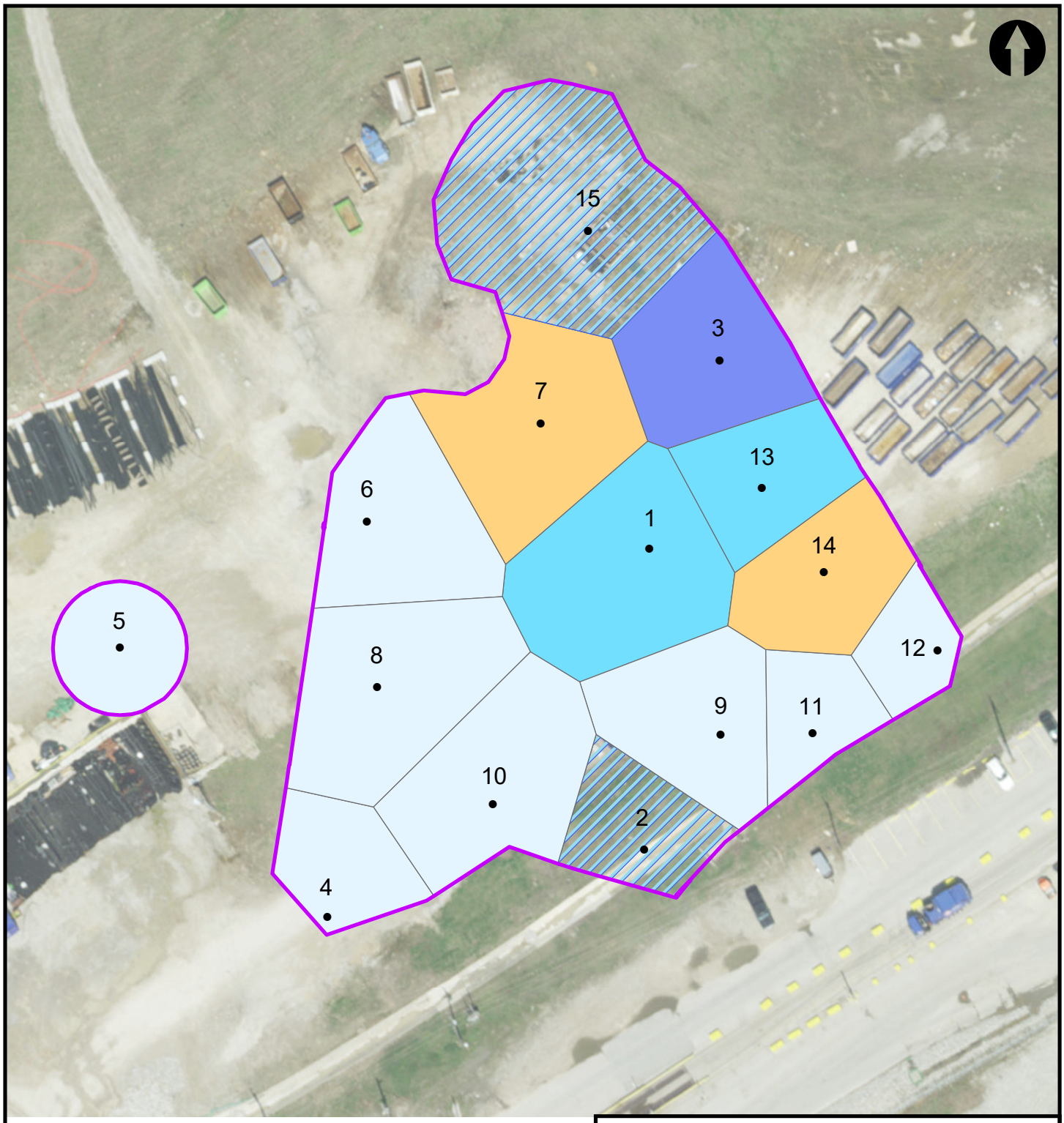

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 9

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 9 (16-18')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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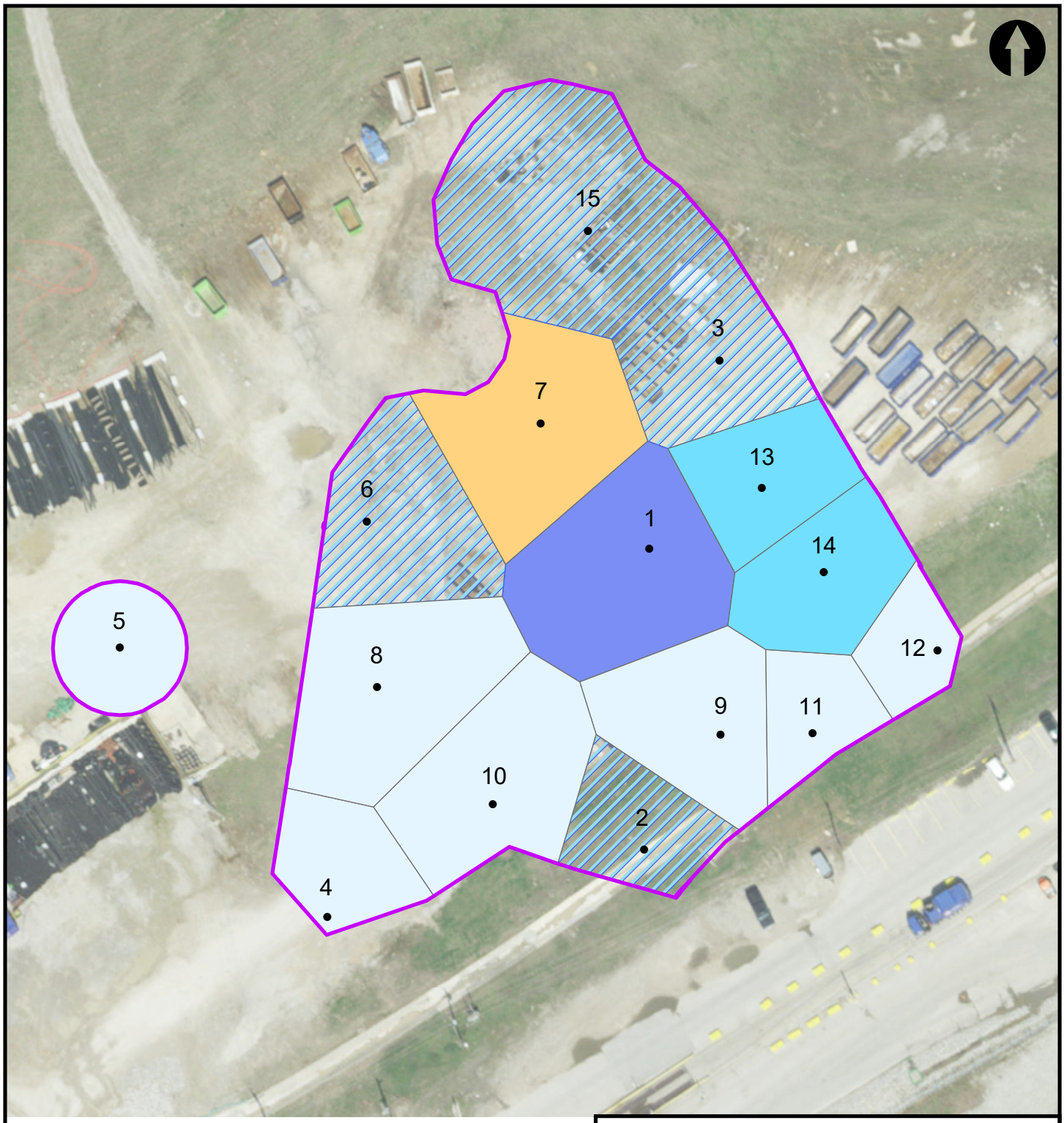

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 10

THIESSEN POLYGON ANALYSIS - CDL
COMBINED THORIUM
LAYER 10 (18-20')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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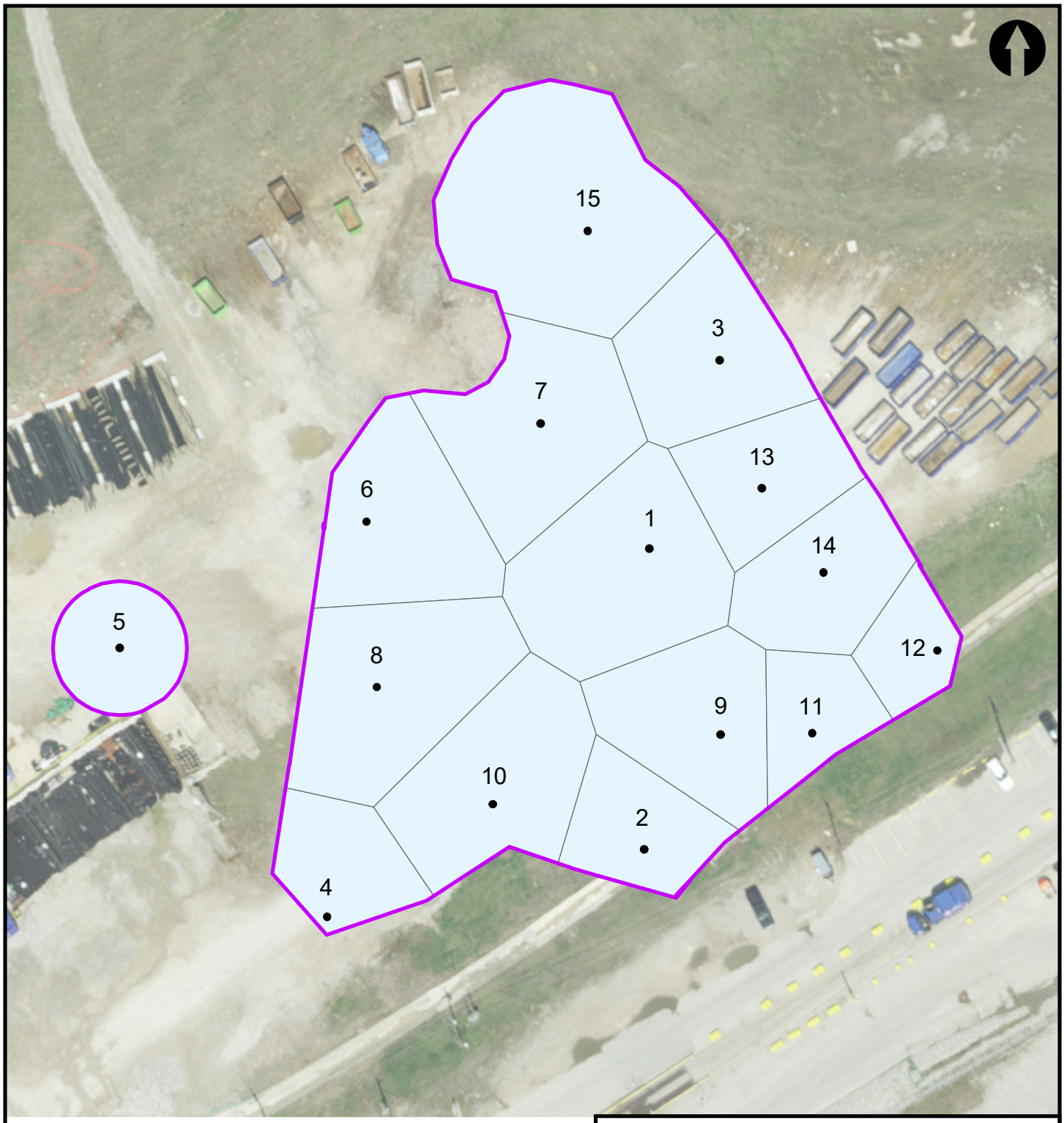
ATTACHMENT 4 COMBINED RADIUM THIESSEN POLYGON FIGURES



Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 1

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 1 (0-2')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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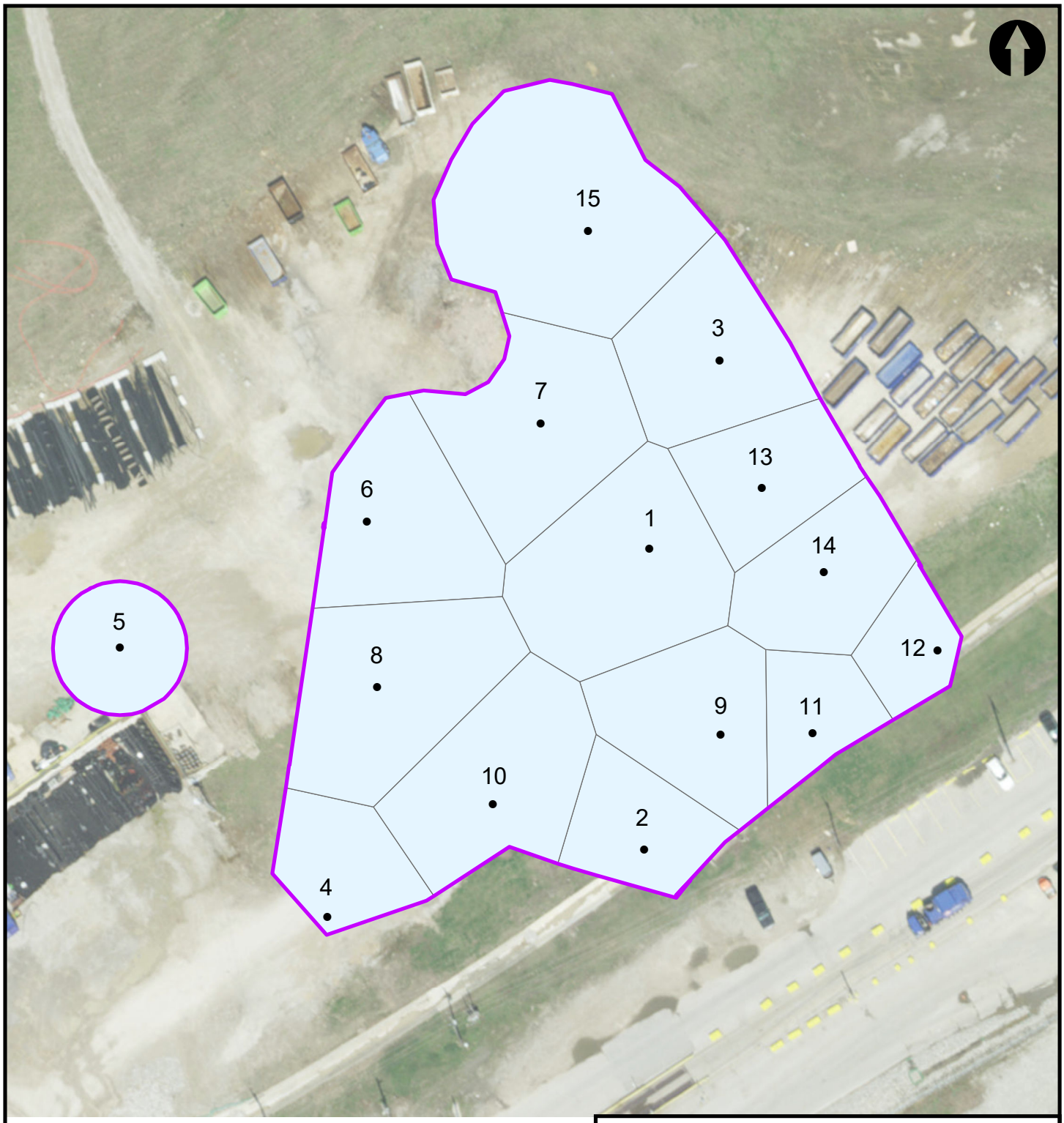

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 2

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 2 (2-4')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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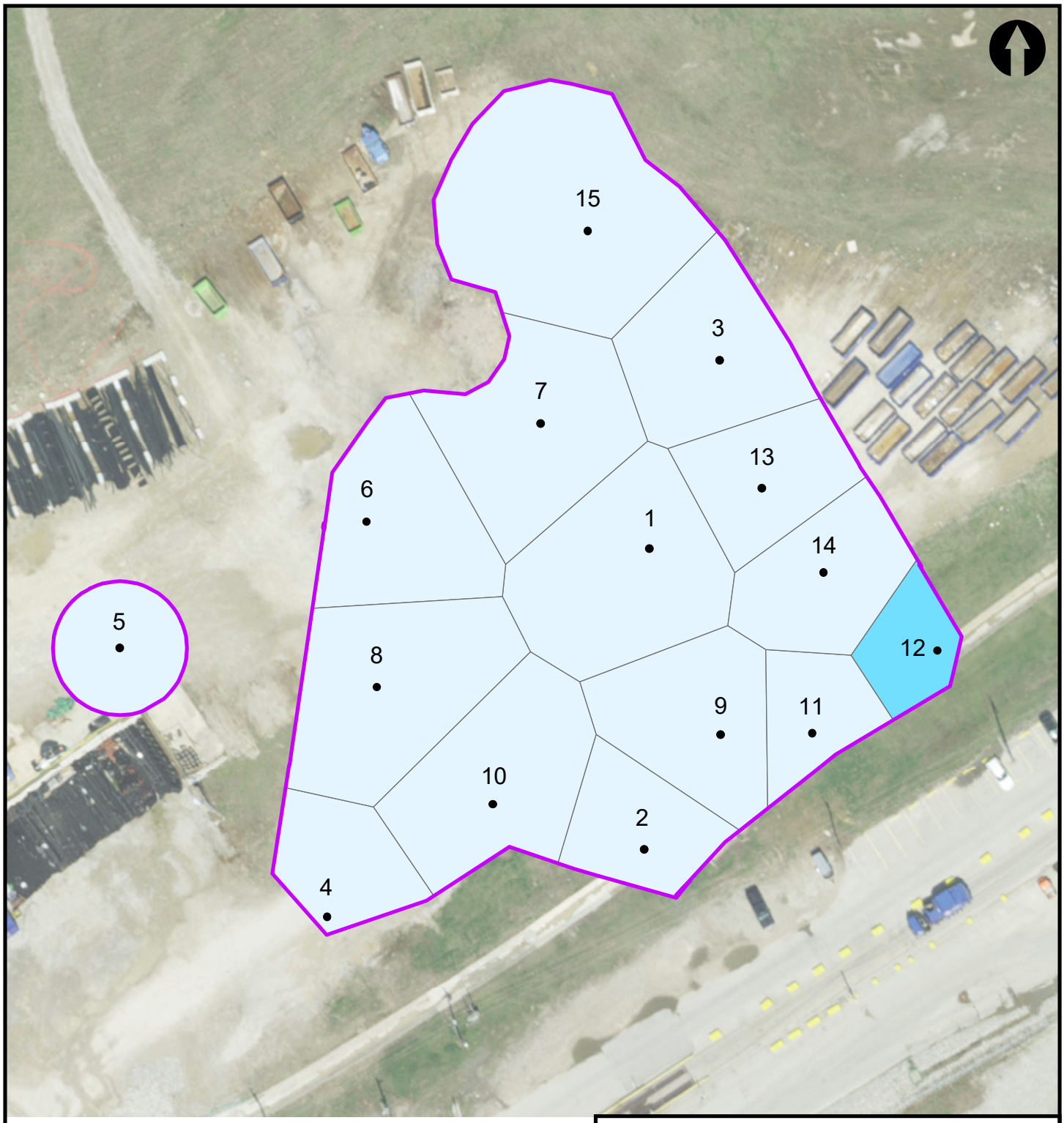

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 3

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 3 (4-6')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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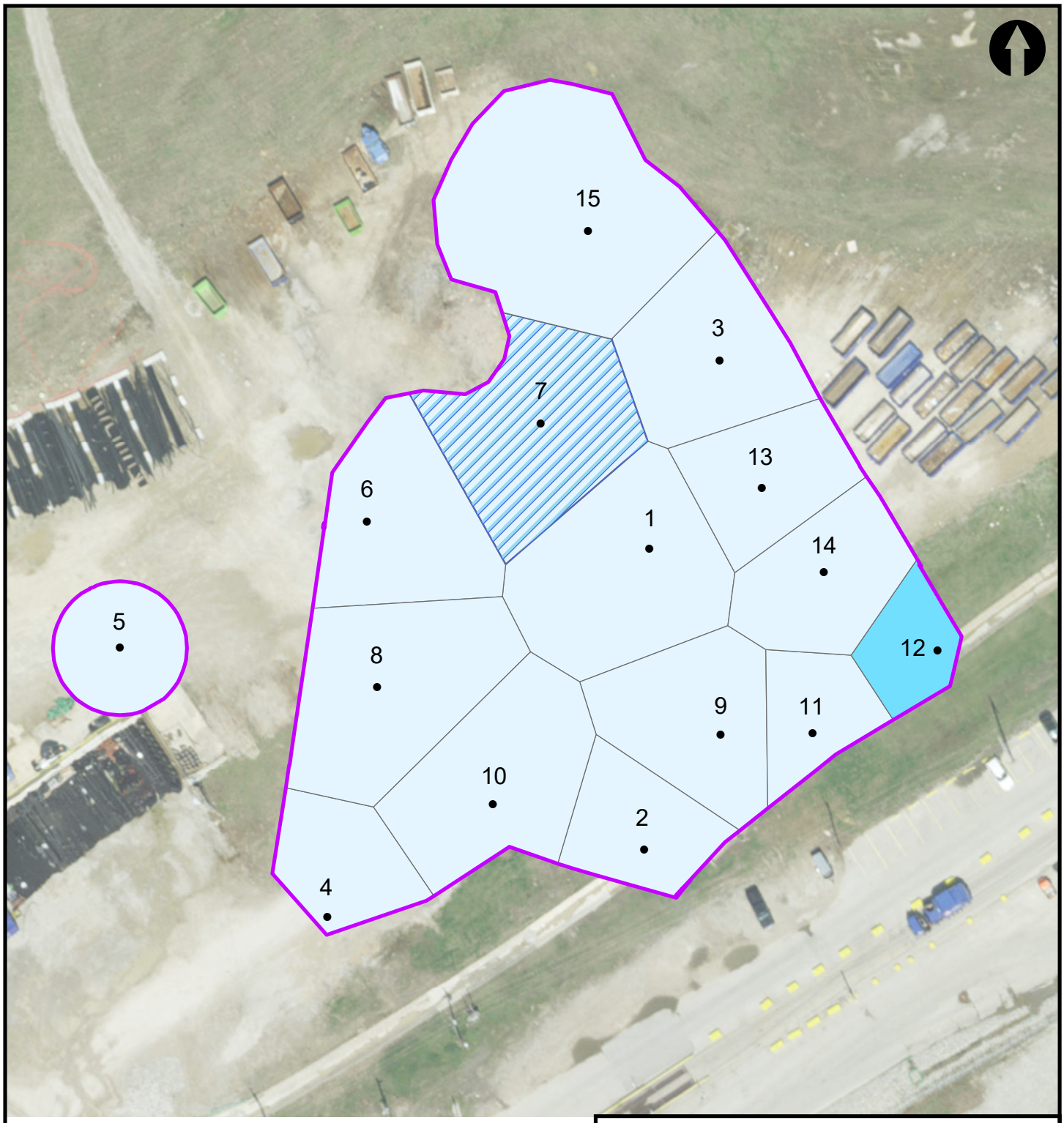

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 4

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 4 (6-8')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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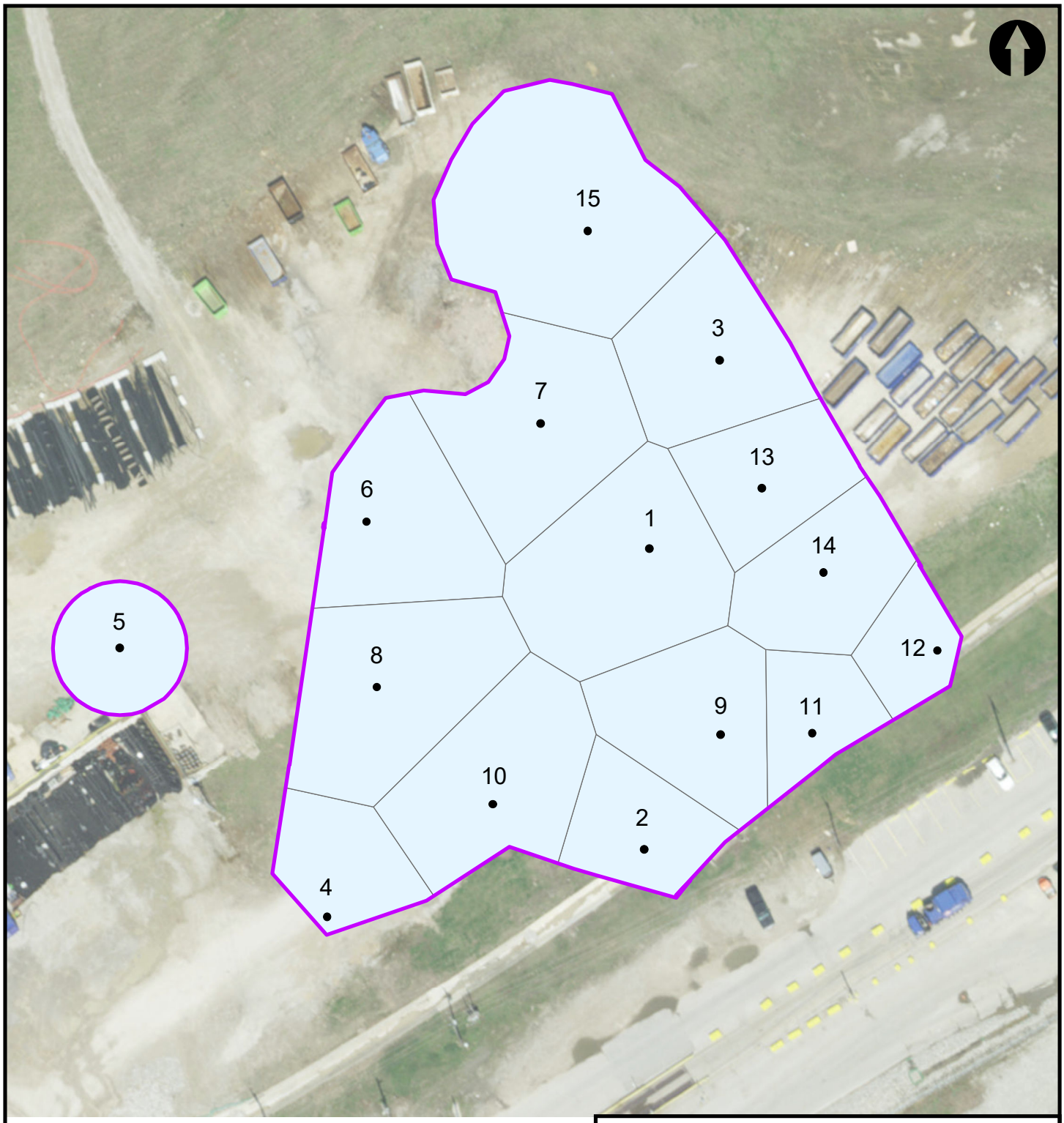

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 5

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 5 (8-10')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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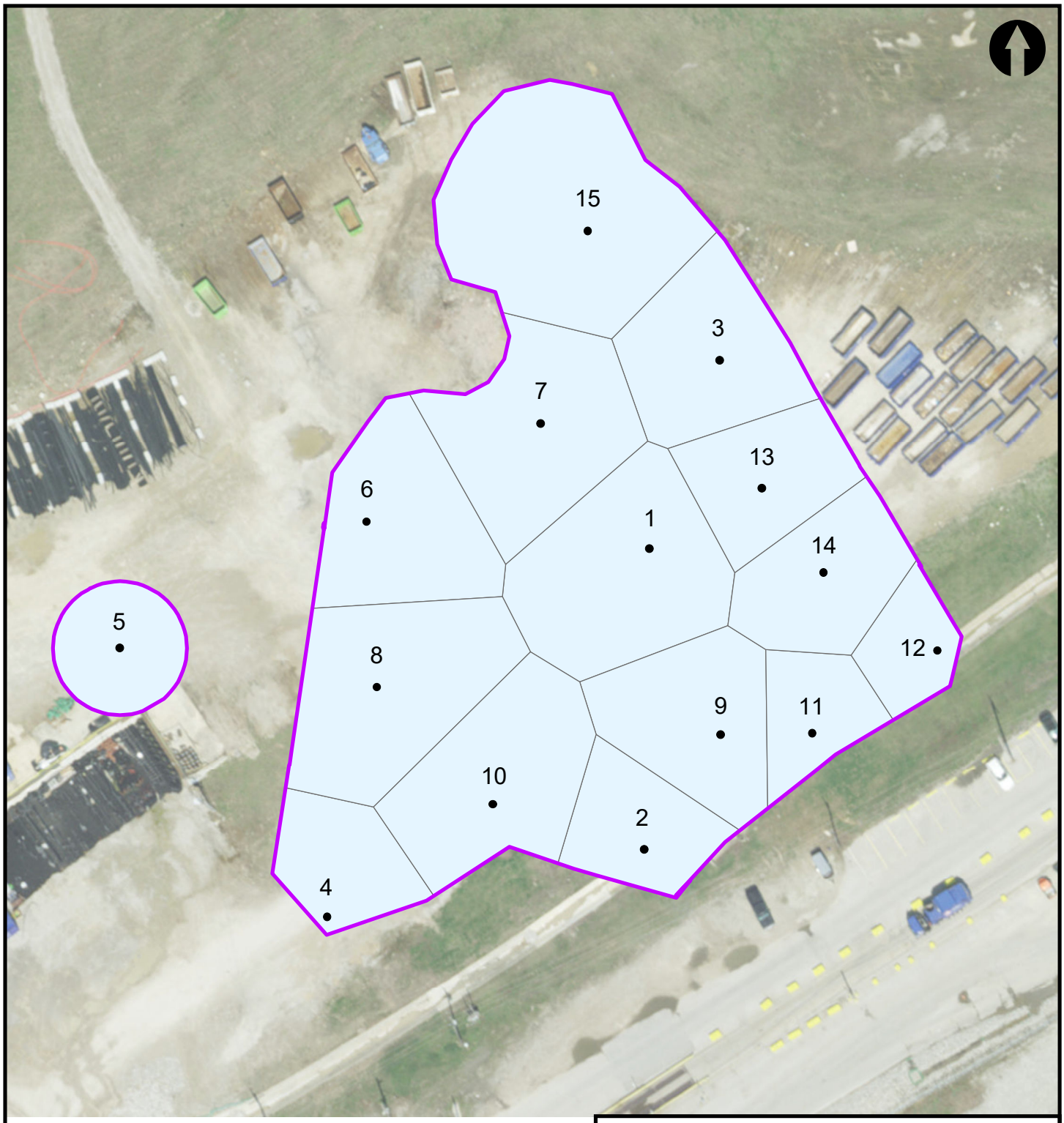

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 6

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 6 (10-12')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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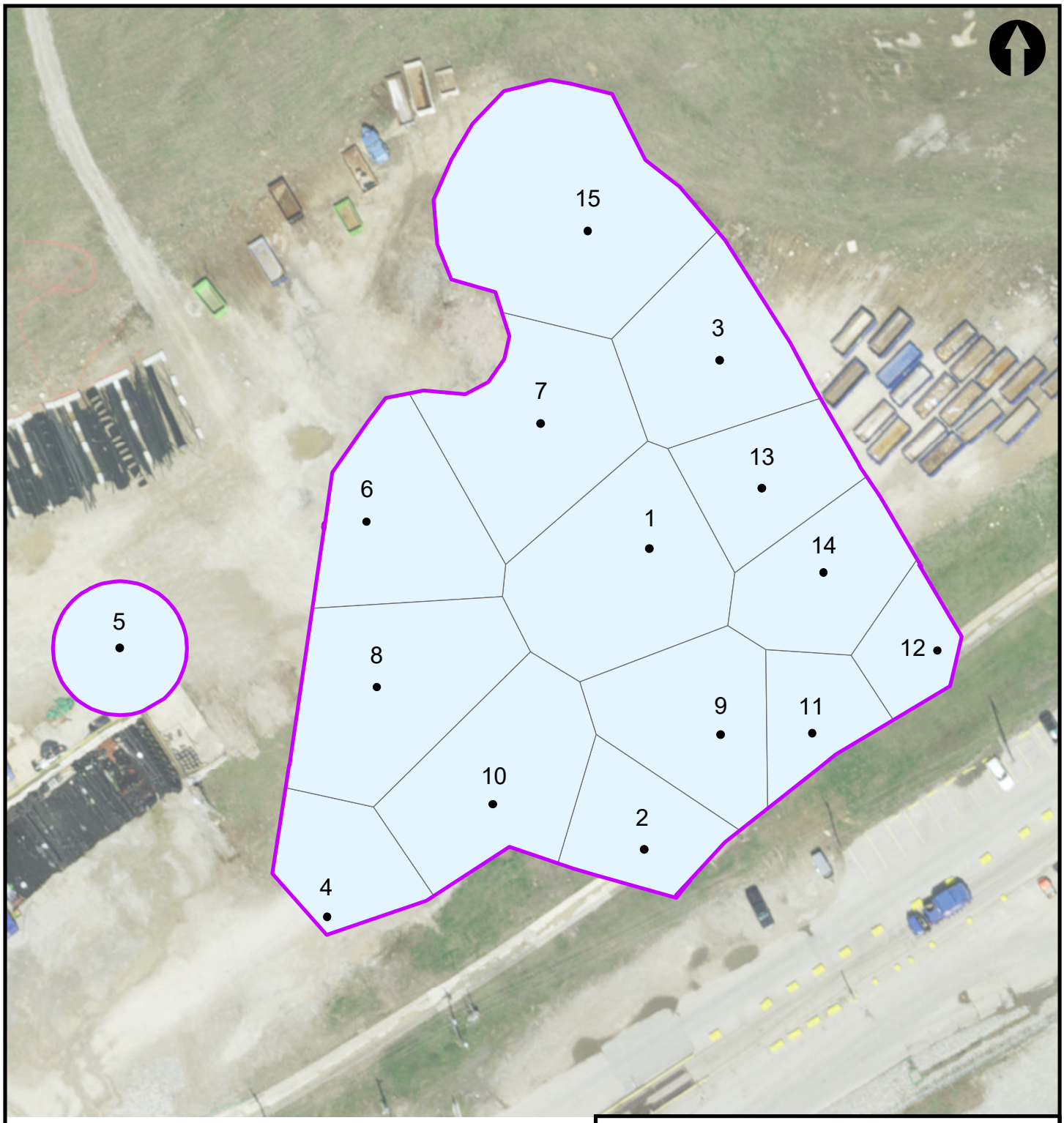

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 7

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 7 (12-14')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

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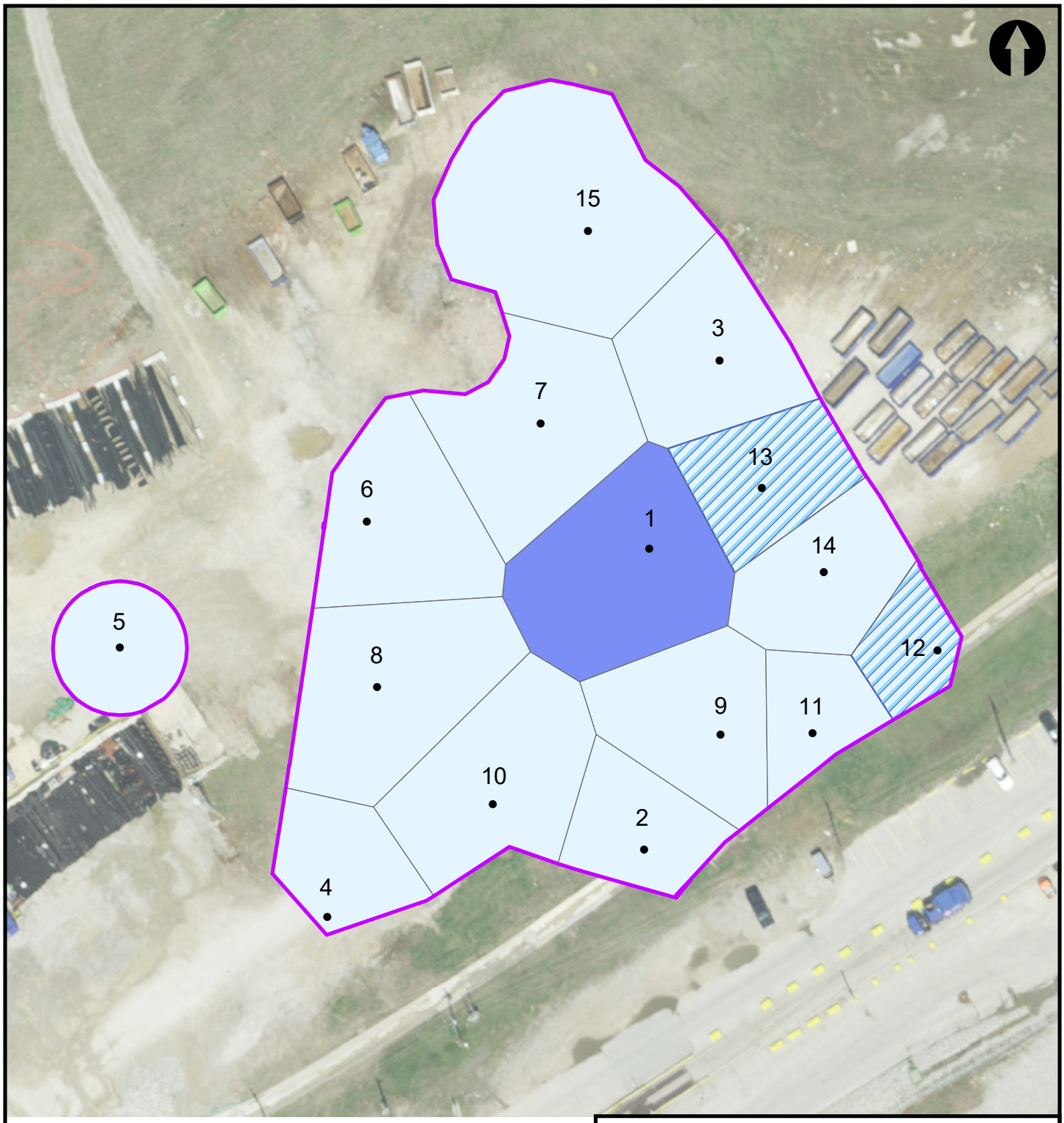

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 8

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 8 (14-16')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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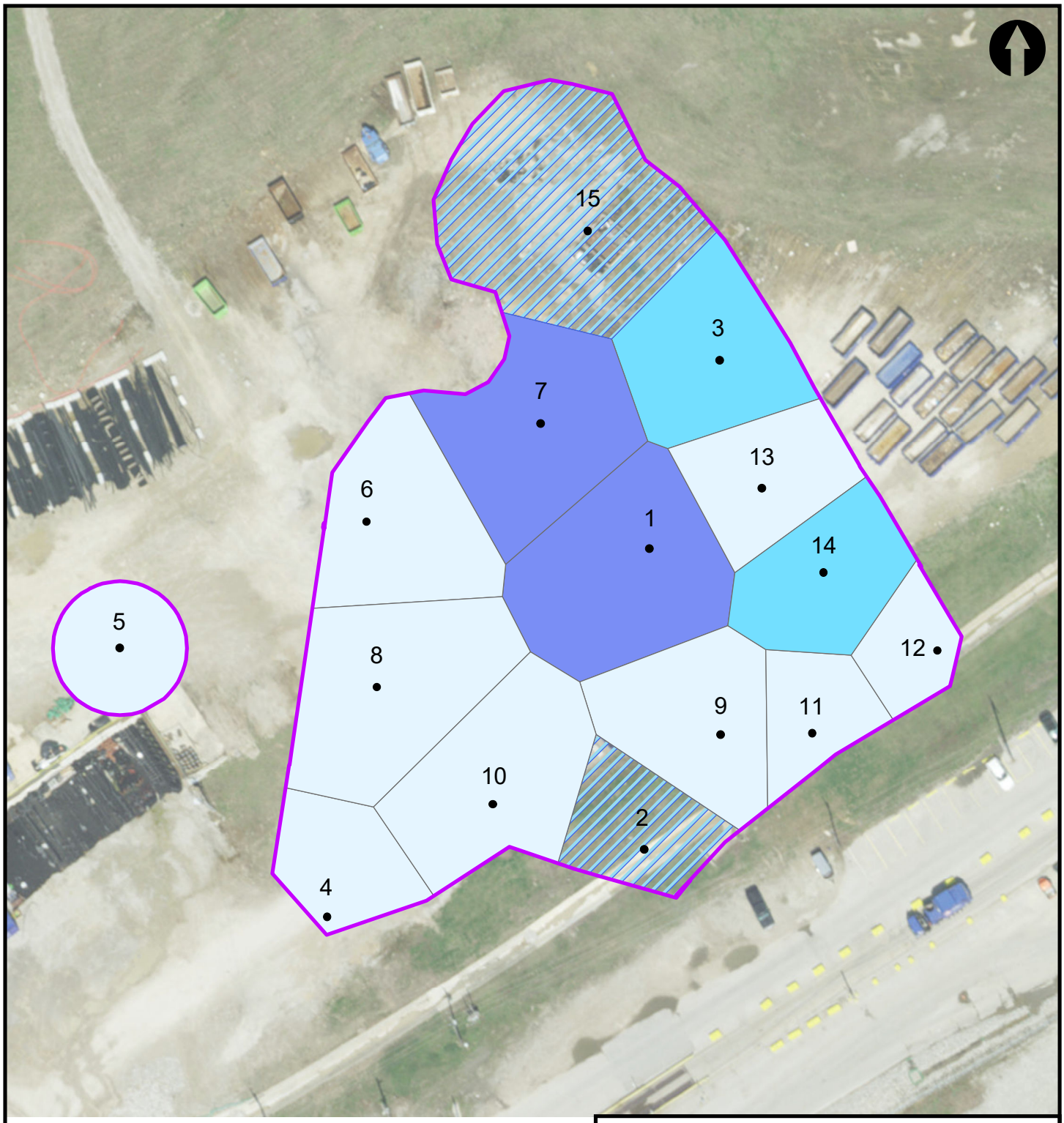

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 9

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 9 (16-18')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

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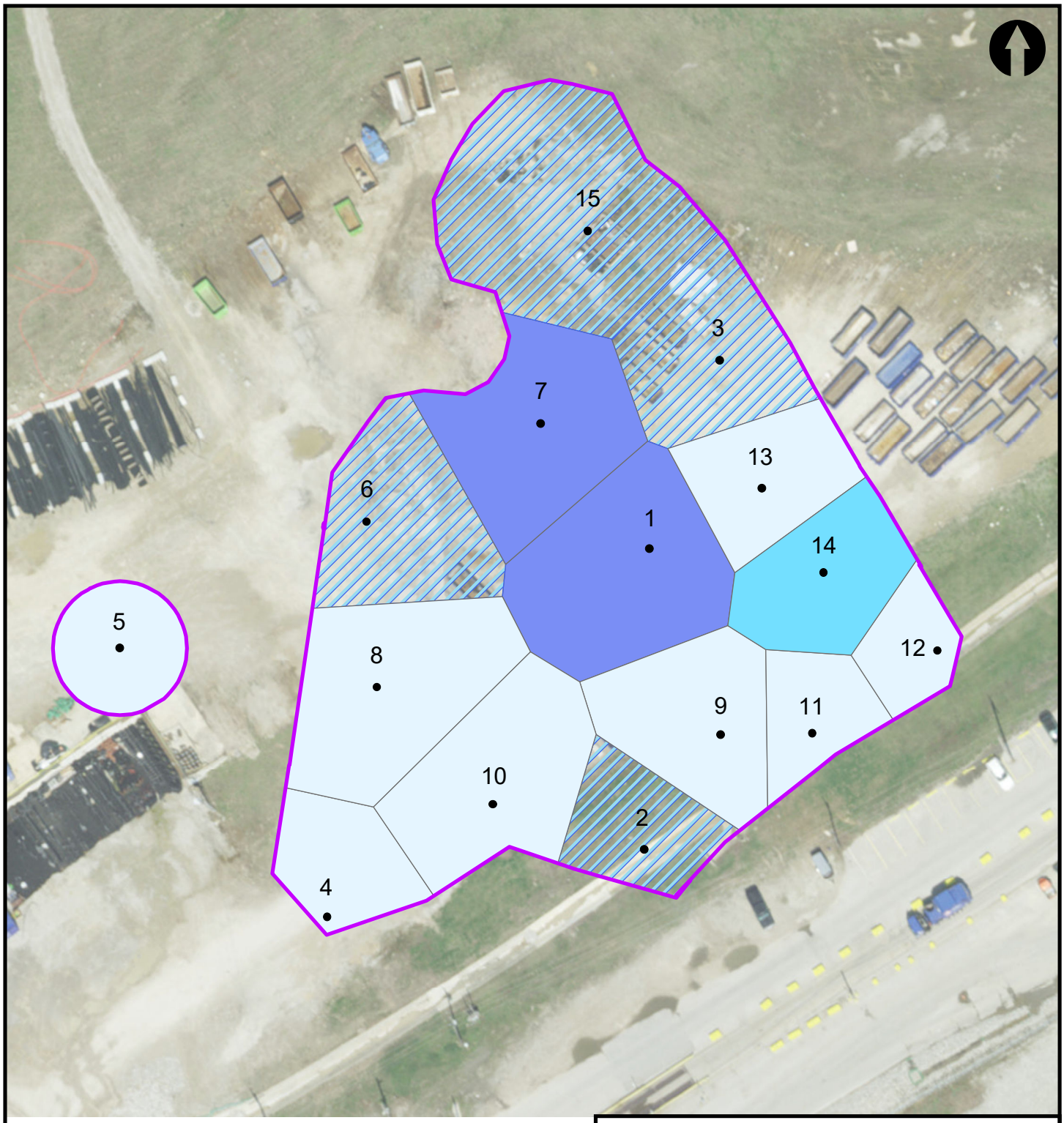

Legend

- Boring Location
- <52.9 pCi/g
- >52.9 - 500 pCi/g
- 500 - 1,000 pCi/g
- 1,000 – 5,000 pCi/g
- Not Sampled
- Lateral Extent of RIM > 52.9 pCi/g in the CDL in the Top 16 ft Below DI Datum

0 25 50 100 Feet

FIGURE 10

THIESSEN POLYGON ANALYSIS - CDL
COMBINED RADIUM
LAYER 10 (18-20')

WEST LAKE LANDFILL SUPERFUND SITE
OU-1 REMEDIAL DESIGN
BRIDGETON, ST. LOUIS COUNTY, MO

PARSONS

File path: \nybuf03fs01\PCTGprojects\West_lake\Surfer\cover_design\ArcMap Analysis 022023\CD Excavation Analysis

Date Saved: 4/5/2023 3:48:34 PM

ATTACHMENT 5 ATTRIBUTE TABLES

Attachment 5 – Attribute Tables

Layer 1 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 1

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	2.09	<52.9	2.48	<52.9	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	5.88	<52.9	106	>52.9 - 500	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	1.951666667	<52.9	2.076333333	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	2.533333333	<52.9	11.07333333	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	2.07	<52.9	2.76	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	1.89	<52.9	3.61	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	2.26	<52.9	4.23	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	1.83	<52.9	2.6	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.538333333	<52.9	11.55333333	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	1.98	<52.9	2.323	<52.9	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	13.8	<52.9	371	>52.9 - 500	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	3.206666667	<52.9	52.65	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	0.981	<52.9	1.25	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	7.408	<52.9	193.12	>52.9 - 500	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	1.85	<52.9	1.76	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 2 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 2

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	2.09	<52.9	2.48	<52.9	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	5.88	<52.9	106	>52.9 - 500	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	2.15	<52.9	2.146666667	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	3.195185185	<52.9	28.15740741	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	2.07	<52.9	2.76	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	1.89	<52.9	3.61	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	2.26	<52.9	4.23	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	1.83	<52.9	2.6	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.393333333	<52.9	4.563333333	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	1.98	<52.9	2.323	<52.9	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	25.48888889	<52.9	570.8888889	500 - <1000	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	3.846666667	<52.9	66.43333333	>52.9 - 500	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	0.981	<52.9	1.25	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	7.408	<52.9	193.12	>52.9 - 500	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	1.85	<52.9	1.76	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 3 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 3

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	**Total Area (ft^2)** 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	1.84	<52.9	2.815	<52.9	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	2.58	<52.9	19.8	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	1.741666667	<52.9	2.371666667	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	2.235	<52.9	26.68833333	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	2.07	<52.9	2.76	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	2.02	<52.9	2.2	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	1.28	<52.9	3.41	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	4.88	<52.9	70.1	>52.9 - 500	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.013333333	<52.9	4.398333333	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	4.6005	<52.9	79.098	>52.9 - 500	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.66	<52.9	16	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	81.86153846	>52.9 - 500	1253.846154	1000 – <5000	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	1.97	<52.9	2.39	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	4.909	<52.9	97.825	>52.9 - 500	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	2.02	<52.9	2.34	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 4 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 4

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	1.59	<52.9	3.15	<52.9	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	2.58	<52.9	19.8	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	1.371833333	<52.9	2.798333333	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	2.555	<52.9	26.37666667	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	1.51	<52.9	10.1	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	2.02	<52.9	2.2	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	Not Sampled	Not Sampled	Not Sampled	Not Sampled	6442.023496
8	835802.602	1069473.477	CD-EA-199	4.88	<52.9	70.1	>52.9 - 500	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.47	<52.9	14.712	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	7.221	<52.9	155.873	>52.9 - 500	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.66	<52.9	16	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	57.66	>52.9 - 500	637.6	500 - <1000	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	1.97	<52.9	2.39	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	2.41	<52.9	2.53	<52.9	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	2.02	<52.9	2.34	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 5 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 5

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	**Total Area (ft^2)** 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	1.59	<52.9	3.15	<52.9	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	1.53	<52.9	1.73	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	1.523983333	<52.9	2.225333333	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	2.011666667	<52.9	2.783333333	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	2.26	<52.9	8.31	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	7.3	<52.9	182	>52.9 - 500	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	1.91	<52.9	4.33	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	4.54	<52.9	74.7	>52.9 - 500	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.194333333	<52.9	21.25833333	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	7.221	<52.9	155.873	>52.9 - 500	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	0.765	<52.9	4.21	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	1.1615	<52.9	29.37333333	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	1.78	<52.9	2.87	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	2.41	<52.9	2.53	<52.9	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	1.34	<52.9	0.968	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 6 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 6

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	4.39	<52.9	72.3	>52.9 - 500	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	1.53	<52.9	1.73	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	1.74	<52.9	2.476	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	1.792	<52.9	2.388	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	2.26	<52.9	8.31	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	7.3	<52.9	182	>52.9 - 500	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	1.91	<52.9	4.33	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	4.54	<52.9	74.7	>52.9 - 500	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	2.13	<52.9	19.79	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	8.961	<52.9	562.17	500 - <1000	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	0.765	<52.9	4.21	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	0.795666667	<52.9	15.76333333	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	1.78	<52.9	2.87	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	0.781	<52.9	0.48	<52.9	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	1.34	<52.9	0.968	<52.9	9799.551762

Attachment 5 – Attribute Tables

Layer 7 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 7

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	4.39	<52.9	72.3	>52.9 - 500	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	1.54	<52.9	1.28	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	2.569666667	<52.9	25.755	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	1.405818182	<52.9	1.736181818	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	4.1	<52.9	87.9	>52.9 - 500	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	1.58	<52.9	2.96	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	0.829	<52.9	26	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	1.83	<52.9	7.92	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	17.91692308	<52.9	64.21538462	>52.9 - 500	4988.713354
10	835854.774	1069420.545	CD-EA-174	8.961	<52.9	562.17	500 - <1000	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.19	<52.9	1.85	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	1.178333333	<52.9	14.07	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	1	<52.9	2.19	<52.9	3777.681723
14	836004.133	1069525.25	CD-EA-175	0.781	<52.9	0.48	<52.9	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	2.47	<52.9	344	>52.9 - 500	9799.551762

Attachment 5 – Attribute Tables

Layer 8 Attribute Table

Attachment 5 - Attribute Tables
Attribute Table for Layer 8

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	**Total Area (ft^2)** 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	1082.195	1000 – <5000	159.65	>52.9 - 500	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	1.54	<52.9	1.28	<52.9	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	3.152	<52.9	39.88	<52.9	5194.119636
4	835780.058	1069369.66	CD-EA-208	1.52	<52.9	1.94	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	4.1	<52.9	87.9	>52.9 - 500	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	1.58	<52.9	2.96	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	0.829	<52.9	26	<52.9	6442.023496
8	835802.602	1069473.477	CD-EA-199	1.83	<52.9	7.92	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	5.557272727	<52.9	43.77090909	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	4.904	<52.9	281.658	>52.9 - 500	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.19	<52.9	1.85	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	Not Sampled	Not Sampled	Not Sampled	Not Sampled	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	Not Sampled	Not Sampled	Not Sampled	Not Sampled	3777.681723
14	836004.133	1069525.25	CD-EA-175	40.8319	<52.9	97.9635	>52.9 - 500	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	16.97333333	<52.9	326.8888889	>52.9 - 500	9799.551762

Attachment 5 – Attribute Tables

Layer 9 Attribute Table

Attachment 5 - Attribute Tables

Attribute Table for Layer 9

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	2160	1000 – <5000	247	>52.9 - 500	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	225.525	>52.9 - 500	4222.25	1000 – <5000	5194.119636
4	835780.058	1069369.66	CD-EA-208	1.726666667	<52.9	1.928333333	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	3.01	<52.9	3.58	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	1.82	<52.9	1.81	<52.9	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	2770	1000 – <5000	580	500 - <1000	6442.023496
8	835802.602	1069473.477	CD-EA-199	2.15	<52.9	1.89	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	1.538333333	<52.9	1.511666667	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	0.847	<52.9	1.146	<52.9	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.35	<52.9	1.29	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	0.756833333	<52.9	4.293333333	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	6.96	<52.9	185	>52.9 - 500	3777.681723
14	836004.133	1069525.25	CD-EA-175	141.9189091	>52.9 - 500	829.5245455	500 - <1000	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	Not Sampled	Not Sampled	Not Sampled	Not Sampled	9799.551762

Attachment 5 – Attribute Tables

Layer 10 Attribute Table

Attachment 5 - Attribute Tables
Attribute Table for Layer 10

Polygon Number	Easting NAD83 State Plane MO East	Northing NAD83 State Plane MO East	BORINGS IN LAYER	Average Combined Radium (pCi/g)	Average Combined Radium Category (pCi/g)	Average Combined Thorium (pCi/g)	Average Combined Thorium Category (pCi/g)	Total Area (ft^2) 73775 A_i, Shape Area (ft^2)
1	835925.578	1069536.038	CD-EA-200	2405.454545	1000 – <5000	1842.727273	1000 – <5000	7132.882253
2	835923.065	1069400.292	CD-EA-190-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled	3279.477237
3	835957.19	1069621.183	CD-EA-200-B	Not Sampled	Not Sampled	Not Sampled	Not Sampled	5194.119636
4	835780.058	1069369.66	CD-EA-208	1.71	<52.9	1.97	<52.9	3029.232845
5	835686.34	1069491.195	CD-EA-199-B	3.01	<52.9	3.58	<52.9	2861.908938
6	835797.913	1069548.224	CD-EA-199-C	Not Sampled	Not Sampled	Not Sampled	Not Sampled	5491.237826
7	835876.462	1069592.606	CD-EA-200-C	2824.444444	1000 – <5000	962.2222222	500 - <1000	6442.023496
8	835802.602	1069473.477	CD-EA-199	2.15	<52.9	1.89	<52.9	6905.572237
9	835957.593	1069452.157	CD-EA-190-R	1.735555556	<52.9	1.635555556	<52.9	4988.713354
10	835854.774	1069420.545	CD-EA-174	0.847	<52.9	1.146	<52.9	6170.375766
11	835999.19	1069452.697	CD-EA-190-C	1.35	<52.9	1.29	<52.9	2518.660372
12	836055.699	1069489.883	CD-EA-175-A	0.654909091	<52.9	2.239090909	<52.9	2006.848584
13	835976.26	1069563.391	CD-EA-200-A	6.96	<52.9	185	>52.9 - 500	3777.681723
14	836004.133	1069525.25	CD-EA-175	80.8828	>52.9 - 500	195.447	>52.9 - 500	4177.158164
15	835897.854	1069679.576	CD-EA-200-D	Not Sampled	Not Sampled	Not Sampled	Not Sampled	9799.551762

ATTACHMENT 6 TOTAL ACTIVITY ESTIMATES OF COMBINED THORIUM AND COMBINED RADIUM

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 1

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 1

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	2.09	2.48	7132.882253	2	41626	1.24E+09	1.47E+09	1E-12	1.24E-03	1.47E-03
2	CD-EA-190-B	5.88	106	3279.477237	2	41626	1.61E+09	2.89E+10	1E-12	1.61E-03	2.89E-02
3	CD-EA-200-B	1.95	2.08	5194.119636	2	41626	8.44E+08	8.98E+08	1E-12	8.44E-04	8.98E-04
4	CD-EA-208	2.53	11.1	3029.232845	2	41626	6.39E+08	2.79E+09	1E-12	6.39E-04	2.79E-03
5	CD-EA-199-B	2.07	2.76	2861.908938	2	41626	4.93E+08	6.58E+08	1E-12	4.93E-04	6.58E-04
6	CD-EA-199-C	1.89	3.61	5491.237826	2	41626	8.64E+08	1.65E+09	1E-12	8.64E-04	1.65E-03
7	CD-EA-200-C	2.26	4.23	6442.023496	2	41626	1.21E+09	2.27E+09	1E-12	1.21E-03	2.27E-03
8	CD-EA-199	1.83	2.60	6905.572237	2	41626	1.05E+09	1.49E+09	1E-12	1.05E-03	1.49E-03
9	CD-EA-190-R	2.54	11.6	4988.713354	2	41626	1.05E+09	4.80E+09	1E-12	1.05E-03	4.80E-03
10	CD-EA-174	1.98	2.32	6170.375766	2	41626	1.02E+09	1.19E+09	1E-12	1.02E-03	1.19E-03
11	CD-EA-190-C	13.8	371	2518.660372	2	41626	2.89E+09	7.78E+10	1E-12	2.89E-03	7.78E-02
12	CD-EA-175-A	3.21	52.7	2006.848584	2	41626	5.36E+08	8.80E+09	1E-12	5.36E-04	8.80E-03
13	CD-EA-200-A	0.981	1.25	3777.681723	2	41626	3.09E+08	3.93E+08	1E-12	3.09E-04	3.93E-04
14	CD-EA-175	7.41	193	4177.158164	2	41626	2.58E+09	6.72E+10	1E-12	2.58E-03	6.72E-02
15	CD-EA-200-D	1.85	1.76	9799.551762	2	41626	1.51E+09	1.44E+09	1E-12	1.51E-03	1.44E-03

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 2

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 2

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	2.09	2.48	7132.882253	2	41626	1.24E+09	1.47E+09	1E-12	1.24E-03	1.47E-03
2	CD-EA-190-B	5.88	106	3279.477237	2	41626	1.61E+09	2.89E+10	1E-12	1.61E-03	2.89E-02
3	CD-EA-200-B	2.15	2.15	5194.119636	2	41626	9.30E+08	9.28E+08	1E-12	9.30E-04	9.28E-04
4	CD-EA-208	3.20	28.2	3029.232845	2	41626	8.06E+08	7.10E+09	1E-12	8.06E-04	7.10E-03
5	CD-EA-199-B	2.07	2.76	2861.908938	2	41626	4.93E+08	6.58E+08	1E-12	4.93E-04	6.58E-04
6	CD-EA-199-C	1.89	3.61	5491.237826	2	41626	8.64E+08	1.65E+09	1E-12	8.64E-04	1.65E-03
7	CD-EA-200-C	2.26	4.23	6442.023496	2	41626	1.21E+09	2.27E+09	1E-12	1.21E-03	2.27E-03
8	CD-EA-199	1.83	2.60	6905.572237	2	41626	1.05E+09	1.49E+09	1E-12	1.05E-03	1.49E-03
9	CD-EA-190-R	2.39	4.56	4988.713354	2	41626	9.94E+08	1.90E+09	1E-12	9.94E-04	1.90E-03
10	CD-EA-174	1.98	2.32	6170.375766	2	41626	1.02E+09	1.19E+09	1E-12	1.02E-03	1.19E-03
11	CD-EA-190-C	25.5	571	2518.660372	2	41626	5.34E+09	1.20E+11	1E-12	5.34E-03	1.20E-01
12	CD-EA-175-A	3.85	66.4	2006.848584	2	41626	6.43E+08	1.11E+10	1E-12	6.43E-04	1.11E-02
13	CD-EA-200-A	0.981	1.25	3777.681723	2	41626	3.09E+08	3.93E+08	1E-12	3.09E-04	3.93E-04
14	CD-EA-175	7.41	193	4177.158164	2	41626	2.58E+09	6.72E+10	1E-12	2.58E-03	6.72E-02
15	CD-EA-200-D	1.85	1.76	9799.551762	2	41626	1.51E+09	1.44E+09	1E-12	1.51E-03	1.44E-03

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 3

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 3

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	1.84	2.82	7132.882253	2	41626	1.09E+09	1.67E+09	1E-12	1.09E-03	1.67E-03
2	CD-EA-190-B	2.58	19.8	3279.477237	2	41626	7.04E+08	5.41E+09	1E-12	7.04E-04	5.41E-03
3	CD-EA-200-B	1.74	2.37	5194.119636	2	41626	7.53E+08	1.03E+09	1E-12	7.53E-04	1.03E-03
4	CD-EA-208	2.24	26.7	3029.232845	2	41626	5.64E+08	6.73E+09	1E-12	5.64E-04	6.73E-03
5	CD-EA-199-B	2.07	2.76	2861.908938	2	41626	4.93E+08	6.58E+08	1E-12	4.93E-04	6.58E-04
6	CD-EA-199-C	2.02	2.20	5491.237826	2	41626	9.23E+08	1.01E+09	1E-12	9.23E-04	1.01E-03
7	CD-EA-200-C	1.28	3.41	6442.023496	2	41626	6.86E+08	1.83E+09	1E-12	6.86E-04	1.83E-03
8	CD-EA-199	4.88	70.1	6905.572237	2	41626	2.81E+09	4.03E+10	1E-12	2.81E-03	4.03E-02
9	CD-EA-190-R	2.01	4.40	4988.713354	2	41626	8.36E+08	1.83E+09	1E-12	8.36E-04	1.83E-03
10	CD-EA-174	4.60	79.1	6170.375766	2	41626	2.36E+09	4.06E+10	1E-12	2.36E-03	4.06E-02
11	CD-EA-190-C	1.66	16.0	2518.660372	2	41626	3.48E+08	3.35E+09	1E-12	3.48E-04	3.35E-03
12	CD-EA-175-A	81.9	1254	2006.848584	2	41626	1.37E+10	2.09E+11	1E-12	1.37E-02	2.09E-01
13	CD-EA-200-A	1.97	2.39	3777.681723	2	41626	6.20E+08	7.52E+08	1E-12	6.20E-04	7.52E-04
14	CD-EA-175	4.91	97.8	4177.158164	2	41626	1.71E+09	3.40E+10	1E-12	1.71E-03	3.40E-02
15	CD-EA-200-D	2.02	2.34	9799.551762	2	41626	1.65E+09	1.91E+09	1E-12	1.65E-03	1.91E-03

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 4

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 4

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	1.59	3.15	7132.882253	2	41626	9.44E+08	1.87E+09	1E-12	9.44E-04	1.87E-03
2	CD-EA-190-B	2.58	19.8	3279.477237	2	41626	7.04E+08	5.41E+09	1E-12	7.04E-04	5.41E-03
3	CD-EA-200-B	1.37	2.80	5194.119636	2	41626	5.93E+08	1.21E+09	1E-12	5.93E-04	1.21E-03
4	CD-EA-208	2.56	26.4	3029.232845	2	41626	6.44E+08	6.65E+09	1E-12	6.44E-04	6.65E-03
5	CD-EA-199-B	1.51	10.1	2861.908938	2	41626	3.60E+08	2.41E+09	1E-12	3.60E-04	2.41E-03
6	CD-EA-199-C	2.02	2.20	5491.237826	2	41626	9.23E+08	1.01E+09	1E-12	9.23E-04	1.01E-03
7	CD-EA-200-C	0.955	3.87	6442.023496	2	41626	5.12E+08	2.08E+09	1E-12	5.12E-04	2.08E-03
8	CD-EA-199	4.88	70.1	6905.572237	2	41626	2.81E+09	4.03E+10	1E-12	2.81E-03	4.03E-02
9	CD-EA-190-R	2.47	14.7	4988.713354	2	41626	1.03E+09	6.11E+09	1E-12	1.03E-03	6.11E-03
10	CD-EA-174	7.22	156	6170.375766	2	41626	3.71E+09	8.01E+10	1E-12	3.71E-03	8.01E-02
11	CD-EA-190-C	1.66	16.0	2518.660372	2	41626	3.48E+08	3.35E+09	1E-12	3.48E-04	3.35E-03
12	CD-EA-175-A	57.7	638	2006.848584	2	41626	9.63E+09	1.07E+11	1E-12	9.63E-03	1.07E-01
13	CD-EA-200-A	1.97	2.39	3777.681723	2	41626	6.20E+08	7.52E+08	1E-12	6.20E-04	7.52E-04
14	CD-EA-175	2.41	2.53	4177.158164	2	41626	8.38E+08	8.80E+08	1E-12	8.38E-04	8.80E-04
15	CD-EA-200-D	2.02	2.34	9799.551762	2	41626	1.65E+09	1.91E+09	1E-12	1.65E-03	1.91E-03

Notes:

1. Yellow-highlighted borings indicate that samples were not collected from the boring within this layer.
2. Yellow-highlighted combined radium values for each boring were calculated by averaging the values from Layers 3 and 5.
3. Yellow-highlighted combined thorium values for each boring were calculated by averaging the values from Layers 3 and 5.

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 5

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 5

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	1.59	3.15	7132.882253	2	41626	9.44E+08	1.87E+09	1E-12	9.44E-04	1.87E-03
2	CD-EA-190-B	1.53	1.73	3279.477237	2	41626	4.18E+08	4.72E+08	1E-12	4.18E-04	4.72E-04
3	CD-EA-200-B	1.52	2.23	5194.119636	2	41626	6.59E+08	9.62E+08	1E-12	6.59E-04	9.62E-04
4	CD-EA-208	2.01	2.78	3029.232845	2	41626	5.07E+08	7.02E+08	1E-12	5.07E-04	7.02E-04
5	CD-EA-199-B	2.26	8.31	2861.908938	2	41626	5.38E+08	1.98E+09	1E-12	5.38E-04	1.98E-03
6	CD-EA-199-C	7.30	182	5491.237826	2	41626	3.34E+09	8.32E+10	1E-12	3.34E-03	8.32E-02
7	CD-EA-200-C	1.91	4.33	6442.023496	2	41626	1.02E+09	2.32E+09	1E-12	1.02E-03	2.32E-03
8	CD-EA-199	4.54	74.7	6905.572237	2	41626	2.61E+09	4.29E+10	1E-12	2.61E-03	4.29E-02
9	CD-EA-190-R	2.19	21.3	4988.713354	2	41626	9.11E+08	8.83E+09	1E-12	9.11E-04	8.83E-03
10	CD-EA-174	7.22	156	6170.375766	2	41626	3.71E+09	8.01E+10	1E-12	3.71E-03	8.01E-02
11	CD-EA-190-C	0.765	4.21	2518.660372	2	41626	1.60E+08	8.83E+08	1E-12	1.60E-04	8.83E-04
12	CD-EA-175-A	1.16	29.4	2006.848584	2	41626	1.94E+08	4.91E+09	1E-12	1.94E-04	4.91E-03
13	CD-EA-200-A	1.78	2.87	3777.681723	2	41626	5.60E+08	9.03E+08	1E-12	5.60E-04	9.03E-04
14	CD-EA-175	2.41	2.53	4177.158164	2	41626	8.38E+08	8.80E+08	1E-12	8.38E-04	8.80E-04
15	CD-EA-200-D	1.34	0.968	9799.551762	2	41626	1.09E+09	7.90E+08	1E-12	1.09E-03	7.90E-04

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 6

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 6

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	4.39	72.3	7132.882253	2	41626	2.61E+09	4.29E+10	1E-12	2.61E-03	4.29E-02
2	CD-EA-190-B	1.53	1.73	3279.477237	2	41626	4.18E+08	4.72E+08	1E-12	4.18E-04	4.72E-04
3	CD-EA-200-B	1.74	2.48	5194.119636	2	41626	7.52E+08	1.07E+09	1E-12	7.52E-04	1.07E-03
4	CD-EA-208	1.79	2.39	3029.232845	2	41626	4.52E+08	6.02E+08	1E-12	4.52E-04	6.02E-04
5	CD-EA-199-B	2.26	8.31	2861.908938	2	41626	5.38E+08	1.98E+09	1E-12	5.38E-04	1.98E-03
6	CD-EA-199-C	7.30	182	5491.237826	2	41626	3.34E+09	8.32E+10	1E-12	3.34E-03	8.32E-02
7	CD-EA-200-C	1.91	4.33	6442.023496	2	41626	1.02E+09	2.32E+09	1E-12	1.02E-03	2.32E-03
8	CD-EA-199	4.54	74.7	6905.572237	2	41626	2.61E+09	4.29E+10	1E-12	2.61E-03	4.29E-02
9	CD-EA-190-R	2.13	19.8	4988.713354	2	41626	8.85E+08	8.22E+09	1E-12	8.85E-04	8.22E-03
10	CD-EA-174	8.96	562	6170.375766	2	41626	4.60E+09	2.89E+11	1E-12	4.60E-03	2.89E-01
11	CD-EA-190-C	0.765	4.21	2518.660372	2	41626	1.60E+08	8.83E+08	1E-12	1.60E-04	8.83E-04
12	CD-EA-175-A	0.796	15.8	2006.848584	2	41626	1.33E+08	2.63E+09	1E-12	1.33E-04	2.63E-03
13	CD-EA-200-A	1.78	2.87	3777.681723	2	41626	5.60E+08	9.03E+08	1E-12	5.60E-04	9.03E-04
14	CD-EA-175	0.781	0.480	4177.158164	2	41626	2.72E+08	1.67E+08	1E-12	2.72E-04	1.67E-04
15	CD-EA-200-D	1.34	0.968	9799.551762	2	41626	1.09E+09	7.90E+08	1E-12	1.09E-03	7.90E-04

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 7

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 7

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	4.39	72.3	7132.882253	2	41626	2.61E+09	4.29E+10	1E-12	2.61E-03	4.29E-02
2	CD-EA-190-B	1.54	1.28	3279.477237	2	41626	4.20E+08	3.49E+08	1E-12	4.20E-04	3.49E-04
3	CD-EA-200-B	2.57	25.8	5194.119636	2	41626	1.11E+09	1.11E+10	1E-12	1.11E-03	1.11E-02
4	CD-EA-208	1.41	1.74	3029.232845	2	41626	3.55E+08	4.38E+08	1E-12	3.55E-04	4.38E-04
5	CD-EA-199-B	4.10	87.9	2861.908938	2	41626	9.77E+08	2.09E+10	1E-12	9.77E-04	2.09E-02
6	CD-EA-199-C	1.58	2.96	5491.237826	2	41626	7.22E+08	1.35E+09	1E-12	7.22E-04	1.35E-03
7	CD-EA-200-C	0.829	26.0	6442.023496	2	41626	4.45E+08	1.39E+10	1E-12	4.45E-04	1.39E-02
8	CD-EA-199	1.83	7.92	6905.572237	2	41626	1.05E+09	4.55E+09	1E-12	1.05E-03	4.55E-03
9	CD-EA-190-R	17.9	64.2	4988.713354	2	41626	7.44E+09	2.67E+10	1E-12	7.44E-03	2.67E-02
10	CD-EA-174	8.96	562	6170.375766	2	41626	4.60E+09	2.89E+11	1E-12	4.60E-03	2.89E-01
11	CD-EA-190-C	1.19	1.85	2518.660372	2	41626	2.50E+08	3.88E+08	1E-12	2.50E-04	3.88E-04
12	CD-EA-175-A	1.18	14.1	2006.848584	2	41626	1.97E+08	2.35E+09	1E-12	1.97E-04	2.35E-03
13	CD-EA-200-A	1.00	2.19	3777.681723	2	41626	3.14E+08	6.89E+08	1E-12	3.14E-04	6.89E-04
14	CD-EA-175	0.781	0.480	4177.158164	2	41626	2.72E+08	1.67E+08	1E-12	2.72E-04	1.67E-04
15	CD-EA-200-D	2.47	344	9799.551762	2	41626	2.02E+09	2.81E+11	1E-12	2.02E-03	2.81E-01

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 8

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 8

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	1082	160	7132.882253	2	41626	6.43E+11	9.48E+10	1E-12	6.43E-01	9.48E-02
2	CD-EA-190-B	1.54	1.28	3279.477237	2	41626	4.20E+08	3.49E+08	1E-12	4.20E-04	3.49E-04
3	CD-EA-200-B	3.15	39.9	5194.119636	2	41626	1.36E+09	1.72E+10	1E-12	1.36E-03	1.72E-02
4	CD-EA-208	1.52	1.94	3029.232845	2	41626	3.83E+08	4.89E+08	1E-12	3.83E-04	4.89E-04
5	CD-EA-199-B	4.10	87.9	2861.908938	2	41626	9.77E+08	2.09E+10	1E-12	9.77E-04	2.09E-02
6	CD-EA-199-C	1.58	2.96	5491.237826	2	41626	7.22E+08	1.35E+09	1E-12	7.22E-04	1.35E-03
7	CD-EA-200-C	0.829	26.0	6442.023496	2	41626	4.45E+08	1.39E+10	1E-12	4.45E-04	1.39E-02
8	CD-EA-199	1.83	7.92	6905.572237	2	41626	1.05E+09	4.55E+09	1E-12	1.05E-03	4.55E-03
9	CD-EA-190-R	5.56	43.8	4988.713354	2	41626	2.31E+09	1.82E+10	1E-12	2.31E-03	1.82E-02
10	CD-EA-174	4.90	282	6170.375766	2	41626	2.52E+09	1.45E+11	1E-12	2.52E-03	1.45E-01
11	CD-EA-190-C	1.19	1.85	2518.660372	2	41626	2.50E+08	3.88E+08	1E-12	2.50E-04	3.88E-04
12	CD-EA-175-A	0.968	9.18	2006.848584	2	41626	1.62E+08	1.53E+09	1E-12	1.62E-04	1.53E-03
13	CD-EA-200-A	3.98	93.6	3777.681723	2	41626	1.25E+09	2.94E+10	1E-12	1.25E-03	2.94E-02
14	CD-EA-175	40.8	98.0	4177.158164	2	41626	1.42E+10	3.41E+10	1E-12	1.42E-02	3.41E-02
15	CD-EA-200-D	17.0	327	9799.551762	2	41626	1.38E+10	2.67E+11	1E-12	1.38E-02	2.67E-01

Notes:

1. Yellow-highlighted borings indicate that samples were not collected from the boring within this layer.
2. Yellow-highlighted combined radium values for each boring were calculated by averaging the values from Layers 7 and 9.
3. Yellow-highlighted combined thorium values for each boring were calculated by averaging the values from Layers 7 and 9.

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 9

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 9

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	2160	247	7132.882253	2	41626	1.28E+12	1.47E+11	1E-12	1.28E+00	1.47E-01
2	CD-EA-190-B	NA	NA	3279.477237	2	41626	-	-	1E-12	-	-
3	CD-EA-200-B	226	4222	5194.119636	2	41626	9.75E+10	1.83E+12	1E-12	9.75E-02	1.83E+00
4	CD-EA-208	1.73	1.93	3029.232845	2	41626	4.35E+08	4.86E+08	1E-12	4.35E-04	4.86E-04
5	CD-EA-199-B	3.01	3.58	2861.908938	2	41626	7.17E+08	8.53E+08	1E-12	7.17E-04	8.53E-04
6	CD-EA-199-C	1.82	1.81	5491.237826	2	41626	8.32E+08	8.27E+08	1E-12	8.32E-04	8.27E-04
7	CD-EA-200-C	2770	580	6442.023496	2	41626	1.49E+12	3.11E+11	1E-12	1.49E+00	3.11E-01
8	CD-EA-199	2.15	1.89	6905.572237	2	41626	1.24E+09	1.09E+09	1E-12	1.24E-03	1.09E-03
9	CD-EA-190-R	1.54	1.51	4988.713354	2	41626	6.39E+08	6.28E+08	1E-12	6.39E-04	6.28E-04
10	CD-EA-174	0.847	1.15	6170.375766	2	41626	4.35E+08	5.89E+08	1E-12	4.35E-04	5.89E-04
11	CD-EA-190-C	1.35	1.29	2518.660372	2	41626	2.83E+08	2.70E+08	1E-12	2.83E-04	2.70E-04
12	CD-EA-175-A	0.757	4.29	2006.848584	2	41626	1.26E+08	7.17E+08	1E-12	1.26E-04	7.17E-04
13	CD-EA-200-A	6.96	185	3777.681723	2	41626	2.19E+09	5.82E+10	1E-12	2.19E-03	5.82E-02
14	CD-EA-175	142	830	4177.158164	2	41626	4.94E+10	2.88E+11	1E-12	4.94E-02	2.88E-01
15	CD-EA-200-D	NA	NA	9799.551762	2	41626	-	-	1E-12	-	-

Notes:

1. NA indicates samples were not collected from the boring within this layer.
2. "-" indicates activity values could not be calculated.

Attachment 6 – Total Activity Estimates of Combined Thorium and Combined Radium

Total Activity Estimates for Layer 10

Attachment 6 - Total Activity Estimates of Combined Thorium and Combined Radium
Estimates for Layer 10

Polygon Number	BORINGS IN LAYER	R_i, Average Combined Radium (pCi/g)	T_i, Average Combined Thorium (pCi/g)	A_i, Shape Area (ft^2)	x_i, Layer Thickness (ft)	ρ_B, Soil Bulk Density (g/ft^3)	Combined Radium ($A_i*x_i*R_i*\rho_B$) (pCi)	Combined Thorium ($A_i*x_i*T_i*\rho_B$) (pCi)	pCi to Ci Conversion (Ci/pCi)	Combined Radium (Ci)	Combined Thorium (Ci)
1	CD-EA-200	2405	1843	7132.882253	2	41626	1.43E+12	1.09E+12	1E-12	1.43E+00	1.09E+00
2	CD-EA-190-B	NA	NA	3279.477237	2	41626	-	-	1E-12	-	-
3	CD-EA-200-B	NA	NA	5194.119636	2	41626	-	-	1E-12	-	-
4	CD-EA-208	1.71	1.97	3029.232845	2	41626	4.31E+08	4.97E+08	1E-12	4.31E-04	4.97E-04
5	CD-EA-199-B	3.01	3.58	2861.908938	2	41626	7.17E+08	8.53E+08	1E-12	7.17E-04	8.53E-04
6	CD-EA-199-C	NA	NA	5491.237826	2	41626	-	-	1E-12	-	-
7	CD-EA-200-C	2824	962	6442.023496	2	41626	1.51E+12	5.16E+11	1E-12	1.51E+00	5.16E-01
8	CD-EA-199	2.15	1.89	6905.572237	2	41626	1.24E+09	1.09E+09	1E-12	1.24E-03	1.09E-03
9	CD-EA-190-R	1.74	1.64	4988.713354	2	41626	7.21E+08	6.79E+08	1E-12	7.21E-04	6.79E-04
10	CD-EA-174	0.847	1.15	6170.375766	2	41626	4.35E+08	5.89E+08	1E-12	4.35E-04	5.89E-04
11	CD-EA-190-C	1.35	1.29	2518.660372	2	41626	2.83E+08	2.70E+08	1E-12	2.83E-04	2.70E-04
12	CD-EA-175-A	0.655	2.24	2006.848584	2	41626	1.09E+08	3.74E+08	1E-12	1.09E-04	3.74E-04
13	CD-EA-200-A	6.96	185	3777.681723	2	41626	2.19E+09	5.82E+10	1E-12	2.19E-03	5.82E-02
14	CD-EA-175	80.9	195	4177.158164	2	41626	2.81E+10	6.80E+10	1E-12	2.81E-02	6.80E-02
15	CD-EA-200-D	NA	NA	9799.551762	2	41626	-	-	1E-12	-	-

Notes:

1. NA indicates samples were not collected from the boring within this layer.
2. "-" indicates activity values could not be calculated.

APPENDIX E – BULK DENSITY ESTIMATE

APPENDIX E – BULK DENSITY ESTIMATE
WEST LAKE LANDFILL SUPERFUND SITE OPERABLE UNIT 1

Prepared For:

The United States Environmental Protection Agency Region VII

Prepared on Behalf of:

The West Lake Landfill OU-1 Respondents

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JULY 2023

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LIST OF ACRONYMS

CDL	Closed Demolition Landfill
cm^3	cubic centimeter
DI	Design Investigation
DIER	Design Investigation Evaluation Report
ft	foot/feet
g	gram(s)
ISL	Inactive Sanitary Landfill
NCC	non-combustible cover
MSW	municipal solid waste
OU	Operable Unit
pCi	picocurie(s)
pcf	per cubic foot
R^2	coefficient of determination
Site	West Lake Landfill Superfund Site
USEPA	United States Environmental Protection Agency

APPENDIX E BULK DENSITY ESTIMATE

This appendix evaluates the dry bulk density of waste materials below the Design Investigation (DI) datum[1] (as defined in the *Design Investigation Evaluation Report* [DIER] [Parsons et al. 2023]). This evaluation demonstrates that the estimated dry bulk density of waste at the West Lake Landfill Superfund Site (Site), is 1.47 grams per cubic centimeter (g/cm^3) (91.9 pounds per cubic foot [pcf]). The waste is considered to include decomposed municipal solid waste (MSW) intermingled with soils, radiologically-impacted materials (RIM), and construction/demolition debris. These materials may occur in discrete layers or randomly intermingled. This analysis does not differentiate between these potential conditions, but instead looks at the typical conditions of the overall mass of material for consideration in evaluating the bulk parameters for large quantities of materials for disposal and engineering evaluations.

The average dry bulk density of waste material below the DI datum was estimated based on data collected during the DI and presented in Table 5-10b of the DIER (Parsons et al. 2023). These data are summarized in Table 1. The moisture content values used to determine the dry bulk densities are provided in Table 2. The dry bulk densities are assumed to represent waste material below the DI datum within the areal extent of the potential final cover areas within Area 1, Area 2, Closed Demolition Landfill (CDL), and Inactive Sanitary Landfill (ISL).

Core intervals were weighed as part of the bulk density estimation process. As shown in Table 5-10b of the DIER (Parsons et al. 2023), cores between the ground surface and 4 feet (ft) below DI datum included NCC[2] or pad[3]. Since these materials are not representative of waste materials, these samples were excluded from this analysis.

The average dry bulk density of waste material was calculated in Microsoft Excel within Table 1, as follows:

1. Calculate the sample volume using core length recovered and core diameter (i.e., 3.875 inches).
2. Calculate the field density by dividing the measured weight by the sample volume.
3. Calculate the dry bulk density with the following equation:

   Dry bulk density = field density/(1+(moisture content percent/100))

The moisture content values used to determine the dry bulk density were calculated as the average of moisture content values for samples within the same core interval. For example, for boring CD-EA-200-D, moisture content values of 48.3 percent (%) and 28.8% for samples CD-EA-200-D-12-16-N and CD-EA-200-D-15-15.5-N, respectively, were averaged. The result of 38.6% was used as the moisture content value for the CD-EA-200-D core interval of 12 to 16 ft below the DI datum.

The average dry bulk density of waste material was calculated to be 1.47 g/cm^3 (91.9 pcf), which is the arithmetic mean of 62 samples from 13 DI borings.

Figure 1 shows the locations of borings with sample data evaluated in this appendix and differentiates between borings with and without samples containing RIM greater than 52.9 picocuries per gram (>52.9 pCi/g). In addition, spatial correlations in the dry bulk density data were evaluated. Specifically, the maximum, minimum, and arithmetic mean (average) of dry bulk density values for each sample within a boring were calculated. The maximum, minimum, and arithmetic mean for samples within each boring are provided next to each boring in Figure 1 and summarized in Table 3.

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[1] The DI datum is discussed in the DIER (Parsons et al. 2023) and Appendix A of the Revised Excavation Plan.
[2] A non-combustible cover (NCC) limestone gravel layer is present over portions of Areas 1 and 2 (EMSI et al. 2021) above the DI datum.
[3] Pad includes gravel access paths and drilling pads constructed during the DI above the DI datum and discussed in the DIER (Parsons et al. 2023).

A statistical analysis of the dry bulk density sample population (as provided in Table 1) was performed to evaluate the uncertainty associated with the average dry bulk density value of 1.47 g/cm^3. Normality of the sample population was evaluated with a histogram, box and whisker plot, and probability distribution function plot, as shown in Figures 2, 3, and 4, respectively. As shown in these figures, the dry bulk density data appear normally distributed. In addition, the coefficient of variation test (USEPA 2000) and Studentized Range Test (USEPA 2000; 2006) were used to evaluate normality and applied as shown in Table 4. Based on the Studentized Range Test, the dry bulk density sample population is statistically not normally distributed.

The following sample sets from the population with dry bulk density data were also evaluated:

- Samples with RIM greater than >52.9 pCi/g;
- Samples with RIM >7.9 pCi/g; and
- Samples collected between 4 and 20 ft below the DI datum.

Descriptive statistics of the maximum, minimum, median, standard deviation, and average dry bulk density of waste material for the sample population and three sample sets are provided in Table 5. In addition, Table 5 provides results of the coefficient of variation and Studentized Range tests for the three sample sets. Based on the Studentized Range Test, the dry bulk density of the three sample sets is statistically normally distributed.

Additional correlations in the dry bulk density data were evaluated, as follows:

- The dry bulk density and combined thorium values of samples with RIM >52.9 pCi/g were plotted (see Figure 5); and
- The dry bulk density and combined radium values of samples with RIM >52.9 pCi/g were plotted (see Figure 6).

As shown in Figure 5, the coefficient of determination (R^2) values of linear and exponential regressions are 0.16. The low R^2 values suggest dry bulk density and combined thorium values are negligibly to weakly correlated. As shown in Figure 6, the R^2 values of linear and exponential regressions are 0.15; this suggests the dry bulk density and combined radium values are negligibly to weakly correlated.

Although the Studentized Range Test suggests the sample population is not normally distributed, the arithmetic mean dry bulk density of the sample population (i.e., 1.47 g/cm^3) is used to represent the dry bulk density of waste material at the site based on the following rationale:

- The Studentized Range Test suggests the three sample sets from the population are normally distributed.
- The average and median of the three sample sets are within 0.11 g/cm^3 of the average and median of the sample population.
- The dry bulk density data fall within two standard deviations of the population average with the exception of A2-PB-147 from 10 to 15 ft below DI datum (0.624 g/cm^3).
- The Conceptual Site Model (Parsons et al. 2023) suggests that RIM at the Site is commingled with MSW, which is generally less dense than mineral rock and soils, as discussed below.
- The arithmetic mean value is above the upper end of the range of MSW bulk unit weights (including water) summarized by the United States Environmental Protection Agency (1995). The upper end of the reported MSW bulk densities is typically 1.3 g/cm^3 based on data collected in various studies from around the world in the 1980s and 1990s. A couple of studies looked at MSW as old as 40 years, and those reported a wide range of values from 0.7 to 1.7 g/cm^3. It would be expected that 50-year-old MSW in a humid climate would be significantly decomposed with consolidation occurring over the decades, so that the densities would increase over time compared to measurements of “fresh” waste that most of the studies evaluated.

- Mineral soils typically have a dry density ranging from 1.3 g/cm^3 to 2.3 g/cm^3 (NAVFAC 1986). The waste at the West Lake Landfill has been observed to typically have a relatively high organic content despite decomposition over the decades. The organic materials should have a specific gravity of close to 1 making it unlikely that the bulk density of the decomposed waste would be substantially higher than the low end of mineral soil densities.

REFERENCES

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TABLES

TABLE 1 SUMMARY OF BULK DENSITY VALUES

Boring ID	Depth Below DI Datum (ft)		Weight (lb)	Length Recovered[1] (in)	Volume[2, 3] (ft^3)	Field Density[4, 5] (lb/ft^3)	Average Moisture Content[4, 6] (%)	Dry Bulk "Field" Density[4, 7] (lb/ft^3)	Dry Bulk "Field" Density[8] (g/cm^3)	Description	Combined Radium (pCi/g)	Combined Thorium (pCi/g)
	Start	End										
A1-SB-143	4	8	29.7	36	0.25	121	21.8	99.2	1.59	Waste, silt, sand, some clay	2.72	21.0
	8	12	22	38	0.26	85	32.4	64.1	1.03	Waste, silt, little sand, trace gravel	1.99	2.23
	12	16	8.5	9	0.06	NA	NA	NA	NA	Only slough recovered	NA	NA
	16	20	30.4	36	0.25	124	25.7	98.4	1.58	Waste, silt, sand, little clay	2.27	3.27
A2-PB-147	5	10	46	54	0.37	125	21.1	103.1	1.65	Waste, silt, little sand, little clay	1.29	2.12
	10	15	14.1	45	0.31	46	17.8	39.0	0.62	Waste, silt, little sand, little clay	1.86	1.83
	15	20	19.1	37	0.25	76	22.3	61.9	0.99	Waste, some silt, little clay, trace sand	8.01	230
	20	25	48.2	60	0.41	118	13.8	103.4	1.66	Waste, gravel, sand, clay, some silt	6.06	144
	25	30	31	36	0.25	126	20.2	105.0	1.68	Waste, clay, some gravel, some silt, little sand	1.94	7.87
	30	35	56.8	60	0.41	139	11.7	124.2	1.99	Gravel, silt, waste, some clay, little sand	2.53	2.62 J
	35	40	36.3	40	0.27	133	18.4	112.3	1.80	Clay, sand, silt, waste	5.75	5.04
	40	45	44.3	60	0.41	108	21.5	89.0	1.43	Waste, silt, some gravel, some sand	1.35	1.63
	45	50	44.7	48	0.33	136	14.3	119.4	1.91	Sand, silt, some clay, trace refuse	1.81	1.99
	50	55	56.6	60	0.41	138	17.8	117.3	1.88	Sand, silt, gravel, little clay	1.86	1.47
	55	60	67.4	60	0.41	165	27.7	128.9	2.06	Silt, sand, clay	1.93	1.54 J
A2-SB-015	4	8	59.7	60	0.41	146	13.5	128.4	2.06	Gravel, silt, waste, some sand, little clay	1240	12600
	8	12	20.7	24	0.16	126	28.2	98.6	1.58	Waste	1.16	9.01
	12	16	27.9	33	0.23	124	11.8	110.8	1.77	Waste, silt, some clay, little gravel, little sand	1.17	2.02
A2-SB-020	4	8	28.8	36	0.25	117	28.9	90.9	1.46	Waste, silt, sand, some clay, little gravel	96	2570
	8	12	20.9	34	0.23	90	25.8	71.6	1.15	Waste, little silt, trace sand, trace gravel	0.97	1.01
	12	16	16	26	0.18	90	26.7	71.2	1.14	Waste, gravel, some sand, some silt, trace clay	1.65	2.01
	16	20	34.1	48	0.33	104	30.1	80.0	1.28	Waste, silt, sand, little gravel, some clay	1.39	1.33
A2-SB-034	4	8	58.1	55	0.38	155	19.0	130.1	2.08	Silt, clay, waste, sand, some gravel	171	7880
	8	12	27.7	36	0.25	113	27.3	88.6	1.42	Waste, silt, some sand, little gravel	1.93	2.72
	12	16	15.2	30	0.20	74	45.8	50.9	0.82	Waste, trace sand	0.57	0.494 U
	16	20	45.4	64	0.44	104	36.4	76.2	1.22	Waste, silt, clay, some gravel, little sand	0.69	0.462 U
A2-SB-039	4	8	20.9	26	0.18	118	37.5	85.7	1.37	Waste, silt, some sand, trace gravel	1.13	1.33
	8	12	15.8	19	0.13	122	22.6	99.4	1.59	Waste, silt, little sand, little gravel	0.85	3.08
	12	16	20.7	24	0.16	126	35.9	93.0	1.49	Waste, silt, sand, little gravel	0.83	1.19
	16	20	29	40	0.27	106	26.9	83.7	1.34	Waste, little silt, trace gravel	2.85	35.9

TABLE 1 SUMMARY OF BULK DENSITY VALUES

Boring ID	Depth Below Dl Datum (ft)		Weight (lb)	Length Recovered[1] (in)	Volume[2, 3] (ft^3)	Field Density[4, 5] (lb/ft^3)	Average Moisture Content[4, 6] (%)	Dry Bulk "Field" Density[4, 7] (lb/ft^3)	Dry Bulk "Field" Density[8] (g/cm^3)	Description	Combined Radium (pCi/g)	Combined Thorium (pCi/g)
	Start	End										
A2-SB-049	4	8	54.8	60	0.41	134	13.3	118.1	1.89	Silt, waste, some sand, some clay	2.53	8.54 J
	8	12	30.8	41	0.28	110	19.7	92.0	1.47	Waste, silt, some sand, trace clay	1.68	2.69
	12	16	35.4	56	0.38	93	34.1	69.1	1.11	Waste	1.38	10.6
	16	20	32.8	48	0.33	100	30.9	76.5	1.23	Waste, silt, sand, some clay	0.15	0.376 U
A1-SB-052	4	8	50.4	52	0.35	142	9.6	129.6	2.08	Silt, gravel, some sand, little clay	24.1	690 J
	8	12	23.8	34	0.23	103	62.1	63.3	1.01	Waste, gravel, some silt, little sand, trace clay	0.42	2.39
	12	16	23.8	34	0.23	103	27.9	80.2	1.28	Waste, gravel, some silt, little sand, trace clay	1.19	1.65
	16	20	29.9	48	0.33	91	23.4	74.0	1.18	Waste, sand, little clay, trace silt	1.14	0.95
A2-SB-138	4	8	16.7	30	0.20	82	14.5	71.2	1.14	Waste, silt, some clay, little sand	486	10300
	8	12	24	32	0.22	110	23.6	88.9	1.42	Waste, sand, silt, some clay, little gravel	2.34	3.98
	12	16	26.2	38	0.26	101	27.8	79.0	1.27	Waste, clay, little silt, trace sand	1.53	6.42
	16	20	6.8	18	0.12	55	31.1	42.2	0.68	Waste	0.64	6.22
A2-TH-112	4	8	16.5	22	0.15	110	49.7	73.4	1.18	Silt, waste, gravel, some sand, some clay	0.38	6.33
	8	12	32.3	43	0.29	110	23.7	89.0	1.43	Sand, waste, silt, some gravel, trace clay	1.64	1.76
	12	16	27	38	0.26	104	20.4	86.5	1.39	Silt, waste, little clay, little sand	2.31	2.60
	16	20	19.6	26	0.18	110	36.5	80.9	1.30	Waste, sand, little silt	1.10	1.08
ISL-EA-179-D	5	10	27.1	47	0.32	84	16.8	72.3	1.16	One foot of silty clay over wood/waste	1.70	4.69
	10	15	22.2	35	0.24	93	58.7	58.6	0.94	Silt/waste	2.65	31.4
	15	20	34.4	46	0.31	110	59.9	68.5	1.10	One foot of silt/waste over sandy silt	0.169 U	0.799
	20	25	26.8	39	0.27	101	34.7	74.8	1.20	Silt/waste	3.06	69.4
	25	30	19.2	30	0.20	94	55.9	60.2	0.96	Silt/waste	2.01	3.01 J
	30	35	47.6	55	0.38	127	26.9	99.9	1.60	Silty clay	2.54	3.10
	35	40	57.5	60	0.41	140	6.5	131.9	2.11	Alluvial sand	0.855	1.07
CD-EA-200-D	4	8	30.2	32	0.22	138	17.6	117.6	1.88	Silty clay with rock	2.02	2.34
	8	12	30.1	48	0.33	92	40.2	65.5	1.05	Silt and waste	1.34	0.97
	12	16	22	44	0.30	73	38.6	52.9	0.85	Silt and waste	2.47	344
	16	20	7.7	8	0.05	141	NA	NA	NA	Silt	NA	NA
CD-EA-202-B	5	10	43.8	45	0.31	143	17.5	121.4	1.94	Upper 3/4 is gray-brown, stiff. Lower 1/4 is black, loose	2.07	2.31
	10	15	33.9	39	0.27	127	35.8	93.8	1.50	Dark gray, soft, some visible debris; brown sand seam at base	0.957	1.50
	15	20	38.7	32	0.22	177	33.1	133.1	2.13	Dark gray, wet (circled), in top 1/2; Lower 1/2 is soft, wet; top 1/2 - loose, trace debris	1.41	2.09

TABLE 1 SUMMARY OF BULK DENSITY VALUES

Boring ID	Depth Below DI Datum (ft)		Weight (lb)	Length Recovered[1] (in)	Volume[2, 3] (ft^3)	Field Density[4, 5] (lb/ft^3)	Average Moisture Content[4, 6] (%)	Dry Bulk "Field" Density[4, 7] (lb/ft^3)	Dry Bulk "Field" Density[8] (g/cm^3)	Description	Combined Radium (pCi/g)	Combined Thorium (pCi/g)
	Start	End										
CD-EA-202-B	20	25	22	21	0.14	154	27.9	120.0	1.92	Dark gray, wet (circled), soft, visible debris in lower 1/2, saturated	1.66	1.71
	25	30	57	52	0.35	161	22.4	131.2	2.10	Medium gray, upper 3/4 - sand, saturated; lower 1/4 sl. Stiff, visible debris	1.08	1.18
	30	35	47.8	46	0.31	152	23.2	123.6	1.98	Dark gray, mostly s. stiff to soft; firm seam near base, visible debris near base; top 1/4 wet	1.38	1.81
	35	40	57.8	55	0.38	154	16.6	132.1	2.12	Medium gray, alt. layer of stiff and loose, visible debris in mid section, wet. Alluvium at 39 feet, loose	1.04	1.32
	40	45	not measured	not measured	NA	NA	21.1	NA	NA	Alluvium medium gray, loose, sand, wet	0.727	1.03 J
							Average:	**91.9**	**1.47**			
							Standard Dev.:	**25.2**	**0.403**			
							Median:	**89.0**	**1.43**			
							Maximum	**133**	**2.13**			
							Minimum	**39.0**	**0.624**			

Notes:

1. Length Recovered values greater than the depth interval are due to sloughing.
2. The inner diameter of the sonic boring is 3.875 inches. Thus, the sample core diameter was 3.875 inches.
3. The volume of the sample was calculated as length*pi*(diameter/2)^2. The conversion from inches to feet for both the diameter and length recovered is included in the volume calculation in this column.
4. NA indicates that either a field density calculation is not applicable due to material recovery or a moisture content result was not available for that sample.
5. Field density was calculated as weight/volume.
6. This value was calculated by averaging the moisture content for each sample between the sample start and end depth intervals. See Table 2 for details.
7. Dry bulk field density was calculated as field density/(1+moisture content/100)).
8. Dry bulk field density (lb/ft^3) was converted to dry density (g/cm^3) by dividing by 62.428.

TABLE 2 AVERAGE MOISTURE CONTENT VALUES FOR BULK DENSITY CALCULATIONS

Boring ID	Depth Below DI Datum (ft)		Average Moisture Content[1] (%)	Available Moisture Contents within Depth Range[2]					
	Start	End		Moisture Content (%)	Depth (ft)	Moisture Content (%)	Depth (ft)	Moisture Content (%)	Depth (ft)
A1-SB-143	4	8	21.8	21.8	4.4-4.9	-	-	-	-
	8	12	32.4	32.4	8.4-8.9	-	-	-	-
	12	16	not sampled	NA	NA	-	-	-	-
	16	20	25.7	25.7	16.5-17	-	-	-	-
A2-PB-147	5	10	21.1	21.1	3-8	-	-	-	-
	10	15	17.8	17.8	8-13	-	-	-	-
	15	20	22.3	31.1	13-18	13.4	19-19.5	-	-
	20	25	13.8	13.8	18-23	-	-	-	-
	25	30	20.2	20.2	23-28	-	-	-	-
	30	35	11.7	12.3	28-33	-	-	-	-
	35	40	18.4	18.4	33-38	-	-	-	-
	40	45	21.5	21.5	38-43	-	-	-	-
	45	50	14.3	14.3	43-48	-	-	-	-
	50	55	17.8	17.8	48-53	-	-	-	-
	55	60	27.7	22.3	53-58	33.1	53-58	-	-
A2-SB-015	4	8	13.5	7.99	4.5-5	14.9	5.5-6	17.7	6.5-7
	8	12	28.2	28.2	9-9.5	-	-	-	-
	12	16	11.8	11.8	12.8-13.3	-	-	-	-
A2-SB-020	4	8	28.9	14	4.4-4.9	18.5	5-5.5	54.2	5.7-6.2
	8	12	25.8	25.8	9.4-9.9	-	-	-	-
	12	16	26.7	26.7	13-13.5	-	-	-	-
	16	20	30.1	30.1	18.8-19.3	-	-	-	-
A2-SB-034	4	8	19.0	19	5-5.5	-	-	-	-
	8	12	27.3	27.3	10-10.5	-	-	-	-
	12	16	45.8	45.8	13.9-14.4	-	-	-	-
	16	20	36.4	36.4	19.5-20	-	-	-	-
A2-SB-039	4	8	37.5	37.5	4.9-5.4	-	-	-	-
	8	12	22.6	22.6	8.8-9.3	-	-	-	-
	12	16	35.9	35.9	13-13.5	-	-	-	-
	16	20	26.9	26.9	17.7-18.2	-	-	-	-
A2-SB-049	4	8	13.3	13.3	4.8-5.3	-	-	-	-
	8	12	19.7	19.7	8.5-9	-	-	-	-
	12	16	34.1	34.1	12.9-13.4	-	-	-	-
	16	20	30.9	30.9	16.6-17.1	-	-	-	-

TABLE 2 AVERAGE MOISTURE CONTENT VALUES FOR BULK DENSITY CALCULATIONS

Boring ID	Depth Below DI Datum (ft)		Average Moisture Content[1] (%)	Available Moisture Contents within Depth Range[2]					
	Start	End		Moisture Content (%)	Depth (ft)	Moisture Content (%)	Depth (ft)	Moisture Content (%)	Depth (ft)
A1-SB-052	4	8	9.6	16.9	3.5-4	-	-	-	-
	8	12	62.1	62.1	10-10.5	-	-	-	-
	12	16	27.9	27.9	14.2-14.7	-	-	-	-
	16	20	23.4	23.4	19.5-20	-	-	-	-
A2-SB-138	4	8	14.5	27.8	4-4.5	-	-	-	-
	8	12	23.6	23.6	9.9-10.4	-	-	-	-
	12	16	27.8	27.8	14.2-14.7	-	-	-	-
	16	20	31.1	31.1	17.1-17.6	-	-	-	-
A2-TH-112	4	8	49.7	49.7	4.4-4.9	-	-	-	-
	8	12	23.7	23.7	9.5-10	-	-	-	-
	12	16	20.4	20.4	13.5-14	-	-	-	-
	16	20	36.5	35.6	17-17.5	-	-	-	-
ISL-EA-179-D	5	10	16.8	16.8	5-10	-	-	-	-
	10	15	58.7	58.7	10-15	-	-	-	-
	15	20	59.9	59.9	15-20	-	-	-	-
	20	25	34.7	34.7	20-25	-	-	-	-
	25	30	55.9	55.9	25-30	-	-	-	-
	30	35	26.9	26.9	30-35	-	-	-	-
	35	40	6.08	6.08	35-40	-	-	-	-
CD-EA-200-D	4	8	17.6	17.6	4-8	-	-	-	-
	8	12	40.2	40.2	8-12	-	-	-	-
	12	16	38.6	48.3	12-16	28.8	15-15.5	-	-
	16	20	not sampled	-	-	-	-	-	-
CD-EA-202-B	5	10	17.5	17.5	5-10	-	-	-	-
	10	15	35.8	35.8	10-15	-	-	-	-
	15	20	33.1	33.1	15.5-16	-	-	-	-
	20	25	27.9	27.9	20.5-21	-	-	-	-
	25	30	22.4	22.4	25-30	-	-	-	-
	30	35	22.4	22.4	30-35	-	-	-	-
	35	40	16.6	16.6	35-40	-	-	-	-
	40	45	21.1	21.1	40-45	-	-	-	-

Notes:

1. This value was calculated by averaging the moisture content for each sample between the sample start and end depth intervals. For example, the average moisture content of A2-PB-147 between 15 and 20 ft below DI datum was calculated by averaging 31.1 and 13.4 which are the moisture contents for samples A2-PB-147-13-18-N and A2-PB-147-19-19.5-N, respectively.
2. '-' indicates additional moisture content results are not available for the depth range.

TABLE 3 EVALUATION OF DRY BULK DENSITY SAMPLES PER BORING

Boring	Number of Samples Evaluated in Boring	Dry Bulk Density (g/cm^3)			
		Maximum	Minimum	Median	Arithmetic Mean (Average)
A1-SB-143	3	1.59	1.03	1.58	1.40
A2-PB-147	11	2.06	0.62	1.68	1.61
A2-SB-015	3	2.06	1.58	1.77	1.80
A2-SB-020	4	1.46	1.14	1.21	1.26
A2-SB-034	4	2.08	0.82	1.32	1.38
A2-SB-039	4	1.59	1.34	1.43	1.45
A2-SB-049	4	1.89	1.11	1.35	1.42
A1-SB-052	4	2.08	1.01	1.23	1.39
A2-SB-138	4	1.42	0.68	1.20	1.13
A2-TH-112	4	1.43	1.18	1.34	1.32
ISL-EA-179-D	7	2.11	0.94	1.16	1.30
CD-EA-200-D	3	1.88	0.85	1.05	1.26
CD-EA-202-B	7	2.13	1.50	1.98	1.96

TABLE 4 EVALUATION OF DRY BULK DENSITY POPULATION USING COEFFICIENT OF VARIATION AND STUDENTIZED RANGE TESTS

Coefficient of Variation Test[1]	
Parameter	**Value**
Average (X) (g/cubic centimeters)	1.47
Standard Deviation (s) (g/cubic centimeters)	0.403
Coefficient of Variation	**0.274**
Evaluation: Test is inconclusive because Coefficient of Variation is not greater than 1.	

Studentized Range Test[3]	
Parameter	**Value**
Sample Maximum (g/cubic centimeters)	2.13
Sample Minimum (g/cubic centimeters)	0.62
Sample Range[4] (w)/Standard Deviation (s)	**3.74**
Evaluation[5,6]: Because *w/s* falls outside the critical values of 3.75 and 5.94, the assumption of normality is rejected.	

Notes:

1. The coefficient of variation (CV) is calculated as follows: CV = standard deviation/average.
2. X - average; g - grams; s - standard deviation; w - sample range
3. According to the Studentized Range Test, if w/s falls outside the two critical values, then the data do not follow a normal curve.
4. The sample range (w) is the sample maximum minus the sample minimum.
5. This evaluation assumes the level of significance, α, for the Studentized Range Test is 0.01.
6. This evaluation assumes critical values as follows: *a* is 3.75 and *b* is 5.94.

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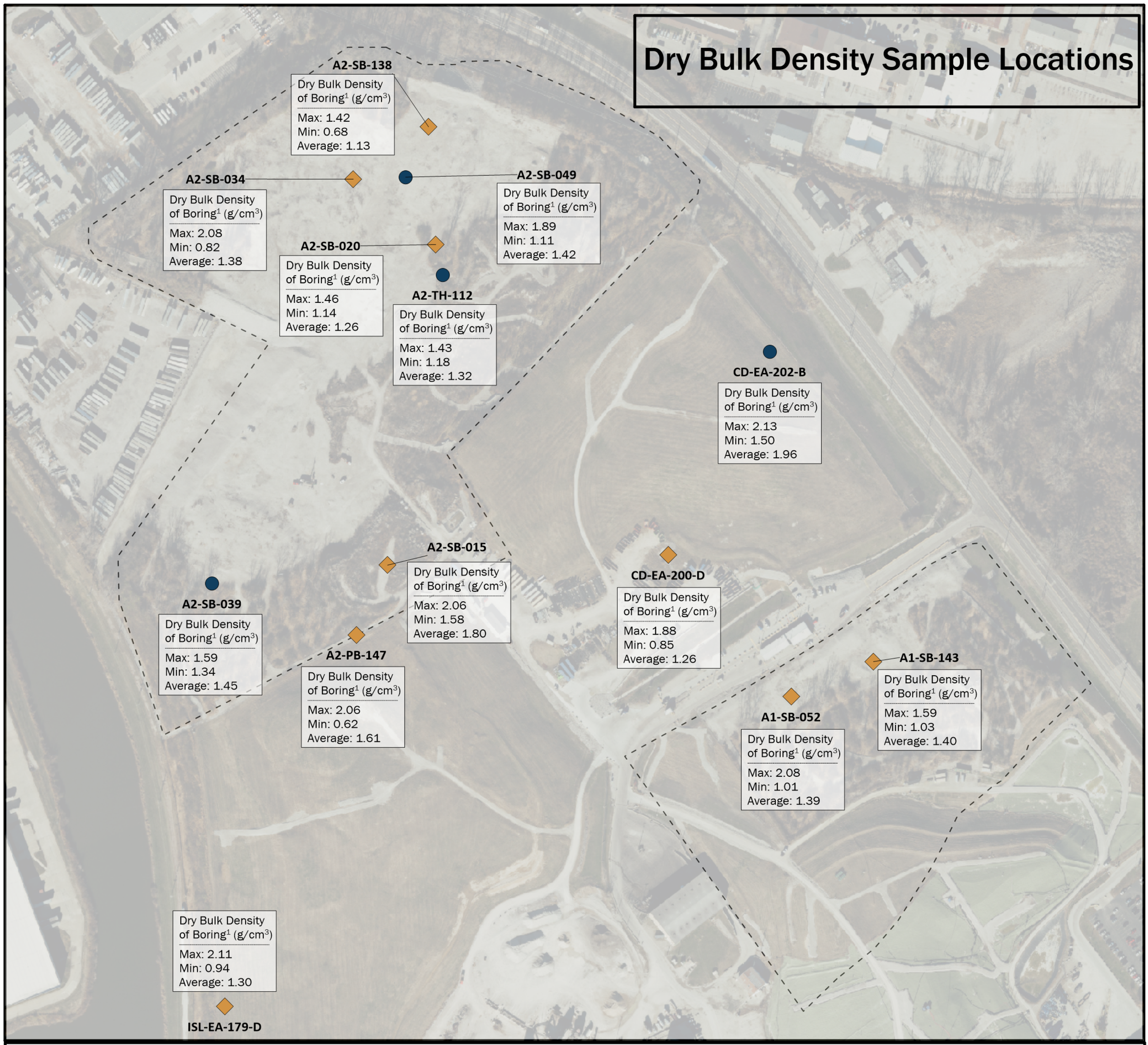
TABLE 5 DESCRIPTIVE STATISTICS

Set of Dry Bulk Density Samples	Number of Samples Evaluated in Sample Set (n)	Dry Bulk Density (g/cm^3)					Coefficient of Variation	Studentized Range Test Result	Critical Value[1] *a*	Critical Value[1] *b*	Assumption of Normality Based on Studentized Range Test Result
		Maximum	Minimum	Median	Arithmetic Mean (Average)	Standard Deviation					
Samples with RIM >52.9 pCi/g	9	2.084	0.847	1.46	1.50	0.489	0.326	2.53	2.44	3.72	Not rejected
Samples with RIM >7.9 pCi/g	15	2.084	0.847	1.46	1.46	0.427	0.292	2.89	2.80	4.44	Not rejected
Samples Collected Between 4 and 20 Feet Below DI Datum	46	2.133	0.624	1.32	1.37	0.371	0.272	4.06	3.55	5.67	Not rejected
Entire Population (see Table 1)	62	2.133	0.624	1.43	1.47	0.403	0.274	3.74	3.75	5.94	Rejected

Note: This evaluation assumes the level of significance, α, for the Studentized Range Test is 0.01. Critical values vary based on the the sample size (n) and level of significance evaluated.

FIGURES

Dry Bulk Density Sample Locations



Legend

- Boring Does Not Contain Sample with RIM >52.9 pCi/g
- Boring Contains Sample with RIM >52.9 pCi/g
- OU-1 Area 1 & 2 Boundaries

N

0 250 500 750 1000 Feet

Note:

1. The maximum, minimum, and average dry bulk density values were calculated from dry bulk density data provided in Table 1 of Appendix E. Samples collected below 4 feet below the Design Investigation datum were included in the evaluation.

PROJECT

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ON BEHALF OF

WEST LAKE LANDFILL OU-1 RESPONDENTS

TITLE

SPATIAL DISTRIBUTION OF DRY BULK DENSITY SAMPLES

July 31, 2023
Drawn by: MC | Approved by: LB

FIGURE 1

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FIGURE 2 HISTOGRAM OF DRY BULK DENSITY SAMPLE POPULATION

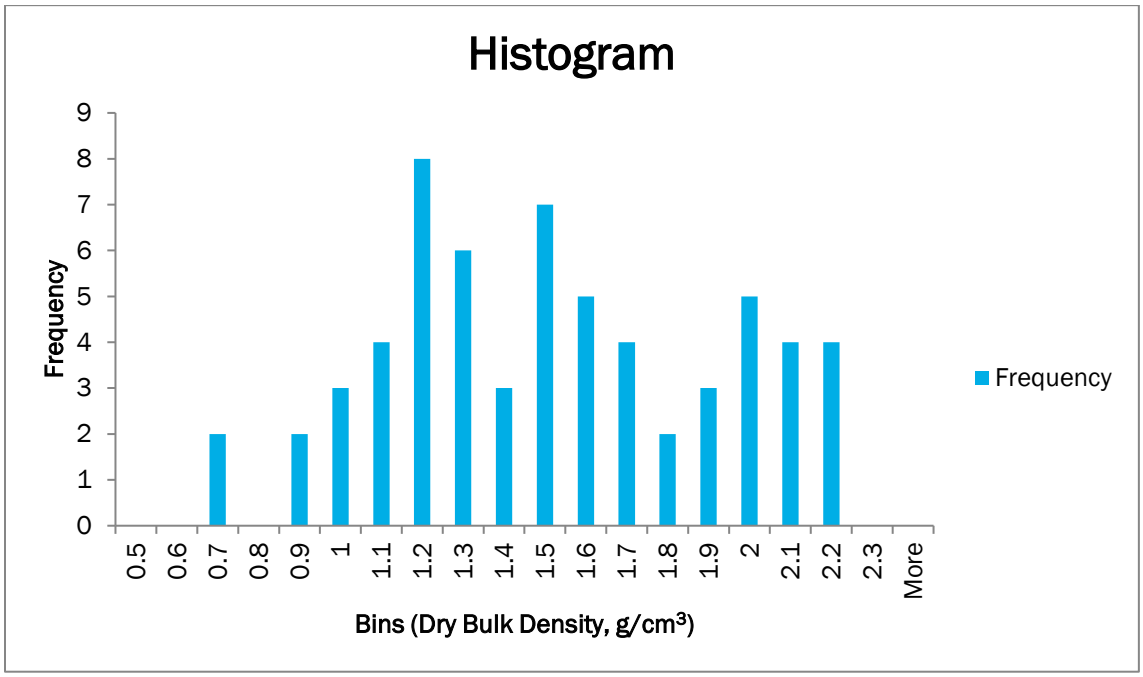


FIGURE 3 BOX AND WHISKER PLOT OF DRY BULK DENSITY SAMPLE POPULATION

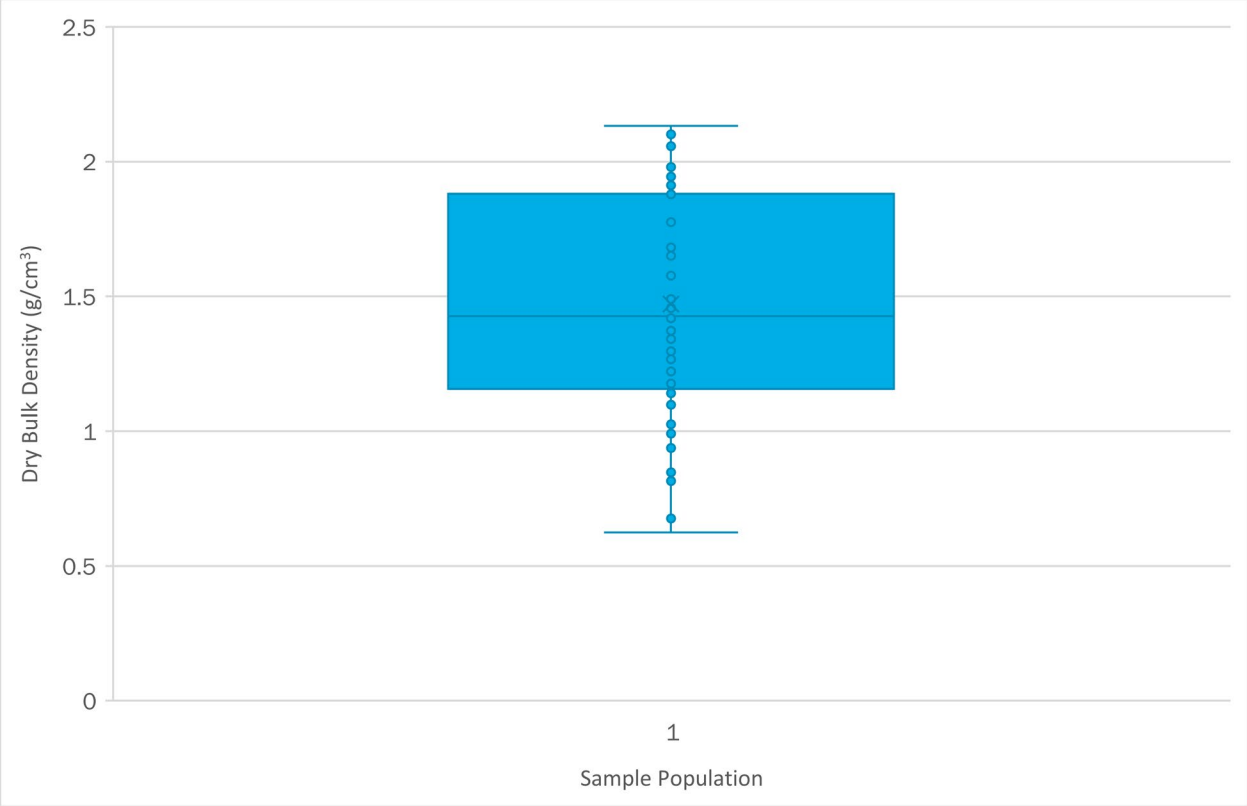


FIGURE 4 PROBABILITY DISTRIBUTION FUNCTION OF DRY BULK DENSITY SAMPLE POPULATION

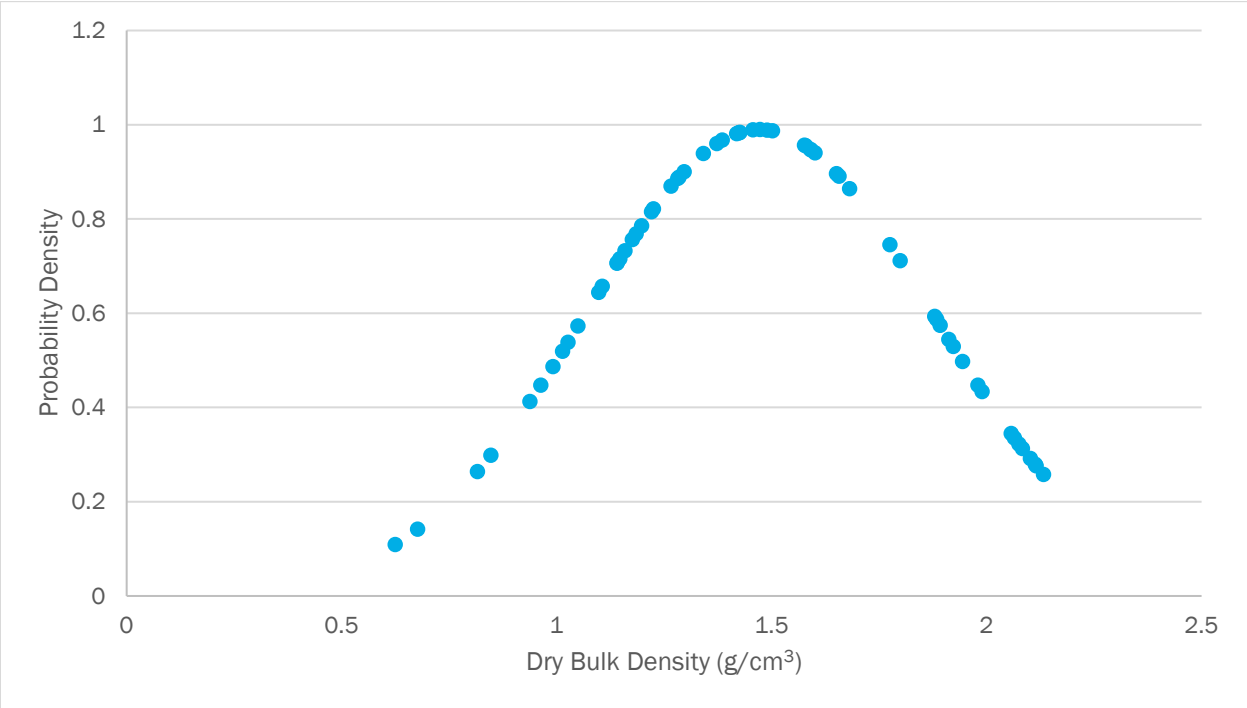


FIGURE 5 CORRELATION OF DRY BULK DENSITY AND COMBINED THORIUM IN SAMPLES WITH RIM >52.9 PCI/G

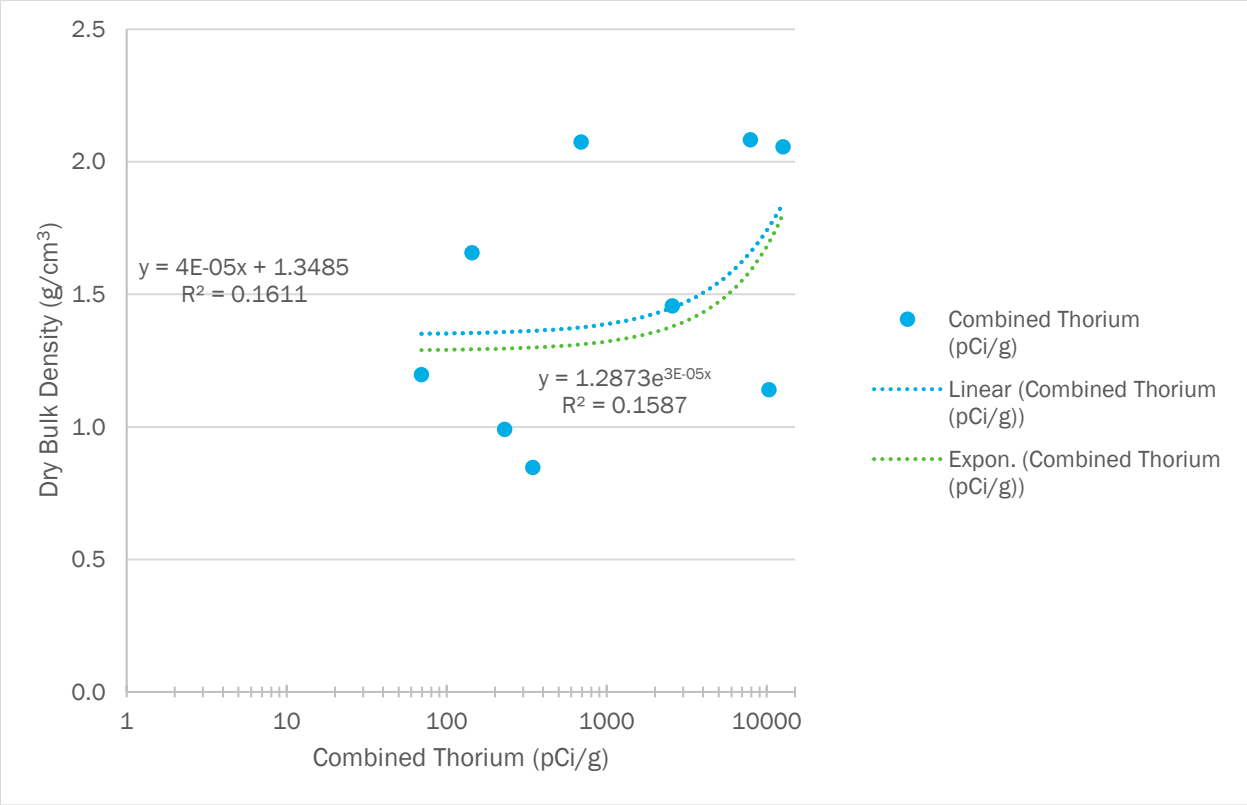
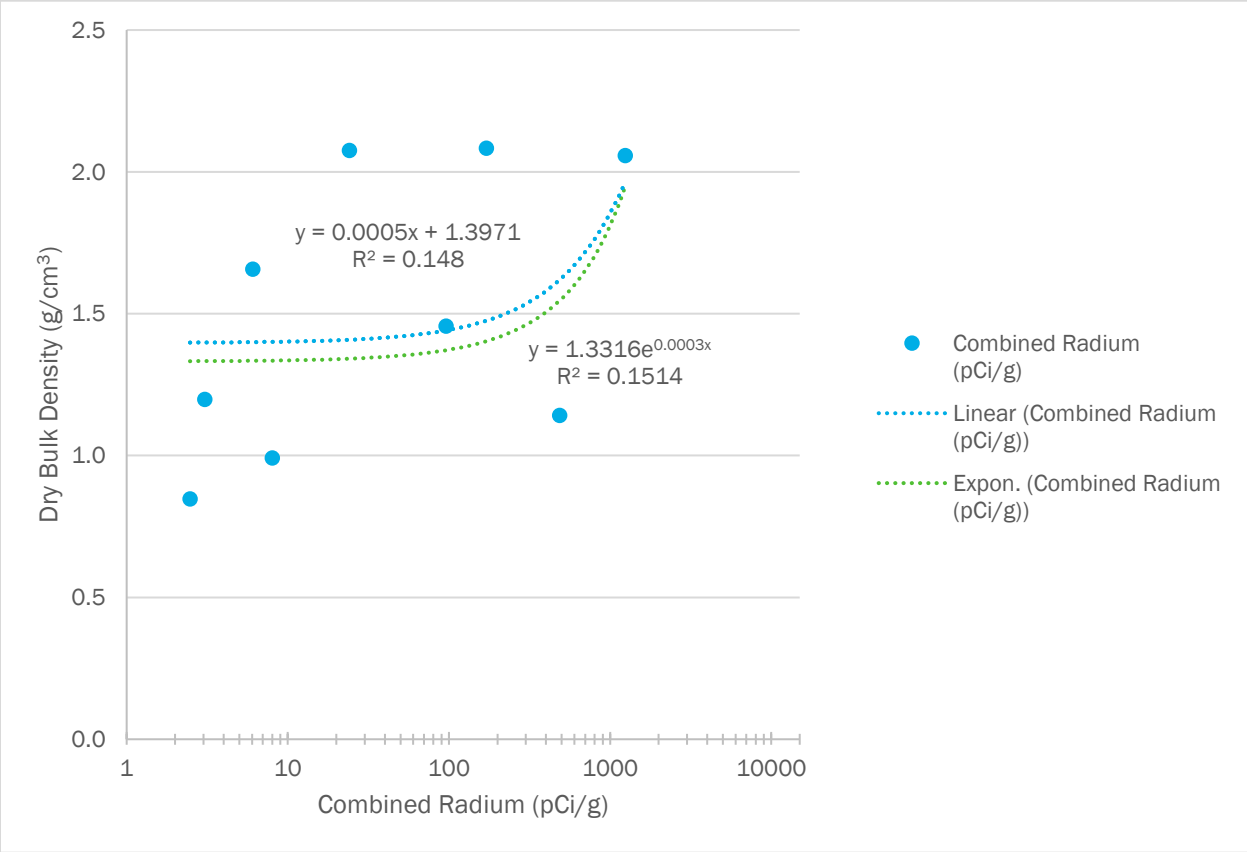


FIGURE 6 CORRELATION OF DRY BULK DENSITY AND COMBINED RADIUM IN SAMPLES WITH RIM >52.9 PCI/G



APPENDIX F – OTHER EXCAVATION AREAS

APPENDIX F – OTHER EXCAVATION AREAS
WEST LAKE LANDFILL SUPERFUND SITE OPERABLE UNIT 1

Prepared For:

The United States Environmental Protection Agency Region VII

Prepared on Behalf of:

The West Lake Landfill OU-1 Respondents

Prepared By:

PARSONS

301 Plainfield Road, Suite 350
Syracuse, New York 13212

In Association With:

Engineering for a Better World
FEEZOR ENGINEERING, INC.

3377 Hollenberg Drive
Bridgeton, Missouri 63044

And

AMERIPHYSICS

9111 Cross Park Drive, Suite D200
Knoxville, TN 37923

JULY 2023

TABLES

TABLE 1 OTHER EXCAVATION AREAS ESTIMATED VOLUMES

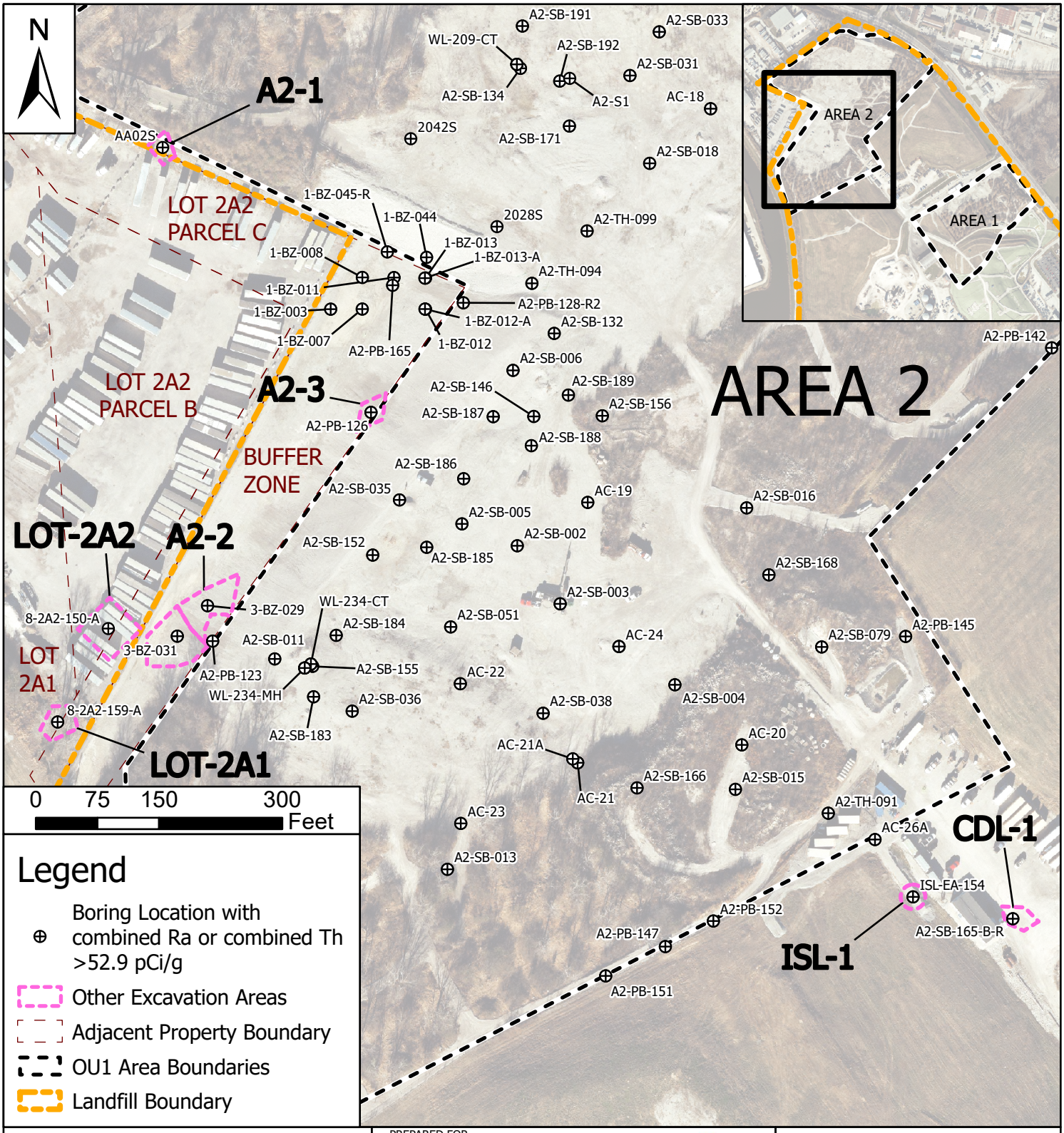
Other Area ID	Location Description	Boring with RIM >52.9 pCi/g	Delineating Borings	Estimated Excavation Area (sq ft)	Overburden Thickness (Note 1) (ft)	Overburden Volume (Note 1) (cy)	RIM >52.9 pCi/g Thickness (ft)	RIM >52.9 pCi/g Volume (cy)	Total Estimated Excavation Volume (cy)
A2-1	Northern boundary of Lot 2A2	AA02S (Note 2)	A2-PB-130, 2-2A2-062 (Note 3)	740	0	0	1	30	30
A2-2	Buffer Zone	3-BZ-031	A2-PB-123-A, 3-BZ-032, 3-BZ-036, 3-BZ-035, 3-BZ-034, A2-PB-123-B, and modeled extent of RIM>52.9 pCi/g surrounding A2-PB-123 (Note 3)	3,400	2.9	370	0.5	60	430
	Buffer Zone	3-BZ-029	A2-PB-123-A, 3-BZ-032, A2-PB-124, 2-BZ-027-A, and modeled extent of RIM>52.9 pCi/g surrounding A2-PB-123 (Note 3)	2,700	5.4	540	1	100	640
A2-3	Buffer Zone	A2-PB-126	A2-PB-126-A, 1-BZ-004, A2-PB-126-C (Note 3)	900	17	570	2	70	640

Other Area ID	Location Description	Boring with RIM >52.9 pCi/g	Delineating Borings	Estimated Excavation Area (sq ft)	Overburden Thickness (Note 1) (ft)	Overburden Volume (Note 1) (cy)	RIM >52.9 pCi/g Thickness (ft)	RIM >52.9 pCi/g Volume (cy)	Total Estimated Excavation Volume (cy)
CDL-1	Western side of CDL	A2-SB-165B-R	A2-SB-165-A, A2-SB-165-C, A2-SB-165-D-R, A2-SB-165-H, A2-SB-165-E	840	0.9	30	0.5	20	50
ISL-1	Northeast corner of ISL	ISL-EA-154	Estimated 700 sq ft area centered on ISL-EA-154 (Note 3)	700	5	130	5	130	260
LOT-2A1	Southern portion of Lot 2A1	8-2A2-159-A	8-2A2-158-B, 8-2A2-158-A, 8-2A2-159-E, 8-2A2-160-C, 8-2A2-159-B	1,300	1.5	70	0.5	20	90
LOT-2A2	Southern portion of Lot 2A2	8-2A2-150-A	8-2A2-149, 8-2A2-146, 8-2A2-151, 8-2A2-154	3,000	3.2	360	0.5	60	420
TOTALS						2,100		500	2,600

Notes:

1. This "overburden" volume is likely to include materials that will be excavated for other remedial purposes (i.e., not just for accessing the RIM >52.9 pCi/g); therefore, much of the RIM >52.9 pCi/g in "Other Excavation Areas" will need to be segregated for off-site disposal from material that needs to be excavated for other reasons.
2. Surface sample, no overburden thickness.
3. Additional sampling to be performed to complete delineation of RIM > 52.9 pCi/g.
4. ft – feet; cy – cubic yards; sq ft – square feet; pCi/g – picocuries per gram

FIGURES



Legend

- Boring Location with combined Ra or combined Th >52.9 pCi/g
- Other Excavation Areas
- Adjacent Property Boundary
- OU1 Area Boundaries
- Landfill Boundary

PROJECT

WEST LAKE LANDFILL SUPERFUND SITE
REVISED EXCAVATION PLAN
BRIDGETON, ST. LOUIS COUNTY, MO

PREPARED FOR

THE UNITED STATES
ENVIRONMENTAL PROTECTION
AGENCY REGION VII

ON BEHALF OF

WEST LAKE LANDFILL OU-1
RESPONDENTS

FIGURE 1

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APPROVED BY: GB
DATE: 7/31/2023

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LOCATIONS OF OTHER EXCAVATION AREAS

PROJECT NUMBER: AA-000

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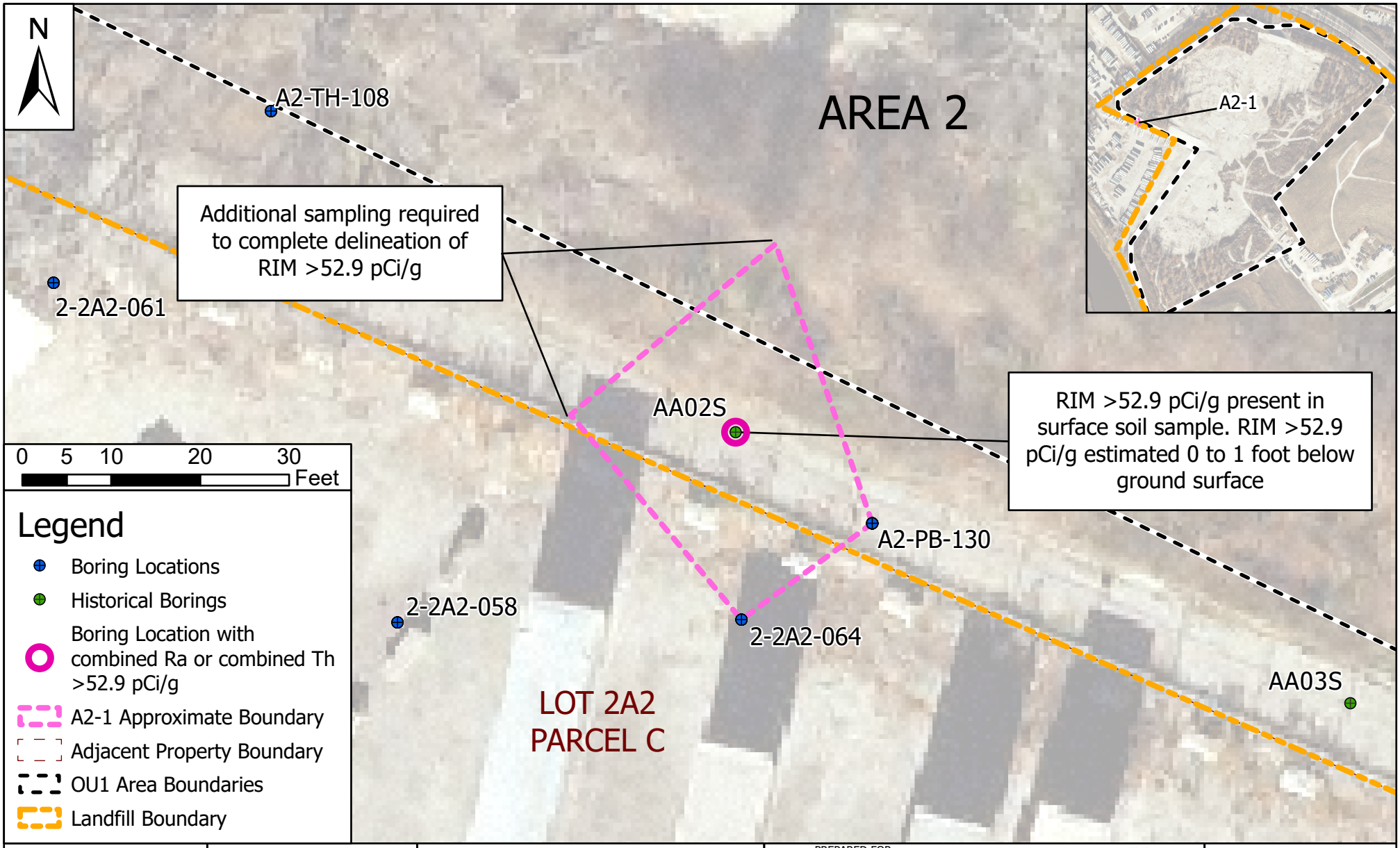

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ON BEHALF OF WEST LAKE LANDFILL OU-1 RESPONDENTS

FIGURE 2

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OTHER EXCAVATION AREAS - A2-1

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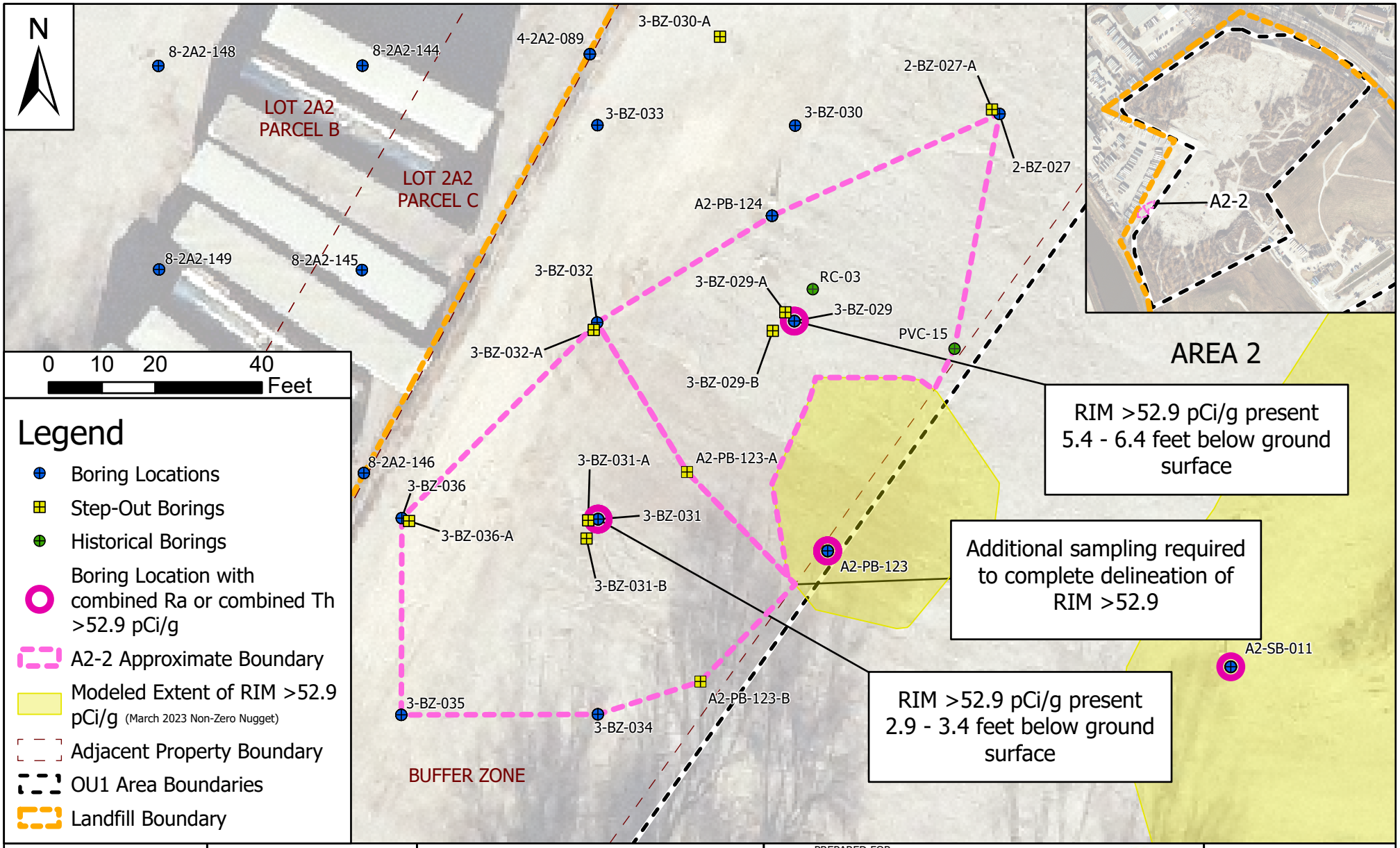

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FIGURE 3

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OTHER EXCAVATION AREAS - A2-2

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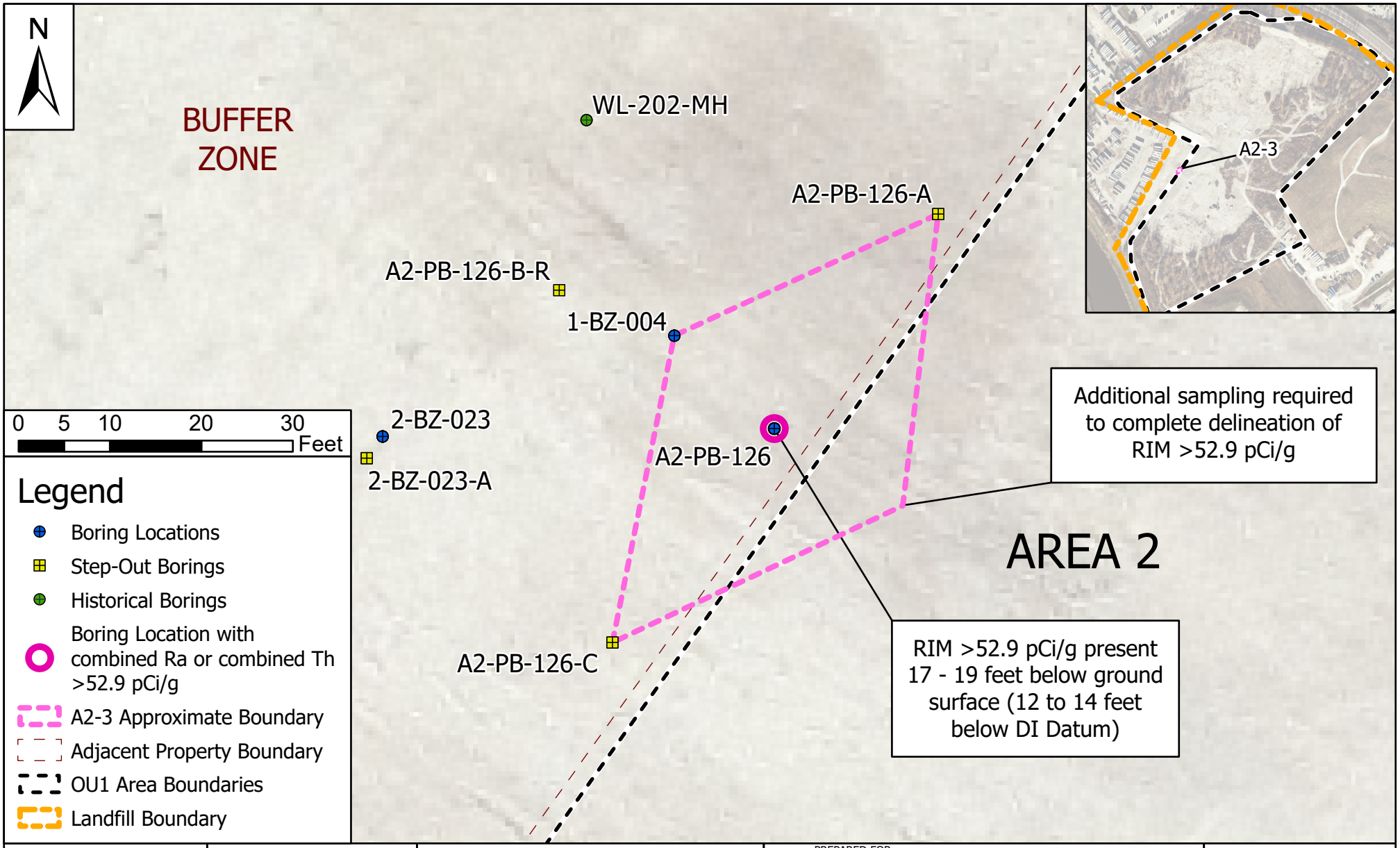

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FIGURE 4

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OTHER EXCAVATION AREAS - A2-3

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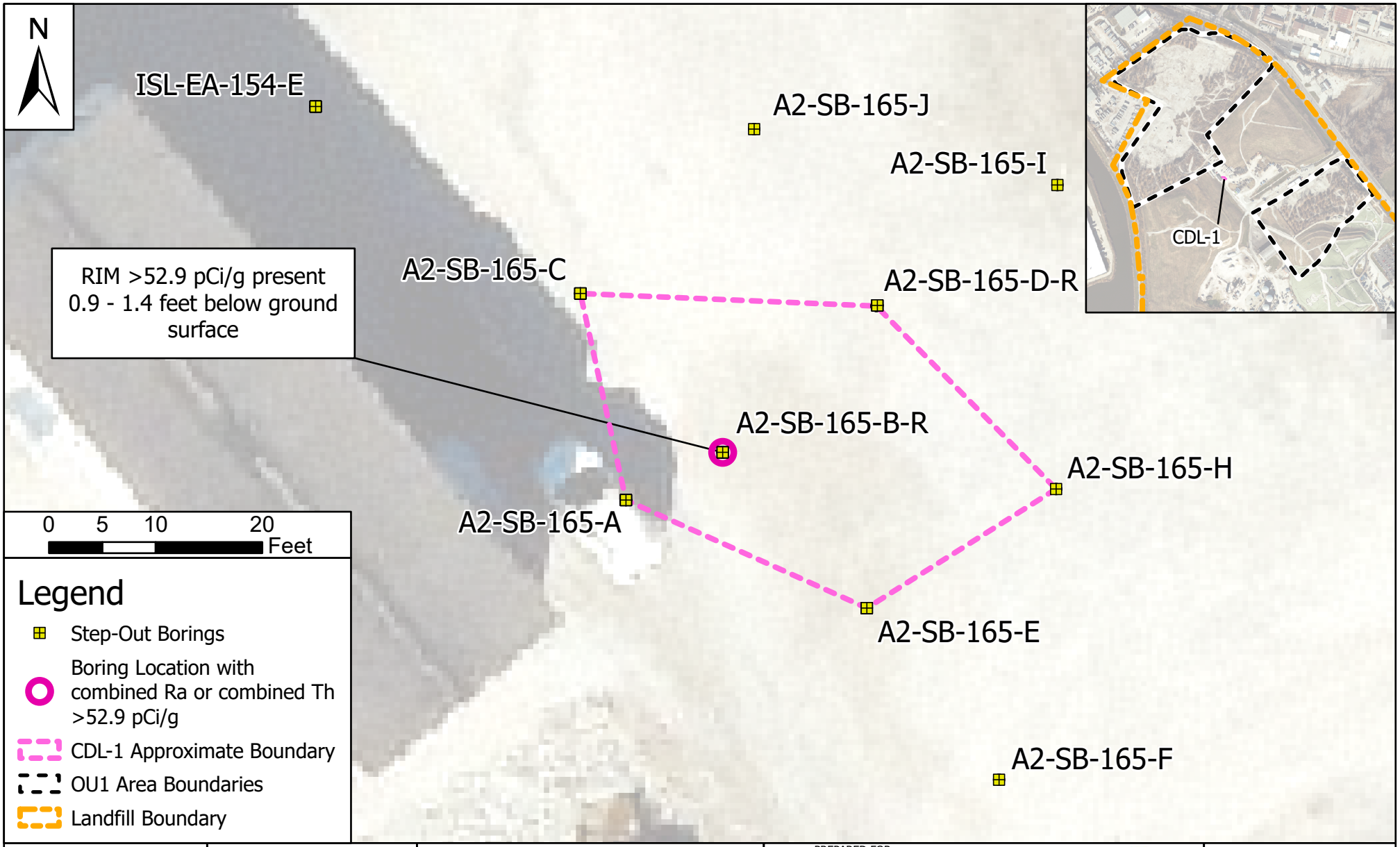

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FIGURE 5

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OTHER EXCAVATION AREAS - CDL-1

PROJECT NUMBER: AA-000

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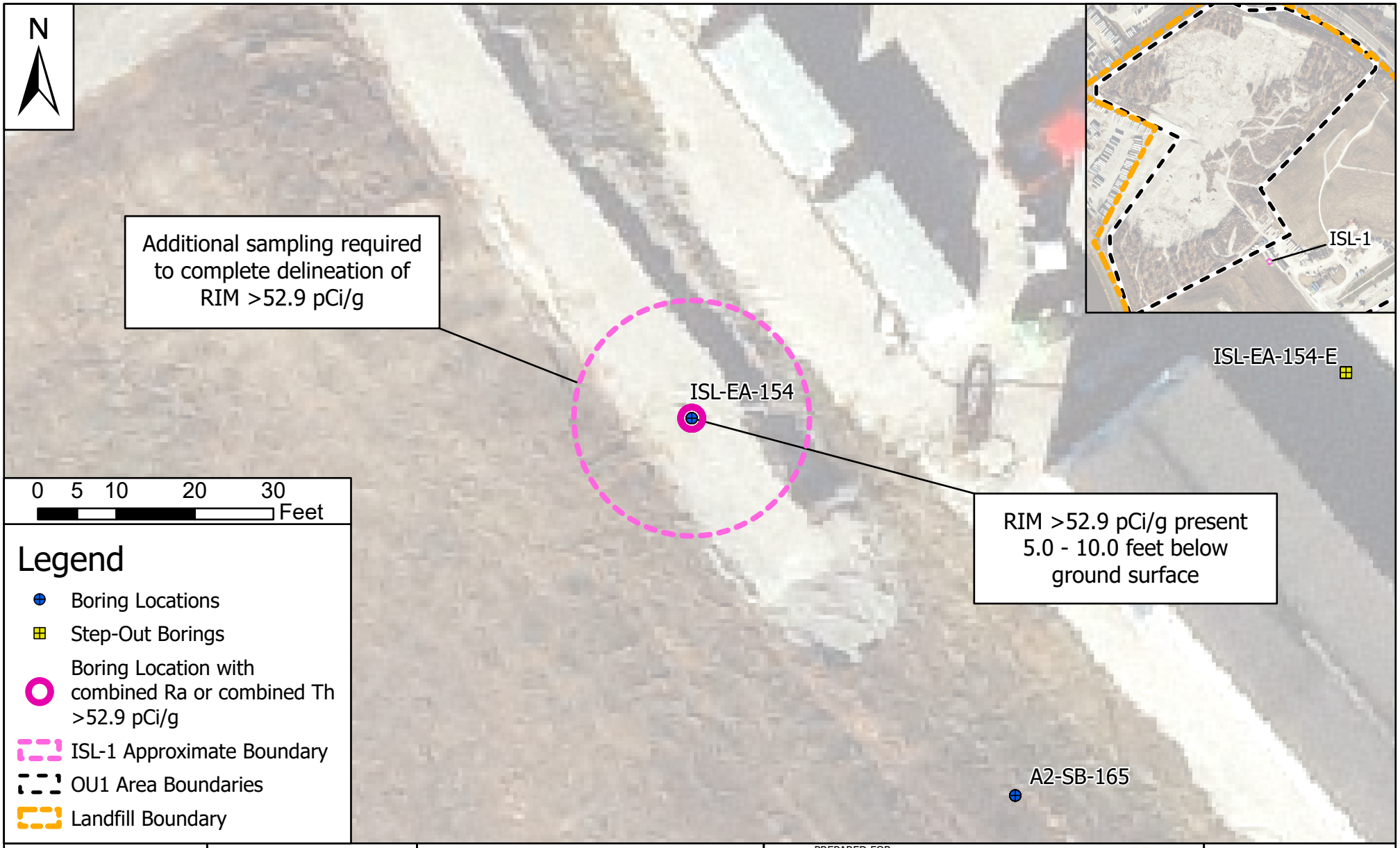

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ON BEHALF OF WEST LAKE LANDFILL OU-1 RESPONDENTS

FIGURE 6

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OTHER EXCAVATION AREAS - ISL-1

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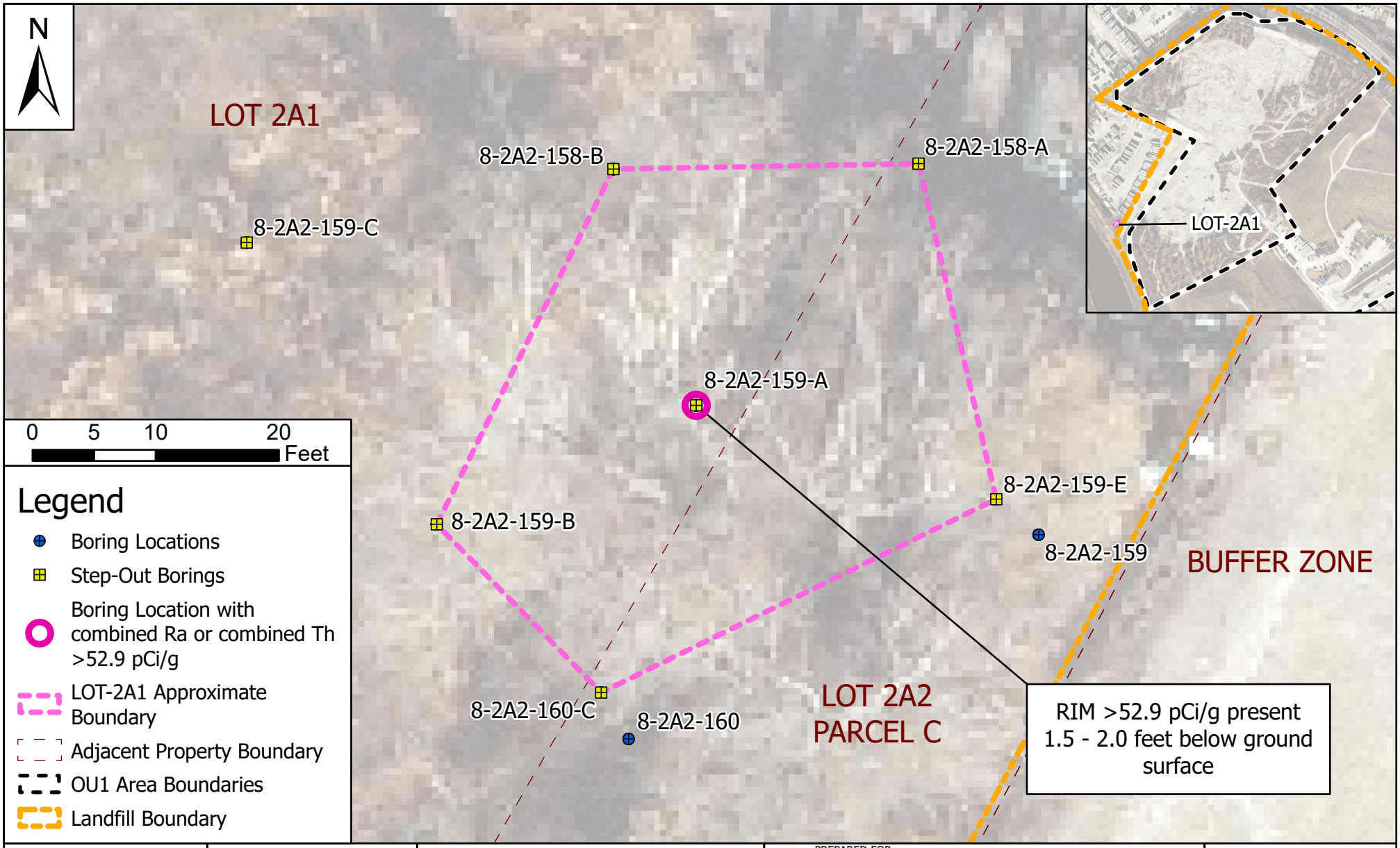

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ON BEHALF OF

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FIGURE 7

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OTHER EXCAVATION AREAS - LOT-2A1

PROJECT NUMBER: AA-000

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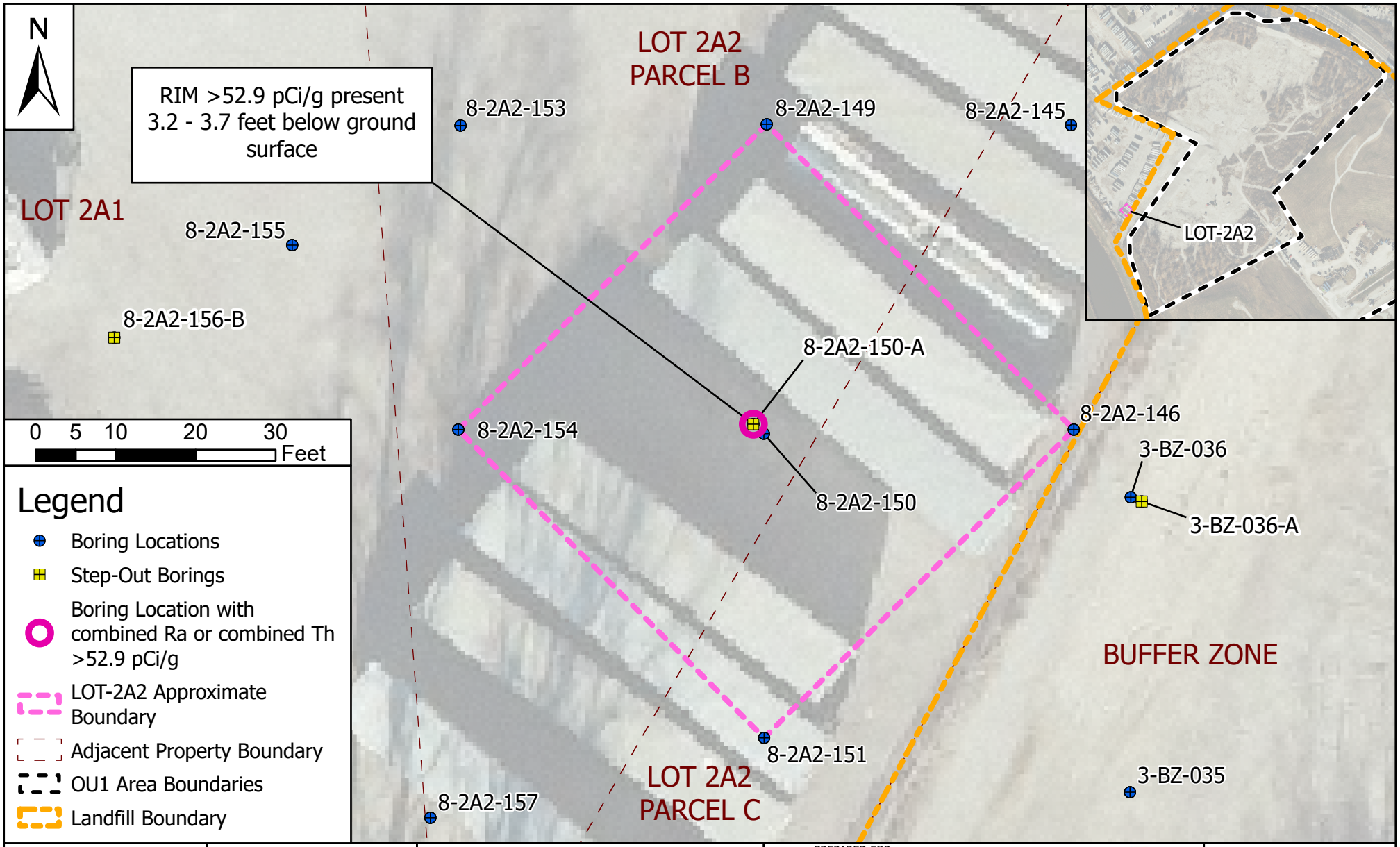

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FIGURE 8

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OTHER EXCAVATION AREAS - LOT-2A2

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