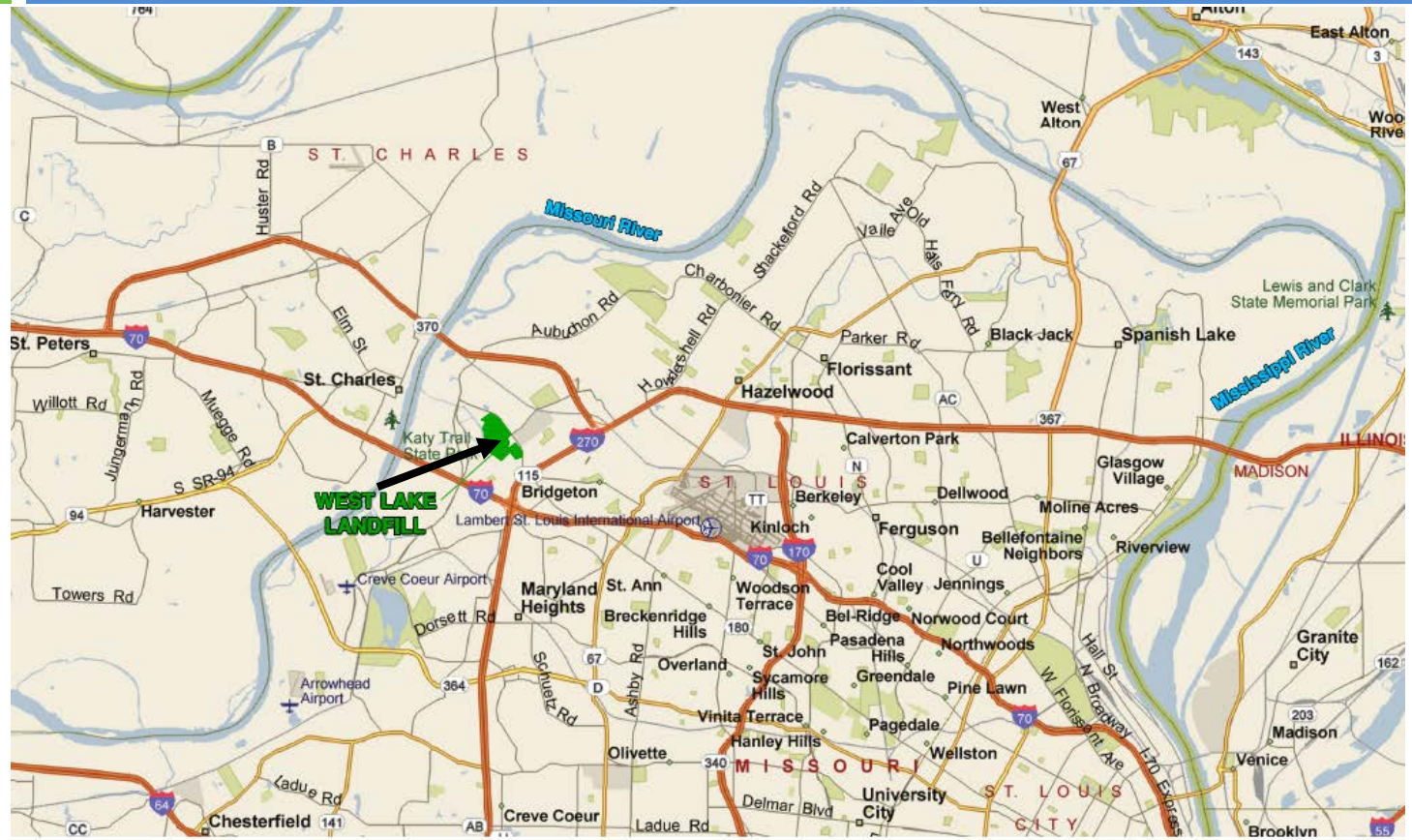
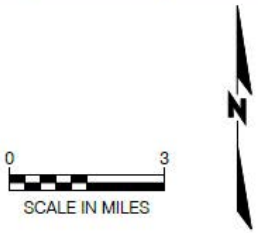
WEST LAKE LANDFILL SUPERFUND SITE BRIDGETON, MO

EXTENT AND DISTRIBUTION OF RIM

December 2017

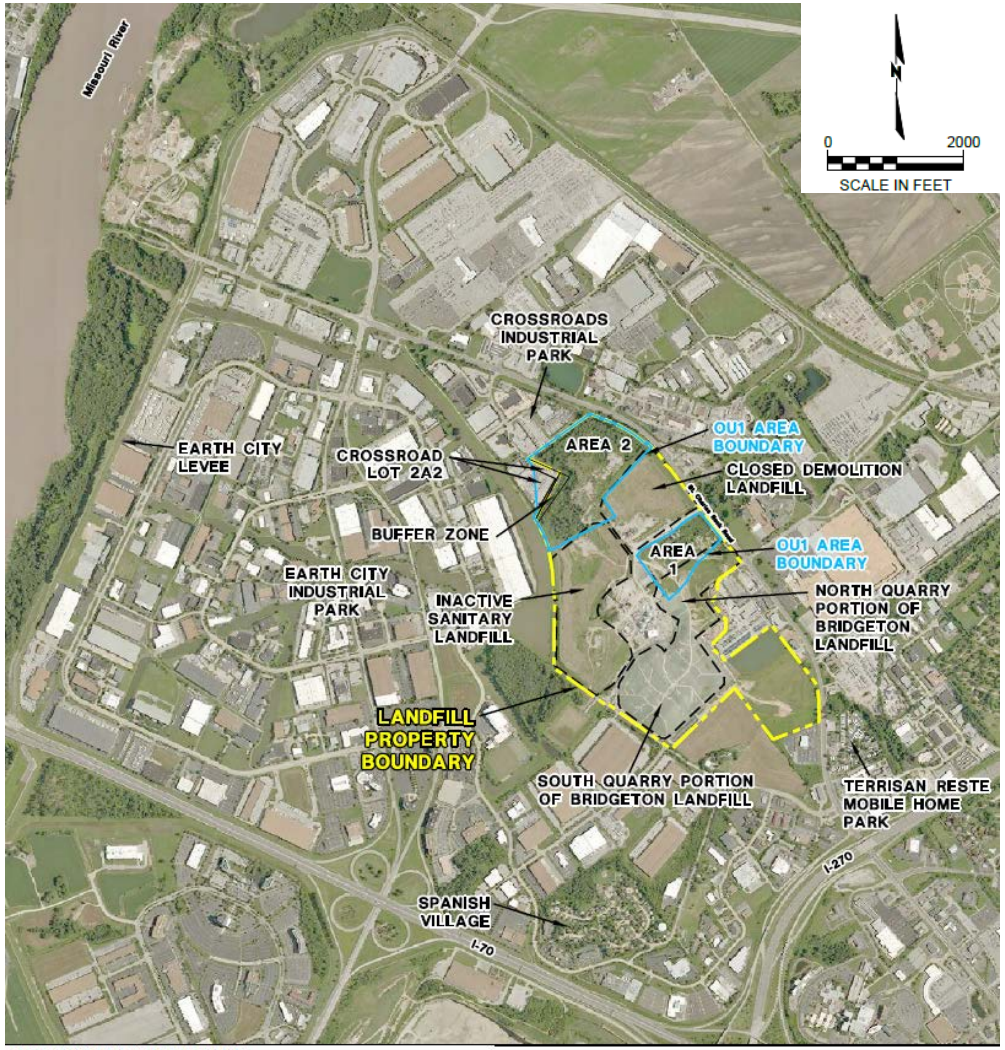
West Lake Landfill Site Vicinity





- NW St. Louis County
- North of I-70, and west of I-270

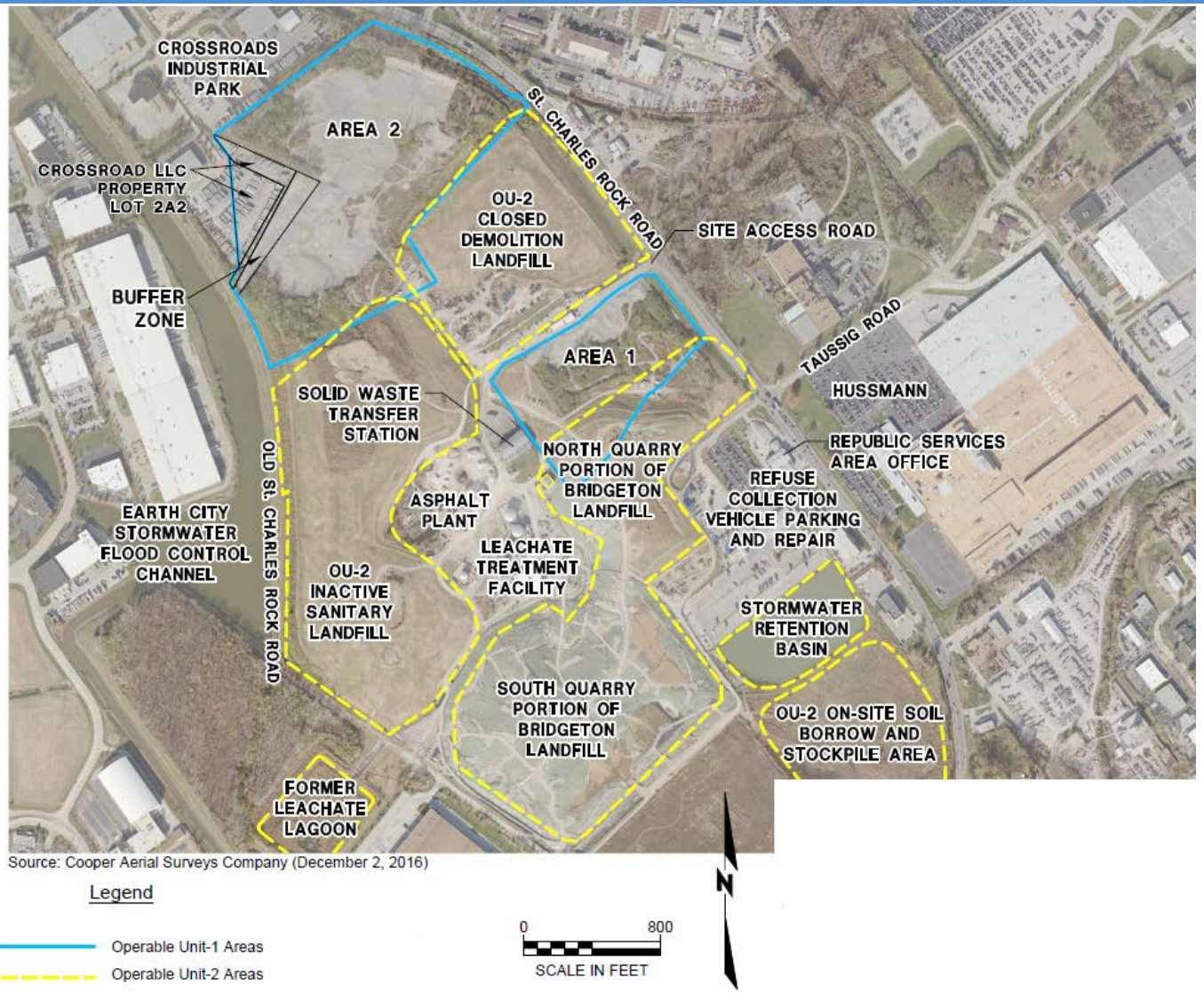
West Lake Landfill Site Location



Source: USGS Aerial Photography

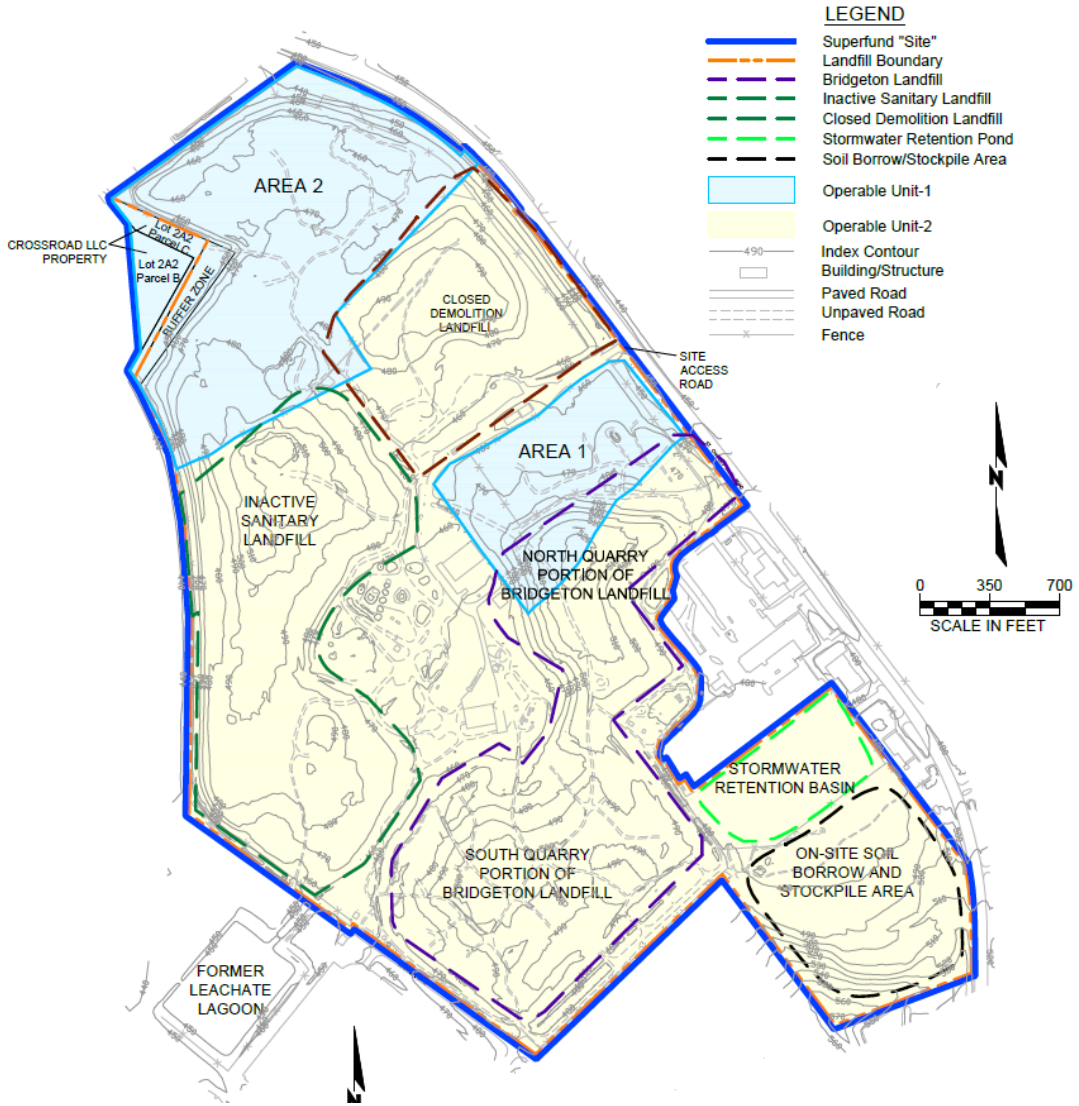
- Two near-by residential areas
  - Terrisan Reste Mobile Home Park
  - Spanish Village
- Heavy Commercial, Industrial
  - Earth City Business Park (West)
- Approximately 1.5 miles from the Missouri River
- Located near operational runways of the St. Louis Lambert Field International Airport.

West Lake Landfill Operations



- 5 inactive landfill areas
- Solid waste transfer operation
- Asphalt plant
- Leachate treatment facility
- Crossroads Industrial Park (Lot 2A2)

West Lake Landfill Operable Units



- OU-1:Contains Radiological Impacted Materials (RIM)
  - Area 1 and Area 2
- OU-2: Not RIM impacted
  - Closed Demolition Landfill
  - Inactive Sanitary Landfill
  - The Bridgeton Landfill
- OU-3: Site Wide Groundwater

West Lake Landfill OU-1

- OU-1 includes: Area 1, Area 2, and the Buffer Zone/Lot 2A2
  - Area 1 and Area 2 - landfill cells that contain:
    - Municipal solid waste (MSW), industrial waste, and construction/demolition debris, some of which is contaminated with radiological material
  - Buffer Zone/Lot 2A2
    - Historical erosion of Area 2 contaminated these two adjacent properties
- Site Contaminants:
  - Waste or soil contaminated with radiological materials - Uranium, Radium, and Thorium (and daughters) identified as COCs
  - Other typical landfill contaminants - Trace metals and Volatile Organic Compounds also identified as COCs

Origin of Waste Radiological Materials

- Uranium ore processing at the Mallinckrodt facility in St. Louis - Manhattan Project
- Sulfate precipitation
  - removes radium from ore and a small amount of uranium
  - barium sulfate residues created during this processing step which can be leached to recover uranium

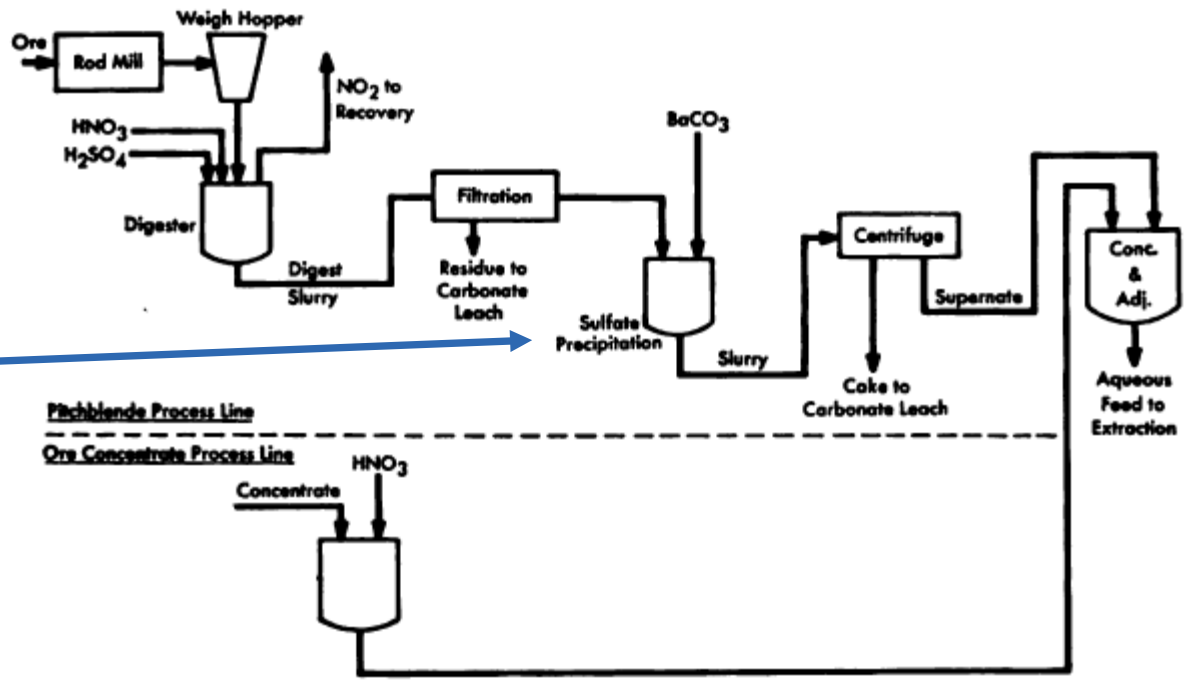


FIG. 3.2.A. Dual-cycle ether extraction process, part 1.

Origin of Waste Radiological Materials

- Leached Barium Sulfate Residues (LBSR)
  - Barium sulfate residues further processed (leached) to recover additional uranium
  - Multiple leaching steps can be performed to maximize uranium recovery
  - LBSR contains uranium decay products including radium and thorium
  - Decay products often not in secular equilibrium
  - Small amounts of uranium remain (approximately 0.05% to 0.1%)

Origin of Waste Radiological Materials

- Uranium Ore Processing Operations
  - Processed at plant in downtown St. Louis
  - Moved to Site near St. Louis Airport/Latty Avenue Sites
  - Sold by the federal government to a private party (Continental Mining) and licensed by the Atomic Energy Commission (AEC)
- Cotter Corporation acquires materials
  - Shipped all residuals from Latty Avenue facility to other re-processing facilities except 8,700 tons of LBSR

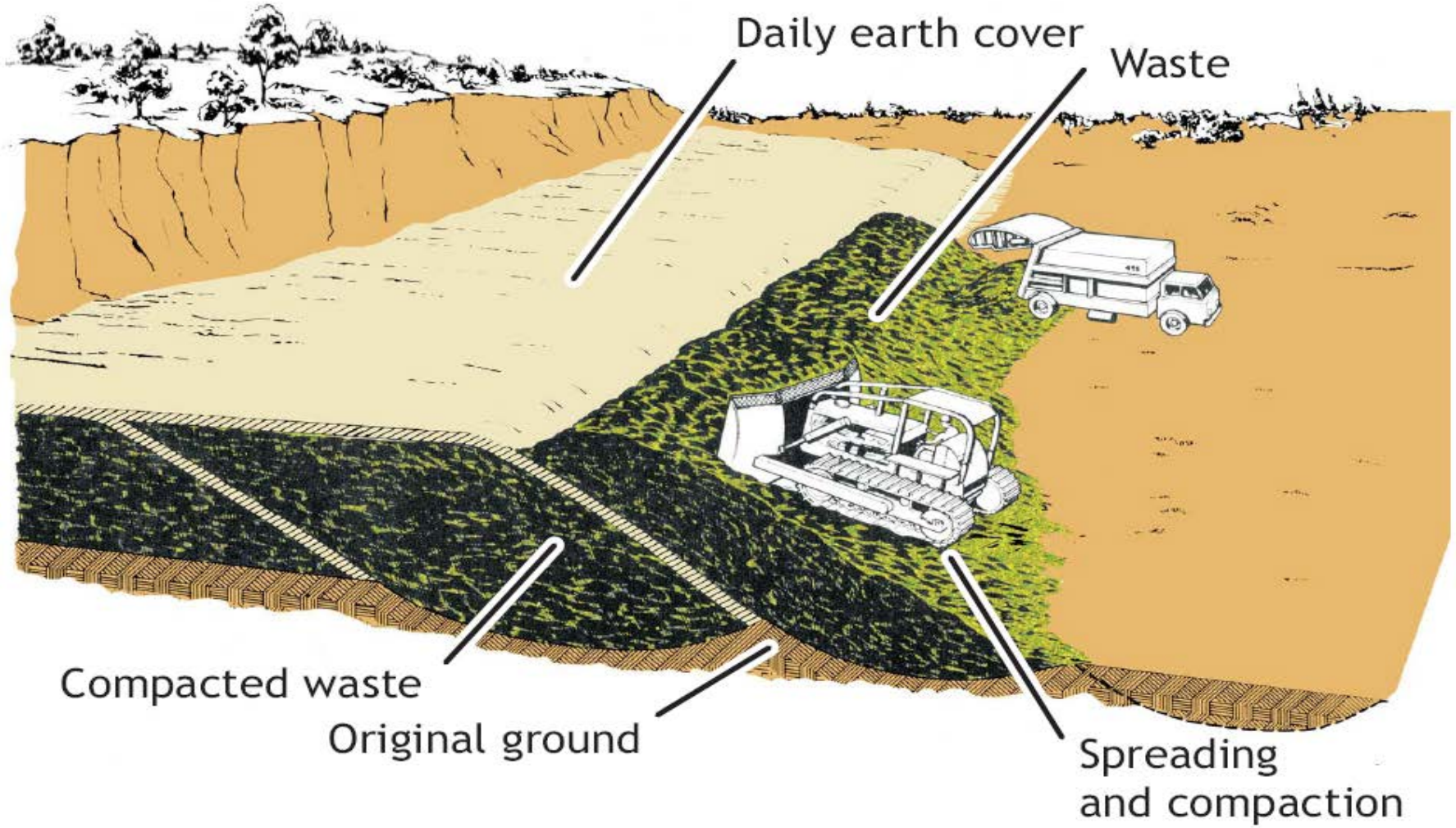
Origin of Waste Radiological Materials

- Approximately 8,700 tons of LBSR mixed with about 34,000 tons of impacted soil at Latty Avenue Site
  - Latty Avenue Site located approximately 4 miles from West Lake
  - LBSR spread over the ground surface
  - LBSR excavated along with approximately 18 inches of soil
  - LBSR/soil mix transported by trucks to West Lake Landfill and stockpiled (July – Oct 1973)
  - Materials in these piles used at landfill for cover or other operations

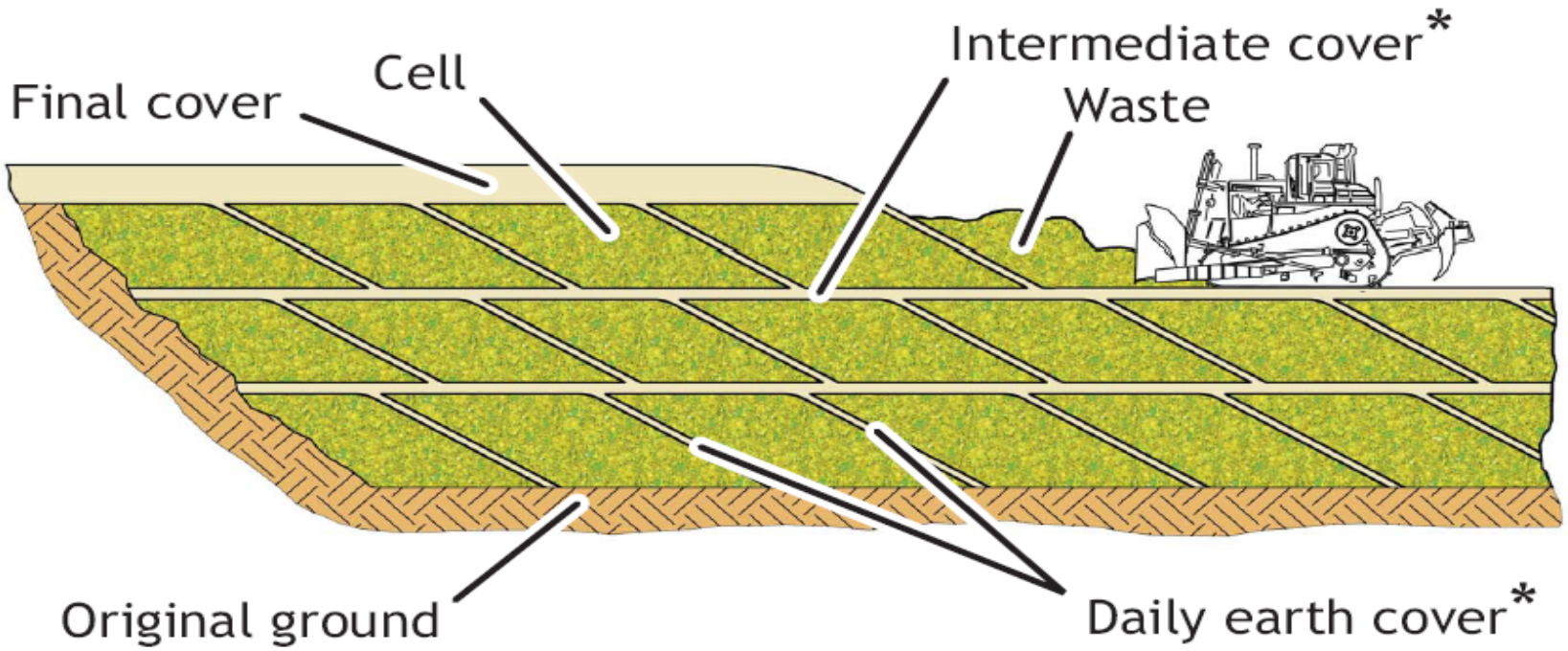
Landfill Operations

- Used as fill and cover for normal landfilling operations – daily, intermediate, and final cover
  - Radiological materials delivered to the site over several months in 1973
    - Potentially stockpiled
    - Time period landfill operations utilized these materials is uncertain
  - Materials have been found in soil distributed within landfill wastes due to decomposition of trash, differential settlement, and compaction from additional materials placed in and above locations with RIM

Landfill Operations



Landfill Cell Configuration



*Highly idealized soil layers. This configuration does not reflect mixing of soil with trash or distortion of soil layers by subsequent compaction and placement of additional fill.

Landfill Settlement

Occurrences of RIM

- Radiologically impacted materials (RIM) have contaminated some of the soil materials, solid waste materials, and demolition debris in Area 1 and Area 2
- These materials that have become contaminated are referred to as RIM
- RIM has been found at varying depths (surface and subsurface)
- RIM has been found in discontinuous volumes or layers (thicknesses from a few inches to several feet)

Definition of RIM

- Site specific background for Ra-226 and Ra-228 estimated at 2.9 pCi/g
- Combined Radium (Ra-226 plus Ra-228)
  - Greater than 7.9 pCi/g
- Combined Thorium (Th-230 plus Th-232)
  - Greater than 7.9 pCi/g
- Combined Uranium (U-234 plus U-235 plus U-238)
  - Greater than 54.5 pCi/g

Basis of RIM Definition

- RIM contains similar radionuclides to uranium mill tailings
  - Uranium and Thorium decay series
  - Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations (40 CFR 192) – Residual Radioactive Material
  - UMTRCA regulations specify an unrestricted use radium clean-up goal of 5 pCi/g over background (40 CFR 192.12)

Basis of RIM Definition

- OSWER Directive 9200.4-25
  - Uranium Mill Tailings typically 300-1,000 pCi/g Ra-226
  - UMTRCA subsurface standard not appropriate for the Site because subsurface contamination exceeds 15 pCi/g
  - 5 pCi/g Ra-226 standard applies to combined Radium and Thorium to define RIM in the surface and subsurface

Basis of RIM Definition

- Additional Considerations for Uranium
  - 10 CFR 40 Appendix A – Criterion 6(6)
    - Dose based ARAR – Compared to ARAR protectiveness criteria of 12 mrem/yr (EPA Rad Q&A – Question 35)
    - Dose assessment and ARAR protectiveness evaluation in progress
    - Preliminary evaluations indicate 50 pCi/g over background will not exceed the benchmark dose and the benchmark dose is less than 12 mrem/yr
  - Compared to remediation goals from nearby FUSRAP sites
    - St. Louis Airport Site – RG for U-238 50 pCi/g over background
    - St. Louis Downtown Site – RG for U-238 50 pCi/g over background in top 6 feet, 150 pCi/g over background below 6 feet
  - Site-specific risks evaluated in Baseline Risk Assessment

RIM Characterization

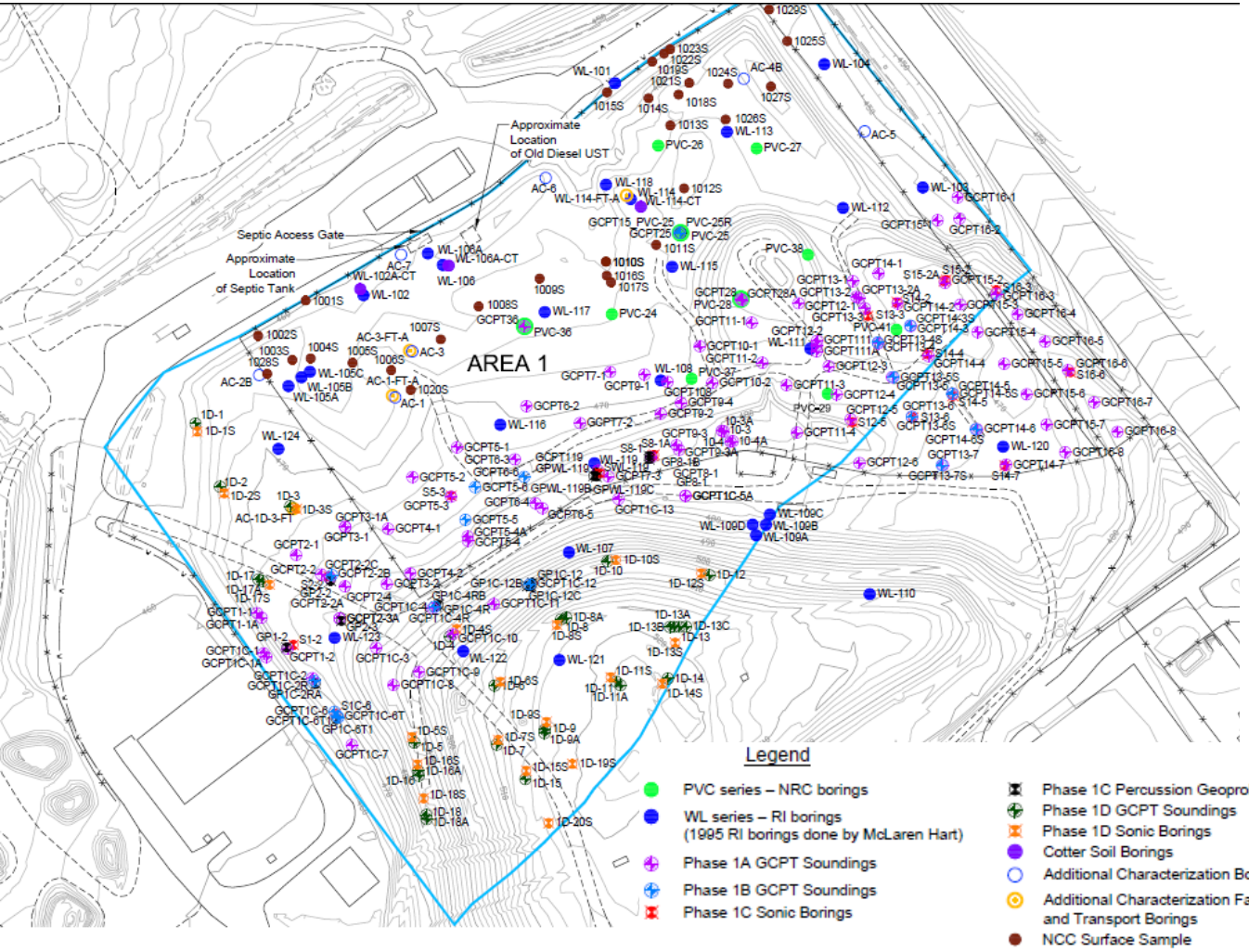
- NRC 1970s-1980s (41 Borings)
- Original EPA RI 1990s (84 Borings)
- Phase 1 Investigations 2013-2015 (36 Borings, 112 gamma cone penetration tests)
- Additional Characterization 2015 (41 Borings)
- Total of approximately 314 Borings and GCPT

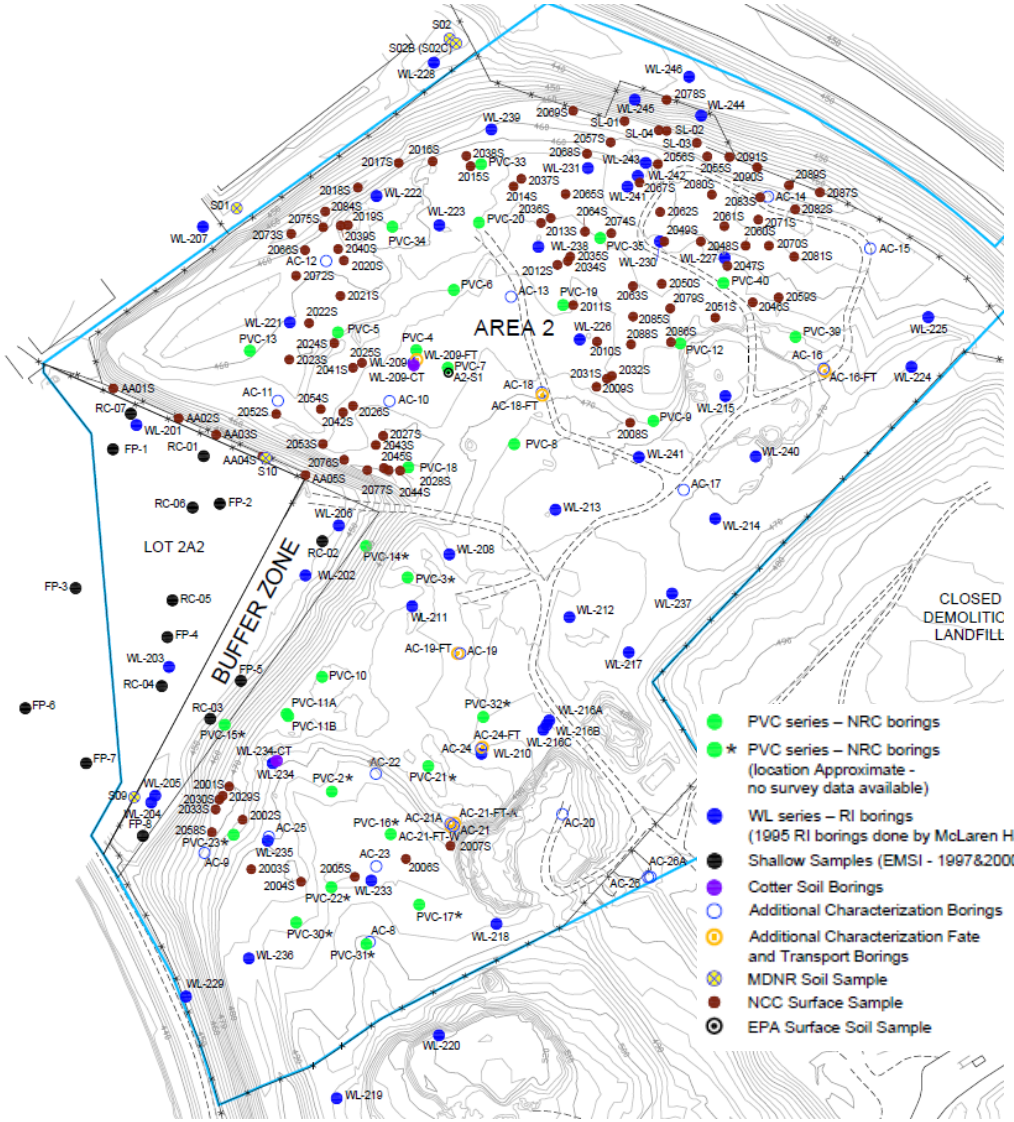
Summary Data

- NRC survey (1982)
  - 41 Borings, 12 surface samples, plus On-Site testing
  - RIM estimated as deep as 455 feet above mean sea level (AMSL) and 20 feet below the ground surface (BGS)
  - Estimate of RIM thickness ranged from 2-15 feet in borings
  - Areal Extent – 2 acres in Area 1, 14 acres in Area 2

- EPA Investigations (1990-2015)
  - 273 Borings, Approx. 500 samples
  - Sampling shows RIM as deep as 429 feet AMSL and more than 90 feet BGS
  - Estimate of RIM thickness is 1-25 feet in borings
  - Areal Extent – 8.2 acres in Area 1, 24.9 acres in Area 2

Sample Locations in Areas 1 and 2

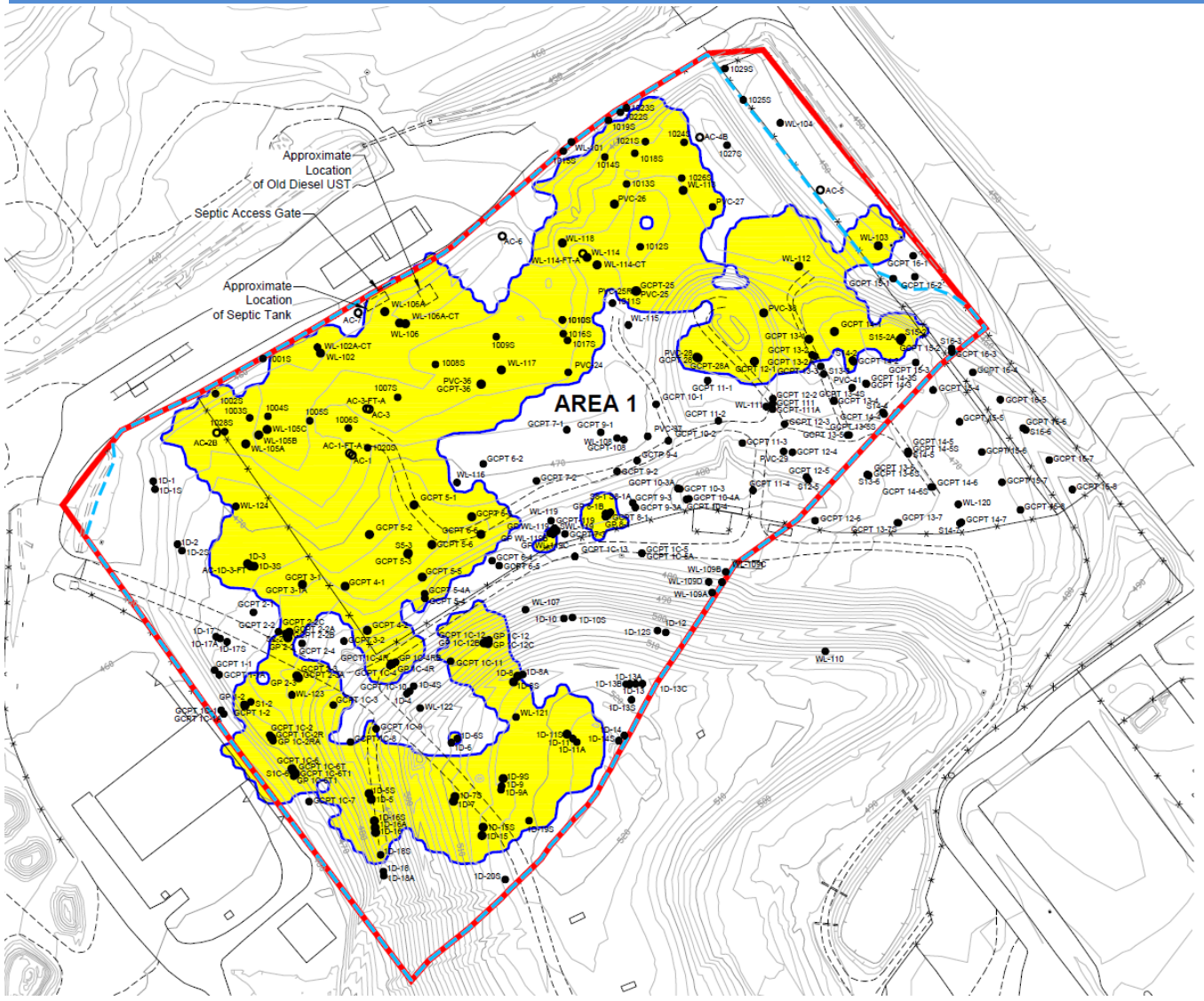




Biased and unbiased sample locations for Areas 1 & 2 are shown.

Areal RIM Extent – Area 1

From 8-25-17 FFS



LEGEND

- OU-1 Area Boundary
- Approximate Edge of Refuse
- and Soil Boring or Surface Soil Sample
- Geostatistical-Based Estimate of RIM Extent
- 490 Index Contour
- Intermediate Contour
- Depression Contour
- Building/Structure
- Paved Road
- Unpaved Road
- Fence
- Retaining Wall

Notes:

- The Areal Extent of RIM Shown on this Figure does not Represent a Contiguous Layer, but Rather Portrays the Composite Occurrence of RIM at all Depths/Elevations
- Aerial Topography Provided By Cooper Aerial Surveys Co. and is Dated December 2, 2016
- All Elevations Are Above Mean Sea Level (amsl)

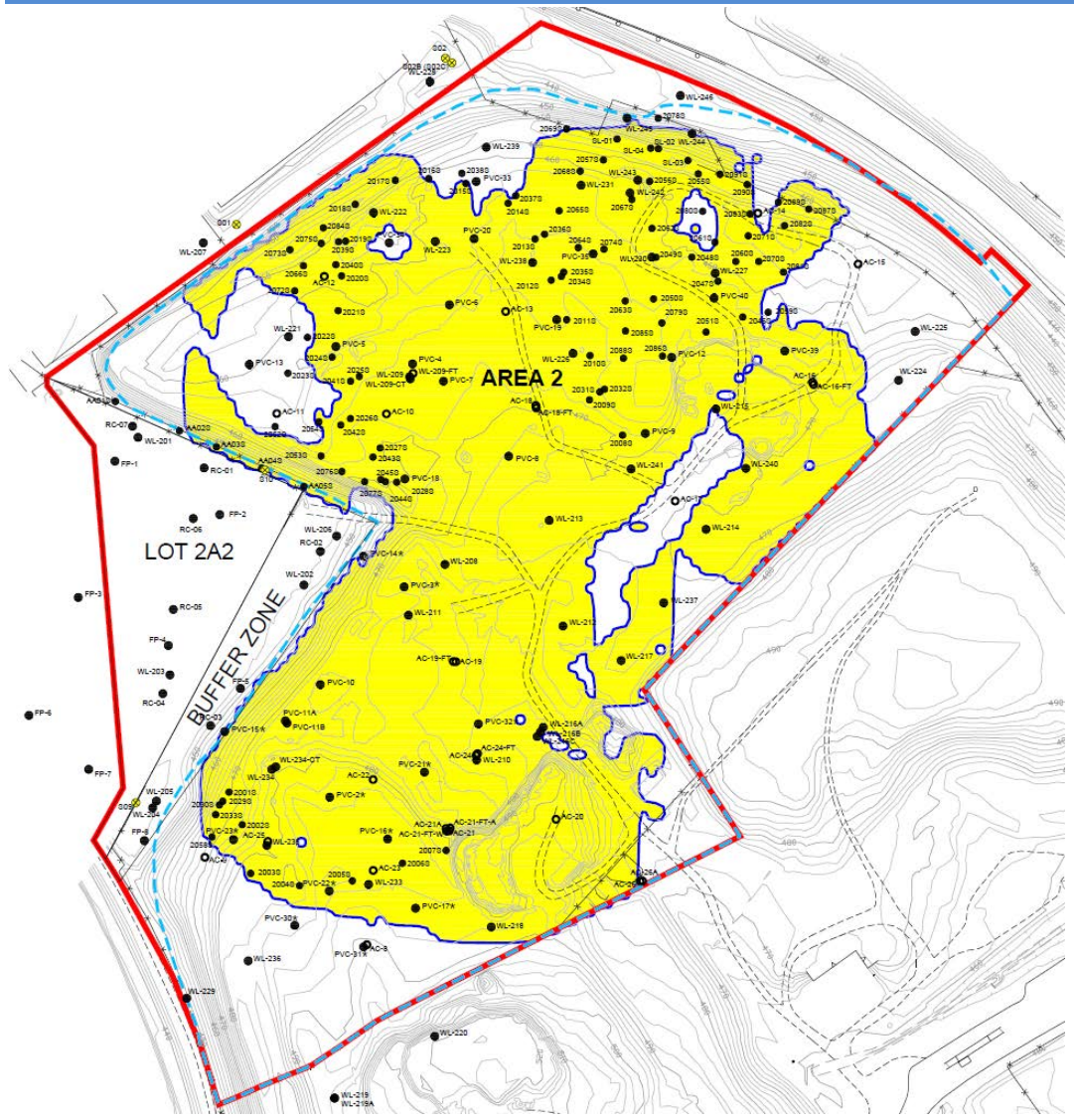
N

150 0 150

SCALE IN FEET

Aerial RIM Extent – Area 2

From 8-25-17 FFS



LEGEND

- OU-1 Area Boundary
- Approximate Edge of Refuse
- ●, ○ and ⊗ Soil Boring or Surface Soil Sample
- * Location Approximate-No Survey Data Available
- Geostatistical-Based Estimate of RIM Extent
- Index Contour
- Intermediate Contour
- Depression Contour
- Building/Structure
- Paved Road
- Unpaved Road
- Fence
- Retaining Wall

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Borings from Additional Characterization

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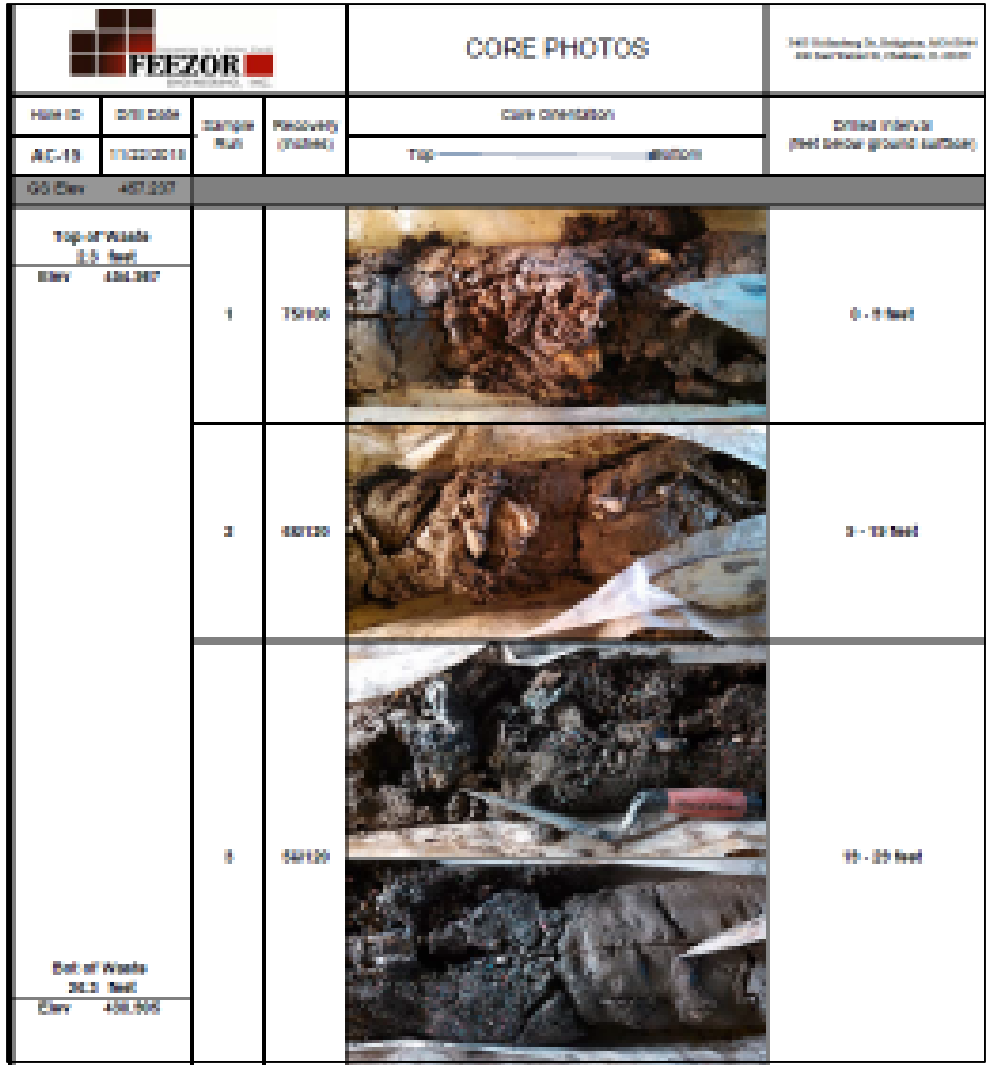
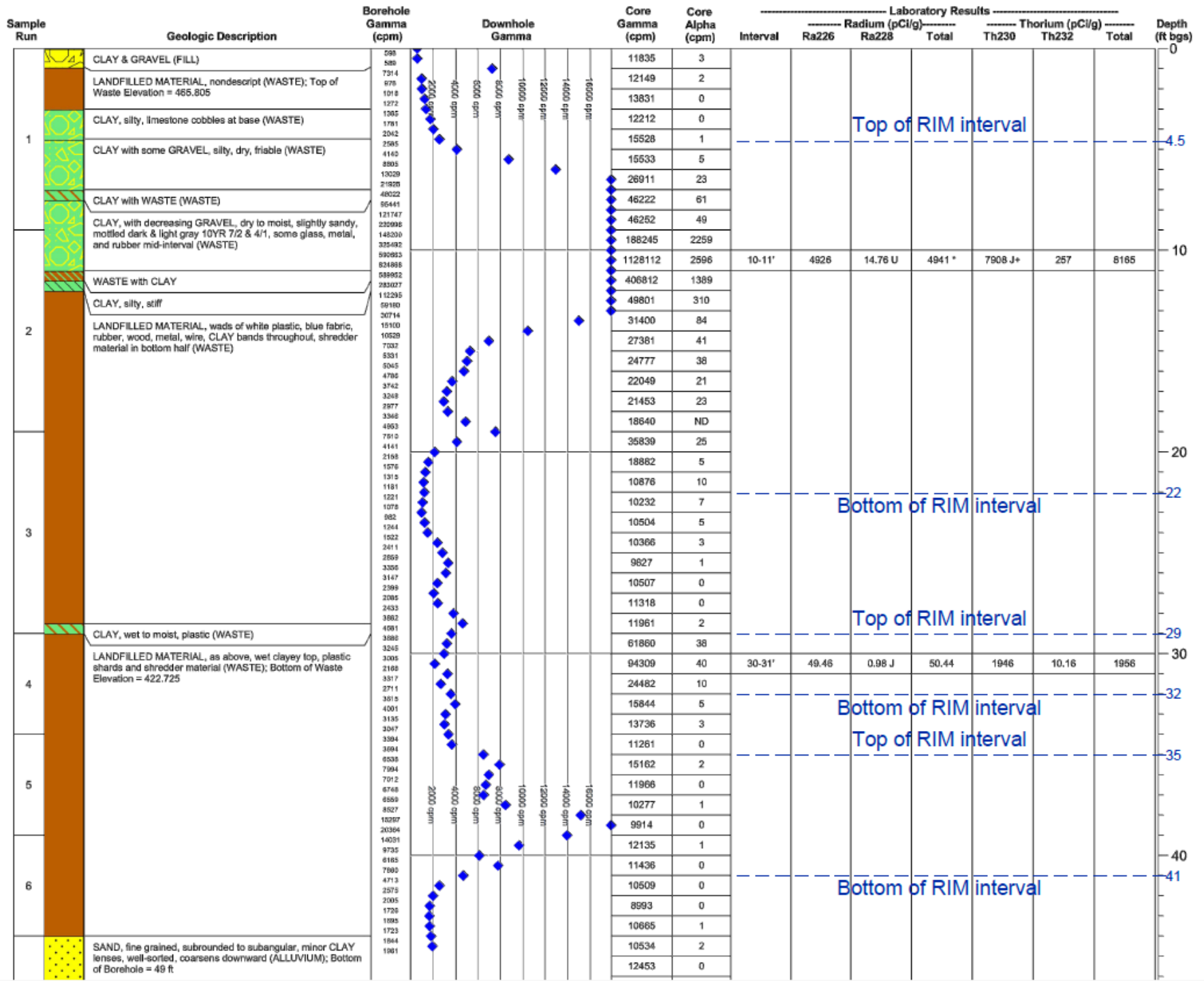


AC-1 Boring Log

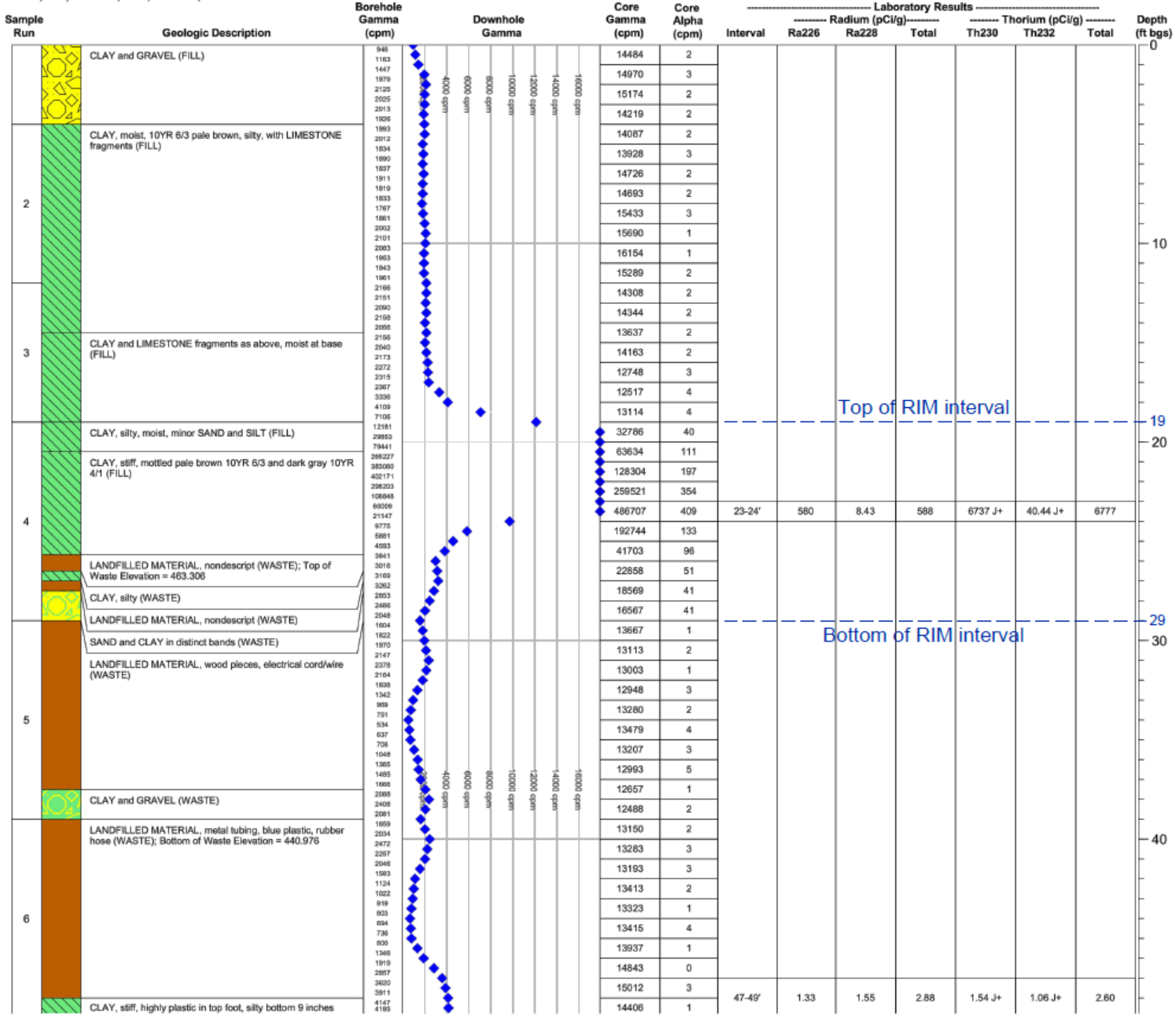
RIM Estimated at:

4.5’to 22’ bgs
29’ to 32’ bgs
35’ to 41’ bgs



AC-1 Boring Photos

AC-20 Boring Log - RIM Estimated 19’ bgs to 29’ bgs



AC-20 – Actual Boring Photos

19-29 Feet BGS

29-39 Feet BGS

Geostatistical Evaluation of Data

- Geostatistical estimates of the volume and extent of RIM were conducted as presented within the FFS – using 3D indicator kriging.
- Estimates also included volumes of non-RIM impacted overburden and “set-back” due to excavation safety concerns.
  - Maximum areal extent of RIM in Area 1 is approximately 8.4 acres.
  - Maximum areal extent of RIM in Area 2 is approximately 26.8 acres
  - Area 1 vol. estimate is 58,700 cubic yards of RIM
  - Area 2 vol. estimate is 251,000 cubic yards of RIM

Volume Considerations

Area 1 - Total RIM Volume	
Threshold 7.9 pCi/g	
RIM	58,700
Vertical Over Burden	355,000
Excavation Setback	472,000
Total Volume	885,700

Area 2 - Total RIM Volume	
Threshold 7.9 pCi/g	
RIM	251,000
Vertical Over Burden	376,000
Excavation Setback	334,000
Total Volume	961,000

End of Presentation