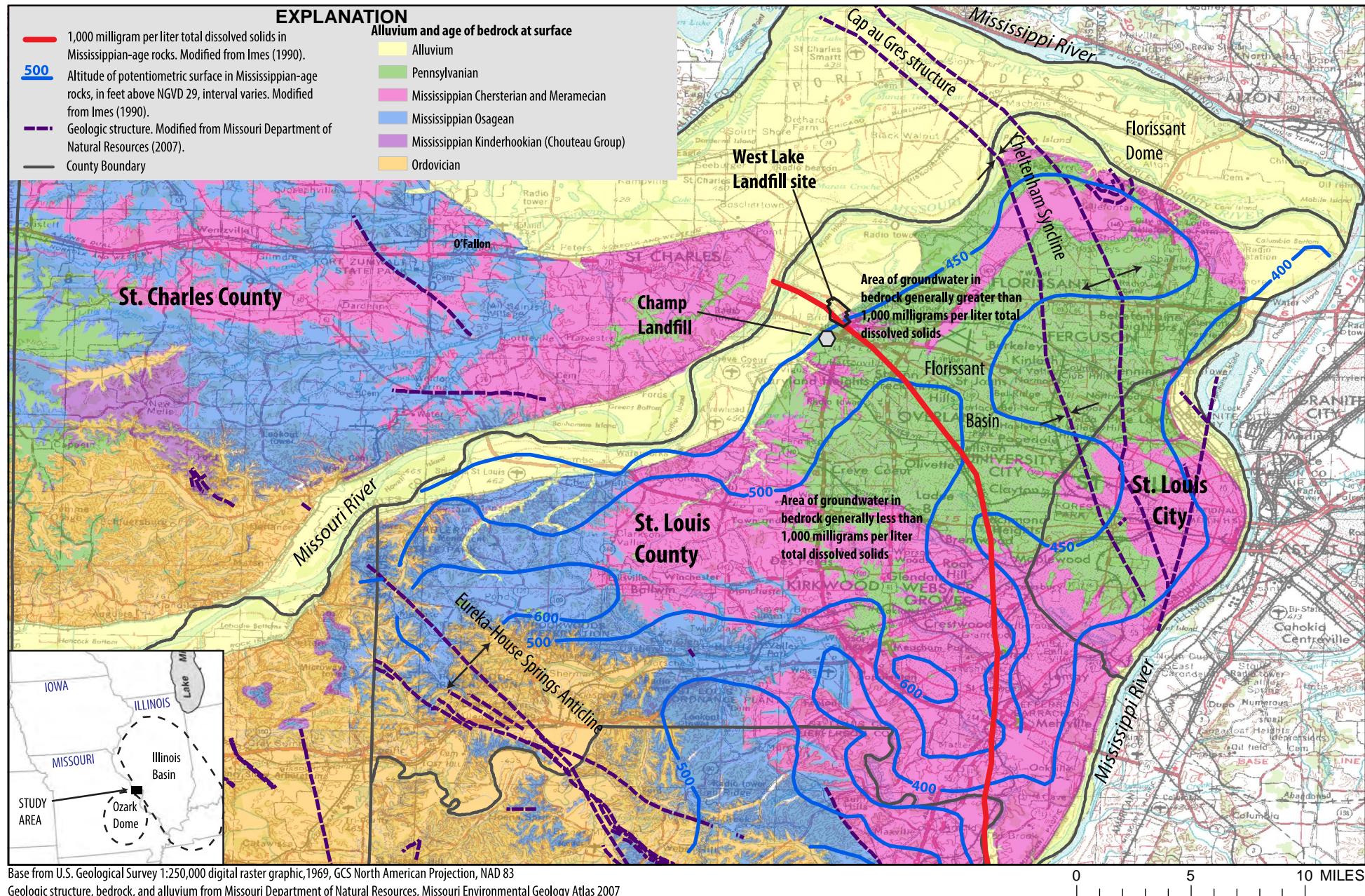


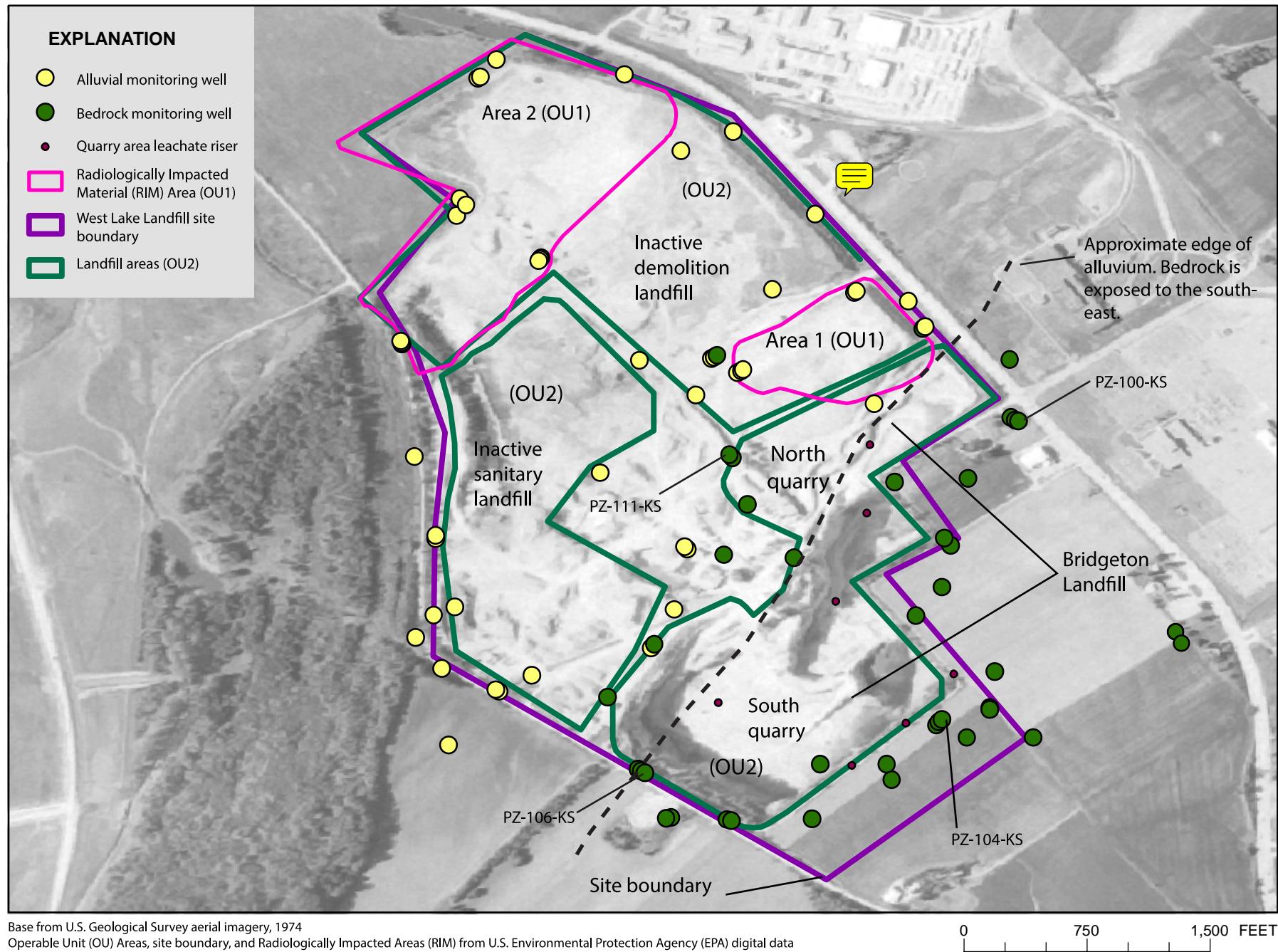
**APPENDIX R**

**GEOCHEMICAL DIAGRAMS**

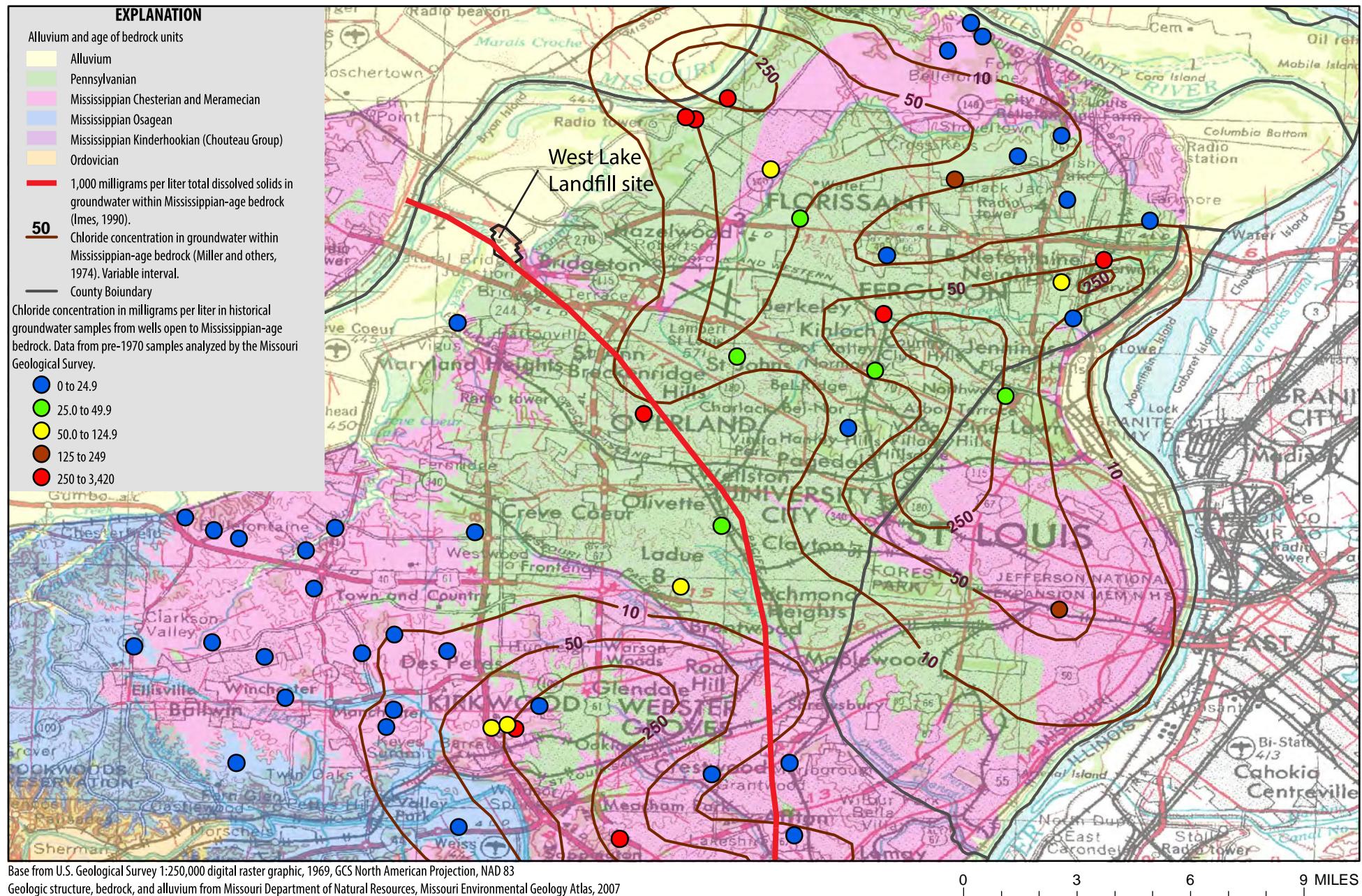
DRAFT



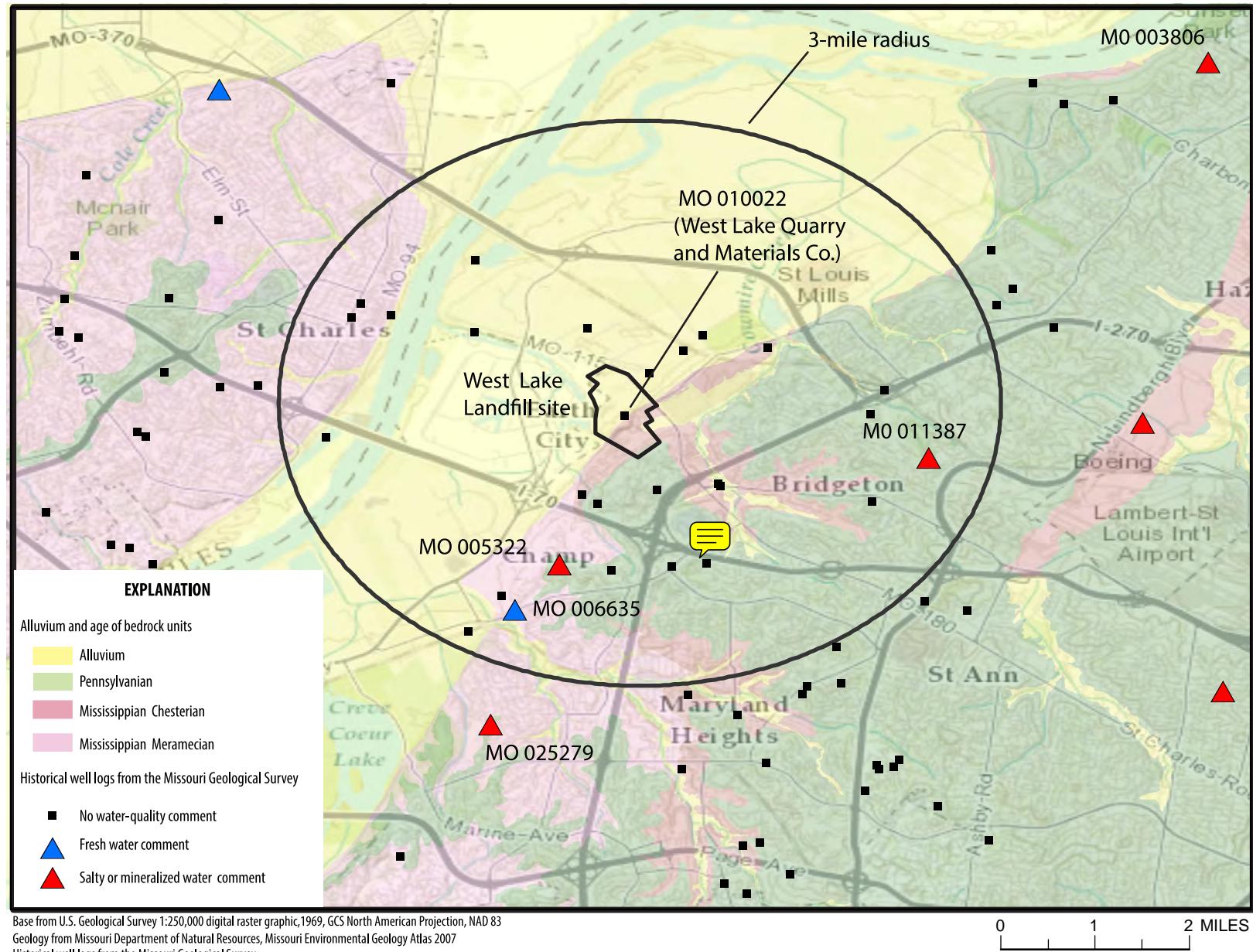
**Figure 1.** Geologic structure, age of bedrock units, and generalized potentiometric surface within the Mississippian-age bedrock in St. Louis County and St. Louis City.



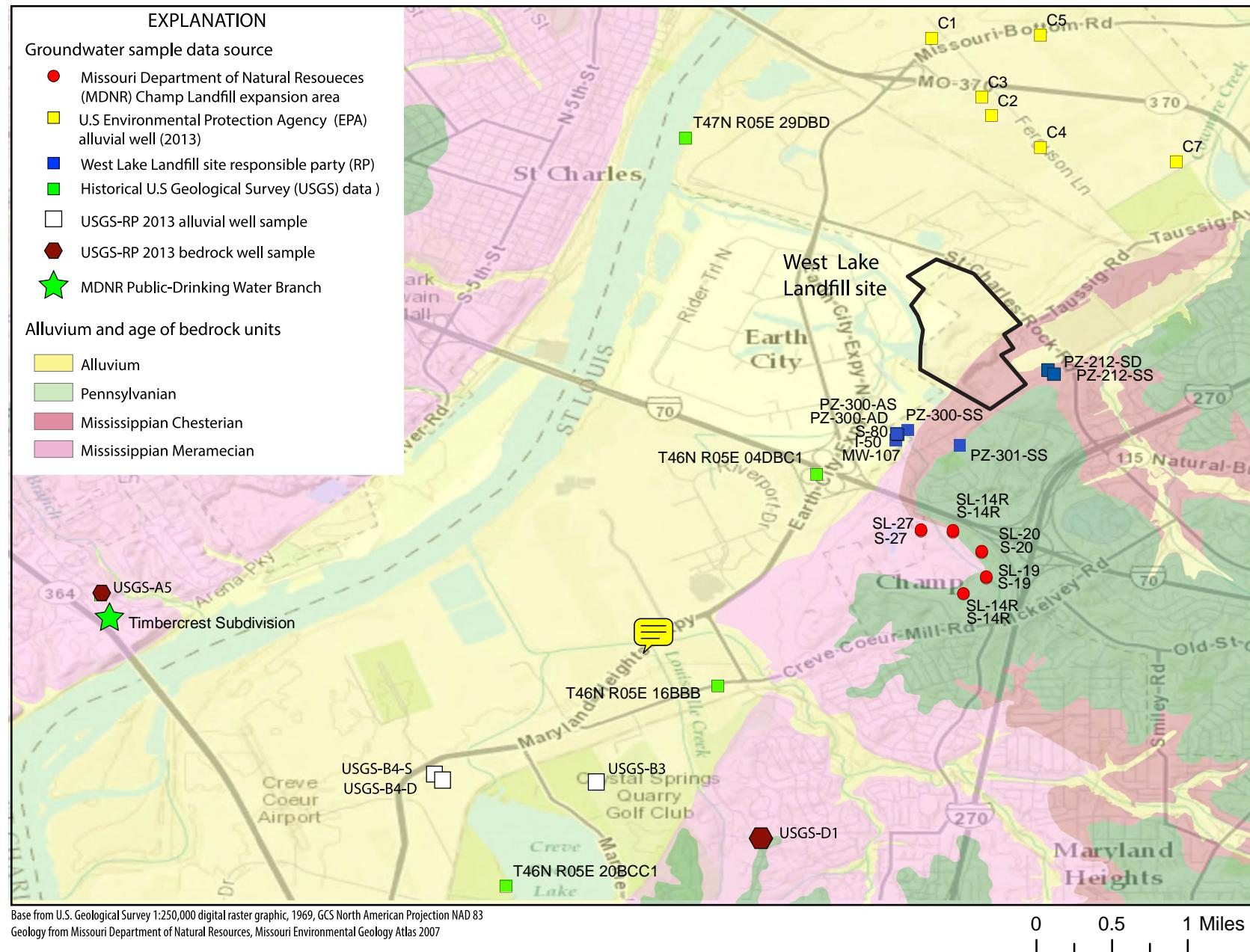
**Figure 2.** 1974 aerial photograph of the West Lake Landfill site, former landfill areas, areas containing radiologically impacted material (RIM), and monitoring wells at the West Lake Landfill site.



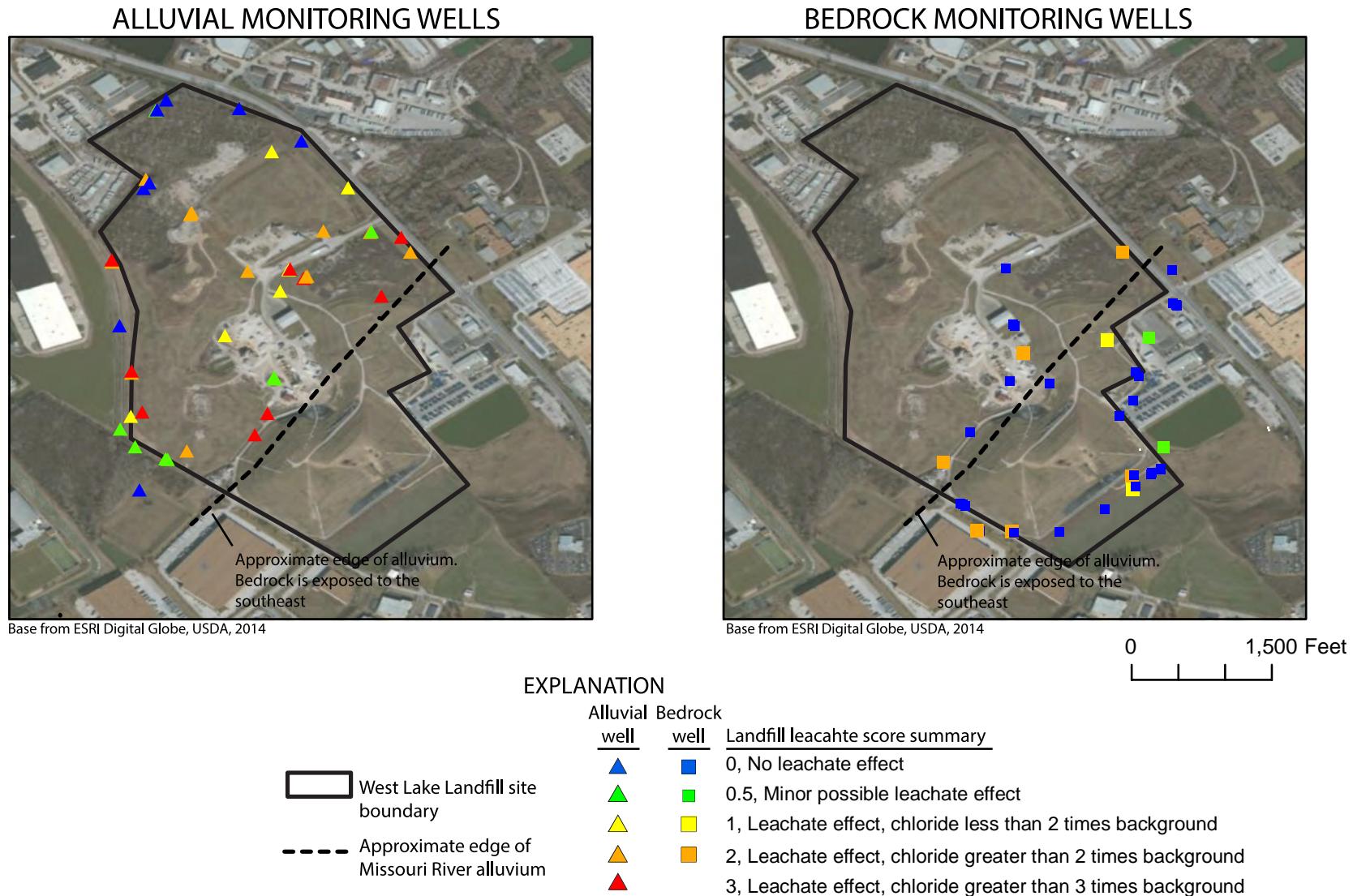
**Figure 3.** Contours of chloride concentration in the Mississippian-age bedrock from Miller and others (1974) and chloride concentration in historical (1934–70) water samples from water wells analyzed by the Missouri Geological Survey (MGS). Historical MGS sample data pulled from the USGS National Water Information System (<http://waterdata.usgs.gov/nwis>). Note chloride contours and data values are from different sources and may not directly correspond to each other.



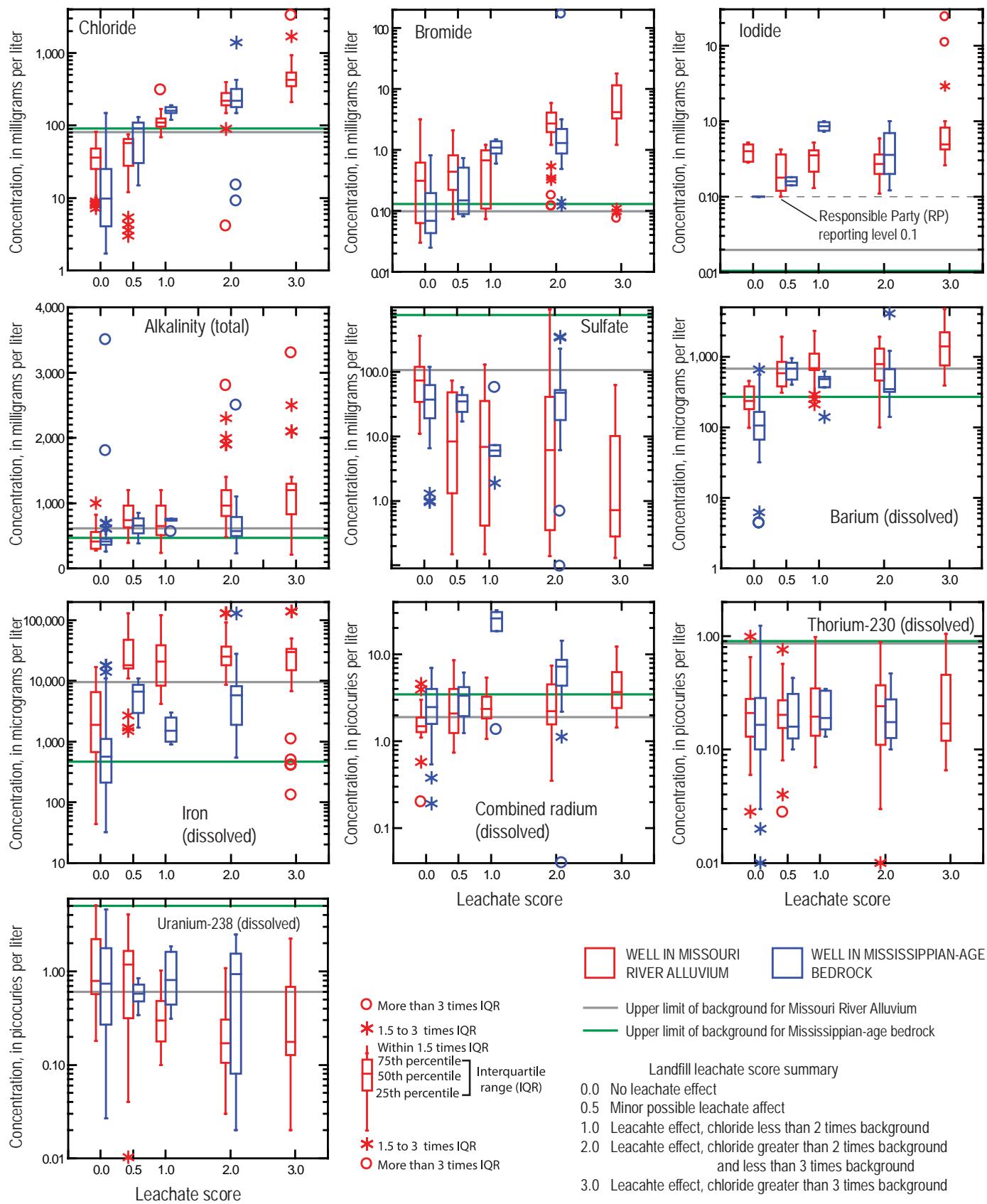
**Figure 4.** Water wells with historical geologic logs drilled within a 3-mile radius of the West Lake Landfill site and geologic logs with water-quality comments.



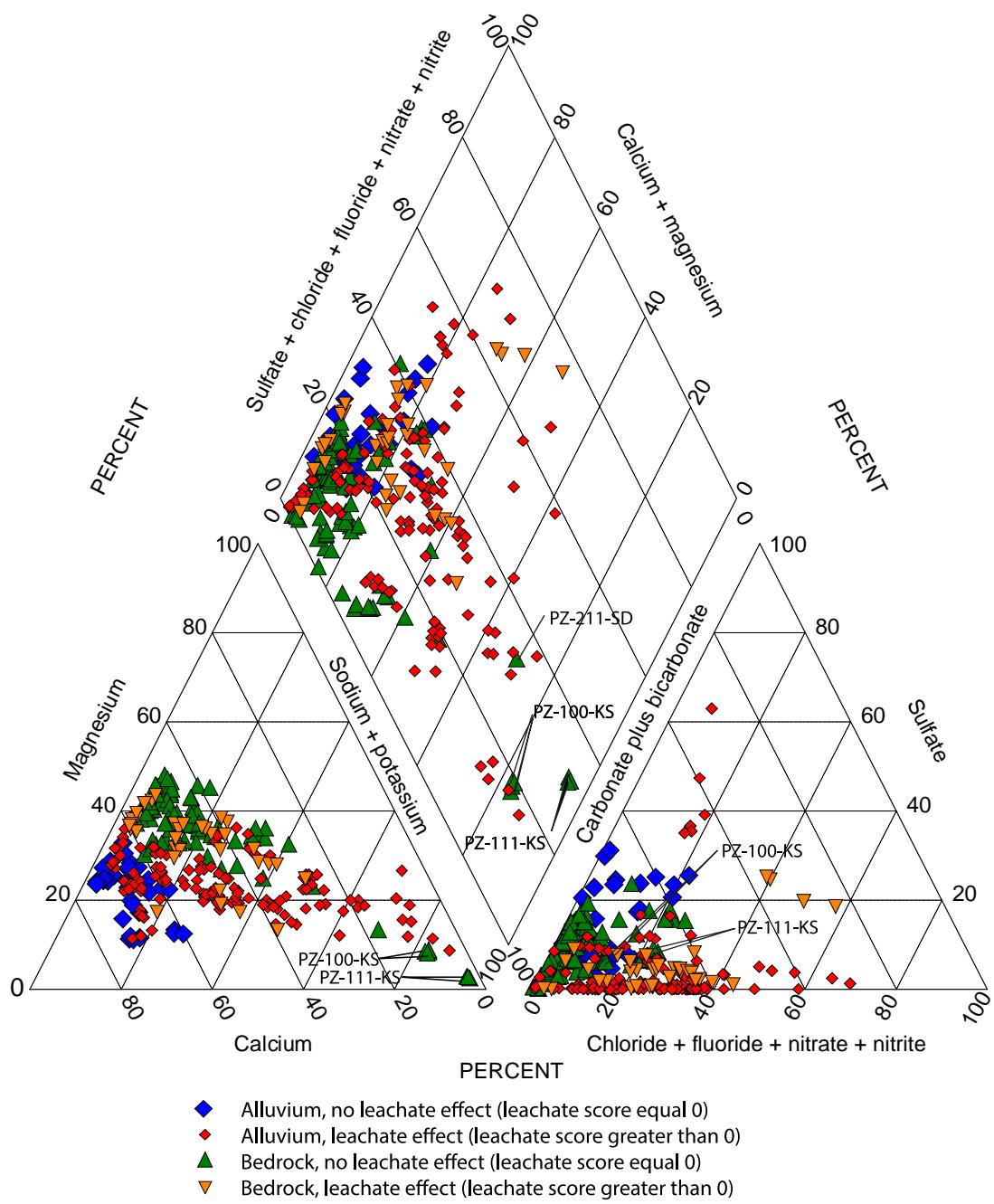
**Figure 5.** Location of background groundwater samples within 5 miles of the West Lake Landfill site.



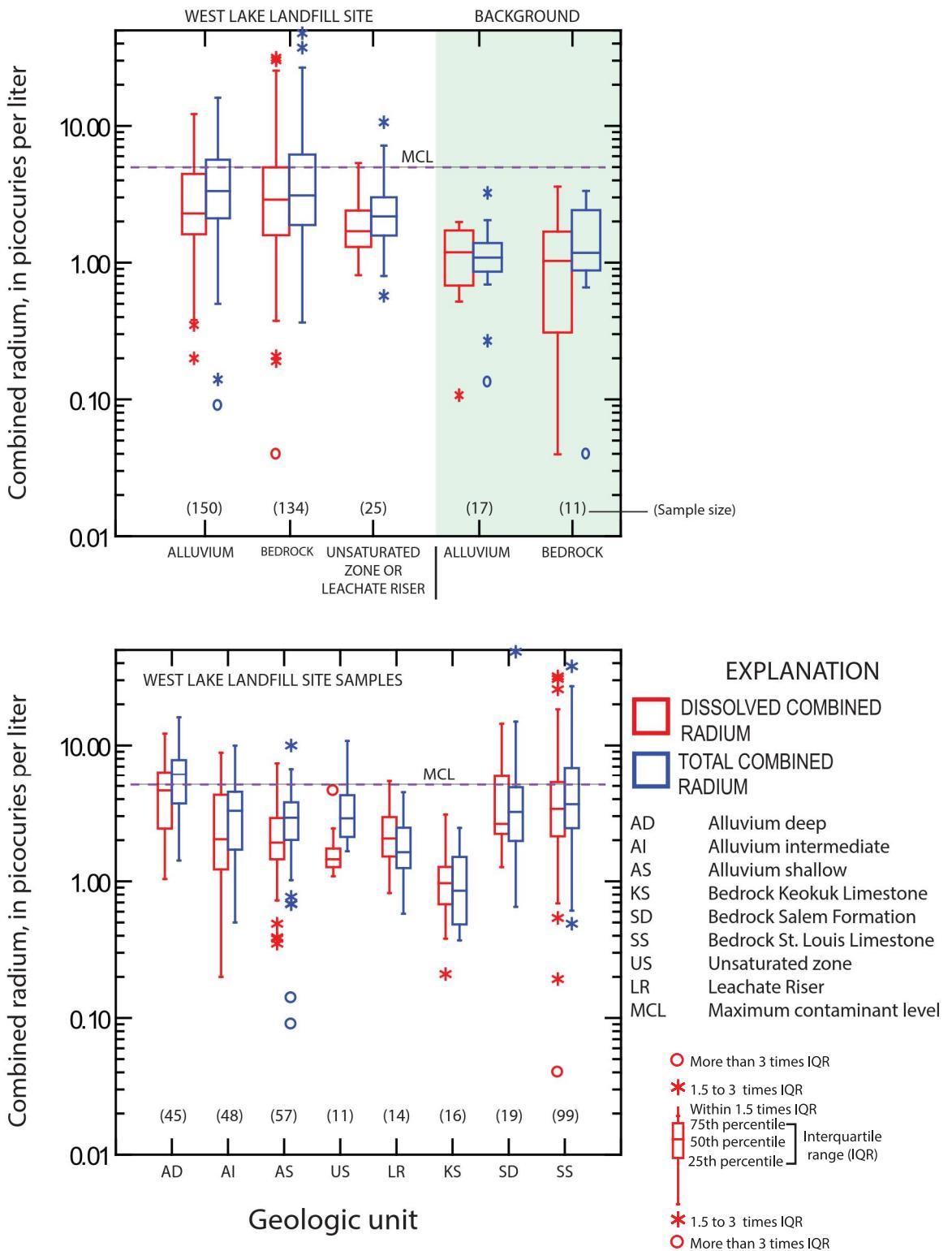
**Figure 6.** Monitoring wells at the West Lake Landfill site with landfill leachate effects. The presence of landfill leachate identified using concentrations of bromide (Br), chloride (Cl) and iodide (I).



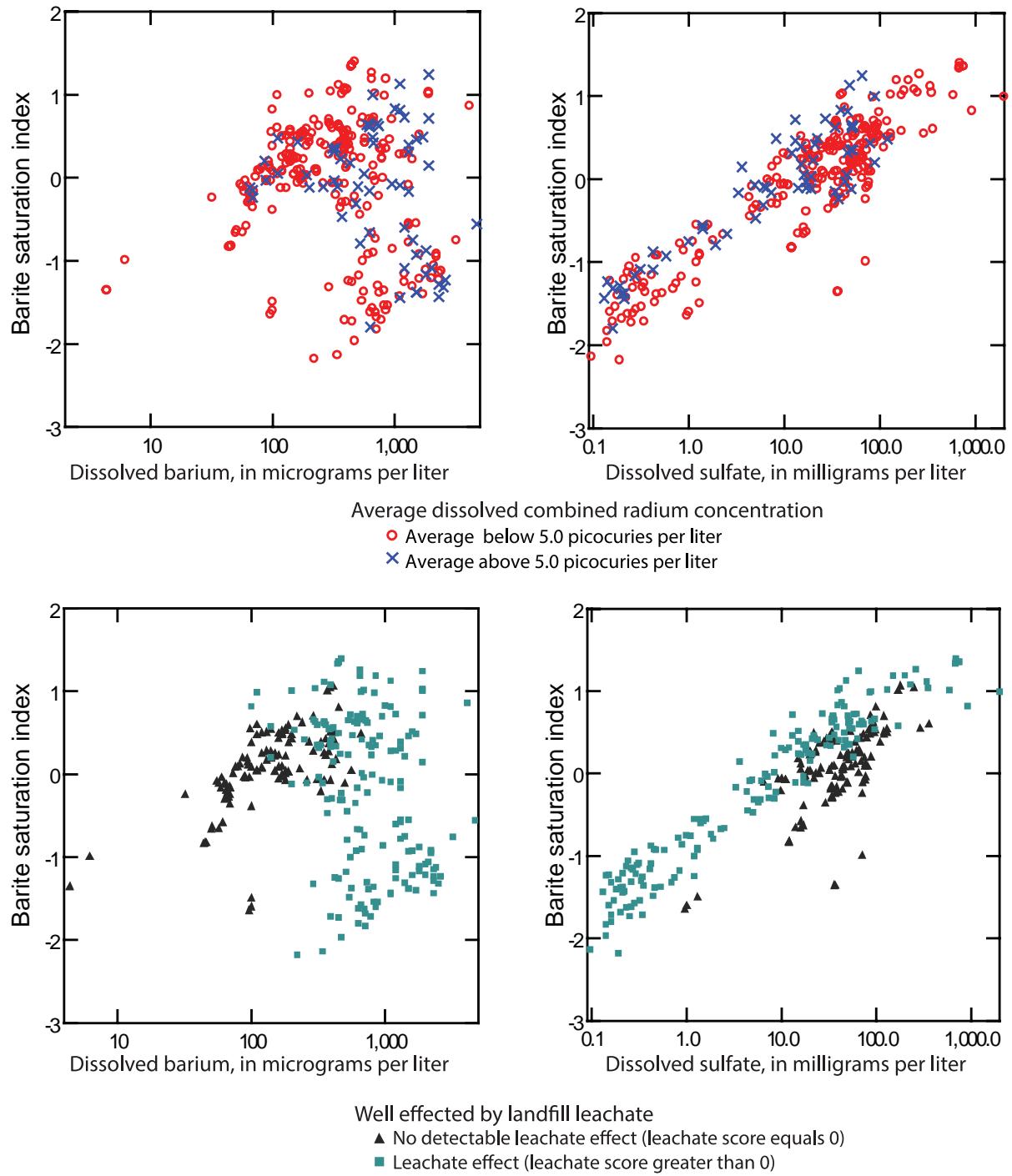
**Figure 7.** Boxplots of constituents in samples from monitoring wells at the West Lake Landfill site in relation to landfill leachate effects.



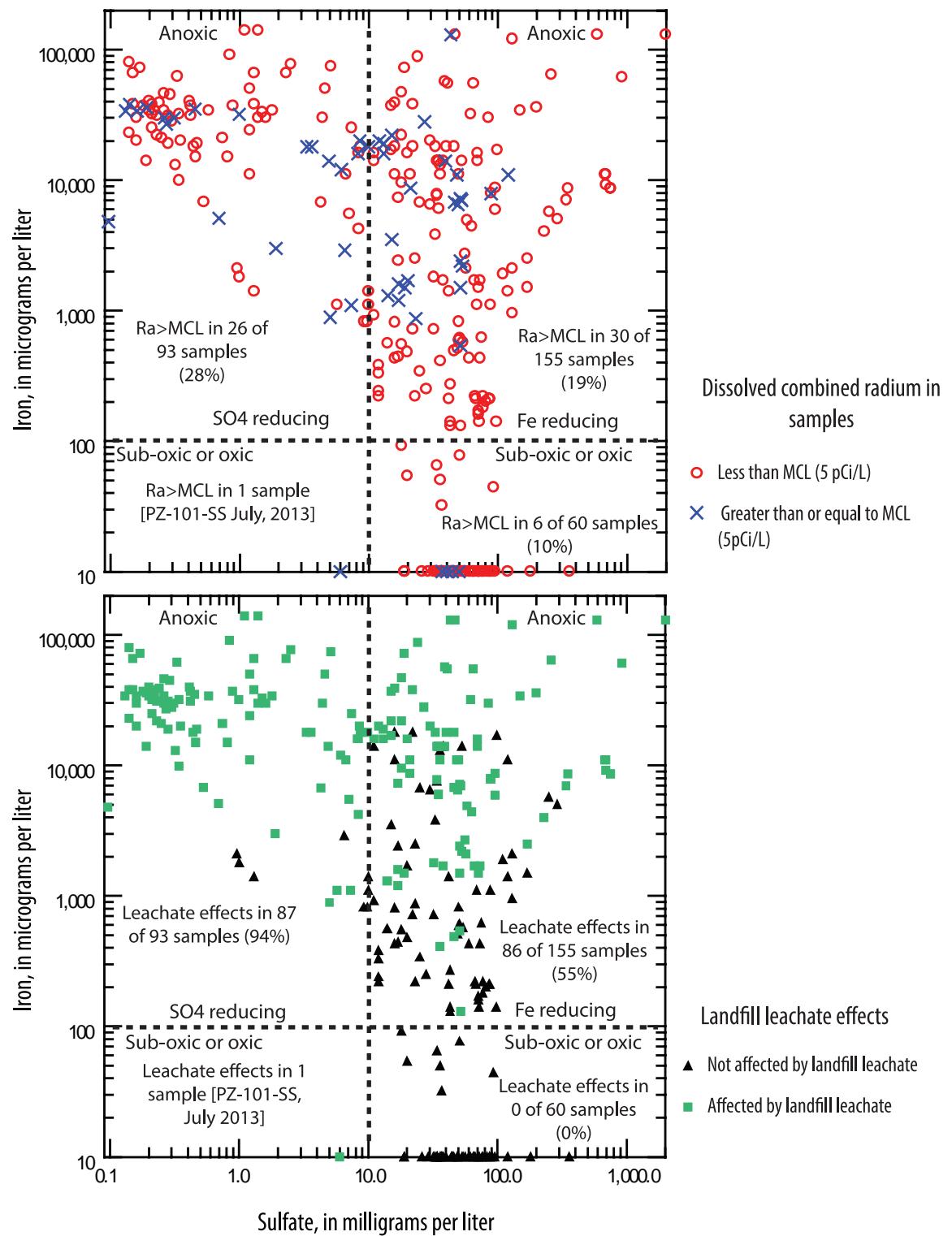
**Figure 8.** Trilinear diagram of major ions in groundwater samples from the West Lake Landfill site.



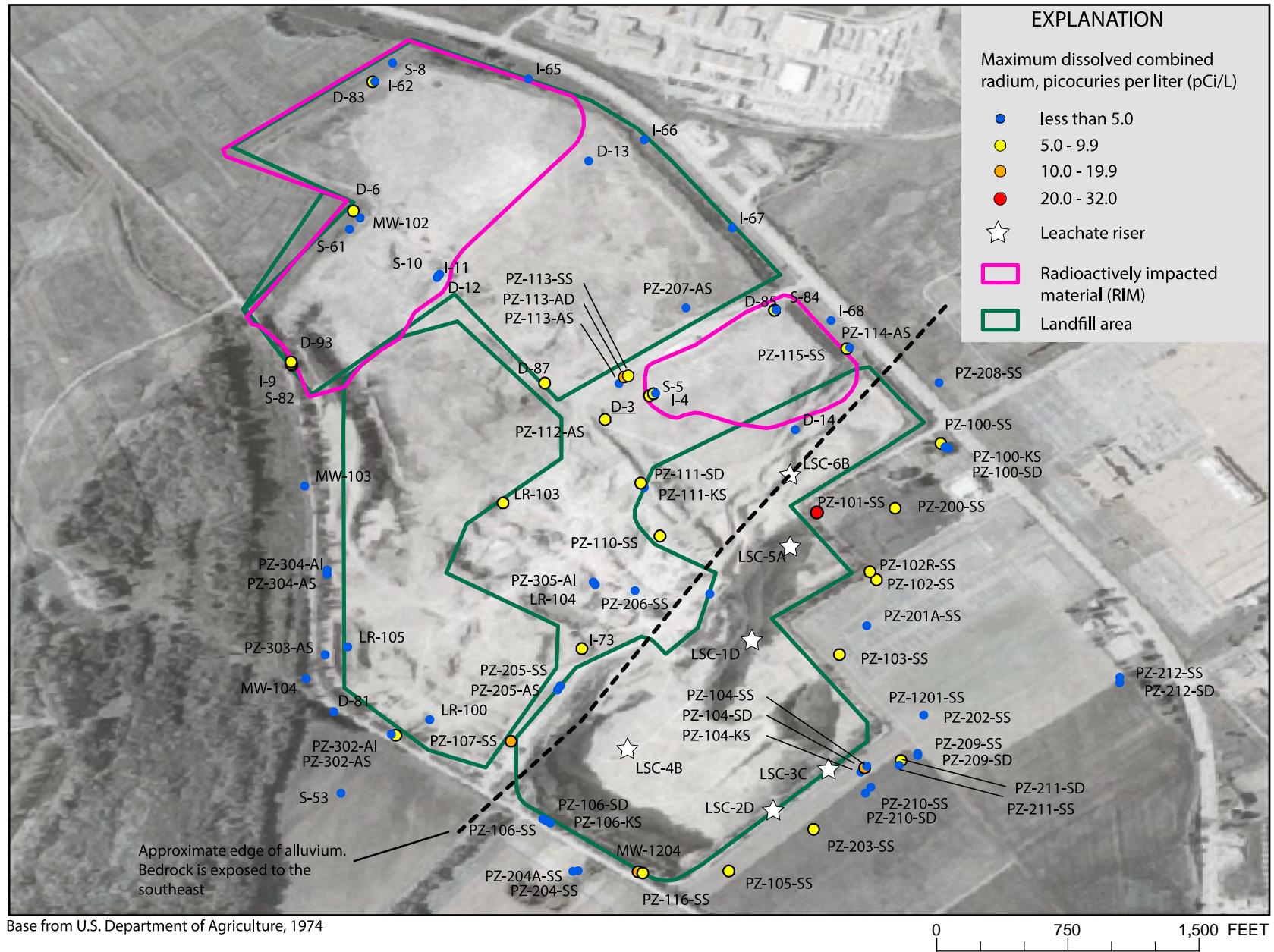
**Figure 9.** Box plots showing concentrations of dissolved and total combined radium in groundwater samples from monitoring wells in various geologic units at the West Lake Landfill site. Data from 2012–14.



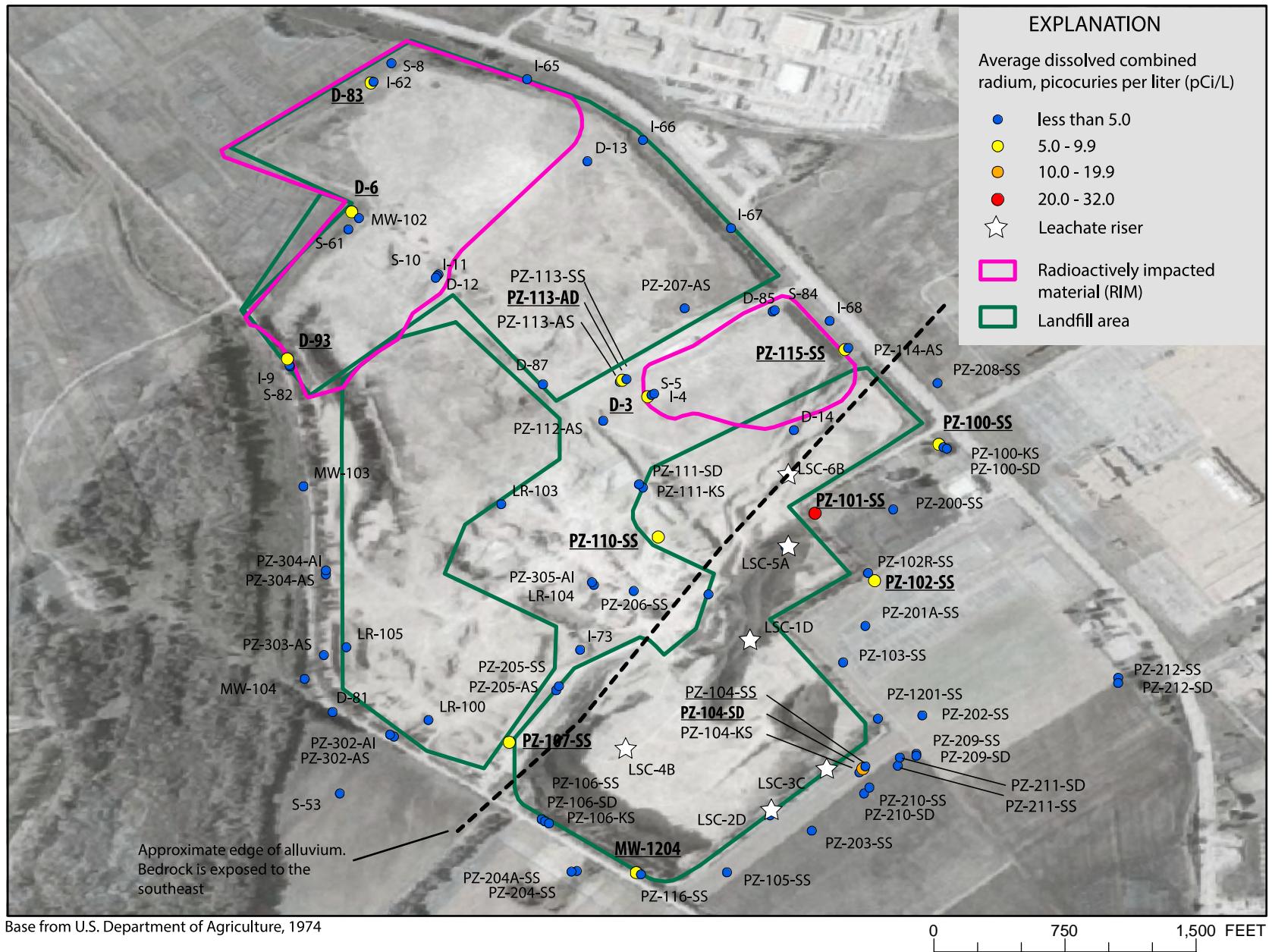
**Figure 10.** Barite saturation index in relation to dissolved barium (Ba) or sulfate ( $\text{SO}_4$ ) concentrations, the presence of dissolved combined radium above the maximum contaminant level (MCL), and the effects from landfill leachate in groundwater samples from the West Lake Landfill site (2012–14).



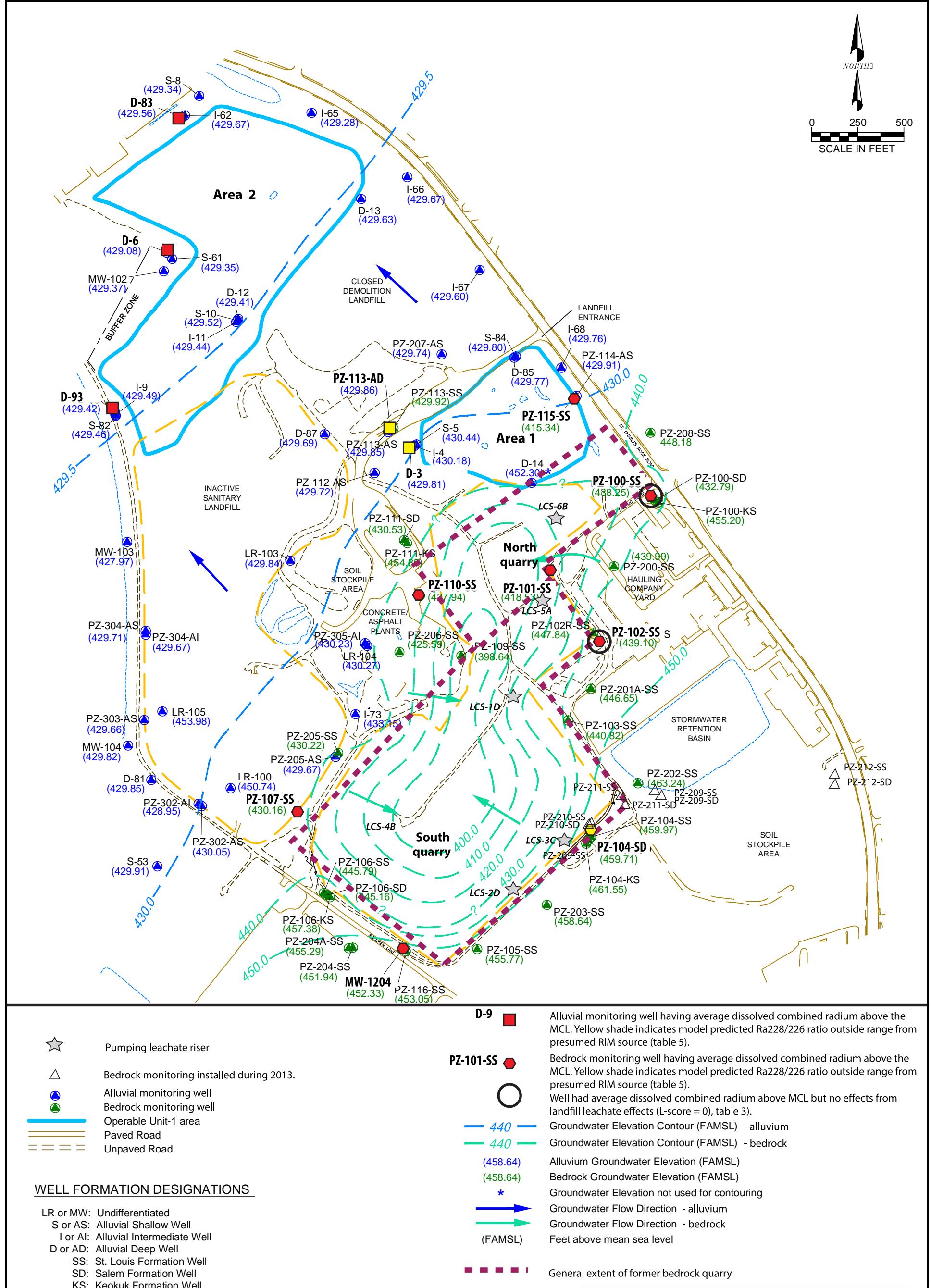
**Figure 11.** Relation between dissolved concentrations of sulfate ( $\text{SO}_4$ ), iron (Fe), and dissolved combined radium above the maximum contaminant level (MCL) in groundwater samples from the West Lake Landfill site.



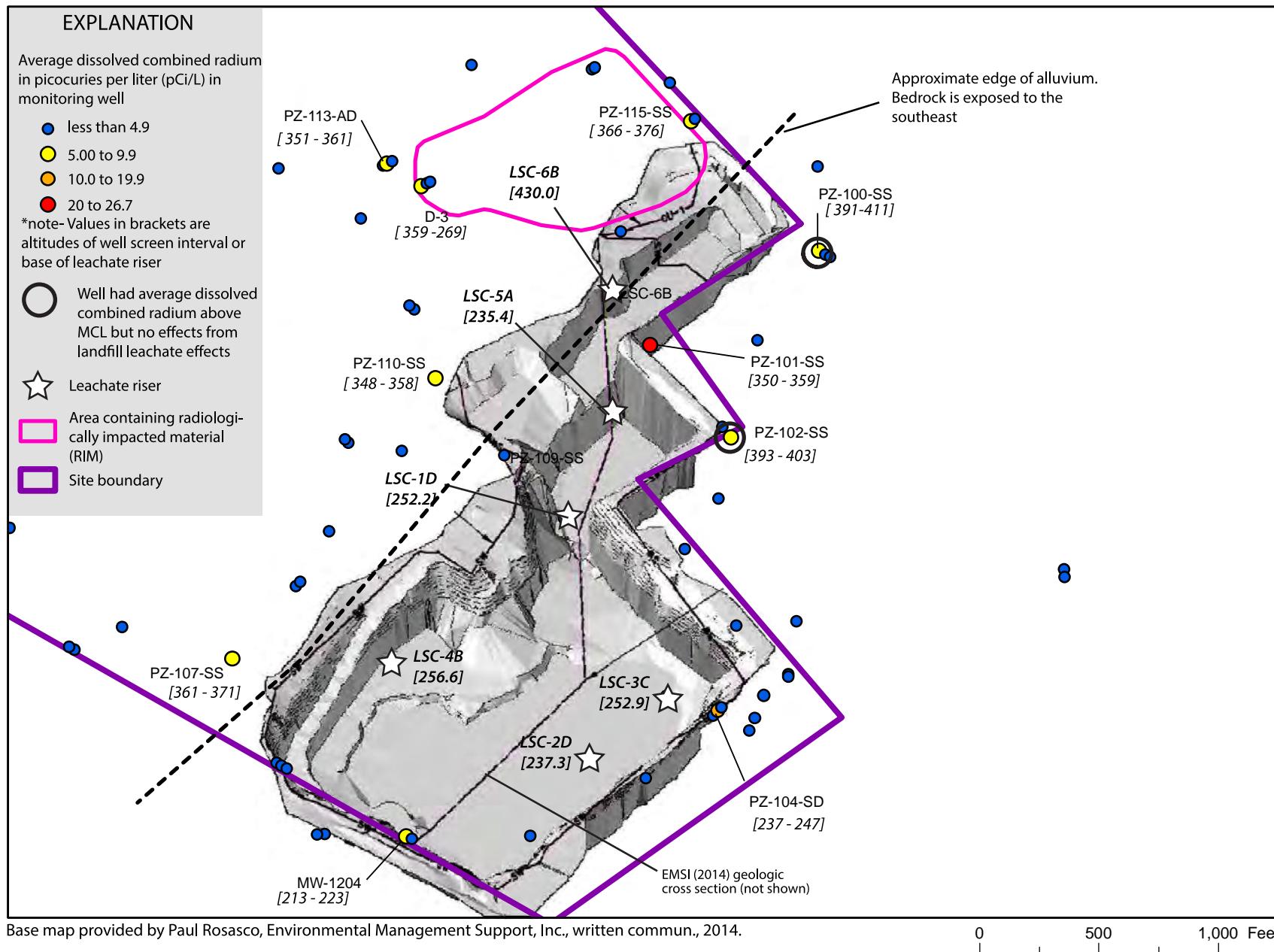
**Figure 12.** Maximum concentration of dissolved combined radium detected in groundwater samples from the West Lake Landfill site (2012–14).



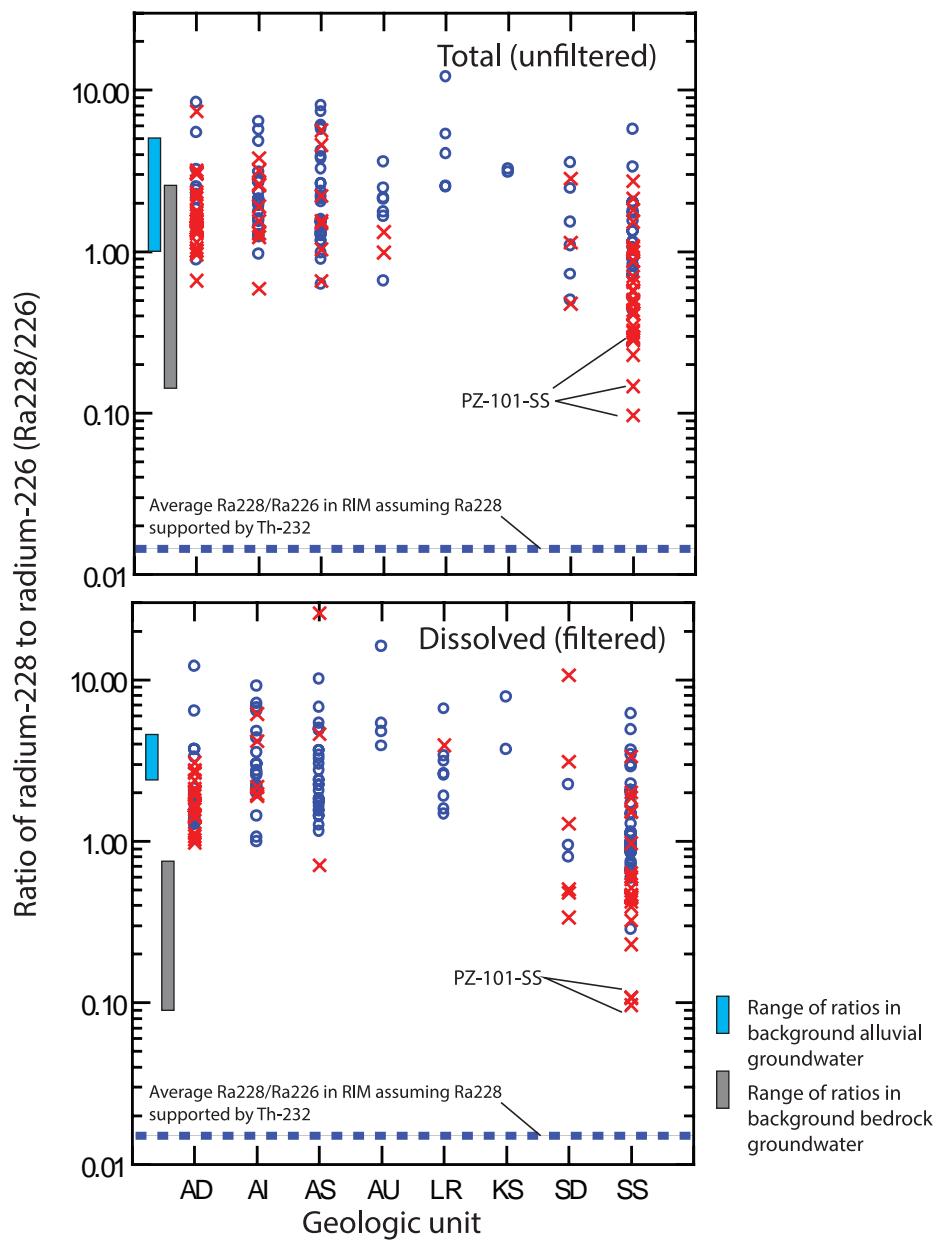
**Figure 13.** Average concentration of dissolved combined radium in groundwater samples from the West Lake Landfill site (2012-14). Wells with average dissolved combined radium values above the MCL underlined and bold-face.



**Figure 14.** Monitoring wells with average dissolved combined radium above the maximum contaminant level (MCL) and degree of landfill leachate effects in those wells, and results of radium isotope mass balance in relation to water levels measured during July 2012.



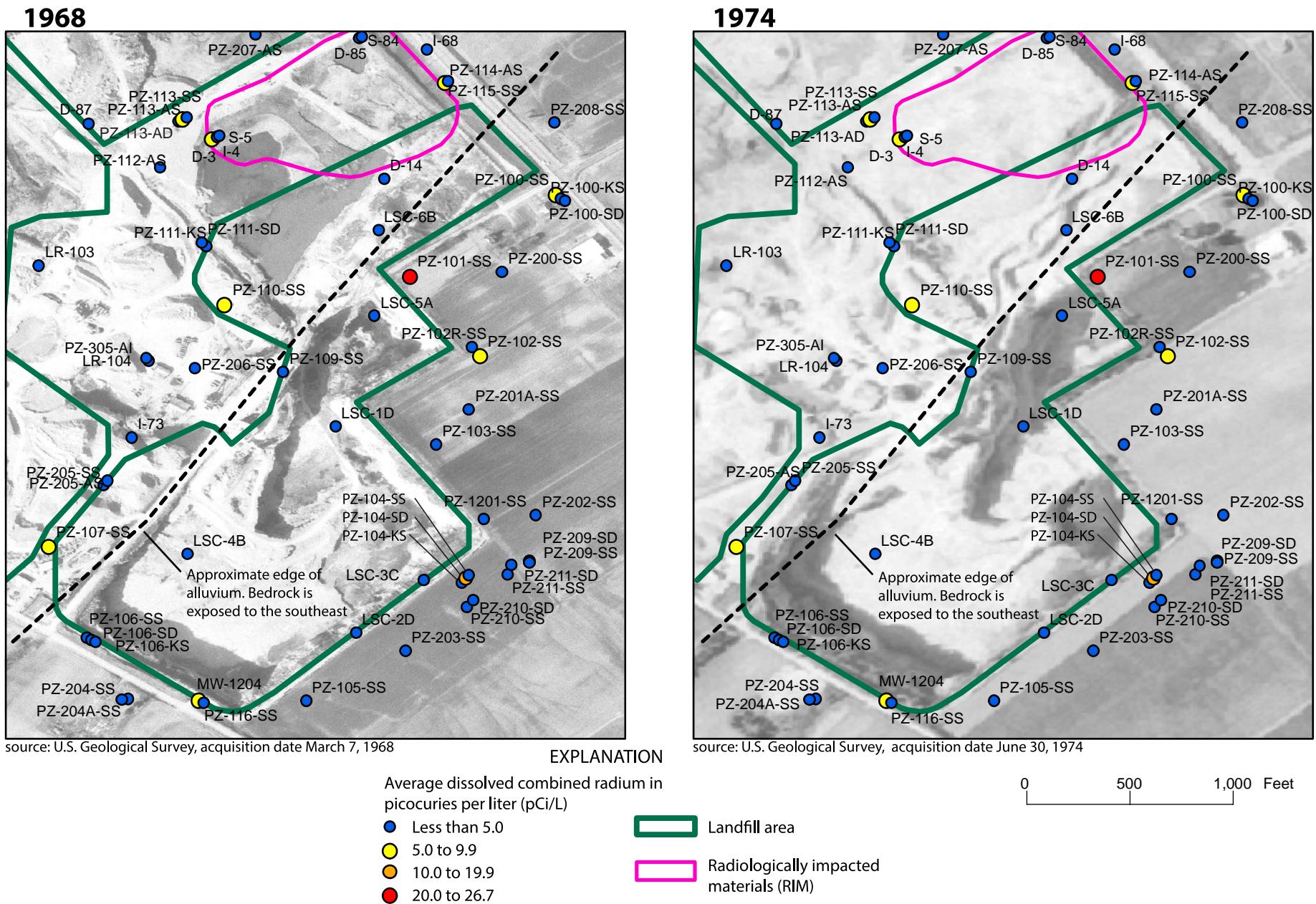
**Figure 15.** Approximate location of monitoring wells and leachate risers in the vicinity of the South and North quarry that have dissolved combined radium above the maximum contaminant level, and elevation of quarry floor and well screen intervals.



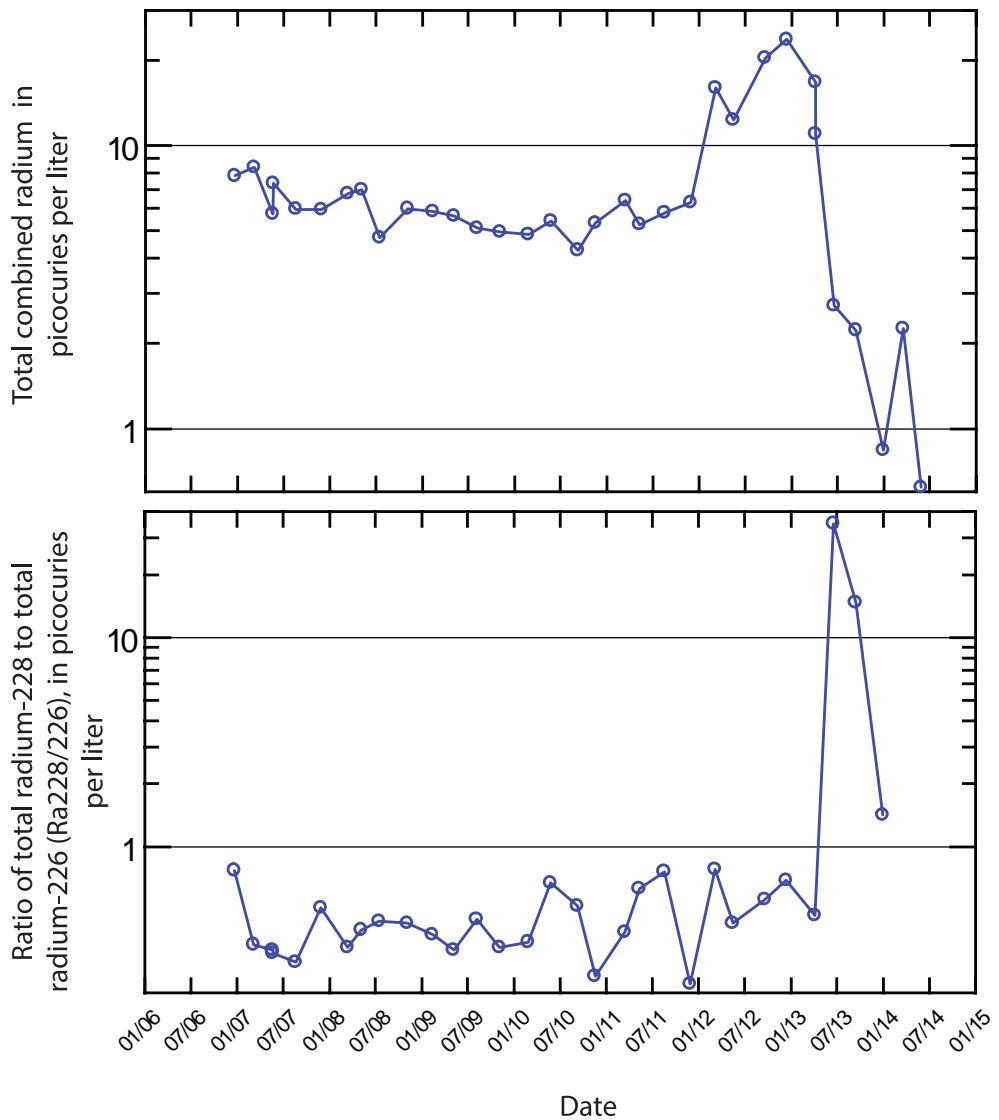
AD	Alluvium, deep	LR	Leachate Riser
AI	Alluvium, intermediate	KS	Bedrock, Keokuk Limestone
AS	Alluvium, shallow	SD	Bedrock, Salem Formation
AU	Unsaturated zone	SS	Bedrock, St. Louis Limestone

- Combined radium below 5 pCi/L (picocuries per liter) maximum contaminant level (MCL)
- ✖ Combined radium above 5 pCi/L (picocuries per liter) maximum contaminant level (MCL)

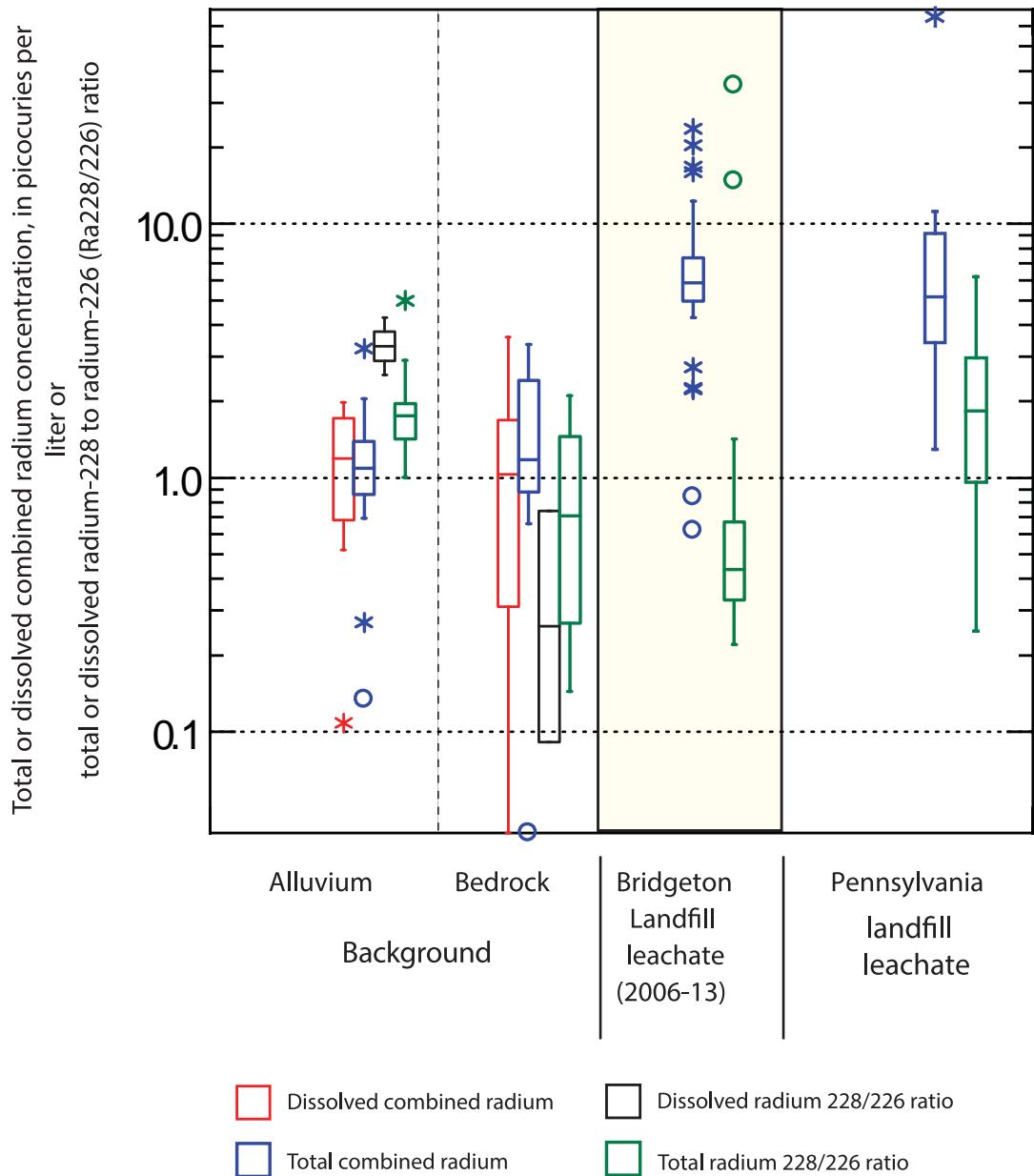
**Figure 16.** Plots showing ratio of radium-228 to radium-226 (Ra228/226) in groundwater samples from monitoring wells completed in various geologic units at the West Lake Landfill site in relation to ratios in background groundwater samples and radiologically impacted material (RIM). Ratio of Ra228/226 in radiologically impacted material (RIM) based on sample data contained in McLaren and Hart Inc. (1996).



**Figure 17.** Average dissolved combined radium in monitoring wells near the North and South quarry areas at the West Lake Landfill site in relation to site features shown on 1968 and 1974 aerial photographs. Imagery obtained from U.S. Geological Survey (2014).



**Figure 18.** Concentrations of total combined radium and ratio of total radium-228 to radium-226 (Ra228/226) in samples from leachate discharged from the Bridgeton Landfill (2006–14).

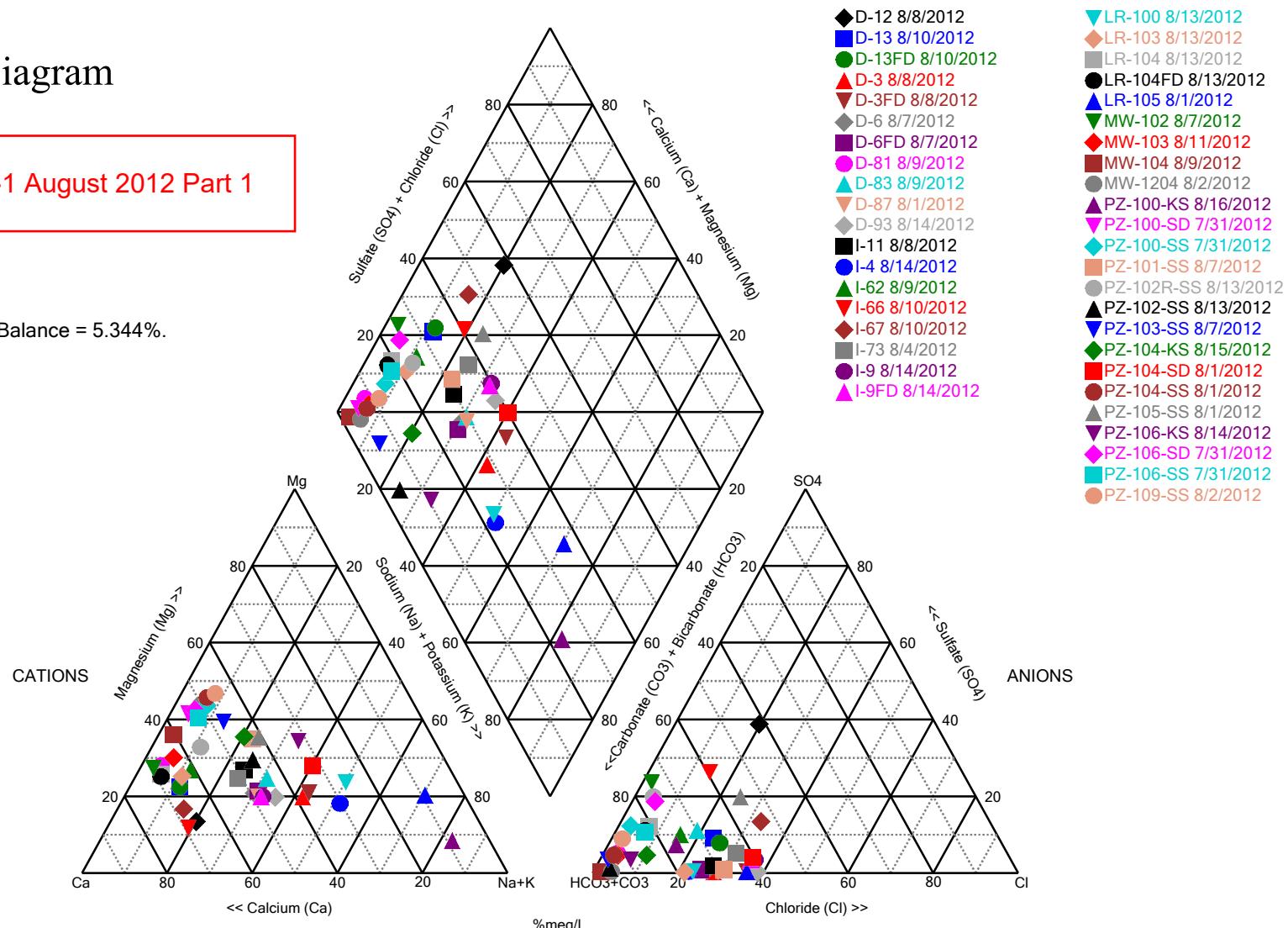


**Figure 19.** Comparison of dissolved and total combined radium and ratio of total and dissolved radium-228 to radium-226 (Ra228/226) in background groundwater samples to leachate pumped from the Bridgeton Landfill (2006–13) and selected Pennsylvania landfills. Pennsylvania leachate data from Civil and Environmental Consultants, Inc. (2005).

## Piper Diagram

Figure E-1 August 2012 Part 1

Cation-Anion Balance = 5.344%.



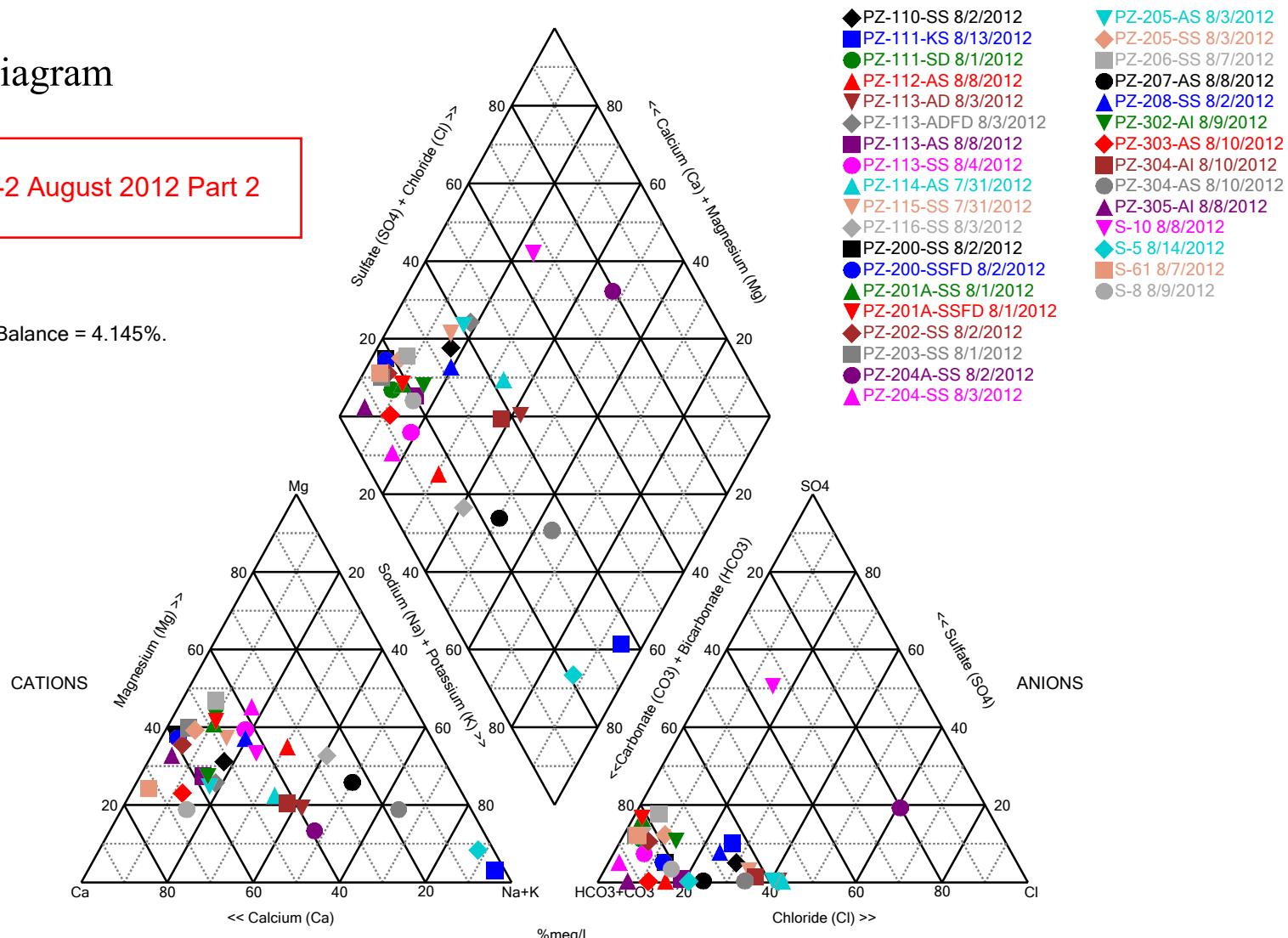
Analysis Run 5/5/2014 3:26 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-2 August 2012 Part 2

Cation-Anion Balance = 4.145%.



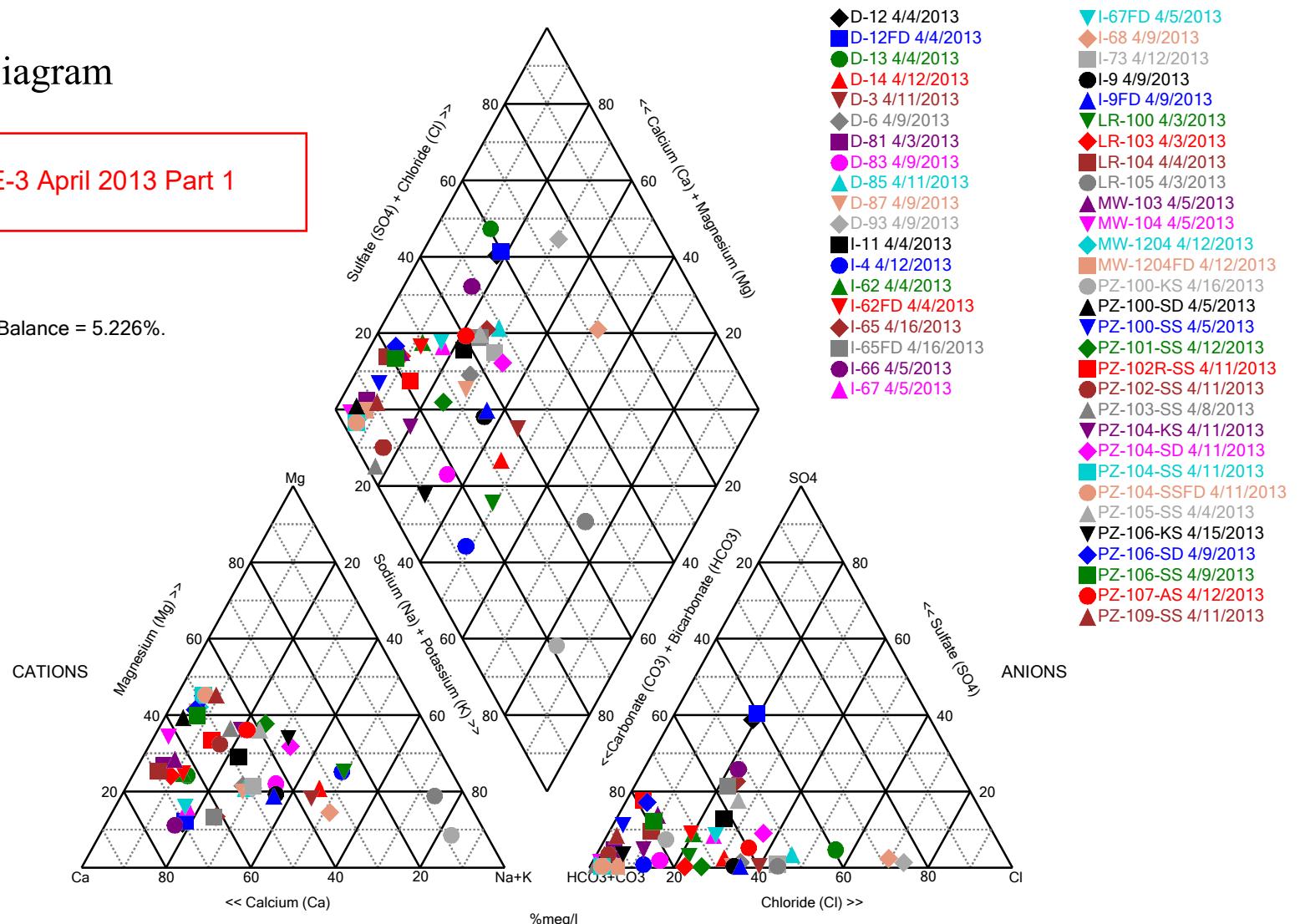
Analysis Run 5/5/2014 3:31 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-3 April 2013 Part 1

Cation-Anion Balance = 5.226%.



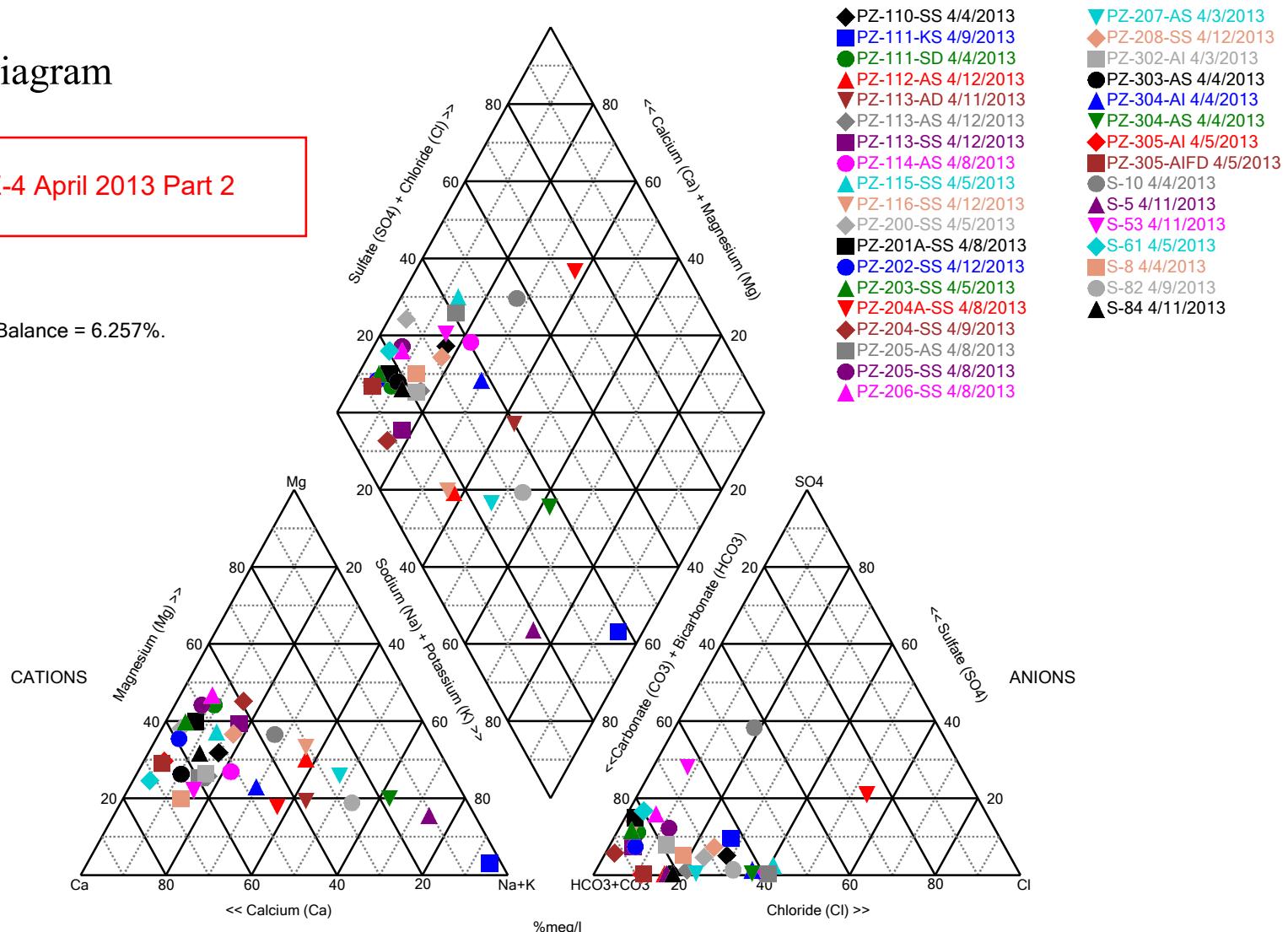
Analysis Run 5/5/2014 3:24 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-4 April 2013 Part 2

Cation-Anion Balance = 6.257%.



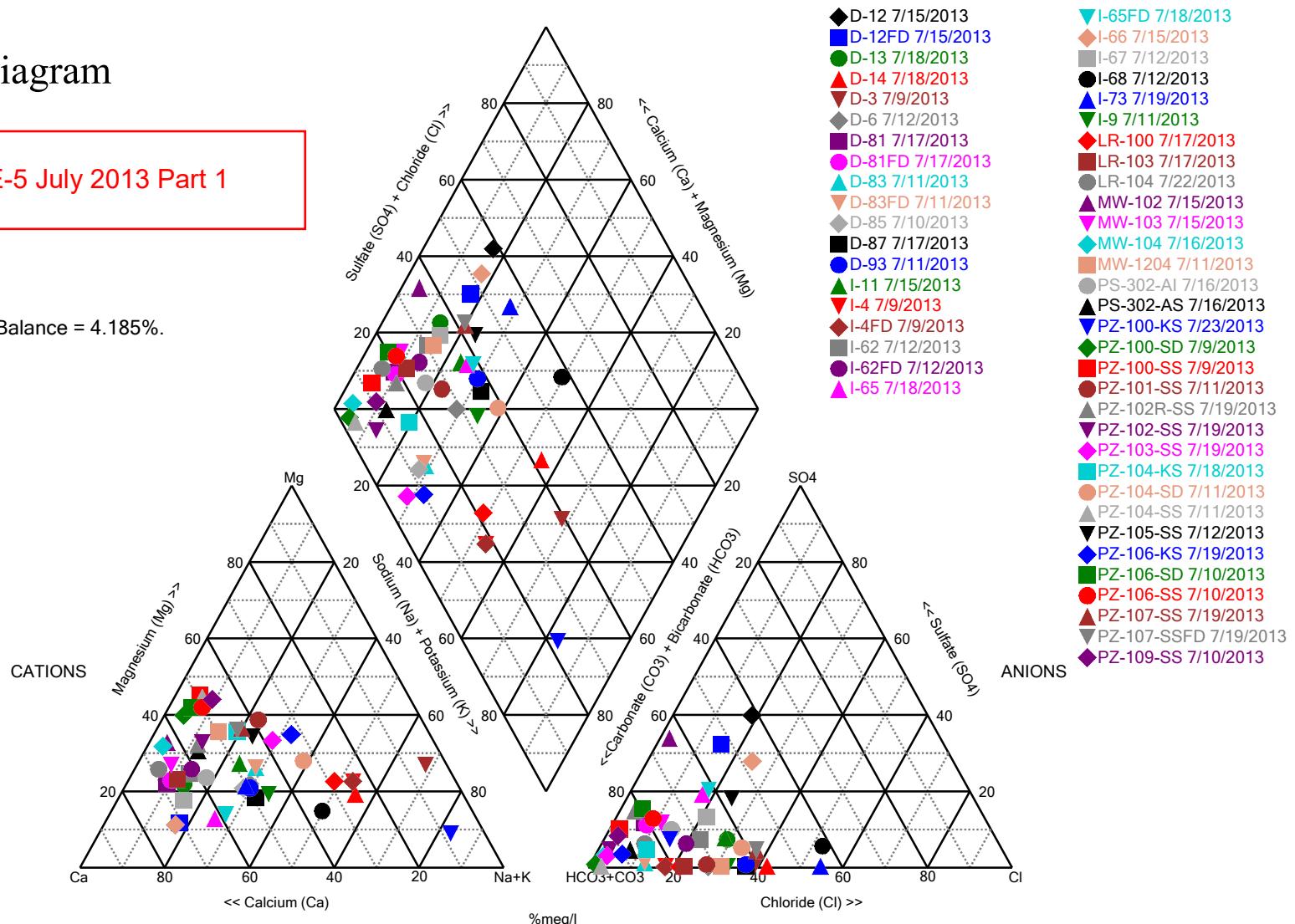
Analysis Run 5/5/2014 3:38 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-5 July 2013 Part 1

Cation-Anion Balance = 4.185%.



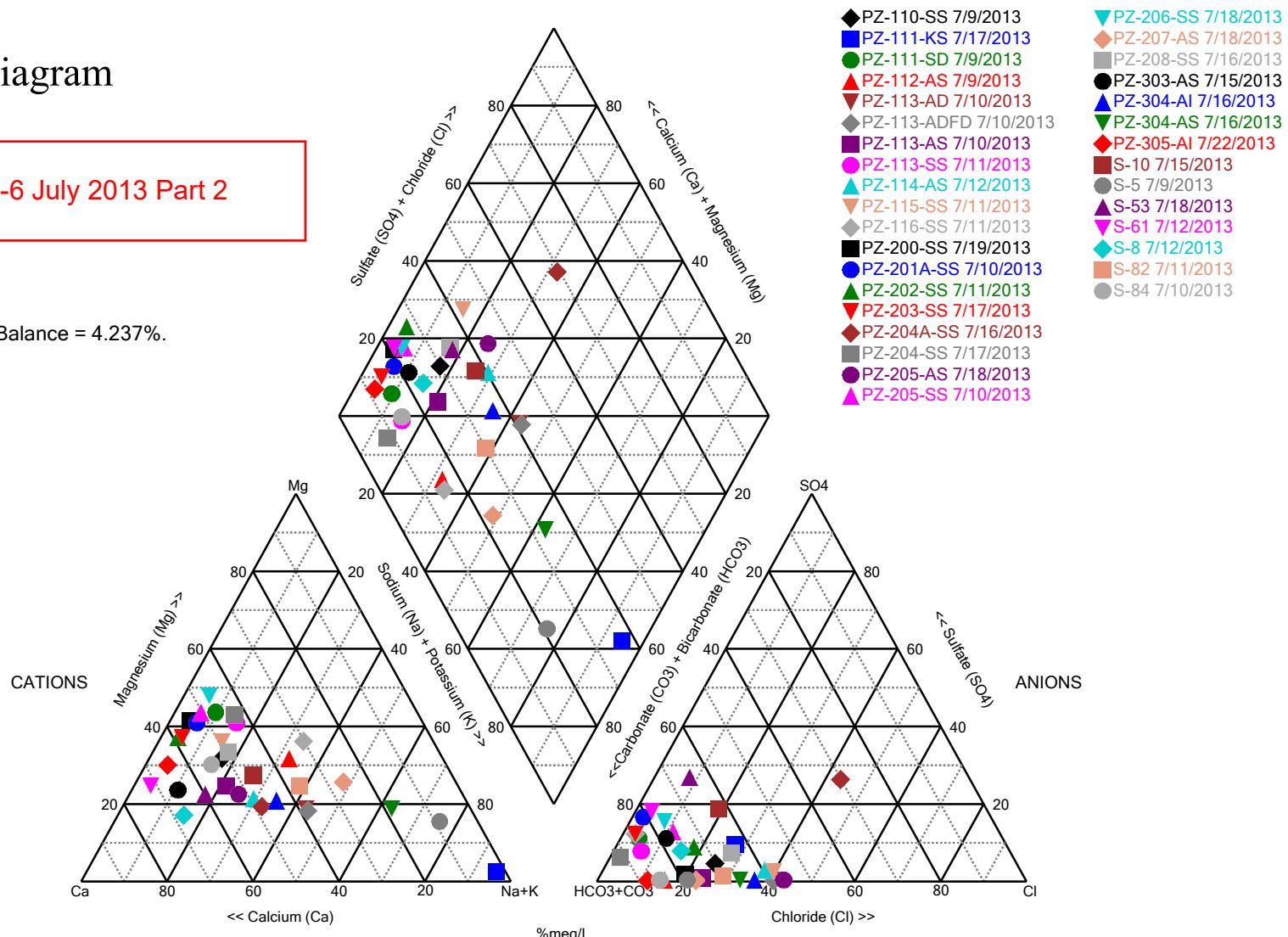
Analysis Run 5/5/2014 3:25 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-6 July 2013 Part 2

Cation-Anion Balance = 4.237%.



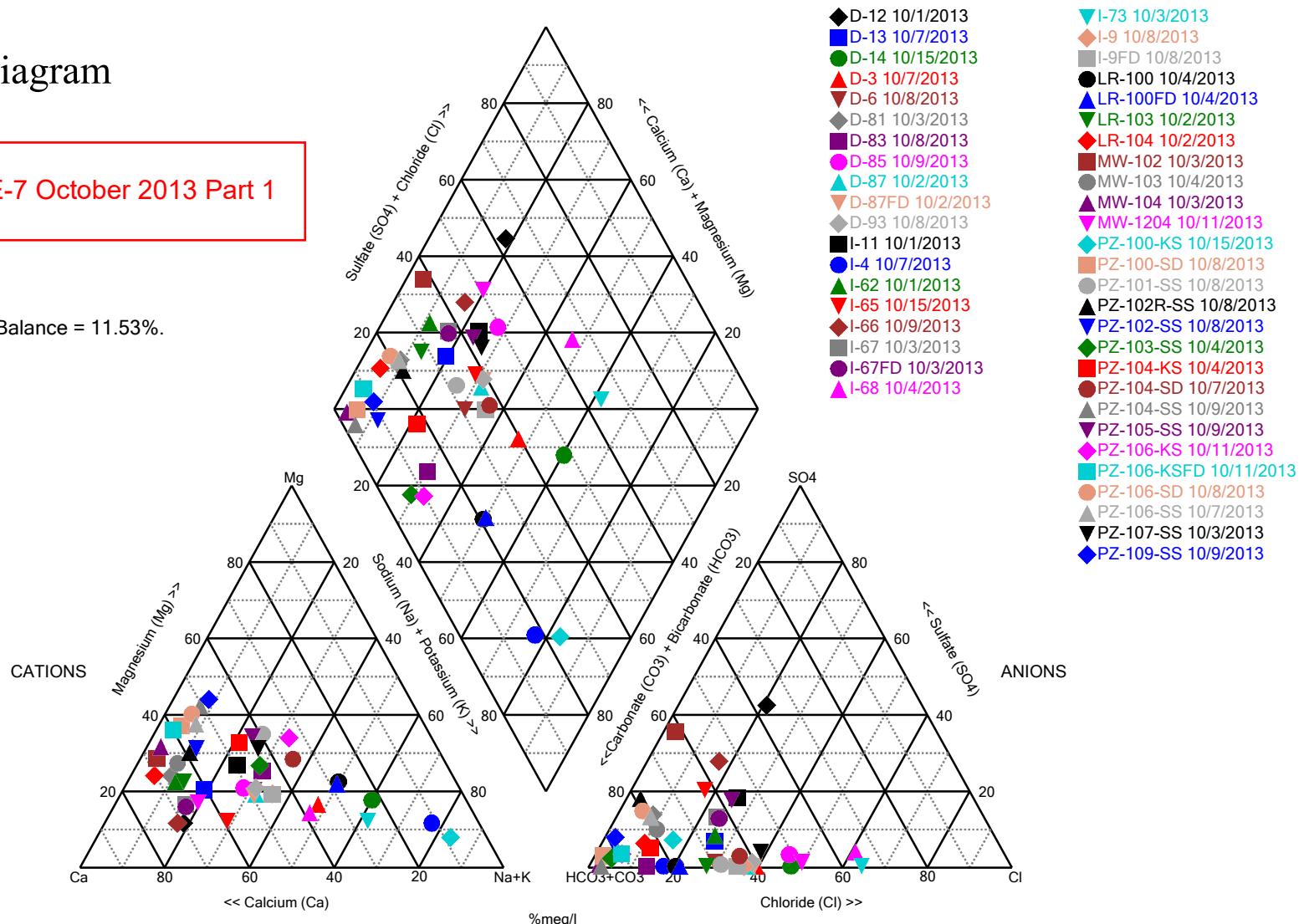
Analysis Run 5/5/2014 3:30 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-7 October 2013 Part 1

Cation-Anion Balance = 11.53%.



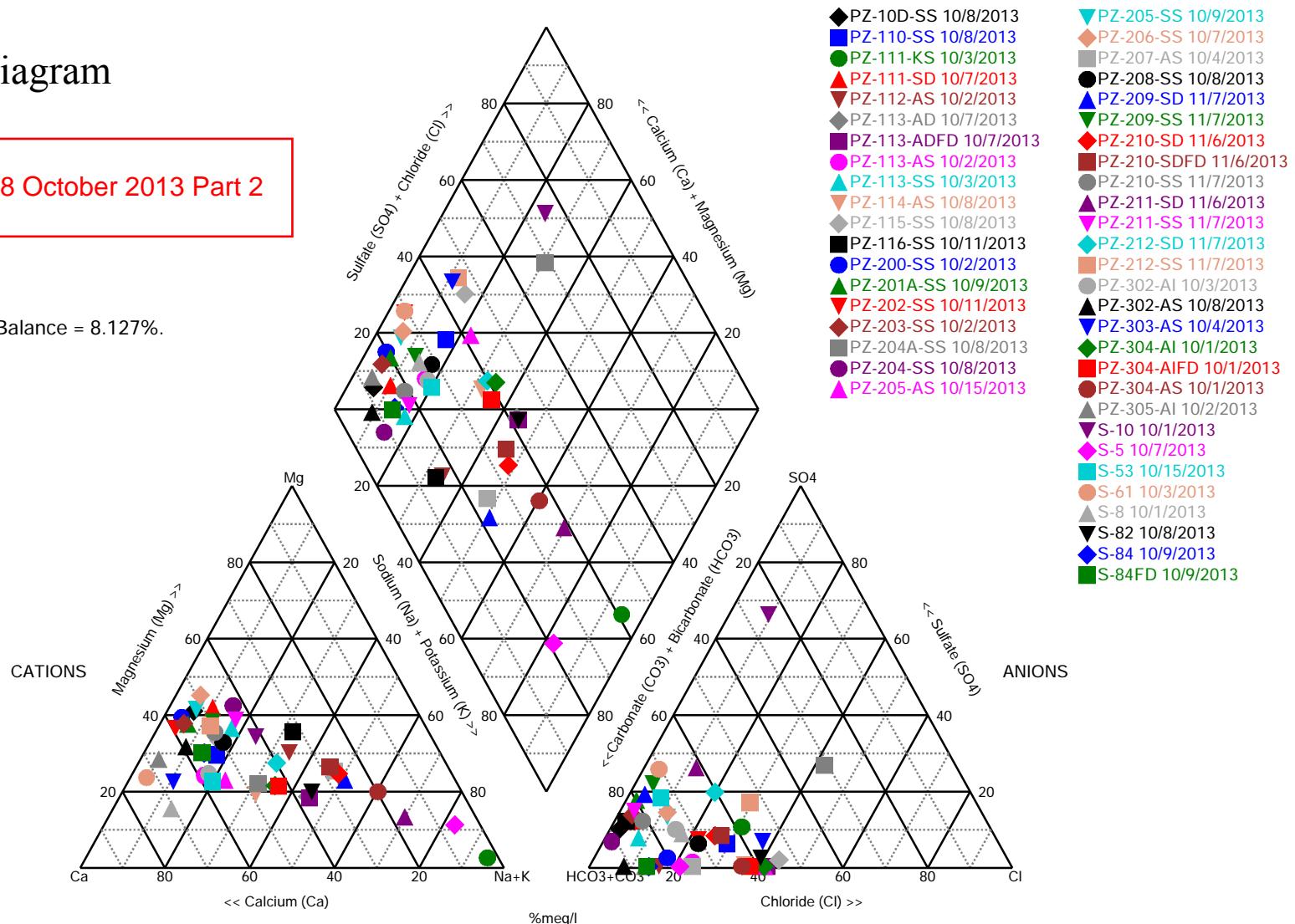
Analysis Run 5/5/2014 3:27 PM

Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

## Piper Diagram

Figure E-8 October 2013 Part 2

Cation-Anion Balance = 8.127%.



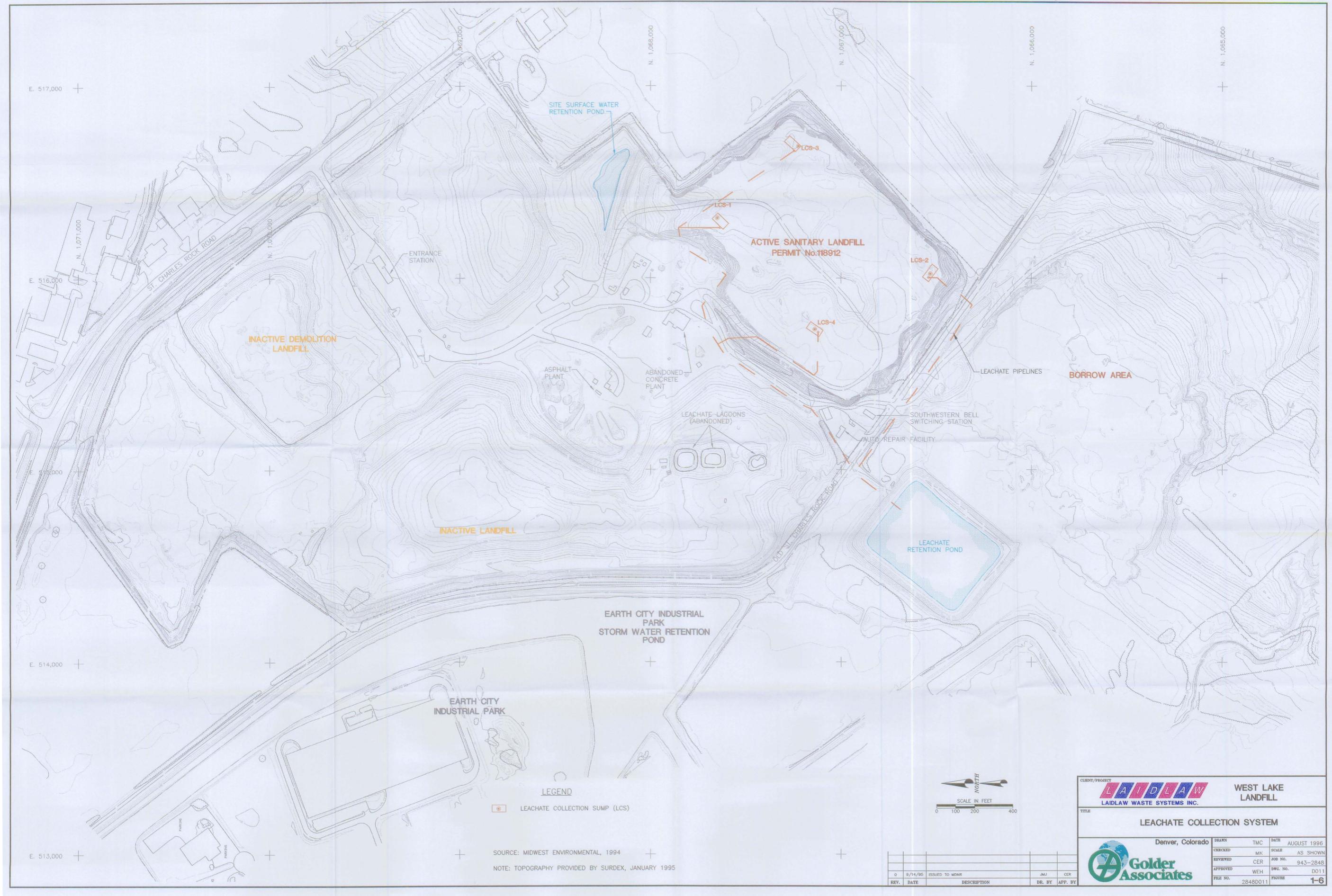
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Facility: Bridgeton LF Client: Bridgeton LF Data File: Bridgeton OU-1 Additional Monitoring Geochemistry Data for Piper+Stiff

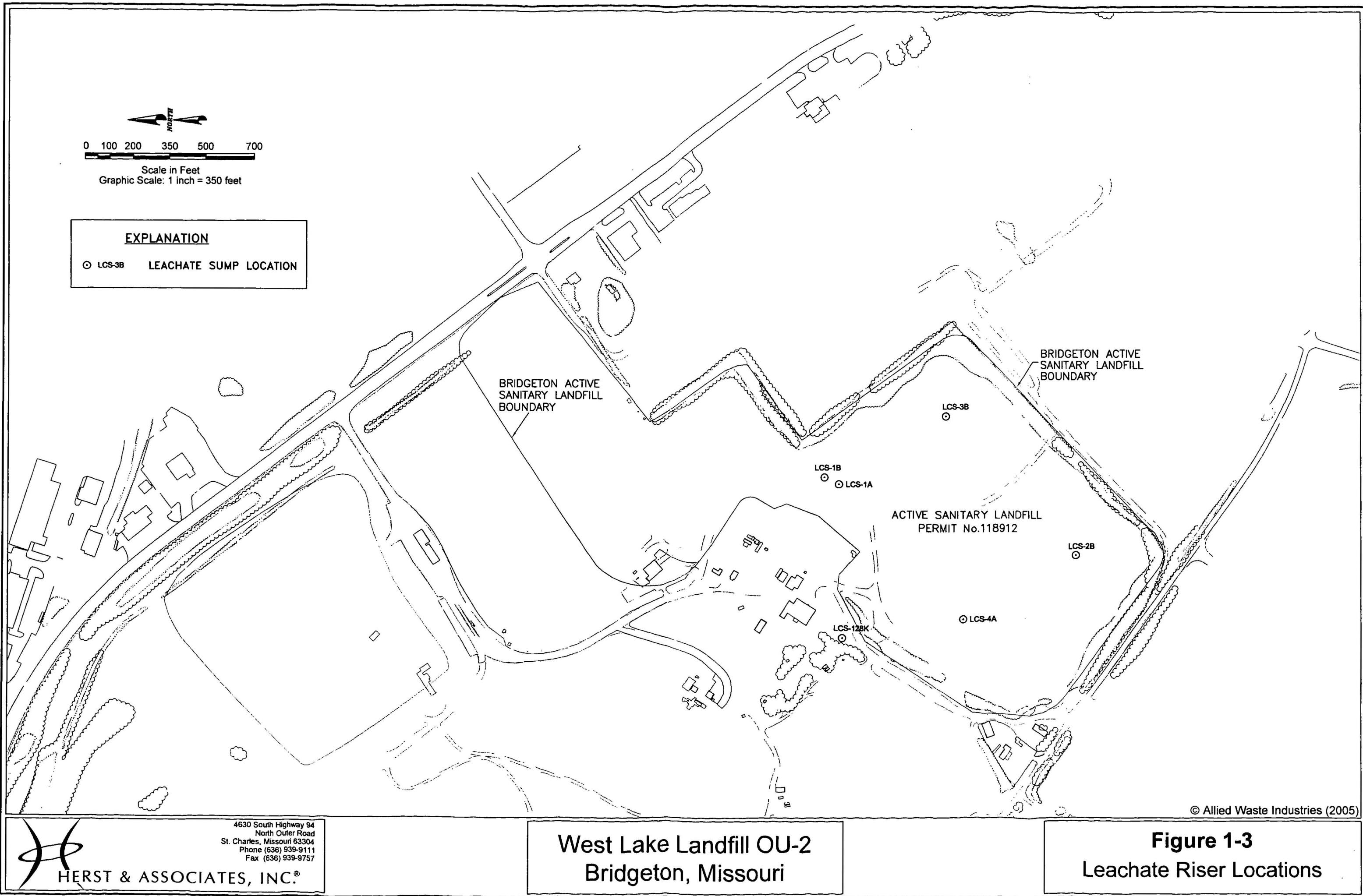
**APPENDIX S**

**LEACHATE COLLECTION SYSTEM DATA**

DRAFT



CLIENT/PROJECT		LAIDLAW		WEST LAKE LANDFILL	
		LAIDLAW WASTE SYSTEMS INC.			
TITLE		LEACHATE COLLECTION SYSTEM			
Denver, Colorado	DRAWN	TMC	DATE	AUGUST 1996	
	CHECKED	MK	SCALE	AS SHOWN	
	REVIEWED	CER	JOB NO.	943-2848	
	APPROVED	WEH	DWG. NO.	D011	
Golder Associates	FILE NO.	28480011	FIGURE	1-6	



**LEGEND**

◆ LCS-6A Leachate Sump Location

NORTH

0 100 200 350 500 700

Scale in Feet  
Graphic Scale: 1 inch = 350 feet

TOPOGRAPHY PROVIDED BY SANBORN, JANUARY 20, 2003  
BOUNDARIES ARE APPROXIMATE



© Allied Waste Industries (2006)

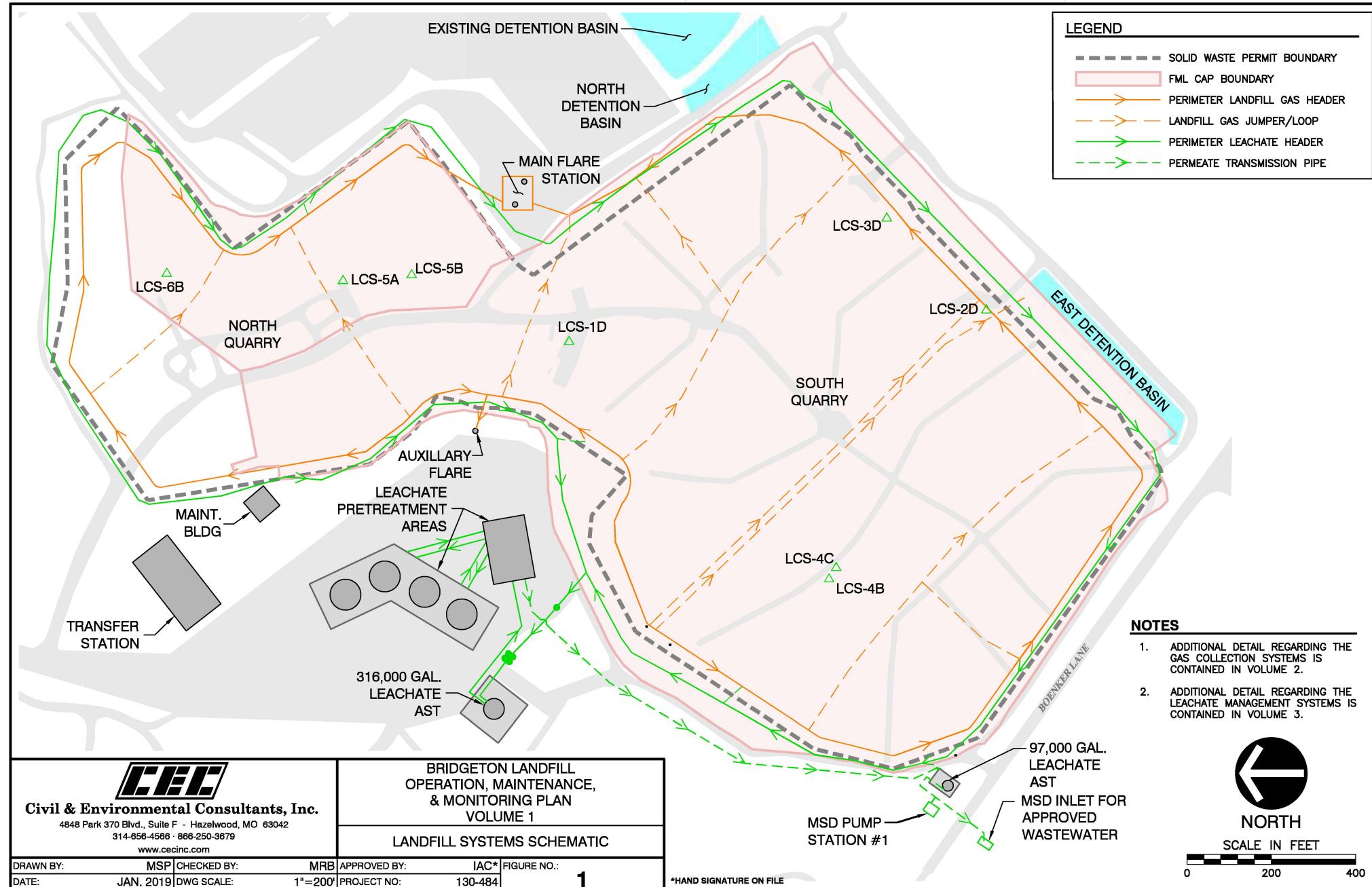


HERST & ASSOCIATES, INC.\*

4030 South Highway 94  
North Outer Road  
St. Charles, Missouri 63304  
Phone (800) 936-4111  
Fax (800) 939-9757

West Lake Landfill OU-2  
Bridgeton, Missouri

**Figure 1-3**  
Leachate Risers - Former  
Active Sanitary Landfill



**Table 6.1 Organic compounds detected in leachate**

Compound	Active Sanitary Landfill Leachate				Inactive Landfill Leachate			
	LCS-1	LCS-2	LCS-3	LCS-4	LR-100	LR-103	LR-104	LR-105
Acetone	<b>1.2</b>	<b>0.65</b>	<b>0.038</b>	<b>0.61</b>	<0.010	<0.010	<0.010	<b>0.04</b>
Benzene	<0.5	<b>0.009</b>	<0.005	<0.005	<0.005	<0.005	<0.005	<b>0.007</b>
Chlorobenzene	<0.5	<b>0.035</b>	<b>0.029</b>	<b>0.011</b>	<b>0.044</b>	<0.005	<0.005	<b>0.74</b>
1,4-Dichlorobenzene	<0.5	<b>0.081</b>	<b>0.009</b>	<b>0.056</b>	<b>0.01</b>	<0.005	<0.005	<b>0.068</b>
Ethylbenzene	<0.5	<b>0.049</b>	<b>0.023</b>	<b>0.07</b>	<b>0.012</b>	<0.005	<0.005	<b>0.089</b>
2-Hexanone	<1	<b>0.1</b>	<0.010	<b>0.18</b>	<0.010	<0.010	<0.010	<0.010
Methyl Ethyl Ketone	<b>3</b>	<b>1.3</b>	<b>0.11</b>	<b>2.6</b>	<0.010	<0.010	<0.010	<0.010
Methyl iso-butyl Ketone	<1	<b>0.08</b>	<0.010	<b>0.076</b>	<0.010	<0.010	<0.010	<0.010
Styrene	<0.5	<b>0.005</b>	<0.005	<b>0.006</b>	<0.005	<0.005	<0.005	<0.005
Toluene	<0.5	<b>0.097</b>	<b>0.015</b>	<b>0.12</b>	<0.005	<0.005	<0.005	<b>0.007</b>
Total Xylenes	<0.5	<b>0.14</b>	<b>0.035</b>	<b>0.17</b>	<b>0.057</b>	<0.005	<0.005	<b>0.43</b>
m+p Cresol	<b>1.9</b>	<b>0.95</b>	<b>0.077</b>	<b>0.26</b>	<0.010	<0.010	<0.010	R
2,4-Dimethylphenol	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<b>0.082</b>
bis(2-ethylhexyl)phthalate	<b>0.019</b>	<b>0.022</b>	<b>0.017</b>	<0.010	<b>0.12</b>	<0.006	<0.006	<b>0.036</b>
Diethyl phthalate	<b>0.033</b>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dimethyl phthalate	<b>0.012</b>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenol	<b>0.29</b>	<b>0.16</b>	<0.010	<b>0.017</b>	<0.010	<0.010	<0.010	R
Naphthalene	<0.010	<0.010	<0.010	<0.010	<b>0.011</b>	<0.010	<0.010	<0.010
Volatile Petroleum Hydrocarbons	<b>0.41</b>	<b>0.4</b>	<b>0.12</b>	<b>0.48</b>	<b>0.17</b>	<0.05	<0.05	<b>0.95</b>
Diesel-range Petroleum Hydrocarbons	<b>79</b>	<b>6.9</b>	<b>2.2</b>	<b>0.22</b>	<b>2.2</b>	<b>0.63</b>	<b>0.08</b>	<b>4.4</b>

Notes:

All results in mg/l

R: Data point rejected during data validation

Results above the reporting limit are shown in ***boldface/italic*** type

Inactive landfill leachate riser LR-101 was not installed due to the absence of leachate at this location.

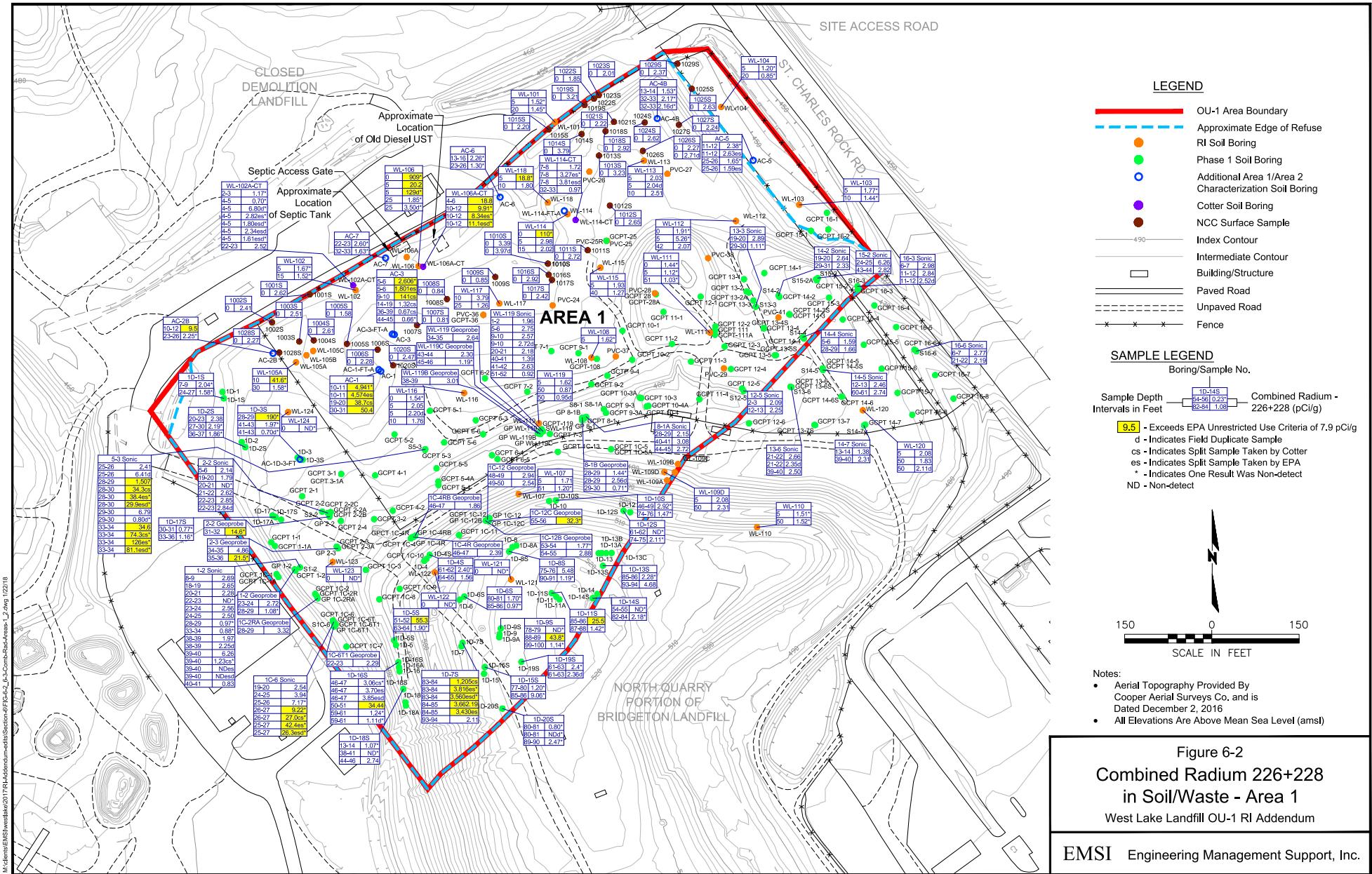
Inactive landfill leachate riser LR-102 was not sampled due to minimal (<6 inches) liquid thickness.

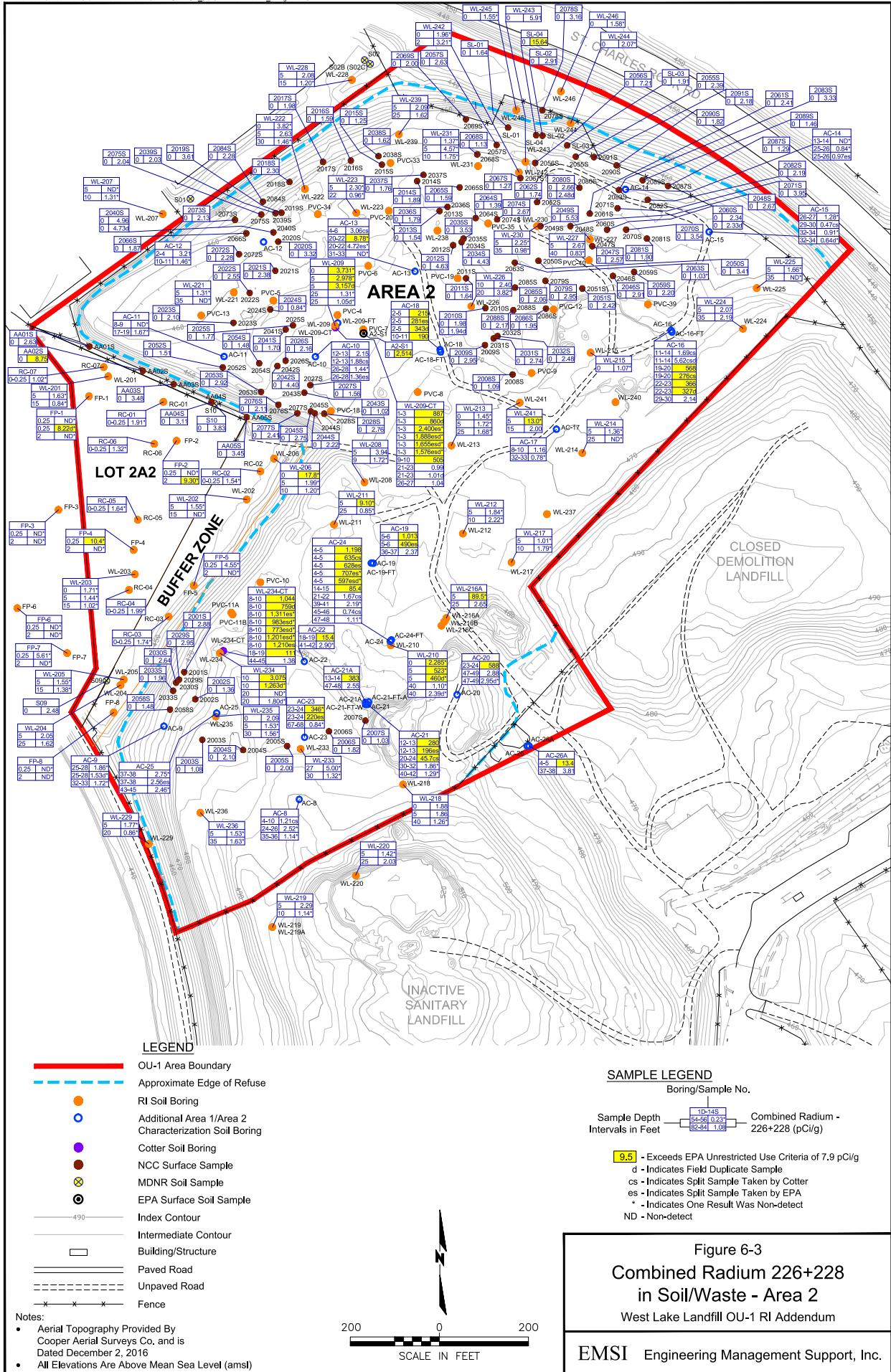
**APPENDIX T**

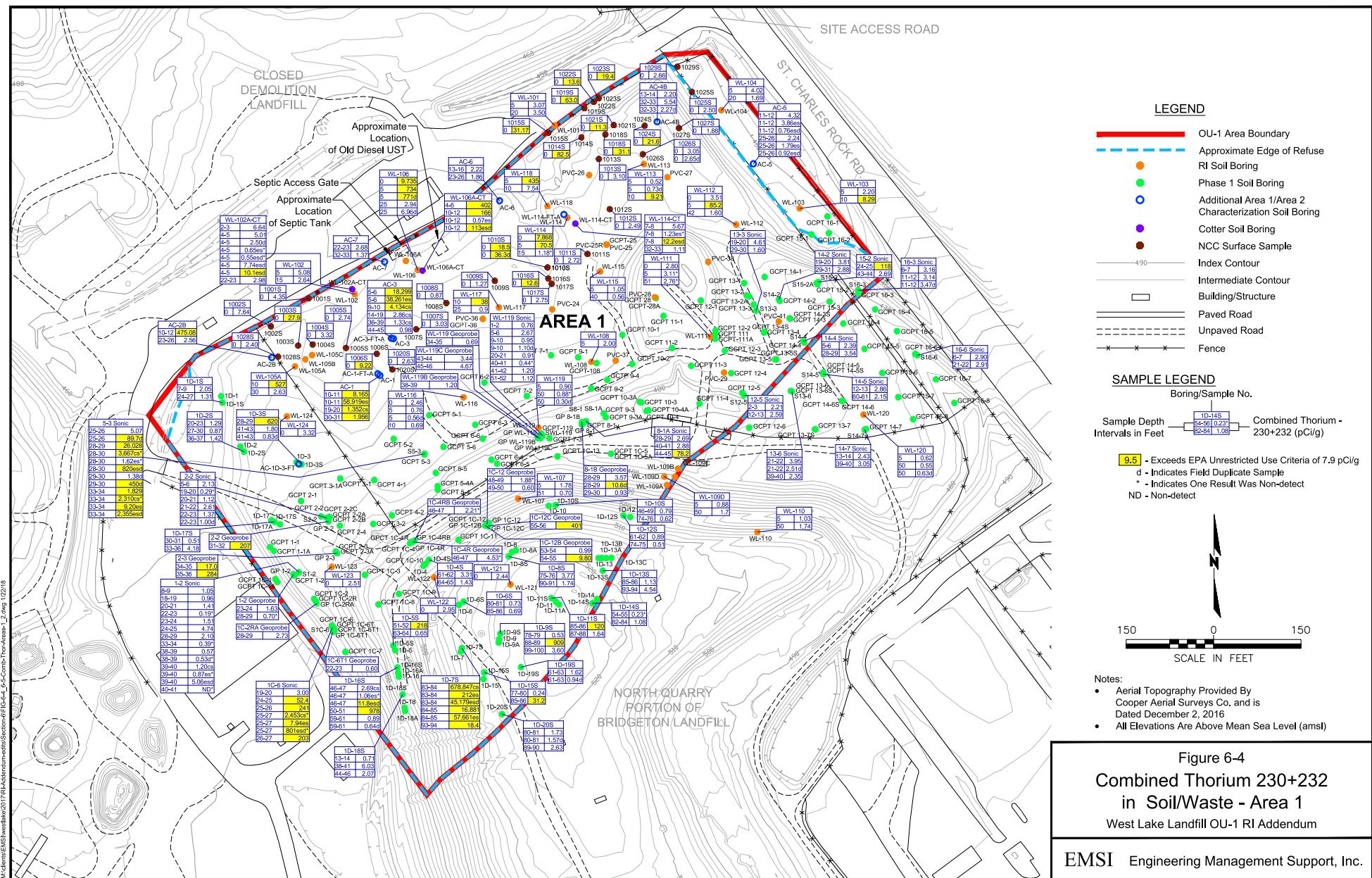
**SOIL RADIONUCLIDE IMPACTS**

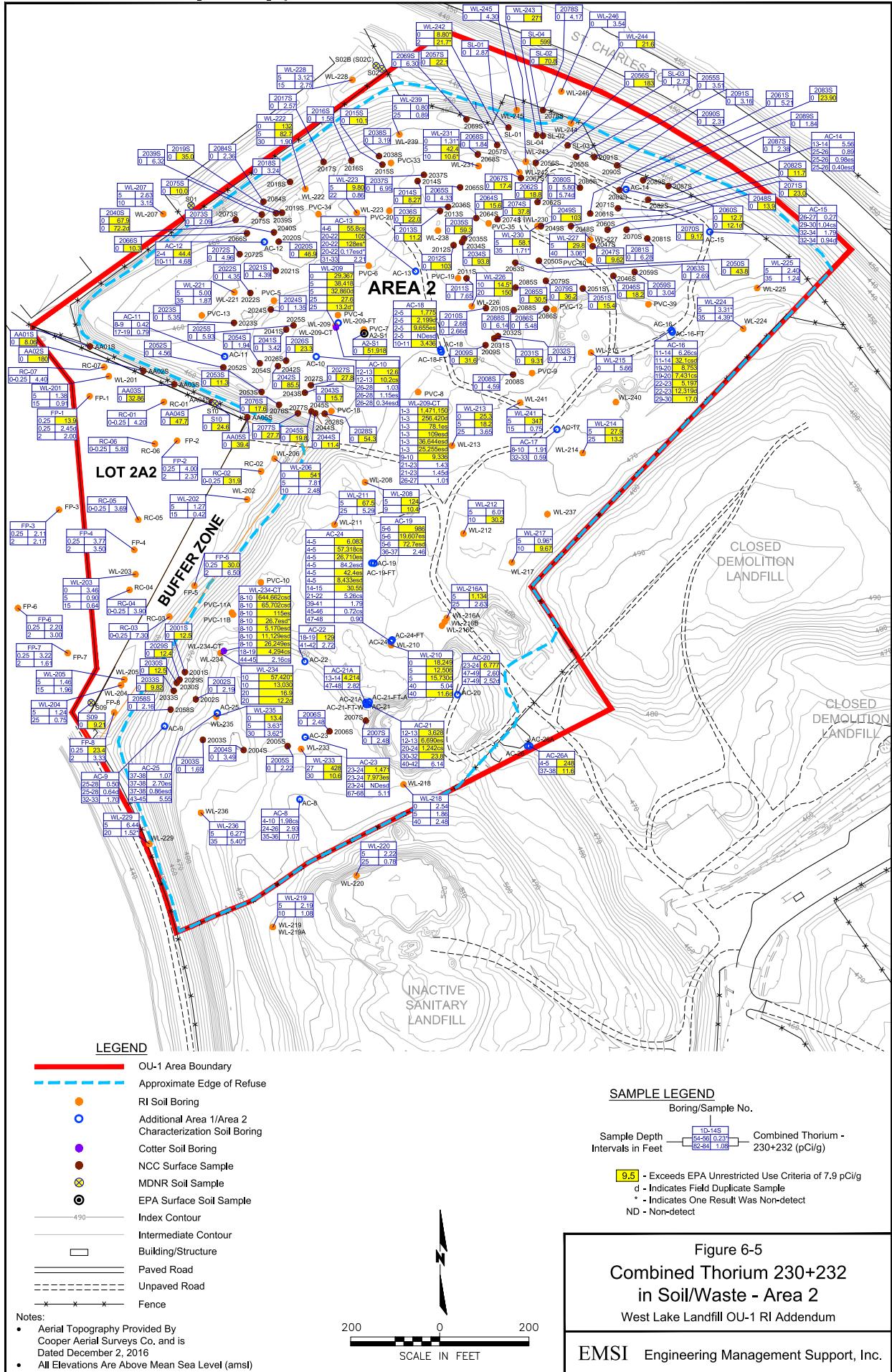
DRAFT

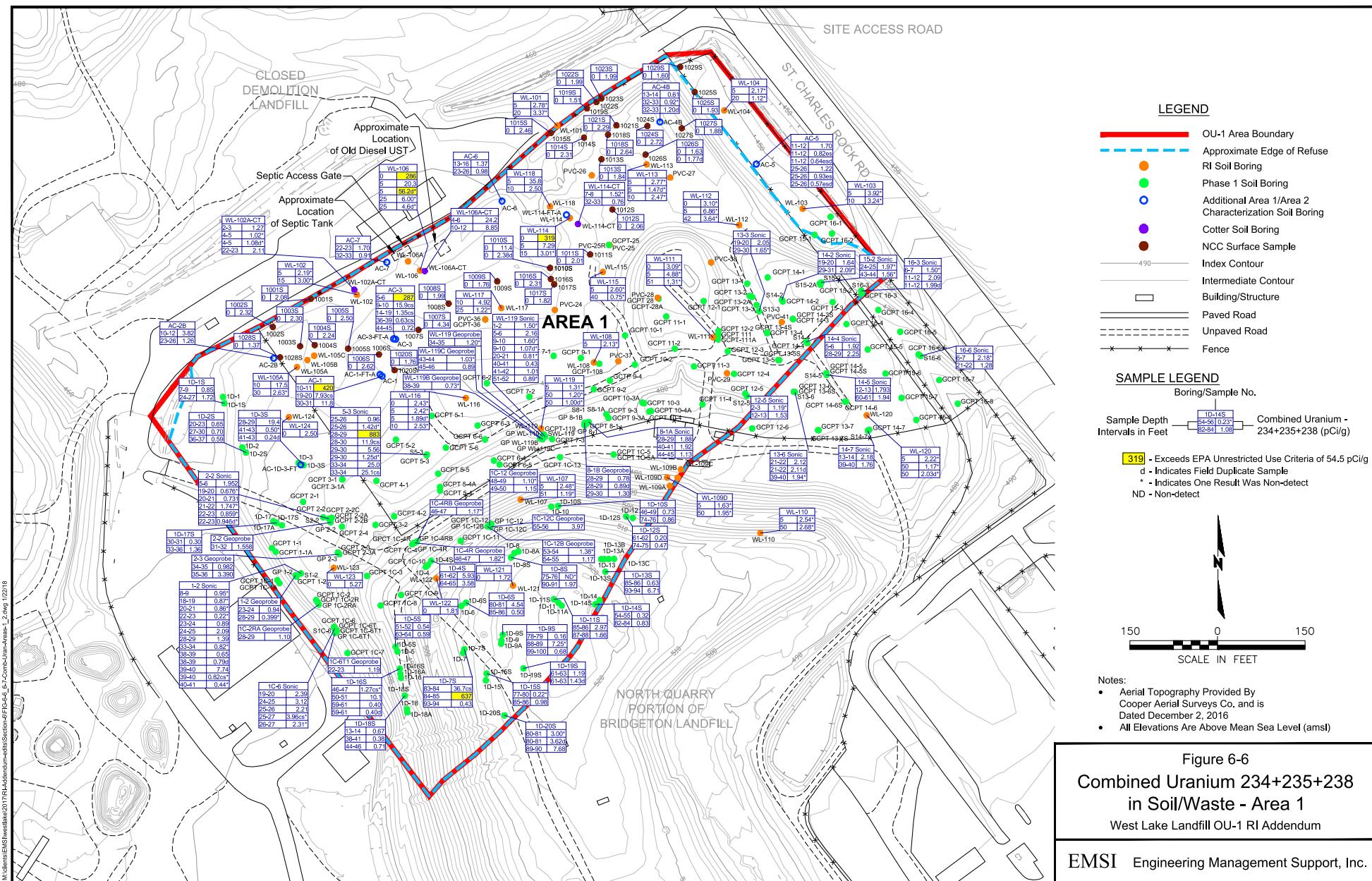


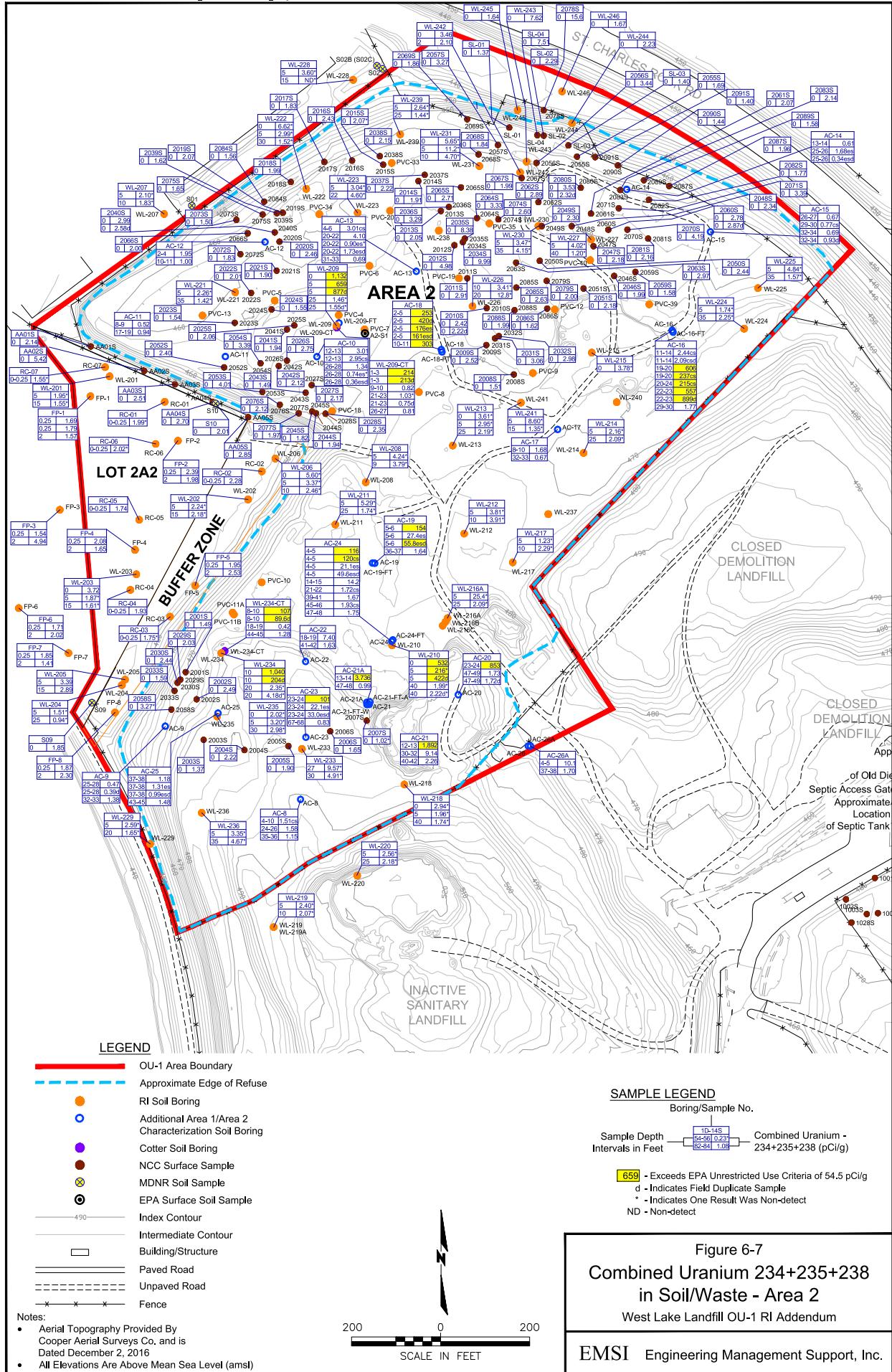


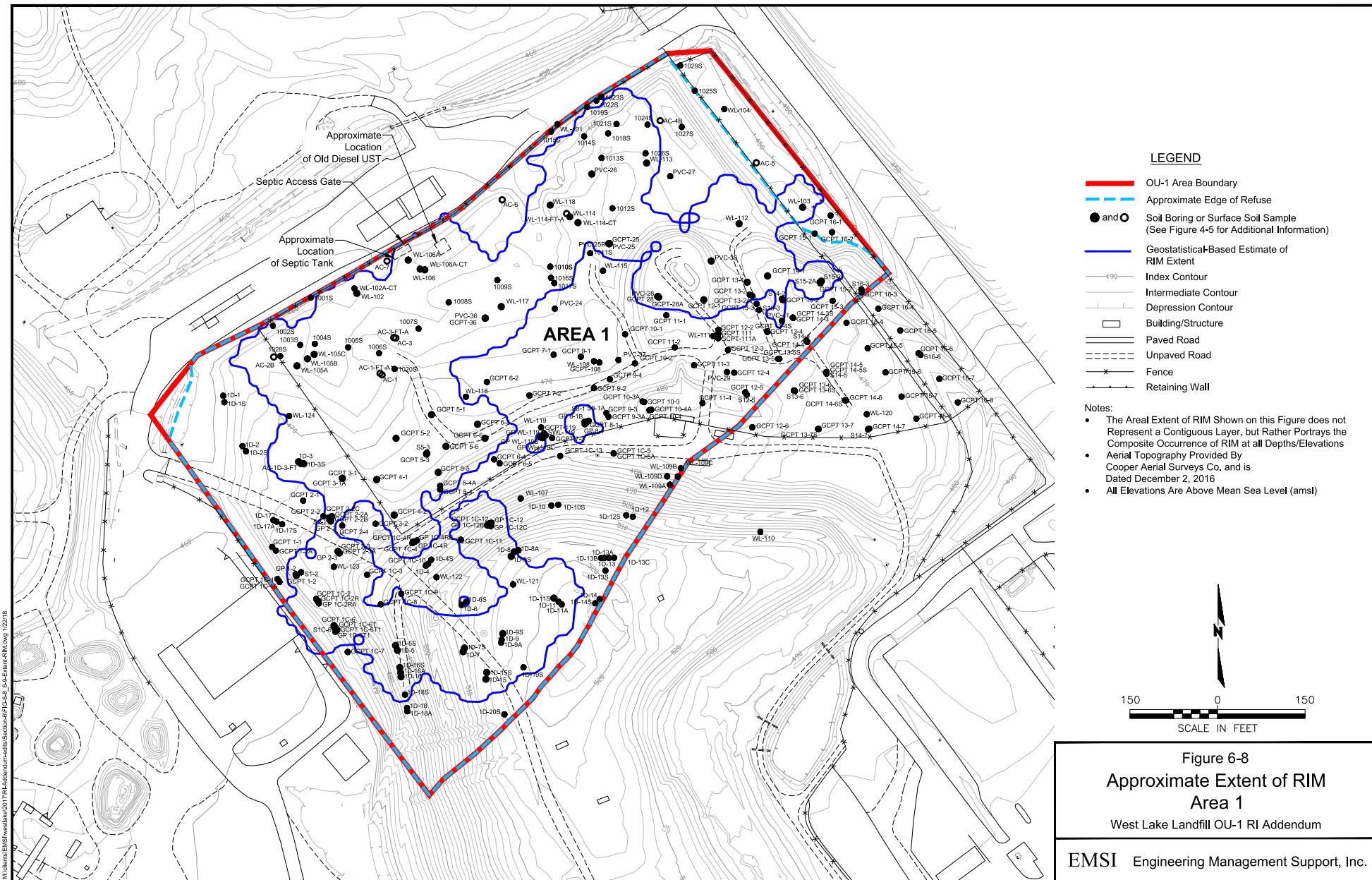


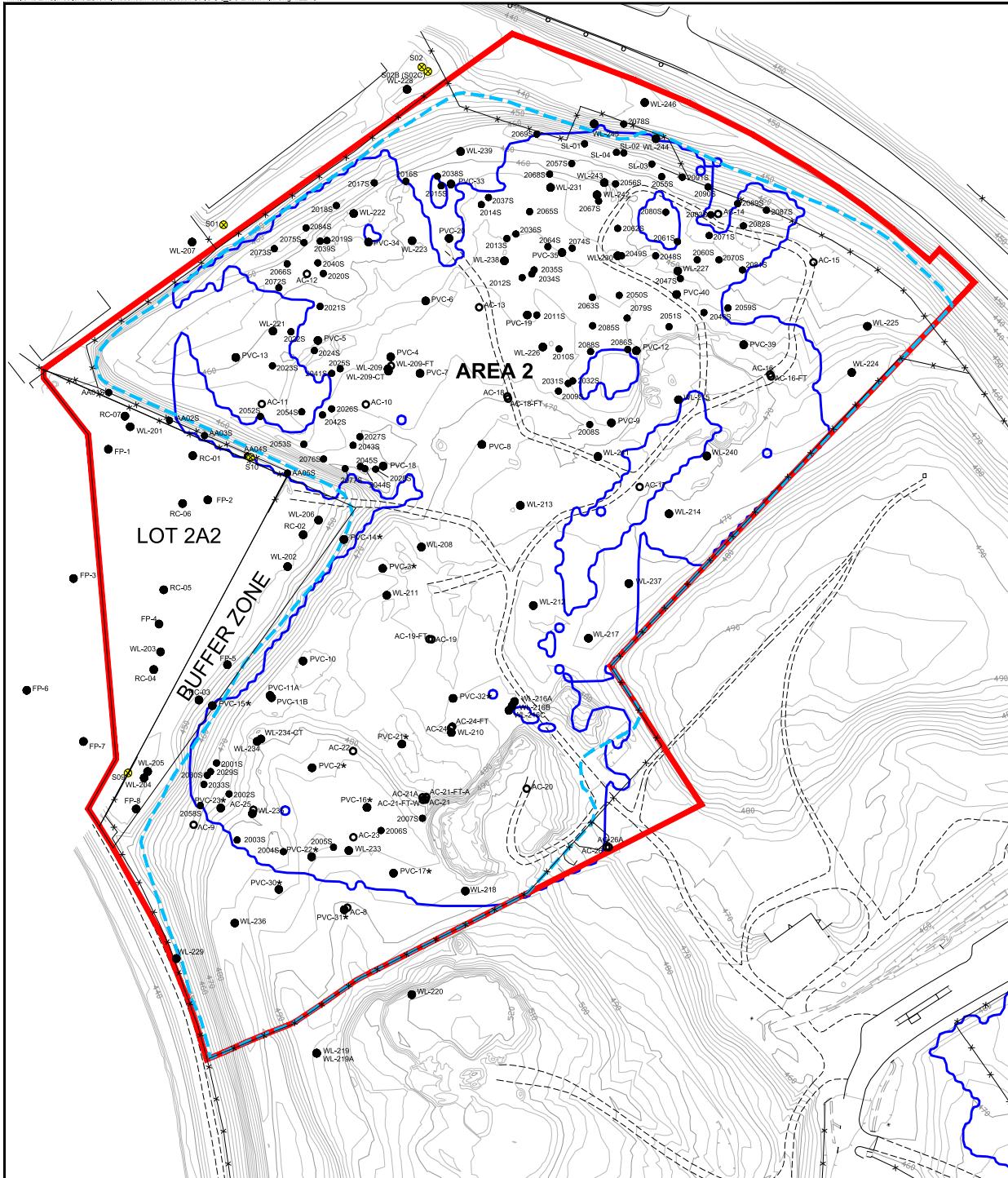










LEGEND

- OU-1 Area Boundary
- Approximate Edge of Refuse
- , ○ and ⊗ Soil Boring or Surface Soil Sample  
(See Figure 4-5 for Additional Information)
- \* 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

200                    0                    200  
SCALE IN FEET

## 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)

Figure 6-9  
Approximate Extent of RIM  
Area 2  
West Lake Landfill OU-1 RI Addendum

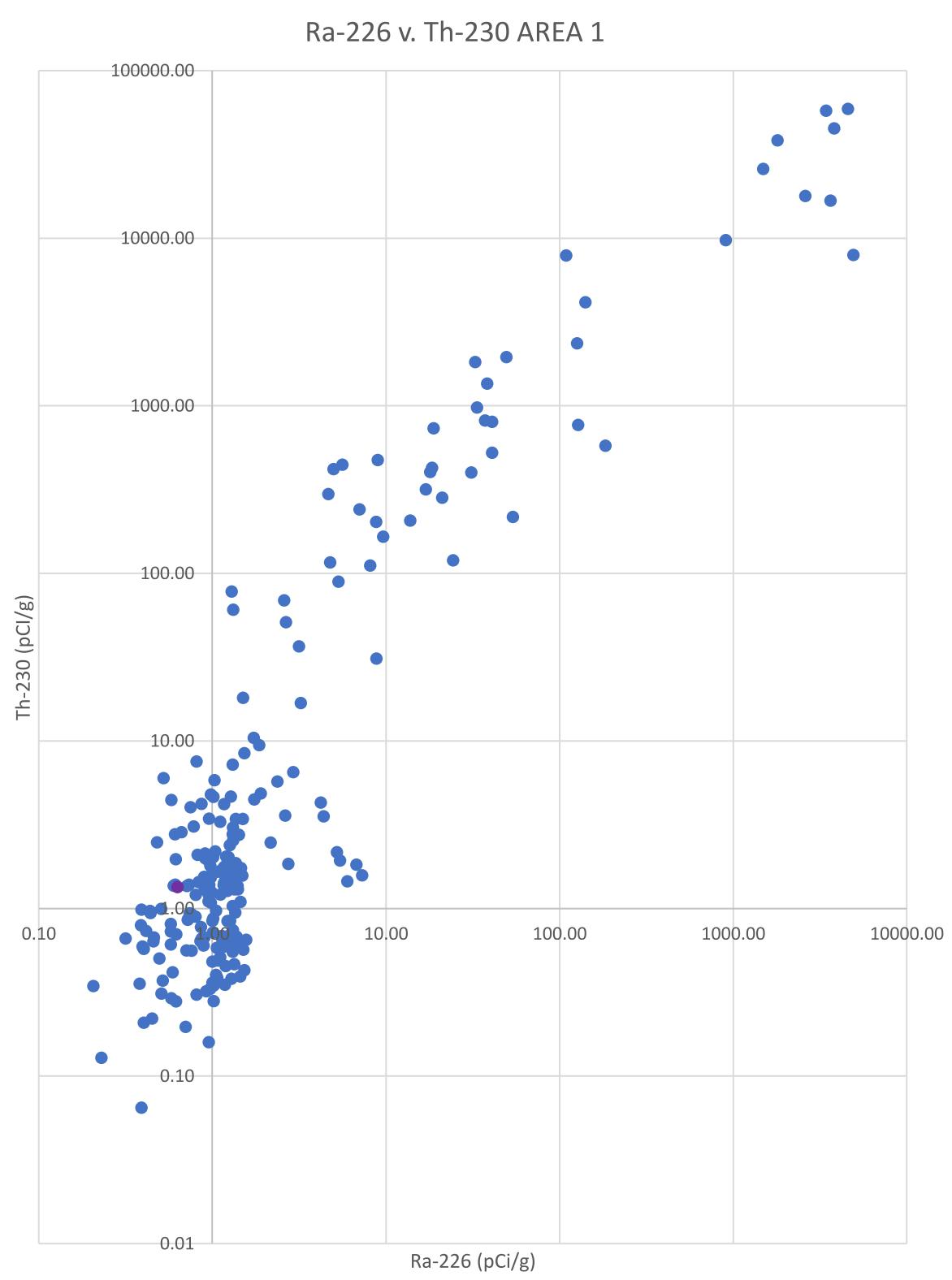


Figure 6-10

## Ra-226 v. Th-230 - Area 1

West Lake Landfill OU-1 RI Addendum

EMSI    Engineering Management Support, Inc.

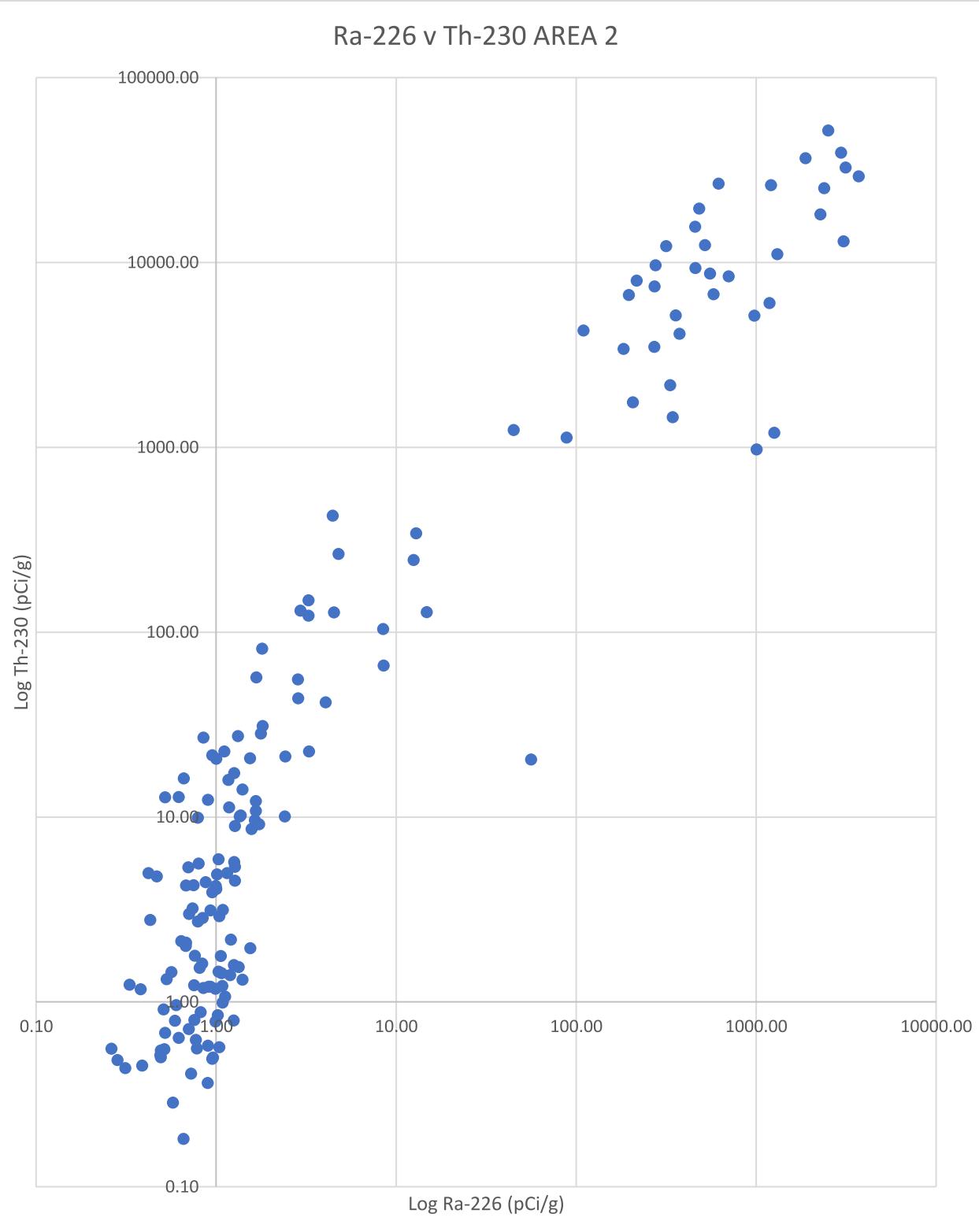
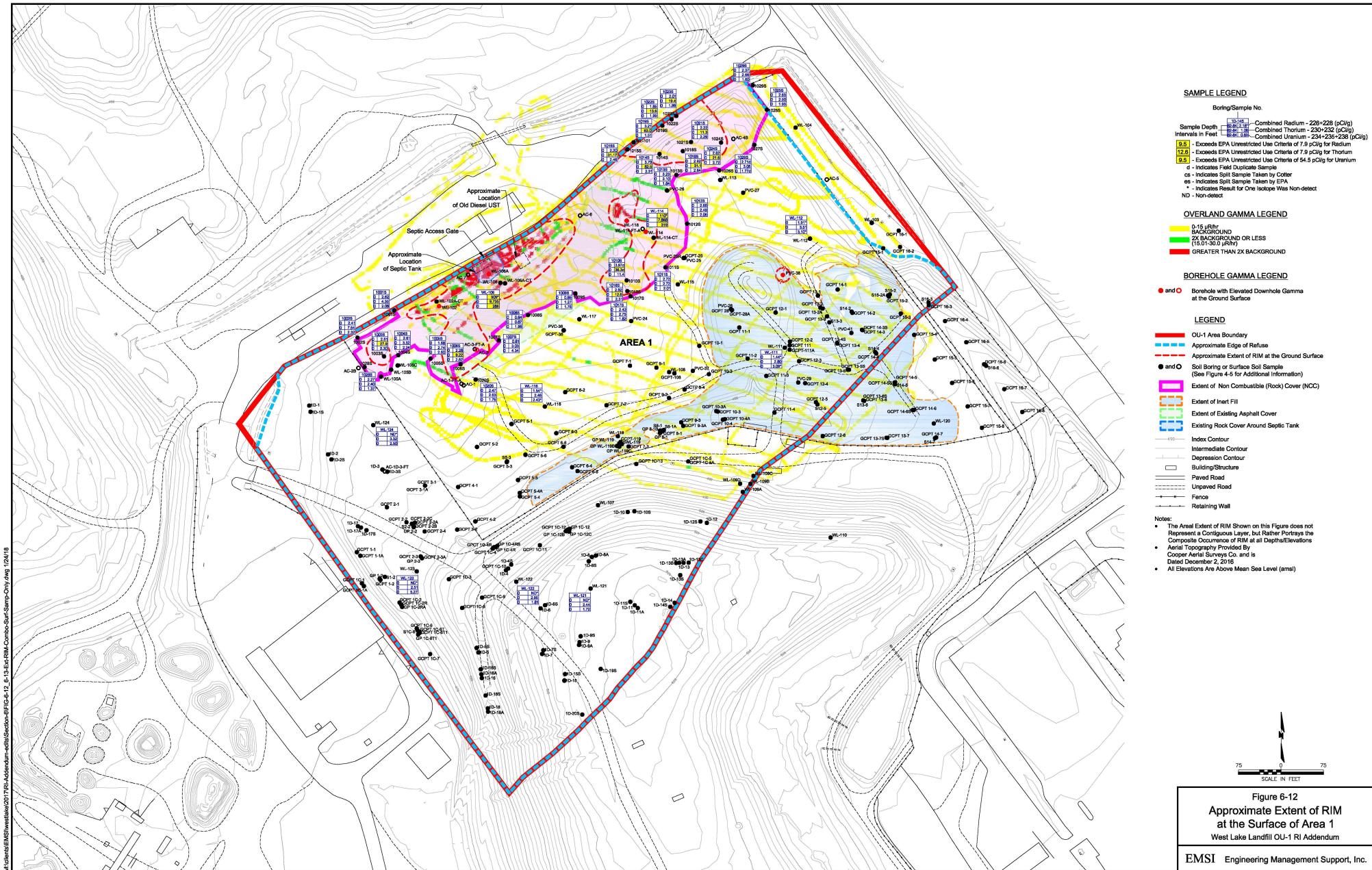


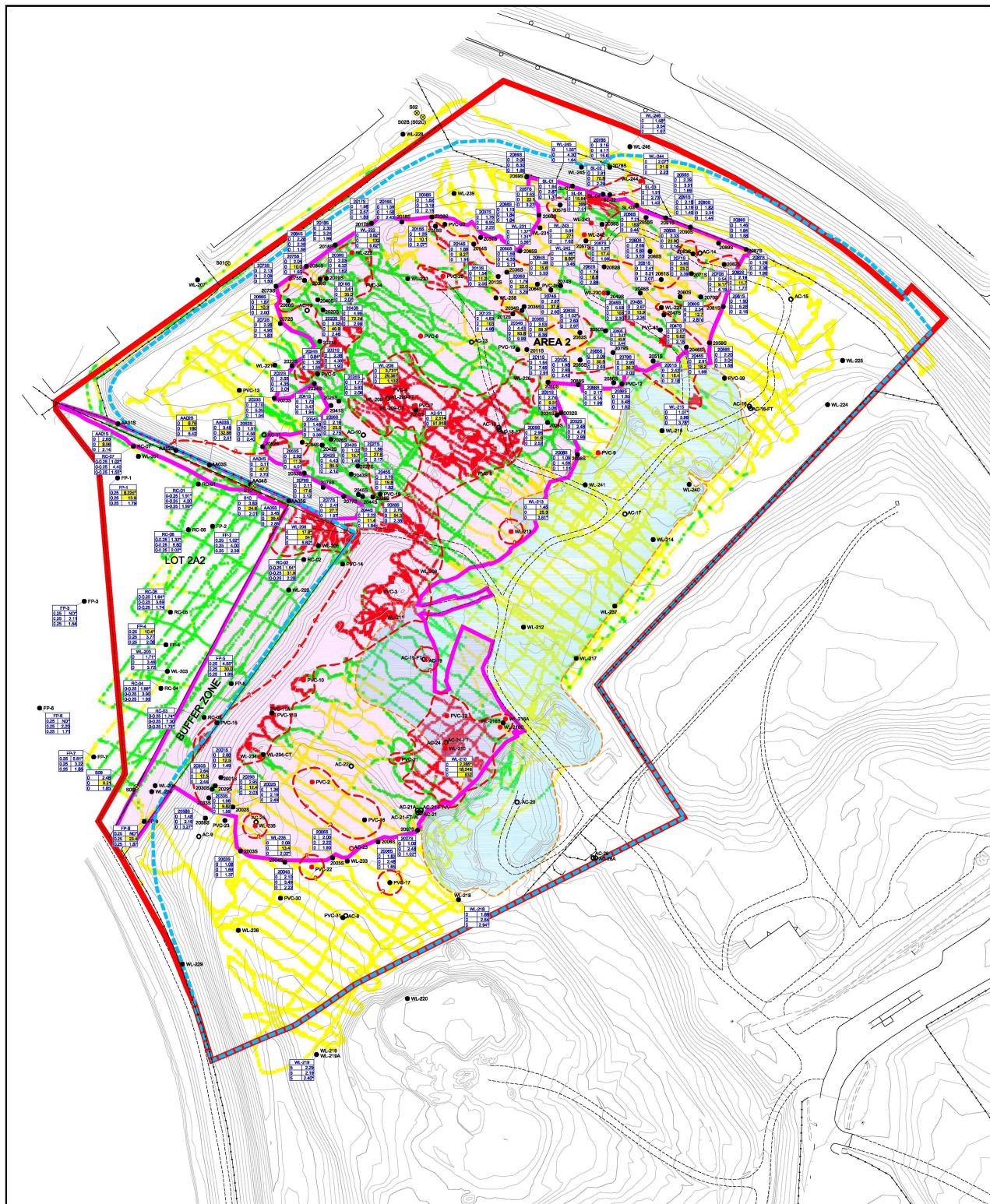
Figure 6-11

## Ra-226 v. Th-230 - Area 2

West Lake Landfill OU-1 RI Addendum

EMSI    Engineering Management Support, Inc.





#### SAMPLE LEGEND

Boring/Sample No.

	Combined Radium - 226+228 (pCi/g)
	Combined Thorium - 230+232 (pCi/g)
	Combined Uranium - 234+238 (pCi/g)
	Exceeds EPA Unrestricted Use Criteria of 7.9 pCi/g for Radium
	Exceeds EPA Unrestricted Use Criteria of 19.0 pCi/g for Thorium
	Indicates Field Duplicate Sample
	Indicates Split Sample Taken by Cother
	Indicates Split Sample Taken by EPA
	Indicates Result for One Isotope Was Non-detect
	ND - Non-detect

#### OVERLAND GAMMA LEGEND

	0-15 $\mu$ R/hr BACKGROUND
	2X BACKGROUND OR LESS (15.01-30.0 $\mu$ R/hr)
	GREATERTHAN 2X BACKGROUND

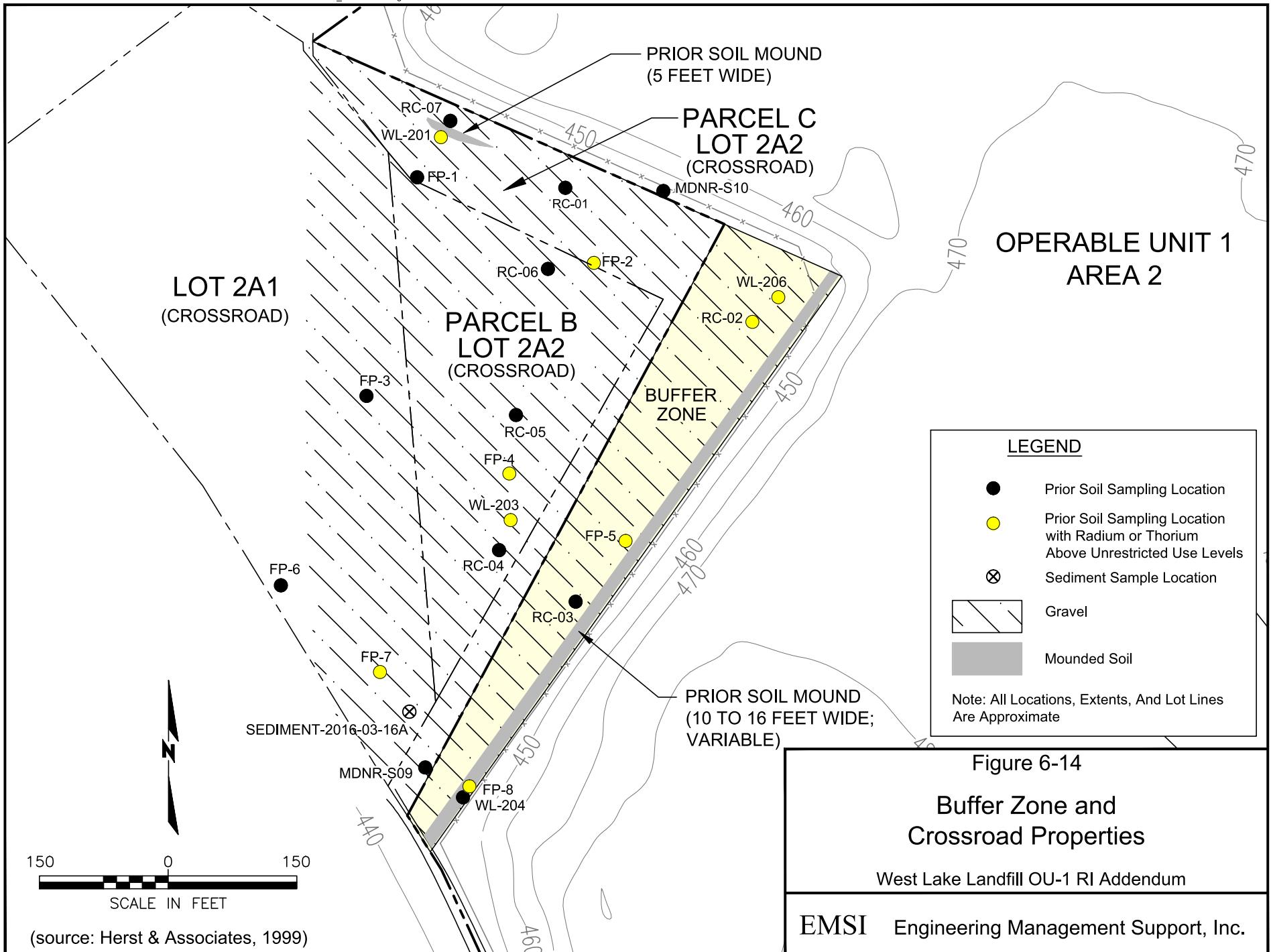
#### BOREHOLE GAMMA LEGEND

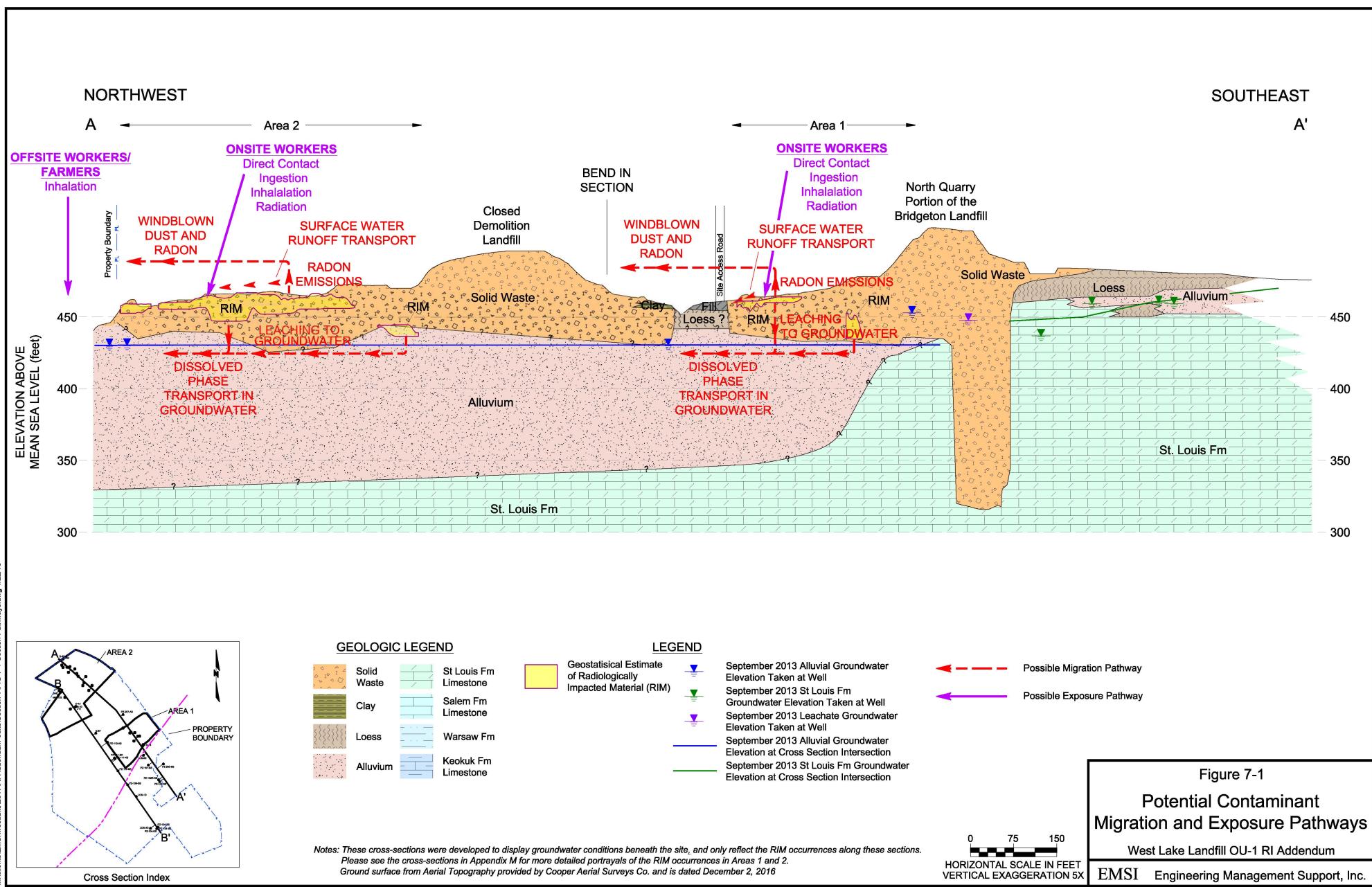
- and ○ Borehole with Elevated Downhole Gamma at the Ground Surface

#### LEGEND

- OU-1 Area Boundary
  - Approximate Edge of Refuse
  - Approximate Extent of RIM at the Ground Surface
  - and ○ Soil Boring or Surface Soil Sample (See Figure 4-5 for Additional Information)
  - Extent of Non Combustible (Rock) Cover (NCC)
  - Extent of Inert Fill
  - Existing Rock Cover on Road
  - Index Contour
  - Intermediate Contour
  - Depression Contour
  - Paved Road
  - Unpaved Road
  - Fence
  - Retaining Wall
- Notes:
- Aerial Topography Provided By Cooper Aerial Surveys Co. and is Dated December 2, 2016
  - All Elevations Are Above Mean Sea Level (amsl)

Figure 6-13  
Approximate Extent of RIM  
at the Surface of Area 2  
West Lake Landfill OU-1 RI Addendum

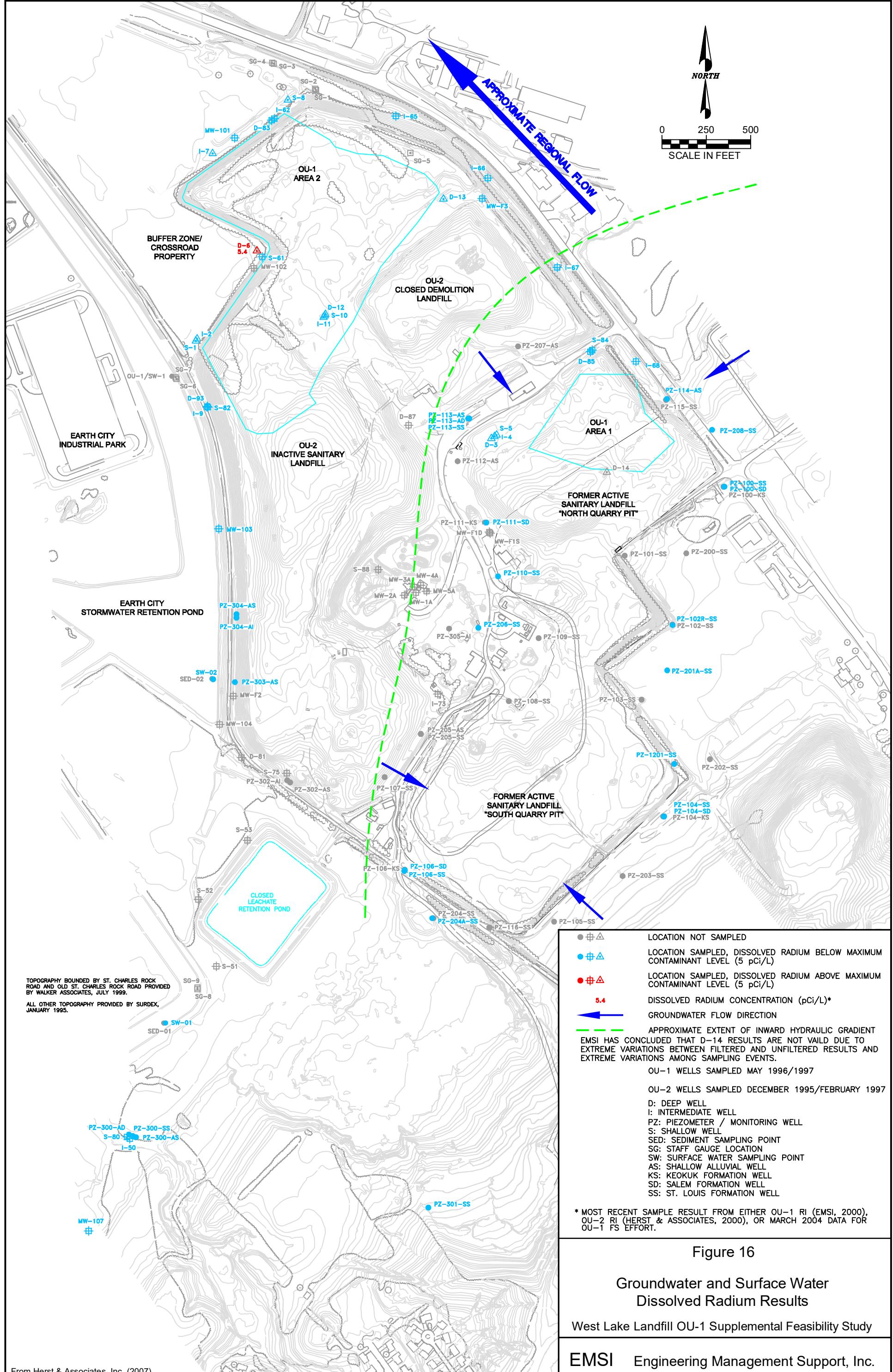


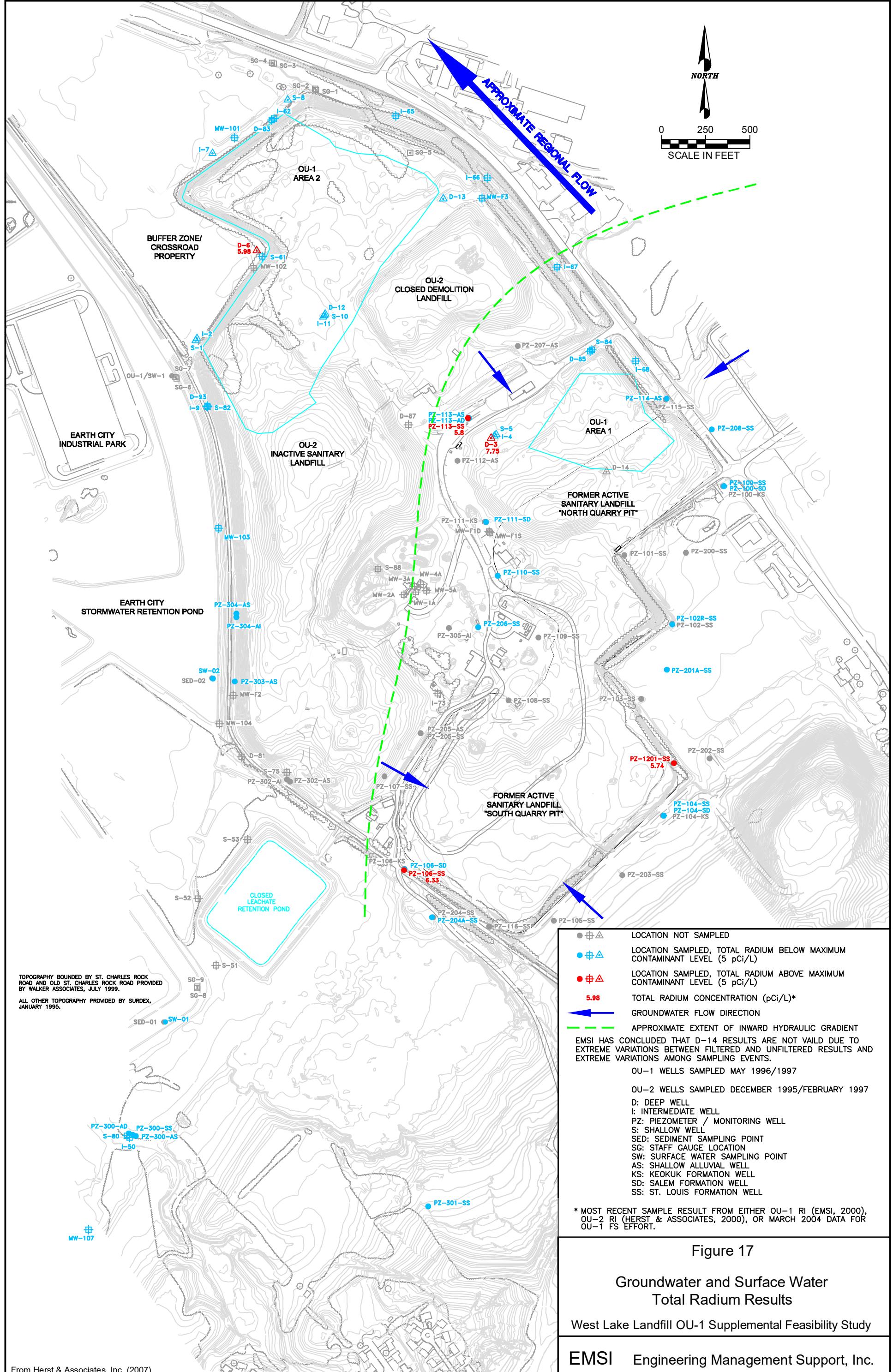


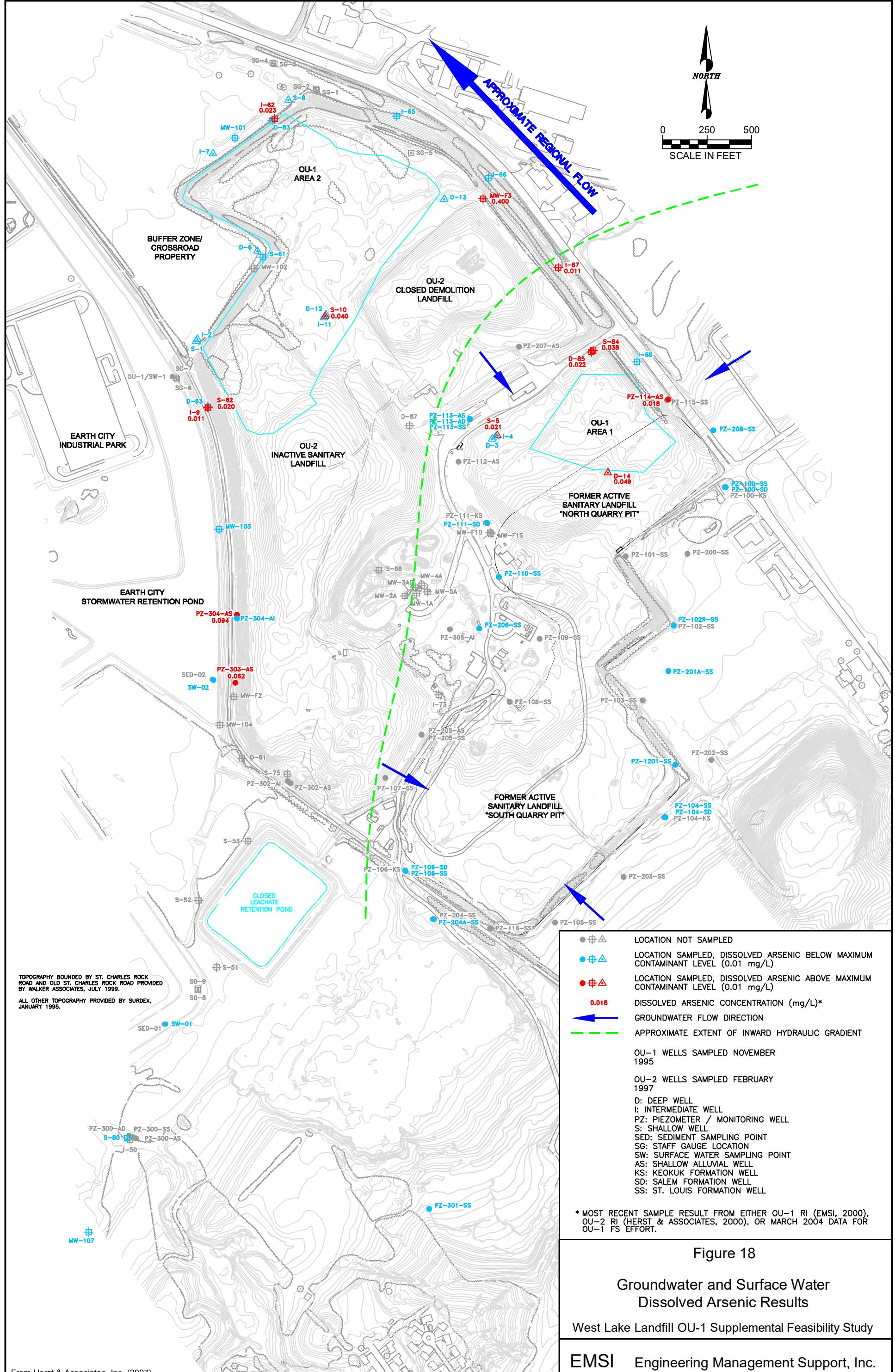
**APPENDIX U**

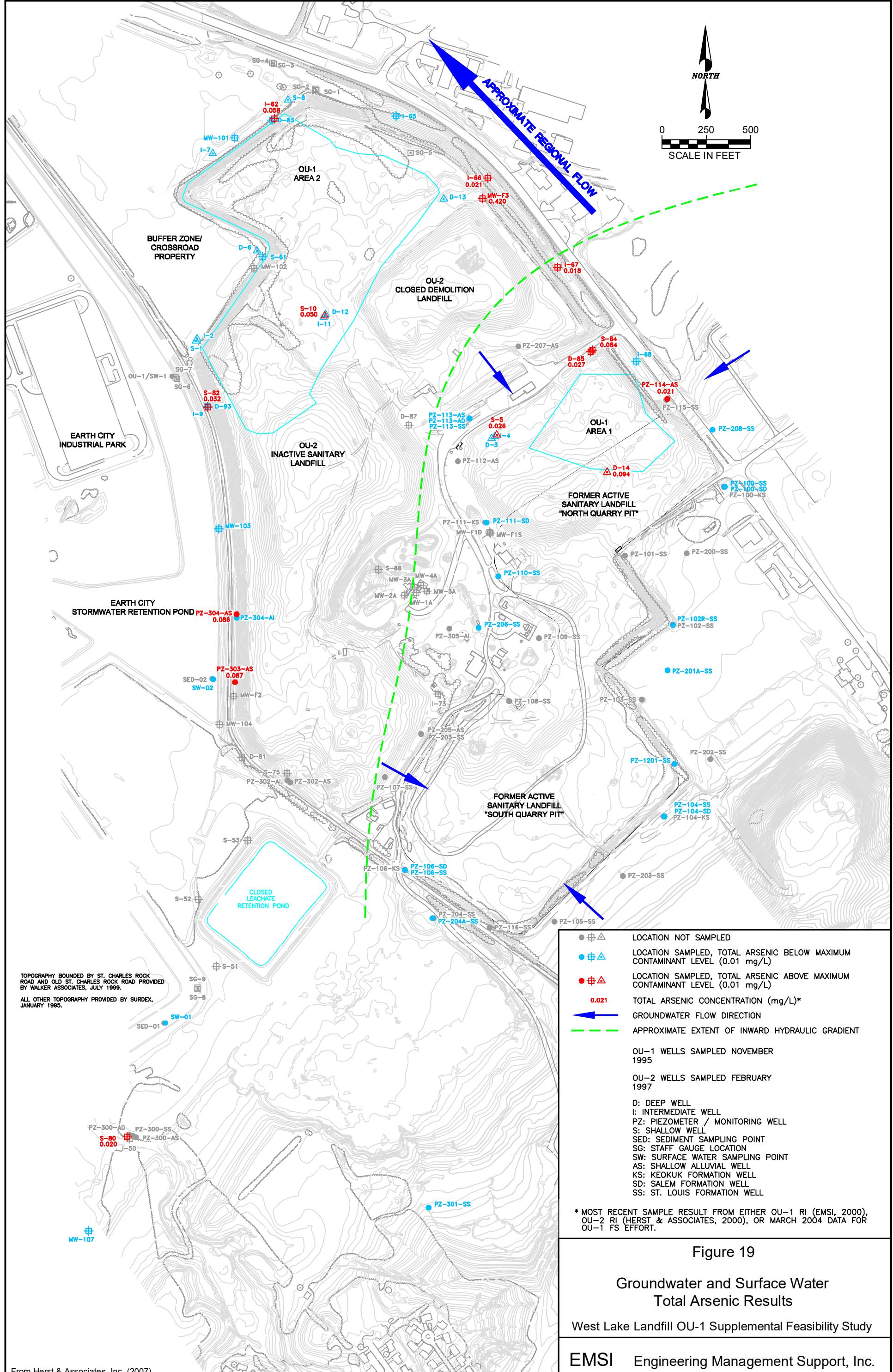
**COPC ISOCONCENTRATION FIGURES**

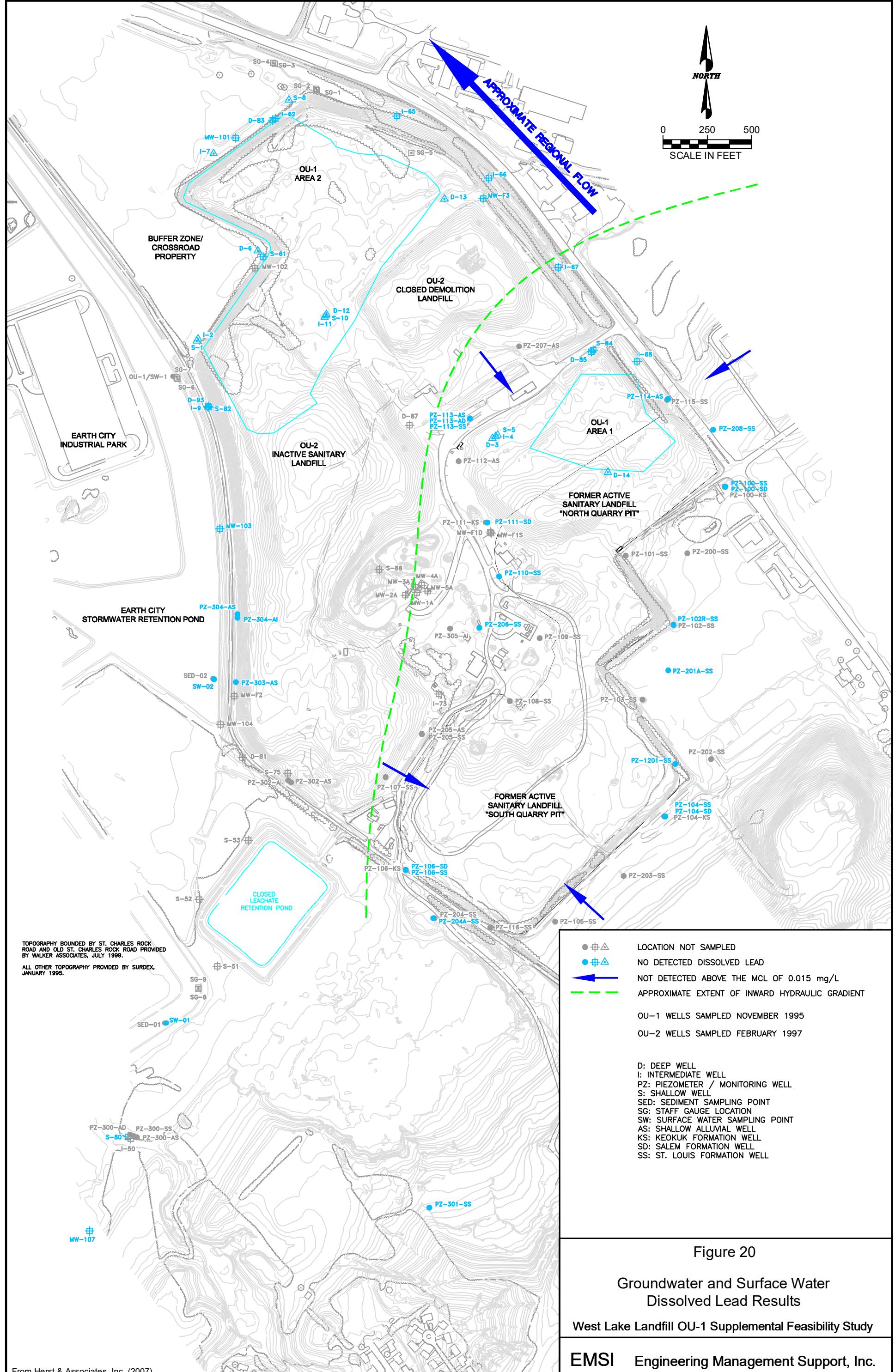
DRAFT

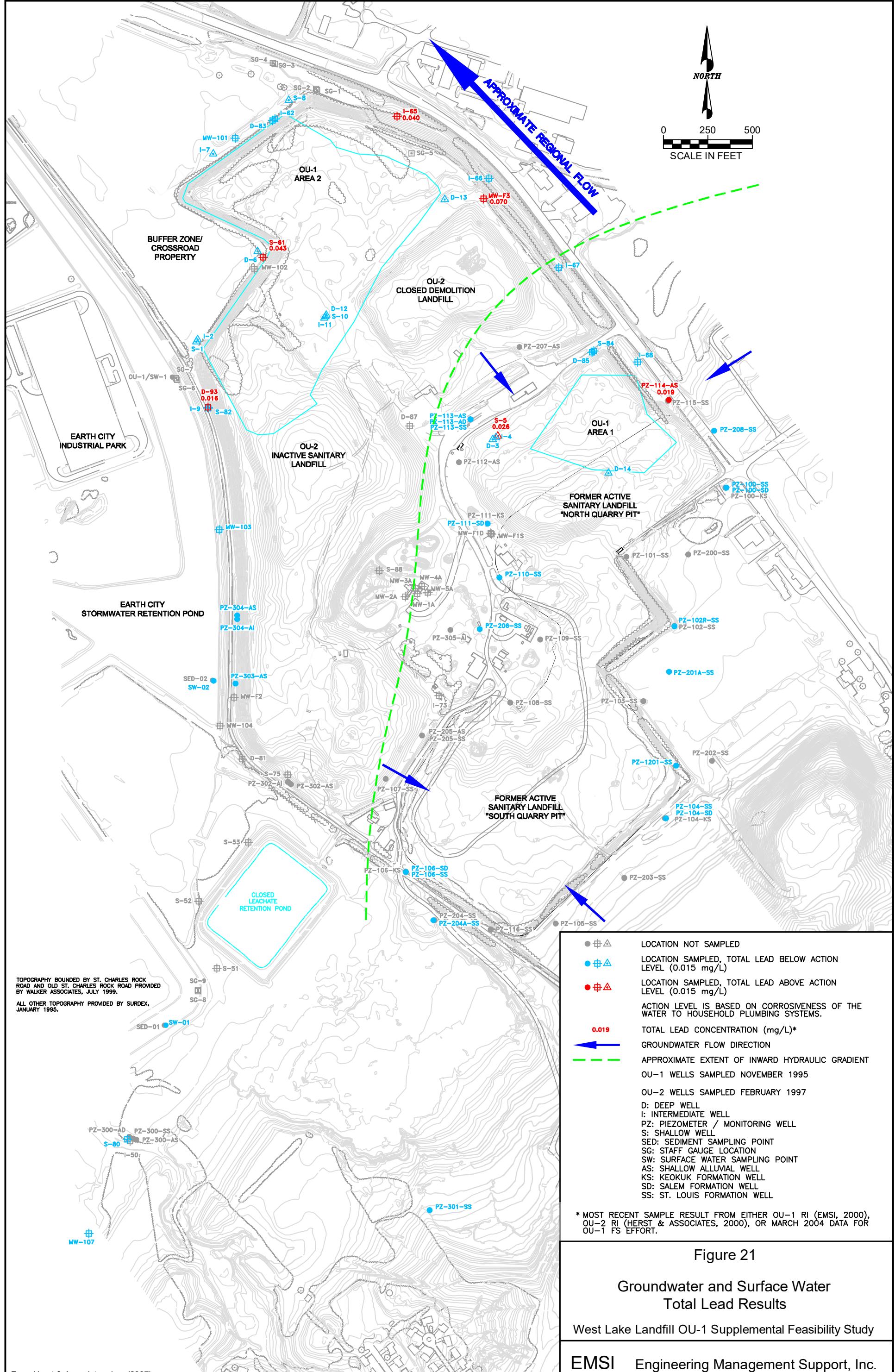


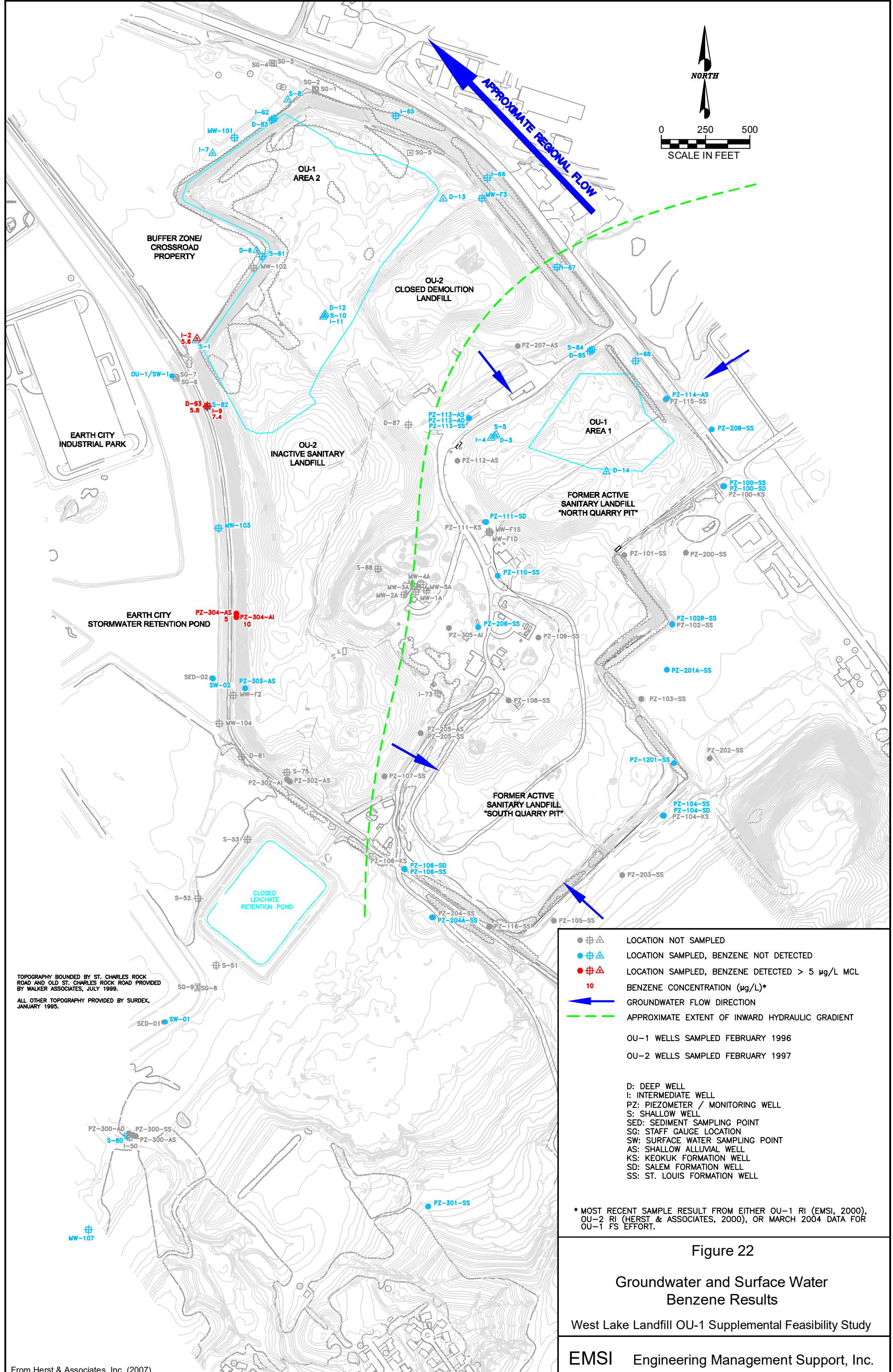


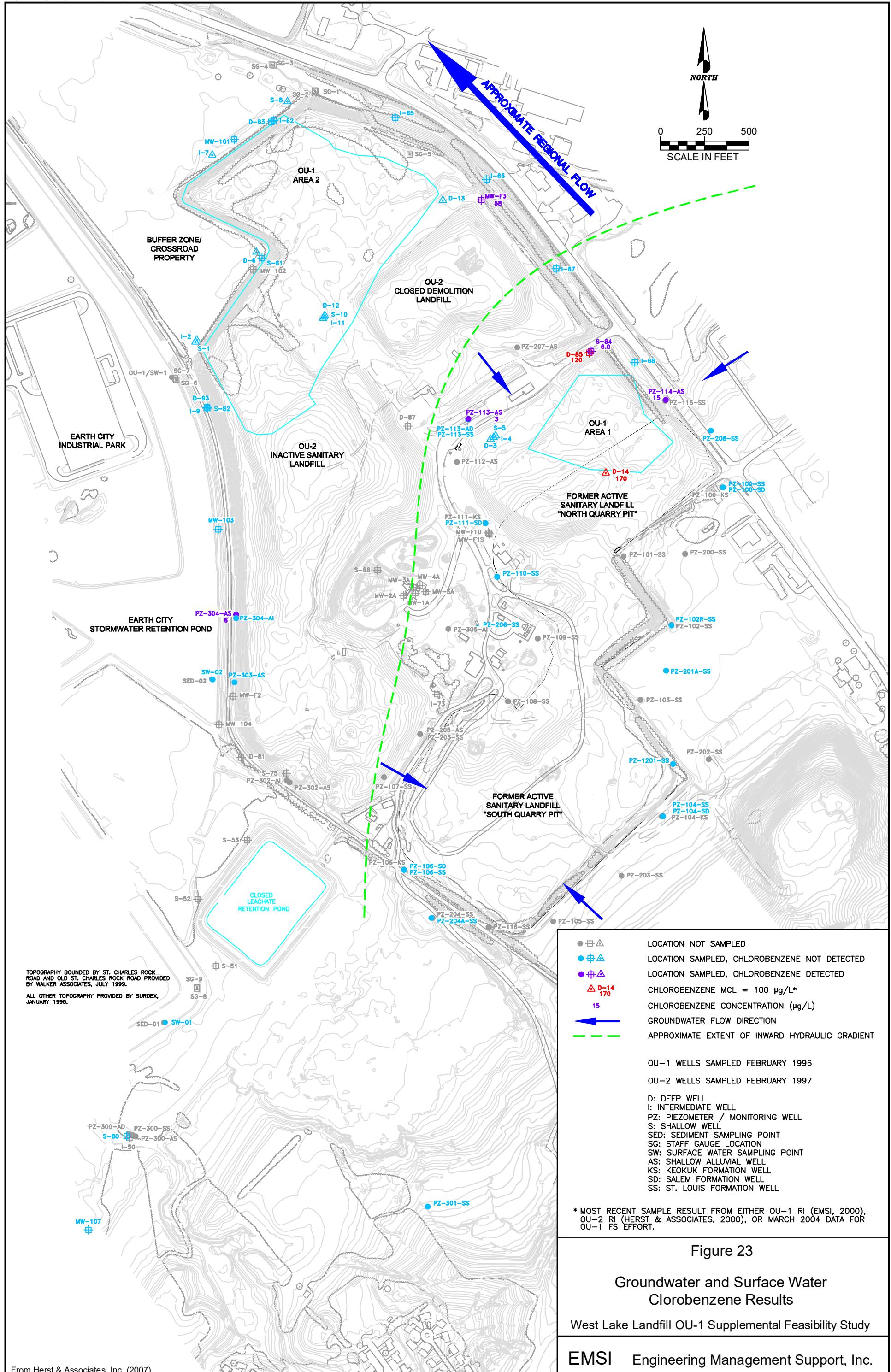


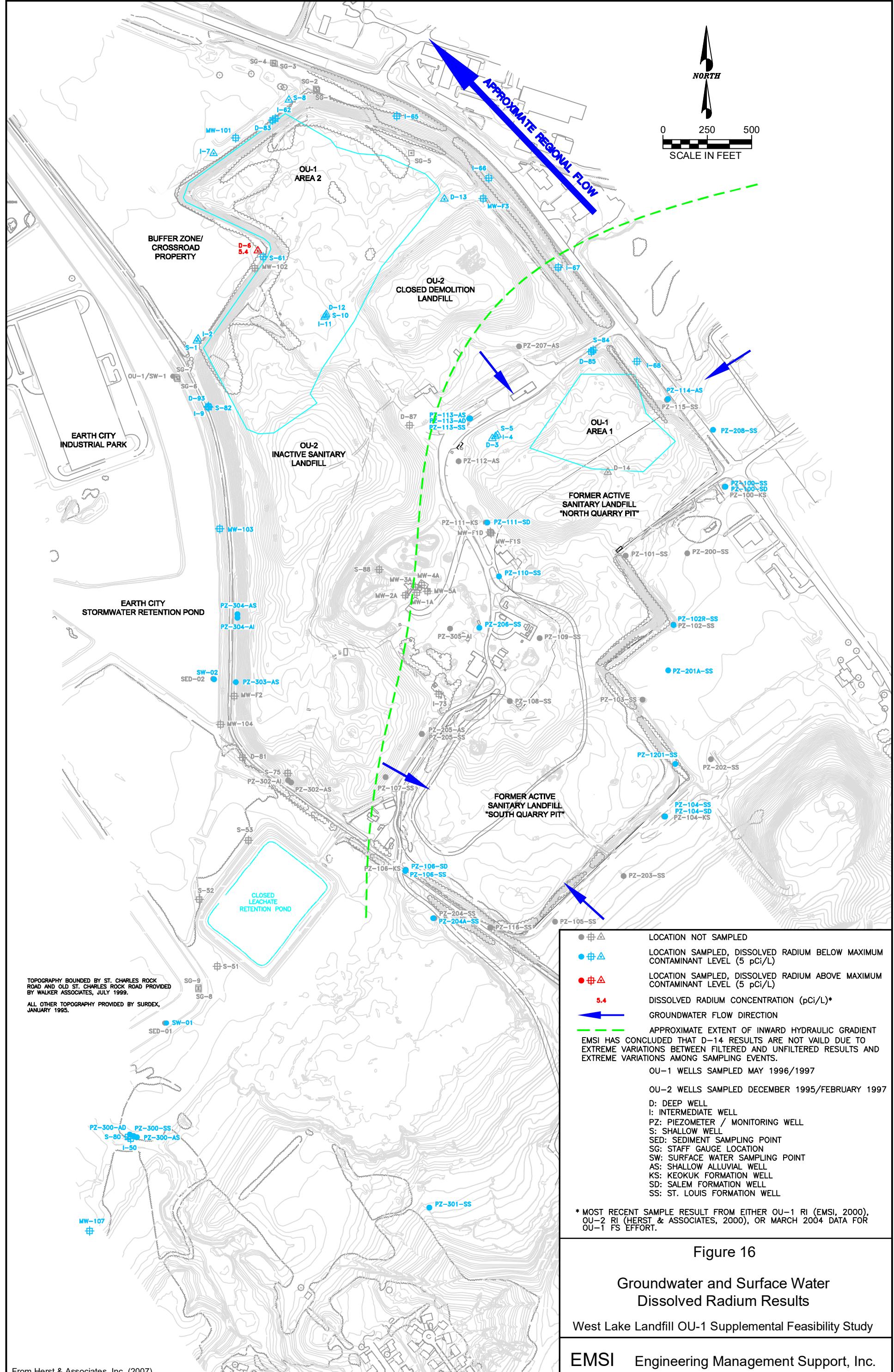


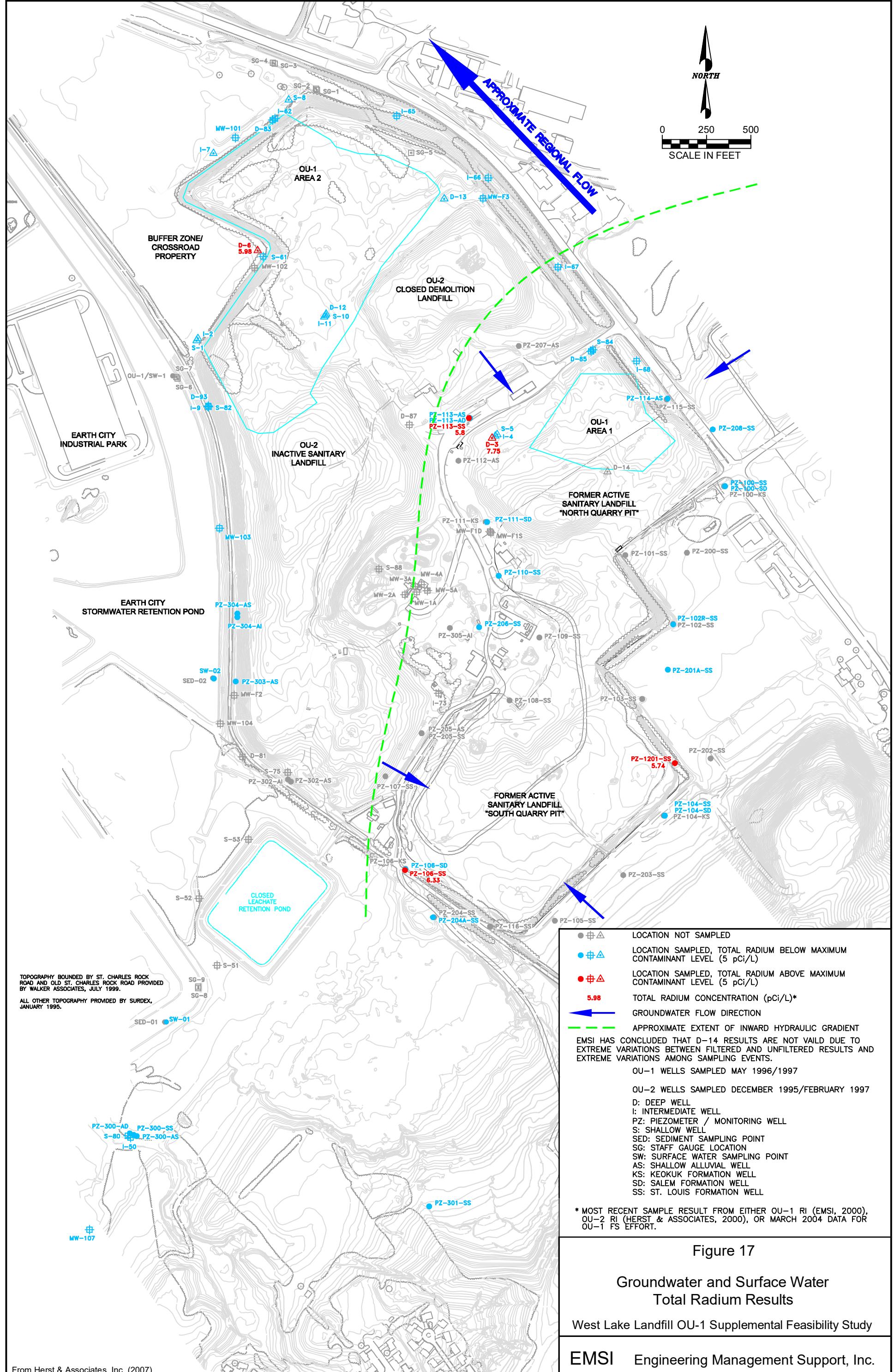


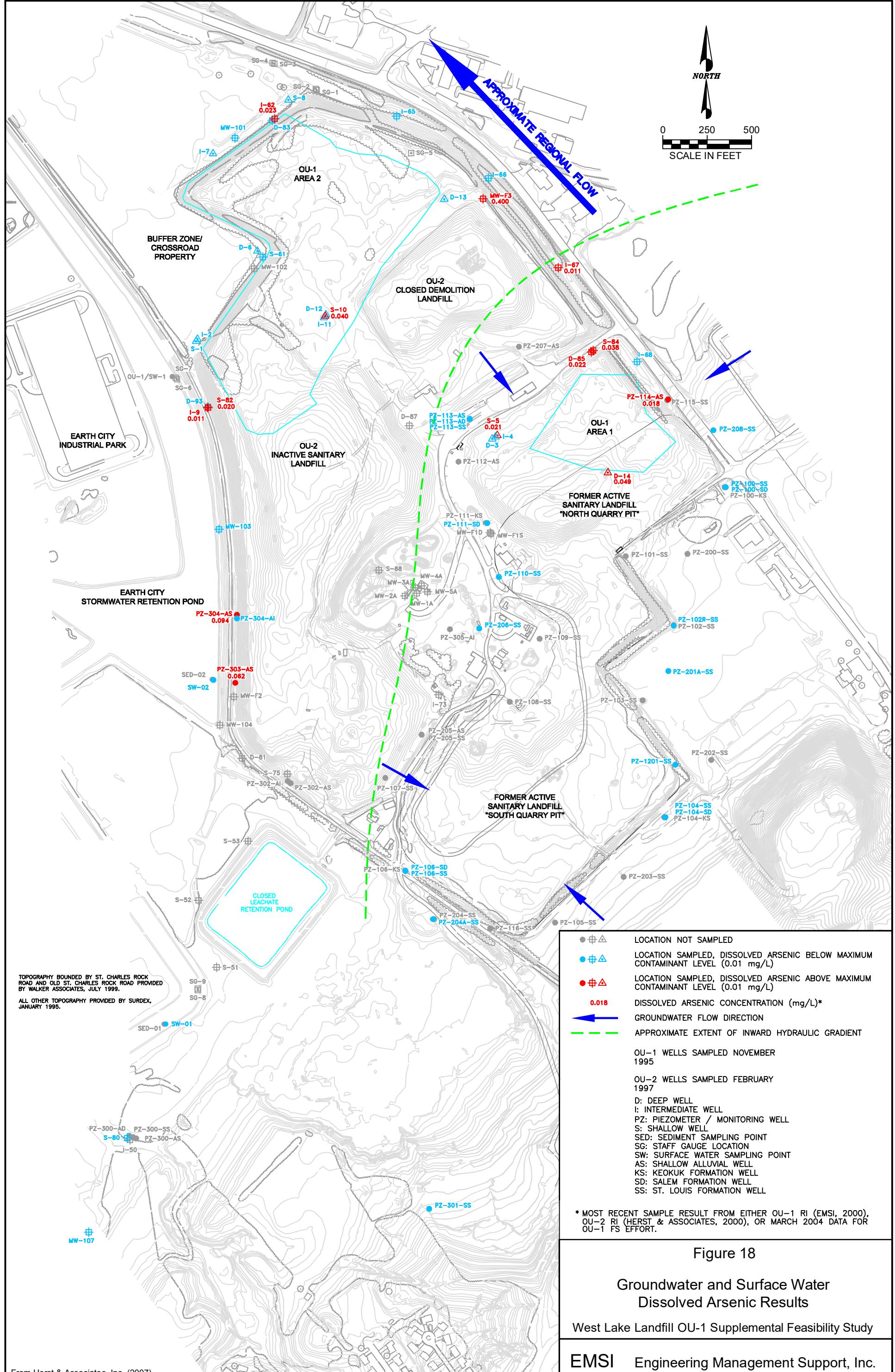


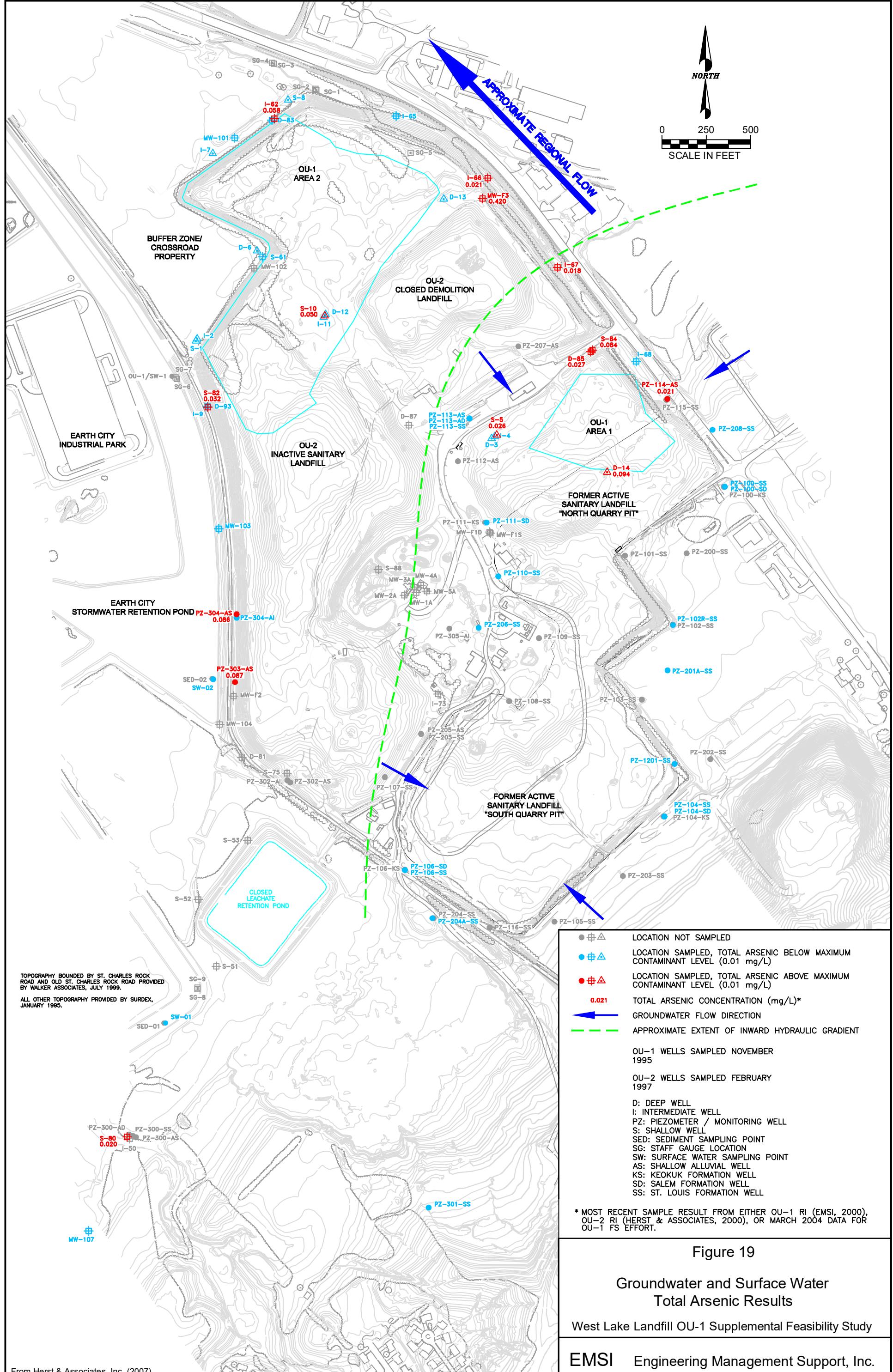


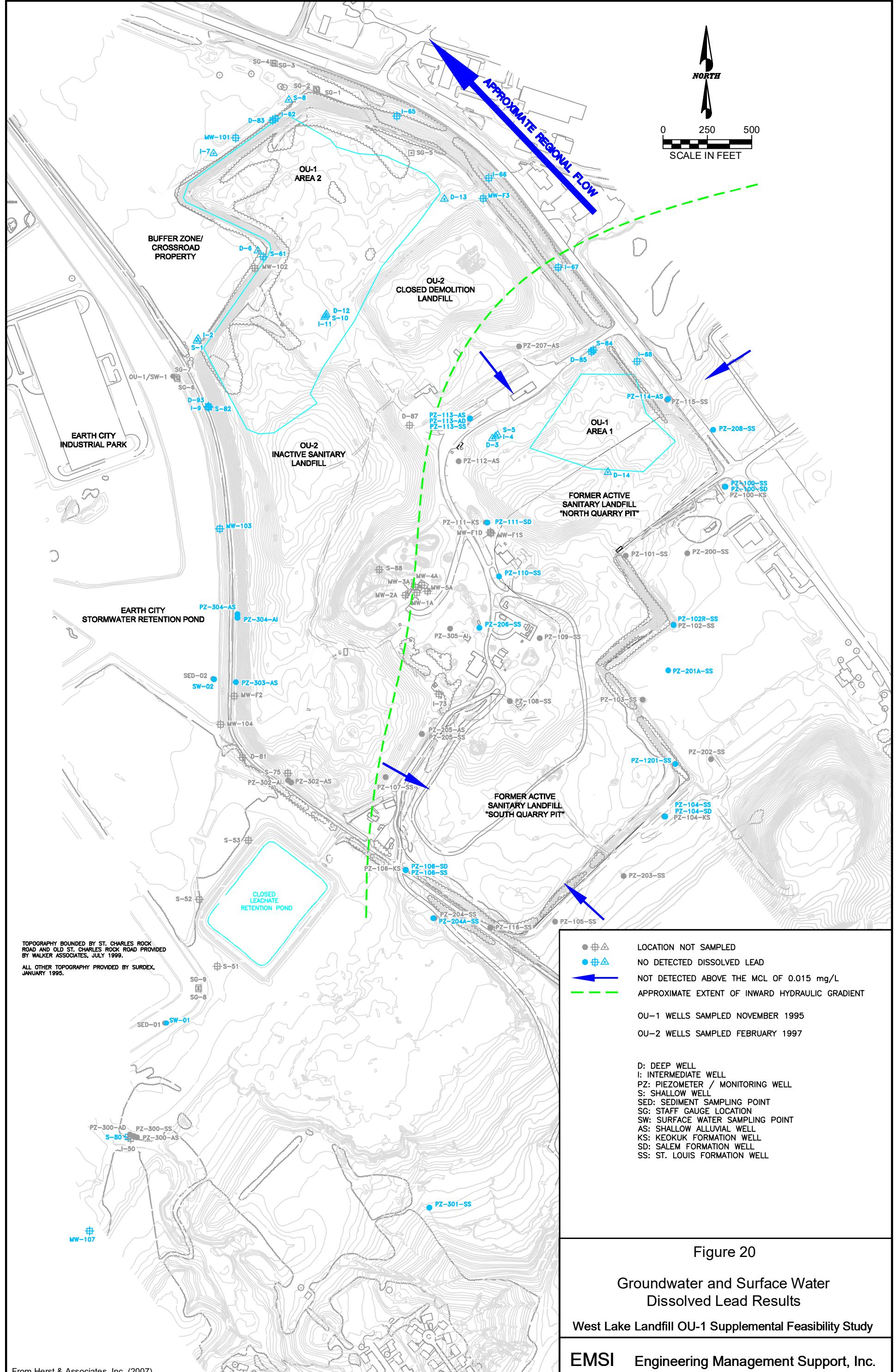


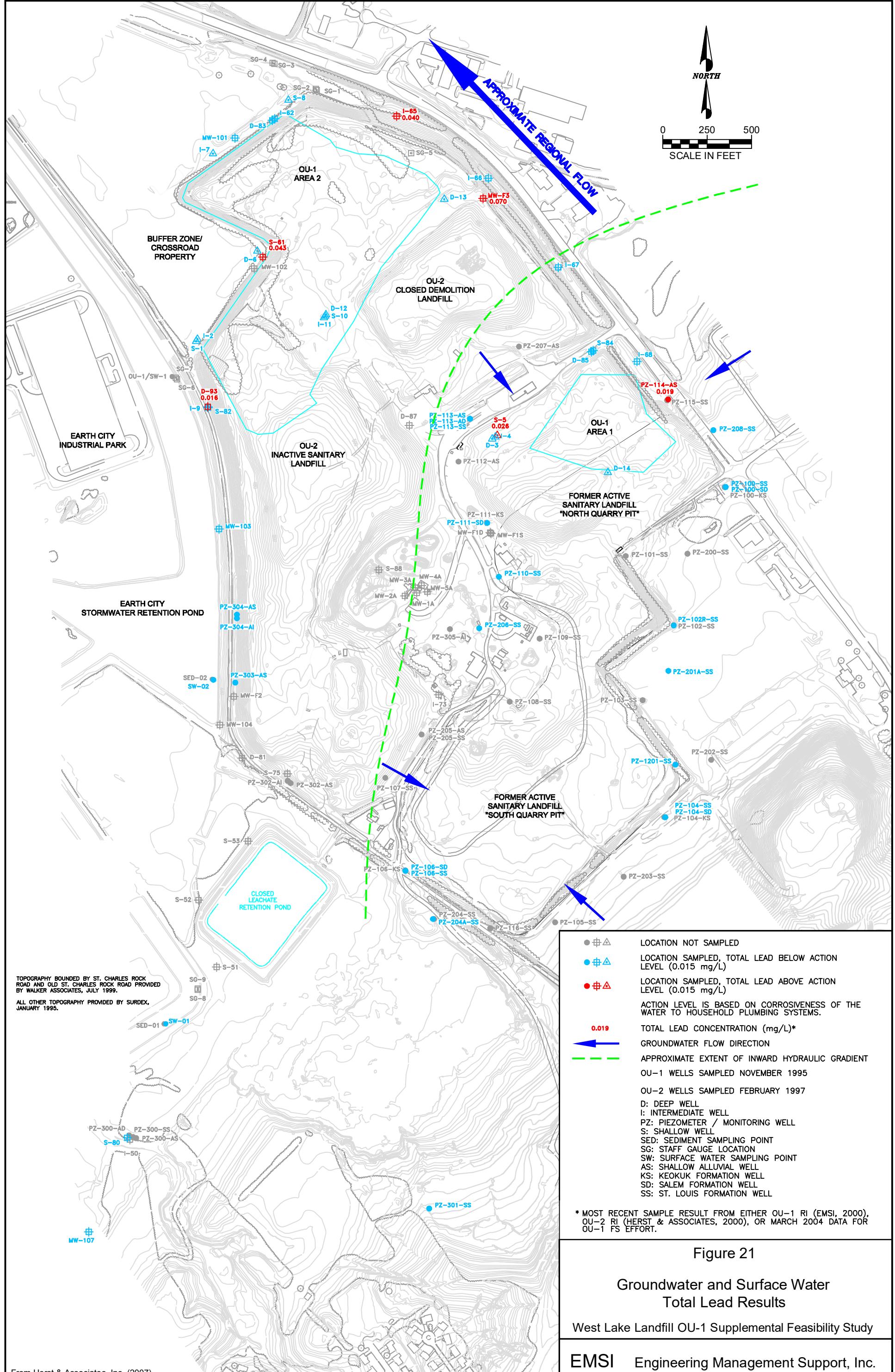


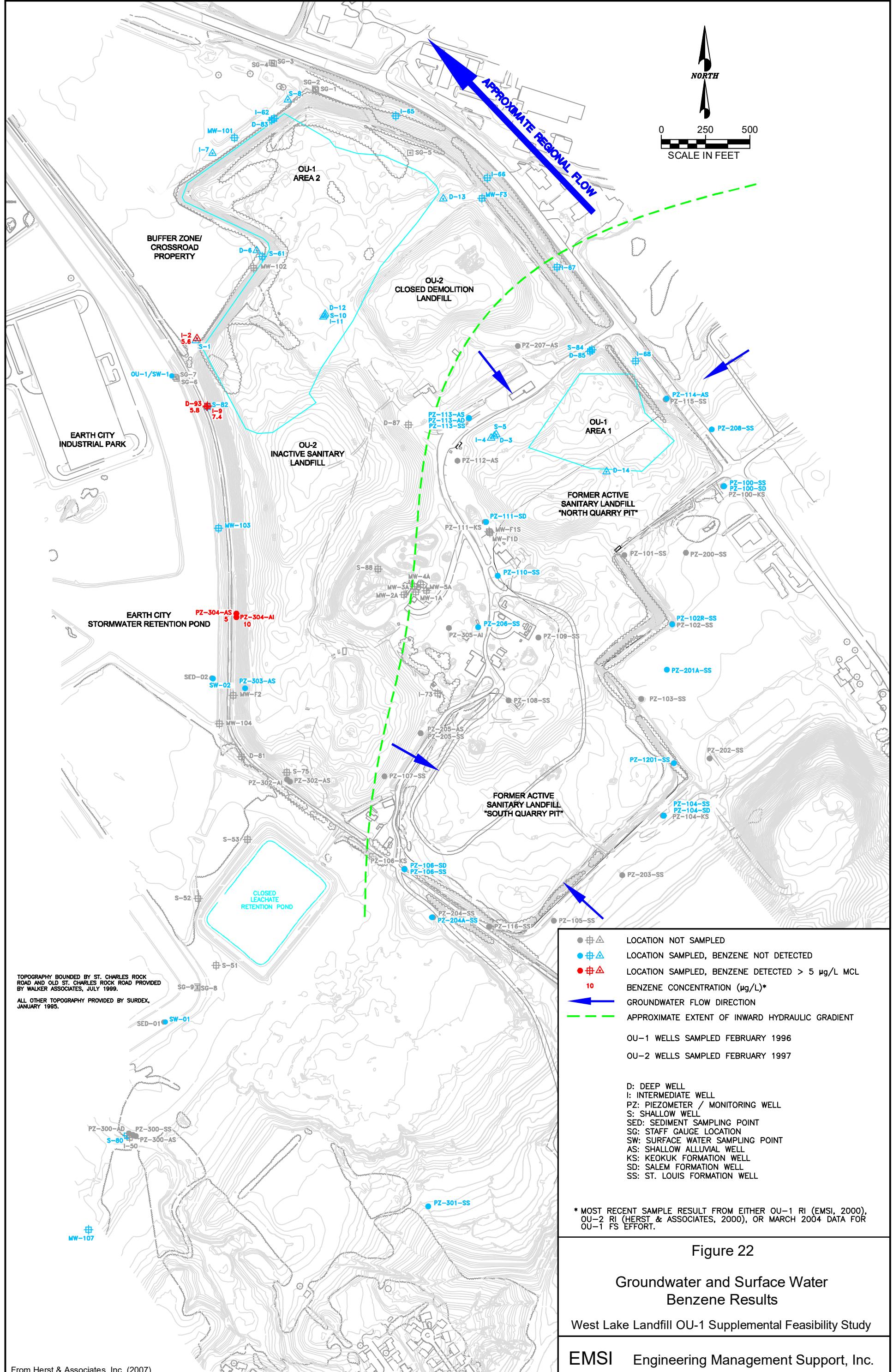


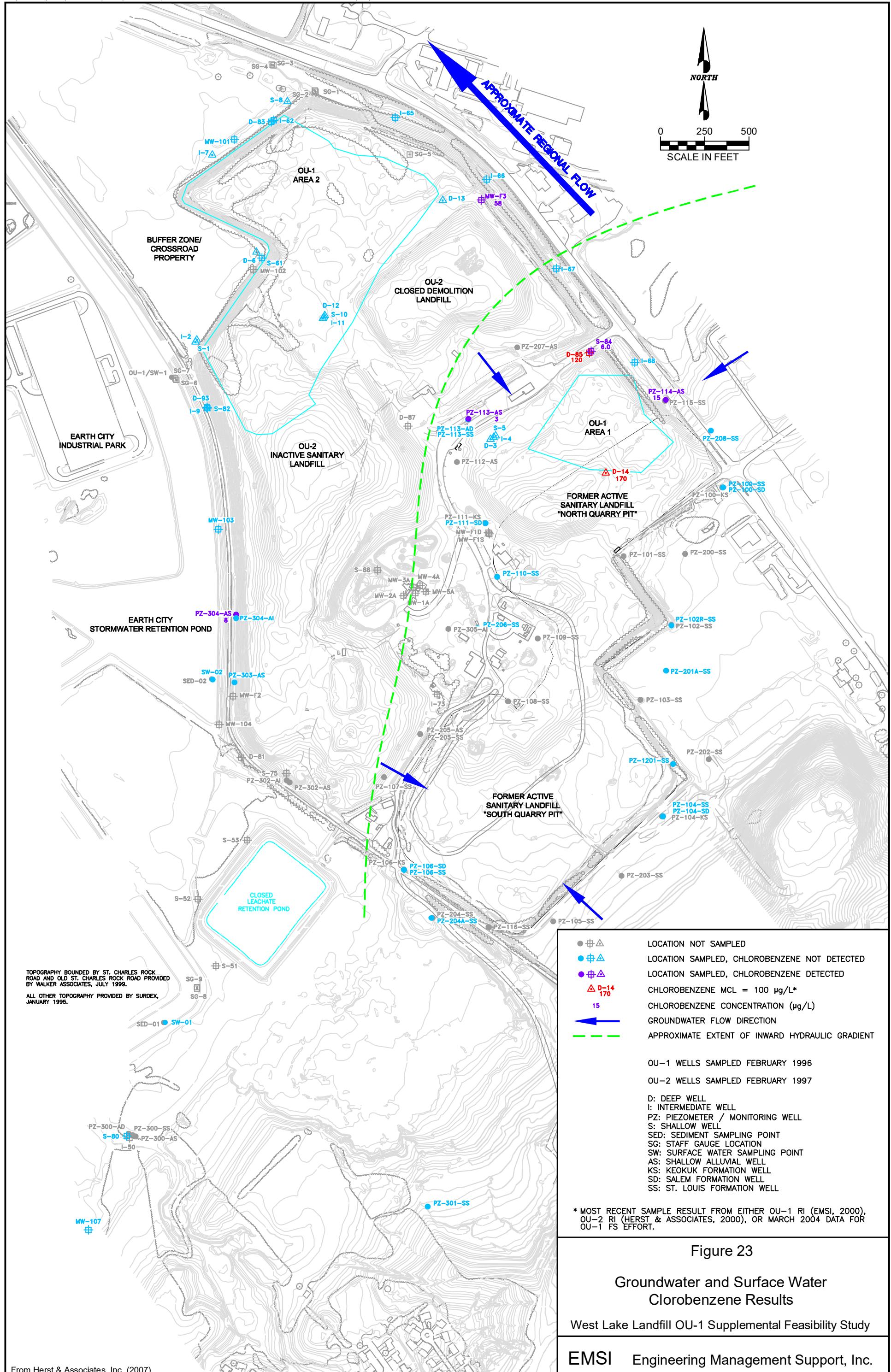


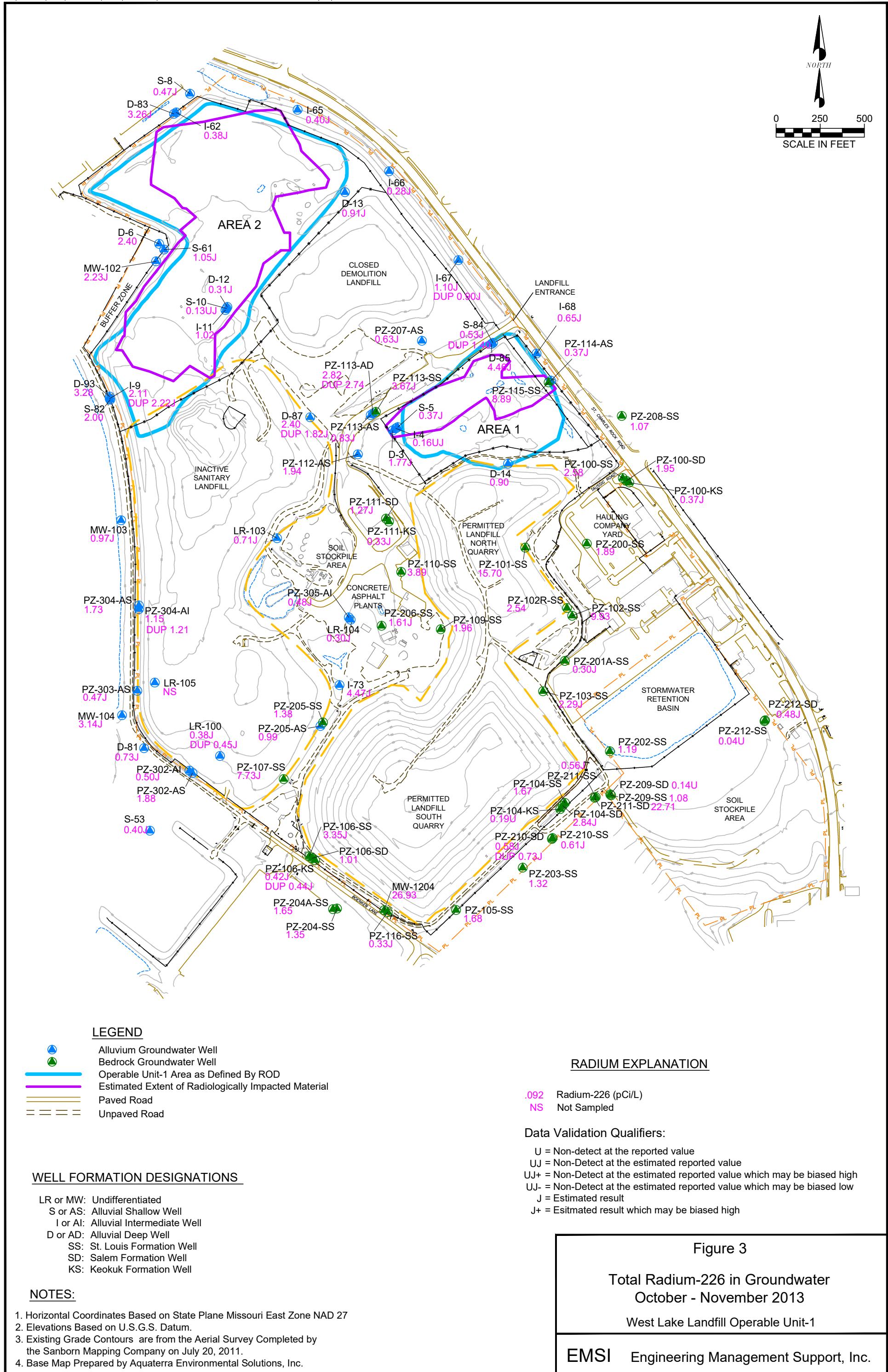






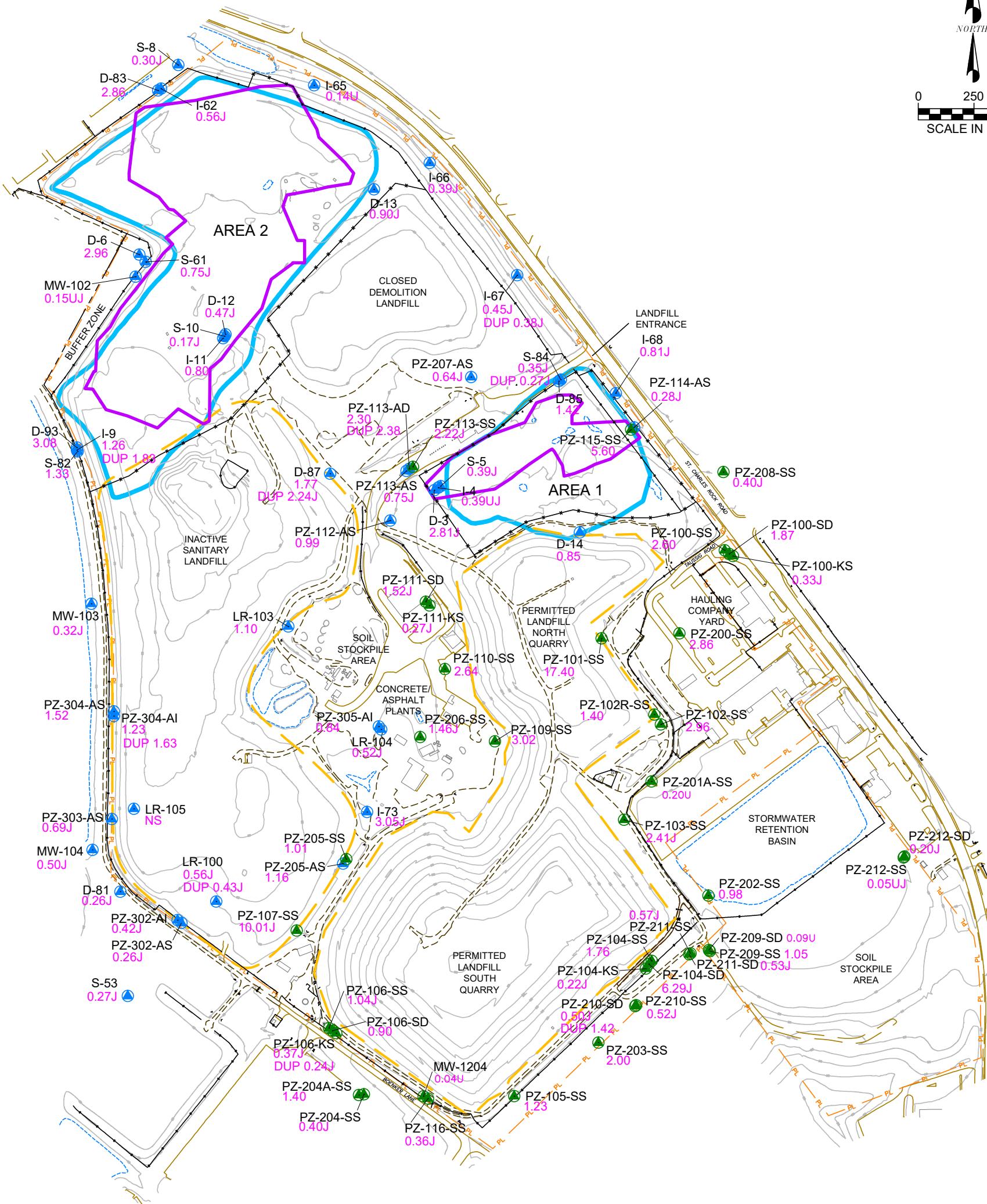








0 250 500  
SCALE IN FEET



#### LEGEND

- Alluvium Groundwater Well
- Bedrock Groundwater Well
- Operable Unit-1 Area as Defined By ROD
- Estimated Extent of Radiologically Impacted Material
- Paved Road
- Unpaved Road

#### RADIUM EXPLANATION

- .092 Radium-226 (pCi/L)
- NS Not Sampled

#### Data Validation Qualifiers:

- U = Non-detect at the reported value
- UJ = Non-Detect at the estimated reported value
- UJ+ = Non-Detect at the estimated reported value which may be biased high
- UJ- = Non-Detect at the estimated reported value which may be biased low
- J = Estimated result
- J+ = Esitmated result which may be biased high

#### WELL FORMATION DESIGNATIONS

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

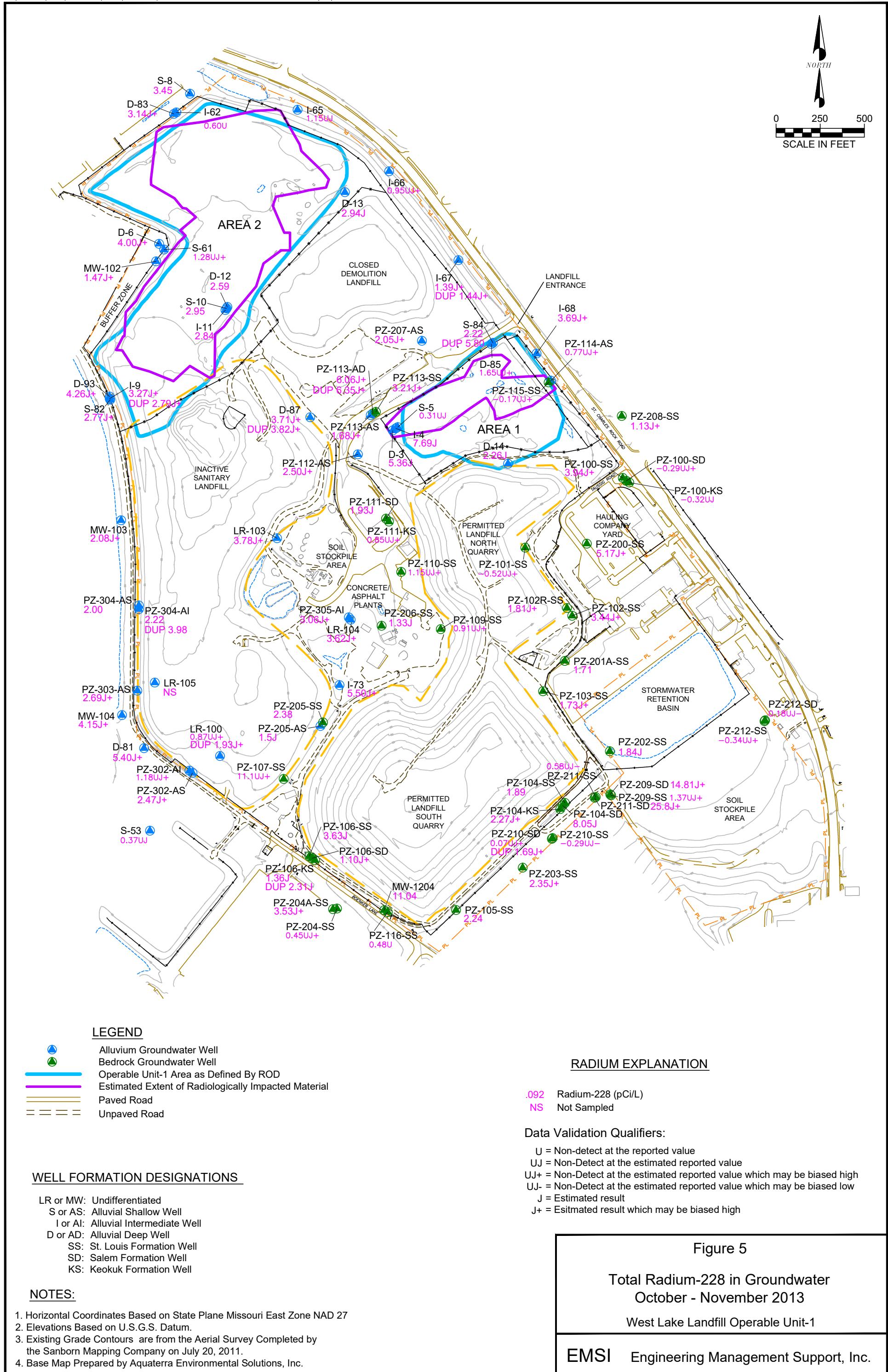
#### NOTES:

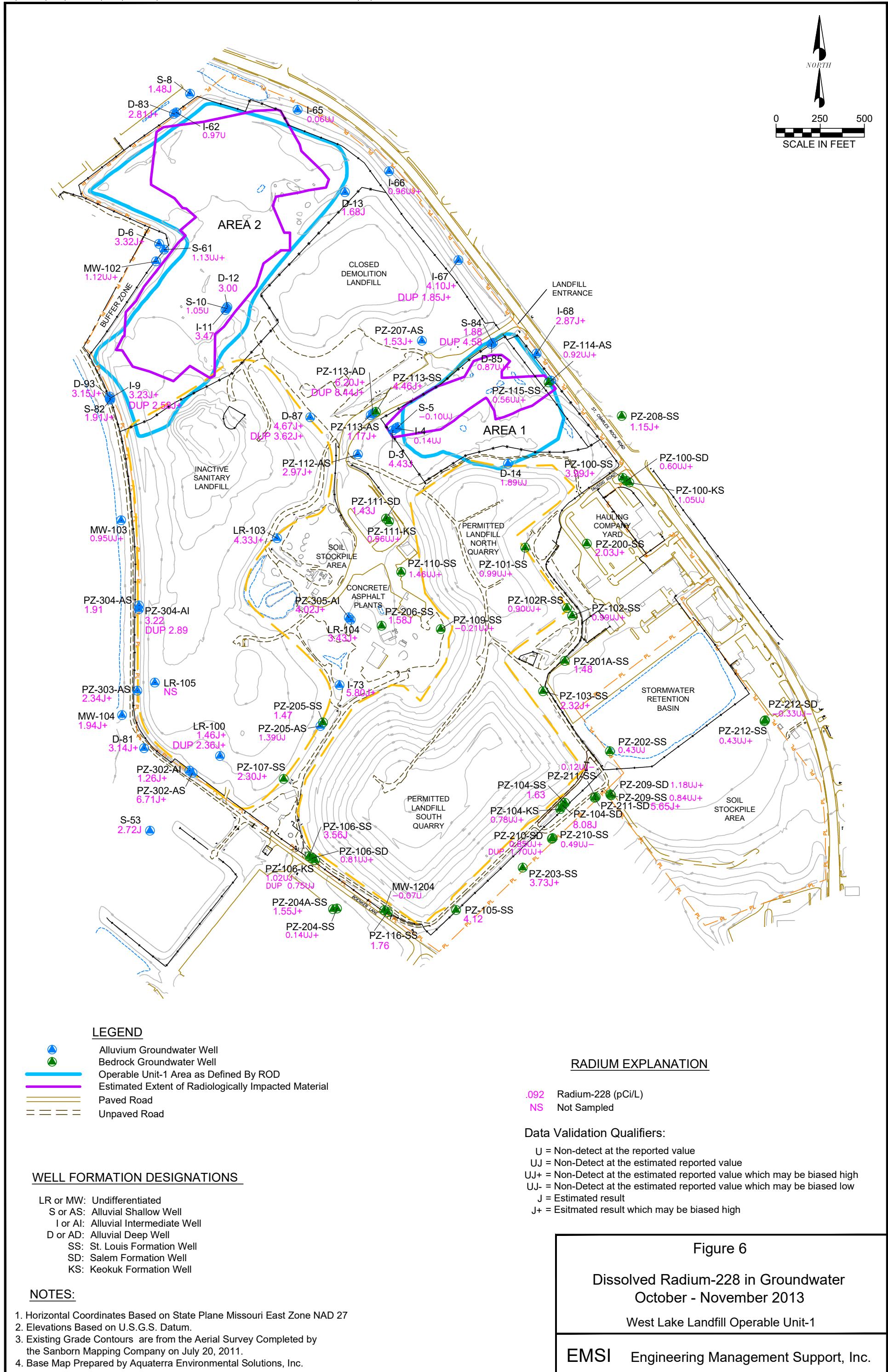
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

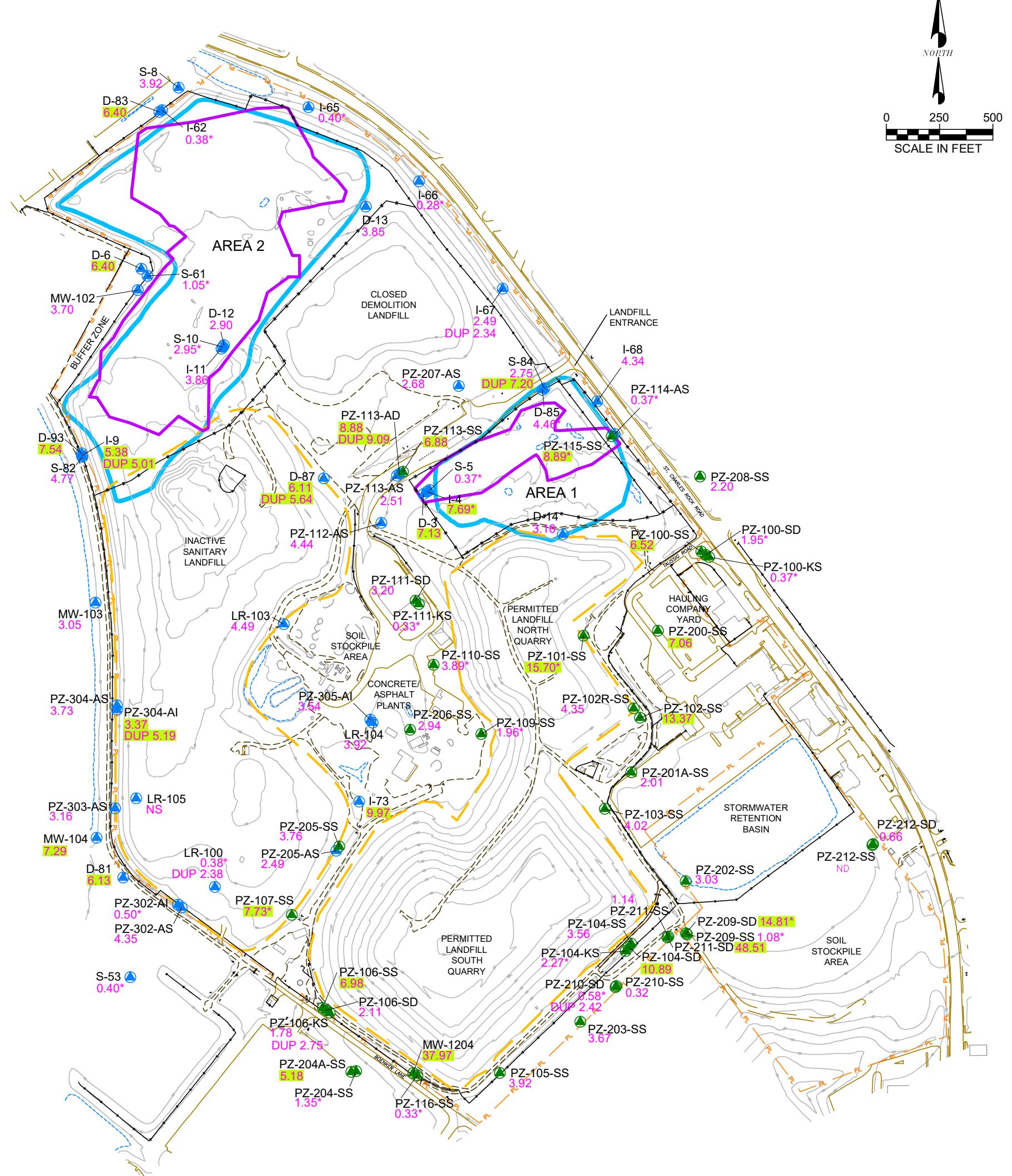
Figure 4  
Dissolved Radium-226 in Groundwater  
October - November 2013

West Lake Landfill Operable Unit-1

EMSI Engineering Management Support, Inc.





**LEGEND**

- Alluvium Groundwater Well
- Bedrock Groundwater Well
- Operable Unit-1 Area as Defined By ROD
- Estimated Extent of Radiologically Impacted Material
- Paved Road
- Unpaved Road

**RADIUM EXPLANATION**

- 1.72 Total Radium result that is less than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228
- 4.50\* Combined Ra-226 and Ra-228 results unless one of results was non-detect, in which case only the detected result is shown and the value is flagged with a \*
- 6.10 Total Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228
- ND Both Radium-226 and Radium-228 were non-detect
- NS Not Sampled

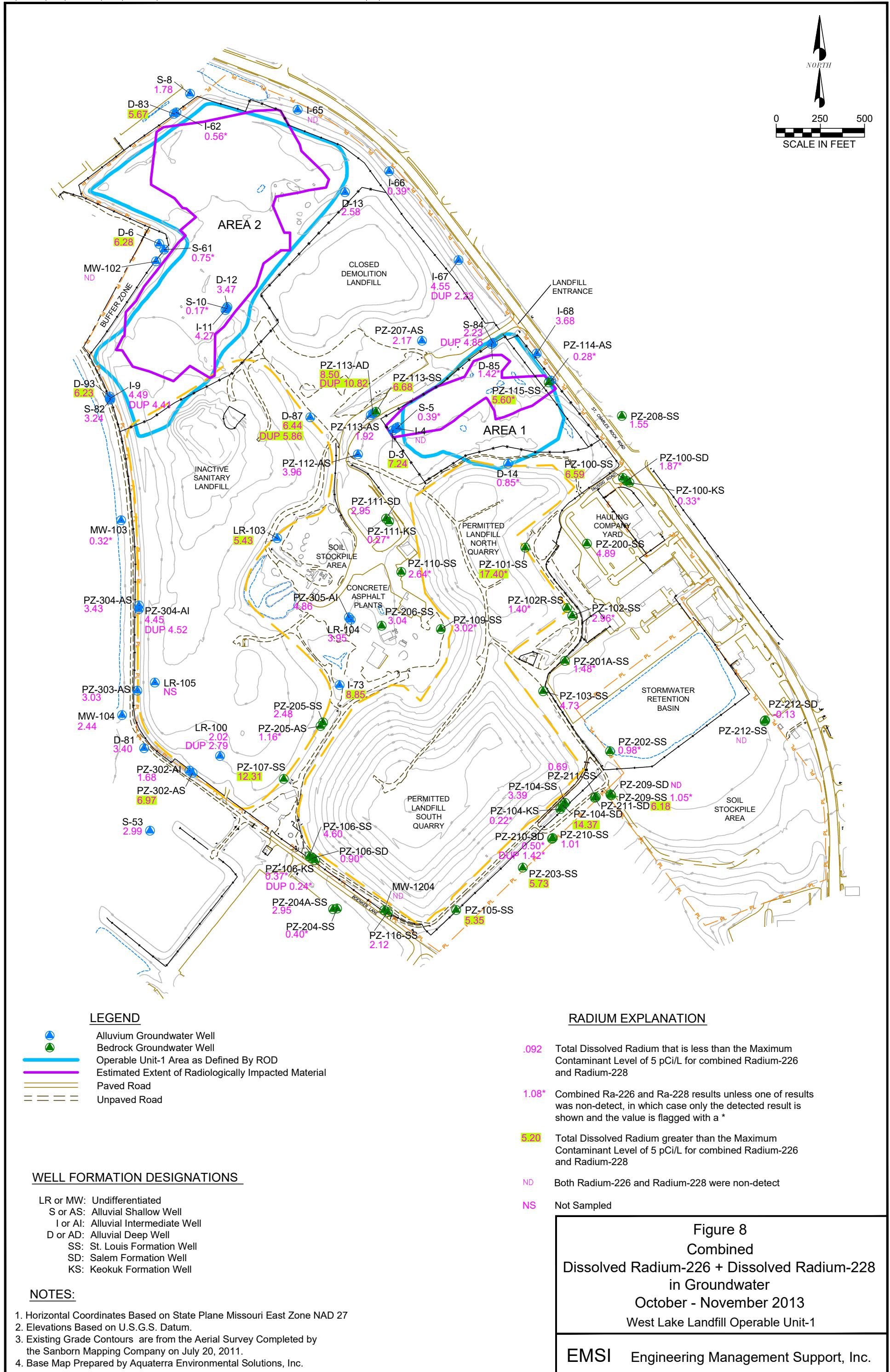
**WELL FORMATION DESIGNATIONS**

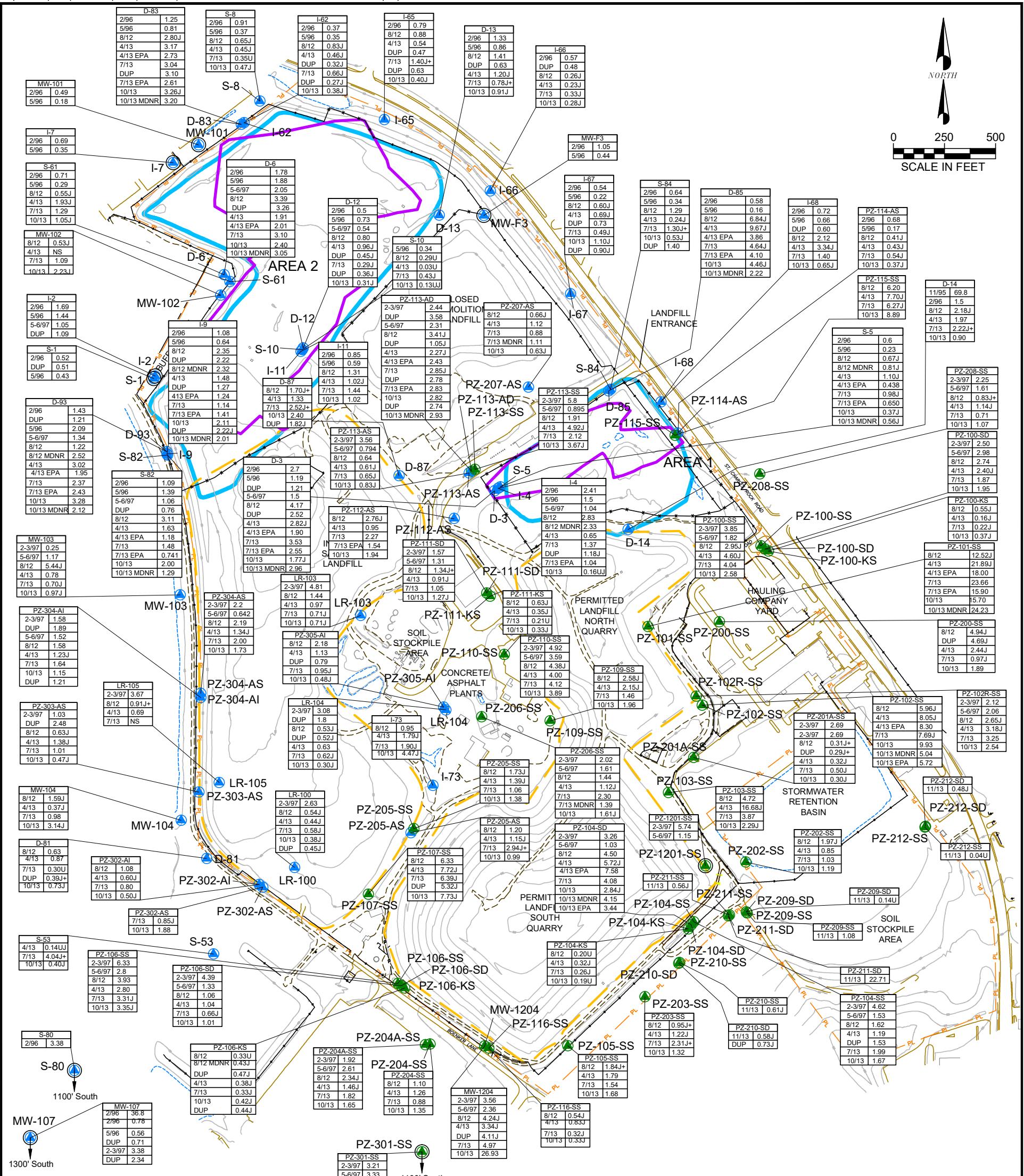
- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

- Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
- Elevations Based on U.S.G.S. Datum.
- Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
- Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**Figure 7**  
**Combined**  
**Total Radium-226 + Total Radium-228**  
**in Groundwater**  
**October - November 2013**  
**West Lake Landfill Operable Unit-1**





**Data Validation Qualifiers:**

- U = Non-detect at the reported value
- UJ = Non-Detect at the estimated reported value
- UJ+ = Non-Detect at the estimated reported value which may be biased high
- UJ- = Non-Detect at the estimated reported value which may be biased low
- J = Estimated result
- J+ = esimated result which may be biased high

Well Number  
Date Sampled

MW-1204 2-3/97 3.56

### RADIUM EXPLANATION

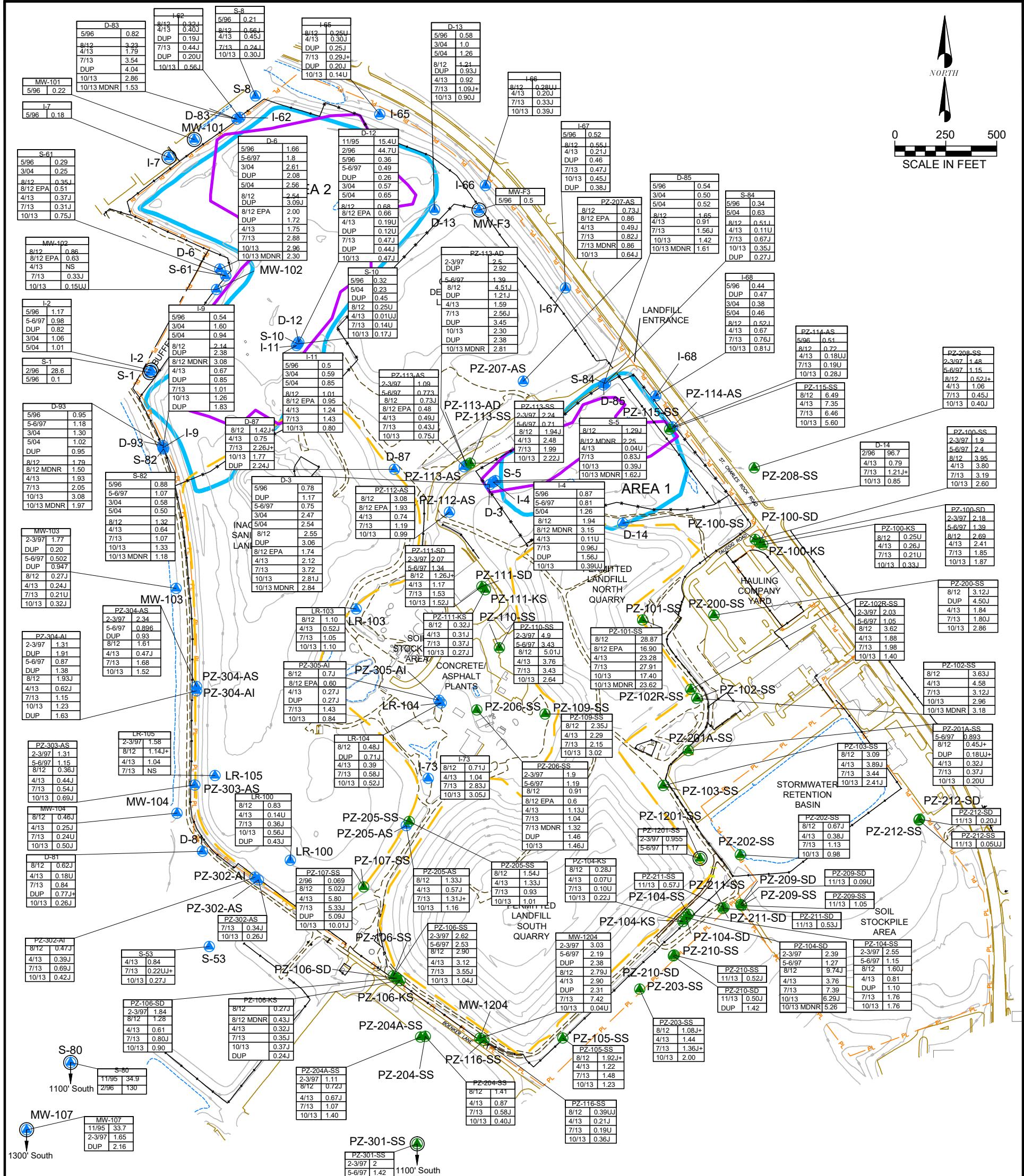
EMSI has concluded that D-14 results are not valid due to extreme variations between filtered and unfiltered results and extreme variations among sampling events.

OU-1 Wells Sampled 11/95, 2/96, 5/96, 5/97, 3/04, 5/04, 8/12, 4/13 and 7/13  
OU-2 Wells Sampled 2-3/97 and 5-6/97, 8/12, 4/13 and 7/13

Data from either OU-1 RI (EMSI, 2000), OU-2 RI (Herst & Associates, 2000), or 2004 Data for OU-1 FS Effort.

**Figure 9**  
**2013, 2012 and RI/FS Results for Total Radium-226 in Groundwater**

West Lake Landfill Operable Unit-1

**LEGEND**

- Alluvium Groundwater Well
- Bedrock Groundwater Well
- RI/FS Groundwater Well That No Longer Exists
- Operable Unit-1 Area as Defined By ROD
- Estimated Extent of Radiologically Impacted Material
- Paved Road
- Unpaved Road

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**Data Validation Qualifiers:**

- U = Non-detect at the reported value
- UJ = Non-Detect at the estimated reported value
- UJ+ = Non-Detect at the estimated reported value which may be biased high
- UJ- = Non-Detect at the estimated reported value which may be biased low
- J = Estimated result
- J+ = esimated result which may be biased high

**Well Number**Date Sampled MW-1204  
2-3/97 3.03**RADIUM EXPLANATION**

EMSI has concluded that D-14 results are not valid due to extreme variations between filtered and unfiltered results and extreme variations among sampling events.

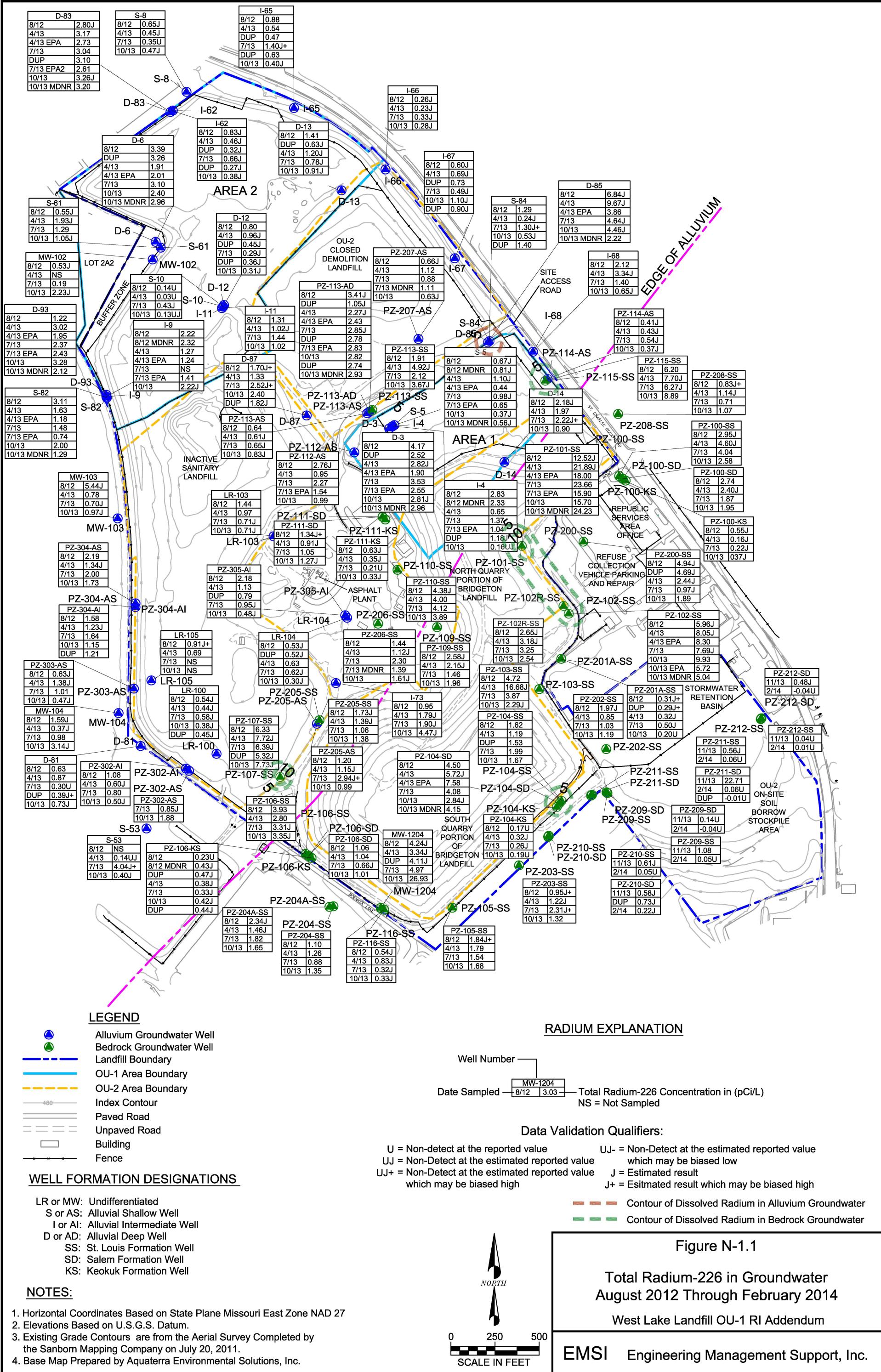
OU-1 Wells Sampled 11/95, 2/96, 5/96, 5/97, 3/04, 5/04, 8/12, 4/13 and 7/13  
OU-2 Wells Sampled 2-3/97 and 5-6/97, 8/12, 4/13 and 7/13

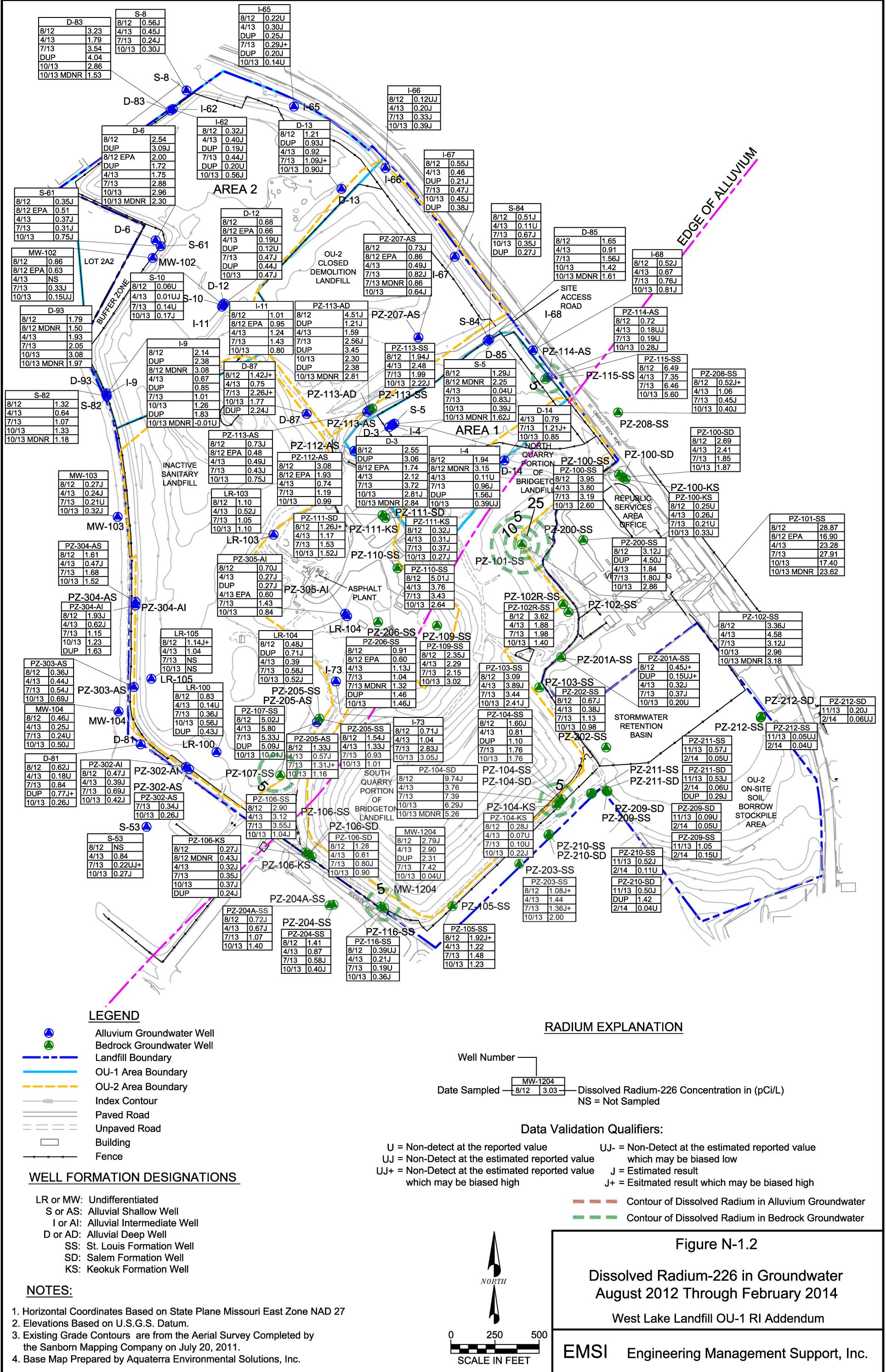
Data from either OU-1 RI (EMSI, 2000), OU-2 RI (Herst & Associates, 2000), or 2004 Data for OU-1 FS Effort.

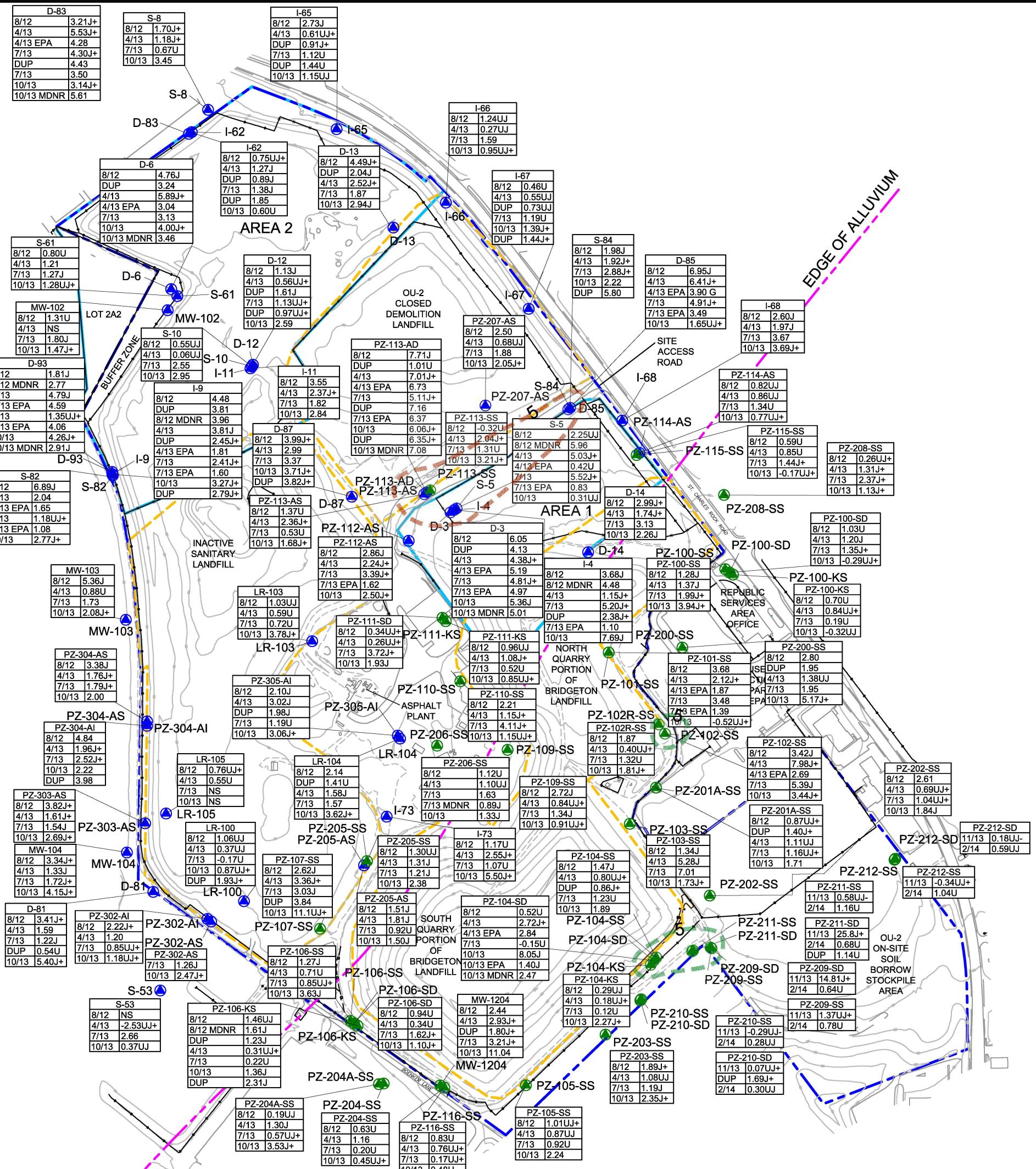
**Figure 10****2013, 2012 and RI/FS Results for Dissolved Radium-226 in Groundwater**

West Lake Landfill Operable Unit-1

**EMSI** Engineering Management Support, Inc.



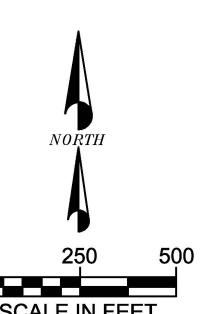




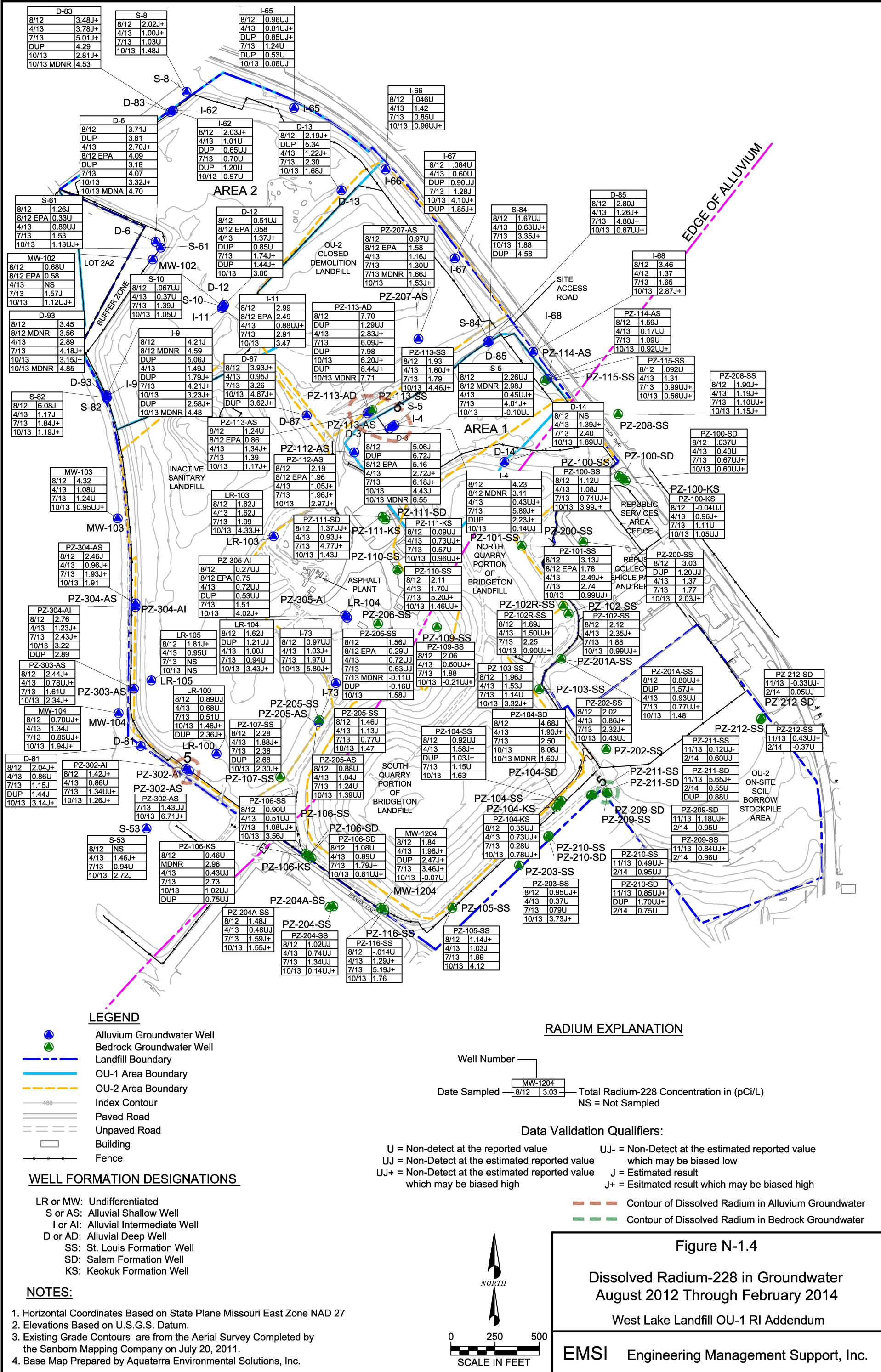
U = Non-detect at the reported value  
 UJ = Non-Detect at the estimated reported value  
 UJ+ = Non-Detect at the estimated reported value which may be biased high

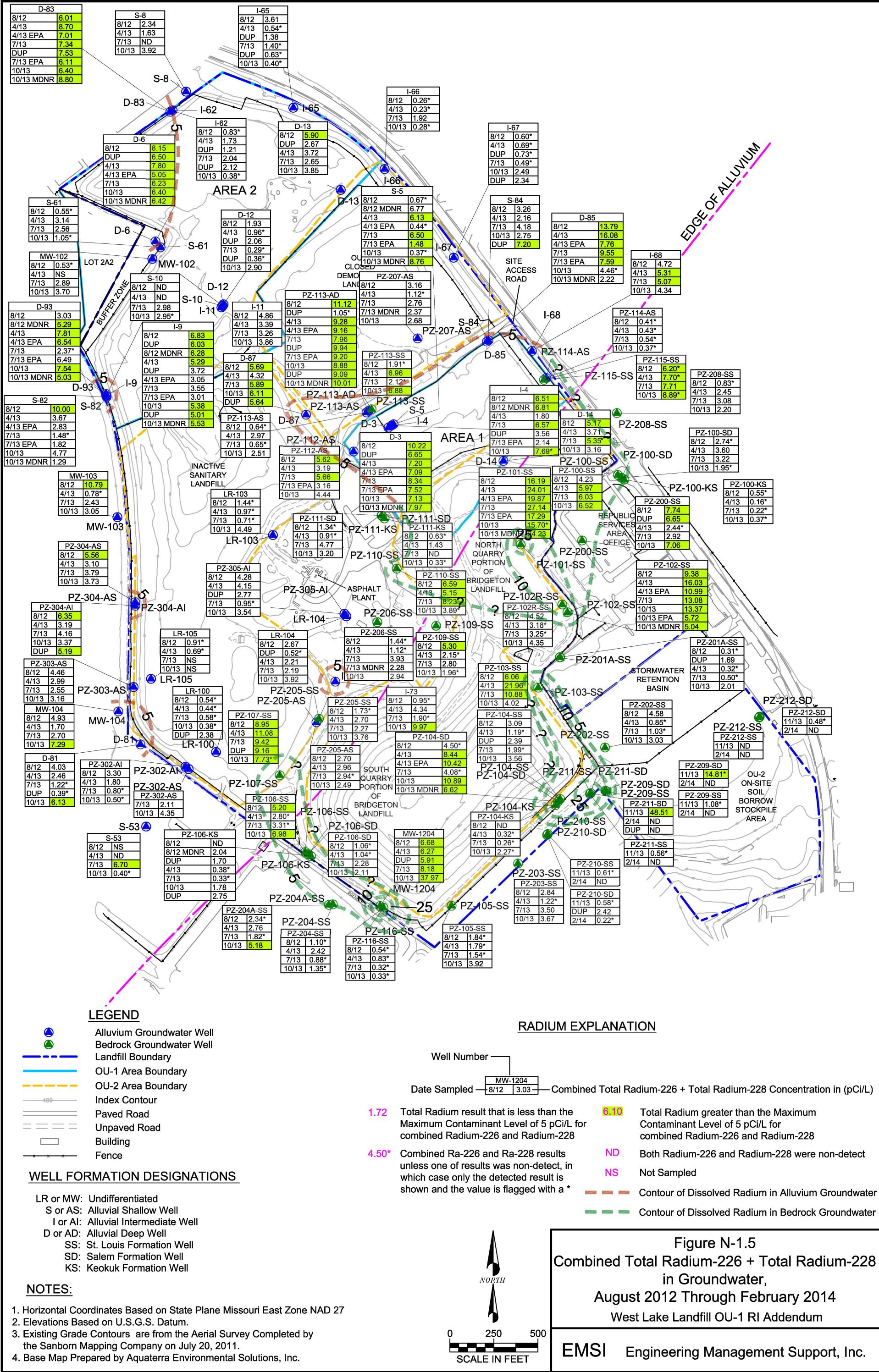
UJ- = Non-Detect at the estimated reported value which may be biased low  
 J = Estimated result  
 J+ = Esitmated result which may be biased high

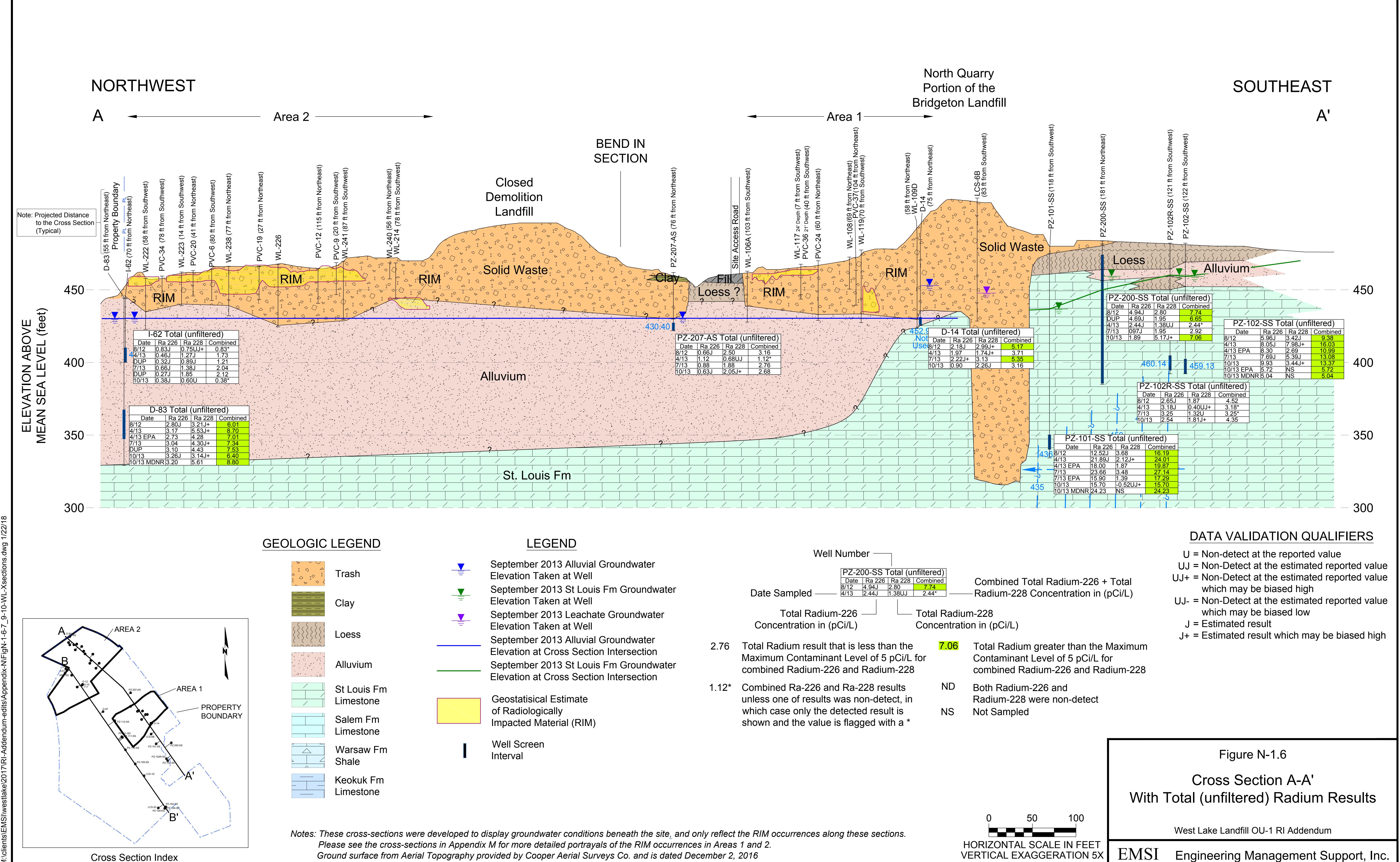
— Contour of Dissolved Radium in Alluvium Groundwater  
 - - - Contour of Dissolved Radium in Bedrock Groundwater



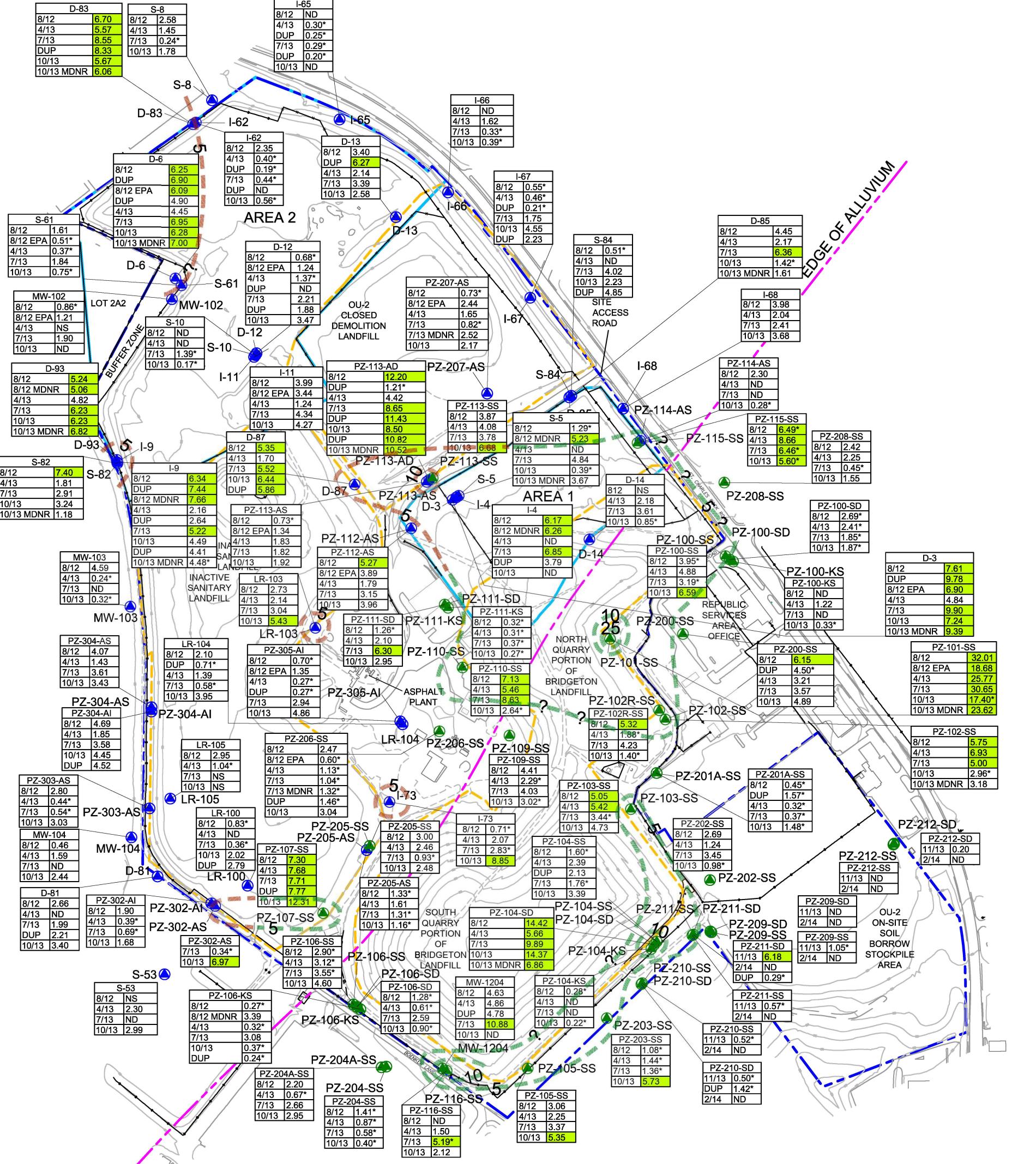
**Figure N-1.3**  
**Total Radium-228 in Groundwater**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**









**LEGEND**

- Alluvium Groundwater Well
- Bedrock Groundwater Well
- Landfill Boundary
- OU-1 Area Boundary
- OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**RADIUM EXPLANATION**

Well Number: MW-1204  
 Date Sampled: 8/12 3.03  
 Combined Total Radium-226 + Total Radium-228 Concentration in (pCi/L)

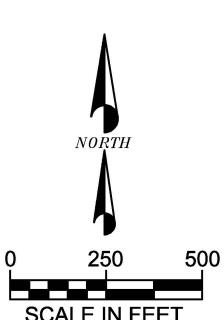
- 1.72 Total Dissolved Radium result that is less than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228
- 4.50\* Combined Ra-226 and Ra-228 results unless one of results was non-detect, in which case only the detected result is shown and the value is flagged with a \*

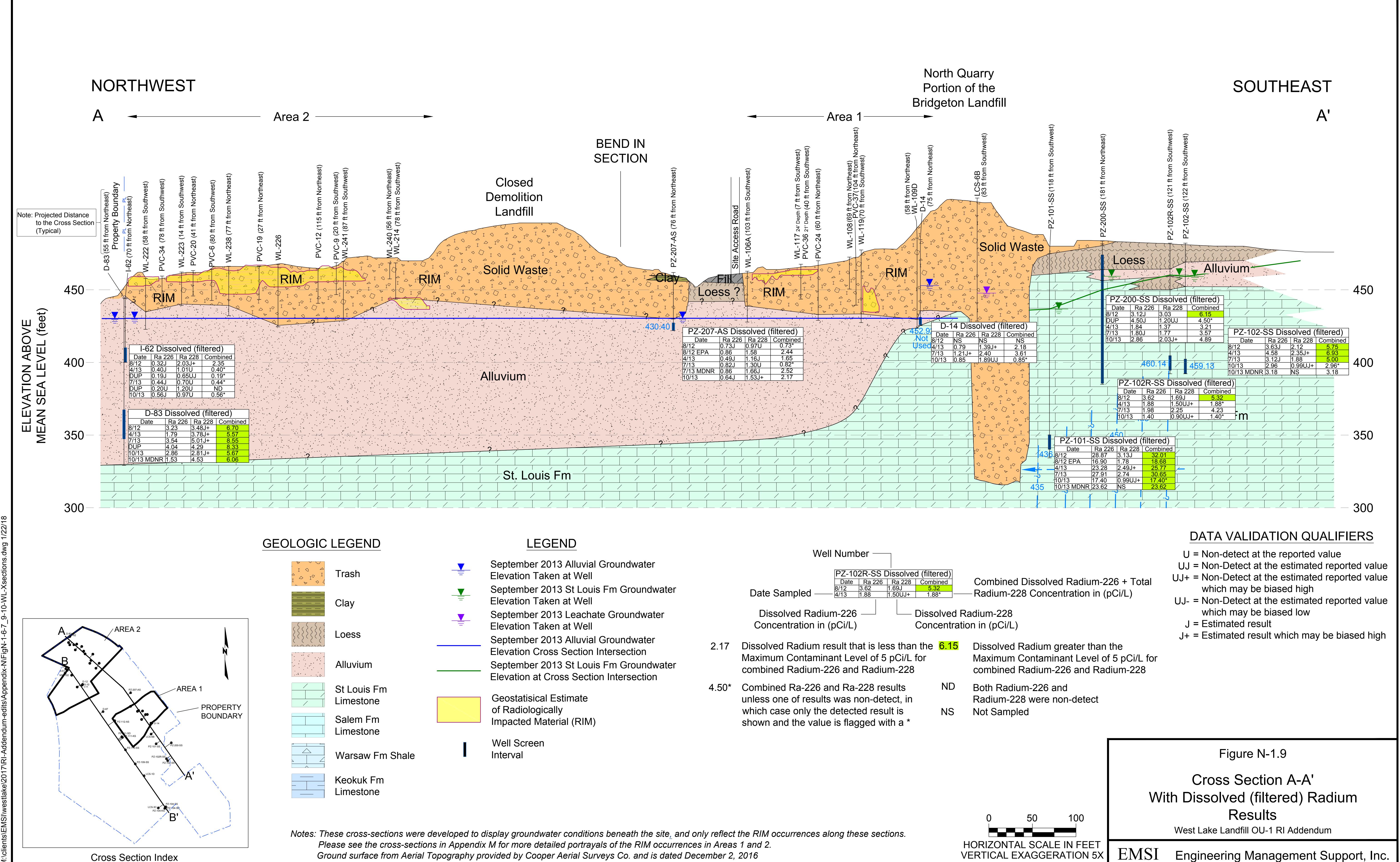
- 6.10 Total Dissolved Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228

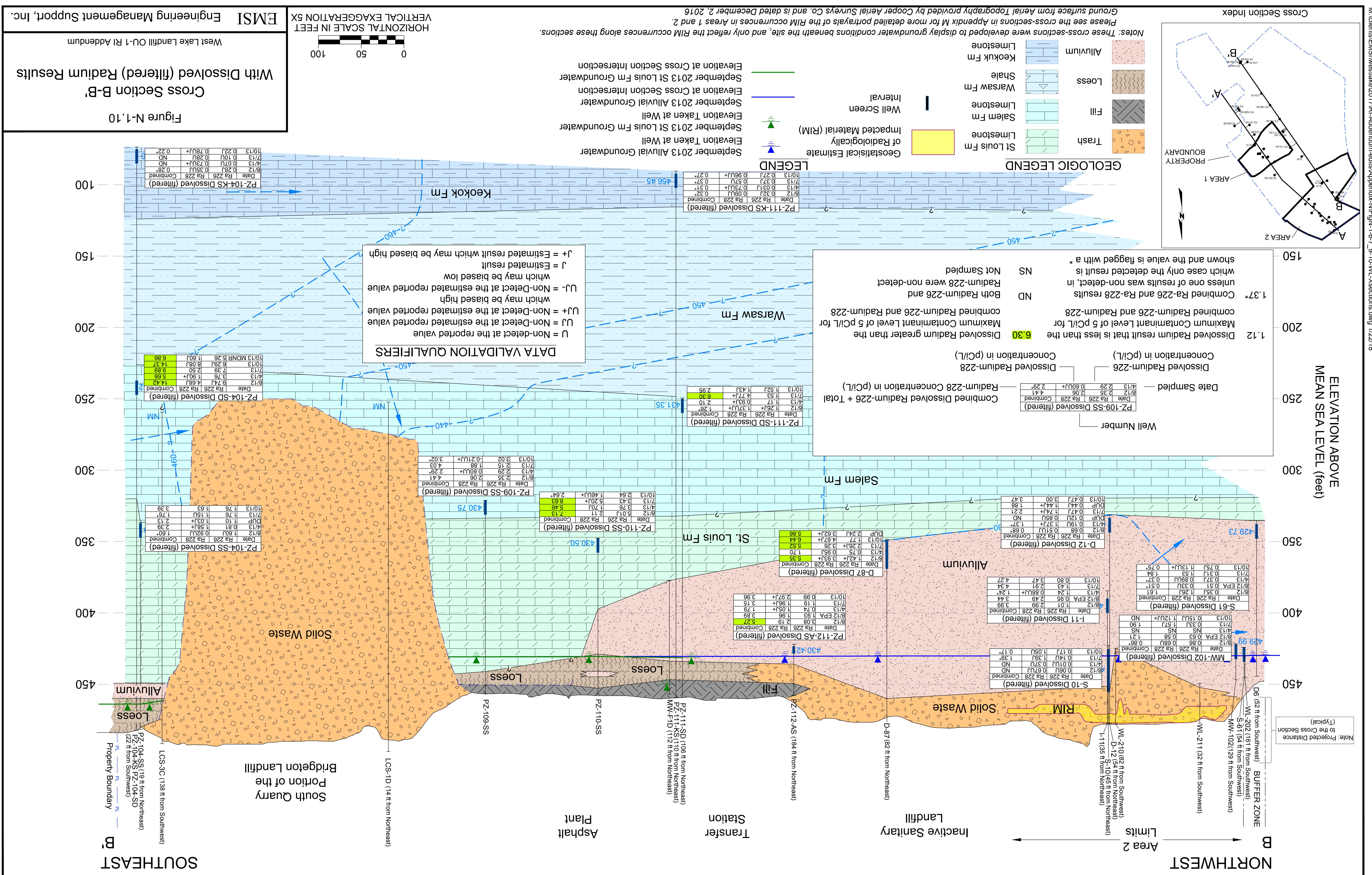
- ND Both Radium-226 and Radium-228 were non-detect  
 NS Not Sampled

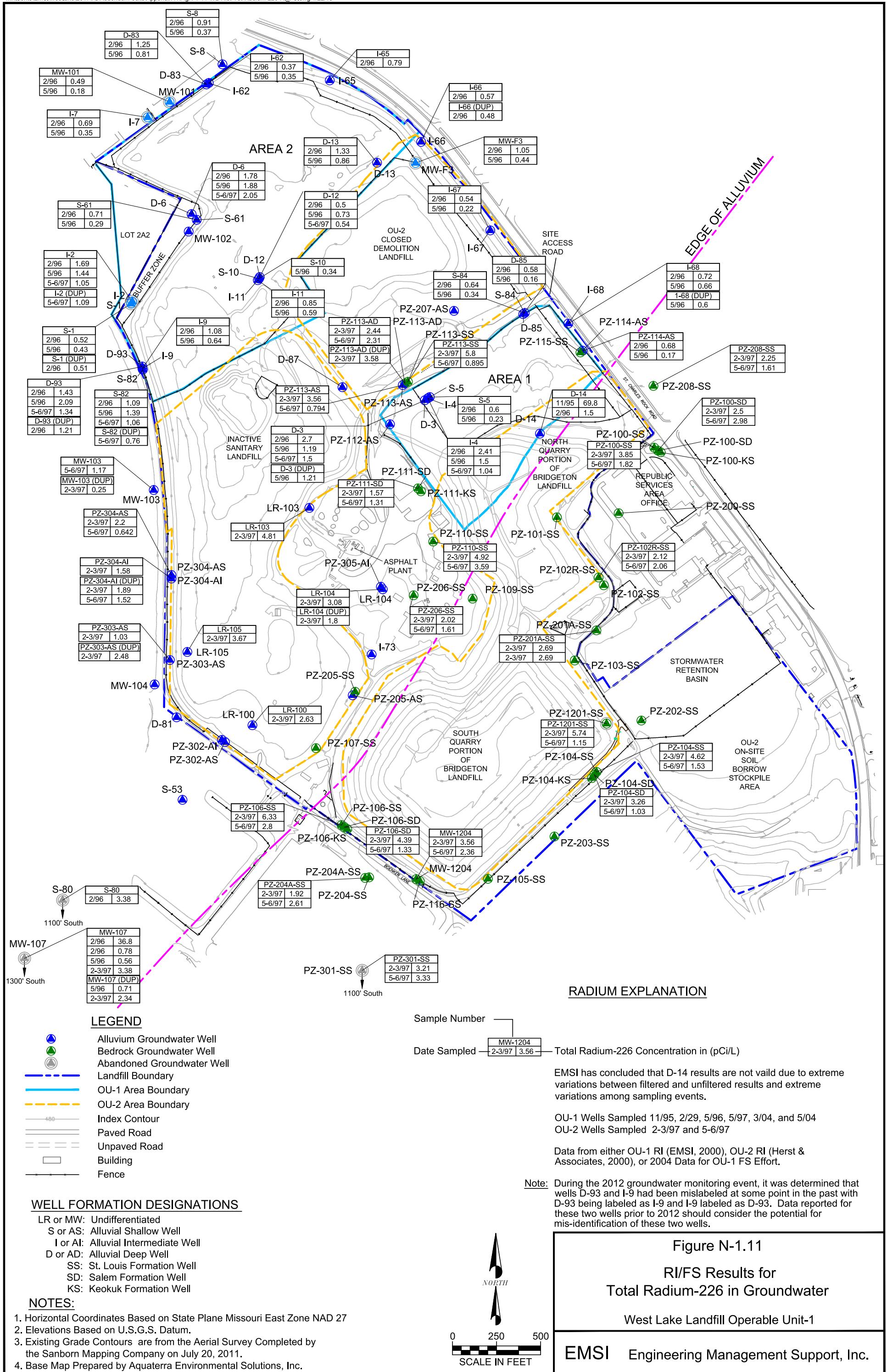
- Contour of Dissolved Radium in Alluvium Groundwater  
 — Contour of Dissolved Radium in Bedrock Groundwater

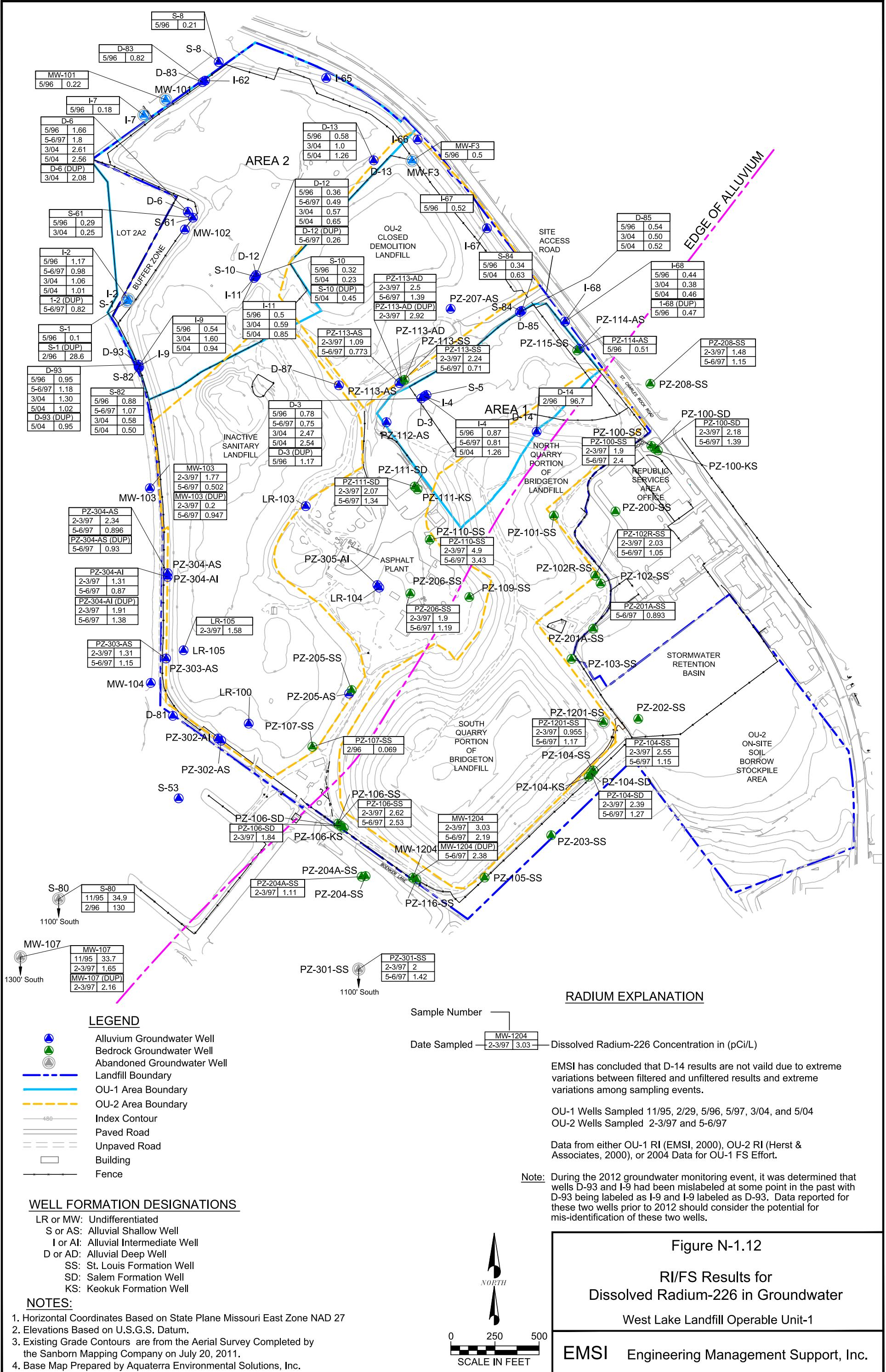
**Figure N-1.8**  
**Combined Dissolved Radium-226 + Dissolved Radium-228 in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

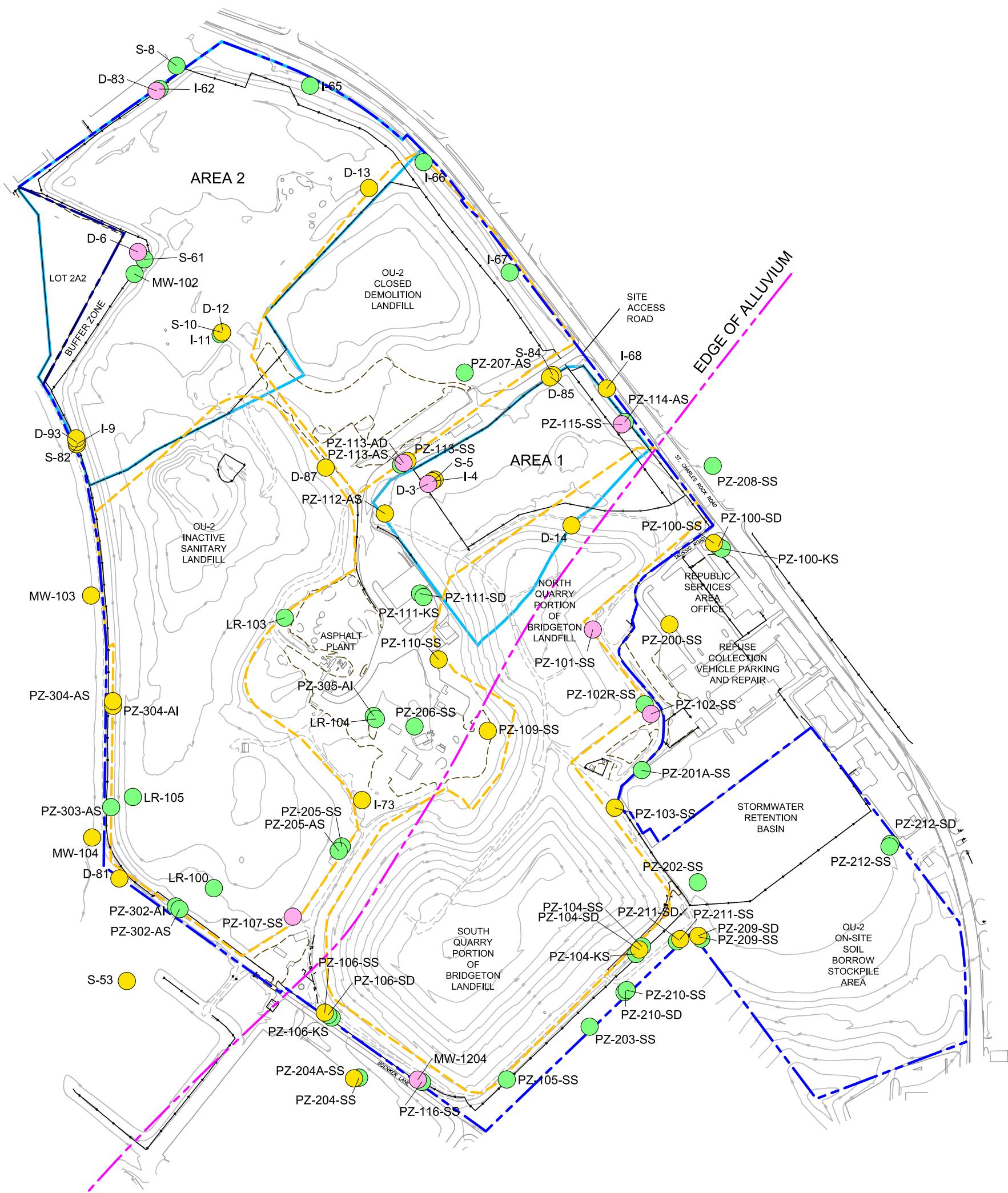










**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - -** OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**RADIUM EXPLANATION**

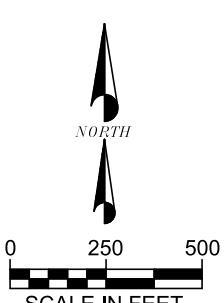
- (**Pink circle**) Total Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (all sampling dates)
- (**Yellow circle**) Total Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (at least one sampling date but not all sampling dates)
- (**Green circle**) Total Radium less than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (all sampling dates)

**WELL FORMATION DESIGNATIONS**

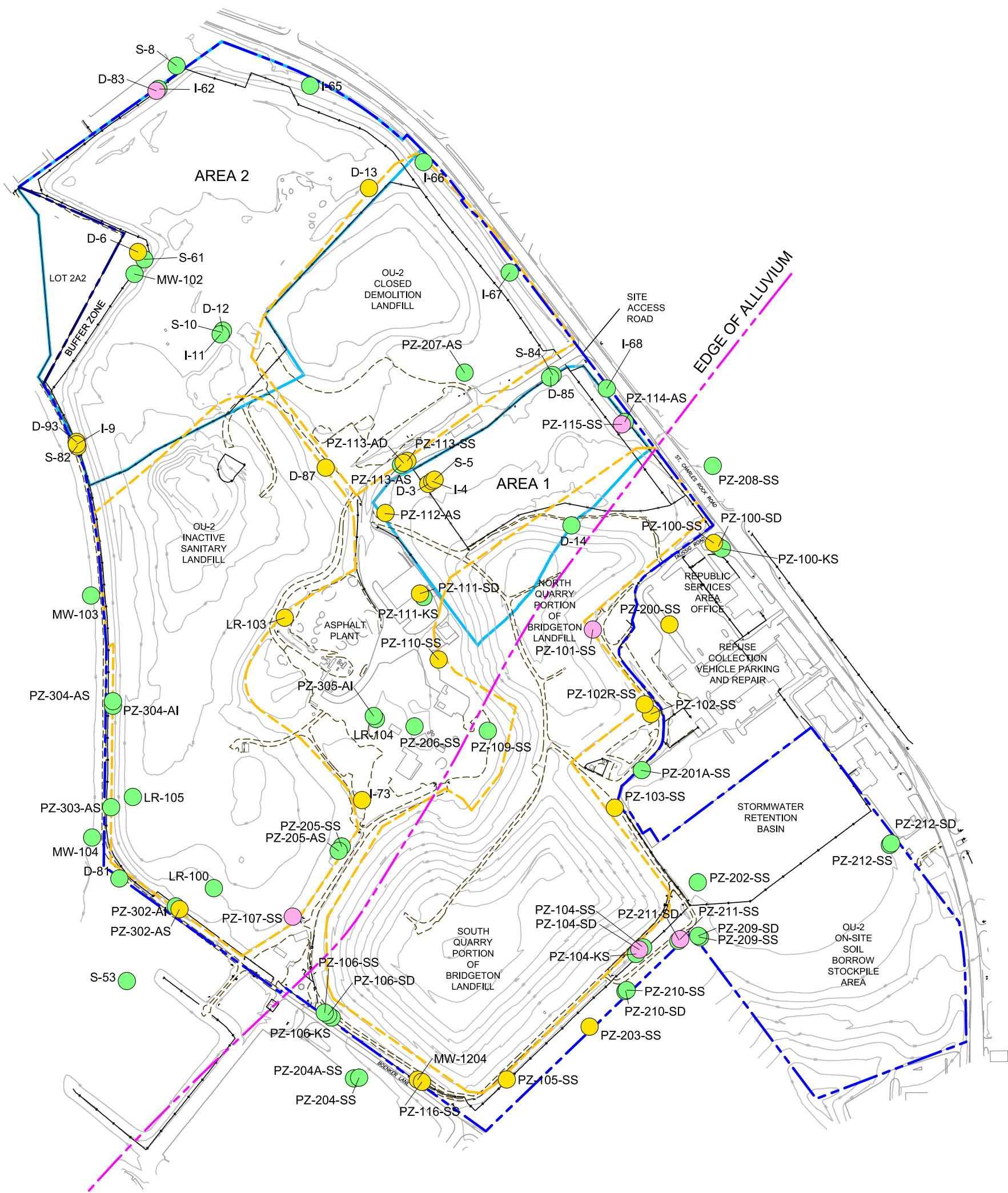
- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 7-2**  
**Combined Total Radium-226 + 228**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**RADIUM EXPLANATION**

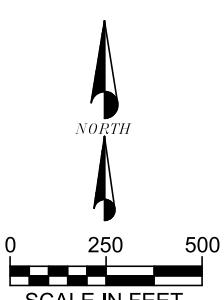
- (●) Dissolved Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (all sampling dates)
- (○) Dissolved Radium greater than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (at least one sampling date but not all sampling dates)
- (○) Dissolved Radium less than the Maximum Contaminant Level of 5 pCi/L for combined Radium-226 and Radium-228 (all sampling dates)

**WELL FORMATION DESIGNATIONS**

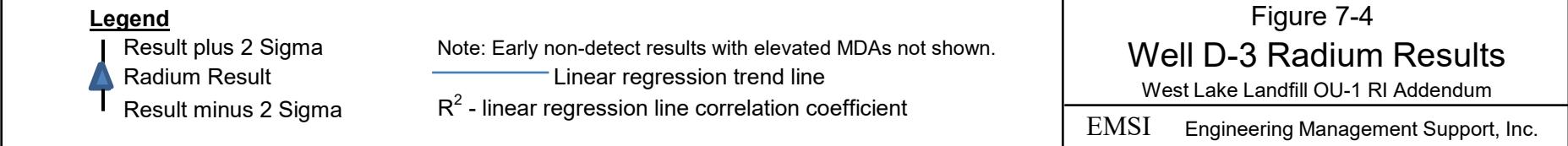
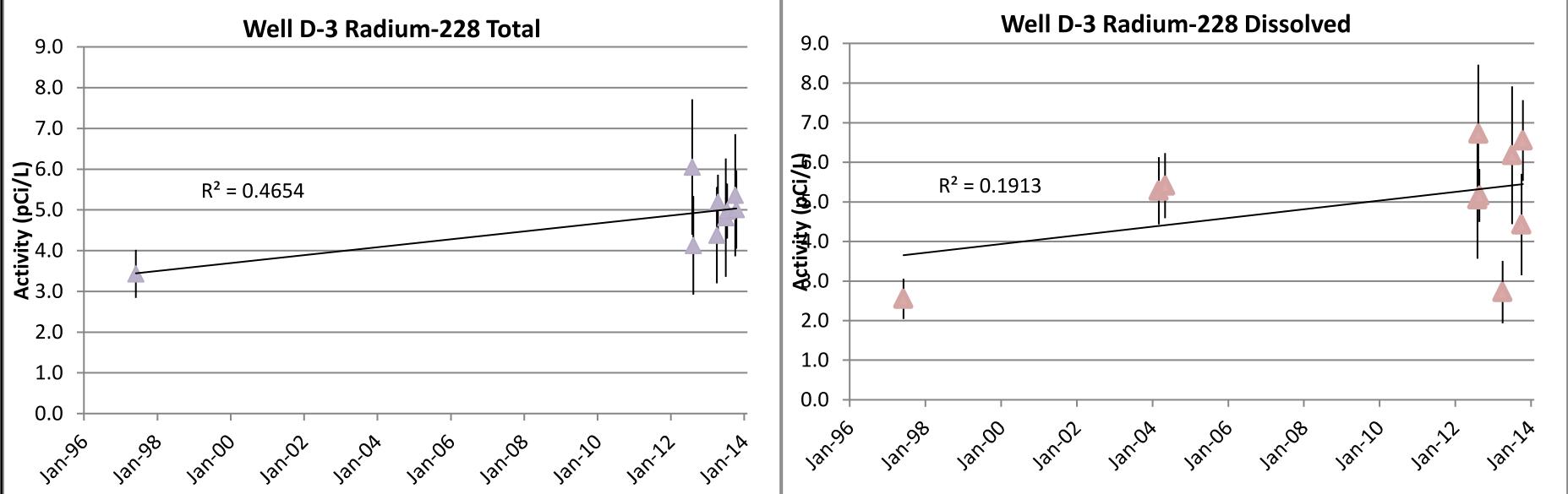
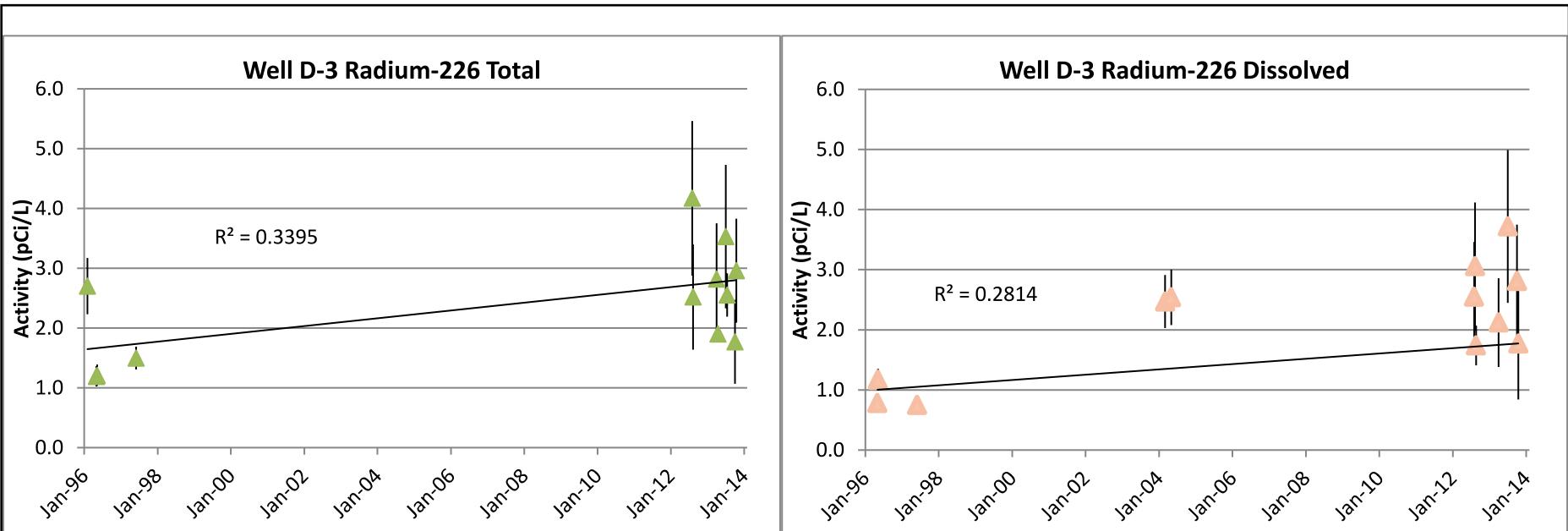
- LR or MW: Undifferentiated
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- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

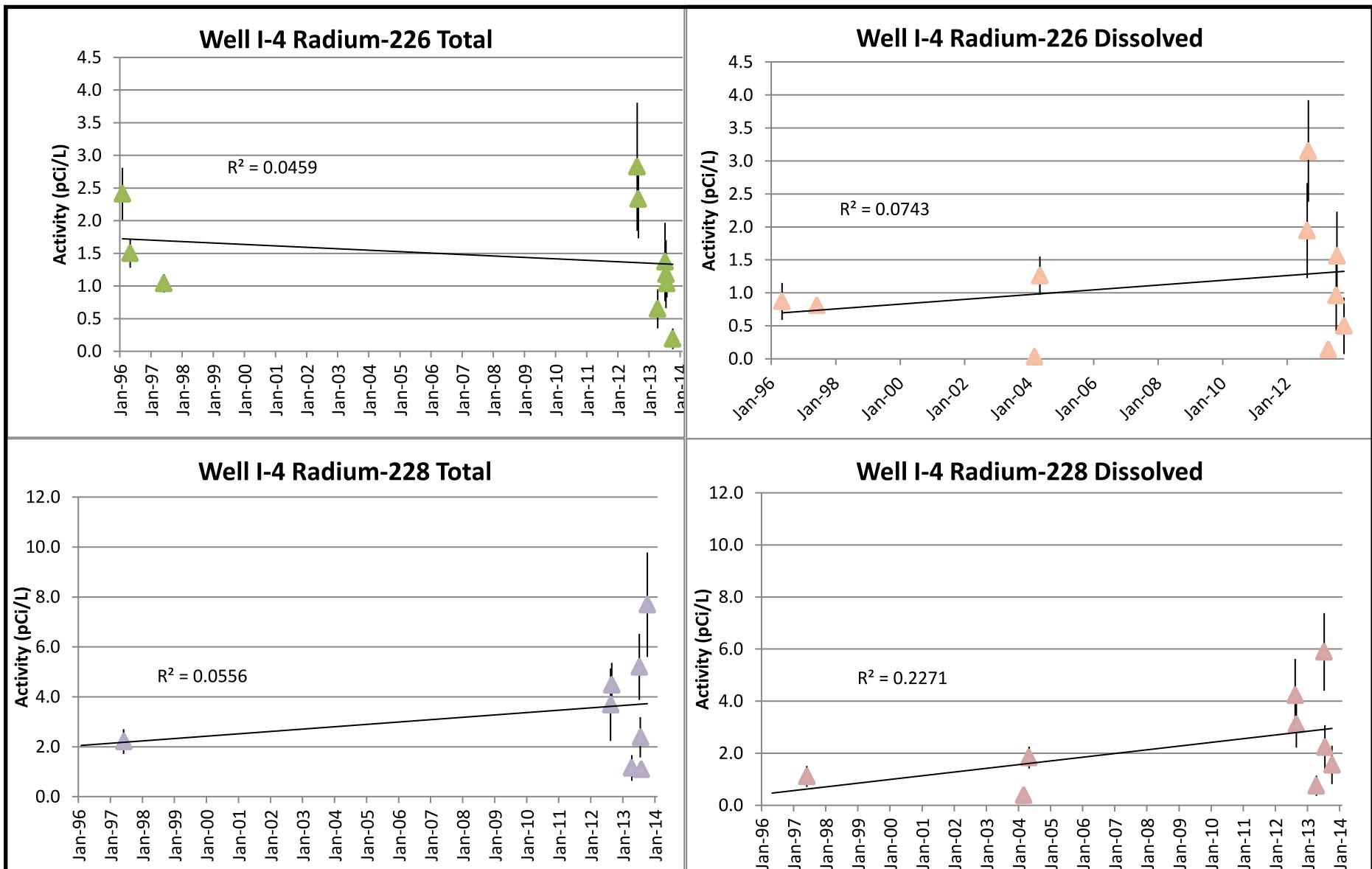
**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 7-3**  
**Combined Dissolved Radium-226 + 228**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**





#### Legend

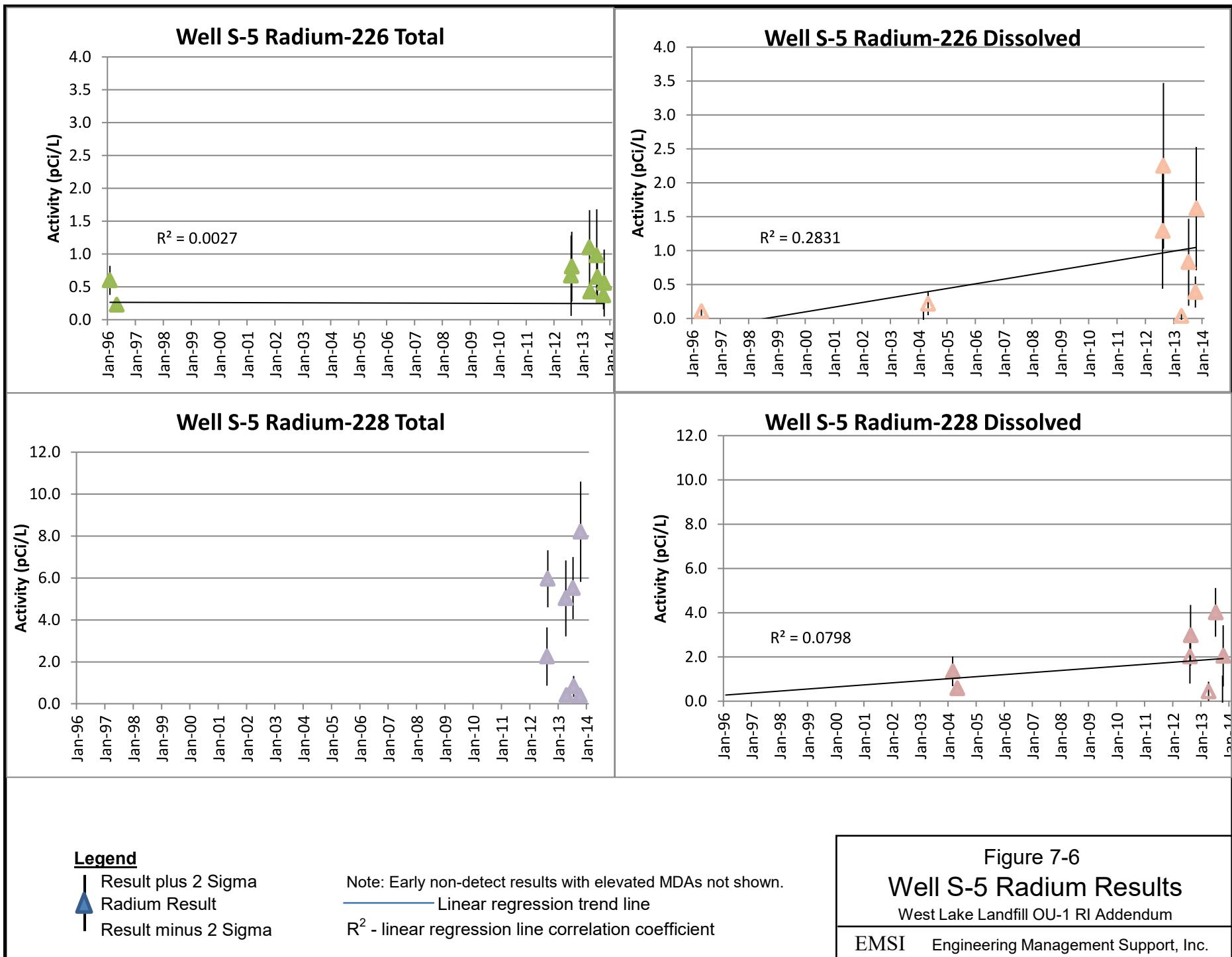
- Result plus 2 Sigma
- Result minus 2 Sigma
- Radium Result

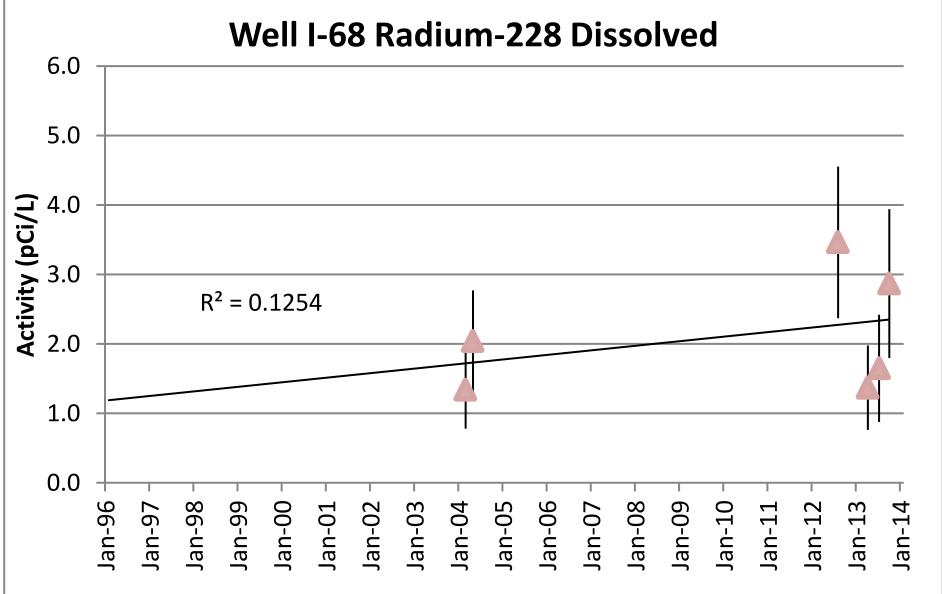
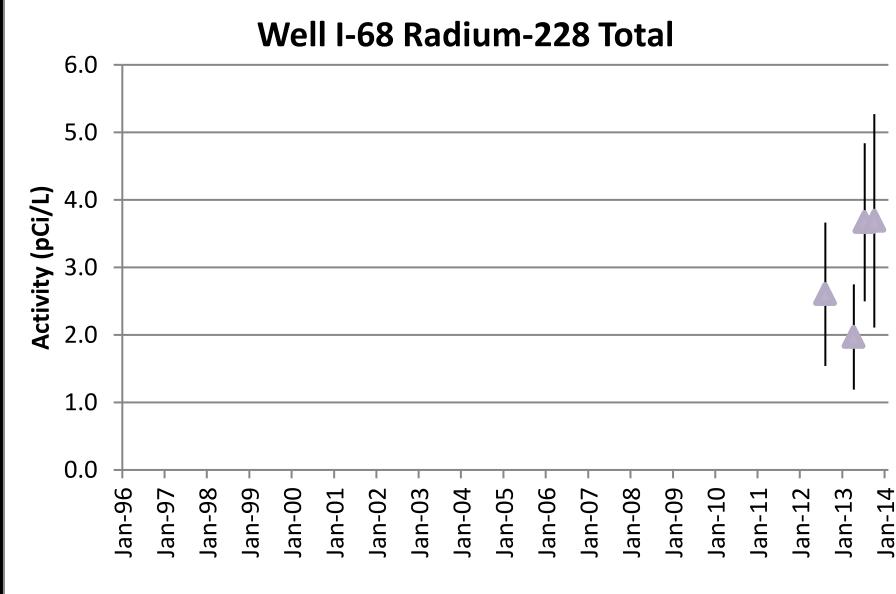
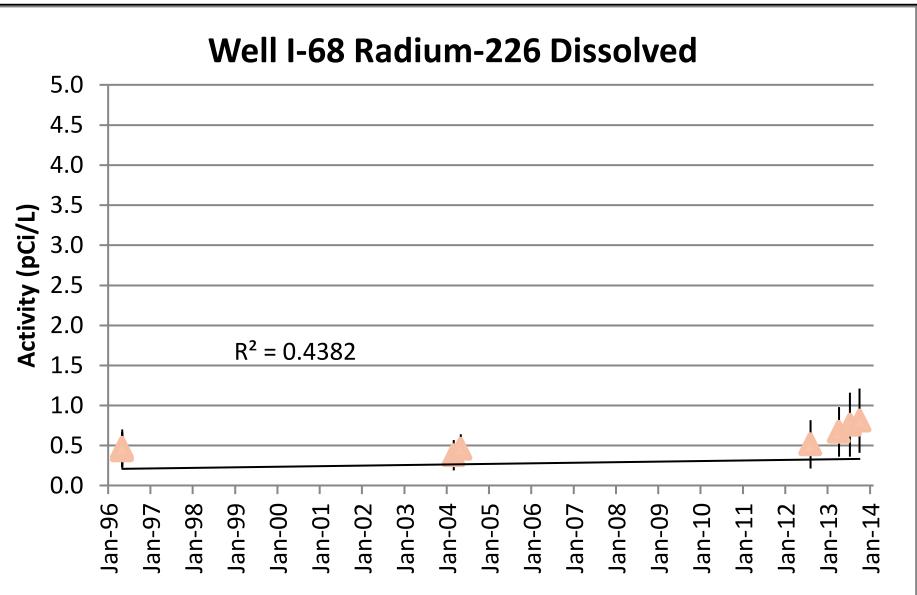
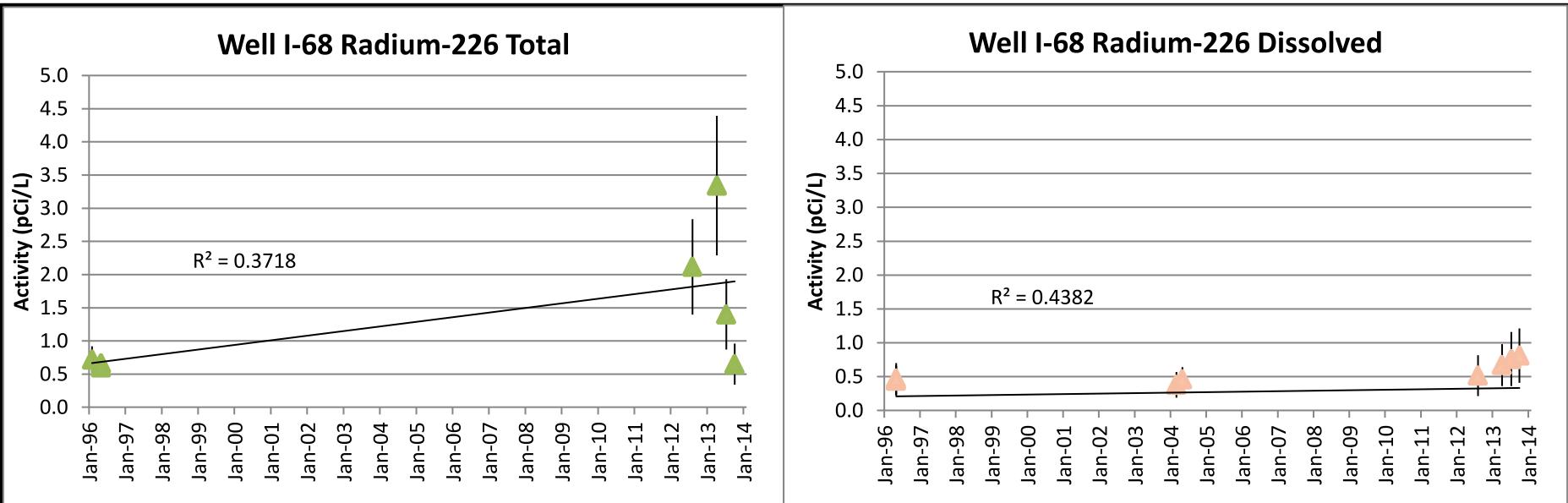
Note: Early non-detect results with elevated MDAs not shown.

Linear regression trend line

$R^2$  - linear regression line correlation coefficient

**Figure 7-5**  
**Well I-4 Radium Results**  
West Lake Landfill OU-1 RI Addendum

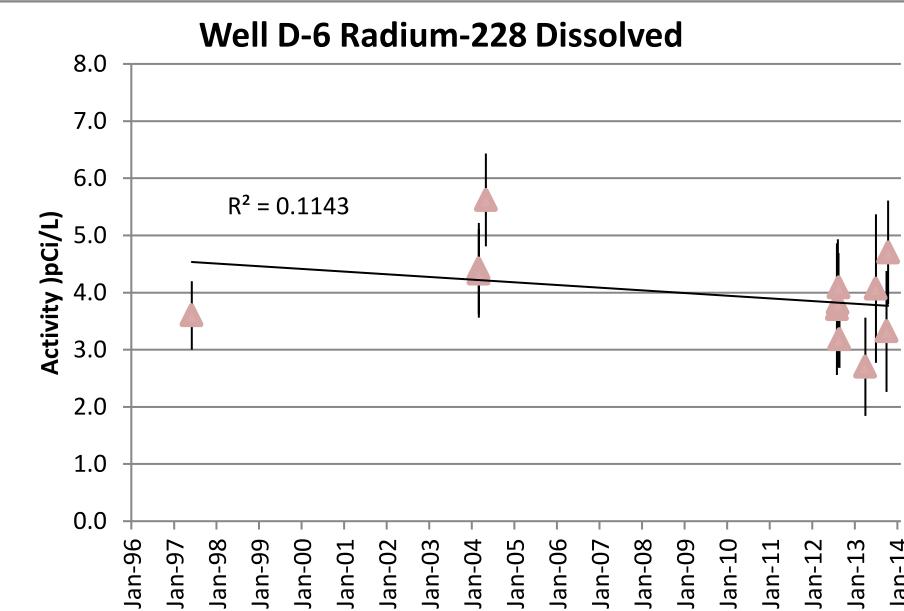
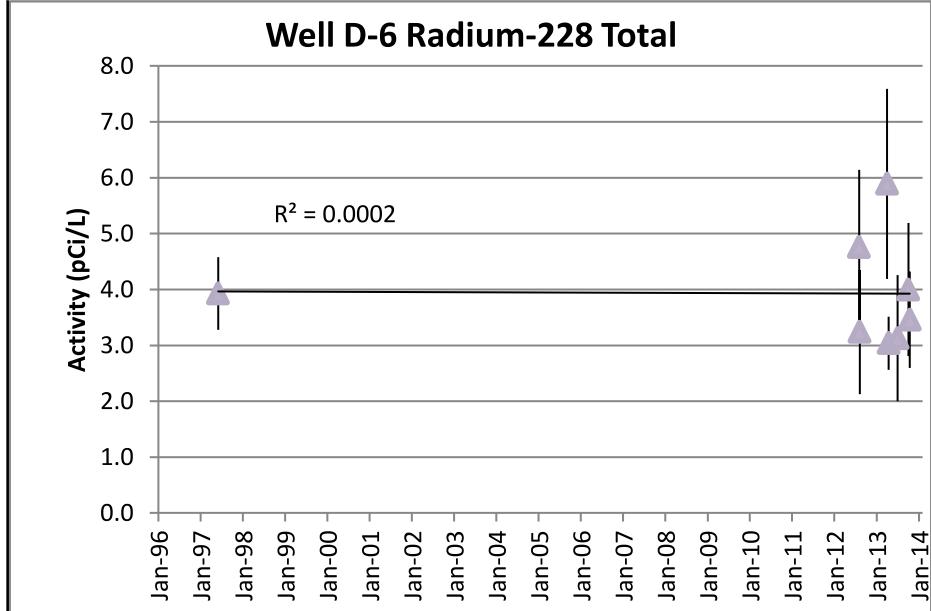
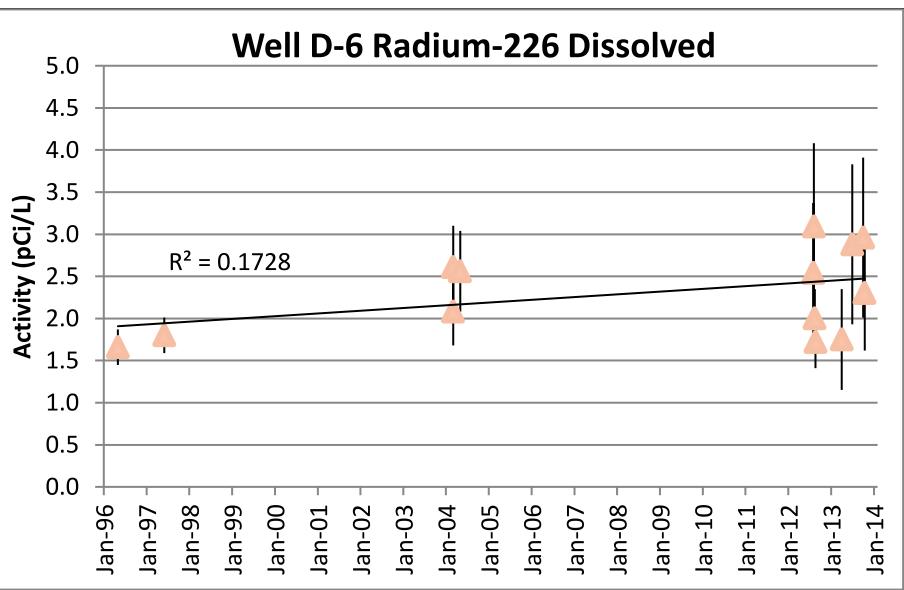
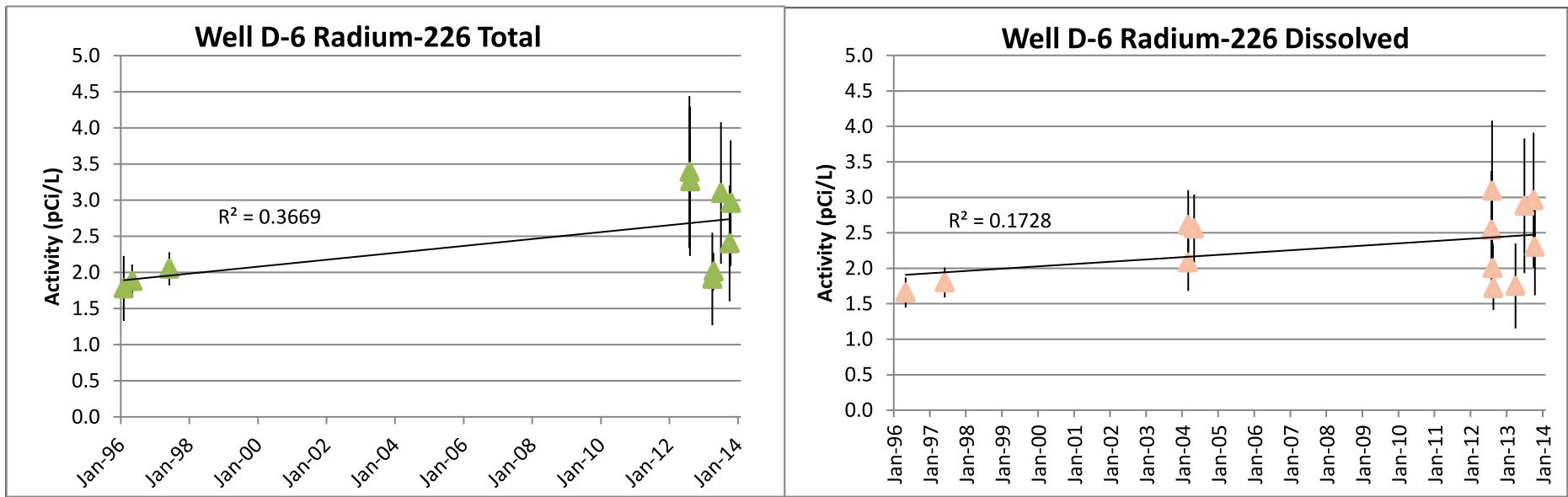



**Legend**

- Result plus 2 Sigma
- Result minus 2 Sigma
- Radium Result

Note: Early non-detect results with elevated MDAs not shown.  
 Linear regression trend line  
 $R^2$  - linear regression line correlation coefficient

**Figure 7-7**  
**Well I-68 Radium Results**  
 West Lake Landfill OU-1 RI Addendum  
 EMSI    Engineering Management Support, Inc.

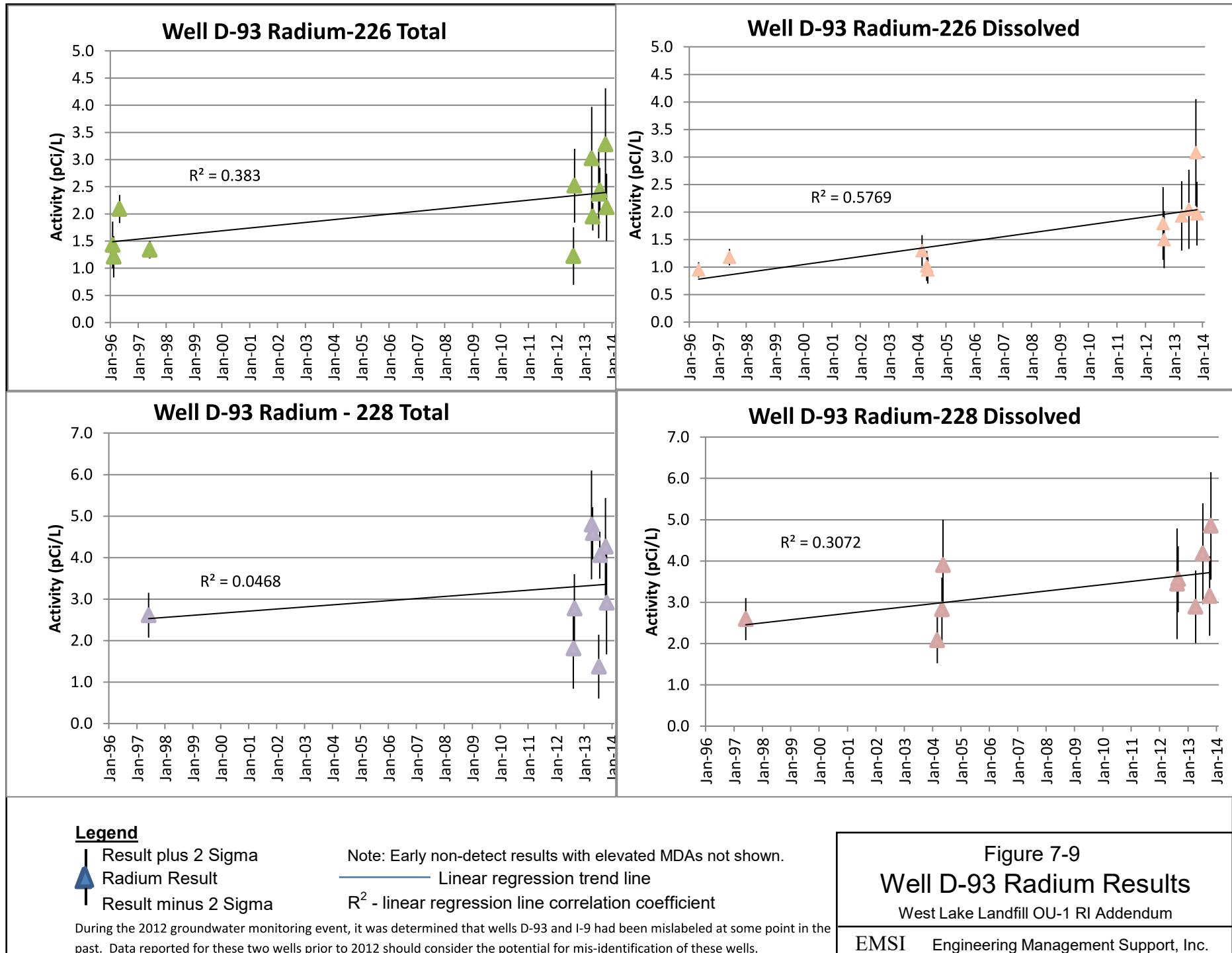


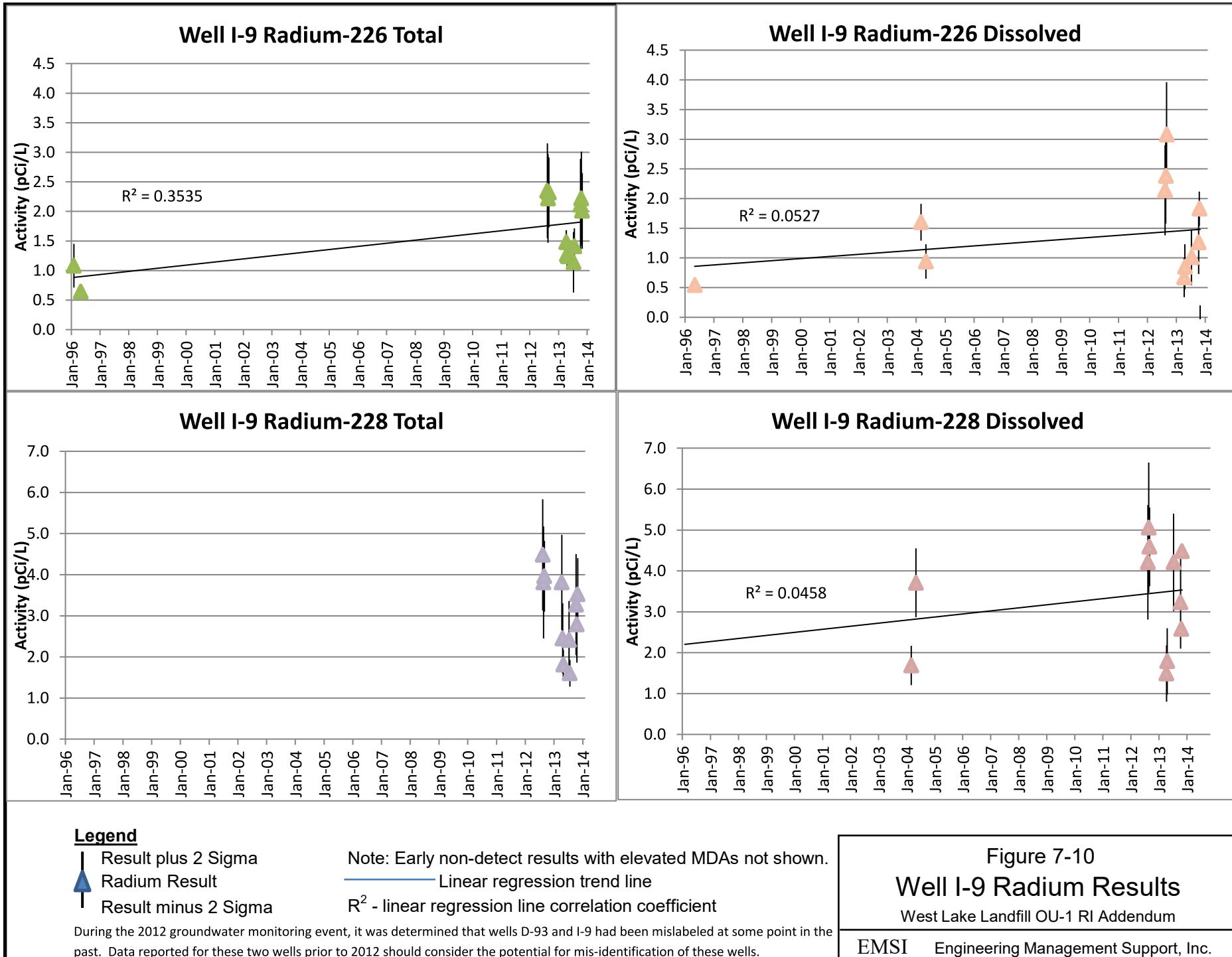
#### Legend

- Result plus 2 Sigma
- Radium Result
- Result minus 2 Sigma

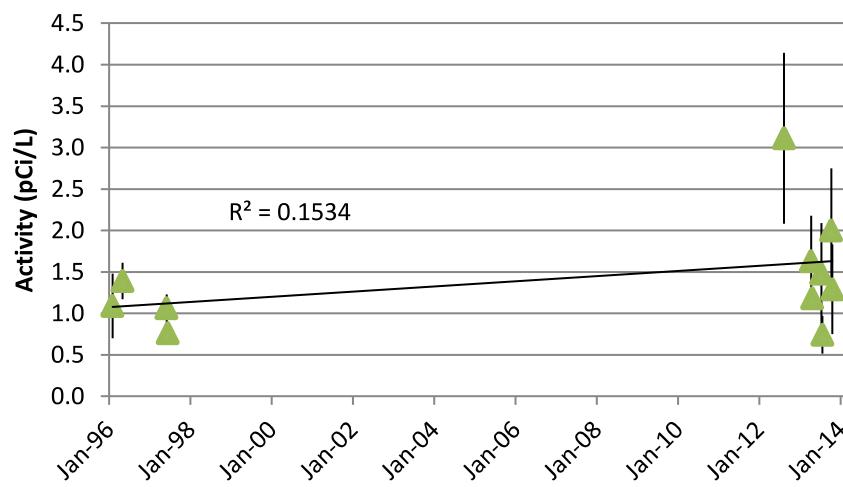
Note: Early non-detect results with elevated MDAs not shown.  
 — Linear regression trend line  
 $R^2$  - linear regression line correlation coefficient

Figure 7-8  
**Well D-6 Radium Results**  
 West Lake Landfill OU-1 RI Addendum  
 EMSI    Engineering Management Support, Inc.

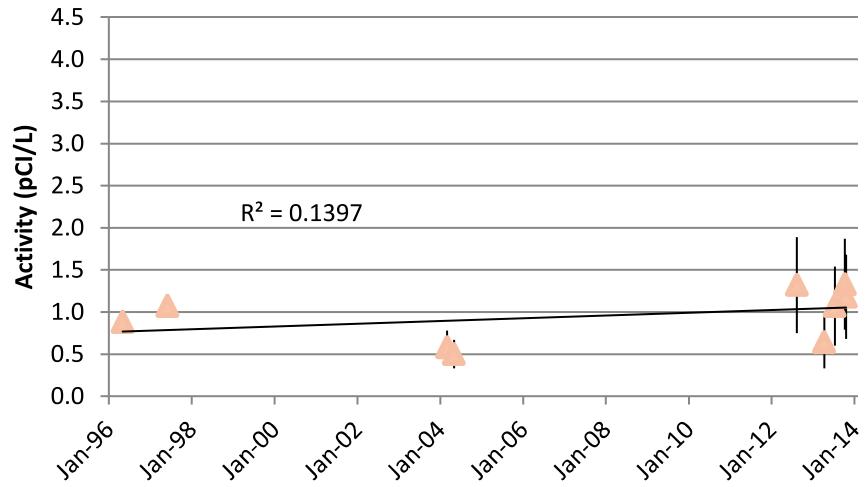




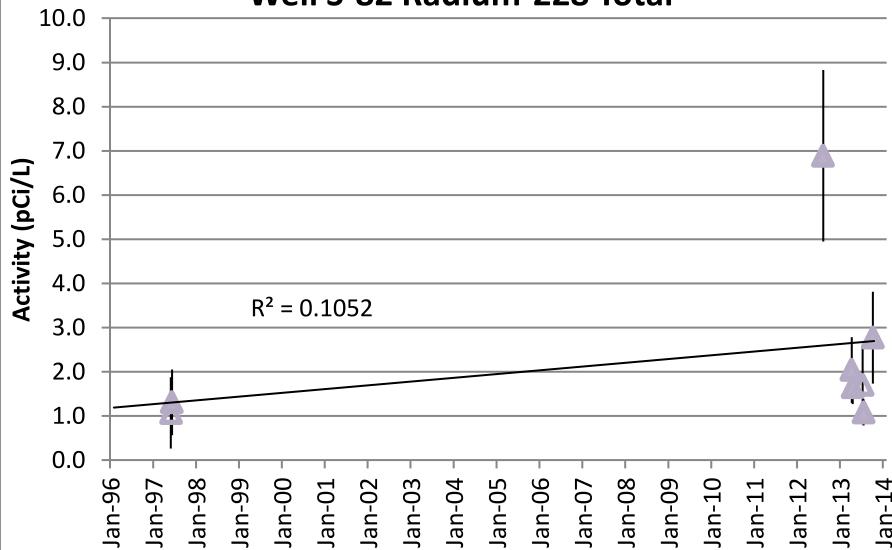
### Well S-82 Radium-226 Total



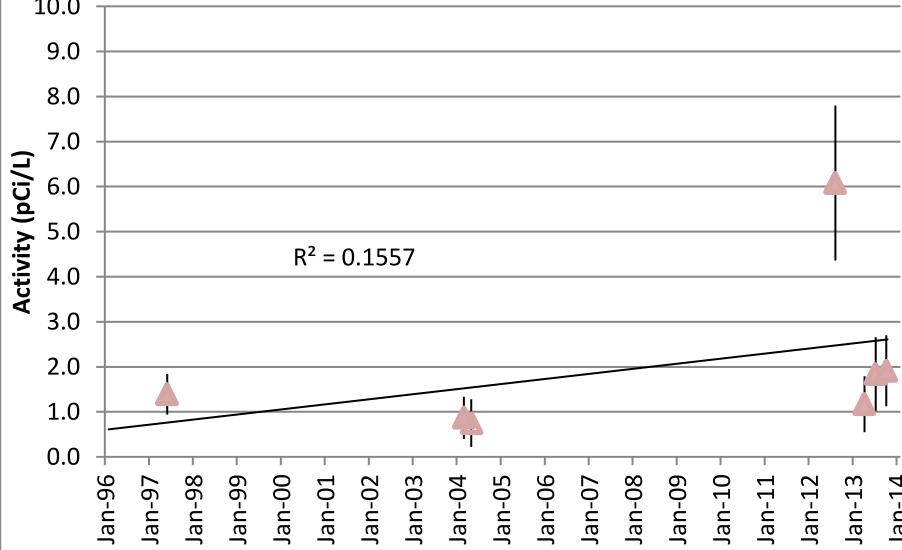
### Well S-82 Radium-226 Dissolved



### Well S-82 Radium-228 Total



### Well S-82 Radium-228 Dissolved

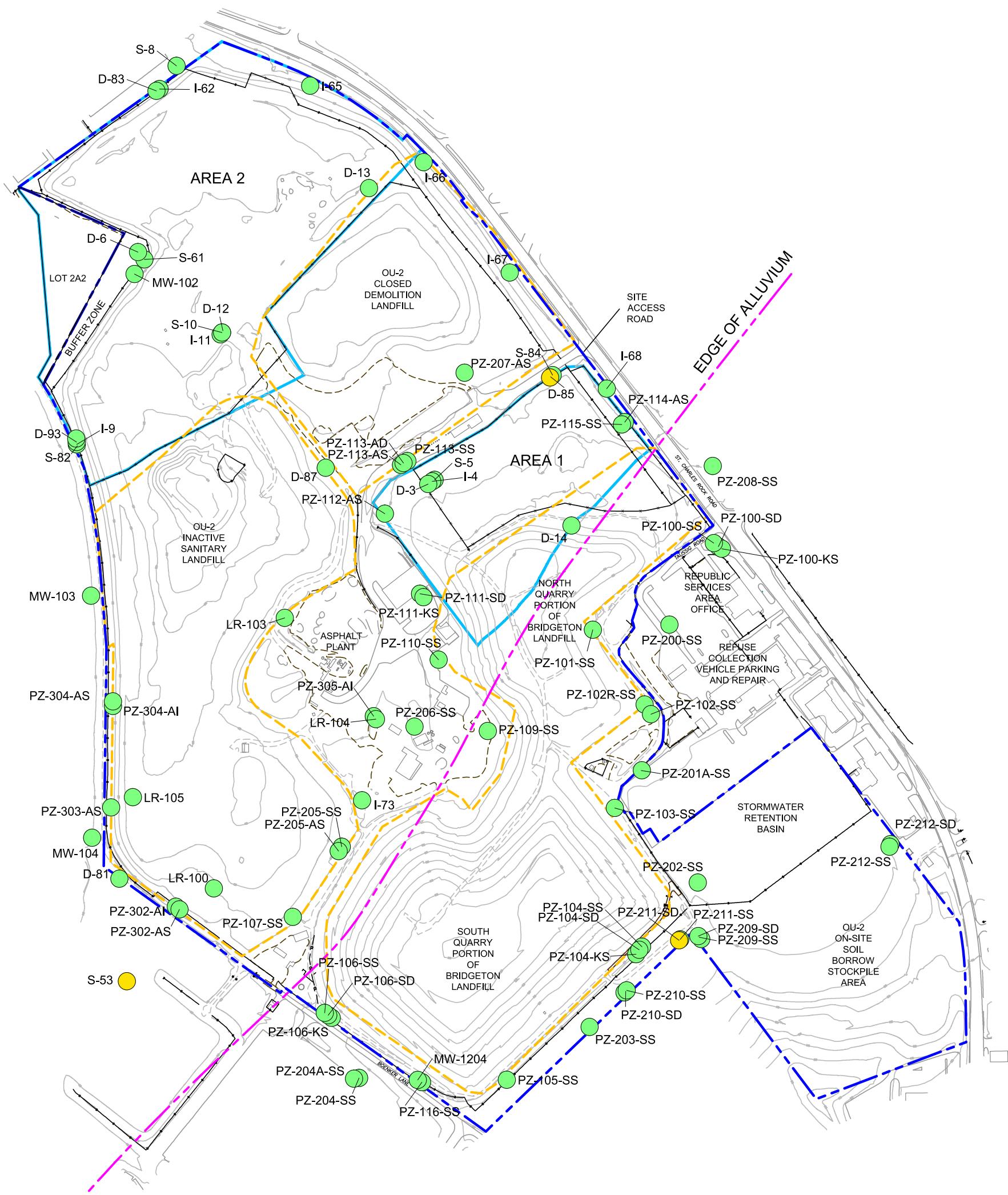


#### Legend

- Result plus 2 Sigma
- Radium Result
- Result minus 2 Sigma

Note: Early non-detect results with elevated MDAs not shown.  
— Linear regression trend line  
 $R^2$  - linear regression line correlation coefficient

Figure 7-11  
**Well S-82 Radium Results**  
West Lake Landfill OU-1 RI Addendum  
EMSI Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary** (Dashed Blue Line)
- OU-1 Area Boundary** (Solid Blue Line)
- OU-2 Area Boundary** (Dashed Yellow Line)
- Index Contour** (Thin Grey Lines)
- Paved Road** (Solid Black Line)
- Unpaved Road** (Dashed Black Line)
- Building** (White Box)
- Fence** (Dashed Line)

**WELL FORMATION DESIGNATIONS**

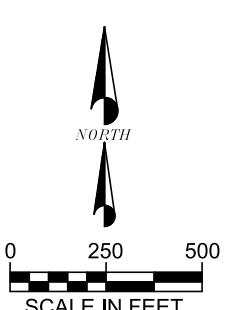
- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

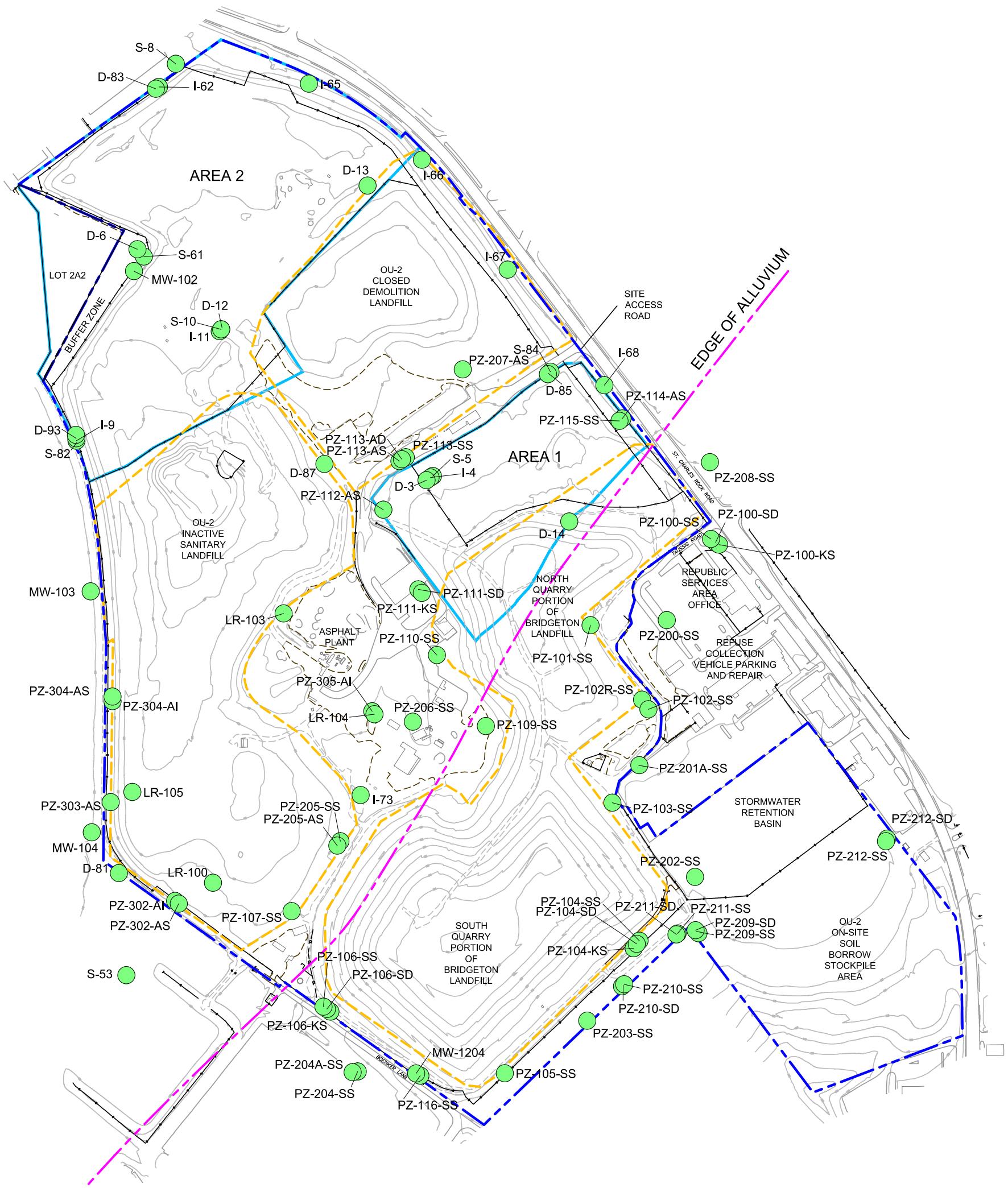
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**THORIUM EXPLANATION**

- (Pink Circle) Total Thorium-230 + 232 less than 15 pCi/L [the Gross Alpha MCL] (all sampling dates)
- (Yellow Circle) Total Thorium-230 + 232 less than 15 pCi/L [the Gross Alpha MCL] (at least one sampling date but not all sampling dates)
- (Green Circle) Total Thorium-230 + 232 less than 15 pCi/L [Less than the Gross Alpha MCL] (all sampling dates)



**Figure 7-12**  
**Combined Total Thorium-230 + 232**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

**LEGEND**

- Dashed Blue Line:** Landfill Boundary
- Solid Blue Line:** OU-1 Area Boundary
- Dashed Yellow Line:** OU-2 Area Boundary
- Index Contour:** 480
- Paved Road:** Solid Gray Line
- Unpaved Road:** Dashed Gray Line
- Building:** White Box
- Fence:** Dashed Line with Asterisks

**WELL FORMATION DESIGNATIONS**

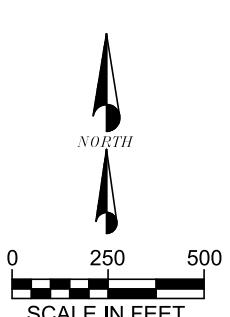
- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

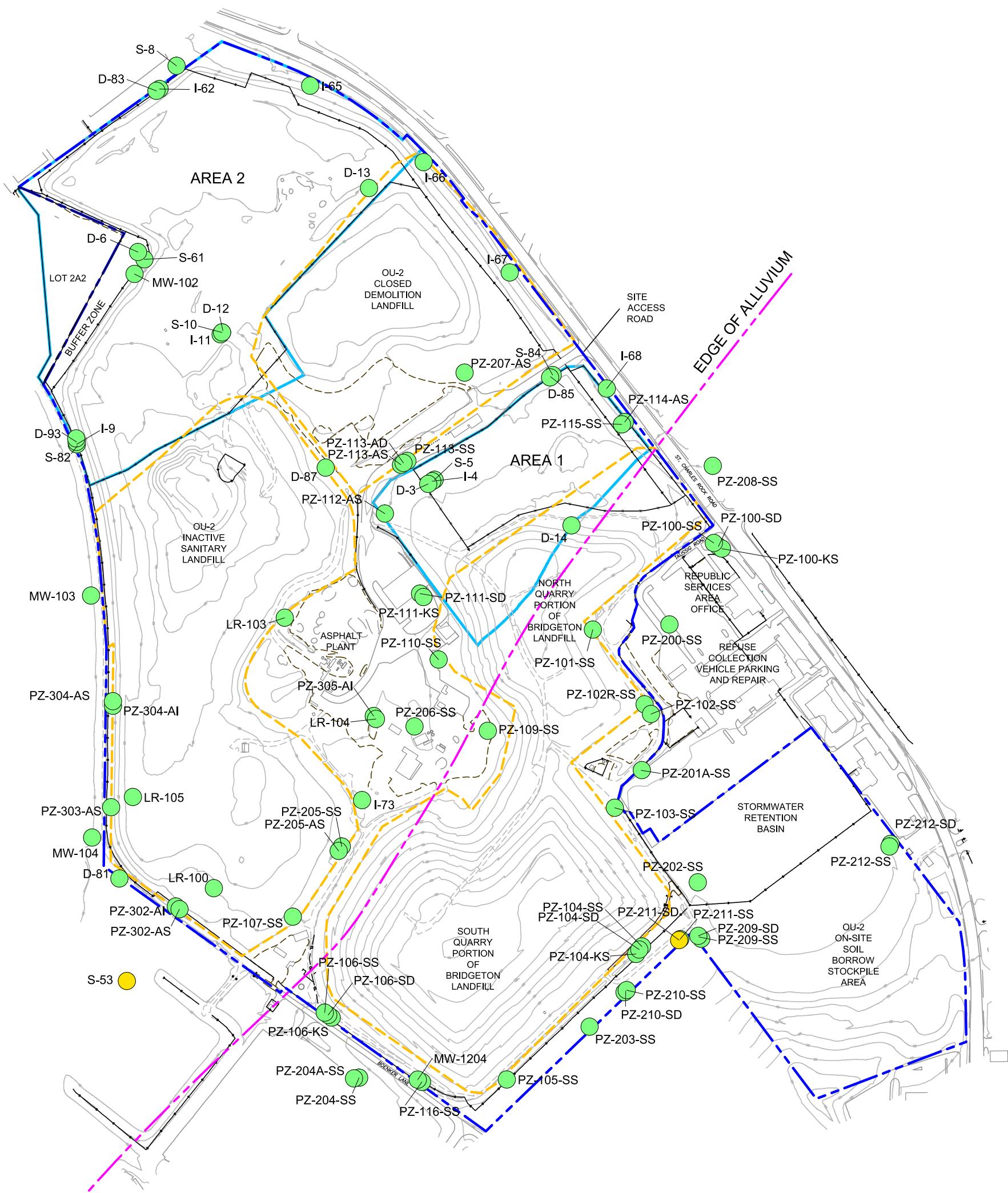
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**THORIUM EXPLANATION**

- (Pink Circle) Dissolved Thorium-230 + 232 less than 15 pCi/L [the Gross Alpha MCL] (all sampling dates)
- (Yellow Circle) Dissolved Thorium-230 + 232 less than 15 pCi/L [the Gross Alpha MCL] (at least one sampling date but not all sampling dates)
- (Green Circle) Dissolved Thorium-230 + 232 less than 15 pCi/L [Less than the Gross Alpha MCL] (all sampling dates)



**Figure 7-13**  
**Combined Dissolved Thorium-230 + 232**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - -** OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- — —** Fence

**WELL FORMATION DESIGNATIONS**

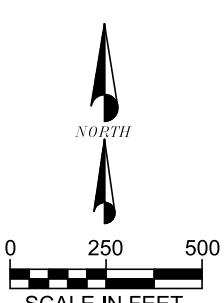
- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

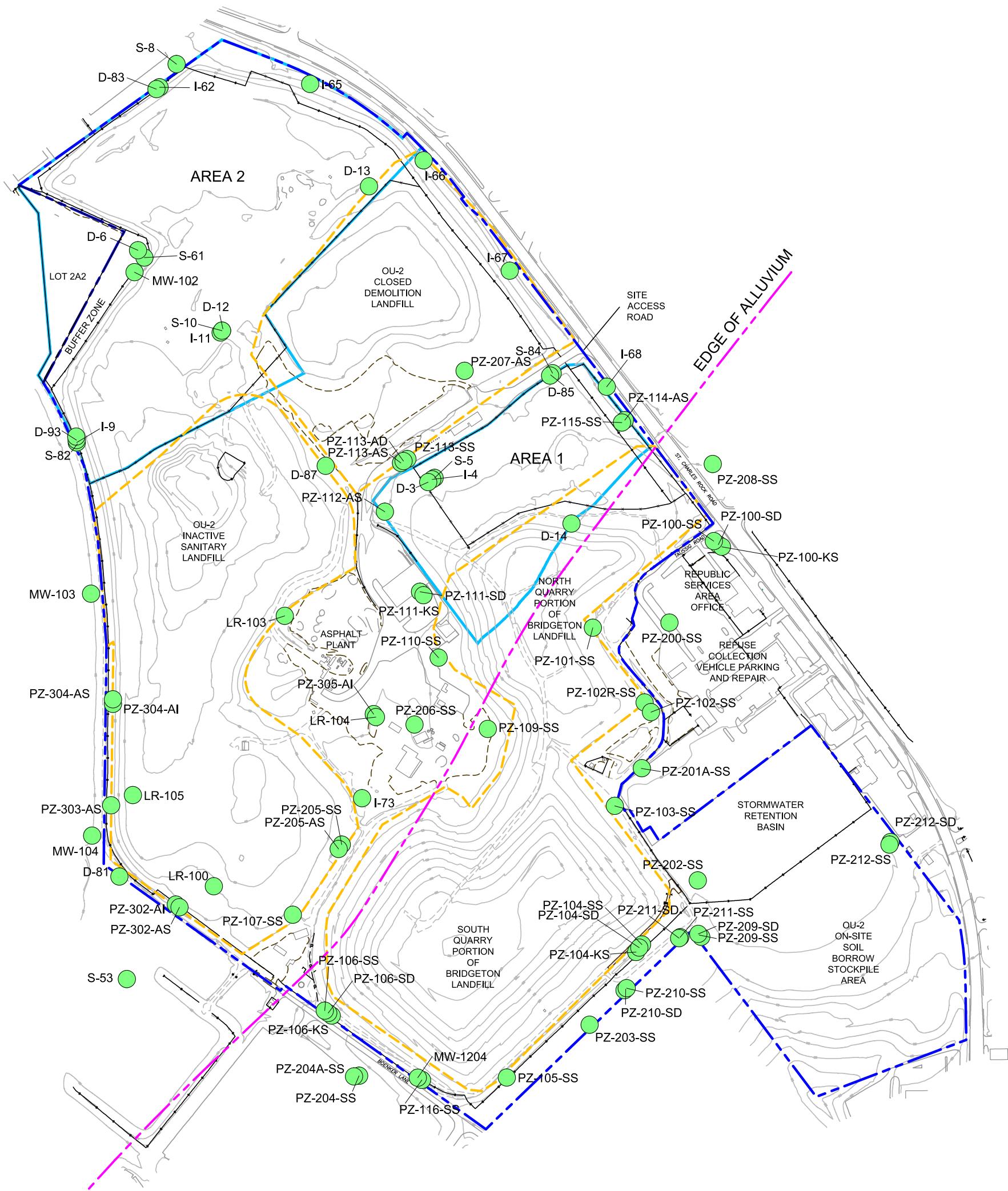
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

**URANIUM EXPLANATION**

- Pink circle:** Total Uranium greater than the Maximum Contaminant Level of 30 µg/L [converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (all sampling dates)
- Yellow circle:** Total Uranium greater than the Maximum Contaminant Level of 30 µg/L [converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (at least one sampling date but not all sampling dates)
- Green circle:** Total Uranium greater than the Maximum Contaminant Level of 30 µg/L [Less than converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (all sampling dates)



**Figure 7-14**  
**Total Uranium**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

**LEGEND**

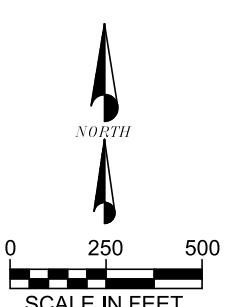
- Landfill Boundary
- OU-1 Area Boundary
- - -** OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

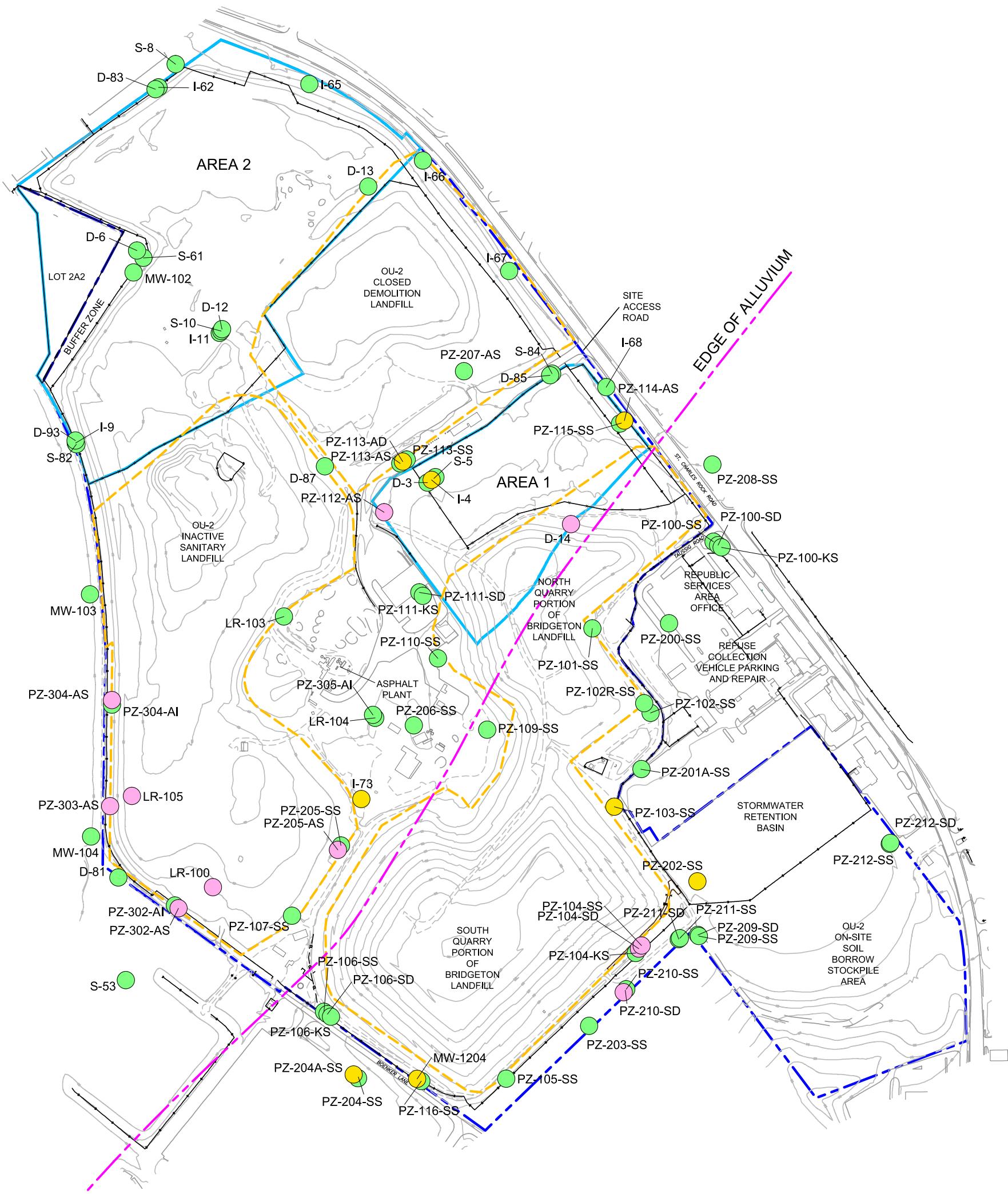
**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



- URANIUM EXPLANATION**
- Pink circle:** Dissolved Uranium greater than the Maximum Contaminant Level of 30 µg/L [converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (all sampling dates)
  - Yellow circle:** Dissolved Uranium greater than the Maximum Contaminant Level of 30 µg/L [converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (at least one sampling date but not all sampling dates)
  - Green circle:** Dissolved Uranium greater than the Maximum Contaminant Level of 30 µg/L [Less than converted to mass from Uranium-234, Uranium-235 and Uranium-238 activities] (all sampling dates)

**Figure 7-15**  
**Combined Dissolved Uranium 234 + 235 + 238**  
**in Groundwater,**  
**August 2012 Through February 2014**  
**West Lake Landfill OU-1 RI Addendum**

**LEGEND**

- Dashed Blue Line**: Landfill Boundary
- Solid Blue Line**: OU-1 Area Boundary
- Dashed Yellow Line**: OU-2 Area Boundary
- Index Contour**
- Paved Road**
- Unpaved Road**
- Building**
- Fence**

**BENZENE EXPLANATION**

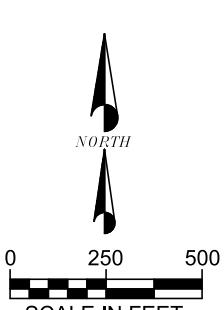
- (Pink Circle): Benzene greater than the Maximum Contaminant Level of 5 µg/L for Benzene (all sampling dates)
- (Yellow Circle): Benzene greater than the Maximum Contaminant Level of 5 µg/L for Benzene (at least one sampling date but not all sampling dates)
- (Green Circle): Benzene less than the Maximum Contaminant Level of 5 µg/L for Benzene (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

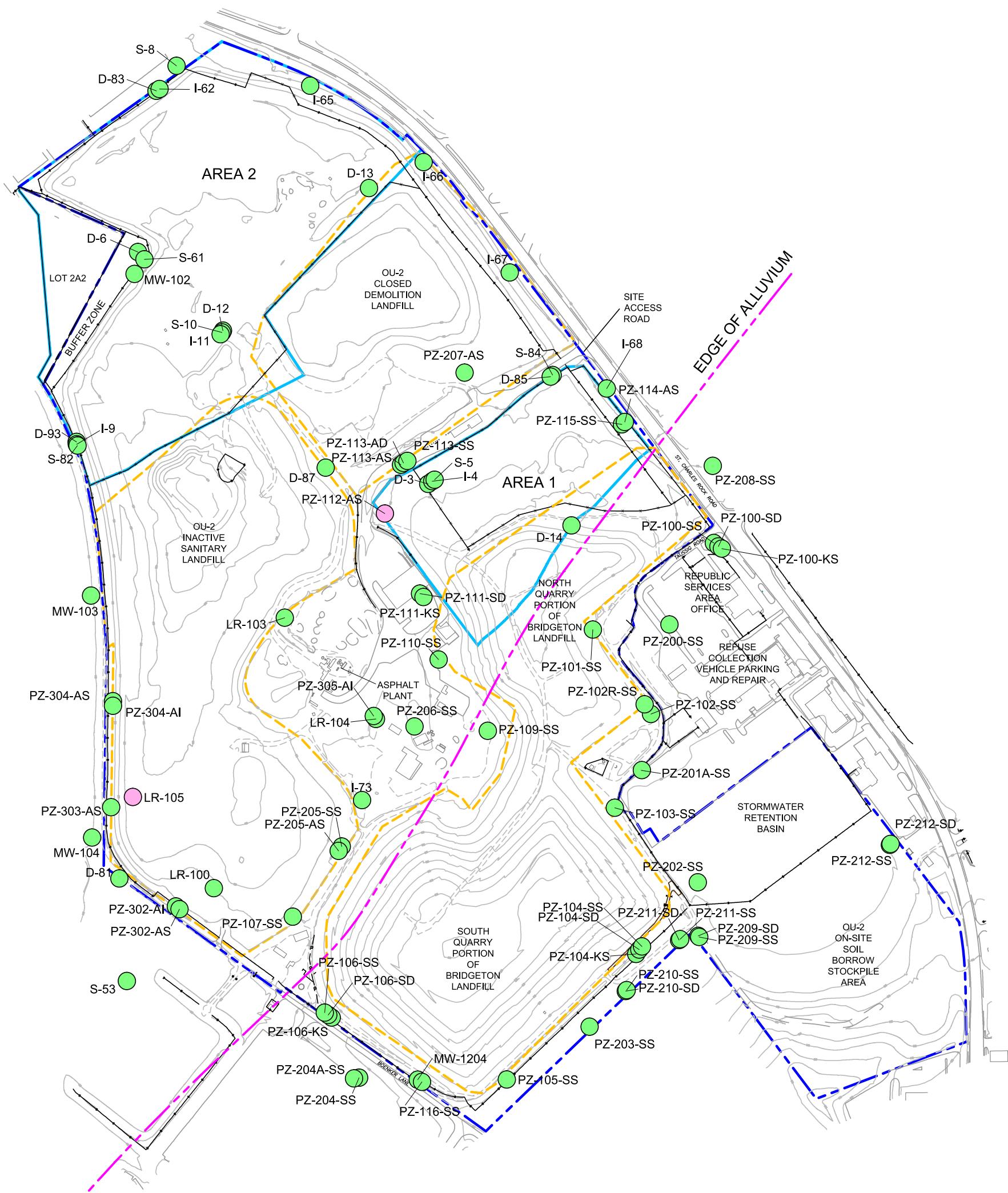
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-1**  
**Benzene in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**CHLOROBENZENE EXPLANATION**

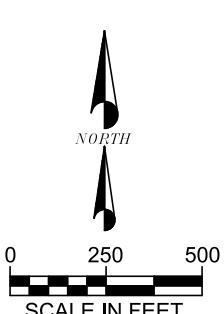
- (Pink circle) Total Chlorobenzene greater than the Maximum Contaminant Level of 100 µg/L for Chlorobenzene (all sampling dates)
- (Yellow circle) Total Chlorobenzene greater than the Maximum Contaminant Level of 100 µg/L for Chlorobenzene (at least one sampling date but not all sampling dates)
- (Green circle) Total Chlorobenzene less than the Maximum Contaminant Level of 100 µg/L for Chlorobenzene (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

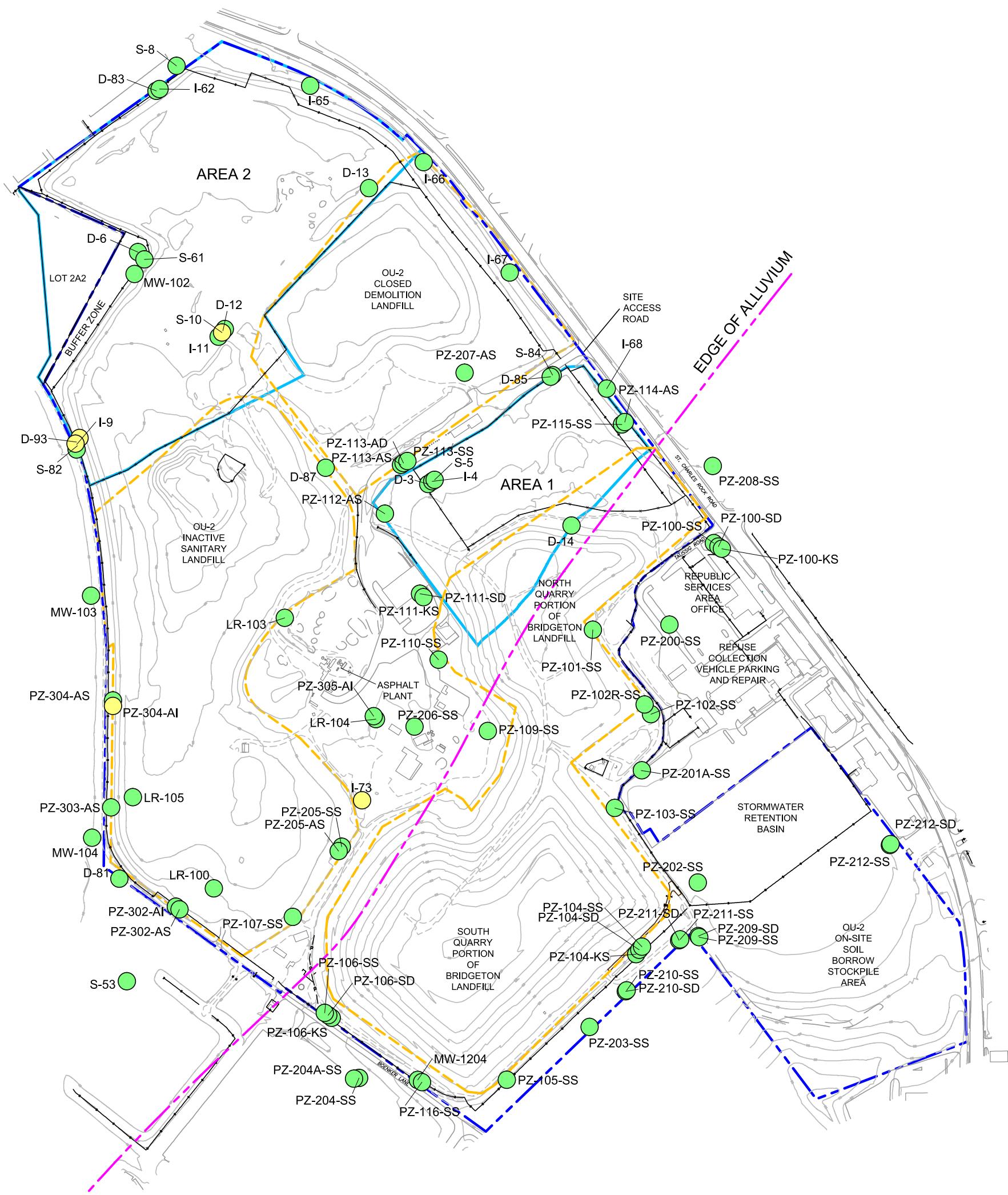
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-2**  
**Chlorobenzene in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- \* — Fence

**VINYL CHLORIDE EXPLANATION**

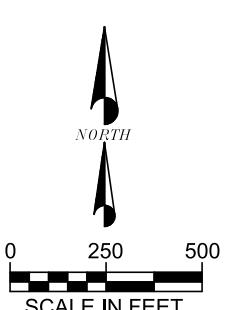
- (Pink circle) Total Vinyl Chloride greater than the Maximum Contaminant Level of 2 µg/L for Vinyl Chloride (all sampling dates)
- (Yellow circle) Total Vinyl Chloride greater than the Maximum Contaminant Level of 2 µg/L for Vinyl Chloride (at least one sampling date but not all sampling dates)
- (Green circle) Total Vinyl Chloride less than the Maximum Contaminant Level of 2 µg/L for Vinyl Chloride (all sampling dates)

**WELL FORMATION DESIGNATIONS**

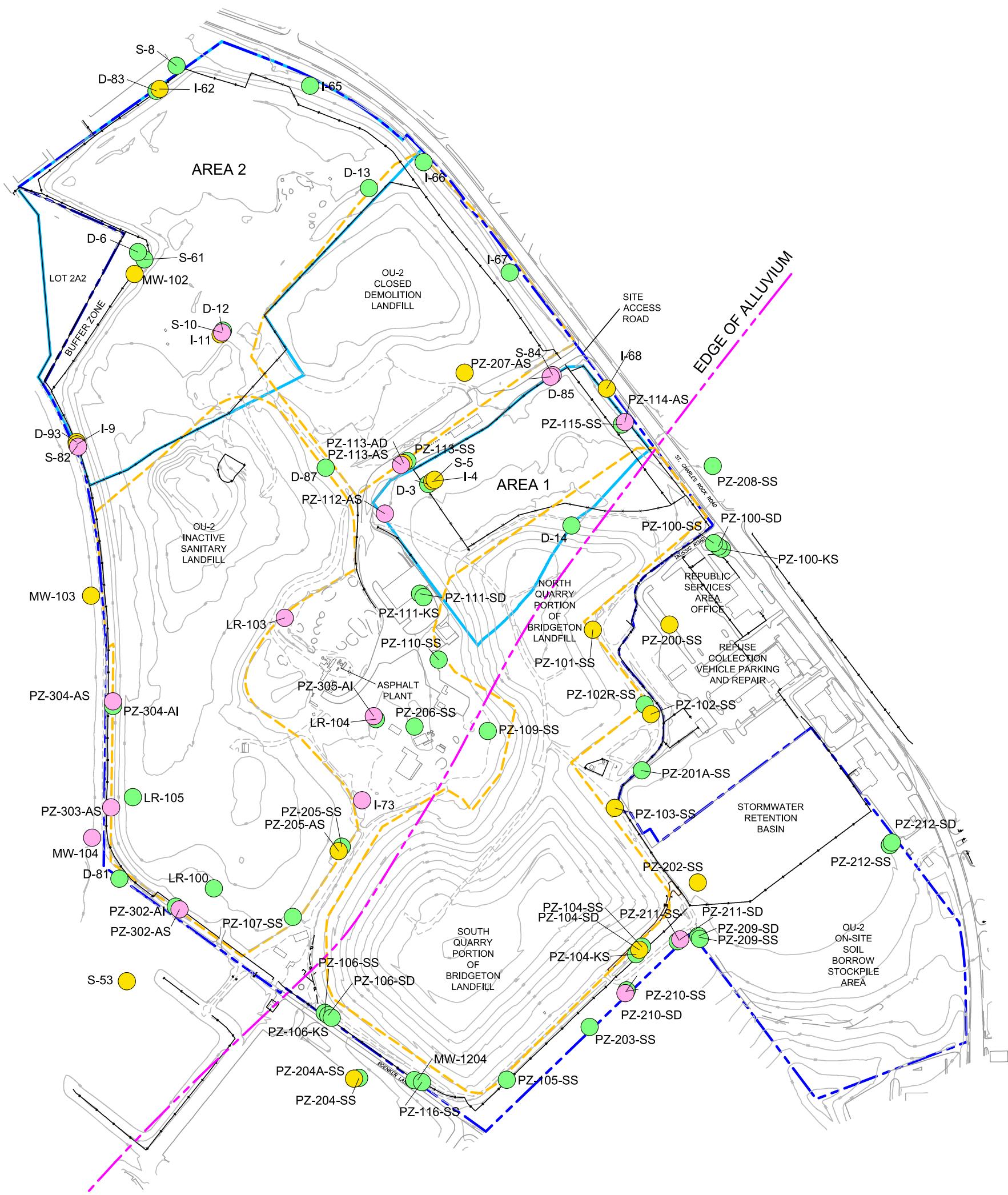
- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-3**  
Vinyl Chloride in Groundwater,  
August 2012 Through November 2013  
West Lake Landfill OU-1 RI Addendum

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**ARSENIC EXPLANATION**

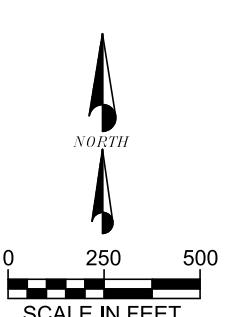
- (Pink circle) Total Arsenic greater than the Maximum Contaminant Level of 10 µg/L for Arsenic (all sampling dates)
- (Yellow circle) Total Arsenic greater than the Maximum Contaminant Level of 10 µg/L for Arsenic (at least one sampling date but not all sampling dates)
- (Green circle) Total Arsenic less than the Maximum Contaminant Level of 10 µg/L for Arsenic (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

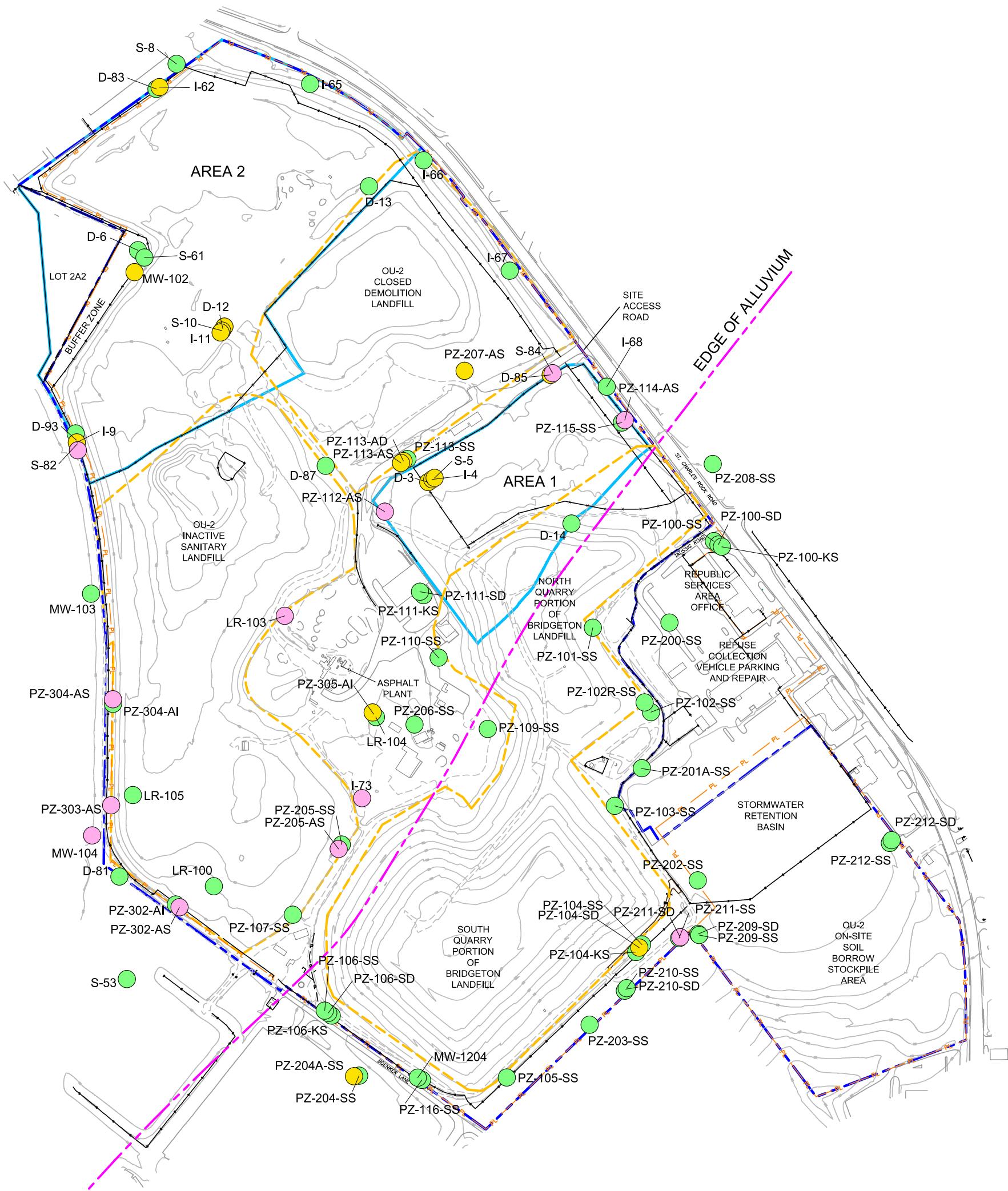
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-4**  
**Total Arsenic in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Dashed Line:** Landfill Boundary
- Solid Blue Line:** OU-1 Area Boundary
- Dashed Yellow Line:** OU-2 Area Boundary
- Index Contour:** 480
- Paved Road:**
- Unpaved Road:**
- Building:**
- Fence:**

**ARSENIC EXPLANATION**

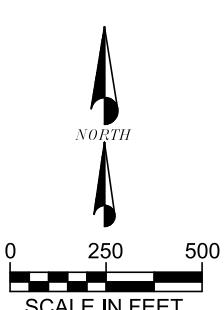
- (Pink circle) Dissolved Arsenic greater than the Maximum Contaminant Level of 10 µg/L for Arsenic (all sampling dates)
- (Yellow circle) Dissolved Arsenic greater than the Maximum Contaminant Level of 10 µg/L for Arsenic (at least one sampling date but not all sampling dates)
- (Green circle) Dissolved Arsenic less than the Maximum Contaminant Level of 10 µg/L for Arsenic (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

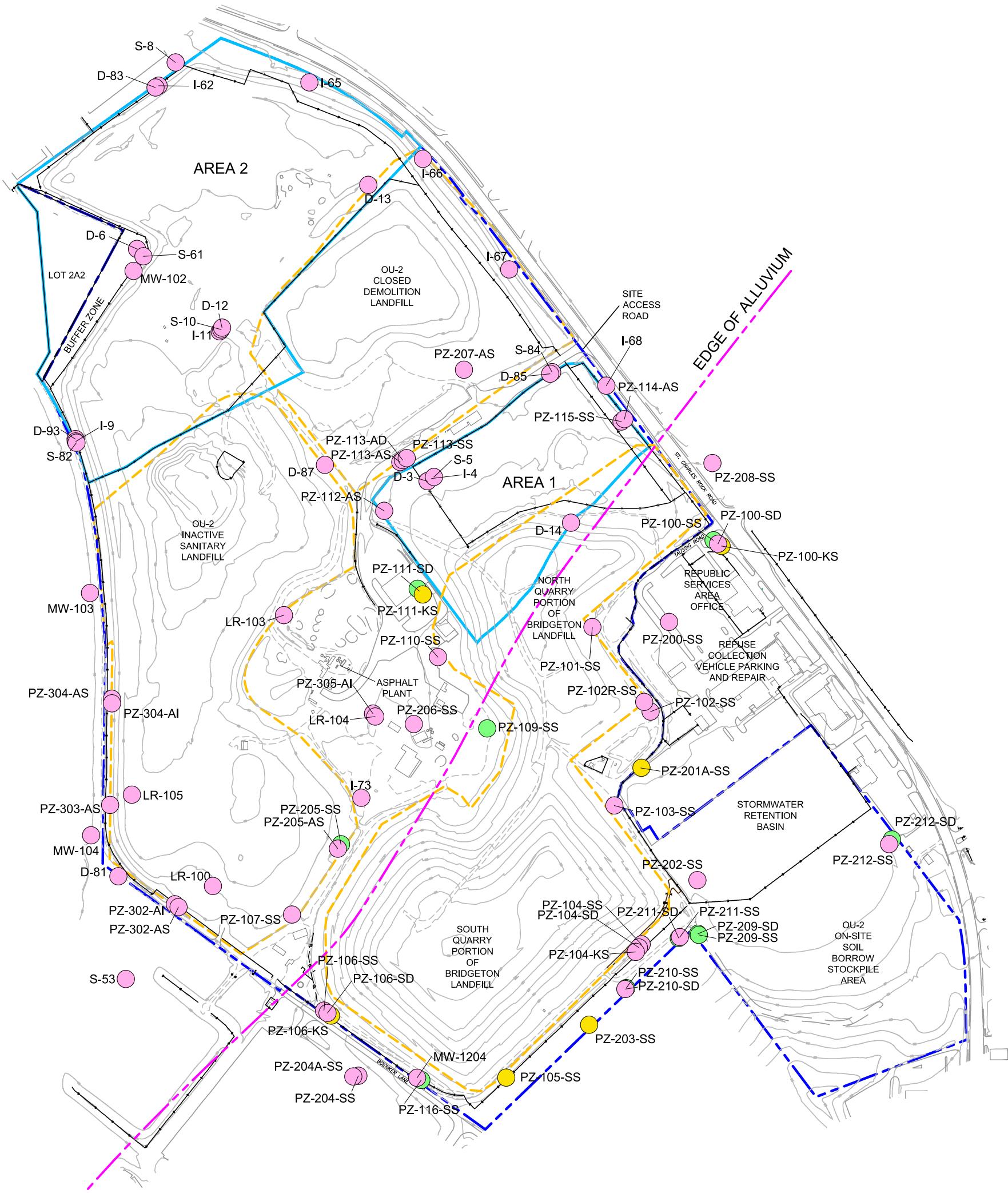
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-5**  
**Dissolved Arsenic in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

EMSI Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - -** OU-2 Area Boundary
- Index Contour
- Paved Road
- - -** Unpaved Road
- Building
- Fence

**IRON EXPLANATION**

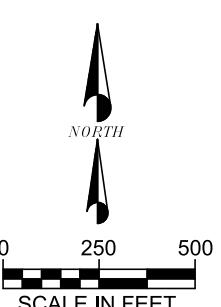
- (**Pink circle**) Total Iron greater than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (all sampling dates)
- (**Yellow circle**) Total Iron greater than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (at least one sampling date but not all sampling dates)
- (**Green circle**) Total Iron less than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

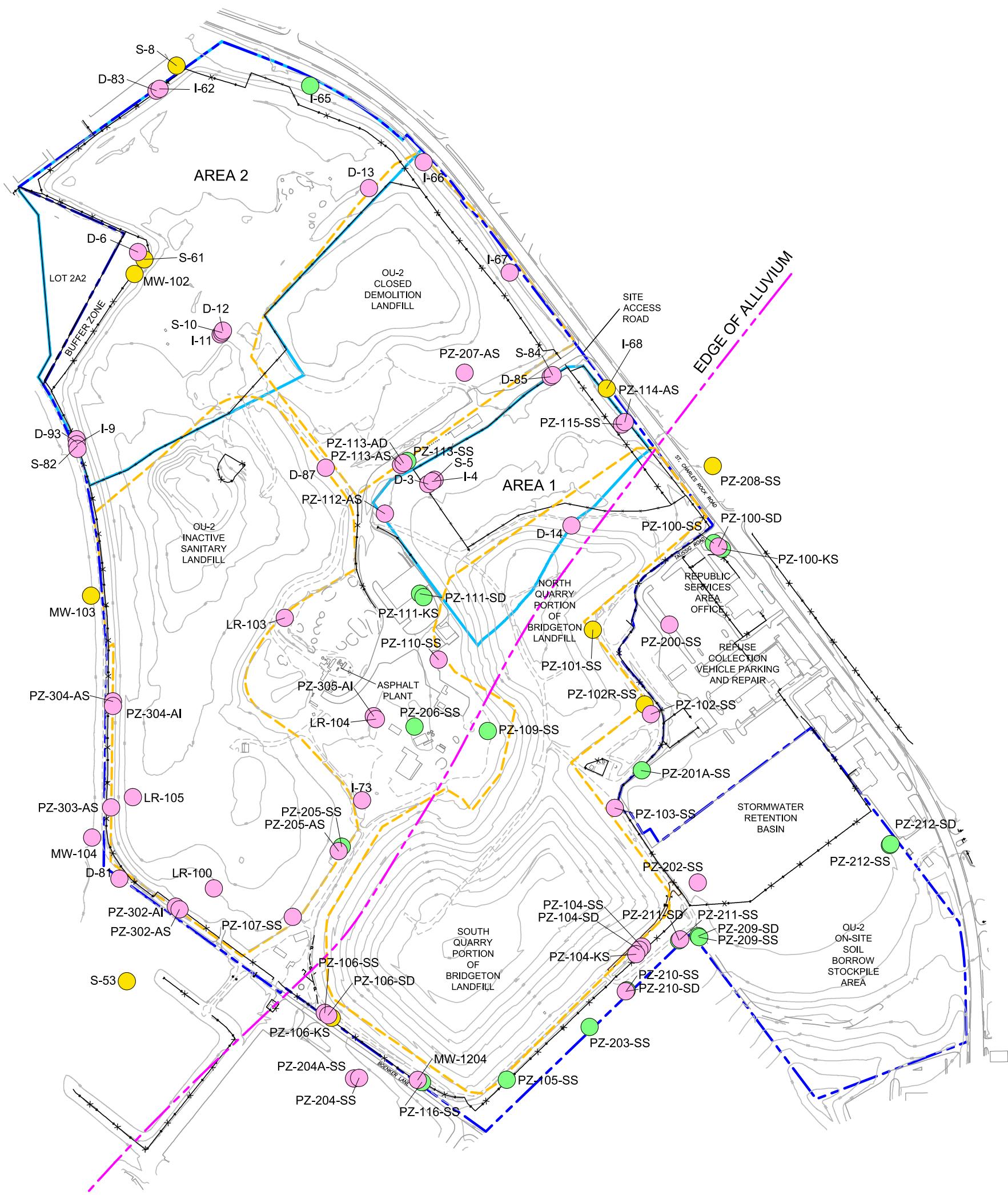
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-6**  
**Total Iron in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Dashed Blue Line:** Landfill Boundary
- Solid Blue Line:** OU-1 Area Boundary
- Dashed Yellow Line:** OU-2 Area Boundary
- Index Contour:** 480
- Paved Road:** Solid Gray Line
- Unpaved Road:** Dashed Gray Line
- Building:** White Box
- Fence:** Dashed Line with Crosses

**IRON EXPLANATION**

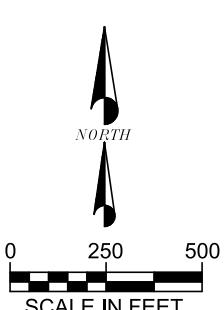
- (Pink Circle) Dissolved Iron greater than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (all sampling dates)
- (Yellow Circle) Dissolved Iron greater than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (at least one sampling date but not all sampling dates)
- (Green Circle) Dissolved Iron less than the Secondary Maximum Contaminant Level of 300 µg/L for Iron (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

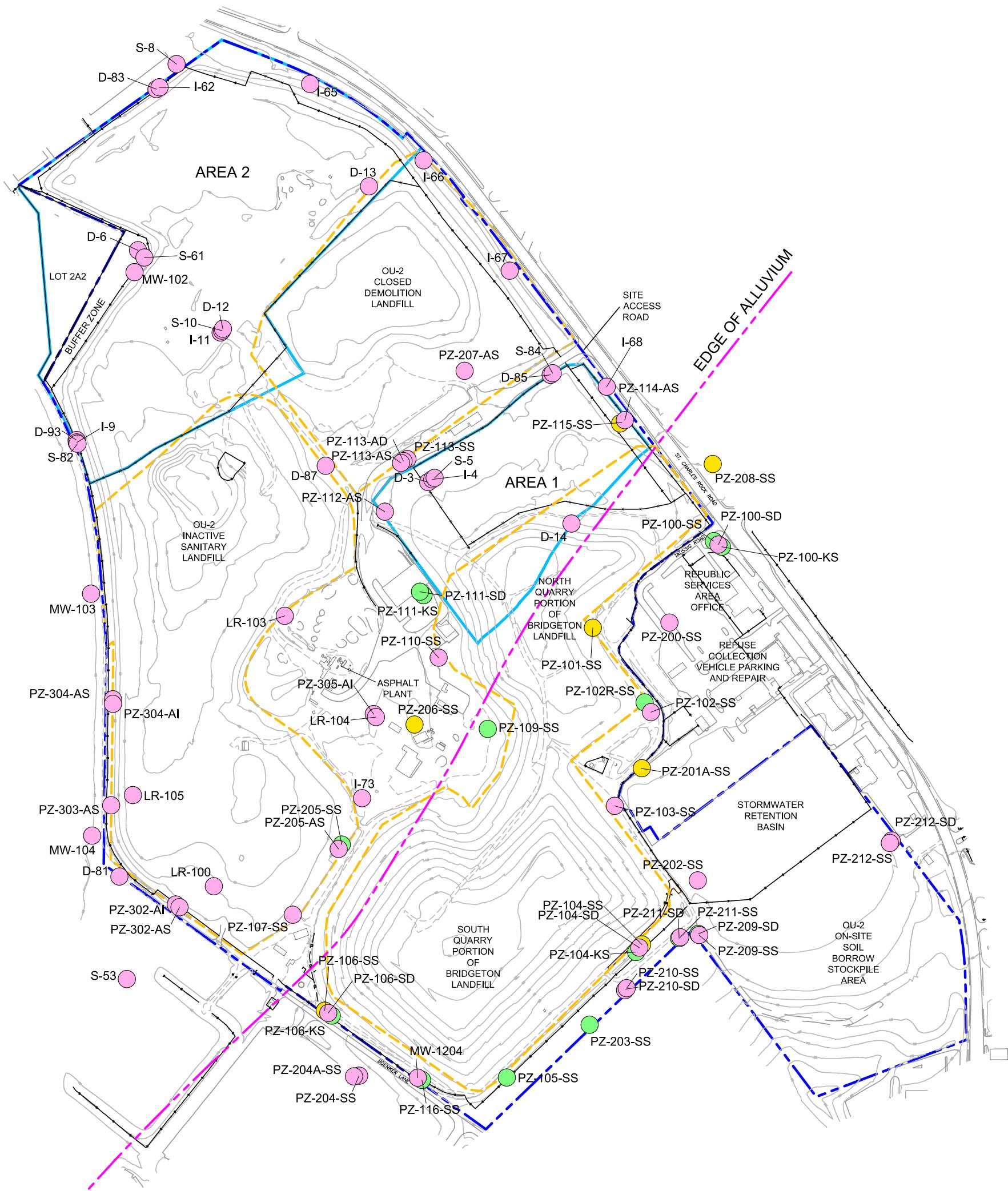
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-7**  
**Dissolved Iron in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

EMSI Engineering Management Support, Inc.

**LEGEND**

- Dashed Blue Line:** Landfill Boundary
- Solid Blue Line:** OU-1 Area Boundary
- Dashed Yellow Line:** OU-2 Area Boundary
- Index Contour:** 480
- Paved Road:** Solid Yellow Line
- Unpaved Road:** Dashed Yellow Line
- Building:** White Box
- Fence:** Dashed Black Line

**MANGANESE EXPLANATION**

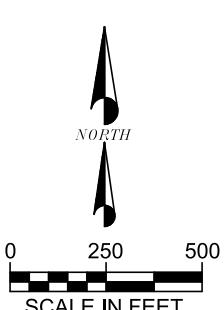
- (Pink Circle) Total Manganese greater than the Secondary Maximum Contaminant Level of 50 µg/L for Manganese (all sampling dates)
- (Yellow Circle) Total Manganese greater than the Secondary Maximum Contaminant Level of 50 µg/L for Manganese (at least one sampling date but not all sampling dates)
- (Green Circle) Total Manganese less than the Secondary Maximum Contaminant Level of 50 µg/L for Manganese (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

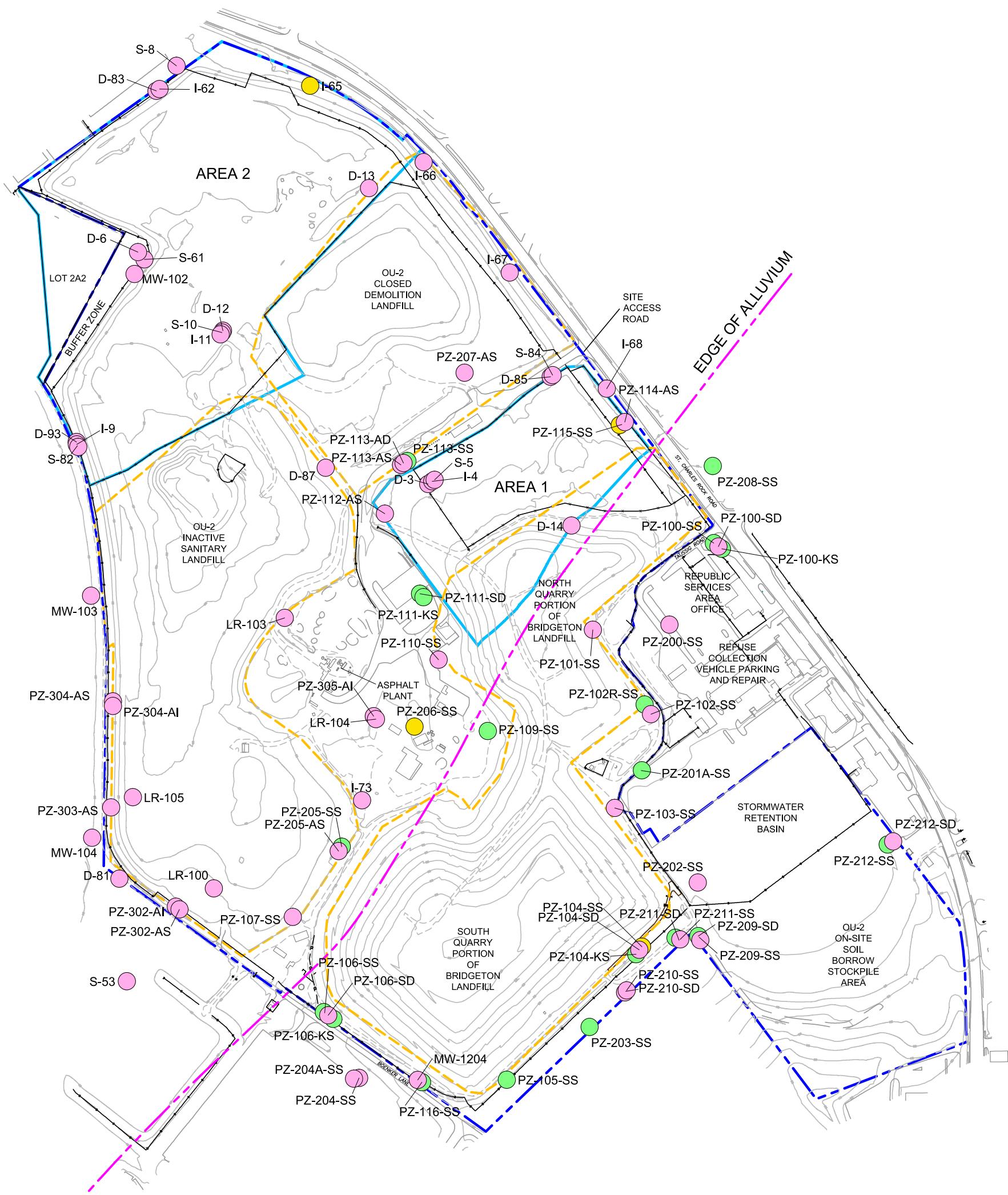
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-8**  
**Total Manganese in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Dashed Blue Line:** Landfill Boundary
- Solid Blue Line:** OU-1 Area Boundary
- Dashed Yellow Line:** OU-2 Area Boundary
- Index Contour:** 480
- Paved Road:** Solid Gray Line
- Unpaved Road:** Dashed Gray Line
- Building:** White Box
- Fence:** Dashed Line with Asterisks

**MANGANESE EXPLANATION**

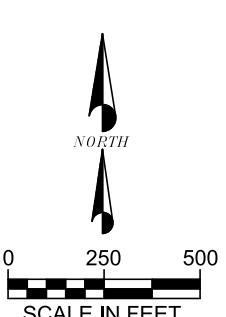
- (Pink Circle) Dissolved Manganese greater than the Maximum Contaminant Level of 50 µg/L for Manganese (all sampling dates)
- (Yellow Circle) Dissolved Manganese greater than the Maximum Contaminant Level of 50 µg/L for Manganese (at least one sampling date but not all sampling dates)
- (Green Circle) Dissolved Manganese less than the Maximum Contaminant Level of 50 µg/L for Manganese (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

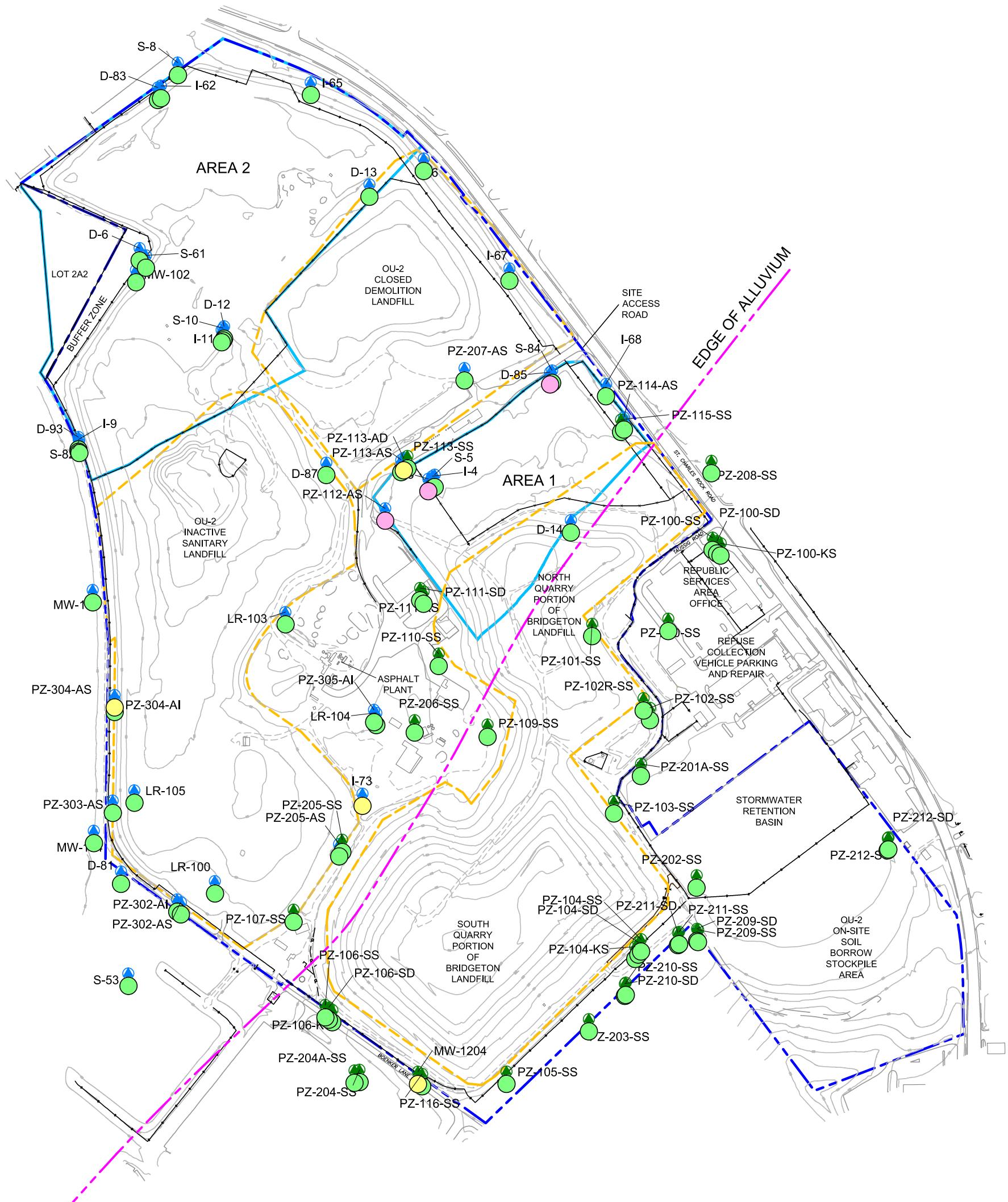
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-9**  
**Dissolved Manganese in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

LEGEND

- Landfill Boundary
- OU-1 Area Boundary
- OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

WELL FORMATION DESIGNATIONS

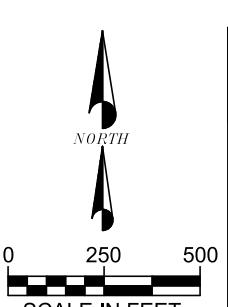
- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

NOTES:

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.

BARIUM EXPLANATION

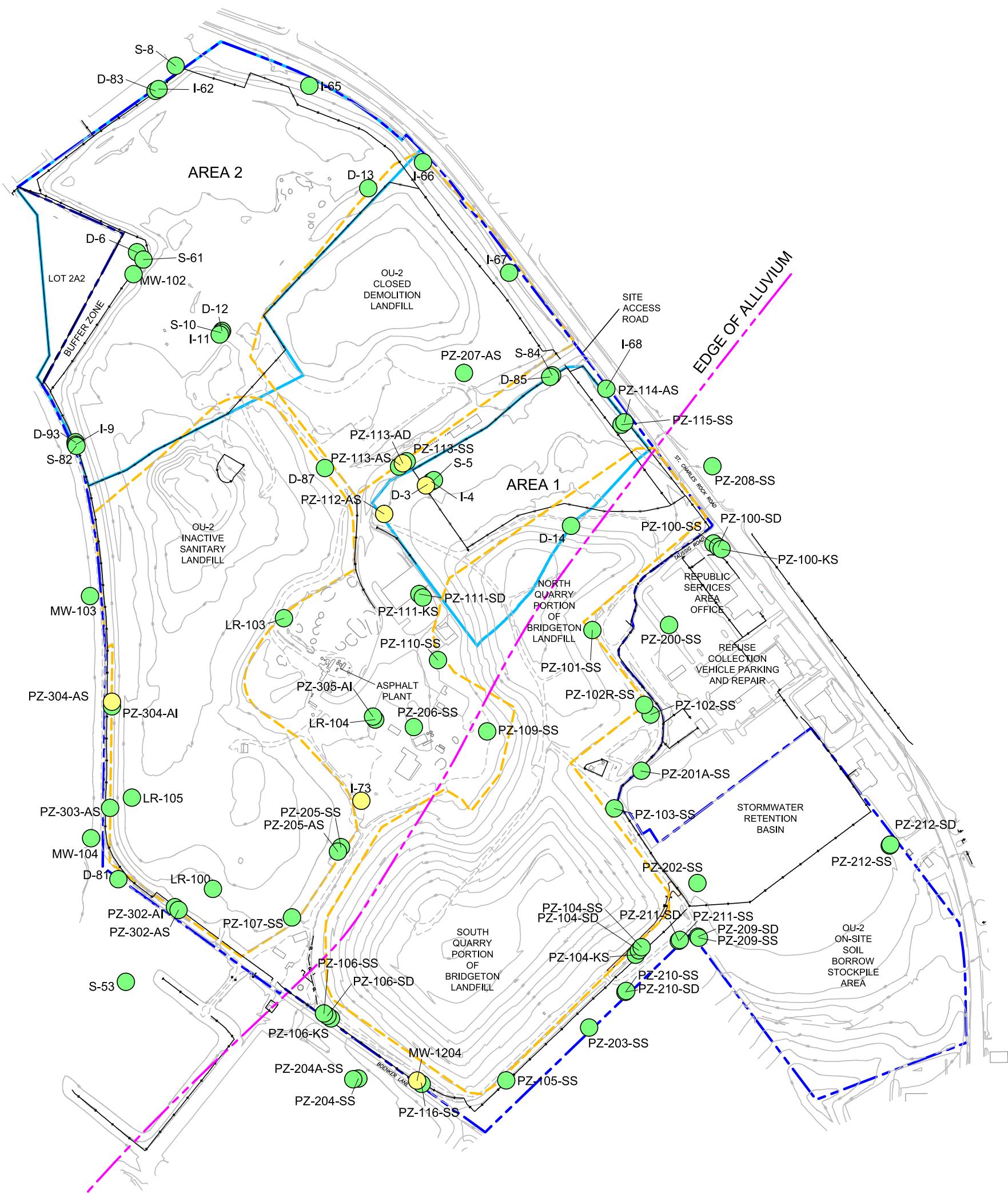
- Total Barium greater than the Maximum Contaminant Level of 2,000 µg/L for Barium (all sampling dates)
- Total Barium greater than the Maximum Contaminant Level of 2,000 µg/L for Barium (at least one sampling date but not all sampling dates)
- Total Barium less than the Maximum Contaminant Level of 2,000 µg/L for Barium (all sampling dates)



**Figure 8-10**  
**Total Barium in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**BARIUM EXPLANATION**

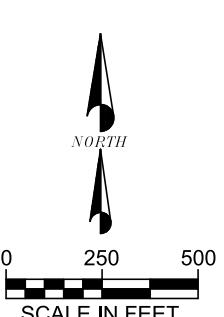
- (●) Dissolved Barium greater than the Maximum Contaminant Level of 2,000 µg/L for Barium (all sampling dates)
- (○) Dissolved Barium greater than the Maximum Contaminant Level of 2,000 µg/L for Barium (at least one sampling date but not all sampling dates)
- (○) Dissolved Barium less than the Maximum Contaminant Level of 2,000 µg/L for Barium (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

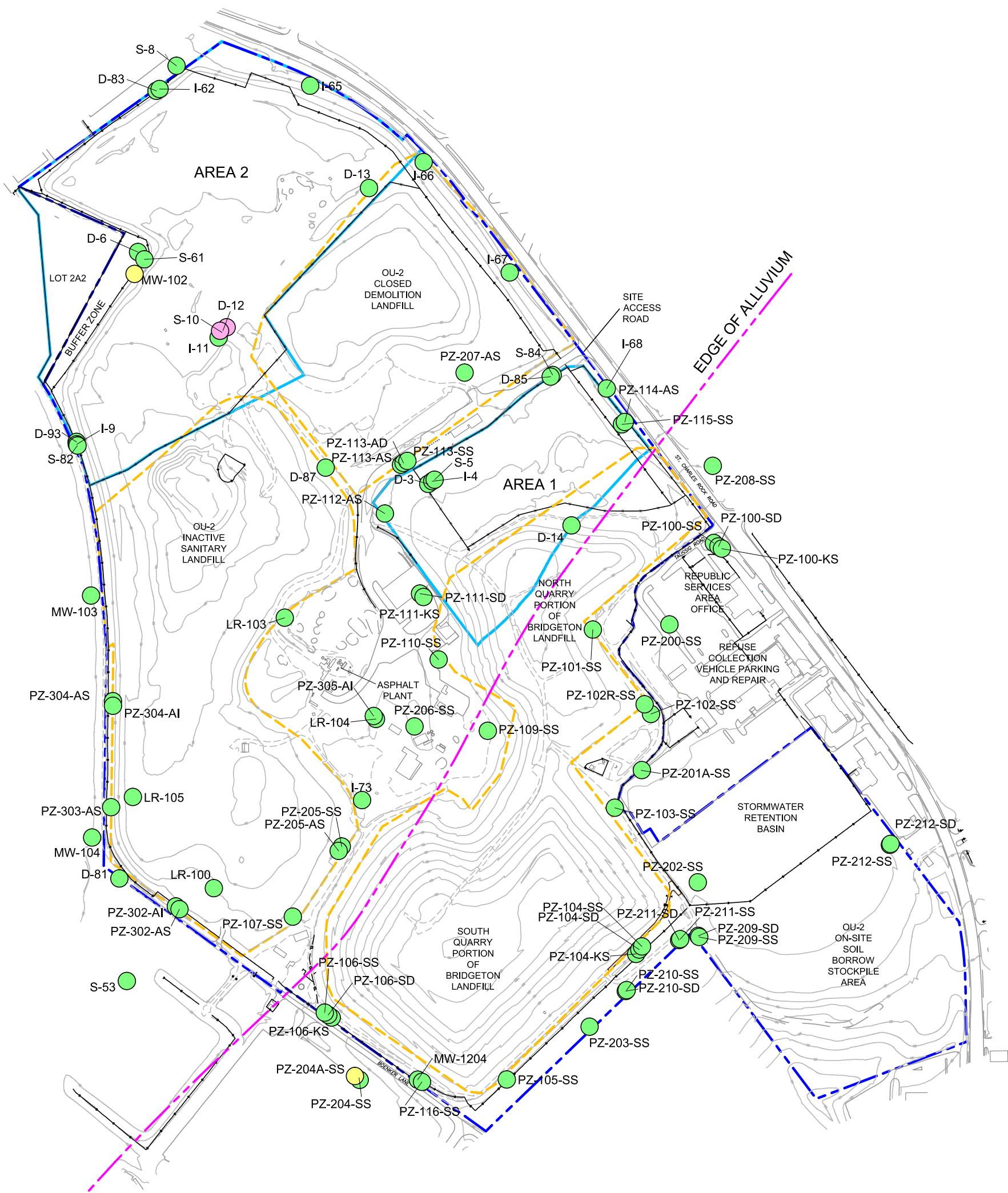
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-11**  
**Dissolved Barium in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**SULFATE EXPLANATION**

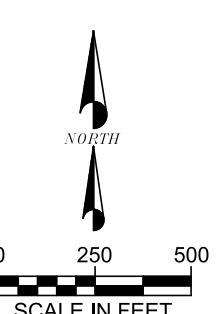
- Total Sulfate greater than the Secondary Maximum Contaminant Level of 250 mg/L for Sulfate (all sampling dates)
- Total Sulfate greater than the Secondary Maximum Contaminant Level of 250 mg/L for Sulfate (at least one sampling date but not all sampling dates)
- Total Sulfate less than the Secondary Maximum Contaminant Level of 250 mg/L for Sulfate (all sampling dates)

**WELL FORMATION DESIGNATIONS**

- LR or MW: Undifferentiated  
 S or AS: Alluvial Shallow Well  
 I or AI: Alluvial Intermediate Well  
 D or AD: Alluvial Deep Well  
 SS: St. Louis Formation Well  
 SD: Salem Formation Well  
 KS: Keokuk Formation Well

**NOTES:**

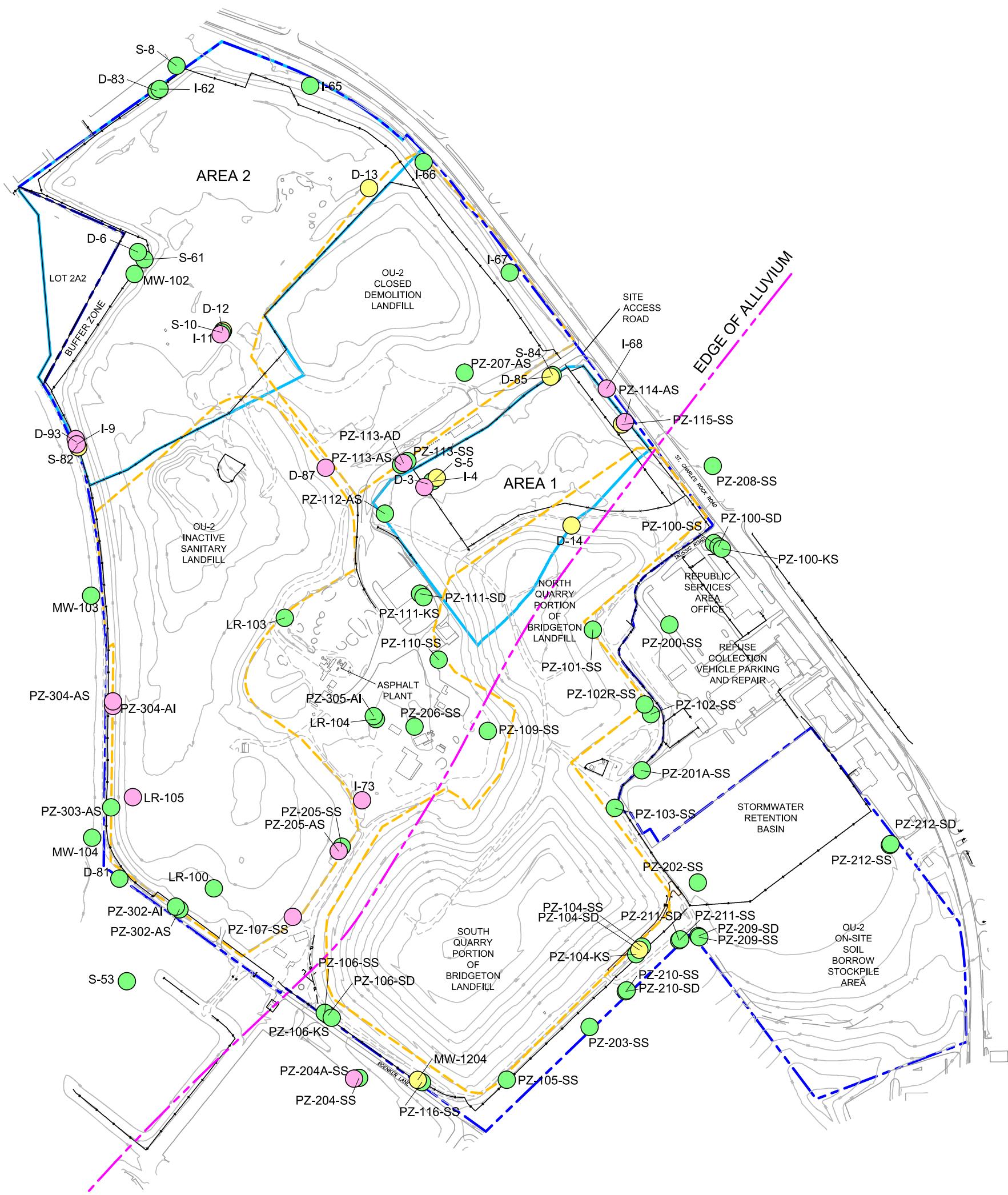
1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-12**  
**Sulfate in Groundwater,**  
**August 2012 Through November 2013**

West Lake Landfill OU-1 RI Addendum

**EMSI** Engineering Management Support, Inc.

**LEGEND**

- Landfill Boundary
- OU-1 Area Boundary
- - - OU-2 Area Boundary
- Index Contour
- Paved Road
- Unpaved Road
- Building
- Fence

**CHLORIDE EXPLANATION**

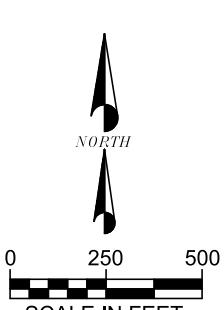
- (Pink circle) Chloride greater than the Secondary Maximum Contaminant Level of 250 mg/L for Chloride (all sampling dates)
- (Yellow circle) Chloride greater than the Secondary Maximum Contaminant Level of 250 mg/L for Chloride (at least one sampling date but not all sampling dates)
- (Green circle) Chloride less than the Secondary Maximum Contaminant Level of 250 mg/L for Chloride (all sampling dates)

**WELL FORMATION DESIGNATIONS**

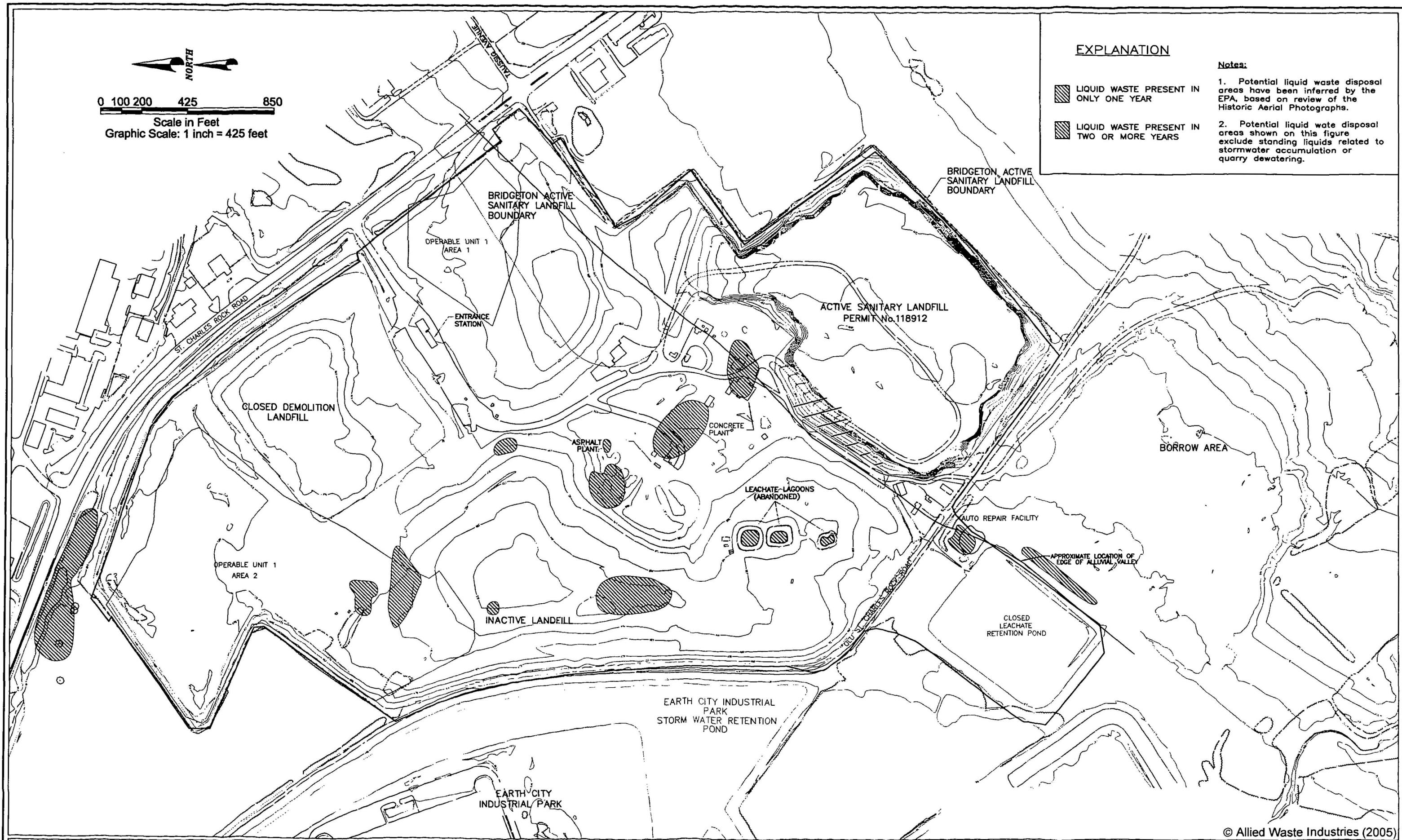
- LR or MW: Undifferentiated
- S or AS: Alluvial Shallow Well
- I or AI: Alluvial Intermediate Well
- D or AD: Alluvial Deep Well
- SS: St. Louis Formation Well
- SD: Salem Formation Well
- KS: Keokuk Formation Well

**NOTES:**

1. Horizontal Coordinates Based on State Plane Missouri East Zone NAD 27
2. Elevations Based on U.S.G.S. Datum.
3. Existing Grade Contours are from the Aerial Survey Completed by the Sanborn Mapping Company on July 20, 2011.
4. Base Map Prepared by Aquaterra Environmental Solutions, Inc.



**Figure 8-13**  
Chloride in Groundwater,  
August 2012 Through February 2014  
West Lake Landfill OU-1 RI Addendum



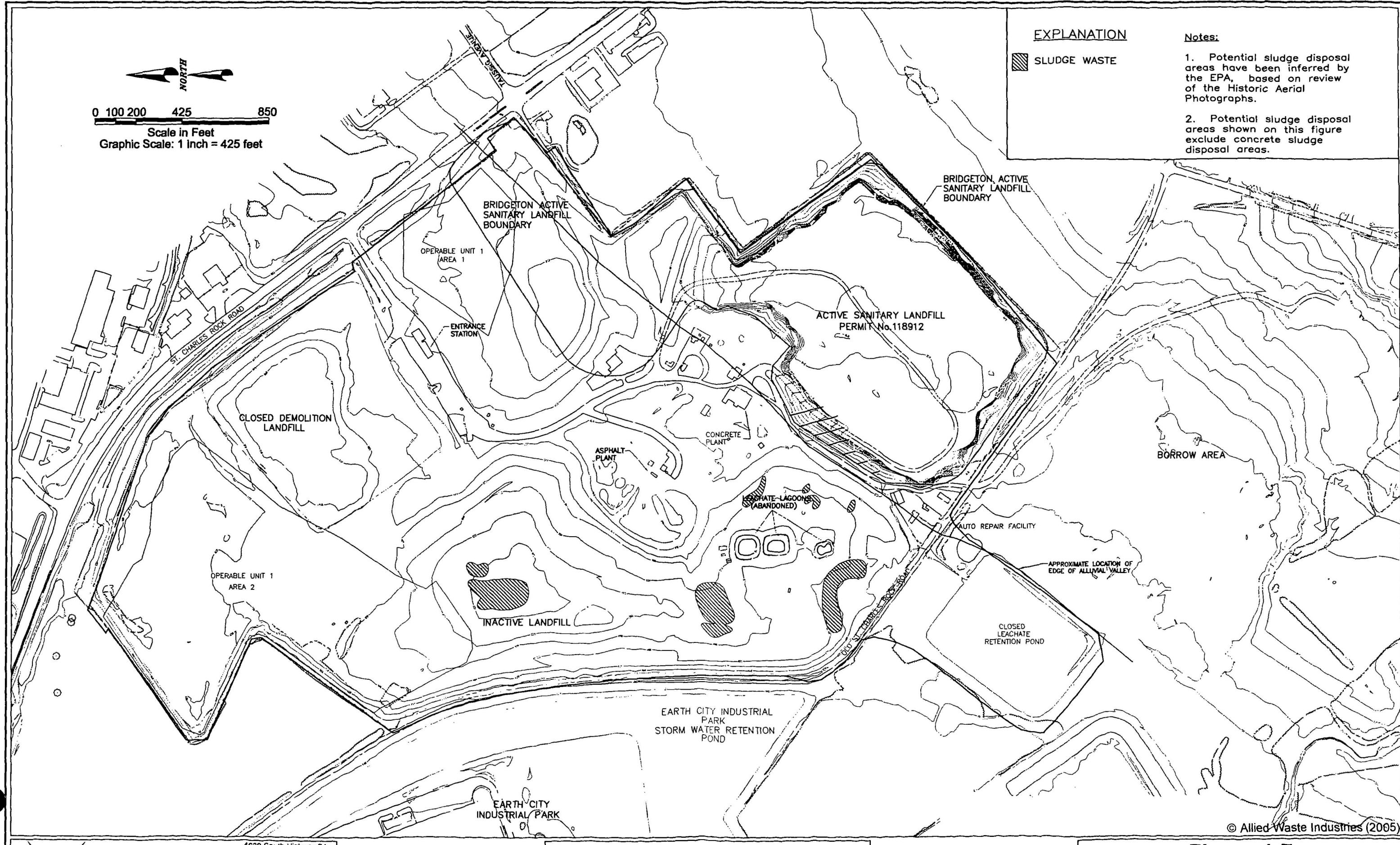
4630 South Highway 94  
North Outer Road  
St. Charles, Missouri 63304  
Phone (636) 939-9111  
Fax (636) 939-9757

 HERST & ASSOCIATES, INC.<sup>®</sup>

West Lake Landfill OU-2  
Bridgeton, Missouri

© Allied Waste Industries (2005)

**Figure 1-6**  
Potential Liquid Disposal Areas  
Inferred by EPA



West Lake Landfill OU-2  
Bridgeton, Missouri

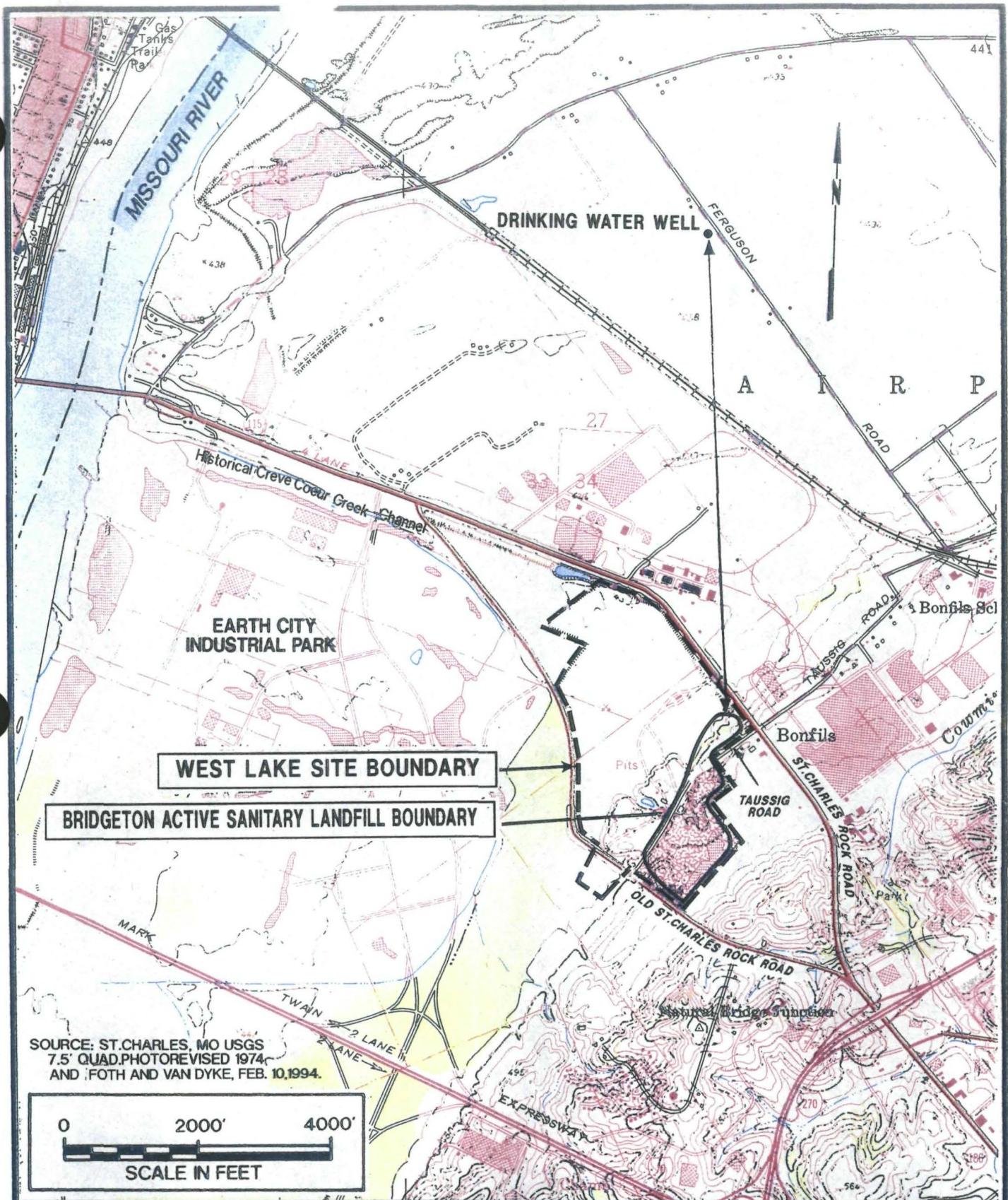


4630 South Highway 94  
North Outer Road  
St. Charles, Missouri 63304  
Phone (636) 939-9111  
Fax (636) 939-9757

**Figure 1-7**  
Potential Sludge Disposal Areas

**APPENDIX V**

**PREVIOUSLY IDENTIFIED NEARBY RECEPTORS**



Denver, Colorado

CLIENT/PROJECT



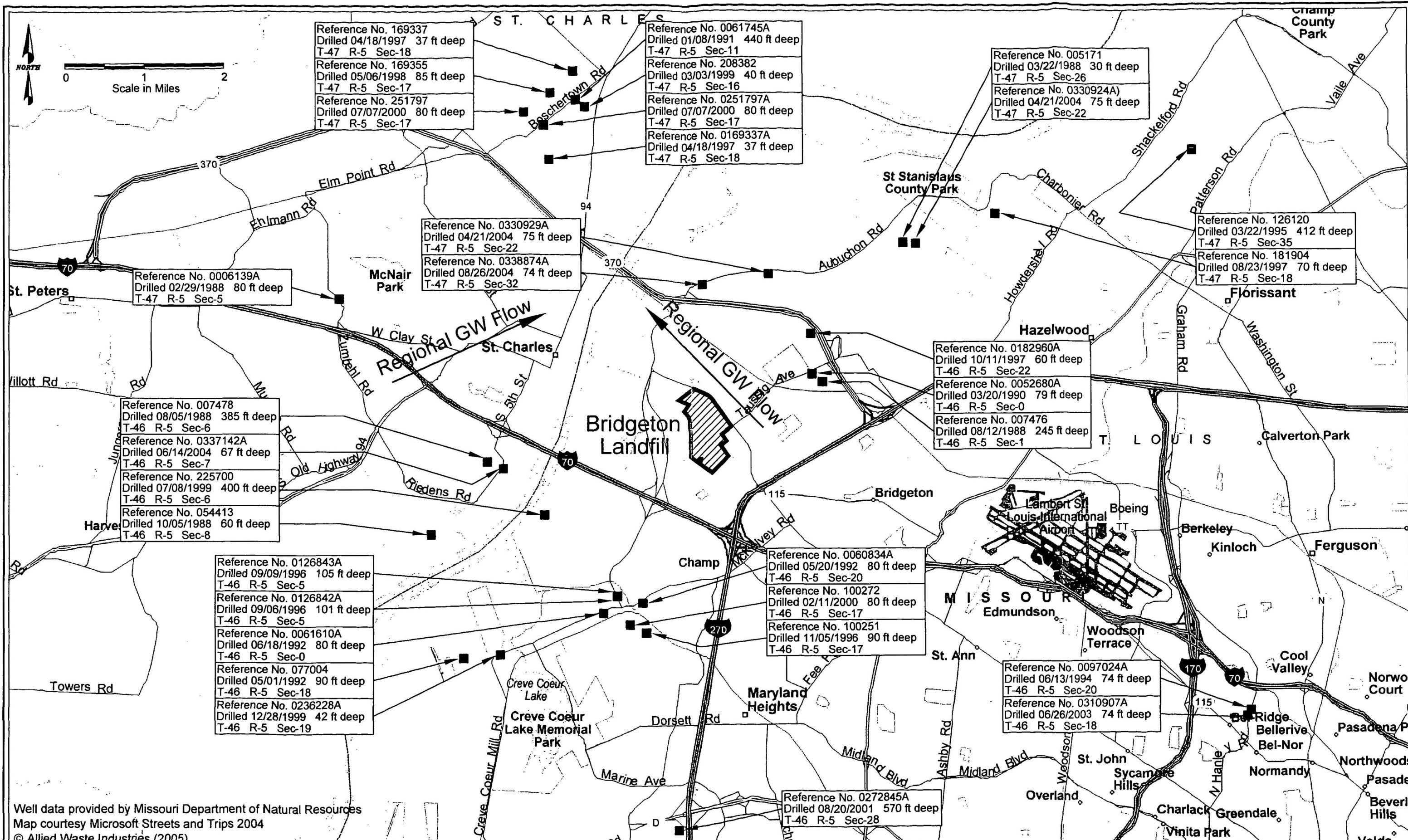
WEST LAKE LANDFILL

LAI DLAW  
LAIDLAW WASTE SYSTEMS INC.

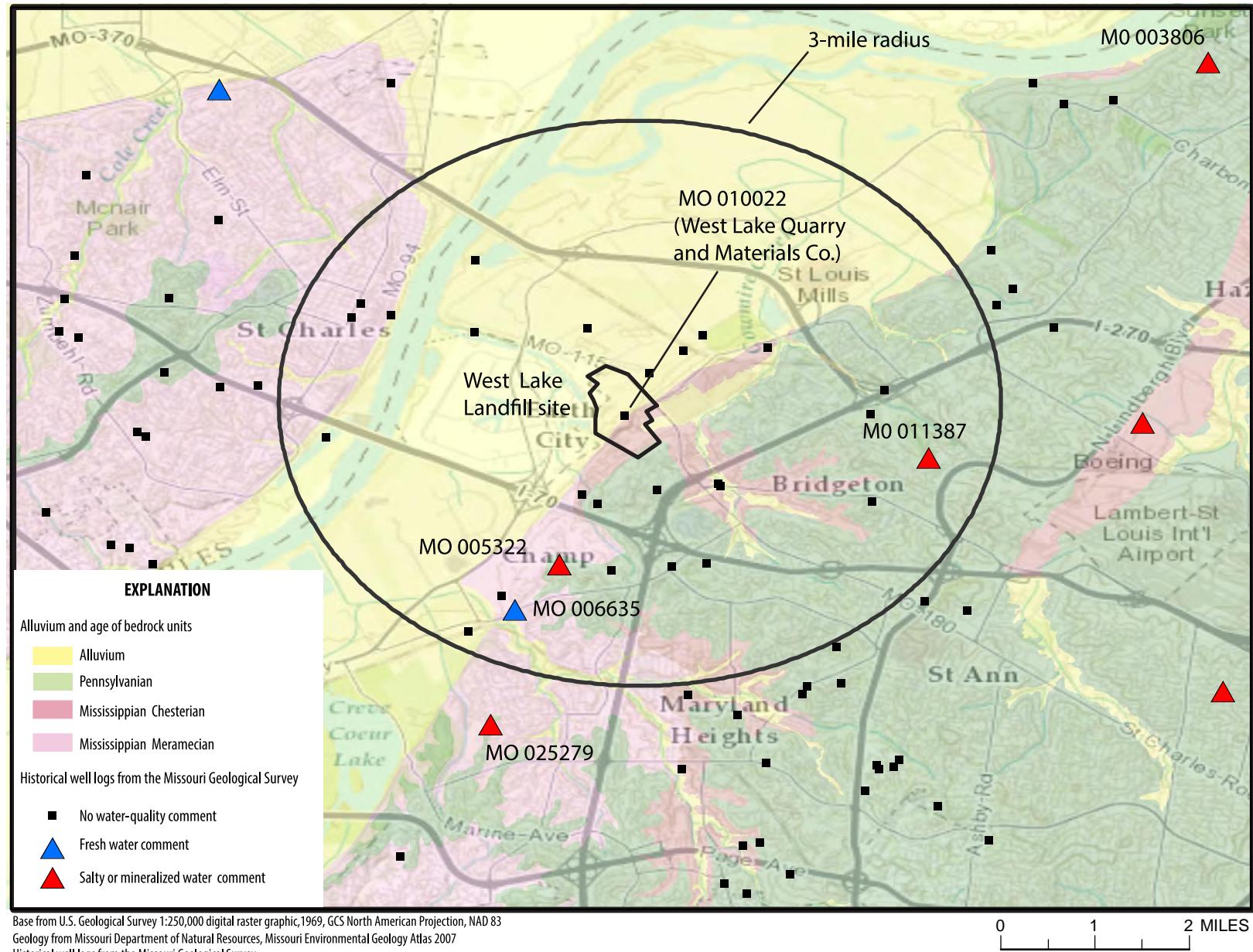
TITLE

### CLOSEST DRINKING WATER WELL LOCATION

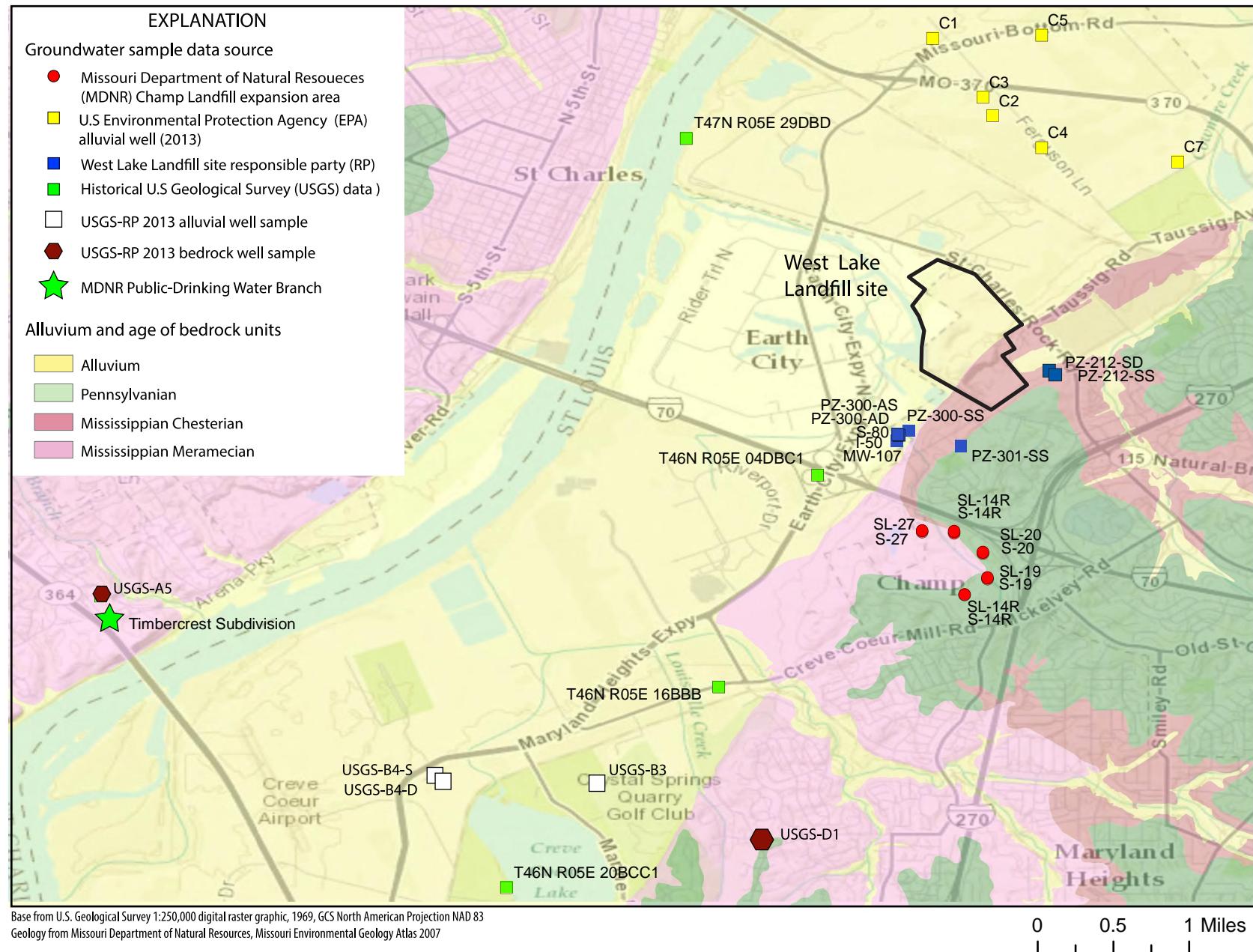
DRAWN BY	BDL	DATE	AUG 1996	JOB NO.	953-2848
CHECKED BY	CER	SCALE	1:24,000	DWG NO./REV. NO.	
REVIEWED BY	WEH	FILE NO.		FIGURE NO.	2-1



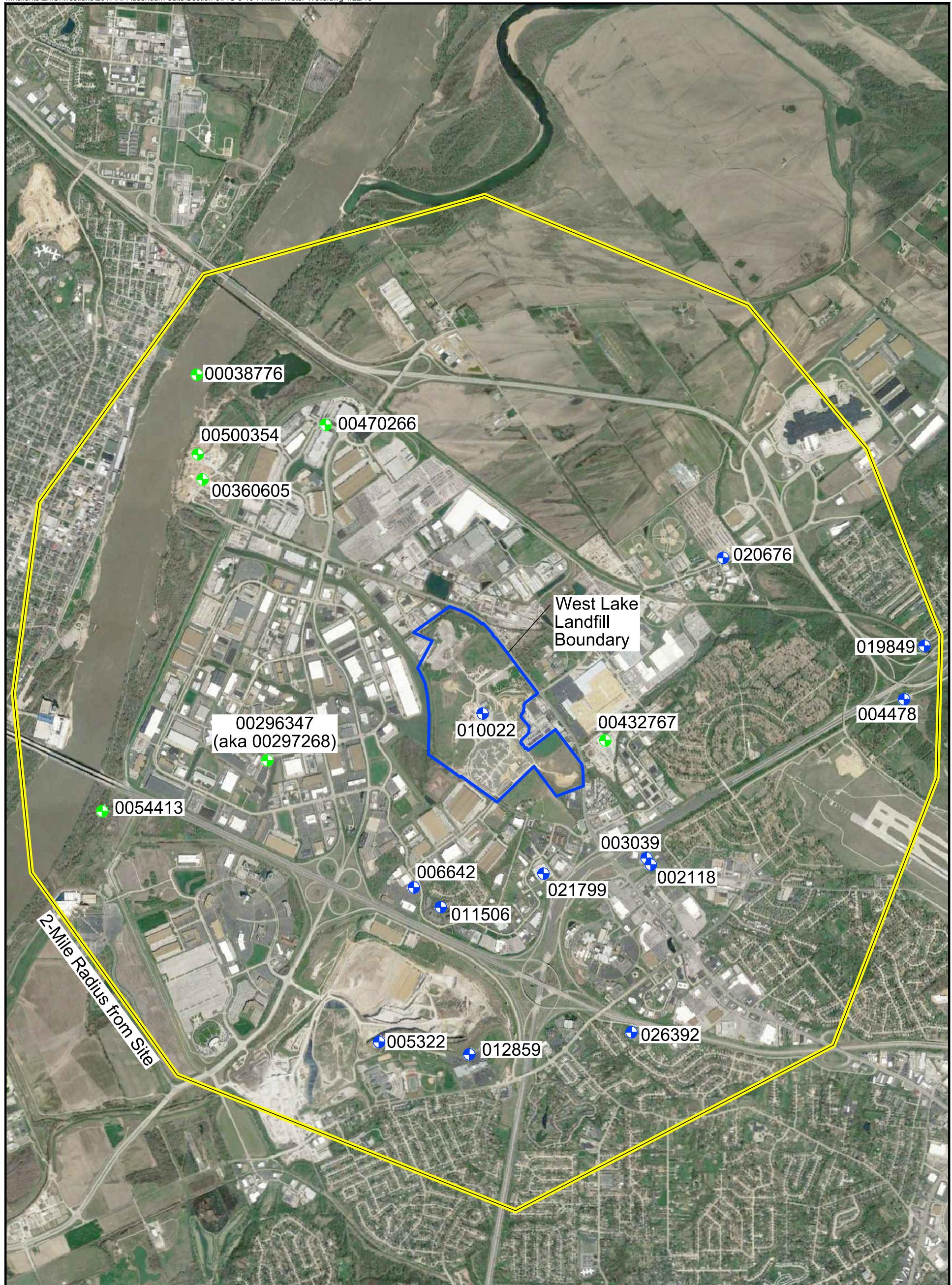
West Lake Landfill OU-2  
Bridgeton, Missouri



**Figure 4.** Water wells with historical geologic logs drilled within a 3-mile radius of the West Lake Landfill site and geologic logs with water-quality comments.



**Figure 5.** Location of background groundwater samples within 5 miles of the West Lake Landfill site.



Legend

- Private Well (Post-1987)
- Private Well (1987 & Earlier)

0 1200 2400  
SCALE IN FEET

Date of Aerial Photograph April 22, 2016,  
Google Earth Images.

Figure 5-19  
Registered or Other Supply Wells  
(from Missouri DNR Websites)  
Within Two Miles of Site

West Lake Landfill OU-1 RI Addendum

EMSI Engineering Management Support, Inc.

**APPENDIX W**

**PRELIMINARY MONITORING WELL INVENTORY PHOTO-DOCUMENTATION**

DRAFT

**APPENDIX W. WEST LAKE LANDFILL OU-3 PHOTO-DOCUMENTATION  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN**

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Photo 1. Monitoring Well D-13

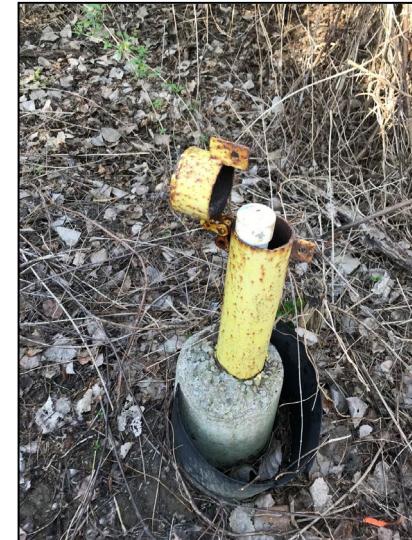


Photo 2. Monitoring Well I-65



Photo 3. Monitoring Well I-66



Photo 4. Monitoring Well D-12

**APPENDIX W. WEST LAKE LANDFILL OU-3 PHOTO-DOCUMENTATION  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN**

---



Photo 5. Monitoring Well S-10



Photo 6. Monitoring Well D-6



Photo 7. Monitoring Well I-9 (mislabeled)



Photo 8. Monitoring Well S-82

**APPENDIX W. WEST LAKE LANDFILL OU-3 PHOTO-DOCUMENTATION  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN**

---



Photo 9. Monitoring Well D-93 (mislabeled)



Photo 10. Monitoring Well MW-103



Photo 11. Monitoring Well I-62



Photo 12. Monitoring Well D-83

**APPENDIX W. WEST LAKE LANDFILL OU-3 PHOTO-DOCUMENTATION  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN**

---



Photo 13. Monitoring Well D-3



Photo 14. Monitoring Well I-4



Photo 15. Monitoring Well S-5



Photo 16. Monitoring Well D-89

**APPENDIX W. WEST LAKE LANDFILL OU-3 PHOTO-DOCUMENTATION  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN**

---



Photo 17. Monitoring Well D-81



Photo 18. Monitoring Well D-87



Photo 19. Clustered Monitoring Wells D-12, I-11, and S-10