TO:	Ed Kolodziej	**cc:**	Joanne Reinhold, GE
FROM:	Rick Boone & Clifford Yantz, O'Brien & Gere		Scott Cormier, O'Brien & Gere
RE:	EI CA750 – Supplemental Isoconcentration Maps		
FILE:	612/51731		
DATE:	December 3, 2014		

In August 2013, O'Brien & Gere submitted documentation on behalf of General Electric Company (GE) supporting RCRA Corrective Action Environmental Indicator, *Migration of Contaminated Groundwater Under Control* (CA750), for the GE Aviation facility in Evendale, OH. Documentation included the completed EI guidance form as well as statistical trends and graphical analysis derived using Monitoring and Remediation Optimization Software (MAROS). In August 2014, U.S. EPA requested supplemental isoconcentration contour maps to further support the conclusions regarding stable or shrinking plumes at the facility. The following provides summary notes to guide the reader through review of the attached isoconcentration maps and time-series graphs.

INTRODUCTION

The overall extent of impacted groundwater in the Perched zone, Upper Sand & Gravel (USG), and Lower Sand & Gravel (LSG) units appears to be stable or decreasing, as evident by stable or decreasing: 1) total mass of the plumes, 2) center of mass of the plumes and 3) most individual well concentrations. Information supporting this conclusion was presented in our August 2013 Migration of Contaminated Groundwater Under Control Environmental Indicator (EI) Determination (RCRA Info Code (CA750)) submitted to U.S. EPA in August 2013. The attached figures provide isoconcentration maps for each of the plumes for the semi-annual sampling events from the fourth quarters (4Q) of 2007, 2009, 2011 and 2013. A 2007 map was not prepared for the Perched zone due to insufficient data coverage. These figures are provided as a supplement to the already submitted EI to aid in the two dimensional visualization of the plumes to support the EI conclusions that the plumes are stable or decreasing in the Perched, USG and LSG units. There are several associated notes:

- The number of wells included in contouring varies between 2007 and 2013 as a result of additional off-site investigations in 2009 and the number of wells sampled during the particular quarterly event. Therefore, the accuracy of the estimated extent of chemical data is a function of the amount and location of available data. Temporal analysis based on an increasing number of data locations can lead to a false indication of plume movement and expansion.
- Total chlorinated volatile organic compound (CVOC) concentrations are mapped under the assumption of a single plume for the purposes of simplification and temporal comparisons. However, it is noted that dissolved VOCs in the USG and LSG are likely to have a much more complex origin, including older releases during periods of higher historical pumping rates and drawdown, the presence of a mixed or co-mingled plume from a potential upgradient source(s), differing compound degradation rates, or a combination of these. In addition, due to the likelihood that groundwater concentrations at well OSMW-5D represent a separate or co-mingled plume, data from well OSMW-5D were not included in the isoconcentration contouring.
- The IRM groundwater extraction system was started in July 2011with full operation of the extraction wells by December 2011. The 2011 and 2013 isoconcentration maps show the extraction well capture zones. Variability in CVOC concentrations at selected wells is estimated to be associated with some shifting of groundwater flow directions due to IRM pumping.

Additional support is provided by the attached **Figures 8, 9** and **10**. These figures are provided to illustrate the general decreasing trends of the constituent concentrations within individual Perched, USG and LSG wells as a result of IRM pumping and natural attenuation.

DISCUSSION

The following sections highlight some of the key conclusions obtained from a review of the isoconcentration maps and time-series concentration graphs for each of the water-bearing units (Perched Zone, USG, and LSG).

PERCHED ZONE

The isoconcentration maps for the Perched zone for 2009, 2011 and 2013 indicate an overall decreasing extent of the Perched zone plume, especially downgradient of the Perched zone extraction wells. Concentrations along the downgradient portion of the Perched zone plume have dropped from highs of over 1,700 µg/L total CVOCs to 577 µg/L. Perched zone pumping appears to be redistributing higher concentrations within the central portion of the plume as evident by the concentrations at AF-24P, which increased during the 4Q 2013 sampling. **Figure 8** illustrates that most of the Perched zone wells have decreasing trends and that downgradient well H-221 has a somewhat stable trend since 2007. Since the nearest upgradient well (OSMW-10P) has a decreasing trend, groundwater at H-221 is anticipated to continue to stabilize for a period of time, then decrease.

USG

The isoconcentration maps for the USG for 2007, 2009, 2011 and 2013 indicate an overall decreasing extent of the USG plume. In addition, the Perched zone pumping appears to have reduced concentrations along the eastern portion of the USG plume by continued vertical gradient reversal and capturing Perched zone constituents. Concentrations along the eastern portion of the USG plume have dropped from highs of over 3,700 µg/L total CVOCs to approximately 1,400 µg/L. The southwestern portion of the USG plume near OSMW-8S appears relatively stable and, with CVOC concentrations in upgradient well OSMW-6S demonstrating a significant decreasing trend (**Figure 9**), it is anticipated that the plume downgradient of OSWM-6S should continue to decrease over time. Similarly, the concentrations in OSMW-9S peaked in 2012, but have stabilized since then. Concentrations in upgradient well OSMW-4S have decreased from highs of over 500 µg/L total CVOCs to less than 50 µg/L total CVOCs, and the overall size of the USG plume has remained stable along the western portion of the plume.

LSG

The isoconcentration maps for the LSG aquifer for 2007, 2009, 2011 and 2013 indicate an overall decreasing LSG plume. Concentrations within the LSG plume have dropped from highs of over 1,500 µg/L total CVOCs to generally less than 500 µg/L, as indicated by decreasing trends in groundwater from wells OSMW-1D, OSMW-3D and PMW-3D (**Figure 10**). This decreasing trend in concentrations has resulted in a reduction of the mass of the LSG plume as presented in the original EI submittal. As noted above, LSG pumping may be modifying groundwater flow directions and redistributing concentrations within the LSG plume. This appears to be the case for concentrations at TMW-2D, which increased during the 4Q 2012 sampling (but has since decreased), and also concentration increases in OSMW-3D during the 2Q 2014 event, with a return to below 50 µg/L during the 3Q 2014 sampling event. **Figure 10** illustrates that most of the LSG wells have decreasing trends, except for OSMW-8D and OSMW-6D (vinyl choride only). The concentrations in OSMW-8D have increased since 2Q 2012 to near pre-pumping levels and vinyl chloride (VC) concentrations at OSMW-6D have fluctuated between approximately 50 µg/L and 150 µg/L since IRM pumping began (**Figure 10**). Despite these exceptions, the overall size and mass of the LSG plume has decreased over the period of monitoring.

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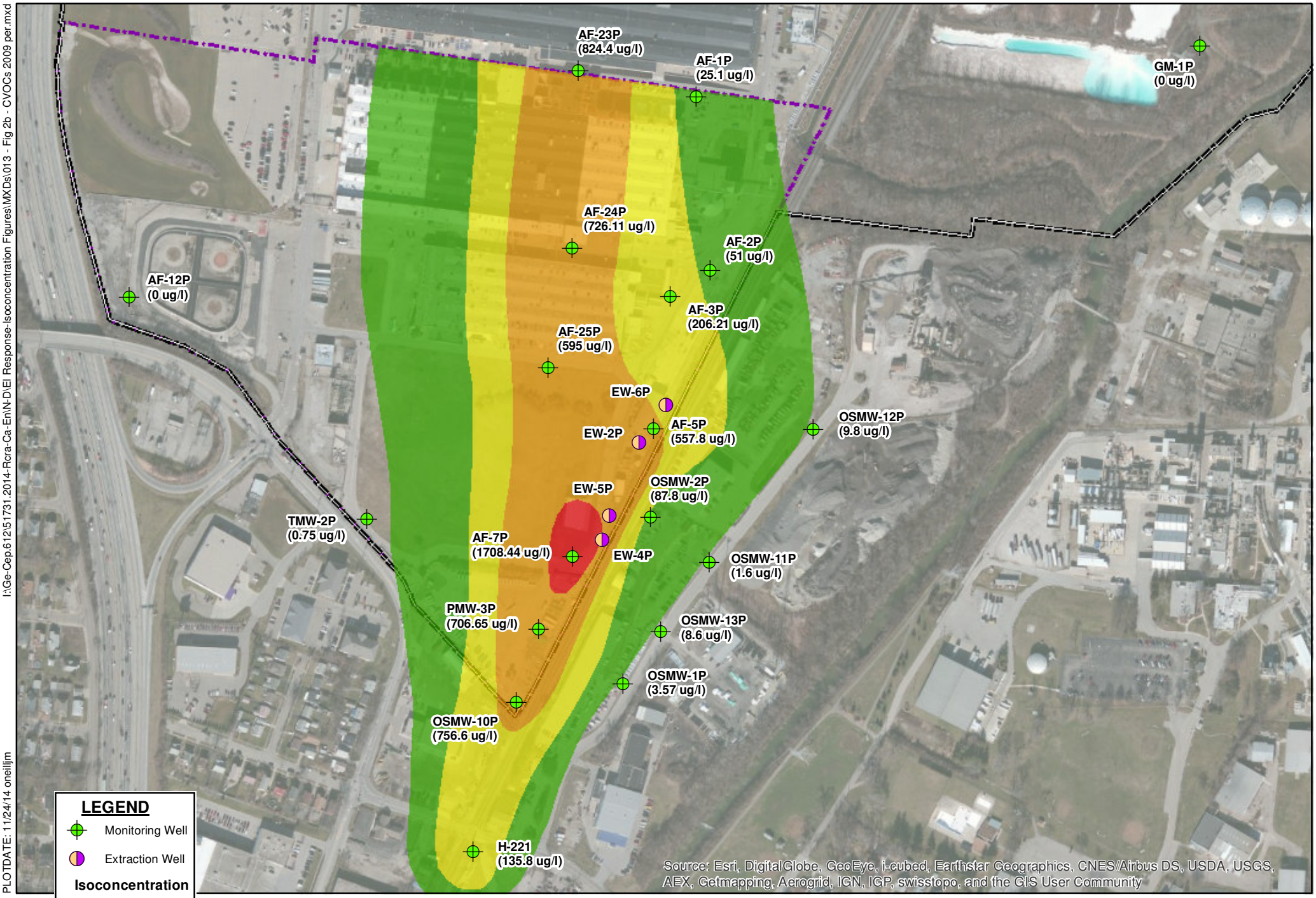
FIGURE 2b



I:\Ge-Cep.612\51731.2014-Rcra-Ca-En\N-D\EI Response-Isoconcentration Figures\MXDs\013 - Fig 2b - CVOCs 2009 per.mxd

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PERCHED CVOCs ISOCONCENTRATIONS
2009 (4TH QTR)

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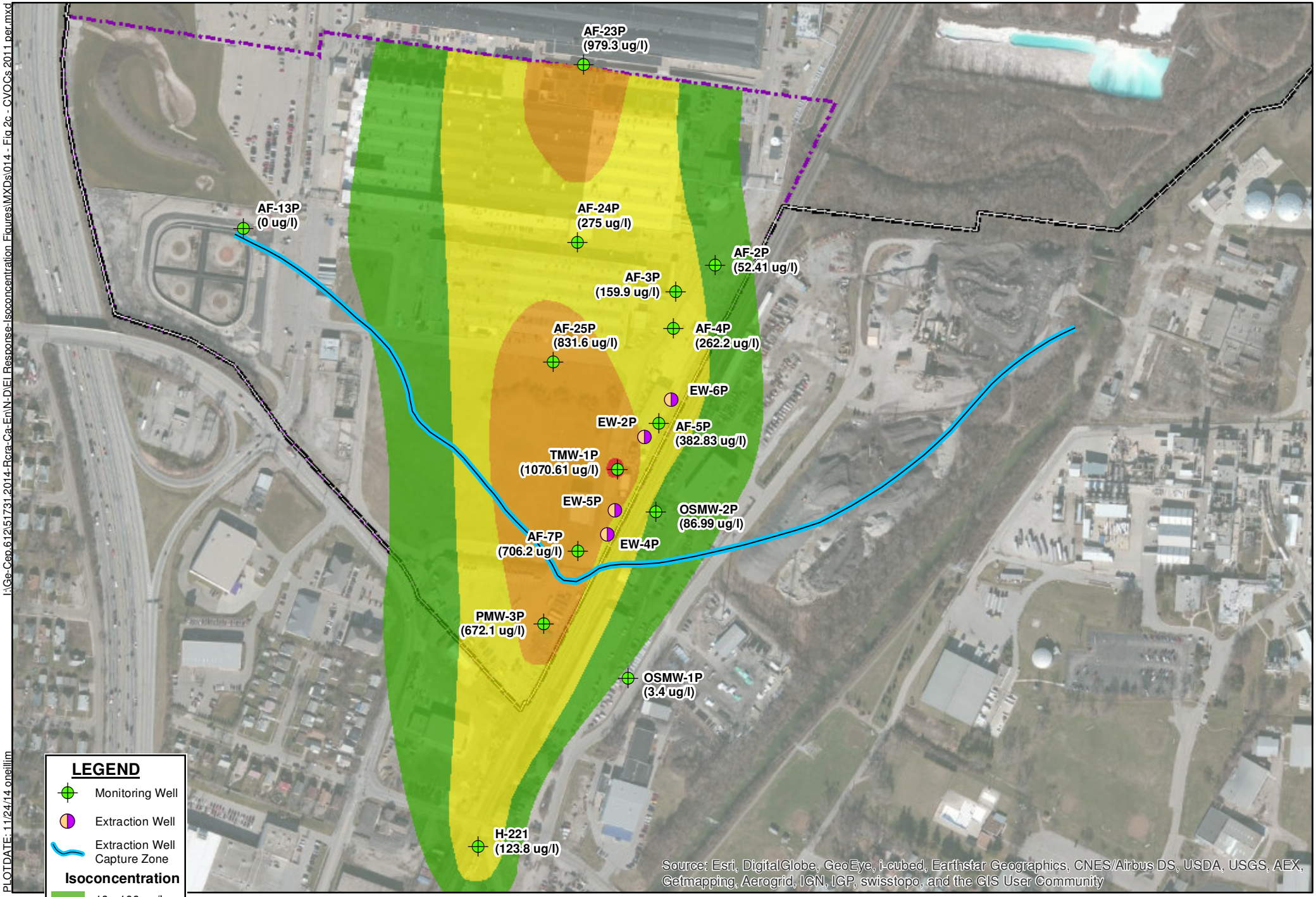
FIGURE 2c



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PERCHED CVOCs ISOCONCENTRATIONS
2011 (4TH QTR)

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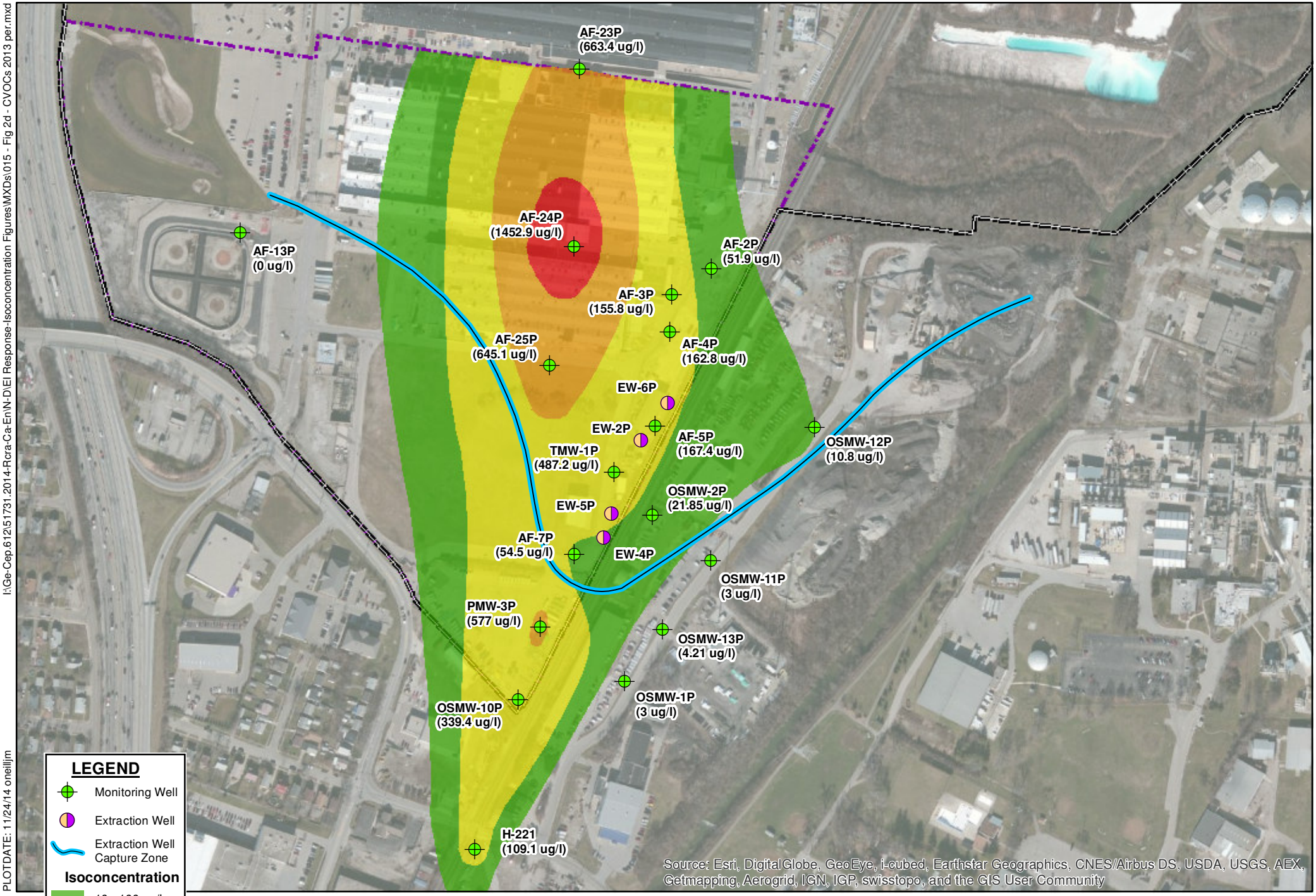
FIGURE 2d



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LEGEND

- Monitoring Well
- Extraction Well
- Extraction Well Capture Zone

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

PERCHED CVOCs ISOCONCENTRATIONS 2013 (4TH QTR)

0 100 200 300 400
Feet

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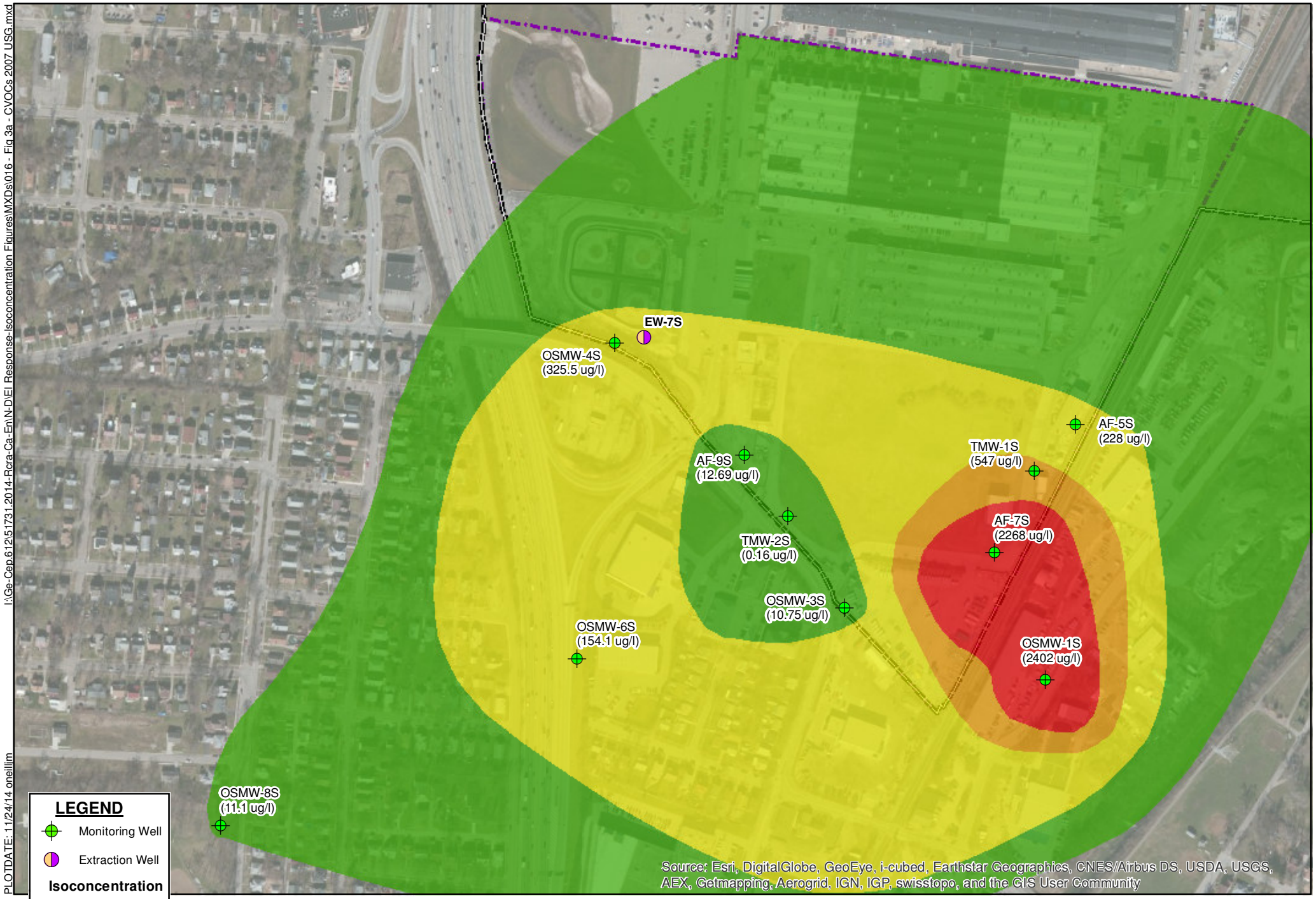
FIGURE 3a



LEGEND

- Monitoring Well
- Extraction Well

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

USG CVOCs ISOCONCENTRATIONS 2007 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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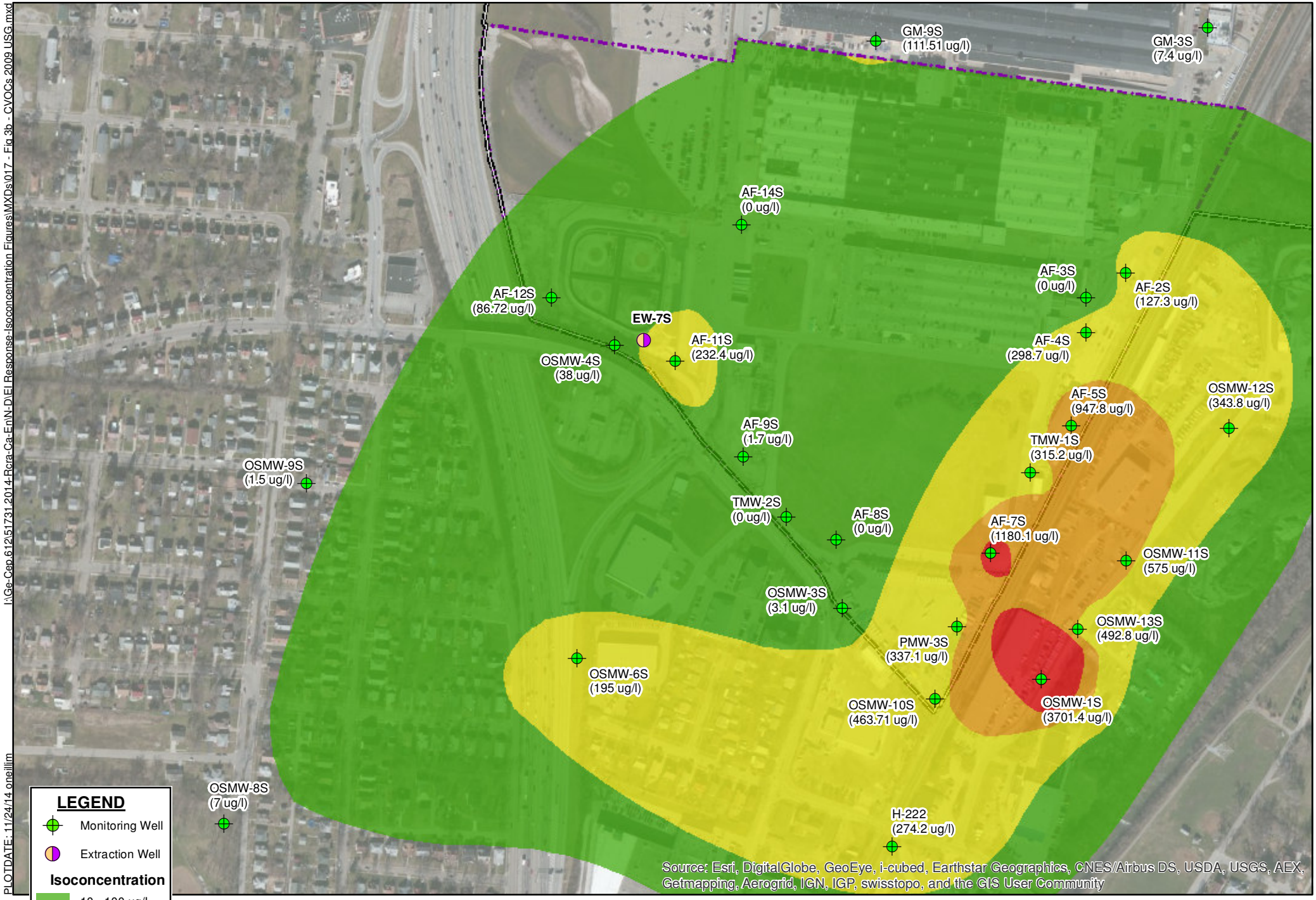
FIGURE 3b



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USG CVOCs ISOCONCENTRATIONS
2009 (4TH QTR)

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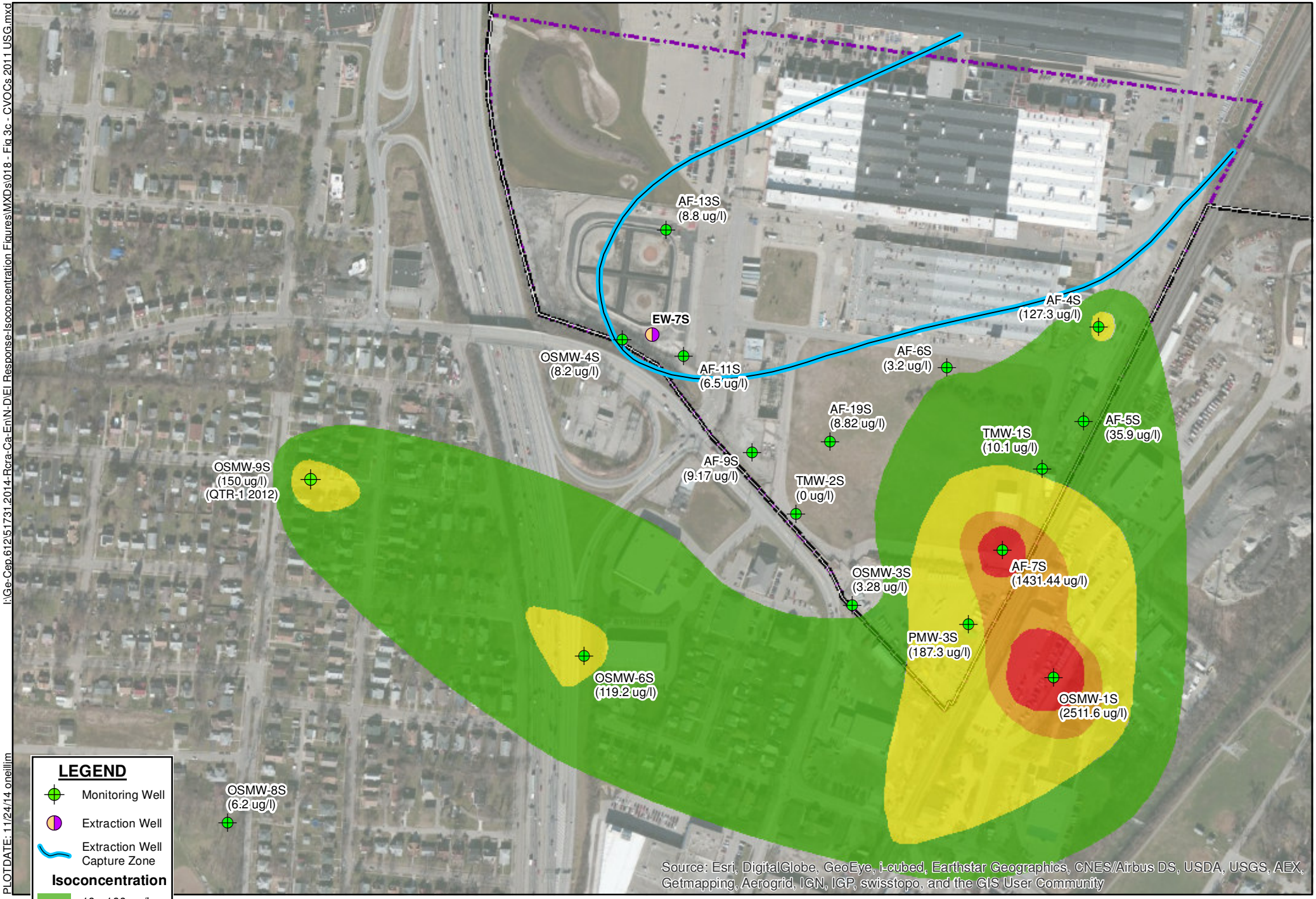
FIGURE 3c



LEGEND

- Monitoring Well
- Extraction Well
- Extraction Well Capture Zone

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

USG CVOCs ISOCONCENTRATIONS 2011 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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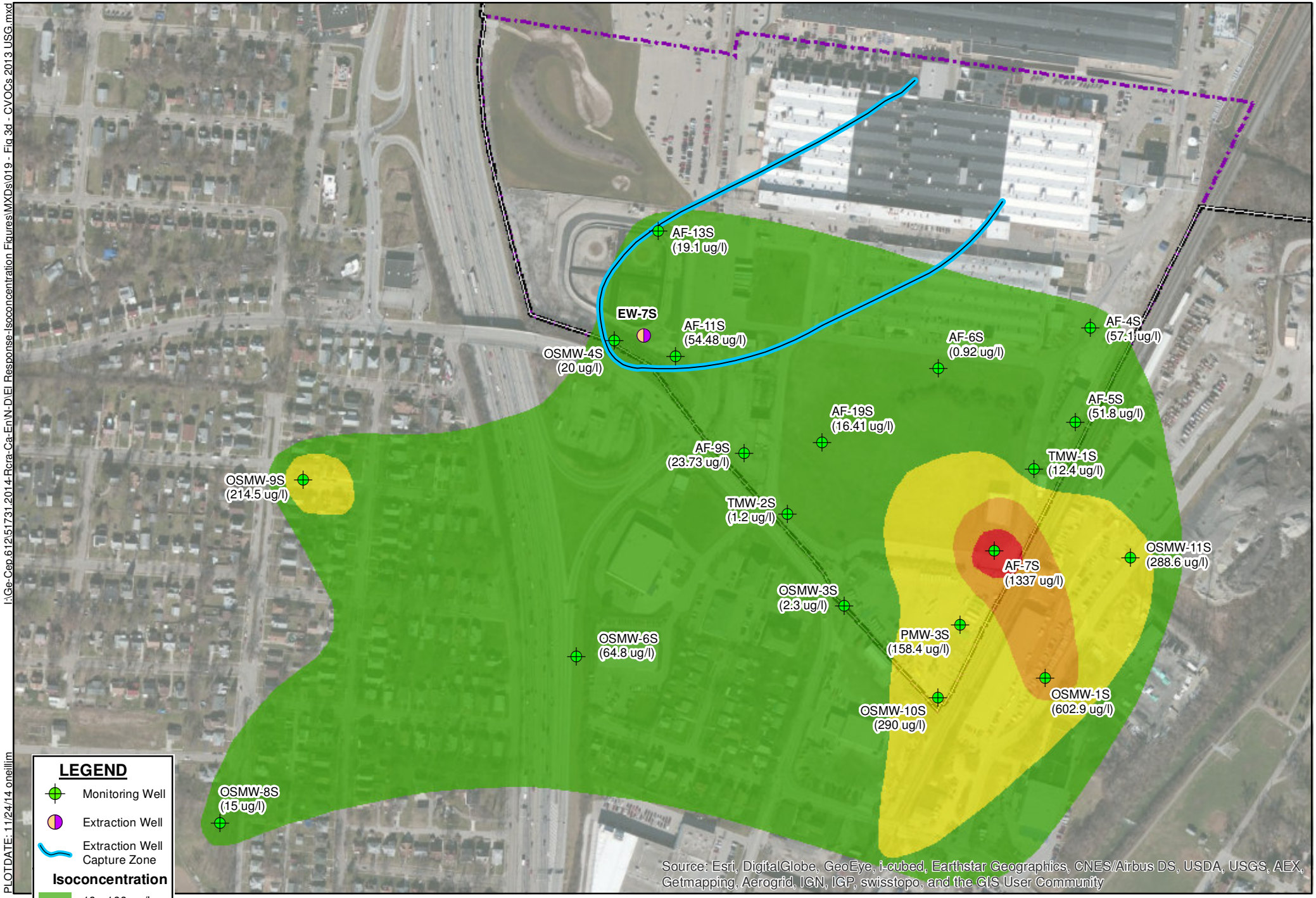
FIGURE 3d



LEGEND

- Monitoring Well
- Extraction Well
- Extraction Well Capture Zone

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

USG CVOCs ISOCONCENTRATIONS 2013 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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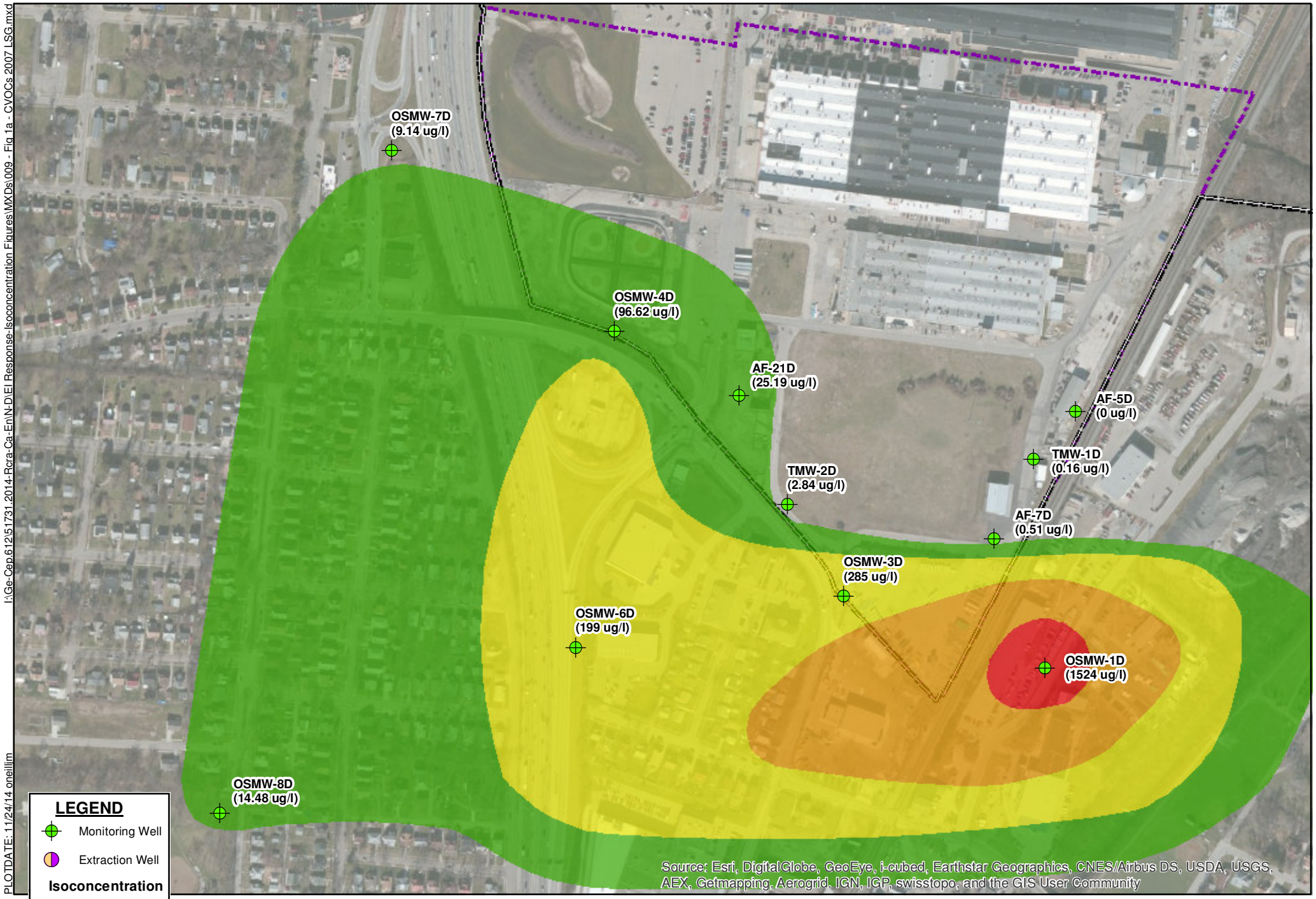
FIGURE 1a



LEGEND

- Monitoring Well
- Extraction Well

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

LSG CVOCs ISOCONCENTRATIONS 2007 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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FIGURE 1b

LEGEND

- Monitoring Well
- Extraction Well

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

LSG CVOCs ISOCONCENTRATIONS 2009 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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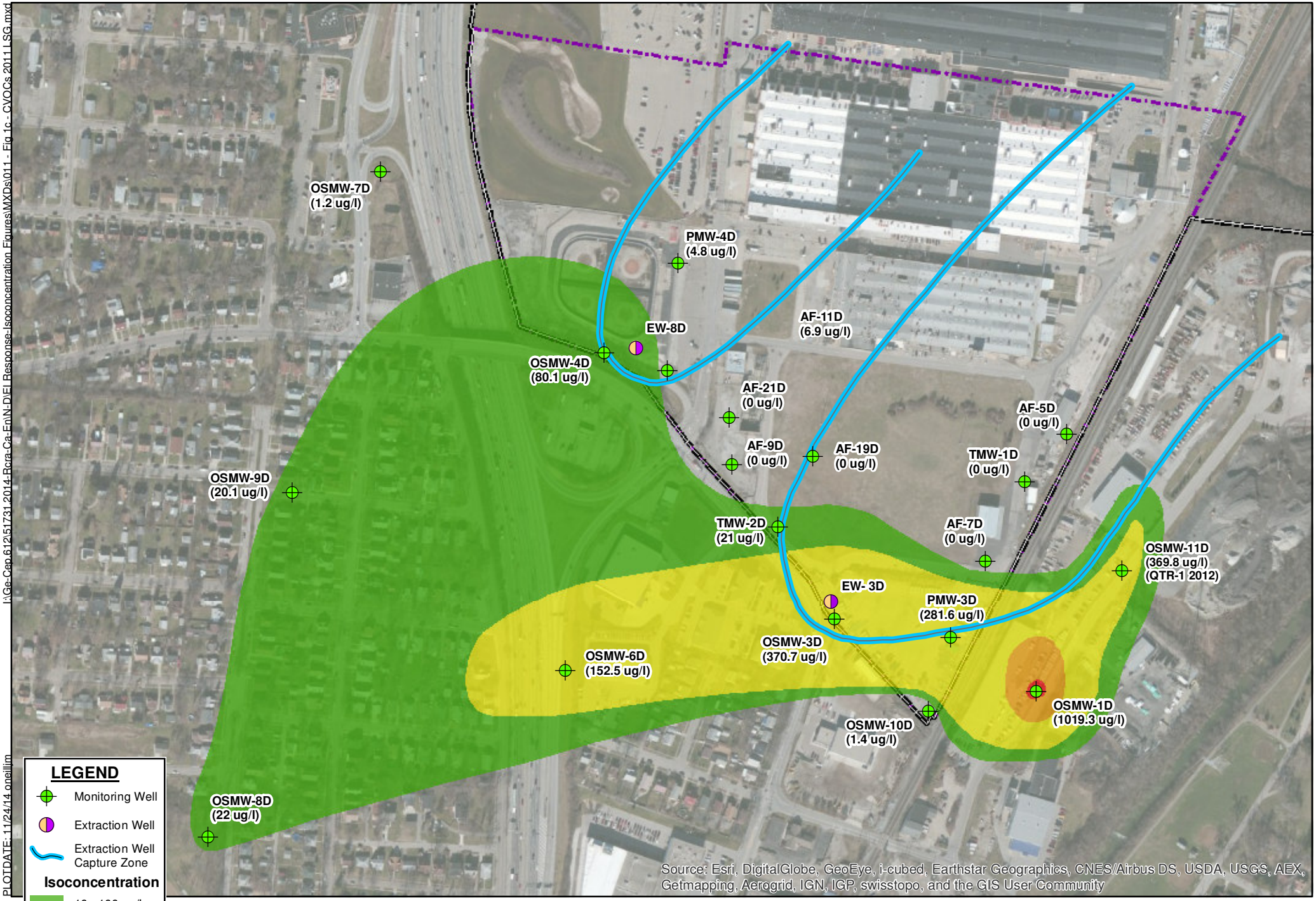
FIGURE 1c



LEGEND

- Monitoring Well
- Extraction Well
- Extraction Well Capture Zone

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

LSG CVOCs ISOCONCENTRATIONS 2011 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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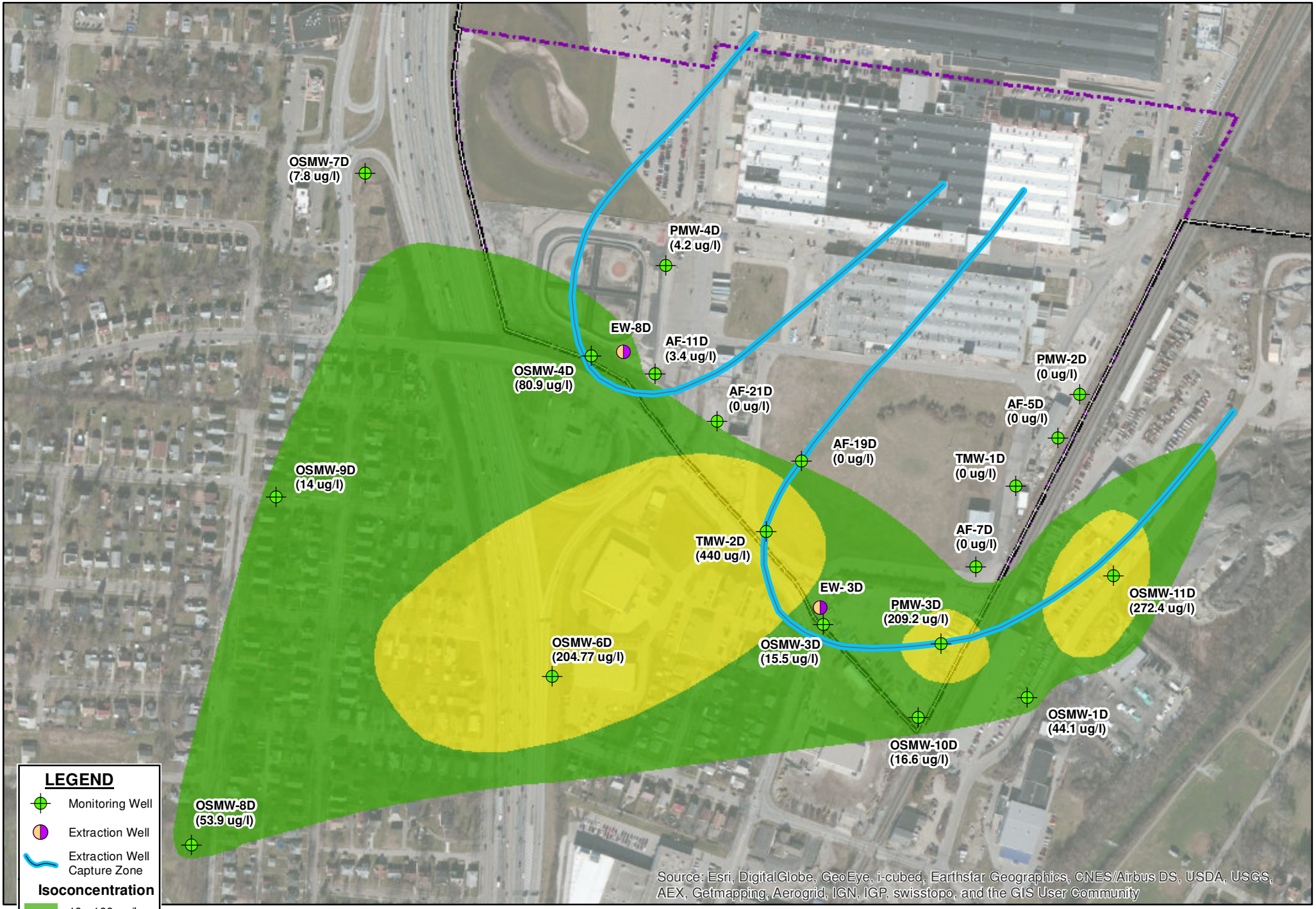
FIGURE 1d



LEGEND

- Monitoring Well
- Extraction Well
- Extraction Well Capture Zone

Isoconcentration

- 10 - 100 ug/L
- 100 - 500 ug/L
- 500 - 1000 ug/L
- > 1000 ug/L

LSG CVOCs ISOCONCENTRATIONS 2013 (4TH QTR)

0 100 200 300 400
Feet

N W E S

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I:\Ge-Cep.612\51502.2014 Evendale O&M\Docs\Reports\3rd Qtr Report 2014\Figures\005 - Figure 8 - Perched Wells and Charts 2014 Q3.mxd

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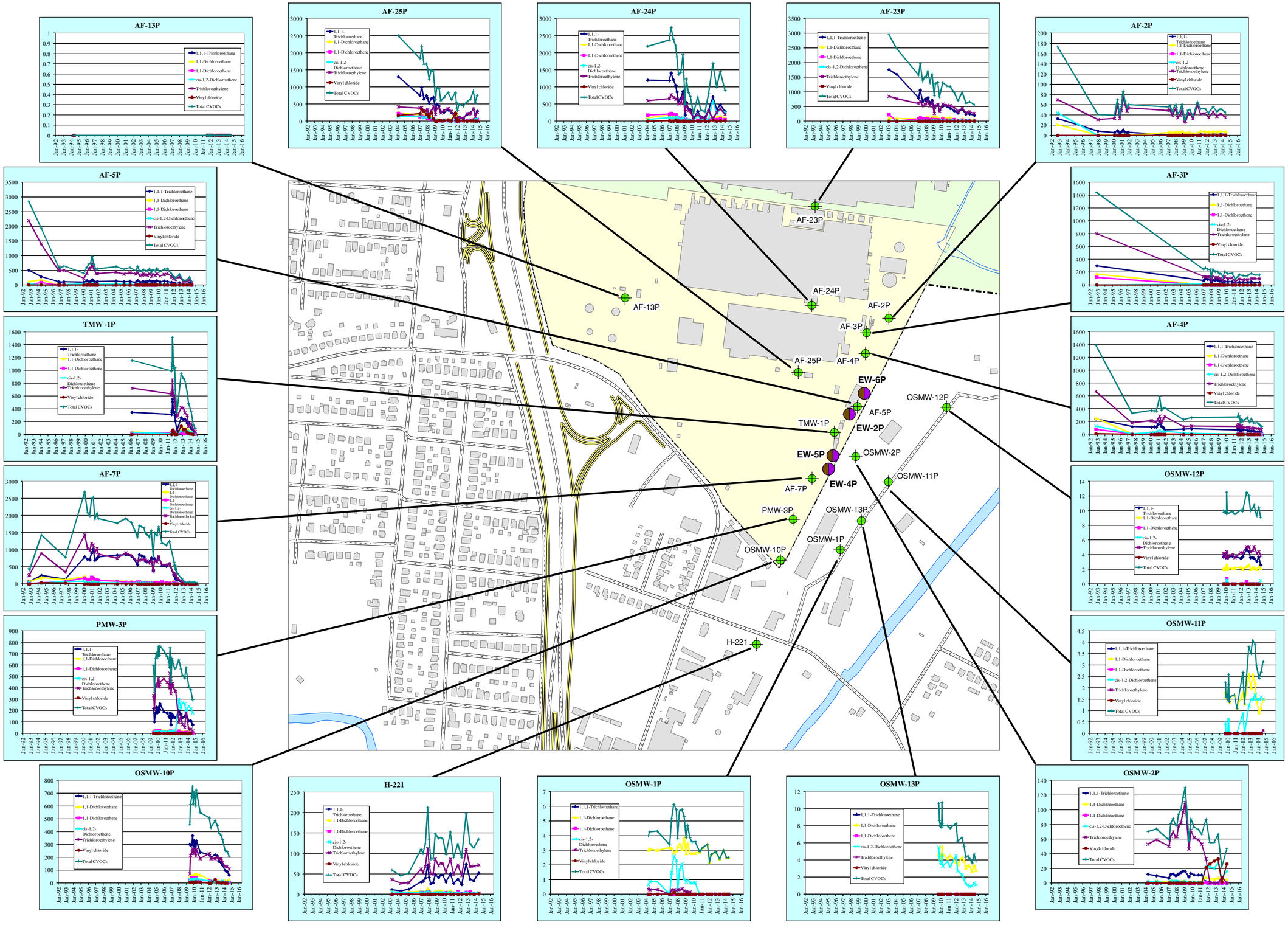

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FIGURE 8

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EVENDALE, OHIO

LEGEND

PERCHED ZONE MONITORING WELL - GROUNDWATER SAMPLE COLLECTED FOR ANALYTICAL ANALYSIS

PERCHED ZONE EXTRACTION WELL

GRAPH KEY

- 1,1,1-TRICHLOROETHANE
- 1,1-DICHLOROETHANE
- 1,1-DICHLOROETHENE
- CIS-1,2-DICHLOROETHENE
- TRICHLOROETHYLENE
- VINYL CHLORIDE
- TOTAL CVOCS

NOTES:
1. RESULTS ARE SHOWN IN ug/L
2. NON-DETECTED RESULTS ARE SHOWN AT THE X AXIS.
3. CONCENTRATION SCALE MAY VARY BY GRAPH.

PERCHED ZONE HISTORICAL GROUNDWATER ANALYTICAL RESULTS FOR IRM MONITORING WELLS

N

0 250 500 1,000
Feet

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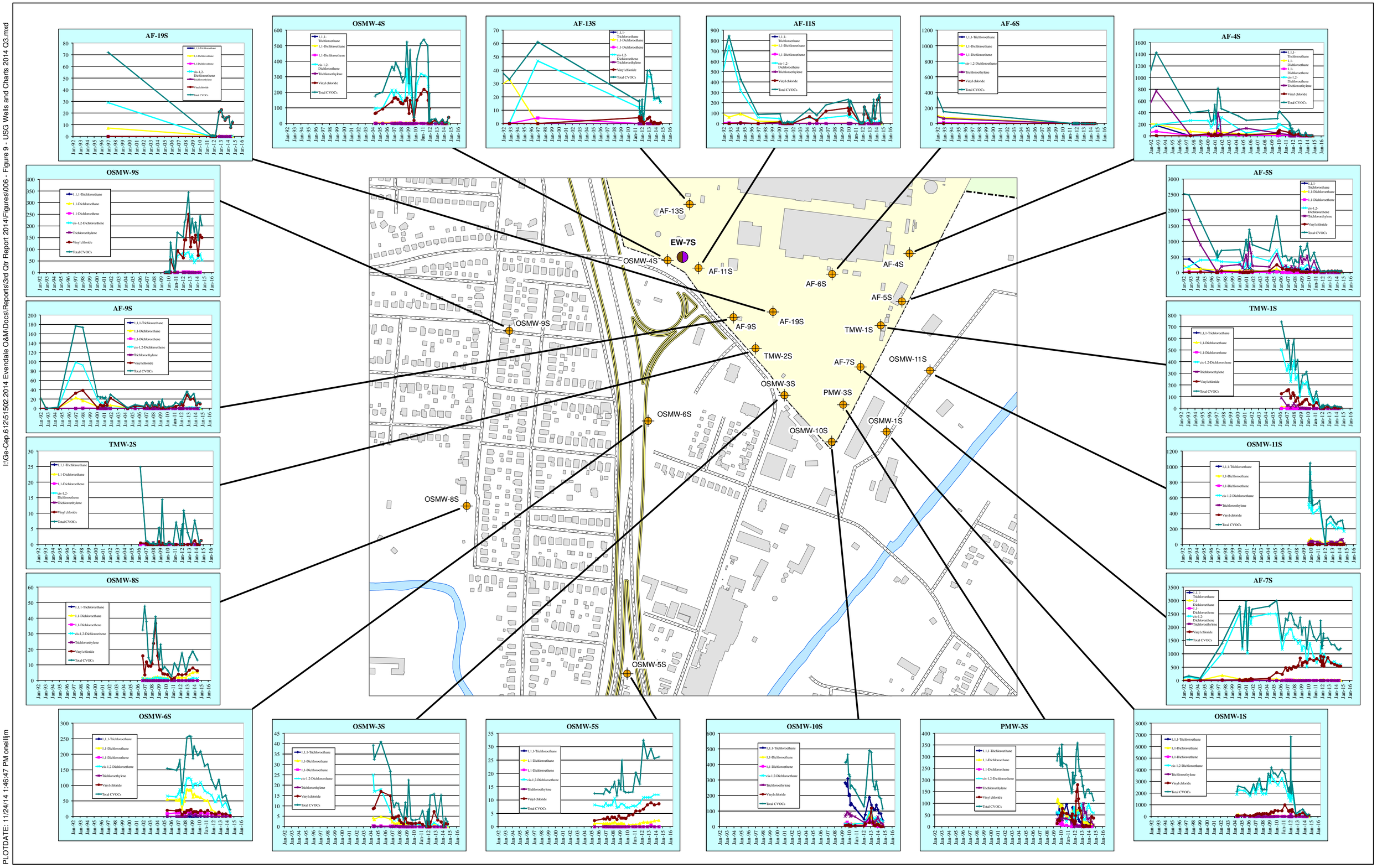

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FIGURE 9

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EVENDALE, OHIO

LEGEND

USG MONITORING WELL - GROUNDWATER SAMPLE COLLECTED FOR ANALYTICAL ANALYSIS

USG EXTRACTION WELL

GRAPH KEY

- 1,1,1-TRICHLOROETHANE
- 1,1-DICHLOROETHANE
- 1,1-DICHLOROETHENE
- CIS-1,2-DICHLOROETHENE
- TRICHLOROETHYLENE
- VINYL CHLORIDE
- TOTAL CVOCS

NOTES:
1. RESULTS ARE SHOWN IN ug/l.
2. NON-DETECTED RESULTS ARE SHOWN AT THE X AXIS.
3. CONCENTRATION SCALE MAY VARY BY GRAPH.

UPPER SAND AND GRAVEL HISTORICAL GROUNDWATER ANALYTICAL RESULTS FOR IRM MONITORING WELLS

N

0 250 500 1,000
Feet

OCTOBER 2014
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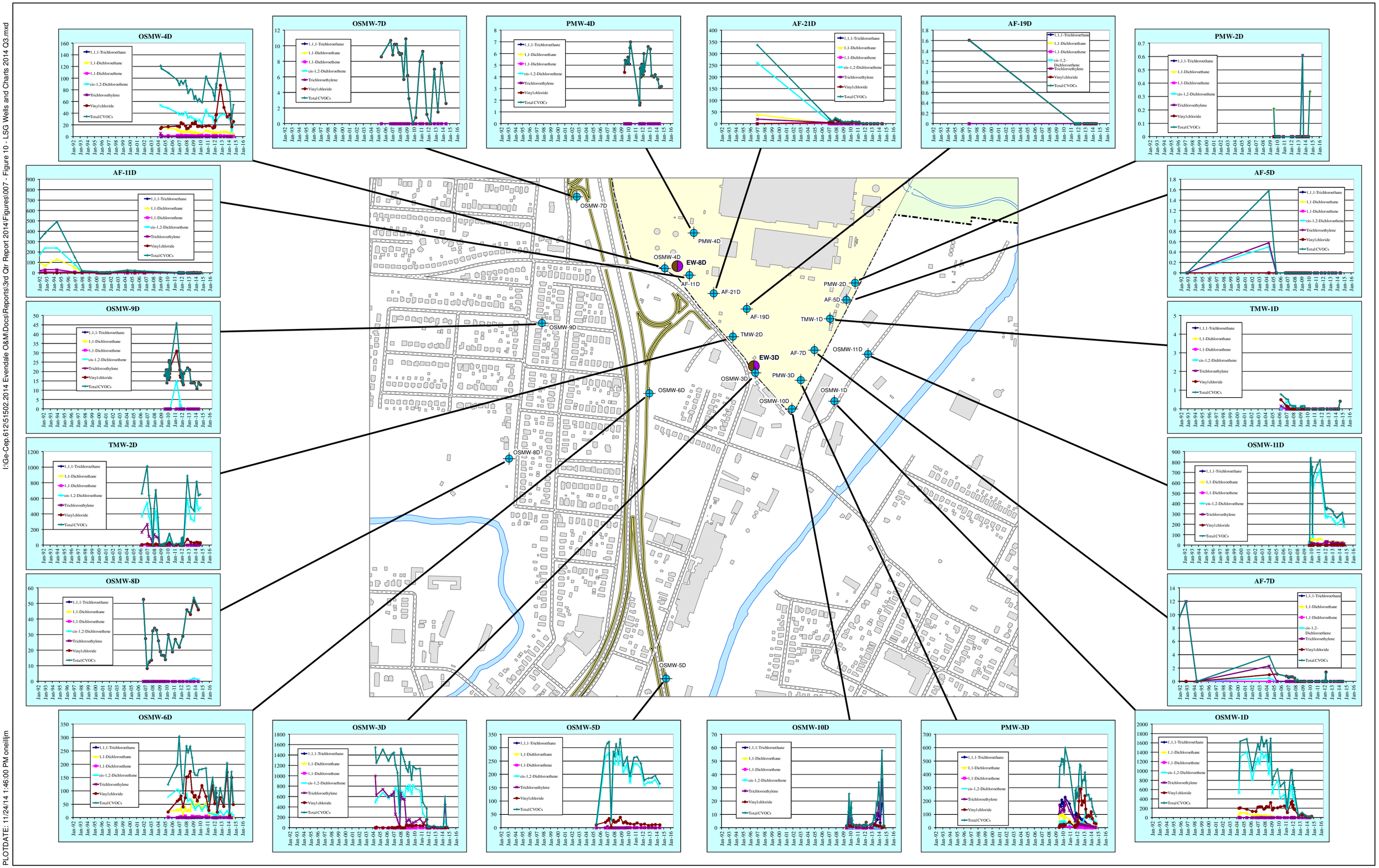

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FIGURE 10

GE
EVENDALE, OHIO

LEGEND

- LSG MONITORING WELL - GROUNDWATER SAMPLE COLLECTED FOR ANALYTICAL ANALYSIS
- LSG EXTRACTION WELL

GRAPH KEY

- 1,1,1-TRICHLOROETHANE
- 1,1-DICHLOROETHANE
- 1,1-DICHLOROETHENE
- CIS-1,2-DICHLOROETHENE
- TRICHLOROETHYLENE
- VINYL CHLORIDE
- TOTAL CVOCS

NOTES:
1. RESULTS ARE SHOWN IN ug/L
2. NON-DETECTED RESULTS ARE SHOWN AT THE X AXIS.
3. CONCENTRATION SCALE MAY VARY BY GRAPH.

LOWER SAND AND GRAVEL HISTORICAL GROUNDWATER ANALYTICAL RESULTS FOR IRM MONITORING WELLS

N

0 250 500 1,000
Feet

OCTOBER 2014
612/51502-007

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