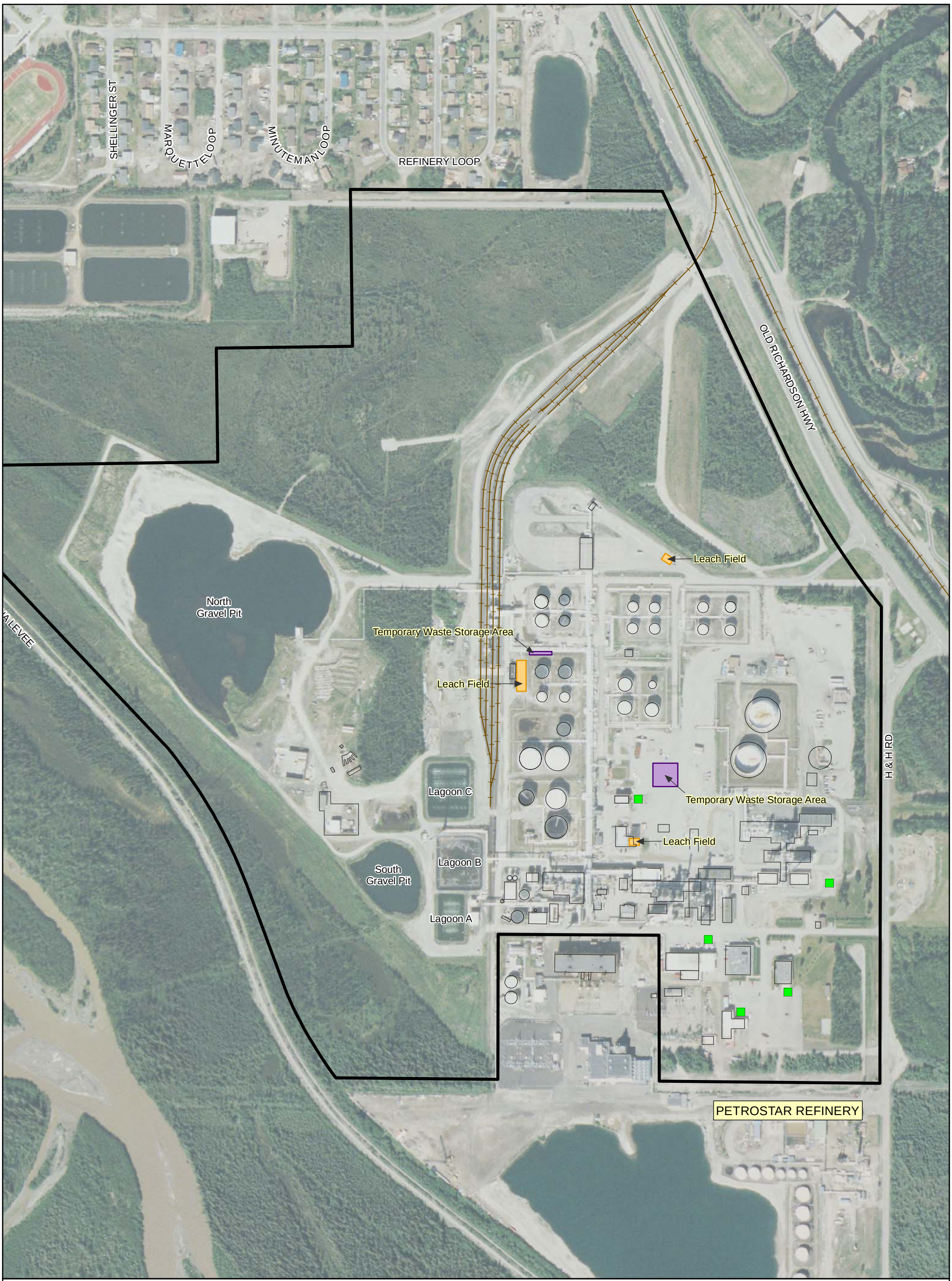


UST

Domestic Wastewater Leach Field

Temporary Waste Storage Area

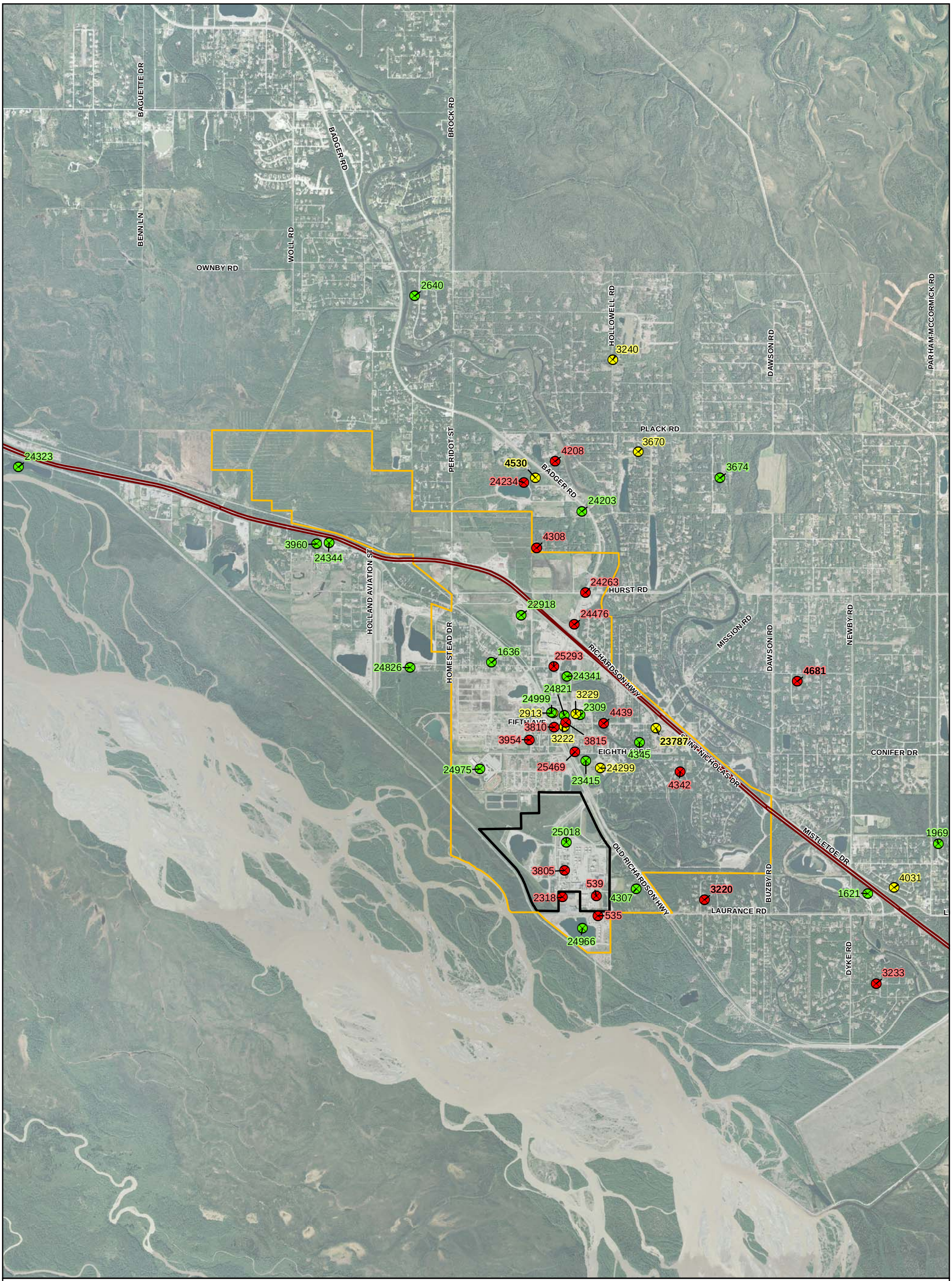
FHRA Property Boundary

Note: Additional domestic wastewater leach fields are present at the Firehouse and Construction Office (abandoned).

0 200 400 800

Feet

Figure 29
USTs, SEPTIC LEACH FIELDS, WASTE STORAGE AREAS
North Pole Refinery
Flint Hills Resources Alaska, LLC



ADEC Contaminated Sites

- Active
- Cleanup Complete
- Cleanup Complete - Institutional Controls
- FHRA Property Boundary
- North Pole City Boundary

N

0 1,500 3,000 6,000

Feet

Figure 30
ADEC CONTAMINATED SITES
IN THE AREA OF THE FHRA
North Pole Refinery
Flint Hills Resources Alaska, LLC

Cross-Section Locations

Monitoring Well Within 10 Feet of the Water Table

Monitoring Well 10 to 55 Feet Below the Water Table

Monitoring Well 55 to 90 Feet Below the Water Table

Monitoring Well 90 to 160 Feet Below the Water Table

CMT Wells, Multiple Screens

Observation Well Within 10 Feet of the Water Table

Recovery Well Within 10 Feet of the Water Table

FHRA Property Boundary

N

0 800 1,600 3,200

Feet

Figure 31
CROSS-SECTION LOCATIONS
North Pole Refinery
Flint Hills Resources Alaska, LLC

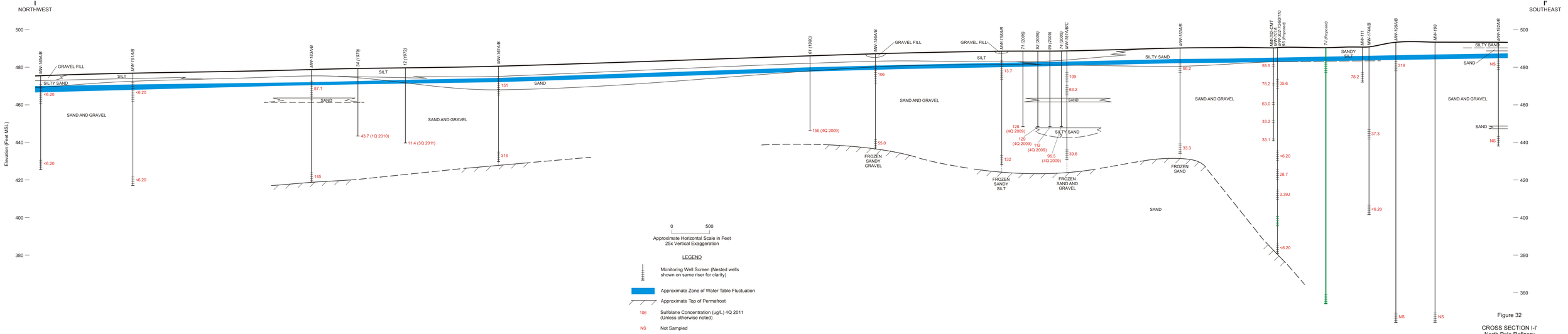


Figure 32

CROSS SECTION I-I'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Alaska\02-AK\01\0201100\1 North Pole Refinery Data Gap Investment\Plan\Graphics\2012 Cross Sections\Area Cross Section I-I' CDR RLG 03-016-12

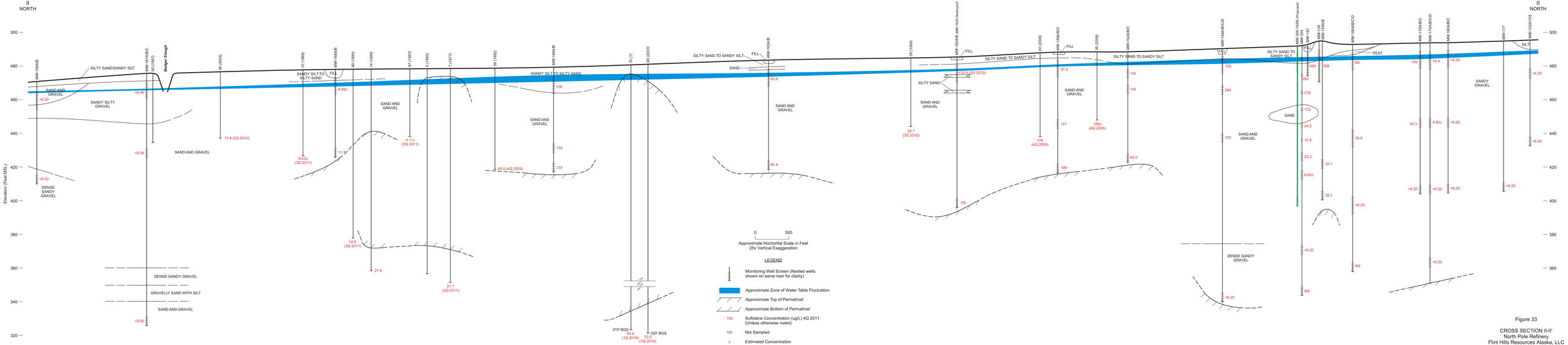
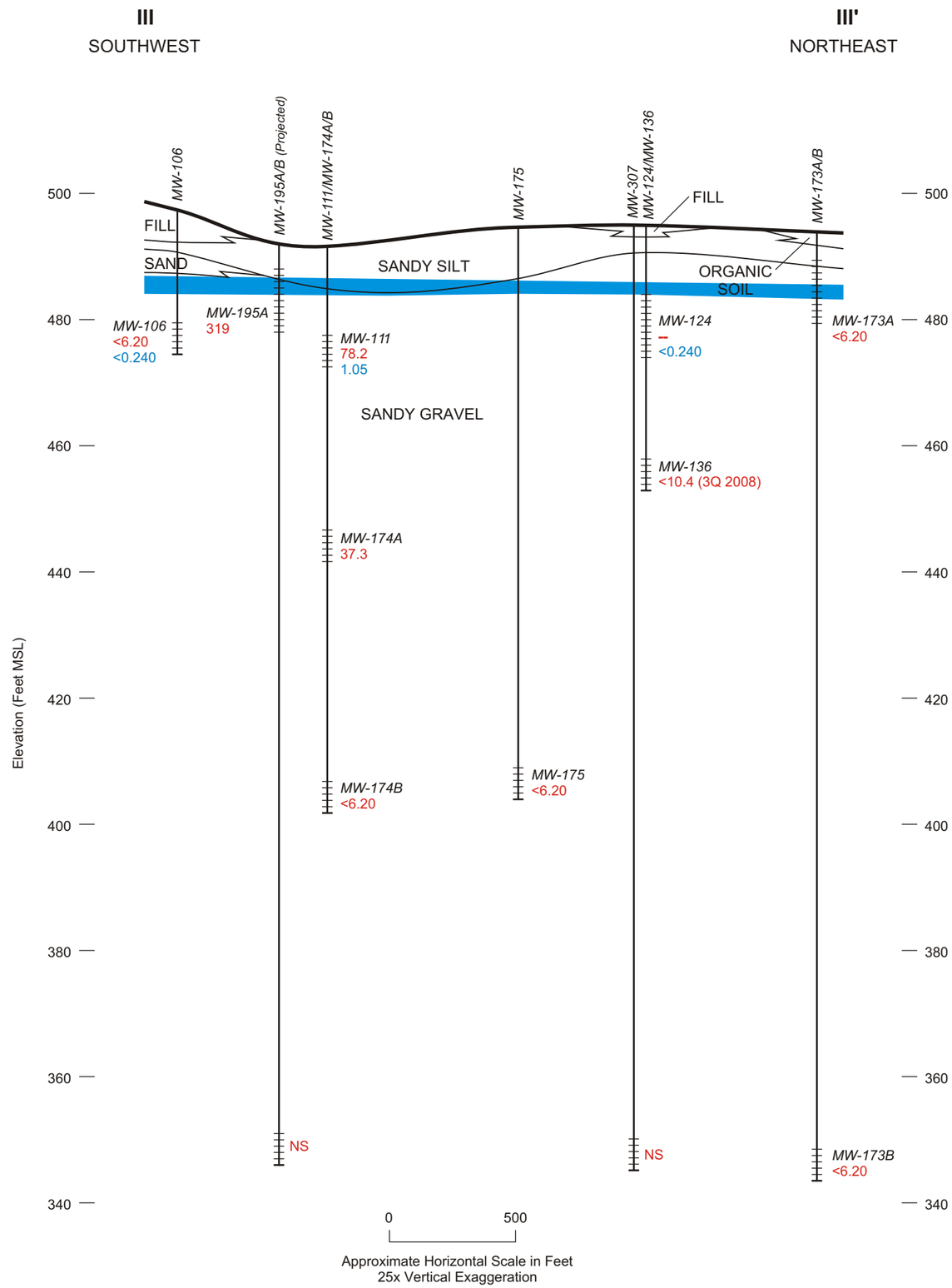


Figure 33

CROSS SECTION II-II'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Projects\AK\FHR\Refinery\Maps\Figures\2011 Cross Sections\Hydro Cross Sections II-II' CSR Rev 03 04-12



LEGEND

Monitoring Well Screen (Nested wells shown on same riser for clarity)

Approximate Zone of Water Table Fluctuations

Approximate Top of Permafrost

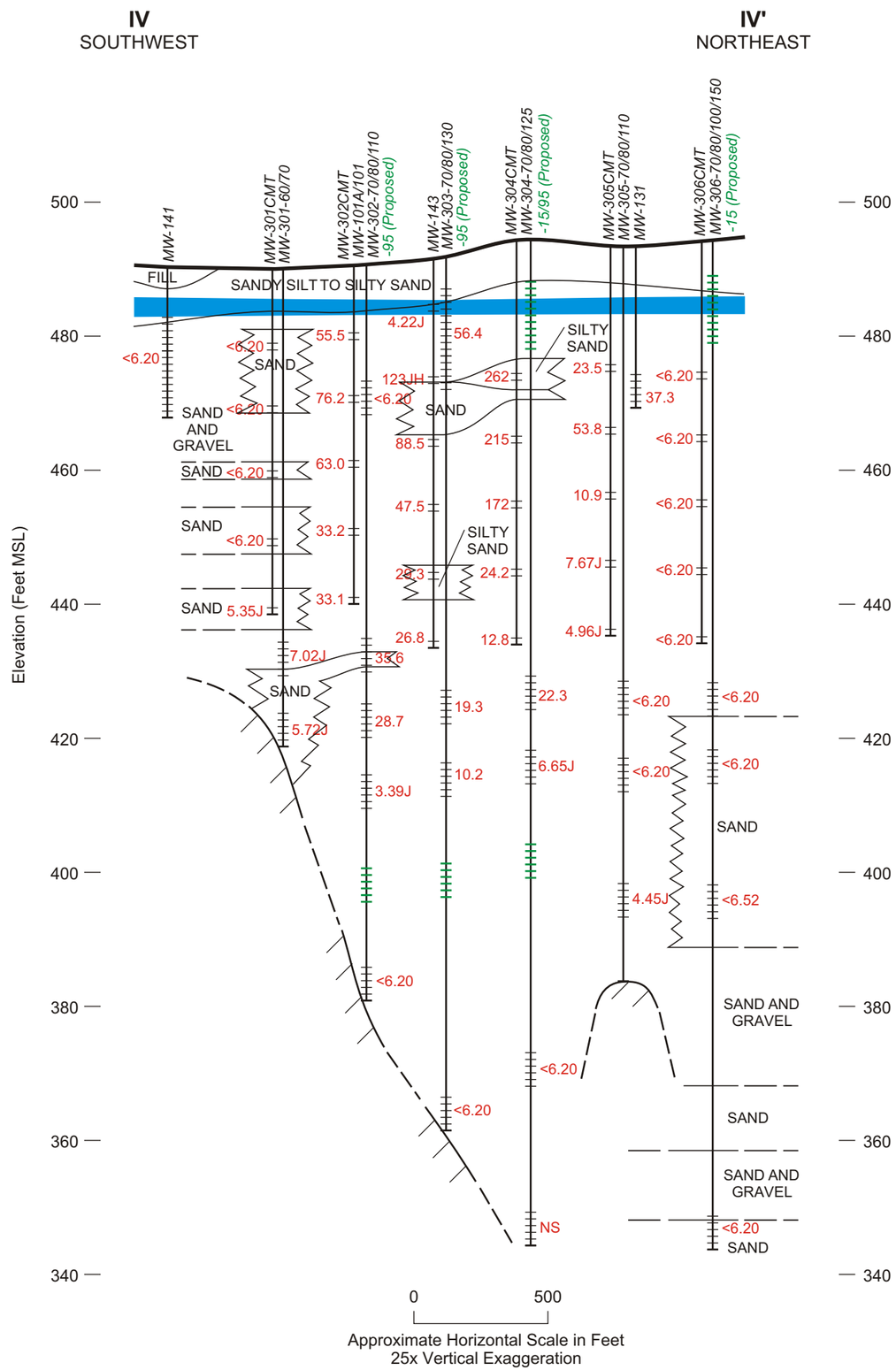
MW-139 — Well Name
312 — Fourth Quarter 2011 Sulfolane Concentration (ug/L)
46.8 — Fourth Quarter Benzene Concentration (ug/L)

NS — Not Sampled

Figure 34

CROSS SECTION III-III'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\02011001\WorkFiles\Workfiles\Graphics\Site Cross Section III-III'.CDR RLG 03-16-12



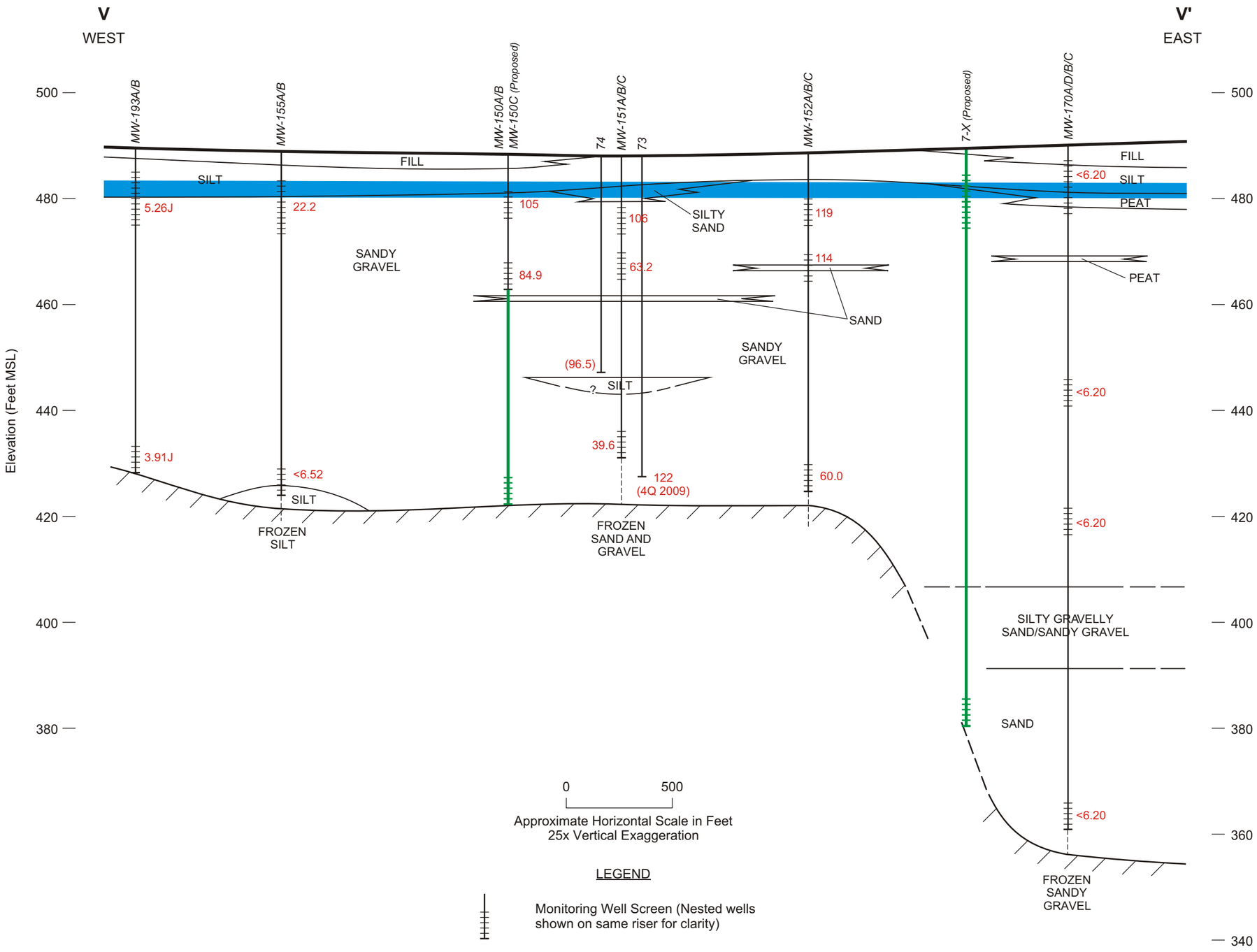
LEGEND

- Monitoring Well Screen (Nested wells shown on same riser for clarity)
- Approximate Zone of Water Table Fluctuation
- Approximate Top of Permafrost
- 262 — Sulfolane Concentration (ug/L) 4Q 2011
- J — Estimated Concentration
- JH — Estimated Results Biased High
- NS — Not Sampled

Figure 35

CROSS SECTION IV-IV'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\02011001\WorkFiles\Graphics\2012 Cross Sections\Cross Section IV-IV'.CDR RLG 03-16-12



0 500

Approximate Horizontal Scale in Feet
25x Vertical Exaggeration

LEGEND

Monitoring Well Screen (Nested wells shown on same riser for clarity)

Approximate Zone of Water Table Fluctuation

Approximate Top of Permafrost

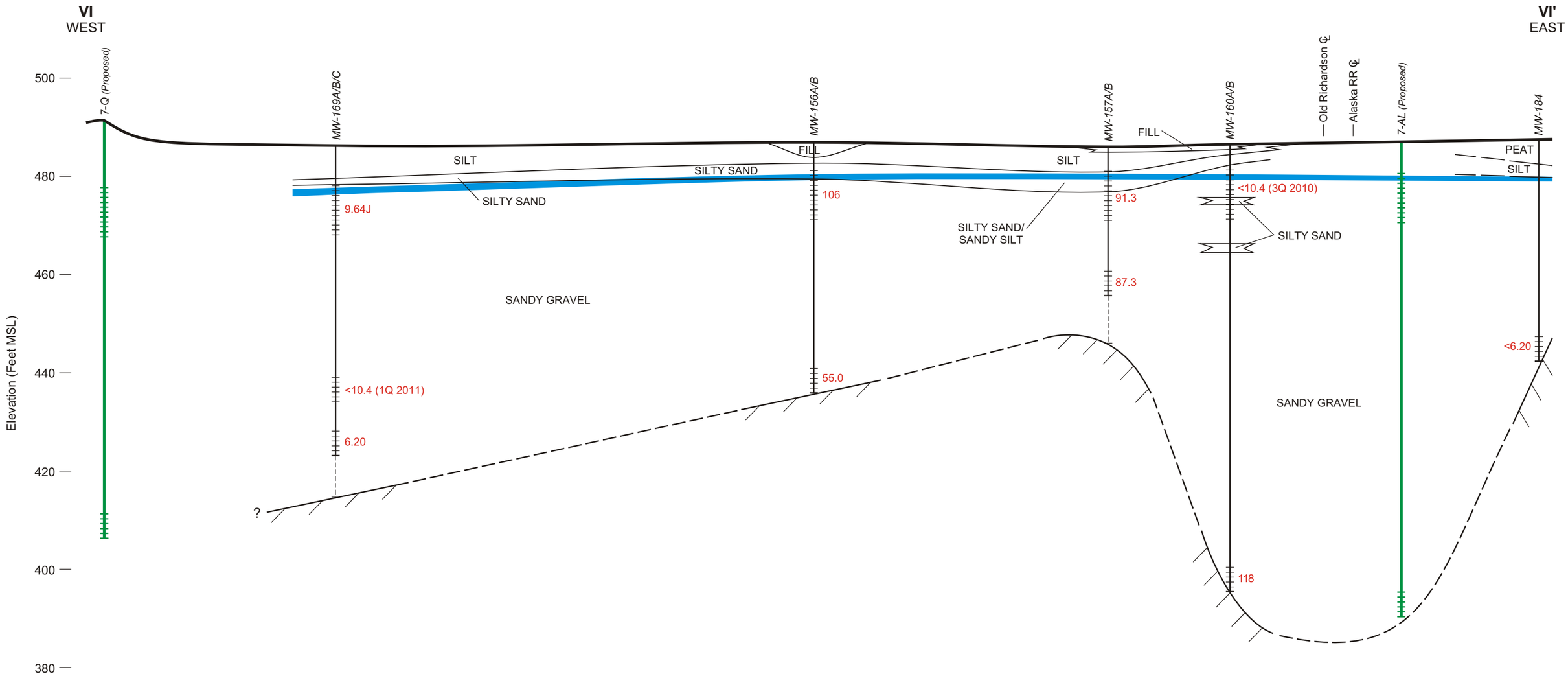
119 Sulfolane Concentration (ug/L) 4Q 2011 (Unless otherwise noted)

J Estimated Concentration

Figure 36

CROSS SECTION V-V'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\02011001\WorkFiles\Graphics\2012 Cross Sections\Area Cross Section V-V'.CDR RLG 03-16-12



0 500

Approximate Horizontal Scale in Feet
25x Vertical Exaggeration

LEGEND

Monitoring Well Screen (Nested wells shown on same riser for clarity)

Approximate Zone of Water Table Fluctuation

Approximate Top of Permafrost

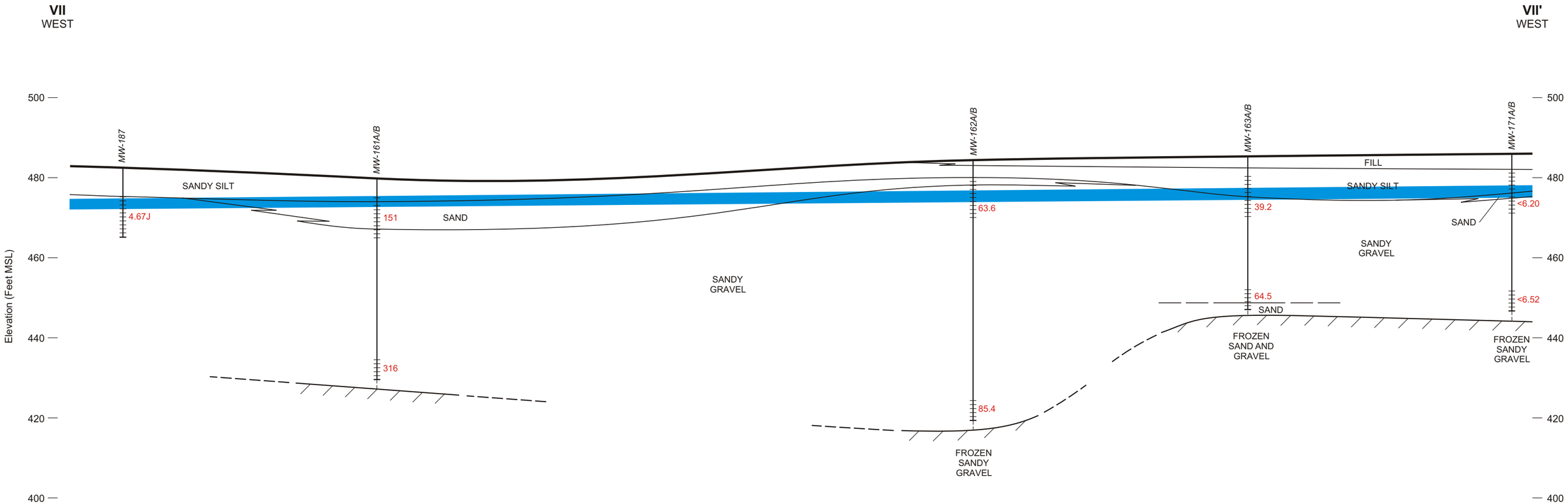
106 Sulfolane Concentration (ug/L) 4Q 2011 (Unless otherwise noted)

J Estimated Concentration

Figure 37

CROSS SECTION VI-VI'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\02011001\WorkFiles\Graphics\Cross Section Rossens.CDR RLG 03-16-12



LEGEND

Monitoring Well Screen (Nested wells shown on same riser for clarity)

Approximate Zone of Water Table Fluctuation

Approximate Top of Permafrost

316 Sulfolane Concentration (ug/L) 4Q 2011 (Unless otherwise noted)

J Estimated Concentration

Figure 38

CROSS SECTION VII-VII'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\2011001\WorkFiles\Graphics\2012 Cross Sections\Area Cross Section VII-VII'.CDR RLG-03-16-12

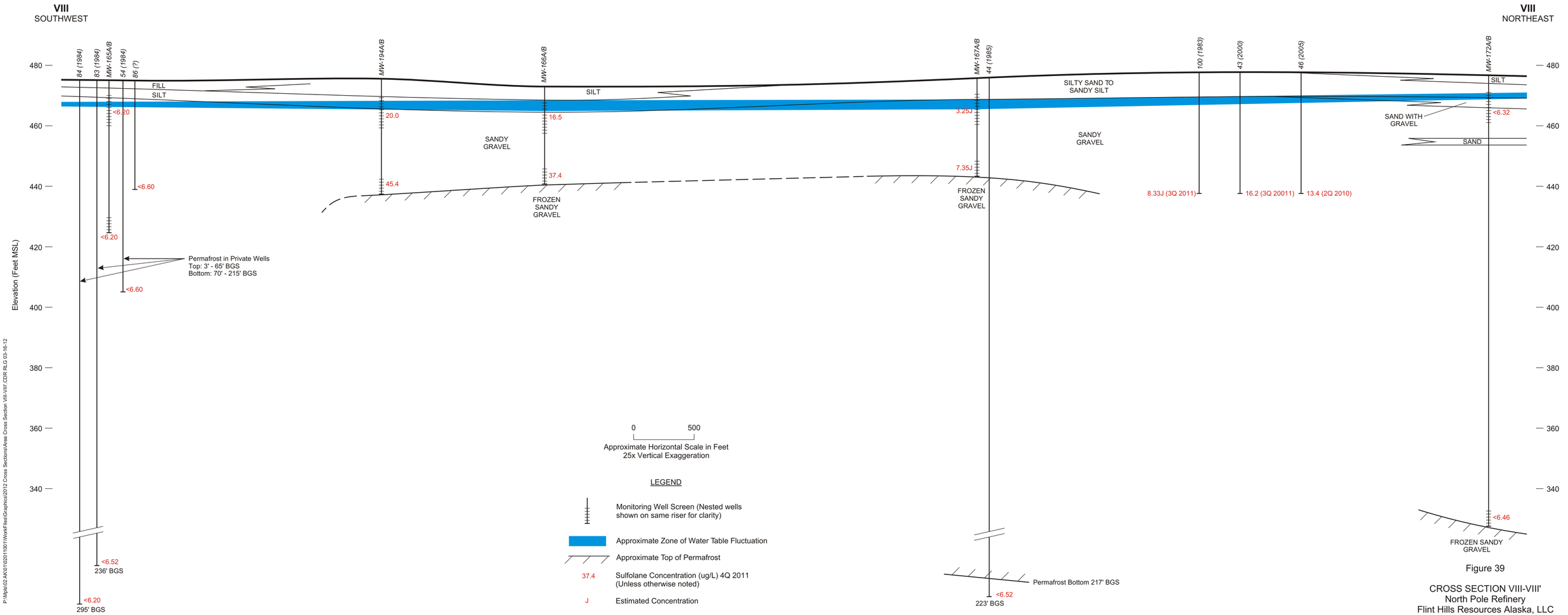
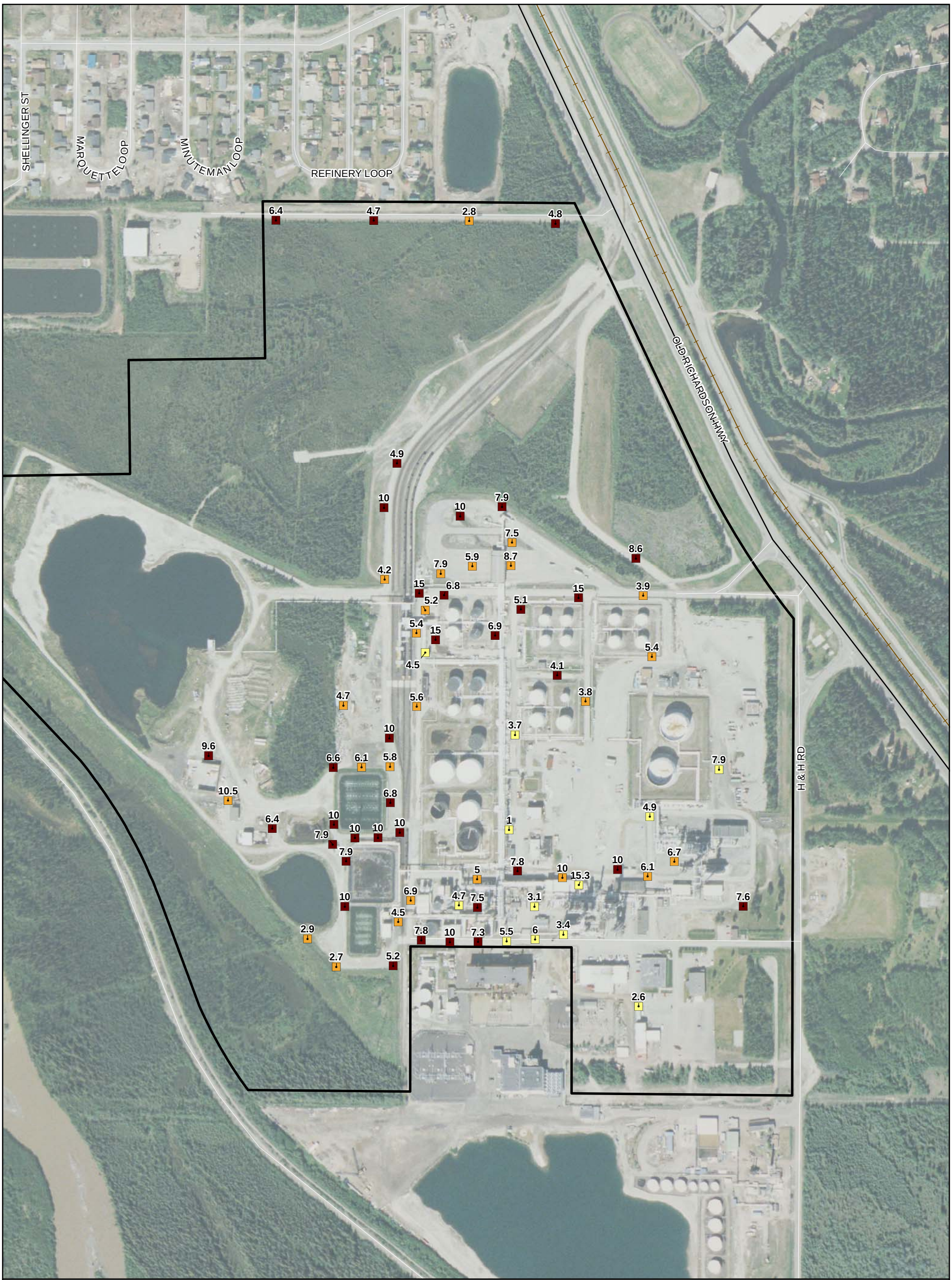


Figure 39

CROSS SECTION VIII-VIII'
North Pole Refinery
Flint Hills Resources Alaska, LLC

P:\Mpls\02 AK\01\2011001\WorkFiles\Graphics\2012 Cross Sections\Area Cross Section VIII-VIII'.CDR RLG 03-16-12



Silt Thickness at Soil Borings

- 0 - 2 feet
- 2 - 4 feet
- Greater than 4 feet
- FHRA Property Boundary

Number in boring location marker is depth (ft) to contact between fine-grained soil and gravel.

0 200 400 800
Feet

Figure 40
SILT THICKNESS
North Pole Refinery
Flint Hills Resources Alaska, LLC

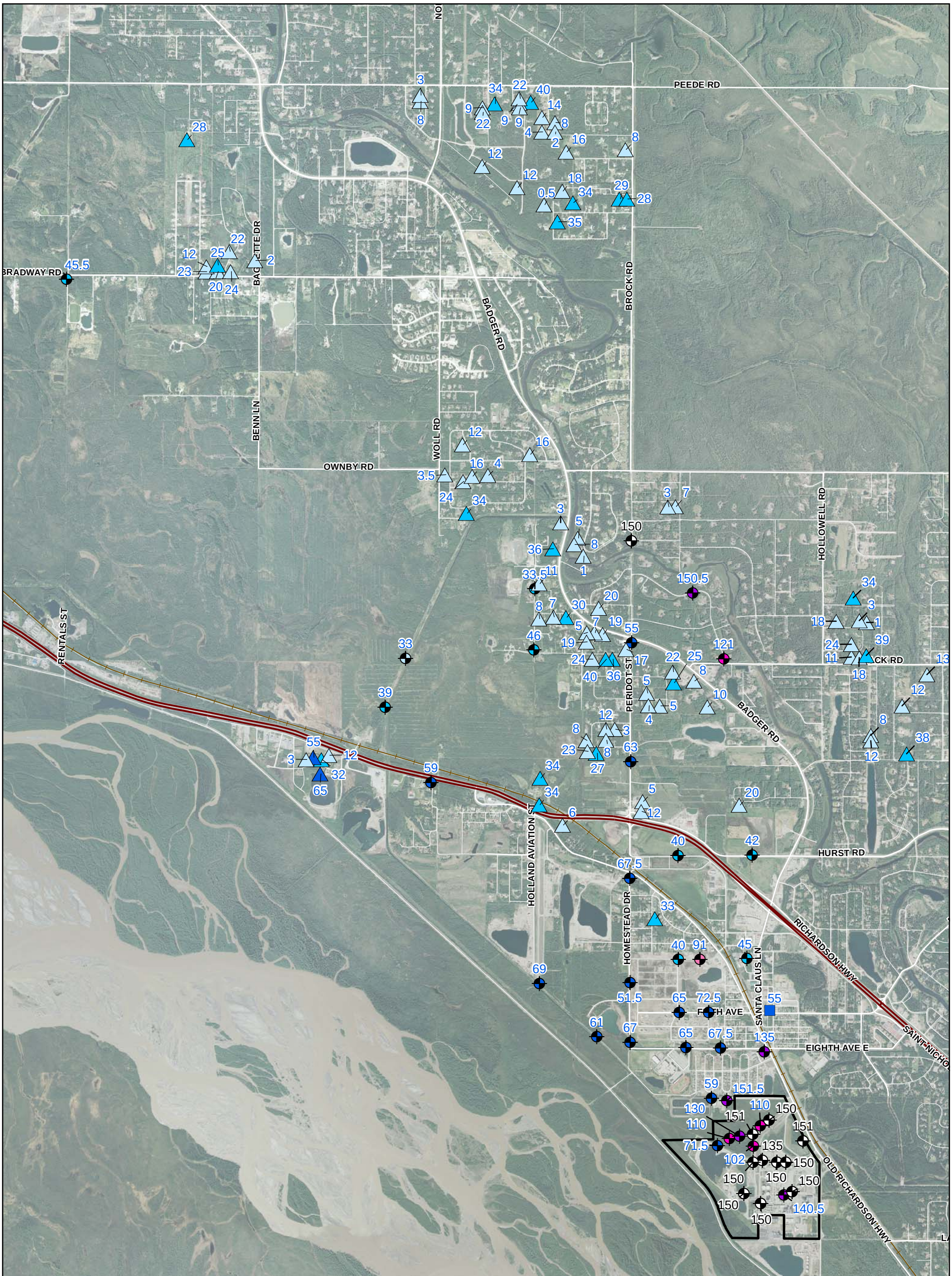
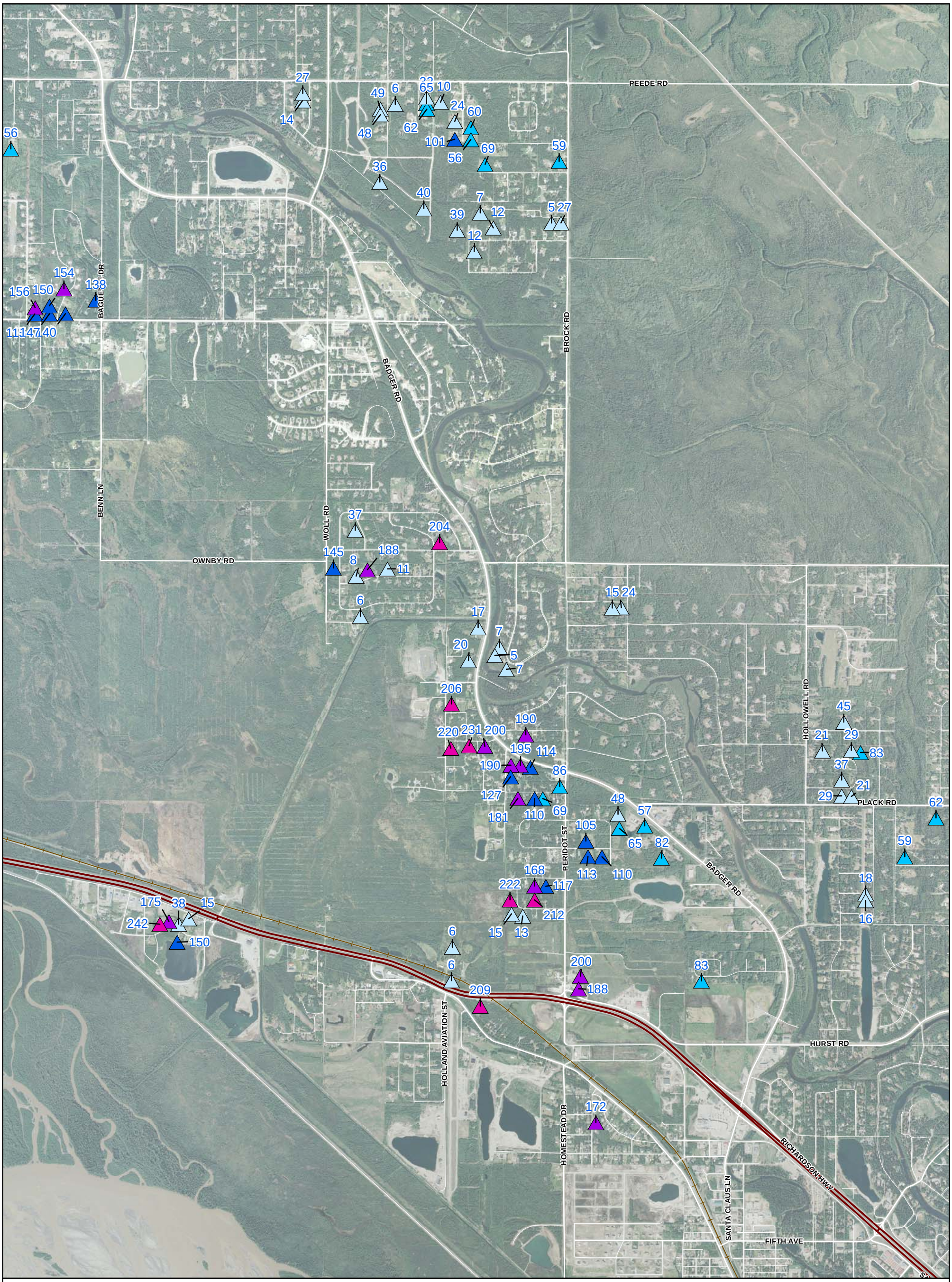


Figure 41
DEPTH TO TOP OF PERMAFROST
North Pole Refinery
Flint Hills Resources Alaska, LLC



Permafrost Thickness

- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250

0 1,000 2,000 4,000
Feet

Figure 42
PERMAFROST THICKNESS
North Pole Refinery
Flint Hills Resources Alaska, LLC

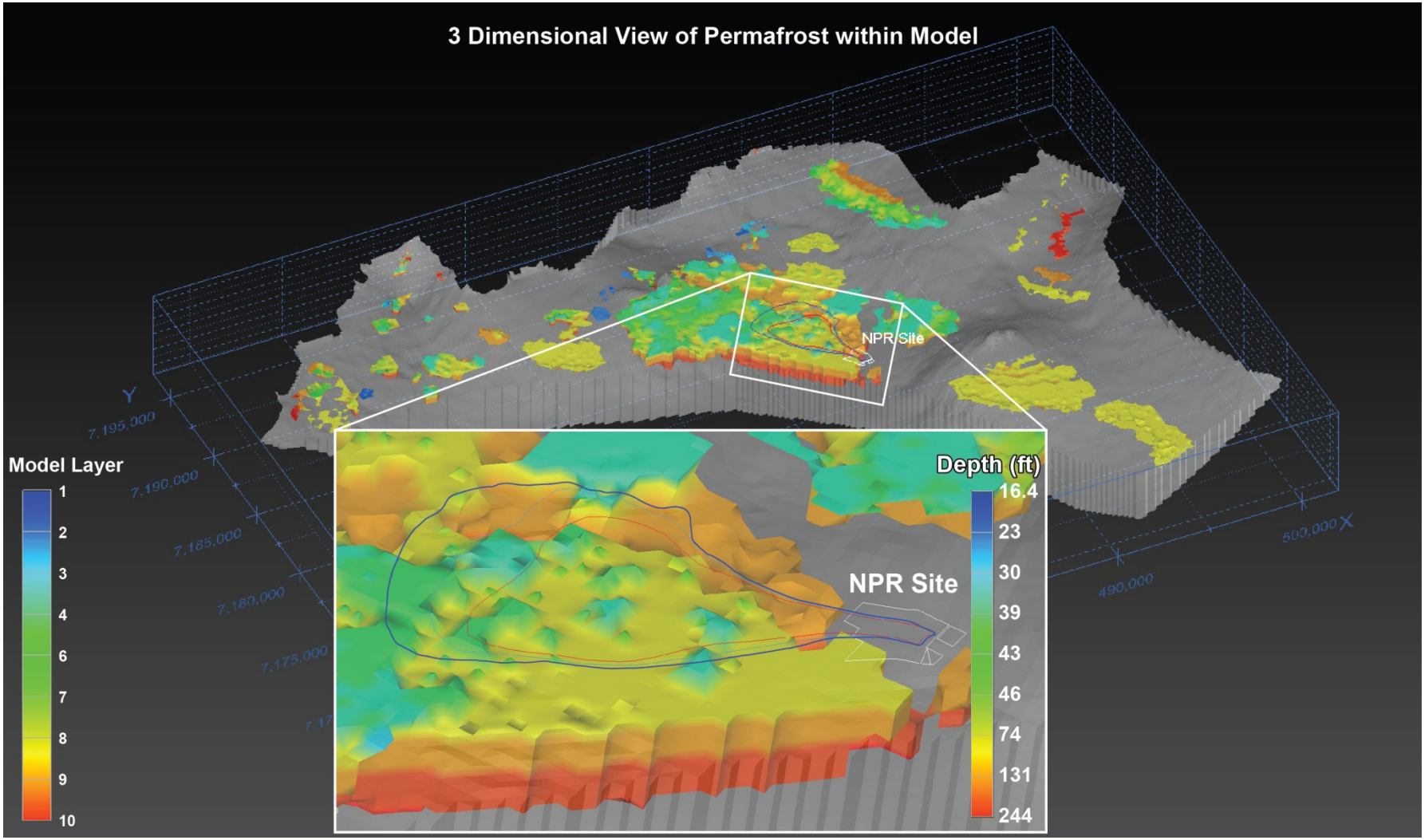


Figure 43
THREE-DIMENSIONAL REPRESENTATION OF PERMAFROST IN THE STUDY AREA
North Pole Refinery
Flint Hills Resources Alaska, LLC

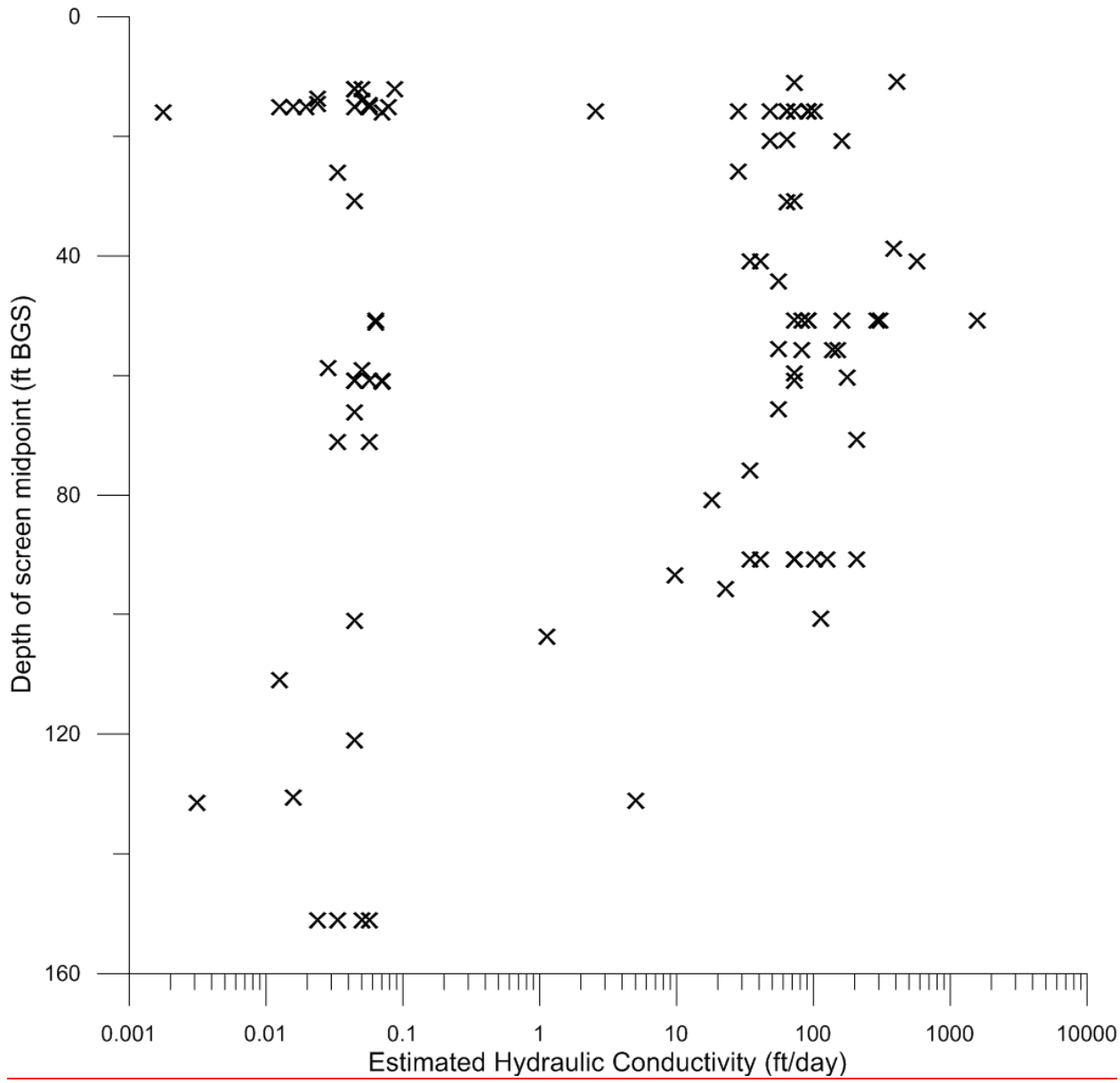
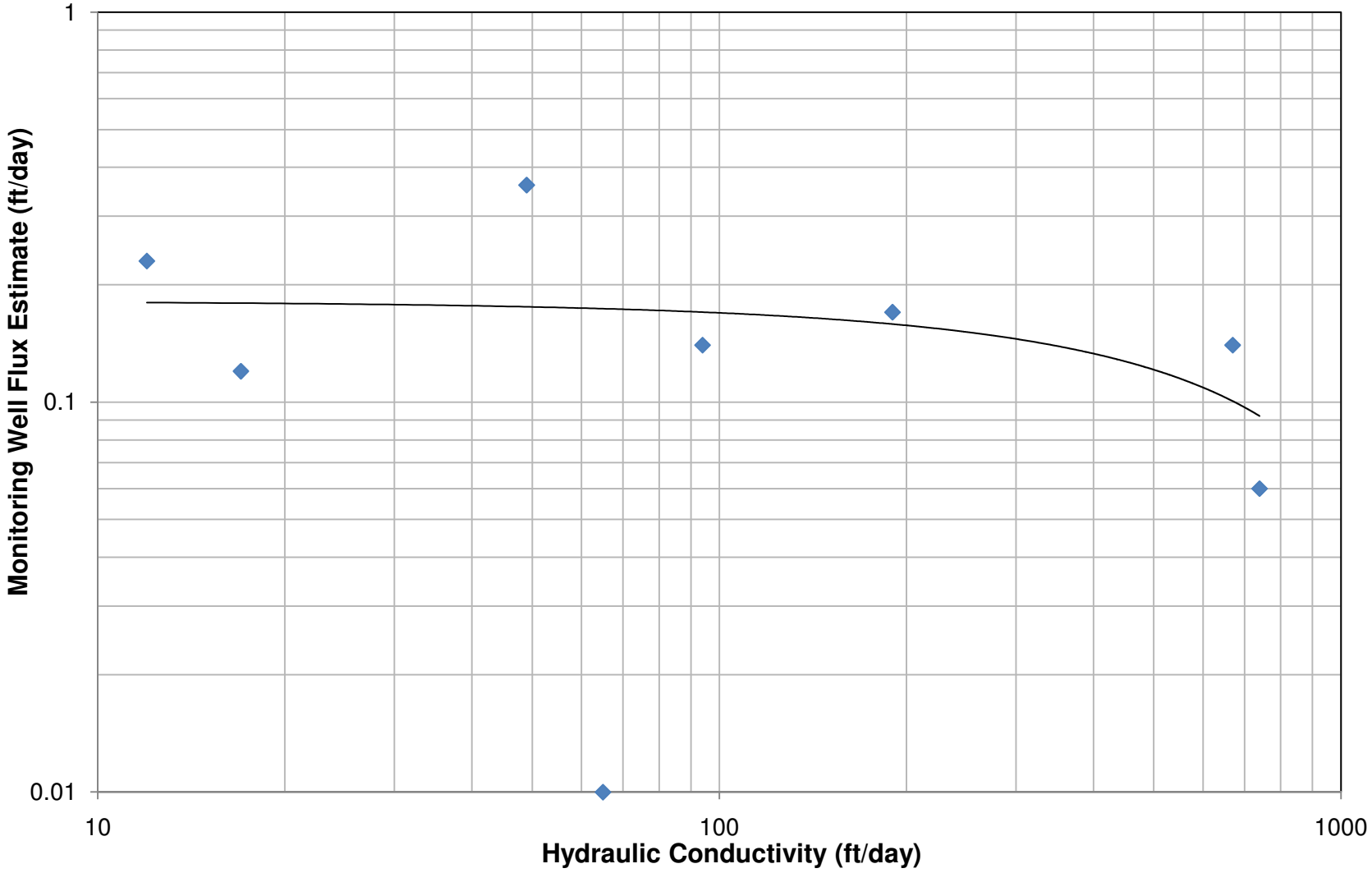


Figure 44
SCATTER PLOT OF ESTIMATED HYDRAULIC CONDUCTIVITY BASED ON GRAIN SIZE DISTRIBUTIONS
North Pole Refinery
Flint Hills Resources Alaska, LLC

Figure 45
Groundwater Flux vs. Single Well Pump Testing Hydraulic Conductivity Estimates
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Observation Well

Recovery Well

Production Wells

GVEA Injection Well (Approximate)

GVEA Production Well (Approximate)

FHRA Property Boundary

486.55 Groundwater Elevation (feet MSL)

Groundwater Elevation Contours

0 200 400 800

Feet

Figure 46
GROUNDWATER ELEVATIONS
AUGUST 17-21, 2009
North Pole Refinery
Flint Hills Resources Alaska, LLC

Figure 47
GROUNDWATER ELEVATION and LNAPL THICKNESS AT MW-138
North Pole Refinery
Flint Hills Resources Alaska, LLC

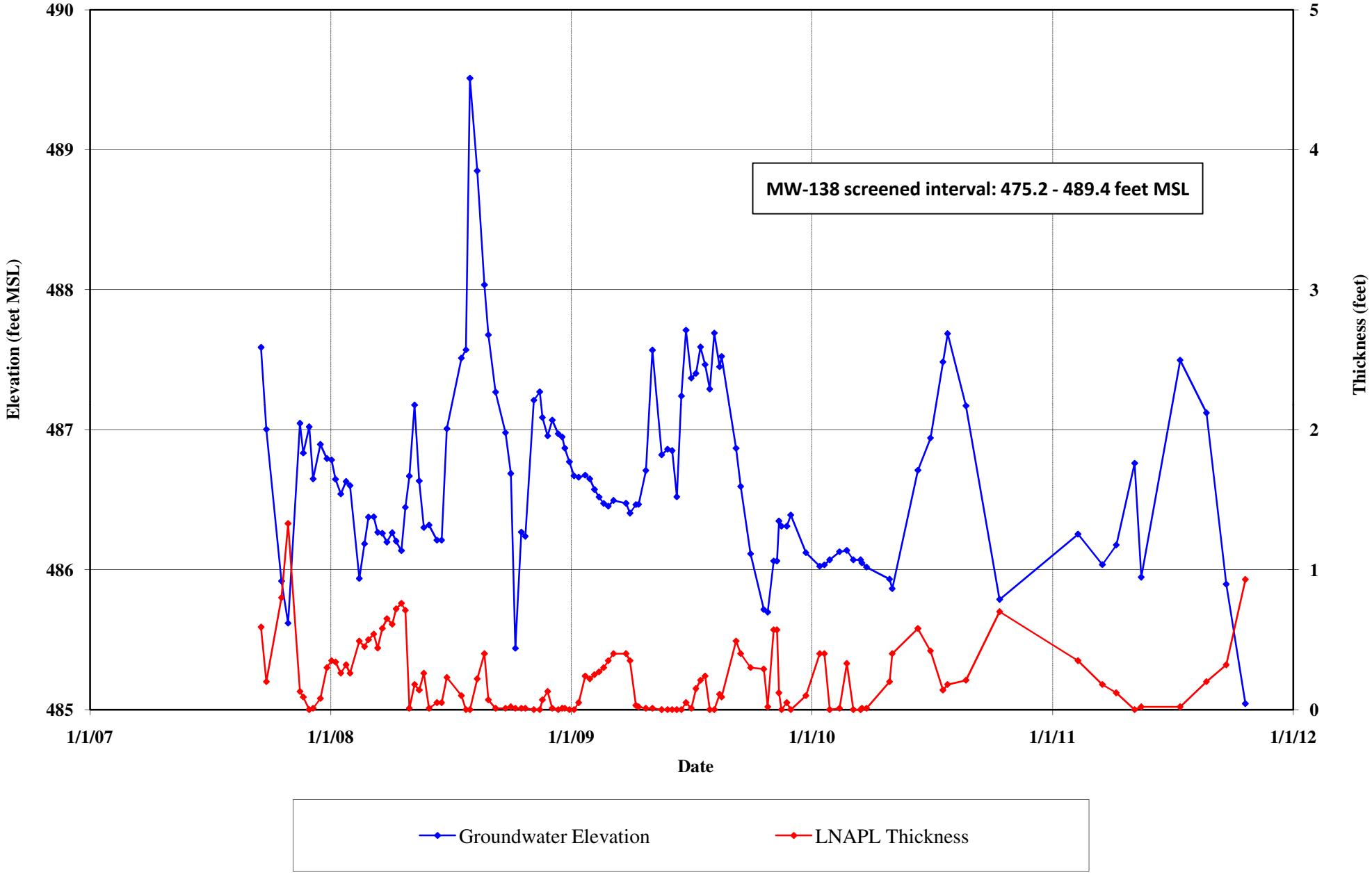
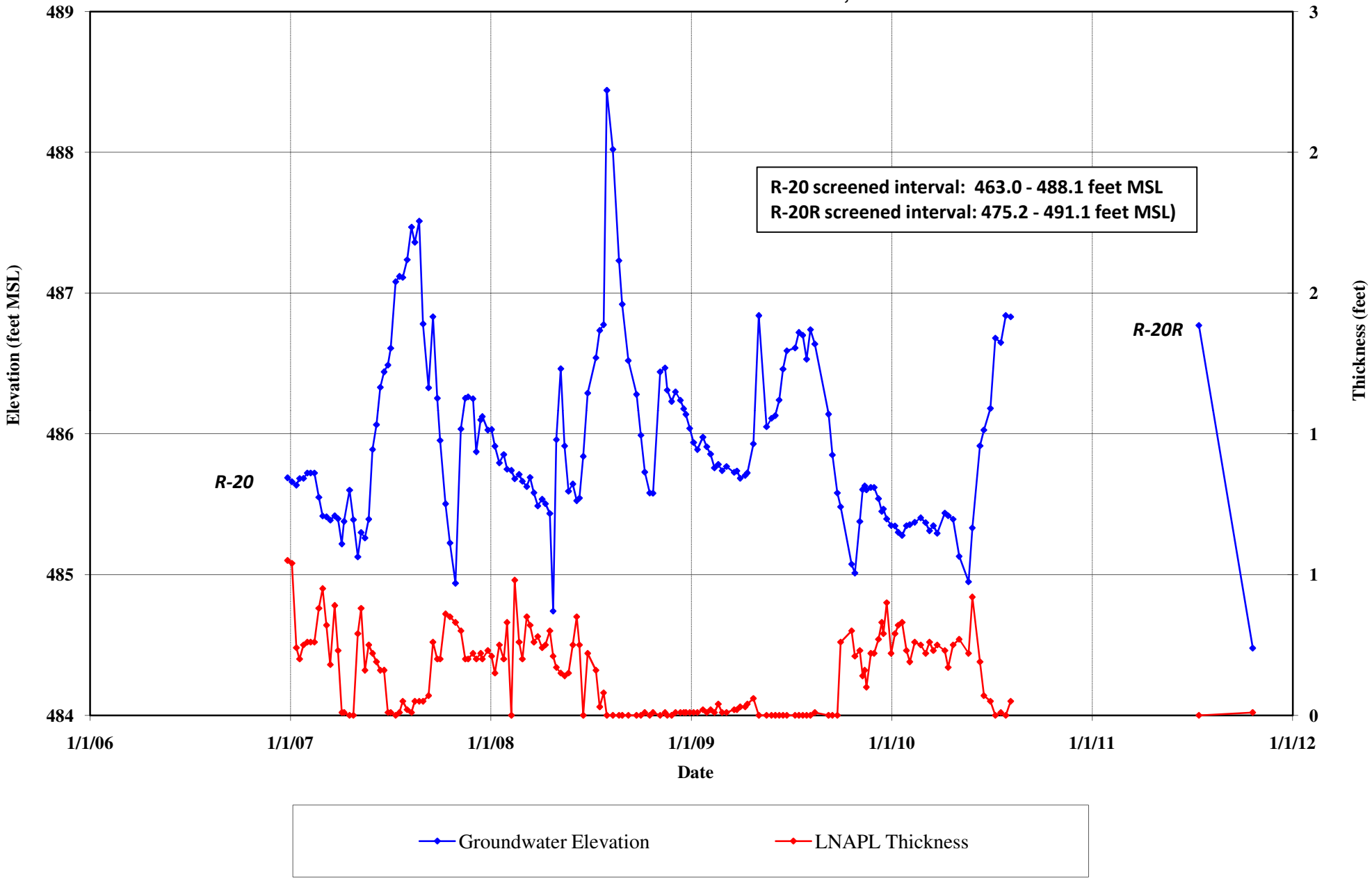
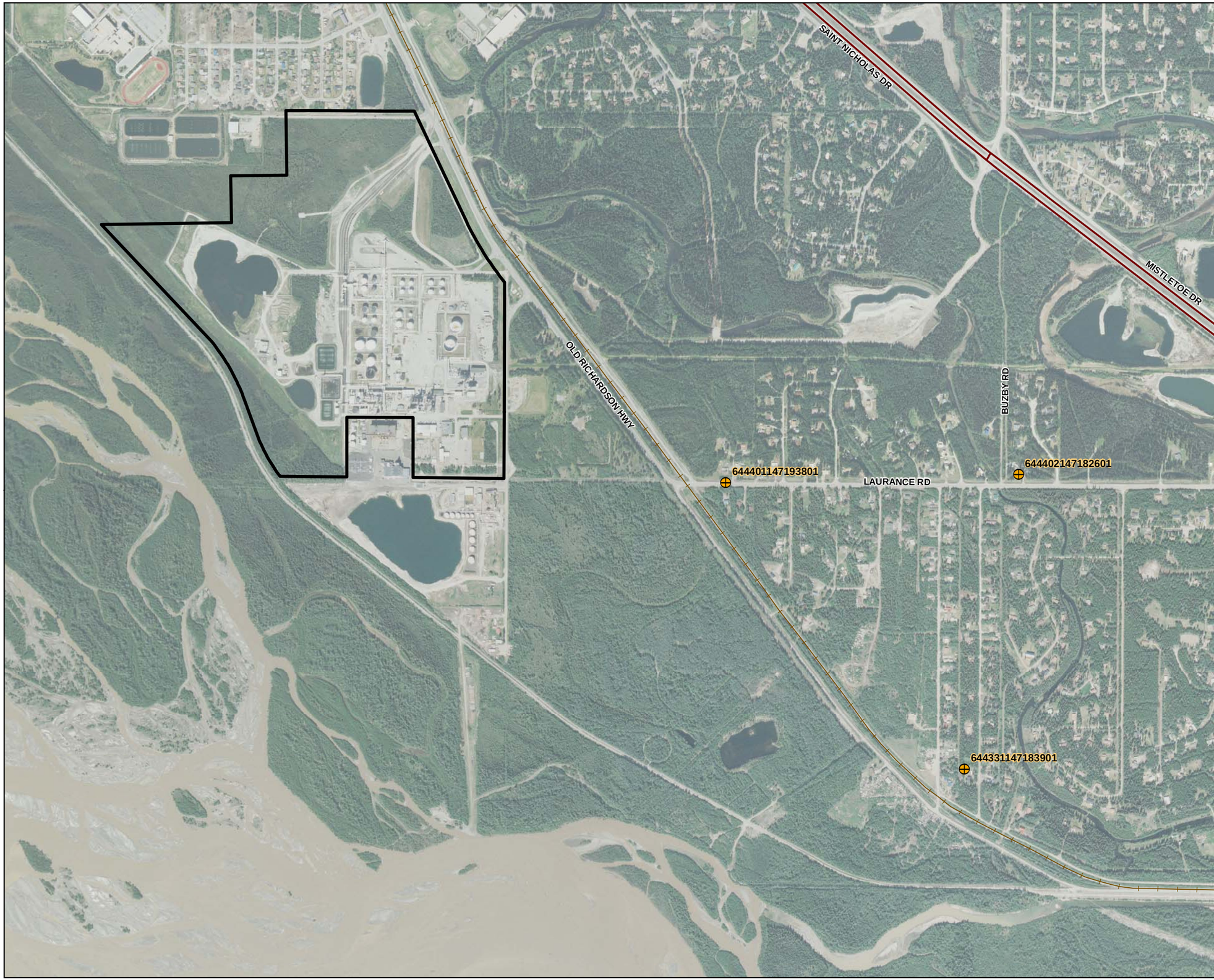


Figure 48
GROUNDWATER ELEVATION and LNAPL THICKNESS AT R-20 AND R-20R
North Pole Refinery
Flint Hills Resources Alaska, LLC





USGS Water Table Wells

FHRA Property Boundary

1,000 500 0 1,000

Feet

Figure 49
LOCATIONS OF USGS
WATER TABLE WELLS
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Groundwater Elevation Contours (Dashed Where Approximate)

FHRA Property Boundary

481 Groundwater Elevation (feet msl)

0 750 1,500 3,000

Feet

Figure 50
GROUNDWATER ELEVATIONS
AT THE WATER TABLE
MARCH 25, 2011
MANUAL MEASUREMENTS
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Groundwater Elevation Contours (Dashed Where Approximate)

FHRA Property Boundary

481 Groundwater Elevation (feet msl)

0 750 1,500 3,000

Feet

Figure 51
GROUNDWATER ELEVATIONS
AT THE WATER TABLE
MARCH 11, 2011
DATA LOGGER MEASUREMENTS
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Groundwater Elevation Contours (Dashed Where Approximate)

FHRA Property Boundary

481 Groundwater Elevation (feet msl)

0 750 1,500 3,000

Feet

Figure 52
GROUNDWATER ELEVATIONS
10-55' BELOW THE WATER TABLE
MARCH 11, 2011
DATA LOGGER MEASUREMENTS
North Pole Refinery
Flint Hills Resources Alaska, LLC