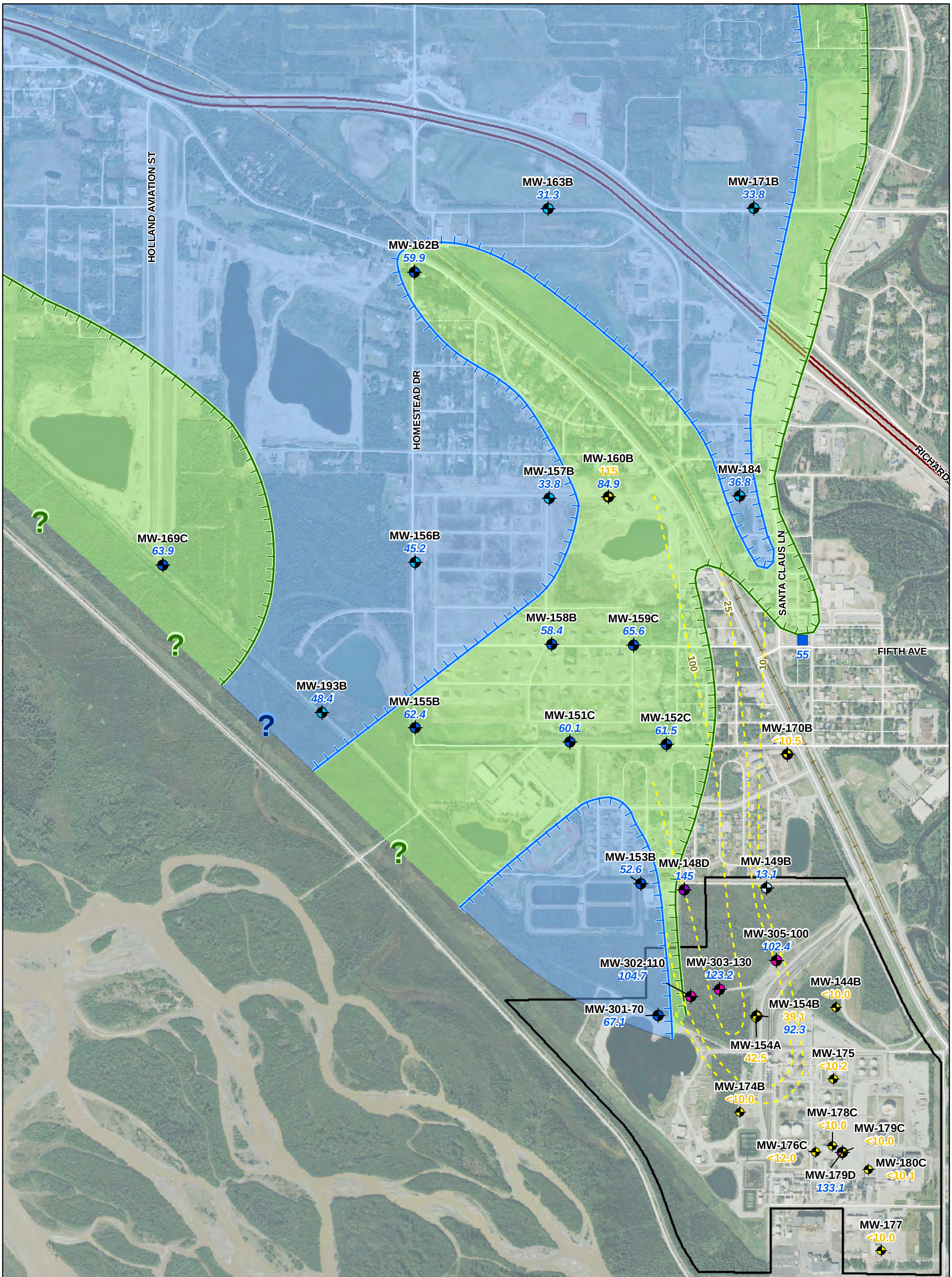


Figure 90
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
55-90' BELOW THE WATER TABLE
FOURTH QUARTER 2010
North Pole Refinery
Flint Hills Resources Alaska, LLC

MW-167B
25.8
MW-172B
<10.6
145.2
MW-168B
46.2
MW-182B
38.4
MW-166B
29.5
MW-185C
113.4
MW-194B
30.1
MW-164C
58.6
MW-183B
52.1
MW-163B
31.3
MW-171B
33.8
MW-162B
59.9
MW-160B
84.9
MW-184
36.8
MW-157B
33.8
MW-156B
45.2
MW-169C
63.9
MW-158B
58.4
MW-159C
65.6
MW-193B
48.4
MW-155B
62.4
MW-151C
60.1
MW-152C
61.5
MW-170C
<10.6
126.8
MW-148D
145
MW-149B
13.1
MW-153B
52.6
MW-305-100
102.4
MW-303-130
123.2
MW-301-70
67.1
MW-154B
92.3
MW-173B
<10.3
MW-302-110
104.7
MW-179D
133.1
55
?
HOLLAND AVIATION ST
HOMESTEAD DR
PERIDOT ST
SANTA CLAUS LN
HOLLOWELL RD
BADGER RD
HURST RD
RICHARDSON HWY
FIFTH AVE
EIGHTH AVE E
OLD RICHARDSON HWY

Monitoring Well
City Well
Depth To Permafrost (BWT)
FHRA Property Boundary
0 - 24.9 Ft
Aquifer Frozen at 55' Below the Water Table
25 - 49.9 Ft
Aquifer Frozen at 90' Below the Water Table
50 - 74.9 Ft
118 Sulfolane Concentration (µg/L)
75 - 99.9 Ft
59.0 Depth to Permafrost (feet BGS)
100 - 124.9 Ft
*Extent of aquifer frozen at 160' below the water table is unknown.
125 - 150 Ft

0 750 1,500 3,000
Feet

Figure 91
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
90-160' BELOW THE WATER TABLE
FOURTH QUARTER 2010
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

J Estimated value

JL Estimated value, biased low

NS Not Sampled

0 750 1,500 3,000

Feet

Figure 92
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
AT THE WATER TABLE
FIRST QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

J Estimated value

JL Estimated value, biased low

UJ The analyte was not reported above the limit of quantitation; however, the limit of quantitation is estimated because ice was observed in the sample.

NS Not Sampled

0 750 1,500 3,000

Feet

Figure 93
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
10-55' BELOW THE WATER TABLE
FIRST QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

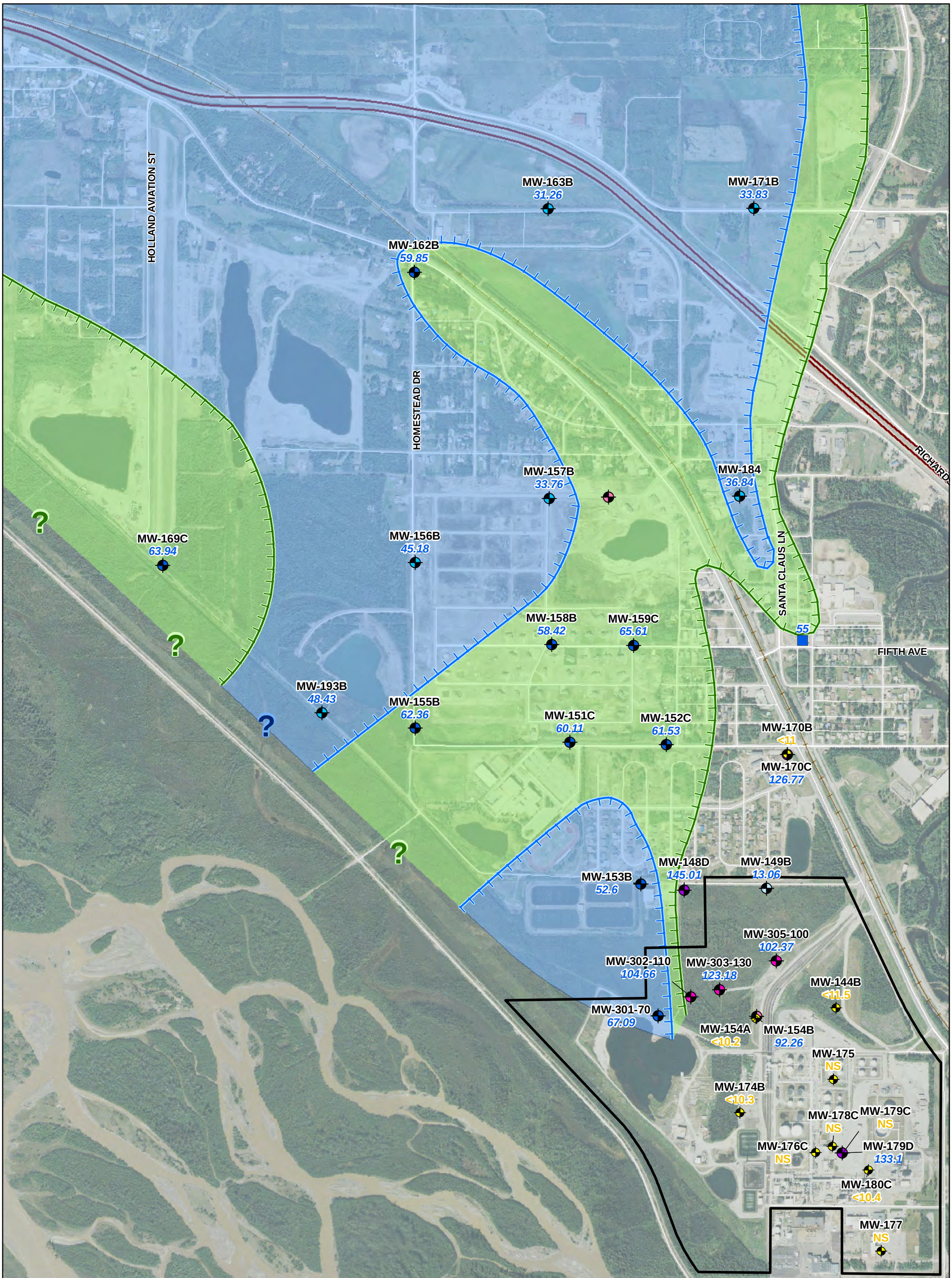
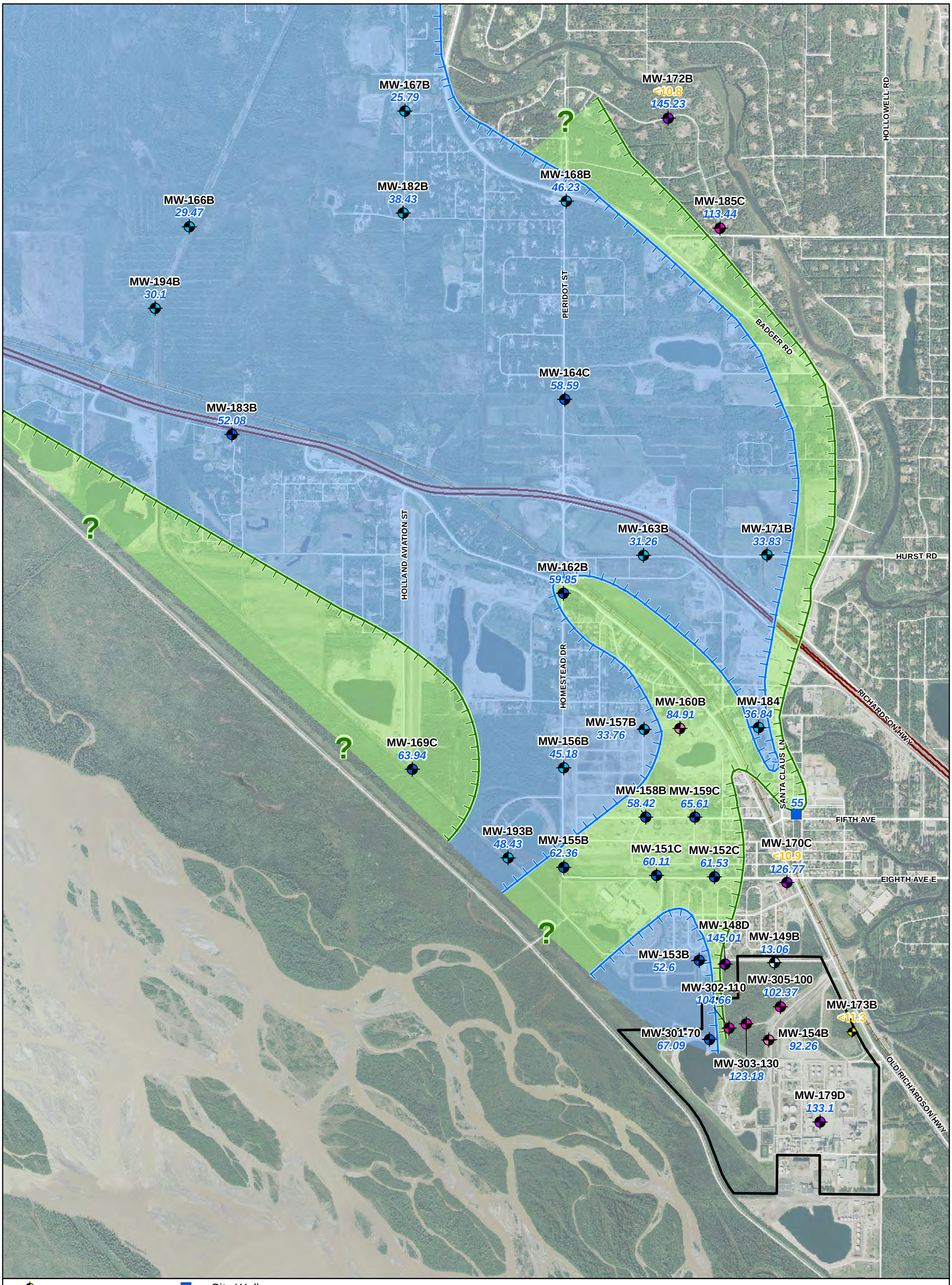


Figure 94
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
55-90' BELOW THE WATER TABLE
FIRST QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Depth to Permafrost (BWT)

- 0 - 24.9 Ft
- 25 - 49.9 Ft
- 50 - 74.9 Ft
- 75 - 99.9 Ft
- 100 - 124.9 Ft
- 125 - 149.9 Ft

City Well

FHRA Property Boundary

Aquifer Frozen at 55' Below the Water Table

Aquifer Frozen at 90' Below the Water Table

118 Sulfolane Concentration (µg/L)

59.0 Depth to Permafrost (feet BGS)

*Extent of aquifer frozen at 160' below the water table is unknown.

0 750 1,500 3,000

Feet

Figure 95
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
90-160' BELOW THE WATER TABLE
FIRST QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

NS Not Sampled

**Sulfolane was analyzed by EPA Method 1625B with Iso-dilution

0 750 1,500 3,000

Feet

Figure 96
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
AT THE WATER TABLE
SECOND QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

Monitoring Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

J Estimated value

JL Estimated value, biased low

UJ The analyte was not reported above the limit of quantitation; however, the limit of quantitationis estimated because ice was observed in the sample.

NS Not Sampled

**Sulfolane was analyzed by EPA Method 1625B with Iso-dilution

0 750 1,500 3,000

Feet

Figure 97
SULFOLANE CONCENTRATIONS IN GROUNDWATER
10-55' BELOW THE WATER TABLE
SECOND QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

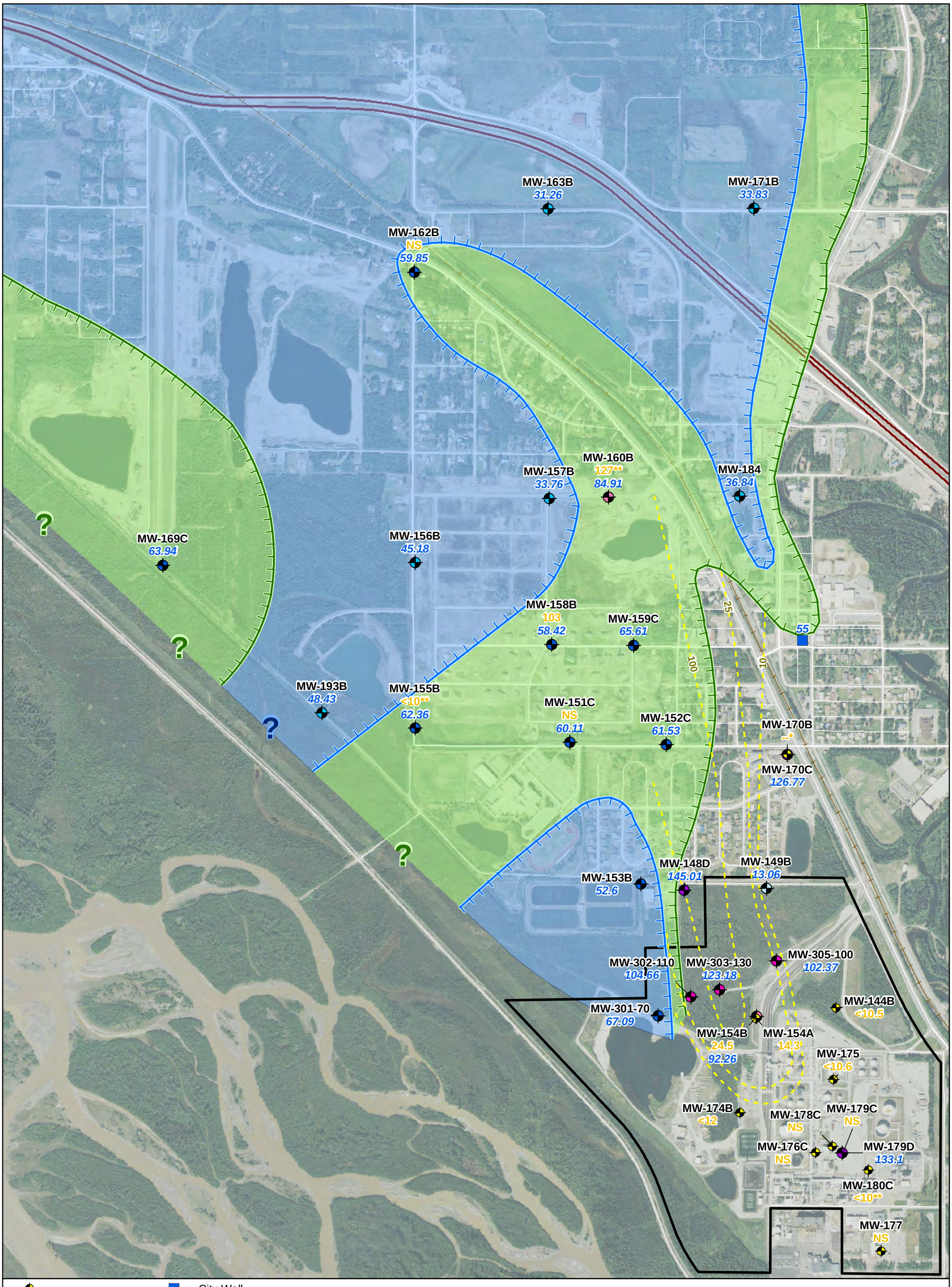
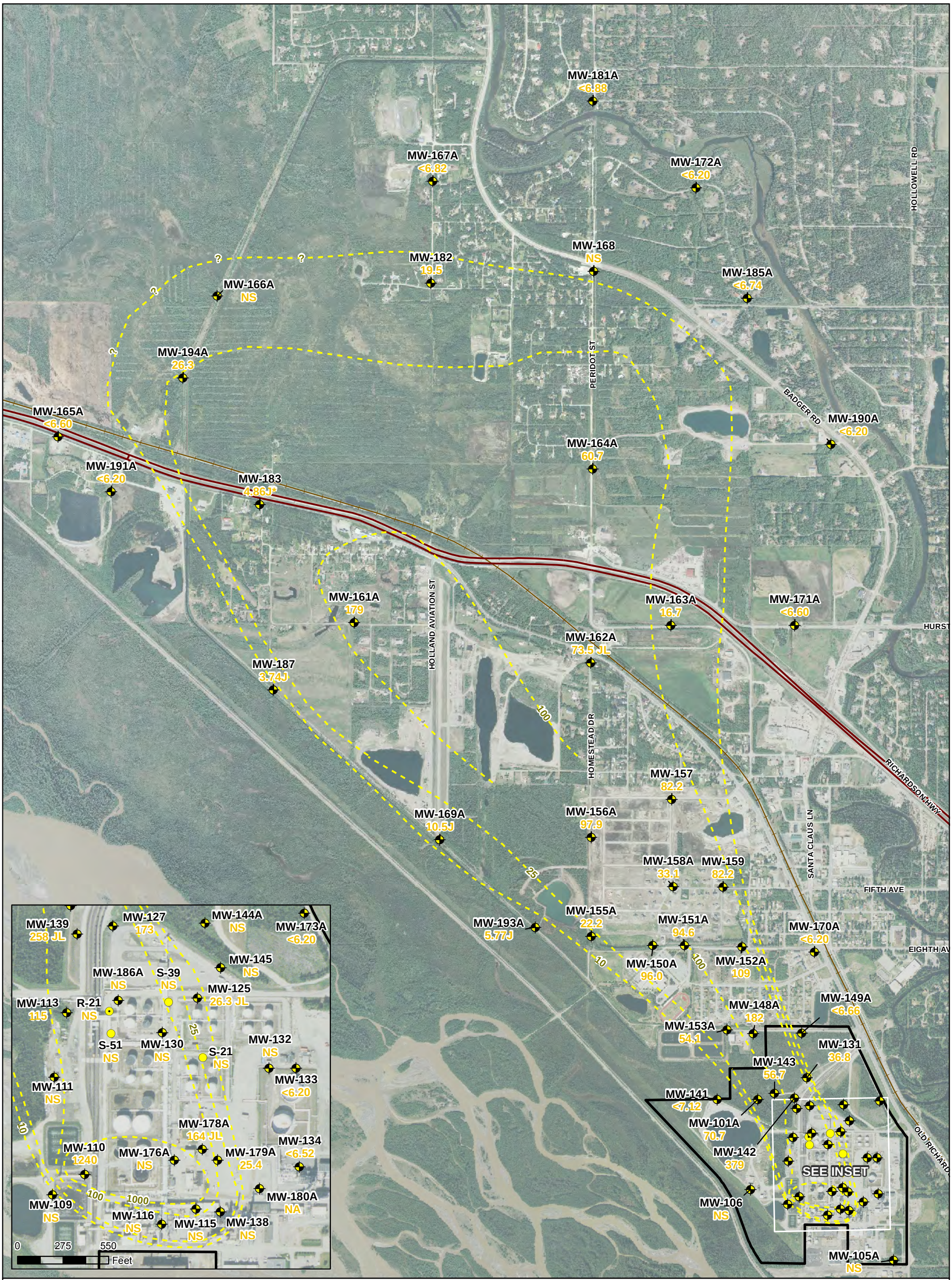


Figure 98
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
55-90' BELOW THE WATER TABLE
SECOND QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Observation Well

Recovery Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

J Estimated value

JL Result Biased Low

NS Not Sampled

* Data not used in contour

NA Not Analyzed

0 750 1,500 3,000

Feet

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.

Figure 99
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
AT THE WATER TABLE
THIRD QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

MW-189B
<6.20
MW-181B
<6.74
MW-167B
5.75J
HOLLOWELL RD
?
?
?
MW-166B
NS
MW-185B
10.1J
MW-194B
43.1
PERIDOT ST
BADGER RD
MW-165B
<6.60
100
MW-190B
<6.20
MW-191B
<6.20
MW-183B
136
MW-164B
120
MW-164C
114
MW-161B
302
HOLLAND AVIATION ST
MW-163B
65.5
MW-171B
<6.52
HURST
MW-162B
80.6
HOMESTEAD DR
RICHARDSON HWY
MW-184
<6.20
10
25
MW-156B
65.1
MW-169B
NS
MW-169C
<6.20
MW-158B
125
SANTA CLAUS LN
FIFTH AVE
MW-150B
77.4
MW-151B
62.3
MW-193B
3.67J
MW-152B
113
MW-170D
<6.82
EIGHTH AV
MW-155B
<6.20
MW-151C
39.3
MW-153B
33.7
MW-148B
251
MW-104
NS
MW-147B
<6.20
MW-186B
33.6
MW-101
40.7
MW-129
NS
OLD RICHARD
MW-174A
41.4
MW-178B
52.2
MW-180B
<6.88
MW-176B
NS
MW-105
NS
MW-179B
3.40J

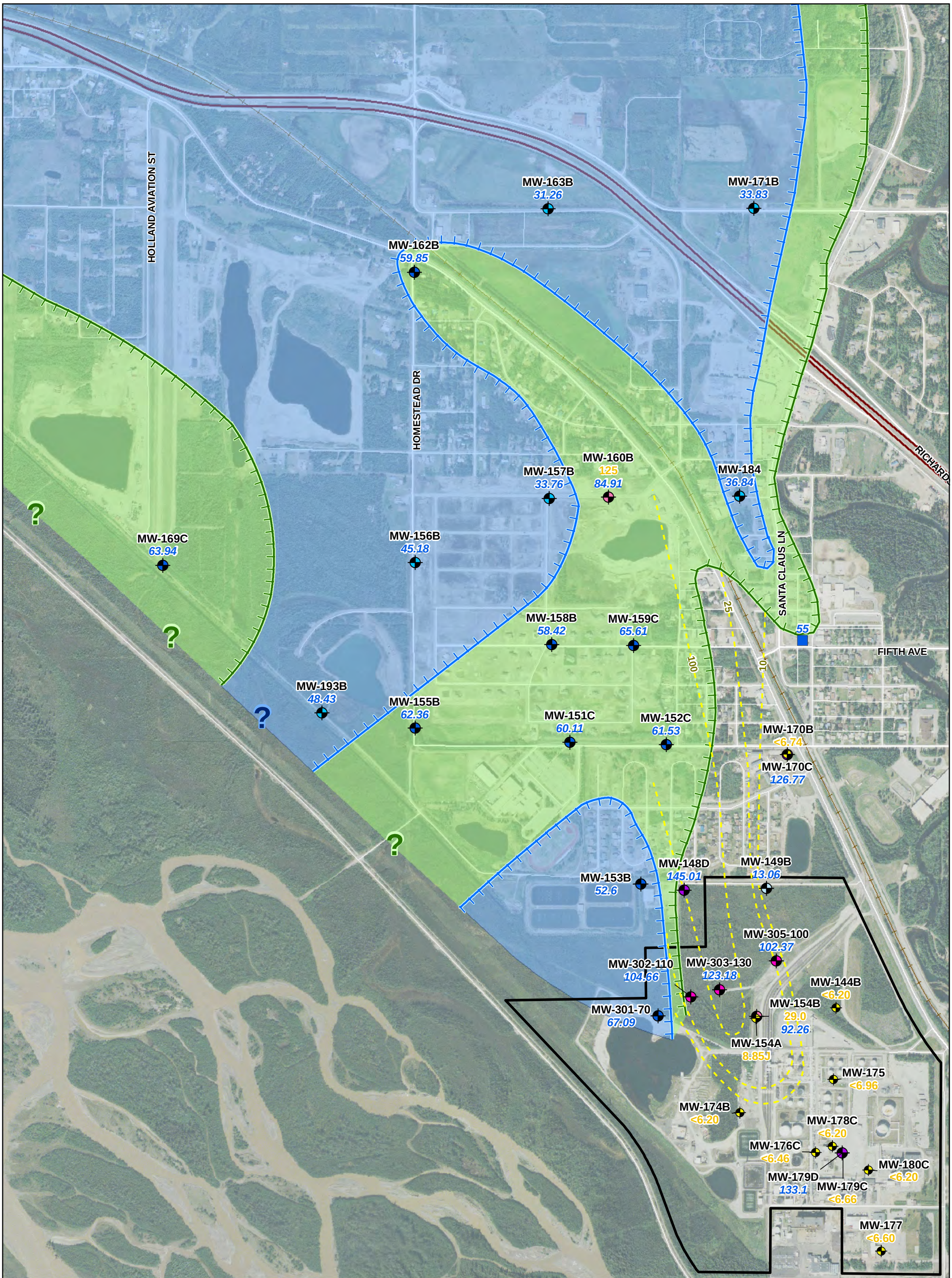
Monitoring Well
Approximate Sulfolane Isopleth in ug/L
FHRA Property Boundary
118 Sulfolane Concentration (µg/L)
J Estimated value
NS Not Sampled

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with iso-dilution
Wells were guaged for LNAPL July 14 and 15, 2011

N

0 750 1,500 3,000
Feet

Figure 100
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
10-55' BELOW THE WATER TABLE
THIRD QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Depth to Permafrost (BWT)

- 0 - 24.9 Ft
- 25 - 49.9 Ft
- 50 - 74.9 Ft
- 75 - 99.9 Ft
- 100 - 124.9 Ft
- 125 - 149.9 Ft
- City Well

FHRA Property Boundary

Aquifer Frozen at 55' Below the Water Table

Aquifer Frozen at 90' Below the Water Table

Approximate Sulfolane Isopleth in µg/L

118 Sulfolane Concentration (µg/L)

NS Not Sampled

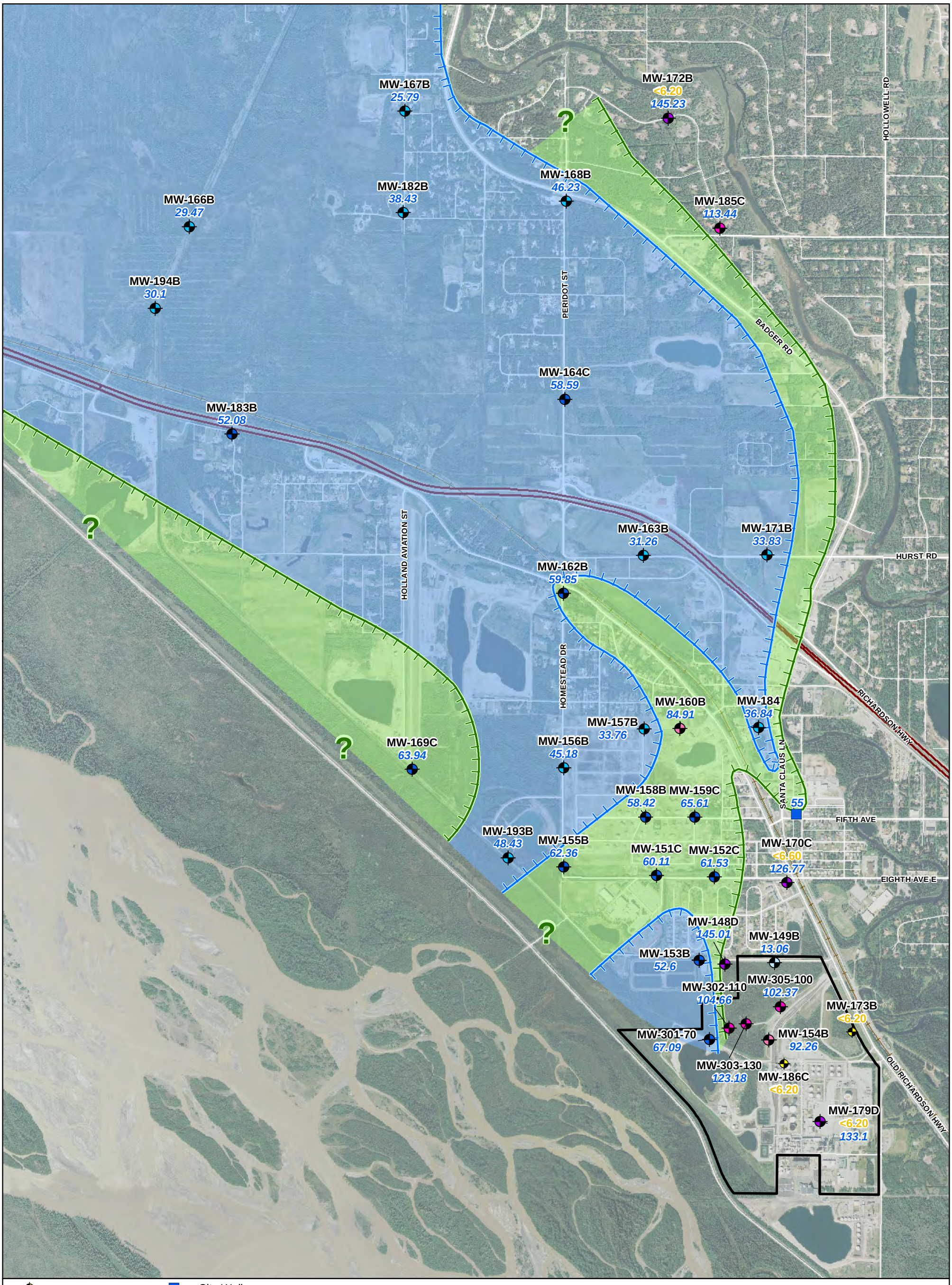
59.0 Depth to Permafrost (feet BGS)

0 450 900 1,800

Feet

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with iso-dilution
Wells were guaged for LNAPL July 14 and 15, 2011

Figure 101
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
55-90' BELOW THE WATER TABLE
THIRD QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Depth to Permafrost (BWT)

- 0 - 24.9 Ft
- 25 - 49.9 Ft
- 50 - 74.9 Ft
- 75 - 99.9 Ft
- 100 - 124.9 Ft
- 125 - 149.9 Ft

City Well

FHRA Property Boundary

Aquifer Frozen at 55' Below the Water Table

Aquifer Frozen at 90' Below the Water Table

<10.3 Sulfolane Concentration (µg/L)

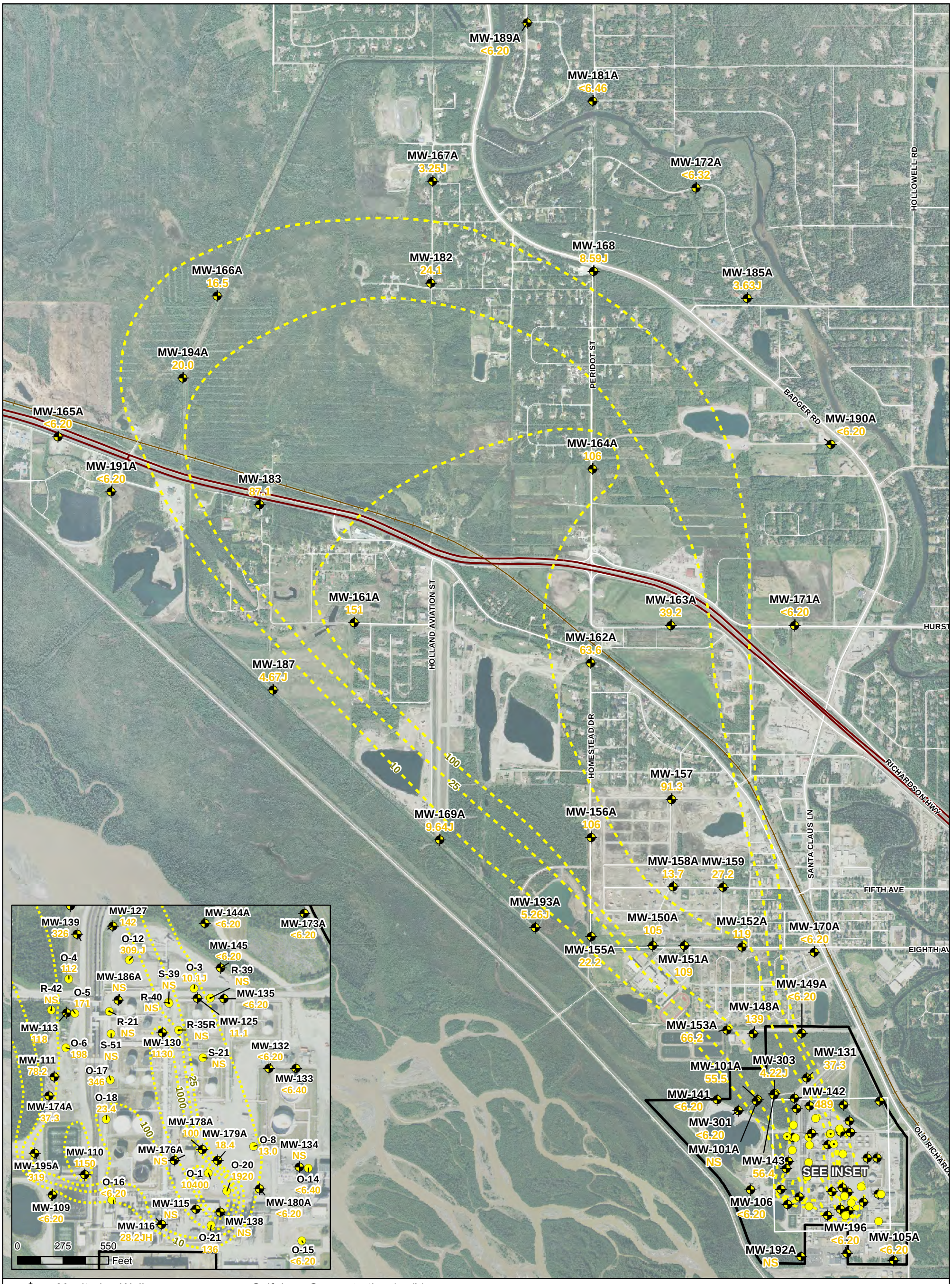
59.0 Depth to Permafrost (feet BGS)

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with iso-dilution
Wells were guaged for LNAPL July 14 and 15, 2011

0 750 1,500 3,000

Feet

Figure 102
SULFOLANE CONCENTRATIONS IN GROUNDWATER
90-160' BELOW THE WATER TABLE
THIRD QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Observation Well

Recovery Well

Approximate Sulfolane Isopleth in µg/L

FHRA Property Boundary

118 Sulfolane Concentration (µg/L)

J Estimated value

NS Not Sampled

JH Estimated results biased high due to sulfolane-d8 surrogate failure

0 750 1,500 3,000

Feet

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.

Figure 103
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
AT THE WATER TABLE
FOURTH QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC

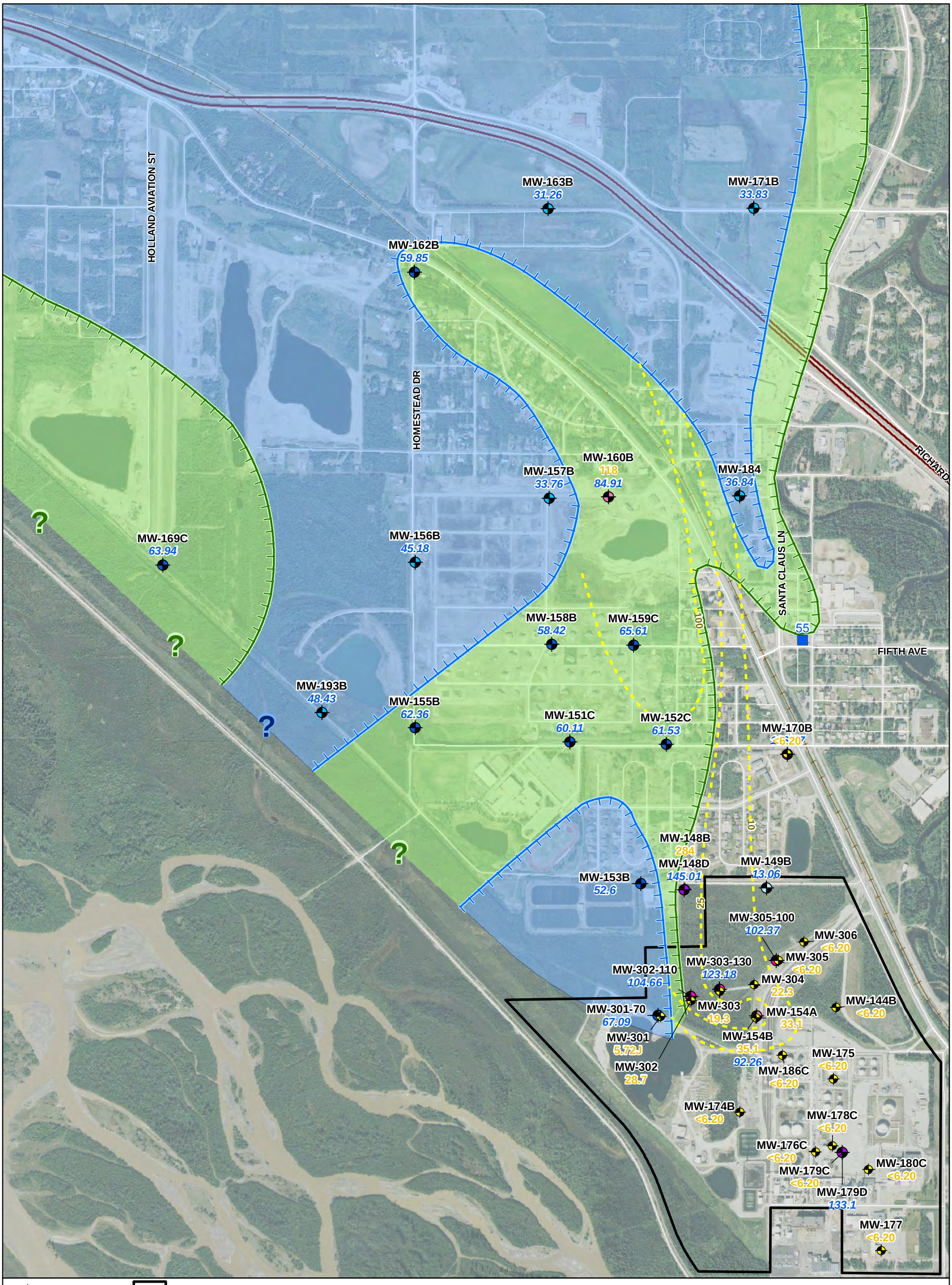
MW-189B
<6.52
MW-181B
<6.46
MW-167B
7.35J
MW-168B
11.7
MW-182B
19.5
MW-166B
37.4
MW-185B
10.9
MW-194B
45.4
MW-165B
<6.20
MW-190B
<6.20
MW-164B
134
MW-191B
<6.20
MW-164C
133
MW-161B
316
MW-163B
64.5
MW-171B
<6.52
MW-162B
85.4
MW-184
<6.20
MW-169C
<6.20
MW-156B
55.0
MW-193B
3.91J
MW-155B
<6.52
MW-151B
63.2
MW-152B
114
MW-170D
<6.20
MW-150B
84.9
MW-151C
39.6
MW-148B
284
MW-153B
33.3
MW-306
<6.20
MW-305
53.8
MW-147B
<6.20
MW-104
<6.20
MW-301
7.02J
MW-101
35.6
MW-303
123 JH
SEE INSET
MW-304
262
MW-192B
NS
MW-105
<6.40
MW-129
<6.20
MW-186B
35.8
MW-174B
37.3
MW-178B
243
MW-176B
NS
MW-179B
4.80J
MW-180B
<6.20
HOLLOWELL RD
PERIDOT ST
BADGER RD
HOLLAND AVIATION ST
HOMESTEAD DR
SANTA CLAUS LN
RICHARDSON HWY
FIFTH AVE
EIGHTH AV
HURST
OLD RICHARD
10
25
100
0 275 550 Feet
0 750 1,500 3,000 Feet

Monitoring Well
Observation Well
Recovery Well
Approximate Sulfolane Isopleth in µg/L
FHRA Property Boundary

118 Sulfolane Concentration (µg/L)
J Estimated value
NS Not Sampled

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.

Figure 104
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
10-55' BELOW THE WATER TABLE
FOURTH QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Depth to Permafrost

- 0 - 24.9
- 25 - 49.9
- 50 - 74.9
- 75 - 99.9
- 100 - 124.9
- 125 - 149.9
- City Well

FHRA Property Boundary

Aquifer Frozen at 55' Below the Water Table

Aquifer Frozen at 90' Below the Water Table

Approximate Sulfolane Isopleth in µg/L

118 Sulfolane Concentration (µg/L)

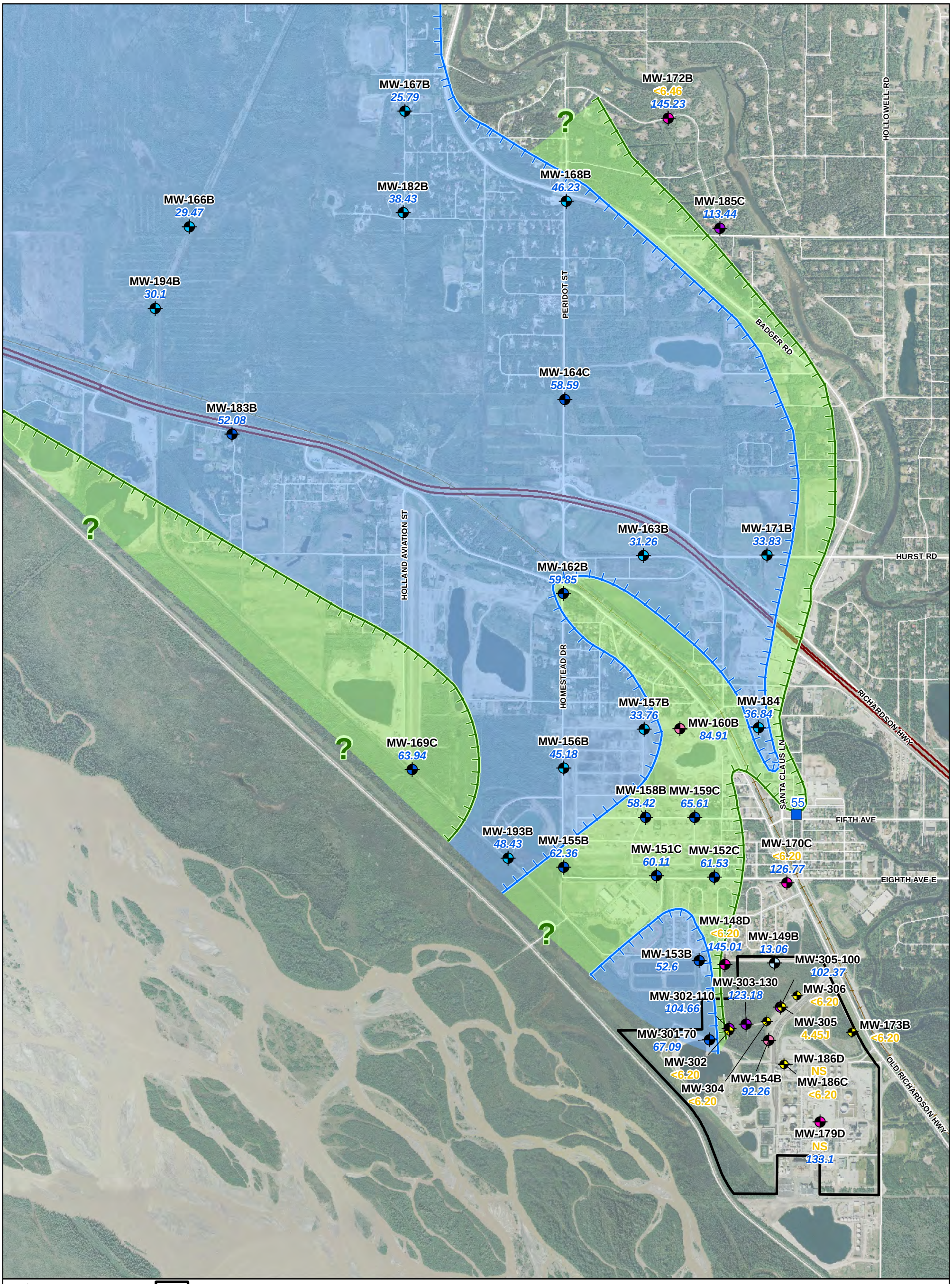
13.1 Depth to Permafrost (feet BWT)

0 450 900 1,800

Feet

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.

Figure 105
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
55-90' BELOW THE WATER TABLE
FOURTH QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC



Monitoring Well

Depth to Permafrost (BWT)

- 0 - 24.9 Ft
- 25 - 49.9 Ft
- 50 - 74.9 Ft
- 75 - 99.9 Ft
- 125 - 149.9 Ft
- 100 - 124.9 Ft
- City Well

FHRA Property Boundary

Aquifer Frozen at 55' Below the Water Table

Aquifer Frozen at 90' Below the Water Table

Approximate Sulfolane Isopleth in µg/L

118 Sulfolane Concentration (µg/L)

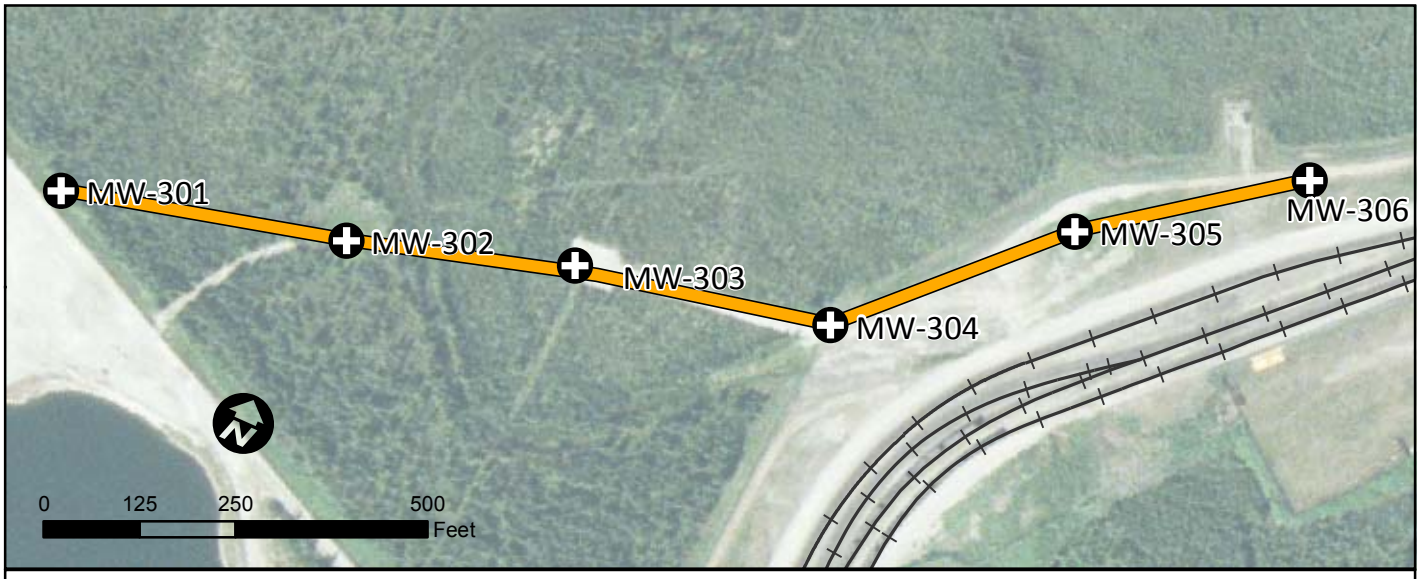
13.1 Depth to Permafrost (feet BWT)

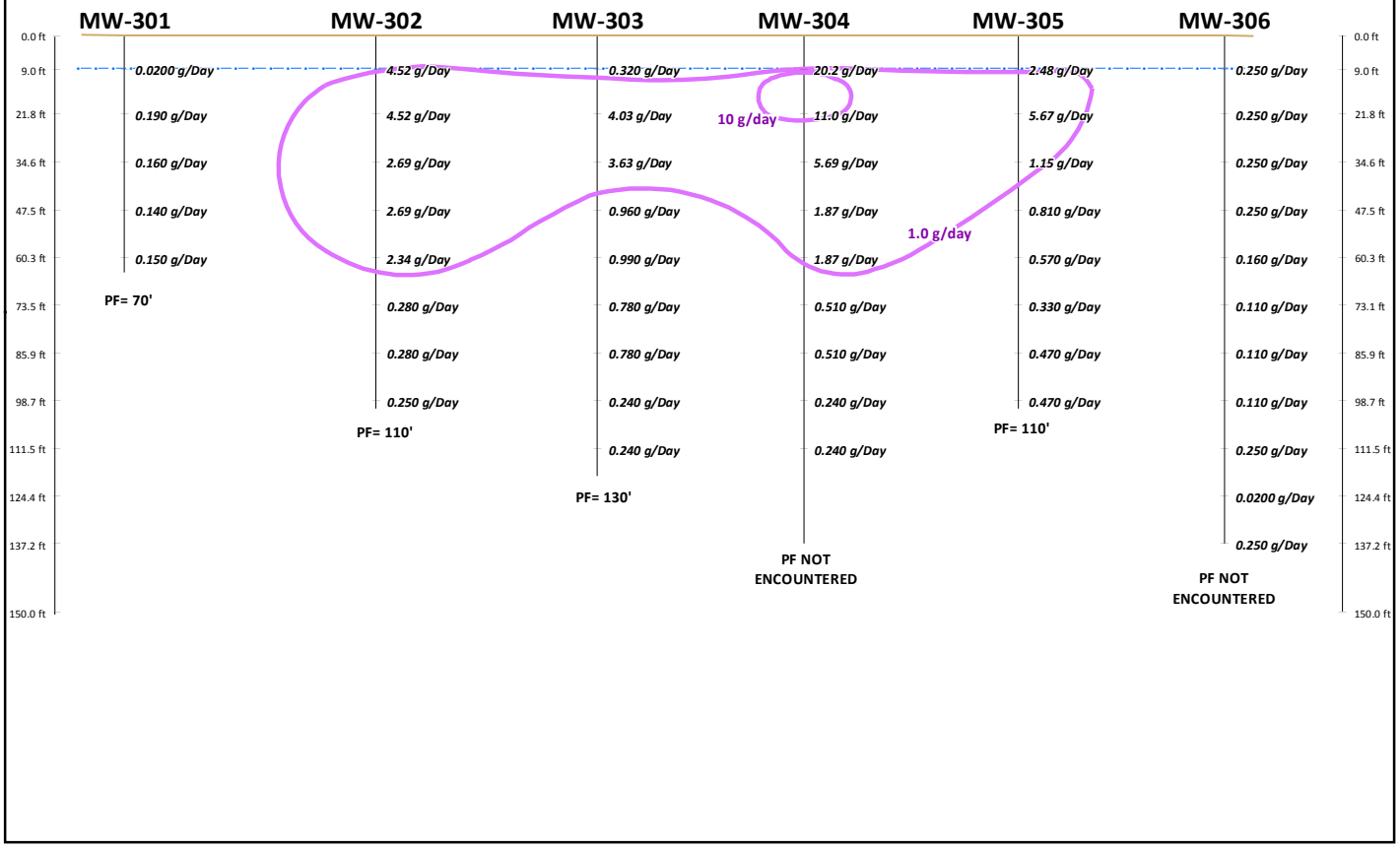
0 750 1,500 3,000

Feet

Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.

Figure 106
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
90-160' BELOW THE WATER TABLE
FOURTH QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC





LEGEND:

- CLUSTER WELLS
- APPROXIMATE GW
- GROUND SURFACE
- MASS FLUX CONTOUR

NOTES:

Mass flux values shown were calculated using the Mass Flux Toolkit.
Depths associated with flux values were determined by the Toolkit.
PF= Permafrost encountered at bottom of boring.

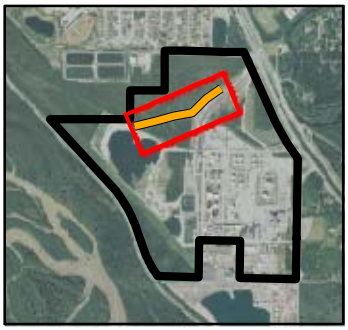


Figure 107
SULFOLANE MASS FLUX RATES
North Pole Refinery
Flint Hills Resources Alaska, LLC

CITY: SF DIV/GROUP: ENV/IM DB:K ERNST LD: G FRANCE PIC: A OHRT PM: TM:
PROJECT:
Path: Q:\FlintHillsResources\NorthPoleRefinery\Rev_SiteCharacterization\MXD\Sulfolane_MassFlux_v2.mxd Date Saved: 7/17/2012 11:57:44 AM

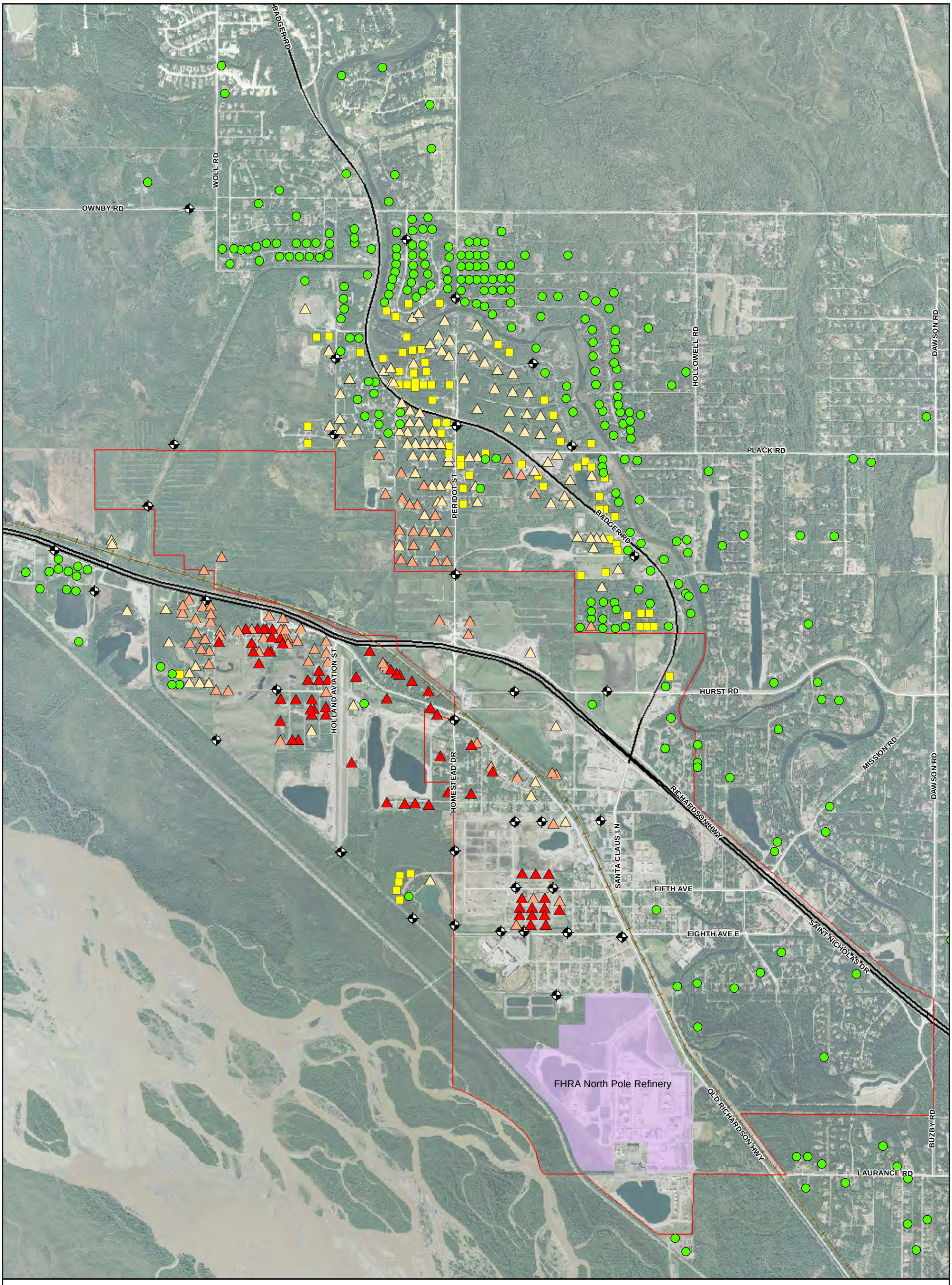


Figure 108
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
FROM PRIVATE WELLS
North Pole Refinery
Flint Hills Resources Alaska, LLC

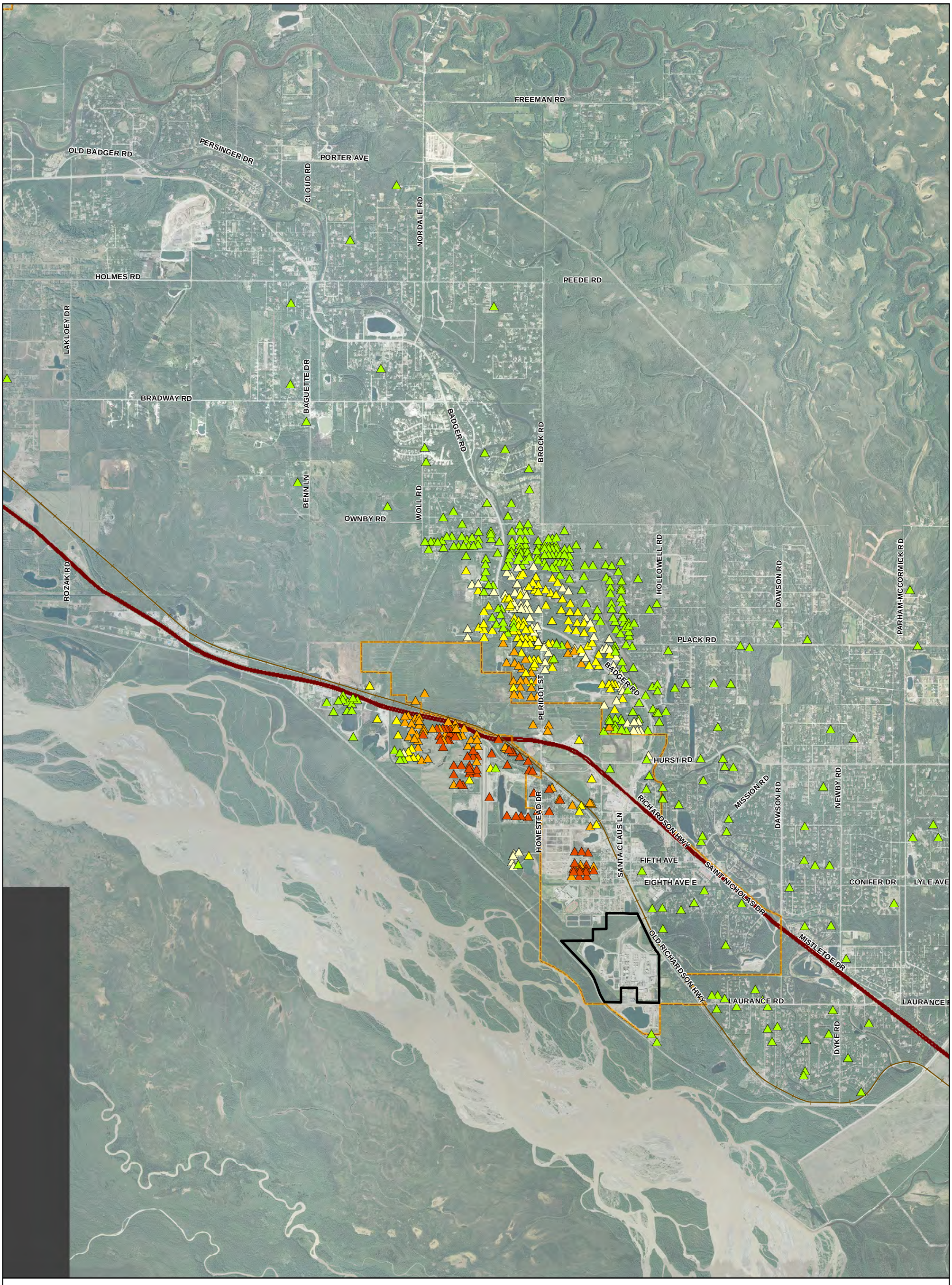
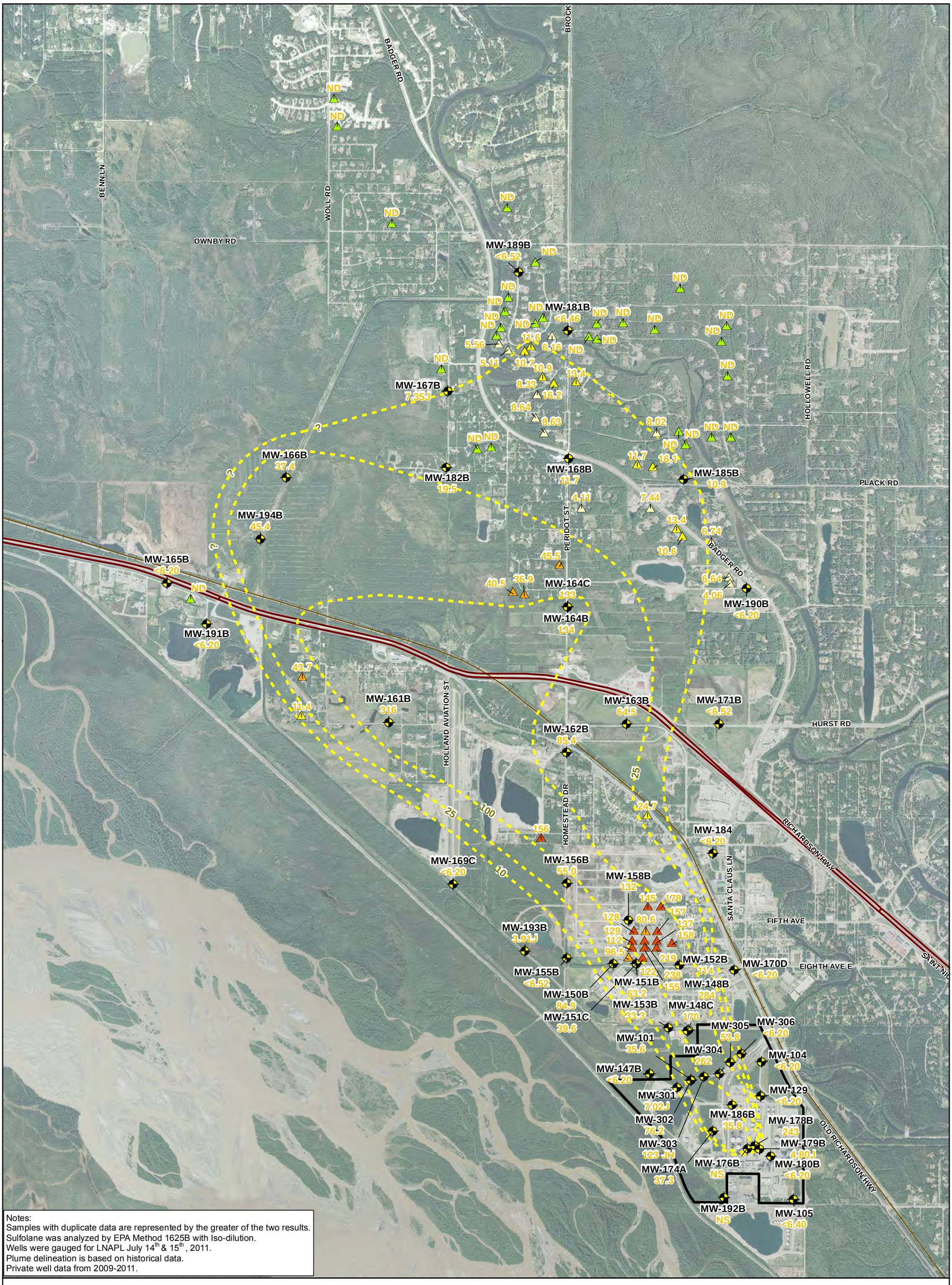


Figure 109
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
FROM PRIVATE WELLS-
EXTENDED VIEW
North Pole Refinery
Flint Hills Resources Alaska, LLC



Notes:
Samples with duplicate data are represented by the greater of the two results.
Sulfolane was analyzed by EPA Method 1625B with Iso-dilution.
Wells were gauged for LNAPL July 14th & 15th, 2011.
Plume delineation is based on historical data.
Private well data from 2009-2011.

Private Wells

- Not Detected
- 3.2 µg/L - 10 µg/L (J-flagged)
- 10 µg/L - 25 µg/L
- 25 µg/L - 100 µg/L
- Greater than 100 µg/L

- Monitoring Well
- Approximate Sulfolane Isopleth in µg/L
- FHRA Property Boundary
- 118 Sulfolane Concentration (µg/L)
- J Estimated value
- NS Not Sampled

0 1,000 2,000 4,000
Feet

Figure 110
SULFOLANE CONCENTRATIONS
IN GROUNDWATER
10-55' BELOW THE WATER TABLE
FROM PRIVATE WELLS
FOURTH QUARTER 2011
North Pole Refinery
Flint Hills Resources Alaska, LLC