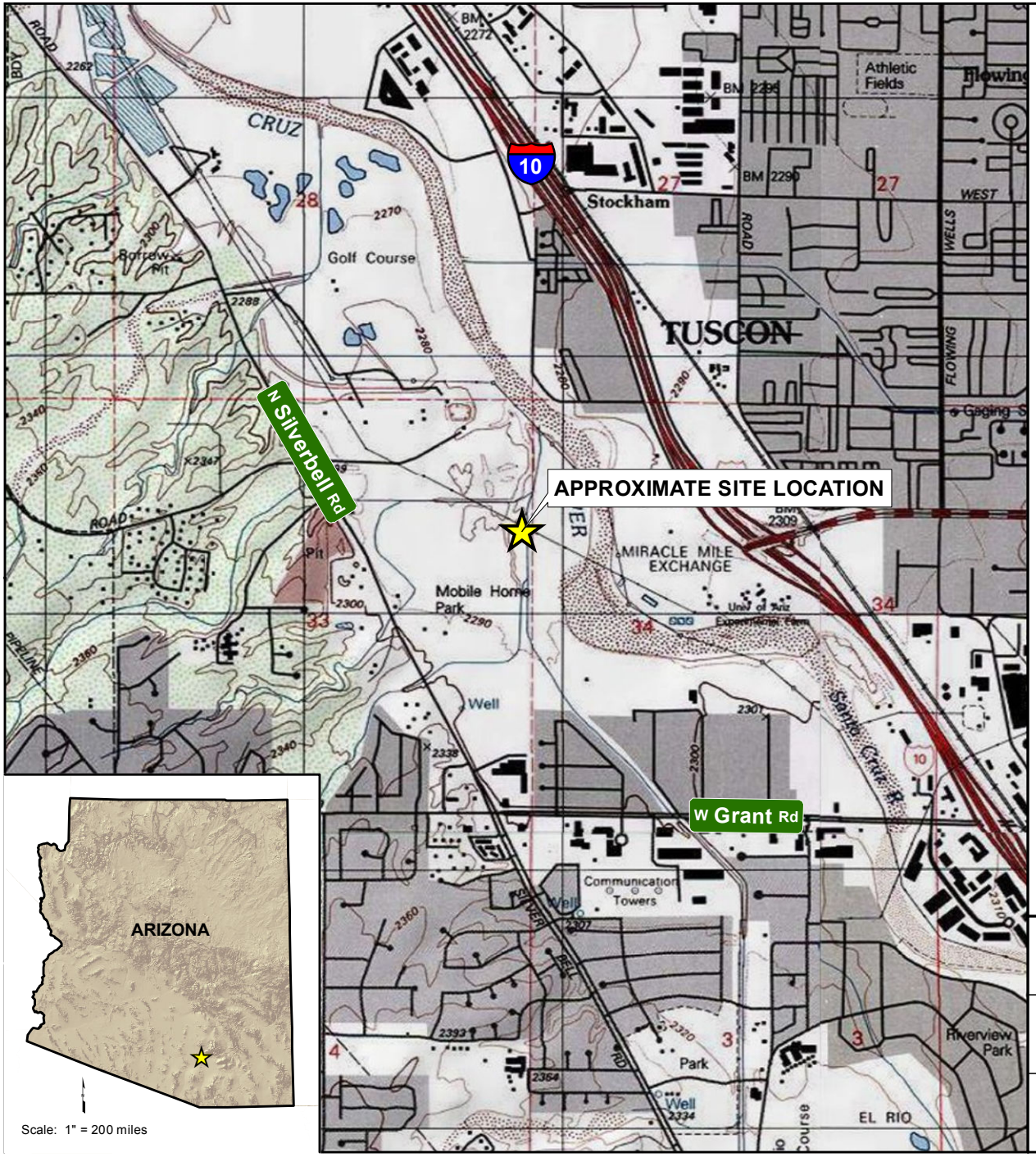
FIGURES



LEGEND

Approximate site location

NOTES

· Topographic map source: ESRI USA Topo Maps.

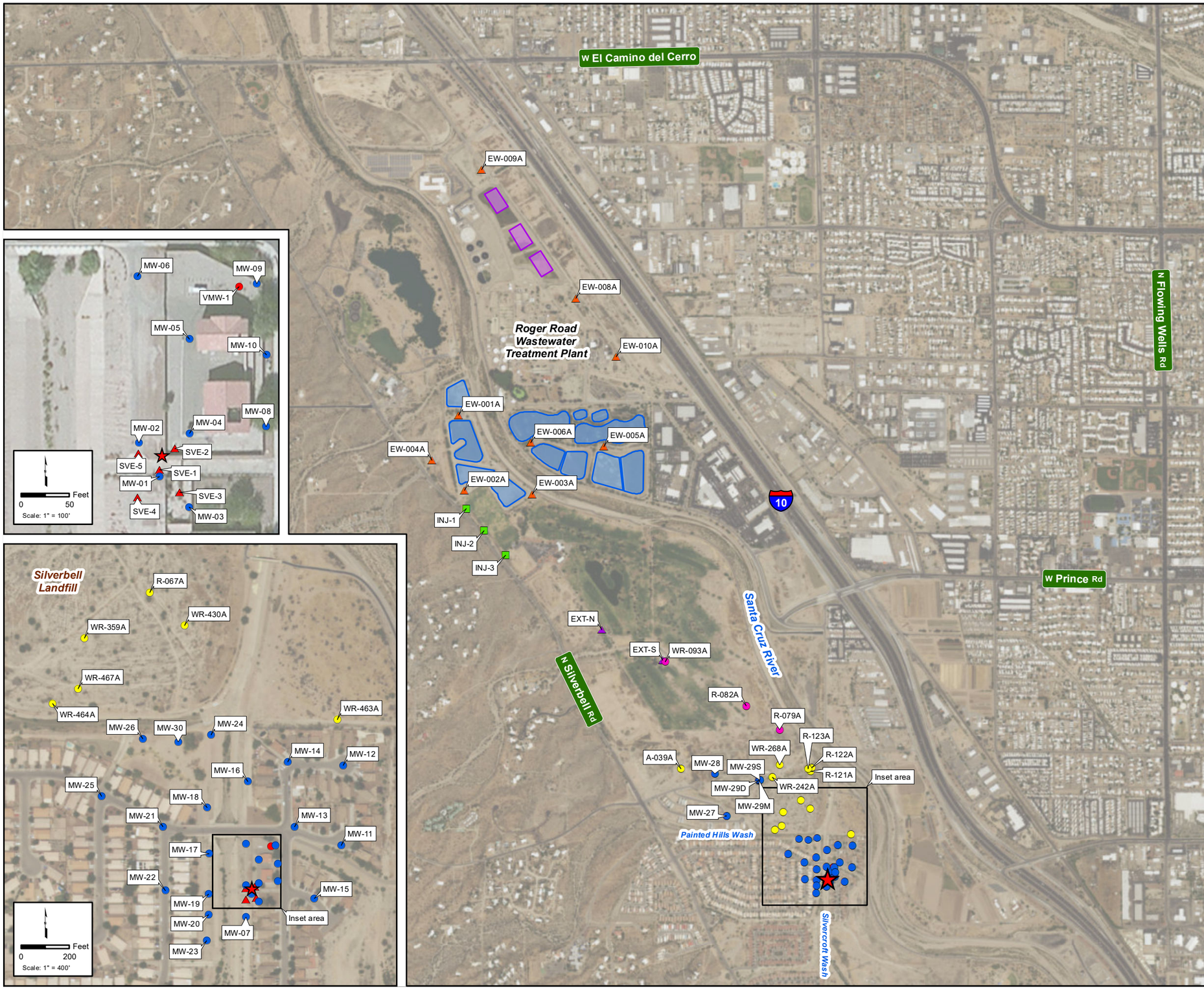
Feet
0 1,000 2,000
Scale: 1" = 2,000'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

SITE VICINITY MAP

ARCADIS

FIGURE
1



LEGEND

- Silvercroft Wash release site
- Sweetwater Recharge Facility (existing recharge basin)
- Sweetwater Recharge Facility (future recharge basin)
- KM groundwater monitor well
- KM soil vapor monitor well
- KM soil vapor extraction well
- COT groundwater monitor well
- Proposed additional COT groundwater monitor well
- SRF groundwater extraction well
- Proposed COT groundwater extraction well
- Proposed COT groundwater injection well

NOTES

· Aerial photo source: ESRI World Imagery.
· KM = Kinder Morgan, Inc.
· COT = City of Tucson.
· SRF = Sweetwater Recharge Facility.

Feet
0 750 1,500
Scale: 1" = 1,500'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
2

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2016\Figure 02 site location map.mxd 1/30/2017

Figure 3
Hydrographs of All Wells
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

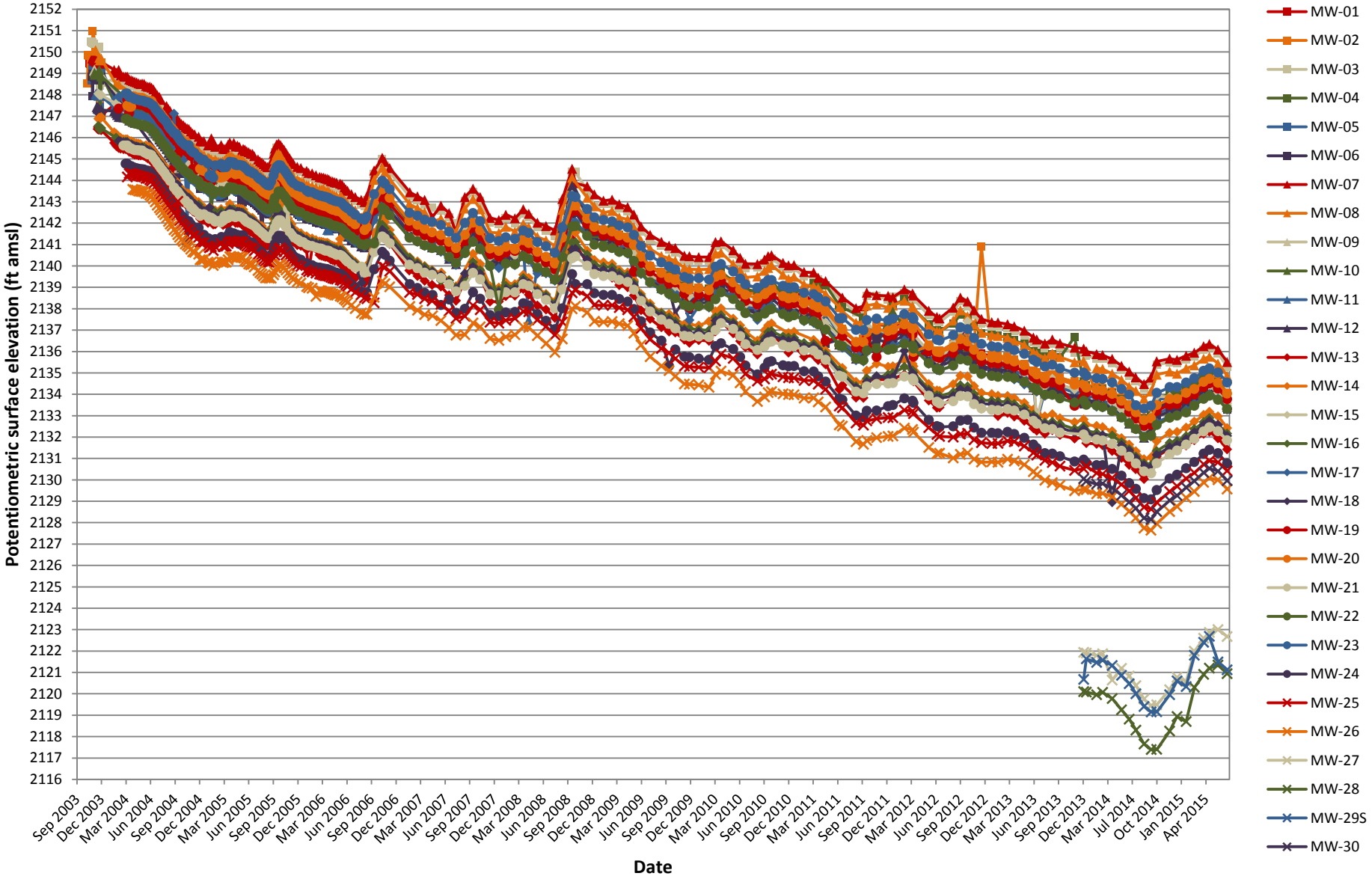


Figure 4
Apparent LNAPL Thickness vs. Time, East Side of Silvercroft Wash
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

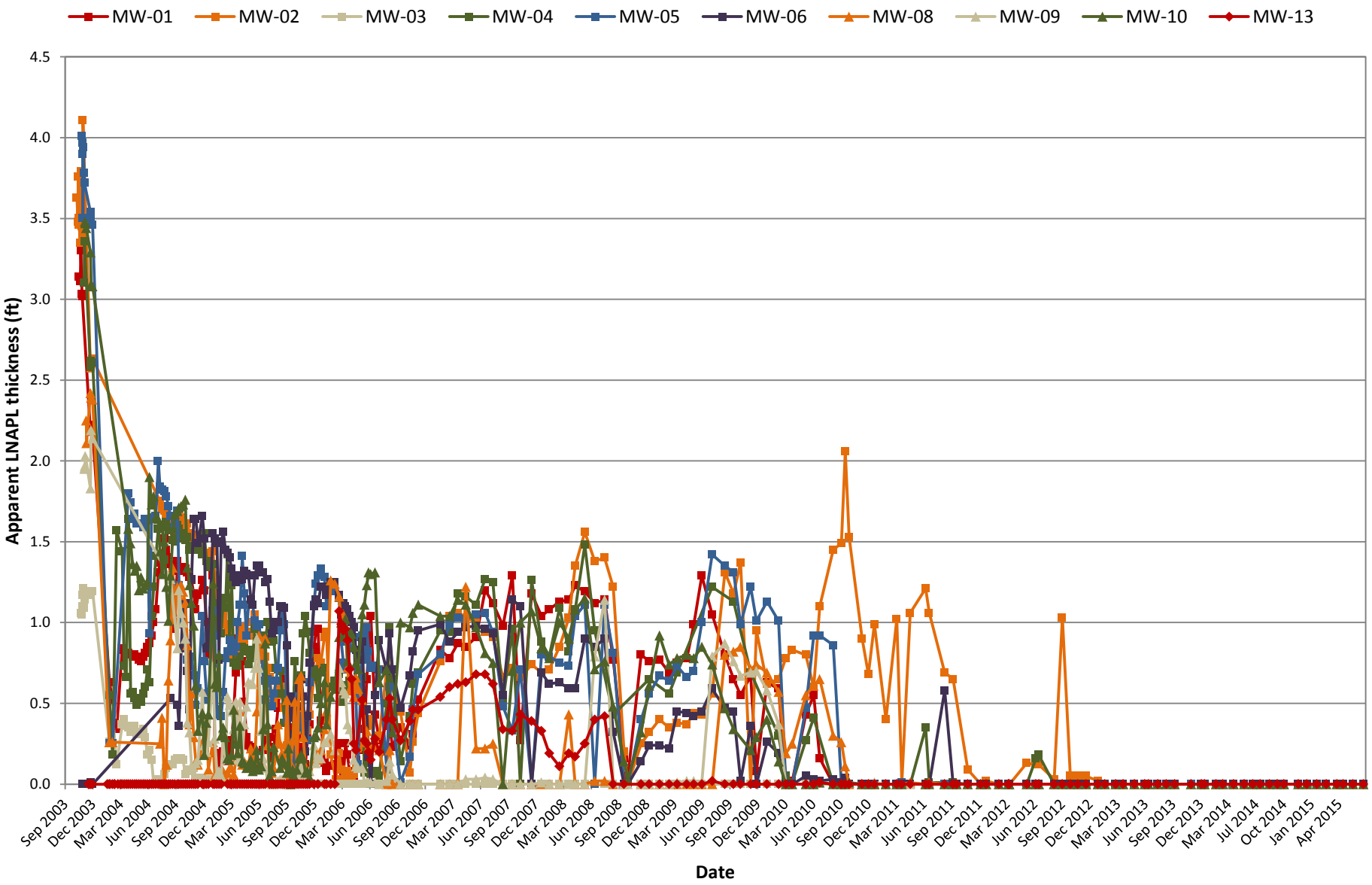
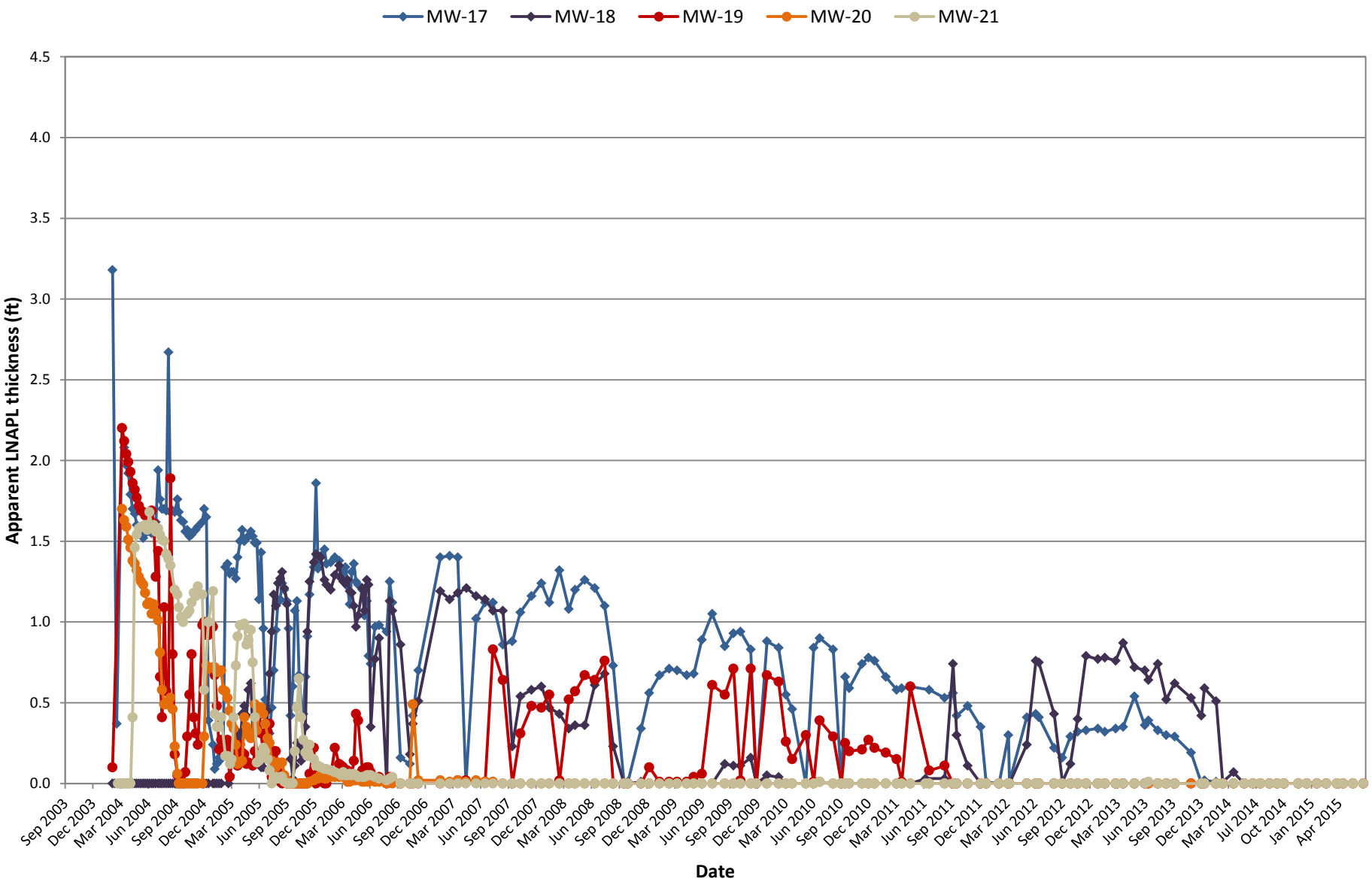
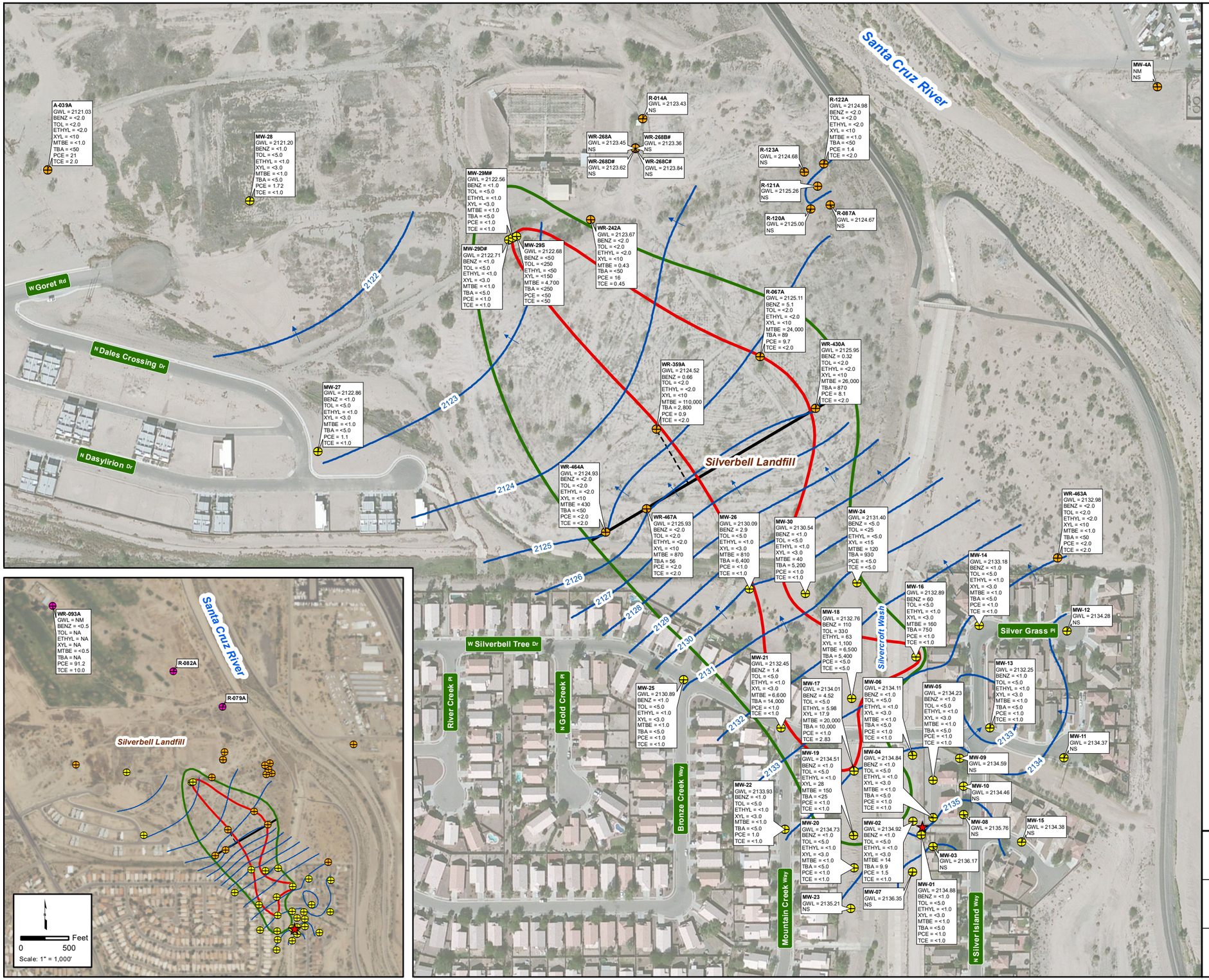


Figure 5
Apparent LNAPL Thickness vs. Time, West Side of Silvercroft Wash
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona





LEGEND

- Release point
- Groundwater monitor well (monitored by ARCADIS)
- Groundwater monitor well (monitored by City of Tucson)
- Groundwater monitor well (City of Tucson, proposed to be monitored)
- Groundwater elevation contour
- Direction of groundwater flow
- Approximate extent of dissolved phase BTEX above AWQS
- Approximate extent of dissolved phase MTBE above 20 µg/L
- Mass flux transect line
- Projection of monitor well to transect line

NOTES

- Aerial photo source: ESRI World Imagery.
- Depths to groundwater were measured on 4/16/2015 (ARCADIS wells) and on 4/2/2015 and 4/21/2015 (City of Tucson wells).
- Wells were sampled from 4/17/2015 to 4/23/2015 (ARCADIS wells) and from 4/20/2015 to 4/23/2015 (City of Tucson wells).
- Groundwater elevations are expressed in feet above mean sea level (ft amsl).
- Analytical results are expressed in micrograms per liter (µg/L).
- No wells contained light non-aqueous phase liquid (LNAPL) during the April 2015 monitoring event.
- GWL = groundwater elevation.
- BENZ = benzene.
- TOL = toluene.
- ETHYL = ethylbenzene.
- XYL = total xylenes.
- MTBE = methyl tertiary-butyl ether.
- TBA = tert-butyl alcohol.
- PCE = tetrachloroethene.
- TCE = trichloroethene.
- # = well is screened at a greater depth and is not used in contouring.
- < = analyte not detected above indicated laboratory detection limit.
- NM = not measured.
- NS = not sampled.

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

GROUNDWATER ELEVATION CONTOURS WITH ANALYTICAL RESULTS, SECOND QUARTER 2015

ARCADIS

FIGURE 6

\\Scottsdale-AZ\OfficeData\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2016\Figure 06 GW elevation contours Q2 2015.mxd 1/30/2017

Figure 7
Cumulative LNAPL Extracted vs. Time
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

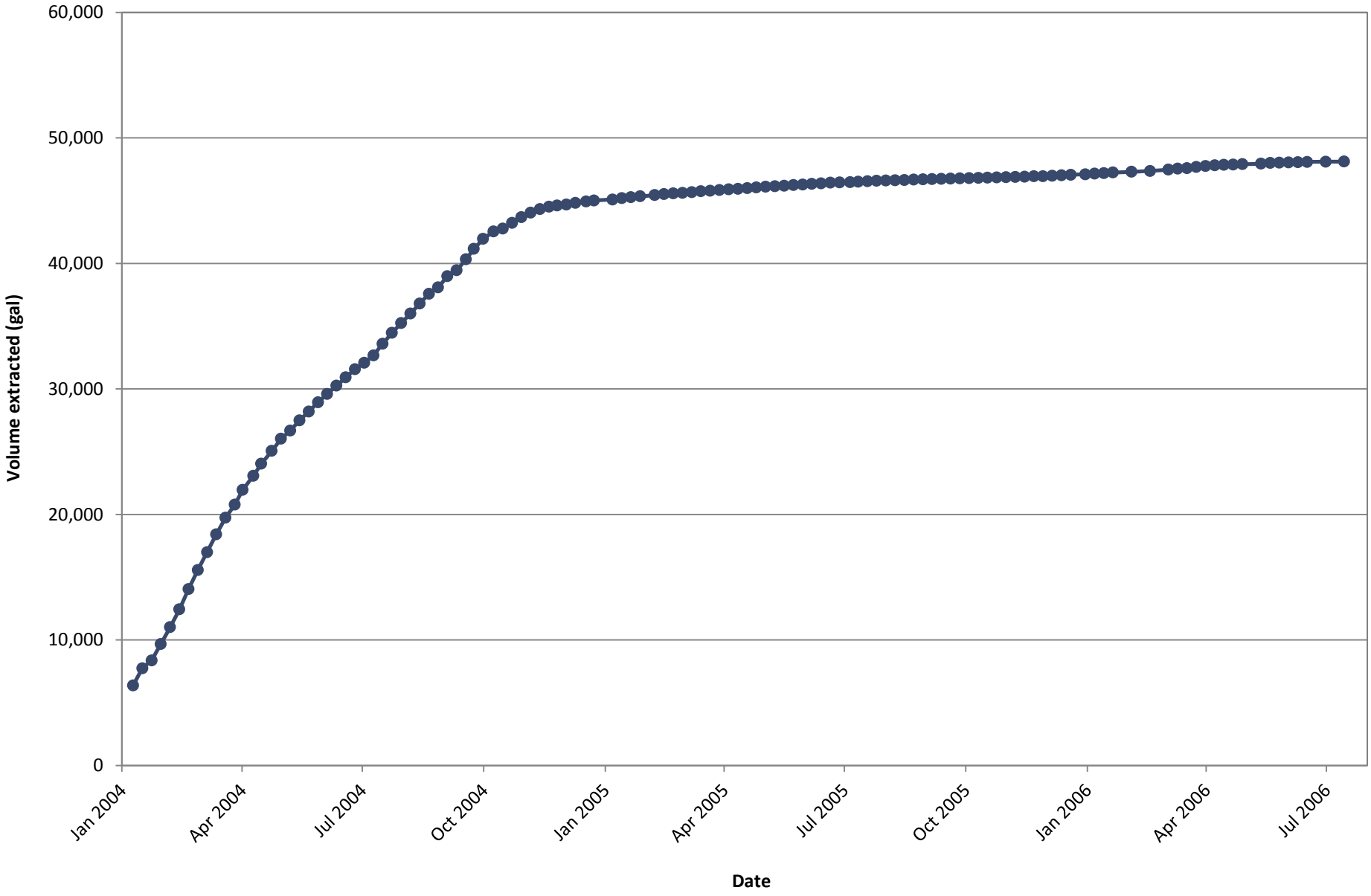
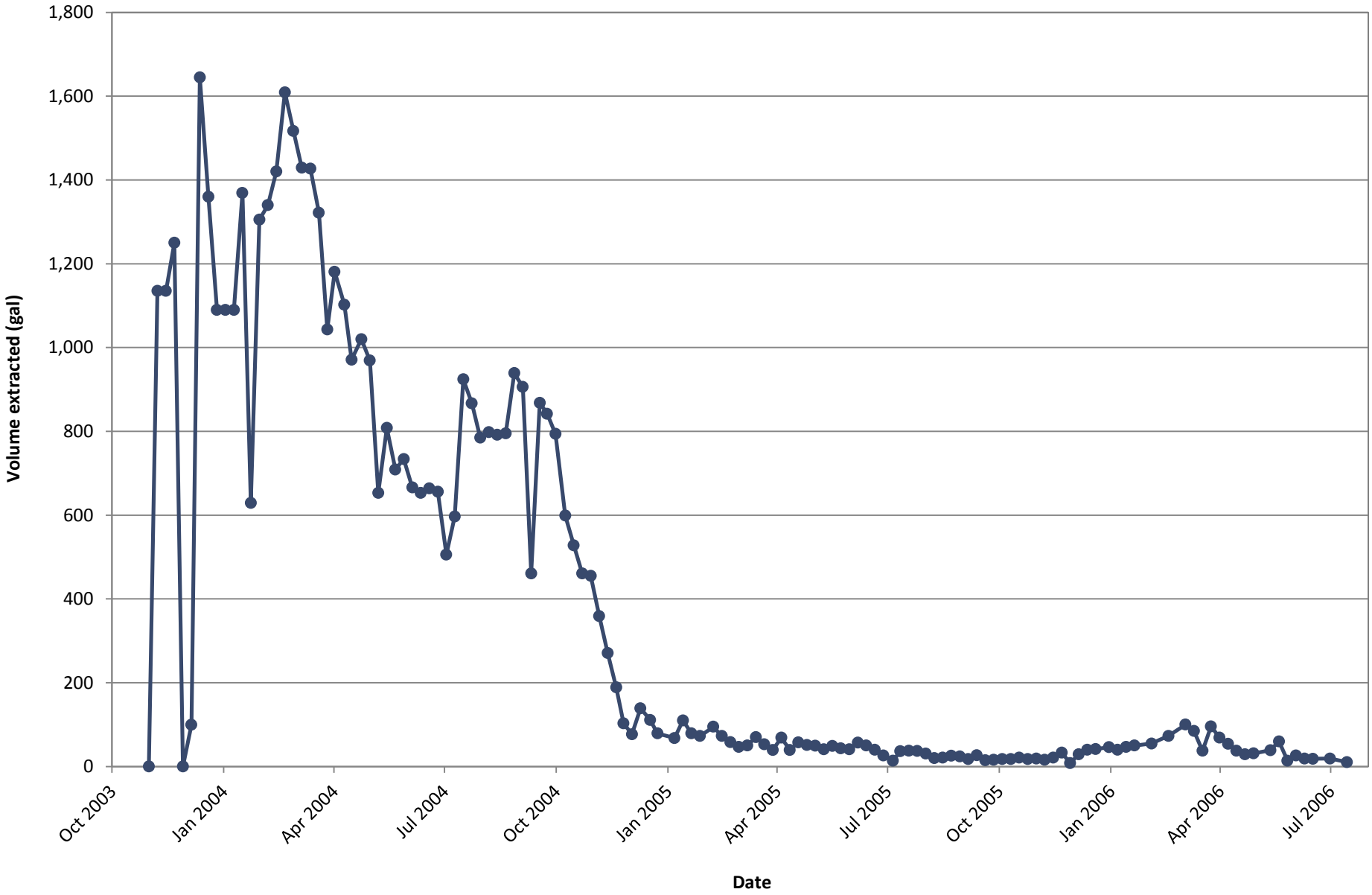
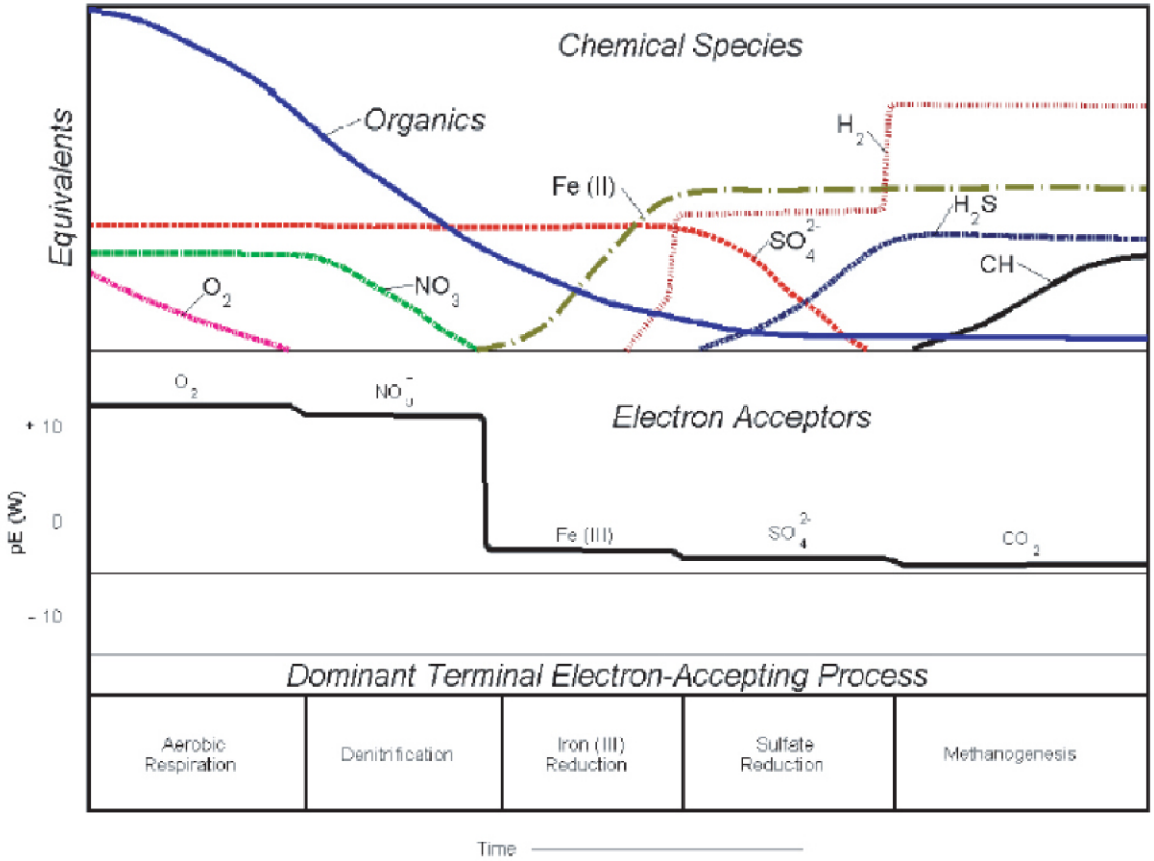


Figure 8
Weekly LNAPL Extracted vs. Time
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona



Geochemical Evolution of Ground Water



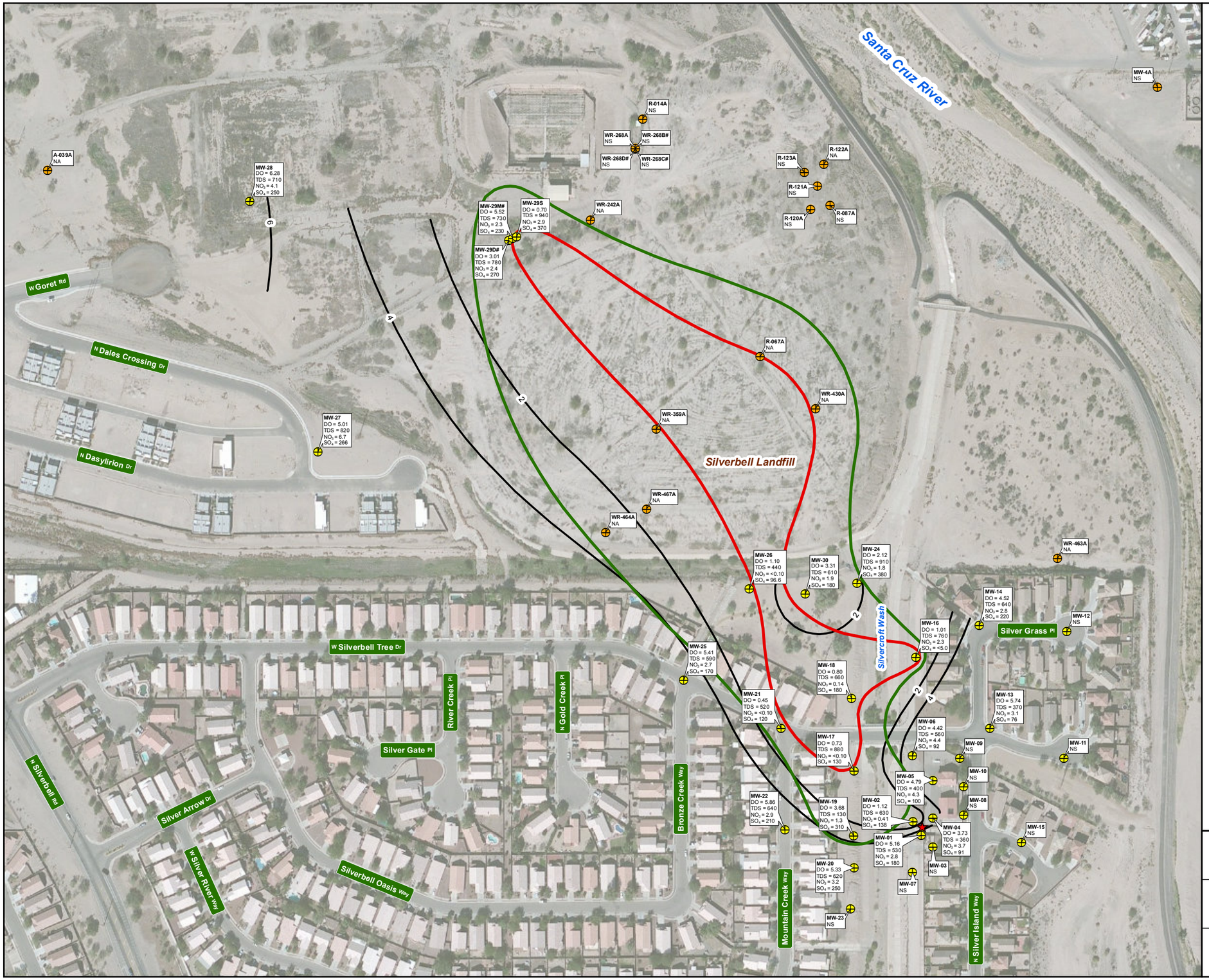
Source: ITRC, 2005 (from Bouwer and McCarthy, 1984)

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

GEOCHEMICAL EVOLUTION OF GROUNDWATER

ARCADIS

FIGURE
9



LEGEND

- Release point
- Groundwater monitor well (monitored by ARCADIS)
- Groundwater monitor well (monitored by City of Tucson)
- DO concentration contour
- Approximate extent of dissolved phase BTEX above AWQS
- Approximate extent of dissolved phase MTBE above 20 µg/L

NOTES

- Aerial photo source: ESRI World Imagery.
- Wells were sampled from 4/17/2015 to 4/23/2015 (ARCADIS wells) and from 4/21/2015 to 4/23/2015 (City of Tucson wells).
- Analytical results are expressed in milligrams per liter (mg/L).
- No wells contained light non-aqueous phase liquid (LNAPL) during the April 2015 monitoring event.
- MNA = monitored natural attenuation.
- DO = dissolved oxygen.
- TDS = total dissolved solids.
- NO_3 = nitrate.
- SO_4 = sulfate.
- # = well is screened at a greater depth and is not used in contouring.
- < = analyte not detected above indicated laboratory detection limit.
- NA = not analyzed for MNA parameters.
- NS = not sampled.

N

Feet
0 125 250
Scale: 1" = 250'

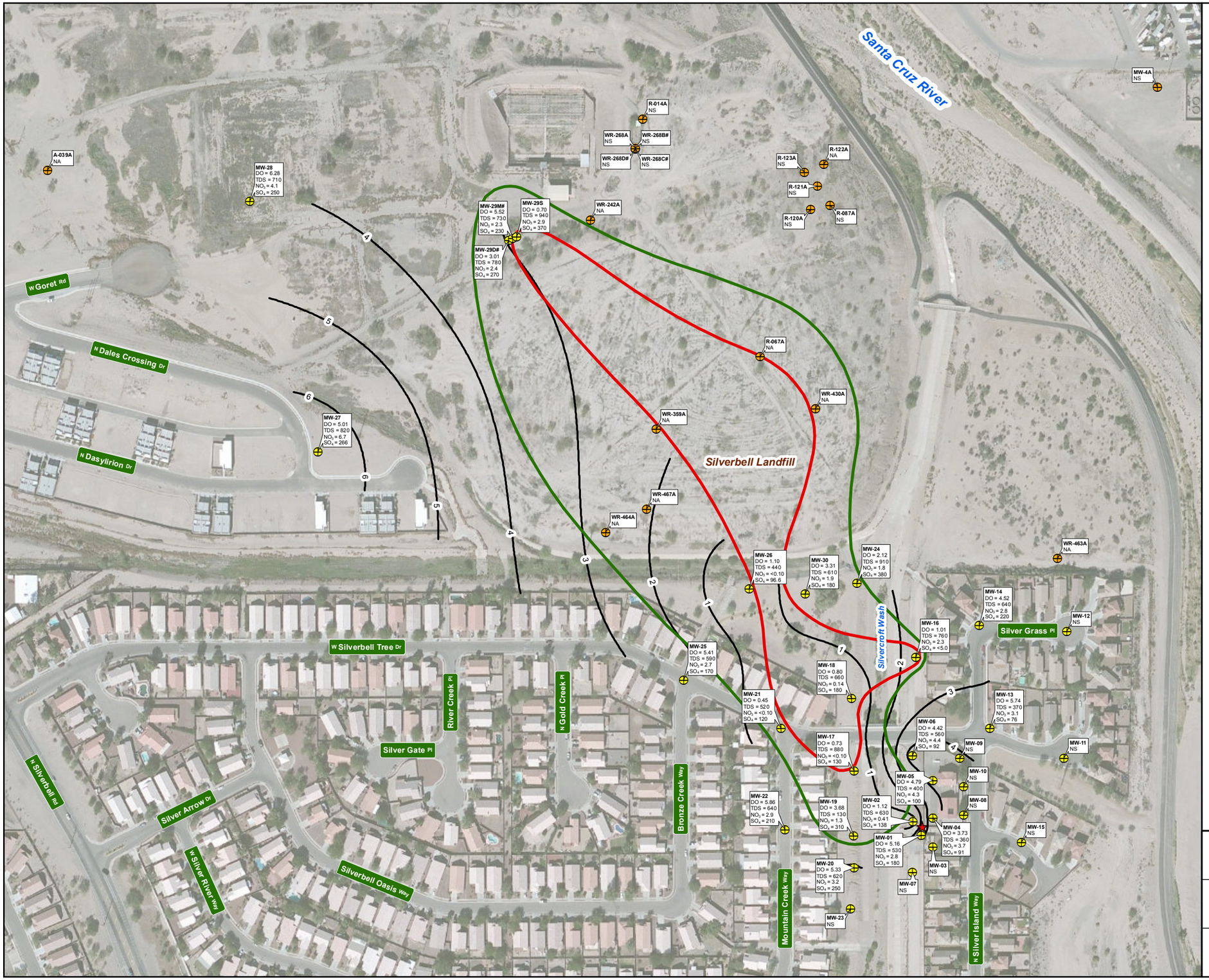
SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

DO IN GROUNDWATER CONTOURS WITH MNA ANALYTICAL RESULTS, SECOND QUARTER 2015

ARCADIS

FIGURE
10

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\2015 Q2\Figure 07 DO contours Q2 2015.mxd 8/10/2015



LEGEND

- Release point
- Groundwater monitor well (monitored by ARCADIS)
- Groundwater monitor well (monitored by City of Tucson)
- Nitrate concentration contour
- Approximate extent of dissolved phase BTEX above AWQS
- Approximate extent of dissolved phase MTBE above 20 µg/L

NOTES

- Aerial photo source: ESRI World Imagery.
- Wells were sampled from 4/17/2015 to 4/23/2015 (ARCADIS wells) and from 4/21/2015 to 4/23/2015 (City of Tucson wells).
- Analytical results are expressed in milligrams per liter (mg/L).
- No wells contained light non-aqueous phase liquid (LNAPL) during the April 2015 monitoring event.
- MNA = monitored natural attenuation.
- DO = dissolved oxygen.
- TDS = total dissolved solids.
- NO_3 = nitrate.
- SO_4 = sulfate.
- # = well is screened at a greater depth and is not used in contouring.
- < = analyte not detected above indicated laboratory detection limit.
- NA = not analyzed for MNA parameters.
- NS = not sampled.

N

Feet
0 125 250
Scale: 1" = 250'

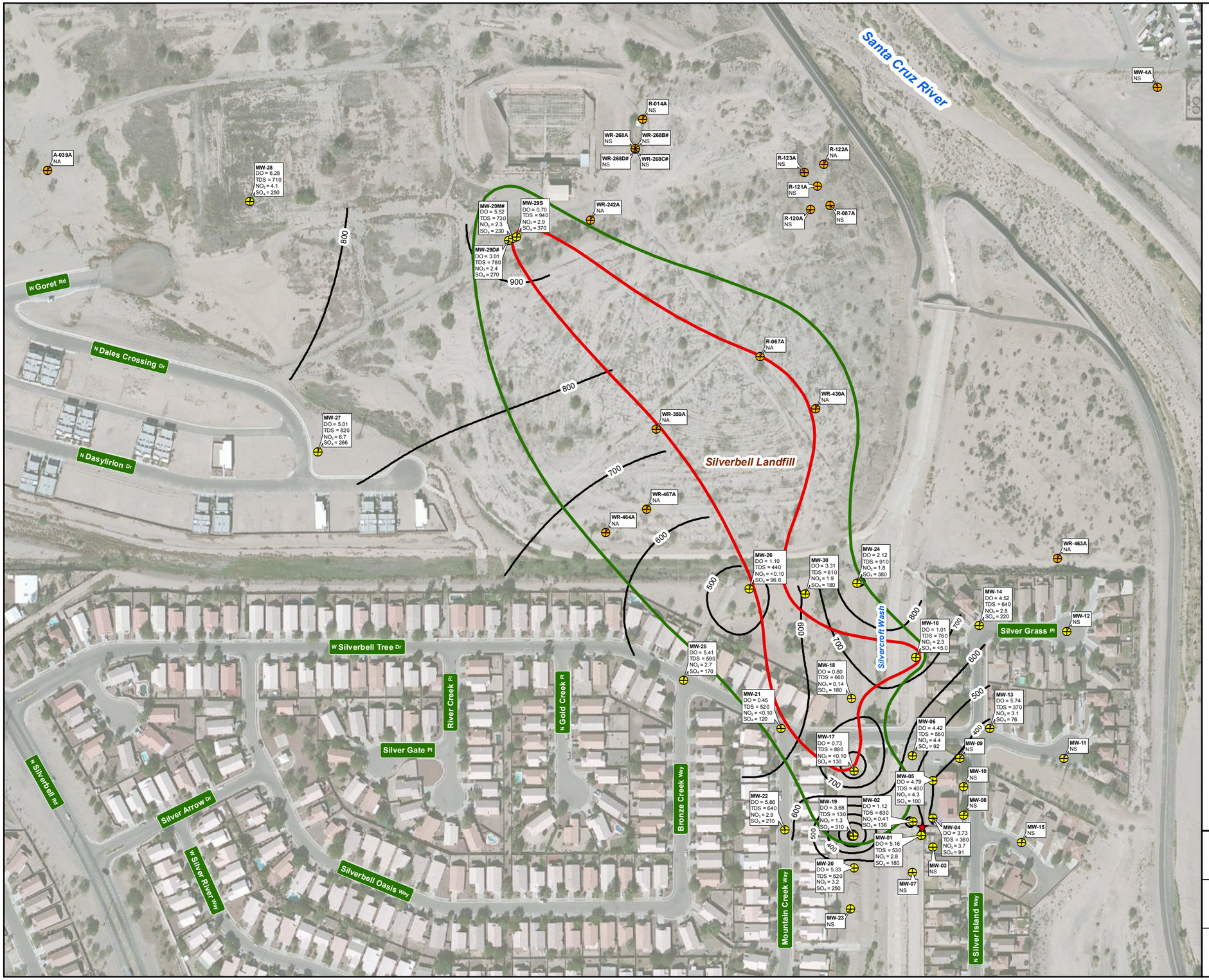
SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

NITRATE IN GROUNDWATER CONTOURS WITH MNA ANALYTICAL RESULTS, SECOND QUARTER 2015

ARCADIS

FIGURE 11

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\2015 Q2\Figure 09 NO3 contours Q2 2015.mxd 8/10/2015



LEGEND

- Release point
- Groundwater monitor well (monitored by ARCADIS)
- Groundwater monitor well (monitored by City of Tucson)
- TDS concentration contour
- Approximate extent of dissolved phase BTEX above AWQS
- Approximate extent of dissolved phase MTBE above 20 µg/L

NOTES

- Aerial photo source: ESRI World Imagery.
- Wells were sampled from 4/17/2015 to 4/23/2015 (ARCADIS wells) and from 4/21/2015 to 4/23/2015 (City of Tucson wells).
- Analytical results are expressed in milligrams per liter (mg/L).
- No wells contained light non-aqueous phase liquid (LNAPL) during the April 2015 monitoring event.
- MNA = monitored natural attenuation.
- DO = dissolved oxygen.
- TDS = total dissolved solids.
- NO_3 = nitrate.
- SO_4 = sulfate.
- # = well is screened at a greater depth and is not used in contouring.
- < = analyte not detected above indicated laboratory detection limit.
- NA = not analyzed for MNA parameters.
- NS = not sampled.

N

Feet
0 125 250
Scale: 1" = 250'

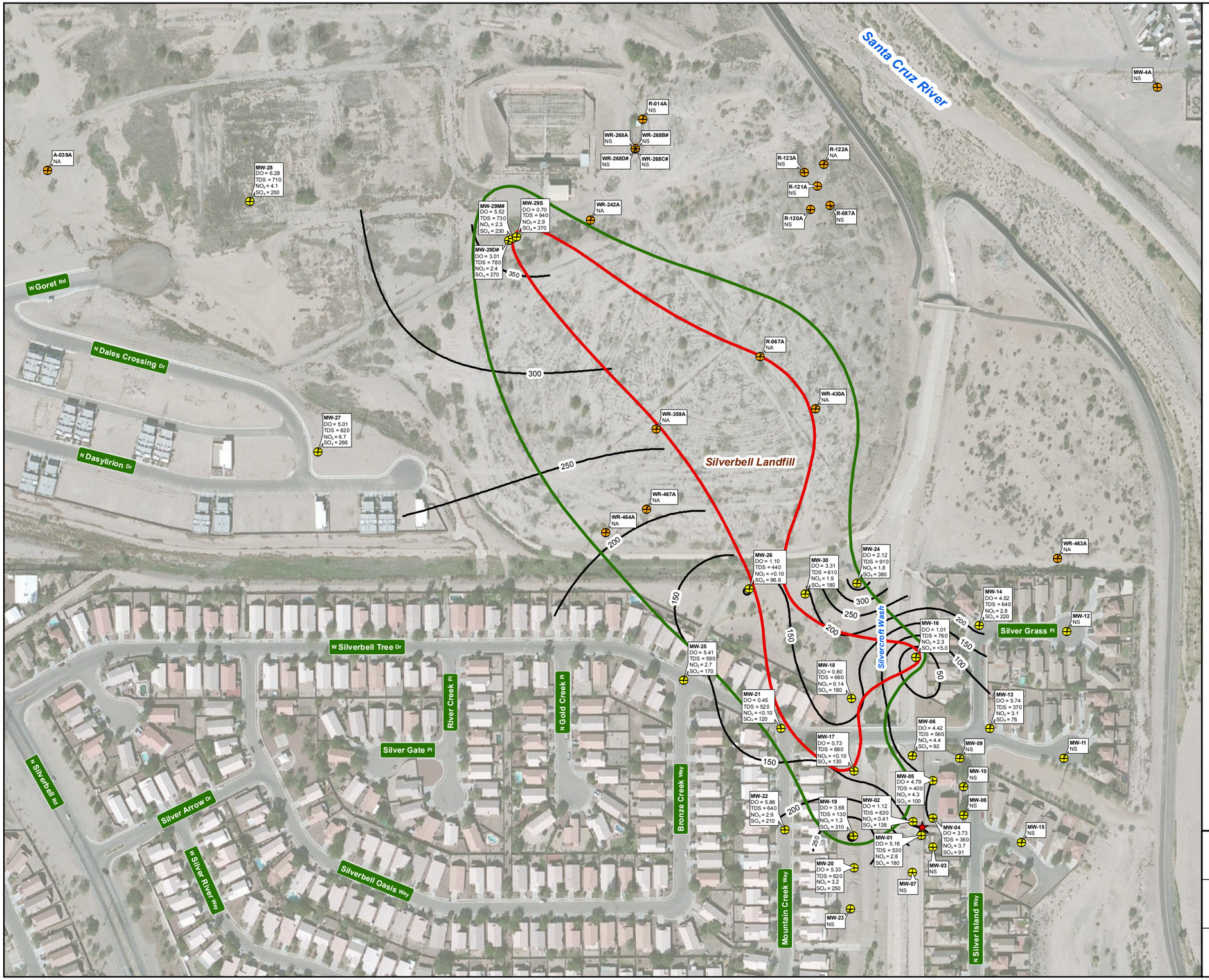
SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

TDS IN GROUNDWATER CONTOURS WITH MNA ANALYTICAL RESULTS, SECOND QUARTER 2015

ARCADIS

FIGURE
12

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\2015 Q2\Figure 08 TDS contours Q2 2015.mxd 8/10/2015



LEGEND

- Release point
- Groundwater monitor well (monitored by ARCADIS)
- Groundwater monitor well (monitored by City of Tucson)
- Sulfate concentration contour
- Approximate extent of dissolved phase BTEX above AWQS
- Approximate extent of dissolved phase MTBE above 20 µg/L

NOTES

- Aerial photo source: ESRI World Imagery.
- Wells were sampled from 4/17/2015 to 4/23/2015 (ARCADIS wells) and from 4/21/2015 to 4/23/2015 (City of Tucson wells).
- Analytical results are expressed in milligrams per liter (mg/L).
- No wells contained light non-aqueous phase liquid (LNAPL) during the April 2015 monitoring event.
- MNA = monitored natural attenuation.
- DO = dissolved oxygen.
- TDS = total dissolved solids.
- NO_3 = nitrate.
- SO_4 = sulfate.
- # = well is screened at a greater depth and is not used in contouring.
- < = analyte not detected above indicated laboratory detection limit.
- NA = not analyzed for MNA parameters.
- NS = not sampled.

N

Feet
0 125 250
Scale: 1" = 250'

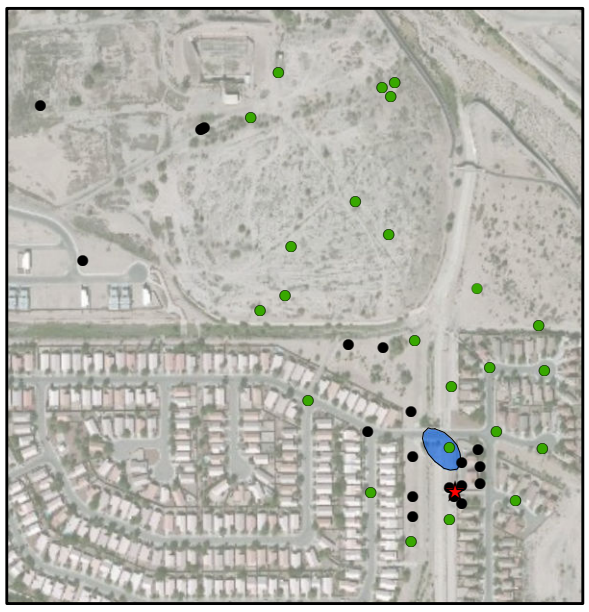
SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

SULFATE IN GROUNDWATER CONTOURS WITH MNA ANALYTICAL RESULTS, SECOND QUARTER 2015

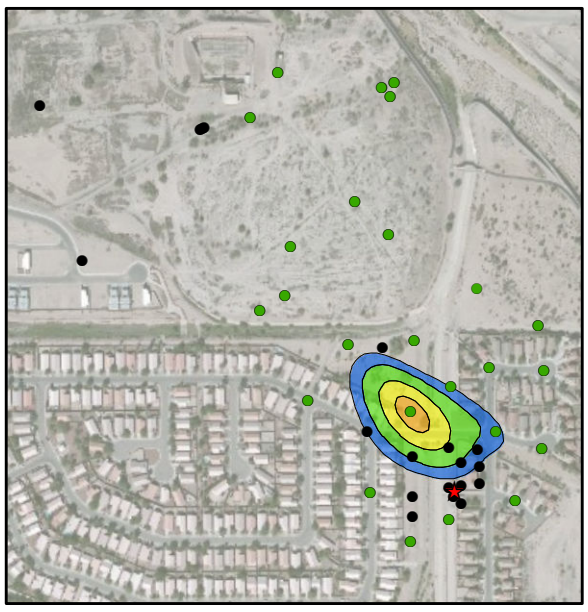
ARCADIS

FIGURE 13

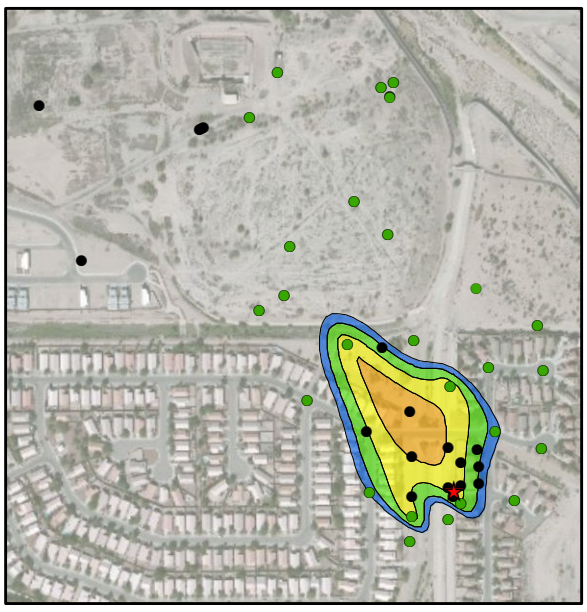
\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\2015 Q2\Figure 10 SO4 contours Q2 2015.mxd 8/10/2015



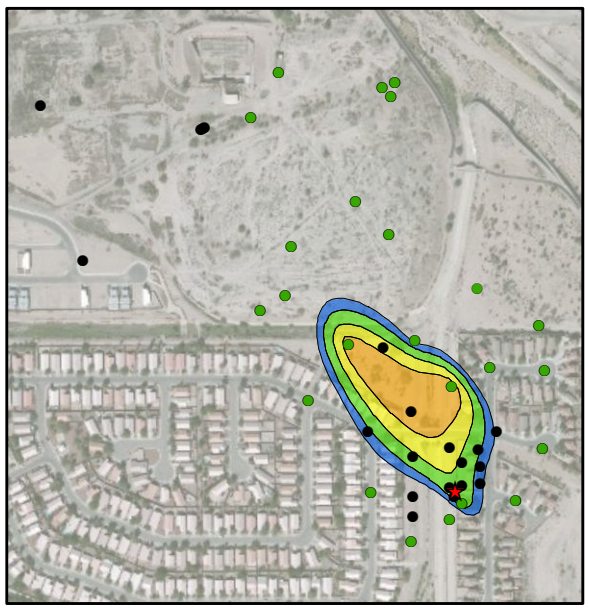
Q4 2003



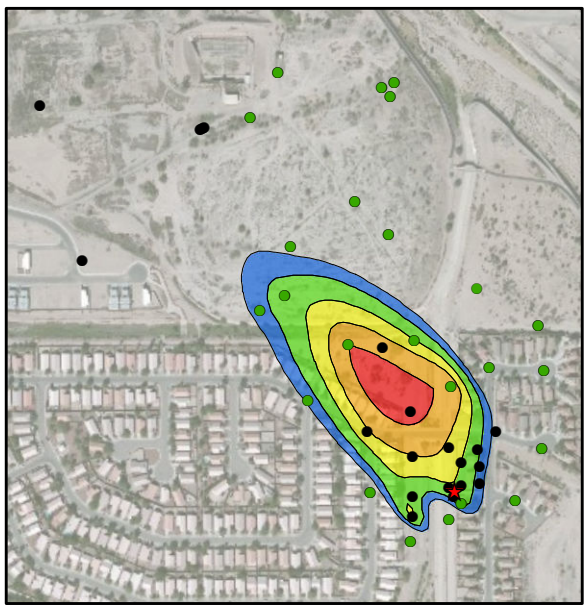
Q4 2004



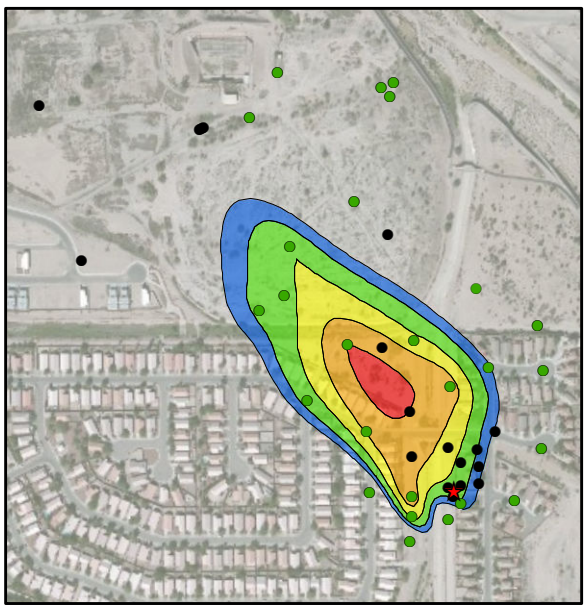
Q4 2005



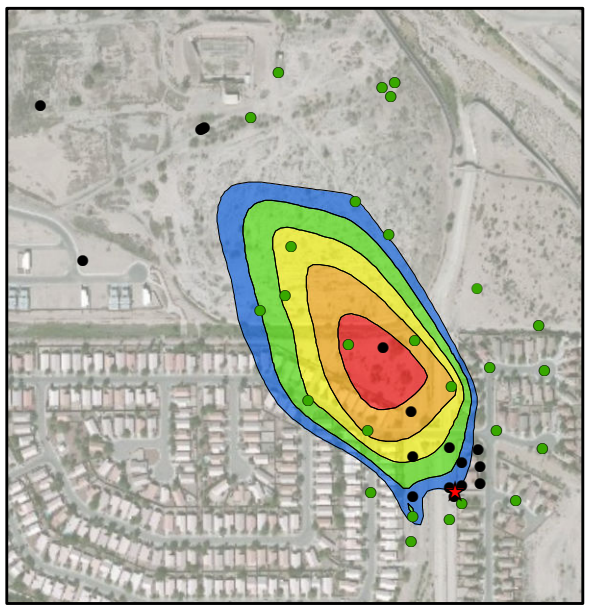
Q4 2006



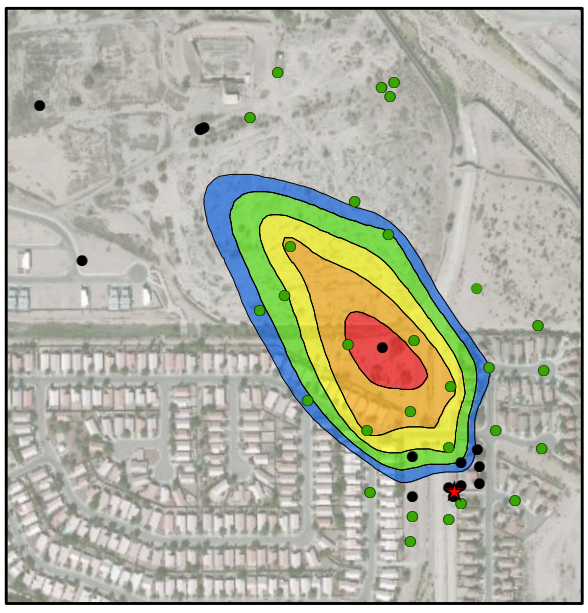
Q4 2007



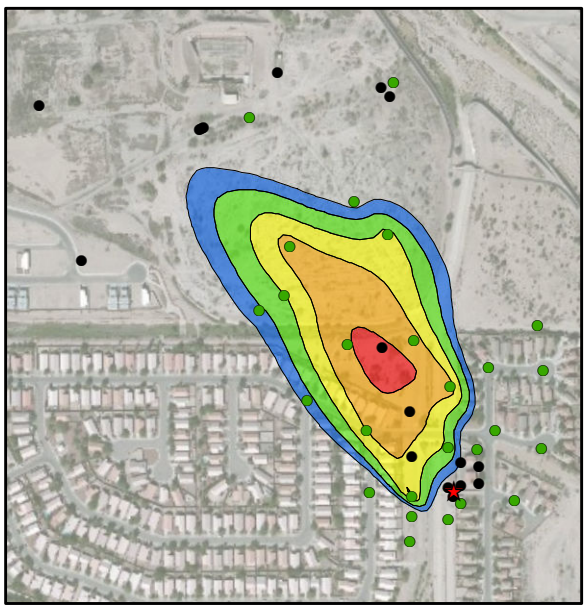
Q4 2008



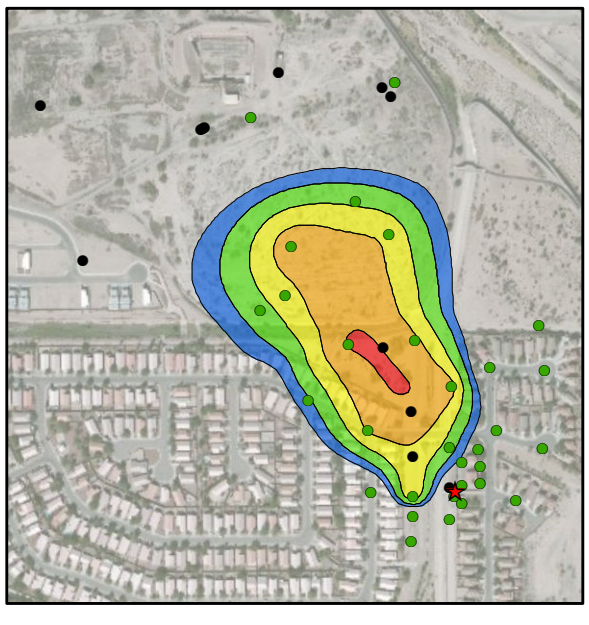
Q4 2009



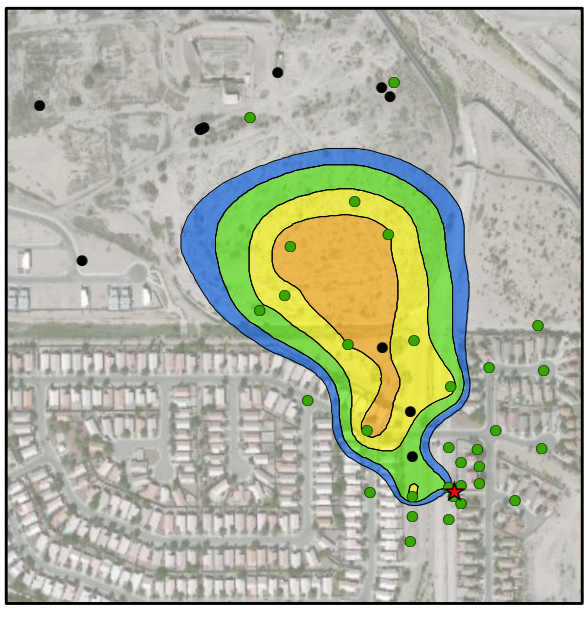
Q4 2010



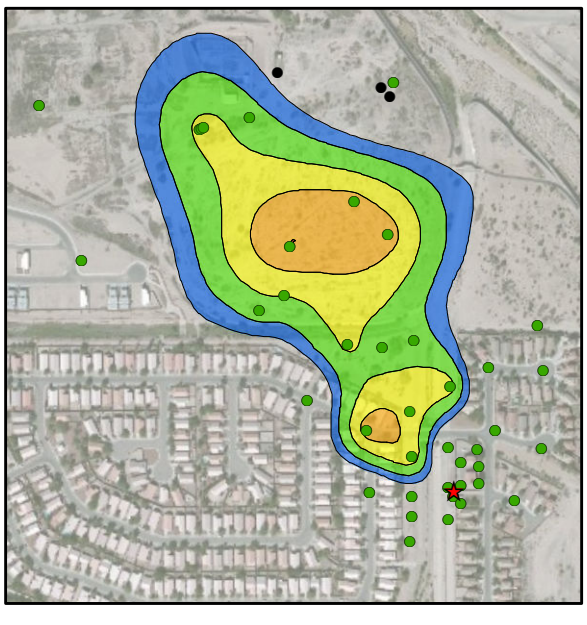
Q4 2011



Q4 2012



Q4 2013



Q4 2014

LEGEND

- Groundwater monitor well (sampled)
- Groundwater monitor well (not sampled)
- Release point

MTBE CONCENTRATIONS

- > 100,000 µg/L
- > 10,000 µg/L
- > 1,000 µg/L
- > 100 µg/L
- > 20 µg/L

NOTES

· Aerial photo source: ESRI World Imagery

Plumes calculated by kriging analytical data.

N

Feet
0 300 600
Scale: 1" = 600'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

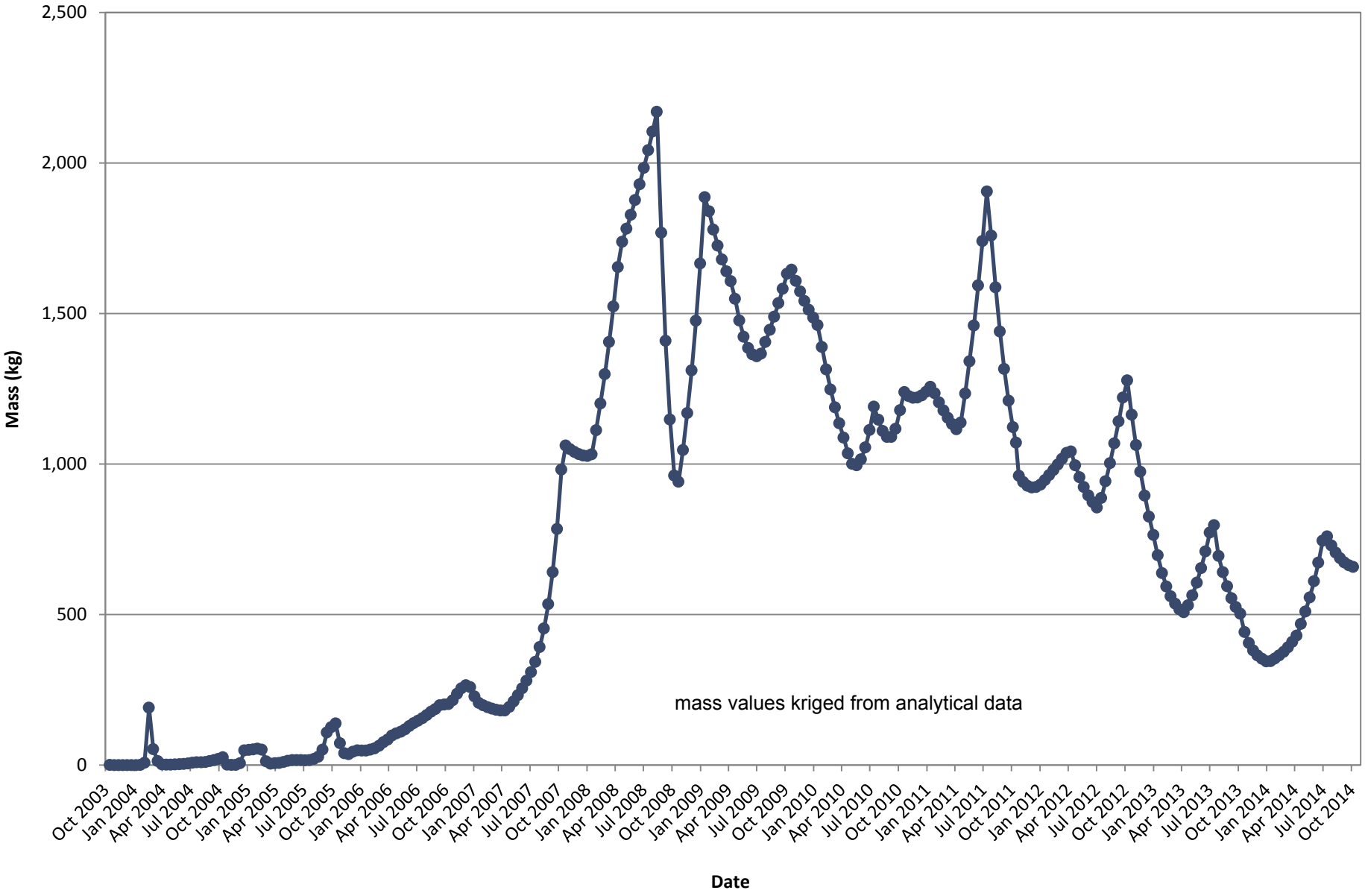
EVOLUTION OF MTBE PLUME, 2003-2014

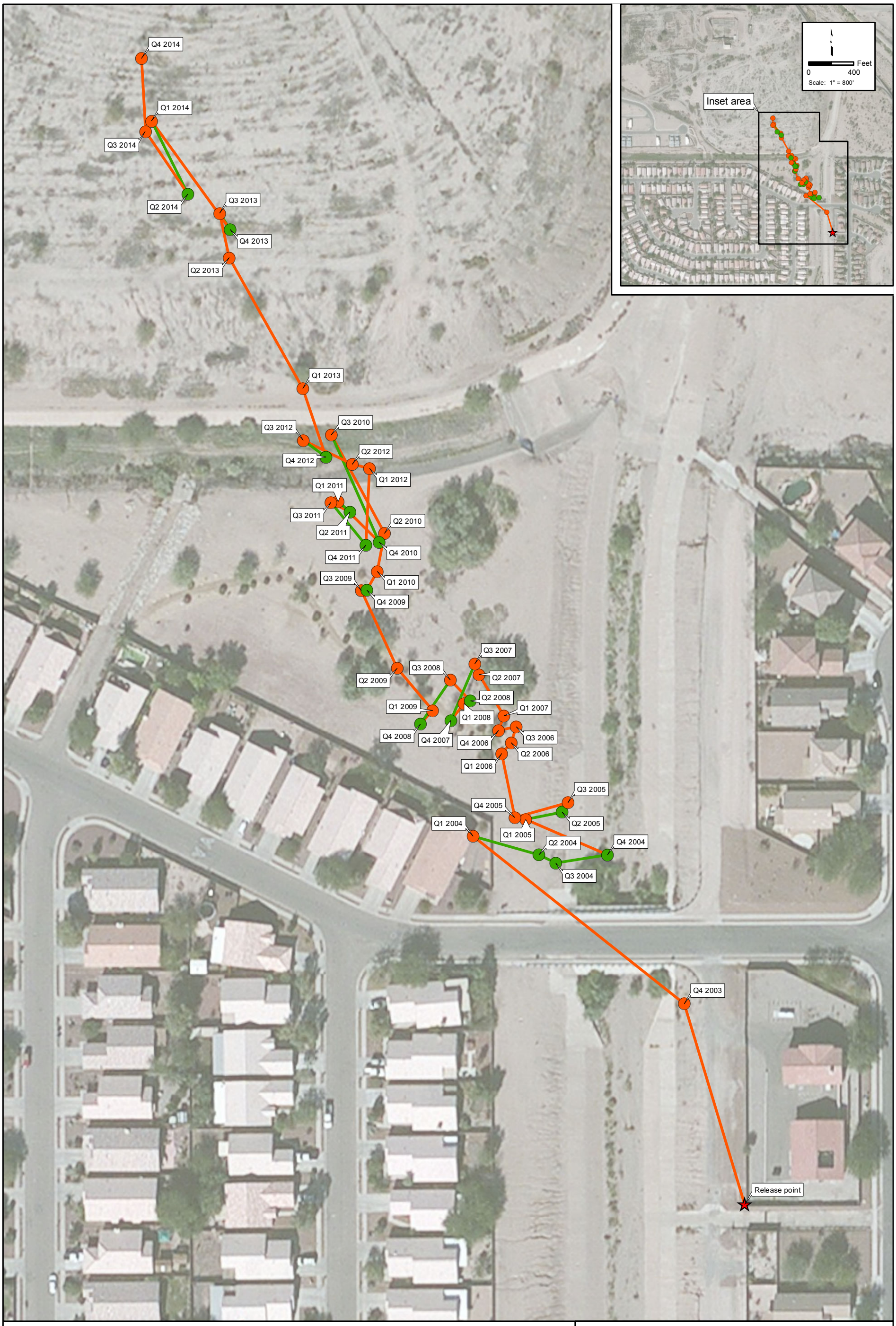
ARCADIS

FIGURE
14

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2014\Figure 14 MTBE plume evolution 2003-2014.mxd 2/5/2015

Figure 15
Dissolved-Phase MTBE Mass in Groundwater vs. Time
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona





LEGEND

- Release point
- Center of mass of MTBE in groundwater (advancing)
- Center of mass of MTBE in groundwater (retreating)
- Path of MTBE center of mass migration (advancing)
- Path of MTBE center of mass migration (retreating)

LEGEND

· Aerial photo source: ESRI World Imagery

Centers of mass calculated from kriged plumes.

N

Feet
0 40 80
Scale: 1" = 80'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

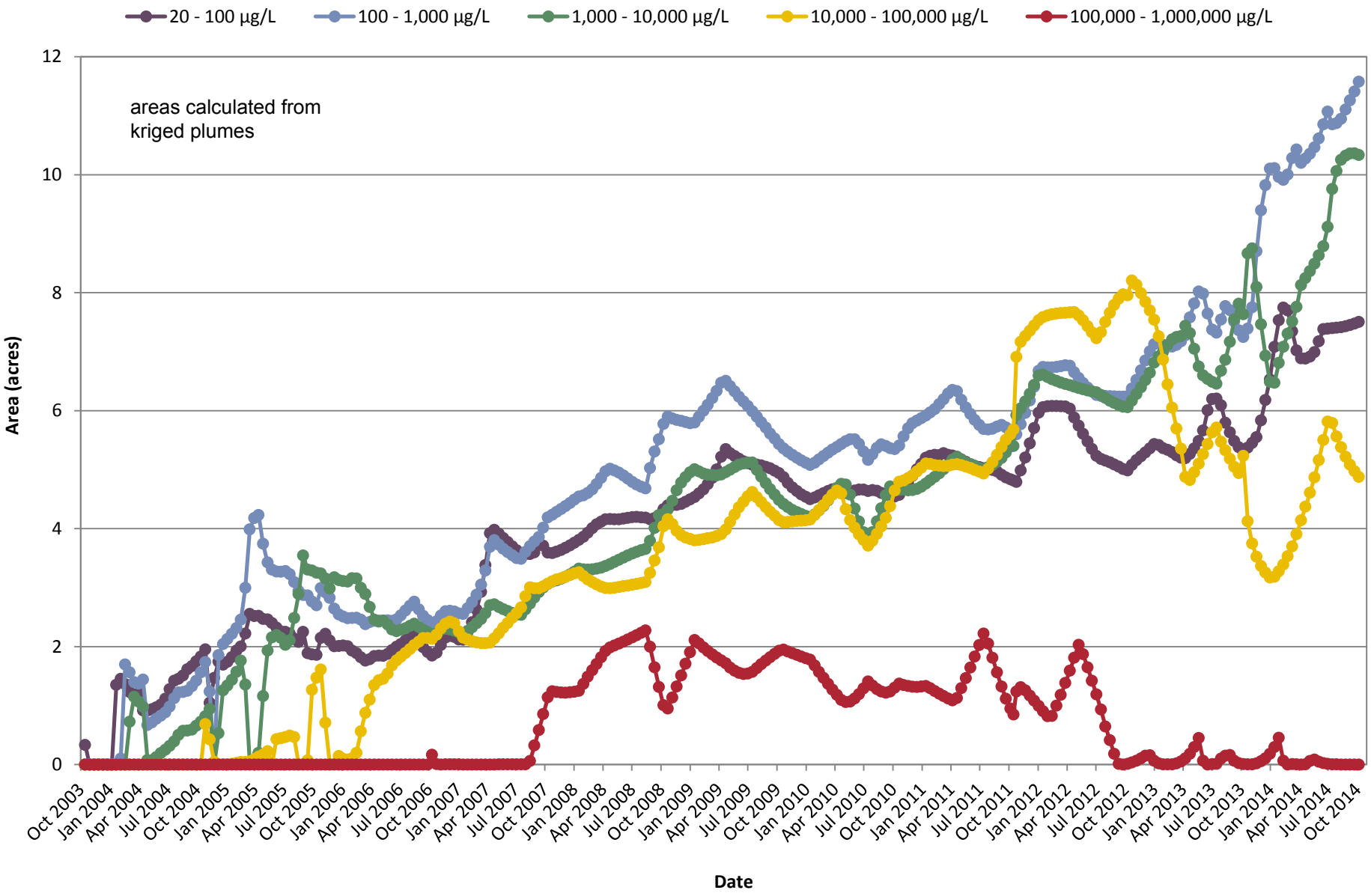
CENTER OF MASS OF MTBE IN GROUNDWATER 2003-2014

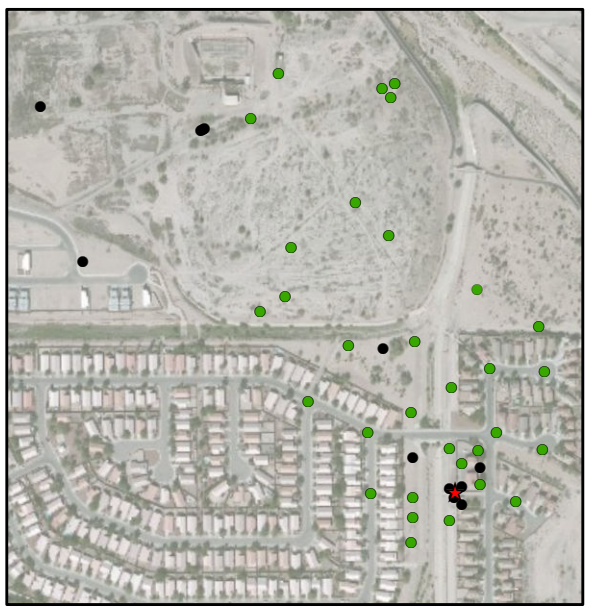
ARCADIS

FIGURE
16

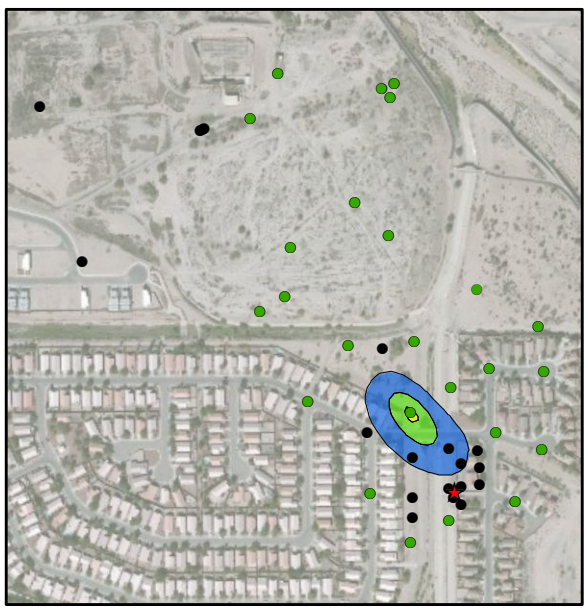
\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2014\Figure 16 MTBE center of mass migration 2003-2014.mxd 2/5/2015

Figure 17
MTBE Concentration Band Areas vs. Time
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

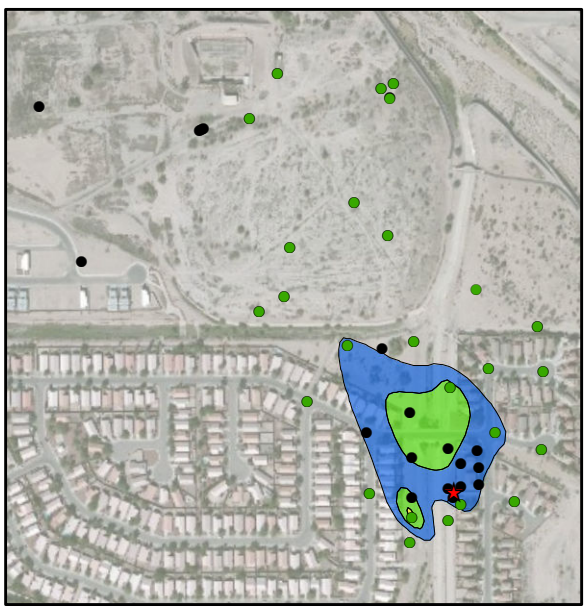




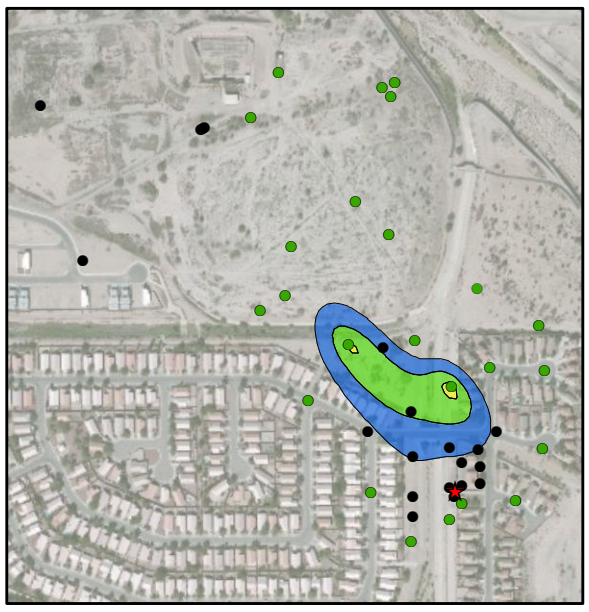
Q4 2003



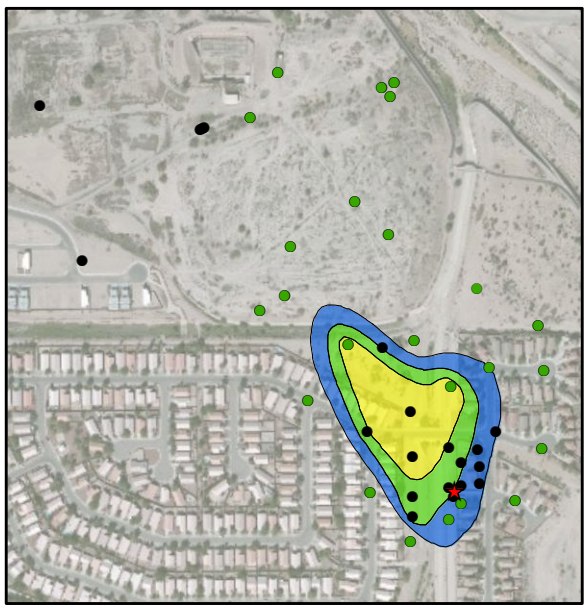
Q4 2004



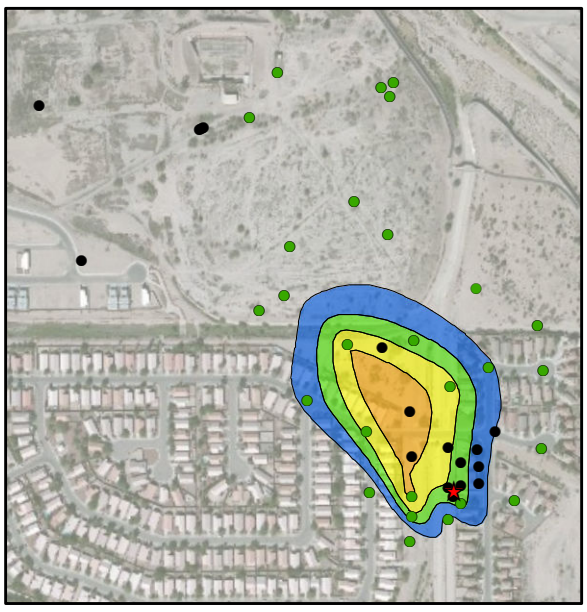
Q4 2005



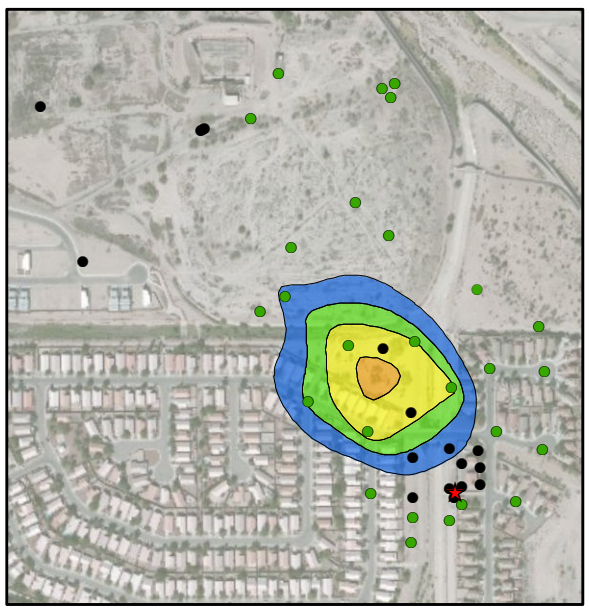
Q4 2006



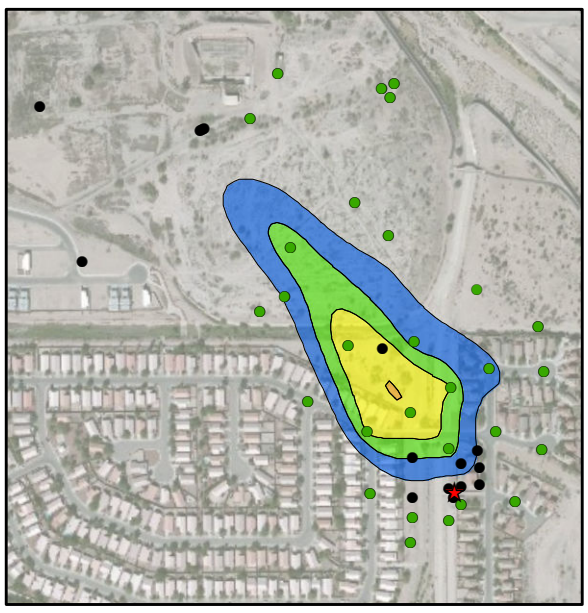
Q4 2007



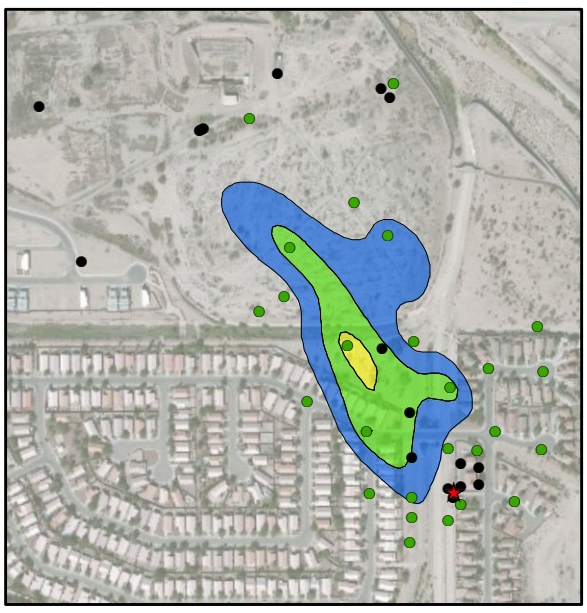
Q4 2008



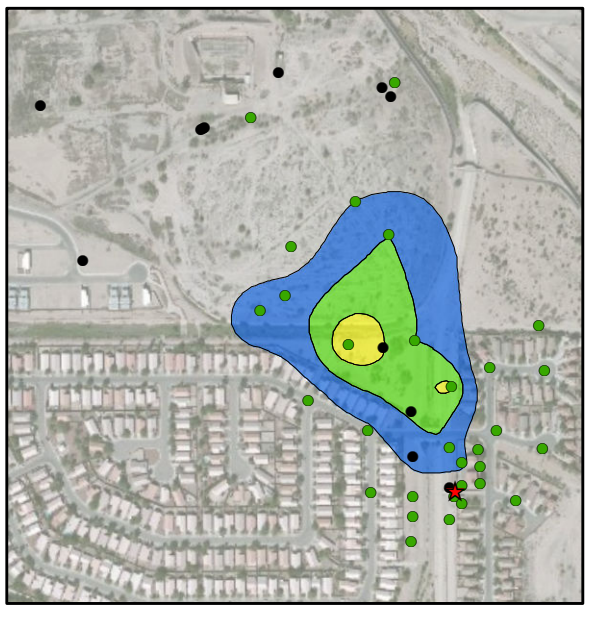
Q4 2009



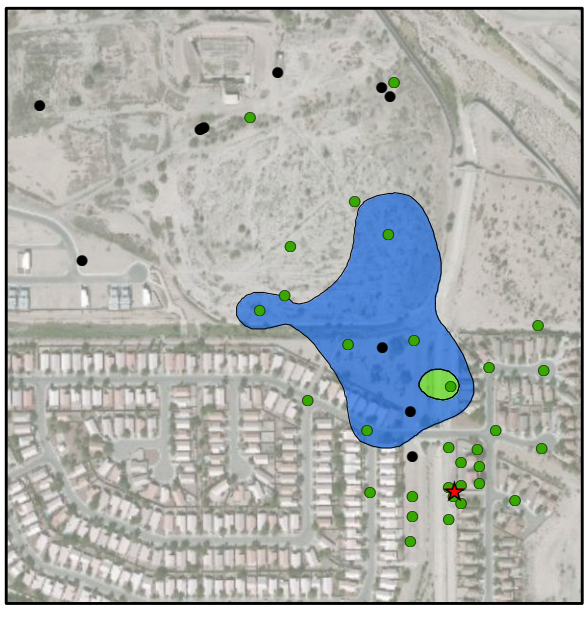
Q4 2010



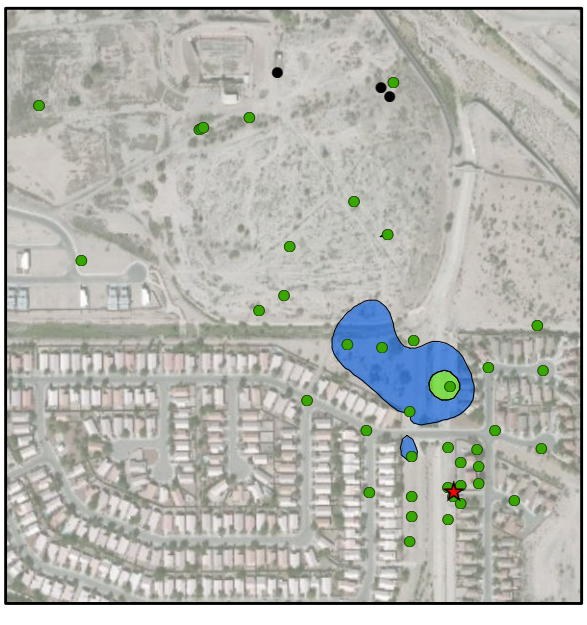
Q4 2011



Q4 2012



Q4 2013



Q4 2014

LEGEND

- Groundwater monitor well (sampled)
- Groundwater monitor well (not sampled)
- Release point

BENZENE CONCENTRATIONS

- > 100,000 µg/L
- > 10,000 µg/L
- > 1,000 µg/L
- > 100 µg/L
- > 5 µg/L

NOTES

· Aerial photo source: ESRI World Imagery

Plumes calculated by kriging analytical data.

N

0 400 800 Feet

Scale: 1" = 800'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

EVOLUTION OF BENZENE PLUME, 2003-2014

ARCADIS

FIGURE
18

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2014\Figure 18 benzene plume evolution 2003-2014.mxd 2/5/2015

Figure 19
Dissolved-Phase Benzene Mass in Groundwater vs. Time
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

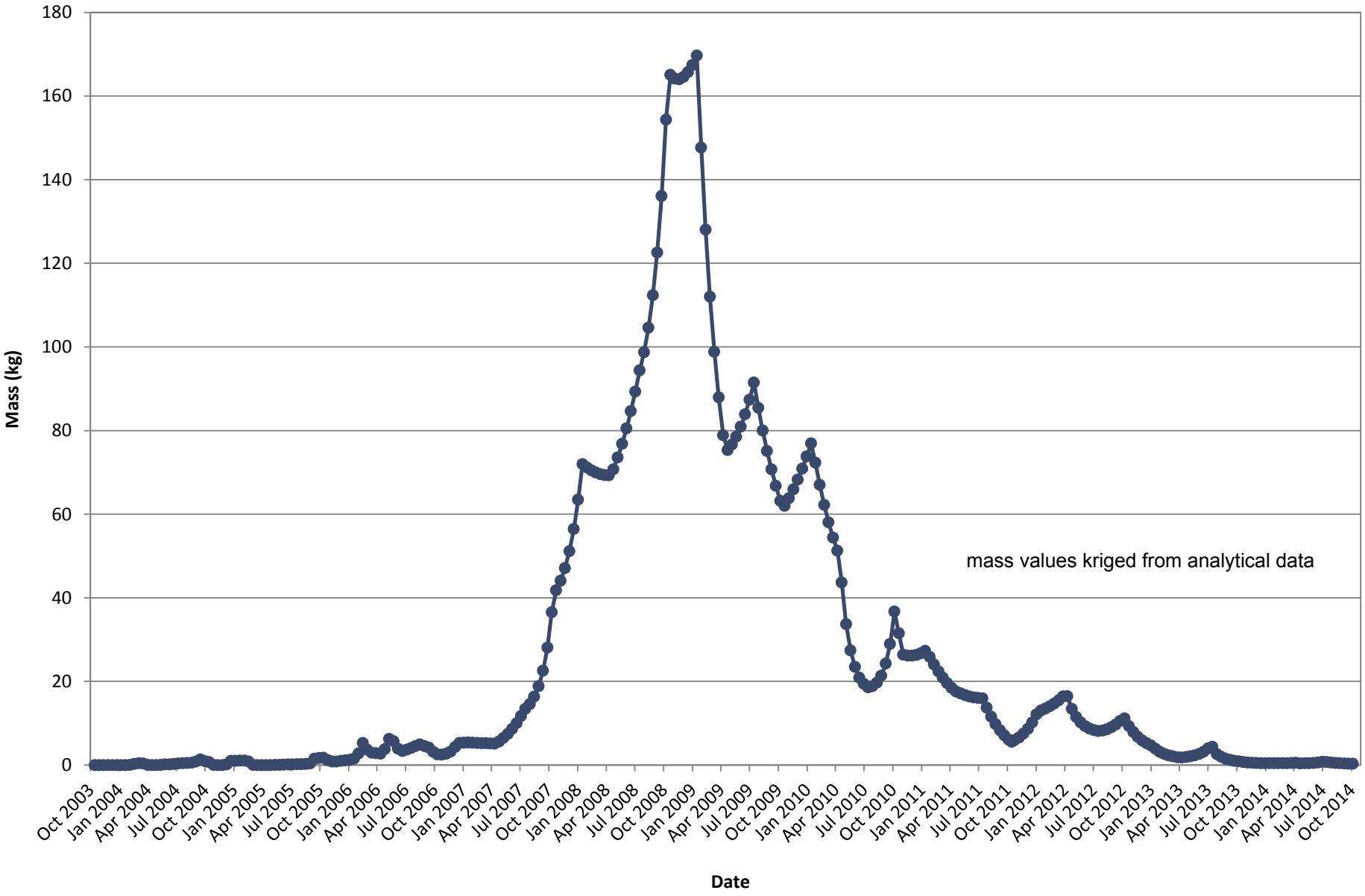


Figure 20
MTBE and TBA Concentrations vs. Time in MW-24
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona

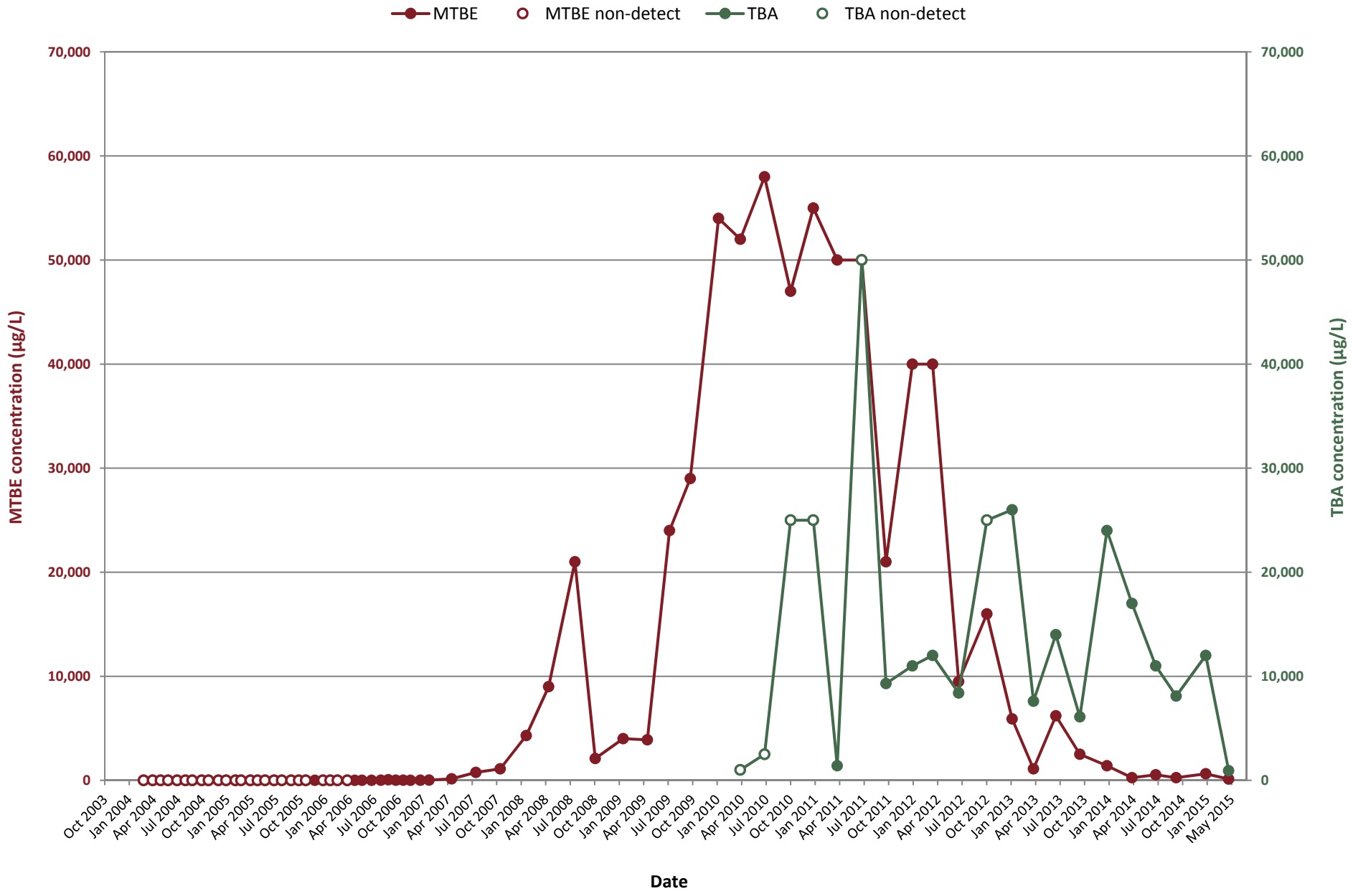
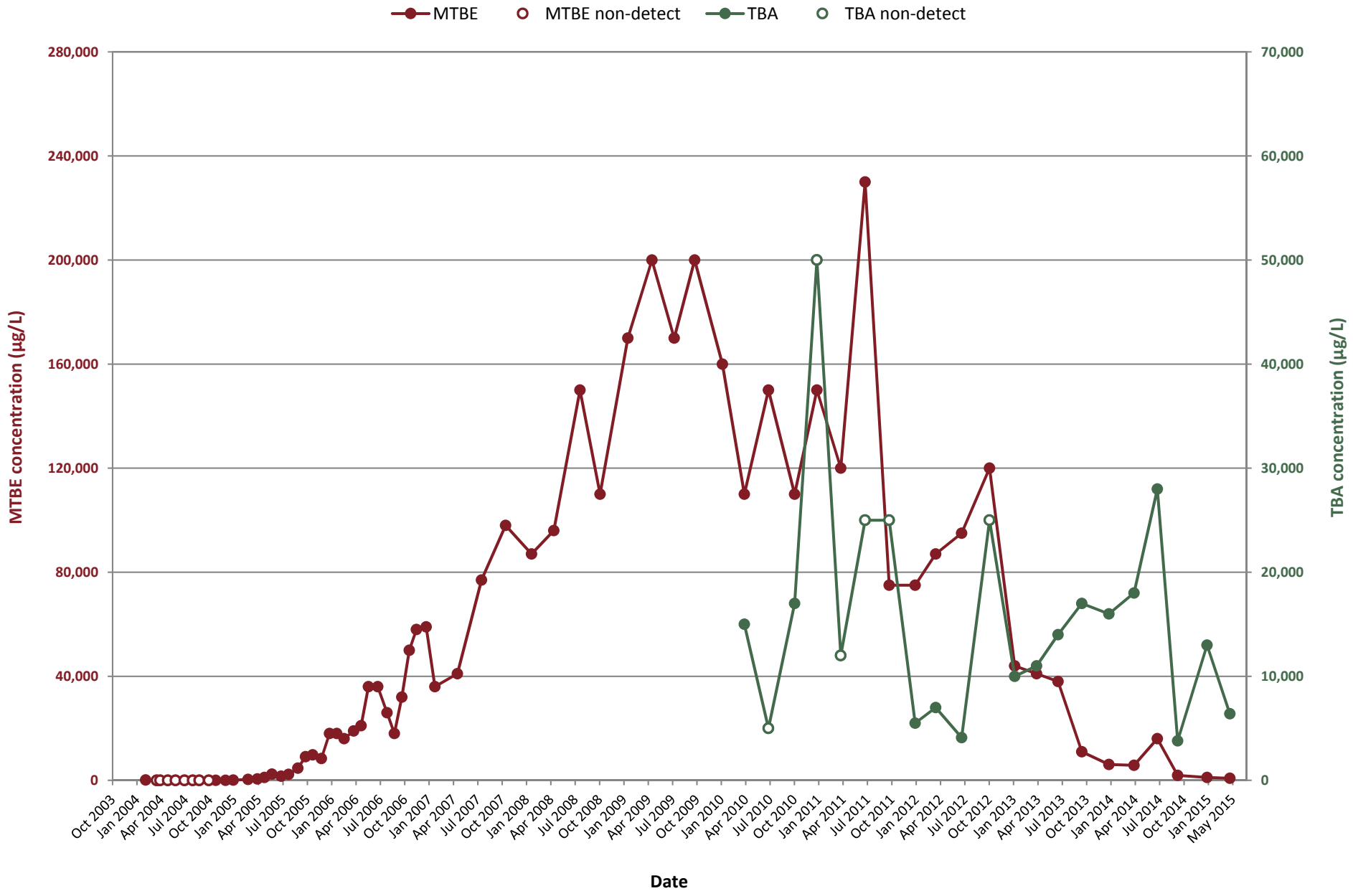
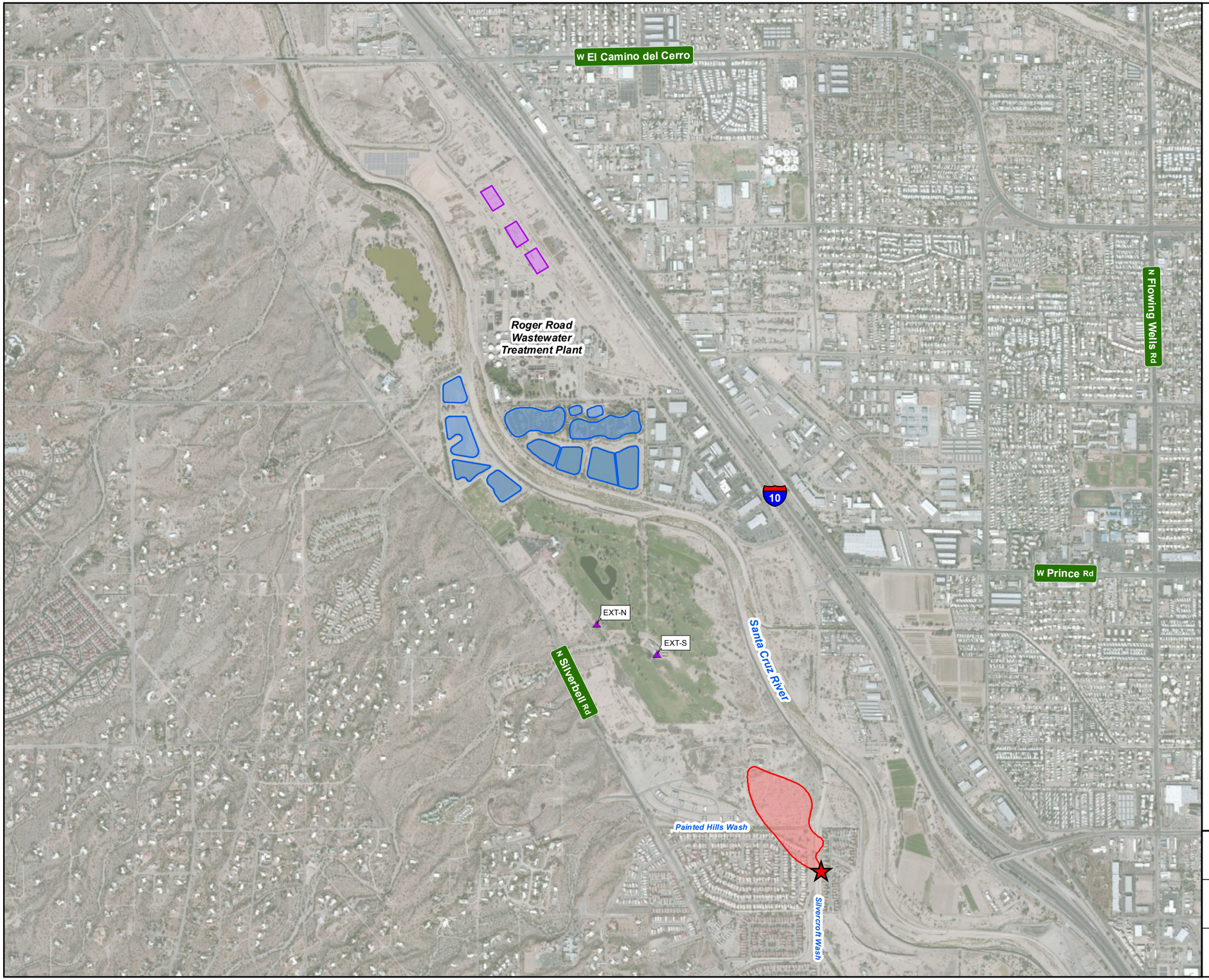


Figure 21
MTBE and TBA Concentrations vs. Time in MW-26
SFPP, L.P.
Silvercroft Wash Release Site, Tucson, Arizona





LEGEND

- Silvercroft Wash release site
- Sweetwater Recharge Facility (existing recharge basin)
- Sweetwater Recharge Facility (future recharge basin)
- Proposed COT groundwater extraction well
- Approximate extent of dissolved-phase MTBE above 20 µg/L (Q4 2014)

NOTES

· Aerial photo source: ESRI World Imagery.
· COT = City of Tucson.

N

Feet
0 750 1,500
Scale: 1" = 1,500'

SILVERCROFT WASH RELEASE SITE
TUCSON, ARIZONA
REMEDIAL INVESTIGATION REPORT

PROPOSED CITY OF TUCSON EXTRACTION WELL LOCATIONS

ARCADIS

FIGURE
22

\\Scottsdale-AZ\Project\KMEP (Kinder Morgan Energy Partners)\10022-Silvercroft Wash\GIS\Projects\RI report 2014\Figure 22 proposed extraction wells Q4 2014.mxd 2/5/2015