NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
Colleen Cripps, Ph.D., Administrator

April 15, 2015

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Re: **BMI Plant Sites, Common Areas Projects and Other Industrial Sites, Henderson, Nevada**
Draft Up-Gradient Groundwater Quality Technical Memorandum for TDS, Arsenic and Perchlorate

Dear Messrs.:

All of the parties listed above shall be referred to as "the Companies" for the purposes of this letter. The NDEP has prepared a Draft Up-Gradient Groundwater Quality Technical Memorandum for TDS, Arsenic and Perchlorate (attachment A). This work was performed as a part of the NDEP's January 21, 2014 Regional Groundwater Goals and Directives letter (attachment B). The NDEP has provided this evaluation to the Companies in draft form and requests that any comments or concerns be submitted to the NDEP for consideration within 60 days and not after June 15, 2015.

Please contact the undersigned with any questions at jdotchin@ndep.nv.gov or 702-486-2850 Ext. 235.

Sincerely,

James (JD) Dotchin
Supervisor, Special Projects Branch
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NDEP-Las Vegas

JD:jd

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Kurt Fehling, The Fehling Group
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Michael Long, Hargis + Associates
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Paul Black, Neptune and Company, Inc.
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cc: David Sadoff, AIG Consultants, Inc., 121 Spear Street, 3rd Floor, San Francisco, CA 94105
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"Attachment A"

BMI Regional Goals and Directives

1. Containment of identified contaminants of potential concern (COPCs) at site property boundaries for groundwater above remediation standards will be a required performance measure for any selected long term groundwater remedy.
    a. Property boundary is the legal property boundary
    b. Remediation Standards will be defined as either BCL's or Background
2. Ultimate Remedial Action Objective (RAO) is to permanently restore the down gradient aquifer from site property boundaries to the Las Vegas Wash (the Wash) to below remediation standards.
3. All remedy evaluations must address all contaminants of potential concern (COPCs) discovered on the individual properties regardless of origin of these chemicals, including alleged trespass contaminants.
    a. All COPC's on site including regional indicator chemicals must be considered when evaluating and selecting a groundwater remedy
    b. Shallow water bearing zone should be the focus of the groundwater remedy, Middle and Deeper water bearing zones will be evaluated for potential vertical migration and impact to the Shallow water bearing zone. If these deeper water bearing zones are shown to significantly impact the Shallow Zone a groundwater remedy may be required for these deeper zones or locations where they interface with the Shallow Zone.
    c. Responsibility for implementation and/or cost of ultimate long term groundwater remedy implementation operation and maintenance for alleged trespass contaminants will be addressed on a site by site basis, after remedy evaluation is completed.
4. Long term remedy evaluations can assume containment of COPC's at the up-gradient property boundaries for additional trespass contaminants. Alternatively the NDEP would consider a joint remedial option.
5. Up-gradient groundwater quality (i.e. CLO4, As, TDS)
    a. NDEP will develop and defend the definition of up-gradient groundwater quality.
    b. Costs for this activity may be apportioned as an All Company Task.
    c. Up-gradient groundwater quality may be different at each facility/property and may influence complex wide RAOs.
    d. If up-gradient GW exceeds remediation standards this will be considered with regards to site wide and downgradient RAOs.
6. In off-property areas where plumes are likely co-mingled, NDEP is developing a list of regional indicator chemicals, to serve as surrogates and drivers for determining whether individual plant site remedies are cumulatively protective and will achieve the off-site remedial action objective of aquifer restoration
7. In downgradient areas, NDEP will be evaluating the performance of achieving the remedial action objective along certain transect points of compliance. Performance metrics will likely include statistical evaluation of groundwater concentration trends, annual estimates of contaminant flux, hydraulic containment evaluations, mass discharge, and mass removal rates. Current transects being considered are:
        1. Property boundaries,
        2. Warm Springs Road,
        3. Galleria Drive/Athens Road (likely), and

4. Immediately up-gradient of the Las Vegas Wash.

8. Downgradient areas of the facilities site boundaries will be evaluated to determine the need for additional assessment or corrective actions after groundwater remedies are in place. If allocations are not developed by the companies; NDEP may perform work and seek reimbursement from the companies.
    a. Ecological risk would be considered after restoration of downgradient aquifer has been demonstrated or as a portion of the feasibility study (FS) under protectiveness and effectiveness.
    b. The groundwater (GW) remedy evaluation must also consider the vapor intrusion pathway in off-site areas.

HACKENBERRY ASSOCIATES, LLC

Technical Memorandum

To:	Kurt Fehling, Kirk Stowers, and JD Dotchin
From:	Paul S. Hackenberry, Jr., C.E.M. #1823 (Exp. 4/15/2015) Paul K. Black, PhD, Neptune & Company, Inc. Anna L. Springsteen, MS, Neptune & Company, Inc.
Deliverable reviewed:	Up-Gradient Groundwater Review
Deliverable date:	February 27, 2015

Background

The up-gradient groundwater review for TDS, arsenic, and perchlorate was initiated in response to the Nevada Division of Environmental Protection's (NDEP's) BMI Regional Goals and Directives letter sent to Basic Remediation Company, Olin Corporation, NV Environmental Response Trust, Montrose Chemical Corporation of CA, Stauffer Management Company, LLC, and Titanium Metals Corporation (TIMET), herein referred to as the BMI Companies. In the communication to the BMI Companies the NDEP stated that it would "...develop and defend the definition of up-gradient groundwater quality" in terms of total dissolved solids (TDS), perchlorate, and arsenic (NDEP, 2013 and 2014). The NDEP, also, noted that groundwater quality might be different for each site and that if up-gradient groundwater exceeded remediation standards this would be considered with regards to site wide and down gradient Remedial Action Objectives (RAOs) (NDEP, 2013 and 2014).

Groundwater and Well Data Sources

The NERT online groundwater database was used to develop the list of wells and compile data for TDS, arsenic, and perchlorate. The NERT online database, which is maintained by Neptune and Company, Inc. (Neptune) includes:

1. all groundwater data submitted to Neptune through DVSRs, and
2. the "All Wells database," which is maintained by the BMI Companies for construction details and other well-specific information.

Selection Criteria for Up-Gradient Wells

In reviewing the online database it was apparent that to obtain appropriate groundwater well data for graphical presentation and statistical summaries some selection criteria were needed to identify suitable up-gradient wells. Five criteria were established to select data from the NERT online database:

1. Wells must have samples collected after 2004, because this was when sampling and analysis plans became consistent site wide;

2. Wells must have more than one sample for each of the three analytes (TDS, perchlorate, and arsenic);
3. Wells must be located along the east, south, or west perimeter of company properties;
4. Wells located in alluvium, transitional Muddy Creek formation (xMCf), Upper Muddy Creek formation (UMCf) must be screened in a shallow or middle water bearing zone; and
5. Wells must be no deeper than 100 ft.

The date range 2004-2013 was selected because it included wells across the BMI Companies and the former Upper Ponds area. In total 16 up-gradient and cross-gradient wells were selected for review as listed below and shown in Figure 1.

1. AA-MW-05
2. AA-MW-24
3. AA-UW2
4. AA-UW3
5. AA-UW4
6. AA-UW5
7. DBMW-16
8. DBMW-17
9. H-11
10. HMWWT-6
11. MCF-03B
12. MW-01
13. TMMW-101
14. TMMW-102
15. TMMW-103
16. TMMW-104

Data Validation Status

The validation status of data selected for the up-gradient groundwater analysis was reviewed to confirm that the sleceted data are considered useable. Three data validation fields (validation flag, validation level, and final validation qualifier) were examined to determine validation percentage. On this basis, TDS data validation was 90% of the data used; arsenic data validation was 100% of the data used; and perchlorate data validation was 89% of the data used. The non-validated portion of the TDS and perchlorate data is because the validation fields were blank; however, it does not mean that these data non-validated.

Methods for TDS, Arsenic, and Perchlorate Review

The review of up-gradient groundwater for TDS, arsenic, and perchlorate was conducted using spatial data plots, box plots, and quantile plots (EPA, 2006). The spatial plots display the data on a map that shows the BMI Industrial area and former Upper and Lower Ponds. The numbers on the legend reflect the minimum; the 25th, 50th, 75th, and 90th percentiles; and the maximum. The foregoing scale provides context to relate to the box plots and quantile plots. The box plots provide a visual summary of the data distribution, displaying the minimum; 25th, 50th, and 75th percentiles; and maximum. The quantile plots include the following: minimum; 25th, 75th, and 90th percentiles; median, average, geomean; and maximum. The plots are attached organized first by analyte (TDS, arsenic, and perchlorate) and then by plot type (spatial plot, box plot, and quantile plot).

TDS Summary

The regional distribution for TDS is shown in the attached bubble plot. The spatial data plot identifies the up-gradient wells used herein for the review. The color intensity and size of the bubble points reflects the average concentration recorded in each well. The spatial plot shows relatively high concentrations on the plant site (often greater than 3,000 mg/L), and a few very high concentrations to the north of the Upper and Lower Ponds. The upgradient wells exhibit lower concentrations in general, confirming their representation of upgradient (background) conditions. The box plots show large differences between some of the wells, suggesting, perhaps that wells AA-UW2, AA-UW3 and AA-UW4 do not represent background conditions (concentrations near or greater han 4,000 mg/L). The data for the remaining wells are all considerably less than 3,000 mg/L. The quantile plot shows that the minimum value from this upgradient data set was 550 mg/L; the maximum was 7,000 mg/L; and the 90th percentile is 2,900 mg/L. The upper end of up gradient and of background excluding wells AA-UW2, AA-UW3 and AAUW-4 appears to be about 3,000 mg/L. The EPA TDS secondary water quality standard is 500 mg/L.

Arsenic Summary

The regional distribution for arsenic is shown in the attached spatial plot. The spatial data plot highlights the up-gradient wells used herein for the evaluation. The upgradient wells appear to represent lower concentrations than those observed from wells on the BMI Complex, however, wells to the west of the BMI Complex appear to exhibit lower concentrations again, suggesting, perhaps, that these upgradient wells exhibit some elevated arsenic concentrations. The box plots show that wells AAUW-4 and MCF-03B have the highest values for the up-gradient wells, generally greater than 80 µg/L. The quantile plot shows that the minimum value reported was less than 1 µg/L; the maximum was 97 µg/L; and the 90th percentile is 59 µg/L. The upper end of up gradient and of background appears to be about 60 µg/L. The EPA current MCL is 10 µg/L and the former MCL was 50 µg/L.

Perchlorate Summary

The regional distribution for perchlorate is shown in the attached spatial plot. The spatial data plot identifies the up-gradient wells used herein for the evaluation. The spatial plot shows high concenrtations on the NERT property, and comparatively low concentrations in the selected upgradient wells. The quantile plot shows that the reported minimum value was less than 1 µg/L; the maximum was 7,600 µg/L; and the 90th percentile is 397 µg/L. Wells TMMW-102, TMMW-103, H-11, and MW-01 have the highest values for the up-gradient wells, generally greater than 1,000 µg/L. A reasonable upper end of the upgradient data appears to be somewhere in the range of 400 µg/L to several thousand mg/L. However, the box plots suggests the background levels are considerably less, and probably do not exceed about 250 µg/L. The data for perchlorate in particular indicate that the perchlorate impacted groundwater has extended beyond these up-gradient wells. The Nevada provisional standard is 18 µg/L.

References

Nevada Division of Environmental Protection, 2013. *Regional Groundwater Response to Comments & NDEP Proposed BMI Regional Groundwater Goals and Directives*. BMI Plant Sites, Regional Area and Common Areas Projects, Henderson, Nevada. October 1.

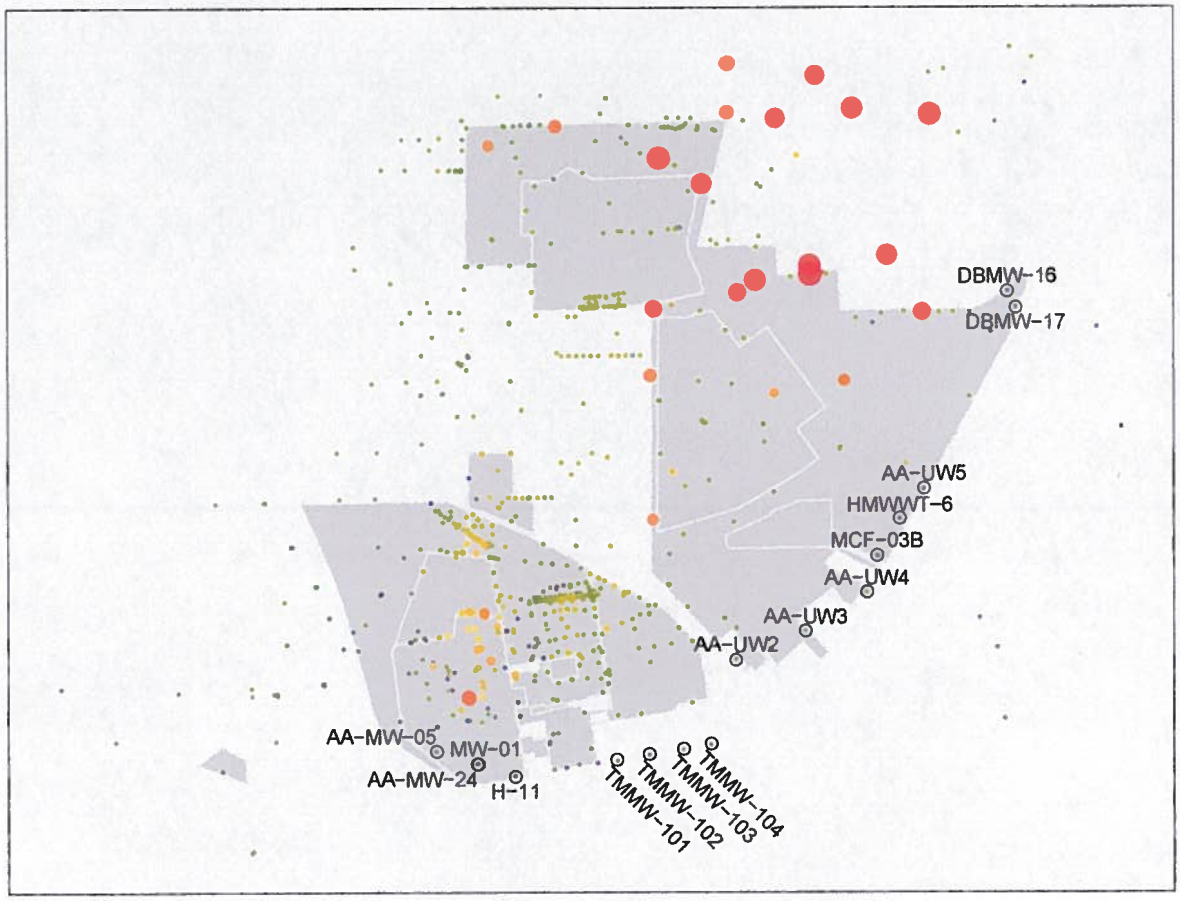
Nevada Division of Environmental Protection, 2014. NDEP BMI Regional Groundwater Goals and Directives. BMI Plant Sites, Regional Area and Common Areas Projects, Henderson, Nevada. January 21.

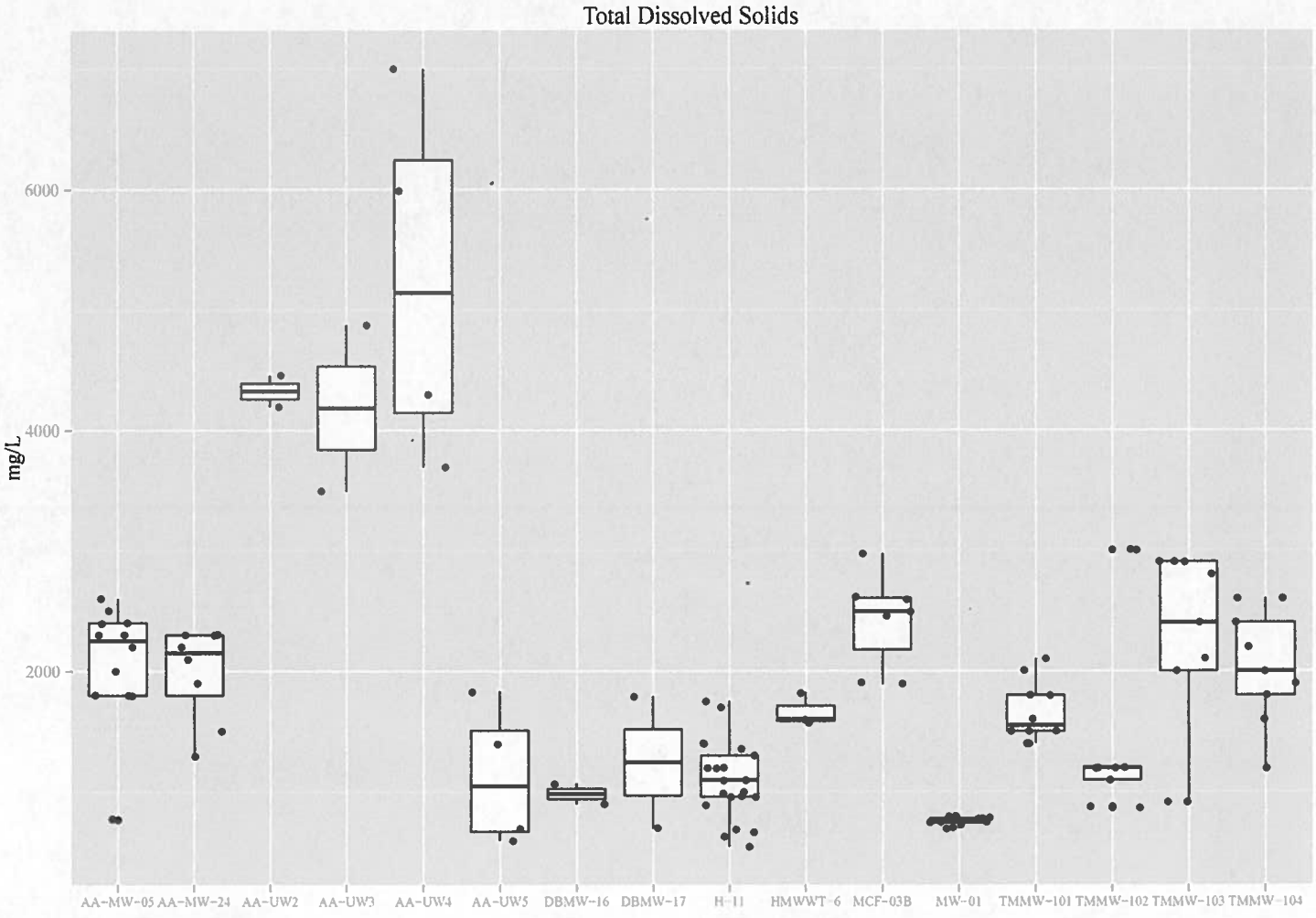
U.S. EPA, 2006. Data Quality Assessment: Statistical Methods for Practioners, EPA QA/G-9S. Office of Environmental Information, Washington, D.C. EPA/240/B-06/003. February.

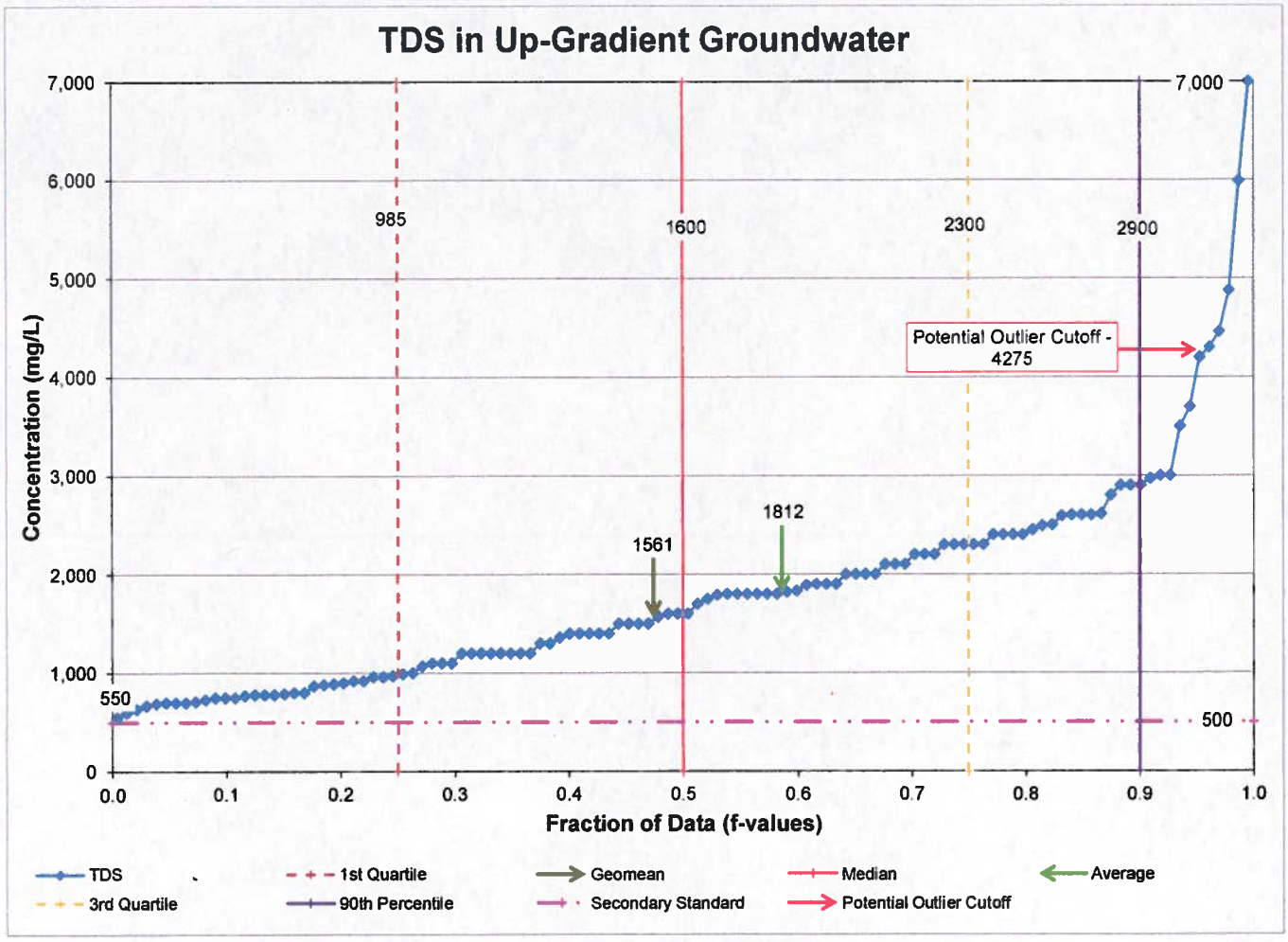
TDS

Spatial Data Plot
Box Plot
Quantile Plot

Total Dissolved Solids mean concentrations 2004–2014



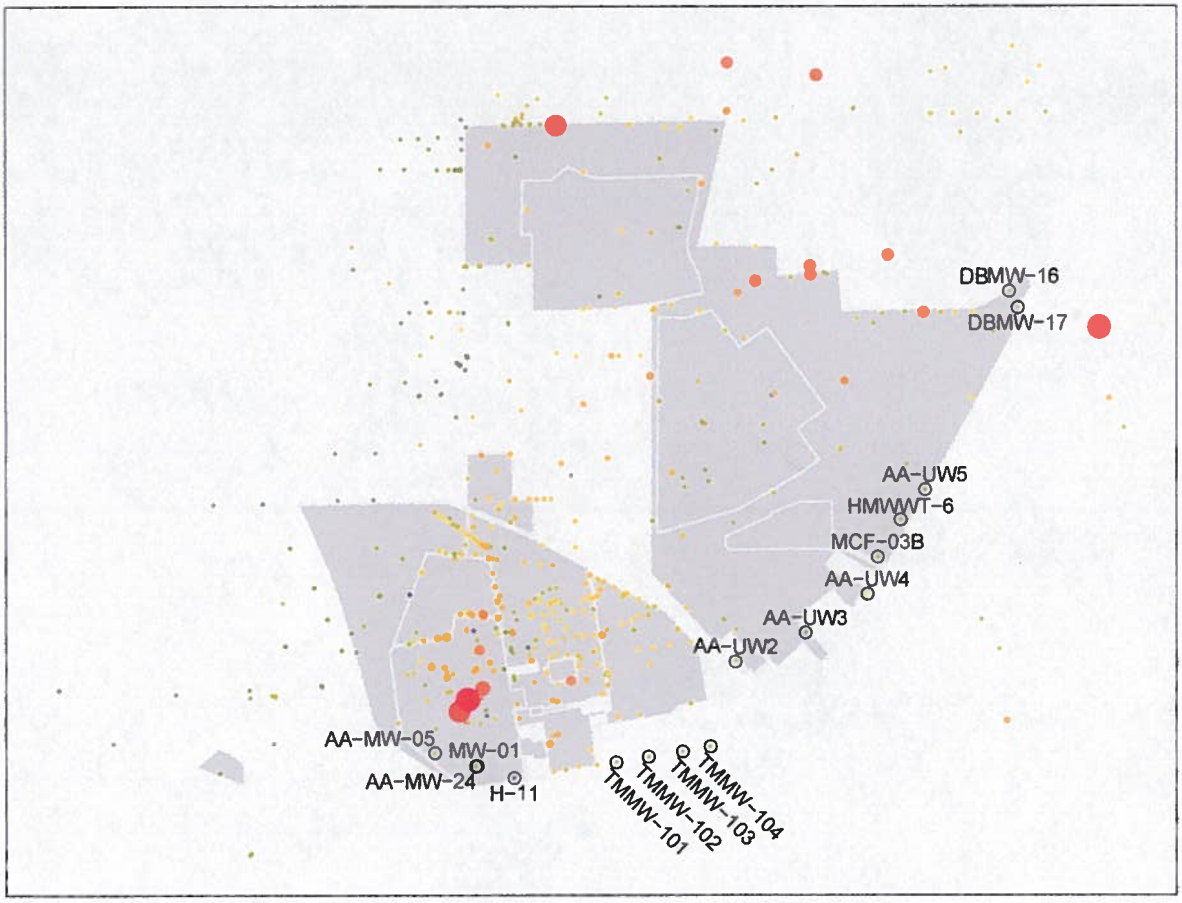

Total Dissolved Solids
mg/L
6000
4000
2000
AA-MW-05
AA-MW-24
AA-UW2
AA-UW3
AA-UW4
AA-UW5
DBMW-16
DBMW-17
H-11
HMWWT-6
MCF-03B
MW-01
TMMW-101
TMMW-102
TMMW-103
TMMW-104

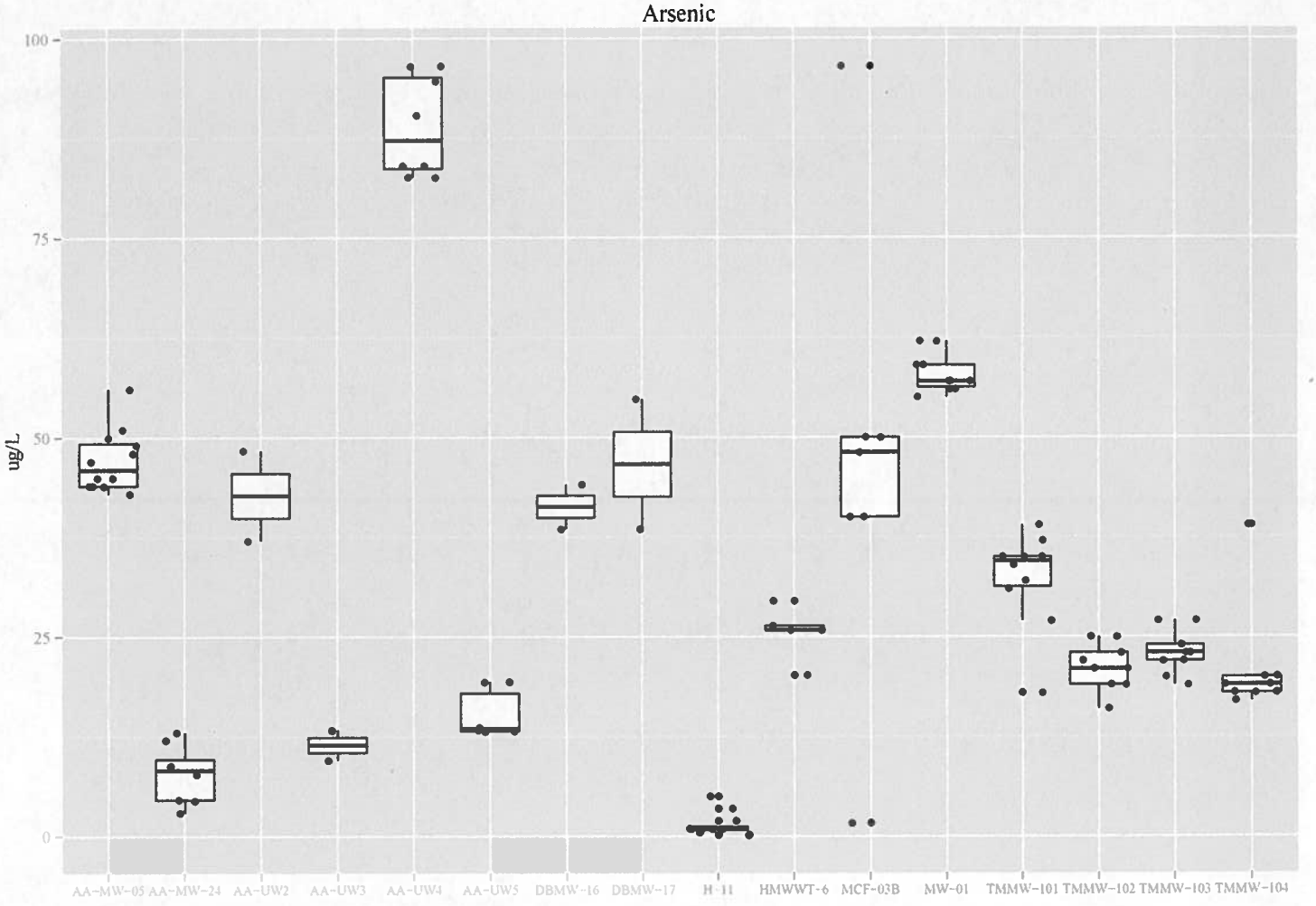

TDS in Up-Gradient Groundwater
Concentration (mg/L)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Fraction of Data (f-values)
985
1600
2300
2900
7,000
Potential Outlier Cutoff - 4275
1812
1561
550
500
TDS
1st Quartile
Geomean
Median
Average
3rd Quartile
90th Percentile
Secondary Standard
Potential Outlier Cutoff

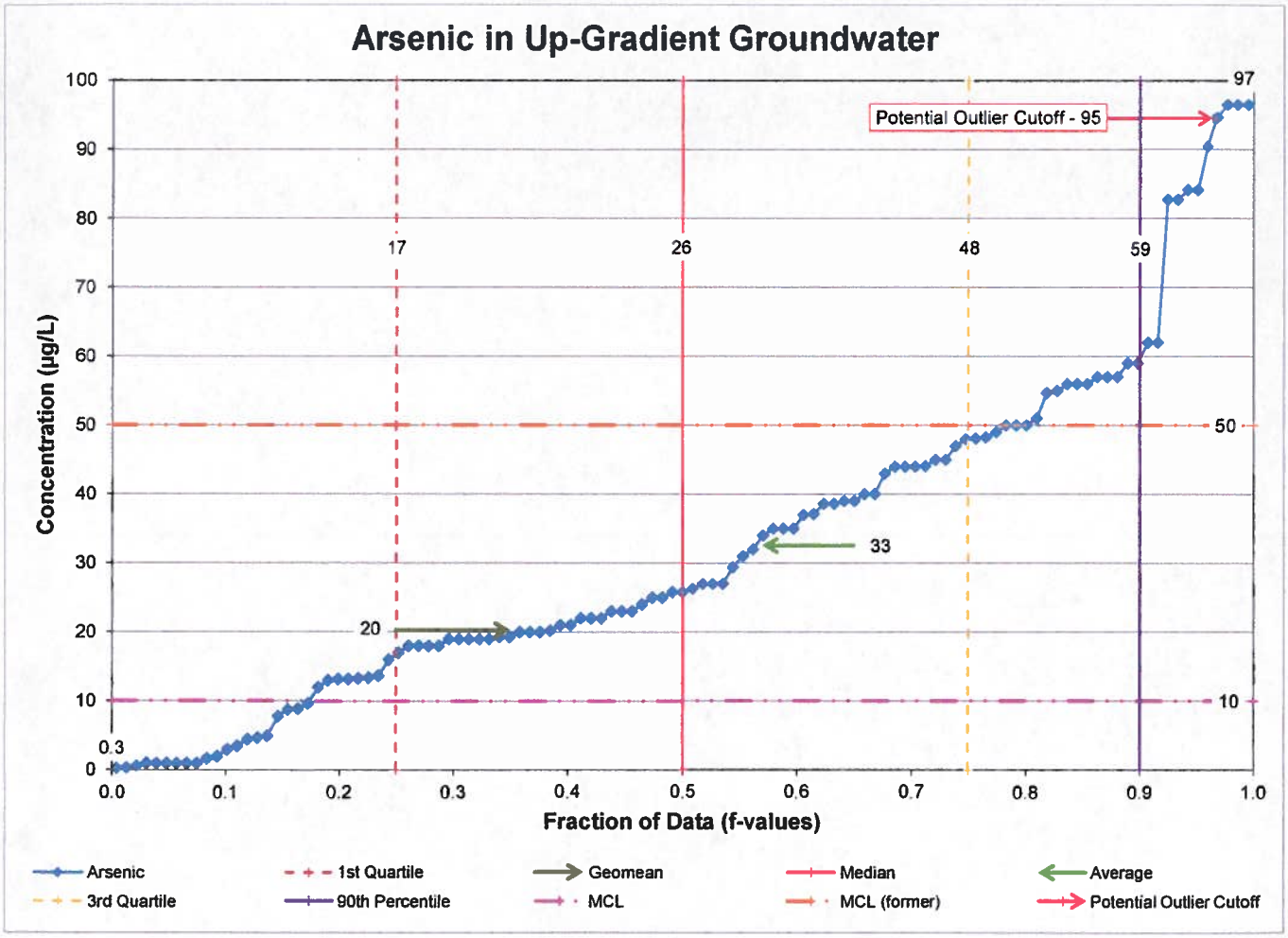
ARSENIC

Spatial Data Plot
Box Plot
Quantile Plot

Arsenic mean concentrations 2004–2014



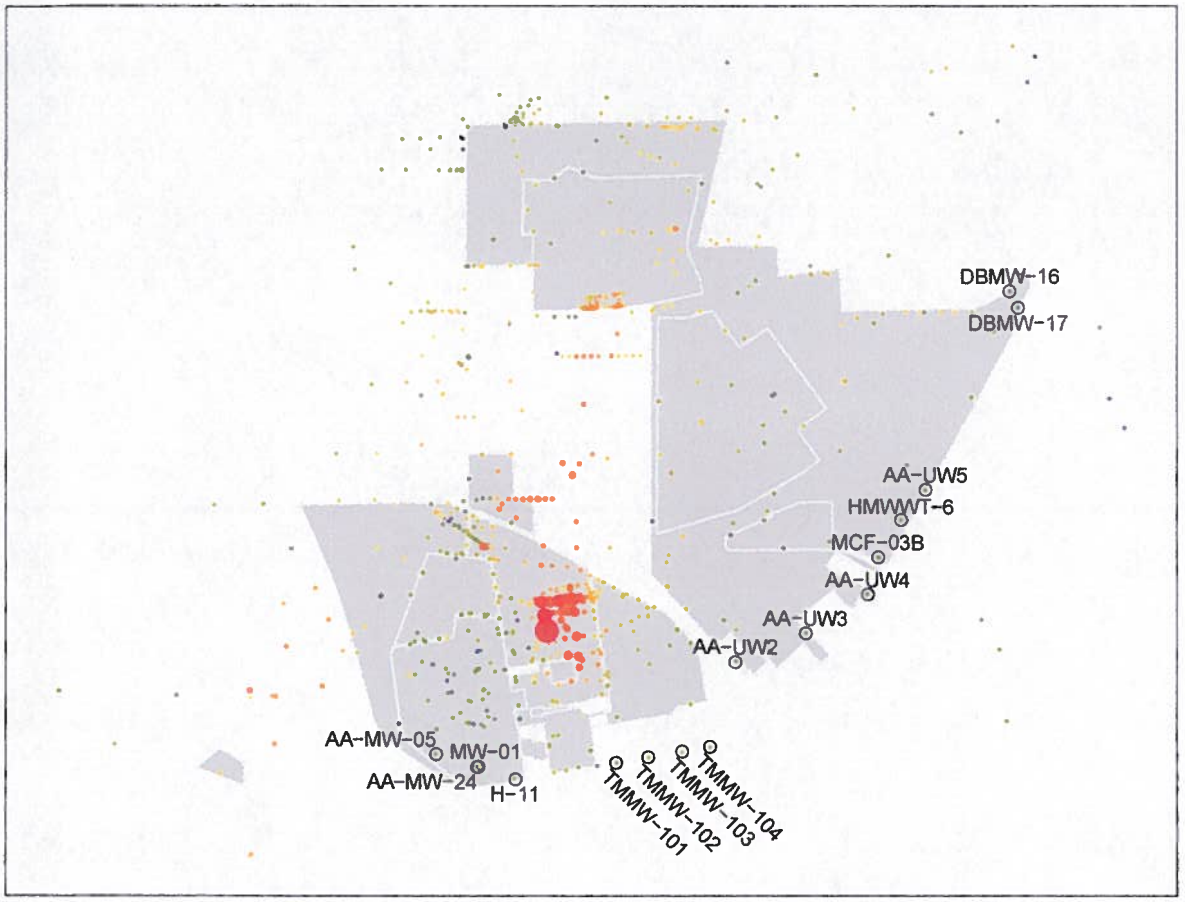

Arsenic
ug/L
100
75
50
25
0
AA-MW-05
AA-MW-24
AA-UW2
AA-UW3
AA-UW4
AA-UW5
DBMW-16
DBMW-17
H-11
HMWWT-6
MCF-03B
MW-01
TMMW-101
TMMW-102
TMMW-103
TMMW-104

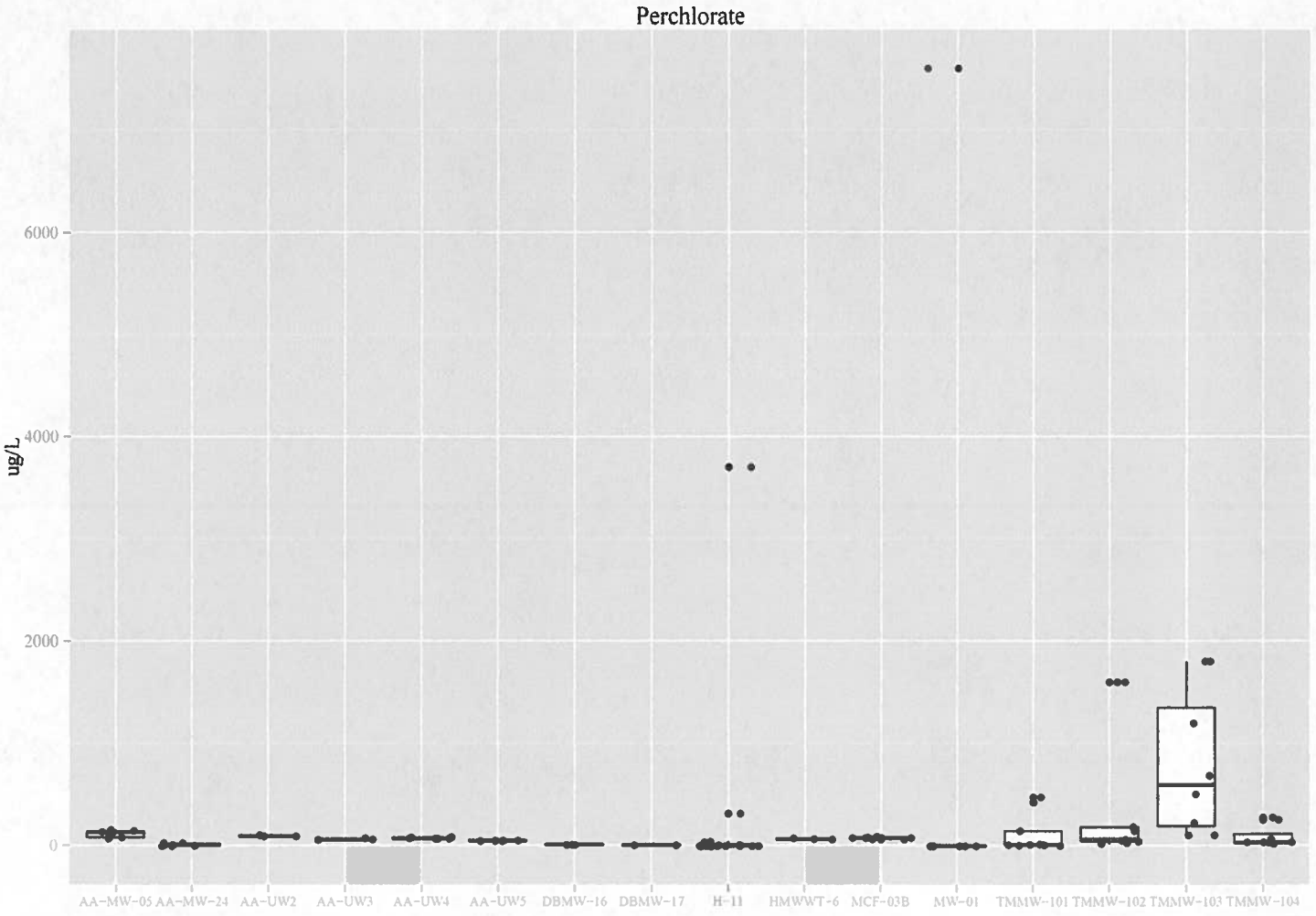

Arsenic in Up-Gradient Groundwater
Concentration (µg/L)
Fraction of Data (f-values)
Potential Outlier Cutoff - 95
97
17
26
48
59
50
33
20
10
0.3
0
Arsenic
1st Quartile
Geomean
Median
Average
3rd Quartile
90th Percentile
MCL
MCL (former)
Potential Outlier Cutoff

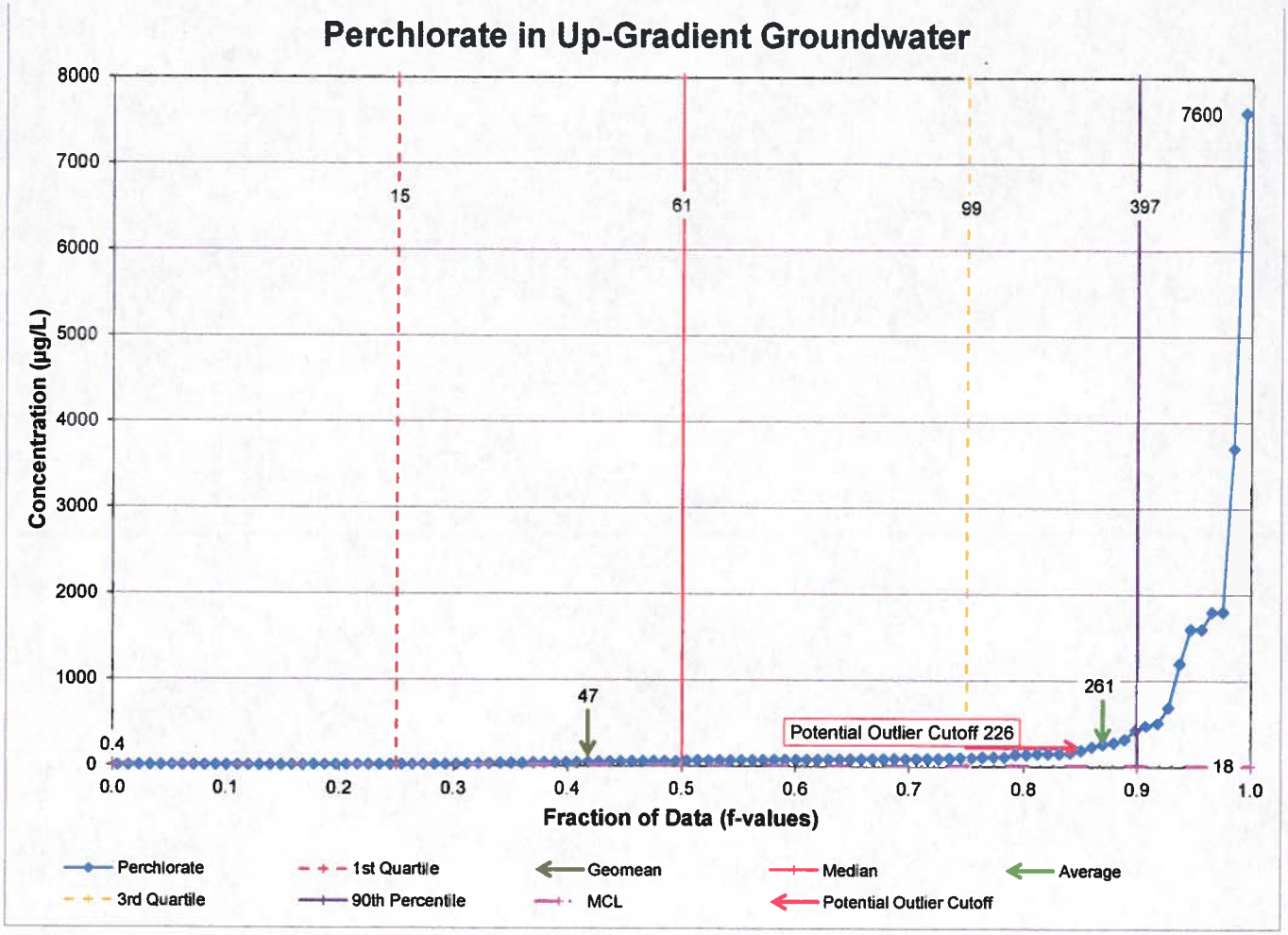
PERCHLORATE

Spatial Data Plot
Box Plot
Quantile Plot

Perchlorate mean concentrations 2004–2014




Perchlorate
ug/L
6000
4000
2000
0
AA-MW-05
AA-MW-24
AA-UW2
AA-UW3
AA-UW4
AA-UW5
DBMW-16
DBMW-17
H-11
HMWWT-6
MCF-03B
MW-01
TMMW-101
TMMW-102
TMMW-103
TMMW-104


Perchlorate in Up-Gradient Groundwater
Concentration (µg/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
0.4
15
61
99
397
7600
47
261
Potential Outlier Cutoff 226
18
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Fraction of Data (f-values)
Perchlorate
1st Quartile
Geomean
Median
Average
3rd Quartile
90th Percentile
MCL
Potential Outlier Cutoff