2008 SUPPLEMENTAL SHALLOW SOIL BACKGROUND REPORT

BMI COMMON AREAS (EASTSIDE)
CLARK COUNTY, NEVADA

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I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

September 16, 2009

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ABBREVIATION AND ACRONYM LIST

ANOVA	analysis of variance
bgs	below ground surface
BMI	Basic Management, Inc.
BRC	Basic Remediation Company
DOE	U.S. Department of Energy
DQIs	data quality indicators
DVSR	Data Validation Summary Report
ERM	ERM-West, Inc.
FSSOP	Field Sampling and Standard Operating Procedures
GEL	General Engineering Laboratories
GiSdT®	Guided Interactive Statistical Decision Tools
HSD	Honestly Significant Difference
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDA	minimum detectable activity
MDL	method detection limit
mg/kg	milligrams per kilogram
MS/MSD	matrix spike/matrix spike duplicate
NBMG	Nevada Bureau of Mines and Geology
NDEP	Nevada Division of Environmental Protection
NRS	Nevada Revised Statutes
PARCC	precision, accuracy, representativeness, comparability, and completeness
pCi/g	pico Curies per gram
PID	photoionization detector
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SQL	sample quantitation limit
SVOC	semi-volatile organic compound
SSURGO	Soil Survey Geographic
SOP	standard operating procedure
µg/kg	micrograms per kilogram
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
WRS	Wilcoxon Rank Sum

1.0 INTRODUCTION

On behalf of Basic Remediation Company (BRC), ERM-West, Inc. (ERM) has prepared this Supplemental Shallow Soil Background Report applicable to the Basic Management, Inc. (BMI) Complex and Common Areas in Clark County, Nevada. The supplemental shallow soil background data were collected in accordance with the *Supplemental Background Shallow Soil Sampling and Analysis Plan* (SAP) dated March 2008, and approved by the Nevada Division of Environmental Protection (NDEP) in March 2008. The general scope of work included the collection of soil samples from background areas upgradient of the Site industrial areas and analysis of these samples for metals and radionuclides that are of interest at sites within the Complex and Common Areas. In addition, since the sample locations were adjacent to Lake Mead Parkway, surface samples were analyzed for semi-volatile organic compounds (SVOCs), as well as field screened using a photoionization detector (PID).

This revision of the report, Revision 6, incorporates (1) comments received from the NDEP, dated August 1, 2008, on Revision 0 of the report, dated July 2008; (2) comments received from the NDEP, dated September 23, 2008, on Revision 1 of the report, dated August 2008; (3) resolution of issues discussed during teleconferences between NDEP and BRC on August 5, 2008 and September 26, 2008; (4) comments received from the NDEP, dated November 13, 2008, on Revision 2 of the report, dated October 2008; (5) comments received from the NDEP, dated February 17, 2009, on Revision 3 of the report, dated December 2008; (6) comments received from the NDEP, dated April 20, 2009, on a revised redline version of the text subsequent to Revision 3 of the report, dated March 2009; (7) redline edits received from the NDEP on May 10, 2009, on text revision excerpts sent to NDEP on April 29, 2009; (8) comments received from the NDEP, dated June 29, 2009, on Revision 4 of the report, dated June 2009; and (9) redline edits received from the NDEP on September 11, 2009, on Revision 5 of the report, dated July 2009. The NDEP comments and BRC's responses to these comments are included in Appendix A. Also included in Appendix A is a redline/strikeout version of the text showing the revisions from the July 2009 version of the report. An electronic version of the entire report, as well as original format files (MS Word and MS Excel) of all text and tables are included in Appendix B.

1.1 OBJECTIVES AND PURPOSE

The purpose of this investigation was to collect and analyze data for metals and radionuclides in background shallow soils that are comparable to site soils in geologic units not covered by the existing *Background Shallow Soil Summary Report* (BRC/TIMET 2007) dataset collected in 2005. This supplemental background study was primarily undertaken because background comparisons for arsenic have failed at both the Mohawk and Parcel 4B sub-areas. However, there is no history of arsenic contamination at these sites; therefore, some consideration has been given to the possibility that the eastern part of the site exhibits different background levels of arsenic and, potentially, other metals. This supplemental shallow soil background sampling event specifically targeted the lithologic units defined as "Pediment and fan deposits of the River Mountains" (Qr_1 and Qr_2, respectively) depicted as being located in the eastern-most corner of the Common Areas[1] in the Nevada Bureau of Mines and Geology (NBMG) *Las Vegas SE Folio Geologic Map (1977) and the Geologic Map of the Henderson Quadrangle, Nevada* (NBMG 1980) (see Figure 1, Qr_1 and Qr_2 labels). This part of the site is close to the northern part of the River Mountains range.

A mile or two to the northeast of the Mohawk area, in the vicinity of the Henderson Landfill, and still in the River Mountains range, very high concentrations of arsenic have been observed in background samples.[2] Consequently, the reason for collecting these supplemental background samples was so that a specific subset of background conditions could be used for comparison with site concentrations, primarily at the Mohawk and Parcel 4B sub-areas.

At present, insufficient background data exist for alluvial fan materials downgradient of the northern River Mountains to evaluate whether concentrations of site-related chemicals detected in site samples in the eastern portion of the BMI Common Areas statistically exceed concentrations of these chemicals in shallow background soil.[3] Therefore, the specific objectives

[1] These units fall within the Mohawk sub-area and the eastern portion of Parcel 4B.

[2] The supplemental background sample locations are west of the River Mountains. Formations associated with these mountains contain volcanic intrusions that are known to contain elevated concentrations of naturally occurring arsenic (Bevans *et al*. 1998). The supplemental background locations are geologically similar to the western and central portions of the Henderson Landfill (see Figure 2 for landfill location). The central portion of the landfill relates to the artificial fill area that covers the pediment and fan deposits of the River Mountains and further to the east the Horse Spring Formation (from CH2MHill 2006; approved by NDEP on August 7, 2006). The western portion relates to the uncovered areas of the pediment and fan deposits of the River Mountains and the modern wash deposits (CH2MHill 2006). Arsenic levels found in undisturbed areas from the western and central portions of the landfill ranged from 3.7 to 34 milligrams per kilogram (mg/kg).

[3] Shallow soils are those from 0 to 10 feet below ground surface (bgs). The existing BRC/TIMET background shallow soil dataset consists of samples collected almost exclusively from soils originating from the McCullough Range. Only background sample location BRC-BKG-12 is considered to be a mixed alluvium location. No samples during the BRC/TIMET background shallow soil investigation were collected exclusively from the alluvial fan materials downgradient of the River Mountains. Although there were several background samples collected by Environ (2003) in this geologic unit, given recent sample results at the site, the Environ data is considered inadequate for characterizing the northern part of the River Mountains.

proposed for the supplemental shallow soil background study included the collection of the following data:

- From background locations within soil units that are representative of Site soils not covered by the existing background shallow soil dataset;
- That form a sufficient sample population that can be used to support statistical comparison of on-site and background datasets; and
- That could be used to evaluate the comparability of soil originating from geologic units from the River Mountains; that is, comparison of the northern River Mountains (this 2008 Supplemental dataset) with the southern River Mountains and McCullough Range (2005 BRC/TIMET dataset).

The supplemental shallow soil background investigation focused on collection of metals and radionuclide data from the lithologic units noted above. To support this data collection effort, soils collected during the supplemental shallow background investigation were also analyzed for SVOCs to evaluate potential soil impacts at the background sample locations. The underlying assumption was that if potential chemical impacts were observed at a given sample location, the designation of those samples as representing background conditions would be suspect. The scope of the investigation, which included surface and subsurface soil sample collection, is presented in detail in Section 2.

1.2 SITE LOCATION AND GEOLOGIC SETTING

The Site is located in Clark County, Nevada, and is situated approximately 2 miles west of the River Mountains and 1 mile north of the McCullough Range (Figure 2). For reference, it is noted that the Upper Ponds occupy the southern portion of the BMI Common Areas, and the Lower Ponds occupy the northern part of the BMI Common Areas. The McCullough Range is the primary source of materials upslope of the BMI Complex, the Lower Ponds, and the western and central portions of the Upper Ponds. Both the River Mountains and the McCullough Range are primary sources of materials upslope of the eastern portion of the Upper Ponds. According to NBMG (1980), the River Mountains and McCullough Range consist of volcanic rocks: dacite in the River Mountains and andesite in the McCullough Range. The land surface slopes in a westerly to northwesterly direction from the River Mountains and in a northerly to northeasterly direction from the McCullough Range. Near the Site, the surface topography slopes in a northerly direction towards the Las Vegas Wash.

A soils map reproduced from the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database shows that the soil type classification for the Upper and Lower Ponds area proper is map unit 600, "slickens," a non-native soil type (artificial fill). This term is presumed to reflect the non-native material observed in those Ponds that were used for waste disposal. The soil type classification for the BMI Complex is map unit 615, "urban land." Native soils underlying the slickens and urban land are assumed to be consistent with the surrounding map units (*i.e.*, primarily map unit 184, and, to a lesser extent, map units 112, 117, 182, 187 and 326). As seen in the USDA soils map excerpted on Figure 3 that is based on the 1985 USDA Soils Survey (USDA 1985), the area targeted in this investigation falls within the boundaries of mapped soil unit 182 (Caliza-Pittman-Arizo complex), which is the native soil type mapped as being present in the eastern portion of the BMI Common Areas and associated with the Qr_1 and Qr_2 lithologic units.

2.0 SUMMARY OF THE INVESTIGATION

This section describes the scope of work performed for the supplemental shallow soil investigation, including identification of the sampling locations, presentation of the sampling and analytical methods employed and analytical results, and a summary of analyte detection frequencies. In addition, this section discusses the scope and findings of the data validation and usability evaluations performed on the data generated during this sampling event, by which the suitability of the data for evaluation as a background dataset was judged. Other investigation results, which primarily involved comparisons between datasets associated with different soil units and/or depths, were developed after performing statistical analyses. The scope and findings associated with these statistical evaluations are presented in Section 3.

2.1 SAMPLING LOCATIONS

Soil samples were collected from three depth intervals at each sampling location, including surface soil (0 to 0.5 feet bgs), and two subsurface depths (4 to 6 feet and 9 to 11 feet bgs). The supplemental shallow background soil study was focused on the collection of data for site-related metals and radionuclides. Data for SVOCs were also collected to evaluate whether the supplemental shallow background soil locations are impacted by other anthropogenic sources.

Soil samples were collected from 10 initial sampling locations adjacent to Lake Mead Parkway, on the south side of the roadway away from the Site. These 10 locations are shown on Figure 1, along with sampling locations for the 2005 BRC/TIMET and 2003 Environ studies on Figure 2.

The 10 sampling locations were selected because they exhibited the following characteristics:

- They are off-Site locations, in relatively close proximity to the Site; however, they are upgradient and sufficiently distant from the Site such that impacts from Site operations are not likely;
- They are upwind of the Site (wind direction plots indicate the predominant wind direction is from the south and southwest; see Figure 2) and are thus less likely to have been affected by aerial deposition of wind-borne dusts or vapors from Site operations; and
- They are upslope of the Site and are thus unlikely to have been affected by overland surface-water transport of potentially contaminated site soils.

Available background sample locations are constrained due to rapid development in the area. Undeveloped areas in close proximity to the site, without access problems, are scarce. Although the 10 locations are adjacent to Lake Mead Parkway, as can be seen from Figure 1 they are within undisturbed areas. Therefore, the 10 sampling locations were chosen because they exhibited the characteristics identified above and are considered adequate for representing undisturbed alluvial material washed down from the northern River Mountains.

2.2 SUMMARY OF SAMPLING PROCEDURES AND ANALYSES

Soil samples were collected from a single boring at each location, drilled using a hollow-stem auger rig. Samples were collected in a split-spoon sampler lined with stainless steel sleeves. Samples collected from each boring are considered independent samples. Sampling and sample handling procedures were consistent with the standard operating procedures (SOPs) developed for the BMI Common Areas as provided in the *BRC Field Sampling and Standard Operating Procedures* (FSSOP; BRC, ERM and MWH 2008). Subsurface soil samples were collected from each two-foot interval of drill core (*i.e.*, 4 to 6 feet bgs and 9 to 11 feet bgs).

For this study, surface soil is defined as the upper 0.5 feet of the soil horizon; subsurface soil is defined as below 0.5 feet bgs. Soil samples were collected from three zones in each boring as follows:

- Surface Soil (soil samples collected from within the depth interval from 0-0.5 ft bgs; hereinafter referred to as "0 ft bgs" interval);
- Shallow Subsurface Soil (soil samples collected from within the depth interval from 4-6 ft bgs; core homogenized; hereinafter referred to as "5 ft bgs" interval); and
- Deeper Subsurface Soil (soil samples collected from within the depth interval from 9-11 ft bgs; core homogenized; hereinafter referred to as "10 ft bgs" interval).

Ten borings were advanced and three samples from each zone were collected for an initial total of 30 soil samples. Field duplicate samples were collected at three locations; from locations BRC-BKG-R01 (0 ft bgs), BRC-BKG-R05 (0 ft bgs), and BRC-BKG-R08 (5 ft bgs) for metals and SVOCs; and from locations BRC-BKG-R01 (5 ft bgs), BRC-BKG-R05 (0 ft bgs), and BRC-BKG-R08 (5 ft bgs) for radionuclides. Inadequate sample volume was collected from location BRC-BKG-R01 (0 ft bgs), the first sample collected, which is why the field duplicate at this location for radionuclides is at a different depth (5 ft bgs) than that for metals and SVOCs. Because these samples are considered field duplicates, and not split samples, each is considered an independent sample. Therefore, there were a total of 33 soil samples collected as part of this investigation. Soil boring logs representing each location are also included in Appendix C.

The soil samples were submitted for analysis to TestAmerica in St. Louis, Missouri. Analyses were conducted at three TestAmerica laboratory locations: St. Louis, Missouri; Burlington, Vermont; and West Sacramento, California. General Engineering Laboratories (GEL), located in Charleston, South Carolina, performed the radionuclide analyses.[4] At the time of analysis, all laboratories were NDEP-certified laboratories for the analyses conducted. Surface and subsurface sample analyses consisted of a full suite of metals, eight radionuclides (radium-226, radium-228, thorium-228, thorium-230, thorium-232, uranium-233/234, uranium-235/236, and uranium-238), SVOCs, and general soil characteristics. The individual analytes, analytical methods, and sample quantitation limits (SQLs) are presented in Table 1. These analytes and methods are consistent with the BRC site-related chemicals list and analytical program previously established in the *BRC Quality Assurance Project Plan* (QAPP; BRC and ERM 2009). All radionuclide analyses underwent full dissolution preparatory methods. All preparatory methods and analyses are consistent with the 2005 BRC/TIMET background dataset.

The detection frequencies for metals and radionuclides evaluated during this supplemental shallow soil background study are presented in Table 2. Detection frequencies observed for these analytes during the 2005 shallow background study are also provided in Table 2 for comparison. As seen in Table 2, most of the metals and radionuclides that are the subject of the supplemental shallow soil background investigation were detected routinely in the 2008 shallow soil samples. Exceptions are:

- Antimony
- Boron
- Chromium (VI)
- Lithium
- Mercury
- Niobium
- Platinum
- Selenium
- Silver
- Thallium
- Tin
- Tungsten
- Uranium-235/236
- Zirconium

[4] GEL labeled all primary samples that required matrix spike/matrix spike duplicates (MS/MSD) with the sample name specified on the chain-of-custody, but included a MS/MSD identification (*e.g.*, BRC-BKG-R02-5-MS/MSD). Due to the unaccustomed labeling, all samples with the MS/MSD label were inadvertently regarded as quality control samples and not included with the original sample dataset. GEL was contacted and they confirmed the results for samples labeled as MS/MSD are actual primary sample results.

These fourteen constituents were detected in fewer than fifty percent of the samples in which they were analyzed during the supplemental shallow soil background investigation. Most of these same compounds were also not detected routinely during the 2005 shallow soil background investigation. Exceptions to this observation consist of lithium, mercury, tin and zirconium, which were routinely detected in the 2005 samples but not in the 2008 samples. Selenium and thallium were also detected at a noticeably lower frequency in the 2008 supplemental shallow samples than in the 2005 samples. In contrast, cadmium and silver were detected at a noticeably higher frequency in the 2008 supplemental shallow background samples than in those from the 2005 shallow background investigation. It should be noted that variations in detection frequencies are influenced by the associated SQL, and may not reflect trends in actual concentrations; the effect of SQLs on detection frequencies is discussed further in Section 3.5.

2.3 DATA VALIDATION SUMMARY

All of the data were subjected to a Level 3 review. In addition to the Level 3 review, 20 percent of all data collected during the course of the investigation were subjected to full Level 4 data validation. Level 3 and 4 reviews are provided in the *Data Validation Summary Report (DVSR)—2008 Supplemental Shallow Soil Background Sampling Event* (BRC and ERM 2008; approved by NDEP on June 9, 2008). Metals data were validated in accordance with the U.S. Environmental Protection Agency (USEPA) guidance document *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004) and the data validation SOP (SOP-40; BRC, ERM and MWH 2008). Organics data were validated in accordance with the USEPA guidance document *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1999) and SOP-40 (BRC, ERM and MWH, 2008).[5] USEPA has not standardized the validation of radionuclide data. Radionuclide results for supplemental shallow soil background samples were validated in accordance with SOP-40 (BRC, ERM and MWH 2008) and the project QAPP (BRC and ERM 2009).

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[5] Revised validation procedures have been specified in NDEP's guidance document *Revisions to Data Validation of Organic Data based on June 2008 National Functional Guidelines for Superfund Organic Methods Data Review – USEPA-540-R-08-01* (NDEP 2009a). Because these data were collected and validated prior to March 2009, these revised procedures were not employed. The primary changes relative to the 1999 USEPA guidance and SOP-40 (BRC, ERM and MWH 2008) are associated with the manner in which blanks are evaluated and where data are rejected due to very low internal standards. A review of the data indicates that for this dataset no SVOC qualifier changes are necessary and there are no changes to the DVSR findings.

Based on data validation and review, data qualifiers were placed in the electronic supplemental shallow soil background database to classify whether the data were acceptable, acceptable with qualification, or rejected. Where applicable, an indication of result bias is presented. In addition, for every data validation qualifier, a secondary comment code was entered to indicate the reason for qualification. The DVSR (BRC and ERM 2008) provides the definitions for the data validation qualifiers and comment codes used in the supplemental shallow soil background database. Validation qualifiers and definitions are based on those used by USEPA in the current validation guidelines (USEPA 2004) and summarized in the SOP-40 (BRC, ERM, and MWH 2008).

Results that are qualified as estimated may generally be usable for the purposes of establishing background and for comparison to Site-specific sample data. Based on the evaluation of the dataset, 100 percent of the data obtained during the field investigation are valid (that is, not rejected) and acceptable for their intended use. With 100 percent of the dataset validated as usable, the overall objective of the data collection event was met.

2.4 DATA USABILITY EVALUATION

The analytical data were reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992) and *Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Complex and Common Area in Henderson, Nevada* (NDEP 2008a). A quality assurance/quality control (QA/QC) review of the analytical results was conducted during the sampling events. According to both NDEP's and USEPA's Data Usability Guidance, there are six principal evaluation criteria by which data are judged for usability. The six criteria are:

- availability of information associated with site data;
- documentation;
- data sources;
- analytical methods and detection limits;
- data review; and
- data quality indicators, including precision, accuracy, representativeness, comparability, and completeness.

In addition to the six principal evaluation criteria, NDEP's Data Usability Guidance includes a step for data exploration. Items for this step are discussed in Section 3. A summary of these six criteria for determining data usability is provided below. Data usability evaluation tables are provided in Appendix B.

2.4.1 Criterion I – Availability of Information Associated with Supplemental Shallow Soil Background Data

The usability analysis of the supplemental shallow soil background data requires the availability of sufficient data for review. The required information is available from documentation associated with the data collection efforts. Data have been validated per the NDEP-approved DVSR (BRC and ERM 2008). The following lists the information sources and the availability of such information for the data usability process:

- Background description and objectives provided in the NDEP-approved SAP (BRC 2008) and in Section 1.
- A site map with sample locations is provided on Figure 1.
- Sampling design and procedures were provided in the NDEP-approved SAP (BRC 2008) and discussed in Sections 2.1 and 2.2.
- Analytical methods and detection limits are provided in Table 1.
- A complete dataset is provided in Appendix B.
- Field conditions and physical parameter data as applicable to the background dataset are provided in the field investigation report (GES 2008) and DVSR (BRC and ERM 2008).
- The laboratory provides a narrative with each analytical data package outlining any problems encountered in the laboratory, control limit exceedances, and rationale for any deviations from protocol. These narratives are included as part of the DVSR (BRC and ERM 2008).
- QC results are provided by the laboratory, including blanks, replicates, and spikes. The laboratory QC results are included as part of the DVSR (BRC and ERM 2008).
- Data flags used by the laboratory were defined adequately.

- Electronic files containing the raw data made available by the laboratory are included as part of the DVSR (BRC and ERM 2008).

2.4.2 Criterion II – Documentation Review

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. For the purposes of this data usability analysis, the chain-of-custody forms prepared in the field were reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the dataset as discussed in the DVSR (BRC and ERM 2008). Based on the documentation review, all samples analyzed by the laboratory correspond to their respective geographic locations as discussed in Section 2.2 and shown on Figure 1. The samples were collected in accordance with the NDEP-approved SAP (BRC 2008) and SOPs developed for the BMI Common Areas as provided in the FSSOP (BRC, ERM and MWH 2008). Field procedures included documentation of sample times, dates and locations, and other sample-specific information (*e.g.*, sample depth). Information from field forms generated during sample collection activities was imported into the project database.

The analytical data were reported in a format that provides adequate information for evaluation, including appropriate quality control measures and acceptance criteria. Each laboratory report describes the analytical method used, provides results and detection limits on a sample-by-sample basis, and provides the results of appropriate quality control samples (*e.g.*, laboratory control spike samples, sample surrogates and internal standards [organic analyses only], and matrix spike samples). All laboratory reports provided the documentation required by USEPA's Contract Laboratory Program (USEPA 1999, 2001, 2004) which includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data generated during sample analysis. Reported sample analysis results were imported into the project database.

Note that there were labeling issues with the samples analyzed by GEL. GEL labeled all primary samples that required matrix spike/matrix spike duplicates (MS/MSD) with the sample name specified on the chain-of-custody, but included a MS/MSD identification (*e.g.*, BRC-BKG-R02-5-MS/MSD). Due to the unaccustomed labeling, all samples with the MS/MSD label were inadvertently regarded as quality control samples and not included with the original sample dataset. GEL was contacted and they confirmed the results for samples labeled as MS/MSD are actual primary sample results.

2.4.3 Criterion III –Data Sources

The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate for the exposure area and medium of interest and that appropriate analytical methods were used. The data collection activities were developed to characterize a broad spectrum of background metals and radionuclides in soil. As described in the SAP, samples were collected in areas of no known impacts for the target soil lithologies.

The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA. Given previous issues with analysis of radionuclides at the BMI Complex (NDEP, 2009b), note that all radionuclide analyses underwent full dissolution preparatory methods. These preparatory methods and analyses are consistent with the 2005 BRC/TIMET background dataset.

Based on the review of the available information, the data sources for chemical and physical parameter measurements are adequate for use.

2.4.4 Criterion IV – Analytical Methods and Detection Limits

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the detection limits are low enough to allow adequate characterization of the data. At a minimum, this data usability criterion can be met through the determination that routine USEPA reference analytical methods were used in analyzing the samples. Table 1 identifies the USEPA methods that were used in conducting the laboratory analysis of soil samples. Each of the identified USEPA methods is considered the most appropriate method for the respective constituent class and each was approved by NDEP as part of the SAP (BRC 2008).

Laboratory SQLs were based on those outlined in the reference method, the SAP, and the project QAPP (BRC and ERM 2009). In accordance with respective laboratory SOPs, the analytical processes included instrument calibration, laboratory method blanks, and other verification standards used to ensure quality control during the analyses of collected samples.

Even though the same analytical methods were used for the samples collected as part of this background study and the prior background sampling events, the SQLs for several metals vary between those events. Datasets with multiple sample-specific detection limits are not uncommon in analytical chemistry data. This has minimal effect on datasets for analytes with high frequencies of detection. However, it is of concern for datasets with numerous non-detections, for which variable SQLs can result in difficulties in differentiating whether datasets are actually different or merely an artifact of detection limits. As evidence of this potential problem, as discussed in Sections 2.2 and 3.5, in a few instances (*i.e.*, for cadmium, selenium, and silver) the variations in SQLs for the background data have potentially caused differences in frequency of detection.

Therefore, it should be recognized that having differences in SQLs for a given analyte may compromise statistical analyses in this report and future background comparisons. As discussed in Section 2.2, fourteen constituents were detected in fewer than fifty percent of the samples--differences in detection limits are anticipated to have the greatest effect on calculations of descriptive statistics and statistical analyses for these constituents. BRC uses the computer statistical software program Guided Interactive Statistical Decision Tools (GiSdT®; Neptune and Company 2007) to conduct non-parametric tests including the Wilcoxon Rank Sum (WRS) test, quantile test, and slippage test when comparing site data to background data. The Gehan ranking system is used for these tests to accommodate multiple detection limits within the same dataset. Regardless, for datasets with relatively low frequencies of detection and variable SQLs, particularly when detection limits are among the largest values in the dataset, conclusions from the statistical test results should be treated with caution. In cases where either the background or site dataset has low frequencies of detection, greater emphasis should be given to the maximum detections, means, and medians as well as a review of the SQLs rather than simply the results of the statistical tests.

Radionuclides represent a different situation than metals. Radionuclide detection frequencies are considered using the minimum detectable activity (MDA) as the reported value below which measured results are considered "non-detections." As discussed in Section 3.1.3, when radionuclides are not detected at activities greater than the MDA, the laboratory reports the measured activity, including those lower than the MDA. Therefore, all reported results for radionuclides are used in the statistical evaluations, regardless of where they fall relative to the MDA. The MDA and radionuclide detection frequencies relative to the MDA have no effect on statistical comparisons of the radionuclide data.

2.4.5 Criterion V – Data Review

The data review portion of the data usability process focuses primarily on the quality of the analytical data received from the laboratory. However for this study, the data review also included evaluation of the SVOC data to identify any evidence of impacts that might indicate that these locations are not suitable for consideration as background. Both elements are discussed below.

Data Quality Review. Soil sample data were subject to data validation. The DVSR was prepared as a separate deliverable (BRC and ERM 2008). The analytical data were validated according to the internal procedures using the principles of USEPA National Functional Guidelines (USEPA 1999, 2001, 2004) and were designed to ensure completeness and adequacy of the dataset. Any analytical errors and/or limitations in the data have been addressed and an explanation for data qualification provided in the respective data tables. The results of ERM's data review for these issues are presented in the DVSR and are summarized as qualifiers in the dataset provided electronically in Appendix B.

For some analytical results, quality criteria were not met and various data qualifiers were added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in SOP-40 (BRC, ERM and MWH 2008) and the project QAPP (BRC and ERM 2009). Sample results are rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria. Only rejected data are considered unusable for decision-making purposes. No samples were rejected in the supplemental shallow soil background dataset. Sample results qualified as estimated indicate an elevated uncertainty in the value. A bias flag may have been applied to indicate a direction of the bias. Estimated analytical results are included in the supplemental shallow soil background dataset "as is"; the potential bias noted was not addressed quantitatively in the statistical analyses that follow.

Evaluation for Evidence of Impacts/Background Unsuitability. The surface samples at each boring location[6] were analyzed for SVOCs. As previously noted, the purpose of these analyses was to identify any evidence of impacts that might indicate that these locations are not suitable for consideration as background. As summarized in Table 3, only one SVOC was detected in the samples; bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected at low concentrations (56 micrograms per kilogram [µg/kg] and 69 µg/kg[7]) in the two samples collected from location BRC-BKG-R01 (initial and field duplicate). The SQLs for the SVOC analyses were relatively low (*i.e.*, approximately 34 µg/kg for most compounds), and are consistent with

6 There was one exception – the surface soil sample at location BRC-BKG-R09 was not analyzed for SVOCs.
7 Both results were flagged as estimated (J) due to their low concentrations below the SQLs.

the SQLs presented in the project QAPP (BRC and ERM 2009). Furthermore, the data review performed for the SVOC data did not identify any issues of concern with respect to the SVOC data quality (BRC and ERM 2008). Therefore, the SVOC data did not provide any evidence suggesting that use of the samples for determining background conditions would not be appropriate.

2.4.6 Criterion VI – Data Quality Indicators

Data quality indicators (DQIs) are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected. The DQIs include precision, accuracy, representativeness, comparability, and completeness (PARCC). The project QAPP provides the definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the dataset. Data validation activities included the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria were qualified during the validation process using the guidelines presented in the National Functional Guidelines (USEPA 1999, 2001, 2004).

Precision is a measure of the degree of agreement between replicate measurements of the same source or sample. Precision is expressed by relative percent difference (RPD) between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source. Precision is generally assessed using a subset of the measurements made. The precision of the data was evaluated using several laboratory QA/QC procedures such as laboratory duplicates, laboratory control sample (LCS), laboratory control sample duplicate (LCSD), and MS/MSD results. Based on ERM's review of the results of these procedures, there do not appear to be any widespread data usability issues associated with precision.

Accuracy measures the level of bias that an analytical method or measurement exhibits. To measure accuracy, a standard or reference material containing a known concentration is analyzed or measured and the result is compared to the known value. Several QC parameters are used to evaluate the accuracy of reported analytical results:

- Holding times and sample temperatures;
- LCS percent recovery;
- MS/MSD percent recovery (organics);

- Spike sample recovery (inorganics)
- Surrogate spike recovery; and
- Blank sample results.

Detailed discussions of and tables with specific exceedances, with respect to precision and accuracy, are provided in the NDEP-approved DVSR (BRC and ERM 2008) and data qualified as a result of this evaluation are presented with qualifiers in the dataset provided electronically in Appendix B.

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition (USEPA 2002). There is no standard method or formula for evaluating representativeness, which is a qualitative term. Representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific sampling task, and by collection of an adequate number of samples from the relevant types of locations. As discussed in Section 2.1, for this background investigation, care was taken to select sampling locations that were close to the Common Areas but did not appear to have been impacted by known historical operations at the Site or from nearby facilities. The representativeness of the sampling locations was also assessed by (1) physical inspection of the locations prior to drilling to identify evidence of impacts; and (2) collection and analysis of samples for organic constituents that could indicate impacts. Evidence of impacts was not suggested by either process. Data representativeness was further assessed during the data evaluation process as discussed in Section 3.4. Based on the assessments of representativeness referenced above (see further discussions in Sections 2.4.5 and 3.4), BRC concludes that the data are representative of background conditions.

Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of measurements made. Analytical completeness is a measure of the number of overall accepted analytical results, including estimated values, compared to the total number of analytical results requested on samples submitted for analysis after review of the analytical data. None of the data were eliminated due to data usability concerns. The percent completeness for the dataset is 100 percent.

Comparability is a qualitative characteristic expressing the confidence with which one dataset can be compared with another. The desire for comparability is the basis for specifying the analytical methods; these methods are consistent with those used in the 2005 BRC/TIMET background dataset. The comparability goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The ranges of sample results from both the supplemental shallow soil background dataset and the 2005 BRC/TIMET background dataset are provided electronically in Appendix B. As discussed in Sections 2.2 and 2.4.4, differences in detection limits among datasets may affect data comparability, particularly for datasets comprised primarily of non-detected values. For these datasets, left-censored data can result in difficulties in differentiating whether datasets are actually different or merely an artifact of detection limits. Note that for constituents with detection limits that are sufficiently low (*i.e.*, lower than risk-based screening levels), comparisons between site and background may be less important as these left-censored data are likely to indicate conditions that pose an "acceptable" risk and further analysis is not necessary.

3.0 STATISTICAL METHODS AND FINDINGS

The exploratory data analysis and statistical evaluation of data for shallow background soils generally followed industry-standard guidance documents (USEPA 2006a,b; Navy 1999, 2002) and standards agreed upon with NDEP, including the *Guidance on the Development of Summary Statistics Tables* (NDEP 2008b). These guidance documents discuss the use of statistical plots, calculation of summary statistics, treatment of non-detect data, and selection of statistical tests. The following sections discuss data preparation, statistical plots, summary statistics, and statistical tests, and the types of comparisons conducted.

3.1 DATA PREPARATION

3.1.1 Spatial Independence Assumptions

There are 10 soil boring locations that were sampled for the supplemental shallow soil background dataset. The 10 soil boring locations are treated as spatially independent in this supplemental shallow background soil study. The concentrations of each analyte at each sample location and depth is dependent on the origin of the soil and the composition of the parent material (with the exception of anthropogenic deposition of analytes such as lead).

Naturally occurring variability is associated with the deposition of sediments, and these variations may never be fully characterized and result in unexplainable data clusters. The naturally occurring variability may be impacted by sediment transport, leaching, weathering, and other geochemical processes within the alluvium; therefore, when statistical tests are performed, it is expected that some spatial correlation may be seen, but the impact of this on the background evaluation is assumed to be negligible. All background data were treated as independent in the statistical tests and calculations performed for this study. Treating the data points as independent is more conservative since the larger number of samples will result in narrower confidence intervals when comparing the background data to site data. Note also that the sample results from the three field duplicates were also treated as independent. There is no obvious indication in the data that the variances between duplicate results are any different than the variance between other sample results.

3.1.2 Data Filtering and Combining Rules

Results from both the 2005 BRC/TIMET (which includes the Environ dataset) and 2008 supplemental shallow soil background (this report) analytical datasets were validated. In order to prepare the datasets for statistical evaluation, results from each dataset were filtered so that each shallow background soil sample had one result per analyte and the two datasets were combined into one database. The following steps were taken to filter and combine the 2005 BRC/TIMET and 2008 Supplemental shallow soil background datasets into one database.

1) Filtered out all laboratory QC samples from both datasets

2) Filtered out all split sample results from both datasets; retained field duplicate results in the 2008 Supplemental shallow soil background dataset

3) Filtered out all rejected (R-qualified) data in both datasets

4) Aligned chemical names for both datasets so that names are exactly the same for each

5) Aligned units for both datasets so they are exactly the same for each

6) Filtered non-metals/non-radionuclides (*e.g.*, percent moisture) from both datasets

7) Filtered out all metals and radionuclides from the 2005 BRC/TIMET background dataset that were not included in the 2008 Supplemental shallow soil background dataset

8) Added fields to both datasets that include Dataset (2005 BRC/TIMET, 2008 Supplemental), Origin (McCullough, River, North River, or Mixed), and Depth (0, 5, or 10)

9) Aligned field names for both datasets so they can be combined for statistical evaluation

10) Identified final subset of fields that will be required to conduct the data analyses

For direct comparisons between the 2005 BRC/TIMET dataset and the 2008 Supplemental dataset, any chemical analyzed by one study but not the other was not considered in the comparison.

After filtering and prior to final combination of the two datasets, a comparison table was prepared. Table 2 provides a constituent-by-constituent comparison between the 2005 BRC/TIMET and the 2008 Supplemental datasets for the total number of observations (sample size), the number of observations that were detected concentrations (number of detects), and the frequency of detected concentrations as a percentage of the total number of observations.

Based on the information shown in Table 2, the following observations were made:

- The 2005 BRC/TIMET background dataset contains results for 42 metals and anions and 35 radionuclides; while the 2008 Supplemental dataset contains results for 38 metals and eight radionuclides.[8]

- The sample size for the 2005 BRC/TIMET background dataset is generally 120 results for each analyte (with a few exceptions);[9] while the sample size for the 2008 Supplemental dataset is generally 33 results for each analyte.

- In cases where analyte results are available for both datasets, the detection frequencies were compared. As discussed in Section 2.2, detection frequencies were notably different for cadmium, lithium, mercury, selenium, silver, thallium, tin, zirconium, and uranium-233/234.

3.1.3 Treatment of Data Qualified as Non-Detections

When radionuclides were not detected at activities greater than the MDA, the laboratory reported the measured activity. Treatment of radionuclide data qualified as non-detections followed U.S. Department of Energy (DOE) guidance (DOE 1997), which states that, for radionuclide activity data:

> "All of the actual values, including those that are negative, should be included in the statistical analysis. Practices such as assigning a zero, a detect limit value, or some in-between value to the below-detectable data point, or discarding those data points can severely bias the resulting parameter estimates and should be avoided."

Therefore, for radionuclides, the reported activities (in pico Curies per gram [pCi/g]) were used without censoring to calculate all descriptive statistics (Tables 4 through 26), prepare plots (*e.g.*, boxplots), and conduct statistical analyses presented in this report.

For metals, a value of one-half the SQL was used as a replacement value for non-detected data for t-tests, parametric and nonparametric analysis of variance (ANOVA, Kruskal-Wallis tests), and calculation of parametric and nonparametric correlation coefficients. The ½-SQL

[8] The following five inorganic constituents were included in the 2005 background investigation but were not included in the 2008 investigation: chloride, fluoride, nitrate, nitrite, and sulfate. Phosphorus was included in the 2008 investigation, but was not included in the 2005 analyte list. With NDEP concurrence, the project list of analytes was reduced in 2007 from 35 radionuclides to the following eight: uranium-238, uranium-233/234, thorium-230, and radium-226 (Uranium-238 Decay Chain), thorium-232, radium-228, and thorium-228 (Thorium-232 Decay Chain) and uranium-235/236 (Uranium-235 Decay Chain).

[9] For the 2005 BRC/TIMET dataset, 104 of the 120 data points are from the 2005 BRC/TIMET investigation and 16 of the 120 data points are from the 2003 Environ investigation (BRC/TIMET 2007).

substitution method was not applied to data analyzed using the WRS test because this test (as currently supported by GiSdT®) handles non-detected values using the Gehan ranking system (the Gehan test uses a modified ranking of sample results to accommodate non-detected values together with detected values), a method considered to be more robust than the ½-SQL substitution method. The GiSdT® version of the WRS test uses the Mantel (1981) approach, which is equivalent to using the Gehan ranking system. The summary statistics (Tables 4 through 26) and plots (boxplots, individual value plots, and probability plots in Appendix D) incorporate the full SQL for non-detects.

It should be noted that the method detection limit (MDL) is established by the laboratories and represents the minimum concentration of a substance that can be measured and reported with 99 percent probability that the analyte concentration is greater than zero. MDLs are established using matrices with little or no interfering species using reagent matrices and are considered the lowest possible reporting limit. Often, the MDL is represented as the instrument detection limit.

The SQL is defined as the MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes, and takes into account sample characteristics, sample preparation, and analytical adjustments. It represents the sample-specific detection limit and all non-detected results are reported to this level. Because the SQL is a sample-specific detection limit, for the dataset as a whole there may be instances where the maximum non-detect value may be higher than the lowest detected concentration, the median SQL for a chemical in a dataset may be greater than the median detected concentration, or the median SQL may be different across different datasets. A review of the data reveals that this is sometimes the case for certain metals detected at low concentrations near the SQL (*e.g.*, the median SQL for silver is often higher than the median detection). In such cases, these limitations may compromise statistical analyses in this report and potential future background comparisons.

3.2 STATISTICAL PLOTS

Statistical plots are used in exploratory data analysis to show characteristics and relationships of the data, to evaluate fit to a normal distribution, to identify anomalous data points or outliers, and to provide a general overview of the data. Probability plots, boxplots, and individual value plots were constructed as part of the data evaluation for this investigation. Preliminary evaluation of the data included an assessment of data characteristics through graphical and quantitative analysis. The 2008 Supplemental data were summarized overall and by depth interval, with data plotted for the various groupings. The 2008 Supplemental data were compared with the 2005

BRC/TIMET background data using the probability plots, boxplots, and individual value plots. The graphical analysis of the analytical data is described in the following sections, and Appendix D contains the statistical plots.

Probability Plots. The distribution plots for each chemical include a probability plot that shows how well the dataset for the chemical fits a normal or lognormal distribution. Probability plots are also useful to visually identify outliers and to evaluate the possible presence of multiple populations within a dataset. Potential multiple populations are identified by inflection points on the probability plot. Inflection points are not defined statistically, and should be used with considerable caution.

The probability plots are graphs of values, ordered from lowest to highest and plotted against a standard normal or lognormal distribution function. The vertical axis is scaled in units of concentration (or activity, in the case of radionuclides), and the horizontal axis is scaled in units of the normal/lognormal distribution function. The vertical scale is plotted as a linear scale (concentration versus normal/lognormal quantile) and populations of data that plot approximately as a straight line in a linear scale are referred to as normally distributed (or lognormally distributed).

Boxplots. Boxplots provide a method for comparing data groupings or datasets side by side. The boxplots simultaneously display the full range of data, as well as key summary statistics, such as the median, 25th and 75th percentiles, and minimum and maximum values. The top and bottom of the box are the 75th and 25th percentiles, respectively, of the dataset. The length from the top to the bottom of the box is the interquartile range; therefore, the box represents the middle 50 percent of the data. The width of the box is arbitrary. The horizontal line within the box depicts the median value (the 50th percentile) of the dataset. The upper and lower whiskers are defined as follows:

Upper whisker = 75^{th} percentile + (1.5 • interquartile range)

Lower whisker = 25^{th} percentile – (1.5 • interquartile range)

These plots show the symmetry of the dataset, the range of data, and a measure of central tendency (median).

The boxplots, which group data for each dataset, by chemical, and by depth interval, are provided along with the probability and individual value plots for each analyte in Appendix D for the 2008 Supplemental dataset and the 2005 BRC/TIMET background dataset (including

Environ dataset). Accordingly, these boxplots are presented to (a) provide an overview of the 2008 Supplemental and 2005 BRC/TIMET background datasets for soils, (b) facilitate visual comparisons of the 2008 Supplemental background dataset to the 2005 BRC/TIMET background dataset, and (c) facilitate visual comparisons of constituent concentration data for the different depth intervals.

Probability plots and boxplots were also used for identifying anomalous data points (outliers) and data clusters in the 2008 Supplemental and 2005 BRC/TIMET datasets. All anomalous data points and clusters were investigated further.

Scatterplots. A scatterplot uses a Cartesian coordinate system to display values for two variables from a dataset (*e.g.*, arsenic *vs.* aluminum concentrations for the 2008 dataset). The data are displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis.

Scatterplots were constructed for those constituent pairs with significant correlation coefficients. Scatterplots were visually examined and best professional judgment was used to ascertain whether high-concentration outliers[10] occur "near" the least-square linear trend line. Where high-concentration outliers occur "near" the trend line, one may infer that these concentrations are consistent with background concentrations. Scatterplots were generated to support the correlation analysis conducted to further justify that the supplemental data collected are representative of background conditions.

3.3 DESCRIPTIVE SUMMARY STATISTICS

Descriptive summary statistics for metals and radionuclides were calculated for the 2008 Supplemental and 2005 BRC/TIMET datasets (Tables 4 through 26). Descriptive summary statistics for each of the two datasets were also prepared for the following depth intervals, structured around the sampling intervals employed for the 2005 shallow soil background sampling event and the 2008 supplemental shallow soil sampling event (Section 2.2):

- Surface soils (0 ft bgs);
- Shallow subsurface soils (5 ft bgs);

[10] Note that elevated concentration outliers targeted for further evaluation were identified from boxplots (see Section 3.4).

- Deeper subsurface soils (10 ft bgs);
- Subsurface combined (5 and 10 ft bgs); and
- All depths combined (0, 5 and 10 ft bgs).

The descriptive summary statistics calculated for each analyte include the sample size, frequency of detections, and, for both censored and detected data, the minimum and maximum concentration, the median, the mean, and the 25th and 75th percentiles (quantiles). Note that frequency of detection is calculated for radionuclides in terms of the proportion of sample results that are greater than the sample specific MDA. However, for all other data summaries and statistical analyses the uncensored data are used (see Section 2.4.4).

3.4 IDENTIFICATION AND TREATMENT OF OUTLIERS

The data collected for this study are intended to represent background conditions for the eastern sub-areas of the BMI Common Areas. Several lines of evidence are used to verify that these data are representative of these background conditions. For example, supplemental shallow background soil samples were collected from known/suspected unimpacted areas upgradient of the Site industrial areas, and the SVOC data did not provide compelling evidence suggesting that data were inappropriate for characterizing background conditions (Criterion V of Section 2.4). A further line of evidence involves an evaluation of outliers in this background dataset. Statistical outliers are data points that are extremely large or small relative to the rest of the data, and may not, therefore, be representative of the population sampled (USEPA 2000a).

For this investigation, boxplots,[11] individual value plots, and probability plots were used to identify statistical outliers that would undergo further examination (see Appendix D). If an outlier was identified, the next step was to confirm that the datum was not a result of a transcription or other verifiable error.[12] If confirmed not to be an error, correlation analyses were conducted and used to identify those constituent pairs that should be visually examined in

[11] Statistical outliers within the 2008 dataset were defined as those points corresponding to detected metal concentrations or radionuclide activities (*i.e.*, ignoring non-detection report limit artifacts) that were greater than the 75th percentile + 1.5 times the interquartile range for the (i) combined depth plots and (ii) individual depth plots, and are shown as an asterisk (*) on the boxplots (see Section 3.2).

[12] Reporting or transcription errors are unlikely given the direct electronic data uploads from the laboratory, which were in turn uploaded directly into the spreadsheets used for statistical analysis, with no manual entry of concentration values.

scatterplots to ascertain whether high-concentration outliers were consistent with the background dataset (see Section 3.7.5).[13]

Based on the overall findings of the outlier analysis, statistical outliers represented only a small proportion of the entire dataset and no consistent pattern was observed among outliers. It is not unusual for a dataset of this size to have some outliers. This supports the premise that these data are representative of naturally occurring background conditions. Given the lack of scientifically defensible reasons to consider these statistical outliers to be incongruous with background conditions (*i.e.*, "true" outliers), these data were considered representative of background and retained in the supplemental shallow background soil dataset. See also Appendix E for a more detailed discussion of outliers.

3.5 FREQUENCY OF DETECTION

As noted in Section 2.2, cadmium, silver, and uranium-233/234 were detected at noticeably higher frequencies in the 2008 supplemental shallow background samples than in those from the 2005 BRC/TIMET shallow background samples, while lithium, mercury, selenium, thallium, tin and zirconium were detected at noticeably lower frequencies in the 2008 supplemental shallow soil samples than in the 2005 BRC/TIMET shallow soil samples. The statistical summaries in Tables 4 through 26 were evaluated to assess the likely influence of SQLs on these observed detection frequencies. This evaluation determined that variations in SQLs are likely to have had effects on detection frequencies for certain constituents (*i.e.*, cadmium selenium, and silver), as summarized below.

Cadmium	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection[14]	63.6%	13.3%
Median SQLs for Non-Detects (mg/kg)	0.04	0.1291
Median Detected Concentration (mg/kg)	0.11	0.105
Assessment of SQL Effects on Frequency of Detection	The 2005 cadmium frequency of detections is appreciably lower than that for the 2008 data. The detected concentrations are comparable between the two datasets. The range of the 2008 detected values (0.053 to 0.26 mg/kg) is higher than the non-detect	

[13] Scatterplots and correlation analyses were performed with the statistical outlier included in the dataset.
[14] For all summary tables in this section, the value for Percent Detection reflects the full dataset for each event, as taken from Table 2, and the values provided for the other parameters were taken from Tables 4 and 9.

SQLs for that event (0.04 mg/kg); however, a large percentage of these data would not have been reported as detections under the higher 2005 SQLs (*i.e.*, the median value of 2008 detections was 0.11 mg/kg– less than the 2005 median SQL for non-detections [0.1291 mg/kg]). It therefore appears likely that the higher SQLs of the 2005 dataset are one cause of the lower frequency of detection in that dataset, although lower cadmium concentrations in the 2005 samples could be another explanation.

Lithium	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection	18.2%	100%
Median SQLs for Non-Detects (mg/kg)	7.314	--
Median Detected Concentration (mg/kg)	32.95	12.75

Assessment of SQL Effects on Frequency of Detection

The 2008 lithium frequency of detections is appreciably lower than that for the 2005 data. The range of 2005 detections (7.5 to 26.5 mg/kg) is higher than a large percentage of the 2008 non-detect SQLs, based on the 7.314 mg/kg median 2008 SQL value, and many would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples may have generally lower lithium concentrations than the 2005 samples, despite the higher 2008 median detected concentration. However, the elevated 2008 SQLs (*i.e.*, 75th percentile of 14.628 mg/kg and beyond, which are higher than the majority of the 2005 detections [median detect 12.75 mg/kg]), complicate the analysis.

Mercury	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection	0%	77.5%
Median SQLs for Non-Detects (mg/kg)	0.00668	0.0072
Median Detected Concentration (mg/kg)	- -	0.019

Assessment of SQL Effects on Frequency of Detection

The 2008 mercury frequency of detections is appreciably lower than that of the 2005 data; the non-detect SQLs of the two events are fairly comparable. The range of 2005 detections (0.0084 to 0.11 mg/kg) is higher than the 2008 non-detect SQLs (0.00668 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower mercury concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in the frequency of detections in this case.

Selenium

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	0%	43.3%
Median SQLs for Non-Detects (mg/kg)	0.32	0.1579
Median Detected Concentration (mg/kg)	- -	0.29
Assessment of SQL Effects on Frequency of Detection	The 2008 frequency of detections for selenium is appreciably lower than for the 2005 data; the SQLs for the 2008 non-detects are about twice as high as those for the 2005 samples. A large percentage of the 2005 data detections (more than 50% based on median detect value 0.29 mg/kg), would not have been reported as detections under the higher 2008 SQLs (0.32 mg/kg). Therefore, it appears likely that the higher SQLs of the 2008 dataset are one cause of the lower frequency of detection in that dataset, although lower selenium concentrations in the 2008 samples could be another explanation.	

Silver

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	42.4%	13.3%
Median SQLs for Non-Detects (mg/kg)	0.11	0.2609
Median Detected Concentration (mg/kg)	0.076	0.0445
Assessment of SQL Effects on Frequency of Detection	The 2005 silver frequency of detections is appreciably lower than that for the 2008 data; SQLs for the 2005 non-detects are more than twice as high as those for the 2008 samples. The range of 2008 detections (0.054 to 0.17 mg/kg) is lower than the 2005 non-detect SQLs (0.2609 mg/kg), and would not have been reported as detections if present at those levels in the 2005 samples. Therefore, it appears likely that the higher SQLs of the 2005 dataset are one cause of the lower frequency of detections in that dataset, although lower silver concentrations in the 2005 samples could be another explanation.	

Thallium

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	18.2%	35%
Median SQLs for Non-Detects (mg/kg)	0.3	0.5428
Median Detected Concentration (mg/kg)	0.46	1.1
Assessment of SQL Effects on Frequency of Detection	The 2008 thallium frequency of detections is about 52% less than that for the 2005 data, SQLs for the 2008 non-detects are slightly lower than those for the 2005 samples. The majority of 2005	

detections (1.1 mg/kg median value) are higher than the 2008 non-detect SQLs (0.3 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower mercury concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.

Tin

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	48.5%	99%
Median SQLs for Non-Detects (mg/kg)	0.3	0.187
Median Detected Concentration (mg/kg)	0.43	0.49
Assessment of SQL Effects on Frequency of Detection	The 2008 tin frequency of detections is appreciably less than that for the 2005 data; the non-detect SQLs for the 2008 data are nearly twice as high as those for the 2005 data. The majority of 2005 detections (0.4 mg/kg 1st quartile value) are higher than the 2008 non-detect SQLs (0.3 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower tin concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.	

Uranium-233/234

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	100%	50.8%
Median MDA for Non-Detects (pCi/g)	Not determined, because all results, including those lower than the MDA, were used in statistical analyses	
Median Detected Activity (pCi/g)	1.17	0.99
Assessment of MDA Effects on Frequency of Detection	The 2005 shallow soil frequency of detection for uranium-233/234 is appreciably less than the frequency of detection of the 2008 data. The detected concentrations are comparable between the two datasets. Reported uranium-233/234 detections in both datasets are higher than the 2005 SQLs associated with non-detections. The assessment of SQL effects on the frequency of detection was not completely conclusive, but based on the above, it does not appear likely that the SQLs are contributing appreciably to the frequency of detection differences. Note that frequency of detection for U-233/234 has no effect on other data summaries and statistical analyses performed in this study, because the radionuclide data are not censored for these purposes.	

Zirconium	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection	39.4%	100%
Mean SQLs for Non-Detects (mg/kg)	0.8	- -
Mean Detected Concentration (mg/kg)	11.5	125
Assessment of SQL Effects on Frequency of Detection	The 2008 zirconium frequency of detections is less than that of the 2005 data. The range of 2005 detections (60.1 to 179 mg/kg) is higher than the 2008 non-detect SQLs (0.8 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower tin concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.	

Datasets with high frequency of detects tend to be better suited to statistical analyses than those with low frequency of detects (*i.e.*, less than 50 percent), because detection limits in the latter tend to influence the results. The majority of the elements in this study have comparable frequency of detects near 100 percent, and statistical analyses were performed without concern for the effect of non-detections on the findings. For the other elements with far less than 100 percent frequency of detects, the frequency of detects tended to be comparably low in the two datasets; as discussed in the following section, statistical analyses considering the effects of non-detections were developed for these elements or were omitted altogether if the number of detections was too low. The eight metals discussed above represent the few cases in which frequency of detects were appreciably different between the two datasets; these are of particular concern in this study because this situation complicates statistical comparisons. As discussed above, BRC's evaluation of the associated SQLs and ranges of detected concentrations found that differences in SQLs did not appear to have caused the differences in frequency of detects, with the possible exception of cadmium, selenium, and silver, for which the evaluations were inconclusive. For these three metals, statistical comparisons may not be reliable between the two datasets, or in the future, between the background datasets and BMI Common Areas site data.

3.6 STATISTICAL METHODS

Statistical evaluations were used to infer whether metal concentrations and radionuclide activity in 2008 supplemental shallow background soils were comparable to those in the 2005 BRC/TIMET shallow background soils. The following procedures were conducted as part of the statistical evaluations:

- Data were organized by lithologic unit, constituent, and soil interval;
- Data were viewed using boxplots and scatterplots (Section 3.2);
- Data were characterized using descriptive statistics and tests of normality (Section 3.3 and 3.6);
- 2008 supplemental background data were compared to 2005 BRC/TIMET background data using two- and multiple independent sample tests (Sections 3.7.1 and 3.7.2);[15,16]
- 2008 supplement background data were tested to identify potential differences among 0 ft bgs, 5 ft bgs, and 10 ft bgs depth intervals using multiple independent sample tests (Sections 3.7.3); and
- Inter-element associations were identified using correlation analyses and used to further verify that samples were appropriate for characterizing background conditions (Section 3.7.4).

3.6.1 Hypothesis Testing

A common application of classical statistics is to test a scientific hypothesis. A statistical test examines a set of sample data and, based on the underlying distribution of the data, leads to a decision whether to (i) accept[17] the hypothesis or (ii) reject the hypothesis in favor of accepting an alternative complementary one (Sokal and Rohlf 1981). Accordingly, statistical hypotheses are framed in terms of a null hypothesis (H_o) and an alternative hypothesis (H_a).

In this study, the *t*-test was used to evaluate the null hypothesis that the mean concentrations are the same for two background populations for a specific constituent; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the means are different. Similarly, the WRS/Gehan tests were used to evaluate the null hypothesis that median

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15 2008 River dataset was compared to the 2005 McCullough, 2005 River, and 2005 Mixed datasets for the following soil intervals: (i) 0 ft bgs, (ii) 5 ft bgs, (iii) 10 ft bgs, (iv) 5-10 ft bgs combined, and (v) 0-10 ft bgs (0, 5, and 10 ft bgs depths combined).

16 Tests of proportions and comparisons of detected-only data were used when two- and multiple independent sample tests were not recommended—*i.e.*, when sample sizes were greater than four samples and frequency of detections were less than 50 percent.

17 Note that according to classical statistics, the null hypothesis is never proven, as the absence of evidence against the null hypothesis does not establish it. In other words, strictly speaking, one may either “reject” or “fail to reject” the null hypothesis. However, for this study and as commonly used in practice, the term “accept” is used instead of “fail to reject” the null hypothesis (Sokal and Rohlf 1981).

concentrations are the same for two background populations for a specific constituent;[18] conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the medians are different. ANOVA/Kruskal-Wallis tests were used to evaluate the null hypothesis that mean/median concentrations are the same among several background populations for a specific constituent; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the mean/median concentrations are different.

Quantile and slippage tests were used to evaluate the null hypothesis that larger concentrations are similar for two background distributions of a specific constituent[19]; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the larger values are different (*i.e.*, the values in the right-tail of one distribution are larger than the values in the right-tail of the other distribution).

Correlation tests were used to characterize the relationship (or lack thereof) between concentrations of two constituents. The null hypothesis is that there is no correlation between two constituents (*i.e.*, no inter-element correlation); conversely, should this null hypothesis be rejected, one would accept the alternative hypothesis and infer that there exists a relationship (positive or negative) in concentrations between the two constituents. Correlation tests for the Pearson and Kendall-Tau correlation coefficients are described in Neter *et al*. (1996) and Kendall and Gibbbons (1990). These hypotheses were also discussed in the Background Shallow Soil Summary Report (BRC/TIMET 2007).

3.6.2 Statistical Tests

Statistical tests were conducted to compare the 2008 Supplemental and 2005 BRC/TIMET shallow soil datasets and to determine whether there exist relationships between the two constituents. A key decision is whether a parametric or nonparametric statistical test is to be

[18] Note that strictly speaking, the WRS/Gehan tests test whether or not measurements (location, central) from one dataset consistently tend to be larger (or smaller) than those from the other dataset based upon the premise that both datasets were drawn from a single population (*i.e.*, their probability distributions are equal). This test determines which distribution is higher by comparing the relative ranks of the two data sets when the data from both sources are sorted into a single list. These tests require that the two samples to be independent, and the observations to be ordinal or continuous measurements.

[19] The quantile test more formally tests whether the proportion of background (or site) observations from the combined dataset is the same in the upper portion of the combined dataset as it is in the entire combined dataset. The slippage test more formally tests whether the number of site data points that are greater than the maximum background value is reasonable given the number of site samples and the number of background samples.

used. Parametric statistical tests used in this evaluation of supplemental background concentrations assume the following:

- Samples are independent and drawn randomly from the population;
- Data are normally distributed for each population.

Nonparametric methods/tests are not dependent on a specific distribution (*e.g.*, normal distribution) (Gilbert 1987; Sokal and Rohlf 1981; Zar 1984).[20] These methods do not require estimates of the population variance or mean. Nonparametric statistical tests assume that samples are independent and drawn randomly from the population.

Methods used to evaluate and compare the data groups for this supplemental background dataset are summarized below. The computer statistical software program GiSdT® (Neptune and Company 2007) was used to perform two-sample statistical comparisons. All parametric and nonparametric multiple independent sample comparisons and correlation analyses were performed using SPSS v.15. Consistent with previous studies of background concentrations at BRC, a level of significance (α) equal to 0.05 was used to evaluate the tests (BRC/TIMET 2007).[21]

3.6.2.1 Two-Sample Tests

Statistical comparisons between the 2008 Supplemental dataset and the 2005 BRC/TIMET background dataset for each depth interval were performed using the Quantile test, Slippage test, the *t*-test, and the WRS test with Gehan modification. The Quantile test, Slippage test, and WRS test are non-parametric. That is, the tests are distribution free, thus an assumption of whether the data are normally or lognormally distributed is not necessary.

***t*-Test.** The *t*-test is a hypothesis test for two population means to determine whether they are significantly different. Underlying assumptions of the *t*-test are that both datasets are comprised

[20] Accordingly, nonparametric tests are also known as distribution-free tests.
[21] Where appropriate, a confidence level (1-α) of 95 percent confidence was used.

of randomly sampled data, data are independent and normally distributed, and datasets have equal variances[22] (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984).

Wilcoxon Rank Sum (WRS). The WRS test performs a test for a difference between the sum of the ranks for two populations. This is a nonparametric method for assessing differences in the centers of the distributions that relies on the relative rankings of data values. Knowledge of the precise form of the population distributions is not necessary. The two underlying distributions are assumed to have approximately the same shape. The WRS test has less power than the two-sample *t*-test when the data are normally distributed, but the assumptions are not as restrictive. The GiSdT® version of the WRS test uses the Mantel approach for ranking which is equivalent to using the Gehan ranking system.

Quantile Test. The Quantile test performs a test for a shift to the right in the right-tail of the site or tested population versus the reference population. Conceptually, this tests whether the values in the right-tail of the tested distribution are generally larger than the values in the right-tail of the reference distribution. The Quantile test is performed using a defined quantile = 0.80.

Slippage Test. The Slippage test looks for a shift to the right in the extreme right-tail of one population versus the extreme right-tail of a reference population. This test evaluates whether the number of data points from the site data that are greater than the maximum from the background data is reasonable, or if the number is larger than expected under the assumption that the site and background populations are similar.

3.6.2.2 Multiple Independent Sample Tests

One-Way Analysis of Variance (ANOVA). The parametric one-way ANOVA tests the hypothesis that multiple (*k*) population means are equal (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984). Where one-way ANOVA indicated the existence of significant differences among soil strata, the Tukey Honestly Significant Difference (HSD) test was used to conduct pair-wise *post-hoc* comparisons.[23]

[22] Student *t*-test is used when datasets have equal variances. Welch's or Satterthwaite *t*-test may be applied when datasets have unequal variances. Note that the *t*-test is considered to be robust to deviations from the underlying assumptions (Sokal and Rohlf 1981).
[23] Note that only *post-hoc* (= *a posteriori*) comparisons were conducted.

Kruskal-Wallis Test. The Kruskal-Wallis test is a non-parametric analog for the one-way ANOVA that is based on ranks and is used to test the equality of medians among multiple (*k*) populations. The Kruskal-Wallis test is used to test the null hypothesis that several populations have the same continuous distribution. If the null hypothesis is rejected, one may infer that measurements tend to be higher in one or more of the populations. Fundamentally, this test is analogous to a parametric one-way ANOVA with the exception that the measured/observed values are replaced by their ranks. Accordingly, it is an extension of the WRS test for three or more groups. Where Kruskal-Wallis tests indicated the existence of significant differences among soil strata, examinations of boxplots were used to evaluate pair-wise *post-hoc* comparisons.[24]

Examination of Constituents with Less than 50 Percent Frequency of Detection. When frequency of detection is less than 50 percent, even the nonparametric tests have little power to detect differences in central values (Smeti *et al*. 2007). For those constituents where the frequency of detection was less than 50 percent, two- or multiple independent sample tests were not conducted. The following approach was conducted:

1. For individual constituent datasets in which SQLs are comparable, a Z-test for two proportions[25] was conducted to identify similarities in datasets based on the proportion of detected concentrations.

2. For individual constituent datasets in which SQLs are comparable, where the proportion of detected concentrations was found to be similar and the number of detected concentrations was greater than four for both datasets, independent two- or multiple-sample tests were conducted on detected data only.

3.6.2.3 Correlation Analysis

Correlations or "measures of association" are of interest because they offer another line of evidence to confirm that the data are consistent with a background dataset (see Section 3.4). Inter-element correlation analyses were conducted for exploratory purposes and used to identify

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[24] One-half the SQL was substituted for non-detected concentrations in lieu of Gehan ranking. Visual examinations of boxplots were used to conduct *post-hoc* pairwise comparisons.
[25] In this investigation, the Z-test for two proportions (http://www.dimensionresearch.com/resources/calculators/ztest.html) was used to test the null hypothesis that the proportion of detected concentrations is the same among two datasets. If the null hypothesis is rejected, one may infer that the two populations are different with respect to the proportion of detected data.

those constituent pairs that should be further examined (*i.e.*, visual examination of scatterplots) to ascertain whether high-concentration outliers were congruous with the background dataset.

Pearson's Product-Moment Correlation Coefficient. The Pearson product-moment correlation coefficient (r) is a parametric measure of the correlation between two variables (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984). Pearson's correlation reflects the degree of linear relationship between two variables and ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between variables. A correlation of -1 means that there is a perfect negative linear relationship between variables. A correlation of 0 means there is no linear relationship between the two variables.

Kendall Tau Correlation Coefficient. The Kendall tau rank correlation coefficient (or Kendall tau coefficient) is a non-parametric statistic used to measure the degree of correspondence between the ranks of two populations. As with the Pearson's correlation coefficient, Kendall tau ranges from +1 to -1. A value of +1 means that there is 100 percent positive association between the two variables—*i.e.*, rankings for both variables are identical. A value of -1 means that there is 100 percent negative association between the two variables—*i.e.*, the ranking of one variable is the reverse of the other variable. A value of zero indicates the absence of an association between the two variables—*i.e.*, rankings are independent.

3.6.2.4 Adjustment for Use of Multiple Tests

An adjustment may be applied when multiple hypotheses of no effect are tested. Note that by random chance alone, approximately 1 out of every 20 hypothesis tests on the same dataset are expected to be statistically significant at a level of 0.05 if the tests are independent ($\alpha = 0.05$; Sokal and Rohlf 1981). Accordingly, an adjustment may be applied to safeguard against falsely giving the appearance of statistically significant results when a single hypothesis is tested using multiple statistical tests. In this background study, adjustment for the use of multiple tests was performed for the three applications listed below. Note that the conservatism of using the family-wise significance level for individual tests was recognized and "close" results were identified.

Use of Multiple Two-Sample Tests. Four two-sample statistical tests were used to evaluate whether two datasets were obtained from the same population: t-test, WRS/Gehan test, quantile test, and slippage test. The t-test and WRS/Gehan test assess whether central tendencies (*i.e.*, means or medians, respectively) are the same. Whereas, the quantile test and slippage test assess whether values in the right-tails of the distributions are the same. If a statistically significant difference was found using any one of the statistical tests, it was inferred that the data were obtained from two different populations. Accordingly, an adjustment to the significance level was conducted when all four of the two-sample comparison tests were applied. Neptune and Company, Inc., performed simulation studies on the suite of four background comparison tests, and determined that an adjustment to the family-wise error rate[26] of one-half was reasonable when all four of these tests were applied (NDEP 2009c). For this study, a nominal family-wise significance level of 0.05 was desired; thus, an adjusted significance level of 0.025 was used (= ½ * 0.05). A significance level of 0.025 is consistent with the Site versus background comparisons being conducted for the project.

Differences Among Background Populations Based on Tests For Multiple Constituents. Differences among lithologies or depth intervals were evaluated based on the findings of ANOVA/Kruskal-Wallis tests for each of 46 metals and radionuclides. As noted earlier, due to random chance alone, 1 out of every 20 hypothesis test on the same data is expected to be statistically significant at a significance level of 0.05 ($\alpha = 0.05$). For ANOVA/Kruskal-Wallis tests, a qualitative adjustment was applied when evaluating whether lithologies or depth intervals were different based on comparisons for multiple constituents. For this study, a nominal family-wise significance level of 0.05 was desired; thus, lithologies and depth intervals were considered different when more than five percent of all the ANOVA/Kruskal-Wallis tests were found to be significantly different.

Multiple Post-Hoc Pairwise Comparisons. When ANOVA identified a statistically significant difference among lithologies or among depth intervals, the Tukey's Honestly Significant Difference (Tukey's HSD) was used to identify which pairs of lithologies or which pairs of depth intervals were different. Tukey's HSD uses the Studentized range statistic to make all pairwise comparisons between groups and adjusts the investigation-wise error rate to the error rate for the collection for all pairwise comparisons (SPSS 2006).

3.7 RESULTS OF STATISTICAL ANALYSES

A key objective of this investigation is to evaluate whether the 2008 Supplemental shallow soil background dataset is statistically similar to or different from the 2005 BRC/TIMET background data. The results of the following statistical analyses are provided with the intention of supporting a weight-of-evidence evaluation as part of this investigation.

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[26] Family-wise error rate is the probability of making one or more Type I errors (false discoveries) among all the hypotheses when performing multiple pairwise tests (Hochberg and Tamhane 1987; Benjamini and Hochberg 1995).

3.7.1 Comparison of 2008 Supplemental and 2005 BRC/TIMET Datasets (All Depths Combined)

The 2008 Supplemental and 2005 BRC/TIMET shallow background soil datasets were evaluated to determine if there are differences among the following subsets of the shallow background concentration data:

- 2008 River;
- 2005 McCullough;
- 2005 River; and
- 2005 Mixed.

If no differences are found, combining/pooling these subsets of the background concentration data may be recommended for subsequent evaluations to provide a more powerful comparison between site and background concentrations. Conversely, if differences are found, it is recommended that comparisons between site and background concentrations be performed with the appropriate subset of the background concentration data.

Probability plots, boxplots, and individual value plots were also used to compare the 2008 Supplemental and 2005 BRC/TIMET datasets. These plots are included in Appendix D. The results of the statistical analyses are included in Appendix F.

The 2008 dataset was compared to each of following lithologic units: 2005 McCullough, 2005 River, and 2005 Mixed datasets (Table F-2 of Appendix F). Consistent with the *Background Shallow Soil Summary Report* (BRC/TIMET 2007), if a given dataset had fewer than four detections, it was deemed to lack data sufficient to support a robust statistical analysis and was not included in the statistical comparisons. If no more than two datasets had greater than four detections, no statistical comparisons were performed for that constituent. Accordingly, statistical tests were not performed for chromium (VI), niobium, platinum and tungsten—and it was not possible to determine whether significant differences were associated with the 2008 River and the three 2005 soil lithology datasets for these metals.

Overall, statistical comparisons indicated that significant differences existed for 34 of 46 constituents among the four lithologic units: 2005 McCullough, 2005 River, 2005 Mixed, and 2008 River (Table F-2 of Appendix F):

- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Mercury
- Molybdenum
- Nickel
- Palladium
- Phosphorus
- Potassium
- Silicon
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium
- Zirconium
- Radium-226
- Radium-228
- Thorium-228
- Thorium-230
- Thorium-232
- Uranium-233/234
- Uranium-238

The greatest number of significant differences was noted between 2005 McCullough and 2005 River datasets.

Differences between the 2008 River dataset and all of the 2005 datasets were identified for 14 constituents (Table F-2 of Appendix F):

- Arsenic
- Barium
- Boron
- Lithium
- Magnesium
- Palladium
- Potassium
- Silicon
- Sodium
- Strontium
- Zirconium
- Radium-228
- Thorium-230
- Uranium-233/234

With respect to the 2008 River dataset, a greater number of significant differences were noted between (a) 2008 River and 2005 McCullough and (b) 2008 River and 2005 Mixed datasets compared to other inter-lithologic unit comparisons. As might be expected, the fewest number of significant differences were noted between the 2005 River and 2008 River datasets. Note that higher concentrations of arsenic in the 2008 River soils compared to the 2005 River soils may be inferred from the Tukey HSD comparison results. For most constituents, the probability values (*p*-values) for the ANOVA/Kruskal-Wallis were less than 0.001 (Table F-2). Accordingly, the application of a correction to the family-wise significance level would not change the overall conclusions that differences exist among the four lithologic units and that the 2008 River dataset is significantly different than the three 2005 datasets for several constituents.

When the frequency of detections is less than 50 percent, even the nonparametric tests have little power to detect differences in central values (Smeti *et al*. 2007). For constituents with frequency of detects less than 50 percent and similar detection limits, a binomial proportions test was conducted to determine if frequency of detects between background datasets were comparable. Where frequency of detects were found to be similar, subsequent comparisons using detected-only data were conducted for infrequently detected constituents to identify potential similarities among background datasets.[27] Differences between the 2008 and the 2005 background datasets may also be inferred from these analyses (Table F-4 of Appendix F) and are summarized as follows:

Constituent	**Sample Size*** (n > 4)	**Z-Test for Two Proportions**	**Additional Analysis Candidate**
Antimony	Yes	Similar frequency of detection	Yes
Boron	Yes	Similar frequency of detection	Yes
Silver	Yes	Dissimilar frequency of detection	No
Tin	Yes	Similar frequency of detection	Yes

* for two or more lithologic units

Comparisons of detected-only values between 2008 River and 2005 lithologic units were mixed for infrequently detected constituents—*i.e.*, differences may be inferred for some infrequently detected constituents; while no differences may be inferred for other infrequently detected constituents (Table F-9). Note that infrequently detected constituents are, by definition, characterized by a high proportion of censored data. Accordingly, it is both reasonable and defensible that study conclusions related to similarities/dissimilarities among background datasets consider the overall preponderance of the evidence from the more reliable statistical analyses associated with the majority of the 46 constituents with greater frequency of detects.

All in all, from these statistical comparisons, it may be inferred that the 2008 River data differ with respect to metal concentrations and radionuclide activities from the 2005 lithologic units. Therefore, it is recommended that the 2008 Supplemental Background dataset not be pooled with the 2005 BRC/TIMET background dataset for future applications; however, this will be evaluated site-specifically on a case-by-case basis.

[27] Only when datasets have comparable detection limits can this analysis be performed as a line of evidence to infer differences between datasets; otherwise, the test will only reflect differences in detection limits.

3.7.2 Comparison of 2008 Supplemental and 2005 BRC/TIMET Datasets (Depth-Specific Evaluations)

The 2008 Supplemental and 2005 BRC/TIMET shallow background soil datasets were also evaluated on a depth interval-specific basis to further evaluate potential similarities/dissimilarities. Accordingly, two-sample tests were performed to compare the 2008 River to the 2005 McCullough datasets for each of three separate depth intervals: 0 ft bgs, 5 ft bgs, and 10 ft bgs depths intervals.[28] ANOVA/Kruskal-Wallis analyses compared concentrations/activities of constituents in the 5-10 ft bgs depth interval (combined 5 ft bgs and 10 ft bgs datasets) among three lithologic units: 2008 River, 2005 McCullough, and 2005 Mixed[29] (Table F-3). The results of the statistical analyses are included in Appendix F. Probability plots, boxplots, and individual value plots were used to semi-quantitatively compare the 2008 Supplemental and 2005 BRC/TIMET data. These plots are included in Appendix D.

3.7.2.1 Two Sample Test Results (individual 0, 5 & 10 ft bgs comparisons)

Consistent with the findings of statistical comparisons described in the prior section, differences in metal concentrations were inferred based on statistical comparisons between the 2008 River and the 2005 McCullough datasets (Tables F-6, F-7, and F-8 in Appendix F):

- Arsenic (all depths)
- Barium (all depths)
- Beryllium (5 and 10 ft bgs)
- Boron (all depths)
- Cobalt (all depths)
- Copper (5 and 10 ft bgs)
- Iron (5 ft bgs)
- Lead (5 and 10 ft)
- Lithium (10 ft bgs)
- Magnesium (0 and 10 ft bgs)
- Manganese (5 ft bgs)
- Nickel (all depths)
- Palladium (0 and 5 ft bgs)
- Phosphorus (all depths)
- Potassium (all depths)
- Silicon (5 ft bgs)
- Silver (0 ft bgs)
- Sodium (all depths)
- Strontium (0 and 5 ft bgs)
- Tin (5 ft bgs)
- Titanium (all depths)
- Vanadium (0 and 5 ft)
- Zirconium (all depths)

[28] The sample size for constituents in the 2005 River and 2005 Mixed datasets for 0 ft bgs, 5 ft bgs and 10 ft bgs depth intervals were less than four samples and were considered insufficient to support statistical testing.
[29] The sample size for constituents in the 2005 River dataset (5-10 ft bgs combined depth interval) were less than four samples and were considered insufficient to support statistical testing.

No differences in radionuclide activities were inferred based on the results of statistical comparisons for any of the three depth intervals (Tables F-6, F-7, and F-8 in Appendix F). For most constituents, the *p*-value for at least one parametric or nonparametric two-sample test is less than 0.001 (Tables F-6 through F-8). Accordingly, the application of a correction to the family-wise significance level would not change the overall conclusion that differences exist between 2008 River and 2005 McCullough on a depth interval basis.

3.7.2.2 ANOVA/Kruskal-Wallis Test Results (5 - 10 ft bgs combined)

Consistent with the *Background Shallow Soil Summary Report* (BRC/TIMET 2007), the datasets for the 5 ft bgs and 10 ft bgs depth intervals within a lithologic unit were combined to produce a dataset for the 5-to-10 (5-10) ft bgs depth interval. Overall, a number of significant differences in metal concentrations among the three lithologic units (2008 River, 2005 McCullough, and 2005 Mixed) were identified for the 5-10 ft bgs depth interval based on the results of ANOVA/Kruskal-Wallis tests (Table F-3 in Appendix F). The only constituents for which no significant differences were identified were:

- Calcium
- Zinc
- Thorium-228
- Thorium-232

For most constituents, the *p*-values for the ANOVA/Kruskal-Wallis tests were less than 0.001 (Table F-3). Accordingly, the application of a correction to the family-wise significance level would not change the overall conclusions that differences exist among the four lithologic units with respect to the 5-10 ft bgs depth interval.

Consistent with the 2005 Shallow Background Study (BRC/TIMET), no statistical tests were conducted for metals that had fewer than four detections in one or more of the unit-specific datasets, specifically:

- Antimony
- Boron
- Cadmium
- Chromium (VI)
- Mercury
- Niobium
- Platinum
- Selenium
- Silver
- Thallium
- Tungsten

Because these constituents were not subjected to statistical comparisons, it was not possible to determine whether significant differences were associated with the 5-10 ft bgs depth interval among the 2008 River, 2005 McCullough, and 2005 Mixed datasets.

Significant differences were noted between the 2008 River dataset and the datasets for the other two lithologic units (Table F-3 of Appendix F). More significant differences were identified between the 2008 River and 2005 McCullough datasets. However, differences in metal concentrations and radionuclide activities were inconsistent between the units—*i.e.*, one lithologic unit did not have consistently higher concentrations or activities. The 2005 Mixed dataset was nearly always indistinguishable from either one or both of the other two lithologic units. That is, for all elements except uranium-238, the 2005 Mixed dataset was (1) statistically indistinguishable from both the 2005 McCullough and the 2008 River datasets (*e.g.*, arsenic, lead); (2) statistically indistinguishable from the 2005 McCullough dataset but had inferred significant differences from the 2008 River dataset (*e.g.*, magnesium, manganese); or (3) statistically indistinguishable from the 2008 River dataset but had inferred significant differences from the 2005 McCullough dataset (*e.g.*, barium, tin) (Table F-3 of Appendix F). This observation is consistent with the interpretation of the 2005 Mixed dataset being derived from soils that reflect a mixture of McCullough and River soils. The 2005 Mixed dataset had significant differences inferred relative to the 2008 River dataset for several common parent elements (*e.g.*, silicon, aluminum, magnesium, potassium), which suggests a closer affinity between the Mixed and McCullough soils.

The following constituents were considered to be present at higher concentrations in the 2008 River dataset than the other two datasets:

- Arsenic
- Palladium
- Silicon
- Strontium
- Chromium
- Potassium
- Sodium
- Uranium

For infrequently detected constituents (less than 50 percent frequency of detection), differences between the 2008 River and the 2005 datasets may also be inferred from these analyses (Table F-5 of Appendix F) and are summarized as follows:

Constituent	**Sample Size*** (n > 4)	**Z-Test For Two Proportions**	**Additional Analysis Candidate**
Antimony	Yes	Similar frequency of detection	Yes

* for two or more lithologic units

Results of comparisons of detected-only values between 2008 River and 2005 lithologic units were mixed for infrequently detected constituents-*i.e.*, differences may be inferred for only some infrequently detected constituents (antimony, boron). Note that infrequently detected constituents are, by definition, characterized by a high proportion of censored data. Accordingly, it is both reasonable and defensible that study conclusions related to similarities/dissimilarities among background datasets consider the overall preponderance of the evidence from the more reliable statistical analyses for the vast majority of the 46 constituents with greater frequency of detects.

Again, when results of statistical comparisons are taken as a whole, it may be inferred that the 2008 River data differ with respect to metal concentrations from the 2005 lithologic units. These findings support the recommendation not to pool the 2008 Supplemental Background dataset with the 2005 BRC/TIMET background datasets for future applications.

3.7.3 Comparison of 2008 Supplemental Shallow Data by Depth Intervals

Soil samples were collected from three depth intervals from the 2008 Supplemental shallow background soil study: 0 ft bgs, 5 ft bgs, and 10 ft bgs. Data for samples from each depth interval were compared using the statistical tests identified in Section 3.6.2. Multiple population (ANOVA) tests were selected and used to compare data among surface, middle shallow, and deeper shallow soil samples. The results of the statistical analyses are included in Appendix F. Results that are statistically significant at a *p*-level of 0.05 are indicated in each table (see Section 3.6.2.4 regarding correction for use of multiple tests). Boxplots and individual value plots shown in Appendix D compare the data by depth interval and offer a visual semi-quantitative appraisal of differences for each analyte among the groups of data. Statistical tests provide a quantitative analysis to determine if the differences are statistically significant at a specified significance level.

For the most part, metal concentrations were comparable among the three soil depth intervals (Table F-1 of Appendix F). Statistically significant differences in concentrations or activity among soil depth intervals were found for only seven of 46 constituents examined:

- Cobalt[30]
- Nickel
- Potassium
- Sodium
- Thorium-230
- Uranium-233/234
- Uranium-238

[30] The ANOVA results for cobalt suggested that there were significant differences between lithologic units; however, the *post-hoc* testing did not identify specific differences.

For most constituents, the *p*-values for the ANOVA/Kruskal-Wallis tests were greater than 0.05 (Table F-1). Accordingly, the application of a correction to the family-wise significance level would not change the overall conclusions that few differences exist among the 0, 5, and 10 ft bgs depth intervals for the 2008 Supplemental shallow soil data (Table F-1).

The statistical comparisons found that statistically significant differences could be inferred primarily between (i) 0 ft bgs and 5 ft bgs and (ii) 0 ft bgs and 10 ft bgs for metals; no significant differences were inferred for metals between the 5 ft bgs and 10 ft bgs datasets. For radionuclides, comparisons found that statistically significant differences could be inferred primarily between the 0 ft bgs and 10 ft bgs datasets only. In addition to those apparent significant differences, only one other significant difference was inferred for radionuclides. This was for the thorium-230 5 ft bgs and 10 ft bgs datasets.

Differences in metal concentrations and radionuclide activities were inconsistent between the units—*i.e.*, one lithologic unit did not have consistently higher concentrations or activities. Sodium concentrations and radionuclide activities were found to be greater for the 10 ft bgs depth interval as compared to the other depth intervals. Nickel and potassium concentrations were found to be greater in the 0 ft bgs depth interval as compared to deeper intervals.

Although some identified statistically significant differences were observed for the above metals and radionuclides, these differences may not be significant from a geochemical perspective. Nonetheless, the findings of these statistical analyses suggest that the 0 ft bgs, 5 ft bgs, and 10 ft bgs depth intervals may be pooled and applied as a single dataset for future applications.

3.7.4 Inter-Element Correlations

In addition to statistical tests comparing shallow background soils data among lithologic units and depth intervals, the 2008 River data were evaluated with respect to inter-element correlations. Correlations or “measures of association” are of interest because they offer another line of evidence to confirm that data are consistent with a background dataset (see Section 3.4). Correlation analyses were conducted and used to identify those constituent pairs that should be visually examined in scatterplots to ascertain whether high-concentration outliers should be considered consistent with the background dataset. Both parametric (Pearson’s product-moment) and nonparametric (Kendall tau) correlation coefficients are presented in correlation matrices (Appendix G). Note that statistically significant correlation coefficients (at a significance level of

0.05)[31] are indicated by bold font and are color-coded for parametric and nonparametric coefficients in each table. Scatterplots for constituents with significant correlation coefficients and high-concentration outliers are also presented in Appendix G.

Statistically significant associations were observed for several elements. The association of aluminum with trace metals was evaluated, and statistically significant associations were found for barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, nickel, phosphorus, potassium, silicon, silver, tin, titanium, uranium, vanadium, and zirconium (Table G-1 of Appendix G). Strong inter-element correlations are normally expected between alkaline and alkaline-earth metals (BRC/TIMET 2007)—for the 2008 Supplemental background data, statistically significant correlation coefficients between alkaline and alkaline-earth metals ranged from 0.25 to 0.40 (Table G-3 of Appendix G). These associations may be useful in distinguishing soils derived from different source materials and in distinguishing site-related contamination from natural background. Statistically significant associations among thorium-232 decay chain radionuclides were not observed (Table G-5 of Appendix G).[32] Statistically significant associations among uranium-238 decay chain radionuclides were observed—correlation coefficients ranged from 0.32 to 0.54. Both the thorium-232 and uranium-238 chains were determined to be in approximate secular equilibrium following equivalence testing outlined in NDEP's *Guidance for Evaluating Secular Equilibrium at the BMI Complex and Common Areas February* (NDEP 2009d). There continues to be an issue for the Th-232 chain, in which it is common for BRC site and background data to observe approximate secular equilibrium, but a lack of correlation between isotopes in the decay chain. To date, the issue is unresolved. The results of the equivalence testing for secular equilibrium are as follows:

Chain	Equivalence Test		Secular Equilibrium?	Mean Proportion			
	Delta	**p-value**		**Ra-226**	**Th-230**	**U-233/234**	**U-238**
U-238	0.1	0.03	Yes	0.2114	0.2934	0.2716	0.2236
				Ra-228	**Th-228**	**Th-232**	
Th-232	0.1	0.00	Yes	0.3143	0.3647	0.3210	

31 An adjustment for multiple comparisons was not applied to the correlation analyses because these analyses were used to identify constituents requiring further analysis and not for distinguishing between datasets using multiple tests.

32 Further investigation produced no explanation for the lack of correlation among thorium-232 decay chain radionuclides.

3.7.5 Scatterplots

In addition to the calculated inter-element correlations, scatterplots with regression lines provide a visual assessment of inter-element associations. Statistically significant associations and high-concentration outliers were identified for several elements within the 2008 dataset (Appendix G):

- Aluminum
- Arsenic
- Barium
- Copper
- Lithium
- Nickel
- Strontium

Scatterplots for identified constituent pairs were examined to determine whether high-concentration outliers are consistent with background (Appendix G)—*i.e.*, high-concentration outliers were "near" the linear least-square trend line. To identify potential deviations from trend lines, constituents listed above were plotted against constituents that were correlated and considered ubiquitous and relatively constant for identified lithologic units—*i.e.*, aluminum, iron, and magnesium. In general, no consistent and conspicuous deviations from least-square trend lines were observed for high concentration outliers.

Certain inter-element relationships are expected on the basis of geochemical behavior and expected mineralogical associations. For example, alkaline metals (such as lithium, sodium, and potassium) and alkaline-earth metals (such as barium, calcium, and magnesium) can be expected to behave similarly in solution and may therefore be expected to show an association in certain environmental media. Other metals are found in association in common minerals and show correlations in soils containing these minerals (such as feldspars; metal oxides such as hematite, goethite and pyrolusite; and carbonate minerals such as calcite). These associations are useful in distinguishing soils derived from different source materials and in distinguishing site-related contamination from natural background.

The association of aluminum with trace metals was also evaluated. Trace metals such as chromium, cobalt, copper, nickel, and vanadium may occur as impurities in the common alumino-silicate family of minerals known as feldspars. Clays and other secondary aluminum minerals in soils may host sorption sites for trace metals, thereby associating these metals. In general, these associations are evident.

Scatterplots were also constructed for radionuclides within the thorium-232 and uranium-238 decay chains and are included in Appendix G. Often, species within the decay chains (parents and daughters) show correlations unless there are great differences in geochemical behavior and sufficient mechanisms to separate the species. In general, most of the radionuclides in the uranium-238 decay chain (radium-226, thorium-230, and uranium-233/234) did show significant associations. Radionuclides in the thorium-232 decay chain (radium-228 and thorium-228) did not show significant associations, confirming the correlation results presented in Section 3.7.4.

Finally, scatterplots were constructed for arsenic and other metals commonly found at high levels in the Upper Ponds (chromium, lead, manganese, and vanadium) as well as radium-226 to support the contention that the 2008 Supplemental dataset is representative of background. Some correlation between these elevated levels would be expected in the ponds given the depositional history of the site. In general, most of these contaminants did show varying degrees of visual correlation with arsenic, with the possible exception of manganese. If aerial deposition of wind-borne dusts from Site operations were occurring at the background locations, a similar pattern may be expected. However, these same metals and radium-226 did not show any correlation with arsenic in either the 2008 Supplemental or 2005 BRC/TIMET background datasets. Although some correlation appears evident between arsenic and vanadium in the 2008 Supplemental dataset, this is primarily driven by their highest concentrations being found in the same sample (BRC-BKG-R09) in the subsurface (10 ft bgs); likely not a result of contamination from the site.

4.0 SUMMARY AND CONCLUSIONS

The purpose of the 2008 Supplemental shallow soil background study was to collect and analyze data for metals and radionuclides in background shallow soils that are representative of soils in geologic units not covered by the existing 2005 background shallow soil dataset (BRC/TIMET 2007). The objectives of this study are to determine whether these background data are representative of distinct geologic unit from the northern River Mountains, and whether they can be added to the background data pool to accommodate background comparisons at portions of the Common Areas (*i.e.*, the Mohawk sub-area and portions of Parcel 4B).

Soil sampling was conducted in April 2008. Samples were collected from 10 soil boring locations that represent the specific lithologies targeted by this supplemental shallow soil background sampling study and that extend the representative range of soils found in the vicinity of the Site. A total of 30 field and three duplicate soil samples were collected from the 10 borings for analysis.[33] The data validation for the 2008 Supplemental dataset included 20 percent full validation and 100 percent partial validation. Results qualified as estimated based on the data validation are usable for the purposes of establishing background concentrations and for comparison to site-specific sample data. No soil sample results were rejected. One hundred percent of the dataset were validated as usable, indicating that the overall data collection objectives for the study were met. However, as noted in Section 3.5, for a few metals (*e.g.*, cadmium, selenium, and silver), variations in SQLs may have affected the frequency of detection and the validity/applicability of statistical analyses between the 2008 and 2005 background datasets as well as in comparisons of these data to future site data.

Based on sampling location characteristics, information obtained from published documentation, site inspection, and sample collection, it is reasonable to conclude that the background samples collected as part of this investigation reflect shallow background soil conditions that may be used to support assessments of soils at the Mohawk sub-area and Parcel 4B. As discussed in Section 2.4, SVOC analyses were used to assess the potential for impacts to the sampling locations from anthropogenic sources. SVOC detections in surface soil samples collected at the background sampling locations are limited to bis(2-ethylhexyl)phthalate, a common lab contaminant. Therefore, the SVOC data did not provide any evidence suggesting that use of the samples for characterizing background conditions would be inappropriate. The results of

[33] The field duplicates were evaluated as independent samples in the statistical analyses.

correlation analyses and scatterplots also corroborate the conclusion that this dataset is appropriate for use as a representative shallow background soil dataset.

Key findings from the analyses of the shallow background soils data include:

- Based on the statistical analyses performed, there appear to be distinct differences between the populations associated with soils derived primarily from the McCullough and River Mountains, and with soils representing a mixture of both sources. It is therefore appropriate to perform comparisons of background to site data using the subset of background data that most closely matches the geologic conditions as follows:

Portion of Site	Applicable Background Dataset
Eastern portion (*e.g.*, Mohawk, eastern part of Parcel 4B)	2008 River dataset
Northwestern portion (*e.g.*, Western Hook)[34]	2005 McCullough dataset
Central or remaining portion	2005 McCullough and Mixed datasets

  Distinct differences between the 2008 River (North River) dataset and the 2005 River (South River) dataset were also observed (*e.g.*, arsenic concentrations are greater in soils derived from North River sediments as compared to soils derived from South River sediments). Although it is appropriate to perform comparisons of background to site data for Mohawk and parts of Parcel 4B using either the 2008 (North) River or the 2005 (South) River datasets, given the proximity of the 2008 River dataset to these areas, this is considered the more appropriate dataset for comparison purposes. Although there may be instances where the 2005 (South) River dataset may be appropriate, future use of this dataset is considered unlikely.

- Because statistical analyses suggest that the 2008 Supplemental and 2005 BRC/TIMET datasets exhibit a number of statistically significant differences, it is recommended not to

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[34] Note that portions of surface and/or near surface soils in the northwestern portion of the Site may also be associated with the Upper Muddy Creek formation (UMCf). BRC is currently conducting a study that should provide data that will determine naturally-occurring arsenic conditions in this portion of the Site. This study will include the evaluation of potential arsenic mobilization and/or accumulation mechanisms, and a more detailed geologic characterization including pedogenic, hydrogeologic and geochemical site conditions. In addition, subsurface (and potentially surface) soils in the north central portion of the Site may be associated with the deeper alluvium, characterized by a separate deep background dataset for the project.

combine these datasets in support of future comparisons to site data. Potential exceptions to this recommendation will be considered on a case-by-case basis—for example, for areas of the site that may occur at the interface of different geologic units (*e.g.*, Parcel 4B).

- Findings of the ANOVA/Kruskal-Wallis tests found few statistically significant differences among the 0, 5, and 10 ft bgs depth intervals for the 2008 River background data. These findings suggests that data for the 0, 5, and 10 ft bgs depth intervals may be pooled and applied as a single dataset, promoting more powerful statistical analyses for future assessments in support of decision-making. Because of the limited inferred differences in the depth-specific sample populations for the 2008 River unit, it is not necessary or appropriate to compare depth-specific Site data to the associated depth-specific background dataset.

Although the various background datasets are all contained within the project database, combining the background dataset by depth and/or lithology for subsequent comparison with Site data will be influenced by potential exposures at varying depth intervals and the location of a particular receptor – in other words, based on data usability and conceptual site model considerations.

These findings suggest that these data are appropriate for supporting future assessments and decision-making with respect to soils at sites within the BMI Complex and Common Areas. Specific decisions regarding how best to use the shallow background soils data for future Site-to-background comparisons will be made on a case-by-case basis in consultation with NDEP.

5.0 REFERENCES

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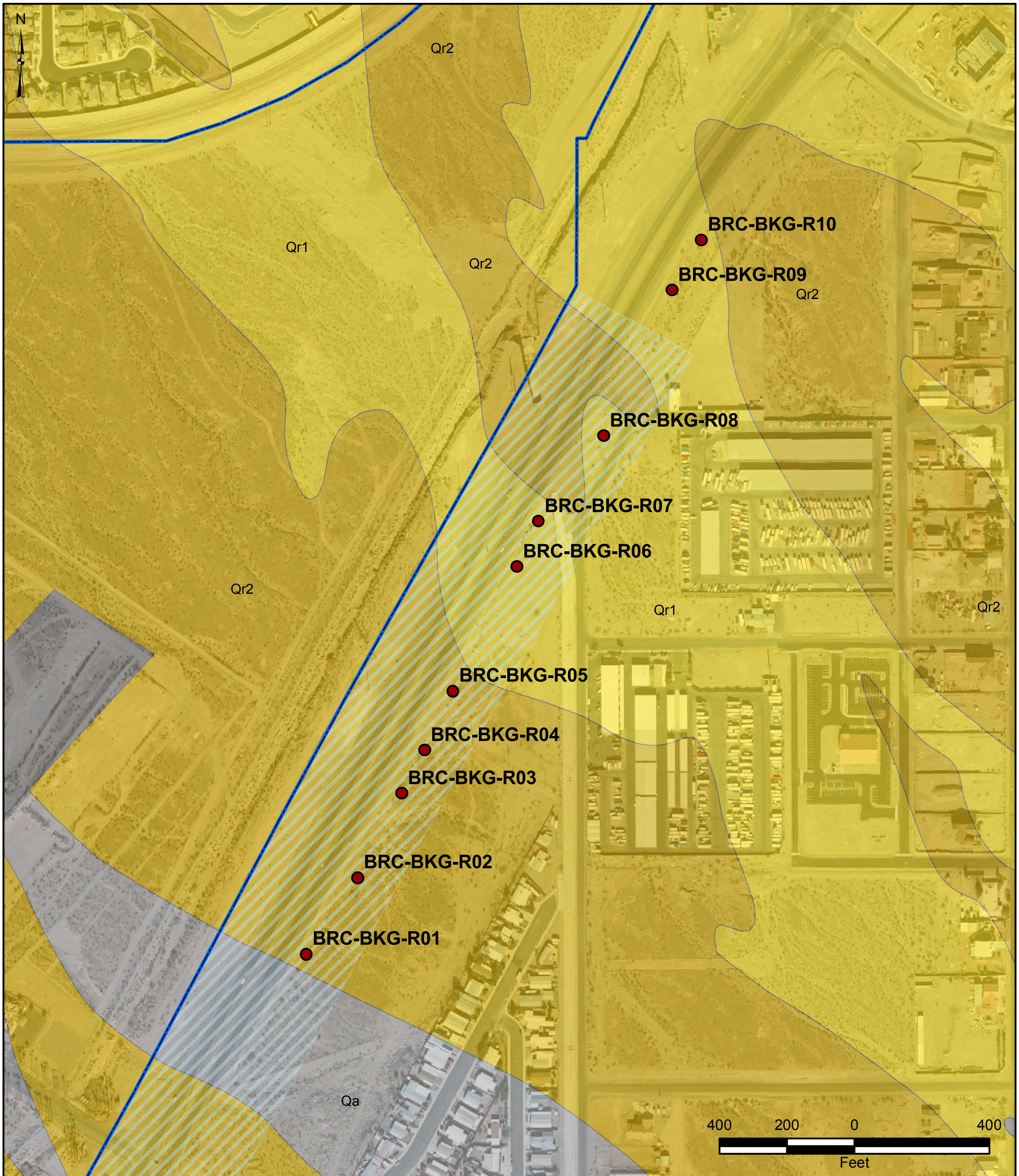
FIGURES



Site AOC3 Boundary

NDOT Right-of-Way (400 Ft)

Supplemental Background Sample Location

Lithology

Qr1

Qr2

January 2008 Aerial Photo from AeroTech Mapping.

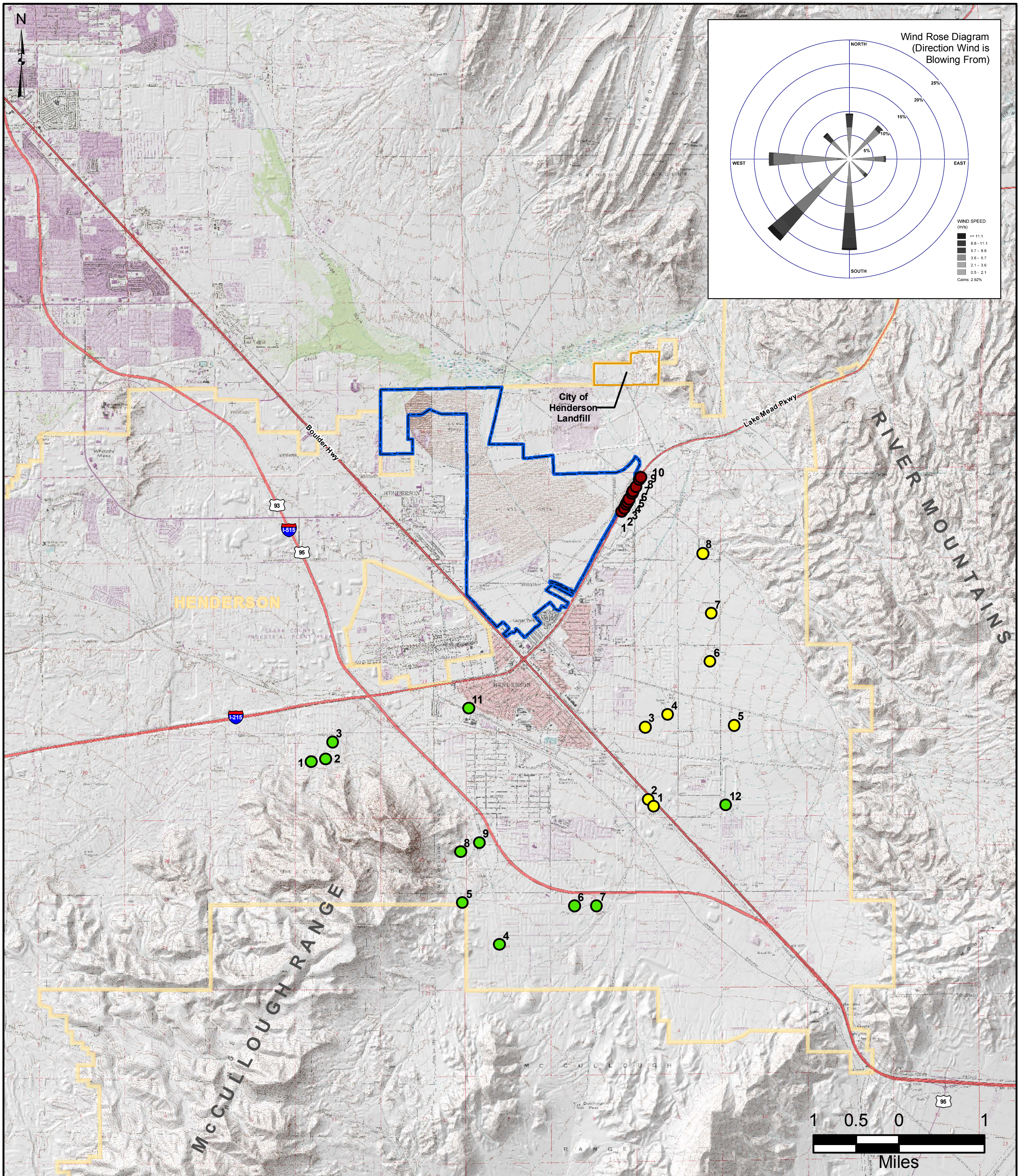
BMI Common Areas (Eastside)
Clark County, Nevada

FIGURE 1

SUPPLEMENTAL BACKGROUND SAMPLE LOCATIONS

Basic Remediation COMPANY

Prepared by MKJ (ERM) | ERM | Date 09/14/09 | JOB No. 0064276 FILE: GIS/BRC/SUPPL-BACKGROUND_FIGURE1.MXD



Site AOC3 Boundary

City of Henderson Boundary

Supplemental Background Sample Location

BRC/TIMET Background Sample Location

ENVIRON Background Sample Location

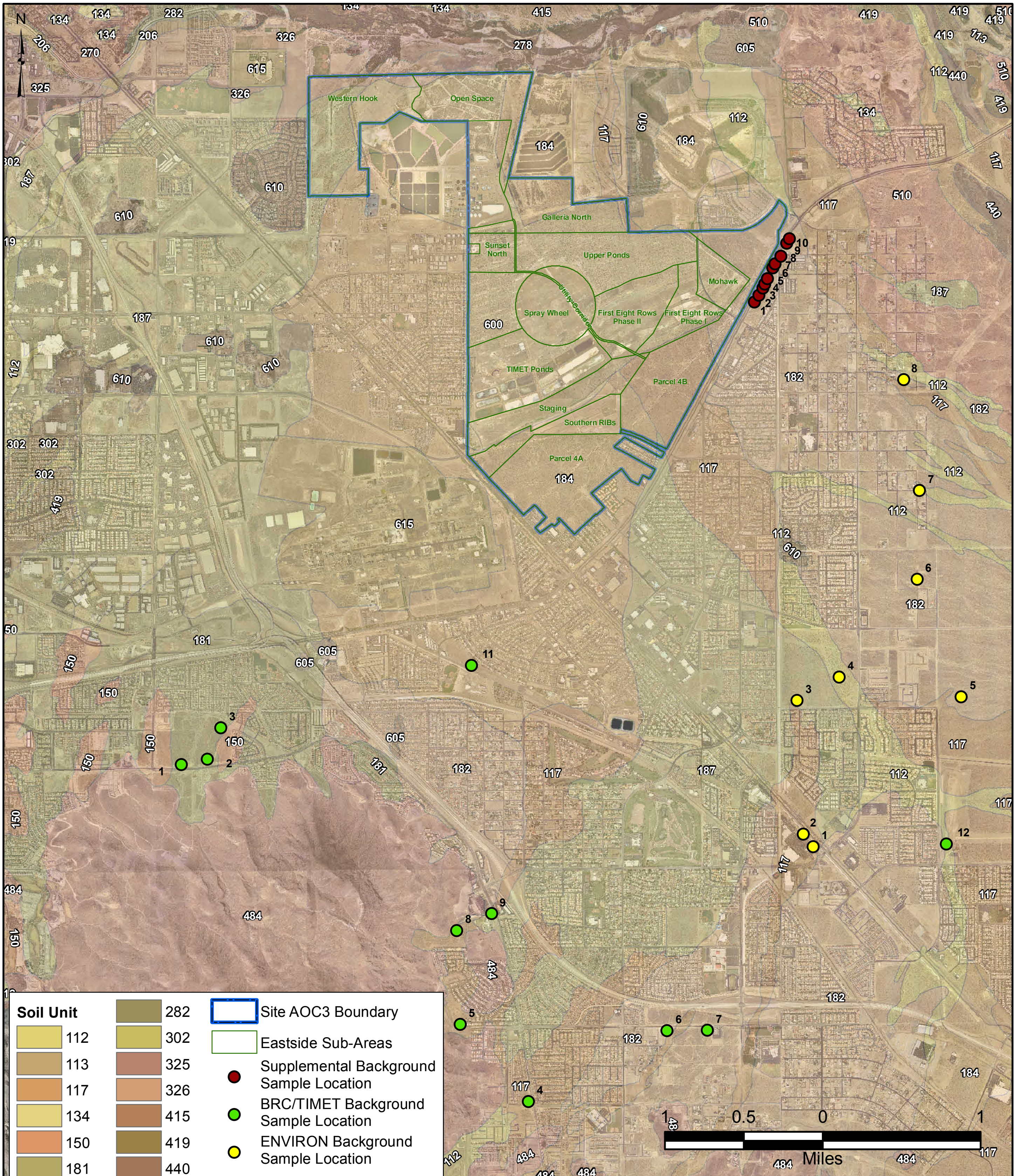
BMI Common Areas (Eastside)
Clark County, Nevada

FIGURE 2

REGIONAL TOPOGRAPHIC MAP AND SAMPLE LOCATIONS

Basic Remediation COMPANY

Prepared by		Date	JOB No. 0064276
MKJ (ERM)	ERM	09/14/09	FILE: GIS/BRC/SUPPL-BACKGROUND_FIGURE2.MXD



Fall 2006 Aerial Photo.

BMI Common Areas (Eastside)
Clark County, Nevada

FIGURE 3

REGIONAL USDA SOILS MAP AND SAMPLE LOCATIONS

Basic Remediation Company

Prepared by		Date	JOB No. 0064276
MKJ (ERM)	ERM	09/15/09	FILE: GIS/BRC/SUPPL-BACKGROUND_FIGURE3.MXD

TABLES

TABLE 1
PROJECT LIST OF ANALYTES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 3)

Parameter of Interest	Preparation Method	Analytical Method	Compound List	CAS Number	Laboratory Limits		Sample Depths
Metals	EPA 3050M	EPA 6020/6010B	Aluminum	7429-90-5	5	mg/kg	0, 5, 10
			Antimony	7440-36-0	0.5	mg/kg	0, 5, 10
			Arsenic	7440-38-2	1	mg/kg	0, 5, 10
			Barium	7440-39-3	2	mg/kg	0, 5, 10
			Beryllium	7440-41-7	0.1	mg/kg	0, 5, 10
			Boron	7440-42-8	10	mg/kg	0, 5, 10
			Cadmium	7440-43-9	0.05	mg/kg	0, 5, 10
			Calcium	7440-70-2	50	mg/kg	0, 5, 10
			Chromium	7440-47-3	1	mg/kg	0, 5, 10
			Cobalt	7440-48-4	0.2	mg/kg	0, 5, 10
			Copper	7440-50-8	1	mg/kg	0, 5, 10
			Iron	7439-89-6	5	mg/kg	0, 5, 10
			Lead	7439-92-1	0.3	mg/kg	0, 5, 10
			Lithium	1313-13-9	5	mg/kg	0, 5, 10
			Magnesium	7439-95-4	50	mg/kg	0, 5, 10
			Manganese	7439-96-5	0	mg/kg	0, 5, 10
			Molybdenum	7439-98-7	1	mg/kg	0, 5, 10
			Nickel	7440-02-0	1	mg/kg	0, 5, 10
			Niobium	7440-03-1	3	mg/kg	0, 5, 10
			Palladium	7440-05-3	0.1	mg/kg	0, 5, 10
			Phosphorus	7723-14-0	50	mg/kg	0, 5, 10
			Platinum	7440-06-4	0.1	mg/kg	0, 5, 10
			Potassium	7440-09-7	10	mg/kg	0, 5, 10
			Selenium	7782-49-2	0.5	mg/kg	0, 5, 10
			Silicon	7440-21-3	25	mg/kg	0, 5, 10
			Silver	7440-22-4	0.2	mg/kg	0, 5, 10
			Sodium	7440-23-5	20	mg/kg	0, 5, 10
			Strontium	7440-24-6	0.5	mg/kg	0, 5, 10
			Sulfur	7704-34-9	500	mg/kg	0, 5, 10
			Thallium	7440-28-0	0.2	mg/kg	0, 5, 10
			Tin	7440-31-5	0.2	mg/kg	0, 5, 10
			Titanium	7440-32-6	0.5	mg/kg	0, 5, 10
			Tungsten	7440-33-7	0.5	mg/kg	0, 5, 10
			Uranium	7440-61-1	0.1	mg/kg	0, 5, 10
			Vanadium	7440-62-2	1.0	mg/kg	0, 5, 10
			Zinc	7440-66-6	2	mg/kg	0, 5, 10
			Zirconium	7440-67-7	10	mg/kg	0, 5, 10
	EPA 3060A	EPA 7196A	Chromium (VI)	18540-29-9	0.4	mg/kg	0, 5, 10
	EPA 7471A	EPA 7471A	Mercury	7439-97-6	0.0333	mg/kg	0, 5, 10
Radionuclides	GL-RAD-A-021/	HASL A-01-R	Thorium-232	7440-29-1	1.0	pCi/g	0, 5, 10
	GL-RAD-A-015 [1]		Thorium-228	14274-82-9	1.0	pCi/g	0, 5, 10
	(Total Dissolution)		Thorium-230	14269-63-7	1.0	pCi/g	0, 5, 10
	GL-RAD-A-021/		Uranium-233/234	13966-29-5	1.0	pCi/g	0, 5, 10
	GL-RAD-A-015 [1]		Uranium 235/236	15117-96-1	1.0	pCi/g	0, 5, 10
	(Total Dissolution)		Uranium-238	7440-61-1	1.0	pCi/g	0, 5, 10
	GL-RAD-A-021/	EPA 903.1	Radium-226	13982-63-3	1.0	pCi/g	0, 5, 10
	GL-RAD-A-015 [1]	EPA 904.0	Radium-228	15262-20-1	1.0	pCi/g	0, 5, 10
Misc. Soil Characteristics	EPA 9060		Total organic carbon (TOC)	7440-44-0	25	mg/kg	5, 10
	ASTM D2216-98		Percent moisture	%MOISTURE		percent	5, 10
	EPA 9045C		pH in soil	pH	NA	pHunits	0, 5, 10
	EPA 9080 or 9081		Cation exchange capacity	NA	NA	meq/100g	0, 5, 10
	ASTM D422		Soil Texture Class	NA	NA	% of total	0, 5, 10

TABLE 1
PROJECT LIST OF ANALYTES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 2 of 3)

Parameter of Interest	Preparation Method	Analytical Method	Compound List	CAS Number	Laboratory Limits		Sample Depths
Semivolatile Organic Compounds	EPA 3550B	EPA 8270C	1,2,4,5-Tetrachlorobenzene	95-94-3	330	µg/kg	0
			1,2-Diphenylhydrazine	122-66-7	330	µg/kg	0
			1,4-Dioxane	123-91-1	330	µg/kg	0
			2,2'/4,4'-Dichlorobenzil	3457-46-3	330	µg/kg	0
			2,4,5-Trichlorophenol	95-95-4	330	µg/kg	0
			2,4,6-Trichlorophenol	88-06-2	330	µg/kg	0
			2,4-Dichlorophenol	120-83-2	330	µg/kg	0
			2,4-Dimethylphenol	105-67-9	330	µg/kg	0
			2,4-Dinitrophenol	51-28-5	1600	µg/kg	0
			2,4-Dinitrotoluene	121-14-2	330	µg/kg	0
			2,6-Dinitrotoluene	606-20-2	330	µg/kg	0
			2-Chloronaphthalene	91-58-7	330	µg/kg	0
			2-Chlorophenol	95-57-8	330	µg/kg	0
			2-Methylnaphthalene	91-57-6	330	µg/kg	0
			2-Nitroaniline	88-74-4	1600	µg/kg	0
			2-Nitrophenol	88-75-5	330	µg/kg	0
			3,3-Dichlorobenzidine	91-94-1	1600	µg/kg	0
			3-Nitroaniline	99-09-2	1600	µg/kg	0
			4,4'-Dichlorobenzil	3457-46-3	330	µg/kg	0
			4-Bromophenyl phenyl ether	101-55-3	330	µg/kg	0
			4-Chloro-3-methylphenol	59-50-7	330	µg/kg	0
			4-Chlorophenyl phenyl ether	7005-72-3	330	µg/kg	0
			4-Chlorothioanisole	123-09-1	1600	µg/kg	0
			4-Chlorothiophenol	106-54-7	330	µg/kg	0
			4-Nitroaniline	100-01-6	1600	µg/kg	0
			4-Nitrophenol	100-02-7	1600	µg/kg	0
			Acenaphthene	83-32-9	330	µg/kg	0
			Acenaphthylene	208-96-8	330	µg/kg	0
			Acetophenone	98-86-2	330	µg/kg	0
			Aniline	62-53-3	330	µg/kg	0
			Anthracene	120-12-7	330	µg/kg	0
			Azobenzene	103-33-3	330	µg/kg	0
			Benzo(a)anthracene	56-55-3	330	µg/kg	0
			Benzo(a)pyrene	50-32-8	330	µg/kg	0
			Benzo(b)fluoranthene	205-99-2	330	µg/kg	0
			Benzo(g,h,i)perylene	191-24-2	330	µg/kg	0
			Benzo(k)fluoranthene	207-08-9	330	µg/kg	0
			Benzoic acid	65-85-0	1600	µg/kg	0
			Benzyl alcohol	100-51-6	330	µg/kg	0
			bis(2-Chloroethoxy)methane	111-91-1	330	µg/kg	0
			bis(2-Chloroethyl) ether	111-44-4	330	µg/kg	0
			bis(2-Chloroisopropyl) ether	108-60-1	330	µg/kg	0
			bis(2-Ethylhexyl) phthalate	117-81-7	330	µg/kg	0
			bis(Chloromethyl) ether	542-88-1	330	µg/kg	0
			bis(p-Chlorophenyl) sulfone	80-07-9	330	µg/kg	0
			bis(p-Chlorophenyl)disulfide	1142-19-4	330	µg/kg	0
			Butylbenzyl phthalate	85-68-7	330	µg/kg	0
			Carbazole	86-74-8	330	µg/kg	0

TABLE 1
PROJECT LIST OF ANALYTES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 3 of 3)

Parameter of Interest	Preparation Method	Analytical Method	Compound List	CAS Number	Laboratory Limits		Sample Depths
Semivolatile Organic Compounds (continued)	EPA 3550B	EPA 8270C	Chrysene	218-01-9	330	µg/kg	0
			Dibenzo(a,h)anthracene	53-70-3	330	µg/kg	0
			Dibenzofuran	132-64-9	330	µg/kg	0
			Dichloromethyl ether	542-88-1	330	µg/kg	0
			Diethyl phthalate	84-66-2	330	µg/kg	0
			Dimethyl phthalate	131-11-3	330	µg/kg	0
			Di-n-butyl phthalate	84-74-2	330	µg/kg	0
			Di-n-octyl phthalate	117-84-0	330	µg/kg	0
			Diphenyl disulfide	882-33-7	330	µg/kg	0
			Diphenyl sulfide	139-66-2	330	µg/kg	0
			Diphenyl sulfone	127-63-9	330	µg/kg	0
			Fluoranthene	206-44-0	330	µg/kg	0
			Fluorene	86-73-7	330	µg/kg	0
			Hexachlorobenzene	118-74-1	330	µg/kg	0
			Hexachlorobutadiene	87-68-3	330	µg/kg	0
			Hexachlorocyclopentadiene	77-47-4	1600	µg/kg	0
			Hexachloroethane	67-72-1	330	µg/kg	0
			Hydroxymethyl phthalimide	118-29-6	330	µg/kg	0
			Indeno(1,2,3-cd)pyrene	193-39-5	330	µg/kg	0
			Isophorone	78-59-1	330	µg/kg	0
			m,p-Cresol	106-44-5	660	µg/kg	0
			Naphthalene	91-20-3	330	µg/kg	0
			Nitrobenzene	98-95-3	330	µg/kg	0
			N-nitrosodi-n-propylamine	621-64-7	330	µg/kg	0
			N-nitrosodiphenylamine	86-30-6	330	µg/kg	0
			o-Cresol	95-48-7	330	µg/kg	0
			Octachlorostyrene	29082-74-4	330	µg/kg	0
			p-Chloroaniline	106-47-8	330	µg/kg	0
			p-Chlorobenzenethiol	106-54-7	330	µg/kg	0
			Pentachlorobenzene	608-93-5	330	µg/kg	0
			Pentachlorophenol	87-86-5	1600	µg/kg	0
			Phenanthrene	85-01-8	330	µg/kg	0
			Phenol	108-95-2	330	µg/kg	0
			Phthalic acid	88-99-3	330	µg/kg	0
			Pyrene	129-00-0	330	µg/kg	0
			Pyridine	110-86-1	660	µg/kg	0
			Thiophenol	108-98-5	330	µg/kg	0
			Tentatively Identified Compounds (TICs)		NA	µg/kg	0

Notes:
Reporting Limits - Based on laboratory limits for primary laboratory (TestAmerica).
Laboratory limits are subject to matrix interferences and may not always be achieved in all samples.
NA = Not applicable.
Activities for specific radionuclide will be back-quantitated from those analyzed.
[1]GEL Laboratories method.

TABLE 2
DATASET ANALYTE LIST AND DETECTION FREQUENCY
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	2008 Supplemental			2005 BRC/TIMET		
		Sample Size	No. of Detects	Detection Frequency	Sample Size	No. of Detects	Detection Frequency
Metals (mg/kg)	Aluminum	33	33	100.0%	120	120	100.0%
	Antimony	33	13	39.4%	120	49	40.8%
	Arsenic	33	33	100.0%	120	120	100.0%
	Barium	33	33	100.0%	120	120	100.0%
	Beryllium	33	33	100.0%	120	120	100.0%
	Boron	33	15	45.5%	104	34	32.7%
	Cadmium	33	21	63.6%	120	16	13.3%
	Calcium	33	33	100.0%	104	104	100.0%
	Chloride	--	--	--	104	72	69.2%
	Chromium (Total)	33	33	100.0%	120	120	100.0%
	Chromium (VI)	33	0	0.0%	104	0	0.0%
	Cobalt	33	33	100.0%	120	120	100.0%
	Copper	33	33	100.0%	120	120	100.0%
	Fluoride	--	--	--	104	13	12.5%
	Iron	33	33	100.0%	120	120	100.0%
	Lead	33	33	100.0%	120	120	100.0%
	Lithium	33	6	18.2%	104	104	100.0%
	Magnesium	33	33	100.0%	120	120	100.0%
	Manganese	33	33	100.0%	120	120	100.0%
	Mercury	33	0	0.0%	120	93	77.5%
	Molybdenum	33	33	100.0%	120	120	100.0%
	Nickel	33	33	100.0%	120	120	100.0%
	Niobium	33	1	3.0%	104	0	0.0%
	Nitrate	--	--	--	104	90	86.5%
	Nitrite	--	--	--	104	5	4.8%
	Palladium	33	33	100.0%	104	104	100.0%
	Phosphorus	33	33	100.0%	104	104	100.0%
	Platinum	33	0	0.0%	104	5	4.8%
	Potassium	33	33	100.0%	104	104	100.0%
	Selenium	33	0	0.0%	120	52	43.3%
	Silicon	33	33	100.0%	104	104	100.0%
	Silver	33	14	42.4%	120	104	13.3%
	Sodium	33	33	100.0%	104	104	100.0%
	Strontium	33	33	100.0%	104	81	100.0%
	Sulfate	--	--	--	104	42	77.9%
	Thallium	33	6	18.2%	120	16	35.0%
	Tin	33	16	48.5%	104	103	99.0%
	Titanium	33	33	100.0%	120	120	100.0%
	Tungsten	33	2	6.1%	104	0	0.0%
	Uranium	33	33	100.0%	103	103	100.0%
	Vanadium	33	33	100.0%	120	120	100.0%
	Zinc	33	33	100.0%	120	120	100.0%
	Zirconium	33	13	39.4%	104	104	100.0%

TABLE 2
DATASET ANALYTE LIST AND DETECTION FREQUENCY
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	2008 Supplemental			2005 BRC/TIMET		
		Sample Size	No. of Detects	Detection Frequency	Sample Size	No. of Detects	Detection Frequency
Radionuclides (pCi/g)	Actinium-227	--	--	--	104	0	0.0%
	Actinium-228	--	--	--	120	120	100.0%
	Bismuth-210	--	--	--	104	1	1.0%
	Bismuth-211	--	--	--	104	0	0.0%
	Bismuth 212	--	--	--	120	68	56.7%
	Bismuth-214	--	--	--	120	120	100.0%
	Cobalt-57	--	--	--	104	0	0.0%
	Cobalt-60	--	--	--	104	0	0.0%
	Lead-210	--	--	--	120	2	1.7%
	Lead-211	--	--	--	104	0	0.0%
	Lead-212	--	--	--	120	120	100.0%
	Lead-214	--	--	--	120	120	100.0%
	Polonium-210	--	--	--	104	1	1.0%
	Polonium-212	--	--	--	104	64	61.5%
	Polonium-214	--	--	--	104	104	100.0%
	Polonium-215	--	--	--	104	0	0.0%
	Polonium-216	--	--	--	104	104	100.0%
	Polonium-218	--	--	--	104	96	92.3%
	Potassium-40	--	--	--	120	120	100.0%
	Protactinium-234	--	--	--	104	0	0.0%
	Radium-223	--	--	--	104	0	0.0%
	Radium-224	--	--	--	104	104	100.0%
	Radium-226	33	31	93.9%	104	96	92.3%
	Radium-228	33	28	84.8%	84	68	81.0%
	Thallium-207	--	--	--	104	0	0.0%
	Thallium-208	--	--	--	120	120	100.0%
	Thorium-227	--	--	--	104	0	0.0%
	Thorium-228	33	33	100.0%	120	120	100.0%
	Thorium-230	33	27	81.8%	120	120	100.0%
	Thorium-231	--	--	--	104	11	10.6%
	Thorium-232	33	33	100.0%	120	120	100.0%
	Thorium-234	--	--	--	120	65	54.2%
	Uranium-233/234	33	33	100.0%	120	61	50.8%
	Uranium-235/236	33	11	33.3%	120	54	45.0%
	Uranium-238	33	33	100.0%	120	120	100.0%

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
ND Non-detect

TABLE 3
SEMI-VOLATILE ORGANIC COMPOUNDS ANALYTICAL RESULTS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

	BRC-BKG-R01	BRC-BKG-R01	BRC-BKG-R02	BRC-BKG-R03	BRC-BKG-R04	BRC-BKG-R05	BRC-BKG-R05	BRC-BKG-R06	BRC-BKG-R07	BRC-BKG-R08	BRC-BKG-R10
	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs	0 ft bgs
Chemical	N	FD	N	N	N	N	FD	N	N	N	N
1,2,4,5-Tetrachlorobenzene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
1,2-Diphenylhydrazine	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
1,4-Dioxane	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,4,5-Trichlorophenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,4,6-Trichlorophenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,4-Dichlorophenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,4-Dimethylphenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,4-Dinitrophenol	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
2,4-Dinitrotoluene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2,6-Dinitrotoluene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2-Chloronaphthalene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2-Chlorophenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2-Methylnaphthalene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2-Nitroaniline	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
2-Nitrophenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
3,3'-Dichlorobenzidine	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
3-Methylphenol/4-Methylphenol	< 69 U	< 69 U	< 70 U	< 68 U	< 69 U	< 68 U	< 70 U	< 69 U	< 68 U	< 68 U	< 69 U
3-Nitroaniline	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
4-Bromophenyl phenyl ether	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
4-Chloro-3-Methylphenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
4-Chlorophenyl phenyl ether	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
4-Chlorothioanisole	< 7.9 U	< 7.8 U	< 7.9 U	< 7.8 U	< 7.9 U	< 7.8 U	< 8 U	< 7.9 U	< 7.8 U	< 7.8 U	< 7.9 U
4-Nitrophenol	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
Acenaphthene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Acenaphthylene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Acetophenone	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Aniline	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Anthracene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Azobenzene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzenethiol	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U	< 130 U
Benzo(a)anthracene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzo(a)pyrene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzo(b)fluoranthene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzo(g,h,i)perylene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzo(k)fluoranthene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzoic acid	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzyl alcohol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Benzyl butyl phthalate	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
bis(2-Chloroethoxy) methane	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
bis(2-Chloroethyl) ether	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
bis(2-Chloroisopropyl) ether	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
bis(2-Ethylhexyl) phthalate	**69 J**	**56 J**	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U

TABLE 3
SEMI-VOLATILE ORGANIC COMPOUNDS ANALYTICAL RESULTS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 2 of 2)

Chemical	BRC-BKG-R01 0 ft bgs N	BRC-BKG-R01 0 ft bgs FD	BRC-BKG-R02 0 ft bgs N	BRC-BKG-R03 0 ft bgs N	BRC-BKG-R04 0 ft bgs N	BRC-BKG-R05 0 ft bgs N	BRC-BKG-R05 0 ft bgs FD	BRC-BKG-R06 0 ft bgs N	BRC-BKG-R07 0 ft bgs N	BRC-BKG-R08 0 ft bgs N	BRC-BKG-R10 0 ft bgs N
bis(p-Chlorophenyl) disulfide	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U	< 210 U
bis(p-Chlorophenyl) sulfone	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
Carbazole	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Chrysene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Dibenzo(a,h)anthracene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Dibenzofuran	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Dibutyl phthalate	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Diethyl phthalate	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Dimethyl phthalate	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Di-n-octyl phthalate	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U	< 15 U
Diphenyl sulfone	< 6.9 U	< 6.9 U	< 6.9 U	< 6.8 U	< 6.9 U	< 6.8 U	< 7 U	< 6.9 U	< 6.8 U	< 6.8 U	< 6.9 U
Fluoranthene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Fluorene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Hexachloro-1,3-butadiene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Hexachlorobenzene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Hexachlorocyclopentadiene	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
Hexachloroethane	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Hydroxymethyl phthalimide	< 45 U	< 45 U	< 45 U	< 45 U	< 45 U	< 44 U	< 45 U	< 45 U	< 45 U	< 44 U	< 45 U
Indeno(1,2,3-cd)pyrene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Isophorone	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Naphthalene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Nitrobenzene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
N-nitrosodi-n-propylamine	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
N-nitrosodiphenylamine	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
o-Cresol	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U	< 120 U
Octachlorostyrene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
p-Chloroaniline	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
p-Chlorothiophenol	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U	< 190 U
Pentachlorobenzene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Pentachlorophenol	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
Phenanthrene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Phenol	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Phenyl Disulfide	< 30 U	< 30 U	< 30 U	< 30 U	< 30 U	< 29 U	< 30 U	< 30 U	< 29 U	< 29 U	< 30 U
Phenyl Sulfide	< 3.6 U	< 3.6 U	< 3.7 U	< 3.6 U	< 3.7 U	< 3.6 U	< 3.7 U	< 3.7 U	< 3.6 U	< 3.6 U	< 3.6 U
Phthalic acid	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U	< 260 U
p-Nitroaniline	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 340 U	< 350 U	< 340 U	< 340 U	< 340 U	< 340 U
Pyrene	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U
Pyridine	< 34 U	< 34 U	< 35 U	< 34 U	< 35 U	< 34 U	< 35 U	< 35 U	< 34 U	< 34 U	< 34 U

Note: All units in ug/kg.

TABLE 4
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2008 SUPPLEMENTAL SHALLOW BACKGROUND SOIL SAMPLES - RIVER - ALL DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	33	100.0%	0	--	--	--	--	--	--	33	5330	7165	9260	9742	12700	15500
	Antimony	33	39.4%	20	0.126	0.126	0.126	0.126	0.126	0.126	13	0.19	0.255	0.3	0.3185	0.37	0.61
	Arsenic	33	100.0%	0	--	--	--	--	--	--	33	4.5	6.15	7.7	8.648	9.6	27.6
	Barium	33	100.0%	0	--	--	--	--	--	--	33	211	307	428	466.3	632.5	755
	Beryllium	33	100.0%	0	--	--	--	--	--	--	33	0.28	0.35	0.4	0.4394	0.49	0.78
	Boron	33	45.5%	18	6.6	6.6	6.6	6.6	6.6	6.6	15	7.1	7.4	9.7	13.24	11.8	57
	Cadmium	33	63.6%	12	0.04	0.04	0.04	0.04	0.04	0.04	21	0.053	0.0805	0.11	0.1201	0.15	0.26
	Calcium	33	100.0%	0	--	--	--	--	--	--	33	3430	20550	25400	27830	35450	71300
	Chromium (Total)	33	100.0%	0	--	--	--	--	--	--	33	3.2	7.25	9.9	10.83	13.6	23.6
	Chromium (VI)	33	0.0%	33	0.41	0.41	0.42	0.4406	0.47	0.56	0	--	--	--	--	--	--
	Cobalt	33	100.0%	0	--	--	--	--	--	--	33	3.7	4.2	4.7	5.036	5.25	8.9
	Copper	33	100.0%	0	--	--	--	--	--	--	33	8	9.45	10.8	12.8	13.5	36.2
	Iron	33	100.0%	0	--	--	--	--	--	--	33	6210	7770	9310	10260	11800	21700
	Lead	33	100.0%	0	--	--	--	--	--	--	33	7.6	10.2	12.1	15.18	16	53
	Lithium	33	18.2%	27	3.657	3.657	7.314	9.887	14.63	36.57	6	26.3	29.98	32.95	33.18	35.88	41.8
	Magnesium	33	100.0%	0	--	--	--	--	--	--	33	1550	6480	7580	8206	9635	15000
	Manganese	33	100.0%	0	--	--	--	--	--	--	33	178	238	295	410.5	383	2070
	Mercury	33	0.0%	33	0.00668	0.00668	0.00668	0.00668	0.00668	0.00668	0	--	--	--	--	--	--
	Molybdenum	33	100.0%	0	--	--	--	--	--	--	33	0.28	0.5	0.64	0.7885	1.05	2.3
	Nickel	33	100.0%	0	--	--	--	--	--	--	33	9.1	10.55	11.8	12.64	13.95	22
	Niobium	33	3.0%	32	3	3	3	3	3	3	1	4.6	--	4.6	4.6	--	4.6
	Palladium	33	100.0%	0	--	--	--	--	--	--	33	0.35	0.58	0.73	0.7876	0.94	1.6
	Phosphorus	33	100.0%	0	--	--	--	--	--	--	33	296	620.5	754	806.1	951	1710
	Platinum	33	0.0%	33	0.048	0.048	0.048	0.048	0.048	0.048	0	--	--	--	--	--	--
	Potassium	33	100.0%	0	--	--	--	--	--	--	33	1090	2110	2820	3525	4395	9000
	Selenium	33	0.0%	33	0.32	0.32	0.32	0.32	0.32	0.32	0	--	--	--	--	--	--
	Silicon	33	100.0%	0	--	--	--	--	--	--	33	344	833	1190	1433	1525	7480
	Silver	33	42.4%	19	0.11	0.11	0.11	0.11	0.11	0.11	14	0.054	0.06925	0.076	0.095	0.1225	0.17
	Sodium	33	100.0%	0	--	--	--	--	--	--	33	274	854	1370	1576	2030	4210
	Strontium	33	100.0%	0	--	--	--	--	--	--	33	172	293.5	379	392.3	471	761
	Thallium	33	18.2%	27	0.3	0.3	0.3	0.3	0.3	0.3	6	0.43	0.4375	0.46	0.7167	0.8825	2
	Tin	33	48.5%	17	0.3	0.3	0.3	0.3	0.3	0.3	16	0.32	0.345	0.43	0.4831	0.5925	1
	Titanium	33	100.0%	0	--	--	--	--	--	--	33	215	318.5	380	408.1	523	611
	Tungsten	33	6.1%	31	0.5	0.5	0.5	0.5	0.5	0.5	2	0.96	--	0.98	0.98	--	1
	Uranium	33	100.0%	0	--	--	--	--	--	--	33	0.56	0.73	0.92	1.173	1.25	4.3
	Vanadium	33	100.0%	0	--	--	--	--	--	--	33	19	24.6	29.4	30.37	33.6	55.3
	Zinc	33	100.0%	0	--	--	--	--	--	--	33	25	30.05	35.2	37.01	42.3	70.5
	Zirconium	33	39.4%	20	0.8	0.8	0.8	0.8	0.8	0.8	13	9.1	10.35	11.5	11.67	12.5	16.8
Radionuclides (pCi/g)	Radium-226	33	93.9%	2	--	--	--	--	--	--	31	0.153	0.7975	0.992	1.101	1.375	2.75
	Radium-228	33	84.8%	5	--	--	--	--	--	--	28	0.573	1.165	1.38	1.545	1.985	2.86
	Thorium-228	33	100.0%	0	--	--	--	--	--	--	33	1.1	1.35	1.64	1.785	2.235	3.37
	Thorium-230	33	81.8%	6	--	--	--	--	--	--	27	1	1.02	1.34	1.495	1.84	3.64
	Thorium-232	33	100.0%	0	--	--	--	--	--	--	33	1.14	1.345	1.49	1.545	1.71	2.8
	Uranium-233/234	33	100.0%	0	--	--	--	--	--	--	33	0.7	0.867	1.17	1.462	1.96	4.78
	Uranium-235/236	33	33.3%	22	--	--	--	--	--	--	11	0.0224	0.05995	0.088	0.1015	0.12	0.241
	Uranium-238	33	100.0%	0	--	--	--	--	--	--	33	0.545	0.788	0.938	1.198	1.43	4.01

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 5
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2008 SUPPLEMENTAL SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 0 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	12	100.0%	0	--	--	--	--	--	--	12	6630	8500	10600	10920	13200	15500
	Antimony	12	41.7%	7	0.126	0.126	0.126	0.126	0.126	0.126	5	0.24	0.27	0.33	0.378	0.51	0.61
	Arsenic	12	100.0%	0	--	--	--	--	--	--	12	4.5	6	6.95	7.217	8.525	10.5
	Barium	12	100.0%	0	--	--	--	--	--	--	12	282	310	404	440.3	543.3	710
	Beryllium	12	100.0%	0	--	--	--	--	--	--	12	0.35	0.3775	0.415	0.4917	0.6475	0.78
	Boron	12	33.3%	8	6.6	6.6	6.6	6.6	6.6	6.6	4	9.7	9.9	11.05	12.88	17.68	19.7
	Cadmium	12	58.3%	5	0.04	0.04	0.04	0.04	0.04	0.04	7	0.079	0.092	0.13	0.1444	0.17	0.26
	Calcium	12	100.0%	0	--	--	--	--	--	--	12	20700	23230	25650	29520	32230	51400
	Chromium (Total)	12	100.0%	0	--	--	--	--	--	--	12	3.2	7.7	10.65	12.22	16.75	23.6
	Chromium (VI)	12	0.0%	12	0.41	0.41	0.42	0.4333	0.4475	0.5	0	--	--	--	--	--	--
	Cobalt	12	100.0%	0	--	--	--	--	--	--	12	4.1	4.325	5.1	5.683	7.05	8.9
	Copper	12	100.0%	0	--	--	--	--	--	--	12	8.6	10	12.85	15.68	18	36.2
	Iron	12	100.0%	0	--	--	--	--	--	--	12	6630	7835	9685	11640	15480	21700
	Lead	12	100.0%	0	--	--	--	--	--	--	12	9	10.6	15.05	19.93	22.85	53
	Lithium	12	0.0%	12	3.657	3.657	5.486	7.314	12.8	14.63	0	--	--	--	--	--	--
	Magnesium	12	100.0%	0	--	--	--	--	--	--	12	5470	7548	8290	8839	10250	13300
	Manganese	12	100.0%	0	--	--	--	--	--	--	12	199	302	359.5	541.8	592.8	2070
	Mercury	12	0.0%	12	0.00668	0.00668	0.00668	0.00668	0.00668	0.00668	0	--	--	--	--	--	--
	Molybdenum	12	100.0%	0	--	--	--	--	--	--	12	0.28	0.415	0.6	0.7717	0.8475	2.3
	Nickel	12	100.0%	0	--	--	--	--	--	--	12	9.8	11.18	13.95	14.21	16.95	22
	Niobium	12	8.3%	11	3	3	3	3	3	3	1	4.6	--	4.6	4.6	--	4.6
	Palladium	12	100.0%	0	--	--	--	--	--	--	12	0.45	0.5475	0.645	0.6483	0.75	0.87
	Phosphorus	12	100.0%	0	--	--	--	--	--	--	12	461	696.3	785	872.9	1026	1710
	Platinum	12	0.0%	12	0.048	0.048	0.048	0.048	0.048	0.048	0	--	--	--	--	--	--
	Potassium	12	100.0%	0	--	--	--	--	--	--	12	1370	2750	5475	5155	6860	9000
	Selenium	12	0.0%	12	0.32	0.32	0.32	0.32	0.32	0.32	0	--	--	--	--	--	--
	Silicon	12	100.0%	0	--	--	--	--	--	--	12	461	964	1460	2062	2715	7480
	Silver	12	50.0%	6	0.11	0.11	0.11	0.11	0.11	0.11	6	0.071	0.08	0.135	0.1257	0.1625	0.17
	Sodium	12	100.0%	0	--	--	--	--	--	--	12	274	547.5	804.5	1152	1535	4210
	Strontium	12	100.0%	0	--	--	--	--	--	--	12	183	252.8	328	315.5	385.3	430
	Thallium	12	41.7%	7	0.3	0.3	0.3	0.3	0.3	0.3	5	0.43	0.435	0.45	0.758	1.235	2
	Tin	12	58.3%	5	0.3	0.3	0.3	0.3	0.3	0.3	7	0.36	0.42	0.57	0.5829	0.64	1
	Titanium	12	100.0%	0	--	--	--	--	--	--	12	247	293.3	390	412.5	533	611
	Tungsten	12	8.3%	11	0.5	0.5	0.5	0.5	0.5	0.5	1	0.96	--	0.96	0.96	--	0.96
	Uranium	12	100.0%	0	--	--	--	--	--	--	12	0.65	0.7075	0.845	0.8917	1.135	1.2
	Vanadium	12	100.0%	0	--	--	--	--	--	--	12	19	25.45	31.6	30.38	34.88	39.8
	Zinc	12	100.0%	0	--	--	--	--	--	--	12	25	27.53	38.55	40.63	51.53	70.5
	Zirconium	12	41.7%	7	0.8	0.8	0.8	0.8	0.8	0.8	5	10.7	11.45	12.7	13.18	15.15	16.8
Radionuclides (pCi/g)	Radium-226	11	100.0%	0	--	--	--	--	--	--	11	0.574	0.725	0.807	0.8639	0.952	1.3
	Radium-228	11	81.8%	2	--	--	--	--	--	--	9	0.751	1.08	1.35	1.451	1.94	2.3
	Thorium-228	11	100.0%	0	--	--	--	--	--	--	11	1.1	1.29	1.58	1.757	2.31	2.56
	Thorium-230	11	81.8%	2	--	--	--	--	--	--	9	1	1.02	1.3	1.29	1.44	1.98
	Thorium-232	11	100.0%	0	--	--	--	--	--	--	11	1.35	1.36	1.5	1.557	1.76	1.85
	Uranium-233/234	11	100.0%	0	--	--	--	--	--	--	11	0.7	0.801	0.865	0.9454	0.885	1.82
	Uranium-235/236	11	18.2%	9	--	--	--	--	--	--	2	0.0249	0.0493	0.0605	0.06998	0.113	0.118
	Uranium-238	11	100.0%	0	--	--	--	--	--	--	11	0.564	0.74	0.773	0.8184	0.881	1.1

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 6
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2008 SUPPLEMENTAL SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 5 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	11	100.0%	0	--	--	--	--	--	--	11	6830	8450	8860	9322	10700	12800
	Antimony	11	36.4%	7	0.126	0.126	0.126	0.126	0.126	0.126	4	0.19	0.1925	0.235	0.245	0.3075	0.32
	Arsenic	11	100.0%	0	--	--	--	--	--	--	11	5.1	6.1	7.2	8.518	9.1	20.2
	Barium	11	100.0%	0	--	--	--	--	--	--	11	386	406	532	546.6	682	742
	Beryllium	11	100.0%	0	--	--	--	--	--	--	11	0.33	0.37	0.38	0.41	0.46	0.58
	Boron	11	45.5%	6	6.6	6.6	6.6	6.6	6.6	6.6	5	7.3	7.5	8.3	8.78	10.3	11.8
	Cadmium	11	54.5%	5	0.04	0.04	0.04	0.04	0.04	0.04	6	0.053	0.06425	0.0915	0.1073	0.155	0.2
	Calcium	11	100.0%	0	--	--	--	--	--	--	11	3430	16400	20700	22960	26300	45800
	Chromium (Total)	11	100.0%	0	--	--	--	--	--	--	11	6	6.7	8.9	9	11.2	12.1
	Chromium (VI)	11	0.0%	11	0.41	0.42	0.43	0.44	0.47	0.51	0	--	--	--	--	--	--
	Cobalt	11	100.0%	0	--	--	--	--	--	--	11	4	4.1	4.7	4.627	5.1	5.2
	Copper	11	100.0%	0	--	--	--	--	--	--	11	8.7	9.5	10.7	11.26	12.8	16.6
	Iron	11	100.0%	0	--	--	--	--	--	--	11	7560	7810	8420	9261	10500	12200
	Lead	11	100.0%	0	--	--	--	--	--	--	11	7.6	10.5	11.9	12.29	14.6	17.8
	Lithium	11	18.2%	9	3.657	3.657	3.657	10.16	14.63	36.57	2	26.3	--	34.05	34.05	--	41.8
	Magnesium	11	100.0%	0	--	--	--	--	--	--	11	5290	6220	7550	8332	8880	15000
	Manganese	11	100.0%	0	--	--	--	--	--	--	11	191	231	260	297.4	351	569
	Mercury	11	0.0%	11	0.00668	0.00668	0.00668	0.00668	0.00668	0.00668	0	--	--	--	--	--	--
	Molybdenum	11	100.0%	0	--	--	--	--	--	--	11	0.41	0.6	0.7	0.7618	0.87	1.2
	Nickel	11	100.0%	0	--	--	--	--	--	--	11	9.1	9.7	10.4	10.89	12	14.1
	Niobium	11	0.0%	11	3	3	3	3	3	3	0	--	--	--	--	--	--
	Palladium	11	100.0%	0	--	--	--	--	--	--	11	0.62	0.73	0.93	0.8909	1.1	1.2
	Phosphorus	11	100.0%	0	--	--	--	--	--	--	11	296	564	776	725.9	870	1000
	Platinum	11	0.0%	11	0.048	0.048	0.048	0.048	0.048	0.048	0	--	--	--	--	--	--
	Potassium	11	100.0%	0	--	--	--	--	--	--	11	1430	1850	2490	2785	3440	4440
	Selenium	11	0.0%	11	0.32	0.32	0.32	0.32	0.32	0.32	0	--	--	--	--	--	--
	Silicon	11	100.0%	0	--	--	--	--	--	--	11	344	843	990	1073	1380	1750
	Silver	11	36.4%	7	0.11	0.11	0.11	0.11	0.11	0.11	4	0.06	0.0625	0.072	0.06975	0.07475	0.075
	Sodium	11	100.0%	0	--	--	--	--	--	--	11	670	1060	1380	1590	1940	3380
	Strontium	11	100.0%	0	--	--	--	--	--	--	11	308	379	451	453.2	543	673
	Thallium	11	9.1%	10	0.3	0.3	0.3	0.3	0.3	0.3	1	0.51	--	0.51	0.51	--	0.51
	Tin	11	36.4%	7	0.3	0.3	0.3	0.3	0.3	0.3	4	0.34	0.34	0.375	0.3825	0.4325	0.44
	Titanium	11	100.0%	0	--	--	--	--	--	--	11	318	324	363	414.3	516	606
	Tungsten	11	0.0%	11	0.5	0.5	0.5	0.5	0.5	0.5	0	--	--	--	--	--	--
	Uranium	11	100.0%	0	--	--	--	--	--	--	11	0.56	0.72	0.78	1.041	1.1	2.4
	Vanadium	11	100.0%	0	--	--	--	--	--	--	11	22.5	24.1	28.6	27.54	29.4	32.4
	Zinc	11	100.0%	0	--	--	--	--	--	--	11	27.3	28.4	32.7	32.36	35.6	38.8
	Zirconium	11	36.4%	7	0.8	0.8	0.8	0.8	0.8	0.8	4	9.1	9.325	10.45	10.53	11.8	12.1
Radionuclides (pCi/g)	Radium-226	12	91.7%	1	--	--	--	--	--	--	11	0.163	0.9043	1.05	1.076	1.378	1.6
	Radium-228	12	91.7%	1	--	--	--	--	--	--	11	0.573	1.368	1.59	1.779	2.42	2.86
	Thorium-228	12	100.0%	0	--	--	--	--	--	--	12	1.28	1.398	1.735	1.742	1.988	2.41
	Thorium-230	12	66.7%	4	--	--	--	--	--	--	8	1	1	1.05	1.283	1.61	2.36
	Thorium-232	12	100.0%	0	--	--	--	--	--	--	12	1.14	1.253	1.455	1.493	1.655	2.06
	Uranium-233/234	12	100.0%	0	--	--	--	--	--	--	12	0.795	1.063	1.345	1.423	1.97	2.22
	Uranium-235/236	12	33.3%	8	--	--	--	--	--	--	4	0.0224	0.05483	0.0949	0.1005	0.1205	0.241
	Uranium-238	12	100.0%	0	--	--	--	--	--	--	12	0.705	0.9143	0.979	1.125	1.528	1.7

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 7
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2008 SUPPLEMENTAL SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	10	100.0%	0	--	--	--	--	--	--	10	5330	5773	7905	8788	12730	13900
	Antimony	10	40.0%	6	0.126	0.126	0.126	0.126	0.126	0.126	4	0.27	0.2725	0.29	0.3175	0.39	0.42
	Arsenic	10	100.0%	0	--	--	--	--	--	--	10	4.8	7.775	9.25	10.51	10.23	27.6
	Barium	10	100.0%	0	--	--	--	--	--	--	10	211	237.5	291	409.2	616.5	755
	Beryllium	10	100.0%	0	--	--	--	--	--	--	10	0.28	0.2975	0.355	0.409	0.535	0.67
	Boron	10	60.0%	4	6.6	6.6	6.6	6.6	6.6	6.6	6	7.1	7.25	9.1	17.2	24.45	57
	Cadmium	10	80.0%	2	0.04	--	0.04	0.04	--	0.04	8	0.069	0.07525	0.1015	0.1084	0.1275	0.19
	Calcium	10	100.0%	0	--	--	--	--	--	--	10	3760	18800	30250	31180	39850	71300
	Chromium (Total)	10	100.0%	0	--	--	--	--	--	--	10	5.4	6.875	12.15	11.19	13.68	19.8
	Chromium (VI)	10	0.0%	10	0.41	0.4175	0.42	0.45	0.4825	0.56	0	--	--	--	--	--	--
	Cobalt	10	100.0%	0	--	--	--	--	--	--	10	3.7	3.875	4.6	4.71	5.625	6.2
	Copper	10	100.0%	0	--	--	--	--	--	--	10	8	8.275	10.15	11.03	13.28	16.4
	Iron	10	100.0%	0	--	--	--	--	--	--	10	6210	7118	9595	9702	11850	14100
	Lead	10	100.0%	0	--	--	--	--	--	--	10	7.7	8.35	11.7	12.67	15.48	23.7
	Lithium	10	40.0%	6	14.63	14.63	14.63	14.63	14.63	14.63	4	31.2	31.43	32.95	32.75	33.88	33.9
	Magnesium	10	100.0%	0	--	--	--	--	--	--	10	1550	5705	7165	7308	8855	11900
	Manganese	10	100.0%	0	--	--	--	--	--	--	10	178	215.3	273.5	377.4	380	1320
	Mercury	10	0.0%	10	0.00668	0.00668	0.00668	0.00668	0.00668	0.00668	0	--	--	--	--	--	--
	Molybdenum	10	100.0%	0	--	--	--	--	--	--	10	0.4	0.46	0.8	0.838	1.15	1.4
	Nickel	10	100.0%	0	--	--	--	--	--	--	10	10.7	11.4	12.3	12.69	13.5	16.9
	Niobium	10	0.0%	10	3	3	3	3	3	3	0	--	--	--	--	--	--
	Palladium	10	100.0%	0	--	--	--	--	--	--	10	0.35	0.475	0.805	0.841	1.085	1.6
	Phosphorus	10	100.0%	0	--	--	--	--	--	--	10	442	578.5	738	814.2	1025	1320
	Platinum	10	0.0%	10	0.048	0.048	0.048	0.048	0.048	0.048	0	--	--	--	--	--	--
	Potassium	10	100.0%	0	--	--	--	--	--	--	10	1090	1690	2485	2383	2890	4150
	Selenium	10	0.0%	10	0.32	0.32	0.32	0.32	0.32	0.32	0	--	--	--	--	--	--
	Silicon	10	100.0%	0	--	--	--	--	--	--	10	479	691.8	1105	1074	1428	1670
	Silver	10	40.0%	6	0.11	0.11	0.11	0.11	0.11	0.11	4	0.054	0.05725	0.072	0.07425	0.0935	0.099
	Sodium	10	100.0%	0	--	--	--	--	--	--	10	853	1333	1990	2070	3013	3310
	Strontium	10	100.0%	0	--	--	--	--	--	--	10	172	239.5	413	417.4	531.3	761
	Thallium	10	0.0%	10	0.3	0.3	0.3	0.3	0.3	0.3	0	--	--	--	--	--	--
	Tin	10	50.0%	5	0.3	0.3	0.3	0.3	0.3	0.3	5	0.32	0.325	0.36	0.424	0.555	0.6
	Titanium	10	100.0%	0	--	--	--	--	--	--	10	215	268.5	377.5	395.9	531.8	539
	Tungsten	10	10.0%	9	0.5	0.5	0.5	0.5	0.5	0.5	1	1	--	1	1	--	1
	Uranium	10	100.0%	0	--	--	--	--	--	--	10	0.61	0.7425	1.55	1.656	1.975	4.3
	Vanadium	10	100.0%	0	--	--	--	--	--	--	10	21.9	25.53	32.05	33.48	37.7	55.3
	Zinc	10	100.0%	0	--	--	--	--	--	--	10	31.1	31.58	37.55	37.77	43.13	44.7
	Zirconium	10	40.0%	6	0.8	0.8	0.8	0.8	0.8	0.8	4	9.2	9.575	11.1	10.93	12.1	12.3
Radionuclides (pCi/g)	Radium-226	10	90.0%	1	--	--	--	--	--	--	9	0.153	0.912	1.335	1.391	1.92	2.75
	Radium-228	10	80.0%	2	--	--	--	--	--	--	8	0.947	1.033	1.31	1.368	1.53	2.1
	Thorium-228	10	100.0%	0	--	--	--	--	--	--	10	1.29	1.313	1.65	1.869	2.228	3.37
	Thorium-230	10	100.0%	0	--	--	--	--	--	--	10	1.12	1.503	1.975	1.974	2.153	3.64
	Thorium-232	10	100.0%	0	--	--	--	--	--	--	10	1.15	1.258	1.415	1.593	1.798	2.8
	Uranium-233/234	10	100.0%	0	--	--	--	--	--	--	10	0.985	1.378	1.915	2.077	2.405	4.78
	Uranium-235/236	10	50.0%	5	--	--	--	--	--	--	5	0.0734	0.07798	0.1406	0.1373	0.1895	0.21
	Uranium-238	10	100.0%	0	--	--	--	--	--	--	10	0.545	1.086	1.43	1.702	2.115	4.01

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 8
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2008 SUPPLEMENTAL SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 5 AND 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	21	100.0%	0	--	--	--	--	--	--	21	5330	6725	8860	9068	11150	13900
	Antimony	21	38.1%	13	0.126	0.126	0.126	0.126	0.126	0.126	8	0.19	0.2175	0.275	0.2813	0.315	0.42
	Arsenic	21	100.0%	0	--	--	--	--	--	--	21	4.8	6.45	8.7	9.467	10	27.6
	Barium	21	100.0%	0	--	--	--	--	--	--	21	211	291	449	481.2	675.5	755
	Beryllium	21	100.0%	0	--	--	--	--	--	--	21	0.28	0.315	0.38	0.4095	0.46	0.67
	Boron	21	52.4%	10	6.6	6.6	6.6	6.6	6.6	6.6	11	7.1	7.3	8.3	13.37	11.8	57
	Cadmium	21	66.7%	7	0.04	0.04	0.04	0.04	0.04	0.04	14	0.053	0.072	0.0955	0.1079	0.1325	0.2
	Calcium	21	100.0%	0	--	--	--	--	--	--	21	3430	16550	24900	26870	38850	71300
	Chromium (Total)	21	100.0%	0	--	--	--	--	--	--	21	5.4	6.95	9.9	10.04	12.55	19.8
	Chromium (VI)	21	0.0%	21	0.41	0.42	0.42	0.4448	0.475	0.56	0	--	--	--	--	--	--
	Cobalt	21	100.0%	0	--	--	--	--	--	--	21	3.7	4.1	4.6	4.667	5.15	6.2
	Copper	21	100.0%	0	--	--	--	--	--	--	21	8	9.3	10.4	11.15	12.8	16.6
	Iron	21	100.0%	0	--	--	--	--	--	--	21	6210	7770	8890	9471	11750	14100
	Lead	21	100.0%	0	--	--	--	--	--	--	21	7.6	9.65	11.9	12.47	14.3	23.7
	Lithium	21	28.6%	15	3.657	3.657	14.63	11.95	14.63	36.57	6	26.3	29.98	32.95	33.18	35.88	41.8
	Magnesium	21	100.0%	0	--	--	--	--	--	--	21	1550	6040	7480	7844	8640	15000
	Manganese	21	100.0%	0	--	--	--	--	--	--	21	178	225.5	270	335.5	355	1320
	Mercury	21	0.0%	21	0.00668	0.00668	0.00668	0.00668	0.00668	0.00668	0	--	--	--	--	--	--
	Molybdenum	21	100.0%	0	--	--	--	--	--	--	21	0.4	0.55	0.7	0.7981	1.1	1.4
	Nickel	21	100.0%	0	--	--	--	--	--	--	21	9.1	10.4	11.5	11.75	12.8	16.9
	Niobium	21	0.0%	21	3	3	3	3	3	3	0	--	--	--	--	--	--
	Palladium	21	100.0%	0	--	--	--	--	--	--	21	0.35	0.66	0.89	0.8671	1.04	1.6
	Phosphorus	21	100.0%	0	--	--	--	--	--	--	21	296	582	754	768	908.5	1320
	Platinum	21	0.0%	21	0.048	0.048	0.048	0.048	0.048	0.048	0	--	--	--	--	--	--
	Potassium	21	100.0%	0	--	--	--	--	--	--	21	1090	1740	2490	2594	3235	4440
	Selenium	21	0.0%	21	0.32	0.32	0.32	0.32	0.32	0.32	0	--	--	--	--	--	--
	Silicon	21	100.0%	0	--	--	--	--	--	--	21	344	766.5	1000	1074	1380	1750
	Silver	21	38.1%	13	0.11	0.11	0.11	0.11	0.11	0.11	8	0.054	0.06175	0.072	0.072	0.0765	0.099
	Sodium	21	100.0%	0	--	--	--	--	--	--	21	670	1195	1570	1819	2375	3380
	Strontium	21	100.0%	0	--	--	--	--	--	--	21	172	330	451	436.1	522.5	761
	Thallium	21	4.8%	20	0.3	0.3	0.3	0.3	0.3	0.3	1	0.51	--	0.51	0.51	--	0.51
	Tin	21	42.9%	12	0.3	0.3	0.3	0.3	0.3	0.3	9	0.32	0.335	0.36	0.4056	0.475	0.6
	Titanium	21	100.0%	0	--	--	--	--	--	--	21	215	321	363	405.5	523	606
	Tungsten	21	4.8%	20	0.5	0.5	0.5	0.5	0.5	0.5	1	1	--	1	1	--	1
	Uranium	21	100.0%	0	--	--	--	--	--	--	21	0.56	0.73	1.1	1.334	1.8	4.3
	Vanadium	21	100.0%	0	--	--	--	--	--	--	21	21.9	24.2	29.2	30.37	32.4	55.3
	Zinc	21	100.0%	0	--	--	--	--	--	--	21	27.3	30.9	34.4	34.94	38.5	44.7
	Zirconium	21	38.1%	13	0.8	0.8	0.8	0.8	0.8	0.8	8	9.1	9.4	10.8	10.73	11.95	12.3
Radionuclides (pCi/g)	Radium-226	22	90.9%	2	--	--	--	--	--	--	20	0.153	0.9433	1.195	1.219	1.465	2.75
	Radium-228	22	86.4%	3	--	--	--	--	--	--	19	0.573	1.235	1.43	1.592	2.015	2.86
	Thorium-228	22	100.0%	0	--	--	--	--	--	--	22	1.28	1.36	1.675	1.8	2.213	3.37
	Thorium-230	22	81.8%	4	--	--	--	--	--	--	18	1	1.02	1.495	1.597	2.01	3.64
	Thorium-232	22	100.0%	0	--	--	--	--	--	--	22	1.14	1.258	1.455	1.539	1.693	2.8
	Uranium-233/234	22	100.0%	0	--	--	--	--	--	--	22	0.795	1.07	1.47	1.72	2.203	4.78
	Uranium-235/236	22	40.9%	13	--	--	--	--	--	--	9	0.0224	0.07298	0.09725	0.1173	0.185	0.241
	Uranium-238	22	100.0%	0	--	--	--	--	--	--	22	0.545	0.9148	1.185	1.387	1.67	4.01

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 9
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - ALL DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	120	100.0%	0	--	--	--	--	--	--	120	3740	6683	8420	8899	11200	15300
	Antimony	120	40.8%	71	0.0394	0.3298	0.3298	0.2644	0.3298	0.3298	49	0.12	0.15	0.22	0.2394	0.29	0.5
	Arsenic	120	100.0%	0	--	--	--	--	--	--	120	2.1	3.3	3.9	4.132	4.975	7.2
	Barium	120	100.0%	0	--	--	--	--	--	--	120	73	143.5	190	222.5	237.8	836
	Beryllium	120	100.0%	0	--	--	--	--	--	--	120	0.16	0.44	0.54	0.5566	0.69	0.89
	Boron	104	32.7%	70	3.2	3.2	3.2	3.2	3.2	3.2	34	5.2	5.8	6.8	7.112	8.3	11.6
	Cadmium	120	13.3%	104	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	16	0.052	0.09275	0.105	0.106	0.1275	0.16
	Calcium	104	100.0%	0	--	--	--	--	--	--	104	8160	17380	23650	28130	35480	82800
	Chromium (Total)	120	100.0%	0	--	--	--	--	--	--	120	2.6	7	8.8	8.937	10.8	16.7
	Chromium (VI)	104	0.0%	104	0.25	0.25	0.26	0.258	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	120	100.0%	0	--	--	--	--	--	--	120	3.7	6.325	8.25	8.225	9.775	16.3
	Copper	120	100.0%	0	--	--	--	--	--	--	120	7.8	14.33	17.2	17.07	19.78	30.5
	Iron	120	100.0%	0	--	--	--	--	--	--	120	5410	10430	13050	12810	15100	19700
	Lead	120	100.0%	0	--	--	--	--	--	--	120	3	6.325	7.75	9.447	10.8	35.1
	Lithium	104	100.0%	0	--	--	--	--	--	--	104	7.5	10.8	12.75	13.85	16.38	26.5
	Magnesium	120	100.0%	0	--	--	--	--	--	--	120	4580	6910	9425	9505	11700	17500
	Manganese	120	100.0%	0	--	--	--	--	--	--	120	151	343.3	419	424.9	497.3	1090
	Mercury	120	77.5%	27	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	93	0.0084	0.013	0.019	0.02169	0.025	0.11
	Molybdenum	120	100.0%	0	--	--	--	--	--	--	120	0.17	0.38	0.475	0.5467	0.6275	2
	Nickel	120	100.0%	0	--	--	--	--	--	--	120	7.8	11.4	15.35	15.12	17.75	30
	Niobium	104	0.0%	104	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	104	100.0%	0	--	--	--	--	--	--	104	0.14	0.2825	0.4	0.4615	0.55	1.5
	Phosphorus	104	100.0%	0	--	--	--	--	--	--	104	636	1193	1460	1415	1658	2010
	Platinum	104	4.8%	99	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	5	0.045	0.0545	0.064	0.0708	0.0905	0.099
	Potassium	104	100.0%	0	--	--	--	--	--	--	104	625	1218	1535	1730	2073	3890
	Selenium	120	43.3%	68	0.0467	0.1579	0.1579	0.1514	0.1579	0.1579	52	0.1	0.23	0.29	0.2938	0.3575	0.6
	Silicon	104	100.0%	0	--	--	--	--	--	--	104	335	562.3	720	981	1083	4150
	Silver	120	13.3%	104	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	16	0.019	0.03625	0.0445	0.0495	0.06825	0.083
	Sodium	104	100.0%	0	--	--	--	--	--	--	104	111	203.3	452	485.7	690.3	1320
	Strontium	104	100.0%	0	--	--	--	--	--	--	104	69	133.5	186	222.9	258	808
	Thallium	120	35.0%	78	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	42	0.1	0.16	1.1	0.9174	1.425	1.8
	Tin	104	99.0%	1	0.187	--	0.187	0.187	--	0.187	103	0.2	0.4	0.49	0.4796	0.56	0.8
	Titanium	120	100.0%	0	--	--	--	--	--	--	120	200	392.3	503.5	510.3	618	1010
	Tungsten	104	0.0%	104	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	103	100.0%	0	--	--	--	--	--	--	103	0.43	0.82	0.94	1.001	1.1	2.7
	Vanadium	120	100.0%	0	--	--	--	--	--	--	120	14.6	25.63	35.55	35.41	43.55	59.1
	Zinc	120	100.0%	0	--	--	--	--	--	--	120	15.4	28.5	37.15	37.23	43.18	121
	Zirconium	104	100.0%	0	--	--	--	--	--	--	104	60.1	111.3	125	126.3	145	179
Radionuclides (pCi/g)	Radium-226	104	92.3%	8	--	--	--	--	--	--	96	0.494	0.8908	1.065	1.112	1.255	2.36
	Radium-228	84	81.0%	16	--	--	--	--	--	--	68	0.946	1.663	1.96	1.916	2.17	2.94
	Thorium-228	120	100.0%	0	--	--	--	--	--	--	120	1.07	1.473	1.705	1.687	1.908	2.28
	Thorium-230	120	100.0%	0	--	--	--	--	--	--	120	0.66	0.98	1.19	1.246	1.405	3.01
	Thorium-232	120	100.0%	0	--	--	--	--	--	--	120	1.05	1.403	1.57	1.614	1.808	2.23
	Uranium-233/234	120	50.8%	59	--	--	--	--	--	--	61	0.47	0.83	0.99	1.109	1.218	2.84
	Uranium-235/236	120	45.0%	66	--	--	--	--	--	--	54	0.0009	0.0435	0.0595	0.06799	0.09075	0.21
	Uranium-238	120	100.0%	0	--	--	--	--	--	--	120	0.45	0.86	1.015	1.085	1.223	2.37

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 10
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - ALL DATA - 0 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	45	100.0%	0	--	--	--	--	--	--	45	5530	7230	9950	9730	11800	13900
	Antimony	45	57.8%	19	0.0394	0.0394	0.3298	0.2075	0.3298	0.3298	26	0.12	0.2	0.245	0.2777	0.365	0.5
	Arsenic	45	100.0%	0	--	--	--	--	--	--	45	2.1	3	3.7	4.131	5.3	7.2
	Barium	45	100.0%	0	--	--	--	--	--	--	45	90.4	148	190	219	228	604
	Beryllium	45	100.0%	0	--	--	--	--	--	--	45	0.16	0.41	0.61	0.5847	0.765	0.89
	Boron	37	43.2%	21	3.2	3.2	3.2	3.2	3.2	3.2	16	5.2	5.725	6.1	6.963	8.1	11.6
	Cadmium	45	17.8%	37	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	8	0.092	0.1018	0.11	0.1189	0.1375	0.16
	Calcium	37	100.0%	0	--	--	--	--	--	--	37	10900	15950	19500	21560	26150	43200
	Chromium (Total)	45	100.0%	0	--	--	--	--	--	--	45	3.6	7.9	10.8	10.44	12.95	16.7
	Chromium (VI)	37	0.0%	37	0.25	0.25	0.25	0.2508	0.25	0.26	0	--	--	--	--	--	--
	Cobalt	45	100.0%	0	--	--	--	--	--	--	45	4.1	7.15	8.8	8.464	9.55	14.6
	Copper	45	100.0%	0	--	--	--	--	--	--	45	8.1	16	18.5	17.84	19.75	25.9
	Iron	45	100.0%	0	--	--	--	--	--	--	45	8960	11950	14400	14010	16450	19700
	Lead	45	100.0%	0	--	--	--	--	--	--	45	6	9.05	10.9	12.99	16.05	35.1
	Lithium	37	100.0%	0	--	--	--	--	--	--	37	7.5	9.85	12.4	13.73	17.75	23.9
	Magnesium	45	100.0%	0	--	--	--	--	--	--	45	4880	8420	9750	10090	12150	17500
	Manganese	45	100.0%	0	--	--	--	--	--	--	45	263	405.5	455	471.9	508.5	1090
	Mercury	45	88.9%	5	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	40	0.0091	0.016	0.021	0.02365	0.0285	0.082
	Molybdenum	45	100.0%	0	--	--	--	--	--	--	45	0.27	0.36	0.45	0.5238	0.71	1.1
	Nickel	45	100.0%	0	--	--	--	--	--	--	45	8.4	13.8	16.6	16.49	18.45	30
	Niobium	37	0.0%	37	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	37	100.0%	0	--	--	--	--	--	--	37	0.19	0.245	0.29	0.3549	0.375	1.5
	Phosphorus	37	100.0%	0	--	--	--	--	--	--	37	636	1300	1520	1473	1670	1990
	Platinum	37	2.7%	36	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	1	0.082	--	0.082	0.082	--	0.082
	Potassium	37	100.0%	0	--	--	--	--	--	--	37	1240	1600	1840	2236	2865	3890
	Selenium	45	62.2%	17	0.0467	0.1579	0.1579	0.1448	0.1579	0.1579	28	0.11	0.23	0.3	0.3057	0.355	0.6
	Silicon	37	100.0%	0	--	--	--	--	--	--	37	335	596.5	844	1393	1895	4150
	Silver	45	17.8%	37	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	8	0.036	0.03625	0.05	0.05263	0.06825	0.083
	Sodium	37	100.0%	0	--	--	--	--	--	--	37	111	146	166	248.2	323	693
	Strontium	37	100.0%	0	--	--	--	--	--	--	37	86.8	118.5	143	167.7	169.5	808
	Thallium	45	44.4%	25	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	20	0.13	0.165	1.1	0.8755	1.4	1.7
	Tin	37	100.0%	0	--	--	--	--	--	--	37	0.28	0.505	0.55	0.5505	0.62	0.8
	Titanium	45	100.0%	0	--	--	--	--	--	--	45	244	441.5	535	535.2	632.5	936
	Tungsten	37	0.0%	37	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	37	100.0%	0	--	--	--	--	--	--	37	0.43	0.795	0.89	0.9127	1	1.8
	Vanadium	45	100.0%	0	--	--	--	--	--	--	45	15.7	25.4	35	35.17	42.75	57.3
	Zinc	45	100.0%	0	--	--	--	--	--	--	45	24.8	35.5	42.2	43.98	49.5	121
	Zirconium	37	100.0%	0	--	--	--	--	--	--	37	60.1	114.5	123	125.2	140.5	176
Radionuclides (pCi/g)	Radium-226	37	89.2%	4	--	--	--	--	--	--	33	0.494	0.8745	0.987	1.006	1.15	1.58
	Radium-228	30	76.7%	7	--	--	--	--	--	--	23	1.11	1.693	1.94	1.933	2.118	2.94
	Thorium-228	45	100.0%	0	--	--	--	--	--	--	45	1.15	1.52	1.76	1.736	1.925	2.28
	Thorium-230	45	100.0%	0	--	--	--	--	--	--	45	0.72	0.925	1.15	1.114	1.245	1.7
	Thorium-232	45	100.0%	0	--	--	--	--	--	--	45	1.13	1.49	1.71	1.68	1.83	2.23
	Uranium-233/234	45	37.8%	28	--	--	--	--	--	--	17	0.47	0.76	0.88	0.884	1.01	1.23
	Uranium-235/236	45	44.4%	25	--	--	--	--	--	--	20	0.011	0.045	0.06	0.06664	0.097	0.13
	Uranium-238	45	100.0%	0	--	--	--	--	--	--	45	0.45	0.79	0.91	0.9049	1.035	1.38

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 11
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - ALL DATA - 5 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	42	100.0%	0	--	--	--	--	--	--	42	4840	6528	7770	8547	10900	15300
	Antimony	42	26.2%	31	0.0394	0.0394	0.3298	0.2549	0.3298	0.3298	11	0.13	0.14	0.17	0.1936	0.23	0.35
	Arsenic	42	100.0%	0	--	--	--	--	--	--	42	2.3	3.25	3.7	3.864	4.425	6.1
	Barium	42	100.0%	0	--	--	--	--	--	--	42	73	143	214.5	229.7	273.3	561
	Beryllium	42	100.0%	0	--	--	--	--	--	--	42	0.25	0.44	0.5	0.5276	0.625	0.77
	Boron	34	29.4%	24	3.2	3.2	3.2	3.2	3.2	3.2	10	5.4	5.875	6.8	7.08	8.5	9.1
	Cadmium	42	19.0%	34	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	8	0.052	0.06775	0.096	0.09313	0.115	0.14
	Calcium	34	100.0%	0	--	--	--	--	--	--	34	8160	15750	22600	29320	37600	82800
	Chromium (Total)	42	100.0%	0	--	--	--	--	--	--	42	3.1	6.35	7.7	7.938	9.725	12.1
	Chromium (VI)	34	0.0%	34	0.26	0.26	0.26	0.2632	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	42	100.0%	0	--	--	--	--	--	--	42	3.9	6	7.3	7.781	9.7	14.8
	Copper	42	100.0%	0	--	--	--	--	--	--	42	7.8	12.93	15.35	16.13	19.85	30.5
	Iron	42	100.0%	0	--	--	--	--	--	--	42	6350	9415	12100	12230	14530	18800
	Lead	42	100.0%	0	--	--	--	--	--	--	42	4.9	6.475	7.1	8.131	9.225	23.3
	Lithium	34	100.0%	0	--	--	--	--	--	--	34	8.5	10.45	11.7	12.6	14.63	21.3
	Magnesium	42	100.0%	0	--	--	--	--	--	--	42	4580	5620	8075	8325	11030	13600
	Manganese	42	100.0%	0	--	--	--	--	--	--	42	183	303.5	374.5	404.7	495.8	863
	Mercury	42	69.0%	13	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	29	0.0084	0.013	0.018	0.01831	0.0225	0.034
	Molybdenum	42	100.0%	0	--	--	--	--	--	--	42	0.17	0.345	0.445	0.5231	0.58	2
	Nickel	42	100.0%	0	--	--	--	--	--	--	42	7.8	10.68	13.1	13.91	16.6	22.7
	Niobium	34	0.0%	34	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	34	100.0%	0	--	--	--	--	--	--	34	0.14	0.315	0.435	0.4332	0.5275	0.84
	Phosphorus	34	100.0%	0	--	--	--	--	--	--	34	842	1148	1470	1414	1743	2010
	Platinum	34	5.9%	32	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	2	0.045	--	0.072	0.072	--	0.099
	Potassium	34	100.0%	0	--	--	--	--	--	--	34	872	1110	1370	1610	2088	3260
	Selenium	42	40.5%	25	0.0467	0.1579	0.1579	0.149	0.1579	0.1579	17	0.1	0.185	0.28	0.2665	0.355	0.4
	Silicon	34	100.0%	0	--	--	--	--	--	--	34	399	536	720.5	742.7	859.3	1360
	Silver	42	19.0%	34	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	8	0.019	0.02775	0.044	0.04638	0.069	0.077
	Sodium	34	100.0%	0	--	--	--	--	--	--	34	179	389	502.5	573.7	733.8	1320
	Strontium	34	100.0%	0	--	--	--	--	--	--	34	69	152	210	206.4	254.3	441
	Thallium	42	35.7%	27	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	15	0.1	0.15	0.4	0.7813	1.4	1.8
	Tin	34	100.0%	0	--	--	--	--	--	--	34	0.2	0.4	0.445	0.4553	0.53	0.75
	Titanium	42	100.0%	0	--	--	--	--	--	--	42	213	358	476.5	496.7	612.8	1010
	Tungsten	34	0.0%	34	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	33	100.0%	0	--	--	--	--	--	--	33	0.67	0.805	1	0.9627	1.1	1.3
	Vanadium	42	100.0%	0	--	--	--	--	--	--	42	14.6	25.23	33.5	33.7	42.55	59.1
	Zinc	42	100.0%	0	--	--	--	--	--	--	42	17.6	25.88	33.6	34.15	41.9	52.4
	Zirconium	34	100.0%	0	--	--	--	--	--	--	34	78.9	115.3	133	131.9	148.3	179
Radionuclides (pCi/g)	Radium-226	34	94.1%	2	--	--	--	--	--	--	32	0.577	0.853	1.08	1.07	1.205	1.82
	Radium-228	29	82.8%	5	--	--	--	--	--	--	24	1.15	1.495	2	1.878	2.22	2.42
	Thorium-228	42	100.0%	0	--	--	--	--	--	--	42	1.07	1.515	1.755	1.722	1.955	2.15
	Thorium-230	42	100.0%	0	--	--	--	--	--	--	42	0.75	1.048	1.155	1.21	1.373	2.44
	Thorium-232	42	100.0%	0	--	--	--	--	--	--	42	1.1	1.395	1.56	1.596	1.785	2.06
	Uranium-233/234	42	54.8%	19	--	--	--	--	--	--	23	0.53	0.8075	0.98	1.061	1.178	2.44
	Uranium-235/236	42	42.9%	24	--	--	--	--	--	--	18	0.0009	0.0385	0.055	0.05866	0.08325	0.13
	Uranium-238	42	100.0%	0	--	--	--	--	--	--	42	0.45	0.8575	1.02	1.038	1.17	1.95

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 12
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - ALL DATA - 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	33	100.0%	0	--	--	--	--	--	--	33	3740	6340	7880	8215	10300	13300
	Antimony	33	36.4%	21	0.3298	0.3298	0.3298	0.3298	0.3298	0.3298	12	0.12	0.1325	0.155	0.1983	0.25	0.41
	Arsenic	33	100.0%	0	--	--	--	--	--	--	33	3.1	3.7	4.2	4.473	5.35	6.7
	Barium	33	100.0%	0	--	--	--	--	--	--	33	82.5	137.5	171	218.3	202.5	836
	Beryllium	33	100.0%	0	--	--	--	--	--	--	33	0.29	0.45	0.53	0.5552	0.635	0.89
	Boron	33	24.2%	25	3.2	3.2	3.2	3.2	3.2	3.2	8	5.5	5.9	7.4	7.45	8.575	10.2
	Cadmium	33	0.0%	33	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	0	--	--	--	--	--	--
	Calcium	33	100.0%	0	--	--	--	--	--	--	33	17900	22150	32000	34290	44950	70200
	Chromium (Total)	33	100.0%	0	--	--	--	--	--	--	33	2.6	6.8	8.2	8.155	9.5	14.1
	Chromium (VI)	33	0.0%	33	0.26	0.26	0.26	0.2606	0.26	0.27	0	--	--	--	--	--	--
	Cobalt	33	100.0%	0	--	--	--	--	--	--	33	3.7	5.95	8.9	8.464	10.2	16.3
	Copper	33	100.0%	0	--	--	--	--	--	--	33	10.2	14.6	17	17.21	19.85	23.9
	Iron	33	100.0%	0	--	--	--	--	--	--	33	5410	9175	12300	11900	14500	19100
	Lead	33	100.0%	0	--	--	--	--	--	--	33	3	5.45	6	6.285	7	11.7
	Lithium	33	100.0%	0	--	--	--	--	--	--	33	9.9	11.8	13.4	15.26	17.4	26.5
	Magnesium	33	100.0%	0	--	--	--	--	--	--	33	5240	6510	10900	10210	12700	16900
	Manganese	33	100.0%	0	--	--	--	--	--	--	33	151	308.5	398	386.3	467	641
	Mercury	33	72.7%	9	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	24	0.0092	0.011	0.014	0.0225	0.01875	0.11
	Molybdenum	33	100.0%	0	--	--	--	--	--	--	33	0.33	0.44	0.54	0.6079	0.645	1.9
	Nickel	33	100.0%	0	--	--	--	--	--	--	33	7.9	11.4	14.7	14.82	17.95	22.1
	Niobium	33	0.0%	33	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	33	100.0%	0	--	--	--	--	--	--	33	0.25	0.395	0.55	0.6103	0.84	1.2
	Phosphorus	33	100.0%	0	--	--	--	--	--	--	33	722	1060	1370	1352	1645	1960
	Platinum	33	6.1%	31	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	2	0.064	--	0.064	0.064	--	0.064
	Potassium	33	100.0%	0	--	--	--	--	--	--	33	625	942	1250	1287	1395	2270
	Selenium	33	21.2%	26	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	7	0.26	0.27	0.29	0.3129	0.39	0.4
	Silicon	33	100.0%	0	--	--	--	--	--	--	33	423	561.5	680	763.9	892.5	1380
	Silver	33	0.0%	33	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	0	--	--	--	--	--	--
	Sodium	33	100.0%	0	--	--	--	--	--	--	33	196	512	662	661.4	808.5	1190
	Strontium	33	100.0%	0	--	--	--	--	--	--	33	114	188	258	301.9	407	684
	Thallium	33	21.2%	26	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	7	1.1	1.2	1.2	1.329	1.5	1.6
	Tin	33	97.0%	1	0.187	--	0.187	0.187	--	0.187	32	0.21	0.3625	0.405	0.4234	0.51	0.63
	Titanium	33	100.0%	0	--	--	--	--	--	--	33	200	394	490	493.4	606.5	858
	Tungsten	33	0.0%	33	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	33	100.0%	0	--	--	--	--	--	--	33	0.68	0.865	0.95	1.138	1.3	2.7
	Vanadium	33	100.0%	0	--	--	--	--	--	--	33	19.2	29.65	38.8	37.92	45.9	57.5
	Zinc	33	100.0%	0	--	--	--	--	--	--	33	15.4	23.35	34.1	31.95	39.8	51.7
	Zirconium	33	100.0%	0	--	--	--	--	--	--	33	68.4	101.5	123	121.9	147	177
Radionuclides (pCi/g)	Radium-226	33	93.9%	2	--	--	--	--	--	--	31	0.507	0.9385	1.22	1.275	1.595	2.36
	Radium-228	25	84.0%	4	--	--	--	--	--	--	21	0.946	1.705	2.02	1.938	2.155	2.92
	Thorium-228	33	100.0%	0	--	--	--	--	--	--	33	1.16	1.375	1.5	1.574	1.83	2.13
	Thorium-230	33	100.0%	0	--	--	--	--	--	--	33	0.66	1.005	1.5	1.472	1.68	3.01
	Thorium-232	33	100.0%	0	--	--	--	--	--	--	33	1.05	1.335	1.5	1.549	1.78	2.1
	Uranium-233/234	33	63.6%	12	--	--	--	--	--	--	21	0.58	1.035	1.25	1.477	1.91	2.84
	Uranium-235/236	33	48.5%	17	--	--	--	--	--	--	16	0.001	0.0485	0.077	0.0817	0.1015	0.21
	Uranium-238	33	100.0%	0	--	--	--	--	--	--	33	0.58	1.03	1.36	1.388	1.67	2.37

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 13
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - ALL DATA - 5 AND 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	75	100.0%	0	--	--	--	--	--	--	75	3740	6470	7880	8401	10800	15300
	Antimony	75	30.7%	52	0.0394	0.3298	0.3298	0.2851	0.3298	0.3298	23	0.12	0.14	0.16	0.1961	0.25	0.41
	Arsenic	75	100.0%	0	--	--	--	--	--	--	75	2.3	3.4	3.9	4.132	4.8	6.7
	Barium	75	100.0%	0	--	--	--	--	--	--	75	73	142	188	224.6	245	836
	Beryllium	75	100.0%	0	--	--	--	--	--	--	75	0.25	0.44	0.5	0.5397	0.63	0.89
	Boron	67	26.9%	49	3.2	3.2	3.2	3.2	3.2	3.2	18	5.4	5.875	6.95	7.244	8.525	10.2
	Cadmium	75	10.7%	67	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	8	0.052	0.06775	0.096	0.09313	0.115	0.14
	Calcium	67	100.0%	0	--	--	--	--	--	--	67	8160	18800	28800	31760	42500	82800
	Chromium (Total)	75	100.0%	0	--	--	--	--	--	--	75	2.6	6.4	8.1	8.033	9.6	14.1
	Chromium (VI)	67	0.0%	67	0.26	0.26	0.26	0.2619	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	75	100.0%	0	--	--	--	--	--	--	75	3.7	6	7.9	8.081	10	16.3
	Copper	75	100.0%	0	--	--	--	--	--	--	75	7.8	13.6	16.1	16.6	19.8	30.5
	Iron	75	100.0%	0	--	--	--	--	--	--	75	5410	9370	12300	12090	14500	19100
	Lead	75	100.0%	0	--	--	--	--	--	--	75	3	5.9	6.7	7.319	7.8	23.3
	Lithium	67	100.0%	0	--	--	--	--	--	--	67	8.5	11.2	12.8	13.91	15.8	26.5
	Magnesium	75	100.0%	0	--	--	--	--	--	--	75	4580	5990	9360	9153	11600	16900
	Manganese	75	100.0%	0	--	--	--	--	--	--	75	151	304	383	396.6	488	863
	Mercury	75	70.7%	22	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	53	0.0084	0.012	0.015	0.02021	0.0215	0.11
	Molybdenum	75	100.0%	0	--	--	--	--	--	--	75	0.17	0.38	0.49	0.5604	0.61	2
	Nickel	75	100.0%	0	--	--	--	--	--	--	75	7.8	11.2	13.8	14.31	17.5	22.7
	Niobium	67	0.0%	67	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	67	100.0%	0	--	--	--	--	--	--	67	0.14	0.34	0.49	0.5204	0.7	1.2
	Phosphorus	67	100.0%	0	--	--	--	--	--	--	67	722	1090	1420	1383	1660	2010
	Platinum	67	6.0%	63	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	4	0.045	0.04975	0.064	0.068	0.09025	0.099
	Potassium	67	100.0%	0	--	--	--	--	--	--	67	625	1080	1310	1451	1780	3260
	Selenium	75	32.0%	51	0.0467	0.1579	0.1579	0.1535	0.1579	0.1579	24	0.1	0.2375	0.285	0.28	0.3575	0.4
	Silicon	67	100.0%	0	--	--	--	--	--	--	67	399	543	690	753.2	883	1380
	Silver	75	10.7%	67	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	8	0.019	0.02775	0.044	0.04638	0.069	0.077
	Sodium	67	100.0%	0	--	--	--	--	--	--	67	179	432	615	616.9	784	1320
	Strontium	67	100.0%	0	--	--	--	--	--	--	67	69	160	219	253.4	342	684
	Thallium	75	29.3%	53	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	22	0.1	0.1575	1.15	0.9555	1.5	1.8
	Tin	67	98.5%	1	0.187	--	0.187	0.187	--	0.187	66	0.2	0.3875	0.435	0.4398	0.52	0.75
	Titanium	75	100.0%	0	--	--	--	--	--	--	75	200	368	490	495.3	600	1010
	Tungsten	67	0.0%	67	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	66	100.0%	0	--	--	--	--	--	--	66	0.67	0.84	0.995	1.05	1.2	2.7
	Vanadium	75	100.0%	0	--	--	--	--	--	--	75	14.6	25.5	35.9	35.56	44.4	59.1
	Zinc	75	100.0%	0	--	--	--	--	--	--	75	15.4	25.5	34.1	33.18	40.3	52.4
	Zirconium	67	100.0%	0	--	--	--	--	--	--	67	68.4	107	126	127	148	179
Radionuclides (pCi/g)	Radium-226	67	94.0%	4	--	--	--	--	--	--	63	0.507	0.938	1.12	1.171	1.34	2.36
	Radium-228	54	83.3%	9	--	--	--	--	--	--	45	0.946	1.605	2.005	1.906	2.18	2.92
	Thorium-228	75	100.0%	0	--	--	--	--	--	--	75	1.07	1.41	1.66	1.657	1.9	2.15
	Thorium-230	75	100.0%	0	--	--	--	--	--	--	75	0.66	1.04	1.21	1.325	1.56	3.01
	Thorium-232	75	100.0%	0	--	--	--	--	--	--	75	1.05	1.36	1.52	1.575	1.78	2.1
	Uranium-233/234	75	58.7%	31	--	--	--	--	--	--	44	0.53	0.9	1.13	1.244	1.45	2.84
	Uranium-235/236	75	45.3%	41	--	--	--	--	--	--	34	0.0009	0.043	0.058	0.0688	0.09	0.21
	Uranium-238	75	100.0%	0	--	--	--	--	--	--	75	0.45	0.93	1.07	1.192	1.42	2.37

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 14
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - McCULLOUGH - ALL DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	101	100.0%	0	--	--	--	--	--	--	101	3740	6810	8470	9131	11450	15300
	Antimony	101	42.6%	58	0.0394	0.3298	0.3298	0.2998	0.3298	0.3298	43	0.12	0.15	0.22	0.2409	0.29	0.5
	Arsenic	101	100.0%	0	--	--	--	--	--	--	101	2.1	3.35	3.9	4.112	4.9	7.2
	Barium	101	100.0%	0	--	--	--	--	--	--	101	73	140.5	175	182.3	216.5	465
	Beryllium	101	100.0%	0	--	--	--	--	--	--	101	0.16	0.45	0.54	0.5811	0.725	0.89
	Boron	95	35.8%	61	3.2	3.2	3.2	3.2	3.2	3.2	34	5.2	5.8	6.8	7.112	8.3	11.6
	Cadmium	101	5.9%	95	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	6	0.095	0.0965	0.105	0.1153	0.1375	0.16
	Calcium	95	100.0%	0	--	--	--	--	--	--	95	9440	18400	24500	29030	37300	82800
	Chromium (Total)	101	100.0%	0	--	--	--	--	--	--	101	2.6	6.85	9	9.029	11.15	16.7
	Chromium (VI)	95	0.0%	95	0.25	0.25	0.26	0.2581	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	101	100.0%	0	--	--	--	--	--	--	101	3.7	7.05	8.8	8.672	9.95	16.3
	Copper	101	100.0%	0	--	--	--	--	--	--	101	10.1	14.7	17.6	17.49	19.9	25.9
	Iron	101	100.0%	0	--	--	--	--	--	--	101	5410	10700	13500	13200	15550	19700
	Lead	101	100.0%	0	--	--	--	--	--	--	101	3	6.1	7.3	8.467	9.5	35.1
	Lithium	95	100.0%	0	--	--	--	--	--	--	95	7.5	10.8	12.9	14.04	17.1	26.5
	Magnesium	101	100.0%	0	--	--	--	--	--	--	101	4690	8410	10200	10180	12350	17500
	Manganese	101	100.0%	0	--	--	--	--	--	--	101	151	333	409	416	492	863
	Mercury	101	78.2%	22	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	79	0.0084	0.012	0.018	0.02232	0.027	0.11
	Molybdenum	101	100.0%	0	--	--	--	--	--	--	101	0.17	0.39	0.48	0.5328	0.605	2
	Nickel	101	100.0%	0	--	--	--	--	--	--	101	7.9	12.9	16	15.93	18.4	30
	Niobium	95	0.0%	95	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	95	100.0%	0	--	--	--	--	--	--	95	0.16	0.3	0.42	0.4801	0.58	1.5
	Phosphorus	95	100.0%	0	--	--	--	--	--	--	95	862	1250	1490	1474	1690	2010
	Platinum	95	5.3%	90	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	5	0.045	0.0545	0.064	0.0708	0.0905	0.099
	Potassium	95	100.0%	0	--	--	--	--	--	--	95	625	1180	1580	1754	2230	3890
	Selenium	101	38.6%	62	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	39	0.1	0.26	0.3	0.3059	0.35	0.6
	Silicon	95	100.0%	0	--	--	--	--	--	--	95	335	551	721	1007	1120	4150
	Silver	101	5.9%	95	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	6	0.043	0.04375	0.051	0.05817	0.0785	0.083
	Sodium	95	100.0%	0	--	--	--	--	--	--	95	128	214	487	498.4	693	1320
	Strontium	95	100.0%	0	--	--	--	--	--	--	95	75.5	143	192	232.5	267	808
	Thallium	101	26.7%	74	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	27	0.13	1.1	1.2	1.156	1.5	1.8
	Tin	95	100.0%	0	--	--	--	--	--	--	95	0.24	0.41	0.51	0.4985	0.57	0.8
	Titanium	101	100.0%	0	--	--	--	--	--	--	101	262	446	533	552.1	654	1010
	Tungsten	95	0.0%	95	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	94	100.0%	0	--	--	--	--	--	--	94	0.62	0.84	0.97	1.032	1.1	2.7
	Vanadium	101	100.0%	0	--	--	--	--	--	--	101	20.2	32.55	36.9	38.26	44.9	59.1
	Zinc	101	100.0%	0	--	--	--	--	--	--	101	15.4	30.95	38.9	38.48	44.1	121
	Zirconium	95	100.0%	0	--	--	--	--	--	--	95	86.1	116	129	131.2	146	179
Radionuclides (pCi/g)	Radium-226	95	95.8%	4	--	--	--	--	--	--	91	0.494	0.952	1.09	1.148	1.27	2.36
	Radium-228	81	80.2%	16	--	--	--	--	--	--	65	0.946	1.635	1.93	1.894	2.155	2.92
	Thorium-228	101	100.0%	0	--	--	--	--	--	--	101	1.15	1.51	1.78	1.737	1.93	2.28
	Thorium-230	101	100.0%	0	--	--	--	--	--	--	101	0.73	1.045	1.21	1.294	1.475	3.01
	Thorium-232	101	100.0%	0	--	--	--	--	--	--	101	1.22	1.44	1.66	1.656	1.845	2.23
	Uranium-233/234	101	50.5%	50	--	--	--	--	--	--	51	0.63	0.9	1.05	1.186	1.235	2.84
	Uranium-235/236	101	44.6%	56	--	--	--	--	--	--	45	0.0009	0.044	0.06	0.06962	0.0925	0.21
	Uranium-238	101	100.0%	0	--	--	--	--	--	--	101	0.65	0.92	1.05	1.157	1.315	2.37

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 15
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - McCULLOUGH - 0 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	37	100.0%	0	--	--	--	--	--	--	37	6340	7370	10400	10040	12300	13900
	Antimony	37	62.2%	14	0.0394	0.2572	0.3298	0.2676	0.3298	0.3298	23	0.12	0.2	0.25	0.2765	0.36	0.5
	Arsenic	37	100.0%	0	--	--	--	--	--	--	37	2.1	2.95	3.7	4.141	5.35	7.2
	Barium	37	100.0%	0	--	--	--	--	--	--	37	90.4	143.5	171	180.4	215	445
	Beryllium	37	100.0%	0	--	--	--	--	--	--	37	0.16	0.445	0.66	0.6184	0.79	0.89
	Boron	34	47.1%	18	3.2	3.2	3.2	3.2	3.2	3.2	16	5.2	5.725	6.1	6.963	8.1	11.6
	Cadmium	37	8.1%	34	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	3	0.11	0.11	0.13	0.1333	0.16	0.16
	Calcium	34	100.0%	0	--	--	--	--	--	--	34	11200	16400	19850	22180	26880	43200
	Chromium (Total)	37	100.0%	0	--	--	--	--	--	--	37	3.6	7.85	11.1	10.62	13.4	16.7
	Chromium (VI)	34	0.0%	34	0.25	0.25	0.25	0.2509	0.25	0.26	0	--	--	--	--	--	--
	Cobalt	37	100.0%	0	--	--	--	--	--	--	37	5.7	7.8	9.3	9.046	9.7	14.6
	Copper	37	100.0%	0	--	--	--	--	--	--	37	12.1	16.85	18.7	18.62	20.15	25.9
	Iron	37	100.0%	0	--	--	--	--	--	--	37	9030	12650	14600	14540	16650	19700
	Lead	37	100.0%	0	--	--	--	--	--	--	37	6	8.6	10.5	11.74	12.2	35.1
	Lithium	34	100.0%	0	--	--	--	--	--	--	34	7.5	9.925	12.15	13.84	18.05	23.9
	Magnesium	37	100.0%	0	--	--	--	--	--	--	37	7380	8925	10200	10880	12600	17500
	Manganese	37	100.0%	0	--	--	--	--	--	--	37	263	405.5	455	460.2	508.5	747
	Mercury	37	89.2%	4	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	33	0.0091	0.0155	0.022	0.02467	0.0325	0.082
	Molybdenum	37	100.0%	0	--	--	--	--	--	--	37	0.3	0.37	0.46	0.5211	0.67	0.9
	Nickel	37	100.0%	0	--	--	--	--	--	--	37	10.9	15.5	17.1	17.56	18.9	30
	Niobium	34	0.0%	34	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	34	100.0%	0	--	--	--	--	--	--	34	0.21	0.26	0.3	0.3682	0.3875	1.5
	Phosphorus	34	100.0%	0	--	--	--	--	--	--	34	1220	1340	1535	1539	1713	1990
	Platinum	34	2.9%	33	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	1	0.082	--	0.082	0.082	--	0.082
	Potassium	34	100.0%	0	--	--	--	--	--	--	34	1240	1610	1880	2280	3013	3890
	Selenium	37	59.5%	15	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	22	0.17	0.2675	0.315	0.3214	0.3625	0.6
	Silicon	34	100.0%	0	--	--	--	--	--	--	34	335	570.3	1035	1447	2558	4150
	Silver	37	8.1%	34	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	3	0.044	0.044	0.057	0.06133	0.083	0.083
	Sodium	34	100.0%	0	--	--	--	--	--	--	34	128	149.8	169.5	258.9	342	693
	Strontium	34	100.0%	0	--	--	--	--	--	--	34	97.7	124.3	144.5	174.4	176.8	808
	Thallium	37	35.1%	24	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	13	0.13	0.71	1.2	1.104	1.5	1.7
	Tin	34	100.0%	0	--	--	--	--	--	--	34	0.38	0.5175	0.56	0.5712	0.63	0.8
	Titanium	37	100.0%	0	--	--	--	--	--	--	37	371	475	558	580.6	666	936
	Tungsten	34	0.0%	34	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	34	100.0%	0	--	--	--	--	--	--	34	0.62	0.8175	0.925	0.9471	1.025	1.8
	Vanadium	37	100.0%	0	--	--	--	--	--	--	37	23.6	33.7	36.1	38.32	43.9	57.3
	Zinc	37	100.0%	0	--	--	--	--	--	--	37	29.3	38.1	43.1	45.89	51.2	121
	Zirconium	34	100.0%	0	--	--	--	--	--	--	34	99.3	117.8	125	130.7	142	176
Radionuclides (pCi/g)	Radium-226	34	94.1%	2	--	--	--	--	--	--	32	0.494	0.8873	1.01	1.026	1.165	1.58
	Radium-228	29	75.9%	7	--	--	--	--	--	--	22	1.11	1.685	1.93	1.899	2.08	2.66
	Thorium-228	37	100.0%	0	--	--	--	--	--	--	37	1.15	1.665	1.83	1.801	1.955	2.28
	Thorium-230	37	100.0%	0	--	--	--	--	--	--	37	0.73	0.93	1.16	1.13	1.255	1.7
	Thorium-232	37	100.0%	0	--	--	--	--	--	--	37	1.32	1.535	1.77	1.743	1.895	2.23
	Uranium-233/234	37	32.4%	25	--	--	--	--	--	--	12	0.63	0.83	0.93	0.9341	1.025	1.23
	Uranium-235/236	37	40.5%	22	--	--	--	--	--	--	15	0.011	0.045	0.06	0.06592	0.0935	0.13
	Uranium-238	37	100.0%	0	--	--	--	--	--	--	37	0.65	0.82	0.92	0.9422	1.055	1.38

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 16
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - McCULLOUGH - 5 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	34	100.0%	0	--	--	--	--	--	--	34	5090	6635	7950	8772	11230	15300
	Antimony	34	29.4%	24	0.0394	0.3298	0.3298	0.2935	0.3298	0.3298	10	0.13	0.14	0.17	0.2	0.2525	0.35
	Arsenic	34	100.0%	0	--	--	--	--	--	--	34	2.3	3.325	3.7	3.856	4.4	6.1
	Barium	34	100.0%	0	--	--	--	--	--	--	34	73	139.5	201	195.3	225.3	465
	Beryllium	34	100.0%	0	--	--	--	--	--	--	34	0.38	0.4675	0.54	0.5626	0.6675	0.77
	Boron	31	32.3%	21	3.2	3.2	3.2	3.2	3.2	3.2	10	5.4	5.875	6.8	7.08	8.5	9.1
	Cadmium	34	8.8%	31	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	3	0.095	0.095	0.097	0.09733	0.1	0.1
	Calcium	31	100.0%	0	--	--	--	--	--	--	31	9440	17300	25900	31160	38500	82800
	Chromium (Total)	34	100.0%	0	--	--	--	--	--	--	34	3.1	6.35	8	8.124	9.8	12.1
	Chromium (VI)	31	0.0%	31	0.26	0.26	0.26	0.2635	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	34	100.0%	0	--	--	--	--	--	--	34	4.8	6.375	7.85	8.376	10.23	14.8
	Copper	34	100.0%	0	--	--	--	--	--	--	34	10.1	13.58	15.4	16.65	20.35	24.2
	Iron	34	100.0%	0	--	--	--	--	--	--	34	6350	9698	12750	12760	15650	18800
	Lead	34	100.0%	0	--	--	--	--	--	--	34	4.9	6.35	6.85	7.194	8	10.9
	Lithium	31	100.0%	0	--	--	--	--	--	--	31	8.5	10.6	11.9	12.81	15.3	21.3
	Magnesium	34	100.0%	0	--	--	--	--	--	--	34	4690	6588	9060	8989	11300	13600
	Manganese	34	100.0%	0	--	--	--	--	--	--	34	183	299.3	359.5	398.2	480.5	863
	Mercury	34	70.6%	10	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	24	0.0084	0.01225	0.017	0.01825	0.02275	0.034
	Molybdenum	34	100.0%	0	--	--	--	--	--	--	34	0.17	0.365	0.465	0.5165	0.5575	2
	Nickel	34	100.0%	0	--	--	--	--	--	--	34	9.2	11.3	15.05	14.79	17.65	22.7
	Niobium	31	0.0%	31	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	31	100.0%	0	--	--	--	--	--	--	31	0.16	0.34	0.45	0.4571	0.55	0.84
	Phosphorus	31	100.0%	0	--	--	--	--	--	--	31	938	1190	1490	1463	1780	2010
	Platinum	31	6.5%	29	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	2	0.045	--	0.072	0.072	--	0.099
	Potassium	31	100.0%	0	--	--	--	--	--	--	31	872	1080	1390	1635	2110	3260
	Selenium	34	35.3%	22	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	12	0.1	0.2375	0.3	0.2883	0.3575	0.39
	Silicon	31	100.0%	0	--	--	--	--	--	--	31	399	538	742	757.2	887	1360
	Silver	34	8.8%	31	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	3	0.043	0.043	0.045	0.055	0.077	0.077
	Sodium	31	100.0%	0	--	--	--	--	--	--	31	179	417	536	605.3	745	1320
	Strontium	31	100.0%	0	--	--	--	--	--	--	31	75.5	159	219	218.5	258	441
	Thallium	34	20.6%	27	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	7	0.16	0.21	1.4	1.081	1.8	1.8
	Tin	31	100.0%	0	--	--	--	--	--	--	31	0.25	0.4	0.46	0.479	0.53	0.75
	Titanium	34	100.0%	0	--	--	--	--	--	--	34	299	411.8	531	548.4	671.5	1010
	Tungsten	31	0.0%	31	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	30	100.0%	0	--	--	--	--	--	--	30	0.72	0.8175	1	0.984	1.1	1.3
	Vanadium	34	100.0%	0	--	--	--	--	--	--	34	21.8	30.18	36.3	37.04	43.08	59.1
	Zinc	34	100.0%	0	--	--	--	--	--	--	34	17.6	26.9	35.7	35.42	42.9	51.3
	Zirconium	31	100.0%	0	--	--	--	--	--	--	31	105	117	135	136.1	149	179
Radionuclides (pCi/g)	Radium-226	31	100.0%	0	--	--	--	--	--	--	31	0.577	0.965	1.09	1.109	1.22	1.82
	Radium-228	27	81.5%	5	--	--	--	--	--	--	22	1.15	1.49	1.85	1.849	2.21	2.41
	Thorium-228	34	100.0%	0	--	--	--	--	--	--	34	1.31	1.628	1.805	1.783	1.973	2.15
	Thorium-230	34	100.0%	0	--	--	--	--	--	--	34	0.75	1.07	1.185	1.253	1.398	2.44
	Thorium-232	34	100.0%	0	--	--	--	--	--	--	34	1.22	1.395	1.6	1.625	1.828	2.06
	Uranium-233/234	34	52.9%	16	--	--	--	--	--	--	18	0.76	0.9175	1.07	1.136	1.215	2.44
	Uranium-235/236	34	41.2%	20	--	--	--	--	--	--	14	0.0009	0.04225	0.055	0.06026	0.0845	0.13
	Uranium-238	34	100.0%	0	--	--	--	--	--	--	34	0.77	0.965	1.05	1.127	1.23	1.95

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 17
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - McCULLOUGH - 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	30	100.0%	0	--	--	--	--	--	--	30	3740	6503	8345	8413	10430	13300
	Antimony	30	33.3%	20	0.3298	0.3298	0.3298	0.3298	0.3298	0.3298	10	0.12	0.135	0.155	0.2	0.26	0.41
	Arsenic	30	100.0%	0	--	--	--	--	--	--	30	3.1	3.675	4.15	4.367	5.025	6.7
	Barium	30	100.0%	0	--	--	--	--	--	--	30	82.5	135.8	167.5	169.9	192.5	340
	Beryllium	30	100.0%	0	--	--	--	--	--	--	30	0.29	0.4375	0.51	0.556	0.64	0.89
	Boron	30	26.7%	22	3.2	3.2	3.2	3.2	3.2	3.2	8	5.5	5.9	7.4	7.45	8.575	10.2
	Cadmium	30	0.0%	30	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	0	--	--	--	--	--	--
	Calcium	30	100.0%	0	--	--	--	--	--	--	30	17900	21130	32150	34600	45580	70200
	Chromium (Total)	30	100.0%	0	--	--	--	--	--	--	30	2.6	6.15	8.2	8.093	9.525	14.1
	Chromium (VI)	30	0.0%	30	0.26	0.26	0.26	0.2607	0.26	0.27	0	--	--	--	--	--	--
	Cobalt	30	100.0%	0	--	--	--	--	--	--	30	3.7	6.55	8.95	8.547	10.2	16.3
	Copper	30	100.0%	0	--	--	--	--	--	--	30	10.2	14.6	17	17.06	19.83	23.9
	Iron	30	100.0%	0	--	--	--	--	--	--	30	5410	9075	12600	12050	14750	19100
	Lead	30	100.0%	0	--	--	--	--	--	--	30	3	5.2	6	5.88	6.7	7.8
	Lithium	30	100.0%	0	--	--	--	--	--	--	30	9.9	11.8	13.85	15.54	18.35	26.5
	Magnesium	30	100.0%	0	--	--	--	--	--	--	30	5530	8795	11050	10680	12780	16900
	Manganese	30	100.0%	0	--	--	--	--	--	--	30	151	289.3	394	381.5	462.8	641
	Mercury	30	73.3%	8	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	22	0.0092	0.011	0.0135	0.02323	0.02125	0.11
	Molybdenum	30	100.0%	0	--	--	--	--	--	--	30	0.33	0.4275	0.515	0.5657	0.6025	1.9
	Nickel	30	100.0%	0	--	--	--	--	--	--	30	7.9	11.65	15.2	15.21	18.28	22.1
	Niobium	30	0.0%	30	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	30	100.0%	0	--	--	--	--	--	--	30	0.25	0.3975	0.585	0.6307	0.845	1.2
	Phosphorus	30	100.0%	0	--	--	--	--	--	--	30	862	1113	1430	1411	1653	1960
	Platinum	30	6.7%	28	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	2	0.064	--	0.064	0.064	--	0.064
	Potassium	30	100.0%	0	--	--	--	--	--	--	30	625	913	1220	1282	1428	2270
	Selenium	30	16.7%	25	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	5	0.26	0.265	0.27	0.28	0.3	0.31
	Silicon	30	100.0%	0	--	--	--	--	--	--	30	423	547.8	665.5	765.6	951.5	1380
	Silver	30	0.0%	30	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	0	--	--	--	--	--	--
	Sodium	30	100.0%	0	--	--	--	--	--	--	30	196	517	646	659.4	805.3	1190
	Strontium	30	100.0%	0	--	--	--	--	--	--	30	114	195.8	272	312.8	408.8	684
	Thallium	30	23.3%	23	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	7	1.1	1.2	1.2	1.329	1.5	1.6
	Tin	30	100.0%	0	--	--	--	--	--	--	30	0.24	0.3775	0.42	0.4363	0.5125	0.63
	Titanium	30	100.0%	0	--	--	--	--	--	--	30	262	415.5	503.5	521.2	617.3	858
	Tungsten	30	0.0%	30	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	30	100.0%	0	--	--	--	--	--	--	30	0.68	0.915	1.1	1.176	1.3	2.7
	Vanadium	30	100.0%	0	--	--	--	--	--	--	30	20.2	33.78	39.15	39.58	46.43	57.5
	Zinc	30	100.0%	0	--	--	--	--	--	--	30	15.4	24	34.55	32.79	40.08	51.7
	Zirconium	30	100.0%	0	--	--	--	--	--	--	30	86.1	103	124.5	126.7	149.5	177
Radionuclides (pCi/g)	Radium-226	30	93.3%	2	--	--	--	--	--	--	28	0.507	0.9825	1.25	1.326	1.663	2.36
	Radium-228	25	84.0%	4	--	--	--	--	--	--	21	0.946	1.705	2.02	1.938	2.155	2.92
	Thorium-228	30	100.0%	0	--	--	--	--	--	--	30	1.16	1.38	1.53	1.606	1.845	2.13
	Thorium-230	30	100.0%	0	--	--	--	--	--	--	30	0.81	1.145	1.555	1.544	1.72	3.01
	Thorium-232	30	100.0%	0	--	--	--	--	--	--	30	1.23	1.363	1.52	1.584	1.805	2.1
	Uranium-233/234	30	70.0%	9	--	--	--	--	--	--	21	0.85	1.115	1.34	1.553	1.925	2.84
	Uranium-235/236	30	53.3%	14	--	--	--	--	--	--	16	0.001	0.04925	0.082	0.0848	0.1033	0.21
	Uranium-238	30	100.0%	0	--	--	--	--	--	--	30	0.85	1.068	1.385	1.455	1.778	2.37

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 18
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - McCULLOUGH - 5 AND 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	64	100.0%	0	--	--	--	--	--	--	64	3740	6538	8055	8604	10880	15300
	Antimony	64	31.3%	44	0.0394	0.3298	0.3298	0.31	0.3298	0.3298	20	0.12	0.14	0.165	0.2	0.245	0.41
	Arsenic	64	100.0%	0	--	--	--	--	--	--	64	2.3	3.425	3.9	4.095	4.675	6.7
	Barium	64	100.0%	0	--	--	--	--	--	--	64	73	138.3	176	183.4	217.8	465
	Beryllium	64	100.0%	0	--	--	--	--	--	--	64	0.29	0.46	0.525	0.5595	0.64	0.89
	Boron	61	29.5%	43	3.2	3.2	3.2	3.2	3.2	3.2	18	5.4	5.875	6.95	7.244	8.525	10.2
	Cadmium	64	4.7%	61	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	3	0.095	0.095	0.097	0.09733	0.1	0.1
	Calcium	61	100.0%	0	--	--	--	--	--	--	61	9440	19150	29500	32850	44700	82800
	Chromium (Total)	64	100.0%	0	--	--	--	--	--	--	64	2.6	6.25	8.15	8.109	9.775	14.1
	Chromium (VI)	61	0.0%	61	0.26	0.26	0.26	0.2621	0.26	0.32	0	--	--	--	--	--	--
	Cobalt	64	100.0%	0	--	--	--	--	--	--	64	3.7	6.45	8.25	8.456	10.2	16.3
	Copper	64	100.0%	0	--	--	--	--	--	--	64	10.1	13.95	16.4	16.84	19.88	24.2
	Iron	64	100.0%	0	--	--	--	--	--	--	64	5410	9533	12650	12430	14850	19100
	Lead	64	100.0%	0	--	--	--	--	--	--	64	3	5.7	6.5	6.578	7.2	10.9
	Lithium	61	100.0%	0	--	--	--	--	--	--	61	8.5	11.5	13.2	14.15	15.95	26.5
	Magnesium	64	100.0%	0	--	--	--	--	--	--	64	4690	7023	9620	9780	12180	16900
	Manganese	64	100.0%	0	--	--	--	--	--	--	64	151	293.8	374.5	390.4	469.5	863
	Mercury	64	71.9%	18	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	46	0.0084	0.011	0.015	0.02063	0.02225	0.11
	Molybdenum	64	100.0%	0	--	--	--	--	--	--	64	0.17	0.4025	0.49	0.5395	0.58	2
	Nickel	64	100.0%	0	--	--	--	--	--	--	64	7.9	11.53	15.2	14.99	17.98	22.7
	Niobium	61	0.0%	61	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	61	100.0%	0	--	--	--	--	--	--	61	0.16	0.36	0.5	0.5425	0.715	1.2
	Phosphorus	61	100.0%	0	--	--	--	--	--	--	61	862	1165	1450	1438	1680	2010
	Platinum	61	6.6%	57	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	4	0.045	0.04975	0.064	0.068	0.09025	0.099
	Potassium	61	100.0%	0	--	--	--	--	--	--	61	625	1055	1310	1461	1850	3260
	Selenium	64	26.6%	47	0.1579	0.1579	0.1579	0.1579	0.1579	0.1579	17	0.1	0.26	0.29	0.2859	0.345	0.39
	Silicon	61	100.0%	0	--	--	--	--	--	--	61	399	540.5	703	761.3	894	1380
	Silver	64	4.7%	61	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	3	0.043	0.043	0.045	0.055	0.077	0.077
	Sodium	61	100.0%	0	--	--	--	--	--	--	61	179	450	617	631.9	790	1320
	Strontium	61	100.0%	0	--	--	--	--	--	--	61	75.5	172.5	229	264.9	351.5	684
	Thallium	64	21.9%	50	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	14	0.16	0.925	1.3	1.205	1.65	1.8
	Tin	61	100.0%	0	--	--	--	--	--	--	61	0.24	0.395	0.44	0.458	0.525	0.75
	Titanium	64	100.0%	0	--	--	--	--	--	--	64	262	416.5	510.5	535.6	643.5	1010
	Tungsten	61	0.0%	61	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	60	100.0%	0	--	--	--	--	--	--	60	0.68	0.8675	1	1.08	1.2	2.7
	Vanadium	64	100.0%	0	--	--	--	--	--	--	64	20.2	30.88	37.5	38.23	45.48	59.1
	Zinc	64	100.0%	0	--	--	--	--	--	--	64	15.4	26.45	35.2	34.19	41.33	51.7
	Zirconium	61	100.0%	0	--	--	--	--	--	--	61	86.1	112	131	131.5	149	179
Radionuclides (pCi/g)	Radium-226	61	96.7%	2	--	--	--	--	--	--	59	0.507	0.974	1.13	1.216	1.375	2.36
	Radium-228	52	82.7%	9	--	--	--	--	--	--	43	0.946	1.595	1.965	1.891	2.178	2.92
	Thorium-228	64	100.0%	0	--	--	--	--	--	--	64	1.16	1.455	1.725	1.7	1.91	2.15
	Thorium-230	64	100.0%	0	--	--	--	--	--	--	64	0.75	1.083	1.275	1.389	1.618	3.01
	Thorium-232	64	100.0%	0	--	--	--	--	--	--	64	1.22	1.38	1.56	1.606	1.798	2.1
	Uranium-233/234	64	60.9%	25	--	--	--	--	--	--	39	0.76	0.9525	1.165	1.331	1.583	2.84
	Uranium-235/236	64	46.9%	34	--	--	--	--	--	--	30	0.0009	0.0435	0.06	0.07176	0.09275	0.21
	Uranium-238	64	100.0%	0	--	--	--	--	--	--	64	0.77	1.01	1.165	1.281	1.468	2.37

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 19
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - MIXED - ALL DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	11	100.0%	0	--	--	--	--	--	--	11	4840	5480	6180	6698	6370	10900
	Antimony	11	54.5%	5	0.0394	0.0394	0.3298	0.2136	0.3298	0.3298	6	0.13	0.13	0.21	0.2283	0.2975	0.44
	Arsenic	11	100.0%	0	--	--	--	--	--	--	11	2.9	4.4	5.3	4.873	5.7	5.9
	Barium	11	100.0%	0	--	--	--	--	--	--	11	211	346	424	468.3	604	836
	Beryllium	11	100.0%	0	--	--	--	--	--	--	11	0.38	0.43	0.52	0.5036	0.56	0.62
	Boron	9	0.0%	9	3.2	3.2	3.2	3.2	3.2	3.2	0	--	--	--	--	--	--
	Cadmium	11	18.2%	9	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	2	0.11	--	0.125	0.125	--	0.14
	Calcium	9	100.0%	0	--	--	--	--	--	--	9	8160	10170	16100	18640	28500	36400
	Chromium (Total)	11	100.0%	0	--	--	--	--	--	--	11	5	7.8	8.8	8.864	10.2	11.7
	Chromium (VI)	9	0.0%	9	0.25	0.25	0.26	0.2567	0.26	0.26	0	--	--	--	--	--	--
	Cobalt	11	100.0%	0	--	--	--	--	--	--	11	5.1	5.4	6.1	6.909	7.8	12.3
	Copper	11	100.0%	0	--	--	--	--	--	--	11	11.1	14.3	18.3	18.6	23.2	30.5
	Iron	11	100.0%	0	--	--	--	--	--	--	11	9180	10800	11200	11700	13600	14000
	Lead	11	100.0%	0	--	--	--	--	--	--	11	8.9	9.1	9.9	12.57	17.5	21
	Lithium	9	100.0%	0	--	--	--	--	--	--	9	9.1	10.1	11.7	11.82	13.35	14.9
	Magnesium	11	100.0%	0	--	--	--	--	--	--	11	4580	5100	5450	6059	6880	9090
	Manganese	11	100.0%	0	--	--	--	--	--	--	11	345	414	469	507.3	504	1090
	Mercury	11	54.5%	5	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	6	0.0097	0.01293	0.016	0.01562	0.019	0.019
	Molybdenum	11	100.0%	0	--	--	--	--	--	--	11	0.22	0.73	0.9	0.8591	1.1	1.3
	Nickel	11	100.0%	0	--	--	--	--	--	--	11	8.9	10.3	11.3	11.3	12.1	13.8
	Niobium	9	0.0%	9	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	9	100.0%	0	--	--	--	--	--	--	9	0.14	0.19	0.22	0.2656	0.37	0.48
	Phosphorus	9	100.0%	0	--	--	--	--	--	--	9	636	724.5	804	798.4	874	984
	Platinum	9	0.0%	9	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0	--	--	--	--	--	--
	Potassium	9	100.0%	0	--	--	--	--	--	--	9	1240	1240	1380	1473	1710	1840
	Selenium	11	72.7%	3	0.0467	0.0467	0.1579	0.1208	0.1579	0.1579	8	0.17	0.2375	0.335	0.34	0.4	0.59
	Silicon	9	100.0%	0	--	--	--	--	--	--	9	527	621.5	690	707.9	793.5	883
	Silver	11	18.2%	9	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	2	0.048	--	0.052	0.052	--	0.056
	Sodium	9	100.0%	0	--	--	--	--	--	--	9	111	134.5	265	351.7	571.5	901
	Strontium	9	100.0%	0	--	--	--	--	--	--	9	69	85.6	92	122.1	179.5	219
	Thallium	11	63.6%	4	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	7	0.12	0.16	1.1	0.8829	1.3	1.4
	Tin	9	88.9%	1	0.187	--	0.187	0.187	--	0.187	8	0.2	0.21	0.235	0.255	0.3175	0.34
	Titanium	11	100.0%	0	--	--	--	--	--	--	11	200	219	244	271.9	313	398
	Tungsten	9	0.0%	9	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	9	100.0%	0	--	--	--	--	--	--	9	0.43	0.57	0.71	0.6778	0.79	0.84
	Vanadium	11	100.0%	0	--	--	--	--	--	--	11	19.2	21.7	23.2	23.04	24.4	26
	Zinc	11	100.0%	0	--	--	--	--	--	--	11	21.4	23.9	25.2	30.66	35.3	52.4
	Zirconium	9	100.0%	0	--	--	--	--	--	--	9	60.1	64.8	69	75.24	89.15	92.9
Radionuclides (pCi/g)	Radium-226	9	55.6%	4	--	--	--	--	--	--	5	0.583	0.611	0.756	0.735	0.8535	0.926
	Radium-228	3	100.0%	0	--	--	--	--	--	--	3	2.14	2.14	2.42	2.5	2.94	2.94
	Thorium-228	11	100.0%	0	--	--	--	--	--	--	11	1.17	1.28	1.44	1.459	1.62	1.9
	Thorium-230	11	100.0%	0	--	--	--	--	--	--	11	0.66	0.78	0.84	0.9055	1.02	1.37
	Thorium-232	11	100.0%	0	--	--	--	--	--	--	11	1.05	1.26	1.44	1.423	1.47	1.93
	Uranium-233/234	11	18.2%	9	--	--	--	--	--	--	2	0.47	0.68	0.76	0.7364	0.8	0.9
	Uranium-235/236	11	45.5%	6	--	--	--	--	--	--	5	0.021	0.035	0.053	0.05936	0.076	0.13
	Uranium-238	11	100.0%	0	--	--	--	--	--	--	11	0.57	0.59	0.66	0.7191	0.82	0.94

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 20
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - MIXED - 0 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	4	100.0%	0	--	--	--	--	--	--	4	5530	5708	6270	7168	9525	10600
	Antimony	4	75.0%	1	0.0394	--	0.0394	0.0394	--	0.0394	3	0.2	0.2	0.22	0.2867	0.44	0.44
	Arsenic	4	100.0%	0	--	--	--	--	--	--	4	3.3	3.575	4.85	4.725	5.75	5.9
	Barium	4	100.0%	0	--	--	--	--	--	--	4	260	287.3	396.5	414.3	559	604
	Beryllium	4	100.0%	0	--	--	--	--	--	--	4	0.38	0.405	0.545	0.5225	0.6175	0.62
	Boron	3	0.0%	3	3.2	3.2	3.2	3.2	3.2	3.2	0	--	--	--	--	--	--
	Cadmium	4	25.0%	3	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	1	0.11	--	0.11	0.11	--	0.11
	Calcium	3	100.0%	0	--	--	--	--	--	--	3	10900	10900	16100	14530	16600	16600
	Chromium (Total)	4	100.0%	0	--	--	--	--	--	--	4	7.8	8.3	10.3	10.03	11.48	11.7
	Chromium (VI)	3	0.0%	3	0.25	0.25	0.25	0.25	0.25	0.25	0	--	--	--	--	--	--
	Cobalt	4	100.0%	0	--	--	--	--	--	--	4	5.4	5.575	6.25	6.925	8.95	9.8
	Copper	4	100.0%	0	--	--	--	--	--	--	4	11.1	12.73	18.05	17.6	22.03	23.2
	Iron	4	100.0%	0	--	--	--	--	--	--	4	11000	11580	13450	12980	13900	14000
	Lead	4	100.0%	0	--	--	--	--	--	--	4	8.9	11.05	18.8	16.88	20.78	21
	Lithium	3	100.0%	0	--	--	--	--	--	--	3	9.1	9.1	13.5	12.5	14.9	14.9
	Magnesium	4	100.0%	0	--	--	--	--	--	--	4	5450	5750	6765	6613	7323	7470
	Manganese	4	100.0%	0	--	--	--	--	--	--	4	422	430.3	479.5	617.8	943.5	1090
	Mercury	4	75.0%	1	0.0072	--	0.0072	0.0072	--	0.0072	3	0.0097	0.0097	0.017	0.01523	0.019	0.019
	Molybdenum	4	100.0%	0	--	--	--	--	--	--	4	0.27	0.385	0.78	0.7325	1.033	1.1
	Nickel	4	100.0%	0	--	--	--	--	--	--	4	10.3	10.58	11.75	11.9	13.38	13.8
	Niobium	3	0.0%	3	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	3	100.0%	0	--	--	--	--	--	--	3	0.19	0.19	0.2	0.2033	0.22	0.22
	Phosphorus	3	100.0%	0	--	--	--	--	--	--	3	636	636	745	728.3	804	804
	Platinum	3	0.0%	3	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0	--	--	--	--	--	--
	Potassium	3	100.0%	0	--	--	--	--	--	--	3	1520	1520	1840	1733	1840	1840
	Selenium	4	100.0%	0	--	--	--	--	--	--	4	0.17	0.185	0.245	0.3125	0.5075	0.59
	Silicon	3	100.0%	0	--	--	--	--	--	--	3	761	761	789	782.7	798	798
	Silver	4	25.0%	3	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	1	0.056	--	0.056	0.056	--	0.056
	Sodium	3	100.0%	0	--	--	--	--	--	--	3	111	111	123	126.7	146	146
	Strontium	3	100.0%	0	--	--	--	--	--	--	3	86.8	86.8	91.4	91.83	97.3	97.3
	Thallium	4	75.0%	1	0.5428	--	0.5428	0.5428	--	0.5428	3	0.16	0.16	1	0.8533	1.4	1.4
	Tin	3	100.0%	0	--	--	--	--	--	--	3	0.28	0.28	0.33	0.3167	0.34	0.34
	Titanium	4	100.0%	0	--	--	--	--	--	--	4	244	257.8	306	312	372.3	392
	Tungsten	3	0.0%	3	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	3	100.0%	0	--	--	--	--	--	--	3	0.43	0.43	0.51	0.5233	0.63	0.63
	Vanadium	4	100.0%	0	--	--	--	--	--	--	4	23.2	23.35	24	24.3	25.55	26
	Zinc	4	100.0%	0	--	--	--	--	--	--	4	24.8	27.25	34.95	35.63	44.68	47.8
	Zirconium	3	100.0%	0	--	--	--	--	--	--	3	60.1	60.1	63.5	63.23	66.1	66.1
Radionuclides (pCi/g)	Radium-226	3	33.3%	2	--	--	--	--	--	--	1	0.63	0.63	0.835	0.779	0.872	0.872
	Radium-228	1	100.0%	0	--	--	--	--	--	--	1	2.94	--	2.94	2.94	--	2.94
	Thorium-228	4	100.0%	0	--	--	--	--	--	--	4	1.34	1.365	1.46	1.47	1.585	1.62
	Thorium-230	4	100.0%	0	--	--	--	--	--	--	4	0.72	0.735	0.9	0.9	1.065	1.08
	Thorium-232	4	100.0%	0	--	--	--	--	--	--	4	1.26	1.295	1.43	1.398	1.468	1.47
	Uranium-233/234	4	25.0%	3	--	--	--	--	--	--	1	0.47	0.53	0.735	0.685	0.79	0.8
	Uranium-235/236	4	75.0%	1	--	--	--	--	--	--	3	0.035	0.03975	0.059	0.07075	0.1135	0.13
	Uranium-238	4	100.0%	0	--	--	--	--	--	--	4	0.57	0.575	0.745	0.75	0.93	0.94

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 21
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - MIXED - 5 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	4	100.0%	0	--	--	--	--	--	--	4	4840	4903	5285	6578	9545	10900
	Antimony	4	25.0%	3	0.0394	0.0394	0.3298	0.233	0.3298	0.3298	1	0.13	--	0.13	0.13	--	0.13
	Arsenic	4	100.0%	0	--	--	--	--	--	--	4	2.9	3.35	4.75	4.525	5.475	5.7
	Barium	4	100.0%	0	--	--	--	--	--	--	4	211	244.8	370.5	347	425.8	436
	Beryllium	4	100.0%	0	--	--	--	--	--	--	4	0.4	0.4075	0.445	0.4525	0.505	0.52
	Boron	3	0.0%	3	3.2	3.2	3.2	3.2	3.2	3.2	0	--	--	--	--	--	--
	Cadmium	4	25.0%	3	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	1	0.14	--	0.14	0.14	--	0.14
	Calcium	3	100.0%	0	--	--	--	--	--	--	3	8160	8160	9440	10270	13200	13200
	Chromium (Total)	4	100.0%	0	--	--	--	--	--	--	4	5	5.525	7.95	7.775	9.85	10.2
	Chromium (VI)	3	0.0%	3	0.26	0.26	0.26	0.26	0.26	0.26	0	--	--	--	--	--	--
	Cobalt	4	100.0%	0	--	--	--	--	--	--	4	5.1	5.325	6.25	6.35	7.475	7.8
	Copper	4	100.0%	0	--	--	--	--	--	--	4	11.6	13.08	18.05	19.55	27.53	30.5
	Iron	4	100.0%	0	--	--	--	--	--	--	4	9370	9803	11150	11340	13080	13700
	Lead	4	100.0%	0	--	--	--	--	--	--	4	8.9	8.95	9.25	9.95	11.65	12.4
	Lithium	3	100.0%	0	--	--	--	--	--	--	3	9.3	9.3	10.9	10.47	11.2	11.2
	Magnesium	4	100.0%	0	--	--	--	--	--	--	4	4580	4668	5015	5925	8093	9090
	Manganese	4	100.0%	0	--	--	--	--	--	--	4	394	399	453	451.8	503.3	507
	Mercury	4	25.0%	3	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	1	0.019	--	0.019	0.019	--	0.019
	Molybdenum	4	100.0%	0	--	--	--	--	--	--	4	0.22	0.4	0.955	0.8575	1.218	1.3
	Nickel	4	100.0%	0	--	--	--	--	--	--	4	10	10.3	11.25	11	11.45	11.5
	Niobium	3	0.0%	3	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	3	100.0%	0	--	--	--	--	--	--	3	0.14	0.14	0.19	0.1867	0.23	0.23
	Phosphorus	3	100.0%	0	--	--	--	--	--	--	3	842	842	906	910.7	984	984
	Platinum	3	0.0%	3	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0	--	--	--	--	--	--
	Potassium	3	100.0%	0	--	--	--	--	--	--	3	1240	1240	1240	1353	1580	1580
	Selenium	4	50.0%	2	0.0467	--	0.1023	0.1023	--	0.1579	2	0.28	--	0.34	0.34	--	0.4
	Silicon	3	100.0%	0	--	--	--	--	--	--	3	527	527	563	593.3	690	690
	Silver	4	25.0%	3	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	1	0.048	--	0.048	0.048	--	0.048
	Sodium	3	100.0%	0	--	--	--	--	--	--	3	196	196	265	247	280	280
	Strontium	3	100.0%	0	--	--	--	--	--	--	3	69	69	84.4	81.8	92	92
	Thallium	4	100.0%	0	--	--	--	--	--	--	4	0.12	0.365	1.1	0.905	1.25	1.3
	Tin	3	100.0%	0	--	--	--	--	--	--	3	0.2	0.2	0.21	0.21	0.22	0.22
	Titanium	4	100.0%	0	--	--	--	--	--	--	4	213	214.5	242	273.8	364.8	398
	Tungsten	3	0.0%	3	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	3	100.0%	0	--	--	--	--	--	--	3	0.67	0.67	0.74	0.75	0.84	0.84
	Vanadium	4	100.0%	0	--	--	--	--	--	--	4	21.3	21.4	23.05	23.03	24.63	24.7
	Zinc	4	100.0%	0	--	--	--	--	--	--	4	21.4	22.05	25.25	31.08	45.93	52.4
	Zirconium	3	100.0%	0	--	--	--	--	--	--	3	78.9	78.9	92.7	88.17	92.9	92.9
Radionuclides (pCi/g)	Radium-226	3	33.3%	2	--	--	--	--	--	--	1	0.592	0.592	0.637	0.6617	0.756	0.756
	Radium-228	2	100.0%	0	--	--	--	--	--	--	2	2.14	--	2.28	2.28	--	2.42
	Thorium-228	4	100.0%	0	--	--	--	--	--	--	4	1.28	1.343	1.615	1.603	1.85	1.9
	Thorium-230	4	100.0%	0	--	--	--	--	--	--	4	0.84	0.8475	0.945	1.025	1.283	1.37
	Thorium-232	4	100.0%	0	--	--	--	--	--	--	4	1.44	1.448	1.545	1.615	1.853	1.93
	Uranium-233/234	4	25.0%	3	--	--	--	--	--	--	1	0.75	0.755	0.78	0.8025	0.8725	0.9
	Uranium-235/236	4	50.0%	2	--	--	--	--	--	--	2	0.021	0.02325	0.053	0.0545	0.08725	0.091
	Uranium-238	4	100.0%	0	--	--	--	--	--	--	4	0.64	0.64	0.65	0.69	0.78	0.82

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 22
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - MIXED - 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	3	100.0%	0	--	--	--	--	--	--	3	6150	6150	6180	6233	6370	6370
	Antimony	3	66.7%	1	0.3298	--	0.3298	0.3298	--	0.3298	2	0.13	--	0.19	0.19	--	0.25
	Arsenic	3	100.0%	0	--	--	--	--	--	--	3	5.3	5.3	5.5	5.533	5.8	5.8
	Barium	3	100.0%	0	--	--	--	--	--	--	3	573	573	697	702	836	836
	Beryllium	3	100.0%	0	--	--	--	--	--	--	3	0.54	0.54	0.54	0.5467	0.56	0.56
	Boron	3	0.0%	3	3.2	3.2	3.2	3.2	3.2	3.2	0	--	--	--	--	--	--
	Cadmium	3	0.0%	3	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	0	--	--	--	--	--	--
	Calcium	3	100.0%	0	--	--	--	--	--	--	3	26600	26600	30400	31130	36400	36400
	Chromium (Total)	3	100.0%	0	--	--	--	--	--	--	3	7.9	7.9	8.8	8.767	9.6	9.6
	Chromium (VI)	3	0.0%	3	0.26	0.26	0.26	0.26	0.26	0.26	0	--	--	--	--	--	--
	Cobalt	3	100.0%	0	--	--	--	--	--	--	3	5.2	5.2	5.4	7.633	12.3	12.3
	Copper	3	100.0%	0	--	--	--	--	--	--	3	14.3	14.3	18.3	18.67	23.4	23.4
	Iron	3	100.0%	0	--	--	--	--	--	--	3	9180	9180	10800	10460	11400	11400
	Lead	3	100.0%	0	--	--	--	--	--	--	3	9.4	9.4	9.9	10.33	11.7	11.7
	Lithium	3	100.0%	0	--	--	--	--	--	--	3	11.7	11.7	12.6	12.5	13.2	13.2
	Magnesium	3	100.0%	0	--	--	--	--	--	--	3	5240	5240	5340	5500	5920	5920
	Manganese	3	100.0%	0	--	--	--	--	--	--	3	345	345	469	434	488	488
	Mercury	3	66.7%	1	0.0072	--	0.0072	0.0072	--	0.0072	2	0.014	--	0.0145	0.0145	--	0.015
	Molybdenum	3	100.0%	0	--	--	--	--	--	--	3	0.89	0.89	0.9	1.03	1.3	1.3
	Nickel	3	100.0%	0	--	--	--	--	--	--	3	8.9	8.9	11.2	10.9	12.6	12.6
	Niobium	3	0.0%	3	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	3	100.0%	0	--	--	--	--	--	--	3	0.34	0.34	0.4	0.4067	0.48	0.48
	Phosphorus	3	100.0%	0	--	--	--	--	--	--	3	722	722	727	756.3	820	820
	Platinum	3	0.0%	3	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0	--	--	--	--	--	--
	Potassium	3	100.0%	0	--	--	--	--	--	--	3	1240	1240	1380	1333	1380	1380
	Selenium	3	66.7%	1	0.1579	--	0.1579	0.1579	--	0.1579	2	0.39	--	0.395	0.395	--	0.4
	Silicon	3	100.0%	0	--	--	--	--	--	--	3	680	680	680	747.7	883	883
	Silver	3	0.0%	3	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	0	--	--	--	--	--	--
	Sodium	3	100.0%	0	--	--	--	--	--	--	3	432	432	711	681.3	901	901
	Strontium	3	100.0%	0	--	--	--	--	--	--	3	160	160	199	192.7	219	219
	Thallium	3	0.0%	3	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	0	--	--	--	--	--	--
	Tin	3	66.7%	1	0.187	--	0.187	0.187	--	0.187	2	0.21	--	0.23	0.23	--	0.25
	Titanium	3	100.0%	0	--	--	--	--	--	--	3	200	200	221	216	227	227
	Tungsten	3	0.0%	3	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	3	100.0%	0	--	--	--	--	--	--	3	0.71	0.71	0.73	0.76	0.84	0.84
	Vanadium	3	100.0%	0	--	--	--	--	--	--	3	19.2	19.2	21.7	21.37	23.2	23.2
	Zinc	3	100.0%	0	--	--	--	--	--	--	3	21.4	21.4	23.9	23.5	25.2	25.2
	Zirconium	3	100.0%	0	--	--	--	--	--	--	3	68.4	68.4	69	74.33	85.6	85.6
Radionuclides (pCi/g)	Radium-226	3	100.0%	0	--	--	--	--	--	--	3	0.583	0.583	0.784	0.7643	0.926	0.926
	Radium-228	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thorium-228	3	100.0%	0	--	--	--	--	--	--	3	1.17	1.17	1.23	1.253	1.36	1.36
	Thorium-230	3	100.0%	0	--	--	--	--	--	--	3	0.66	0.66	0.78	0.7533	0.82	0.82
	Thorium-232	3	100.0%	0	--	--	--	--	--	--	3	1.05	1.05	1.26	1.2	1.29	1.29
	Uranium-233/234	3	0.0%	3	--	--	--	--	--	--	0	0.58	0.58	0.68	0.7167	0.89	0.89
	Uranium-235/236	3	0.0%	3	--	--	--	--	--	--	0	0.046	0.046	0.053	0.05067	0.053	0.053
	Uranium-238	3	100.0%	0	--	--	--	--	--	--	3	0.58	0.58	0.76	0.7167	0.81	0.81

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 23
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - MIXED - 5 AND 10 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	7	100.0%	0	--	--	--	--	--	--	7	4840	5090	6150	6430	6370	10900
	Antimony	7	42.9%	4	0.0394	0.112	0.3298	0.2572	0.3298	0.3298	3	0.13	0.13	0.13	0.17	0.25	0.25
	Arsenic	7	100.0%	0	--	--	--	--	--	--	7	2.9	4.7	5.3	4.957	5.7	5.8
	Barium	7	100.0%	0	--	--	--	--	--	--	7	211	346	436	499.1	697	836
	Beryllium	7	100.0%	0	--	--	--	--	--	--	7	0.4	0.43	0.52	0.4929	0.54	0.56
	Boron	6	0.0%	6	3.2	3.2	3.2	3.2	3.2	3.2	0	--	--	--	--	--	--
	Cadmium	7	14.3%	6	0.1291	0.1291	0.1291	0.1291	0.1291	0.1291	1	0.14	--	0.14	0.14	--	0.14
	Calcium	6	100.0%	0	--	--	--	--	--	--	6	8160	9120	19900	20700	31900	36400
	Chromium (Total)	7	100.0%	0	--	--	--	--	--	--	7	5	7.1	8.8	8.2	9.6	10.2
	Chromium (VI)	6	0.0%	6	0.26	0.26	0.26	0.26	0.26	0.26	0	--	--	--	--	--	--
	Cobalt	7	100.0%	0	--	--	--	--	--	--	7	5.1	5.2	6	6.9	7.8	12.3
	Copper	7	100.0%	0	--	--	--	--	--	--	7	11.6	14.3	18.3	19.17	23.4	30.5
	Iron	7	100.0%	0	--	--	--	--	--	--	7	9180	9370	11100	10960	11400	13700
	Lead	7	100.0%	0	--	--	--	--	--	--	7	8.9	9.1	9.4	10.11	11.7	12.4
	Lithium	6	100.0%	0	--	--	--	--	--	--	6	9.3	10.5	11.45	11.48	12.75	13.2
	Magnesium	7	100.0%	0	--	--	--	--	--	--	7	4580	4930	5240	5743	5920	9090
	Manganese	7	100.0%	0	--	--	--	--	--	--	7	345	394	469	444.1	492	507
	Mercury	7	42.9%	4	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	3	0.014	0.014	0.015	0.016	0.019	0.019
	Molybdenum	7	100.0%	0	--	--	--	--	--	--	7	0.22	0.89	0.94	0.9314	1.3	1.3
	Nickel	7	100.0%	0	--	--	--	--	--	--	7	8.9	10	11.2	10.96	11.5	12.6
	Niobium	6	0.0%	6	1.015	1.015	1.015	1.015	1.015	1.015	0	--	--	--	--	--	--
	Palladium	6	100.0%	0	--	--	--	--	--	--	6	0.14	0.1775	0.285	0.2967	0.42	0.48
	Phosphorus	6	100.0%	0	--	--	--	--	--	--	6	722	725.8	831	833.5	925.5	984
	Platinum	6	0.0%	6	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0	--	--	--	--	--	--
	Potassium	6	100.0%	0	--	--	--	--	--	--	6	1240	1240	1310	1343	1430	1580
	Selenium	7	57.1%	3	0.0467	0.0467	0.1579	0.1208	0.1579	0.1579	4	0.28	0.3075	0.395	0.3675	0.4	0.4
	Silicon	6	100.0%	0	--	--	--	--	--	--	6	527	554	680	670.5	738.3	883
	Silver	7	14.3%	6	0.2609	0.2609	0.2609	0.2609	0.2609	0.2609	1	0.048	--	0.048	0.048	--	0.048
	Sodium	6	100.0%	0	--	--	--	--	--	--	6	196	247.8	356	464.2	758.5	901
	Strontium	6	100.0%	0	--	--	--	--	--	--	6	69	80.55	126	137.2	204	219
	Thallium	7	57.1%	3	0.5428	0.5428	0.5428	0.5428	0.5428	0.5428	4	0.12	0.365	1.1	0.905	1.25	1.3
	Tin	6	83.3%	1	0.187	--	0.187	0.187	--	0.187	5	0.2	0.205	0.21	0.218	0.235	0.25
	Titanium	7	100.0%	0	--	--	--	--	--	--	7	200	213	221	249	265	398
	Tungsten	6	0.0%	6	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0	--	--	--	--	--	--
	Uranium	6	100.0%	0	--	--	--	--	--	--	6	0.67	0.7	0.735	0.755	0.84	0.84
	Vanadium	7	100.0%	0	--	--	--	--	--	--	7	19.2	21.3	21.7	22.31	24.4	24.7
	Zinc	7	100.0%	0	--	--	--	--	--	--	7	21.4	21.4	24	27.83	26.5	52.4
	Zirconium	6	100.0%	0	--	--	--	--	--	--	6	68.4	68.85	82.25	81.25	92.75	92.9
Radionuclides (pCi/g)	Radium-226	6	66.7%	2	--	--	--	--	--	--	4	0.583	0.5898	0.6965	0.713	0.8195	0.926
	Radium-228	2	100.0%	0	--	--	--	--	--	--	2	2.14	--	2.28	2.28	--	2.42
	Thorium-228	7	100.0%	0	--	--	--	--	--	--	7	1.17	1.23	1.36	1.453	1.7	1.9
	Thorium-230	7	100.0%	0	--	--	--	--	--	--	7	0.66	0.78	0.84	0.9086	1.02	1.37
	Thorium-232	7	100.0%	0	--	--	--	--	--	--	7	1.05	1.26	1.44	1.437	1.62	1.93
	Uranium-233/234	7	14.3%	6	--	--	--	--	--	--	1	0.58	0.68	0.77	0.7657	0.89	0.9
	Uranium-235/236	7	28.6%	5	--	--	--	--	--	--	2	0.021	0.03	0.053	0.05286	0.076	0.091
	Uranium-238	7	100.0%	0	--	--	--	--	--	--	7	0.58	0.64	0.66	0.7014	0.81	0.82

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 24
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - RIVER - ALL DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	8	100.0%	0	--	--	--	--	--	--	8	6820	7110	8945	8995	10570	12000
	Antimony	8	0.0%	8	0.0394	0.0394	0.0394	0.0394	0.0394	0.0394	0	--	--	--	--	--	--
	Arsenic	8	100.0%	0	--	--	--	--	--	--	8	2.6	2.9	3.35	3.363	3.725	4.3
	Barium	8	100.0%	0	--	--	--	--	--	--	8	322	344	372.5	392.1	417.8	561
	Beryllium	8	100.0%	0	--	--	--	--	--	--	8	0.25	0.2825	0.3	0.32	0.3625	0.43
	Boron	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cadmium	8	100.0%	0	--	--	--	--	--	--	8	0.052	0.06775	0.0955	0.09425	0.1175	0.14
	Calcium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Chromium (Total)	8	100.0%	0	--	--	--	--	--	--	8	4.3	6.75	7.6	7.875	8.825	12.4
	Chromium (VI)	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cobalt	8	100.0%	0	--	--	--	--	--	--	8	3.9	3.95	4.15	4.388	4.675	5.6
	Copper	8	100.0%	0	--	--	--	--	--	--	8	7.8	8.1	8.6	9.538	9.65	16.3
	Iron	8	100.0%	0	--	--	--	--	--	--	8	7520	8000	9320	9413	10480	11800
	Lead	8	100.0%	0	--	--	--	--	--	--	8	7	13.2	18	17.51	23.45	23.5
	Lithium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Magnesium	8	100.0%	0	--	--	--	--	--	--	8	4630	4738	5245	5698	6815	7810
	Manganese	8	100.0%	0	--	--	--	--	--	--	8	223	359.5	409.5	423.6	540.8	546
	Mercury	8	100.0%	0	--	--	--	--	--	--	8	0.013	0.01825	0.02	0.02	0.0235	0.024
	Molybdenum	8	100.0%	0	--	--	--	--	--	--	8	0.22	0.23	0.275	0.2925	0.3425	0.42
	Nickel	8	100.0%	0	--	--	--	--	--	--	8	7.8	8.475	9.65	10.23	11.25	15.4
	Niobium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Palladium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Phosphorus	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Platinum	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Potassium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Selenium	8	62.5%	3	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467	5	0.1	0.105	0.11	0.126	0.155	0.18
	Silicon	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Silver	8	100.0%	0	--	--	--	--	--	--	8	0.019	0.027	0.0365	0.04238	0.06375	0.076
	Sodium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Strontium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thallium	8	100.0%	0	--	--	--	--	--	--	8	0.1	0.13	0.14	0.1413	0.1575	0.18
	Tin	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Titanium	8	100.0%	0	--	--	--	--	--	--	8	235	261	297.5	309.6	326	473
	Tungsten	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Uranium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Vanadium	8	100.0%	0	--	--	--	--	--	--	8	14.6	15.18	16.3	16.46	17.65	18.6
	Zinc	8	100.0%	0	--	--	--	--	--	--	8	23	26.05	29.45	30.53	35.98	40.6
	Zirconium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
Radionuclides (pCi/g)	Radium-226	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Radium-228	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thorium-228	8	100.0%	0	--	--	--	--	--	--	8	1.07	1.248	1.415	1.368	1.513	1.52
	Thorium-230	8	100.0%	0	--	--	--	--	--	--	8	0.9	0.93	1.135	1.105	1.23	1.35
	Thorium-232	8	100.0%	0	--	--	--	--	--	--	8	1.1	1.158	1.37	1.351	1.53	1.58
	Uranium-233/234	8	100.0%	0	--	--	--	--	--	--	8	0.53	0.5425	0.66	0.65	0.7175	0.81
	Uranium-235/236	8	50.0%	4	--	--	--	--	--	--	4	0.016	0.03325	0.056	0.05925	0.09	0.103
	Uranium-238	8	100.0%	0	--	--	--	--	--	--	8	0.45	0.485	0.67	0.6738	0.84	0.92

Notes:

mg/kg	milligrams per kilogram
Max	maximum concentration
Min	minimum concentration
pCi/g	picocuries per gram
Q1	1st quartile (25th percentile)
Q3	3rd quartile (75th percentile)

TABLE 25
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 0 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	4	100.0%	0	--	--	--	--	--	--	4	7650	7970	8945	9385	11240	12000
	Antimony	4	0.0%	4	0.0394	0.0394	0.0394	0.0394	0.0394	0.0394	0	--	--	--	--	--	--
	Arsenic	4	100.0%	0	--	--	--	--	--	--	4	2.8	2.9	3.35	3.45	4.1	4.3
	Barium	4	100.0%	0	--	--	--	--	--	--	4	347	348.8	373.5	380	417.8	426
	Beryllium	4	100.0%	0	--	--	--	--	--	--	4	0.28	0.2825	0.315	0.335	0.4075	0.43
	Boron	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cadmium	4	100.0%	0	--	--	--	--	--	--	4	0.092	0.09375	0.1045	0.1103	0.1325	0.14
	Calcium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Chromium (Total)	4	100.0%	0	--	--	--	--	--	--	4	7.2	7.475	8.65	9.225	11.55	12.4
	Chromium (VI)	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cobalt	4	100.0%	0	--	--	--	--	--	--	4	4.1	4.125	4.4	4.625	5.35	5.6
	Copper	4	100.0%	0	--	--	--	--	--	--	4	8.1	8.275	9.35	10.78	14.7	16.3
	Iron	4	100.0%	0	--	--	--	--	--	--	4	8960	9045	9950	10170	11500	11800
	Lead	4	100.0%	0	--	--	--	--	--	--	4	15.7	16.85	21.9	20.75	23.5	23.5
	Lithium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Magnesium	4	100.0%	0	--	--	--	--	--	--	4	4880	5025	6275	6310	7630	7810
	Manganese	4	100.0%	0	--	--	--	--	--	--	4	373	376.8	409.5	434.3	516.5	545
	Mercury	4	100.0%	0	--	--	--	--	--	--	4	0.019	0.0195	0.0215	0.0215	0.0235	0.024
	Molybdenum	4	100.0%	0	--	--	--	--	--	--	4	0.27	0.2825	0.335	0.34	0.4025	0.42
	Nickel	4	100.0%	0	--	--	--	--	--	--	4	8.4	8.825	10.45	11.18	14.25	15.4
	Niobium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Palladium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Phosphorus	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Platinum	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Potassium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Selenium	4	50.0%	2	0.0467	--	0.0467	0.0467	--	0.0467	2	0.11	--	0.12	0.12	--	0.13
	Silicon	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Silver	4	100.0%	0	--	--	--	--	--	--	4	0.036	0.036	0.0365	0.04525	0.06325	0.072
	Sodium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Strontium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thallium	4	100.0%	0	--	--	--	--	--	--	4	0.13	0.13	0.145	0.15	0.175	0.18
	Tin	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Titanium	4	100.0%	0	--	--	--	--	--	--	4	285	287.3	298	338.5	430.3	473
	Tungsten	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Uranium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Vanadium	4	100.0%	0	--	--	--	--	--	--	4	15.7	15.73	16.75	16.95	18.38	18.6
	Zinc	4	100.0%	0	--	--	--	--	--	--	4	29.1	29.68	34.45	34.65	39.83	40.6
	Zirconium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
Radionuclides (pCi/g)	Radium-226	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Radium-228	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thorium-228	4	100.0%	0	--	--	--	--	--	--	4	1.27	1.29	1.42	1.408	1.513	1.52
	Thorium-230	4	100.0%	0	--	--	--	--	--	--	4	0.92	0.99	1.22	1.178	1.323	1.35
	Thorium-232	4	100.0%	0	--	--	--	--	--	--	4	1.13	1.158	1.395	1.375	1.573	1.58
	Uranium-233/234	4	100.0%	0	--	--	--	--	--	--	4	0.53	0.5425	0.615	0.62	0.7025	0.72
	Uranium-235/236	4	50.0%	2	--	--	--	--	--	--	2	0.028	0.03325	0.073	0.06925	0.1015	0.103
	Uranium-238	4	100.0%	0	--	--	--	--	--	--	4	0.45	0.495	0.745	0.715	0.905	0.92

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

TABLE 26
DESCRIPTIVE SUMMARY STATISTICS FOR METALS AND RADIONUCLIDES IN 2005 BRC/TIMET SHALLOW BACKGROUND SOIL SAMPLES - RIVER - 5 FEET BGS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Analyte Group	Analyte	Sample Size	Detection Frequency	Censored (Non-Detect) Data							Detected Data						
				ND Count	Min	Q1	Median	Mean	Q3	Max	Detect Count	Min	Q1	Median	Mean	Q3	Max
Metals (mg/kg)	Aluminum	4	100.0%	0	--	--	--	--	--	--	4	6820	6848	8400	8605	10570	10800
	Antimony	4	0.0%	4	0.0394	0.0394	0.0394	0.0394	0.0394	0.0394	0	--	--	--	--	--	--
	Arsenic	4	100.0%	0	--	--	--	--	--	--	4	2.6	2.775	3.35	3.275	3.7	3.8
	Barium	4	100.0%	0	--	--	--	--	--	--	4	322	327.3	367	404.3	518.5	561
	Beryllium	4	100.0%	0	--	--	--	--	--	--	4	0.25	0.26	0.3	0.305	0.355	0.37
	Boron	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cadmium	4	100.0%	0	--	--	--	--	--	--	4	0.052	0.05525	0.0705	0.07825	0.109	0.12
	Calcium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Chromium (Total)	4	100.0%	0	--	--	--	--	--	--	4	4.3	4.875	6.9	6.525	7.8	8
	Chromium (VI)	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Cobalt	4	100.0%	0	--	--	--	--	--	--	4	3.9	3.9	4	4.15	4.55	4.7
	Copper	4	100.0%	0	--	--	--	--	--	--	4	7.8	7.875	8.25	8.3	8.775	8.9
	Iron	4	100.0%	0	--	--	--	--	--	--	4	7520	7560	8510	8660	9910	10100
	Lead	4	100.0%	0	--	--	--	--	--	--	4	7	8.5	13.4	14.28	20.93	23.3
	Lithium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Magnesium	4	100.0%	0	--	--	--	--	--	--	4	4630	4645	4860	5085	5750	5990
	Manganese	4	100.0%	0	--	--	--	--	--	--	4	223	256	441.5	413	541.5	546
	Mercury	4	100.0%	0	--	--	--	--	--	--	4	0.013	0.01425	0.0185	0.0185	0.02275	0.024
	Molybdenum	4	100.0%	0	--	--	--	--	--	--	4	0.22	0.22	0.24	0.245	0.275	0.28
	Nickel	4	100.0%	0	--	--	--	--	--	--	4	7.8	8.025	8.95	9.275	10.85	11.4
	Niobium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Palladium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Phosphorus	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Platinum	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Potassium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Selenium	4	75.0%	1	0.0467	--	0.0467	0.0467	--	0.0467	3	0.1	0.1	0.11	0.13	0.18	0.18
	Silicon	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Silver	4	100.0%	0	--	--	--	--	--	--	4	0.019	0.02025	0.0315	0.0395	0.06675	0.076
	Sodium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Strontium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thallium	4	100.0%	0	--	--	--	--	--	--	4	0.1	0.1075	0.14	0.1325	0.15	0.15
	Tin	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Titanium	4	100.0%	0	--	--	--	--	--	--	4	235	239.5	277	280.8	325.8	334
	Tungsten	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Uranium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Vanadium	4	100.0%	0	--	--	--	--	--	--	4	14.6	14.7	15.9	15.98	17.33	17.5
	Zinc	4	100.0%	0	--	--	--	--	--	--	4	23	23.68	26.4	26.4	29.13	29.8
	Zirconium	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
Radionuclides (pCi/g)	Radium-226	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Radium-228	0	--	0	--	--	--	--	--	--	0	--	--	--	--	--	--
	Thorium-228	4	100.0%	0	--	--	--	--	--	--	4	1.07	1.113	1.36	1.328	1.51	1.52
	Thorium-230	4	100.0%	0	--	--	--	--	--	--	4	0.9	0.915	1.035	1.033	1.148	1.16
	Thorium-232	4	100.0%	0	--	--	--	--	--	--	4	1.1	1.153	1.37	1.328	1.46	1.47
	Uranium-233/234	4	100.0%	0	--	--	--	--	--	--	4	0.53	0.565	0.69	0.68	0.785	0.81
	Uranium-235/236	4	50.0%	2	--	--	--	--	--	--	2	0.016	0.02475	0.056	0.04925	0.067	0.069
	Uranium-238	4	100.0%	0	--	--	--	--	--	--	4	0.45	0.485	0.65	0.6325	0.7625	0.78

Notes:

mg/kg milligrams per kilogram
Max maximum concentration
Min minimum concentration
pCi/g picocuries per gram
Q1 1st quartile (25th percentile)
Q3 3rd quartile (75th percentile)

APPENDIX A

NDEP COMMENTS AND BRC'S RESPONSE TO COMMENTS

Response to NDEP Comments Received June 29, 2009 on the Supplemental Shallow Soil Background Report dated June 2009

1. General comment, the electronic and printed versions of the report are different. Sections are different, pagination is different, etc. We have performed our review against the printed version for the most part, but some of the responses-to-comments (RTC) that we could not fully track might be because they are dealt with in the electronic version. This needs to be rectified before NDEP can complete its review. If the electronic version is the correct version then NDEP will need to perform another review. If it is the printed version, then these comments should be sufficient.

Response: *BRC and its consultant did a review of the printed version of the report and the electronic versions of the report that were included on the CD and found no differences between either the printed version, PDF electronic version, or Word electronic version of the report. The printed version of the report was printed using the PDF electronic version, so these two versions are identical. If NDEP compared the printed version to the Word electronic version, there may be differences in pagination due to differences between ERM's and NDEP's computer systems, versions of Word, installed fonts, and/or printers. This frequently causes the printouts (and what you see on the screen) to be different. These differences are beyond our control.*

2. General comment, note also that the printed redline version does not always show the same Section numbers as the revised printed version. This also complicates review at this stage.

Response: *See response to comment #1 above. If significant changes are made to a document, differences in pagination, heading styles, etc. between the redline version and the final version of the text will likely always exist due to how Word generates the redline text.*

3. General comment, use of the term "probability (p) values" repeatedly is unnecessary. The term "p-value" is in common (statistical) use, should be used throughout, and can be defined in a footnote at its first occurrence.

Response: *The term "p-value" is defined on page 3-21 and used throughout the remainder of the text.*

4. Page 1-2; 2nd sentence. Please change "(Qr1 and Qr2)" to "(Qr1 and Qr2, respectively)".

Response: *This sentence has been changed as suggested on page 1-2.*

5. Page 3-2; last line of last full paragraph. Change "observation" to "observations".

Response: *This sentence has been changed as suggested on page 3-2.*

6. Page 3-4; 3rd paragraph, 3rd sentence. The text near the end of this sentence is confusing. Please reword.

Response: *This sentence on page 3-4 has been modified as suggested.*

7. Page 3-13; Section 3.6.1. The description here only applies to classical statistical hypothesis testing. This distinction should be made. Either include the term "classical statistics" early in the Section, or insert a footnote to this effect.

Response: *The term classical statistics has been added to the first sentence of this section.*

8. Page 3-13; Footnote 17. Please change "19981" to "1981".

Response: *This change has been made on page 3-13.*

9. Page 3-14; Section 3.6.2, 1st sentence. Please change "…relationships between two…" to "…relationships between the two…".

Response: *This change has been made on page 3-14.*

10. Page 3-17; Section 3.6.2.3, 2nd sentence. Please change the text in the parentheses from "…visually…" to "…visual…".

Response: *This change has been made on page 3-17.*

11. Page 3.17; paragraph under 2nd bullet. Comment 47 from the previous round of comments was not addressed. Analytical DQOs is a misnomer. DQOs are aimed at the decision to be made, not at analytical quality.

Response: *The term "analytical data quality objectives (DQOs)" has been replaced with "project limit requirements" on page 3-17.*

12. Page 3-18; Section 3.6.2.4. A reference needs to be provided for the statement: "…1/20 hypothesis tests is expected to be significant." A reference to one or more of the statistical references already provided could be made here.

Response: *Reference to Sokal and Rohlf 1981 has been added to this sentence on page 3-18.*

13. Page 3-18; Use of Multiple Two-Sample Tests. NDEP is about to release a white paper that justifies a simple rule-of-thumb of dividing the family-wise error rate (0.05) by 2 (0.025) for this suite of comparison tests. Perhaps this reference can be used here if the timing is appropriate.

Response: *Reference to NDEP's document on this issue has been added on page 3-18, replacing the personal communication with Gilbert reference.*

14. Page 3-19; Section 3.7, 1st sentence. Please change "…to or different to…" to "…to or different from…".

Response: *This change has been made on page 3-19.*

15. Page 3-19; Footnote 26. It is not clear why this footnote is included in this report. Other than this footnote and the text referring to Bonferroni in the results Sections, there is no discussion about the overall Bonferroni correction factor. Please include a brief section on this if Bonferroni is going to be used in this report.

Response: *This footnote has been removed from the report.*

16. Page 3-21; 2nd sentence under first set of bullets. Please clarify which 2005 dataset is, or datasets are, being referred to in this instance.

Response: *The reference is to differences between the 2008 dataset and any of the 2005 datasets, therefore, the word 'one' has been replaced with the word 'any' in this sentence on page 3-21.*

17. Page 3-21; Last sentence. Please change "…2005 dataset…" to "…2005 datasets…".

Response: *This change has been made on page 3-21.*

18. Page 3-22; last paragraph. Comment 53 from the previous round of comments does not appear to be addressed in this version. This study compares 2005 and 2008 data. Please clarify how that is consistent with results from the 2005 study only.

Response: *As suggested in the previous comment, this sentence has been removed from this paragraph on page 3-22.*

19. Tables 2 and 9 disagree regarding the number detects for tin. All values in these Tables should be reviewed for accuracy. The frequency of detections section for tin should also be reviewed for accuracy.

Response: *Table 2 has been revised to indicate the correct frequency of detection for tin. No changes are necessary to the text.*

20. Appendix A, the NDEP has the following comments:
    a. General comment, in addition to the comments provided above for specific RTCs, see below.

Response: *See response to comments below.*

    b. Previous comment 26 does not appear to be addressed in the printed version, but does seem to be addressed in the electronic version. Please revise accordingly.

Response: *The following has been added to the end of Section 2.4.4 on page 2-9: "Radionuclides represent a different situation than metals. Radionuclide detection frequencies are considered using the minimum detectable activity (MDA) as the reported value below which measured results are considered "non-detections." As discussed in Section 3.1.3, when radionuclides are not detected at activities greater than the MDA, the laboratory reports the measured activity, including those lower than the MDA. Therefore, all reported results for radionuclides are used in the statistical evaluations, regardless of where they fall relative to the MDA; therefore, the MDA and radionuclide detection frequencies relative to the MDA have no effect on statistical comparisons of the radionuclide data."*

    c. Previous comment 40 is not addressed. While NDEP understands that ½ the detection limit (DL) was used, NDEP is suggesting that the data can be ranked in Microsoft EXCEL prior to running the Kruskal-Wallis (K-W) test using the Gehan ranking scheme. The K-W test can be run on the Gehan ranks. The RTC needs to acknowledge a preference for using ½ DL in lieu of Gehan ranking.

Response: *Agreed. As noted in this comment, although the data can be ranked in Microsoft EXCEL prior to running the Kruskal-Wallis (K-W) test using the Gehan ranking scheme, preference was given for using 1/2-DL.*

    d. The phrase "analytical DQOs" shows up once or twice (perhaps depending on if the reader is using the electronic or printed version), despite the previous comment 47. Please verify that BRC Standard Operating Procedure 0 is being implemented.

Response: *See response to comment #11 above.*

Response to NDEP Comments Received April 20, 2009 on the Supplemental Shallow Soil Background Report Redline Text dated March 2009

General Comments:

1. Several comments that were raised by NDEP in a previous round of comments were not completely or adequately addressed. Additional issues were also identified and are listed below in the specific comments.

Response: *See response to comments below.*

2. Chapter 2 should still provide more information on data usability. NDEP guidance indicates what this Section should cover. Perhaps reference to subsequent analyses presented in Section 3 and the iterative nature of validation, usability and data analysis would help. It appears that the data are mostly usable for the statistical analyses presented herein. Estimated values are used directly and detection limits are established reasonably for the supplemental background data. But, there are some issues. In particular, comparability between data and the detection limits for some chemicals is a problem. That is, the 2005 Shallow Soils background data and the 2008 Supplemental Shallow Soils background data sets have different detection limits for some metals. This problem might cause further issues when the data are used for background comparisons with site data. This should all be noted, so that users of these background data understand the potential limitations and can adjust as necessary.

Response: *The prior Section 2 text included a reference to this particular concern. See Criterion VI - Data Quality Indicators section pertaining to Comparability, in which was stated:* "As discussed in Section 2.4., differences in detection limits among datasets may affect data comparability for datasets comprised primarily of non-detected values. For these datasets, left-censored data can result in difficulties in differentiating whether datasets are actually different or merely an artifact of detection limits. Note that for constituents with detection limits that meet data quality objectives (DQOs), comparisons between site and background may be less important as these left-censored data are likely to indicate conditions that pose an "acceptable" risk and further analysis is not necessary." *In the revised draft, text has been added to Section 2.4 in the discussion of Criterion IV – Analytical Methods and Detection Limits regarding this issue.*

Regarding the issue of different detection limits, here and in Section 3.1.3, it is stated that these limitations may compromise statistical analyses in this report and potential future background comparisons.

Specific Comments:

3. General comment, please note that the comments provided below are based upon the page numbering provided in the red-line strike-out version of the document that matches the hard copy that was provided to the NDEP. Please note that the pagination varies wildly depending on which version of Microsoft WORD is used and the default settings of the user.

Response: *BRC noticed that several of NDEP's comments referenced pagination that was not consistent with the clean copy. Despite this, we believe we were able to identify and revise the relevant text as needed, as discussed in the responses to comments.*

4. Table of Contents and Section 2.4: The Table of Contents specifies numeric subsections (e.g., 2.4.1, 2.4.2, etc.) but the section headings in the text do not. Please clarify. Also, the numbering convention after the "STATISTICAL PLOTS" section needs to be addressed.

Response: *This is a reflection of the redline/strikeout version of the text. The final 'clean' text of the report has been reviewed for pagination and other final production issues.*

5. Page 1-2, 4th line. Please specify which background data is being referred to.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009. In addition, reference to the City of Henderson landfill report has been provided, with information on arsenic levels in the report provided in a footnote on page 1-2.*

6. Page 1-2, 1st paragraph , last line. Collection of the "following" data – insert "the following".

Response: *The subject sentence has been modified on page 1-2 as noted.*

7. Page 1-2, 1st bullet. Please specify if the soils units that were sampled were from soils off-site or from background locations.

Response: *The subject text has been modified on page 1-3 to note that these locations were background locations within soil units that are representative of Site soils not covered by the existing background shallow soil dataset.*

8. Page 1-2; 1st paragraph under bullet: Please specify in the text (in parentheses) which unit corresponds to "Qr1" and "Qr2".

Response: *The subject text has been modified on page 1-2 to clarify that the Qr_1 and Qr_2 units correspond to the lithologic units defined as "Pediment and fan deposits of the River Mountains."*

9. Page 1-2, last paragraph. Borings are introduced here without first telling us what type of samples will be collected. This needs more discussion to provide the appropriate context.

Response: *The subject text has been revised on page 1-3 to provide a better context, including removal of the references to borings (pending discussion of this sampling methodology until Section 2), and the addition of a reference to the scope of work description in Section 2.*

10. Page 1-3, last full paragraph. It is not clear that "southeastern most edge" is the most appropriate description. Please clarify. Please note that this is a global comment and will not be repeated.

Response: *The subject text has been revised to "eastern-most corner" on page 1-2 and a footnote has been added to clarify that the units in question fall within the Mohawk sub-area and Parcel 4B.*

11. Page 2-1 top. The introductory sentence or Section should provide more information on what is to come. This Section covers more than is discussed in this sentence.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009. The introductory paragraph of Section 2 has been expanded to include a reference to the main topics/procedures discussed in Section 2.*

12. Page 2-1, Section 2.1, 1st paragraph. Change "The background soil study collected data for site-related metals and radionuclides." to "The background soil study was focused on collection of data for site-related metals and radionuclides."

Response: *The subject text has been revised on page 2-1 as suggested.*

13. Pages 2-2 and 2-3, paragraph starting at the bottom of page 2-2. Please explain why reporting detection limits (RDLs) been introduced. NDEP guidance discusses sample quantitation limits (SQLs) as the preferred language. Please rectify this or provide adequate explanation for the use of RDLs.

Response: *The text, tables and database have been revised to reflect the use of the SQL term.*

14. Page 2-4, Section 2.3, 1st paragraph. Please provide a reference to NDEP's guidance on data validation and discuss this, as necessary.

Response: *The subject text has been revised on page 2-4 to include a reference to NDEP's guidance, and a brief discussion.*

15. Page 2-5, paragraph after bullets. Change "In addition to the six principal evaluation criteria, NDEP's Data Usability Guidance includes a step for data analysis" to "In addition to the six principal evaluation criteria, NDEP's Data Usability Guidance includes a step for data exploration."

Response: *The subject text has been revised on page 2-6 as suggested.*

16. Page 2-8, 1st full paragraph, wording after dashes. Change "differences in detection limits is anticipated" to "differences in detection limits are anticipated".

Response: *The subject text has been revised on page 2-8 as suggested.*

17. Page 2-8, 1st full paragraph, next sentence. Please clarify which "future statistical analyses" might be performed.

Response: *The subject sentence has been removed from the report, due to revised rewording elsewhere in the paragraph.*

18. Page 2-8, 1st full paragraph. Please clarify when these tests might be used (i.e., for background comparisons). Otherwise this paragraph is confusing because these tests are not the only tests used in this report.

Response: *See response to comment #19 below.*

19. Page 2-8, 1st full paragraph. The paragraph is confusing. It appears to be an attempt to say that multiple detection limits are unlikely to have an effect on the use of these data for background comparisons with site data. This is not correct, and is one of the problems that has been identified by NDEP, resulting in NDEP guidance on detection limits. When detection limits are very different between the two datasets that are being compared, then results of statistical tests can be driven by non-detects. Use of Gehan's test and Gehan's ranking system and the quantile test can mitigate this effect to some extent. Note that the paragraph says that the biggest effect will be seen in the summary statistics – if it is seen in the summary statistics, then it will be seen in any test that uses those summary statistics. Note, the final sentence of the paragraph is fine, and the discussion of the non-parametric tests is fine, but it is not connected well to the beginning of the paragraph. For a few chemicals (some of those listed), the difference in detection limits is likely to drive the results of the background comparisons (e.g., antimony).

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

20. Page 2-8, Criterion V, 1st paragraph. This paragraph seems unnecessary here. The content has been addressed above.

Response: *The subject text is merely an introductory paragraph intended to introduce the content of the Criterion V elements (qa/qc review and SVOC review to determine whether there* *are other impacts on the locations), which have not been previously discussed in detail. The section was rewritten in response to prior NDEP comments that indicated further discussion of the SVOC data was needed. Therefore, the text has been retained in the document.*

21. Page 2-9, Data Quality Review. It would be worth noting that the estimated values are used "as is" in the statistical analyses that follow. That is, some potential bias is noted, but it will not be addressed quantitatively.

Response: *The subject text has been modified on page 2-9 as suggested.*

22. Page 2-10, 1st full paragraph, last sentence. Change "wide-spread" to "widespread".

Response: *The subject text has been modified on page 2-11 as suggested.*

23. Pages 2-10 and 2-11. Discussion of representativeness only describes what the criterion is. It does not describe whether it has been satisfied for this study.

Response: *Text has been revised on page 2-11 in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009. The subject text has been expanded to discuss the means by which the representativeness criterion was evaluated, and to note that it has been satisfied for this investigation.*

24. Page 2-11, last sentence. Detection limits do not meet the data quality objectives (DQOs). This is not possible. DQOs are about decisions that will be made with data, not about characteristics of the sampling and analysis program. Please edit.

Response: *The subject text has been modified on page 2-12 for clarification.*

25. Page 3-3; 2nd bullet: It should be noted that 104 of the 120 data points are from the 2005 background investigation and 16 are from the Environ investigation.

Response: *A footnote has been added to page 3-3 that indicates that 104 of the 120 data points are from the 2005 investigation and 16 of the 120 data points are from the Environ investigation.*

26. Page 3-3; Section 3.1.3, 1st paragraph under bullet: NDEP's specific comment #21 from the previous round of comments was not addressed. The discussion did not appear in the Data Usability sections "Criterion IV" or "Criterion VI". In particular, there is no discussion of minimum detectable activity (MDA) in Section 2.

Response: *As noted in the response to comment #21 of the previous round of comments, the original purpose of the subject paragraph was to discuss the effects of reporting limits on detection frequencies. Because this particular issue is discussed in greater detail elsewhere in* *the report relative to metals, the paragraph that is the subject of this comment was removed from the report during the last round of revisions (redline text edits submitted in March 2009).*

In this regard, radionuclides represent a different situation than metals. The report presents radionuclide detection frequencies using the Minimum Detectable Activity (MDA) as the reported value below which measured results are considered "non-detections." However, unlike metals, the project laboratory reports all measured values, including those lower than the MDA. (The project laboratory only reports values down to the SQL for metals.) All reported results for radionuclides are used in the statistical evaluations, regardless of where they fall relative to the MDA; therefore, the MDA and radionuclide detection frequencies relative to the MDA have no effect on statistical comparisons of the radionuclide data. A discussion to this effect has been added to Section 2.4.4

27. Page 3-4, partial paragraph at the top of the page, last sentence. Change "The GiSdT's…" to "GisdT's….".

Response: *BRC understands that this comment has been retracted by NDEP.*

28. Page 3-4, 1st full paragraph, 1st sentence. Although the United Stated Environmental Protection Agency (USEPA) suggests that a method detection limit (MDL) is established as some form of confidence interval, this is in fact incorrect. The number of (low concentration) samples analyzed is not taken into account in the calculation of an MDL, in which case it is not a confidence construct. It is instead an estimated 99th quantile of the distribution for the low concentration samples analyzed, often assuming a normal distribution. Please change the text to say 99% probability instead of 99% confidence, since that is actually a more accurate statement.

Response: *The text in the revised report has been changed on page 3-4 as noted in NDEP's comment.*

29. Page 3-4, 1st full paragraph, last sentence. This seems to be overstated. If the SQL is used as defined in recent NDEP guidance, then statistical issues of this kind are unlikely to result. For some BRC datasets in the recent past quantitation limits (QLs) or reporting limits (RLs) have been used for non-detects instead of SQLs. In those cases detection limits (DLs) were often higher than detected values, which caused problems for statistical analysis of the data. The use of SQLs largely mitigates the problem. Although it is still possible for the largest non-detect to exceed some detected values, it is likely to be a rare occurrence if SQLs are used as defined in NDEP's guidance. It is extremely unlikely that the median RDL (SQL) for non-detects (i.e., the reported non-detect value) will be greater than the median for the detects.

Response: *BRC agrees that the use of SQLs largely mitigates the issues discussed in NDEP's comment, and has found that the median SQL for non-detects is routinely lower than the median for the detects, after reverting to the use of the SQL in place of PQLs. However, review of the data indicates that for certain metals with routinely low detections near the SQL (e.g., silver),* *the detections are lower than the SQLs. This is likely the result of sample-specific dilutions. Therefore, the subject text has been modified on page 3-4 as follows:*

> *"Therefore, because the SQL is a sample-specific detection limit, for the dataset as a whole there may be instances where the maximum non-detect value may be higher than the lowest detected concentration, the median SQL for a chemical in a dataset is greater than the median detected concentration, or median SQL for non-detects are different for different datasets. A review of the data reveals that this is sometimes the case for certain metals detected at low concentrations near the SQL (e.g., the median SQL for silver is often higher than the median detection). In such cases, these limitations may compromise statistical analyses in this report and potential future background comparisons."*

30. Page 3-5, 2nd paragraph. If the term boxplots is used as one word, then the first sentence needs to be changed from "Probability and boxplots" to "Probability plots and boxplots".

Response: *The subject text has been modified on page 3-6 as suggested.*

31. Page 3-5, 3rd paragraph. Please note that the size of the dataset is still not the issue. Appendix D shows plots for many chemicals. These plots show the background data. The background data have already been defined. There is no real need to describe the dataset as large here, and no clear benefit in doing so. Nevertheless, the first sentence is acceptable and the second one can simply state that the data for each analyte are presented in Table 2 (or summaries of the data if that is more accurate).

Response: *The subject text has been modified to remove reference to size of the dataset*

32. Page 3-6, footnote 9, Section 3.4, and Appendix E: In response to BRC's response-to-comment #23, some text has been added, and some text has been shifted around with the creation of a new Appendix. Statistical outliers might exist based on some statistical criterion, however there appear to be no real outliers in these data when taking into account other factors. The text at the beginning of Section 3.4 represents an improvement, and suggests that the goal of the outlier analysis is to confirm that this is a reasonable background dataset. If this is indeed the goal of the outlier analysis, then this should be stated more clearly. Then, the idea that statistical outliers will be identified, but will then be checked using correlation plots and other means is not unreasonable. Other means or lines of evidence could perhaps include regional background data or the other background datasets at the Site. NDEP's concern is that the presentation then over-emphasizes the role of boxplots to identify statistical outliers. The formulas for statistical outliers in boxplots roughly correspond to the idea that the data will be contained inside about 3 standard deviations if the data are normal. That is, the rule admits more outliers as more data are included. The rule is meant as a guideline, and not as a hard rule, and its effectiveness depends on the nature of the underlying distribution. The correlation analyses, however, can point much more clearly to the presence of unusual data points, which is the real purpose here. None of these data stand out clearly from the boxplots (even the "outliers" are not much greater than the whisker values), and the correlation analysis reveals no obvious outliers. Hence, there is probably no

reason to spend additional effort on this issue. Basically, please note that statistical outliers are few and that exceptions are for chemicals with many non-detects, then point to the correlation analysis revealing nothing of interest from this perspective, that SVOCs were not found, and that the data seem reasonable. The benefit of the outlier analysis is to demonstrate that this is a reasonable background dataset. The disbenefit is that false rejection of data that is indeed background can result if undue importance is made of the outlier analysis.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

33. Section 3.5. Please discuss if the chemical analysis has been thoroughly reviewed for some of these cases. For example, the mercury case is particularly interesting, where the RDLs are about the same in both datasets, but the frequency of detection (FOD) is very different. Although differences in concentration are possible in the two geologies, this magnitude of difference might not always be expected, and sometimes, chemical analytical issues are indicated instead.

Response: *Differences due to different laboratory or different analytical methods are minimized as the same laboratory and the same methods were used to generate both the 2005 background shallow soil dataset and the 2008 background supplemental shallow soil dataset. In addition, the chemical analysis has been reviewed as part of the laboratory's QA/QC protocols. The laboratory reported no concerns with the analytical protocols nor did they report or provide any evidence that there existed analytical issues with the data.*

With regard to mercury, although differences in FOD were observed, the detected concentrations are not substantially greater than the SQLs. Given information to date, differences in SQLs do not appear to have caused the differences in the frequency of detections..

34. Page 3-12, 1st paragraph, 1st sentence. Change "tend to drive the analyses" to "can adversely impact the results of the statistical analyses".

Response: *The text has been revised on page 3-12 to read "…tend to influence the results."*

35. Page 3-13; Footnote 15: The reference to four samples is repeated in both textual and numeric from (i.e., "four" and "4"). Please revise using one form.

Response: *Text has been revised on page 3-23 from "… four (4)…" to "…four…"*

36. Page 3-13; Section 3.6.1: This section requires a rewrite. Classical statistics is set up so that the null hypothesis can be rejected, but not so that the alternative hypothesis can be accepted. This is a limitation of classical statistics. The text should state something along the lines of "(i) fail to reject the null hypothesis or (ii) reject the null hypothesis". Of course, most practitioners assume that a rejected null hypothesis implies acceptance of the alternative, despite the technical flaws in doing so. NDEP recognizes the challenge, but such overt

admittance to accepting null hypotheses should be avoided or placed in context. The 2nd paragraph of this section also needs to be reworked. The previous round of comments stated that null hypotheses are not about data sets, rather about population parameters. However, the word "datasets" is still used in the text when defining the null hypothesis. Hypothesis tests are about comparing parameters. If the null and alternative hypotheses were clearly stated, this would become clear. Also, the null hypothesis is not that the mean/median are comparable, it is that they are the same (identical). Furthermore the second sentence fragment in this paragraph refers to "hypotheses". If there is one null hypothesis you can't reject or fail to reject multiple hypotheses. Please state either fail to reject the null hypothesis or reject the null hypothesis. The 2nd, 3rd, and 4th paragraphs can all benefit from some rewording. Also change "null hypothesis was that" to "null hypothesis is that".

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

37. Page 3-14, Section 3.6.2, 1st sentence. Change "Statistical tests were conducted to infer whether datasets are comparable" to "Statistical tests were conducted to compare the 2005 and supplemental background datasets". Comparability is of itself an issue that is addressed in data usability.

Response: *The text has been modified on page 3-14 as suggested.*

38. Page 3-14, last paragraph. Delete "for its validity".

Response: *The subject text has been modified on page 3-14 as suggested.*

39. Page 3-15, 1st paragraph, last sentence. The use of 0.05 as a significance level requires some further explanation considering the use of Bonferroni corrections in the ANOVA and Kruskal-Wallis tests, and the common use of 0.025 in BRC reports for comparing site and background data using the four background comparison tests (t, Gehan (Wlicoxon Rank Sum), Quantile and Slippage).

Response: *See response to comment #48 below.*

40. Page 3-15, Two-Sample Tests. The Gehan modification could be applied to the data prior to using the data in the Kruskal-Wallis test. This can be done in Microsoft EXCEL, and does not need to be done in the statistical software. Then the Gehan ranks can be used as the data for the Kruskal-Wallis test.

Response: *The text has been modified on page 3-16 to indicate that one-half the SQL was substituted for non-detected concentrations (see footnote #23).*

41. Page 3-15, t-Test. All the data for a t-test are assumed to be independent, it is not just the two populations that are independent. It could be added that the t-test is fairly robust to deviations from the underlying assumptions.

Response: *The text has been modified on page 3-15 as suggested. Text mentioning that the "…t-test is considered to be relatively robust to deviations from the underlying assumptions" was added (see footnote #25).*

42. Page 3-15, Wilcoxon Rank Sum (WRS). The 3rd sentence appears to be missing a closing period.

Response: *The missing closing period has been added to the end of the 4th sentence on page 3-15.*

43. Pages 3-15 and 3-16, Quantile test. The inserted sentence can be removed. Here the test is of relative proportions in the tails of the distribution. The null hypothesis is that these proportions are the same. As such, the description of the underlying distributions is not relevant (although it is relevant for the WRS test).

Response: *Inserted sentence was removed.*

44. Page 3-16, Kruskal-Wallis Test, 1st sentence. Change "Kruskal-Wallis test is a non-parametric one-way ANOVA for ranks" to "The Kruskal-Wallis test is a non-parametric analog for the one-way ANOVA that is based on ranks"

Response: *Text has been modified on page 3-16 as suggested.*

45. Page 3-16, Footnote 22. NDEP has previously made the code available for the Behrens-Fisher multiple comparison tests. NDEP can do this again, please advise.

Response: *The text has been modified on page 3-16 to indicate that visual examinations of boxplots were used to conduct post-hoc pairwise comparisons (see footnote #27)*

46. Page 3-17, 1st full paragraph. A caveat that this is done for data exploration purposes and to provide a line of evidence could be added, so that the reader does not think this is a formal statistical result upon which a decision will be made. The purpose of this analysis is only exploration.

Response: *The text has been modified on page 3-17 to indicate that correlations were conducted for exploratory purposes and provide an additional line of evidence to confirm that data are consistent with the background dataset.*

47. Page 3-17, 2nd full paragraph. "Analytical DQOs" is a misnomer. DQOs are aimed at the decision to be made, not at analytical quality. Change the last part-sentence to "one may only conclude that these constituents are present…."

Response: Response: *Text has been modified on page 3-17 as suggested.*

48. Page 3-18, Section 3.6.2.1: The description of the Bonferroni adjustment is reasonable. However, its application requires more thought. The Bonferroni adjustment is considered reasonable when tests are performed on the same dataset and are relatively unrelated (perhaps not independent tests, but close to that concept). It is typically applied in an ANOVA setting when multiple comparisons are used. However, its application could be more general, and the general intent is to avoid making too much of apparently statistically significant results when many tests are run (for example, if using a nominal 0.05 significance level, then 5% of tests are expected to fail even when there are no differences or effects). There are a few considerations that need to be made as follows:
    a. Pacific Northwest National Laboratories (PNNL) performed simulation studies on the suite of 4 background comparison tests, and determined that an adjustment to the family-wise error rate of ½ was appropriate for these tests. i.e., if a nominal family-wise significance level of 0.05 is desired, then a significance level of 0.025 should be used for each of the four individual background comparison tests.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

    b. The Tukey Honestly Significant Difference tests might already account for multiple test adjustments, depending on how they are run.

Response: *Agreed. The Tukey HSD does account for multiple test adjustments. Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

    c. It is not clear exactly which sets of tests to which an adjustment should apply. The text mentions 46 constituents, but it is not clear that the Bonferroni (or any other) adjustment should be applied across constituents. It is usually applied to sets of tests performed on the same dataset. So, it might be applied to the four background comparison tests for one constituent, or to the multiple comparisons for an ANOVA. Or, it might be applied to all the tests that are performed on one set of data. Some further consideration should be given to its application.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

    d. The overall approach is to use 0.05 regardless. Consequently, much of the discussion is moot and could be shortened. This does not seem like an unreasonable approach in light of the difficulty in establishing an adjustment factor. That is, use 0.05, but note "close" results and recognize the conservatism of using the family-wise value on individual tests.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

49. Page 3-18; Section 3.6.2.1: This section does not appear in the Table of Contents. Please clarify.

Response: *See response to specific comment #3.*

50. Page 3-19, Section 3.7.1, 1st sentence. Please note that the goal is not to see if the datasets can be combined into one dataset. The data will be combined into one dataset. The goal is to determine if there are differences between subsets of the background data, so that background comparisons should be performed with appropriate subsets of the background data, or if there are no differences, in which case all the background data can be used (in combination) for background comparisons. The sentence makes it seem as if there is some goal to physically combine data (in Microsoft ACCESS or EXCEL for example), and that is not the goal – that will be done anyway – the issue is how the data will then be used.

Response: *As originally intended, the text has been modified to make clear that the intent is to determine whether (a) the combined dataset (i.e., dataset comprised of both 2008 Supplemental and 2005 BRC/TIMET data) may used for future comparisons or (b) subsets of the combined dataset (e.g., 2005 McCullough, 2005 Mixed) should be used for future evaluations.*

51. Page 3-19, Section 3.7.1, 1st paragraph. The conclusion of this report is that there are differences. The way this paragraph is written, one would expect the report to show no differences. Perhaps the paragraph could be completed with something that acknowledges that statistical differences exist for some metals as described below.

Response: *Text was streamlined to eliminate confusion/impression that no differences were observed among lithologic unit (as described later in the section).*

52. Page 3-19, last paragraph, last sentence. What follows after the dashes does not obviously follow what comes before the dashes. There appear to be two different thoughts here. Please reword.

Response: *The subject text has been modified for clarification.*

53. Page 3-22, paragraph at the top of the page, 2nd sentence. It is not clear what this sentence means. This study compares 2005 and 2008 data. How is that consistent with results from the 2005 study only? NDEP suggests that BRC delete the sentence.

Response: *Text has been revised to note that both two-sample and multi-sample tests were used to evaluate differences among lithologic units with regard to depth intervals:*

1 *Two-sample tests were used to assess differences in concentrations/activities between 2005 McCullough and 2008 River lithologic units for each of three separate depth intervals: 0 ft bgs, 5 ft bgs, and 10 ft bgs.*

2. *ANOVA/Kruskal-Wallis tests were used to assess differences in concentrations/activities for the combined 5 and 10 ft interval among three lithologic units: 2005 McCullough, 2005 Mixed, and 2008 River. Note that 2005 River was not included because the dataset was comprised of four samples or less.*

54. Page 3-27, last paragraph, 3rd sentence. The reference to BRC/TIMET 2007 seems inadequate. Presumably that reference itself references another source for this (reasonable) assertion.

Response: *Text has been revised to provide rationale for association among alkaline metals and alkaline-earth metals. Rationale is discussed in BRC/TIMET (2007).*

55. Page 3-28, 1st full paragraph. It is not clear what is intended by this sentence. Correlations exist between radionuclides and metals, but they should be evaluated based on geochemistry. This conclusion is true for all the correlation here, not just ones between metals and radionuclides. Can this be expanded upon, or should the back half of the sentence be deleted (and the remaining partial sentence moved up?).

Response: *Text has been modified-- second half of sentence was deleted and the remaining sentence moved up to previous paragraph.*

56. Page 3-28. Scatterplots heading: This heading should have the section "3.7.5" preceding it according to the Table of Contents. Please verify.

Response: *See response to specific comment #3.*

57. Page 3-29; 1st full paragraph: NDEP's previous comment #50 was not addressed by BRC. There is no discussion regarding correlations within the thorium chain.

Response: *Text has been modified on page 3-28 to note that no correlations were found between analyzed radionuclides associated with the thorium-232 decay chain.*

58. Section 3.7.4: NDEP's previous comment #51 was not addressed. The purpose of the correlation analysis is really to confirm that this is a reasonable background dataset (another line of evidence). Organizationally it would be better if this section was moved towards the front (near the outlier section), but otherwise, the conclusion needs to be more obvious that this correlation analysis further justifies that these are background data.

Response: *Text has been revised in accordance with text provided to and modified as appropriate by NDEP on May 10, 2009.*

59. Page 4-1; 2nd paragraph: This paragraph mentions "statistical outliers" and "potential outliers". There are no actual outliers in this dataset. Please change "potential outliers" to "statistical outliers". Also, where is the exploratory data analysis (EDA), correlation analysis, etc. discussed in this paragraph? Surely these all provide additional evidence to confirm that these data are background data. The focus of this paragraph should be changed to one of demonstrating through multiple lines of evidence (including the SVOC analysis) that these are reasonable background data. Alternately, the paragraph should be deleted. There are no outliers in this dataset, other than according to a rule of thumb that is applied to box plots. That is not enough to call out outliers. There is still too much emphasis on outliers here.

Response: *Paragraph has been deleted.*

60. Page 4-2, Table. The table implies differences between the River, mixed, and McCullough data. However, it does not also imply a difference for the Northern River data that are the primary subject of this report and the few River data that are part of the 2005 study (including the ENVIRON data). Comparisons appear to have been made between the 2008 and 2005 River data in this report, resulting in identified differences. Hence, some clarification is needed.

Response: *Text has been revised to note the difference between the 2008 (North) River and the 2005 (South) River datasets. It is recommended using either the 2008 River or the 2005 River background dataset when comparing to site soil data, depending on which background dataset is most appropriate for the site's geological conditions. It is also noted that the 2008 River dataset is likely the more appropriate dataset for site comparisons, and future use of the 2005 River dataset is unlikely.*

61. Page 4-2; 2nd bullet: Please change "This findings…" to "These findings…"

Response: *The subject text has been modified as suggested.*

Response to NDEP Comments Received February 17, 2009 on the Supplemental Shallow Soil Background Report dated December 2008

General Comments:

1. From the previous round of revisions the first general comment was not entirely addressed. There are still several instances in the text where the phrase "At the direction of NDEP…" still exists (pages 3-7, 3-18, 3-20). This phrase is not necessary. It is not clear why BRC includes this phrase. Please discuss with NDEP if necessary.

Response: *This phrase was retained in previous versions of the report when NDEP requested statistical analyses that were not identified or proposed in existing state or federal guidance. Given BRC agreement to perform these analyses at NDEP's request, the subject phrase has been deleted from this version of the report.*

2. The objectives as stated in Section 1.1 seem on target. The basic goal is to determine if the northern River range geology is different enough that a local background dataset corresponding to that area is different than the background dataset reported in the 2005 BRC/TIMET background report. The final conclusion verifies that this is the case, but there are other ancillary conclusions that do not seem necessary. The focus should be on whether the supplemental background dataset is statistically similar to or different to the 2005 BRC/TIMET background data, while also bearing in mind the differences within the 2005 BRC/TIMET background data. Some specific comments on this issue are also provided below.

Response: *A key objective of this study is to evaluate whether the supplemental shallow soil background dataset is statistically similar to or different to the 2005 BRC/TIMET background data. Text has been modified to focus on this objective.*

3. Although the final conclusion of the statistical analysis is that there are differences, and the final table in Section 4 suggests that sub-sets of the background data that could be used for different sub-areas, more should be made of the overall result of the background studies that a rich background dataset has been assembled that covers several different soil geologies at the site, and that for each sub-area background comparison the appropriate sub-set of the background data should be used. This should also be extended to differences by depth as necessary.

Response: *The overall robustness of the assembled background soil data will be identified and described in the upcoming Background Soil Summary Report. Note that the findings of this study found few statistically significant differences among the 0, 5, and 10 ft bgs depth intervals for the 2008 River background data. As suggested in the report, the 0, 5, and 10 ft bgs data may be pooled and applied as a single dataset, promoting more powerful statistical analyses for future assessments in support of decision-making.*

4. Overall, more emphasis should be placed on the conclusion that the background data differ by geology, with minor differences by depth, and that appropriate sub-sets of the background

data should be identified for sub-area background comparisons. This is not explicitly clear within the report, however, it is expected that this issue can be resolved within the forthcoming report which will encompass all of the background data sets.

Response: *Text in Section 4 has been revised to emphasize that background data differ by geology, with minor differences by depth within the 2008 River dataset. Recommendations for the use of specific datasets is provided in Section 4, Summary and Conclusions.*

5. The results of the semi-volatile organic compound (SVOC) analyses are not discussed in the report until a one line mention in the conclusions of Section 4. There was a purpose to collecting these data, and some discussion of the results is warranted. There is also some discussion under Criterion V in the Data Usability Section, but this is inadequate. The results need to be discussed in more detail in Section 3.

Response: *BRC has expanded the discussion in Section 2.4 in response to NDEP's comment.*

In BRC's opinion, presentation of these results under Criterion V in the Data Usability Section (Section 2.4 - with a table summarizing the results, Table 3), separate and apart from the discussion of the metals and radionuclide results, is appropriate given (1) the purpose of the analyses (i.e., as indications of the potential for impacts to the sampling location that could suggest a certain location should be excluded from the background dataset); (2) the fact that there is no intent to establish background SVOC concentrations for comparison to detections at the site; and (3) the general lack of SVOC detections (only bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was reported).

Furthermore, Section 3 comprises the summary of statistical analyses performed on the background datasets. Because statistical analyses were not performed on the SVOC data, including discussion of those data within Section 3 seems inappropriate. Thus, discussion of the SVOC results will be confined to Section 2.4.

6. Some of the Data Usability sections are inadequate. For example, for Criteria II and II no references are provided demonstrating that these criteria were met. There is discussion, but no references to where the relevant information is presented. Some further comments are made in the specific comments below.

Response: *See responses in Specific Comment #12 below.*

Specific Comments:

7. Page 1-2; last paragraph (after bullets). It is not clear in this document what "Qr1" and "Qr2" refer to. Please clarify.

Response: *The subject sentence has been expanded to provide an explanation of the terms Qr1 and Qr2 (mapped lithologic units representing pediment and fan deposits of the River Mountains).*

8. Page 1-3; last paragraph. In this paragraph reference is made to Figure 3. However, the relationship between designations in Figure 3 and Qr1 and Qr2 mentioned on Page 1-2 is not clear. Please clarify.

Response: *The paragraph has been expanded to define the soil units and clarify their relationship to lithologic units Qr1 and Qr2.*

9. Page 2-1; Section 2.1; second paragraph. Change “and along” to “along”.

Response: *The revised text has been modified as suggested.*

10. Page 2-1; Section 2.1; last paragraph. Change “because the” to “because they”.

Response: *The revised text has been modified as suggested.*

11. Page 2-5; Section 2.4; first paragraph. Reference should be made to the October 2008 NDEP guidance on Data Usability, rather than the United States Environmental Protection Agency’s (USEPA’s) 1992 guidance.

Response: *NDEP’s 2008 guidance builds on USEPA’s 1992 guidance and both are now referenced.*

12. Pages 2-6 and 2-7; Criterion II and III. The purpose of the criterion is described, and a description is provided that various activities were performed appropriately. But, there is no practical way to verify these assertions. References to the available information are needed. Appropriate references might include the data validation summary report (DVSR), laboratory reports, field reports, etc.

Response: *Appropriate references have been added to the subject text as requested in NDEP’s comment.*

13. Page 2-7; Criterion IV, last sentence. NDEP suggests that BRC delete “although unfortunate”. This is not necessary in the report. (Please note that this occurs in at least two other places in the report.)

Response: *The subject text has been modified as suggested; however, it should be noted that the cited example is the only such occurrence that BRC was able to identify in the report.*

14. Page 2-8; Criterion IV, top of page. NDEP suggests that BRC reword the last two sentences along the lines of “BRC uses GiSdT to conduct non-parametric tests including the Wilcoxon Rank Sum test, the quantile test and the slippage test. The Gehan ranking system is used for these tests to accommodate multiple detection limits within the same dataset. However, if

detection limits are among the largest values in the dataset, then conclusions from the statistical test results should be treated with caution.”.

Response: *The revised text has been modified as suggested.*

15. Page 2-8; Criterion V, first line. Change “primarily of” to “primarily on”.

Response: *The revised text has been modified as suggested.*

16. Pages 2-8 and 2-9; Criterion V and VI. Reference is made to the DVSR, but reference should also be made to the Tables in Appendix B, since these tables show results of the data usability evaluation.

Response: *The revised text has been modified as suggested.*

17. Page 3-1; Section 3.0. The USEPA references need to updated to the more recent 2006 USEPA guidance.

Response: *The revised text has been modified as suggested to reflect the more current guidance.*

18. Page 3-1; Section 3.0, last line. The following sections do not discuss data usability. The Data Usability section is Section 2. Please revise.

Response: *The comment refers to a section of test that lists topics discussed in Section 3.0. In response to this comment, the term “data usability” has been removed from that list.*

19. Page 3-2; bullet (bottom of page). It would be helpful to list the four metals that are not included in the 2008 data, and to recognize that changes to the site-related chemicals list (SRC list) for radionuclides are the reason why only eight radionuclides are included (and perhaps list those nuclides by their radionuclide chains).

Response: *A footnote has been added to explain the differences between the two datasets in this regard, and the reasons for the changes.*

20. Page 3-3; 1st Bullet. There is a minor error in the response to specific comment 3 in Appendix A, which indicates that 104 data points from the 2005 BRC/TIMET dataset and 15 from the Environ dataset comprise the 2005 background dataset. The 15 should be changed to 16.

Response: *The tallies of sample points have been reviewed and BRC has confirmed that there are 120 total data points in the 2005 BRC/TIMET dataset; 104 from the 2005 background investigation and 16 from the Environ investigation.*

21. Page 3-3; 1st paragraph (after bullets). This paragraph is confusing. The discussion jumps from metals to radionuclides and back to metals again. Some cleanup of this issue would help. Also, it is not clear what this discussion is doing in this section. It appears that this discussion would be more appropriate in the Data Usability section under Criterion IV and/or VI. It is not clear why sample- specific Minimum Detectable Activities (MDAs) should have an effect on detection frequency. Since all radionuclide data are going to be used, it is not clear why this argument is even necessary, except, perhaps, in terms of data usability.

Response: *The original purpose of this paragraph was to discuss the effects of reporting limits on detection frequencies. Because this particular issue has been discussed in greater detail elsewhere in the report, the paragraph that is the subject of this comment has been removed from the report.*

22. Page 3-4; 1st paragraph (top of page). The Gehan ranking method should be described here.

Response: *The text has been expanded to include a discussion of the Gehan ranking method.*

23. Page 3-4, Section 3.1.4. It is not clear why the section on outliers appears before the exploratory analysis (plots) presented in Section 3.2, and summary statistics presented in Section 3.3, especially since the outlier analysis relies on some of these plots (box plots in particular). Outlier analysis is usually one of the last statistical analyses performed, not the first. In addition, the treatment of outliers is over-emphasized. There are no outliers in this dataset. This is demonstrated by the plots and correlation analysis. We recognize that outliers are defined according to the 1.5 x box height measure used to identify more extreme tail data, but this is a definition of statistical outlier, and not of an outlier per se. Outliers should not be identified based on agreement with an underlying statistical distribution, which might not reflect the underlying process anyway (parametric distributions are approximations to reality that are used to support prediction and decision making). In addition, with the number of data points involved, some values outside the 1.5 box height limits should be expected, even if the underlying process is normal. NDEP continues to be concerned about the large emphasis on outlier analysis in this report, given the potential uses of these data for background comparisons.

Response: *The text has been revised and moved to follow Section 3.3. For further details regarding outliers, the reader is referred to Appendix E.*

24. Page 3-8; Box plots, last paragraph. The reference to 6,700 records is unnecessary and not very informative. What is more informative is the number of data points per chemical and the number of chemicals. Please revise.

Response: *The reference to the number of records was included to give perspective to the term "large," which is a subjective term. The subject text has been revised to include a reference to Table 2, which present the number of data points associated with each analyte.*

25. Page 3-10; first paragraph. It is not clear why barium is being discussed here. There is no discussion of any other chemical in this section. NDEP suggests that BRC either delete this discussion from here, or use this as an opportunity to describe more conclusions from the plots and summary statistics.

Response: *The paragraph that is the subject of this comment has been deleted from the revised document.*

26. Page 3-10; Chemical sub-sections under Section 3.4. For cadmium, the median detected concentration for the 2005 BRC/TIMET shallow data set is less than the respective reportable detection limit (RDL) for non-detects. For silver, both the 2005 BRC/TIMET and 2008 Supplemental datasets have median RDLs that are greater than the median detected concentration. For selenium the median RDLs for non-detects differ by a factor of two. For thallium, the median RDL for non-detects are different for the 2005 BRC/TIMET and 2008 Supplemental datasets. All of these issues can compromise statistical analyses in this report and potential future background comparisons. Some further discussion of these issues is needed in the Data Usability section. NDEP recognizes that there are not good options, but some further recognition of the issues would clarify the limitations of the future uses of this data. There is also a discrepancy between the text in the "Assessment of RDL Effects…"section and the 2008 non-detect RDL for zirconium. The text in the assessment portion refers to a 2008 non-detect RDL of 0.3 mg/kg while the value in the table is 0.8 mg/kg. Please clarify.

Response: *The following text has been added to as the last paragraph of Section 3.1.3 "It should be noted that the method detection limit (MDL) is established by the laboratories and represents the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are established using matrices with little or no interfering species using reagent matrices and are considered the lowest possible reporting limit. Often, the MDL is represented as the instrument detection limit. The RDL (also known as the sample quantitation limit [SQL]) is defined as the MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes, and takes into account sample characteristics, sample preparation, and analytical adjustments. It represents the sample-specific detection limit and all non-detected results are reported to this level. Therefore, because the RDL is a sample-specific detection limit, for the dataset as a whole there may be instances where the maximum non-detect value may be higher than the lowest detected concentration, the median RDL for a chemical in a dataset is greater than the median detected concentration, or median RDL for non-detects are different for different datasets. It is recognized that these limitations may compromise statistical analyses in this report and potential future background comparisons.*

Also, the document has been revised to repair the discrepancy between the zirconium text and table.

27. Page 3-14; Section 3.5. NDEP suggests that BRC reword the first sentence. "Findings ….were used to infer…" does not seem like a good construction. The following sentence

states "Specifically, the following were conducted", however, conducting does not follow from because the previous sentence, which refers to findings. It is also not clear what was conducted, although presumably it is some form of statistical procedure. The bullets might also need to be reworded once the introductory paragraph is changed.

Response: *The subject paragraph has been revised to address NDEP's comment; no revisions to the bullets were necessary.*

28. Page 3-15; footnote 8. This footnote should be listed on the previous page.

Response: *The pagination has been adjusted such that the footnote in question now falls on the page in which it is referenced.*

29. Page 3-15, Section 3.5.1. The first sentence is incomplete. Statistical hypotheses are framed in terms of both a null and an alternative hypothesis. Both need to be specified. More description is needed in this introductory paragraph. Reference should also be made to significance testing or classical statistical methods, or the like, since the statement is not true otherwise. In addition, the description of the null hypothesis in each of the 2 cases should also be rewritten. Null hypotheses are not about datasets, they are about population parameters. For example, BRC needs to discuss if mean concentrations are statistically similar for different populations (although a different statistic is used for the Wilcoxon Rank Sum (WRS), quantile, slippage and Kruskal-Wallis (KW) tests).

Response: *The subject paragraph has been revised to address NDEP's comment.*

30. Page 3-15, Section 3.5.2. There is still a mathematical form for non-parametric tests. For example, the WRS test assumes symmetry in the respective distributions. The difference is that a parametric form of statistical distribution is not assumed.

Response: *The subject text has been revised to address NDEP's comment.*

31. Page 3-16, first paragraph. A significance level of 0.05 is indicated here. When many tests are used on the same data, a smaller significance level should be used. Note also that, on the next page, an indication is made that a significance level of 0.025 is used for the set of 2-sample tests. Some clarification is needed.

Response: *It is ERM's understanding that NDEP is referring to the use of a correction when more than one test in a particular study is applied when a single null hypothesis of no effect is tested. A Bonferroni correction/adjustment is one of the more basic and common procedure used to adjust the alpha level to account for random chance when using multiple tests to test a single null hypothesis. Text has been revised and a discussion of a Bonferroni correction has been included in the report as Section 3.6.2.4 to provide an added perspective to the findings of multiple tests.*

Note that the use of a Bonferroni correction would not have changed the overall conclusions of the study with regard to significant geochemical differences (i) among 0, 5, and 10 ft bgs depth intervals within the 2008 River background data (Table E-1), (ii) among the four lithologic units (Tables F-2 and F-3), and (iii) between 2008 River and 2005 McCullough by depth interval (Tables F-6 through F-8)

32. Page 3-16, t-test. Reference to large sample sizes is made. This should be accompanied to reference to the Central Limit Theorem, which is the basis for assuming the mean is normal even when the data are not normal.

Response: *The subject text has been revised to identify that parametric tests assume that both datasets are normally distributed and have equal variances.*

33. Page 3-17, Kruskal-Wallis test, 2nd sentence. Change "The Kruskal-Wallis tests" to "The Kruskal-Wallis test is used to test".

Response: *The revised text has been modified as noted in the comment.*

34. Page 3-18, Item 1. Change "conduct test" to "conduct a test".

Response: *The revised text has been modified as noted in the comment.*

35. Page 3-18, paragraph below Item 2. It is not clear what is meant by these paragraphs. It is not clear why a reference to tests involving medians is made here. Please explain why all the tests are not admissible again.

Response: *The subject text has been revised to address NDEP's comment.*

36. Page 3-18, 2nd paragraph below Item 2. The last sentence should be reworded. The intent seems to be that the tests involving full datasets unimpacted by non-detects (NDs) are more reliable. While that might be true as a general statement, it is not a helpful statement for chemicals such as thallium, or silver, or antimony, which are affected by their detection limits (DLs). This same statement appears several times in this report. NDEP suggests that it is reworded everywhere it appears. If BRC does not agree that performing this analysis is productive, then NDEP is willing to discuss the issue. The binomial proportions tests are reasonable if the DLs are approximately the same. Performing comparisons for the detected data if the frequency of detection (FOD) is the same and the DLs are about the same can perhaps be performed through exploratory data analysis (EDA) as opposed to using statistical significance tests.

Response: *A key reason/objective for this study is to determine whether there is sufficient evidence to suggest that background lithologic units and depth intervals are different to promote/ensure proper future application of the data to different sites of interest. Conclusions of* *this study are based on the preponderance of the evidence for 46 constituents. Given the relatively few constituents affected by their detection limits and the associated unreliability of statistical analyses for these constituents, study objectives can be met considering the more reliable analyses for the far greater number of the 46 constituents.*

Concerns with regard to the low frequency of detects (FODs) for thallium, silver, antimony are more appropriate and will be addressed when applying background datasets to identify specific constituents at sites that are considered to be elevated above background concentrations.

Text has been revised in Section 3.7 to indicate that study conclusions related to whether differences exists is better served based on the preponderance of the evidence from the more reliable analyses associated with the majority of the 46 constituent with greater frequency of detects.

37. Page 3-18, Footnote 14. The test of proportions is not usually described as a non-parametric test. It is usually described as a binomial test, a proportions test, or as a chi-square test for independence.

Response: *The text has been modified to more accurately describe the Z-test for two proportions.*

38. Page 3-19, Pearson's section, 2nd sentence. Change "The Pearson's" to "Pearson's".

Response: *The revised text has been modified as noted in the comment.*

39. Page 3-19, Footnotes 15 and 16. These footnotes are unnecessary, since the same words are in the text.

Response: *The two footnotes referenced in NDEP's comment have been deleted from the revised text.*

40. Page 3-19, Section 3.5.3, first sentence. This sentence seems strange since the previous analysis of the 2005 data suggest that these data should be sub-setted for background comparisons because of geologic differences.

Response: *The primary conclusion from the 2007 report was that: "The statistical test of background soil sample data, based on location, suggest a number of statistically significant differences; however, because the data represent the range of background conditions at the site, there is no rationale for dividing the data into separate datasets based on location, soil origin, or study." Therefore, the sentence in the report is considered appropriate.*

41. Page 3-19, Section 3.5.3, third sentence. NDEP suggests that BRC delete the words "semi-quantitatively" as they are not necessary.

Response: *The revised text has been modified as noted in the comment.*

42. Page 3-20, first paragraph. This paragraph describes differences for arsenic, and then jumps into other differences that have nothing to do with concentration differences. The other differences are issues with the data set that have been described previously. If these paragraphs and bullets are to remain here, then the discussion of arsenic should be moved down in this sub-section. It would also help to include some discussion about other metals for which differences were observed.

Response: *The subject paragraph and bullets have been deleted from the revised document.*

43. Page 3-20, last line. Change “the Test of Proportion” to “a binomial proportions test”.

Response: *The revised text has been modified as noted in the comment.*

44. Page 3-21; Table. Detection limits for cadmium and thallium are not similar, so it is difficult to understand why the test of proportion is applicable in these instances. Pages 3-10 and 3-12 show markedly different RDLs for the different background data sets for these metals.

Response: *Tables embedded within text and Tables E-4 and E-5 have been revised.*

45. Page 3-21, paragraph under table. Much like in subsequent sections, more specific results should be detailed here. Also, the statement in the last sentence is unnecessary (see previous comment).

Response: *The subject text has been expanded as noted in the comment.*

46. Section 3.5.3 in general. This section probably summarizes the most important results in the study. However, specific results are not provided in this section in nearly the level of detail provided in subsequent sections. The important results should be described in this section, including identifying metals and radionuclides for which differences are seen.

Response: *Text has been revised to provide specific results, including identifying metals and radionuclides for which differences were observed.*

47. Page 3-25, 2nd paragraph. Change “2008 River differs” to “2007 River data differ” (or some other similar change).

Response: *The revised text has been changed to read “2008 River data differ” in place of “2008 River differs.”*

48. Page 3-25, Section 3.5.5, 1st paragraph. Reference is again made to a significance level of 0.05. Clarification is needed considering the comment above.

Response: *Please see response to Specific Comment #31.*

49. Page 3-27; last paragraph, 1st sentence. A comment from the previous round of comments was not addressed. Please change "…were be examined…" to "…were examined…".

Response: *The revised text has been modified as noted in the comment.*

50. Page 3-28; 3rd paragraph. This paragraph does not discuss correlations within the thorium chain. The issues here should be discussed in greater detail.

Response: *The revised text has been expanded as noted in NDEP's comment.*

51. Section 3.5.6 in general. The final conclusions that the correlation analysis together with the EDA suggests that these are background data is not made sufficiently clear in this section. This is the purpose of the section. The outlier analysis should also be included in this section as well, since it is also aimed at whether these data seem to represent background (although both sections could come before the comparisons between data sub-sets). And, mention of the organics results should be made in the same context.

Response: *The revised text has been expanded as noted in NDEP's comment.*

52. Page 4-1; 1st paragraph, last sentence. NDEP believes that this sentence does not fully describe the objective. The objective is to add background data from another geology (to accommodate background comparisons at the Mohawk sub-area and Parcel 4B). The statistical analyses are performed to determine if this is appropriate, or if the data do not represent background conditions, or if they do not represent a geology that is already covered in the 2005 background dataset.

Response: *The revised text has been modified to reflect NDEP's comment.*

53. Page 4-1; 3rd paragraph, 2nd sentence. Change "Several outliers" to "Several statistical outliers". Suggest instead that the focus of this paragraph be changed to one of using the organic data, the correlation analysis, the EDA and outlier analysis to confirm that these are background data. This can be achieved by merging, and rewording as necessary, this and the next paragraph.

Response: *The subject sentence has been modified as noted in the comment, and the paragraph has been merged with the subsequent paragraph and reorganized.*

54. Page 4-1; 4th paragraph, 2nd sentence. The results of the SVOCs analysis should be described in Section 3.

Response: *See prior response regarding the inappropriateness of including the discussion in Section 3. The discussion of SVOC results has been expanded in Section 2.4 and is summarized in this paragraph.*

55. Page 4-1; 5th paragraph. The purpose of this is not clear. The datasets do not overlap for some metals (e.g., arsenic) in the way described. That is the purpose. That is, these data represent a different geology. NDEP suggests that BRC delete this paragraph and refocus on the objectives.

Response: *The paragraph that is the subject of this comment has been deleted from the revised document.*

56. Page 4-1; 5th paragraph, last sentence. Start a new paragraph here.

Response: *The text has been modified as suggested in NDEP's comment.*

57. Page 4-1; bullets. Suggest moving the 3rd bullet to the 1st.

Response: *The bullet order has been modified as suggested in NDEP's comment.*

58. Table 1. There are still a few instances in the summary statistics table where the maximum non-detect value is greater than the minimum detect value (e.g., lithium and silver). Please clarify.

Response: *See response to comment #26.*

59. Appendix E Tables. Different shading is used for some test results, presumably as a consequence of different nominal significance levels. However, it is not clear in the tables exactly how the shading is used. Please clarify.

Response: *NDEP requested that results be presented for both parametric and nonparamentric statistical tests. Grey text and shading were used to identify results for statistical tests that are less preferred given the distribution of the datasets.A footnote has been added to the tables to clarify this.*

Response to NDEP Comments Received November 13, 2008 on the Supplemental Shallow Soil Background Report dated October 2008

General Comments:

1. There are several instances of analyses that have been performed “at the direction of NDEP”. It is not clear that these references are necessary or useful. If these references are not necessary, NDEP would prefer they be deleted.

Response: *Unnecessary references to analyses being performed at the direction of NDEP have been removed from Revision 3 of the report.*

2. The data usability section does not adhere fully to the new NDEP guidance on data usability. The main concern is comparability between data sets (background, and site when the data are used for background comparisons). The issue is difference in detection limits. Whereas NDEP does not expect re-sampling to be performed to address this issue, it would be helpful to understand why this has happened so that it can be avoided in the future, and for BRC to provide some explanation in the text of the potential consequences for the statistical analysis that has been performed or might be performed in the future when comparing background and site data.

Response: *Section 2.4 in Revision 3 of the report has been expanded to include discussion of effects of detection limit variability and potential effects on usability. Discussion have been conducted with the laboratories to try and help alleviate this issue.*

3. As noted above, the comparability issue is related to a detection limit issue that must be resolved. Currently the supplemental background database identifies three types of “detection limit” that are labeled method detection limit (MDL), reporting detection limit (RDL) and quantitation limit (QL). The QL has been used in the statistical analyses. However, detects are reported between the RDL and the QL. This bifurcation complicates statistical analysis and interpretation. NDEP requires that the lowest possible detection limit be used so that censoring of data is minimized prior to analyzing data and making decisions. In the case of the supplemental background data, this means the RDL should be used. Note that for antimony the RDL is always twice the MDL. It is not clear why this is the case, but perhaps there is a dilution factor of two involved. NDEP did not investigate other metals for this specific effect.

Response: *This version of the report has been revised to include the use of the RDL to calculate descriptive statistics, prepare plots, and conduct statistical analyses.*

4. Detection limit issues also arise for radionuclides. For the supplemental background database the same three detection limits are included. However, the RDL and QL do not appear to play a role. The MDL is used, but NDEP assumes this represents the minimum detectable activity (MDA). The MDA is used to identify non-detects. Then the summary statistics table separates non-detects from detects in its analysis and presentation. On the non-detects side, the values used are the reported values and not the MDA. If non-detects are

separated then the MDA should be summarized, however, there is no need to separate the non-detects from the detects for radionuclides. The actual values are reported and they can be used directly throughout.

Response: *Use of reported values for radionuclides is consistent with USDOE guidance. As described in the Supplemental Background document, with respect to radionuclides, values reported by the laboratory are used throughout.*

5. NDEP also notes that the 2005 background data have been represented in the same way in this supplemental background report. However, in the 2005 report the detection limits for both metals and radionuclides were handled differently. NDEP also reviewed some past datasets and reports and finds inconsistency in the way in which detection limits have been used for both metals and radionuclides. NDEP will write guidance on how to separate detects from non-detects and how to present the results.

Response: *See response to general comment #3 above. BRC will adhere to NDEP's guidance on this issue for a future deliverables.*

6. It would have been helpful to bring the scatter plots and correlation analysis into the discussion on outliers. These outliers are simply values that exceed 1.5 x the inter-quartile range. Some of these outliers should be expected. The correlation analysis can be used to demonstrate that these values are not outliers in any other sense. It would be helpful to tie these arguments together in Section 3.1.4 where outliers are discussed.

Response: *A reference to Section 3.5.6 has been added toSection 3.1.4 in Revision 3 of the report regarding additional discussion on outliers.*

Specific Comments:

1. Page 2-7, Criterion IV, this seems inadequate given the issues with detection limits between the different background studies and with the site studies. Some understanding of why the detection limits are so different between studies for some metals is needed.

Response: *This section in Revision 3 of the report has been expanded to include discussion of detection limit-related issues between the different background studies and site data. Also, see response to general comment #3 above. BRC will adhere to NDEP's guidance on this issue for a future deliverables.*

2. Page 2-10, Criterion VI, it is not clear that comparability is adequately addressed here. The challenge is the difference in detection limits between background studies and between background and site studies.

Response: *The subject text in Revision 3 of the report has been expanded to include discussion of detection limit-related issues between the different background studies and site data.*

3. Page 3-3, 1st bullet, the text indicates that 120 samples are usually available for each analyte in the BRC/TIMET background dataset. Perhaps some clarification is needed – as far as NDEP understands the datasets, this number should be 104, and 16 samples should be attributed to ENVIRON's previous background study.

Response: *It is true that of the total sample size of 120, 104 are from the 2005 BRC/TIMET background investigation, and 15 are from the earlier ENVIRON background study. Based on the conclusions of the 2007 BRC/TIMET report, that is,* "The results of this analysis indicate that the BRC/TIMET and Environ datasets are generally comparable and can be combined for further statistical evaluation and comparisons.*", the combined dataset was used in this report, and the different data sources are generally not distinguished from one another.*

4. Page 3-3, Section 3.1.3, the discussion of non-detects for radionuclides does not seem accurate for this dataset. The discussion seems to imply that all radionuclide analyses generate activity results, even if the results are negative. However, the data includes non-detects. Some clarification is needed. NDEP requires that all reported values are used without censoring.

Response: *The subject text has been revised for clarification. Consistent with USDOE guidance regarding use of analytical data for radionuclides, all values reported by the laboratory were used without censoring to calculate descriptive statistics, prepare plots, and conduct statistical analyses.*

5. Page 3-3, last paragraph, this does not seem accurate. Whereas ½ the detection limit might be used in t-tests and ANOVA, it is not also used in the non-parametric tests. Some clarification is needed.

Response: *The subject text has been revised for clarification.*

6. Page 3-5, Footnote, the example given for calcium (5 & 10 foot datasets) seems to contradict the formal definition of an outlier in the text (i.e., "In some cases…a given point that was considered an outlier for a given depth interval did not fall outside the 1.5 interquartile range….". Please clarify.

Response: *The subject footnote originally read that* "In some cases…a given point that was considered an outlier for a given depth interval did not fall outside the 1.5 interquartile range <u>for the combined 2008 dataset</u> *[underline added for emphasis]…" and is not contradictory. However, to avoid confusion to the reader, this footnote has been reworded.*

7. Page 3-9, 5th bullet, is the "0-10 ft bgs combined" depth class referring to "all data points" or only 0 ft and 10 ft samples alone? The tables that provide summary statistics do not have a 0-10 ft bgs combined class. Please clarify.

Response: *The bullet was intended to refer to all depths combined; the bullet has been reworded for clarification in the revised document.*

8. Page 3-10, Footnote 6, this footnote is difficult to understand and should be reworded.

Response: *After changing to use of RDLs in the evaluation, the uncertainty reflected in the footnote was resolved, and the footnote was therefore removed.*

9. Page 3-12, FOD issues, the NDEP has the following comments:
   a. Although some analysis of frequency of detection (FOD) and detection limits (DLs) has been provided, some issues still remain unresolved regarding the effect of non-detects (NDs) and detects (Ds) on statistical analysis of the data. Each chemical included in this section is described here, with reference to both the 2005 and 2008 background datasets:
      i. Cadmium – the NDs have about the same DLs, however there are many more NDs in the 2005 dataset. All the detects are less than the NDs, in which case statistical comparisons are probably compromised.
      ii. Lithium – probably the background concentrations are simply different, but the large range of NDs in the 2008 data makes statistical comparison very difficult.
      iii. Mercury – NDs are similar for both datasets, but the 2008 dataset also includes detects, which are nearly all less than the NDs. Consequently, statistical analysis is compromised.
      iv. Selenium – Similar to mercury, except here the NDs have different values as well, by a factor of 2, which further compromises statistical analysis.
      v. Silver – The NDs are about the same, but again most of the detects are less than the NDs, compromising the statistical comparisons.
      vi. Thallium – Although there are detects that are greater than NDs, the NDs are different for the 2 datasets, again compromising any statistical analysis.
      vii. Tin – Similar DLs to thallium in the two datasets, but all the detects are again less than all the NDs, compromising the statistical analysis.
      viii. Zirconium – Again all the detects are less than the NDs, compromising statistical analysis.

Response: *The use of RDLs as opposed to PQLs provided some clarification in the potential effects of reporting limit variability on element FOD in the datasets. This section has accordingly been substantially revised.*

   b. There are a few larger issues as follows:
      i. It is not clear why for several of these chemicals all, or nearly all, of the detects have values that are less than the NDs. This seems to imply that the lowest possible detection limit has not been associated with the data. If so, this is something that must be changed.
      ii. The DLs are different for the two datasets. While this is not necessarily unusual, it is unfortunate because the DLs then drive the statistical analysis.

Response: *The use of RDLs as opposed to PQLs has resulted in substantial revisions to this section, and the summary statistics data tables. As is currently presented in the revised report, the detections are higher than the RDLs. As discussed in Section 3.4 of the revised report, for most of the elements with low FODs, differences in the RDLs are not perceived as causing differences in FODs between the sample sets.*

NDEP is correct that for datasets comprised principally of non-detected values, DLs will "drive" statistical analyses. However, tests proposed for comparing site to background concentrations (e.g., WRS, Quantile) can accommodate datasets with relatively low FODs (as low as 50% FOD) and multiple DLs. Further, if DLs meet DQOs, these left-censored data have value and can/should be utilized (using non-statistical methods) to support decision-making.

c. At this time, NDEP recommends that the statistical analysis for these chemicals be qualified appropriately, with reference to the problems caused by the issues raised above. The statistical analysis results are sufficiently affected by the NDs and DLs that they cannot be used reliably to compare the 2005 and 2008 data for some metals. The same will apply to use of these data for background comparisons with site data.

Response: *See responses above – in the analyses summarized in the revised text, few elements were identified for which detection limit issues affected the data sets to an extent that the two data sets could not be compared. That said, in cases with low FOD (i.e., less than 50%), statistical comparisons were not performed.*

10. Page 3-14, first paragraph, it's not clear what the point of this paragraph is in this section. More relevant and important observations would reflect the ND and DL problems raised in the previous comment.

Response: *The subject text has been revised to reflect the non-detect detection limit issues.*

11. Page 3-14, Footnote 7, similar to a previous comment, is the "0-10 ft bgs combined" depth class referring to "all data points" or only 0 ft and 10 ft samples alone? Please clarify.

Response: *The footnote was intended to refer to the soil depth from 0 to 10 feet below ground surface (ft bgs); the footnote has been reworded for clarification in the revised document.*

12. Page 3-14, Footnote 8, please change "…recommend - …" to "… recommended - …"

Response: *The footnote has been revised as noted in NDEP's comment.*

13. Page 3-15, references in Section 3.5.2, the references to Singh and Singh and to DON seem inappropriate. There is a long history of non-parametric statistics, with far better references than these two documents, especially since the purpose of these two documents is not

focused on non-parametric statistical analysis. NDEP suggests that BRC delete the references.

Response: *BRC agrees that these two documents do not represent seminal work with regard to nonparametric statistics. Rather, these two documents were cited because the definition provided in BRC's document was derived in large part from these two technical guidance documents. Nonetheless, the references noted in NDEP's comment have been deleted from the revised document.*

14. Page 3-17, footnote 12, we have provided these tests in R previously, however, we recognize that they have not been updated for new versions of R. These tests could be included in GiSdT or EnviroGiSdT if the need is identified. Please advise the NDEP on this matter.

Response: *At this point, as most of the future statistical comparison test that will need to be performed are likely to be site versus background datasets, we do not feel that these tests need to be included.*

15. Page 3-17, items 1 and 2, whereas NDEP recommended this approach, the approach was intended to be qualified. The tests of proportions are only appropriate if the DLs are about the same in the compared datasets. Also, the removal of NDs to complete the tests should be considered in light of the actual data. This seems like a reasonable approach if the NDs are interfering with the statistical analysis in unreasonable ways. This is most likely to occur when the NDs are greater than the detects. So, although these approaches are reasonable options, the conditions need to be appropriate and justified before employing them.

Response: *The text has been revised to clarify that for constituents with comparable DLs, the Test of Proportions was used to determine if FODs were comparable. When FODs were found to be comparable, then analyses on detected-only values were conducted. BRC found it reasonable and proceeded to apply NDEP's recommended approach to constituents listed in Sections 3.5.3 and 3.5.4.*

16. Page 3-18, 1st sentence, this sentence needs to be reworded (use of similarity and inferred twice each makes the sentence awkward).

Response: *The subject text has been reworded in the revised text for clarification.*

17. Page 3-19, 2nd paragraph, please change "…differences…" to "…difference…"

Response: *The subject text in the document has been revised as noted in the comment.*

18. Page 3-20, paragraph prior to table, also see comment above on pg. 3-17. Tests of proportions are appropriate only when the detection limits are similar. This should be made clear. Proportions tests can then be used to determine if the frequency of detection is similar

or different, and this is then a line of evidence that can be used for differences between datasets. Otherwise, tests of proportions just reflect differences in detection limits, and that is not useful. It is not a matter that the frequency of detection needs to be similar to justify removing some non-detects and repeating the statistical analysis. It is a matter of whether the NDs provide any useful information. If the only NDs in the datasets have much greater values than the detects, then it might be reasonable to look at statistical comparisons without those data points. This will depend to some extent on why the detection limits are so high. Also, note that it is not the case that NDEP will generally recommend this approach. This should be an approach of last resort to try to glean something from problematic data.

Response: *The text has been revised to clarify that the tests of proportions are best performed when detection limits are similar, for the reason noted in the above comment.*

19. Page 3-21, Table, there are two footnotes under the table (top of page) that are similar. Please delete one of these.

Response: *The redundant footnote has been deleted.*

20. Page 3-21, Footnote 17, please change "… sample sixe..." to "… sample size…"

Response: *The subject text in the document has been revised as noted in the comment.*

21. Page 3-21, 3rd paragraph, the conclusion that the 2005 "Mixed" dataset was frequently indistinguishable from either one or both of the other two lithological units is a bit misleading. Roughly ¼ of the analytes are shown to be significantly different for the non-parametric tests in Table E-3. Furthermore, the results seem to point toward the idea that the parent material is in fact different (i.e., many of the significant differences were evident between the 2005 "Mixed" and 2008 "River" data for common parent minerals such as Si, Al, Mg, K, etc.).

Response: *The subject text has been revised for clarification. That is, for all elements except uranium-238, the 2005 Mixed dataset (1) was statistically indistinguishable from both the 2005 McCullough and the 2008 River datasets (e.g., arsenic, lead); (2) was statistically indistinguishable from the 2005 McCullough dataset but had inferred significant differences from the 2008 River dataset (e.g., magnesium, manganese; or (3) was statistically indistinguishable from the 2008 River dataset but had inferred significant differences from the 2005 McCullough dataset (e.g., barium, tin). This observation is consistent with the interpretation of the 2005 Mixed dataset being derived from soils that reflect a mixture of McCullough and River sediments. However, as noted in NDEP's comment, the 2005 Mixed dataset does have significant differences inferred relative to the 2008 River dataset for several common parent elements (e.g., silicon, aluminum, magnesium, potassium), which suggests a closer affinity between the Mixed and McCullough sediments. The subject text has been expanded to include this interpretation.*

22. Page 3-23, 2nd last paragraph, the term "post hoc" should be removed. All the comparisons performed in this document are post hoc comparisons. There is no need to use the terminology, especially when it is not used everywhere – partial use like this could lead the reader to think there is something different about these particular analyses.

Response: *The document has been revised to note that in support of ANOVAs and Kruskal-Wallis tests, post-hoc (= a posteriori) comparisons were conducted. The term* "post hoc" *has been removed from the remainder of the document.*

23. Page 3-24, Last paragraph, 2nd sentence, please change "…not to pooled…" to "…not to pool…"

Response: *The subject text in the document has been revised as noted in the comment.*

24. Page 3-27, 1st paragraph under bullets, 1st sentence, please change "…were be examined…" to "…were examined…"

Response: *The subject text in the document has been revised as noted in the comment.*

25. Page 3-28, last paragraph, although correlations might be expected between co-deposited contaminants, this is not quite the driver for these correlation analyses. The relationships in background should be different than those in contaminated sediment.

Response: *Agreed. No changes have been made to the document in response to this comment.*

26. Page 3-28, last sentence, is the 9-11 ft bgs class referring to 10 ft bgs? If so, this should probably be stated to keep things uniform throughout the text.

Response: *The text in Section 2.2 has been revised to clarify that the soil samples collected from 9 to 11 ft bgs are referred to as "10 ft bgs" samples throughout the report, and references to the "9 to 11 ft bgs" interval have been replaced with "10 ft bgs." The report similarly refers to samples from the 4 to 6 ft bgs interval as being "5 ft bgs" samples.*

27. Page 4-1, 2nd paragraph, at this time NDEP does not concur with the statements that all the data are usable. There appear to be detection limit issues that need to be resolved. See comments above.

Response: *As discussed in responses to prior comments, after changing to the use of RDLs instead of PQLs, detection limits are not generally issues for most of the elements, in terms of RDL differences potentially causing appreciable differences in element FODs between the datasets.*

28. Appendix E, certain grey cells are darker than others. Is there a particular reason why? Table E-3 has commas instead of decimal points in the p-value column. What does the blue text indicate in Tables E-4 and E-5?

Response: *The Appendix E tables have been revised to depict 1) similarly shaded grey cells; 2) decimal places in the p-value column; and 3) definition of the blue text.*

Response to NDEP Comments Received September 23, 2008 on the Supplemental Shallow Soil Background Report dated August 2008

General Comments:

1. Relative to the previous version of this report, the document contains more interpretation of the data, but should still be expanded per some of the following general comments.

Response: *Revision 2 of the report has been expanded to include additional interpretation of the data in accordance with NDEP comments, including among other things comparisons of frequency of detections, potential effects of variable reporting limits, and comparison of constituent concentrations in various datasets.*

2. The document makes a case for using the 2005 BRC/TIMET and 2008 Supplemental background datasets separately, however, insufficient interpretation is given in the text about the statistical differences suggested in the results tables. Please note that based upon a review of the data, the NDEP concurs that the data sets should be separated.

Response: *As noted above, revision 2 of the report has been expanded to include additional interpretation regarding the inferred statistical differences between the datasets.*

3. The point of this study was to determine if these background data are different than the 2005 background data. It was expected that the data sets would be different for arsenic, with the 2008 arsenic data being greater than the 2005 data. This appears to be demonstrated for arsenic, however, some conclusions that make this very clear would be helpful.

Response: *As noted above, revision 2 of the report has been expanded to include additional interpretation and conclusions regarding the inferred statistical differences between the datasets.*

4. There are also significant differences for other metals that should be noted in the conclusions prior to suggesting that the data sets be separated.

Response: *As noted above, revision 2 of the report has been expanded to include additional interpretation and conclusions regarding the inferred statistical differences between the datasets. Because a number of elements are inferred to have statistically significant differences, that discussion is provided in the body of the report (Section 3.5).*

5. On the issue of separating the 2005 and 2008 datasets, the point should be made clear in the conclusions (it is currently in the Introduction) that the purpose is to see if sub-sets of the background data are statistically different such that they should be used separately for background comparisons at different sites within the BMI Complex and Common Areas. For example, the 2008 data set should be used at the BMI Common Areas Mohawk Sub-Area and Parcel 4B, but is probably not appropriate at other sites. This should be a conclusion. There is very little substance to the current conclusions.

Response: *The Conclusions section (Section 4) has been expanded to discuss the applicability of the background datasets for the various portions of the Site.*

6. The comparison between the 2005 and 2008 data would benefit from breaking out the 2005 data into River and McCullough Range data. The 2005 data report suggests difference between River and McCullough for many metals and radionuclides, in which case comparison between all three groups would have been somewhat more useful. This would have provided a more useful geologic comparison across all geologies of current interest.

Response: *The statistical analyses performed in Revision 2 of this report evaluated separate datasets for the 2005 McCullough, River and Mixed datasets, as compared to the 2008 River dataset. Specifically, the following statistical analyses were performed (based on data availability):*

- 2008 supplemental: 0 vs 5 vs 10 depths; multiple population tests (ANOVA, Kruskal-Wallis; included in the last revision)

- 2008 vs 2005 (all depths combined): 2008 River vs 2005 McCullough vs 2005 Mixed vs 2005 River; multiple population tests (ANOVA, Kruskal-Wallis)

- 2008 vs 2005 (5&10 depths combined): 2008 River vs 2005 McCullough vs 2005 Mixed vs 2005 River; multiple population tests (ANOVA, Kruskal-Wallis)

2008 vs 2005 (0 and 5 and 10 ft depths separately): there isn't enough 2005 River and 2005 Mixed for each specific depth; therefore, depth-specific comparisons were only conducted for 2008 River vs 2005 McCullough; therefore, these were two-sample tests (t-test, WRS, slippage; quantile).

Depending on the results, several Test of Proportions were run, and based on these additional two-sample tests were conducted for specific constituents/lithologies.

7. Several metals suffer from confounding detection limits (DLs). That is, not only are the metals not detected in both the 2005 and 2008 datasets (or detected very infrequently), but the DLs are different. Performing statistical analyses in these cases does not seem reasonable. Note that correlation analyses were not performed for these chemicals, and these analyses should not be performed to statistically compare the 2005 and 2008 data either. Comparisons between the 2005 and 2008 data should instead focus on what these differences are, and why they have happened. Conclusions cannot be drawn for these chemicals, although this does not stop the overall conclusion that the two datasets are different for many chemicals, in which case they represent different geologies.

Response: *The influence of reporting limits was evaluated as part of the revised study, and is discussed in Section 3.4. As noted in the report, it appears that variable reporting limits have affected the frequency of detection in a few cases.*

8. It is not clear that the radionuclides in the uranium chain show differences between the two background data sets. U-233/4 is the only one that shows minor differences, the others do not show differences. It might be more reasonable to question the U-233/4 data and ask why there are a few greater concentrations (activities) for this radionuclide.

Response: *As presented in Revision 2 of this report, statistical comparisons performed for radionuclides for the various geologic units indicate that significant differences can be inferred for most of the isomers evaluated.*

9. There are some problems with the statistical comparison tests (t-tests, quantile, slippage, and Wilcoxon Rank Sum) as conducted. The tests that have been used are 1-sided because they were programmed to support background comparisons. Background comparisons compare site and background data, and, site data cannot be less than background (excepting case of inadequately characterized background data). Consequently these tests are constructed as 1-sided tests. The case at hand is different, and constitutes a comparison of two background datasets. There is no reason to believe that one is greater than the other for a given chemical, and no reason to believe that one cannot be less than the other. Consequently, these tests should be run as 2-sided tests. This is possible for all the tests, although EnviroGiSdT is not programmed to do this for these tests. We note also that 1-sided tests have been performed, but that the direction of the test has been chosen based, presumably, on looking at the exploratory data analysis (EDA) and then deciding which way to run the test. Hence, the direction differs by chemical. Neptune and Company, Inc. has redone each statistical test, except the slippage test, and is including those results as an attachment to this document as Attachment B. These tests can be added to the GiSdT and EnviroGiSdT software if desired.

Response: *As presented in Revision 2 of this report, 2-sample tests performed for the various geologic units employed 2-sided tests (via the Neptune GiSdT website), except for the slippage test.*

10. There is a lot of statistical language in this report that needs to be changed. For example:

- The discussion of power is unnecessary since no power analysis is performed.
- Some discussion of data points that bring into question whether all the data represent background conditions is acceptable, but that should also be handled through the correlation analysis and possibly some other analyses (see specific comments below).
- The discussion of “accepting alternative hypotheses” should be changed, since most statisticians would say that alternative hypotheses cannot be accepted.
- Parametric tests do not always assume normality as stated, although this is the case for *t*-tests and analysis of variance (ANOVA).
- Non-parametric tests usually have some assumptions (e.g., symmetry) associated with them – they are not without statistical assumptions.

- The slippage test should be described differently. It is about determining if the number of data points in one data set that exceed the maximum of the other data set is statistically unusual.

In summary, it would be better to have less statistical jargon to explain what is being done given the limitations of the statistical jargon provided.

Response: *The text in revision 2 to the report has been revised to reflect a more precise use of statistical verbiage and to exclude discussion of issues that do not pertain.*

11. The correlation analyses should be used to determine if some of the results of concern (the comparatively high concentrations results) are consistent with background. That is, find some correlations that are significant, and then look at the scatter plots to determine if these data points are consistent with the relationship between those two chemicals. Repeat as necessary for correlated chemical pairs. This would support the conclusion that all the data are representative of background conditions.

Response: *Section 3.5.6 provides the correlation analyses and scatterplots that were used to evaluate outlier consistency with background.*

Specific Comments:
12. Page iv, acronym list, “MDC” should be changed to “MDA”.

Response: *The acronym has been revised as noted.*

13. Page 1-1, Section 1.1, 3rd paragraph, the reference to a discussion in Section 3.1.5 is not correct. Section 3.1.5 does not exist in this report.

Response: *The reference has been revised to reflect the correct section (3.1.4).*

14. Page 2-1, Section 2.1, 2nd bullet, if wind roses are to be referred to in this way, then a reference and figure should be provided. Also, our understanding is that although there are predominant winds, the wind direction changes and some wind-blown deposition is possible here. Consequently, use of the term “unlikely” appears to be an overstatement.

Response: *Figure 2 has been revised to include a windrose showing the predominant wind direction. The text has been revised to reference that figure, and the wording has been revised on page 2-1 to address NDEP’s comment.*

15. Page 2-8, Section 2.4, 1st paragraph, 4th sentence, please include a reference to “…several laboratory QA/QC procedures.” This comment was included in the previous review and was not addressed.

Response: *The text has been revised on pages 2-8 and 2-9 to include the various applicable laboratory QA/QC procedures.*

16. Page 3-3, Section 3.1.3, 1st sentence, the reference to DOE guidance is presumed to be referring to year 1990. In addition, the DOE reference that points to an electronic version of the guidance documentation is not active. Please resolve this reference.

Response: *The text on page 3-3 and references section have been revised to reflect a more current applicable reference.*

17. Page 3-4, Section 3.1.4, this exposition of outliers should be used to help determine if the few high values of concern are representative of background conditions. The term outlier as used should be defined, which in this case is these are data points that are outside of the 1.5 times the inter-quartile range. We also note that the statistical outliers are not problematic unless there is some physical reason (contamination, geology, reporting errors, etc.). Otherwise "outliers" should not be removed from statistical analysis for any reason. Rather than saying the outliers have no apparent cause, it would be better to point to the sample design that is focused on suspected unimpacted areas, and then specifically evaluate the high concentrations in the correlation analysis as a further line of evidence to support lack of contaminant impact. This is the real issue here is to determine if the (few) high concentrations are still representative of background conditions. The correlation analysis identifies correlated chemicals. Scatter plots can then be used to determine if there are unusual values in the data that warrant concern about the background representativeness of the data. If the data, including the high observations fall close to the regression line, then the high values probably represent background conditions. This issue was specifically discussed with BRC after the last NDEP comment letter was issued.

Response: *The text has been revised in various locations to reflect outlier evaluation, including the use of correlation analyses and scatterplots. No outliers were considered unlikely to reflect background, and no data points were removed from the dataset.*

18. Page 3-4, Section 3.1.4, 2nd paragraph, last sentence, the example that points to two elevated arsenic concentrations needs to be more specific. Please identify the sample locations where these elevated concentrations were observed. This comment has been included in a previous review of this report, but has not been addressed. Also see general comment about the use of the correlation analysis.

Response: *This portion of the text has been reworked substantially; all observed outliers associated with each element are identified (with the associated sample location specified).*

19. Page 3-4, Section 3.1.4, last sentence, if the "outliers" shown on the box plots have no apparent cause, why is an example of a cause (reporting errors) given? Also see general comment about the presentation regarding outliers.

Response: *The wording that is the subject of this comment has been revised in response to this comment.*

20. Page 3-6, Section 3.3, 1st paragraph, Tables 4 through 8 provide the same information as Appendix E, just presented in a different format. It is suggested that one set of tables be eliminated.

Response: *The tables in question have been merged and are presented as Tables 4 through 26 in the main text.*

21. Page 3-7, Section 3.3, 1st paragraph, 3rd sentence, the reference to "… if aerial deposition of wind-borne dusts from Site operations were suspected, then higher levels of metals typically found in soils at the Site; for example, arsenic…" is quite confusing as it was expected that arsenic concentrations would be naturally higher for these background sample locations

Response: *Although arsenic was expected to be higher for these background sample locations, the issue is whether the two samples with the highest arsenic concentrations are representative of background. The point was to establish that it is unlikely that these arsenic levels are from the site. The sentence has been reworded to read "…for example, arsenic and vanadium would be expected* at the surface *in these samples."*

22. Page 3-7, Section 3.3, 1st paragraph, last sentence, please list other examples. Some discussion of the chemicals that are affected by the non-detect status would be helpful – see general comments.

Response: *Section 3.4 has been added to the main text to present and discuss issues relative to elements with inconsistent frequencies of detection (FODs) observed between the sampling events, including evaluation of whether reporting limits affected the observed FODs. Elements with low FODs are discussed in Section 2.2 (expanded text new to this revision).*

23. Page 3-7, Section 3.4, 1st sentence, please change "…data from different settings…" to "…data from different geological settings…".

Response: *The subject wording (now in section 3.5) has been revised as indicated in NDEP's comment.*

24. Page 3-7, Section 3.4, 2nd sentence, please reference Section 3.4.2 for the "statistical tests" and change the reference to the statistical plots from Section 3.3 to Section 3.2.

Response: *The references in question have been revised as indicated in NDEP's comment.*

25. Page 3-7, Section 3.4, last sentence, it is not clear what is meant by this sentence. It can probably be deleted. Perhaps its intent was a contrast with analysis performed on the 2005 data, which covered at least two geologies. Please clarify.

Response: *The subject wording (now in section 3.5) has been deleted as suggested in NDEP's comment.*

26. Page 3-7, Section 3.4.1, 1st paragraph, most statisticians would say that alternative hypotheses cannot be accepted. The technical reasons for this are varied. This is one of the vagaries of classical statistics. Null hypotheses can be rejected, but that's about as far as the statistics can go. Some rewording should be provided. For example, rejection of the null hypotheses provides evidence that the populations are not the same.

Response: *The subject wording (now in section 3.5.1) has been revised consistent with this comment.*

27. Page 3-8, Section 3.4.1, this discussion of Type II error rates and power is unnecessary. Type II error and power have not been used in the statistical analysis at all. DQOs were not established, so there is no real target for Type I or Type II errors. A *post hoc* target of 0.025 for the tests for Type I error might be reasonable, but a *post hoc* analysis of power has not been attempted and probably will not be. Consequently, the conventional value of 80 percent for power has no basis. These paragraphs should be removed, unless a formal data quality assessment is to be performed.

Response: *The discussion of Type II error rates and power has been removed from this version of the report, as suggested in NDEP's comment (see Section 3.5.1).*

28. Page 3-8, Section 3.4.1, note also that NDEP does not rigidly interpret the p-values reported for the statistical tests. Per previous comments on other documents, if the p-value is very small (e.g., << 0.05) then an effect is indicated. It is large (e.g., >> 0.025) then an effect is not indicated. If it is somewhere in between (e.g., near 0.025) then there are probably not enough data to support a rigid conclusion (although DQOs are not performed so this statement is difficult to support on a project-specific basis). This is why NDEP prefers that BRC considers multiple lines of evidence before reaching a conclusion (e.g., summary statistics, plots, detection limit effects, correlations, and the statistical tests).

Response: *A weight of evidence approach that considers summary statistics, plots of the data, detection limit effects, statistical comparisons, and correlations has been taken to reach conclusions with regard to whether the 2008 supplemental background data should/should not be combined with the 2005 background data to support future applications. Discussion of p-values is provided make clear how statistical tests will be interpreted as a particular line of evidence.*

29. Page 3-8, Section 3.4.2, parametric tests do not all assume normality, although they often do. The *t*-test does assume normality, although of the mean rather than the data really. The definitions and assumption here should be revised.

Response: *The subject wording (now in section 3.5.2) has been revised to describe one key attribute of nonparametric tests—i.e., they do not require specific mathematical form for the underlying distribution of the data (Singh and Singh 2007).*

30. Page 3-8, Section 3.4.2, non-parametric tests do make assumptions. Often an assumption of symmetry is used, although it is usually ignored in application. For example, the Wilcoxon Rank Sum test assumes symmetry. The definitions and assumption here should be revised.

Response: *The subject wording (now in section 3.5.2) has been revised to remove the implication that nonparametric tests make no assumptions regarding the distribution of the data.*

31. Page 3-9, Section 3.4.2, these tests should be run 2-sided for this problem.

Response: *As previously noted in response to general comment #9, the 2-sample tests were re-run using 2-sided tests for the statistical evaluations presented in this version of the report.*

32. Page 3-9, Section 3.4.2, Wilcoxon Rank Sum test, it should probably be noted that the Gehan ranking system is relevant for non-detects, and that it is also applied to the quantile test, and should be applied to the Kruskal-Wallis test.

Response: *The Gehan ranking system is supported by GiSdT for two-sample tests. However, GiSdT currently does not support multiple independent sample tests. For the nonparametric Kruskal-Wallis test, the one-half detection limit substitution method was applied to non-detected metal concentrations because SPSS v.15 (the statistical software used to conduct Kruskal-Wallis tests) does not currently support the Gehan ranking system.*

33. Page 3-9, 2nd sentence, this is a global comment. The acronym "GISdt" is incorrect. The acronym should be "GiSdT"

Response: *References to the* "GiSdT" *acronym in the report have been revised as noted in NDEP's comment.*

34. Page 3-11, Section 3.4.3, this section needs to be expanded. Also, the statistical test results could not be reproduced. This concern was raised in a previous review and still remains an issue. The p-values contained in Appendix F seem to be calculated based on 1-sided tests, when in fact all tests should be performed as two-sided tests. In addition the direction of the test seems to be chosen in a *post hoc* fashion (based on the plots or the summary statistics, perhaps). The results in the table below present examples of the different test results that we

have observed (yellow – highlights similar results). Two-sided, two sample t-test results are also included for comparison (gray).

5' shallow soil samples assuming the conditions:
Alpha = 0.025

Analyte	Neptune & Co. Calculations (one-sided) $\mu_1 - \mu_2 > 0$	Neptune & Co. Calculations (two-sided) $\mu_1 - \mu_2 \neq 0$	2008 Supplemental report (version 0)	2008 Supplemental report (revision 1)
Beryllium (Be)	2.2 E-4	4.39 E-4	1.0 E+0	2.2 E-4
Cobalt (Co)	3.4 E-10	6.75 E-10	1.0 E+0	3.4 E-10
Lead (Pb)	9.99 E-1	3.93 E-4	2.0 E-4	2.0 E-4
Arsenic (As)	9.98 E-1	4.27 E-3	2.1 E-3	2.1 E-3
Niobium (Ni)	4.51 E-40	9.02 E-40	1.0 E+0	4.5 E-40

The results for Be, Co, and Ni are in agreement for the 1-sided test. However, those for Pb and As are not, because the test was run the other way round. The test should instead be run as 2-sided tests, with the results given in gray in the table above. In a few cases this will change the conclusions that have been drawn for some metals, but it will not change the overall conclusion that the 2005 and 2008 data sets represent different geologies.

Response: *In response to a previous NDEP comment, and as discussed during a September 26 teleconference, the statistical evaluations were re-run for this resubmittal to include separate datasets for each geologic unit (McCullough, River [2005 and 2008 datasets], and Mixed), and employed 2-sided 2-sample tests in cases where two populations were compared. Because of the increased number of populations, many of the prior 2-sample analyses were re-run as multiple-sample tests.*

35. Page 3-11, Section 3.4.3, the statistical results presented in the tables in Appendix F differ from the results presented in Revision 0 of this report for the analytes in the 5', 10', and 5' & 10' (combined) soil layers for metals. We find this to be odd given that the sample sizes and summary statistics for metals at these depths are consistent with those presented in the previous version of this report. However, the statistical results presented in Appendix F seem to be recalculated. See previous NDEP comments or BRC table for examples. This issue needs to be addressed with the NDEP.

Response: *BRC has identified no explanation for the changes in statistical results. However, the issue is moot for this resubmittal, due to the revised statistical analyses performed.*

36. Page 3-12, Section 3.4.3, 2nd paragraph, the sentence fragment "…enough differences exist such that there is an apparent difference…" needs to be reworded.

Response: *The subject wording (now section 3.5.3) has been revised in response to NDEP's comment.*

37. Page 3-12, Section 3.4.3, 2nd paragraph, last sentence, the reference to "most cases" needs to be expanded perhaps in the form of an analyte-specific list or table.

Response: *This phrase has been removed and a recommendation not to pool/combine the 2008 supplemental background data and the 2005 background data is put forth based on the preponderance of evidence.*

38. Page 3-12, Section 3.4.3, 2nd paragraph, whereas the conclusion to separate datasets might be reasonable, the conclusion that should be drawn here and in Chapter 4 is that the data suggest geologic differences between the background locations.

Response: *The subject wording (now in section 3.5.3) has been revised in response to NDEP's comment.*

39. Page 3-12, Section 3.4.4, 2nd paragraph, please also discuss strontium and uranium. This comment also acts as a general comment with respect to interpreting p-values in the tables throughout the report. It is apparent that rounding of p-values has occurred in specific cases (such as strontium and uranium) which makes them appear to be statistically significant. In future reports, we recommend that p-values be reported to four significant figures.

Response: *To avoid improper interpretation (e.g., 0.054 or 0.045 as 0.05), p-values are reported to significant figures needed to properly interpret statistical test findings.*

40. Page 3-13, Section 3.4.5, this section needs to be expanded. There is very little information in this section with respect to differences and similarities between the two background datasets. Of particular interest are the "outliers" that have been identified. The correlation analysis can be used to explore these outliers to determine if they appear consistent with other background data, or if they seem unusual to the point that contamination could be the problem.

Response: *In the resubmittal, the section discussing the statistical comparison of the various background sets (Section 3.5) has been expanded significantly to make note of the inferred similarities and differences, including outlier evaluation using correlation analysis.*

41. Page 3-13, Section 3.4.5, last sentence, is the p-level supposed to be set at 0.05? Please clarify.

Response: *The sentence has been revised to indicate that statistically significant (at a significance level of 0.05) correlation coefficients are indicated in bold type in the table.*

42. Page 3-13, Section 3.4.5, 2nd paragraph, 2nd sentence, please reference the specific tables in Appendix G.

Response: *References to the specific tables in Appendix F have been added to the text.*

43. Page 3-13, Section 3.4.5, 2nd paragraph, 3rd sentence, the correlation coefficients appear to be located in Appendix F.

Response: *The reference in the revised text has been changed to reflect the correct Appendix (now Appendix F).*

44. Page 3-13, Section 3.4.5, 3rd paragraph, the heading "Correlation Analyses" is used twice in this section. Is it supposed to be entitled "Scatter Plots"?

Response: *NDEP's presumption is correct - The second heading entitled "Correlation Analyses" has been changed to "Scatterplots."*

45. Page 3-13, Section 3.4.5, reference to Appendix G, please include some form of heading on the scatter plots in Appendix G and provide appropriate references in the text.

Response: *Headings have been added to each of the sets of scatterplots in Appendix F.*

46. Page 3-14, Section 3.4.5, 4th paragraph, 1st sentence, please change "…) as well radium-226…" to "…) as well as radium-226…"

Response: *The subject wording (now in Section 3.5.6) has been changed as noted in NDEP's comment.*

47. Page 3-14, Section 3.4.5, 4th paragraph, 5th sentence, please change "20008" to "2008".

Response: *The date (now in Section 3.5.6) has been changed as noted in NDEP's comment.*

48. Page 4-1, Section 4.0, the conclusions are basically copied and pasted text from previous sections of this report and not really conclusions. It would be helpful if this section could focus on removing the points repeated in the report and expanding on what the overall findings mean in the context of future background comparisons.

Response: *The conclusions section of the revised report has been expanded to include additional discussion regarding the meaning of the overall findings in the context of future background comparisons with Site data.*

49. Page 4-1, Section 4.0, fourth paragraph, a further analysis of the correlations would indicate if all the data (including the high concentrations) represent background conditions.

Response: *As previously noted, correlation analyses were performed for this purpose, and the findings of those analyses are presented in the revised report. The conclusions section has been expanded to include a summary of findings in this regard.*

50. Page 4-1, Section 4.0, fourth paragraph, data for the SVOCs have not been presented. If this conclusion is to be drawn then the data need to be reported.

Response: *The SVOC data are presented in Table 3 of the report, and a reference to the SVOC results has been added to Section 2.4.*

51. Page 4-1, Section 4.0, last paragraph, 2nd sentence, aren't the two datasets supposed to be inconsistent and therefore not combined? See general comments related to the issue of background data set "consistency". The datasets should be housed together as the background data with some recognition that it might be more appropriate to perform background comparisons against relevant subsets of the entire background dataset because they represent different geological formations. This should be the primary conclusion it seems, perhaps coupled with some observations about north-eastern portions of the site should be compared to the 2008 background data, western portions to the McCullough component of the 2005 data, south-eastern to the River component of the 2005 data, and middle areas to some combination. A final conclusion like that would have more utility for future use of this report.

Response: *The subject wording has been revised for clarity, and the conclusions section has been expanded to include a discussion similar to what is provided in NDEP's comment.*

52. Appendix D, plots that are cause for concern in the sense that it is not clear what utility there is in performing statistical tests based on the information available. Instead, some review of why the DLs are so different for the non-detects (NDs) in the two sets of data is warranted. Suggesting that these chemicals are different in concentration between the two datasets is probably not reasonable because of the confounding of the DLs. Performing statistical tests based on substitution of ½ DL does not make sense for these chemicals; the data simply do not support statistical analysis in this way.
    a. Antimony –the high DLs for some samples are problematic for the statistical tests that have been run.
    b. Boron – questionable because of the high DLs in the 2008 data.
    c. Cadmium – DL issues in the 2005 data
    d. Chromium VI – please explain the purpose of the statistical tests
    e. Lithium.
    f. Mercury – all NDs in the 2008 data, yet there are many lower detections in the 2005 data. Please explain.
    g. Niobium.

h. Platinum.
i. Selenium – another problematic one because the 2008 DLs are too high.
j. Silver.
k. Thallium.
l. Tungsten.
m. For some of these metals there are always analytical issues it seems. But, the analytical issues make the statistical tests useless, and they probably should not be run. Some more consideration needs to be given to the metals for which statistical testing makes sense. Issues that should be addressed include:
    i. Please explain why the DLs are so high for many of the NDs. If these are background data there should not be matrix issues.
    ii. Is it reasonable to remove some NDs and rerun the statistical tests (e.g., cadmium)? This depends on how much useful information it is believed is contained in the NDs
    iii. Is it appropriate to run a test of proportion of detects instead (would be possible perhaps if the DLs were similar and lower for most of these metals, but at least should be considered)?

Response: *The text has been expanded to discuss observed differences in the reporting limits as they pertain to differences in FOD for the datasets (Section 3.4). As discussed during the September 26 teleconference, the statistical evaluations performed in support of this resubmittal excluded datasets with fewer than 4 detections. For datasets with FODs less than 50%, the datasets were subjected to a Test of Proportions and if inferred to not have significant differences, those populations were then subjected to 2-sided 2-sample tests with non-detect values removed.*

53. Appendix G, Tables, please reword or explain what “less preferred analyses” are referring to in the context of this report.

Response: *The reference to less preferred analyses relates to whether the data are normally distributed or not. With preference for a particular correlation result given to whether both pairs are normally distributed (preference given to the Pearson correlation results) or not (preference given to the Kendall tau correlation results).The following is included in Section 3.5.6, page 3-26 of the text: “Note that statistically significant correlation coefficients (at a significance level of 0.05) are indicated by bold font and are color-coded for parametric and nonparametric coefficients in each table.”*

Response to NDEP Comments Received August 1, 2008 on the Supplemental Shallow Soil Background Report dated July 2008

General Comments

1. This document contains very little interpretation of the data. It is mostly a presentation of some of the methods that were used, without much in the way of results, interpretation or intermediate conclusions. Consequently, it is left mostly to the NDEP to work throughout the figures and tables to see if the final conclusions are supported.

Response: *As discussed with NDEP on a teleconference call on August 5, 2008 it was agreed that the 2005 BRC/TIMET background dataset and the 2008 supplemental background datasets would be maintained as separate datasets. The report presents comparison statistics to support keeping the datasets separate. The report also presents statistics and information to support the use of the 2008 supplemental dataset as a background dataset. Discussion on these issues is included in Sections 3 and 4 of the report.*

2. The statistical methods used are not always appropriate. 2-sample tests have been used when analysis of variance should be used with multiple comparisons. 2-sample tests are not appropriate when there are more than 2 populations of interest. The statistical hypotheses that are being tested have not been presented. Since the statistical hypotheses are not described it is difficult to know exactly what analyses have been run. Furthermore, It is unclear why the approach taken in the NDEP-approved BRC/TIMET background report was not also followed here. Appropriate statistical tests and conclusions were drawn in that report.

Response: *The statistics that were used compared the 2008 supplemental dataset to the 2005 BRC/TIMET dataset, therefore 2-sample tests were considered appropriate and used in the report. Because the datasets are considered separate, multiple comparisons between datasets were not conducted. However, the revised report also performs multiple comparisons regarding the depth data for the 2008 supplemental dataset only. Because this dataset was collected from one geologic unit (the River Mountains range), multiple comparisons were not conducted on this basis. The depth-specific multiple comparisons are discussed in Section 3.4 of the report.*

3. Of particular interest is the purpose of collecting these supplemental background data, this is not adequately addressed by the document. It is noted that this supplemental study was undertaken because background comparisons for arsenic failed at both Mohawk and Parcel 4B. However, there is no history of arsenic contamination at these sites, in which case some consideration was given to the possibility that the north-eastern part of the site exhibited different background levels of arsenic and, potentially, other metals. The north-eastern part of the site is close to the northern part of the River Mountains range. A mile or two to the east of the Mohawk area, in the vicinity of the Henderson Landfill, and still in the River Mountains range, very high concentrations of arsenic have been observed in background samples. Consequently, the purpose of collecting these supplemental samples was so that a specific subset of background conditions could be used for comparison with metals

concentrations at Mohawk and Parcel 4B. This should be made clear in the revised document.

Response: *As discussed on an August 5 teleconference and in a meeting on August 22, BRC agrees with keeping the two background datasets separate and applying each individually as appropriate. The most appropriate use of the 2008 supplemental background dataset is for the Mohawk and Parcel 4B sub-areas. Section 1.1 has been revised to discuss this issue.*

4. Prior to collection, a few hypotheses were reasonable. Either these supplemental background data represented a different background population, or they did not. The hope, in some sense, was that they would be different, and, in particular, greater concentrations for arsenic so that this specific subset of data could be used for background comparisons for Mohawk and Parcel 4B. However, even though BRC concluded that arsenic concentrations are different in the supplemental background data, BRC has concluded that it is appropriate to combine all the background data. This does not seem like a prudent path forward. It is suggested that BRC discuss this matter with the NDEP prior to resubmittal.

Response: *Discussions on this issue took place on August 5 and August 22, 2008. See response to general comment #3 above.*

5. The NDEP-approved BRC/TIMET background report presents statistical analyses by various factors, including geology and depth. It is reasonable to conclude from those analyses that background comparisons should, in general, be performed using the appropriate subset of the background data, where appropriateness is defined in terms of geology and depth of the site samples that need to undergo background comparisons. The same applies here. It is not clear why this has not been done. What has been done instead does not meet the NDEP's expectations. Our expectation was a report that covered the same ground that was covered in the BRC/TIMET background report.

Response: *As noted in response to general comment #2 above, multiple comparisons regarding the depth data for the 2008 supplemental dataset have been conducted. Because this dataset was collected from one geologic unit (the River Mountains range), multiple comparisons were not conducted on this basis. These comparisons are discussed and presented in Section 3.4.*

6. The context that has been provided is not fully accurate. The ENVIRON data covered the River Mountain range. The issue here is that the Mohawk sub-area and Parcel 4B fail background comparisons for arsenic and a potential reason is because background is inadequately characterized for the northern part of the River Range. Basically, the potential is for separation of the McCullough Mountains range, mixed geologies, River Mountains range and supplemental background data (northern River Range), because the geologies are different for all 4 groups. The northern part of the River Mountains range is close to areas of very high natural arsenic (e.g., near the Henderson Landfill), hence the potential for higher arsenic concentrations in this northern area, and for different distributions for other naturally

occurring metals. This should be explained more completely, otherwise the reason for the supplemental study is not clear enough.

Response: *See response to general comment #3 above. A discussion on local high arsenic levels in included in Section 3.1.5.*

7. The data validation and data usability sections are devoid of results, interpretation and conclusions. Clearly some data have been removed. This has to do with some aspects of data usability but has not been presented that way. Also, it is not clear exactly how many samples have been removed. It appears that there are 33 samples collected, but data are reported for 31 samples for metals and 29 samples for radionuclides. However, only one sample appears to have been rejected (after the data usability section). For most of the report the number 33 is used in error, since the number of actual data points used is less than this. Further explanation and revision is needed.

Response: *A note has been added in Section 2.2 regarding a sample labeling issue with GEL, which led to the erroneous omission of several radionuclide samples. This has been rectified. No data have been removed in the revised report. As noted in Section 2.3 (Data Validation Summary), page 2-3, "Based on the evaluation of the dataset, 100 percent of the data obtained during the field investigation are valid (that is, not rejected) and acceptable for their intended use. With 100 percent of the dataset validated as usable, the overall objective of the data collection event was met." Data usability tables were presented in Appendix B; and Section 2.4 provides results and conclusions on data usability.*

8. The discussion of outliers is also lacking. If any one of these samples is considered to be an outlier and not usable as presented, then all of the samples should be questioned considering their close proximity to each other and to relevant features, such as the BRC Site and the adjacent road. That is, it is reasonable to think that either all the samples are representative of background, or they are not. In addition, it is not reasonable at all to reject the sample results for metals based on the presence of low levels of bis(2-ethylhexyl)phthalate, which is a known laboratory contaminant.

Response: *The discussion on outliers, as defined by the boxplots presented in the report, has been expanded in Section 3.1.5. Because the outliers shown on the boxplots have no apparent cause (e.g., reporting errors), all outliers have been retained in the dataset. The discussion on outliers has also been expanded to include information on arsenic concentrations from other reports in the area, as an example that the data represent naturally occurring variability.*

9. In addition, we cannot reproduce the statistical test results. The summary statistics are based on 31 samples for metals and 29 for radionuclides, and we can reproduce those, however, we cannot reproduce the statistical test results. This issue must be reconciled.

Response: *The revised report includes all data used in the statistical tests on the report CD (Appendix B) exactly as used in the report.*

10. Goals are stated but the analysis and discussion are not presented or interpreted in a way that provides strong support for the stated goals of this report. We do not agree with the final conclusion that the background data sets can simply be combined, although we agree that the background data can be housed in the same database. Appropriate subsets of the background data should be defined prior to performing background comparisons with site data. For Mohawk and Parcel 4B this subset might be the supplemental background data set only. For other areas it might be all the background data, or a different subset (e.g., it might be reasonable to use only the McCullough Mountain data for areas on the west of the BMI facility).

Response: *See response to general comment #3 above.*

<u>Specific Comments</u>

11. Page 1-1, Section 1.1, second sentence states, "The objective of this report is to determine whether these data can be used to supplement the existing representative background soil dataset." Please note that it is never clearly stated how this objective can be obtained. Please state how certain results of the analysis tie to the stated objective.

Response: *See response to general comment #3 above.*

12. Page 1-2, Bullet 3. Please specifically identify what is being compared. It is assumed that the comparison is being made between the soils originating from the River Mountains range and those originating from the McCullough Mountains range; however this should be clarified. Clarification should be given regarding the 4 potential geologically distinct background data sets as discussed above.

Response: *Text stating that the comparison is to the northern River Mountains (this 2008 Supplemental dataset) with the southern River Mountains and McCullough Range (2005 BRC/TIMET dataset) has been added to Section 1.1, page 1-2.*

13. Page 2-1, Section 2.1, the three bullets describe why the 10 sampling locations were selected relative to the influence of the Site, but there is little information explaining why the samples are oriented (spatially) the way they appear in Figure 1. It would also be helpful to indicate something along the lines of why these locations were chosen with respect to their adequacy in representing the area's soils. That is, the constraints on sampling locations should be described – e.g., undisturbed alluvial material washed down from the northern area of the River Range.

Response: *Clarification on the location of the 10 samples has been provided in Section 2.1, page 2-1.*

14. Page 2-1, Section 2.1, second bullet, the supplemental samples are located relatively close to the site, and this fact, when taken with the predominant wind direction from the South and

Southwest, seems to at least allow for the existence of site-related contamination. A simple way to confirm or deny the suspicion of aeolian deposition would be to collect some samples near the supplemental locations and test them for asbestos. This could also explain why one of the samples did not seem to represent background conditions, and, as noted in the general comments, it might not be unreasonable to then assume that all of these samples do not represent background conditions.

Response: *As discussed on an August 5 teleconference and in a meeting on August 22, BRC and NDEP agree that the sample locations do represent background conditions. There is no indication of any impacts from the site or other potential sources.*

15. Page 2-2; Paragraph beneath bullets. Comment: We note that BRC will probably most often collect site surface samples from the top 2 feet. This could raise a comparability issue that will need to be addressed for each site risk assessment report.

Response: *BRC will discuss this issue with NDEP to ensure that comparability issues will not arise at the site.*

16. Page 2-2; Paragraph beneath bullets, some further description of the field duplicates should be provided (e.g.: which locations and which depths?).

Response: *Further description has been provided on page 2-2.*

17. Page 2-2; Section 2.3, please reference where the Level 3 and Level 4 reviews are outlined.

Response: *Reference to the Level 3 and Level 4 reviews has been provided on page 2-3.*

18. Page 2-3; first paragraph. Please explain if radionuclide validation was conducted by comparison or using methods outlined in these documents? It isn't clear what is meant by "data validation was conducted using several documents". In the last sentence of the first paragraph, what is meant by "applicable methods"? Is this in reference to the two documents listed in this sentence?

Response: *Clarification on this issue has been provided on page 2-3. Reference to the project QAPP and SOP-40 has been provided.*

19. Page 2-3; second paragraph, sentence two, please change the word "signify" to "classify".

Response: *The wording has been changed on page 2-3.*

20. Page 2-3; last paragraph, this seems to contradict the information in Section 3.2.5. Please clarify if data were or were not rejected.

Response: *The text on page 2-4 is correct; 100 percent of the data obtained during the field investigation are valid (that is, not rejected) and acceptable for their intended use. Section 3.1.5 has been revised to be consistent with this section.*

21. Section 2.3, the data validation section does not present any results or conclusions. Some of the data have been qualified for some reasons, and some have been rejected it seems (since 33 samples are not used in the statistical analysis). Some summary of the data validation reported in the DVSR should be provided. Most of what is provided here is simply approach or guidance, and not application to these samples and data.

Response: *See response to general comment #7 above.*

22. Page 3-1, it is not clear why a section on Data Usability is contained in a Chapter entitled Statistical Methods. Data Usability probably belongs more in Chapter 2 (perhaps Section 2.4).

Response: *This section has been moved to Section 2.4.*

23. Page 3-2; Bullet 6, please clarify what is meant by the bullet, "A narrative of qualified data is provided with each analytical data package, the laboratory provided a narrative of quality assurance/quality control (QA/QC) procedures and results"? This bullet needs to be reworded. Also, a summary of the results of would be helpful.

Response: *This text has been reworded (as discussed in response to comment #24 below) on page 2-5. As identified in this bullet, the narratives are included as part of the DVSR.*

24. Page 3-2; Bullet 7, related to the previous comment, it is suggested that BRC combine the QA/QC portion of bullet 6 with bullet 7.

Response: *Bullet 6 has been reworded to discuss the narratives only – narratives do not usually discuss procedures, only deviations from. Therefore, with this change in text, it is more appropriate to keep these bulleted items separate on page 2-5.*

25. Page 3-2; fourth to last sentence, please change "...all samples analyzed by the laboratory were correlated to the correct geographic location." to "...all samples analyzed by the laboratory corresponded to their respective geographic locations."

Response: *The wording has been changed on page 2-5.*

26. Page 3-2; second to last sentence, please change the sentence to "Field procedures included documentation of sample times, dates and locations, and other sample-specific information (e.g., sample depth)."

Response: *The wording has been changed on page 2-5.*

27. Page 3-3; paragraph one, please change the second sentence to "Each laboratory report describes the analytical method used, provides results and detection limits on a sample-by-sample basis, and provides the results of appropriate quality control samples (e.g., laboratory control spike samples, sample surrogates and internal standards [organic analyses only], and matrix spike samples).

Response: *The wording has been changed on page 2-6.*

28. Page 3-3; last sentence, please remove the word "performing" from the sentence.

Response: *The wording has been changed on page 2-6.*

29. Page 3-4; last sentence, please include a reference for the National Functional Guidelines.

Response: *Reference to the National Functional Guidelines has been provided on page 2-7.*

30. Page 3-4; Criterion V, a summary of some form would be helpful. It is not clear at all how some data were removed.

Response: *As noted in response to general comment #7 above, no data have been removed in the revised report.*

31. Page 3-5; first paragraph, define "RPD" as "relative percent difference" prior to using the acronym (this is a global comment which will not be repeated for each instance of acronym usage without definition). Also, is there a reference to the results associated with the data precision analysis?

Response: *The acronym has been defined on page 2-7.*

32. Page 3-6; first full paragraph (on comparability), please point to specific appendices.

Response: *Reference to Appendix B has been added on page 2-9.*

33. Page 3-6; last paragraph of Section 3.1, last sentence, this sentence is not relevant here. This is a conclusion that should follow the statistical analysis and not data usability.

Response: *The last part of this sentence on page 2-9 has been removed.*

34. Page 3-6, this section again does not adequately summarize what was found in this application of data usability. There appears to be a disconnect between this and the removal of data from the statistical analysis.

Response: *As noted in response to general comment #7 above, no data have been removed in the revised report.*

35. Page 3-6; Section 3.2.1, second-to-last sentence states: "Therefore, when statistical tests are performed it is expected that numerous spatially correlated datasets may be identified, but it is likely that the apparent correlation is randomly distributed and not indicative of non-independent sampling locations." It is not clear what is meant by the phrase "it is likely that the apparent correlation is randomly distributed". Please elaborate.

Response: *The text has been reworded on page 3-1 for clarity, consistent with language from the 2005 shallow background report.*

36. Page 3-6; Section 3.2.1, last sentence. Please change the text to read "...samples will result in narrower confidence intervals..."

Response: *The wording has been changed on page 3-1.*

37. Page 3-6; Section 3.2.1, last sentence. Change "is" to "in".

Response: *The wording has been changed on page 3-1.*

38. Page 3-6; Section 3.2.2, first sentence. Change the text to read "Results from both the 2005 BRC/TIMET (which includes the Environ dataset) and supplemental shallow soil background (this report) analytical datasets were validated."

Response: *The wording has been changed on page 3-1.*

39. Page 3-7; Sentence after bullet 10, change "versus" to "and".

Response: *The wording has been changed on page 3-2.*

40. Page 3-8; Bullet two. Detection frequency was also notably different for lithium as shown in Table 2.

Response: *Text has been added regarding this issue on page 3-3.*

41. Page 3-8; First full paragraph, first sentence. Change "The detection frequencies..." to "The detection frequency..."

Response: *The wording has been changed on page 3-3.*

42. Page 3-8; First full paragraph, 3rd sentence. The term minimum detectable concentration (MDC) is, in our experience, usually referred to as the minimum detectable activity (MDA), since radionuclide data are presented in terms of radioactivity rather than concentration.

Response: *The wording has been changed on page 3-3, and the acronym changed elsewhere in the report.*

43. Page 3-8; Section 3.2.3; 3rd full paragraph. It would be helpful if plots included different symbols for detects and non-detects.

Response: *The boxplots and individual value plots do include different symbols for detects and non-detects. Because of software limitations the probability plots do not.*

44. Page 3-8; Section 3.2.3; 4th full paragraph, 3rd sentence. It is not clear why it is always critical to note and consider detection rates. Perhaps the sentence can be reworded.

Response: *This sentence has been removed on page 3-3.*

45. Page 3-9; Section 3.2.4, sentence four. It is not clear that this section is useful. The issue of field duplicates has been discussed earlier, and the issue of splits is irrelevant to this study. If the section is retained then change the text to "Therefore, the dataset used to prepare the plots and summary statistics contains..."

Response: *This section has been removed.*

46. Page 3-9; Section 3.2.5, first paragraph, last sentence. Clarification should be provided regarding the phrase “statistical quantities”. Specifically, it is of interest to know whether this includes distribution comparison test procedures.

Response: *The sentence has been revised on page 3-4 to read: “…all statistical plots and tests were performed with the outlier.”*

47. Page 3-9; Section 3.2.5, second paragraph. It is noted that surface sample BRC-BKG-R01 was removed from the 2008 Supplemental dataset while the deeper samples at this sampling location were included in the dataset. There are several related issues:

a. This analysis should have appeared under Data Usability, since the issue is one of lack of representativeness of the sample.
b. Given the similar location of all the supplemental background samples, if one sample is rejected then, perhaps all samples should be rejected as background.
c. The reference to the presence of bis(2-ethylhexyl)phthalate is irrelevant. This has no bearing on the metals concentrations, and this chemical is perhaps the most common form of laboratory contaminant for chemical analysis. Its presence at such low level is not particularly surprising, and should not be used to justify removal of the metals data.

Response: *BRC agrees that retention of this sample is reasonable. Therefore, the dataset has been revised to reflect this. Text referring to its elimination from the dataset has been removed from the report.*

48. Page 3-9; Section 3.2.5, last paragraph. The sample with the elevated arsenic concentrations should be identified in the text.

Response: *These sample identifications have been provided on page 3-4.*

49. Page 3-10; Second paragraph. Change text to "Probability plots are also useful to visually identify outliers and to evaluate the possible presence of multiple populations within a dataset."

Response: *The wording has been changed on page 3-5.*

50. Page 3-10; Second paragraph. Inflection points are not defined statistically, and should be used with considerable caution. They are "defined" only by looking at the data, which can be inadequate and misleading.

Response: *A sentence has been added on page 3-5 addressing this concern.*

51. Page 3-10; Last paragraph, second sentence states, "The boxplots generated for this evaluation are outlier plots." The intended meaning of this statement in not clear. Please revise and clarify, or remove.

Response: *This sentence has been removed.*

52. Page 3-10; Last paragraph, seventh sentence. Remove the portion of the sentence "in the plots constructed for the BRC/TIMET data"

Response: *This portion of the sentence on page 3-5 has been removed.*

53. Page 3-11; third sentence states “The box plots group data for each chemical all together, and by depth interval are provided along with the probability and individual value plots for each chemical in Appendix C.” This sentence should be reworded.

Response: *The wording has been changed on page 3-6.*

54. Page 3-11; fourth sentence. What about the Supplemental dataset? Boxplots and probability plots were also constructed for this dataset. Why weren't these data also included in the detection of anomalous data points and or data clusters?

Response: *Reference to the supplemental dataset has been added to this sentence on page 3-6.*

55. Page 3-11; fourth paragraph states “ Although several data clusters were apparent on the probability plots, most of the data indicate the potential for a single population for almost all the metals. One exception to this is zirconium which had two distinct populations between the two datasets. This was the only obvious example. Although other inflections are noticeable, none appear to be due to differences between the two datasets, as indicated in the boxplots and individual data plots.” This point of this paragraph and the line of reasoning it uses are not clear. Is the point to argue that for most analytes, the BRC/TIMET data represent a single population? If that were the case, then the presence of several data clusters would seem to provide evidence against that. Also, there is no definitive method used to assess the presence of multiple populations for a given analyte. Finally, it is not clear how this is useful in the context of the overall stated goal of this report.

Response: *See response to general comment #3 above. This and the following two paragraphs have been removed.*

56. Page 3-11, last full sentence. The choice of the term “enrichment” seems unfortunate, since enrichment of some radionuclides is a scientific term reflecting separation of isotopes. It seems that the term is being used more generally here and it is suggested that this be reworded.

Response: *See response to specific comment #55 above.*

57. Page 3-12; Section 3.4. This would be a place to provide and results or interpretation.

Response: *Agreed. A summary has been provided in Section 3.3*

58. Page 3-12; Section 3.5, last sentence. Change text to "...from the River Mountains and the McCullough Range were not performed."

Response: *The wording has been changed on page 3-7.*

59. Page 3-12; Section 3.5. Given the description of each statistical plot used in Section 3.3, it would be appropriate to have a brief description of each statistical test that was used in the report.

Response: *Agreed. Descriptions of each of the tests have been provided on pages 3-9 and 3-10.*

60. Page 3-13; Section 3.5.1, second paragraph. This paragraph needs to be re-organized. It starts out talking about differences between the arsenic concentrations, and then moves on to differences regarding characteristics of the BRC\TIMET data versus the supplemental samples. In general, it would be helpful it text and paragraphs start with the most general information (e.g. properties of the respective datasets that are consistent across all analytes) and work towards increasing levels of specificity.

Response: *The wording has been changed in Section 3.4.3.*

61. Page 3-13; Section 3.5.1, third paragraph, first sentence. Please note that the larger variability of the BRC/TIMET dataset is largely a consequence of the larger sample size.

Response: *Agreed. Clarification on this has been added to page 3-11.*

62. Page 3-13; last paragraph, second sentence. The first half of this sentence, "Because the purpose of the 2008 background study was to provide supplemental data to fill a data gap in the 2005 BRC/TIMET dataset…" does not logically connect to the conclusion, "….this (i.e. increased range of data from BRC/TIMET relative to supplemental data) is not an unexpected outcome." Note: italicized text was added by the NDEP for clarity. Please elaborate on how the fact that "the purpose of the 2008 background study was to provide supplemental data to fill a data gap in the 2005 BRC/TIMET dataset" explains the increased variability of the BRC/TIMET data relative to the supplemental samples.

Response: *The phrase "…the purpose of the 2008 background study was to provide supplemental data to fill a data gap in the 2005 BRC/TIMET dataset, and because…" has been removed from this sentence on page 3-11.*

63. Page 3-13; last sentence states, "The results of this analysis indicated that the 2008 Supplemental and 2005 BRC/TIMET datasets are generally comparable and will be combined for further statistical evaluation and comparisons." These determinations need to be made on a per analyte basis. As an example, the previous paragraph starts out by saying that the concentrations for arsenic differ between the BRC/TIMET and the supplemental datasets. In general, we do not concur with the conclusions, although we agree that the different background datasets can be housed in one database.

Response: *See response to general comment #3 above.*

64. Page 3-14; Section 3.5.2. The purpose of this section is not clear. Many analytes show natural differences in concentration as a function of depth. How are the results of these analyses useful in a decision-making context? Perhaps different depth layers should be used for background comparisons, as appropriate.

Response: *See response to general comment #3 above. This section (Section 3.4) has been revised to include multiple population tests.*

65. Page 3-14; Section 3.5.2, sixth sentence. The P-value is 0.05 not 0.5. In addition, when interpreting the results of multiple correlated tests, it is often more appropriate to use a decreased significance level due to the increased likelihood of finding "significant" results by chance. For the situation where this suite of tests is performed, a p-value of 0.025 has been shown to be more appropriate. Also, as noted in the general comments, the tests performed are not appropriate when multiple populations are concerned.

Response: *For the ANOVA tests a p-value of 0.05 was considered appropriate since a suite of tests was not performed. For the 2-sample tests used in the Comparison of BRC/TIMET and Supplemental datasets, because a suite of tests was performed, a p-value of 0.025 was used as indicated on page 3-10.*

66. Page 3-14; Section 3.5.2, last sentence. Power analysis has not been used in any portion of this data collection. Please change the phrase "confidence and power" to "significance level".

Response: *The wording has been changed on page 3-12.*

67. Page 3-14; First sentence. Please change the phrase "comparable to" to "representative of".

Response: *The wording has been changed on page 4-1.*

68. Page 4-1; second paragraph, last sentence states "It is reasonable to conclude that the background samples collected reflect background conditions for Site soils based on sampling location characteristics information obtained from published documentation, site inspection, and sample collection." It is not clear that this is necessarily the case, as there is still some potential for aeolian deposition anthropogenic contamination at this location.

Response: *See response to specific comment #14 above.*

69. Page 4-1; third paragraph, fourth sentence states, "No soil sample results were rejected." This seems to contradict the text in section 3.2.5. Please clarify if samples were or were not rejected.

Response: *As noted above in several previous responses to comments, no samples were rejected from the dataset. The report has been revised to reflect this.*

70. Page 4-2, first sentence. 1) There is subject verb disagreement in the first clause. 2) If it is true that "because the data represent the range of background conditions at the site, there is no rationale for dividing the data into separate datasets based on location, soil origin, depth, or study" then why were these tests performed? It seems that this report has been constructed in such a way that the supplemental background data will not be useful for background comparisons at Mohawk and Parcel 4B. However, we disagree with the conclusions, and we believe this should have been the case.

Response: *See response to general comment #3 above.*

71. Page 4-2, last paragraph. This appears to be the first time that the sample size of 31 has been mentioned.

Response: *The number of samples has been changed to 33 on page 4-1.*

72. Appendix D. The radionuclide results seem fine, other than the U-235/236 results seem unusually low. This is also the case in the previous BRC/TIMET background dataset, so perhaps this is an endemic problem that should be reviewed.

Response: *It should be noted that every effort has been made to maintain consistent sample preparation methods and laboratory analyses for all samples collected for the project.*

73. Appendix E. Many of these tests should be 2-sided and should account for the multiple populations through ANOVA or Kruskal-Wallis analysis. Note, however, that the quantile and slippage tests are 1-sided, and some care should be taken to make sure that these tests are run the right way round (i.e., to capture difference if they exist).

Response: *See response to general comment #3 above.*

74. Appendix E; Table E-5, The p-values presented for the background comparison of 2008 Supplemental vs. 2005 BRC/TIMET could not be reproduced. This could be due to the differences in sample sizes between the electronic dataset that accompanies this report and the dataset used to construct the tables in Appendix E. As an example, p-values from the Supplemental Report and those calculated by Neptune and Company are compared:

Arsenic p-values

Source	**t-test**	**Wilcoxon Rank Sum test with Gehan modification**
Supplemental Report	2.8 E-6	3.1 E-15
Neptune Calculations	5.08 E-6	4.04 E-14

Further clarification is also needed with respect to the types of t-tests being conducted in this report (e.g., one-sided or two-sided).

Response: *We cannot explain the differences found. The revised report includes all data used in the statistical tests on the report CD (Appendix B) exactly as used in the report.*

75. Table E1; Page 2 of 2. For Thallium, the max detect at 0ft bgs (2) is 4x the max detect at 5ft bgs (0.51).

Response: *Depth interval comparison statistics in the revised report have been conducted using multiple population tests (Appendix G), therefore, this table no longer exists in the revised report.*

76. Table E5. For Cadmium and Zirconium, the basis comments appear to be incomplete.

Response: *All tables have been reviewed to ensure that all comments are complete.*

77. Table E-6. For Boron, Cadmium, and Uranium-233/234; -235/236, please specify the types of plots that are being referenced (i.e., probability plots or box plots?). For Lithium and Mercury, please change "ot" to "to" in the basis comments. Also, for lithium, it appears that the basis comment may be incomplete.

Response: *The basis comments have been revised and completed.*

78. Table E-7. For Mercury, Tin, and Zirconium, the basis comments appear to be incomplete.

Response: *The basis comments have been revised and completed.*

79. Tables E-8 and E-9. For Zirconium, the basis comments appear to be incomplete.

Response: *The basis comments have been revised and completed.*

REDLINE/STRIKEOUT TEXT

1.0 INTRODUCTION

On behalf of Basic Remediation Company (BRC), ERM-West, Inc. (ERM) has prepared this Supplemental Shallow Soil Background Report applicable to the Basic Management, Inc. (BMI) Complex and Common Areas in Clark County, Nevada. The supplemental shallow soil background data were collected in accordance with the *Supplemental Background Shallow Soil Sampling and Analysis Plan* (SAP) dated March 2008, and approved by the Nevada Division of Environmental Protection (NDEP) in March 2008. The general scope of work included the collection of soil samples from background areas upgradient of the Site industrial areas and analysis of these samples for metals and radionuclides that are of interest at sites within the Complex and Common Areas. In addition, since the sample locations were adjacent to Lake Mead Parkway, surface samples were analyzed for semi-volatile organic compounds (SVOCs), as well as field screened using a photoionization detector (PID).

This revision of the report, Revision 65, incorporates (1) comments received from the NDEP, dated August 1, 2008, on Revision 0 of the report, dated July 2008; (2) comments received from the NDEP, dated September 23, 2008, on Revision 1 of the report, dated August 2008; (3) resolution of issues discussed during teleconferences between NDEP and BRC on August 5, 2008 and September 26, 2008; (4) comments received from the NDEP, dated November 13, 2008, on Revision 2 of the report, dated October 2008; (5) comments received from the NDEP, dated February 17, 2009, on Revision 3 of the report, dated December 2008; (6) comments received from the NDEP, dated April 20, 2009, on a revised redline version of the text subsequent to Revision 3 of the report, dated March 2009; (7) redline edits received from the NDEP on May 10, 2009, on text revision excerpts sent to NDEP on April 29, 2009; ~~and~~ (8) comments received from the NDEP, dated June 29, 2009, on Revision 4 of the report, dated June 2009; and (9) redline edits received from the NDEP on September 11, 2009, on Revision 5 of the report, dated July 2009. The NDEP comments and BRC's responses to these comments are included in Appendix A. Also included in Appendix A is a redline/strikeout version of the text showing the revisions from the July~~June~~ 2009 version of the report. An electronic version of the entire report, as well as original format files (MS Word and MS Excel) of all text and tables are included in Appendix B.

1.1 OBJECTIVES AND PURPOSE

The purpose of this investigation was to collect and analyze data for metals and radionuclides in background shallow soils that are comparable to site soils in geologic units not covered by the existing *Background Shallow Soil Summary Report* (BRC/TIMET 2007) dataset collected in 2005. This supplemental background study was primarily undertaken because background comparisons for arsenic have failed at both the Mohawk and Parcel 4B sub-areas. However, there is no history of arsenic contamination at these sites; therefore, some consideration has been given to the possibility that the eastern part of the site exhibits different background levels of arsenic and, potentially, other metals. This supplemental shallow soil background sampling event specifically targeted the lithologic units defined as "Pediment and fan deposits of the River Mountains" (Qr_1 and Qr_2, respectively) depicted as being located in the eastern-most corner of the Common Areas[1] in the Nevada Bureau of Mines and Geology (NBMG) *Las Vegas SE Folio Geologic Map (1977) and the Geologic Map of the Henderson Quadrangle, Nevada* (NBMG 1980) (see Figure 1, Qr_1 and Qr_2 labels). This part of the site is close to the northern part of the River Mountains range.

A mile or two to the northeast of the Mohawk area, in the vicinity of the Henderson Landfill, and still in the River Mountains range, very high concentrations of arsenic have been observed in background samples.[2] Consequently, the reason for collecting these supplemental background samples was so that a specific subset of background conditions could be used for comparison with site concentrations, primarily at the Mohawk and Parcel 4B sub-areas.

At present, insufficient background data exist for alluvial fan materials downgradient of the northern River Mountains to evaluate whether concentrations of site-related chemicals detected in site samples in the eastern portion of the BMI Common Areas statistically exceed concentrations of these chemicals in shallow background soil.[3] Therefore, the specific objectives

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[1] These units fall within the Mohawk sub-area and the eastern portion of Parcel 4B.

[2] The supplemental background sample locations are west of the River Mountains. Formations associated with these mountains contain volcanic intrusions that are known to contain elevated concentrations of naturally occurring arsenic (Bevans *et al*. 1998). The supplemental background locations are geologically similar to the western and central portions of the Henderson Landfill (see Figure 2 for landfill location). The central portion of the landfill relates to the artificial fill area that covers the pediment and fan deposits of the River Mountains and further to the east the Horse Spring Formation (from CH2MHill 2006; approved by NDEP on August 7, 2006). The western portion relates to the uncovered areas of the pediment and fan deposits of the River Mountains and the modern wash deposits (CH2MHill 2006). Arsenic levels found in undisturbed areas from the western and central portions of the landfill ranged from 3.7 to 34 milligrams per kilogram (mg/kg).

[3] Shallow soils are those from the 0 to 10 feet below ground surface (bgs). The existing BRC/TIMET background shallow soil dataset consists of samples collected almost exclusively from soils originating from the McCullough Range. Only background sample location BRC-BKG-12 is considered to be a mixed alluvium location. No samples during the BRC/TIMET background shallow soil investigation were collected exclusively from the alluvial fan materials downgradient of the River Mountains. Although there were several background samples collected by Environ (2003) in this geologic unit, given recent sample results at the site, the Environ data is considered inadequate for characterizing the northern part of the River Mountains.

proposed for the supplemental shallow soil background study included the collection of the following data:

- From background locations within soil units that are representative of Site soils not covered by the existing background shallow soil dataset;
- That form a sufficient sample population that can be used to support statistical comparison of on-site and background datasets; and
- That could be used to evaluate the comparability of soil originating from geologic units from the River Mountains; that is, comparison of the northern River Mountains (this 2008 Supplemental dataset) with the southern River Mountains and McCullough Range (2005 BRC/TIMET dataset).

The supplemental shallow soil background investigation focused on collection of metals and radionuclide data from the lithologic units noted above. To support this data collection effort, soils collected during the supplemental shallow background investigation were also analyzed for SVOCs to evaluate potential soil impacts at the background sample locations. The underlying assumption was that if potential chemical impacts were observed at a given sample location, the designation of those samples as representing background conditions would be suspect. The scope of the investigation, which included surface and subsurface soil sample collection, is presented in detail in Section 2.

1.2 SITE LOCATION AND GEOLOGIC SETTING

The Site is located in Clark County, Nevada, and is situated approximately 2 miles west of the River Mountains and 1 mile north of the McCullough Range (Figure 2). For reference, it is noted that the Upper Ponds occupy the southern portion of the BMI Common Areas, and the Lower Ponds occupy the northern part of the BMI Common Areas. The McCullough Range is the primary source of materials upslope of the BMI Complex, the Lower Ponds, and the western and central portions of the Upper Ponds. Both the River Mountains and the McCullough Range are primary sources of materials upslope of the eastern portion of the Upper Ponds. According to NBMG (1980), the River Mountains and McCullough Range consist of volcanic rocks: dacite in the River Mountains and andesite in the McCullough Range. The land surface slopes in a westerly to northwesterly direction from the River Mountains and in a northerly to northeasterly direction from the McCullough Range. Near the Site, the surface topography slopes in a northerly direction towards the Las Vegas Wash.

A soils map reproduced from the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database shows that the soil type classification for the Upper and Lower Ponds area proper is map unit 600, "slickens," a non-native soil type (artificial fill). This term is presumed to reflect the non-native material observed in those Ponds that were used for waste disposal. The soil type classification for the BMI Complex is map unit 615, "urban land." Native soils underlying the slickens and urban land are assumed to be consistent with the surrounding map units (*i.e.*, primarily map unit 184, and, to a lesser extent, map units 112, 117, 182, 187 and 326). As seen in the USDA soils map excerpted on Figure 3 that is based on the 1985 USDA Soils Survey (USDA 1985), the area targeted in this investigation falls within the boundaries of mapped soil unit 182 (Caliza-Pittman-Arizo complex), which is the native soil type mapped as being present in the eastern portion of the BMI Common Areas and associated with the Qr_1 and Qr_2 lithologic units.

2.0 SUMMARY OF THE INVESTIGATION

This section describes the scope of work performed for the supplemental shallow soil investigation, including identification of the sampling locations, presentation of the sampling and analytical methods employed and analytical results, and a summary of analyte detection frequencies. In addition, this section discusses the scope and findings of the data validation and usability evaluations performed on the data generated during this sampling event, by which the suitability of the data for evaluation as a background dataset was judged. Other investigation results, which primarily involved comparisons between datasets associated with different soil units and/or depths, were developed after performing statistical analyses. The scope and findings associated with these statistical evaluations are presented in Section 3.

2.1 SAMPLING LOCATIONS

Soil samples were collected from three depth intervals at each sampling location, including surface soil (0 to 0.5 feet bgs), and two subsurface depths (4 to 6 feet and 9 to 11 feet bgs). The supplemental shallow background soil study was focused on the collection of data for site-related metals and radionuclides. Data for SVOCs were also collected to evaluate whether the supplemental shallow background soil locations are impacted by other anthropogenic sources.

Soil samples were collected from 10 initial sampling locations adjacent to Lake Mead Parkway, on the south side of the roadway away from the Site. These 10 locations are shown on Figure 1, along with sampling locations for the 2005 BRC/TIMET and 2003 Environ studies on Figure 2.

The 10 sampling locations were selected because they exhibited the following characteristics:

- They are off-Site locations, in relatively close proximity to the Site; however, they are upgradient and sufficiently distant from the Site such that impacts from Site operations are not likely;
- They are upwind of the Site (wind direction plots indicate the predominant wind direction is from the south and southwest; see Figure 2) and are thus less likely to have been affected by aerial deposition of wind-borne dusts or vapors from Site operations; and
- They are upslope of the Site and are thus unlikely to have been affected by overland surface-water transport of potentially contaminated site soils.

Available background sample locations are constrained due to rapid development in the area. Undeveloped areas in close proximity to the site, without access problems, are scarce. Although the 10 locations are adjacent to Lake Mead Parkway, as can be seen from Figure 1 they are within undisturbed areas. Therefore, the 10 sampling locations were chosen because they exhibited the characteristics identified above and are considered adequate for representing undisturbed alluvial material washed down from the northern River Mountains.

2.2 SUMMARY OF SAMPLING PROCEDURES AND ANALYSES

Soil samples were collected from a single boring at each location, drilled using a hollow-stem auger rig. Samples were collected in a split-spoon sampler lined with stainless steel sleeves. Samples collected from each boring are considered independent samples. Sampling and sample handling procedures were consistent with the standard operating procedures (SOPs) developed for the BMI Common Areas as provided in the *BRC Field Sampling and Standard Operating Procedures* (FSSOP; BRC, ERM and MWH 2008). Subsurface soil samples were collected from each two-foot interval of drill core (*i.e.*, 4 to 6 feet bgs and 9 to 11 feet bgs).

For this study, surface soil is defined as the upper 0.5 feet of the soil horizon; subsurface soil is defined as below 0.5 feet bgs. Soil samples were collected from three zones in each boring as follows:

- Surface Soil (soil samples collected from within the depth interval from 0-0.5 ft bgs; hereinafter referred to as "0 ft bgs" interval);
- Shallow Subsurface Soil (soil samples collected from within the depth interval from 4-6 ft bgs; core homogenized; hereinafter referred to as "5 ft bgs" interval); and
- Deeper Subsurface Soil (soil samples collected from within the depth interval from 9-11 ft bgs; core homogenized; hereinafter referred to as "10 ft bgs" interval).

Ten borings were advanced and three samples from each zone were collected for an initial total of 30 soil samples. Field duplicate samples were collected at three locations; from locations BRC-BKG-R01 (0 ft bgs), BRC-BKG-R05 (0 ft bgs), and BRC-BKG-R08 (5 ft bgs) for metals and SVOCs; and from locations BRC-BKG-R01 (5 ft bgs), BRC-BKG-R05 (0 ft bgs), and BRC-BKG-R08 (5 ft bgs) for radionuclides. Inadequate sample volume was collected from location BRC-BKG-R01 (0 ft bgs), the first sample collected, which is why the field duplicate at this location for radionuclides is at a different depth (5 ft bgs) than that for metals and SVOCs. Because these samples are considered field duplicates, and not split samples, each is considered an independent sample. Therefore, there were a total of 33 soil samples collected as part of this investigation. Soil boring logs representing each location are also included in Appendix C.

The soil samples were submitted for analysis to TestAmerica in St. Louis, Missouri. Analyses were conducted at three TestAmerica laboratory locations: St. Louis, Missouri; Burlington, Vermont; and West Sacramento, California. General Engineering Laboratories (GEL), located in Charleston, South Carolina, performed the radionuclide analyses.[4] At the time of analysis, all laboratories were NDEP-certified laboratories for the analyses conducted. Surface and subsurface sample analyses consisted of a full suite of metals, eight radionuclides (radium-226, radium-228, thorium-228, thorium-230, thorium-232, uranium-233/234, uranium-235/236, and uranium-238), SVOCs, and general soil characteristics. The individual analytes, analytical methods, and sample quantitation limits (SQLs) are presented in Table 1. These analytes and methods are consistent with the BRC site-related chemicals list and analytical program previously established in the *BRC Quality Assurance Project Plan* (QAPP; BRC and ERM 2009). All radionuclide analyses underwent full dissolution preparatory methods. All preparatory methods and analyses are consistent with the 2005 BRC/TIMET background dataset.

The detection frequencies for metals and radionuclides evaluated during this supplemental shallow soil background study are presented in Table 2. Detection frequencies observed for these analytes during the 2005 shallow background study are also provided in Table 2 for comparison. As seen in Table 2, most of the metals and radionuclides that are the subject of the supplemental shallow soil background investigation were detected routinely in the 2008 shallow soil samples. Exceptions are:

- Antimony
- Boron
- Chromium (VI)
- Lithium
- Mercury
- Niobium
- Platinum
- Selenium
- Silver
- Thallium
- Tin
- Tungsten
- Uranium-235/236
- Zirconium

[4] GEL labeled all primary samples that required matrix spike/matrix spike duplicates (MS/MSD) with the sample name specified on the chain-of-custody, but included aan MS/MSD identification (*e.g.*, BRC-BKG-R02-5-MS/MSD). Due to the unaccustomed labeling, all samples with the MS/MSD label were inadvertently regarded as quality control samples and not included with the original sample dataset. GEL was contacted and they confirmed the results for samples labeled as MS/MSD are actual primary sample results.

These fourteen constituents were detected in fewer than fifty percent of the samples in which they were analyzed during the supplemental shallow soil background investigation. Most of these same compounds were also not detected routinely during the 2005 shallow soil background investigation. Exceptions to this observation consist of lithium, mercury, tin and zirconium, which were routinely detected in the 2005 samples but not in the 2008 samples. Selenium and thallium were also detected at a noticeably lower frequency in the 2008 supplemental shallow samples than in the 2005 samples. In contrast, cadmium, and silver, and uranium-233/234 were detected at a noticeably higher frequency in the 2008 supplemental shallow background samples than in those from the 2005 shallow background investigation. It should be noted that variations in detection frequencies are influenced by the associated SQL, and may not reflect trends in actual concentrations; the effect of SQLs on detection frequencies is discussed further in Section 3.5.

2.3 DATA VALIDATION SUMMARY

All of the data were subjected to a Level 3 review. In addition to the Level 3 review, 20 percent of all data collected during the course of the investigation were subjected to full Level 4 data validation. Level 3 and 4 reviews are provided in the *Data Validation Summary Report (DVSR)—2008 Supplemental Shallow Soil Background Sampling Event* (BRC and ERM 2008; approved by NDEP on June 9, 2008). Metals data were validated in accordance with the U.S. Environmental Protection Agency (USEPA) guidance document *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004) and the data validation SOP (SOP-40; BRC, ERM and MWH 2008). Organics data were validated in accordance with the USEPA guidance document *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1999) and SOP-40 (BRC, ERM and MWH, 2008).[5] USEPA has not standardized the validation of radionuclide data. Radionuclide results for supplemental shallow soil background samples were validated in accordance with SOP-40 (BRC, ERM and MWH 2008) and the project QAPP (BRC and ERM 2009).

[5] Revised validation procedures have been specified in NDEP's guidance document *Revisions to Data Validation of Organic Data based on June 2008 National Functional Guidelines for Superfund Organic Methods Data Review – USEPA-540-R-08-01* (NDEP 2009a). Because these data were collected and validated prior to March 2009, these revised procedures were not employed. The primary changes relative to the 1999 USEPA guidance and SOP-40 (BRC, ERM and MWH 2008) are associated with the manner in which blanks are evaluated and where data are rejected due to very low internal standards. A review of the data indicates that for this dataset no SVOC qualifier changes are necessary and there are no changes to the DVSR findings.

Based on data validation and review, data qualifiers were placed in the electronic supplemental shallow soil background database to classify whether the data were acceptable, acceptable with qualification, or rejected. Where applicable, an indication of result bias is presented. In addition, for every data validation qualifier, a secondary comment code was entered to indicate the reason for qualification. The DVSR (BRC and ERM 2008) provides the definitions for the data validation qualifiers and comment codes used in the supplemental shallow soil background database. Validation qualifiers and definitions are based on those used by USEPA in the current validation guidelines (USEPA 2004) and summarized in the SOP-40 (BRC, ERM, and MWH 2008).

Results that are qualified as estimated may generally be usable for the purposes of establishing background and for comparison to Site-specific sample data. Based on the evaluation of the dataset, 100 percent of the data obtained during the field investigation are valid (that is, not rejected) and acceptable for their intended use. With 100 percent of the dataset validated as usable, the overall objective of the data collection event was met.

2.4 DATA USABILITY EVALUATION

The analytical data were reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992) and *Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Complex and Common Area in Henderson, Nevada* (NDEP 2008a). A quality assurance/quality control (QA/QC) review of the analytical results was conducted during the sampling events. According to both NDEP's and USEPA's Data Usability Guidance, there are six principal evaluation criteria by which data are judged for usability. The six criteria are:

- availability of information associated with site data;
- documentation;
- data sources;
- analytical methods and detection limits;
- data review; and
- data quality indicators, including precision, accuracy, representativeness, comparability, and completeness.

In addition to the six principal evaluation criteria, NDEP's Data Usability Guidance includes a step for data exploration. Items for this step are discussed in Section 3. A summary of these six criteria for determining data usability is provided below. Data usability evaluation tables are provided in Appendix B.

2.4.1 Criterion I – Availability of Information Associated with Supplemental Shallow Soil Background Data

The usability analysis of the supplemental shallow soil background data requires the availability of sufficient data for review. The required information is available from documentation associated with the data collection efforts. Data have been validated per the NDEP-approved DVSR (BRC and ERM 2008). The following lists the information sources and the availability of such information for the data usability process:

- Background description and objectives provided in the NDEP-approved SAP (BRC 2008) and in Section 1.
- A site map with sample locations is provided on Figure 1.
- Sampling design and procedures were provided in the NDEP-approved SAP (BRC 2008) and discussed in Sections 2.1 and 2.2.
- Analytical methods and detection limits are provided in Table 1.
- A complete dataset is provided in Appendix B.
- Field conditions and physical parameter data as applicable to the background dataset are provided in the field investigation report (GES 2008) and DVSR (BRC and ERM 2008).
- The laboratory provides a narrative with each analytical data package outlining any problems encountered in the laboratory, control limit exceedances, and rationale for any deviations from protocol. These narratives are included as part of the DVSR (BRC and ERM 2008).
- QC results are provided by the laboratory, including blanks, replicates, and spikes. The laboratory QC results are included as part of the DVSR (BRC and ERM 2008).
- Data flags used by the laboratory were defined adequately.

- Electronic files containing the raw data made available by the laboratory are included as part of the DVSR (BRC and ERM 2008).

2.4.2 Criterion II – Documentation Review

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. For the purposes of this data usability analysis, the chain-of-custody forms prepared in the field were reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the dataset as discussed in the DVSR (BRC and ERM 2008). Based on the documentation review, all samples analyzed by the laboratory correspond to their respective geographic locations as discussed in Section 2.2 and shown on Figure 1. The samples were collected in accordance with the NDEP-approved SAP (BRC 2008) and SOPs developed for the BMI Common Areas as provided in the FSSOP (BRC, ERM and MWH 2008). Field procedures included documentation of sample times, dates and locations, and other sample-specific information (*e.g.*, sample depth). Information from field forms generated during sample collection activities was imported into the project database.

The analytical data were reported in a format that provides adequate information for evaluation, including appropriate quality control measures and acceptance criteria. Each laboratory report describes the analytical method used, provides results and detection limits on a sample-by-sample basis, and provides the results of appropriate quality control samples (*e.g.*, laboratory control spike samples, sample surrogates and internal standards [organic analyses only], and matrix spike samples). All laboratory reports provided the documentation required by USEPA's Contract Laboratory Program (USEPA 1999, 2001, 2004) which includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data generated during sample analysis. Reported sample analysis results were imported into the project database.

Note that there were labeling issues with the samples analyzed by GEL. GEL labeled all primary samples that required matrix spike/matrix spike duplicates (MS/MSD) with the sample name specified on the chain-of-custody, but included a MS/MSD identification (*e.g.*, BRC-BKG-R02-5-MS/MSD). Due to the unaccustomed labeling, all samples with the MS/MSD label were inadvertently regarded as quality control samples and not included with the original sample dataset. GEL was contacted and they confirmed the results for samples labeled as MS/MSD are actual primary sample results.

2.4.3 Criterion III –Data Sources

The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate for the exposure area and medium of interest and that appropriate analytical methods were used. The data collection activities were developed to characterize a broad spectrum of background metals and radionuclides in soil. As described in the SAP, samples were collected in areas of no known impacts for the target soil lithologies.

-The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA. Given previous issues with analysis of radionuclides at the BMI Complex (NDEP, 2009b), note that all radionuclide analyses underwent full dissolution preparatory methods. These preparatory methods and analyses are consistent with the 2005 BRC/TIMET background dataset.

Based on the review of the available information, the data sources for chemical and physical parameter measurements are adequate for use.

2.4.4 Criterion IV – Analytical Methods and Detection Limits

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the detection limits are low enough to allow adequate characterization of the data. At a minimum, this data usability criterion can be met through the determination that routine USEPA reference analytical methods were used in analyzing the samples. Table 1 identifies the USEPA methods that were used in conducting the laboratory analysis of soil samples. Each of the identified USEPA methods is considered the most appropriate method for the respective constituent class and each was approved by NDEP as part of the SAP (BRC 2008).

Laboratory SQLs were based on those outlined in the reference method, the SAP, and the project QAPP (BRC and ERM 2009). In accordance with respective laboratory SOPs, the analytical processes included instrument calibration, laboratory method blanks, and other verification standards used to ensure quality control during the analyses of collected samples.

Even though the same analytical methods were used for the samples collected as part of this background study and the prior background sampling events, the SQLs for several metals vary between those events. Datasets with multiple sample-specific detection limits are not uncommon in analytical chemistry data. This has minimal effect on datasets for analytes with high frequencies of detection. However, it is of concern for datasets with numerous non-detections, for which variable SQLs can result in difficulties in differentiating whether datasets are actually different or merely an artifact of detection limits. As evidence of this potential problem, as discussed in Sections 2.2 and 3.5, in a few instances (*i.e.*, for cadmium, selenium, and silver) the variations in SQLs for the background data have potentially caused differences in frequency of detection.

Therefore, it should be recognized that having differences in SQLs for a given analyte may compromise statistical analyses in this report and future background comparisons. As discussed in Section 2.2, fourteen constituents were detected in fewer than fifty percent of the samples--differences in detection limits are anticipated to have the greatest effect on calculations of descriptive statistics and statistical analyses for these constituents. BRC uses the computer statistical software program Guided Interactive Statistical Decision Tools (GiSdT®; Neptune and Company 2007) to conduct non-parametric tests including the Wilcoxon Rank Sum (WRS) test, quantile test, and slippage test when comparing site data to background data. The Gehan ranking system is used for these tests to accommodate multiple detection limits within the same dataset. Regardless, for datasets with relatively low frequencies of detection and variable SQLs, particularly when detection limits are among the largest values in the dataset, conclusions from the statistical test results should be treated with caution. In cases where either the background or site dataset has low frequencies of detection, greater emphasis should be given to the maximum detections, means, and medians as well as a review of the SQLs rather than simply the results of the statistical tests.

Radionuclides represent a different situation than metals. Radionuclide detection frequencies are considered using the minimum detectable activity (MDA) as the reported value below which measured results are considered "non-detections." As discussed in Section 3.1.3, when radionuclides are not detected at activities greater than the MDA, the laboratory reports the measured activity, including those lower than the MDA. Therefore, all reported results for radionuclides are used in the statistical evaluations, regardless of where they fall relative to the MDA. The MDA and radionuclide detection frequencies relative to the MDA have no effect on statistical comparisons of the radionuclide data.

2.4.5 Criterion V – Data Review

The data review portion of the data usability process focuses primarily on the quality of the analytical data received from the laboratory. However for this study, the data review also included evaluation of the SVOC data to identify any evidence of impacts that might indicate that these locations are not suitable for consideration as background. Both elements are discussed below.

Data Quality Review. Soil sample data were subject to data validation. The DVSR was prepared as a separate deliverable (BRC and ERM 2008). The analytical data were validated according to the internal procedures using the principles of USEPA National Functional Guidelines (USEPA 1999, 2001, 2004) and were designed to ensure completeness and adequacy of the dataset. Any analytical errors and/or limitations in the data have been addressed and an explanation for data qualification provided in the respective data tables. The results of ERM's data review for these issues are presented in the DVSR and are summarized as qualifiers in the dataset provided electronically in Appendix B.

For some analytical results, quality criteria were not met and various data qualifiers were added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in SOP-40 (BRC, ERM and MWH 2008) and the project QAPP (BRC and ERM 2009). Sample results are rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria. Only rejected data are considered unusable for decision-making purposes. No samples were rejected in the supplemental shallow soil background dataset. Sample results qualified as estimated indicate an elevated uncertainty in the value. A bias flag may have been applied to indicate a direction of the bias. Estimated analytical results are included in the supplemental shallow soil background dataset "as is"; the potential bias noted was not addressed quantitatively in the statistical analyses that follow.

Evaluation for Evidence of Impacts/Background Unsuitability. The surface samples at each boring location[6] were analyzed for SVOCs. As previously noted, the purpose of these analyses was to identify any evidence of impacts that might indicate that these locations are not suitable for consideration as background. As summarized in Table 3, only one SVOC was detected in the samples; bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected at low concentrations (56 micrograms per kilogram [μg/kg] and 69 μg/kg[7]) in the two samples collected from location BRC-BKG-R01 (initial and field duplicate). The SQLs for the SVOC analyses were relatively low (*i.e.*, approximately 34 μg/kg for most compounds), and are consistent with

[6] There was one exception – the surface soil sample at location BRC-BKG-R09 was not analyzed for SVOCs.
[7] Both results were flagged as estimated (J) due to their low concentrations below the SQLs.

the SQLs presented in the project QAPP (BRC and ERM 2009). Furthermore, the data review performed for the SVOC data did not identify any issues of concern with respect to the SVOC data quality (BRC and ERM 2008). Therefore, the SVOC data did not provide any evidence suggesting that use of the samples for determining background conditions would not be appropriate.

2.4.6 Criterion VI – Data Quality Indicators

Data quality indicators (DQIs) are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected. The DQIs include precision, accuracy, representativeness, comparability, and completeness (PARCC). The project QAPP provides the definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the dataset. Data validation activities included the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria were qualified during the validation process using the guidelines presented in the National Functional Guidelines (USEPA 1999, 2001, 2004).

Precision is a measure of the degree of agreement between replicate measurements of the same source or sample. Precision is expressed by relative percent difference (RPD) between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source. Precision is generally assessed using a subset of the measurements made. The precision of the data was evaluated using several laboratory QA/QC procedures such as ~~field duplicates,~~ laboratory duplicates, laboratory control sample (LCS), laboratory control sample duplicate (LCSD), and MS/MSD results. Based on ERM's review of the results of these procedures, there do not appear to be any widespread data usability issues associated with precision.

Accuracy measures the level of bias that an analytical method or measurement exhibits. To measure accuracy, a standard or reference material containing a known concentration is analyzed or measured and the result is compared to the known value. Several QC parameters are used to evaluate the accuracy of reported analytical results:

- Holding times and sample temperatures;
- LCS percent recovery;
- MS/MSD percent recovery (organics);

- Spike sample recovery (inorganics)
- Surrogate spike recovery; and
- Blank sample results.

Detailed discussions of and tables with specific exceedances, with respect to precision and accuracy, are provided in the NDEP-approved DVSR (BRC and ERM 2008) and data qualified as a result of this evaluation are presented with qualifiers in the dataset provided electronically in Appendix B.

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition (USEPA 2002). There is no standard method or formula for evaluating representativeness, which is a qualitative term. Representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific sampling task, and by collection of an adequate number of samples from the relevant types of locations. As discussed in Section 2.1, for this background investigation, care was taken to select sampling locations that were close to the Common Areas but did not appear to have been impacted by known historical operations at the Site or from nearby facilities. The representativeness of the sampling locations was also assessed by (1) physical inspection of the locations prior to drilling to identify evidence of impacts; and (2) collection and analysis of samples for organic constituents that could indicate impacts. Evidence of impacts was not suggested by either process. Data representativeness was further assessed during the data evaluation process as discussed in Section 3.4. Based on the assessments of representativeness referenced above (see further discussions in Sections 2.4.5 and 3.4), BRC concludes that the data are representative of background conditions.

Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of measurements made. Analytical completeness is a measure of the number of overall accepted analytical results, including estimated values, compared to the total number of analytical results requested on samples submitted for analysis after review of the analytical data. None of the data were eliminated due to data usability concerns. The percent completeness for the dataset is 100 percent.

Comparability is a qualitative characteristic expressing the confidence with which one dataset can be compared with another. The desire for comparability is the basis for specifying the analytical methods; these methods are consistent with those used in the 2005 BRC/TIMET background dataset. The comparability goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The ranges of sample results from both the supplemental shallow soil background dataset and the 2005 BRC/TIMET background dataset are provided electronically in Appendix B. As discussed in Sections 2.2 and 2.4.4, differences in detection limits among datasets may affect data comparability, particularly for datasets comprised primarily of non-detected values. For these datasets, left-censored data can result in difficulties in differentiating whether datasets are actually different or merely an artifact of detection limits. Note that for constituents with detection limits that are sufficiently low (*i.e.*, lower than risk-based screening levels), comparisons between site and background may be less important as these left-censored data are likely to indicate conditions that pose an "acceptable" risk and further analysis is not necessary.

3.0 STATISTICAL METHODS AND FINDINGS

The exploratory data analysis and statistical evaluation of data for shallow background soils generally followed industry-standard guidance documents (USEPA 2006a,b; Navy 1999, 2002) and standards agreed upon with NDEP, including the *Guidance on the Development of Summary Statistics Tables* (NDEP 2008b). These guidance documents discuss the use of statistical plots, calculation of summary statistics ~~(such as the arithmetic mean)~~, treatment of non-detect data, and selection of statistical tests. The following sections discuss data preparation, statistical plots, summary statistics, and statistical tests, and the types of comparisons conducted.

3.1 DATA PREPARATION

3.1.1 Spatial Independence Assumptions

There are 10 soil boring locations that were sampled for the supplemental shallow soil background dataset. The 10 soil boring locations are treated as spatially independent in this supplemental shallow background soil study. The concentrations of each analyte at each sample location and depth is dependent on the origin of the soil and the composition of the parent material (with the exception of anthropogenic deposition of analytes such as lead).

Naturally occurring variability is associated with the deposition of sediments, and these variations may never be fully characterized and result in unexplainable data clusters. The naturally occurring variability may be impacted by sediment transport, leaching, weathering, and other geochemical processes within the alluvium; therefore, when statistical tests are performed, it is expected that some spatial correlation may be seen, but the impact of this on the background evaluation is assumed to be negligible. All background data~~, and all sampling locations~~ were ~~therefore~~ treated as independent in the statistical tests and calculations performed for this study. Treating the data points as independent is more conservative since the larger number of samples will result in narrower confidence intervals when comparing the background data to site data. Note also that the sample results from the three field duplicates were also treated as independent. There is no obvious indication in the data that the variances between duplicate results are any different than the variance between other sample results.

3.1.2 Data Filtering and Combining Rules

Results from both the 2005 BRC/TIMET (which includes the Environ dataset) and 2008 supplemental shallow soil background (this report) analytical datasets were validated. In order to prepare the datasets for statistical evaluation, results from each dataset were filtered down so that each shallow background soil sample had one result per analyte and the two datasets were combined into one database. The following steps were taken to filter and combine the 2005 BRC/TIMET and 2008 Supplemental shallow soil background datasets into one database.

1) Filtered out all laboratory QC samples from both datasets
2) Filtered out all split sample results from both datasets; retained field duplicate results in the 2008 Supplemental shallow soil background dataset
3) Filtered out all rejected (R-qualified) data in both datasets
4) Aligned chemical names for both datasets so that names are exactly the same for each
5) Aligned units for both datasets so they are exactly the same for each
6) Filtered non-metals/non-radionuclides (*e.g.*, percent moisture) from both datasets
7) Filtered out all metals and radionuclides from the 2005 BRC/TIMET background dataset that were not included in the 2008 Supplemental shallow soil background dataset
8) Added fields to both datasets that include Dataset (2005 BRC/TIMET, 2008 Supplemental), Origin (McCullough, River, North River, or Mixed), and Depth (0, 5, or 10)
9) Aligned field names for both datasets so they can be combined for statistical evaluation
10) Identified final subset of fields that will be required to conduct the data analyses

For direct comparisons between the 2005 BRC/TIMET dataset and the 2008 Supplemental dataset, any chemical analyzed by one study but not the other was not considered in the comparison.

After filtering and prior to final combination of the two datasets, a comparison table was prepared. Table 2 provides a constituent-by-constituent comparison between the 2005 BRC/TIMET and the 2008 Supplemental datasets for the total number of observations (sample size), the number of observations that were detected concentrations (number of detects), and the frequency of detected concentrations as a percentage of the total number of observations.

Based on the information shown in Table 2, the following observations were made:

- The 2005 BRC/TIMET background dataset contains results for 42 metals and anions and 35 radionuclides; while the 2008 Supplemental dataset contains results for 38 metals and eight radionuclides.[8]

- The sample size for the 2005 BRC/TIMET background dataset is generally 120 results for each analyte (with a few exceptions);[9] while the sample size for the 2008 Supplemental dataset is generally 33 results for each analyte.

- In cases where analyte results are available for both datasets, the detection frequencies were compared. As discussed in Section 2.2, detection frequencies were notably different for cadmium, lithium, mercury, selenium, silver, thallium, tin, zirconium, and uranium-233/234.

3.1.3 Treatment of Data Qualified as Non-Detections

When radionuclides were not detected at activities greater than the MDA, the laboratory reported the measured activity. Treatment of radionuclide data qualified as non-detections followed U.S. Department of Energy (DOE) guidance (DOE 1997), which states that, for radionuclide activity data:

> "All of the actual values, including those that are negative, should be included in the statistical analysis. Practices such as assigning a zero, a detect limit value, or some in-between value to the below-detectable data point, or discarding those data points can severely bias the resulting parameter estimates and should be avoided."

Therefore, for radionuclides, the reported activities (in pico Curies per gram [pCi/g]) were used without censoring to calculate all descriptive statistics (Tables 4 through 26), prepare plots (*e.g.*, boxplots), and conduct statistical analyses presented in this report.

For metals, a value of one-half the SQL was used as a replacement value for non-detected data for t-tests, parametric and nonparametric analysis of variance (ANOVA, Kruskal-Wallis tests), and calculation of parametric and nonparametric correlation coefficients. The ½-SQL

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[8] The following five inorganic constituents were included in the 2005 background investigation but were not included in the 2008 investigation: chloride, fluoride, nitrate, nitrite, and sulfate. Phosphorus was included in the 2008 investigation, but was not included in the 2005 analyte list. With NDEP concurrence, the project list of analytes was reduced in 2007 from 35 radionuclides to the following eight: uranium-238, uranium-233/234, thorium-230, and radium-226 (Uranium-238 Decay Chain), thorium-232, radium-228, and thorium-228 (Thorium-232 Decay Chain) and uranium-235/236 (Uranium-235 Decay Chain).

[9] For the 2005 BRC/TIMET dataset, 104 of the 120 data points are from the 2005 BRC/TIMET investigation and 16 of the 120 data points are from the 2003 Environ investigation (BRC/TIMET 2007).

substitution method was not applied to data analyzed using the WRS test because this test (as currently supported by GiSdT®) handles non-detected values using the Gehan ranking system (the Gehan test uses a modified ranking of sample results to accommodate non-detected values together with detected values), a method considered to be more robust than the ½-SQL substitution method. The GiSdT® version of the WRS test uses the Mantel (1981) approach, which is equivalent to using the Gehan ranking system. The summary statistics (Tables 4 through 26) and plots (boxplots, individual value plots, and probability plots in Appendix D) incorporate the full SQL for non-detects.

It should be noted that the method detection limit (MDL) is established by the laboratories and represents the minimum concentration of a substance that can be measured and reported with 99 percent probability that the analyte concentration is greater than zero. MDLs are established using matrices with little or no interfering species using reagent matrices and are considered the lowest possible reporting limit. Often, the MDL is represented as the instrument detection limit.

The SQL is defined as the MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes, and takes into account sample characteristics, sample preparation, and analytical adjustments. It represents the sample-specific detection limit and all non-detected results are reported to this level. BecauseTherefore, because the SQL is a sample-specific detection limit, for the dataset as a whole there may be instances where the maximum non-detect value may be higher than the lowest detected concentration, the median SQL for a chemical in a dataset may be greater than the median detected concentration, or the median SQL may be different across for different datasets. A review of the data reveals that this is sometimes the case for certain metals detected at low concentrations near the SQL (*e.g.*, the median SQL for silver is often higher than the median detection). In such cases, these limitations may compromise statistical analyses in this report and potential future background comparisons.

3.2 STATISTICAL PLOTS

Statistical plots are used in exploratory data analysis to show characteristics and relationships of the data, to evaluate fit to a normal distribution, to identify anomalous data points or outliers, and to provide a general overview of the data. Probability plots, boxplots, and individual value plots were constructed as part of the data evaluation for this investigation. Preliminary evaluation of the data included an assessment of data characteristics through graphical and quantitative analysis. The 2008 Supplemental data were summarized overall and by depth interval, with data plotted for the various groupings. The 2008 Supplemental data were compared with the 2005

BRC/TIMET background data using the probability plots, boxplots, and individual value plots. The graphical analysis of the analytical data is described in the following sections, and Appendix D contains the statistical plots.

Probability Plots. The distribution plots for each chemical include a probability plot that shows how well the dataset for the chemical fits a normal or lognormal distribution. Probability plots are also useful to visually identify outliers and to evaluate the possible presence of multiple populations within a dataset. Potential multiple populations are identified by inflection points on the probability plot. Inflection points are not defined statistically, and should be used with considerable caution.

The probability plots are graphs of values, ordered from lowest to highest and plotted against a standard normal or lognormal distribution function. The vertical axis is scaled in units of concentration (or activity, in the case of radionuclides), and the horizontal axis is scaled in units of the normal/lognormal distribution function. The vertical scale is plotted as a linear scale (concentration versus normal/lognormal quantile) and populations of data that plot approximately as a straight line in a linear scale are referred to as normally distributed (or lognormally distributed).

Boxplots. Boxplots provide a method for comparing data groupings or datasets side by side. The boxplots simultaneously display the full range of data, as well as key summary statistics, such as the median, 25th and 75th percentiles, and minimum and maximum values. The top and bottom of the box are the 75th and 25th percentiles, respectively, of the dataset. The length from the top to the bottom of the box is the interquartile range; therefore, the box represents the middle 50 percent of the data. The width of the box is arbitrary. The horizontal line within the box depicts the median value (the 50th percentile) of the dataset. The upper and lower whiskers are defined as follows:

Upper whisker = 75^{th} percentile + (1.5 • interquartile range)

Lower whisker = 25^{th} percentile – (1.5 • interquartile range)

These plots show the symmetry of the dataset, the range of data, and a measure of central tendency (median).

The boxplots, which group data for each dataset, by chemical, and by depth interval, are provided along with the probability and individual value plots for each analyte in Appendix D for the 2008 Supplemental dataset and the 2005 BRC/TIMET background dataset (including

Environ dataset). Accordingly, these boxplots are presented to (a) provide an overview of the 2008 Supplemental and 2005 BRC/TIMET background datasets for soils, (b) facilitate visual comparisons of the 2008 Supplemental background dataset to the 2005 BRC/TIMET background dataset, and (c) facilitate visual comparisons of constituent concentration data for the different depth intervals.

Probability plots and boxplots were also used for identifying anomalous data points (outliers) and data clusters in the 2008 Supplemental and 2005 BRC/TIMET datasets. All anomalous data points and clusters were investigated further.

Scatterplots. A scatterplot uses a Cartesian coordinate system to display values for two variables from a dataset (*e.g.*, arsenic *vs.* aluminum concentrations for the 2008 dataset). The data are displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis.

Scatterplots were constructed for those constituent pairs with significant correlation coefficients. Scatterplots were visually examined and best professional judgment was used to ascertain whether high-concentration outliers[10] occur "near" the least-square linear trend line. Where high-concentration outliers occur "near" the trend line, one may infer that these concentrations are consistent with background concentrations. Scatterplots were generated to support the correlation analysis conducted to further justify that the supplemental data collected are representative of background conditions.

3.3 DESCRIPTIVE SUMMARY STATISTICS

Descriptive summary statistics for metals and radionuclides were calculated for the 2008 Supplemental and 2005 BRC/TIMET datasets (Tables 4 through 26). Descriptive summary statistics for each of the two datasets were also prepared for the following depth intervals, structured around the sampling intervals employed for the 2005 shallow soil background sampling event and the 2008 supplemental shallow soil sampling event (Section 2.2):

- Surface soils (0 ft bgs);
- Shallow subsurface soils (5 ft bgs);

[10] Note that elevated concentration outliers targeted for further evaluation were identified from boxplots (see Section 3.4).

- Deeper subsurface soils (10 ft bgs);
- Subsurface combined (5 and 10 ft bgs); and
- All depths combined (0, 5 and 10 ft bgs).

The descriptive summary statistics calculated for each analyte include the sample size, frequency of detections, and, for both censored and detected data, the minimum and maximum concentration, the median, the mean, and the 25th and 75th percentiles (quantiles). Note that frequency of detection is calculated for radionuclides in terms of the proportion of sample results that are greater than the sample specific MDA. However, for all other data summaries and statistical analyses the uncensored data are used (see Section 2.4.4).

3.4 IDENTIFICATION AND TREATMENT OF OUTLIERS

The data collected for this study are intended to represent background conditions for the eastern sub-areas of the BMI Common Areas. Several lines of evidence are used to verify that these data are representative of these background conditions. For example, supplemental shallow background soil samples were collected from known/suspected unimpacted areas upgradient of the Site industrial areas, and the SVOC data did not provide compelling evidence suggesting that data were inappropriate for characterizing background conditions (Criterion V of Section 2.4). A further line of evidence involves an evaluation of outliers in this background dataset. Statistical outliers are data points that are extremely large or small relative to the rest of the data, and may not, therefore, be representative of the population sampled (USEPA 2000a).

For this investigation, boxplots,[11] individual value plots, and probability plots were used to identify statistical outliers that would undergo further examination (see Appendix D). If an outlier was identified, the next step was to confirm that the datum was not a result of a transcription or other verifiable error.[12] If confirmed not to be an error, correlation analyses were conducted and used to identify those constituent pairs that should be visually examined in

[11] Statistical outliers within the 2008 dataset were defined as those points corresponding to detected metal concentrations or radionuclide activities (*i.e.*, ignoring non-detection report limit artifacts) that were greater than the 75th percentile + 1.5 times the interquartile range for the (i) combined depth plots and (ii) individual depth plots, and are shown as an asterisk (*) on the boxplots (see Section 3.2).

[12] Reporting or transcription errors are unlikely given the direct electronic data uploads from the laboratory, which were in turn uploaded directly into the spreadsheets used for statistical analysis, with no manual entry of concentration values.

scatterplots to ascertain whether high-concentration outliers were consistent with the background dataset (see Section 3.7.5).[13]

Based on the overall findings of the outlier analysis, statistical outliers represented only a small proportion of the entire dataset and no consistent pattern was observed among outliers. It is not unusual for a dataset of this size to have some outliers. This supports the premise that these data are representative of naturally occurring background conditions. Given the lack of scientifically defensible reasons to consider these statistical outliers to be incongruous with background conditions (*i.e.*, "true" outliers), these data were considered representative of background and retained in the supplemental shallow background soil dataset. See also Appendix E for a more detailed discussion of outliers.

3.5 FREQUENCY OF DETECTION

As noted in Section 2.2, cadmium, silver, and uranium-233/234 were detected at noticeably higher frequencies in the 2008 supplemental shallow background samples than in those from the 2005 BRC/TIMET shallow background samples, while ~~and~~ lithium, mercury, selenium, thallium, tin and zirconium were detected at noticeably lower frequencies in the 2008 supplemental shallow soil samples than in the 2005 BRC/TIMET shallow soil samples~~background study~~. The statistical summaries in Tables 4 through 26 were evaluated to assess the likely influence of SQLs on these observed detection frequencies. This evaluation determined that variations in SQLs are likely to have had effects on detection frequencies for certain constituents (*i.e.*, cadmium selenium, and silver), as summarized below.

Cadmium	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection[14]	63.6%	13.3%
Median SQLs for Non-Detects (mg/kg)	0.04	0.1291
Median Detected Concentration (mg/kg)	0.11	0.105
Assessment of SQL Effects on Frequency of Detection	The 2005 cadmium frequency of detections is appreciably lower than that for the 2008 data. The detected concentrations are comparable between the two datasets. The range of the 2008 detected values (0.053 to 0.26 mg/kg) is higher than the non-detect	

[13] Scatterplots and correlation analyses were performed with the statistical outlier included in the dataset.
[14] For all summary tables in this section, the value for Percent Detection reflects the full dataset for each event, as taken from Table 2, and the values provided for the other parameters were taken from Tables 4 and 9.

SQLs for that event (0.04 mg/kg); however, a large percentage of these data would not have been reported as detections under the higher 2005 SQLs (*i.e.*, the median value of 2008 detections was 0.11 mg/kg– less than the 2005 median SQL for non-detections [0.1291 mg/kg]). It therefore appears likely that the higher SQLs of the 2005 dataset are one cause of the lower frequency of detection in that dataset, although lower cadmium concentrations in the 2005 samples could be another explanation.

Lithium	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection	18.2%	100%
Median SQLs for Non-Detects (mg/kg)	7.314	--
Median Detected Concentration (mg/kg)	32.95	12.75

Assessment of SQL Effects on Frequency of Detection

The 2008 lithium frequency of detections is appreciably lower than that for the 2005 data. The range of 2005 detections (7.5 to 26.5 mg/kg) is higher than a large percentage of the 2008 non-detect SQLs, based on the 7.314 mg/kg median 2008 SQL value, and many would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples may have generally lower lithium concentrations than the 2005 samples, despite the higher 2008 median detected concentration. However, the elevated 2008 SQLs (*i.e.*, 75th percentile of 14.628 mg/kg and beyond, which are higher than the majority of the 2005 detections [median detect 12.75 mg/kg]), complicate the analysis.

Mercury	**2008 Supplemental Shallow Data**	**2005 BRC/TIMET Shallow Data**
Percent Detection	0%	77.5%
Median SQLs for Non-Detects (mg/kg)	0.00668	0.0072
Median Detected Concentration (mg/kg)	- -	0.019

Assessment of SQL Effects on Frequency of Detection

The 2008 mercury frequency of detections is appreciably lower than that of the 2005 data; the non-detect SQLs of the two events are fairly comparable. The range of 2005 detections (0.0084 to 0.11 mg/kg) is higher than the 2008 non-detect SQLs (0.00668 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower mercury concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in the frequency of detections in this case.

Selenium

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	0%	43.3%
Median SQLs for Non-Detects (mg/kg)	0.32	0.1579
Median Detected Concentration (mg/kg)	- -	0.29

Assessment of SQL Effects on Frequency of Detection

The 2008 frequency of detections for selenium is appreciably lower than for the 2005 data; the SQLs for the 2008 non-detects are about twice as high as those for the 2005 samples. A large percentage of the 2005 data detections (more than 50% based on median detect value 0.29 mg/kg), would not have been reported as detections under the higher 2008 SQLs (0.32 mg/kg). Therefore, it appears likely that the higher SQLs of the 2008 dataset are one cause of the lower frequency of detection in that dataset, although lower selenium concentrations in the 2008 samples could be another explanation.

Silver

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	42.4%	13.3%
Median SQLs for Non-Detects (mg/kg)	0.11	0.2609
Median Detected Concentration (mg/kg)	0.076	0.0445

Assessment of SQL Effects on Frequency of Detection

The 2005 silver frequency of detections is appreciably lower than that for the 2008 data; SQLs for the 2005 non-detects are more than twice as high as those for the 2008 samples. The range of 2008 detections (0.054 to 0.17 mg/kg) is lower than the 2005 non-detect SQLs (0.2609 mg/kg), and would not have been reported as detections if present at those levels in the 2005 samples. Therefore, it appears likely that the higher SQLs of the 2005 dataset are one cause of the lower frequency of detections in that dataset, although lower silver concentrations in the 2005 samples could be another explanation.

Thallium

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	18.2%	35%
Median SQLs for Non-Detects (mg/kg)	0.3	0.5428
Median Detected Concentration (mg/kg)	0.46	1.1

Assessment of SQL Effects on Frequency of Detection

The 2008 thallium frequency of detections is about 52~~17~~% less than that for the 2005 data, SQLs for the 2008 non-detects are slightly lower than those for the 2005 samples. The majority of 2005 detections (1.1 mg/kg median value) are higher than the 2008 non-detect SQLs (0.3 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower mercury concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.

Tin

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	48.5%	99%
Median SQLs for Non-Detects (mg/kg)	0.3	0.187
Median Detected Concentration (mg/kg)	0.43	0.49

Assessment of SQL Effects on Frequency of Detection

The 2008 tin frequency of detections is appreciably less than that for the 2005 data; the non-detect SQLs for the 2008 data are nearly twice as high as those for the 2005 data. The majority of 2005 detections (0.4 mg/kg 1st quartile value) are higher than the 2008 non-detect SQLs (0.3 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower tin concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.

Uranium-233/234

	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	100%	50.8%
Median MDA for Non-Detects (pCi/g)	Not determined, because all results, including those lower than the MDA, were used in statistical analyses	
Median Detected Activity (pCi/g)	1.17	0.99

Assessment of MDA Effects on Frequency of Detection

The 2005 shallow soil frequency of detection for uranium-233/234 is appreciably less than the frequency of detection of the 2008 data. The detected concentrations are comparable between the two datasets. Reported uranium-233/234 detections in both datasets are higher than the 2005 SQLs associated with non-detections. The assessment of SQL effects on the frequency of detection was not completely conclusive, but based on the above, it does not appear likely that the SQLs are contributing appreciably to the frequency of detection differences. Note that frequency of detection for U-233/234 has no effect on other data summaries and statistical analyses performed in this study, because the radionuclide data are not censored for these purposes.

Zirconium	2008 Supplemental Shallow Data	2005 BRC/TIMET Shallow Data
Percent Detection	39.4%	100%
Mean SQLs for Non-Detects (mg/kg)	0.8	- -
Mean Detected Concentration (mg/kg)	11.5	125
Assessment of SQL Effects on Frequency of Detection	The 2008 zirconium frequency of detections is less than that of the 2005 data. The range of 2005 detections (60.1 to 179 mg/kg) is higher than the 2008 non-detect SQLs (0.8 mg/kg), and would have been reported as detections if present at those levels in the 2008 samples. This suggests that the 2008 samples have generally lower tin concentrations than the 2005 samples. Differences in SQLs do not appear to have caused the differences in frequency of detections in this case.	

Datasets with high frequency of detects tend to be better suited to statistical analyses than those with low frequency of detects (*i.e.*, less than 50 percent), because detection limits in the latter tend to influence the results. The majority of the elements in this study have comparable frequency of detects near 100 percent, and statistical analyses were performed without concern for the effect of non-detections on the findings. For the other elements with far less than 100 percent frequency of detects, the frequency of detects tended to be comparably low in the two datasets; as discussed in the following section, statistical analyses considering the effects of non-detections were developed for these elements or were omitted altogether if the number of detections was too low. The eight metals discussed above represent the few cases in which frequency of detects were appreciably different between the two datasets; these are of particular concern in this study because this situation complicates statistical comparisons. As discussed above, BRC's evaluation of the associated SQLs and ranges of detected concentrations found that differences in SQLs did not appear to have caused the differences in frequency of detects, with the possible exception of cadmium, selenium, and silver, for which the evaluations were inconclusive. For these three metals, statistical comparisons may not be reliable between the two datasets, or in the future, between the background datasets and BMI Common Areas site data.

3.6 STATISTICAL METHODS

Statistical evaluations were used to infer whether metal concentrations and radionuclide activity in 2008 supplemental shallow background soils were comparable to those in the 2005

BRC/TIMET shallow background soils. The following procedures were conducted as part of the statistical evaluations:

- Data were organized by lithologic unit, constituent, and soil interval;
- Data were viewed using boxplots and scatterplots (Section 3.2);
- Data were characterized using descriptive statistics and tests of normality (Section 3.3 and 3.6);
- 2008 supplemental background data were compared to 2005 BRC/TIMET background data using two- and multiple independent sample tests (Sections 3.7.1 and 3.7.2);[15,16]
- 2008 supplement background data were tested to identify potential differences among 0 ft bgs, 5 ft bgs, and 10 ft bgs depth intervals using multiple independent sample tests (Sections 3.7.3); and
- Inter-element associations were identified using correlation analyses and used to further verify that samples were appropriate for characterizing background conditions (Section 3.7.4).

3.6.1 Hypothesis Testing

A common application of classical statistics is to test a scientific hypothesis. A statistical test examines a set of sample data and, based on the underlying distribution of the data, leads to a decision whether to (i) accept[17] the hypothesis or (ii) reject the hypothesis in favor of accepting an alternative complementary one (Sokal and Rohlf 1981). Accordingly, statistical hypotheses are framed in terms of a null hypothesis (H_o) and an alternative hypothesis (H_a).

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[15] 2008 River dataset was compared to the 2005 McCullough, 2005 River, and 2005 Mixed datasets for the following soil intervals: (i) 0 ft bgs, (ii) 5 ft bgs, (iii) 10 ft bgs, (iv) 5-10 ft bgs combined, and (v) 0-10 ft bgs (0, 5, and 10 ft bgs depths combined).

[16] Tests of proportions and comparisons of detected-only data were used when two- and multiple independent sample tests were not recommended—*i.e.*, when sample sizes were greater than four samples and frequency of detections were less than 50 percent.

[17] Note that according to classical statistics, the null hypothesis is never proven, as the absence of evidence against the null hypothesis does not establish it. In other words, strictly speaking, one may either "reject" or "fail to reject" the null hypothesis. However, for this study and as commonly used in practice, the term "accept" is used instead of "fail to reject" the null hypothesis (Sokal and Rohlf 1981).

In this study, the *t*-test was used to evaluate the null hypothesis that the mean concentrations are the same for two background populations for a specific constituent; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the means are different. Similarly, the WRS/Gehan tests were used to evaluate the null hypothesis that median concentrations are the same for two background populations for a specific constituent;[18] conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the medians are different. ANOVA/Kruskal-Wallis tests were used to evaluate the null hypothesis that mean/median concentrations are the same among several background populations for a specific constituent; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the mean/median concentrations are different.

Quantile and slippage tests were used to evaluate the null hypothesis that larger concentrations are similar~~the same~~ for two background distributions of a specific constituent[19]; conversely, the rejection of the null hypothesis results in the acceptance of the alternative hypothesis that the larger values are different (*i.e.*, the values in the right-tail of one distribution are larger than the values in the right-tail of the other distribution).

Correlation tests~~analysis~~ were used to characterize the relationship (or lack thereof) between concentrations of two constituents. The null hypothesis is that there is no correlation between two constituents (*i.e.*, no inter-element correlation); conversely, should this null hypothesis be rejected, one would accept the alternative hypothesis and infer that there exists a relationship (positive or negative) in concentrations between the two constituents. Correlation tests for the Pearson and Kendall-Tau correlation coefficients are described in Neter *et al*. (1996) and Kendall and Gibbbons (1990). These hypotheses were also discussed in the *Background Shallow Soil Summary Report* (BRC/TIMET 2007).

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[18] Note that strictly speaking, the WRS/Gehan tests test whether or not measurements (location, central) from one dataset consistently tend to be larger (or smaller) than those from the other dataset based upon the premise that both datasets were drawn from a single population (*i.e.*, their probability distributions are equal). This test determines which distribution is higher by comparing the relative ranks of the two data sets when the data from both sources are sorted into a single list. These tests require that the two samples to be independent, and the observations to be ordinal or continuous measurements.

[19] The quantile test more formally tests whether the proportion of background (or site) observations from the combined dataset is the same in the upper portion of the combined dataset as it is in the entire combined dataset. The slippage test more formally tests whether the number of site data points that are greater than the maximum background value is reasonable given the number of site samples and the number of background samples.

3.6.2 Statistical Tests

Statistical tests were conducted to compare the 2008 Supplemental and 2005 BRC/TIMET shallow soil datasets and to determine whether there exist relationships between the two constituents. A key decision is whether a parametric or nonparametric statistical test is to be used. Parametric statistical tests used in this evaluation of supplemental background concentrations assume the following:

- Samples are independent and drawn randomly from the population;.
- Data are normally distributed for each population.

Nonparametric methods/tests are not dependent on a specific distribution (*e.g.*, normal distribution) (Singh and Singh 2007; Gilbert 1987; Sokal and Rohlf 1981; Zar 1984).[20] These methods do not require estimates of the population variance or mean. Nonparametric statistical tests assume that samples are independent and drawn randomly from the population.

Methods used to evaluate and compare the data groups for this supplemental background dataset are summarized below. The computer statistical software program GiSdT® (Neptune and Company 2007) was used to perform two-sample statistical comparisons. All parametric and nonparametric multiple independent sample comparisons and correlation analyses were performed using SPSS v.15. Consistent with previous studies of background concentrations at BRC, a level of significance (α) equal to 0.05 was used to evaluate the tests (BRC/TIMET 2007).[21]

3.6.2.1 Two-Sample Tests

Statistical comparisons between the 2008 Supplemental dataset and the 2005 BRC/TIMET background dataset for each depth interval were performed using the Quantile test, Slippage test, the *t*-test, and the WRS test with Gehan modification. The Quantile test, Slippage test, and WRS test are non-parametric. That is, the tests are distribution free, thus an assumption of whether the data are normally or lognormally distributed is not necessary.

[20] Accordingly, nonparametric tests are also known as distribution-free tests.
[21] Where appropriate, a confidence level (1-α) of 95 percent confidence was used.

***t*-Test.** The *t*-test is a hypothesis test for two population means to determine whether they are significantly different. Underlying assumptions of the *t*-test are that both datasets are comprised of randomly sampled data, data are independent and normally distributed, and datasets have equal variances[22] (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984).

Wilcoxon Rank Sum (WRS). The WRS test performs a test for a difference between the sum of the ranks for two populations. This is a nonparametric method for assessing differences in the centers of the distributions that relies on the relative rankings of data values. Knowledge of the precise form of the population distributions is not necessary. The two underlying distributions are assumed to have approximately the same shape. The WRS test has less power than the two-sample *t*-test when the data are normally distributed, but the assumptions are not as restrictive. The GiSdT® version of the WRS test uses the Mantel approach for ranking which is equivalent to using the Gehan ranking system.

Quantile Test. The Quantile test performs a test for a shift to the right in the right-tail of the site or tested population versus the reference population. Conceptually, this tests whether the This may be regarded as being equivalent to detecting if the values in the right-tail of the tested distribution are generally larger than the values in the right-tail of the reference distribution. The Quantile test is performed using a defined quantile = 0.80.

Slippage Test. The Slippage test looks for a shift to the right in the extreme right-tail of one population versus the extreme right-tail of a reference population. This test evaluates whether is equivalent to asking if a set of the number of data points fromlargest values of the site data thattested distribution are greatersignificantly larger (in a statistical sense) than the maximum fromvalue of the background data is reasonable, or if the number is larger than expected under the assumption that the site and background populations are similarreference distribution.

3.6.2.2 Multiple Independent Sample Tests

One-Way Analysis of Variance (ANOVA). The parametric one-way ANOVA tests the hypothesis that multiple (*k*) population means are equal (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984). Where one-way ANOVA indicated the existence of significant differences among soil

[22] Student *t*-test is used when datasets have equal variances. Welch's or Satterthwaite *t*-test may be applied when datasets have unequal variances. Note that the t-test is considered to be relatively robust to deviations from the underlying assumptions (Sokal and Rohlf 1981).

strata, the Tukey Honestly Significant Difference (HSD) test was used to conduct pair-wise *post-hoc* comparisons.[23]

Kruskal-Wallis Test. The Kruskal-Wallis test is a non-parametric analog for the one-way ANOVA that is based on ranks and is used to test the equality of medians among multiple (k) populations. The Kruskal-Wallis test is used to test the null hypothesis that several populations have the same continuous distribution. If the null hypothesis is rejected, one may infer that measurements tend to be higher in one or more of the populations. Fundamentally, this test is analogous to a parametric one-way ANOVA with the exception that the measured/observed values are replaced by their ranks. Accordingly, it is an extension of the WRSWilcoxon-Mann-Whitney test for three or more groups. Where Kruskal-Wallis tests indicated the existence of significant differences among soil strata, examinations of boxplots were used to evaluateconduct pair-wise *post-hoc* comparisons.[24]

Examination of Constituents with Less than 50 Percent Frequency of Detection. When frequency of detectiondetections is less than 50 percent, even the nonparametric tests have little power to detect differences in central values (Smeti *et al*. 2007). For those constituents where the frequency of detection was less than 50 percent, two- or multiple independent sample tests were not conducted. The following approach was conducted:

1. For individual constituent datasets in which SQLs are comparable, a Z-test for two proportions[25] was conducted to identify similarities in datasets based on the proportion of detected concentrations.

2. For individual constituent datasets in which SQLs are comparable and SQLs are higher than detections, where the proportion of detected concentrations was found to be similar and the number of detected concentrations was greater than four for both datasets, independent two- or multiple- independent sample tests were conducted on detected data only.

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[23] Note that only *post-hoc* (= *a posteriori*) comparisons were conducted.

[24] One-half the SQL was substituted for non-detected concentrations in lieu of Gehan ranking. Visual examinations of boxplots were used to conduct *post-hoc* pairwise comparisons.

[25] In this investigation, the Z-test for two proportions (http://www.dimensionresearch.com/resources/calculators/ztest.html) was used to test the null hypothesis that the proportion of detected concentrations is the same among two datasets. If the null hypothesis is rejected, one may infer that the two populations are different with respect to the proportion of detected data.

Note that for constituents with frequency of detections less than 50 percent and SQLs meeting project limit requirements, one may conclude that these constituents are present in shallow background soils.

3.6.2.3 Correlation Analysis

Correlations or "measures of association" are of interest because they offer another line of evidence to confirm that the data are consistent with a background dataset (see Section 3.4). Inter-element correlation analyses were conducted for exploratory purposes and used to identify those constituent pairs that should be further examined (*i.e.*, visual examination of scatterplots) to ascertain whether high-concentration outliers were congruous with the background dataset.

Pearson's Product-Moment Correlation Coefficient. The Pearson product-moment correlation coefficient (r) is a parametric measure of the correlation between two variables (Sokal and Rohlf 1981; Gilbert 1987; Zar 1984). Pearson's correlation reflects the degree of linear relationship between two variables and ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between variables. A correlation of -1 means that there is a perfect negative linear relationship between variables. A correlation of 0 means there is no linear relationship between the two variables.

Kendall Tau Correlation Coefficient. The Kendall tau rank correlation coefficient (or Kendall tau coefficient) is a non-parametric statistic used to measure the degree of correspondence between the ranks of two populations. As with the Pearson's correlation coefficient, Kendall tau ranges from +1 to -1. A value of +1 means that there is 100 percent positive association between the two variables—*i.e.*, rankings for both variables are identical. A value of -1 means that there is 100 percent negative association between the two variables—*i.e.*, the ranking of one variable is the reverse of the other variable. A value of zero indicates the absence of an association between the two variables—*i.e.*, rankings are independent.

3.6.2.4 Adjustment for Use of Multiple Tests

An adjustment may be applied when multiple hypotheses a single hypothesis of no effect areis tested. using more than one statistical test. Note that by random chance alone, approximately 1one out of every 20 hypothesis tests on the same dataset are is expected to be statistically significant at a level of 0.05 if the tests are independent (α = 0.05; Sokal and Rohlf 1981). Accordingly, an adjustment may be applied to safeguard against falsely giving the appearance of statistically significant results when a single hypothesis is tested using multiple statistical tests.

In this background study, adjustment for the use of multiple tests was performed for the three applications listed below. Note that the conservatism of using the family-wise significance level for individual tests was recognized and "close" results were identified.

Use of Multiple Two-Sample Tests. Four two-sample statistical tests were used to evaluate whether two datasets were obtained from the same population: t-test, WRS/Gehan test, quantile test, and slippage test. The t-test and WRS/Gehan test assess whether central tendencies (*i.e.*, means or medians, respectively) are the same. Whereas, the quantile test and slippage test assess whether values in the right-tails of the distributions are the same. If a statistically significant difference was found using any one of the statistical tests, it was inferred that the data were obtained from two different populations. Accordingly, an adjustment to the significance level was conducted when all four of the two-sample comparison tests were applied. Neptune and Company, Inc.,~~Pacific Northwest National Laboratories (PNNL)~~ performed simulation studies on the suite of four background comparison tests, and determined that an adjustment to the family-wise error rate[26] of one-half was reasonable~~appropriate~~ when all four of these tests were applied (NDEP 2009c~~2009b~~). For this study, a nominal family-wise significance level of 0.05 was desired; thus, an adjusted significance level of 0.025 was used (= ½ * 0.05). A significance level of 0.025 is consistent with the Site versus background comparisons being conducted for the project.

Differences Among Background Populations Based on Tests For Multiple Constituents. Differences among lithologies or depth intervals were evaluated based on the findings of ANOVA/Kruskal-Wallis tests for each of 46 metals and radionuclides. As noted earlier, due to random chance alone, 1 out of every 20 hypothesis test on the same data is expected to be statistically significant at a significance level of 0.05 ($\alpha = 0.05$). For ANOVA/Kruskal-Wallis tests, a qualitative adjustment was applied when evaluating whether lithologies or depth intervals were different based on comparisons for multiple constituents. For this study, a nominal family-wise significance level of 0.05 was desired; thus, lithologies and depth intervals were considered different when more than five percent of all the ANOVA/Kruskal-Wallis tests were found to be significantly different.

Multiple Post-Hoc Pairwise Comparisons. When ANOVA identified a statistically significant difference among lithologies or among depth intervals, the Tukey's Honestly Significant

[26] Family-wise error rate is the probability of making one or more Type I errors (false discoveries) among all the hypotheses when performing multiple pairwise tests (Hochberg and Tamhane 1987; Benjamini and Hochberg 1995).

Difference (Tukey's HSD) was used to identify which pairs of lithologies or which pairs of depth intervals were different. Tukey's HSD uses the Studentized range statistic to make all pairwise comparisons between groups and adjusts the investigation-wise error rate to the error rate for the collection for all pairwise comparisons (SPSS 2006).

3.7 RESULTS OF STATISTICAL ANALYSES

A key objective of this investigation is to evaluate whether the 2008 Supplementalsupplemental shallow soil background dataset is statistically similar to or different from the 2005 BRC/TIMET background data. The results of the following statistical analyses are provided with the intention of supporting a weight-of-evidence evaluation as part of this investigation.

3.7.1 Comparison of 2008 Supplemental and 2005 BRC/TIMET Datasets (All Depths Combined)

The 2008 Supplemental and 2005 BRC/TIMET shallow background soil datasets were evaluated to determine if there are differences among the following subsets of the shallow background concentration data:

- 2008 River;
- 2005 McCullough;
- 2005 River; and
- 2005 Mixed.

If no differences are found, combining/pooling these subsets of the background concentration data may be recommended for subsequent evaluations to provide a more powerful comparison between site and background concentrations. Conversely, if differences are found, it is recommended that comparisons between site and background concentrations be performed with the appropriate subset of the background concentration data.

Probability plots, boxplots, and individual value plots were also used to compare the 2008 Supplemental and 2005 BRC/TIMET datasets. These plots are included in Appendix D. The results of the statistical analyses are included in Appendix F.

The 2008 dataset was compared to each of following lithologic units: 2005 McCullough, 2005 River, and 2005 Mixed datasets (Table F-2 of Appendix F). Consistent with the *Background Shallow Soil Summary Report* (BRC/TIMET 2007), if a given dataset had fewer than four detections, it was deemed to lack data sufficient to support a robust statistical analysis and was not included in the statistical comparisons. If no more than two datasets had greater than four detections, no statistical comparisons were performed for that constituent. Accordingly, statistical tests were not performed for chromium (VI), niobium, platinum and tungsten—and it was not possible to determine whether significant differences were associated with the 2008 River and the three 2005 soil lithology datasets for these metals.

Overall, statistical comparisons indicated that a number of significant differences existed for 34 of 46 constituents among the four lithologic units: 2005 McCullough, 2005 River, 2005 Mixed, and 2008 River (Table F-2 of Appendix F):

- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Mercury
- Molybdenum
- Nickel
- Palladium
- Phosphorus
- Potassium
- Silicon
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium
- Zirconium
- Radium-226
- Radium-228
- Thorium-228
- Thorium-230
- Thorium-232
- Uranium-233/234
- Uranium-238

The greatest number of significant differences was noted between 2005 McCullough and 2005 River datasets.

Differences between the 2008 River dataset and allany of the 2005 datasets were identified for 14 constituents (Table F-2 of Appendix F):

- Arsenic
- Barium
- Boron
- Palladium
- Potassium
- Silicon
- Zirconium
- Radium-228
- Thorium-230

- Lithium
- Magnesium
- Sodium
- Strontium
- Uranium-233/234

With respect to the 2008 River dataset, a greater number of significant differences were noted between (a) 2008 River and 2005 McCullough and (b) 2008 River and 2005 Mixed datasets as compared to other inter-lithologic unit comparisons. As might be expected, the fewest number of significant differences were noted between the 2005 River and 2008 River datasets. Note that higher concentrations of arsenic in the 2008 River soils as compared to the 2005 River soils may be inferred from the Tukey HSD comparison results. For most constituents, the probability (*p*) values (*p*-values) for the ANOVA/Kruskal-Wallis were less than 0.001 (Table F-2). Accordingly, the application of a Bonferroni correction to the family-wise significance level would not change the overall conclusions that differences exist among the four lithologic units and that the 2008 River dataset is significantly different than the three 2005 datasets for several constituents.

When the frequency of detections is less than 50 percent, even the nonparametric tests have little power to detect differences in central values (Smeti *et al*. 2007). For constituents with frequency of detects less than 50 percent and similar detection limits, a binomial proportions test was conducted to determine if frequency of detects between background datasets were comparable. Where frequency of detects were found to be similar, subsequent comparisons using detected-only data were conducted for infrequently detected constituents to identify potential similarities among background datasets.[27] Differences between the 2008 and the 2005 background datasets may also be inferred from these analyses (Table F-4 of Appendix F) and are summarized as follows:

Constituent	**Sample Size*** (n > 4)	**Z-Test for Two Proportions**	**Additional Analysis Candidate**
Antimony	Yes	Similar frequency of detection	Yes
Boron	Yes	Similar frequency of detection	Yes
Silver	Yes	Dissimilar frequency of detection	No
Tin	Yes	Similar frequency of detection	Yes
Radium-228	Yes	Similar frequency of detection	Yes

* for two or more lithologic units

[27] Only when datasets have comparable detection limits can this analysis be performed as a line of evidence to infer differences between datasets; otherwise, the test will only reflect differences in detection limits.

Comparisons of detected-only values between 2008 River and 2005 lithologic units were mixed for infrequently detected constituents—*i.e.*, differences may be inferred for some infrequently detected constituents; while no differences may be inferred for other infrequently detected constituents (Table F-9). Note that infrequently detected constituents are, by definition, characterized by a high proportion of censored data. Accordingly, it is both reasonable and defensible that study conclusions related to similarities/dissimilarities among background datasets consider the overall preponderance of the evidence from the more reliable statistical analyses associated with the majority of the 46 constituents with greater frequency of detects.

All in all, from these statistical comparisons, it may be inferred that the 2008 River data differ with respect to metal concentrations and radionuclide activities fromto the 2005 lithologic units. Therefore, it is recommended that the 2008 Supplemental Background dataset not be pooled with the 2005 BRC/TIMET background dataset for future applications; however, this will be evaluated site-specifically on a case-by-case basis.

3.7.2 Comparison of 2008 Supplemental and 2005 BRC/TIMET Datasets (Depth-Specific Evaluations)

The 2008 Supplemental and 2005 BRC/TIMET shallow background soil datasets were also evaluated on a depth interval-specific basis to further evaluate potential similarities/dissimilarities. Accordingly, two-sample tests were performed to compare the 2008 River to the 2005 McCullough datasets for each of three separate depth intervals: 0 ft bgs, 5 ft bgs, and 10 ft bgs depths intervals.[28] ANOVA/Kruskal-Wallis analyses compared concentrations/activities of constituents in the 5-10 ft bgs depth interval (combined 5 ft bgs and 10 ft bgs datasets) among three lithologic units: 2008 River, 2005 McCullough, and 2005 Mixed[29] (Table F-3). The results of the statistical analyses are included in Appendix F. Probability plots, boxplots, and individual value plots were used to semi-quantitatively compare the 2008 Supplemental and 2005 BRC/TIMET data. These plots are included in Appendix D.

[28] The sample size for constituents in the 2005 River and 2005 Mixed datasets for 0 ft bgs, 5 ft bgs and 10 ft bgs depth intervals were less than four samples and were considered insufficient to support statistical testing.robust comparisons.

[29] The sample size for constituents in the 2005 River dataset (5-10 ft bgs combined depth interval) were less than four samples and were considered insufficient to support statistical testing.robust comparisons.

3.7.2.1 Two Sample Test Results (individual 0, 5 & 10 ft bgs comparisons)

Consistent with the findings of statistical comparisons described in the prior section, a number of differences in metal concentrations were inferred based on statistical comparisons between the 2008 River and the 2005 McCullough datasets (Tables F-6, F-7, and F-8 in Appendix F):

- Arsenic (all depths)
- Barium (all depths)
- Beryllium (5 and 10 ft bgs)
- Boron (all depths)
- Cobalt (all depths)
- Copper (5 and 10 ft bgs)
- Iron (5 ft bgs)
- Lead (5 and 10 ft)
- Lithium (10 ft bgs)
- Magnesium (0 and 10 ft bgs)
- Manganese (5 ft bgs)
- Nickel (all depths)
- Palladium (0 and 5 ft bgs)
- Phosphorus (all depths)
- Potassium (all depths)
- Silicon (5 ft bgs)
- Silver (0 ft bgs)
- Sodium (all depths)
- Strontium (0 and 5 ft bgs)
- Tin (5 ft bgs)
- Titanium (all depths)
- Vanadium (0 and 5 ft)
- Zirconium (all depths)

No differences in radionuclide activities were inferred based on the results of statistical comparisons for any of the three depth intervals (Tables F-6, F-7, and F-8 in Appendix F). For most constituents, the *p*-value for at least one parametric or nonparametric two-sample testtests is less than 0.001 (Tables FE-6 through F-8E-6). Accordingly, the application of a Bonferroni correction to the family-wise significance level would not change the overall conclusion that differences exist between 2008 River and 2005 McCullough on a depth interval basis.

3.7.2.2 ANOVA/Kruskal-Wallis Test Results (5 - 10 ft bgs combined)

Consistent with the *Background Shallow Soil Summary Report* (BRC/TIMET 2007), the datasets for the 5 ft bgs and 10 ft bgs depth intervals within a lithologic unit were combined to produce a dataset for the 5-to-10 (5-10) ft bgs depth interval. Overall, a number of significant differences in metal concentrations among the three lithologic units (2008 River, 2005 McCullough, and 2005 Mixed) were identified for the 5-10 ft bgs depth interval based on the results of ANOVA/Kruskal-Wallis tests (Table F-3 in Appendix F). The only constituents for which no significant differences were identified wereinclude:

- Calcium
- Zinc
- Thorium-228
- Thorium-232

For most constituents, the *p*-values for the ANOVA/Kruskal-Wallis tests were less than 0.001 (Table F-3). Accordingly, the application of a Bonferroni correction to the family-wise significance level would not change the overall conclusions that differences exist among the four lithologic units with respect to the 5-10 ft bgs depth interval.

Consistent with the 2005 Shallow Background Study (BRC/TIMET), no statistical tests were conducted for metals that had fewer than four detections in one or more of the unit-specific datasets, specifically:

- Antimony
- Boron
- Cadmium
- Chromium (VI)
- Mercury
- Niobium
- Platinum
- Selenium
- Silver
- Thallium
- Tungsten

Because these constituents were not subjected to statistical comparisons, it was not possible to determine whether significant differences were associated with the 5-10 ft bgs depth interval among the 2008 River, 2005 McCullough, and 2005 Mixed datasets.

Significant differences were noted between the 2008 River dataset and the datasets for the other two lithologic units (Table F-3 of Appendix F). More significant differences were identified between the 2008 River and 2005 McCullough datasets. However, differences in metal concentrations and radionuclide activities were inconsistent between the units—*i.e.*, one lithologic unit did not have consistently higher concentrations or activities. The 2005 Mixed dataset was nearly always indistinguishable from either one or both of the other two lithologic units. That is, for all elements except uranium-238, the 2005 Mixed dataset was (1) statistically indistinguishable from both the 2005 McCullough and the 2008 River datasets (*e.g.*, arsenic, lead); (2) statistically indistinguishable from the 2005 McCullough dataset but had inferred significant differences from the 2008 River dataset (*e.g.*, magnesium, manganese); or (3) statistically indistinguishable from the 2008 River dataset but had inferred significant differences from the 2005 McCullough dataset (*e.g.*, barium, tin) (Table F-3 of Appendix F). This observation is consistent with the interpretation of the 2005 Mixed dataset being derived from soils that reflect a mixture of McCullough and River soils. The 2005 Mixed dataset had significant differences inferred relative to the 2008 River dataset for several common parent elements (*e.g.*, silicon, aluminum, magnesium, potassium), which suggests a closer affinity between the Mixed and McCullough soils.

The following constituents were considered to be present at higher concentrations in the 2008 River dataset than the other two datasets:

- Arsenic
- Chromium
- Palladium
- Potassium
- Silicon
- Sodium
- Strontium
- Uranium

For infrequently detected constituents (less than 50 percent frequency of detection), differences between the 2008 River and the 2005 datasets may also be inferred from these analyses (Table F-5 of Appendix F) and are summarized as follows:

Constituent	Sample Size* (n > 4)	Z-Test For Two Proportions	Additional Analysis Candidate
Antimony	Yes	Similar frequency of detection	Yes
~~Radium-226~~	~~Yes~~	~~Similar frequency of detection~~	~~Yes~~
~~Radium-228~~	~~Yes~~	~~Similar frequency of detection~~	~~Yes~~

* for two or more lithologic units

Results of comparisons~~Comparisons~~ of detected-only values between 2008 River and 2005 lithologic units were mixed for infrequently detected constituents-—*i.e.*, differences may be inferred for only some infrequently detected constituents (antimony, boron~~); while no differences may be inferred for other infrequently detected constituents (radium-226, radium-228~~). Note that infrequently detected constituents ~~constituents~~ are, by definition, characterized by a high proportion of censored data. Accordingly, it is both reasonable and defensible that study conclusions related to similarities/dissimilarities among background datasets consider the overall preponderance of the evidence from the more reliable statistical analyses for the vast majority of the 46 constituents with greater frequency of detects.

Again, when results of statistical comparisons are taken as a whole, it may be inferred that the 2008 River data differ with respect to metal concentrations from ~~and radionuclide activities to~~ the 2005 lithologic units. These findings support the recommendation not to pool the

2008 Supplemental Background dataset with the 2005 BRC/TIMET background datasets for future applications.

3.7.3 Comparison of 2008 Supplemental Shallow Data by Depth Intervals

Soil samples were collected from three depth intervals from the 2008 Supplemental shallow background soil study: 0 ft bgs, 5 ft bgs, and 10 ft bgs. Data for samples from each depth interval were compared using the statistical tests identified in Section 3.6.2. Multiple population (ANOVA) tests were selected and used to compare data among surface, middle shallow, and deeper shallow soil samples. The results of the statistical analyses are included in Appendix F. Results that are statistically significant at a p-level of 0.05 are indicated in each table (see Section 3.6.2.4 regarding correction for use of multiple tests). Boxplots and individual value plots shown in Appendix D compare the data by depth interval and offer a visual semi-quantitative appraisal of differences for each analyte among the groups of data. Statistical tests provide a quantitative analysis to determine if the differences are statistically significant at a specified significance level.

For the most part, metal concentrations were comparable among the three soil depth intervals (Table F-1 of Appendix F). Statistically significant differences in concentrations or activity among soil depth intervals were found for only seven of 46 constituents examined:

- Cobalt[30]
- Nickel
- Potassium
- Sodium
- Thorium-230
- Uranium-233/234
- Uranium-238

For most constituents, the *p*-values for the ANOVA/Kruskal-Wallis tests were greater than 0.05 (Table F-1). Accordingly, the application of a ~~Bonferroni~~ correction to the family-wise significance level would not change the overall conclusions that few differences exist among the 0, 5, and 10 ft bgs depth intervals for the 2008 Supplemental~~supplemental~~ shallow soil data (Table F-1). ~~In fact, using a Bonferroni correction, differences for only two of 46 constituents would be statistically significant: concentrations of potassium and activities of uranium-233/234 (Table F-1).~~

The statistical comparisons found that statistically significant differences could be inferred primarily between (i) 0 ft bgs and 5 ft bgs and (ii) 0 ft bgs and 10 ft bgs for metals; no significant

[30] The ANOVA results for cobalt suggested that there were significant differences between lithologic units; however, the *post-hoc* testing did not identify specific differences.

differences were inferred for metals between the 5 ft bgs and 10 ft bgs datasets. For radionuclides, comparisons found that statistically significant differences could be inferred primarily between the 0 ft bgs and 10 ft bgs datasets only. In addition to those apparent significant differences, only one other significant difference was inferred for radionuclides. This was, for the thorium-230 5 ft bgs and 10 ft bgs datasets.

Differences in metal concentrations and radionuclide activities were inconsistent between the units—*i.e.*, one lithologic unit did not have consistently higher concentrations or activities. Sodium concentrations and radionuclide activities were found to be greater for the 10 ft bgs depth interval as compared to the other depth intervals. Nickel and potassium concentrations were found to be greater in the 0 ft bgs depth interval as compared to deeper intervals.

Although some identified statistically significant differences were observed for the above metals and radionuclides, these differences may not be significant from a geochemical perspective. Nonetheless, the findings of these statistical analyses suggest that the 0 ft bgs, 5 ft bgs, and 10 ft bgs depth intervals may be pooled and applied as a single dataset for future applications.

3.7.4 Inter-Element Correlations

In addition to statistical tests comparing shallow background soils data among lithologic units and depth intervals, the 2008 River data were evaluated with respect to inter-element correlations. Correlations or "measures of association" are of interest because they offer another line of evidence to confirm that data are consistent with a background dataset (see Section 3.4). Correlation analyses were conducted and used to identify those constituent pairs that should be visually examined in scatterplots to ascertain whether high-concentration outliers should be considered consistent with the background dataset. Both parametric (Pearson's product-moment) and nonparametric (Kendall tau) correlation coefficients are presented in correlation matrices (Appendix G). Note that statistically significant correlation coefficients (at a significance level of 0.05)[31] are indicated by bold font and are color-coded for parametric and nonparametric coefficients in each table. Scatterplots for constituents with significant correlation coefficients and high-concentration outliers are also presented in Appendix G.

[31] An adjustment for multiple comparisons was not applied to the correlation analyses because these analyses were used to identify constituents requiring further analysis and not for distinguishing between datasets using multiple tests.

Statistically significant associations were observed for several elements. The association of aluminum with trace metals was evaluated, and statistically significant associations were found for barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, nickel, phosphorus, potassium, silicon, silver, tin, titanium, uranium, vanadium, and zirconium (Table G-1 of Appendix G). Strong inter-element correlations are normally expected between alkaline and alkaline-earth metals (BRC/TIMET 2007)—for the 2008 Supplementalsupplemental background data, statistically significant correlation coefficients between alkaline and alkaline-earth metals ranged from 0.25 to 0.40 (Table G-3 of Appendix G). These associations may be useful in distinguishing soils derived from different source materials and in distinguishing site-related contamination from natural background. Statistically significant associations among thorium-232 decay chain radionuclides were not observed (Table G-5 of Appendix G).[32] Statistically significant associations among uranium-238 decay chain radionuclides were observed—correlation coefficients ranged from 0.32 to 0.54. Both the thorium-232 and uranium-238 chains were determined to be in approximate secular equilibrium following equivalence testing outlined in NDEP's *Guidance for Evaluating Secular Equilibrium at the BMI Complex and Common Areas February* (NDEP 2009d). There continues to be an issue for the Th-232 chain, in which it is common for BRC site and background data to observe approximate secular equilibrium, but a lack of correlation between isotopes in the decay chain. To date, the issue is unresolved. The results of the equivalence testing for secular equilibrium are as follows:

Chain	Equivalence Test		Secular Equilibrium?	Mean Proportion			
	Delta	p-value		Ra-226	Th-230	U-233/234	U-238
U-238	0.1	0.03	Yes	0.2114	0.2934	0.2716	0.2236
				Ra-228	Th-228	Th-232	
Th-232	0.1	0.00	Yes	0.3143	0.3647	0.3210	

3.7.5 Scatterplots

In addition to the calculated inter-element correlations, scatterplots with regression lines provide a visual assessment of inter-element associations. Statistically significant associations and high-concentration outliers were identified for several elements within the 2008 dataset (Appendix G):

[32] Further investigation produced no explanation for the lack of correlation among thorium-232 decay chain radionuclides.

- Aluminum
- Arsenic
- Barium
- Copper
- Lithium
- Nickel
- ~~Palladium~~
- ~~Silver~~
- Strontium

Scatterplots for identified constituent pairs were examined to determine whether high-concentration outliers are consistent with background (Appendix G)—*i.e.*, high-concentration outliers were "near" the linear least-square trend line. To identify potential deviations from trend lines, constituents listed above were plotted against constituents that were correlated and considered ubiquitous and relatively constant for identified lithologic units—*i.e.*, aluminum, iron, and magnesium. In general, no consistent and conspicuous deviations from least-square trend lines were observed for high concentration outliers.

Certain inter-element relationships are expected on the basis of geochemical behavior and expected mineralogical associations. For example, alkaline metals (such as lithium, sodium, and potassium) and alkaline-earth metals (such as barium, calcium, and magnesium) can be expected to behave similarly in solution and may therefore be expected to show an association in certain environmental media. Other metals are found in association in common minerals and show correlations in soils containing these minerals (such as feldspars; metal oxides such as hematite, goethite and pyrolusite; and carbonate minerals such as calcite). These associations are useful in distinguishing soils derived from different source materials and in distinguishing site-related contamination from natural background.

The association of aluminum with trace metals was also evaluated. Trace metals such as chromium, cobalt, copper, nickel, and vanadium may occur as impurities in the common alumino-silicate family of minerals known as feldspars. Clays and other secondary aluminum minerals in soils may host sorption sites for trace metals, thereby associating these metals. In general, these associations are evident.

Scatterplots were also constructed for radionuclides within the thorium-232 and uranium-238 decay chains and are included in Appendix G. Often, species within the decay chains (parents and daughters) show correlations unless there are great differences in geochemical behavior and sufficient mechanisms to separate the species. In general, most of the radionuclides in the uranium-238 decay chain (radium-226, thorium-230, and uranium-233/234) did show significant associations. Radionuclides in the thorium-232 decay chain (radium-228 and thorium-228) did not show significant associations, confirming the correlation results presented in Section 3.7.4.

Finally, scatterplots were constructed for arsenic and other metals commonly found at high levels in the Upper Ponds (chromium, lead, manganese, and vanadium) as well as radium-226 to support the contention that the 2008 Supplemental dataset is representative of background. Some correlation betweencorrelation betweens these elevated levels would be expected in the ponds given the depositional history of the site. In general, most of these contaminants did show varying degrees of visual correlation with arsenic, with the possible exception of manganese. If aerial deposition of wind-borne dusts from Site operations were occurring at the background locations, a similar pattern may be expected. However, these same metals and radium-226 did not show any correlation with arsenic in either the 2008 Supplementalsupplemental or 2005 BRC/TIMET background datasets. Although some correlation appears evident between arsenic and vanadium in the 2008 Supplemental dataset, this is primarily driven by their highest concentrations being found in the same sample (BRC-BKG-R09) in the subsurface (10 ft bgs); likely not a result of contamination from the site.

4.0 SUMMARY AND CONCLUSIONS

The purpose of the 2008 Supplemental shallow soil background study was to collect and analyze data for metals and radionuclides in background shallow soils that are representative of soils in geologic units not covered by the existing 2005 background shallow soil dataset (BRC/TIMET 2007). The objectives of this study are report was to determine whether these background data, which areare assumed representative of distinct geologic unit from the northern River Mountains, and whether they can another geology, may be added to the background data pool to accommodate background comparisons at portions of the Common Areas (*i.e.*, the Mohawk sub-area and portions of Parcel 4B).

Soil sampling was conducted in April 2008. Samples were collected from 10 soil boring locations that represent the specific lithologies targeted by this supplemental shallow soil background sampling study and that extend the representative range of soils found in the vicinity of the Site. A total of 30 field and three duplicate soil samples were collected from the 10 borings for analysis.[33] The data validation for the 2008 Supplemental dataset included 20 percent full validation and 100 percent partial validation. Results qualified as estimated based on the data validation are usable for the purposes of establishing background concentrations and for comparison to site-specific sample data. No soil sample results were rejected. One hundred percent of the dataset were validated as usable, indicating that the overall data collection objectives for the study were met. However, as noted in Section 3.5, for a few metals (*e.g.*, cadmium, selenium, and silver), variations in SQLs may have affected the frequency of detection and the validity/applicability of statistical analyses between the 2008 and 2005 background datasets as well as in comparisons of these data to future site data.

Based on sampling location characteristics, information obtained from published documentation, site inspection, and sample collection, it is reasonable to conclude that the background samples collected as part of this investigation reflect shallow background soil conditions that may be used to support assessments of soils at the Mohawk sub-area and Parcel 4B. As discussed in Section 2.4, SVOC analyses were used to assess the potential for impacts to the sampling locations from anthropogenic sources. SVOC detections in surface soil samples collected at the background sampling locations are limited to bis(2-ethylhexyl)phthalate, a common lab contaminant. Therefore, the SVOC data did not provide any evidence suggesting that use of the samples for characterizing background conditions would be inappropriate. The results of

[33] The field duplicates were evaluated as independent samples in the statistical analyses.

correlation analyses and scatterplots also corroborate the conclusion that this dataset is appropriate for use as a representative shallow background soil dataset.

Key findings from the analyses of the shallow background soils data include:

- Based on the statistical analyses performed, there appear to be distinct differences between the populations associated with soils derived primarily from the McCullough and River Mountains, and with soils representing a mixture of both sources. It is therefore appropriate to perform comparisons of background to siteSite data using the subset of background data that most closely matches the geologic conditions of that part of the Site as follows:

Portion of Site	Applicable Background Dataset
EasternSoutheastern portion (*e.g.*, Mohawk, eastern part of Parcel 4B)	2008 River dataset
Northeastern portion	2005 McCullough and Mixed datasets
Northwestern portion (*e.g.*, Western Hook)[34]	2005 McCullough dataset
Central or remaining portion	2005 McCullough and Mixed datasets

Distinct differences between the 2008 River (North River) dataset and the 2005 River (South River) dataset were also observed (*e.g.*, arsenic concentrations are greater in soils derived from North River sediments as compared to soils derived from South River sediments). Although it is appropriate to perform comparisons of background to siteSite data for Mohawk and parts of Parcel 4B using either the 2008 (North) River or the 2005 (South) River datasets based on the geologic conditions at the Site, given the proximity of the 2008 River dataset to these areasthe Site, this is considered the more appropriate dataset for comparison purposes. Although there may be instances where the 2005 (South) River dataset may be appropriate, future use of this dataset is considered unlikely.

[34] Note that portions of surface and/or near surface soils in the northwestern portion of the Site may also be associated with the Upper Muddy Creek formation (UMCf). BRC is currently conducting a study that should provide data that will determine naturally-occurring arsenic conditions in this portion of the Site. This study will include the evaluation of potential arsenic mobilization and/or accumulation mechanisms, and a more detailed geologic characterization including pedogenic, hydrogeologic and geochemical site conditions. In addition, subsurface (and potentially surface) soils in the north central portion of the Site may be associated with the deeper alluvium, characterized by a separate deep background dataset for the project.

- Because statistical analyses suggest that the 2008 Supplemental and 2005 BRC/TIMET datasets exhibit a number of statistically significant differences, it is recommended not to combine these datasets in support of future comparisons to site data. Potential exceptions to this recommendation will be considered on a case-by-case basis—for example, for areas of the site that may occur at the interface of different geologic units (*e.g.*, Parcel 4B).

- Findings of the ANOVA/Kruskal-Wallis tests found few statistically significant differences among the 0, 5, and 10 ft bgs depth intervals for the 2008 River background data. These findings suggests that data for the 0, 5, and 10 ft bgs depth intervals may be pooled and applied as a single dataset, promoting more powerful statistical analyses for future assessments in support of decision-making.

- Because of the limited inferred differences in the depth-specific sample populations for the 2008 River unit, it is not necessary or appropriate to compare depth-specific Site data to the associated depth-specific background dataset.

Although the various background datasets are all contained within the project database, combining the background dataset by depth and/or lithology for subsequent comparison with Site data will be influenced by potential exposures at varying depth intervals and the location of a particular receptor – in other words, based on data usability and conceptual site model considerations.

These findings suggest that these data are appropriate for supporting future assessments and decision-making with respect to soils at sites within the BMI Complex and Common Areas. Specific decisions regarding how best to use the shallow background soils data for future Site-to-background comparisons will be made on a case-by-case basis in consultation with NDEP.

5.0 REFERENCES

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APPENDIX B

DATA USABILITY TABLES AND ELECTRONIC DATASET

APPENDIX C

SOIL BORING LOGS

EXPLORATION LOG
BRC-BKG-RO1

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/8/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	7 10 10	SM	Brown (7.5 YR 5/4) silty SAND with gravel, few cobbles, dry and medium dense.						
2.5			...cobbles.						
	31 12 15		...light brown.						
5									
7.5									
	12 20 28		...dense.						
10									
			END OF BORING AT 10.5 FEET						
12.5									
15									

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 1

EXPLORATION LOG
BRC-BKG-RO2

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/8/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA

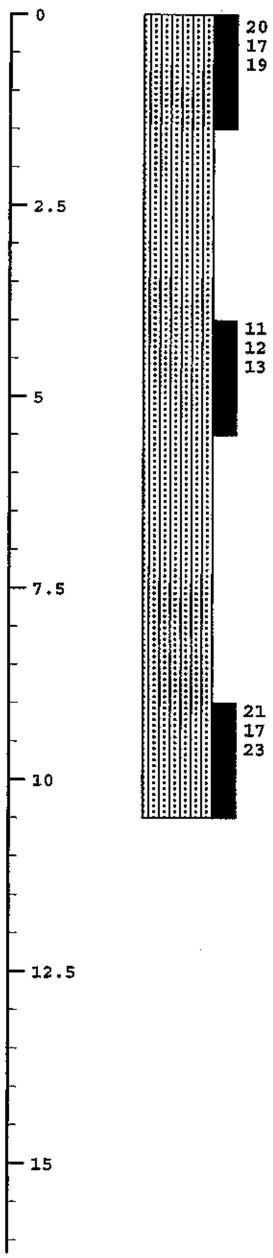
ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	6 7 9	SM	Pink (7.5 YR 7/4) silty SAND with gravel dry, and medium dense.						
2.5			...cobbles.						
	36 28 23		...light brown, dense.						
5									
7.5			...gravel layer from approximately 8 to 8.5 feet.						
	17 31 26								
10			...very dense.						
			END OF BORING AT 10.5 FEET						
12.5									
15									

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

EXPLORATION LOG
BRC-BKG-RO3

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/8/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
		SM	Ligth brown (10 YR 6/3) silty SAND with gravel, dry and medium dense. ...gravel layer from approximately 3-4 feet. ...gravel layer from approximatley 8.5 8.8 feet. ...dense.						
			END OF BORING AT 10.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 3

EXPLORATION LOG
BRC-BKG-RO4

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/8/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	6 9 18	SM	Light yellowish brown (10 YR 6/4) silty SAND with gravel dry and medium dense.						
2.5			...gravel layer approximatley 1" thick.						
5	8 14 16								
7.5			...gravel layer approximately 3" thick.						
10	10 20 24		...dense.						
			END OF BORING AT 10.5 FEET						
12.5									
15									

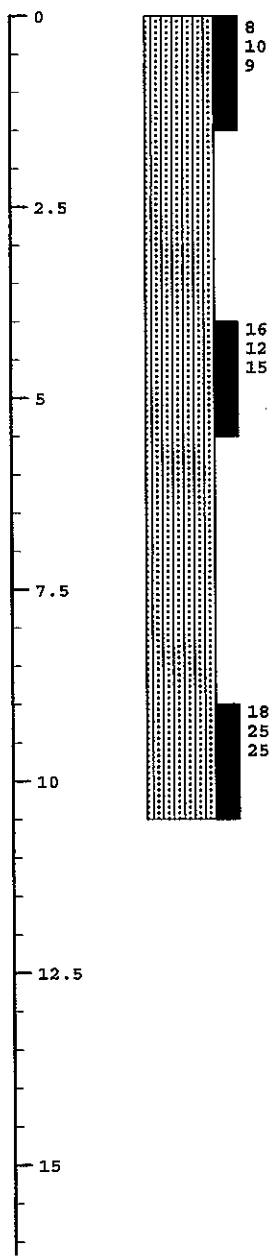
The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 4

EXPLORATION LOG
BRC-BKG-RO5

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
		SM	Pink (7.5 YR 7/4) silty SAND with gravel, few cobbles, dry and loose.						
			...medium dense.						
			...gravel layer approximately 1.5" thick. ...very dense.						
			END OF BORING AT 10.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

EXPLORATION LOG
BRC-BKG-RO6

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENVOUNTERED **DATE MEASURED:** NA

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	15 21 42	SM	Yellowish brown (10 YR 5/4) silty SAND with gravel dry and very dense.						
2.5			...moist.						
			...gravel layer approximatley 2" thick.						
5	8 6 7	SP	Yellowish brown (10 YR 5/4) poorly-graded SAND with silt and gravel, moist and loose.						
7.5									
10	15 17 29		...medium dense.						
			END OF BORING AT 10.5 FEET						
12.5									
15									

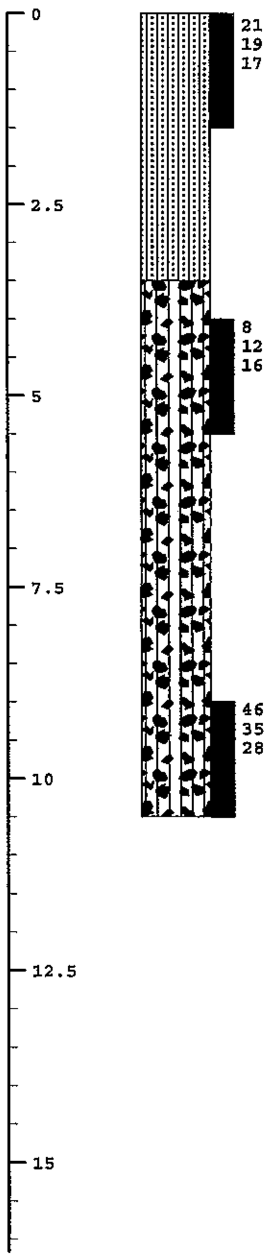
The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 6

EXPLORATION LOG
BRC-BKG-RO7

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0		SM	Pink (7.5 YR 7/4) silty SAND with gravel dry and medium dense.						
		GM	Pink (7.5 YR 7/4) silty GRAVEL with sand dry and medium dense.						
			...very dense and moist.						
			END OF BORING AT 10.5 FEET						

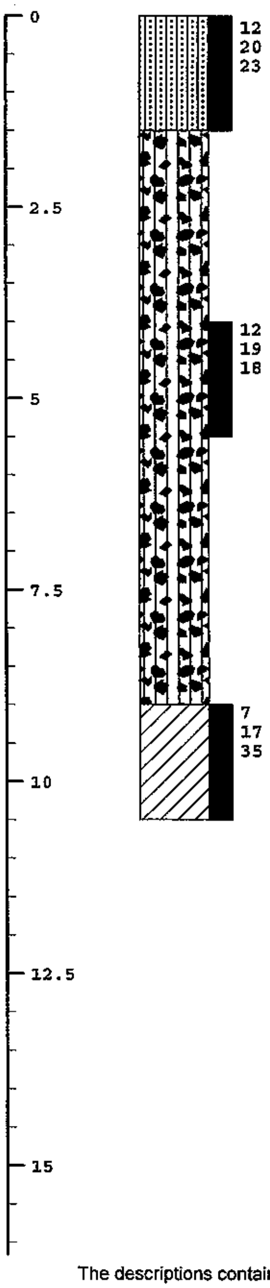
The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 7

EXPLORATION LOG
BRC-BKG-RO8

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	12 20 23	SM	Pink (7.5 6/4) silty SAND with gravel dry and dense.						
2.5		GM	Light brownish gray (10 YR 6/2) silty GRAVEL with sand dry and very dense.						
	12 19 18		...thin gravel layer from approximatley 3-3.1'.						
5									
7.5			...gravel layer from approximately 7-8'.						
10	7 17 35	CL	Very pale brown (10 YR 8/2) sandy lean CLAY, little silt, dry and very stiff.						
			END OF BORING AT 10.5 FEET						
12.5									
15									

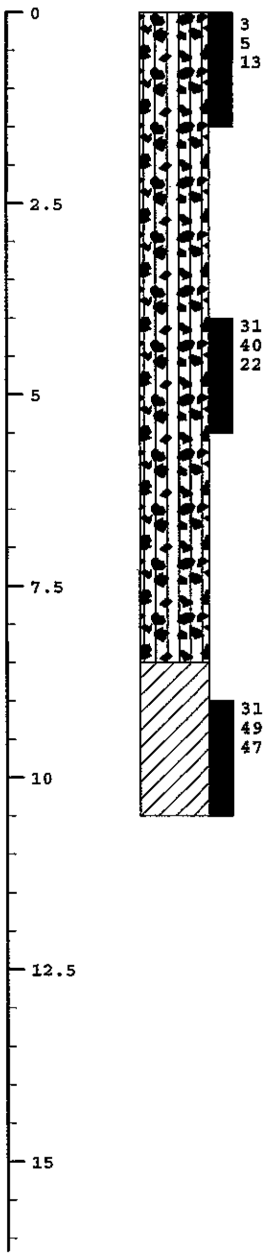
The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 8

EXPLORATION LOG
BRC-BKG-RO9

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	3 5 13	GM	Pale brown (10 YR 6/3) silty GRAVEL with sand dry and medium dense.						
	31 40 22		...very dense.						
5			...moist.						
	31 49 47	CL	Light yellowish brown (10 YR 6/4) lean CLAY, moist and very stiff..						
10			**END OF BORING AT 10.5 FEET**						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

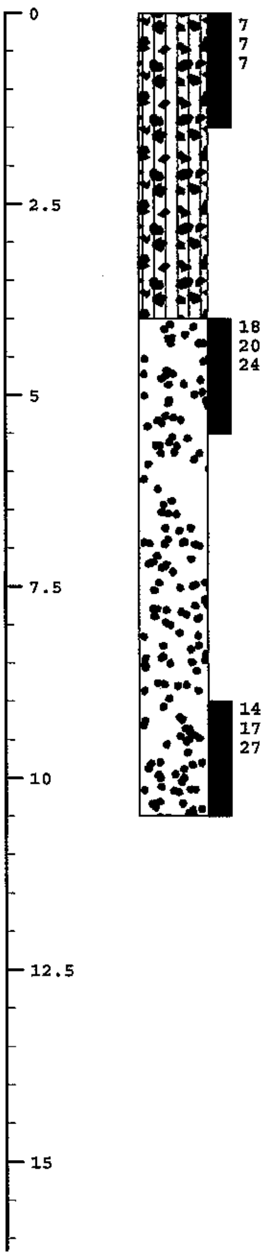
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC. **Figure No.** 9

EXPLORATION LOG
BRC-BKG-R10

PROJECT: SUPPLEMENTAL SHALLOW BACKGROUND DATA **PROJECT NO.:** 20082325V1
BORING LOCATION: LAKE MEADE/MOHAWK **EXPLORATION DATE:** 4/9/08
EXPLORATION SIZE (dia.): 6 1/2" O.D. H.S. AUGER **EQUIPMENT:** D-50+ TRACK RIG
ELEVATION: EXISTING GROUND SURFACE **LOGGED BY:** EASTON/WATKINS

INITIAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA
FINAL DEPTH TO WATER: NOT ENCOUNTERED **DATE MEASURED:** NA

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
0	7 7 7	GM	Light yellowish brown (10 YR 6/3) silty GRAVEL with sand dry and medium dense.						
	18 20 24	GP	Light brown (7.5 Year 6/3) poorly-graded GRAVEL with sand, trace silt, dry and very dense. ...gravel layer from approximately 4-4.5'.						
	14 17 27								
			END OF BORING AT 10.5 FEET						

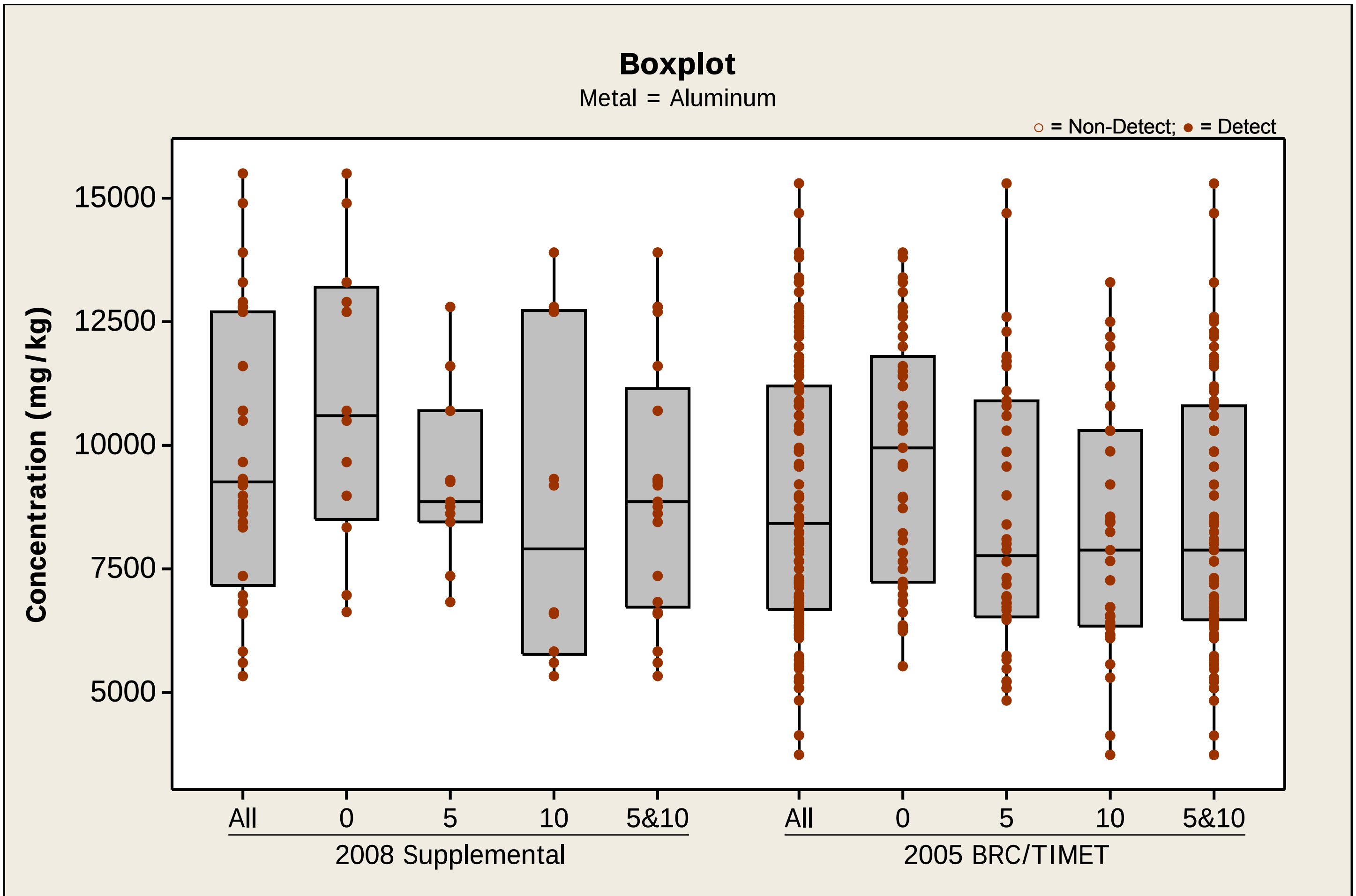


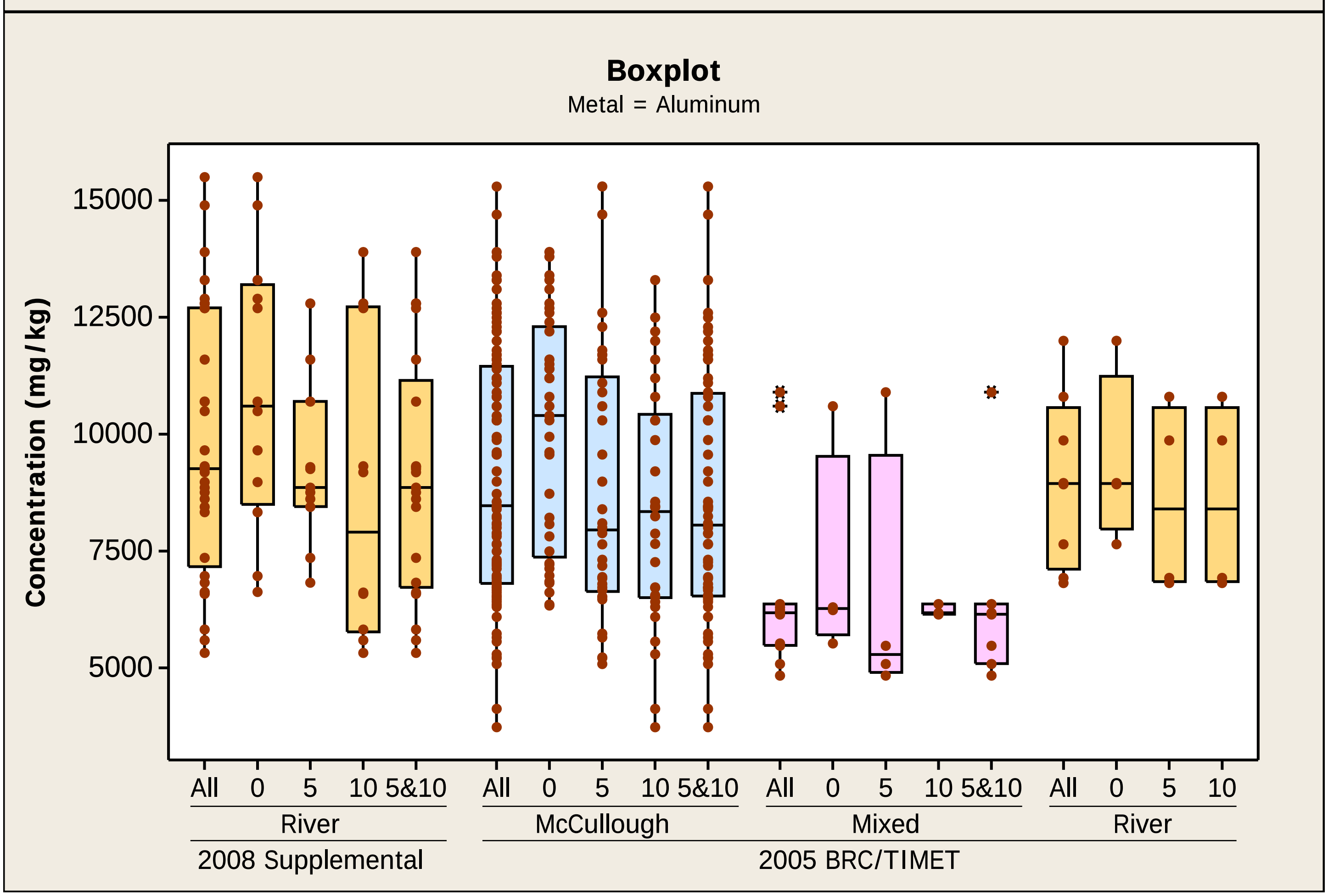
The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

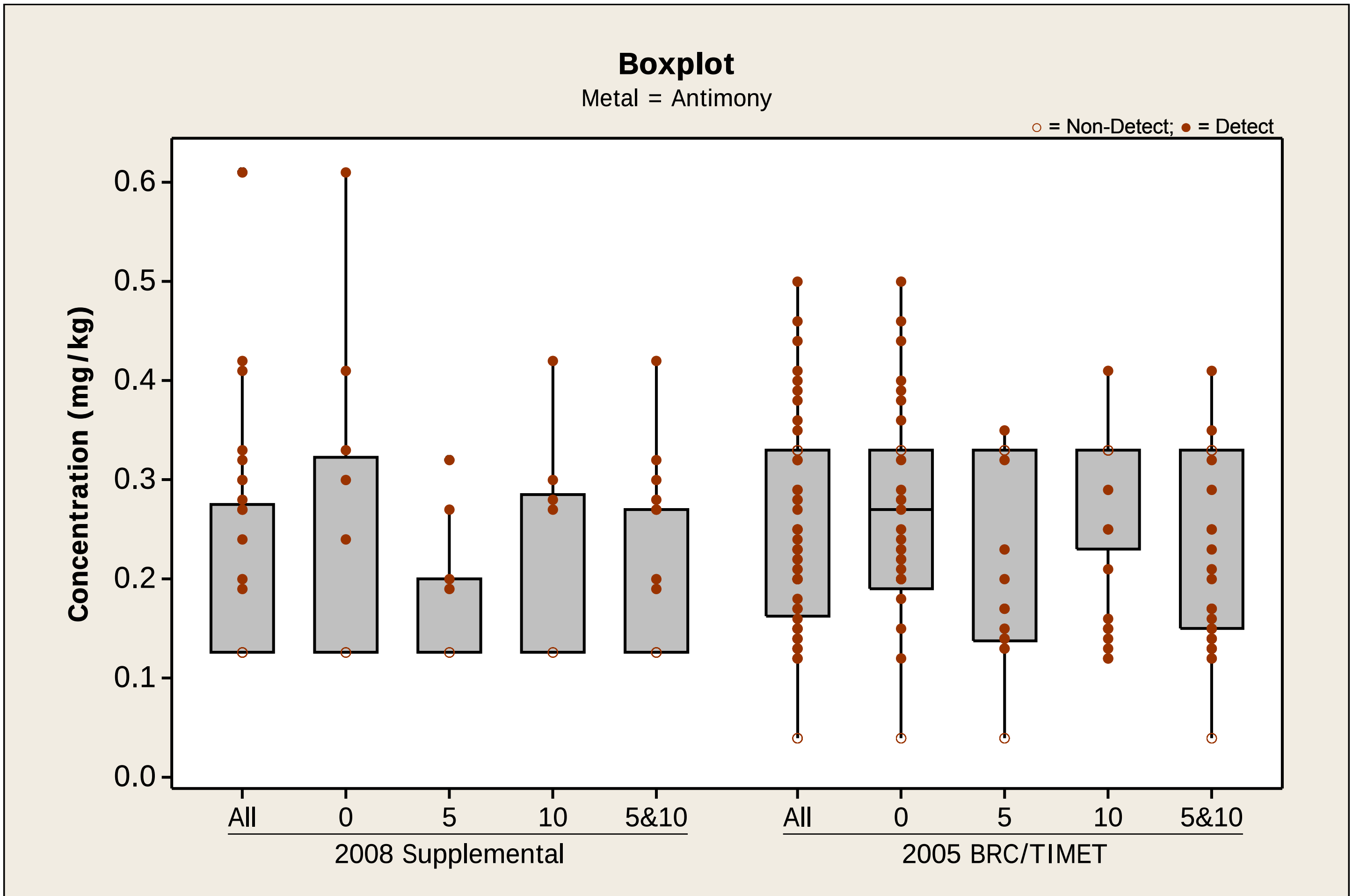
APPENDIX D

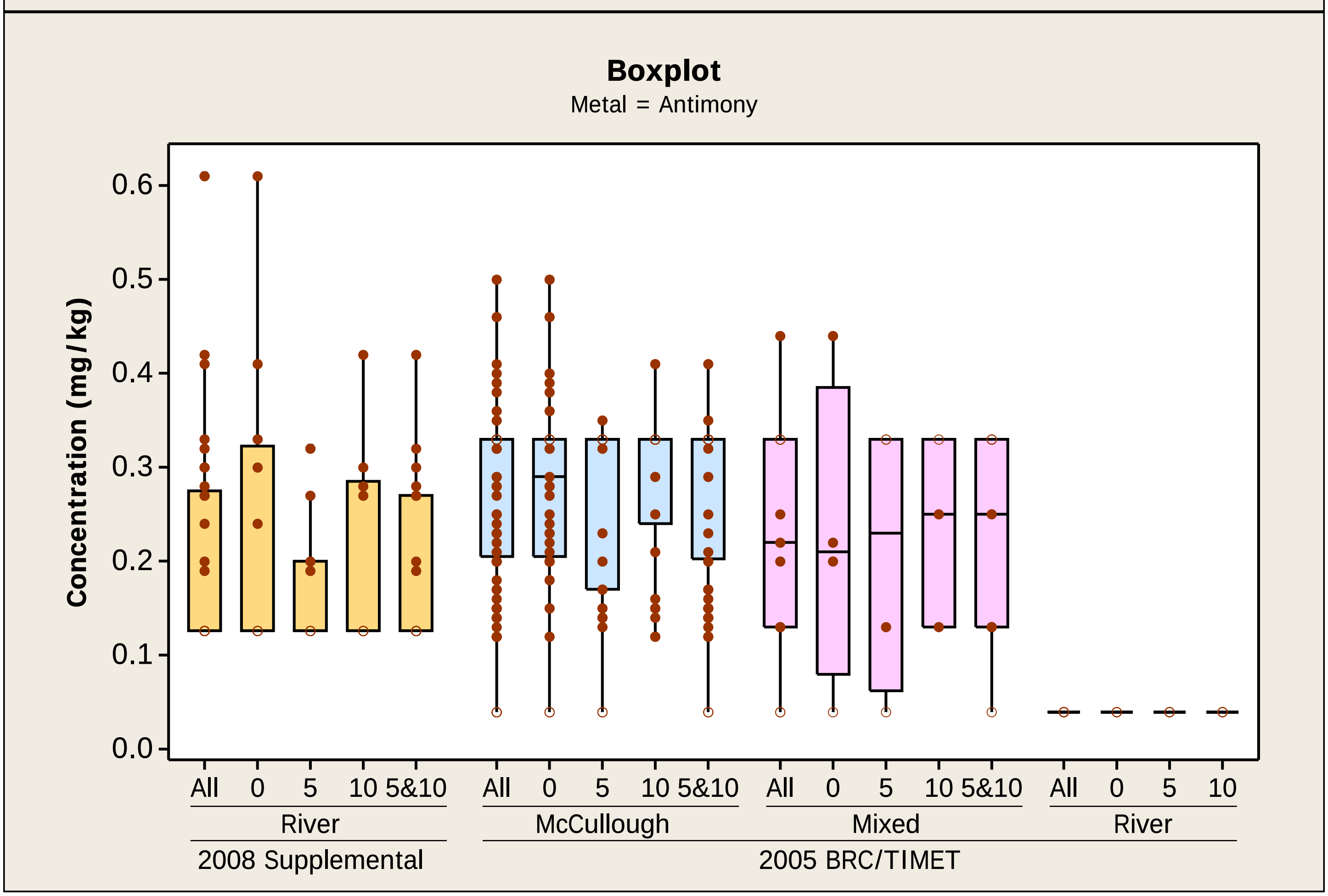
STATISTICAL PLOTS

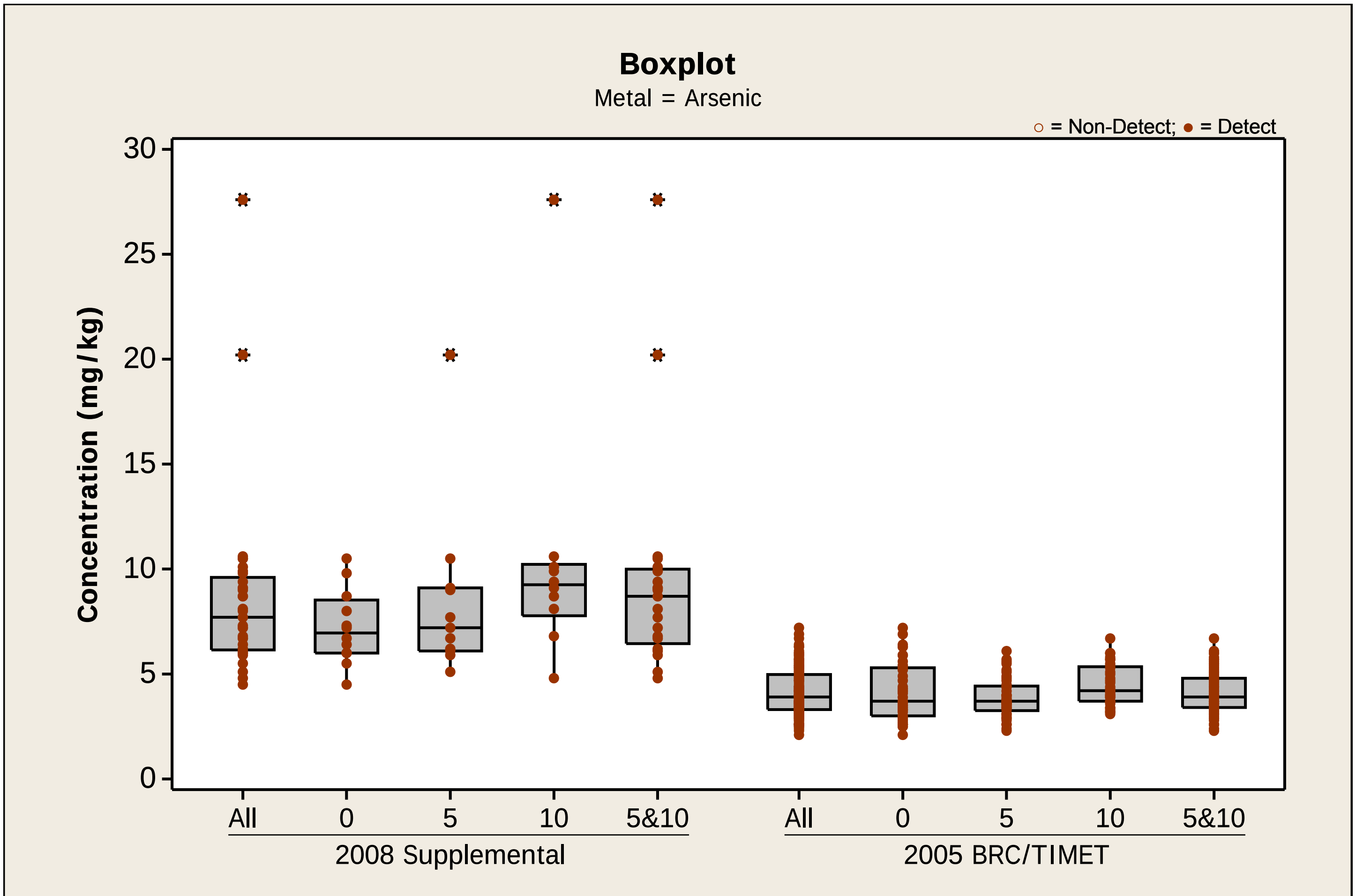
BOXPLOTS


Boxplot
Metal = Aluminum
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
15000
12500
10000
7500
5000
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

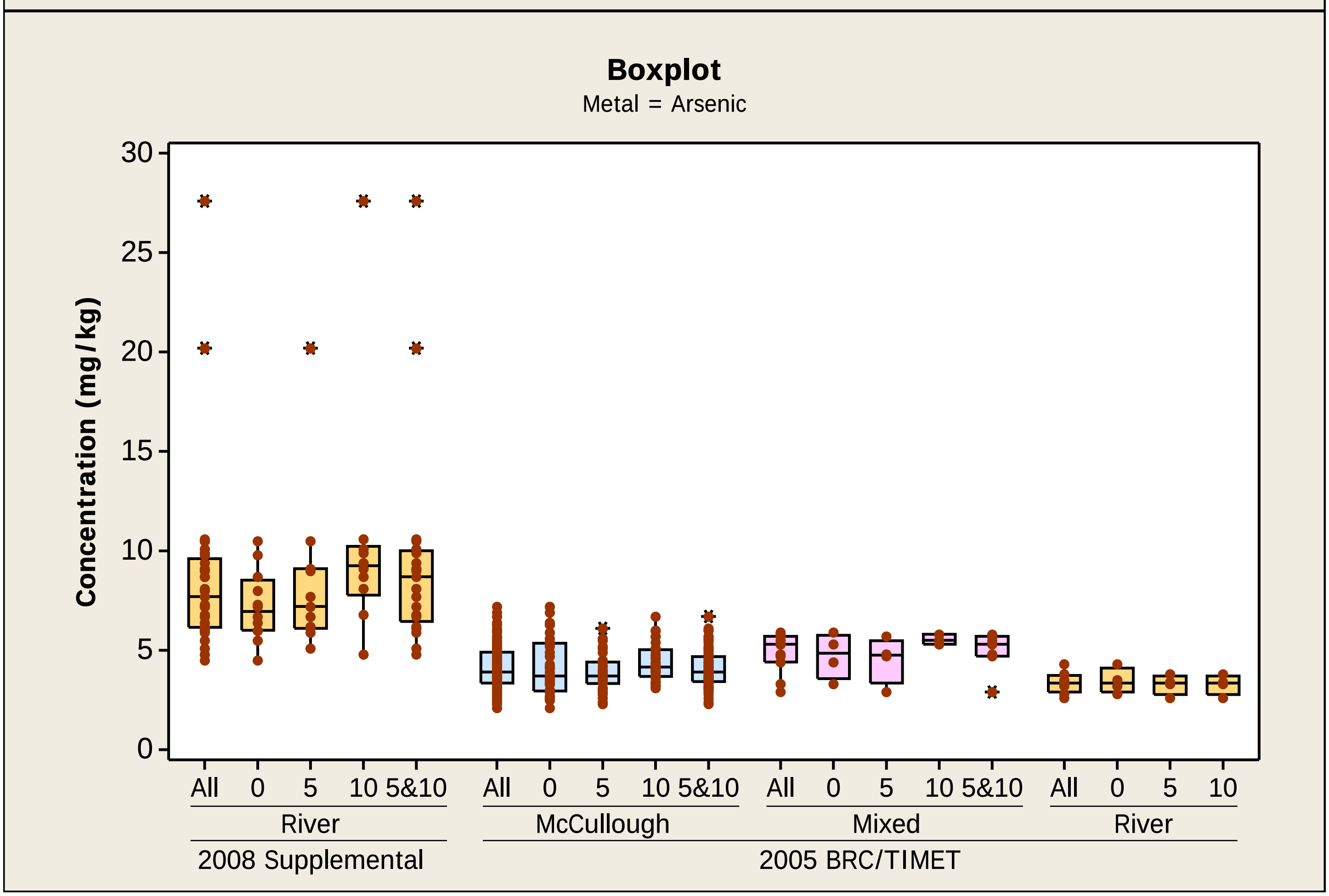

Boxplot
Metal = Aluminum
Concentration (mg/kg)
15000
12500
10000
7500
5000
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Antimony
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

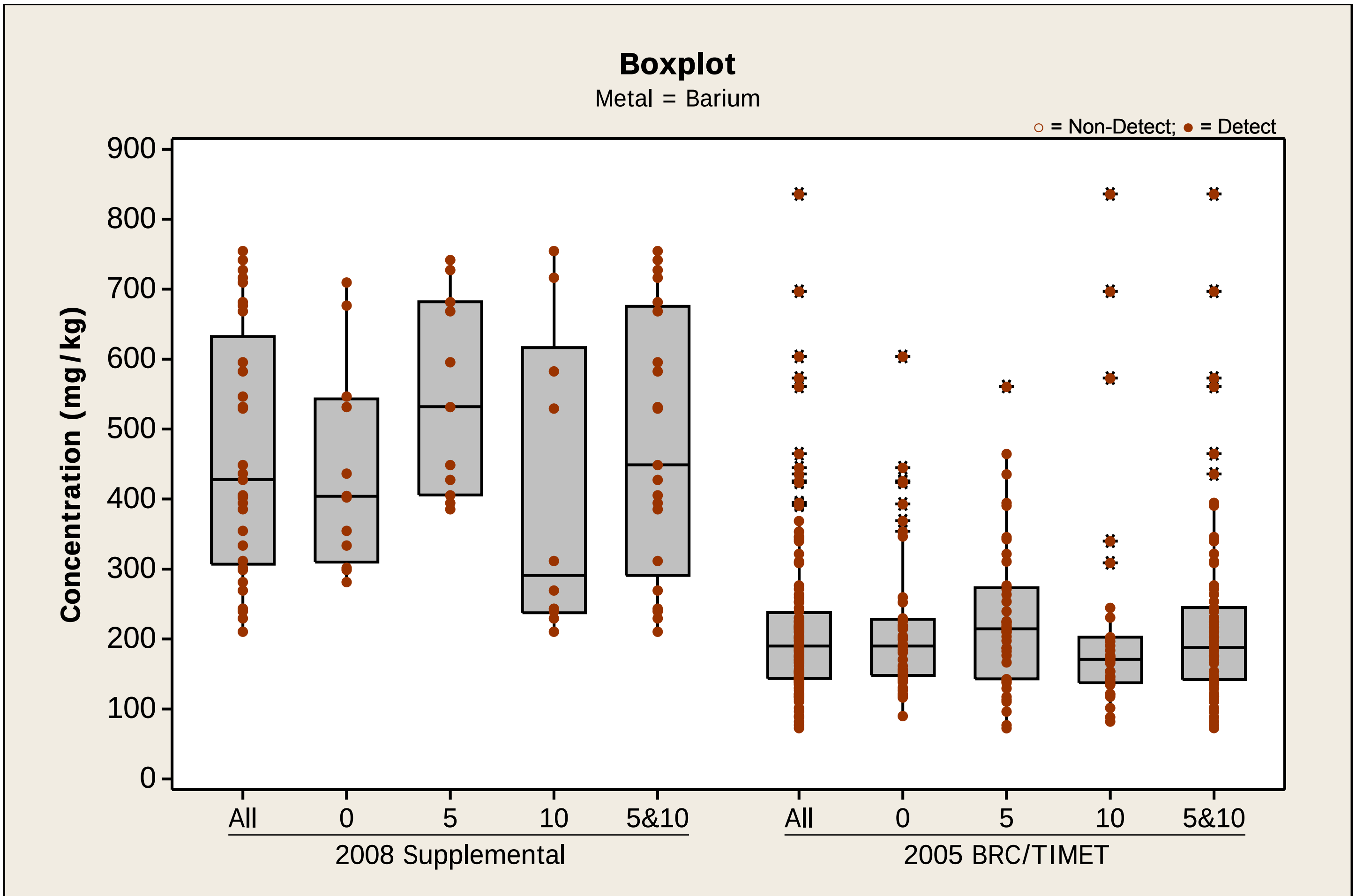

Boxplot
Metal = Antimony
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

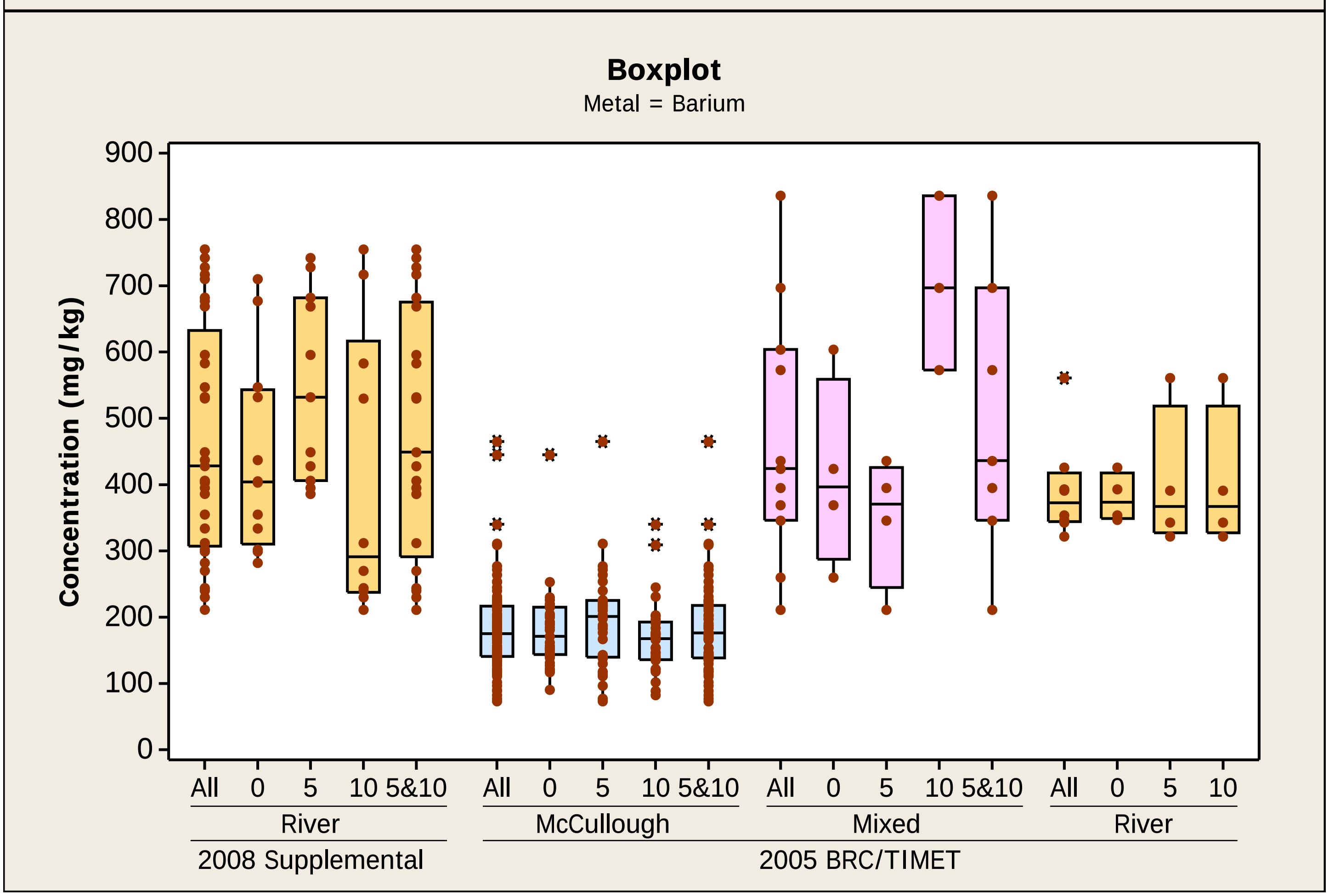


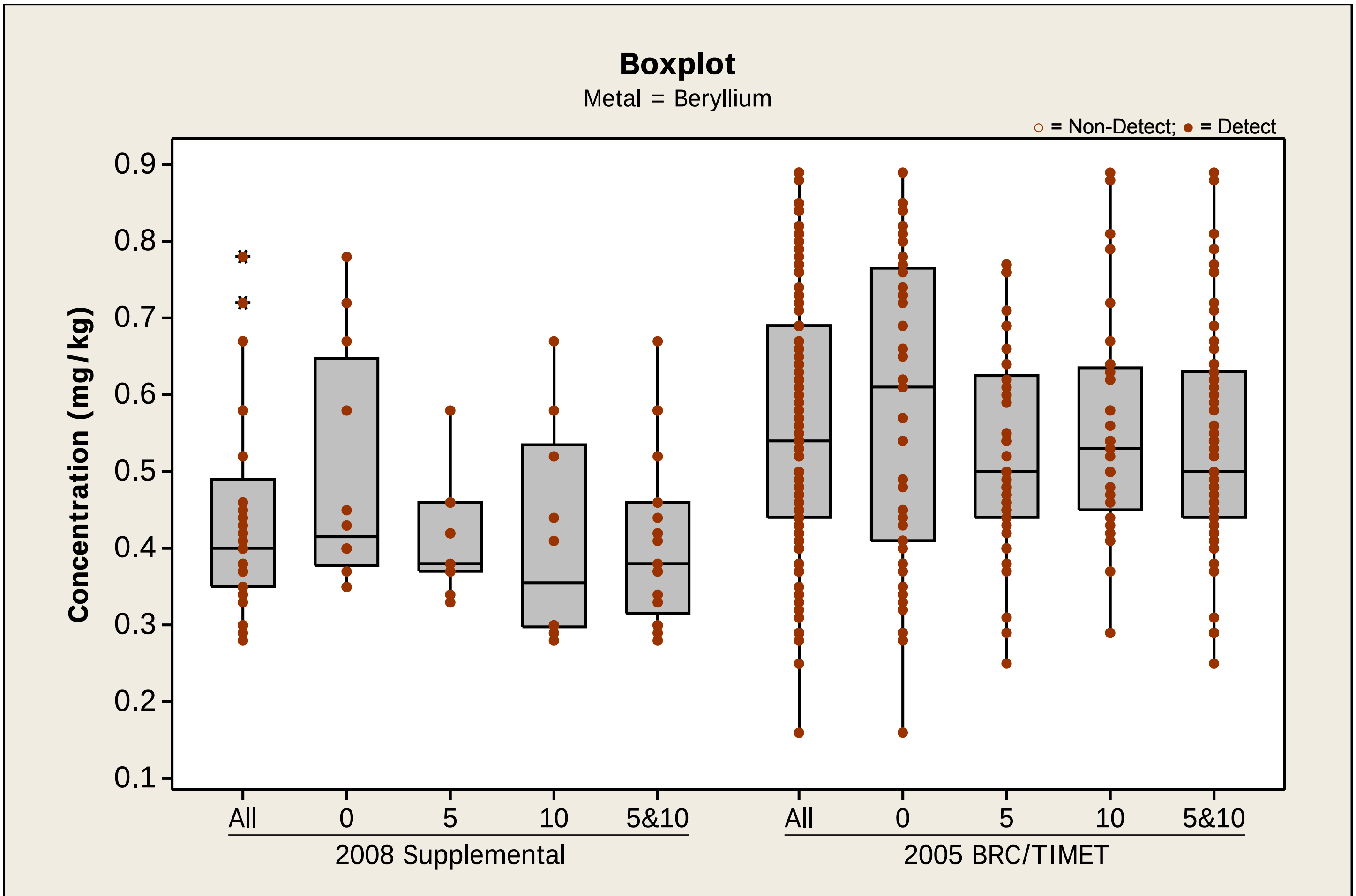
Boxplot
Metal = Arsenic
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0
5
10
15
20
25
30
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

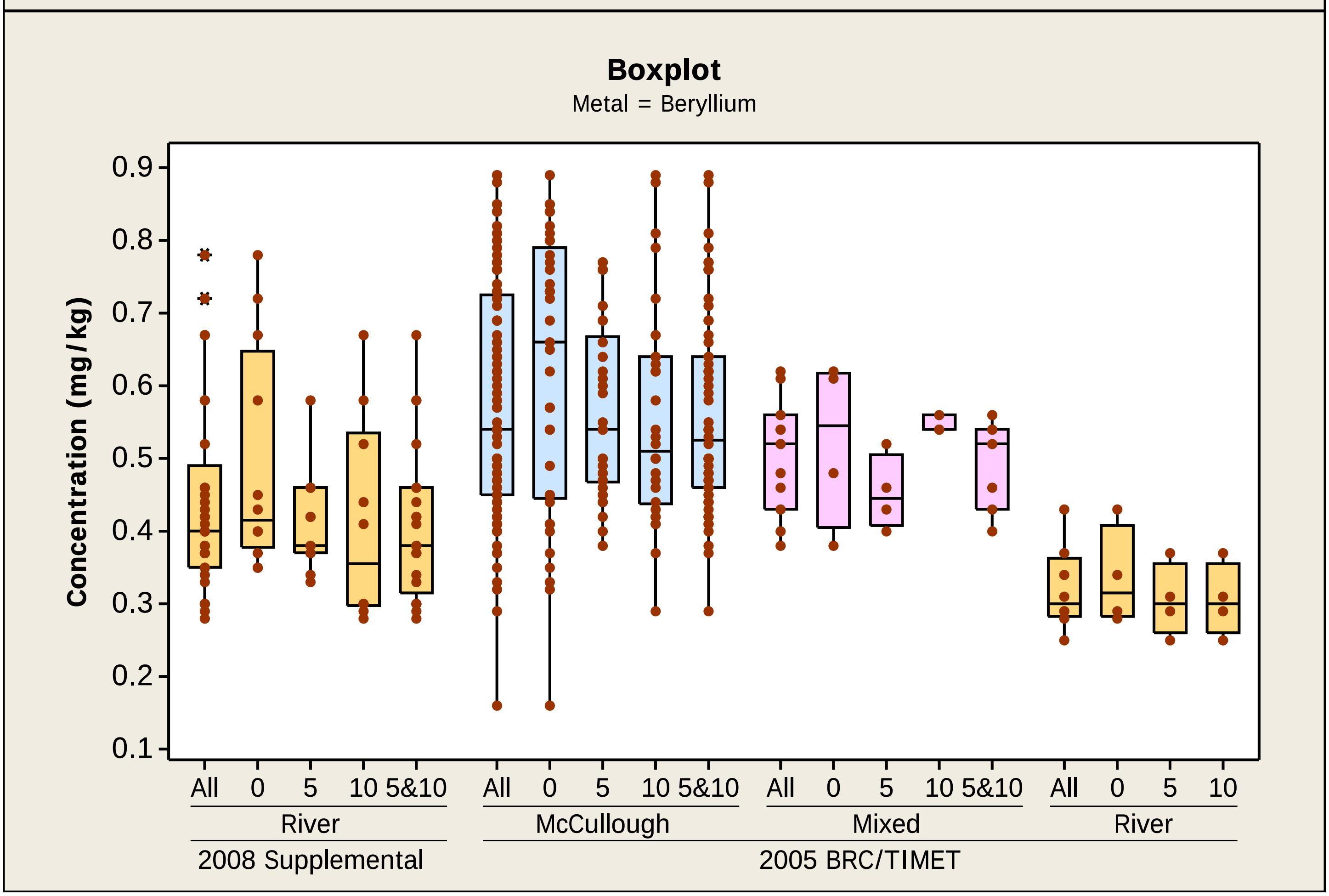


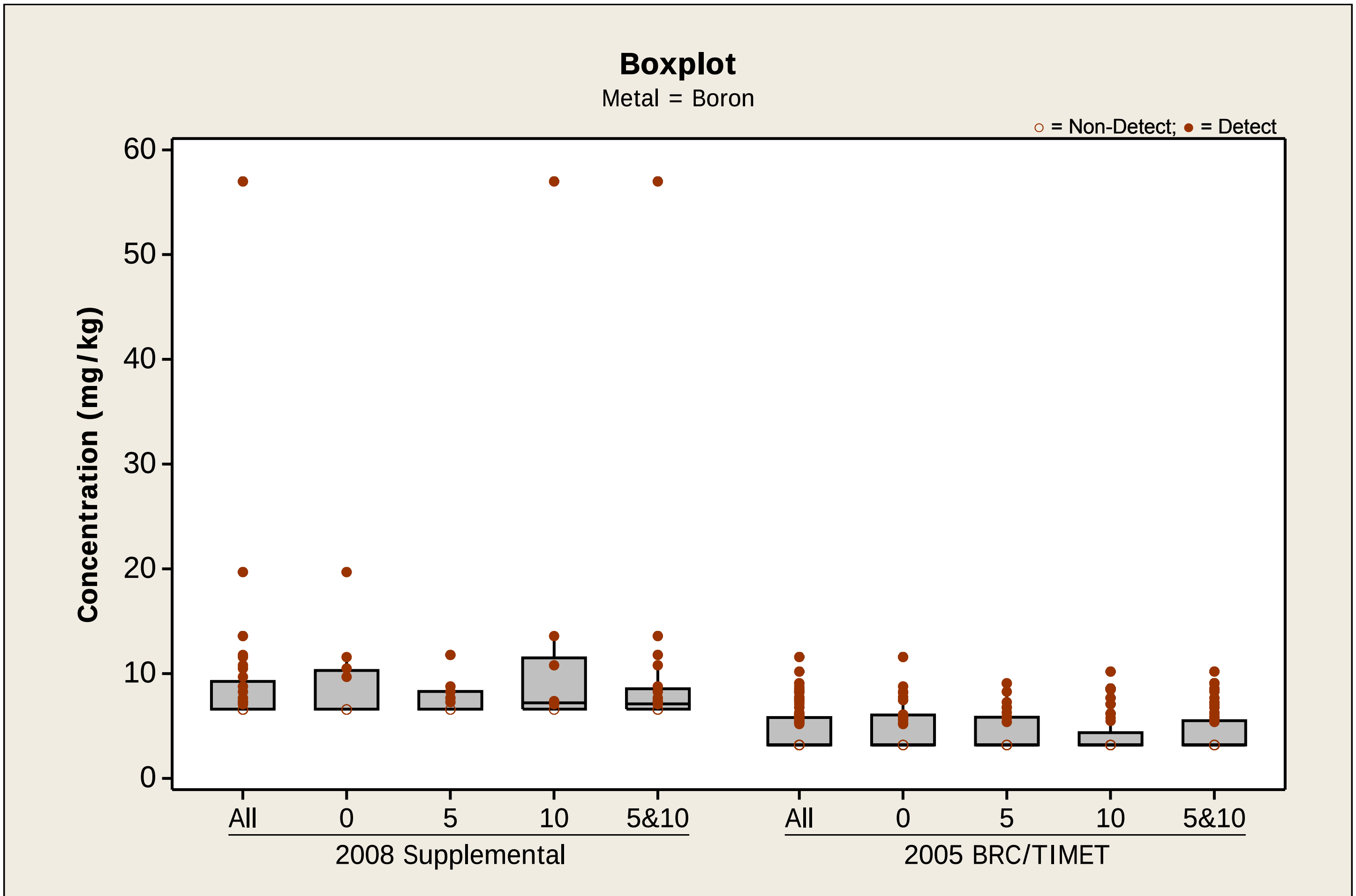
Boxplot
Metal = Arsenic
Concentration (mg/kg)
0
5
10
15
20
25
30
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

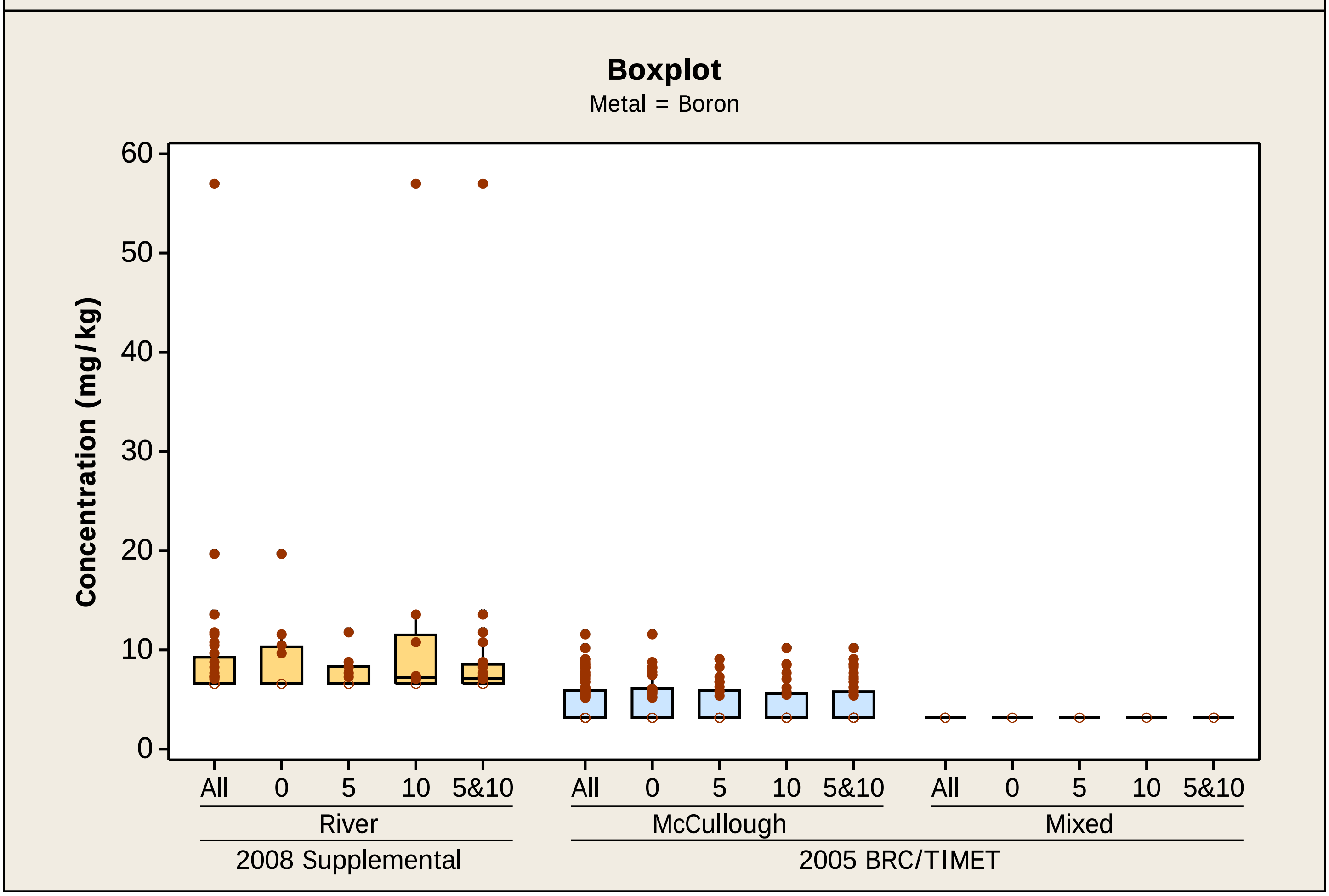

Boxplot
Metal = Barium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0
100
200
300
400
500
600
700
800
900
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

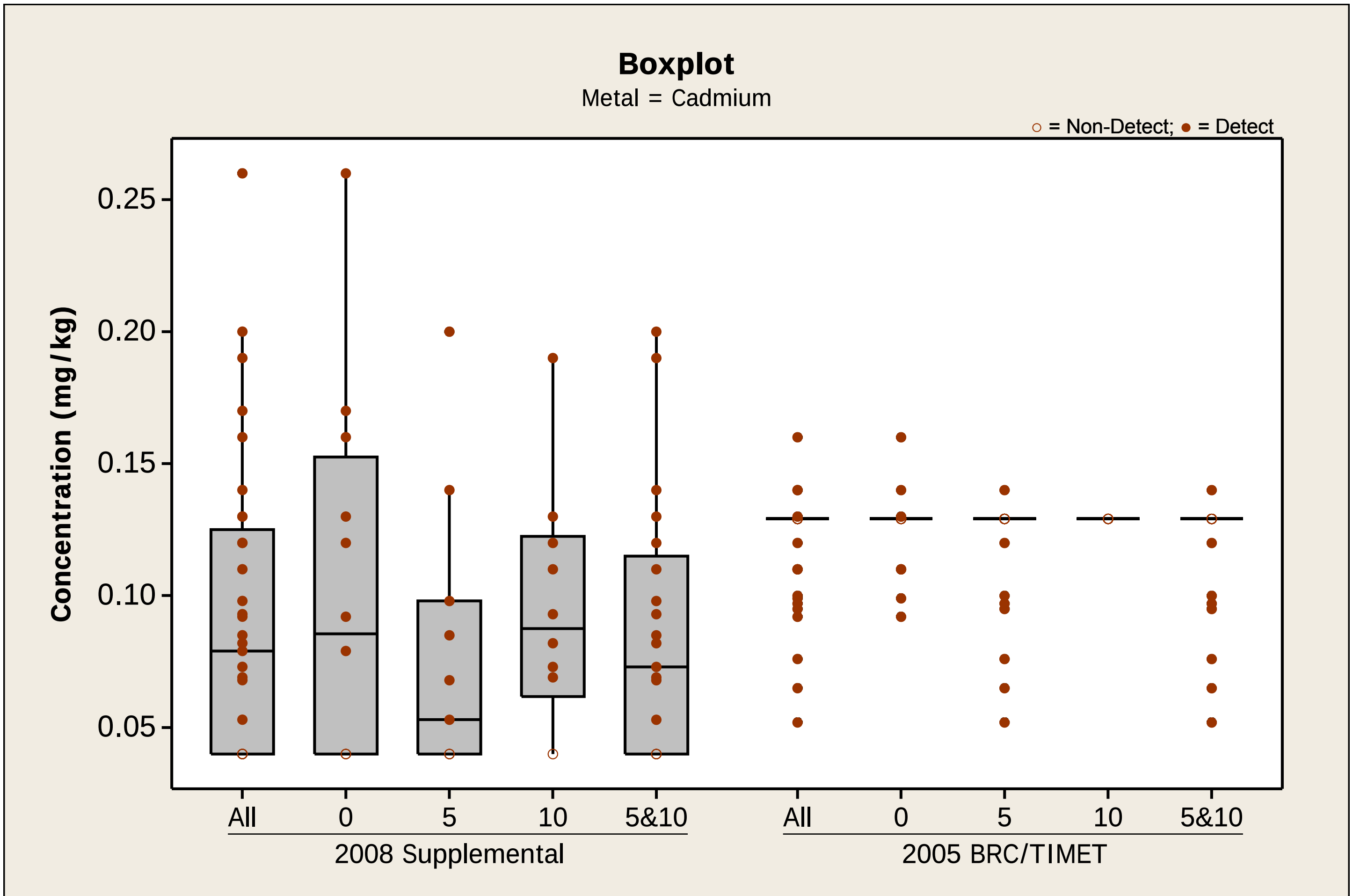

Boxplot
Metal = Barium
Concentration (mg/kg)
0
100
200
300
400
500
600
700
800
900
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET


Boxplot
Metal = Beryllium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
All 0 5 10 5&10
2008 Supplemental
All 0 5 10 5&10
2005 BRC/TIMET

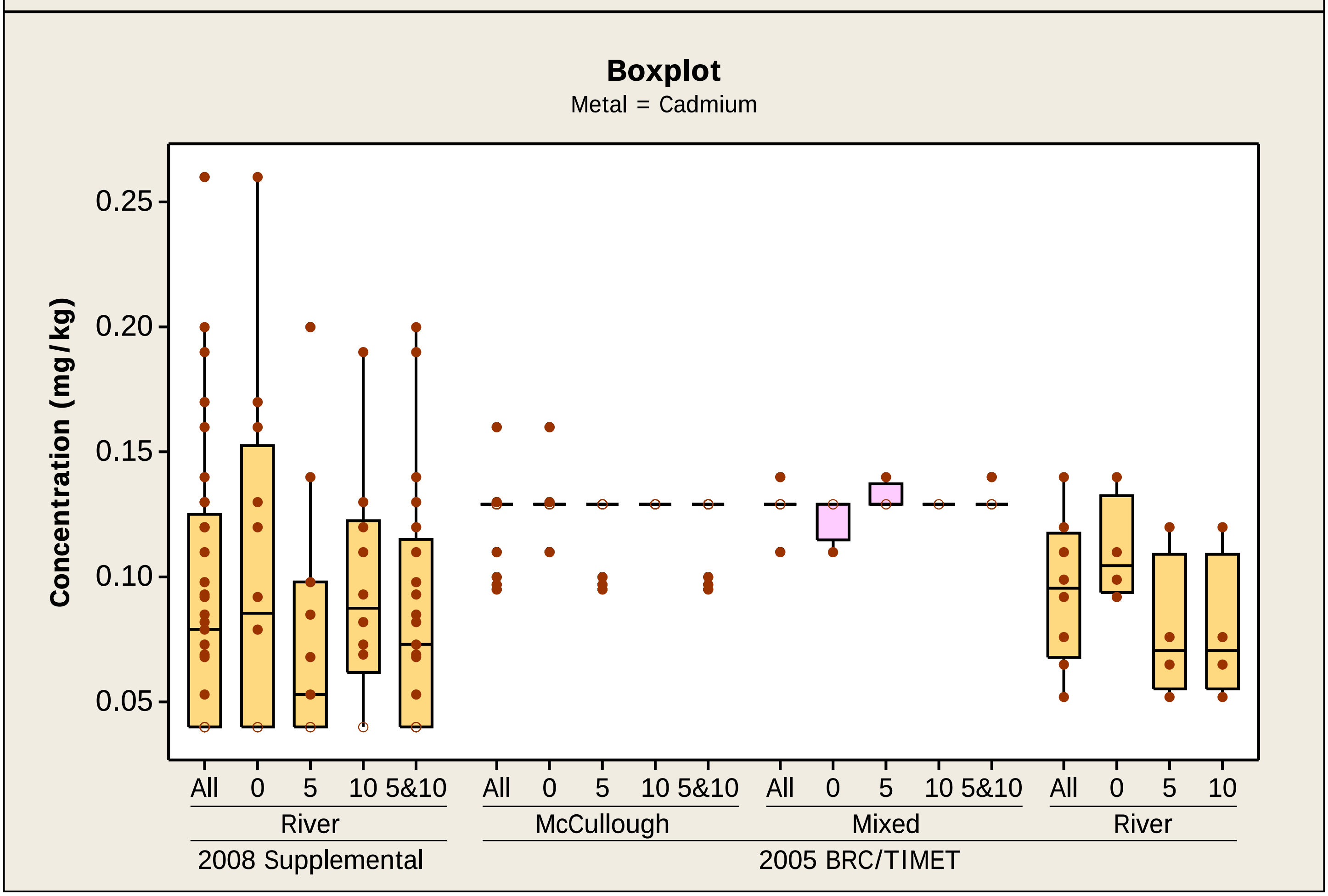

Boxplot
Metal = Beryllium
Concentration (mg/kg)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
All 0 5 10 5&10
River
2008 Supplemental
All 0 5 10 5&10
McCullough
All 0 5 10 5&10
Mixed
All 0 5 10
River
2005 BRC/TIMET


Boxplot
Metal = Boron
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
60
50
40
30
20
10
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

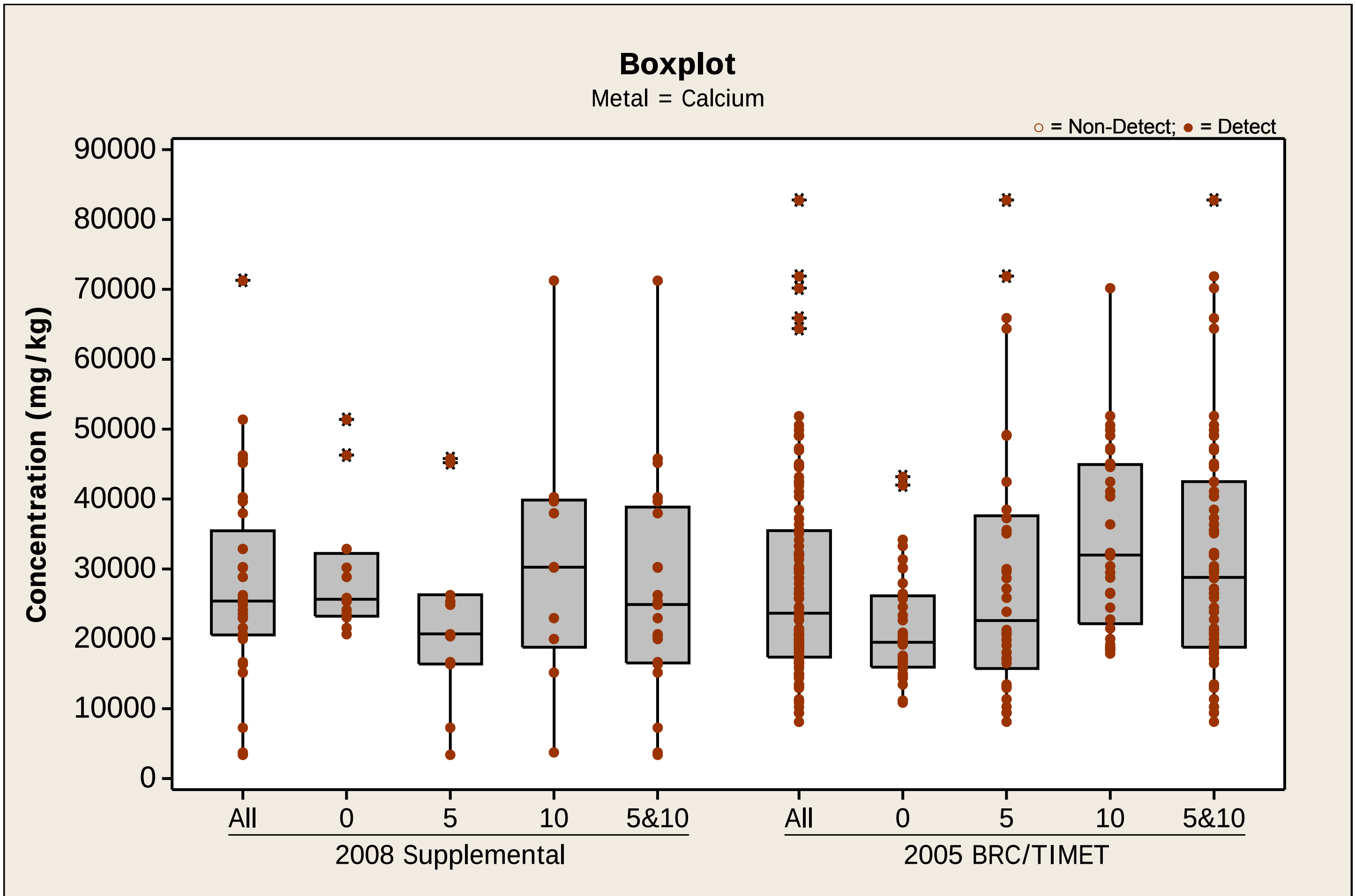

Boxplot
Metal = Boron
Concentration (mg/kg)
60
50
40
30
20
10
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

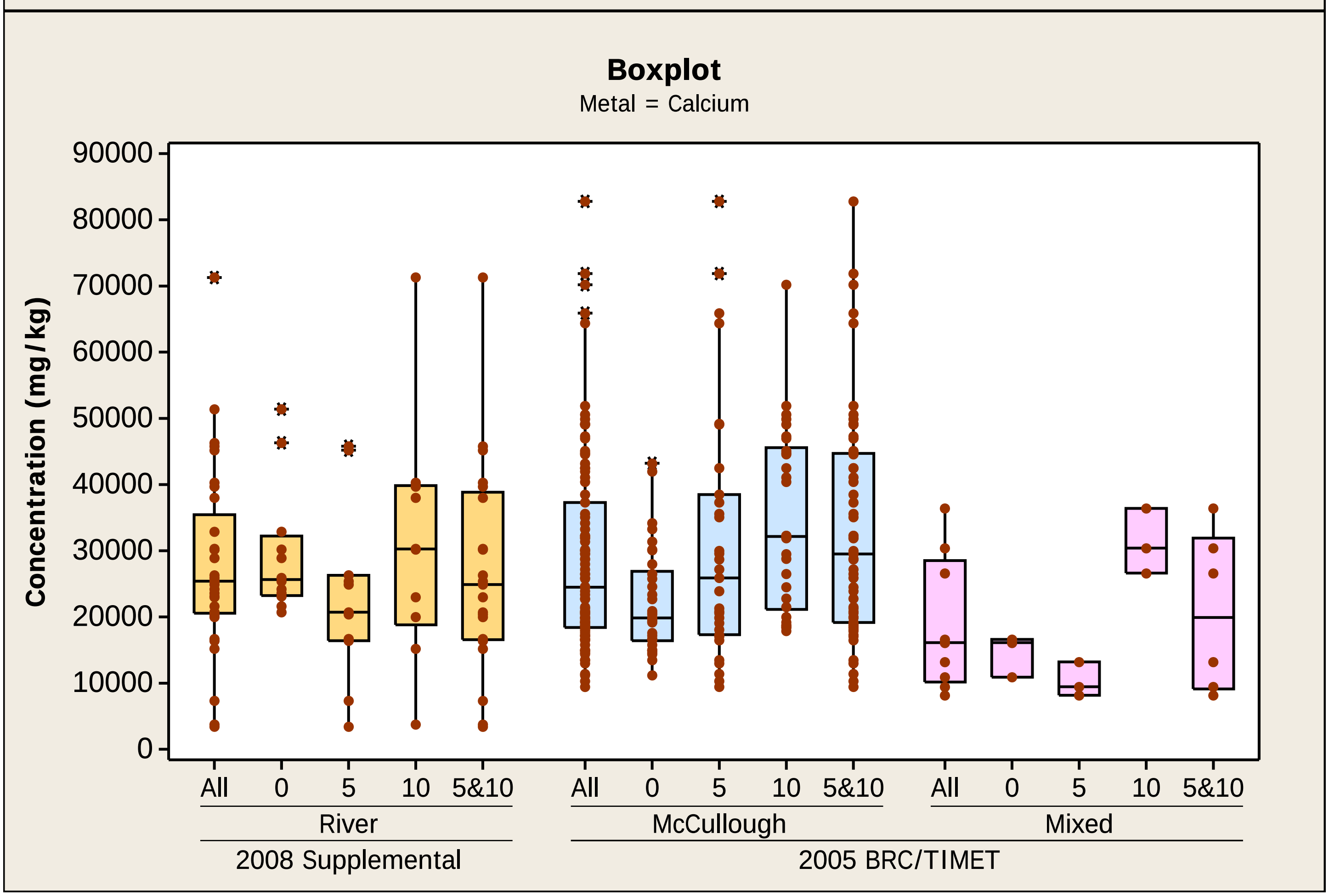


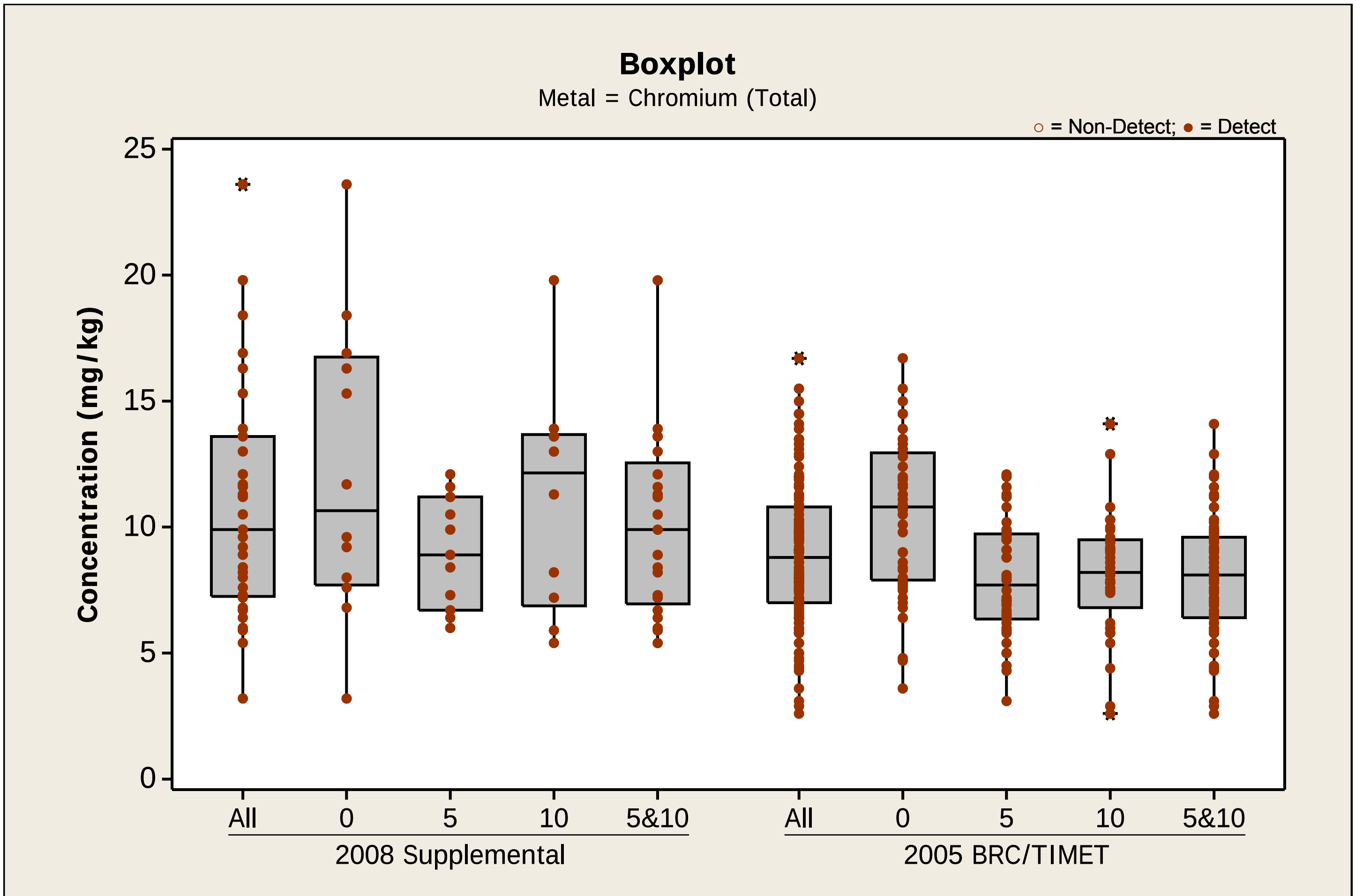
Boxplot
Metal = Cadmium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.25
0.20
0.15
0.10
0.05
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

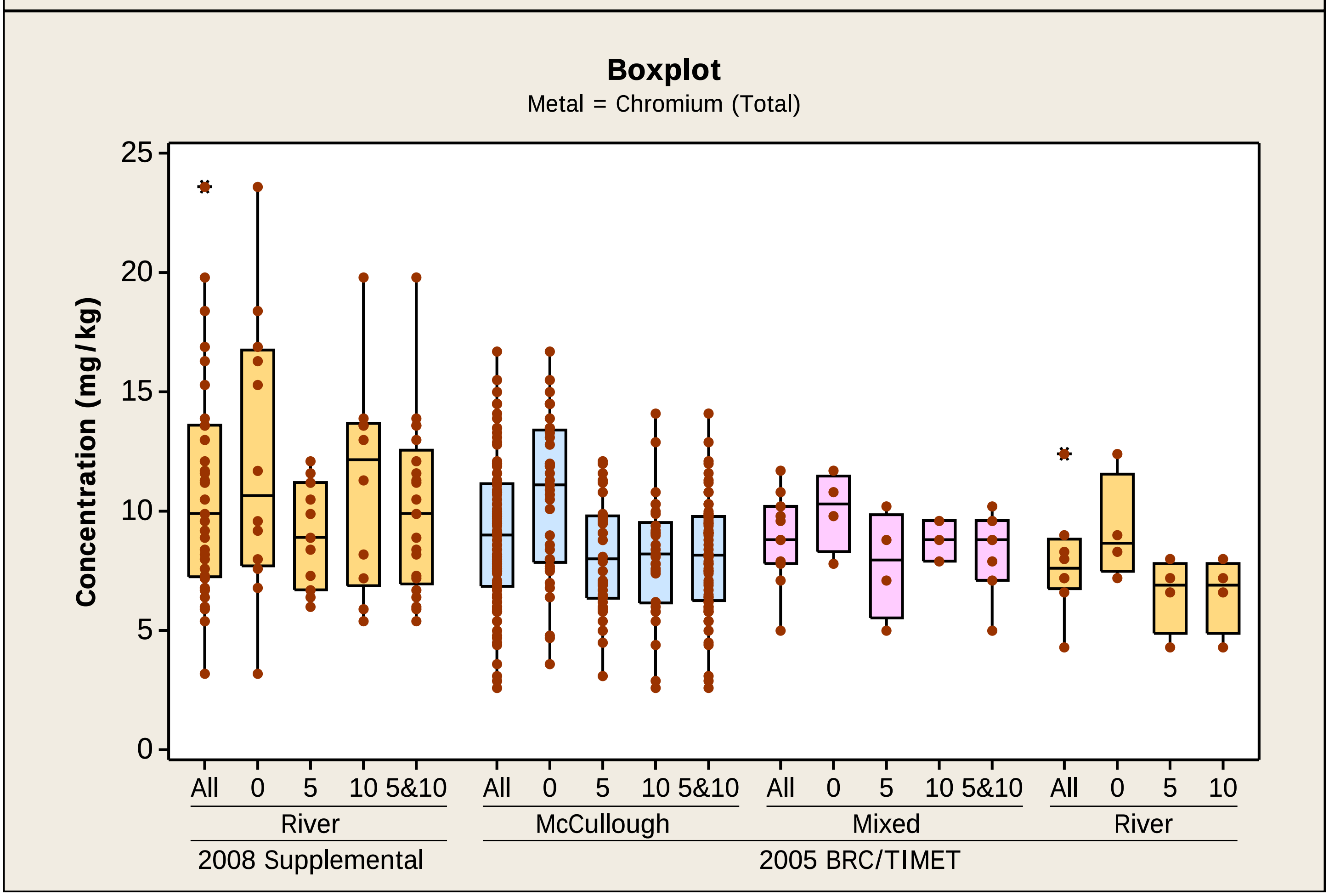


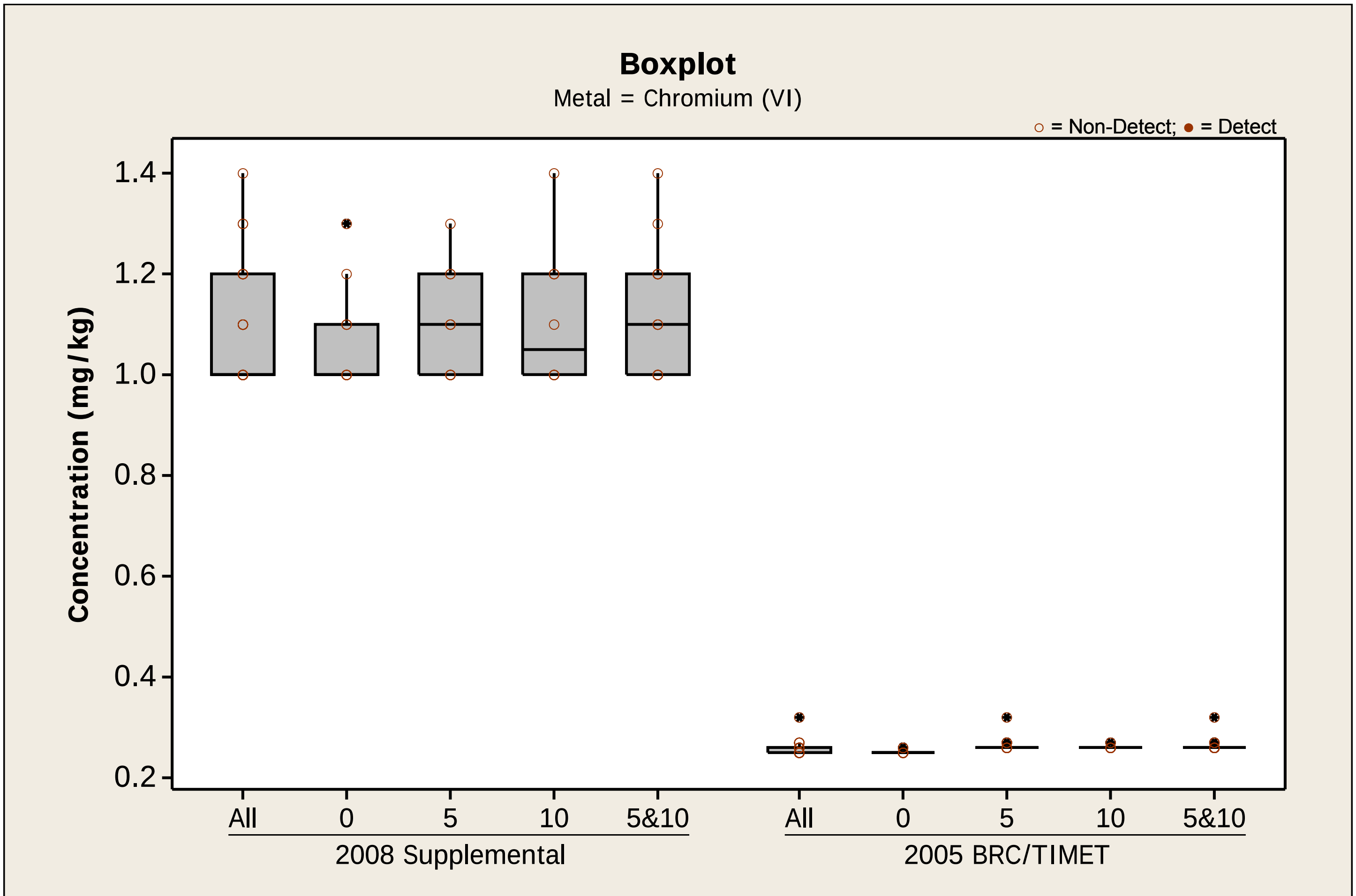
Boxplot
Metal = Cadmium
Concentration (mg/kg)
0.25
0.20
0.15
0.10
0.05
All 0 5 10 5&10
River
2008 Supplemental
All 0 5 10 5&10
McCullough
All 0 5 10 5&10
Mixed
All 0 5 10
River
2005 BRC/TIMET

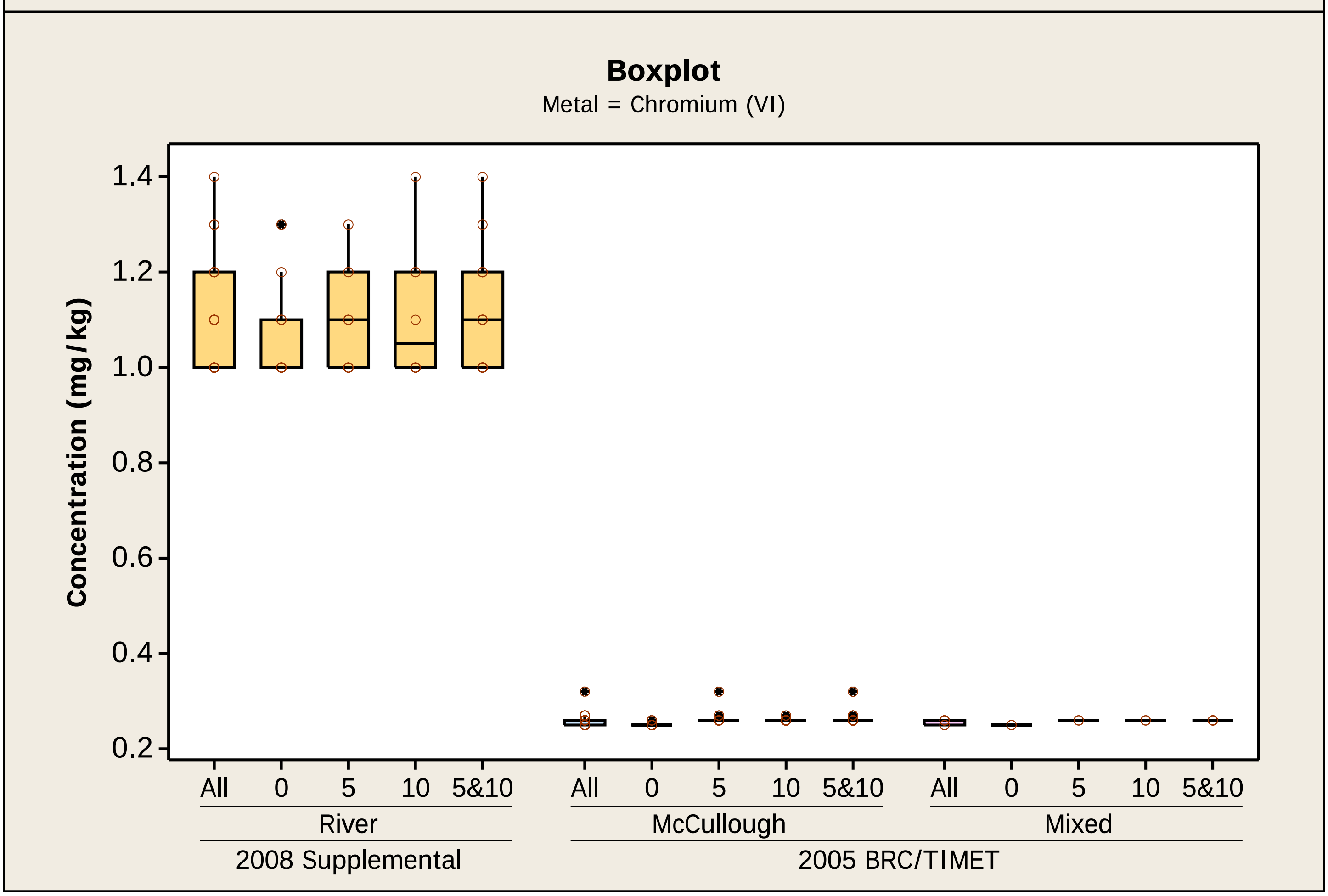

Boxplot
Metal = Calcium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

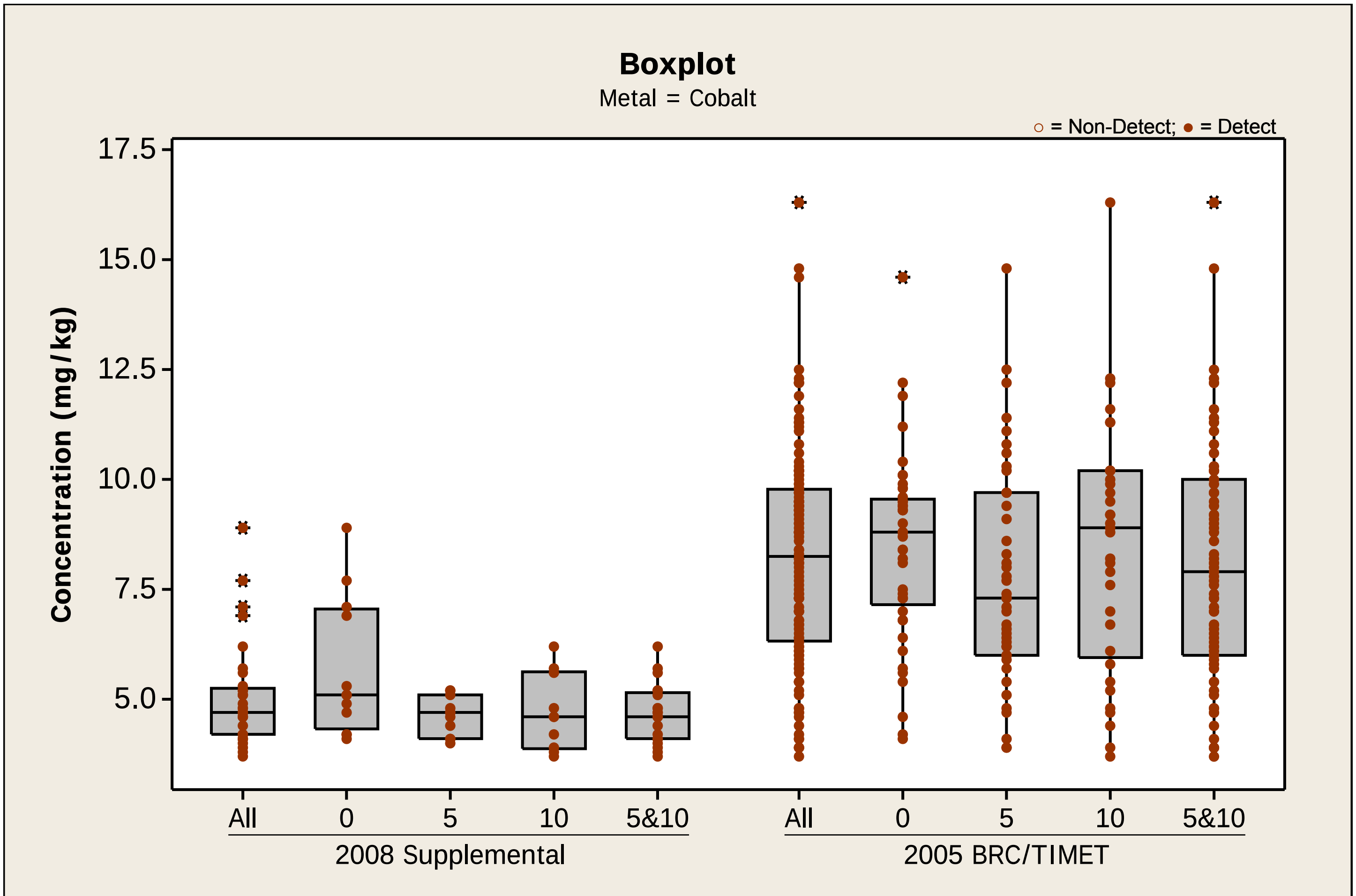

Boxplot
Metal = Calcium
Concentration (mg/kg)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

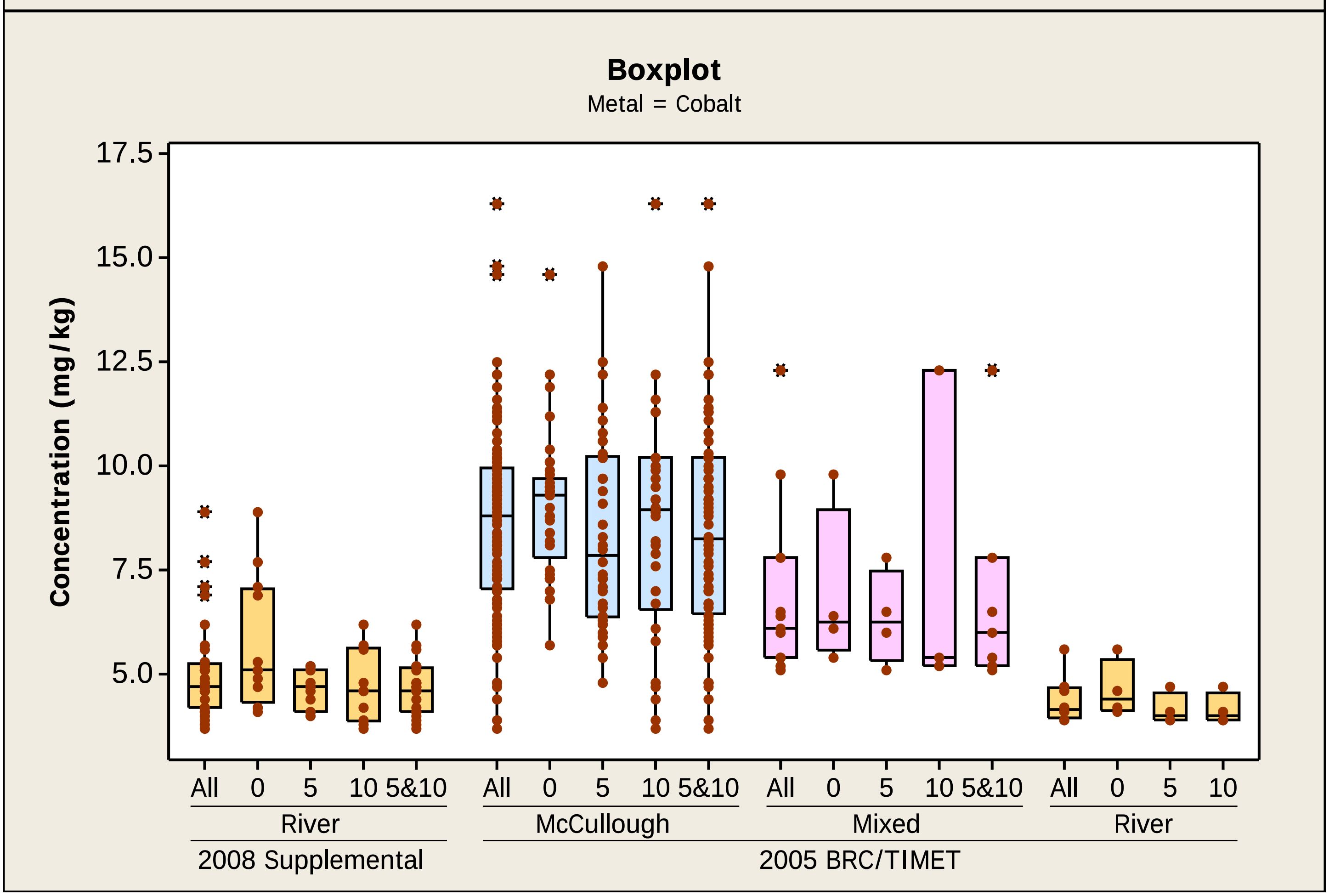

Boxplot
Metal = Chromium (Total)
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
25
20
15
10
5
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

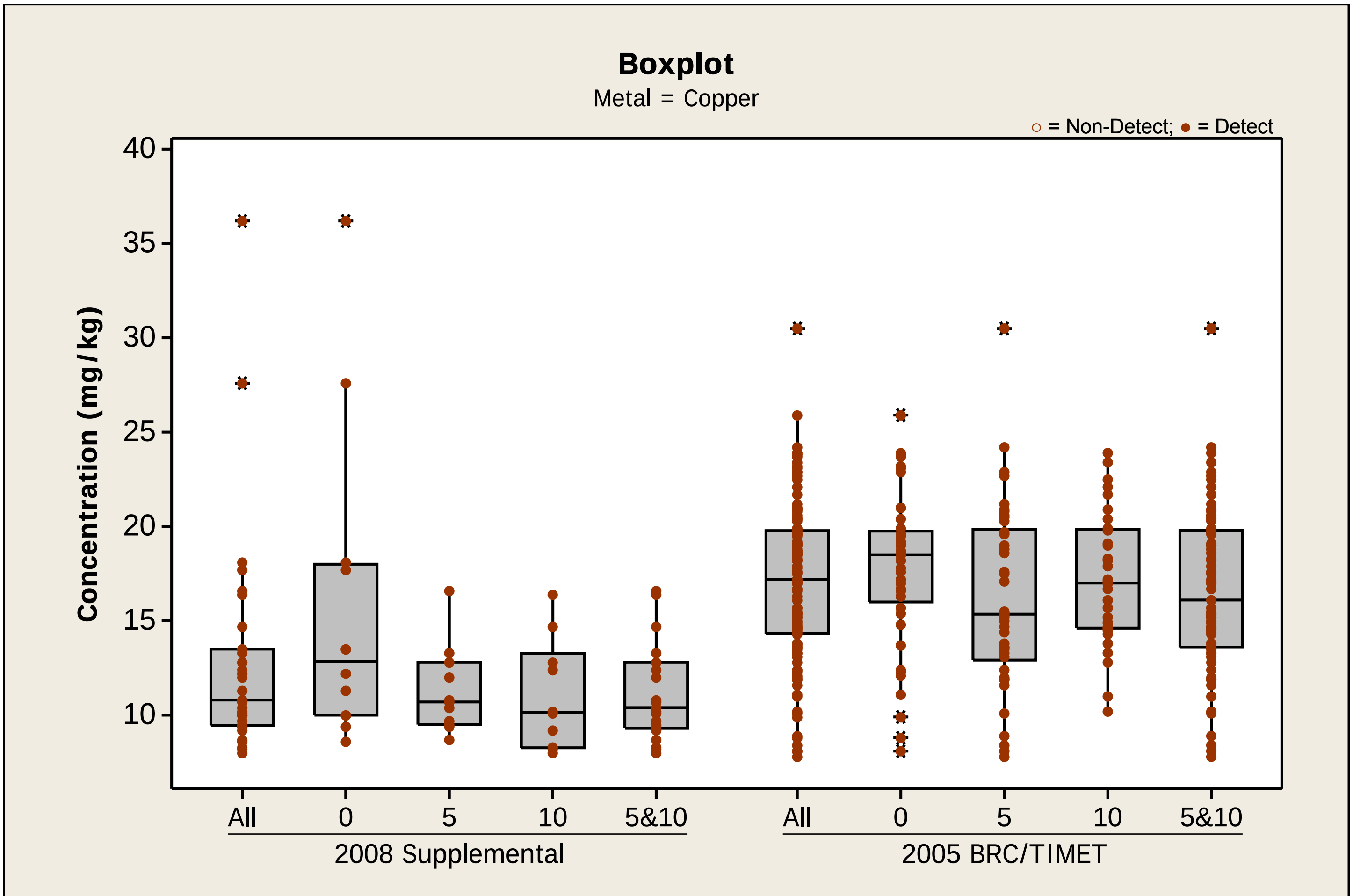

Boxplot
Metal = Chromium (Total)
Concentration (mg/kg)
25
20
15
10
5
0
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

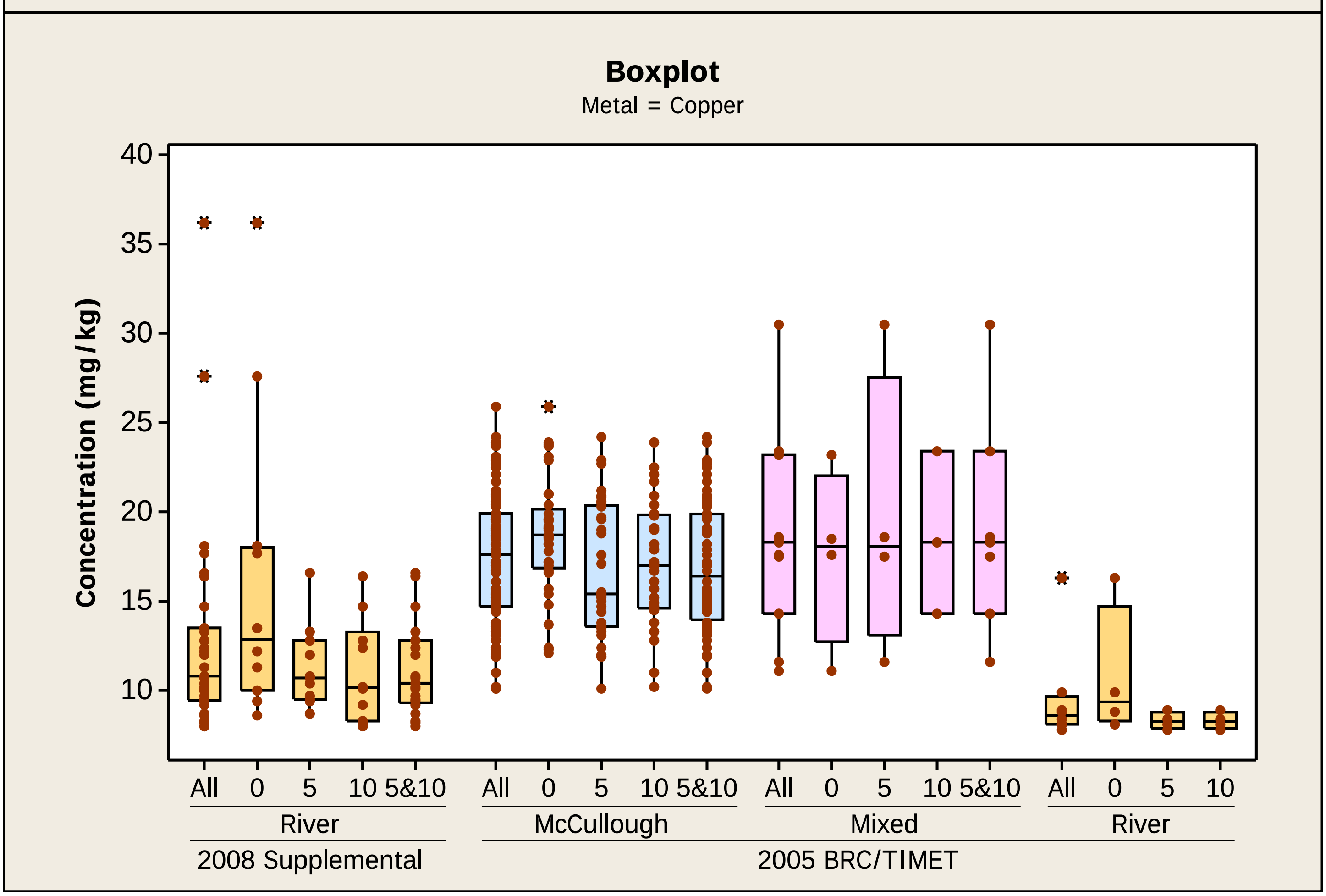

Boxplot
Metal = Chromium (VI)
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

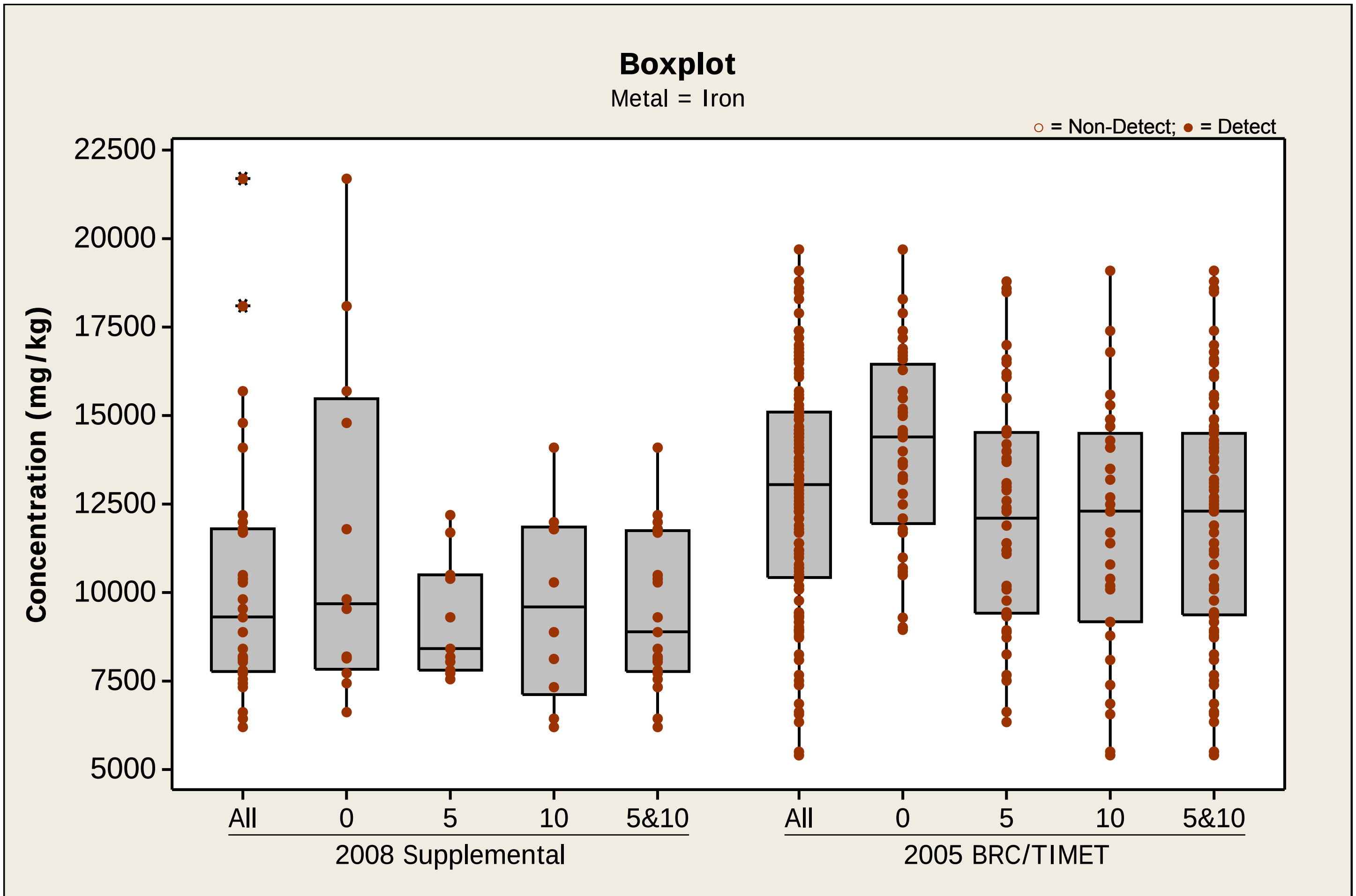

Boxplot
Metal = Chromium (VI)
Concentration (mg/kg)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

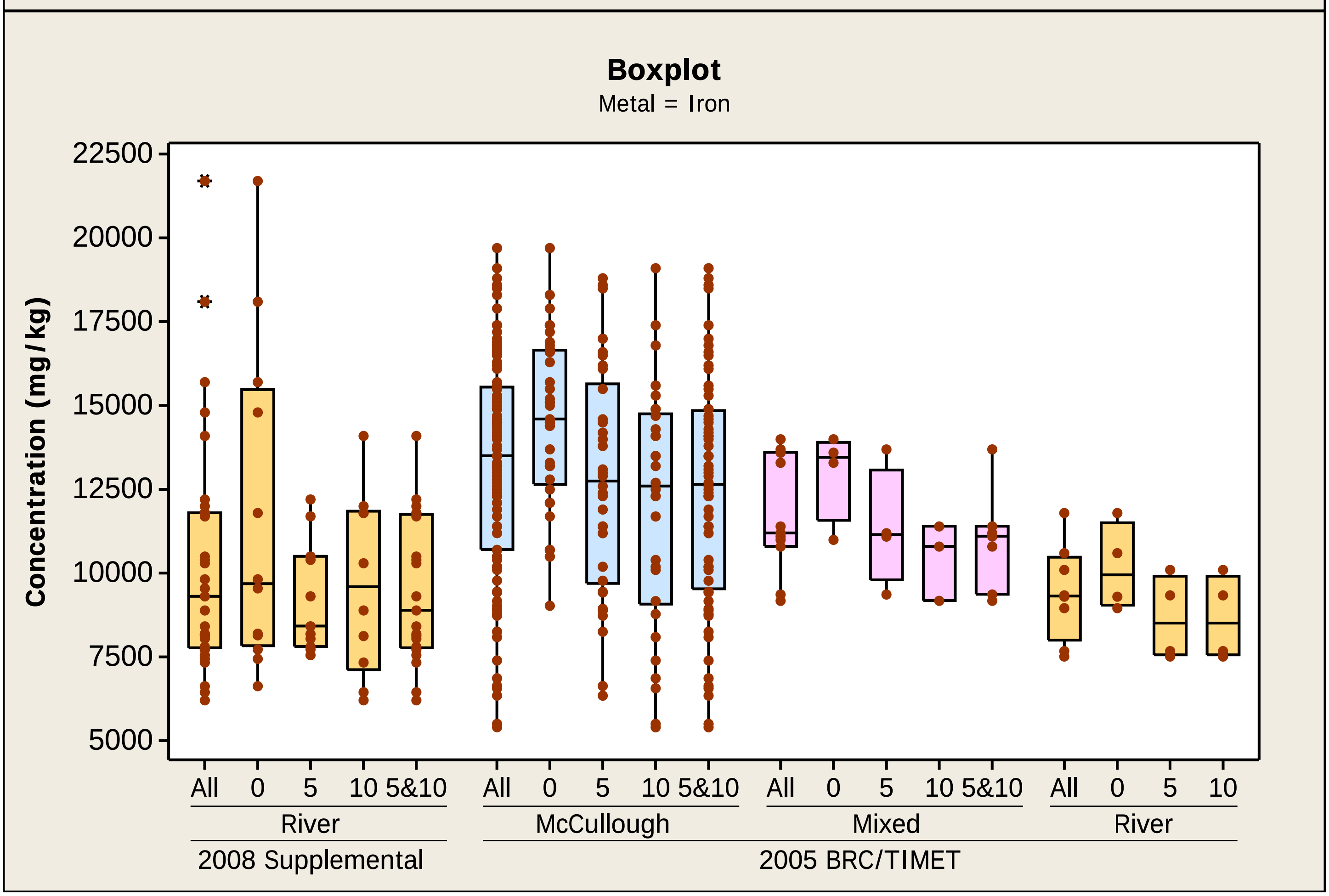

Boxplot
Metal = Cobalt
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
17.5
15.0
12.5
10.0
7.5
5.0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

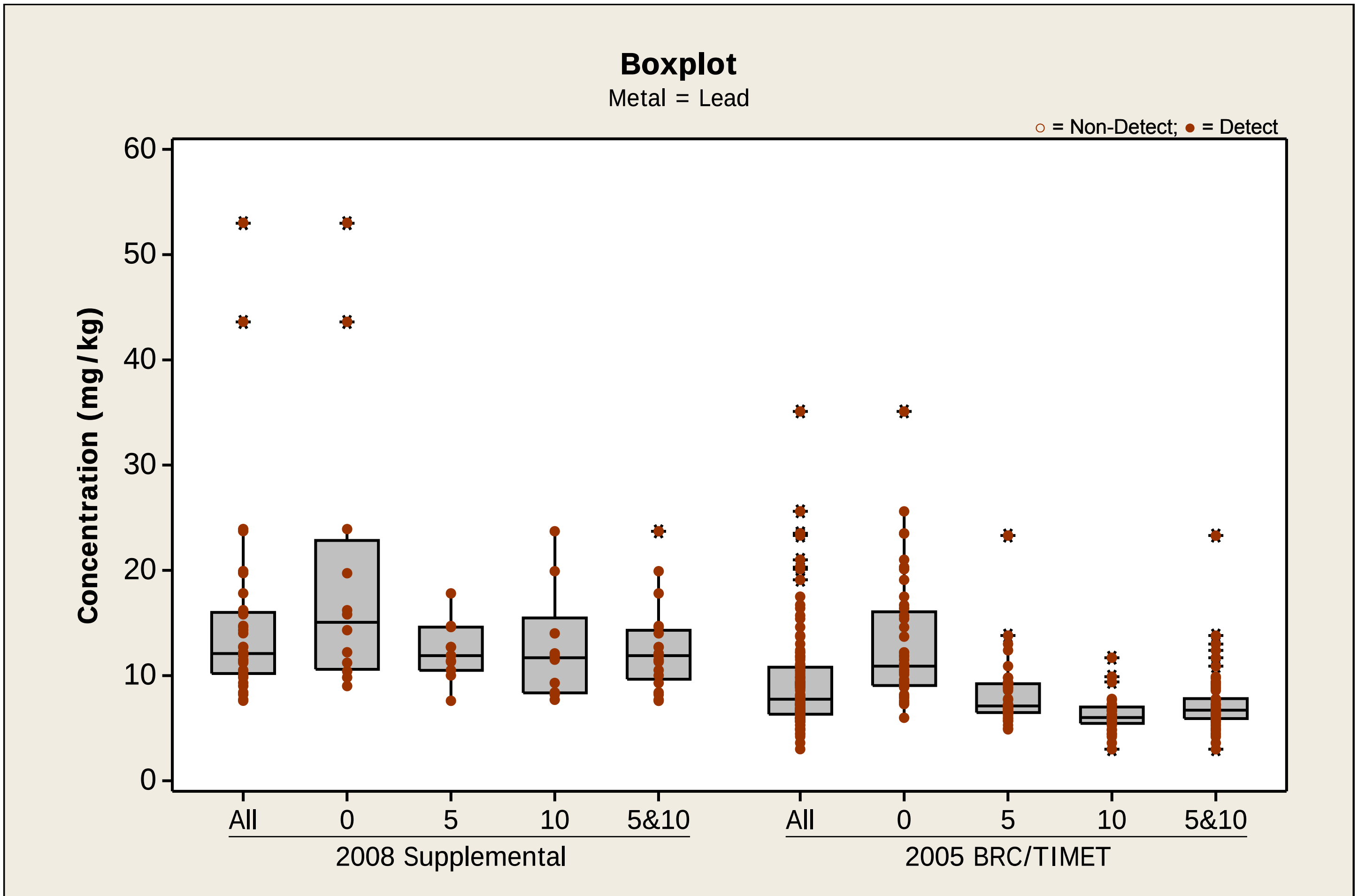

Boxplot
Metal = Cobalt
Concentration (mg/kg)
17.5
15.0
12.5
10.0
7.5
5.0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

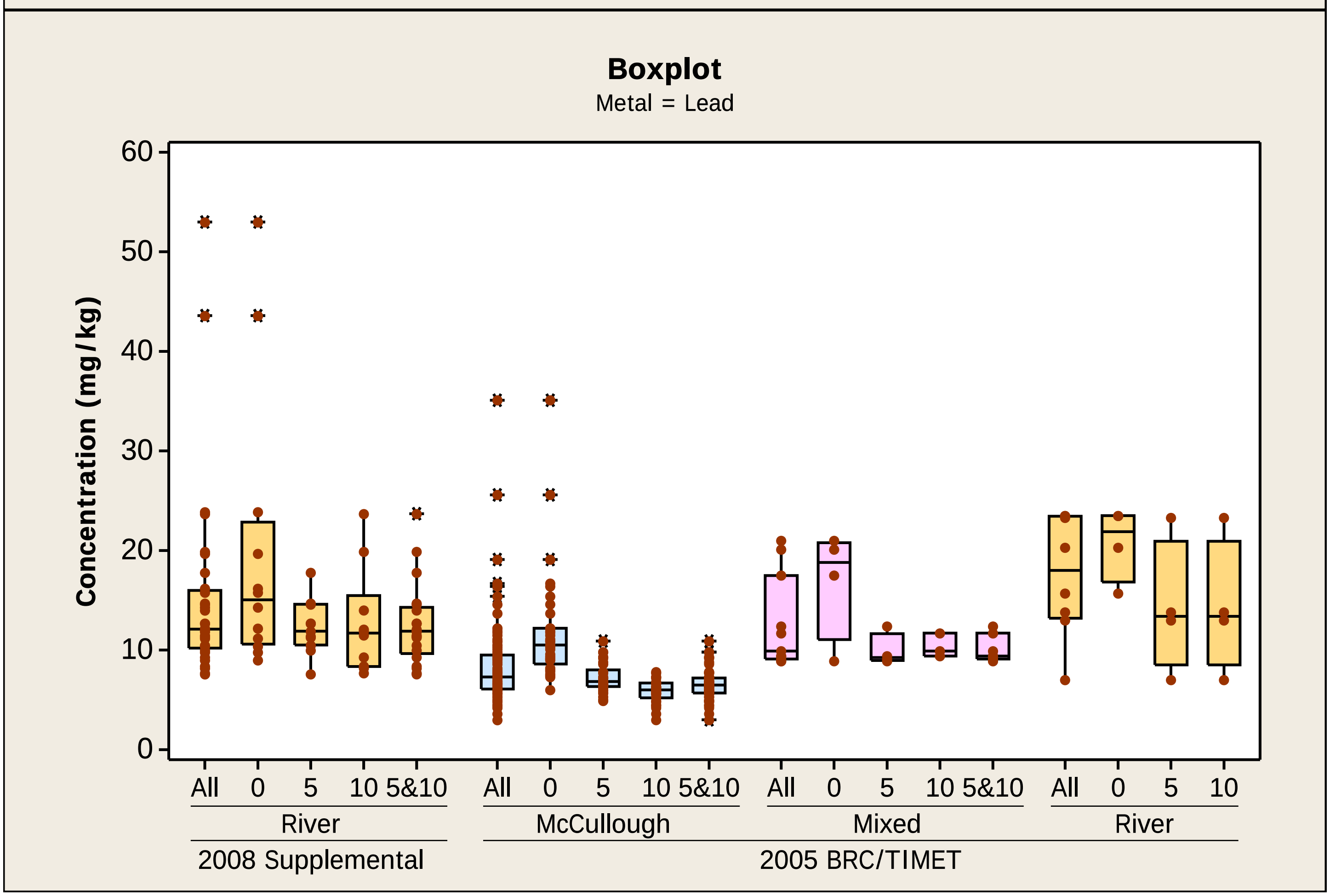

Boxplot
Metal = Copper
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
40
35
30
25
20
15
10
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

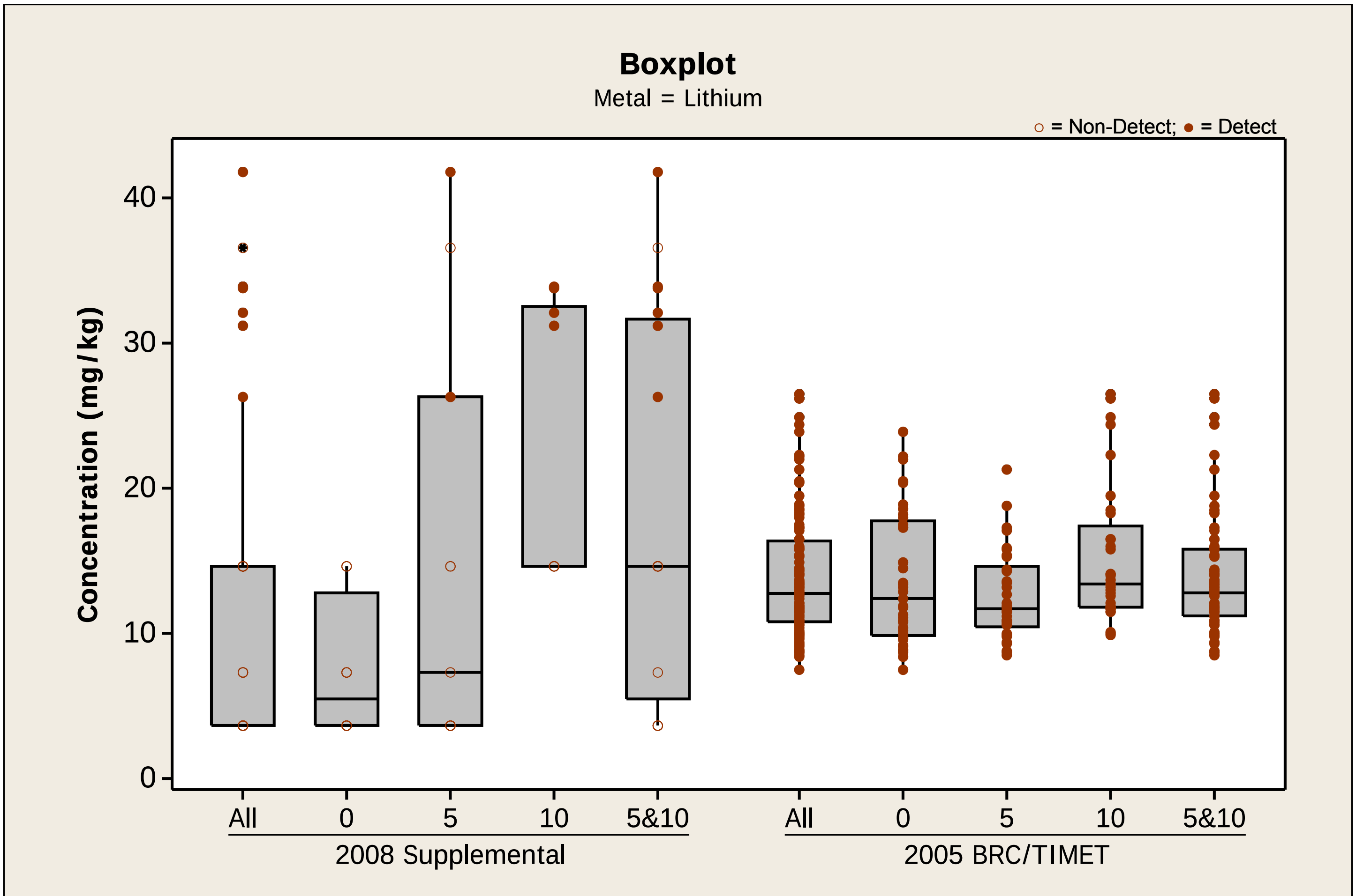

Boxplot
Metal = Copper
Concentration (mg/kg)
40
35
30
25
20
15
10
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

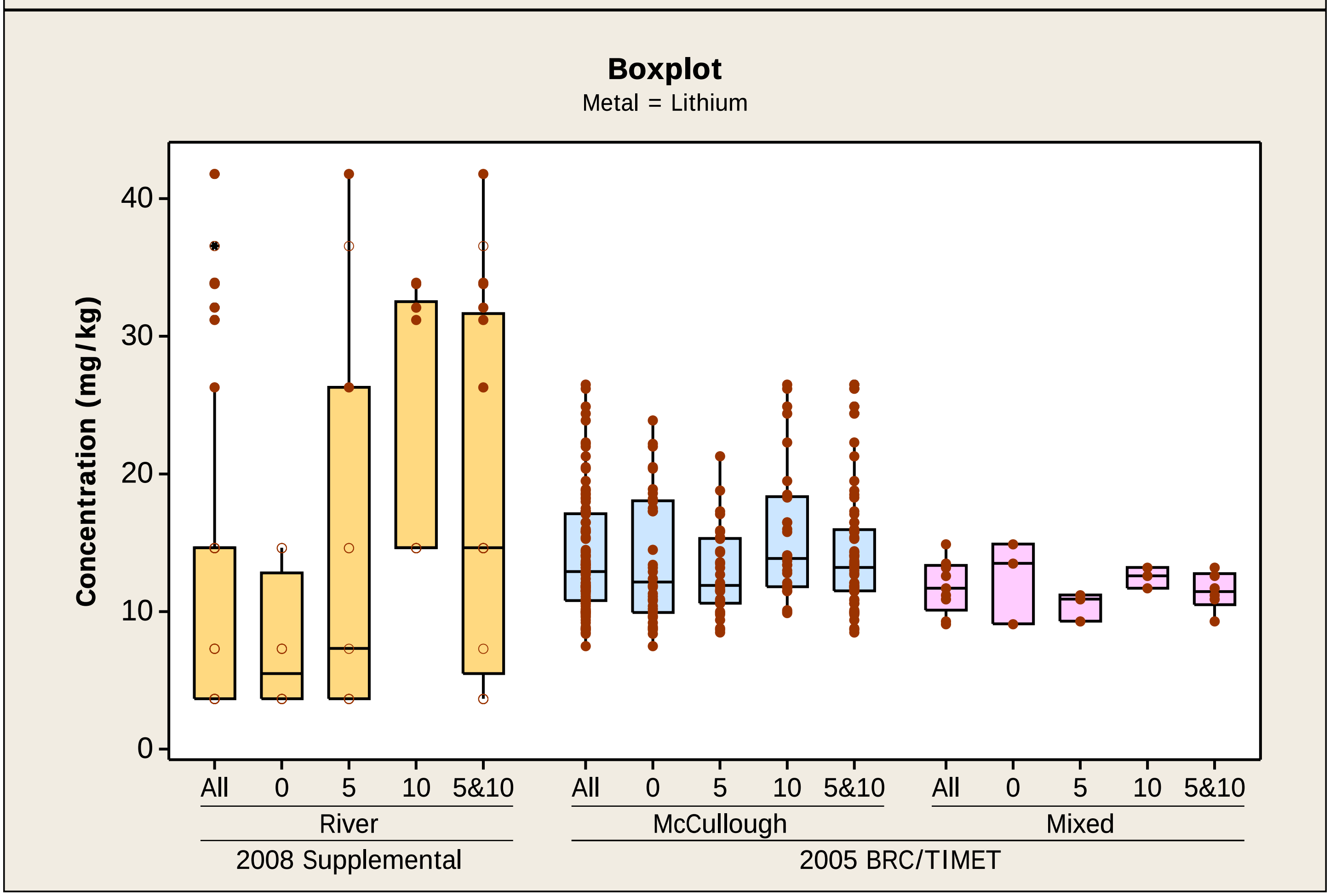

Boxplot
Metal = Iron
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
22500
20000
17500
15000
12500
10000
7500
5000
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

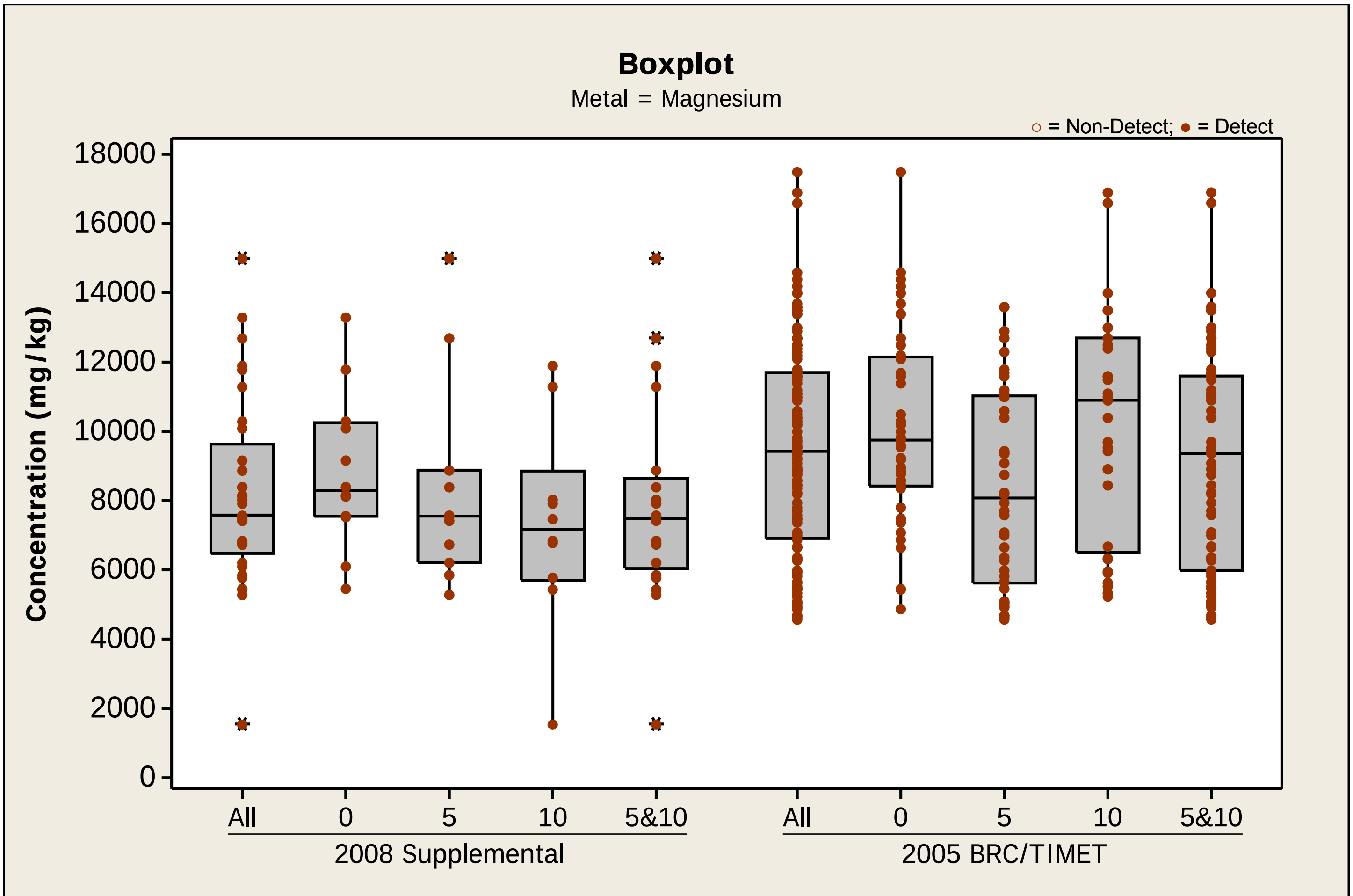

Boxplot
Metal = Iron
Concentration (mg/kg)
22500
20000
17500
15000
12500
10000
7500
5000
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Lead
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
60
50
40
30
20
10
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

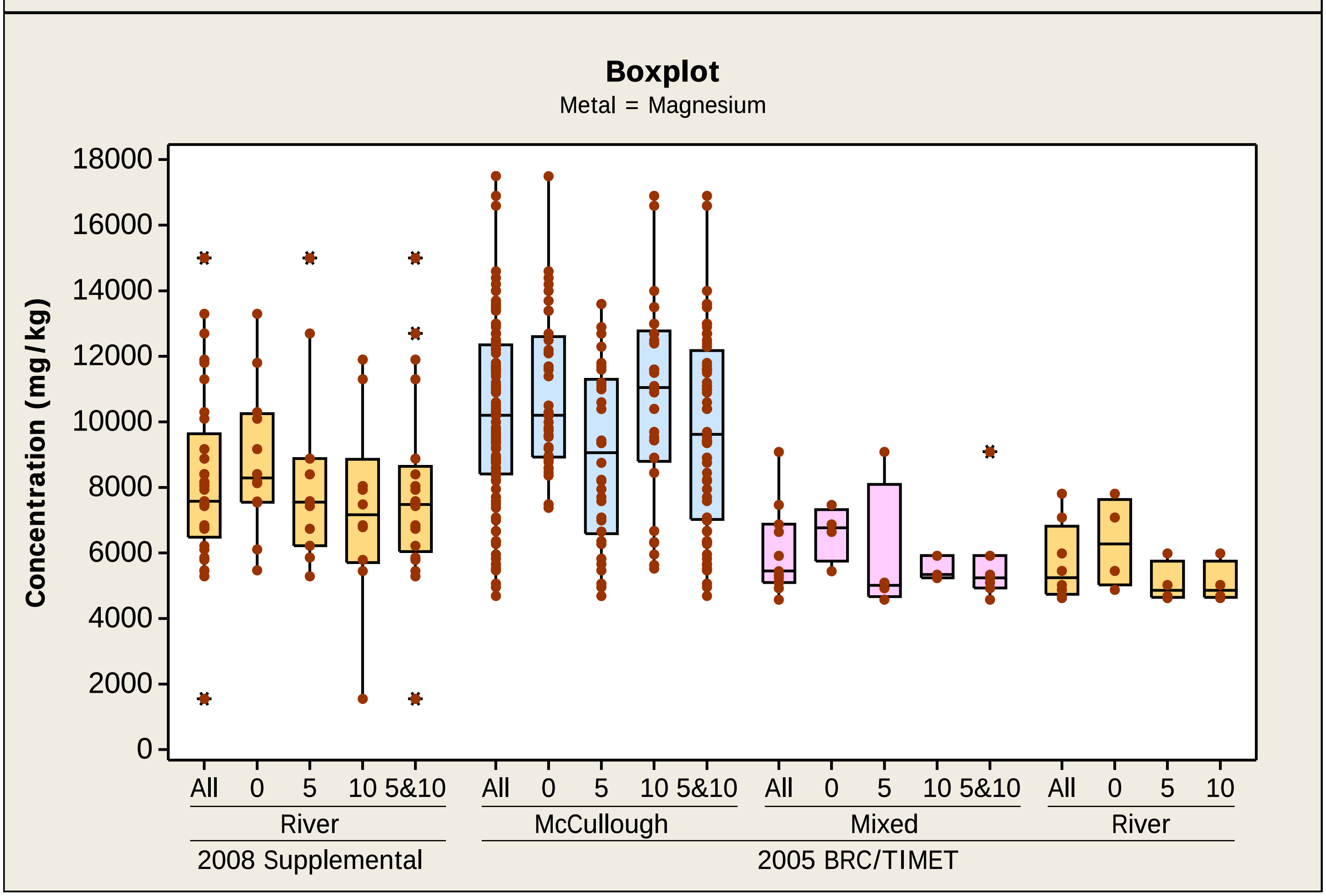

Boxplot
Metal = Lead
Concentration (mg/kg)
60
50
40
30
20
10
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Lithium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0
10
20
30
40
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

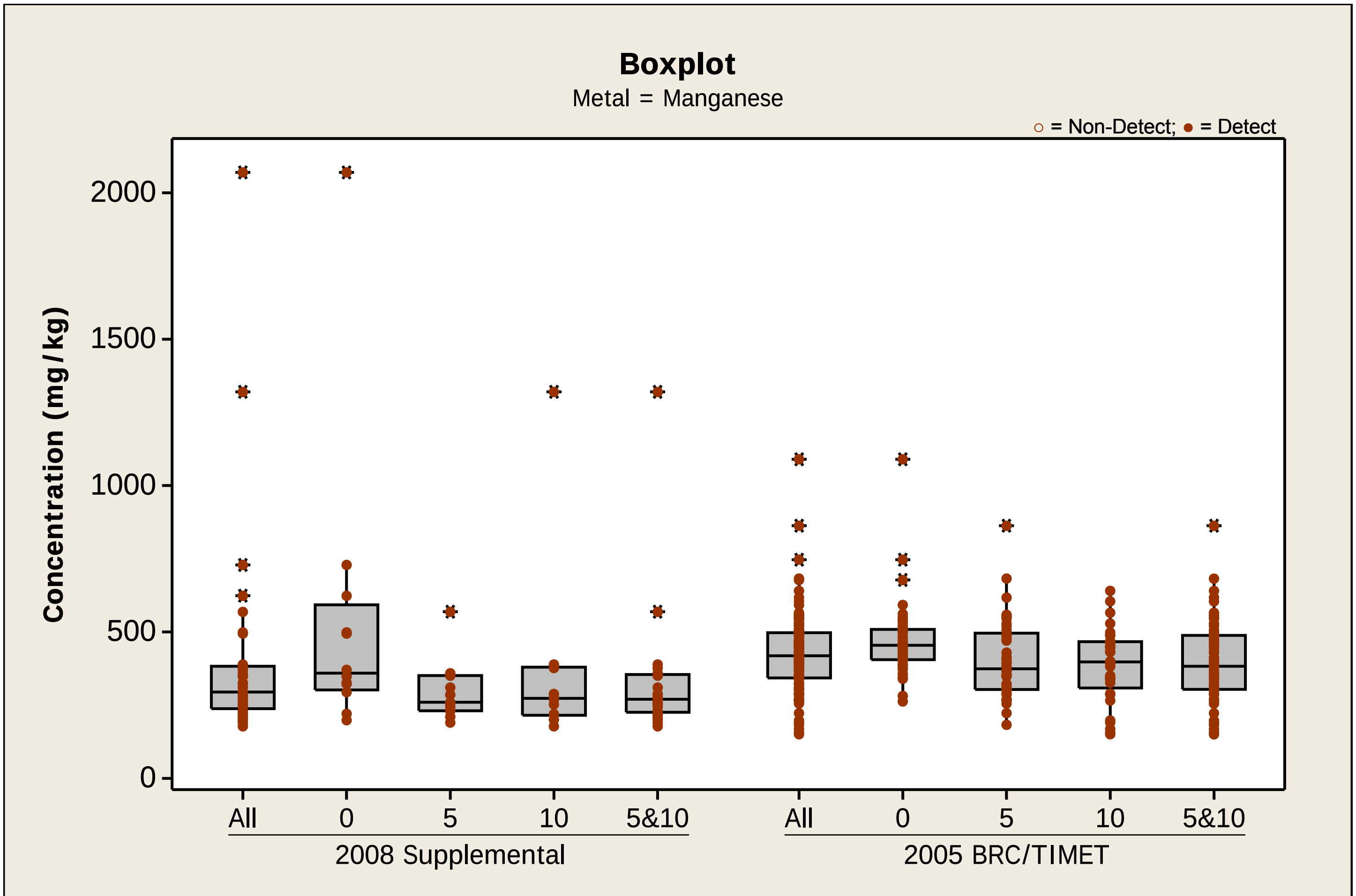

Boxplot
Metal = Lithium
Concentration (mg/kg)
0
10
20
30
40
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET



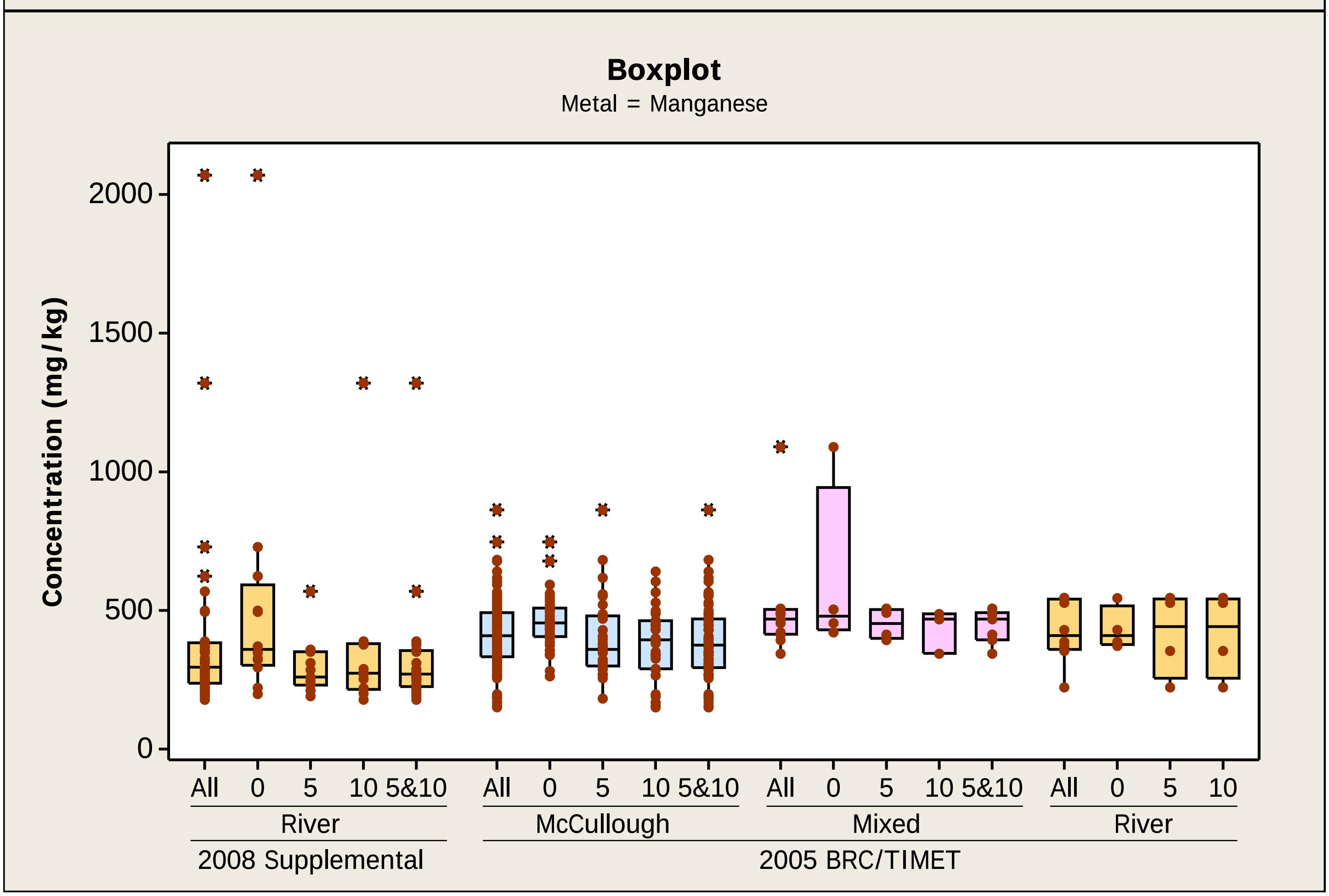
Boxplot
Metal = Magnesium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET



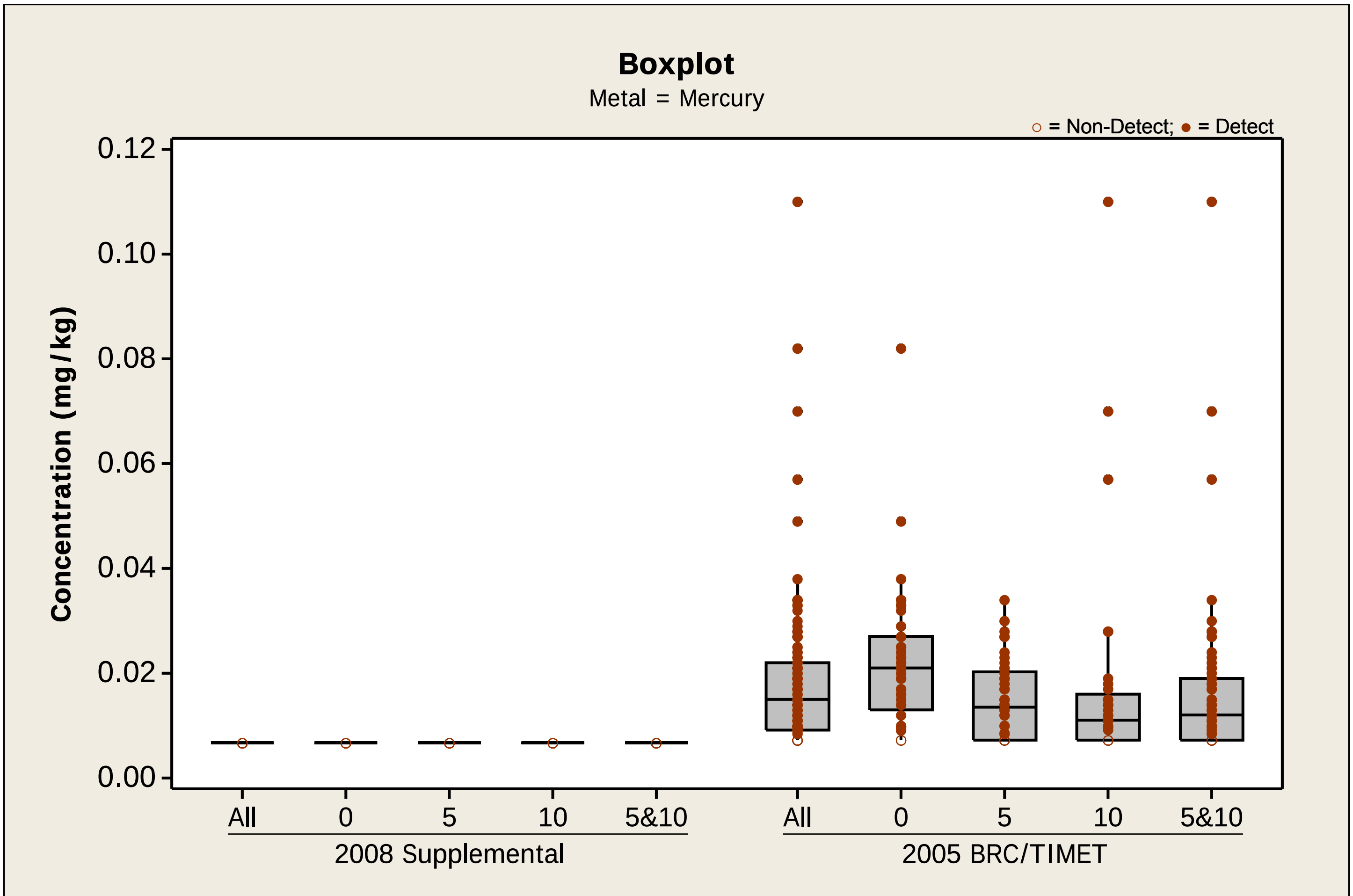
Boxplot
Metal = Magnesium
Concentration (mg/kg)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

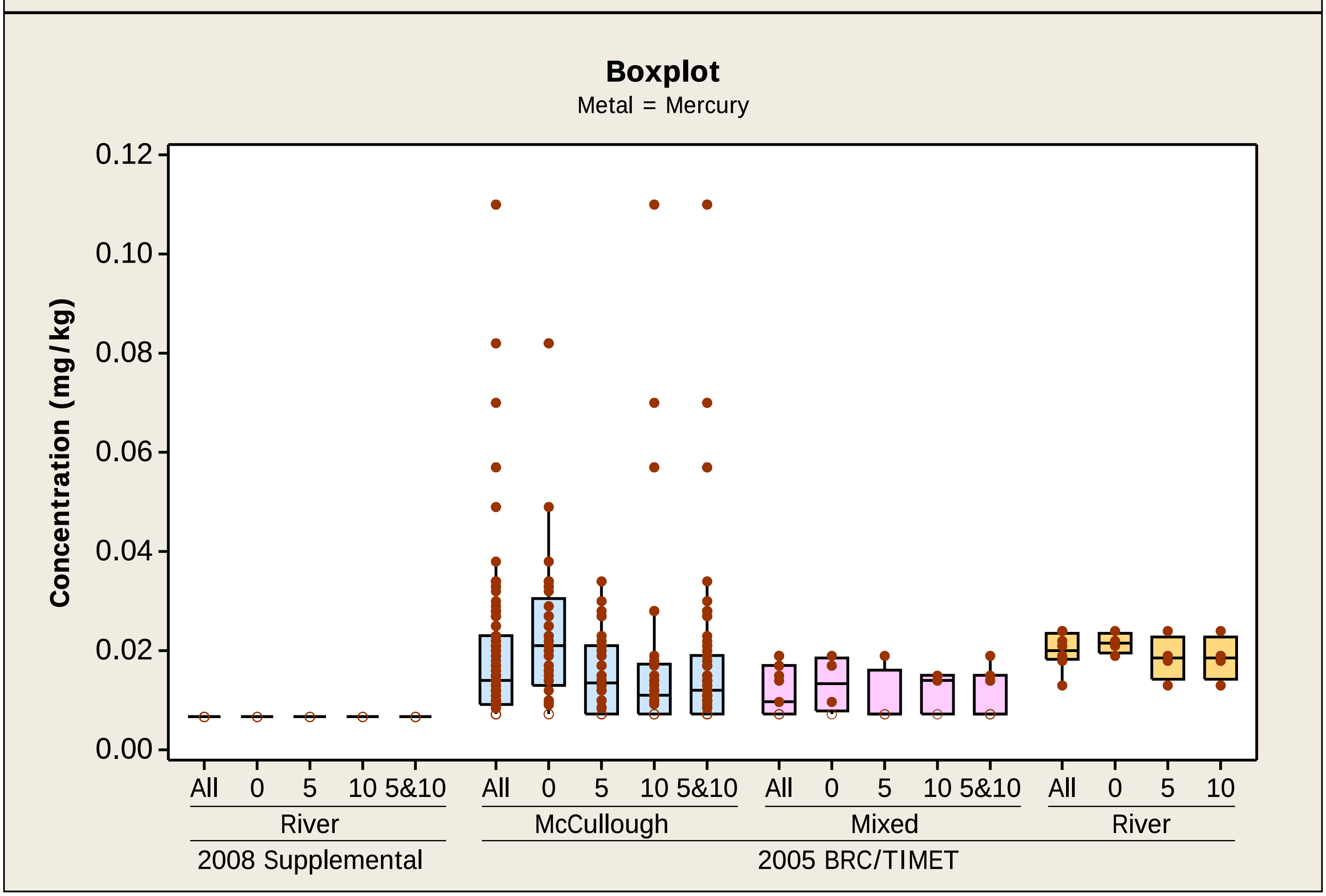


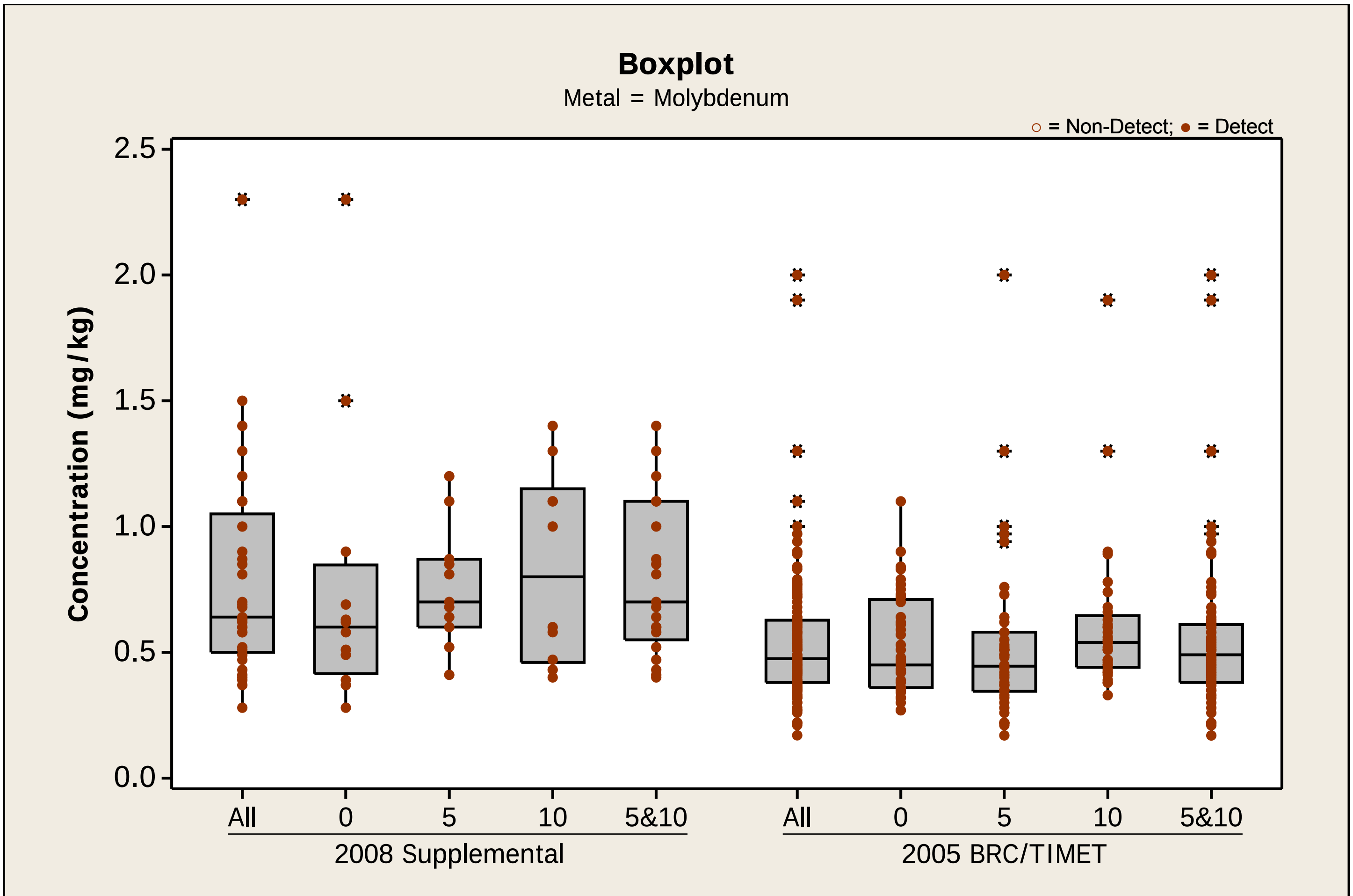
Boxplot
Metal = Manganese
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
2000
1500
1000
500
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET



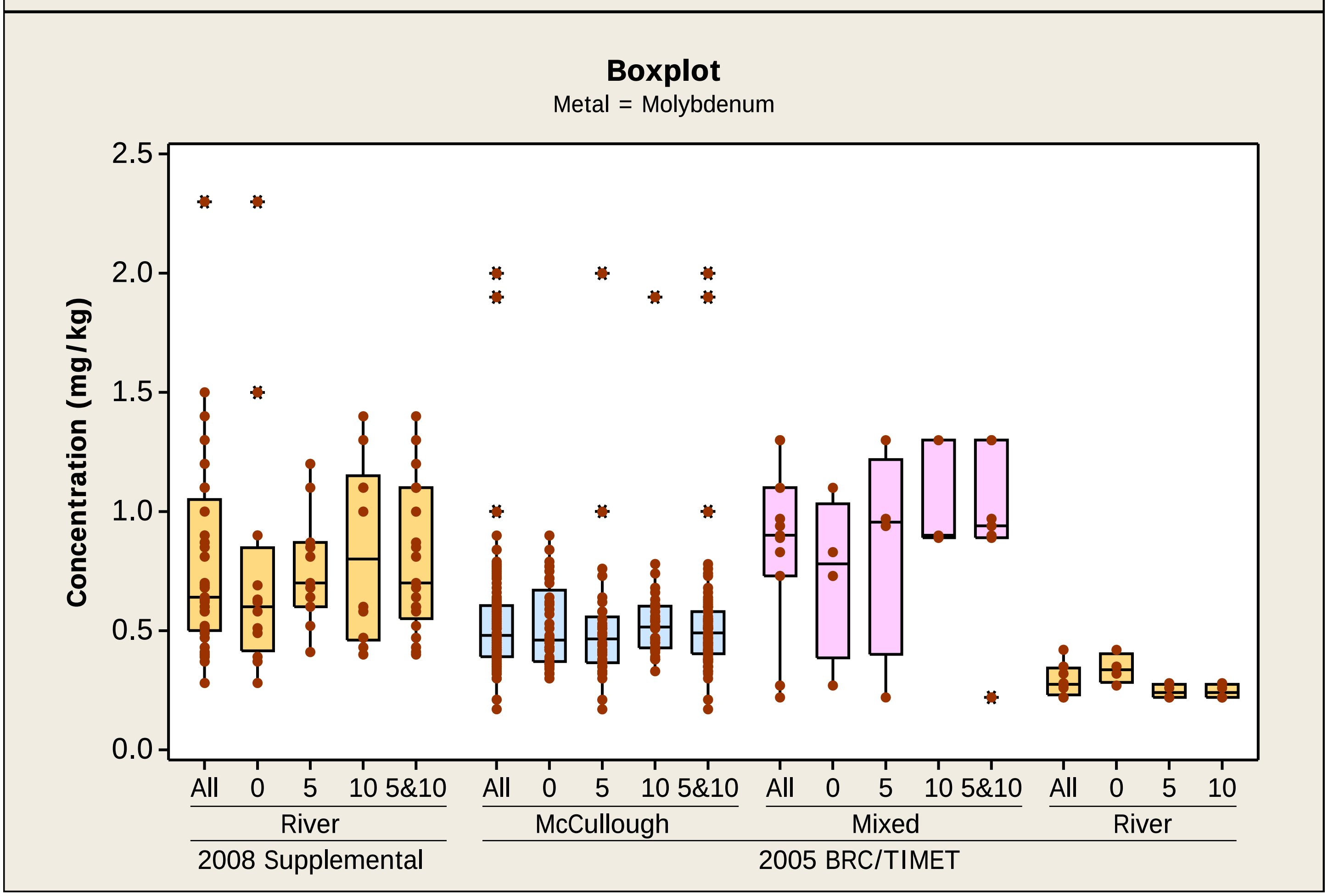
Boxplot
Metal = Manganese
Concentration (mg/kg)
2000
1500
1000
500
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Mercury
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

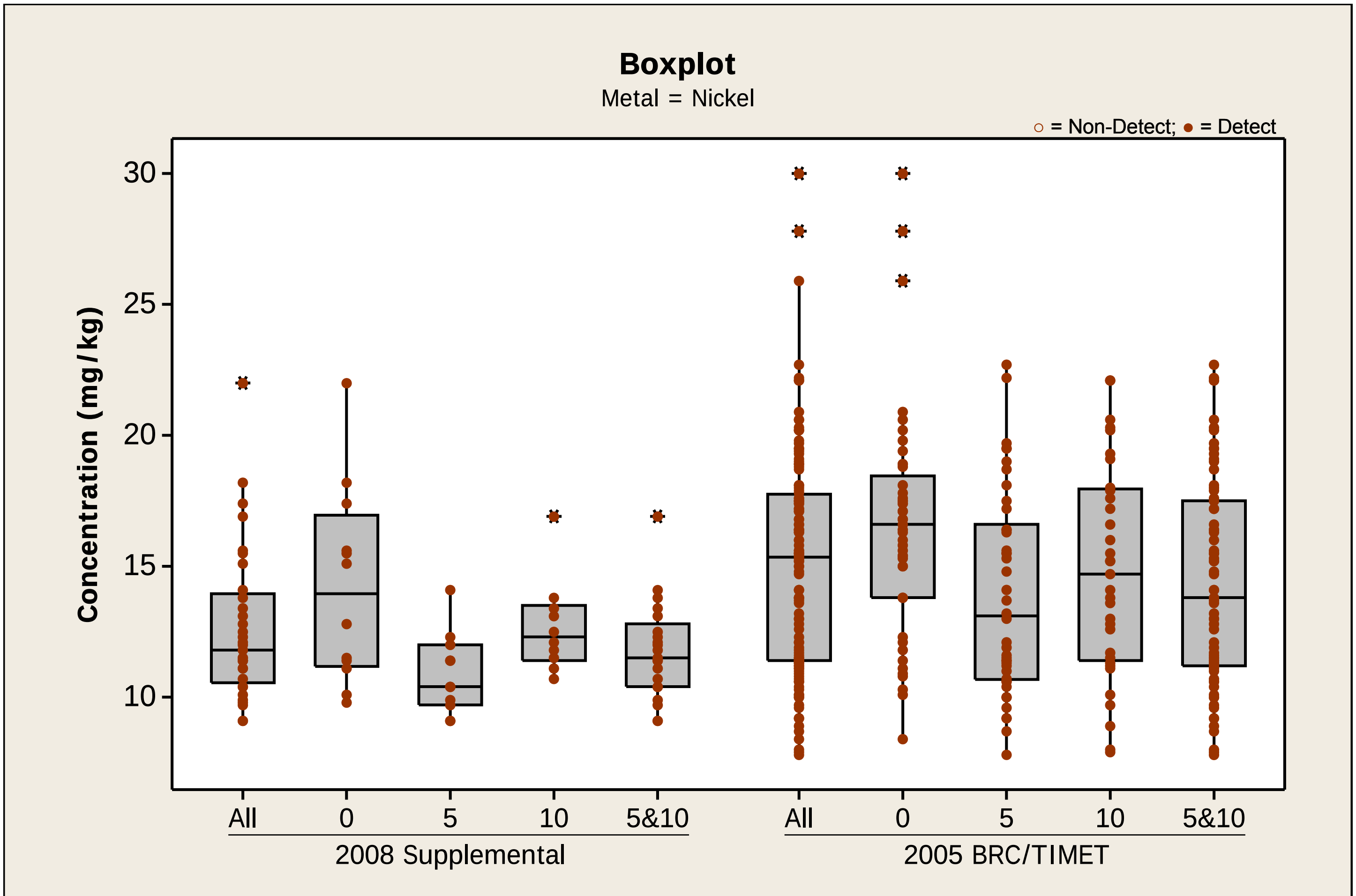

Boxplot
Metal = Mercury
Concentration (mg/kg)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

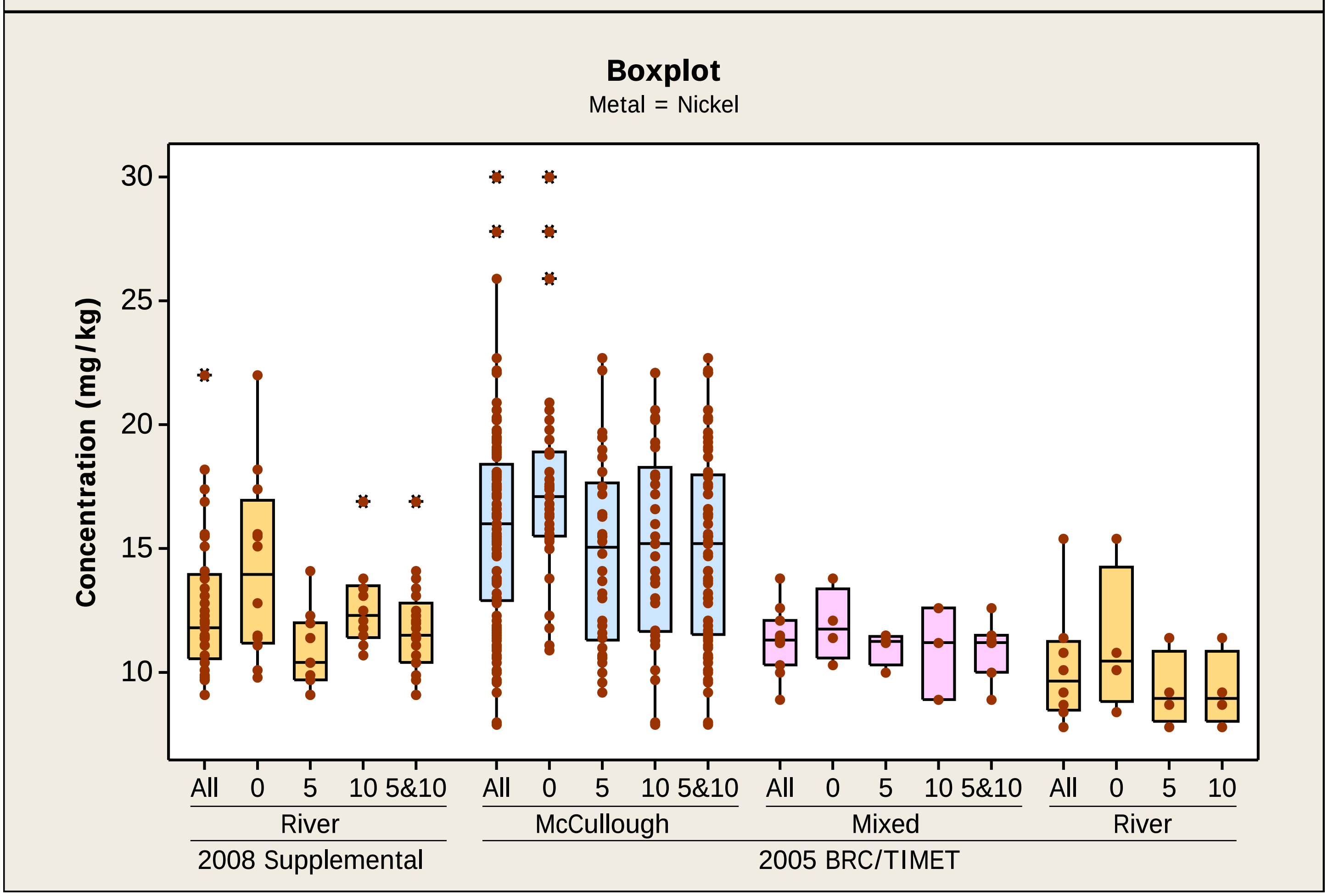


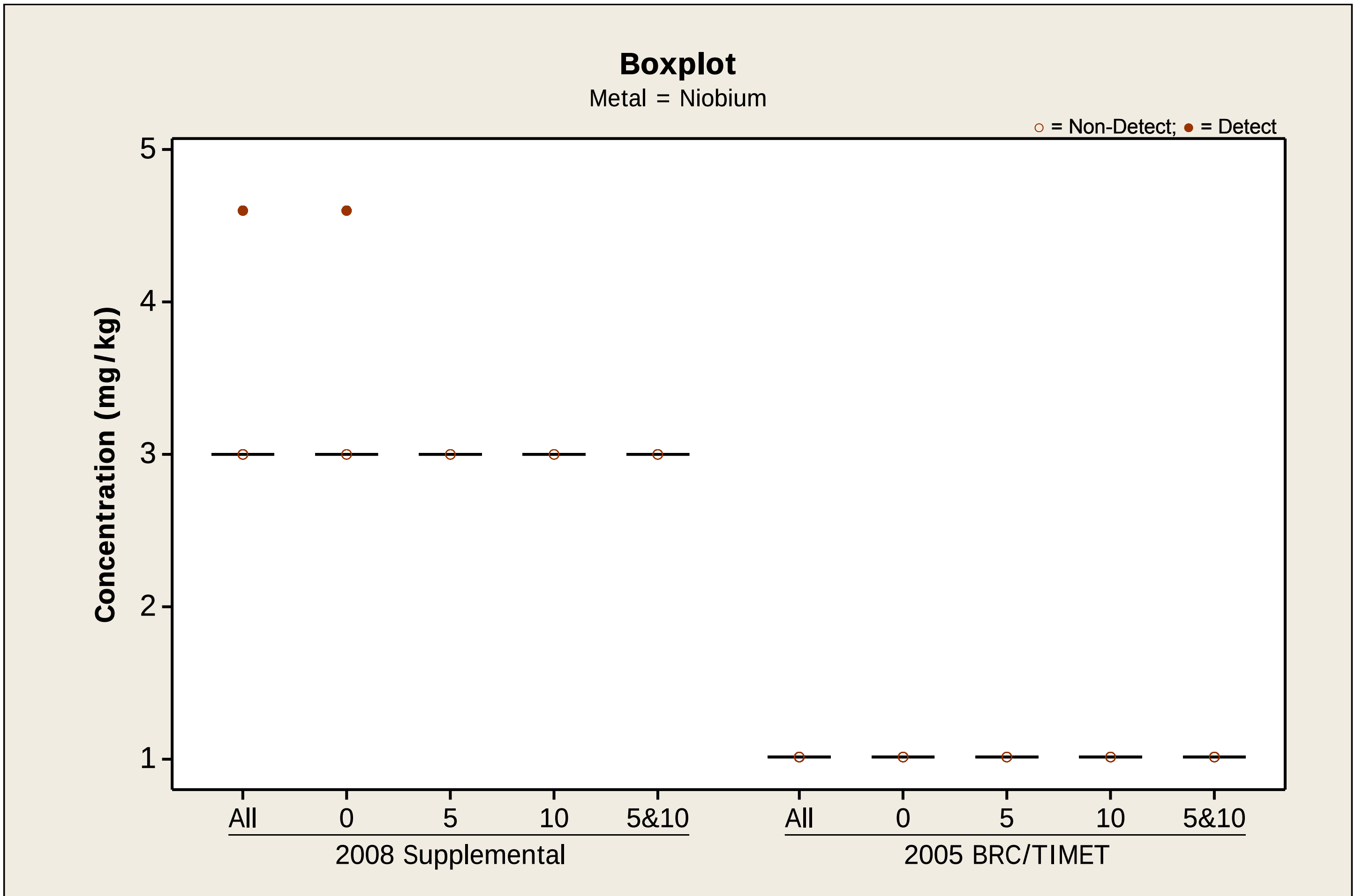
Boxplot
Metal = Molybdenum
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
2.5
2.0
1.5
1.0
0.5
0.0
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

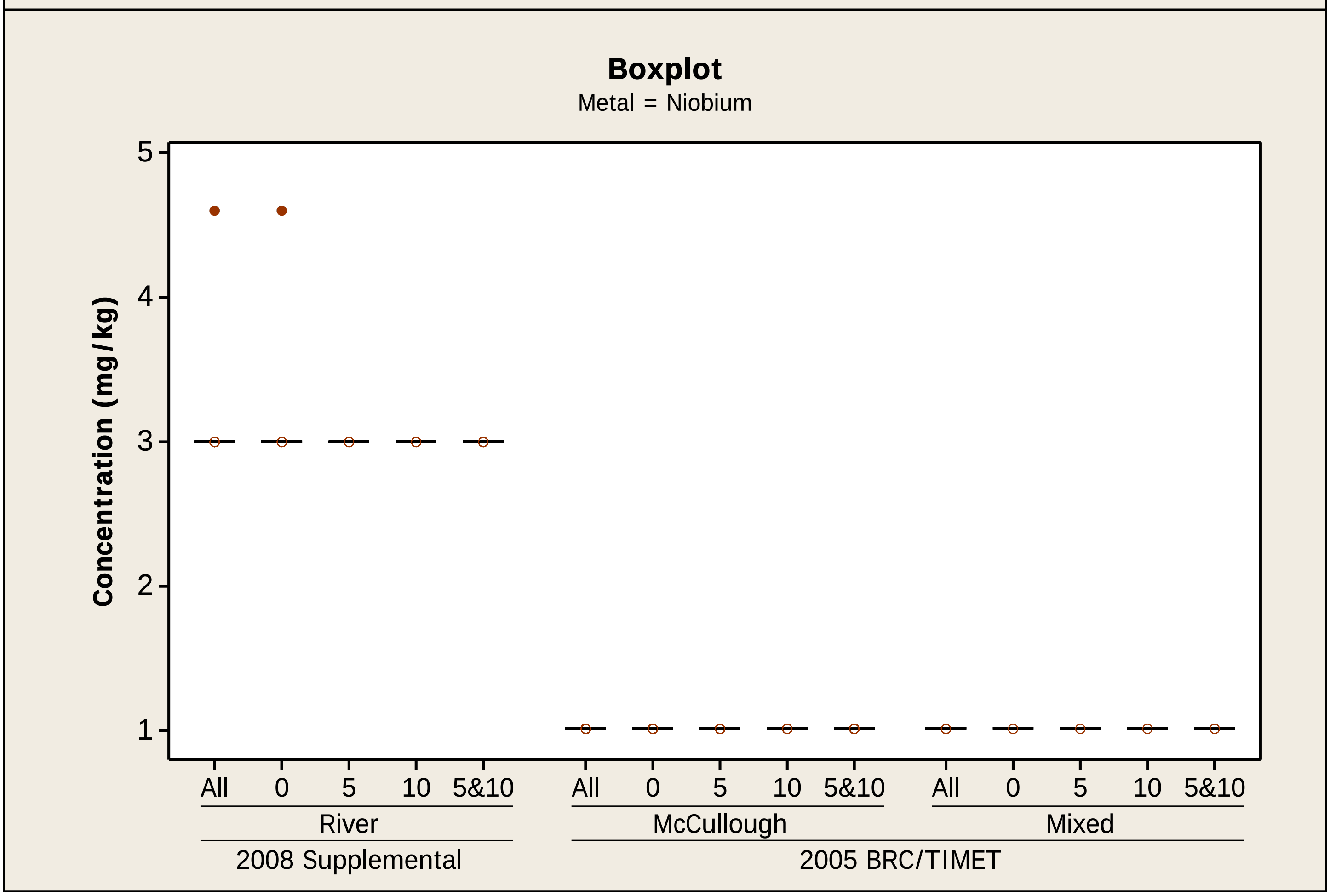


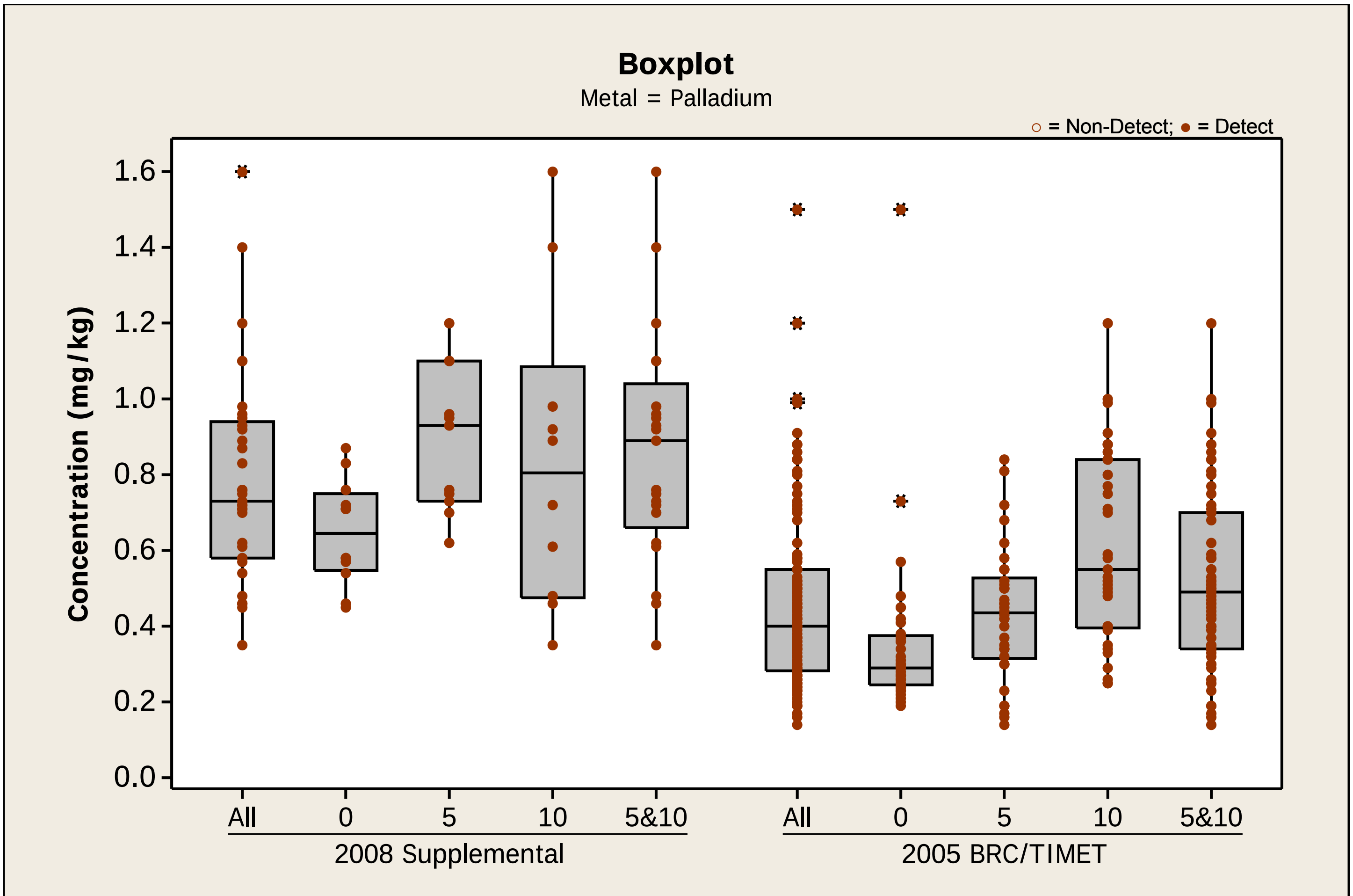
Boxplot
Metal = Molybdenum
Concentration (mg/kg)
2.5
2.0
1.5
1.0
0.5
0.0
All 0 5 10 5&10
River
2008 Supplemental
All 0 5 10 5&10
McCullough
All 0 5 10 5&10
Mixed
All 0 5 10
River
2005 BRC/TIMET

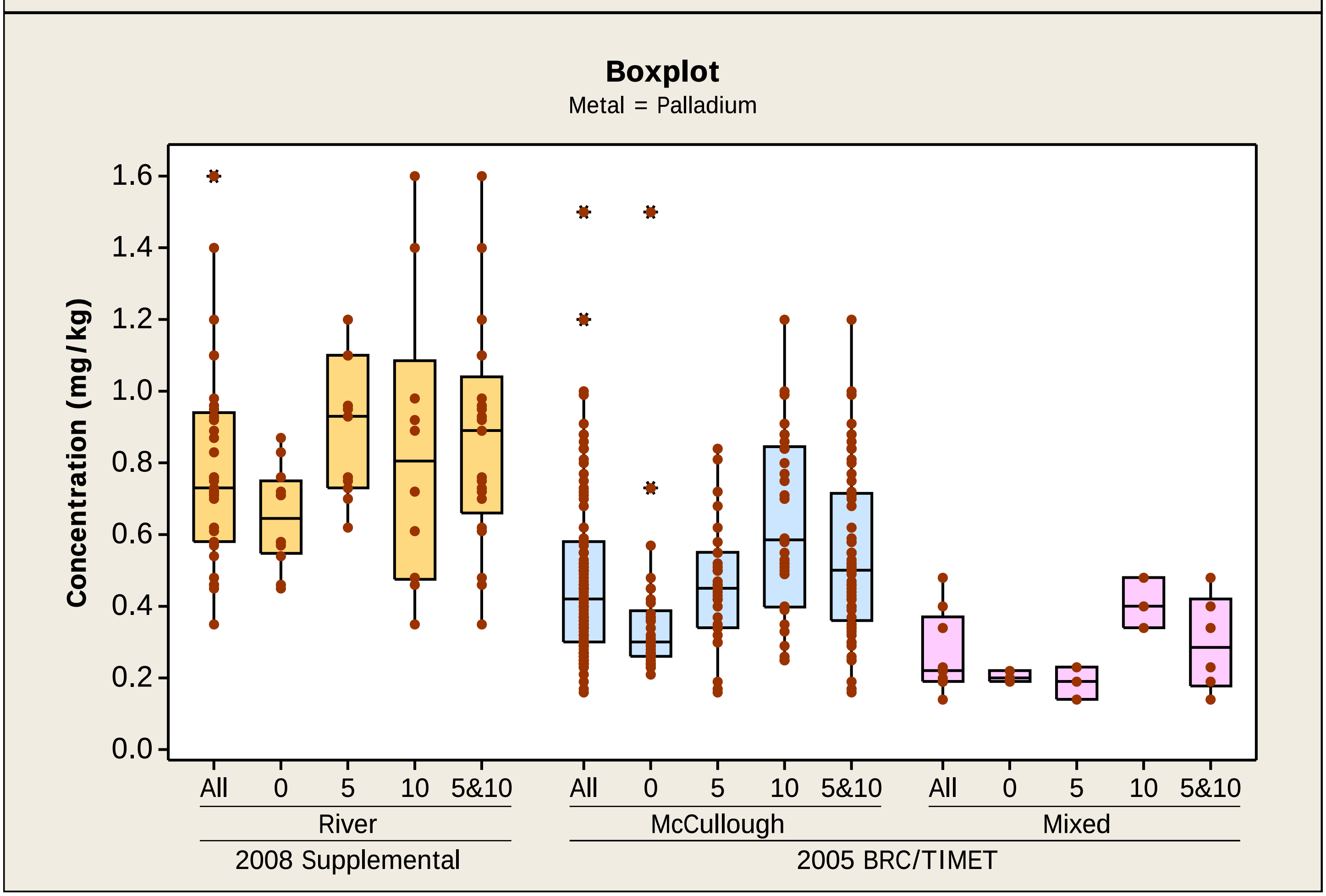

Boxplot
Metal = Nickel
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
30
25
20
15
10
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

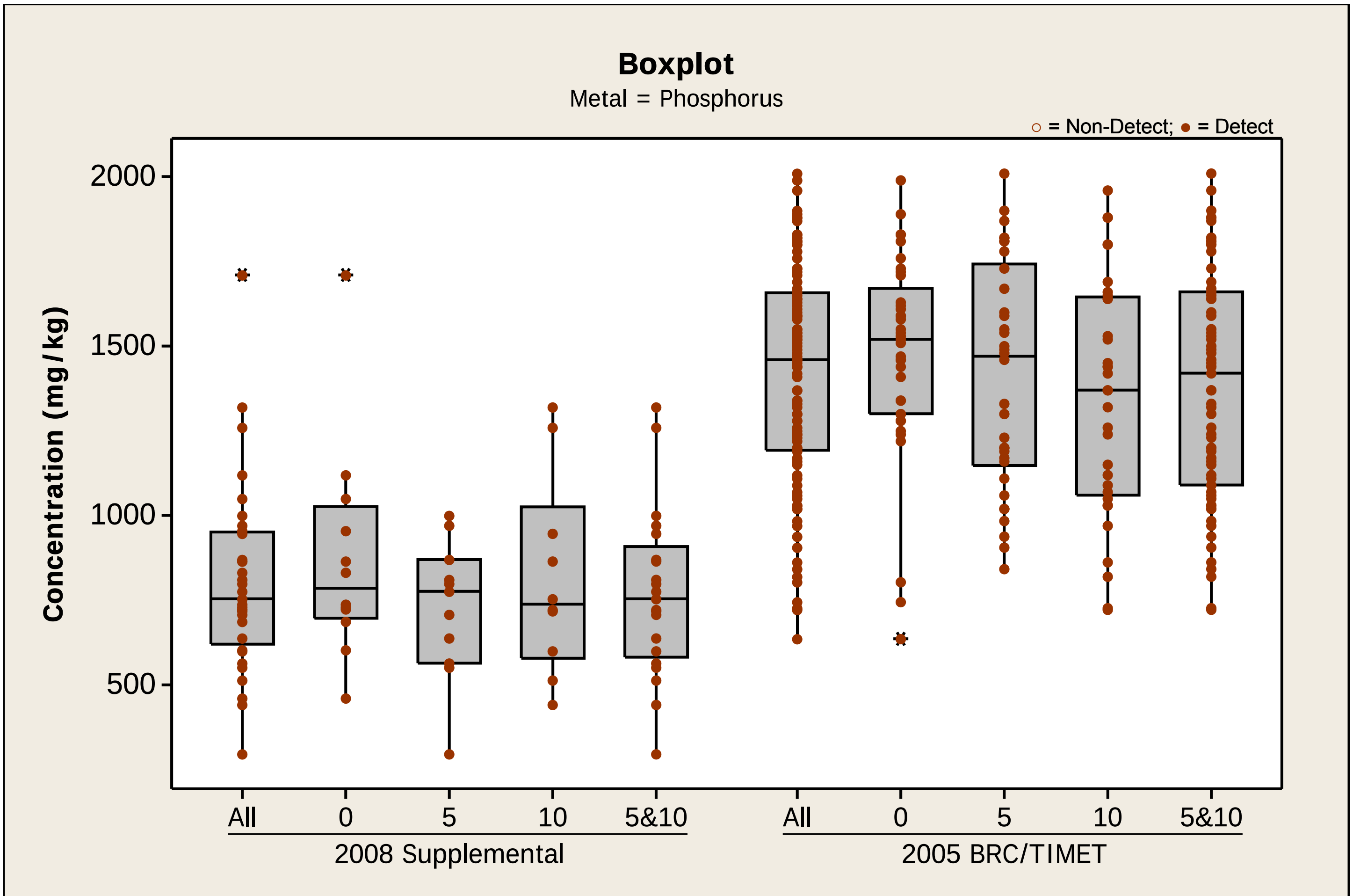

Boxplot
Metal = Nickel
Concentration (mg/kg)
30
25
20
15
10
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

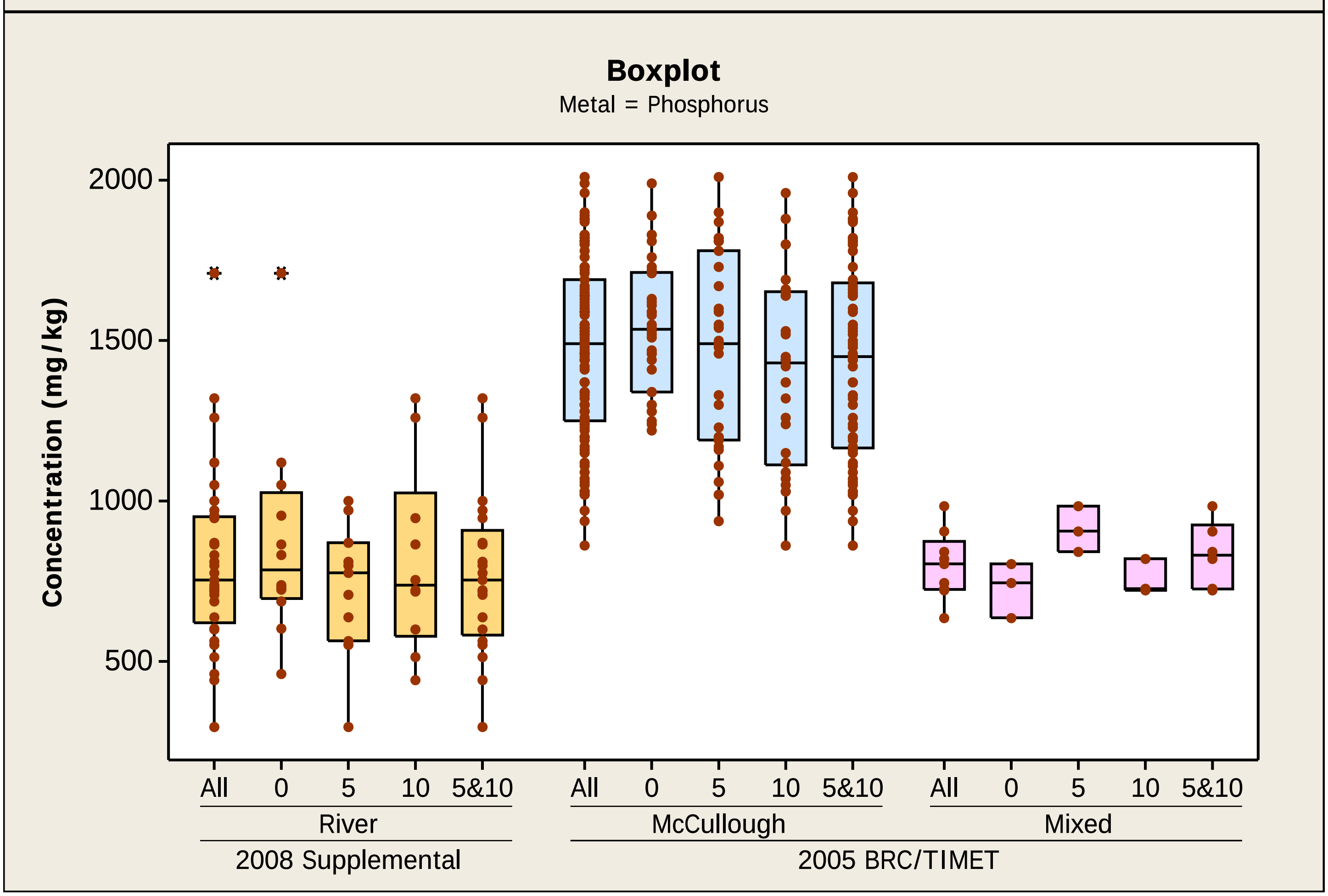

Boxplot
Metal = Niobium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
5
4
3
2
1
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

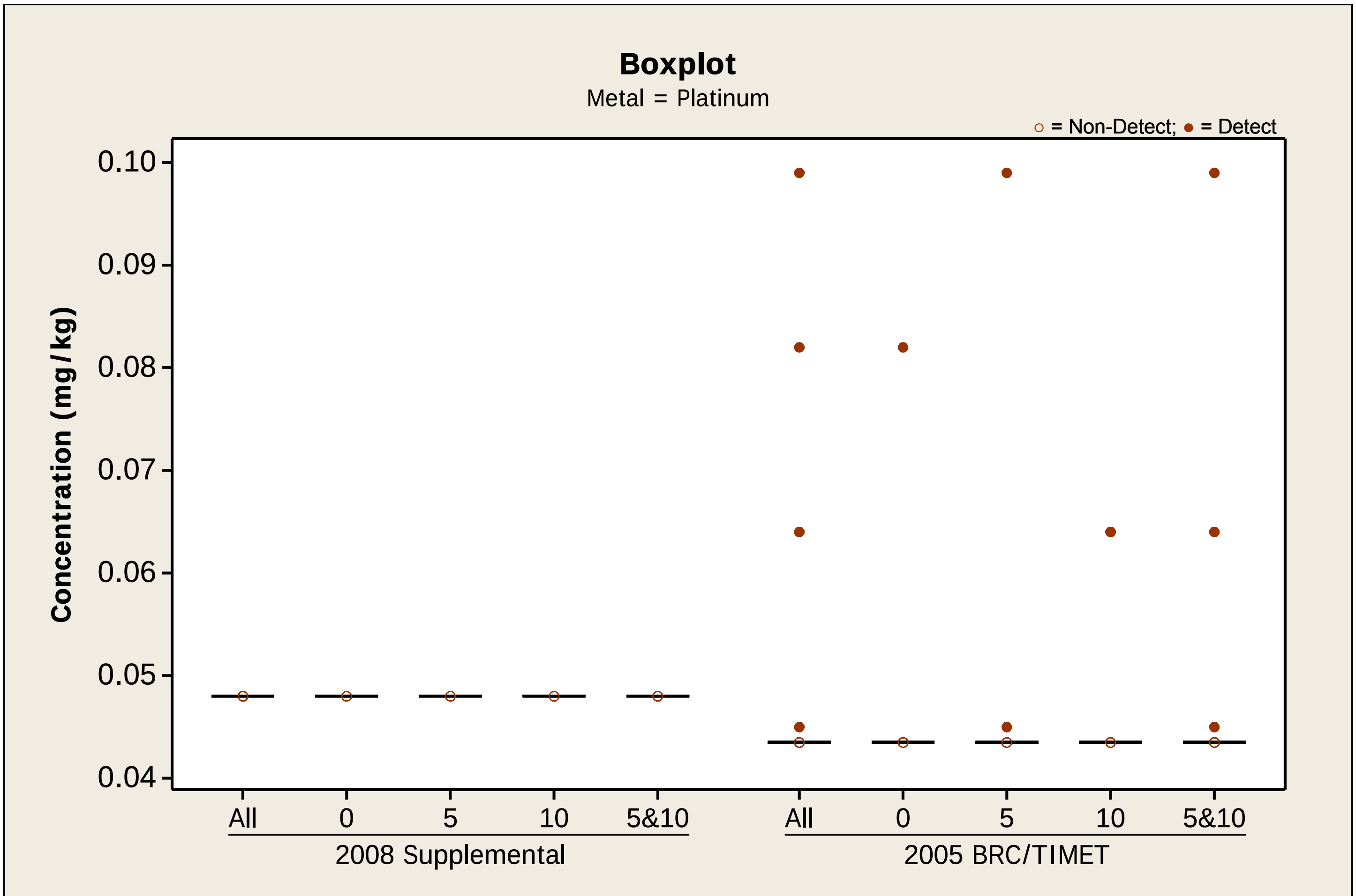

Boxplot
Metal = Niobium
Concentration (mg/kg)
5
4
3
2
1
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

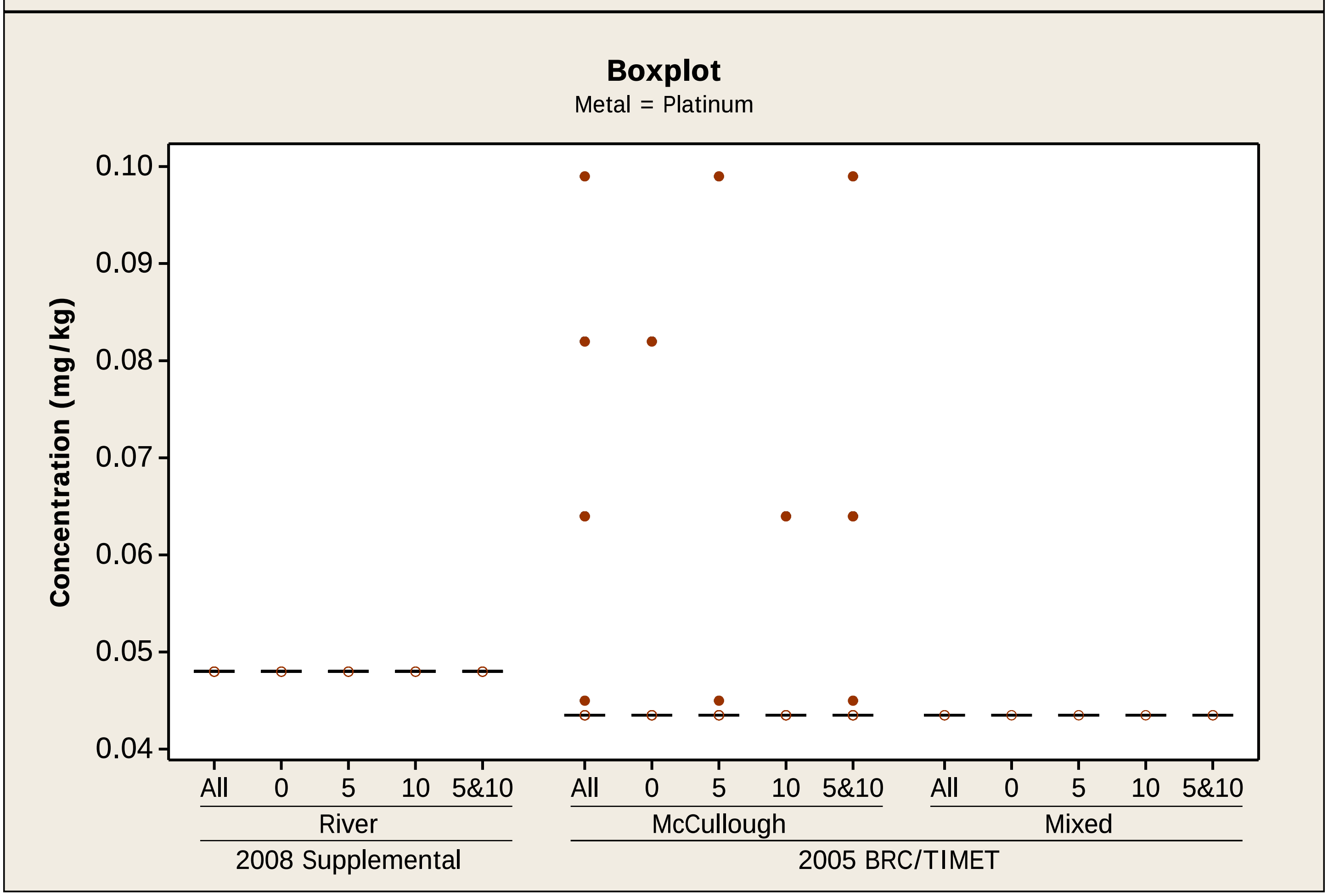

Boxplot
Metal = Palladium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

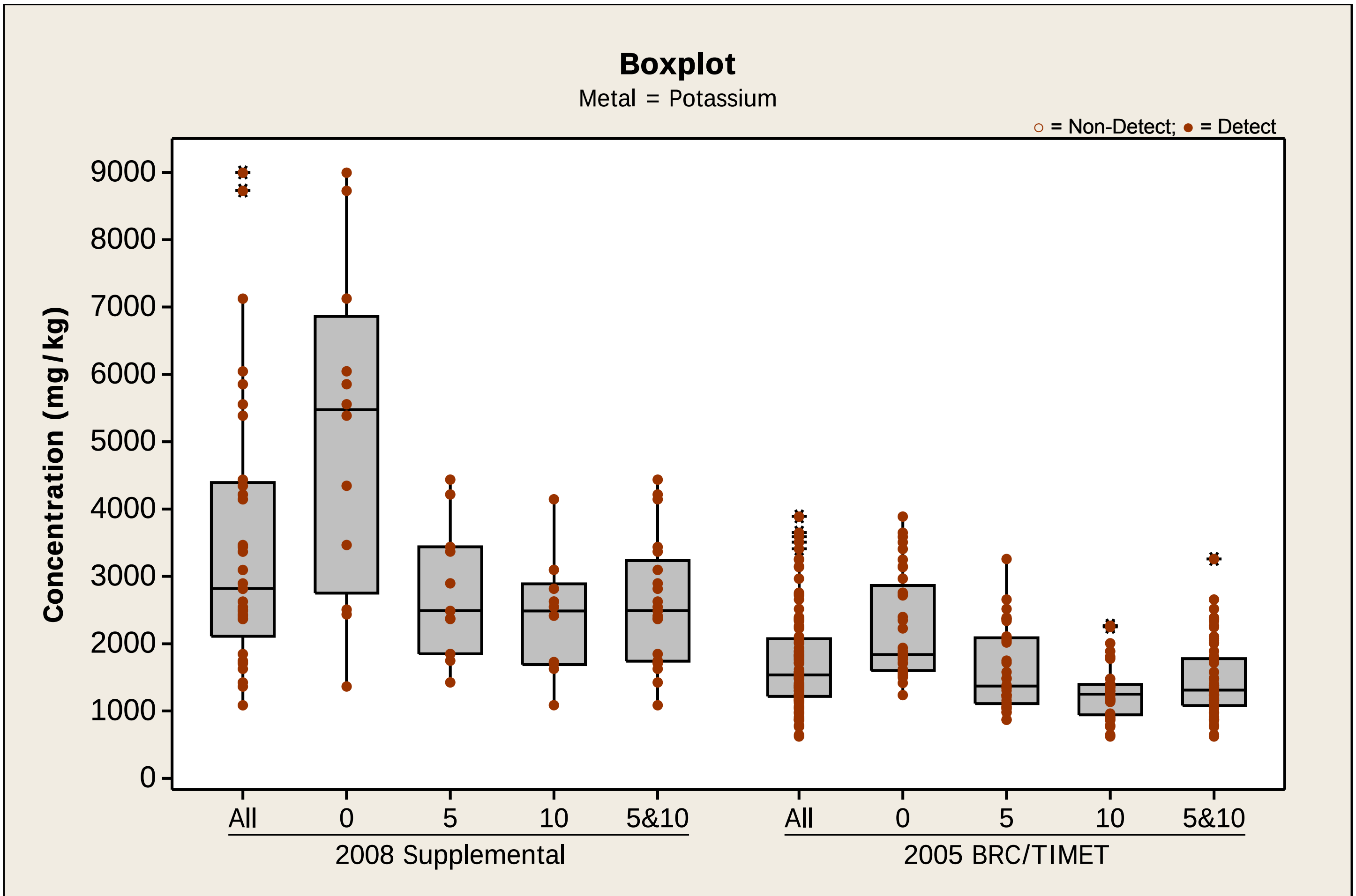

Boxplot
Metal = Palladium
Concentration (mg/kg)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

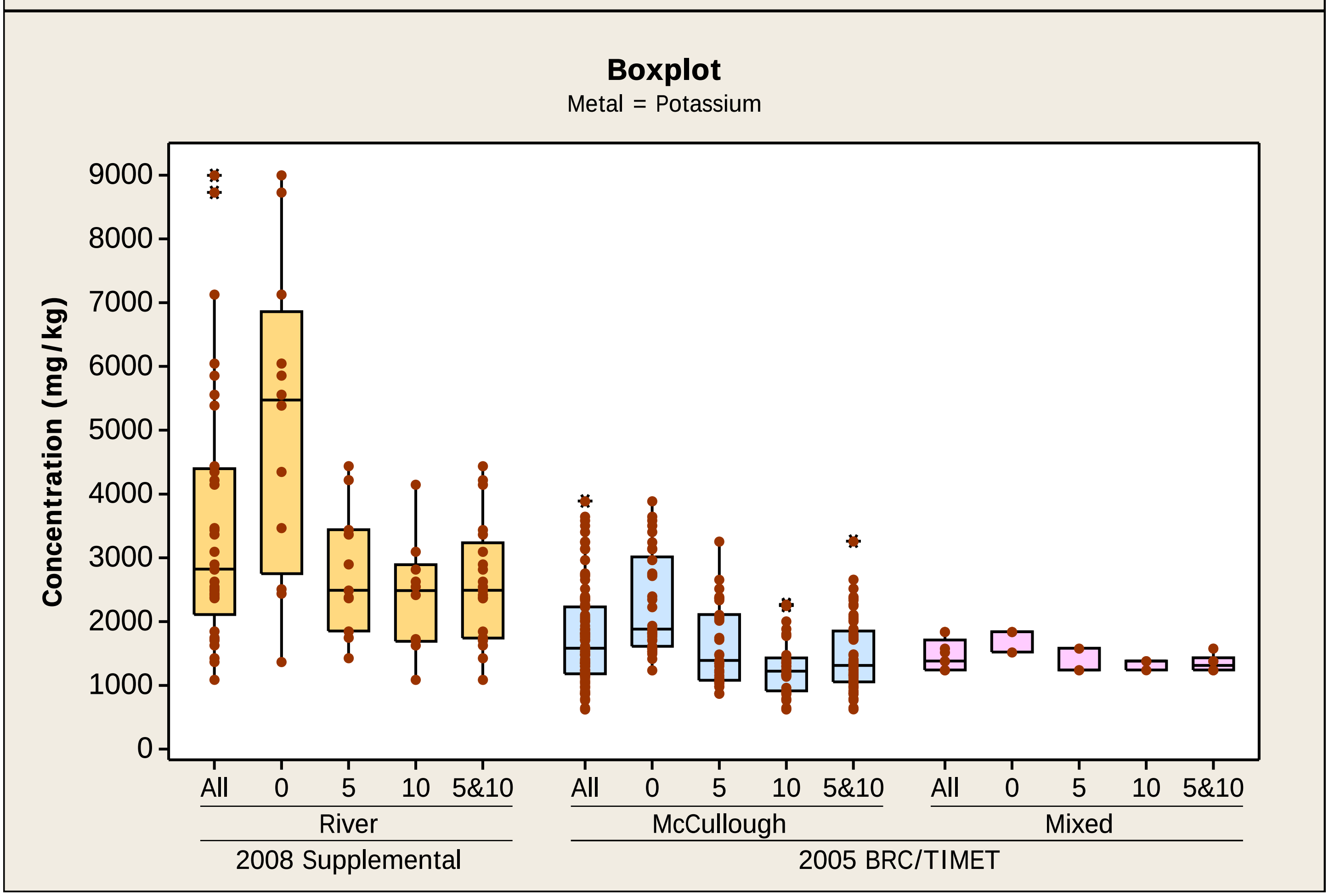

Boxplot
Metal = Phosphorus
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
2000
1500
1000
500
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

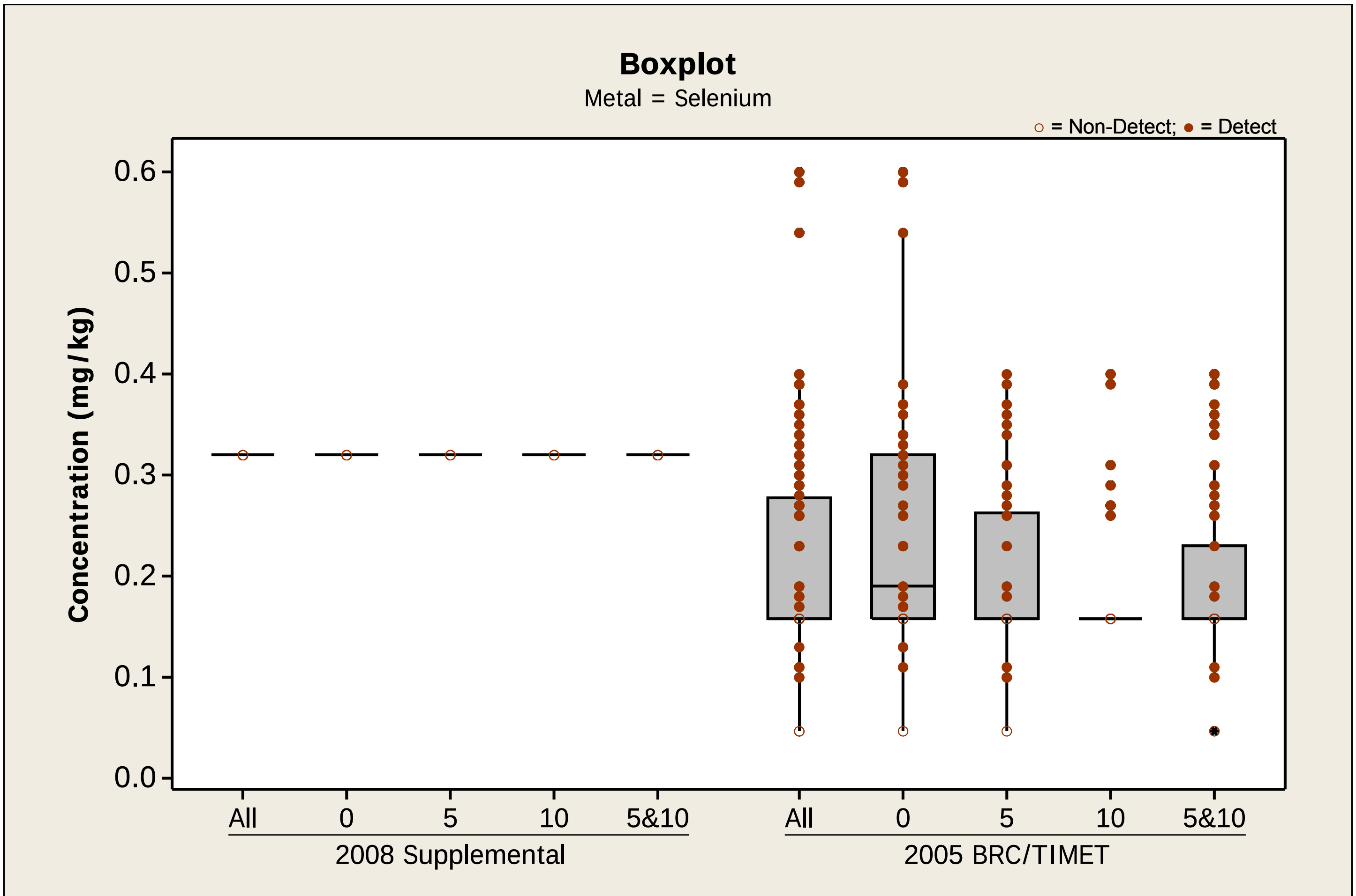

Boxplot
Metal = Phosphorus
Concentration (mg/kg)
2000
1500
1000
500
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

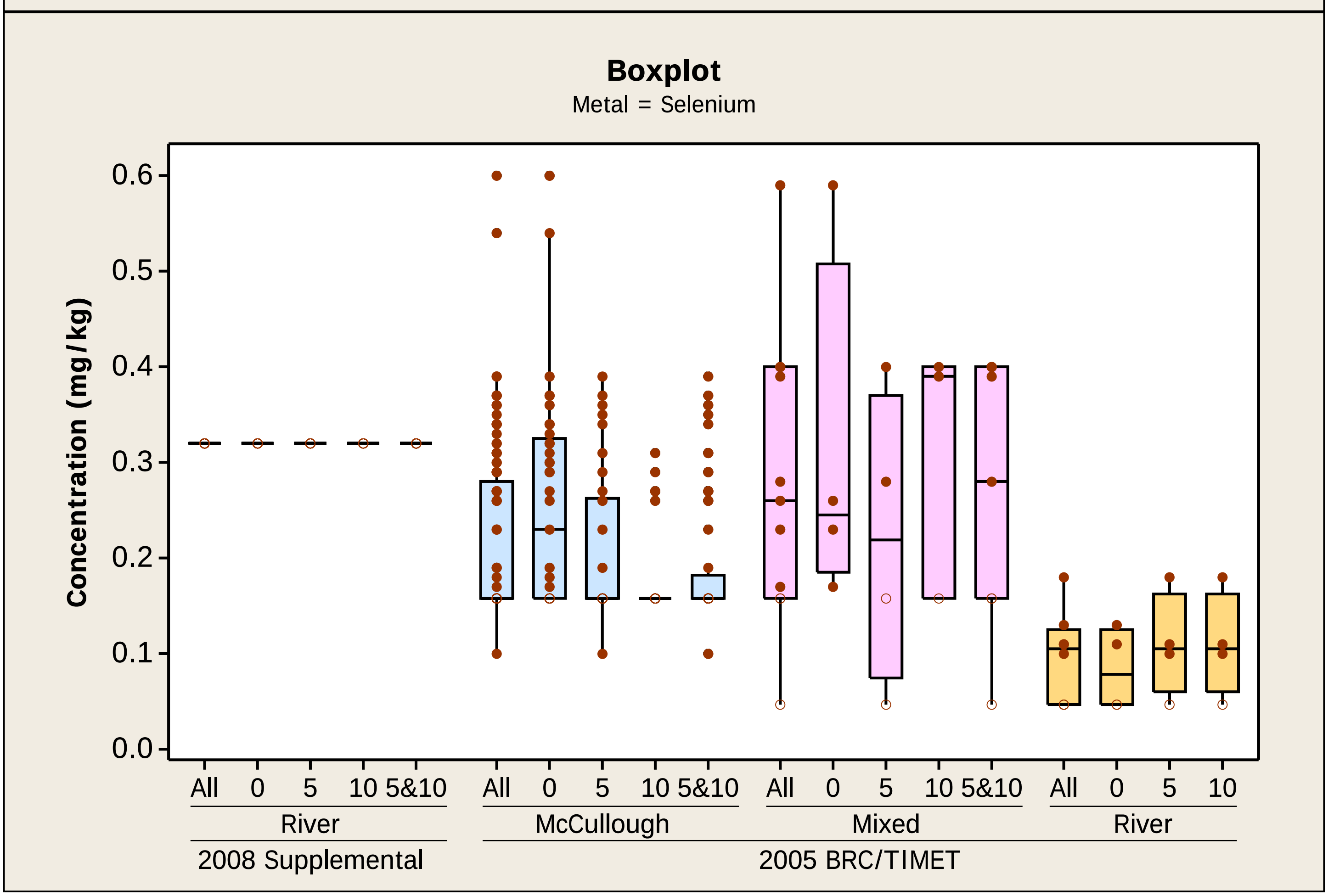

Boxplot
Metal = Platinum
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

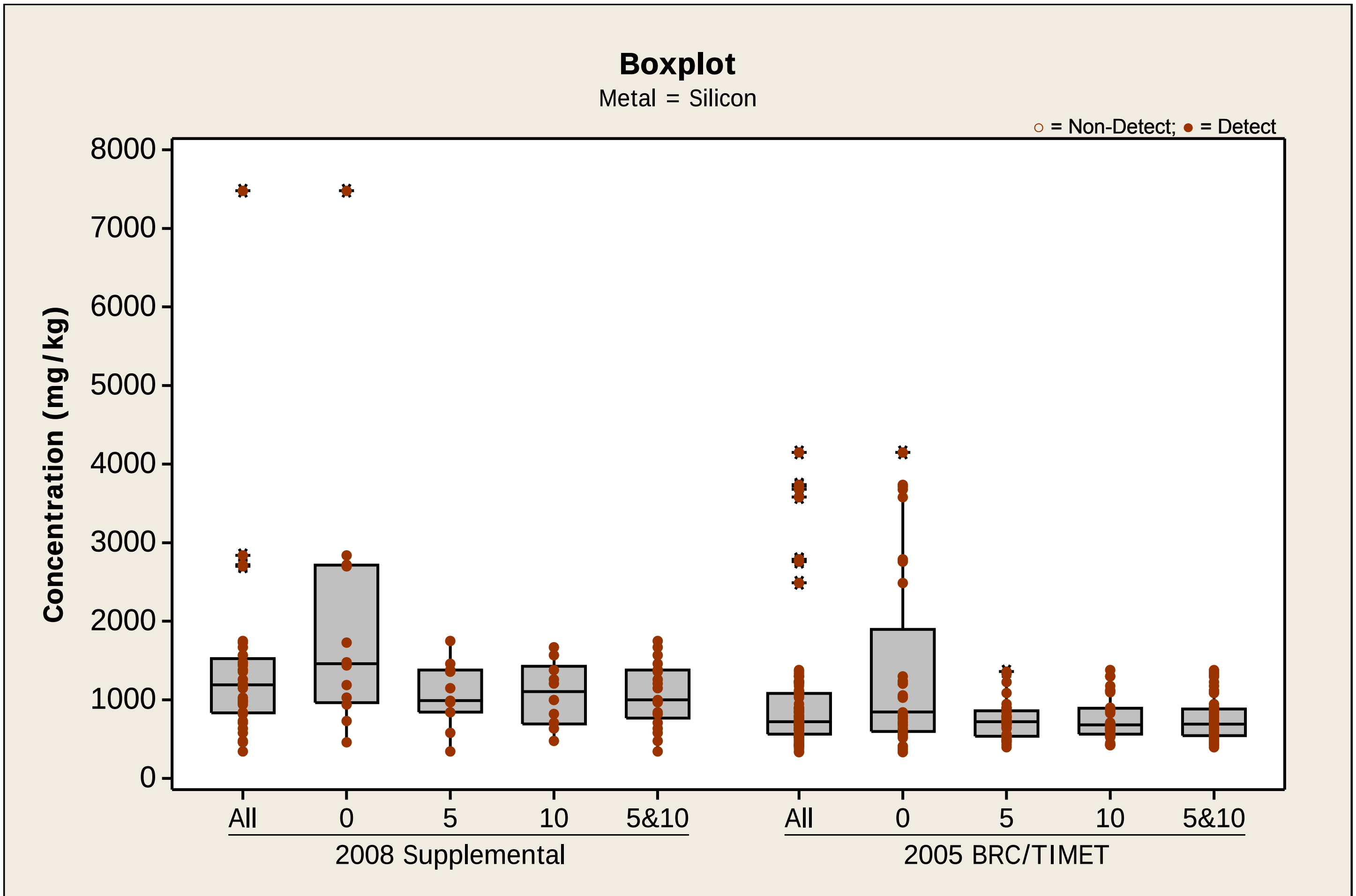

Boxplot
Metal = Platinum
Concentration (mg/kg)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

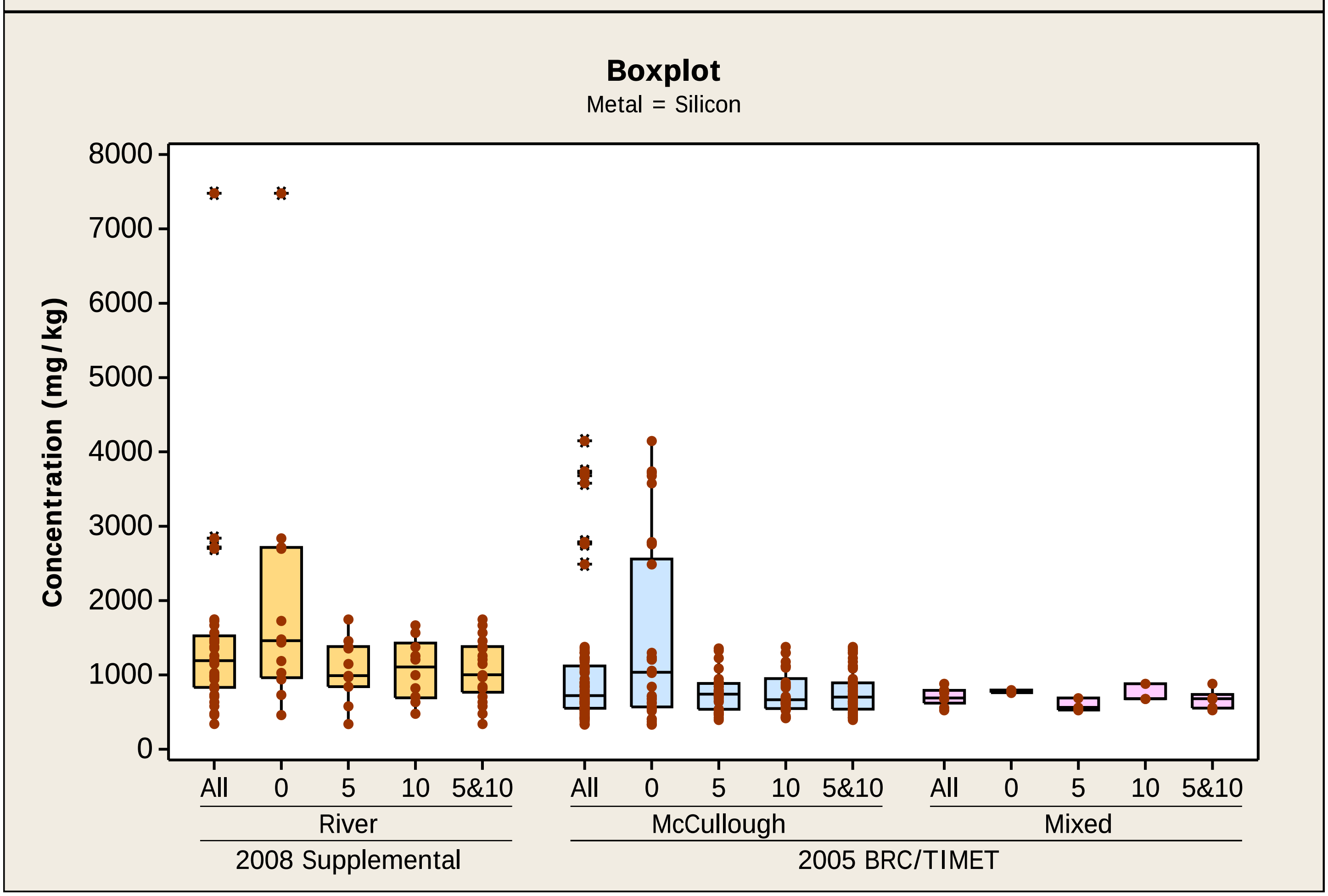

Boxplot
Metal = Potassium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

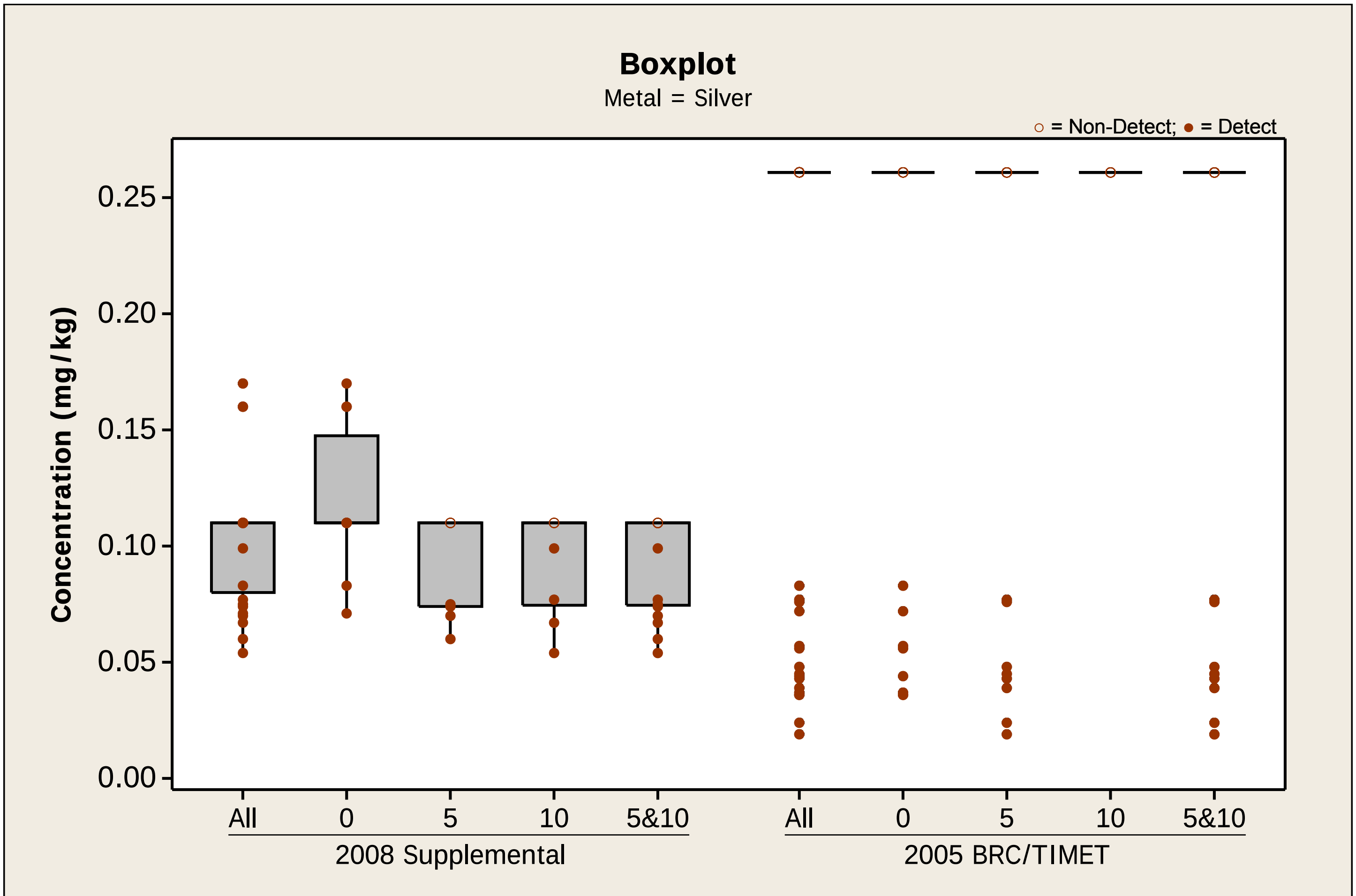

Boxplot
Metal = Potassium
Concentration (mg/kg)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

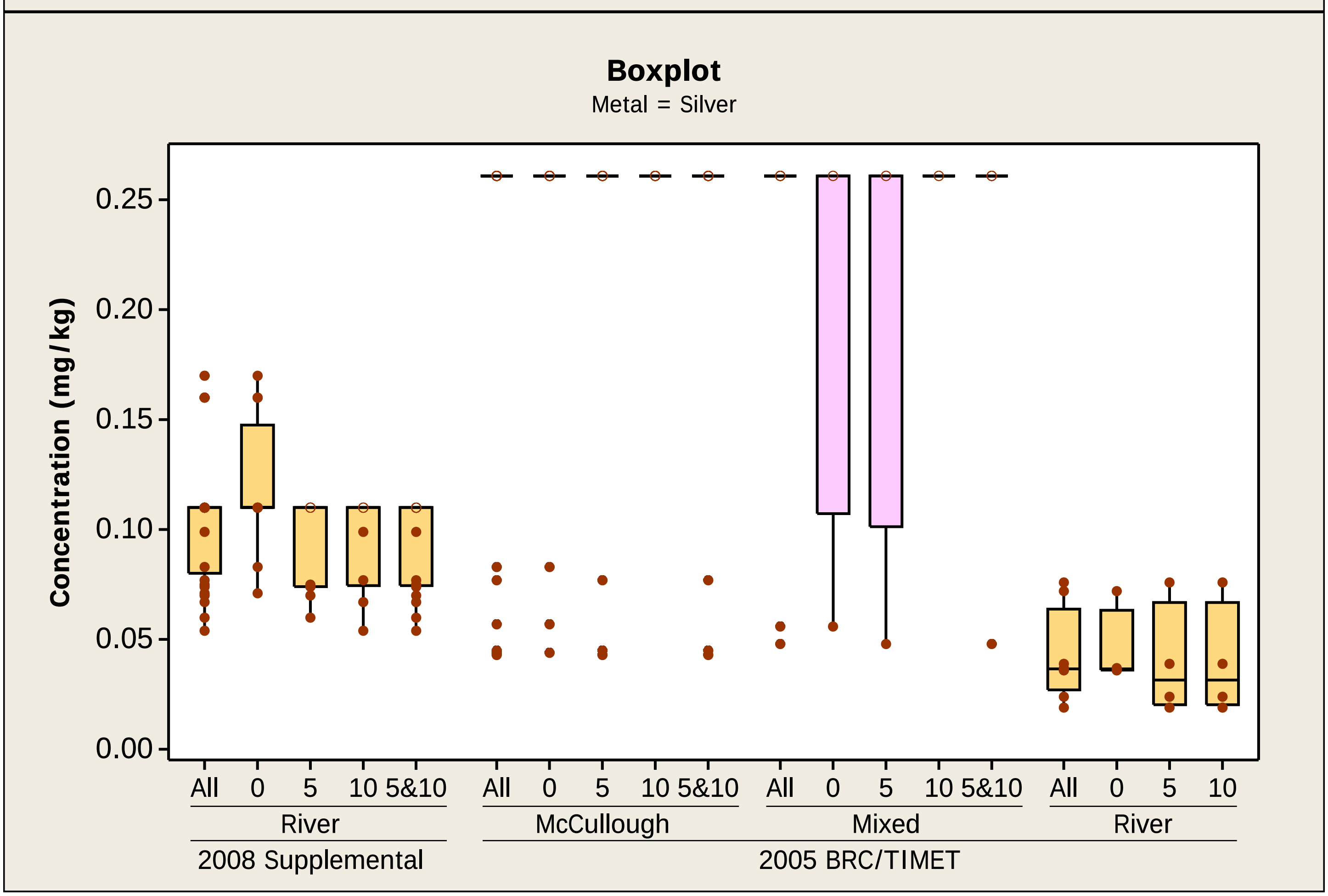

Boxplot
Metal = Selenium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

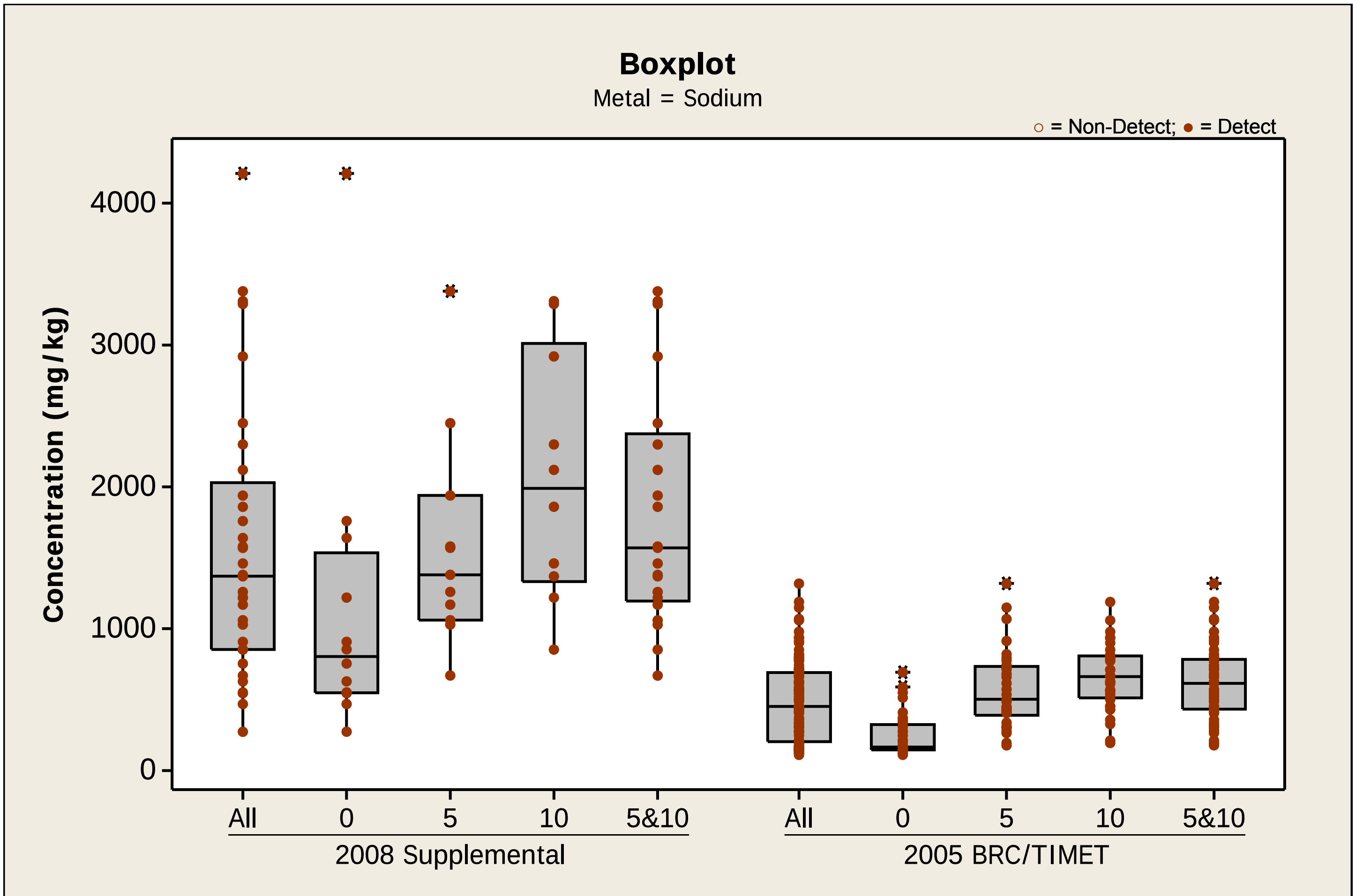

Boxplot
Metal = Selenium
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
All 0 5 10 5&10
River
2008 Supplemental
All 0 5 10 5&10
McCullough
All 0 5 10 5&10
Mixed
All 0 5 10
River
2005 BRC/TIMET

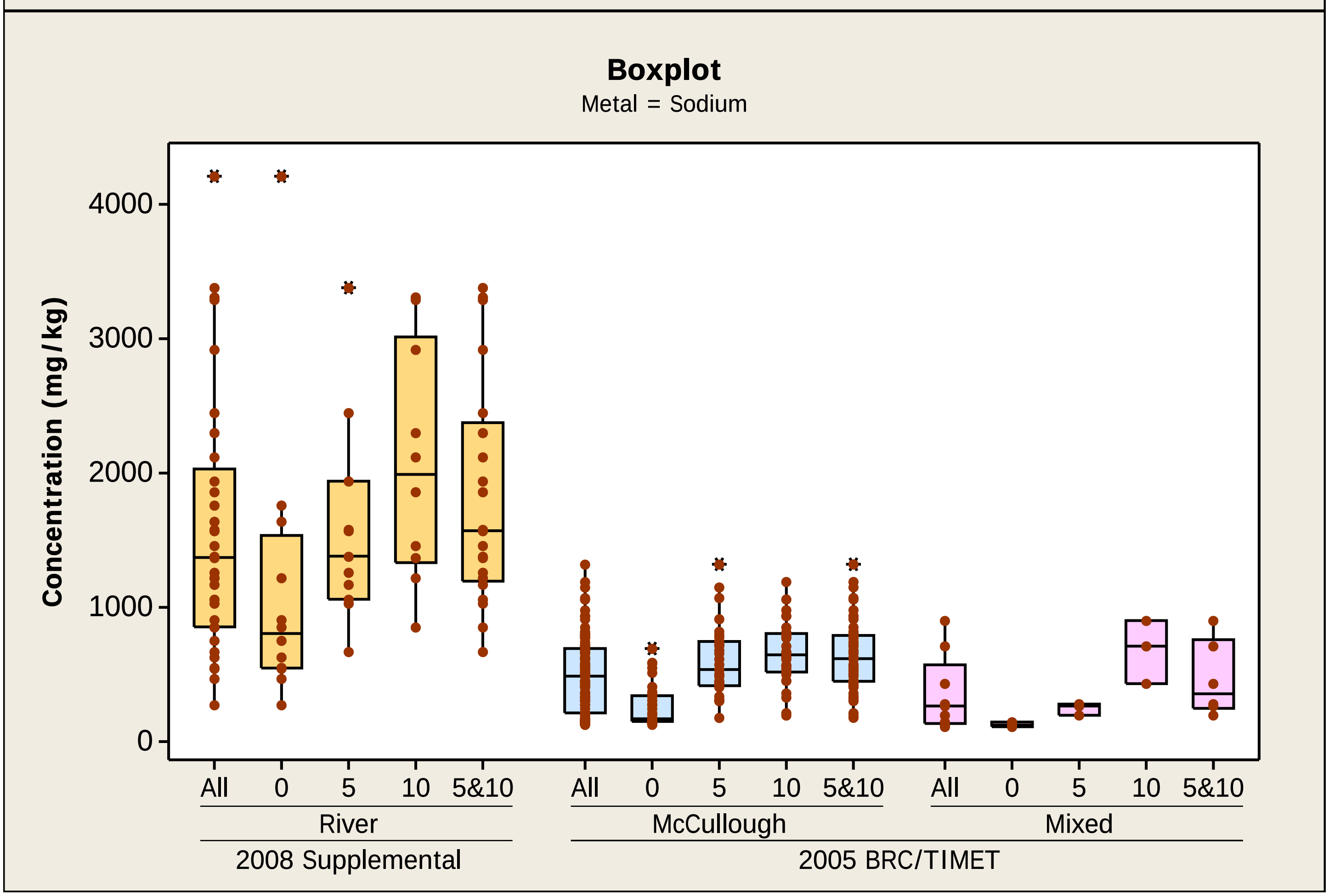

Boxplot
Metal = Silicon
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
8000
7000
6000
5000
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

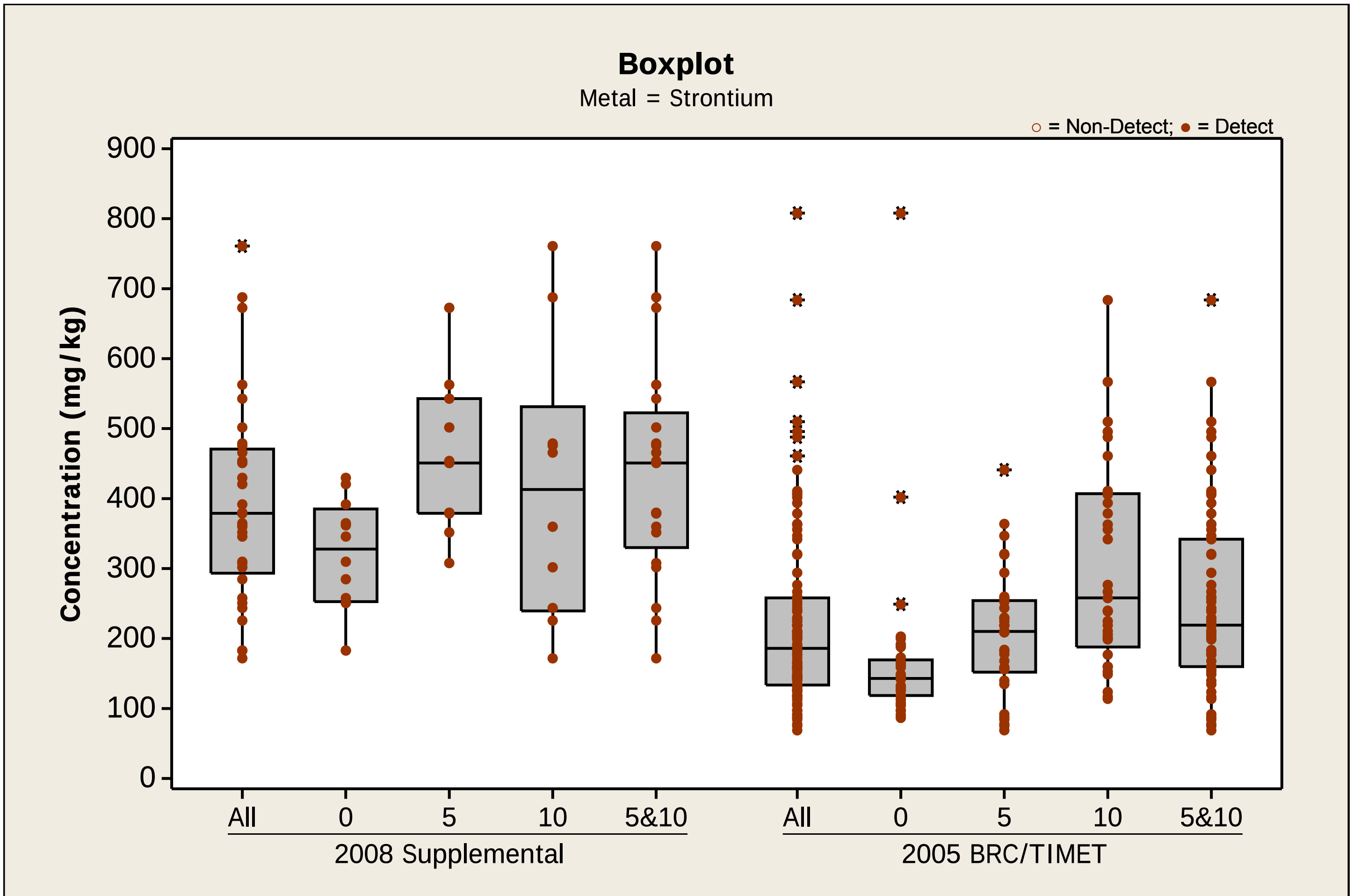

Boxplot
Metal = Silicon
Concentration (mg/kg)
8000
7000
6000
5000
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

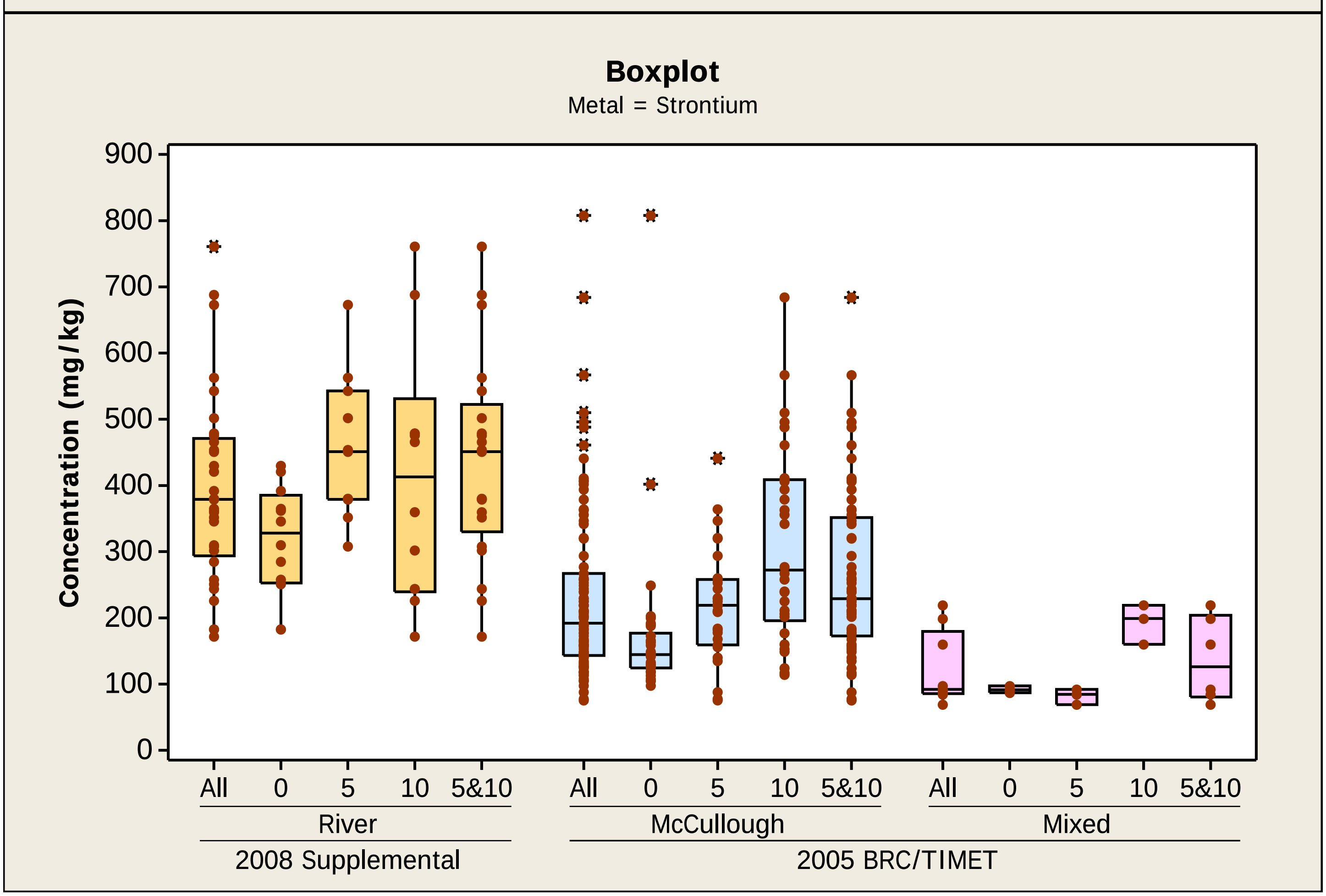

Boxplot
Metal = Silver
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0.00
0.05
0.10
0.15
0.20
0.25
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

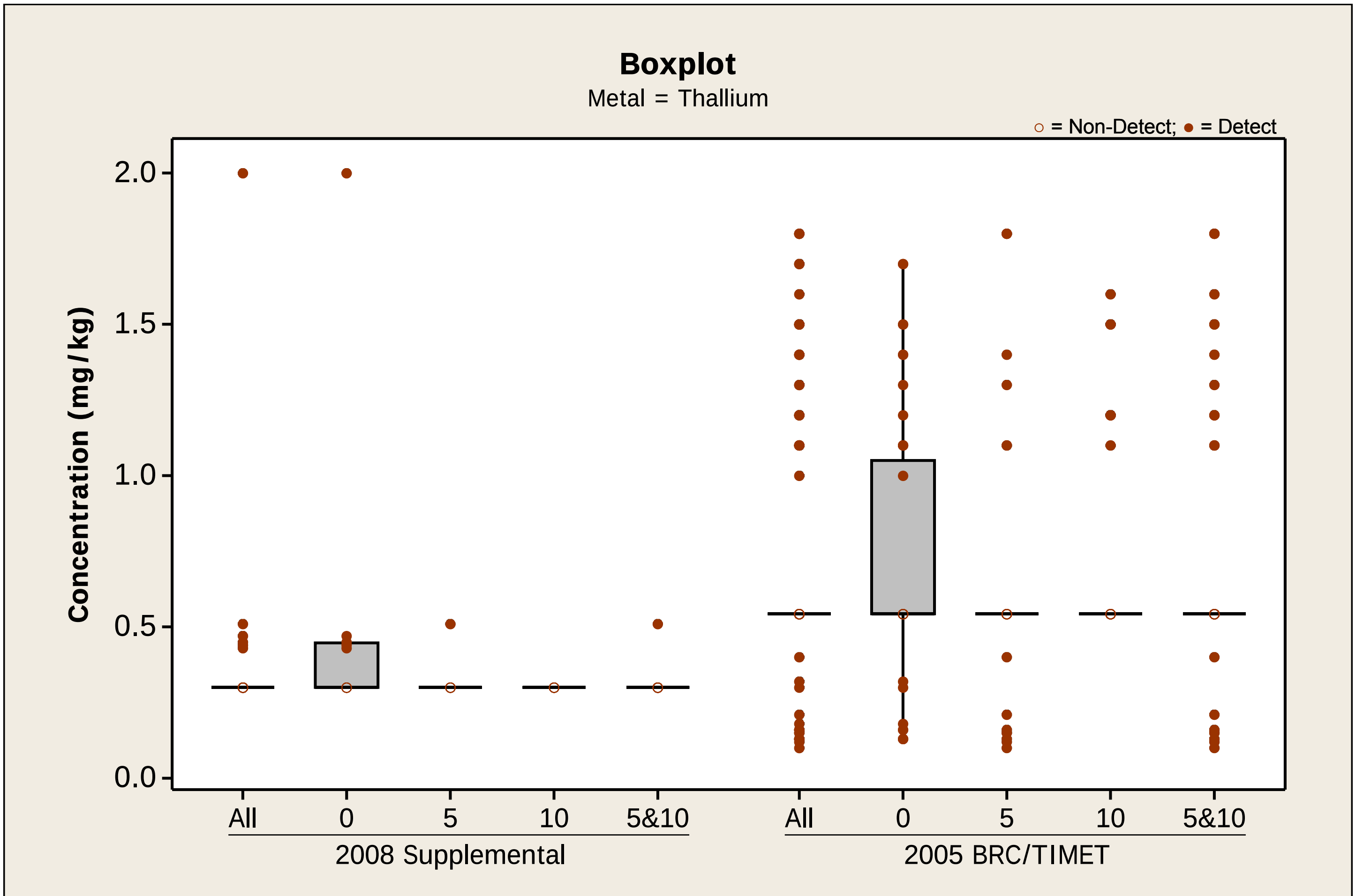

Boxplot
Metal = Silver
Concentration (mg/kg)
0.00
0.05
0.10
0.15
0.20
0.25
All 0 5 10 5&10
River
2008 Supplemental
All 0 5 10 5&10
McCullough
All 0 5 10 5&10
Mixed
All 0 5 10
River
2005 BRC/TIMET

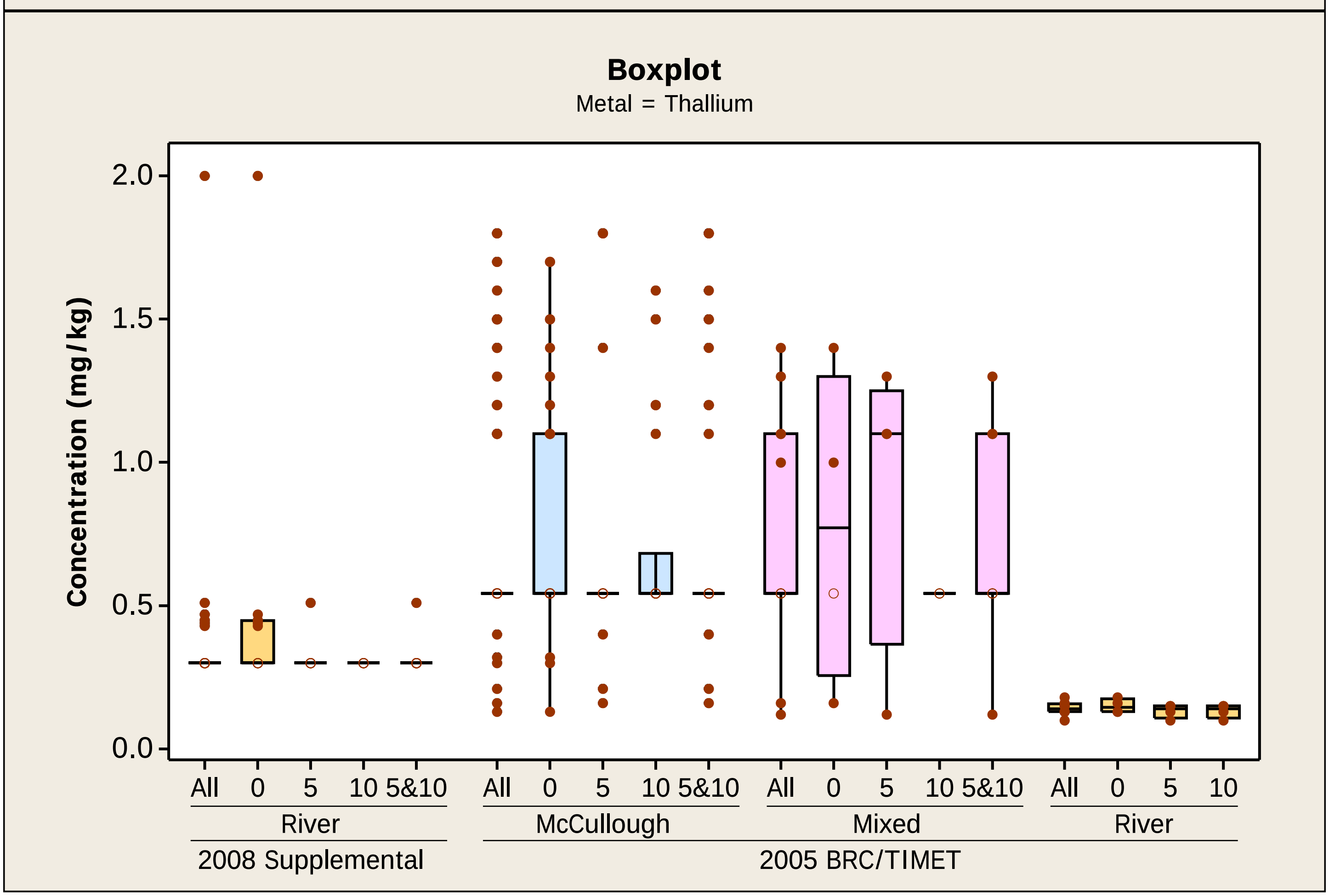

Boxplot
Metal = Sodium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

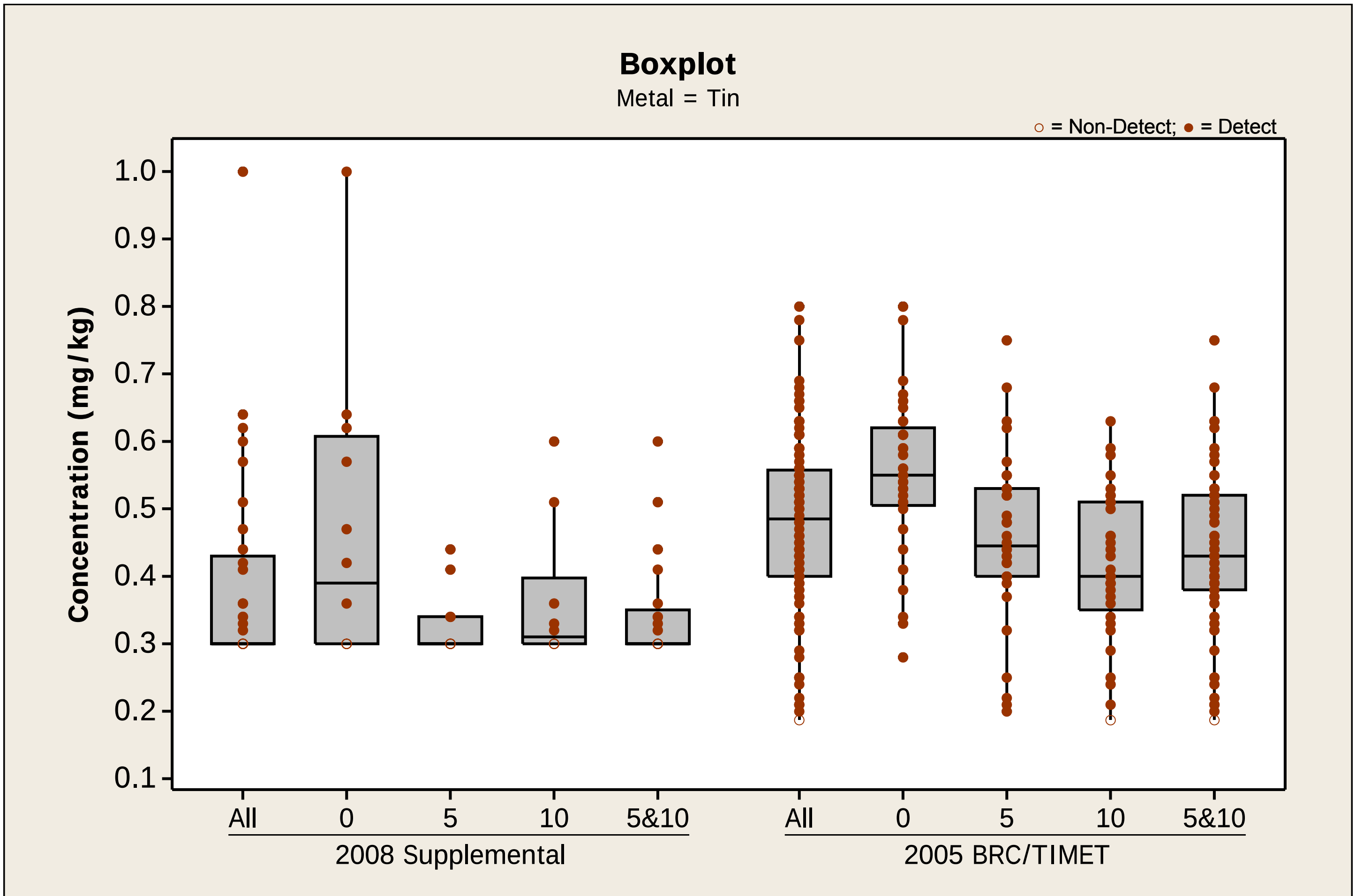

Boxplot
Metal = Sodium
Concentration (mg/kg)
4000
3000
2000
1000
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

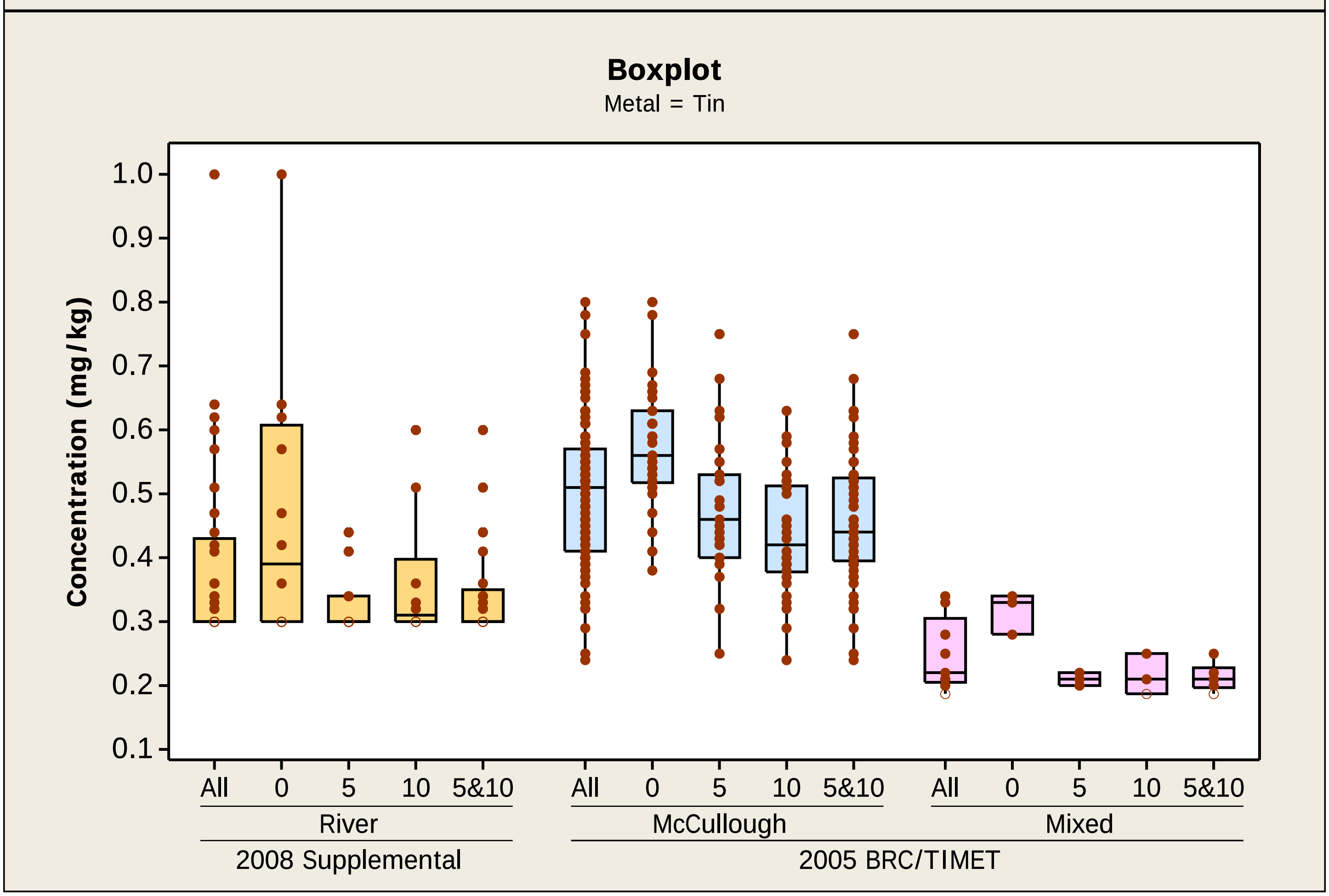

Boxplot
Metal = Strontium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
900
800
700
600
500
400
300
200
100
0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

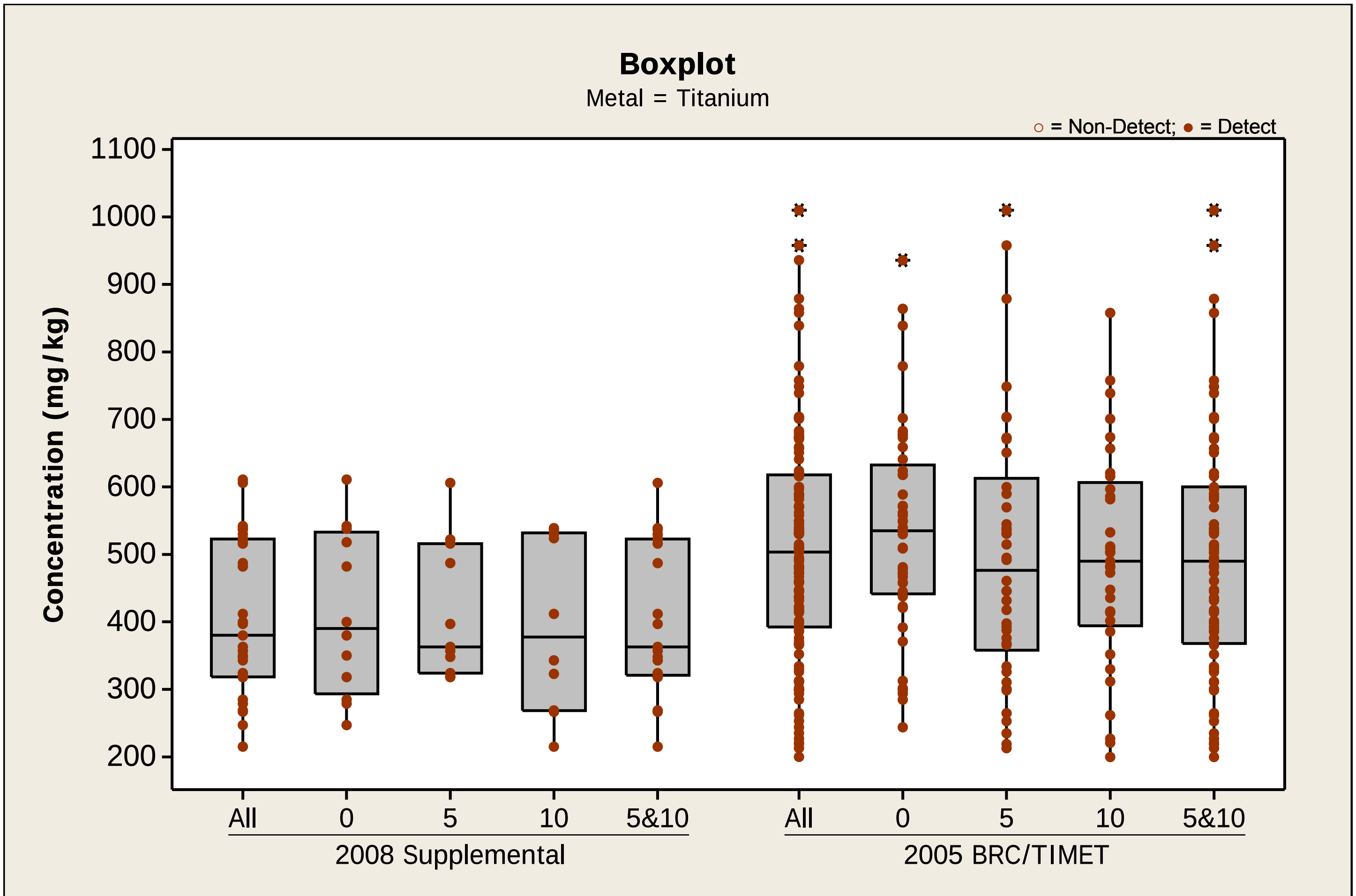

Boxplot
Metal = Strontium
Concentration (mg/kg)
900
800
700
600
500
400
300
200
100
0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

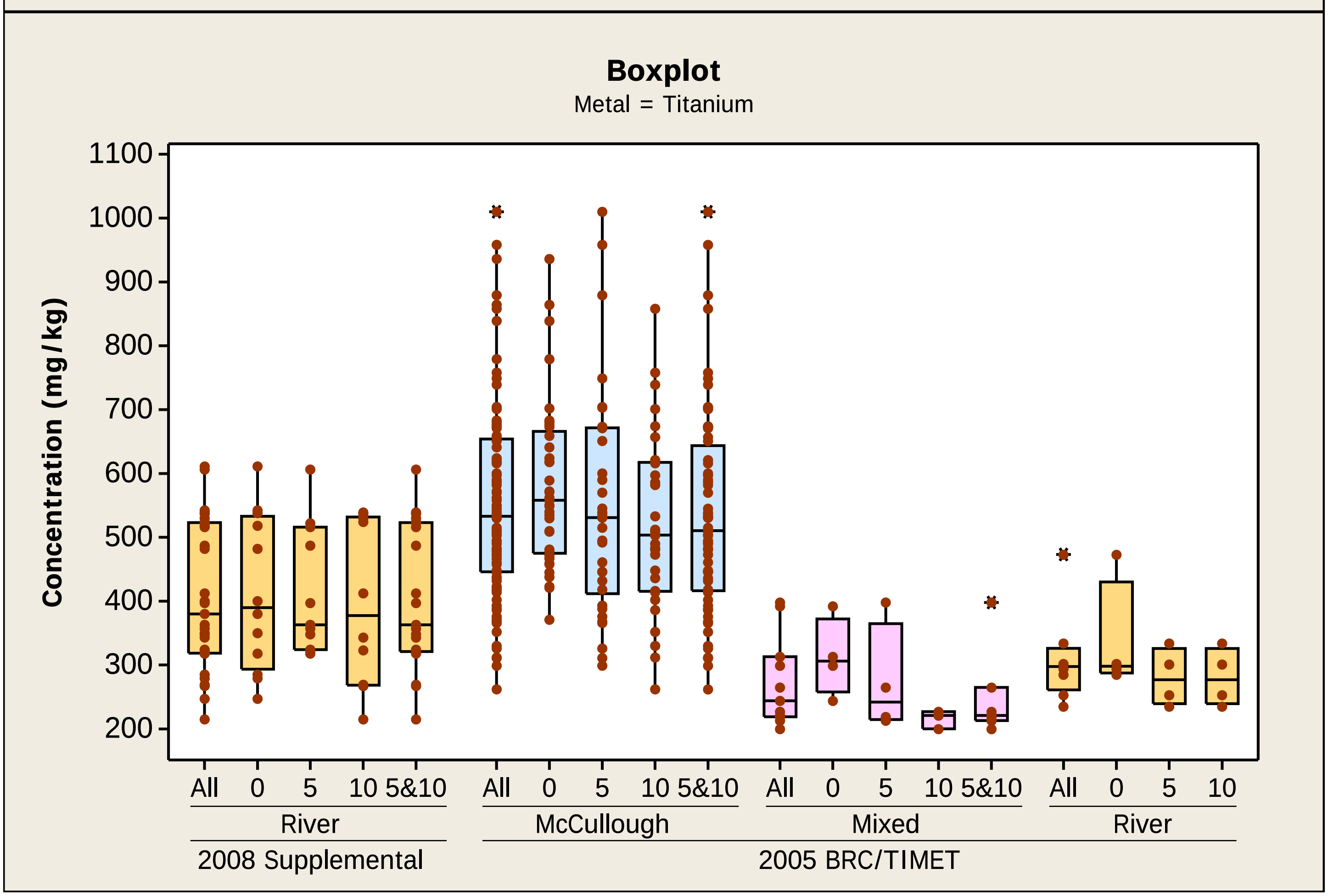

Boxplot
Metal = Thallium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
2.0
1.5
1.0
0.5
0.0
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

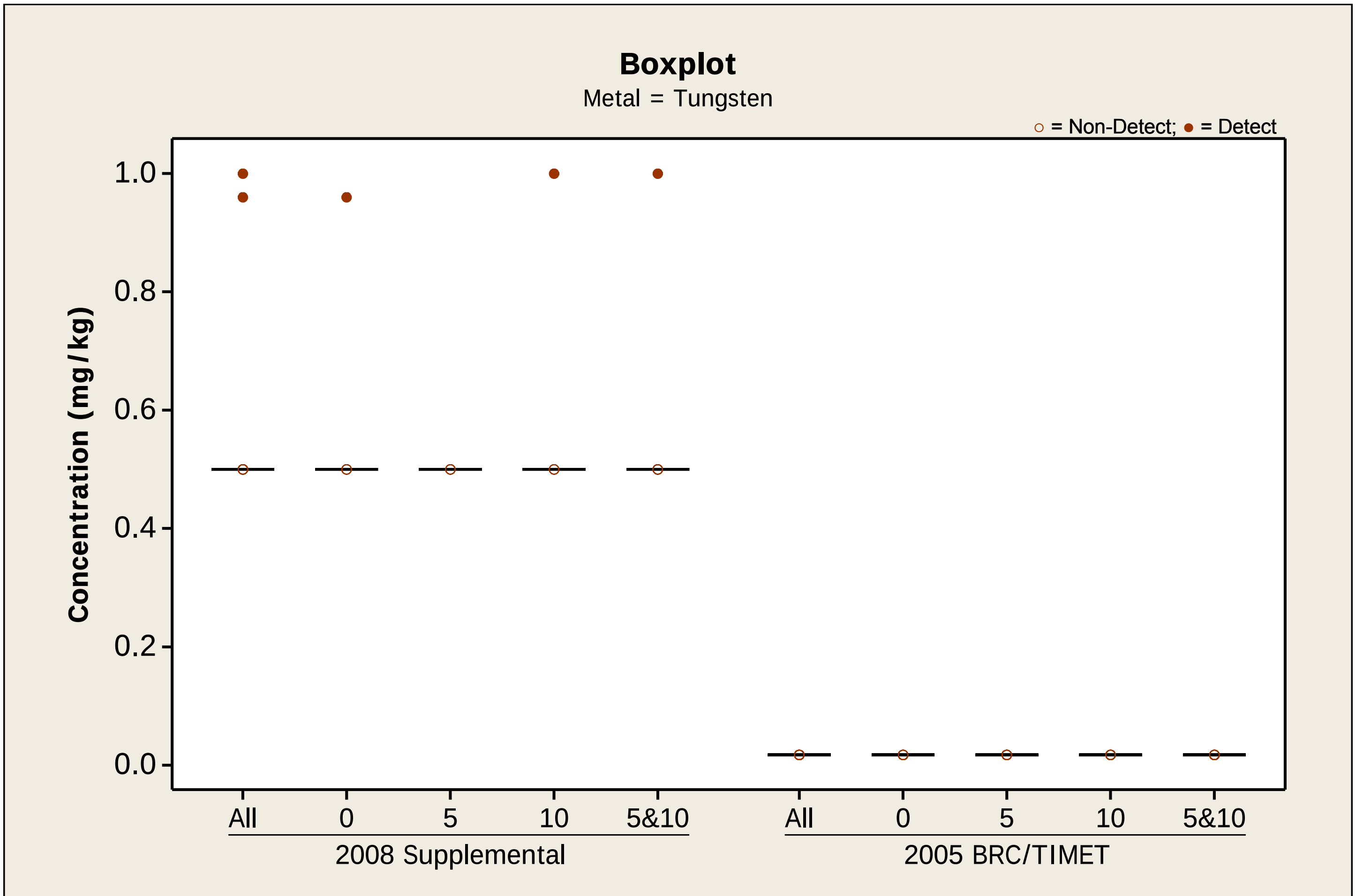

Boxplot
Metal = Thallium
Concentration (mg/kg)
2.0
1.5
1.0
0.5
0.0
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

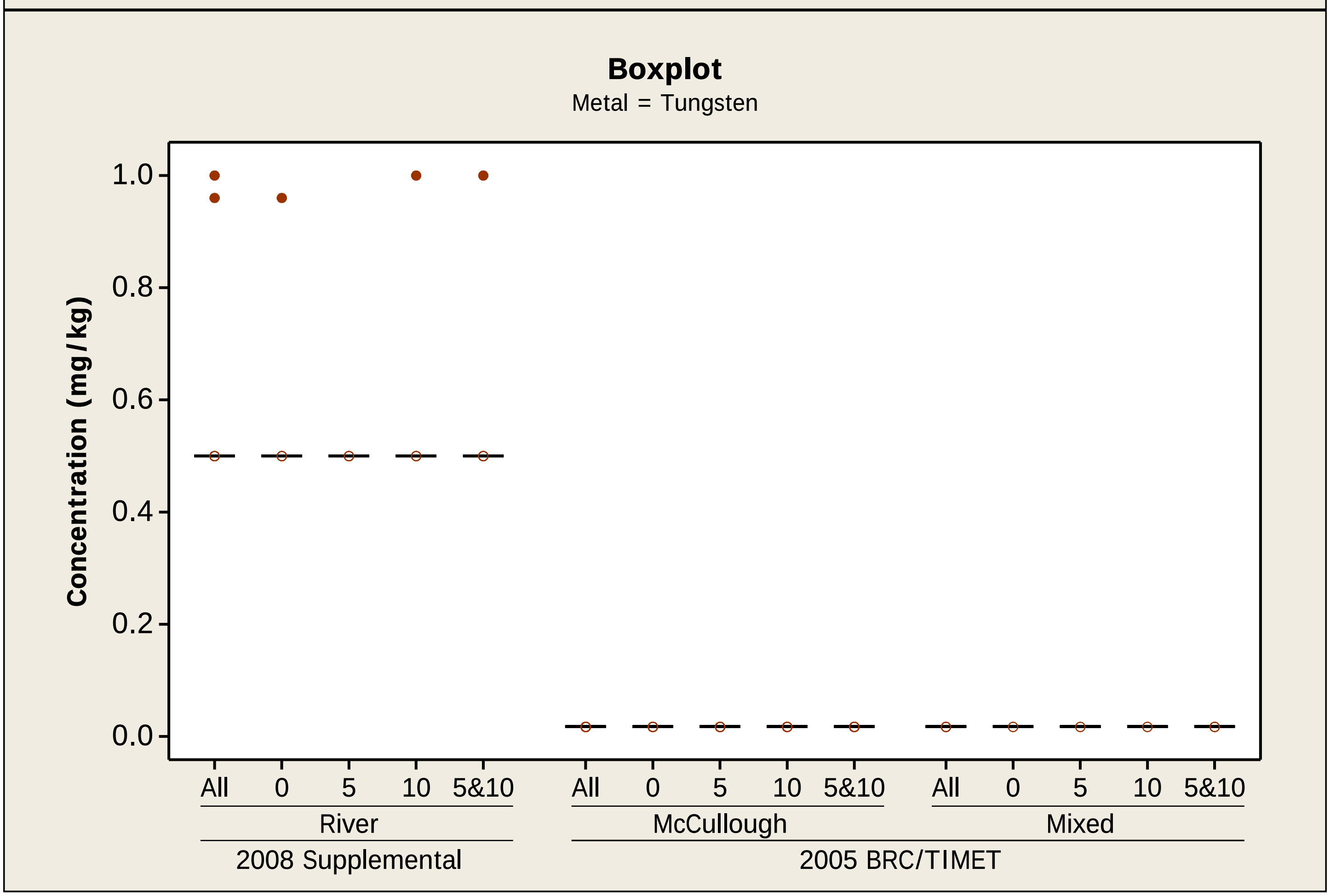

Boxplot
Metal = Tin
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

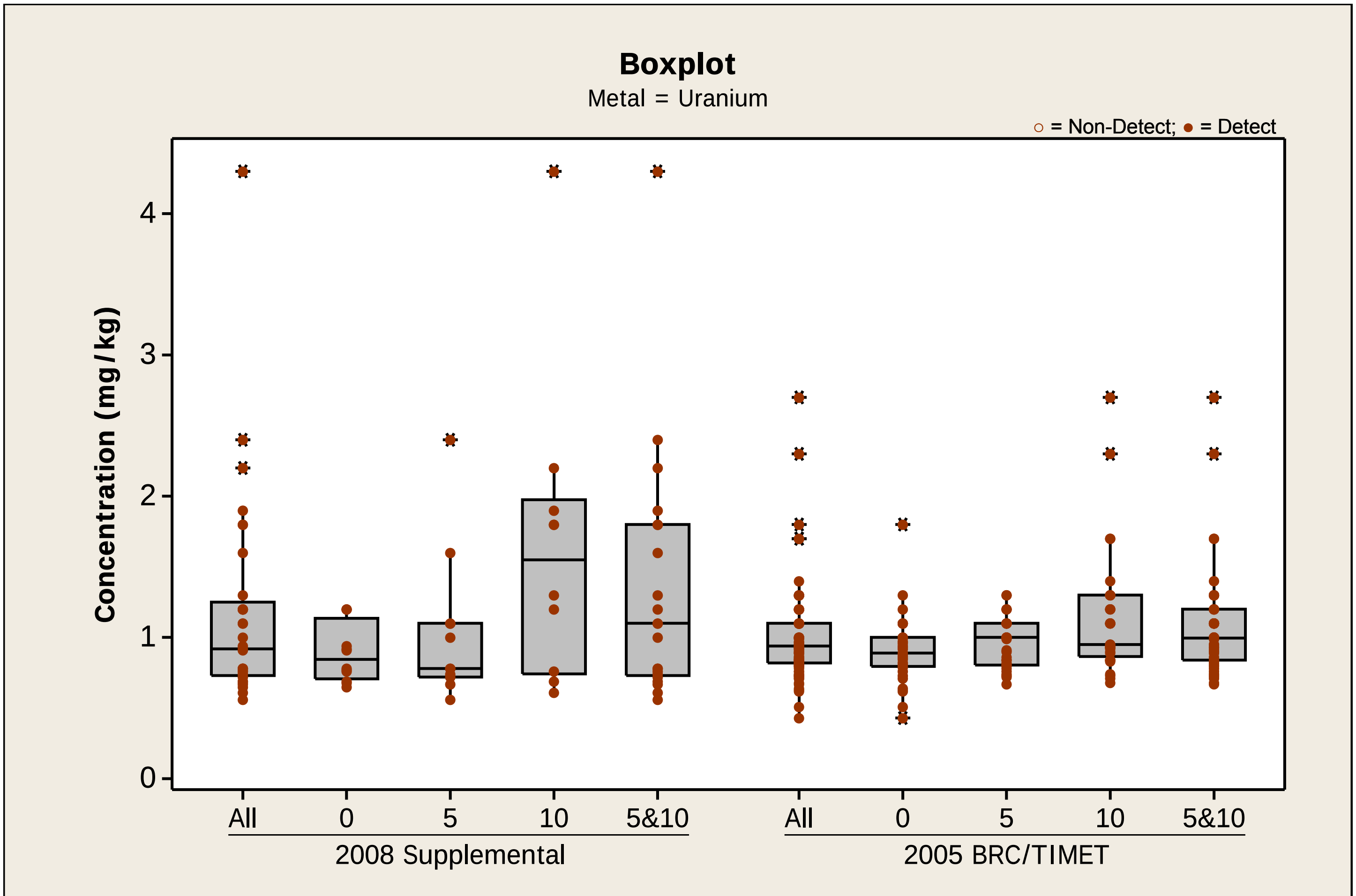

Boxplot
Metal = Tin
Concentration (mg/kg)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Titanium
○ = Non-Detect; ● = Detect
1100
1000
900
800
700
600
500
400
300
200
Concentration (mg/kg)
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

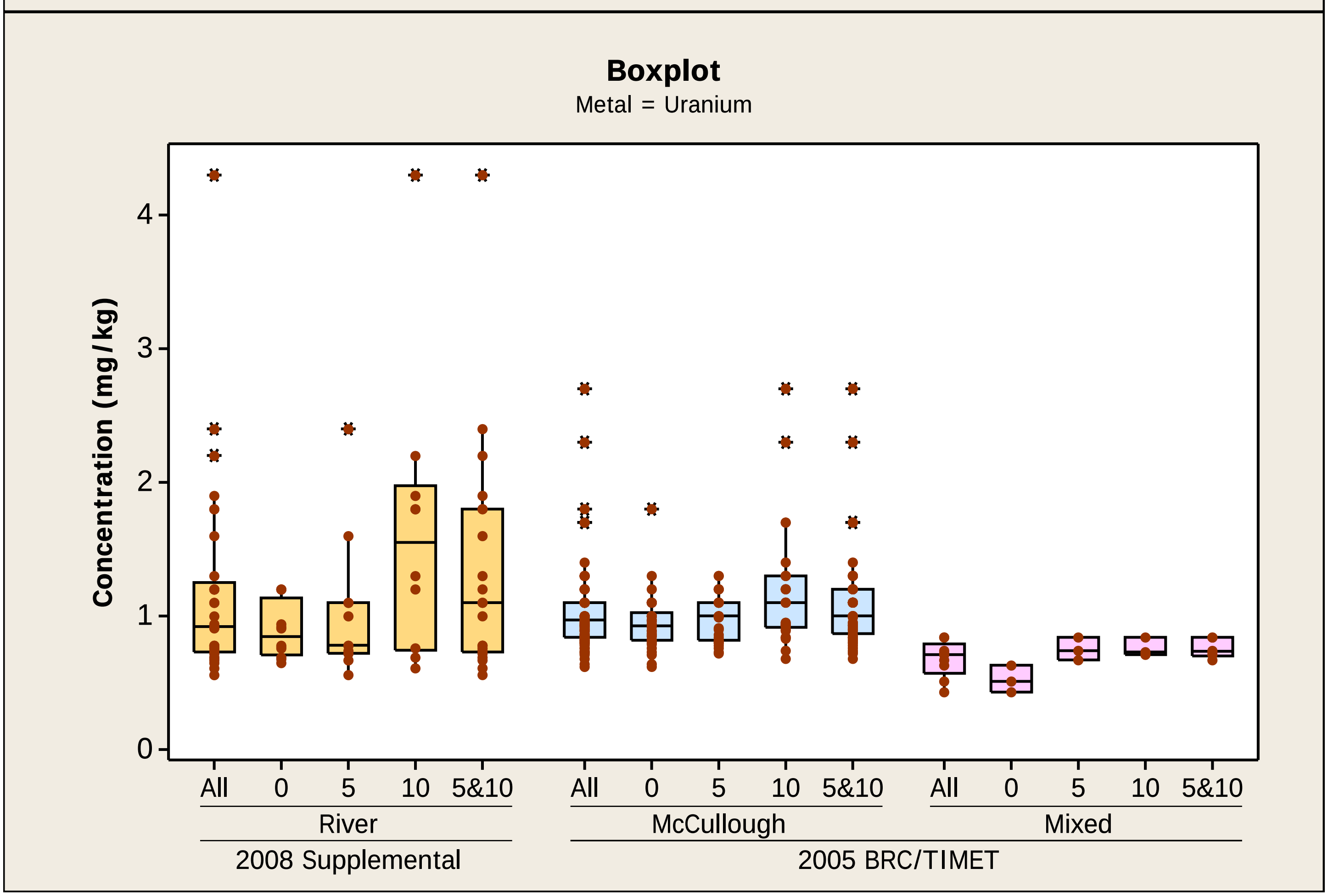

Boxplot
Metal = Titanium
1100
1000
900
800
700
600
500
400
300
200
Concentration (mg/kg)
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Metal = Tungsten
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
1.0
0.8
0.6
0.4
0.2
0.0
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

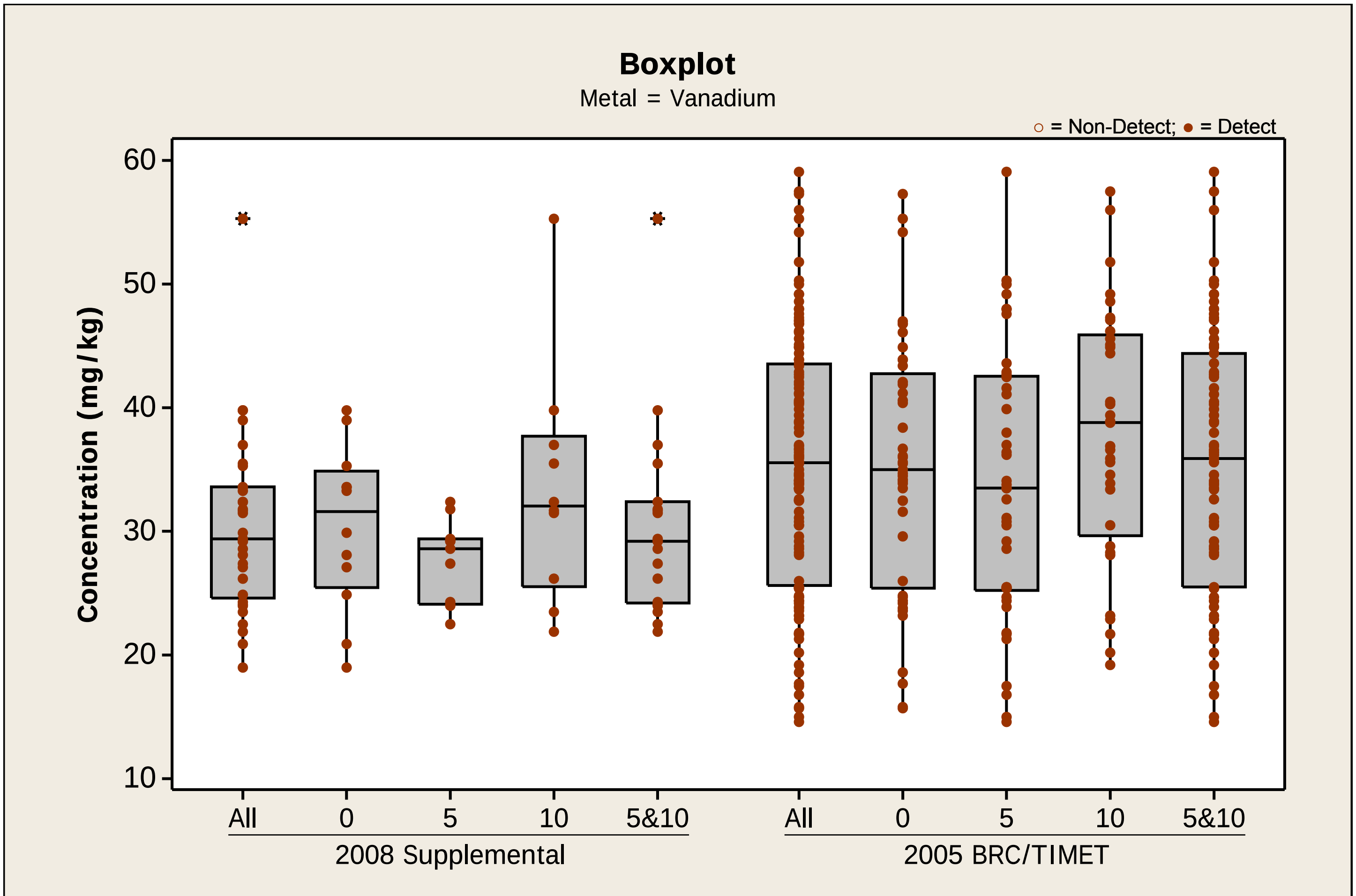

Boxplot
Metal = Tungsten
Concentration (mg/kg)
1.0
0.8
0.6
0.4
0.2
0.0
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

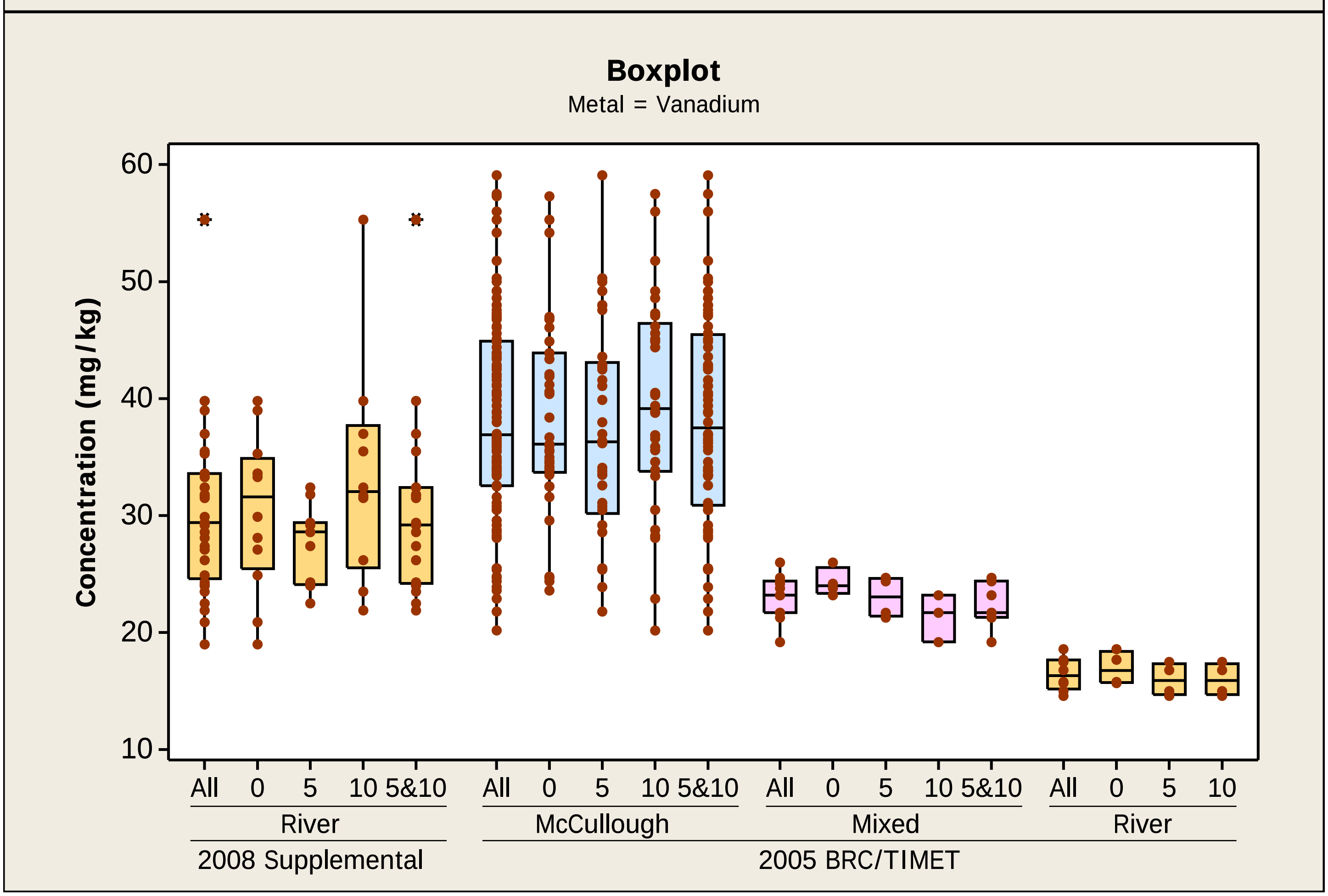


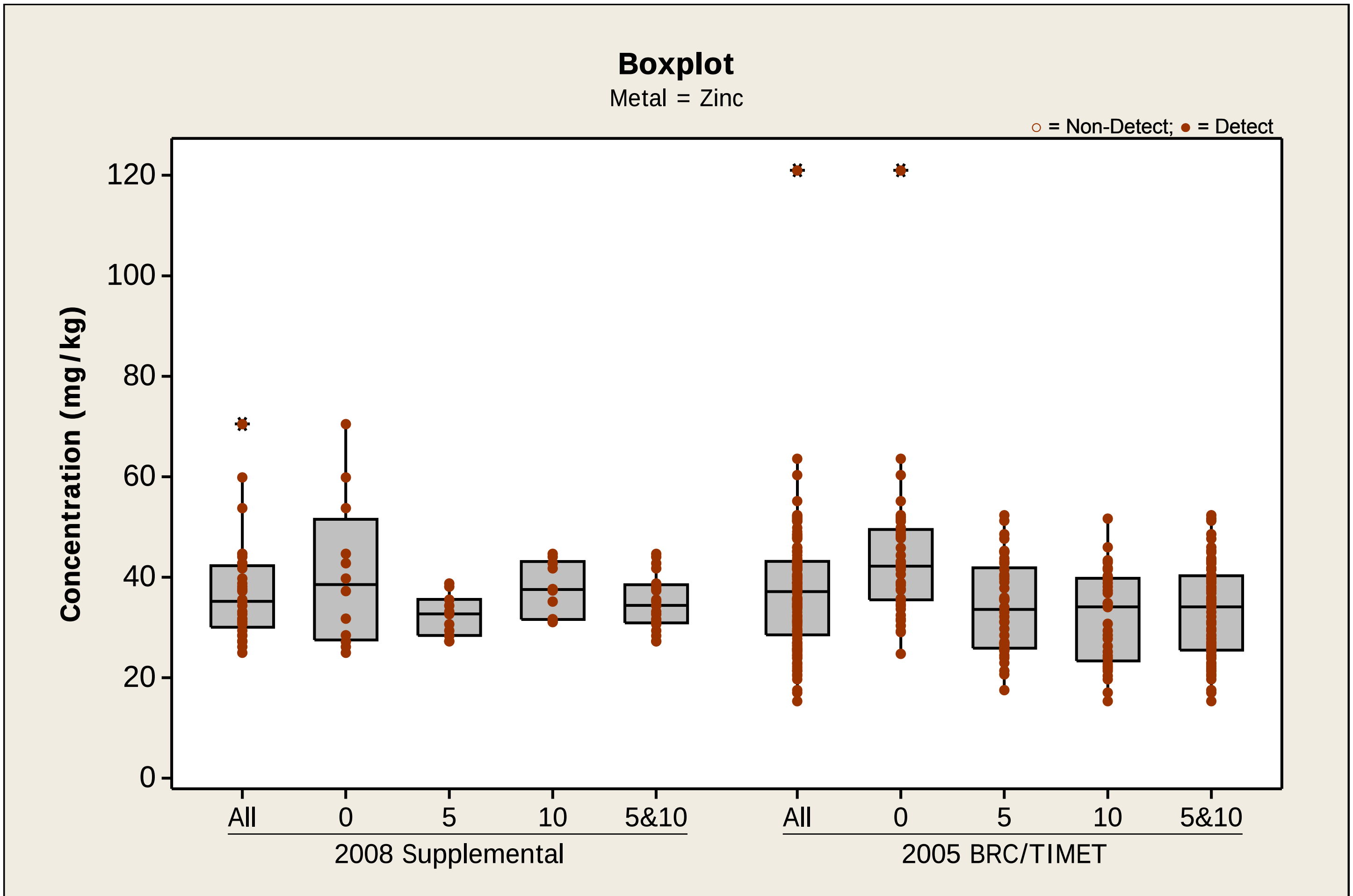
Boxplot
Metal = Uranium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0
1
2
3
4
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

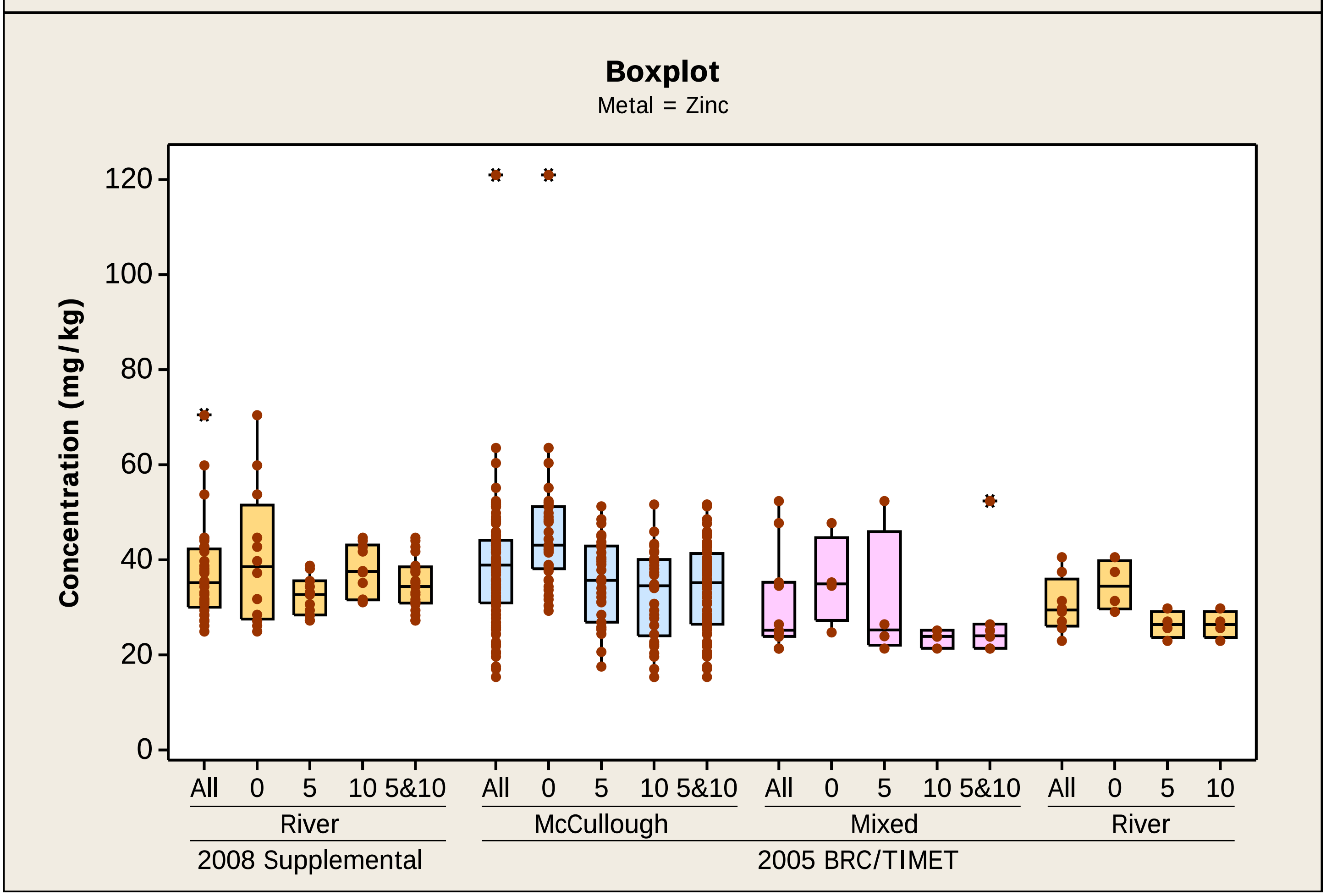


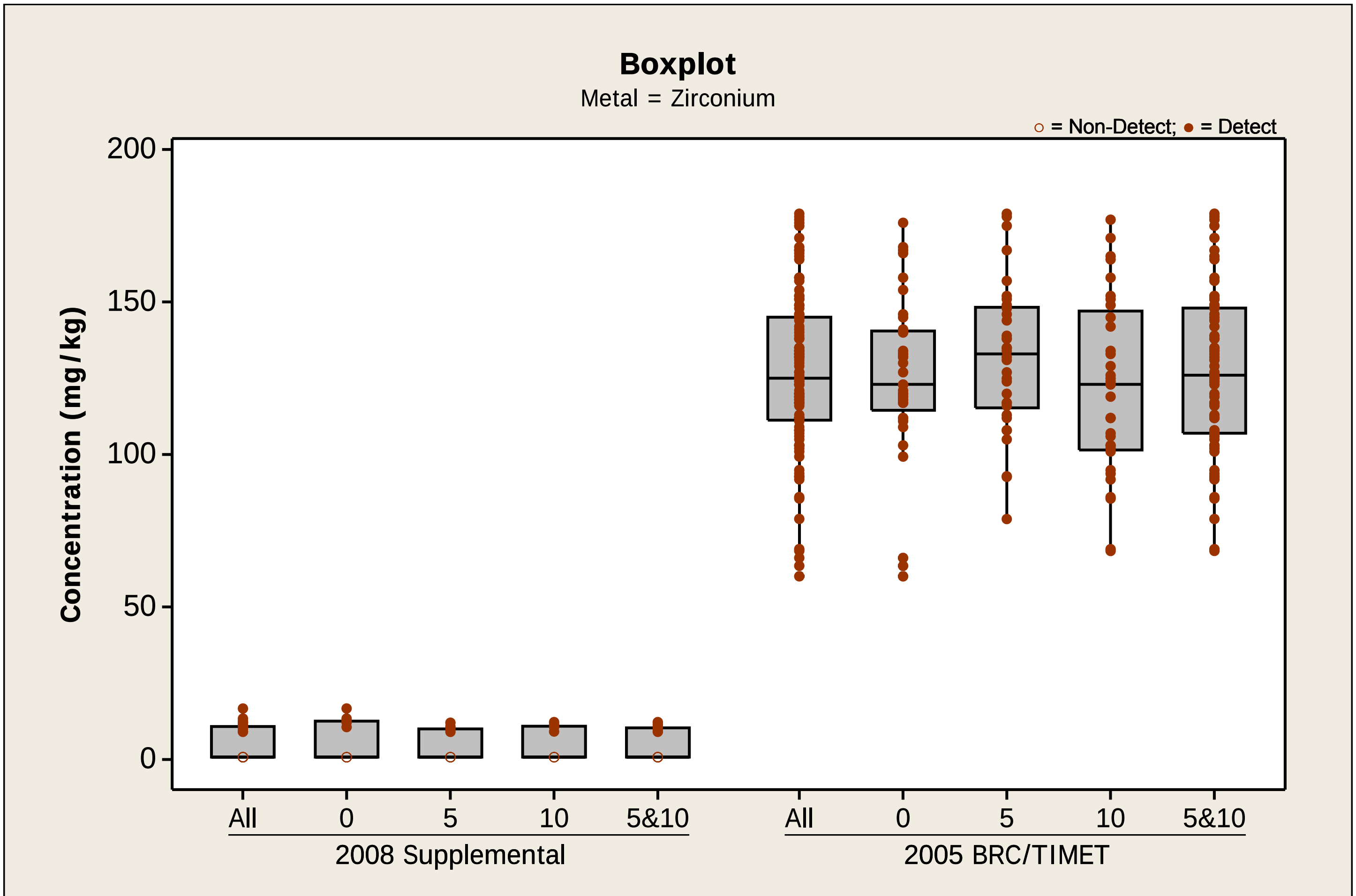
Boxplot
Metal = Uranium
Concentration (mg/kg)
0
1
2
3
4
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

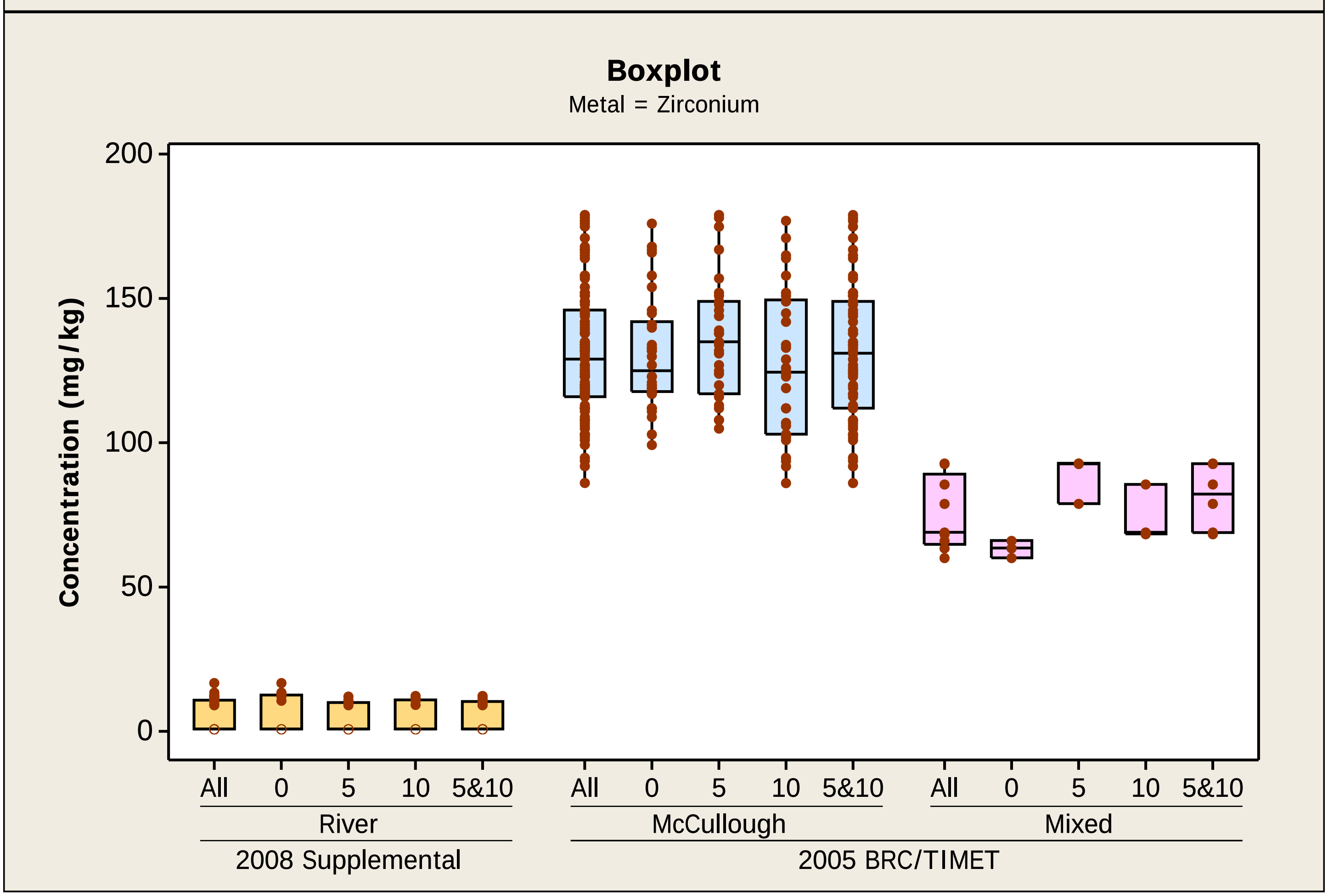

Boxplot
Metal = Vanadium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
60
50
40
30
20
10
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

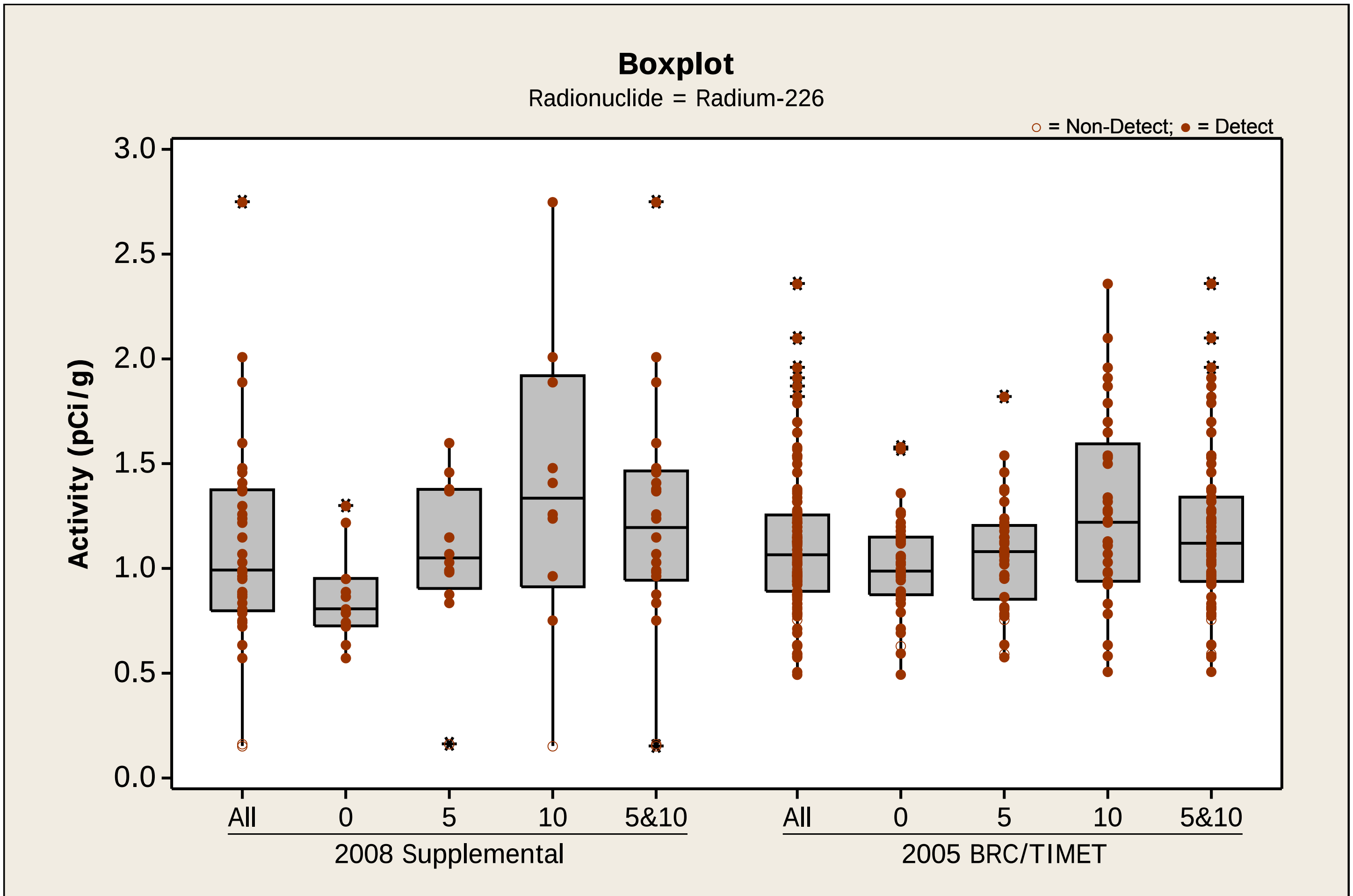

Boxplot
Metal = Vanadium
Concentration (mg/kg)
60
50
40
30
20
10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

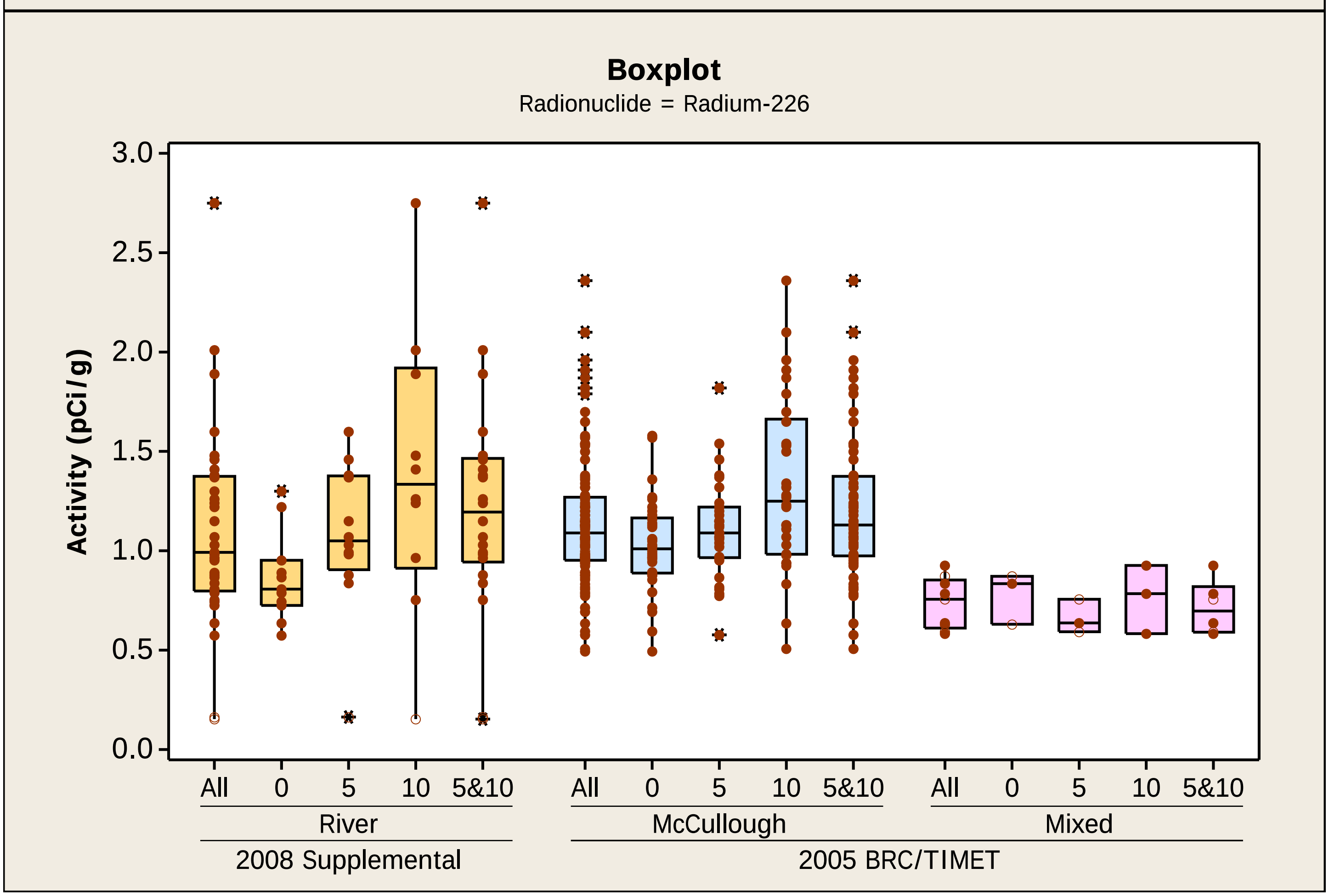

Boxplot
Metal = Zinc
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
0
20
40
60
80
100
120
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

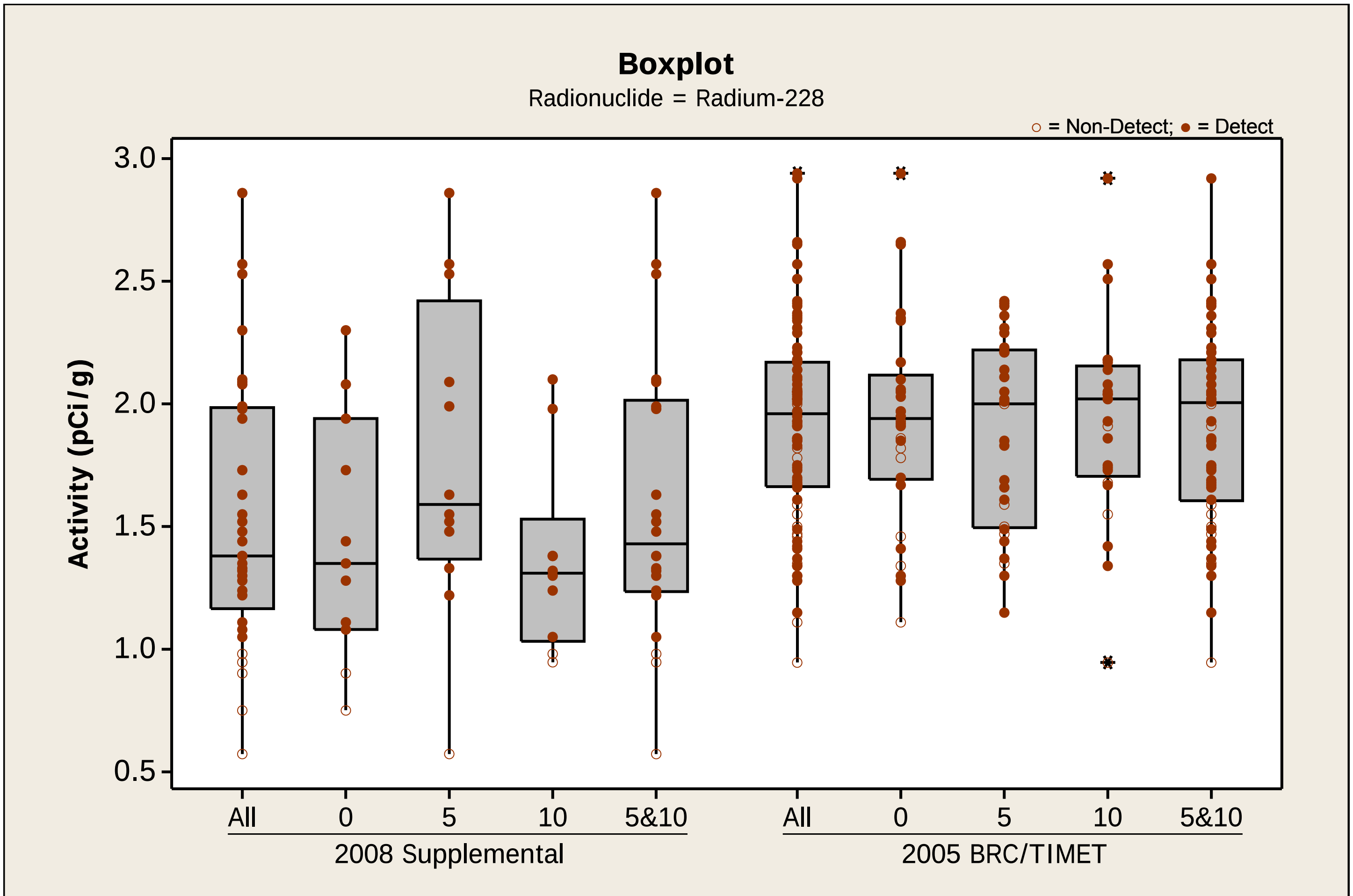

Boxplot
Metal = Zinc
Concentration (mg/kg)
0
20
40
60
80
100
120
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10 5&10
All 0 5 10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

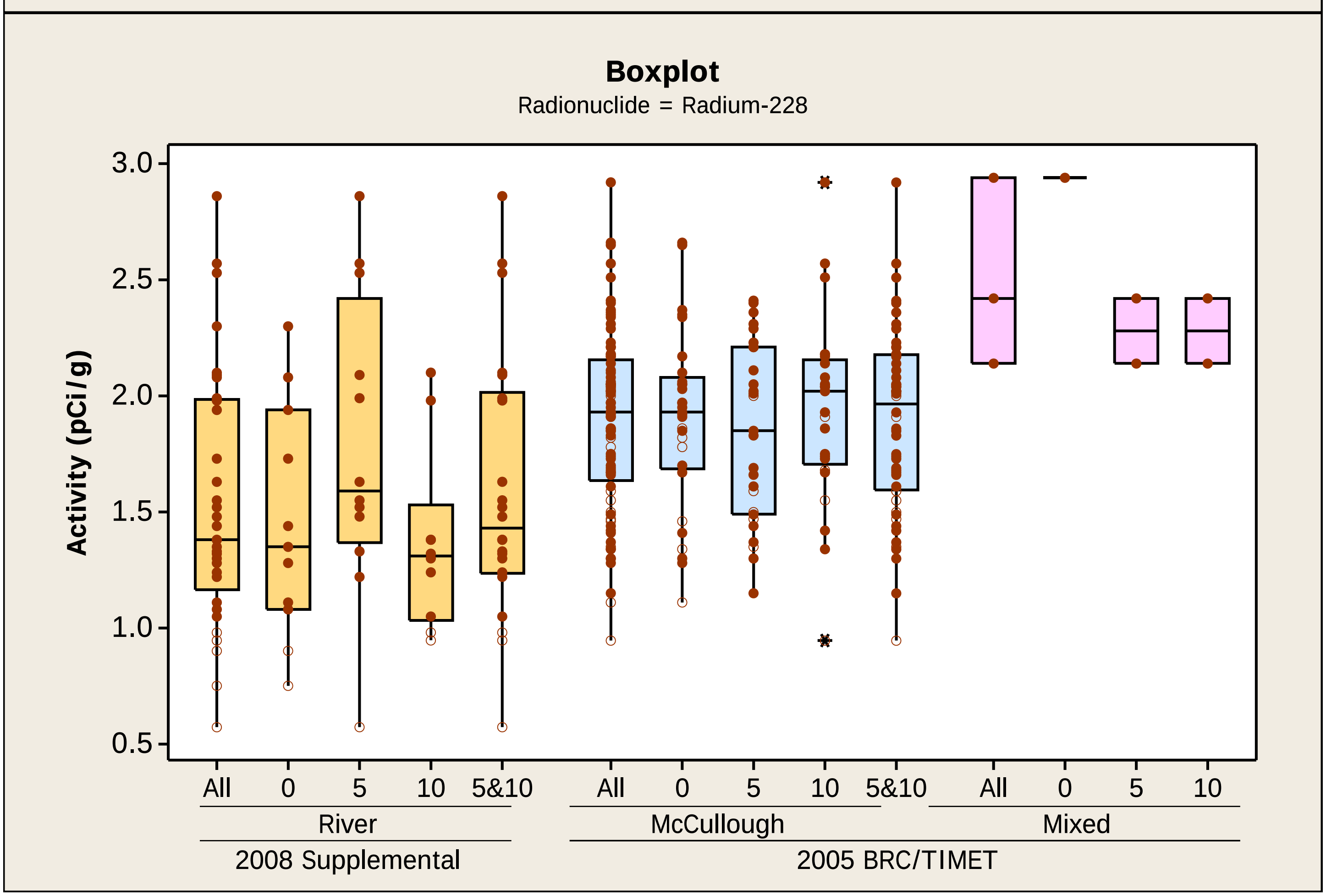

Boxplot
Metal = Zirconium
○ = Non-Detect; ● = Detect
Concentration (mg/kg)
200
150
100
50
0
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

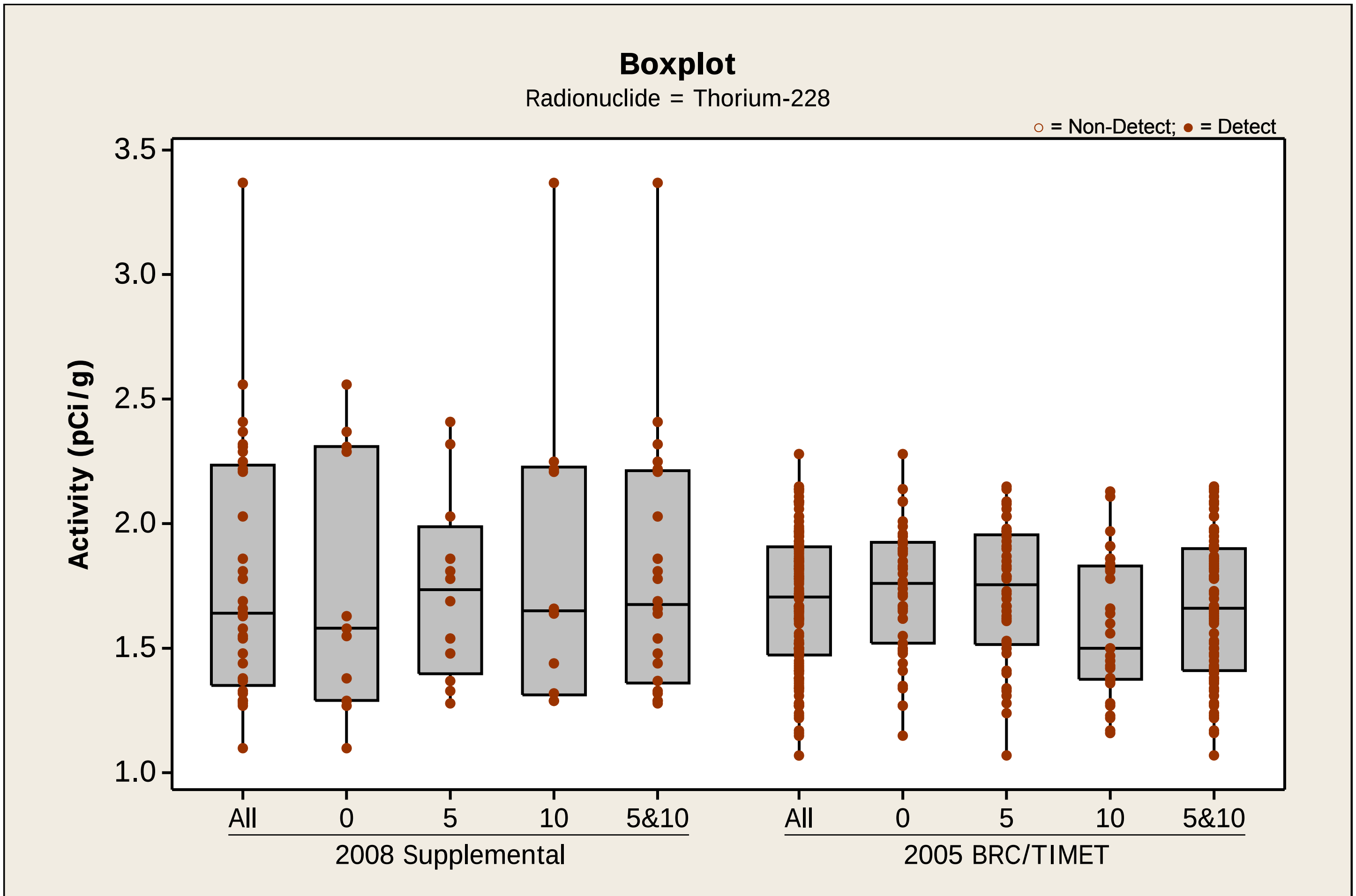

Boxplot
Metal = Zirconium
Concentration (mg/kg)
200
150
100
50
0
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

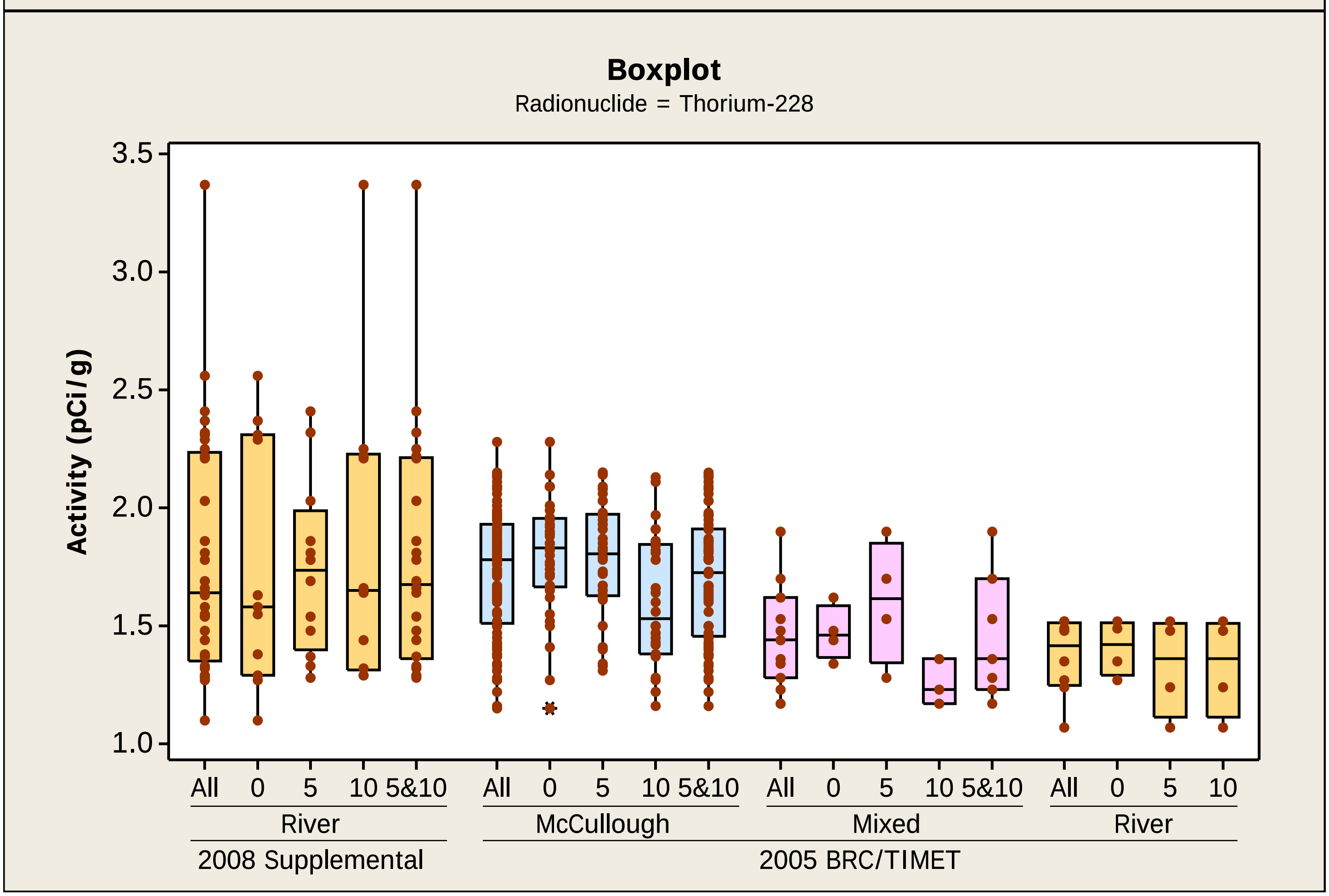

Boxplot
Radionuclide = Radium-226
○ = Non-Detect; ● = Detect
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

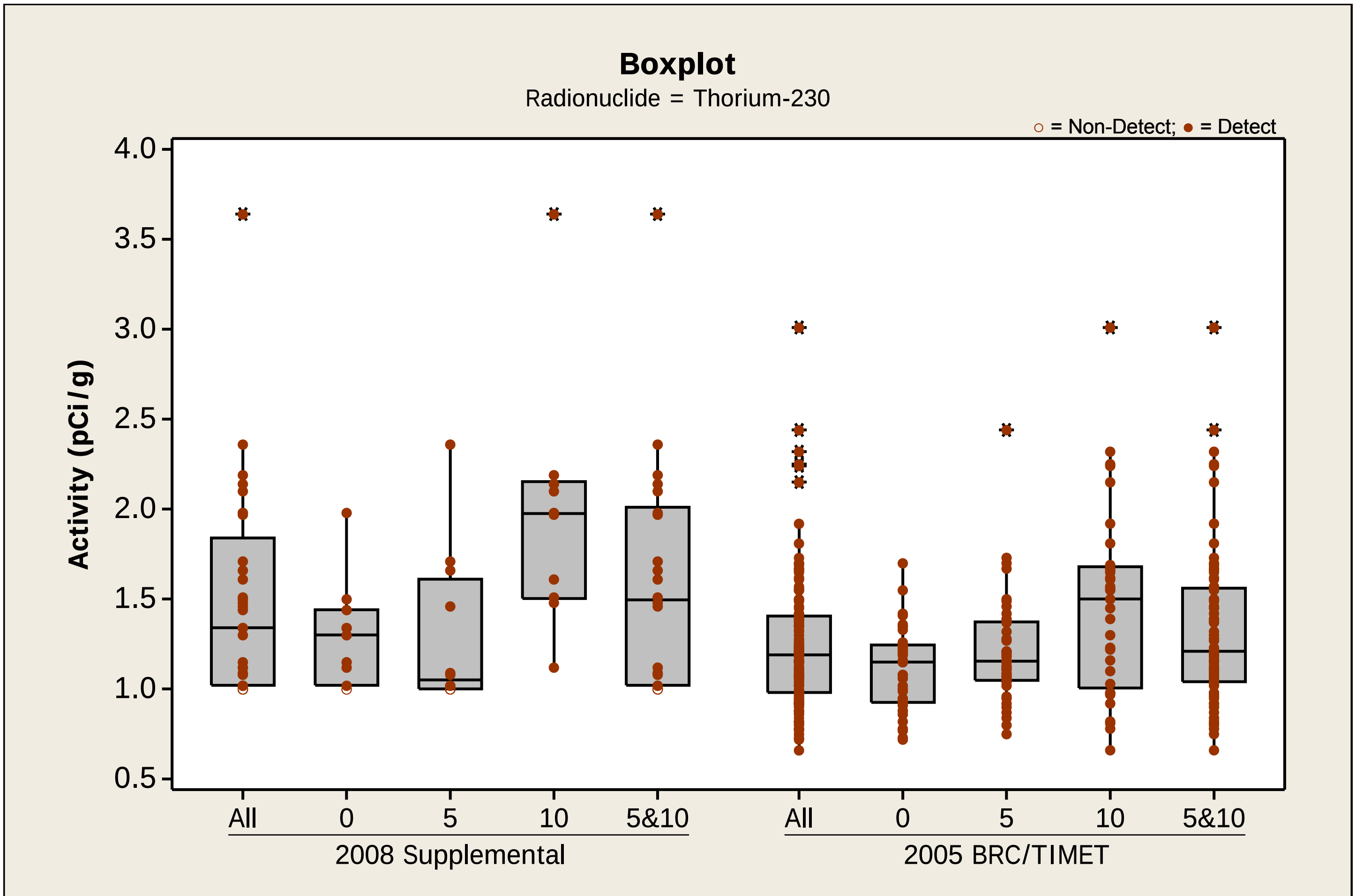

Boxplot
Radionuclide = Radium-226
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
2005 BRC/TIMET

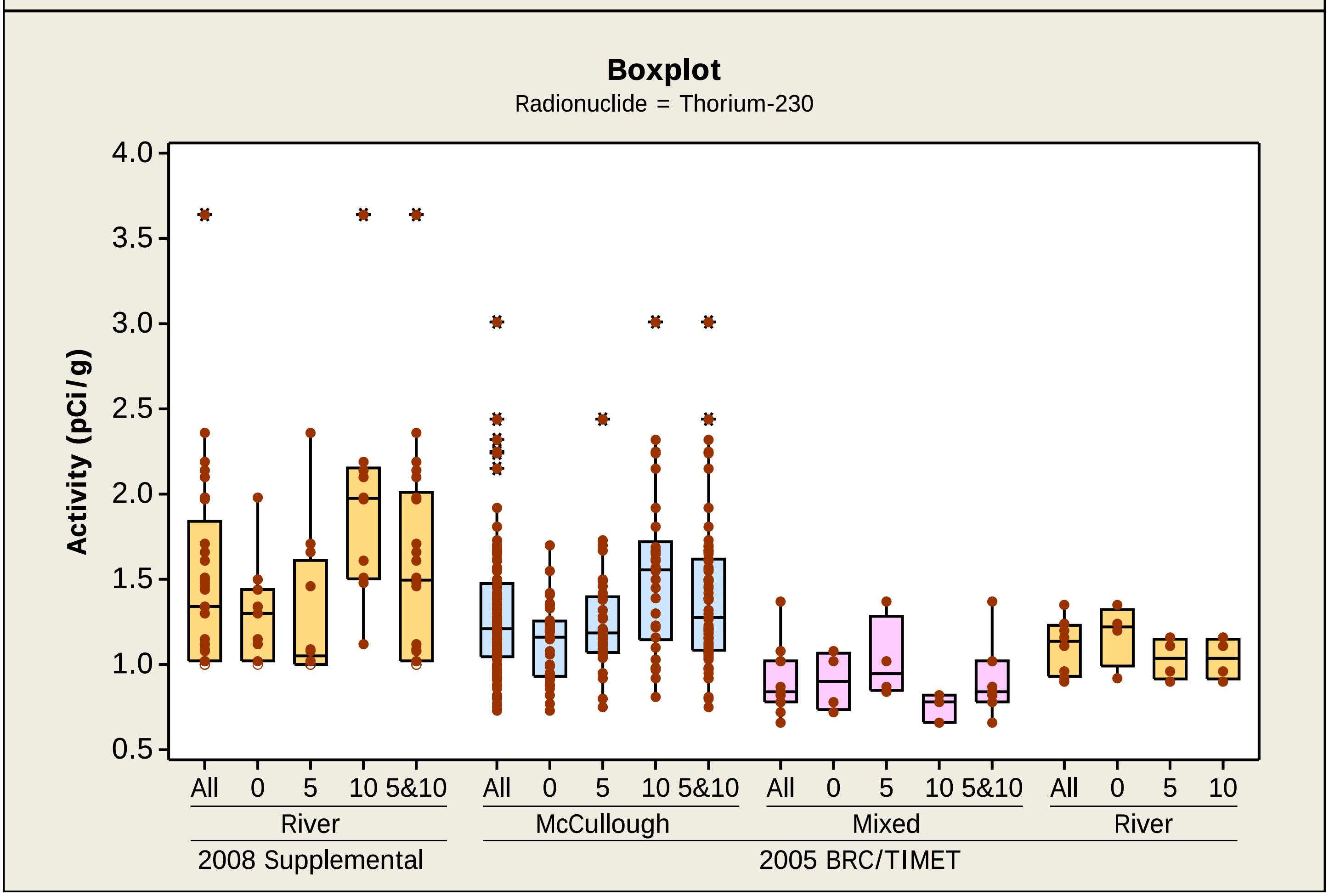

Boxplot
Radionuclide = Radium-228
○ = Non-Detect; ● = Detect
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

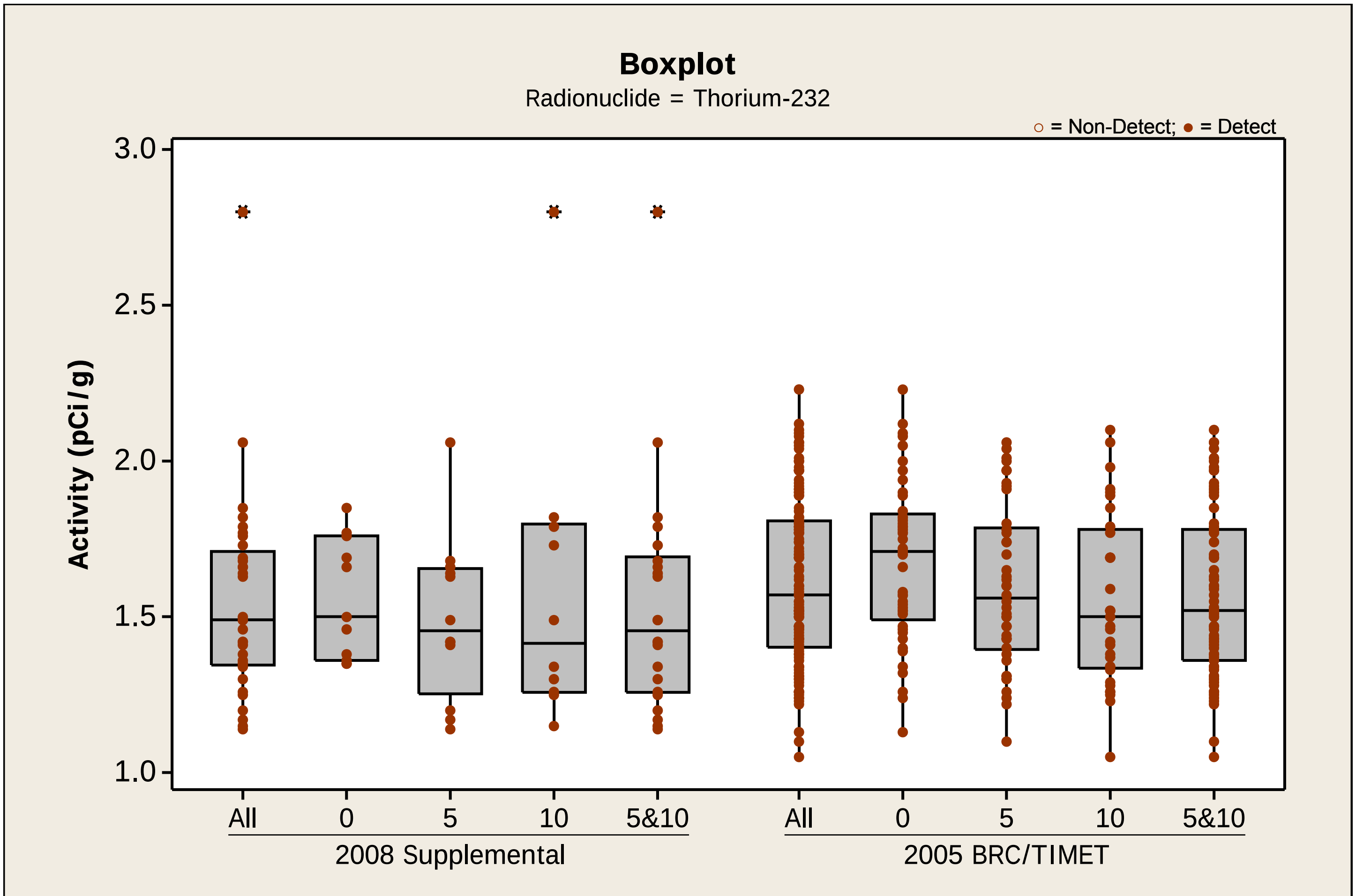

Boxplot
Radionuclide = Radium-228
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

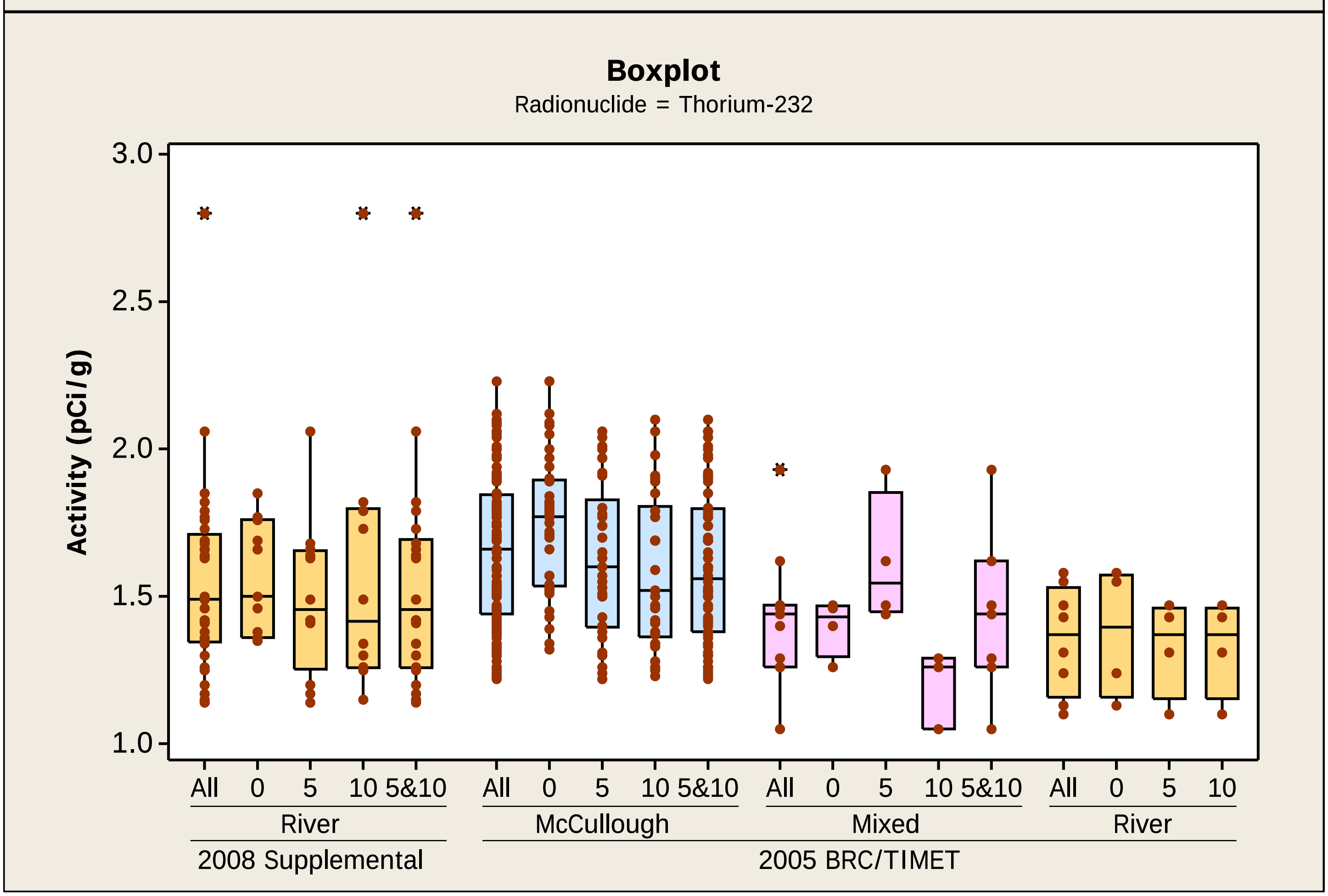

Boxplot
Radionuclide = Thorium-228
○ = Non-Detect; ● = Detect
Activity (pCi/g)
3.5
3.0
2.5
2.0
1.5
1.0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

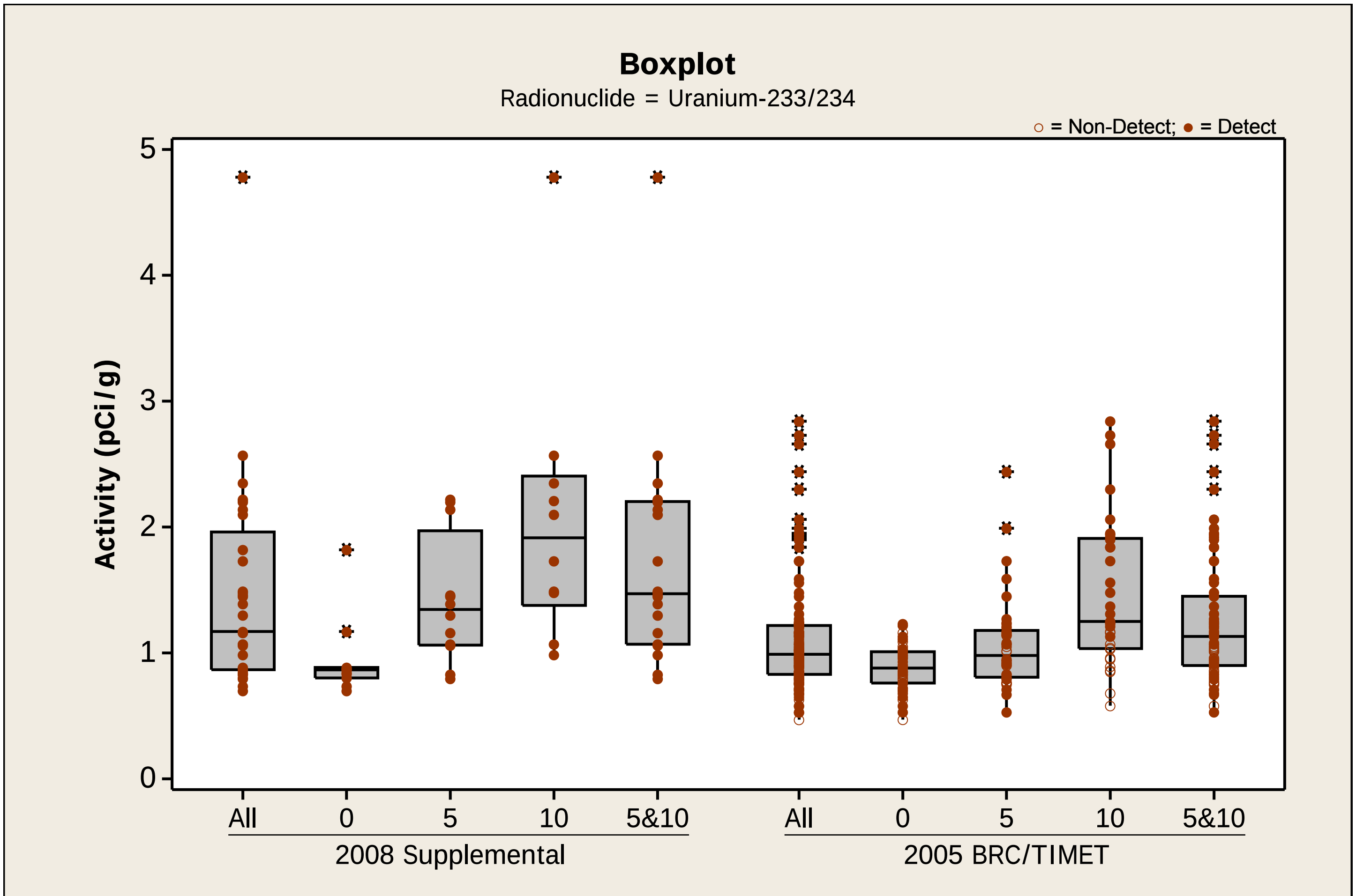

Boxplot
Radionuclide = Thorium-228
Activity (pCi/g)
3.5
3.0
2.5
2.0
1.5
1.0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Radionuclide = Thorium-230
○ = Non-Detect; ● = Detect
Activity (pCi/g)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

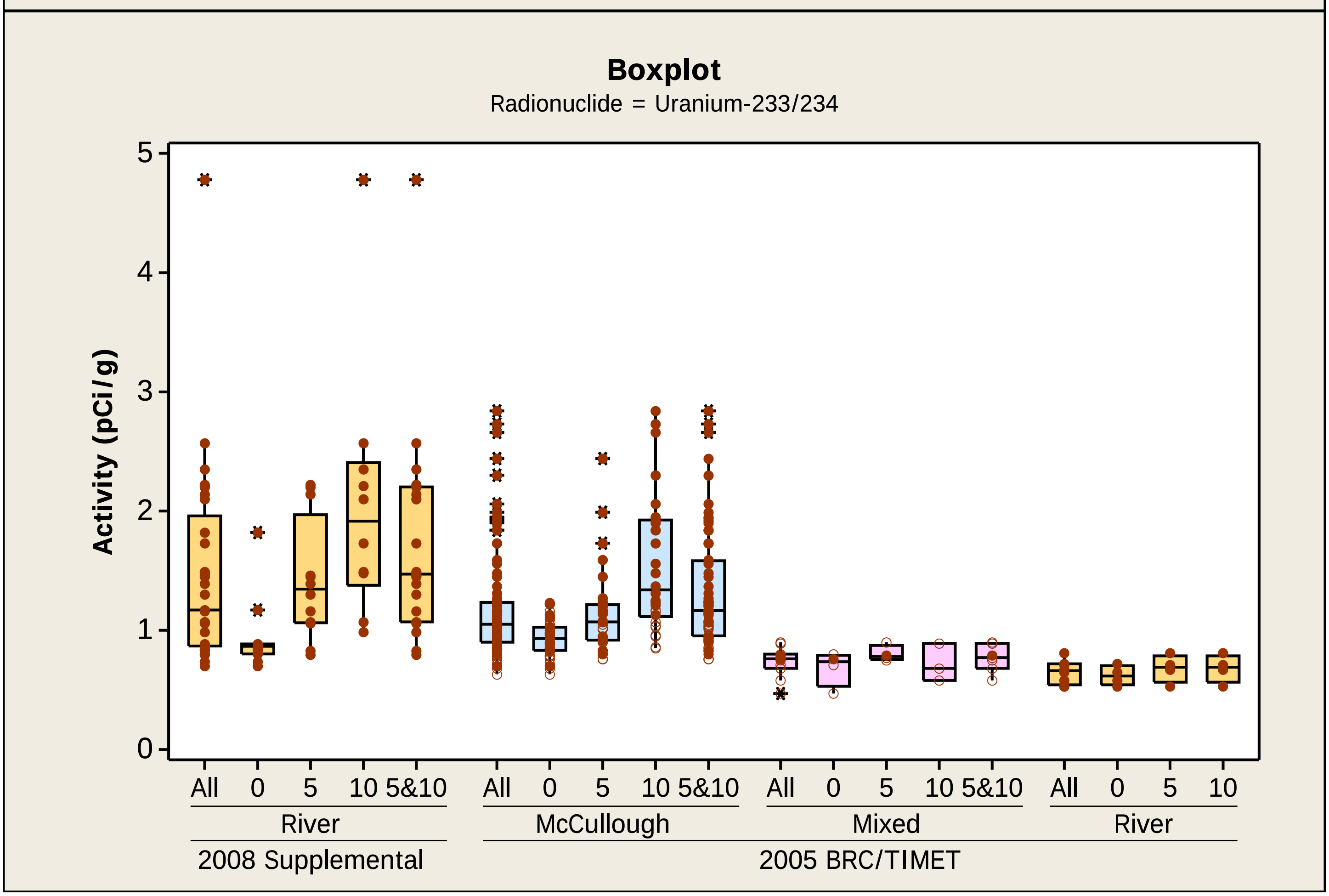

Boxplot
Radionuclide = Thorium-230
Activity (pCi/g)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Boxplot
Radionuclide = Thorium-232
○ = Non-Detect; ● = Detect
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
All
0
5
10
5&10
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET

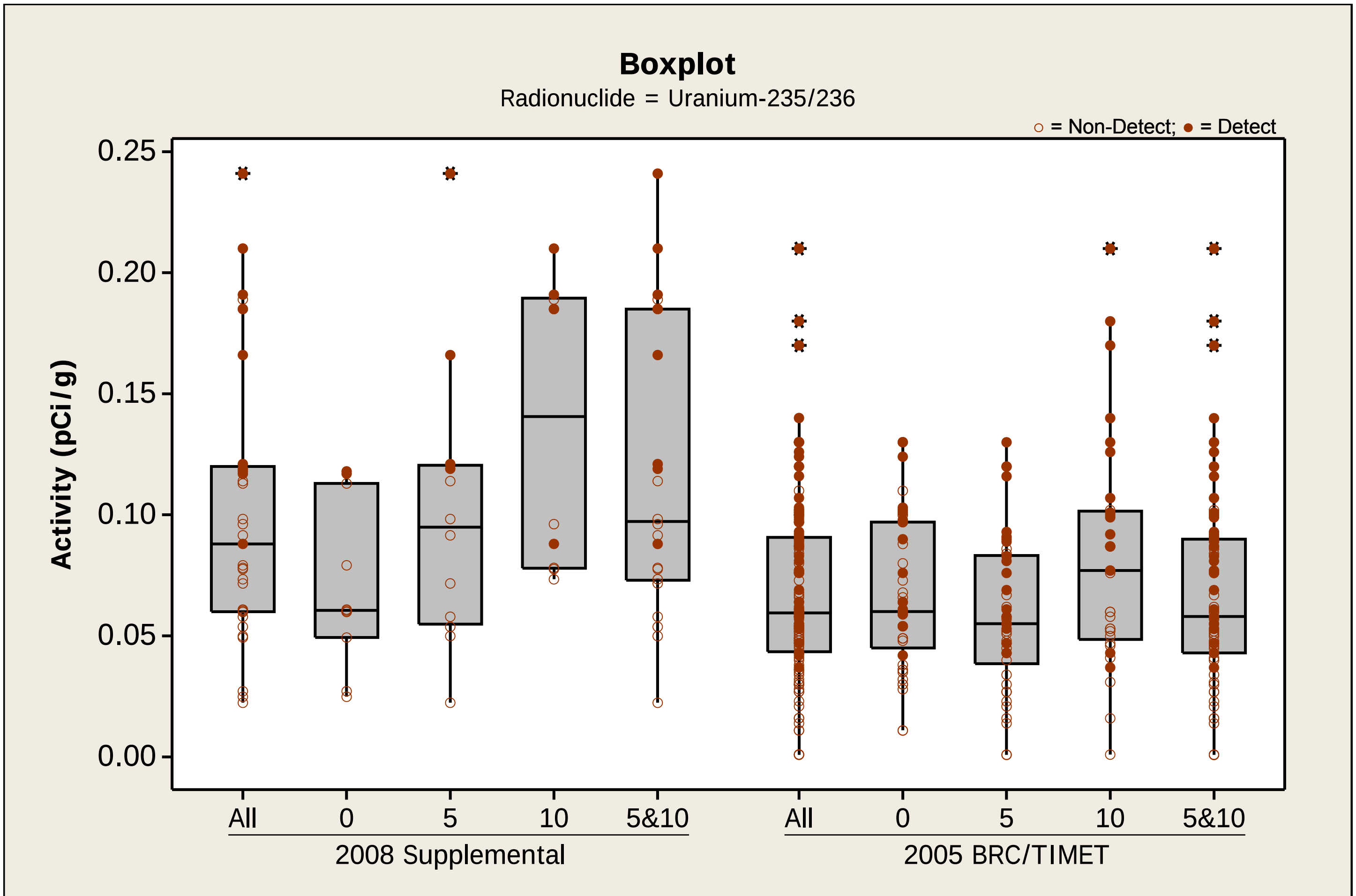

Boxplot
Radionuclide = Thorium-232
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
5&10
All
0
5
10
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



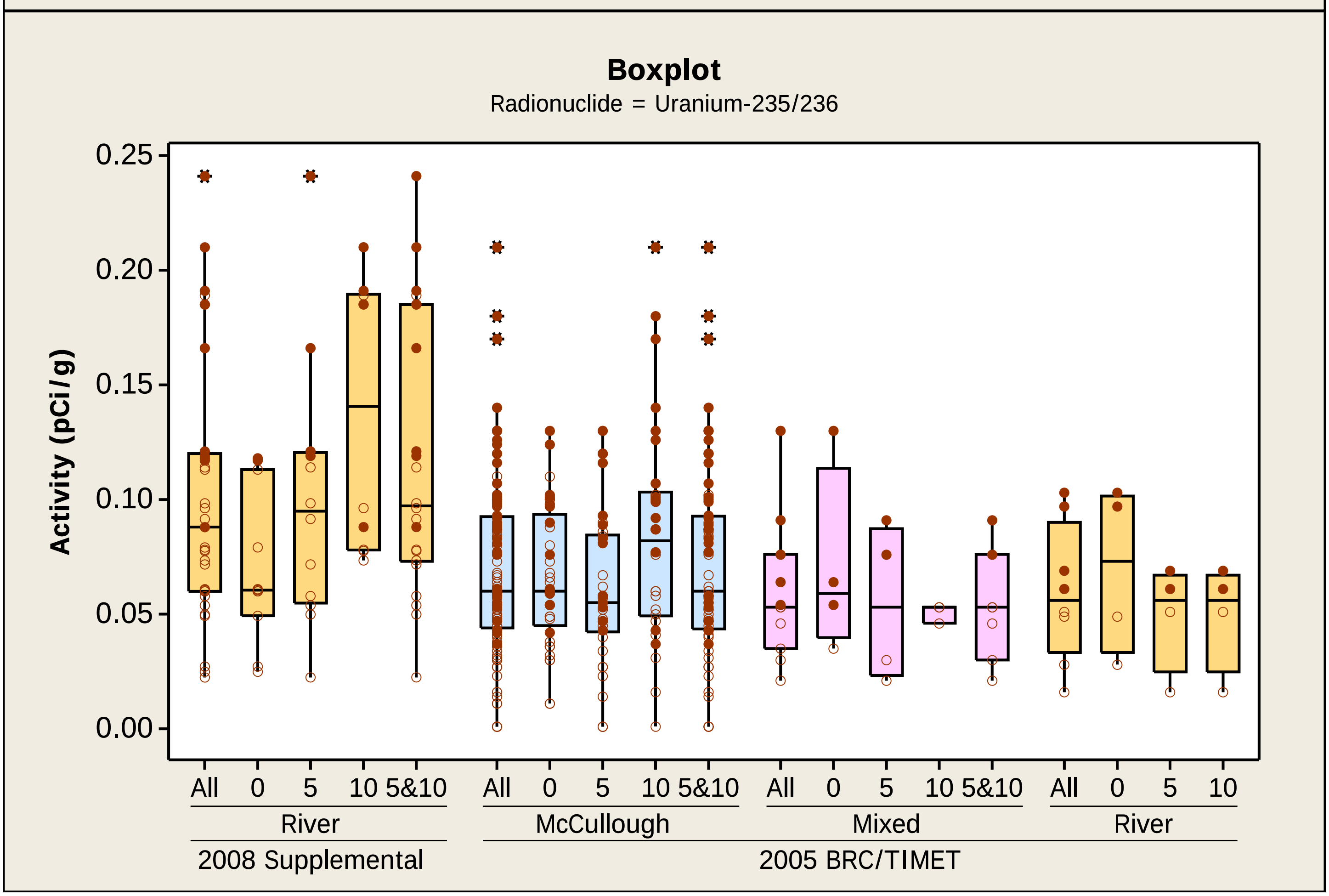
Boxplot
Radionuclide = Uranium-233/234
○ = Non-Detect; ● = Detect
Activity (pCi/g)
0
1
2
3
4
5
All
0
5
10
5&10
2008 Supplemental
2005 BRC/TIMET



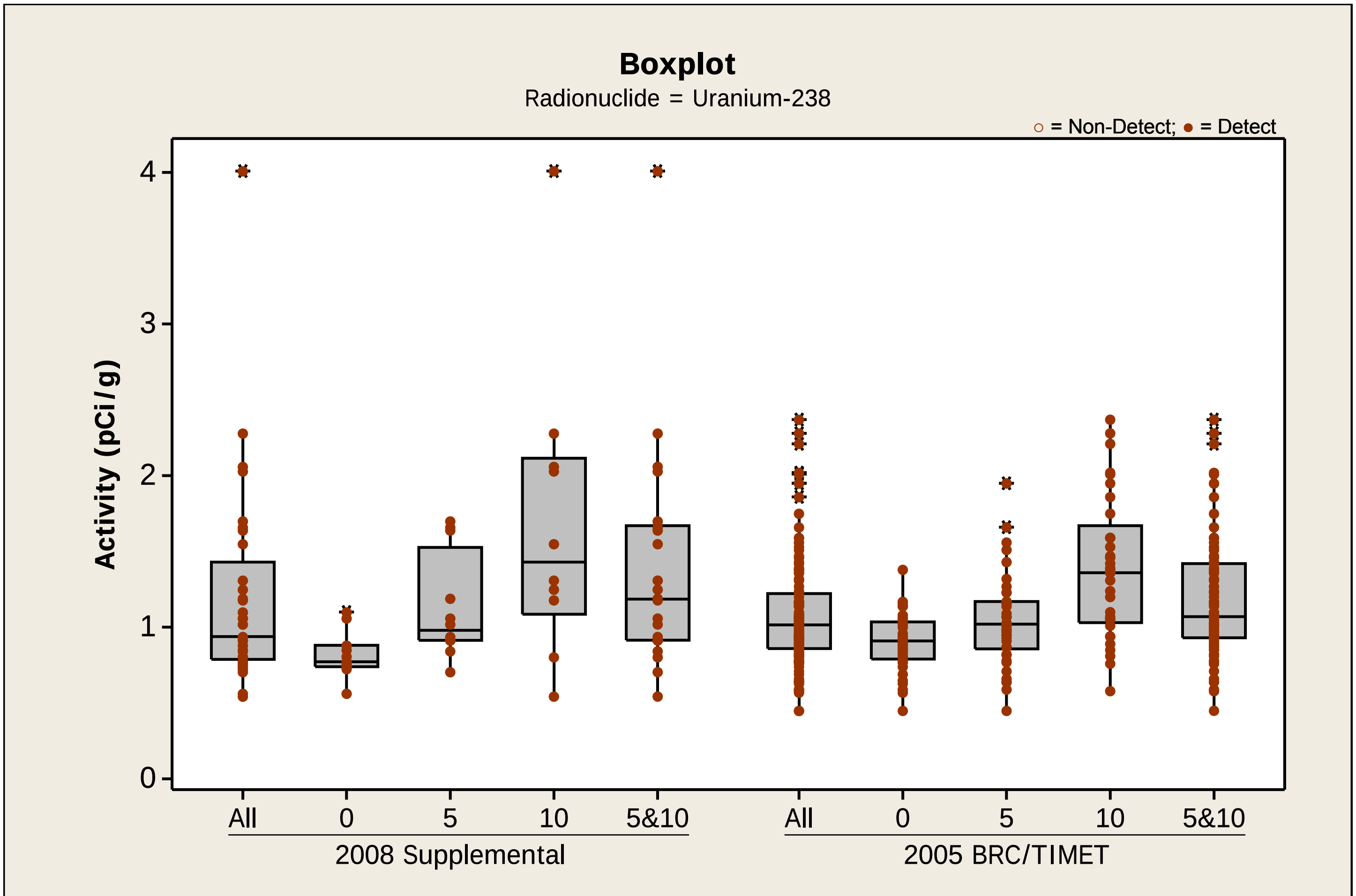
Boxplot
Radionuclide = Uranium-233/234
Activity (pCi/g)
0
1
2
3
4
5
All
0
5
10
5&10
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

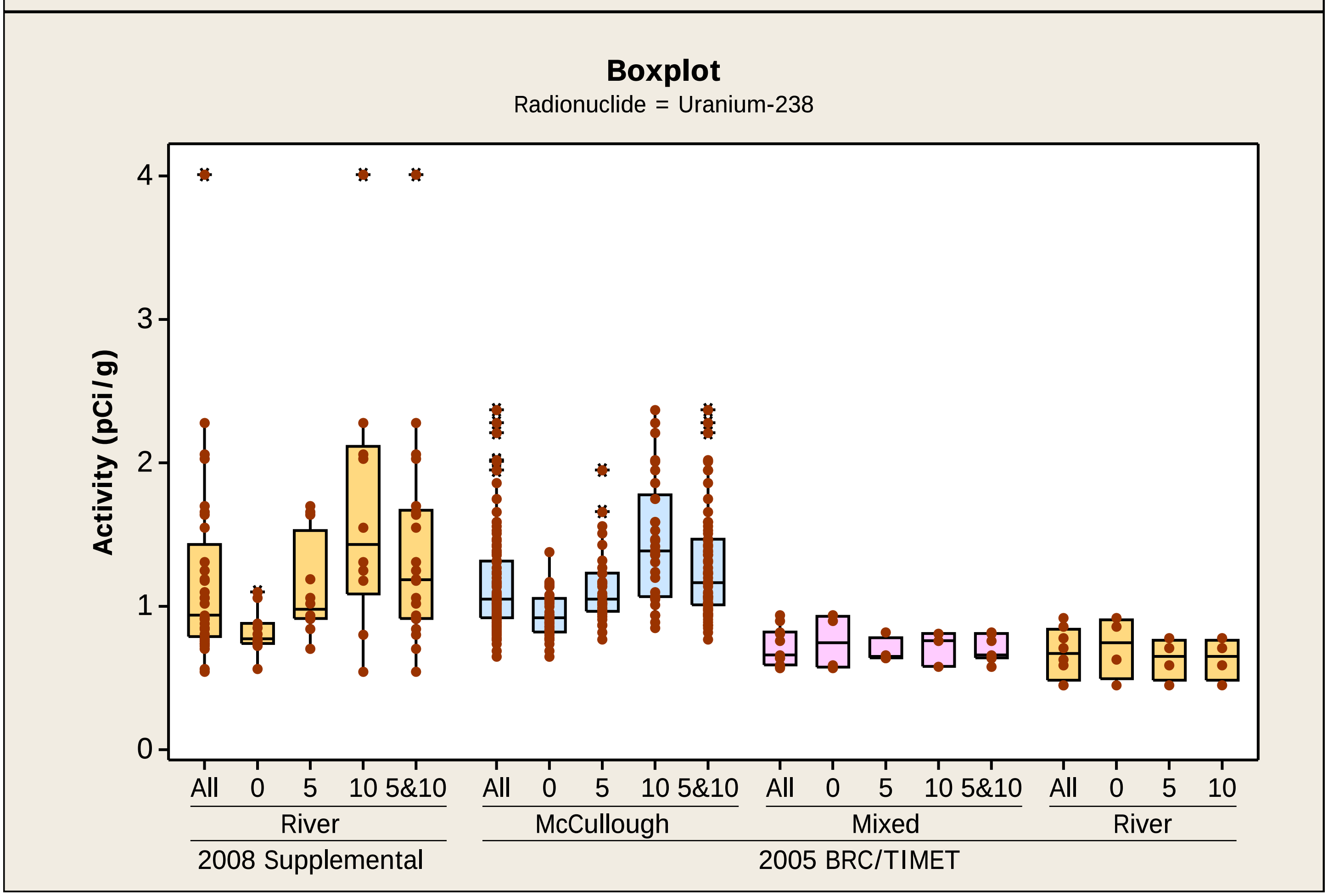


Boxplot
Radionuclide = Uranium-235/236
○ = Non-Detect; ● = Detect
Activity (pCi/g)
0.25
0.20
0.15
0.10
0.05
0.00
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET

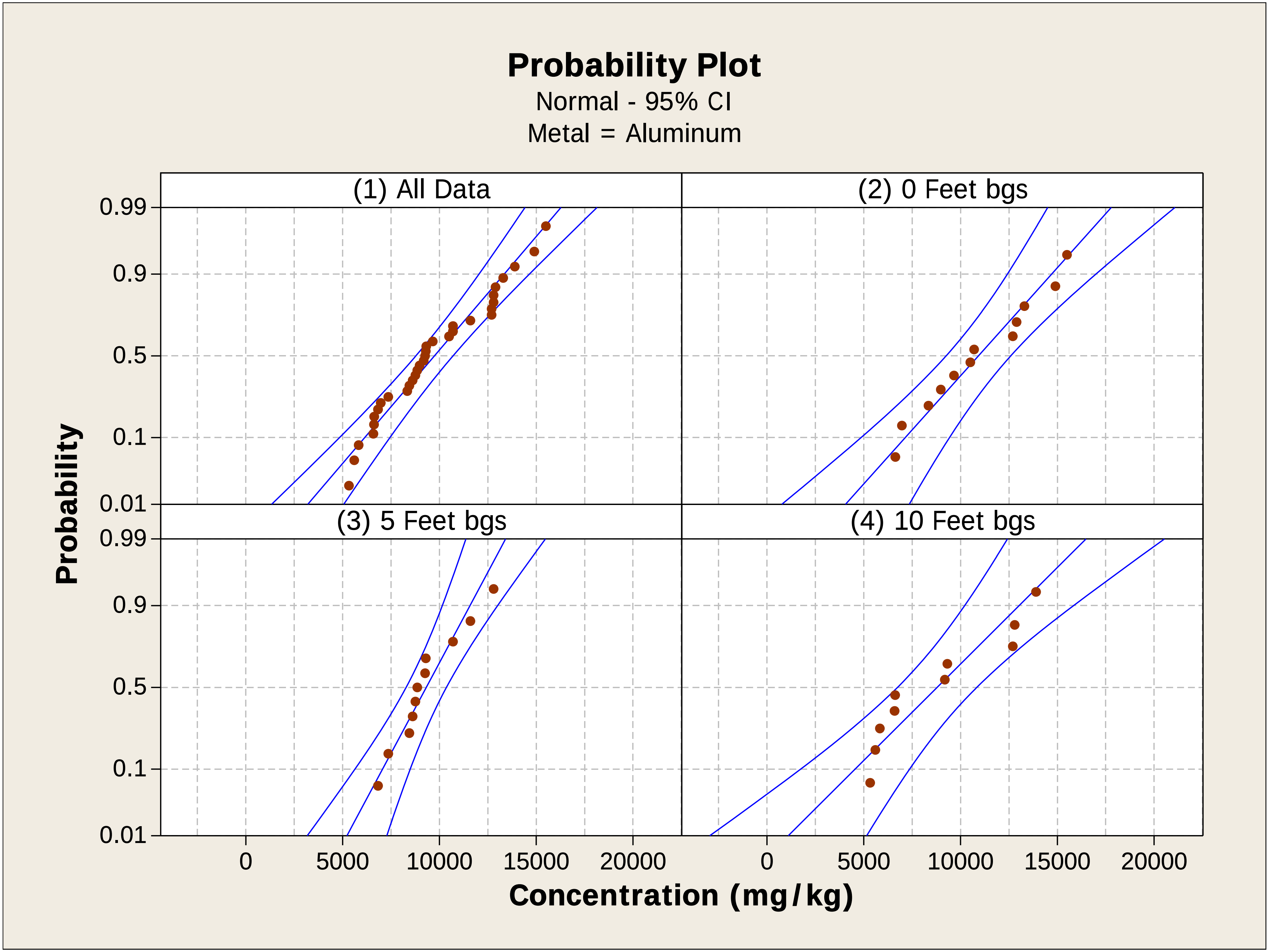


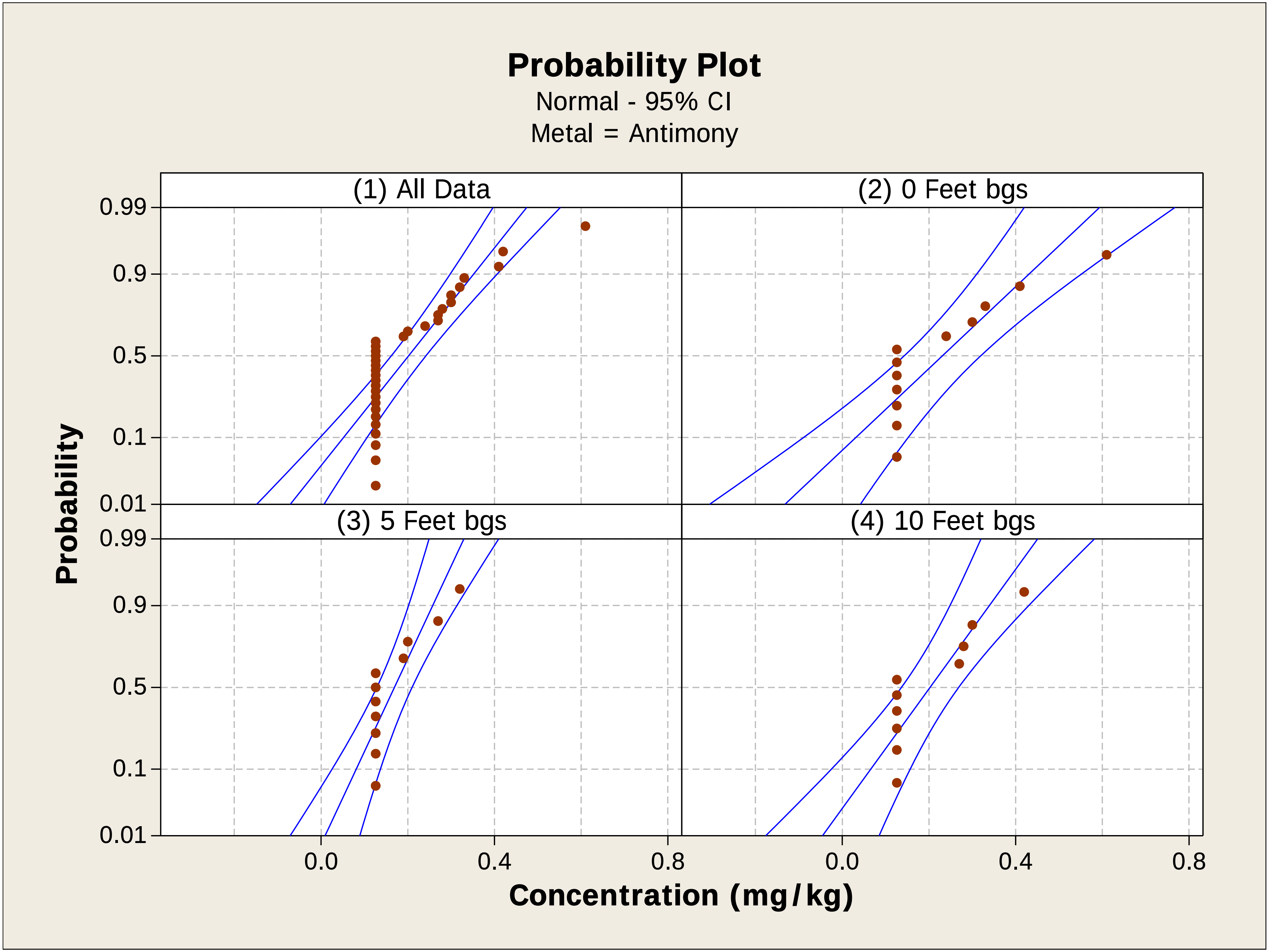
Boxplot
Radionuclide = Uranium-235/236
Activity (pCi/g)
0.25
0.20
0.15
0.10
0.05
0.00
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

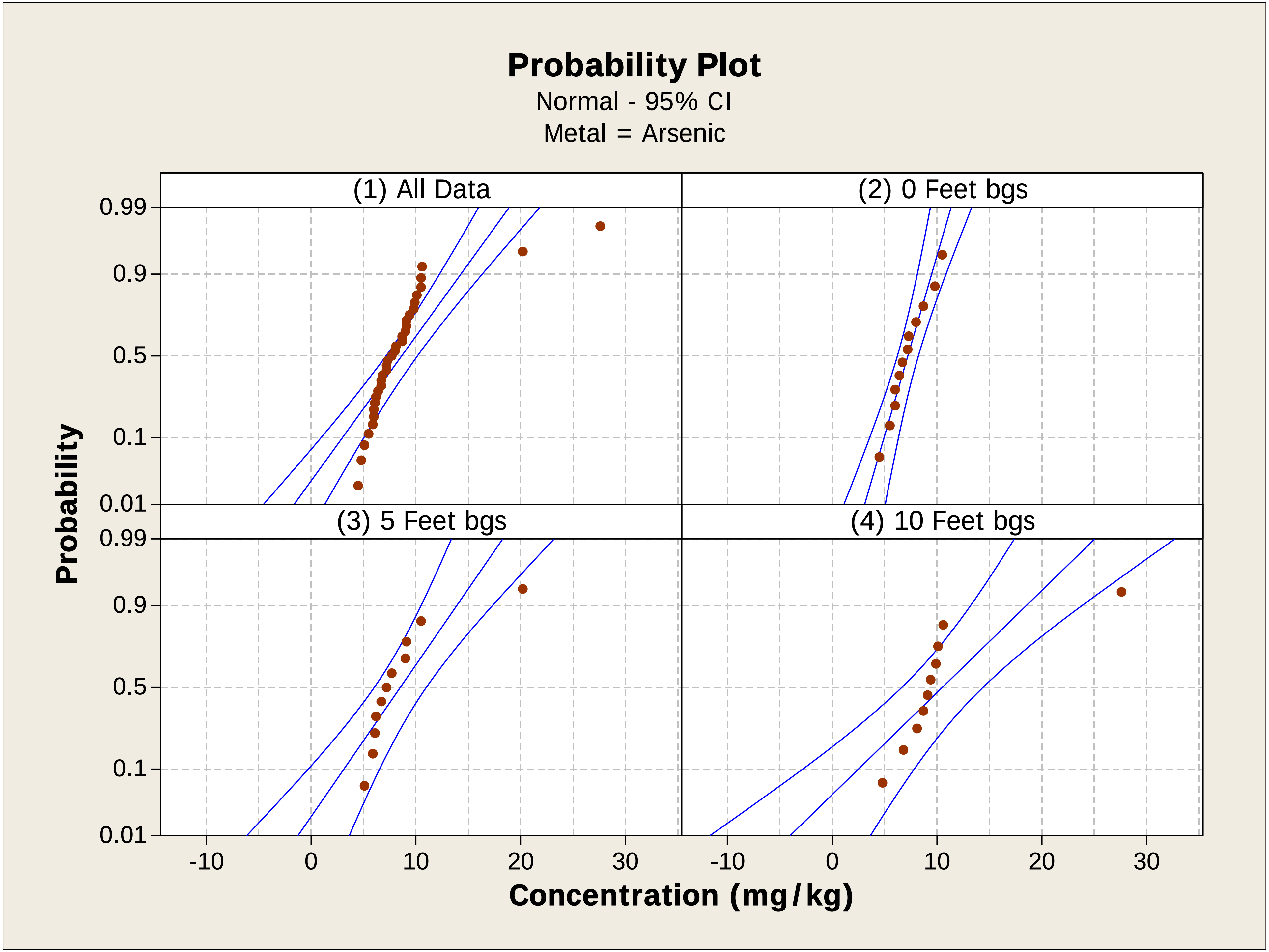

Boxplot
Radionuclide = Uranium-238
○ = Non-Detect; ● = Detect
Activity (pCi/g)
0
1
2
3
4
All
0
5
10
5&10
2008 Supplemental
All
0
5
10
5&10
2005 BRC/TIMET


Boxplot
Radionuclide = Uranium-238
Activity (pCi/g)
0
1
2
3
4
All
0
5
10
5&10
River
2008 Supplemental
All
0
5
10
5&10
McCullough
All
0
5
10
5&10
Mixed
All
0
5
10
River
2005 BRC/TIMET

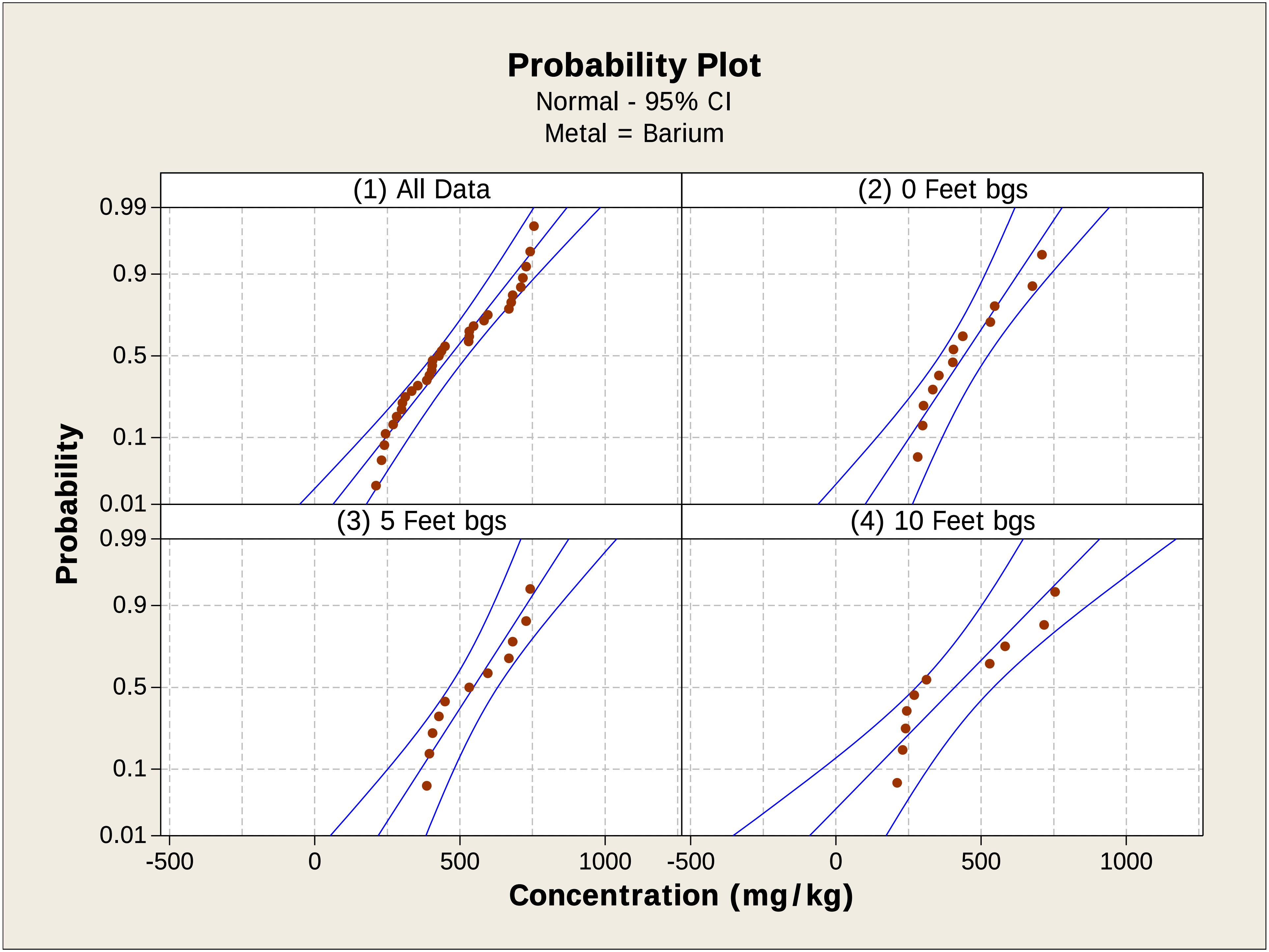
PROBABILITY PLOTS


Probability Plot
Normal - 95% CI
Metal = Aluminum
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
5000
10000
15000
20000
Concentration (mg/kg)

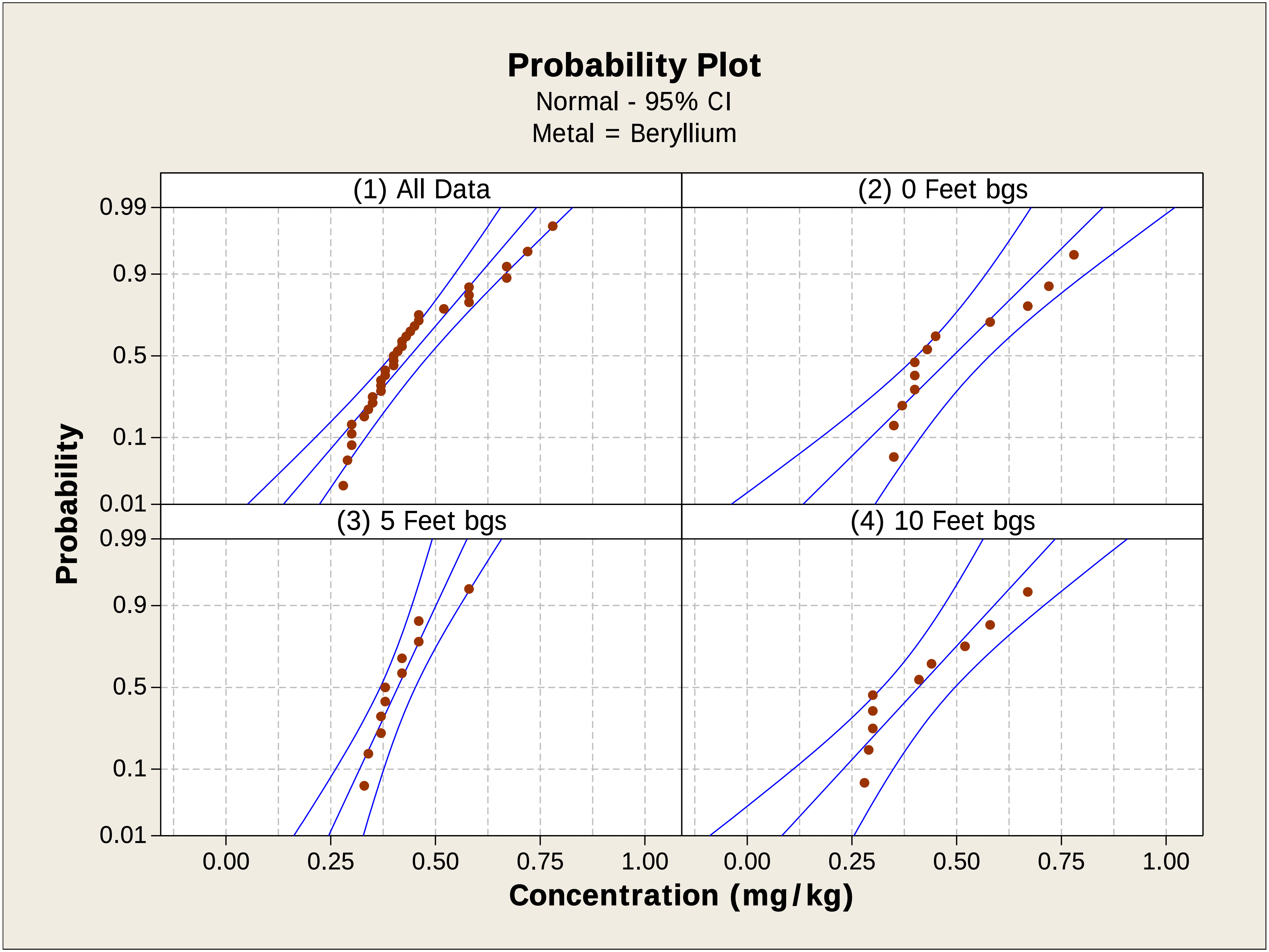

Probability Plot
Normal - 95% CI
Metal = Antimony
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.0
0.4
0.8
Concentration (mg/kg)



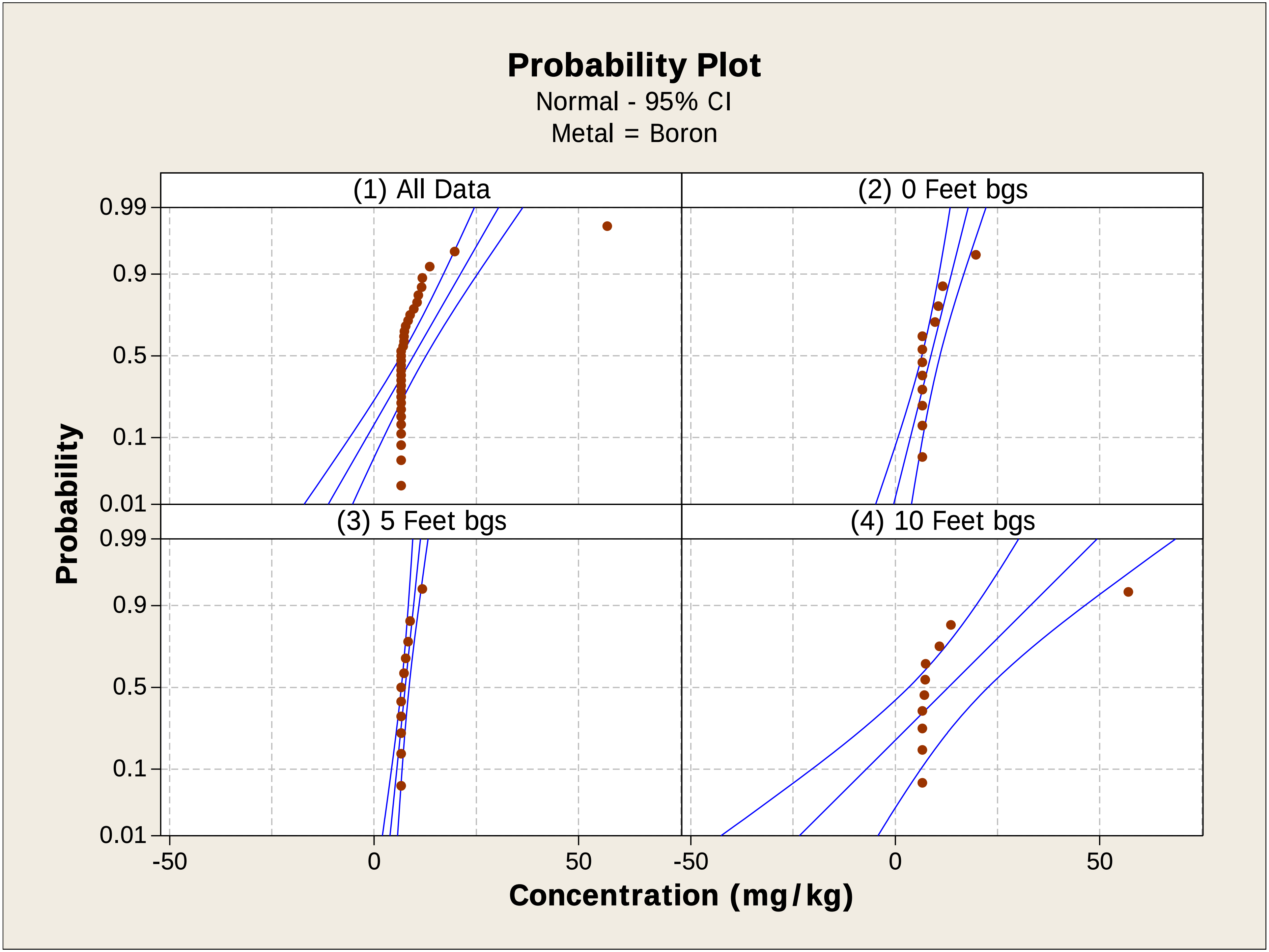
Probability Plot
Normal - 95% CI
Metal = Arsenic
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-10
0
10
20
30
Concentration (mg/kg)

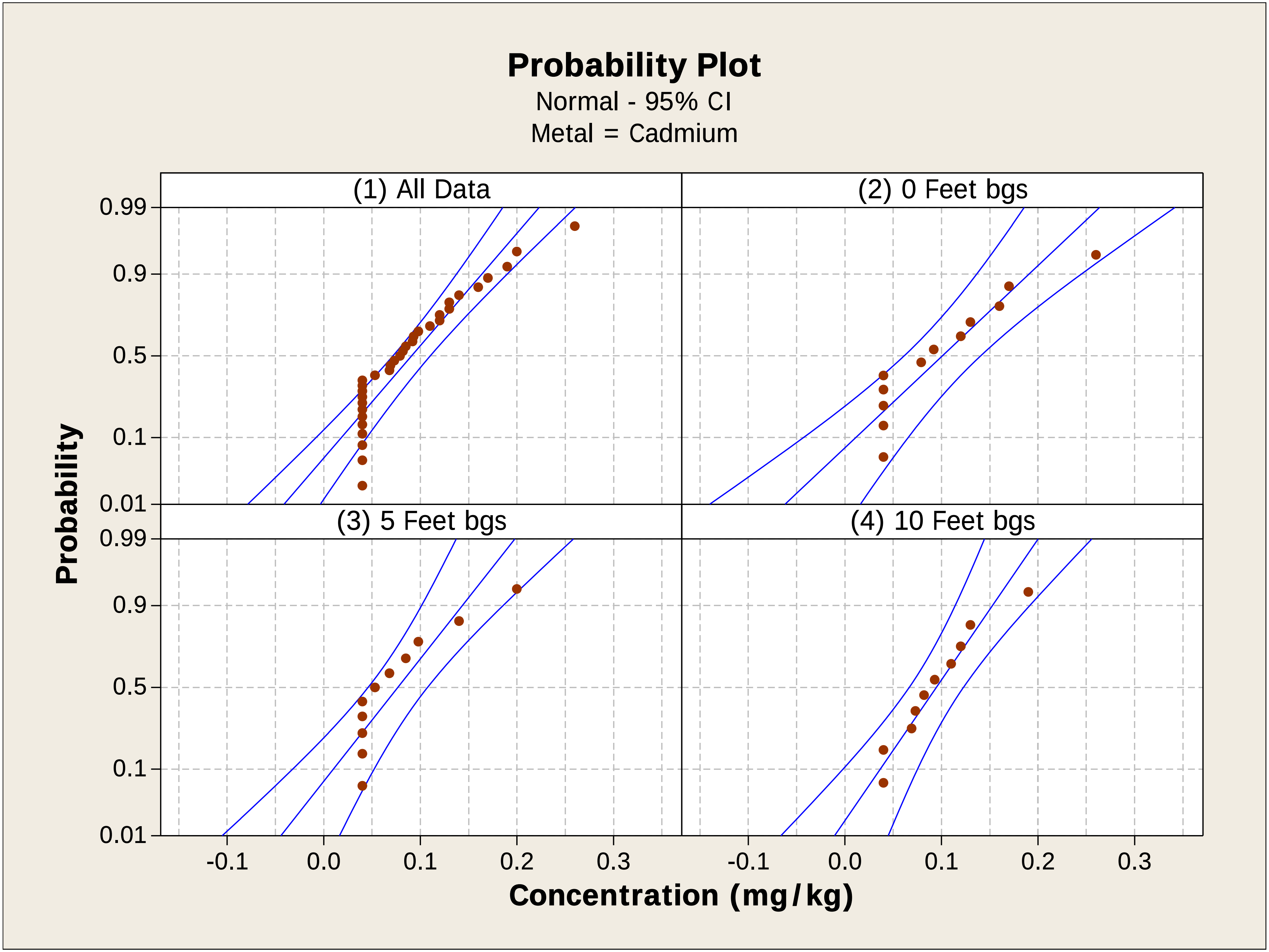


Probability Plot
Normal - 95% CI
Metal = Barium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-500
0
500
1000
Concentration (mg/kg)

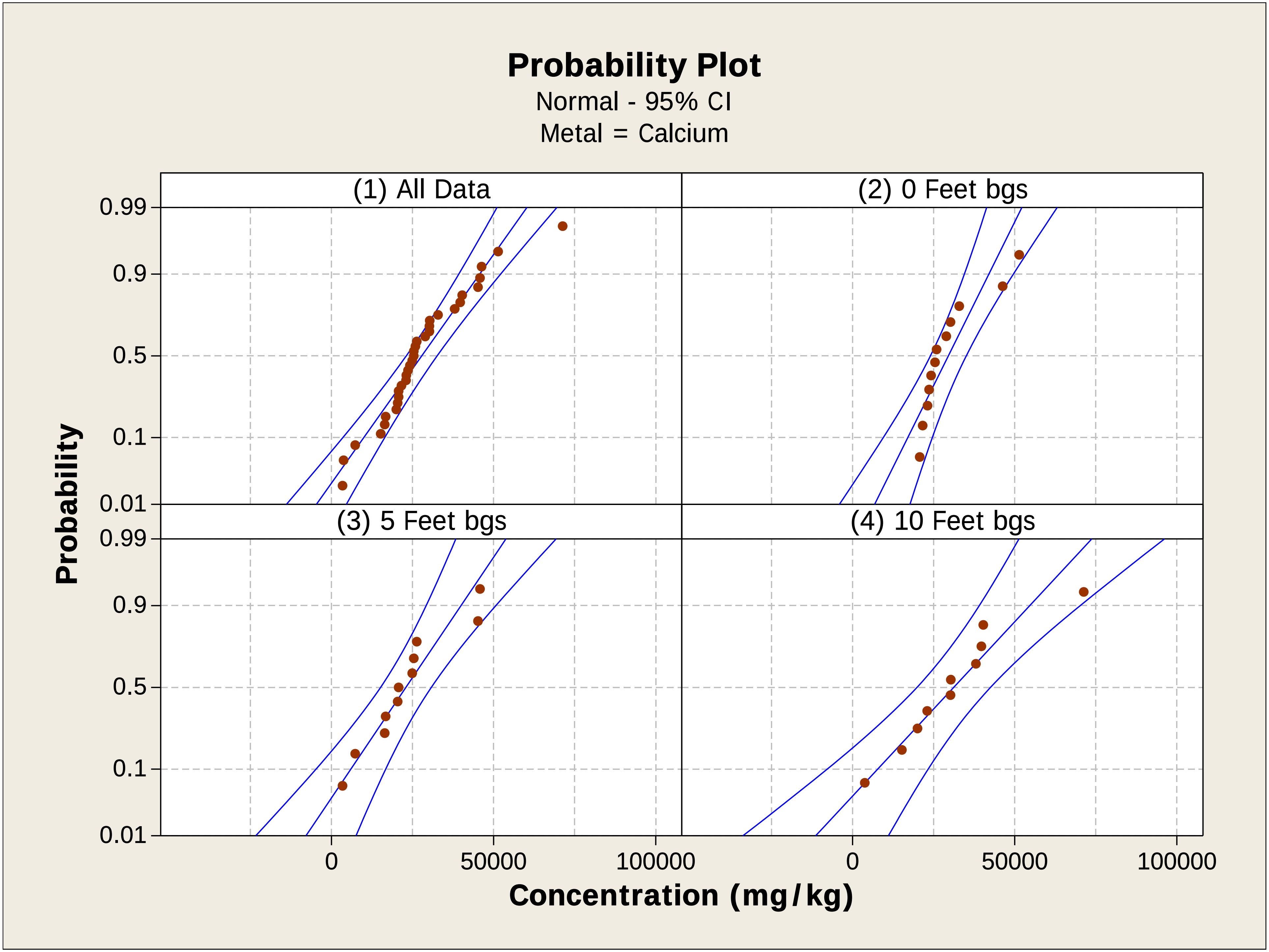


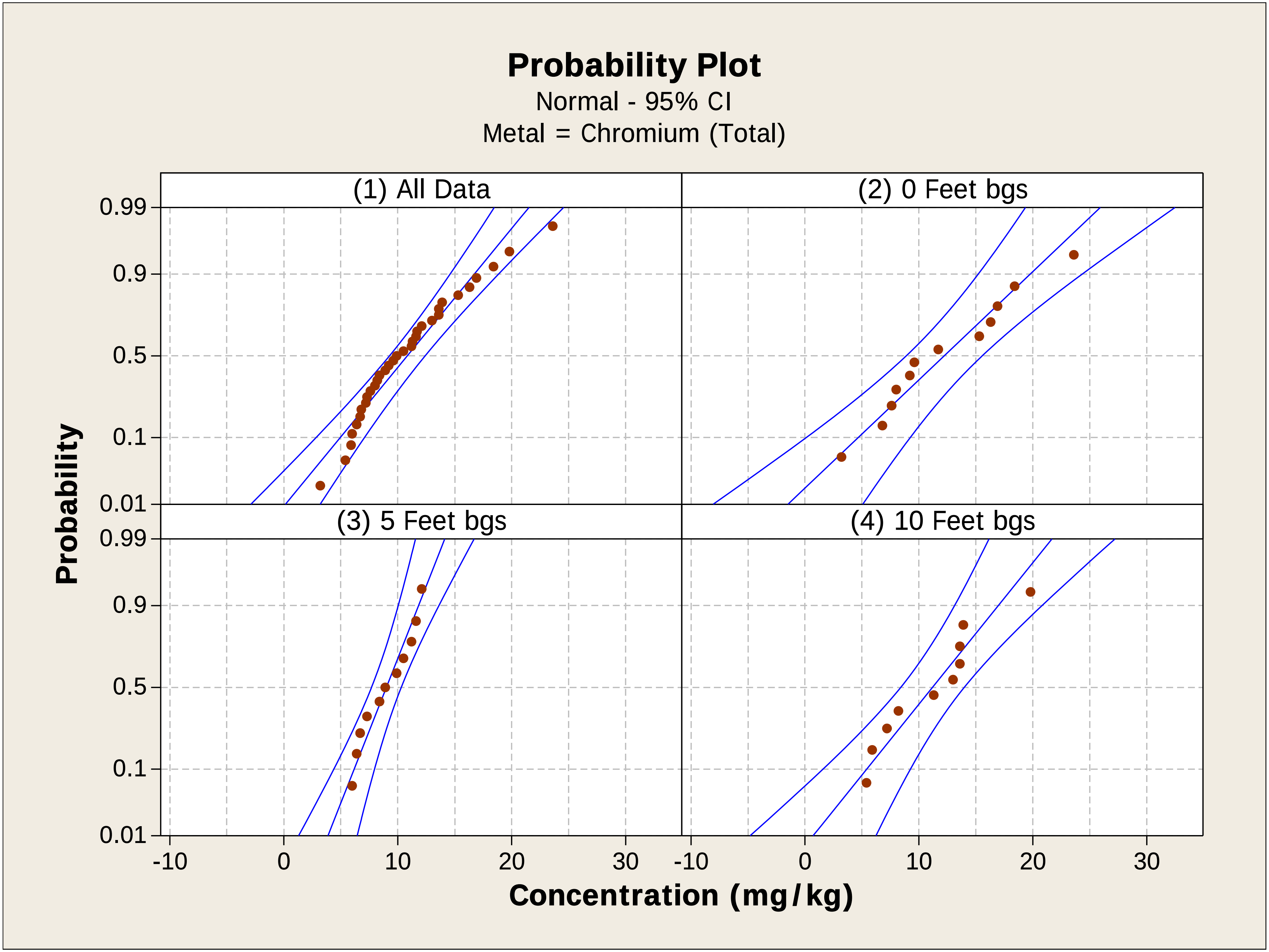
Probability Plot
Normal - 95% CI
Metal = Beryllium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.00
0.25
0.50
0.75
1.00
Concentration (mg/kg)


Probability Plot
Normal - 95% CI
Metal = Boron
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-50
0
50
Concentration (mg/kg)

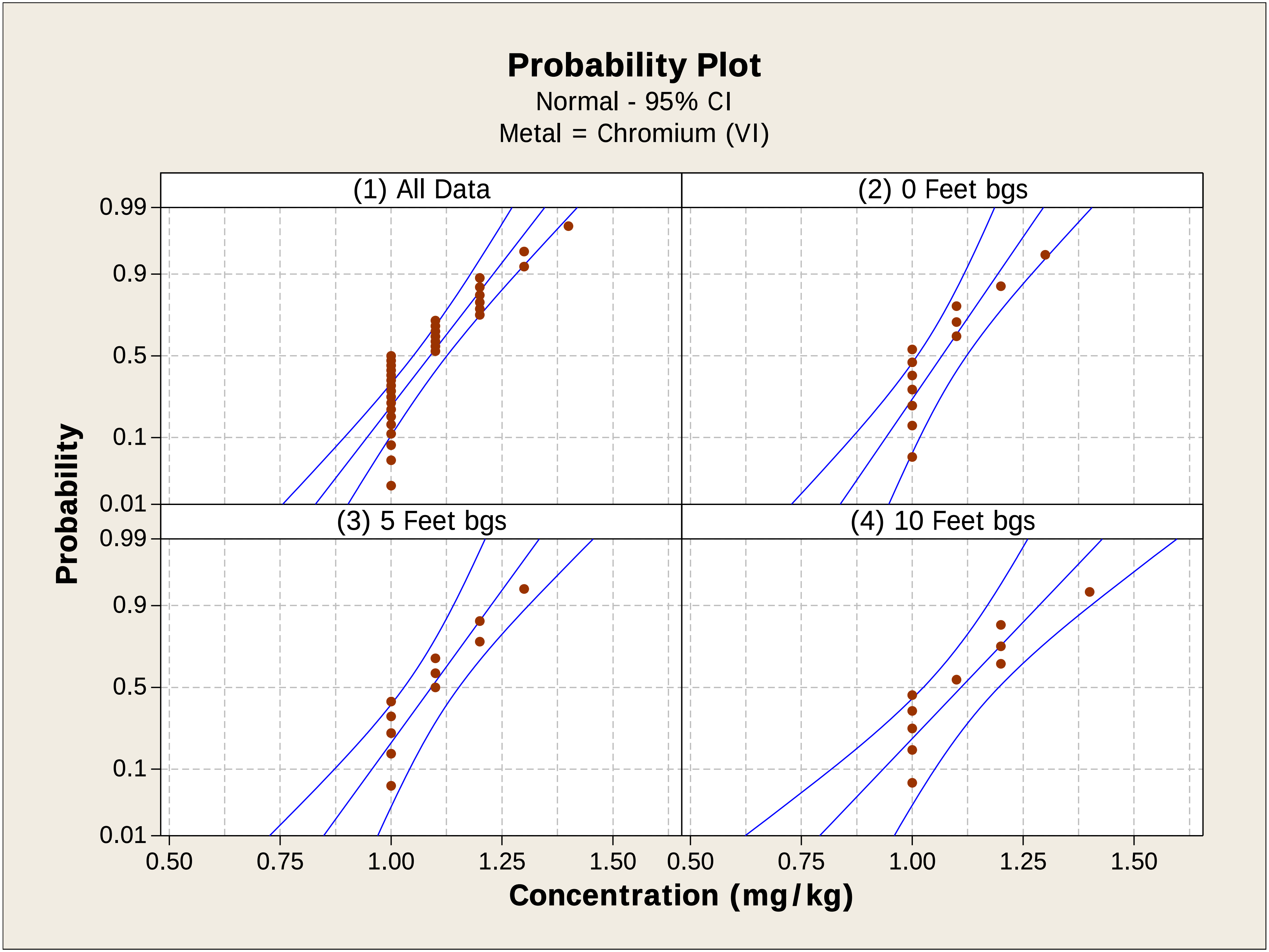


Probability Plot
Normal - 95% CI
Metal = Cadmium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-0.1
0.0
0.1
0.2
0.3
Concentration (mg/kg)

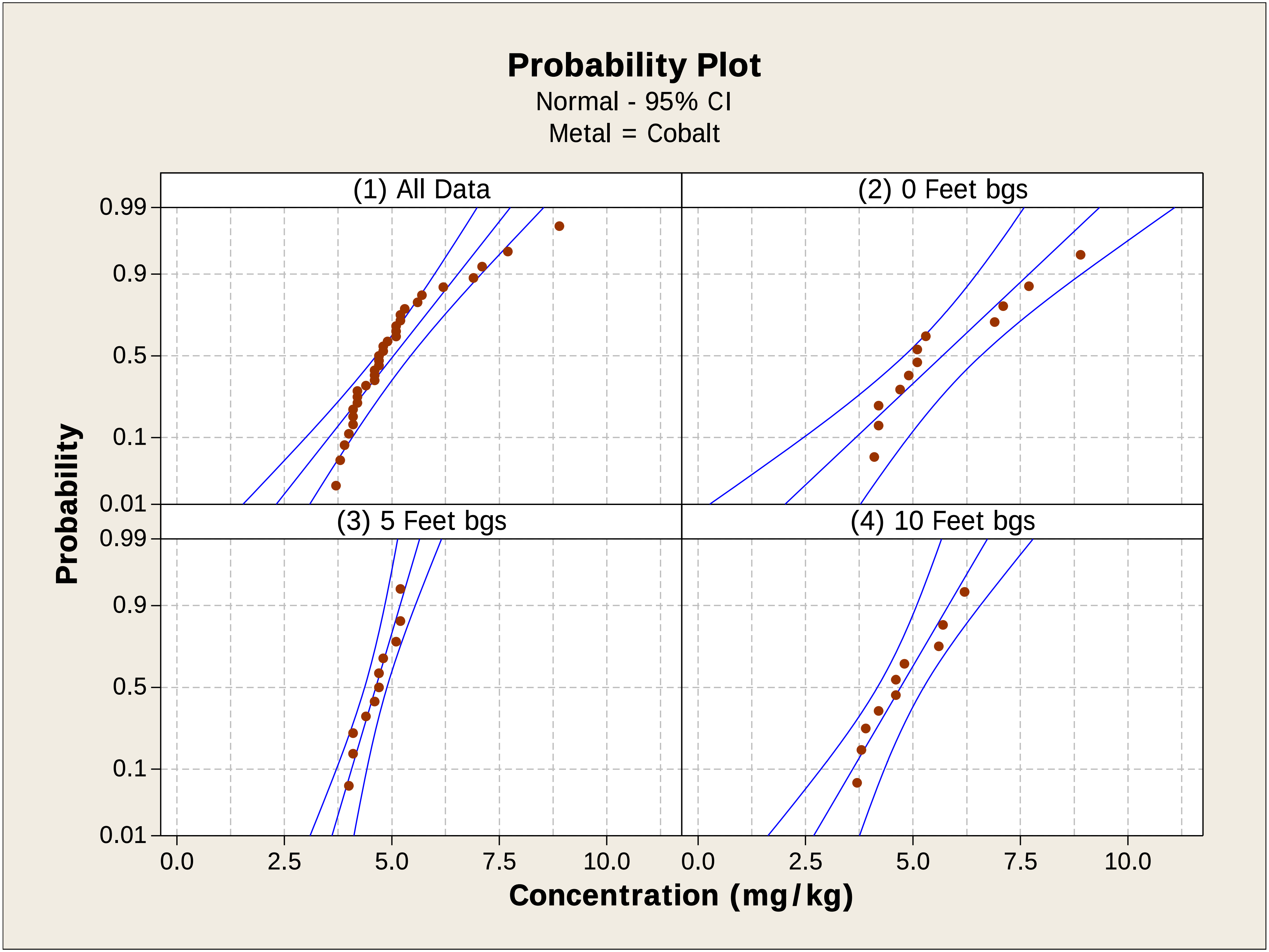

Probability Plot
Normal - 95% CI
Metal = Calcium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
50000
100000
Concentration (mg/kg)



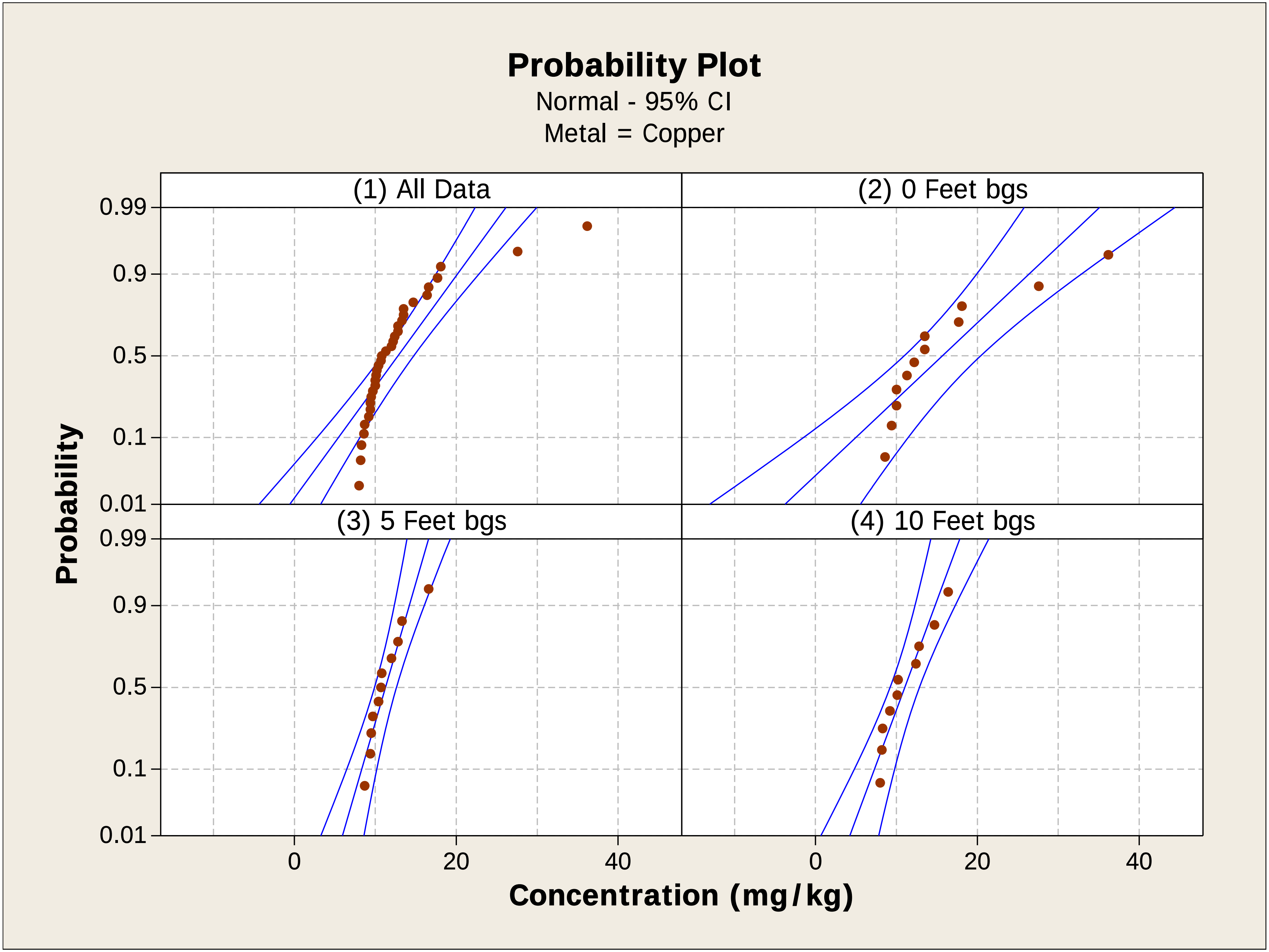
Probability Plot
Normal - 95% CI
Metal = Chromium (Total)
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-10
0
10
20
30
Concentration (mg/kg)



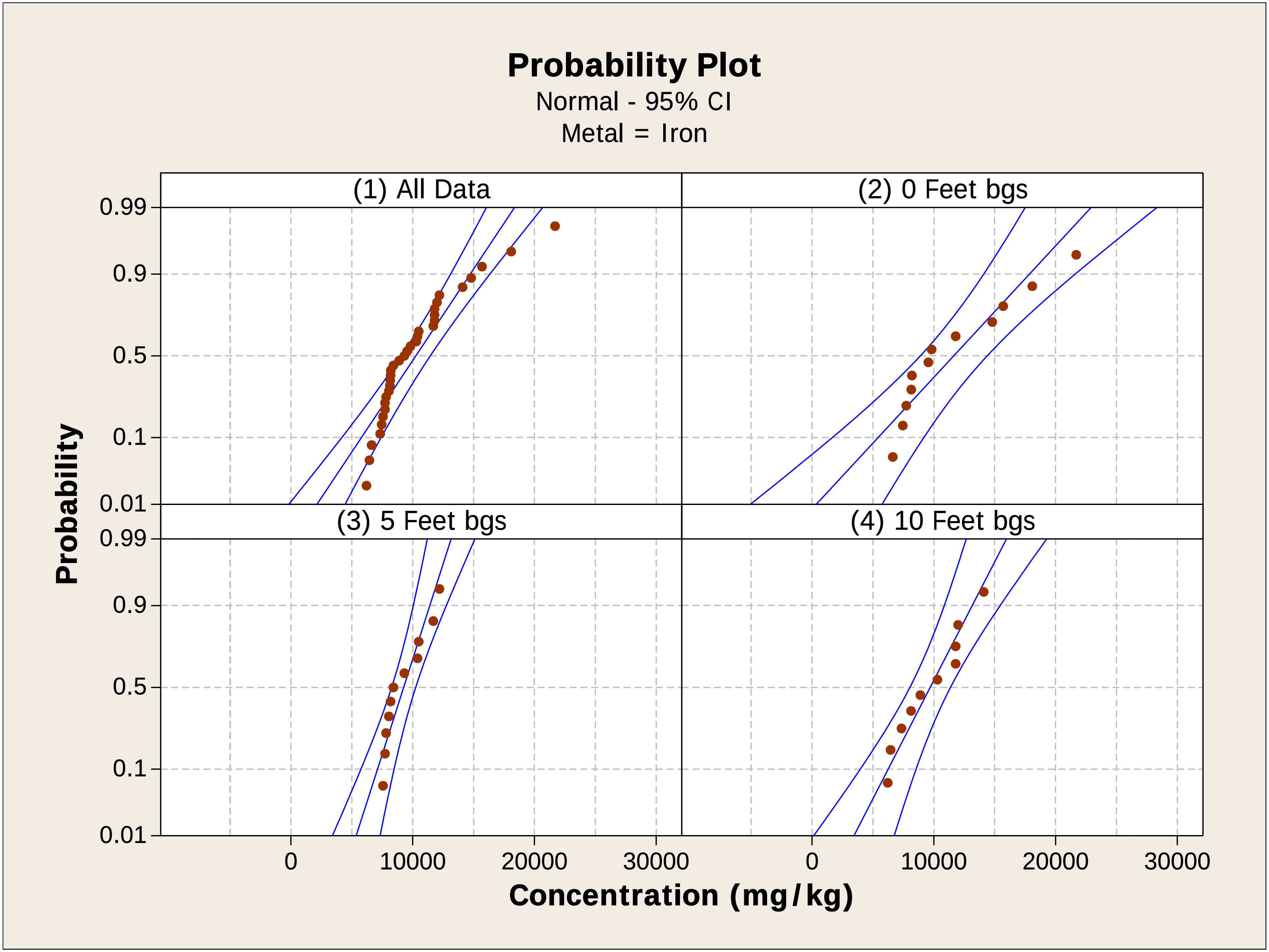
Probability Plot
Normal - 95% CI
Metal = Chromium (VI)
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0.50
0.75
1.00
1.25
1.50
Concentration (mg/kg)



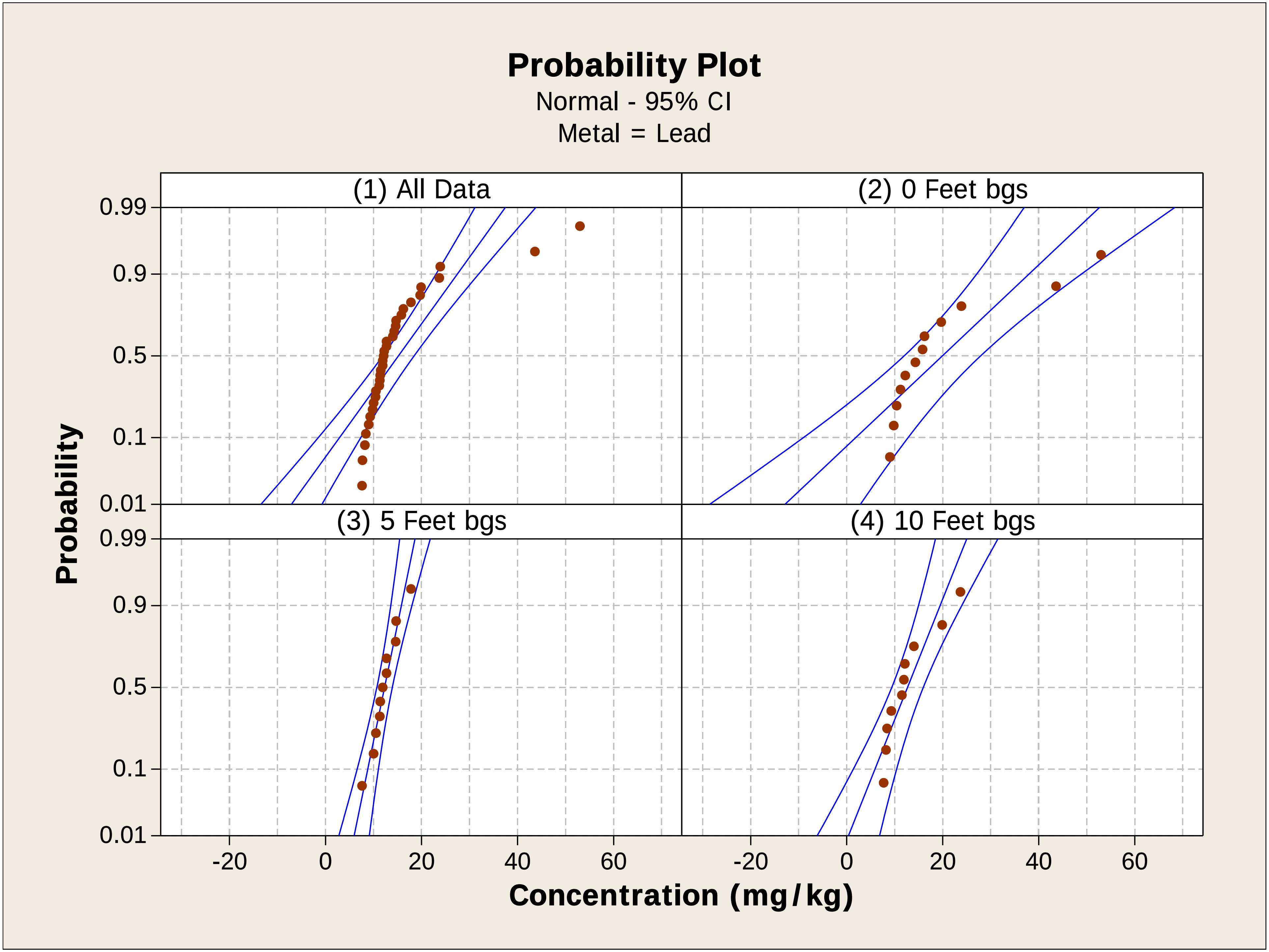
Probability Plot
Normal - 95% CI
Metal = Cobalt
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.0
2.5
5.0
7.5
10.0
Concentration (mg/kg)

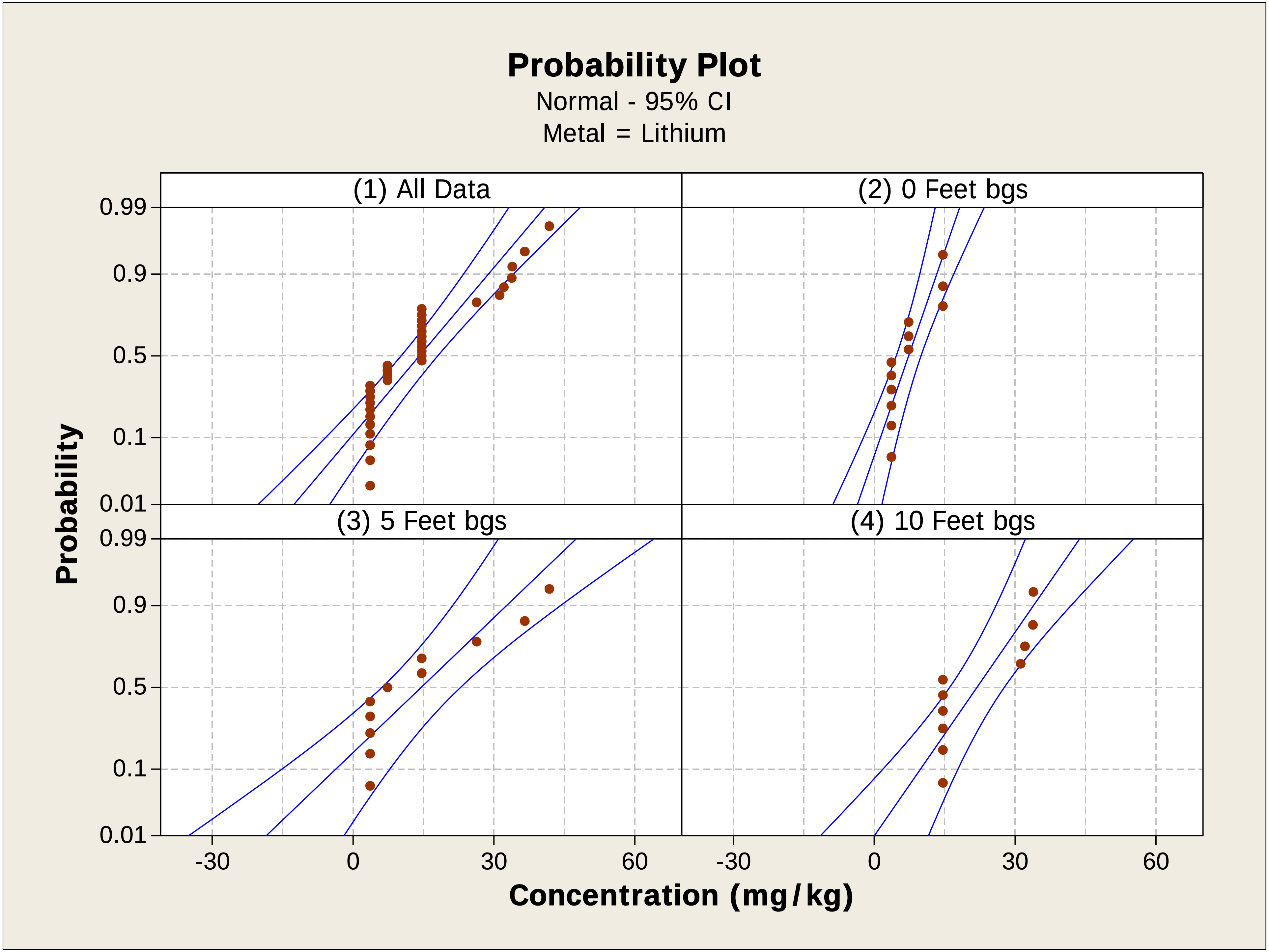


Probability Plot
Normal - 95% CI
Metal = Copper
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
20
40
Concentration (mg/kg)

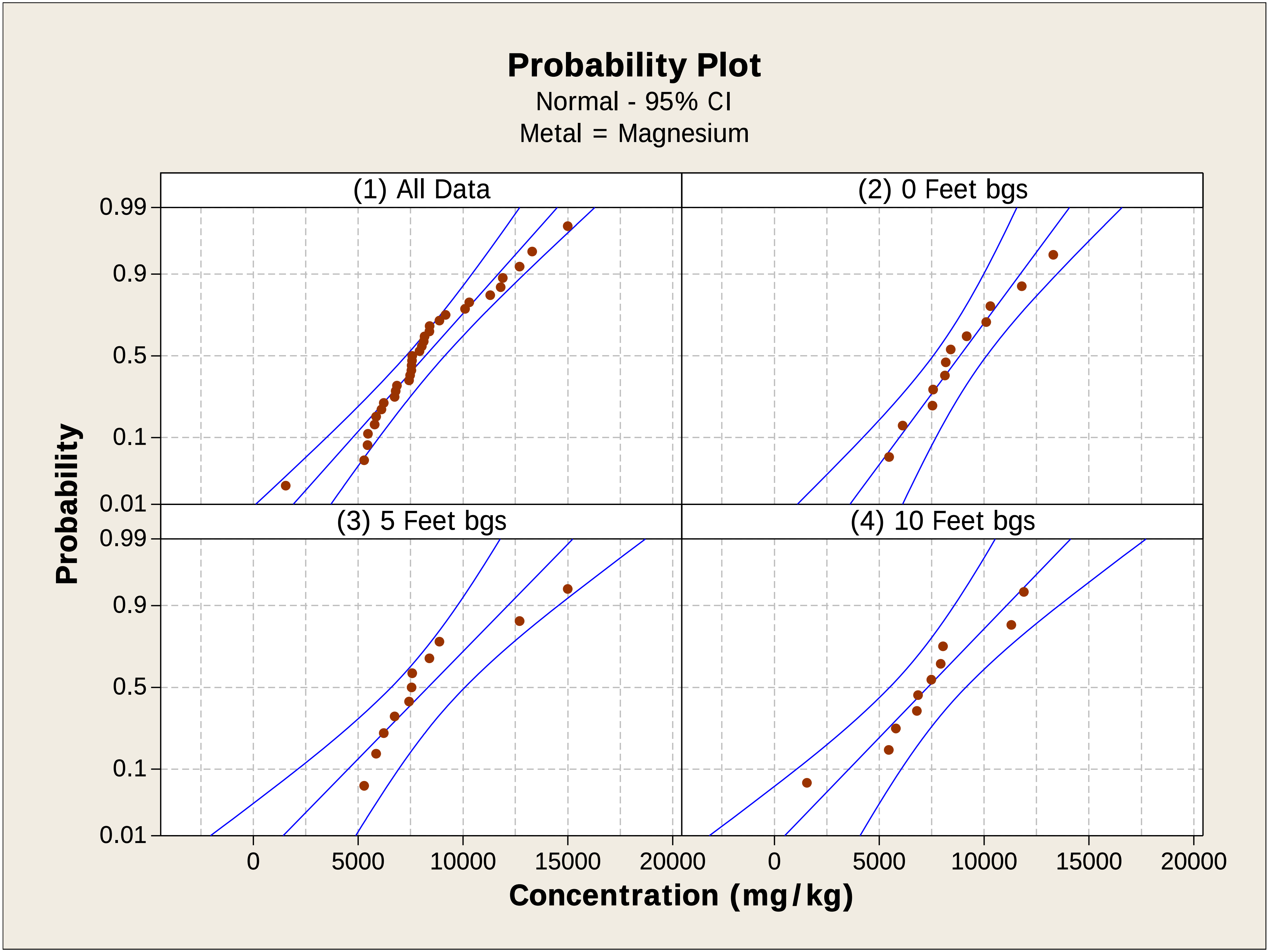


Probability Plot
Normal - 95% CI
Metal = Iron
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
10000
20000
30000
Concentration (mg/kg)

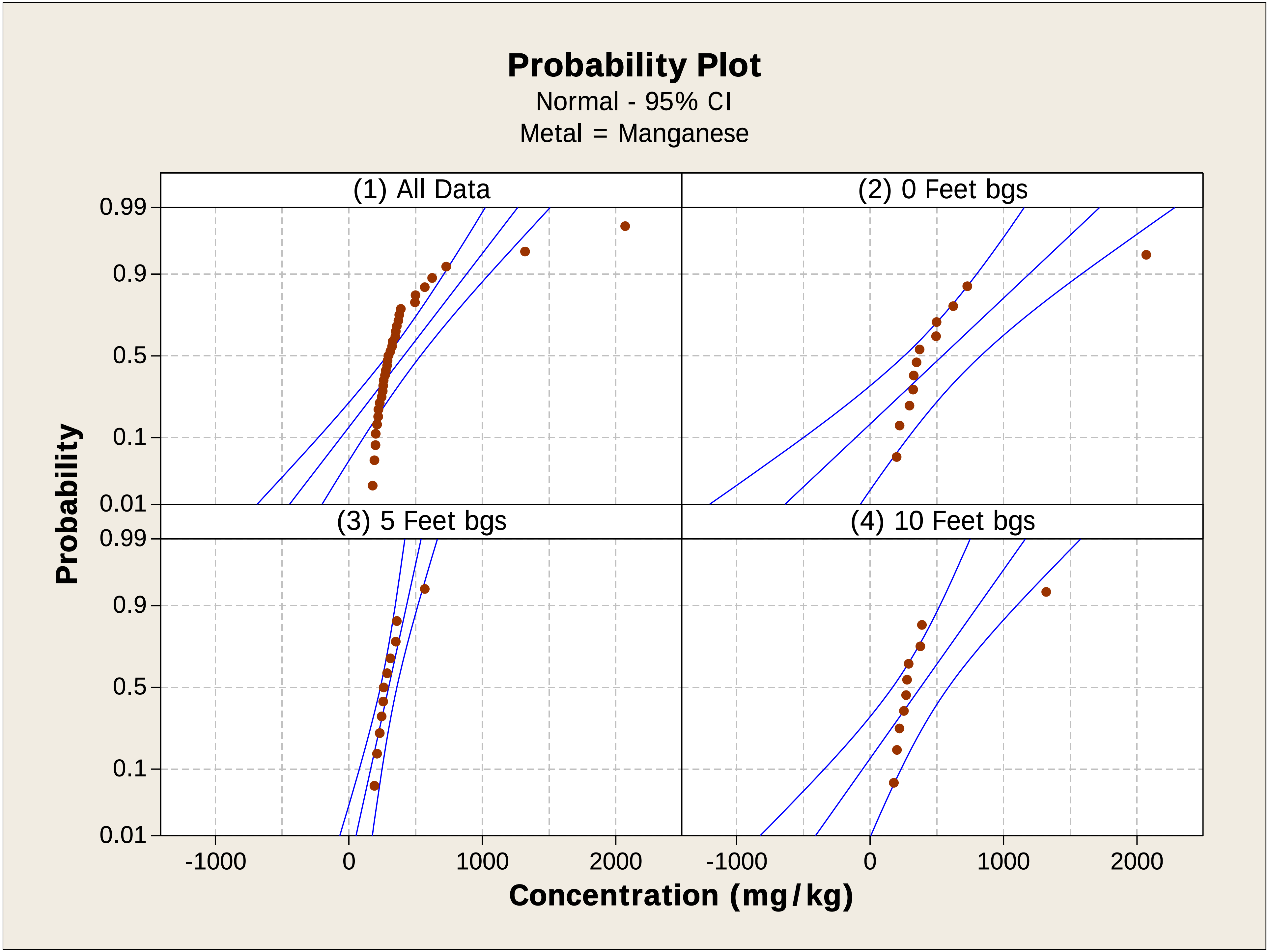

Probability Plot
Normal - 95% CI
Metal = Lead
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.99
0.9
0.5
0.1
0.01
-20
0
20
40
60
-20
0
20
40
60
Concentration (mg/kg)



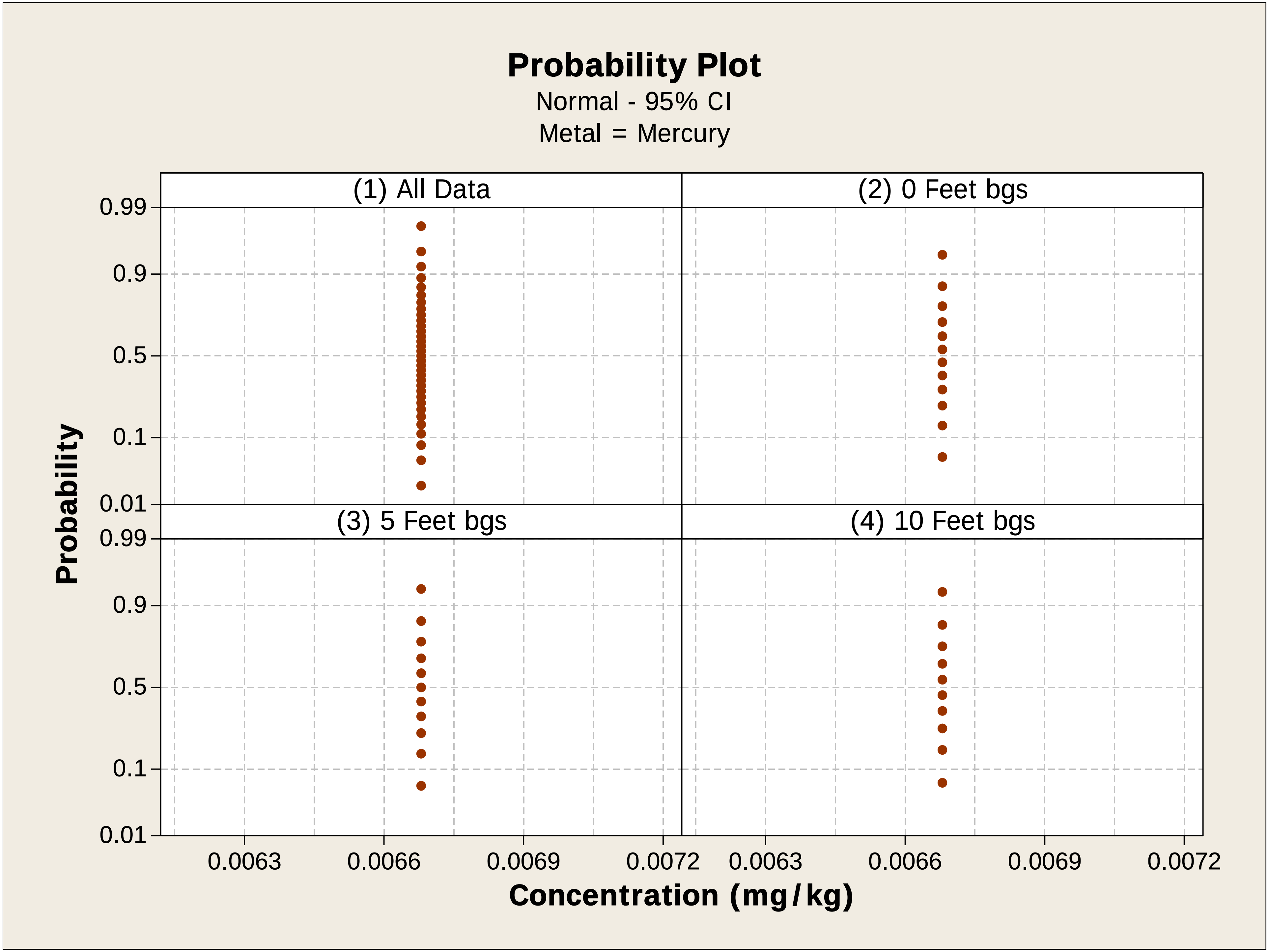
Probability Plot
Normal - 95% CI
Metal = Lithium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-30
0
30
60
Concentration (mg/kg)



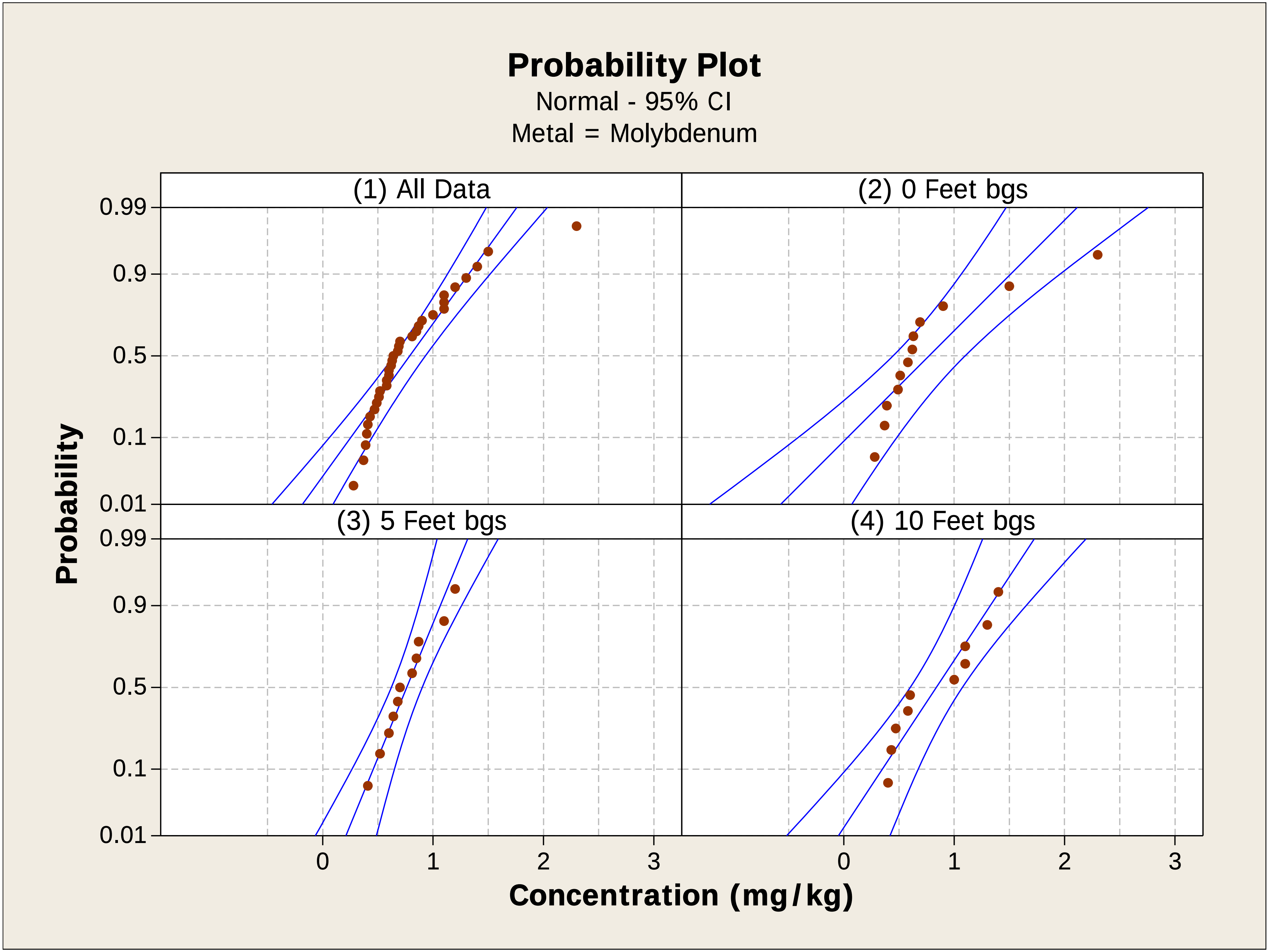
Probability Plot
Normal - 95% CI
Metal = Magnesium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
5000
10000
15000
20000
Concentration (mg/kg)

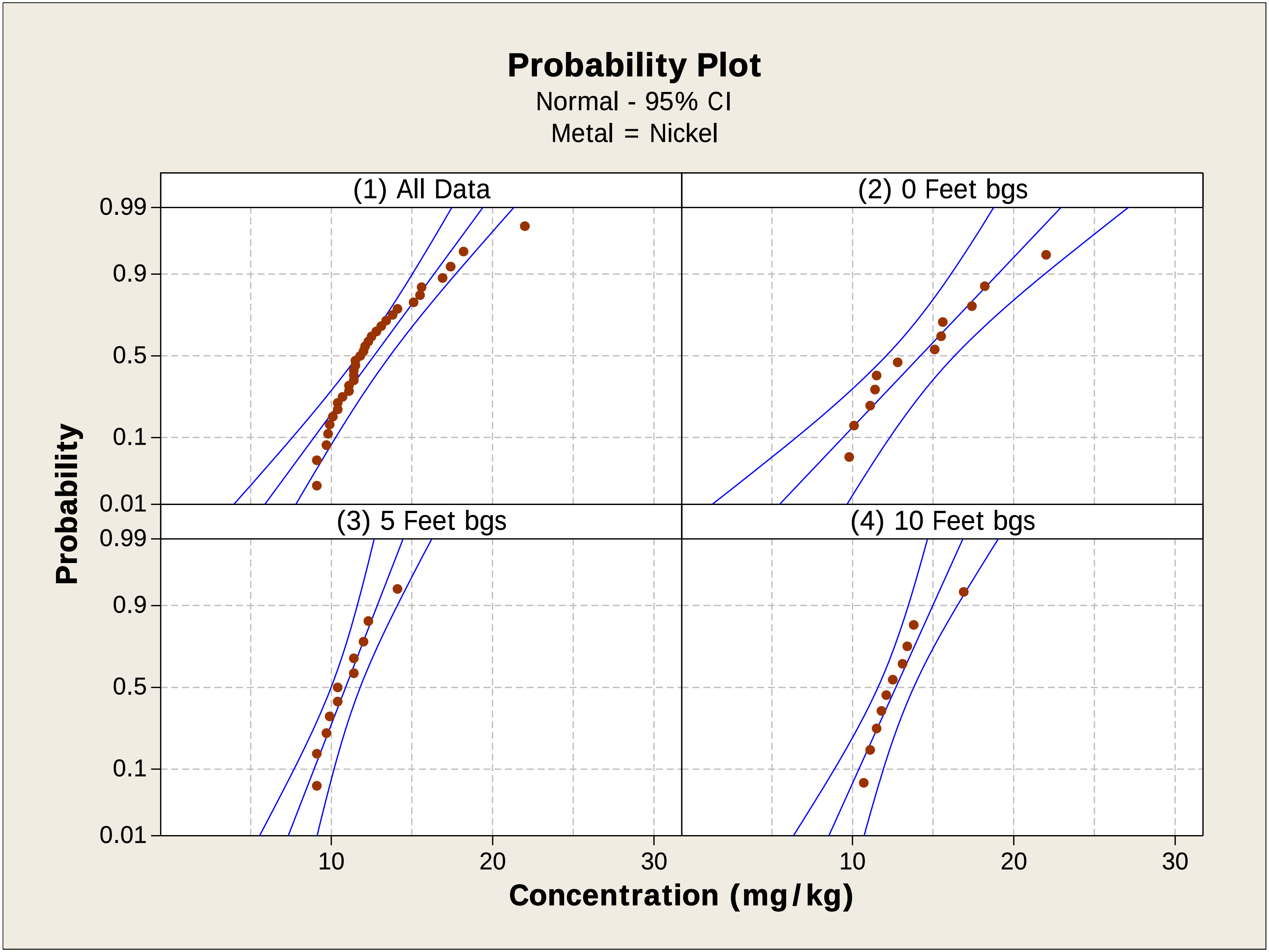


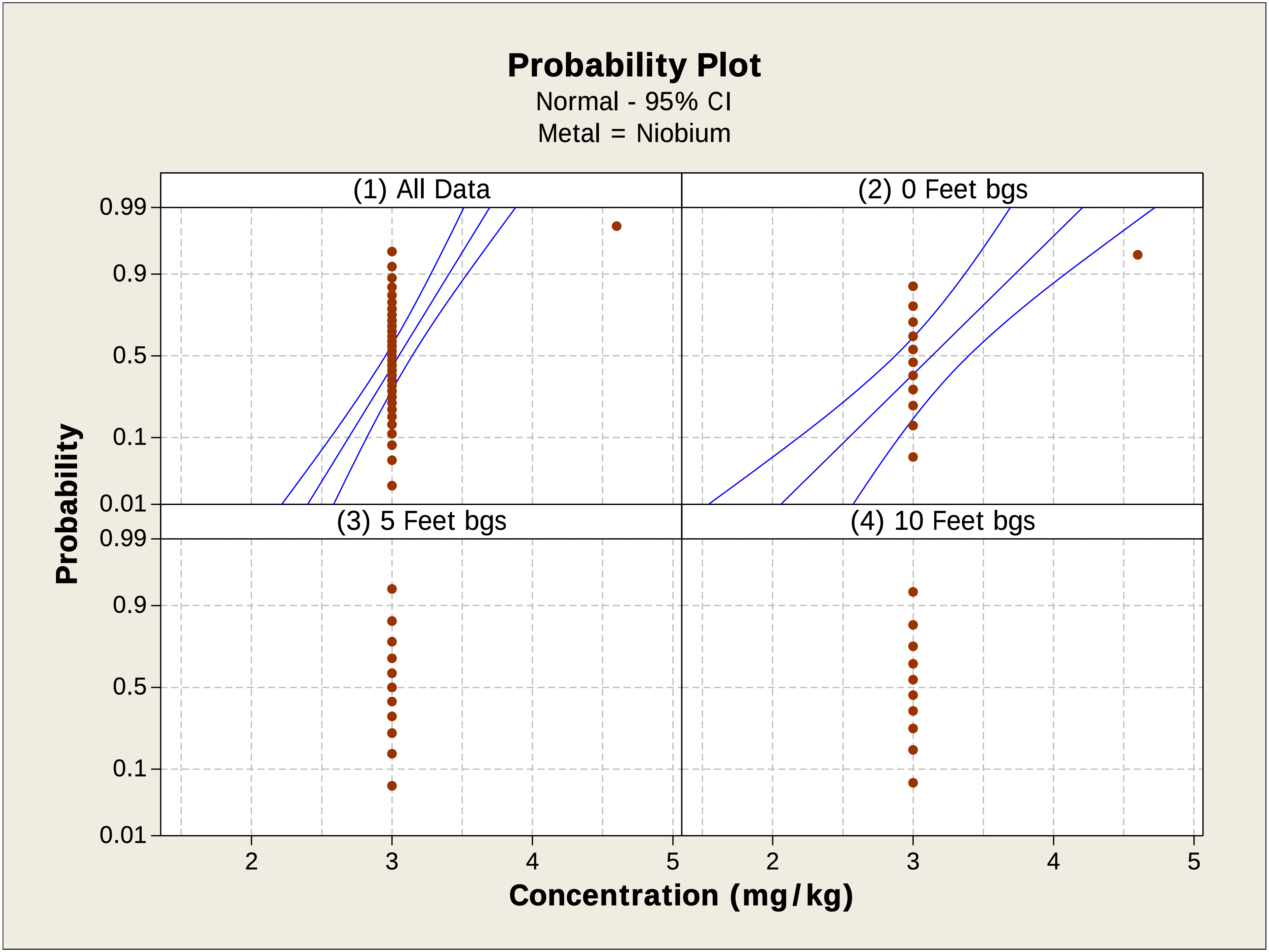
Probability Plot
Normal - 95% CI
Metal = Manganese
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-1000
0
1000
2000
Concentration (mg/kg)



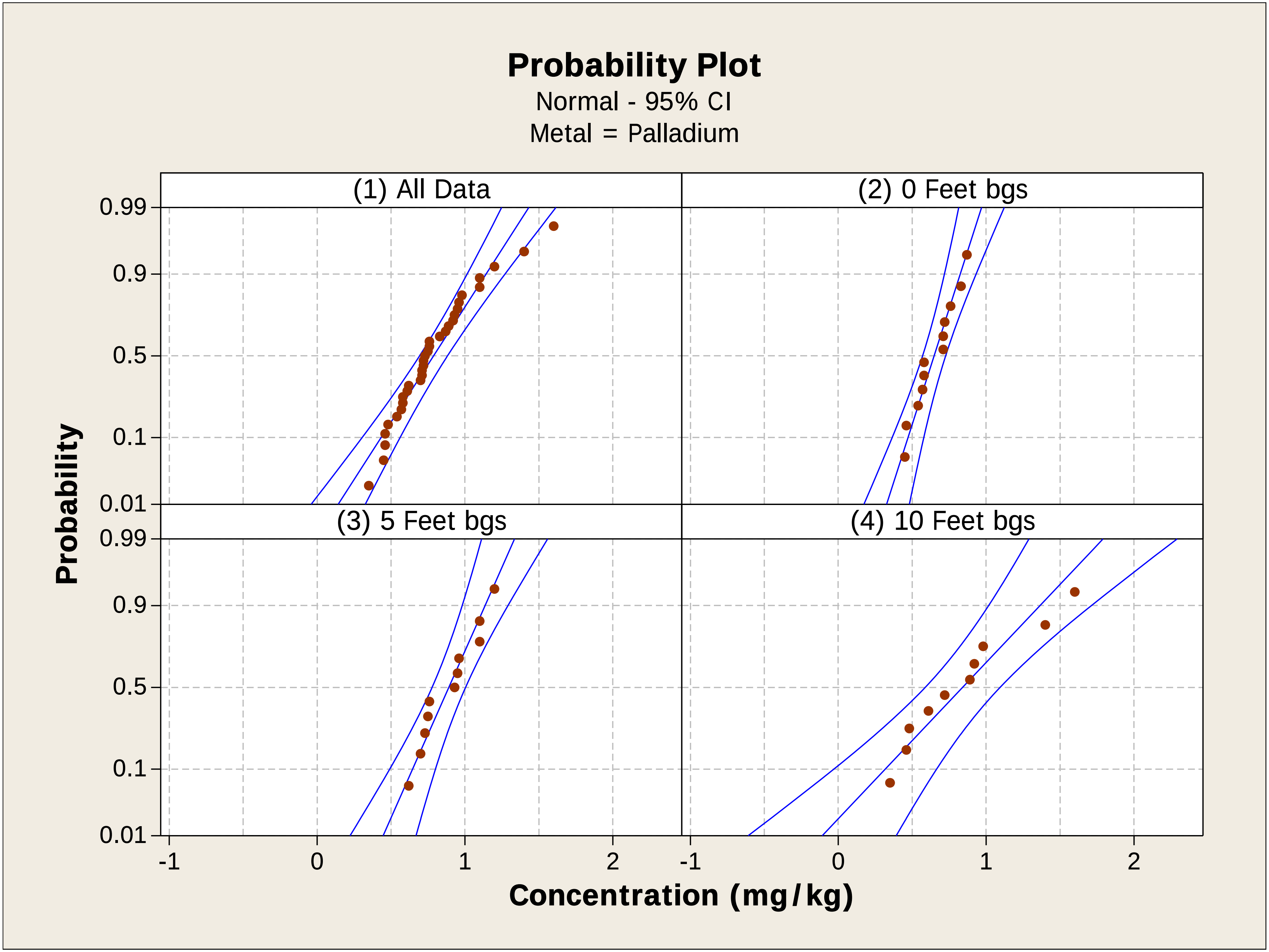
Probability Plot
Normal - 95% CI
Metal = Mercury
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.0063
0.0066
0.0069
0.0072
Concentration (mg/kg)


Probability Plot
Normal - 95% CI
Metal = Molybdenum
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
0
1
2
3
Probability
Concentration (mg/kg)

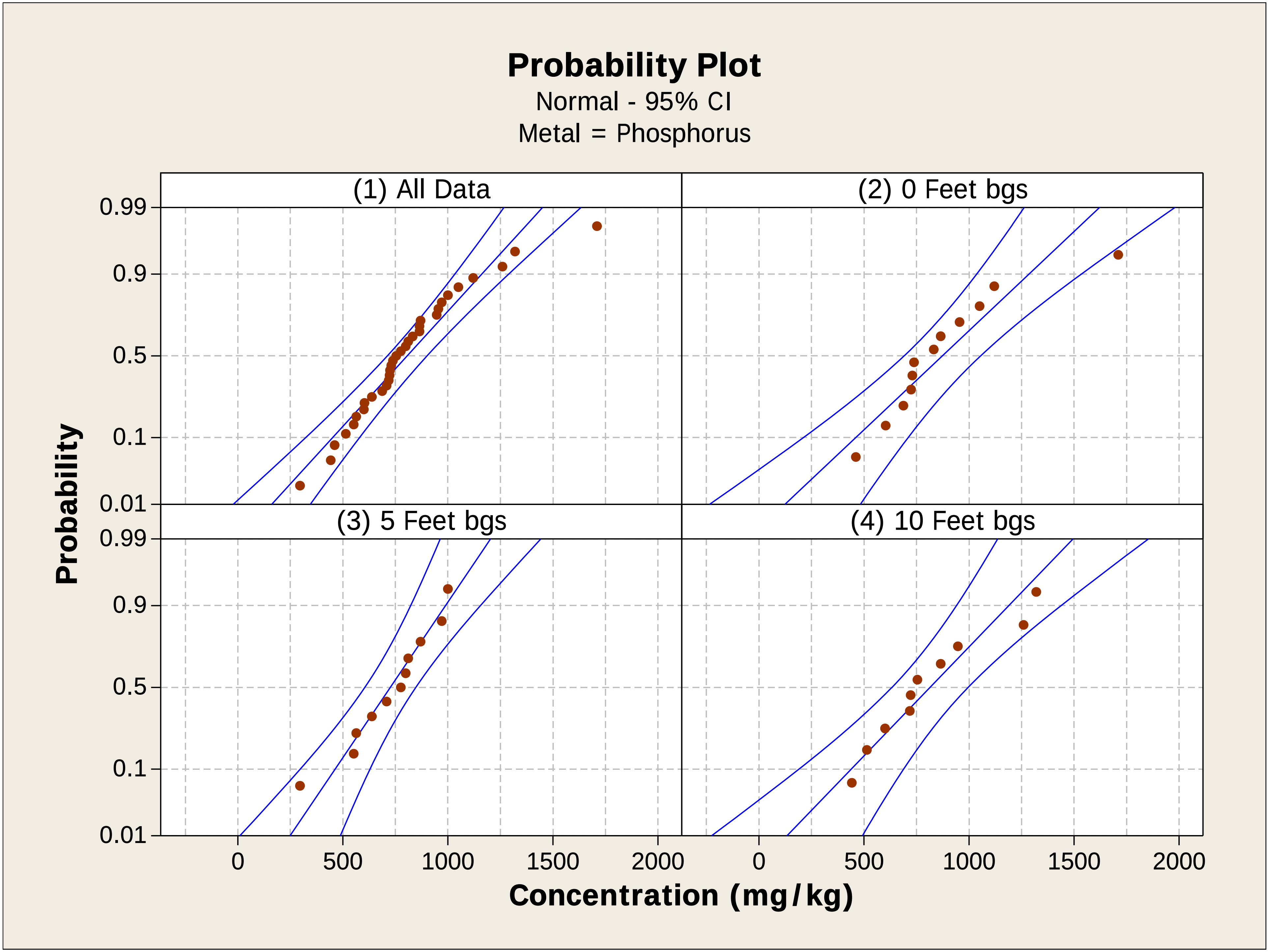

Probability Plot
Normal - 95% CI
Metal = Nickel
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
10
20
30
Concentration (mg/kg)



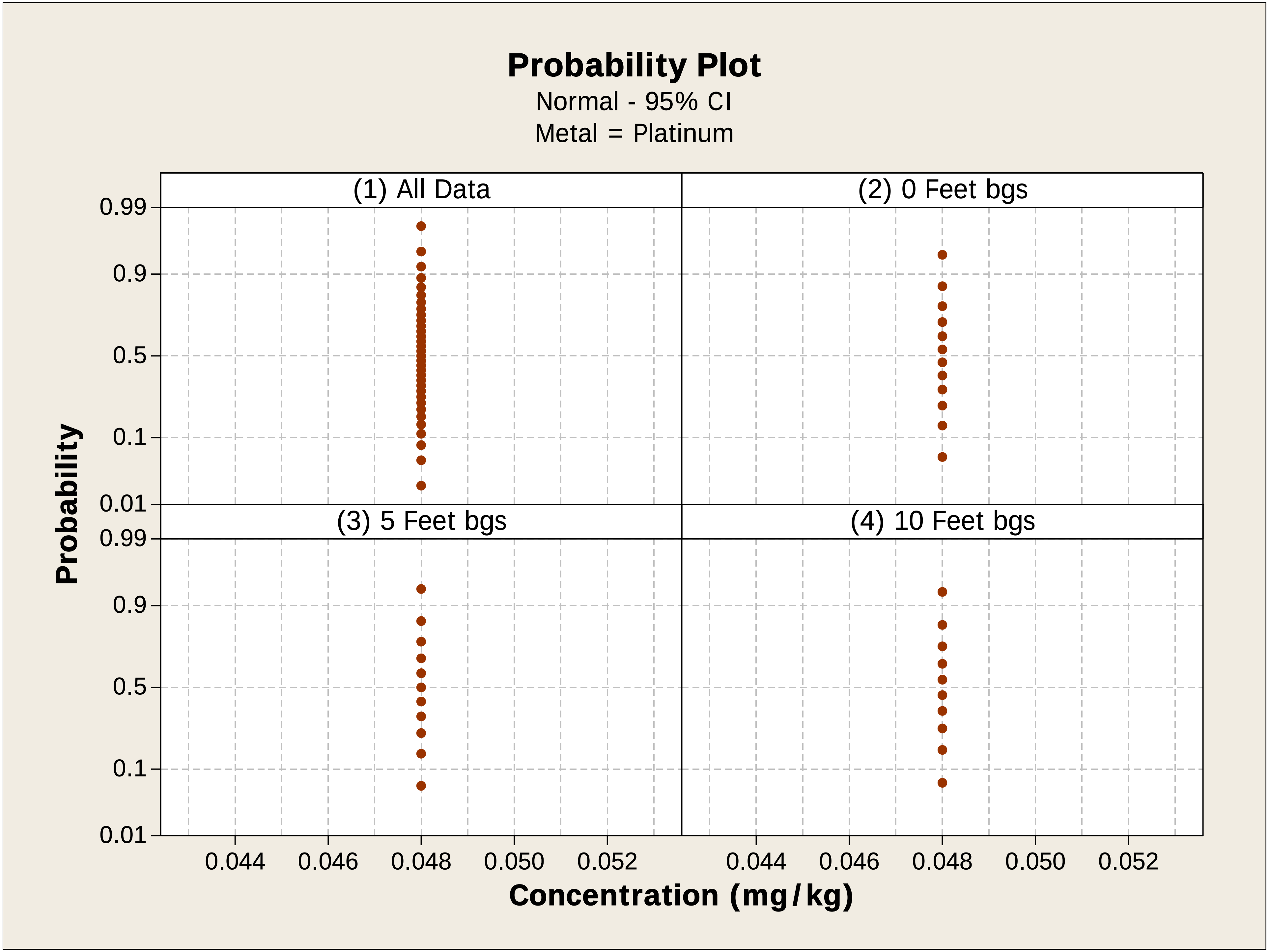
Probability Plot
Normal - 95% CI
Metal = Niobium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
2
3
4
5
Concentration (mg/kg)

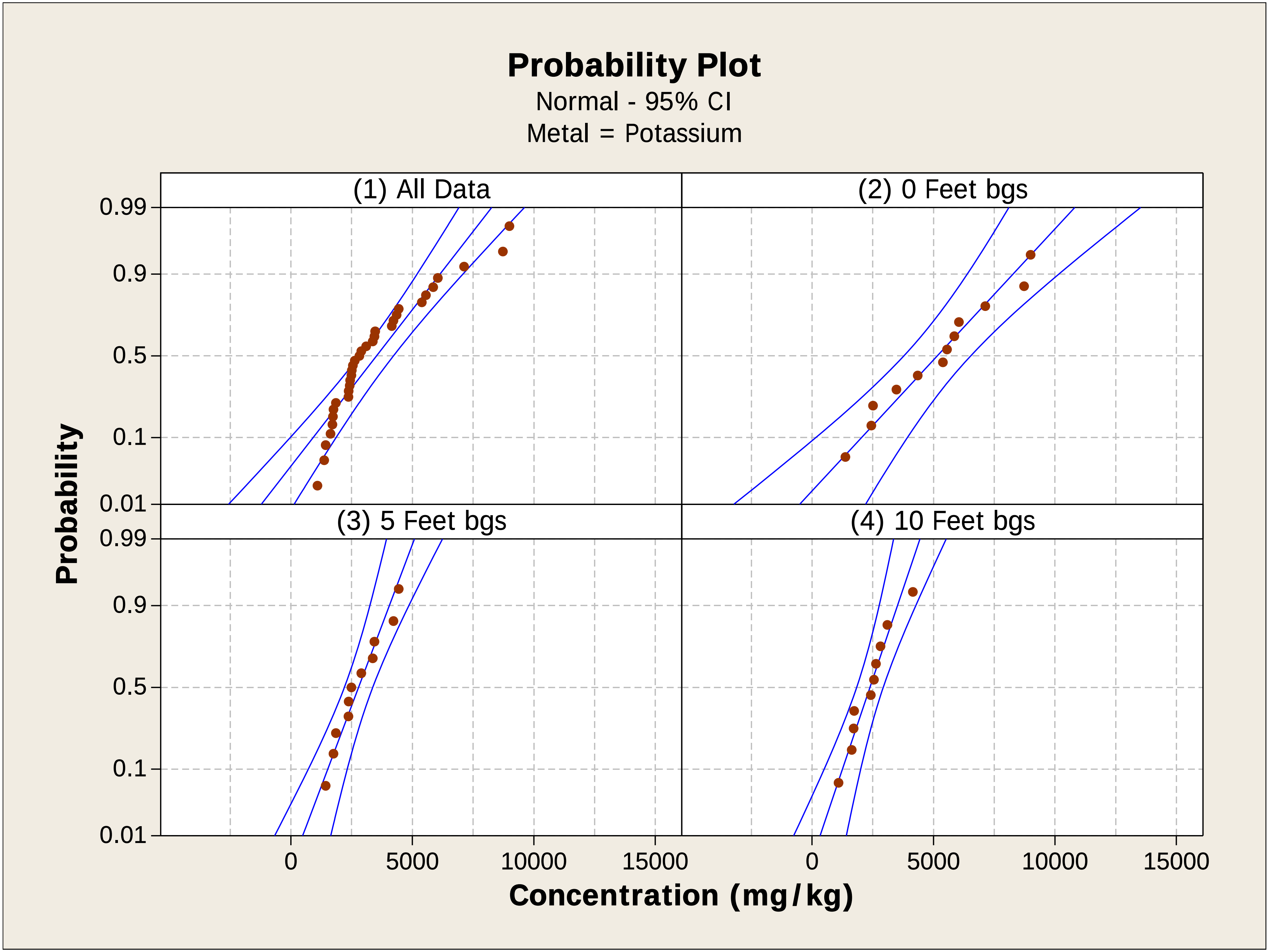


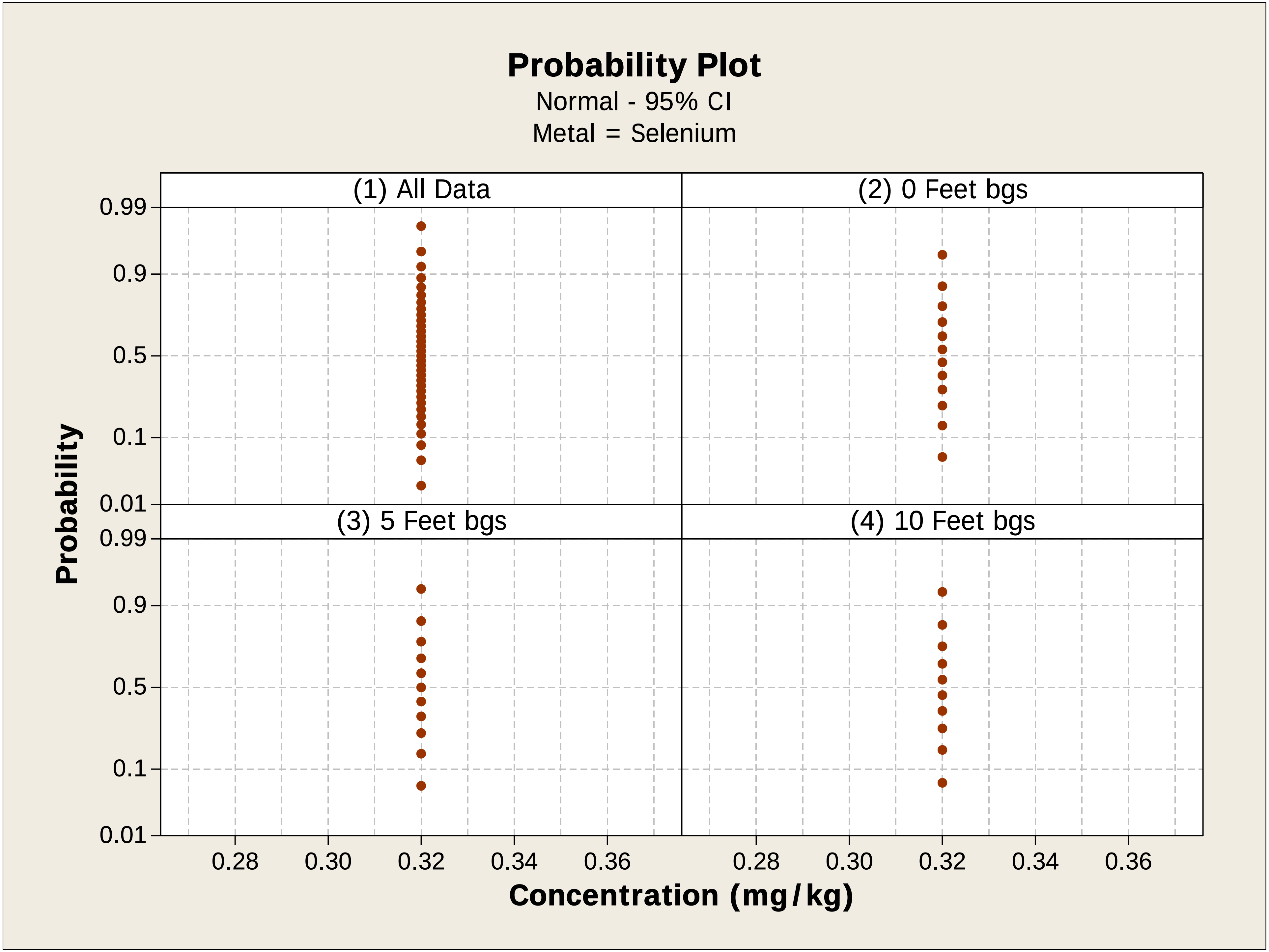
Probability Plot
Normal - 95% CI
Metal = Palladium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
-1
0
1
2
Concentration (mg/kg)



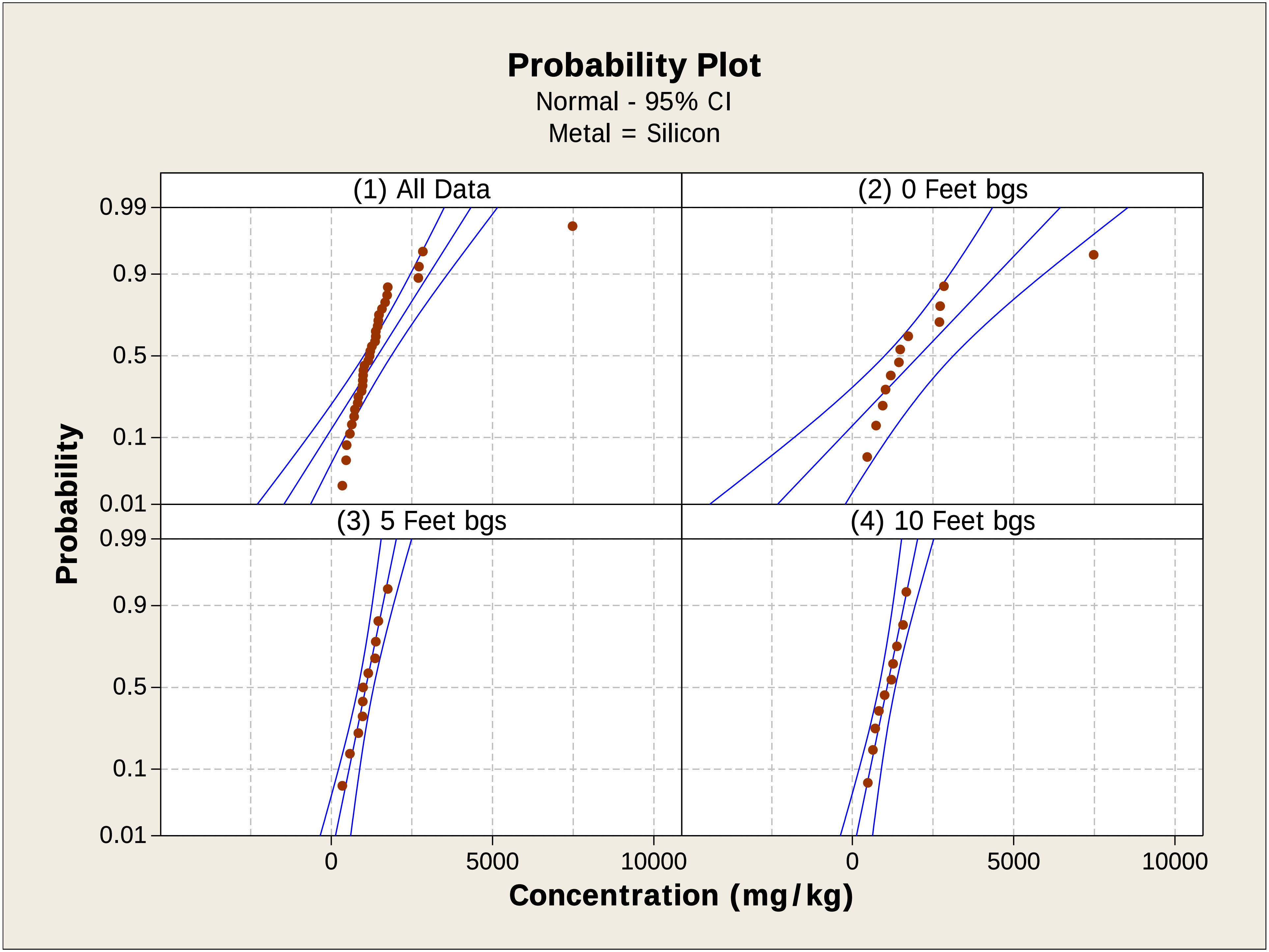
Probability Plot
Normal - 95% CI
Metal = Phosphorus
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
500
1000
1500
2000
Concentration (mg/kg)


Probability Plot
Normal - 95% CI
Metal = Platinum
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.044
0.046
0.048
0.050
0.052
Concentration (mg/kg)

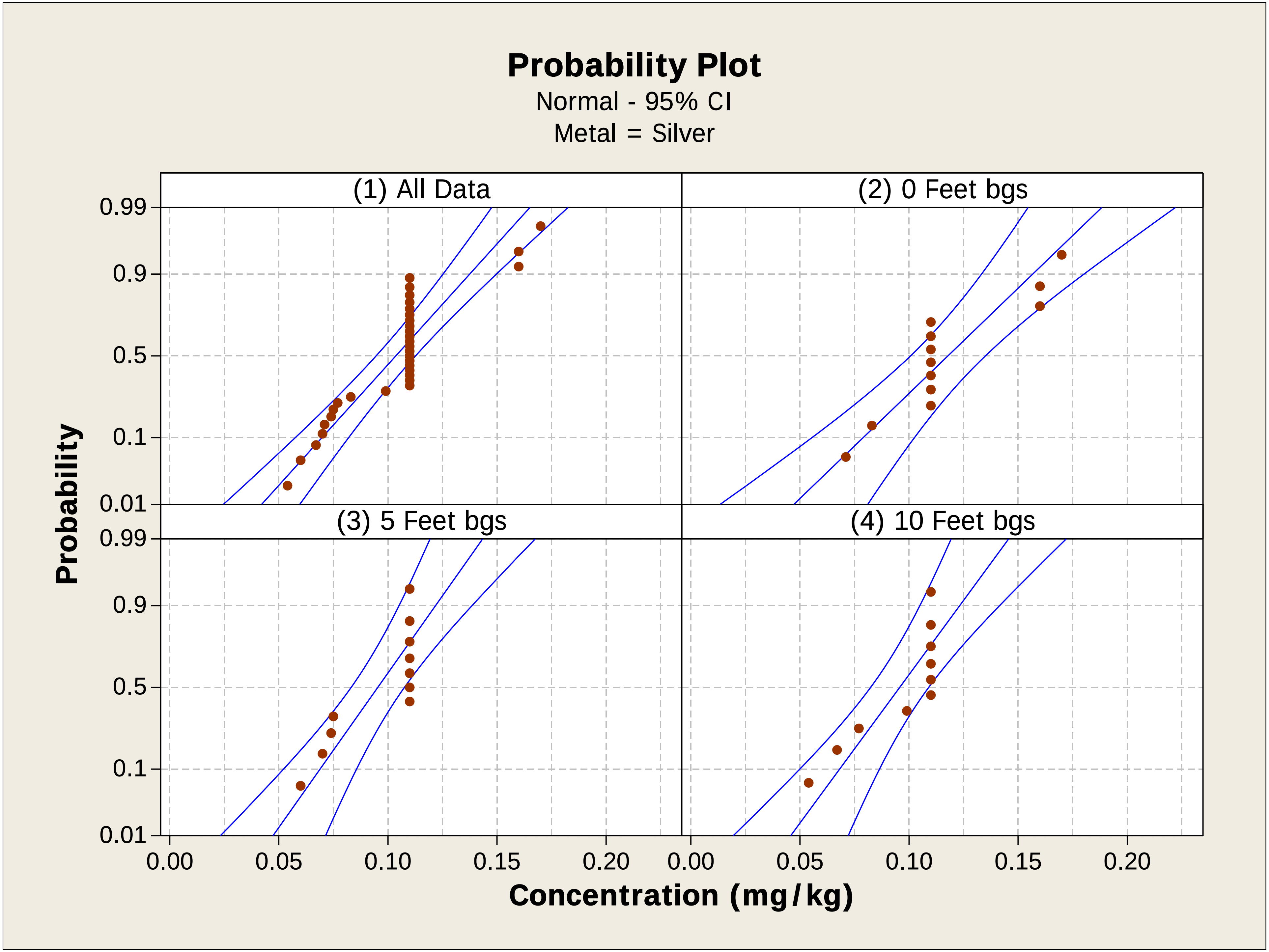

Probability Plot
Normal - 95% CI
Metal = Potassium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
5000
10000
15000
Concentration (mg/kg)



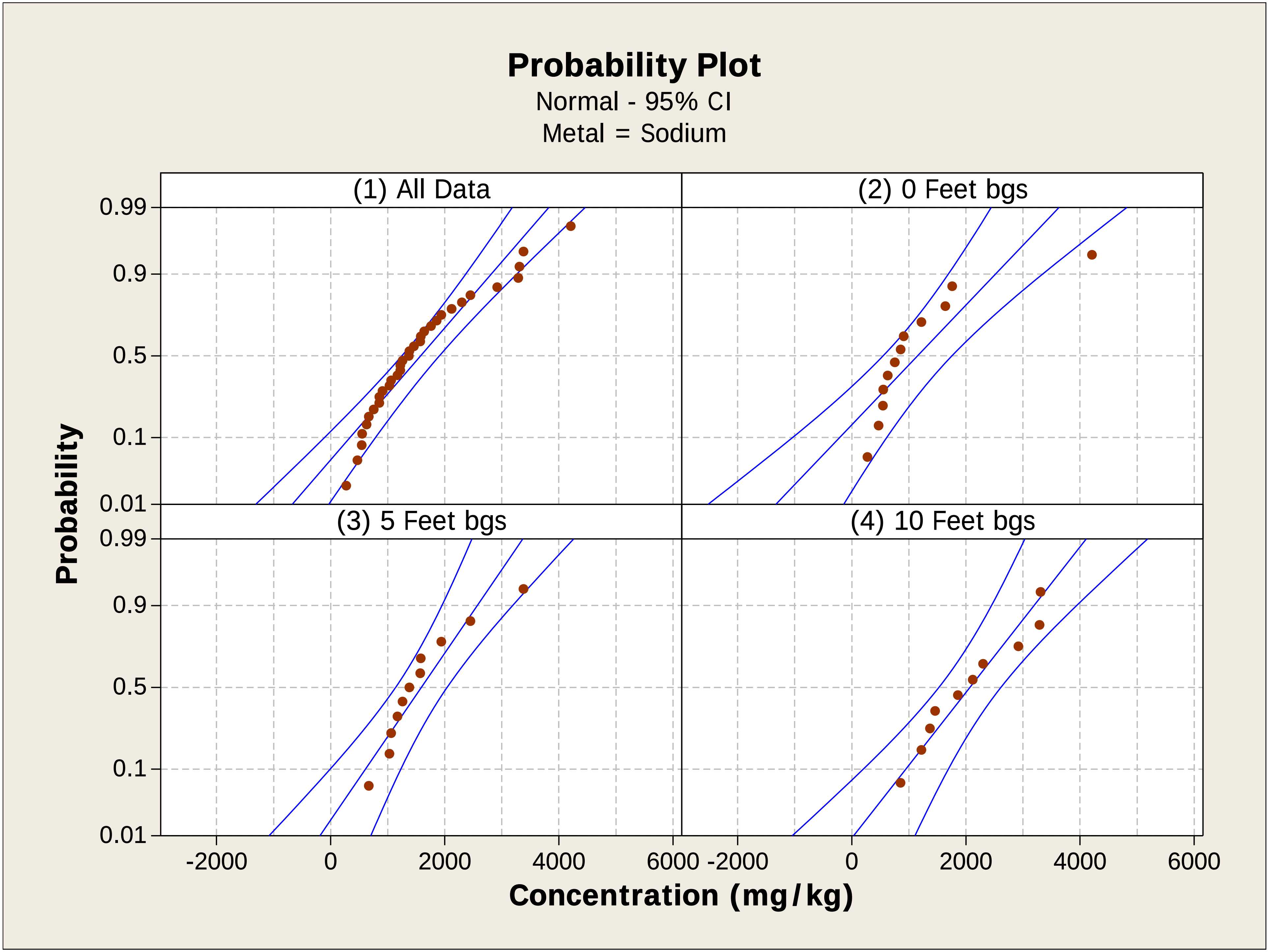
Probability Plot
Normal - 95% CI
Metal = Selenium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0.28
0.30
0.32
0.34
0.36
Concentration (mg/kg)



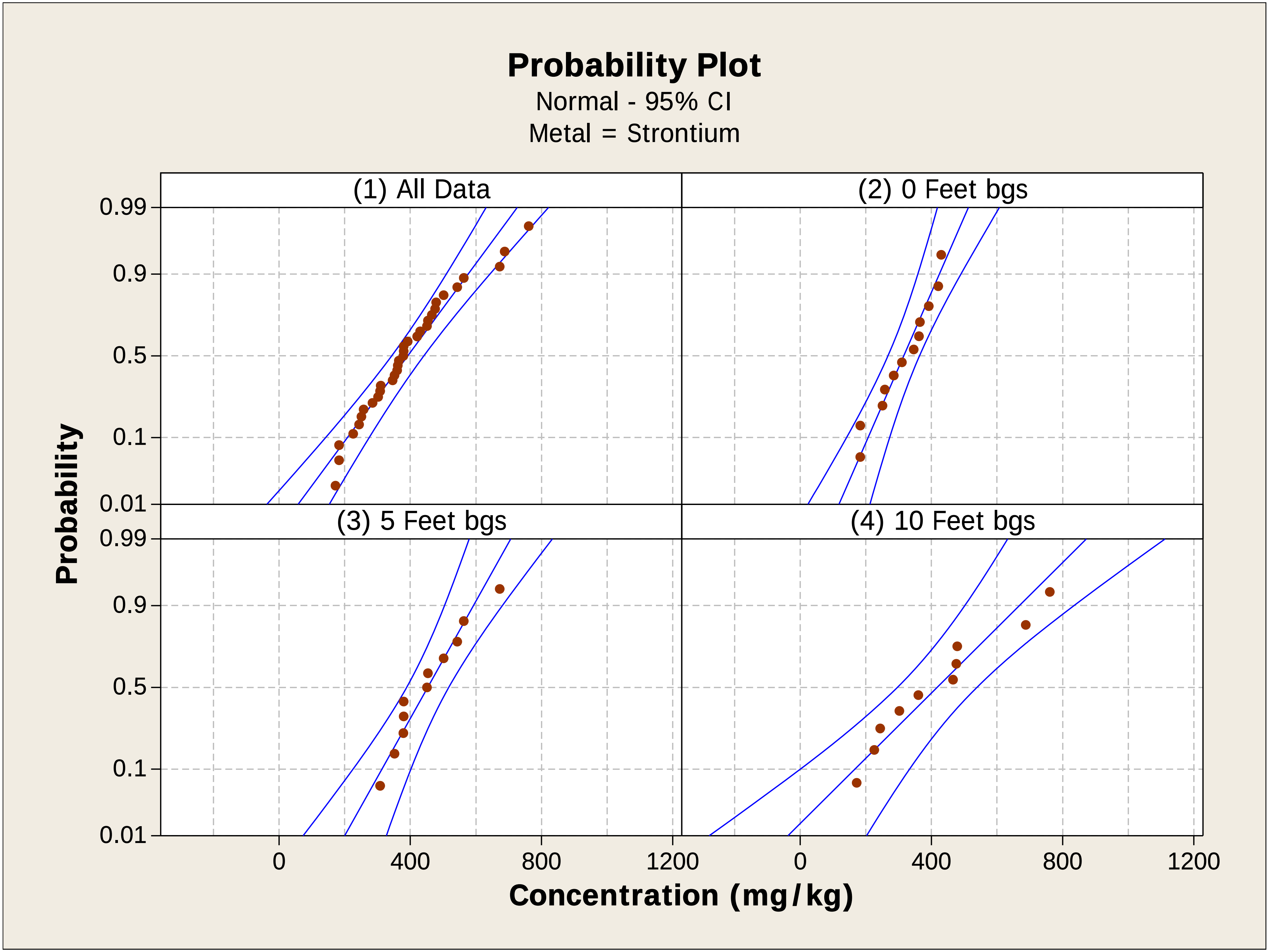
Probability Plot
Normal - 95% CI
Metal = Silicon
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
5000
10000
Concentration (mg/kg)

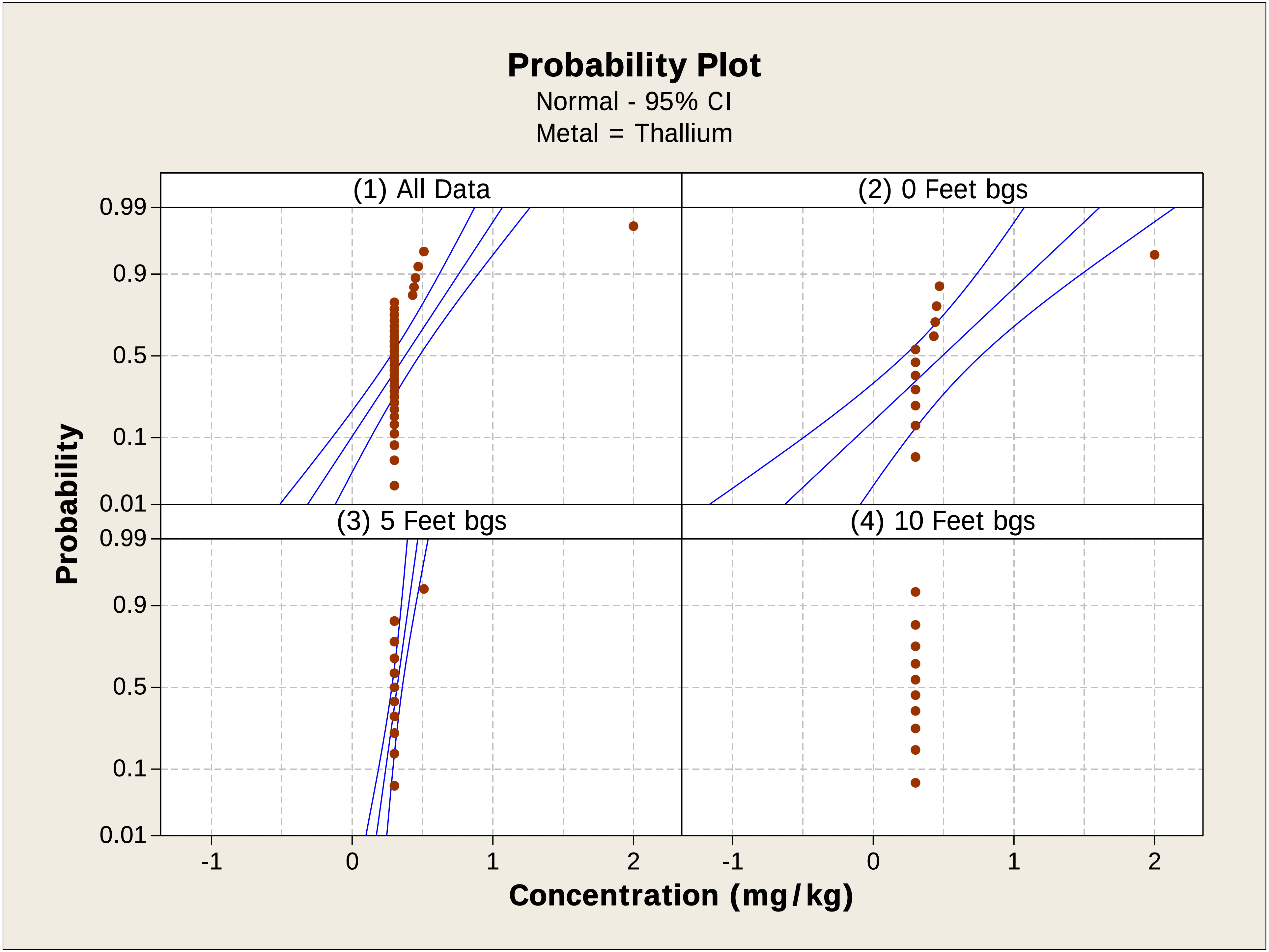


Probability Plot
Normal - 95% CI
Metal = Silver
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.00
0.05
0.10
0.15
0.20
Concentration (mg/kg)

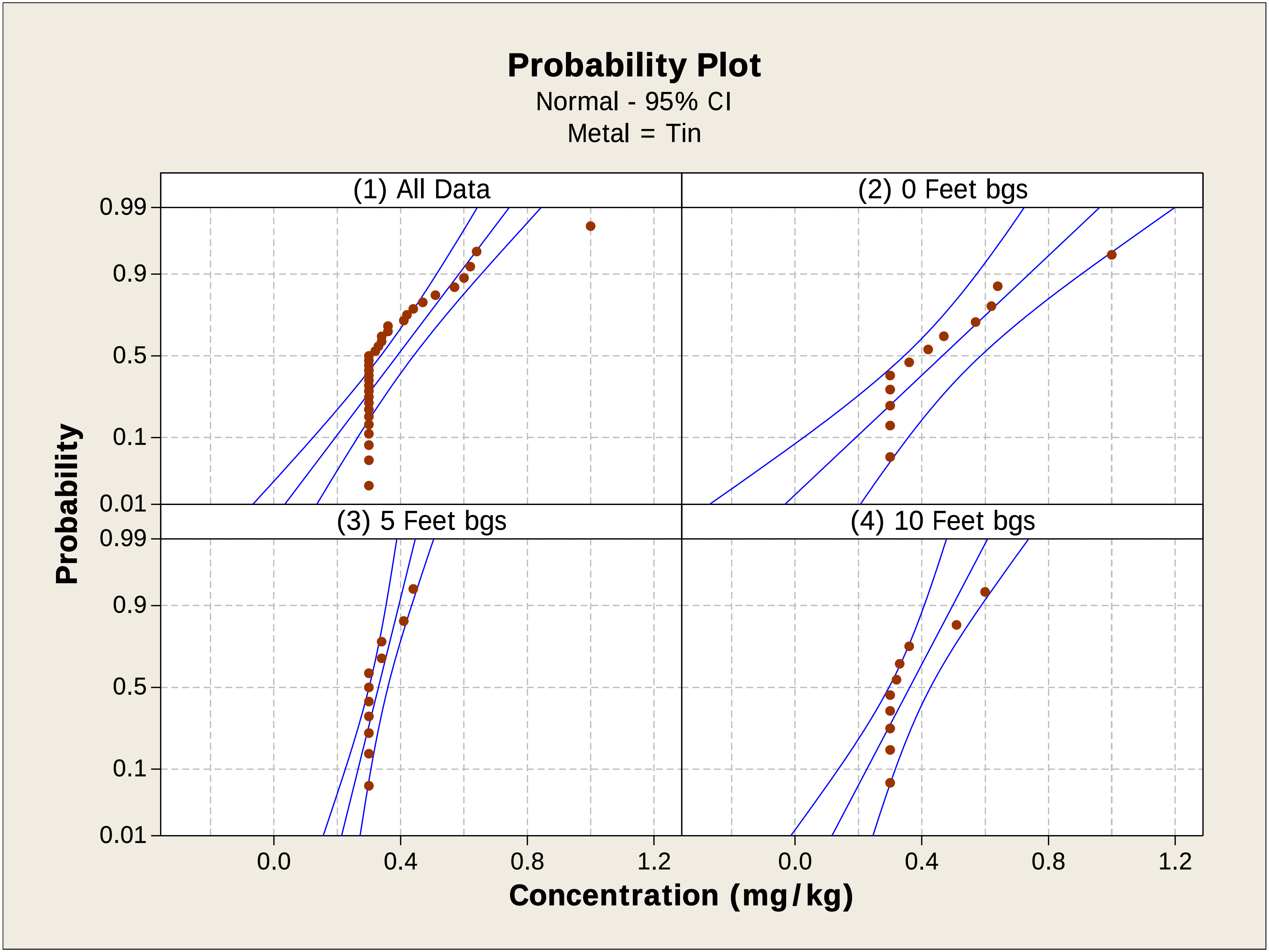


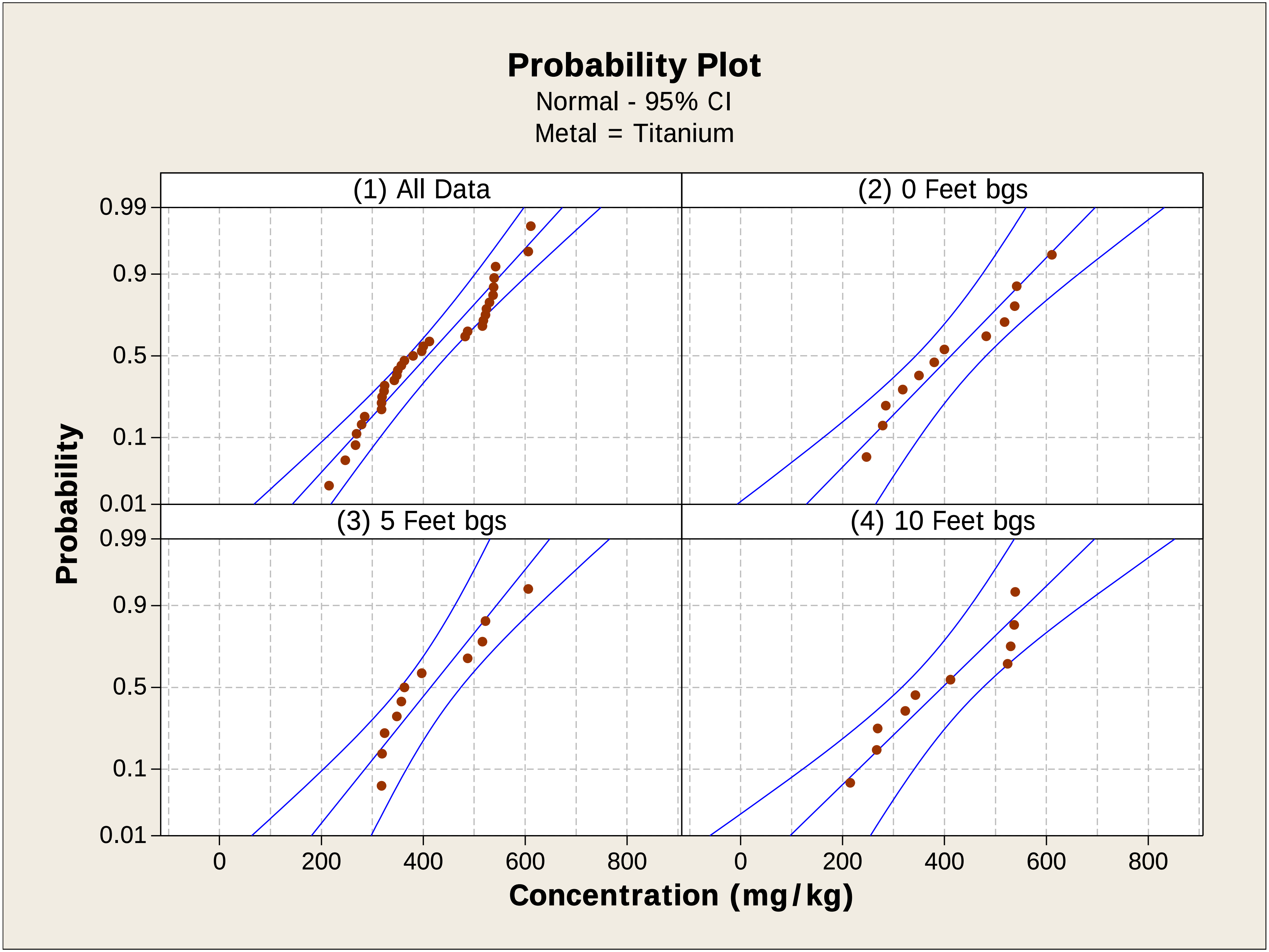
Probability Plot
Normal - 95% CI
Metal = Sodium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-2000
0
2000
4000
6000
Concentration (mg/kg)


Probability Plot
Normal - 95% CI
Metal = Strontium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
400
800
1200
Concentration (mg/kg)

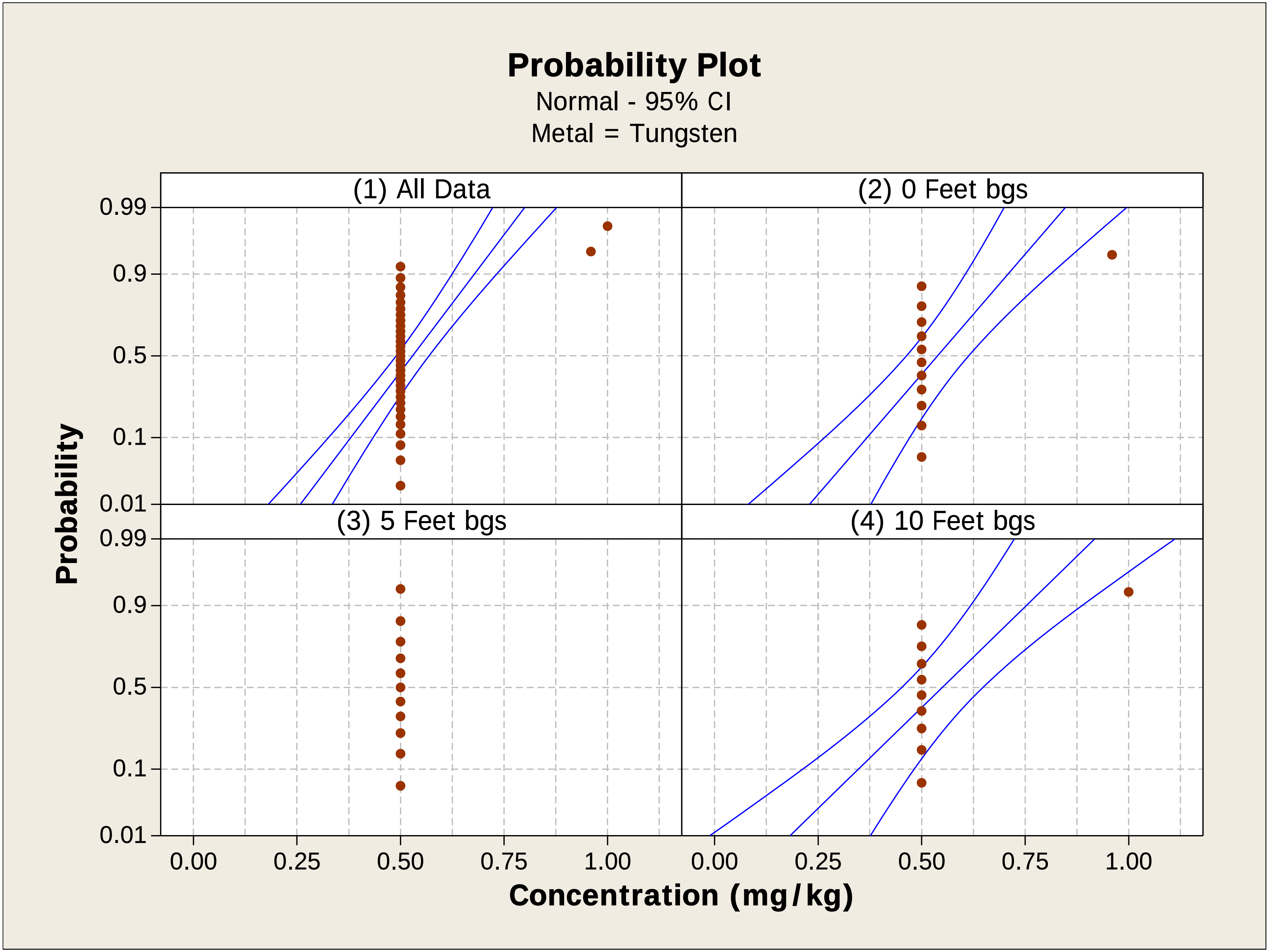


Probability Plot
Normal - 95% CI
Metal = Thallium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
-1
0
1
2
Concentration (mg/kg)

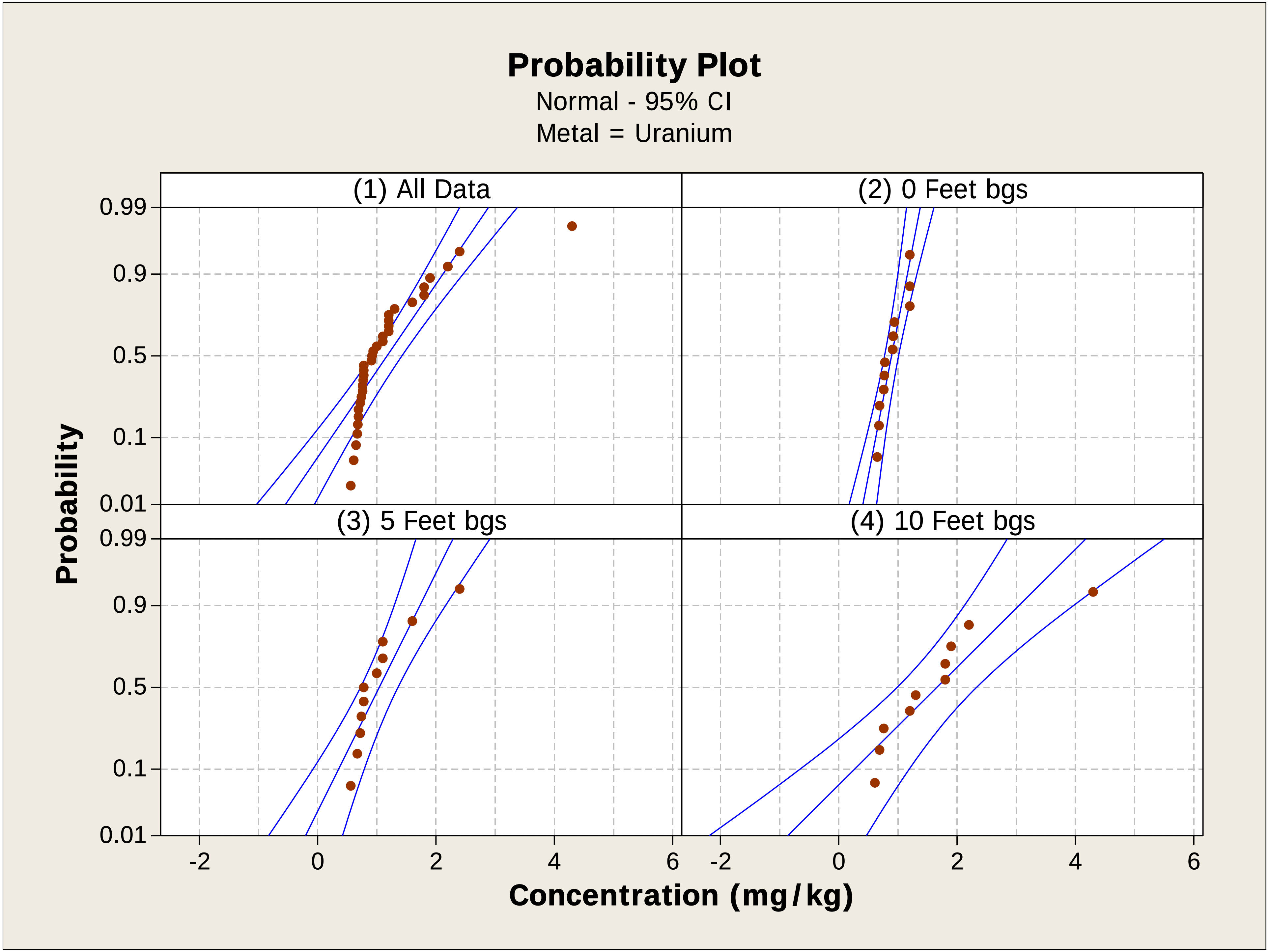

Probability Plot
Normal - 95% CI
Metal = Tin
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.0
0.4
0.8
1.2
Concentration (mg/kg)



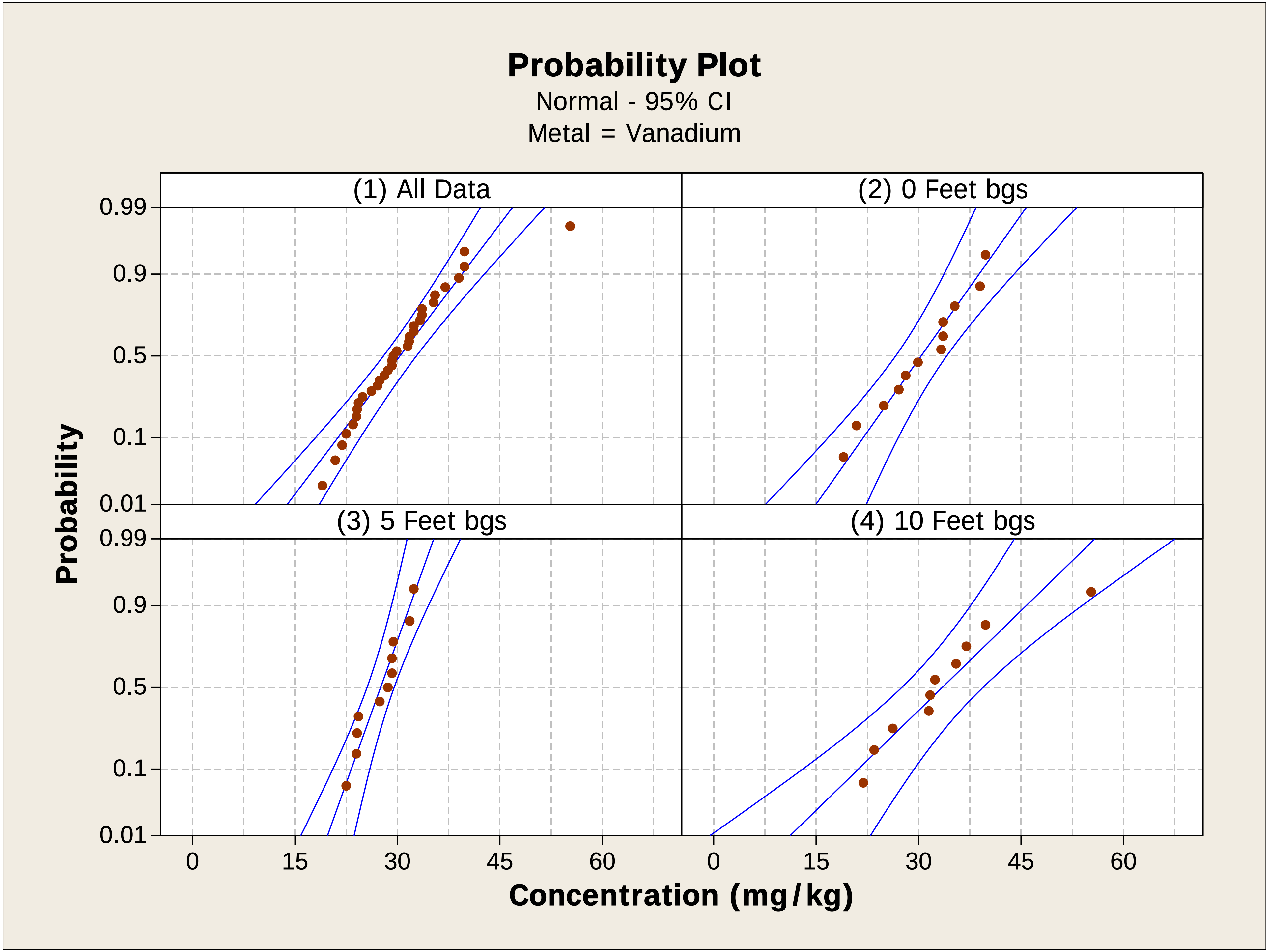
Probability Plot
Normal - 95% CI
Metal = Titanium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
200
400
600
800
Concentration (mg/kg)

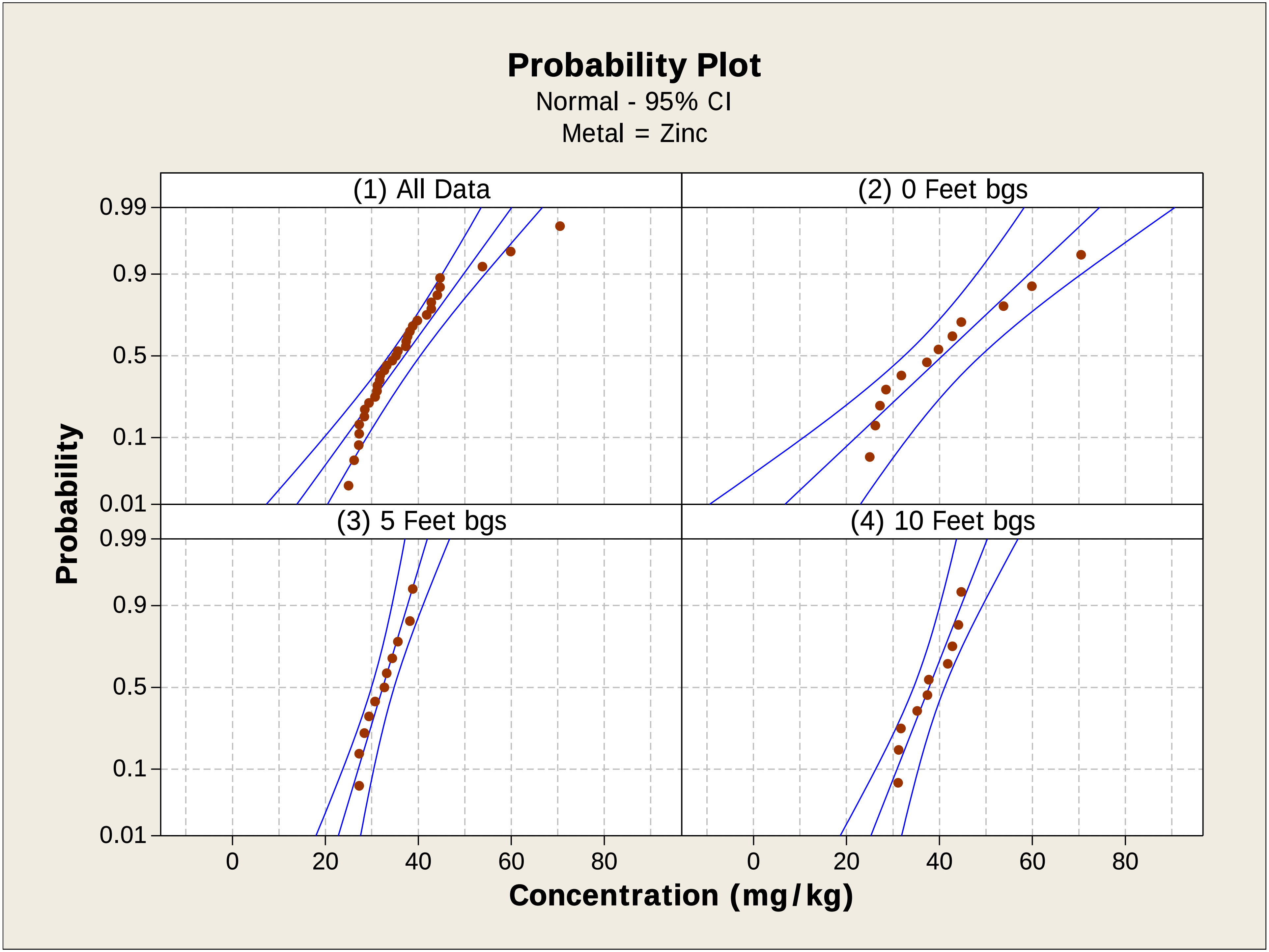


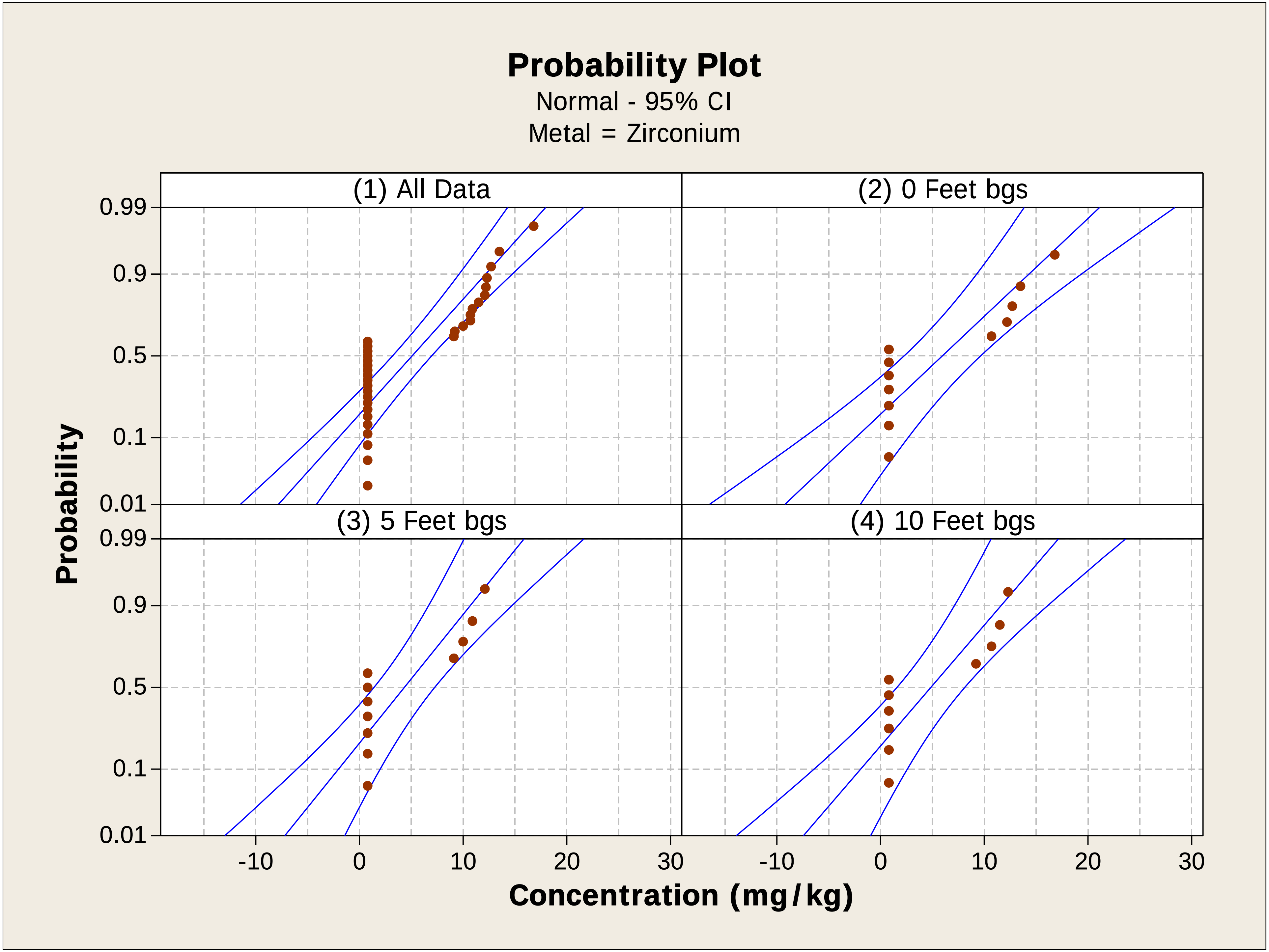
Probability Plot
Normal - 95% CI
Metal = Tungsten
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0.00
0.25
0.50
0.75
1.00
Concentration (mg/kg)



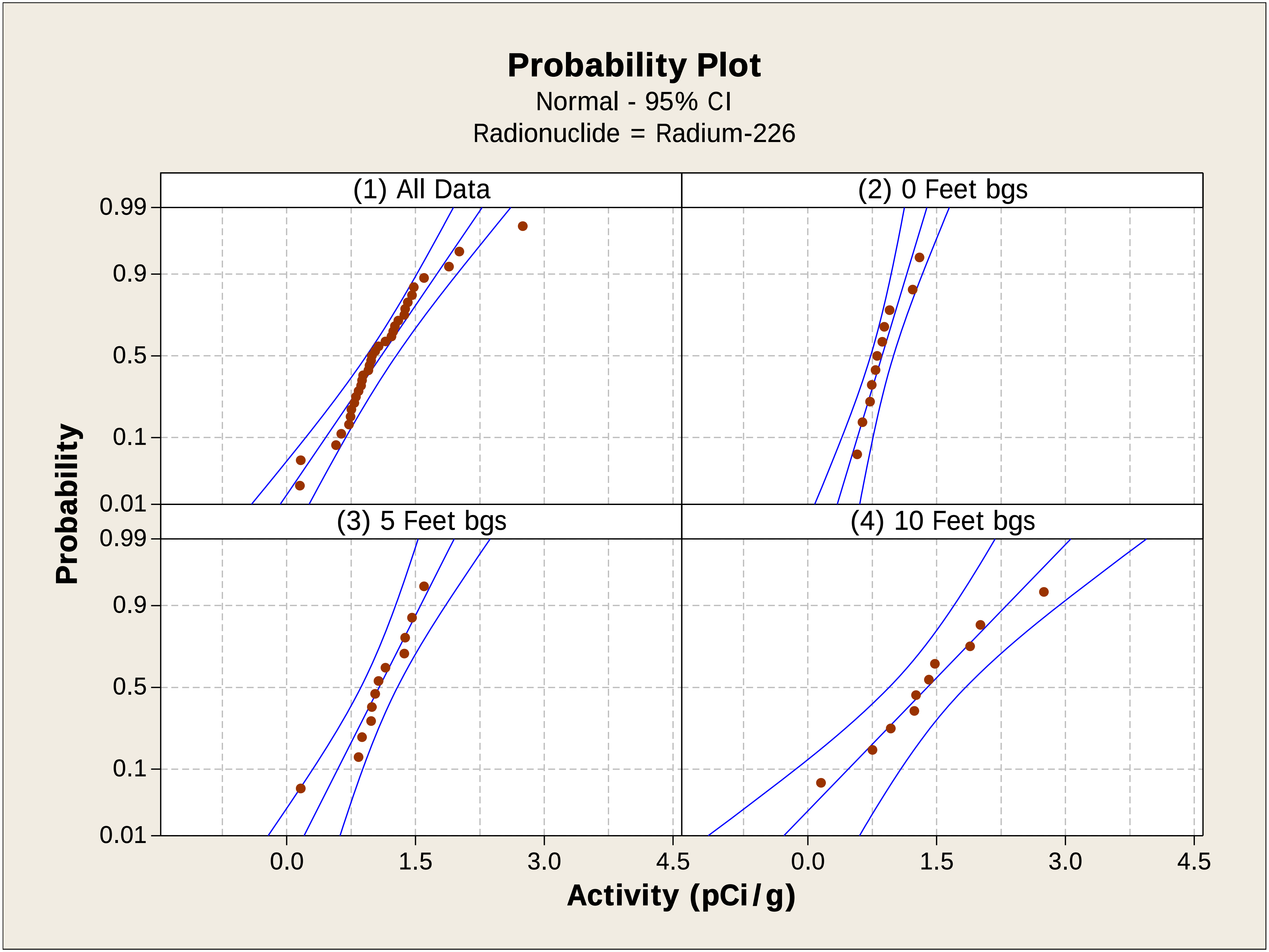
Probability Plot
Normal - 95% CI
Metal = Uranium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-2
0
2
4
6
Concentration (mg/kg)


Probability Plot
Normal - 95% CI
Metal = Vanadium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
15
30
45
60
Concentration (mg/kg)

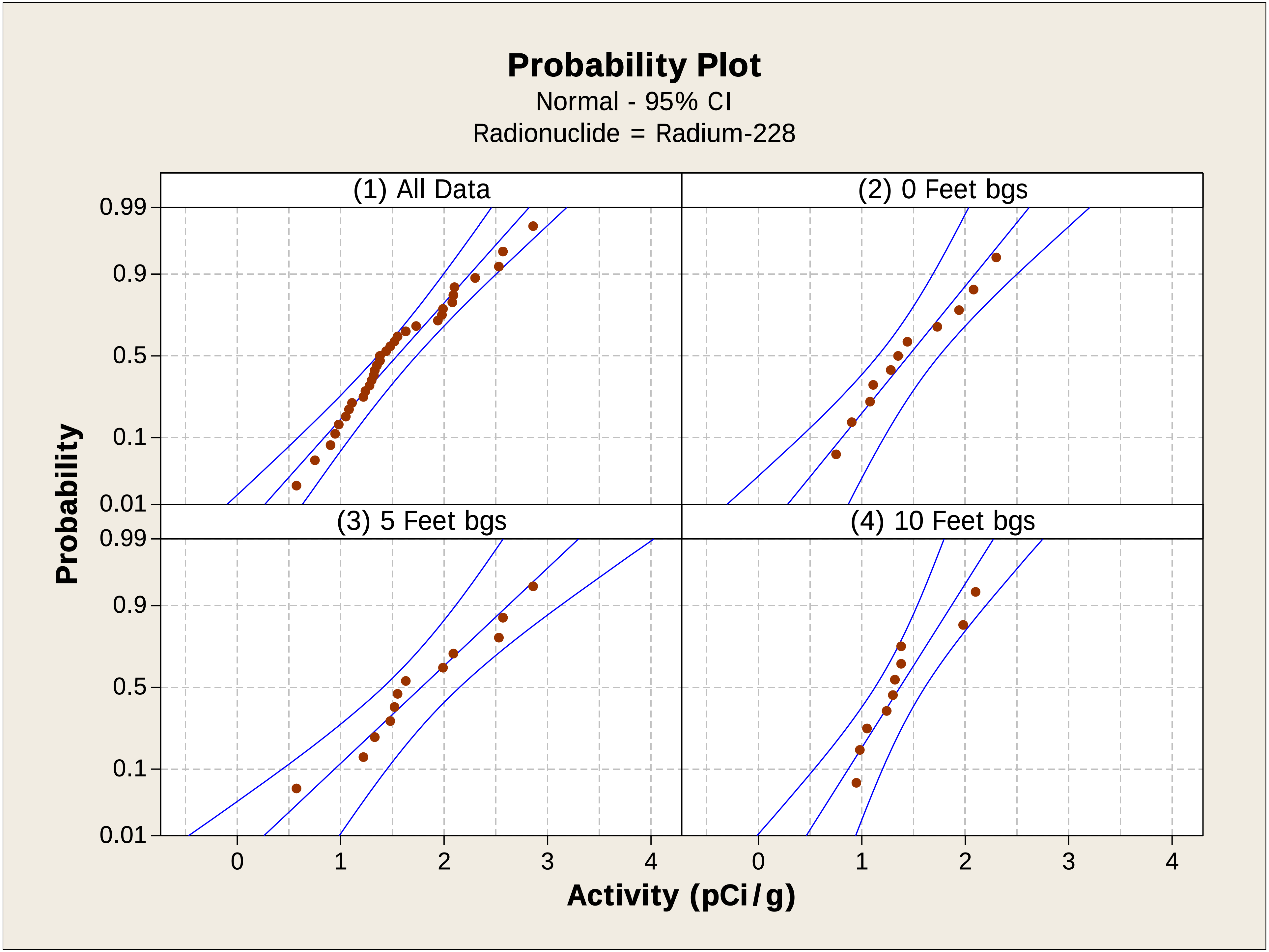

Probability Plot
Normal - 95% CI
Metal = Zinc
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
20
40
60
80
Concentration (mg/kg)

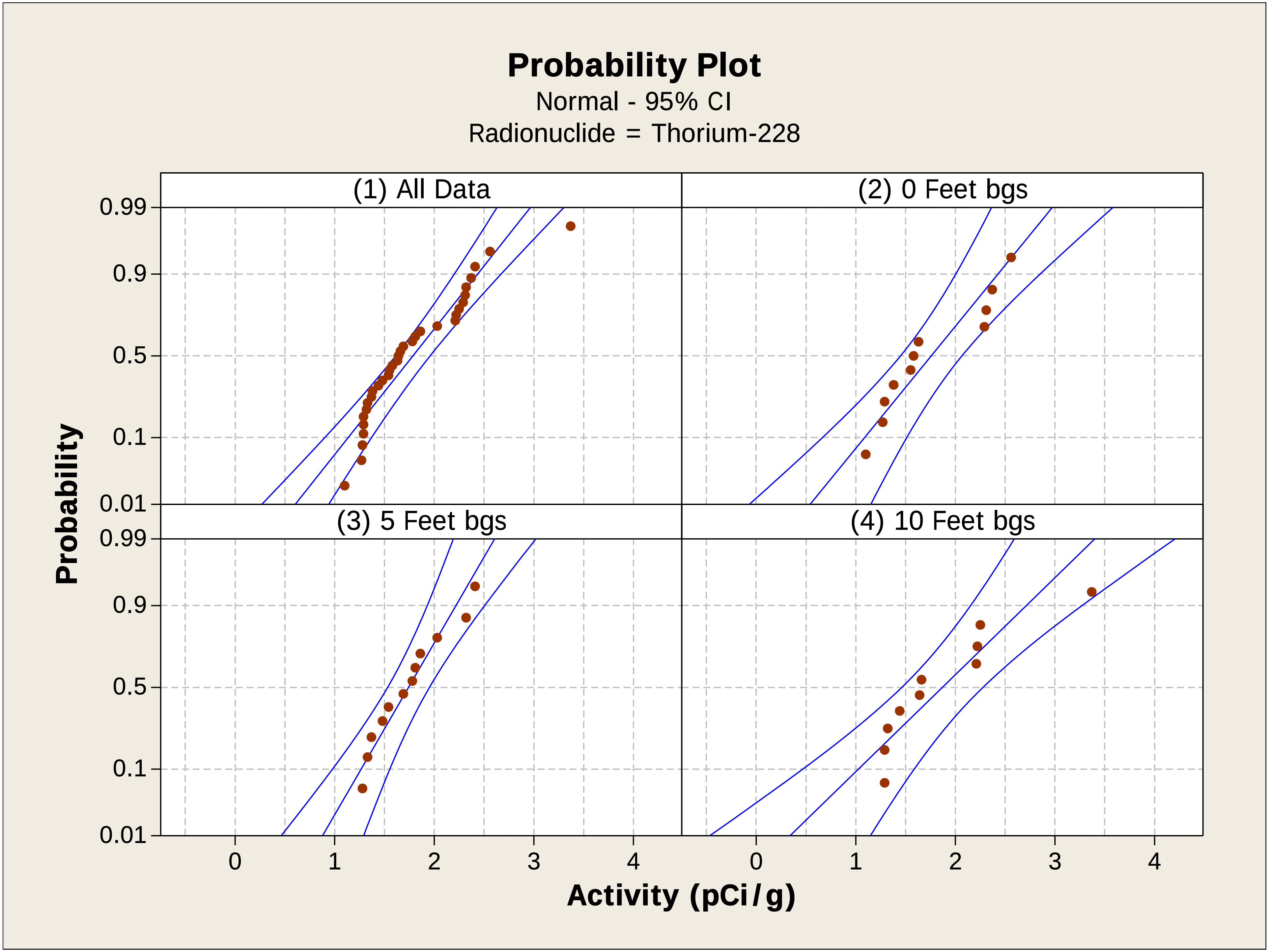


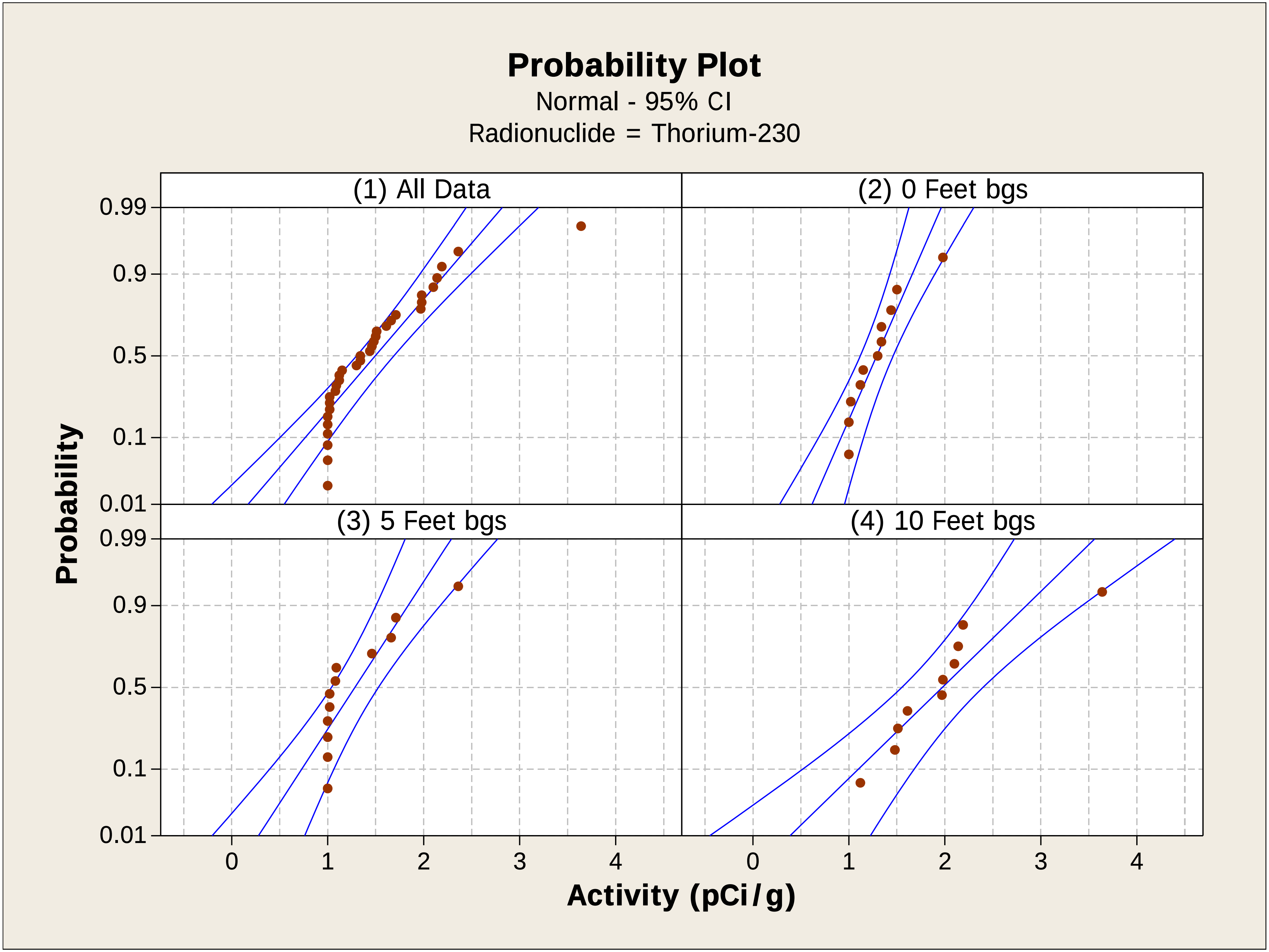
Probability Plot
Normal - 95% CI
Metal = Zirconium
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-10
0
10
20
30
Concentration (mg/kg)



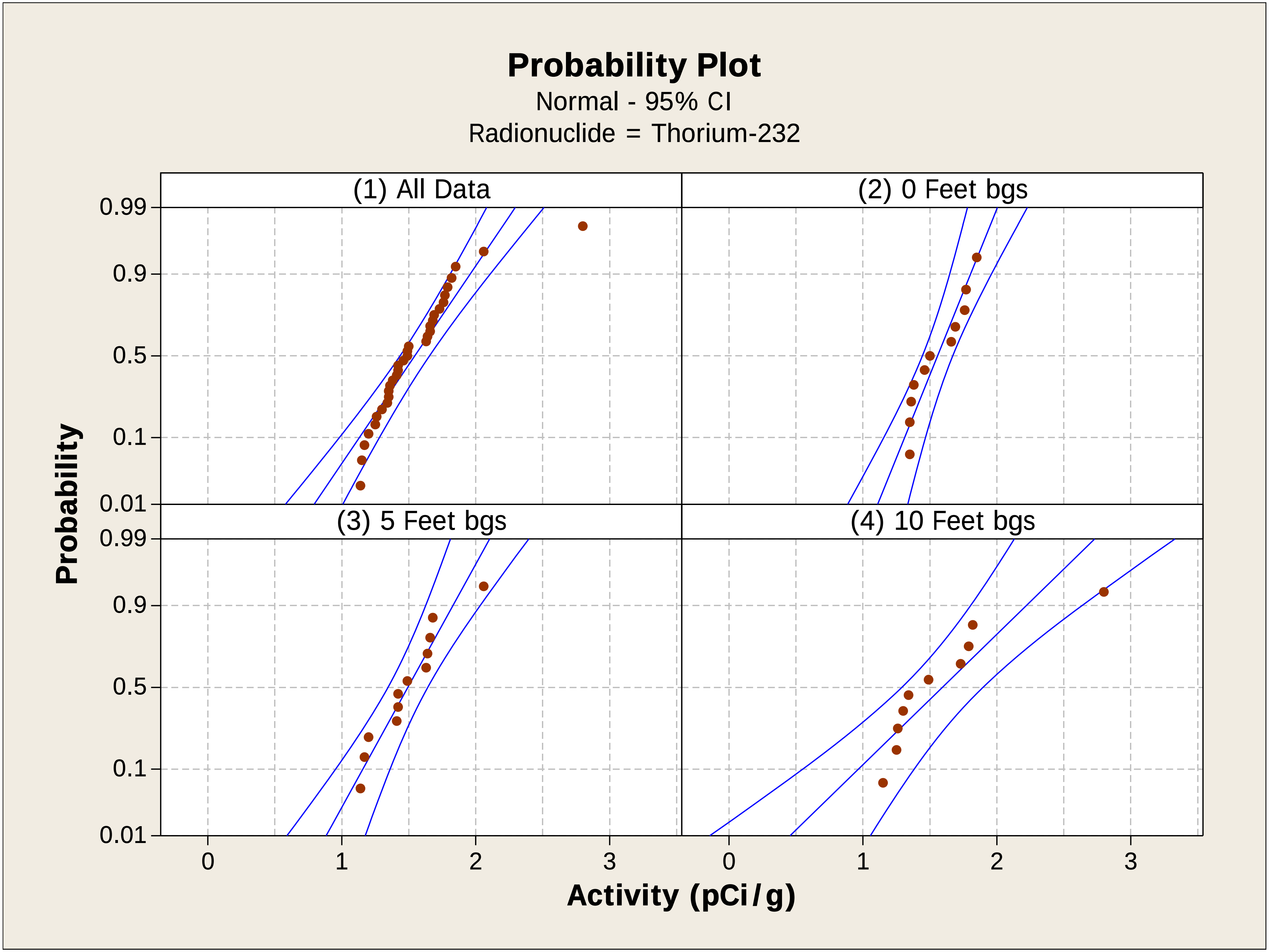
Probability Plot
Normal - 95% CI
Radionuclide = Radium-226
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.0
1.5
3.0
4.5
Activity (pCi/g)


Probability Plot
Normal - 95% CI
Radionuclide = Radium-228
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
0 1 2 3 4
Probability
Activity (pCi/g)

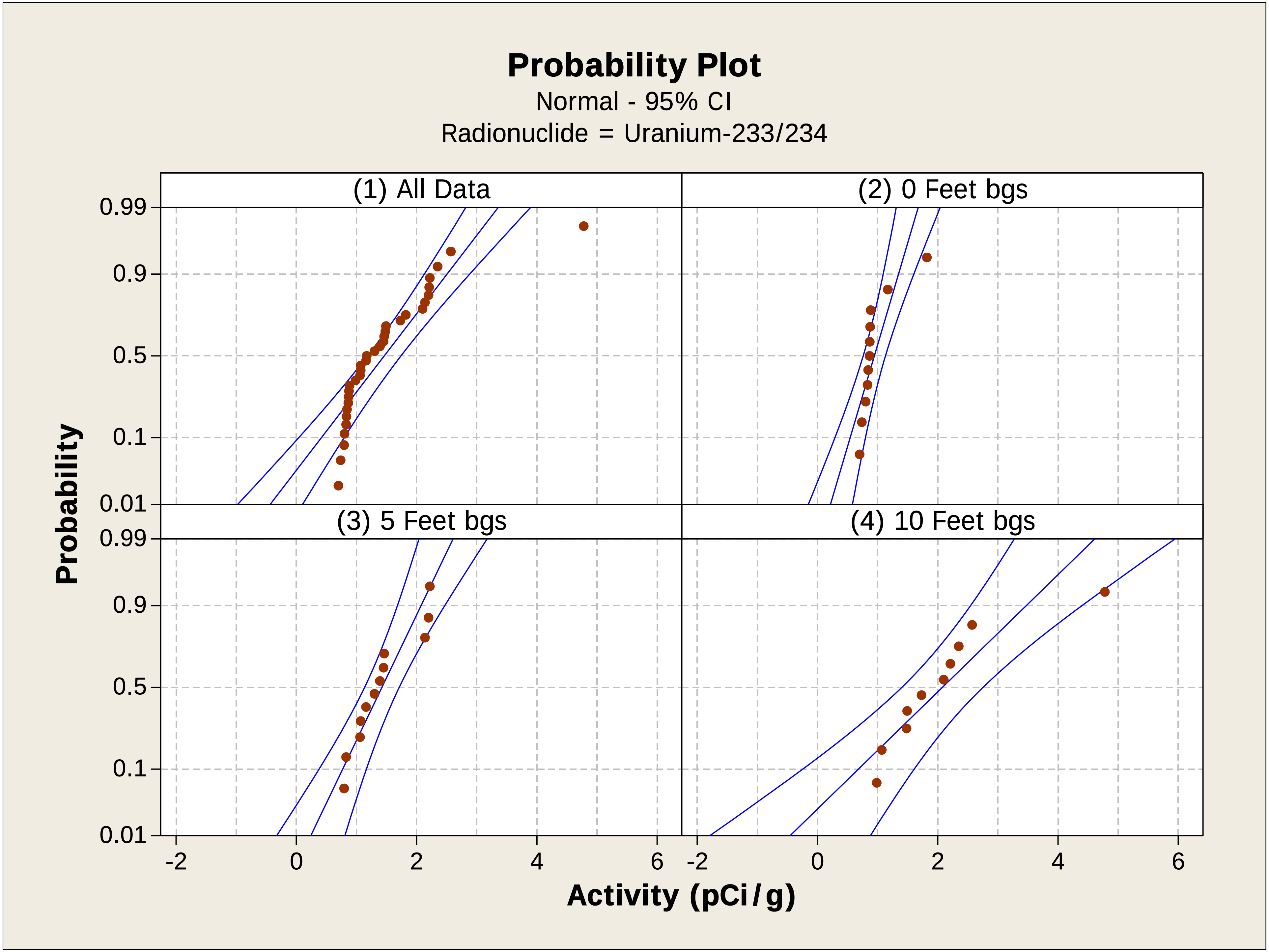

Probability Plot
Normal - 95% CI
Radionuclide = Thorium-228
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
1
2
3
4
Activity (pCi/g)

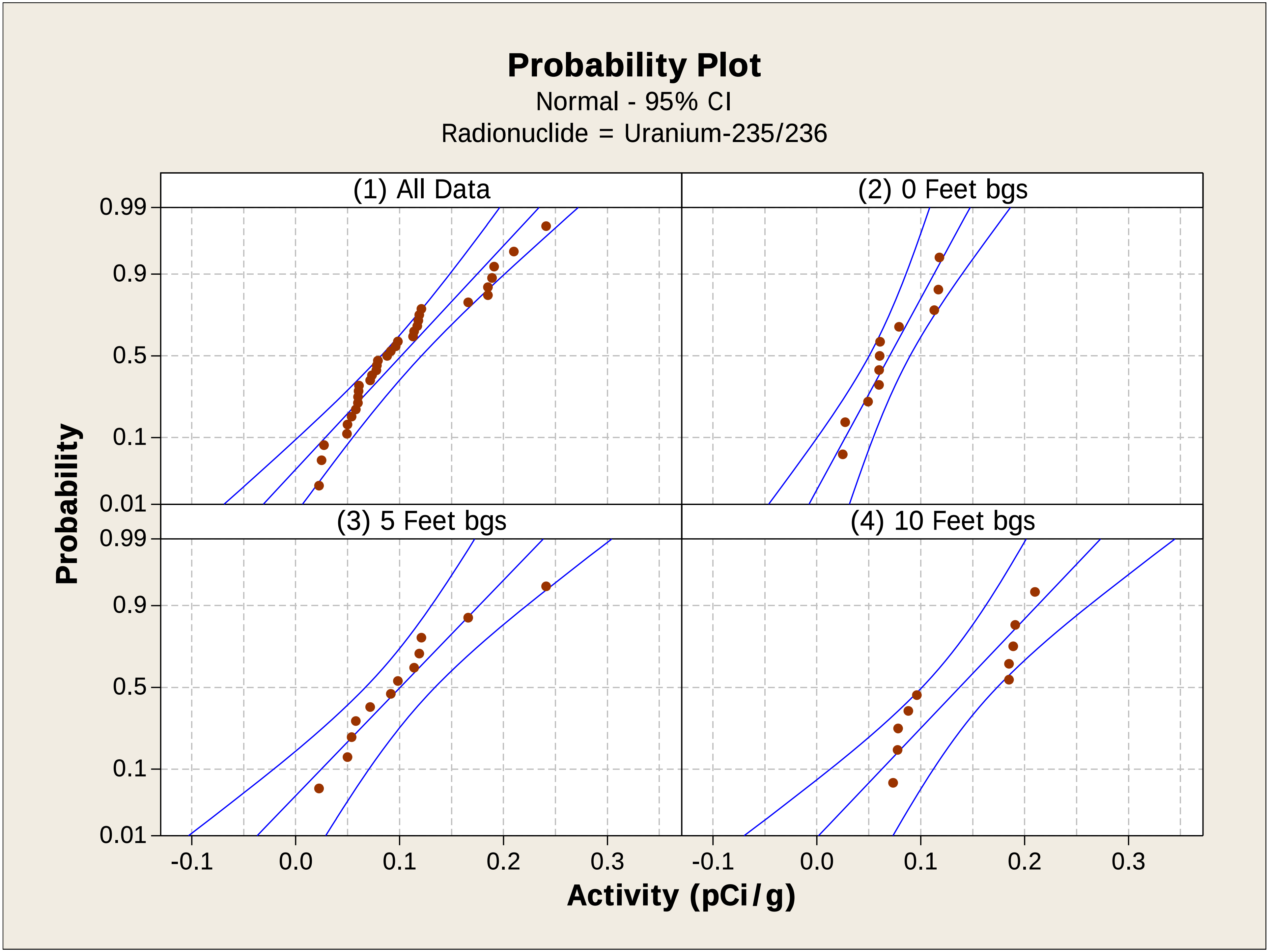


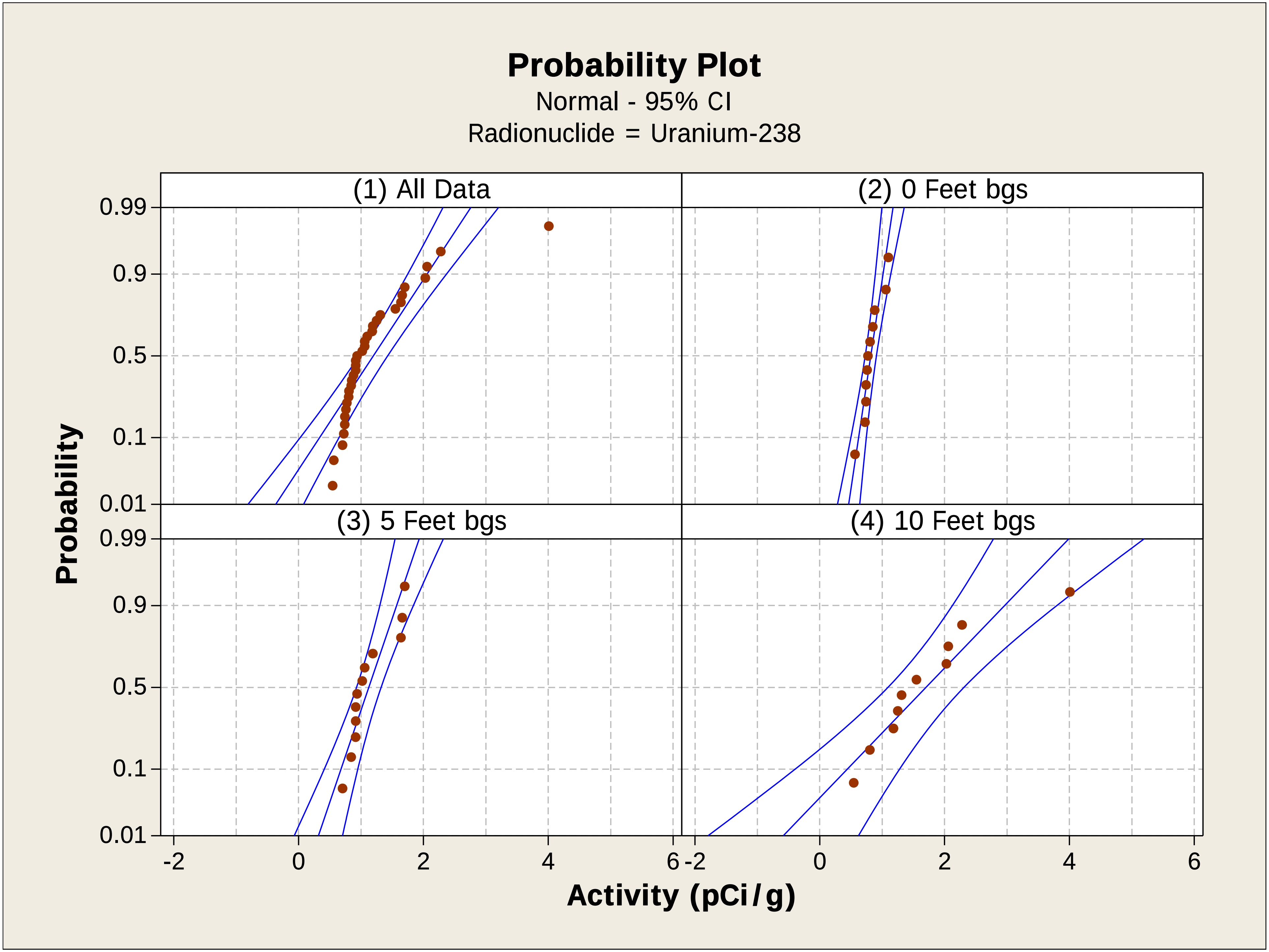
Probability Plot
Normal - 95% CI
Radionuclide = Thorium-230
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
0.99
0.9
0.5
0.1
0.01
Probability
0
1
2
3
4
Activity (pCi/g)



Probability Plot
Normal - 95% CI
Radionuclide = Thorium-232
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0
1
2
3
Activity (pCi/g)

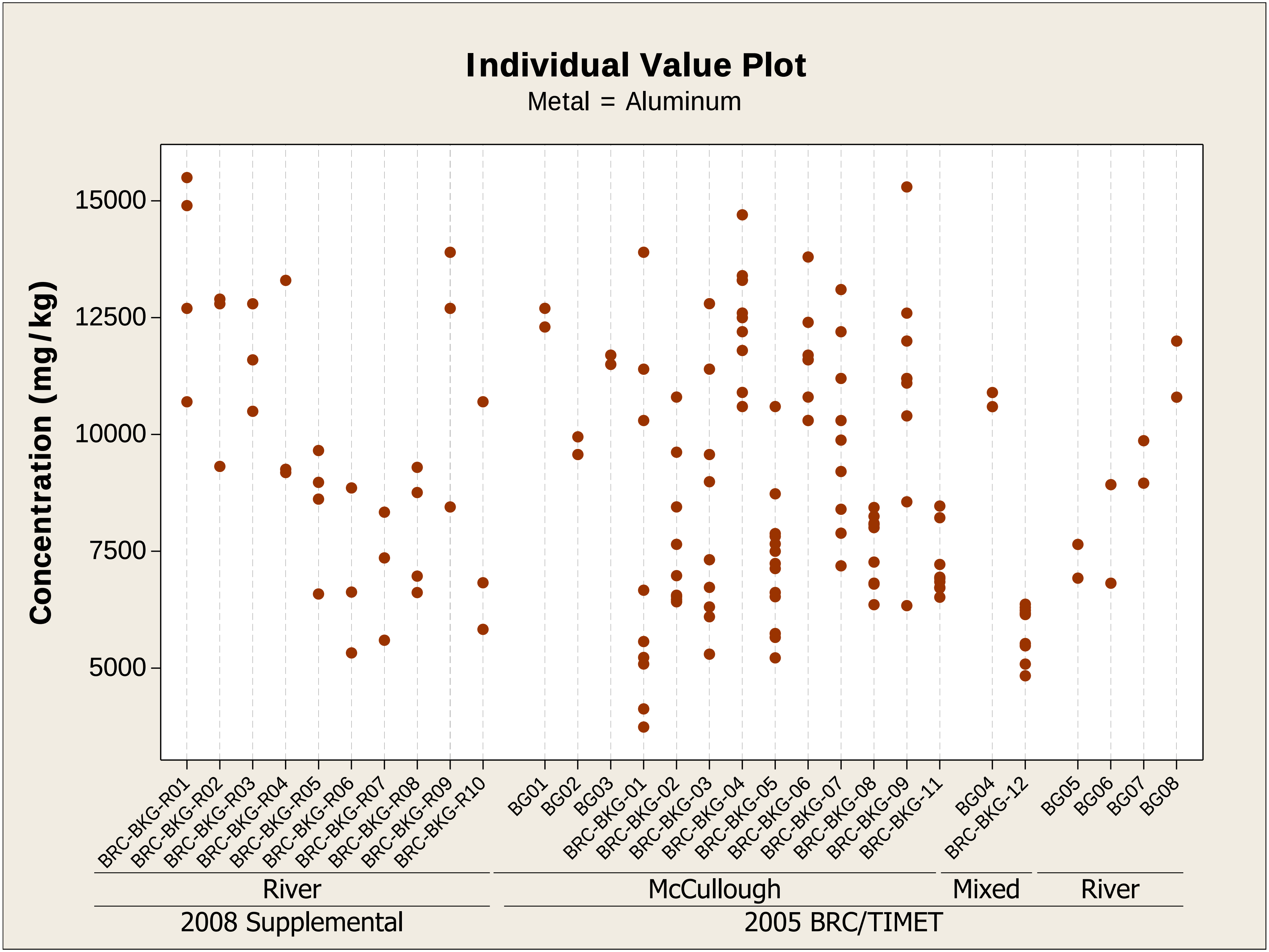

Probability Plot
Normal - 95% CI
Radionuclide = Uranium-233/234
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-2
0
2
4
6
Activity (pCi/g)

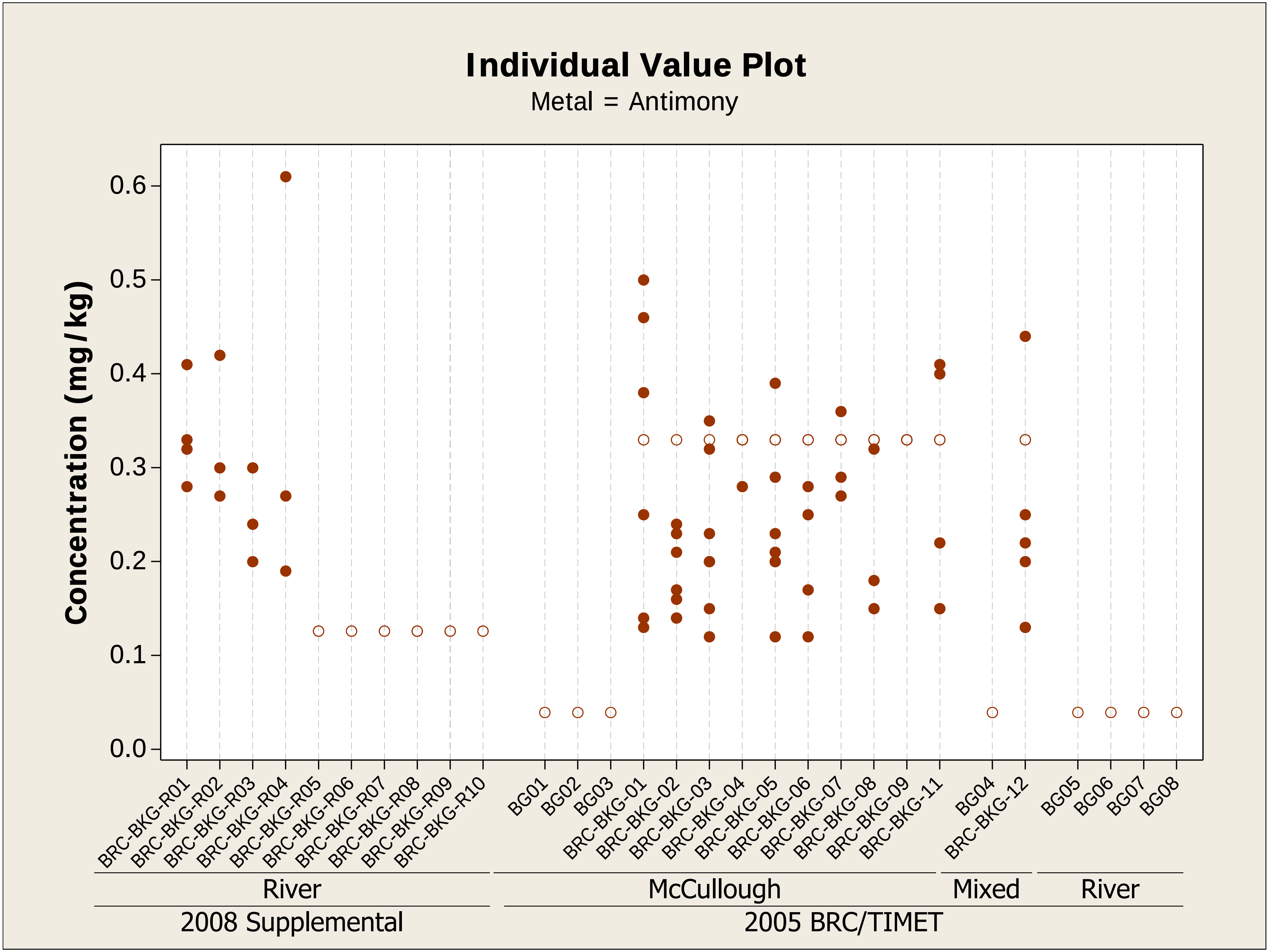

Probability Plot
Normal - 95% CI
Radionuclide = Uranium-235/236
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
-0.1
0.0
0.1
0.2
0.3
Activity (pCi/g)

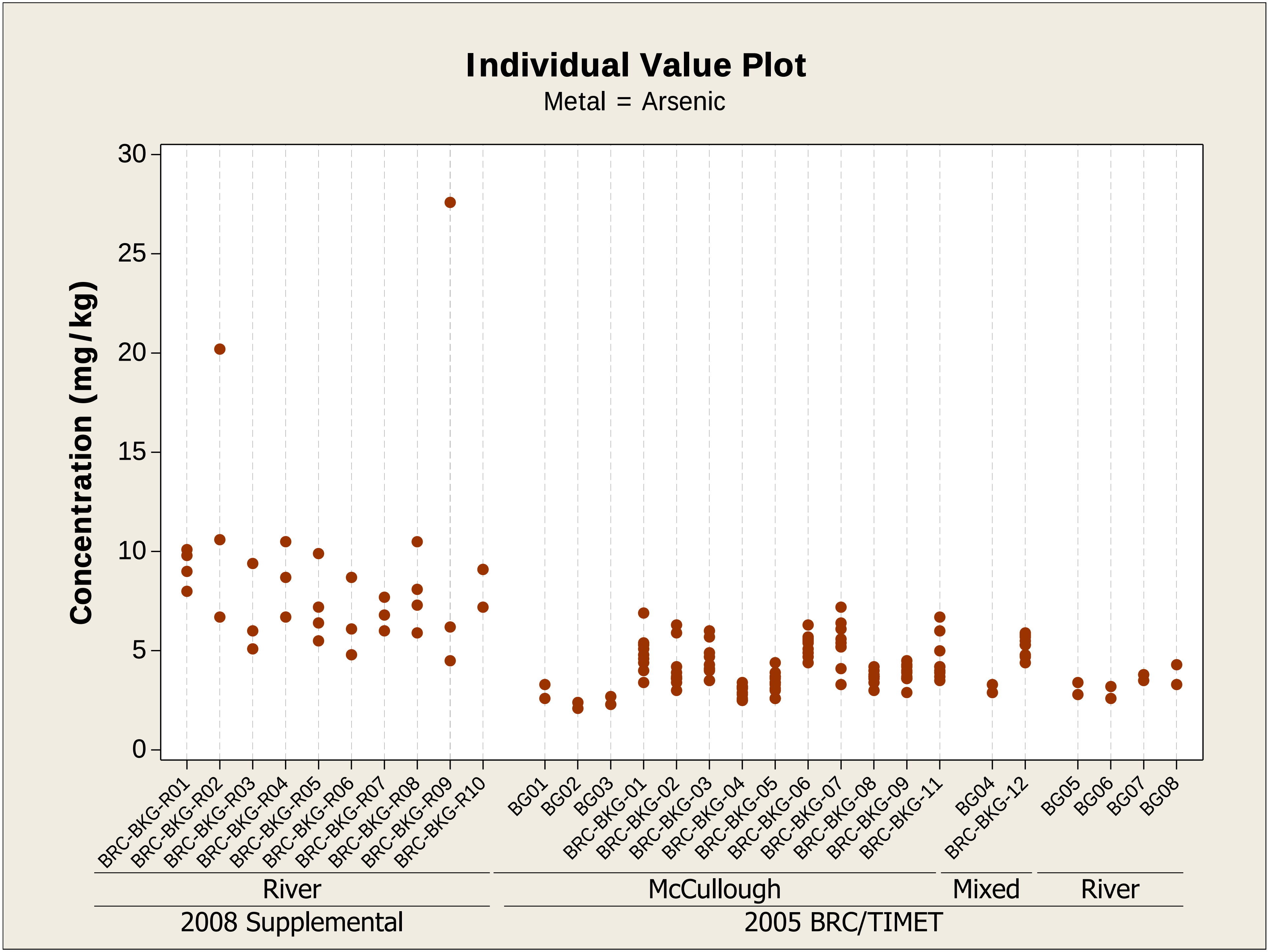


Probability Plot
Normal - 95% CI
Radionuclide = Uranium-238
(1) All Data
(2) 0 Feet bgs
(3) 5 Feet bgs
(4) 10 Feet bgs
Probability
0.99
0.9
0.5
0.1
0.01
0.99
0.9
0.5
0.1
0.01
-2
0
2
4
6
-2
0
2
4
6
Activity (pCi/g)

INDIVIDUAL VALUE PLOTS


Individual Value Plot
Metal = Aluminum
Concentration (mg/kg)
15000
12500
10000
7500
5000
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Antimony
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



Individual Value Plot
Metal = Arsenic
Concentration (mg/kg)
0
5
10
15
20
25
30
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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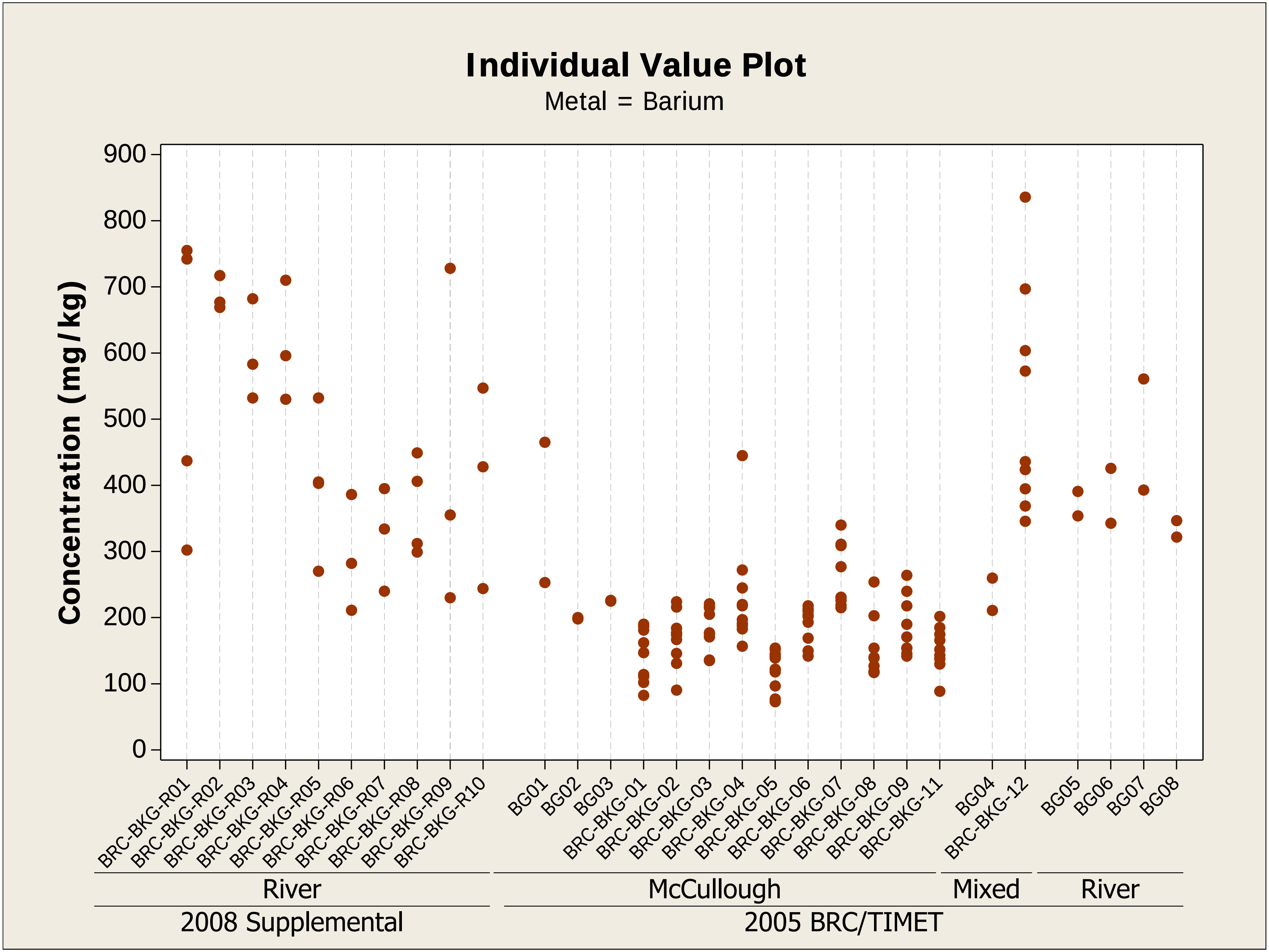

Individual Value Plot
Metal = Barium
Concentration (mg/kg)
0
100
200
300
400
500
600
700
800
900
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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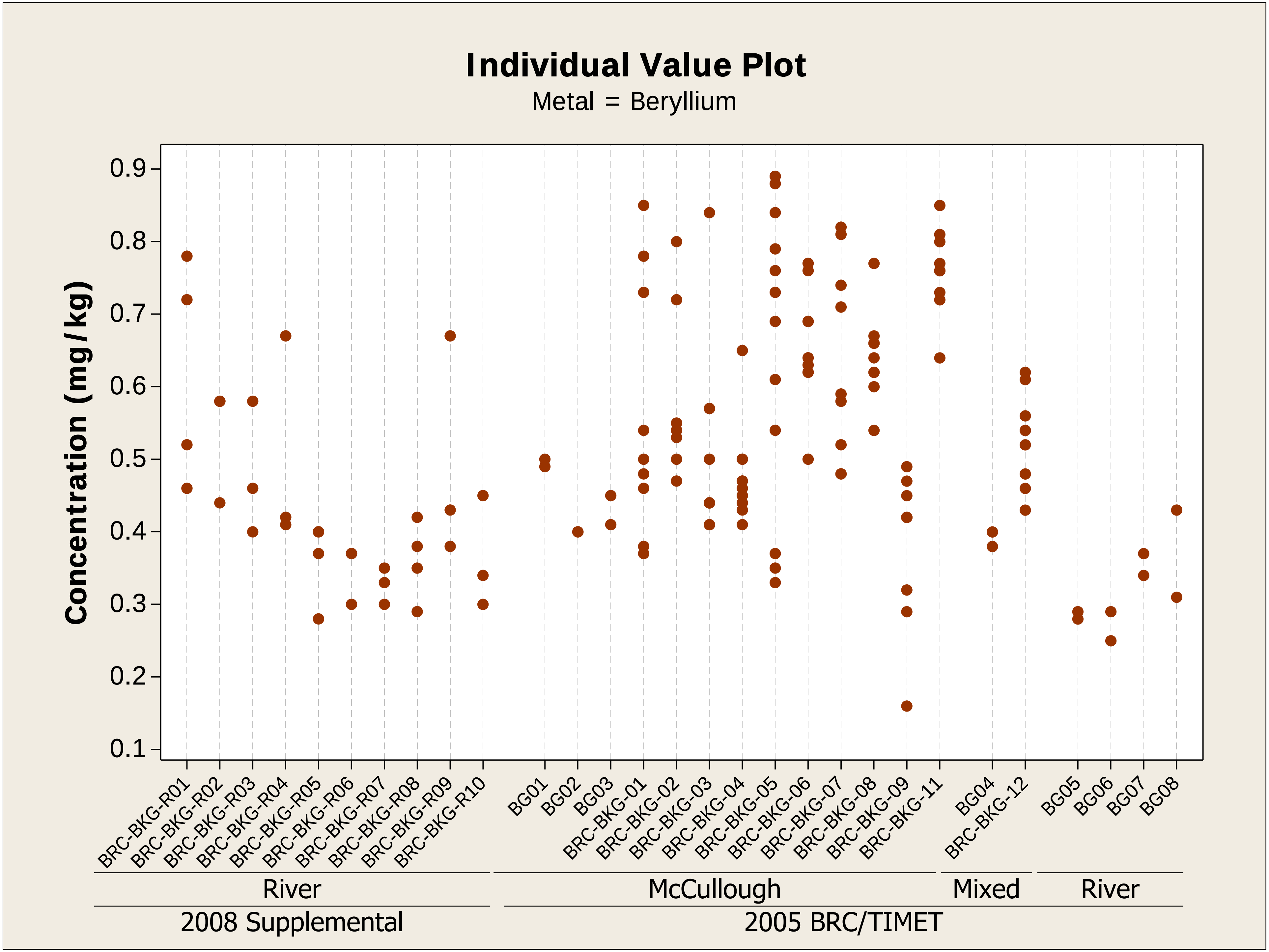
Individual Value Plot
Metal = Beryllium
Concentration (mg/kg)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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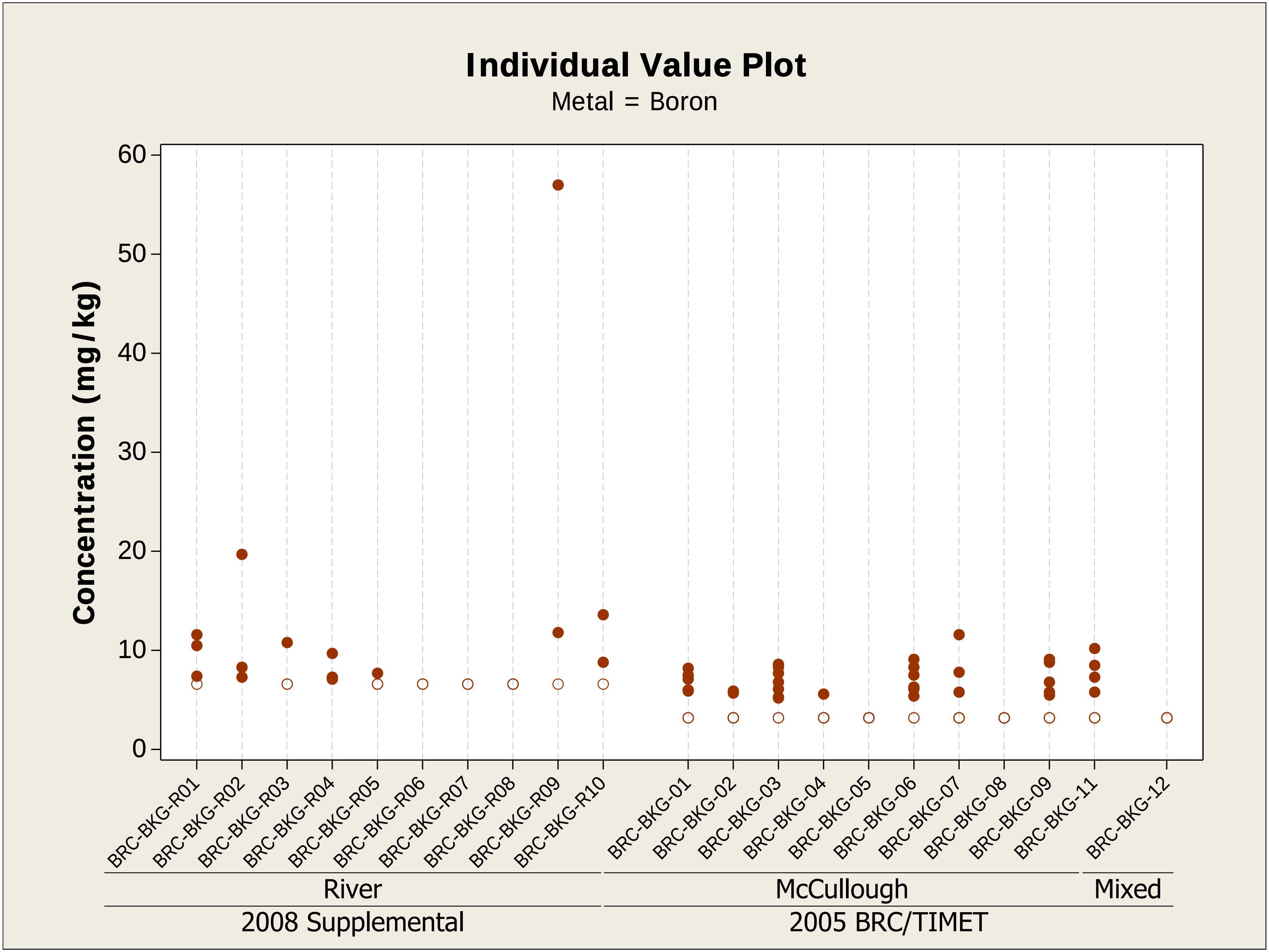
Individual Value Plot
Metal = Boron
Concentration (mg/kg)
60
50
40
30
20
10
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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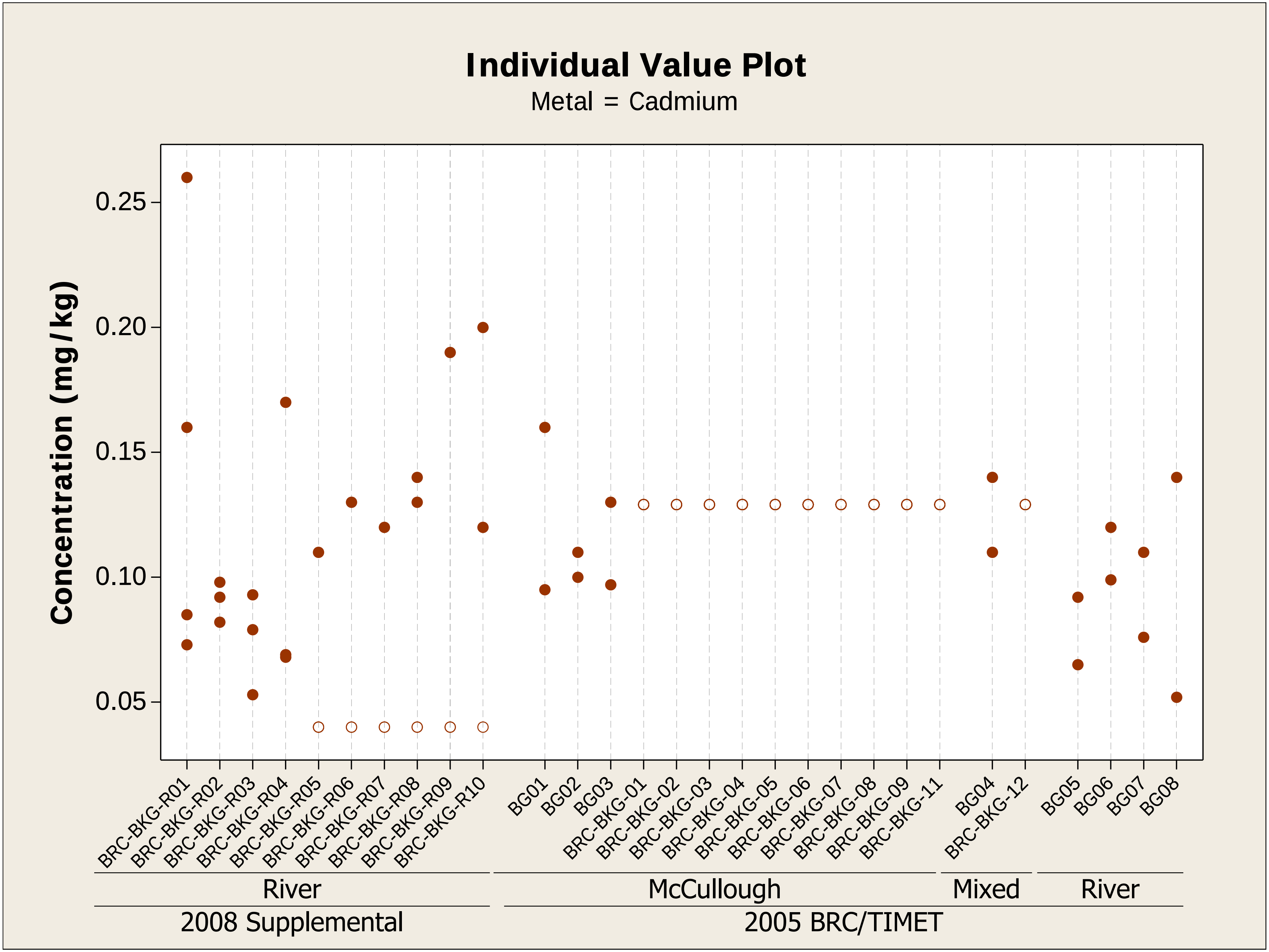

Individual Value Plot
Metal = Cadmium
Concentration (mg/kg)
0.25
0.20
0.15
0.10
0.05
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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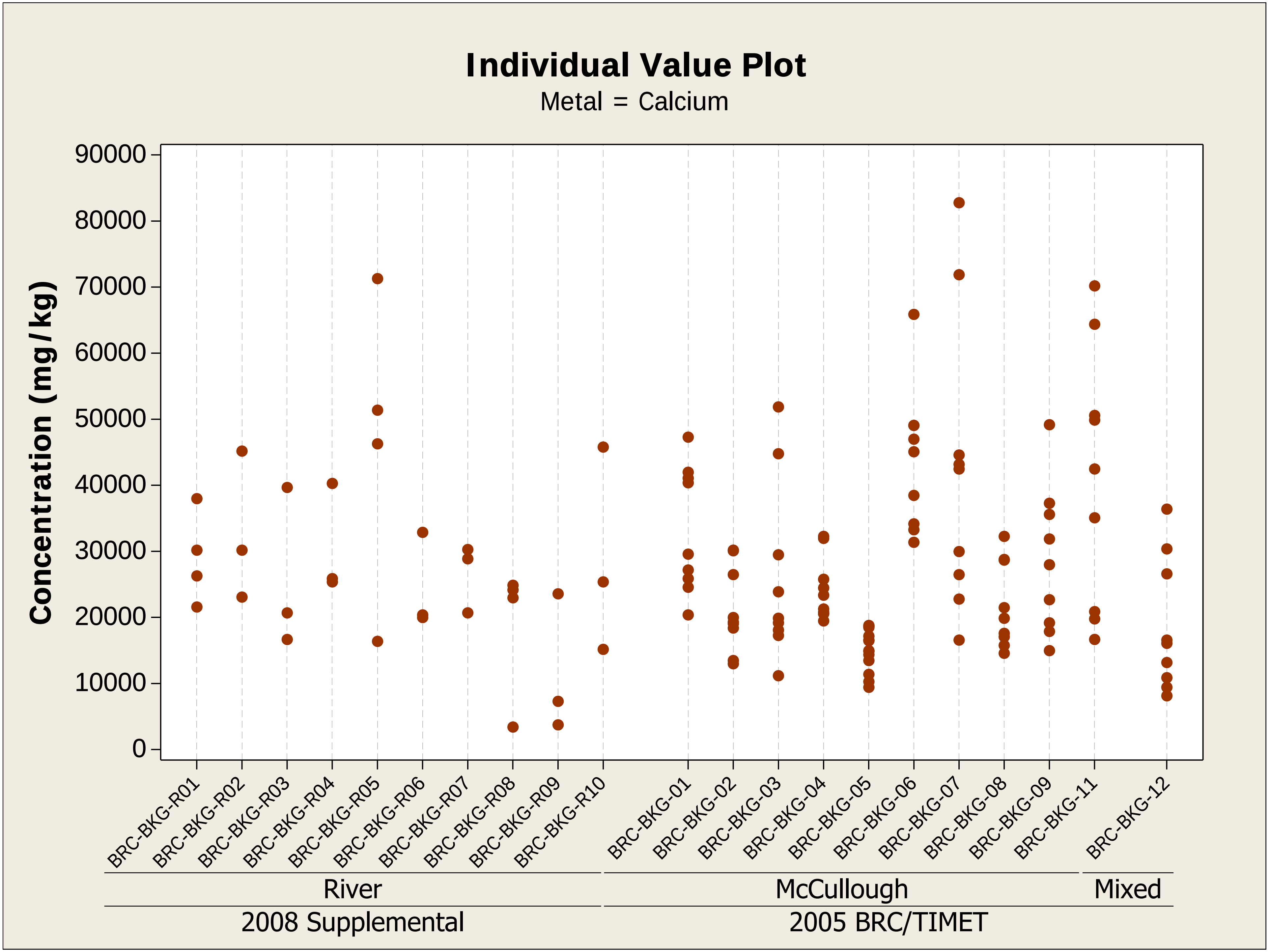
Individual Value Plot
Metal = Calcium
Concentration (mg/kg)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
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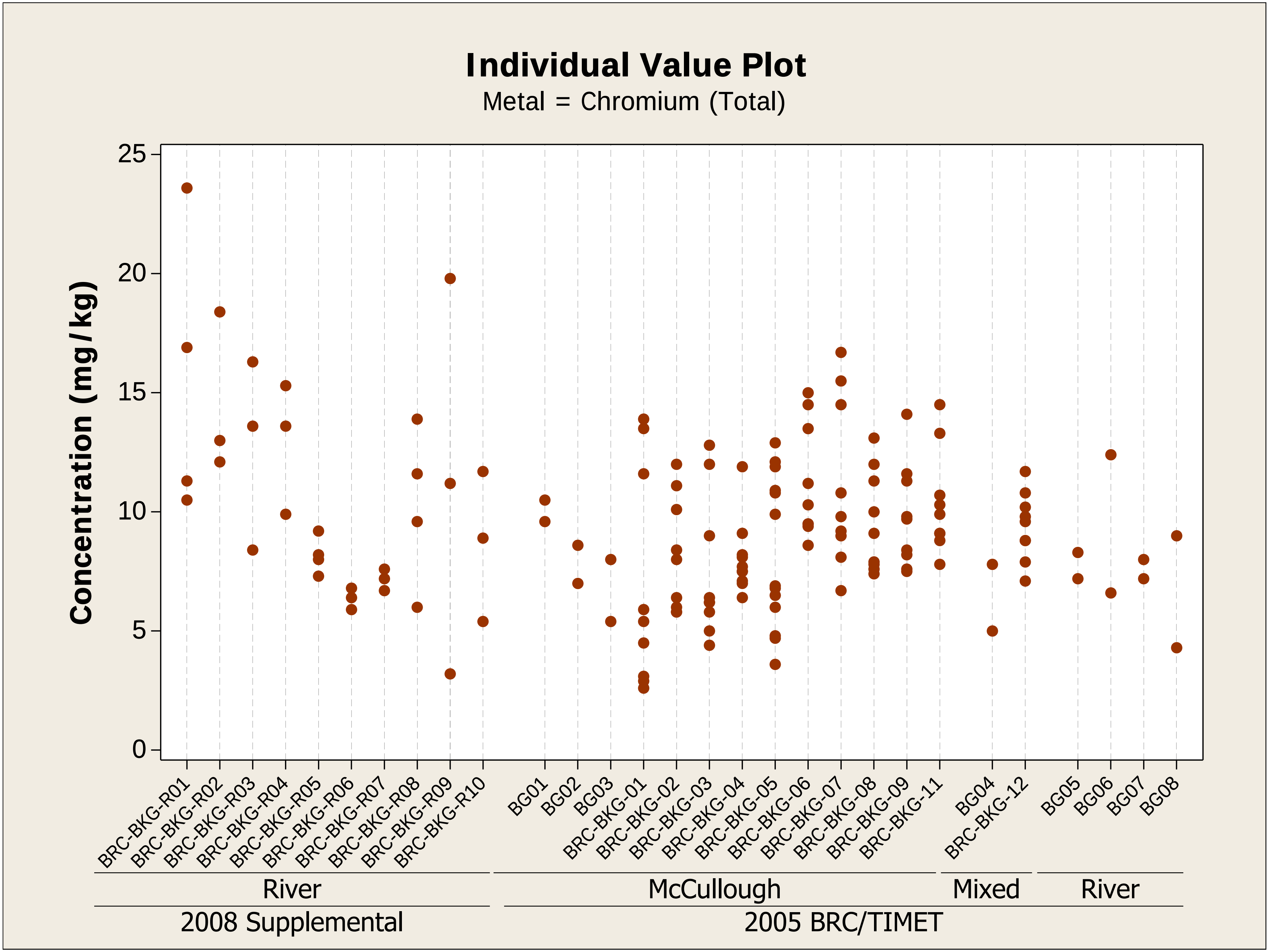

Individual Value Plot
Metal = Chromium (Total)
Concentration (mg/kg)
0
5
10
15
20
25
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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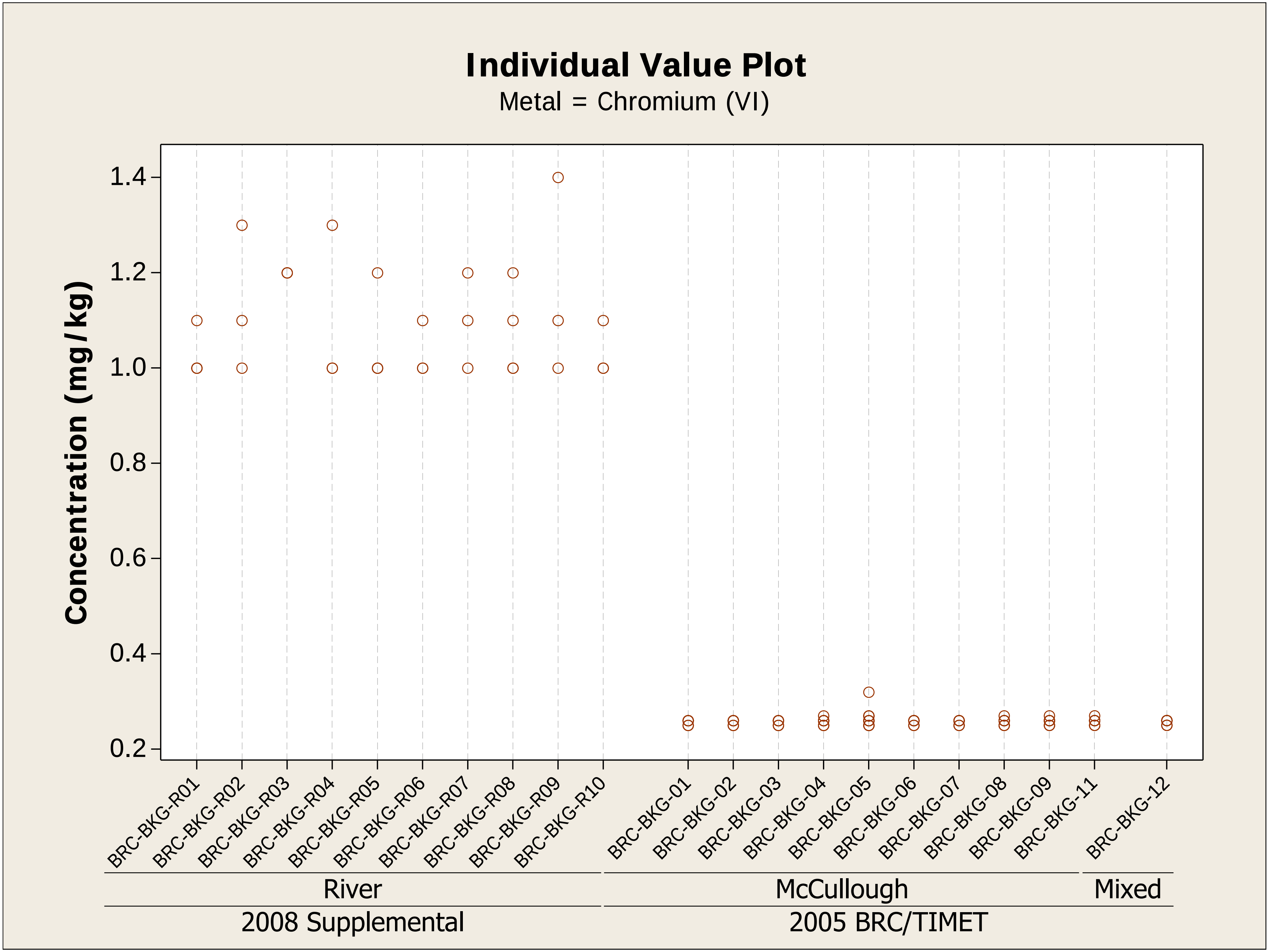

Individual Value Plot
Metal = Chromium (VI)
Concentration (mg/kg)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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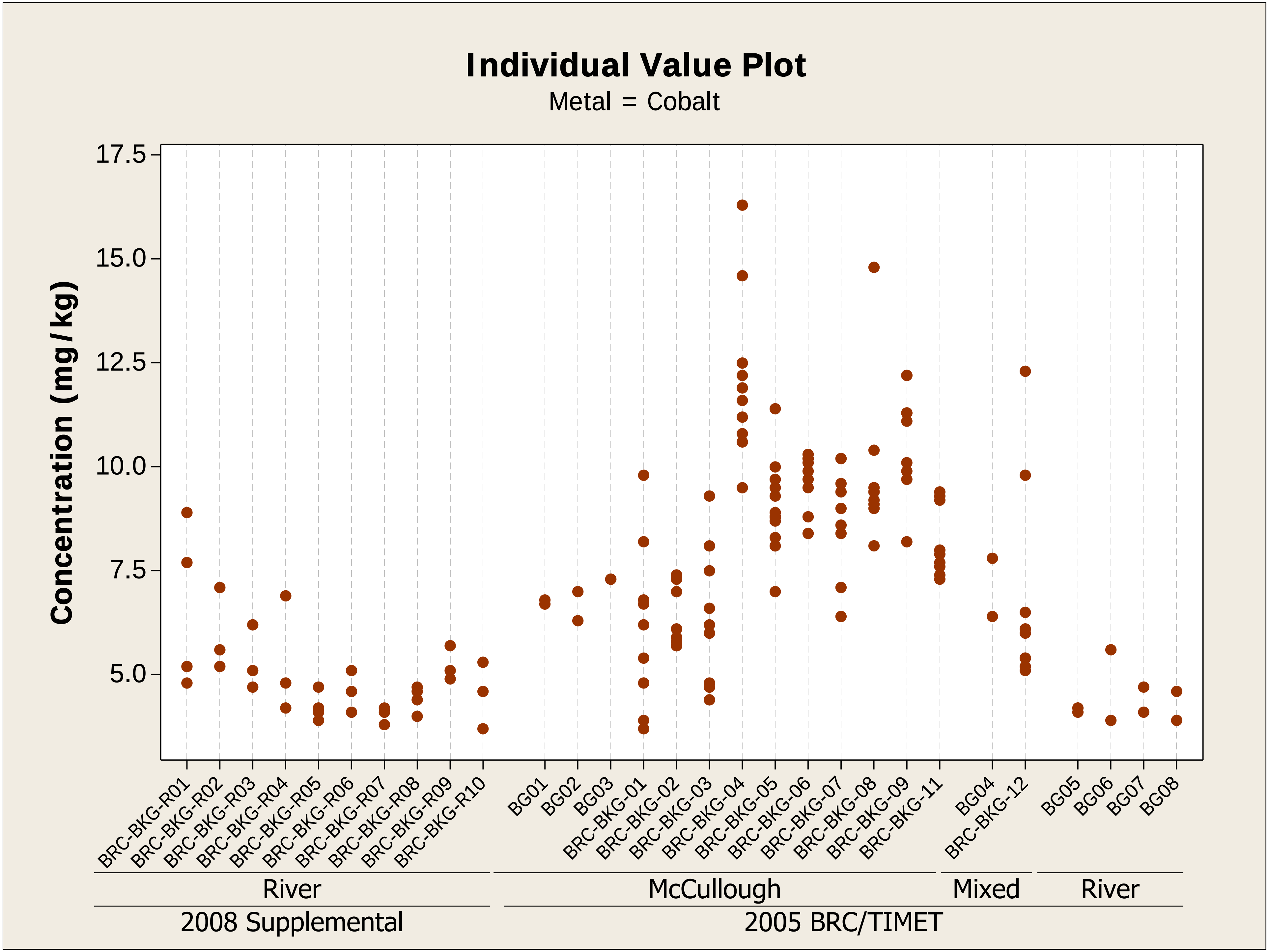

Individual Value Plot
Metal = Cobalt
Concentration (mg/kg)
17.5
15.0
12.5
10.0
7.5
5.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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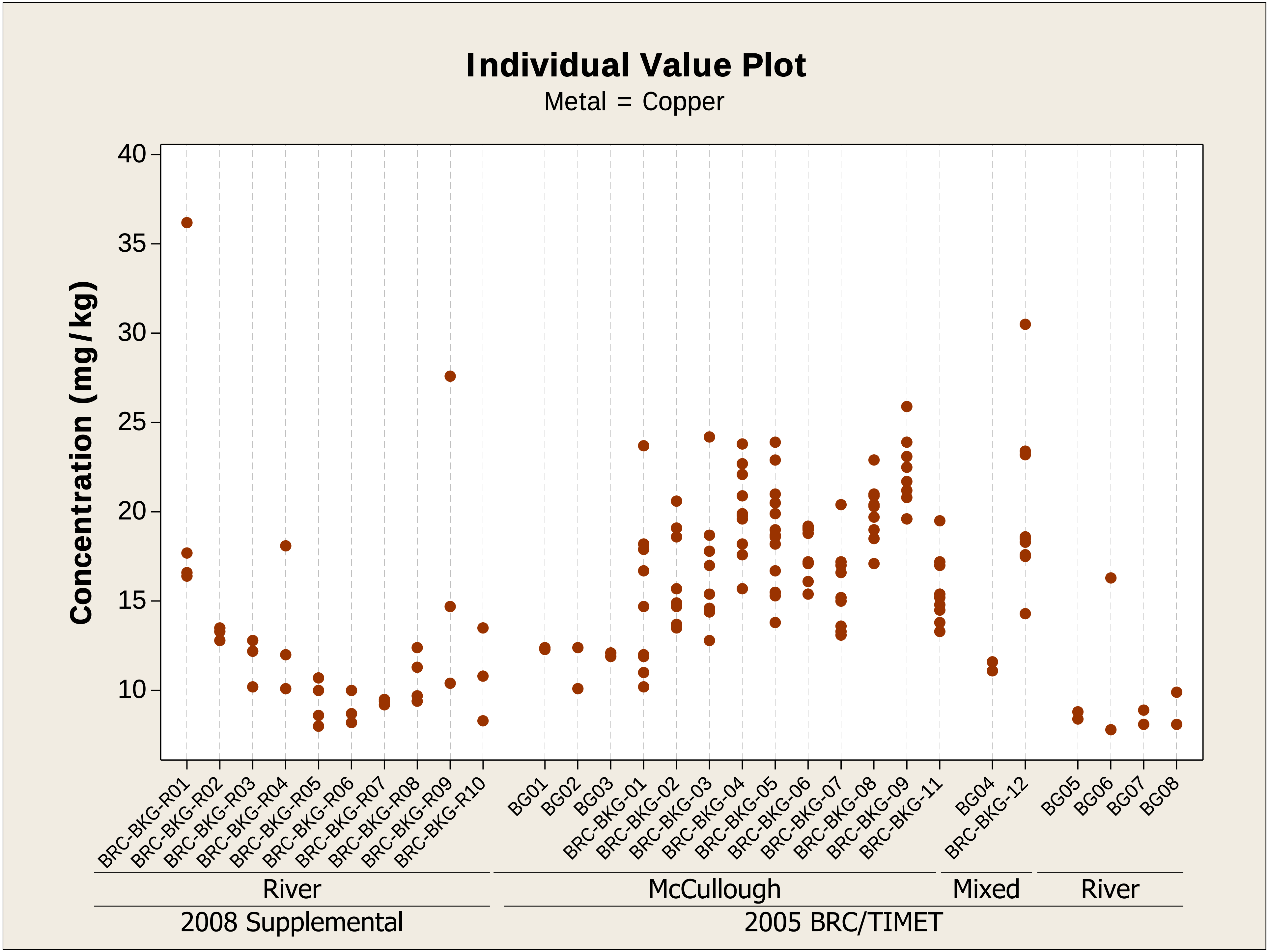
Individual Value Plot
Metal = Copper
Concentration (mg/kg)
40
35
30
25
20
15
10
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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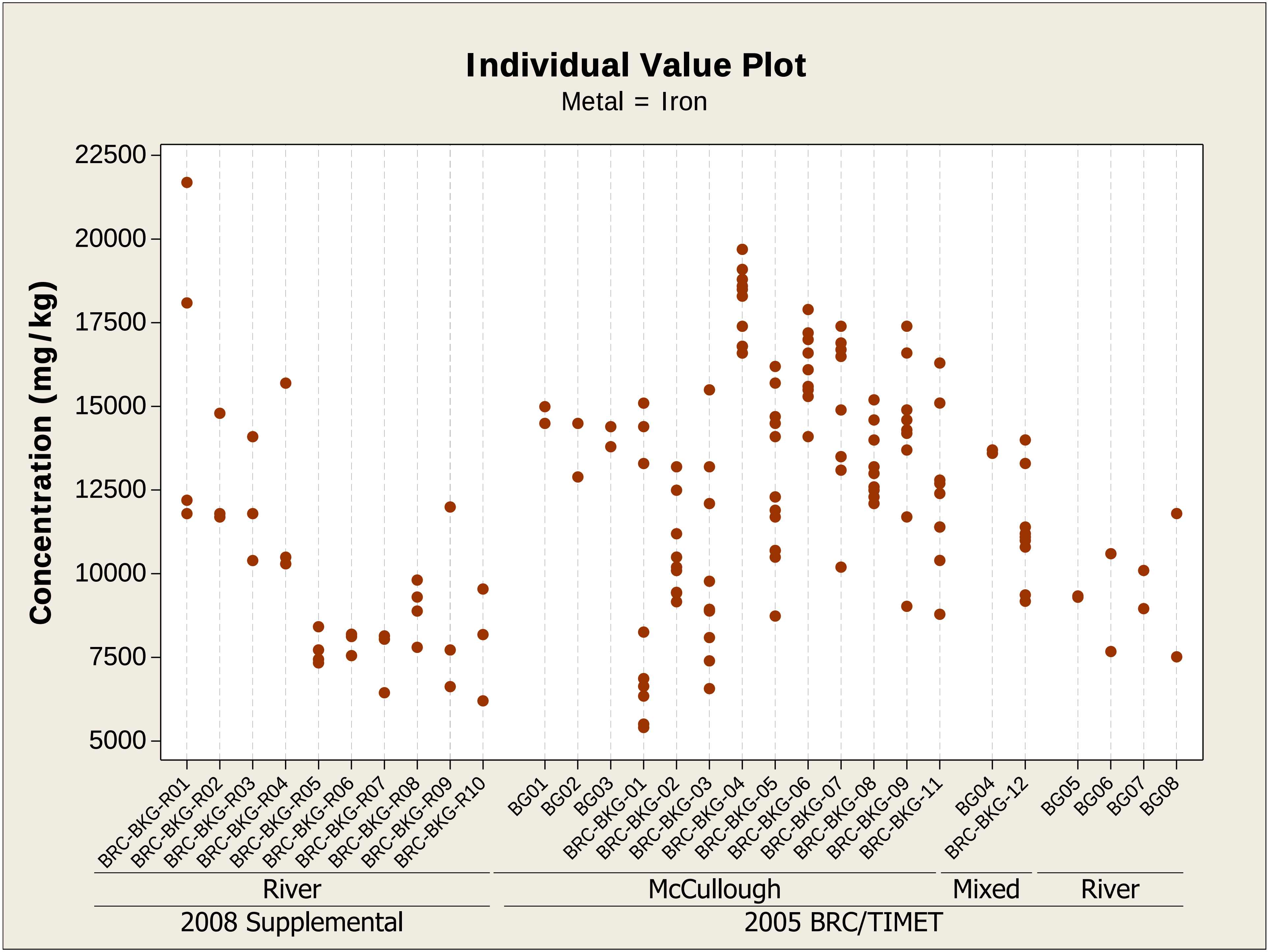

Individual Value Plot
Metal = Iron
Concentration (mg/kg)
22500
20000
17500
15000
12500
10000
7500
5000
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
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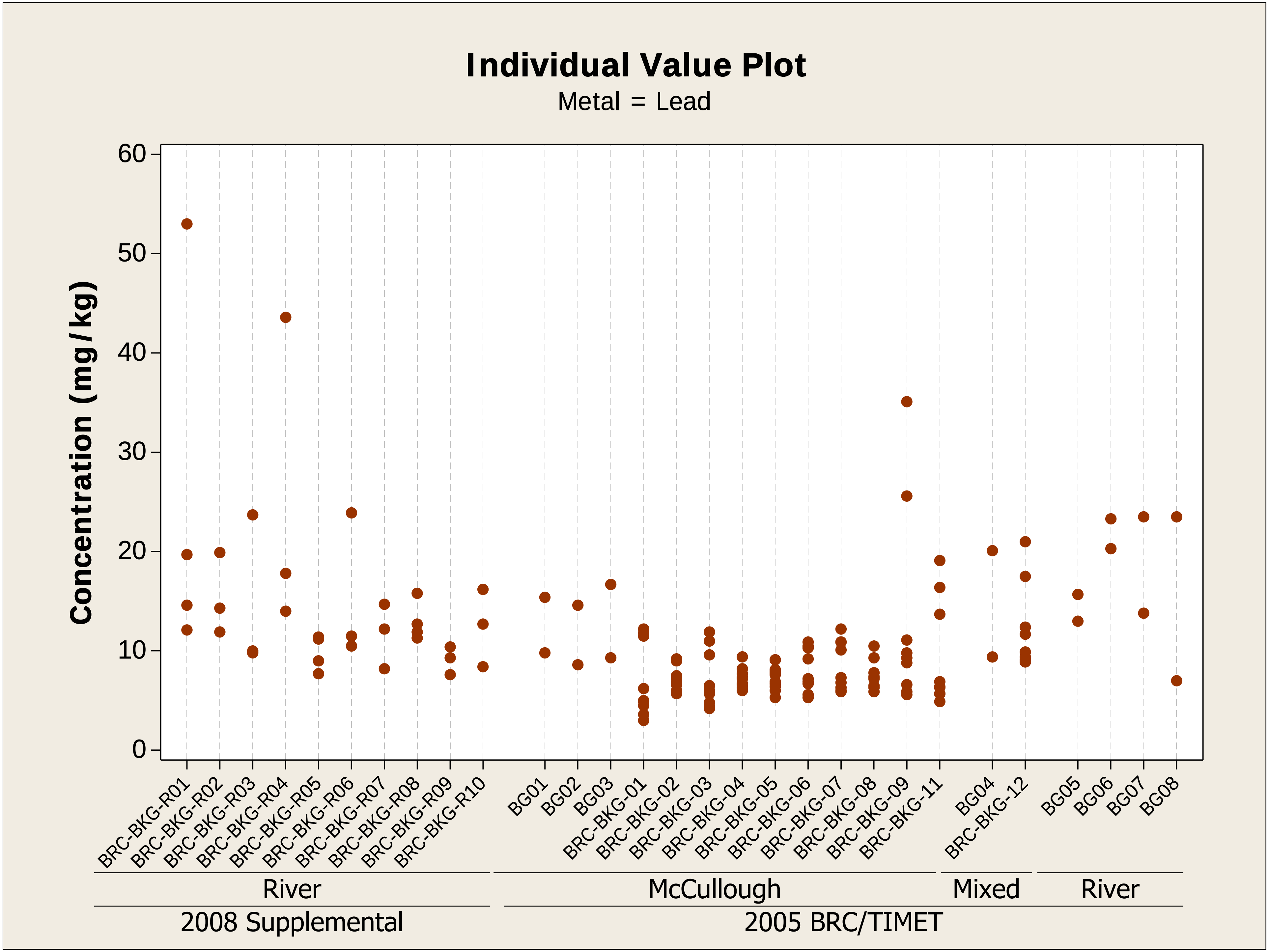
Individual Value Plot
Metal = Lead
Concentration (mg/kg)
0
10
20
30
40
50
60
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
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River
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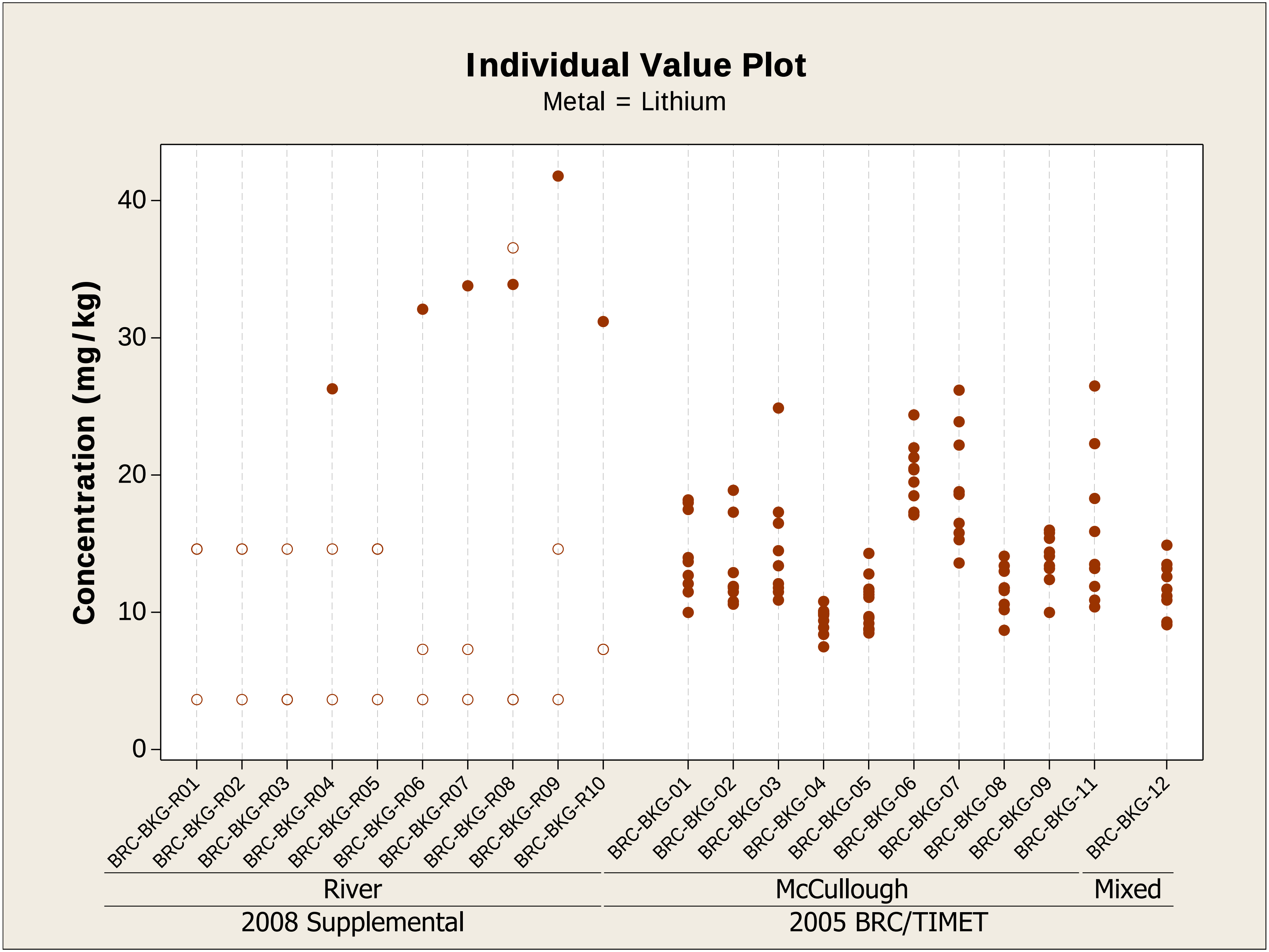

Individual Value Plot
Metal = Lithium
Concentration (mg/kg)
0
10
20
30
40
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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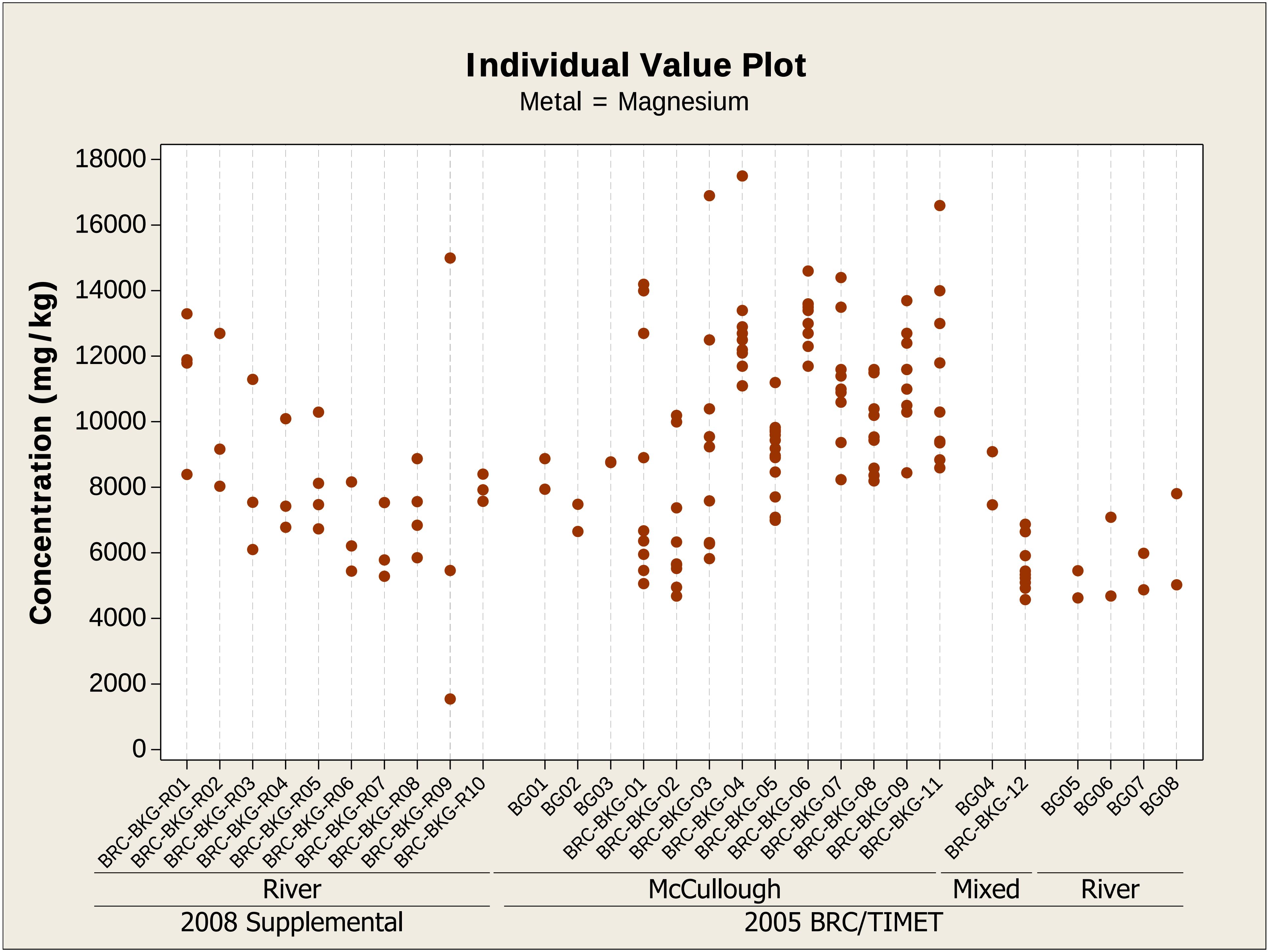

Individual Value Plot
Metal = Magnesium
Concentration (mg/kg)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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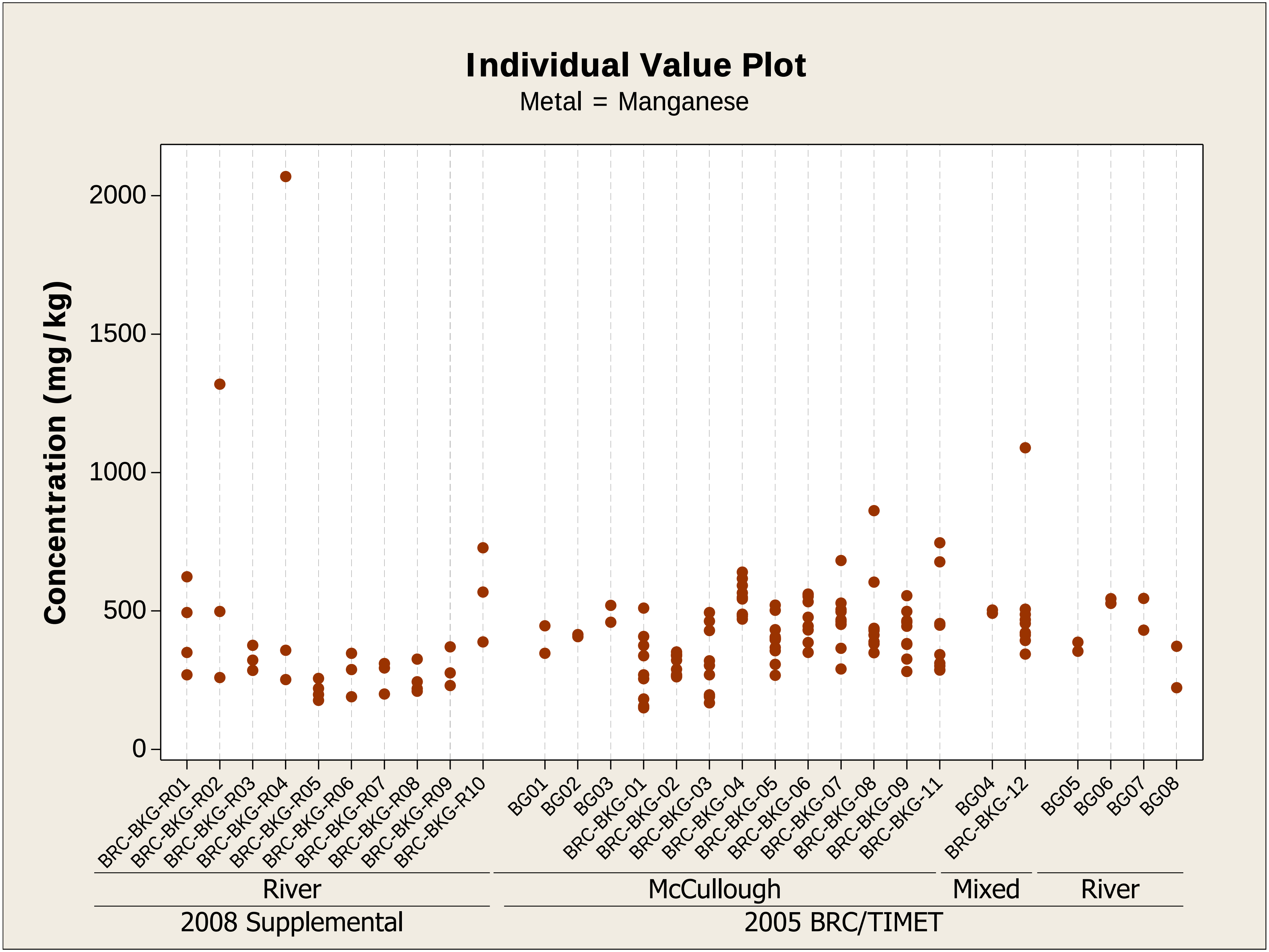
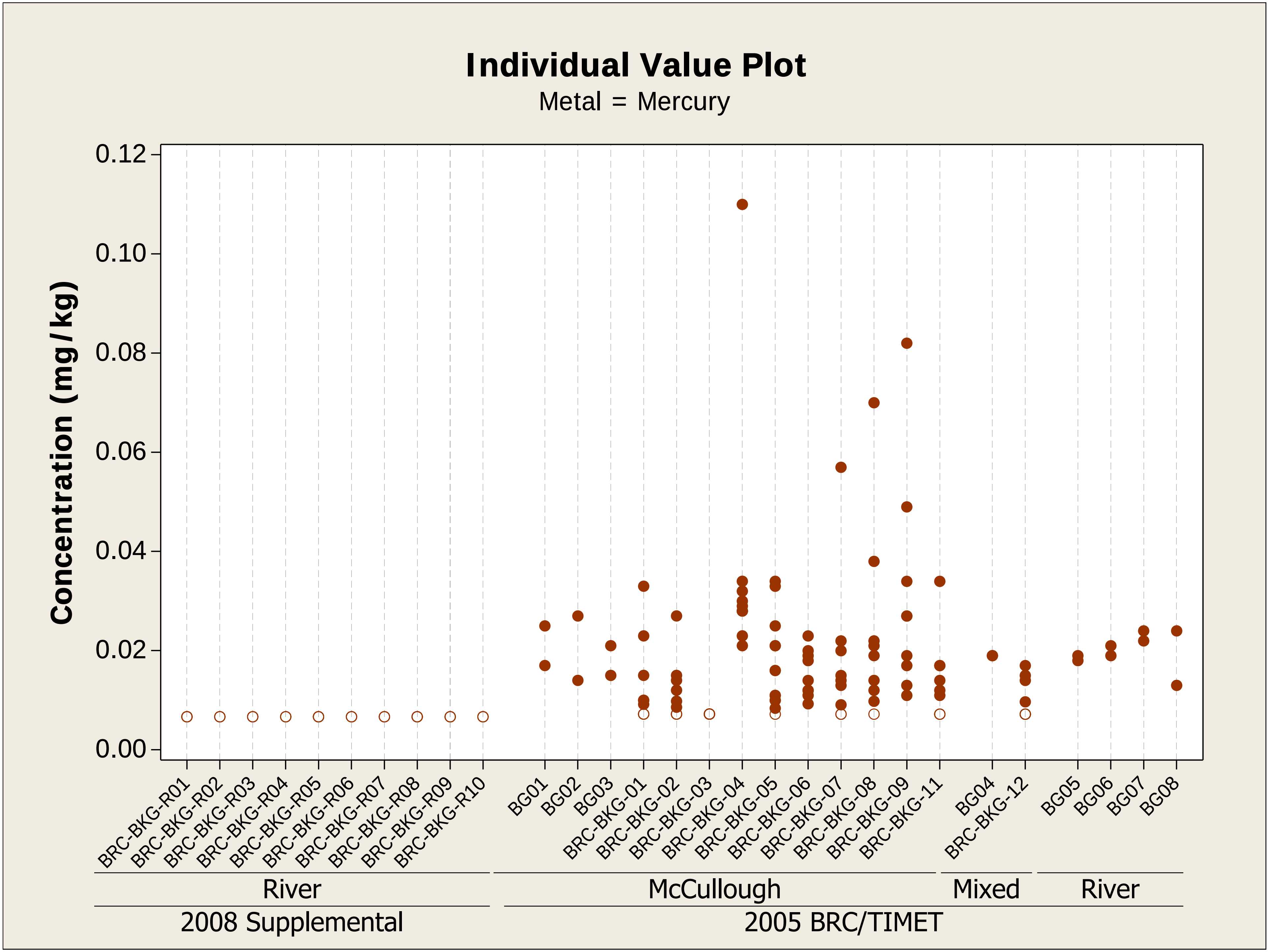
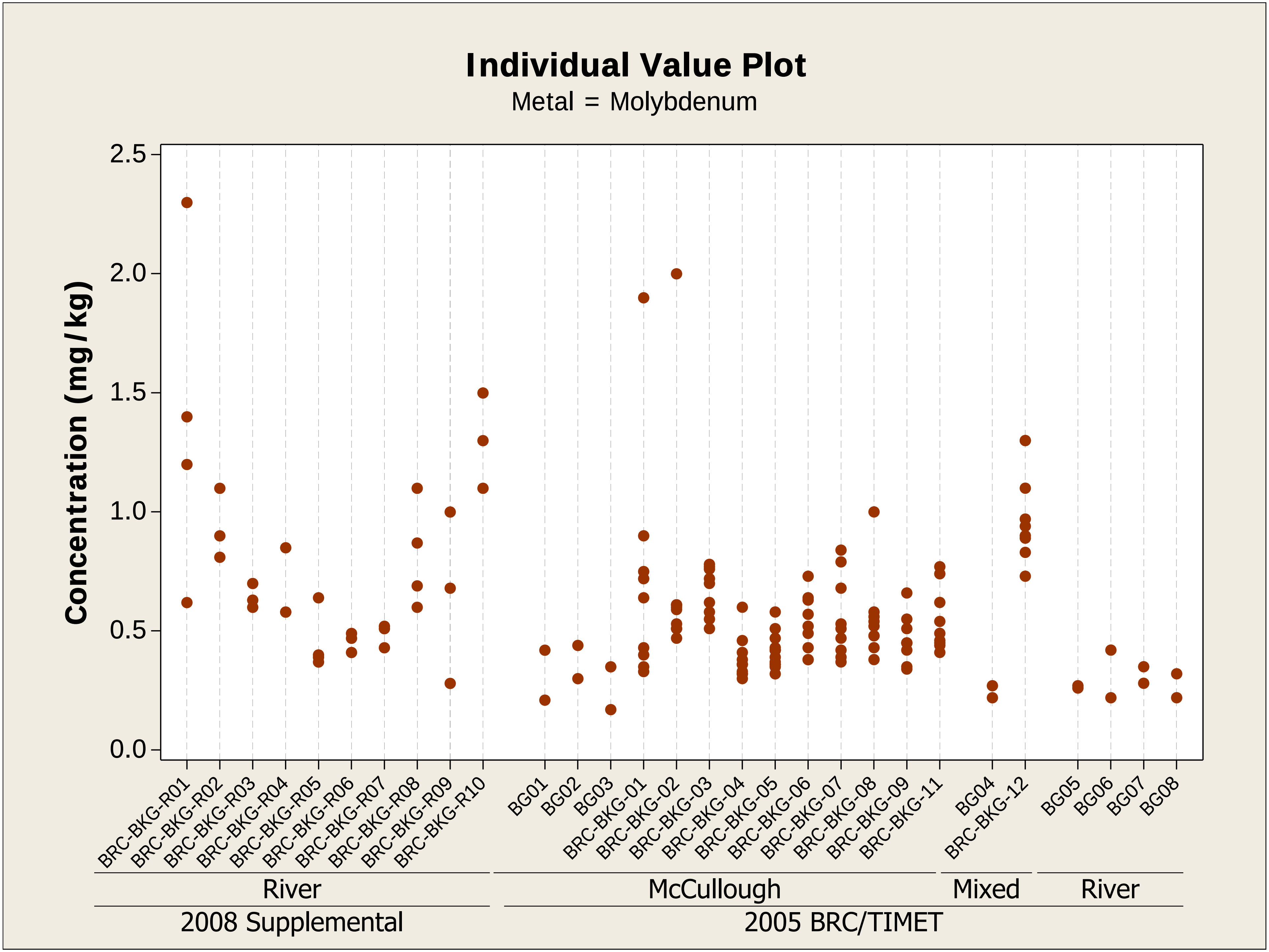


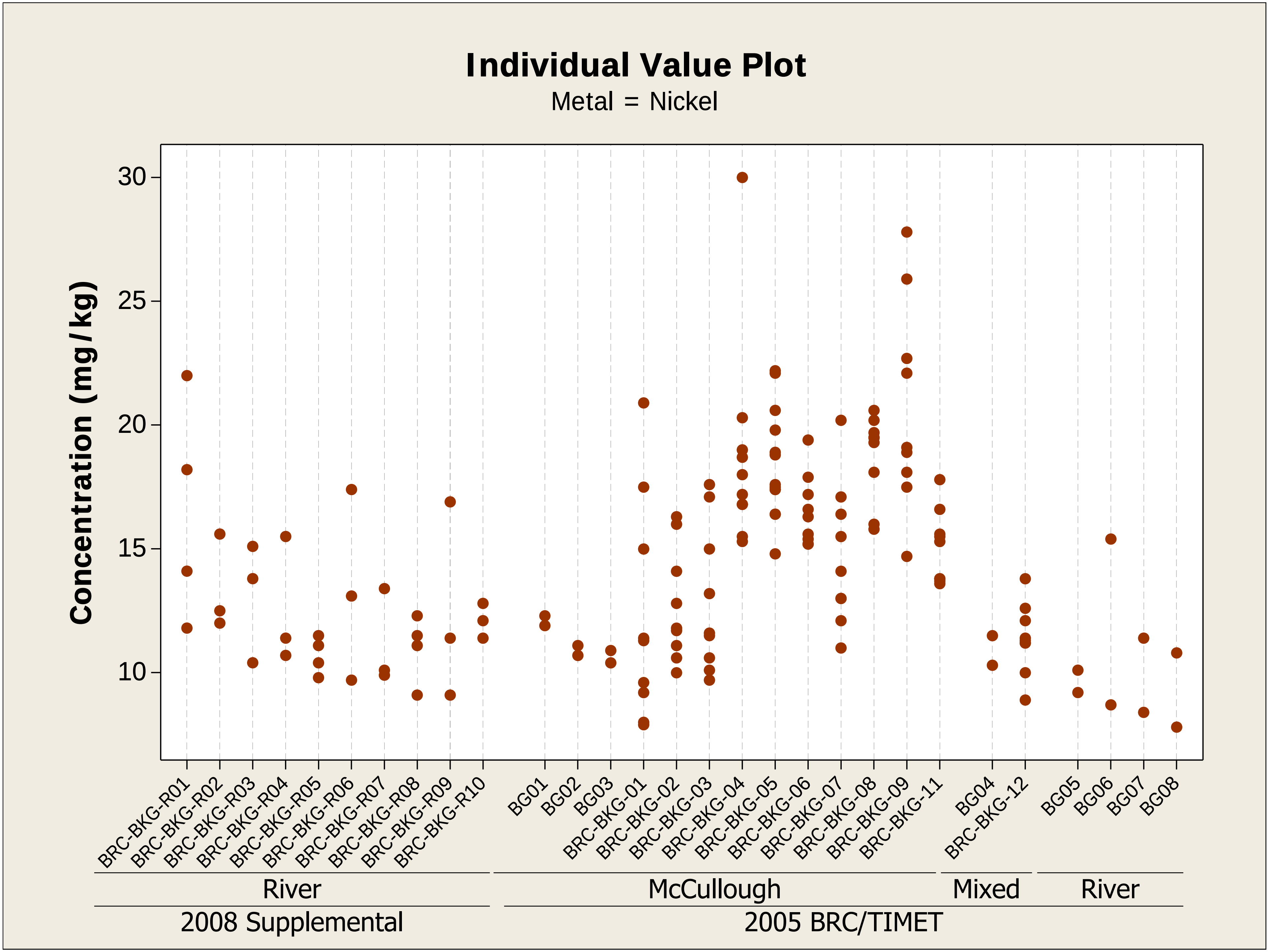
Individual Value Plot
Metal = Manganese
Concentration (mg/kg)
2000
1500
1000
500
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



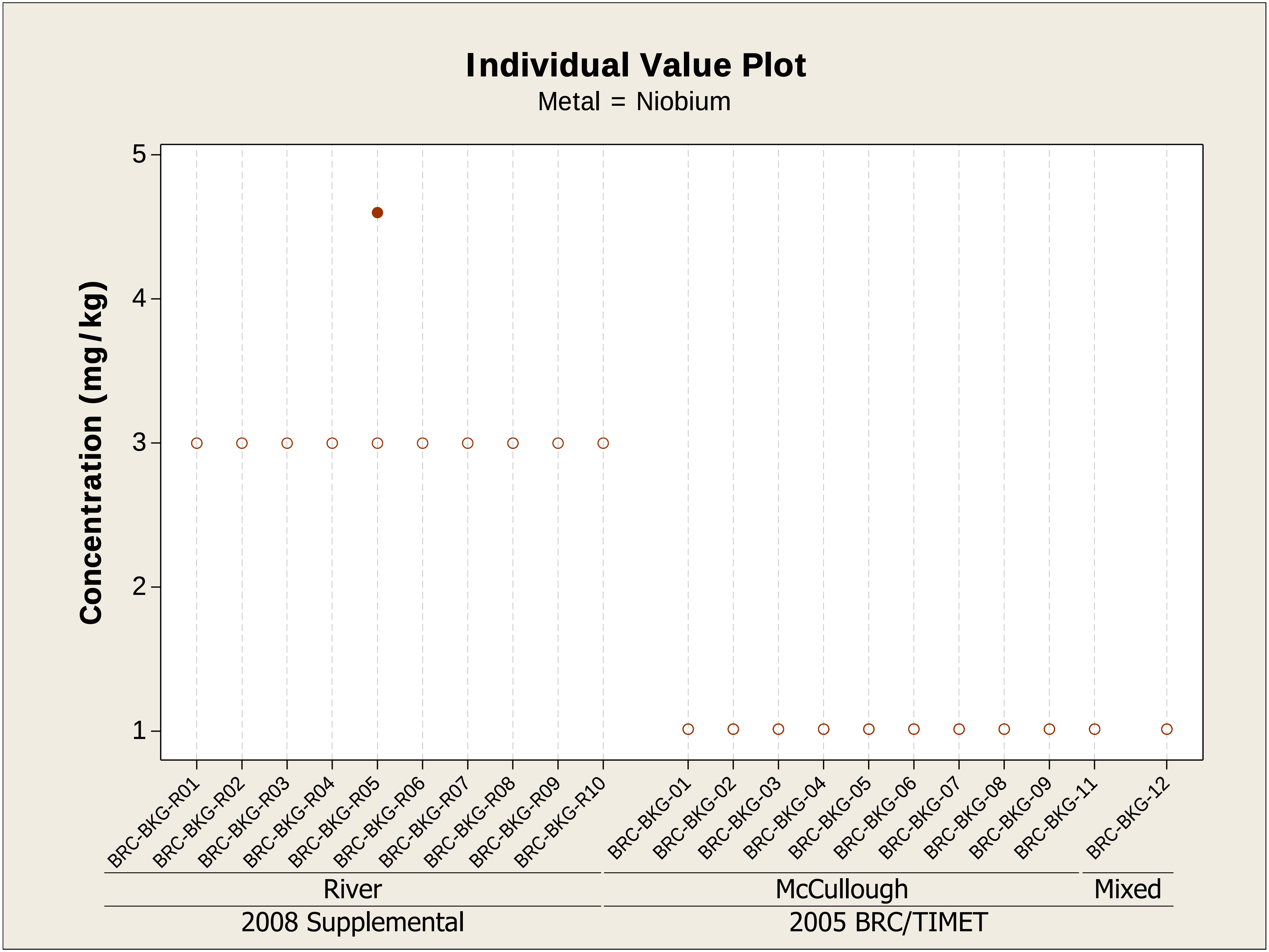
Individual Value Plot
Metal = Mercury
Concentration (mg/kg)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



Individual Value Plot
Metal = Molybdenum
Concentration (mg/kg)
0.0
0.5
1.0
1.5
2.0
2.5
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



Individual Value Plot
Metal = Nickel
Concentration (mg/kg)
30
25
20
15
10
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Niobium
Concentration (mg/kg)
5
4
3
2
1
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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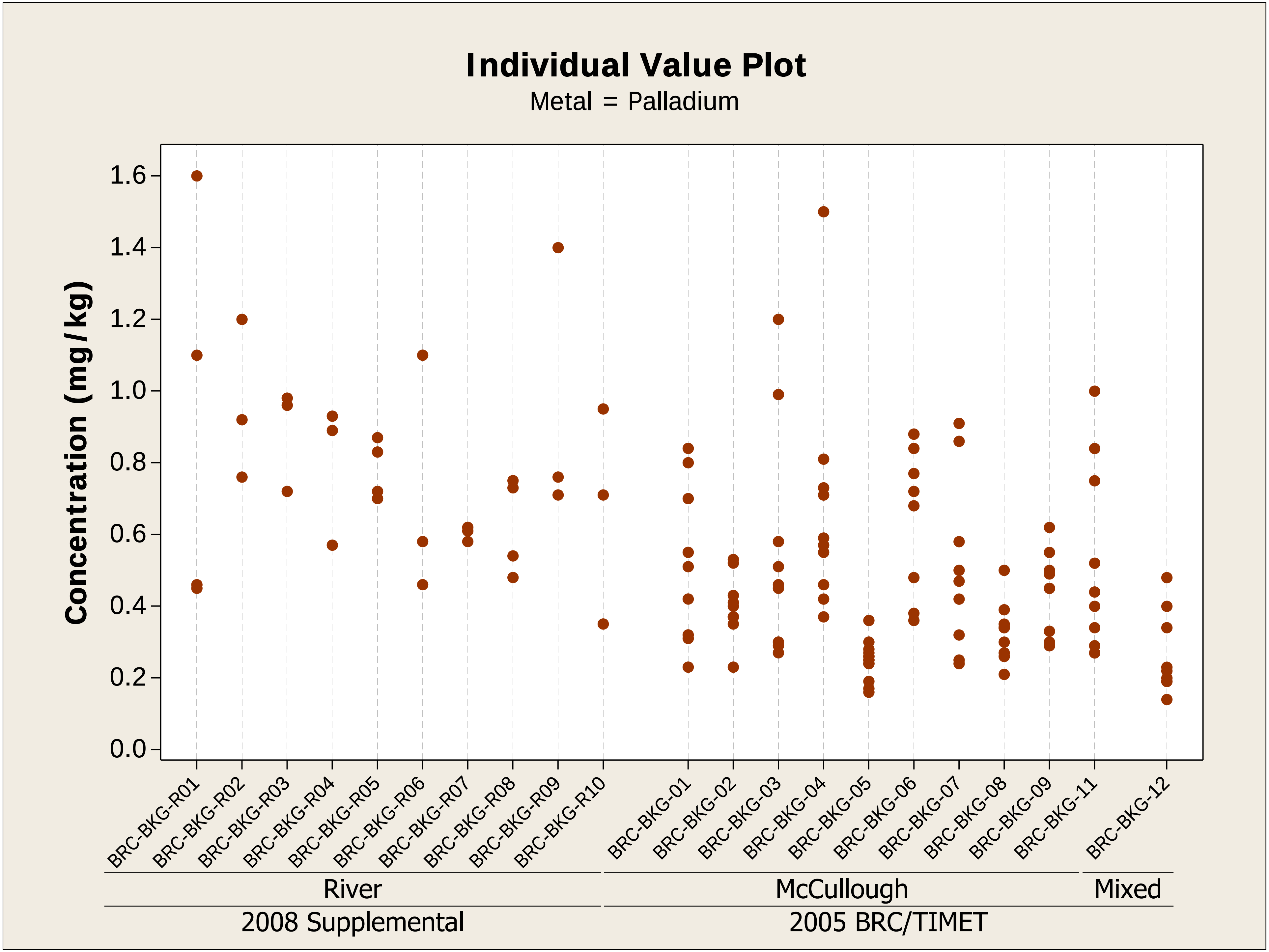
Individual Value Plot
Metal = Palladium
Concentration (mg/kg)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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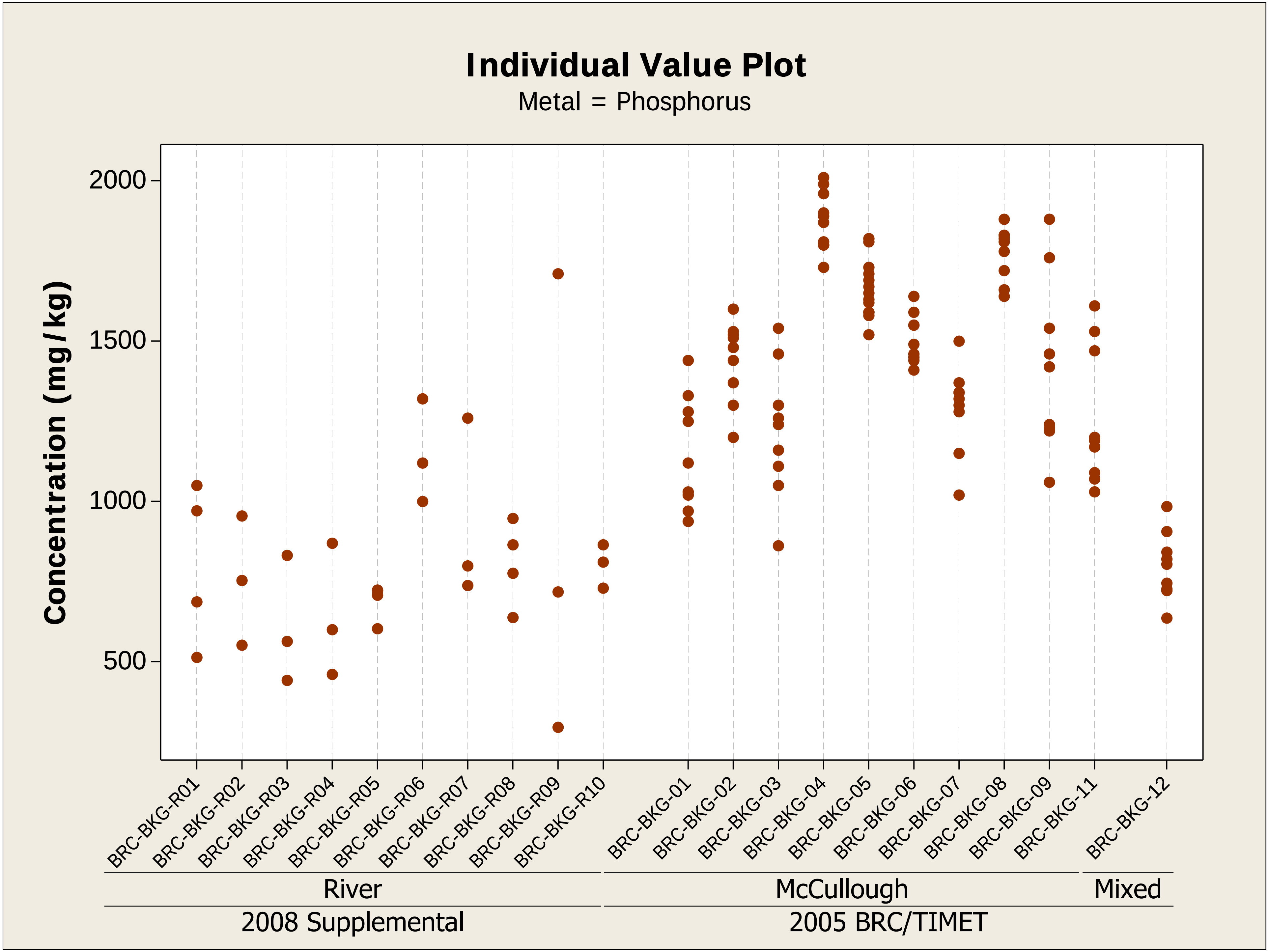
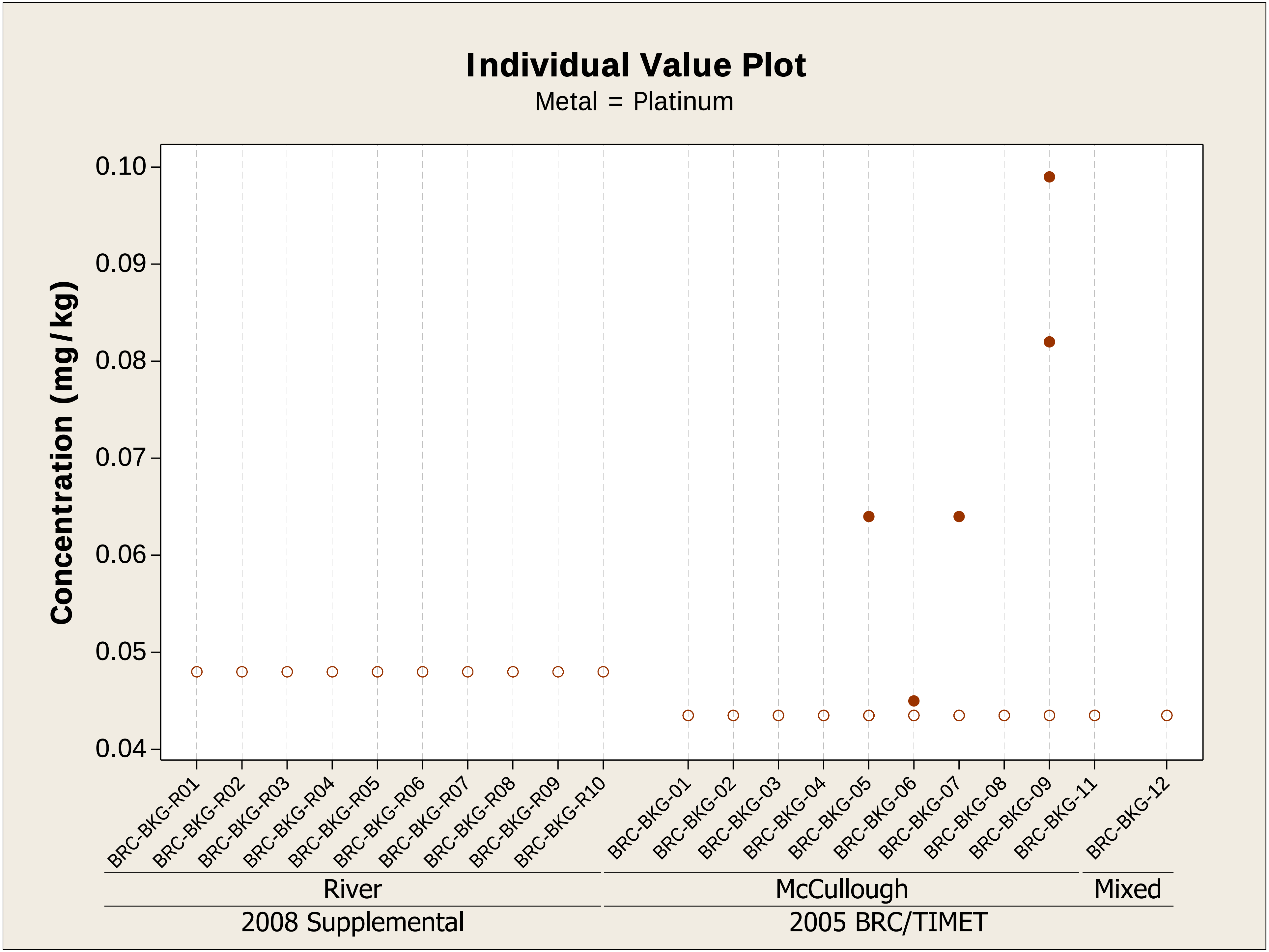

Individual Value Plot
Metal = Phosphorus
Concentration (mg/kg)
2000
1500
1000
500
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Platinum
Concentration (mg/kg)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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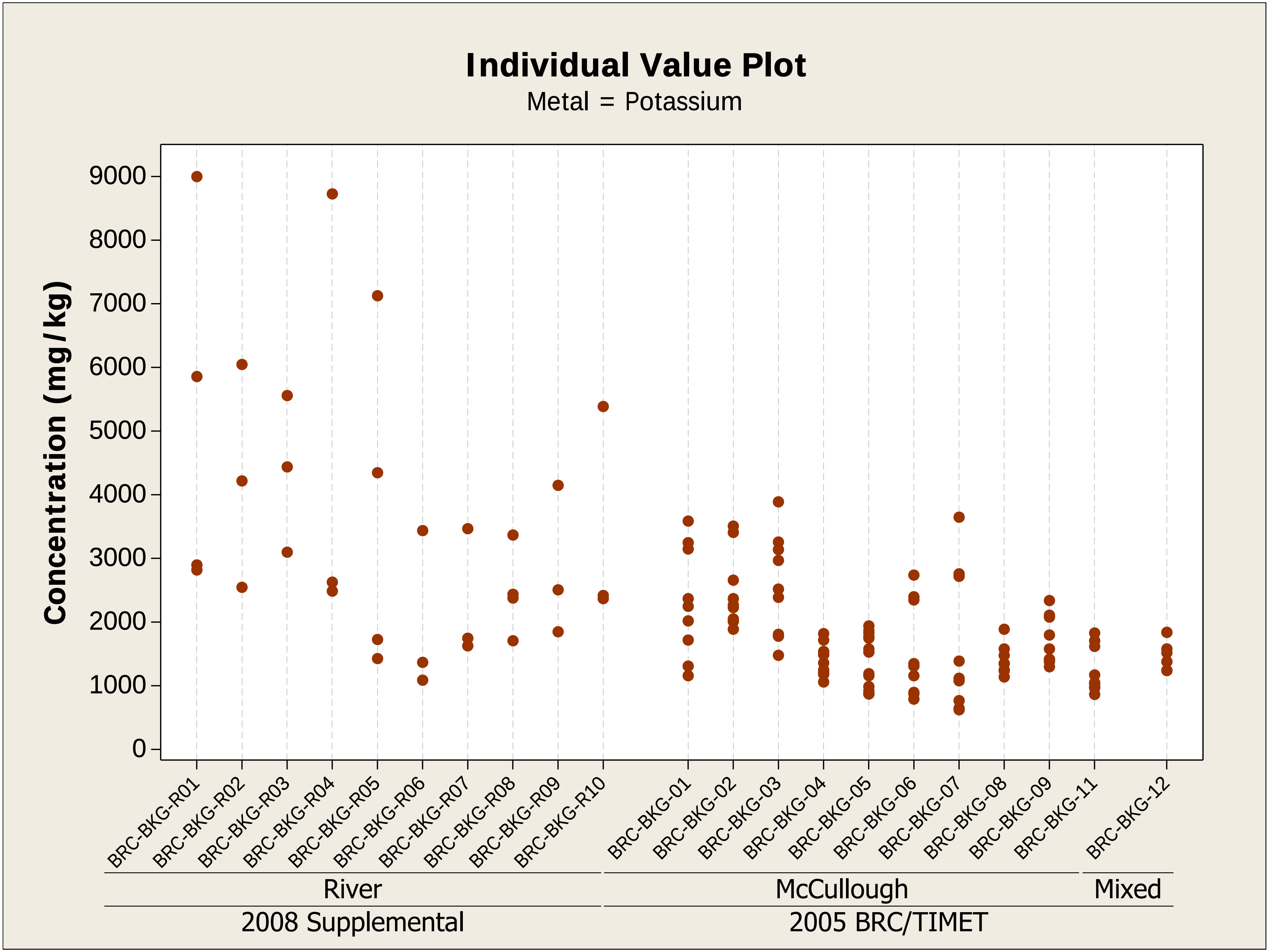
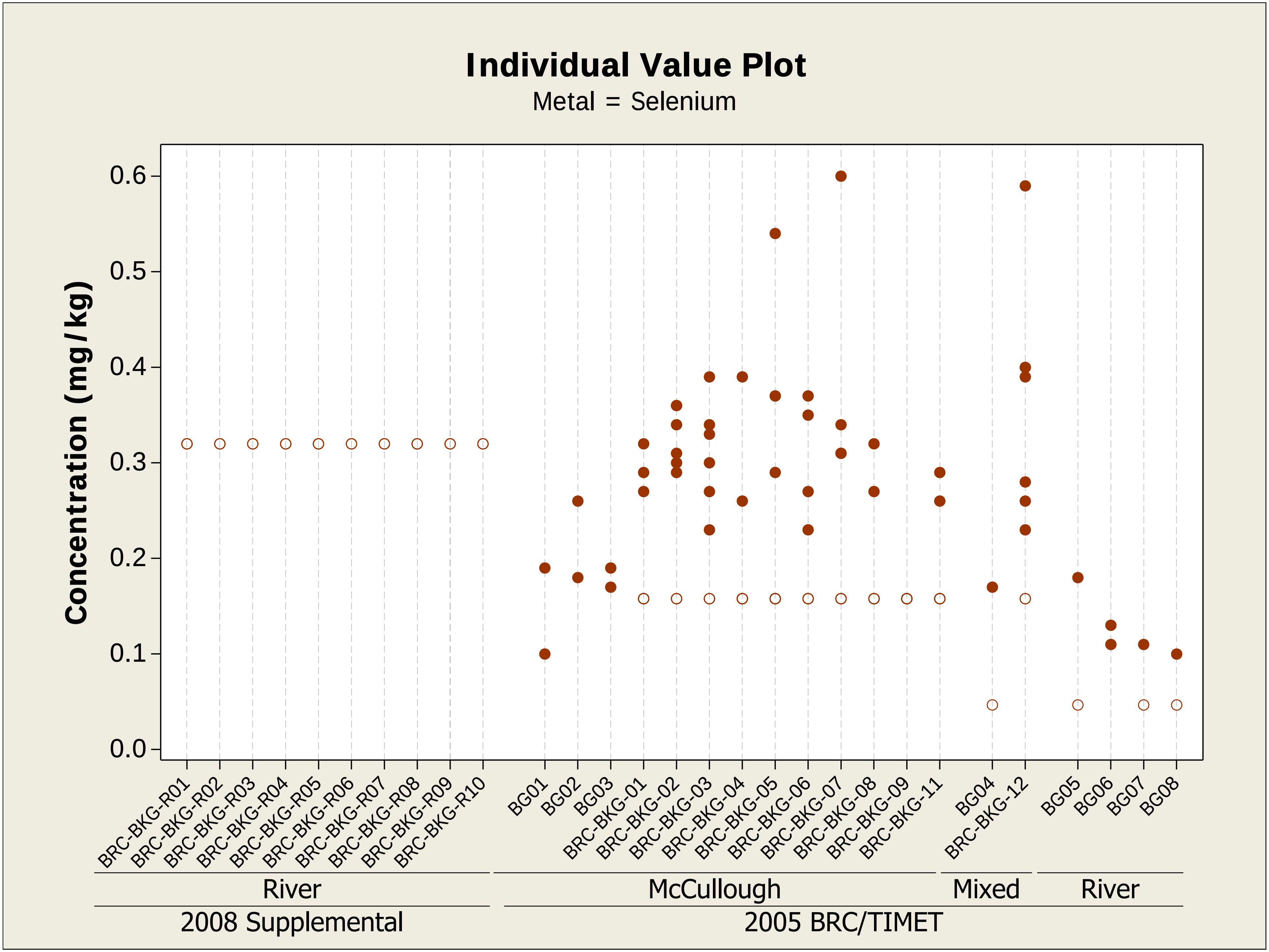

Individual Value Plot
Metal = Potassium
Concentration (mg/kg)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Selenium
Concentration (mg/kg)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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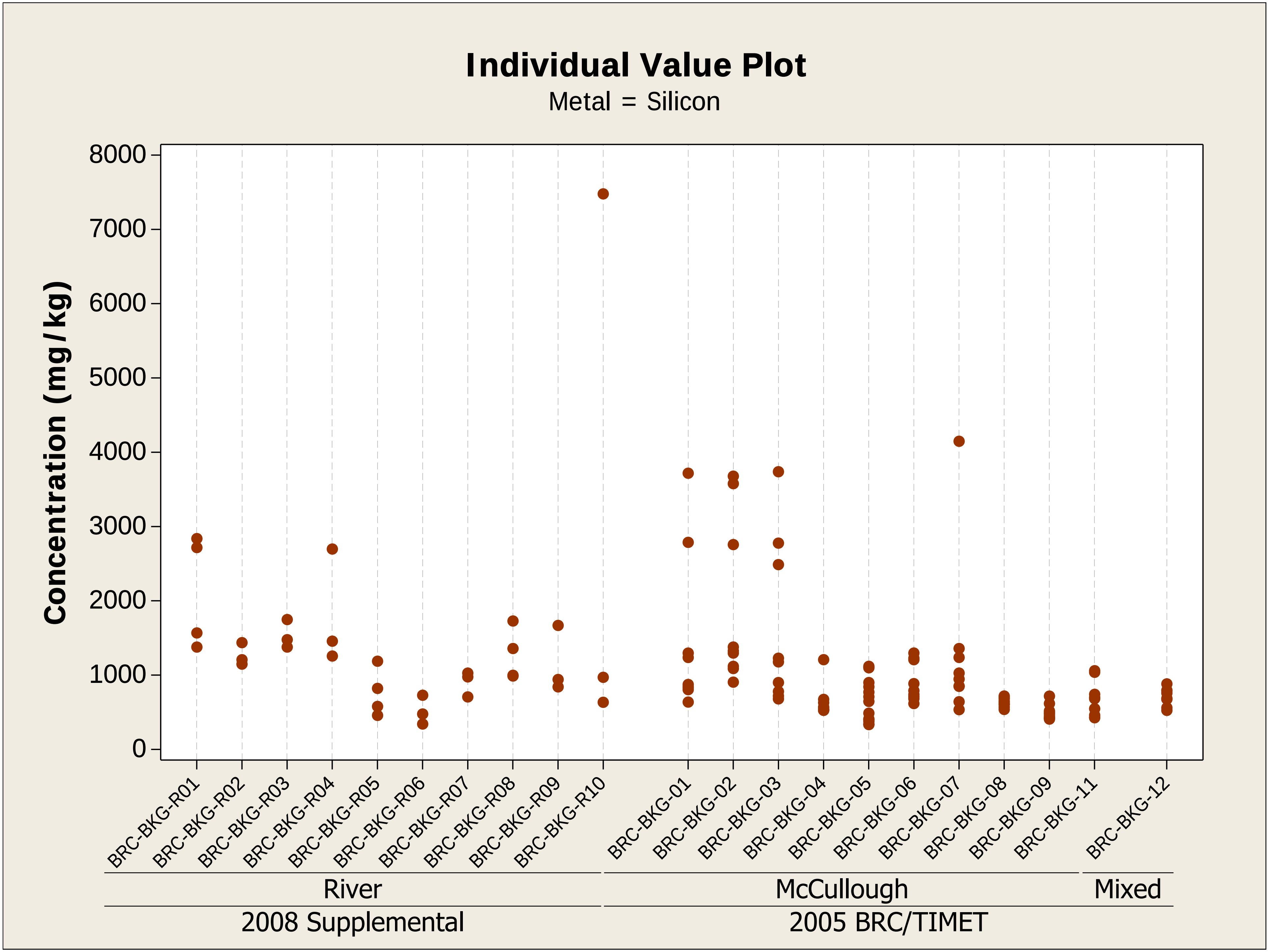

Individual Value Plot
Metal = Silicon
Concentration (mg/kg)
0
1000
2000
3000
4000
5000
6000
7000
8000
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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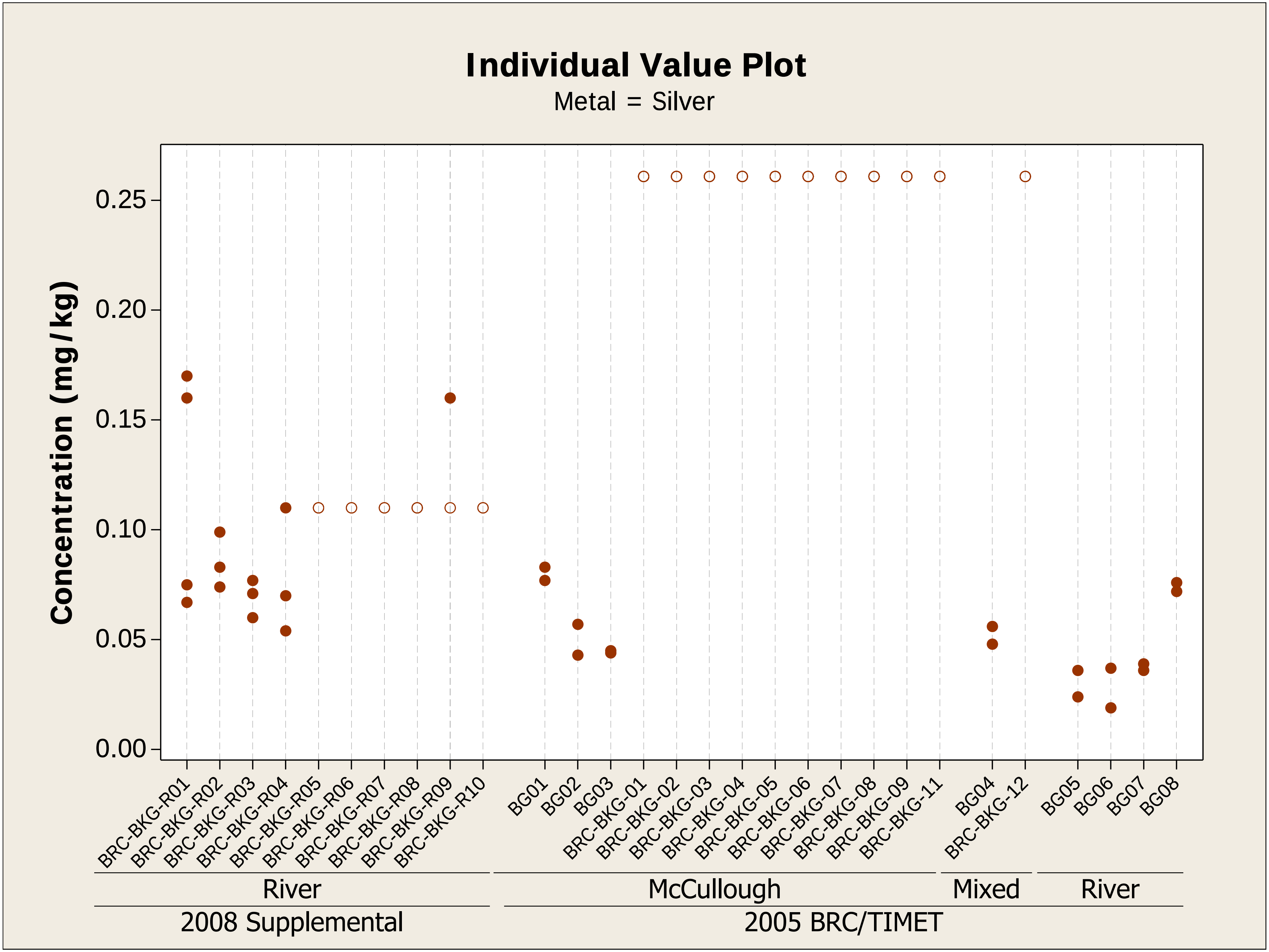
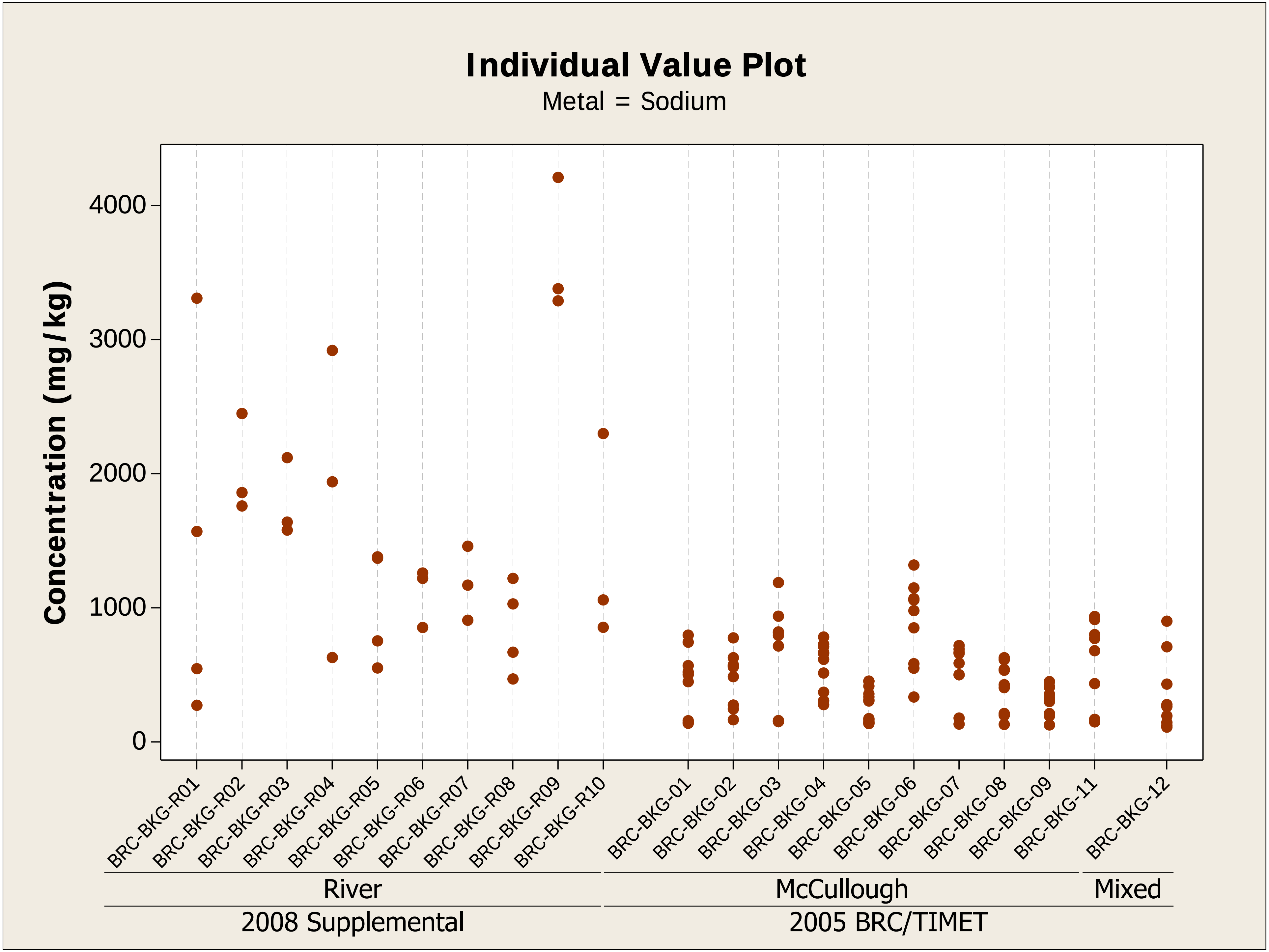
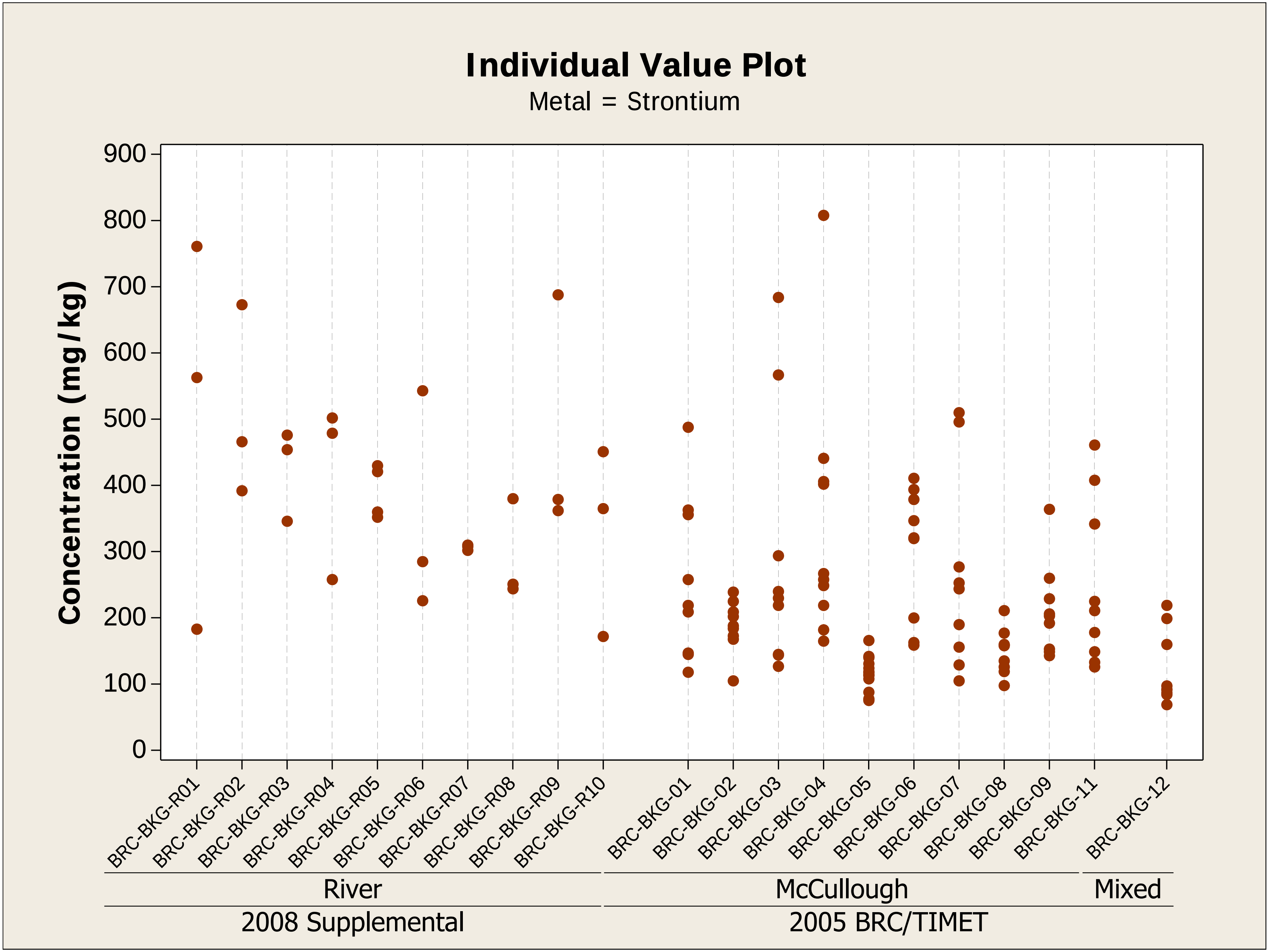

Individual Value Plot
Metal = Silver
Concentration (mg/kg)
0.25
0.20
0.15
0.10
0.05
0.00
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Sodium
Concentration (mg/kg)
0
1000
2000
3000
4000
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Metal = Strontium
Concentration (mg/kg)
0
100
200
300
400
500
600
700
800
900
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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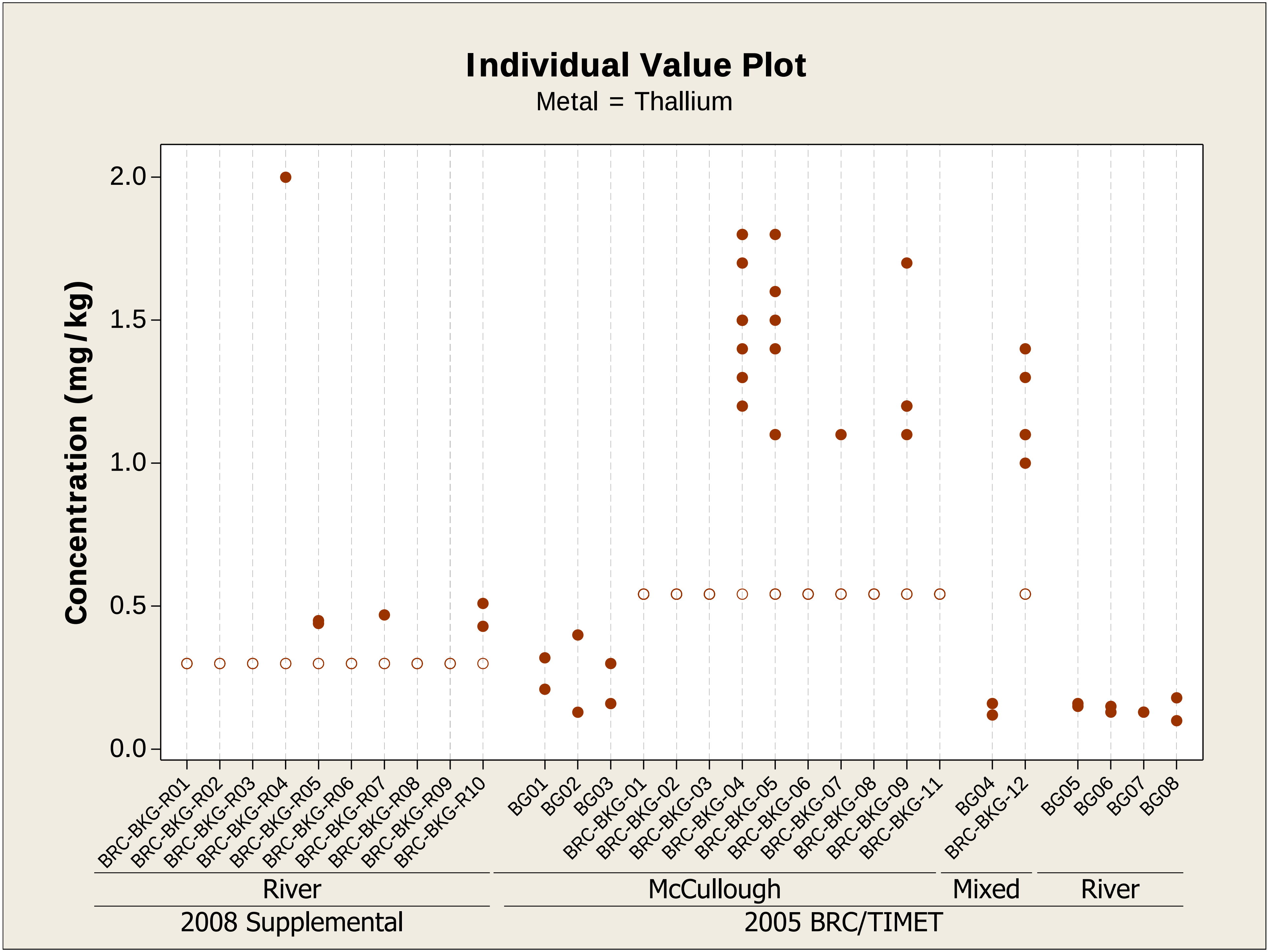
Individual Value Plot
Metal = Thallium
Concentration (mg/kg)
2.0
1.5
1.0
0.5
0.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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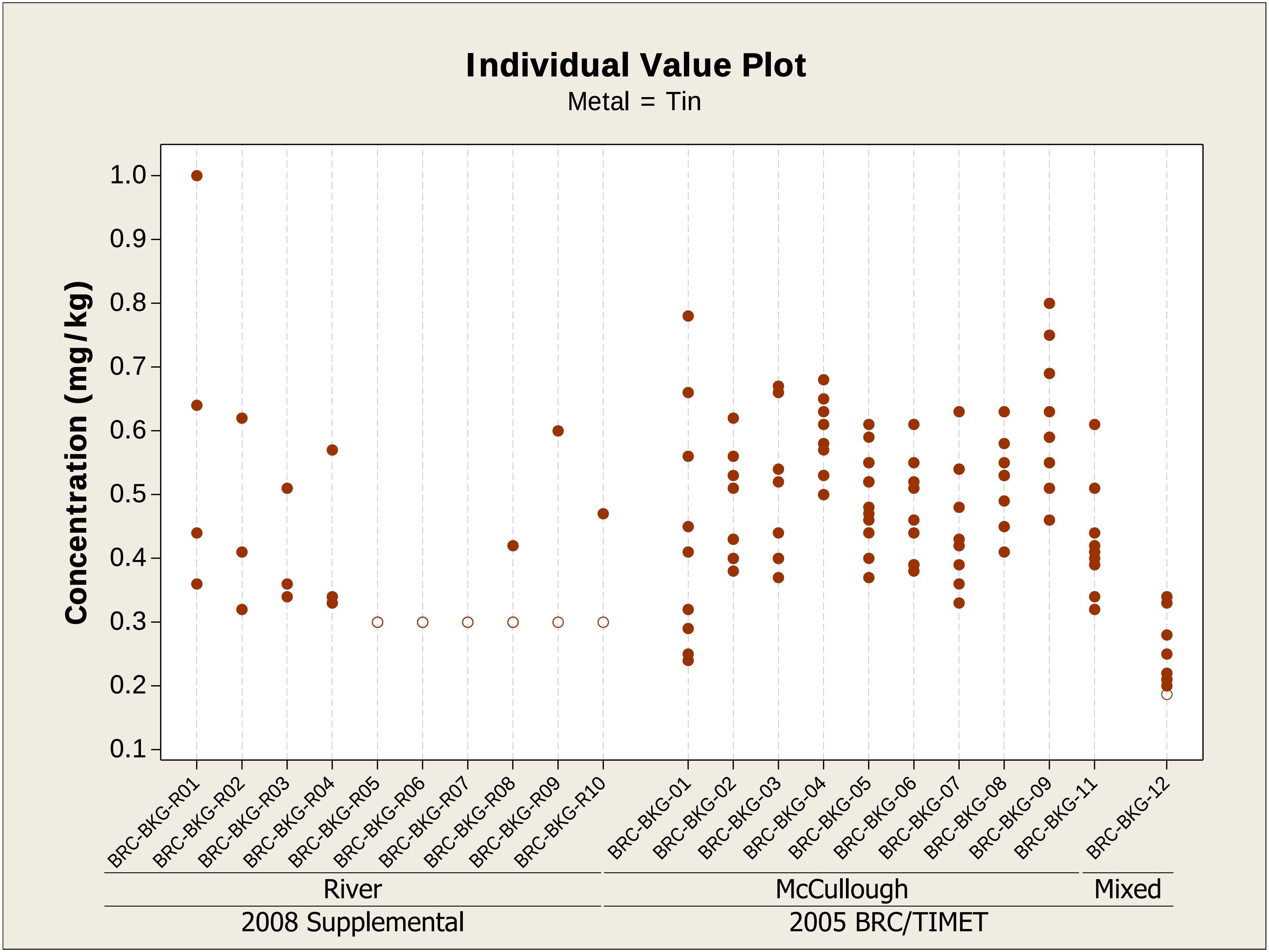

Individual Value Plot
Metal = Tin
Concentration (mg/kg)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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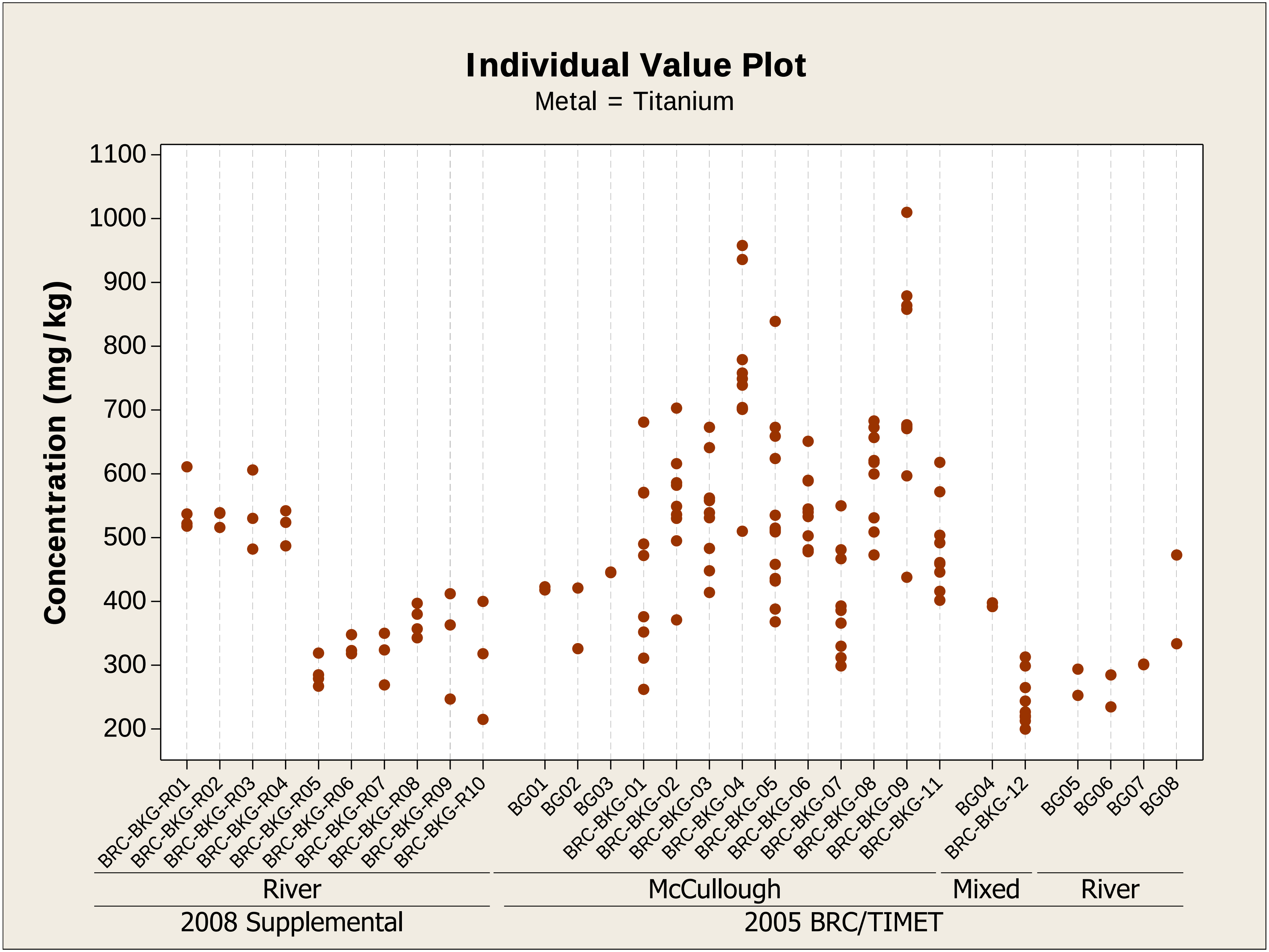

Individual Value Plot
Metal = Titanium
Concentration (mg/kg)
1100
1000
900
800
700
600
500
400
300
200
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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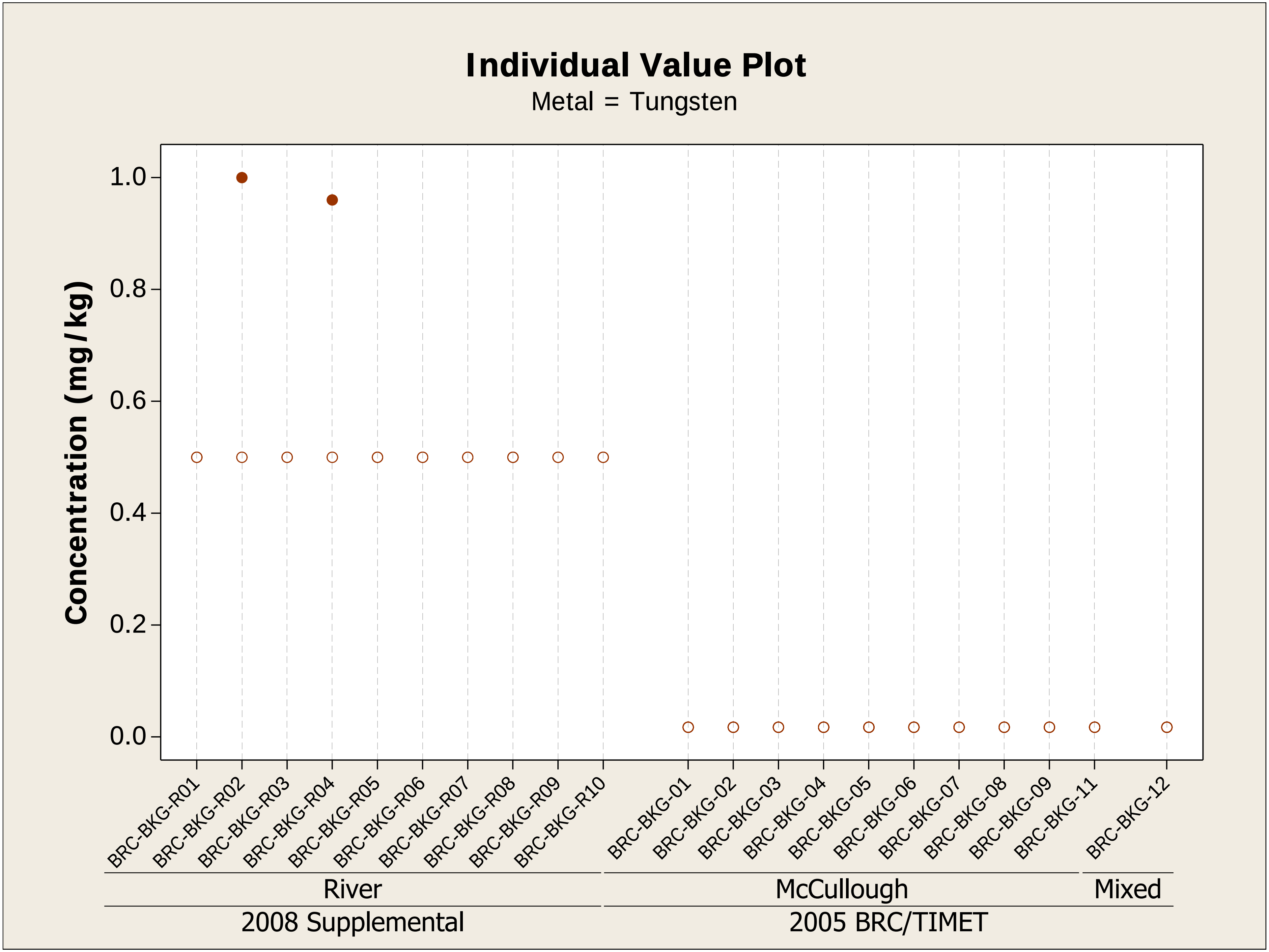
Individual Value Plot
Metal = Tungsten
Concentration (mg/kg)
1.0
0.8
0.6
0.4
0.2
0.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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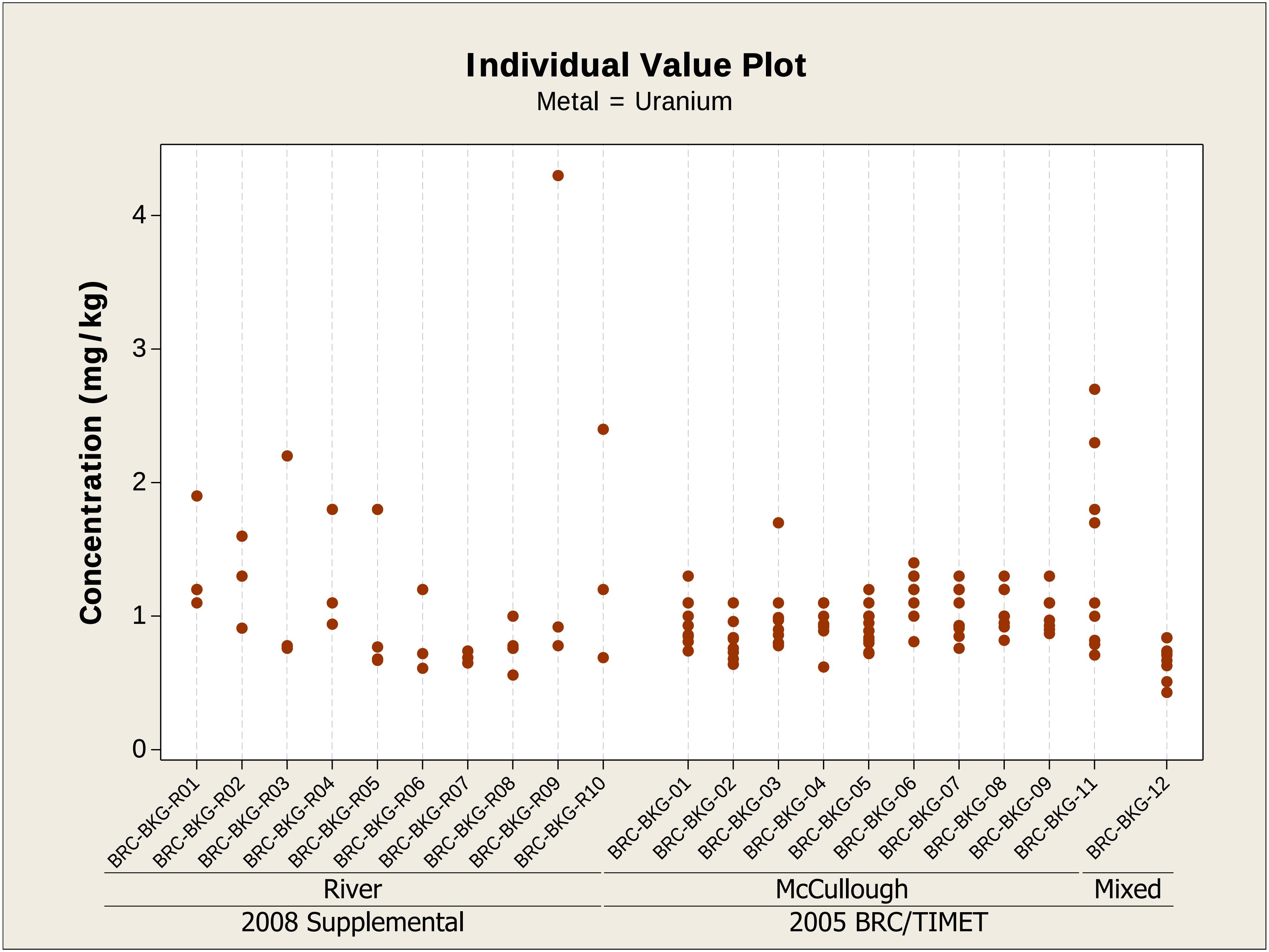

Individual Value Plot
Metal = Uranium
Concentration (mg/kg)
0
1
2
3
4
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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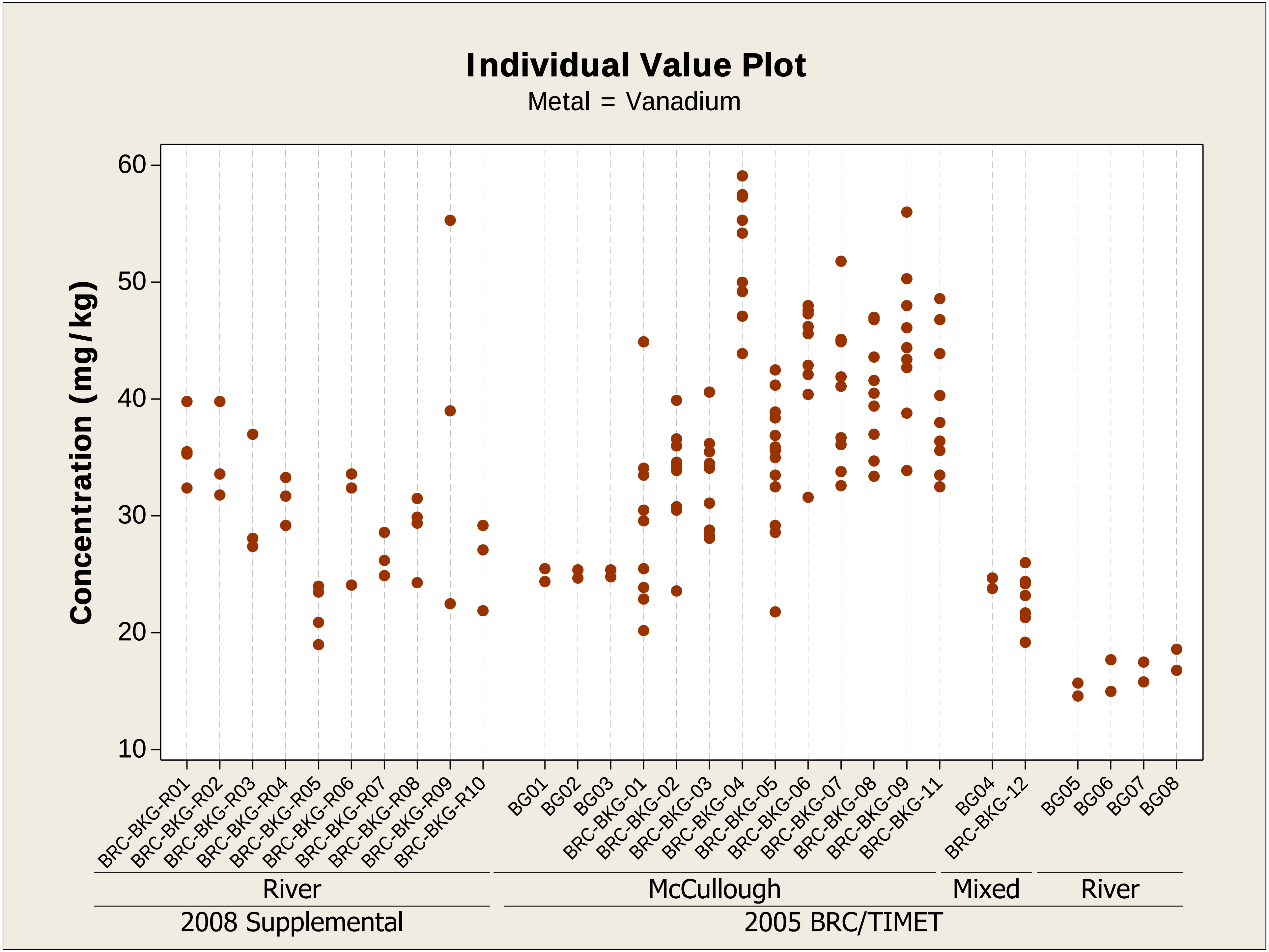
Individual Value Plot
Metal = Vanadium
Concentration (mg/kg)
60
50
40
30
20
10
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
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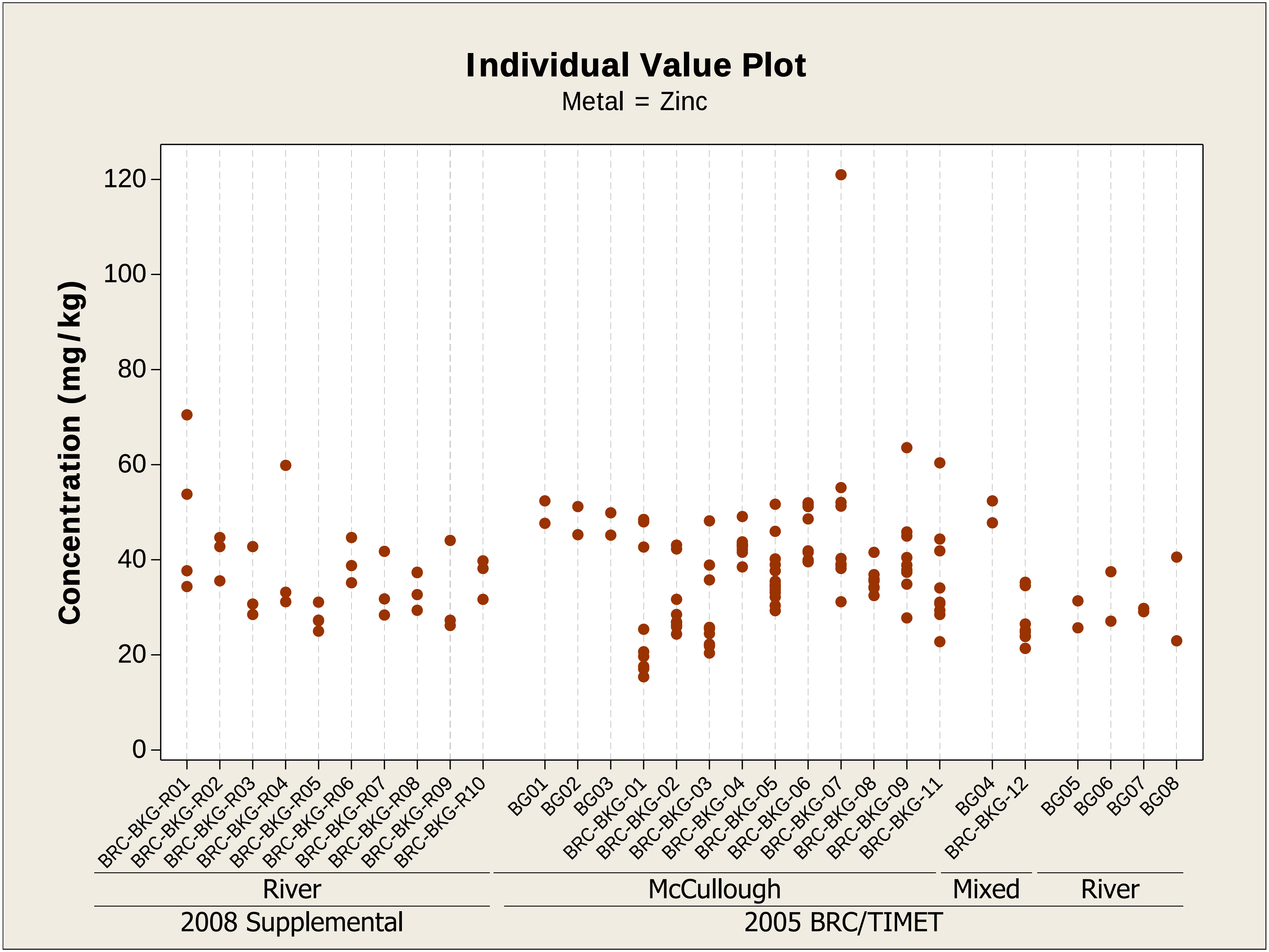

Individual Value Plot
Metal = Zinc
Concentration (mg/kg)
0
20
40
60
80
100
120
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
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River
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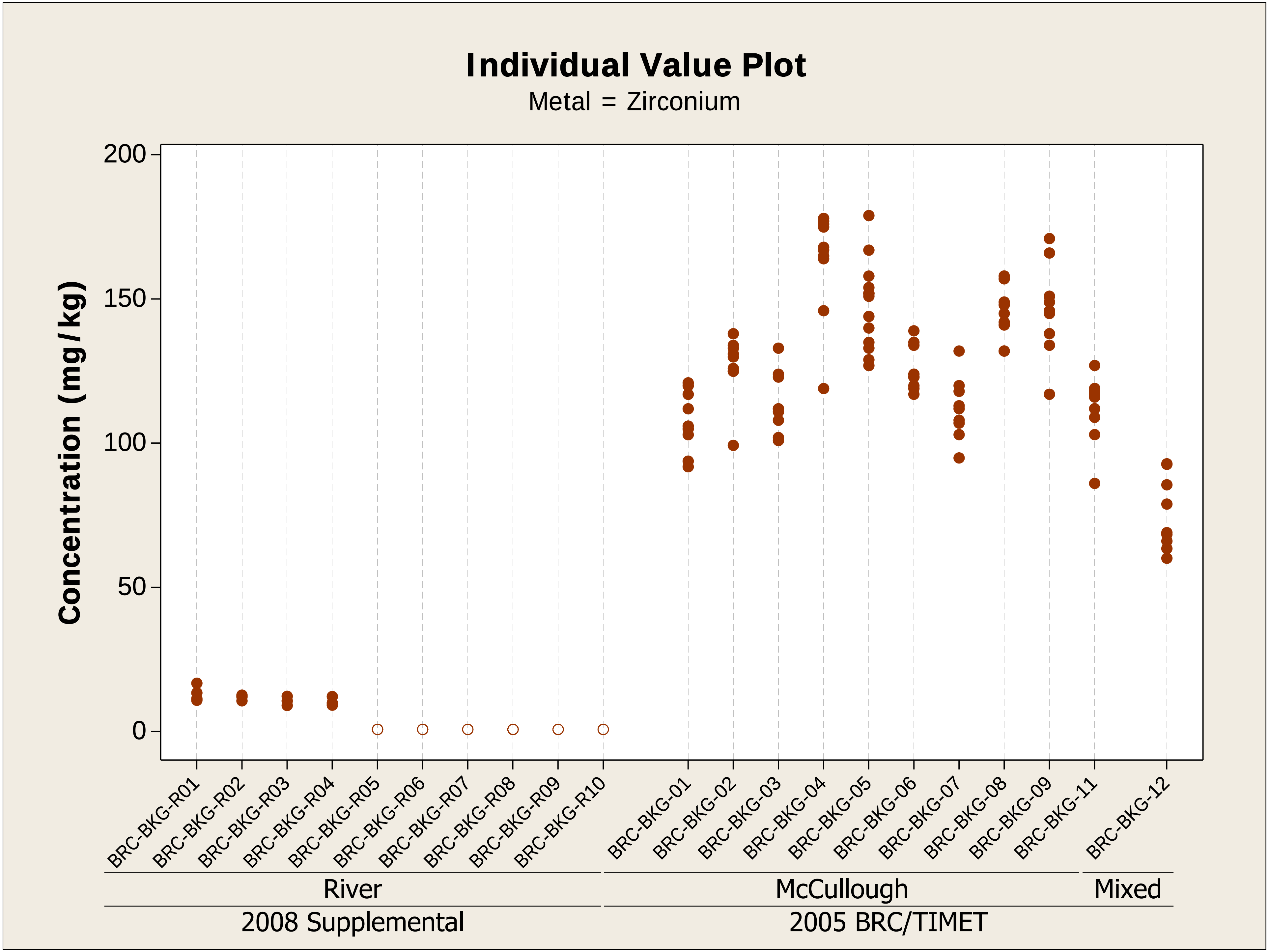
Individual Value Plot
Metal = Zirconium
Concentration (mg/kg)
200
150
100
50
0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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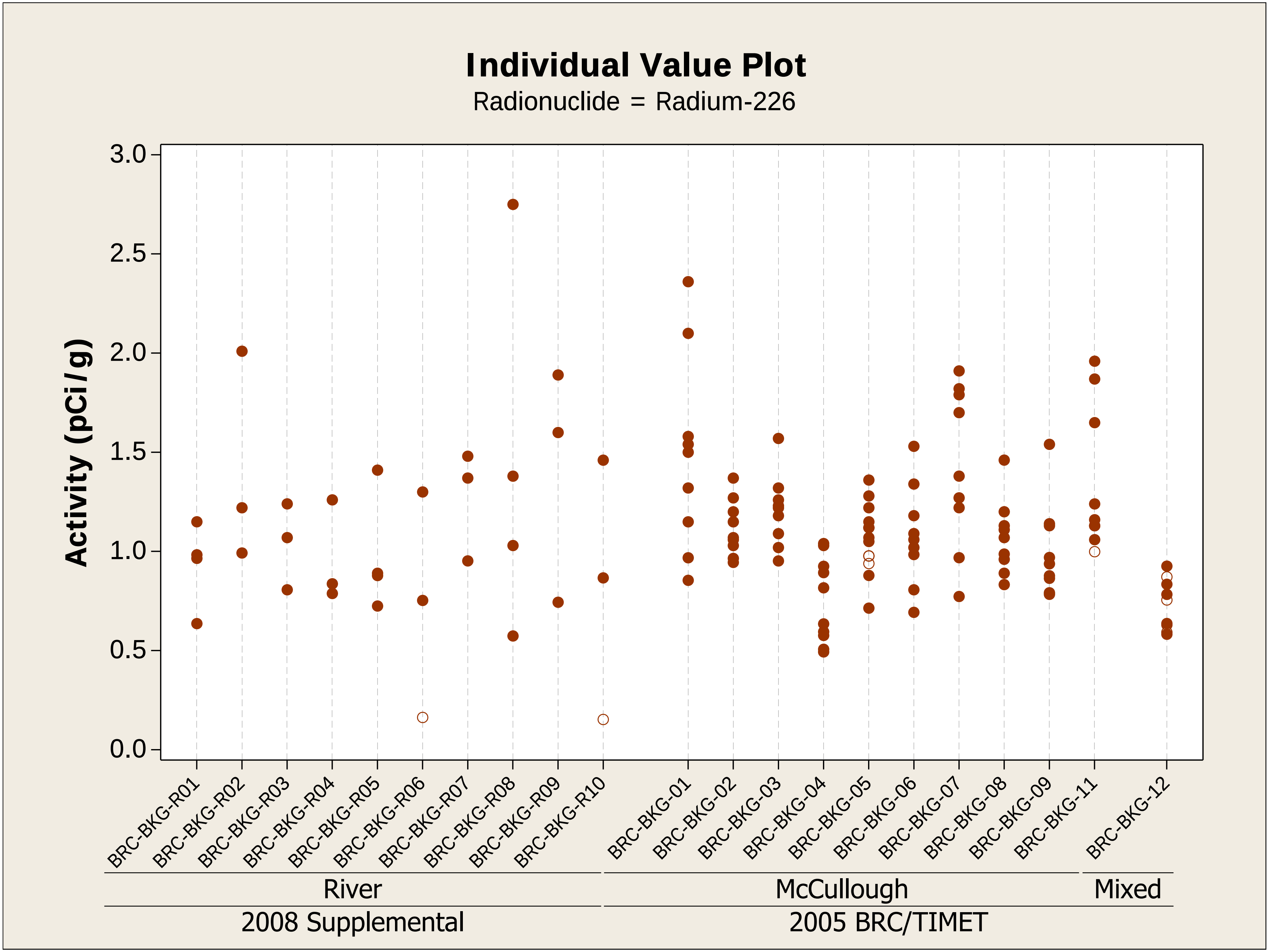
Individual Value Plot
Radionuclide = Radium-226
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
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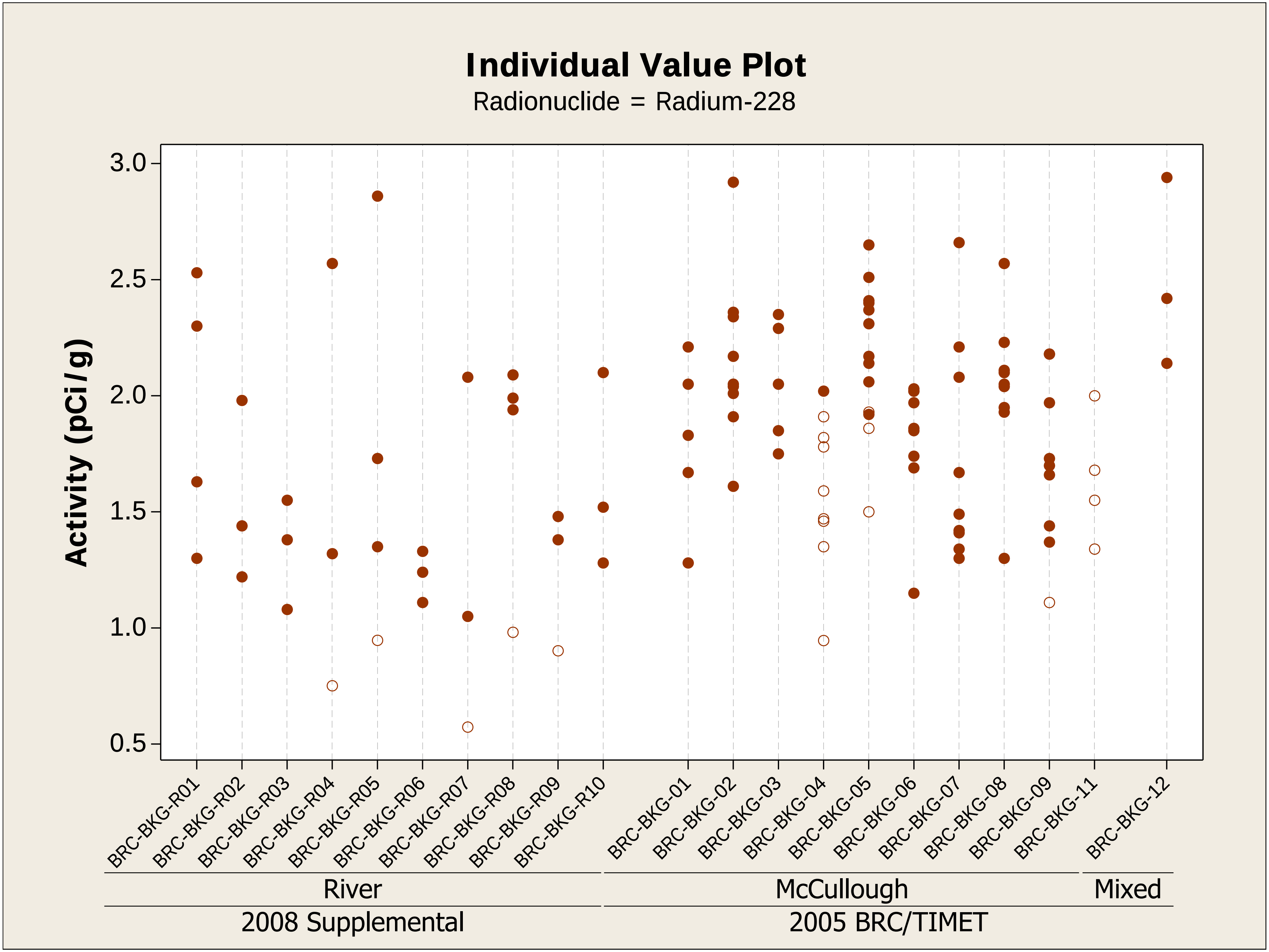
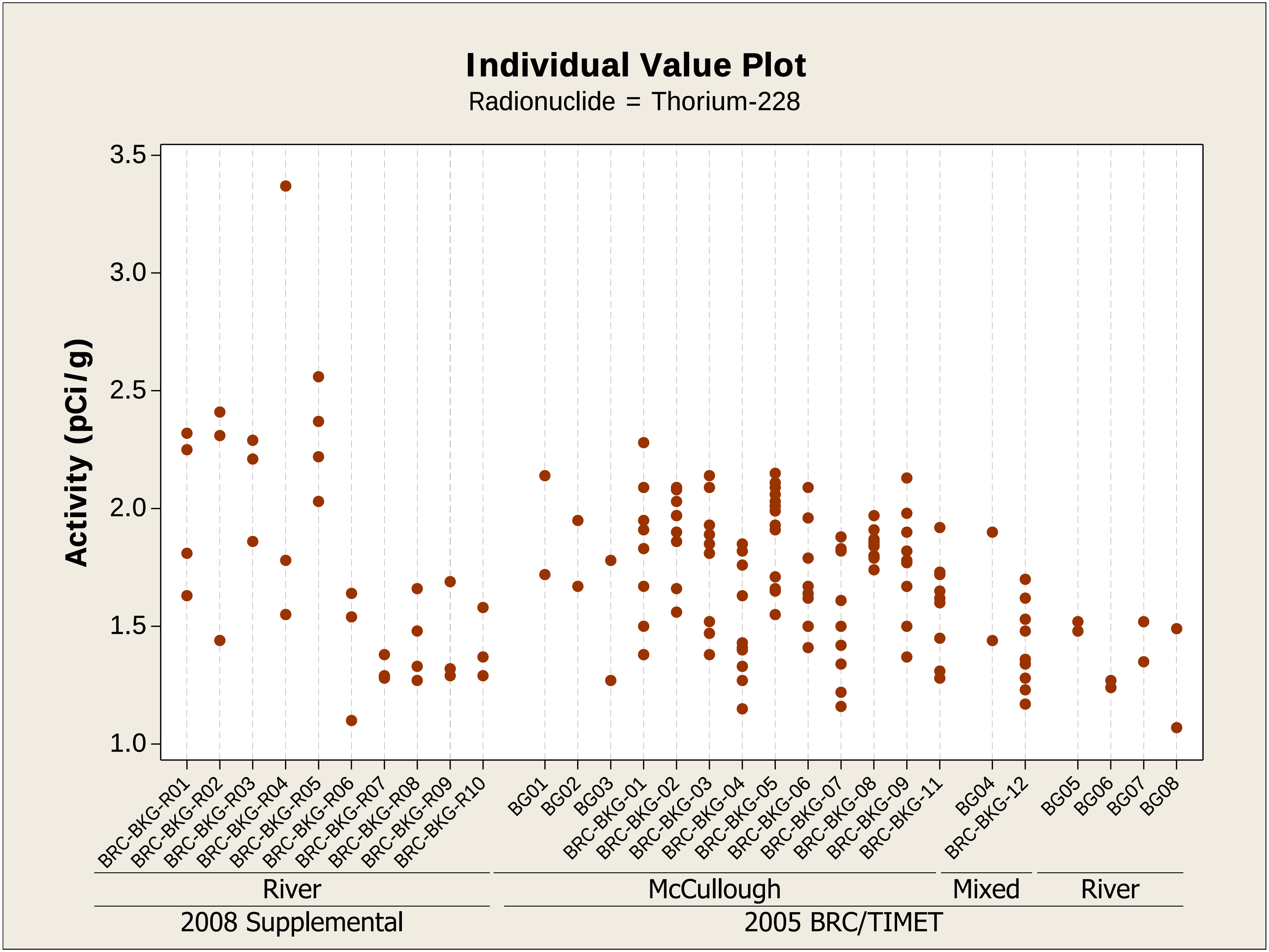
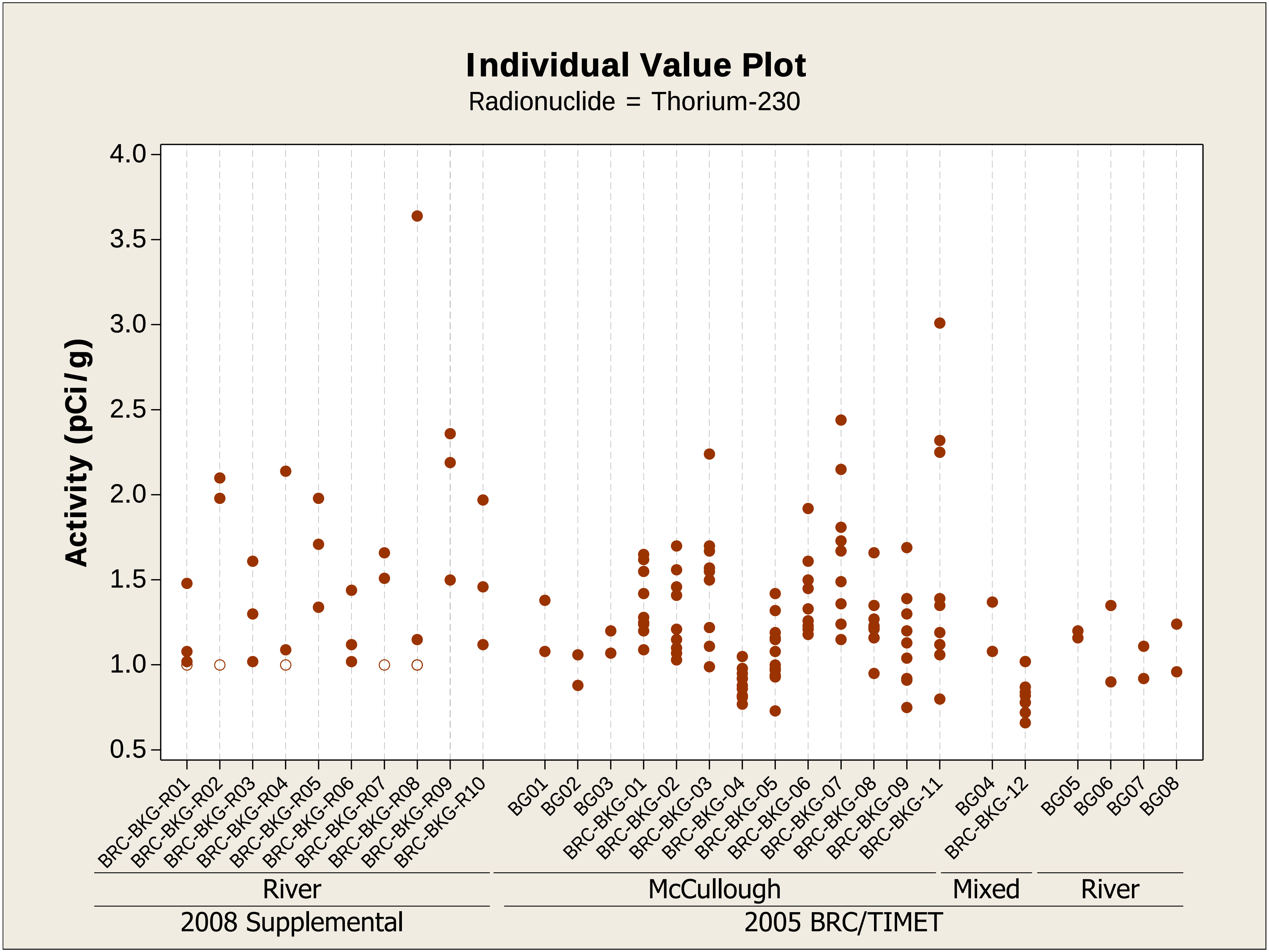
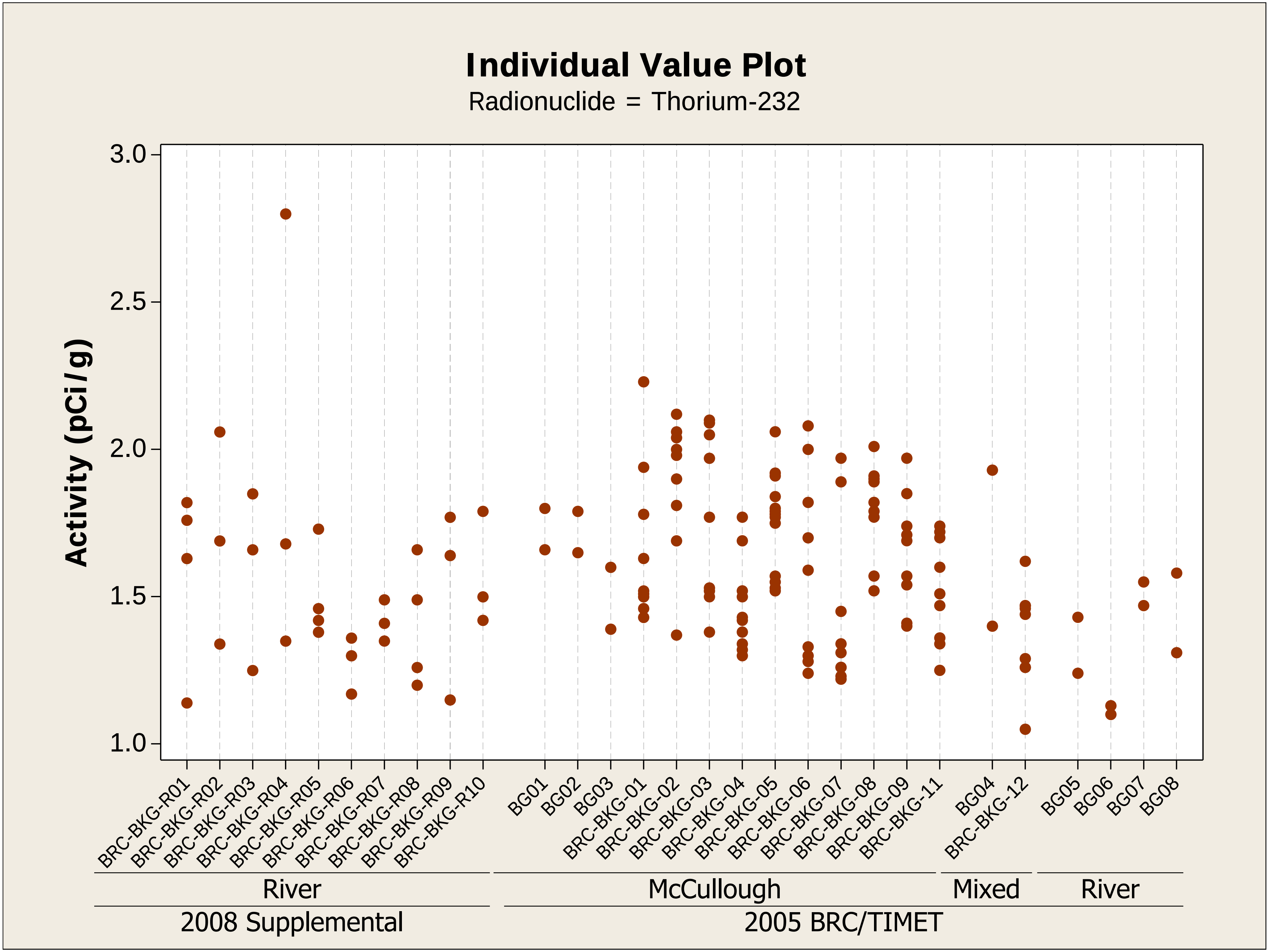

Individual Value Plot
Radionuclide = Radium-228
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
0.5
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BRC-BKG-12
River
McCullough
Mixed
2008 Supplemental
2005 BRC/TIMET

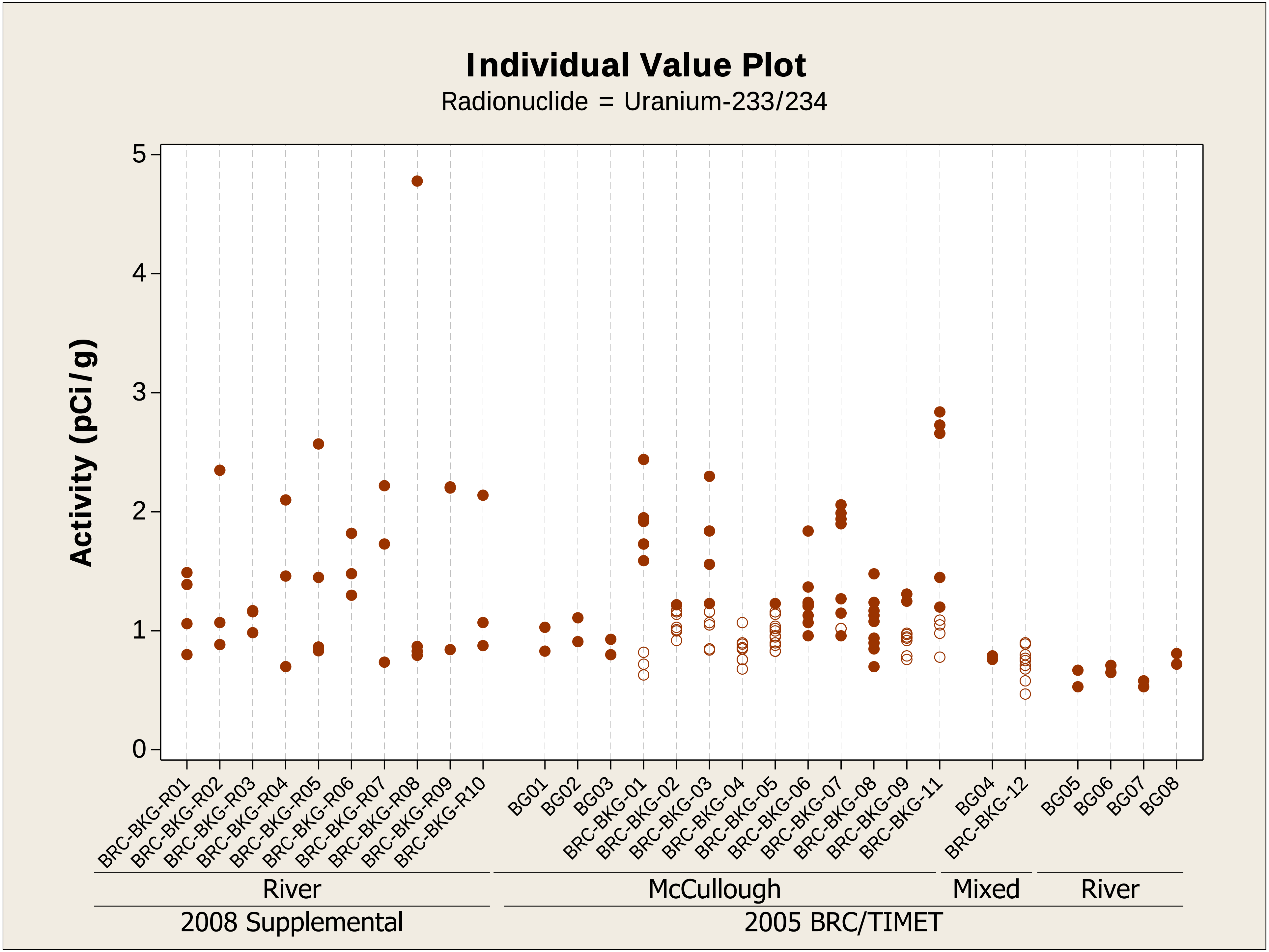


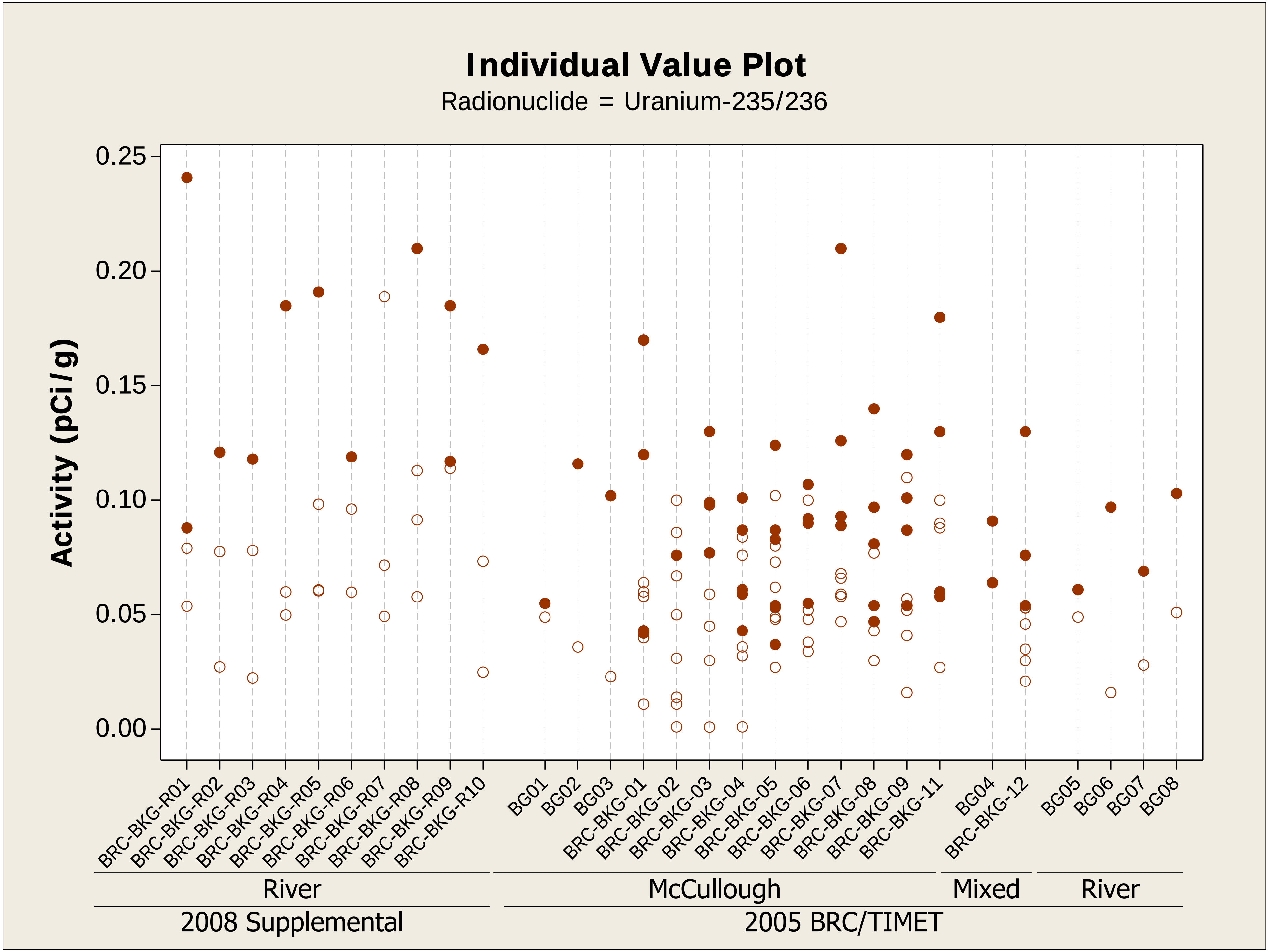
Individual Value Plot
Radionuclide = Thorium-228
Activity (pCi/g)
3.5
3.0
2.5
2.0
1.5
1.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

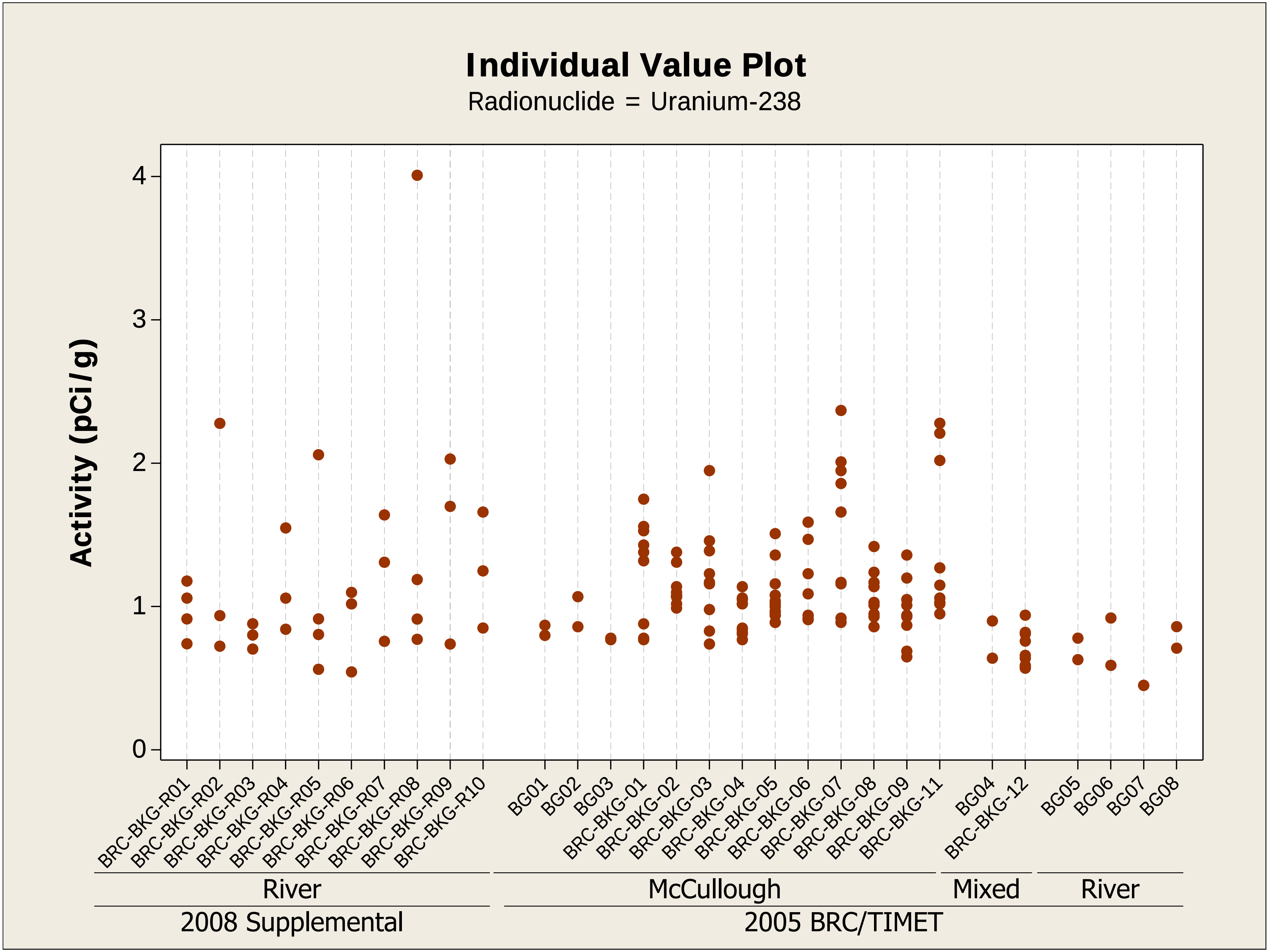


Individual Value Plot
Radionuclide = Thorium-230
Activity (pCi/g)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Radionuclide = Thorium-232
Activity (pCi/g)
3.0
2.5
2.0
1.5
1.0
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Radionuclide = Uranium-233/234
Activity (pCi/g)
0
1
2
3
4
5
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET


Individual Value Plot
Radionuclide = Uranium-235/236
Activity (pCi/g)
0.25
0.20
0.15
0.10
0.05
0.00
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET



Individual Value Plot
Radionuclide = Uranium-238
Activity (pCi/g)
0
1
2
3
4
BRC-BKG-R01
BRC-BKG-R02
BRC-BKG-R03
BRC-BKG-R04
BRC-BKG-R05
BRC-BKG-R06
BRC-BKG-R07
BRC-BKG-R08
BRC-BKG-R09
BRC-BKG-R10
BG01
BG02
BG03
BRC-BKG-01
BRC-BKG-02
BRC-BKG-03
BRC-BKG-04
BRC-BKG-05
BRC-BKG-06
BRC-BKG-07
BRC-BKG-08
BRC-BKG-09
BRC-BKG-11
BG04
BRC-BKG-12
BG05
BG06
BG07
BG08
River
McCullough
Mixed
River
2008 Supplemental
2005 BRC/TIMET

APPENDIX E

DISCUSSION OF STATISTICAL OUTLIERS

Appendix E
Discussion of Statistical Outliers

Anomalously high statistical outliers were identified using the criterion identified in Section 3.4 of the report for the following constituents:

Arsenic	BRC-BKG-R02 (5 ft bgs) BRC-BKG-R09 (10 ft bgs)	Silicon	BRC-BKG-R10 (0 ft bgs)
Boron	BRC-BKG-R09 (10 ft bgs)	Sodium	BRC-BKG-R09 (0 ft bgs)
Cadmium	BRC-BKG-R01 (0 ft bgs) BRC-BKG-R10 (5 ft bgs) BRC-BKG-R09 (10 ft bgs)	Thallium	BRC-BKG-R04 (0 ft bgs)
Copper	BRC-BKG-R01 (0 ft bgs)	Tin	BRC-BKG-R01 (0 ft bgs)
Lead	BRC-BKG-R01 (0 ft bgs) BRC-BKG-R04 (0 ft bgs)	Uranium	BRC-BKG-R09 (10 ft bgs)
Magnesium	BRC-BKG-R09 (5 ft bgs)	Thorium-230	BRC-BKG-R08 (10 ft bgs)
Manganese	BRC-BKG-R04 (0 ft bgs) BRC-BKG-R02 (10 ft bgs)	Thorium-232	BRC-BKG-R04 (10 ft bgs)
Molybdenum	BRC-BKG-R01 (0 ft bgs)	Uranium-233/234	BRC-BKG-R08 (10 ft bgs)
Phosphorus	BRC-BKG-R09 (0 ft bgs)	Uranium-235/236	BRC-BKG-R01 (5 ft bgs)
		Uranium-238	BRC-BKG-R08 (10 ft bgs)

As seen above, several samples exhibit statistical outliers for one or more constituents. However, no one sample is routinely anomalously high in a way that suggests the associated detections are not representative of background. That said, the surface samples at locations BRC-BKG-R01 and BRC-BKG-R04 exhibited elevated constituent concentrations relative to the other samples (*i.e.*, BRC-BKG-R01 and BRC-BKG-R04) as follows:

- The surface sample at location BRC-BKG-R01 had the highest detected value for several metals (aluminum, beryllium, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, potassium, tin, titanium, and zinc), and in several instances it is the highest of either

2005 BRC/TIMET or 2008 Supplemental datasets (aluminum, cadmium, chromium, copper, iron, lead, molybdenum, potassium, and tin).

- The surface sample at location BRC-BKG-R04 also had high detect values for several metals (lead, manganese, potassium, and thallium).

As discussed in Section 3.7.4, these values were further evaluated using correlation analysis/scatter plots to evaluate whether they were statistical outliers. This analysis identified no statistical outliers. Furthermore, there is no consistent pattern to the data that would suggest that the data are not indicative of naturally occurring background conditions. Sample locations BRC-BKG-R01 and BRC-BKG-R04 are not adjacent to each other, and if aerial deposition of wind-borne dusts from Site operations were suspected, then higher levels of metals typically found in soils at the site; for example, arsenic and vanadium would be expected at the surface in these samples. However, this is not the case. As noted above, the highest arsenic concentrations are found in the subsurface (BRC-BKG-R02 at 5 ft bgs and BRC-BKG-R09 at 10 ft bgs).

The supplemental background sample locations are west of the River Mountains. Formations associated with these mountains contain volcanic intrusions that are known to contain elevated concentrations of naturally occurring arsenic (Bevans *et al.*, 1998). The supplemental background locations are geologically similar to the western and central portions of the Henderson Landfill (see Figure 2 for landfill location). The central portion of the landfill relates to the artificial fill area that covers the pediment and fan deposits of the River Mountains and further to the east the Horse Spring Formation (from CH2MHill 2006; approved by NDEP on August 7, 2006). The western portion relates to the uncovered areas of the pediment and fan deposits of the River Mountains and the modern wash deposits (CH2MHill 2006). Arsenic levels found in undisturbed areas from the western and central portions of the landfill ranged from 3.7 to 34 mg/kg. The two highest arsenic concentrations from the supplemental background dataset (sample location BRC-BKG-R02 at 5 ft bgs and sample location BRC-BKG-R09 at 10 ft bgs) are within this range. They are therefore likely due to naturally occurring variability.

Based on the overall findings of the outlier analysis, statistical outliers represent only a small proportion of the entire dataset. In addition, the lack of a consistent pattern related to statistical outliers would suggest that the data are not indicative of naturally occurring background conditions. Moreover, background soil samples were collected from known/suspected unimpacted areas upgradient of the Site industrial areas, and the SVOC data did not provide compelling evidence suggesting that data were inappropriate for characterizing background conditions. Given this weight-of-evidence for the lack of scientifically defensible reasons to consider these statistical outliers to be incongruous with background conditions (i.e., "true" outliers), these data were considered representative of background and retained in the supplementary background soil dataset.

REFERENCES

Bevans, H.E.; Lico, M.S.; Lawrence, S.J. 1998. Water Quality in the Las Vegas Valley Area and the Carson and Truckee River Basins, Nevada and California", 1992-96; updated March 19.

CH2MHill. 2006. Technical Memorandum: Henderson Landfill Response Program Site Soils Criteria. June 2.

APPENDIX F

DATASET COMPARISON STATISTICS

Comparison of Soil Depth Strata for 2008 Supplemental Dataset (Table F-1)

Comparison of 2008 versus 2005 Datasets – All Depths Data – All Lithologies (Table F-2)

Comparison of 2008 versus 2005 Datasets – 5 and 10 ft bgs – All Lithologies (Table F-3)

Comparison of 2008 versus 2005 Datasets – Test of Proportions – All Depths Data (Table F-4)

Comparison of 2008 versus 2005 Datasets – Test of Proportions – 5 and 10 ft bgs Data (Table F-5)

Comparison of 2008 versus 2005 McCullough – 0 ft bgs Data (Table F-6)

Comparison of 2008 versus 2005 McCullough – 5 ft bgs Data (Table F-7)

Comparison of 2008 versus 2005 McCullough – 10 ft bgs Data (Table F-8)

Additional Two-Sample Comparisons Identified by the Test of Proportions (Table F-9)

TABLE F-1
COMPARISON OF SOIL DEPTH STRATA FOR 2008 SUPPLEMENTAL DATASET
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

		Soil Stratum							Parametric Test						Nonparametric Test						
		0-ft bgs		5-ft bgs		10-ft bgs		Param	ANOVA			Tukey HSD			Kruskal-Wallis			Box Plots			
Metal		SW Signif	Normal?	SW Signif	Normal?	SW Signif	Normal?	**test?**	F	*p*	Signif?	0 ≠ 5	5 ≠ 10	0 ≠ 10	X^2	*p*	Signif?	0 ≠ 5	5 ≠ 10	0 ≠ 10	**Notes**
Aluminum	Al	0.71	Yes	0.47	Yes	0.08	Yes	Yes	1.85	0.18	*NS*				3.58	0.17	*NS*				
Antimony	Sb	0.06	Yes	0.003	No	0.09	Yes	No	0.57	0.57	*NS*				0.60	0.74	*NS*				
Arsenic	As	0.83	Yes	< 0.001	No	< 0.001	No	No	1.59	0.22	*NS*				4.46	0.11	*NS*				
Barium	Ba	0.12	Yes	0.08	Yes	0.02	No	No	1.98	0.16	*NS*				4.60	0.10	*NS*				
Beryllium	Be	0.17	Yes	0.09	Yes	0.06	Yes	Yes	1.58	0.22	*NS*				2.47	0.29	*NS*				
Boron	Bo	< 0.001	No	0.09	Yes	< 0.001	No	No	1.14	0.334	*NS*				0.86	0.65	*NS*				
Cadmium	Cd	0.03	No	0.001	No	0.30	Yes	No	0.51	0.61	*NS*				1.15	0.56	*NS*				
Calcium	Ca	0.01	No	0.28	Yes	0.50	Yes	No	1.05	0.36	*NS*				2.60	0.27	*NS*				
Chromium	Cr	0.79	Yes	0.41	Yes	0.39	Yes	Yes	1.50	0.24	*NS*				2.24	0.33	*NS*				
Chromium VI	Cr VI																				test not conducted*
Cobalt	Co	0.06	Yes	0.29	Yes	0.35	Yes	Yes	3.31	0.05	Signif				3.81	0.15	*NS*				post-hoc test did not identify differences
Copper	Cu	0.006	No	0.13	Yes	0.22	Yes	No	2.62	0.09	*NS*				3.14	0.21	*NS*				
Iron	Fe	0.08	Yes	0.07	Yes	0.51	Yes	Yes	1.57	0.23	*NS*				0.92	0.63	*NS*				
Lead	Pb	0.002	No	0.90	Yes	0.05	No	No	2.54	0.10	*NS*				2.72	0.26	*NS*				
Lithium	Li	0.002	No	< 0.001	No	0.06	Yes														test not conducted*
Magnesium	Mg	0.85	Yes	0.02	No	0.51	Yes	No	0.89	0.42	*NS*				2.58	0.28	*NS*				
Manganese	Mn	< 0.001	No	0.02	No	< 0.001	No	No	1.36	0.27	*NS*				4.42	0.11	*NS*				
Mercury	Hg																				test not conducted*
Molybdenum	Mo	0.002	No	0.78	Yes	0.14	Yes	No	0.10	0.91	*NS*				1.32	0.52	*NS*				
Nickel	Ni	0.34	Yes	0.44	Yes	0.13	Yes	Yes	4.59	0.02	Signif	✓			7.50	0.02	Signif				0-ft > 5-ft
Niobium	Nb																				test not conducted*
Palladium	Pd	0.54	Yes	0.46	Yes	0.40	Yes	Yes	2.74	0.08	*NS*				6.96	0.03	Signif				
Phosphorus	P	0.06	Yes	0.70	Yes	0.37	Yes	Yes	0.80	0.46	*NS*				0.87	0.65	*NS*				
Platinum	Pt																				test not conducted*
Potassium	K	0.78	Yes	0.60	Yes	0.73	Yes	Yes	9.32	0.001	Signif	✓		✓	9.61	0.008	Signif				0-ft > 5-ft; 0-ft > 10-ft
Selenium	Se																				test not conducted*
Silicon	Si	0.001	No	0.96	Yes	0.76	Yes	No	2.65	0.09	*NS*				3.37	0.19	*NS*				
Silver	Ag	0.004	No	< 0.001	No	0.01	No	No	3.55	0.04	*NS*				2.86	0.24	*NS*				
Sodium	Na	0.001	No	0.11	Yes	0.45	Yes	No	2.74	0.08	*NS*				7.94	0.02	Signif			✓	0-ft < 10-ft
Strontium	Sr	0.48	Yes	0.55	Yes	0.45	Yes	Yes	3.26	0.05	*NS*				6.30	0.04	Signif				
Thallium	Tl	< 0.001	No																		test not conducted*
Tin	Sn	0.04	No	0.001	No	0.02	No	No	2.12	0.14	*NS*				2.99	0.22	*NS*				
Titantium	Ti	0.42	Yes	0.06	Yes	0.08	Yes	Yes	0.08	0.93	*NS*				0.12	0.94	*NS*				
Tungstun	W																				test not conducted*
Uranium	U	0.05	No	0.005	No	0.03	No	No	3.75	0.04	Signif				3.83	0.15	*NS*				
Vanadium	V	0.75	Yes	0.32	Yes	0.25	Yes	Yes	1.95	0.16	*NS*				3.12	0.21	*NS*				
Zinc	Zn	0.21	Yes	0.44	Yes	0.18	Yes	Yes	2.18	0.13	*NS*				3.37	0.19	*NS*				
Zirconium	Zr	0.001	No	0.03	No	0.06	Yes	No	0.24	0.79	*NS*				0.73	0.69	*NS*				
Radium 226	Ra226	0.26	Yes	0.21	Yes	0.98	Yes	Yes	3.28	0.05	*NS*			✓	7.63	0.02	Signif				0-ft < 10-ft
Radium 228	Ra228	0.73	Yes	0.80	Yes	0.07	Yes	Yes	1.86	0.17	*NS*				3.93	0.14	*NS*				
Thorium 228	Th228	0.10	Yes	0.43	Yes	0.03	No	No	0.19	0.83	*NS*				0.081	0.96	*NS*				
Thorium 230	Th230	0.08	Yes	0.001	No	0.04	No	No	6.98	0.003	Signif				11	0.003	Signif		✓	✓	5-ft < 10-ft; 0-ft < 10-ft
Thorium 232	Th232	0.09	Yes	0.38	Yes	0.01	No	No	0.26	0.77	*NS*				0.84	0.66	*NS*				
Uranium 233/234	U233/234	< 0.001	No	0.84	Yes	0.03	No	No	6.96	0.003	Signif				14	0.001	Signif			✓	0-ft < 10-ft
Uranium 235/236	U235/236		No		No		No														test not conducted*
Uranium 238	U238	0.27	Yes	0.02	No	0.13	Yes	No	6.12	0.006	Signif				11	0.005	Signif			✓	0-ft < 10-ft

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the Kruskal-Wallis model.
NDEP requested that results be presented for both parametric and nonparamentric statistical tests. Grey boxes and text identify results for statistical tests that are less preferred given the distribution of the datasets.

Notes:

Param Test? = Consistent with the Shallow Background Study (2007), parametric ANOVAs were performed only when there were normal distributions and 100 percent detected values for all three soil strata; otherwise, non-parametric Kruskal-Wallis tests were performed

0, 5, 10 = 0 ft, 5 ft, and 10 ft bgs

SW Signif = Shapiro-Wilk significance -- if significance < 0.05, then reject the null hypothesis of normality

p = probability

NS = not statistically significant at the signficance level (α) of 0.05

≠ = not equal to

* = test not conducted because one or more soil strata had less than 4 detected values

TABLE F-2
COMPARISON OF 2008 VERSUS 2005 DATASETS - ALL DEPTHS DATA - ALL LITHOLOGIES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

											Parametric Test										Nonparametric Test									
		2005 McCullough (A)		2005 River (B)		2005 Mixed (C)		2008 River (D)		Param	ANOVA			Tukey HSD						Kruskal-Wallis			Box Plots							
Metal		SW Signif	Normal?	SW Signif	Normal?	SW Signif	Normal?	SW Signif	Normal?	test?	F	p	Signif?	A ≠ B	A ≠ C	A≠ D	B ≠ C	B ≠ D	C ≠ D	X^2	p	Signif?	A ≠ B	A ≠ C	A≠ D	B ≠ C	B ≠ D	C ≠ D	Notes
Aluminum	Al	0.005	No	0.66	Yes	< 0.001	No	0.17	Yes	No	3.7	0.013	Signif		✓				✓	14	0.003	Signif						✓	
Antimony	Sb	< 0.001	No			0.02	No	< 0.001	No	No	7.1	< 0.001	Signif							25	< 0.001	Signif							
Arsenic	As	0.00	No	0.94	Yes	0.08	Yes	< 0.001	No	No	35	< 0.001	Signif			✓		✓	✓	71	< 0.001	Signif					✓		
Barium	Ba	< 0.001	No	0.04	No	0.67	Yes	0.03	No	No	72	< 0.001	Signif	✓	✓	✓				89	< 0.001	Signif		✓	✓				
Beryllium	Be	0.01	No	0.49	Yes	0.73	Yes	0.002	No	No	14	< 0.001	Signif	✓		✓	✓			39	< 0.001	Signif	✓						
Boron	Bo	< 0.001	No		No			< 0.001	No	No	9.3	< 0.001	Signif			✓			✓	34	< 0.001	Signif						✓	
Cadmium	Cd	< 0.001	No	0.99	Yes			< 0.001	No	No	3.2	0.024	Signif	✓		✓	✓			14	0.002	Signif	✓		✓				
Calcium	Ca	< 0.001	No		No	0.19	Yes	0.05	Yes	No	2.1	0.12	*NS*							5.3	0.07	*NS*							
Chromium	Cr	0.66	Yes	0.55	Yes	0.93	Yes	0.12	Yes	Yes	3.1	0.029	Signif			✓				4.9	0.18	*NS*							
Chromium VI	Cr VI																												
Cobalt	Co	0.12	Yes	0.05	Yes	0.00	No	< 0.001	No	No	34	< 0.001	Signif	✓	✓	✓	✓			70	< 0.001	Signif	✓						
Copper	Cu	0.327	Yes	< 0.001	No	0.39	Yes	< 0.001	No	No	18	< 0.001	Signif	✓		✓	✓		✓	51	< 0.001	Signif	✓			✓			
Iron	Fe	0.13	Yes	0.80	Yes	0.16	Yes	< 0.001	No	No	9.4	< 0.001	Signif	✓		✓				28	< 0.001	Signif	✓						
Lead	Pb	< 0.001	No	0.23	Yes	0.00	No	< 0.001	No	No	15	< 0.001	Signif	✓		✓				54	< 0.001	Signif	✓						
Lithium	Li	< 0.001	No		No	0.85	Yes	< 0.001	No	No	4.2	0.02	Signif			✓			✓	27	< 0.001	Signif						✓	
Magnesium	Mg	0.33	Yes	0.12	Yes	0.13	Yes	0.12	Yes	Yes	16	< 0.001	Signif	✓	✓	✓				42	< 0.001	Signif	✓						
Manganese	Mn	0.16	Yes	0.35	Yes	< 0.001	No	< 0.001	No	No	0.68	0.56	*NS*							14	0.003	Signif						✓	
Mercury	Hg	< 0.001	No	0.42	Yes	0.01	No			No	11	< 0.001	Signif							82	< 0.001	Signif							
Molybdenum	Mo	< 0.001	No	0.44	Yes	0.16	Yes	< 0.001	No	No	12	< 0.001	Signif		✓	✓	✓	✓		37	< 0.001	Signif				✓			
Nickel	Ni	0.02	No	0.14	Yes	0.87	Yes	0.002	No	No	14	< 0.001	Signif	✓	✓	✓				38	< 0.001	Signif	✓						
Niobium	Nb				No					No																			
Palladium	Pd	< 0.001	No		No	0.11	Yes	0.06	Yes	No	25	< 0.001	Signif		✓	✓				42	< 0.001	Signif						✓	
Phosphorus	P	0.13	Yes		No	0.96	Yes	0.05	No	No	89	< 0.001	Signif		✓	✓				73	< 0.001	Signif		✓					
Platinum	Pt	< 0.001	No		No					No																			
Potassium	K	< 0.001	No		No	0.08	Yes	0.001	No	No	29	< 0.001	Signif			✓			✓	33	< 0.001	Signif						✓	
Selenium	Se	< 0.001	No	0.03	No	0.06	Yes																						
Silicon	Si	< 0.001	No		No	0.76	Yes	< 0.001	No	No	3.5	0.032	Signif							14	< 0.001	Signif						✓	
Silver	Ag	< 0.001	No	0.07	Yes			< 0.001	No	No	71	< 0.001	Signif	✓		✓	✓			84	< 0.001	Signif	✓						
Sodium	Na	< 0.001	No		No	0.04	No	0.01	No	No	53	< 0.001	Signif			✓			✓	51	< 0.001	Signif						✓	
Strontium	Sr	< 0.001	No		No	0.02	No	0.16	Yes	No	23	< 0.001	Signif		✓	✓			✓	42	< 0.001	Signif						✓	
Thallium	Tl	< 0.001	No	0.78	Yes	0.19	Yes	< 0.001	No	No	4.9	0.003	Signif	✓		✓	✓		✓	58	< 0.001	Signif	✓			✓			
Tin	Sn	0.55	Yes		No	0.03	No	< 0.001	No	No	32	< 0.001	Signif		✓	✓				42	< 0.001	Signif		✓					
Titantium	Ti	0.01	No	0.03	No	0.04	No	0.03	No	No	25	< 0.001	Signif	✓	✓	✓			✓	55	< 0.001	Signif		✓					
Tungstun	W				No					No																			
Uranium	U	< 0.001	No		No	0.47	Yes	< 0.001	No	No	4.5	0.013	Signif						✓	16	< 0.001	Signif		✓					
Vanadium	V	0.34	Yes	0.76	Yes	0.81	Yes	0.02	No	No	32	< 0.001	Signif	✓	✓	✓		✓	✓	61	< 0.001	Signif	✓						
Zinc	Zn	< 0.001	No	0.60	Yes	0.01	No	< 0.001	No	No	2.3	0.08	*NS*							11	0.01	Signif	✓	✓					
Zirconium	Zr	0.054	Yes		No	0.19	Yes	< 0.001	No	No	544	< 0.001	Signif		✓	✓			✓	89	< 0.001	Signif			✓				
Radium 226	Ra226	< 0.001	No			0.33	Yes	0.04	No	No	4.9	0.01	Signif		✓				✓	15	< 0.001	Signif		✓					
Radium 228	Ra228	0.83	Yes					0.25	Yes	Yes	11	< 0.001	Signif			✓				17	< 0.001	Signif							
Thorium 228	Th228	0.04	No	0.17	Yes	0.80	Yes	0.00	No	No	6.0	< 0.001	Signif	✓	✓			✓	✓	18	< 0.001	Signif	✓						
Thorium 230	Th230	< 0.001	No	0.54	Yes	0.19	Yes	< 0.001	No	No	6.2	< 0.001	Signif		✓				✓	20	< 0.001	Signif						✓	
Thorium 232	Th232	0.01	No	0.50	Yes	0.39	Yes	< 0.001	No	No	5.9	< 0.001	Signif	✓	✓					19	< 0.001	Signif	✓						
Uranium 233/234	U233/234	< 0.001	No	0.63	Yes			< 0.001	No	No	7.7	0.0007	Signif	✓		✓		✓		22	< 0.001	Signif	✓				✓		
Uranium 235/236	U235/236	0.002	No			0.27	Yes	0.01	No	No	5.8	0.001	Signif			✓			✓	11	0.01	Signif						✓	
Uranium 238	U238	< 0.001	No	0.62	Yes	0.19	Yes	< 0.001	No	No	6.6	< 0.001	Signif	✓	✓			✓	✓	35	< 0.001	Signif	✓						

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the Kruskal-Wallis model.
NDEP requested that results be presented for both parametric and nonparamentric statistical tests. Grey boxes and text identify results for statistical tests that are less preferred given the distribution of the datasets.

Notes:

Param Test? = Consistent with the Shallow Background Study (2007), parametric ANOVAs were performed only when there were normal distributions and 100 percent detected values for all three soil strata; otherwise, non-parametric Kruskal-Wallis tests were performed
0, 5, 10 = 0 ft, 5 ft, and 10 ft bgs
SW Signif = Shapiro-Wilk significance -- if significance < 0.05, then reject the null hypothesis of normality
p = probability
NS = not statistically significant at the signficance level (α) of 0.05
≠ = not equal to
* = test not conducted because one or more soil strata had less than 4 detected values

TABLE F-3
COMPARISON OF 2008 VERSUS 2005 DATASETS - 5 AND 10 FT BGS DATA - ALL LITHOLOGIES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

		2005 McCullough (A)		2005 River (B)		2005 Mixed (C)		2008 River (D)		Param	Parametric Test: ANOVA			Tukey HSD						Nonparametric Test: Kruskal-Wallis			Box Plots						
Metal		SW Signif	Normal?	SW Signif	Normal?	SW Signif	Normal?	SW Signif	Normal?	**test?**	F	*p*	Signif?	A ≠ B	A ≠ C	A≠ D	B ≠ C	B ≠ D	C ≠ D	X^2	*p*	Signif?	A ≠ B	A ≠ C	A≠ D	B ≠ C	B ≠ D	C ≠ D	**Notes**
Aluminum	Al	0.031	No			0.01	No	0.21	Yes	No	2.8	0.07	*NS*							8.0	0.02	Signif						✓	
Antimony	Sb	< 0.001	No					0.004	No	No																			
Arsenic	As	0.03	No			0.06	Yes	< 0.001	No	No	33	<0.001	Signif			✓			✓	46	< 0.001	Signif			✓				
Barium	Ba	< 0.001	No			0.91	Yes	0.08	Yes	No	62	<0.001	Signif		✓	✓				48	< 0.001	Signif		✓	✓				
Beryllium	Be	0.01	No			0.29	Yes	0.071	Yes	No	12	<0.001	Signif			✓				20	< 0.001	Signif			✓				
Boron	Bo	< 0.001	No					< 0.001	No	No																			
Cadmium	Cd							0.00	No	No																			
Calcium	Ca	< 0.001	No			0.31	Yes	0.19	Yes	No	2.3	0.11	*NS*							4.2	0.12	*NS*							
Chromium	Cr	0.95	Yes			0.58	Yes	0.11	Yes	Yes	4.2	0.02	Signif			✓				4.5	0.10	*NS*							
Chromium VI	Cr VI																												
Cobalt	Co	0.31	Yes			0.01	No	0.47	Yes	No	22	<0.001	Signif			✓				38	< 0.001	Signif			✓				
Copper	Cu	0.131	Yes			0.58	Yes	0.06	Yes	Yes	23	<0.001	Signif			✓			✓	32	< 0.001	Signif			✓				
Iron	Fe	0.39	Yes			0.34	Yes	0.23	Yes	Yes	7.2	0.001	Signif			✓				14	< 0.001	Signif			✓				
Lead	Pb	0.059	Yes			0.06	Yes	0.02	No	No	54	<0.001	Signif		✓	✓				50	< 0.001	Signif			✓				
Lithium	Li	< 0.001	No			0.91	Yes	< 0.001	No	No	0.36	0.70	NS			✓			✓	7.4	0.02	Signif						✓	
Magnesium	Mg	0.07	Yes			0.00	No	0.09	Yes	No	8.5	<0.001	Signif		✓	✓				17	< 0.001	Signif						✓	
Manganese	Mn	0.06	Yes			0.35	Yes	< 0.001	No	No	1.45	0.24	*NS*							13	< 0.001	Signif						✓	
Mercury	Hg	< 0.001	No																										
Molybdenum	Mo	< 0.001	No			0.09	Yes	0.16	Yes	No	10	<0.001	Signif		✓	✓				20	< 0.001	Signif		✓					
Nickel	Ni	0.16	Yes			0.46	Yes	0.271	Yes	Yes	10	<0.001	Signif		✓	✓				17	< 0.001	Signif		✓					
Niobium	Nb																												
Palladium	Pd	0.04	No			0.77	Yes	0.71	Yes	No	19	<0.001	Signif			✓			✓	25	< 0.001	Signif						✓	
Phosphorus	P	0.05	No			0.64	Yes	0.75	Yes	No	49	<0.001	Signif		✓	✓				48	< 0.001	Signif			✓				
Platinum	Pt																												
Potassium	K	< 0.001	No			0.07	Yes	0.36	Yes	No	24	<0.001	Signif			✓			✓	26	< 0.001	Signif			✓			✓	
Selenium	Se	< 0.001	No																										
Silicon	Si	< 0.001	No			0.37	Yes	0.88	Yes	No	9.6	<0.001	Signif			✓			✓	12	< 0.001	Signif						✓	
Silver	Ag							< 0.001	No	No																			
Sodium	Na	0.318	Yes			0.27	Yes	0.05	No	No	55	<0.001	Signif			✓			✓	43	< 0.001	Signif						✓	
Strontium	Sr	0.00	No			0.29	Yes	0.77	Yes	No	18	<0.001	Signif			✓			✓	26	< 0.001	Signif						✓	
Thallium	Tl	< 0.001	No																										
Tin	Sn	0.51	Yes			< 0.001	No	< 0.001	No	No	36	<0.001	Signif		✓	✓				35	< 0.001	Signif		✓	✓				
Titantium	Ti	0.03	No			0.00	No	0.11	Yes	No	16	<0.001	Signif		✓	✓			✓	25	< 0.001	Signif		✓					
Tungstun	W																												
Uranium	U	< 0.001	No			0.25	Yes	< 0.001	No	No	3.5	0.035	Signif						✓	8.8	0.01	Signif			✓			✓	
Vanadium	V	0.64	Yes			0.63	Yes	0.002	No	No	15	<0.001	Signif		✓	✓				27	< 0.001	Signif		✓					
Zinc	Zn	0.29	Yes			< 0.001	No	0.32	Yes	No	2.0	0.14	*NS*							5	0.07	*NS*							
Zirconium	Zr	0.301	Yes			0.23	Yes	0.00	No	No	310	<0.001	Signif		✓	✓			✓	57	< 0.001	Signif			✓				
Radium 226	Ra226	0.01	No					0.23	Yes	No																			
Radium 228	Ra228	0.93	Yes					0.27	Yes	No																			
Thorium 228	Th228	0.05	No			0.47	Yes	0.01	No	No	2.8	0.07	*NS*							5	0.09	*NS*							
Thorium 230	Th230	< 0.001	No			0.15	Yes	0.00	No	No	5.5	0.01	Signif		✓				✓	12	< 0.001	Signif						✓	
Thorium 232	Th232	0.01	No			0.90	Yes	0.00	No	No	1.3	0.27	*NS*							4	0.13087	*NS*							
Uranium 233/234	U233/234	< 0.001	No					< 0.001	No	No																			
Uranium 235/236	U235/236	0.011	No					0.12	Yes	No																			
Uranium 238	U238	< 0.001	No			0.28	Yes	< 0.001	No	No	5.5	0.01	Signif		✓				✓	17	< 0.001	Signif		✓				✓	

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ RDL--Gehan ranking was not used to accommodate nondetects in the Kruskal-Wallis model.
NDEP requested that results be presented for both parametric and nonparamentric statistical tests. Grey boxes and text identify results for statistical tests that are less preferred given the distribution of the datasets.

Notes:

Param Test? = Consistent with the Shallow Background Study (2007), parametric ANOVAs were performed only when there were normal distributions and 100 percent detected values for all three soil strata; otherwise, non-parametric Kruskal-Wallis tests were performed
0, 5, 10 = 0 ft, 5 ft, and 10 ft bgs
SW Signif = Shapiro-Wilk significance -- if significance < 0.05, then reject the null hypothesis of normality
p = probability
NS = not statistically significant at the signficance level (α) of 0.05
≠ = not equal to
* = test not conducted because one or more soil strata had less than 4 detected values

TABLE F-4
COMPARISON OF 2008 VERSUS 2005 DATASETS - TEST OF PROPORTIONS - ALL DEPTHS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

		2005 McCullough			2005 River			2005 Mixed			2008 River			McC vs. 2008 River		River vs. 2008 River		Mixed vs.2008 River	
Metal		N	#Detect	%Detect	N	#Detect	%Detect	N	#Detect	%Detect	N	#Detect	%Detect	Z stat	Different?	Z stat	Different?	Z stat	Different?
Antimony	Sb	101	43	43%	8	0	0%	11	6	55%	33	13	39%	0.118	*NS*			0.528	*NS*
Boron	Bo	95	34	36%				9	0	0%	33	15	45%	0.776	*NS*				
Silver	Ag	101	6	6%	8	8	100%	11	2	18%	33	14	42%	4.824	Yes	2.535	Yes		
Tin	Sn	95	95	100%				9	8	89%	33	16	48%	7.1	Yes			1.8	*NS*

Notes:
N = sample size
NS = not significantly different at significance level of 0.05 (2-tailed test)
Yes = significantly different at significance level of 0.05 (2-tailed test)

Blue text indicates dataset with four or fewer detected values. Statistics were not run on datasets with four or fewer detected values.
Test of Proportion from http://www.dimensionresearch.com/resources/calculators/ztest.html

TABLE F-5
COMPARISON OF 2008 VERSUS 2005 DATASETS - TEST OF PROPORTIONS - 5 AND 10 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

		2005 McCullough			**2005 River**			**2005 Mixed**			**2008 River**			McC vs. 2008 River		River vs. 2008 River		Mixed vs.2008 River	
Metal		N	#Detect	%Detect	N	#Detect	%Detect	N	#Detect	%Detect	N	#Detect	%Detect	Z stat	Different?	Z stat	Different?	Z stat	Different?
Antimony	Sb	64	20	31%				7	3	43%	21	8	38%	0.312	*NS*			-0.22	*NS*

Notes:
N = sample size
NS = not significantly different at significance level of 0.05 (2-tailed test)
Yes = significantly different at significance level of 0.05 (2-tailed test)

Blue text indicates dataset with four or fewer detected values. Statistics were not run on datasets with four or fewer detected values.
Test of Proportion from http://www.dimensionresearch.com/resources/calculators/ztest.html

TABLE F-6
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 0 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Aluminum	3.7 E-1	1.9 E-1	5.6 E-2	3.8 E-1	NO	mg/kg	Multiple tests
Antimony	6.2 E-1	3.8 E-1	2.4 E-1	5.1 E-1	NO	mg/kg	Multiple tests
Arsenic	5.3 E-5	2.7 E-4	4.2 E-4	1.4 E-5	YES	mg/kg	Multiple tests
Barium	5.7 E-5	1.0 E-6	2.3 E-3	6.5 E-7	YES	mg/kg	Multiple tests
Beryllium	2.9 E-2	6.1 E-2	6.1 E-2	3.0 E-2	NO	mg/kg	Multiple tests
Boron	1.6 E-1	1.6 E-1	2.6 E-1	2.6 E-1	NO	mg/kg	Multiple tests
Cadmium	3.5 E-1	2.6 E-2	5.6 E-2	1.3 E-2	NO	mg/kg	Low detection frequency; based on plots
Calcium	3.2 E-2	3.4 E-1	6.4 E-2	7.2 E-3	NO	mg/kg	Multiple tests
Chromium (Total)	3.9 E-1	1.5 E-2	1.2 E-2	4.7 E-1	NO	mg/kg	Mean and median are similar
Chromium (VI)	5.2 E-10	1.0 E+0	NA	NA	NO	mg/kg	ND in both datasets
Cobalt	3.7 E-6	4.2 E-2	5.6 E-4	1.1 E-5	YES	mg/kg	Multiple tests
Copper	2.6 E-1	5.3 E-1	5.6 E-2	7.0 E-3	NO	mg/kg	Multiple tests
Iron	6.9 E-2	5.3 E-1	2.4 E-1	2.2 E-2	NO	mg/kg	Multiple tests
Lead	7.3 E-2	5.0 E-2	5.6 E-2	9.5 E-3	NO	mg/kg	Multiple tests
Lithium	7.3 E-12	4.8 E-2	1.0 E+0	6.1 E-6	YES	mg/kg	Multiple tests
Magnesium	1.4 E-2	2.2 E-1	8.6 E-2	1.1 E-2	YES	mg/kg	Max detect, mean and median in 2005 dataset are higher than in 2008 Suppl.
Manganese	5.9 E-1	4.7 E-1	2.4 E-1	2.6 E-1	NO	mg/kg	Multiple tests
Mercury	2.6 E-9	4.2 E-2	1.0 E+0	2.8 E-6	YES	mg/kg	100% ND in 2008 Suppl. dataset
Molybdenum	1.6 E-1	3.8 E-1	5.6 E-2	1.9 E-1	NO	mg/kg	Multiple tests
Nickel	1.6 E-2	2.9 E-1	4.2 E-1	1.3 E-2	YES	mg/kg	Max detect, mean and median in 2005 dataset are higher than in 2008 Suppl.
Niobium	5.2 E-4	2.6 E-1	1.0 E+0	9.2 E-2	YES	mg/kg	100% ND in 2005 dataset
Palladium	1.8 E-5	2.1 E-3	7.4 E-1	9.9 E-6	YES	mg/kg	Multiple tests
Phosphorus	9.0 E-6	7.0 E-2	7.0 E-2	8.0 E-6	YES	mg/kg	Mean and median in 2005 dataset much higher
Platinum	7.9 E-1	7.4 E-1	1.0 E+0	5.5 E-1	NO	mg/kg	Multiple tests

TABLE F-6
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 0 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Potassium	1.8 E-3	1.5 E-5	1.9 E-6	3.5 E-4	YES	mg/kg	Multiple tests
Selenium	1.1 E-2	6.1 E-2	1.0 E+0	1.1 E-1	NO	mg/kg	100% of detects in 2005 dataset consistent with 2008 Suppl. reporting limit
Silicon	3.1 E-1	5.7 E-1	2.6 E-1	1.5 E-1	NO	mg/kg	Multiple tests
Silver	2.9 E-2	1.0 E+0	1.2 E-1	1.6 E-1	NO	mg/kg	Multiple tests
Sodium	1.5 E-2	1.5 E-5	1.5 E-5	7.5 E-6	YES	mg/kg	Multiple tests
Strontium	1.6 E-4	4.2 E-4	7.4 E-1	2.1 E-5	YES	mg/kg	Multiple tests
Thallium	3.6 E-1	3.6 E-1	2.4 E-1	2.9 E-1	NO	mg/kg	Multiple tests
Tin	5.7 E-2	5.7 E-1	2.6 E-1	2.1 E-2	NO	mg/kg	Multiple tests
Titanium	5.9 E-4	4.2 E-2	9.0 E-3	9.6 E-4	YES	mg/kg	Multiple tests
Tungsten	3.6 E-4	2.6 E-1	1.0 E+0	9.2 E-2	NO	mg/kg	Multiple tests
Uranium	4.4 E-1	1.7 E-1	5.4 E-1	3.4 E-1	NO	mg/kg	Multiple tests
Vanadium	2.5 E-3	4.2 E-2	3.8 E-3	4.6 E-3	YES	mg/kg	Max detect, mean and median in 2005 datset are higher than in 2008 Suppl.
Zinc	2.9 E-1	4.7 E-1	7.6 E-1	1.9 E-1	NO	mg/kg	Multiple tests
Zirconium	3.2 E-32	4.8 E-2	2.6 E-11	3.2 E-7	YES	mg/kg	Multiple tests
Radium-226	1.2 E-1	6.2 E-1	4.2 E-1	4.9 E-2	NO	mg/kg	Multiple tests
Radium-228	1.5 E-1	2.8 E-1	1.8 E-1	7.7 E-2	NO	mg/kg	Multiple tests
Thorium-228	7.9 E-1	1.5 E-1	1.7 E-3	4.4 E-1	NO	mg/kg	Multiple tests
Thorium-230	6.2 E-1	4.1 E-1	2.3 E-1	1.9 E-1	NO	mg/kg	Multiple tests
Thorium-232	1.5 E-2	5.3 E-2	5.3 E-2	1.6 E-2	NO	mg/kg	Results are similar in both datasets
Uranium-233/234	9.6 E-3	5.9 E-1	2.3 E-1	3.0 E-1	NO	mg/kg	Multiple tests
Uranium-235/236	7.8 E-1	5.9 E-1	5.9 E-1	6.8 E-1	NO	mg/kg	Multiple tests
Uranium-238	3.2 E-2	3.3 E-1	1.9 E-1	1.9 E-2	NO	mg/kg	Multiple tests

Note: Background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
BOLD with Highlight indicates datasets are different.
WRS = Wilcoxon Rank Sum Test with the Gehan Modification
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

TABLE F-7
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 5 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 2)

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Aluminum	4.5 E-1	7.6 E-1	5.7 E-1	2.5 E-1	NO	mg/kg	Multiple tests
Antimony	3.1 E-1	8.4 E-1	5.4 E-1	2.2 E-1	NO	mg/kg	Low detection frequency; however, detects at similar concentrations in both datasets
Arsenic	4.2 E-3	7.7 E-7	7.7 E-7	1.7 E-6	YES	mg/kg	Multiple tests
Barium	4.5 E-6	6.4 E-6	5.7 E-5	1.5 E-6	YES	mg/kg	Multiple tests
Beryllium	1.7 E-5	8.7 E-1	8.3 E-3	1.1 E-4	YES	mg/kg	Multiple tests
Boron	3.4 E-2	3.8 E-2	2.6 E-1	9.3 E-2	NO	mg/kg	Multiple tests
Cadmium	9.9 E-1	5.6 E-2	6.0 E-1	1.2 E-1	NO	mg/kg	Multiple tests
Calcium	1.3 E-1	7.4 E-1	1.4 E-1	2.5 E-1	NO	mg/kg	Multiple tests
Chromium (Total)	2.7 E-1	2.8 E-1	1.0 E+0	2.7 E-1	NO	mg/kg	Multiple tests
Chromium (VI)	4.4 E-9	9.5 E-1	NA	NA	NO	mg/kg	ND in both datasets
Cobalt	8.5 E-11	9.6 E-1	1.2 E-9	1.3 E-6	YES	mg/kg	Multiple tests
Copper	3.9 E-6	9.8 E-1	5.4 E-3	7.4 E-5	YES	mg/kg	Multiple tests
Iron	6.4 E-5	1.0 E+0	4.4 E-4	1.4 E-3	YES	mg/kg	Multiple tests
Lead	7.0 E-5	6.4 E-6	7.7 E-7	3.8 E-6	YES	mg/kg	Multiple tests
Lithium	5.5 E-1	7.5 E-1	5.5 E-2	3.1 E-2	NO	mg/kg	Multiple tests
Magnesium	5.2 E-1	7.2 E-1	2.4 E-1	3.9 E-1	NO	mg/kg	Multiple tests
Manganese	1.9 E-2	8.2 E-1	4.2 E-1	9.6 E-3	YES	mg/kg	Mean, median, and max of 2005 dataset is higher than in the 2008 Suppl.
Mercury	8.4 E-8	1.0 E+0	1.0 E+0	2.3 E-4	YES	mg/kg	100% ND in 2008 Suppl. dataset
Molybdenum	1.1 E-2	2.8 E-2	7.6 E-1	6.9 E-4	NO	mg/kg	The mean and median in the 2008 dataset are slightly elevated over 2005, however, the max in 2005 is greater
Nickel	1.4 E-5	1.0 E+0	1.3 E-3	1.5 E-3	YES	mg/kg	Multiple tests
Niobium	NA	1.0 E+0	NA	NA	NO	mg/kg	ND in both datasets
Palladium	5.8 E-6	3.6 E-4	8.8 E-5	7.0 E-6	YES	mg/kg	Multiple tests
Phosphorus	1.8 E-9	1.0 E+0	2.8 E-9	1.4 E-6	YES	mg/kg	Multiple tests
Platinum	7.0 E-1	1.0 E+0	1.0 E+0	6.3 E-1	NO	mg/kg	Multiple tests

TABLE F-7
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 5 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 2 of 2)

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Potassium	3.2 E-3	5.0 E-3	2.9 E-3	6.0 E-4	YES	mg/kg	Multiple tests
Selenium	7.1 E-1	1.0 E+0	1.0 E+0	2.7 E-1	NO	mg/kg	Multiple tests
Silicon	3.1 E-2	3.8 E-2	1.4 E-2	8.5 E-3	YES	mg/kg	Results in 2008 dataset are slighlty elevated over 2005
Silver	2.9 E-17	1.0 E+0	4.3 E-1	3.8 E-1	NO	mg/kg	Multiple tests
Sodium	1.6 E-3	1.2 E-5	8.8 E-5	1.7 E-5	YES	mg/kg	Multiple tests
Strontium	1.2 E-5	1.2 E-5	8.8 E-5	4.4 E-6	YES	mg/kg	Multiple tests
Thallium	5.6 E-3	1.0 E+0	1.1 E-2	1.8 E-1	NO	mg/kg	Multiple tests
Tin	2.1 E-5	1.0 E+0	1.0 E-3	4.5 E-5	YES	mg/kg	Low detect frequency in the 2008 Suppl. dataset; range of detects in 2008 dataset is mid-range of 2005 detects
Titanium	3.8 E-3	1.0 E+0	4.1 E-2	1.2 E-2	YES	mg/kg	2005 max, median and mean are elevated compared to 2008 Suppl. dataset
Tungsten	NA	1.0 E+0	NA	NA	NO	mg/kg	ND in both datasets
Uranium	7.4 E-1	6.2 E-1	6.7 E-2	2.9 E-1	NO	mg/kg	Multiple tests
Vanadium	8.0 E-6	1.0 E+0	7.0 E-5	1.2 E-3	YES	mg/kg	Multiple tests
Zinc	1.2 E-1	1.0 E+0	8.3 E-3	2.7 E-1	NO	mg/kg	Multiple tests
Zirconium	2.2 E-29	1.0 E+0	2.3 E-10	1.0 E-6	YES	mg/kg	Low detect frequency in the 2008 Suppl. dataset; min and max detect in the 2005 dataset are >5x 2008 max detect
Radium-226	7.5 E-1	2.0 E-1	7.2 E-1	9.6 E-1	NO	pCi/g	Multiple tests
Radium-228	8.2 E-1	4.7 E-1	2.4 E-2	9.5 E-1	NO	pCi/g	Multiple tests
Thorium-228	7.3 E-1	5.6 E-1	6.4 E-2	4.7 E-1	NO	pCi/g	Multiple tests
Thorium-230	4.6 E-1	3.1 E-1	7.4 E-1	2.5 E-1	NO	pCi/g	Multiple tests
Thorium-232	1.5 E-1	8.4 E-1	1.0 E+0	1.6 E-1	NO	pCi/g	Multiple tests
Uranium-233/234	7.3 E-3	9.7 E-2	7.4 E-1	1.5 E-2	NO	pCi/g	Multiple tests
Uranium-235/236	1.8 E-1	1.6 E-1	6.4 E-2	3.3 E-1	NO	pCi/g	Multiple tests
Uranium-238	9.9 E-1	3.6 E-1	7.4 E-1	4.9 E-1	NO	pCi/g	Multiple tests

Note: Background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
BOLD with Highlight indicates datasets are different.
WRS = Wilcoxon Rank Sum Test with the Gehan Modification
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

TABLE F-8
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 10 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Aluminum	7.5 E-1	3.1 E-1	2.5 E-1	8.5 E-1	NO	mg/kg	Multiple tests
Antimony	8.0 E-1	4.4 E-1	2.5 E-1	9.5 E-1	NO	mg/kg	Multiple tests
Arsenic	1.3 E-2	5.9 E-7	3.7 E-8	9.8 E-6	YES	mg/kg	Multiple tests
Barium	6.4 E-3	1.2 E-3	2.3 E-3	3.3 E-5	YES	mg/kg	Multiple tests
Beryllium	1.2 E-2	4.3 E-1	2.2 E-1	1.5 E-2	YES	mg/kg	2005 mean and median are elevated compared to the 2008 Suppl. dataset
Boron	1.4 E-1	8.9 E-2	1.2 E-2	1.2 E-2	YES	mg/kg	Low detection frequency; of detects, 2008 Supp. max detect is greater than 5 x the max 2005 detect.
Cadmium	1.4 E-1	5.8 E-2	1.0 E+0	1.6 E-2	NO	mg/kg	Multiple tests
Calcium	6.0 E-1	3.4 E-1	2.5 E-1	3.9 E-1	NO	mg/kg	Multiple tests
Chromium (Total)	6.3 E-2	1.2 E-3	2.5 E-1	7.7 E-2	NO	mg/kg	Multiple tests
Chromium (VI)	6.8 E-7	1.0 E+0	NA	NA	NO	mg/kg	ND in both datasets
Cobalt	7.8 E-8	7.6 E-2	2.3 E-5	2.4 E-4	YES	mg/kg	Multiple tests
Copper	3.9 E-5	7.6 E-2	1.4 E-3	1.1 E-4	YES	mg/kg	Multiple tests
Iron	4.1 E-2	7.6 E-2	5.2 E-2	4.9 E-2	NO	mg/kg	Multiple tests
Lead	2.8 E-3	5.9 E-7	3.7 E-8	3.4 E-6	YES	mg/kg	Multiple tests
Lithium	6.6 E-1	8.9 E-2	2.3 E-3	4.2 E-1	YES	mg/kg	Multiple tests
Magnesium	6.7 E-3	1.1 E-1	2.4 E-2	9.5 E-3	YES	mg/kg	Multiple tests
Manganese	9.7 E-1	3.4 E-1	2.5 E-1	8.0 E-2	NO	mg/kg	Multiple tests
Mercury	1.5 E-3	7.6 E-2	1.0 E+0	3.1 E-4	YES	mg/kg	100% ND in 2008 Suppl. dataset
Molybdenum	5.9 E-2	1.5 E-2	7.5 E-1	5.7 E-2	NO	mg/kg	Multiple tests
Nickel	1.0 E-2	7.6 E-2	2.4 E-2	5.9 E-2	YES	mg/kg	2005 max, mean and median are elevated compared to the 2008 Suppl. dataset
Niobium	NA	1.0 E+0	NA	NA	NO	mg/kg	ND in both datasets
Palladium	1.5 E-1	8.9 E-2	5.8 E-2	1.6 E-1	NO	mg/kg	Multiple tests
Phosphorus	4.5 E-5	7.6 E-2	7.6 E-4	8.2 E-5	YES	mg/kg	Multiple tests
Platinum	7.7 E-1	5.6 E-1	1.0 E+0	4.1 E-1	NO	mg/kg	Multiple tests

TABLE F-8
COMPARISON OF 2008 VERSUS 2005 McCULLOUGH - 10 FT BGS DATA
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
Potassium	3.3 E-3	1.2 E-3	5.5 E-5	5.3 E-4	YES	mg/kg	Multiple tests
Selenium	2.0 E-3	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple tests
Silicon	4.6 E-2	1.5 E-2	5.8 E-2	2.8 E-2	NO	mg/kg	Multiple tests
Silver	1.5 E-7	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple tests
Sodium	6.1 E-4	5.9 E-7	3.7 E-8	5.9 E-6	YES	mg/kg	Multiple tests
Strontium	1.5 E-1	3.1 E-1	5.8 E-2	1.3 E-1	NO	mg/kg	Multiple tests
Thallium	1.5 E-4	1.1 E-1	1.0 E+0	9.9 E-2	NO	mg/kg	Multiple tests
Tin	2.1 E-2	3.4 E-1	7.5 E-1	9.7 E-3	NO	mg/kg	Multiple tests
Titanium	1.9 E-2	7.6 E-2	2.4 E-2	4.9 E-2	YES	mg/kg	2005 mean and median are elevated compared to the 2008 Suppl. dataset
Tungsten	2.3 E-3	2.5 E-1	1.0 E+0	8.3 E-2	NO	mg/kg	Multiple tests
Uranium	2.0 E-1	6.2 E-3	2.5 E-1	2.4 E-1	NO	mg/kg	Multiple tests
Vanadium	9.9 E-2	3.4 E-1	5.6 E-1	5.7 E-2	NO	mg/kg	Multiple tests
Zinc	4.9 E-2	3.1 E-1	5.6 E-1	1.1 E-1	NO	mg/kg	Multiple tests
Zirconium	1.3 E-23	7.6 E-2	1.2 E-9	2.7 E-6	YES	mg/kg	Both the min and max detect in the 2005 dataset are greater than 5 times the max detect in the 2008 dataset
Radium-226	7.3 E-1	3.1 E-1	2.5 E-1	7.0 E-1	NO	pCi/g	Multiple tests
Radium-228	1.5 E-2	7.1 E-2	7.1 E-2	5.6 E-3	NO	pCi/g	Results are similar in both datasets
Thorium-228	2.5 E-1	5.2 E-2	2.3 E-3	3.8 E-1	NO	pCi/g	Multiple tests
Thorium-230	9.0 E-2	3.1 E-1	2.5 E-1	7.2 E-2	NO	pCi/g	Multiple tests
Thorium-232	9.6 E-1	3.4 E-1	2.5 E-1	4.1 E-1	NO	pCi/g	Multiple tests
Uranium-233/234	9.3 E-2	8.9 E-2	2.5 E-1	1.0 E-1	NO	pCi/g	Multiple tests
Uranium-235/236	1.4 E-1	8.9 E-2	1.0 E+0	2.1 E-1	NO	pCi/g	Multiple tests
Uranium-238	4.6 E-1	8.9 E-2	2.5 E-1	6.6 E-1	NO	pCi/g	Multiple tests

Note: Background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
BOLD with Highlight indicates datasets are different.
WRS = Wilcoxon Rank Sum Test with the Gehan Modification
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

TABLE F-9
ADDITIONAL TWO-SAMPLE COMPARISONS IDENTIFIED BY THE TEST OF PROPORTIONS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Chemical	t-Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Datasets Statistically Different?	Units	Basis
2008 versus 2005 McCullough (5 and 10 ft bgs)							
Antimony (Detects Only)	2.1 E-2	2.1 E-1	2.9 E-1	1.7 E-2	YES	mg/kg	Mean and median in 2008 dataset are higher than the 2005 dataset
Boron (Detects Only)	2.0 E-1	5.4 E-2	1.4 E-2	1.6 E-2	YES	mg/kg	Max 2008 detect greatly exceeds the 2005 max detect.
Radium-226 (All Data)	3.9 E-1	6.2 E-1	2.5 E-1	5.0 E-1	NO	pCi/g	Multiple tests
Radium-228 (All Data)	7.0 E-2	4.6 E-1	6.9 E-1	2.2 E-2	NO	pCi/g	Multiple tests
Uranium-235/236 (Detects Only)	2.2 E-3	8.9 E-3	2.3 E-1	1.3 E-3	YES	pCi/g	Multiple tests
2008 versus 2005 McCullough (All Depths)							
Antimony (Detects Only)	3.6 E-2	3.6 E-1	2.3 E-1	1.6 E-2	NO	mg/kg	Multiple tests
Boron (Detects Only)	8.0 E-2	4.6 E-4	6.4 E-3	2.7 E-4	YES	mg/kg	Multiple tests
Thallium (Detects Only)	1.6 E-1	6.2 E-1	1.8 E-1	2.6 E-1	YES	mg/kg	Mean and median in 2005 dataset are higher than the 2008 dataset
Radium-228 (All Data)	6.3 E-3	8.7 E-1	7.0 E-1	2.3 E-3	NO	pCi/g	Detects in both datasets are in range with each other
Uranium-235/236 (Detects Only)	8.7 E-4	2.1 E-3	2.0 E-1	2.8 E-4	YES	pCi/g	Multiple tests
2008 versus 2005 Mixed (All Depths)							
Antimony (Detects Only)	1.4 E-1	6.3 E-1	6.8 E-1	7.2 E-2	NO	mg/kg	Multiple tests
Tin (Detects Only)	1.3 E-4	1.0 E-1	6.7 E-4	2.6 E-4	YES	mg/kg	Multiple tests
Tin (All Data)	2.1 E-1	8.6 E-2	6.7 E-4	1.1 E-2	YES	mg/kg	Multiple tests
Uranium-235/236 (Detects Only)	2.3 E-3	2.9 E-1	5.8 E-2	1.5 E-2	YES	pCi/g	Mean and Median in 2008 dataset are higher than the 2005 dataset
2008 versus 2005 River (All Depths)							
Cadmium (Detects Only)	1.1 E-1	1.7 E-1	1.7 E-1	2.5 E-1	YES	mg/kg	Multiple tests

Note: Background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
BOLD with Highlight indicates datasets are different.
WRS = Wilcoxon Rank Sum Test with the Gehan Modification
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

APPENDIX G

INTER-ELEMENT CORRELATION STATISTICAL EVALUATIONS AND SCATTERPLOTS

Correlations for 2008 Supplemental Dataset Metals (Table G-1)

Correlation for 2005 BRC/TIMET Dataset Metals (Table G-2)

Correlation between 2008 Supplemental Dataset Alkaline and Alkaline-Earth Metals (Table G-3)

Correlation between 2005 BRC/TIMET Dataset Alkaline and Alkaline-Earth Metals (Table G-4)

Correlation between 2008 Supplemental Dataset Radionuclides (Table G-5)

Correlation for 2005 BRC/TIMET Dataset Radionuclides (Table G-6)

Metal	N	#Detect	Shapiro Wilks SW Stat	SW Signif	Normal?	Param Test?
Aluminum	33	33	0.954	0.175	Yes	Yes
Antimony	33	13	0.858	0.001	No	No
Arsenic	33	33	0.65	< 0.001	No	No
Barium	33	33	0.928	0.032	No	No
Beryllium	33	33	0.884	0.002	No	No
Boron	33	15	0.343	< 0.001	No	No
Cadmium	33	21	0.826	< 0.001	No	No
Calcium	33	33	0.936	0.052	Yes	Yes
Chromium	33	33	0.948	0.116	Yes	Yes
Chromium VI	33	0				
Cobalt	33	33	0.833	< 0.001	No	No
Copper	33	33	0.692	< 0.001	No	No
Iron	33	33	0.857	< 0.001	No	No
Lead	33	33	0.649	< 0.001	No	No
Lithium	33	6	0.786	< 0.001	No	No
Magnesium	33	33	0.948	0.119	Yes	Yes
Manganese	33	33	0.555	< 0.001	No	No
Mercury	33	0				
Molybdenum	33	33	0.853	< 0.001	No	No
Nickel	33	33	0.885	0.002	No	No
Niobium	33	1				
Palladium	33	33	0.938	0.058	Yes	Yes
Phosphorus	33	33	0.934	0.045	No	No
Platinum	33	0	0.168	< 0.001		
Potassium	33	33	0.87	0.001	No	No
Selenium	33	0	0.364	< 0.001		
Silicon	33	33	0.597	< 0.001	No	No
Silver	33	14	0.757	< 0.001	No	No
Sodium	33	33	0.909	0.009	No	No
Strontium	33	33	0.953	0.164	Yes	Yes
Thallium	33	6	0.326	< 0.001	No	No
Tin	33	16	0.76	< 0.001	No	No
Titanium	33	33	0.928	0.03	No	No
Tungsten	33	2				
Uranium	33	33	0.702	< 0.001	No	No
Vanadium	33	33	0.919	0.017	No	No
Zinc	33	33	0.864	0.001	No	No
Zirconium	33	13	0.719	< 0.001	No	No

Inter-Element Correlation (upper triangle: Kendall Tau; lower triangle: Pearson Correlation Coefficient)

	Al	Sb	As	Ba	Be	Bo	Cd	Ca	Cr (Tot)	Cr (VI)	Co	Cu	Fe
Al		-0.208	0.109	.426(**)	.855(**)	0.017	.285(*)	0.023	.490(**)		.575(**)	.597(**)	.570(**)
Sb	-0.308		-0.047	-.393(**)	-0.253	0.226	0.03	-0.128	-0.243		-0.22	-0.213	-.348(**)
As	.353(*)	0.177		0.055	0.192	-0.105	.360(**)	0.159	.353(**)		0.203	0.168	.302(*)
Ba	.440(*)	-.567(**)	-0.021		.428(**)	-.274(*)	-0.018	0.049	.258(*)		.320(**)	.379(**)	.379(**)
Be	.933(**)	-0.205	.462(**)	0.329		0.008	.357(**)	0.027	.516(**)		.646(**)	.597(**)	.613(**)
Bo	0.279	.385(*)	.704(**)	-0.265	0.337		0.053	-.286(*)	-0.01		0.018	-0.07	-0.117
Cd	.371(*)	0.172	.422(*)	-0.187	.577(**)	0.311		0.086	.408(**)		.345(**)	.267(*)	.399(**)
Ca	-0.087	-0.147	-0.05	-0.012	-0.108	-.357(*)	-0.008		0.027		-0.046	-0.017	-0.002
Cr (Tot)	.666(**)	-0.209	.456(**)	0.231	.775(**)	.383(*)	.613(**)	-0.117			.574(**)	.474(**)	.645(**)
Cr (VI)													
Co	.765(**)	-0.195	0.21	0.253	.878(**)	0.167	.619(**)	-0.13	.798(**)			.647(**)	.721(**)
Cu	.698(**)	-0.11	0.11	0.087	.673(**)	0.057	.492(**)	-0.086	.490(**)		.720(**)		.615(**)
Fe	.789(**)	-.363(*)	0.267	0.326	.896(**)	0.118	.618(**)	-0.057	.855(**)		.935(**)	.658(**)	
Pb	.475(**)	-0.016	0.065	0.104	.642(**)	-0.119	.566(**)	0.04	.537(**)		.763(**)	.653(**)	.753(**)
Li	0.05	0.072	.449(**)	-0.026	0.12	0.195	0.239	0.048	0.239		-0.047	-0.039	0.049
Mg	.374(*)	-0.331	-0.077	.487(**)	.424(*)	-.405(*)	0.137	0.195	0.326		.478(**)	0.289	.465(**)
Mn	0.305	0.142	0.086	.361(*)	.413(*)	-0.08	.364(*)	-0.026	0.317		.488(**)	0.312	.443(**)
Hg													
Mo	0.328	-0.154	0.267	0.148	.413(*)	0.089	.492(**)	-0.136	.544(**)		.481(**)	.541(**)	.523(**)
Ni	.523(**)	-0.068	0.332	-0.125	.704(**)	0.317	.684(**)	-0.09	.699(**)		.812(**)	.603(**)	.770(**)
Nb													
Pd	.356(*)	-0.248	.487(**)	.477(**)	0.234	0.297	-0.059	0.143	0.111		-0.096	-0.035	0.034
P	-0.213	0.166	-0.265	-.530(**)	-0.242	-0.013	0.023	-0.089	-0.301		-0.06	0.299	-0.202
Pt													
K	.702(**)	-0.096	0.074	0.256	.708(**)	0.122	.355(*)	0.018	.561(**)		.621(**)	.387(*)	.641(**)
Se													
Si	.411(*)	-0.054	0.054	0.207	.410(*)	0.037	.360(*)	-0.068	.377(*)		.419(*)	0.333	.392(*)
Ag	-.587(**)	.822(**)	0.051	-.687(**)	-.498(**)	0.315	-0.021	-0.129	-.374(*)		-.475(**)	-.435(*)	-.596(**)
Na	0.197	-0.189	0.31	0.266	0.044	0.283	-0.277	-0.143	-0.038		-0.123	0.112	-0.164
Sr	0.309	-0.266	.492(**)	.484(**)	0.178	0.269	-0.129	0.159	0.065		-0.157	-0.089	-0.028
Tl	0.189	0.331	0.055	0.205	0.271	-0.03	0.269	0.072	0.134		0.223	0.112	0.204
Sn	.786(**)	-0.237	.354(*)	0.196	.893(**)	0.298	.683(**)	-0.085	.849(**)		.908(**)	.698(**)	.937(**)
Ti	.704(**)	-.653(**)	0.216	.664(**)	.721(**)	-0.014	0.317	-0.082	.697(**)		.669(**)	.428(*)	.822(**)
W													
U	0.313	0.084	.811(**)	-0.059	.383(*)	.693(**)	.434(*)	0.102	.398(*)		0.173	0.088	0.223
V	.563(**)	-0.006	.634(**)	0.014	.629(**)	.593(**)	.507(**)	-0.239	.572(**)		.571(**)	.533(**)	.553(**)
Zn	.494(**)	0.051	0.288	-0.01	.715(**)	0.15	.743(**)	-0.04	.668(**)		.820(**)	.584(**)	.796(**)
Zr	.706(**)	0.016	.460(**)	-0.031	.844(**)	.386(*)	.702(**)	-0.058	.769(**)		.856(**)	.687(**)	.832(**)

	Pb	Li	Mg	Mn	Hg	Mo	Ni	Nb	Pd	P	Pt	K
Al	.242(*)	0.048	.302(*)	.287(*)		0.183	.279(*)		.292(*)	-.270(*)	0.216	.613(**)
Sb	-0.168	-0.038	-0.196	-0.161		-0.255	-0.142		-0.189	0.082	0.287	-0.13
As	0.202	.402(**)	.278(*)	0.171		.346(**)	.332(**)		0.103	-0.215	0.248	-0.011
Ba	0.203	-0.002	.351(**)	0.195		.270(*)	-0.061		.395(**)	-.383(**)	-0.231	.248(*)
Be	.303(*)	0.111	.387(**)	.325(**)		0.244	.366(**)		.323(**)	-.274(*)	0.211	.549(**)
Bo	-0.144	0.051	0.039	-0.023		-0.014	0.135		-0.179	0.13	0.252	0.066
Cd	0.211	0.175	0.183	0.238		0.23	.478(**)		0.026	-0.026	0.226	0.183
Ca	0.188	.270(*)	0.203	0.025		-0.145	0.019		0.147	-0.053	-0.231	0.089
Cr (Tot)	.264(*)	0.21	.358(**)	0.207		.347(**)	.427(**)		0.12	-0.231	0.231	.389(**)
Cr (VI)												
Co	.407(**)	0.01	.356(**)	.506(**)		.296(*)	.502(**)		0.087	-0.104	0.172	.345(**)
Cu	.339(**)	-0.081	.259(*)	.445(**)		.434(**)	.323(**)		0.122	-0.055	0.154	.350(**)
Fe	.480(**)	0.05	.312(*)	.426(**)		.395(**)	.461(**)		0.141	-0.177	0.154	.399(**)
Pb		-0.085	.243(*)	.516(**)		0.196	.266(*)		-0.107	0.04	-0.17	0.14
Li	-0.046		0.227	-0.192		0.102	0.091		.313(*)	-0.198	0.234	-0.031
Mg	.398(*)	0.181		0.205		.261(*)	0.235		0.076	-.332(**)	-0.246	.288(*)
Mn	.649(**)	-0.162	0.178			.322(**)	.360(**)		-0.137	0.108	-0.046	0.205
Hg												
Mo	.459(**)	0.234	0.32	0.203			0.234		0.105	-0.023	0.124	0.082
Ni	.666(**)	0.083	0.188	0.324		.460(**)			-0.121	0.115	0.201	0.166
Nb												
Pd	-0.253	0.322	0.008	-0.148		0.084	-0.165			-.273(*)	0.232	0.145
P	-0.024	-0.267	-.463(**)	-0.152		-0.067	0.192		-0.332		-0.077	-0.207
Pt												
K	.443(**)	-0.155	0.342	.466(**)		0.115	.445(**)		-0.044	-0.264	0.055	
Se												
Si	.357(*)	-0.1	0.174	.382(*)		.473(**)	0.319		-0.059	-0.165	0.034	.468(**)
Ag	-.352(*)	0.088	-.382(*)	-0.328		-0.192	-0.271		-0.242	0.111	0.302	-0.331
Na	-.353(*)	0.142	-0.034	-0.184		-0.037	-0.167		.507(**)	0.013	0.318	-0.307
Sr	-0.305	0.332	-0.012	-0.18		0.041	-0.23		.987(**)	-0.317	.370(*)	-0.087
Tl	.479(**)	-0.151	0.112	.789(**)		-0.089	0.114		-0.119	-0.256	-0.015	.503(**)
Sn	.716(**)	0.023	.357(*)	.381(*)		.593(**)	.796(**)		0.043	-0.109	0.252	.622(**)
Ti	.515(**)	0.076	.408(*)	.376(*)		.430(*)	.436(*)		0.336	-.377(*)	0.006	.456(**)
W												
U	0.003	.387(*)	-0.145	-0.007		0.22	0.296		.566(**)	-0.219	.762(**)	-0.020
V	.362(*)	0.197	-0.134	0.269		0.335	.614(**)		0.308	0.168	.632(**)	0.122
Zn	.839(**)	0.003	0.319	.584(**)		.515(**)	.817(**)		-0.147	0.032	0.128	.473(**)
Zr	.662(**)	0.137	.365(*)	0.26		.542(**)	.808(**)		0.024	-0.014	0.334	.513(**)

	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	W	U	V	Zn	Zr
Al		.548(**)	-.279(*)	0.053	.306(*)	0.03	.595(**)	.540(**)		.250(*)	.360(**)	0.217	.402(**)
Sb		-.367(**)	.810(**)	-.276(*)	-0.199	.375(*)	-0.248	-.391(**)		-0.203	-0.188	-0.004	0.009
As		0.17	-0.113	0.109	0.088	-0.007	0.228	0.231		.538(**)	.344(**)	.372(**)	.292(*)
Ba		.311(*)	-.486(**)	0.186	.401(**)	-0.066	0.233	.486(**)		0.104	0.086	0.004	0.074
Be		.524(**)	-.332(*)	0.085	.330(**)	0.012	.607(**)	.586(**)		.316(*)	.419(**)	.303(*)	.402(**)
Bo		-0.107	.351(**)	-0.089	-0.229	0.049	0.087	-0.091		-0.049	-0.035	0.15	.351(**)
Cd		.292(*)	-0.002	-0.183	0.012	0.096	.537(**)	.272(*)		.312(*)	.343(**)	.478(**)	.386(**)
Ca		-0.019	-0.158	-0.076	0.15	.289(*)	0.063	-0.004		.246(*)	0.046	0.069	0.031
Cr (Tot)		.493(**)	-0.249	0.027	0.139	0.014	.582(**)	.528(**)		.322(**)	.382(**)	.373(**)	.386(**)
Cr (VI)													
Co		.451(**)	-0.257	0.069	0.083	-0.012	.644(**)	.528(**)		.298(*)	.535(**)	.425(**)	.442(**)
Cu		.520(**)	-.314(*)	0.101	0.114	-0.055	.581(**)	.497(**)		.264(*)	.492(**)	.296(*)	.307(*)
Fe		.580(**)	-.351(**)	0.006	0.145	-0.046	.709(**)	.717(**)		.310(*)	.553(**)	.448(**)	.379(**)
Pb		.367(**)	-0.236	-.241(*)	-0.068	0.046	.436(**)	.427(**)		0.14	.415(**)	.455(**)	0.201
Li		-0.056	0.015	0.194	.328(**)	0.116	0.029	0.042		.360(**)	0.095	0.087	0.184
Mg		0.218	-0.203	-0.082	-0.012	0.039	.283(*)	.279(*)		.251(*)	0.103	0.234	.255(*)
Mn		.362(**)	-0.238	-0.036	-0.137	-0.016	.405(**)	.320(**)		0.236	.411(**)	.359(**)	0.216
Hg													
Mo		.358(**)	-0.204	0.107	0.101	-0.108	.330(*)	.389(**)		.262(*)	.246(*)	.290(*)	0.182
Ni		.321(**)	-0.17	-0.042	-0.132	0.011	.516(**)	0.233		.290(*)	.490(**)	.547(**)	.475(**)
Nb													
Pd		0.082	-0.189	.395(**)	.924(**)	0.106	0.138	0.219		.268(*)	0.034	-0.044	0.076
P		-0.197	0.134	-0.11	-.260(*)	-0.066	-0.059	-.254(*)		-0.184	0.097	0.103	0.027
Pt													
K		.491(**)	-0.194	-0.146	0.156	0.208	.458(**)	.381(**)		0.086	0.106	0.127	.247(*)
Se													
Si			-.404(**)	-0.08	0.108	-0.032	.586(**)	.546(**)		0.173	.325(**)	.285(*)	0.172
Ag		-0.138		-.281(*)	-0.201	0.284	-0.259	-.441(**)		-.271(*)	-.291(*)	-0.043	-0.013
Na		-0.205	-0.27		.397(**)	-0.213	-0.028	0.042		.319(**)	0.135	-0.103	-0.021
Sr		-0.08	-0.241	.528(**)		0.114	0.138	0.203		0.242	0.038	-0.048	0.053
Tl		0.244	-0.074	-0.255	-0.145		0.073	-0.101		-0.106	-0.039	0.206	0.188
Sn		.518(**)	-.459(**)	-0.114	-0.015	0.168		.563(**)		.273(*)	.496(**)	.540(**)	.562(**)
Ti		.344(*)	-.793(**)	0.038	0.303	0.117	.722(**)			0.227	.424(**)	.361(**)	.294(*)
W													
U		-0.016	0	.438(*)	.529(**)	-0.039	0.302	0.179			.414(**)	.269(*)	0.245
V		0.156	-0.288	.357(*)	0.264	-0.007	.591(**)	.460(**)		.672(**)		.498(**)	.405(**)
Zn		.383(*)	-0.246	-0.293	-0.218	.356(*)	.796(**)	.514(**)		0.229	.549(**)		.485(**)
Zr		0.256	-0.213	-0.095	-0.04	0.104	.869(**)	.461(**)		.372(*)	.596(**)	.792(**)	

Kendall Tau

Pearson Correlation Coefficient

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the nonparametric analysis.

Notes:
1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (ORANGE type) is a measure of linear association between two metals
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**
Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in GREY
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
*** Correlation is significant at the 0.001 level (2-tailed).

TABLE G-2
CORRELATION FOR 2005 BRC/TIMET DATASET METALS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Inter-Element Correlation (upper triangle: Kendall Tau; lower triangle: Pearson Correlation Coefficient)

Metal	N	#Detect	Shapiro Wilks SW Stat	Shapiro Wilks SW Signif	Shapiro Wilks Normal?	Param Test?		Al	Sb	As	Ba	Be	Bo	Cd	Ca	Cr (Tot)	Cr (VI)
Aluminum	120	120	0.95	< 0.001	No	No	Al		.168(*)	-0.083	.227(**)	0.028	.253(**)	-0.13	.167(*)	.257(**)	
Antimony	120	49	0.83	< 0.001	No	No	Sb	.229(*)		-.183(**)	0.104	-.267(**)	0.093	0.123	0.104	-0.111	
Arsenic	120	120	0.96	0.005	No	No	As	-0.039	-.241(**)		0.005	.319(**)	.357(**)	.146(*)	.345(**)	.251(**)	
Barium	120	120	0.71	< 0.001	No	No	Ba	0.03	0.031	0.106		-.191(**)	-0.011	-.220(**)	0.052	0.066	
Beryllium	120	120	0.98	0.051	Yes	Yes	Be	0.025	-.399(**)	.445(**)	-.254(**)		0.131	.207(**)	0.016	.421(**)	
Boron	104	34	0.70	< 0.001	No	No	Bo	.380(**)	-0.03	.581(**)	-0.136	0.18		.327(**)	.358(**)	.141(*)	
Cadmium	120	16	0.61	< 0.001	No	No	Cd	-0.164	-.223(*)	.357(**)	-.345(**)	.448(**)	-0.068		.181(*)	-0.055	
Calcium	104	104	0.89	< 0.001	No	No	Ca	0.104	.197(*)	.481(**)	-0.038	0.039	.378(**)	0.065		-0.008	
Chromium	120	120	0.99	0.848	Yes	Yes	Cr (Tot)	.394(**)	-0.143	.389(**)	0.056	.584(**)	.317(**)	0.138	-0.057		
Chromium VI	104	0	0.61	< 0.001			Cr (VI)										
Cobalt	120	120	0.98	0.100	Yes	Yes	Co	.548(**)	0.114	-0.116	-0.118	.246(**)	-0.015	.421(**)	-0.072	.342(**)	
Copper	120	120	0.98	0.221	Yes	Yes	Cu	.208(*)	0.008	0.094	-0.041	0.167	0.006	.581(**)	-.344(**)	.307(**)	
Iron	120	120	0.99	0.369	Yes	Yes	Fe	.741(**)	0.103	-0.019	-0.035	.369(**)	0.092	0.15	-0.074	.634(**)	
Lead	120	120	0.71	< 0.001	No	No	Pb	0.121	0.064	-0.072	.334(**)	-.203(*)	0.069	-.446(**)	-.260(**)	.267(**)	
Lithium	104	104	0.91	< 0.001	No	No	Li	.322(**)	0.012	.769(**)	-0.015	.329(**)	.673(**)	-0.074	.581(**)	.424(**)	
Magnesium	120	120	0.97	0.033	No	No	Mg	.609(**)	0.176	.280(**)	-.316(**)	.312(**)	.525(**)	.344(**)	.416(**)	.365(**)	
Manganese	120	120	0.93	< 0.001	No	No	Mn	.392(**)	0.035	-0.042	.376(**)	0.179	-0.089	-0.036	-0.171	.386(**)	
Mercury	120	93	0.62	< 0.001	No	No	Hg	.187(*)	0.154	-.267(**)	-0.054	-.260(**)	-0.126	0.034	-0.071	-0.04	
Molybdenum	120	120	0.74	< 0.001	No	No	Mo	-.209(*)	-.193(*)	.435(**)	.233(*)	.181(*)	0.143	.335(**)	-0.058	.243(**)	
Nickel	120	120	0.97	0.024	No	No	Ni	.431(**)	0.086	-0.084	-.263(**)	.269(**)	0.086	.411(**)	-.203(*)	.421(**)	
Niobium	104	0	0.59	< 0.001			Nb										
Palladium	104	104	0.88	< 0.001	No	No	Pd	.249(*)	.238(*)	0.096	0.035	-.262(**)	.251(*)	0.051	.564(**)	-.310(**)	
Phosphorus	104	104	0.97	0.034	No	No	P	.431(**)	.208(*)	-.548(**)	-.451(**)	0.12	-.219(*)	0.14	-.291(**)	0.084	
Platinum	104	5	0.36	< 0.001			Pt										
Potassium	104	104	0.92	< 0.001	No	No	K	.316(**)	-.323(**)	.271(**)	-0.041	0.173	.459(**)	-.371(**)	-.212(*)	.327(**)	
Selenium	120	52	0.61	< 0.001	No	No	Se	-0.097	-.351(**)	.349(**)	-0.044	.416(**)	0.056	.495(**)	-0.177	.300(**)	
Silicon	104	104	0.63	< 0.001	No	No	Si	.255(**)	-.279(**)	.413(**)	-0.075	.365(**)	.360(**)	-.223(*)	-0.023	.359(**)	
Silver	120	16	0.46	< 0.001	No	No	Ag	-0.171	-.228(*)	.362(**)	-.332(**)	.449(**)	0.054	.980(**)	-0.033	0.139	
Sodium	104	104	0.94	< 0.001	No	No	Na	0.048	0.07	.203(*)	0.02	-0.097	.271(**)	.257(**)	.588(**)	-.246(*)	
Strontium	104	104	0.83	< 0.001	No	No	Sr	.232(*)	.251(*)	0.081	0.058	-.295(**)	.239(*)	0.047	.524(**)	-.319(**)	
Thallium	120	42	0.61	< 0.001	No	No	Tl	.179(*)	0.072	-0.115	-0.085	0.026	-.258(**)	.451(**)	-.299(**)	0.065	
Tin	104	103	0.99	0.557	Yes	Yes	Sn	.679(**)	0.102	-.222(*)	-.214(*)	0.06	.220(*)	-.207(*)	-0.157	.384(**)	
Titantium	120	120	0.98	0.177	Yes	Yes	Ti	.553(**)	0.097	-.246(**)	-.390(**)	0.052	0.119	.344(**)	-0.128	0.139	
Tungsten	104	0	0.58	< 0.001			W										
Uranium	103	103	0.80	< 0.001	No	No	U	0.157	0.189	.278(**)	-.235(*)	0.105	.442(**)	0.108	.534(**)	-0.025	
Vanadium	120	120	0.98	0.261	Yes	Yes	V	.527(**)	0.103	-0.016	-.332(**)	.272(**)	0.11	.547(**)	0.108	.305(**)	
Zinc	120	120	0.82	< 0.001	No	No	Zn	.636(**)	0.032	0.115	-0.098	.351(**)	.331(**)	-0.054	0.001	.616(**)	
Zirconium	104	104	0.98	0.294	Yes	Yes	Zr	.490(**)	.305(**)	-.568(**)	-.432(**)	-0.079	-0.117	.207(*)	-.204(*)	-0.047	

	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	Nb
Al	.401(**)	.187(**)	.554(**)	.195(**)	.235(**)	.459(**)	.382(**)	.208(**)	-0.11	.334(**)	
Sb	0.105	0.033	0.079	-0.059	-0.013	.134(*)	0.053	.177(*)	-.252(**)	0.066	
As	-0.07	0.021	-0.031	-0.051	.608(**)	.166(**)	-0.076	-.238(**)	.441(**)	-0.05	
Ba	-0.027	-0.021	0.09	.326(**)	0.088	-0.072	.330(**)	0.1	0.084	-.182(**)	
Be	.191(**)	0.121	.251(**)	0.028	.232(**)	.215(**)	0.073	-.223(**)	.272(**)	.285(**)	
Bo	0.04	-0.044	0.094	-0.061	.426(**)	.379(**)	-0.048	-0.072	.153(*)	0.063	
Cd	.238(**)	.179(**)	0.028	-.462(**)	-0.006	.180(**)	-0.112	-0.09	.134(*)	.204(**)	
Ca	0.019	-.197(**)	0.037	-.211(**)	.460(**)	.349(**)	-0.065	-0.063	0.001	-0.117	
Cr (Tot)	.255(**)	.222(**)	.465(**)	.317(**)	.315(**)	.252(**)	.251(**)	-0.027	.259(**)	.337(**)	
Cr (VI)											
Co		.535(**)	.562(**)	0.004	0.006	.532(**)	.424(**)	.150(*)	0.026	.673(**)	
Cu	.664(**)		.288(**)	0.03	-0.124	.303(**)	.256(**)	0.08	.254(**)	.630(**)	
Fe	.737(**)	.405(**)		.210(**)	0.126	.454(**)	.484(**)	.159(*)	-0.008	.448(**)	
Pb	-0.083	-0.056	0.075		0.004	-0.07	.340(**)	.178(**)	-0.024	0.034	
Li	-0.03	-0.162	0.153	-0.037		.368(**)	-0.002	-.159(*)	.253(**)	-0.007	
Mg	.635(**)	.386(**)	.594(**)	-0.132	.557(**)		.245(**)	0.111	0.055	.476(**)	
Mn	.569(**)	.327(**)	.592(**)	.340(**)	-0.003	.244(**)		.167(**)	0.047	.281(**)	
Hg	.285(**)	.194(*)	.184(*)	.262(**)	-.203(*)	.198(*)	0.118		-.163(*)	.126(*)	
Mo	0.024	.345(**)	-0.11	-0.074	0.108	-0.091	0.135	-0.143		0.059	
Ni	.817(**)	.712(**)	.579(**)	0.068	-0.025	.620(**)	.349(**)	.317(**)	-0.04		
Nb											
Pd	0.133	-0.149	-0.027	-.358(**)	.365(**)	.451(**)	-0.104	0.014	-0.096	-0.009	
P	.613(**)	.279(**)	.562(**)	-0.079	-.284(**)	.329(**)	.290(**)	.212(*)	-.375(**)	.614(**)	
Pt											
K	-0.136	0.123	0.038	.207(*)	0.18	0.013	-0.023	-0.127	.294(**)	0.046	
Se	0.134	.288(**)	.186(*)	-0.155	0.046	0.07	-0.04	-0.047	.299(**)	0.136	
Si	-0.155	-0.034	0.07	0.102	.325(**)	0.077	-0.03	-0.15	.227(*)	-0.014	
Ag	.419(**)	.595(**)	0.137	-.469(**)	-0.083	.341(**)	-0.048	0.036	.335(**)	.423(**)	
Na	-0.075	-.303(**)	-0.096	-.423(**)	.359(**)	.195(*)	-.208(*)	-0.098	0.035	-.266(**)	
Sr	0.125	-0.137	-0.049	-.350(**)	.339(**)	.421(**)	-0.105	0.013	-0.059	-0.018	
Tl	.517(**)	.534(**)	.434(**)	-0.167	-.330(**)	.264(**)	.204(*)	.244(**)	0.037	.427(**)	
Sn	.564(**)	.473(**)	.538(**)	.332(**)	0.007	.489(**)	.275(**)	.260(**)	-0.133	.745(**)	
Ti	.653(**)	.540(**)	.517(**)	-.189(*)	-0.139	.505(**)	.196(*)	.211(*)	-0.064	.644(**)	
W											
U	0.143	-0.031	0.013	-.212(*)	.522(**)	.574(**)	-0.08	-0.017	-0.093	0.16	
V	.826(**)	.587(**)	.686(**)	-.295(**)	0.134	.727(**)	.330(**)	.202(*)	-0.007	.710(**)	
Zn	.437(**)	.185(*)	.731(**)	.264(**)	.325(**)	.481(**)	.427(**)	0.11	-0.116	.437(**)	
Zr	.624(**)	.362(**)	.465(**)	-0.137	-.277(**)	.337(**)	0.186	.250(*)	-.400(**)	.651(**)	

	Pd	P	Pt	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	W	U	V	Zn	Zr
Al	.213(**)	.298(**)		.160(*)	-0.048	0.021	-0.117	0.027	.204(**)	0	.541(**)	.382(**)		.263(**)	.418(**)	.555(**)	.344(**)
Sb	.164(*)	.162(*)		-.256(**)	-.162(*)	-.305(**)	0.072	0.095	.176(*)	0.082	0.069	0.043		.194(**)	0.108	0.048	.228(**)
As	0.064	-.428(**)		0.076	.312(**)	.309(**)	.185(*)	0.114	0.055	0.02	-.192(**)	-.155(*)		0.114	-0.019	-0.054	-.413(**)
Ba	.141(*)	-.172(*)		0.096	-.149(*)	0.045	-.289(**)	0.042	.159(*)	-.151(*)	0.074	-.124(*)		-0.042	-0.068	0.067	-0.116
Be	-.218(**)	0.067		0.013	.400(**)	.303(**)	.305(**)	-0.082	-.240(**)	0.116	0.058	0.067		-0.002	.188(**)	.218(**)	-0.048
Bo	.213(**)	-0.118		0.039	.277(**)	0.118	.282(**)	.290(**)	.210(**)	-0.028	0.085	0.033		.311(**)	0.089	.151(*)	-0.039
Cd	.202(**)	0.043		-.435(**)	.415(**)	-.291(**)	.730(**)	.383(**)	.206(**)	.496(**)	-.208(**)	0.111		.192(*)	.271(**)	-.154(*)	.157(*)
Ca	.542(**)	-.206(**)		-.152(*)	-0.047	0.068	-0.003	.434(**)	.543(**)	-.183(*)	-0.093	-0.062		.408(**)	.143(*)	0.041	-.149(*)
Cr (Tot)	-.210(**)	0.04		.138(*)	.234(**)	.208(**)	0.048	-.199(**)	-.225(**)	0.049	.259(**)	0.118		-0.001	.221(**)	.435(**)	-0.022
Cr (VI)																	
Co	0.089	.434(**)		-0.085	0.103	-.226(**)	.292(**)	-0.039	0.069	.386(**)	.416(**)	.484(**)		.237(**)	.676(**)	.398(**)	.455(**)
Cu	-0.107	.280(**)		0.11	.145(*)	-.220(**)	.332(**)	-.193(**)	-0.117	.428(**)	.463(**)	.486(**)		0.123	.458(**)	.144(*)	.370(**)
Fe	0.011	.377(**)		0.009	0.112	-0.001	0.102	-0.061	-0.003	.243(**)	.389(**)	.354(**)		0.125	.504(**)	.681(**)	.316(**)
Pb	-.366(**)	0.021		.288(**)	-0.076	0.114	-.344(**)	-.399(**)	-.366(**)	-.192(**)	.312(**)	-0.074		-.214(**)	-.140(*)	.366(**)	-0.019
Li	.236(**)	-.261(**)		0.074	.152(*)	.238(**)	-0.06	.188(**)	.224(**)	-.245(**)	-0.018	-0.119		.281(**)	0.083	.175(**)	-.240(**)
Mg	.311(**)	.193(**)		-0.047	0.123	-0.077	.252(**)	0.128	.289(**)	.235(**)	.353(**)	.376(**)		.464(**)	.549(**)	.398(**)	.193(**)
Mn	-0.061	.283(**)		-0.013	-0.065	-0.096	-0.098	-.138(*)	-0.071	0.068	.287(**)	.161(**)		0.075	.276(**)	.397(**)	.223(**)
Hg	0.04	.153(*)		-0.006	-0.074	-.226(**)	-0.035	-0.09	0.046	0.125	.191(**)	.150(*)		0.006	0.083	.169(**)	.188(**)
Mo	-0.08	-.292(**)		.252(**)	.316(**)	.256(**)	.236(**)	0.02	-0.078	0.105	-0.032	0.07		-0.06	0.069	-0.086	-.305(**)
Ni	-0.077	.462(**)		0.037	.144(*)	-.192(**)	.331(**)	-.165(*)	-0.094	.372(**)	.564(**)	.503(**)		.248(**)	.538(**)	.359(**)	.502(**)
Nb																	
Pd		-0.057		-.133(*)	-.167(*)	-0.04	-0.003	.549(**)	.928(**)	-0.059	-0.026	.144(*)		.406(**)	.286(**)	-0.058	0.007
P	-0.036			-0.099	-0.069	-.147(*)	0.082	-0.041	-0.073	.201(**)	.370(**)	.452(**)		0.112	.421(**)	.325(**)	.688(**)
Pt																	
K	-.215(*)	-0.105			0.056	.348(**)	-.228(**)	-.229(**)	-0.122	-0.12	.320(**)	.199(**)		-.151(*)	-0.066	0.092	-0.048
Se	-.272(**)	-0.165		.232(*)		.196(**)	.429(**)	0.006	-.161(*)	.291(**)	-0.014	0.051		-.143(*)	0.105	0.011	-0.099
Si	-0.169	-0.078		.752(**)	0.193		-.187(*)	0.011	-0.045	-.332(**)	0.016	-0.082		-0.113	-.136(*)	0.082	-.245(**)
Ag	-0.034	0.128		-.245(*)	.493(**)	-0.171		0.119	-0.003	.680(**)	-0.031	.245(**)		0.102	.347(**)	-0.072	.191(*)
Na	.638(**)	-0.072		-.295(**)	-0.161	-.195(*)	0.08		.558(**)	-0.103	-.173(*)	-0.011		.294(**)	0.094	-.135(*)	-0.005
Sr	.981(**)	-0.051		-0.188	-.262(**)	-0.159	-0.02	.590(**)		-0.062	-0.031	.135(*)		.392(**)	.266(**)	-0.07	0
Tl	-0.017	.333(**)		-0.163	.327(**)	-.263(**)	.466(**)	-0.177	-0.001		0.116	.339(**)		0.004	.379(**)	0.03	.318(**)
Sn	-0.053	.527(**)		.442(**)	-0.053	.273(**)	-0.045	-.221(*)	-0.035	0.179		.612(**)		.159(*)	.426(**)	.443(**)	.456(**)
Ti	0.161	.632(**)		.223(*)	0.051	-0.025	.355(**)	-0.029	0.156	.449(**)	.770(**)			.205(**)	.611(**)	.233(**)	.570(**)
W																	
U	.540(**)	0.025		-0.182	-.234(*)	-0.085	0.109	.410(**)	.494(**)	-0.091	0.058	0.159			.347(**)	0.107	.184(**)
V	.384(**)	.638(**)		-0.086	0.138	-0.094	.553(**)	0.14	.360(**)	.500(**)	.611(**)	.789(**)		.351(**)		.319(**)	.432(**)
Zn	-0.119	.367(**)		.293(**)	0.069	.403(**)	-0.078	-0.141	-0.136	0.107	.544(**)	.275(**)		0.054	.367(**)		.270(**)
Zr	0.055	.877(**)		-0.068	-.263(**)	-0.149	.243(*)	-0.011	0.046	.429(**)	.602(**)	.767(**)		0.114	.653(**)	.286(**)	

Kendall Tau

Pearson Correlation Coefficient

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the nonparametric analysis.

Notes:
1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (ORANGE type) is a measure of linear association between two metals
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**
Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in GREY
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
*** Correlation is significant at the 0.001 level (2-tailed).

TABLE G-3
CORRELATION BETWEEN 2008 SUPPLEMENTAL DATASET ALKALINE AND ALKALINE-EARTH METALS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Metal	N	#Detect	Shapiro Wilks SW Stat	Shapiro Wilks SW Signif	Shapiro Wilks Normal?	Param Test?		Ba	Ca	K	Li	Mg	Na	Sr
Barium	33	33	0.928	0.032	No	No	Ba		0.049	**.248(*)**	-0.002	**.351(**)**	0.186	**.401(**)**
Calcium	33	33	0.936	0.052	Yes	Yes	Ca	-0.012		0.089	**.270(*)**	0.203	-0.076	0.15
Potassium	33	33	0.87	0.001	No	No	K	-.530(**)	-0.089		-0.031	**.288(*)**	-0.146	0.156
Lithium	33	6	0.786	< 0.001	No	No	Li	-0.026	0.048	-0.267		0.227	0.194	**.328(**)**
Magnesium	33	33	0.948	0.119	Yes	Yes	Mg	.487(**)	0.195	-.463(**)	0.181		-0.082	0.057
Sodium	33	33	0.909	0.009	No	No	Na	0.266	-0.143	0.013	0.142	-0.034		**.397(**)**
Strontium	33	33	0.953	0.164	Yes	Yes	Sr	.484(**)	0.159	-0.317	0.332	-0.012	.528(**)	

Inter-Element Correlation: upper triangle = Kendall Tau; lower triangle = Pearson Correlation Coefficient

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the nonparametric analysis.

Notes:
1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (**ORANGE** type) is a measure of linear association between two metals
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**
Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in **GREY**
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
*** Correlation is significant at the 0.001 level (2-tailed).

TABLE G-4
CORRELATION BETWEEN 2005 BRC/TIMET DATASET ALKALINE AND ALKALINE-EARTH METALS
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Metal	N	#Detect	Shapiro Wilks			Param		Inter-Element Correlation						
			SW Stat	SW Signif	Normal?	Test?		Ba	Ca	K	Li	Mg	Na	Sr
Barium	120	120	0.71	< 0.001	No	No	Ba		0.052	0.096	0.088	**-0.072**	0.042	**.159(*)**
Calcium	104	104	0.89	< 0.001	No	No	Ca	-0.038		**-.152(*)**	**.460(**)**	**.349(**)**	**.434(**)**	**.543(**)**
Potassium	104	104	0.92	< 0.001	No	No	K	-0.041	-.212(*)		0.18	0.013	**-.229(**)**	-0.122
Lithium	104	104	0.91	< 0.001	No	No	Li	-0.015	.581(**)	0.074		**.368(**)**	**.188(**)**	**.224(**)**
Magnesium	120	120	0.97	0.033	No	No	Mg	-.316(**)	.416(**)	-0.047	.557(**)		0.128	**.289(**)**
Sodium	104	104	0.94	< 0.001	No	No	Na	0.02	.588(**)	-.295(**)	.359(**)	.195(*)		**.558(**)**
Strontium	104	104	0.83	< 0.001	No	No	Sr	0.058	.524(**)	-0.188	.339(**)	.421(**)	.590(**)	

Upper triangle: Kendall Tau. Lower triangle: Pearson Correlation Coefficient.

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by ½ SQL--Gehan ranking was not used to accommodate nondetects in the nonparametric analysis.

Notes:

1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (**ORANGE** type) is a measure of linear association between two metals
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**
Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in **GREY**
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
*** Correlation is significant at the 0.001 level (2-tailed).

TABLE G-5
CORRELATION BETWEEN 2008 SUPPLEMENTAL DATASET RADIONUCLIDES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA

Radionuclide	N	#Detect	Shapiro-Wilk Stat	Shapiro-Wilk Signif.	Shapiro-Wilk Normal?	Param Test?
Radium 226	33	31	0.93	0.039	No	No
Radium 228	33	28	0.96	0.253	Yes	Yes
Thorium 228	33	33	0.90	0.004	No	No
Thorium 230	33	27	0.81	< 0.0001	No	No
Thorium 232	33	33	0.85	< 0.0001	No	No
Uranium 233/234	33	33	0.77	< 0.0001	No	No
Uranium 235/236	33	11	0.92	0.013	No	No
Uranium 238	33	33	0.74	< 0.0001	No	No

Inter-Element Correlation (upper triangle: Kendall Tau; lower triangle: Pearson Correlation Coefficient)

	Ra226	Ra228	Th228	Th230	Th232	U233/234	U235/236	U238
Ra226		-0.135	0.006	**.319(*)**	-0.152	**.427(**)**	0.157	**.501(**)**
Ra228	-0.227		0.034	-0.182	-0.074	-0.213	-0.175	-0.139
Th228	-0.040	0.010		0.008	0.204	-0.057	0.046	-0.15
Th230	.702(**)	-0.245	0.074		0.066	**.522(**)**	0.24	**.350(**)**
Th232	-0.174	-0.104	.548(**)	0.068		-0.013	-0.059	-0.057
U233/234	.786(**)	-0.302	-0.047	.830(**)	-0.045		**.319(**)**	**.541(**)**
U235/236	.417(*)	-0.118	0.152	.423(*)	0.033	.546(**)		**.329(**)**
U238	.812(**)	-0.263	-0.116	.839(**)	-0.090	.931(**)	.529(**)	

All statistical anlayses were performed using SPSS v. 15.0

All non-detected values were replaced by reported measured values

Notes:

1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (**ORANGE** type) is a measure of linear association between two radionuclides
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**

Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in **GREY**

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

*** Correlation is significant at the 0.001 level (2-tailed).

TABLE G-6
CORRELATION FOR 2005 BRC/TIMET DATASET RADIONUCLIDES
2008 SUPPLEMENTAL BACKGROUND STUDY
CLARK COUNTY, NEVADA
(Page 1 of 1)

Radionuclide	N	#Detect	Shapiro-Wilk Stat	Shapiro-Wilk Signif.	Shapiro-Wilk Normal?	Param Test?		Ra226	Ra228	Th228	Th230	Th232	U233/234	U235/236	U238
Radium 226	104	96	0.95	0.002	No	No	Ra226		0.061	0.032	**.443(**)**	0.056	**.411(**)**	0.078	**.422(**)**
Radium 228	84	68	0.99	0.735	Yes	Yes	Ra228	0.002		**.224(**)**	-0.039	**.208(**)**	0.019	**-.175(*)**	-0.019
Thorium 228	120	120	0.96	0.015	No	No	Th228	-0.110	.297(**)		0.059	**.563(**)**	0.079	-0.066	0.018
Thorium 230	120	120	0.91	< 0.0001	No	No	Th230	.663(**)	-0.125	-0.039		0.083	**.452(**)**	**.201(**)**	**.417(**)**
Thorium 232	120	120	0.96	0.008	No	No	Th232	-0.038	.305(**)	.765(**)	-0.044		0.026	-0.077	-0.031
Uranium 233/234	120	61	0.81	< 0.0001	No	No	U233/234	.691(**)	-0.081	-0.104	.762(**)	-0.136		**.182(**)**	**.632(**)**
Uranium 235/236	120	54	0.94	0.001	No	No	U235/236	.263(**)	-.266(*)	-0.170	.372(**)	-0.149	.397(**)		**.201(**)**
Uranium 238	120	120	0.87	< 0.0001	No	No	U238	.707(**)	-0.141	-0.124	.756(**)	-0.167	.880(**)	.435(**)	

Inter-Element Correlation: upper triangle = Kendall Tau; lower triangle = Pearson Correlation Coefficient

All statistical anlayses were performed using SPSS v. 15.0
All non-detected values were replaced by reported measured values

Notes:

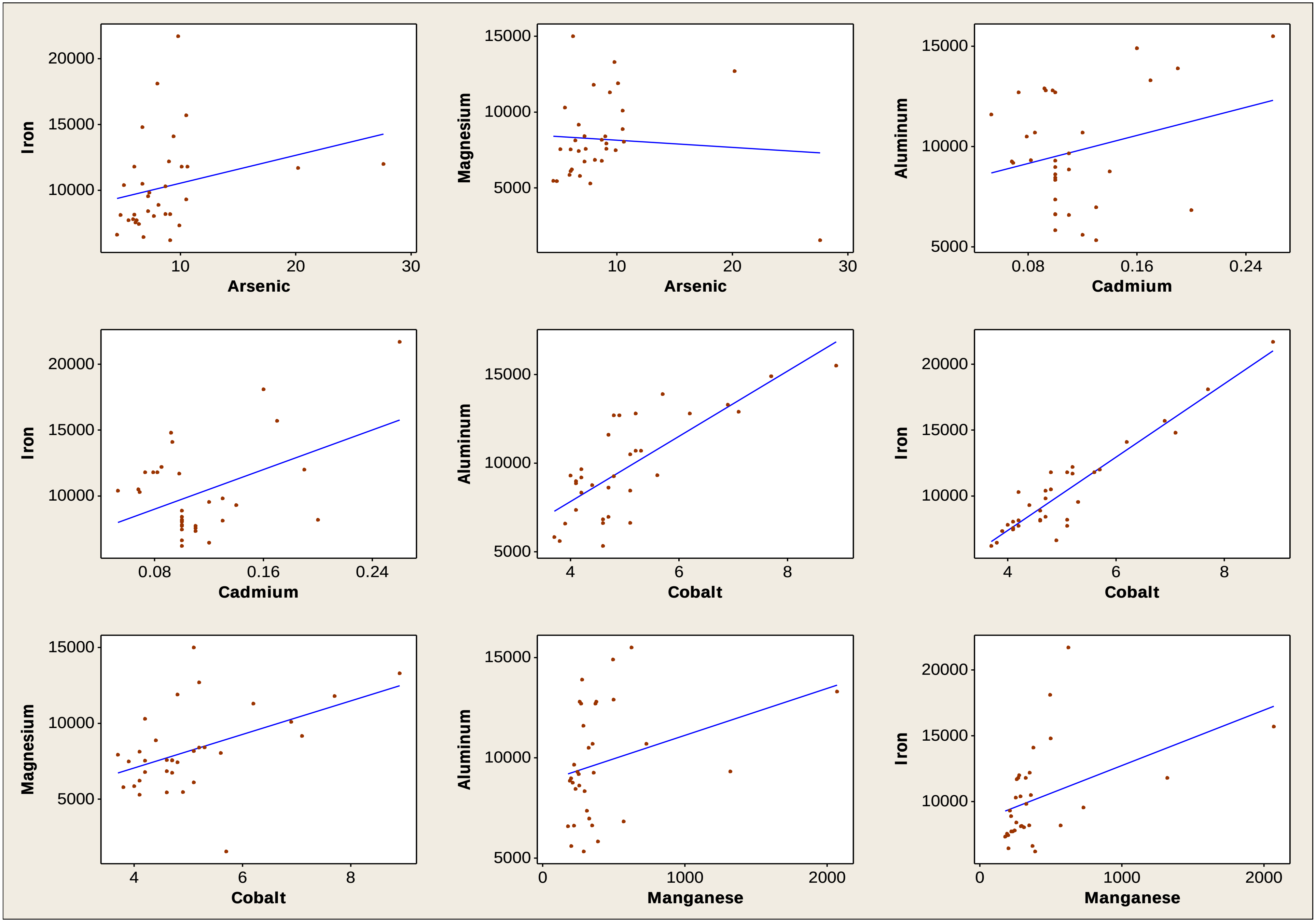
1. For data that are normally distributed, a parametric correlation analysis was conducted. The parametric Pearson correlation coefficient (ORANGE type) is a measure of linear association between two radionuclides
2. For data that are not normally distributed or have non-detected values, a nonparametric correlation analysis was conducted. The nonparametric Kendall tau is a measure of the association between rank orders.

Significant correlations are indicated in **BOLD**
Statistically insignificant correlations or correlations from less preferred analyses given the data distribution are indicated in GREY

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
*** Correlation is significant at the 0.001 level (2-tailed).

SCATTERPLOTS

OUTLIERS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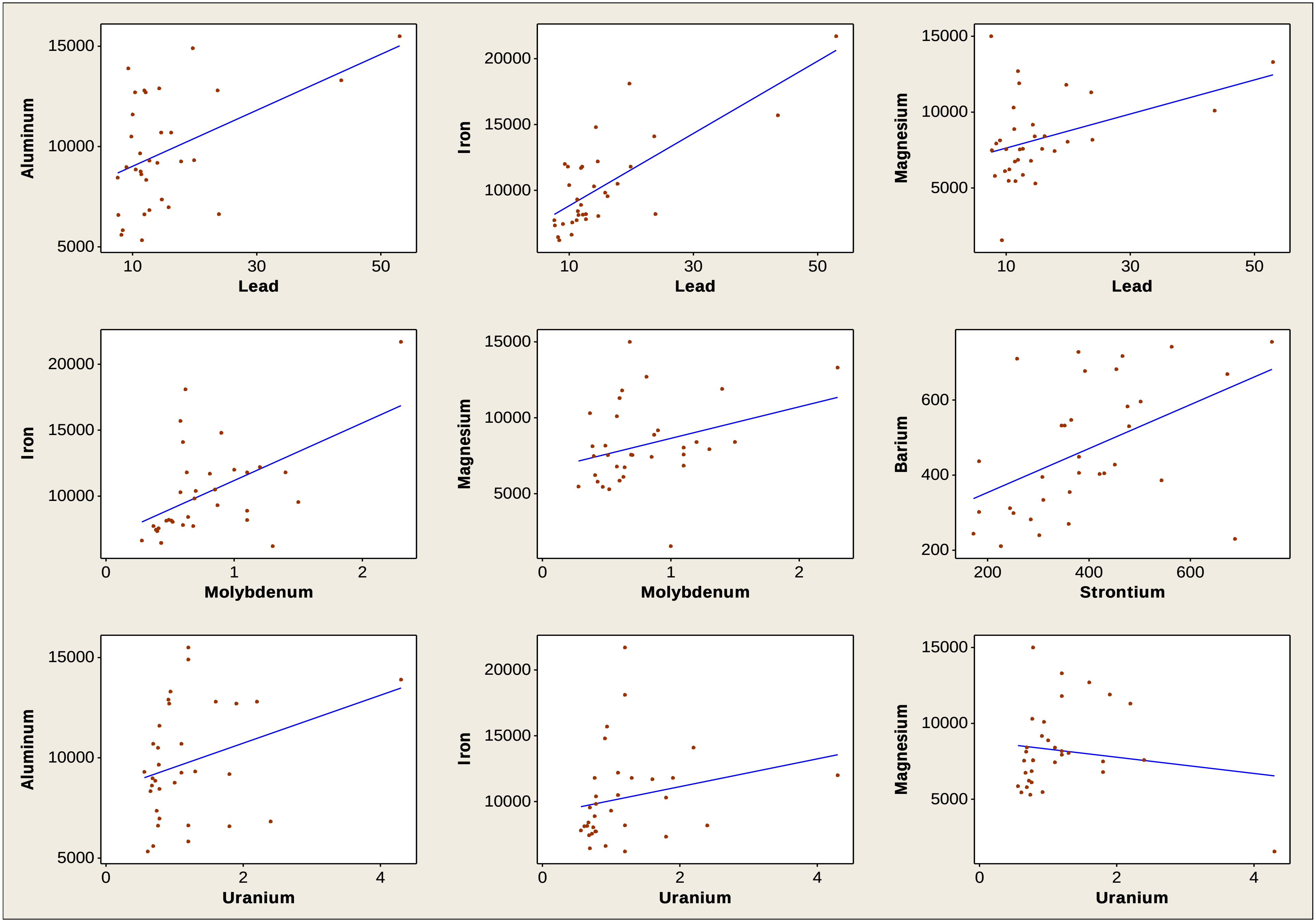
Manganese
Iron
Manganese

OUTLIERS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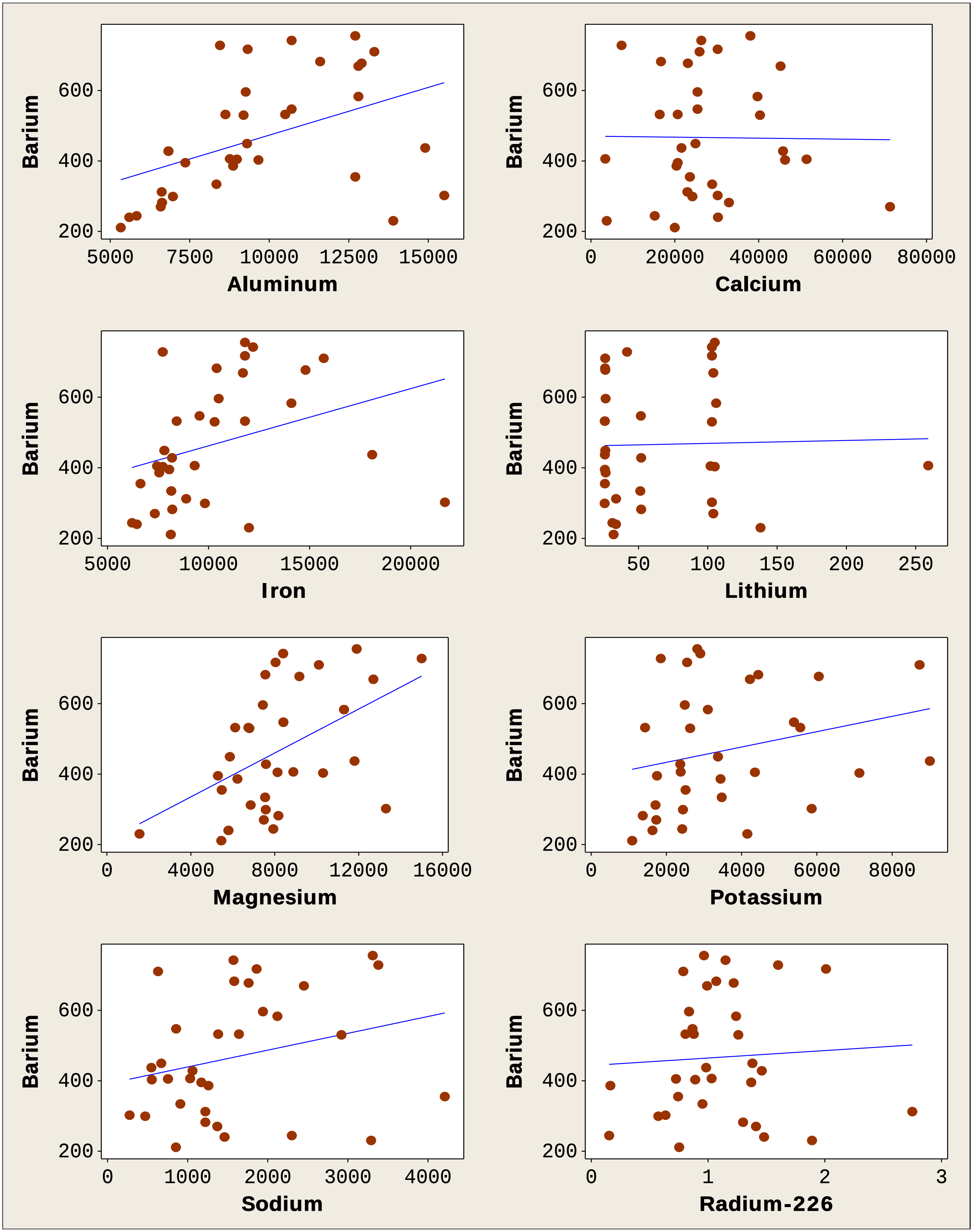
Uranium
Magnesium
Uranium

BARIUM WITH ALKALINE METALS



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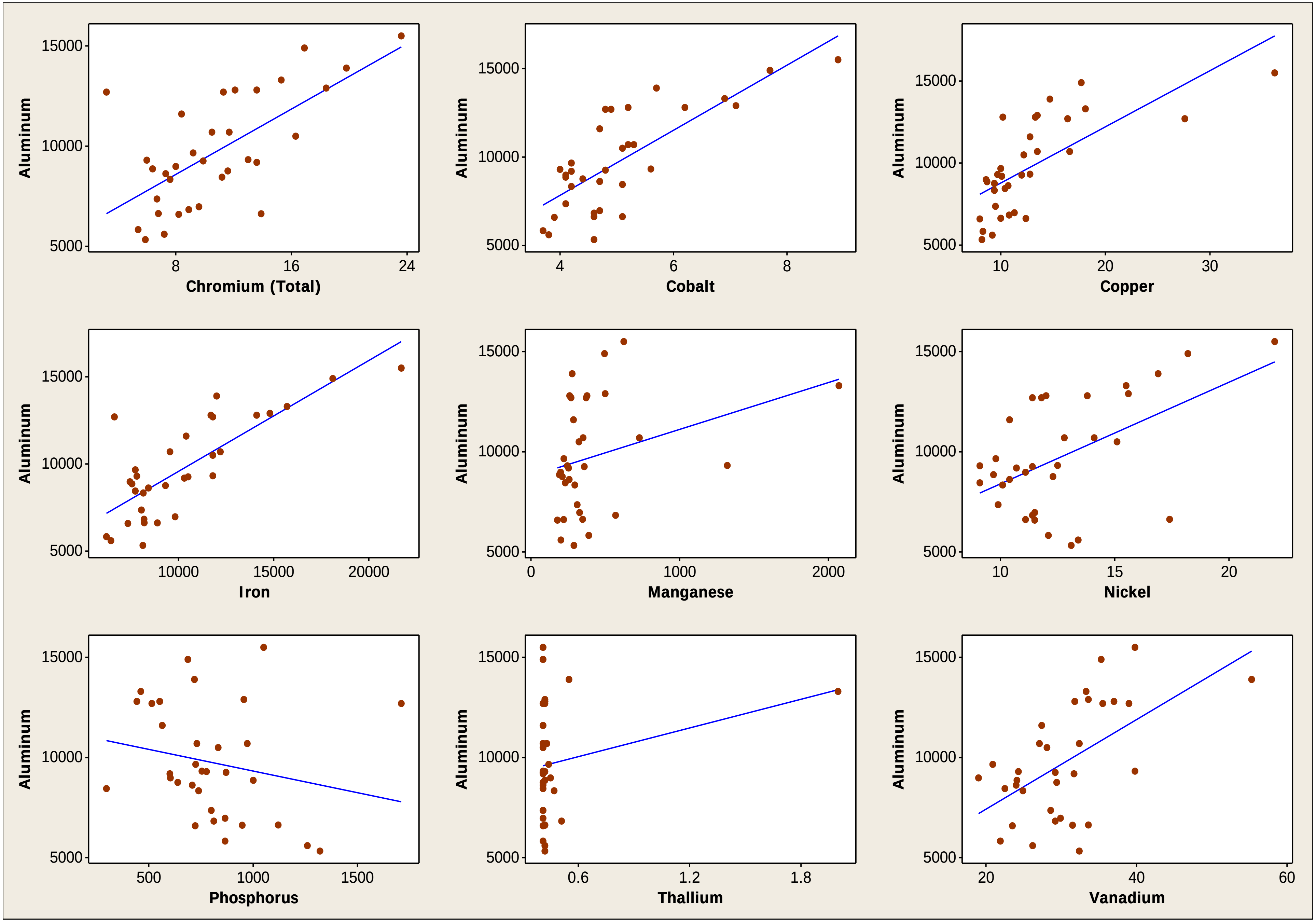

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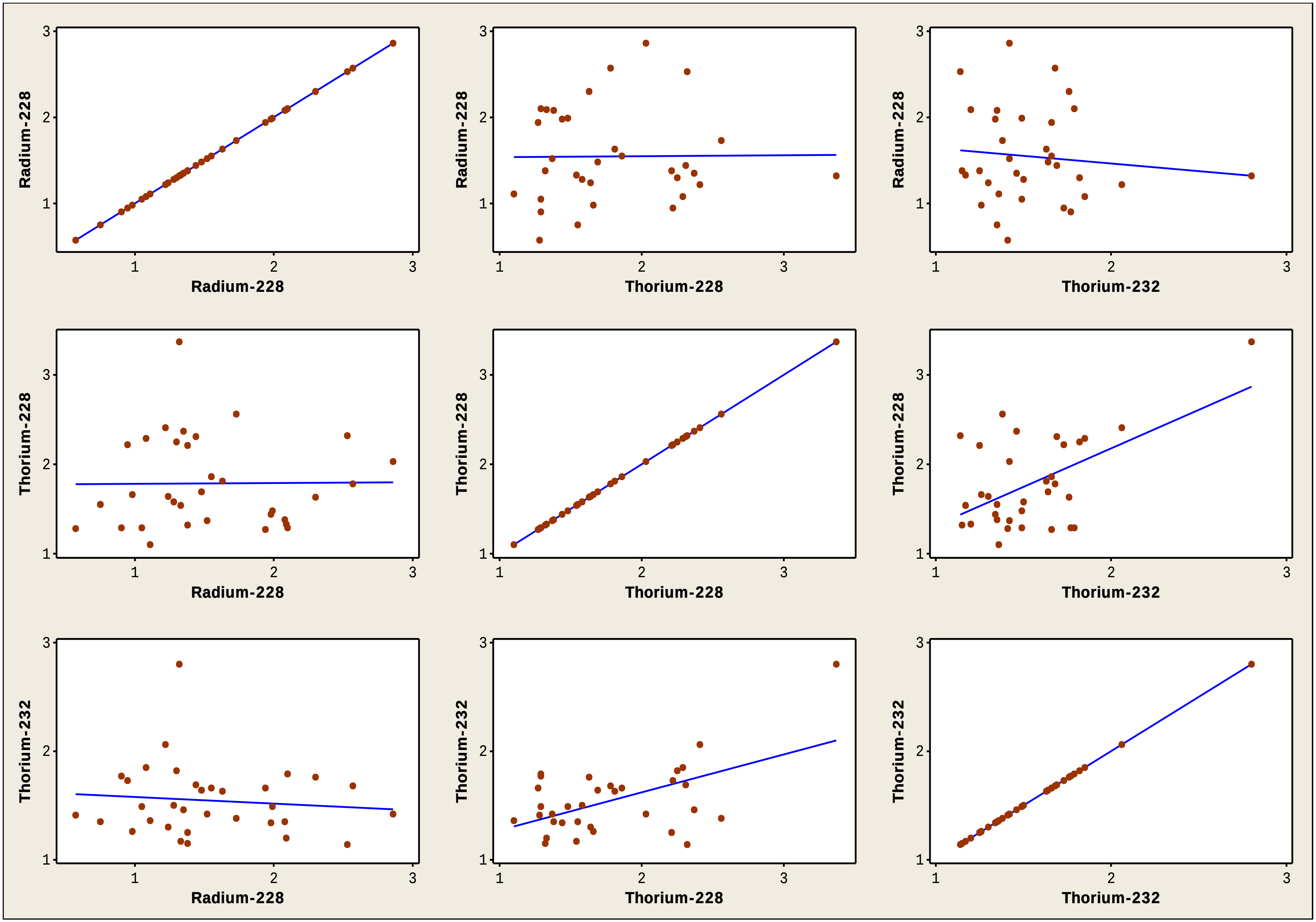

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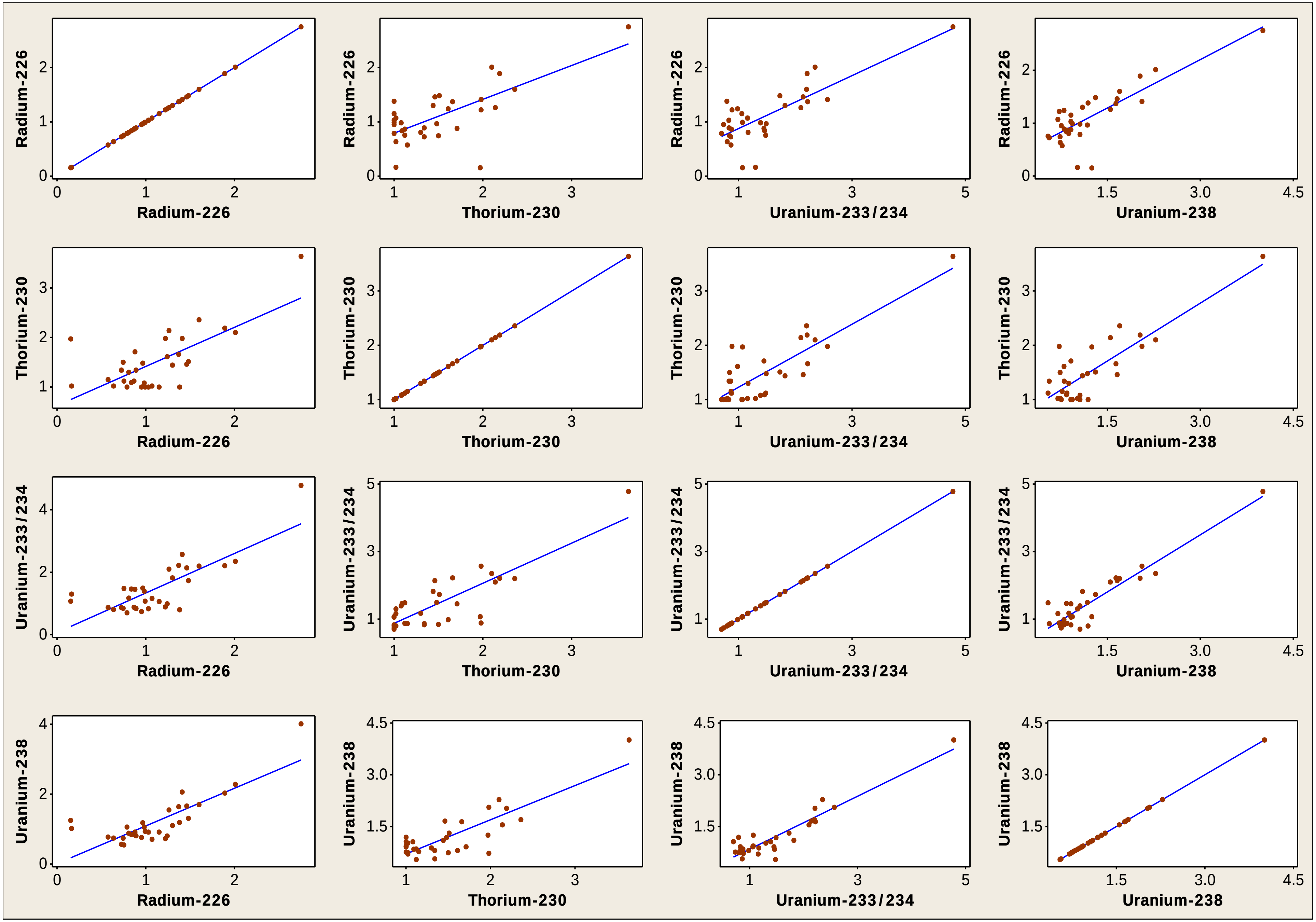

ARSENIC WITH OTHER CONTAMINANTS