FINAL REMEDIAL DESIGN REPORT
FOR THE
QUARRY NO. 4 DEMONSTRATION PROJECT

Prepared For:

United States Environmental Protection Agency

and

Pennsylvania Department of Environmental Protection

Prepared By:

Penn Environmental & Remediation, Inc.
2755 Bergey Road
Hatfield, PA 19440

June 3, 2013 (Original)
January 10, 2014 (Revised Final)
HA4013-14000

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1.0 INTRODUCTION

This report provides the final analysis and conclusions of the Quarry 4 Demonstration Project undertaken by Liberty Property Trust and Liberty Property Limited Partnership (collectively, "Liberty") pursuant to the Consent Decree that Liberty entered with respect to the Crater Resources Superfund Site (the "Crater Site"). This report incorporates the soil data and analyses presented in Liberty's *Interim Remedial Design Report* (August 12, 2010) and supplements it with the final results and analysis of ground water sampling over the two-year study period. As will be more fully discussed in this report, the analysis of soil and ground water data demonstrates that it is not necessary to limit infiltration into Quarry 4 since infiltration is not causing any Crater Site contaminants of concern ("COCs") to leach from Quarry No. 4 at concentrations that would cause or contribute to ground water degradation based upon the statistical comparison of upgradient and downgradient ground water sampling results. This result, therefore, also demonstrates that the "multimedia cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers... constructed in accordance with the Commonwealth's Residual Waste Landfill Regulations for final cover of Class 1 residual waste landfills, set forth in 25 Pa Code Section 288.234 and 288.236-237' selected in the ROD [for the Crater Site] is not necessary to prevent unacceptable leaching of contaminants from soils and sediments in and at Quarry No. 4 into the ground water at the Site." Accordingly, Liberty requests, at the conclusion of this report, that EPA confirm that Liberty has met the standard set forth in the Consent Decree and ROD for the Quarry 4 Demonstration Project and grant a waiver of the cap and drainage layer requirements for Quarry 4.

Liberty Property Limited Partnership, of which Liberty Property Trust is the sole general partner, owns the property located at 2201 Renaissance Boulevard in Upper Merion Township, Montgomery County, PA. The 2201 Renaissance Boulevard property was developed by Liberty and it is currently occupied by an office building, associated parking lots and lined storm water detention basins. There is a former sand and gravel quarry located in the southeast corner of the 2201 Renaissance Boulevard property and extending onto an adjacent property, which was filled in historically. This quarry is known locally as Quarry No. 4 and is referred to throughout this document as the Site and/or Quarry No. 4. The location of the 2201 Renaissance Boulevard property is shown on Figure 1, and the layout of the 2201 Renaissance Boulevard property and adjacent surrounding properties, including the approximate boundaries of Quarry No. 4 is shown on Figure 2.

The Crater Resources Superfund Site Cooperating Respondent Group (The Group) completed a Remedial Investigation/Feasibility Study (RI/FS) of the Crater Site, which included among other things the investigation of four quarries - Quarry Nos. 1 through 4. Quarry Nos. 1 through 3 were the primary focus of the RI/FS since they were disposal sites for Waste Ammonia Liquor (WAL), the waste of concern at the Crater site. These quarries are located south and west of the 2201 Renaissance property at the approximate locations shown on Figure 2. Quarry No. 4 was also investigated as part of the RI/FS. No known waste disposal activities occurred at Quarry No. 4, however, according to the Record of Decision ("ROD") developed for the Crater site by the United States Environmental Protection Agency (USEPA) it was investigated to evaluate

whether it may have been impacted by waste disposal activities associated with the other three quarries.

Prior to the issuance of the ROD for the Crater site, Liberty performed investigations at the 2201 Renaissance Boulevard property and on their immediately adjacent property to the west (2301 Renaissance Boulevard) in cooperation with USEPA. EPA issued a comfort letter to Liberty on August 26, 1998 with respect to the property. Liberty subsequently developed the 2201 property. As part of the development process, Liberty obtained all required local building approvals from Upper Merion Township as well as approvals from the Pennsylvania Department of Environmental Protection (PADEP) and the U.S Army Corps of Engineers for the modification of wetland areas. In addition, Liberty provided its development plans to, and met with, USEPA to review those plans. USEPA expressed no objections to Liberty's proposed plans, which incorporated features designed to prevent infiltration into the area of Quarry No. 4. Liberty incorporated these features into its plans in anticipation that the ROD, which had not been issued at the time of Liberty's development activities, might require such features.

In September 2000, the USEPA issued the ROD for the Crater site. The ROD requires various remedial activities including the construction of caps over Quarry Nos. 1, 2 and 4. As outlined in the ROD, the caps must be constructed in accordance with the Commonwealth of Pennsylvania's Residual Waste Regulations for final cover of Class I residual waste landfills as set forth in 25 Pa. Code Sections 288.234 and 288.236-237 (ROD, page 7). The ROD states that the exact design of the cap may be modified during design to address site-specific features and land use (ROD, page 60).

On January 24, 2001, Liberty met with PADEP and USEPA to discuss its proposal for satisfying the capping requirements for Quarry No. 4 as set forth in the ROD for the Crater site pursuant to a proposed settlement with the USEPA. Liberty's presentation at the meeting and in its written report described how Liberty had already covered much of Quarry No. 4 in the development of the 2201 property which was coordinated with the USEPA. Further, it demonstrated how existing and planned conditions over Quarry No. 4 satisfy Pennsylvania's residual waste landfill capping requirements as called for in the ROD. At the meeting, PADEP requested some additional information to support this demonstration and, in light of the technical data discussed at the meeting, PADEP recommended that Liberty refocus its demonstration from a showing that capping standards had been satisfied or meet criteria for modifications, to a showing that the cap and drainage layer requirements of the regulations can be waived on the basis that unacceptable leaching is not occurring through the materials in the quarry. Such waiver is specifically provided for in the capping regulations to be followed at the Site, which are cited in the ROD.

In response to the results of this meeting, Liberty prepared and submitted to the PADEP and USEPA on February 12, 2001 a document entitled "Proposal to Cap Quarry No. 4". This Proposal to Cap Quarry No. 4 included: 1) a request to waive the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry; 2) a summary of the activities that have or would have been completed to verify compliance with the performance standards for the uniform soil layer as set forth in 25 Pa. Code Section 288.234; and 3) a discussion of post-closure land use.

PADEP and USEPA subsequently reviewed the Proposal to Cap Quarry No. 4 and USEPA issued a comment letter dated April 9, 2001. As outlined in the letter, PADEP and USEPA indicated that they did not believe that existing structures and soil placed over Quarry No. 4 by Liberty satisfied the cap/drainage layer/cover requirements in 25 Pa. Code 288.234. Also, PADEP and USEPA indicated that they did not believe that the proposal contained sufficient information to demonstrate that it was not necessary to limit infiltration into the quarry. However, they acknowledged that based on available data, a waiver may still have merit and indicated that if Liberty wished to pursue the waiver option, additional information and data would need to be generated and evaluated.

By subsequent letter dated April 23, 2001, USEPA stated that if Liberty chooses to pursue the waiver, it should develop a demonstration project in its proposed Remedial Design Work Plan (RDWP) required by Section VI of the Unilateral Administrative Order (UAO) issued on April 30, 2001 for the Crater Site. The UAO outlines the procedures and methods that must be followed in implementing the response actions selected in the ROD. Liberty submitted a Final RDWP to USEPA on June 11, 2004 entitled "Remedial Design Work Plan for the Quarry No. 4 Demonstration Project, 2201 Renaissance Boulevard, Upper Merion Township, Montgomery County, PA." The RDWP was submitted to USEPA as required by Section VI.C of the UAO and set forth Liberty's demonstration project to show that it satisfies the criteria for waiver. The RDWP also included the details of the additional data gathering and evaluation activities that would be implemented to support a request to waive the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) based upon a demonstration that it is not necessary to limit infiltration into the quarry and that a waiver of the cap will not cause or contribute to ground water degradation as a result of leachate production.

On January 25, 2008, a Consent Decree between Liberty and the United States was entered by the U.S. District Court for the Eastern District of Pennsylvania (C.V. Action No. 2:07-cv-05119). The Consent Decree recognized Liberty's ongoing work related to the Quarry No. 4 Demonstration Project and converted Liberty's obligations under the UAO to obligations under the Consent Decree, which now serves as the controlling authority for Liberty's work. Liberty's obligations under the UAO were terminated and superseded by the Consent Decree.

The Consent Decree recognized that the Remedial Design Work Plan would provide for "the performance of a demonstration project designed to determine whether the 'multimedia cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers... constructed in accordance with the Commonwealth's Residual Waste Landfill Regulations for final cover of Class 1 residual waste landfills, set forth in 25 Pa Code Section 288.234 and 288.236-237' selected in the ROD, is not necessary to prevent unacceptable leaching of contaminants from soils and sediments in and at Quarry No. 4 into the ground water at the Site, as measured by the analytical methods contained in the Remedial Design Work Plan approved by EPA." Consent Decree, p 25.

The preliminary interim data evaluation activities required by the RDWP were completed in 2010. As required by the RDWP, the results of the preliminary interim data evaluation activities were submitted to EPA in the "*Interim Remedial Design Report for the Quarry No. 4 Demonstration Project, 2201 Renaissance Boulevard, Upper Merion Township, Montgomery*

County, PA" (August 12, 2010) prepared by Penn E&R (IRDR). In addition to outlining the results of the preliminary data evaluation activities, the IRDR also presented the additional investigations that were required to be implemented to support Liberty's request for a waiver of the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry. The additional investigations required by the IRDR included the installation of three new wells and the sampling of these wells and four other existing wells on a quarterly basis for a period of two years. The well installation activities and eight quarterly ground water sampling events have now been completed. The well installation activities were summarized in a letter to EPA dated May 23, 2011 and quarterly letter reports have been provided to EPA at the completion of each quarterly ground water sampling event.

As more fully discussed below, no tested compounds were detected in the soil samples collected from the quarry cover material at concentrations exceeding site-specific soil screening levels developed for Quarry No. 4. These results confirm that the soil cover placed over Quarry No. 4 during the development of Liberty's 2201 Property will not have an adverse impact on human health, Quarry No. 4 or the ground water.

With regards to ground water, more than 50% of the sample results were non-detect (ND) for volatile and semivolatile organic compounds (VOCs and SVOCs) and cyanide. Therefore, a statistical analysis of that data was not performed given that such an evaluation would not provide statistically valid conclusions. These findings are consistent with those of the ground water monitored natural attenuation sampling being conducted by The Group, which has found that organic contaminants of concern (COC) are not typically associated with Quarry 4 as in almost all cases more than 50% of the VOC, SVOC and cyanide results for the wells they sampled located downgradient of Quarry No. 4 (wells MW-15S, MW-16S and MW-17S) were also ND. They found that only chloroform in well MW-15S was detected in more than 50% of the samples (nine out of eleven).

The statistical evaluation of inorganics presented in this document has focused on data collected for total inorganics (rather than dissolved inorganics) since ground water risks for the Crater Site, consistent with USEPA policy, were calculated using total inorganic results and these results formed the basis for the ROD. The analytical results and a summary of the results of the statistical analysis for the dissolved inorganic data are provided in Appendix A for completeness.

Of the twenty-three total inorganics included in the analytical program, six were ND in over 50% of the samples and, as a result, a statistical analysis of these metals was not performed. The statistical evaluation of the results for eleven of the remaining 17 metals tested revealed that the median/means of the concentrations at the downgradient wells were equal to, or less than, those of the upgradient data (i.e. no statistical difference between upgradient and downgradient concentrations for these metals was observed). The median concentrations of chromium in one downgradient well; cobalt, copper, nickel and lead in another downgradient well; and sodium in another were higher than the pooled upgradient concentrations. However, a statistical analysis was also performed on concentrations of the same suite of metals for just the last four sampling events. In this case, the mean/median concentrations of sixteen of the 17 metals tested at the

downgradient wells were equal to, or less than, those of the upgradient data. The median concentration of only lead in well MW-24 was higher than the pooled upgradient concentration.

With regards to lead, the results of the analysis of the concentrations for the last four events show that of the four downgradient monitoring wells (MW-15S, MW-16S, MW-17S and MW-24), the median concentrations for this metal was higher only in well MW-24 compared to the upgradient data. Additionally, a statistical comparison of the pooled downgradient data to the pooled upgradient data for all eight sampling events for lead shows that the concentrations for lead in the pooled downgradient data were not statistically higher than the pooled upgradient data. Sodium is not a COC at the Crater Resources Superfund Site and, as a result, a ground water standard for this parameter was not developed or included in the ROD. Based on the results of the analysis and although there is a slight statistical difference primarily in one downgradient well, overall, there appears to be very little statistical difference between ground water quality upgradient and downgradient of Quarry No. 4.

This Final Remedial Design Report (FRDR) provides the final analysis of the soil cover and ground water sampling results, and the conclusions of the Quarry 4 Demonstration Project. Comments received from EPA on September 16, 2013 regarding the Agency's review of the original submittal of the FRDR on June 3, 2013 have been addressed and incorporated into this report. As described in this report, the statistical analysis of the ground water sampling data collected during the two-year study period demonstrates that infiltration is not causing COCs to leach from Quarry No. 4 at concentrations that would cause or contribute to groundwater degradation. Further, this report demonstrates that that the "multimedia cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers… constructed in accordance with the Commonwealth's Residual Waste Landfill Regulations for final cover of Class 1 residual waste landfills, set forth in 25 Pa Code Section 288.234 and 288.236-237' selected in the ROD is not necessary to prevent unacceptable leaching of contaminants from soils and sediments in and at Quarry No. 4 into the groundwater at the Site." Therefore, Liberty requests that EPA confirm that it has met the standard set forth in the Consent Decree and ROD for the Quarry 4 Demonstration Project and that EPA grant a waiver of the cap and drainage layer requirements for Quarry 4.

2.0 LOCATION AND CONFIGURATION OF QUARRY NO. 4

Historical information suggests that Quarry No. 4 was mined for sand and gravel from sometime in the 1800s until the early 1900s. Based on a review of historical aerial photographs, the quarry was inactive and filled with water between at least 1945 and 1959. A 1965 aerial photograph shows that Quarry No. 4 was being filled with what appears to be earthen material. There may have been some water still present in the center of the quarry at this time. Between 1965 and 1975, it appears that the quarry was being actively filled with earthen material. By 1980, the quarry appears to have been filled to grade. The 1980 photograph shows that there is vegetation present on the surface of the quarry and there are also dirt access roads present in the central portion of the quarry and along its southeast end. There appears to have been some minor filling/grading-taking place on the surface of the quarry in 1985. No activities were evident on the quarry in 1990 or 1995. By 1995, the surface of the quarry was covered with vegetation.

As shown on Figure 2, Quarry No. 4 is located in the southeast corner of Liberty's 2201 Renaissance Boulevard property. The former quarry which, as indicated above, appears to have been historically filled primarily with earthen material, is about 630 feet long by, at its maximum, 300 feet wide. As documented in the IRDR, the quarry appears to have been excavated to a maximum depth of about 35 feet below the ground surface (BGS). Approximately 80 percent of the quarry is located on Liberty's 2201 property. The other 20 percent is located off of the 2201 property on properties to the east and south.

The pre-construction topography of Quarry No. 4 (i.e., prior to the redevelopment of the former brownfield properties that would later become Liberty's 2201 and adjacent 2301 Renaissance Boulevard properties) is shown on Figure 3. As can be seen from Figure 3, the surface elevation of Quarry No. 4 ranged from approximately 127 feet to 130 feet above mean sea level (MSL), with an average elevation of about 128.5 feet above MSL. The quarry surface was relatively flat but, like surrounding topography, sloped to the east and southeast, which is the direction storm water currently drains. The current configuration of the southeast portion of Liberty's 2201 Renaissance Boulevard property and Quarry No. 4 is shown on Figure 4. Figure 4 also includes a cross-section showing the cover materials that were placed over the quarry as part of the redevelopment of Liberty's 2201 and adjacent 2301 Renaissance Boulevard properties.

As shown on Figure 4, a portion of the eastern end of Quarry No. 4 has been covered with an impermeable 40-mil PVC liner installed as part of the construction of a permanent dry detention basin for the 2201 property. In addition, a small portion of the western end of the quarry is also covered with an impermeable 40-mil PVC liner installed to form another permanent wet detention basin, most of which extends onto Liberty's adjacent 2301 Renaissance Boulevard property. The detention basins were designed so that erosion of the soil layers overlying the liners do not occur. Also, the bottom of the eastern detention basin is at an elevation of about 132 feet above MSL. Therefore, no less than 3 feet of soil was placed on top of the surface of the quarry prior to the installation of the 40-mil PVC liner in the eastern detention basin. The bottom of the western detention basin was completed at an elevation of about 135 feet above MSL. Therefore, approximately 7 feet of soil was placed on top of the quarry prior to the installation of the 40-mil PVC liner in the western detention basin. Water from the two detention basins drains to a natural swale located west of Quarry No. 4, which then flows to the east and southeast.

In addition, a small portion of the southern end of the 2201 Building is located over Quarry No. 4. All water that collects on top of the building is directed to the detention basins located on the 2201/2301 properties. The elevation of the concrete pad on which the building is located is at 151.50 feet above MSL. Therefore, over 20 feet of soil was placed on top of the quarry prior to the construction of the building. Also, the north central portion of the quarry is covered with an asphalt parking lot. The surface elevation of this lot is about 142 feet above MSL. Therefore, over 10 feet of soil was placed over the quarry in this area. The remaining portions of the quarry have been covered with at least 2 feet of soil.

Liberty's completed construction of the 2201/2301 Renaissance Boulevard properties has increased runoff from Quarry No. 4 by about 80 percent as compared to the volume of runoff from the quarry prior to the redevelopment of these two former brownfield sites. This increase in the runoff rate obviously reduces the volume of water which can infiltrate into the quarry. A copy of the calculations verifying this increase in the runoff rate is included in Appendix B.

3.0 QUARRY NO. 4 DEMONSTRATION PROJECT

This Section of the Final Report presents and describes the additional data gathering and evaluation activities that were implemented in accordance with the RDWP and IRDR to support Liberty's request to waive the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry. The data gathering and evaluation activities implemented were divided into the following three separate tasks:

- Task 1 - Data Evaluation
- Task 2 - Evaluation of Soils Used as Cover at Quarry No. 4
- Task 3 - Groundwater Monitoring Program

A discussion of the activities performed as part of the implementation of each of these Tasks is provided below.

3.1 Task 1 - Data Evaluation

As part of the Task 1 activities, Liberty performed a detailed analysis of the hydrogeologic setting of Quarry No. 4 and the immediate surrounding areas. The primary objectives of the hydrogeologic evaluation were to confirm the direction of ground water flow and evaluate shallow and deep ground water flow beneath Quarry No. 4, and determine what, if any new monitoring wells would need to be installed to support the Quarry No. 4 Demonstration project. As part of this analysis, Liberty obtained depth-to-water level measurements from existing wells located downgradient and in the immediate vicinity of Quarry No. 4 and developed ground water contour maps for the shallow and deep groundwater systems. Liberty also developed hydrogeologic cross-sections for the Quarry No. 4 area using lithologic and hyrdrogeologic information obtained from the existing wells installed upgradient and downgradient of Quarry No. 4 and the soil borings and test trenches previously installed in the quarry. Liberty also compiled and reviewed available geologic/hydrogeologic reports generated for this portion of Upper Merion Township as well as those developed for the Crater Site by The Group. The results of this hydrogeologic evaluation were included in the IRDR and are presented in Appendix C.

3.2 Task 2 - Evaluation of Soils Used as Cover at Quarry No. 4

As indicated earlier, a majority of the surface of Quarry No. 4 was covered with 2 or more feet of soil as part of the development of Liberty's 2201 Renaissance Boulevard Property (2201 Property). A majority of this soil was obtained from the northern portions of the 2201 Property, which were cut to required construction grades, and used to fill the southern portions of the 2201 Property, including areas over Quarry No. 4. Although there is no evidence that these soils were impacted in any way by potential contaminants, the EPA requested that Liberty evaluate these soils to ensure that their presence would not have an impact on Quarry No. 4 or ground water.

As part of this evaluation and on July 29, 2010, Liberty installed three soil borings through the soil cover placed over the quarry. These borings were designated SB-1, SB-2 and SB-3 and they

were installed at the approximate locations shown on Figure 5. These locations were selected because they provide a representative evaluation of the soil cover in areas covered with from 2 to almost 20 feet of soil, and the locations were approved by EPA. The soil borings were installed using a direct push drill rig and were terminated on the top of the surface of the quarry (boring SB-1 was completed at 15 feet, boring SB-2 was competed at 9 feet and boring SB-3 was completed at 10 feet) and continuous soil samples were collected from each location. The soil samples were screened for volatile organic compounds with a photoionization detector (PID) and each sample was visually inspected for evidence of impacts. A lithologic log for each boring is included in Appendix D.

To confirm the field screening results, one soil sample at each boring location was selected for laboratory analysis. Since no evidence of impact was identified and, in accordance with the IRDR, the sample selected from each boring for analysis was obtained from the mid-point within the boring. The three selected samples, designated Q4-SB1-S (collected from boring SB-1 at a depth of 8 feet), Q4-SB2-S (collected from boring SB-2 at a depth of 6 feet) and Q4-SB3-S (collected from boring SB-3 at a depth of 5 feet) were submitted to CompuChem, an EPA approved CLP laboratory located in Cary, NC for analysis of the Target Compound List (TCL) volatile and semivolatile organic compounds (VOCs and SVOCs) and the Target Analyte List (TAL) inorganics (metals and cyanide). The samples were analyzed using USEPA Method SOM01.2 (GC/MS) for organics and USEPA Method ILM05.4 (ICP) for inorganics.

As part of the soil sampling activities and as required by the approved RDWP, a field blank and rinsate blank, and a blind duplicate were collected. The blind duplicate was designated Q4-SB2A-S and was collected at sample location Q4-SB-2-S. The rinsate blank and the blind duplicate were analyzed for the TCL VOCs and SVOCs and the TAL inorganics (metals and cyanide), and the trip blank was analyzed for the TCL VOCs.

The RDWP/IRDR required the collection of water samples if water was encountered during the installation of the three borings. No evidence of any water, including perched water was encountered during the installation of the borings. Therefore, no water samples were collected.

Upon completion of the soil boring installation activities, drill cuttings were placed into the borehole and the remaining annular space was filled with soil cuttings and capped with bentonite. The horizontal location of the borings was also determined so that they could be accurately plotted on site plans. The soil boring installation and sampling activities were completed in accordance with the Sampling and Analysis Plan included in Section 5.0 of the approved RDWP

3.3 Task 3 - Ground Water Monitoring Program

As discussed above, a detailed review of available information regarding the hydrogeologic setting of Quarry No. 4 and the surrounding areas was completed. The results of this evaluation were included in the IRDR and are presented in Appendix B. Based on the results of this evaluation and consistent with the approved IRDR, existing monitoring wells MW-15S, MW-16S and MW-17S, along with a newly installed well designated MW-24 were used to evaluate ground water conditions downgradient of Quarry No. 4 and existing well MW-10 along with two

newly installed wells designated MW-22 and MW-23 were used to evaluate ground water conditions upgradient of the quarry. The well installation and ground water sampling activities that were implemented are discussed below.

3.3.1 Well Installation Activities

The newly installed upgradient wells were designated MW-22 and MW-23 and the newly installed downgradient well was designated MW-24. These wells were installed using a hollow-stem auger drill rig between August 20 and August 28, 2010 in accordance with the requirements of the IRDR. The newly installed and existing wells were subsequently developed on September 13 and 14, 2010.

Monitoring Well Network

As indicated in the IRDR, the monitoring well network used to evaluate ground water conditions upgradient and downgradient of Quarry No. 4 included four existing wells installed as part of the Crater site investigations and three newly installed wells.

Upgradient Wells

The existing well located hydraulically upgradient of Quarry No. 4 that was incorporated into the ground water monitoring program included well MW-10. The location of this well in relationship to Quarry No. 4 is shown on Figure 6, and the construction specifications for this well are summarized in Table 1. As can be seen from Table 1, well MW-10 is completed at 105 feet BGS with 20 feet of screen. To supplement this well, two additional shallow wells were installed upgradient of Quarry No. 4. These wells were installed and were designated MW-22 and MW-23. As can be seen from Figure 6, well MW-22 was installed south of Quarry No. 4 and well MW-23 was installed southwest of the quarry.

Downgradient Wells

The existing wells located hydraulically downgradient of the quarry that were incorporated into the ground water monitoring program included wells MW-15S, MW-16S and MW-17S. The locations of these wells in relationship to Quarry No. 4 are shown on Figure 6, and the construction specifications for these wells are summarized in Table 1. In addition to existing shallow wells MW-15S, MW-16S and MW-17S and consistent with the IRDR, Liberty installed a new well directly downgradient and near the northwest end of Quarry No. 4. This well was designated MW-24 and it was installed at the approximate location shown on Figure 6.

Monitoring Well Installation

As discussed in Section 5.0 of the RDWP, the three new wells were installed using a hollow-stem auger drilling rig. Well MW-22 was completed at a depth of 56. 5 feet BGS, well MW-23 was completed at a depth of 60 feet BGS and well MW-24 was completed at a depth of 80 feet BGS so that each could monitor the upper portion of the water table. During installation of the wells, split-spoon soil samples were collected at 5-foot intervals from a depth of 20 feet BGS in

wells MW-22 and MW-23 and 35 feet BGS in well MW-24 to the approximate completion depth of each well with continuous split-spoons samples being collected over a 6 to 10-foot interval near the water table at each well location. The contents of each split-spoon were screened in the field with a PID for volatile organic vapors and will be visually inspected for signs of contamination.

A 6-inch borehole was initially drilled at each well location. Upon reaching the desired completion depths, a 2-inch diameter PVC well was constructed in the boreholes. The wells were installed and constructed as described in Section 5.0 of the approved RDWP. The monitoring wells were constructed using 2-inch diameter, flush-threaded, Schedule 40 PVC casing with a 10-foot long bottom section of 0.01-inch slotted screen at well MW-22 and a 20-foot long section at wells MW-23 and MW-24. The annular space between the borehole wall and well screen at each location, with the exception of well MW-22 where 5 feet of sand was placed above the screen, was filled with clean silica sand to a depth of approximately 2 feet above the top of the well screen. A 2-foot-thick bentonite seal was placed above the sand pack and hydrated with potable water. The remainder of the borehole annulus at each location was filled to grade with a cement-bentonite grout. The wells were completed with a locking 4-inch diameter well cap anchored in a concrete collar. Wells MW-22 and MW-23 were completed with about 3.5 feet of stickup and well MW-24 was completed flush with the surrounding parking lot. Construction/completion logs for each of the newly installed wells and for the existing wells included in the demonstration project are included in Appendix D.

Following installation, the new wells and existing wells MW-10, MW-15S, MW-16S, MW-17S, MW-18 were developed using a combination of decontaminated bailers and submersible pumps with dedicated polyethylene/teflon lined tubing until the water ran generally clear and was of acceptable turbidity. All development water was placed in 55-gallon drums. Drill cuttings from the ground surface to the saturated zone at well locations MW-22 and MW-23 were raked into the ground surface but drill cuttings from the saturated zone at these wells locations and all drill cuttings at well MW-24 were placed in 55-gallon drums. Also, the horizontal and vertical location of the existing and new wells were surveyed by a Pennsylvania-licensed surveyor to facilitate calculation of the ground water elevation in each well and to allow for the assessment of the principal direction of ground water flow.

3.3.2 Ground Water Sampling

Eight quarterly ground water sampling events were implemented between October 2010 and August 2012 (October 2010, January 2011, April 2011, July 2011, October 2011, January 2012, April 2012 and August 2012). As part of this sampling, each of the three upgradient wells (wells MW-10, MW-22 and MW-23) and the four downgradient wells (wells MW-15S, MW-16S, MW-17S and MW-24) included in the Quarry No. 4 Demonstration project were sampled. The samples were collected following procedures included in Section 5.0 of the RDWP and the IRDR.

Prior to collecting samples, a depth-to-water level measurement was collected from each well. The wells were then purged using decontaminated/dedicated equipment following low-flow purging procedures. The purge water was discharged through a closed cell and in-situ

measurements of pH, temperature, conductivity and turbidity were collected. The well purging was continued until the in situ measurements stabilized. The ground water samples were then collected directly from the dedicated tubing into laboratory supplied sample bottleware. All purge water was containerized in 55-gallon drums.

The ground water samples collected during each quarterly sampling event were submitted to CompuChem for analysis of the TCL VOCs and SVOCs and the TAL inorganics (metals [total and dissolved] and cyanide). The samples were analyzed using USEPA Method SOM01.2 (GC/MS) for organics and USEPA Method ILM05.4 (ICP) for inorganics. As part of each quarterly sampling event, and as required by the approved RDWP, a field blank and rinsate blank, and a blind duplicate were collected. The rinsate blanks and the blind duplicates were analyzed for the TCL VOCs and SVOCs and the TAL inorganics (metals and cyanide), and the trip blanks were analyzed for the TCL VOCs.

In addition to the wells included in the demonstration project, ground water samples were also collected from existing well MW-18 throughout the duration of the monitoring program. The samples collected from well MW-18 were analyzed for the same parameters as were the other ground water samples. Consistent with the RDWP and IRDR, although existing well MW-18 was sampled, the sample results were not completed in the statistical evaluation of the ground water data but the results were provided to EPA.

4.0 DATA ANALYSIS

This Section of the Final Report includes an analysis of the soil and ground water data generated as part of the Quarry No. 4 demonstration project.

4.1 Soils Used as Cover at Quarry No. 4

As indicated earlier and as shown on Figure 4, a majority of the surface of Quarry No. 4 was covered with 2 or more feet of soil as part of the development of Liberty's 2201 Renaissance Boulevard Property. A majority of this soil was obtained from the northern portions of the 2201 Renaissance Boulevard Property, which were cut to required construction grades, and used to fill the southern portions of the 2201 Renaissance Boulevard Property, including areas over Quarry No. 4. Although there is no evidence that these soils were impacted in any way by potential contaminants, the EPA requested that Liberty evaluate these soils to ensure that their presence would not have an impact on Quarry No. 4 or ground water.

As part of this evaluation, three soil borings were installed through the soil cover placed over the quarry. These borings were designated SB-1, SB-2 and SB-3 and they were installed at the approximate locations shown on Figure 5. The soil borings were terminated on the top of the surface of the quarry (boring SB-1 was completed at 15 feet, boring SB-2 was competed at 9 feet and boring SB-3 was completed at 10 feet) and continuous soil samples were collected from each location. The soil samples were screened for volatile organic compounds with a PID and each sample was visually inspected for evidence of impacts. A lithologic log for each boring is included in Appendix D.

A review of the lithologic logs reveals that the cover material placed over the quarry consists mainly of reddish brown silty clay with some sand and gravel. No visual evidence of impacts was identified and no elevated ID readings were measured in any of the soil samples. Additionally, no evidence of perched water or ground water was identified in any of the soils borings.

To confirm the field screening results, one soil sample at each boring location was selected for laboratory analysis. Since no evidence of impact was identified and, in accordance with the IRDR, the sample from each boring selected for analysis was obtained from the mid-point within the boring. The three selected samples, designated Q4-SB1-S (collected from boring SB-1 at a depth of 8 feet), Q4-SB2-S (collected from boring SB-2 at a depth of 6 feet) and Q4-SB3-S (collected from boring SB-3 at a depth of 5 feet) were submitted to CompuChem for analysis of the TCL VOCs and SVOCs and the TAL inorganics (metals and cyanide). The results of the analysis of these samples are summarized in Table 2 and a complete copy of the analytical data package along with the data validation report for these samples is included on a CD in Appendix E1.

In evaluating the soil sample results, the data were compared to site-specific soil screening levels calculated for Quarry No. 4 during the Crater Remedial Investigations (Table 32 in the RI Report) and background upper tolerance limits for inorganics developed by The Group for the Crater Site or, if no site-specific screening levels or background standards were available for a

particular compound a site-specific screening level for that compound was calculated using EPA's Regional Screening Level Master Table (May 2013) and a Dilution Attenuation Factor of 5. A review of Table 2 reveals that no tested compounds were detected in the three soil samples at concentrations exceeding site-specific soil screening levels. These results confirm that the soil cover placed over Quarry No. 4 during the development of Liberty's 2201 Property is not impacted and will not have an adverse impact on human health, Quarry No. 4 or the ground water.

4.2 Ground Water Conditions

4.2.1 Ground Water Flow

Depth to water in all wells was measured prior to each quarterly sampling event. The data were referenced to mean sea level then plotted on a base map to establish the direction of ground water flow. As can be seen from Table 1, depth-to-water at the Site generally ranges from about 40 feet in the area of upgradient well MW-23 to 80 feet BGS in the area of downgradient well MW-15S. Potentiometric surface elevation contour maps created from the July 2011, October 2011, January 2012 and April 2012 sampling events are shown on Figure 7A through 7D, respectively. A review of these figures reveals the direction of ground water flow beneath the Quarry No. 4 area is generally northeast, which is consistent with prior measurements collected at the Site and flow directions determined by The Group for the Crater Site.

4.2.2 Ground Water Sampling

Eight quarterly ground water sampling events were implemented between October 2010 and August 2012 (October 2010, January 2011, April 2011, July 2011, October 2011, January 2012, April 2012 and August 2012). The samples were collected following procedures included in the IRDR. Field and quality assurance/quality control (QA/QC) samples were shipped under chain of custody documentation to CompuChem for analysis of the TCL VOCs and SVOCs and TAL metals (total and dissolved) and cyanide. Validated analytical results are summarized in Table 3 and a complete copy of the analytical data package along with the data validation report for each sampling event is included on CDs in Appendix E2.

A detailed statistical analysis of the ground water data is provided below in Section 4.3.

4.3 Statistical Analysis and Results

The IRDR required that a statistical analysis of the ground water data from the Quarry No. 4 Demonstration Project be performed at the completion of four quarters of sampling and at the completion of the two year monitoring period. This report presents the results of the statistical analyses performed on the entire two-year data set. The primary objective of these analyses was to determine whether there exists a statistically significant difference between the ground water quality upgradient and downgradient of Quarry No. 4. As described below, although there is a slight statistical difference primarily in one downgradient well, overall, there appears to be very little statistical difference between ground water quality upgradient and downgradient of Quarry No. 4. Consistent with the RDWP and the Consent Decree, the conclusion, based on the results

described below, that there appears to be very little statistical difference between ground water quality upgradient and downgradient of Quarry No. 4. supports Liberty's request for a waiver of the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry.

4.3.1 Statistical Methodology

The statistical analyses were applied to data from eight consecutive quarterly sampling events between October 2010 and August 2012. Data from wells MW-10, MW-22 and MW-23 (Upgradient Well Group) were used to represent ground water conditions upgradient of Quarry No. 4; and data from wells MW-15S, MW-16S, MW-17S and MW-24 (Downgradient Well Group) were used to represent ground water conditions downgradient of the quarry. Statistical analyses were performed following the guidelines included in the IRDR and the USEPA document entitled *"Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009"* (Unified Guidance), and according to 40 C.F.R. sections 264.97(h) and 258.53 (g) (RCRA ground water monitoring regulations). USEPA's software package ProUCL 4.1 and software applications based on the Unified Guidance were used to process and statistically analyze the data sets.

4.3.1.1 Data Preparation and Adjustment

The ground water data were initially evaluated for non-detects (NDs). The type of initial statistical analysis performed on the data was governed to a large extent by the percentage of non-detects in each particular data set.

The intra-group analyses, comparing results within the upgradient group of wells or within the downgradient group of wells, involved applying the non-parametric Kruskal-Wallis test. However, consistent with Section 15.6 of the Unified Guidance, if non-detects exceeded 50 percent no statistical analysis was performed. For the inter-group analyses, comparing the downgradient results to upgradient, individual parameters with less than 15% NDs were analyzed using the parametric one-way ANOVA F-Test. If an individual parameter had greater than 15% and less than 50% NDs it was analyzed using the non-parametric one-way ANOVA Kruskal-Wallis test. The statistical distribution of data sets in the latter category cannot necessarily be considered to be normal because of the significant number of NDs, and hence these data were analyzed using a non-parametric test. Figure 8 shows the decision tree indicating the basis for selecting the particular statistical approaches adopted for the inter-group comparisons. Prior to implementing statistical testing, the non-detects in the adjusted data set were converted to the Method Detection Limits (MDLs) associated with those entries.

When data were analyzed using either the parametric or non-parametric methods described above, the tests were performed at a 95% confidence level (i.e. $\alpha = 0.05$). Individual parameters having more than 50% NDs were not, as indicated above and consistent with Section 15.6 of the Unified Guidance, analyzed statistically because of the likelihood the conclusions from the results would not be reliable.

The validated inorganic data set was processed in specific ways that involved making adjustments to permit optimal use of the data in the statistical tests. The data processing consisted of adjustments to metals data values flagged with a qualifier, including:

B – Not Detected. Not detected substantially above the level reported in the laboratory or field blank
J – Analyte present. Reported value may not be accurate or precise.
K – Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L – This result should be considered a biased low quantitative estimate.
< – Not detected above the reporting limit.

Values having the qualifiers J, K and L were accepted as the given values, and each entry was set without those qualifiers. Values associated with 'B' or '<' qualifiers were assumed to be not detected above the MDL, and were converted to '< MDL', where MDL was the laboratory method detection limit for each specific metal at the time of laboratory analysis. Appendix F includes a table listing the MDLs for each metal for each date when the analysis was performed. The values were provided by the laboratory (CompuChem).

Appendix G includes tables summarizing the analytical results for the total metals for each well. The page for each well gives the validated data set as well as the data set following adjustment. Table 4 provides a list of total inorganics that were not submitted for statistical testing due to a high percentage of non-detects. The table includes the percentage of non-detects associated with each metal.

Based on a preliminary review of data, an evaluation of potential outliers in the metals data was also performed. As part of this process, an evaluation of the nature of the data distribution (normal or log-normal) using the Shapiro-Wilk test was first completed, followed by application of Dixon's Test to identify statistical outliers. As indicated below, any significant outliers were removed from the database. Computer applications were created for both tests based on the description of the methods and example problems in the Unified Guidance (Chapter 10 and Chapter 12, respectively). The computer output for Dixon's Test is included as Appendix H1.

Table 5 gives the results of evaluating the normality of each data set using the Shapiro-Wilk test. As seen, data sets were generally found to have either a normal or log-normal distribution, while in a minority of cases neither distribution seemed to apply. Table 6 provides a summary of the results of applying Dixon's Test to each data set. For those data sets that included a statistical outlier(s), the outlier values are shown in Table 6. Dixon's Test was set up to apply to either normally distributed or log-normally distributed data. When the preponderance of the well data for a given metal, 4 or more of the 7 wells, was shown to be normally distributed (see the far right column of Table 5), then outliers were identified on the basis of the data being normally distributed for that metal. Otherwise, the outliers were identified on the basis of the data being log-normally distributed.

The subsequent intra-group and inter-group analyses were performed on the metals data sets in which the statistical outliers identified in Table 6 were omitted.

None of the organics data were adjusted in any way. The data set could not be analyzed statistically because, in general, over 75 percent of the entries were non-detects with only a few values associated with 'B' qualifiers. Appendix I includes a summary of the validated data set for the organics for each well.

4.3.1.2 Statistical Analysis for Intra-Group Analyses

The non-parametric statistical test Kruskal-Wallis was applied to evaluate variation within the upgradient group of wells with respect to each parameter and subsequently within the downgradient group of wells. These analyses were denoted as 'intra-group' analyses. This was followed by applying parametric and non-parametric tests to compare the statistical difference in means or medians between-the upgradient data sets and the downgradient data sets. These analyses were denoted as 'inter-group' analyses, as described in the following section.

4.3.1.3 Parametric Tests for Inter-Group Analyses

Parametric tests were utilized only for inter-group analyses in which downgradient data were compared to upgradient data. As shown on Figure 8, for data sets with less than 15 percent non-detects, the one-way ANOVA F-test was used, unless results of the Sahpiro-Wilk test indicated non-normal distribution, in which case non-parametric tests were applied. The one-way ANOVA F-test involves testing the null hypothesis (H_0) that for a given parameter, the means for two or more data sets are the same. The H_0 was rejected if the calculated F-statistic exceeded a 'critical point'. The critical point is based on the degrees of freedom and can be found in Table 17-1 of the Unified Guidance. The critical point and the F-statistic for each data set were generated using a computer code based on the methodology specified in the Unified Guidance. If the H_0 was rejected it was assumed that the means for that parameter for at least one pair of wells in the group differed significantly and Bonferroni post-hoc pairwise comparisons were performed.

In these post-hoc tests, Chapter 17 of the Unified Guidance recommends that to keep the overall false positive rate close to the targeted rate of 5%, the individual contrasts (post-hoc tests) should be set up as follows: Given $(p-1)$ separate background-compliance contrasts, if $(p-1) \leq 5$, each contrast was run at a significance level equal to $\alpha^* = .05/(p-1)$. However, if $(p-1) > 5$, each contrast was run at a significance level equal to $\alpha^* = .01$. This calculation was included in the computer code for the method.

In addition to applying the one-way ANOVA F-test to the data for the eight sampling events, the test was also applied to the metals data characterized by a normal distribution for just the last four sampling events. Where a statistical outlier was included in the concentration values for the last four events, it was replaced by the value for the 4th sampling event. In two such instances, the value for the fourth event was also a statistical outlier. Hence in those cases, the value for the third sampling event was used to replace the outlier within the data for the last four events.

4.3.1.4 Non-Parametric Tests for Inter-Group Analyses

As stated in Section 4.3.1.2, the non-parametric one-way ANOVA, known as the Kruskal-Wallis test, was-utilized for all intra-group testing where the percentage of non-detects was 50 percent or less.

For the inter-group analyses (comparison of downgradient data to upgradient), if an individual parameter had greater than 15% and less than 50% NDs it was analyzed using the non-parametric one-way ANOVA, known as the Kruskal-Wallis test. The statistical distribution of data sets in this category cannot necessarily be considered to be normal because of the significant number of NDs, and hence these data were analyzed using the non-parametric test. Also, as shown on Figure 8, in certain cases even when the percent NDs was less than 15%, if the Shapiro-Wilk test indicated a non-normal distribution, then the parameter for the given well(s) was analyzed using this non-parametric method.

The Kruskal-Wallis test produces an H statistic that is compared to the chi-square distribution (X^2) critical point. The critical point is based on the degrees of freedom and can be found in Table 17-2 of Appendix D of the Unified Guidance. A computer code based on the methodology specified in the Unified Guidance was used to generate the H statistic and the critical point. If the H statistic was greater than the X^2 critical point, the H_0 was rejected and the medians for that parameter for at least one pair of wells in the group were assumed to differ significantly and post-hoc pairwise comparisons were performed by the program.

When the Kruskal-Wallace test was performed, a post-hoc test recommended in the Unified Guidance to identify which well pair(s) had significantly differing medians was used. This test involves the use of the average data ranks obtained from the Kruskal-Wallis test results and the Z-statistic, as the Unified Guidance states that data ranks approximately follow the standard normal distribution.

As with the parametric one-way ANOVA post-hoc test, the post-hoc test associated with the Kruskal-Wallis test involved setting up the individual contrasts such that each contrast would be run at a significance level equal to $\alpha^* = .05/(p-1)$, and that if $(p-1) > 5$, each contrast would be run at a significance level equal to $\alpha^* = .01$. This calculation was included in the computer code for the method.

In addition to applying the Kruskal-Wallis ANOVA test to the data for the eight sampling events, the test was also applied to the metals data not characterized by a normal distribution for just the last four sampling events. Where a statistical outlier was included in the concentration values for the last four events, it was replaced by the value for the 4th sampling event. In two such instances, the value for the fourth event was also a statistical outlier. Hence in those cases, the value for the third sampling event was used to replace the outlier within the data for the last four events.

4.3.1.5 Graphical Presentations

Inorganics data with no more than 50 percent non-detects were plotted as concentration vs. time plots to identify evidence of concentration trends. If statistically significant trends are occurring, the assumption inherent to several statistical tests that the data are stable or stationary would be violated. Prior to plotting, the non-detects in the adjusted data set were converted to the MDLs associated with those entries. Appendix J1 contains plots for the total metals and Table 7 lists the total metals that were found to have statistically significant decreasing or increasing trends. As seen, the instances of decreasing trends far outweigh those with increasing trends. These trends were confirmed at the 80 to 90% probability level based on application of the Mann-Kendall test for trends.

Box plots were created to provide a graphical display of the data distribution and those generated for total metals are contained in Appendix J2. Box plots display the data as quartiles, i.e., as the 0th, 25th, 50th, 75th, and 100th percentiles. The band near the middle of the box represents the 50th percentile (the median), and the length of the whiskers (lines drawn to the minimum and maximum values) represent the extent of the distribution. Statistical outliers, where present, are indicated by isolated points located above or below the vertical extent of the whiskers. Table 6 lists the outliers that were identified as statistical outliers based on application of Dixon's Test to the total metals data. Computer output from running Dixon's Test is included in Appendix H1. The box plots were created using ProUCL 4.1.

Q-Q plots (Quintile-Quintile) were created for inorganics data sets with non-detects of 50 percent or less. The purpose was to give a graphical indication to what extent each data set was normally distributed. When the plotted points deviate substantially from a straight-line plot, the metal data for the given wells are believed to have a non-normal distribution. Table 5 lists the results of running the Shapiro-Wilk test to evaluate the normality of the data distribution for each metal and each well. When the Shapiro-Wilk test indicated likely non-normal distribution, the data set was subsequently analyzed by non-parametric tests, even if the percentage of non-detects was less than 15 percent. The Q-Q plots for total metals are included in Appendix J3. The plots were created using ProUCL 4.1.

4.3.2 Evaluation of Organics

4.3.2.1 Volatile Organic Compounds (VOCs)

The majority of sample results were non-detect for VOCs and Quarry 4 does not appear to be a source of VOCs to ground water. As shown in the tables in Appendix I, for both upgradient and downgradient wells, the percentage of NDs for all VOCs far exceeded 50%. With the exception of primarily acetone, which is a standard laboratory-introduced contaminant and is not a Site-related contaminant, VOCs that were detected were generally detected at estimated concentrations below the laboratory method reporting limit (MRL). Also, the VOCs detected in the downgradient wells were also generally the same VOCs that were detected in the upgradient wells with the VOCs in both the downgradient and upgradient wells generally being detected in the same concentration range (i.e. at estimated concentrations below the MRLs). Since NDs for

VOCs were consistently well above 50% and consistent with Section 15.6 of the Unified Guidance, no statistical analysis of the VOC data was performed.

Given the excessive number of samples with no detections of VOCs, no statistically valid conclusion can be drawn as to the difference in the mean or median VOC concentrations between upgradient and downgradient wells. Also, given that the same general VOCs were detected in the downgradient wells as in the upgradient wells and in the same concentration range (i.e. below MRLs), there appears to be no unacceptable leaching of VOCs from soils and sediments in and at Quarry No. 4 into the ground water at the Site.

4.3.2.2 Semivolatile Organic Compounds (SVOCs)

The majority of sample results were non-detect for SVOCs and Quarry 4 does not appear to be a source of SVOCs to ground water. As shown in the tables in Appendix I, no SVOCs were detected in any of the samples from the upgradient or downgradient wells at concentrations exceeding their MRLs with the exception of bis (2-ethylhexyl) phthalate (BEHP) and the compound caprolactam, which was detected in only one sample at a concentration well below its USEPA Regional Screening Level for tap water.

BEHP was detected in a few samples from upgradient wells: MW-10 (2.2J µg/l), MW-22 (2.9J and 7.9 µg/l) and MW-23 (2.5L µg/l). It was also detected in six samples from downgradient wells: MW-15S (3.3J µg/l), MW-16S (2.4J µg/l), MW-17S (3.0 ug/l and 2.4J µg/l) and MW-24 (3.5L µg/l and 8.6L µg/l). The concentration range at which BHEP was detected in the downgradient wells is similar to the concentration range in which it was detected in the upgradient wells. BEHP is a typical blank contaminant. Although not attributed to blank contamination for its respective monitoring events, given its limited number of detections and the rather similar concentration range in both the upgradient and downgradient wells, it is unlikely that BEHP is present as a result of site activities.

Since the percentage of non-detects for all SVOCs, including those for BEHP far exceeds 50%, no statistical analysis of the SVOC data was performed and, as a result, no statistically valid conclusion can be drawn as to the difference in the mean or median SVOC concentrations between upgradient and downgradient wells. Given this and since SVOCs were generally not detected in the ground water samples and the one compound that was, BHEP, was detected at similar concentrations in both the downgradient and upgradient wells, unacceptable leaching of SVOCs from soils and sediments in and at Quarry No. 4 into the ground water at the Site does not appear to be occurring.

4.3.3 Evaluation of Inorganics

4.3.3.1 Cyanide

Cyanide was non-detect in over 87% of the samples collected from upgradient wells MW-10 and MW-23 and downgradient wells MW-15S, MS-16S and MW-24 and the detected cyanide concentrations in these wells ranged from 1.6J to 2.4J (see Tables in Appendix I). Cyanide was detected in less than 40 percent of the samples collected from upgradient well MW-22 (1.6J, 4.0J

and 3.0J µg/l) and downgradient well MW-17S (1.8J, 4.6J and 11.3 µg/l). As the percentage of non-detects for cyanide exceeds 50% in all the wells, no statistical analysis of the cyanide data was performed as the results would not likely yield reliable conclusions. Given the excessive number of samples with no detections of cyanide, no statistically valid statement can be made as to the difference in the mean or median cyanide concentrations between upgradient and downgradient wells.

4.3.3.2 Total Inorganics

The statistical evaluation of inorganics presented below used data collected for total (not dissolved) inorganics since ground water risks at the Crater Site were calculated, consistent with USEPA policy, using total inorganic results and these results formed the basis for the ROD (per EPA Comment letter dated April 9, 2001). For completeness purposes, however, the statistical analysis of the dissolved metals was also completed and the results of this analysis are included in Appendix A.

Of the 23 inorganics analyzed, five metals (antimony, cadmium, selenium, silver and thallium) were not detected above their MDLs in over 50% of the samples. Table 4 provides a list of metals exhibiting a high number of non-detect results. Of the metals shown, with the exception of mercury, the percentage of non-detects ranged from 62.5% to 100%. Consequently, and consistent with Section 15.6 of the Unified Guidance, a statistical analysis of these metals was not performed. In upgradient well MW-22, mercury was detected in all but one of the eight samples collected, but in the remaining samples, the percentage of non-detects ranged from 75% to 100%. For this reason, mercury data were statistically analyzed only for the intra-group analysis of the upgradient wells.

4.3.3.2.1 Intra-Group Results for Upgradient Wells

The non-parametric Kruskal-Wallis test was utilized to evaluate potential spatial variation among the three upgradient wells. This involved analyzing the upgradient data set for aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium and zinc. The results are shown in Table 8. Of these inorganics, only beryllium showed no significant difference in the median concentrations among the wells; for the remaining metals the results indicated that the median concentrations of at least one well pair differed significantly. This was determined by using the Kruskal-Wallis test to calculate the H-statistic which was compared to the appropriate critical point. As shown in Table 8, for beryllium its H-statistic value was less than the critical point.

The post-hoc test involving the use of average data ranks was run on the data for the remaining metals as these were the parameters for which the H_0 was rejected in the Kruskal-Wallis test. This analysis showed for which pairs of wells the median concentrations differed significantly. The last column of Table 8 shows that the median concentrations in MW-22 equaled those of MW-23 for thirteen of the 18 metals. Also the median concentrations in MW-10 were effectively the same as those in MW-23 for eight of the 18 metals. For specific results of the post-hoc analyses, please refer to the computer output for this analysis included in Appendix H2.

As shown in Table 8, the intra-group data analysis of the inorganics for the upgradient wells indicates that no significant spatial variation was demonstrated for beryllium. Statistically significant spatial variation was demonstrated for the remaining metals: aluminum, arsenic, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium and zinc. Penn E&R does not believe the demonstrated spatial variation among the upgradient wells impacts the validity of the conclusions of the subsequent inter-group statistical analysis. However, the heterogeneity of the ground water system at the site should be recognized.

4.3.3.2.2 Intra-Group Results for Downgradient Wells

As with the upgradient wells, the non-parametric Kruskal-Wallis test was utilized to evaluate potential spatial variation among the four downgradient wells. This involved analyzing the downgradient data set for aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium and zinc. The results are shown in Table 9. Of these inorganics, only beryllium and vanadium showed no significant difference in the median concentrations among the wells based on the post-hoc analyses. For the remaining metals the results indicated that the median concentrations of at least one well pair differed significantly. Table 9 shows that although the H-statistic value for vanadium was greater than the critical point, the subsequent post-hoc analysis showed that the median concentrations for this metal did not differ significantly for any of the well pairs.

The post-hoc test involving the use of average data ranks was run on the data for the remaining metals as these were the parameters for which the H_0 was rejected in the Kruskal-Wallis test. This analysis showed for which pairs of wells the median concentrations differed significantly. The last column of Table 9 shows that the median concentrations in MW-15S equaled those of MW-16S and MW-17S for nine of the 17 metals, and the median concentrations for MW-16S were effectively the same as those for MW-17S and MW-24 for 11 of the 17 metals. For the specific results of the post-hoc analyses, please refer to the computer output for this analysis included in Appendix H2.

As shown in Table 9, the intra-group data analysis of inorganics for the downgradient wells indicates that there was no significant spatial variation demonstrated for beryllium and vanadium. Statistically significant spatial variation was demonstrated for aluminum, arsenic, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, and zinc. However, Penn E&R does not believe the demonstrated spatial variation among the downgradient wells impacts the validity of the conclusions of the subsequent inter-group statistical analysis.

4.3.3.2.3 Inter-Group Results - Upgradient vs. Downgradient

As discussed above, the inter-group inorganic concentration comparisons were accomplished by applying the parametric one-way F-test ANOVA or the non-parametric ANOVA known as the Kruskal-Wallis test, as appropriate.

The inorganics selected for the one-way ANOVA were the four inorganics in the upgradient and downgradient wells with NDs less than 15% and with near normal distribution (calcium, chromium, magnesium and potassium). When the F-statistic computed by the test was less than the critical point, then one concludes that there is no significant difference among the mean concentrations for a given parameter. This indicates that the mean of each downgradient well is statistically the same as the mean of the pooled upgradient data.

When the F-statistic is greater than the critical point, then one concludes that there is at least one downgradient well whose mean concentration was significantly greater than either the means of the other downgradient wells or the pooled upgradient mean. In this case, the post-hoc Bonferroni t-test was run to compare each downgradient well in turn with the pooled background data. The H_0 of $\hat{C}_w \leq \hat{C}_p$ was used, where $\hat{C}_w$ is the mean of a downgradient well and $\hat{C}_p$ is the upgradient pooled mean. If this hypothesis was rejected, it implied that $\hat{C}_w > \hat{C}_p$.

The results, given in Tables 10 and 11, show that the mean concentrations for calcium, magnesium and potassium at all downgradient wells were less than or equal to the pooled upgradient means. In well MW-16S, the mean concentration for chromium was higher than that for the pooled upgradient well but this was not the case for the other three downgradient wells. Details of this can be seen in the computer output for the parametric ANOVA inter-group analysis included in Appendix H3.

The results given in Tables 12 and 13 for the analysis of the data for the last four sampling events indicate that none of the metals whose data follow a normal distribution demonstrates a significantly higher mean concentration than the pooled background data. Detailed test results can be seen in the computer output for parametric ANOVA inter-group analysis included in Appendix H4.

For inorganics that had NDs > 15% and < 50%, or whose distribution was believed not to be normal, the non-parametric ANOVA Kruskal-Wallis test was utilized. This involved analyzing the data for 13 inorganics: aluminum, arsenic, barium, beryllium, cobalt, copper, iron, lead, manganese, nickel, sodium, vanadium and zinc.

A post-hoc test was run whenever the Kruskal-Wallis computed H-statistic exceeded the critical point indicating the median concentration of at least one of the downgradient wells differed significantly from that of either the medians of the other downgradient wells or the pooled upgradient median concentration. The post-hoc test, discussed above, involves the use of average data ranks to identify which downgradient well, if any, has a significantly higher median compared to the pooled upgradient median.

The results of the Kruskal-Wallis test and the post-hoc analysis for the total metals are given in Tables 10 and 11. This analysis showed that the H_0 of $\hat{C}_w \leq \hat{C}_p$ was rejected for cobalt, copper, lead, nickel and sodium. The post-hoc tests showed that the median concentrations of cobalt, copper, lead and nickel in well MW-24, and sodium in well MW-17S exceeded those of the pooled upgradient group. As shown in Table 11, the H_0 was also rejected for aluminum, barium, iron and magnesium, however, post-hoc tests indicated that in none of the downgradient wells did the median concentration for these metals exceed those for the upgradient group. In these

cases, it is likely that the H_0 was rejected because of significant differences among the downgradient wells themselves. Detailed test results can be seen in the computer output for the Kruskal-Wallis inter-group analysis included in Appendix H5

The results given in Tables 12 and 13 for the analysis of the data for the last four sampling events indicate that only one of the metals (lead) whose data did not have a normal distribution demonstrates a significantly higher mean concentration than the pooled background data. The exceedance occurred at well MW-24. Detailed test results can be seen in the computer output for the Kruskal-Wallis intergroup analysis included in Appendix H6. However, a statistical comparison of the pooled downgradient data for total lead to the pooled upgradient data was performed using the non-parametric Tarone-Ware two-sample test for all eight sampling events. The results showed that the median concentrations of lead in the pooled downgradient data were not statistically higher than the pooled upgradient data.

5.0 CONCLUSIONS

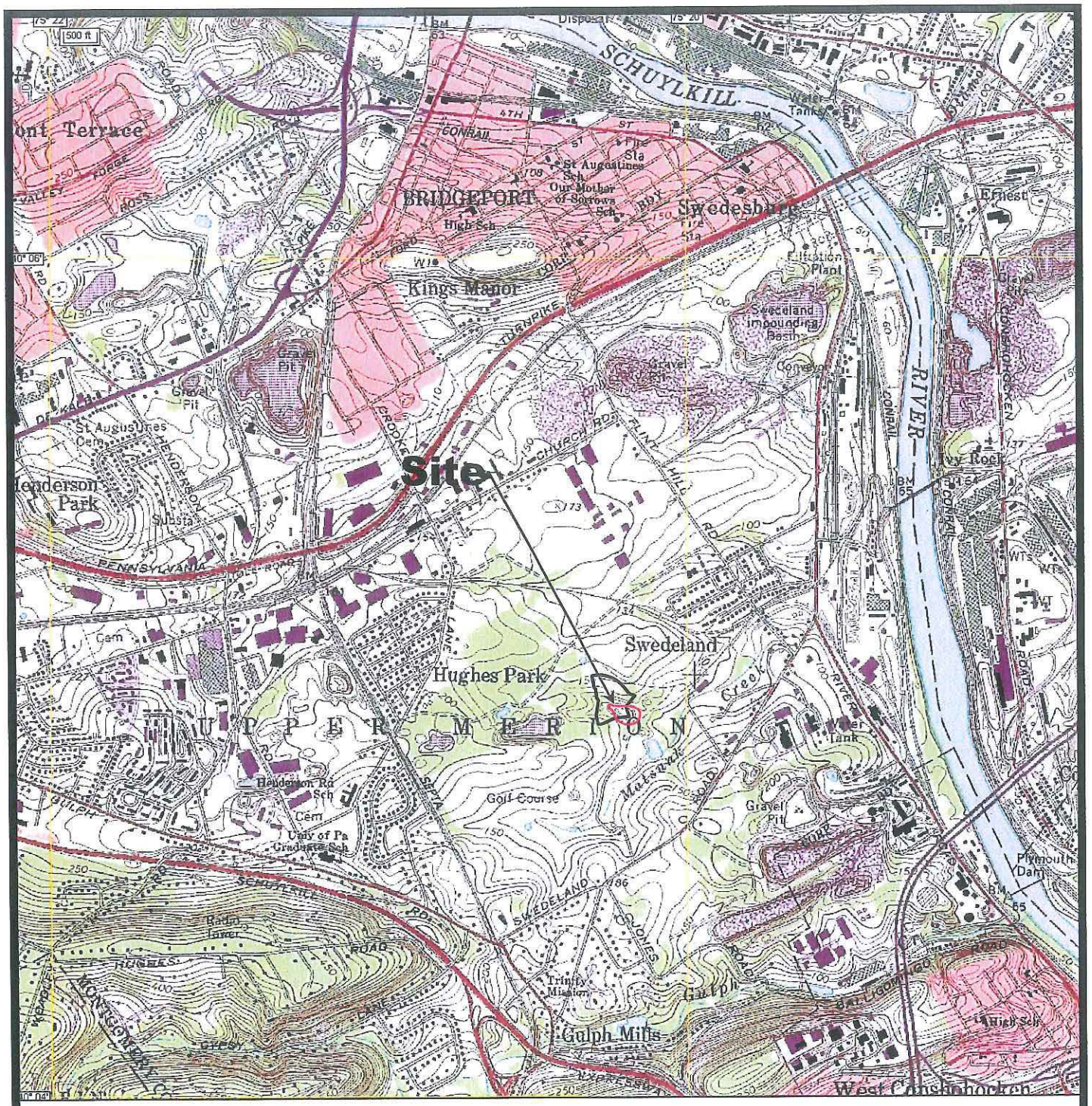
The portion of Quarry No. 4 located on Liberty's 2201Renaissance Boulevard properties has been covered with at least 2 feet of soil and in many areas more than 5 feet. The completed construction of the 2201 Renaissance Boulevard properties and the covering of the quarry has increased runoff from Quarry No. 4 by about 80 percent as compared to the volume of runoff from the quarry prior to the redevelopment of these two former brownfield sites. This increase in the runoff rate obviously reduces the volume of water which can infiltrate into the quarry. Additionally, no tested compounds were detected in the three soil samples collected from the material used to cover Quarry No. 4 at concentrations exceeding site-specific soil screening levels. These results confirm that the soil cover placed over Quarry No. 4 during the development of Liberty's 2201 Property is not impacted and will not have an adverse impact on human health, Quarry No. 4 or the ground water.

Many of the parameters analyzed in the ground water samples collected in the eight sampling events from October 2010 through August 2012 had such a significant percentage of non-detect results (> 50%) that no statistical analysis could accurately determine or identify any statistically significant difference between the downgradient and the upgradient mean concentrations. This was true for VOCs, SVOCs and cyanide. These findings are consistent with those of the ground water monitored natural attenuation sampling results for wells located downgradient of Quarry No. 4 (wells MW-15S, MW-16S and MW-17S) being conducted by The Group, which has found that organic COC are not typically associated with Quarry 4, because, with the exception of chloroform in MW-15S, more than 50% of the VOC, SVOC and cyanide were non-detect.

Of the twenty-three total inorganics included in the analytical program, six were ND in over 50% of the samples and, as a result, a statistical analysis of these metals was not performed. The statistical evaluation of the results for eleven of the remaining 17 metals tested revealed that the median/means of the concentrations at the downgradient wells were equal to, or less than, those of the upgradient data (i.e. no statistical difference between upgradient and downgradient concentrations for these metals was observed). The median concentrations of chromium in one downgradient well; cobalt, copper, nickel and lead in another downgradient well; and sodium in another were higher than the pooled upgradient concentrations. (Sodium is not a COC at the Crater Resources Superfund Site and, as a result, a ground water standard for this parameter was not developed or included in the ROD.)

A statistical analysis was also performed on concentrations of the same suite of metals for just the last four sampling events. In this case, the mean/median concentrations of sixteen of the 17 metals tested at the downgradient wells were equal to, or less than, those of the upgradient data. The median concentration of only lead in one of the four downgradient wells, well MW-24, was higher than the pooled upgradient concentration. A statistical comparison of the pooled downgradient data to the pooled upgradient data for all eight sampling events for lead shows that the concentrations for lead in the pooled downgradient data were not statistically higher than the pooled upgradient data. Based on the results of the analysis and although there is a slight statistical difference primarily in one downgradient well, overall, there appears to be very little statistical difference between ground water quality upgradient and downgradient of Quarry No. 4.

The analysis of soil and ground water data demonstrates that it is not necessary to limit infiltration into Quarry 4 since infiltration is not causing any Crater Site contaminants of concern ("COCs") to leach from Quarry No. 4 at concentrations that would cause or contribute to groundwater degradation based upon the statistical comparison of upgradient and downgradient groundwater sampling results. This result, therefore, also demonstrates that the "multimedia cap consisting of a series of low-permeability clays, geotextile liners, sand drainage layers... constructed in accordance with the Commonwealth's Residual Waste Landfill Regulations for final cover of Class 1 residual waste landfills, set forth in 25 Pa Code Section 288.234 and 288.236-237' selected in the ROD [for the Crater Site] is not necessary to prevent unacceptable leaching of contaminants from soils and sediments in and at Quarry No. 4 into the ground water at the Site." Therefore, Liberty requests that EPA confirm that it has met the standard set forth in the Consent Decree and ROD for the Quarry 4 Demonstration Project and that EPA grant a waiver of the cap and drainage layer requirements for Quarry 4.



SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

2201 PROP. BOUNDARY

QUARRY 4 BOUNDARY

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Source: www.terraserver.com/ www.topozone.com; USGS Norristown Quadrangle.

Penn E&R
Environmental & Remediation, Inc.
Hatfield, Pennsylvania 19440
215-997-9000 fax 215-822-8575

FIGURE 1

MAP SHOWING THE LOCATION OF THE
2201 RENAISSANCE BOULEVARD PROPERTY AND QUARRY No. 4
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA
QUARRY No. 4 DEMOLITION PROJECT

Date:	Project Number:	Scale:
16-APR-2013	HA 4013-LPT	1"=2000'+/-

LEGEND :

APPROXIMATE LIMIT OF QUARRY

APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.

NOTES :

(1) BOUNDARIES FOR QUARRY Nos. 1 THROUGH 3 WERE OBTAINED FROM KEY ENVIRONMENTAL, INC., FIGURE 17, DECEMBER 2008.

(2) BOUNDARY FOR QUARRY No. 4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

300' 0 300' 600'

SCALE: 1"=200'

Penn E&R
Environmental & Remediation, Inc.
COST EFFECTIVE ENVIRONMENTAL SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440
(215) 997-9000
359 NORTH GATE DRIVE, SUITE 400, WARRENDALE, PA 15086
(724) 934-3530

DWG FILE: HA4013-016
DESIGNED BY: MDC
DRAWN BY: MDC
CHKD BY: MAC
DATE: 6-OCT-2009

FIGURE 2
SITE MAP FOR 2201 RENAISSANCE BOULEVARD SHOWING THE LOCATION OF QUARRY No. 4 AND OFF-SITE QUARRY Nos. 1 THROUGH 3

QUARRY No. 4 DEMONSTATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

GRAPHIC SCALE: SCALE: 1"=300'
FIGURE NO. 1
SHEET NO.:

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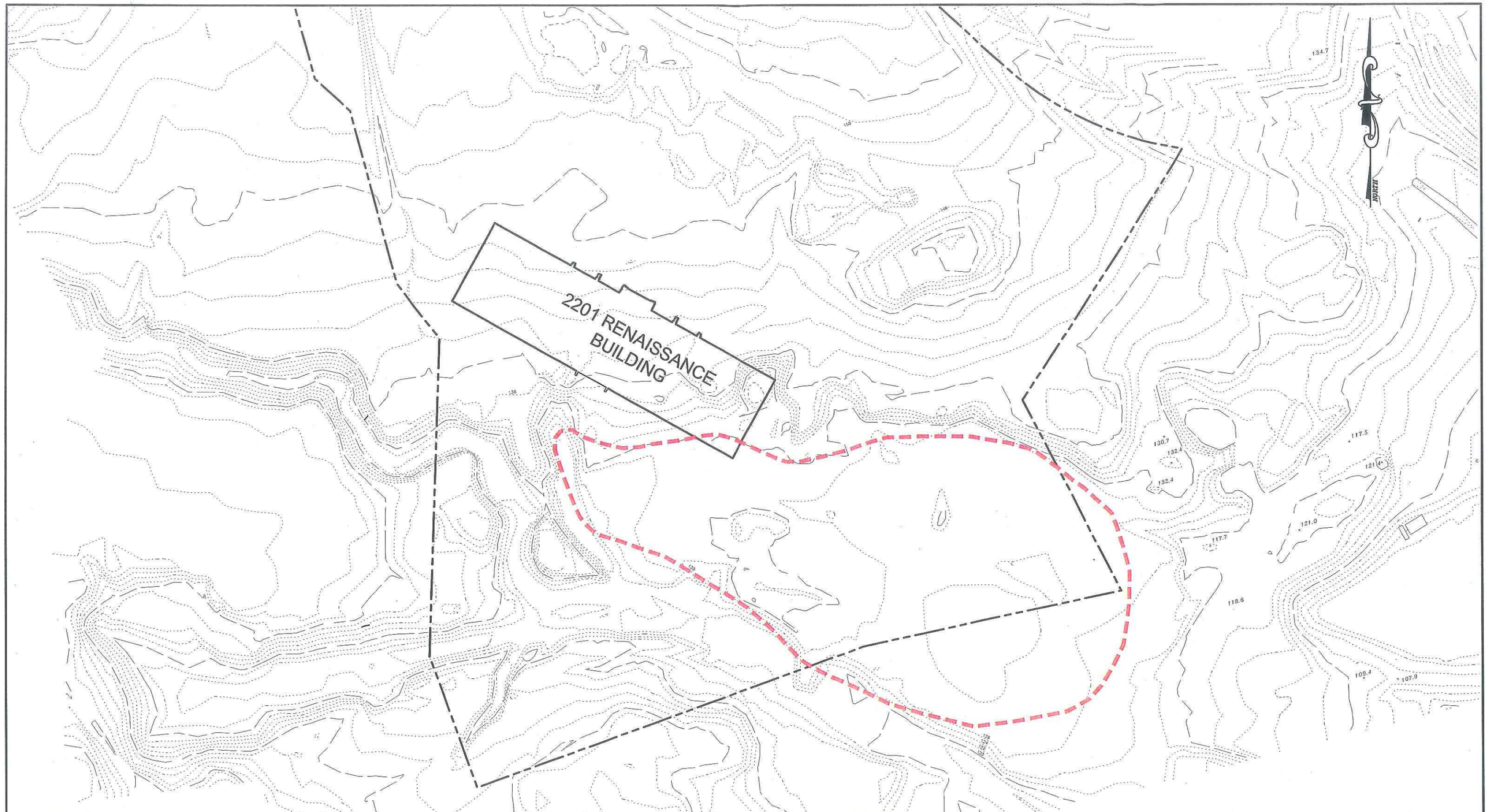

LEGEND:

- PRE-CONSTRUCTION TOPOGRAPHY
- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF QUARRY No.4

NOTES:

1. BOUNDARY FOR QUARRY No.4 WAS OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

100' 0 100' 200'

SCALE: 1"=100'

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HA4013-021	
DESIGNED BY	MDC
DRAWN BY	MDC
CHKD BY	MAC
DATE	6-OCT-2009

FIGURE 3
PARTIAL SITE PLAN SHOWING THE APPROXIMATE LIMIT OF QUARRY No. 4 AND PRE CONSTRUCTION ELEVATIONS

QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

GRAPHIC SCALE	FIGURE NO.	SHEET NO.:
SCALE: 1"=100'	3	

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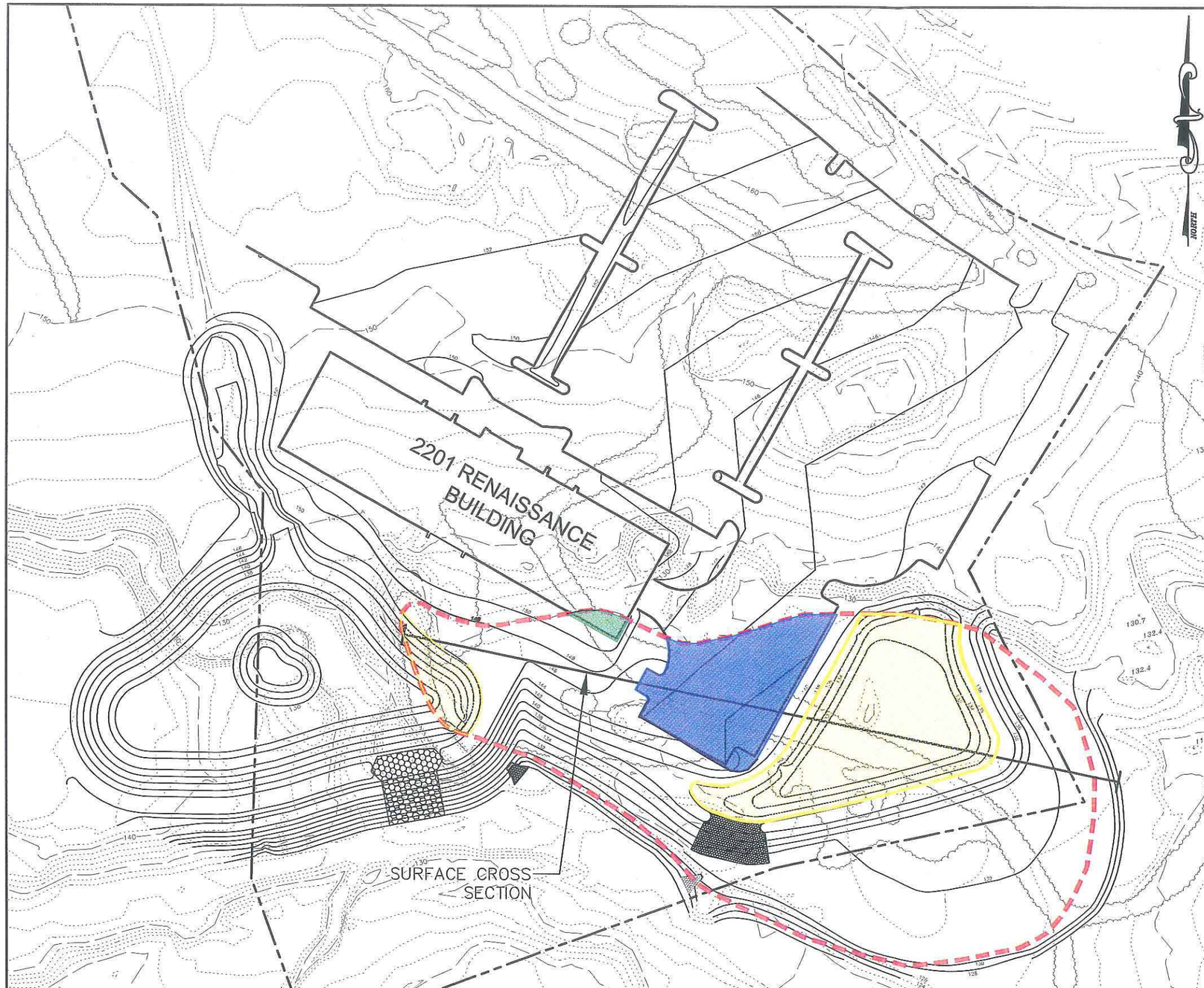

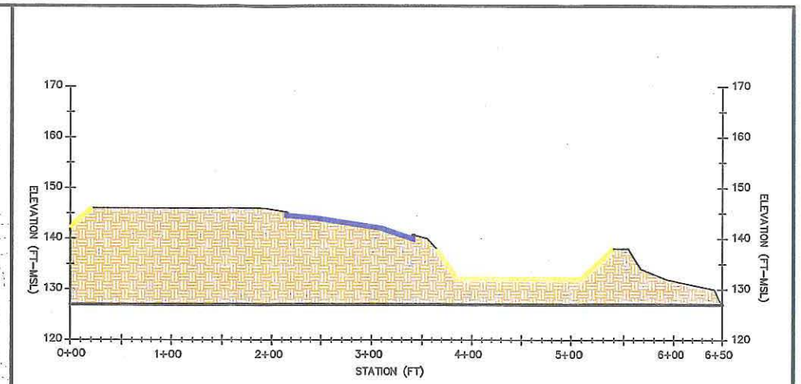

SURFACE CROSS SECTION

HORIZONTAL SCALE: 1"=150'
VERTICAL SCALE: 1"=30'

LEGEND:

- PRE-CONSTRUCTION TOPOGRAPHY
- POST-CONSTRUCTION TOPOGRAPHY
- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF QUARRY No. 4
- DETENTION BASIN WITH IMPERMEABLE LINER
- ASPHALT PARKING LOT
- BUILDING
- SOIL COVER

NOTES:

1. BOUNDARY FOR QUARRY No. 4 WAS OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

100' 0 100' 200'

SCALE: 1"=100'

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359 NORTH GATE DRIVE, SUITE 400, WARRENDALE, PA 15086
(724) 934-3530

DWG FILE	HA4013-018
DESIGNED BY	MDC
DRAWN BY	MDC
CHKD BY	MAC
DATE	6-OCT-2009

FIGURE 4
PARTIAL SITE PLAN SHOWING THE APPROXIMATE LIMIT OF QUARRY No. 4 AND PRE AND POST CONSTRUCTION ELEVATIONS

QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

GRAPHIC SCALE: SCALE: 1"=100'
FIGURE NO.: 4
SHEET NO.:

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LEGEND :

– APPROXIMATE LIMIT OF QUARRY

– APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.

– SOIL SAMPLE LOCATION

NOTES :

(1) BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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(215) 997-9000

DWG FILE	HA4013
DESIGNED BY	MDC
DRAWN BY	TJW
CHKD BY	MAC
DATE	12/21/2010

FIGURE 5
SITE MAP SHOWING LOCATIONS OF SOIL BORINGS INSTALLED TO EVALUATE THE QUARRY No.4 COVER MATERIAL
QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY, PA

GRAPHIC SCALE: SCALE: 1"=200'
FIGURE NO.
SHEET NO.:

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G:\PROJECT FILES\GRAPHICS\HA4013-LPT\04 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 5.DWG 4/16/2013 11:52 AM NAIK, ARVIND G.

LEGEND :

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.
- MW–17S – MONITORING WELL LOCATION

NOTES :

(1) BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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359 NORTH GATE DRIVE, SUITE 400, WARRENDALE, PA 15086
(724) 934-3530

DWG FILE: HA4013-023
DESIGNED BY: MDC
DRAWN BY: MDC
CHKD BY: MAC
DATE: 6-OCT-2009

FIGURE 6

SITE MAP SHOWING THE GROUND WATER MONITORING WELL NETWORK FOR THE QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

GRAPHIC SCALE: SCALE: 1"=200'
FIGURE NO. 15
SHEET NO.:

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G:\PROJECT FILES\GRAPHICS\HA4013-LPT\04 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 6.DWG,4/16/2013 11:53 AM,NAIK, ARVIND G.

NORTH

LEGEND

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD
- MONITORING WELL LOCATION
- GROUND WATER CONTOUR
- GROUND WATER CONTOUR ESTIMATED

NOTES :
1. BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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REV.	DISCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			

FIGURE 7A

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – JULY 20, 2011

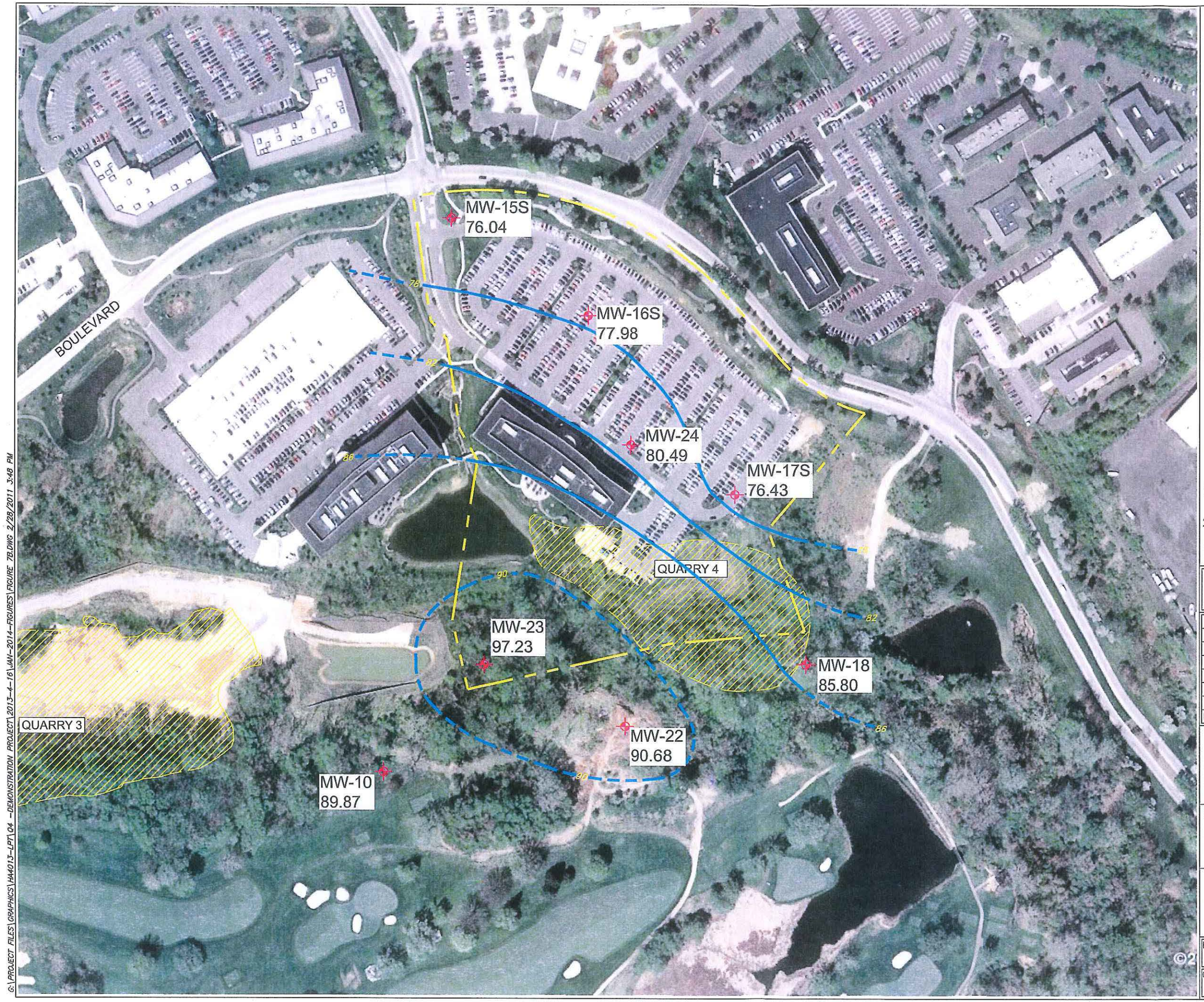
QUARRY NO. 4 DEMONSTRATION PROJECT

PREPARED FOR: LIBERTY PROPERTY TRUST
65 VALLEY STREAM PARKWAY
GREAT VALLEY CORPORATE CENTER
MALVERN, PA 19355

Penn E&R
Environmental & Remediation, Inc.
AR301199
DEDICATED TO PROVIDING COST EFFECTIVE SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440, PH: 215-997-9000

DRAWN BY:	SCALE:	PROJECT NO.:
TJW; 07/20/2011	1" = 200'	HA4013
CHECKED BY: *MAC.; 07/20/2011*	APPROVED BY: *MAC; 07/20/2011*	SHEET NO.: SHEET 1 OF 1

G:\PROJECT FILES\GRAPHICS\HA4013-LPT\Q4 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 7A.DWG 2/28/2011 3:48 PM



NORTH

LEGEND

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD
- MONITORING WELL LOCATION
- GROUND WATER CONTOUR
- GROUND WATER CONTOUR ESTIMATED

NOTES :

1. BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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REV.	DISCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			

FIGURE 7B

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – OCTOBER 18, 2011

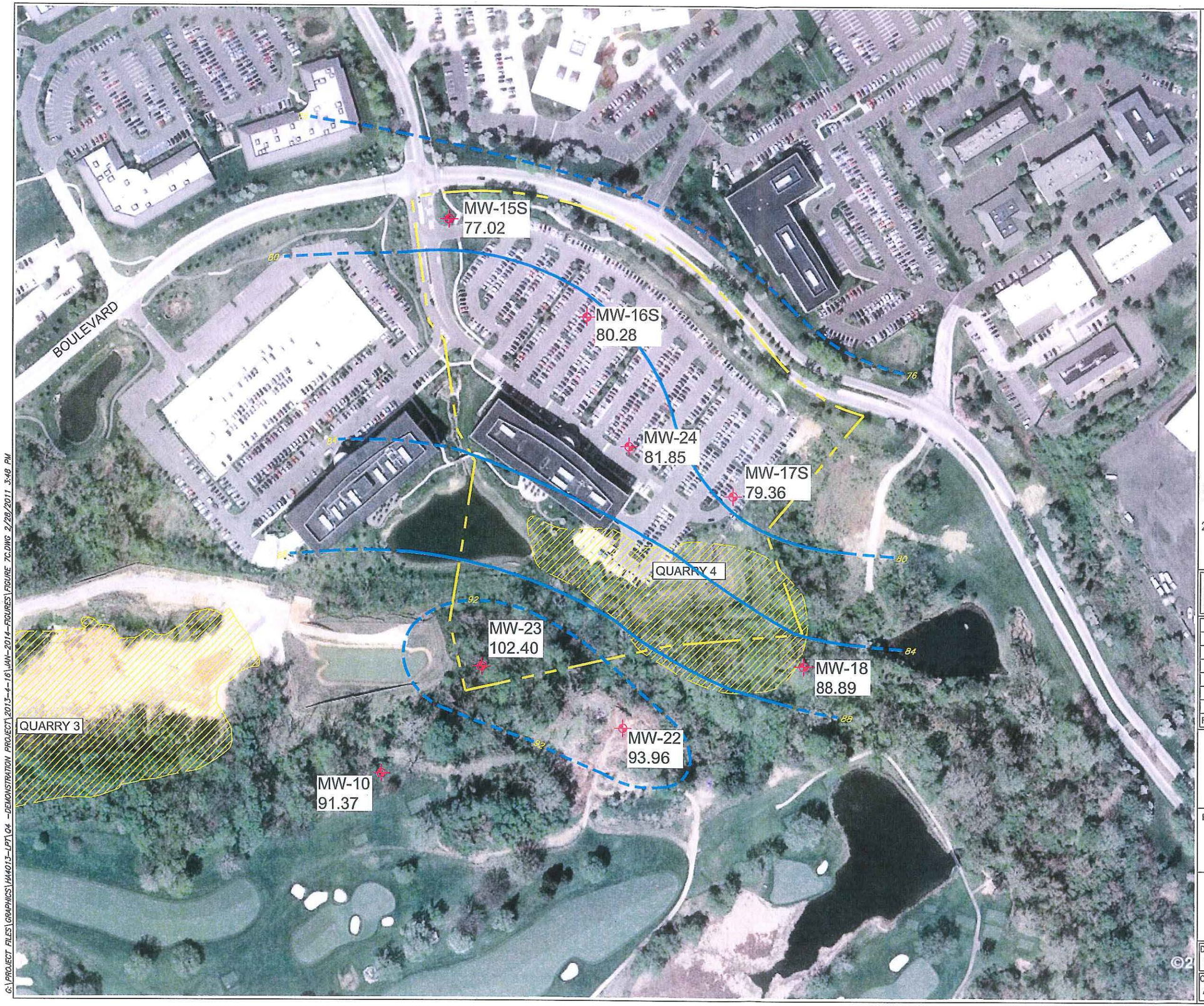
QUARRY NO. 4 DEMONSTRATION PROJECT

PREPARED FOR: LIBERTY PROPERTY TRUST
65 VALLEY STREAM PARKWAY
GREAT VALLEY CORPORATE CENTER
MALVERN, PA 19355

Penn E&R
Environmental & Remediation, Inc.
AR301200
DEDICATED TO PROVIDING COST EFFECTIVE SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440, PH: 215-997-9000

DRAWN BY:	SCALE:	PROJECT NO.:
TJW; 01/23/2012	1" = 200'	HA4013
CHECKED BY:	APPROVED BY:	SHEET NO.:
MAC.; 01/23/2012	*MAC; 01/23/2012*	SHEET 1 OF 1

G:\PROJECT FILES\GRAPHICS\HA4013-LPT\04 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 7B.DWG 2/28/2011 3:48 PM



NORTH

LEGEND

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD
- MONITORING WELL LOCATION
- GROUND WATER CONTOUR
- GROUND WATER CONTOUR ESTIMATED

NOTES :

1. BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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REV.	DISCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			

FIGURE 7C

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – JANUARY 24, 2012

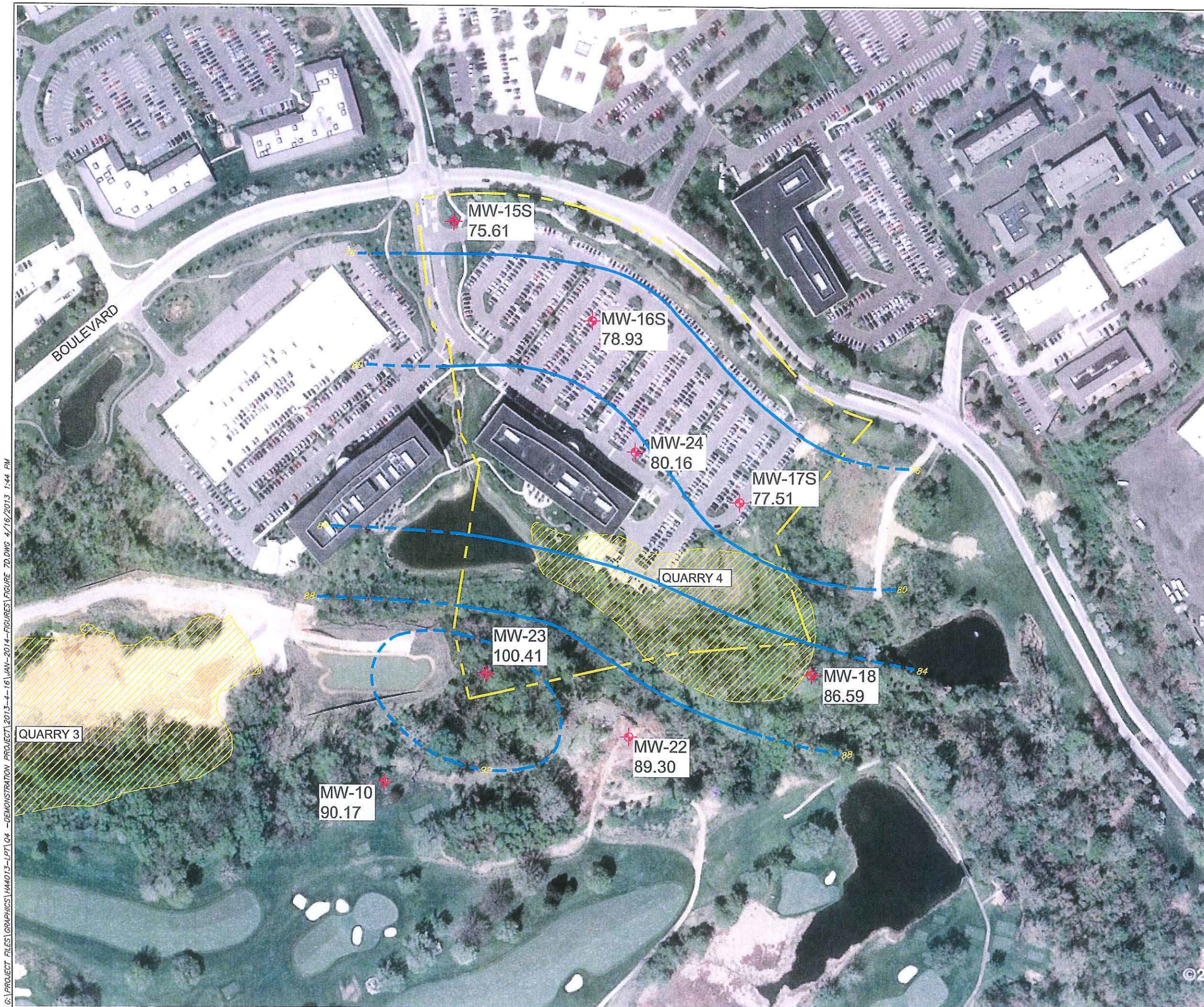
QUARRY NO. 4 DEMONSTRATION PROJECT

PREPARED FOR: LIBERTY PROPERTY TRUST
65 VALLEY STREAM PARKWAY
GREAT VALLEY CORPORATE CENTER
MALVERN, PA 19355

Penn E&R Environmental & Remediation, Inc.
AR301201
DEDICATED TO PROVIDING COST EFFECTIVE SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440, PH: 215-997-9000

DRAWN BY:	SCALE:	PROJECT NO.:
TJW; 01/23/2012	1" = 200'	HA4013
CHECKED BY:	APPROVED BY:	SHEET NO.:
MAC.; 01/23/2012	*MAC; 01/23/2012*	SHEET 1 OF 1

G:\PROJECT FILES\GRAPHICS\HA4013-LPT\04 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 7C.DWG 2/28/2011 3:48 PM



LEGEND

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD
- MONITORING WELL LOCATION
- GROUND WATER CONTOUR
- GROUND WATER CONTOUR ESTIMATED

NOTES :

1. BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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REV.	DISCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			

FIGURE 7D

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP – APRIL 26, 2012

QUARRY NO. 4 DEMONSTRATION PROJECT

PREPARED FOR: LIBERTY PROPERTY TRUST
65 VALLEY STREAM PARKWAY
GREAT VALLEY CORPORATE CENTER
MALVERN, PA 19355

Penn E&R
Environmental & Remediation, Inc.
AR301202
DEDICATED TO PROVIDING COST EFFECTIVE SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440, PH: 215-997-9000

DRAWN BY:	SCALE:	PROJECT NO.:
TJW; 01/23/2012	1" = 200'	HA4013
CHECKED BY: *MAC.; 01/23/2012*	APPROVED BY: *MAC; 01/23/2012*	SHEET NO.: SHEET 1 OF 1

G:\PROJECT FILES\GRAPHICS\HA4013-LPT\04 -DEMONSTRATION PROJECT\2013-4-16\JAN-2014-FIGURES\FIGURE 7D.DWG 4/16/2013 1:44 PM

Figure 8

Decision Tree for Selecting Statistical Method for Inter-Group Data Analysis

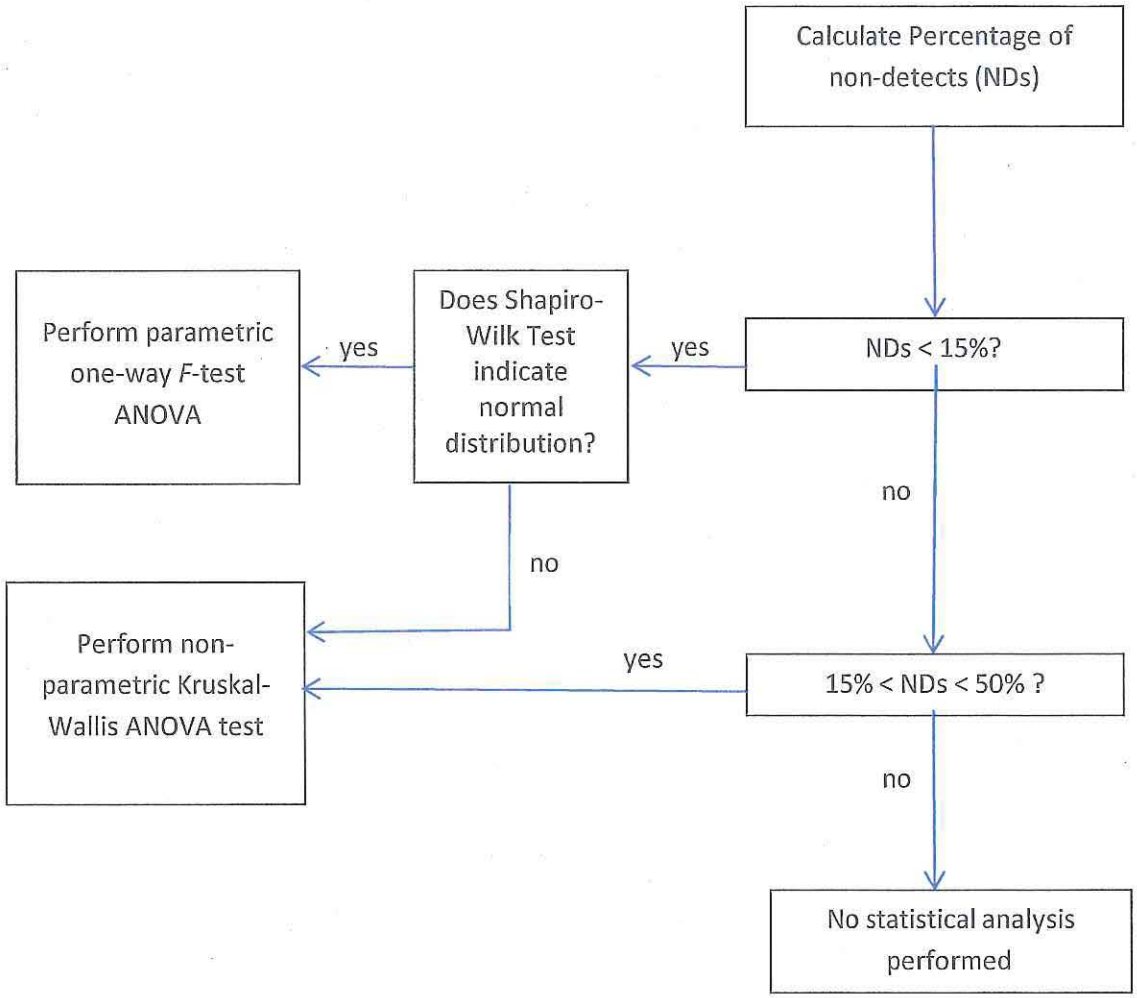

TABLE 1

CONSTRUCTION DETAILS AND DEPTH-TO-WATER/GROUND WATER ELEVATIONS FOR WELLS INCLUDED IN THE QUARRY NO. 4 DEMONSTRATION PROJECT

Well	Total Well Depth (ft-btoc)	Screened Interval (ft-btoc)	Measuring Point Elevation (ft-msl)	Oct. 6, 2010		Jan. 11, 2011		Apr. 19, 2011		July 21, 2011	
				Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)
Upgradient:											
MW-10	105.00	85 - 105	151.87	60.60	91.27	64.87	87.00	63.80	88.07	65.72	86.15
MW-22	60.00	50-60	142.18	56.91	85.27	58.64	83.54	48.41	93.77	58.88	83.30
MW-23	63.70	43.7-63.7	140.51	39.21	101.30	46.65	93.86	40.54	99.97	52.44	88.07
Downgradient:											
MW-15S	115.99	97 - 115.99	158.07	83.11	74.96	84.89	73.18	84.48	73.59	84.89	73.18
MW-16S	98.82	85 - 98.82	153.18	76.35	76.83	77.44	75.74	77.75	75.43	78.77	74.41
MW-17S	109.57	98 - 109.57	140.63	60.45	80.18	66.92	73.71	63.56	77.07	66.53	74.10
MW-24	80.00	60-80	147.97	67.20	80.77	71.85	76.12	69.10	78.87	71.65	76.32

Well	Total Well Depth (ft-btoc)	Screened Interval (ft-btoc)	Measuring Point Elevation (ft-msl)	Oct. 18, 2011		Jan. 24, 2012		Apr. 26, 2012		Aug. 8, 2012	
				Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)	Depth-To-Water (ft-btoc)	Ground Water Elevation (ft-msl)
Upgradient:											
MW-10	105.00	85 - 105	151.87	62.00	89.87	60.50	91.37	61.70	90.17	63.50	88.37
MW-22	60.00	50-60	142.18	51.50	90.68	48.22	93.96	52.88	89.30	55.60	86.58
MW-23	63.70	43.7-63.7	140.51	43.28	97.23	38.11	102.40	40.10	100.41	44.75	95.76
Downgradient:											
MW-15S	115.99	97 - 115.99	158.07	82.03	76.04	81.05	77.02	82.46	75.61	83.25	74.82
MW-16S	98.82	85 - 98.82	153.18	75.20	77.98	72.90	80.28	74.25	78.93	75.92	77.26
MW-17S	109.57	98 - 109.57	140.63	64.20	76.43	61.27	79.36	63.12	77.51	63.20	77.43
MW-24	80.00	60-80	147.97	67.48	80.49	66.12	81.85	67.81	80.16	68.65	79.32

Notes

ft-btoc - Feet below the top of well casing
ft-bgs - Feet below the ground surface
ft-msl - Feet mean sea level
N/A - Information not available

TABLE 2

SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES COLLECTED FROM THE QUARRY NO. 4 COVER MATERIAL QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS[1]	SAMPLE DESIGNATION/ANALYTICAL RESULTS[2]				QUARRY NO. 4 SITE-SPECIFIC SSL[4]
	Q4-SB1-S	Q4-SB2-S	Q4-SB2A-S[3]	Q4-SB3-S	
Date Sampled:	7/29/2010	7/29/2010	7/29/2010	7/29/2010	
Volatile Organics:					
Acetone	0.036B	0.032 B	0.025 B	0.11	3
Chloromethane	0.0022B	0.0051U	0.0014 B	0.0038 B	0.25
Cyclohexane	0.0026B	0.0036 B	0.0025 B	0.0025 B	65
1,4-Dioxane	0.100R	0.100 R	0.110 R	0.100 R	0.0065
Ethylbenzene	0.0051U	0.0051U	0.0054U	0.0052U	3
Methylene Chloride	0.0007B	0.00084 B	0.0010 B	0.00095 B	0.0065
Methyl Ethyl Ketone (2-Butanone)	0.0039J	0.0037 J	0.011U	0.015	7.5
4-Methyl-2-pentanone	0.010U	0.0014 J	0.011U	0.0018 J	2.25
Toluene	0.00053B	0.0051U	0.00080 B	0.00056 B	3
Semivolatile Organics:					
Benzo(a)anthracene	0.037 J	0.2U	0.2U	0.2U	1
Benzo(a)pyrene	0.040 J	0.2U	0.2U	0.2U	3
Chrysene	0.038 J	0.2U	0.2U	0.2U	60
Fluoranthene	0.068 J	0.2U	0.2U	0.2U	1,200
Inorganics:					
Aluminum	6,200	8,600	7,230	6,660	21,825[5]
Antimony	0.61 J	0.91 J	1.2 J	1.2 L	1.35[6]
Arsenic	3.5	2.6	2.4	3.1 J	13.1[5]
Barium	17.0 J	32.5	38.3	31.4	330
Beryllium	0.85	1.4	1.6	1.4 J	13
Cadmium	0.30 J	0.44 J	0.55 J	0.57 J	2
Calcium	1,590	1,040	1,880	1,280	NSA
Chromium	14.6	18.2	14.2	14.6	37.4[5]
Cobalt	13.6	16.7	23.0	19.0 J	490
Copper	41.7	39.0	44.2	46.4	52,000
Iron	22,100	35,300	39,400	41,500	67,004[5]
Lead	20.1	27.3	35.7	50.6 J	400
Magnesium	1,140	1,200	1,560	781 J	NSA
Manganese	332	285	388	456 K	4,113[5]
Nickel	17.8	25.2	29.0	29.8 J	190
Potassium	248 J	392 J	350 J	348 J	NSA
Silver	1.1 UL	1.2 UL	1.1 UL	1.2 UL	6
Sodium	142 B	141 B	133 B	152 B	NSA
Vanadium	20.7	21.1	19.7	22.8	1,000
Zinc	137 L	190 L	208 L	353 L	2,700
Cyanide	2.8U	2.9U	2.9U	0.25 J	8
Sample Depth[7]:	8	6	6	5	*

Notes:

(1) - The samples were analyzed for the TCL volatile and semivolatile organic compounds, and the TAL inorganics. Only those compounds detected above laboratory method limits are listed.

(2) - All results are in milligrams per kilogram

(3) - Sample Q4-SB2A-S is a blind duplicate of sample Q4-SB2-S.

(4) - Site-Specific Soil Screening Levels Calculated for Quarry No. 4 During the Crater Remedial Investigation (Table 32 of the RI)

(5) - Crater Resources Superfund Site, UESPA Approved Background Upper Tolerance Limits for Inorganics.

(6) - Site-Specific Soil Screening Levels were not calculated for these compounds as part of the RI. These SSLs were obtained from USEPA's Regional Screening Level Master Table (May 2013) abased on a Dilution Attenuiation Factor of 5.

(7) - Sample collection depths are in feet below the ground surface.

USEPA - United States Environmental Protection Agency

SSL - Soil Screening Level

J - This result should be considered a quantitative estimate.

B - This result is qualitatively invalid because the compound/analyte was also detected in a blank at a similar concentration.

C - The result is between the estimated quantitation limit and the instrument detection limit

U - This analyte was not detected. The numeric value represents the sample quantitation/detection limit

L - This result should be considered a biased low quantitative estimate

K - This result should be considered a biased high quantitative estimate

U - This compound was analyzed but not detected. The numerical value represents the sample quantitation limit

NSA - No standard available

Bold - Maximum concentration for this compound was detected above its site-specific or default SSL or background upper tolerance limit.

TABLE 3

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS (1) UPGRADIENT WELLS																								Ground Water Standards(2)
	MW-10								MW-22								MW-23								
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	
Volatiles:																									
Dichlorodifluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.056J	19(3)
Chloromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.24J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23B	19(3)
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.095J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	110(3)
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.10J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	26(3)
Acetone	<5.0UR	<5.0UR	<5.0R	<5.0U	<5.0UR	<5.0UR	13	5.9R	<0.50UR	4.4B	<5.0R	4.1B	<5.0UR	2.8L	16	6.4R	<5.0UR	3.6B	<5.0R	<5.0UR	3.1L	<5.0UR	15	4.4R	95.9
2-Butanone	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	2.3R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	490(3)
Carbon Disulfide	<0.50	<0.50	<0.50	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	0.11J	<0.50	<0.50	0.099J	72(3)
Methylene Chloride	0.52B	<0.50	0.26K	0.24B	0.25B	0.20B	0.54B	<0.50	0.48B	<0.50	0.31B	0.23B	0.20B	0.15B	0.72B	<0.50	0.75B	<0.50	0.28B	0.25B	0.23B	<0.50	0.79B	<0.50	5(4)
Trans-1,2-dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.6(3)
Methyl tert butyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.051J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	12(3)
Chloroform	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1
1,1,1-Trichlorothane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	200(4)
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.056J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5(4)
1,1,2,2-Tetrachloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.066(3)
Toluene	0.20B	<0.50	<0.50	<0.50	0.13B	0.19JB	5.4B	0.42B	0.17B	<0.50	<0.50	<0.50	0.44B	0.50B	8.8B	0.32B	0.23B	<0.50	<0.50	<0.50	0.13B	0.15B	3.3B	0.11B	1,000(4)
Trans-1,3-dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.24J	-
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.053B	3.5(3)
Chlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	7.2(3)
Cyclohexane	<0.50	0.19B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.17B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1,300(3)
Carbon Tetrachloride	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.055B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.032B	0.39(3)
Benzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.053B	5
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.051B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	700(4)
Total Xylenes	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.071B	<0.50	<0.50	<0.50	<0.50	0.42J	<0.50	<0.50	0.033B	0.209J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	10,000(4)
Isopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.040B	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	39(3)
1,3-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.10B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.032B	-
1,4-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.42(3)
1,2-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	28(3)
1,2,4-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.17B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.39(3)
1,2,3-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.15B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52(3)
Semivolatiles:																									
Caprolactam	<5.3UR	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0UR	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	770(3)
2,4-Dimethylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	1.15
Phenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	7,860
2-Methylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	12.5
4-Methylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	47.7
Naphthalene	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	5
Di-N-Butylphthalate	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	67(3)
Bis(2-ethylhexyl)phthalate	<5.3	<5.3	<4.6	2.2J	<4.7	<4.7	<4.8	<5.0	<5.0	2.9J	<4.7	<5.3	<4.7	<4.6	<4.8	**7.9**	<5.1	<5.0	<5.0	2.5L	<4.8	<4.6UL	<4.7	<5.0	6(4)
Cyanide:																									
Total	<10.0	<10.0	<10.0	<10.0R	<10.0	<10.0	<10.0	<10.0	1.6J	4.0J	2.0B	<10.0UR	3.0J	1.4B	2.3B	<10.0	<10.0	<10.0	<10.0	<10.0	2.4J	<10.0	<10.0	<10.0	10
Available	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	5.8	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	-

Notes:

(1) - All results are reported in micrograms per liter.
(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.
(3) - USEPA Regional Screening Levels for Tapwater, May, 2013
(4) - USEPA Maximum Contaminant Levels
J - Anaylte present. Reported value may not be accurate or precise.
B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.
U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.
L - This result should be considered a biased low quantitative estimate.
K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.
NA - Not Analyzed
< 0.5 - Compound not detected above the listed laboratory method reporting limit.
Bold - Compound was detected above its listed ground water standard.

TABLE 3

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS (1) UPGRADIENT WELLS																									Ground Water Standards(2)
	MW-10								MW-22								MW-23									
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*		
Metals (Dissolved):																										
Aluminum	135B	<200	59.9B	<200	<200	<200	<200	86.1B	746	520	93.2B	**1,890**	120J	245	<200.0	24.5B	465	124J	180B	**3,370**	89.1J	641	<200	19.3B	1,600(3)
Antimony	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	6(4)
Arsenic	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	1
Barium	**54.0J**	**48.6J**	**53.6J**	**64.6J**	**53.9J**	**54.30J**	**56.8J**	**47.1J**	**119J**	**84.7J**	**139J**	**96.2J**	**129J**	**124J**	**123J**	**111J**	21.2J	16.6J	12.0J	**112J**	14.5J	28.8J	9.9J	9.8J	40
Beryllium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	1.5B	<5.0	0.83J	<5.0	2.5J	<5.0	0.41B	0.41B	0.78B	<5.0	<5.0	<5.0	3.0J	<5.0	0.61B	<5.0	0.52B	4
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	1.2B	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	5(4)
Calcium	20,100	19,600	20,700	22,000	23,000	17,300	18,100	18,300	164,000	143,000	183,000	157,000	185,000	166,000	183,000	158,000	27,400	24,800	27,100	31,100	34,600	22,200	21,300	20,700	-
Chromium	6.1J	6.2J	<10.0	1.9B	<10.0	5.9J	3.5J	1.1B	2.7B	<10.0	<10.0	**10.8**	3.1J	3.9J	1.3J	<10.0	4.0B	3.1J	2.2B	**12.2**	**11.3**	**16.5**	<10.0	<10.0	8
Cobalt	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL	<50.0	**3.4J**	<50.0	**9.1J**	<50.0	**2.2J**	3.6B	<50.0UL	<50.0	**1.5J**	<50.0	**29.9J**	<50.0	**4.0J**	<50.0	<50.0UL	0.47(3)
Copper	<25.0	<25.0	<25.0	1.1B	0.88J	0.99J	1.5J	5.3B	8.1J	4.5J	<25.0	14.8J	2.7J	2.8J	4.7J	1.5B	<25.0	<25.0	<25.0	22.8J	1.2J	4.2J	<25.0	1.3B	1,300(4)
Iron	142	74.0B	<100.0	50.7J	50.9B	62.9B	<100.0	<100	**3,340**	**4,260**	56.1B	**12,400**	**516**	**1,570**	<100.0	<100	**2,110**	**1,640**	**483**	**47,000**	**833**	**7,470**	<100.0	<100	250
Lead	<10.0UL	<10.0	<10.0	<10.0	<10.0	<10.0UL	<10.0	4.2J	<10.0UL	2.4B	<10.0	8.3J	1.7J	<10.0UL	<10.0	<10.0	<10.0UL	<10.0	<10.0	**31**	<10.0	5.1L	<10.0	<10.0	15
Magnesium	15,300	15,000	14,800	16,100	14,800	14,200	13,600	8,850	75,400	131,000	89,300	167,000	127,000	106,000	122,000	105,000	17,600	17,200	17,300	17,700	16,800	15,500	14,100	13,400	-
Manganese	4.1J	17.0	2.4J	4.2J	3.3J	4.8J	<15.0	<15.0	**347**	**277**	**324**	**456**	**498**	**339**	**253**	**205**	**80.8**	62.4	17.3	**1,750**	**71.3**	**290**	<15.0	33.8	66.8
Mercury	<0.20	0.14B	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20J	**20.9L**	0.39	**39.4**	**9.3**	**12.8**	**3.2**	**3.7**	<0.20	0.10B	<0.20	<0.20	<0.20	<0.20	0.089B	<0.20	2(4)
Nickel	<40.0	21.5J	<40.0	<40.0	<40.0	4.4J	5.8J	1.9B	24.9J	16.6J	4.6J	**46.2**	16.3J	11.8J	6.9J	4.2J	7.6J	7.5J	<40.0	**49.5**	12.0J	15.1J	1.8J	11.1J	30(3)
Potassium	1,130J	774J	840J	1,010J	1,000J	1,710J	1,240J	1,950J	10,400	6,810	12,100	7,750	15,300	15,200	13,200	10,600	774J	425J	<5,000	756J	<5,000	594J	161J	165J	-
Selenium	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	**2.4J**	<35.0	<35.0	<35.0	<35.0	<35.0UL	**3.0B**	<35.0	0.4
Silver	<10.0	<10.0	<10.0	1.4B	0.95B	<10.0	<10.0	<10.0UL	<10.0	<10.0	<10.0	2.0B	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0	<10.0	1.5B	<10.0	**7.2K**	<10.0	<10.0UL	7.1(3)
Sodium	1,480J	1,360B	1,210J	1,420B	1,720J	1,370J	1,390J	1,060J	158,000	55,100	133,000	24,700	41,300	59,300	59,700	65,000	2,340J	2,340B	2,270J	2,430J	2,340J	1,930J	1,800J	1,910J	-
Thallium	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	2.0(4)
Vanadium	0.85B	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	1.9B	1.6B	<50.0	3.7J	<50.0	1.1J	<50.0	<50.0	1.6B	0.77B	<50.0	**9.8J**	<50.0	1.6J	<50.0	<50.0	6.3(3)
Zinc	11.2B	2.6B	3.8L	4.6B	6.7J	5.7J	6.6J	10.3L	64.9B	64.8L	9.0L	167	20.9J	33.7J	16.1J	8.4L	75.2B	16.3B	9.9L	292	8.3J	51.8J	4.8J	4.7L	470(3)
Metals (Totals):																										
Aluminum	367	102J	174B	51.9B	81.7J	477	94.5B	58.8J	**16,800**	**78,200**	206B	**83,900J**	683	**5,160**	927	1,260	**1,670**	**2,130**	1,020	**26,800**	798	**10,500**	**2,370**	**2,100**	1,600(3)
Antimony	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.8B	<60.0	**11.2J**	<60.0	**10.6J**	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	**12.9J**	<60.0	**10.0J**	<60.0	<60.0	6(4)
Arsenic	<10.0	<10.0	<10UJ	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	**21.7**	**43.2K**	<10.0UJ	**64.9J**	<10.0UL	**7.1J**	<10.0UL	<10.0	<10.0	<10.0	<10.0UJ	<10.0	<10.0UL	**9.6K**	<10.0UL	<10.0	1
Barium	**57.8J**	**55.2J**	**57.4J**	**65.5J**	**56.5J**	**59.0J**	**58.8J**	**48.4J**	**205**	**579**	**144J**	**615J**	**130J**	**144J**	**130J**	**115J**	**57.3J**	**82.5J**	27.2J	**714**	28.0J	**386**	**84.4J**	**88.7J**	40
Beryllium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0U	**18.3**	**89.5**	<5.0	**90.8J**	<5.0	**5.1**	1.8B	2.0J	<5.0	1.4J	<5.0	**24.3**	<5.0	**9.1**	2.3B	1.9J	4
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	3.3B	**28.5**	<5.0	**35.9J**	<5.0	1.2B	<5.0	<5.0UL	<5.0	<5.0	<5.0	**8.7**	<5.0	0.51B	0.94B	<5.0UL	5(4)
Calcium	20,800	20,400	20,200	20,000	20,100	18,500	18,700	20,200	330,000	1,730,000	190,000	155,000J	201,000	193,000	183,000	179,000	27,100	26,400	25,900	24,300	34,300	24,300	22,700	21,000	-
Chromium	**13.2**	**105**	1.7B	6.9J	2.0J	**16.6**	**13.3**	2.5B	**114**	**129**	2.7B	**2,170J**	**29.8**	**73.9**	**19.8**	**108**	**27**	**59.5**	**12.9**	**63**	**97.5**	**391**	**40.2**	**179**	8
Cobalt	<50.0	**2.6J**	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL	**60.1**	**368**	<50.0	**395J**	**4.4J**	**24.3J**	<50	<50.0UL	<50.0	**14.4J**	2.7B	**212**	**4.4J**	**86.7**	**20.9J**	**11.0L**	0.47(3)
Copper	<25.0	<25.0	<25.0	1.0J	<25.0	3.3J	2.6B	6.3B	130	854	0.81B	595J	6.8J	33.2	9.5J	13.1J	13.8J	15.4J	2.3B	190	6.9J	76.7	17.4J	19.7J	1,300(4)
Iron	**787**	**1,370**	223	**254**	**244**	**1,280**	**320**	164	**108,000**	**439,000**	**498**	**475,000J**	**4,580**	**31,900**	**4,560**	**8,450**	**15,400**	**25,600**	**5,000**	**354,000**	**7,280**	**137,000**	**36,300**	**27,500**	250
Lead	<10.0UL	<10.0	<10.0UL	1.5J	<10.0UL	<10.0	<10.0	<10.0	**65.1L**	**319**	<10.0UL	**360J**	2.9L	**18.7**	4.1B	6.1J	10.3L	**18.2**	3.1L	**234**	4.6L	**93.9**	20.8B	**19.7**	15
Magnesium	15,800	16,500	15,600	16,100	15,000	14,200	14,200	10,300	148,000	493,000	92,500	588,000J	128,000	118,000	116,000	118,000	17,400	18,200	17,000	18,800	16,900	16,500	15,200	14,100	-
Manganese	9.8J	37.7	13.3J	13.4J	14.3J	23.1	12.9J	6.5J	**2,280**	**9,620**	**322**	**10,800J**	**544**	**763**	**319**	**336**	**462**	**779**	**133**	**12,600**	**286**	**5,490**	**1,180**	**1,150**	66.8
Mercury	<0.20	<0.20UL	<0.20	<0.20	<0.20	0.11J	<0.20	<0.20	1.7	**42.9L**	<0.20	**52.0J**	**12**	**18.8**	**13**	**17.3**	<0.20	<0.20UL	0.68	<0.20	<0.20	<0.20	<0.20	<0.20	2(4)
Nickel	9.9J	**155**	2.3B	4.5J	2.3B	11.1B	10.2J	2.6J	**334**	**1,230**	7.2J	**2,280J**	**31.6J**	**104**	27.4J	**73.6**	27.2J	56.8	9.7J	**305**	**56.5**	**296**	**49.0**	**116**	30(3)
Potassium	1,180J	844J	883J	1,000J	994J	1,760J	1,240J	2,080J	11,800	10,200	12,500	19,700J	15,300	15,100	13,700	11,100	1,080J	793J	487J	2,110J	507J	1,780J	1,100J	617J	-
Selenium	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	**6.0J**	<35.0	<35.0	**6.1J**	<35.0	<35.0UL	<35.0	<35.0	**3.1J**	<35.0	<35.0	**8.7J**	<35.0	<35.0UL	<35.0	<35.0	0.4
Silver	<10.0UL	<10.0L	<10.0	1.1B	<10.0	<10.0	<10.0	<10.0	<10.0UL	3.8B	<10.0	8.2B	1.8B	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0	1.8B	<10.0	**8.2K**	<10.0	<10.0	7.1(3)
Sodium	1,350B	1,350B	1,130J	1,410B	1,290J	1,230J	1,090J	1,350J	151,000	33,200	137,000	23,300J	42,200	55,800	61,700	64,100	2,070B	2,400J	2,050J	1,690B	2,040J	2,020J	1,870J	1,880J	-
Thallium	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	**9.8J**	13.5B	<25.0	<25.0R	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	2.0(4)
Vanadium	1.4B	1.3J	<50.0	<50.0	<50.0	1.5J	<50.0	<50.0	**28.6J**	**108**	<50.0	**148J**	2.1J	**9.3J**	2.9B	2.0J	5.2B	**7.0J**	2.1B	**72.7**	3.0J	**30.7J**	5.4B	5.1J	6.3(3)
Zinc	7.1J	19.7B	5.2L	<60.0	<60.0	11.7B	8.8J	14.7J	**1,510**	**7,700L**	16.2L	**6,710J**	58.7J	407	80.6	110	97.1	146L	31.8L	**2,360**	42.2J	839	194	172	470(3)

Notes:

(1) - All results are reported in micrograms per liter.
(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.
(3) - USEPA Regional Screening Levels for Tapwater, May, 2013
(4) - USEPA Maximum Contaminant Levels
J - Anaylte present. Reported value may not be accurate or precise.
B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.
U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.
L - This result should be considered a biased low quantitative estimate.
K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.
NA - Not Analyzed
< 0.5 - Compound not detected above the listed laboratory method reporting limit.
Bold - Compound was detected above its listed ground water standard.

TABLE 3

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS [1] DOWNGRADIENT WELLS																																	Ground Water Standards[2]
	MW-15S								MW-16S								MW-17S								MW-24								
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	
Volatiles:																																		
Dichlorodifluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.046B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.70B	19[3]
Chloromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.30J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.33J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.31K	19[3]
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.14J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.061B	110[3]
1,1-Dichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	26[3]
Acetone	<5UR	3.2B	<5.0R	<5.0UR	<5.0UR	4.2L	16	11R	<5.0UR	5.0UR	<5.0R	4.8B	2.9L	<5.0UR	15	6.4R	<5.0UR	3.1B	4.2L	<5.0UR	<5.0UR	<5.0UR	14	18R	<5.0UR	3.8B	4.7B	<5.0UR	<5.0UR	2.9L	15	18R	95.9
2-Butanone	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0UR	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	1.8R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	1.6R	490[3]
Carbon Disulfide	<0.50	<0.50	<0.50	<0.5	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	1.8	<0.50	<0.50	<0.50	0.067J	<0.50	<0.50	<0.50	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18 J	<0.50	<0.50	<0.50	0.76B	72[3]
Methylene Chloride	0.41B	<0.50	0.23J	0.23B	0.19B	<0.50UJ	0.63B	0.38B	0.87B	<0.50	0.22K	0.23B	0.25B	<0.50	1.4B	<0.50	0.75B	<0.50	0.26K	0.21B	0.21B	<0.50	0.97B	0.42B	0.69B	0.18B	0.30B	0.19B	0.20B	0.15B	0.57B	0.45B	5[4]
Trans-1,2-dichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.055J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	8.6[3]
Methyl tert butyl ether	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	12[3]
Chloroform	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1
1,1,1-Trichloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.04J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	200[4]
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.091J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5[4]
1,1,2,2-Tetrachloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.066[3]
Toluene	0.17B	<0.50	<0.50	<0.50	<0.50	0.087B	3.0B	0.37B	0.21B	<0.50	<0.50	<0.50	<0.50	0.11B	6.7B	1.7	0.27B	<0.50	<0.50	<0.50	<0.50	0.26B	4.5B	0.28B	0.19B	<0.50	<0.50	<0.50	0.24B	0.63B	18	0.13B	1,000[4]
Trans-1,3-dichloropropene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.050B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	0.066B	3.5[3]
Chlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.10J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	7.2[3]
Cyclohexane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	0.092B	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1,300[3]
Carbon Tetrachloride	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.096B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.041B	0.39[3]
Benzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.060B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.092B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	700[4]
Total Xylenes	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.157B	0.42J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.033B	10,000(4)
Isopropylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.085B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	39[3]
1,3-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.15B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.044B	-
1,4-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.42[3]
1,2-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.034B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.040B	28[3]
1,2,4-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.24B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.088B	0.39[3]
1,2,3-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52[3]
Semivolatiles:																																		
Caprolactam	<5.0R	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0R	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	5.0L	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0UL	770[3]
2,4-Dimethylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	1.15
Phenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	7,860
2-Methylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	12.5
4-Methylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	47.7
Naphthalene	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0UL	5
Di-N-Butylphthalate	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0	67[3]
Bis(2-ethylhexyl)phthalate	<5.0	<5.3	<4.8	3.3J	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	2.4J	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	3.0J	2.4J	<5.0	3.5L	<4.8UL	**8.6L**	<5.0	<4.7UL	<4.5	<5.0	6[4]
Cyanide:																																		
Total	<10.0	<10.0	<10.0	<10.0	2.1J	3.4B	<10.0	<10.0	<10.0	1.6J	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1.8J	**11.3**	4.3B	<10.0	4.6J	2.4B	2.8B	1.6B	<10.0	<10.0	<10.0	<10.0	<10.0	1.9B	<10.0	<10.0	10
Available	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	-

Notes:

(1) - All results are reported in micrograms per liter.

(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.

(3) - USEPA Regional Screening Levels for Tapwater, May, 2013

(4) - USEPA Maximum Contaminant Levels

J - Anaylte present. Reported value may not be accurate or precise.

B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.

U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.

L - This result should be considered a biased low quantitative estimate.

K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.

NA - Not Analyzed

< 0.5 - Compound not detected above the listed laboratory method reporting limit.

Bold - Compound was detected above its listed ground water standard.

TABLE 3

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
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ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS [1] DOWNGRADIENT WELLS																																Ground Water Standards[2]
	MW-15S								MW-16S								MW-17S								MW-24								
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	
Metals (Dissolved):																																	
Aluminum	213B	77.4J	74.6B	227	<200	29.9B	<200	<200	646	246	880	**3,770**	385	97.7B	<200	34.5B	297B	182J	299	326	<200	244	20.2B	53.6B	891	635	802	**3,650**	73.2	1,040	<200.0	<200	1,600[3]
Antimony	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.0B	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	8.3B	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60	6[4]
Arsenic	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	<10.0	<10.0UL	**7.6J**	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	<10.0	<10.0UL	**7.0J**	<10.0UL	<10.0	<10.0UL	<10.0	1
Barium	**47.9J**	**62.9J**	**44.3J**	**51.3J**	**50.2J**	**79.2J**	**49.2J**	**48.0J**	**49.6J**	**54.3J**	**55.5J**	**81.9J**	**47.7J**	**45.9J**	39.0J	**43.4J**	7.1J	33.7J	15.1J	15.2J	17.7J	8.3J	11.0J	10.0J	**52.5J**	33.3J	32.0J	26.2J	29.1J	**27.2J**	18.6J	14.1J	40
Beryllium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	1.2B	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.97B	<5.0	0.63J	<5.0	2.5J	<5.0	0.88B	<5.0	0.82B	4
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.85B	<5.0UL	5[4]
Calcium	87,000	93,100	87,800J	100,000	106,000	99,500	95,500	91,200	56,200	63,800	60,500	85,400	67,000	54,700	52,500	51,000	10,700	31,200	17,300	15,600	16,900	9,900	13,600	11,300	69,800	63,000	39,800	35,900	35,900	17,900	11,400	10,300	-
Chromium	**9.0J**	7.0J	7.7J	**14.4**	2.6J	6.5J	<10.0	2.4B	**26.8**	**9.6J**	**60.1**	**264**	**60.7**	**13.9**	<10.0	2.1B	3.4B	7.2J	2.6B	**12.1**	1.6J	**10.2**	<10.0	0.89B	7.8J	<10.0	**8.5J**	**362**	**25**	**32.2**	<10.0	<10.0	8
Cobalt	<50.0	**4.7J**	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL	<50.0	**1.6J**	**2.7J**	**11.7J**	<50.0	<50.0	3.5B	<50.0UL	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL	12.1B	**8.3J**	**8.9J**	**61.9**	**2.9J**	**28.5J**	4.2B	<50.0UL	0.47[3]
Copper	<25.0	5.7J	<25.0	2.2B	1.1J	1.3J	<25.0	0.88B	6.2J	<25.0	8.1J	52.0	8.5J	2.3J	<25.0	1.9B	<25.0	<25.0	1.4B	3.6B	<25.0	6.8J	<25.0	2.7B	4.8J	<25.0	3.1B	27.5	2.2J	7.6J	<25.0	<25.0	1,300[4]
Iron	**353**	**297**	54.3B	**794**	62.5J	120	<100.0	<100	**2,220**	**1,490**	**3,190**	**22,900**	**2,660**	**561**	<100.0	<100	**700**	**812**	**843**	**1,190**	**147**	**594**	<100.0	<100	**3,740**	**3,620**	**2,920**	**17,100**	**871**	**5,760**	<100.0	<100	250
Lead	<10.0UL	<10.0	<10.0	1.2J	<10.0	<10.0UL	<10.0	<10.0	<10.0UL	<10.0	2.2J	**20.9**	1.9J	<10.0UL	<10.0	3.0J	<10.0UL	<10.0	<10.0	2.1J	<10.0	<10.0UL	<10.0	<10.0	**14.9L**	15.1B	12.6	**73.5**	2.9J	**23.3L**	<10.0	<10.0	15
Magnesium	48,400	52,400	49,600	55,300	54,800	55,600	53,200	50,900	35,200	39,500	38,700	49,000	38,300	36,500	31,200	30,300	1,480J	10,600	3,930J	2,770J	3,490J	1,460J	2,380J	1,710J	5,880	4,410J	2,980J	2,590J	2,390J	1,500J	954J	892J	-
Manganese	16.4	20.0	3.7J	36.3	5.1J	9.9J	<15.0	22.5	48.5	56.2	**145**	**370**	**86.4**	12.6J	19.3	<15.0	**124**	64.2	**92.9**	41.6	**120**	29.0	57.5	33.0	**275**	**126**	**153**	**1,130**	60.2	**580**	52.9	125	66.8
Mercury	<0.20	0.12B	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20UL	<0.20	0.075J	0.059J	<0.20	<0.20	<0.20	<0.20	<0.20UL	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20UL	<0.20	<0.20	<0.20	0.10B	0.090B	<0.20	2[4]
Nickel	10.0J	8.5J	4.7J	9.7J	<40.0	6.6J	0.85J	3.9J	25.7J	**41.0**	**37.8J**	**165**	**47.2**	11.4J	0.86J	5.6J	<40.0	6.1J	2.6B	10.1J	<40.0	7.1J	<40.0	2.0B	**31.2J**	7.2J	10.4J	**215**	17.8J	**43.6**	4.5J	**30.3J**	30[3]
Potassium	2,650J	2,490J	1,550J	1,940J	1,780J	3,470J	2,010J	1,940J	6,880	5,200	4,910J	8,620	5,860	6,720	6,150	6,350	1,510J	5,090	2,880J	2,700J	2,970J	1,030J	2,490J	1,800J	5,530	1,850J	1,370J	1,590J	1,140J	1,670J	642J	526J	-
Selenium	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	3.4B	<35.0	**2.5J**	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	3.1B	<35.0	0.4
Silver	<10.0	1.2B	<10.0	1.3B	1.2B	<10.0	<10.0	<10.0UL	<10.0	<10.0	<10.0	1.3B	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0	<10.0	1.7B	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0	<10.0	1.3B	<10.0	<10.0	<10.0	<10.0UL	7.1[3]
Sodium	13,000	65,400	13,700	14,000	10,400	101,000	13,200	13,200	32,000	133,000	76,700	24,700	12,400	11,300	33,900	11,600	136,000	770,000	449,000	343,000	403,000	56,200	346,000	284,000	7,790	47,600	39,500	9,650	17,200	15,500	6,950	7,370	-
Thallium	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	2.0[4]
Vanadium	1.5B	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	2.8B	2.0B	3.3B	**17.4J**	2.7J	0.98J	<50.0	<50.0	1.2B	1.2B	<50.0	<50.0	<50.0	1.9J	<50.0	<50.0	1.9B	1.1B	<50.0	5.7J	<50.0	1.9J	<50.0	<50.0	6.3[3]
Zinc	23.4B	55.6L	5.6L	11.0B	5.3J	9.1J	<60.0	5.9L	37.2B	30.3L	24.9L	262	31.1J	16.7J	7.1J	6.8L	22.1B	17.1B	9.8L	17.3B	3.9J	18.0J	<60.0	<60.0UL	32.0B	23.0L	47.6L	147	59.8J	113	50.7J	30.6L	470[3]
Metals (Totals):																																	
Aluminum	459	444	156B	1,120K	<200	378	173B	1,280	**2,180**	**8,330**	**3,620**	**34,500**	1,410	435	246B	474	502	1,360	739	977	<200	1,310	387B	33.2J	**19,200**	**26,600**	**6,320**	**30,900**	830	**25,900**	1,250	**3,220**	1,600[3]
Antimony	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.6J	4.3B	<60.0	3.3J	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	7.1B	<60.0	<60.0	<60.0	<60.0	<60.0	6.9B	<60.0	4.9B	6[4]
Arsenic	<10.0	3.2B	<10.0UJ	<10.0	<10.0UL	<10.0	<10.0UL	3.6B	**2.6J**	**20.9K**	**7.4J**	**61.4**	<10.0UL	<10.0	<10.0UL	<10.0	<10.0	4.1B	<10.0UJ	<10.0	<10.0UL	<10.0	<10.0UL	12.3B	**37.1**	**72.2K**	**14.3J**	**49.1**	<10.0UL	**55.6K**	<10.0UL	5.8B	1
Barium	**48.3J**	**67.1J**	**45.2J**	**61.7J**	**49.2J**	**78.9J**	**50.3J**	**62.4J**	**60.4J**	**123J**	**73.2J**	**384**	**56.7J**	**49.6J**	**42.6J**	**44.6J**	8.2J	**44.8J**	16.9J	18.3J	17.7J	15.4J	13.6J	13.1J	**109J**	**638**	**50.1J**	**109J**	31.2J	**166J**	25.6J	**43.5J**	40
Beryllium	<5.0	<5.0	<5.0	1.2J	<5.0	0.59B	<5.0	2.0J	<5.0	2.1J	1.2B	**8.3**	<5.0	<5.0	0.27B	0.38B	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.41B	1.8J	**12.6**	**54.8**	**4.3J**	**18.8**	1.1B	**19.0**	1.1B	3.1J	4
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.72B	<5.0UL	<5.0	1.5J	<5.0	**14.5**	<5.0	<5.0	<5.0	<5.0UL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL	<5.0	4.8J	<5.0	2.4J	<5.0	<5.0	<5.0	<5.0UL	5[4]
Calcium	85,400	93,200	91,000	107,000	105,000	98,100	98,900	103,000	66,200	165,000	77,200	566,000	71,200	60,100	56,700	57,200	11,400	37,300	21,200	18,200	17,000	8,850	16,100	104,000	63,700	72,600	37,600	34,300	34,200	21,100	14,700	11,700	-
Chromium	**20.1**	**28.4**	**67.8**	**55.7**	2.8J	**23.2**	**30.2**	**17.7**	**152**	**980**	**655**	**2,710**	**275**	**59.0**	**13.3**	**55.6**	5.6J	**65.6**	**26.2**	**33.4**	**8.2J**	**97.9**	**24.1**	2.4B	**143**	**43.4**	**93.4**	**1,660**	**87.2**	**706**	**55.5**	**1,920**	8
Cobalt	<50.0	**10.1J**	<50.0	**4.7J**	<50.0	**1.1J**	**3.6J**	<50.0UL	<50.0	**37.0J**	**15.6J**	**119**	**5.9J**	**1.6J**	<50.0	<50.0UL	<50.0	**5.1J**	3.0B	**3.7J**	<50.0	**3.1J**	<50.0	<50.0UL	**201**	**402**	**81.6**	**355**	**14.8J**	**350**	**13.3J**	**99.1L**	0.47[3]
Copper	<25.0	<25.0	1.6B	5.8J	<25.0	2.8J	1.0B	8.7J	31.8	142	61.7	546	27.9	7.5J	4.9J	8.5J	5.2J	13.8J	3.7B	7.8J	0.99J	27.9	2.7B	4.7B	119	464	36.8	180	7.4J	153	8.1J	72.6	1,300[4]
Iron	**1,170**	**1,620**	**590**	**4,530**	131	**1,710J**	**440**	**7,080**	**11,000**	**59,200**	**23,300**	**238,000**	**10,900**	**2,900**	**983**	**2,110**	**1,680**	**6,200**	**2,990**	**3,690**	**257**	**3,530**	**1,460**	39.9B	**80,300**	**86,400**	**28,900**	**120,000**	**5,150**	**108,000**	**6,590**	**22,700**	250
Lead	<10.0UL	2.4B	<10.0UL	5.9J	<10.0UL	2.2J	<10.0	7.3J	9.3L	**52.2**	**18.7L**	**224**	8.5L	1.9J	2.1B	<10.0	<10.0UL	9.4B	3.8L	6.2J	<10.0UL	7.5J	3.4B	2.6J	**395L**	**1,470**	**136L**	**595**	**23.4L**	**699**	**29.4**	**143**	15
Magnesium	47,500	52,900	51,000	61,100	54,400	54,300	55,400	58,100	39,900	94,800	46,800	281,000	44,000	39,100	33,500	35,200	1,600J	12,400	4,440J	3,240J	3,490J	2,110J	2,710J	2,570J	8,940	9,560	4,310J	7,320	2,420J	5,820	1,340J	1,650J	-
Manganese	45	51.1	20.1	**229**	11.4J	**67.0**	27.1	**296**	**140**	**795**	**373**	**3,340**	**188**	43.9	46.3	32.2	**148**	**189**	**168**	**118**	**125**	**96.0**	**85.8**	**172**	**3,020**	**6,140**	**1,070**	**4,640**	**212**	**4,410**	**219**	**1,540**	66.8
Mercury	<0.20	<0.20UL	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.079B	<0.20	0.28	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20UL	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.35B	<0.20	0.071J	<0.20	0.23	<0.20	<0.20	2[4]
Nickel	17.6J	22.4J	**36.7J**	**35.2J**	<40.0	16.9B	15.9J	21.6J	**98.3**	**792**	**349**	**1,600**	**149**	32.9B	8.3J	**56.6**	<40.0	**51.0**	16.4J	27.0J	4.2J	**53.1**	14.1J	3.3J	**196**	**235**	**87.9**	**974**	**53.7**	**507**	**40.7**	**1,070**	30[3]
Potassium	2,740J	2,570J	1,600J	2,050J	1,730J	3,370J	2,000J	2,370J	7,110	6,070	5,110	13,700	5,860	7,050	5,730	6,460	1,550J	5,420	3,010J	2,810J	2,940J	1,220J	2,650J	1,130J	7,390	2,800J	1,890J	3,640J	1,260J	4,000J	1,200J	1,370J	-
Selenium	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	<35.0	<35.0	<35.0	**8.6J**	<35.0	<35.0UL	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	**2.8J**	**6.2J**	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0	0.4
Silver	<10.0L	3.9B	<10.0	0.83B	<10.0	<10.0	<10.0	<10.0	<10.0UL	1.2B	<10.0	2.2B	0.79B	<10.0	<10.0	<10.0U	<10.0UL	<10.0	<10.0	1.2B	<10.0	<10.0	<10.0	<10.0	<10.0UL	<10.0	<10.0	0.83B	<10.0	<10.0	<10.0	<10.0	7.1[3]
Sodium	13,100	63,300	13,800	13,000	9,710	90,300	13,000	16,800	33,100	134,000	66,700	28,800	12,500	11,500	30,200	9,910	134,000	786,000	417,000	341,000	389,000	50,100	349,000	7,220	7,550	15,900	39,100	9,420	17,300	15,200	7,190	4,620J	-
Thallium	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	4.5B	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	<25.0	11.5B	6.5B	<25.0	<25.0UL	<25.0	<25.0	<25.0UL	2.0[4]
Vanadium	2.1B	1.9J	<50.0	4.1J	<50.0	1.6J	<50.0	4.9J	**10.2J**	**45.9J**	**20.0J**	**174**	**9.3J**	2.4J	<50.0	<50.0	2.3B	4.5J	<50.0	2.9J	<50.0	4.8J	1.4B	<50.0	**19.8J**	**20.8J**	**7.2J**	**35.9J**	<50.0	**29.0J**	1.9B	**7.9J**	6.3[3]
Zinc	15.6J	29.0L	9.3L	47.6J	4.9J	24.5B	7.4J	70.5	137	495L	169L	**3,000**	87.4	41.8J	24.8J	29.4J	28.9J	105L	32.5L	50.9J	4.0J	83.1	17.1J	6.3J	**547**	**800L**	247L	**963**	90.4	**1,020**	85.2	171	470[3]

Notes:

(1) - All results are reported in micrograms per liter.
(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.
(3) - USEPA Regional Screening Levels for Tapwater, May, 2013
(4) - USEPA Maximum Contaminant Levels
J - Anaylte present. Reported value may not be accurate or precise.
B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.
U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.
L - This result should be considered a biased low quantitative estimate.
K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.
NA - Not Analyzed
< 0.5 - Compound not detected above the listed laboratory method reporting limit.
Bold - Compound was detected above its listed ground water standard.

Table 4
List of Total Metals Not Tested Due to High Percentage of Non-Detects

Percent NDs by Well - Total Metals

	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
Antimony	100	**75**	**75**	**87.5**	**87.5**	100	100
Cadmium	100	**62.5**	**87.5**	100	**75**	100	**75**
Mercury	**87.5**	**12.5**	**87.5**	100	**87.5**	100	**75**
Selenium	100	**75**	**75**	100	**87.5**	**87.5**	**87.5**
Silver	100	100	**87.5**	100	100	100	100
Thallium	100	**87.5**	100	100	100	100	100

Table 5
Results of Shapiro-Wilk Test of Normal Distribution for Total Metals Data Sets

	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24	Number of wells having normal distribution
Aluminum	L	L	L	X	L	N	L	1
Arsenic	X	X	N	X	L	N	N	3
Barium	X	L	L	N	L	N	N	3
Beryllium	X	L	L	N	N	N	N	4
Calcium	X	X	N	N	X	N	N	4
Chromium	N	N	N	N	L	N	L	5
Cobalt	X	X	L	N	L	L	N	2
Copper	X	L	L	N	L	X	N	2
Iron	L	L	L	L	L	N	N	2
Lead	X	L	L	X	L	L	L	0
Magnesium	X	N	N	N	X	N	N	5
Manganese	L	X	L	N	L	N	N	3
Nickel	L	L	L	N	L	L	L	1
Potassium	L	N	N	N	N	X	L	4
Sodium	X	N	X	X	L	N	N	3
Vanadium	X	X	L	L	L	N	N	2
Zinc	N	L	L	L	L	N	N	3

N = Untransformed data set has a normal distribution based on Shapiro-Wilk test
L = Log transformed data set has a normal distrinution, while the untransformed data set does not.
X = Neither log-transformed data set nor untransformed data set has a normal distribution.

Table 6

Outliers to be Removed from Total Metals Data Sets Based on Dixon's Outlier Test and Shapiro-Wilk Test for Normality

(Using predominant Shapiro-Wilk results for each metal)

Metal	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24	Outlier Set Used
Aluminum	x	x	x	x	x	x	x	L
Arsenic	x	x	9.6	x	x	x	x	L
Barium	65.5	579 / 615	x	x	x	44.8	x	L
Beryllium	x	89.5 / 90.8	24.3	x	8.3	x	54.8	N
Calcium	x	1,730,000	34,300	x	566,000	104,000	x	N
Chromium	105	2,170	391	x	2,710	x	1,660 / 1,920	N
Cobalt	x	x	x	x	x	x	x	L
Copper	x	x	x	x	x	x	x	L
Iron	x	x	x	x	x	x	x	L
Lead	x	x	x	x	x	x	x	L
Magnesium	x	493,000 / 588,000	x	x	281,000	12,400	x	N
Manganese	x	x	x	x	x	x	x	L
Nickel	155	x	x	x	x	x	x	L
Potassium	x	x	x	x	13,700	5,420	x	N
Sodium	x	x	x	x	x	x	x	L
Vanadium	x	x	x	x	x	x	x	L
Zinc	x	x	x	x	x	x	x	L

x = No upper outlier identified by Dixon's Test.

N = Used results from Dixon's Test for normally distributed case
(as majority of well data sets for the metal were normally distributed per the Shapiro-Wilk test - See Table 5.)

L = Used results from Dixon's Test for log-normally distributed case
(as majority of well data sets for the metal were log-normally distributed per the Shapiro-Wilk test - See Table 5.)

Note: Values where present represent statistical outliers
'101 / 116' represents two statistical outliers, 101.0 and 116.0.

Table 7
Statistically Significant Decreasing Trends in Concentration vs. Time Plots
(October 2010 - August 2012)

Total Metals

MW-10 (Total)	Ca	Fe	Mg											
MW-22 (Total)	As	Ba	Be	Co	Mg	Mn	V							
MW-23 (Total)	Ca	Mg												
MW-15S (Total)	Co													
MW-16S (Total)	Al	Ba	Be	Cr	Co	Cu	Fe	Pb	Mg	Mn	Ni	Na	V	Zn
MW-17S (Total)	Al	Ba	Ca	Fe	Mg	Mn	K	Zn						
MW-24 (Total)	Al	As	Ba	Be	Ca	Co	Cu	Fe	Mg	Mn	K	Na		

Statistically Significant Increasing Trends in Concentration vs. Time Plots
(October 2010 - August 2012)

Total Metals

MW-10 (Total)	K	Na	Zn											
MW-22 (Total)	Na													
MW-23 (Total)	Ba	Cr	Cu	Fe										
MW-15S (Total)	Ba	Pb	Mg											
MW-16S (Total)	none													
MW-17S (Total)	none													
MW-24 (Total)	none													

Notes: (1) Indicated metals were found to be significantly declining (or increasing) at a probability of 80 or 90%, based on application of the Mann-Kendall test for trends.
(2) Statistical outliers were included in the data used for the trend analysis.

Table 8
Summary of Results from Background Intra-Group Analysis

Total Metals

Metal	Critical Point for Kruskal-Wallis Test	Kruskal-Wallis Test Statistic (H)	Overall Conclusions	Conclusions from Post-Hoc Anaysis
Aluminum	5.99	12.68	NE	1
Arsenic	5.99	6.46	NE	1,2
Barium	5.99	8.30	NE	1,2
Beryllium	5.99	4.69	E	-
Calcium	5.99	18.70	NE	1,2
Chromium	5.99	9.14	NE	1
Cobalt	5.99	8.96	NE	1
Copper	5.99	9.45	NE	1
Iron	5.99	14.06	NE	1
Lead	5.99	11.14	NE	1
Magnesium	5.99	15.04	NE	2
Manganese	5.99	15.36	NE	1
Mercury	5.99	9.98	NE	2
Nickel	5.99	12.27	NE	1
Potassium	5.99	15.77	NE	2
Sodium	5.99	17.18	NE	2
Vanadium	5.99	7.38	NE	1,2
Zinc	5.99	15.45	NE	1

Note: A non-parametric method was used for the analysis - the Kruskal-Wallis test, including associated post-hoc test of contrasts recommended in USEPA Unified Guidance

E = Medians are equal among the 3 background wells (H statistic < critical point)

NE = Medians are not equal among the 3 background wells (H statistic > critical point)

1 = Median for MW-22 same as MW-23

2 = Median for MW-10 same as MW-23

3 = Median for MW-10 same as MW-22

Table 9
Summary of Results from Downgradient Intra-Group Analysis

Total Metals

Metal	Critical Point for Kruskal-Wallis Test	Kruskal-Wallis Test Statistic (H)	Overall Conclusions	Conclusions from Post-Hoc Analysis
Aluminum	7.81	13.29	NE	1,2,4,5
Arsenic	7.81	8.42	NE	1,2,4,5
Barium	7.81	15.81	NE	1,3,5
Beryllium	7.81	6.85	E	-
Calcium	7.81	21.91	NE	1,5,6
Chromium	7.81	10.82	NE	1,2,3,5,6
Cobalt	7.81	17.01	NE	1,2,4,5
Copper	7.81	17.17	NE	2,4,5
Iron	7.81	16.35	NE	1,2,4,5
Lead	7.81	18.90	NE	1,2,4,5
Magnesium	7.81	23.44	NE	1,6
Manganese	7.81	15.13	NE	1,2,4,5
Mercury	Non-detects comprised 75% or more of each data set			
Nickel	7.81	14.92	NE	1,2,4,5
Potassium	7.81	13.30	NE	2,3,6
Sodium	7.81	11.22	NE	1,2,3,4,5
Vanadium	7.81	8.60	E**	1,2,3,4,5,6
Zinc	7.81	18.08	NE	2,4,5

Note: A non-parametric method was used for the analysis - the Kruskal-Wallis test, including associated post-hoc test of contrasts recommended in USEPA Unified Guidance

E = Medians are equal among the 4 downgradient wells (H statistic < critical point)

NE = Medians are not equal among the 4 downgradient wells (H statistic > critical point

E** = Although the Kruskal-Wallis test indicates the medians for at least one pair of the 4 wells differ, the post-hoc analysis indicated no difference in the medians among the 4 wells.

1 = Median for MW-15S same as MW-16S
2 = Median for MW-15S same as MW-17S
3 = Median for MW-15S same as MW-24
4 = Median for MW-16S same as MW-17S
5 = Median for MW-16S same as MW-24
6 = Median for MW-17S same as MW-24

Table 10

Summary of Results of ANOVA Inter-Group Statistical Tests Without Outliers Comparing Individual Downgradient Wells and Pooled Upgradient Data - All Eight Sampling Events

Total Metals

	Analytical Method	MW-15S	MW-16S	MW-17S	MW-24
Aluminum	NP	E	E	E	E
Arsenic	NP	E	E	E	E
Barium	NP	E	E	E	E
Beryllium	NP	E	E	E	E
Calcium	P	E	E	E	E
Chromium	P	E	**> upgd**	E	E
Cobalt	NP	E	E	E	**> upgd**
Copper	NP	E	E	E	**> upgd**
Iron	NP	E	E	E	E
Lead	NP	E	E	E	**> upgd**
Magnesium	P	E	E	E	E
Manganese	NP	E	E	E	E
Nickel	NP	E	E	E	**> upgd**
Potassium	P	E	E	E	E
Sodium	NP	E	E	**> upgd**	E
Vanadium	NP	E	E	E	E
Zinc	NP	E	E	E	E

P = Parametric method (One-way F-Statistic ANOVA with Bonferroni t-test as post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

NP = Non-parametric method (Kruskal-Wallis test including its post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

E = Mean/median is equal to or less than upgradient mean/median at a probability of 95%

>upgd = Mean/median is greater than upgradient mean/median at a probability of 95%

Table 11
ANOVA Statistics for Inter-Group Analysis Without Outliers Comparing Individual Downgradient Wells and Pooled Upgradient Data - All Eight Sampling Events

Total Metals

Metal	Overall Test Results		Results of Post-Hoc Tests on Individual Downgradient Wells								Test
			MW-15S		MW-16S		MW-17S		MW-24		
	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	
Aluminum	*9.49**	*13.25**	2.24	-1.83	2.24	0.52	2.24	-1.26	2.24	2.18	KPH
Arsenic	9.49	9.12	+	+	+	+	+	+	+	+	K
Barium	*9.49**	*19.77**	2.24	-1.27	2.24	-0.82	2.24	-4.41	2.24	-0.72	KPH
Beryllium	9.49	7.35	+	+	+	+	+	+	+	+	K
Calcium	2.57	2.22	+	+	+	+	+	+	+	+	A
Chromium	**2.58**	**4.63**	2.32	-0.26	**2.32**	**3.71**	2.32	-0.23	2.32	1.85	AB
Cobalt	**9.49**	**16.13**	2.24	-1.11	2.24	0.35	2.24	-1.17	**2.24**	**3.07**	KPH
Copper	**9.49**	**16.46**	2.24	-1.81	2.24	1.60	2.24	-1.12	**2.24**	**2.32**	KPH
Iron	*9.49**	*14.01**	2.24	-1.94	2.24	0.60	2.24	-1.67	2.24	1.94	KPH
Lead	**9.49**	**19.81**	2.24	-1.41	2.24	0.70	2.24	-0.88	**2.24**	**3.46**	KPH
Magnesium	*2.57**	*4.58**	2.32	0.74	2.32	0.24	2.32	-2.86	2.32	-2.84	AB
Manganese	*9.49**	*12.58**	2.24	-2.00	2.24	-0.41	2.24	-1.08	2.24	2.09	KPH
Mercury	Non-detects comprised more than 75% of the total data set										
Nickel	**9.49**	**14.06**	2.24	-1.41	2.24	1.25	2.24	-1.28	**2.24**	**2.31**	KPH
Potassium	2.56	1.66	+	+	+	+	+	+	+	+	A
Sodium	**9.49**	**18.76**	2.24	1.79	2.24	2.16	**2.24**	**4.11**	2.24	0.93	KPH
Vanadium	9.49	7.76	+	+	+	+	+	+	+	+	K
Zinc	9.49	14.30*	2.24	-1.9	2.24	0.87	2.24	-1.15	2.24	2.24	KPH

A = One-Way ANOVA F-Test
AB = One-Way ANOVA F-Test followed by the post-hoc Bonferroni t-test
K = Non-parametric ANOVA - Kruskal-Wallis test
KPH = Non-parametric ANOVA - Kruskal-Wallis test followed by the post-hoc test recommended in the Unified Guidance (2009)
+ = Test indicated no significant differences among the four downgradient wells and the pooled upgradient wells, hence no post-hoc tests were conducted on individual downgradient wells.

Notes: (1) Value pairs shown with asterisks indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. However, the post-hoc tests revealed that none of the downgradient wells had means/medians significantly greater than that of the pooled upgradient data.

(2) Value pairs in **bold** indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. In these cases, post-hoc tests revealed that the mean/median of at least one downgradient well was significantly greater than that of the pooled upgradient data.

Table 12

Summary of Results of ANOVA Inter-Group Statistical Tests Without Outliers Comparing Individual Downgradient Wells and Pooled Upgradient Data - Last Four Sampling Events

Total Metals

	Analytical Method	MW-15S	MW-16S	MW-17S	MW-24
Aluminum	NP	E	E	E	E
Arsenic	NP	E	E	E	E
Barium	NP	E	E	E	E
Beryllium	NP	E	E	E	E
Calcium	P	E	E	E	E
Chromium	P	E	E	E	E
Cobalt	NP	E	E	E	E
Copper	NP	E	E	E	E
Iron	NP	E	E	E	E
Lead	NP	E	E	E	**> upgd**
Magnesium	P	E	E	E	E
Manganese	NP	E	E	E	E
Nickel	NP	E	E	E	E
Potassium	P	E	E	E	E
Sodium	NP	E	E	E	E
Vanadium	NP	E	E	E	E
Zinc	NP	E	E	E	E

P = Parametric method (One-way F-Statistic ANOVA with Bonferroni t-test as post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

NP = Non-parametric method (Kruskal-Wallis test including its post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

E = Mean/median is equal to or less than upgradient mean/median at a probability of 95%

>upgd = Mean/median is greater than upgradient mean/median at a probability of 95%

Table 13
ANOVA Statistics for Inter-Group Analysis Without Outliers Comparing Individual Downgradient Wells and Pooled Upgradient Data - Last Four Sampling Events

Total Metals

Metal	Overall Test Results		Results of Post-Hoc Tests on Individual Downgradient Wells								Test
			MW-15S		MW-16S		MW-17S		MW-24		
	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	
Aluminum	9.49	7.48	+	+	+	+	+	+	+	+	K
Arsenic	9.49	2.65	+	+	+	+	+	+	+	+	K
Barium	*9.49**	*14.65**	2.24	-0.72	2.24	-1.67	2.24	-3.61	2.24	-1.61	KPH
Beryllium	9.49	2.72	+	+	+	+	+	+	+	+	K
Calcium	2.80	1.87	+	+	+	+	+	+	+	+	A
Chromium	2.80	2.00	+	+	+	+	+	+	+	+	A
Cobalt	*9.49**	*11.13**	2.24	-1.39	2.24	-0.81	2.24	-1.39	2.24	1.98	KPH
Copper	9.49	6.08	+	+	+	+	+	+	+	+	K
Iron	9.49	7.61	+	+	+	+	+	+	+	+	K
Lead	**9.49**	**9.97**	2.24	-0.58	2.24	-0.58	2.24	-0.47	**2.24**	**2.55**	KPH
Magnesium	*2.80*	*2.43*	+	+	+	+	+	+	+	+	A
Manganese	9.49	6.59	+	+	+	+	+	+	+	+	K
Mercury	Non-detects comprised more than 75% of the total data set										
Nickel	9.49	7.23	+	+	+	+	+	+	+	+	K
Potassium	2.80	1.15	+	+	+	+	+	+	+	+	A
Sodium	9.49	6.64	+	+	+	+	+	+	+	+	K
Vanadium	9.49	1.24	+	+	+	+	+	+	+	+	K
Zinc	9.49	9.04	+	+	+	+	+	+	+	+	K

A = One-Way ANOVA F-Test
AB = One-Way ANOVA F-Test followed by the post-hoc Bonferroni t-test
K = Non-parametric ANOVA - Kruskal-Wallis test
KPH = Non-parametric ANOVA - Kruskal-Wallis test followed by the post-hoc test recommended in the Unified Guidance (2009)
+ = Test indicated no significant differences among the four downgradient wells and the pooled upgradient wells, hence no post-hoc tests were conducted on individual downgradient wells.

Notes: (1) Value pairs shown with asterisks indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. However, the post-hoc tests revealed that none of the downgradient wells had means/medians significantly greater than that of the pooled upgradient data.

(2) Value pairs in **bold** indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. In these cases, post-hoc tests revealed that the mean/median of at least one downgradient well was significantly greater than that of the pooled upgradient data.

(3) Values indicate the results of using only the concentrations for the last four events. (Where an outlier was included in the concentration values for the last four events, it was replaced by the value for the 4th sampling event.)

Appendix A: Analytical Results and Statistical Data Analysis for Dissolved Metals

Attachment A-1: Dissolved Metals Data – Validated Set and Data Set Modified for Statistical Testing

Attachment A-2: Concentration vs. Time Plots for Dissolved Metals by Well

Attachment A-3: Box Plots for Dissolved Metals

Attachment A-4: Q-Q Plots for Dissolved Metals

Attachment A-5: Computer Output for Outlier Identification using Dixon's Test for Dissolved Metals

Attachment A-6: Computer Output for Kruskal-Wallis Intra-Group Analysis for Dissolved Metals

Attachment A-7: Computer Output for Parametric ANOVA Inter-Group Analysis for Dissolved Metals

Attachment A-8: Computer Output for Kruskal-Wallis Inter-Group Analysis for Dissolved Metals

Table A-1: List of Dissolved Metals Not Tested Due to High Percentage of Non-Detects

Table A-2: Results of Shapiro-Wilk Test for Normal Distribution on Dissolved Metals

Table A-3 Outliers for Removal from Dissolved Metals Data Sets Based on Dixon's Outlier Test and Shapiro-Wilk Test for Normality

Table A-4: Statistically Significant Decreasing Trends in Concentration of Dissolved Metals vs. Time Plots

Table A-5: Summary of Results from Background Intra-Group Analysis

Table A-6: Summary of Results from Downgradient Intra-Group Analysis

Table A-7: Summary of Results of ANOVA Inter-Group Statistical Tests on Dissolved Metals

Table A-8: ANOVA Statistics for Inter-Group Analysis on Dissolved Metals

Appendix A-1

Dissolved Metals Data

NOTES FOR ATTACHMENT A-1 TABLES:

(1) - All results are reported in micrograms per liter.

(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.

(3) - USEPA Regional Screening Levels for Tapwater, April 2009

(4) - USEPA Maximum Contaminant Levels

J - Analyte present. Reported value may not be accurate or precise.

B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.

U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.

L - This result should be considered a biased low quantitative estimate.

K - Analyte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.

NA - Not Analyzed

Bold - Compound was detected above its listed ground water standard.

MW-10 Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	135B	<200	59.9B	<200	<200	<200	<200	86.1B
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	54.0J	48.6J	53.6J	64.6J	53.9J	54.30J	56.8J	47.1J
Beryllium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	1.5B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Dissolved)	20,100	19,600	20,700	22,000	23,000	17,300	18,100	18,300
Chromium (Dissolved)	6.1J	6.2J	<10.0	1.9B	<10.0	5.9J	3.5J	1.1B
Cobalt (Dissolved)	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL
Copper (Dissolved)	<25.0	<25.0	<25.0	1.1B	0.88J	0.99J	1.5J	5.3B
Iron (Dissolved)	142	74.0B	<100.0	50.7J	50.9B	62.9B	<100.0	<100
Lead (Dissolved)	<10.0UL	<10.0	<10.0	<10.0	<10.0	<10.0UL	<10.0	4.2J
Magnesium (Dissolved)	15,300	15,000	14,800	16,100	14,800	14,200	13,600	8,850
Manganese (Dissolved)	4.1J	17.0	2.4J	4.2J	3.3J	4.8J	<15.0	<15.0
Mercury (Dissolved)	<0.20	0.14B	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Dissolved)	<40.0	21.5J	<40.0	<40.0	<40.0	4.4J	5.8J	1.9B
Potassium (Dissolved)	1,130J	774J	840J	1,010J	1,000J	1,710J	1,240J	1,950J
Selenium (Dissolved)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	1.4B	0.95B	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	1,480J	1,360B	1,210J	1,420B	1,720J	1,370J	1,390J	1,060J
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	0.85B	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0
Zinc (Dissolved)	11.2B	2.6B	3.8L	4.6B	6.7J	5.7J	6.6J	10.3L

MW-10 Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	<42.100	<56.600	<32.40	<32.400	<32.40	<24.400	<13.60	<13.60
Antimony (Dissolved)	<14.700	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	54	48.6	53.6	64.6	53.9	54.3	56.8	47.1
Beryllium (Dissolved)	<0.860	<0.520	<1.100	<1.100	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	20100	19600	20700	22000	23000	17300	18100	18300
Chromium (Dissolved)	6.1	6.2	<1.500	<1.500	<1.500	5.9	3.5	<0.880
Cobalt (Dissolved)	<6.700	<0.980	<2.700	<2.700	<2.700	<0.970	<3.300	<3.300
Copper (Dissolved)	<4.500	<4.000	<0.740	<0.740	0.88	0.99	1.5	<0.810
Iron (Dissolved)	142	<26.000	<19.40	50.7	<19.40	<23.900	<38.80	<38.80
Lead (Dissolved)	<1.500	<2.000	<1.200	<1.200	<1.200	<1.900	<2.000	4.2
Magnesium (Dissolved)	15300	15000	14800	16100	14800	14200	13600	8850
Manganese (Dissolved)	4.1	17	2.4	4.2	3.3	4.8	<4.900	<4.900
Mercury (Dissolved)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Dissolved)	<5.900	21.5	<1.900	<1.900	<1.900	4.4	5.8	<0.680
Potassium (Dissolved)	1130	774	840	1010	1000	1710	1240	1950
Selenium (Dissolved)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Dissolved)	1480	<346.00	1210	<368.00	1720	1370	1390	1060
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	<1.600	<1.600	<0.810	<1.300	<1.300
Zinc (Dissolved)	<1.700	<1.700	3.8	<3.600	6.7	5.7	6.6	10.3

MW-22 Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	746	520	93.2B	1,890	120J	245	<200.0	24.5B
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	119J	84.7J	139J	96.2J	129J	124J	123J	111J
Beryllium (Dissolved)	<5.0	0.83J	<5.0	2.5J	<5.0	0.41B	0.41B	0.78B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	1.2B	<5.0UL
Calcium (Dissolved)	164,000	143,000	183,000	157,000	185,000	166,000	183,000	158,000
Chromium (Dissolved)	2.7B	<10.0	<10.0	**10.8**	3.1J	3.9J	1.3J	<10.0
Cobalt (Dissolved)	<50.0	3.4J	<50.0	9.1J	<50.0	2.2J	3.6B	<50.0UL
Copper (Dissolved)	8.1J	4.5J	<25.0	14.8J	2.7J	2.8J	4.7J	1.5B
Iron (Dissolved)	**3,340**	**4,260**	56.1B	**12,400**	**516**	**1,570**	<100.0	<100
Lead (Dissolved)	<10.0UL	2.4B	<10.0	**8.3J**	1.7J	<10.0UL	<10.0	<10.0
Magnesium (Dissolved)	75,400	131,000	89,300	167,000	127,000	106,000	122,000	105,000
Manganese (Dissolved)	**347**	**277**	**324**	**456**	**498**	**339**	**253**	**205**
Mercury (Dissolved)	0.20J	**20.9L**	0.39	**39.4**	**9.3**	**12.8**	**3.2**	**3.7**
Nickel (Dissolved)	24.9J	16.6J	4.6J	46.2	16.3J	11.8J	6.9J	4.2J
Potassium (Dissolved)	10,400	6,810	12,100	7,750	15,300	15,200	13,200	10,600
Selenium (Dissolved)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	2.0B	<10.0	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	158,000	55,100	133,000	24,700	41,300	59,300	59,700	65,000
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	1.9B	1.6B	<50.0	3.7J	<50.0	1.1J	<50.0	<50.0
Zinc (Dissolved)	64.9B	64.8L	9.0L	167	20.9J	33.7J	16.1J	8.4L

MW-22 Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	746	520	<32.40	1890	120	245	<13.600	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	119	84.7	139	96.2	129	124	123	111
Beryllium (Dissolved)	<0.860	0.83	<1.100	2.5	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	164000	143000	183000	157000	185000	166000	183000	158000
Chromium (Dissolved)	<0.680	<3.100	<1.500	10.8	3.1	3.9	1.3	<0.880
Cobalt (Dissolved)	<6.700	3.4	<2.700	9.1	<2.700	2.2	<3.300	<3.300
Copper (Dissolved)	8.1	4.5	<0.740	14.8	2.7	2.8	4.7	<0.810
Iron (Dissolved)	3340	4260	<19.40	12400	516	1570	<38.800	<38.80
Lead (Dissolved)	<1.500	<2.000	<1.200	8.3	1.7	<1.900	<2.000	<2.000
Magnesium (Dissolved)	75400	131000	89300	167000	127000	106000	122000	105000
Manganese (Dissolved)	347	277	324	456	498	339	253	205
Mercury (Dissolved)	0.2	20.9	0.39	39.4	9.3	12.8	3.2	3.7
Nickel (Dissolved)	24.9	16.6	4.6	46.2	16.3	11.8	6.9	4.2
Potassium (Dissolved)	10400	6810	12100	7750	15300	15200	13200	10600
Selenium (Dissolved)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Dissolved)	158000	55100	133000	24700	41300	59300	59700	65000
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	3.7	<1.600	1.1	<1.300	<1.300
Zinc (Dissolved)	<1.7	64.8	9.0	167	20.9	33.7	16.1	8.4

MW-23 Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	465	124J	180B	3,370	89.1J	641	<200	19.3B
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	21.2J	16.6J	12.0J	112J	14.5	28.8J	9.9J	9.8J
Beryllium (Dissolved)	<5.0	<5.0	<5.0	3.0J	<5.0	0.61B	<5.0	0.52B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Dissolved)	27,400	24,800	27,100	31,100	34,600	22,200	21,300	20,700
Chromium (Dissolved)	4.0B	3.1J	2.2B	**12.2**	**11.3**	**16.5**	<10.0	<10.0
Cobalt (Dissolved)	<50.0	1.5J	<50.0	29.9J	<50.0	4.0J	<50.0	<50.0UL
Copper (Dissolved)	<25.0	<25.0	<25.0	22.8J	1.2J	4.2J	<25.0	1.3B
Iron (Dissolved)	**2,110**	**1,640**	**483**	**47,000**	**833**	**7,470**	<100.0	<100
Lead (Dissolved)	<10.0UL	<10.0	<10.0	**31**	<10.0	5.1L	<10.0	<10.0
Magnesium (Dissolved)	17,600	17,200	17,300	17,700	16,800	15,500	14,100	13,400
Manganese (Dissolved)	**80.8**	62.4	17.3	**1,750**	**71.3**	**290**	<15.0	33.8
Mercury (Dissolved)	<0.20	0.10B	<0.20	<0.20	<0.20	<0.20	0.089B	<0.20
Nickel (Dissolved)	7.6J	7.5J	<40.0	49.5	12.0J	15.1J	1.8J	11.1J
Potassium (Dissolved)	774J	425J	<5,000	756J	<5,000	594J	161J	165J
Selenium (Dissolved)	2.4J	<35.0	<35.0	<35.0	<35.0	<35.0UL	3.0B	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	1.5B	<10.0	7.2K	<10.0	<10.0UL
Sodium (Dissolved)	2,340J	2,340B	2,270J	2,430J	2,340J	1,930J	1,800J	1,910J
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	1.6B	0.77B	<50.0	9.8J	<50.0	1.6J	<50.0	<50.0
Zinc (Dissolved)	75.2B	16.3B	9.9L	292	8.3J	51.8J	4.8J	4.7L

MW-23 Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	465	124	<32.40	3370	89.1	641	<13.60	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	21.2	16.6	12	112	14.5	28.8	9.9	9.8
Beryllium (Dissolved)	<0.860	<0.520	<1.100	3	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	27400	24800	27100	31100	34600	22200	21300	20700
Chromium (Dissolved)	<0.680	3.1	<1.500	12.2	11.3	16.5	<0.880	<0.880
Cobalt (Dissolved)	<6.700	1.5	<2.700	29.9	<2.700	4	<3.300	<3.300
Copper (Dissolved)	<4.500	<4.000	<0.740	22.8	1.2	4.2	<0.810	<0.810
Iron (Dissolved)	2110	1640	483	47000	833	7470	<38.80	<38.80
Lead (Dissolved)	<1.500	<2.000	<1.200	31	<1.200	5.1	<2.000	<2.000
Magnesium (Dissolved)	17600	17200	17300	17700	16800	15500	14100	13400
Manganese (Dissolved)	80.8	62.4	17.3	1750	71.3	290	<4.900	33.8
Mercury (Dissolved)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Dissolved)	7.6	7.5	<1.900	49.5	12	15.1	1.8	11.1
Potassium (Dissolved)	774	425	<391.0	756	<391.0	594	161	165
Selenium (Dissolved)	2.4	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	7.2	<1.500	<1.500
Sodium (Dissolved)	2340	<346.0	2270	2430	2340	1930	1800	1910
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	9.8	<1.600	1.6	<1.300	<1.300
Zinc (Dissolved)	<1.700	<1.7	9.9	292	8.3	51.8	4.8	4.7

MW-15S Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	213B	77.4J	74.6B	227	<200	29.9B	<200	<200
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	47.9J	62.9J	44.3J	51.3J	50.2J	79.2J	49.2J	48.0J
Beryllium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.42B	<5.0
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Dissolved)	87,000	93,100	87800J	100,000	106,000	99,500	95,500	91,200
Chromium (Dissolved)	**9.0J**	7.0J	7.7J	**14.4**	2.6J	6.5J	<10.0	2.4B
Cobalt (Dissolved)	<50.0	4.7J	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL
Copper (Dissolved)	<25.0	5.7J	<25.0	2.2B	1.1J	1.3J	<25.0	0.88B
Iron (Dissolved)	**353**	**297**	54.3B	**794**	62.5J	120	<100.0	<100
Lead (Dissolved)	<10.0UL	<10.0	<10.0	1.2J	<10.0	<10.0UL	<10.0	<10.0
Magnesium (Dissolved)	48,400	52,400	49,600	55,300	54,800	55,600	53,200	50,900
Manganese (Dissolved)	16.4	20.0	3.7J	36.3	5.1J	9.9J	<15.0	22.5
Mercury (Dissolved)	<0.20	0.12B	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Dissolved)	10.0J	8.5J	4.7J	9.7J	<40.0	6.6J	0.85J	3.9J
Potassium (Dissolved)	2,650J	2,490J	1,550J	1,940J	1,780J	3,470J	2,010J	1,940J
Selenium (Dissolved)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	3.4B	<35.0
Silver (Dissolved)	<10.0	1.2B	<10.0	1.3B	1.2B	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	13,000	65,400	13,700	14,000	10,400	101,000	13,200	13,200
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	1.5B	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0
Zinc (Dissolved)	23.4B	55.6L	5.6L	11.0B	5.3J	9.1J	<60.0	5.9L

MW-15S Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	<42.10	77.4	<32.40	227	<32.40	<24.40	<13.60	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	47.9	62.9	44.3	51.3	50.2	79.2	49.2	48
Beryllium (Dissolved)	<0.860	<0.520	<1.100	<1.100	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	87000	93100	87800	100000	106000	99500	95500	91200
Chromium (Dissolved)	9	7	7.7	14.4	2.6	6.5	<0.880	<0.880
Cobalt (Dissolved)	<6.700	4.7	<2.700	<2.700	<2.700	<0.970	<3.300	<3.300
Copper (Dissolved)	<4.500	5.7	<0.740	<0.740	1.1	1.3	<0.810	<0.810
Iron (Dissolved)	353	297	<19.40	794	62.5	120	<38.80	<38.80
Lead (Dissolved)	<1.500	<2.000	<1.200	1.2	<1.200	<1.900	<2.000	<2.000
Magnesium (Dissolved)	48400	52400	49600	55300	54800	55600	53200	50900
Manganese (Dissolved)	16.4	20	3.7	36.3	5.1	9.9	<4.900	22.5
Mercury (Dissolved)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Dissolved)	10	8.5	4.7	9.7	<1.900	6.6	0.85	3.9
Potassium (Dissolved)	2650	2490	1550	1940	1780	3470	2010	1940
Selenium (Dissolved)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Dissolved)	13000	65400	13700	14000	10400	101000	13200	13200
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	<1.600	<1.600	<0.810	<1.300	<1.300
Zinc (Dissolved)	<1.700	55.6	5.6	<3.600	5.3	9.1	<3.500	5.9

MW-16S Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	646	246	880	**3,770**	385	97.7B	<200	34.5B
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.0B
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	7.6J	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	49.6J	54.3J	55.5J	81.9J	47.7J	45.9J	39.0J	43.4J
Beryllium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	1.2B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Dissolved)	56,200	63,800	60,500	85,400	67,000	54,700	52,500	51,000
Chromium (Dissolved)	**26.8**	**9.6J**	**60.1**	**264**	**60.7**	13.9	<10.0	2.1B
Cobalt (Dissolved)	<50.0	1.6J	2.7J	11.7J	<50.0	<50.0	3.5B	<50.0UL
Copper (Dissolved)	6.2J	<25.0	8.1J	52.0	8.5J	2.3J	<25.0	1.9B
Iron (Dissolved)	**2,220**	**1,490**	**3,190**	**22,900**	**2,660**	**561**	<100.0	**<100**
Lead (Dissolved)	<10.0UL	<10.0	2.2J	**20.9**	1.9J	<10.0UL	<10.0	3.0J
Magnesium (Dissolved)	35,200	39,500	38,700	49,000	38,300	36,500	31,200	30,300
Manganese (Dissolved)	48.5	56.2	**145**	**370**	**86.4**	12.6J	19.3	<15.0
Mercury (Dissolved)	<0.20	<0.20UL	<0.20	0.075J	0.059J	<0.20	<0.20	<0.20
Nickel (Dissolved)	25.7J	41.0	37.8J	165	47.2	11.4J	0.86J	5.6J
Potassium (Dissolved)	6,880	5,200	4,910J	8,620	5,860	6,720	6,150	6,350
Selenium (Dissolved)	2.5J	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	1.3B	<10.0	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	32,000	133,000	76,700	24,700	12,400	11,300	33,900	11,600
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	2.8B	2.0B	3.3B	17.4J	2.7J	0.98J	<50.0	<50.0
Zinc (Dissolved)	37.2B	30.3L	24.9L	262	31.1J	16.7J	7.1J	6.8L

MW-16S Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	646	246	880	3770	385	<24.40	<13.60	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.60	<2.60	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	7.6	<4.40	<2.400	<3.500	<3.500
Barium (Dissolved)	49.6	54.3	55.5	81.9	47.7	45.9	39	43.4
Beryllium (Dissolved)	<0.860	<0.520	<1.100	<1.10	<1.10	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.30	<1.30	<0.300	<0.700	<0.700
Calcium (Dissolved)	56200	63800	60500	85400	67000	54700	52500	51000
Chromium (Dissolved)	26.8	9.6	60.1	264	60.7	13.9	<0.880	<0.880
Cobalt (Dissolved)	<6.700	1.6	2.7	11.7	<2.70	<0.970	<3.300	<3.300
Copper (Dissolved)	6.2	<4.000	8.1	52	8.5	2.3	<0.810	<0.810
Iron (Dissolved)	2220	1490	3190	22900	2660	561	<38.80	<38.80
Lead (Dissolved)	<1.500	<2.000	2.2	20.9	1.9	<1.900	<2.000	3
Magnesium (Dissolved)	35200	39500	38700	49000	38300	36500	31200	30300
Manganese (Dissolved)	48.5	56.2	145	370	86.4	12.6	19.3	<4.900
Mercury (Dissolved)	<0.065	<0.065	<0.048	0.075	0.059	<0.073	<0.073	<0.073
Nickel (Dissolved)	25.7	41	37.8	165	47.2	11.4	0.86	5.6
Potassium (Dissolved)	6880	5200	4910	8620	5860	6720	6150	6350
Selenium (Dissolved)	2.5	<5.400	<5.200	<5.20	<5.20	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.73	<0.73	<6.700	<1.500	<1.500
Sodium (Dissolved)	32000	133000	76700	24700	12400	11300	33900	11600
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.30	<3.30	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	17.4	2.7	0.98	<1.300	<1.300
Zinc (Dissolved)	<1.700	30.3	24.9	262	31.1	16.7	7.1	6.8

MW-17S Dissolved Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	297B	182J	299	326	<200	244	20.2B	53.6B
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	8.3B
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	7.1J	33.7J	15.1J	15.2J	17.7J	8.3J	11.0J	10.0J
Beryllium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.97B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Dissolved)	10,700	31,200	17,300	15,600	16,900	9,900	13,600	11,300
Chromium (Dissolved)	3.4B	7.2J	2.6B	12.1	1.6J	10.2	<10.0	0.89B
Cobalt (Dissolved)	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL
Copper (Dissolved)	<25.0	<25.0	1.4B	3.6B	<25.0	6.8J	<25.0	2.7B
Iron (Dissolved)	**700**	**812**	**843**	**1,190**	**147**	**594**	<100.0	<100
Lead (Dissolved)	<10.0UL	<10.0	<10.0	2.1J	<10.0	<10.0UL	<10.0	<10.0
Magnesium (Dissolved)	1,480J	10,600	3,930J	2,770J	3,490J	1,460J	2,380J	1,710J
Manganese (Dissolved)	**124**	64.2	**92.9**	41.6	**120**	29.0	57.5	33.0
Mercury (Dissolved)	<0.20	<0.20UL	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Dissolved)	<40.0	6.1J	2.6B	10.1J	<40.0	7.1J	<40.0	2.0B
Potassium (Dissolved)	1,510J	5,090	2,880J	2,700J	2,970J	1,030J	2,490J	1,800J
Selenium (Dissolved)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	1.7B	<10.0	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	136,000	770,000	449,000	343,000	403,000	56,200	346,000	284,000
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	1.2B	1.2B	<50.0	<50.0	<50.0	1.9J	<50.0	<50.0
Zinc (Dissolved)	22.1B	17.1B	9.8L	17.3B	3.9J	18.0J	<60.0	<60.0UL

MW-17S Dissolved Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	<42.10	182	299	326	<32.40	244	<13.60	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	7.1	33.7	15.1	15.2	17.7	8.3	11	10
Beryllium (Dissolved)	<0.860	<0.520	<1.100	<1.100	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	10700	31200	17300	15600	16900	9900	13600	11300
Chromium (Dissolved)	<0.680	7.2	<1.500	12.1	1.6	10.2	<0.880	<0.880
Cobalt (Dissolved)	<6.700	<0.980	<2.700	<2.700	<2.700	<0.970	<3.300	<3.300
Copper (Dissolved)	<4.500	<4.000	<0.740	<0.740	<0.740	6.8	<0.810	<0.810
Iron (Dissolved)	700	812	843	1190	147	594	<38.80	<38.80
Lead (Dissolved)	<1.500	<2.000	<1.200	2.1	<1.200	<1.900	<2.000	<2.000
Magnesium (Dissolved)	1480	10600	3930	2770	3490	1460	2380	1710
Manganese (Dissolved)	124	64.2	92.9	41.6	120	29	57.5	33
Mercury (Dissolved)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Dissolved)	<5.900	6.1	<1.900	10.1	<1.900	7.1	<0.680	<0.680
Potassium (Dissolved)	1510	5090	2880	2700	2970	1030	2490	1800
Selenium (Dissolved)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Dissolved)	136000	770000	449000	343000	403000	56200	346000	284000
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	<1.600	<1.600	1.9	<1.300	<1.300
Zinc (Dissolved)	<1.700	<1.700	9.8	<3.600	3.9	18.0	<3.500	<3.500

MW-24 Dissolved Metals - Original data display

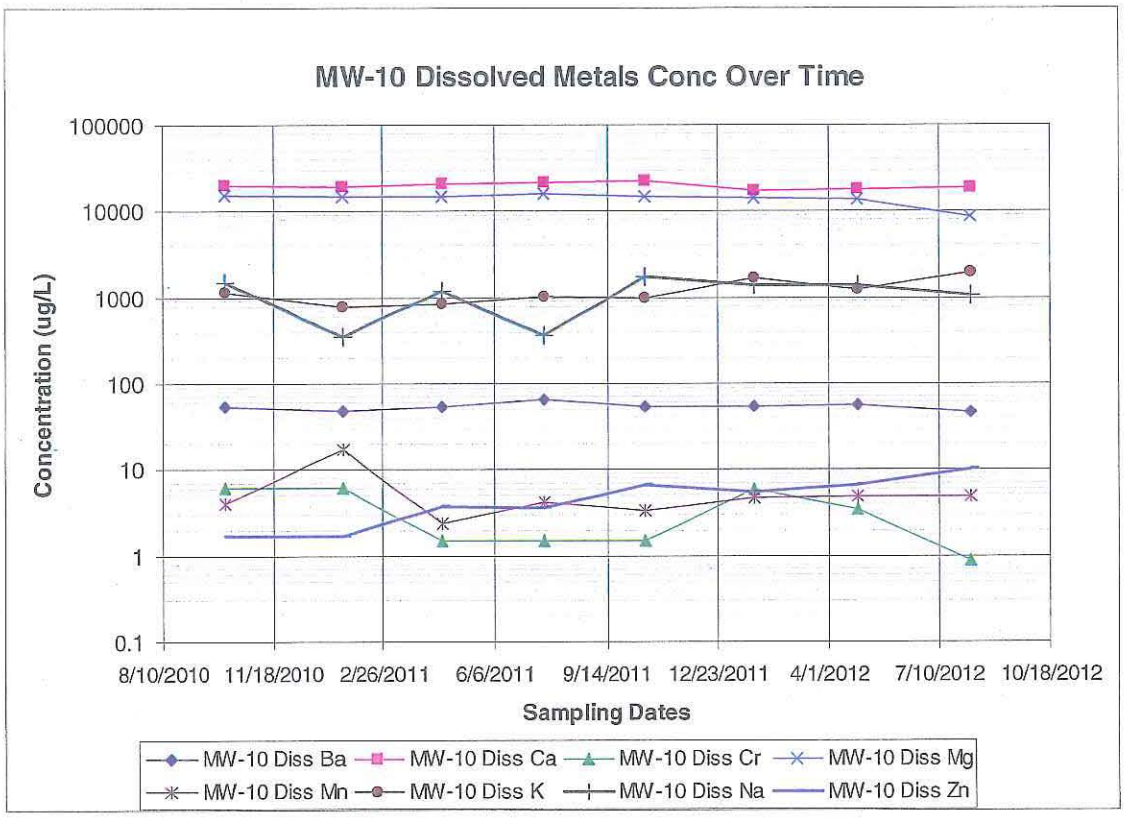
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	891	635	802	3,650	73.2	1,040	<200.0	<200
Antimony (Dissolved)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60
Arsenic (Dissolved)	<10.0	<10.0	<10.0UL	7.0J	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Dissolved)	52.5J	33.3J	32.0J	26.2J	29.1J	27.2J	18.6J	14.1J
Beryllium (Dissolved)	<5.0	0.63J	<5.0	2.5J	<5.0	0.88B	<5.0	0.82B
Cadmium (Dissolved)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.85B	<5.0UL
Calcium (Dissolved)	69,800	63,000	39,800	35,900	35,900	17,900	11,400	10,300
Chromium (Dissolved)	7.8J	<10.0	8.5J	**362**	25	32.2	<10.0	<10.0
Cobalt (Dissolved)	12.1B	8.3J	8.9J	61.9	2.9J	28.5J	4.2B	<50.0UL
Copper (Dissolved)	4.8J	<25.0	3.1B	27.5	2.2J	7.6J	<25.0	<25.0
Iron (Dissolved)	**3,740**	**3,620**	**2,920**	**17,100**	**871**	**5,760**	<100.0	<100
Lead (Dissolved)	**14.9L**	**15.1B**	**12.6**	**73.5**	2.9J	**23.3L**	<10.0	<10.0
Magnesium (Dissolved)	5,880	4,410J	2,980J	2590J	2,390J	1,500J	954J	892J
Manganese (Dissolved)	**275**	**126**	**153**	**1,130**	60.2	**580**	52.9	125
Mercury (Dissolved)	<0.20	<0.20UL	<0.20	<0.20	<0.20	0.10B	0.090B	<0.20
Nickel (Dissolved)	31.2J	7.2J	10.4J	215	17.8J	43.6	4.5J	30.3J
Potassium (Dissolved)	5,530	1,850J	1,370J	1,590J	1,140J	1,670J	642J	526J
Selenium (Dissolved)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	3.1B	<35.0
Silver (Dissolved)	<10.0	<10.0	<10.0	1.3B	<10.0	<10.0	<10.0	<10.0UL
Sodium (Dissolved)	7,790	47,600	39,500	9,650	17,200	15,500	6,950	7,370
Thallium (Dissolved)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Dissolved)	1.9B	1.1B	<50.0	5.7J	<50.0	1.9J	<50.0	<50.0
Zinc (Dissolved)	32.0B	23.0L	47.6L	147	59.8J	113	50.7J	30.6L

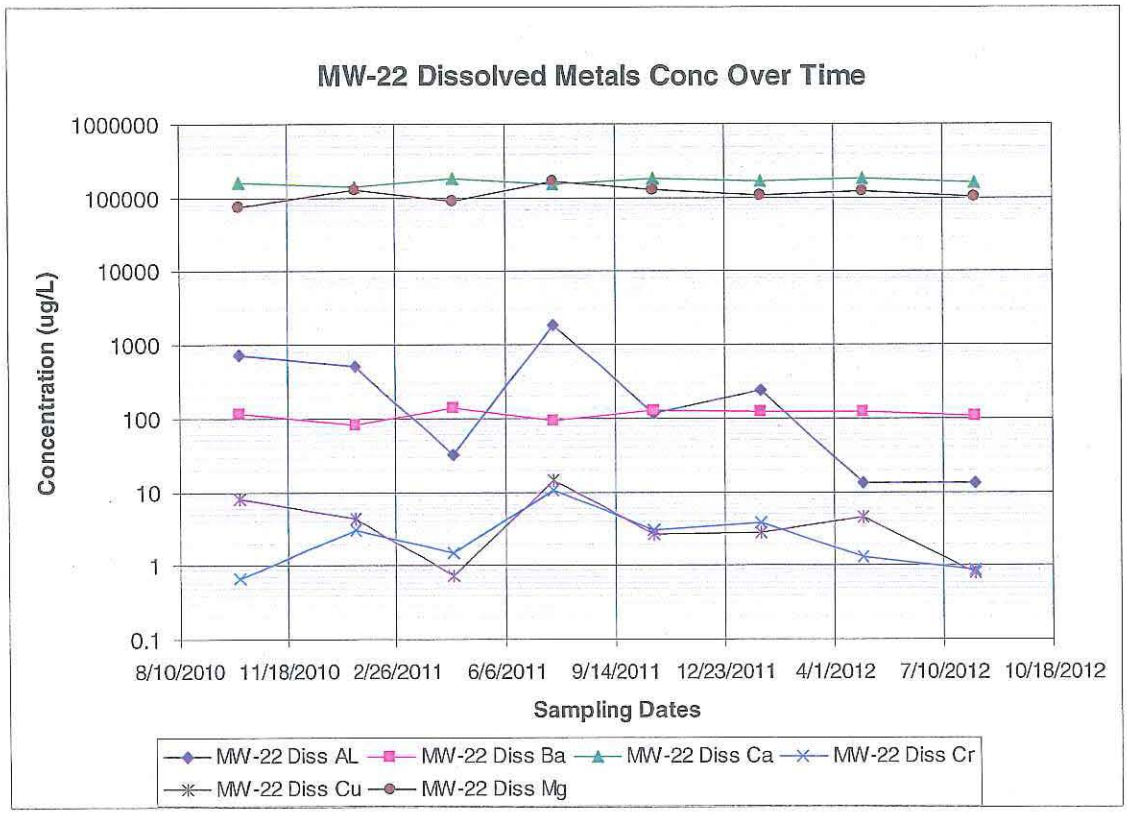
MW-24 Dissolved Metals - After Data Adjustment

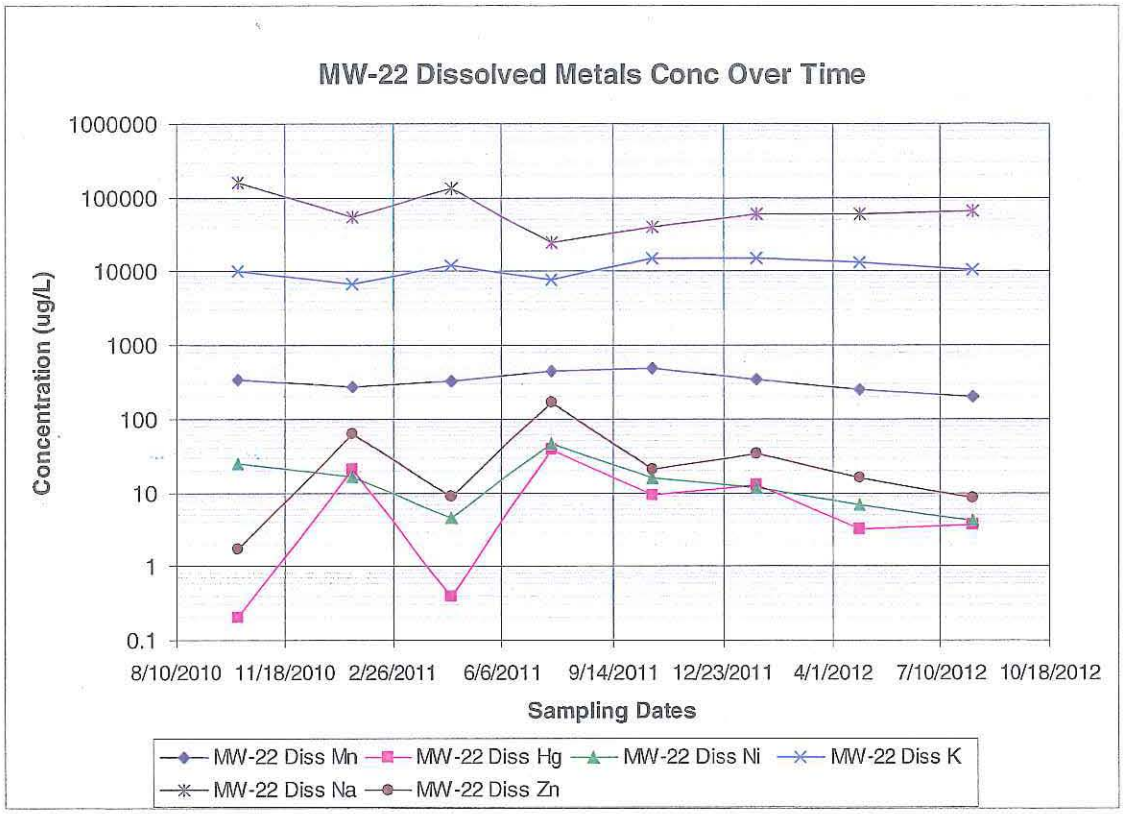
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Dissolved)	891	635	802	3650	73.2	1040	<13.60	<13.60
Antimony (Dissolved)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Dissolved)	<2.000	<2.500	<4.400	7	<4.400	<2.400	<3.500	<3.500
Barium (Dissolved)	52.5	33.3	32	26.2	29.1	27.2	18.6	14.1
Beryllium (Dissolved)	<0.860	0.63	<1.100	2.5	<1.100	<0.310	<0.260	<0.260
Cadmium (Dissolved)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Dissolved)	69800	63000	39800	35900	35900	17900	11400	10300
Chromium (Dissolved)	7.8	<3.100	8.5	362	25	32.2	<0.880	<0.880
Cobalt (Dissolved)	<6.700	8.3	8.9	61.9	2.9	28.5	<3.300	<3.300
Copper (Dissolved)	4.8	<4.000	<0.740	27.5	2.2	7.6	<0.810	<0.810
Iron (Dissolved)	3740	3620	2920	17100	871	5760	<38.80	<38.80
Lead (Dissolved)	14.9	<2.000	12.6	73.5	2.9	23.3	<2.000	<2.000
Magnesium (Dissolved)	5880	4410	2980	2590	2390	1500	954	892
Manganese (Dissolved)	275	126	153	1130	60.2	580	52.9	125
Mercury (Dissolved)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Dissolved)	31.2	7.2	10.4	215	17.8	43.6	4.5	30.3
Potassium (Dissolved)	5530	1850	1370	1590	1140	1670	642	526
Selenium (Dissolved)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Dissolved)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Dissolved)	7790	47600	39500	9650	17200	15500	6950	7370
Thallium (Dissolved)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Dissolved)	<0.430	<0.750	<1.600	5.7	<1.600	1.9	<1.300	<1.300
Zinc (Dissolved)	<1.700	23	47.6	147	59.8	113	50.7	30.6

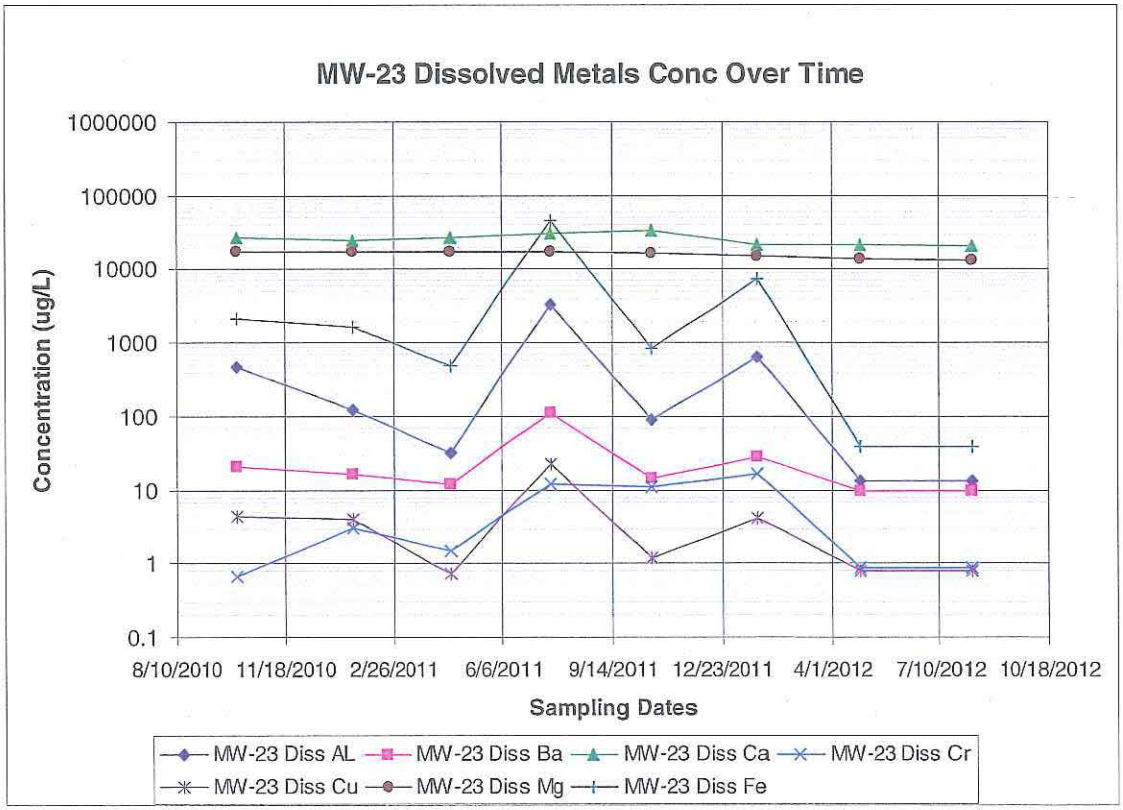
Appendix A-2

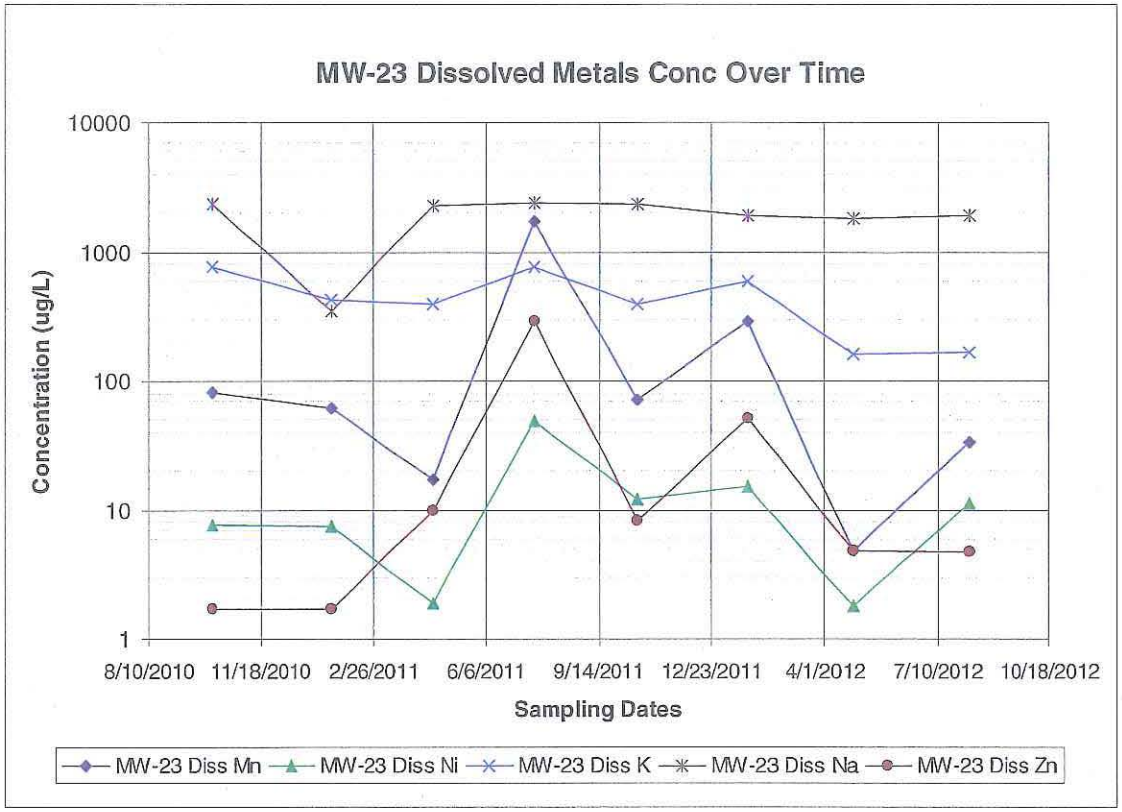
Conc vs Time Plots for Dissolved Metals

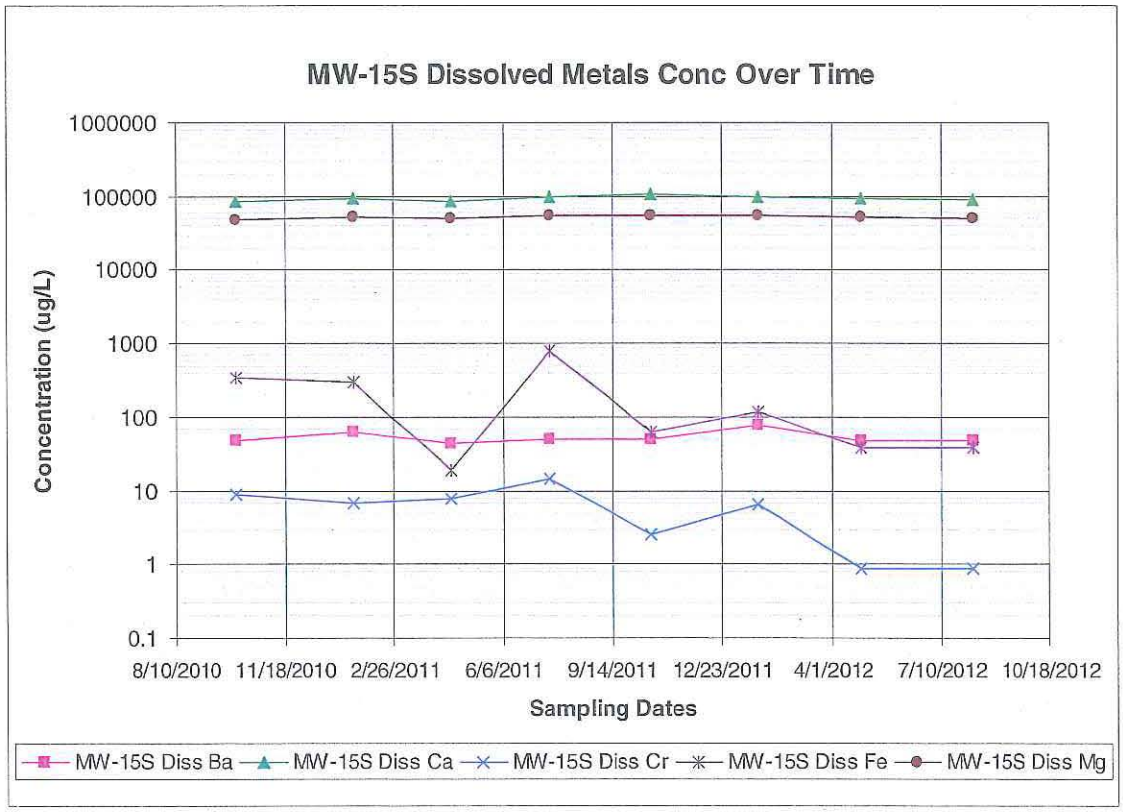

MW-10 Dissolved Metals Conc Over Time
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-10 Diss Ba
MW-10 Diss Ca
MW-10 Diss Cr
MW-10 Diss Mg
MW-10 Diss Mn
MW-10 Diss K
MW-10 Diss Na
MW-10 Diss Zn

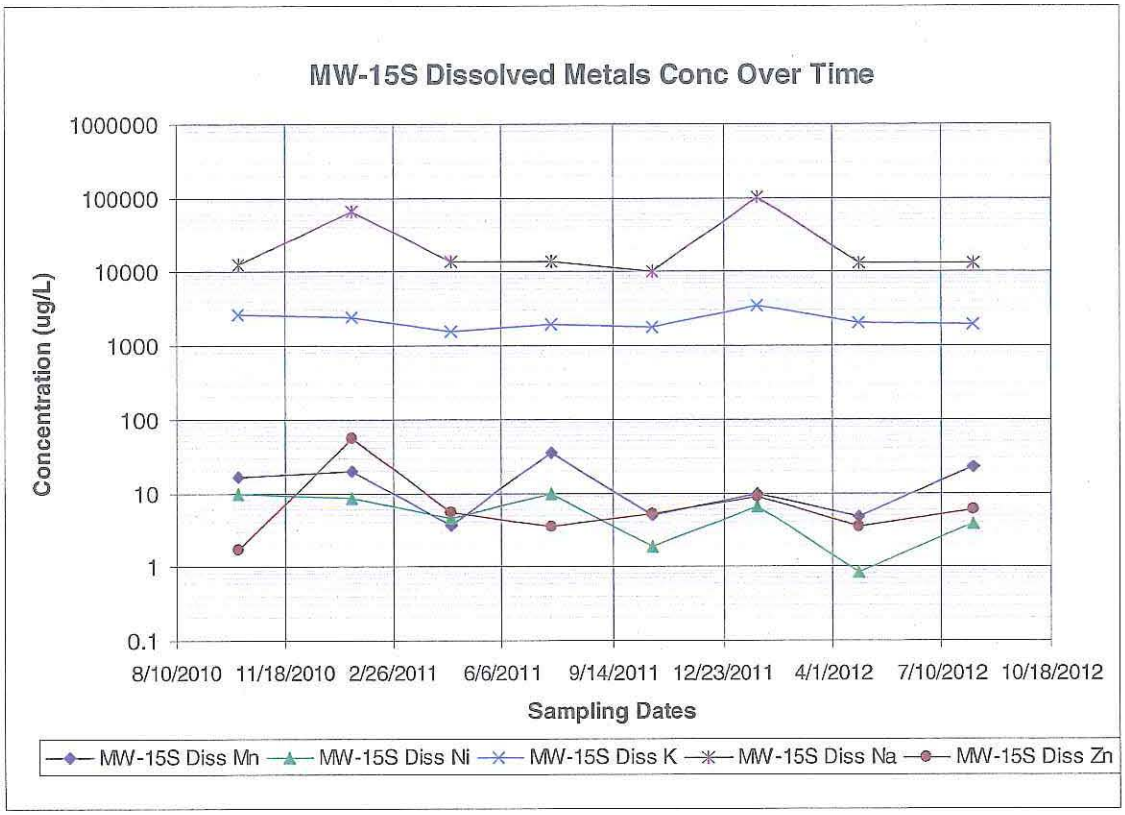

MW-22 Dissolved Metals Conc Over Time
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-22 Diss AL
MW-22 Diss Ba
MW-22 Diss Ca
MW-22 Diss Cr
MW-22 Diss Cu
MW-22 Diss Mg

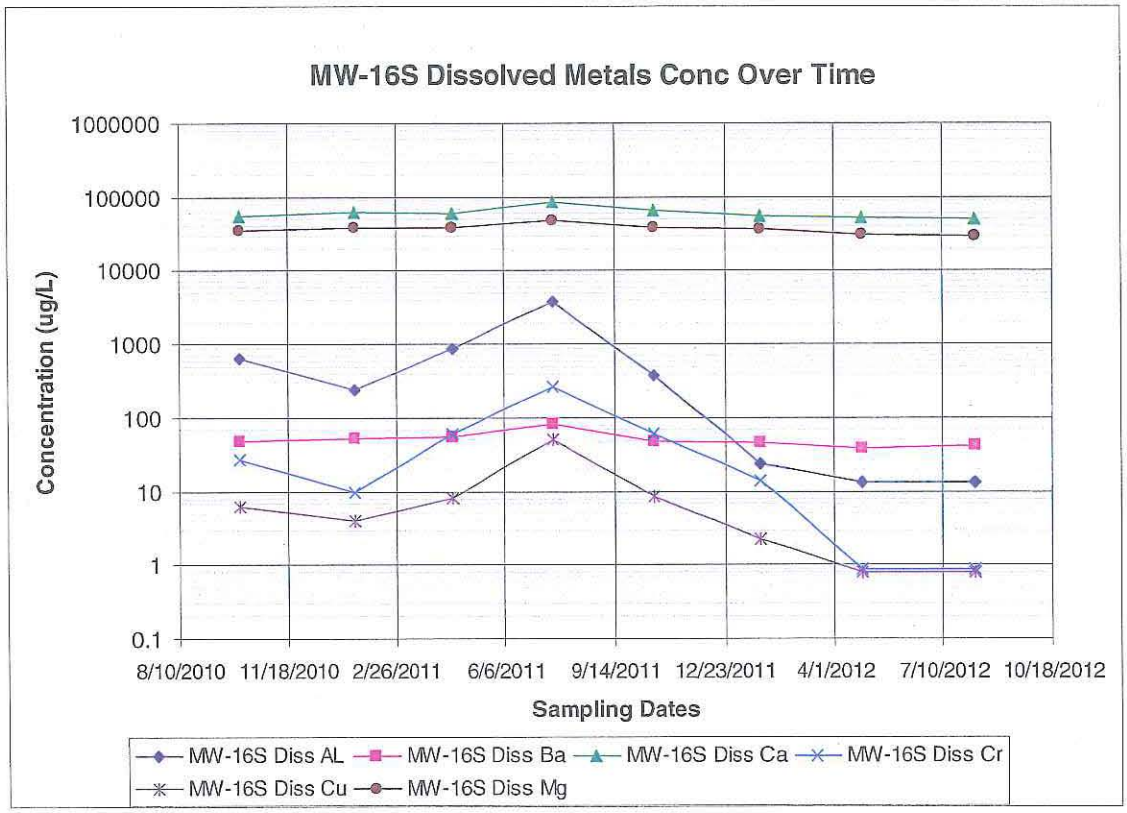

MW-22 Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-22 Diss Mn
MW-22 Diss Hg
MW-22 Diss Ni
MW-22 Diss K
MW-22 Diss Na
MW-22 Diss Zn

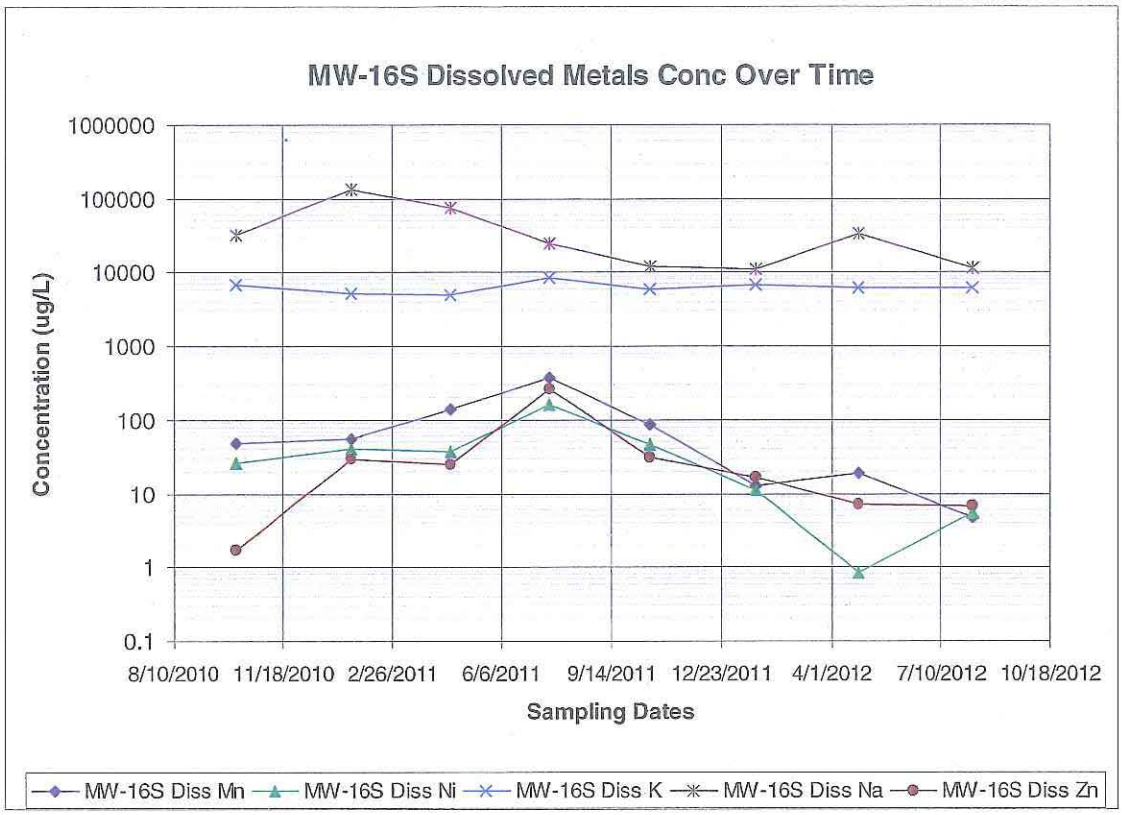

MW-23 Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-23 Diss AL
MW-23 Diss Ba
MW-23 Diss Ca
MW-23 Diss Cr
MW-23 Diss Cu
MW-23 Diss Mg
MW-23 Diss Fe

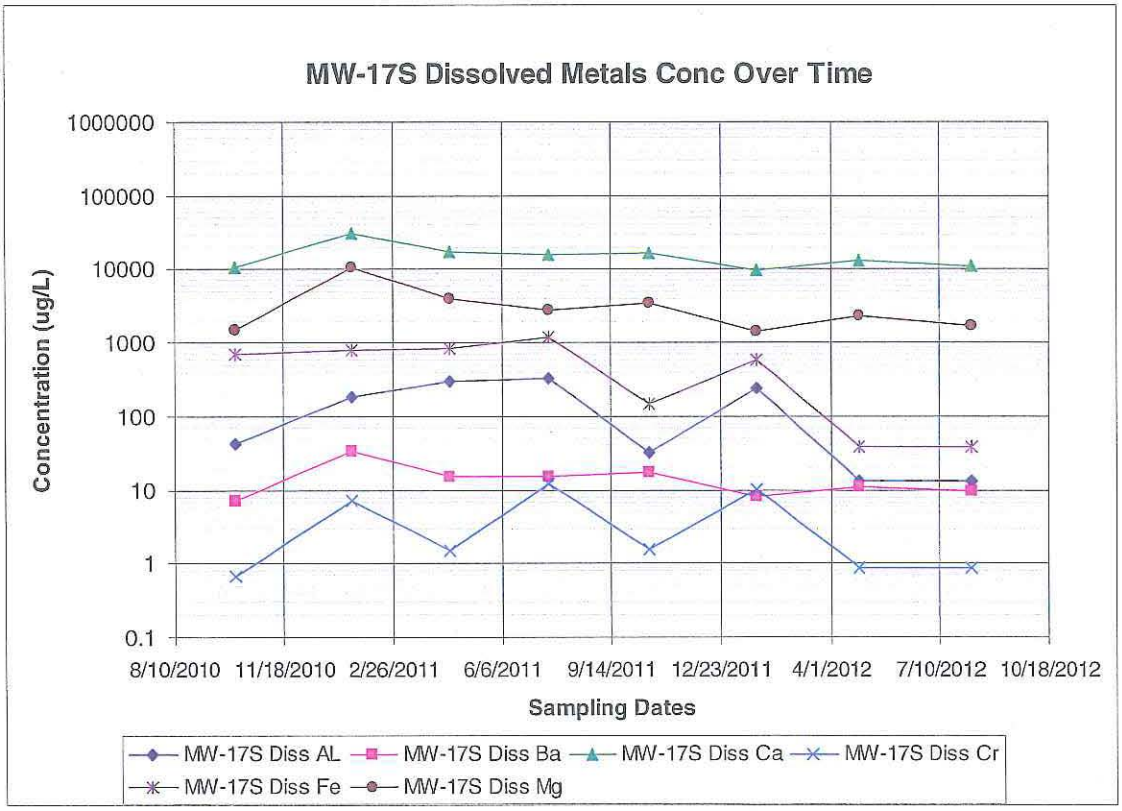

MW-23 Dissolved Metals Conc Over Time
10000
1000
100
10
1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-23 Diss Mn
MW-23 Diss Ni
MW-23 Diss K
MW-23 Diss Na
MW-23 Diss Zn

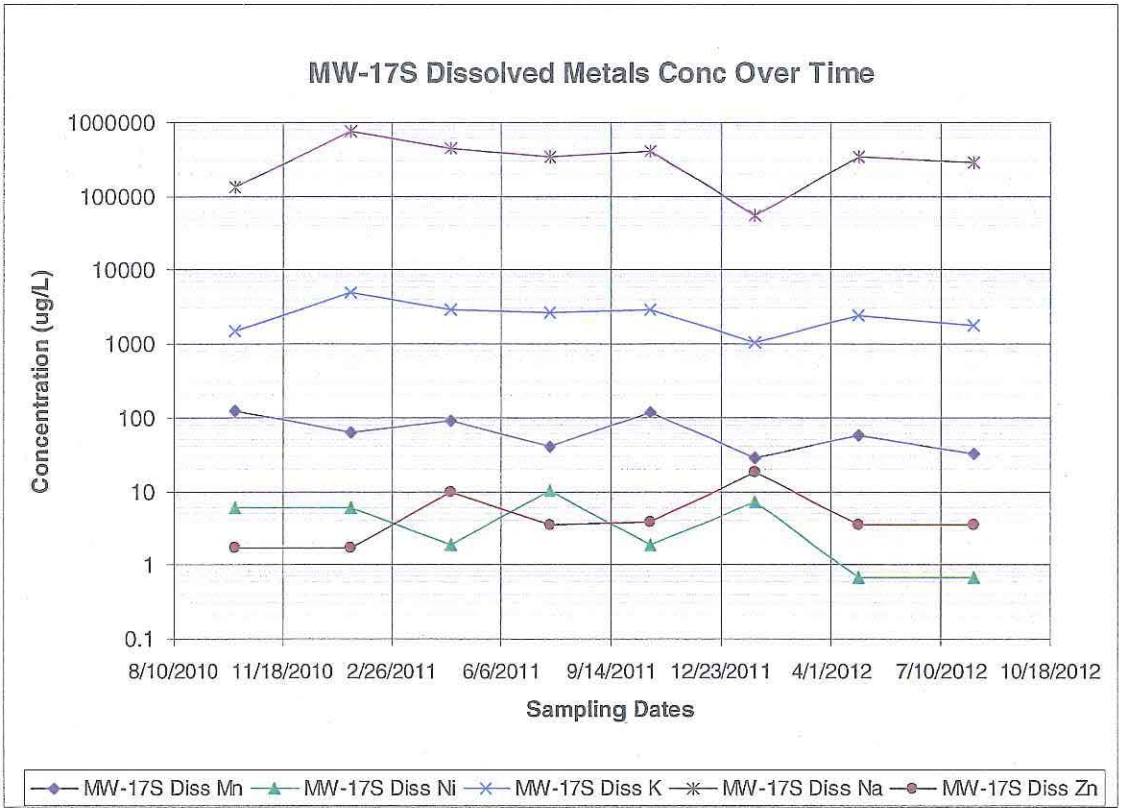

MW-15S Dissolved Metals Conc Over Time
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-15S Diss Ba
MW-15S Diss Ca
MW-15S Diss Cr
MW-15S Diss Fe
MW-15S Diss Mg

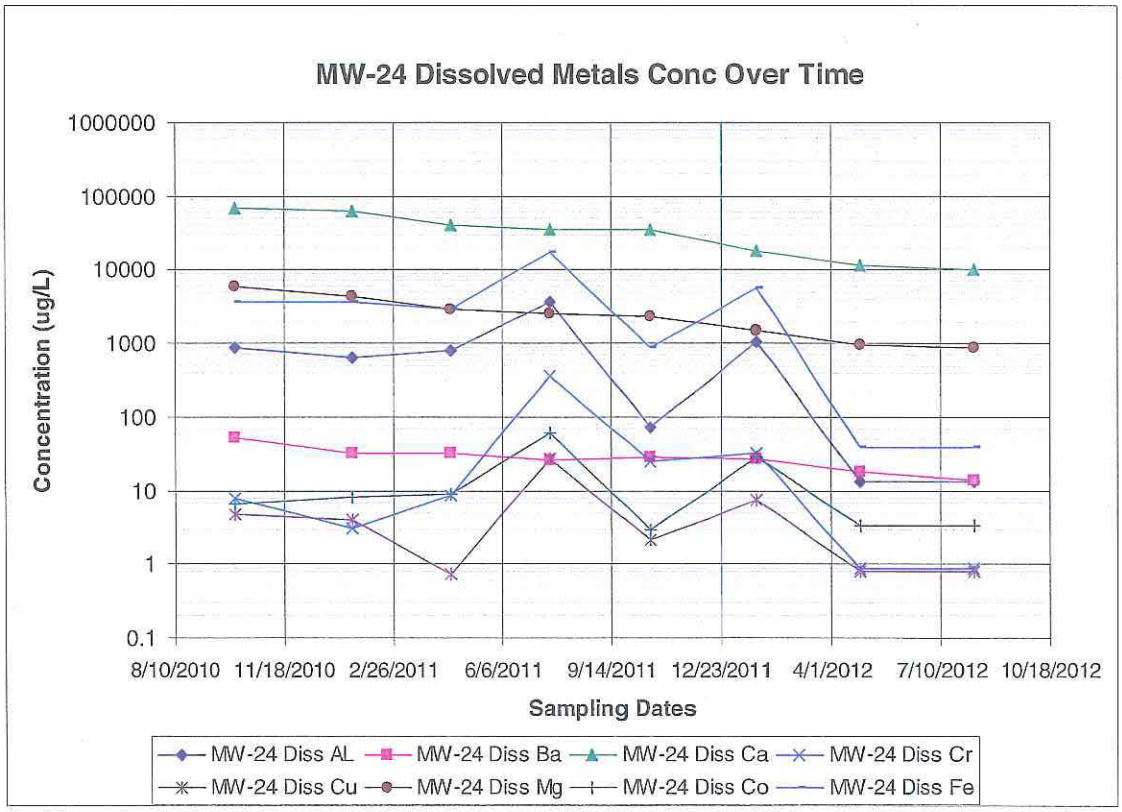

MW-15S Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-15S Diss Mn
MW-15S Diss Ni
MW-15S Diss K
MW-15S Diss Na
MW-15S Diss Zn

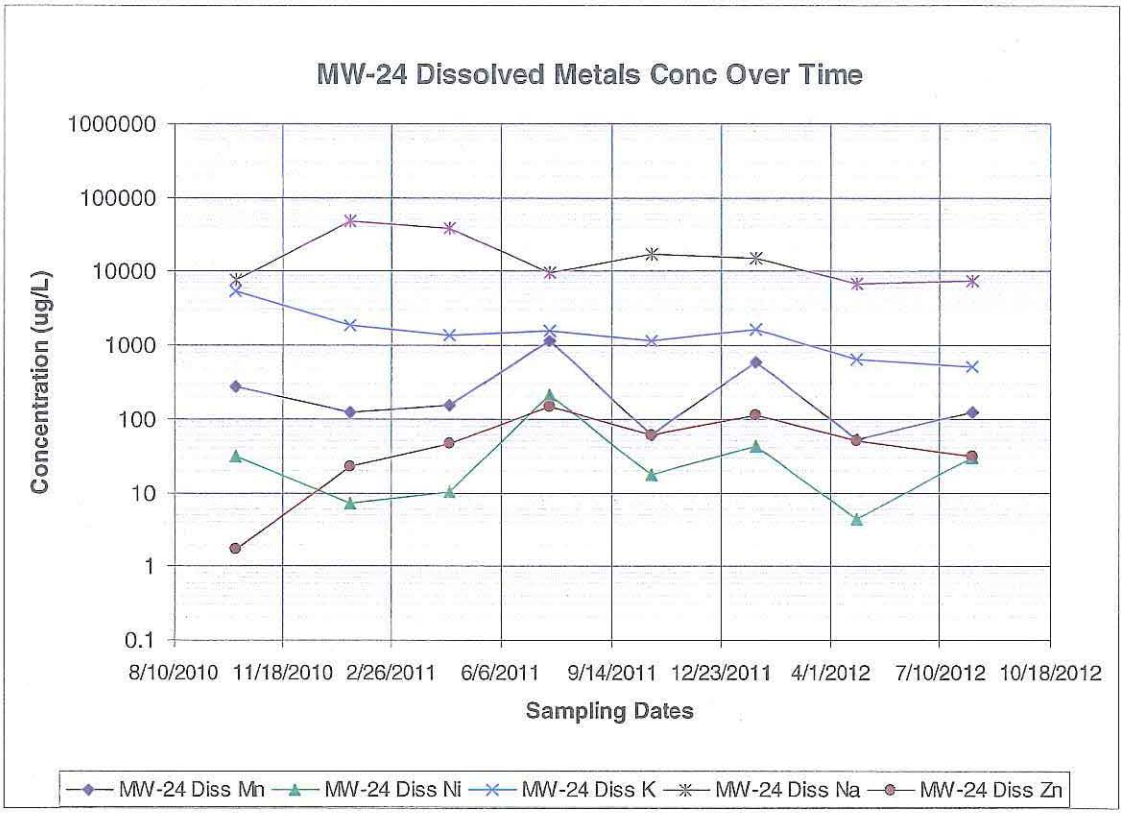

MW-16S Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-16S Diss AL
MW-16S Diss Ba
MW-16S Diss Ca
MW-16S Diss Cr
MW-16S Diss Cu
MW-16S Diss Mg


MW-16S Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-16S Diss Mn
MW-16S Diss Ni
MW-16S Diss K
MW-16S Diss Na
MW-16S Diss Zn


MW-17S Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-17S Diss AL
MW-17S Diss Ba
MW-17S Diss Ca
MW-17S Diss Cr
MW-17S Diss Fe
MW-17S Diss Mg

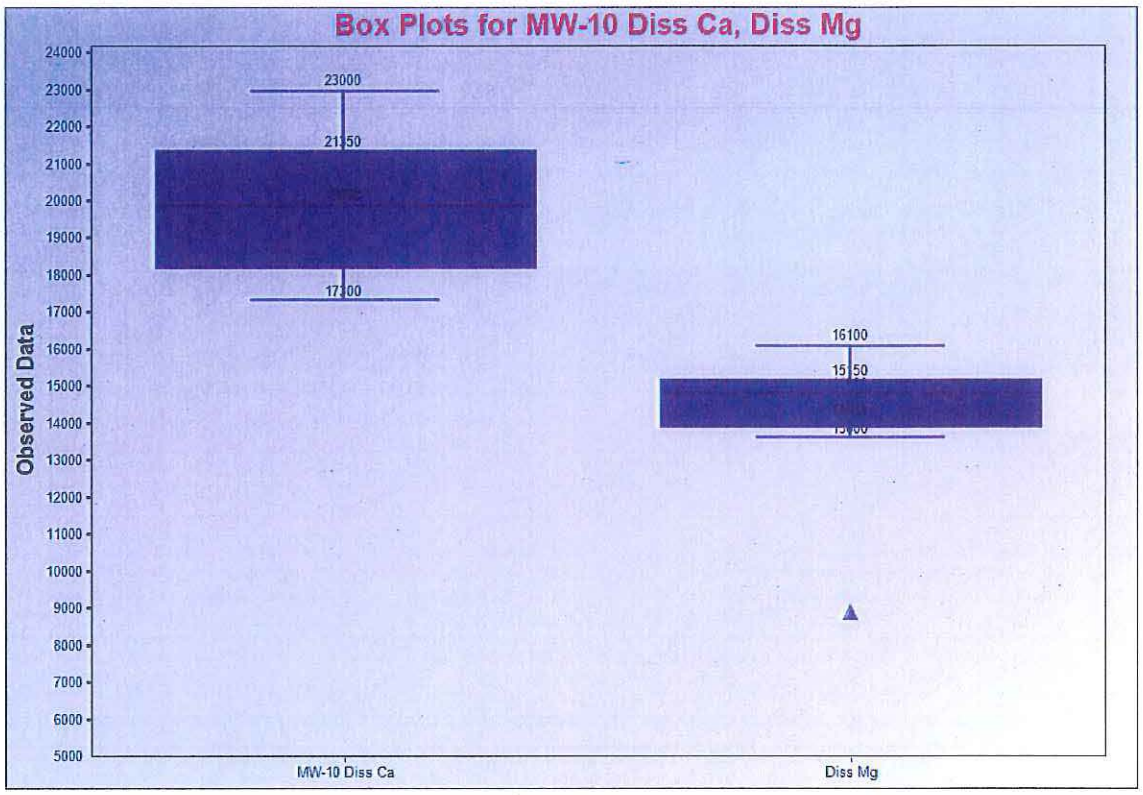

MW-17S Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-17S Diss Mn
MW-17S Diss Ni
MW-17S Diss K
MW-17S Diss Na
MW-17S Diss Zn

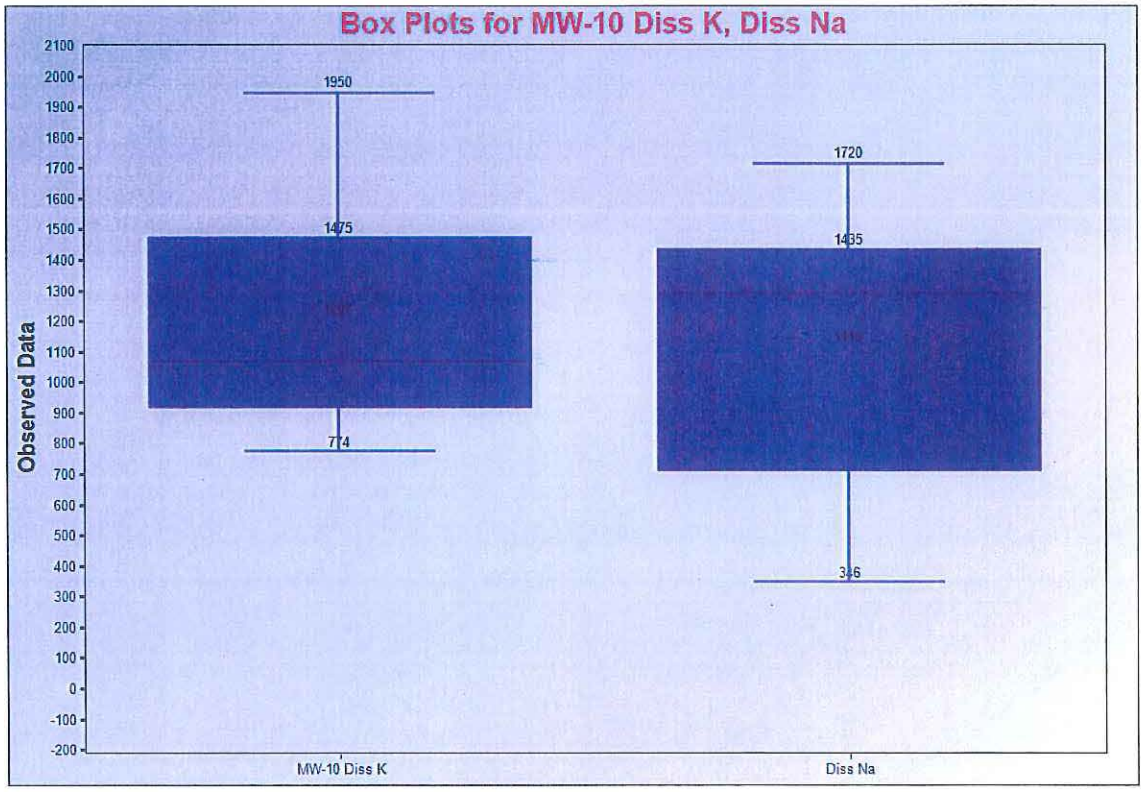

MW-24 Dissolved Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-24 Diss AL
MW-24 Diss Ba
MW-24 Diss Ca
MW-24 Diss Cr
MW-24 Diss Cu
MW-24 Diss Mg
MW-24 Diss Co
MW-24 Diss Fe

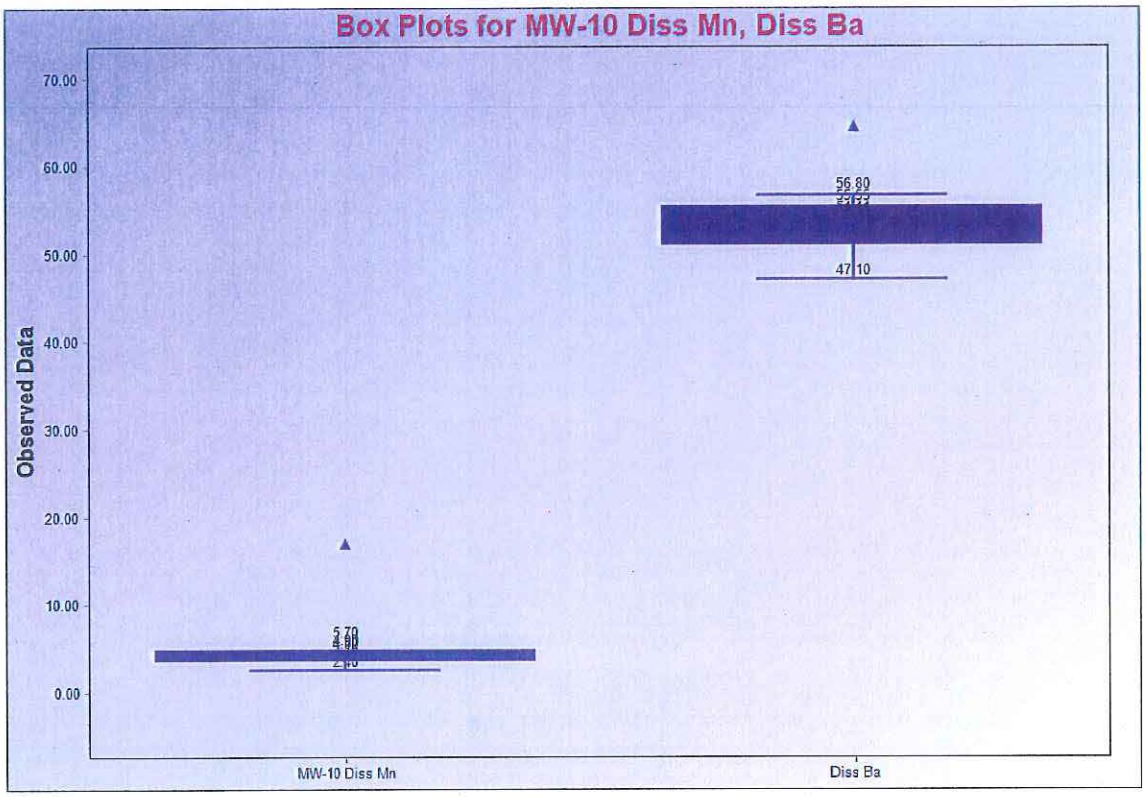

MW-24 Dissolved Metals Conc Over Time
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-24 Diss Mn
MW-24 Diss Ni
MW-24 Diss K
MW-24 Diss Na
MW-24 Diss Zn

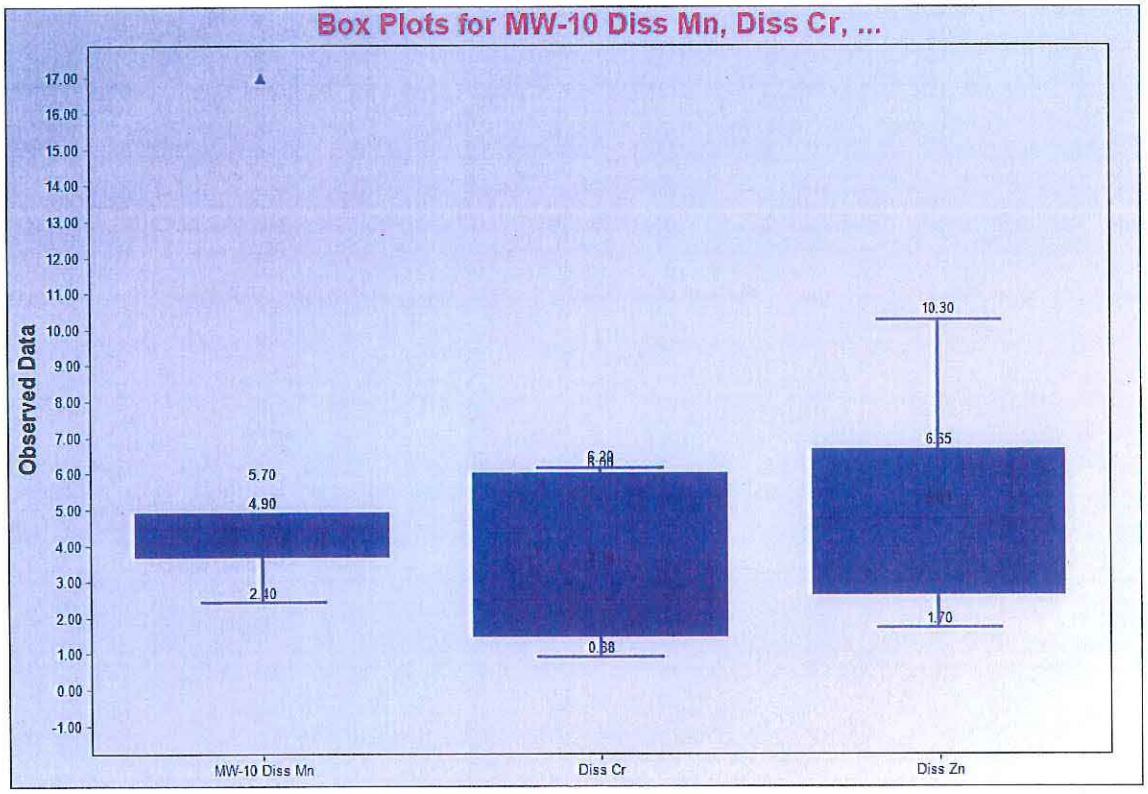
Appendix A-3

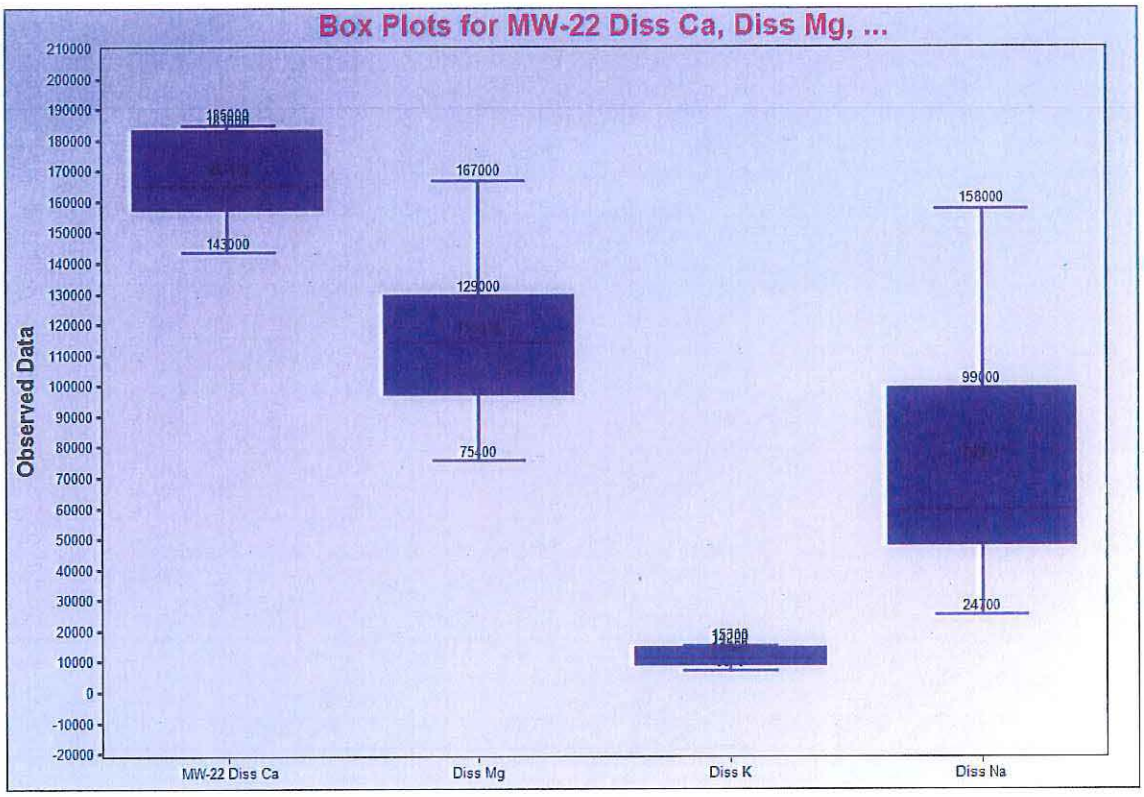
Box Plots for Dissolved Metals

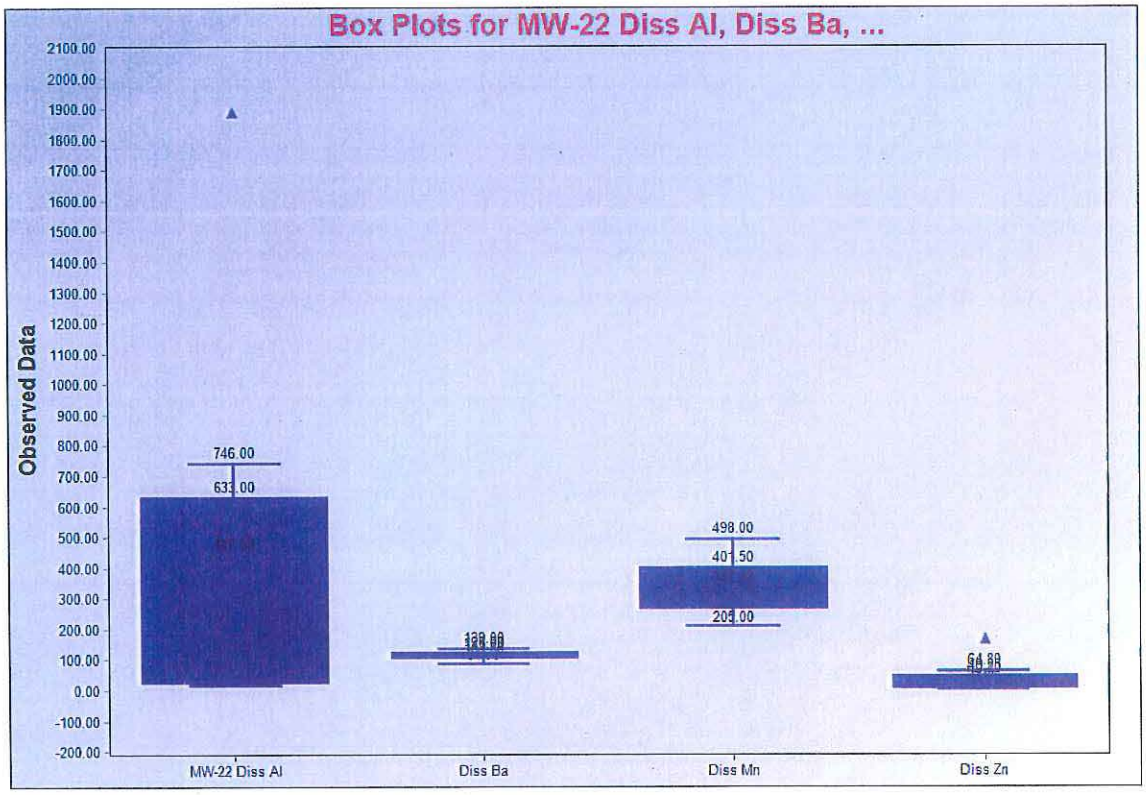

Box Plots for MW-10 Diss Ca, Diss Mg
Observed Data
24000
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
23000
21150
17300
16100
15150
MW-10 Diss Ca
Diss Mg

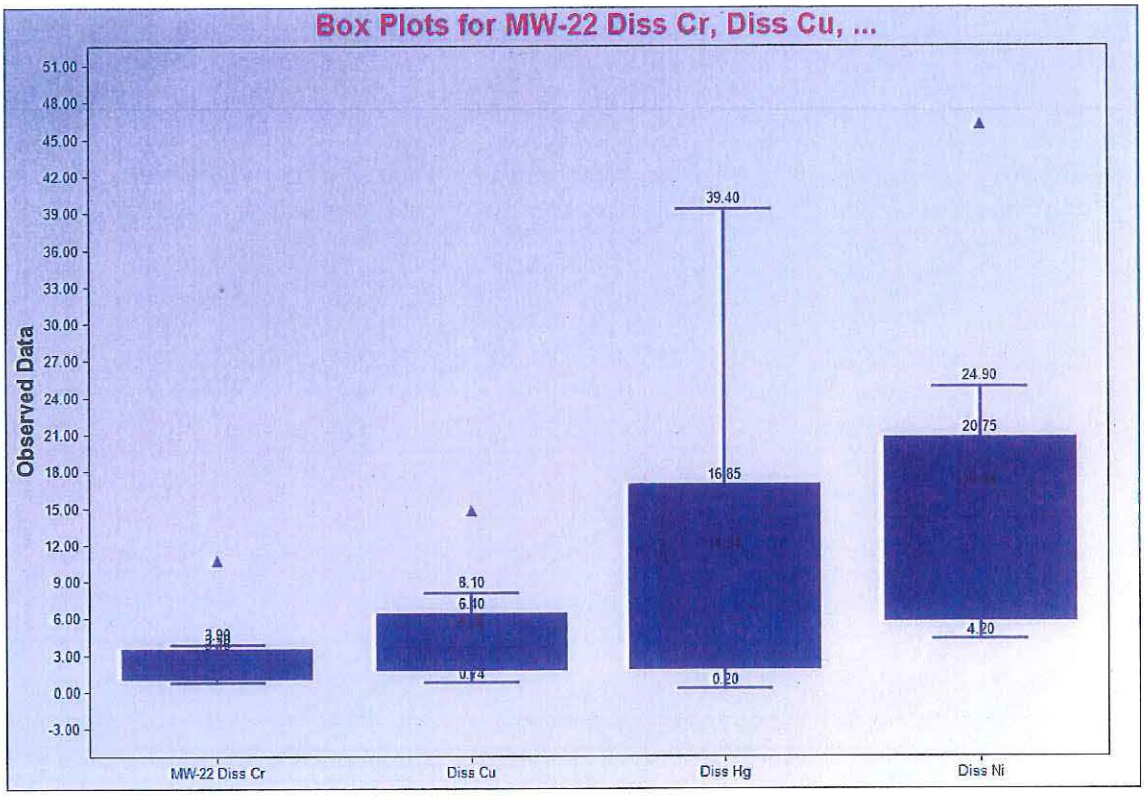

Box Plots for MW-10 Diss K, Diss Na
Observed Data
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
1950
1475
774
1720
1435
346
MW-10 Diss K
Diss Na

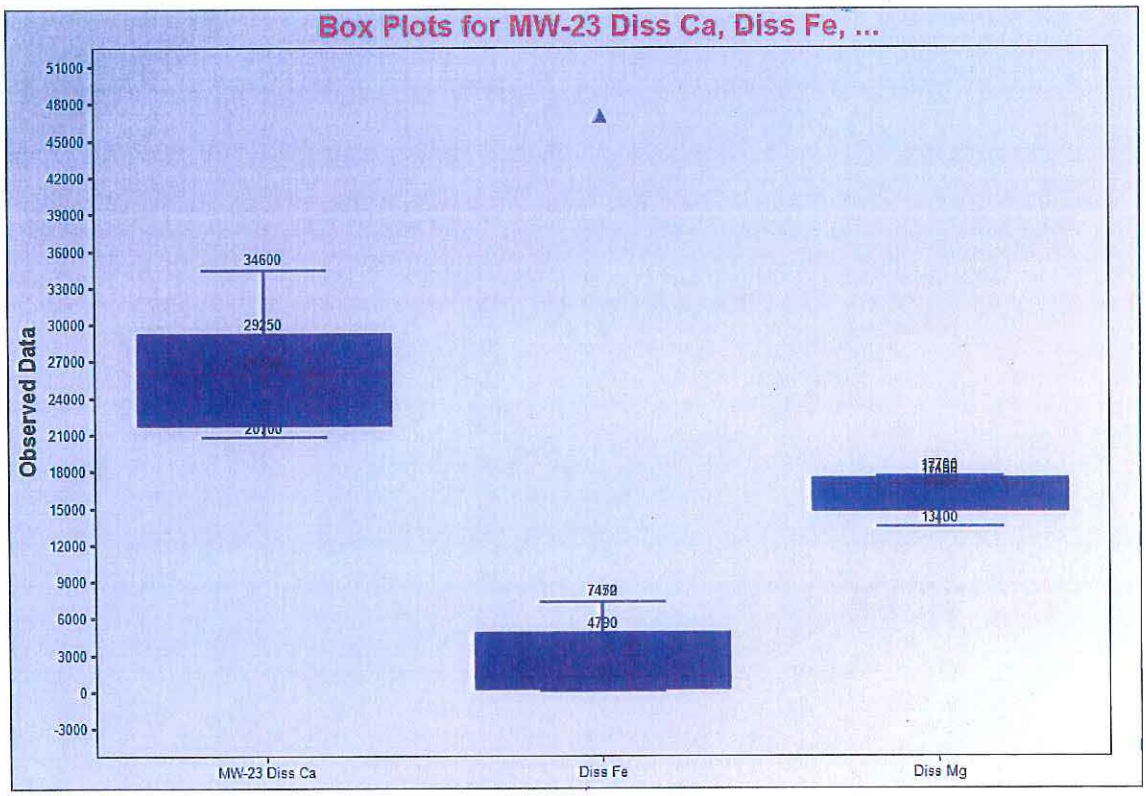

Box Plots for MW-10 Diss Mn, Diss Ba
Observed Data
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
56.80
47.10
5.70
MW-10 Diss Mn
Diss Ba

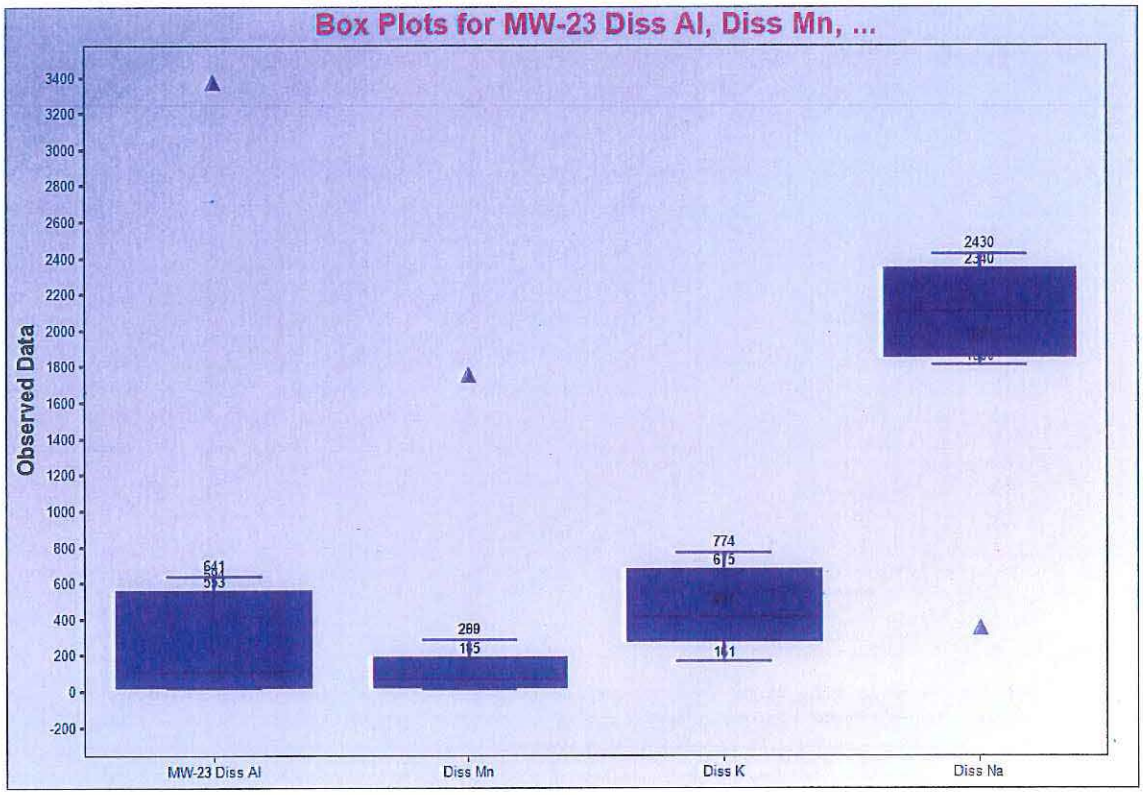

Box Plots for MW-10 Diss Mn, Diss Cr, ...
Observed Data
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
5.70
4.90
2.40
6.20
0.38
10.30
6.65
1.70
MW-10 Diss Mn
Diss Cr
Diss Zn

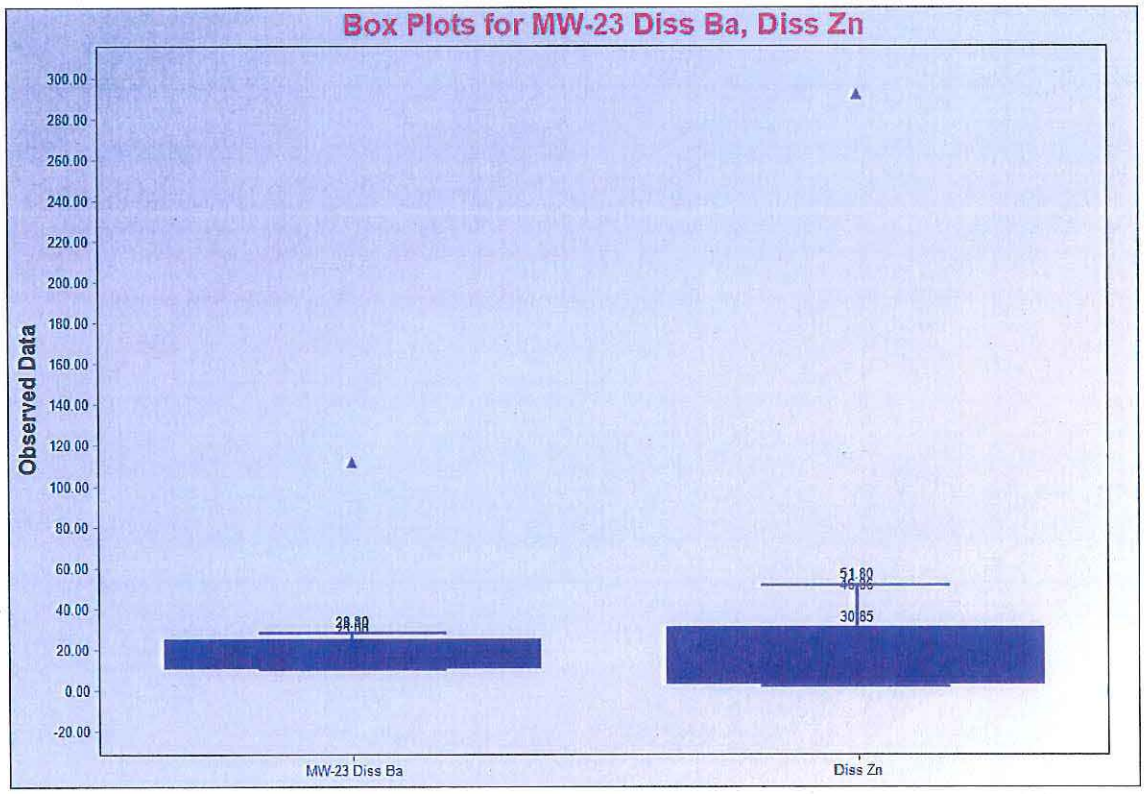

Box Plots for MW-22 Diss Ca, Diss Mg, ...
Observed Data
210000
200000
190000
180000
170000
160000
150000
140000
130000
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
-20000
143000
167000
129000
158000
99000
24700
MW-22 Diss Ca
Diss Mg
Diss K
Diss Na

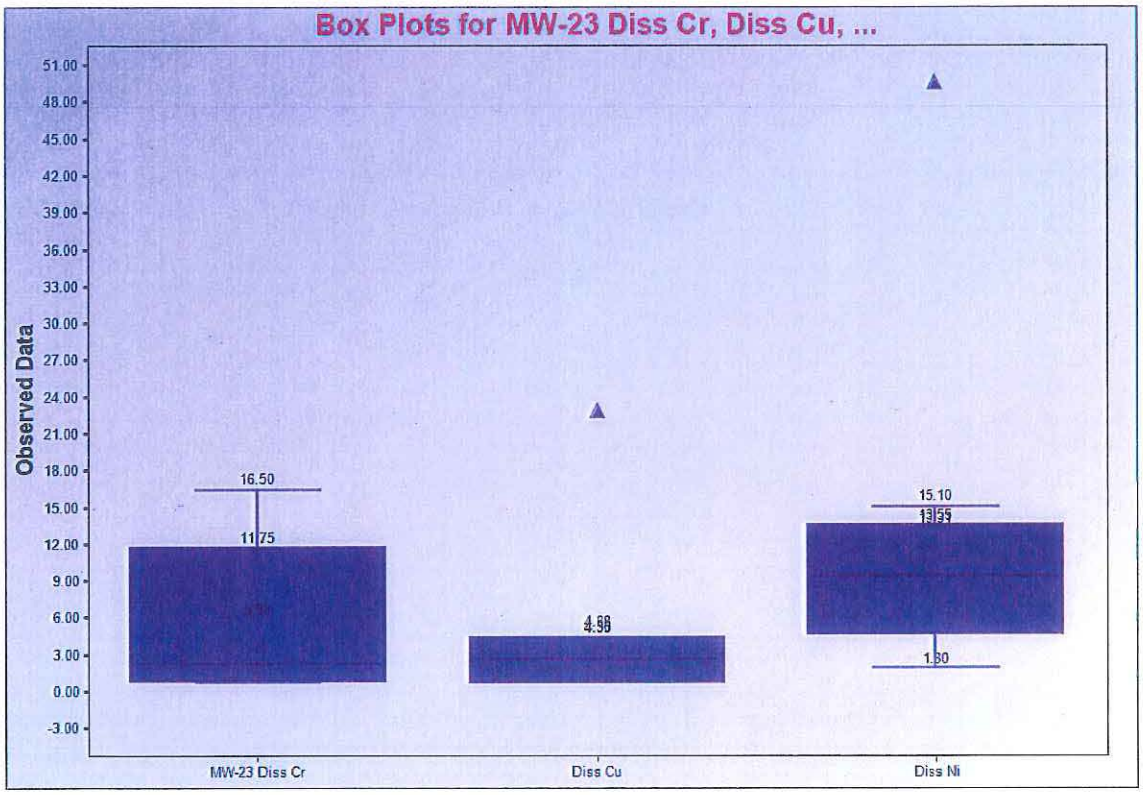

Box Plots for MW-22 Diss Al, Diss Ba, ...
Observed Data
2100.00
2000.00
1900.00
1800.00
1700.00
1600.00
1500.00
1400.00
1300.00
1200.00
1100.00
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
746.00
633.00
498.00
401.50
MW-22 Diss Al
Diss Ba
Diss Mn
Diss Zn

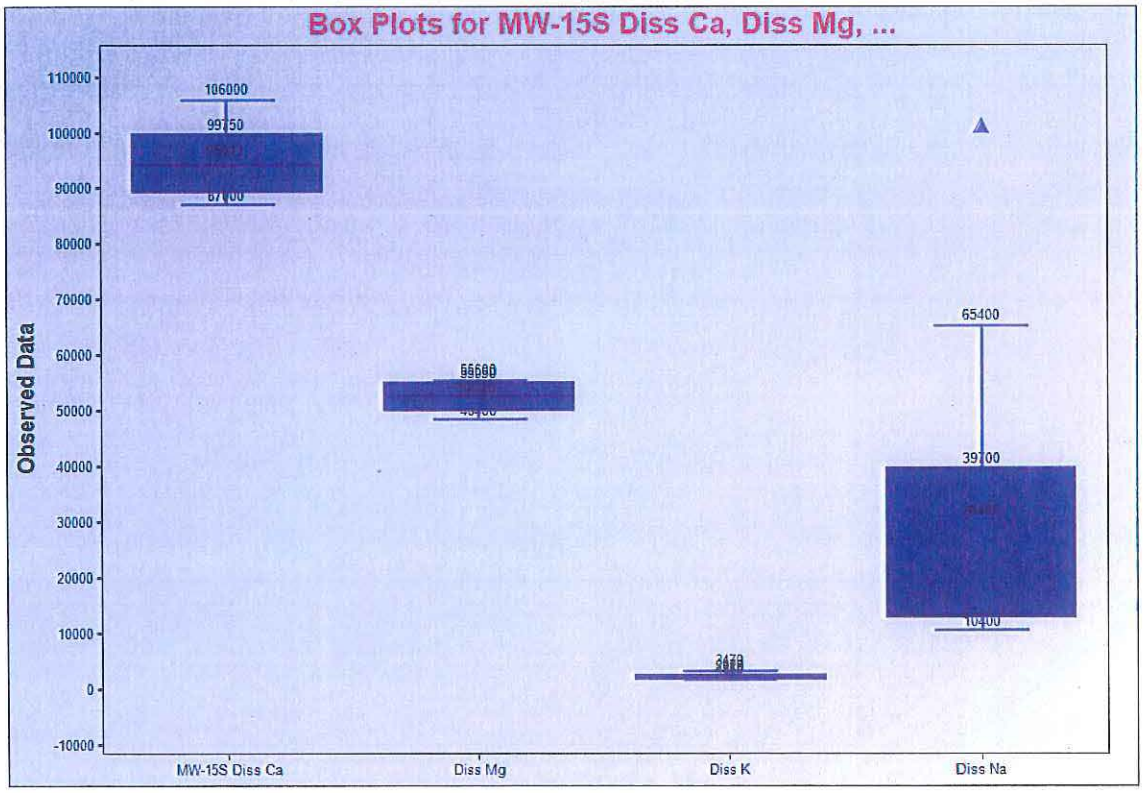

Box Plots for MW-22 Diss Cr, Diss Cu, ...
Observed Data
51.00
48.00
45.00
42.00
39.00
36.00
33.00
30.00
27.00
24.00
21.00
18.00
15.00
12.00
9.00
6.00
3.00
0.00
-3.00
39.40
24.90
20.75
16.85
8.10
6.40
4.20
0.20
MW-22 Diss Cr
Diss Cu
Diss Hg
Diss Ni

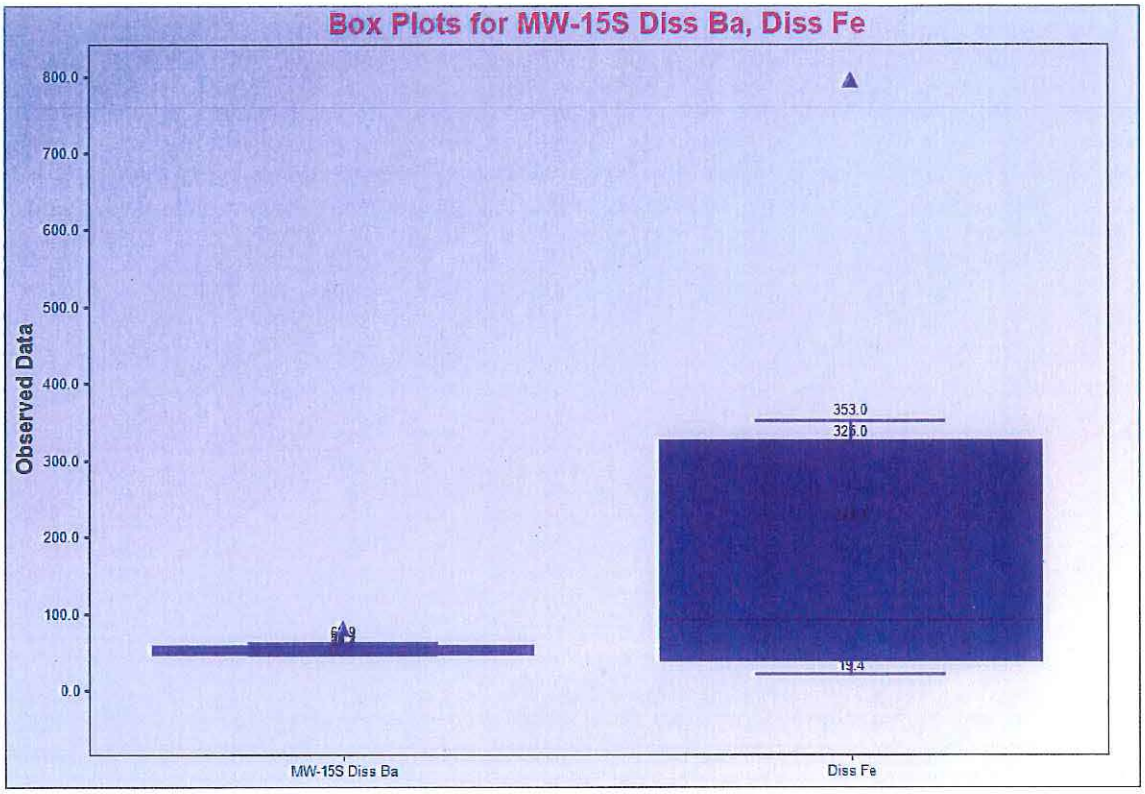

Box Plots for MW-23 Diss Ca, Diss Fe, ...
Observed Data
51000
48000
45000
42000
39000
36000
33000
30000
27000
24000
21000
18000
15000
12000
9000
6000
3000
0
-3000
34600
29150
13400
4790
MW-23 Diss Ca
Diss Fe
Diss Mg

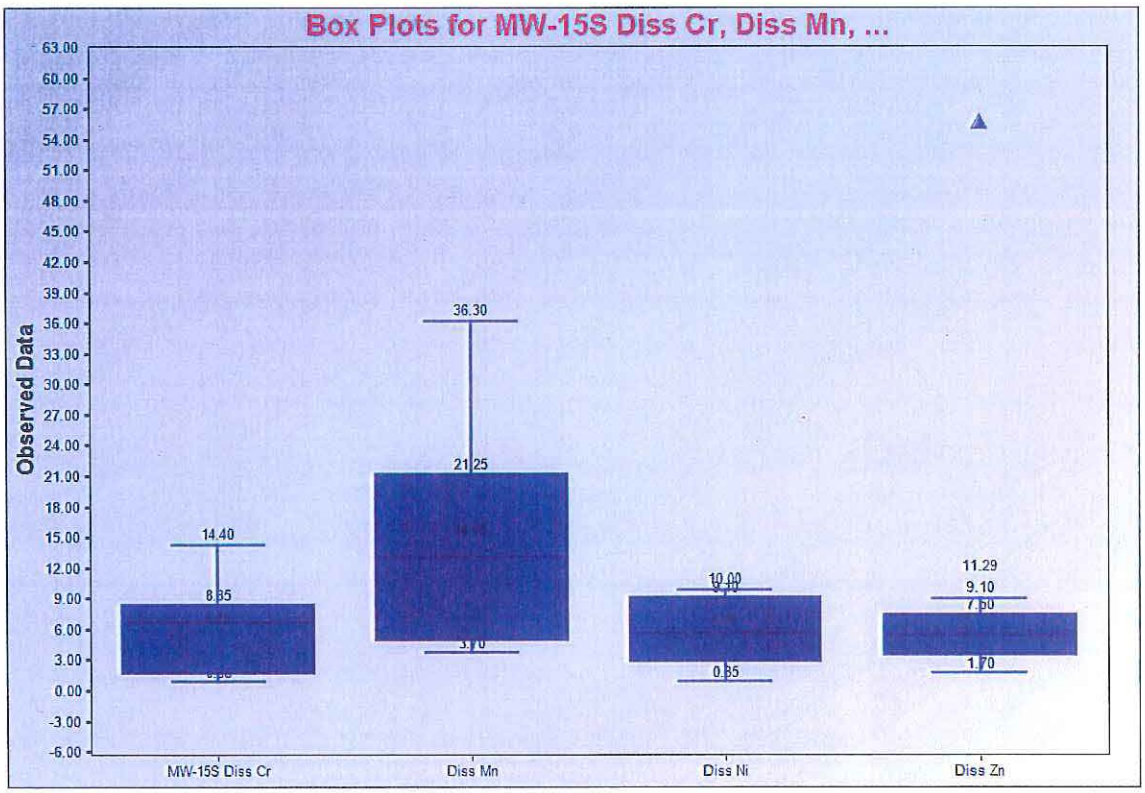

Box Plots for MW-23 Diss Al, Diss Mn, ...
Observed Data
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
2430
774
MW-23 Diss Al
Diss Mn
Diss K
Diss Na

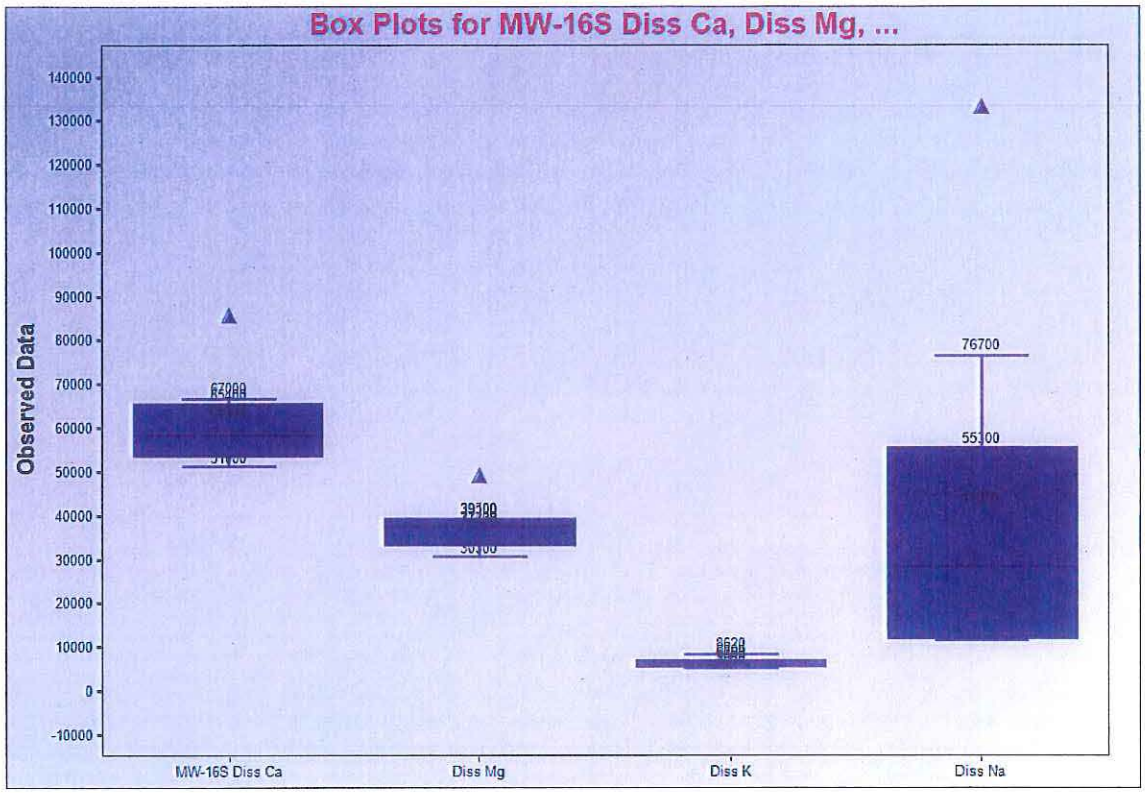

Box Plots for MW-23 Diss Ba, Diss Zn
Observed Data
300.00
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
51.80
30.85
MW-23 Diss Ba
Diss Zn

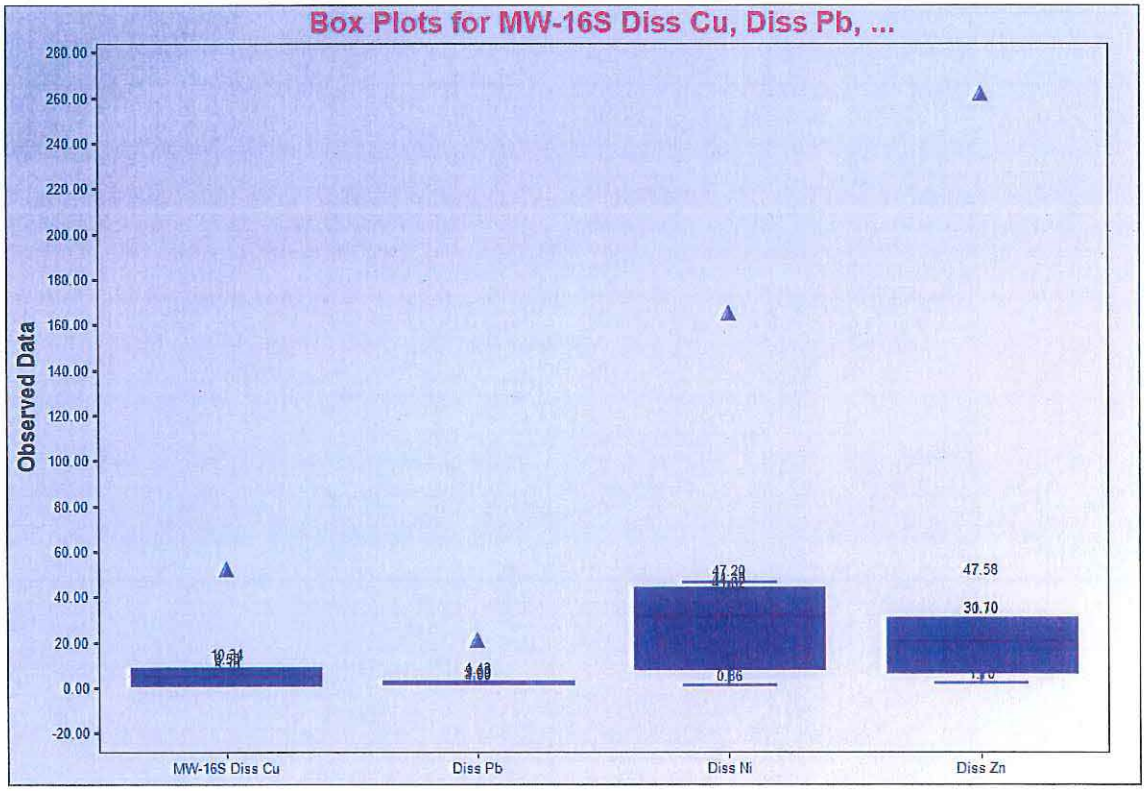

Box Plots for MW-23 Diss Cr, Diss Cu, ...
Observed Data
51.00
48.00
45.00
42.00
39.00
36.00
33.00
30.00
27.00
24.00
21.00
18.00
15.00
12.00
9.00
6.00
3.00
0.00
-3.00
16.50
11.75
15.10
1.30
MW-23 Diss Cr
Diss Cu
Diss Ni

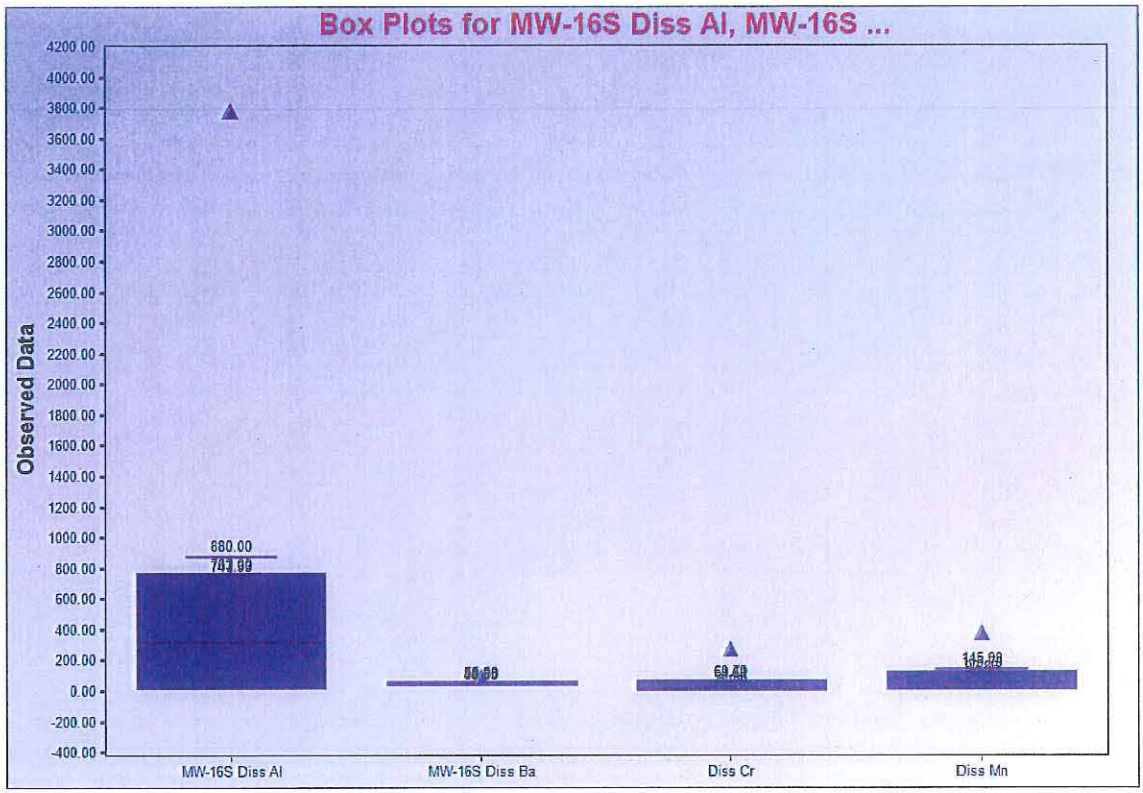

Box Plots for MW-15S Diss Ca, Diss Mg, ...
Observed Data
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
106000
99750
65400
39700
10400
MW-15S Diss Ca
Diss Mg
Diss K
Diss Na

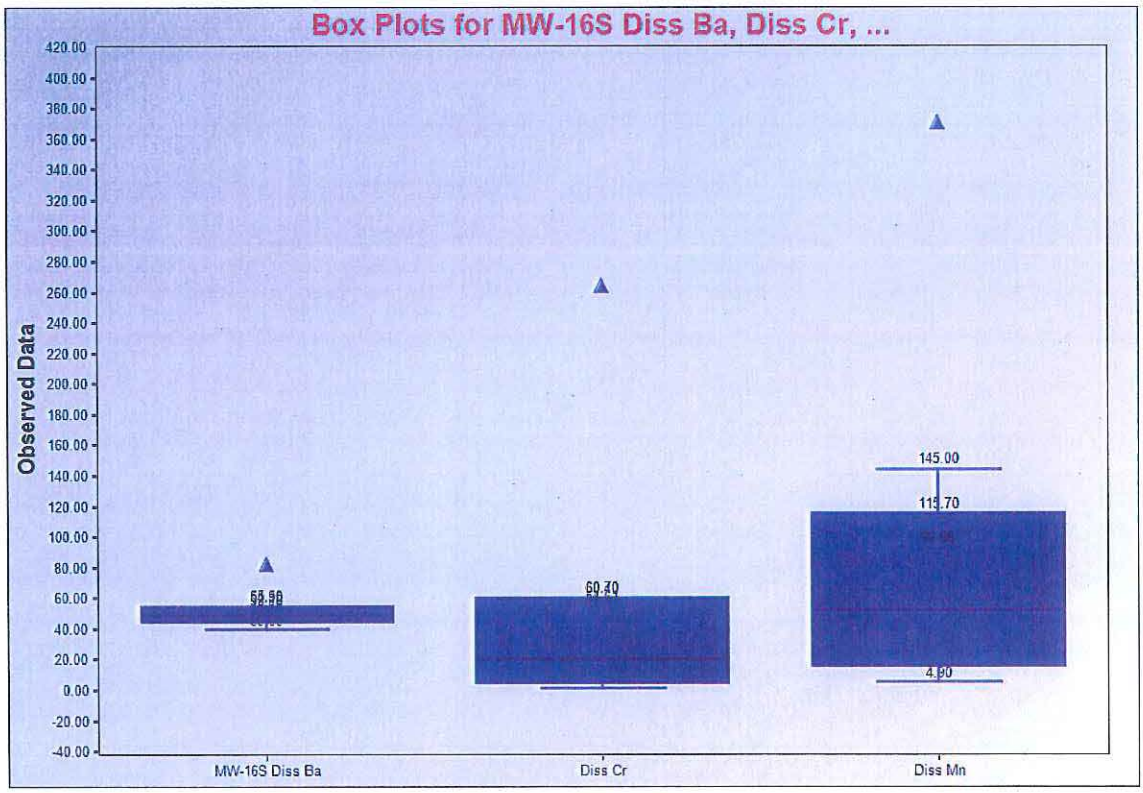

Box Plots for MW-15S Diss Ba, Diss Fe
Observed Data
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
353.0
326.0
19.4
MW-15S Diss Ba
Diss Fe

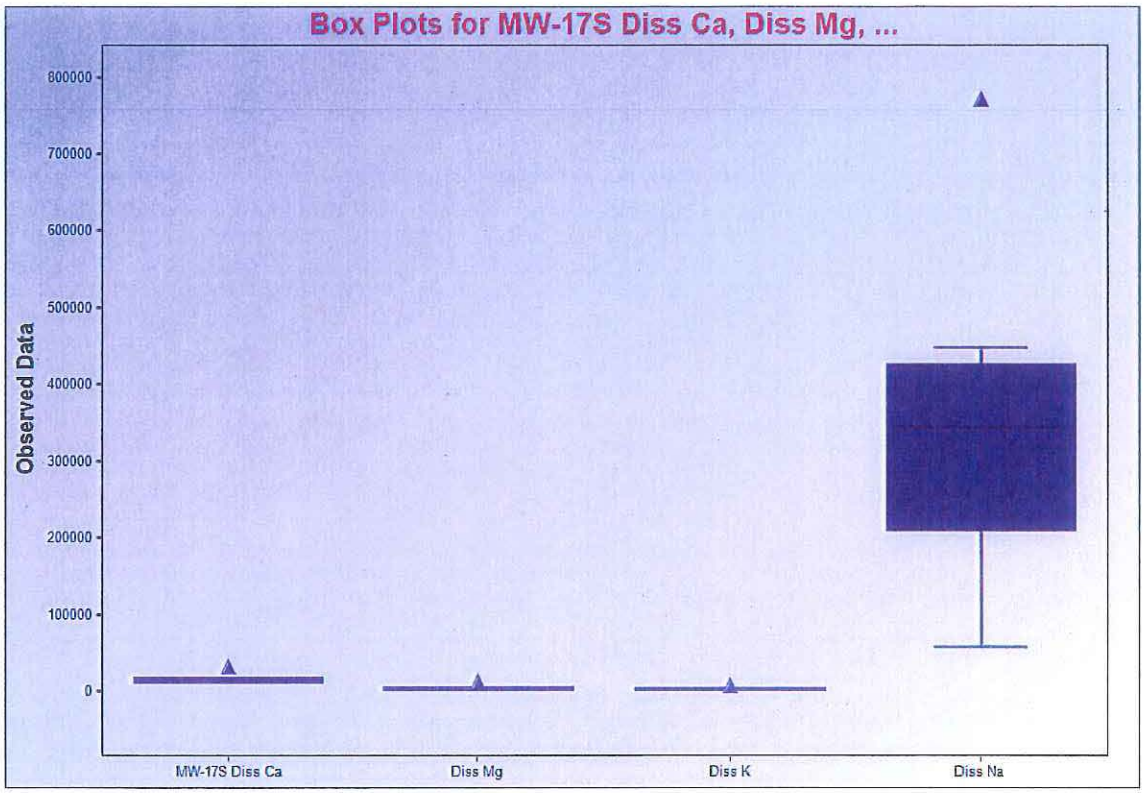

Box Plots for MW-15S Diss Cr, Diss Mn, ...
Observed Data
63.00
60.00
57.00
54.00
51.00
48.00
45.00
42.00
39.00
36.00
33.00
30.00
27.00
24.00
21.00
18.00
15.00
12.00
9.00
6.00
3.00
0.00
-3.00
-6.00
14.40
8.85
36.30
21.25
10.00
0.85
11.29
9.10
1.70
MW-15S Diss Cr
Diss Mn
Diss Ni
Diss Zn

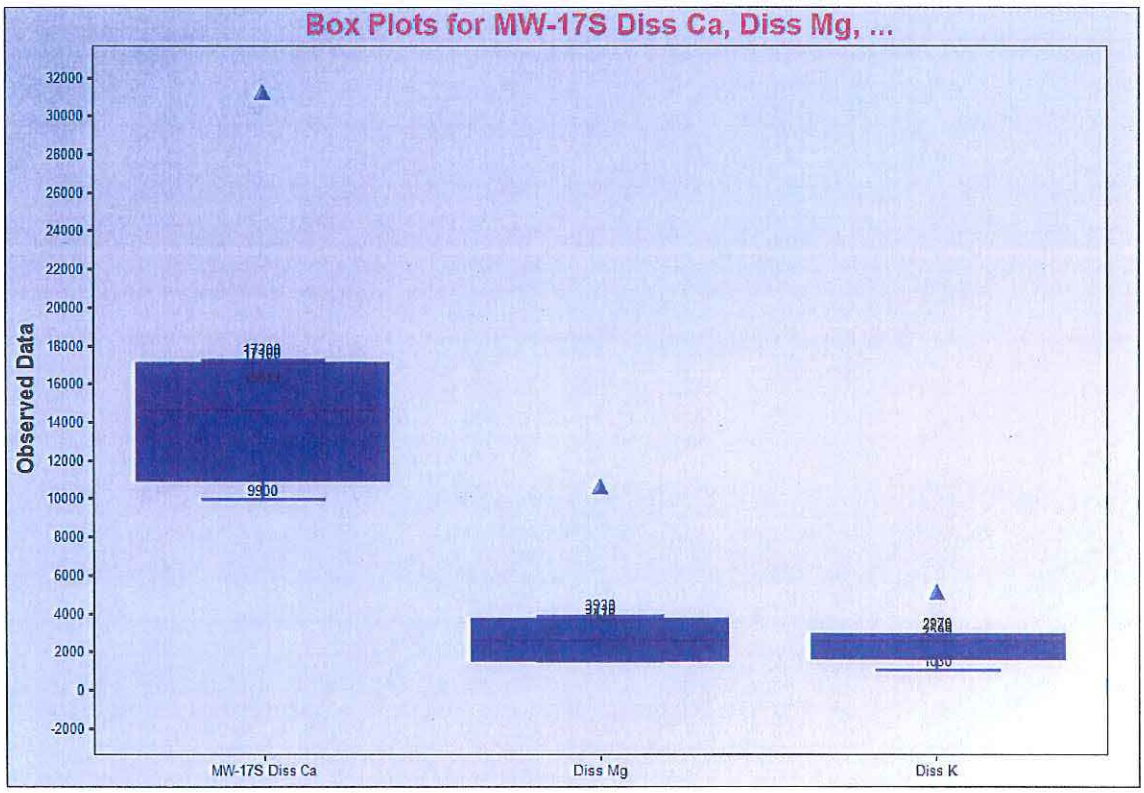

Box Plots for MW-16S Diss Ca, Diss Mg, ...
Observed Data
140000
130000
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
76700
55100
MW-16S Diss Ca
Diss Mg
Diss K
Diss Na

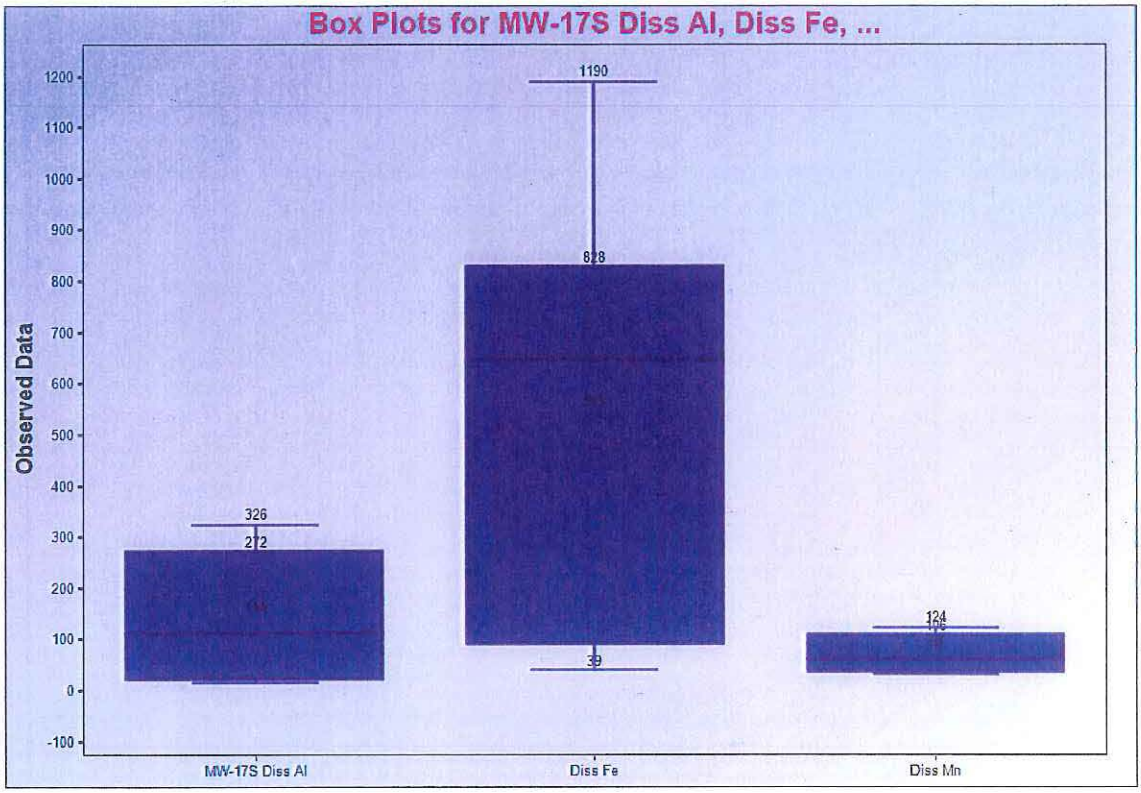

Box Plots for MW-16S Diss Cu, Diss Pb, ...
Observed Data
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
47.58
30.70
0.86
MW-16S Diss Cu
Diss Pb
Diss Ni
Diss Zn

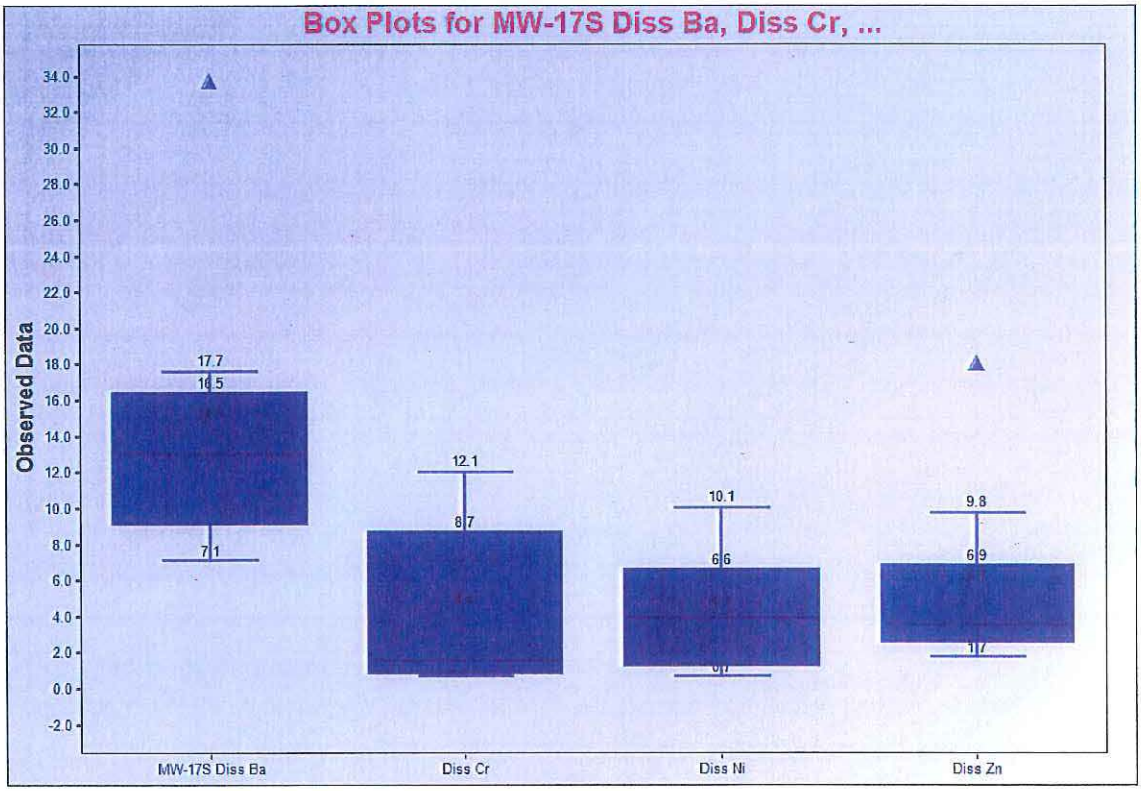

Box Plots for MW-16S Diss Al, MW-16S ...
Observed Data
4200.00
4000.00
3800.00
3600.00
3400.00
3200.00
3000.00
2800.00
2600.00
2400.00
2200.00
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
-200.00
-400.00
680.00
MW-16S Diss Al
MW-16S Diss Ba
Diss Cr
Diss Mn

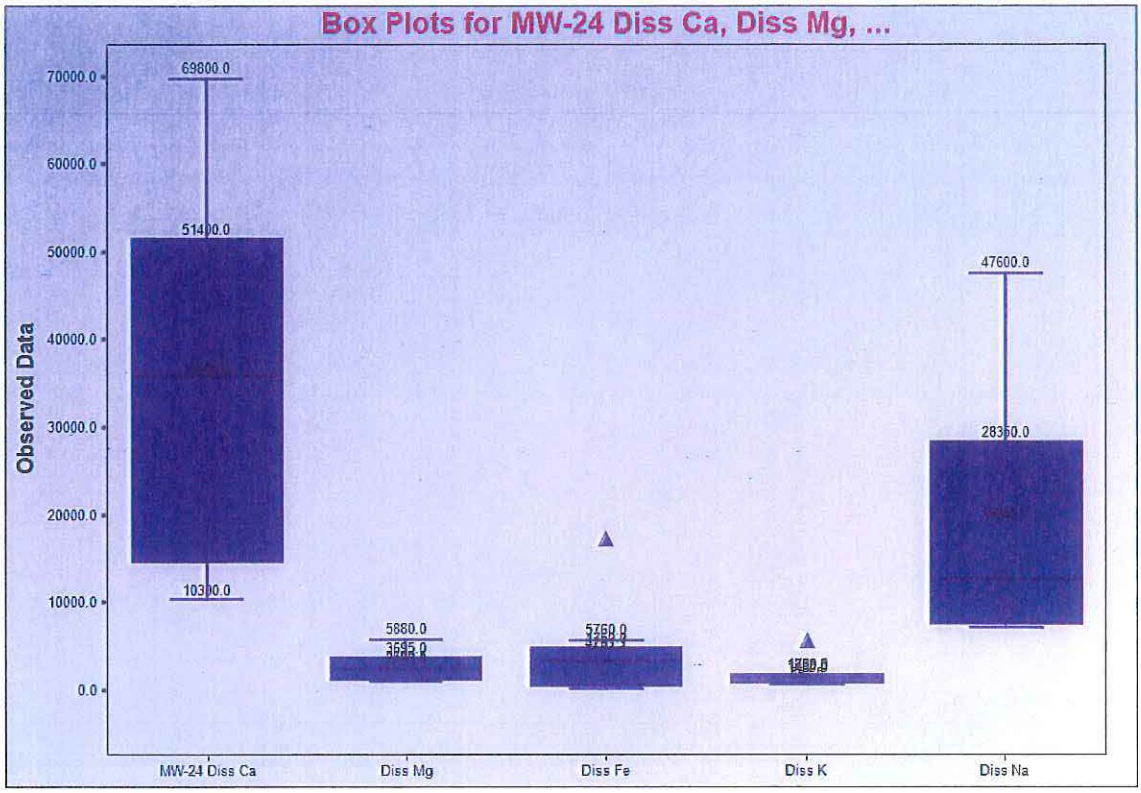

Box Plots for MW-16S Diss Ba, Diss Cr, ...
Observed Data
420.00
400.00
380.00
360.00
340.00
320.00
300.00
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
145.00
60.70
MW-16S Diss Ba
Diss Cr
Diss Mn

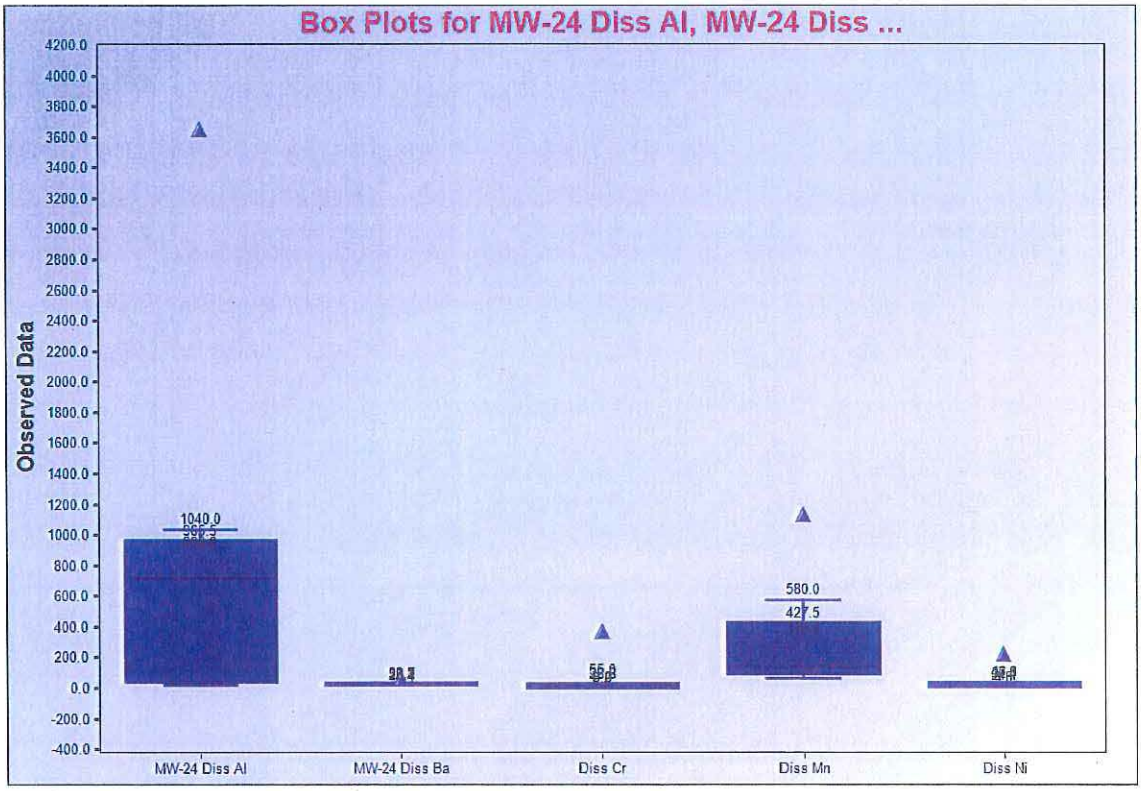

Box Plots for MW-17S Diss Ca, Diss Mg, ...
Observed Data
800000
700000
600000
500000
400000
300000
200000
100000
0
MW-17S Diss Ca
Diss Mg
Diss K
Diss Na

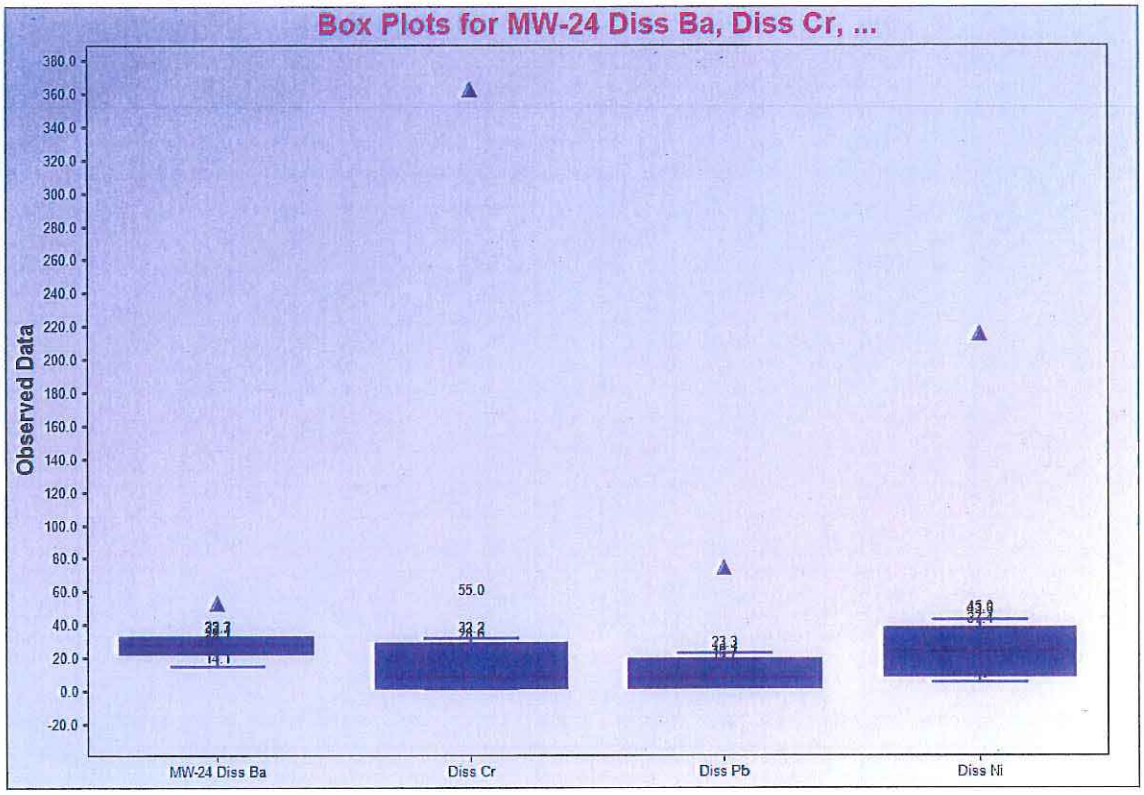

Box Plots for MW-17S Diss Ca, Diss Mg, ...
Observed Data
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
9900
MW-17S Diss Ca
Diss Mg
Diss K

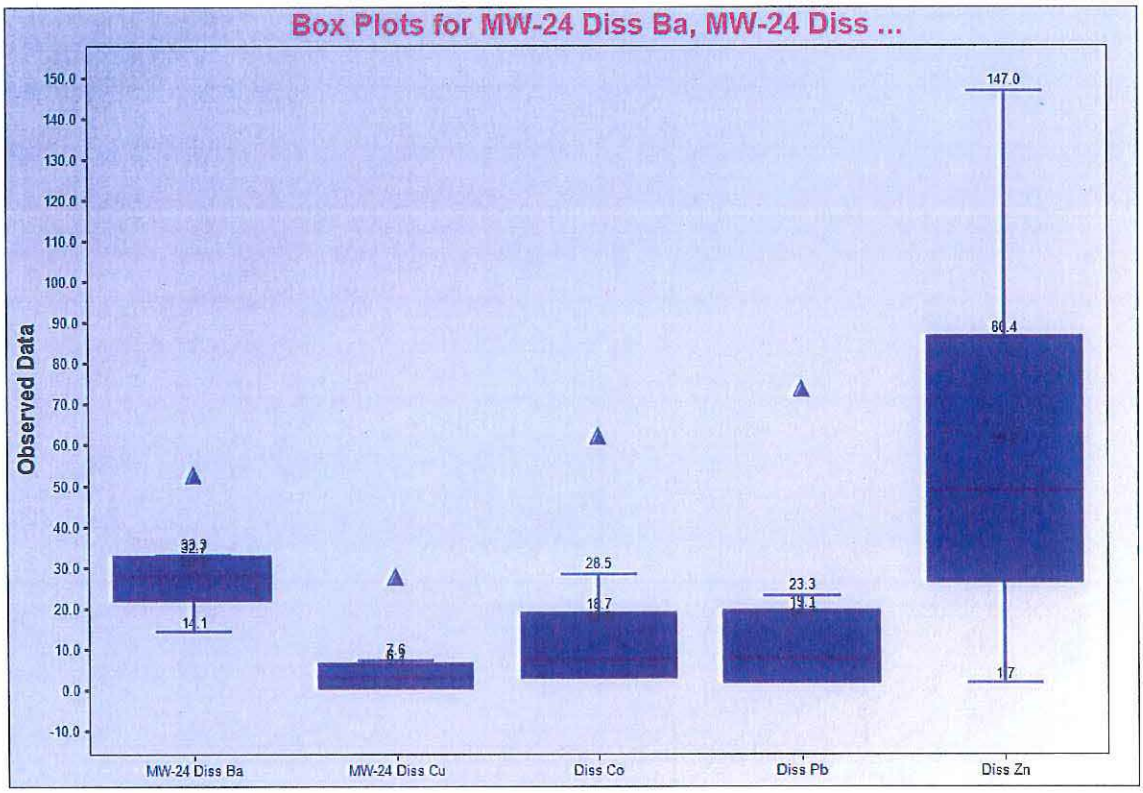

Box Plots for MW-17S Diss Al, Diss Fe, ...
Observed Data
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
1190
326
212
39
124
MW-17S Diss Al
Diss Fe
Diss Mn


Box Plots for MW-17S Diss Ba, Diss Cr, ...
Observed Data
34.0
32.0
30.0
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
17.7
12.1
10.1
9.8
MW-17S Diss Ba
Diss Cr
Diss Ni
Diss Zn


Box Plots for MW-24 Diss Ca, Diss Mg, ...
Observed Data
70000.0
60000.0
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
69800.0
51400.0
10300.0
5880.0
47600.0
28350.0
MW-24 Diss Ca
Diss Mg
Diss Fe
Diss K
Diss Na

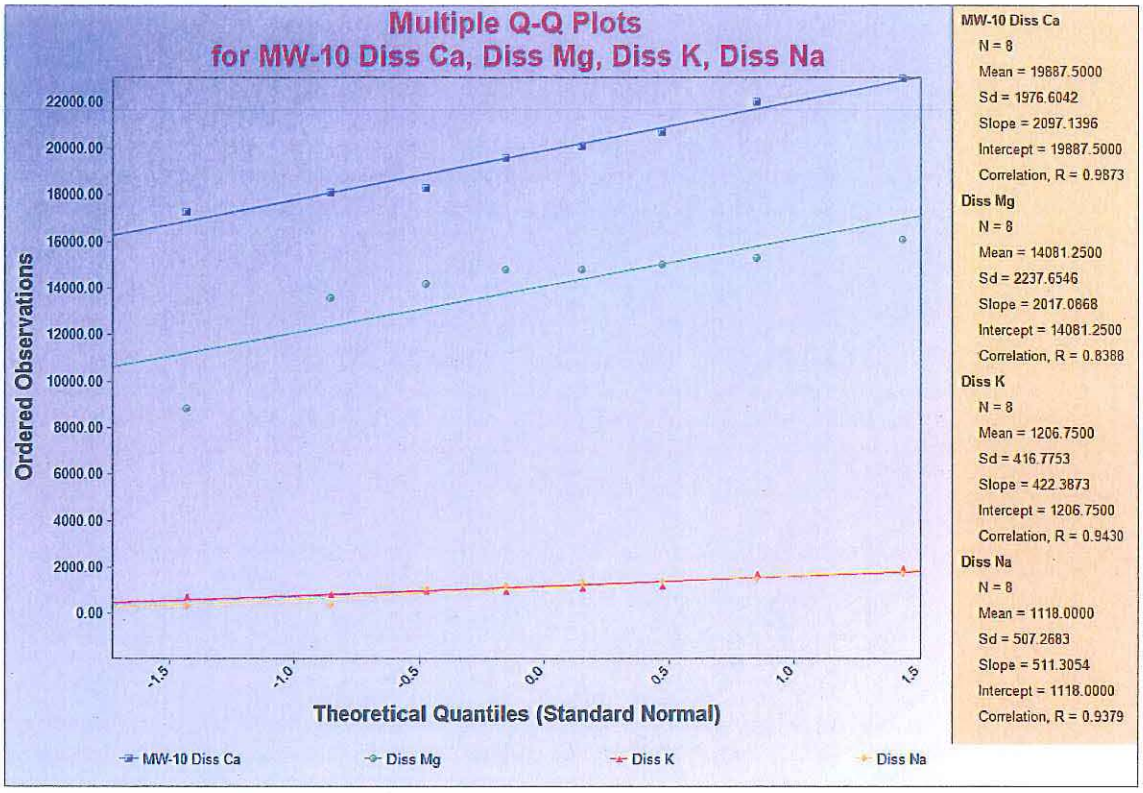

Box Plots for MW-24 Diss Al, MW-24 Diss ...
Observed Data
4200.0
4000.0
3800.0
3600.0
3400.0
3200.0
3000.0
2800.0
2600.0
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-200.0
-400.0
1040.0
580.0
427.5
MW-24 Diss Al
MW-24 Diss Ba
Diss Cr
Diss Mn
Diss Ni

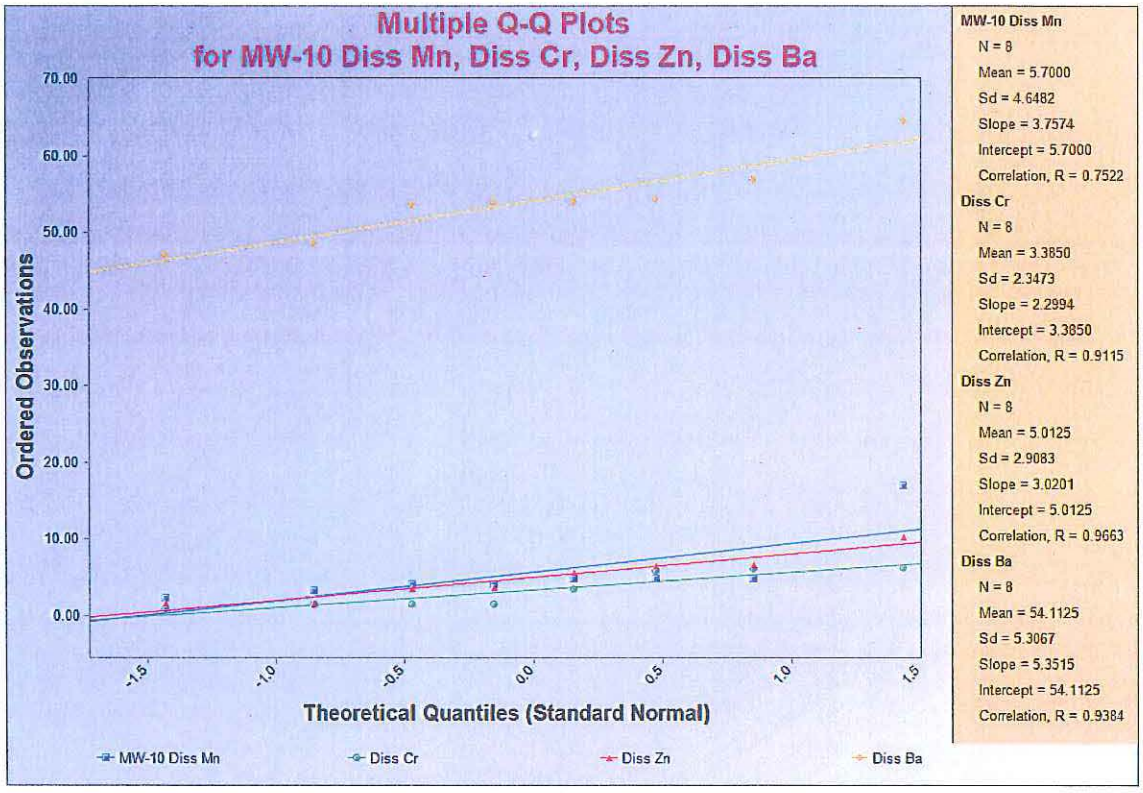

Box Plots for MW-24 Diss Ba, Diss Cr, ...
Observed Data
380.0
360.0
340.0
320.0
300.0
280.0
260.0
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
55.0
MW-24 Diss Ba
Diss Cr
Diss Pb
Diss Ni

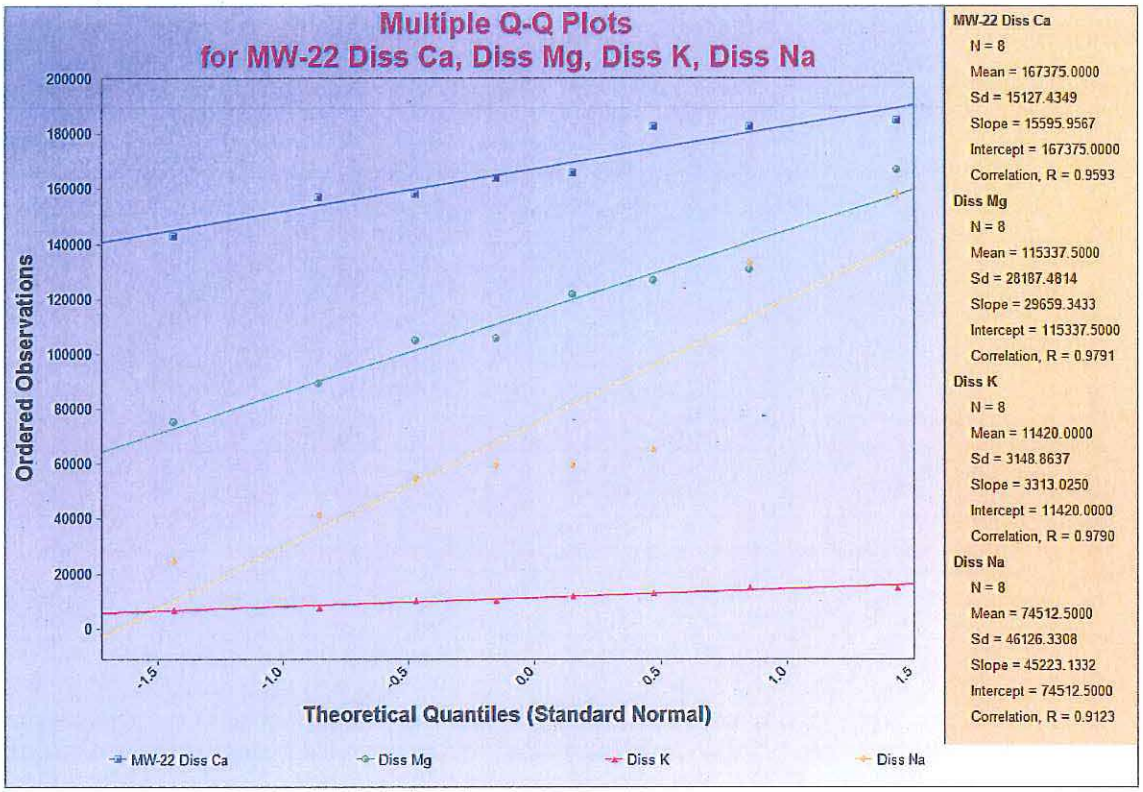

Box Plots for MW-24 Diss Ba, MW-24 Diss ...
Observed Data
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
147.0
28.5
23.3
MW-24 Diss Ba
MW-24 Diss Cu
Diss Co
Diss Pb
Diss Zn

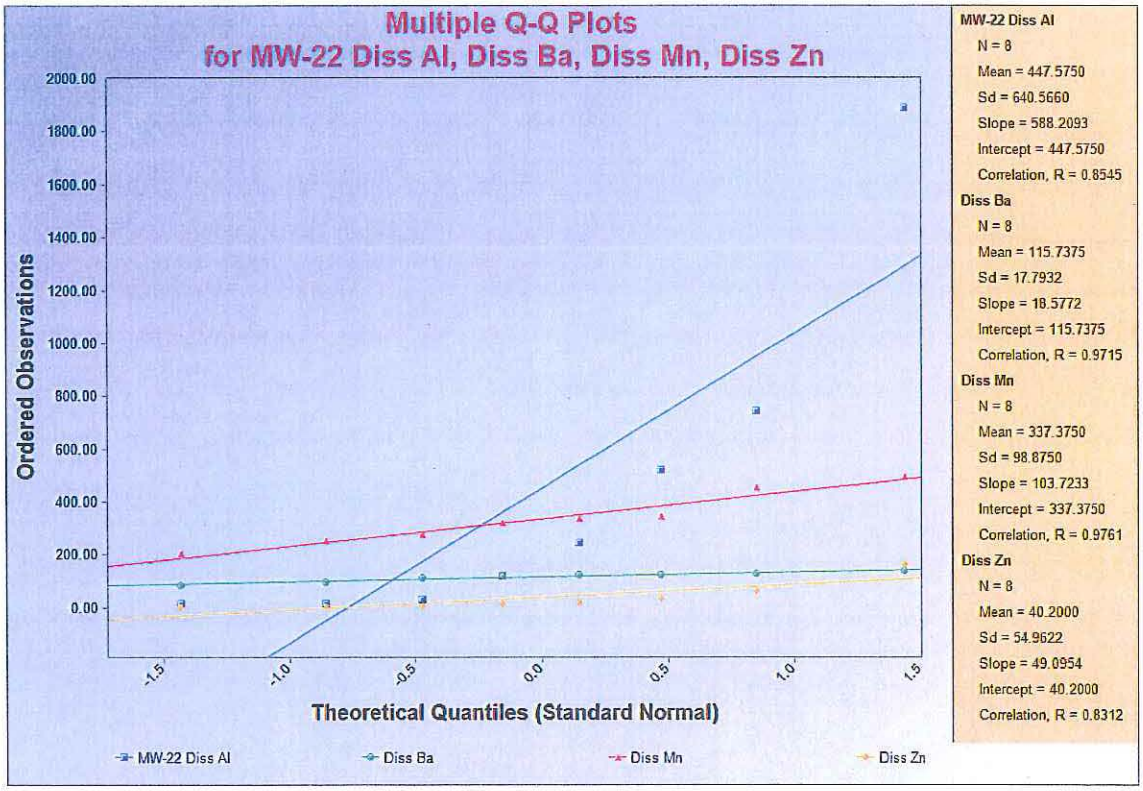
Appendix A-4

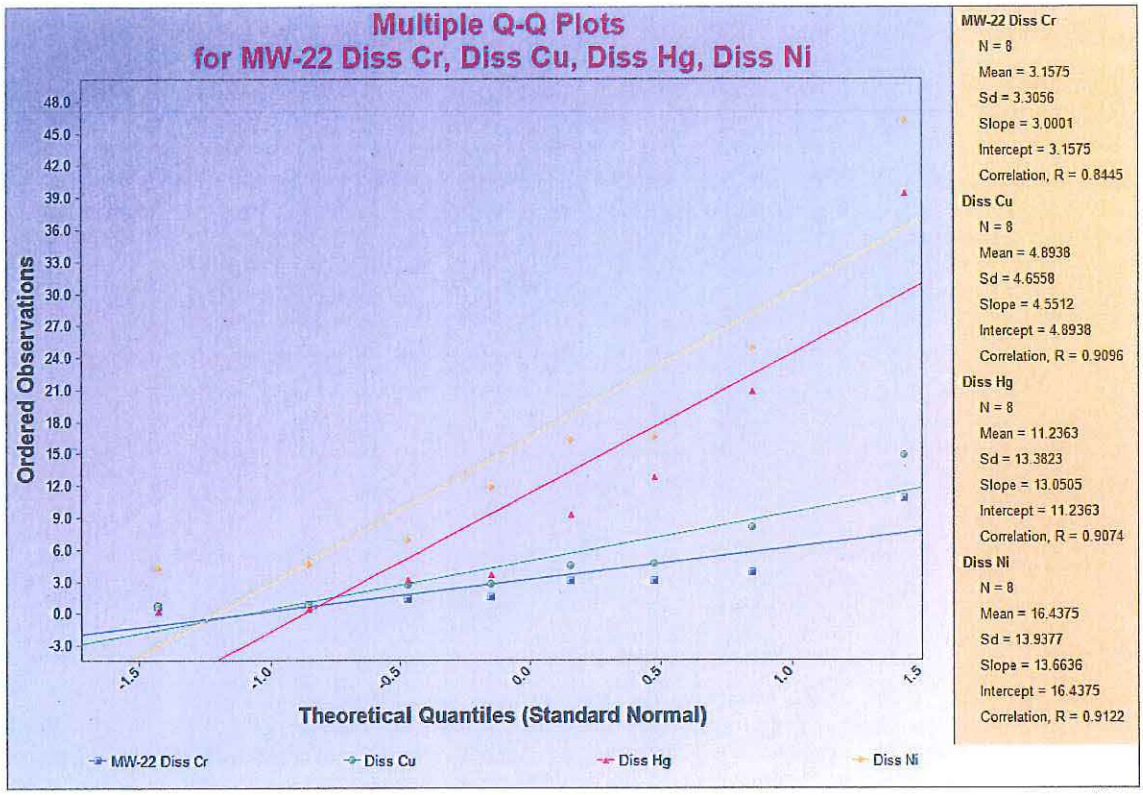
Q-Q Plots for Dissolved Metals

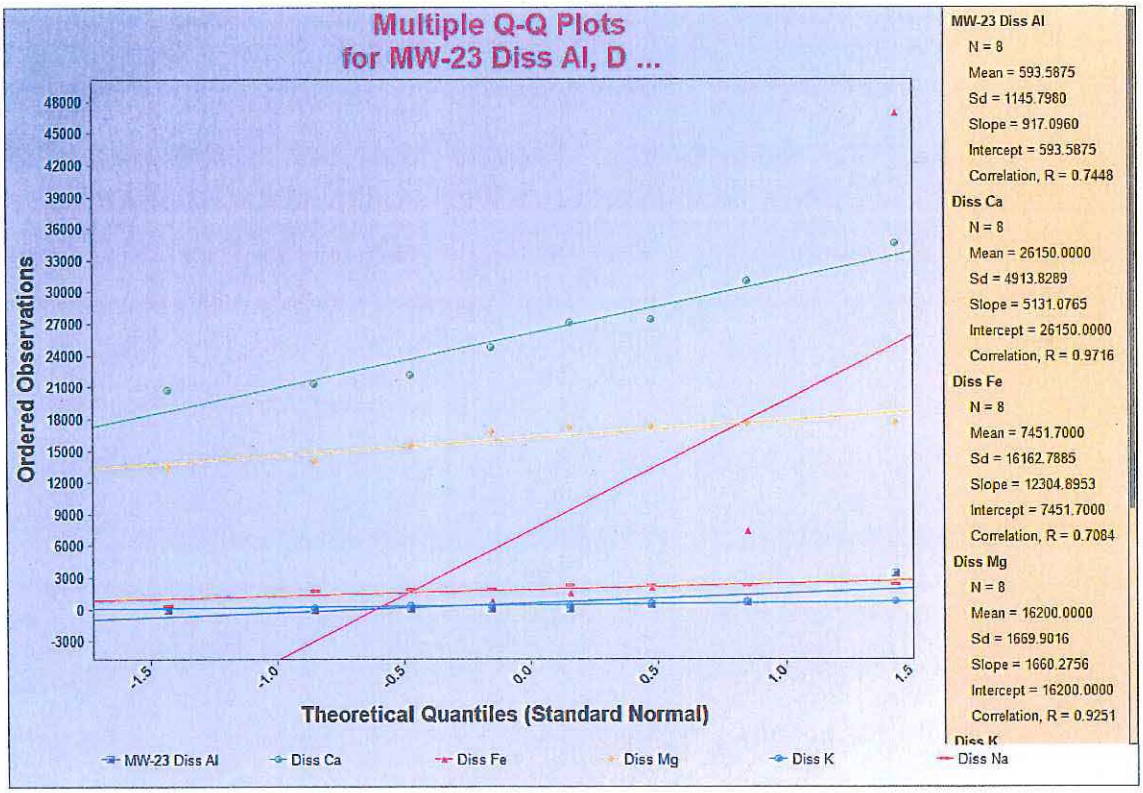

Multiple Q-Q Plots
for MW-10 Diss Ca, Diss Mg, Diss K, Diss Na
Ordered Observations
22000.00
20000.00
18000.00
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
MW-10 Diss Ca
Diss Mg
Diss K
Diss Na
MW-10 Diss Ca
N = 8
Mean = 19887.5000
Sd = 1976.6042
Slope = 2097.1396
Intercept = 19887.5000
Correlation, R = 0.9873
Diss Mg
N = 8
Mean = 14081.2500
Sd = 2237.6546
Slope = 2017.0868
Intercept = 14081.2500
Correlation, R = 0.8388
Diss K
N = 8
Mean = 1206.7500
Sd = 416.7753
Slope = 422.3873
Intercept = 1206.7500
Correlation, R = 0.9430
Diss Na
N = 8
Mean = 1118.0000
Sd = 507.2683
Slope = 511.3054
Intercept = 1118.0000
Correlation, R = 0.9379

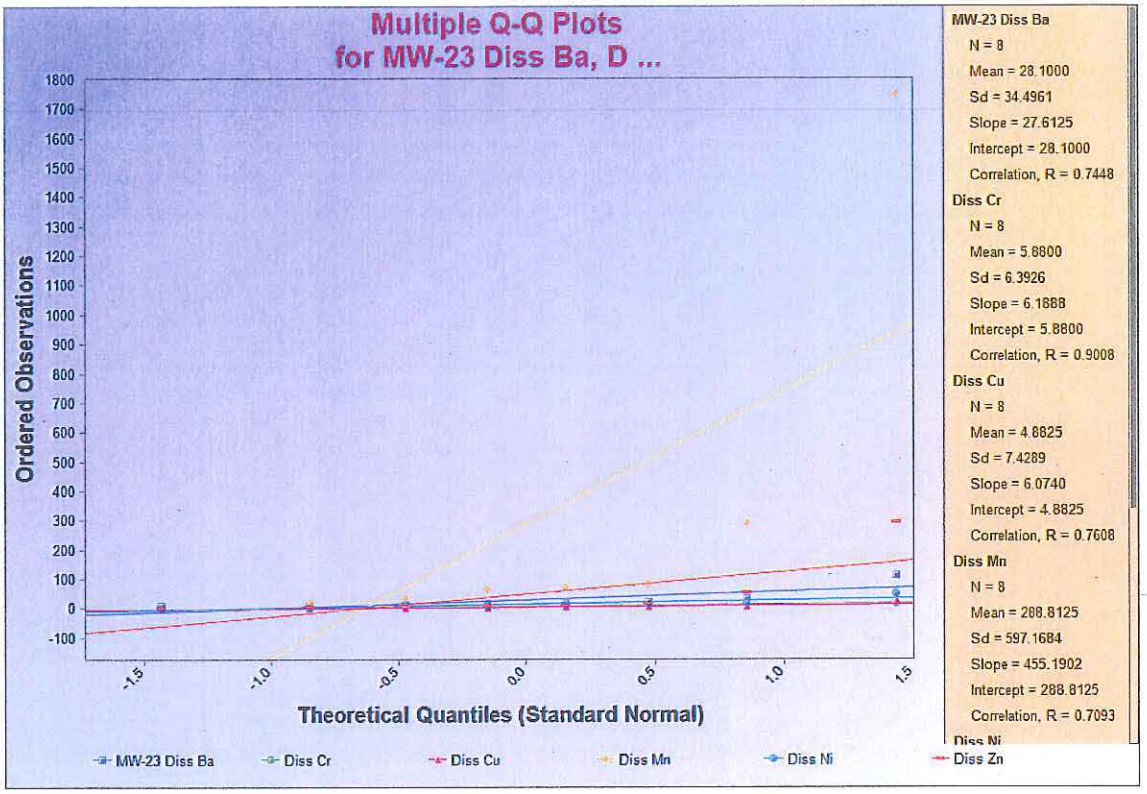

Multiple Q-Q Plots
for MW-10 Diss Mn, Diss Cr, Diss Zn, Diss Ba
Ordered Observations
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
MW-10 Diss Mn
Diss Cr
Diss Zn
Diss Ba
MW-10 Diss Mn
N = 8
Mean = 5.7000
Sd = 4.6482
Slope = 3.7574
Intercept = 5.7000
Correlation, R = 0.7522
Diss Cr
N = 8
Mean = 3.3850
Sd = 2.3473
Slope = 2.2994
Intercept = 3.3850
Correlation, R = 0.9115
Diss Zn
N = 8
Mean = 5.0125
Sd = 2.9083
Slope = 3.0201
Intercept = 5.0125
Correlation, R = 0.9663
Diss Ba
N = 8
Mean = 54.1125
Sd = 5.3067
Slope = 5.3515
Intercept = 54.1125
Correlation, R = 0.9384

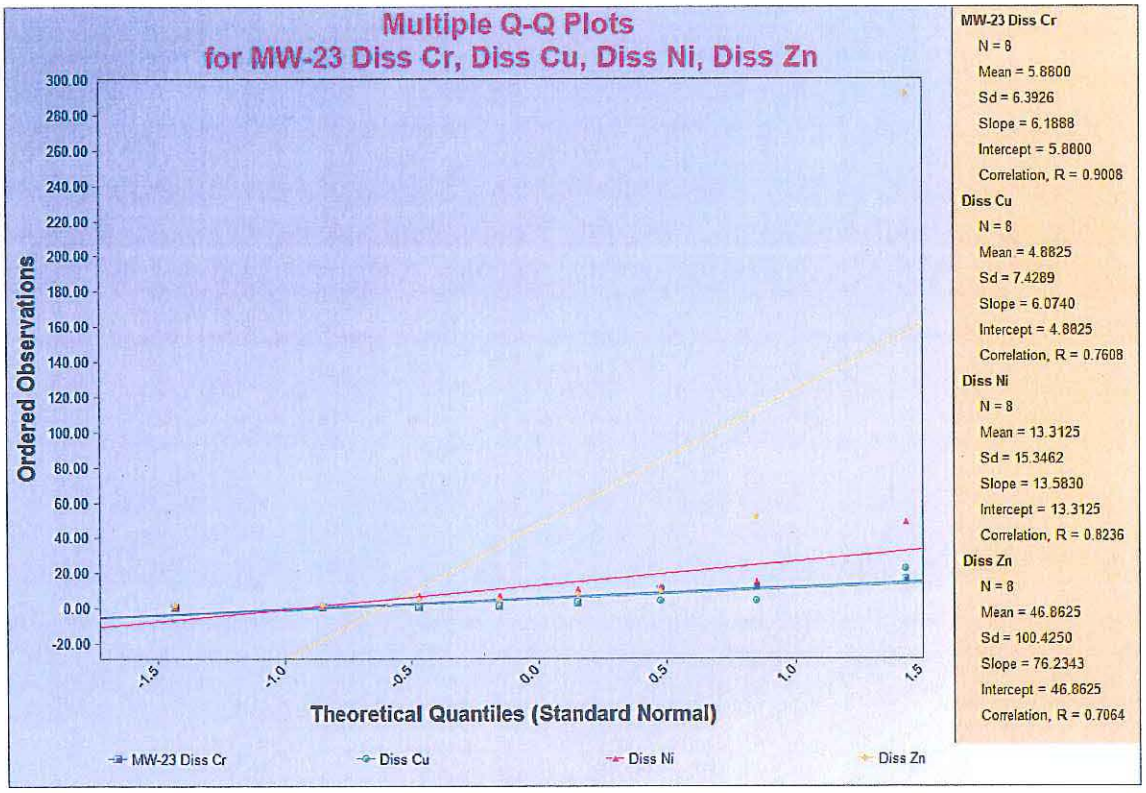

Multiple Q-Q Plots
for MW-22 Diss Ca, Diss Mg, Diss K, Diss Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Diss Ca
Diss Mg
Diss K
Diss Na
MW-22 Diss Ca
N = 8
Mean = 167375.0000
Sd = 15127.4349
Slope = 15595.9567
Intercept = 167375.0000
Correlation, R = 0.9593
Diss Mg
N = 8
Mean = 115337.5000
Sd = 28187.4814
Slope = 29659.3433
Intercept = 115337.5000
Correlation, R = 0.9791
Diss K
N = 8
Mean = 11420.0000
Sd = 3148.8637
Slope = 3313.0250
Intercept = 11420.0000
Correlation, R = 0.9790
Diss Na
N = 8
Mean = 74512.5000
Sd = 46126.3308
Slope = 45223.1332
Intercept = 74512.5000
Correlation, R = 0.9123

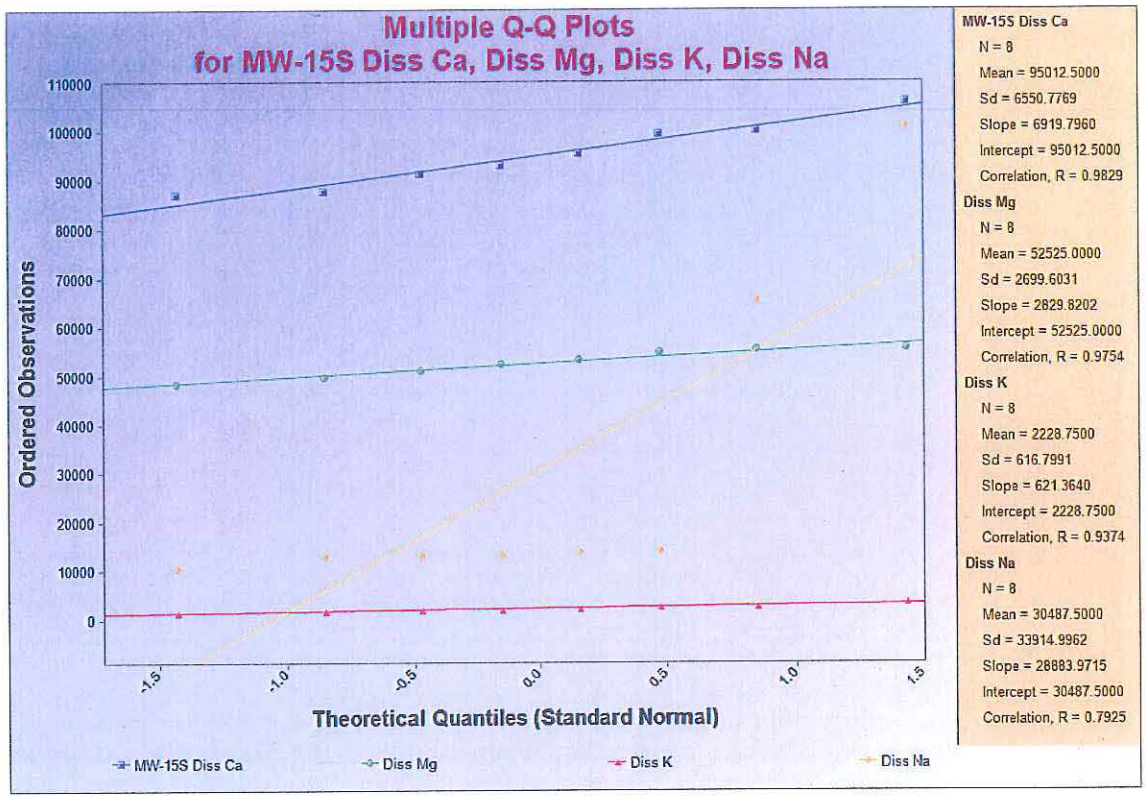

Multiple Q-Q Plots
for MW-22 Diss Al, Diss Ba, Diss Mn, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Diss Al
Diss Ba
Diss Mn
Diss Zn
MW-22 Diss Al
N = 8
Mean = 447.5750
Sd = 640.5660
Slope = 588.2093
Intercept = 447.5750
Correlation, R = 0.8545
Diss Ba
N = 8
Mean = 115.7375
Sd = 17.7932
Slope = 18.5772
Intercept = 115.7375
Correlation, R = 0.9715
Diss Mn
N = 8
Mean = 337.3750
Sd = 98.8750
Slope = 103.7233
Intercept = 337.3750
Correlation, R = 0.9761
Diss Zn
N = 8
Mean = 40.2000
Sd = 54.9622
Slope = 49.0954
Intercept = 40.2000
Correlation, R = 0.8312

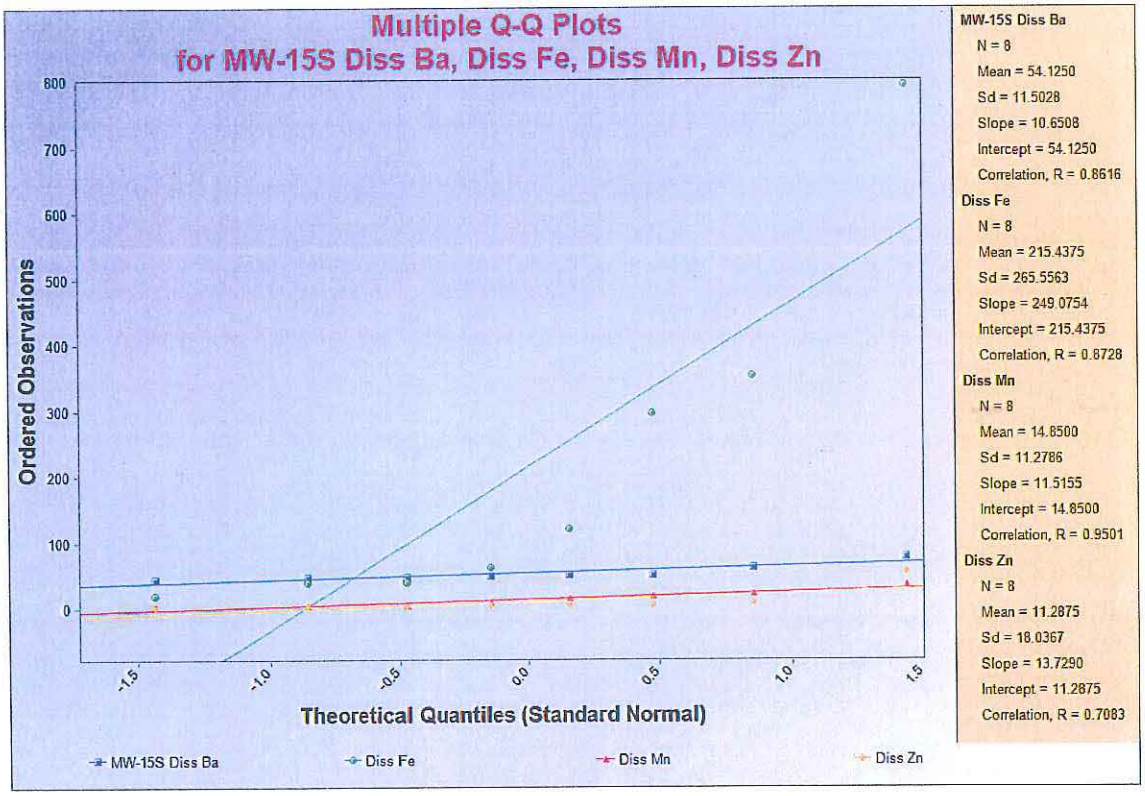

Multiple Q-Q Plots
for MW-22 Diss Cr, Diss Cu, Diss Hg, Diss Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Diss Cr
Diss Cu
Diss Hg
Diss Ni
MW-22 Diss Cr
N = 8
Mean = 3.1575
Sd = 3.3056
Slope = 3.0001
Intercept = 3.1575
Correlation, R = 0.8445
Diss Cu
N = 8
Mean = 4.8938
Sd = 4.6558
Slope = 4.5512
Intercept = 4.8938
Correlation, R = 0.9096
Diss Hg
N = 8
Mean = 11.2363
Sd = 13.3823
Slope = 13.0505
Intercept = 11.2363
Correlation, R = 0.9074
Diss Ni
N = 8
Mean = 16.4375
Sd = 13.9377
Slope = 13.6636
Intercept = 16.4375
Correlation, R = 0.9122

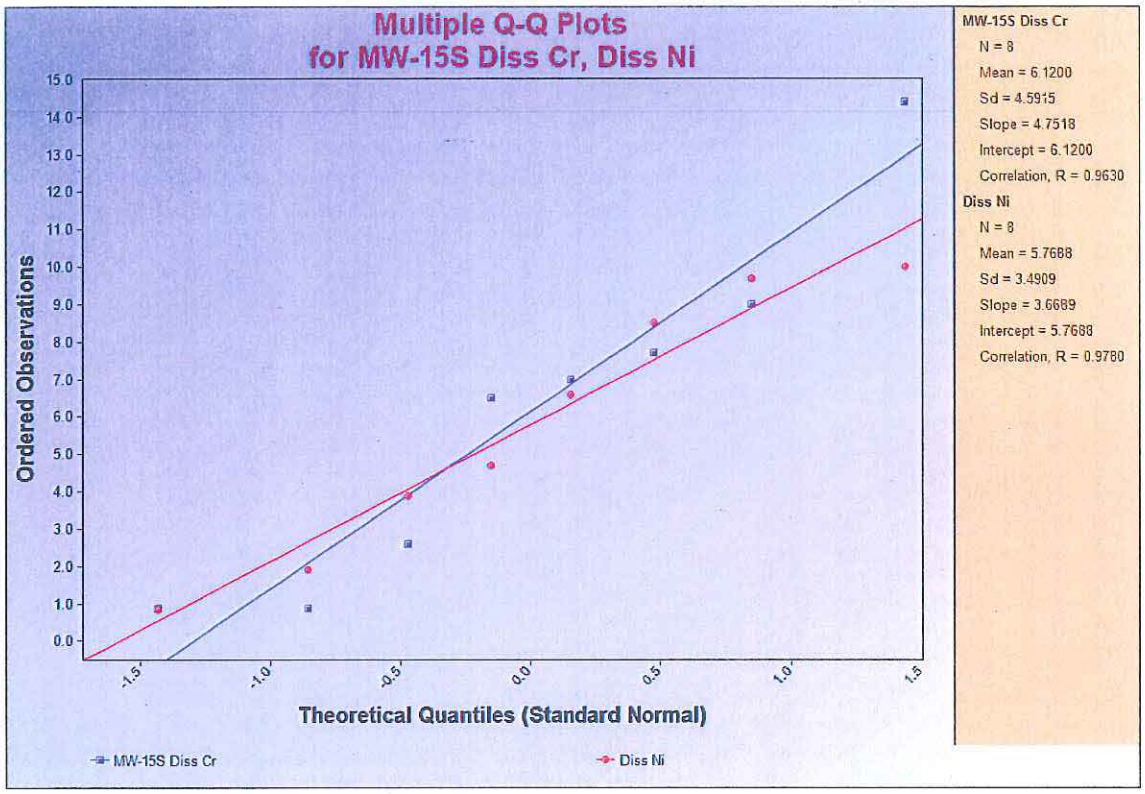

Multiple Q-Q Plots
for MW-23 Diss Al, D ...
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Diss Al
Diss Ca
Diss Fe
Diss Mg
Diss K
Diss Na
MW-23 Diss Al
N = 8
Mean = 593.5875
Sd = 1145.7980
Slope = 917.0960
Intercept = 593.5875
Correlation, R = 0.7448
Diss Ca
N = 8
Mean = 26150.0000
Sd = 4913.8289
Slope = 5131.0765
Intercept = 26150.0000
Correlation, R = 0.9716
Diss Fe
N = 8
Mean = 7451.7000
Sd = 16162.7885
Slope = 12304.8953
Intercept = 7451.7000
Correlation, R = 0.7084
Diss Mg
N = 8
Mean = 16200.0000
Sd = 1669.9016
Slope = 1660.2756
Intercept = 16200.0000
Correlation, R = 0.9251
Diss K

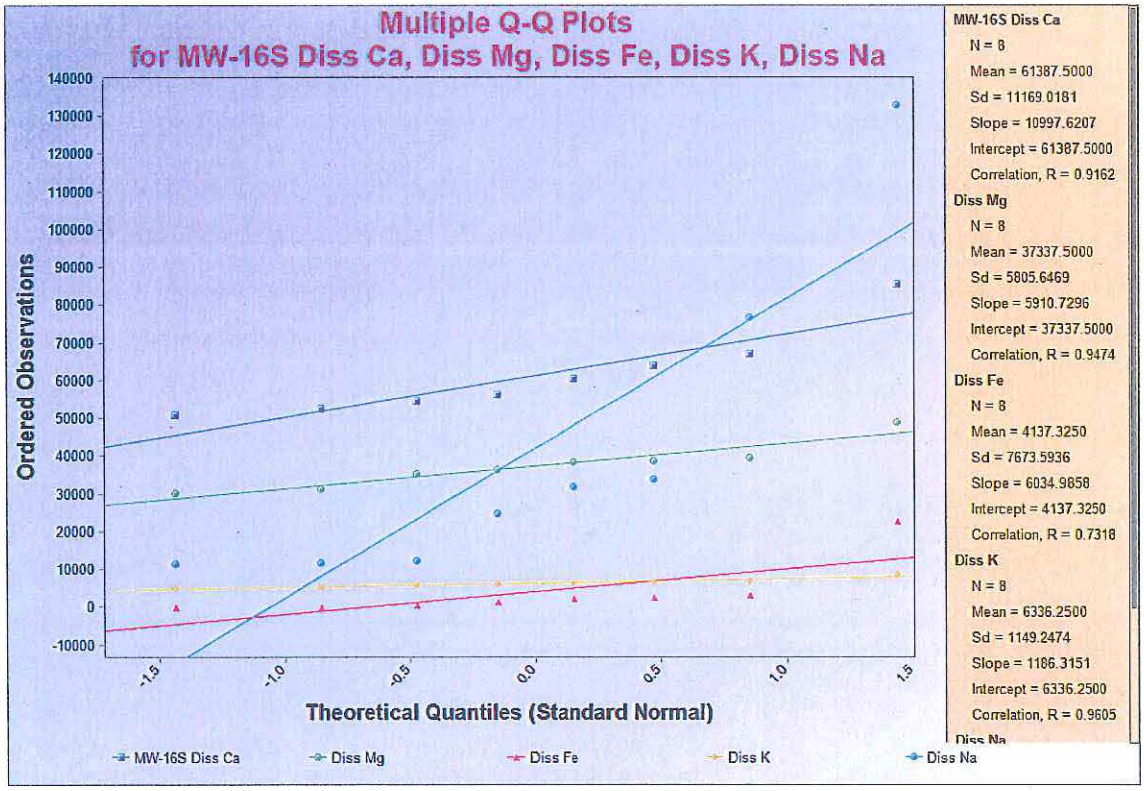

Multiple Q-Q Plots
for MW-23 Diss Ba, D ...
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Diss Ba
Diss Cr
Diss Cu
Diss Mn
Diss Ni
Diss Zn
MW-23 Diss Ba
N = 8
Mean = 28.1000
Sd = 34.4961
Slope = 27.6125
Intercept = 28.1000
Correlation, R = 0.7448
Diss Cr
N = 8
Mean = 5.8800
Sd = 6.3926
Slope = 6.1888
Intercept = 5.8800
Correlation, R = 0.9008
Diss Cu
N = 8
Mean = 4.8825
Sd = 7.4289
Slope = 6.0740
Intercept = 4.8825
Correlation, R = 0.7608
Diss Mn
N = 8
Mean = 288.8125
Sd = 597.1684
Slope = 455.1902
Intercept = 288.8125
Correlation, R = 0.7093

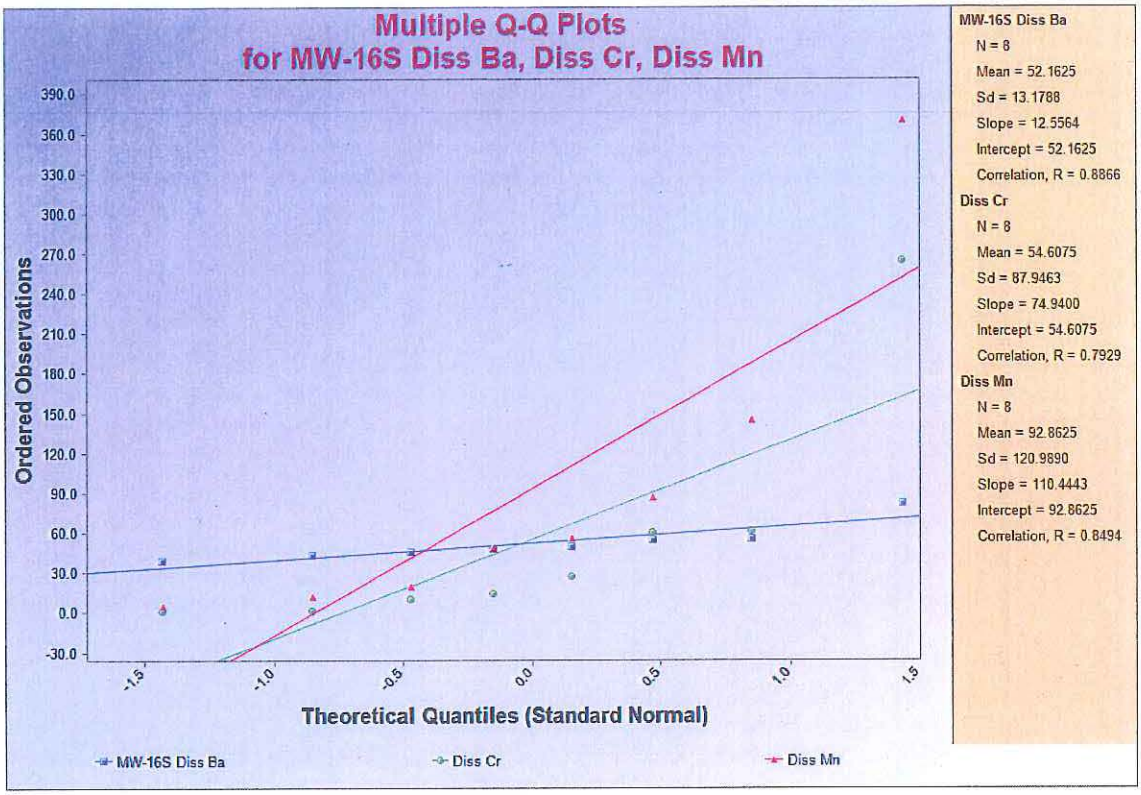

Multiple Q-Q Plots
for MW-23 Diss Cr, Diss Cu, Diss Ni, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Diss Cr
Diss Cu
Diss Ni
Diss Zn
MW-23 Diss Cr
N = 8
Mean = 5.8800
Sd = 6.3926
Slope = 6.1888
Intercept = 5.8800
Correlation, R = 0.9008
Diss Cu
N = 8
Mean = 4.8825
Sd = 7.4289
Slope = 6.0740
Intercept = 4.8825
Correlation, R = 0.7608
Diss Ni
N = 8
Mean = 13.3125
Sd = 15.3462
Slope = 13.5830
Intercept = 13.3125
Correlation, R = 0.8236
Diss Zn
N = 8
Mean = 46.8625
Sd = 100.4250
Slope = 76.2343
Intercept = 46.8625
Correlation, R = 0.7064

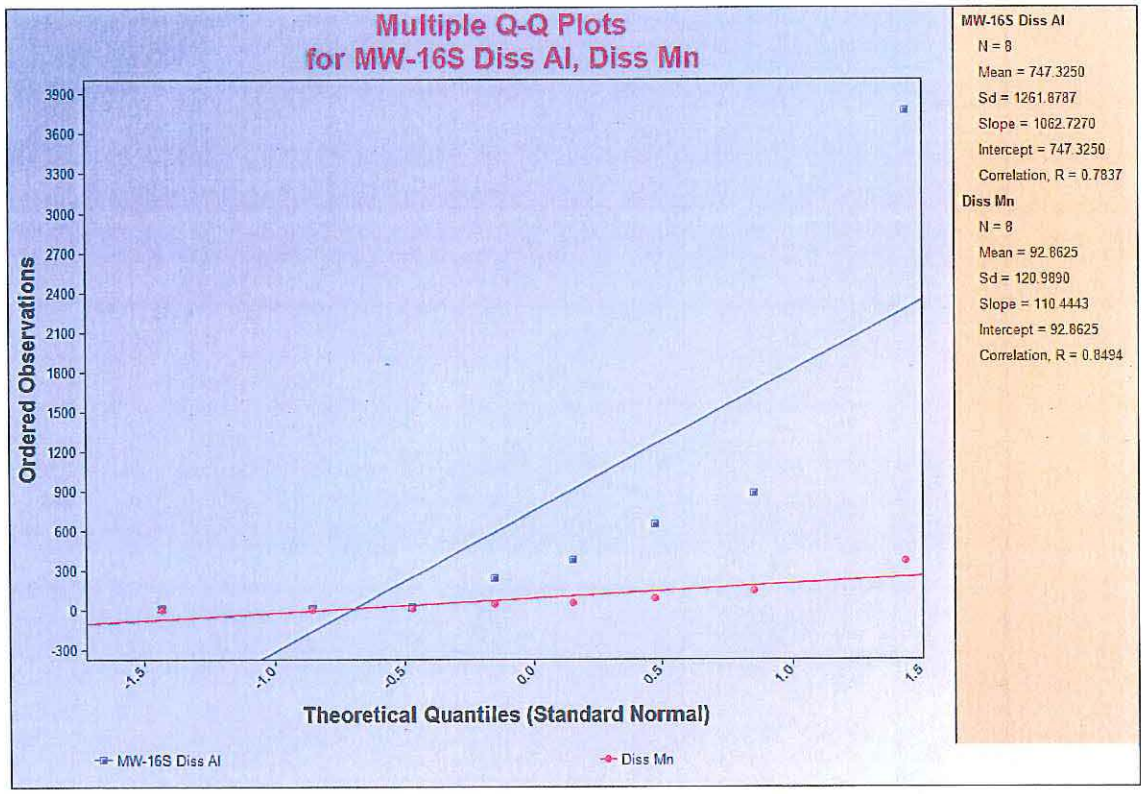

Multiple Q-Q Plots
for MW-15S Diss Ca, Diss Mg, Diss K, Diss Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Diss Ca
Diss Mg
Diss K
Diss Na
MW-15S Diss Ca
N = 8
Mean = 95012.5000
Sd = 6550.7769
Slope = 6919.7960
Intercept = 95012.5000
Correlation, R = 0.9829
Diss Mg
N = 8
Mean = 52525.0000
Sd = 2699.6031
Slope = 2829.8202
Intercept = 52525.0000
Correlation, R = 0.9754
Diss K
N = 8
Mean = 2228.7500
Sd = 616.7991
Slope = 621.3640
Intercept = 2228.7500
Correlation, R = 0.9374
Diss Na
N = 8
Mean = 30487.5000
Sd = 33914.9962
Slope = 28883.9715
Intercept = 30487.5000
Correlation, R = 0.7925

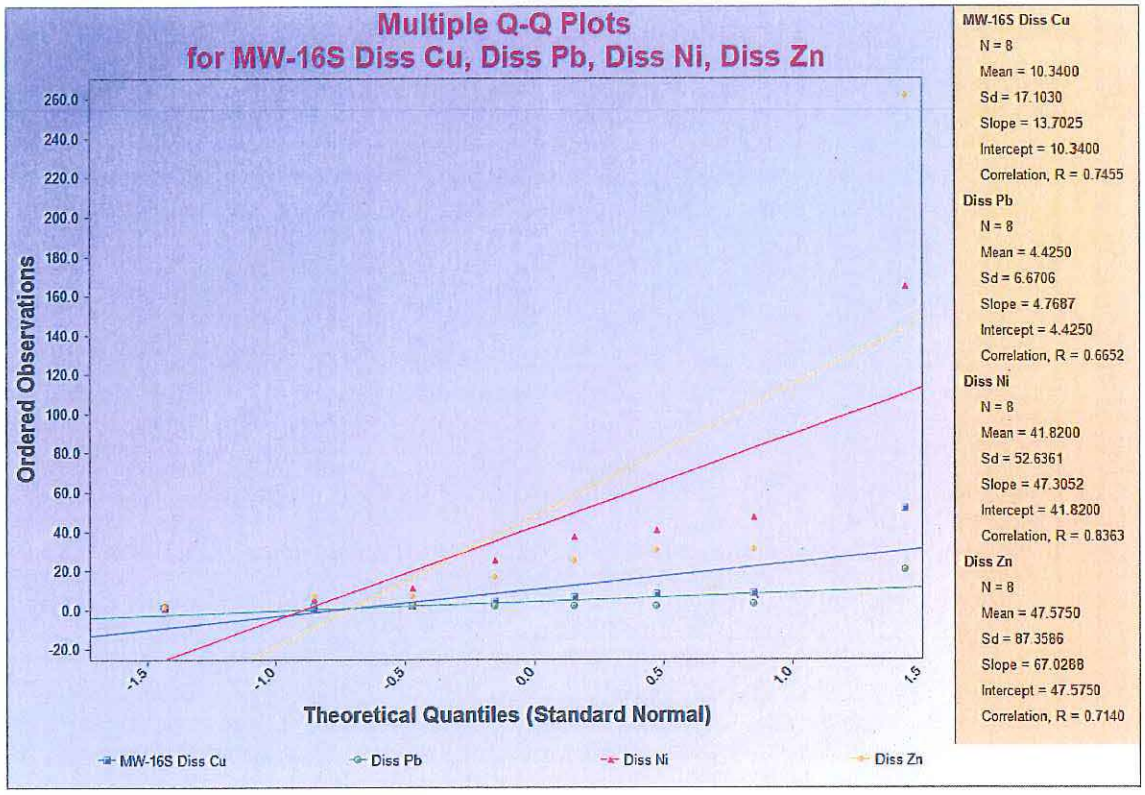

Multiple Q-Q Plots
for MW-15S Diss Ba, Diss Fe, Diss Mn, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Diss Ba
Diss Fe
Diss Mn
Diss Zn
MW-15S Diss Ba
N = 8
Mean = 54.1250
Sd = 11.5028
Slope = 10.6508
Intercept = 54.1250
Correlation, R = 0.8616
Diss Fe
N = 8
Mean = 215.4375
Sd = 265.5563
Slope = 249.0754
Intercept = 215.4375
Correlation, R = 0.8728
Diss Mn
N = 8
Mean = 14.8500
Sd = 11.2786
Slope = 11.5155
Intercept = 14.8500
Correlation, R = 0.9501
Diss Zn
N = 8
Mean = 11.2875
Sd = 18.0367
Slope = 13.7290
Intercept = 11.2875
Correlation, R = 0.7083

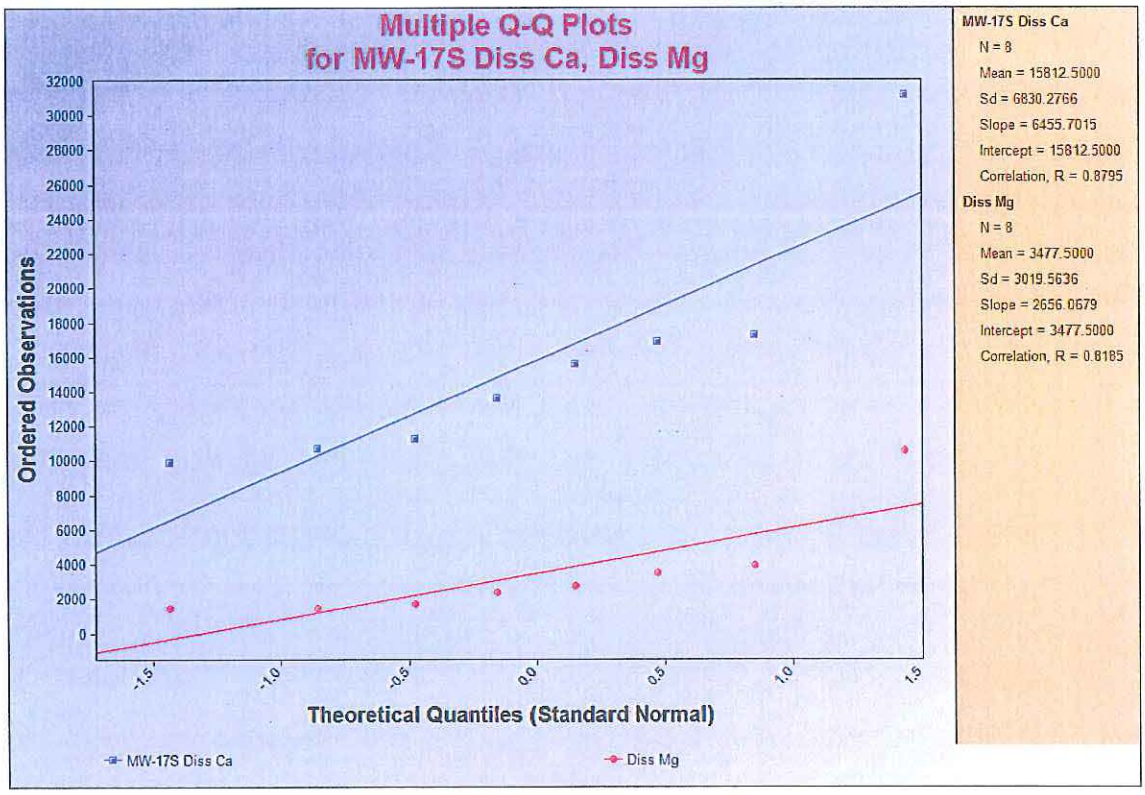

Multiple Q-Q Plots
for MW-15S Diss Cr, Diss Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Diss Cr
Diss Ni
MW-15S Diss Cr
N = 8
Mean = 6.1200
Sd = 4.5915
Slope = 4.7518
Intercept = 6.1200
Correlation, R = 0.9630
Diss Ni
N = 8
Mean = 5.7688
Sd = 3.4909
Slope = 3.6689
Intercept = 5.7688
Correlation, R = 0.9780

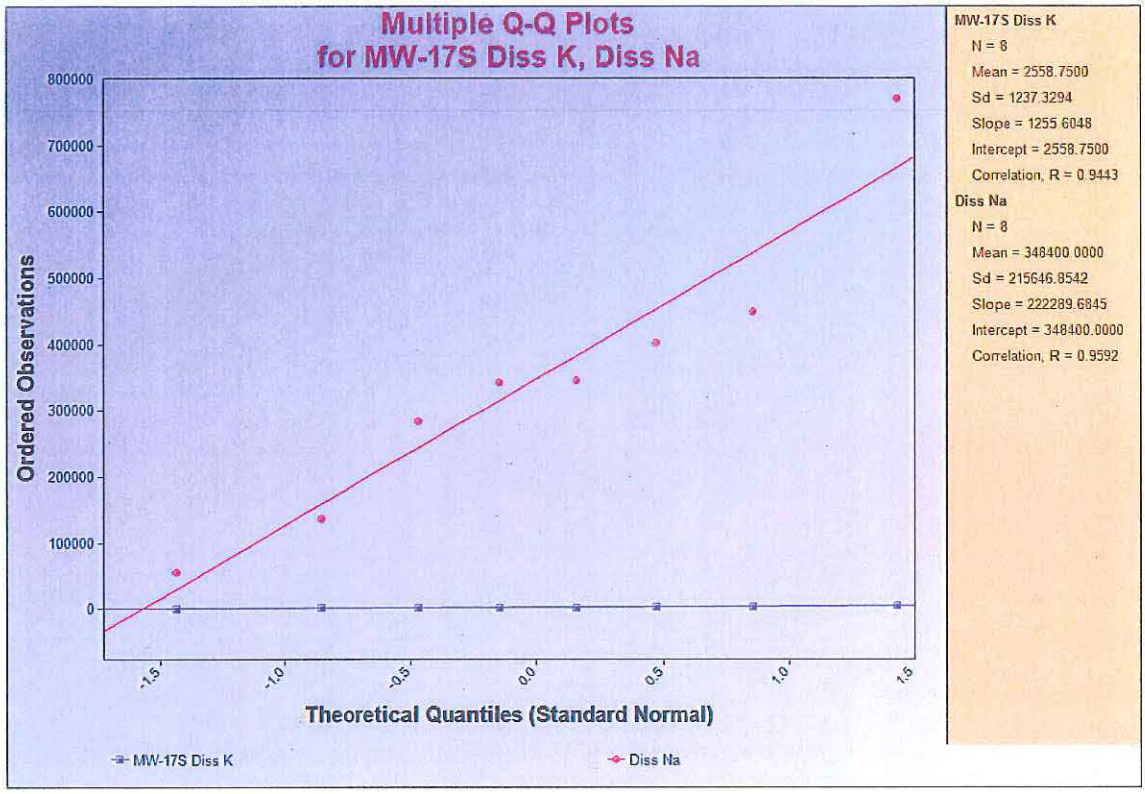

Multiple Q-Q Plots
for MW-16S Diss Ca, Diss Mg, Diss Fe, Diss K, Diss Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Diss Ca
Diss Mg
Diss Fe
Diss K
Diss Na
MW-16S Diss Ca
N = 8
Mean = 61387.5000
Sd = 11169.0181
Slope = 10997.6207
Intercept = 61387.5000
Correlation, R = 0.9162
Diss Mg
N = 8
Mean = 37337.5000
Sd = 5805.6469
Slope = 5910.7296
Intercept = 37337.5000
Correlation, R = 0.9474
Diss Fe
N = 8
Mean = 4137.3250
Sd = 7673.5936
Slope = 6034.9858
Intercept = 4137.3250
Correlation, R = 0.7318
Diss K
N = 8
Mean = 6336.2500
Sd = 1149.2474
Slope = 1186.3151
Intercept = 6336.2500
Correlation, R = 0.9605

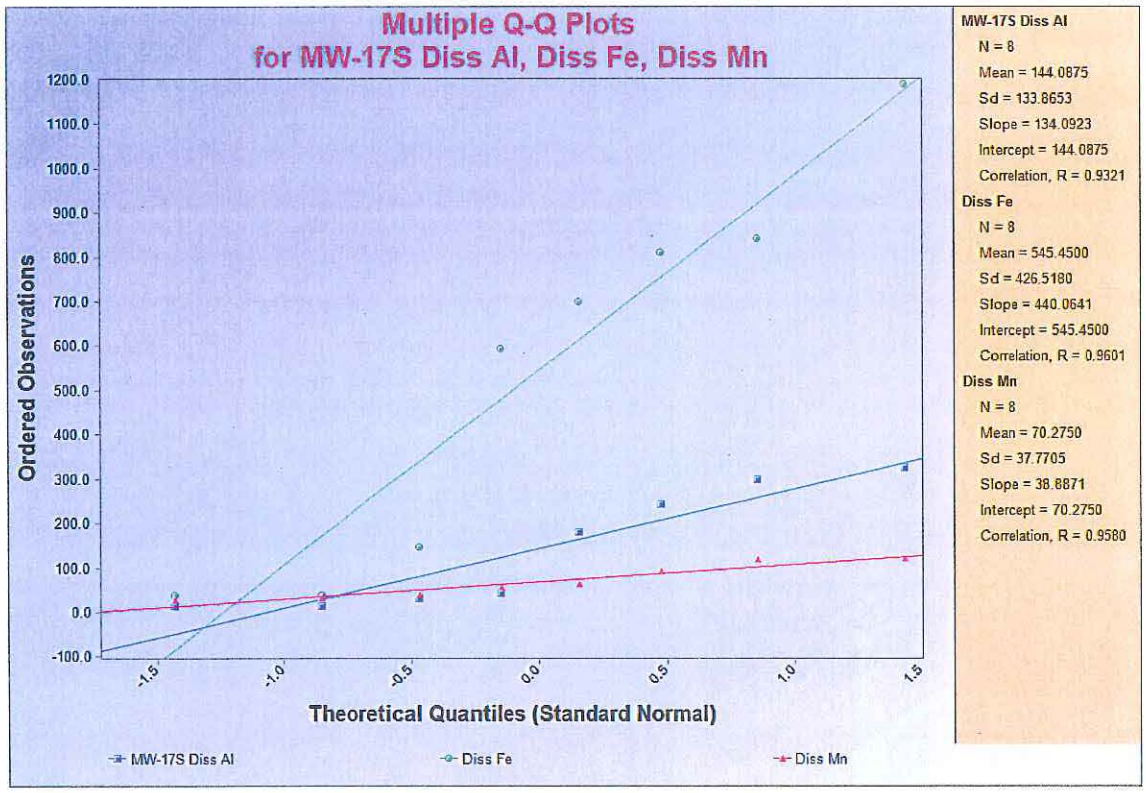

Multiple Q-Q Plots
for MW-16S Diss Ba, Diss Cr, Diss Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Diss Ba
Diss Cr
Diss Mn
MW-16S Diss Ba
N = 8
Mean = 52.1625
Sd = 13.1788
Slope = 12.5564
Intercept = 52.1625
Correlation, R = 0.8866
Diss Cr
N = 8
Mean = 54.6075
Sd = 87.9463
Slope = 74.9400
Intercept = 54.6075
Correlation, R = 0.7929
Diss Mn
N = 8
Mean = 92.8625
Sd = 120.9890
Slope = 110.4443
Intercept = 92.8625
Correlation, R = 0.8494

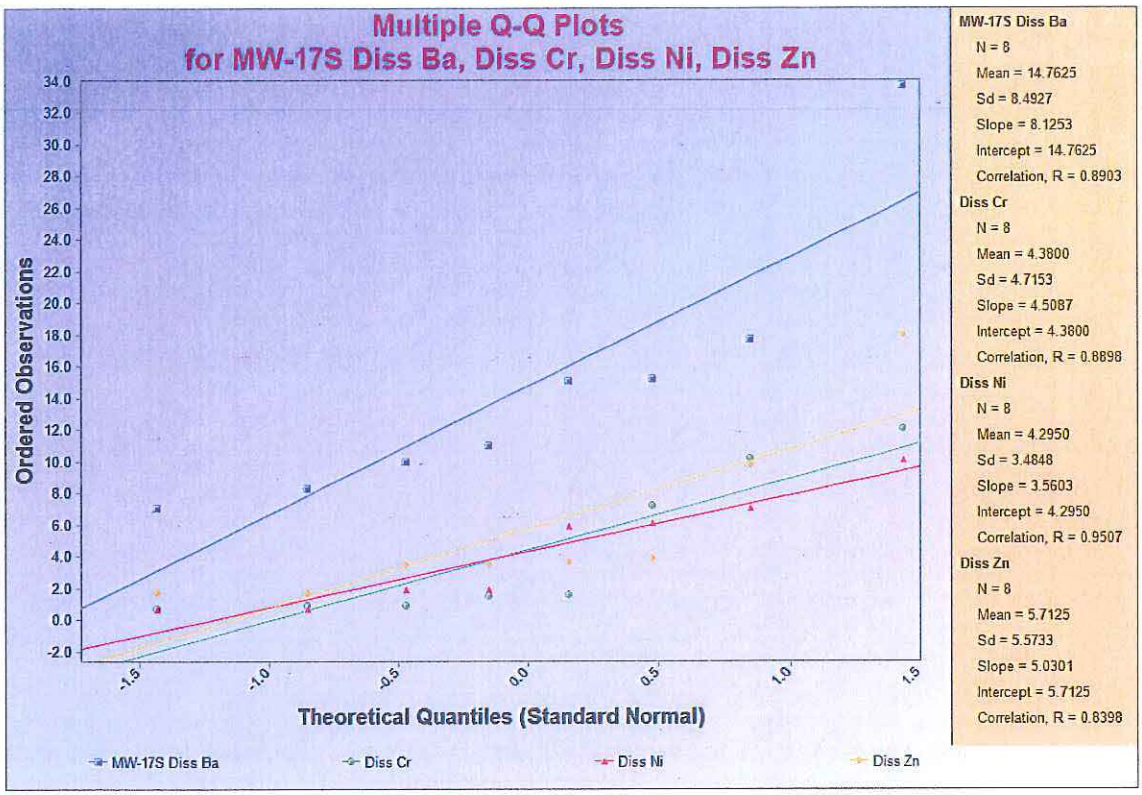

Multiple Q-Q Plots
for MW-16S Diss Al, Diss Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Diss Al
Diss Mn
MW-16S Diss Al
N = 8
Mean = 747.3250
Sd = 1261.8787
Slope = 1062.7270
Intercept = 747.3250
Correlation, R = 0.7837
Diss Mn
N = 8
Mean = 92.8625
Sd = 120.9890
Slope = 110.4443
Intercept = 92.8625
Correlation, R = 0.8494

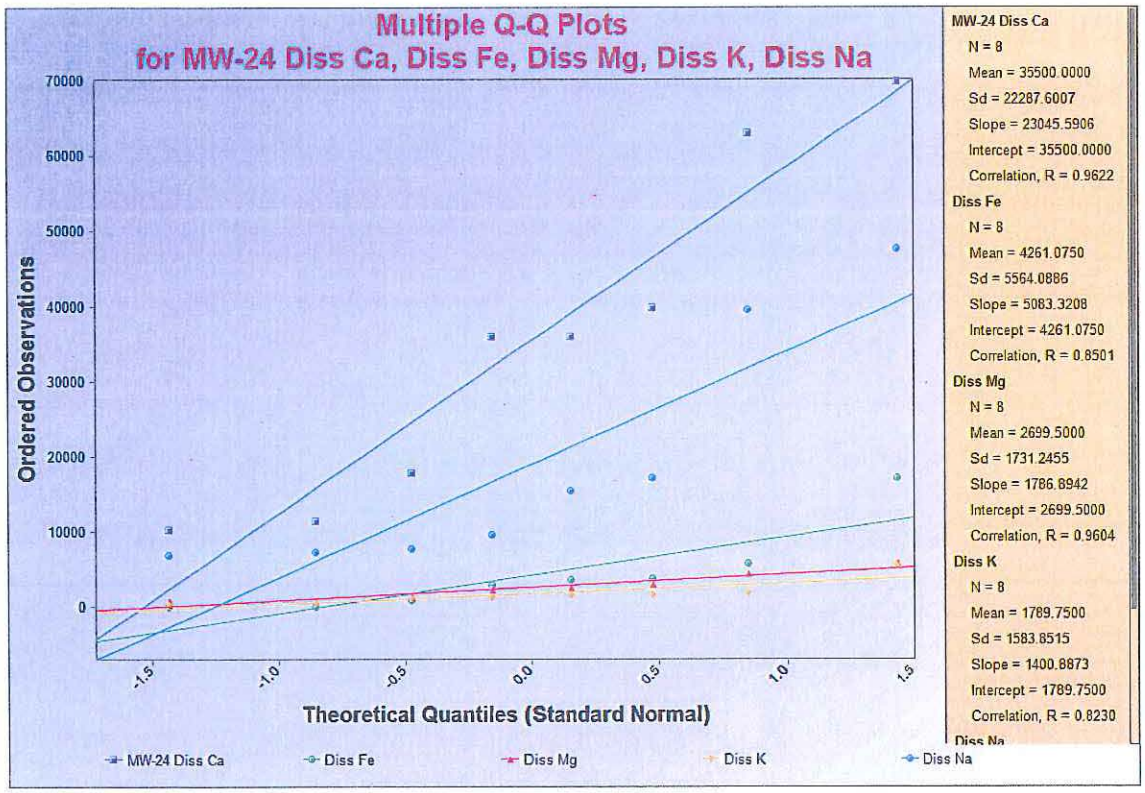

Multiple Q-Q Plots
for MW-16S Diss Cu, Diss Pb, Diss Ni, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Diss Cu
Diss Pb
Diss Ni
Diss Zn
MW-16S Diss Cu
N = 8
Mean = 10.3400
Sd = 17.1030
Slope = 13.7025
Intercept = 10.3400
Correlation, R = 0.7455
Diss Pb
N = 8
Mean = 4.4250
Sd = 6.6706
Slope = 4.7687
Intercept = 4.4250
Correlation, R = 0.6652
Diss Ni
N = 8
Mean = 41.8200
Sd = 52.6361
Slope = 47.3052
Intercept = 41.8200
Correlation, R = 0.8363
Diss Zn
N = 8
Mean = 47.5750
Sd = 87.3586
Slope = 67.0288
Intercept = 47.5750
Correlation, R = 0.7140

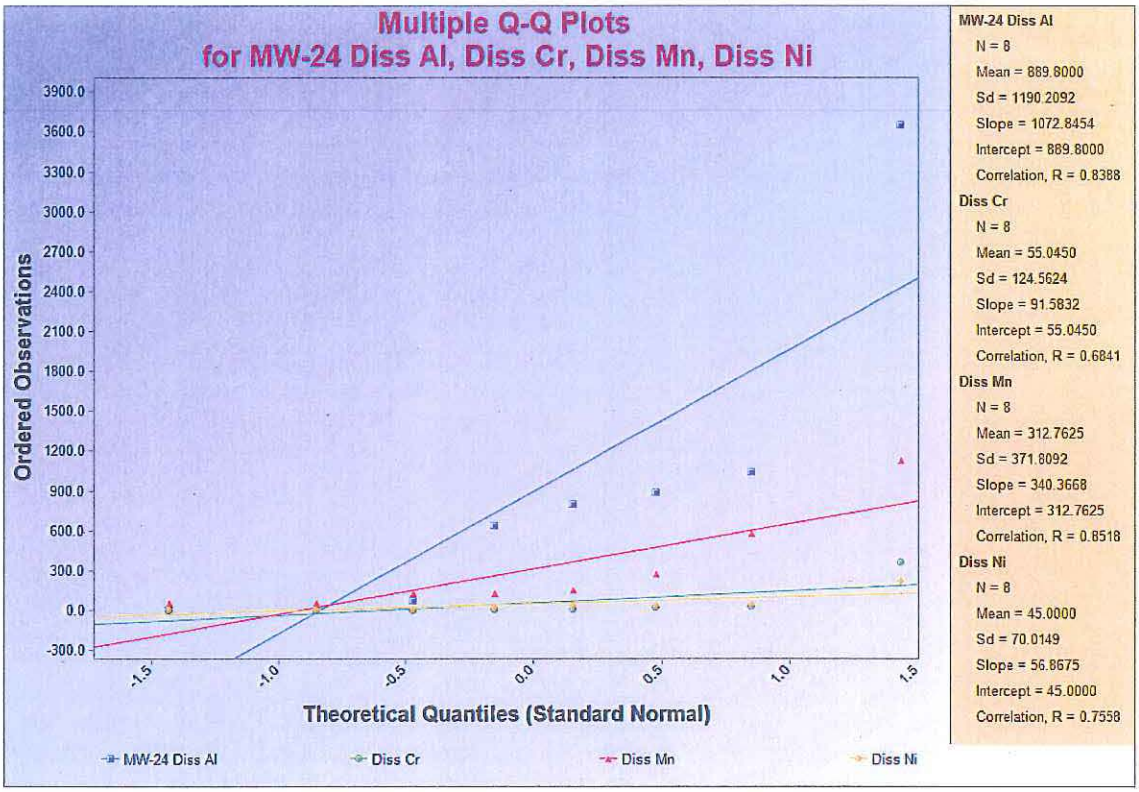

Multiple Q-Q Plots
for MW-17S Diss Ca, Diss Mg
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Diss Ca
Diss Mg
MW-17S Diss Ca
N = 8
Mean = 15812.5000
Sd = 6830.2766
Slope = 6455.7015
Intercept = 15812.5000
Correlation, R = 0.8795
Diss Mg
N = 8
Mean = 3477.5000
Sd = 3019.5636
Slope = 2656.0679
Intercept = 3477.5000
Correlation, R = 0.8185

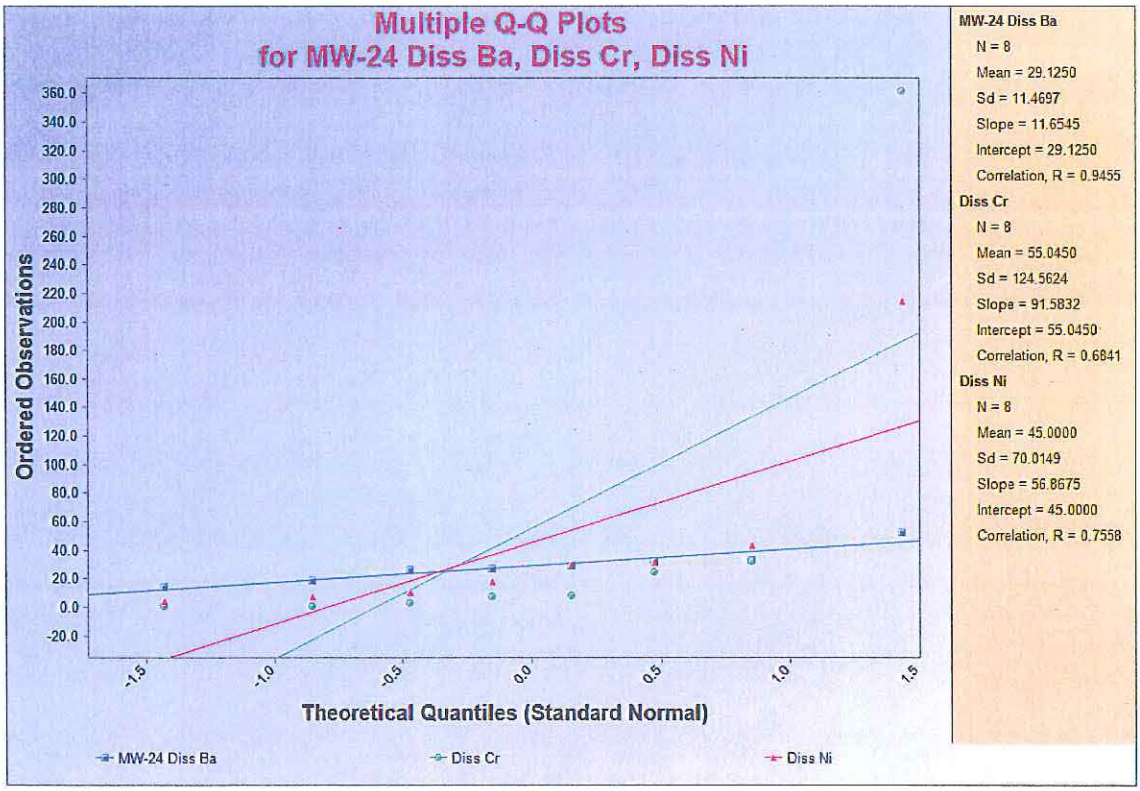

Multiple Q-Q Plots
for MW-17S Diss K, Diss Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Diss K
Diss Na
MW-17S Diss K
N = 8
Mean = 2558.7500
Sd = 1237.3294
Slope = 1255.6048
Intercept = 2558.7500
Correlation, R = 0.9443
Diss Na
N = 8
Mean = 348400.0000
Sd = 215646.8542
Slope = 222289.6845
Intercept = 348400.0000
Correlation, R = 0.9592

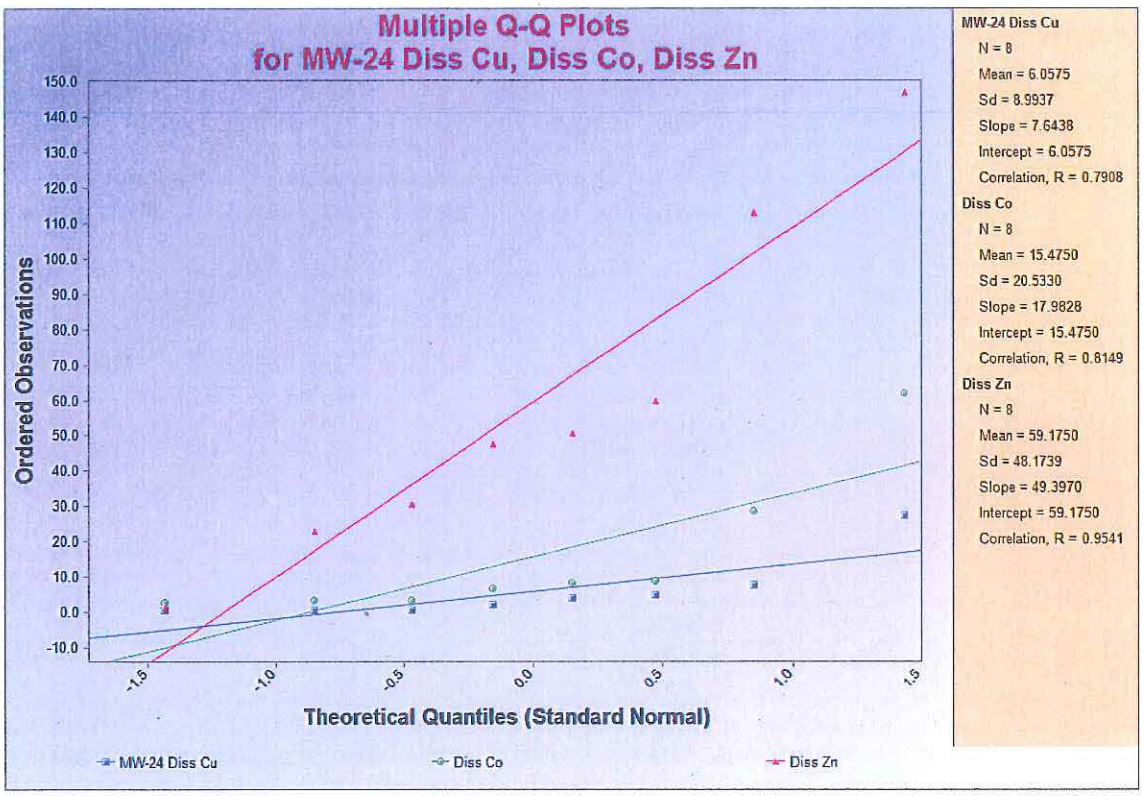

Multiple Q-Q Plots
for MW-17S Diss Al, Diss Fe, Diss Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Diss Al
Diss Fe
Diss Mn
MW-17S Diss Al
N = 8
Mean = 144.0875
Sd = 133.8653
Slope = 134.0923
Intercept = 144.0875
Correlation, R = 0.9321
Diss Fe
N = 8
Mean = 545.4500
Sd = 426.5180
Slope = 440.0641
Intercept = 545.4500
Correlation, R = 0.9601
Diss Mn
N = 8
Mean = 70.2750
Sd = 37.7705
Slope = 38.8871
Intercept = 70.2750
Correlation, R = 0.9580


Multiple Q-Q Plots
for MW-17S Diss Ba, Diss Cr, Diss Ni, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Diss Ba
Diss Cr
Diss Ni
Diss Zn
MW-17S Diss Ba
N = 8
Mean = 14.7625
Sd = 8.4927
Slope = 8.1253
Intercept = 14.7625
Correlation, R = 0.8903
Diss Cr
N = 8
Mean = 4.3800
Sd = 4.7153
Slope = 4.5087
Intercept = 4.3800
Correlation, R = 0.8898
Diss Ni
N = 8
Mean = 4.2950
Sd = 3.4848
Slope = 3.5603
Intercept = 4.2950
Correlation, R = 0.9507
Diss Zn
N = 8
Mean = 5.7125
Sd = 5.5733
Slope = 5.0301
Intercept = 5.7125
Correlation, R = 0.8398


Multiple Q-Q Plots
for MW-24 Diss Ca, Diss Fe, Diss Mg, Diss K, Diss Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Diss Ca
Diss Fe
Diss Mg
Diss K
Diss Na
MW-24 Diss Ca
N = 8
Mean = 35500.0000
Sd = 22287.6007
Slope = 23045.5906
Intercept = 35500.0000
Correlation, R = 0.9622
Diss Fe
N = 8
Mean = 4261.0750
Sd = 5564.0886
Slope = 5083.3208
Intercept = 4261.0750
Correlation, R = 0.8501
Diss Mg
N = 8
Mean = 2699.5000
Sd = 1731.2455
Slope = 1786.8942
Intercept = 2699.5000
Correlation, R = 0.9604
Diss K
N = 8
Mean = 1789.7500
Sd = 1583.8515
Slope = 1400.8873
Intercept = 1789.7500
Correlation, R = 0.8230
Diss Na


Multiple Q-Q Plots
for MW-24 Diss Al, Diss Cr, Diss Mn, Diss Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Diss Al
Diss Cr
Diss Mn
Diss Ni
MW-24 Diss Al
N = 8
Mean = 889.8000
Sd = 1190.2092
Slope = 1072.8454
Intercept = 889.8000
Correlation, R = 0.8388
Diss Cr
N = 8
Mean = 55.0450
Sd = 124.5624
Slope = 91.5832
Intercept = 55.0450
Correlation, R = 0.6841
Diss Mn
N = 8
Mean = 312.7625
Sd = 371.8092
Slope = 340.3668
Intercept = 312.7625
Correlation, R = 0.8518
Diss Ni
N = 8
Mean = 45.0000
Sd = 70.0149
Slope = 56.8675
Intercept = 45.0000
Correlation, R = 0.7558


Multiple Q-Q Plots
for MW-24 Diss Ba, Diss Cr, Diss Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Diss Ba
Diss Cr
Diss Ni
MW-24 Diss Ba
N = 8
Mean = 29.1250
Sd = 11.4697
Slope = 11.6545
Intercept = 29.1250
Correlation, R = 0.9455
Diss Cr
N = 8
Mean = 55.0450
Sd = 124.5624
Slope = 91.5832
Intercept = 55.0450
Correlation, R = 0.6841
Diss Ni
N = 8
Mean = 45.0000
Sd = 70.0149
Slope = 56.8675
Intercept = 45.0000
Correlation, R = 0.7558


Multiple Q-Q Plots
for MW-24 Diss Cu, Diss Co, Diss Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Diss Cu
Diss Co
Diss Zn
MW-24 Diss Cu
N = 8
Mean = 6.0575
Sd = 8.9937
Slope = 7.6438
Intercept = 6.0575
Correlation, R = 0.7908
Diss Co
N = 8
Mean = 15.4750
Sd = 20.5330
Slope = 17.9828
Intercept = 15.4750
Correlation, R = 0.8149
Diss Zn
N = 8
Mean = 59.1750
Sd = 48.1739
Slope = 49.3970
Intercept = 59.1750
Correlation, R = 0.9541

Appendix A-5

Computer Output for Diss Metals Dixon Test

Program Dixon

It performs Dixon's Outlier Test for sample sizes of 25 or less.
It is based upon the description of the test in USEPA's Unified
Guidance (2009) and was tested against the sample case given therein.

Application of Dixon's outlier test to critical dissolved metals - Liberty Property
Selected alpha is 0.05

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
42.10	13.60	2.6101
56.60	13.60	2.6101
32.40	24.40	3.1946
32.40	32.40	3.4782
32.40	32.40	3.4782
24.40	32.40	3.4782
13.60	42.10	3.7400
13.60	56.60	4.0360

C value for straight concentrations = 0.337
C value for logarithmic concentrations (Clog) = 0.208
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (56.60) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (56.60) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
54.00	47.10	3.8523
48.60	48.60	3.8836
53.60	53.60	3.9815
64.60	53.90	3.9871
53.90	54.00	3.9890
54.30	54.30	3.9945
56.80	56.80	4.0395
47.10	64.60	4.1682

C value for straight concentrations = 0.487
C value for logarithmic concentrations (Clog) = 0.452
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (64.60) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (64.60) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
20100.00	17300.00	9.7585
19600.00	18100.00	9.8037
20700.00	18300.00	9.8147
22000.00	19600.00	9.8833
23000.00	20100.00	9.9085
17300.00	20700.00	9.9379
18100.00	22000.00	9.9988
18300.00	23000.00	10.0432

C value for straight concentrations = 0.204
C value for logarithmic concentrations (Clog) = 0.186
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (23000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (23000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.10	0.88	-0.1278
6.20	1.50	0.4055
1.50	1.50	0.4055
1.50	1.50	0.4055
1.50	3.50	1.2528
5.90	5.90	1.7750
3.50	6.10	1.8083
0.88	6.20	1.8245

C value for straight concentrations = 0.021
C value for logarithmic concentrations (Clog) = 0.011
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (6.20) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6.20) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
142.00	19.40	2.9653
26.00	19.40	2.9653
19.40	23.90	3.1739
50.70	26.00	3.2581
19.40	38.80	3.6584
23.90	38.80	3.6584
38.80	50.70	3.9259
38.80	142.00	4.9558

C value for straight concentrations = 0.745
C value for logarithmic concentrations (Clog) = 0.517
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (142.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (142.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
15300.00	8850.00	9.0882
15000.00	13600.00	9.5178
14800.00	14200.00	9.5610
16100.00	14800.00	9.6024
14800.00	14800.00	9.6024
14200.00	15000.00	9.6158
13600.00	15300.00	9.6356
8850.00	16100.00	9.6866

C value for straight concentrations = 0.320
C value for logarithmic concentrations (Clog) = 0.302
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (16100.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (16100.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
4.10	2.40	0.8755
17.00	3.30	1.1939
2.40	4.10	1.4110
4.20	4.20	1.4351
3.30	4.80	1.5686
4.80	4.90	1.5892
4.90	4.90	1.5892
4.90	17.00	2.8332

C value for straight concentrations = 0.883
C value for logarithmic concentrations (Clog) = 0.759
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (17.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (17.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.90	0.68	-0.3857
21.50	1.90	0.6419

1.90	1.90	0.6419
1.90	1.90	0.6419
1.90	4.40	1.4816
4.40	5.80	1.7579
5.80	5.90	1.7750
0.68	21.50	3.0681

C value for straight concentrations = 0.796
C value for logarithmic concentrations (Clog) = 0.533
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (21.50) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (21.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1130.00	774.00	6.6516
774.00	840.00	6.7334
840.00	1000.00	6.9078
1010.00	1010.00	6.9177
1000.00	1130.00	7.0300
1710.00	1240.00	7.1229
1240.00	1710.00	7.4442
1950.00	1950.00	7.5756

C value for straight concentrations = 0.216
C value for logarithmic concentrations (Clog) = 0.156
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1950.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1950.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved Sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1480.00	346.00	5.8464
346.00	368.00	5.9081
1210.00	1060.00	6.9660
368.00	1210.00	7.0984
1720.00	1370.00	7.2226
1370.00	1390.00	7.2371
1390.00	1480.00	7.2998
1060.00	1720.00	7.4501

C value for straight concentrations = 0.178
C value for logarithmic concentrations (Clog) = 0.097
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1720.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1720.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Dissolved zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
1.70	1.70	0.5306
3.80	3.60	1.2809
3.60	3.80	1.3350
6.70	5.70	1.7405
5.70	6.60	1.8871
6.60	6.70	1.9021
10.30	10.30	2.3321

C value for straight concentrations = 0.419
C value for logarithmic concentrations (Clog) = 0.239
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (10.30) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10.30) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
746.00	13.60	2.6101
520.00	13.60	2.6101
32.40	32.40	3.4782
1890.00	120.00	4.7875
120.00	245.00	5.5013
245.00	520.00	6.2538
13.60	746.00	6.6147
13.60	1890.00	7.5443

C value for straight concentrations = 0.610
C value for logarithmic concentrations (Clog) = 0.188
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (1890.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1890.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
119.00	84.70	4.4391
84.70	96.20	4.5664
139.00	111.00	4.7095
96.20	119.00	4.7791
129.00	123.00	4.8122
124.00	124.00	4.8203

123.00	129.00	4.8598
111.00	139.00	4.9345

C value for straight concentrations = 0.234
C value for logarithmic concentrations (Clog) = 0.203
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (139.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (139.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
164000.00	143000.00	11.8706
143000.00	157000.00	11.9640
183000.00	158000.00	11.9704
157000.00	164000.00	12.0076
185000.00	166000.00	12.0197
166000.00	183000.00	12.1172
183000.00	183000.00	12.1172
158000.00	185000.00	12.1281

C value for straight concentrations = 0.071
C value for logarithmic concentrations (Clog) = 0.066
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (185000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (185000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.68	0.68	-0.3857
3.10	0.88	-0.1278
1.50	1.30	0.2624
10.80	1.50	0.4055
3.10	3.10	1.1314
3.90	3.10	1.1314
1.30	3.90	1.3610
0.88	10.80	2.3795

C value for straight concentrations = 0.696
C value for logarithmic concentrations (Clog) = 0.406
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (10.80) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22

Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	2.20	0.7885
3.40	2.70	0.9933
2.70	2.70	0.9933
9.10	3.30	1.1939
2.70	3.30	1.1939
2.20	3.40	1.2238
3.30	6.70	1.9021
3.30	9.10	2.2083

C value for straight concentrations = 0.375
C value for logarithmic concentrations (Clog) = 0.252
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (9.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (9.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
8.10	0.74	-0.3011
4.50	0.81	-0.2107
0.74	2.70	0.9933
14.80	2.80	1.0296
2.70	4.50	1.5041
2.80	4.70	1.5476
4.70	8.10	2.0919
0.81	14.80	2.6946

C value for straight concentrations = 0.479
C value for logarithmic concentrations (Clog) = 0.207
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (14.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (14.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
3340.00	19.40	2.9653
4260.00	38.80	3.6584
19.40	38.80	3.6584
12400.00	516.00	6.2461
516.00	1570.00	7.3588
1570.00	3340.00	8.1137
38.80	4260.00	8.3570
38.80	12400.00	9.4255

C value for straight concentrations = 0.659

C value for logarithmic concentrations (Clog) = 0.185
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (12400.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (12400.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.20	0.1823
2.00	1.50	0.4055
1.20	1.70	0.5306
8.30	1.90	0.6419
1.70	2.00	0.6931
1.90	2.00	0.6931
2.00	2.00	0.6931
2.00	8.30	2.1163

C value for straight concentrations = 0.926
C value for logarithmic concentrations (Clog) = 0.832
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (8.30) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (8.30) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
75400.00	75400.00	11.2306
131000.00	89300.00	11.3998
89300.00	105000.00	11.5617
167000.00	106000.00	11.5712
127000.00	122000.00	11.7118
106000.00	127000.00	11.7519
122000.00	131000.00	11.7830
105000.00	167000.00	12.0257

C value for straight concentrations = 0.463
C value for logarithmic concentrations (Clog) = 0.388
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (167000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (167000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc

347.00	205.00	5.3230
277.00	253.00	5.5334
324.00	277.00	5.6240
456.00	324.00	5.7807
498.00	339.00	5.8260
339.00	347.00	5.8493
253.00	456.00	6.1225
205.00	498.00	6.2106

C value for straight concentrations = 0.171
C value for logarithmic concentrations (Clog) = 0.130
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (498.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (498.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
24.90	4.20	1.4351
16.60	4.60	1.5261
4.60	6.90	1.9315
46.20	11.80	2.4681
16.30	16.30	2.7912
11.80	16.60	2.8094
6.90	24.90	3.2149
4.20	46.20	3.8330

C value for straight concentrations = 0.512
C value for logarithmic concentrations (Clog) = 0.268
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (46.20) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (46.20) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
10400.00	6810.00	8.8261
6810.00	7750.00	8.9554
12100.00	10400.00	9.2496
7750.00	10600.00	9.2686
15300.00	12100.00	9.4010
15200.00	13200.00	9.4880
13200.00	15200.00	9.6291
10600.00	15300.00	9.6356

C value for straight concentrations = 0.013
C value for logarithmic concentrations (Clog) = 0.010
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum

value (15300.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (15300.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Sodium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
158000.00	24700.00	10.1146
55100.00	41300.00	10.6286
133000.00	55100.00	10.9169
24700.00	59300.00	10.9904
41300.00	59700.00	10.9971
59300.00	65000.00	11.0821
59700.00	133000.00	11.7981
65000.00	158000.00	11.9704

C value for straight concentrations = 0.214
C value for logarithmic concentrations (Clog) = 0.128
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (158000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (158000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved Sodium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
55100.00	24700.00	10.1146
133000.00	41300.00	10.6286
24700.00	55100.00	10.9169
41300.00	59300.00	10.9904
59300.00	59700.00	10.9971
59700.00	65000.00	11.0821
65000.00	133000.00	11.7981

C value for straight concentrations = 0.628
C value for logarithmic concentrations (Clog) = 0.425
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum
value (133000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (133000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Dissolved zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
64.80	8.40	2.1282
9.00	9.00	2.1972
167.00	16.10	2.7788

20.90	20.90	3.0397
33.70	33.70	3.5175
16.10	64.80	4.1713
8.40	167.00	5.1180

C value for straight concentrations = 0.644
C value for logarithmic concentrations (Clog) = 0.317
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (167.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (167.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
465.00	13.60	2.6101
124.00	13.60	2.6101
32.40	32.40	3.4782
3370.00	89.10	4.4898
89.10	124.00	4.8203
641.00	465.00	6.1420
13.60	641.00	6.4630
13.60	3370.00	8.1227

C value for straight concentrations = 0.813
C value for logarithmic concentrations (Clog) = 0.301
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (3370.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3370.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
21.20	9.80	2.2824
16.60	9.90	2.2925
12.00	12.00	2.4849
112.00	14.50	2.6741
14.50	16.60	2.8094
28.80	21.20	3.0540
9.90	28.80	3.3604
9.80	112.00	4.7185

C value for straight concentrations = 0.815
C value for logarithmic concentrations (Clog) = 0.560
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (112.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (112.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
27400.00	20700.00	9.9379
24800.00	21300.00	9.9665
27100.00	22200.00	10.0078
31100.00	24800.00	10.1186
34600.00	27100.00	10.2073
22200.00	27400.00	10.2183
21300.00	31100.00	10.3450
20700.00	34600.00	10.4516

C value for straight concentrations = 0.263
C value for logarithmic concentrations (Clog) = 0.220
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (34600.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (34600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.68	0.68	-0.3857
3.10	0.88	-0.1278
1.50	0.88	-0.1278
12.20	1.50	0.4055
11.30	3.10	1.1314
16.50	11.30	2.4248
0.88	12.20	2.5014
0.88	16.50	2.8034

C value for straight concentrations = 0.275
C value for logarithmic concentrations (Clog) = 0.103
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (16.50) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (16.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	1.50	0.4055
1.50	2.70	0.9933
2.70	2.70	0.9933
29.90	3.30	1.1939
2.70	3.30	1.1939
4.00	4.00	1.3863
3.30	6.70	1.9021
3.30	29.90	3.3979

C value for straight concentrations = 0.853
C value for logarithmic concentrations (Clog) = 0.622
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (29.90) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (29.90) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
4.50	0.74	-0.3011
4.00	0.81	-0.2107
0.74	0.81	-0.2107
22.80	1.20	0.1823
1.20	4.00	1.3863
4.20	4.20	1.4351
0.81	4.50	1.5041
0.81	22.80	3.1268

C value for straight concentrations = 0.832
C value for logarithmic concentrations (Clog) = 0.486
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (22.80) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (22.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2110.00	38.80	3.6584
1640.00	38.80	3.6584
483.00	483.00	6.1800
47000.00	833.00	6.7250
833.00	1640.00	7.4025
7470.00	2110.00	7.6544
38.80	7470.00	8.9187
38.80	47000.00	10.7579

C value for straight concentrations = 0.842
C value for logarithmic concentrations (Clog) = 0.259
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (47000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (47000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.20	0.1823
2.00	1.20	0.1823
1.20	1.50	0.4055
31.00	2.00	0.6931
1.20	2.00	0.6931
5.10	2.00	0.6931
2.00	5.10	1.6292
2.00	31.00	3.4340

C value for straight concentrations = 0.869
C value for logarithmic concentrations (Clog) = 0.555
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (31.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (31.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
17600.00	13400.00	9.5030
17200.00	14100.00	9.5539
17300.00	15500.00	9.6486
17700.00	16800.00	9.7291
16800.00	17200.00	9.7527
15500.00	17300.00	9.7585
14100.00	17600.00	9.7757
13400.00	17700.00	9.7813

C value for straight concentrations = 0.028
C value for logarithmic concentrations (Clog) = 0.025
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (17700.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (17700.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
80.80	4.90	1.5892
62.40	17.30	2.8507
17.30	33.80	3.5205
1750.00	62.40	4.1336
71.30	71.30	4.2669
290.00	80.80	4.3920
4.90	290.00	5.6699
33.80	1750.00	7.4674

C value for straight concentrations = 0.843
C value for logarithmic concentrations (Clog) = 0.389
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (1750.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1750.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7.60	1.80	0.5878
7.50	1.90	0.6419
1.90	7.50	2.0149
49.50	7.60	2.0281
12.00	11.10	2.4069
15.10	12.00	2.4849
1.80	15.10	2.7147
11.10	49.50	3.9020

C value for straight concentrations = 0.723
C value for logarithmic concentrations (Clog) = 0.364
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (49.50) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (49.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
774.00	161.00	5.0814
425.00	165.00	5.1059
391.00	391.00	5.9687
756.00	391.00	5.9687
391.00	425.00	6.0521
594.00	594.00	6.3869
161.00	756.00	6.6280
165.00	774.00	6.6516

C value for straight concentrations = 0.030
C value for logarithmic concentrations (Clog) = 0.015
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (774.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (774.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2340.00	346.00	5.8464

346.00	1800.00	7.4955
2270.00	1910.00	7.5549
2430.00	1930.00	7.5653
2340.00	2270.00	7.7275
1930.00	2340.00	7.7579
1800.00	2340.00	7.7579
1910.00	2430.00	7.7956

C value for straight concentrations = 0.143
C value for logarithmic concentrations (Clog) = 0.126
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2430.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2430.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Dissolved Zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
1.70	1.70	0.5306
9.90	4.70	1.5476
292.00	4.80	1.5686
8.30	8.30	2.1163
51.80	9.90	2.2925
4.80	51.80	3.9474
4.70	292.00	5.6768

C value for straight concentrations = 0.827
C value for logarithmic concentrations (Clog) = 0.336
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (292.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (292.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
42.10	13.60	2.6101
77.40	13.60	2.6101
32.40	24.40	3.1946
227.00	32.40	3.4782
32.40	32.40	3.4782
24.40	42.10	3.7400
13.60	77.40	4.3490
13.60	227.00	5.4250

C value for straight concentrations = 0.701
C value for logarithmic concentrations (Clog) = 0.382
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (227.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value

value (227.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
47.90	44.30	3.7910
62.90	47.90	3.8691
44.30	48.00	3.8712
51.30	49.20	3.8959
50.20	50.20	3.9160
79.20	51.30	3.9377
49.20	62.90	4.1415
48.00	79.20	4.3720

C value for straight concentrations = 0.521
C value for logarithmic concentrations (Clog) = 0.458
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (79.20) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (79.20) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
87000.00	87000.00	11.3737
93100.00	87800.00	11.3828
87800.00	91200.00	11.4208
100000.00	93100.00	11.4414
106000.00	95500.00	11.4669
99500.00	99500.00	11.5079
95500.00	100000.00	11.5129
91200.00	106000.00	11.5712

C value for straight concentrations = 0.330
C value for logarithmic concentrations (Clog) = 0.309
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (106000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (106000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
9.00	0.88	-0.1278
7.00	0.88	-0.1278
7.70	2.60	0.9555
14.40	6.50	1.8718
2.60	7.00	1.9459

6.50	7.70	2.0412
0.88	9.00	2.1972
0.88	14.40	2.6672

C value for straight concentrations = 0.399
C value for logarithmic concentrations (Clog) = 0.168
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (14.40) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (14.40) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	0.97	-0.0305
4.70	2.70	0.9933
2.70	2.70	0.9933
2.70	2.70	0.9933
2.70	3.30	1.1939
0.97	3.30	1.1939
3.30	4.70	1.5476
3.30	6.70	1.9021

C value for straight concentrations = 0.500
C value for logarithmic concentrations (Clog) = 0.390
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (6.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
4.50	0.74	-0.3011
5.70	0.74	-0.3011
0.74	0.81	-0.2107
0.74	0.81	-0.2107
1.10	1.10	0.0953
1.30	1.30	0.2624
0.81	4.50	1.5041
0.81	5.70	1.7405

C value for straight concentrations = 0.242
C value for logarithmic concentrations (Clog) = 0.116
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (5.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (5.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
353.00	19.40	2.9653
297.00	38.80	3.6584
19.40	38.80	3.6584
794.00	62.50	4.1352
62.50	120.00	4.7875
120.00	297.00	5.6937
38.80	353.00	5.8665
38.80	794.00	6.6771

C value for straight concentrations = 0.584
C value for logarithmic concentrations (Clog) = 0.269
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (794.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (794.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.20	0.1823
2.00	1.20	0.1823
1.20	1.20	0.1823
1.20	1.50	0.4055
1.20	1.90	0.6419
1.90	2.00	0.6931
2.00	2.00	0.6931
2.00	2.00	0.6931

C value for straight concentrations = 0.000
C value for logarithmic concentrations (Clog) = 0.000
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
48400.00	48400.00	10.7873
52400.00	49600.00	10.8117
49600.00	50900.00	10.8376
55300.00	52400.00	10.8667
54800.00	53200.00	10.8818
55600.00	54800.00	10.9114
53200.00	55300.00	10.9205
50900.00	55600.00	10.9259

C value for straight concentrations = 0.050
C value for logarithmic concentrations (Clog) = 0.047
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (55600.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (55600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
16.40	3.70	1.3083
20.00	4.90	1.5892
3.70	5.10	1.6292
36.30	9.90	2.2925
5.10	16.40	2.7973
9.90	20.00	2.9957
4.90	22.50	3.1135
22.50	36.30	3.5918

C value for straight concentrations = 0.439
C value for logarithmic concentrations (Clog) = 0.239
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (36.30) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (36.30) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
10.00	0.85	-0.1625
8.50	1.90	0.6419
4.70	3.90	1.3610
9.70	4.70	1.5476
1.90	6.60	1.8871
6.60	8.50	2.1401
0.85	9.70	2.2721
3.90	10.00	2.3026

C value for straight concentrations = 0.037
C value for logarithmic concentrations (Clog) = 0.018
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (10.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2650.00	1550.00	7.3460
2490.00	1780.00	7.4844
1550.00	1940.00	7.5704
1940.00	1940.00	7.5704
1780.00	2010.00	7.6059
3470.00	2490.00	7.8200
2010.00	2650.00	7.8823
1940.00	3470.00	8.1519

C value for straight concentrations = 0.485
C value for logarithmic concentrations (Clog) = 0.404
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (3470.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3470.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved Sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
13000.00	10400.00	9.2496
65400.00	13000.00	9.4727
13700.00	13200.00	9.4880
14000.00	13200.00	9.4880
10400.00	13700.00	9.5252
101000.00	14000.00	9.5468
13200.00	65400.00	11.0883
13200.00	101000.00	11.5229

C value for straight concentrations = 0.405
C value for logarithmic concentrations (Clog) = 0.212
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (101000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (101000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Dissolved zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
55.60	3.50	1.2528
5.60	3.60	1.2809
3.60	5.30	1.6677
5.30	5.60	1.7228
9.10	5.90	1.7750
3.50	9.10	2.2083
5.90	55.60	4.0182

C value for straight concentrations = 0.893
C value for logarithmic concentrations (Clog) = 0.654
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (55.60) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (55.60) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
646.00	13.60	2.6101
246.00	13.60	2.6101
880.00	24.40	3.1946
3770.00	246.00	5.5053
385.00	385.00	5.9532
24.40	646.00	6.4708
13.60	880.00	6.7799
13.60	3770.00	8.2348

C value for straight concentrations = 0.769
C value for logarithmic concentrations (Clog) = 0.259
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (3770.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3770.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
49.60	39.00	3.6636
54.30	43.40	3.7705
55.50	45.90	3.8265
81.90	47.70	3.8649
47.70	49.60	3.9040
45.90	54.30	3.9945
39.00	55.50	4.0164
43.40	81.90	4.4055

C value for straight concentrations = 0.686
C value for logarithmic concentrations (Clog) = 0.613
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (81.90) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (81.90) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
56200.00	51000.00	10.8396
63800.00	52500.00	10.8686

60500.00	54700.00	10.9096
85400.00	56200.00	10.9367
67000.00	60500.00	11.0104
54700.00	63800.00	11.0635
52500.00	67000.00	11.1124
51000.00	85400.00	11.3551

C value for straight concentrations = 0.559
C value for logarithmic concentrations (Clog) = 0.499
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (85400.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (85400.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
26.80	0.88	-0.1278
9.60	0.88	-0.1278
60.10	9.60	2.2618
264.00	13.90	2.6319
60.70	26.80	3.2884
13.90	60.10	4.0960
0.88	60.70	4.1059
0.88	264.00	5.5759

C value for straight concentrations = 0.773
C value for logarithmic concentrations (Clog) = 0.258
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (264.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (264.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	0.97	-0.0305
1.60	1.60	0.4700
2.70	2.70	0.9933
11.70	2.70	0.9933
2.70	3.30	1.1939
0.97	3.30	1.1939
3.30	6.70	1.9021
3.30	11.70	2.4596

C value for straight concentrations = 0.495
C value for logarithmic concentrations (Clog) = 0.280
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (11.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (11.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.20	0.81	-0.2107
4.00	0.81	-0.2107
8.10	2.30	0.8329
52.00	4.00	1.3863
8.50	6.20	1.8245
2.30	8.10	2.0919
0.81	8.50	2.1401
0.81	52.00	3.9512

C value for straight concentrations = 0.850
C value for logarithmic concentrations (Clog) = 0.435
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (52.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (52.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2220.00	38.80	3.6584
1490.00	38.80	3.6584
3190.00	561.00	6.3297
22900.00	1490.00	7.3065
2660.00	2220.00	7.7053
561.00	2660.00	7.8861
38.80	3190.00	8.0678
38.80	22900.00	10.0389

C value for straight concentrations = 0.862
C value for logarithmic concentrations (Clog) = 0.309
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (22900.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (22900.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.50	0.4055
2.00	1.90	0.6419
2.20	1.90	0.6419
20.90	2.00	0.6931
1.90	2.00	0.6931
1.90	2.20	0.7885

2.00	3.00	1.0986
3.00	20.90	3.0397

C value for straight concentrations = 0.942
C value for logarithmic concentrations (Clog) = 0.810
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (20.90) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (20.90) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
35200.00	30300.00	10.3189
39500.00	31200.00	10.3482
38700.00	35200.00	10.4688
49000.00	36500.00	10.5051
38300.00	38300.00	10.5532
36500.00	38700.00	10.5636
31200.00	39500.00	10.5841
30300.00	49000.00	10.7996

C value for straight concentrations = 0.534
C value for logarithmic concentrations (Clog) = 0.477
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (49000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (49000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
48.50	4.90	1.5892
56.20	12.60	2.5337
145.00	19.30	2.9601
370.00	48.50	3.8816
86.40	56.20	4.0289
12.60	86.40	4.4590
19.30	145.00	4.9767
4.90	370.00	5.9135

C value for straight concentrations = 0.630
C value for logarithmic concentrations (Clog) = 0.277
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (370.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (370.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S

Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
25.70	0.86	-0.1508
41.00	5.60	1.7228
37.80	11.40	2.4336
165.00	25.70	3.2465
47.20	37.80	3.6323
11.40	41.00	3.7136
0.86	47.20	3.8544
5.60	165.00	5.1059

C value for straight concentrations = 0.739
C value for logarithmic concentrations (Clog) = 0.370
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (165.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (165.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6880.00	4910.00	8.4990
5200.00	5200.00	8.5564
4910.00	5860.00	8.6759
8620.00	6150.00	8.7242
5860.00	6350.00	8.7562
6720.00	6720.00	8.8128
6150.00	6880.00	8.8364
6350.00	8620.00	9.0618

C value for straight concentrations = 0.509
C value for logarithmic concentrations (Clog) = 0.446
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (8620.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (8620.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved Sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
32000.00	11300.00	9.3326
133000.00	11600.00	9.3588
76700.00	12400.00	9.4255
24700.00	24700.00	10.1146
12400.00	32000.00	10.3735
11300.00	33900.00	10.4312
33900.00	76700.00	11.2477
11600.00	133000.00	11.7981

C value for straight concentrations = 0.464

C value for logarithmic concentrations (Clog) = 0.226
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (133000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (133000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Dissolved zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
30.30	6.80	1.9169
24.90	7.10	1.9601
262.00	16.70	2.8154
31.10	24.90	3.2149
16.70	30.30	3.4111
7.10	31.10	3.4372
6.80	262.00	5.5683

C value for straight concentrations = 0.905
C value for logarithmic concentrations (Clog) = 0.584
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (262.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (262.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
42.10	13.60	2.6101
182.00	13.60	2.6101
299.00	32.40	3.4782
326.00	42.10	3.7400
32.40	182.00	5.2040
244.00	244.00	5.4972
13.60	299.00	5.7004
13.60	326.00	5.7869

C value for straight concentrations = 0.086
C value for logarithmic concentrations (Clog) = 0.027
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (326.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (326.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc

7.10	7.10	1.9601
33.70	8.30	2.1163
15.10	10.00	2.3026
15.20	11.00	2.3979
17.70	15.10	2.7147
8.30	15.20	2.7213
11.00	17.70	2.8736
10.00	33.70	3.5175

C value for straight concentrations = 0.630
C value for logarithmic concentrations (Clog) = 0.460
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (33.70) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (33.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
10700.00	9900.00	9.2003
31200.00	10700.00	9.2780
17300.00	11300.00	9.3326
15600.00	13600.00	9.5178
16900.00	15600.00	9.6550
9900.00	16900.00	9.7351
13600.00	17300.00	9.7585
11300.00	31200.00	10.3482

C value for straight concentrations = 0.678
C value for logarithmic concentrations (Clog) = 0.551
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (31200.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (31200.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.68	0.68	-0.3857
7.20	0.88	-0.1278
1.50	0.88	-0.1278
12.10	1.50	0.4055
1.60	1.60	0.4700
10.20	7.20	1.9741
0.88	10.20	2.3224
0.88	12.10	2.4932

C value for straight concentrations = 0.169
C value for logarithmic concentrations (Clog) = 0.065
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum

value (12.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (12.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	0.97	-0.0305
0.98	0.98	-0.0202
2.70	2.70	0.9933
2.70	2.70	0.9933
2.70	2.70	0.9933
0.97	3.30	1.1939
3.30	3.30	1.1939
3.30	6.70	1.9021

C value for straight concentrations = 0.594
C value for logarithmic concentrations (Clog) = 0.368
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum
value (6.70) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (6.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
4.50	0.74	-0.3011
4.00	0.74	-0.3011
0.74	0.74	-0.3011
0.74	0.81	-0.2107
0.74	0.81	-0.2107
6.80	4.00	1.3863
0.81	4.50	1.5041
0.81	6.80	1.9169

C value for straight concentrations = 0.380
C value for logarithmic concentrations (Clog) = 0.186
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (6.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (6.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
700.00	38.80	3.6584
812.00	38.80	3.6584
843.00	147.00	4.9904

1190.00	594.00	6.3869
147.00	700.00	6.5511
594.00	812.00	6.6995
38.80	843.00	6.7370
38.80	1190.00	7.0817

C value for straight concentrations = 0.301
C value for logarithmic concentrations (Clog) = 0.101
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1190.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1190.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.20	0.1823
2.00	1.20	0.1823
1.20	1.50	0.4055
2.10	1.90	0.6419
1.20	2.00	0.6931
1.90	2.00	0.6931
2.00	2.00	0.6931
2.00	2.10	0.7419

C value for straight concentrations = 0.111
C value for logarithmic concentrations (Clog) = 0.087
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1480.00	1460.00	7.2862
10600.00	1480.00	7.2998
3930.00	1710.00	7.4442
2770.00	2380.00	7.7749
3490.00	2770.00	7.9266
1460.00	3490.00	8.1577
2380.00	3930.00	8.2764
1710.00	10600.00	9.2686

C value for straight concentrations = 0.731
C value for logarithmic concentrations (Clog) = 0.504
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (10600.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
124.00	29.00	3.3673
64.20	33.00	3.4965
92.90	41.60	3.7281
41.60	57.50	4.0518
120.00	64.20	4.1620
29.00	92.90	4.5315
57.50	120.00	4.7875
33.00	124.00	4.8203

C value for straight concentrations = 0.044
C value for logarithmic concentrations (Clog) = 0.025
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (124.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (124.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.90	0.68	-0.3857
6.10	0.68	-0.3857
1.90	1.90	0.6419
10.10	1.90	0.6419
1.90	5.90	1.7750
7.10	6.10	1.8083
0.68	7.10	1.9601
0.68	10.10	2.3125

C value for straight concentrations = 0.318
C value for logarithmic concentrations (Clog) = 0.131
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (10.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1510.00	1030.00	6.9373
5090.00	1510.00	7.3199
2880.00	1800.00	7.4955
2700.00	2490.00	7.8200
2970.00	2700.00	7.9010
1030.00	2880.00	7.9655
2490.00	2970.00	7.9963

1800.00	5090.00	8.5350

C value for straight concentrations = 0.592
C value for logarithmic concentrations (Clog) = 0.443
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (5090.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (5090.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved Sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
136000.00	56200.00	10.9367
770000.00	136000.00	11.8204
449000.00	284000.00	12.5567
343000.00	343000.00	12.7455
403000.00	346000.00	12.7542
56200.00	403000.00	12.9067
346000.00	449000.00	13.0148
284000.00	770000.00	13.5541

C value for straight concentrations = 0.506
C value for logarithmic concentrations (Clog) = 0.311
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (770000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (770000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Dissolved zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
1.70	1.70	0.5306
9.80	3.50	1.2528
3.60	3.50	1.2528
3.90	3.60	1.2809
18.00	3.90	1.3610
3.50	9.80	2.2824
3.50	18.00	2.8904

C value for straight concentrations = 0.503
C value for logarithmic concentrations (Clog) = 0.258
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (18.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (18.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
891.00	13.60	2.6101
635.00	13.60	2.6101
802.00	73.20	4.2932
3650.00	635.00	6.4536
73.20	802.00	6.6871
1040.00	891.00	6.7923
13.60	1040.00	6.9470
13.60	3650.00	8.2025

C value for straight concentrations = 0.718
C value for logarithmic concentrations (Clog) = 0.225
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (3650.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3650.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
52.50	14.10	2.6462
33.30	18.60	2.9232
32.00	26.20	3.2658
26.20	27.20	3.3032
29.10	29.10	3.3707
27.20	32.00	3.4657
18.60	33.30	3.5056
14.10	52.50	3.9608

C value for straight concentrations = 0.566
C value for logarithmic concentrations (Clog) = 0.439
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (52.50) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (52.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
69800.00	10300.00	9.2399
63000.00	11400.00	9.3414
39800.00	17900.00	9.7926
35900.00	35900.00	10.4885
35900.00	35900.00	10.4885
17900.00	39800.00	10.5916
11400.00	63000.00	11.0509
10300.00	69800.00	11.1534

C value for straight concentrations = 0.116
C value for logarithmic concentrations (Clog) = 0.057

Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (69800.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (69800.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7.80	0.88	-0.1278
3.10	0.88	-0.1278
8.50	3.10	1.1314
362.00	7.80	2.0541
25.00	8.50	2.1401
32.20	25.00	3.2189
0.88	32.20	3.4720
0.88	362.00	5.8916

C value for straight concentrations = 0.913
C value for logarithmic concentrations (Clog) = 0.402
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (362.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (362.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	2.90	1.0647
8.30	3.30	1.1939
8.90	3.30	1.1939
61.90	6.70	1.9021
2.90	8.30	2.1163
28.50	8.90	2.1861
3.30	28.50	3.3499
3.30	61.90	4.1255

C value for straight concentrations = 0.570
C value for logarithmic concentrations (Clog) = 0.265
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (61.90) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (61.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc

4.80	0.74	-0.3011
4.00	0.81	-0.2107
0.74	0.81	-0.2107
27.50	2.20	0.7885
2.20	4.00	1.3863
7.60	4.80	1.5686
0.81	7.60	2.0281
0.81	27.50	3.3142

C value for straight concentrations = 0.746
C value for logarithmic concentrations (Clog) = 0.365
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (27.50) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (27.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
3740.00	38.80	3.6584
3620.00	38.80	3.6584
2920.00	871.00	6.7696
17100.00	2920.00	7.9793
871.00	3620.00	8.1942
5760.00	3740.00	8.2268
38.80	5760.00	8.6587
38.80	17100.00	9.7468

C value for straight concentrations = 0.665
C value for logarithmic concentrations (Clog) = 0.179
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (17100.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (17100.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
14.90	2.00	0.6931
2.00	2.00	0.6931
12.60	2.00	0.6931
73.50	2.90	1.0647
2.90	12.60	2.5337
23.30	14.90	2.7014
2.00	23.30	3.1485
2.00	73.50	4.2973

C value for straight concentrations = 0.702
C value for logarithmic concentrations (Clog) = 0.319
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (73.50) may be considered a statistical outlier.

As Clog value is less than the critical point, the maximum value value (73.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5880.00	892.00	6.7935
4410.00	954.00	6.8607
2980.00	1500.00	7.3132
2590.00	2390.00	7.7790
2390.00	2590.00	7.8594
1500.00	2980.00	7.9997
954.00	4410.00	8.3916
892.00	5880.00	8.6793

C value for straight concentrations = 0.298
C value for logarithmic concentrations (Clog) = 0.158
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (5880.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (5880.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
275.00	52.90	3.9684
126.00	60.20	4.0977
153.00	125.00	4.8283
1130.00	126.00	4.8363
60.20	153.00	5.0304
580.00	275.00	5.6168
52.90	580.00	6.3630
125.00	1130.00	7.0300

C value for straight concentrations = 0.514
C value for logarithmic concentrations (Clog) = 0.227
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1130.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1130.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
31.20	4.50	1.5041
7.20	7.20	1.9741
10.40	10.40	2.3418
215.00	17.80	2.8792

17.80	30.30	3.4111
43.60	31.20	3.4404
4.50	43.60	3.7751
30.30	215.00	5.3706

C value for straight concentrations = 0.825
C value for logarithmic concentrations (Clog) = 0.470
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (215.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (215.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5530.00	526.00	6.2653
1850.00	642.00	6.4646
1370.00	1140.00	7.0388
1590.00	1370.00	7.2226
1140.00	1590.00	7.3715
1670.00	1670.00	7.4206
642.00	1850.00	7.5229
526.00	5530.00	8.6179

C value for straight concentrations = 0.753
C value for logarithmic concentrations (Clog) = 0.509
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (5530.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (5530.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Sodium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7790.00	6950.00	8.8465
47600.00	7370.00	8.9052
39500.00	7790.00	8.9606
9650.00	9650.00	9.1747
17200.00	15500.00	9.6486
15500.00	17200.00	9.7527
6950.00	39500.00	10.5841
7370.00	47600.00	10.7706

C value for straight concentrations = 0.201
C value for logarithmic concentrations (Clog) = 0.100
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (47600.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (47600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved Sodium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7790.00	6950.00	8.8465
39500.00	7370.00	8.9052
9650.00	7790.00	8.9606
17200.00	9650.00	9.1747
15500.00	15500.00	9.6486
6950.00	17200.00	9.7527
7370.00	39500.00	10.5841

C value for straight concentrations = 0.685
C value for logarithmic concentrations (Clog) = 0.478
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (39500.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (39500.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved zinc - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
23.00	23.00	3.1355
47.60	30.60	3.4210
147.00	47.60	3.8628
59.80	50.70	3.9259
113.00	59.80	4.0910
50.70	113.00	4.7274
30.60	147.00	4.9904

C value for straight concentrations = 0.274
C value for logarithmic concentrations (Clog) = 0.142
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (147.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (147.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Dissolved zinc - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.70	1.70	0.5306
23.00	23.00	3.1355
47.60	30.60	3.4210
59.80	47.60	3.8628
113.00	50.70	3.9259
50.70	59.80	4.0910
30.60	113.00	4.7274

C value for straight concentrations = 0.478

```
C value for logarithmic concentrations (Clog) =   0.152
Critical point from Table 12-1 =   0.507

As C value is less than the critical point, the maximum
value (113.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (113.00) cannot be considered a statistical outlier.
```

Appendix A-6a

Output from Kruskal-Wallis Intra-Group Analysis (Background)

PROGRAM KRUSKAL-WALLIS_SPATIAL

It evaluates the existence of significant differences
among medians of any group of wells
(Based on Section 17.1 of EPA's Unified Guidance)

Input Data

Upgradient Dissolved Metals Group
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Dissolved Aluminum in ug/L

MW-10	MW-22	MW-23
42.100	746	465
56.600	520	124
32.40	32.4	32.4
32.400	120	89.1
32.40	245	641
24.400	13.6	13.6
13.60	13.6	13.6
13.60		

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
13.00	22.00	19.00
14.00	20.00	17.00
10.00	10.00	10.00
10.00	16.00	15.00
10.00	18.00	21.00
7.00	3.50	3.50
3.50	3.50	3.50
3.50		
No. of Samples: 8	7	7
Rank Sum: 71.00	93.00	89.00
Rank Mean: 8.88	13.29	12.71

Kruskal-Wallis statistic corrected for ties: 2.15
Number of tied groups = 2
Number of ties per group:
1 6
2 5
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point,
the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Barium in ug/L

MW-10	MW-22	MW-23
54	119	21.2
48.6	84.7	16.6
53.6	139	12
64.6	96.2	14.5
53.9	129	28.8
54.3	124	9.9
56.8	123	9.8
47.1	111	

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
12.00	19.00	6.00
9.00	16.00	5.00
10.00	23.00	3.00
15.00	17.00	4.00
11.00	22.00	7.00
13.00	21.00	2.00
14.00	20.00	1.00
8.00	18.00	
No. of Samples: 8	8	7
Rank Sum: 92.00	156.00	28.00
Rank Mean: 11.50	19.50	4.00

Kruskal-Wallis statistic corrected for ties: 19.57
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.359) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.137) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (4.416) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Calcium in ug/L

MW-10	MW-22	MW-23
20100	164000	27400
19600	143000	24800
20700	183000	27100
22000	157000	31100
23000	185000	34600
17300	166000	22200
18100	183000	21300
18300	158000	20700

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
5.00	20.00	14.00
4.00	17.00	12.00
6.50	22.50	13.00
9.00	18.00	15.00
11.00	24.00	16.00
1.00	21.00	10.00
2.00	22.50	8.00
3.00	19.00	6.50
No. of Samples: 8	8	8

Rank Sum:	41.50	164.00	94.50
Rank Mean:	5.19	20.50	11.81

Kruskal-Wallis statistic corrected for ties: 18.89
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.331) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.874) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.457) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Chromium in ug/L

MW-10	MW-22	MW-23
6.1	0.68	0.68
6.2	3.1	3.1
1.5	1.5	1.5
1.5	10.8	12.2
1.5	3.1	11.3
5.9	3.9	16.5
3.5	1.3	0.88
0.88	0.88	0.88

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
19.00	1.50	1.50
20.00	14.00	14.00
10.00	10.00	10.00
10.00	21.00	23.00
10.00	14.00	22.00
18.00	17.00	24.00
16.00	7.00	4.50
4.50	4.50	4.50

No. of Samples:	8	8	8
Rank Sum:	107.50	89.00	103.50
Rank Mean:	13.44	11.13	12.94

Kruskal-Wallis statistic corrected for ties: 0.48
Number of tied groups = 4
Number of ties per group:
1 2
2 4
3 5
4 3
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Cobalt in ug/L

MW-10	MW-22	MW-23
6.700	6.700	6.700
0.980	3.4	1.5
2.700	2.700	2.700
2.700	9.1	2.700
2.700	2.700	4.0
0.970	2.2	3.300
3.300	3.300	3.300
3.300	3.300	

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
21.00	21.00	21.00
2.00	18.00	3.00
8.00	8.00	8.00
8.00	23.00	8.00
8.00	8.00	19.00
1.00	4.00	14.50
14.50	14.50	14.50
14.50	14.50	

No. of Samples:	8	8	7
Rank Sum:	77.00	111.00	88.00
Rank Mean:	9.63	13.87	12.57

Kruskal-Wallis statistic corrected for ties: 1.72
Number of tied groups = 3
Number of ties per group:
1 7
2 6
3 3
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Copper in ug/L

MW-10	MW-22	MW-23
4.500	8.1	4.5
4.000	4.5	4.0
0.740	0.74	0.74
0.740	14.8	22.8
0.88	2.7	1.2
0.99	2.8	4.2
1.5	4.7	0.81
0.810	0.81	0.81

Sample Value Ranks By Wells

MW-10 MW-22 MW-23

19.00	22.00	19.00
15.50	19.00	15.50
2.50	2.50	2.50
2.50	23.00	24.00
9.00	13.00	11.00
10.00	14.00	17.00
12.00	21.00	6.50
6.50	6.50	6.50

No. of Samples:	8	8	8
Rank Sum:	77.00	121.00	102.00
Rank Mean:	9.63	15.12	12.75

Kruskal-Wallis statistic corrected for ties: 2.46
Number of tied groups = 4
Number of ties per group:

1	4
2	4
3	2
4	3

95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Iron in ug/L

MW-10	MW-22	MW-23
26.000	3340	2110
19.40	4260	1640
50.7	19.4	483
19.40	516	833
23.900	1570	7470
38.80	38.8	38.8
38.80	38.8	38.8

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
5.00	19.00	18.00
2.00	20.00	17.00
12.00	2.00	13.00
2.00	14.00	15.00
4.00	16.00	21.00
8.50	8.50	8.50
8.50	8.50	8.50

No. of Samples:	7	7	7
Rank Sum:	42.00	88.00	101.00
Rank Mean:	6.00	12.57	14.43

Kruskal-Wallis statistic corrected for ties: 7.32
Number of tied groups = 2
Number of ties per group:

1	3
2	6

95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (1.981) < zc (2.2416), the median for well MW-10 is the same as well MW-22
As z* (2.541) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.560) < zc (2.2416), the median for well MW-22 is the same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Lead in ug/L

MW-10	MW-22	MW-23
1.500	1.500	1.500
2.000	2.000	2.000
1.200	1.200	1.200
1.200	1.7	1.200
1.200	1.900	5.1
1.900	2.000	2.000
2.000	2.000	2.000
4.2		

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
8.00	8.00	8.00
16.50	16.50	16.50
3.50	3.50	3.50
3.50	10.00	3.50
3.50	11.50	22.00
11.50	16.50	16.50
16.50	16.50	16.50
21.00		

No. of Samples:	8	7	7
Rank Sum:	84.00	82.50	86.50
Rank Mean:	10.50	11.79	12.36

Kruskal-Wallis statistic corrected for ties: 0.35
Number of tied groups = 4
Number of ties per group:
1 6
2 3
3 2
4 8
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Magnesium in ug/L

MW-10	MW-22	MW-23
15300	75400	17600
15000	131000	17200
14800	89300	17300
16100	167000	17700

14800	127000	16800
14200	106000	15500
13600	122000	14100
8850	105000	13400

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	9.00	17.00	15.00
	8.00	23.00	13.00
	6.50	18.00	14.00
	11.00	24.00	16.00
	6.50	22.00	12.00
	5.00	20.00	10.00
	3.00	21.00	4.00
	1.00	19.00	2.00
No. of Samples:	8	8	8
Rank Sum:	50.00	164.00	86.00
Rank Mean:	6.25	20.50	10.75

Kruskal-Wallis statistic corrected for ties: 16.99
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.031) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.273) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.758) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Manganese in ug/L

MW-10	MW-22	MW-23
4.1	347	80.8
2.4	277	62.4
4.2	324	17.3
3.3	456	71.3
4.8	498	290
4.9	339	4.9
4.9	253	33.8
	205	

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
3.00	20.00	13.00
1.00	16.00	11.00
4.00	18.00	9.00
2.00	21.00	12.00

5.00	22.00	17.00
7.00	19.00	7.00
7.00	15.00	10.00
	14.00	

No. of Samples:	7	8	7
Rank Sum:	29.00	145.00	79.00
Rank Mean:	4.14	18.13	11.29

Kruskal-Wallis statistic corrected for ties: 17.36
Number of tied groups = 1
Number of ties per group:
1 3
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.160) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.058) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.035) < zc (2.2416), the median for well MW-22 is the same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Mercury in ug/L

MW-10	MW-22	MW-23
0.065	0.2	0.065
0.065	20.9	0.065
0.048	0.39	0.048
0.048	39.4	0.048
0.048	9.3	0.048
0.073	12.8	0.073
0.073	3.2	0.073
0.073	3.7	0.073

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
8.50	17.00	8.50
8.50	23.00	8.50
3.50	18.00	3.50
3.50	24.00	3.50
3.50	21.00	3.50
13.50	22.00	13.50
13.50	19.00	13.50
13.50	20.00	13.50

No. of Samples:	8	8	8
Rank Sum:	68.00	164.00	68.00
Rank Mean:	8.50	20.50	8.50

Kruskal-Wallis statistic corrected for ties: 15.91
Number of tied groups = 3
Number of ties per group:
1 6

```
   2   4
   3   6
95% Chi-Square Distribution value at  2 degrees of freedom:   5.99

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
  at least one well has a median significantly larger or smaller than
  one or more other wells (at a probability of 95%).


              Results Of Post-Hoc Test For Each Compliance Well
 (Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
    Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

   Conclusions:
   Computed alpha used:  0.0250 for each post-hoc contrast

   As z* ( 3.394) > zc (2.2416), the median for well MW-10   is NOT same as well MW-22
   As z* ( 0.000) < zc (2.2416), the median for well MW-10   is the same as well MW-23
   As z* ( 3.394) > zc (2.2416), the median for well MW-22   is NOT same as well MW-23
==========================================================================================

                         PROGRAM KRUSKAL-WALLIS_SPATIAL

 Parameter: Dissolved Nickel       in ug/L
                  MW-10       MW-22       MW-23
                   5.900       24.9        7.6
                   1.900       16.6        7.5
                   1.900       4.6         1.9
                   1.900       46.2        12
                   4.4         16.3        15.1
                   5.8         11.8        1.8
                   0.680       6.9         11.1
                               4.2
 ------------------------------------------------------------------------------------------

                       Sample Value Ranks By Wells

                 MW-10       MW-22       MW-23
                 11.00       21.00       14.00
                  4.50       20.00       13.00
                  4.50        9.00        4.50
                  4.50       22.00       17.00
                  8.00       19.00       18.00
                 10.00       16.00        2.00
                  1.00       12.00       15.00
                              7.00
 ------------------------------------------------------------------------------------------
 No. of Samples:     7           8           7
 Rank Sum:       43.50      126.00       83.50
 Rank Mean:       6.21       15.75       11.93

Kruskal-Wallis statistic corrected for ties:   8.14
Number of tied groups =  1
Number of ties per group:
   1   4
95% Chi-Square Distribution value at  2 degrees of freedom:   5.99

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
  at least one well has a median significantly larger or smaller than
  one or more other wells (at a probability of 95%).


              Results Of Post-Hoc Test For Each Compliance Well
 (Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
    Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance
```

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.837) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.646) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (1.137) < zc (2.2416), the median for well MW-22 is the same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Potassium in ug/L

MW-10	MW-22	MW-23
1130	10400	774
774	6810	425
840	12100	391
1010	7750	756
1000	15300	391
1710	15200	594
1240	13200	161
1950	10600	165

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	13.00	19.00	8.50
	8.50	17.00	5.00
	10.00	21.00	3.50
	12.00	18.00	7.00
	11.00	24.00	3.50
	15.00	23.00	6.00
	14.00	22.00	1.00
	16.00	20.00	2.00
No. of Samples:	8	8	8
Rank Sum:	99.50	164.00	36.50
Rank Mean:	12.44	20.50	4.56

Kruskal-Wallis statistic corrected for ties: 20.34
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.280) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.227) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (4.508) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Sodium in ug/L

MW-10	MW-22	MW-23
1480	158000	2340
346	55100	346
1210	133000	2270
368	24700	2430
1720	41300	2340
1370	59300	1930
1390	59700	1800
1060	65000	1910

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	8.00	24.00	14.50
	1.50	19.00	1.50
	5.00	23.00	13.00
	3.00	17.00	16.00
	9.00	18.00	14.50
	6.00	20.00	12.00
	7.00	21.00	10.00
	4.00	22.00	11.00
No. of Samples:	8	8	8
Rank Sum:	43.50	164.00	92.50
Rank Mean:	5.44	20.50	11.56

Kruskal-Wallis statistic corrected for ties: 18.38
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.260) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.732) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.528) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Zinc in ug/L

MW-10	MW-22	MW-23
1.7	1.7	1.7
1.7	64.8	1.7
3.8	9.0	9.9
3.6	20.9	8.3
6.7	33.7	51.8
5.7	16.1	4.8
6.6	8.4	4.7
10.3		

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
3.00	3.00	3.00
3.00	22.00	3.00
7.00	15.00	16.00
6.00	19.00	13.00
12.00	20.00	21.00
10.00	18.00	9.00
11.00	14.00	8.00
17.00		

No. of Samples:	8	7	7
Rank Sum:	69.00	111.00	73.00
Rank Mean:	8.63	15.86	10.43

Kruskal-Wallis statistic corrected for ties: 4.97
Number of tied groups = 1
Number of ties per group:
1 5
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

Appendix A-6b

Output from Kruskal-Wallis Intra-Group Analysis (Downgradient)

PROGRAM KRUSKAL-WALLIS_SPATIAL

It evaluates the existence of significant differences
among medians of any group of wells
(Based on Section 17.1 of EPA's Unified Guidance)

Input Data

Downgradient Dissolved Metals Group
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Dissolved Aluminum in ug/L

MW-15S	MW-16S	MW-17S	MW-24
42.10	646	42.1	891
77.4	246	182	635
32.40	880	299	802
32.40	385	326	73.2
24.40	24.4	32.4	1040
13.60	13.6	244	13.6
13.60	13.6	13.6	13.6
		13.6	

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	14.50	25.00	14.50	28.00
	17.00	20.00	18.00	24.00
	12.00	27.00	21.00	26.00
	12.00	23.00	22.00	16.00
	9.50	9.50	12.00	29.00
	4.50	4.50	19.00	4.50
	4.50	4.50	4.50	4.50
			4.50	
No. of Samples:	7	7	8	7
Rank Sum:	74.00	113.50	115.50	132.00
Rank Mean:	10.57	16.21	14.44	18.86

Kruskal-Wallis statistic corrected for ties: 3.59
Number of tied groups = 4
Number of ties per group:

1	8
2	2
3	3
4	2

95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point,
the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Barium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
47.9	49.6	7.1	33.3
62.9	54.3	15.1	32
44.3	55.5	15.2	26.2
51.3	47.7	17.7	29.1
50.2	45.9	8.3	27.2
79.2	39.0	11	18.6
49.2	43.4	10	14.1

48.0

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
20.00	23.00	1.00	14.00
28.00	26.00	6.00	13.00
17.00	27.00	7.00	10.00
25.00	19.00	8.00	12.00
24.00	18.00	2.00	11.00
29.00	15.00	4.00	9.00
22.00	16.00	3.00	5.00
21.00			
No. of Samples: 8	7	7	7
Rank Sum: 186.00	144.00	31.00	74.00
Rank Mean: 23.25	20.57	4.43	10.57

Kruskal-Wallis statistic corrected for ties: 23.19
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (0.608) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (4.271) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (2.877) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (3.547) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (2.197) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (1.350) < zc (2.3959), the median for well MW-17S is the same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Calcium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
87000	56200	10700	69800
93100	63800	17300	63000
87800	60500	15600	39800
100000	67000	16900	35900
106000	54700	9900	35900
99500	52500	13600	17900
95500	51000	11300	11400
91200			10300

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
23.00	17.00	3.00	22.00
26.00	20.00	9.00	19.00
24.00	18.00	7.00	13.00
29.00	21.00	8.00	11.50
30.00	16.00	1.00	11.50

28.00	15.00	6.00	10.00
27.00	14.00	4.00	5.00
25.00			2.00

No. of Samples:	8	7	7	8
Rank Sum:	212.00	121.00	38.00	94.00
Rank Mean:	26.50	17.29	5.43	11.75

Kruskal-Wallis statistic corrected for ties: 23.40
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (2.022) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (4.625) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (3.351) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (2.520) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (1.215) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (1.387) < zc (2.3959), the median for well MW-17S is the same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Chromium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
9.0	26.8	0.68	7.8
7.0	9.6	7.2	3.1
7.7	60.1	1.5	8.5
14.4	264	12.1	362
2.6	60.7	1.6	25
6.5	13.9	10.2	32.2
0.88	0.88	0.88	0.88
0.88	0.88	0.88	0.88

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
20.00	27.00	1.00	18.00
15.00	21.00	16.00	13.00
17.00	29.00	10.00	19.00
25.00	31.00	23.00	32.00
12.00	30.00	11.00	26.00
14.00	24.00	22.00	28.00
5.50	5.50	5.50	5.50
5.50	5.50	5.50	5.50

No. of Samples:	8	8	8	8
Rank Sum:	114.00	173.00	94.00	147.00
Rank Mean:	14.25	21.63	11.75	18.37

Kruskal-Wallis statistic corrected for ties: 5.30
Number of tied groups = 1

Number of ties per group:
1 8
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Cobalt in ug/L

MW-15S	MW-16S	MW-17S	MW-24
6.700	6.700	6.700	6.7
4.7	1.6	0.980	8.3
2.700	2.7	2.700	8.9
2.700	11.7	2.700	61.9
2.700	2.70	2.700	2.9
0.970	0.970	0.970	28.5
3.300	3.300	3.300	3.3
3.300	3.300	3.300	3.3

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	25.50	25.50	25.50	25.50
	23.00	5.00	4.00	28.00
	9.50	9.50	9.50	29.00
	9.50	30.00	9.50	32.00
	9.50	9.50	9.50	14.00
	2.00	2.00	2.00	31.00
	18.50	18.50	18.50	18.50
	18.50	18.50	18.50	18.50
No. of Samples:	8	8	8	8
Rank Sum:	116.00	118.50	97.00	196.50
Rank Mean:	14.50	14.81	12.12	24.56

Kruskal-Wallis statistic corrected for ties: 8.56
Number of tied groups = 4
Number of ties per group:
1 3
2 8
3 8
4 4
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (0.067) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.506) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (2.145) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (0.573) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (2.079) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.652) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Copper in ug/L

MW-15S	MW-16S	MW-17S	MW-24
4.500	6.2	4.500	4.8
5.7	4.0	4.000	4.0
0.740	8.1	0.740	0.74
0.740	52	0.740	27.5
1.1	8.5	0.740	2.2
1.3	2.3	6.8	7.6
0.810	0.81	0.810	0.81
0.810	0.81	0.810	0.81

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	22.50	26.00	22.50	24.00
	25.00	20.00	20.00	20.00
	3.50	29.00	3.50	3.50
	3.50	32.00	3.50	31.00
	15.00	30.00	3.50	17.00
	16.00	18.00	27.00	28.00
	10.50	10.50	10.50	10.50
	10.50	10.50	10.50	10.50
No. of Samples:	8	8	8	8
Rank Sum:	106.50	176.00	101.00	144.50
Rank Mean:	13.31	22.00	12.62	18.06

Kruskal-Wallis statistic corrected for ties: 5.38
Number of tied groups = 4
Number of ties per group:

1	6
2	8
3	3
4	2

95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Iron in ug/L

MW-15S	MW-16S	MW-17S	MW-24
353	2220	700	3740
297	1490	812	3620
19.4	3190	843	2920
62.5	2660	1190	871
120	561	147	5760
38.8	38.8	594	38.8
38.8	38.8	38.8	38.8
		38.8	

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
14.00	23.00	17.00	28.00
13.00	22.00	18.00	27.00

1.00	26.00	19.00	25.00
10.00	24.00	21.00	20.00
11.00	15.00	12.00	29.00
5.50	5.50	16.00	5.50
5.50	5.50	5.50	5.50
		5.50	

No. of Samples:	7	7	8	7
Rank Sum:	60.00	121.00	114.00	140.00
Rank Mean:	8.57	17.29	14.25	20.00

Kruskal-Wallis statistic corrected for ties: 7.12
Number of tied groups = 1
Number of ties per group:
1 8
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Lead in ug/L

MW-15S	MW-16S	MW-17S	MW-24
1.500	1.5	1.500	14.9
2.000	2.0	2.000	2.0
1.200	2.2	1.200	12.6
1.2	1.9	2.1	73.5
1.200	1.9	1.200	2.9
1.900	2.0	1.900	23.3
2.000	3.0	2.000	2.0
2.000		2.000	2.0

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
7.00	7.00	7.00	29.00
18.00	18.00	18.00	18.00
3.00	25.00	3.00	28.00
3.00	10.50	24.00	31.00
3.00	10.50	3.00	26.00
10.50	18.00	10.50	30.00
18.00	27.00	18.00	18.00
18.00		18.00	18.00

No. of Samples:	8	7	8	8
Rank Sum:	80.50	116.00	101.50	198.00
Rank Mean:	10.06	16.57	12.69	24.75

Kruskal-Wallis statistic corrected for ties: 12.55
Number of tied groups = 4
Number of ties per group:
1 5
2 3
3 4
4 11
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.383) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.577) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.231) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (0.825) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.738) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.653) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Magnesium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
48400	35200	1480	5880
52400	39500	3930	4410
49600	38700	2770	2980
55300	49000	3490	2590
54800	38300	1460	2390
55600	36500	2380	1500
53200	31200	1710	954
50900	30300		892

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	23.00	18.00	4.00	15.00
	27.00	22.00	13.00	14.00
	25.00	21.00	10.00	11.00
	30.00	24.00	12.00	9.00
	29.00	20.00	3.00	8.00
	31.00	19.00	7.00	5.00
	28.00	17.00	6.00	2.00
	26.00	16.00		1.00
No. of Samples:	8	8	7	8
Rank Sum:	219.00	157.00	55.00	65.00
Rank Mean:	27.37	19.62	7.86	8.13

Kruskal-Wallis statistic corrected for ties: 25.41
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.705) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (4.148) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (4.234) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (2.501) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S

As z* (2.530) > zc (2.3959), the median for well MW-16S is NOT same as well MW-24
As z* (0.057) < zc (2.3959), the median for well MW-17S is the same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Manganese in ug/L

MW-15S	MW-16S	MW-17S	MW-24
16.4	48.5	124	275
20	56.2	64.2	126
3.7	145	92.9	153
36.3	86.4	41.6	1130
5.1	12.6	120	60.2
9.9	19.3	29	580
4.9	4.9	57.5	52.9
22.5		33	125

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	7.00	15.00	24.00	29.00
	9.00	17.00	20.00	26.00
	1.00	27.00	22.00	28.00
	13.00	21.00	14.00	31.00
	4.00	6.00	23.00	19.00
	5.00	8.00	11.00	30.00
	2.50	2.50	18.00	16.00
	10.00		12.00	25.00
No. of Samples:	8	7	8	8
Rank Sum:	51.50	96.50	144.00	204.00
Rank Mean:	6.44	13.79	18.00	25.50

Kruskal-Wallis statistic corrected for ties: 18.39
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.562) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (2.543) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (4.193) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (0.896) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (2.489) > zc (2.3959), the median for well MW-16S is NOT same as well MW-24
As z* (1.650) < zc (2.3959), the median for well MW-17S is the same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Nickel in ug/L

MW-15S	MW-16S	MW-17S	MW-24
10	25.7	5.9	31.2

8.5	41	6.1	7.2
4.7	37.8	1.9	10.4
9.7	47.2	10.1	17.8
1.9	11.4	1.9	43.6
6.6	0.86	7.1	4.5
0.85	5.6	0.68	30.3
3.9		0.68	

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	19.00	24.00	12.00	26.00
	17.00	28.00	13.00	16.00
	10.00	27.00	6.00	21.00
	18.00	30.00	20.00	23.00
	6.00	22.00	6.00	29.00
	14.00	4.00	15.00	9.00
	3.00	11.00	1.50	25.00
	8.00		1.50	
No. of Samples:	8	7	8	7
Rank Sum:	95.00	146.00	75.00	149.00
Rank Mean:	11.88	20.86	9.38	21.29

Kruskal-Wallis statistic corrected for ties: 10.86
Number of tied groups = 2
Number of ties per group:
1 2
2 3
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.971) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.568) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (2.065) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (2.520) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (0.091) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.614) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Potassium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
2650	6880	1510	1850
2490	5200	2880	1370
1550	4910	2700	1590
1940	8620	2970	1140
1780	5860	1030	1670
3470	6720	2490	642
2010	6150	1800	526
1940	6350		

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
18.00	29.00	6.00	12.00
16.50	24.00	20.00	5.00
7.00	23.00	19.00	8.00
13.50	30.00	21.00	4.00
10.00	25.00	3.00	9.00
22.00	28.00	16.50	2.00
15.00	26.00	11.00	1.00
13.50	27.00		
No. of Samples: 8	8	7	7
Rank Sum: 115.50	212.00	96.50	41.00
Rank Mean: 14.44	26.50	13.79	5.86

Kruskal-Wallis statistic corrected for ties: 21.28
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (2.740) > zc (2.3959), the median for well MW-15S is NOT same as well MW-16S
As z* (0.143) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (1.883) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (2.791) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (4.531) > zc (2.3959), the median for well MW-16S is NOT same as well MW-24
As z* (1.685) < zc (2.3959), the median for well MW-17S is the same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Sodium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
13000	32000	136000	7790
65400	133000	770000	47600
13700	76700	449000	39500
14000	24700	343000	9650
10400	12400	403000	17200
101000	11300	56200	15500
13200	33900	346000	6950
13200	11600	284000	7370

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
9.00	17.00	26.00	3.00
22.00	25.00	32.00	20.00
12.00	23.00	31.00	19.00
13.00	16.00	28.00	4.00
5.00	8.00	30.00	15.00
24.00	6.00	21.00	14.00

10.50	18.00	29.00	1.00
10.50	7.00	27.00	2.00

No. of Samples:	8	8	8	8
Rank Sum:	106.00	120.00	224.00	78.00
Rank Mean:	13.25	15.00	28.00	9.75

Kruskal-Wallis statistic corrected for ties: 17.33
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (0.373) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (3.145) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (0.746) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (2.772) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (1.119) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.891) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Dissolved Zinc in ug/L

MW-15S	MW-16S	MW-17S	MW-24
1.7	1.7	1.7	1.7
5.6	30.3	1.7	23
3.6	24.9	9.8	47.6
5.3	31.1	3.6	147
9.1	16.7	3.9	59.8
3.5	7.1	18.0	113
5.9	6.8	3.5	50.7
		3.5	30.6

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
3.00	3.00	3.00	3.00
13.00	23.00	3.00	21.00
9.50	22.00	18.00	26.00
12.00	25.00	9.50	30.00
17.00	19.00	11.00	28.00
7.00	16.00	20.00	29.00
14.00	15.00	7.00	27.00
		7.00	24.00

No. of Samples:	7	7	8	8
Rank Sum:	75.50	123.00	78.50	188.00
Rank Mean:	10.79	17.57	9.81	23.50

Kruskal-Wallis statistic corrected for ties: 12.41
Number of tied groups = 3
Number of ties per group:

```
   1    5
   2    3
   3    2
95% Chi-Square Distribution value at  3 degrees of freedom:   7.81

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
  at least one well has a median significantly larger or smaller than
  one or more other wells (at a probability of 95%).


              Results Of Post-Hoc Test For Each Compliance Well
 (Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
    Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

   Conclusions:
   Computed alpha used:  0.0167 for each post-hoc contrast

   As z* ( 1.442) < zc (2.3959), the median for well MW-15S  is the same as well MW-16S
   As z* ( 0.214) < zc (2.3959), the median for well MW-15S  is the same as well MW-17S
   As z* ( 2.791) > zc (2.3959), the median for well MW-15S  is NOT same as well MW-24
   As z* ( 1.703) < zc (2.3959), the median for well MW-16S  is the same as well MW-17S
   As z* ( 1.301) < zc (2.3959), the median for well MW-16S  is the same as well MW-24
   As z* ( 3.110) > zc (2.3959), the median for well MW-17S  is NOT same as well MW-24
```

Appendix A-7

Output Results for Parametric ANOVA Inter-Group Analysis Diss Metals

Program ANOVA-Bonferroni

Performs one-way analysis of variance comparing downgradient values to background values
It then performs the post-hoc Bonferroni t-test on each compliance well
if hypothesis of equal well means is rejected in the ANOVA analysis.

Based on Section 17.1 of the USEPA Unified Guidance for
Statistical Analysis Of Groundwater Monitoring Data At RCRA Facilities, March 2009

==========

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Barium in ug/L
Input Values:

Bkgd well(s)		---> | Compliance wells --->				
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
54.0	119.0	21.2	47.9	49.6	7.1	33.3
48.6	84.7	16.6	62.9	54.3	15.1	32.0
53.6	139.0	12.0	44.3	55.5	15.2	26.2
64.6	96.2	14.5	51.3	47.7	17.7	29.1
53.9	129.0	28.8	50.2	45.9	8.3	27.2
54.3	124.0	9.9	79.2	39.0	11.0	18.6
56.8	123.0	9.8	49.2	43.4	10.0	14.1
47.1	111.0		48.0			
Well means: 54.1	115.7	16.1	54.1	47.9	12.1	25.8
Backgd mean: 64.0						
Overall mean: 48.2						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	1.87E+04	4	4.67E+03	5.17
Error (within wells)	4.25E+04	47	9.04E+02	
Total	6.11E+04	51		

As F-Statistic is > the 5 percent critical point (2.57),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	54.1	47.9	12.1	25.8
Computed t statistic (t*):	-0.80	-1.24	-4.00	-2.94
Critical table value (tc):	2.32	2.32	2.32	2.32
Well mean significantly greater than background?	no	no	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05

Parameter: Dissolved Calcium in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
20100.0	164000.0	27400.0	87000.0	56200.0	10700.0	69800.0
19600.0	143000.0	24800.0	93100.0	63800.0	17300.0	63000.0
20700.0	183000.0	27100.0	87800.0	60500.0	15600.0	39800.0
22000.0	157000.0	31100.0	100000.0	67000.0	16900.0	35900.0
23000.0	185000.0	34600.0	106000.0	54700.0	9900.0	35900.0
17300.0	166000.0	22200.0	99500.0	52500.0	13600.0	17900.0
18100.0	183000.0	21300.0	95500.0	51000.0	11300.0	11400.0
18300.0	158000.0	20700.0	91200.0			10300.0
Well means: 19887.5	167375.0	26150.0	95012.5	57957.1	13614.3	35500.0

Backgd mean: 71137.5
Overall mean: 60229.6

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	3.27E+10	4	8.17E+09	3.42
Error (within wells)	1.17E+11	49	2.39E+09	
Total	1.50E+11	53		

As F-Statistic is > the 5 percent critical point (2.56),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	95012.5	57957.1	13614.3	35500.0
Computed t statistic (t*):	1.20	-0.63	-2.74	-1.79
Critical table value (tc):	2.31	2.31	2.31	2.31
Well mean significantly greater than background?	no	no	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Iron par in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
26.0	3340.0	2110.0	353.0	2220.0	700.0	3740.0
19.4	4260.0	1640.0	297.0	1490.0	812.0	3620.0
50.7	19.4	483.0	19.4	3190.0	843.0	2920.0
19.4	516.0	833.0	62.5	2660.0	1190.0	871.0
23.9	1570.0	7470.0	120.0	561.0	147.0	5760.0
38.8	38.8	38.8	38.8	38.8	594.0	38.8
38.8	38.8	38.8	38.8	38.8	38.8	38.8
					38.8	
Well means: 31.0	1397.6	1801.9	132.8	1456.9	545.4	2426.9

Backgd mean: 1076.8
Overall mean: 1101.9

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	2.22E+07	4	5.56E+06	2.25
Error (within wells)	1.11E+08	45	2.47E+06	
Total	1.33E+08	49		

As F-Statistic is <= the 5 percent critical point (2.58),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Magnesium in ug/L
Input Values:

	Bkgd well(s) --->			Compliance wells --->			
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	15300.0	75400.0	17600.0	48400.0	35200.0	1480.0	5880.0
	15000.0	131000.0	17200.0	52400.0	39500.0	3930.0	4410.0
	14800.0	89300.0	17300.0	49600.0	38700.0	2770.0	2980.0
	16100.0	167000.0	17700.0	55300.0	49000.0	3490.0	2590.0
	14800.0	127000.0	16800.0	54800.0	38300.0	1460.0	2390.0
	14200.0	106000.0	15500.0	55600.0	36500.0	2380.0	1500.0
	13600.0	122000.0	14100.0	53200.0	31200.0	1710.0	954.0
	8850.0	105000.0	13400.0	50900.0	30300.0		892.0
Well means:	14081.3	115337.5	16200.0	52525.0	37337.5	2460.0	2699.5

Backgd mean: 48539.6
Overall mean: 34957.6

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	2.27E+10	4	5.66E+09	4.76
Error (within wells)	5.95E+10	50	1.19E+09	
Total	8.22E+10	54		

As F-Statistic is > the 5 percent critical point (2.56),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	52525.0	37337.5	2460.0	2699.5
Computed t statistic (t*):	0.28	-0.80	-3.11	-3.26
Critical table value (tc):	2.31	2.31	2.31	2.31
Well mean significantly greater than background?	no	no	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Manganese in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
4.1	347.0	80.8	16.4	48.5	124.0	275.0
2.4	277.0	62.4	20.0	56.2	64.2	126.0
4.2	324.0	17.3	3.7	145.0	92.9	153.0
3.3	456.0	71.3	36.3	86.4	41.6	1130.0
4.8	498.0	290.0	5.1	12.6	120.0	60.2
4.9	339.0	4.9	9.9	19.3	29.0	580.0
4.9	253.0	33.8	4.9	4.9	57.5	52.9
	205.0		22.5		33.0	125.0
Well means: 4.1	337.4	80.1	14.9	53.3	70.3	312.8
Backgd mean: 149.5						
Overall mean: 129.1						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	4.51E+05	4	1.13E+05	3.42
Error (within wells)	1.58E+06	48	3.30E+04	
Total	2.03E+06	52		

As F-Statistic is > the 5 percent critical point (2.57),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	14.9	53.3	70.3	312.8
Computed t statistic (t*):	-1.80	-1.22	-1.06	2.18
Critical table value (tc):	2.31	2.31	2.31	2.31
Well mean significantly greater than background?	no	no	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Nickel p in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
5.9	24.9	7.6	10.0	25.7	5.9	31.2

	1.9	16.6	7.5	8.5	41.0	6.1	7.2
	1.9	4.6	1.9	4.7	37.8	1.9	10.4
	1.9	46.2	12.0	9.7	47.2	10.1	17.8
	4.4	16.3	15.1	1.9	11.4	1.9	43.6
	5.8	11.8	1.8	6.6	0.9	7.1	4.5
	0.7	6.9	11.1	0.9	5.6	0.7	30.3
		4.2		3.9		0.7	
Well means:	3.2	16.4	8.1	5.8	24.2	4.3	20.7
Backgd mean:	9.6						
Overall mean:	11.7						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	2.48E+03	4	6.21E+02	5.10
Error (within wells)	5.72E+03	47	1.22E+02	
Total	8.21E+03	51		

As F-Statistic is > the 5 percent critical point (2.57),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	5.8	24.2	4.3	20.7
Computed t statistic (t*):	-0.84	3.06	-1.16	2.32
Critical table value (tc):	2.32	2.32	2.32	2.32
Well mean significantly greater than background?	no	yes	no	yes

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Potassium in ug/L
Input Values:

	Bkgd well(s)		---> | Compliance wells --->				
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	1130.0	10400.0	774.0	2650.0	6880.0	1510.0	1850.0
	774.0	6810.0	425.0	2490.0	5200.0	2880.0	1370.0
	840.0	12100.0	391.0	1550.0	4910.0	2700.0	1590.0
	1010.0	7750.0	756.0	1940.0	8620.0	2970.0	1140.0
	1000.0	15300.0	391.0	1780.0	5860.0	1030.0	1670.0
	1710.0	15200.0	594.0	3470.0	6720.0	2490.0	642.0
	1240.0	13200.0	161.0	2010.0	6150.0	1800.0	526.0
	1950.0	10600.0	165.0	1940.0	6350.0		
Well means:	1206.7	11420.0	457.1	2228.7	6336.2	2197.1	1255.4
Backgd mean:	4361.3						
Overall mean:	3654.8						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of	Sums of	Degrees of	Mean Squares	F-Statistic

Variation	Squares	Freedom		
Between wells	1.41E+08	4	3.52E+07	2.51
Error (within wells)	6.88E+08	49	1.40E+07	
Total	8.29E+08	53		

As F-Statistic is <= the 5 percent critical point (2.56),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of diss metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Dissolved Zinc in ug/L
Input Values:

Bkgd well(s)		---> | Compliance wells --->				
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.7	1.7	1.7	1.7	1.7	1.7	1.7
1.7	64.8	1.7	5.6	30.3	1.7	23.0
3.8	9.0	9.9	3.6	24.9	9.8	47.6
3.6	20.9	8.3	5.3	31.1	3.6	147.0
6.7	33.7	51.8	9.1	16.7	3.9	59.8
5.7	16.1	4.8	3.5	7.1	18.0	113.0
6.6	8.4	4.7	5.9	6.8	3.5	50.7
10.3					3.5	30.6
Well means: 5.0	22.1	11.8	5.0	16.9	5.7	59.2
Backgd mean: 12.6						
Overall mean: 18.3						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	1.66E+04	4	4.15E+03	8.40
Error (within wells)	2.32E+04	47	4.94E+02	
Total	3.98E+04	51		

As F-Statistic is > the 5 percent critical point (2.57),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	5.0	16.9	5.7	59.2
Computed t statistic (t*):	-0.79	0.45	-0.75	5.07
Critical table value (tc):	2.32	2.32	2.32	2.32
Well mean significantly greater than background?	no	no	no	yes

Appendix A-8

Output Results for Kruskal-Wallis Inter-Group Analysis Diss Metals

Program KruskalWallis-PostHoc

It evaluates the existence of significant differences
among medians of upgradient and downgradient wells
(Based on Section 17.1 of EPA's Unified Guidance)

INPUT DATA

Comparing Diss Metals in Downgradient wells to background using Kruskal-Wallis test
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Dissolved Aluminum in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
42.10	746	465	42.10	646	42.1	891
56.60	520	124	77.4	246	182	635
32.40	32.4	32.4	32.40	880	299	802
32.40	120	89.1	32.40	385	326	73.2
32.40	245	641	24.40	24.4	32.4	1040
24.40	13.6	13.6	13.60	13.6	244	13.6
13.60	13.6	13.6	13.60	13.6	13.6	13.6
13.60					13.6	

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
27.00	27.00	46.00	27.00	50.00
29.00	31.00	38.00	35.00	44.00
21.50	21.50	49.00	39.00	48.00
21.50	21.50	41.00	40.00	30.00
21.50	16.00	16.00	21.50	51.00
16.00	7.50	7.50	36.00	7.50
7.50	7.50	7.50	7.50	7.50
7.50			7.50	
47.00				
43.00				
21.50				
33.00				
37.00				
7.50				
7.50				
42.00				
34.00				
21.50				
32.00				
45.00				
7.50				
7.50				
No. of Samples: 22	7	7	8	7
Rank Sum: 537.50	132.00	205.00	213.50	238.00
Rank Mean: 24.43	18.86	29.29	26.69	34.00

Kruskal-Wallis statistic corrected for ties: 4.35
Number of tied groups = 4
Number of ties per group:

1	14
2	3
3	8
4	3

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical

point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Dissolved Chromium in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
6.1	0.68	0.68	9.0	26.8	0.68	7.8
6.2	3.1	3.1	7.0	9.6	7.2	3.1
1.5	1.5	1.5	7.7	60.1	1.5	8.5
1.5	10.8	12.2	14.4	264	12.1	362
1.5	3.1	11.3	2.6	60.7	1.6	25
5.9	3.9	16.5	6.5	13.9	10.2	32.2
3.5	1.3	0.88	0.88	0.88	0.88	0.88
0.88	0.88	0.88	0.88	0.88	0.88	0.88

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
32.00	40.00	51.00	2.00	38.00
33.00	35.00	41.00	36.00	26.50
19.50	37.00	53.00	19.50	39.00
19.50	48.00	55.00	45.00	56.00
19.50	24.00	54.00	23.00	50.00
31.00	34.00	47.00	42.00	52.00
29.00	9.50	9.50	9.50	9.50
9.50	9.50	9.50	9.50	9.50
2.00				
26.50				
19.50				
43.00				
26.50				
30.00				
16.00				
9.50				
2.00				
26.50				
19.50				
46.00				
44.00				
49.00				
9.50				
9.50				
No. of Samples: 24	8	8	8	8
Rank Sum: 572.00	237.00	320.00	186.50	280.50
Rank Mean: 23.83	29.62	40.00	23.31	35.06

Kruskal-Wallis statistic corrected for ties: 8.18
Number of tied groups = 4
Number of ties per group:

1	3
2	12
3	6
4	4

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

Program KruskalWallis-PostHoc

Parameter: Dissolved Cobalt in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
6.700	6.700	6.700	6.700	6.700	6.700	6.7
0.980	3.4	1.5	4.7	1.6	0.980	8.3
2.700	2.700	2.700	2.700	2.7	2.700	8.9
2.700	9.1	2.700	2.700	11.7	2.700	61.9
2.700	2.700	4.0	2.700	2.70	2.700	2.9
0.970	2.2	3.300	0.970	0.970	0.970	28.5
3.300	3.300	3.300	3.300	3.300	3.300	3.3
3.300	3.300		3.300	3.300	3.300	3.3

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
46.00	46.00	46.00	46.00	46.00
5.50	42.00	8.00	5.50	50.00
17.00	17.00	17.00	17.00	51.00
17.00	17.00	53.00	17.00	55.00
17.00	17.00	17.00	17.00	25.00
2.50	2.50	2.50	2.50	54.00
32.50	32.50	32.50	32.50	32.50
32.50	32.50	32.50	32.50	32.50
46.00				
40.00				
17.00				
52.00				
17.00				
9.00				
32.50				
32.50				
46.00				
7.00				
17.00				
17.00				
41.00				
32.50				
32.50				

No. of Samples:	23	8	8	8	8
Rank Sum:	609.00	206.50	208.50	170.00	346.00
Rank Mean:	26.48	25.81	26.06	21.25	43.25

Kruskal-Wallis statistic corrected for ties: 9.51
Number of tied groups = 5
Number of ties per group:

1	4
2	2
3	15
4	14
5	7

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)

Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-0.10	-0.06	-0.80	2.55
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

==========

Program KruskalWallis-PostHoc

Parameter: Dissolved Copper in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
4.500	8.1	4.5	4.500	6.2	4.500	4.8
4.000	4.5	4.0	5.7	4.0	4.000	4.0
0.740	0.74	0.74	0.740	8.1	0.740	0.74
0.740	14.8	22.8	0.740	52	0.740	27.5
0.88	2.7	1.2	1.1	8.5	0.740	2.2
0.99	2.8	4.2	1.3	2.3	6.8	7.6
1.5	4.7	0.81	0.810	0.81	0.810	0.81
0.810	0.81	0.81	0.810	0.81	0.810	0.81

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
41.00	41.00	47.00	41.00	45.00
35.00	46.00	35.00	35.00	35.00
5.50	5.50	50.50	5.50	5.50
5.50	5.50	56.00	5.50	55.00
23.00	25.00	52.00	5.50	29.00
24.00	27.00	30.00	48.00	49.00
28.00	16.50	16.50	16.50	16.50
16.50	16.50	16.50	16.50	16.50
50.50				
41.00				
5.50				
53.00				
31.00				
32.00				
44.00				
16.50				
41.00				
35.00				
5.50				
54.00				
26.00				
38.00				
16.50				
16.50				
No. of Samples: 24	8	8	8	8
Rank Sum: 684.50	183.00	303.50	173.50	251.50
Rank Mean: 28.52	22.88	37.94	21.69	31.44

Kruskal-Wallis statistic corrected for ties: 5.38
Number of tied groups = 5
Number of ties per group:

1	10
2	12
3	5
4	5

5 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Dissolved Lead in ug/L

Bkgd well(s)		--->	Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.500	1.500	1.500	1.500	1.5	1.500	14.9
2.000	2.000	2.000	2.000	2.0	2.000	2.0
1.200	1.200	1.200	1.200	2.2	1.200	12.6
1.200	1.7	1.200	1.2	1.9	2.1	73.5
1.200	1.900	5.1	1.200	1.9	1.200	2.9
1.900	2.000	2.000	1.900	2.0	1.900	23.3
2.000	2.000	2.000	2.000	3.0	2.000	2.0
4.2			2.000		2.000	2.0

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
14.50	14.50	14.50	14.50	51.00
34.00	34.00	34.00	34.00	34.00
6.00	6.00	45.00	6.00	50.00
6.00	6.00	21.50	44.00	53.00
6.00	6.00	21.50	6.00	46.00
21.50	21.50	34.00	21.50	52.00
34.00	34.00	47.00	34.00	34.00
48.00	34.00		34.00	34.00
14.50				
34.00				
6.00				
18.00				
21.50				
34.00				
34.00				
14.50				
34.00				
6.00				
6.00				
49.00				
34.00				
34.00				

No. of Samples:	22	8	7	8	8
Rank Sum:	509.50	156.00	217.50	194.00	354.00
Rank Mean:	23.16	19.50	31.07	24.25	44.25

Kruskal-Wallis statistic corrected for ties: 14.82
Number of tied groups = 4
Number of ties per group:
1 11
2 6
3 6
4 19
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller

than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-0.57	1.18	0.17	3.31
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

==========

Program KruskalWallis-PostHoc

Parameter: Dissolved Sodium in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1480	158000	2340	13000	32000	136000	7790
346	55100	346	65400	133000	770000	47600
1210	133000	2270	13700	76700	449000	39500
368	24700	2430	14000	24700	343000	9650
1720	41300	2340	10400	12400	403000	17200
1370	59300	1930	101000	11300	56200	15500
1390	59700	1800	13200	33900	346000	6950
1060	65000	1910	13200	11600	284000	7370

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
8.00	25.00	34.00	49.00	19.00
1.50	44.00	47.50	56.00	38.00
5.00	28.00	45.00	55.00	36.00
3.00	29.00	32.50	52.00	20.00
9.00	21.00	24.00	54.00	31.00
6.00	46.00	22.00	40.00	30.00
7.00	26.50	35.00	53.00	17.00
4.00	26.50	23.00	51.00	18.00
50.00				
39.00				
47.50				
32.50				
37.00				
41.00				
42.00				
43.00				
14.50				
1.50				
13.00				
16.00				
14.50				
12.00				
10.00				
11.00				

No. of Samples:	24	8	8	8	8
Rank Sum:	468.00	246.00	263.00	410.00	209.00
Rank Mean:	19.50	30.75	32.88	51.25	26.12

Kruskal-Wallis statistic corrected for ties: 23.78
Number of tied groups = 5

Number of ties per group:

1	2
2	2
3	2
4	2
5	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	1.69	2.01	4.77	0.99
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	yes	no

Appendix A Tables

Table A-1

List of Dissolved Metals Not Tested Due to High Percentage of Non-Detects

Percent NDs by Well - Dissolved Metals

	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
Antimony	100	100	100	100	100	100	100
Arsenic	100	100	100	100	**87.5**	100	**87.5**
Beryllium	100	**75**	**87.5**	100	100	100	**75**
Cadmium	100	100	100	100	100	100	100
Mercury	100	**0**	100	100	**75**	100	100
Selenium	100	100	**87.5**	100	**87.5**	100	100
Silver	100	100	**87.5**	100	100	100	100
Thallium	100	100	100	100	100	100	100
Vanadium	100	**75**	**75**	100	**62.5**	**87.5**	**75**

Table A-2
Results of Shapiro-Wilk Test for Normal Distribution on Dissolved Metals

	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24	Number of wells having normal distribution
Aluminum	N	L	L	N	N	X	N	4
Barium	N	N	N	X	N	N	N	6
Calcium	N	N	N	N	N	N	N	7
Chromium	X	N	L	N	L	X	L	2
Cobalt	X	X	N	N	L	X	L	2
Copper	X	L	X	X	N	X	N	2
Iron	N	L	L	L	N	N	N	4
Lead	X	X	X	X	N	X	X	1
Magnesium	X	N	X	N	N	N	N	5
Manganese	N	N	L	N	N	N	L	5
Nickel	N	L	N	N	N	N	N	6
Potassium	N	N	N	N	N	N	N	7
Sodium	N	N	X	X	L	N	L	3
Zinc	N	L	L	N	N	L	N	4

N = Untransformed data set has a normal distribution based on Shapiro-Wilk test
L = Log transformed data set has a normal distrinution, while the untransformed data set does not.
X = Neither log-transformed data set nor untransformed data set has a normal distribution.

Table A-3

Outliers for Removal from Dissolved Metals Data Sets Based on Dixon's Outlier Test and Shapiro-Wilk Test for Normality

(Using predominant Shapiro-Wilk results for each metal)

Metal	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24	Outlier Set Used
Aluminum	x	1,890	3,370	227	3,770	x	3,650	N
Barium	x	x	112	x	81.9	33.7	52.5	N
Calcium	x	x	x	x	85,400	31,200	x	N
Chromium	x	x	x	x	x	x	x	L
Cobalt	x	x	29.9	x	x	x	x	L
Copper	x	x	x	x	x	x	x	L
Iron	142	12,400	47,000	794	22,900	x	17,100	N
Lead	x	8.3	31.0	x	20.9	x	x	L
Magnesium	x	x	x	x	x	10,600	x	N
Manganese	17.0	x	1,750	x	370	x	x	N
Nickel	21.5	x	49.5	x	165	x	215	N
Potassium	x	x	x	x	x	5,090	5,530	N
Sodium	x	x	x	x	x	x	x	L
Zinc	x	167	292	55.6	262	x	x	N

x = No upper outlier identified by Dixon's Test.

N = Used results from Dixon's Test for normally distributed case
(as majority of well data sets for the metal were normally distributed per the Shapiro-Wilk test - See Table A-2.)

L = Used results from Dixon's Test for log-normally distributed case
(as majority of well data sets for the metal were log-normally distributed per the Shapiro-Wilk test - See Table A-2.)

Note: Values where present represent statistical outliers
'101 / 116' represents two statistical outliers, 101.0 and 116.0.

Table A-4
Statistically Significant Decreasing Trends in Concentration vs. Time Plots
(October 2010 - August 2012)

Dissolved Metals

MW-10 (Diss)	Cr	Mg								
MW-22 (Diss)	Al	Fe	Mg	Mn	Ni	Zn				
MW-23 (Diss)	Al	Ba	Ca	Cu	Fe	Mg	K			
MW-15S (Diss)	Cr	Fe	Ni							
MW-16S (Diss)	Al	Ba	Ca	Cr	Cu	Fe	Mg	Mn	Ni	Na
MW-17S (Diss)	Al	Ca	Fe	Mg	Mn	Ni	K			
MW-24 (Diss)	Al	Ba	Ca	Fe	Mg	Mn	K	Na		

Statistically Significant Increasing Trends in Concentration vs. Time Plots
(October 2010 - August 2012)

Dissolved Metals

MW-10 (Diss)	Mn	K	Zn							
MW-22 (Diss)	K	Na								
MW-23 (Diss)	none									
MW-15S (Diss)	Mg									
MW-16S (Diss)	Pb									
MW-17S (Diss)	none									
MW-24 (Diss)	Zn									

Notes: (1) Indicated metals were found to be significantly declining (or increasing) at a probability of 80 or 90%, based on application of the Mann-Kendall test for trends.
(2) Statistical outliers were included in the data used for the trend analysis.

Table A-5
Summary of Results from Background Intra-Group Analysis

Dissolved Metals

Metal	Critical Point for Kruskal-Wallis Test	Kruskal-Wallis Test Statistic (H)	Overall Conclusions	Conclusions from Post-Hoc Anaysis
Aluminum	5.99	2.15	E	-
Arsenic	All samples were non-detect			
Barium	5.99	19.57	NE	2
Beryllium	Non-detects comprised 75% or more of each data set			
Calcium	5.99	18.89	NE	2
Chromium	5.99	0.48	E	-
Cobalt	5.99	1.72	E	-
Copper	5.99	2.46	E	-
Iron	5.99	7.32	NE	1,3
Lead	5.99	0.35	E	-
Magnesium	5.99	16.99	NE	2
Manganese	5.99	17.36	NE	1,2
Mercury	5.99	15.91	NE	2
Nickel	5.99	8.14	NE	1,2
Potassium	5.99	20.34	NE	2
Sodium	5.99	18.38	NE	2
Vanadium	Non-detects comprised 75% or more of each data set			
Zinc	5.99	9.68	NE	1,2

Note: A non-parametric method was used for the analysis - the Kruskal-Wallis test, including associated post-hoc test of contrasts recommended in USEPA Unified Guidance

E = Medians are equal among the 3 background wells (H statistic < critical point)

NE = Medians are not equal among the 3 background wells (H statistic > critical point)

1 = Median for MW-22 same as MW-23

2 = Median for MW-10 same as MW-23

3 = Median for MW-10 same as MW-22

Table A-6
Summary of Results from Downgradient Intra-Group Analysis

Dissolved Metals

Metal	Critical Point for Kruskal-Wallis Test	Kruskal-Wallis Test Statistic (H)	Overall Conclusions	Conclusions from Post-Hoc Analysis
Aluminum	7.81	3.59	E	-
Arsenic	Non-detects comrpised 87% or more of each data set			
Barium	7.81	23.19	NE	1,5,6
Beryllium	Non-detects comprised 75% or more of each data set			
Calcium	7.81	23.40	NE	1,5,6
Chromium	7.81	5.30	E	-
Cobalt	7.81	8.56	NE	1,2,3,4,5
Copper	7.81	5.38	E	-
Iron	7.81	7.12	E	-
Lead	7.81	12.55	NE	1,2,4,5
Magnesium	7.81	25.41	NE	1,6
Manganese	7.81	18.39	NE	1,4,6
Mercury	Non-detects comprised 75% or more of each data set			
Nickel	7.81	10.86	NE	1,2,3,5
Potassium	7.81	21.28	NE	2,3,6
Sodium	7.81	17.33	NE	1,3,5
Vanadium	Non-detects comprised 62% or more of each data set			
Zinc	7.81	12.41	NE	1,2,4,5

Note: A non-parametric method was used for the analysis - the Kruskal-Wallis test, including associated post-hoc test of contrasts recommended in USEPA Unified Guidance

E = Medians are equal among the 4 downgradient wells (H statistic < critical point)

NE = Medians are not equal among the 4 downgradient wells (H statistic > critical point

E** = Although the Kruskal-Wallis test indicates the medians for at least one pair of the 4 wells differ, the post-hoc analysis indicated no difference in the medians among the 4 wells.

1 = Median for MW-15S same as MW-16S
2 = Median for MW-15S same as MW-17S
3 = Median for MW-15S same as MW-24
4 = Median for MW-16S same as MW-17S
5 = Median for MW-16S same as MW-24
6 = Median for MW-17S same as MW-24

Table A-7

Summary of Results of ANOVA Inter-Group Statistical Tests
Comparing Individual Downgradient Wells and Pooled Upgradient Data

Dissolved Metals

	Analytical Method	MW-15S	MW-16S	MW-17S	MW-24
Aluminum	NP	E	E	E	E
Barium	P	E	E	E	E
Calcium	P	E	E	E	E
Chromium	NP	E	E	E	E
Cobalt	NP	E	E	E	**> upgd**
Copper	NP	E	E	E	E
Iron	P	E	E	E	E
Lead	NP	E	E	E	**> upgd**
Magnesium	P	E	E	E	E
Manganese	P	E	E	E	E
Nickel	P	E	**> upgd**	E	E
Potassium	P	E	E	E	E
Sodium	NP	E	E	**> upgd**	E
Zinc	P	E	E	E	**> upgd**

P = Parametric method (One-way F-Statistic ANOVA with Bonferroni t-test as post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

NP = Non-parametric method (Kruskal-Wallis test including its post-hoc test for comparisons of individual downgradient wells to pooled upgradient)

E = Mean/median is equal to or less than upgradient mean/median at a probability of 95%

>upgd = Mean/median is greater than upgradient mean/median at a probability of 95%

Table A-8
ANOVA Statistics for Inter-Group Analysis Comparing Individual Downgradient Wells and Pooled Upgradient Data

Dissolved Metals

Metal	Overall Test Results		Results of Post-Hoc Tests on Individual Downgradient Wells								Test
			MW-15S		MW-16S		MW-17S		MW-24		
	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	Critical Point	Computed Statistic	
Aluminum	9.49	4.35	+	+	+	+	+	+	+	+	K
Arsenic	Non-detects comprised more than 90% of the total data set										
Barium	*2.57**	*5.16**	2.32	-0.80	2.32	-1.24	2.32	-4.00	2.32	-2.94	AB
Beryllium	Non-detects comprised more than 90% of the total data set										
Calcium	*2.56**	*3.42**	2.31	1.20	2.31	-0.63	2.31	-2.74	2.31	-1.79	AB
Chromium	9.49	8.18	+	+	+	+	+	+	+	+	K
Cobalt	**9.49**	**9.51**	2.24	-0.10	2.24	-0.06	2.24	-0.80	**2.24**	**2.55**	KPH
Copper	9.49	5.38	+	+	+	+	+	+	+	+	K
Iron	2.58	2.25	+	+	+	+	+	+	+	+	A
Lead	**9.49**	**14.82**	2.24	-0.57	2.24	1.18	2.24	0.17	**2.24**	**3.31**	KPH
Magnesium	*2.56**	*4.76**	2.31	0.28	2.31	-0.80	2.31	-3.11	2.31	-3.26	AB
Manganese	*2.57**	*3.42**	2.31	-1.80	2.31	-1.22	2.31	-1.06	2.31	2.18	AB
Mercury	Non-detects comprised more than 80% of the total data set										
Nickel	***2.57***	**5.10**	2.32	-0.84	**2.32**	**3.06**	2.32	-1.16	2.32	2.32	AB
Potassium	2.56	2.51	+	+	+	+	+	+	+	+	A
Sodium	**9.49**	**23.78**	2.24	1.69	2.24	2.01	**2.24**	**4.77**	2.24	0.99	KPH
Vanadium	Non-detects comprised more than 80% of the total data set										
Zinc	**2.57**	***7.33***	2.32	-1.11	2.32	0.08	2.32	-1.09	**2.32**	**4.48**	AB

A = One-Way ANOVA F-Test
AB = One-Way ANOVA F-Test followed by the post-hoc Bonferroni t-test
K = Non-parametric ANOVA - Kruskal-Wallis test
KPH = Non-parametric ANOVA - Kruskal-Wallis test followed by the post-hoc test recommended in the Unified Guidance (2009)
+ = Test indicated no significant differences among the four downgradient wells and the pooled upgradient wells, hence no post-hoc tests were conducted on individual downgradient wells.

Notes: (1) Value pairs shown with asterisks indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. However, the post-hoc tests revealed that none of the downgradient wells had means/medians significantly greater than that of the pooled upgradient data.

(2) Value pairs in **bold** indicate some significant difference among the four downgradient wells and the pooled upgradient wells as the computed statistic exceeds the critical point. In these cases, post-hoc tests revealed that the mean/median of at least one downgradient well was significantly greater than that of the pooled upgradient data.

Appendix B

Runoff Calculations for Quarry No. 4 Pre- and Post-Construction

Chester Valley Engineers, Inc.
83 Chestnut Road
P.O. Box 447
Paoli, Pa. 19301
(610) 644-4623

Project: 14925
Sheet No: 2 of 4
By: RWD Date: 1/25/2001

QUARRY 4
PREDEVELOPMENT FLOW

DRAINAGE AREA: A= 3.07 acs.

CURVE NUMBER: "C" Type Soil - Woods (CN=70) = 3.07 Acs.

CN= 70

TIME OF CONCENTRATION: Tc = 15 min.

24 HR RAINFALL AMOUNT:

$$Q_2 = \frac{(3.2 - 0.2(4.28))}{(3.2 + 0.8(4.28))} = 0.83 \text{ inches}$$

$$Q_{100} = \frac{(7.2 - 0.2(4.28))}{(7.2 + 0.8(4.28))} = 3.79 \text{ inches}$$

RUNOFF VOLUME:

Q2 = 0.83/12 x 133,776 = 9,253 cf
Q100 = 3.79/12 x 133,776 = 42,251 cf

PEAK RUNOFF RATE:

Q2 = 2.72 cfs.
Q100 = 13.56 cfs.

Chester Valley Engineers, Inc.
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(610) 644-4623

Project: 14925
Sheet No: 4 of 4
By: RWD Date: 1/25/2001

QUARRY 4
POSTDEVELOPMENT FLOW

DRAINAGE AREA: A= 3.07 acs.

CURVE NUMBER:

"C" Type soil - Lawn	(CN=74)	= 1.29 Acs.
"C" Type Soil - Woods	(CN=70)	= 0.70 Acs.
Impervious (includes lined basin areas)	(CN=98)	= 1.08 Acs.

$$CN = \frac{(1.29 \times 74) + (0.70 \times 70) + (1.08 \times 98)}{3.07} = 81.53$$

CN= 82

TIME OF CONCENTRATION: Tc = 5 min.

24 HR RAINFALL AMOUNT:

$$Q_2 = \frac{(3.2 - 0.2(2.20))^2}{(3.2 + 0.8(2.20))} = 1.54 \text{ inches}$$

$$Q_{100} = \frac{(7.2 - 0.2(2.20))^2}{(7.2 + 0.8(2.20))} = 5.10 \text{ inches}$$

RUNOFF VOLUME:

Q2 = 1.54/12 x 133,776 = 17,168 cf
Q100 = 5.10/12 x 133,776 = 56,855 cf

PEAK RUNOFF RATE:

Q2 = 6.86 cfs.
Q100 = 21.19 cfs.

Appendix C

Section 3.0 from the IRDR – Hydrogeologic Setting of the Quarry No. 4 Area

3.0 HYDROGEOLOGIC SETTING OF THE QUARRY NO. 4 AREA

The hydrogeologic setting of Quarry No. 4 and the immediately surrounding areas as presented below was developed based on our review of available published geologic literature for Montgomery County and Eastern Pennsylvania, information included in the June 11, 2004 RDWP developed by Penn E&R for the Quarry No. 4 Demonstration Project, and various reports developed for the Crater site by The Group, including the following pertinent reports:

1. Remedial Investigation Report, Crater Resources Site, dated June 4, 1999 and prepared by Environmental Resources Management (ERM);
2. Updated Hydrogeologic Conceptual Site Model, Crater Resources Superfund Site, Upper Merion Township, Pennsylvania, dated August 29, 2005 and prepared by Key Environmental, Inc. (Key);
3. Pre-Design Investigation Results, Crater Resources Superfund Site, Upper Merion Township, Pennsylvania, dated January 2008 and prepared by Key; and
4. Supplemental Ground Water Pre-Design Investigation Results, Crater Resources Superfund Site, Upper Merion Township, Pennsylvania, dated December 2008 and prepared by Key.

3.1 Geologic Setting

The Quarry No. 4 area is located within the Piedmont physiographic province. The Piedmont consists mainly of a series of ridges and valleys trending toward the east-northeast. The ridges are generally underlain by resistant crystalline bedrock while the low-lying valley areas are underlain by less-resistant sedimentary and meta-sedimentary rocks. The 2201 Renaissance Boulevard property and Quarry No. 4 are located in the geologic province known as the Chester Valley which extends over a distance of approximately 50 miles through Montgomery, Chester, and Lancaster Counties. The Chester Valley province is underlain by steeply-dipping, folded and faulted, Cambrian to Ordovician age carbonate bedrock. In the area of Quarry No.4, this folded and fractured carbonate bedrock is overlain by unconsolidated soil.

Geologic cross-sections incorporating the area around Quarry No. 4 are included as Figures 5 through 7 and these are discussed below. The cross-sections were developed using geologic logs developed for soil borings and monitoring wells installed as part of the investigation of the Crater site, as documented in the aforementioned reports.

3.1.1 Soils

The unconsolidated soils present at the surface in the vicinity of Quarry No. 4 include the undifferentiated Pensauken and Bridgeton Formation (Tertiary) and the older Patapsco Formation (Cretaceous). According to the USGS, the Pensauken/Bridgeton Formation consists of dark-reddish-brown, cross-stratified, feldspathic quartz sand and some thin beds of fine gravel and rare layers of clay or silt. The older Patapsco Formation, which is sometimes found below the Pensauken/Bridgeton Formation in the vicinity of the

quarry consists of, according to the USGS intensely colored, variegated, iron-rich clay and, in places, beds of sand. As can be seen on Figures 5 through 7, the Pensauken/Bridgeton and Patapsco Formations are discontinuous and generally range in thickness from 20 feet to 40 feet in and around Quarry No. 4. As discussed further below, ground water is not generally present in these unconsolidated soils in the immediate vicinity of Quarry No. 4.

The soils of the Pensauken/Bridgeton and Patapsco Formations are underlain by a saprolitic soil that was derived from the in-place weathering of the original schist host bedrock. As described by Key (2005), the saprolite consists primarily of fine-grained material (silt, sand and clay) with interdispersed lenses of quartz in some locations. The original schist host bedrock from which the saprolite was derived is part of the Octoraro and Wissahickon Formations. These formations were thrust over the underlying and younger limestone bedrock of the Conestoga Formation almost 450 million years ago (Crawford, 1987). The northern extent of this thrust fault is referred to as the Martic Line and it trends approximately parallel to the strike of the underlying limestone bedrock. Since its emplacement, water percolating through the bedrock over this immense period of time transformed the schist bedrock through geochemical weathering into the schist saprolite present beneath the Quarry No. 4 area.

The soil cover (unconsolidated soil and saprolite) in the immediate vicinity of Quarry No. 4 is, on average, about 100 feet thick just to the north and east of the quarry and up to 140 feet thick to the west and south of the quarry (see Figure 7). However, the thickness of the unconsolidated soils increases quickly to the west of Quarry No. 4 where unconsolidated deposits as thick as 250 feet exist. As reported by Key (2008), this thick accumulation of unconsolidated soils located to the west, southwest and northwest of Quarry No. 4 may represent a horeshoe shaped buried valley, possibly a remnant of a collapsed paleo sinkhole that was subsequently filled with unconsolidated soils. This area of thick accumulation of unconsolidated soils as well as the overburden thickness in other areas surrounding Quarry No. 4 can be seen on an overburden isopatch map developed by Key (2008) for the area, which is included in Appendix B.

3.1.2 Bedrock

As indicated earlier, the Chester Valley province in which Quarry No. 4 is located is underlain by steeply-dipping, folded and faulted, Cambrian to Ordovician age carbonate bedrock consisting of, from oldest to youngest, the: Ledger Formation, Elbrook Formation and Conestoga Formation. The Site is underlain primarily by limestone bedrock of the Conestoga Formation, although the top of the Elbrook Formation was identified in areas just to the north of the quarry in wells installed as part of the Crater Remedial Investigations. According to available information, the Conestoga Formation is up to 500 feet thick in the Upper Merion area of the Chester Valley.

The Conestoga Formation consists of limestone and metamorphosed limestone (marble) that has lenses of micaceous rock composed of shale to metamorphosed shale present.

As shown on Figures 5 through 7, the limestone bedrock in the area of Quarry No. 4 is overlain by schist saprolite. The projected depth to the limestone bedrock directly beneath Quarry No. 4 is 100 feet to 125 feet BGS. However, in general terms, the depth to the limestone bedrock is shallower to the north and east of Quarry No. 4 where the bedrock is encountered at depths of 100 feet or less, and deeper to the west where the depth to bedrock exceeds 250 feet. Differential weathering of the limestone has resulted in this irregular bedrock surface, which is much more pronounced to the west near off-site Quarry No. 3 where the depth to bedrock goes from 20 feet BGS to over 100 feet BGS over a distance of just 35 feet. The bedrock topography in the area of Quarry No. 4 is shown on a map (Bedrock Topography - Figure 5) developed by Key (2008) and included in Appendix B.

Based on information included in the aforementioned Remedial Investigation Report, the bedding of the Conestoga Limestone strikes N75°E to N85°E and dips 60 to 70 degrees south in the vicinity of the Site. Also, Key (January 2008) reported identifying three major water bearing fractures just to the north of Quarry No. 4, each of which was striking east to northeast and dipping steeply to the south. The locations of these fracture traces and their projected orientation at an elevation of 75 feet above mean sea level are shown on Figures 8A and 8B included in Appendix B. These figures were developed by Key using geophysical well logging results from an optical televiewer (Figure 8A) and acoustic televiewer (Figure 8B). These figures show one and possibly two of the water-bearing fractures crossing through or just north of Quarry No. 4. Although Key suggested that a majority of the fractures identified at the Crater site were trending east-northeast, at least two east-southeast trending fractures were identified in the vicinity of Quarry No. 4 (see Figures 8A and 8B in Appendix B). The east-northeast trending fractures were associated with wells completed in the Conestoga Limestone whereas the east-southeast trending fractures were associated with wells completed in the Elbrook Formation, which was identified just to the north of the Crater site. Although the fractures on Figures 8A and 8B are shown as being continuous across the area, their lateral continuity is likely limited as a result of the irregular bedrock topography.

3.1.3 Quarry No. 4

As discussed in Section 2.0, historical information suggests that Quarry No. 4 was mined for sand and gravel from sometime in the 1800s until the early 1900s. Based on a review of historical aerial photographs, the quarry was filled with primarily an earthen fill between at least 1965 (or perhaps earlier) and 1980.

As discussed in more detail in Section 4.0, there have been three investigations of the contents of Quarry No. 4 completed since the early 1990s. Pennoni Associates, Inc. (Pennoni) performed the first investigation in 1993. As part of this investigation, Pennoni installed four soil borings in the quarry. These borings were designated PB-1 and PB-3 through PB-5. Boring PB-1 was completed at a depth of 32 feet BGS, boring PB-3 was completed at a depth of 52 feet BGS, boring PB-4 was completed at a depth of 72 feet BGS, and boring PB-5 was completed at a depth of 52 feet BGS. As part of the Crater Remedial Investigations, ERM installed two soil borings in the quarry. These

borings were designated Q4-B1 and Q4-B2. Boring Q4-B1 was completed at a depth of 80 feet BGS and boring Q4-B2 was completed at a depth of 42 feet BGS. In 1998, Penn E&R installed eight test trenches and two soil borings in the quarry. The test trenches were designated T-1 through T-8 and the borings SB-1 and SB-2. The test trenches were generally excavated to a depth of 15 feet BGS and borings SB-1 and SB-2 were completed at depths of 69 feet and 82 feet BGS, respectively.

The approximate locations at which the aforementioned soil borings/test trenches were installed are shown on Figure 8. Copies of the lithologic logs developed for the boring/test pits installed in Quarry No. 4 are included in Appendix C. Also, information from the lithologic logs developed for the soil borings/test trenches and adjacent monitoring well MW-18 were used to develop the geologic cross-section for the Quarry No. 4 area included as Figure 9.

Based on information included in the lithologic logs and as shown on Figure 9, Quarry No. 4 appears to have been, on average, between 30 feet and 35 feet deep and filled with primarily earthen fill consisting of silty sands, sandy silts, and clayey silts of varying colors. Miscellaneous debris including rock fragments, concrete, slag, cinders, brick, and wood mixed with the soil were noted in the material used to fill the quarry. Most of this miscellaneous debris was encountered within 15 feet of the surface of the quarry. Evidence of vegetative material (i.e., roots) was noted down to a depth of 50 feet in some of the borings. ERM (1999) suggested that the presence of this material at depth indicated that at least a portion of Quarry No. 4 may be a remnant of a former sinkhole that was subsequently filled with natural materials transported from the surface.

As can be seen from Figure 9, Quarry No. 4 is underlain primarily by clayey sand and silt of the Pensauken/Bridgeton Formation and schist saprolite. Also, as indicated above and as shown on Figures 5 through 7, the projected depth to the limestone bedrock directly beneath Quarry No. 4 is 100 feet to 125 feet BGS. As discussed below in more detail, the water table in the area of Quarry No. 4 exists in the saprolite at an average depth of 50 feet BGS in the vicinity of the quarry. With the bottom of Quarry No. 4 present at a maximum depth of 35 feet BGS, the water table is located 10 feet to 15 feet below the bottom of the quarry in the unconsolidated soil and there is at least 50 feet to 75 feet of saturated soil located directly below the quarry.

As part of Liberty's redevelopment of their 2201 and 2301 Renaissance Boulevard properties, the historically-filled Quarry No. 4 was covered primarily with soils, in some areas up to 15 feet thick to bring the two properties to post-construction grade. The cover material placed over Quarry No. 4 is shown on Figure 10, which also incorporates the geologic cross-section included on Figure 9.

As shown on Figure 10, a portion of the eastern end of Quarry No. 4 has been covered with an impermeable 40-mil PVC liner installed as part of the construction of a permanent dry detention basin for the 2201 property. In addition, a small portion of the western end of the quarry is also covered with an impermeable 40-mil PVC liner installed to form another permanent wet detention basin, most of which extends onto Liberty's

adjacent 2301 Renaissance Boulevard property. The detention basins were designed so that erosion of the soil layers overlying the liners do not occur. Also, the bottom of the eastern detention basin is at an elevation of about 132 feet above MSL. Therefore, and based on an average former filled surface elevation for Quarry No. 4 of 128.5 MSL, no less than 3 feet of soil was placed on top of the surface of the quarry prior to the installation of the 40-mil PVC liner in the eastern detention basin. The bottom of the western detention basin was completed at an elevation of about 135 feet above MSL. Therefore, approximately 7 feet of soil was placed on top of the quarry prior to the installation of the 40-mil PVC liner in the western detention basin. Water from the two detention basins drains to a natural swale located west of Quarry No. 4, which then flows to the east and southeast.

In addition, a small portion of the southern end of the 2201 Building is located over Quarry No. 4. All water that collects on top of the building is directed to the detention basins located on the 2201 and 2301 properties. The elevation of the concrete pad on which the building is located is at 151.50 feet above mean sea level. Therefore, over 20 feet of soil was placed on top of the quarry prior to the construction of the building. Also the north central portion of the quarry is covered with an asphalt parking lot. The surface elevation of this lot is about 142 feet above MSL. Therefore, over ten feet of soil was placed over the quarry in this portion of the Site. The remaining portions of the quarry have been covered with at least two feet of soil.

3.2 Hydrogeologic Setting

This section provides a discussion of the hydrologic properties of Quarry No. 4 and the surrounding areas. In completing our evaluation, Penn E&R identified a select number of monitoring wells located in close proximity of Quarry No. 4 that were installed as part of the Crater Remedial Investigations and/or by other nearby property owners. The monitoring wells included to assist with our evaluation of the hydrogeologic setting of the Quarry No. 4 area are shown on Figure 11 and include wells MW-15S, MW-15D, MW-16S, MW-16D, MW-17S and MW-17D located to the east/northeast of Quarry No. 4; wells MW-A, MW-9, MW-10, MW-11S, MW-11D, MW-12, MW-19S and MW-20S located to the west of Quarry No. 4; well MW-18, located immediately to the southeast of the quarry; and wells LMW-1, LMW-2 and AS-1 located further to the east and northeast. Table 1 provides a summary of the construction specifications for these wells.

As can be seen from Table 1, monitoring wells AS-1, MW-A, LMW-1, LMW-2, MW-11S, MW-11D, MW-15D, MW-16D and MW-17D are completed in the Conestoga Limestone. Monitoring wells MW-9, MW-10, MW-12, MW-18, MW-19S and MW-20S are completed in the unconsolidated soil/saprolite and wells MW-15S, MW-16S and MW-17S are completed at the interface between weathered limestone and limestone or saprolite and limestone. Although completed at different depths and in different formations, these wells provide a good representation of flow conditions in and around Quarry No. 4 in the limestone bedrock and overlying unconsolidated soils and saprolite.

3.2.1 Depth-To-Water

Depth-to-water level measurements collected from the wells by Key in July 2008 as well as associated ground water elevations are summarized in Table 1. Table 1 shows that depth-to-water in the vicinity of Quarry No. 4 in July 2008 ranged from about 32 feet to 95 feet BGS but generally averaged from 60 feet to 70 feet BGS. The depth to water in the well located closest to Quarry No. 4, well MW-18, which is located at the immediate southeast end of the quarry, was measured in July of 2008 to be 48.78 feet BGS. The ground surface elevation in the vicinity of well MW-18 is about 124 feet to 125 feet above mean seal level, which is pretty close to the surface elevation of Quarry No. 4 at its southeast end. Therefore, well MW-18 provides a good indication of where the water table exists with regards to the bottom of the quarry. Given this and the fact that the bottom of Quarry No. 4 is located at a maximum depth of 35 feet BGS, in July of 2008, the top of the water table was located about 10 feet below the bottom of the quarry. Historical water level measurements collected by ERM (1999) show that the depth-to-water in well MW-18 was 44.53 feet in October of 1997 and 47.55 feet in January of 1998, which again indicates that the top of the water table during this period was located from 9 feet to 12.5 feet below the bottom of Quarry No. 4.

3.2.2 Ground Water Flow

The water table in the area surrounding the 2201 Renaissance property exists in the middle to lower portions of the saprolite or in the upper portion of the underlying limestone bedrock. In the immediate vicinity of Quarry No. 4, the water table is present in the upper portions of the saprolite. The flow in the saprolite is diffusive, similar to other unconsolidated deposits, and is controlled by surface topography, surface water features and hydraulic gradients. Surface topography in the area of the Site slopes to the east, and surface water flow in nearby streams, Matsunk Creek and Gulph Mills is to the east and they discharge into the Schuylkill River, which is located about ¾-mile to the east of the Site. Ground water elevations calculated using depth-to-water level measurements collected in July 2008 (see Table 1) from the monitoring wells completed in the saprolite (wells MW-9, MW-10, MW-12, MW-18, MW-19S and MW-20S) and at the limestone/saprolite interface and/or limestone/weathered limestone interface (wells MW-15S, MW-16S and MW-17S) were used to develop the potentiometric map included as Figure 12. A review of Figure 12 reveals that the hydraulic gradient and flow in the saprolite is to the east-northeast.

The primary permeability and porosity of the Conestoga Limestone, as reported by the USGS (Slotto, 1994) is negligible and flow in the limestone bedrock is controlled primarily by structural features including bedding planes and fractures. As reported by ERM (1999), the strike of Conestoga Limestone present in the area of Quarry No. 4 ranges from approximately north 75 degrees east (N75E) to N85E, and dips steeply to the south. The strike and high dip angle cause the bedding planes within the limestone to be oriented almost due east/west. Also, Key (2008) determined that the majority of the

fractures (95%) identified in limestone bedrock underlying the area parallel the bedding planes and strike east to northeast and dip steeply toward the south. Ground water elevations calculated using depth-to-water level measurements collected in July 2008 by Key (see Table 1) from the monitoring wells completed in the limestone (wells AS-1, LMW-1, LMW-2, MW-A, MW-11S, MM-11D, MW-15D, MW-16D and MW-17D) were used to develop the potentiometric map included as Figure 13.

A review of Figure 13 reveals that the hydraulic gradient in the limestone bedrock is to the east-northeast. The potentiometric maps developed by ERM (1999) and Key (2005) also reveal hydraulic gradients in the limestone bedrock to the east-northeast. However, both ERM and Key concluded that due to the steeply-dipping limestone beds and the low transmissivity of the saprolite located north of the limestone, ground water flow to the north and northeast, in the direction of the hydraulic gradient would be limited. As such, ground water flow beneath the Site in the limestone bedrock would be expected to be primarily to the east, parallel with bedrock strike and the primary water-bearing fractures identified in the area.

The hydraulic gradient in the saprolite in the area of Quarry No. 4 is relatively flat and ranges between 0.003 (between well MW-9 and MW-19S) and 0.004 (between wells MW-9 and MW-18). Also, the hydraulic gradient in the limestone bedrock in the area of Quarry No. 4 is relatively flat as well ranging between 0.004 (between well MW-11D and MW-16D) and 0.005 (between wells MW-11D and MW-15D). ERM (1999) and Key (2005) reported hydraulic gradients in the saprolite and limestone to be much steeper to the west of Quarry No. 4 and to flatten out in the eastern portion of their study area, which incorporated Quarry No. 4.

Penn E&R also evaluated vertical gradients in the area of Quarry No. 4 using ground water elevations (see Table 1) for nearby well nests MW-11S/11D, MW-15D/15D, MW-16S/16D and MW-17S/17D (see Figure 11). The calculated vertical gradients, which are summarized in Table 2, reveal a very slight downward gradient at well clusters MW-11S/11D, MS-16S/16D and MW-17S/17D (0.004 to 0.006) and a slight upward gradient at well cluster MW-15 (0.002). These results are consistent with those generated by ERM (1999) and Key (2005). Key indicated that the nearly identical potentiometric elevations for the shallow and deep wells, typically within a few tenths of a foot of one another as observed during the measurements collected in July 2008 (see Table 2) suggest that area surrounding Quarry No. 4 was in a transition zone between aquifer recharge areas to the west and discharge areas (i.e., Schuylkill River) to the east.

As discussed earlier, the bottom of Quarry No. 4 is located at a maximum depth of 35 feet BGS, well above the limestone bedrock present beneath the quarry at a depth of 100 feet to 125 feet BGS. The water table in the area of the quarry exists in the saprolite at an average depth of 50 feet BGS. Given this, there is at least 50 feet to 75 feet of saturated soil located directly below the quarry. Based on this and the slight vertical gradients that exist in the vicinity of the quarry, any potential contaminants being leached from materials in Quarry No. 4 to the ground water would be expected to be detected in the saprolite.

TABLE 1

MONITORING WELL SPECIFICATIONS AND DEPTH-TO-WATER AND GROUND WATER ELEVATIONS FOR ON-SITE WELL AND SELECT OFF-SITE WELLS
QUARRY NO. 4 DEMONSTRATION PROJECT

Well	Total Well Depth (ft-btoc)[1]	Screened/ Open Borehole Interval (ft-bgs)[1]	Measuring Point Elevation (ft-msl)	Depth-To-Water (ft)	Ground Water Elevation (ft-msl)	Geologic Formation
AS-1	65.33	N/A	105.45	31.64	73.81	Limestone
LMW-1	112.6	N/A	168.40	95.39	73.01	Limestone
LMW-2	178	N/A	139.04	65.57	73.47	Limestone
MW-A	210	194-210	167.08	91.35	75.73	Limestone
MW-9	250	222 - 242	160.87	78.85	82.02	Schist Saprolite
MW-10	120	85 - 105	145.78	65.70	80.08	Schist Saprolite
MW-11S	115	40 - 115	147.54	70.11	77.43	Limestone
MW-11D	154	145-154	147.33	70.20	77.13	Limestone
MW-12	250	225 - 245	159.10	73.51	85.59	Schist Saprolite
MW-15S	117	97-117	158.07	86.14	71.93	Limestone
MW-15D	168	148 - 168	158.10	86.04	72.06	Limestone
MW-16S	105	85-105	153.18	79.10	74.08	Limestone
MW-16D	257	135 - 257	153.26	79.81	73.45	Limestone
MW-17S	118	98-118	140.63	66.04	74.59	Schist/Limestone
MW-17D	254	232-254	140.58	66.54	74.04	Limestone
MW-18	59.28	40 - 59.28	125.78	48.78	77.00	Schist Saprolite
MW-19S	195	185 -195	138.59	58.21	80.38	Unconsolidated Soils
MW-20S	230	210-230	157.25	77.53	79.72	Unconsolidated Soils

Notes:

[1] - With the exception of wells MW-19S and MW-20S, which was obtained from Key (2008), this information was obtained from ERM (1999).

ft-btoc - Feet below the top of well casing

ft-bgs - Feet below the ground surface

ft-msl - Feet mean sea level

N/A - Information not available

TABLE 2

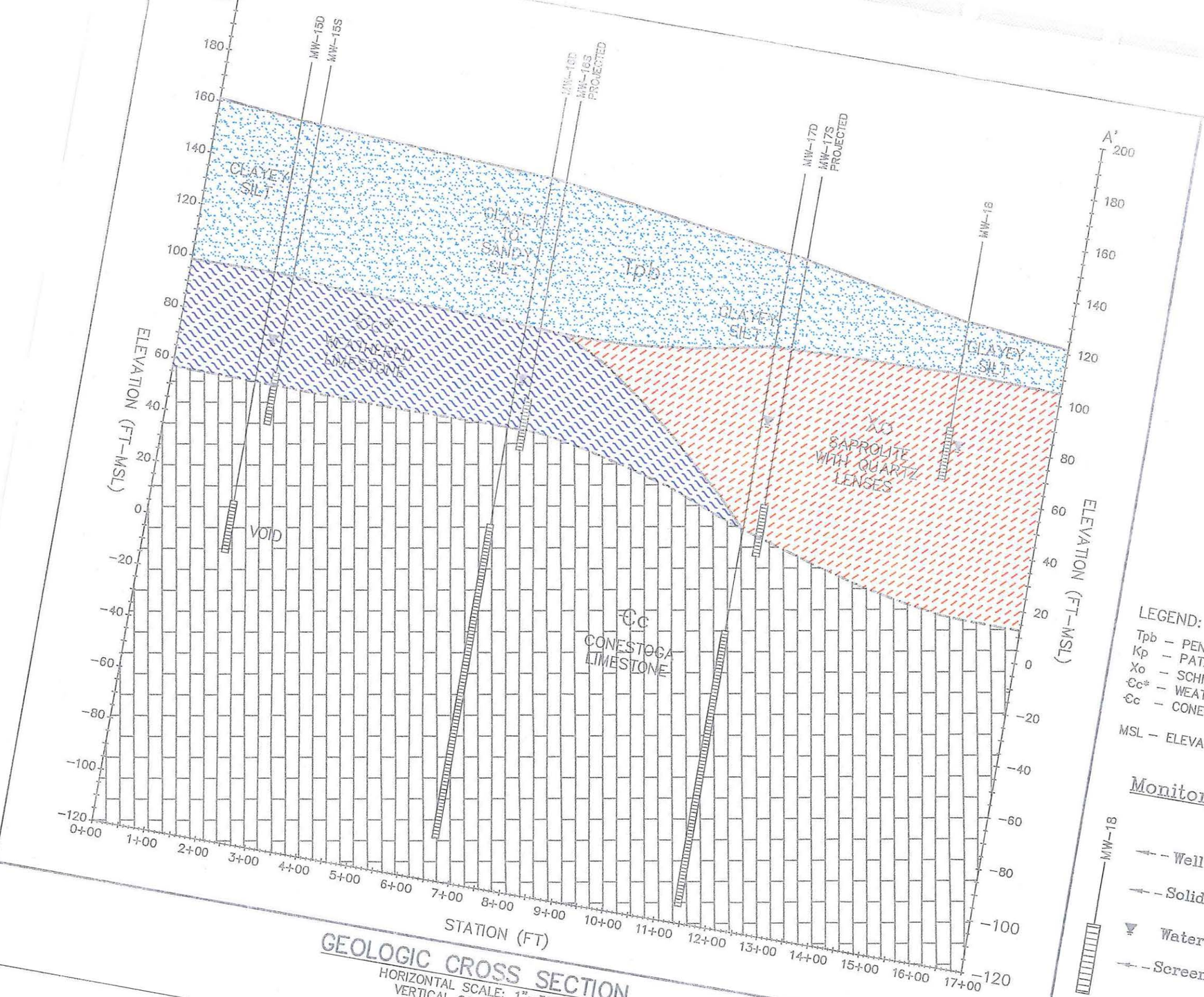
WATER LEVELS AND VERTICAL GRADIENT DATA
FOR ON-SITE AND SELECT OFF-SITE NESTED WELLS
QUARRY NO. 4 DEMONSTRATION PROJECT

Well	Approximate Depth-To-Center of Screen (ft-bgs)	July 14, 2008	
		Depth-To-Water (ft)	Vertical Gradient (ft/ft)
MW-11S	75	70.40	-0.004
MW-11D	150	70.20	
MW-15S	107	86.14	+0.0025
MW-15D	158	86.04	
MW-16S	95	79.10	-0.006
MW-16D	196	79.81	
MW-17S	108	66.04	-0.004
MW-17D	243	66.54	

Notes:

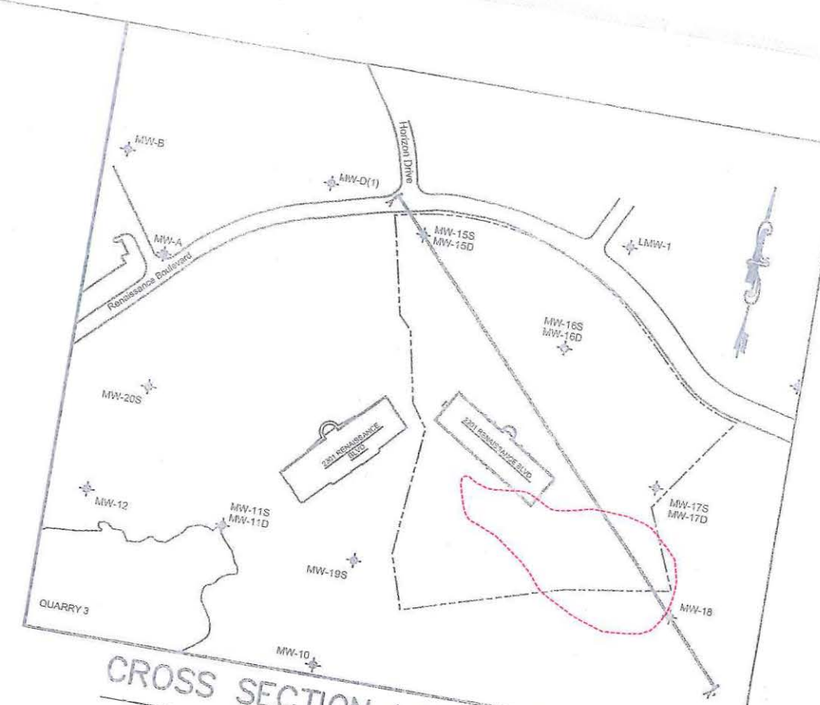
ft - Feet
ft-bgs - Feet below the ground surface
+0.0025 - Indicates an upward flow gradient
-0.004 - Indicates a downward flow gradient

HA4013/Q4DP:vertgrad



GEOLOGIC CROSS SECTION

HORIZONTAL SCALE: 1"=300'
VERTICAL SCALE: 1"=40'



CROSS SECTION LOCATION MAP

SCALE: 1"=400'.

LEGEND:

Tpb – PENSAUKEN/BRIDGETON FORMATION
Kp – PATAPSCO FORMATION
Xo – SCHIST SAPROLITE
Ꞓc* – WEATERED LIMESTONE
Ꞓc – CONESTOGA LIMESTONE

MSL – ELEVATION DATAM MEAN SEA LEVEL

Monitoring Well

MW-18

Well ID

Solid Well Casing

Water Level

Screened Interval of Well

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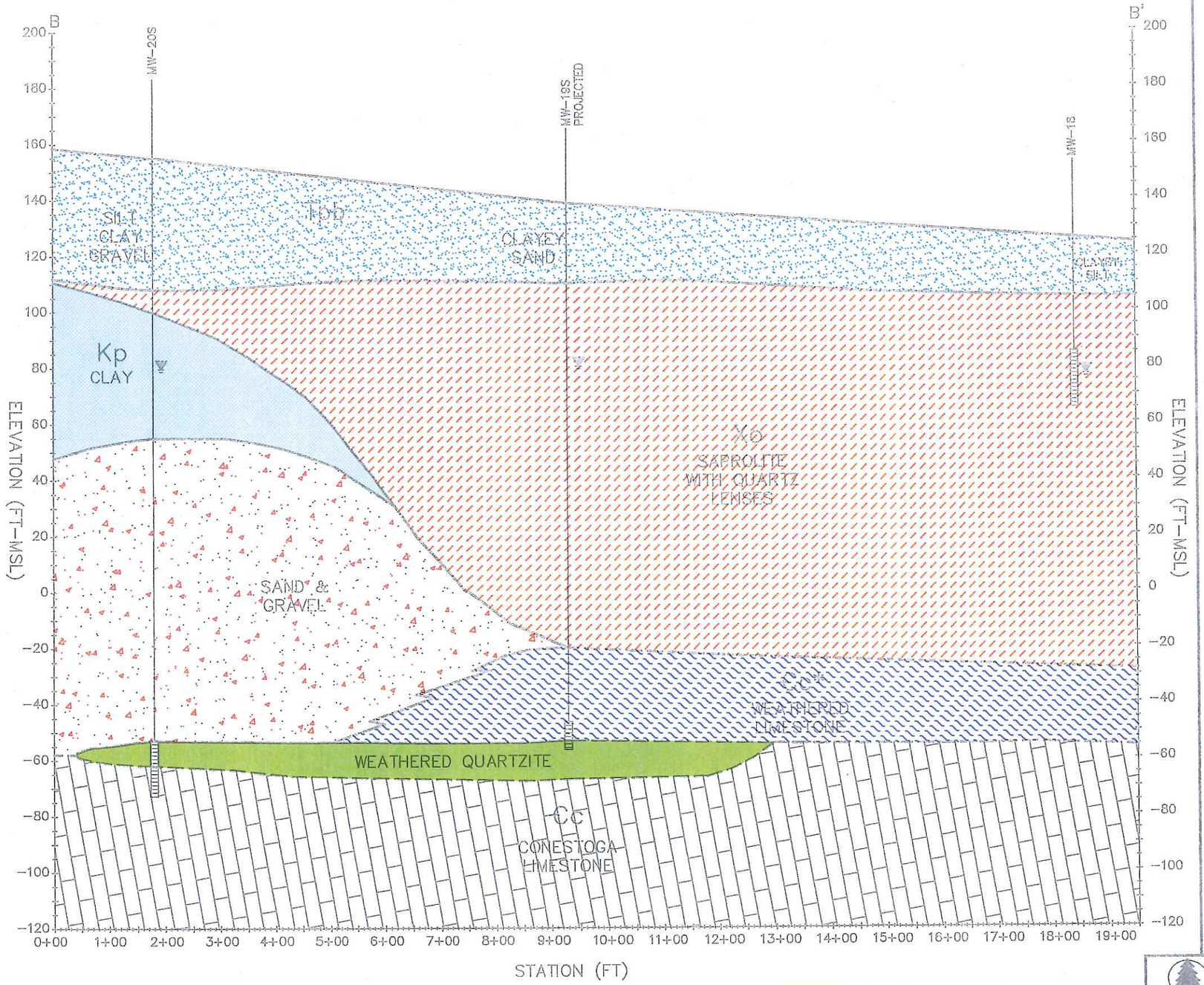
FIGURE 5
GEOLOGIC CROSS SECTION A–A'
QUARRY No.4 DEMONSTRATION

AR301368



GEOLOGIC CROSS SECTION

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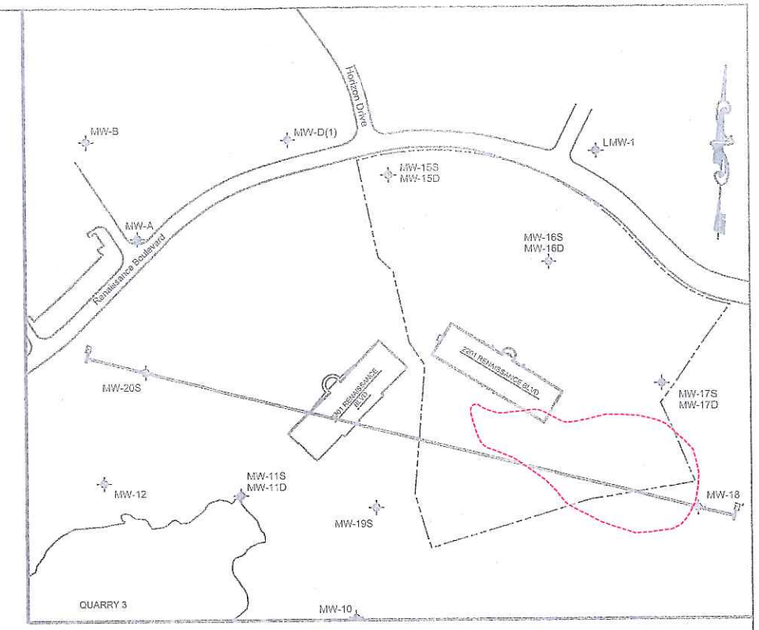
VERTICAL SCALE: 1"=40'



CROSS SECTION LOCATION MAP

SCALE: 1"=400'.

LEGEND:

Tpb – PENSAUKEN/BRIDGETON FORMATION
Kp – PATAPSCO FORMATION
Xo – SCHIST SAPROLITE
Cc* – WEATERED LIMESTONE
Cc – CONESTOGA LIMESTONE

MSL – ELEVATION DATAM MEAN SEA LEVEL

Monitoring Well

- MW-18 – Well ID
- Solid Well Casing
- Water Level
- Screened Interval of Well

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FIGURE 6
GEOLOGIC CROSS SECTION B–B'
QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP
MONTGOMERY COUNTY, PA

GRAPHIC SCALE	FIGURE NO.	SHEET NO.:
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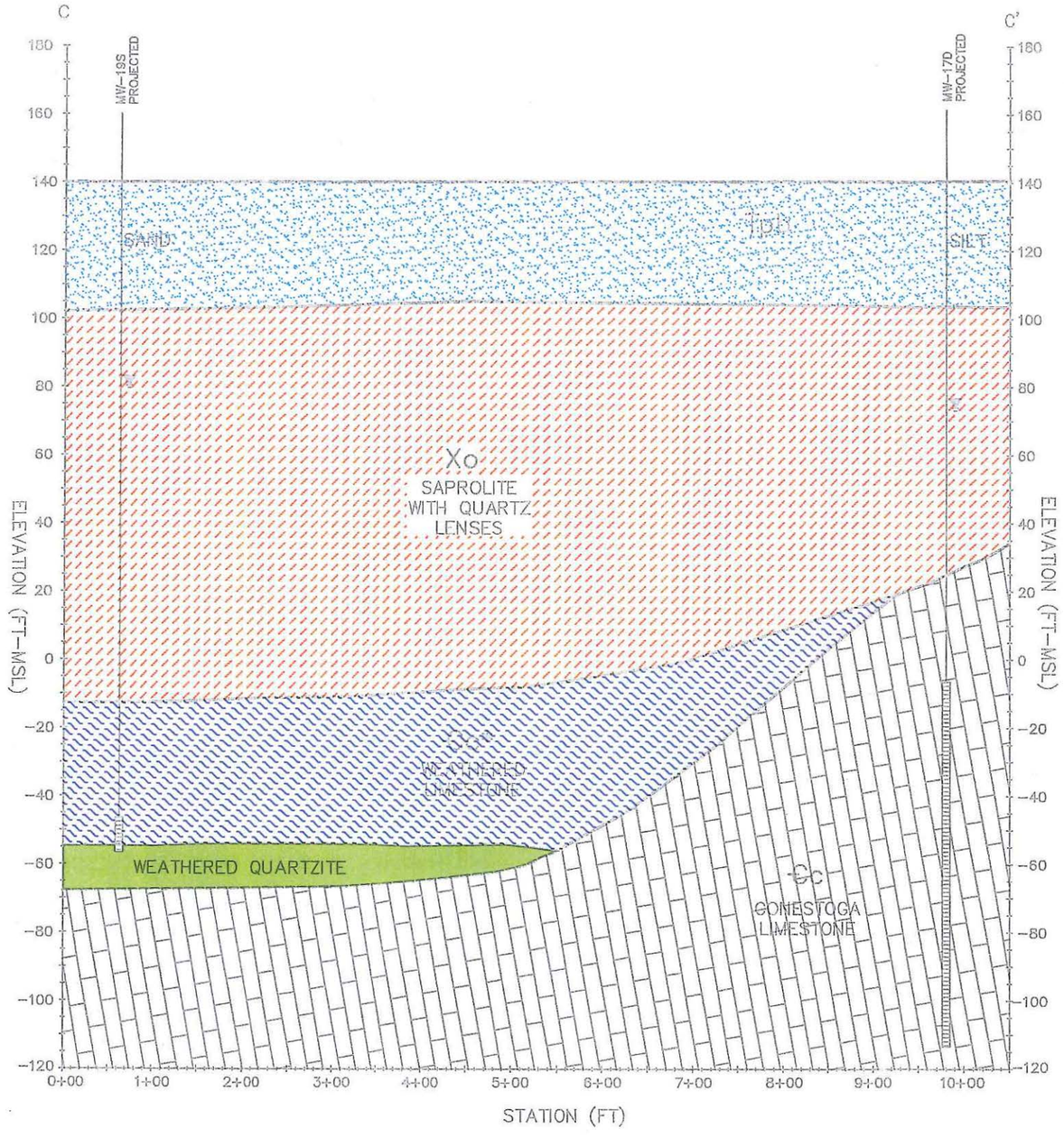

GEOLOGIC CROSS SECTION

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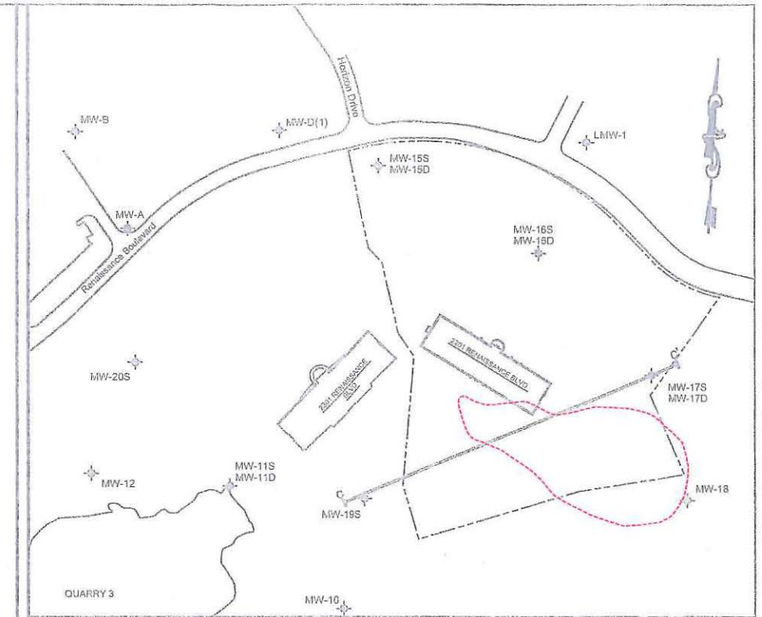
VERTICAL SCALE: 1"=40'



CROSS SECTION LOCATION MAP

SCALE: 1"=400'.

LEGEND:

Tpb – PENSAUKEN/BRIDGETON FORMATION
Kp – PATAPSCO FORMATION
Xo – SCHIST SAPROLITE
Ꞓc* – WEATERED LIMESTONE
Ꞓc – CONESTOGA LIMESTONE

MSL – ELEVATION DATAM MEAN SEA LEVEL

Monitoring Well

MW-18

- Well ID
- Solid Well Casing
- Water Level
- Screened Interval of Well

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DRAWING SCALE	AS NOTED
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SHEET NO.:	

FIGURE 7
GEOLOGIC CROSS SECTION C--C'
QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP
MONTGOMERY COUNTY, PA

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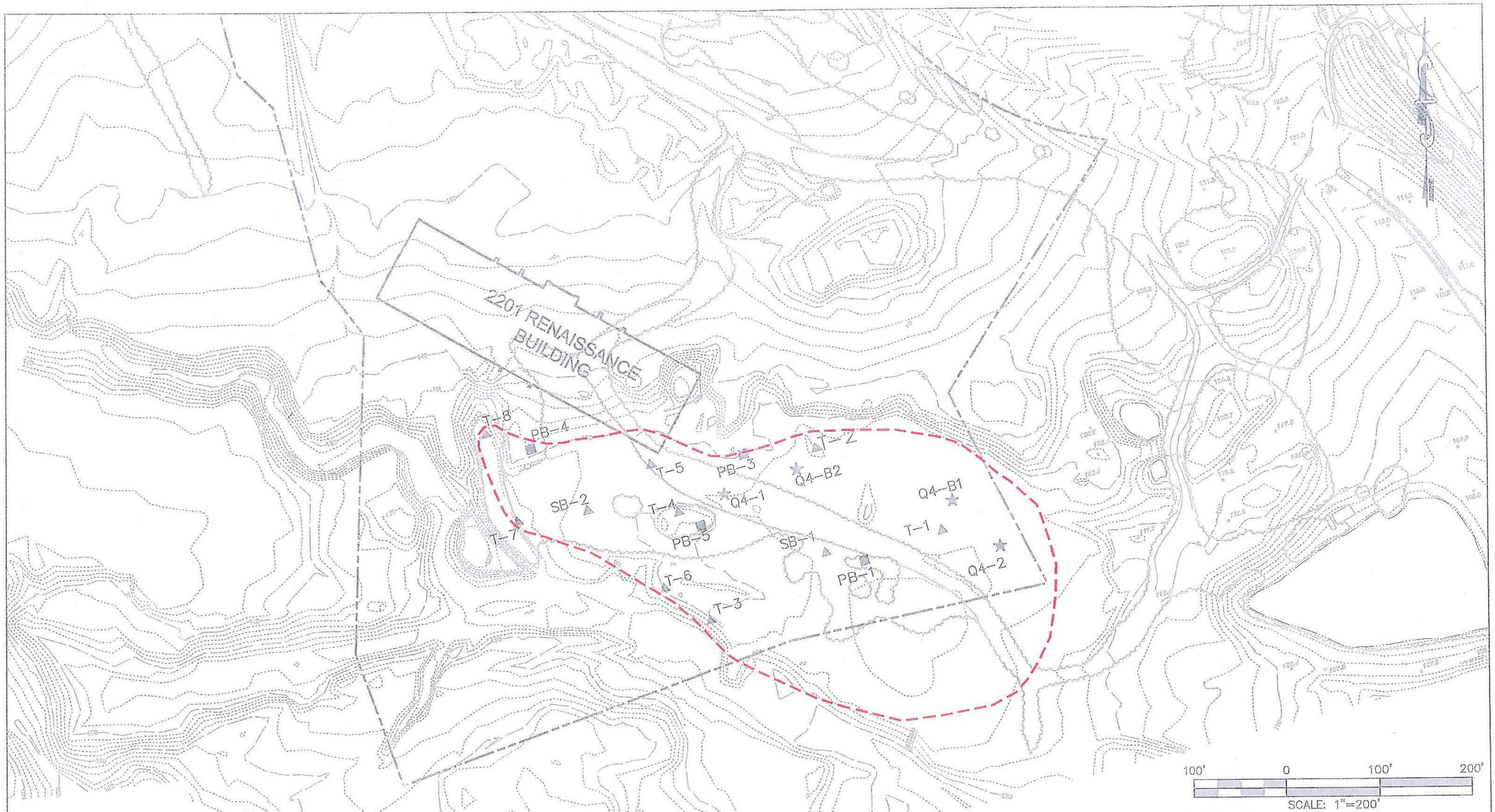

LEGEND:

- PRE-CONSTRUCTION TOPOGRAPHY
- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF QUARRY No.4

PB-4	PENNONI 1993 SOIL SAMPLE/BORING LOCATION
Q4-1/Q4-B1	ERM 1996/1997 SOIL SAMPLE/BORING LOCATION
SB-1/T-7	PENN E&R 1998 TEST-PIT/SOIL SAMPLE LOCATION

NOTES:

1. BOUNDARY FOR QUARRY No.4 WAS OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.
2. THE SOIL BORINGS AND TEST TRENCHES LOCATIONS ARE APPROXIMATE.

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FIGURE 8
PARTIAL SITE MAP SHOWING THE APPROXIMATE LIMIT OF QUARRY No. 4 AND PREVIOUS SOIL BORING LOCATIONS

QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

SCALE: 1"=100'
FIGURE NO. 5
SHEET NO.:

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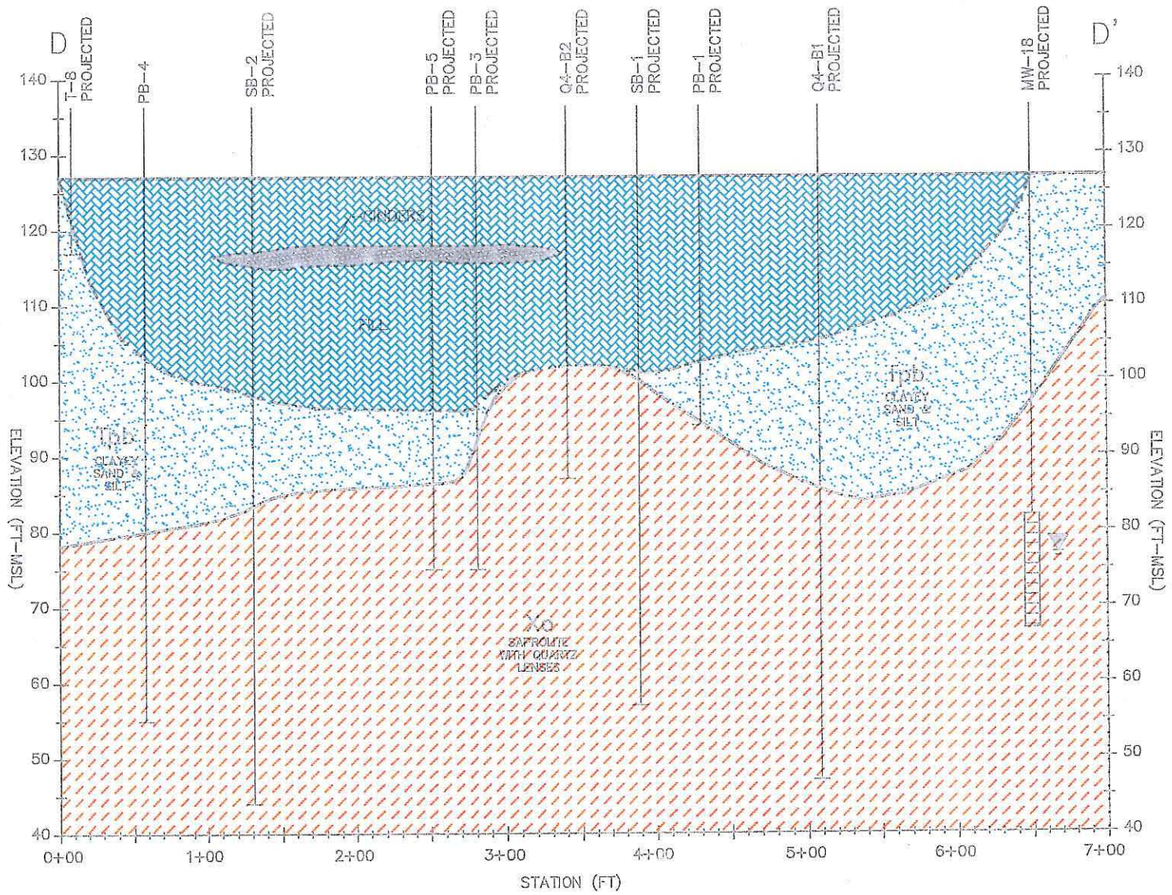
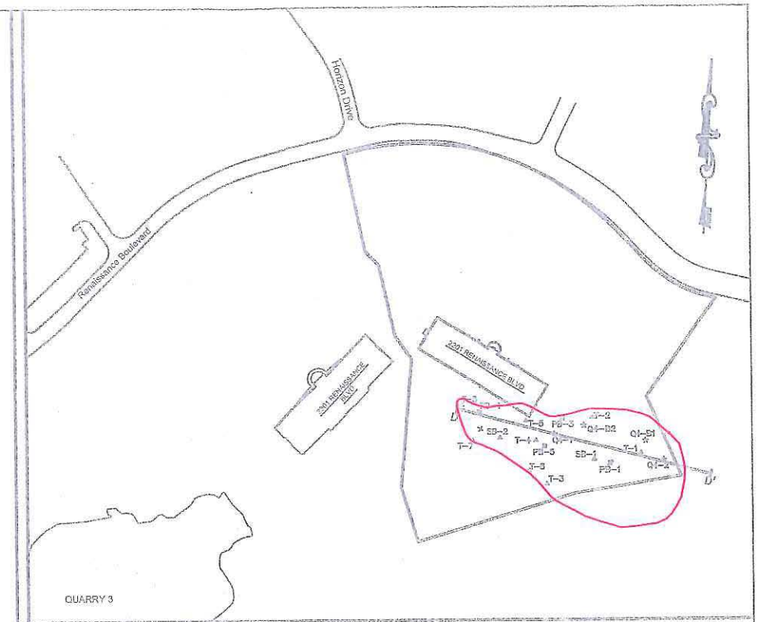


GEOLOGIC CROSS SECTION

HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=40'



CROSS SECTION LOCATION MAP

SCALE: 1"=400'.

LEGEND:

Tpb – PENSAUKEN/BRIDGETON FORMATION
Kp – PATAPSCO FORMATION
Xo – SCHIST SAPROLITE
Ꞓc* – WEATERED LIMESTONE
Ꞓc – CONESTOGA LIMESTONE

– – – – LIMIT OF QUARRY No.4

MSL – ELEVATION DATAM MEAN SEA LEVEL

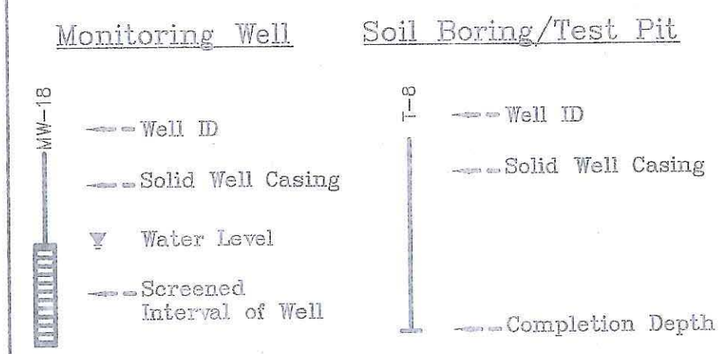


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FIGURE 9
GEOLOGIC CROSS SECTION D--D'
SHOWING QUARRY No. 4
QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP
MONTGOMERY COUNTY, PA

GRAPHIC SCALE: AS NOTED
FIGURE NO.: 9
SHEET NO.:

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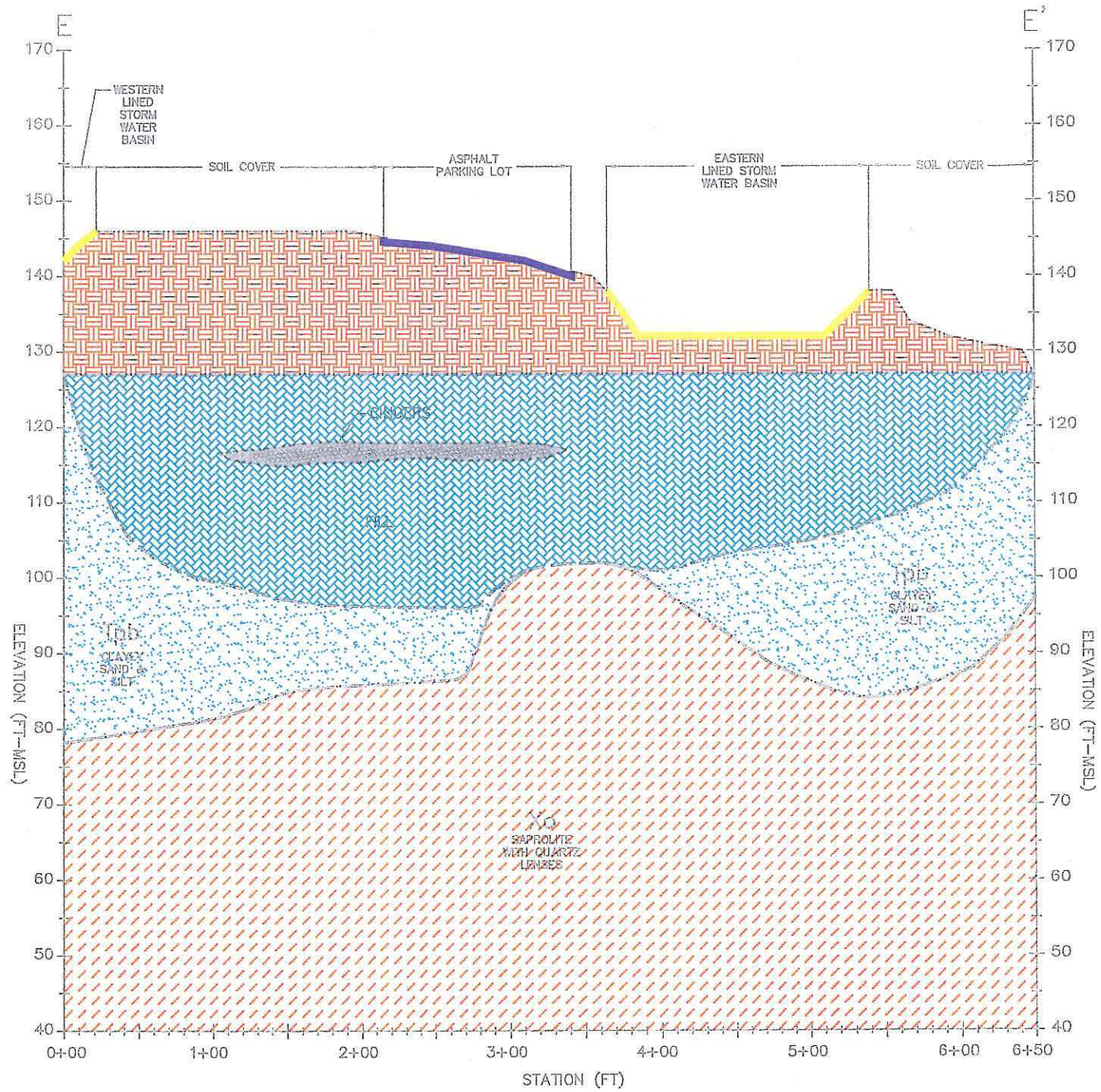
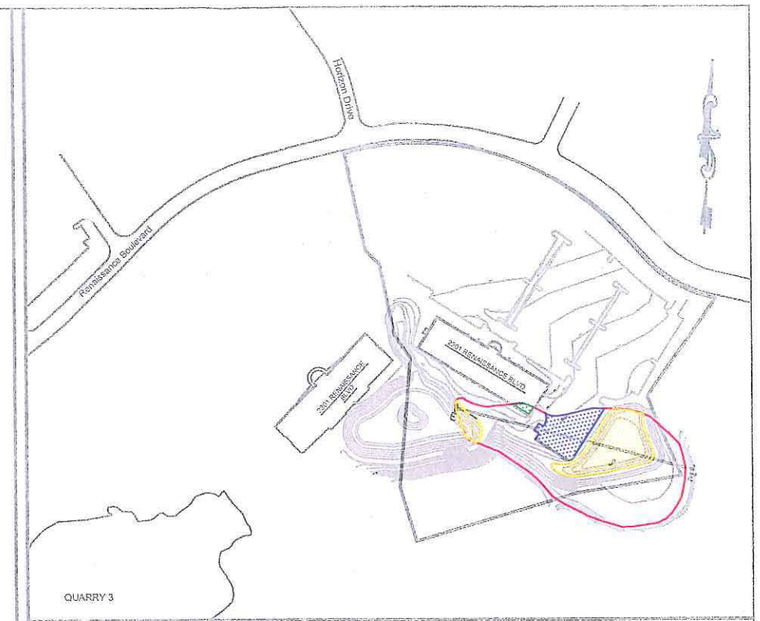


GEOLOGIC CROSS SECTION

HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=20'



CROSS SECTION LOCATION MAP

SCALE: 1"=400'.

LEGEND:

Tpb – PENSAUKEN/BRIDGETON FORMATION
Kp – PATAPSCO FORMATION
Xo – SCHIST SAPROLITE
Ꞓc* – WEATERED LIMESTONE
Ꞓc – CONESTOGA LIMESTONE

MSL – ELEVATION DATAM MEAN SEA LEVEL

– LIMIT OF QUARRY No.4

– SOIL COVER

– DETENTION BASIN WITH IMPERMEABLE LINER

– ASPHALT PARKING LOT

– BUILDING

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FIGURE 10
CROSS SECTION E–E' SHOWING COVER MATERIAL PLACED OVER QUARRY No. 4
QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP
MONTGOMERY COUNTY, PA

DRAWING SCALE	FIGURE NO.	SHEET NO.:
AS NOTED	10	

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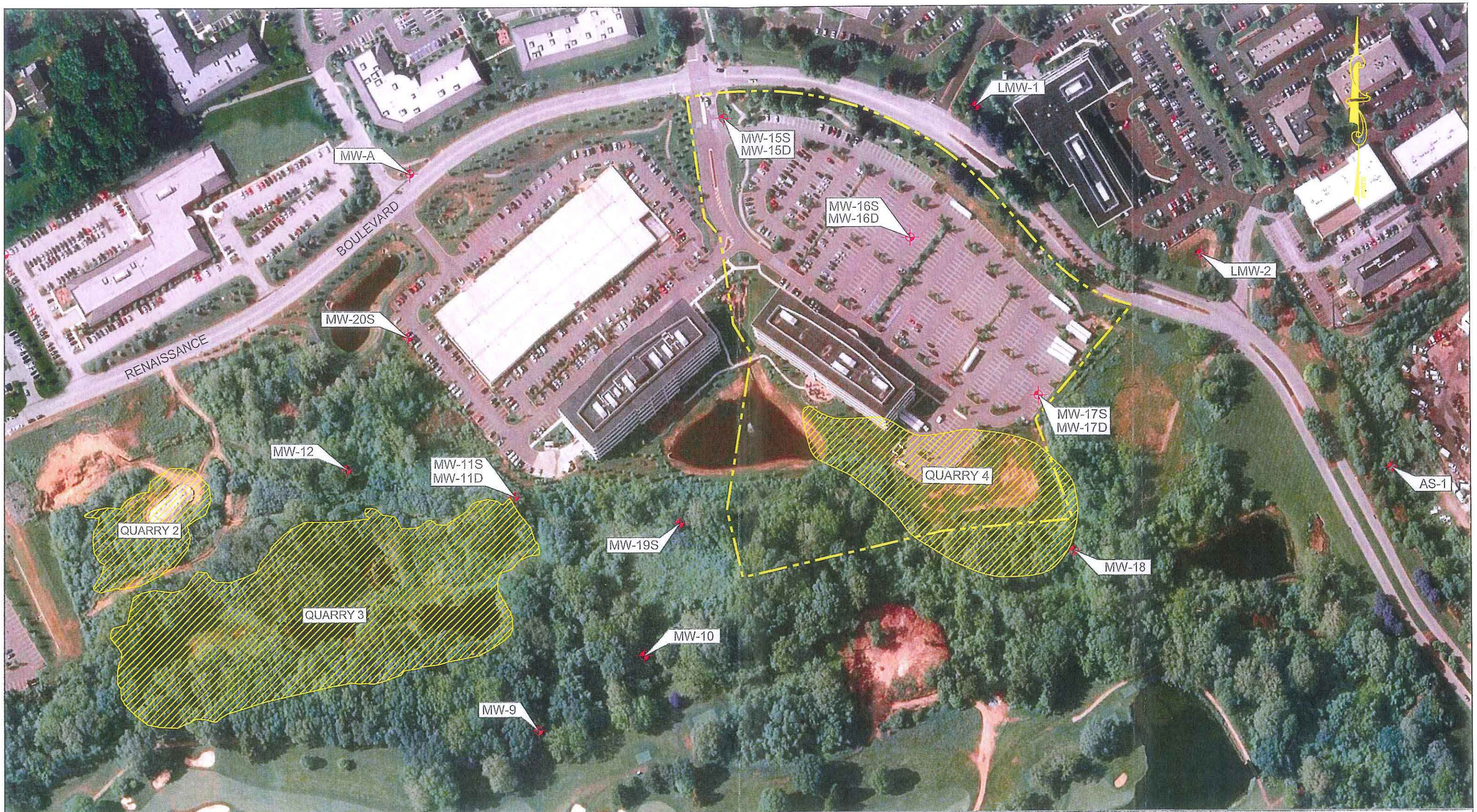

LEGEND :

- APPROXIMATE LIMIT OF QUARRY
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.
- MW-11S — MONITORING WELL LOCATIONS OBTAINED FROM KEY ENVIRONMENTAL, INC. FIGURE 17, DECEMBER 2008.

NOTES :

(1) BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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FIGURE 11
SITE MAP FOR 2201 RENAISSANCE BOULEVARD SHOWING ON-SITE AND SELECT OFF-SITE MONITORING WELLS

QUARRY No.4 DEMONSTRATION PROJECT
UPPER MERION TOWNSHIP, MONTGOMERY COUNTY PA

GRAPHIC SCALE: SCALE: 1"=200'
FIGURE NO.: 6
SHEET NO.:

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LEGEND :

- APPROXIMATE LIMIT OF QUARRY No.4
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.
- MW-18 (77.00) — MONITORING WELL LOCATION WITH GROUND WATER ELEVATION (JULY 14, 2008).
- GOUND WATER CONTOUR.
- GROUND WATER FLOW DIRECTION.

NOTES :

(1) BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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COST EFFECTIVE ENVIRONMENTAL SOLUTIONS
2755 BERGEY ROAD, HATFIELD, PA 19440
(215) 997-9000
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(724) 934-3530

DWG FILE: HAM013-015
DESIGNED BY: MDC
DRAWN BY: MDC
CHKD BY: MAC
DATE: 8-OCT-2009

FIGURE 12
POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP FOR WELLS COMPLETED IN THE SAPROLITE AND UPPER WEATHERED LIMESTONE IN AREA OF QUARRY No. 4

QUARRY No.4 DEMONSTRATION PROJECT

DRAWN SCALE: SCALE: 1"=200'
FIGURE NO.: 12
SHEET NO.:

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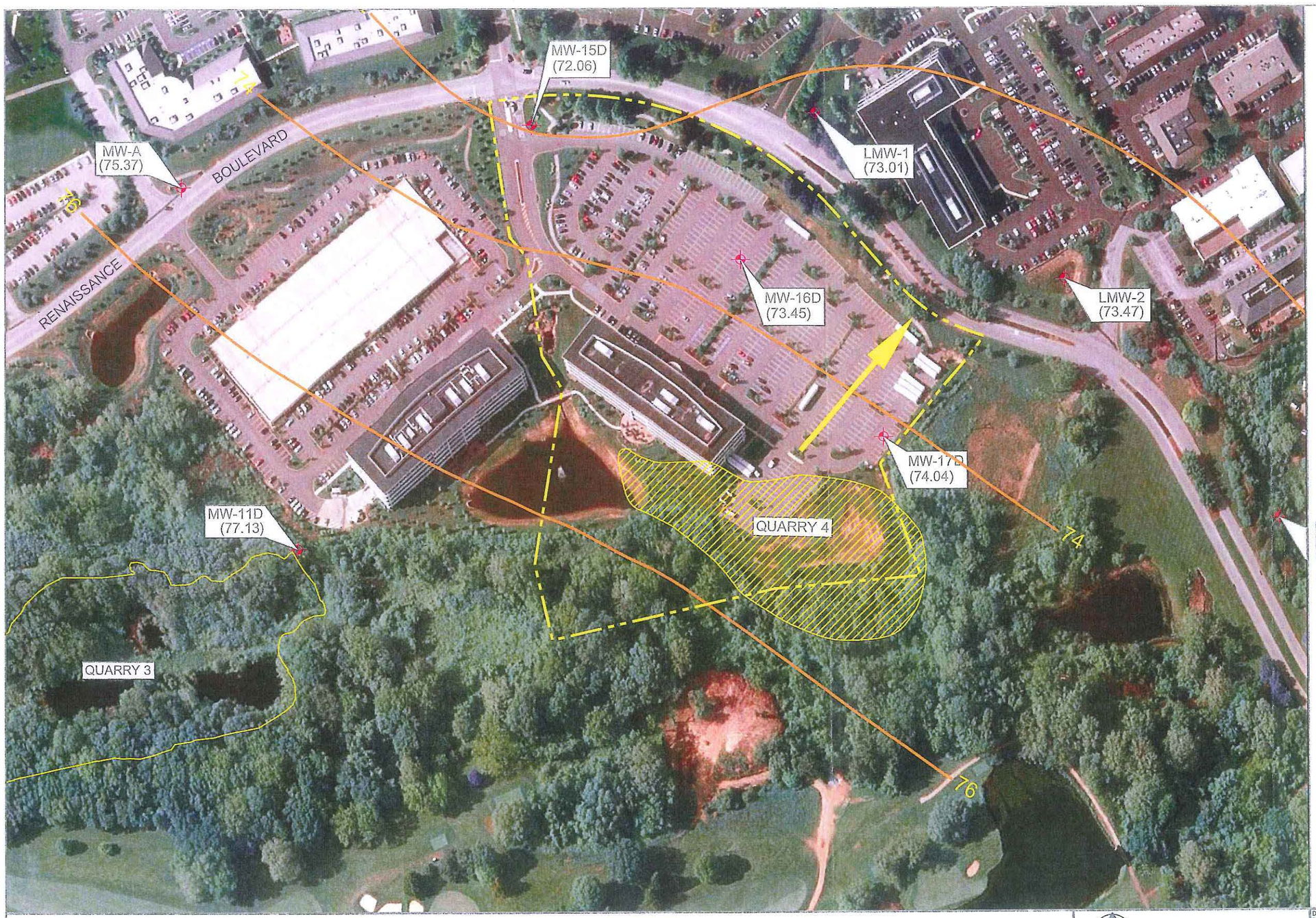

LEGEND :

- APPROXIMATE LIMIT OF QUARRY No.4
- APPROXIMATE PROPERTY BOUNDARY FOR 2201 RENAISSANCE BOULEVARD.
- MW-11D (77.13) – MONITORING WELL LOCATION WITH GROUND WATER ELEVATION JULY 14, 2008.
- GOUND WATER CONTOUR.
- GROUND WATER FLOW DIRECTION.

NOTES :

(1) BOUNDARY FOR QUARRY No.4 OBTAINED FROM HISTORICAL AERIAL PHOTOGRAPHS.

200' 0 200' 400'

SCALE: 1"=200'

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DWG FILE HA4013-022
DESIGNED BY MDC
DRAWN BY MDC
CHKD BY MAC
DATE 8-OCT-2008

FIGURE 13

POTENTIOMETRIC SURFACE ELEVATION CONTOUR MAP FOR WELLS COMPLETED IN THE LIMESTONE BEDROCK IN THE AREA OF QUARRY No. 4

QUARRY No.4 DEMONSTRATION PROJECT

SCALE: 1"=200'

FIGURE NO. 13

SHEET NO.:

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Appendix D

Lithologic Logs for Soil Borings and Construction Logs for Monitoring Wells

Penn E&R
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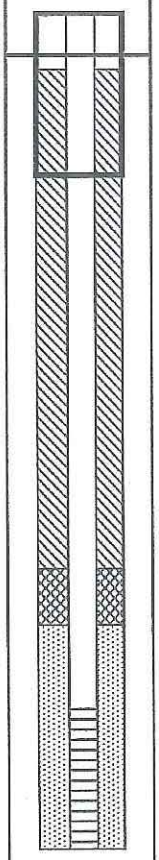
MONITORING WELL INSTALLATION LOG

WELL ID	MW-22
PROJECT NUMBER	HA 4013
PROJECT NAME	Quarry No. 4 Demonstration
SITE LOCATION	King of Prussia, PA

GEOLOGIST	Michael A. Christie,P.G.	WELL DIAMETER	2	inches	DATE	August 24, 2010	
DRILLER(s)	Mike Grahm / Paul Marti	WELL DEPTH	56.5	ft bgs	GROUT TYPE	Bentonite/cement	
DRILLING CO.	AmeriDrill, Inc.	WATER LEVEL (during)	▼ 52	ft bgs	TOP OF GROUT	1	ft bgs
METHOD	Hollow Stem Auger	WATER LEVEL (post)	▽ 53.7	ft bgs	PLUG TYPE	Bentonite	
DRILL RIG	HAS	RISER TYPE	40-PVC		TOP OF PLUG	40.5	ft bgs
OUTER CASING	NA	TOP OF RISER	3.5	ft ags	SAND TYPE	Silica	
CASING TYPE	Steel	SCREEN TYPE	0.01" slot, sch-40 PVC		TOP OF SAND	42.5	ft bgs
BORING DIAMETER	6	SCREEN LENGTH	10	ft	WELL YIELD	NA	gallons
BORING DEPTH	56.5 ft bgs	TOP OF SCREEN	46.5	ft bgs	PUMP RATE	NA	gal/min

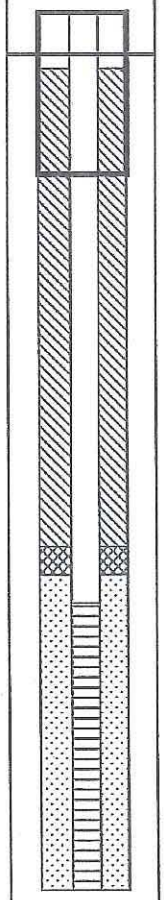
Depth	Water Level	PID	Lithology	Lithologic Description	Nft	Well Installation Diagram	Drilling/Construction Details
0							3.5' stick-up with locking expansion plug
10				0-30' Fill material mixed with brown silty fine sand			40.5' of Grout
20							
30				30'-42' Brown to dk. Brown clayey silt with fine sand, damp			
40				42'-48' Brown to dk. Brown clayey silt with fine sand, moist			2' of Bentonite
50				48'-52' Lt. Brown clayey silt with fine sand and little gravel. moist			15' of #01 Moire Sand
60				52'-57.5' Lt. Brown clayey silt with coarse sand and gravel, wet			10' of 0.01-slot schedule 40 screen
							56.5' Bottom of well/screen
							Boring Refusal encountered at 57.5'
70							
80							
90							

Penn E&R
Environmental & Remediation, Inc.

MONITORING WELL INSTALLATION LOG

WELL ID	MW-23
PROJECT NUMBER	HA 4013
PROJECT NAME	Quarry No. 4 Demonstration
SITE LOCATION	King of Prussia, PA

GEOLOGIST	Michael A. Christie, P.G.	WELL DIAMETER	2	inches	DATE	August 23, 2010	
DRILLER(s)	Mike Grahm / Paul Marti	WELL DEPTH	60	ft bgs	GROUT TYPE	Bentonite/cement	
DRILLING CO.	AmeriDrill, Inc.	WATER LEVEL (during)	▼ 46.5	ft bgs	TOP OF GROUT	1	ft bgs
METHOD	Hollow Stem Auger	WATER LEVEL (post)	▽ 46.34	ft bgs	PLUG TYPE	Bentonite	
DRILL RIG	HAS	RISER TYPE	40-PVC		TOP OF PLUG	36	ft bgs
OUTER CASING	NA	TOP OF RISER	3.7	ft ags	SAND TYPE	Silica	
CASING TYPE	Steel	SCREEN TYPE	0.01" slot, sch-40 PVC		TOP OF SAND	38	ft bgs
BORING DIAMETER	6	SCREEN LENGTH	20	ft	WELL YIELD	NA	gallons
BORING DEPTH	60 ft bgs	TOP OF SCREEN	40	ft bgs	PUMP RATE	NA	gal/min

Depth	Water Level	PID	Lithology	Lithologic Description	Nft	Well Installation Diagram	Drilling/Construction Details
0							3.7' stick-up with locking expansion plug
				0-20' Lt. Brown silt mixed with some fill material			
10							36' of Grout
20							
				20'-40' Brown and lt. gray clayey silt with fine sand			
30							
							2' of Bentonite
40				40'-46' Lt. brown clayey silt with fine sand and some gravel, moist			
							22' of #01 Moire Sand
50							20' of 0.01-slot schedule 40 screen
				46'-60' Lt. Brown clayey silt, wet			
60							60' Bottom of boring
70							
80							
90							

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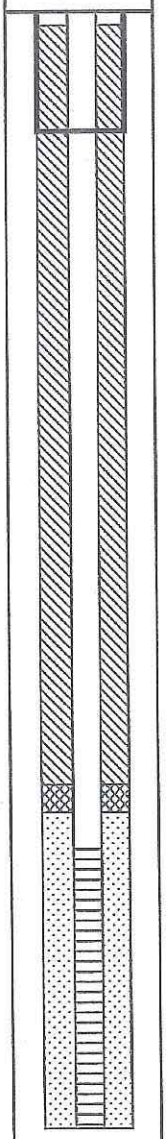
MONITORING WELL INSTALLATION LOG

WELL ID	MW-24
PROJECT NUMBER	HA 4013
PROJECT NAME	Quarry No. 4 Demonstration
SITE LOCATION	King of Prussia, PA

GEOLOGIST	Michael A. Christie, P.G.	WELL DIAMETER	2	inches	DATE	August 28, 2010	
DRILLER(s)	Mike Grahm / Paul Marti	WELL DEPTH	860	ft bgs	GROUT TYPE	Bentonite/cement	
DRILLING CO.	AmeriDrill, Inc.	WATER LEVEL (during)	▼ 71.3	ft bgs	TOP OF GROUT	1	ft bgs
METHOD	Hollow Stem Auger	WATER LEVEL (post)	▽ 69.11	ft bgs	PLUG TYPE	Bentonite	
DRILL RIG	HAS	RISER TYPE	40-PVC		TOP OF PLUG	56	ft bgs
OUTER CASING	NA	TOP OF RISER	0	ft ags	SAND TYPE	Silica	
CASING TYPE	Steel	SCREEN TYPE	0.01" slot, sch-40 PVC		TOP OF SAND	58	ft bgs
BORING DIAMETER	6	SCREEN LENGTH	20	ft	WELL YIELD	NA	gallons
BORING DEPTH	80 ft bgs	TOP OF SCREEN	60	ft bgs	PUMP RATE	NA	gal/min

Depth	Water Level	PID	Lithology	Lithologic Description	Nft	Well Installation Diagram	Drilling/Construction Details
0				0-1' Blacktop and crushed stone			Flush mount cover with locking expansion plug
10				1'-15' Reddish brown clayey silt with trace fine sand			
20							
30				15'-45' Reddish brown clayey silt with fine sand			56' of Grout
40							
50							
60				45'-57' Lt. brown clayey silt with sand and some gray clay fragments			2' of Bentonite
70				57'-65' Brown clayey silt with fine sand and weathered limestone, moist			22' of #01 Moire Sand
80				65'-80' Brown to reddish brown clayey silt with limestone fragments, wet			20' of 0.01-slot schedule 40 screen 80' Bottom of boring
90							

LITHOLOGIC LOGS FOR SOIL BORINGS INSTALLED TO EVALUATE COVER MATERIAL PLACED OVER QUARRY NO. 4
THE QUARRY NO. 4 DEMONSTRATION PROJECT

Soil Boring	Sampling Interval	Sample Collection Depth (bgs)	PID (ppm)	Description	Comments	Notes
SB-1	0'-4'	0"-4"	0.0	Top Soil with Organic material (Sod and Roots)		
		4"-4'	0.0	Reddish Brown Silty Clay with some sand and gravel		
	4'-8'	4'-8'	0.0	Reddish Brown Silty Clay with some sand and gravel		LS@7'-8'
	8'-12'	8'-10'	0.0	Reddish Brown Silty Clay with some sand and gravel		
		10'-12'	0.0	Reddish Brown Silty Clay with some sand and gravel		
	12'-15'	12'-15'	0.0	Reddish Brown Silty Clay with some sand and gravel	No Ground Water Encountered	
SB-2	0'-4'	0"-4"	0.0	Top Soil with Organic material (Sod and Roots)		
		4"-4'	0.0	Reddish Brown Silty Clay with some sand and gravel		
	4'-8'	4'-8'	0.0	Reddish Brown Silty Clay with some sand and gravel		LS@5'-6'
	8'-12'	8'-10'	0.0	Reddish Brown Silty Clay with some sand and gravel		
		10'-12'	0.0	Reddish Brown Silty Clay with some sand and gravel	No Ground Water Encountered	
SB-3	0'-4'	0"-4"	0.0	Top Soil with Organic material (Sod and Roots)		
		4"-4'	0.0	Reddish Brown Silty Clay with some sand and gravel		
	4'-8'	4'-8'	0.0	Reddish Brown Silty Clay with some sand and gravel		LS@4'-5'
	8'-10'	8'-10'	0.0	Reddish Brown Silty Clay with some sand and gravel	No Ground Water Encountered	

NOTES:

bgs - Below Ground Surface
PID - Photo Ionization Detector
ppm - Parts per million
LS - Depth of soil sample sent for laboratory analysis

Appendix E

E1 - Analytical Results for Soil Samples Collected from the Quarry No. 4 Cover

Appendix E
E2 - Analytical Results for the Ground Water Samples

Appendix F

Metals MDLs by Sampling Event – Provided by CompuChem Laboratory

APPENDIX F
MDLS by Sampling Event - Provided by CompuChem Laboratory

Collected Date	Analyte Name	MDL(ug/L)
10/11/2010	ALUMINUM	42.10
10/11/2010	ANTIMONY	14.70
10/11/2010	ARSENIC	2.00
10/11/2010	BARIUM	0.85
10/11/2010	BERYLLIUM	0.86
10/11/2010	CADMIUM	1.10
10/11/2010	CALCIUM	134.00
10/11/2010	CHROMIUM	0.68
10/11/2010	COBALT	6.70
10/11/2010	COPPER	4.50
10/11/2010	IRON	24.10
10/11/2010	LEAD	1.50
10/11/2010	MAGNESIUM	16.60
10/11/2010	MANGANESE	1.30
10/11/2010	NICKEL	5.90
10/11/2010	POTASSIUM	21.50
10/11/2010	SELENIUM	2.30
10/11/2010	SILVER	0.68
10/11/2010	SODIUM	271.00
10/11/2010	THALLIUM	3.90
10/11/2010	VANADIUM	0.43
10/11/2010	ZINC	1.70

Collected Date	Analyte Name	MDL(ug/L)
01/25/2011	ALUMINUM	56.60
01/25/2011	ANTIMONY	3.00
01/25/2011	ARSENIC	2.50
01/25/2011	BARIUM	1.30
01/25/2011	BERYLLIUM	0.52
01/25/2011	CADMIUM	0.33
01/25/2011	CALCIUM	111.00
01/25/2011	CHROMIUM	3.10
01/25/2011	COBALT	0.98
01/25/2011	COPPER	4.00
01/25/2011	IRON	26.00
01/25/2011	LEAD	2.00
01/25/2011	MAGNESIUM	21.50
01/25/2011	MANGANESE	1.80
01/25/2011	NICKEL	1.90
01/25/2011	POTASSIUM	26.30
01/25/2011	SELENIUM	5.40
01/25/2011	SILVER	1.20
01/25/2011	SODIUM	346.00
01/25/2011	THALLIUM	7.80
01/25/2011	VANADIUM	0.75
01/25/2011	ZINC	1.70

Collected Date	Analyte Name	MDL(ug/L)
04/25/2011	ALUMINUM	32.40
04/25/2011	ANTIMONY	2.60
04/25/2011	ARSENIC	4.40
04/25/2011	BARIUM	0.51
04/25/2011	BERYLLIUM	1.10
04/25/2011	CADMIUM	1.30
04/25/2011	CALCIUM	1680.00
04/25/2011	CHROMIUM	1.50
04/25/2011	COBALT	2.70
04/25/2011	COPPER	0.74
04/25/2011	IRON	19.40
04/25/2011	LEAD	1.20
04/25/2011	MAGNESIUM	509.00
04/25/2011	MANGANESE	1.70
04/25/2011	NICKEL	1.90
04/25/2011	POTASSIUM	391.00
04/25/2011	SELENIUM	5.20
04/25/2011	SILVER	0.73
04/25/2011	SODIUM	368.00
04/25/2011	THALLIUM	3.30
04/25/2011	VANADIUM	1.60
04/25/2011	ZINC	3.60

Collected Date	Analyte Name	MDL(ug/L)
07/25/2011	ALUMINUM	32.40
07/25/2011	ANTIMONY	2.60
07/25/2011	ARSENIC	4.40
07/25/2011	BARIUM	0.51
07/25/2011	BERYLLIUM	1.10
07/25/2011	CADMIUM	1.30
07/25/2011	CALCIUM	1680.00
07/25/2011	CHROMIUM	1.50
07/25/2011	COBALT	2.70
07/25/2011	COPPER	0.74
07/25/2011	IRON	19.40
07/25/2011	LEAD	1.20
07/25/2011	MAGNESIUM	509.00
07/25/2011	MANGANESE	1.70
07/25/2011	NICKEL	1.90
07/25/2011	POTASSIUM	391.00
07/25/2011	SELENIUM	5.20
07/25/2011	SILVER	0.73
07/25/2011	SODIUM	368.00
07/25/2011	THALLIUM	3.30
07/25/2011	VANADIUM	1.60
07/25/2011	ZINC	3.60

Collected Date	Analyte Name	MDL(ug/L)
10/21/2011	ALUMINUM	32.40
10/21/2011	ANTIMONY	2.60
10/21/2011	ARSENIC	4.40
10/21/2011	BARIUM	0.51
10/21/2011	BERYLLIUM	1.10
10/21/2011	CADMIUM	1.30
10/21/2011	CALCIUM	1680.00
10/21/2011	CHROMIUM	1.50
10/21/2011	COBALT	2.70
10/21/2011	COPPER	0.74
10/21/2011	IRON	19.40
10/21/2011	LEAD	1.20
10/21/2011	MAGNESIUM	509.00
10/21/2011	MANGANESE	1.70
10/21/2011	NICKEL	1.90
10/21/2011	POTASSIUM	391.00
10/21/2011	SELENIUM	5.20
10/21/2011	SILVER	0.73
10/21/2011	SODIUM	368.00
10/21/2011	THALLIUM	3.30
10/21/2011	VANADIUM	1.60
10/21/2011	ZINC	3.60

Collected Date	Analyte Name	MDL(ug/L)
01/27/2012	ALUMINUM	24.40
01/27/2012	ANTIMONY	3.70
01/27/2012	ARSENIC	2.40
01/27/2012	BARIUM	0.53
01/27/2012	BERYLLIUM	0.31
01/27/2012	CADMIUM	0.30
01/27/2012	CALCIUM	4450.00
01/27/2012	CHROMIUM	1.10
01/27/2012	COBALT	0.97
01/27/2012	COPPER	0.71
01/27/2012	IRON	23.90
01/27/2012	LEAD	1.90
01/27/2012	MAGNESIUM	126.00
01/27/2012	MANGANESE	1.20
01/27/2012	NICKEL	0.84
01/27/2012	POTASSIUM	24.10
01/27/2012	SELENIUM	1.70
01/27/2012	SILVER	6.70
01/27/2012	SODIUM	482.00
01/27/2012	THALLIUM	6.40
01/27/2012	VANADIUM	0.81
01/27/2012	ZINC	5.50

Collected Date	Analyte Name	MDL(ug/L)
05/01/2012	ALUMINUM	13.60
05/01/2012	ANTIMONY	4.20
05/01/2012	ARSENIC	3.50
05/01/2012	BARIUM	0.60
05/01/2012	BERYLLIUM	0.26
05/01/2012	CADMIUM	0.70
05/01/2012	CALCIUM	23.70
05/01/2012	CHROMIUM	0.88
05/01/2012	COBALT	3.30
05/01/2012	COPPER	0.81
05/01/2012	IRON	38.80
05/01/2012	LEAD	2.00
05/01/2012	MAGNESIUM	12.10
05/01/2012	MANGANESE	4.90
05/01/2012	NICKEL	0.68
05/01/2012	POTASSIUM	63.40
05/01/2012	SELENIUM	2.80
05/01/2012	SILVER	1.50
05/01/2012	SODIUM	186.00
05/01/2012	THALLIUM	4.00
05/01/2012	VANADIUM	1.30
05/01/2012	ZINC	3.50

Collected Date	Analyte Name	MDL(ug/L)
08/14/2012	ALUMINUM	13.60
08/14/2012	ANTIMONY	4.20
08/14/2012	ARSENIC	3.50
08/14/2012	BARIUM	0.60
08/14/2012	BERYLLIUM	0.26
08/14/2012	CADMIUM	0.70
08/14/2012	CALCIUM	23.70
08/14/2012	CHROMIUM	0.88
08/14/2012	COBALT	3.30
08/14/2012	COPPER	0.81
08/14/2012	IRON	38.80
08/14/2012	LEAD	2.00
08/14/2012	MAGNESIUM	12.10
08/14/2012	MANGANESE	4.90
08/14/2012	NICKEL	0.68
08/14/2012	POTASSIUM	63.40
08/14/2012	SELENIUM	2.80
08/14/2012	SILVER	1.50
08/14/2012	SODIUM	186.00
08/14/2012	THALLIUM	4.00
08/14/2012	VANADIUM	1.30
08/14/2012	ZINC	3.50

Appendix G

Total Metals Data – Validated Set and Data Set Modified for Statistical Testing

NOTES FOR APPENDIX G TABLES:

(1) - All results are reported in micrograms per liter.

(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.

(3) - USEPA Regional Screening Levels for Tapwater, April 2009

(4) - USEPA Maximum Contaminant Levels

J - Analyte present. Reported value may not be accurate or precise.

B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.

U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.

L - This result should be considered a biased low quantitative estimate.

K - Analyte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.

NA - Not Analyzed

Bold - Compound was detected above its listed ground water standard.

MW-10 Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	367	102J	174B	51.9B	81.7J	477	94.5B	58.8J
Antimony (Total)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.8B
Arsenic (Total)	<10.0	<10.0	<10UJ	<10.0	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Total)	**57.8J**	**55.2J**	**57.4J**	**65.5J**	**56.5J**	**59.0J**	**58.8J**	**48.4J**
Beryllium (Total)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Cadmium (Total)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Total)	20,800	20,400	20,200	20,000	20,100	18,500	18,700	20,200
Chromium (Total)	**13.2**	**105**	1.7B	6.9J	2.0J	**16.6**	13.3	2.5B
Cobalt (Total)	<50.0	2.6J	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0UL
Copper (Total)	<25.0	<25.0	<25.0	1.0J	<25.0	3.3J	2.6B	6.3B
Iron (Total)	**787**	**1,370**	223	**254**	**244**	**1,280**	320	164
Lead (Total)	<10.0L	<10.0	<10.0UL	1.5J	<10.0UL	<10.0	<10.0	<10.0
Magnesium (Total)	15,800	16,500	15,600	16,100	15,000	14,200	14,200	10,300
Manganese (Total)	9.8J	37.7	13.3J	13.4J	14.3J	23.1	12.9J	6.5J
Mercury (Total)	<0.20	<0.20L	<0.20	<0.20	<0.20	0.11J	<0.20	<0.20
Nickel (Total)	9.9J	155	2.3B	4.5J	2.3B	11.1B	10.2J	2.6J
Potassium (Total)	1,180J	844J	883J	1,000J	994J	1,760J	1,240J	2,080J
Selenium (Total)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Total)	<10.0	<10.0L	<10.0	1.1B	<10.0	<10.0	<10.0	<10.0
Sodium (Total)	1,350B	1,350B	1,130J	1,410B	1,290J	1,230J	1,090J	1,350J
Thallium (Total)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	1.4B	1.3J	<50.0	<50.0	<50.0	1.5J	<50.0	<50.0
Zinc (Total)	7.1J	19.7B	5.2L	<60.0	<60.0	11.7B	8.8J	14.7J

MW-10 Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	367	102	<32.400	<32.400	81.7	477	<13.600	58.8
Antimony (Total)	<14.700	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Total)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Total)	57.8	55.2	57.4	65.5	56.5	59	58.8	48.4
Beryllium (Total)	<0.860	<0.520	<1.100	<1.100	<1.100	<0.310	<0.260	<0.260
Cadmium (Total)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	20800	20400	20200	20000	20100	18500	18700	20200
Chromium (Total)	13.2	105	<1.500	6.9	2	16.6	13.3	<0.880
Cobalt (Total)	<6.700	2.6	<2.700	<2.700	<2.700	<0.970	<3.300	<3.300
Copper (Total)	<4.500	<4.000	<0.740	1	<0.740	3.3	<0.810	<0.810
Iron (Total)	787	1370	223	254	244	1280	320	164
Lead (Total)	<1.500	<2.000	<1.200	1.5	<1.200	<1.900	<2.000	<2.000
Magnesium (Total)	15800	16500	15600	16100	15000	14200	14200	10300
Manganese (Total)	9.8	37.7	13.3	13.4	14.3	23.1	12.9	6.5
Mercury (Total)	<0.065	<0.065	<0.048	<0.048	<0.048	0.11	<0.073	<0.073
Nickel (Total)	9.9	155	<1.900	4.5	<1.900	<0.840	10.2	2.6
Potassium (Total)	1180	844	883	1000	994	1760	1240	2080
Selenium (Total)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	<271.000	<346.000	1130	<368.000	1290	1230	1090	1350
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	<0.430	1.3	<1.600	<1.600	<1.600	1.5	<1.300	<1.300
Zinc (Total)	7.1	<1.700	5.2	<3.600	<3.600	<5.500	8.8	14.7

MW-22 Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	**16,800**	**78,200**	206B	**83,900J**	683	5,160	927	1,260
Antimony (Total)	<60.0	**11.2J**	<60.0	**10.6J**	<60.0	<60.0	<60.0	<60.0
Arsenic (Total)	**21.7**	**43.2K**	<10.0UJ	**64.9J**	<10.0UL	**7.1J**	<10.0UL	<10.0
Barium (Total)	**205**	**579**	**144J**	**615J**	**130J**	**144J**	**130J**	**115J**
Beryllium (Total)	**18.3**	**89.5**	<5.0	**90.8J**	<5.0	**5.1**	1.8B	2.0J
Cadmium (Total)	3.3B	**28.5**	<5.0	**35.9J**	<5.0	1.2B	<5.0	<5.0UL
Calcium (Total)	330,000	1,730,000	190,000	155,000J	201,000	193,000	183,000	179,000
Chromium (Total)	**114**	**129**	2.7B	**2,170J**	**29.8**	**73.9**	19.8	**108**
Cobalt (Total)	**60.1**	**368**	<50.0	**395J**	4.4J	**24.3J**	<50	<50.0UL
Copper (Total)	130	854	0.81B	595J	6.8J	33.2	9.5J	13.1J
Iron (Total)	**108,000**	**439,000**	**498**	**475,000J**	**4,580**	**31,900**	**4,560**	**8,450**
Lead (Total)	**65.1L**	**319**	<10.0UL	**360J**	2.9L	**18.7**	4.1B	6.1J
Magnesium (Total)	148,000	493,000	92,500	588,000J	128,000	118,000	116,000	118,000
Manganese (Total)	**2,280**	**9,620**	**322**	**10,800J**	**544**	**763**	**319**	**336**
Mercury (Total)	1.7	**42.9L**	<0.20	**52.0J**	**12**	**18.8**	**13**	**17.3**
Nickel (Total)	334	**1,230**	7.2J	**2,280J**	31.6J	104	27.4J	73.6
Potassium (Total)	11,800	10,200	12,500	19,700J	15,300	15,100	13,700	11,100
Selenium (Total)	**6.0J**	<35.0	<35.0	**6.1J**	<35.0	<35.0	<35.0	<35.0
Silver (Total)	<10.0L	3.8B	<10.0	8.2B	1.8B	<10.0	<10.0	<10.0
Sodium (Total)	151,000	33,200	137,000	23,300J	42,200	55,800	61,700	64,100
Thallium (Total)	**9.8J**	13.5B	<25.0	<25.0R	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	28.6J	108	<50.0	148J	2.1J	9.3J	2.9B	2.0J
Zinc (Total)	**1,510**	**7,700L**	16.2B	**6,710J**	58.7J	407	80.6	110

MW-22 Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	16800	78200	<32.400	83900	683	5160	927	1260
Antimony (Total)	<14.700	11.2	<2.600	10.6	<2.600	<3.700	<4.200	<4.200
Arsenic (Total)	21.7	43.2	<4.400	64.9	<4.400	7.1	<3.500	<3.500
Barium (Total)	205	579	144	615	130	144	130	115
Beryllium (Total)	18.3	89.5	<1.100	90.8	<1.100	5.1	<0.260	2
Cadmium (Total)	<1.100	28.5	<1.300	35.9	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	330000	1730000	190000	155000	201000	193000	183000	179000
Chromium (Total)	114	129	<1.500	2170	29.8	73.9	19.8	108
Cobalt (Total)	60.1	368	<2.700	395	4.4	24.3	<3.300	<3.300
Copper (Total)	130	854	<0.740	595	6.8	33.2	9.5	13.1
Iron (Total)	108000	439000	498	475000	4580	31900	4560	8450
Lead (Total)	65.1	319	<1.200	360	2.9	18.7	<2.000	6.1
Magnesium (Total)	148000	493000	92500	588000	128000	118000	116000	118000
Manganese (Total)	2280	9620	322	10800	544	763	319	336
Mercury (Total)	1.7	42.9	<0.048	52	12	18.8	13	17.3
Nickel (Total)	334	1230	7.2	2280	31.6	104	27.4	73.6
Potassium (Total)	11800	10200	12500	19700	15300	15100	13700	11100
Selenium (Total)	6	<5.400	<5.200	6.1	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	151000	33200	137000	23300	42200	55800	61700	64100
Thallium (Total)	9.8	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	28.6	108	<1.600	148	2.1	9.3	<1.300	2
Zinc (Total)	1510	7700	<3.600	6710	58.7	407	80.6	110

MW-23 Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	1,670	2,130	1,020	**26,800**	798	**10,500**	2,370	2,100
Antimony (Total)	<60.0	<60.0	<60.0	**12.9J**	<60.0	**10.0J**	<60.0	<60.0
Arsenic (Total)	<10.0	<10.0	<10.0UJ	<10.0	<10.0UL	**9.6K**	<10.0UL	<10.0
Barium (Total)	**57.3J**	**82.5J**	27.2J	**714**	28.0J	**386**	**84.4J**	**88.7J**
Beryllium (Total)	<5.0	1.4J	<5.0	**24.3**	<5.0	**9.1**	2.3B	1.9J
Cadmium (Total)	<5.0	<5.0	<5.0	**8.7**	<5.0	0.51B	0.94B	<5.0UL
Calcium (Total)	27,100	26,400	25,900	24,300	34,300	24,300	22,700	21,000
Chromium (Total)	**27**	**59.5**	12.9	**63**	**97.5**	**391**	**40.2**	**179**
Cobalt (Total)	<50.0	**14.4J**	2.7B	**212**	4.4J	**86.7**	**20.9J**	**11.0L**
Copper (Total)	13.8J	15.4J	2.3B	190	6.9J	76.7	17.4J	19.7J
Iron (Total)	**15,400**	**25,600**	**5,000**	**354,000**	**7,280**	**137,000**	**36,300**	**27,500**
Lead (Total)	10.3L	**18.2**	3.1L	**234**	4.6L	**93.9**	**20.8B**	**19.7**
Magnesium (Total)	17,400	18,200	17,000	18,800	16,900	16,500	15,200	14,100
Manganese (Total)	**462**	**779**	**133**	**12,600**	**286**	**5,490**	**1,180**	**1,150**
Mercury (Total)	<0.20	<0.20L	0.68	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Total)	27.2J	56.8	9.7J	305	56.5	296	49.0	116
Potassium (Total)	1,080J	793J	487J	2,110J	507J	1,780J	1,100J	617J
Selenium (Total)	**3.1J**	<35.0	<35.0	**8.7J**	<35.0	<35.0UL	<35.0	<35.0
Silver (Total)	<10.0L	<10.0	<10.0	1.8B	<10.0	8.2K	<10.0	<10.0
Sodium (Total)	2,070B	2,400J	2,050J	1,690B	2,040J	2,020J	1,870J	1,880J
Thallium (Total)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	5.2B	7.0J	2.1B	72.7	3.0J	30.7J	5.4B	5.1J
Zinc (Total)	97.1	146L	31.8L	**2,360**	42.2J	839	194	172

MW-23 Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	1670	2130	1020	26800	798	10500	2370	2100
Antimony (Total)	<14.700	<3.000	<2.600	12.9	<2.600	10	<4.200	<4.200
Arsenic (Total)	<2.000	<2.500	<4.400	<4.400	<4.400	9.6	<3.500	<3.500
Barium (Total)	57.3	82.5	27.2	714	28	386	84.4	88.7
Beryllium (Total)	<0.860	1.4	<1.100	24.3	<1.100	9.1	<0.260	1.9
Cadmium (Total)	<1.100	<0.330	<1.300	8.7	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	27100	26400	25900	24300	34300	24300	22700	21000
Chromium (Total)	27	59.5	12.9	63	97.5	391	40.2	179
Cobalt (Total)	<6.700	14.4	<2.700	212	4.4	86.7	20.9	11
Copper (Total)	13.8	15.4	<0.740	190	6.9	76.7	17.4	19.7
Iron (Total)	15400	25600	5000	354000	7280	137000	36300	27500
Lead (Total)	10.3	18.2	3.1	234	4.6	93.9	<2.000	19.7
Magnesium (Total)	17400	18200	17000	18800	16900	16500	15200	14100
Manganese (Total)	462	779	133	12600	286	5490	1180	1150
Mercury (Total)	<0.065	<0.065	0.68	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Total)	27.2	56.8	9.7	305	56.5	296	49	116
Potassium (Total)	1080	793	487	2110	507	1780	1100	617
Selenium (Total)	3.1	<5.400	<5.200	8.7	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	8.2	<1.500	<1.500
Sodium (Total)	<271.000	2400	2050	<368.000	2040	2020	1870	1880
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	<0.430	7	<1.600	72.7	3	30.7	<1.300	5.1
Zinc (Total)	97.1	146	31.8	2360	42.2	839	194	172

MW-15S Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	459	444	156B	1,120K	<200	378	173B	1,280
Antimony (Total)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	5.6J	4.3B
Arsenic (Total)	<10.0	3.2B	<10.0UJ	<10.0	<10.0UL	<10.0	<10.0UL	**3.6B**
Barium (Total)	**48.3J**	**67.1J**	**45.2J**	**61.7J**	**49.2J**	**78.9J**	**50.3J**	**62.4J**
Beryllium (Total)	<5.0	<5.0	<5.0	1.2J	<5.0	0.59B	<5.0	2.0J
Cadmium (Total)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.72B	<5.0UL
Calcium (Total)	85,400	93,200	91,000	107,000	105,000	98,100	98,900	103,000
Chromium (Total)	**20.1**	**28.4**	**67.8**	**55.7**	2.8J	**23.2**	**30.2**	**17.7**
Cobalt (Total)	<50.0	10.1J	<50.0	4.7J	<50.0	1.1J	3.6J	<50.0UL
Copper (Total)	<25.0	<25.0	1.6B	5.8J	<25.0	2.8J	1.0B	8.7J
Iron (Total)	**1,170**	**1,620**	**590**	**4,530**	131	**1,710**	**440**	**7,080**
Lead (Total)	<10.0L	2.4B	<10.0UL	5.9J	<10.0UL	2.2J	<10.0	7.3J
Magnesium (Total)	47,500	52,900	51,000	61,100	54,400	54,300	55,400	58,100
Manganese (Total)	45	51.1	20.1	**229**	11.4J	67.0	27.1	**296**
Mercury (Total)	<0.20	<0.20L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Total)	17.6J	22.4J	36.7J	35.2J	<40.0	16.9B	15.9J	21.6J
Potassium (Total)	2,740J	2,570J	1,600J	2,050J	1,730J	3,370J	2,000J	2,370J
Selenium (Total)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Total)	<10.0L	3.9B	<10.0	0.83B	<10.0	<10.0	<10.0	<10.0
Sodium (Total)	13,100	63,300	13,800	13,000	9,710	90,300	13,000	16,800
Thallium (Total)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	2.1B	1.9J	<50.0	4.1J	<50.0	1.6J	<50.0	4.9J
Zinc (Total)	15.6J	29.0L	9.3L	47.6J	4.9J	24.5B	7.4J	70.5

MW-15S Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	459	444	<32.400	1120	<32.400	378	<13.600	1280
Antimony (Total)	<14.700	<3.000	<2.600	<2.600	<2.600	<3.700	5.6	<4.200
Arsenic (Total)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Total)	48.3	67.1	45.2	61.7	49.2	78.9	50.3	62.4
Beryllium (Total)	<0.860	<0.520	<1.100	1.2	<1.100	<0.310	<0.260	2
Cadmium (Total)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	85400	93200	91000	107000	105000	98100	98900	103000
Chromium (Total)	20.1	28.4	67.8	55.7	2.8	23.2	30.2	17.7
Cobalt (Total)	<6.700	10.1	<2.700	4.7	<2.700	1.1	3.6	<3.300
Copper (Total)	<4.500	<4.000	<0.740	5.8	<0.740	2.8	<0.810	8.7
Iron (Total)	1170	1620	590	4530	131	1710	440	7080
Lead (Total)	<1.500	<2.000	<1.200	5.9	<1.200	2.2	<2.000	7.3
Magnesium (Total)	47500	52900	51000	61100	54400	54300	55400	58100
Manganese (Total)	45	51.1	20.1	229	11.4	67	27.1	296
Mercury (Total)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Total)	17.6	22.4	36.7	35.2	<1.900	<0.840	15.9	21.6
Potassium (Total)	2740	2570	1600	2050	1730	3370	2000	2370
Selenium (Total)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	13100	63300	13800	13000	9710	90300	13000	16800
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	<0.430	1.9	<1.600	4.1	<1.600	1.6	<1.300	4.9
Zinc (Total)	15.6	29	9.3	47.6	4.9	<5.500	7.4	70.5

MW-16S Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	2,180	**8,330**	3,620	**34,500**	1,410	435	246B	474
Antimony (Total)	<60.0	3.3J	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0
Arsenic (Total)	**2.6J**	**20.9K**	**7.4J**	**61.4**	<10.0UL	<10.0	<10.0UL	<10.0
Barium (Total)	**60.4J**	**123J**	**73.2J**	**384**	**56.7J**	**49.6J**	42.6J	**44.6J**
Beryllium (Total)	<5.0	2.1J	1.2B	**8.3**	<5.0	<5.0	0.27B	0.38B
Cadmium (Total)	<5.0	1.5J	<5.0	**14.5**	<5.0	<5.0	<5.0	<5.0UL
Calcium (Total)	66,200	165,000	77,200	566,000	71,200	60,100	56,700	57,200
Chromium (Total)	**152**	**980**	**655**	**2,710**	**275**	**59.0**	**13.3**	**55.6**
Cobalt (Total)	<50.0	**37.0J**	**15.6J**	**119**	5.9J	1.6J	<50.0	<50.0UL
Copper (Total)	31.8	142	61.7	546	27.9	7.5J	4.9J	8.5J
Iron (Total)	**11,000**	**59,200**	**23,300**	**238,000**	**10,900**	**2,900**	**983**	**2,110**
Lead (Total)	9.3L	**52.2**	18.7L	**224**	8.5L	1.9J	2.1B	<10.0
Magnesium (Total)	39,900	94,800	46,800	281,000	44,000	39,100	33,500	35,200
Manganese (Total)	**140**	**795**	**373**	**3,340**	**188**	43.9	46.3	32.2
Mercury (Total)	<0.20	0.079B	<0.20	0.28	<0.20	<0.20	<0.20	<0.20
Nickel (Total)	98.3	**792**	349	**1,600**	149	32.9B	8.3J	56.6
Potassium (Total)	7,110	6,070	5,110	13,700	5,860	7,050	5,730	6,460
Selenium (Total)	<35.0	<35.0	<35.0	**8.6J**	<35.0	<35.0UL	<35.0	<35.0
Silver (Total)	<10.0L	1.2B	<10.0	2.2B	0.79B	<10.0	<10.0	<10.0UL
Sodium (Total)	33,100	134,000	66,700	28,800	12,500	11,500	30,200	9,910
Thallium (Total)	<25.0	<25.0	4.5B	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	10.2J	45.9J	20.0J	174	9.3	2.4J	<50.0	<50.0
Zinc (Total)	137	495L	169L	**3,000**	87.4	41.8J	24.8J	29.4J

MW-16S Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	2180	8330	3620	34500	1410	435	<13.60	474
Antimony (Total)	<14.700	3.3	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Total)	2.6	20.9	7.4	61.4	<4.400	<2.400	<3.500	<3.500
Barium (Total)	60.4	123	73.2	384	56.7	49.6	42.6	44.6
Beryllium (Total)	<0.860	2.1	<1.100	8.3	<1.100	<0.310	<0.260	<0.260
Cadmium (Total)	<1.100	1.5	<1.300	14.5	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	66200	165000	77200	566000	71200	60100	56700	57200
Chromium (Total)	152	980	655	2710	275	59	13.3	55.6
Cobalt (Total)	<6.700	37	15.6	119	5.9	1.6	<3.300	<3.300
Copper (Total)	31.8	142	61.7	546	27.9	7.5	4.9	8.5
Iron (Total)	11000	59200	23300	238000	10900	2900	983	2110
Lead (Total)	9.3	52.2	18.7	224	8.5	1.9	<2.000	<2.000
Magnesium (Total)	39900	94800	46800	281000	44000	39100	33500	35200
Manganese (Total)	140	795	373	3340	188	43.9	46.3	32.2
Mercury (Total)	<0.065	<0.065	<0.048	0.28	<0.048	<0.073	<0.073	<0.073
Nickel (Total)	98.3	792	349	1600	149	<0.840	8.3	56.6
Potassium (Total)	7110	6070	5110	13700	5860	7050	5730	6460
Selenium (Total)	<2.300	<5.400	<5.200	8.6	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	33100	134000	66700	28800	12500	11500	30200	9910
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	10.2	45.9	20	174	9.3	2.4	<1.300	<1.300
Zinc (Total)	137	495	169	3000	87.4	41.8	24.8	29.4

MW-17S Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	502	1,360	739	977	<200	1,310	387B	33.2J
Antimony (Total)	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	<60.0	7.1B
Arsenic (Total)	<10.0	4.1B	<10.0UJ	<10.0	<10.0UL	<10.0	<10.0UL	**12.3B**
Barium (Total)	8.2J	**44.8J**	16.9J	18.3J	17.7J	15.4J	13.6J	13.1J
Beryllium (Total)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.41B	1.8J
Cadmium (Total)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0UL
Calcium (Total)	11,400	37,300	21,200	18,200	17,000	8,850	16,100	104,000
Chromium (Total)	5.6J	**65.6**	**26.2**	**33.4**	**8.2J**	**97.9**	**24.1**	2.4B
Cobalt (Total)	<50.0	5.1J	3.0B	3.7J	<50.0	3.1J	<50.0	<50.0UL
Copper (Total)	5.2J	13.8J	3.7B	7.8J	0.99J	27.9	2.7B	4.7B
Iron (Total)	**1,680**	**6,200**	**2,990**	**3,690**	**257**	**3,530**	**1,460**	39.9B
Lead (Total)	<10.0L	9.4B	3.8L	6.2J	<10.0UL	7.5J	3.4B	2.6J
Magnesium (Total)	1,600J	12,400	4,440	3240J	3,490J	2,110J	2,710J	2,570J
Manganese (Total)	**148**	**189**	**168**	**118**	**125**	**96.0**	85.8	172
Mercury (Total)	<0.20	<0.20L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel (Total)	<40.0	51.0	16.4J	27.0J	4.2J	53.1	14.1J	3.3J
Potassium (Total)	1,550J	5,420	3,010J	2,810J	2,940	1,220J	2,650	1,130J
Selenium (Total)	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	2.8J
Silver (Total)	<10.0L	<10.0	<10.0	1.2B	<10.0	<10.0	<10.0	<10.0
Sodium (Total)	134,000	786,000	417,000	341,000	389,000	50,100	349,000	7,220
Thallium (Total)	<25.0	<25.0	<25.0	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	2.3B	4.5J	<50.0	2.9J	<50.0	4.8J	1.4B	<50.0
Zinc (Total)	28.9J	105L	32.5L	50.9J	4.0J	83.1	17.1J	6.3J

MW-17S Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	502	1360	739	977	<32.40	1310	<13.60	33.2
Antimony (Total)	<14.70	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Total)	<2.000	<2.500	<4.400	<4.400	<4.400	<2.400	<3.500	<3.500
Barium (Total)	8.2	44.8	16.9	18.3	17.7	15.4	13.6	13.1
Beryllium (Total)	<0.860	<0.520	<1.100	<1.100	<1.100	<0.310	<0.260	1.8
Cadmium (Total)	<1.100	<0.330	<1.300	<1.300	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	11400	37300	21200	18200	17000	8850	16100	104000
Chromium (Total)	5.6	65.6	26.2	33.4	8.2	97.9	24.1	<0.880
Cobalt (Total)	<6.700	5.1	<2.700	3.7	<2.700	3.1	<3.300	<3.300
Copper (Total)	5.2	13.8	<0.740	7.8	0.99	27.9	<0.810	<0.810
Iron (Total)	1680	6200	2990	3690	257	3530	1460	<38.800
Lead (Total)	<1.500	<2.000	3.8	6.2	<1.200	7.5	<2.000	2.6
Magnesium (Total)	1600	12400	4440	3240	3490	2110	2710	2570
Manganese (Total)	148	189	168	118	125	96	85.8	172
Mercury (Total)	<0.065	<0.065	<0.048	<0.048	<0.048	<0.073	<0.073	<0.073
Nickel (Total)	<5.900	51	16.4	27	4.2	53.1	14.1	3.3
Potassium (Total)	1550	5420	3010	2810	2940	1220	2650	1130
Selenium (Total)	<2.300	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	2.8
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	134000	786000	417000	341000	389000	50100	349000	7220
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	<0.430	4.5	<1.600	2.9	<1.600	4.8	<1.300	<1.300
Zinc (Total)	28.9	105	32.5	50.9	4.0	83.1	17.1	6.3

MW-24 Total Metals - Original data display

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	**19,200**	**26,600**	6,320	**30,900**	830	25,900	1,250	3,220
Antimony (Total)	<60.0	<60.0	<60.0	<60.0	<60.0	**6.9B**	<60.0	4.9B
Arsenic (Total)	**37.1**	**72.2K**	**14.3J**	**49.1**	<10.0UL	**55.6K**	<10.0UL	**5.8B**
Barium (Total)	**109J**	**638**	**50.1J**	**109J**	31.2J	**166J**	25.6J	**43.5J**
Beryllium (Total)	**12.6**	**54.8**	**4.3J**	**18.8**	1.1B	**19.0**	1.1B	3.1J
Cadmium (Total)	<5.0	4.8J	<5.0	2.4J	<5.0	<5.0	<5.0	<5.0UL
Calcium (Total)	63,700	72,600	37,600	34,300	34,200	21,100	14,700	11,700
Chromium (Total)	**143**	**43.4**	**93.4**	**1,660**	**87.2**	**706**	**55.5**	**1,920**
Cobalt (Total)	**201**	**402**	**81.6**	**355**	**14.8J**	**350**	**13.3J**	**99.1L**
Copper (Total)	119	464	36.8	180	7.4J	153	8.1J	72.6
Iron (Total)	**80,300**	**86,400**	**28,900**	**120,000**	**5,150**	**108,000**	**6,590**	**22,700**
Lead (Total)	**395L**	**1,470**	**136L**	**595**	**23.4L**	699	**29.4**	**143**
Magnesium (Total)	8,940	9,560	4,310J	7,320	2,420J	5,820	1,340J	1,650J
Manganese (Total)	**3,020**	**6,140**	**1,070**	**4,640**	**212**	**4,410**	219	**1,540**
Mercury (Total)	<0.20	0.35B	<0.20	0.071J	<0.20	0.23	<0.20	<0.20
Nickel (Total)	196	235	87.9	**974**	53.7	507	40.7	**1,070**
Potassium (Total)	7,390	2,800J	1,890J	3,640J	1,260J	4,000J	1,200J	1,370J
Selenium (Total)	**6.2J**	<35.0	<35.0	<35.0	<35.0	<35.0UL	<35.0	<35.0
Silver (Total)	<10.0L	<10.0	<10.0	0.83B	<10.0	<10.0	<10.0	<10.0
Sodium (Total)	7,550	15,900	39,100	9,420	17,300	15,200	7,190	4,620J
Thallium (Total)	<25.0	11.5B	6.5B	<25.0	<25.0UL	<25.0	<25.0	<25.0UL
Vanadium (Total)	19.8J	20.8J	7.2J	35.9J	<50.0	29.0J	1.9B	7.9J
Zinc (Total)	547	800L	247L	963	90.4	1,020	85.2	171

MW-24 Total Metals - After Data Adjustment

	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*
Metals:								
Aluminum (Total)	19200	26600	6320	30900	830	25900	1250	3220
Antimony (Total)	<14.700	<3.000	<2.600	<2.600	<2.600	<3.700	<4.200	<4.200
Arsenic (Total)	37.1	72.2	14.3	49.1	<4.400	55.6	<3.500	<3.500
Barium (Total)	109	638	50.1	109	31.2	166	25.6	43.5
Beryllium (Total)	12.6	54.8	4.3	18.8	<1.100	19	<0.260	3.1
Cadmium (Total)	<1.100	4.8	<1.300	2.4	<1.300	<0.300	<0.700	<0.700
Calcium (Total)	63700	72600	37600	34300	34200	21100	14700	11700
Chromium (Total)	143	43.4	93.4	1660	87.2	706	55.5	1920
Cobalt (Total)	201	402	81.6	355	14.8	350	13.3	99.1
Copper (Total)	119	464	36.8	180	7.4	153	8.1	72.6
Iron (Total)	80300	86400	28900	120000	5150	108000	6590	22700
Lead (Total)	395	1470	136	595	23.4	699	29.4	143
Magnesium (Total)	8940	9560	4310	7320	2420	5820	1340	1650
Manganese (Total)	3020	6140	1070	4640	212	4410	219	1540
Mercury (Total)	<0.065	<0.065	<0.048	0.071	<0.048	0.23	<0.073	<0.073
Nickel (Total)	196	235	87.9	974	53.7	507	40.7	1070
Potassium (Total)	7390	2800	1890	3640	1260	4000	1200	1370
Selenium (Total)	6.2	<5.400	<5.200	<5.200	<5.200	<1.700	<2.800	<2.800
Silver (Total)	<0.680	<1.200	<0.730	<0.730	<0.730	<6.700	<1.500	<1.500
Sodium (Total)	7550	15900	39100	9420	17300	15200	7190	4620
Thallium (Total)	<3.900	<7.800	<3.300	<3.300	<3.300	<6.400	<4.000	<4.000
Vanadium (Total)	19.8	20.8	7.2	35.9	<1.600	29	<1.300	7.9
Zinc (Total)	547	800	247	963	90.4	1020	85.2	171

Appendix H1

Computer Output for Outlier Identification Using Dixon's Test

Program Dixon

It performs Dixon's Outlier Test for sample sizes of 25 or less.
It is based upon the description of the test in USEPA's Unified
Guidance (2009) and was tested against the sample case given therein.

Application of Dixon's outlier test to critical total metals - Liberty Property
Selected alpha is 0.05

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
367.00	13.60	2.6101
102.00	32.40	3.4782
32.40	32.40	3.4782
32.40	58.80	4.0741
81.70	81.70	4.4031
477.00	102.00	4.6250
13.60	367.00	5.9054
58.80	477.00	6.1675

C value for straight concentrations = 0.247
C value for logarithmic concentrations (Clog) = 0.097
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (477.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (477.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
57.80	48.40	3.8795
55.20	55.20	4.0110
57.40	56.50	4.0342
65.50	57.40	4.0500
56.50	57.80	4.0570
59.00	58.80	4.0741
58.80	59.00	4.0775
48.40	65.50	4.1821

C value for straight concentrations = 0.631
C value for logarithmic concentrations (Clog) = 0.611
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum
value (65.50) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum
value (65.50) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.86	0.26	-1.3471
0.52	0.26	-1.3471
1.10	0.31	-1.1712
1.10	0.52	-0.6539
1.10	0.86	-0.1508
0.31	1.10	0.0953
0.26	1.10	0.0953
0.26	1.10	0.0953

C value for straight concentrations = 0.000
C value for logarithmic concentrations (Clog) = 0.000
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
20800.00	18500.00	9.8255
20400.00	18700.00	9.8363
20200.00	20000.00	9.9035
20000.00	20100.00	9.9085
20100.00	20200.00	9.9134
18500.00	20200.00	9.9134
18700.00	20400.00	9.9233
20200.00	20800.00	9.9427

C value for straight concentrations = 0.190
C value for logarithmic concentrations (Clog) = 0.182
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (20800.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (20800.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
13.20	0.88	-0.1278
105.00	1.50	0.4055
1.50	2.00	0.6931
6.90	6.90	1.9315
2.00	13.20	2.5802
16.60	13.30	2.5878
13.30	16.60	2.8094
0.88	105.00	4.6540

C value for straight concentrations = 0.854
C value for logarithmic concentrations (Clog) = 0.434
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (105.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (105.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
787.00	164.00	5.0999
1370.00	223.00	5.4072
223.00	244.00	5.4972
254.00	254.00	5.5373
244.00	320.00	5.7683
1280.00	787.00	6.6682
320.00	1280.00	7.1546
164.00	1370.00	7.2226

C value for straight concentrations = 0.078
C value for logarithmic concentrations (Clog) = 0.037
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1370.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1370.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
15800.00	10300.00	9.2399
16500.00	14200.00	9.5610
15600.00	14200.00	9.5610
16100.00	15000.00	9.6158
15000.00	15600.00	9.6550
14200.00	15800.00	9.6678
14200.00	16100.00	9.6866
10300.00	16500.00	9.7111

C value for straight concentrations = 0.174
C value for logarithmic concentrations (Clog) = 0.163
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (16500.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (16500.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
9.80	6.50	1.8718
37.70	9.80	2.2824

13.30	12.90	2.5572
13.40	13.30	2.5878
14.30	13.40	2.5953
23.10	14.30	2.6603
12.90	23.10	3.1398
6.50	37.70	3.6297

C value for straight concentrations = 0.523
C value for logarithmic concentrations (Clog) = 0.364
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (37.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (37.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
9.90	0.84	-0.1744
155.00	1.90	0.6419
1.90	1.90	0.6419
4.50	2.60	0.9555
1.90	4.50	1.5041
0.84	9.90	2.2925
10.20	10.20	2.3224
2.60	155.00	5.0434

C value for straight concentrations = 0.946
C value for logarithmic concentrations (Clog) = 0.618
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (155.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (155.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1180.00	844.00	6.7382
844.00	883.00	6.7833
883.00	994.00	6.9017
1000.00	1000.00	6.9078
994.00	1180.00	7.0733
1760.00	1240.00	7.1229
1240.00	1760.00	7.4731
2080.00	2080.00	7.6401

C value for straight concentrations = 0.267
C value for logarithmic concentrations (Clog) = 0.195
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2080.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2080.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
271.00	271.00	5.6021
346.00	346.00	5.8464
1130.00	368.00	5.9081
368.00	1090.00	6.9939
1290.00	1130.00	7.0300
1230.00	1230.00	7.1148
1090.00	1290.00	7.1624
1350.00	1350.00	7.2079

C value for straight concentrations = 0.060
C value for logarithmic concentrations (Clog) = 0.033
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1350.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1350.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.43	0.43	-0.8440
1.30	1.30	0.2624
1.60	1.30	0.2624
1.60	1.30	0.2624
1.60	1.50	0.4055
1.50	1.60	0.4700
1.30	1.60	0.4700
1.30	1.60	0.4700

C value for straight concentrations = 0.000
C value for logarithmic concentrations (Clog) = 0.000
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1.60) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1.60) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-10
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7.10	1.70	0.5306
1.70	3.60	1.2809
5.20	3.60	1.2809
3.60	5.20	1.6487
3.60	5.50	1.7047
5.50	7.10	1.9601

8.80	8.80	2.1748
14.70	14.70	2.6878

C value for straight concentrations = 0.532
C value for logarithmic concentrations (Clog) = 0.365
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (14.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (14.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Aluminum-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
16800.00	32.40	3.4782
78200.00	683.00	6.5265
32.40	927.00	6.8320
83900.00	1260.00	7.1389
683.00	5160.00	8.5487
5160.00	16800.00	9.7291
927.00	78200.00	11.2670
1260.00	83900.00	11.3374

C value for straight concentrations = 0.068
C value for logarithmic concentrations (Clog) = 0.015
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (83900.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (83900.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Aluminum-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
16800.00	32.40	3.4782
78200.00	683.00	6.5265
32.40	927.00	6.8320
683.00	1260.00	7.1389
5160.00	5160.00	8.5487
927.00	16800.00	9.7291
1260.00	78200.00	11.2670

C value for straight concentrations = 0.785
C value for logarithmic concentrations (Clog) = 0.197
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (78200.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (78200.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total arsenic

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
21.70	3.50	1.2528
43.20	3.50	1.2528
4.40	4.40	1.4816
64.90	4.40	1.4816
4.40	7.10	1.9601
7.10	21.70	3.0773
3.50	43.20	3.7658
3.50	64.90	4.1728

C value for straight concentrations = 0.353
C value for logarithmic concentrations (Clog) = 0.139
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (64.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (64.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Barium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
205.00	115.00	4.7449
579.00	130.00	4.8675
144.00	130.00	4.8675
615.00	144.00	4.9698
130.00	144.00	4.9698
144.00	205.00	5.3230
130.00	579.00	6.3613
115.00	615.00	6.4216

C value for straight concentrations = 0.074
C value for logarithmic concentrations (Clog) = 0.039
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (615.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (615.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Barium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
205.00	115.00	4.7449
579.00	130.00	4.8675
144.00	130.00	4.8675
130.00	144.00	4.9698
144.00	144.00	4.9698
130.00	205.00	5.3230
115.00	579.00	6.3613

C value for straight concentrations = 0.806
C value for logarithmic concentrations (Clog) = 0.642
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (579.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (579.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Beryllium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
18.30	0.26	-1.3471
89.50	1.10	0.0953
1.10	1.10	0.0953
90.80	2.00	0.6931
1.10	5.10	1.6292
5.10	18.30	2.9069
0.26	89.50	4.4942
2.00	90.80	4.5087

C value for straight concentrations = 0.014
C value for logarithmic concentrations (Clog) = 0.003
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (90.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (90.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Beryllium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
18.30	0.26	-1.3471
89.50	1.10	0.0953
1.10	1.10	0.0953
1.10	2.00	0.6931
5.10	5.10	1.6292
0.26	18.30	2.9069
2.00	89.50	4.4942

C value for straight concentrations = 0.798
C value for logarithmic concentrations (Clog) = 0.272
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (89.50) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (89.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
330000.00	155000.00	11.9512
1730000.00	179000.00	12.0951

190000.00	183000.00	12.1172
155000.00	190000.00	12.1548
201000.00	193000.00	12.1704
193000.00	201000.00	12.2111
183000.00	330000.00	12.7068
179000.00	1730000.00	14.3636

C value for straight concentrations = 0.903
C value for logarithmic concentrations (Clog) = 0.730
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (1730000.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (1730000.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
114.00	1.50	0.4055
129.00	19.80	2.9857
1.50	29.80	3.3945
2170.00	73.90	4.3027
29.80	108.00	4.6821
73.90	114.00	4.7362
19.80	129.00	4.8598
108.00	2170.00	7.6825

C value for straight concentrations = 0.949
C value for logarithmic concentrations (Clog) = 0.601
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (2170.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (2170.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total cobalt - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
60.10	2.70	0.9933
368.00	3.30	1.1939
2.70	3.30	1.1939
395.00	4.40	1.4816
4.40	24.30	3.1905
24.30	60.10	4.0960
3.30	368.00	5.9081
3.30	395.00	5.9789

C value for straight concentrations = 0.069
C value for logarithmic concentrations (Clog) = 0.015
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (395.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (395.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total cobalt - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
60.10	2.70	0.9933
368.00	3.30	1.1939
2.70	3.30	1.1939
4.40	4.40	1.4816
24.30	24.30	3.1905
3.30	60.10	4.0960
3.30	368.00	5.9081

C value for straight concentrations = 0.843
C value for logarithmic concentrations (Clog) = 0.369
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (368.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (368.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total copper - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
130.00	0.74	-0.3011
854.00	6.80	1.9169
0.74	9.50	2.2513
595.00	13.10	2.5726
6.80	33.20	3.5025
33.20	130.00	4.8675
9.50	595.00	6.3886
13.10	854.00	6.7499

C value for straight concentrations = 0.306
C value for logarithmic concentrations (Clog) = 0.075
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (854.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (854.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total copper - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
130.00	0.74	-0.3011
0.74	6.80	1.9169
595.00	9.50	2.2513
6.80	13.10	2.5726
33.20	33.20	3.5025
9.50	130.00	4.8675
13.10	595.00	6.3886

C value for straight concentrations = 0.782
C value for logarithmic concentrations (Clog) = 0.227
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (595.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (595.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Iron-complete

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
108000.00	498.00	6.2106
439000.00	4560.00	8.4251
498.00	4580.00	8.4295
475000.00	8450.00	9.0419
4580.00	31900.00	10.3704
31900.00	108000.00	11.5899
4560.00	439000.00	12.9923
8450.00	475000.00	13.0711

C value for straight concentrations = 0.077
C value for logarithmic concentrations (Clog) = 0.017
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (475000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (475000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Iron-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
108000.00	498.00	6.2106
439000.00	4560.00	8.4251
498.00	4580.00	8.4295
4580.00	8450.00	9.0419
31900.00	31900.00	10.3704
4560.00	108000.00	11.5899
8450.00	439000.00	12.9923

C value for straight concentrations = 0.755
C value for logarithmic concentrations (Clog) = 0.207
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (439000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (439000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total lead - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
65.10	1.20	0.1823
319.00	2.00	0.6931
1.20	2.90	1.0647
360.00	6.10	1.8083
2.90	18.70	2.9285
18.70	65.10	4.1759
2.00	319.00	5.7652
6.10	360.00	5.8861

C value for straight concentrations = 0.115
C value for logarithmic concentrations (Clog) = 0.023
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (360.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (360.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total lead - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
65.10	1.20	0.1823
319.00	2.00	0.6931
1.20	2.90	1.0647
2.90	6.10	1.8083
18.70	18.70	2.9285
2.00	65.10	4.1759
6.10	319.00	5.7652

C value for straight concentrations = 0.799
C value for logarithmic concentrations (Clog) = 0.285
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (319.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (319.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Magnesium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
148000.00	92500.00	11.4350
493000.00	116000.00	11.6613
92500.00	118000.00	11.6784
588000.00	118000.00	11.6784
128000.00	128000.00	11.7598
118000.00	148000.00	11.9050
116000.00	493000.00	13.1083
118000.00	588000.00	13.2845

C value for straight concentrations = 0.201
C value for logarithmic concentrations (Clog) = 0.109
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum

value (588000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (588000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Magnesium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
148000.00	92500.00	11.4350
493000.00	116000.00	11.6613
92500.00	118000.00	11.6784
128000.00	118000.00	11.6784
118000.00	128000.00	11.7598
116000.00	148000.00	11.9050
118000.00	493000.00	13.1083

C value for straight concentrations = 0.861
C value for logarithmic concentrations (Clog) = 0.719
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum
value (493000.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum
value (493000.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Manganese-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2280.00	319.00	5.7652
9620.00	322.00	5.7746
322.00	336.00	5.8171
10800.00	544.00	6.2989
544.00	763.00	6.6373
763.00	2280.00	7.7319
319.00	9620.00	9.1716
336.00	10800.00	9.2873

C value for straight concentrations = 0.113
C value for logarithmic concentrations (Clog) = 0.033
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (10800.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (10800.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total Manganese-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2280.00	319.00	5.7652
9620.00	322.00	5.7746
322.00	336.00	5.8171
544.00	544.00	6.2989

763.00	763.00	6.6373
319.00	2280.00	7.7319
336.00	9620.00	9.1716

C value for straight concentrations = 0.789
C value for logarithmic concentrations (Clog) = 0.423
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (9620.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (9620.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
334.00	7.20	1.9741
1230.00	27.40	3.3105
7.20	31.60	3.4532
2280.00	73.60	4.2986
31.60	104.00	4.6444
104.00	334.00	5.8111
27.40	1230.00	7.1148
73.60	2280.00	7.7319

C value for straight concentrations = 0.466
C value for logarithmic concentrations (Clog) = 0.140
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2280.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2280.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
11800.00	10200.00	9.2301
10200.00	11100.00	9.3147
12500.00	11800.00	9.3759
19700.00	12500.00	9.4335
15300.00	13700.00	9.5252
15100.00	15100.00	9.6224
13700.00	15300.00	9.6356
11100.00	19700.00	9.8884

C value for straight concentrations = 0.512
C value for logarithmic concentrations (Clog) = 0.441
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (19700.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (19700.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total sodium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
151000.00	23300.00	10.0562
33200.00	33200.00	10.4103
137000.00	42200.00	10.6502
23300.00	55800.00	10.9295
42200.00	61700.00	11.0300
55800.00	64100.00	11.0682
61700.00	137000.00	11.8277
64100.00	151000.00	11.9250

C value for straight concentrations = 0.119
C value for logarithmic concentrations (Clog) = 0.064
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (151000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (151000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total sodium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
33200.00	23300.00	10.0562
137000.00	33200.00	10.4103
23300.00	42200.00	10.6502
42200.00	55800.00	10.9295
55800.00	61700.00	11.0300
61700.00	64100.00	11.0682
64100.00	137000.00	11.8277

C value for straight concentrations = 0.641
C value for logarithmic concentrations (Clog) = 0.429
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (137000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (137000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total vanadium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
28.60	1.30	0.2624
108.00	1.60	0.4700
1.60	2.00	0.6931
148.00	2.10	0.7419
2.10	9.30	2.2300
9.30	28.60	3.3534
1.30	108.00	4.6821
2.00	148.00	4.9972

C value for straight concentrations = 0.273

C value for logarithmic concentrations (Clog) = 0.070
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (148.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (148.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total vanadium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
28.60	1.30	0.2624
108.00	1.60	0.4700
1.60	2.00	0.6931
2.10	2.10	0.7419
9.30	9.30	2.2300
1.30	28.60	3.3534
2.00	108.00	4.6821

C value for straight concentrations = 0.744
C value for logarithmic concentrations (Clog) = 0.301
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (108.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (108.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total zinc-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1510.00	16.20	2.7850
7700.00	58.70	4.0724
16.20	80.60	4.3895
6710.00	110.00	4.7005
58.70	407.00	6.0088
407.00	1510.00	7.3199
80.60	6710.00	8.8114
110.00	7700.00	8.9490

C value for straight concentrations = 0.130
C value for logarithmic concentrations (Clog) = 0.028
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (7700.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (7700.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-22
Parameter: Total zinc-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc

1510.00	16.20	2.7850
16.20	58.70	4.0724
6710.00	80.60	4.3895
58.70	110.00	4.7005
407.00	407.00	6.0088
80.60	1510.00	7.3199
110.00	6710.00	8.8114

C value for straight concentrations = 0.777
C value for logarithmic concentrations (Clog) = 0.247
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (6710.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6710.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1670.00	798.00	6.6821
2130.00	1020.00	6.9276
1020.00	1670.00	7.4206
26800.00	2100.00	7.6497
798.00	2130.00	7.6639
10500.00	2370.00	7.7706
2370.00	10500.00	9.2591
2100.00	26800.00	10.1962

C value for straight concentrations = 0.632
C value for logarithmic concentrations (Clog) = 0.287
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (26800.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (26800.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total arsenic

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2.00	2.00	0.6931
2.50	2.50	0.9163
4.40	3.50	1.2528
4.40	3.50	1.2528
4.40	4.40	1.4816
9.60	4.40	1.4816
3.50	4.40	1.4816
3.50	9.60	2.2618

C value for straight concentrations = 0.732
C value for logarithmic concentrations (Clog) = 0.580
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (9.60) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum

value (9.60) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
57.30	27.20	3.3032
82.50	28.00	3.3322
27.20	57.30	4.0483
714.00	82.50	4.4128
28.00	84.40	4.4356
386.00	88.70	4.4853
84.40	386.00	5.9558
88.70	714.00	6.5709

C value for straight concentrations = 0.478
C value for logarithmic concentrations (Clog) = 0.190
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (714.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (714.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.86	0.26	-1.3471
1.40	0.86	-0.1508
1.10	1.10	0.0953
24.30	1.10	0.0953
1.10	1.40	0.3365
9.10	1.90	0.6419
0.26	9.10	2.2083
1.90	24.30	3.1905

C value for straight concentrations = 0.648
C value for logarithmic concentrations (Clog) = 0.294
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (24.30) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (24.30) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
27100.00	21000.00	9.9523
26400.00	22700.00	10.0301
25900.00	24300.00	10.0982
24300.00	24300.00	10.0982
34300.00	25900.00	10.1620

24300.00	26400.00	10.1811
22700.00	27100.00	10.2073
21000.00	34300.00	10.4429

C value for straight concentrations = 0.621
C value for logarithmic concentrations (Clog) = 0.571
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (34300.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (34300.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
27.00	12.90	2.5572
59.50	27.00	3.2958
12.90	40.20	3.6939
63.00	59.50	4.0860
97.50	63.00	4.1431
391.00	97.50	4.5799
40.20	179.00	5.1874
179.00	391.00	5.9687

C value for straight concentrations = 0.582
C value for logarithmic concentrations (Clog) = 0.292
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (391.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (391.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	2.70	0.9933
14.40	4.40	1.4816
2.70	6.70	1.9021
212.00	11.00	2.3979
4.40	14.40	2.6672
86.70	20.90	3.0397
20.90	86.70	4.4625
11.00	212.00	5.3566

C value for straight concentrations = 0.604
C value for logarithmic concentrations (Clog) = 0.231
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (212.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (212.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
13.80	0.74	-0.3011
15.40	6.90	1.9315
0.74	13.80	2.6247
190.00	15.40	2.7344
6.90	17.40	2.8565
76.70	19.70	2.9806
17.40	76.70	4.3399
19.70	190.00	5.2470

C value for straight concentrations = 0.619
C value for logarithmic concentrations (Clog) = 0.274
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (190.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (190.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
15400.00	5000.00	8.5172
25600.00	7280.00	8.8929
5000.00	15400.00	9.6421
354000.00	25600.00	10.1503
7280.00	27500.00	10.2219
137000.00	36300.00	10.4996
36300.00	137000.00	11.8277
27500.00	354000.00	12.7771

C value for straight concentrations = 0.626
C value for logarithmic concentrations (Clog) = 0.244
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (354000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (354000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
10.30	2.00	0.6931
18.20	3.10	1.1314
3.10	4.60	1.5261
234.00	10.30	2.3321
4.60	18.20	2.9014
93.90	19.70	2.9806
2.00	93.90	4.5422
19.70	234.00	5.4553

C value for straight concentrations = 0.607
C value for logarithmic concentrations (Clog) = 0.211
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (234.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (234.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
17400.00	14100.00	9.5539
18200.00	15200.00	9.6291
17000.00	16500.00	9.7111
18800.00	16900.00	9.7351
16900.00	17000.00	9.7410
16500.00	17400.00	9.7642
15200.00	18200.00	9.8092
14100.00	18800.00	9.8416

C value for straight concentrations = 0.167
C value for logarithmic concentrations (Clog) = 0.153
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (18800.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (18800.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-3
Parameter: Total Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
462.00	133.00	4.8903
779.00	286.00	5.6560
133.00	462.00	6.1356
12600.00	779.00	6.6580
286.00	1150.00	7.0475
5490.00	1180.00	7.0733
1180.00	5490.00	8.6107
1150.00	12600.00	9.4415

C value for straight concentrations = 0.577
C value for logarithmic concentrations (Clog) = 0.219
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (12600.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (12600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
27.20	9.70	2.2721
56.80	27.20	3.3032
9.70	49.00	3.8918
305.00	56.50	4.0342
56.50	56.80	4.0395
296.00	116.00	4.7536
49.00	296.00	5.6904
116.00	305.00	5.7203

C value for straight concentrations = 0.032
C value for logarithmic concentrations (Clog) = 0.012
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (305.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (305.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1080.00	487.00	6.1883
793.00	507.00	6.2285
487.00	617.00	6.4249
2110.00	793.00	6.6758
507.00	1080.00	6.9847
1780.00	1100.00	7.0031
1100.00	1780.00	7.4844
617.00	2110.00	7.6544

C value for straight concentrations = 0.206
C value for logarithmic concentrations (Clog) = 0.119
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2110.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2110.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
271.00	271.00	5.6021
2400.00	368.00	5.9081
2050.00	1870.00	7.5337
368.00	1880.00	7.5390
2040.00	2020.00	7.6109
2020.00	2040.00	7.6207
1870.00	2050.00	7.6256
1880.00	2400.00	7.7832

C value for straight concentrations = 0.172
C value for logarithmic concentrations (Clog) = 0.084
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2400.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2400.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.43	0.43	-0.8440
7.00	1.30	0.2624
1.60	1.60	0.4700
72.70	3.00	1.0986
3.00	5.10	1.6292
30.70	7.00	1.9459
1.30	30.70	3.4243
5.10	72.70	4.2863

C value for straight concentrations = 0.588
C value for logarithmic concentrations (Clog) = 0.214
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (72.70) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (72.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-23
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
97.10	31.80	3.4595
146.00	42.20	3.7424
31.80	97.10	4.5757
2360.00	146.00	4.9836
42.20	172.00	5.1475
839.00	194.00	5.2679
194.00	839.00	6.7322
172.00	2360.00	7.7664

C value for straight concentrations = 0.656
C value for logarithmic concentrations (Clog) = 0.257
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (2360.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2360.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Aluminum-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
459.00	13.60	2.6101
444.00	32.40	3.4782

32.40	32.40	3.4782
1120.00	378.00	5.9349
32.40	444.00	6.0958
378.00	459.00	6.1291
13.60	1120.00	7.0211
1280.00	1280.00	7.1546

C value for straight concentrations = 0.128
C value for logarithmic concentrations (Clog) = 0.036
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1280.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1280.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Aluminum-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
459.00	13.60	2.6101
444.00	32.40	3.4782
32.40	32.40	3.4782
1120.00	378.00	5.9349
32.40	444.00	6.0958
378.00	459.00	6.1291
13.60	1120.00	7.0211

C value for straight concentrations = 0.597
C value for logarithmic concentrations (Clog) = 0.202
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (1120.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1120.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
48.30	45.20	3.8111
67.10	48.30	3.8774
45.20	49.20	3.8959
61.70	50.30	3.9180
49.20	61.70	4.1223
78.90	62.40	4.1336
50.30	67.10	4.2062
62.40	78.90	4.3682

C value for straight concentrations = 0.386
C value for logarithmic concentrations (Clog) = 0.330
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (78.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (78.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.86	0.26	-1.3471
0.52	0.31	-1.1712
1.10	0.52	-0.6539
1.20	0.86	-0.1508
1.10	1.10	0.0953
0.31	1.10	0.0953
0.26	1.20	0.1823
2.00	2.00	0.6931

C value for straight concentrations = 0.473
C value for logarithmic concentrations (Clog) = 0.274
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (2.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
85400.00	85400.00	11.3551
93200.00	91000.00	11.4186
91000.00	93200.00	11.4425
107000.00	98100.00	11.4937
105000.00	98900.00	11.5019
98100.00	103000.00	11.5425
98900.00	105000.00	11.5617
103000.00	107000.00	11.5806

C value for straight concentrations = 0.125
C value for logarithmic concentrations (Clog) = 0.116
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (107000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (107000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
20.10	2.80	1.0296
28.40	17.70	2.8736
67.80	20.10	3.0007
55.70	23.20	3.1442
2.80	28.40	3.3464
23.20	30.20	3.4078
30.20	55.70	4.0200

17.70	67.80	4.2166

C value for straight concentrations = 0.242
C value for logarithmic concentrations (Clog) = 0.146
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (67.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (67.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	1.10	0.0953
10.10	2.70	0.9933
2.70	2.70	0.9933
4.70	3.30	1.1939
2.70	3.60	1.2809
1.10	4.70	1.5476
3.60	6.70	1.9021
3.30	10.10	2.3125

C value for straight concentrations = 0.459
C value for logarithmic concentrations (Clog) = 0.311
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (10.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (10.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
4.50	0.74	-0.3011
4.00	0.74	-0.3011
0.74	0.81	-0.2107
5.80	2.80	1.0296
0.74	4.00	1.3863
2.80	4.50	1.5041
0.81	5.80	1.7579
8.70	8.70	2.1633

C value for straight concentrations = 0.364
C value for logarithmic concentrations (Clog) = 0.165
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (8.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (8.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1170.00	131.00	4.8752
1620.00	440.00	6.0868
590.00	590.00	6.3801
4530.00	1170.00	7.0648
131.00	1620.00	7.3902
1710.00	1710.00	7.4442
440.00	4530.00	8.4185
7080.00	7080.00	8.8650

C value for straight concentrations = 0.384
C value for logarithmic concentrations (Clog) = 0.161
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (7080.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (7080.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1.50	1.20	0.1823
2.00	1.20	0.1823
1.20	1.50	0.4055
5.90	2.00	0.6931
1.20	2.00	0.6931
2.20	2.20	0.7885
2.00	5.90	1.7750
7.30	7.30	1.9879

C value for straight concentrations = 0.230
C value for logarithmic concentrations (Clog) = 0.118
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (7.30) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (7.30) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
47500.00	47500.00	10.7685
52900.00	51000.00	10.8396
51000.00	52900.00	10.8762
61100.00	54300.00	10.9023
54400.00	54400.00	10.9041
54300.00	55400.00	10.9223
55400.00	58100.00	10.9699
58100.00	61100.00	11.0203

C value for straight concentrations = 0.297
C value for logarithmic concentrations (Clog) = 0.279

Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (61100.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (61100.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Manganese-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
45.00	11.40	2.4336
51.10	20.10	3.0007
20.10	27.10	3.2995
229.00	45.00	3.8067
11.40	51.10	3.9338
67.00	67.00	4.2047
27.10	229.00	5.4337
296.00	296.00	5.6904

C value for straight concentrations = 0.243
C value for logarithmic concentrations (Clog) = 0.095
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (296.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (296.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total Manganese-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
45.00	11.40	2.4336
51.10	20.10	3.0007
20.10	27.10	3.2995
229.00	45.00	3.8067
11.40	51.10	3.9338
67.00	67.00	4.2047
27.10	229.00	5.4337

C value for straight concentrations = 0.744
C value for logarithmic concentrations (Clog) = 0.410
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (229.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (229.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
17.60	0.84	-0.1744

22.40	1.90	0.6419
36.70	15.90	2.7663
35.20	17.60	2.8679
1.90	21.60	3.0727
0.84	22.40	3.1091
15.90	35.20	3.5610
21.60	36.70	3.6028

C value for straight concentrations = 0.043
C value for logarithmic concentrations (Clog) = 0.014
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (36.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (36.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2740.00	1600.00	7.3778
2570.00	1730.00	7.4559
1600.00	2000.00	7.6009
2050.00	2050.00	7.6256
1730.00	2370.00	7.7706
3370.00	2570.00	7.8517
2000.00	2740.00	7.9157
2370.00	3370.00	8.1227

C value for straight concentrations = 0.384
C value for logarithmic concentrations (Clog) = 0.310
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (3370.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3370.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
13100.00	9710.00	9.1809
63300.00	13000.00	9.4727
13800.00	13000.00	9.4727
13000.00	13100.00	9.4804
9710.00	13800.00	9.5324
90300.00	16800.00	9.7291
13000.00	63300.00	11.0556
16800.00	90300.00	11.4109

C value for straight concentrations = 0.349
C value for logarithmic concentrations (Clog) = 0.183
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (90300.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value

value (90300.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.43	0.43	-0.8440
1.90	1.30	0.2624
1.60	1.60	0.4700
4.10	1.60	0.4700
1.60	1.60	0.4700
1.60	1.90	0.6419
1.30	4.10	1.4110
4.90	4.90	1.5892

C value for straight concentrations = 0.222
C value for logarithmic concentrations (Clog) = 0.134
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (4.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (4.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-15S
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
15.60	4.90	1.5892
29.00	5.50	1.7047
9.30	7.40	2.0015
47.60	9.30	2.2300
4.90	15.60	2.7473
5.50	29.00	3.3673
7.40	47.60	3.8628
70.50	70.50	4.2556

C value for straight concentrations = 0.352
C value for logarithmic concentrations (Clog) = 0.154
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (70.50) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (70.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2180.00	13.60	2.6101
8330.00	435.00	6.0753
3620.00	474.00	6.1612
34500.00	1410.00	7.2513
1410.00	2180.00	7.6871

435.00	3620.00	8.1942
13.60	8330.00	9.0276
474.00	34500.00	10.4487

C value for straight concentrations = 0.768
C value for logarithmic concentrations (Clog) = 0.325
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (34500.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (34500.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total arsenic

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2.60	2.40	0.8755
20.90	2.60	0.9555
7.40	3.50	1.2528
61.40	3.50	1.2528
4.40	4.40	1.4816
2.40	7.40	2.0015
3.50	20.90	3.0397
3.50	61.40	4.1174

C value for straight concentrations = 0.689
C value for logarithmic concentrations (Clog) = 0.341
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (61.40) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (61.40) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
60.40	42.60	3.7519
123.00	44.60	3.7977
73.20	49.60	3.9040
384.00	56.70	4.0378
56.70	60.40	4.1010
49.60	73.20	4.2932
42.60	123.00	4.8122
44.60	384.00	5.9506

C value for straight concentrations = 0.769
C value for logarithmic concentrations (Clog) = 0.529
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (384.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (384.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.86	0.26	-1.3471
2.10	0.26	-1.3471
1.10	0.31	-1.1712
8.30	0.86	-0.1508
1.10	1.10	0.0953
0.31	1.10	0.0953
0.26	2.10	0.7419
0.26	8.30	2.1163

C value for straight concentrations = 0.771
C value for logarithmic concentrations (Clog) = 0.397
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (8.30) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (8.30) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
66200.00	56700.00	10.9455
165000.00	57200.00	10.9543
77200.00	60100.00	11.0038
566000.00	66200.00	11.1004
71200.00	71200.00	11.1732
60100.00	77200.00	11.2542
56700.00	165000.00	12.0137
57200.00	566000.00	13.2463

C value for straight concentrations = 0.788
C value for logarithmic concentrations (Clog) = 0.538
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (566000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (566000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
152.00	13.30	2.5878
980.00	55.60	4.0182
655.00	59.00	4.0775
2710.00	152.00	5.0239
275.00	275.00	5.6168
59.00	655.00	6.4846
13.30	980.00	6.8876
55.60	2710.00	7.9047

C value for straight concentrations = 0.652
C value for logarithmic concentrations (Clog) = 0.262
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (2710.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (2710.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	1.60	0.4700
37.00	3.30	1.1939
15.60	3.30	1.1939
119.00	5.90	1.7750
5.90	6.70	1.9021
1.60	15.60	2.7473
3.30	37.00	3.6109
3.30	119.00	4.7791

C value for straight concentrations = 0.709
C value for logarithmic concentrations (Clog) = 0.326
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (119.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (119.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
31.80	4.90	1.5892
142.00	7.50	2.0149
61.70	8.50	2.1401
546.00	27.90	3.3286
27.90	31.80	3.4595
7.50	61.70	4.1223
4.90	142.00	4.9558
8.50	546.00	6.3026

C value for straight concentrations = 0.750
C value for logarithmic concentrations (Clog) = 0.314
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (546.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (546.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
11000.00	983.00	6.8906
59200.00	2110.00	7.6544
23300.00	2900.00	7.9725
238000.00	10900.00	9.2965
10900.00	11000.00	9.3057
2900.00	23300.00	10.0562
983.00	59200.00	10.9887
2110.00	238000.00	12.3800

C value for straight concentrations = 0.758
C value for logarithmic concentrations (Clog) = 0.294
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (238000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (238000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
9.30	1.90	0.6419
52.20	2.00	0.6931
18.70	2.00	0.6931
224.00	8.50	2.1401
8.50	9.30	2.2300
1.90	18.70	2.9285
2.00	52.20	3.9551
2.00	224.00	5.4116

C value for straight concentrations = 0.774
C value for logarithmic concentrations (Clog) = 0.309
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (224.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (224.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
39900.00	33500.00	10.4193
94800.00	35200.00	10.4688
46800.00	39100.00	10.5739
281000.00	39900.00	10.5941
44000.00	44000.00	10.6919
39100.00	46800.00	10.7536
33500.00	94800.00	11.4595
35200.00	281000.00	12.5461

C value for straight concentrations = 0.758
C value for logarithmic concentrations (Clog) = 0.523
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (281000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (281000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
140.00	32.20	3.4720
795.00	43.90	3.7819
373.00	46.30	3.8351
3340.00	140.00	4.9416
188.00	188.00	5.2364
43.90	373.00	5.9216
46.30	795.00	6.6783
32.20	3340.00	8.1137

C value for straight concentrations = 0.772
C value for logarithmic concentrations (Clog) = 0.331
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (3340.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3340.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total nickel

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
98.30	0.84	-0.1744
792.00	8.30	2.1163
349.00	56.60	4.0360
1600.00	98.30	4.5880
149.00	149.00	5.0039
0.84	349.00	5.8551
8.30	792.00	6.6746
56.60	1600.00	7.3778

C value for straight concentrations = 0.508
C value for logarithmic concentrations (Clog) = 0.134
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1600.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7110.00	5110.00	8.5390
6070.00	5730.00	8.6535

5110.00	5860.00	8.6759
13700.00	6070.00	8.7111
5860.00	6460.00	8.7734
7050.00	7050.00	8.8608
5730.00	7110.00	8.8693
6460.00	13700.00	9.5252

C value for straight concentrations = 0.827
C value for logarithmic concentrations (Clog) = 0.752
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (13700.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (13700.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
33100.00	9910.00	9.2013
134000.00	11500.00	9.3501
66700.00	12500.00	9.4335
28800.00	28800.00	10.2681
12500.00	30200.00	10.3156
11500.00	33100.00	10.4073
30200.00	66700.00	11.1080
9910.00	134000.00	11.8056

C value for straight concentrations = 0.549
C value for logarithmic concentrations (Clog) = 0.284
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (134000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (134000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
10.20	1.30	0.2624
45.90	1.30	0.2624
20.00	2.40	0.8755
174.00	9.30	2.2300
9.30	10.20	2.3224
2.40	20.00	2.9957
1.30	45.90	3.8265
1.30	174.00	5.1591

C value for straight concentrations = 0.742
C value for logarithmic concentrations (Clog) = 0.272
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (174.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (174.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-16S
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
137.00	24.80	3.2108
495.00	29.40	3.3810
169.00	41.80	3.7329
3000.00	87.40	4.4705
87.40	137.00	4.9200
41.80	169.00	5.1299
24.80	495.00	6.2046
29.40	3000.00	8.0064

C value for straight concentrations = 0.843
C value for logarithmic concentrations (Clog) = 0.390
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (3000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (3000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
502.00	13.60	2.6101
1360.00	32.40	3.4782
739.00	33.20	3.5025
977.00	502.00	6.2186
32.40	739.00	6.6053
1310.00	977.00	6.8845
13.60	1310.00	7.1778
33.20	1360.00	7.2152

C value for straight concentrations = 0.038
C value for logarithmic concentrations (Clog) = 0.010
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1360.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1360.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total arsenic

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
2.00	2.00	0.6931
2.50	2.40	0.8755
4.40	2.50	0.9163
4.40	3.50	1.2528
4.40	3.50	1.2528
2.40	4.40	1.4816

3.50	4.40	1.4816
3.50	4.40	1.4816

C value for straight concentrations = 0.000
C value for logarithmic concentrations (Clog) = 0.000
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (4.40) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (4.40) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
8.20	8.20	2.1041
44.80	13.10	2.5726
16.90	13.60	2.6101
18.30	15.40	2.7344
17.70	16.90	2.8273
15.40	17.70	2.8736
13.60	18.30	2.9069
13.10	44.80	3.8022

C value for straight concentrations = 0.836
C value for logarithmic concentrations (Clog) = 0.728
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (44.80) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (44.80) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.86	0.26	-1.3471
0.52	0.31	-1.1712
1.10	0.52	-0.6539
1.10	0.86	-0.1508
1.10	1.10	0.0953
0.31	1.10	0.0953
0.26	1.10	0.0953
1.80	1.80	0.5878

C value for straight concentrations = 0.470
C value for logarithmic concentrations (Clog) = 0.280
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S

Parameter: Total Calcium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
11400.00	8850.00	9.0882
37300.00	11400.00	9.3414
21200.00	16100.00	9.6866
18200.00	17000.00	9.7410
17000.00	18200.00	9.8092
8850.00	21200.00	9.9618
16100.00	37300.00	10.5267
104000.00	104000.00	11.5521

C value for straight concentrations = 0.720
C value for logarithmic concentrations (Clog) = 0.464
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (104000.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (104000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total chromium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.60	0.88	-0.1278
65.60	5.60	1.7228
26.20	8.20	2.1041
33.40	24.10	3.1822
8.20	26.20	3.2658
97.90	33.40	3.5086
24.10	65.60	4.1836
0.88	97.90	4.5839

C value for straight concentrations = 0.350
C value for logarithmic concentrations (Clog) = 0.140
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (97.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (97.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
6.70	2.70	0.9933
5.10	2.70	0.9933
2.70	3.10	1.1314
3.70	3.30	1.1939
2.70	3.30	1.1939
3.10	3.70	1.3083
3.30	5.10	1.6292
3.30	6.70	1.9021

C value for straight concentrations = 0.400

C value for logarithmic concentrations (Clog) = 0.300
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (6.70) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6.70) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.20	0.74	-0.3011
13.80	0.81	-0.2107
0.74	0.81	-0.2107
7.80	0.99	-0.0101
0.99	5.20	1.6487
27.90	7.80	2.0541
0.81	13.80	2.6247
0.81	27.90	3.3286

C value for straight concentrations = 0.520
C value for logarithmic concentrations (Clog) = 0.199
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (27.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (27.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Iron

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1680.00	38.80	3.6584
6200.00	257.00	5.5491
2990.00	1460.00	7.2862
3690.00	1680.00	7.4265
257.00	2990.00	8.0030
3530.00	3530.00	8.1691
1460.00	3690.00	8.2134
38.80	6200.00	8.7323

C value for straight concentrations = 0.422
C value for logarithmic concentrations (Clog) = 0.163
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (6200.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6200.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc

1.50	1.20	0.1823
2.00	1.50	0.4055
3.80	2.00	0.6931
6.20	2.00	0.6931
1.20	2.60	0.9555
7.50	3.80	1.3350
2.00	6.20	1.8245
2.60	7.50	2.0149

C value for straight concentrations = 0.217
C value for logarithmic concentrations (Clog) = 0.118
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (7.50) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (7.50) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1600.00	1600.00	7.3778
12400.00	2110.00	7.6544
4440.00	2570.00	7.8517
3240.00	2710.00	7.9047
3490.00	3240.00	8.0833
2110.00	3490.00	8.1577
2710.00	4440.00	8.3984
2570.00	12400.00	9.4255

C value for straight concentrations = 0.774
C value for logarithmic concentrations (Clog) = 0.580
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (12400.00) may be considered a statistical outlier.
As Clog value is greater than the critical point, the maximum value (12400.00) may be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
148.00	85.80	4.4520
189.00	96.00	4.5643
168.00	118.00	4.7707
118.00	125.00	4.8283
125.00	148.00	4.9972
96.00	168.00	5.1240
85.80	172.00	5.1475
172.00	189.00	5.2417

C value for straight concentrations = 0.183
C value for logarithmic concentrations (Clog) = 0.139
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum

value (189.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (189.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total nickel - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.90	3.30	1.1939
51.00	4.20	1.4351
16.40	5.90	1.7750
27.00	14.10	2.6462
4.20	16.40	2.7973
53.10	27.00	3.2958
14.10	51.00	3.9318
3.30	53.10	3.9722

C value for straight concentrations = 0.043
C value for logarithmic concentrations (Clog) = 0.016
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum
value (53.10) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (53.10) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total nickel - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
5.90	3.30	1.1939
51.00	4.20	1.4351
16.40	5.90	1.7750
27.00	14.10	2.6462
4.20	16.40	2.7973
14.10	27.00	3.2958
3.30	51.00	3.9318

C value for straight concentrations = 0.503
C value for logarithmic concentrations (Clog) = 0.232
Critical point from Table 12-1 = 0.507

As C value is less than the critical point, the maximum
value (51.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value
value (51.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
1550.00	1130.00	7.0300
5420.00	1220.00	7.1066
3010.00	1550.00	7.3460
2810.00	2650.00	7.8823

2940.00	2810.00	7.9409
1220.00	2940.00	7.9862
2650.00	3010.00	8.0097
1130.00	5420.00	8.5979

C value for straight concentrations = 0.574
C value for logarithmic concentrations (Clog) = 0.394
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (5420.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (5420.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
134000.00	7220.00	8.8846
786000.00	50100.00	10.8218
417000.00	134000.00	11.8056
341000.00	341000.00	12.7396
389000.00	349000.00	12.7628
50100.00	389000.00	12.8713
349000.00	417000.00	12.9408
7220.00	786000.00	13.5747

C value for straight concentrations = 0.501
C value for logarithmic concentrations (Clog) = 0.230
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (786000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (786000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
0.43	0.43	-0.8440
4.50	1.30	0.2624
1.60	1.30	0.2624
2.90	1.60	0.4700
1.60	1.60	0.4700
4.80	2.90	1.0647
1.30	4.50	1.5041
1.30	4.80	1.5686

C value for straight concentrations = 0.086
C value for logarithmic concentrations (Clog) = 0.049
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (4.80) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (4.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-17S
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
28.90	4.00	1.3863
105.00	6.30	1.8405
32.50	17.10	2.8391
50.90	28.90	3.3638
4.00	32.50	3.4812
83.10	50.90	3.9299
17.10	83.10	4.4200
6.30	105.00	4.6540

C value for straight concentrations = 0.222
C value for logarithmic concentrations (Clog) = 0.083
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (105.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (105.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Aluminum

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
19200.00	830.00	6.7214
26600.00	1250.00	7.1309
6320.00	3220.00	8.0771
30900.00	6320.00	8.7515
830.00	19200.00	9.8627
25900.00	25900.00	10.1620
1250.00	26600.00	10.1887
3220.00	30900.00	10.3385

C value for straight concentrations = 0.145
C value for logarithmic concentrations (Clog) = 0.047
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (30900.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (30900.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total arsenic

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
37.10	3.50	1.2528
72.20	3.50	1.2528
14.30	4.40	1.4816
49.10	14.30	2.6603
4.40	37.10	3.6136
55.60	49.10	3.8939
3.50	55.60	4.0182
3.50	72.20	4.2794

C value for straight concentrations = 0.242
C value for logarithmic concentrations (Clog) = 0.086
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (72.20) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (72.20) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Barium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
109.00	25.60	3.2426
638.00	31.20	3.4404
50.10	43.50	3.7728
109.00	50.10	3.9140
31.20	109.00	4.6913
166.00	109.00	4.6913
25.60	166.00	5.1120
43.50	638.00	6.4583

C value for straight concentrations = 0.778
C value for logarithmic concentrations (Clog) = 0.446
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (638.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (638.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Beryllium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
12.60	0.26	-1.3471
54.80	1.10	0.0953
4.30	3.10	1.1314
18.80	4.30	1.4586
1.10	12.60	2.5337
19.00	18.80	2.9339
0.26	19.00	2.9444
3.10	54.80	4.0037

C value for straight concentrations = 0.667
C value for logarithmic concentrations (Clog) = 0.271
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (54.80) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (54.80) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Calcium-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
63700.00	11700.00	9.3673
72600.00	14700.00	9.5956
37600.00	21100.00	9.9570
34300.00	34200.00	10.4400
34200.00	34300.00	10.4429
21100.00	37600.00	10.5348
14700.00	63700.00	11.0619
11700.00	72600.00	11.1927

C value for straight concentrations = 0.154
C value for logarithmic concentrations (Clog) = 0.082
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (72600.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (72600.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Calcium-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
63700.00	11700.00	9.3673
37600.00	14700.00	9.5956
34300.00	21100.00	9.9570
34200.00	34200.00	10.4400
21100.00	34300.00	10.4429
14700.00	37600.00	10.5348
11700.00	63700.00	11.0619

C value for straight concentrations = 0.502
C value for logarithmic concentrations (Clog) = 0.311
Critical point from Table 12-1 = 0.507

As C value is less than the critical point, the maximum value (63700.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (63700.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total chromium - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
143.00	43.40	3.7705
43.40	55.50	4.0164
93.40	87.20	4.4682
1660.00	93.40	4.5369
87.20	143.00	4.9628
706.00	706.00	6.5596
55.50	1660.00	7.4146
1920.00	1920.00	7.5601

C value for straight concentrations = 0.139
C value for logarithmic concentrations (Clog) = 0.041
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1920.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1920.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total chromium - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
143.00	43.40	3.7705
43.40	55.50	4.0164
93.40	87.20	4.4682
1660.00	93.40	4.5369
87.20	143.00	4.9628
706.00	706.00	6.5596
55.50	1660.00	7.4146

C value for straight concentrations = 0.590
C value for logarithmic concentrations (Clog) = 0.235
Critical point from Table 12-1 = 0.507

As C value is greater than the critical point, the maximum value (1660.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1660.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total cobalt

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
201.00	13.30	2.5878
402.00	14.80	2.6946
81.60	81.60	4.4018
355.00	99.10	4.5961
14.80	201.00	5.3033
350.00	350.00	5.8579
13.30	355.00	5.8721
99.10	402.00	5.9965

C value for straight concentrations = 0.121
C value for logarithmic concentrations (Clog) = 0.038
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (402.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (402.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total copper

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
119.00	7.40	2.0015
464.00	8.10	2.0919
36.80	36.80	3.6055

180.00	72.60	4.2850
7.40	119.00	4.7791
153.00	153.00	5.0304
8.10	180.00	5.1930
72.60	464.00	6.1399

C value for straight concentrations = 0.623
C value for logarithmic concentrations (Clog) = 0.234
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (464.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (464.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Iron-full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
80300.00	5150.00	8.5468
86400.00	6590.00	8.7933
28900.00	22700.00	10.0301
120000.00	28900.00	10.2716
5150.00	80300.00	11.2935
108000.00	86400.00	11.3667
6590.00	108000.00	11.5899
22700.00	120000.00	11.6952

C value for straight concentrations = 0.106
C value for logarithmic concentrations (Clog) = 0.036
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (120000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (120000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Iron-partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
80300.00	5150.00	8.5468
86400.00	6590.00	8.7933
28900.00	22700.00	10.0301
5150.00	28900.00	10.2716
108000.00	80300.00	11.2935
6590.00	86400.00	11.3667
22700.00	108000.00	11.5899

C value for straight concentrations = 0.210
C value for logarithmic concentrations (Clog) = 0.073
Critical point from Table 12-1 = 0.507

As C value is less than the critical point, the maximum value (108000.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (108000.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total lead

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
395.00	23.40	3.1527
1470.00	29.40	3.3810
136.00	136.00	4.9127
595.00	143.00	4.9628
23.40	395.00	5.9789
699.00	595.00	6.3886
29.40	699.00	6.5497
143.00	1470.00	7.2930

C value for straight concentrations = 0.535
C value for logarithmic concentrations (Clog) = 0.190
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1470.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1470.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Magnesium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
8940.00	1340.00	7.2004
9560.00	1650.00	7.4085
4310.00	2420.00	7.7915
7320.00	4310.00	8.3687
2420.00	5820.00	8.6691
5820.00	7320.00	8.8984
1340.00	8940.00	9.0983
1650.00	9560.00	9.1653

C value for straight concentrations = 0.078
C value for logarithmic concentrations (Clog) = 0.038
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (9560.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (9560.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total Manganese

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
3020.00	212.00	5.3566
6140.00	219.00	5.3891
1070.00	1070.00	6.9754
4640.00	1540.00	7.3395
212.00	3020.00	8.0130
4410.00	4410.00	8.3916
219.00	4640.00	8.4425
1540.00	6140.00	8.7226

C value for straight concentrations = 0.253
C value for logarithmic concentrations (Clog) = 0.084
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (6140.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (6140.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total nickel - full

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
196.00	40.70	3.7062
235.00	53.70	3.9834
87.90	87.90	4.4762
974.00	196.00	5.2781
53.70	235.00	5.4596
507.00	507.00	6.2285
40.70	974.00	6.8814
1070.00	1070.00	6.9754

C value for straight concentrations = 0.094
C value for logarithmic concentrations (Clog) = 0.031
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1070.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1070.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total nickel - partial

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
196.00	40.70	3.7062
235.00	53.70	3.9834
87.90	87.90	4.4762
974.00	196.00	5.2781
53.70	235.00	5.4596
507.00	507.00	6.2285
40.70	974.00	6.8814

C value for straight concentrations = 0.500
C value for logarithmic concentrations (Clog) = 0.206
Critical point from Table 12-1 = 0.507

As C value is less than the critical point, the maximum value (974.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (974.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total potassium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7390.00	1200.00	7.0901
2800.00	1260.00	7.1389
1890.00	1370.00	7.2226
3640.00	1890.00	7.5443
1260.00	2800.00	7.9374
4000.00	3640.00	8.1997
1200.00	4000.00	8.2940
1370.00	7390.00	8.9079

C value for straight concentrations = 0.553
C value for logarithmic concentrations (Clog) = 0.347
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (7390.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (7390.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total sodium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
7550.00	4620.00	8.4382
15900.00	7190.00	8.8804
39100.00	7550.00	8.9293
9420.00	9420.00	9.1506
17300.00	15200.00	9.6291
15200.00	15900.00	9.6741
7190.00	17300.00	9.7585
4620.00	39100.00	10.5739

C value for straight concentrations = 0.683
C value for logarithmic concentrations (Clog) = 0.482
Critical point from Table 12-1 = 0.554

As C value is greater than the critical point, the maximum value (39100.00) may be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (39100.00) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total vanadium

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
19.80	1.30	0.2624
20.80	1.60	0.4700
7.20	7.20	1.9741
35.90	7.90	2.0669
1.60	19.80	2.9857
29.00	20.80	3.0350
1.30	29.00	3.3673
7.90	35.90	3.5807

C value for straight concentrations = 0.201
C value for logarithmic concentrations (Clog) = 0.069
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (35.90) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (35.90) cannot be considered a statistical outlier.

Dixon's Outlier Test:

Well No.: MW-24
Parameter: Total zinc

Concentration values in original and final order

Conc.	Ordered Conc	Log Conc
547.00	85.20	4.4450
800.00	90.40	4.5042
247.00	171.00	5.1417
963.00	247.00	5.5094
90.40	547.00	6.3044
1020.00	800.00	6.6846
85.20	963.00	6.8701
171.00	1020.00	6.9276

C value for straight concentrations = 0.061
C value for logarithmic concentrations (Clog) = 0.024
Critical point from Table 12-1 = 0.554

As C value is less than the critical point, the maximum value (1020.00) cannot be considered a statistical outlier.
As Clog value is less than the critical point, the maximum value value (1020.00) cannot be considered a statistical outlier.

Appendix H2a

Output from Kruskal-Wallis Intra-Group Analysis Bkgd Total Metals

PROGRAM KRUSKAL-WALLIS_SPATIAL

It evaluates the existence of significant differences
among medians of any group of wells
(Based on Section 17.1 of EPA's Unified Guidance)

Input Data

Upgradient Total Metals Group
Selected alpha: 0.05
Value to replace non-detects: 0.01

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Parameter: Total Aluminum in ug/L

MW-10	MW-22	MW-23
367	16800	1670
102	78200	2130
32.4	32.4	1020
32.4	83900	26800
81.7	683	798
477	5160	10500
13.6	927	2370
58.8	1260	2100

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	8.00	21.00	15.00
	7.00	23.00	17.00
	3.00	3.00	13.00
	3.00	24.00	22.00
	6.00	10.00	11.00
	9.00	19.00	20.00
	1.00	12.00	18.00
	5.00	14.00	16.00
No. of Samples:	8	8	8
Rank Sum:	42.00	126.00	132.00
Rank Mean:	5.25	15.75	16.50

Kruskal-Wallis statistic corrected for ties: 12.68
Number of tied groups = 1
Number of ties per group:
1 3
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.970) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (3.182) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.212) < zc (2.2416), the median for well MW-22 is the same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Arsenic in ug/L

MW-10	MW-22	MW-23
2.000	21.7	2.000
2.500	43.2	2.500
4.400	4.4	4.400
4.400	64.9	4.400
4.400	4.4	4.400
2.400	7.1	3.500
3.500	3.5	3.500
3.500	3.5	

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
1.50	21.00	1.50
4.50	22.00	4.50
15.50	15.50	15.50
15.50	23.00	15.50
15.50	15.50	15.50
3.00	20.00	8.50
8.50	8.50	8.50
8.50	8.50	

No. of Samples:	8	8	7
Rank Sum:	72.50	134.00	69.50
Rank Mean:	9.06	16.75	9.93

Kruskal-Wallis statistic corrected for ties: 6.46
Number of tied groups = 4
Number of ties per group:

1	2
2	2
3	6
4	8

95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.267) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (0.247) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (1.943) < zc (2.2416), the median for well MW-22 is the same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Barium in ug/L

MW-10	MW-22	MW-23
57.8	205	57.3
55.2	144	82.5
57.4	130	27.2
56.5	144	714
59.0	130	28
58.8	115	386
48.4		84.4
		88.7

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
8.00	19.00	6.00
4.00	17.50	11.00
7.00	15.50	1.00
5.00	17.50	21.00
10.00	15.50	2.00
9.00	14.00	20.00
3.00		12.00
		13.00
No. of Samples: 7	6	8
Rank Sum: 46.00	99.00	86.00
Rank Mean: 6.57	16.50	10.75

Kruskal-Wallis statistic corrected for ties: 8.30
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.876) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.301) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (1.716) < zc (2.2416), the median for well MW-22 is the same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Beryllium in ug/L

MW-10	MW-22	MW-23
0.860	18.3	0.86
0.520	1.1	1.4
1.100	1.1	1.1
1.100	5.1	1.1
1.100	0.26	9.1
0.310	2.0	0.26
0.260		1.9
0.260		

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
7.50	21.00	7.50
6.00	12.00	16.00
12.00	12.00	12.00
12.00	19.00	12.00
12.00	2.50	20.00
5.00	18.00	2.50
2.50		17.00

2.50

No. of Samples:	8	6	7
Rank Sum:	59.50	84.50	87.00
Rank Mean:	7.44	14.08	12.43

Kruskal-Wallis statistic corrected for ties: 4.69
Number of tied groups = 3
Number of ties per group:
1 4
2 2
3 7
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Calcium in ug/L

MW-10	MW-22	MW-23
20800	330000	27100
20400	190000	26400
20200	155000	25900
20000	201000	24300
20100	193000	24300
18500	183000	22700
18700	179000	21000
20200		

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
8.00	22.00	15.00
7.00	19.00	14.00
5.50	16.00	13.00
3.00	21.00	11.50
4.00	20.00	11.50
1.00	18.00	10.00
2.00	17.00	9.00
5.50		

No. of Samples:	8	7	7
Rank Sum:	36.00	133.00	84.00
Rank Mean:	4.50	19.00	12.00

Kruskal-Wallis statistic corrected for ties: 18.70
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:

Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.315) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.232) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.017) < zc (2.2416), the median for well MW-22 is the same as well MW-23

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Chromium in ug/L

MW-10	MW-22	MW-23
13.2	114	27
1.5	129	59.5
6.9	1.5	12.9
2.0	29.8	63
16.6	73.9	97.5
13.3	19.8	40.2
0.88	108	179

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
7.00	19.00	11.00
2.50	20.00	14.00
5.00	2.50	6.00
4.00	12.00	15.00
9.00	16.00	17.00
8.00	10.00	13.00
1.00	18.00	21.00
No. of Samples: 7	7	7
Rank Sum: 36.50	97.50	97.00
Rank Mean: 5.21	13.93	13.86

Kruskal-Wallis statistic corrected for ties: 9.14
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.627) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.606) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.022) < zc (2.2416), the median for well MW-22 is the same as well MW-23

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Cobalt in ug/L

MW-10	MW-22	MW-23
6.700	60.1	6.7
2.6	368	14.4
2.700	2.7	2.7

2.700	395	212
2.700	4.4	4.4
0.970	24.3	86.7
3.300	3.3	20.9
3.300	3.3	11

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	14.50	20.00	14.50
	2.00	23.00	17.00
	5.00	5.00	5.00
	5.00	24.00	22.00
	5.00	12.50	12.50
	1.00	19.00	21.00
	9.50	9.50	18.00
	9.50	9.50	16.00
No. of Samples:	8	8	8
Rank Sum:	51.50	122.50	126.00
Rank Mean:	6.44	15.31	15.75

Kruskal-Wallis statistic corrected for ties: 8.96
Number of tied groups = 4
Number of ties per group:

1	5
2	4
3	2
4	2

95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.510) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.634) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.124) < zc (2.2416), the median for well MW-22 is the same as well MW-23

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Copper in ug/L

MW-10	MW-22	MW-23
4.500	130	13.8
4.000	854	15.4
0.740	0.74	0.74
1.0	595	190
0.740	6.8	6.9
3.3	33.2	76.7
0.810	9.5	17.4
0.810	13.1	19.7

Sample Value Ranks By Wells

MW-10 MW-22 MW-23

10.00	21.00	15.00
9.00	24.00	16.00
2.50	2.50	2.50
7.00	23.00	22.00
2.50	11.00	12.00
8.00	19.00	20.00
5.50	13.00	17.00
5.50	14.00	18.00
No. of Samples: 8	8	8
Rank Sum: 50.00	127.50	122.50
Rank Mean: 6.25	15.94	15.31

Kruskal-Wallis statistic corrected for ties: 9.45
Number of tied groups = 2
Number of ties per group:
1 4
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.740) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (2.563) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.177) < zc (2.2416), the median for well MW-22 is the same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Iron in ug/L

MW-10	MW-22	MW-23
787	108000	15400
1370	439000	25600
223	498	5000
254	475000	354000
244	4580	7280
1280	31900	137000
320	4560	36300
164	8450	27500

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
7.00	20.00	15.00
9.00	23.00	16.00
2.00	6.00	12.00
4.00	24.00	22.00
3.00	11.00	13.00
8.00	18.00	21.00
5.00	10.00	19.00
1.00	14.00	17.00
No. of Samples: 8	8	8
Rank Sum: 39.00	126.00	135.00
Rank Mean: 4.88	15.75	16.88

Kruskal-Wallis statistic corrected for ties: 14.06
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (3.076) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (3.394) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.318) < zc (2.2416), the median for well MW-22 is the same as well MW-23

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Lead in ug/L

MW-10	MW-22	MW-23
1.500	65.1	10.3
2.000	319	18.2
1.200	1.2	3.1
1.5	360	234
1.200	2.9	4.6
1.900	18.7	93.9
2.000	2.0	2
2.000	6.1	19.7

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	4.50	20.00	16.00
	9.00	23.00	17.00
	2.00	2.00	13.00
	4.50	24.00	22.00
	2.00	12.00	14.00
	6.00	18.00	21.00
	9.00	9.00	9.00
	9.00	15.00	19.00
No. of Samples:	8	8	8
Rank Sum:	46.00	123.00	131.00
Rank Mean:	5.75	15.38	16.37

Kruskal-Wallis statistic corrected for ties: 11.14
Number of tied groups = 3
Number of ties per group:
1 3
2 2
3 5
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.722) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (3.005) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.283) < zc (2.2416), the median for well MW-22 is the same as well MW-23

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Magnesium in ug/L

MW-10	MW-22	MW-23
15800	148000	17400
16500	92500	18200
15600	128000	17000
16100	118000	18800
15000	116000	16900
14200	118000	16500
14200		15200
10300		14100

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	8.00	22.00	14.00
	10.50	17.00	15.00
	7.00	21.00	13.00
	9.00	19.50	16.00
	5.00	18.00	12.00
	3.50	19.50	10.50
	3.50		6.00
	1.00		2.00
No. of Samples:	8	6	8
Rank Sum:	47.50	117.00	88.50
Rank Mean:	5.94	19.50	11.06

Kruskal-Wallis statistic corrected for ties: 15.04
Number of tied groups = 3
Number of ties per group:
1 2
2 2
3 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (3.867) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (1.578) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.406) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Manganese in ug/L

MW-10	MW-22	MW-23
9.8	2280	462
37.7	9620	779
13.3	322	133
13.4	10800	12600
14.3	544	286
23.1	763	5490
12.9	319	1180
6.5	336	1150

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
2.00	20.00	14.00
8.00	22.00	17.00
4.00	12.00	9.00
5.00	23.00	24.00
6.00	15.00	10.00
7.00	16.00	21.00
3.00	11.00	19.00
1.00	13.00	18.00
No. of Samples: 8	8	8
Rank Sum: 36.00	132.00	132.00
Rank Mean: 4.50	16.50	16.50

Kruskal-Wallis statistic corrected for ties: 15.36
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (3.394) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (3.394) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.000) < zc (2.2416), the median for well MW-22 is the same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Mercury in ug/L

MW-10	MW-22	MW-23
0.065	1.7	0.065
0.065	42.9	0.065
0.048	0.048	0.68
0.048	52	0.048
0.048	12.0	0.048
0.11	18.8	0.073
0.073	13.0	0.073
0.073	17.3	0.073

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	8.50	18.00	8.50
	8.50	23.00	8.50
	3.50	3.50	17.00
	3.50	24.00	3.50
	3.50	19.00	3.50
	16.00	22.00	13.00
	13.00	20.00	13.00
	13.00	21.00	13.00
No. of Samples:	8	8	8
Rank Sum:	69.50	150.50	80.00
Rank Mean:	8.69	18.81	10.00

Kruskal-Wallis statistic corrected for ties: 9.98
Number of tied groups = 3
Number of ties per group:
1 6
2 4
3 5
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (2.864) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (0.371) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (2.493) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Nickel in ug/L

MW-10	MW-22	MW-23
9.9	334	27.2
1.9	1230	56.8
4.5	7.2	9.7
1.9	2280	305
0.84	31.6	56.5
10.2	104	296
2.6	27.4	49
	73.6	116

Sample Value Ranks By Wells

MW-10	MW-22	MW-23
8.00	21.00	10.00
2.50	22.00	15.00
5.00	6.00	7.00
2.50	23.00	20.00
1.00	12.00	14.00
9.00	17.00	19.00

```
                 4.00       11.00       13.00
                            16.00       18.00
 ----------------------------------------------------------------------------------------
 No. of Samples:     7           8           8
 Rank Sum:       32.00      128.00      116.00
 Rank Mean:       4.57       16.00       14.50

Kruskal-Wallis statistic corrected for ties:  12.27
Number of tied groups =  1
Number of ties per group:
   1   2
95% Chi-Square Distribution value at  2 degrees of freedom:   5.99

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
  at least one well has a median significantly larger or smaller than
  one or more other wells (at a probability of 95%).


              Results Of Post-Hoc Test For Each Compliance Well
 (Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
    Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

   Conclusions:
   Computed alpha used:  0.0250 for each post-hoc contrast

   As z* ( 3.256) > zc (2.2416), the median for well MW-10   is NOT same as well MW-22
   As z* ( 2.829) > zc (2.2416), the median for well MW-10   is NOT same as well MW-23
   As z* ( 0.442) < zc (2.2416), the median for well MW-22   is the same as well MW-23

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                        PROGRAM KRUSKAL-WALLIS_SPATIAL

 Parameter: Total Potassium        in ug/L
                  MW-10       MW-22       MW-23
                   1180        11800        1080
                   844         10200        793
                   883         12500        487
                   1000        19700        2110
                   994         15300        507
                   1760        15100        1780
                   1240        13700        1100
                   2080        11100        617
 ----------------------------------------------------------------------------------------

                      Sample Value Ranks By Wells

                 MW-10       MW-22       MW-23
                  11.00       19.00        9.00
                   5.00       17.00        4.00
                   6.00       20.00        1.00
                   8.00       24.00       16.00
                   7.00       23.00        2.00
                  13.00       22.00       14.00
                  12.00       21.00       10.00
                  15.00       18.00        3.00
 ----------------------------------------------------------------------------------------
 No. of Samples:     8           8           8
 Rank Sum:       77.00      164.00       59.00
 Rank Mean:       9.63       20.50        7.38

Kruskal-Wallis statistic corrected for ties:  15.77
Number of tied groups =  0
Number of ties per group:
95% Chi-Square Distribution value at  2 degrees of freedom:   5.99

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
```

at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (3.076) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (0.636) < zc (2.2416), the median for well MW-10 is the same as well MW-23
As z* (3.712) > zc (2.2416), the median for well MW-22 is NOT same as well MW-23

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Sodium in ug/L

MW-10	MW-22	MW-23
271	151000	271
346	33200	2400
1130	137000	2050
368	23300	368
1290	42200	2040
1230	55800	2020
1090	61700	1870
1350	64100	1880

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	1.50	24.00	1.50
	3.00	18.00	16.00
	7.00	23.00	15.00
	4.50	17.00	4.50
	9.00	19.00	14.00
	8.00	20.00	13.00
	6.00	21.00	11.00
	10.00	22.00	12.00
No. of Samples:	8	8	8
Rank Sum:	49.00	164.00	87.00
Rank Mean:	6.13	20.50	10.87

Kruskal-Wallis statistic corrected for ties: 17.18
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (4.066) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22

```
  As z* ( 1.344) < zc (2.2416), the median for well MW-10   is the same as well MW-23
  As z* ( 2.722) > zc (2.2416), the median for well MW-22   is NOT same as well MW-23

==========================================================================================

                        PROGRAM KRUSKAL-WALLIS_SPATIAL

 Parameter: Total Vanadium          in ug/L
                  MW-10       MW-22       MW-23
                   0.43        28.6        0.43
                   1.3         108         7.0
                   1.6         1.6         1.6
                   1.6         148         72.7
                   1.6         2.1         3.0
                   1.5         9.3         30.7
                   1.3         1.3         1.3
                   1.3         2           5.1
 ------------------------------------------------------------------------------------------

                       Sample Value Ranks By Wells

                 MW-10       MW-22       MW-23
                  1.50       20.00        1.50
                  5.00       23.00       18.00
                 11.00       11.00       11.00
                 11.00       24.00       22.00
                 11.00       15.00       16.00
                  8.00       19.00       21.00
                  5.00        5.00        5.00
                  5.00       14.00       17.00
 ------------------------------------------------------------------------------------------
 No. of Samples:     8           8           8
 Rank Sum:       57.50      131.00      111.50
 Rank Mean:       7.19       16.37       13.94

Kruskal-Wallis statistic corrected for ties:   7.38
Number of tied groups =  3
Number of ties per group:
   1   2
   2   5
   3   5
95% Chi-Square Distribution value at  2 degrees of freedom:   5.99

  Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
  at least one well has a median significantly larger or smaller than
  one or more other wells (at a probability of 95%).


             Results Of Post-Hoc Test For Each Compliance Well
 (Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
    Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

   Conclusions:
   Computed alpha used:  0.0250 for each post-hoc contrast

   As z* ( 2.599) > zc (2.2416), the median for well MW-10   is NOT same as well MW-22
   As z* ( 1.909) < zc (2.2416), the median for well MW-10   is the same as well MW-23
   As z* ( 0.689) < zc (2.2416), the median for well MW-22   is the same as well MW-23

==========================================================================================

                        PROGRAM KRUSKAL-WALLIS_SPATIAL

 Parameter: Total Zinc              in ug/L
                  MW-10       MW-22       MW-23
                   7.1         1510        97.1
                   1.7         7700        146
```

5.2	16.2	31.8
3.6	6710	2360
3.6	58.7	42.2
5.5	407	839
8.8	80.6	194
14.7	110	172

Sample Value Ranks By Wells

	MW-10	MW-22	MW-23
	6.00	21.00	14.00
	1.00	24.00	16.00
	4.00	9.00	10.00
	2.50	23.00	22.00
	2.50	12.00	11.00
	5.00	19.00	20.00
	7.00	13.00	18.00
	8.00	15.00	17.00
No. of Samples:	8	8	8
Rank Sum:	36.00	136.00	128.00
Rank Mean:	4.50	17.00	16.00

Kruskal-Wallis statistic corrected for ties: 15.45
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 2 degrees of freedom: 5.99

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0250 for each post-hoc contrast

As z* (3.536) > zc (2.2416), the median for well MW-10 is NOT same as well MW-22
As z* (3.253) > zc (2.2416), the median for well MW-10 is NOT same as well MW-23
As z* (0.283) < zc (2.2416), the median for well MW-22 is the same as well MW-23

Appendix H2b

Output from Kruskal-Wallis Intra-Group Analysis Downgrd Total Metals

PROGRAM KRUSKAL-WALLIS_SPATIAL

It evaluates the existence of significant differences
among medians of any group of wells
(Based on Section 17.1 of EPA's Unified Guidance)

Input Data

Downgradient Total Metals Group
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Total Aluminum in ug/L

MW-15S	MW-16S	MW-17S	MW-24
459	2180	502	19200
444	8330	1360	26600
32.4	3620	739	6320
1120	34500	977	30900
32.4	1410	32.4	830
378	435	1310	25900
13.6	13.6	13.6	1250
1280	474	33.2	3220

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	11.00	23.00	13.00	28.00
	10.00	27.00	21.00	30.00
	5.00	25.00	14.00	26.00
	17.00	32.00	16.00	31.00
	5.00	22.00	5.00	15.00
	8.00	9.00	20.00	29.00
	2.00	2.00	2.00	18.00
	19.00	12.00	7.00	24.00
No. of Samples:	8	8	8	8
Rank Sum:	77.00	152.00	98.00	201.00
Rank Mean:	9.63	19.00	12.25	25.13

Kruskal-Wallis statistic corrected for ties: 13.29
Number of tied groups = 2
Number of ties per group:
1 3
2 3
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.999) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.560) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.305) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (1.439) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.306) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.745) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Arsenic in ug/L

MW-15S	MW-16S	MW-17S	MW-24
2.000	2.6	2.000	37.1
2.500	20.9	2.500	72.2
4.400	7.4	4.400	14.3
4.400	61.4	4.400	49.1
4.400	4.4	4.400	4.4
2.400	2.4	2.400	55.6
3.500	3.5	3.500	3.5
3.500	3.5	3.500	3.5

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
1.50	8.00	1.50	28.00
6.50	27.00	6.50	32.00
20.50	25.00	20.50	26.00
20.50	31.00	20.50	29.00
20.50	20.50	20.50	20.50
4.00	4.00	4.00	30.00
12.50	12.50	12.50	12.50
12.50	12.50	12.50	12.50
No. of Samples: 8	8	8	8
Rank Sum: 98.50	140.50	98.50	190.50
Rank Mean: 12.31	17.56	12.31	23.81

Kruskal-Wallis statistic corrected for ties: 8.42
Number of tied groups = 5
Number of ties per group:

1	2
2	3
3	2
4	8
5	8

95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.119) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.000) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (2.452) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (1.119) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.333) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.452) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Barium in ug/L

MW-15S	MW-16S	MW-17S	MW-24

48.3	60.4	8.2	109
67.1	123	16.9	638
45.2	73.2	18.3	50.1
61.7	384	17.7	109
49.2	56.7	15.4	31.2
78.9	49.6	13.6	166
50.3	42.6	13.1	25.6
62.4	44.6		43.5

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	14.00	20.00	1.00	26.50
	23.00	28.00	5.00	31.00
	13.00	24.00	7.00	17.00
	21.00	30.00	6.00	26.50
	15.00	19.00	4.00	9.00
	25.00	16.00	3.00	29.00
	18.00	10.00	2.00	8.00
	22.00	12.00		11.00
No. of Samples:	8	8	7	8
Rank Sum:	151.00	159.00	28.00	158.00
Rank Mean:	18.87	19.88	4.00	19.75

Kruskal-Wallis statistic corrected for ties: 15.81
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (0.220) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (3.161) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (0.192) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (3.374) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (0.027) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.347) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Beryllium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
0.860	0.860	0.860	12.6
0.520	2.1	0.520	4.3
1.100	1.100	1.100	18.8
1.2	1.100	1.100	1.1
1.100	0.310	1.100	19
0.310	0.260	0.310	0.26
0.260	0.260	0.260	3.1
2.0		1.8	

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
12.00	12.00	12.00	28.00
9.50	25.00	9.50	27.00
17.50	17.50	17.50	29.00
22.00	17.50	17.50	17.50
17.50	7.00	17.50	30.00
7.00	3.00	7.00	3.00
3.00	3.00	3.00	26.00
24.00		23.00	
No. of Samples: 8	7	8	7
Rank Sum: 112.50	85.00	107.00	160.50
Rank Mean: 14.06	12.14	13.37	22.93

Kruskal-Wallis statistic corrected for ties: 6.85
Number of tied groups = 5
Number of ties per group:

1	5
2	3
3	2
4	3
5	8

95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point, the wells may be considered to have the same median (at a probability of 95%).

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Calcium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
85400	66200	11400	63700
93200	165000	37300	72600
91000	77200	21200	37600
107000	71200	18200	34300
105000	60100	17000	34200
98100	56700	8850	21100
98900	57200	16100	14700
103000			11700

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
22.00	18.00	2.00	17.00
24.00	30.00	12.00	20.00
23.00	21.00	9.00	13.00
29.00	19.00	7.00	11.00
28.00	16.00	6.00	10.00
25.00	14.00	1.00	8.00
26.00	15.00	5.00	4.00
27.00			3.00
No. of Samples: 8	7	7	8
Rank Sum: 204.00	133.00	42.00	86.00
Rank Mean: 25.50	19.00	6.00	10.75

Kruskal-Wallis statistic corrected for ties: 21.91
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.427) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (4.280) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (3.351) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (2.763) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (1.811) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (1.043) < zc (2.3959), the median for well MW-17S is the same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Chromium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
20.1	152	5.6	143
28.4	980	65.6	43.4
67.8	655	26.2	93.4
55.7	275	33.4	87.2
2.8	59	8.2	706
23.2	13.3	97.9	55.5
30.2	55.6	24.1	
17.7		0.88	

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
7.00	25.00	3.00	24.00
11.00	29.00	19.00	14.00
20.00	27.00	10.00	22.00
17.00	26.00	13.00	21.00
2.00	18.00	4.00	28.00
8.00	5.00	23.00	15.00
12.00	16.00	9.00	
6.00		1.00	

No. of Samples:	8	7	8	6
Rank Sum:	83.00	146.00	82.00	124.00
Rank Mean:	10.38	20.86	10.25	20.67

Kruskal-Wallis statistic corrected for ties: 10.82
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

```
As z* ( 2.379) < zc (2.3959), the median for well MW-15S  is the same as well MW-16S
As z* ( 0.029) < zc (2.3959), the median for well MW-15S  is the same as well MW-17S
As z* ( 2.238) < zc (2.3959), the median for well MW-15S  is the same as well MW-24
As z* ( 2.407) > zc (2.3959), the median for well MW-16S  is NOT same as well MW-17S
As z* ( 0.040) < zc (2.3959), the median for well MW-16S  is the same as well MW-24
As z* ( 2.265) < zc (2.3959), the median for well MW-17S  is the same as well MW-24
```

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Cobalt in ug/L

MW-15S	MW-16S	MW-17S	MW-24
6.700	6.7	6.700	201
10.1	37	5.1	402
2.700	15.6	2.700	81.6
4.7	119	3.7	355
2.700	5.9	2.700	14.8
1.1	1.6	3.1	350
3.6	3.3	3.300	13.3
3.300	3.3	3.300	99.1

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	19.00	19.00	19.00	29.00
	21.00	25.00	16.00	32.00
	4.50	24.00	4.50	26.00
	15.00	28.00	14.00	31.00
	4.50	17.00	4.50	23.00
	1.00	2.00	7.00	30.00
	13.00	10.00	10.00	22.00
	10.00	10.00	10.00	27.00
No. of Samples:	8	8	8	8
Rank Sum:	88.00	135.00	85.00	220.00
Rank Mean:	11.00	16.88	10.63	27.50

Kruskal-Wallis statistic corrected for ties: 17.01
Number of tied groups = 3
Number of ties per group:
1 4
2 5
3 3
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

```
As z* ( 1.253) < zc (2.3959), the median for well MW-15S  is the same as well MW-16S
As z* ( 0.080) < zc (2.3959), the median for well MW-15S  is the same as well MW-17S
As z* ( 3.518) > zc (2.3959), the median for well MW-15S  is NOT same as well MW-24
As z* ( 1.333) < zc (2.3959), the median for well MW-16S  is the same as well MW-17S
As z* ( 2.265) < zc (2.3959), the median for well MW-16S  is the same as well MW-24
As z* ( 3.598) > zc (2.3959), the median for well MW-17S  is NOT same as well MW-24
```

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Copper in ug/L

MW-15S	MW-16S	MW-17S	MW-24
4.500	31.8	5.2	119
4.000	142	13.8	464
0.740	61.7	0.74	36.8
5.8	546	7.8	180
0.740	27.9	0.99	7.4
2.8	7.5	27.9	153
0.810	4.9	0.81	8.1
8.7	8.5	0.81	72.6

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	10.00	23.00	12.00	27.00
	9.00	28.00	20.00	31.00
	2.00	25.00	2.00	24.00
	13.00	32.00	16.00	30.00
	2.00	21.50	7.00	14.00
	8.00	15.00	21.50	29.00
	5.00	11.00	5.00	17.00
	19.00	18.00	5.00	26.00
No. of Samples:	8	8	8	8
Rank Sum:	68.00	173.50	88.50	198.00
Rank Mean:	8.50	21.69	11.06	24.75

Kruskal-Wallis statistic corrected for ties: 17.17
Number of tied groups = 3
Number of ties per group:
1 3
2 3
3 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (2.812) > zc (2.3959), the median for well MW-15S is NOT same as well MW-16S
As z* (0.546) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.465) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (2.265) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (0.653) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.918) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Iron in ug/L

MW-15S	MW-16S	MW-17S	MW-24
1170	11000	1680	80300
1620	59200	6200	86400

590	23300	2990	28900
4530	238000	3690	120000
131	10900	257	5150
1710	2900	3530	108000
440	983	1460	6590
7080	2110	38.8	22700

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	7.00	23.00	10.00	28.00
	9.00	27.00	19.00	29.00
	5.00	25.00	14.00	26.00
	17.00	32.00	16.00	31.00
	2.00	22.00	3.00	18.00
	11.00	13.00	15.00	30.00
	4.00	6.00	8.00	20.00
	21.00	12.00	1.00	24.00
No. of Samples:	8	8	8	8
Rank Sum:	76.00	160.00	86.00	206.00
Rank Mean:	9.50	20.00	10.75	25.75

Kruskal-Wallis statistic corrected for ties: 16.35
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (2.239) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.267) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.465) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (1.972) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.226) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.198) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Lead in ug/L

MW-15S	MW-16S	MW-17S	MW-24
1.500	9.3	1.5	395
2.000	52.2	2.0	1470
1.200	18.7	3.8	136
5.9	224	6.2	595
1.200	8.5	1.2	23.4
2.2	1.9	7.5	699
2.000	2.0	2.0	29.4
7.3	2.0	2.6	143

Sample Value Ranks By Wells

MW-15S MW-16S MW-17S MW-24

4.50	21.00	4.50	29.00
9.50	25.00	9.50	32.00
2.00	22.00	15.00	26.00
16.00	28.00	17.00	30.00
2.00	20.00	2.00	23.00
13.00	6.00	19.00	31.00
9.50	9.50	9.50	24.00
18.00	9.50	14.00	27.00

No. of Samples:	8	8	8	8
Rank Sum:	74.50	141.00	90.50	222.00
Rank Mean:	9.31	17.62	11.31	27.75

Kruskal-Wallis statistic corrected for ties: 18.90
Number of tied groups = 3
Number of ties per group:
1 3
2 2
3 6
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.772) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.426) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.931) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (1.346) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (2.159) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.504) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Magnesium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
47500	39900	1600	8940
52900	94800	4440	9560
51000	46800	3240	4310
61100	44000	3490	7320
54400	39100	2110	2420
54300	33500	2710	5820
55400	35200	2570	1340
58100			1650

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
22.00	19.00	2.00	14.00
24.00	30.00	11.00	15.00
23.00	21.00	8.00	10.00
29.00	20.00	9.00	13.00
26.00	18.00	4.00	5.00
25.00	16.00	7.00	12.00
27.00	17.00	6.00	1.00
28.00			3.00

No. of Samples:	8	7	7	8
Rank Sum:	204.00	141.00	47.00	73.00
Rank Mean:	25.50	20.14	6.71	9.13

Kruskal-Wallis statistic corrected for ties: 23.44
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.176) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (4.123) > zc (2.3959), the median for well MW-15S is NOT same as well MW-17S
As z* (3.720) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (2.854) > zc (2.3959), the median for well MW-16S is NOT same as well MW-17S
As z* (2.418) > zc (2.3959), the median for well MW-16S is NOT same as well MW-24
As z* (0.529) < zc (2.3959), the median for well MW-17S is the same as well MW-24

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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Manganese in ug/L

MW-15S	MW-16S	MW-17S	MW-24
45	140	148	3020
51.1	795	189	6140
20.1	373	168	1070
229	3340	118	4640
11.4	188	125	212
67	43.9	96	4410
27.1	46.3	85.8	219
296	32.2	172	1540

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
6.00	14.00	15.00	28.00
8.00	25.00	19.00	32.00
2.00	24.00	16.00	26.00
22.00	29.00	12.00	31.00
1.00	18.00	13.00	20.00
9.00	5.00	11.00	30.00
3.00	7.00	10.00	21.00
23.00	4.00	17.00	27.00

No. of Samples:	8	8	8	8
Rank Sum:	74.00	126.00	113.00	215.00
Rank Mean:	9.25	15.75	14.13	26.88

Kruskal-Wallis statistic corrected for ties: 15.13
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,

at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.386) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (1.039) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.758) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (0.346) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (2.372) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.718) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Nickel in ug/L

MW-15S	MW-16S	MW-17S	MW-24
17.6	98.3	5.9	196
22.4	792	51	235
36.7	349	16.4	87.9
35.2	1600	27	974
1.9	149	4.2	53.7
0.84	0.84	53.1	507
15.9	8.3	14.1	40.7
21.6	56.6	3.3	1070

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	11.00	23.00	6.00	25.00
	13.00	29.00	18.00	26.00
	16.00	27.00	10.00	22.00
	15.00	32.00	14.00	30.00
	3.00	24.00	5.00	20.00
	1.50	1.50	19.00	28.00
	9.00	7.00	8.00	17.00
	12.00	21.00	4.00	31.00
No. of Samples:	8	8	8	8
Rank Sum:	80.50	164.50	84.00	199.00
Rank Mean:	10.06	20.56	10.50	24.87

Kruskal-Wallis statistic corrected for ties: 14.92
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point,
at least one well has a median significantly larger or smaller than
one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

```
As z* ( 2.239) < zc (2.3959), the median for well MW-15S  is the same as well MW-16S
As z* ( 0.093) < zc (2.3959), the median for well MW-15S  is the same as well MW-17S
As z* ( 3.158) > zc (2.3959), the median for well MW-15S  is NOT same as well MW-24
As z* ( 2.145) < zc (2.3959), the median for well MW-16S  is the same as well MW-17S
As z* ( 0.919) < zc (2.3959), the median for well MW-16S  is the same as well MW-24
As z* ( 3.065) > zc (2.3959), the median for well MW-17S  is NOT same as well MW-24
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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Potassium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
2740	7110	1550	7390
2570	6070	3010	2800
1600	5110	2810	1890
2050	5860	2940	3640
1730	7050	1220	1260
3370	5730	2650	4000
2000	6460	1130	1200
2370			1370

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	15.00	29.00	6.00	30.00
	13.00	26.00	19.00	16.00
	7.00	23.00	17.00	9.00
	11.00	25.00	18.00	21.00
	8.00	28.00	3.00	4.00
	20.00	24.00	14.00	22.00
	10.00	27.00	1.00	2.00
	12.00			5.00
No. of Samples:	8	7	7	8
Rank Sum:	96.00	182.00	78.00	109.00
Rank Mean:	12.00	26.00	11.14	13.63

Kruskal-Wallis statistic corrected for ties: 13.30
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

```
As z* ( 3.073) > zc (2.3959), the median for well MW-15S  is NOT same as well MW-16S
As z* ( 0.188) < zc (2.3959), the median for well MW-15S  is the same as well MW-17S
As z* ( 0.369) < zc (2.3959), the median for well MW-15S  is the same as well MW-24
As z* ( 3.157) > zc (2.3959), the median for well MW-16S  is NOT same as well MW-17S
As z* ( 2.716) > zc (2.3959), the median for well MW-16S  is NOT same as well MW-24
As z* ( 0.545) < zc (2.3959), the median for well MW-17S  is the same as well MW-24
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PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Sodium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
13100	33100	134000	7550
63300	134000	786000	15900
13800	66700	417000	39100
13000	28800	341000	9420
9710	12500	389000	17300
90300	11500	50100	15200
13000	30200	349000	7190
16800	9910	7220	4620

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	12.00	20.00	26.50	4.00
	23.00	26.50	32.00	15.00
	13.00	24.00	31.00	21.00
	10.50	18.00	28.00	5.00
	6.00	9.00	30.00	17.00
	25.00	8.00	22.00	14.00
	10.50	19.00	29.00	2.00
	16.00	7.00	3.00	1.00
No. of Samples:	8	8	8	8
Rank Sum:	116.00	131.50	201.50	79.00
Rank Mean:	14.50	16.44	25.19	9.88

Kruskal-Wallis statistic corrected for ties: 11.22
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (0.413) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (2.279) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (0.986) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (1.866) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.399) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.265) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

==========

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Vanadium in ug/L

MW-15S	MW-16S	MW-17S	MW-24
0.43	10.2	0.43	19.8
1.9	45.9	4.5	20.8
1.6	20	1.6	7.2
4.1	174	2.9	35.9
1.6	9.3	1.6	1.6
1.6	2.4	4.8	29

1.3	1.3	1.3	1.3
4.9	1.3	1.3	7.9

Sample Value Ranks By Wells

	MW-15S	MW-16S	MW-17S	MW-24
	1.50	25.00	1.50	26.00
	15.00	31.00	19.00	28.00
	11.50	27.00	11.50	22.00
	18.00	32.00	17.00	30.00
	11.50	24.00	11.50	11.50
	11.50	16.00	20.00	29.00
	5.50	5.50	5.50	5.50
	21.00	5.50	5.50	23.00
No. of Samples:	8	8	8	8
Rank Sum:	95.50	166.00	91.50	175.00
Rank Mean:	11.94	20.75	11.44	21.88

Kruskal-Wallis statistic corrected for ties: 8.60
Number of tied groups = 3
Number of ties per group:

1	2
2	6
3	6

95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (1.879) < zc (2.3959), the median for well MW-15S is the same as well MW-16S
As z* (0.107) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (2.119) < zc (2.3959), the median for well MW-15S is the same as well MW-24
As z* (1.985) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (0.240) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (2.225) < zc (2.3959), the median for well MW-17S is the same as well MW-24

PROGRAM KRUSKAL-WALLIS_SPATIAL

Parameter: Total Zinc in ug/L

MW-15S	MW-16S	MW-17S	MW-24
15.6	137	28.9	547
29	495	105	800
9.3	169	32.5	247
47.6	3000	50.9	963
4.9	87.4	4.0	90.4
5.5	41.8	83.1	1020
7.4	24.8	17.1	85.2
70.5	29.4	6.3	171

Sample Value Ranks By Wells

MW-15S	MW-16S	MW-17S	MW-24
7.00	23.00	10.00	28.00

	11.00	27.00	22.00	29.00
	6.00	24.00	13.00	26.00
	15.00	32.00	16.00	30.00
	2.00	20.00	1.00	21.00
	3.00	14.00	18.00	31.00
	5.00	9.00	8.00	19.00
	17.00	12.00	4.00	25.00
No. of Samples:	8	8	8	8
Rank Sum:	66.00	161.00	92.00	209.00
Rank Mean:	8.25	20.13	11.50	26.12

Kruskal-Wallis statistic corrected for ties: 18.08
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 3 degrees of freedom: 7.81

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point, at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

Results Of Post-Hoc Test For Each Compliance Well
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Conclusions:
Computed alpha used: 0.0167 for each post-hoc contrast

As z* (2.532) > zc (2.3959), the median for well MW-15S is NOT same as well MW-16S
As z* (0.693) < zc (2.3959), the median for well MW-15S is the same as well MW-17S
As z* (3.811) > zc (2.3959), the median for well MW-15S is NOT same as well MW-24
As z* (1.839) < zc (2.3959), the median for well MW-16S is the same as well MW-17S
As z* (1.279) < zc (2.3959), the median for well MW-16S is the same as well MW-24
As z* (3.118) > zc (2.3959), the median for well MW-17S is NOT same as well MW-24

Appendix H3

Output results for Parametric ANOVA Inter-Group Analysis Total Metals 8 Events

Program ANOVA-Bonferroni

Performs one-way analysis of variance comparing downgradient values to background values
It then performs the post-hoc Bonferroni t-test on each compliance well
if hypothesis of equal well means is rejected in the ANOVA analysis.

Based on Section 17.1 of the USEPA Unified Guidance for
Statistical Analysis Of Groundwater Monitoring Data At RCRA Facilities, March 2009

==========

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Calcium in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
20800.0	330000.0	27100.0	85400.0	66200.0	11400.0	63700.0
20400.0	190000.0	26400.0	93200.0	165000.0	37300.0	72600.0
20200.0	155000.0	25900.0	91000.0	77200.0	21200.0	37600.0
20000.0	201000.0	24300.0	107000.0	71200.0	18200.0	34300.0
20100.0	193000.0	24300.0	105000.0	60100.0	17000.0	34200.0
18500.0	183000.0	22700.0	98100.0	56700.0	8850.0	21100.0
18700.0	179000.0	21000.0	98900.0	57200.0	16100.0	14700.0
20200.0			103000.0			11700.0
Well means: 19862.5	204428.6	24528.6	97700.0	79085.7	18578.6	36237.5

Backgd mean: 80072.7
Overall mean: 67629.8

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	3.63E+10	4	9.07E+09	2.22
Error (within wells)	1.92E+11	47	4.08E+09	
Total	2.28E+11	51		

As F-Statistic is <= the 5 percent critical point (2.57),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Chromium in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
13.2	114.0	27.0	20.1	152.0	5.6	143.0
1.5	129.0	59.5	28.4	980.0	65.6	43.4
6.9	1.5	12.9	67.8	655.0	26.2	93.4
2.0	29.8	63.0	55.7	275.0	33.4	87.2
16.6	73.9	97.5	2.8	59.0	8.2	706.0
13.3	19.8	40.2	23.2	13.3	97.9	55.5
0.9	108.0	179.0	30.2	55.6	24.1	
			17.7		0.9	

Well means:	7.8	68.0	68.4	30.7	312.8	32.7	188.1
Backgd mean:	48.1						
Overall mean:	96.7						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	4.94E+05	4	1.24E+05	4.63
Error (within wells)	1.20E+06	45	2.67E+04	
Total	1.69E+06	49		

As F-Statistic is > the 5 percent critical point (2.58),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	30.7	312.8	32.7	188.1
Computed t statistic (t*):	-0.26	3.71	-0.23	1.85
Critical table value (tc):	2.32	2.32	2.32	2.32
Well mean significantly greater than background?	no	yes	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Magnesium in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
15800.0	148000.0	17400.0	47500.0	39900.0	1600.0	8940.0
16500.0	92500.0	18200.0	52900.0	94800.0	4440.0	9560.0
15600.0	128000.0	17000.0	51000.0	46800.0	3240.0	4310.0
16100.0	118000.0	18800.0	61100.0	44000.0	3490.0	7320.0
15000.0	116000.0	16900.0	54400.0	39100.0	2110.0	2420.0
14200.0	118000.0	16500.0	54300.0	33500.0	2710.0	5820.0
14200.0		15200.0	55400.0	35200.0	2570.0	1340.0
10300.0		14100.0	58100.0			1650.0
Well means: 14712.5	120083.3	16762.5	54337.5	47614.3	2880.0	5170.0

Backgd mean: 44195.5
Overall mean: 34650.4

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	2.03E+10	4	5.07E+09	4.58
Error (within wells)	5.21E+10	47	1.11E+09	
Total	7.24E+10	51		

As F-Statistic is > the 5 percent critical point (2.57),
we reject the hypothesis of equal well means.

RESULTS OF POST-HOC BONFERRONI T-TEST FOR EACH COMPLIANCE WELL
(Required Because F-Statistic in ANOVA Analysis was Greater than Critical Point)

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Well mean:	54337.5	47614.3	2880.0	5170.0
Computed t statistic (t*):	0.74	0.24	-2.86	-2.84
Critical table value (tc):	2.32	2.32	2.32	2.32
Well mean significantly greater than background?	no	no	no	no

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Potassium in ug/L
Input Values:

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1180.0	11800.0	1080.0	2740.0	7110.0	1550.0	7390.0
844.0	10200.0	793.0	2570.0	6070.0	3010.0	2800.0
883.0	12500.0	487.0	1600.0	5110.0	2810.0	1890.0
1000.0	19700.0	2110.0	2050.0	5860.0	2940.0	3640.0
994.0	15300.0	507.0	1730.0	7050.0	1220.0	1260.0
1760.0	15100.0	1780.0	3370.0	5730.0	2650.0	4000.0
1240.0	13700.0	1100.0	2000.0	6460.0	1130.0	1200.0
2080.0	11100.0	617.0	2370.0			1370.0
Well means: 1247.6	13675.0	1059.3	2303.7	6198.6	2187.1	2943.8
Backgd mean: 5327.3						
Overall mean: 4232.1						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	1.28E+08	4	3.20E+07	1.66
Error (within wells)	9.46E+08	49	1.93E+07	
Total	1.07E+09	53		

As F-Statistic is <= the 5 percent critical point (2.56),
we accept the hypothesis of equal well means.

Appendix H4

Output results for Parametric ANOVA inter-group analysis Total Metals 4 events

Program ANOVA-Bonferroni

Performs one-way analysis of variance comparing downgradient values to background values
It then performs the post-hoc Bonferroni t-test on each compliance well
if hypothesis of equal well means is rejected in the ANOVA analysis.

Based on Section 17.1 of the USEPA Unified Guidance for
Statistical Analysis Of Groundwater Monitoring Data At RCRA Facilities, March 2009

==========

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Calcium-last 4 in ug/L
Input Values:

	Bkgd well(s)		---> | Compliance wells --->				
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	20100.0	201000.0	24300.0	105000.0	71200.0	18200.0	34200.0
	18500.0	193000.0	24300.0	98100.0	60100.0	17000.0	21100.0
	18700.0	183000.0	22700.0	98900.0	56700.0	8850.0	14700.0
	20200.0	179000.0	21000.0	103000.0	57200.0	16100.0	11700.0
Well means:	19375.0	189000.0	23075.0	101250.0	61300.0	15037.5	20425.0
Backgd mean:	77150.0						
Overall mean:	61351.8						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	2.46E+10	4	6.16E+09	1.87
Error (within wells)	7.59E+10	23	3.30E+09	
Total	1.01E+11	27		

As F-Statistic is <= the 5 percent critical point (2.80),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Chromium-last 4 in ug/L
Input Values:

	Bkgd well(s)		---> | Compliance wells --->				
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	2.0	29.8	63.0	2.8	275.0	8.2	93.4
	16.6	73.9	97.5	23.2	59.0	97.9	87.2
	13.3	19.8	40.2	30.2	13.3	24.1	706.0
	0.9	108.0	179.0	17.7	55.6	0.9	55.5
Well means:	8.2	57.9	94.9	18.5	100.7	32.8	235.5
Backgd mean:	53.7						
Overall mean:	78.4						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of	Sums of	Degrees of	Mean Squares	F-Statistic

Variation	Squares	Freedom		
Between wells	1.31E+05	4	3.27E+04	2.00
Error (within wells)	3.76E+05	23	1.63E+04	
Total	5.06E+05	27		

As F-Statistic is <= the 5 percent critical point (2.80),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Magnesium-last 4 in ug/L
Input Values:

	Bkgd well(s) --->			Compliance wells --->			
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	15000.0	128000.0	16900.0	54400.0	44000.0	3490.0	2420.0
	14200.0	118000.0	16500.0	54300.0	39100.0	2110.0	5820.0
	14200.0	116000.0	15200.0	55400.0	33500.0	2710.0	1340.0
	10300.0	118000.0	14100.0	58100.0	35200.0	2570.0	1650.0
Well means:	13425.0	120000.0	15675.0	55550.0	37950.0	2720.0	2807.5
Backgd mean:	49700.0						
Overall mean:	35446.8						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	1.26E+10	4	3.16E+09	2.43
Error (within wells)	2.99E+10	23	1.30E+09	
Total	4.25E+10	27		

As F-Statistic is <= the 5 percent critical point (2.80),
we accept the hypothesis of equal well means.

==========

Program ANOVA-Bonferroni

INPUT DATA:

Comparisons of total metals in compliance wells with background wells using ANOVA-Bonferroni
Selected alpha: 0.05
Parameter: Total Potassium-last 4 in ug/L
Input Values:

	Bkgd well(s) --->			Compliance wells --->			
	MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
	994.0	15300.0	507.0	1730.0	5860.0	2940.0	1260.0
	1760.0	15100.0	1780.0	3370.0	7050.0	1220.0	4000.0
	1240.0	13700.0	1100.0	2000.0	5730.0	2650.0	1200.0
	2080.0	11100.0	617.0	2370.0	6460.0	1130.0	1370.0
Well means:	1518.5	13800.0	1001.0	2367.5	6275.0	1985.0	1957.5
Backgd mean:	5439.8						
Overall mean:	4129.2						

ANOVA TABLE COMPARING COMPLIANCE WELLS TO BACKGROUND:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F-Statistic
Between wells	8.87E+07	4	2.22E+07	1.15
Error (within wells)	4.44E+08	23	1.93E+07	
Total	5.32E+08	27		

As F-Statistic is <= the 5 percent critical point (2.80),
we accept the hypothesis of equal well means.

Appendix H5

Output results for Kruskal-Wallis inter-group analysis Total Metals 8 events

Program KruskalWallis-PostHoc

It evaluates the existence of significant differences
among medians of upgradient and downgradient wells
(Based on Section 17.1 of EPA's Unified Guidance)

INPUT DATA

Comparing Total Metals in Downgradient wells to background using Kruskal-Wallis test
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Total Aluminum in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
367	16800	1670	459	2180	502	19200
102	78200	2130	444	8330	1360	26600
32.4	32.4	1020	32.4	3620	739	6320
32.4	83900	26800	1120	34500	977	30900
81.7	683	798	32.4	1410	32.4	830
477	5160	10500	378	435	1310	25900
13.6	927	2370	13.6	13.6	13.6	1250
58.8	1260	2100	1280	474	33.2	3220

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
15.00	19.00	40.00	22.00	49.00
14.00	18.00	46.00	35.00	51.00
7.50	7.50	43.00	24.00	45.00
7.50	30.00	54.00	28.00	53.00
13.00	7.50	36.00	7.50	26.00
21.00	16.00	17.00	34.00	50.00
2.50	2.50	2.50	2.50	31.00
12.00	33.00	20.00	11.00	42.00
48.00				
55.00				
7.50				
56.00				
23.00				
44.00				
27.00				
32.00				
37.00				
39.00				
29.00				
52.00				
25.00				
47.00				
41.00				
38.00				
No. of Samples: 24	8	8	8	8
Rank Sum: 693.00	133.50	258.50	164.00	347.00
Rank Mean: 28.88	16.69	32.31	20.50	43.38

Kruskal-Wallis statistic corrected for ties: 13.25
Number of tied groups = 2
Number of ties per group:
1 4
2 6
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical

point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.83	0.52	-1.26	2.18
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Arsenic in ug/L

Bkgd well(s)		--->	Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
2.000	21.7	2.000	2.000	2.6	2.000	37.1
2.500	43.2	2.500	2.500	20.9	2.500	72.2
4.400	4.4	4.400	4.400	7.4	4.400	14.3
4.400	64.9	4.400	4.400	61.4	4.400	49.1
4.400	4.4	4.400	4.400	4.4	4.400	4.4
2.400	7.1	3.500	2.400	2.4	2.400	55.6
3.500	3.5	3.500	3.500	3.5	3.500	3.5
3.500	3.5		3.500	3.5	3.500	3.5

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
2.50	2.50	13.00	2.50	49.00
10.50	10.50	47.00	10.50	55.00
35.50	35.50	45.00	35.50	46.00
35.50	35.50	53.00	35.50	51.00
35.50	35.50	35.50	35.50	35.50
6.50	6.50	6.50	6.50	52.00
20.50	20.50	20.50	20.50	20.50
20.50	20.50	20.50	20.50	20.50
48.00				
50.00				
35.50				
54.00				
35.50				
44.00				
20.50				
20.50				
2.50				
10.50				
35.50				
35.50				
35.50				
20.50				
20.50				

No. of Samples:	23	8	8	8	8
Rank Sum:	635.50	167.00	241.00	167.00	329.50
Rank Mean:	27.63	20.87	30.13	20.87	41.19

Kruskal-Wallis statistic corrected for ties: 9.12
Number of tied groups = 5

Number of ties per group:

1	4
2	4
3	4
4	14
5	16

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Barium in ug/L

Bkgd well(s)		---> | Compliance wells --->				
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
57.8	205	57.3	48.3	60.4	8.2	109
55.2	144	82.5	67.1	123	16.9	638
57.4	130	27.2	45.2	73.2	18.3	50.1
56.5	144	714	61.7	384	17.7	109
59.0	130	28	49.2	56.7	15.4	31.2
58.8	115	386	78.9	49.6	13.6	166
48.4		84.4	50.3	42.6	13.1	25.6
		88.7	62.4	44.6		43.5

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
27.00	16.00	30.00	1.00	39.50
22.00	33.00	42.00	5.00	51.00
26.00	15.00	34.00	7.00	20.00
23.00	31.00	49.00	6.00	39.50
29.00	18.00	24.00	4.00	11.00
28.00	35.00	19.00	3.00	47.00
17.00	21.00	12.00	2.00	8.00
48.00	32.00	14.00		13.00
45.50				
43.50				
45.50				
43.50				
41.00				
25.00				
36.00				
9.00				
52.00				
10.00				
50.00				
37.00				
38.00				

No. of Samples:	21	8	8	7	8
Rank Sum:	696.00	201.00	224.00	28.00	229.00
Rank Mean:	33.14	25.13	28.00	4.00	28.62

Kruskal-Wallis statistic corrected for ties: 19.77
Number of tied groups = 3
Number of ties per group:

1	2
2	2
3	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.27	-0.82	-4.41	-0.72
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Beryllium in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
0.860	18.3	0.86	0.860	0.860	0.860	12.6
0.520	1.1	1.4	0.520	2.1	0.520	4.3
1.100	1.1	1.1	1.100	1.100	1.100	18.8
1.100	5.1	1.1	1.2	1.100	1.100	1.1
1.100	0.26	9.1	1.100	0.310	1.100	19
0.310	2.0	0.26	0.310	0.260	0.310	0.26
0.260		1.9	0.260	0.260	0.260	3.1
0.260			2.0		1.8	

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
19.00	19.00	19.00	19.00	48.00
15.00	15.00	43.00	15.00	45.00
29.00	29.00	29.00	29.00	50.00
29.00	37.00	29.00	29.00	29.00
29.00	29.00	11.50	29.00	51.00
11.50	11.50	5.00	11.50	5.00
5.00	5.00	5.00	5.00	44.00
5.00	41.50		39.00	
49.00				
29.00				
29.00				
46.00				
5.00				
41.50				
19.00				
38.00				
29.00				
29.00				
47.00				
5.00				
40.00				
No. of Samples: 21	8	7	8	7
Rank Sum: 549.00	187.00	141.50	176.50	272.00
Rank Mean: 26.14	23.37	20.21	22.06	38.86

Kruskal-Wallis statistic corrected for ties: 7.35
Number of tied groups = 6

Number of ties per group:

1	9
2	4
3	3
4	5
5	15
6	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Cobalt in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
6.700	60.1	6.7	6.700	6.7	6.700	201
2.6	368	14.4	10.1	37	5.1	402
2.700	2.7	2.7	2.700	15.6	2.700	81.6
2.700	395	212	4.7	119	3.7	355
2.700	4.4	4.4	2.700	5.9	2.700	14.8
0.970	24.3	86.7	1.1	1.6	3.1	350
3.300	3.3	20.9	3.6	3.3	3.300	13.3
3.300	3.3	11	3.300	3.3	3.300	99.1

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
33.00	33.00	33.00	33.00	50.00
4.00	36.00	44.00	29.00	56.00
9.00	9.00	41.00	9.00	46.00
9.00	28.00	49.00	25.00	53.00
9.00	9.00	30.00	9.00	40.00
1.00	2.00	3.00	14.00	52.00
19.00	24.00	19.00	19.00	38.00
19.00	19.00	19.00	19.00	48.00
45.00				
54.00				
9.00				
55.00				
26.50				
43.00				
19.00				
19.00				
33.00				
39.00				
9.00				
51.00				
26.50				
47.00				
42.00				
37.00				
No. of Samples: 24	8	8	8	8
Rank Sum: 658.00	160.00	238.00	157.00	383.00
Rank Mean: 27.42	20.00	29.75	19.62	47.87

Kruskal-Wallis statistic corrected for ties: 16.13
Number of tied groups = 4
Number of ties per group:

1	9
2	9
3	2
4	5

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.11	0.35	-1.17	3.07
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

==========

Program KruskalWallis-PostHoc

Parameter: Total Copper in ug/L

Bkgd well(s)		--->	Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
4.500	130	13.8	4.500	31.8	5.2	119
4.000	854	15.4	4.000	142	13.8	464
0.740	0.74	0.74	0.740	61.7	0.74	36.8
1.0	595	190	5.8	546	7.8	180
0.740	6.8	6.9	0.740	27.9	0.99	7.4
3.3	33.2	76.7	2.8	7.5	27.9	153
0.810	9.5	17.4	0.810	4.9	0.81	8.1
0.810	13.1	19.7	8.7	8.5	0.81	72.6

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
19.50	19.50	41.00	22.00	47.00
17.50	17.50	49.00	34.50	53.00
4.00	4.00	44.00	4.00	43.00
14.00	23.00	54.00	28.00	51.00
4.00	4.00	39.50	13.00	26.00
16.00	15.00	27.00	39.50	50.00
10.00	10.00	21.00	10.00	29.00
10.00	31.00	30.00	10.00	45.00
48.00				
56.00				
4.00				
55.00				
24.00				
42.00				
32.00				
33.00				
34.50				
36.00				
4.00				
52.00				
25.00				
46.00				
37.00				

38.00

No. of Samples:	24	8	8	8	8
Rank Sum:	661.50	124.00	305.50	161.00	344.00
Rank Mean:	27.56	15.50	38.19	20.13	43.00

Kruskal-Wallis statistic corrected for ties: 16.46
Number of tied groups = 6
Number of ties per group:

1	7
2	5
3	2
4	2
5	2
6	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.81	1.60	-1.12	2.32
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

Program KruskalWallis-PostHoc

Parameter: Total Iron in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
787	108000	15400	1170	11000	1680	80300
1370	439000	25600	1620	59200	6200	86400
223	498	5000	590	23300	2990	28900
254	475000	354000	4530	238000	3690	120000
244	4580	7280	131	10900	257	5150
1280	31900	137000	1710	2900	3530	108000
320	4560	36300	440	983	1460	6590
164	8450	27500	7080	2110	38.8	22700

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
12.00	14.00	37.00	19.00	47.00
16.00	18.00	46.00	31.00	48.00
4.00	11.00	40.00	23.00	43.00
6.00	26.00	53.00	25.00	51.00
5.00	2.00	36.00	7.00	30.00
15.00	20.00	22.00	24.00	49.50
8.00	9.00	13.00	17.00	32.00
3.00	33.00	21.00	1.00	39.00
49.50				
55.00				
10.00				
56.00				

28.00
44.00
27.00
35.00
38.00
41.00
29.00
54.00
34.00
52.00
45.00
42.00

No. of Samples:	24	8	8	8	8
Rank Sum:	708.50	133.00	268.00	147.00	339.50
Rank Mean:	29.52	16.63	33.50	18.37	42.44

Kruskal-Wallis statistic corrected for ties: 14.01
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.94	0.60	-1.67	1.94
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Lead in ug/L

Bkgd well(s)		---> | Compliance wells --->				
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.500	65.1	10.3	1.5	9.3	1.5	395
2.000	319	18.2	2.0	52.2	2.0	1470
1.200	1.2	3.1	1.2	18.7	3.8	136
1.5	360	234	5.9	224	6.2	595
1.200	2.9	4.6	1.2	8.5	1.2	23.4
1.900	18.7	93.9	2.2	1.9	7.5	699
2.000	2.0	2	2.0	2.0	2.0	29.4
2.000	6.1	19.7	7.3	2.0	2.6	143

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
8.50	8.50	36.00	8.50	53.00
18.00	18.00	44.00	18.00	56.00
3.50	3.50	39.50	28.00	47.00
8.50	30.00	49.00	32.00	54.00
3.50	3.50	35.00	3.50	42.00
11.50	24.00	11.50	34.00	55.00

18.00	18.00	18.00	18.00	43.00
18.00	33.00	18.00	25.00	48.00
45.00				
51.00				
3.50				
52.00				
26.00				
39.50				
18.00				
31.00				
37.00				
38.00				
27.00				
50.00				
29.00				
46.00				
18.00				
41.00				

No. of Samples:	24	8	8	8	8
Rank Sum:	641.50	138.50	251.00	167.00	398.00
Rank Mean:	26.73	17.31	31.38	20.87	49.75

Kruskal-Wallis statistic corrected for ties: 19.81
Number of tied groups = 5
Number of ties per group:

1	6
2	4
3	2
4	11
5	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.41	0.70	-0.88	3.46
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

==========

Program KruskalWallis-PostHoc

Parameter: Total Manganese in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
9.8	2280	462	45	140	148	3020
37.7	9620	779	51.1	795	189	6140
13.3	322	133	20.1	373	168	1070
13.4	10800	12600	229	3340	118	4640
14.3	544	286	11.4	188	125	212
23.1	763	5490	67	43.9	96	4410
12.9	319	1180	27.1	46.3	85.8	219
6.5	336	1150	296	32.2	172	1540

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
2.00	14.00	23.00	24.00	48.00
12.00	16.00	42.00	28.00	53.00
5.00	8.00	37.00	25.00	43.00
6.00	31.00	49.00	20.00	51.00
7.00	3.00	27.00	21.00	29.00
9.00	17.00	13.00	19.00	50.00
4.00	10.00	15.00	18.00	30.00
1.00	33.00	11.00	26.00	46.00
47.00				
54.00				
35.00				
55.00				
39.00				
40.00				
34.00				
36.00				
38.00				
41.00				
22.00				
56.00				
32.00				
52.00				
45.00				
44.00				
No. of Samples: 24	8	8	8	8
Rank Sum: 716.00	132.00	217.00	181.00	350.00
Rank Mean: 29.83	16.50	27.12	22.63	43.75

Kruskal-Wallis statistic corrected for ties: 12.58
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-2.00	-0.41	-1.08	2.09
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Nickel in ug/L

Bkgd well(s)		---> | Compliance wells --->				
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
9.9	334	27.2	17.6	98.3	5.9	196
1.9	1230	56.8	22.4	792	51	235
4.5	7.2	9.7	36.7	349	16.4	87.9
1.9	2280	305	35.2	1600	27	974

0.84	31.6	56.5	1.9	149	4.2	53.7
10.2	104	296	0.84	0.84	53.1	507
2.6	27.4	49	15.9	8.3	14.1	40.7
	73.6	116	21.6	56.6	3.3	1070

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
15.00	20.00	39.00	11.00	43.00
5.00	22.00	50.00	31.00	44.00
10.00	28.00	48.00	19.00	38.00
5.00	27.00	54.00	23.00	51.00
2.00	5.00	42.00	9.00	33.00
16.00	2.00	2.00	32.00	49.00
7.00	18.00	13.00	17.00	29.00
47.00	21.00	35.00	8.00	52.00
53.00				
12.00				
55.00				
26.00				
40.00				
25.00				
37.00				
24.00				
36.00				
14.00				
46.00				
34.00				
45.00				
30.00				
41.00				
No. of Samples: 23	8	8	8	8
Rank Sum: 625.00	143.00	283.00	150.00	339.00
Rank Mean: 27.17	17.88	35.38	18.75	42.37

Kruskal-Wallis statistic corrected for ties: 14.06
Number of tied groups = 2
Number of ties per group:
1 3
2 3
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.41	1.25	-1.28	2.31
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

Program KruskalWallis-PostHoc

Parameter: Total Sodium in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
271	151000	271	13100	33100	134000	7550
346	33200	2400	63300	134000	786000	15900
1130	137000	2050	13800	66700	417000	39100
368	23300	368	13000	28800	341000	9420
1290	42200	2040	9710	12500	389000	17300
1230	55800	2020	90300	11500	50100	15200
1090	61700	1870	13000	30200	349000	7190
1350	64100	1880	16800	9910	7220	4620

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
1.50	28.00	37.00	48.50	20.00
3.00	44.00	48.50	56.00	31.00
7.00	29.00	46.00	55.00	39.00
4.50	26.50	35.00	52.00	21.00
9.00	22.00	25.00	54.00	33.00
8.00	47.00	24.00	41.00	30.00
6.00	26.50	36.00	53.00	18.00
10.00	32.00	23.00	19.00	17.00
51.00				
38.00				
50.00				
34.00				
40.00				
42.00				
43.00				
45.00				
1.50				
16.00				
15.00				
4.50				
14.00				
13.00				
11.00				
12.00				

No. of Samples:	24	8	8	8	8
Rank Sum:	479.00	255.00	274.50	378.50	209.00
Rank Mean:	19.96	31.88	34.31	47.31	26.12

Kruskal-Wallis statistic corrected for ties: 18.76
Number of tied groups = 4
Number of ties per group:

1	2
2	2
3	2
4	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	1.79	2.16	4.11	0.93
Critical table value (zc):	2.24	2.24	2.24	2.24

Well median significantly greater than background?	no	no	yes	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Vanadium in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
0.43	28.6	0.43	0.43	10.2	0.43	19.8
1.3	108	7.0	1.9	45.9	4.5	20.8
1.6	1.6	1.6	1.6	20	1.6	7.2
1.6	148	72.7	4.1	174	2.9	35.9
1.6	2.1	3.0	1.6	9.3	1.6	1.6
1.5	9.3	30.7	1.6	2.4	4.8	29
1.3	1.3	1.3	1.3	1.3	1.3	1.3
1.3	2.0	5.1	4.9	1.3	1.3	7.9

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
2.50	2.50	44.00	2.50	45.00
10.00	28.00	52.00	35.00	47.00
22.00	22.00	46.00	22.00	40.00
22.00	34.00	56.00	32.00	51.00
22.00	22.00	42.50	22.00	22.00
16.00	22.00	31.00	36.00	49.00
10.00	10.00	10.00	10.00	10.00
10.00	37.00	10.00	10.00	41.00
48.00				
54.00				
22.00				
55.00				
30.00				
42.50				
10.00				
29.00				
2.50				
39.00				
22.00				
53.00				
33.00				
50.00				
10.00				
38.00				

No. of Samples:	24	8	8	8	8
Rank Sum:	652.50	177.50	291.50	169.50	305.00
Rank Mean:	27.19	22.19	36.44	21.19	38.13

Kruskal-Wallis statistic corrected for ties: 7.76
Number of tied groups = 4
Number of ties per group:

1	4
2	11
3	11
4	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Zinc in ug/L

Bkgd well(s)		--->	Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
7.1	1510	97.1	15.6	137	28.9	547
1.7	7700	146	29	495	105	800
5.2	16.2	31.8	9.3	169	32.5	247
3.6	6710	2360	47.6	3000	50.9	963
3.6	58.7	42.2	4.9	87.4	4.0	90.4
5.5	407	839	5.5	41.8	83.1	1020
8.8	80.6	194	7.4	24.8	17.1	85.2
14.7	110	172	70.5	29.4	6.3	171

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
10.00	15.00	38.00	19.00	47.00
1.00	20.00	46.00	36.00	48.00
6.00	13.00	40.00	23.00	44.00
2.50	26.00	54.00	27.00	50.00
2.50	5.00	33.00	4.00	34.00
7.50	7.50	24.00	31.00	51.00
12.00	11.00	18.00	17.00	32.00
14.00	29.00	21.00	9.00	41.00
52.00				
56.00				
16.00				
55.00				
28.00				
45.00				
30.00				
37.00				
35.00				
39.00				
22.00				
53.00				
25.00				
49.00				
43.00				
42.00				
No. of Samples: 24	8	8	8	8
Rank Sum: 682.50	126.50	274.00	166.00	347.00
Rank Mean: 28.44	15.81	34.25	20.75	43.38

Kruskal-Wallis statistic corrected for ties: 14.30
Number of tied groups = 2
Number of ties per group:
1 2
2 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.90	0.87	-1.15	2.24
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

Appendix H6

Output results for Kruskal-Wallis Inter-Group Analysis Total Metals 4 Events

Program KruskalWallis-PostHoc

It evaluates the existence of significant differences
among medians of upgradient and downgradient wells
(Based on Section 17.1 of EPA's Unified Guidance)

INPUT DATA

Comparing Total Metals in Downgradient wells to background using Kruskal-Wallis test
Selected alpha: 0.05
Value to replace non-detects: 0.01

==========

Parameter: Total Aluminum - last in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
81.7	683	798	32.4	1410	32.4	830
477	5160	10500	378	435	1310	25900
13.6	927	2370	13.6	13.6	13.6	1250
58.8	1260	2100	1280	474	33.2	3220

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
9.00	5.50	22.00	5.50	16.00
13.00	10.00	11.00	21.00	28.00
2.50	2.50	2.50	2.50	18.00
8.00	20.00	12.00	7.00	25.00
14.00				
26.00				
17.00				
19.00				
15.00				
27.00				
24.00				
23.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 197.50	38.00	47.50	36.00	87.00
Rank Mean: 16.46	9.50	11.88	9.00	21.75

Kruskal-Wallis statistic corrected for ties: 7.48
Number of tied groups = 2
Number of ties per group:
1 4
2 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Arsenic - last 4 in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
4.4	4.4	4.400	4.400	4.4	4.400	4.4
2.4	7.1	4.400	2.400	2.4	2.400	55.6
3.5	3.5	3.500	3.500	3.5	3.500	3.5
3.5	3.5	3.500	3.500	3.5	3.500	3.5

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
22.50	22.50	22.50	22.50	22.50
2.50	2.50	2.50	2.50	28.00
11.50	11.50	11.50	11.50	11.50
11.50	11.50	11.50	11.50	11.50
22.50				
27.00				
11.50				
11.50				
22.50				
22.50				
11.50				
11.50				
No. of Samples: 12	4	4	4	4
Rank Sum: 188.50	48.00	48.00	48.00	73.50
Rank Mean: 15.71	12.00	12.00	12.00	18.37

Kruskal-Wallis statistic corrected for ties: 2.65
Number of tied groups = 3
Number of ties per group:
1 4
2 14
3 8
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Barium - last 4 in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
56.5	130	28	49.2	56.7	17.7	31.2
59.0	144	386	78.9	49.6	15.4	166
58.8	130	84.4	50.3	42.6	13.6	25.6
48.4	115	88.7	62.4	44.6	13.1	43.5

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
15.00	12.00	16.00	4.00	7.00
18.00	20.00	13.00	3.00	27.00
17.00	14.00	8.00	2.00	5.00
11.00	19.00	10.00	1.00	9.00
24.50				
26.00				
24.50				
23.00				
6.00				
28.00				
21.00				
22.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 236.00	65.00	47.00	10.00	48.00

Rank Mean:	19.67	16.25	11.75	2.50	12.00

Kruskal-Wallis statistic corrected for ties: 14.25
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-0.72	-1.67	-3.61	-1.61
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Beryllium - last in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.100	1.1	1.1	1.10	1.10	1.10	1.1
0.310	5.1	9.1	0.31	0.31	0.31	19
0.260	0.26	0.26	0.26	0.26	0.26	0.26
0.260	2.0	1.9	2	0.26	1.8	3.1

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
17.00	17.00	17.00	17.00	17.00
11.50	11.50	11.50	11.50	28.00
5.00	5.00	5.00	5.00	5.00
5.00	23.50	5.00	21.00	25.00
17.00				
26.00				
5.00				
23.50				
17.00				
27.00				
5.00				
22.00				

No. of Samples:	12	4	4	4	4
Rank Sum:	181.00	57.00	38.50	54.50	75.00
Rank Mean:	15.08	14.25	9.63	13.63	18.75

Kruskal-Wallis statistic corrected for ties: 2.72
Number of tied groups = 4
Number of ties per group:
1 9
2 4
3 7
4 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Cobalt-last 4 in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
2.700	4.4	4.4	2.7	5.9	2.700	14.8
0.970	24.3	86.7	1.1	1.6	3.1	350
3.300	3.3	20.9	3.6	3.3	3.300	13.3
3.300	3.3	11	3.3	3.3	3.300	99.1

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
5.00	5.00	20.00	5.00	23.00
1.00	2.00	3.00	7.00	28.00
12.00	17.00	12.00	12.00	22.00
12.00	12.00	12.00	12.00	27.00
18.50				
25.00				
12.00				
12.00				
18.50				
26.00				
24.00				
21.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 187.00	36.00	47.00	36.00	100.00
Rank Mean: 15.58	9.00	11.75	9.00	25.00

Kruskal-Wallis statistic corrected for ties: 11.13
Number of tied groups = 3
Number of ties per group:

1	3
2	9
3	2

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-1.39	-0.81	-1.39	1.98
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	no

==========

Program KruskalWallis-PostHoc

Parameter: Total Copper-last 4 in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
0.740	6.8	6.9	0.740	27.9	0.99	7.4
3.3	33.2	76.7	2.8	7.5	27.9	153
0.810	9.5	17.4	0.810	4.9	0.81	8.1
0.810	13.1	19.7	8.7	8.5	0.81	72.6

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
1.50	1.50	23.50	8.00	14.00
10.00	9.00	15.00	23.50	28.00
5.00	5.00	11.00	5.00	16.00
5.00	18.00	17.00	5.00	26.00
12.00				
25.00				
19.00				
20.00				
13.00				
27.00				
21.00				
22.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 180.50	33.50	66.50	41.50	84.00
Rank Mean: 15.04	8.38	16.63	10.38	21.00

Kruskal-Wallis statistic corrected for ties: 6.08
Number of tied groups = 3
Number of ties per group:
1 2
2 5
3 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Iron - last 4 in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
244	4580	7280	131	10900	257	5150
1280	31900	137000	1710	2900	3530	108000
320	4560	36300	440	983	1460	6590
164	8450	27500	7080	2110	38.8	22700

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
4.00	2.00	22.00	5.00	17.00
9.00	11.00	13.00	14.00	27.00
6.00	7.00	8.00	10.00	18.00
3.00	19.00	12.00	1.00	23.00
16.00				

	25.00			
	15.00			
	21.00			
	20.00			
	28.00			
	26.00			
	24.00			
No. of Samples:	12	4	4	4	4
Rank Sum:	197.00	39.00	55.00	30.00	85.00
Rank Mean:	16.42	9.75	13.75	7.50	21.25

Kruskal-Wallis statistic corrected for ties: 7.61
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Lead - last 4 in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.200	2.9	4.6	1.2	8.5	1.2	23.4
1.900	18.7	93.9	2.2	1.9	7.5	699
2.000	2.0	2	2.0	2.0	2.0	29.4
2.000	6.1	19.7	7.3	2.0	2.6	143

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
2.00	2.00	21.00	2.00	24.00
4.50	14.00	4.50	20.00	28.00
9.50	9.50	9.50	9.50	25.00
9.50	19.00	9.50	15.00	27.00
16.00				
22.00				
9.50				
18.00				
17.00				
26.00				
9.50				
23.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 166.50	44.50	44.50	46.50	104.00
Rank Mean: 13.87	11.13	11.13	11.63	26.00

Kruskal-Wallis statistic corrected for ties: 9.97
Number of tied groups = 3
Number of ties per group:

1	3
2	2
3	8

95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic exceeds the Chi-Square critical point at least one well has a median significantly larger or smaller than one or more other wells (at a probability of 95%).

RESULTS OF POST-HOC TEST FOR EACH COMPLIANCE WELL
(Required because Kruskal-Wallis Statistic was greater than Chi-Square Critical Point)
Based on post-hoc method presented in Section 17.1 of the EPA's Unified Guidance

Computed alpha used: 0.0125 for each post-hoc contrast.

	MW-15S	MW-16S	MW-17S	MW-24
Computed z statstic (z*):	-0.58	-0.58	-0.47	2.55
Critical table value (zc):	2.24	2.24	2.24	2.24
Well median significantly greater than background?	no	no	no	yes

==========

Program KruskalWallis-PostHoc

Parameter: Total Manganese - last in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
14.3	544	286	11.4	188	125	212
23.1	763	5490	67	43.9	96	4410
12.9	319	1180	27.1	46.3	85.8	219
6.5	336	1150	296	32.2	172	1540

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
4.00	2.00	15.00	13.00	16.00
5.00	10.00	8.00	12.00	27.00
3.00	6.00	9.00	11.00	17.00
1.00	19.00	7.00	14.00	26.00
22.00				
23.00				
20.00				
21.00				
18.00				
28.00				
25.00				
24.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 194.00	37.00	39.00	50.00	86.00
Rank Mean: 16.17	9.25	9.75	12.50	21.50

Kruskal-Wallis statistic corrected for ties: 6.59
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Nickel - last 4 in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.9	31.6	56.5	1.9	149	4.2	53.7

0.84	104	296	0.84	0.84	53.1	507
10.2	27.4	49	15.9	8.3	14.1	40.7
2.6	73.6	116	21.6	56.6	3.3	1070

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
4.50	4.50	25.00	8.00	19.00
2.00	2.00	2.00	18.00	27.00
10.00	12.00	9.00	11.00	16.00
6.00	13.00	21.00	7.00	28.00
15.00				
23.00				
14.00				
22.00				
20.00				
26.00				
17.00				
24.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 183.50	31.50	57.00	44.00	90.00
Rank Mean: 15.29	7.88	14.25	11.00	22.50

Kruskal-Wallis statistic corrected for ties: 7.23
Number of tied groups = 2
Number of ties per group:
1 3
2 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

Program KruskalWallis-PostHoc

Parameter: Total Sodium - last 4 in ug/L

Bkgd well(s)			---> | Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1290	42200	2040	9710	12500	389000	17300
1230	55800	2020	90300	11500	50100	15200
1090	61700	1870	13000	30200	349000	7190
1350	64100	1880	16800	9910	7220	4620

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
3.00	12.00	15.00	28.00	19.00
2.00	26.00	14.00	22.00	17.00
1.00	16.00	20.00	27.00	10.00
4.00	18.00	13.00	11.00	9.00
21.00				
23.00				
24.00				
25.00				
8.00				
7.00				
5.00				
6.00				

No. of Samples:	12	4	4	4	4
Rank Sum:	129.00	72.00	62.00	88.00	55.00
Rank Mean:	10.75	18.00	15.50	22.00	13.75

Kruskal-Wallis statistic corrected for ties: 6.64
Number of tied groups = 0
Number of ties per group:
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Vanadium - last in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
1.6	2.1	3.0	1.6	9.3	1.6	1.6
1.5	9.3	30.7	1.6	2.4	4.8	29
1.3	1.3	1.3	1.3	1.3	1.3	1.3
1.3	2.0	5.1	4.9	1.3	1.3	7.9

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
14.00	14.00	25.50	14.00	14.00
11.00	14.00	19.00	21.00	27.00
5.50	5.50	5.50	5.50	5.50
5.50	22.00	5.50	5.50	24.00
18.00				
25.50				
5.50				
17.00				
20.00				
28.00				
5.50				
23.00				

No. of Samples:	12	4	4	4	4
Rank Sum:	178.50	55.50	55.50	46.00	70.50
Rank Mean:	14.88	13.87	13.87	11.50	17.62

Kruskal-Wallis statistic corrected for ties: 1.24
Number of tied groups = 3
Number of ties per group:
1 10
2 5
3 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

==========

Program KruskalWallis-PostHoc

Parameter: Total Zinc - last 4 in ug/L

Bkgd well(s) --->			Compliance wells --->			
MW-10	MW-22	MW-23	MW-15S	MW-16S	MW-17S	MW-24
3.6	58.7	42.2	4.9	87.4	4.0	90.4
5.5	407	839	5.5	41.8	83.1	1020
8.8	80.6	194	7.4	24.8	17.1	85.2
14.7	110	172	70.5	29.4	6.3	171

SAMPLE VALUE RANKS BY WELLS

Bkgd wells	MW-15S	MW-16S	MW-17S	MW-24
1.00	3.00	20.00	2.00	21.00
4.50	4.50	13.00	18.00	28.00
8.00	7.00	11.00	10.00	19.00
9.00	16.00	12.00	6.00	23.00
15.00				
26.00				
17.00				
22.00				
14.00				
27.00				
25.00				
24.00				
No. of Samples: 12	4	4	4	4
Rank Sum: 192.50	30.50	56.00	36.00	91.00
Rank Mean: 16.04	7.63	14.00	9.00	22.75

Kruskal-Wallis statistic corrected for ties: 9.04
Number of tied groups = 1
Number of ties per group:
1 2
95% Chi-Square Distribution value at 4 degrees of freedom: 9.49

Because the Kruskal-Wallis statistic is less than the Chi-Square critical point the compliance wells may be considered to have the same median as the background wells (at a probability of 95%).

Appendix I

Tabulated Organics and Cyanide Data

APPENDIX I

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS [1] UPGRADIENT WELLS																								Ground Water Standards[2]
	MW-10								MW-22								MW-23								
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	
Volatiles:																									
Dichlorodifluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.056J	19[3]
Chloromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.24J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23B	19[3]
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.095J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	110[3]
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.10J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	26[3]
Acetone	<5.0UR	<5.0UR	<5.0R	<5.0U	<5.0UR	<5.0UR	13	5.9R	<0.50UR	4.4B	<5.0R	4.1B	<5.0UR	2.8L	16	6.4R	<5.0UR	3.6B	<5.0R	<5.0UR	3.1L	<5.0UR	15	4.4R	95.9
2-Butanone	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	2.3R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	490[3]
Carbon Disulfide	<0.50	<0.50	<0.50	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	0.11J	<0.50	<0.50	0.099J	72[3]
Methylene Chloride	0.52B	<0.50	0.26K	0.24B	0.25B	0.20B	0.54B	<0.50	0.48B	<0.50	0.31B	0.23B	0.20B	0.15B	0.72B	<0.50	0.75B	<0.50	0.28B	0.25B	0.23B	<0.50	0.79B	<0.50	5[4]
Trans-1,2-dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.6[3]
Methyl tert butyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.051J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	12[3]
Chloroform	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1
1,1,1-Trichlorothane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	200[4]
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.056J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5[4]
1,1,2,2-Tetrachloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.066[3]
Toluene	0.20B	<0.50	<0.50	<0.50	0.13B	0.19JB	5.4B	0.42B	0.17B	<0.50	<0.50	<0.50	0.44B	0.50B	8.8B	0.32B	0.23B	<0.50	<0.50	<0.50	0.13B	0.15B	3.3B	0.11B	1,000[4]
Trans-1,3-dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.24J	-
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.053B	3.5[3]
Chlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	7.2[3]
Cyclohexane	<0.50	0.19B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.17B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1,300[3]
Carbon Tetrachloride	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.055B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.032B	0.39[3]
Benzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.053B	5
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.051B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	700[4]
Total Xylenes	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.071B	<0.50	<0.50	<0.50	<0.50	0.42J	<0.50	<0.50	0.033B	0.209J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	10,000[4]
Isopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.040B	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	39[3]
1,3-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.10B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.032B	-
1,4-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.42[3]
1,2-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	28[3]
1,2,4-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.17B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.39[3]
1,2,3-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.15B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52[3]
Semivolatiles:																									
Caprolactam	<5.3UR	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0UR	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	770[3]
2,4-Dimethylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	1.15
Phenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	7,860
2-Methylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	12.5
4-Methylphenol	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0U	<4.8	<4.6U	<4.7	<5.0	47.7
Naphthalene	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	5
Di-N-Butylphthalate	<5.3	<5.3	<4.6	<4.5	<4.7	<4.7	<4.8	<5.0	<5.0	<5.6	<4.7	<5.3	<4.7	<4.6	<4.8	<5.0	<5.1	<5.0	<5.0	<5.0UL	<4.8	<4.6UL	<4.7	<5.0	67[3]
Bis(2-ethylhexyl)phthalate	<5.3	<5.3	<4.6	2.2J	<4.7	<4.7	<4.8	<5.0	<5.0	2.9J	<4.7	<5.3	<4.7	<4.6	<4.8	7.9	<5.1	<5.0	<5.0	2.5L	<4.8	<4.6UL	<4.7	<5.0	6[4]
Cyanide:																									
Total	<10.0	<10.0	<10.0	<10.0R	<10.0	<10.0	<10.0	<10.0	1.6J	4.0J	2.0B	<10.0UR	3.0J	1.4B	2.3B	<10.0	<10.0	<10.0	<10.0	<10.0	2.4J	<10.0	<10.0	<10.0	10
Available	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	5.8	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	-

Notes:
(1) - All results are reported in micrograms per liter.
(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.
(3) - USEPA Regional Screening Levels for Tapwater, May, 2013
(4) - USEPA Maximum Contaminant Levels
J - Anaylte present. Reported value may not be accurate or precise.
B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.
U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.
L - This result should be considered a biased low quantitative estimate.
K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.
NA - Not Analyzed
< 0.5 - Compound not detected above the listed laboratory method reporting limit.
Bold - Compound was detected above its listed ground water standard.

APPENDIX I

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
COLLECTED FROM MONITORING WELLS INCLUDED IN THE
QUARRY NO. 4 DEMONSTRATION PROJECT

ANALYTICAL PARAMETERS	WELL DESIGNATION/ANALYTICAL RESULTS [1] DOWNGRADIENT WELLS																																Ground Water Standards[2]
	MW-15S								MW-16S								MW-17S								MW-24								
	10/10	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	*10/10*	*01/11*	*4/11*	*7/11*	*10/11*	*01/12*	*04/12*	*08/12*	
Volatiles:																																	
Dichlorodifluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.046B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.70B	19[3]
Chloromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.30J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.33J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.31K	19[3]
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.14J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.061B	110[3]
1,1-Dichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.13J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	26[3]
Acetone	<5UR	3.2B	<5.0R	<5.0UR	<5.0UR	4.2L	16	11R	<5.0UR	5.0UR	<5.0R	4.8B	2.9L	<5.0UR	15	6.4R	<5.0UR	3.1B	4.2L	<5.0UR	<5.0UR	<5.0UR	14	18R	<5.0UR	3.8B	4.7B	<5.0UR	<5.0UR	2.9L	15	18R	95.9
2-Butanone	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0UR	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	1.8R	<5.0UR	<5.0	<5.0R	<5.0UR	<5.0	<5.0UR	<5.0	1.6R	490[3]
Carbon Disulfide	<0.50	<0.50	<0.50	<0.5	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	1.8	<0.50	<0.50	<0.50	0.067J	<0.50	<0.50	<0.50	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.18 J	<0.50	<0.50	<0.50	0.76B	72[3]
Methylene Chloride	0.41B	<0.50	0.23J	0.23B	0.19B	<0.50UJ	0.63B	0.38B	0.87B	<0.50	0.22K	0.23B	0.25B	<0.50	1.4B	<0.50	0.75B	<0.50	0.26K	0.21B	0.21B	<0.50	0.97B	0.42B	0.69B	0.18B	0.30B	0.19B	0.20B	0.15B	0.57B	0.45B	5[4]
Trans-1,2-dichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.055J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	8.6[3]
Methyl tert butyl ether	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	12[3]
Chloroform	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1
1,1,1-Trichloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.04J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	200[4]
Trichloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.091J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5[4]
1,1,2,2-Tetrachloroethane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.066[3]
Toluene	0.17B	<0.50	<0.50	<0.50	<0.50	0.087B	3.0B	0.37B	0.21B	<0.50	<0.50	<0.50	<0.50	0.11B	6.7B	1.7	0.27B	<0.50	<0.50	<0.50	<0.50	0.26B	4.5B	0.28B	0.19B	<0.50	<0.50	<0.50	0.24B	0.63B	18	0.13B	1,000[4]
Trans-1,3-dichloropropene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.050B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.063J	0.066B	3.5[3]
Chlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.10J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	7.2[3]
Cyclohexane	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	0.092B	<0.50	0.18B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.23B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1,300[3]
Carbon Tetrachloride	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.096B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.041B	0.39[3]
Benzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.060B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.092B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	700[4]
Total Xylenes	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.157B	0.42J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.033B	10,000(4)
Isopropylbenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.085B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	39[3]
1,3-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.15B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.044B	-
1,4-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.42[3]
1,2-Dichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.034B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.040B	28[3]
1,2,4-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.24B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.088B	0.39[3]
1,2,3-Trichlorobenzene	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50UJ	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.21B	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52[3]
Semivolatiles:																																	
Caprolactam	<5.0R	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0R	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	5.0L	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0UL	770[3]
2,4-Dimethylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	1.15
Phenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	7,860
2-Methylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	12.5
4-Methylphenol	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7U	<4.5	<5.0	47.7
Naphthalene	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0UL	5
Di-N-Butylphthalate	<5.0	<5.3	<4.8	<4.8	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	<5.3	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	<5.0	<5.0	<5.0	<5.6UL	<4.8UL	<5.0UL	<5.0	<4.7UL	<4.5	<5.0	67[3]
Bis(2-ethylhexyl)phthalate	<5.0	<5.3	<4.8	3.3J	<4.7	<4.6	<4.5	<5.0	<5.0	<5.0	<4.8	2.4J	<4.8	<4.7	<4.7	<5.0	<5.0	<5.0	<4.9	<5.0	<4.7	<4.8	3.0J	2.4J	<5.0	3.5L	<4.8UL	**8.6L**	<5.0	<4.7UL	<4.5	<5.0	6[4]
Cyanide:																																	
Total	<10.0	<10.0	<10.0	<10.0	2.1J	3.4B	<10.0	<10.0	<10.0	1.6J	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1.8J	**11.3**	4.3B	<10.0	4.6J	2.4B	2.8B	1.6B	<10.0	<10.0	<10.0	<10.0	<10.0	1.9B	<10.0	<10.0	10
Available	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	NA	NA	NA	NA	NA	NA	<5.0	<5.0	-

Notes:

(1) - All results are reported in micrograms per liter.

(2) - Unless otherwise noted, the listed ground water standards were obtained from Table 13 in the Record of Decision for the Crater Resources Superfund Site, September 2007.

(3) - USEPA Regional Screening Levels for Tapwater, May, 2013

(4) - USEPA Maximum Contaminant Levels

J - Anaylte present. Reported value may not be accurate or precise.

B - Not Detected. Not detected substantially above the level reported in the laboratory or field blank.

U - Not Detected. The associated number indicates approximate sample concentrations necessary to be detected.

L - This result should be considered a biased low quantitative estimate.

K - Anaylte present. Reported value may be biased high. Actual value is expected to be lower

R - Unusable Result. Analyte may or may not be present in the sample.

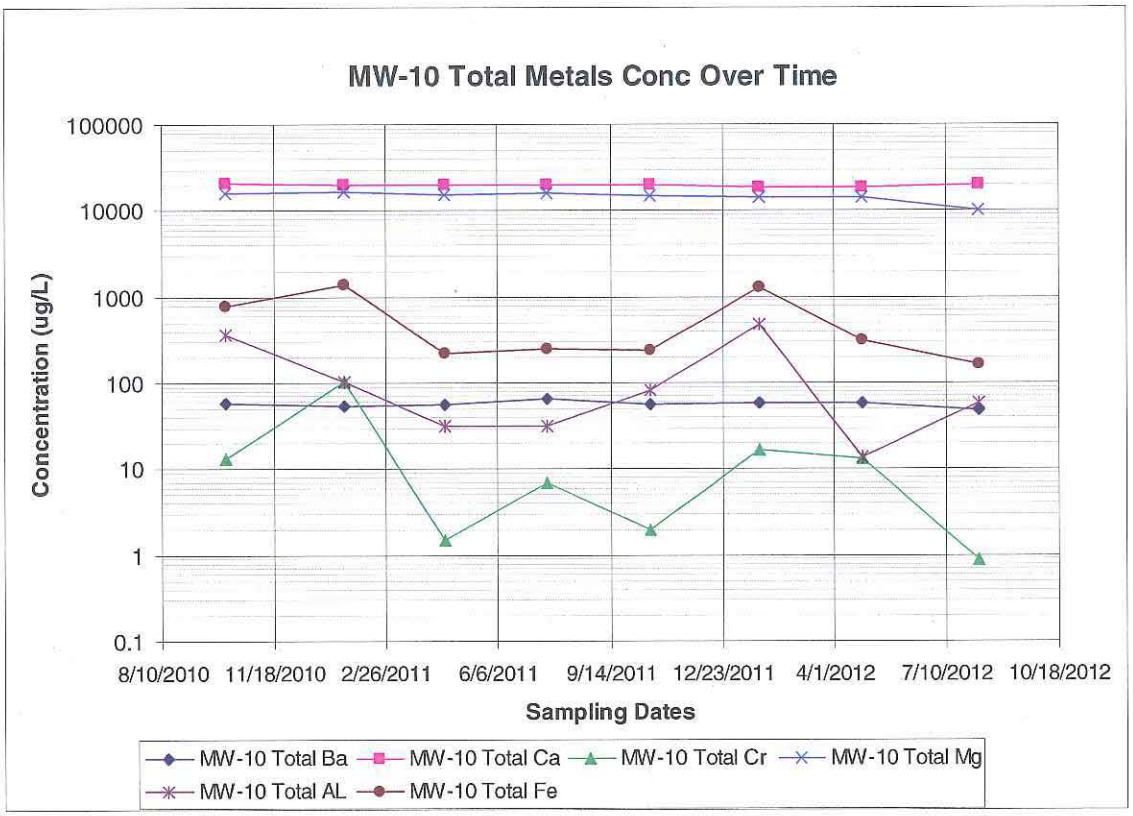
NA - Not Analyzed

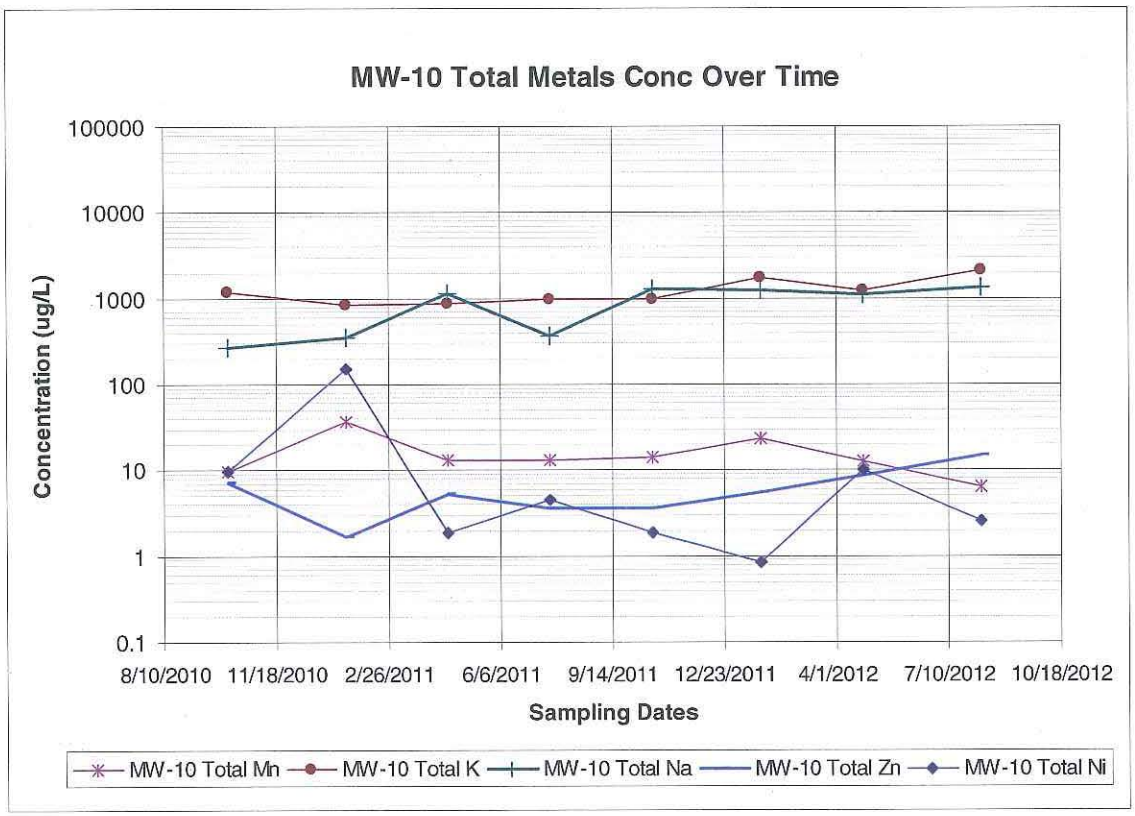
< 0.5 - Compound not detected above the listed laboratory method reporting limit.

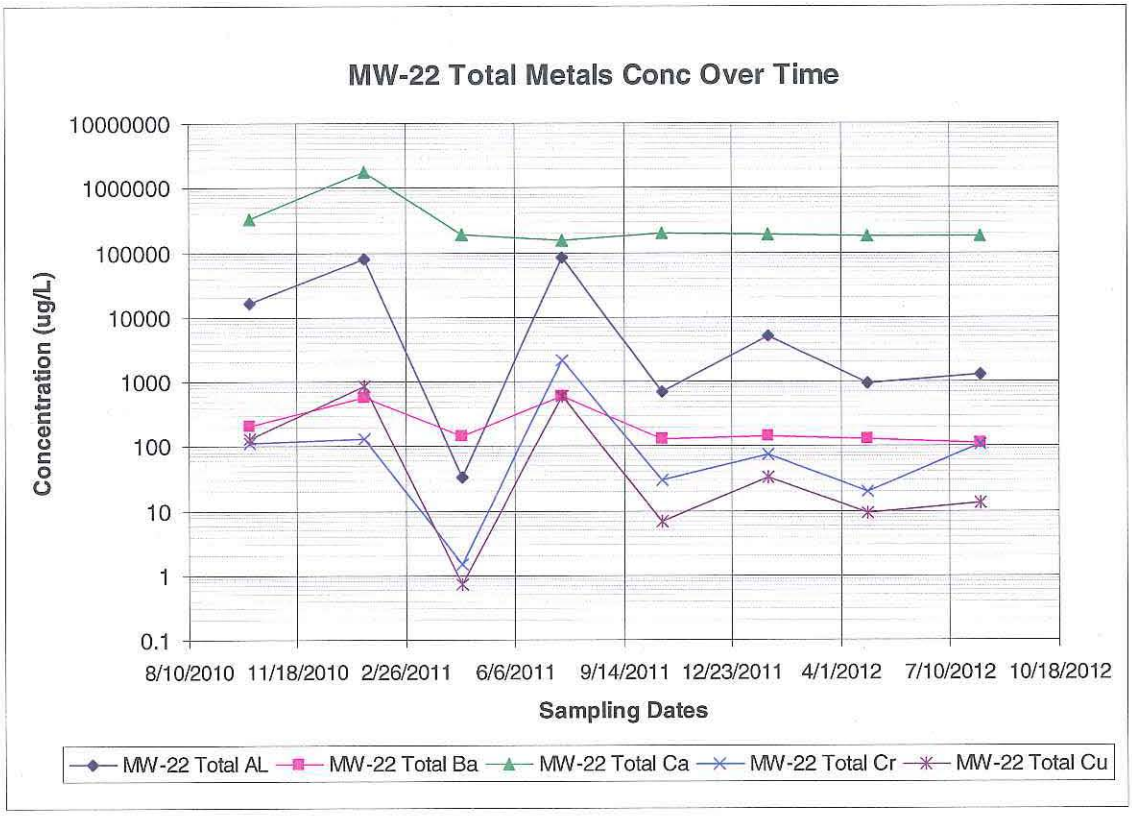
Bold - Compound was detected above its listed ground water standard.

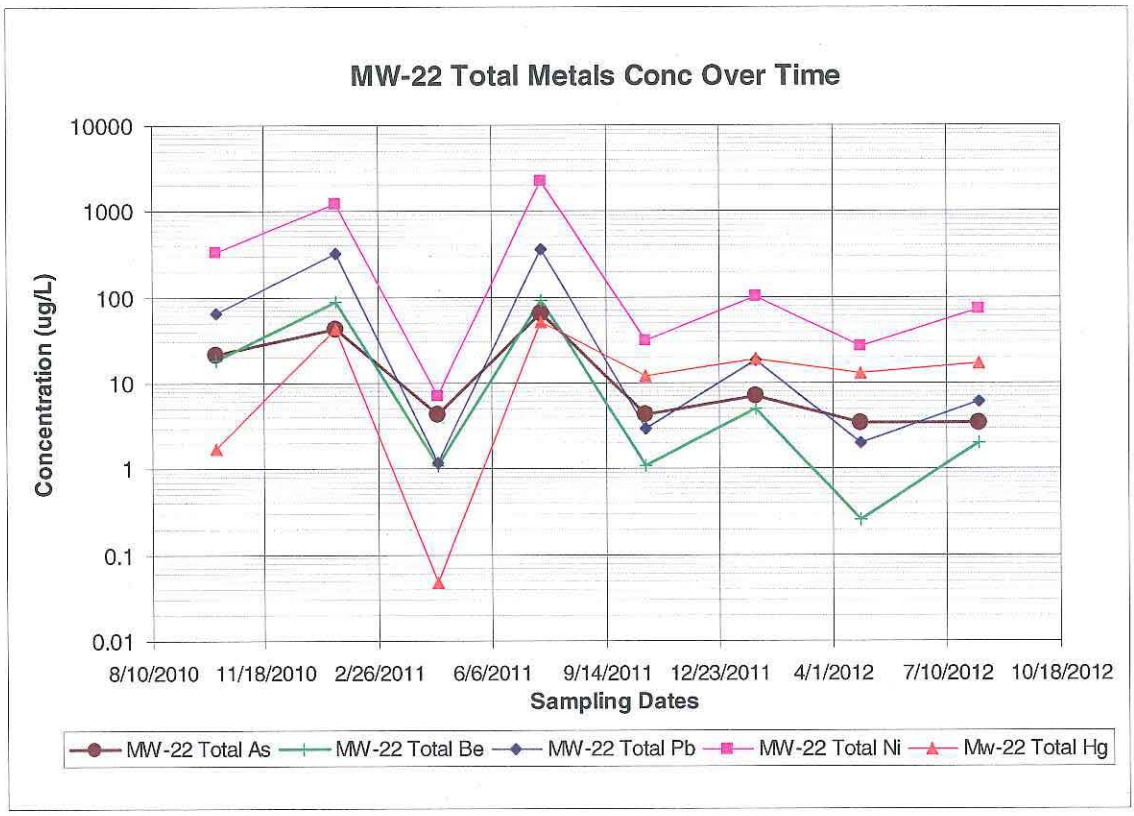
Appendix J1

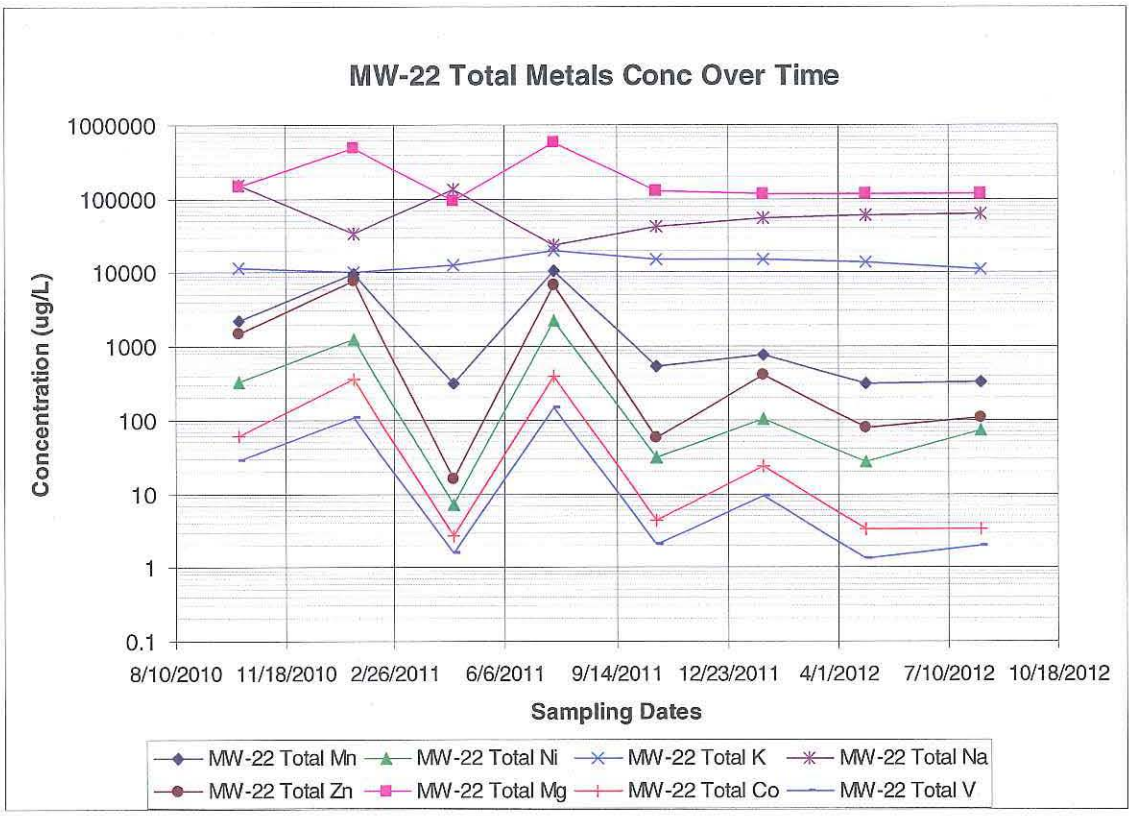
Concentration vs. Time Plots for Total Metals by Well

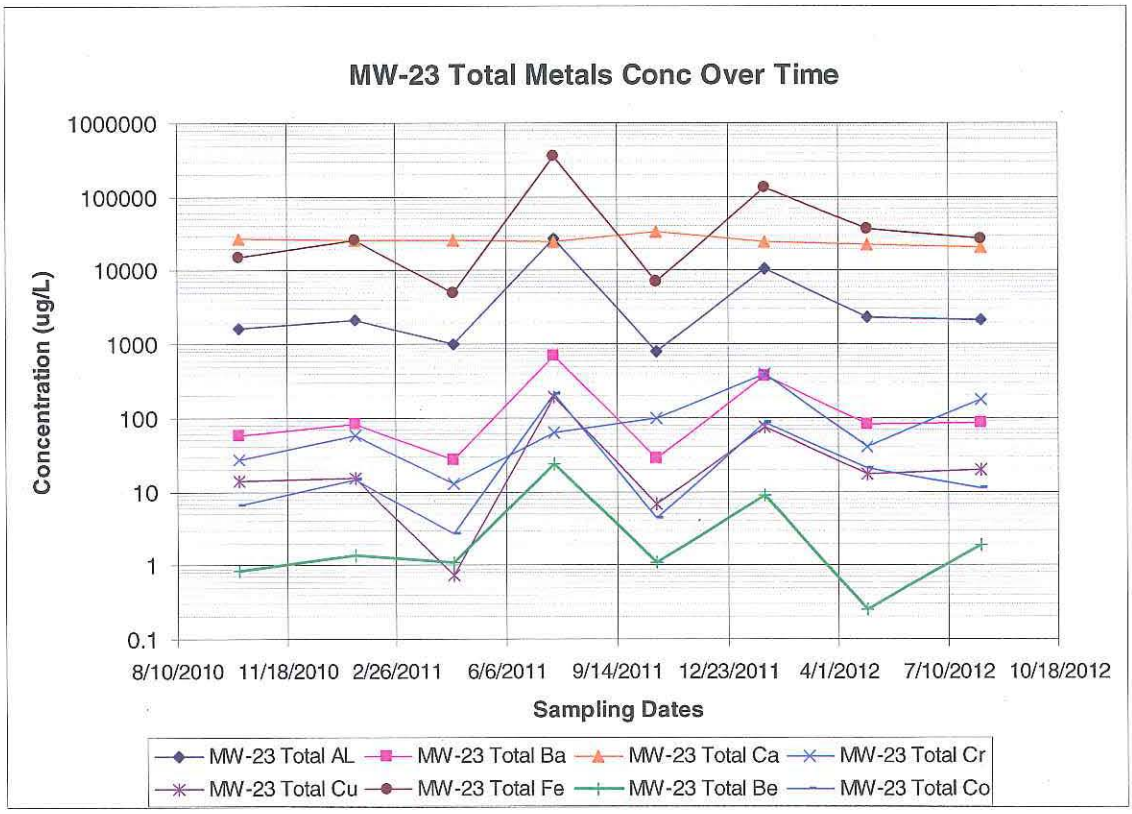

MW-10 Total Metals Conc Over Time
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-10 Total Ba
MW-10 Total Ca
MW-10 Total Cr
MW-10 Total Mg
MW-10 Total AL
MW-10 Total Fe

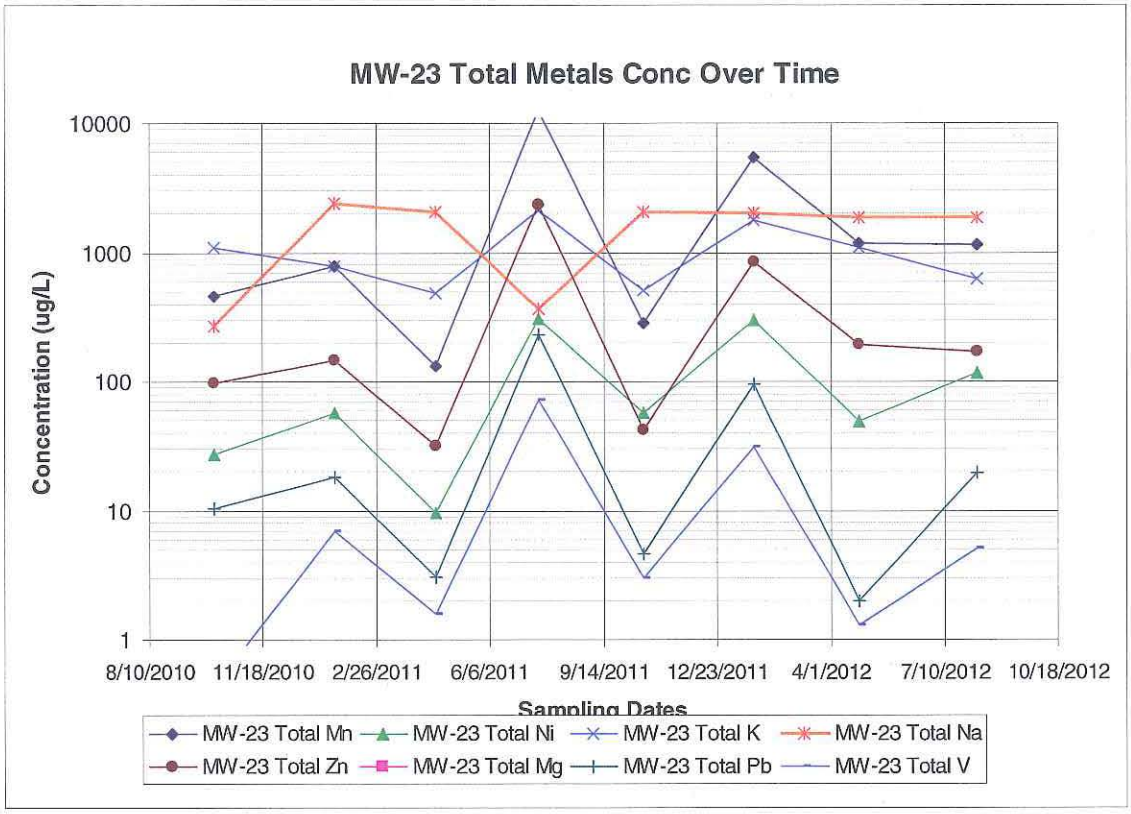

MW-10 Total Metals Conc Over Time
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-10 Total Mn
MW-10 Total K
MW-10 Total Na
MW-10 Total Zn
MW-10 Total Ni

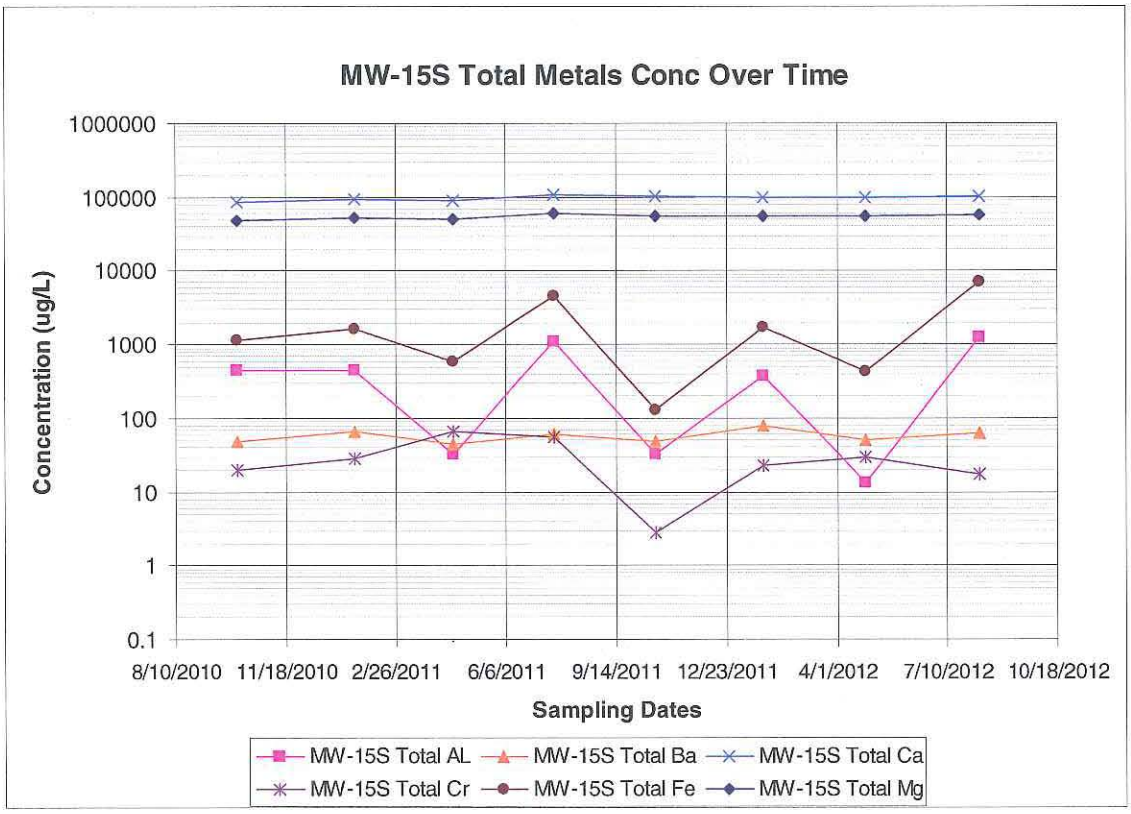

MW-22 Total Metals Conc Over Time
10000000
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-22 Total AL
MW-22 Total Ba
MW-22 Total Ca
MW-22 Total Cr
MW-22 Total Cu

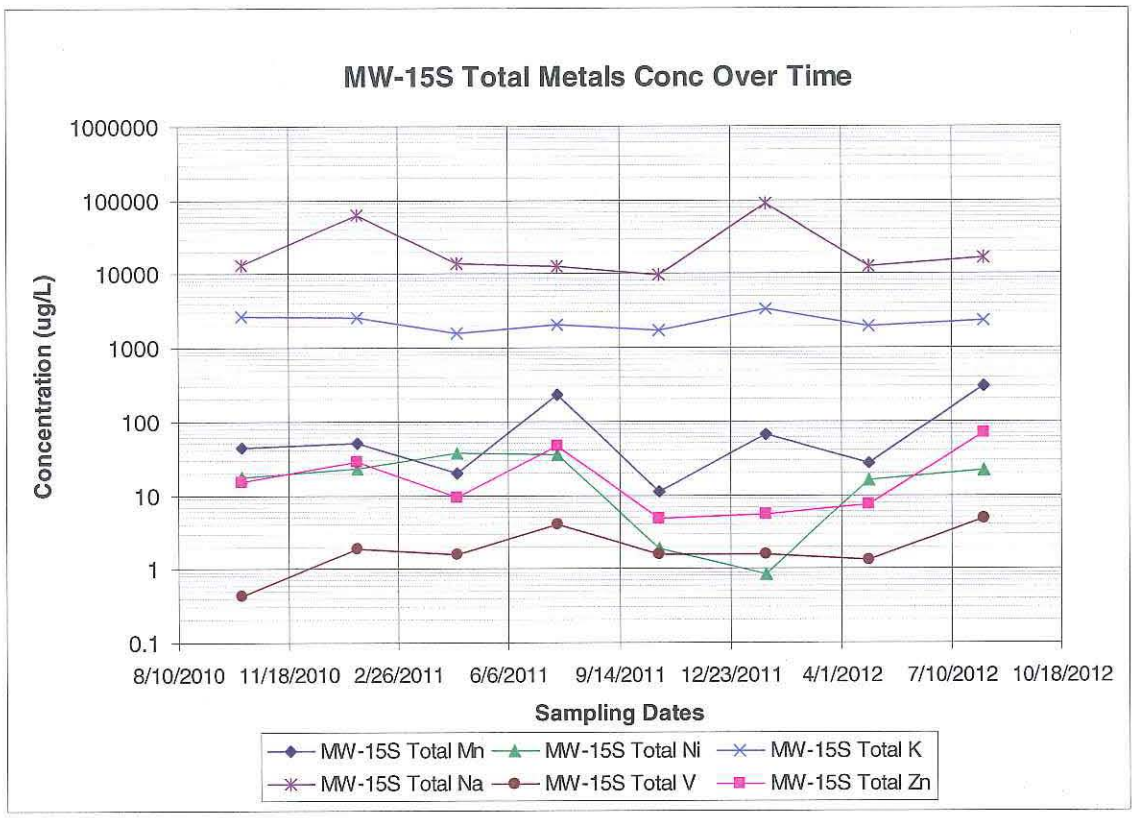

MW-22 Total Metals Conc Over Time
10000
1000
100
10
1
0.1
0.01
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-22 Total As
MW-22 Total Be
MW-22 Total Pb
MW-22 Total Ni
Mw-22 Total Hg

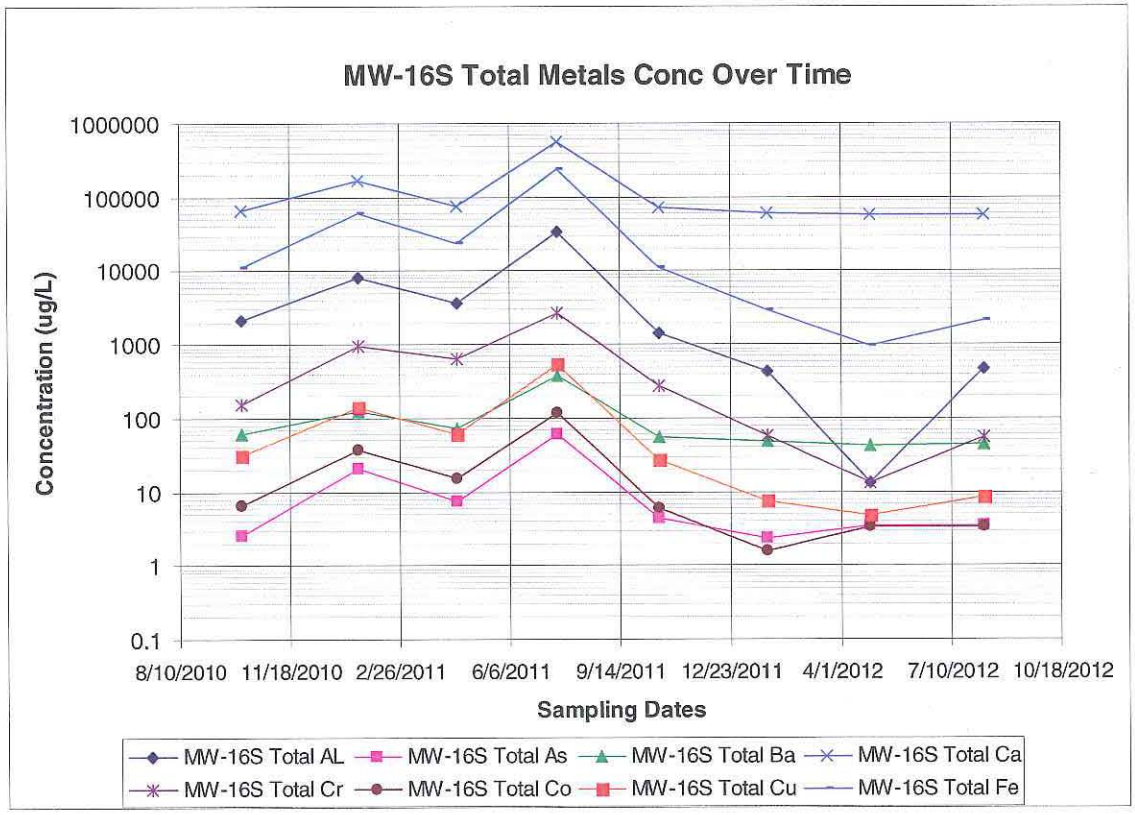

MW-22 Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-22 Total Mn
MW-22 Total Ni
MW-22 Total K
MW-22 Total Na
MW-22 Total Zn
MW-22 Total Mg
MW-22 Total Co
MW-22 Total V

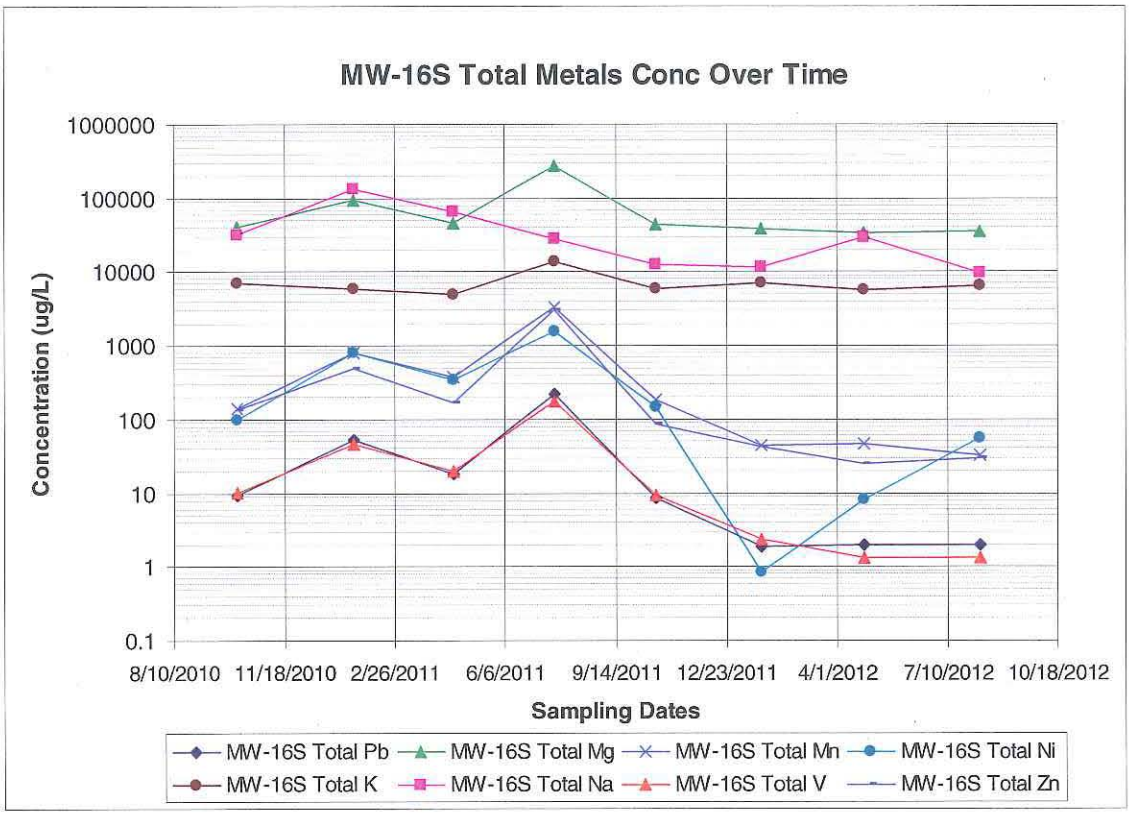

MW-23 Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-23 Total AL
MW-23 Total Ba
MW-23 Total Ca
MW-23 Total Cr
MW-23 Total Cu
MW-23 Total Fe
MW-23 Total Be
MW-23 Total Co

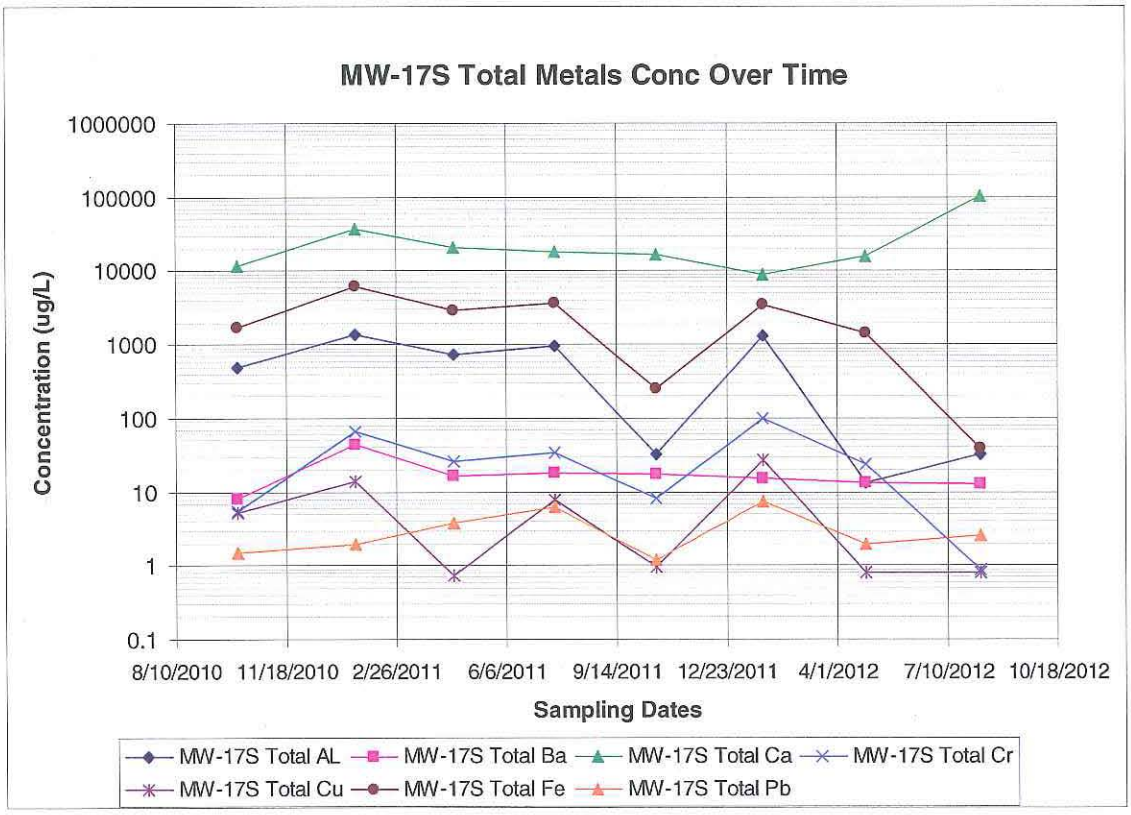

MW-23 Total Metals Conc Over Time
Concentration (ug/L)
10000
1000
100
10
1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-23 Total Mn
MW-23 Total Ni
MW-23 Total K
MW-23 Total Na
MW-23 Total Zn
MW-23 Total Mg
MW-23 Total Pb
MW-23 Total V

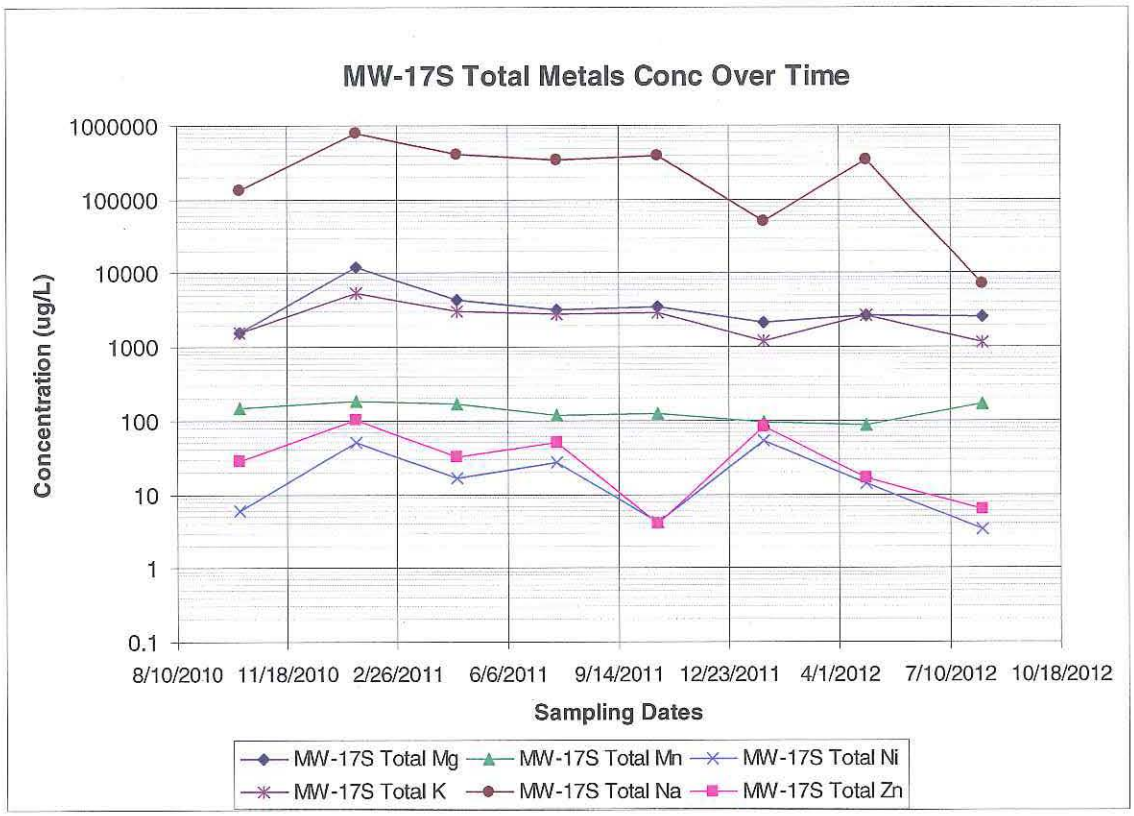

MW-15S Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-15S Total AL
MW-15S Total Ba
MW-15S Total Ca
MW-15S Total Cr
MW-15S Total Fe
MW-15S Total Mg

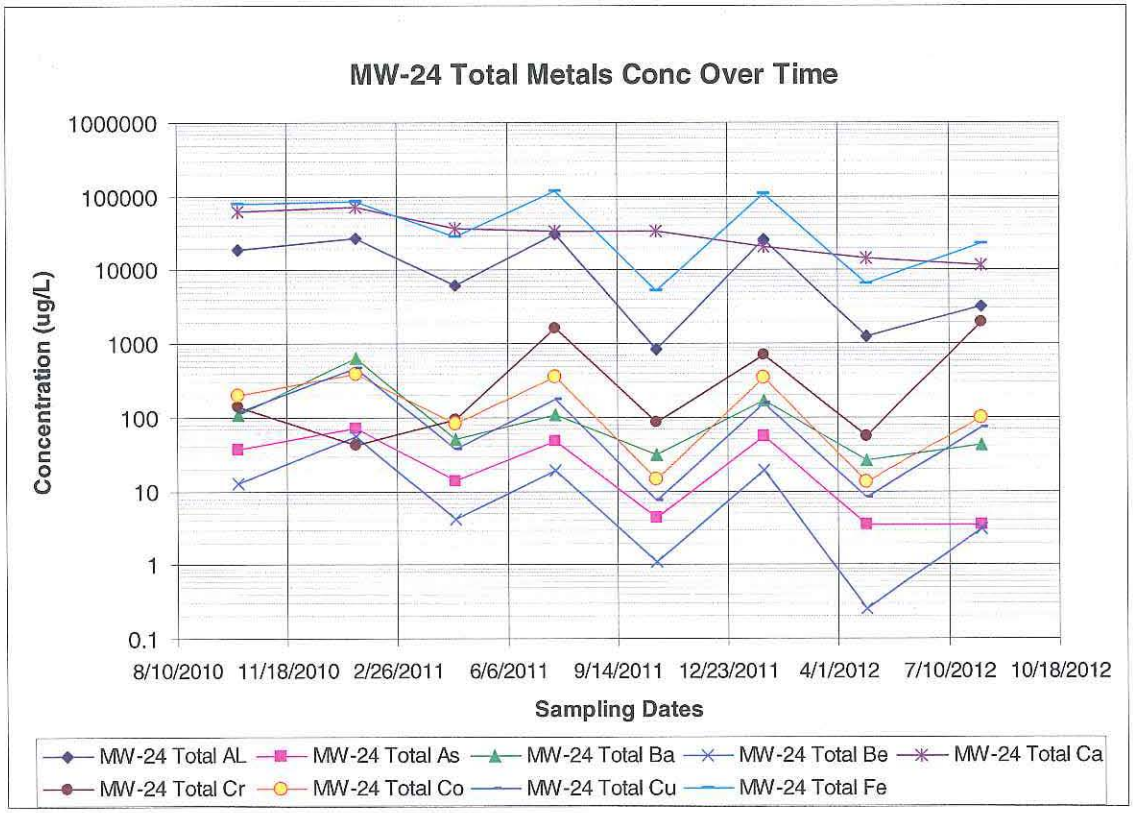

MW-15S Total Metals Conc Over Time
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-15S Total Mn
MW-15S Total Ni
MW-15S Total K
MW-15S Total Na
MW-15S Total V
MW-15S Total Zn

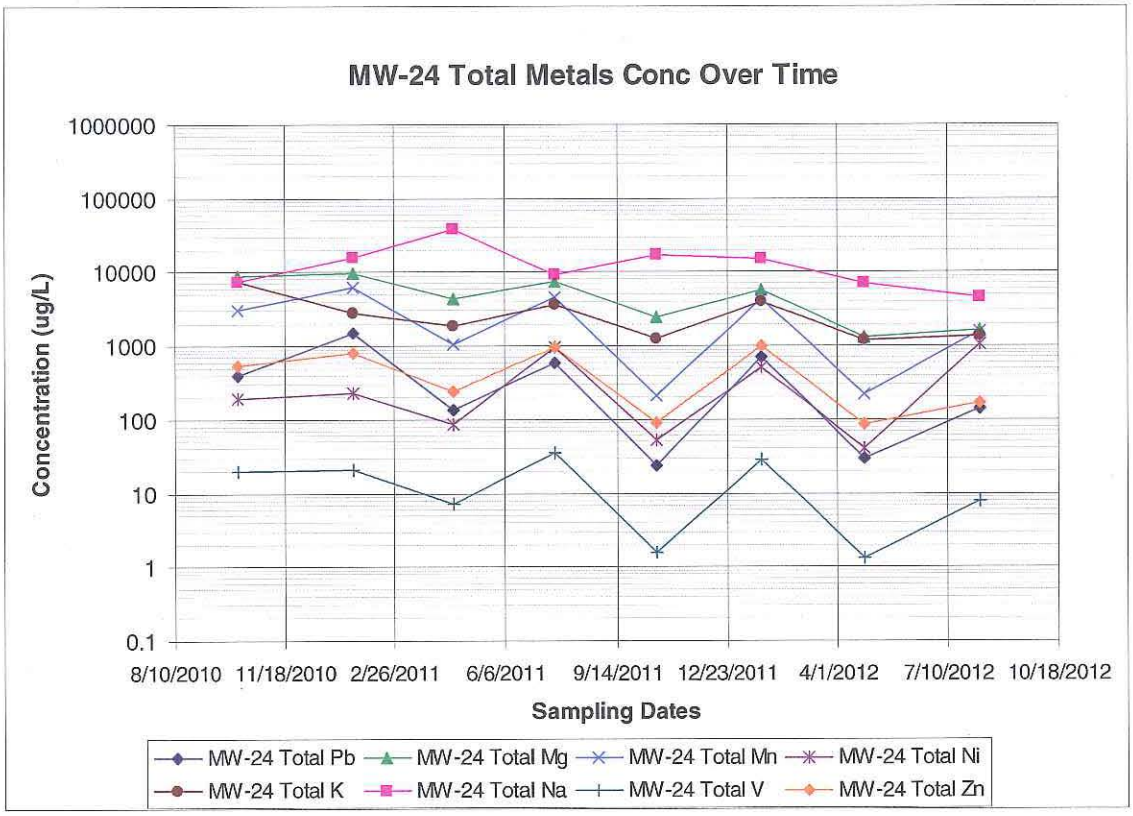

MW-16S Total Metals Conc Over Time
1000000
100000
10000
1000
100
10
1
0.1
Concentration (ug/L)
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-16S Total AL
MW-16S Total As
MW-16S Total Ba
MW-16S Total Ca
MW-16S Total Cr
MW-16S Total Co
MW-16S Total Cu
MW-16S Total Fe


MW-16S Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-16S Total Pb
MW-16S Total Mg
MW-16S Total Mn
MW-16S Total Ni
MW-16S Total K
MW-16S Total Na
MW-16S Total V
MW-16S Total Zn


MW-17S Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-17S Total AL
MW-17S Total Ba
MW-17S Total Ca
MW-17S Total Cr
MW-17S Total Cu
MW-17S Total Fe
MW-17S Total Pb

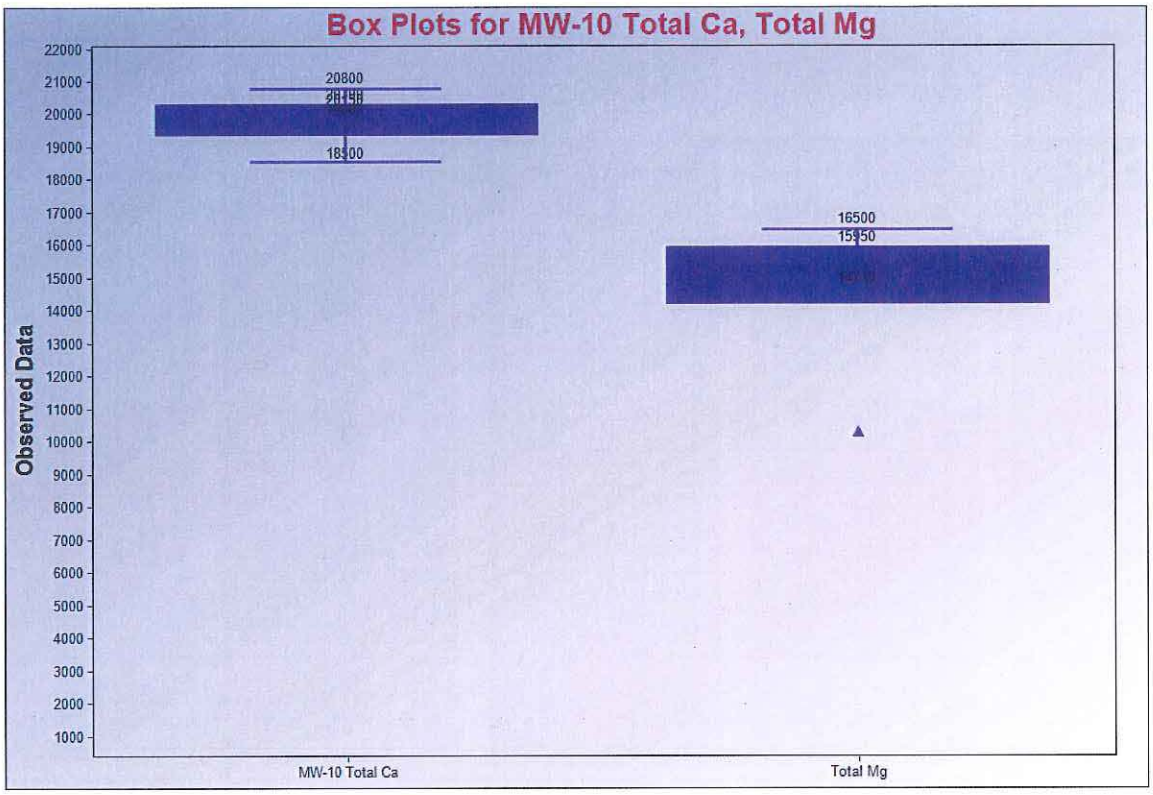

MW-17S Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-17S Total Mg
MW-17S Total Mn
MW-17S Total Ni
MW-17S Total K
MW-17S Total Na
MW-17S Total Zn

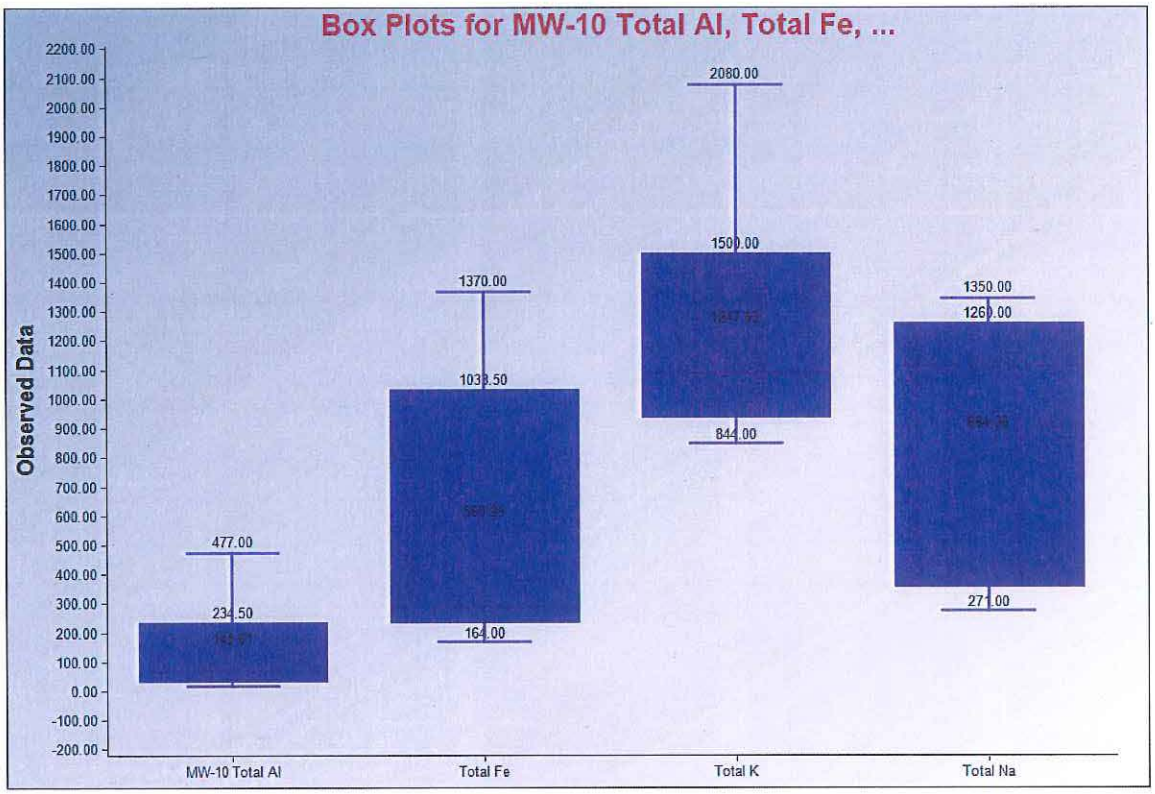

MW-24 Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-24 Total AL
MW-24 Total As
MW-24 Total Ba
MW-24 Total Be
MW-24 Total Ca
MW-24 Total Cr
MW-24 Total Co
MW-24 Total Cu
MW-24 Total Fe

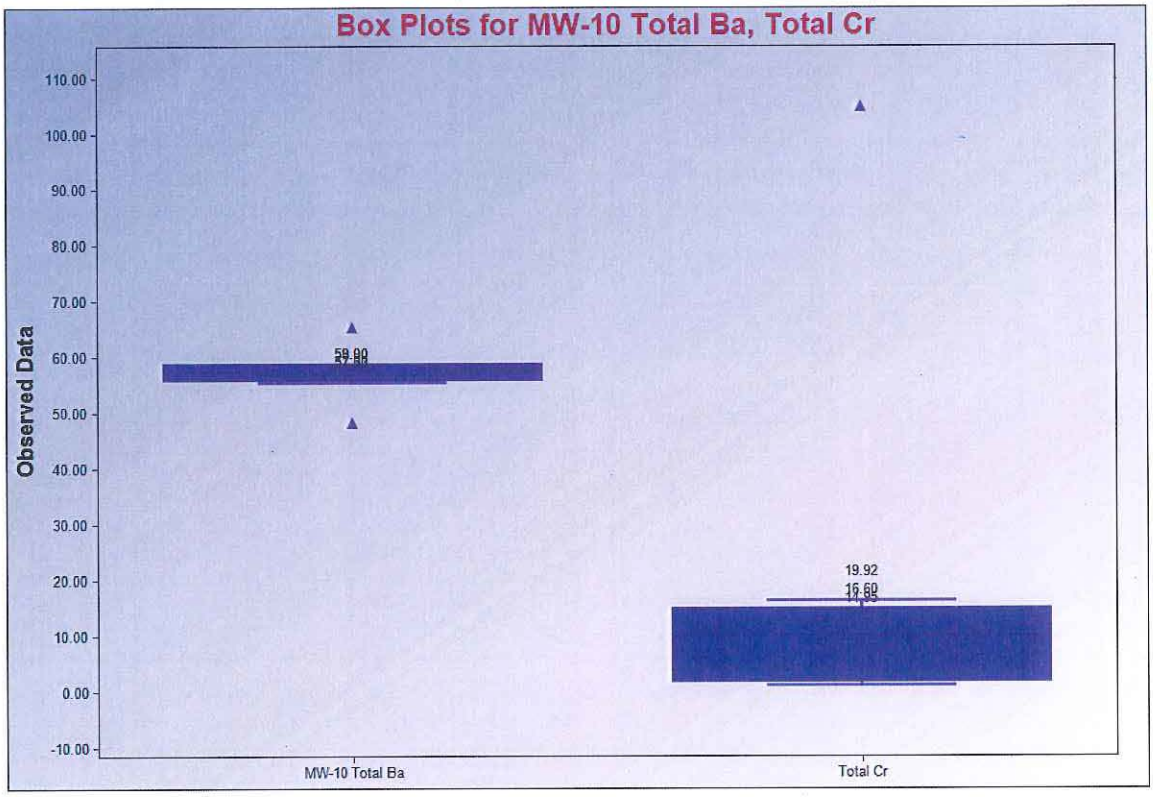

MW-24 Total Metals Conc Over Time
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
Sampling Dates
MW-24 Total Pb
MW-24 Total Mg
MW-24 Total Mn
MW-24 Total Ni
MW-24 Total K
MW-24 Total Na
MW-24 Total V
MW-24 Total Zn

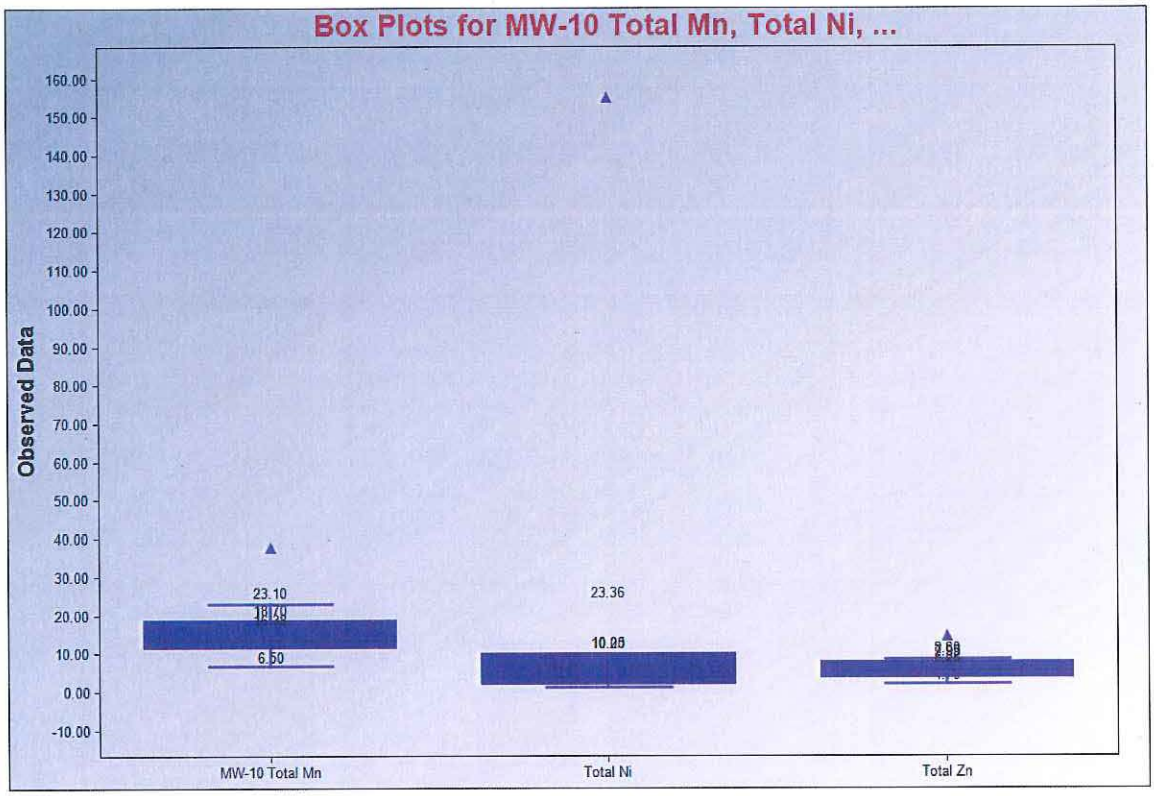
Appendix J2

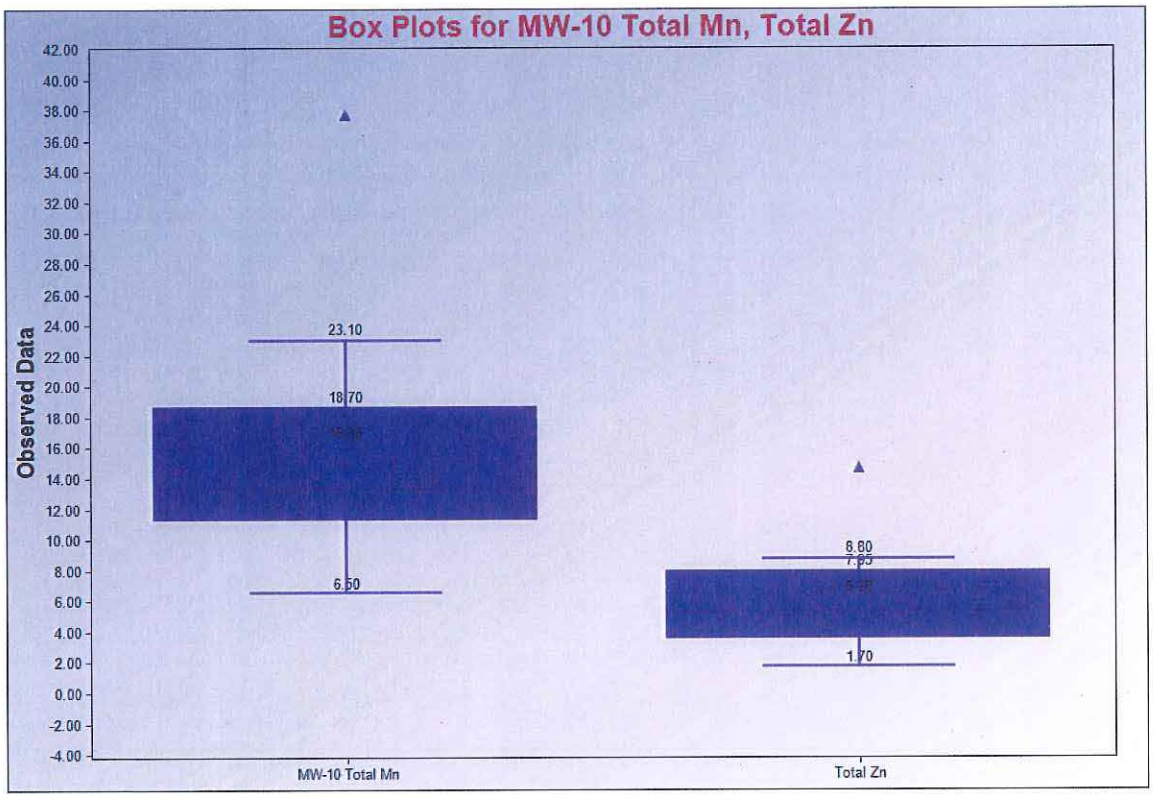
Box Plots for Total Metals

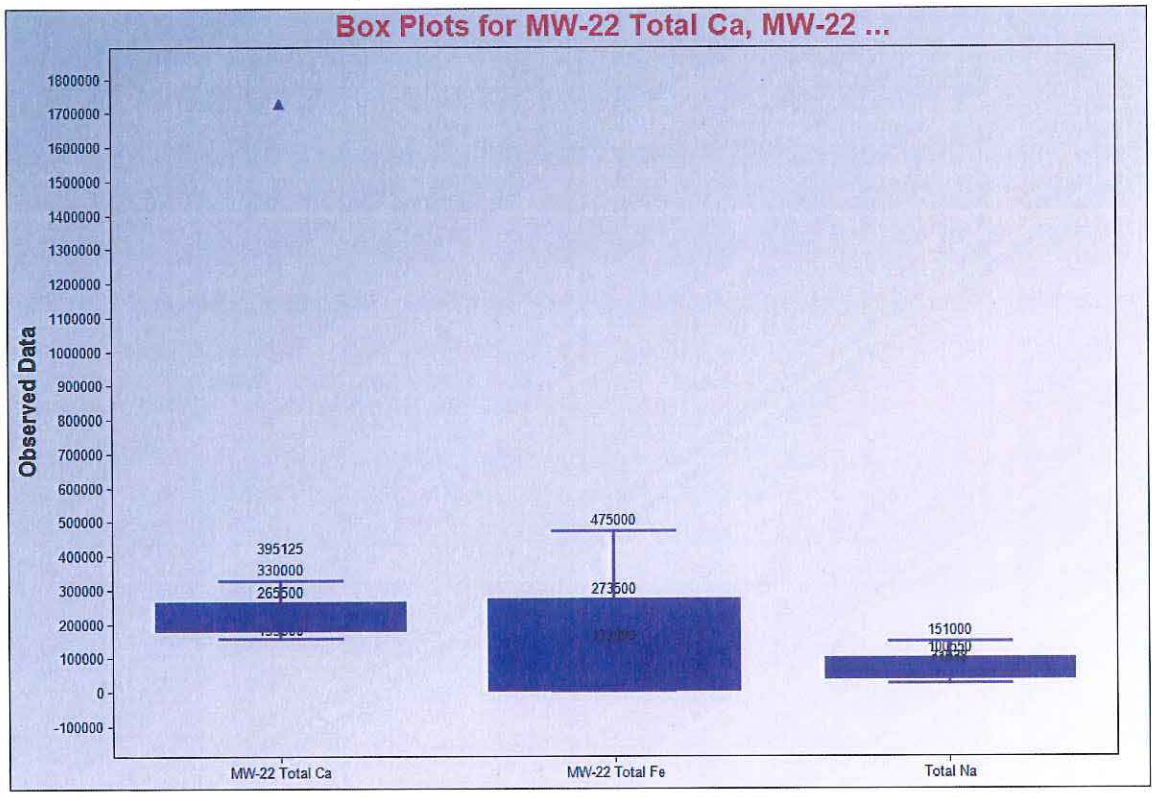

Box Plots for MW-10 Total Ca, Total Mg
Observed Data
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
20800
18500
16500
15950
MW-10 Total Ca
Total Mg

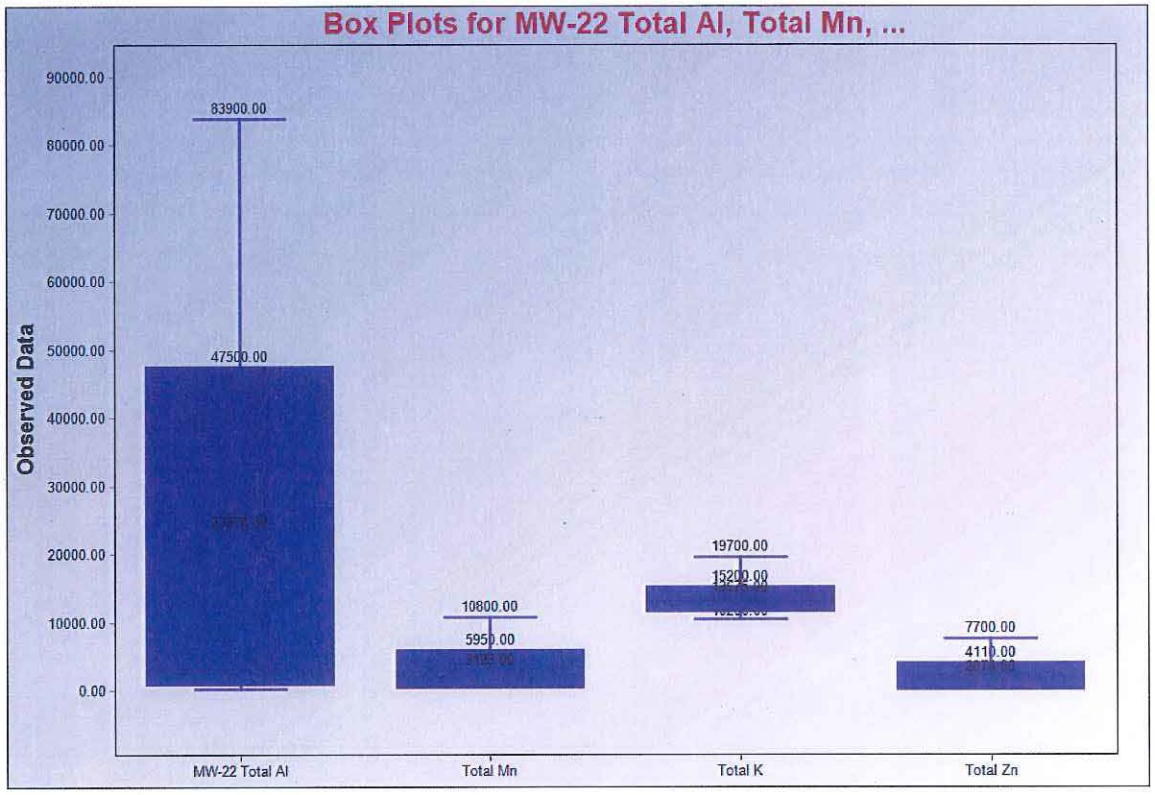

Box Plots for MW-10 Total Al, Total Fe, ...
Observed Data
2200.00
2100.00
2000.00
1900.00
1800.00
1700.00
1600.00
1500.00
1400.00
1300.00
1200.00
1100.00
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
477.00
1370.00
2080.00
1500.00
1350.00
1260.00
844.00
271.00
164.00
MW-10 Total Al
Total Fe
Total K
Total Na

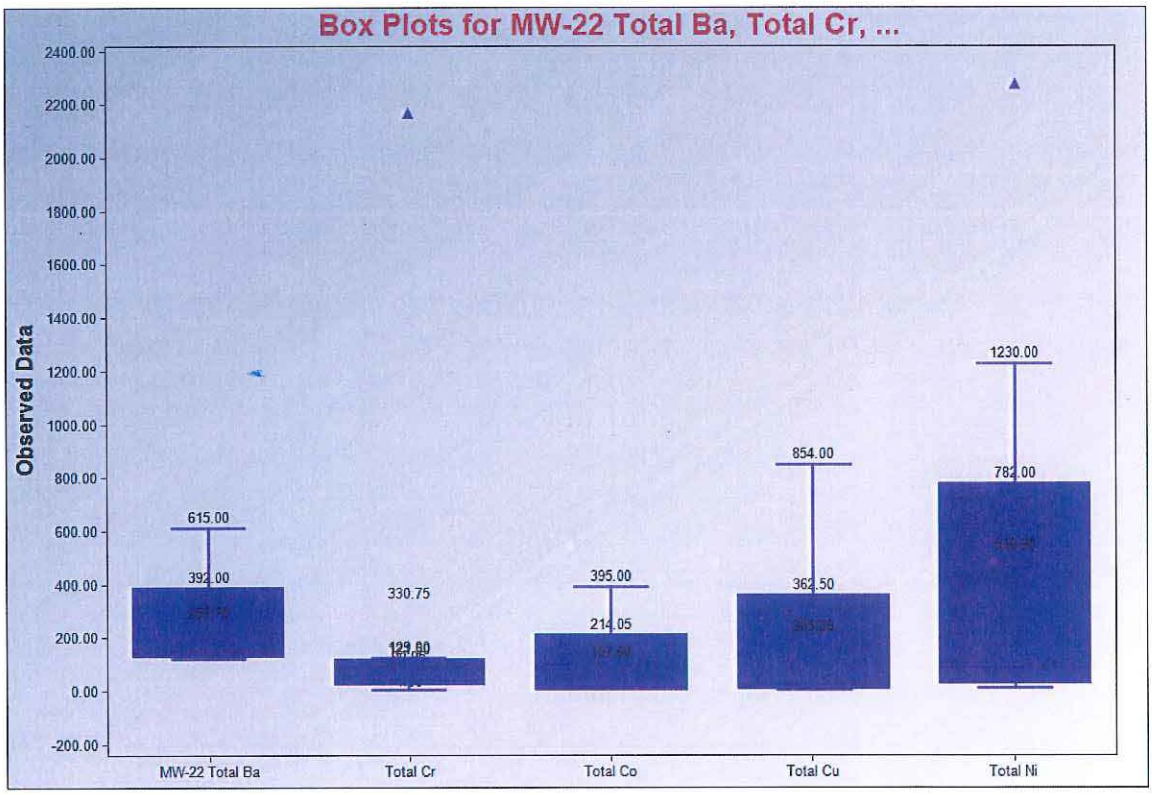

Box Plots for MW-10 Total Ba, Total Cr
Observed Data
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
59.90
19.92
16.60
MW-10 Total Ba
Total Cr

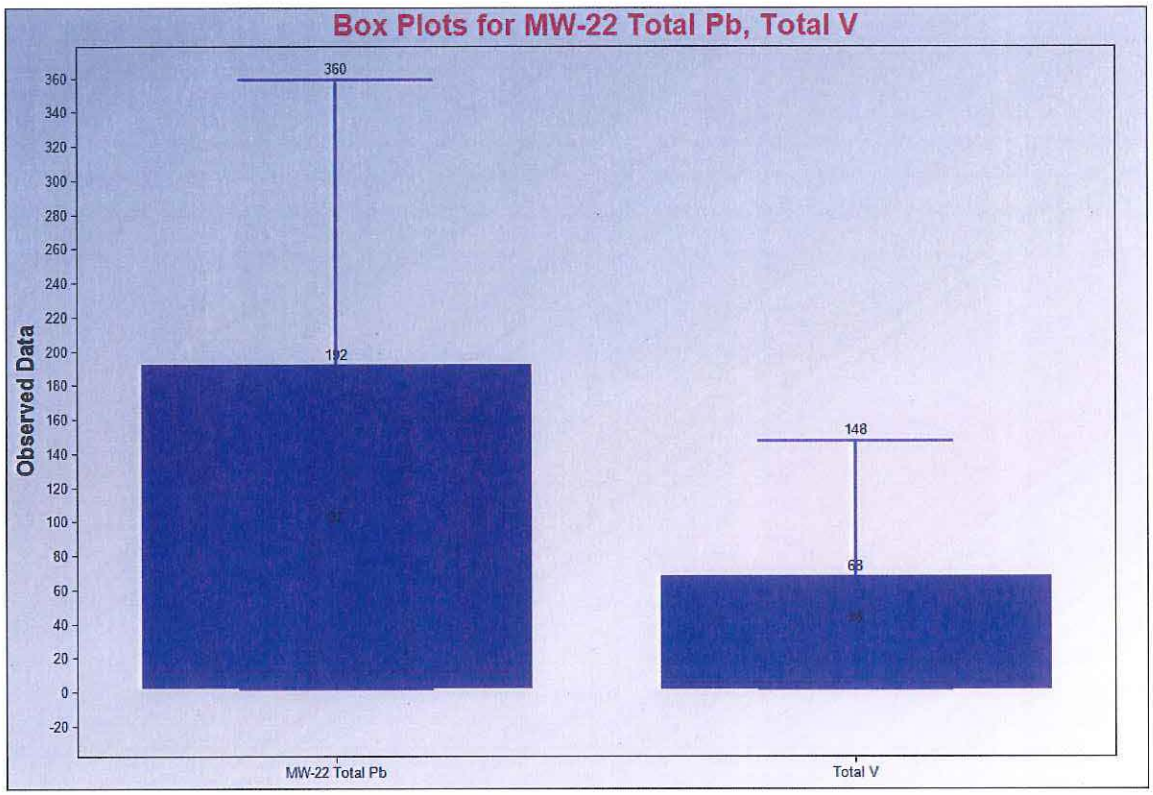

Box Plots for MW-10 Total Mn, Total Ni, ...
Observed Data
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
23.10
6.50
23.36
MW-10 Total Mn
Total Ni
Total Zn

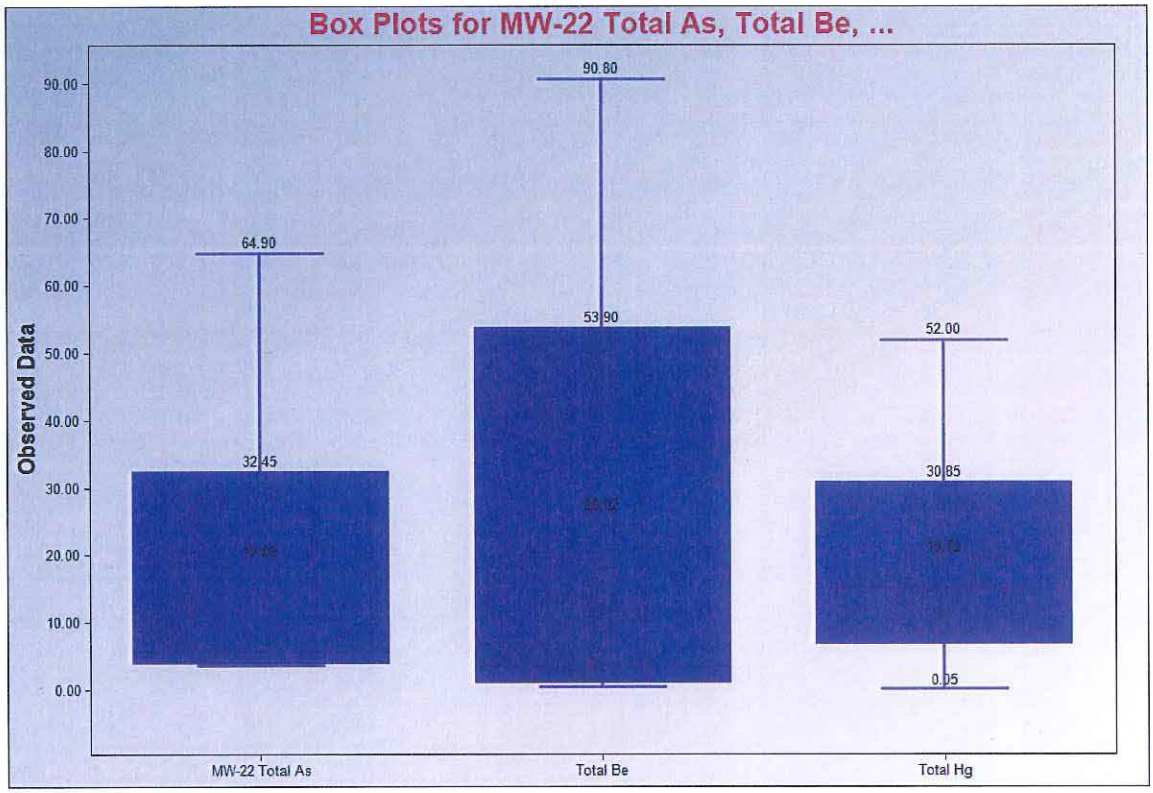

Box Plots for MW-10 Total Mn, Total Zn
Observed Data
42.00
40.00
38.00
36.00
34.00
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
23.10
18.70
6.50
8.80
7.95
1.70
MW-10 Total Mn
Total Zn

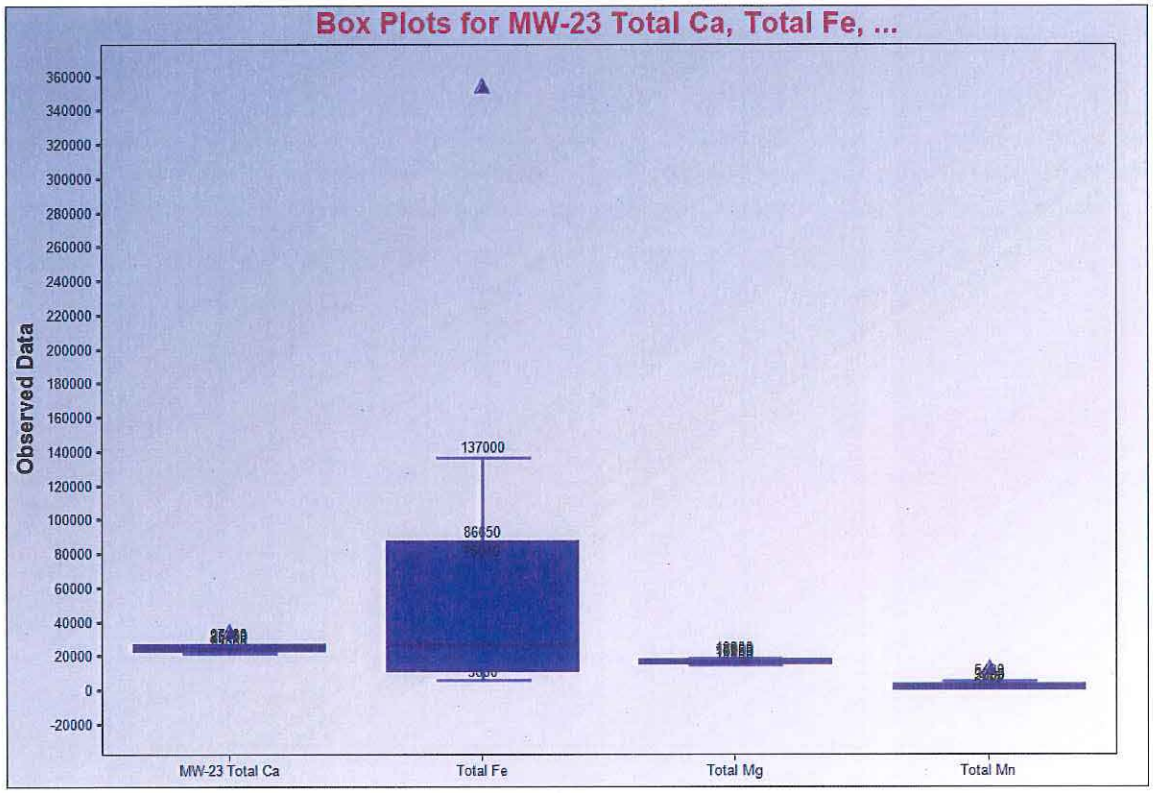

Box Plots for MW-22 Total Ca, MW-22 ...
Observed Data
1800000
1700000
1600000
1500000
1400000
1300000
1200000
1100000
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
-100000
395125
330000
265500
475000
273500
151000
MW-22 Total Ca
MW-22 Total Fe
Total Na

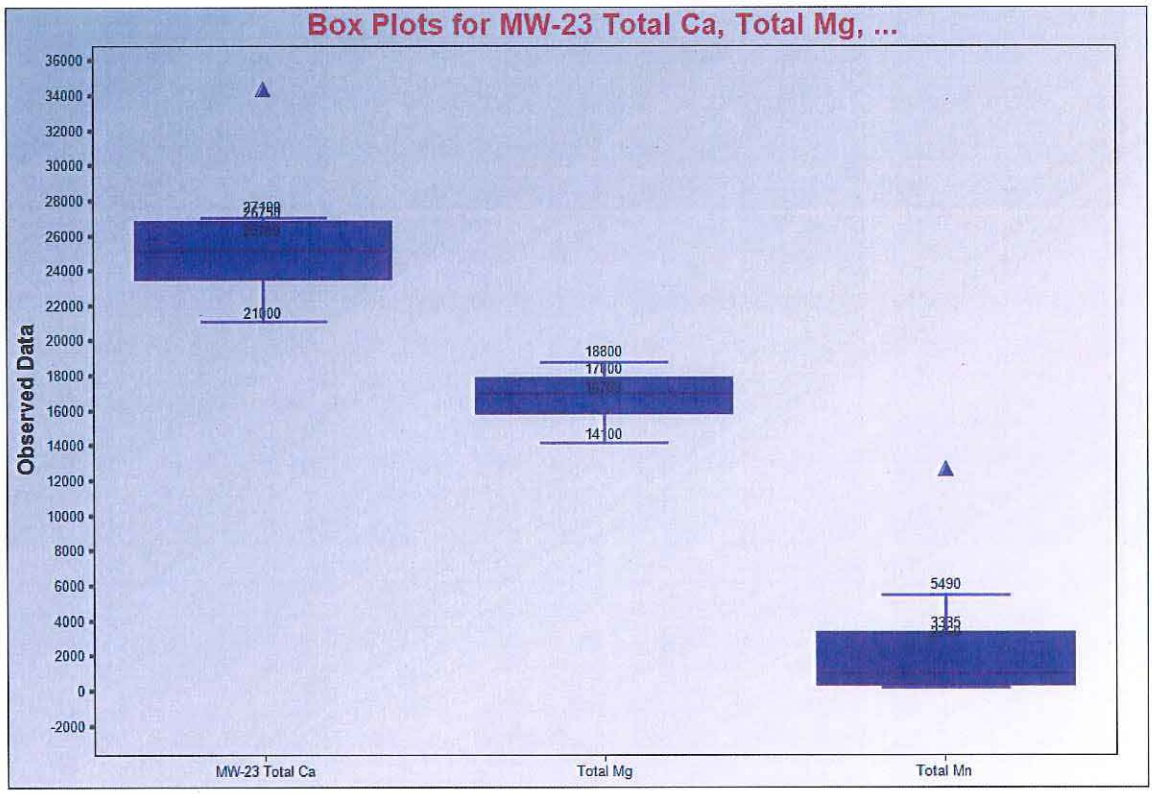

Box Plots for MW-22 Total Al, Total Mn, ...
Observed Data
90000.00
80000.00
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
83900.00
47500.00
10800.00
5950.00
19700.00
15200.00
7700.00
4110.00
MW-22 Total Al
Total Mn
Total K
Total Zn

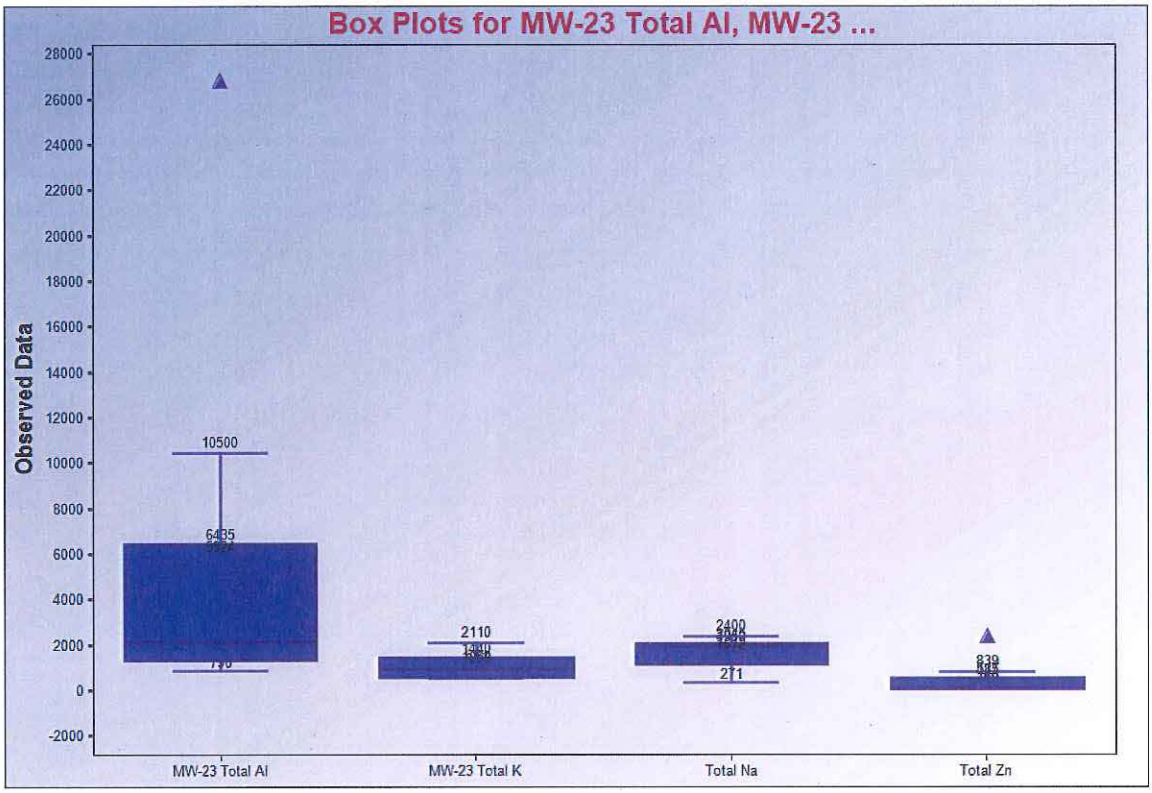

Box Plots for MW-22 Total Ba, Total Cr, ...
Observed Data
2400.00
2200.00
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
-200.00
615.00
392.00
330.75
395.00
214.05
854.00
362.50
1230.00
782.00
MW-22 Total Ba
Total Cr
Total Co
Total Cu
Total Ni

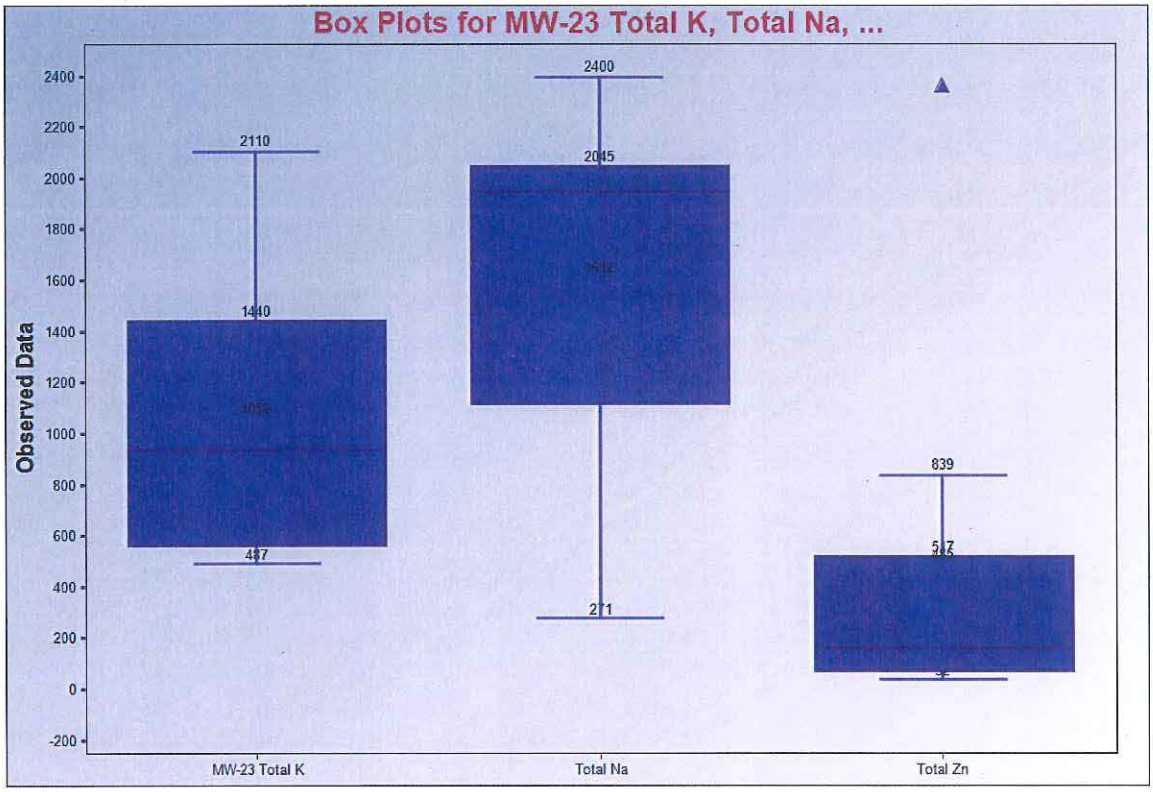

Box Plots for MW-22 Total Pb, Total V
Observed Data
360
192
148
63
MW-22 Total Pb
Total V

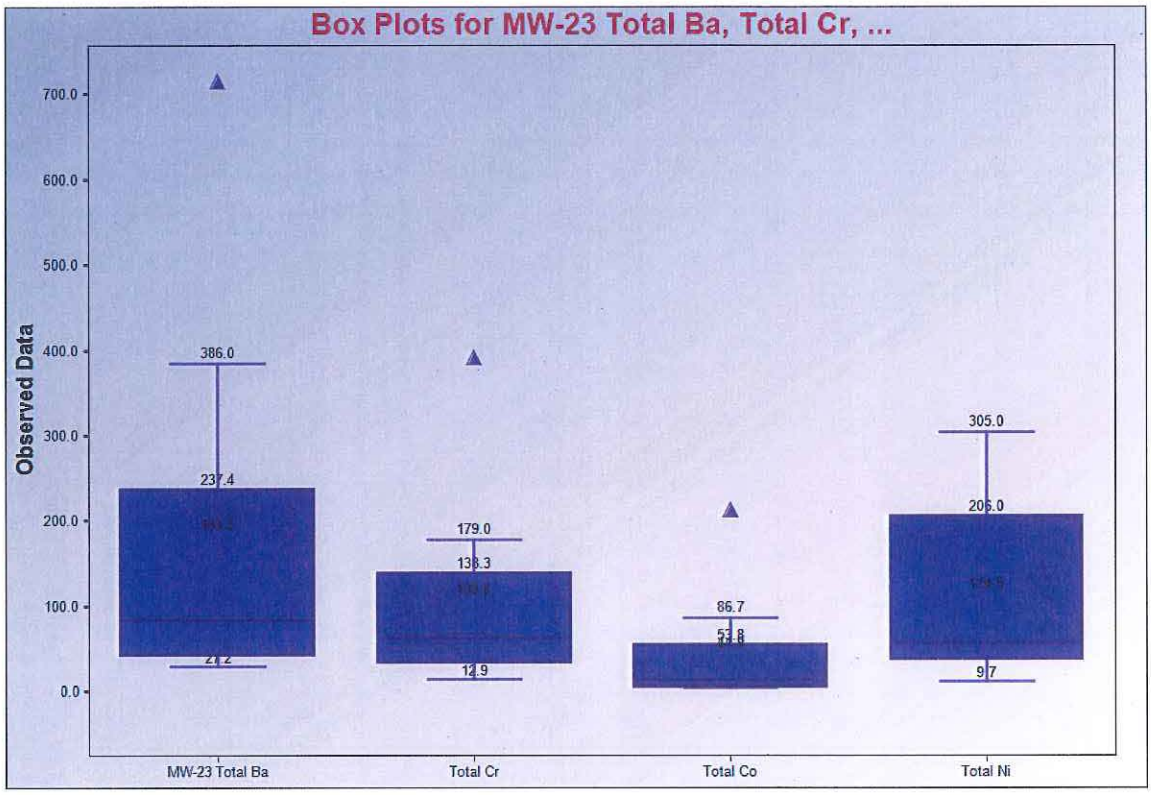

Box Plots for MW-22 Total As, Total Be, ...
Observed Data
90.80
64.90
53.90
52.00
32.45
30.85
0.05
MW-22 Total As
Total Be
Total Hg

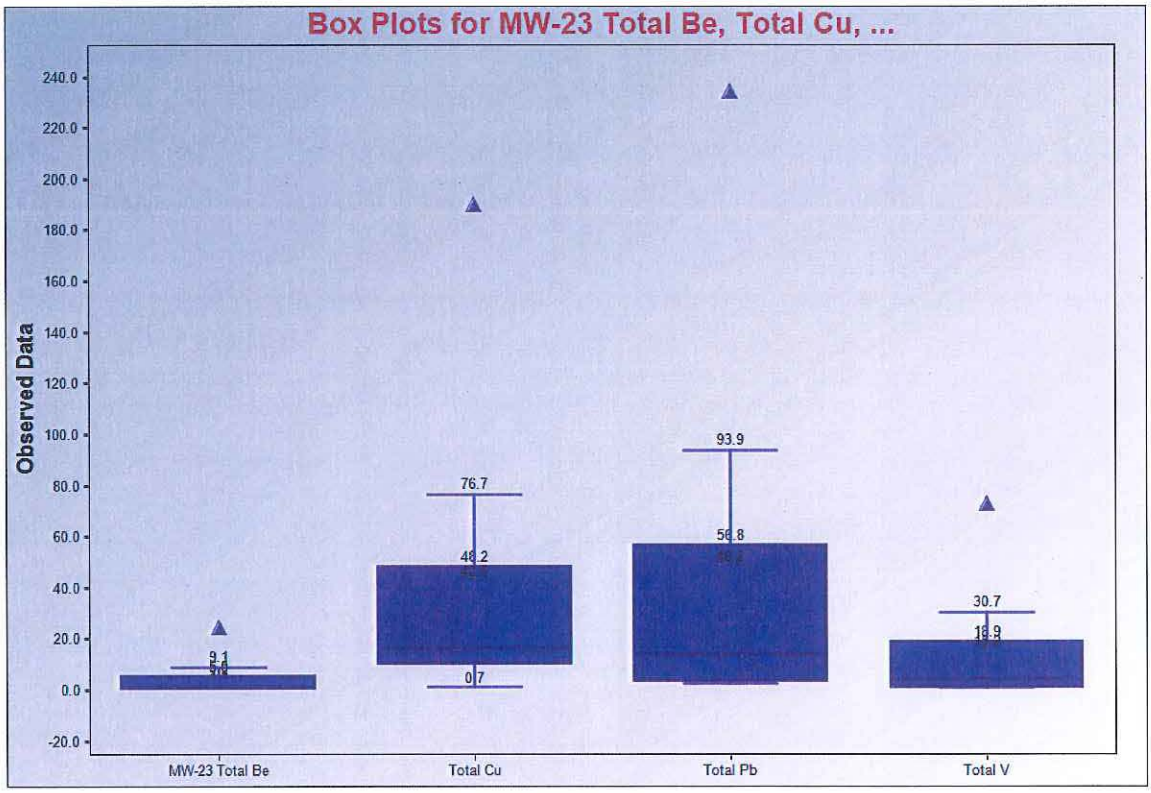

Box Plots for MW-23 Total Ca, Total Fe, ...
Observed Data
360000
340000
320000
300000
280000
260000
240000
220000
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
-20000
137000
MW-23 Total Ca
Total Fe
Total Mg
Total Mn

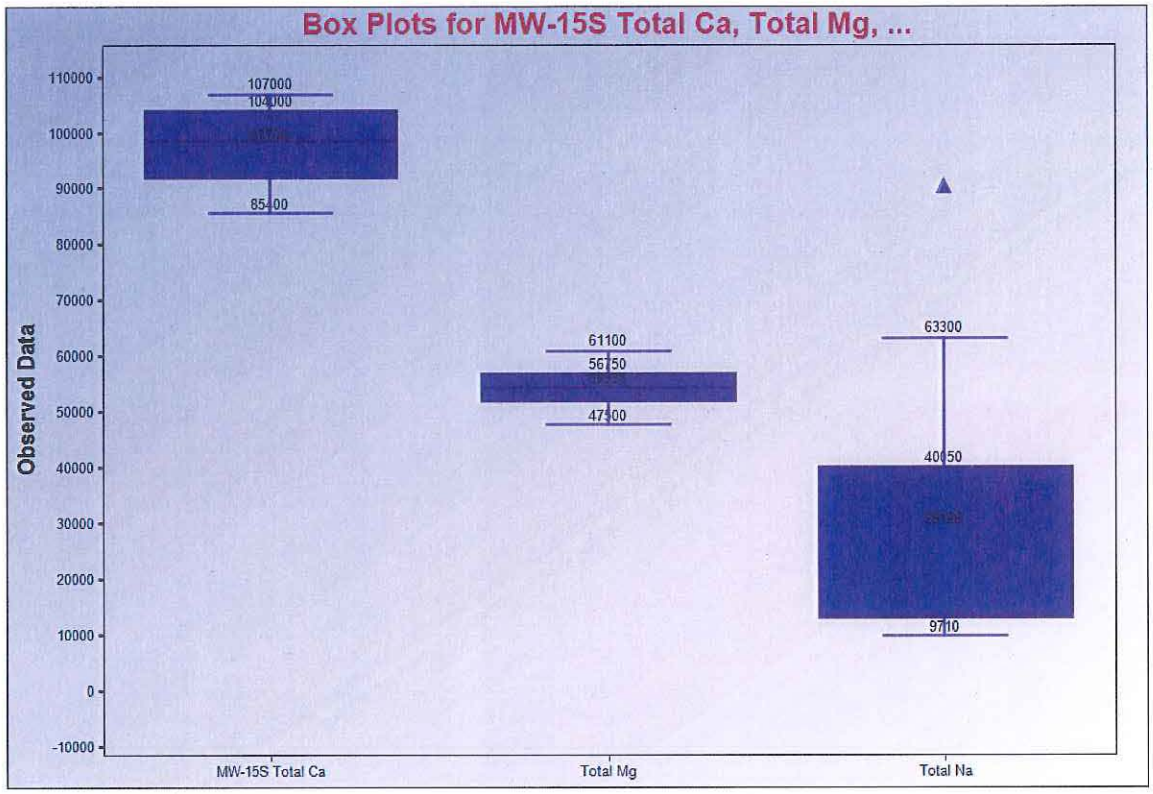

Box Plots for MW-23 Total Ca, Total Mg, ...
Observed Data
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
21000
18800
14100
5490
MW-23 Total Ca
Total Mg
Total Mn

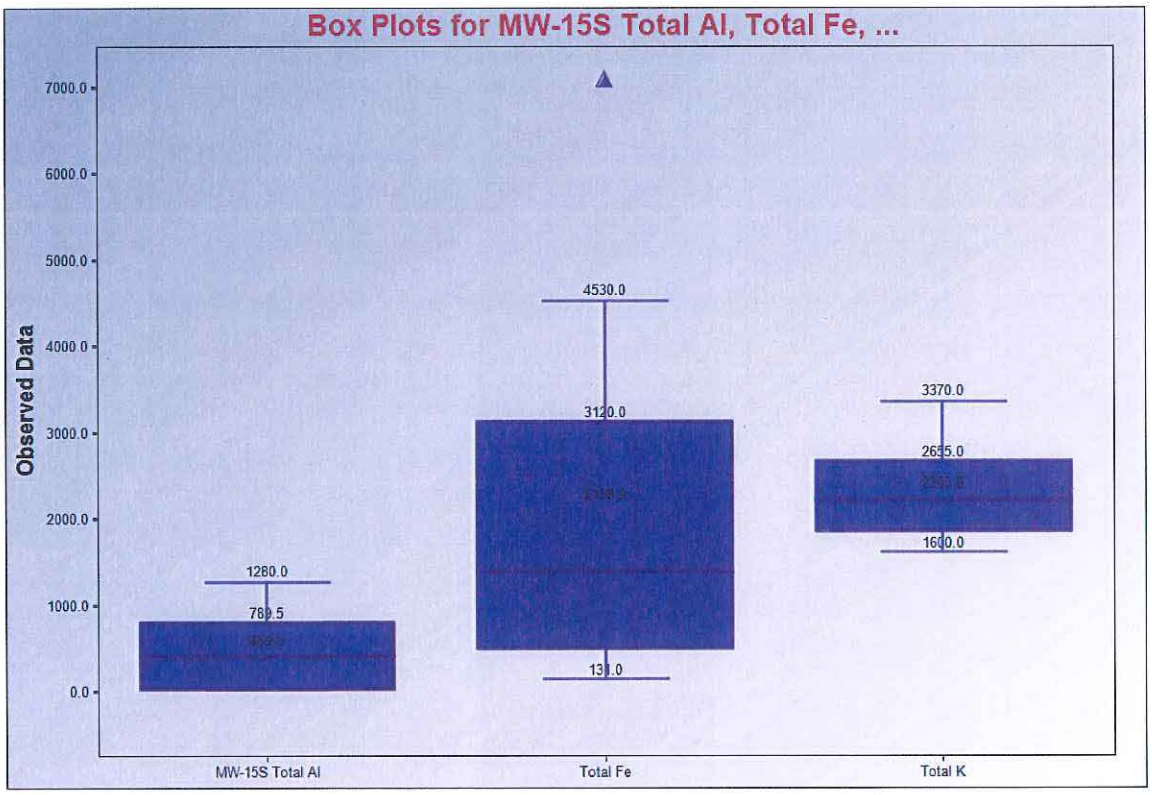

Box Plots for MW-23 Total Al, MW-23 ...
Observed Data
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10500
6435
2110
2400
271
839
MW-23 Total Al
MW-23 Total K
Total Na
Total Zn

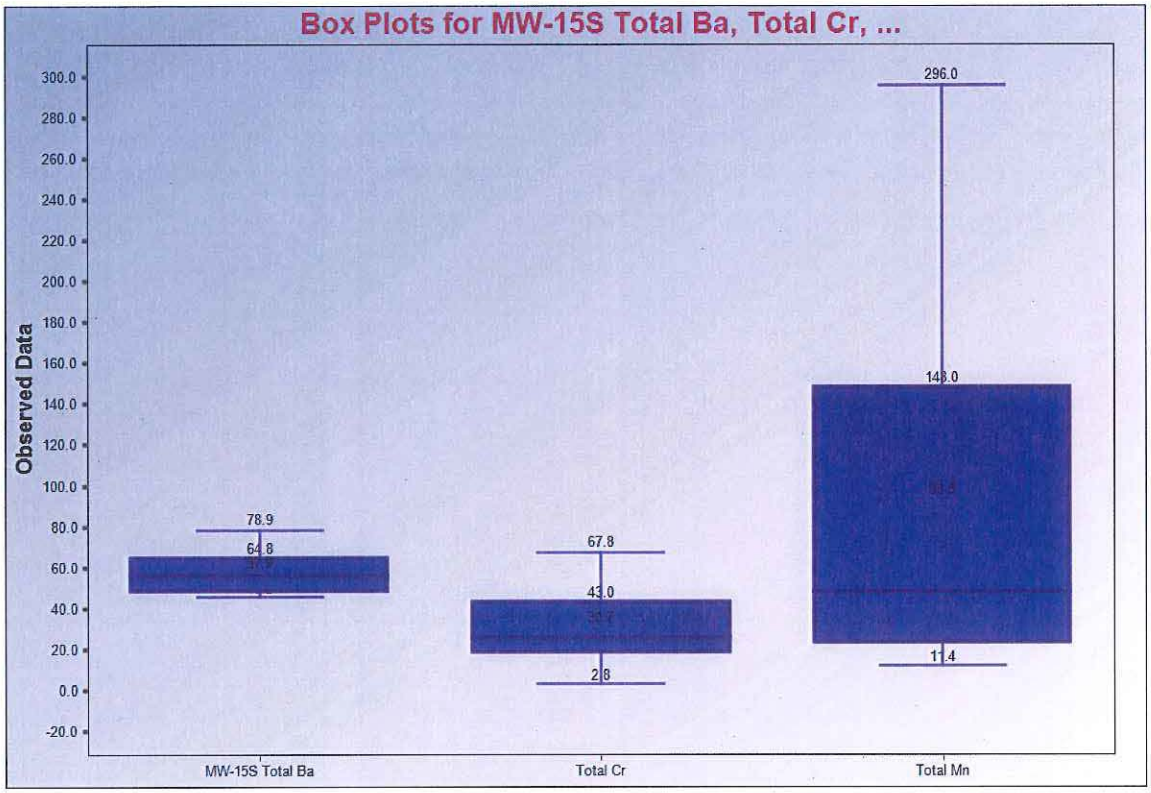

Box Plots for MW-23 Total K, Total Na, ...
Observed Data
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
2110
1440
437
2400
2045
271
839
517
MW-23 Total K
Total Na
Total Zn

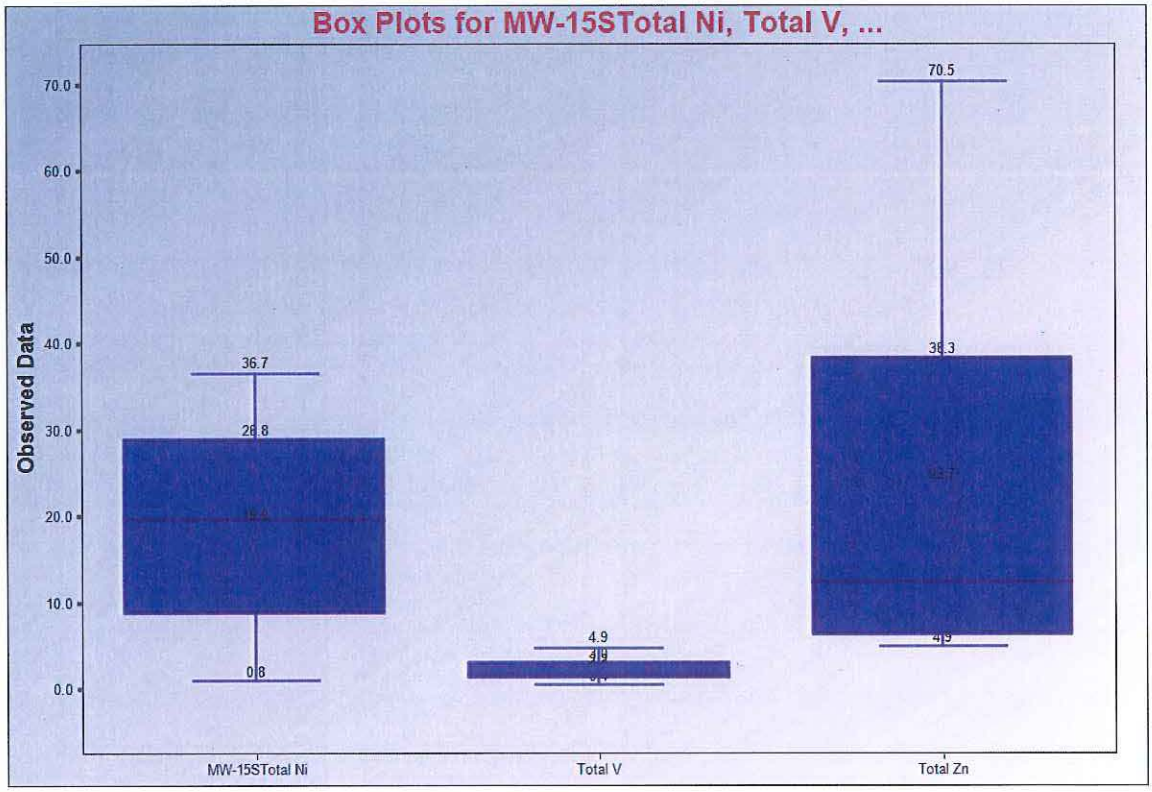

Box Plots for MW-23 Total Ba, Total Cr, ...
Observed Data
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
386.0
237.4
179.0
138.3
12.9
86.7
53.8
305.0
206.0
9.7
MW-23 Total Ba
Total Cr
Total Co
Total Ni

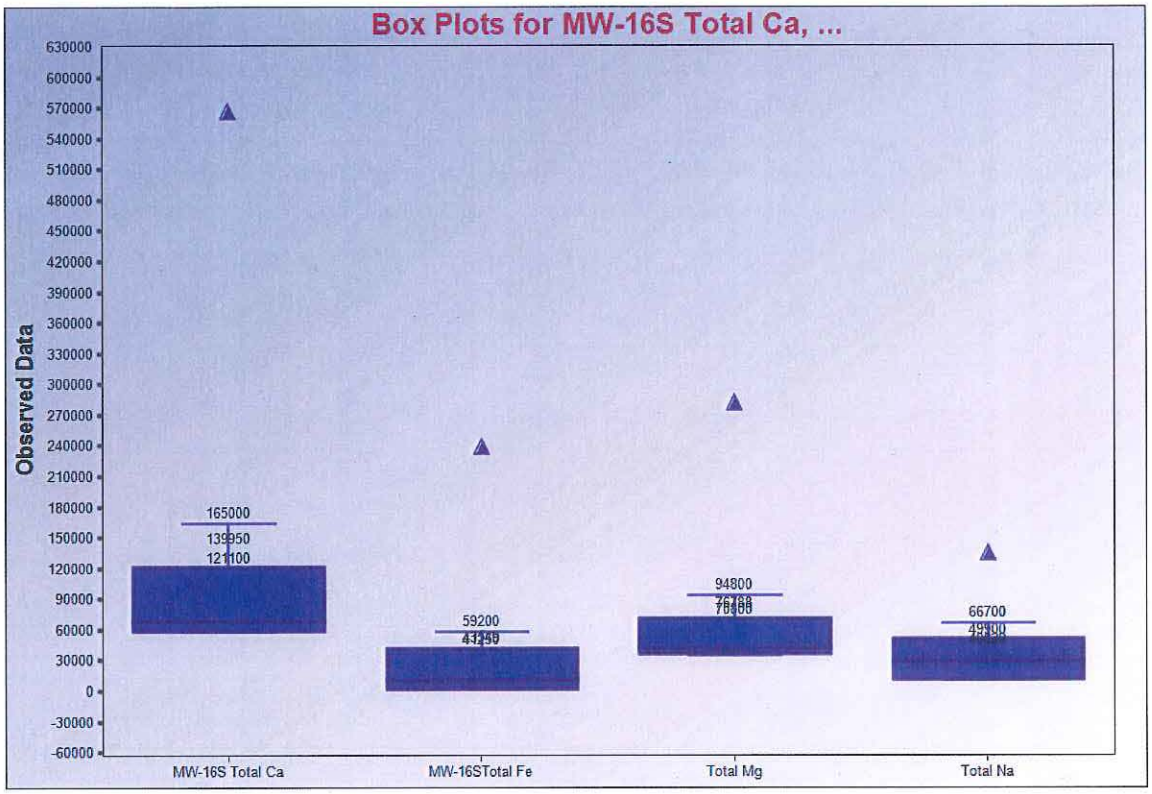

Box Plots for MW-23 Total Be, Total Cu, ...
Observed Data
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
9.1
76.7
48.2
0.7
93.9
56.8
30.7
18.9
MW-23 Total Be
Total Cu
Total Pb
Total V

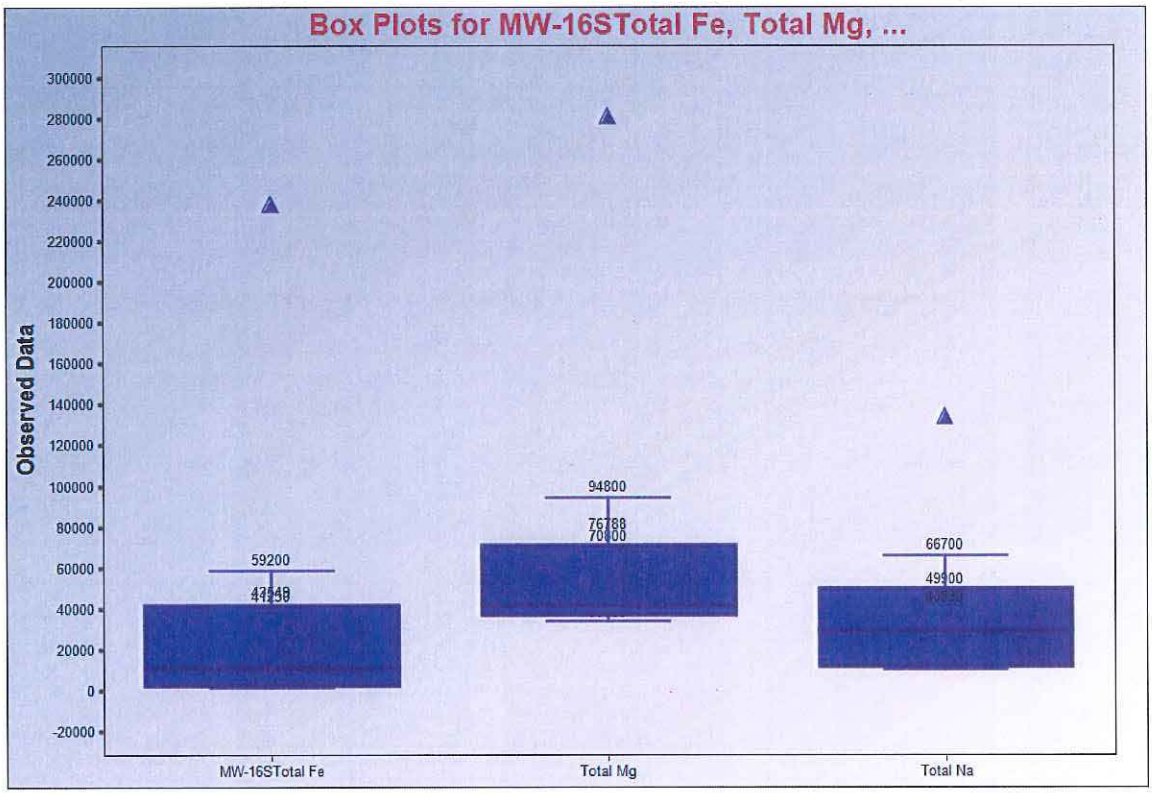

Box Plots for MW-15S Total Ca, Total Mg, ...
Observed Data
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
107000
104000
85400
61100
56750
47500
63300
40050
9710
MW-15S Total Ca
Total Mg
Total Na

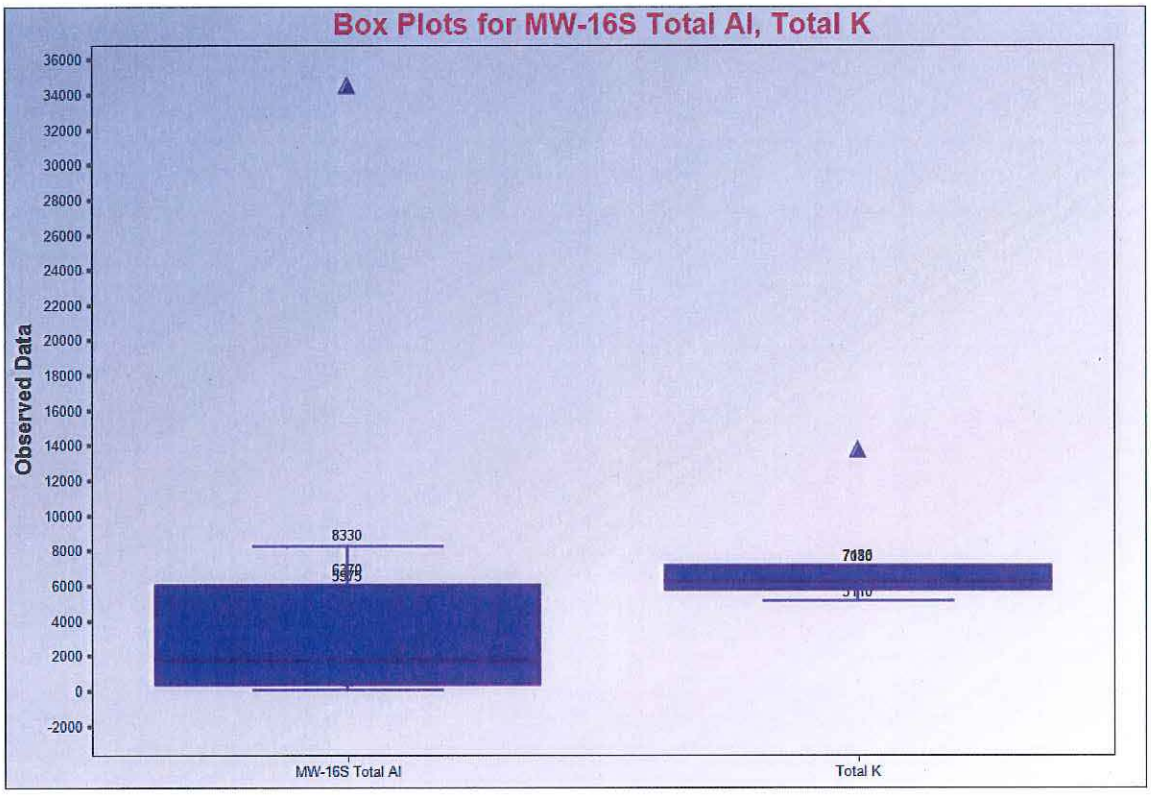

Box Plots for MW-15S Total Al, Total Fe, ...
Observed Data
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
1280.0
4530.0
3120.0
3370.0
1600.0
MW-15S Total Al
Total Fe
Total K

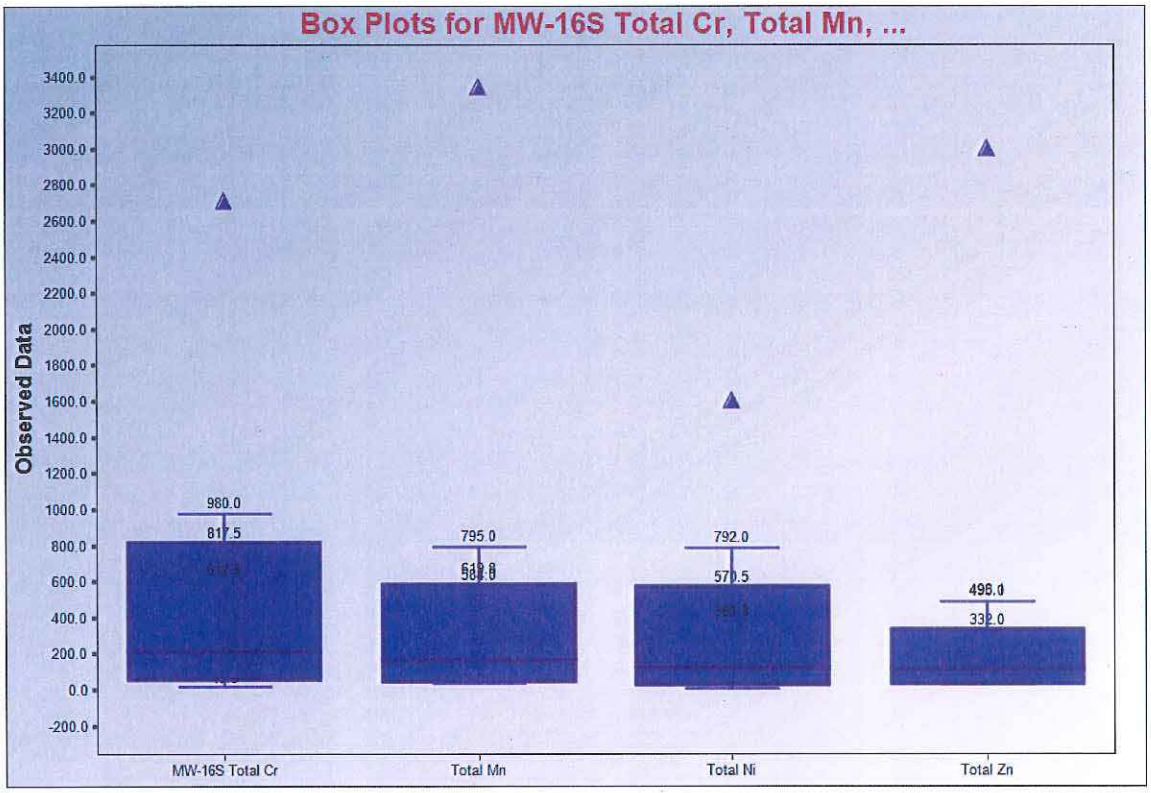

Box Plots for MW-15S Total Ba, Total Cr, ...
Observed Data
300.0
280.0
260.0
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
296.0
78.9
64.8
67.8
43.0
11.4
MW-15S Total Ba
Total Cr
Total Mn

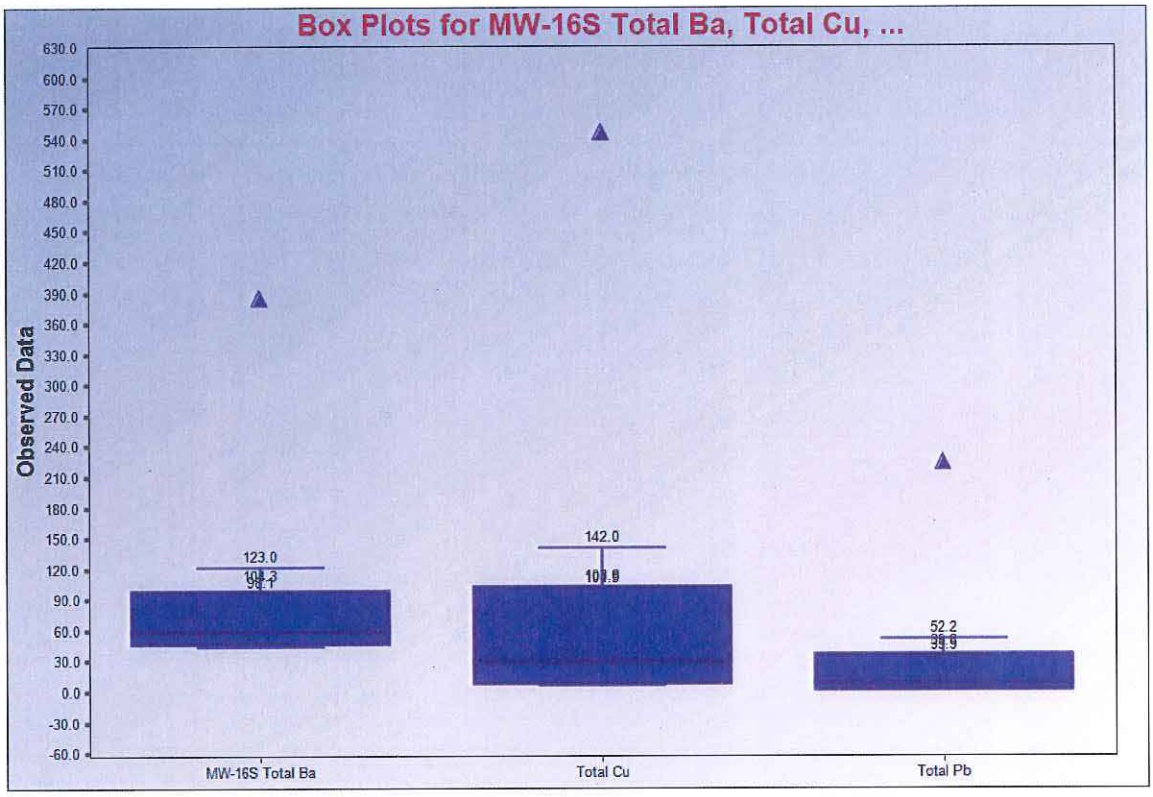

Box Plots for MW-15STotal Ni, Total V, ...
Observed Data
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
70.5
36.7
4.9
MW-15STotal Ni
Total V
Total Zn

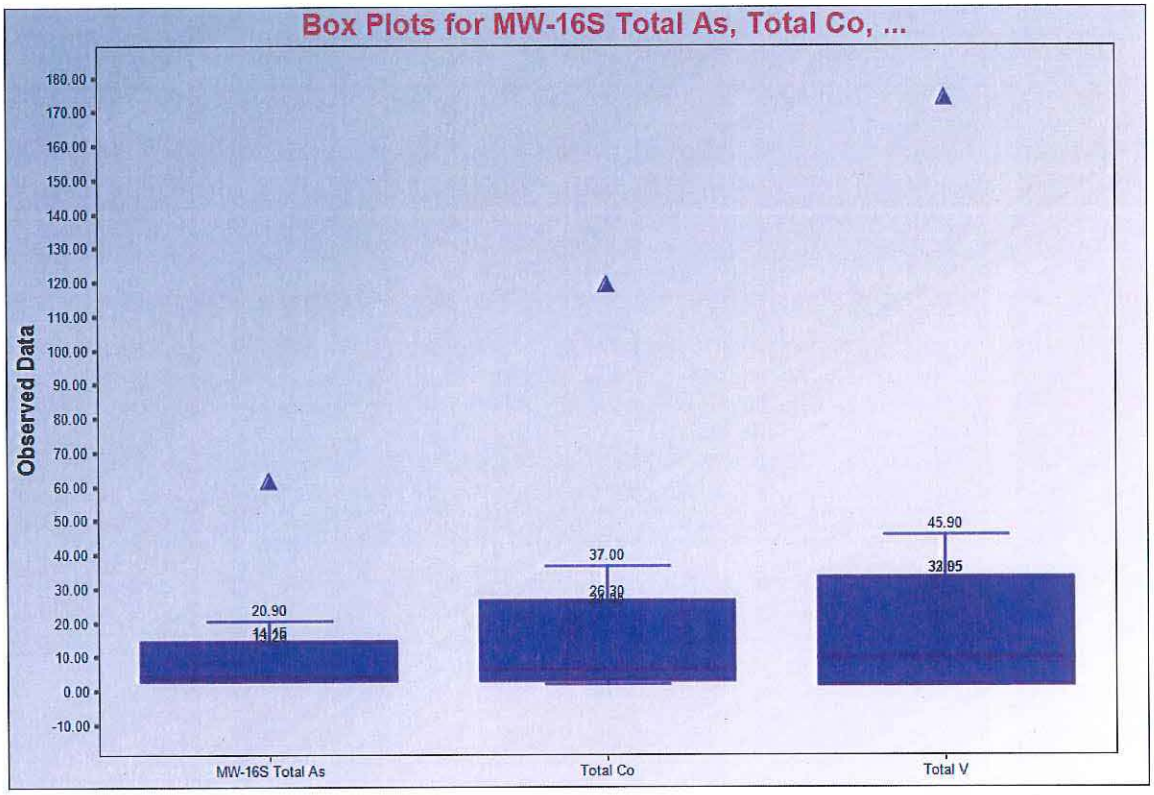

Box Plots for MW-16S Total Ca, ...
Observed Data
630000
600000
570000
540000
510000
480000
450000
420000
390000
360000
330000
300000
270000
240000
210000
180000
150000
120000
90000
60000
30000
0
-30000
-60000
165000
139950
121100
59200
94800
66700
MW-16S Total Ca
MW-16STotal Fe
Total Mg
Total Na

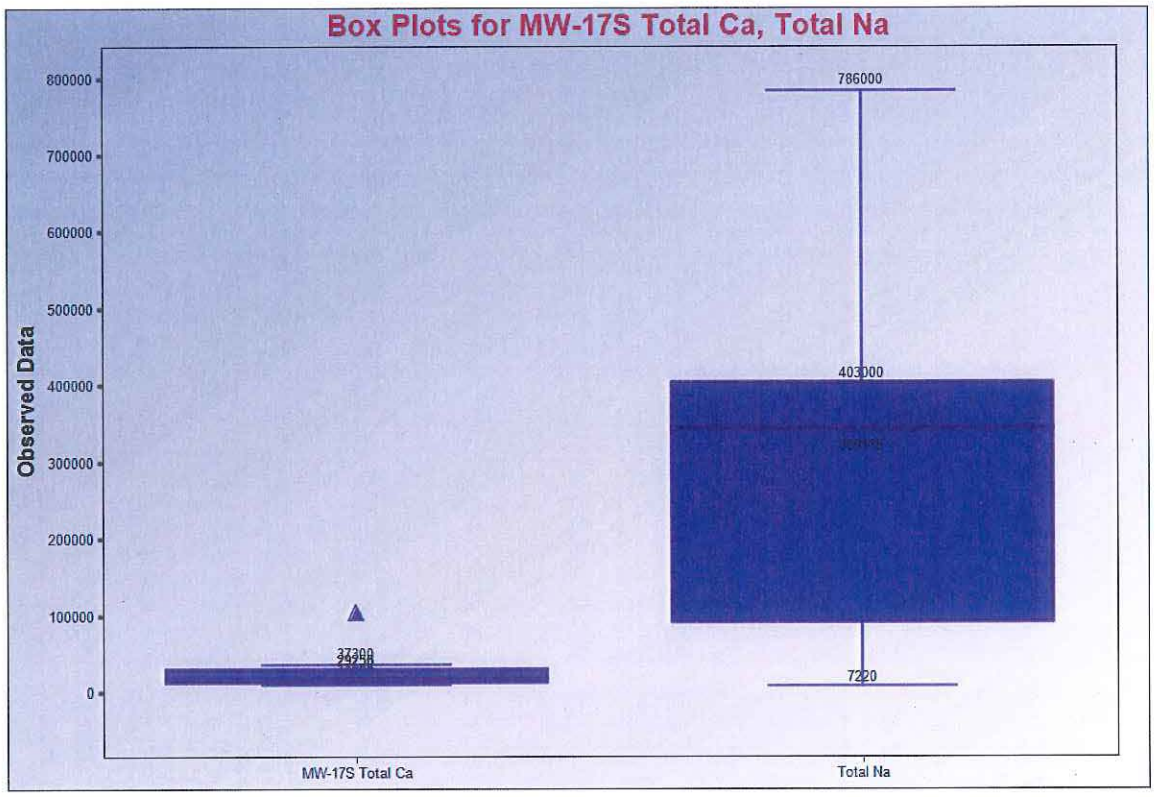

Box Plots for MW-16STotal Fe, Total Mg, ...
Observed Data
300000
280000
260000
240000
220000
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
-20000
59200
94800
76788
70000
66700
49900
MW-16STotal Fe
Total Mg
Total Na

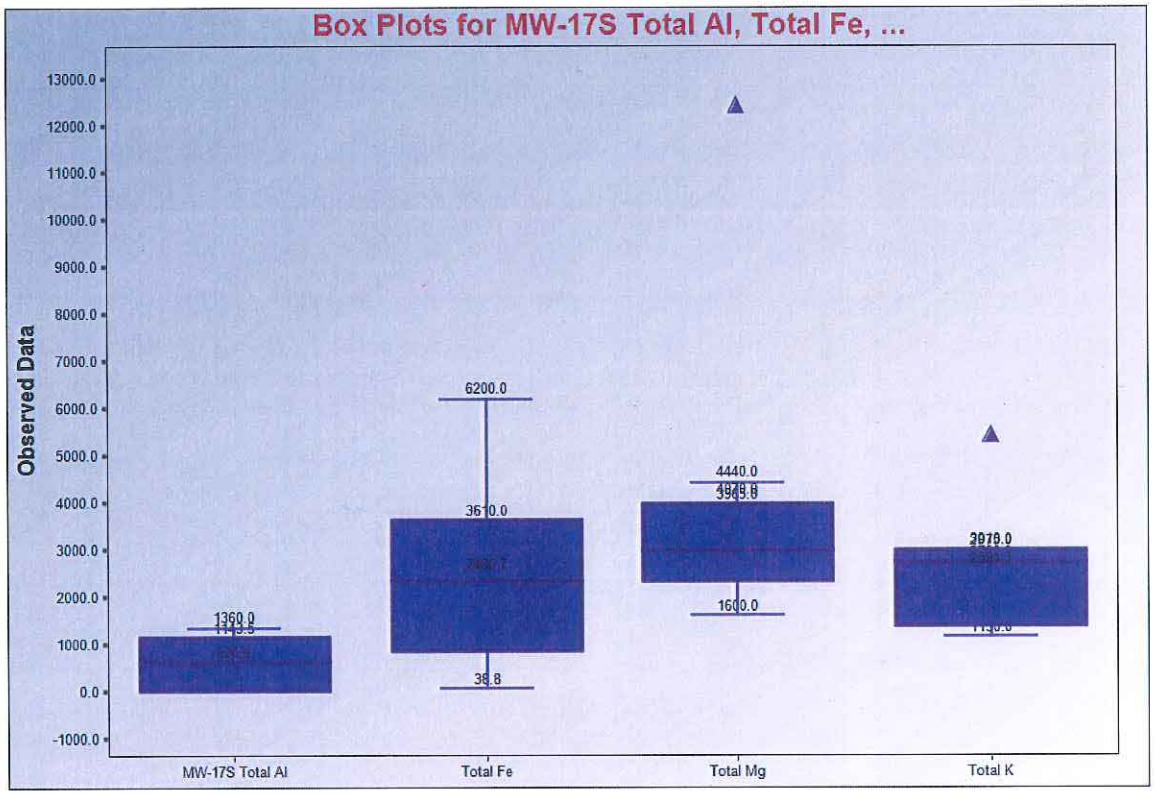

Box Plots for MW-16S Total Al, Total K
Observed Data
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
8330
7080
MW-16S Total Al
Total K

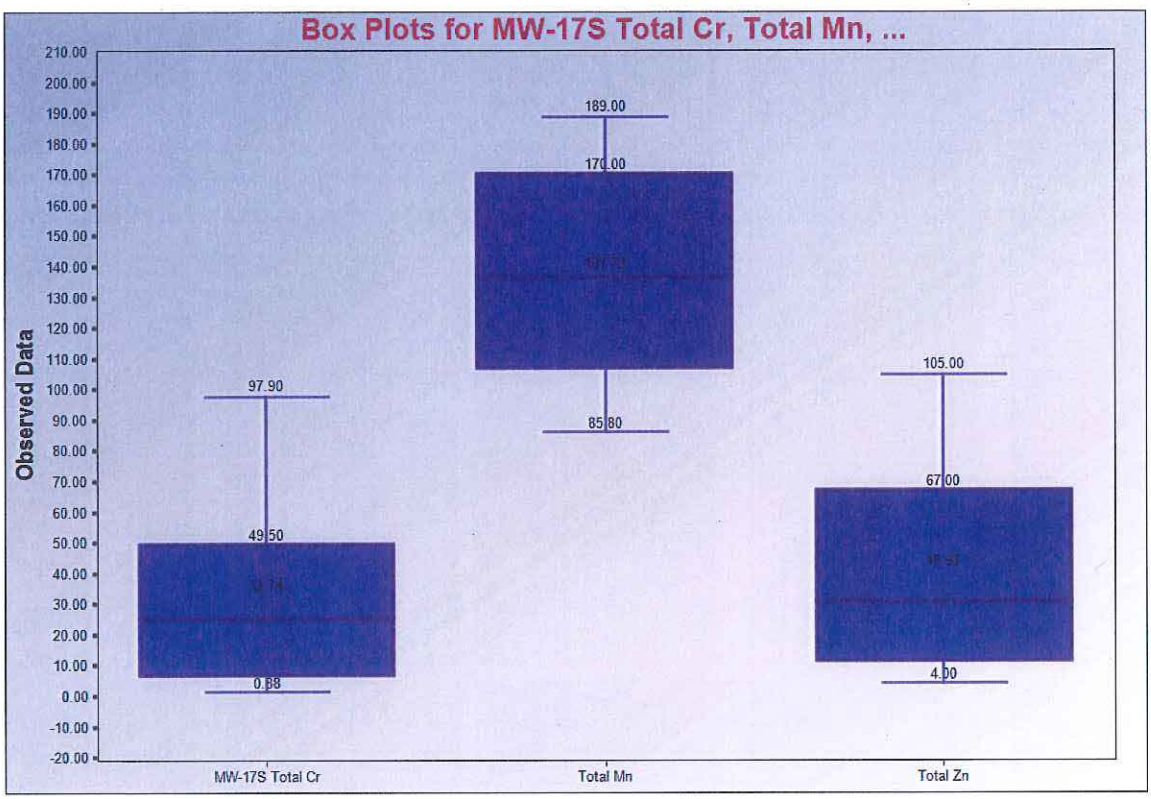

Box Plots for MW-16S Total Cr, Total Mn, ...
Observed Data
3400.0
3200.0
3000.0
2800.0
2600.0
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-200.0
980.0
817.5
795.0
792.0
570.5
498.0
332.0
MW-16S Total Cr
Total Mn
Total Ni
Total Zn

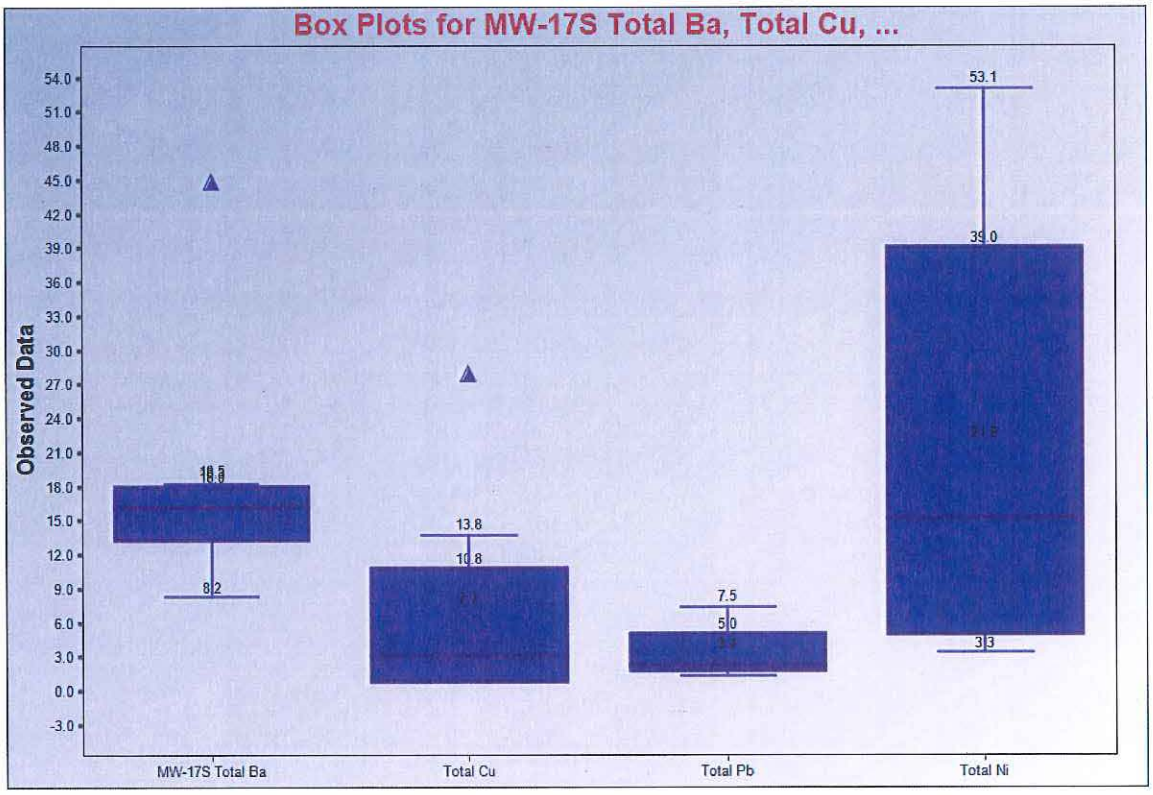

Box Plots for MW-16S Total Ba, Total Cu, ...
Observed Data
630.0
600.0
570.0
540.0
510.0
480.0
450.0
420.0
390.0
360.0
330.0
300.0
270.0
240.0
210.0
180.0
150.0
120.0
90.0
60.0
30.0
0.0
-30.0
-60.0
123.0
142.0
52.2
MW-16S Total Ba
Total Cu
Total Pb

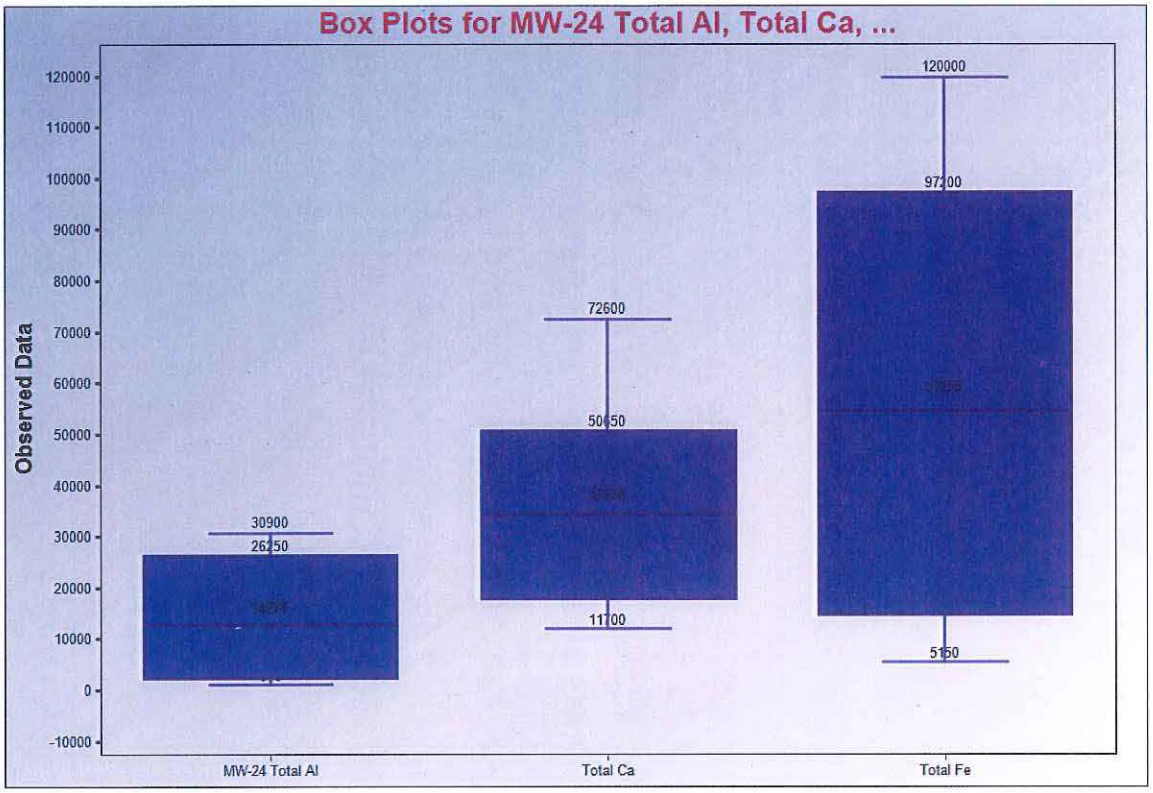

Box Plots for MW-16S Total As, Total Co, ...
Observed Data
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
20.90
37.00
45.90
MW-16S Total As
Total Co
Total V

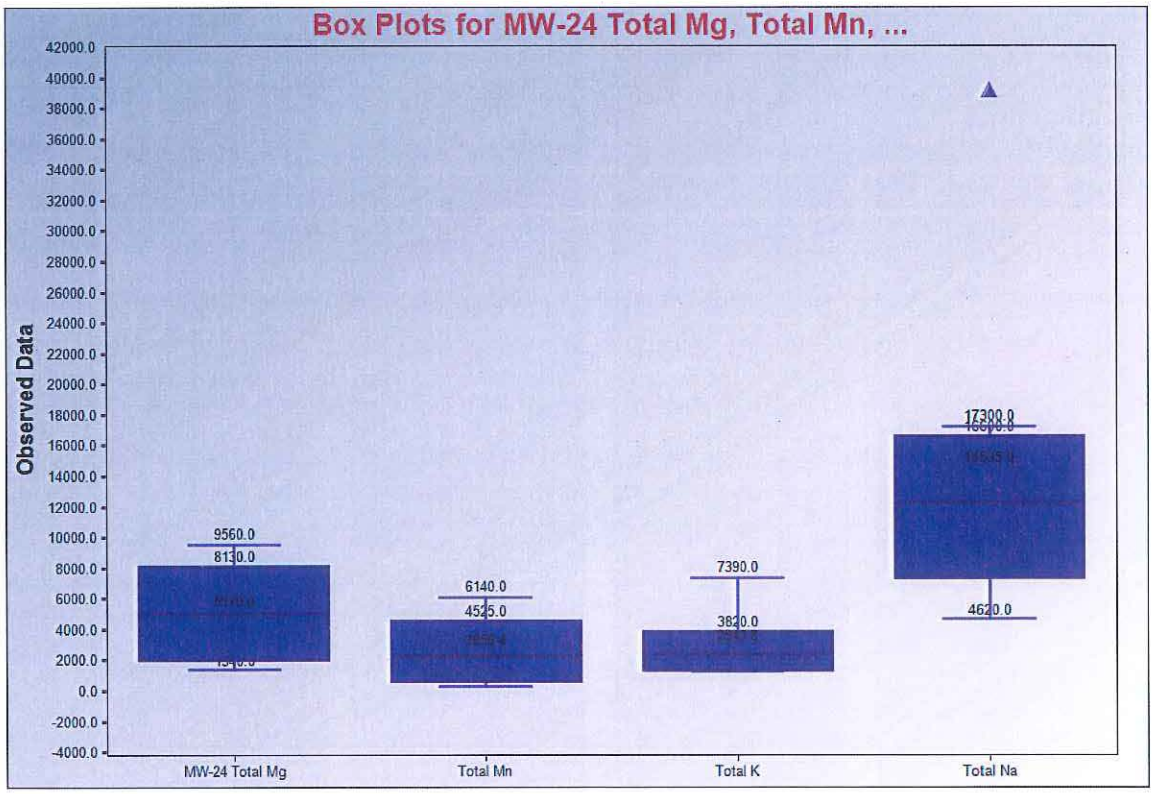

Box Plots for MW-17S Total Ca, Total Na
Observed Data
800000
700000
600000
500000
400000
300000
200000
100000
0
786000
403000
7220
MW-17S Total Ca
Total Na

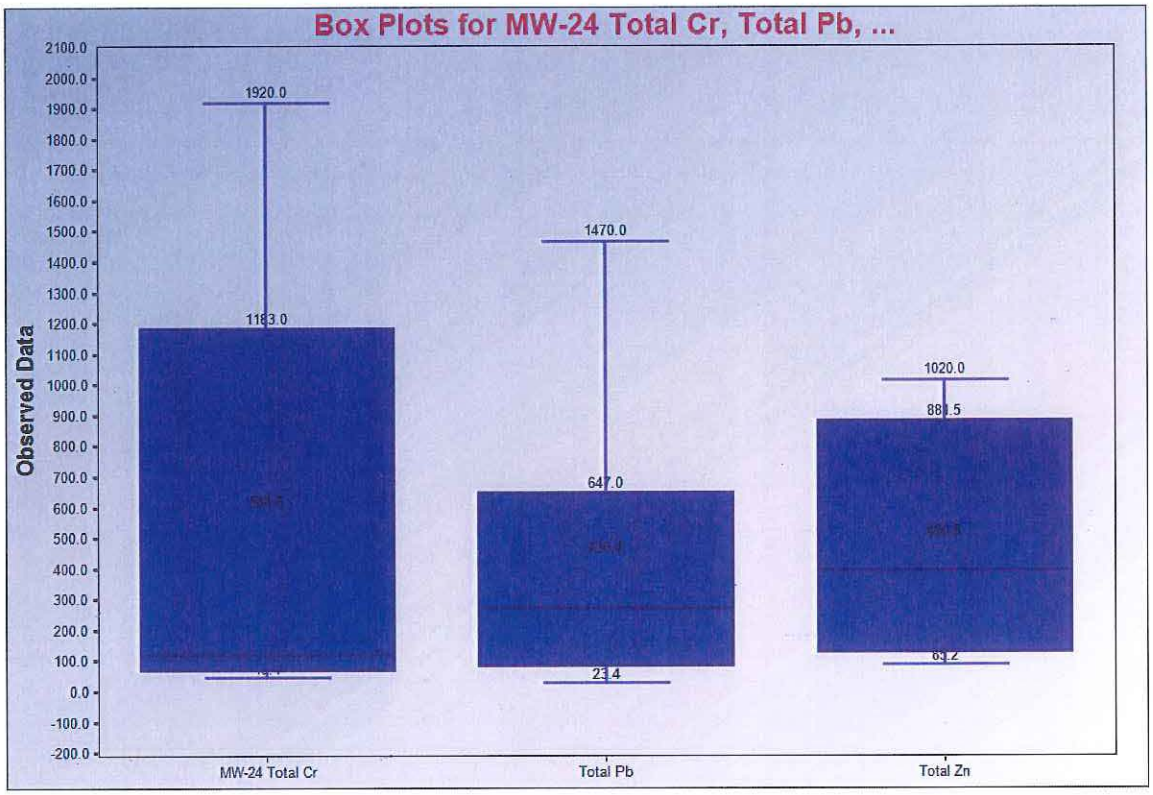

Box Plots for MW-17S Total Al, Total Fe, ...
Observed Data
13000.0
12000.0
11000.0
10000.0
9000.0
8000.0
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-1000.0
6200.0
3610.0
4440.0
1600.0
1360.0
MW-17S Total Al
Total Fe
Total Mg
Total K

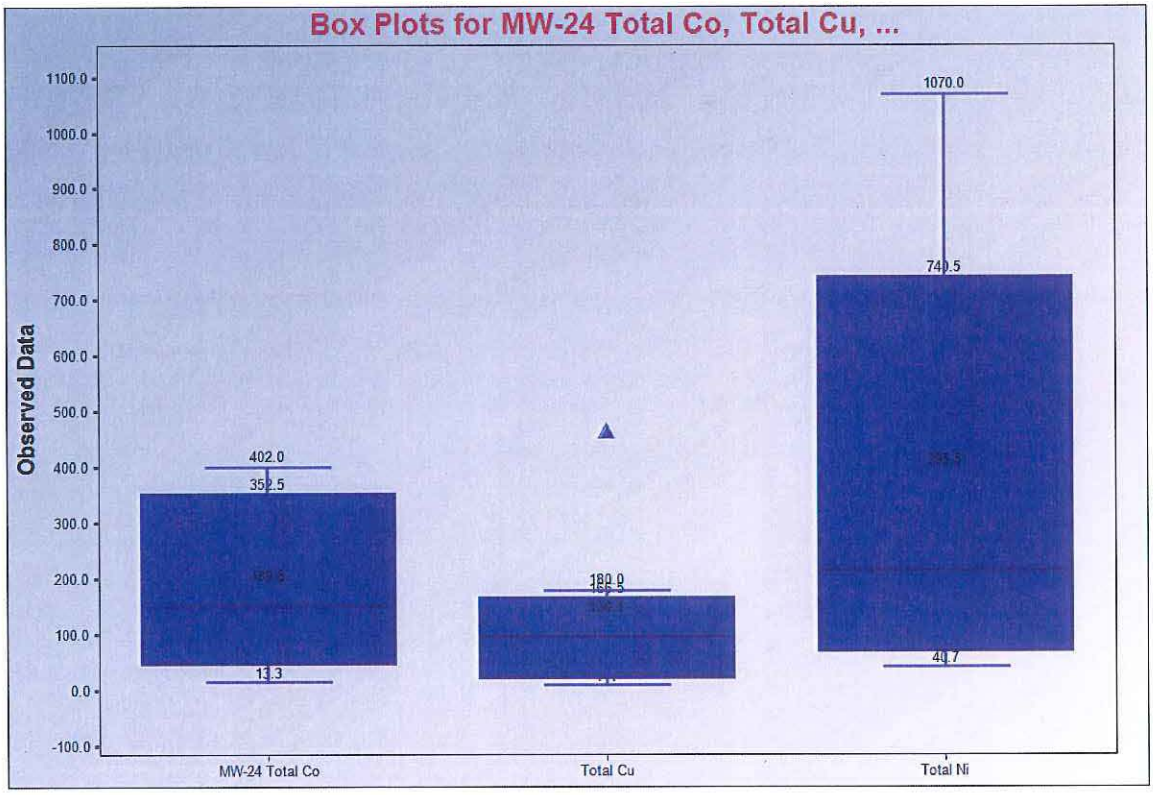

Box Plots for MW-17S Total Cr, Total Mn, ...
Observed Data
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
97.90
49.50
0.88
189.00
170.00
85.80
105.00
67.00
4.00
MW-17S Total Cr
Total Mn
Total Zn

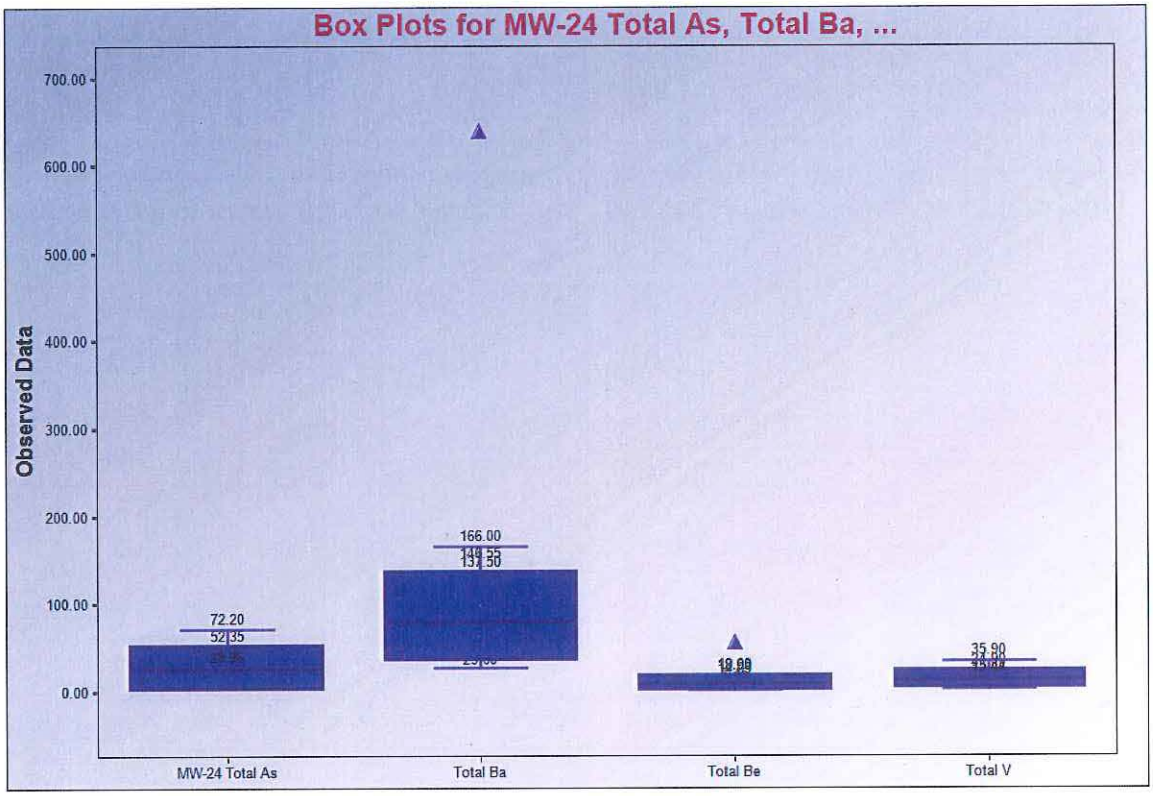

Box Plots for MW-17S Total Ba, Total Cu, ...
Observed Data
54.0
51.0
48.0
45.0
42.0
39.0
36.0
33.0
30.0
27.0
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0
-3.0
8.2
13.8
10.8
7.5
5.0
53.1
39.0
3.3
MW-17S Total Ba
Total Cu
Total Pb
Total Ni

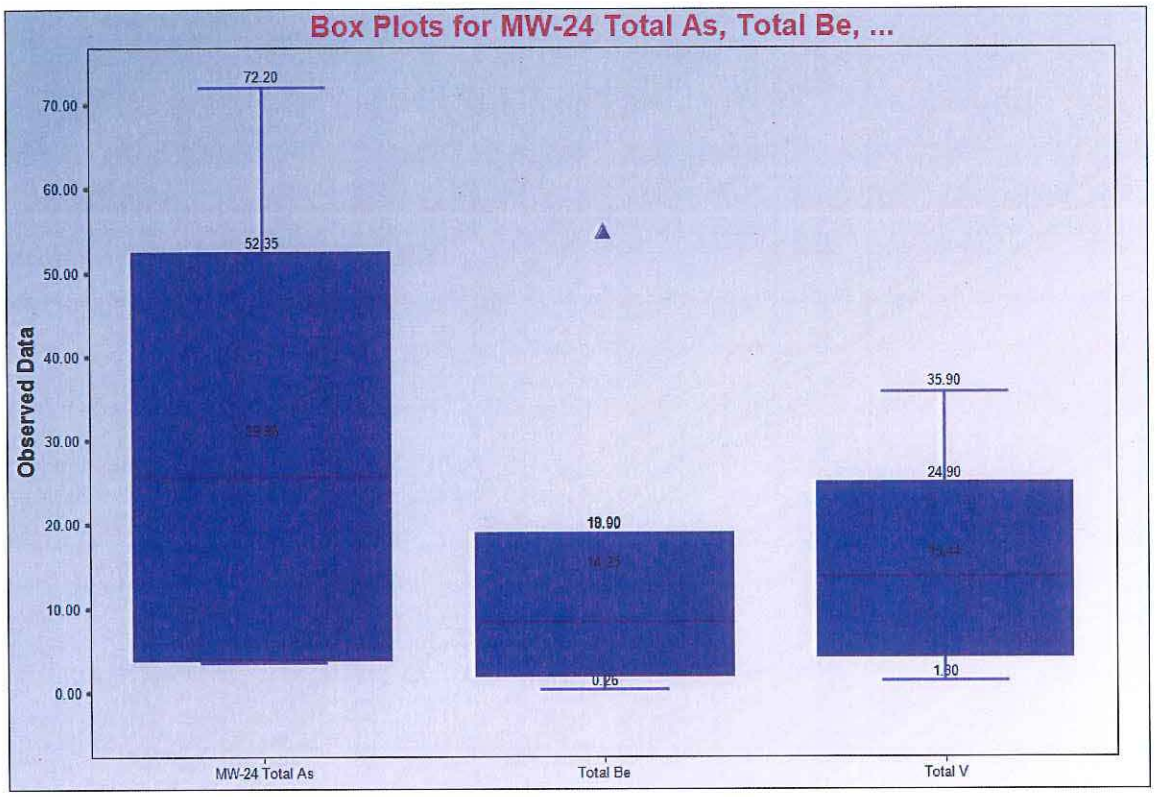

Box Plots for MW-24 Total Al, Total Ca, ...
Observed Data
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
30900
26250
72600
50650
11700
120000
97200
5150
MW-24 Total Al
Total Ca
Total Fe


Box Plots for MW-24 Total Mg, Total Mn, ...
Observed Data
42000.0
40000.0
38000.0
36000.0
34000.0
32000.0
30000.0
28000.0
26000.0
24000.0
22000.0
20000.0
18000.0
16000.0
14000.0
12000.0
10000.0
8000.0
6000.0
4000.0
2000.0
0.0
-2000.0
-4000.0
9560.0
8130.0
6140.0
4525.0
7390.0
3820.0
17300.0
4620.0
MW-24 Total Mg
Total Mn
Total K
Total Na


Box Plots for MW-24 Total Cr, Total Pb, ...
Observed Data
2100.0
2000.0
1900.0
1800.0
1700.0
1600.0
1500.0
1400.0
1300.0
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-100.0
-200.0
1920.0
1183.0
1470.0
647.0
23.4
1020.0
881.5
63.2
MW-24 Total Cr
Total Pb
Total Zn

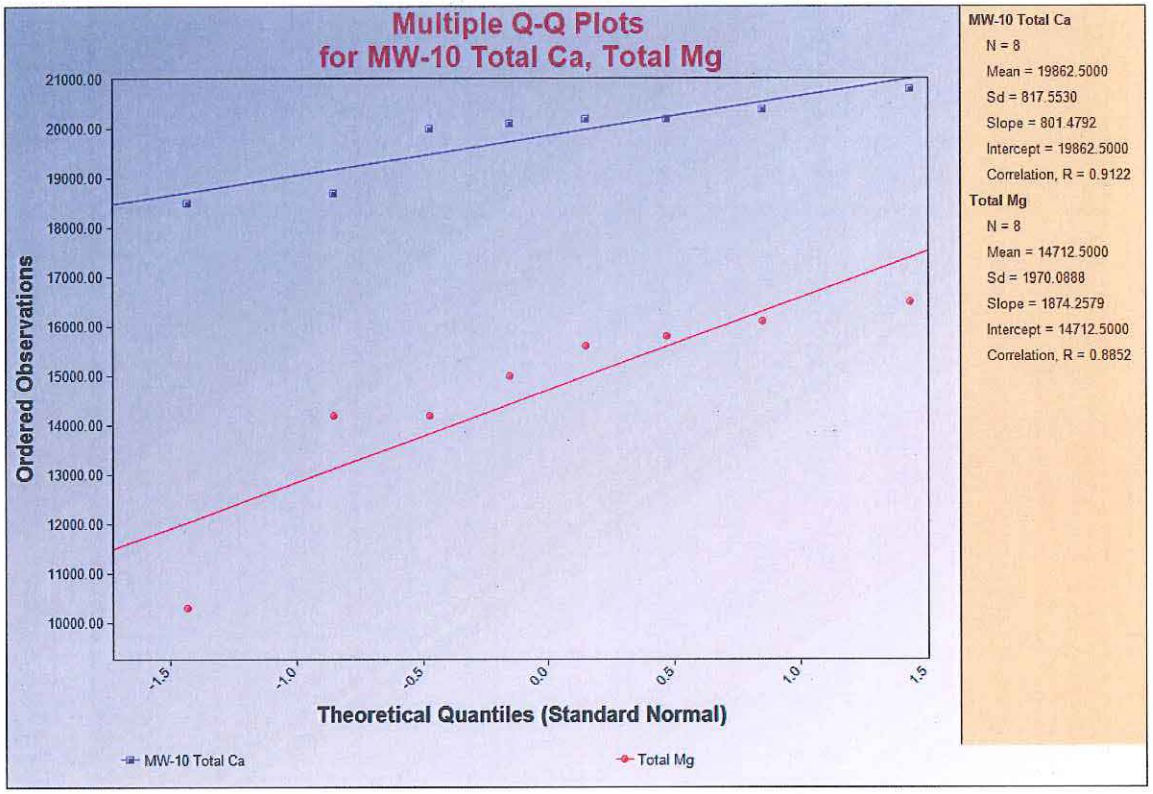

Box Plots for MW-24 Total Co, Total Cu, ...
Observed Data
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-100.0
402.0
352.5
13.3
180.0
1070.0
740.5
40.7
MW-24 Total Co
Total Cu
Total Ni

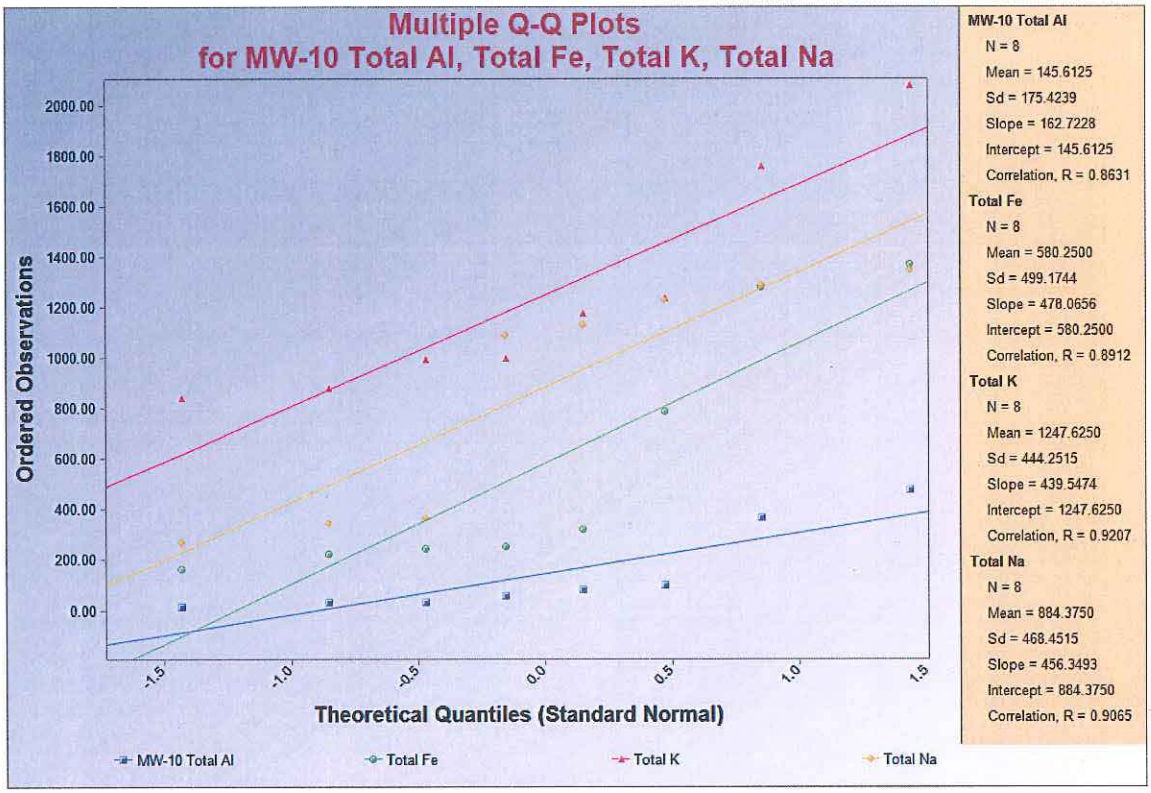

Box Plots for MW-24 Total As, Total Ba, ...
Observed Data
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
72.20
52.35
166.00
MW-24 Total As
Total Ba
Total Be
Total V

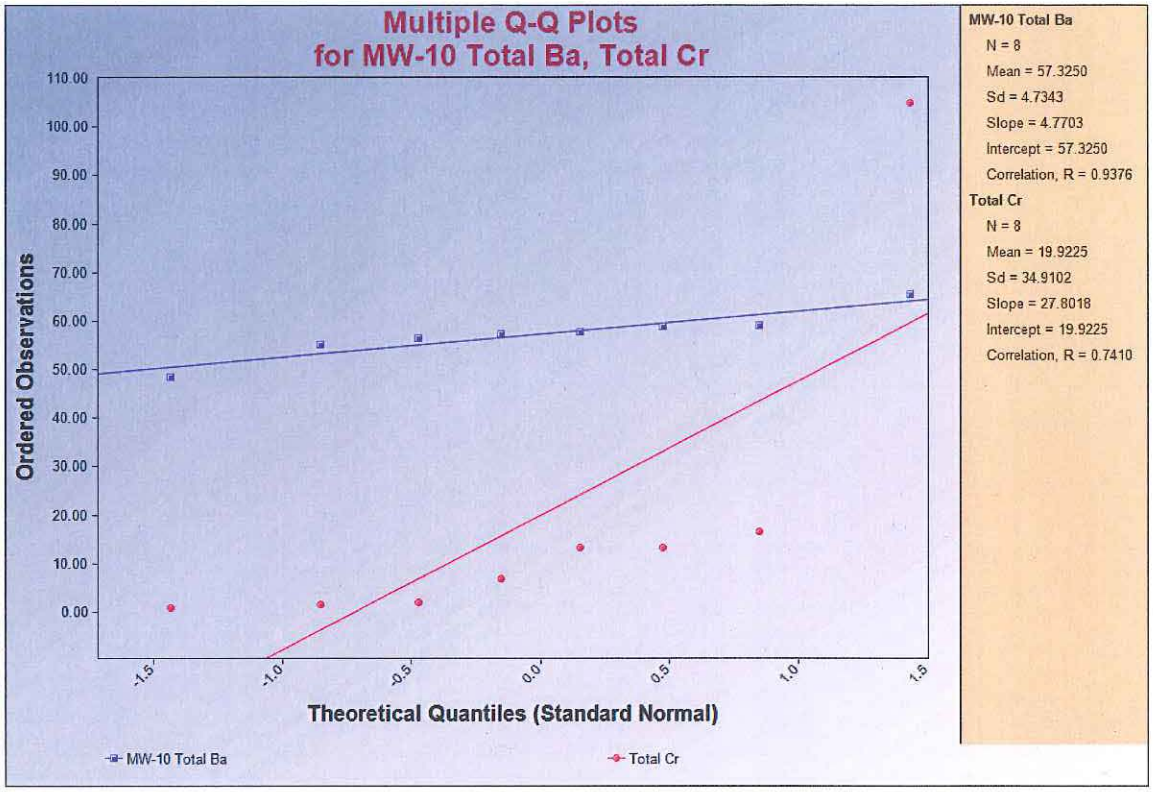

Box Plots for MW-24 Total As, Total Be, ...
Observed Data
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
72.20
52.35
35.90
24.90
18.90
1.30
MW-24 Total As
Total Be
Total V

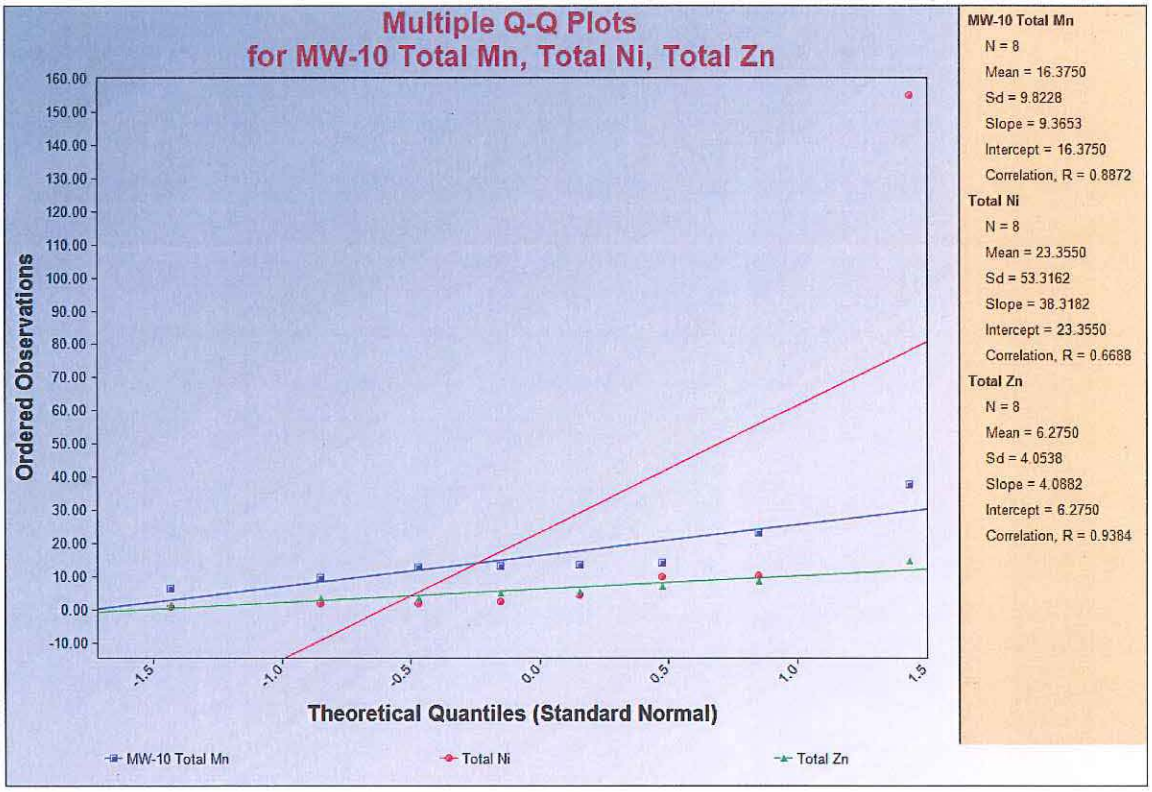
Appendix J3

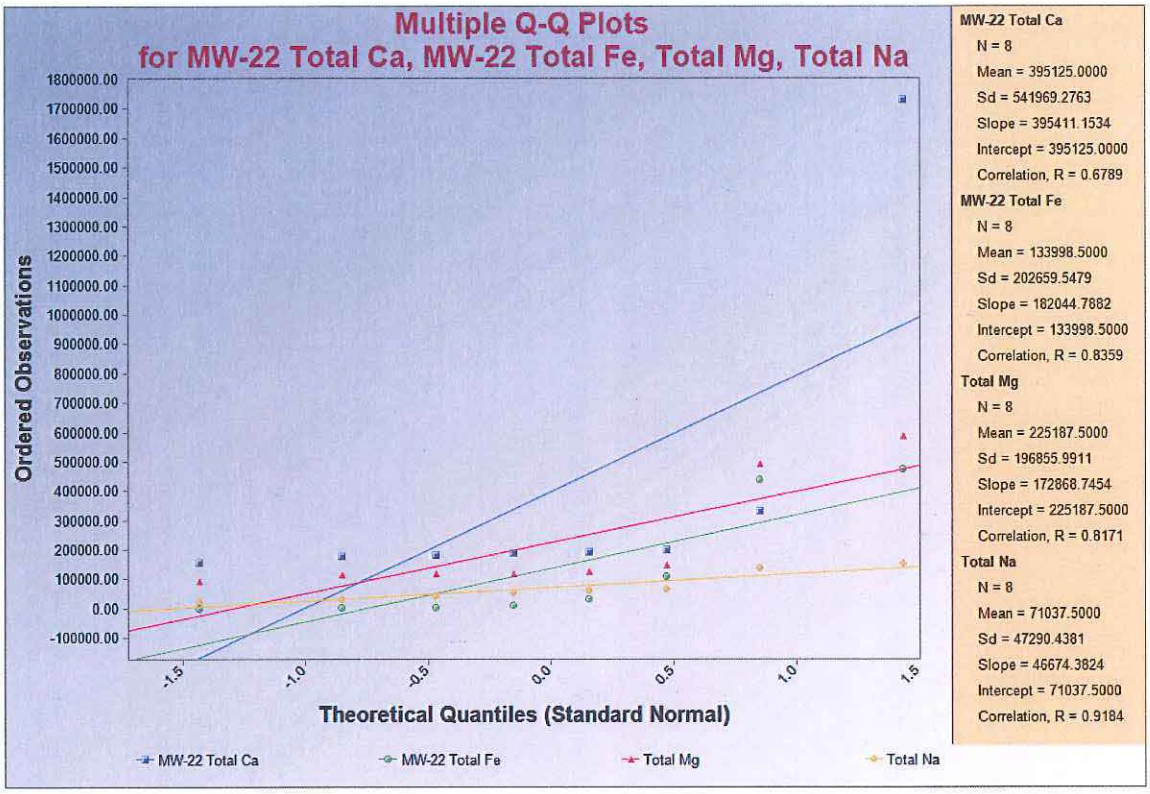
Q-Q Plots for Total Metals

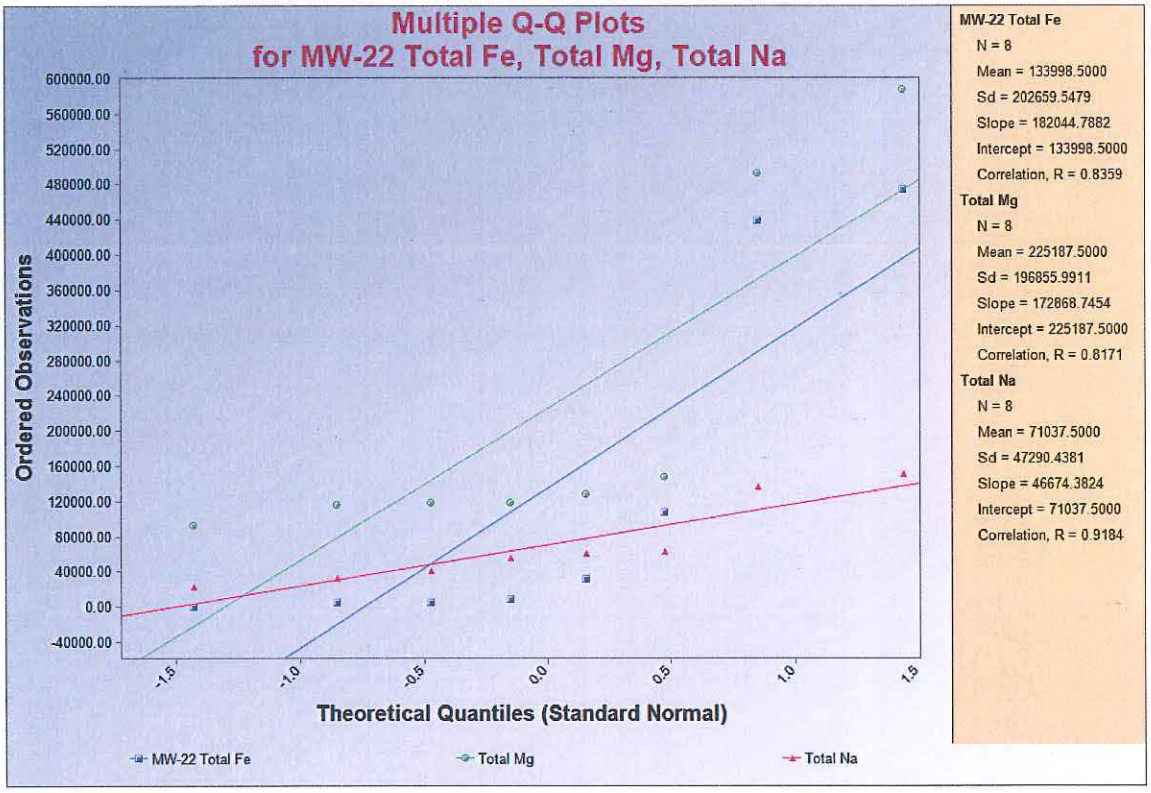

Multiple Q-Q Plots
for MW-10 Total Ca, Total Mg
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-10 Total Ca
Total Mg
MW-10 Total Ca
N = 8
Mean = 19862.5000
Sd = 817.5530
Slope = 801.4792
Intercept = 19862.5000
Correlation, R = 0.9122
Total Mg
N = 8
Mean = 14712.5000
Sd = 1970.0888
Slope = 1874.2579
Intercept = 14712.5000
Correlation, R = 0.8852

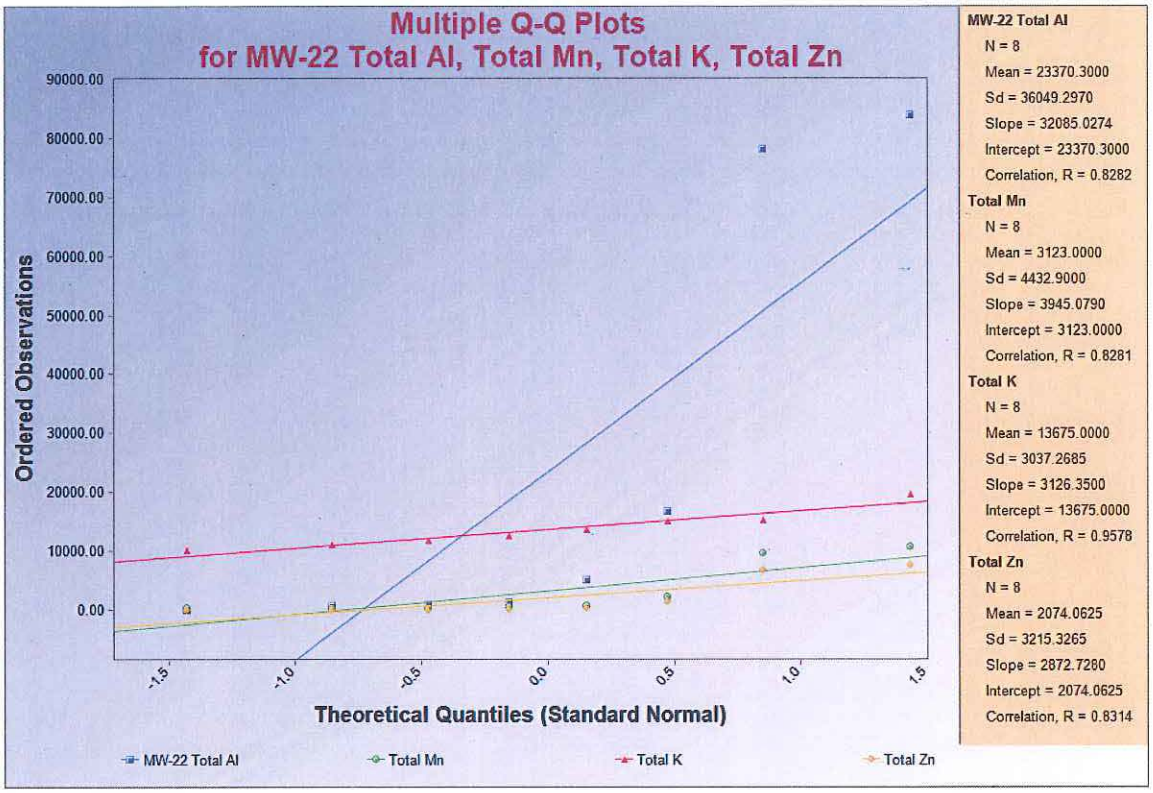

Multiple Q-Q Plots
for MW-10 Total Al, Total Fe, Total K, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-10 Total Al
Total Fe
Total K
Total Na
MW-10 Total Al
N = 8
Mean = 145.6125
Sd = 175.4239
Slope = 162.7228
Intercept = 145.6125
Correlation, R = 0.8631
Total Fe
N = 8
Mean = 580.2500
Sd = 499.1744
Slope = 478.0656
Intercept = 580.2500
Correlation, R = 0.8912
Total K
N = 8
Mean = 1247.6250
Sd = 444.2515
Slope = 439.5474
Intercept = 1247.6250
Correlation, R = 0.9207
Total Na
N = 8
Mean = 884.3750
Sd = 468.4515
Slope = 456.3493
Intercept = 884.3750
Correlation, R = 0.9065

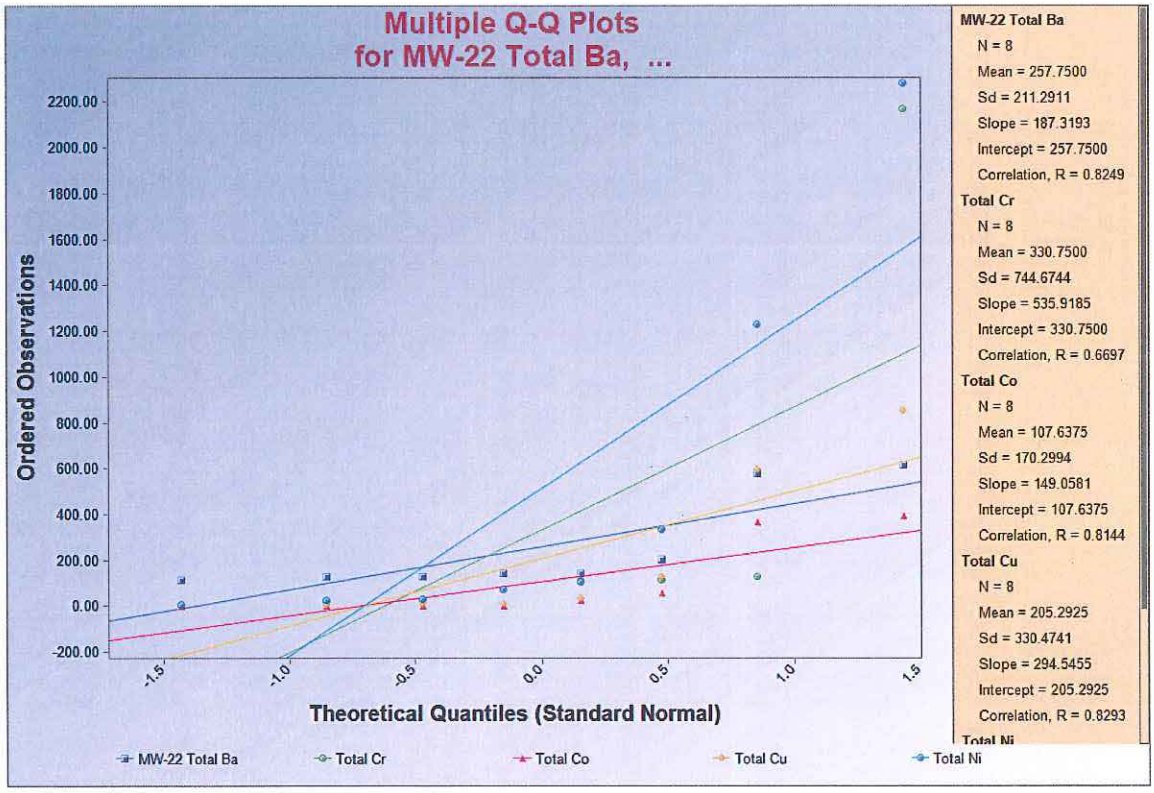

Multiple Q-Q Plots
for MW-10 Total Ba, Total Cr
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-10 Total Ba
Total Cr
MW-10 Total Ba
N = 8
Mean = 57.3250
Sd = 4.7343
Slope = 4.7703
Intercept = 57.3250
Correlation, R = 0.9376
Total Cr
N = 8
Mean = 19.9225
Sd = 34.9102
Slope = 27.8018
Intercept = 19.9225
Correlation, R = 0.7410

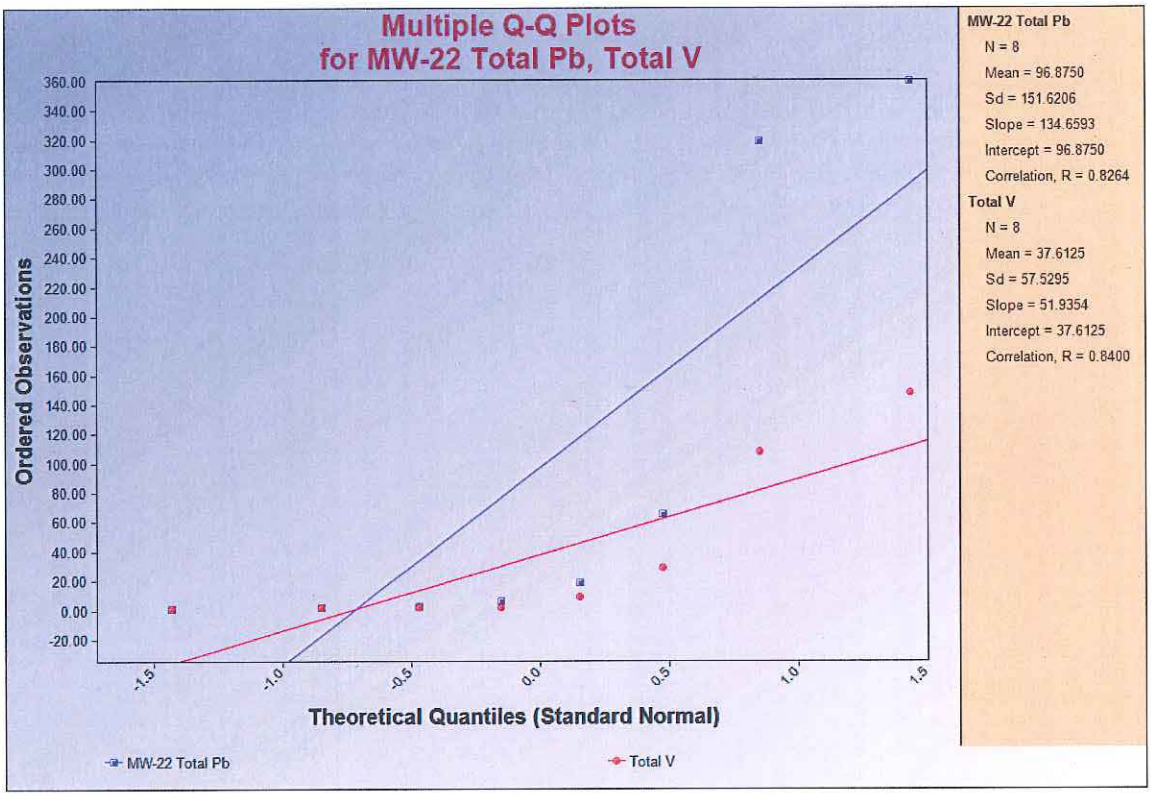

Multiple Q-Q Plots
for MW-10 Total Mn, Total Ni, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-10 Total Mn
Total Ni
Total Zn
MW-10 Total Mn
N = 8
Mean = 16.3750
Sd = 9.8228
Slope = 9.3653
Intercept = 16.3750
Correlation, R = 0.8872
Total Ni
N = 8
Mean = 23.3550
Sd = 53.3162
Slope = 38.3182
Intercept = 23.3550
Correlation, R = 0.6688
Total Zn
N = 8
Mean = 6.2750
Sd = 4.0538
Slope = 4.0882
Intercept = 6.2750
Correlation, R = 0.9384

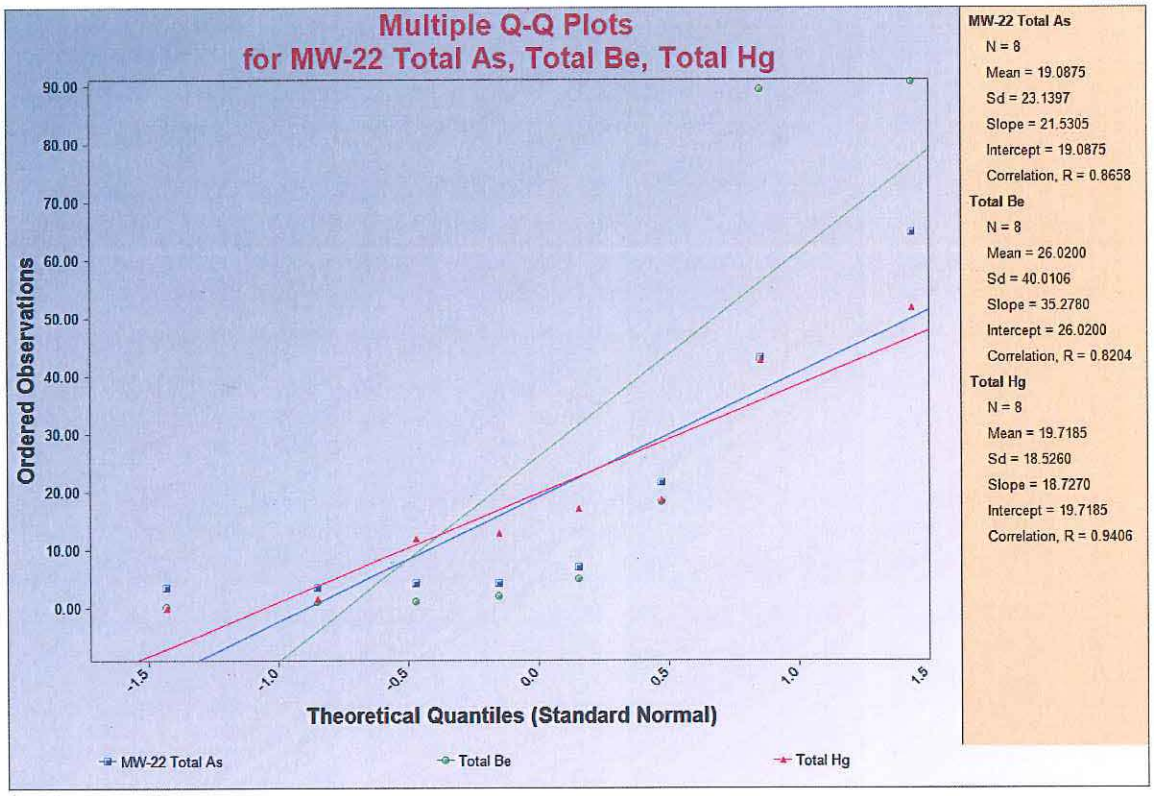

Multiple Q-Q Plots
for MW-22 Total Ca, MW-22 Total Fe, Total Mg, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total Ca
MW-22 Total Fe
Total Mg
Total Na
MW-22 Total Ca
N = 8
Mean = 395125.0000
Sd = 541969.2763
Slope = 395411.1534
Intercept = 395125.0000
Correlation, R = 0.6789
MW-22 Total Fe
N = 8
Mean = 133998.5000
Sd = 202659.5479
Slope = 182044.7882
Intercept = 133998.5000
Correlation, R = 0.8359
Total Mg
N = 8
Mean = 225187.5000
Sd = 196855.9911
Slope = 172868.7454
Intercept = 225187.5000
Correlation, R = 0.8171
Total Na
N = 8
Mean = 71037.5000
Sd = 47290.4381
Slope = 46674.3824
Intercept = 71037.5000
Correlation, R = 0.9184

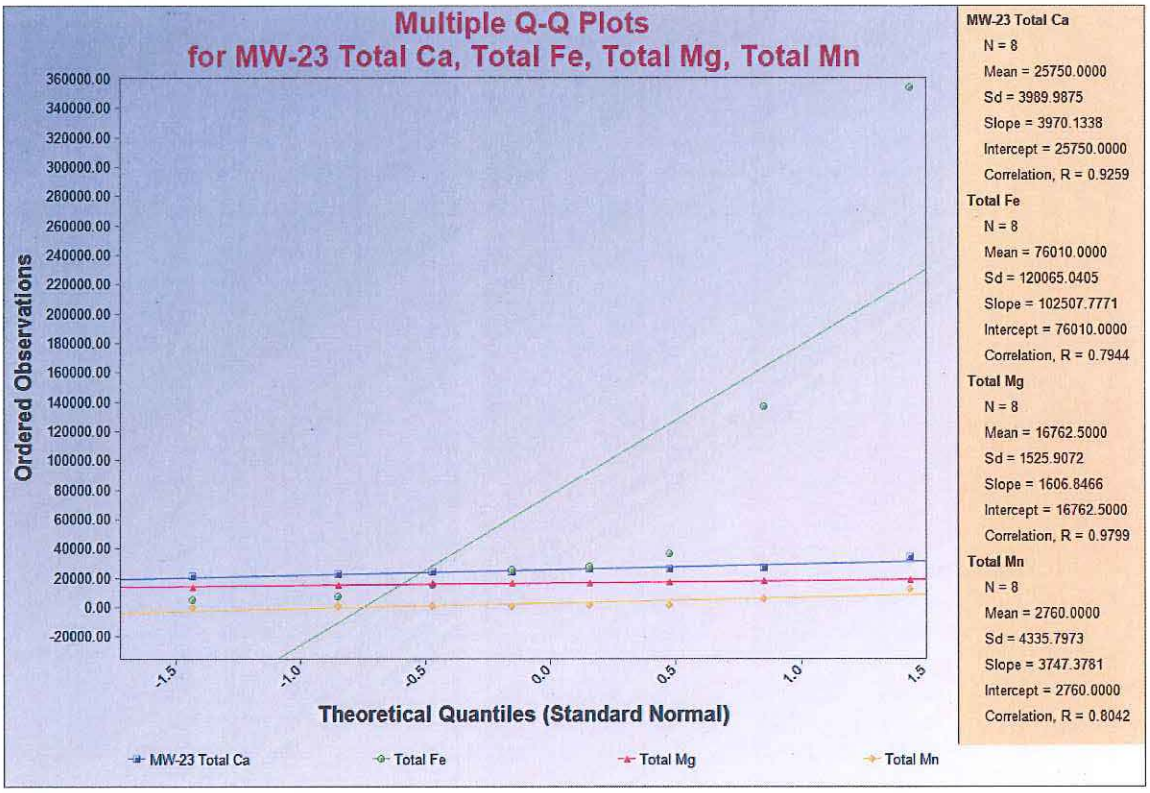

Multiple Q-Q Plots
for MW-22 Total Fe, Total Mg, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total Fe
Total Mg
Total Na
MW-22 Total Fe
N = 8
Mean = 133998.5000
Sd = 202659.5479
Slope = 182044.7882
Intercept = 133998.5000
Correlation, R = 0.8359
Total Mg
N = 8
Mean = 225187.5000
Sd = 196855.9911
Slope = 172868.7454
Intercept = 225187.5000
Correlation, R = 0.8171
Total Na
N = 8
Mean = 71037.5000
Sd = 47290.4381
Slope = 46674.3824
Intercept = 71037.5000
Correlation, R = 0.9184

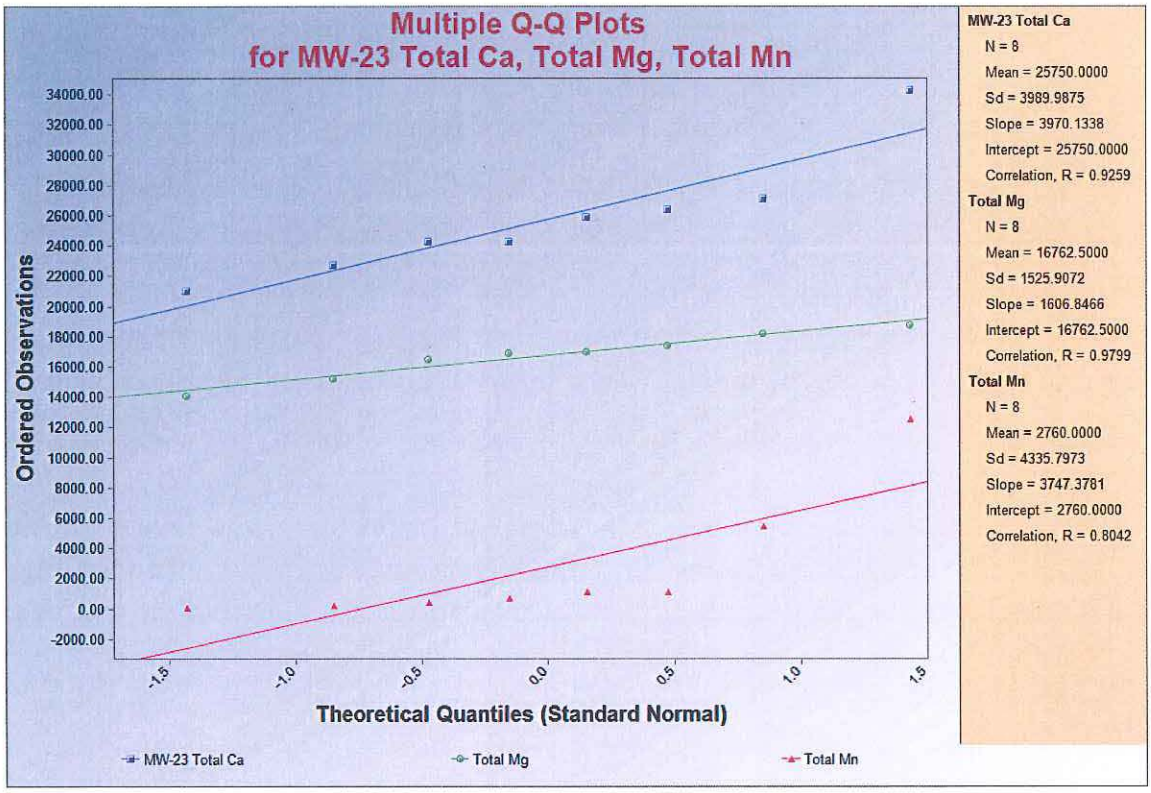

Multiple Q-Q Plots
for MW-22 Total Al, Total Mn, Total K, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total Al
Total Mn
Total K
Total Zn
MW-22 Total Al
N = 8
Mean = 23370.3000
Sd = 36049.2970
Slope = 32085.0274
Intercept = 23370.3000
Correlation, R = 0.8282
Total Mn
N = 8
Mean = 3123.0000
Sd = 4432.9000
Slope = 3945.0790
Intercept = 3123.0000
Correlation, R = 0.8281
Total K
N = 8
Mean = 13675.0000
Sd = 3037.2685
Slope = 3126.3500
Intercept = 13675.0000
Correlation, R = 0.9578
Total Zn
N = 8
Mean = 2074.0625
Sd = 3215.3265
Slope = 2872.7280
Intercept = 2074.0625
Correlation, R = 0.8314

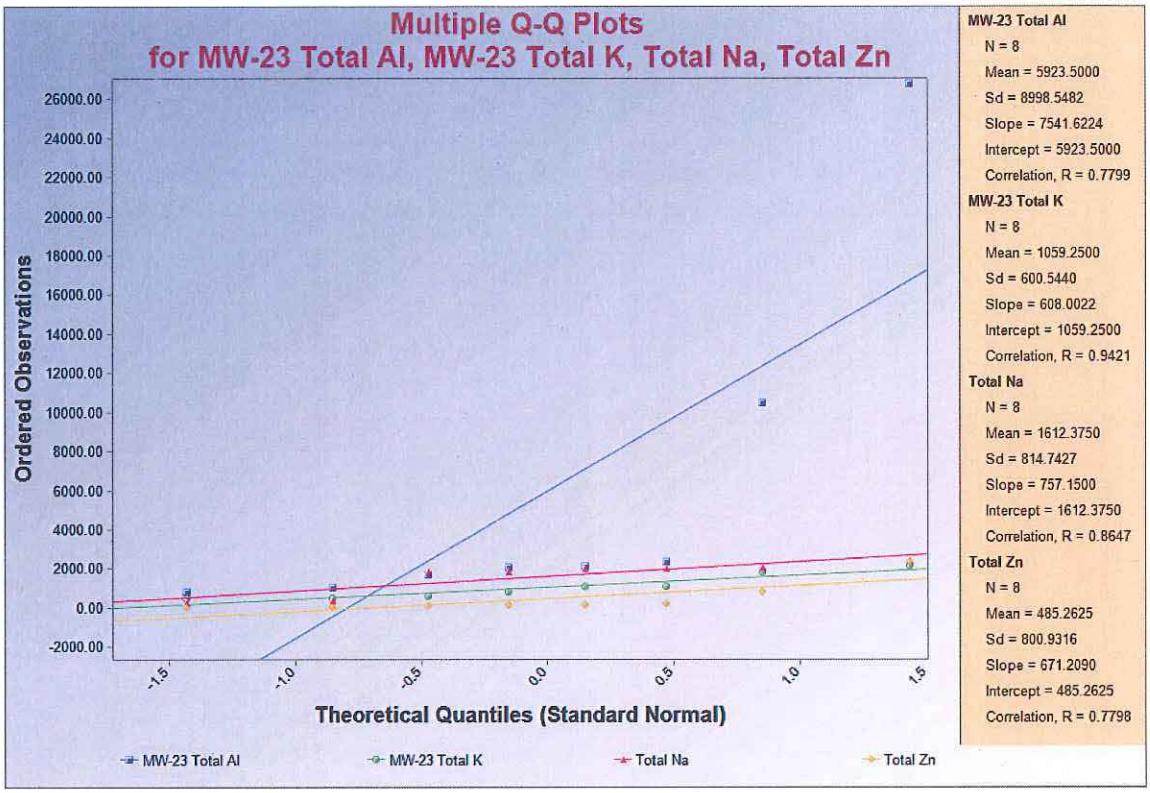

Multiple Q-Q Plots
for MW-22 Total Ba, ...
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total Ba
Total Cr
Total Co
Total Cu
Total Ni
MW-22 Total Ba
N = 8
Mean = 257.7500
Sd = 211.2911
Slope = 187.3193
Intercept = 257.7500
Correlation, R = 0.8249
Total Cr
N = 8
Mean = 330.7500
Sd = 744.6744
Slope = 535.9185
Intercept = 330.7500
Correlation, R = 0.6697
Total Co
N = 8
Mean = 107.6375
Sd = 170.2994
Slope = 149.0581
Intercept = 107.6375
Correlation, R = 0.8144
Total Cu
N = 8
Mean = 205.2925
Sd = 330.4741
Slope = 294.5455
Intercept = 205.2925
Correlation, R = 0.8293
Total Ni

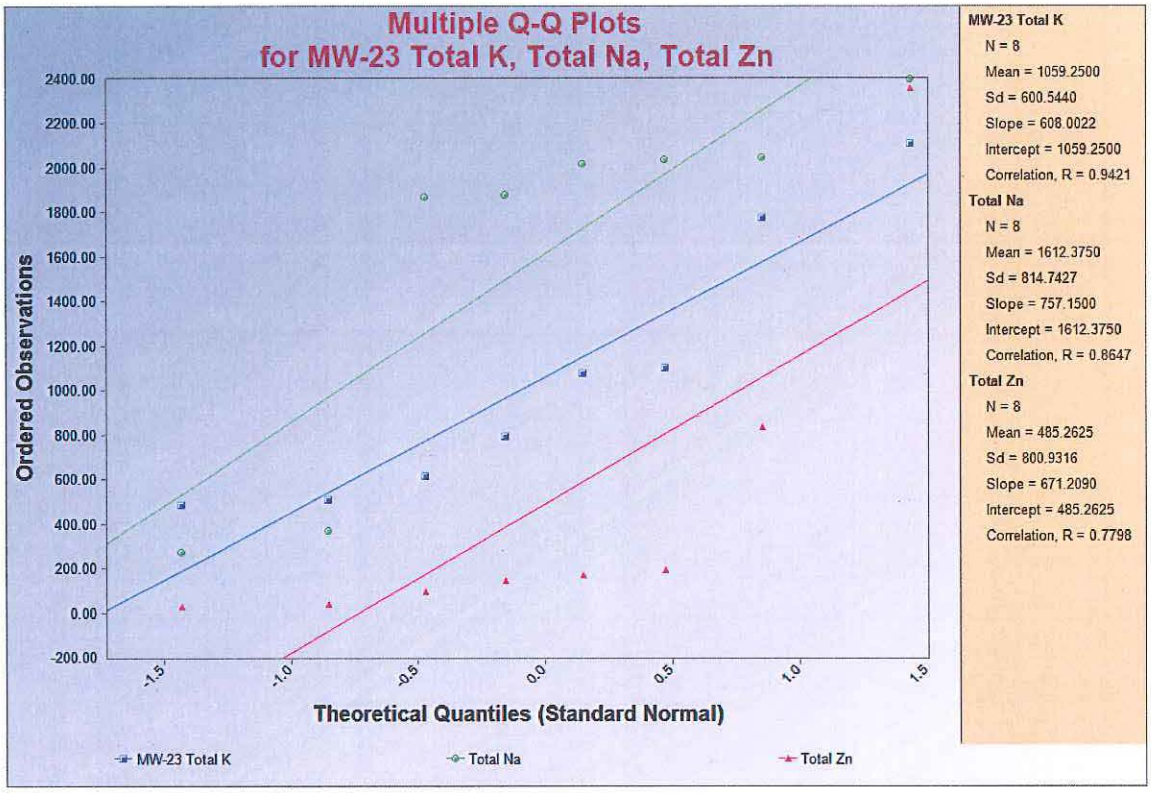

Multiple Q-Q Plots
for MW-22 Total Pb, Total V
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total Pb
Total V
MW-22 Total Pb
N = 8
Mean = 96.8750
Sd = 151.6206
Slope = 134.6593
Intercept = 96.8750
Correlation, R = 0.8264
Total V
N = 8
Mean = 37.6125
Sd = 57.5295
Slope = 51.9354
Intercept = 37.6125
Correlation, R = 0.8400

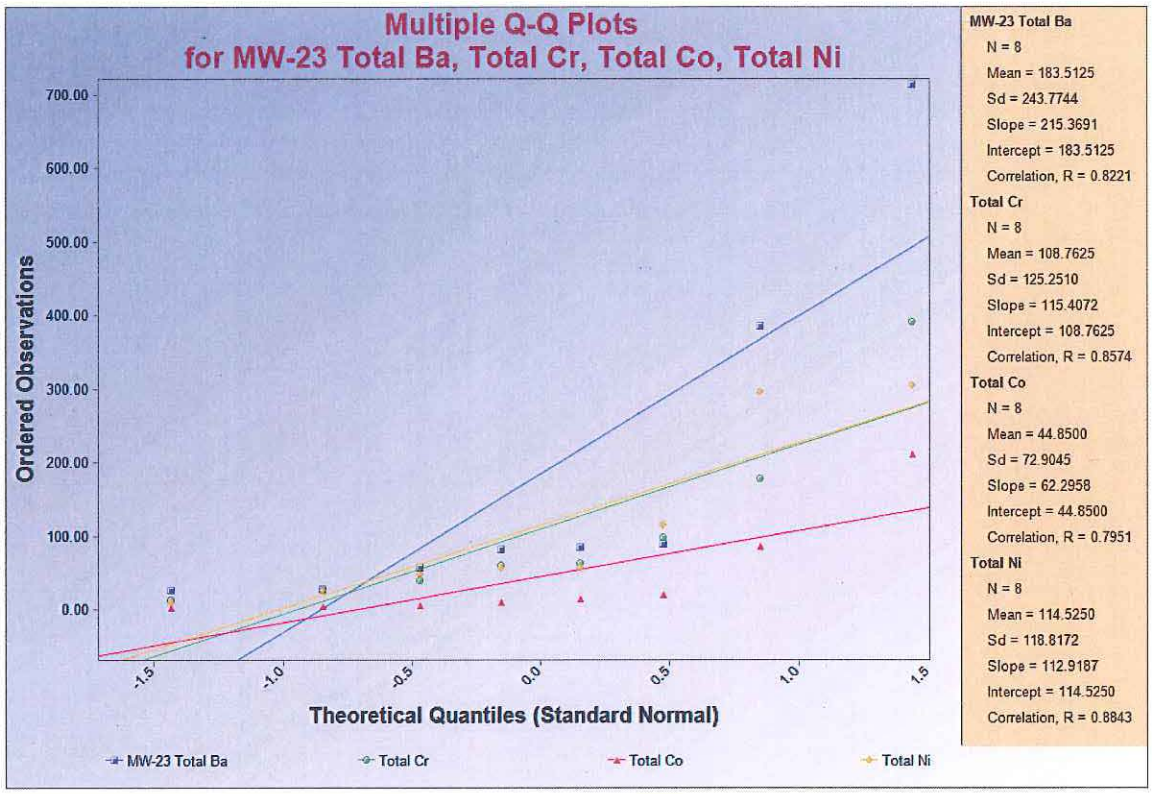

Multiple Q-Q Plots
for MW-22 Total As, Total Be, Total Hg
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-22 Total As
Total Be
Total Hg
MW-22 Total As
N = 8
Mean = 19.0875
Sd = 23.1397
Slope = 21.5305
Intercept = 19.0875
Correlation, R = 0.8658
Total Be
N = 8
Mean = 26.0200
Sd = 40.0106
Slope = 35.2780
Intercept = 26.0200
Correlation, R = 0.8204
Total Hg
N = 8
Mean = 19.7185
Sd = 18.5260
Slope = 18.7270
Intercept = 19.7185
Correlation, R = 0.9406

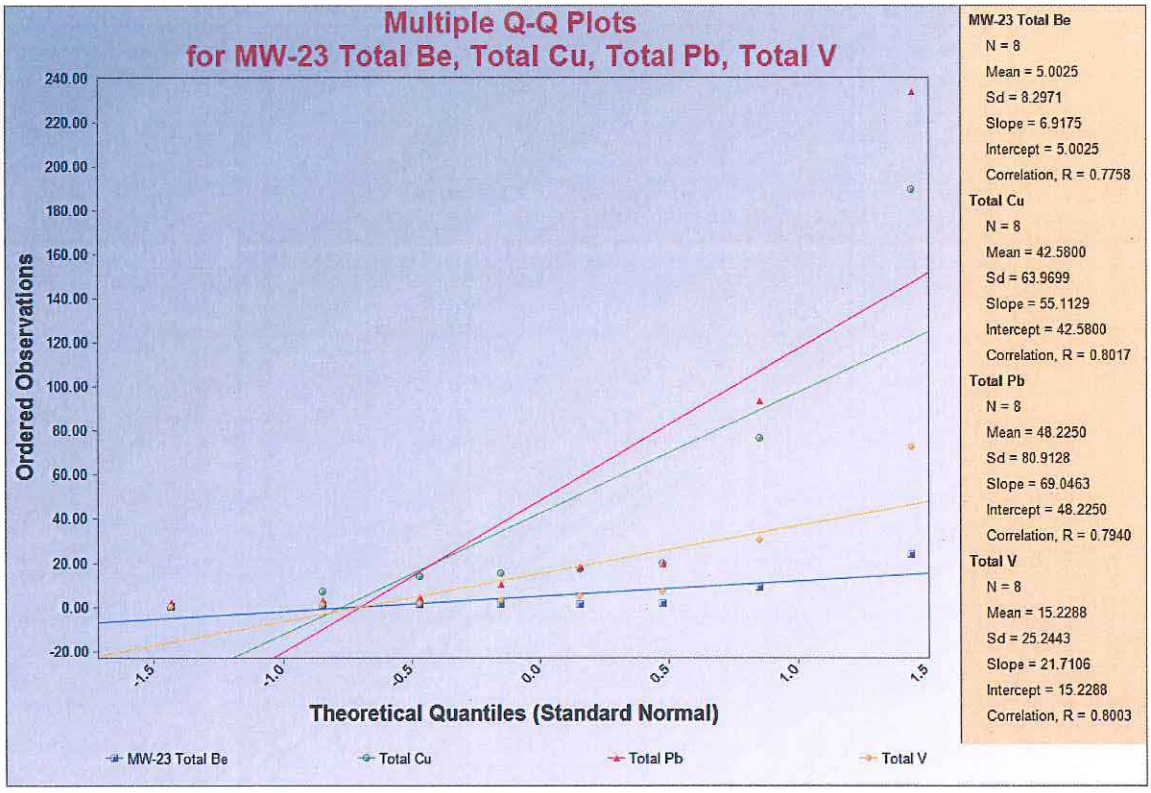

Multiple Q-Q Plots
for MW-23 Total Ca, Total Fe, Total Mg, Total Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Total Ca
Total Fe
Total Mg
Total Mn
MW-23 Total Ca
N = 8
Mean = 25750.0000
Sd = 3989.9875
Slope = 3970.1338
Intercept = 25750.0000
Correlation, R = 0.9259
Total Fe
N = 8
Mean = 76010.0000
Sd = 120065.0405
Slope = 102507.7771
Intercept = 76010.0000
Correlation, R = 0.7944
Total Mg
N = 8
Mean = 16762.5000
Sd = 1525.9072
Slope = 1606.8466
Intercept = 16762.5000
Correlation, R = 0.9799
Total Mn
N = 8
Mean = 2760.0000
Sd = 4335.7973
Slope = 3747.3781
Intercept = 2760.0000
Correlation, R = 0.8042

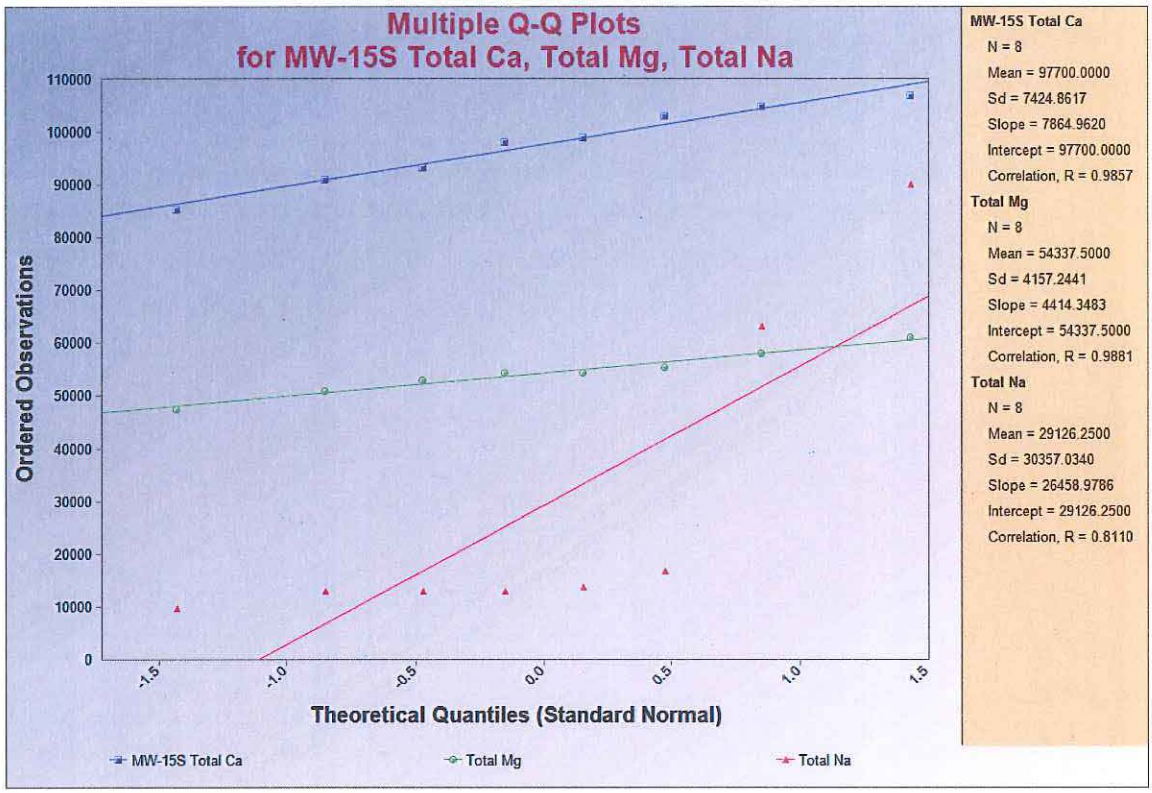

Multiple Q-Q Plots
for MW-23 Total Ca, Total Mg, Total Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Total Ca
Total Mg
Total Mn
MW-23 Total Ca
N = 8
Mean = 25750.0000
Sd = 3989.9875
Slope = 3970.1338
Intercept = 25750.0000
Correlation, R = 0.9259
Total Mg
N = 8
Mean = 16762.5000
Sd = 1525.9072
Slope = 1606.8466
Intercept = 16762.5000
Correlation, R = 0.9799
Total Mn
N = 8
Mean = 2760.0000
Sd = 4335.7973
Slope = 3747.3781
Intercept = 2760.0000
Correlation, R = 0.8042

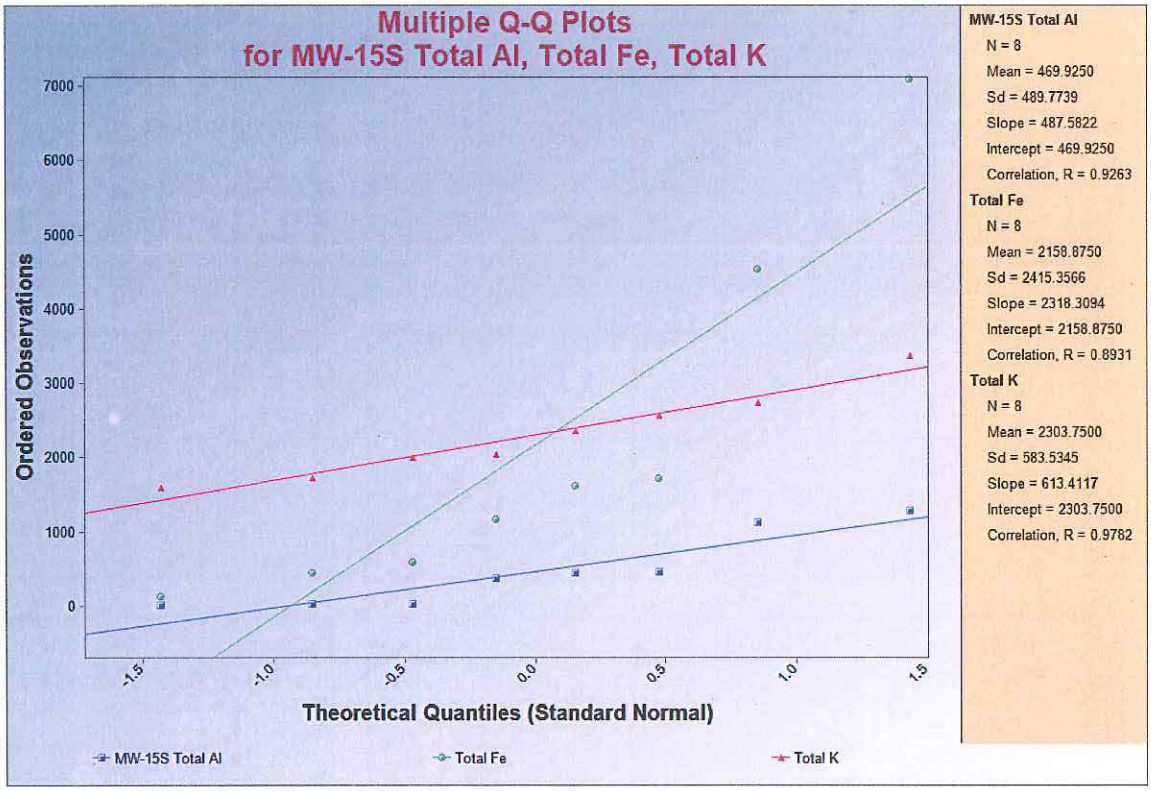

Multiple Q-Q Plots
for MW-23 Total Al, MW-23 Total K, Total Na, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Total Al
MW-23 Total K
Total Na
Total Zn
MW-23 Total Al
N = 8
Mean = 5923.5000
Sd = 8998.5482
Slope = 7541.6224
Intercept = 5923.5000
Correlation, R = 0.7799
MW-23 Total K
N = 8
Mean = 1059.2500
Sd = 600.5440
Slope = 608.0022
Intercept = 1059.2500
Correlation, R = 0.9421
Total Na
N = 8
Mean = 1612.3750
Sd = 814.7427
Slope = 757.1500
Intercept = 1612.3750
Correlation, R = 0.8647
Total Zn
N = 8
Mean = 485.2625
Sd = 800.9316
Slope = 671.2090
Intercept = 485.2625
Correlation, R = 0.7798

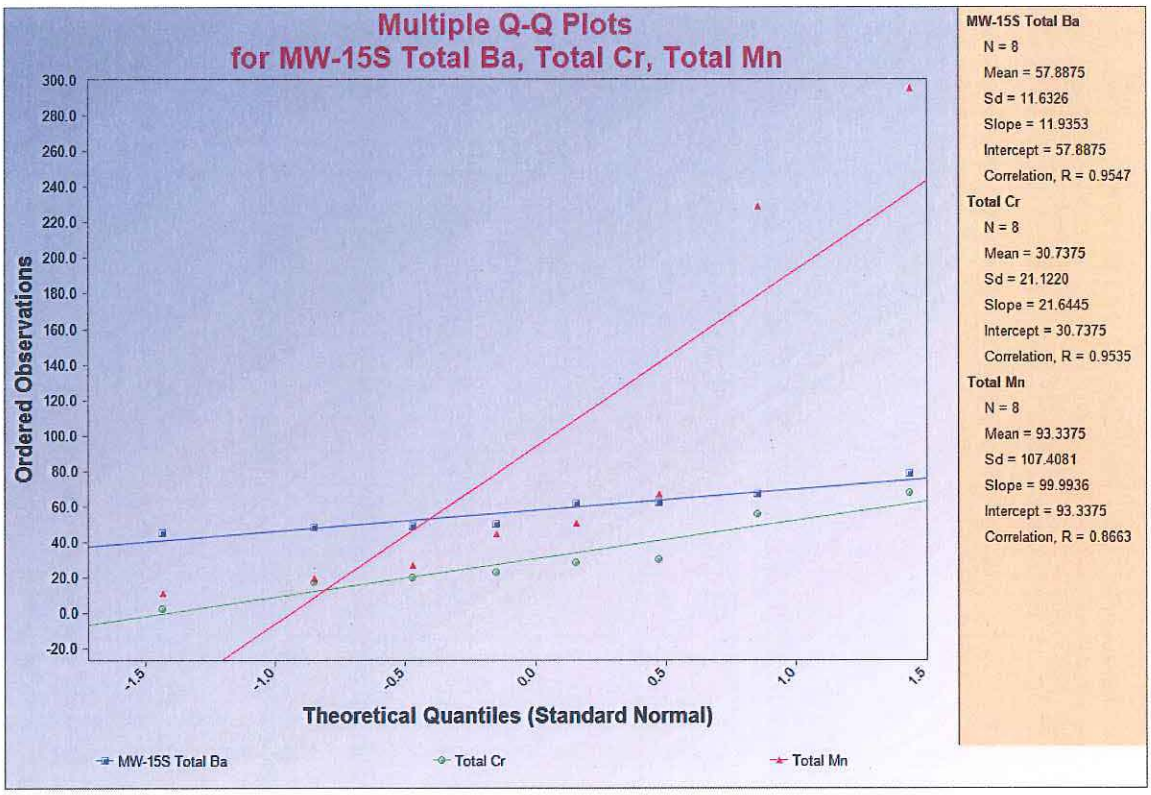

Multiple Q-Q Plots
for MW-23 Total K, Total Na, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-23 Total K
Total Na
Total Zn
MW-23 Total K
N = 8
Mean = 1059.2500
Sd = 600.5440
Slope = 608.0022
Intercept = 1059.2500
Correlation, R = 0.9421
Total Na
N = 8
Mean = 1612.3750
Sd = 814.7427
Slope = 757.1500
Intercept = 1612.3750
Correlation, R = 0.8647
Total Zn
N = 8
Mean = 485.2625
Sd = 800.9316
Slope = 671.2090
Intercept = 485.2625
Correlation, R = 0.7798

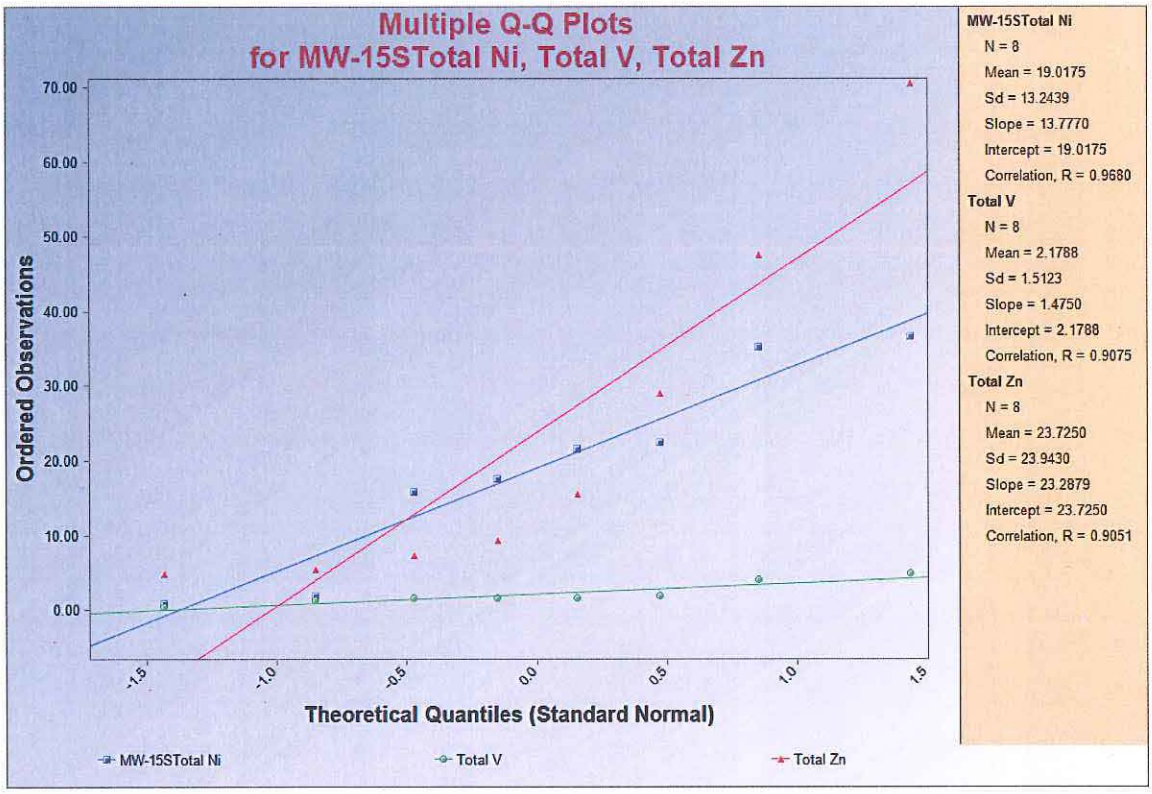

Multiple Q-Q Plots
for MW-23 Total Ba, Total Cr, Total Co, Total Ni
Ordered Observations
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
MW-23 Total Ba
Total Cr
Total Co
Total Ni
MW-23 Total Ba
N = 8
Mean = 183.5125
Sd = 243.7744
Slope = 215.3691
Intercept = 183.5125
Correlation, R = 0.8221
Total Cr
N = 8
Mean = 108.7625
Sd = 125.2510
Slope = 115.4072
Intercept = 108.7625
Correlation, R = 0.8574
Total Co
N = 8
Mean = 44.8500
Sd = 72.9045
Slope = 62.2958
Intercept = 44.8500
Correlation, R = 0.7951
Total Ni
N = 8
Mean = 114.5250
Sd = 118.8172
Slope = 112.9187
Intercept = 114.5250
Correlation, R = 0.8843

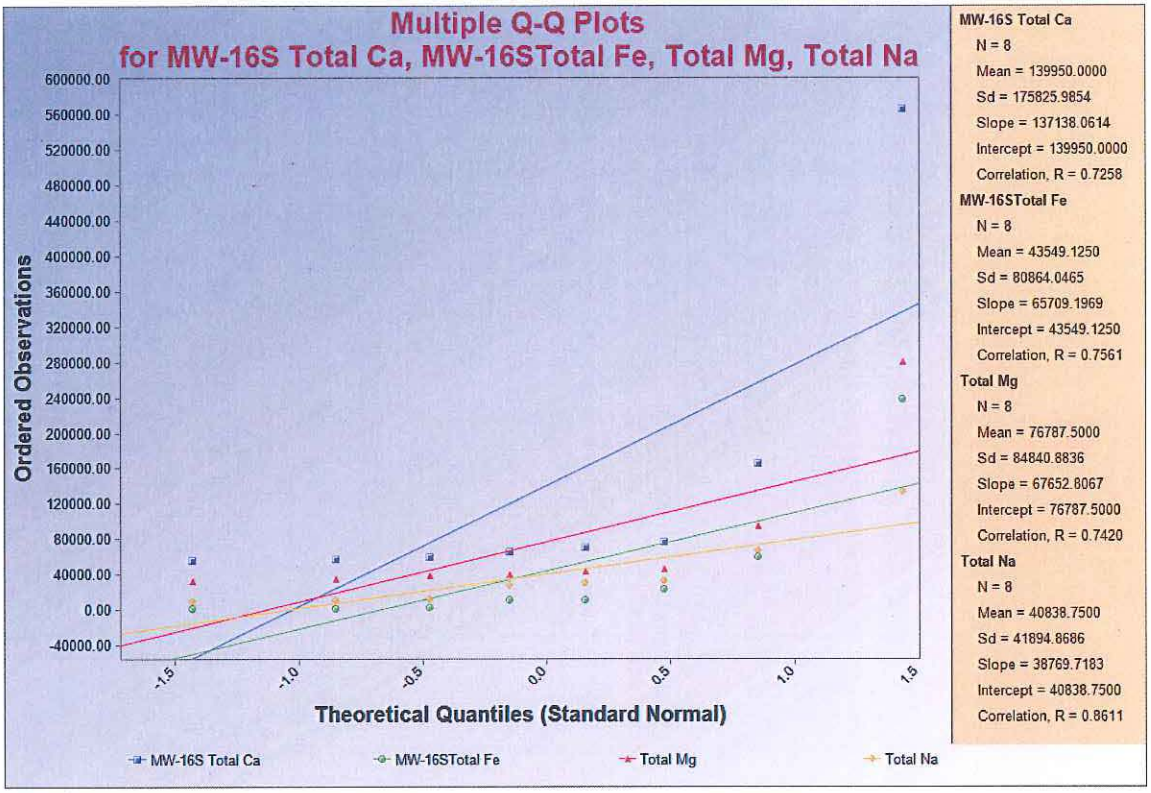

Multiple Q-Q Plots
for MW-23 Total Be, Total Cu, Total Pb, Total V
Ordered Observations
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
MW-23 Total Be
Total Cu
Total Pb
Total V
MW-23 Total Be
N = 8
Mean = 5.0025
Sd = 8.2971
Slope = 6.9175
Intercept = 5.0025
Correlation, R = 0.7758
Total Cu
N = 8
Mean = 42.5800
Sd = 63.9699
Slope = 55.1129
Intercept = 42.5800
Correlation, R = 0.8017
Total Pb
N = 8
Mean = 48.2250
Sd = 80.9128
Slope = 69.0463
Intercept = 48.2250
Correlation, R = 0.7940
Total V
N = 8
Mean = 15.2288
Sd = 25.2443
Slope = 21.7106
Intercept = 15.2288
Correlation, R = 0.8003

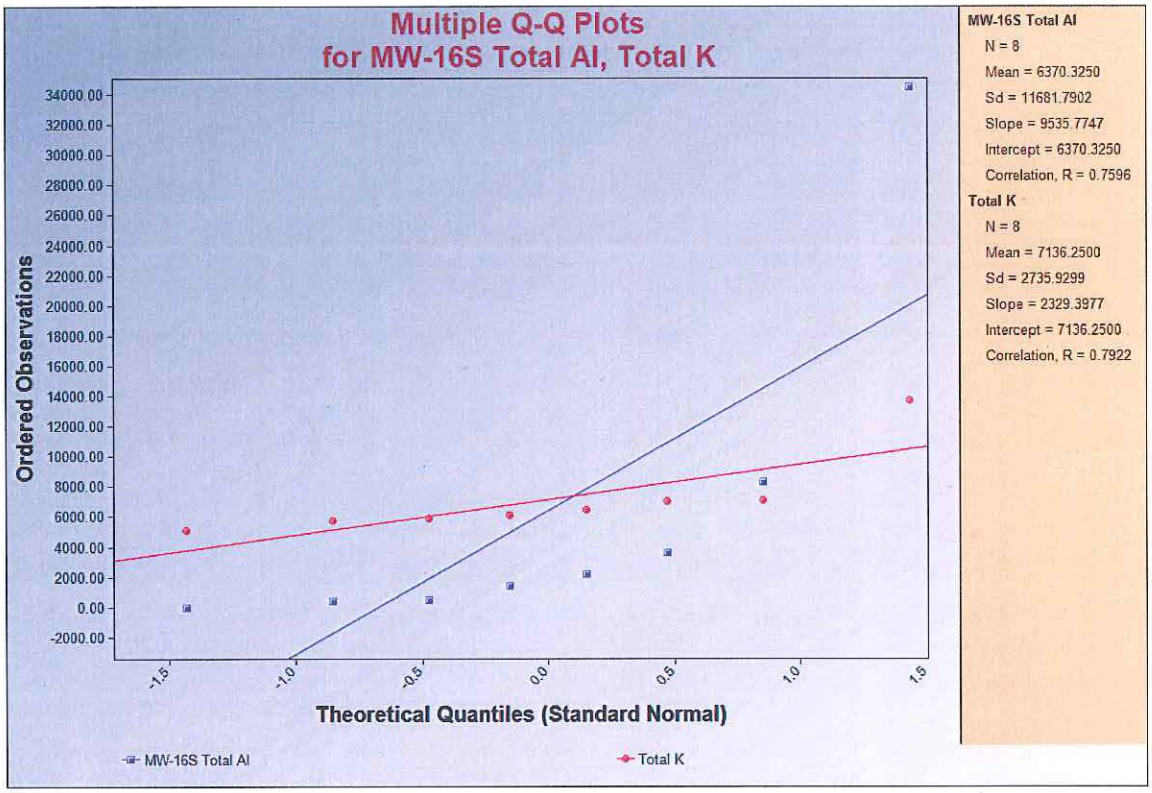

Multiple Q-Q Plots
for MW-15S Total Ca, Total Mg, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Total Ca
Total Mg
Total Na
MW-15S Total Ca
N = 8
Mean = 97700.0000
Sd = 7424.8617
Slope = 7864.9620
Intercept = 97700.0000
Correlation, R = 0.9857
Total Mg
N = 8
Mean = 54337.5000
Sd = 4157.2441
Slope = 4414.3483
Intercept = 54337.5000
Correlation, R = 0.9881
Total Na
N = 8
Mean = 29126.2500
Sd = 30357.0340
Slope = 26458.9786
Intercept = 29126.2500
Correlation, R = 0.8110

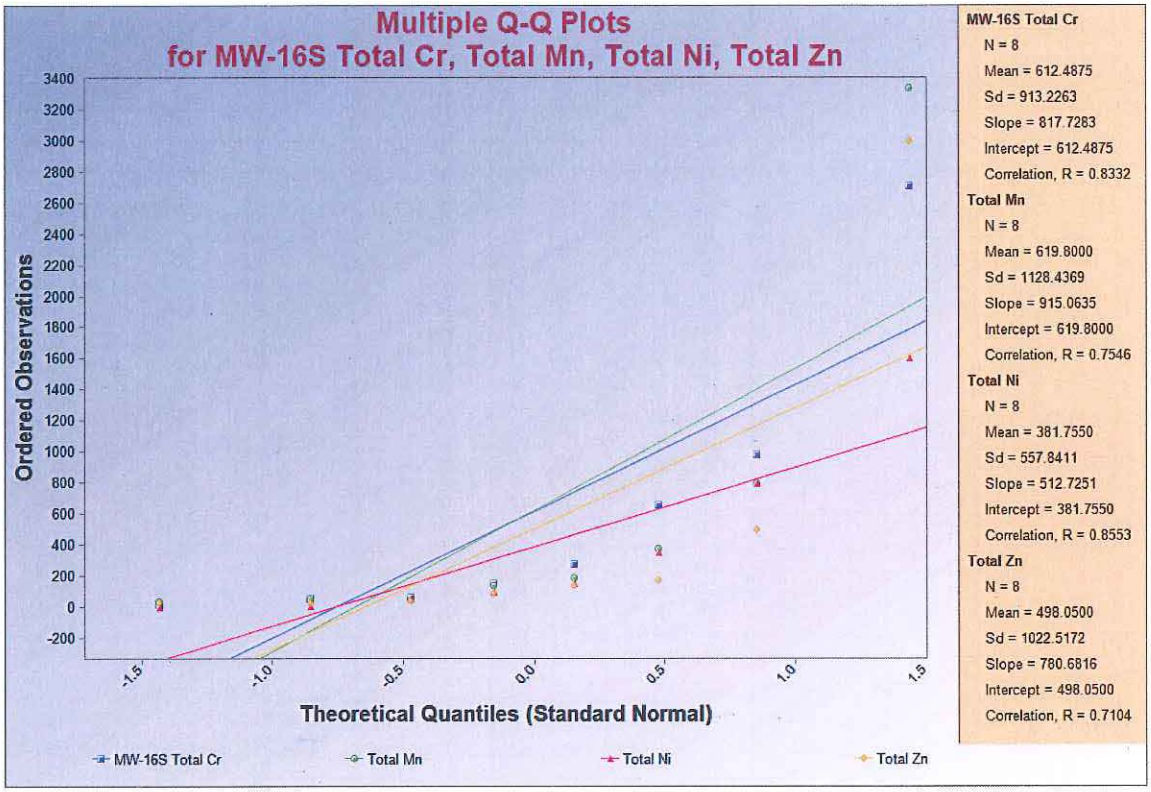

Multiple Q-Q Plots
for MW-15S Total Al, Total Fe, Total K
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Total Al
Total Fe
Total K
MW-15S Total Al
N = 8
Mean = 469.9250
Sd = 489.7739
Slope = 487.5822
Intercept = 469.9250
Correlation, R = 0.9263
Total Fe
N = 8
Mean = 2158.8750
Sd = 2415.3566
Slope = 2318.3094
Intercept = 2158.8750
Correlation, R = 0.8931
Total K
N = 8
Mean = 2303.7500
Sd = 583.5345
Slope = 613.4117
Intercept = 2303.7500
Correlation, R = 0.9782

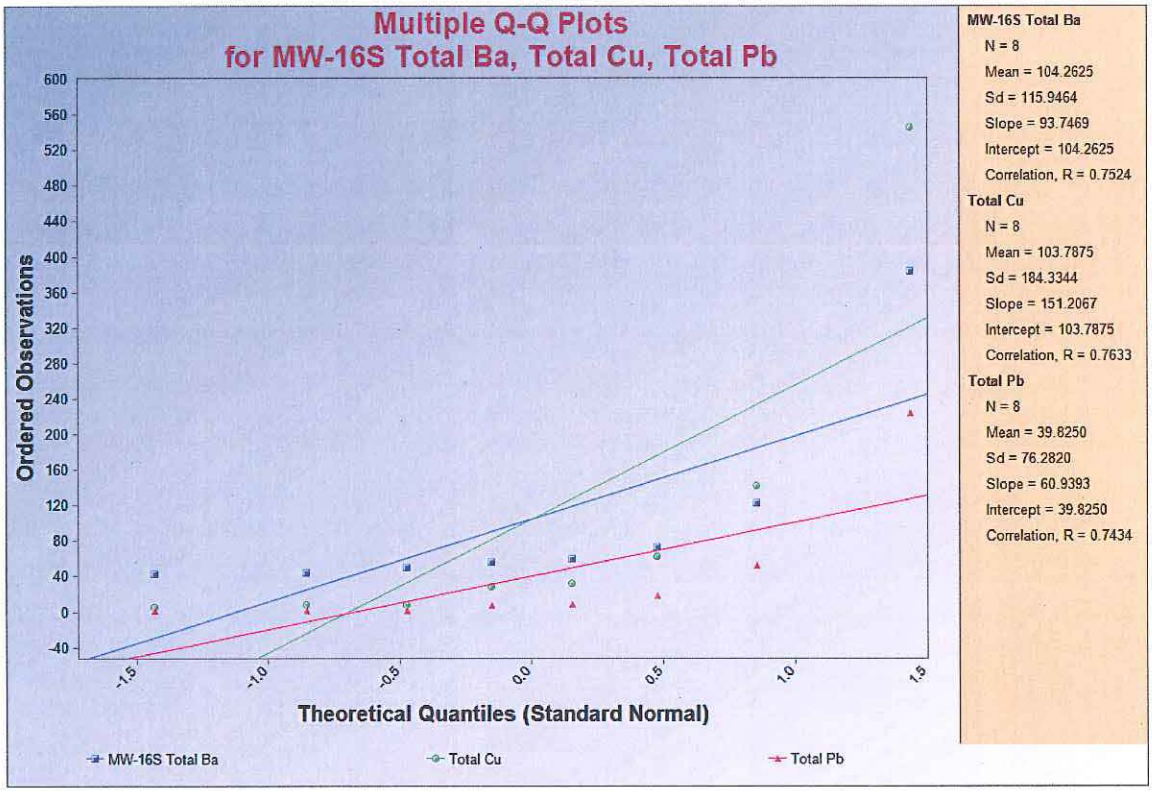

Multiple Q-Q Plots
for MW-15S Total Ba, Total Cr, Total Mn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15S Total Ba
Total Cr
Total Mn
MW-15S Total Ba
N = 8
Mean = 57.8875
Sd = 11.6326
Slope = 11.9353
Intercept = 57.8875
Correlation, R = 0.9547
Total Cr
N = 8
Mean = 30.7375
Sd = 21.1220
Slope = 21.6445
Intercept = 30.7375
Correlation, R = 0.9535
Total Mn
N = 8
Mean = 93.3375
Sd = 107.4081
Slope = 99.9936
Intercept = 93.3375
Correlation, R = 0.8663

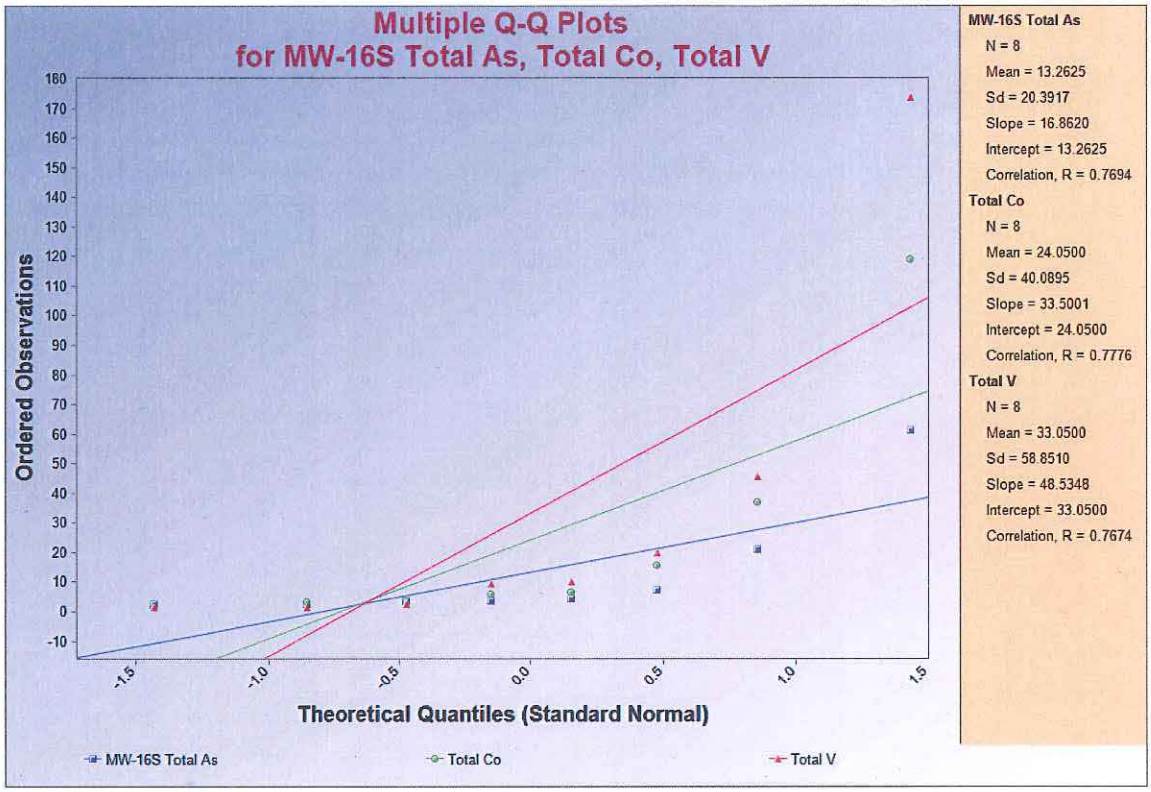

Multiple Q-Q Plots
for MW-15STotal Ni, Total V, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-15STotal Ni
Total V
Total Zn
MW-15STotal Ni
N = 8
Mean = 19.0175
Sd = 13.2439
Slope = 13.7770
Intercept = 19.0175
Correlation, R = 0.9680
Total V
N = 8
Mean = 2.1788
Sd = 1.5123
Slope = 1.4750
Intercept = 2.1788
Correlation, R = 0.9075
Total Zn
N = 8
Mean = 23.7250
Sd = 23.9430
Slope = 23.2879
Intercept = 23.7250
Correlation, R = 0.9051

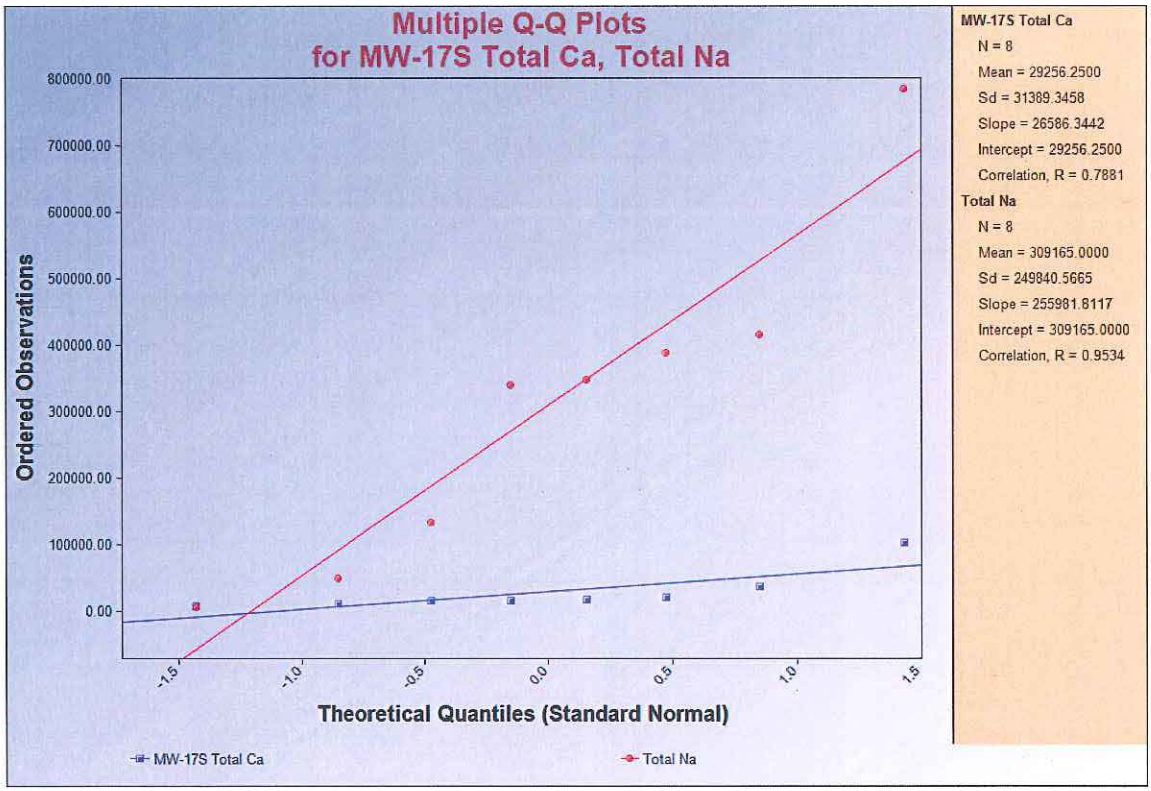

Multiple Q-Q Plots
for MW-16S Total Ca, MW-16STotal Fe, Total Mg, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Total Ca
MW-16STotal Fe
Total Mg
Total Na
MW-16S Total Ca
N = 8
Mean = 139950.0000
Sd = 175825.9854
Slope = 137138.0614
Intercept = 139950.0000
Correlation, R = 0.7258
MW-16STotal Fe
N = 8
Mean = 43549.1250
Sd = 80864.0465
Slope = 65709.1969
Intercept = 43549.1250
Correlation, R = 0.7561
Total Mg
N = 8
Mean = 76787.5000
Sd = 84840.8836
Slope = 67652.8067
Intercept = 76787.5000
Correlation, R = 0.7420
Total Na
N = 8
Mean = 40838.7500
Sd = 41894.8686
Slope = 38769.7183
Intercept = 40838.7500
Correlation, R = 0.8611

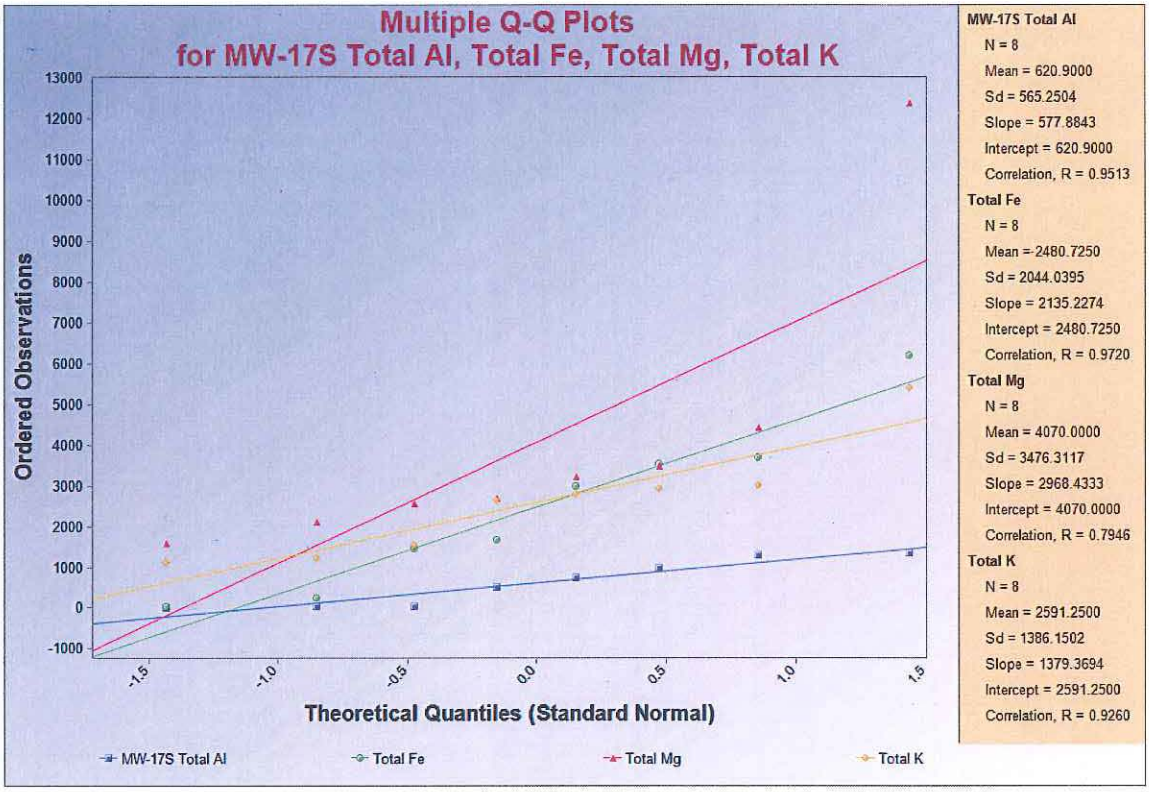

Multiple Q-Q Plots
for MW-16S Total Al, Total K
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Total Al
Total K
MW-16S Total Al
N = 8
Mean = 6370.3250
Sd = 11681.7902
Slope = 9535.7747
Intercept = 6370.3250
Correlation, R = 0.7596
Total K
N = 8
Mean = 7136.2500
Sd = 2735.9299
Slope = 2329.3977
Intercept = 7136.2500
Correlation, R = 0.7922

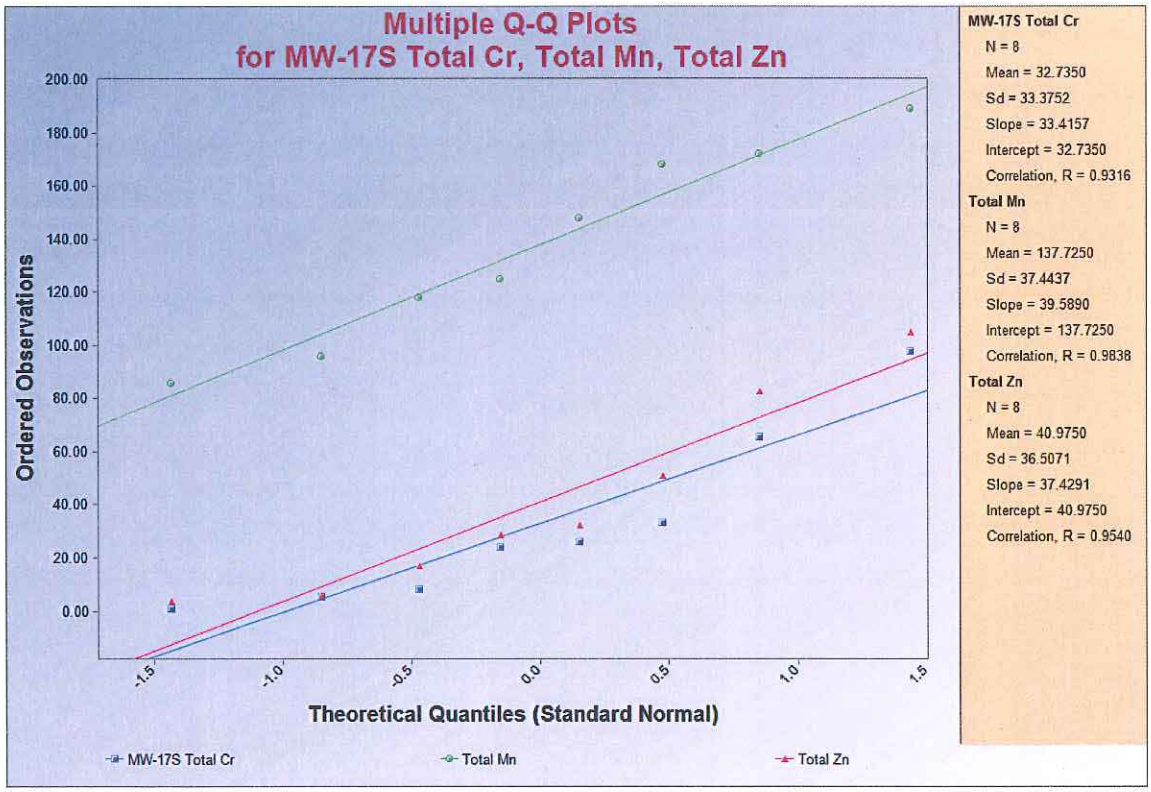

Multiple Q-Q Plots
for MW-16S Total Cr, Total Mn, Total Ni, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Total Cr
Total Mn
Total Ni
Total Zn
MW-16S Total Cr
N = 8
Mean = 612.4875
Sd = 913.2263
Slope = 817.7283
Intercept = 612.4875
Correlation, R = 0.8332
Total Mn
N = 8
Mean = 619.8000
Sd = 1128.4369
Slope = 915.0635
Intercept = 619.8000
Correlation, R = 0.7546
Total Ni
N = 8
Mean = 381.7550
Sd = 557.8411
Slope = 512.7251
Intercept = 381.7550
Correlation, R = 0.8553
Total Zn
N = 8
Mean = 498.0500
Sd = 1022.5172
Slope = 780.6816
Intercept = 498.0500
Correlation, R = 0.7104

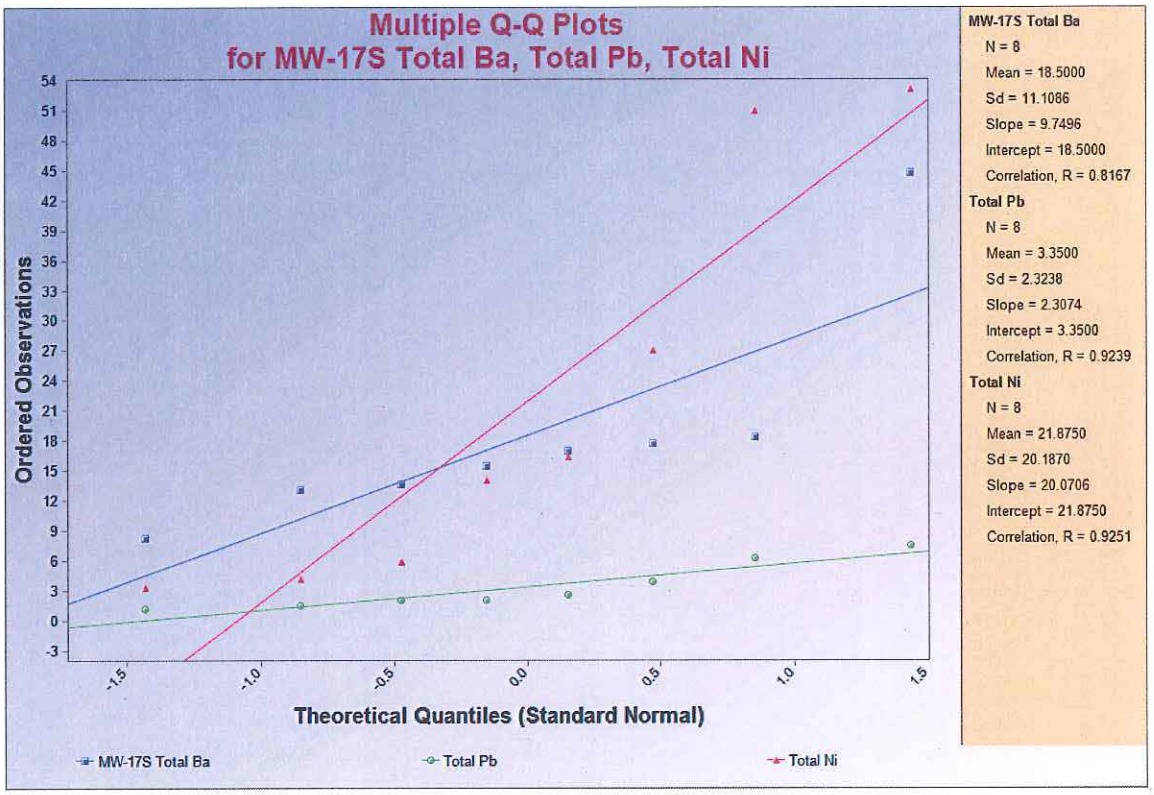

Multiple Q-Q Plots
for MW-16S Total Ba, Total Cu, Total Pb
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Total Ba
Total Cu
Total Pb
MW-16S Total Ba
N = 8
Mean = 104.2625
Sd = 115.9464
Slope = 93.7469
Intercept = 104.2625
Correlation, R = 0.7524
Total Cu
N = 8
Mean = 103.7875
Sd = 184.3344
Slope = 151.2067
Intercept = 103.7875
Correlation, R = 0.7633
Total Pb
N = 8
Mean = 39.8250
Sd = 76.2820
Slope = 60.9393
Intercept = 39.8250
Correlation, R = 0.7434

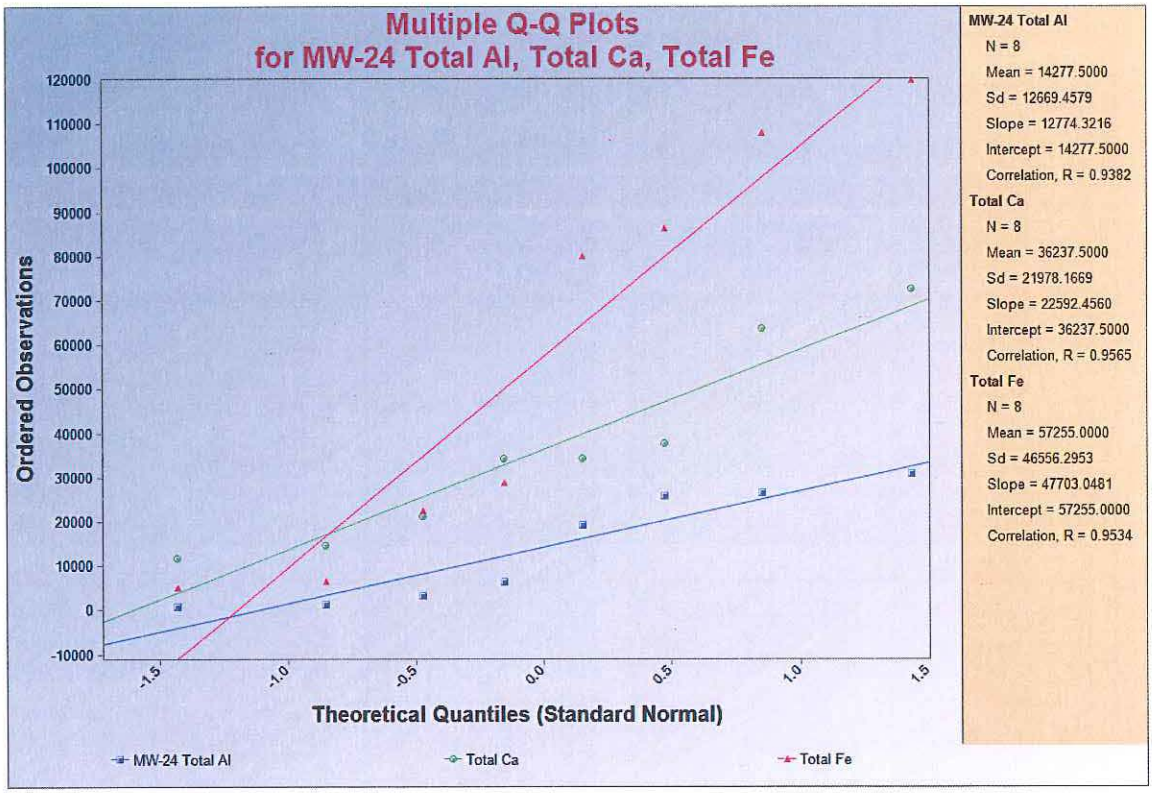

Multiple Q-Q Plots
for MW-16S Total As, Total Co, Total V
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-16S Total As
Total Co
Total V
MW-16S Total As
N = 8
Mean = 13.2625
Sd = 20.3917
Slope = 16.8620
Intercept = 13.2625
Correlation, R = 0.7694
Total Co
N = 8
Mean = 24.0500
Sd = 40.0895
Slope = 33.5001
Intercept = 24.0500
Correlation, R = 0.7776
Total V
N = 8
Mean = 33.0500
Sd = 58.8510
Slope = 48.5348
Intercept = 33.0500
Correlation, R = 0.7674

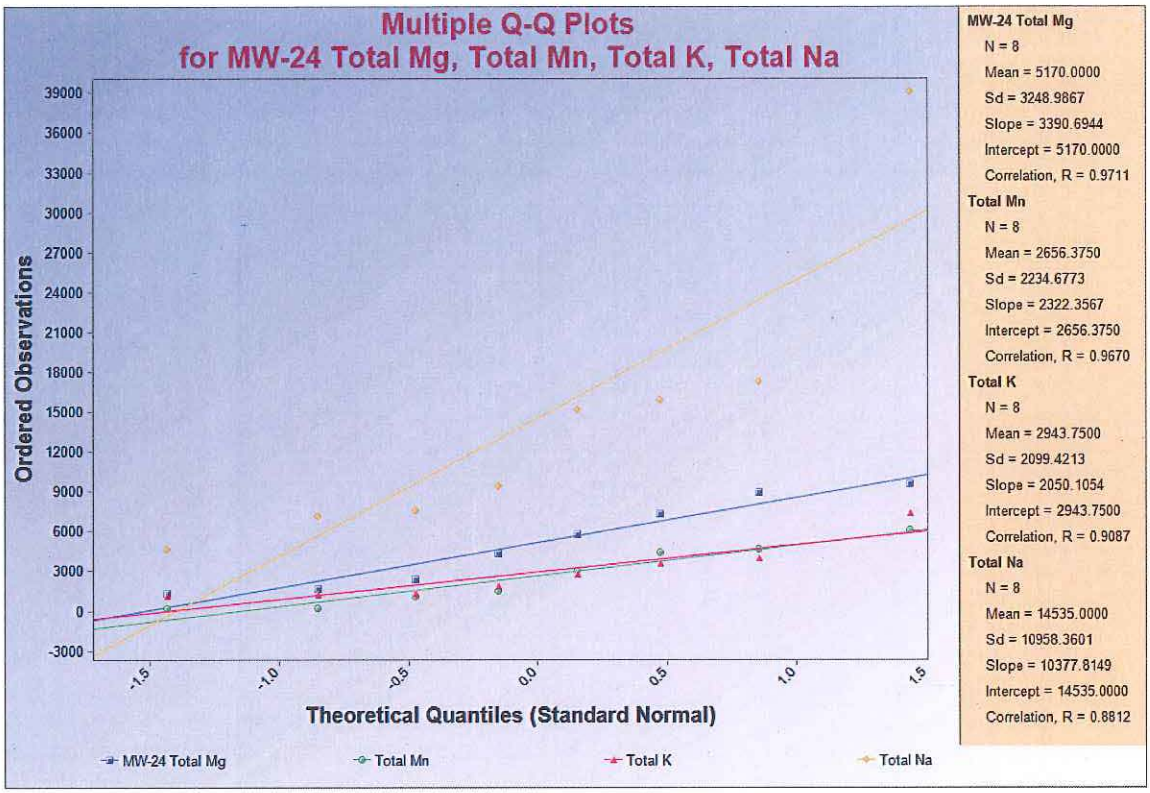

Multiple Q-Q Plots
for MW-17S Total Ca, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Total Ca
Total Na
MW-17S Total Ca
N = 8
Mean = 29256.2500
Sd = 31389.3458
Slope = 26586.3442
Intercept = 29256.2500
Correlation, R = 0.7881
Total Na
N = 8
Mean = 309165.0000
Sd = 249840.5665
Slope = 255981.8117
Intercept = 309165.0000
Correlation, R = 0.9534

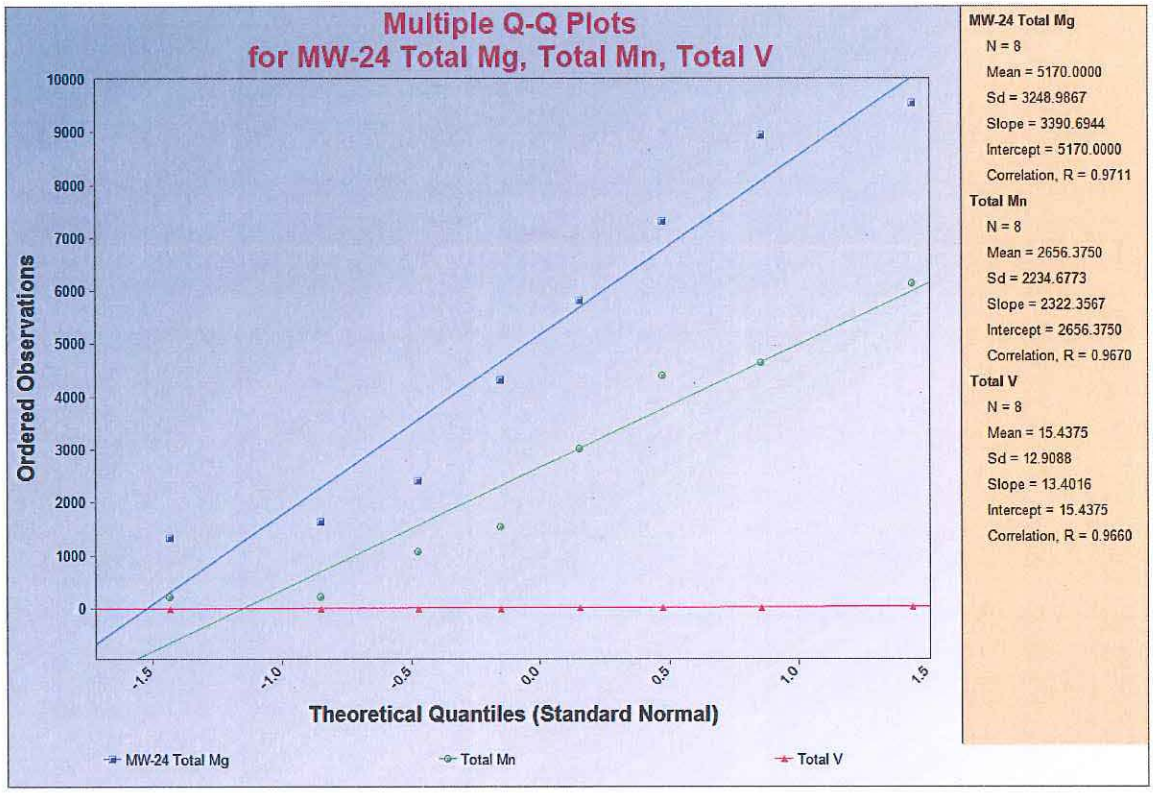

Multiple Q-Q Plots
for MW-17S Total Al, Total Fe, Total Mg, Total K
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Total Al
Total Fe
Total Mg
Total K
MW-17S Total Al
N = 8
Mean = 620.9000
Sd = 565.2504
Slope = 577.8843
Intercept = 620.9000
Correlation, R = 0.9513
Total Fe
N = 8
Mean = 2480.7250
Sd = 2044.0395
Slope = 2135.2274
Intercept = 2480.7250
Correlation, R = 0.9720
Total Mg
N = 8
Mean = 4070.0000
Sd = 3476.3117
Slope = 2968.4333
Intercept = 4070.0000
Correlation, R = 0.7946
Total K
N = 8
Mean = 2591.2500
Sd = 1386.1502
Slope = 1379.3694
Intercept = 2591.2500
Correlation, R = 0.9260

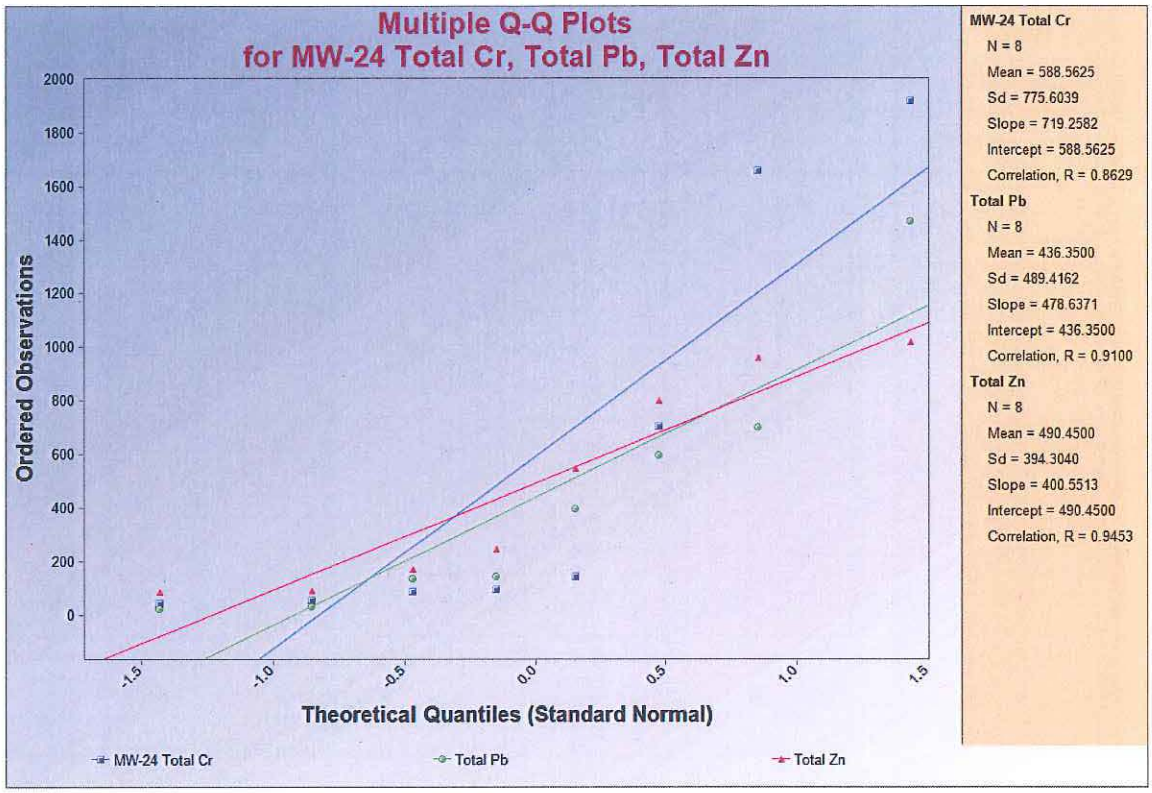

Multiple Q-Q Plots
for MW-17S Total Cr, Total Mn, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Total Cr
Total Mn
Total Zn
MW-17S Total Cr
N = 8
Mean = 32.7350
Sd = 33.3752
Slope = 33.4157
Intercept = 32.7350
Correlation, R = 0.9316
Total Mn
N = 8
Mean = 137.7250
Sd = 37.4437
Slope = 39.5890
Intercept = 137.7250
Correlation, R = 0.9838
Total Zn
N = 8
Mean = 40.9750
Sd = 36.5071
Slope = 37.4291
Intercept = 40.9750
Correlation, R = 0.9540

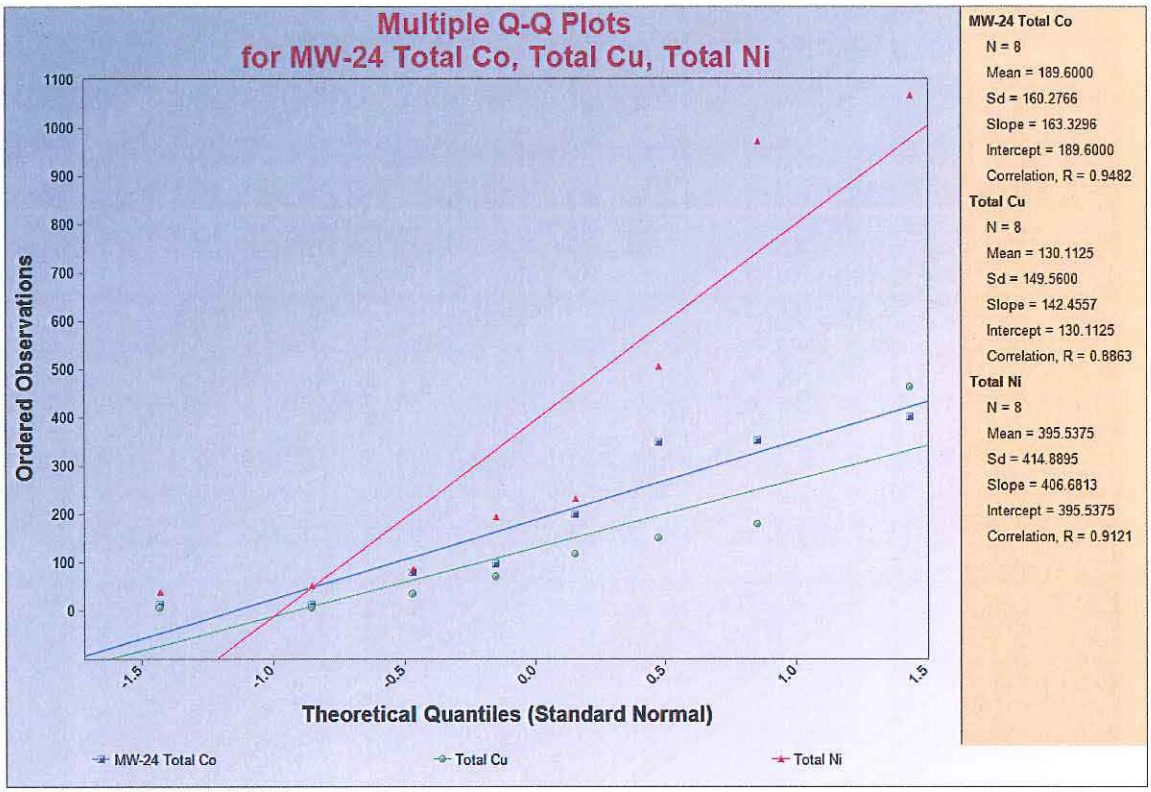

Multiple Q-Q Plots
for MW-17S Total Ba, Total Pb, Total Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-17S Total Ba
Total Pb
Total Ni
MW-17S Total Ba
N = 8
Mean = 18.5000
Sd = 11.1086
Slope = 9.7496
Intercept = 18.5000
Correlation, R = 0.8167
Total Pb
N = 8
Mean = 3.3500
Sd = 2.3238
Slope = 2.3074
Intercept = 3.3500
Correlation, R = 0.9239
Total Ni
N = 8
Mean = 21.8750
Sd = 20.1870
Slope = 20.0706
Intercept = 21.8750
Correlation, R = 0.9251

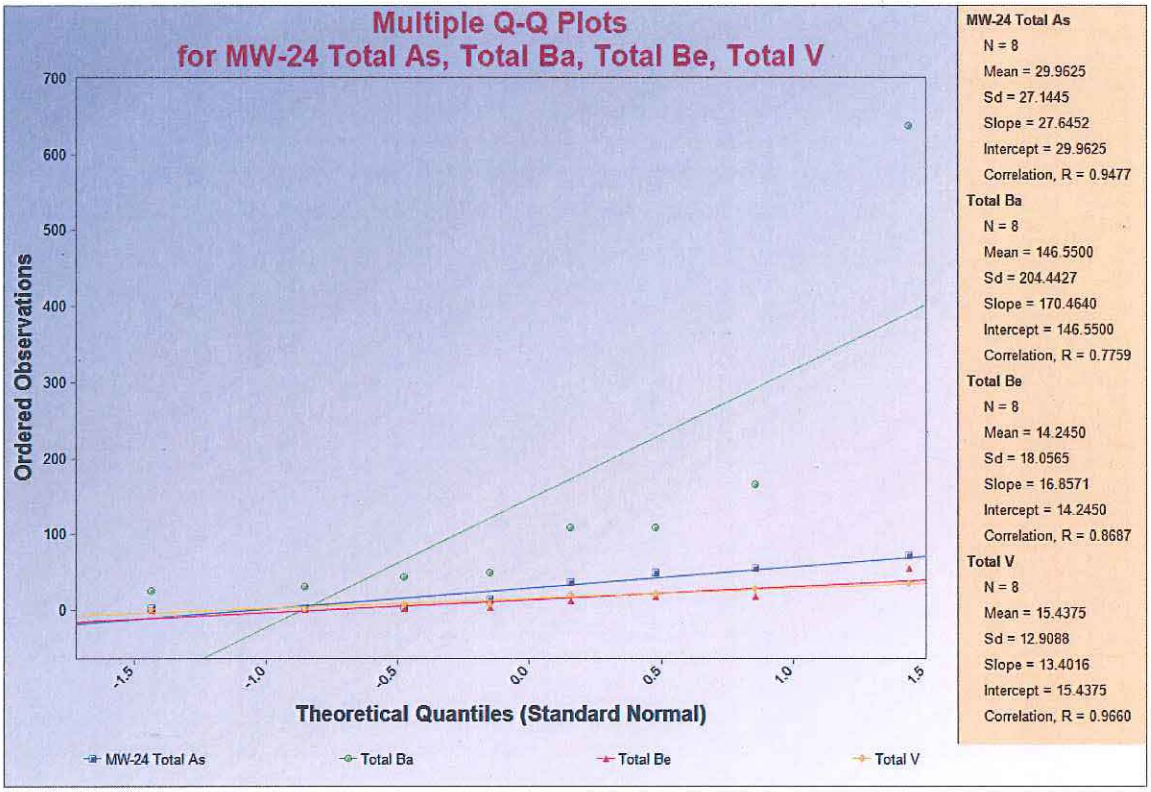

Multiple Q-Q Plots
for MW-24 Total Al, Total Ca, Total Fe
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total Al
Total Ca
Total Fe
MW-24 Total Al
N = 8
Mean = 14277.5000
Sd = 12669.4579
Slope = 12774.3216
Intercept = 14277.5000
Correlation, R = 0.9382
Total Ca
N = 8
Mean = 36237.5000
Sd = 21978.1669
Slope = 22592.4560
Intercept = 36237.5000
Correlation, R = 0.9565
Total Fe
N = 8
Mean = 57255.0000
Sd = 46556.2953
Slope = 47703.0481
Intercept = 57255.0000
Correlation, R = 0.9534

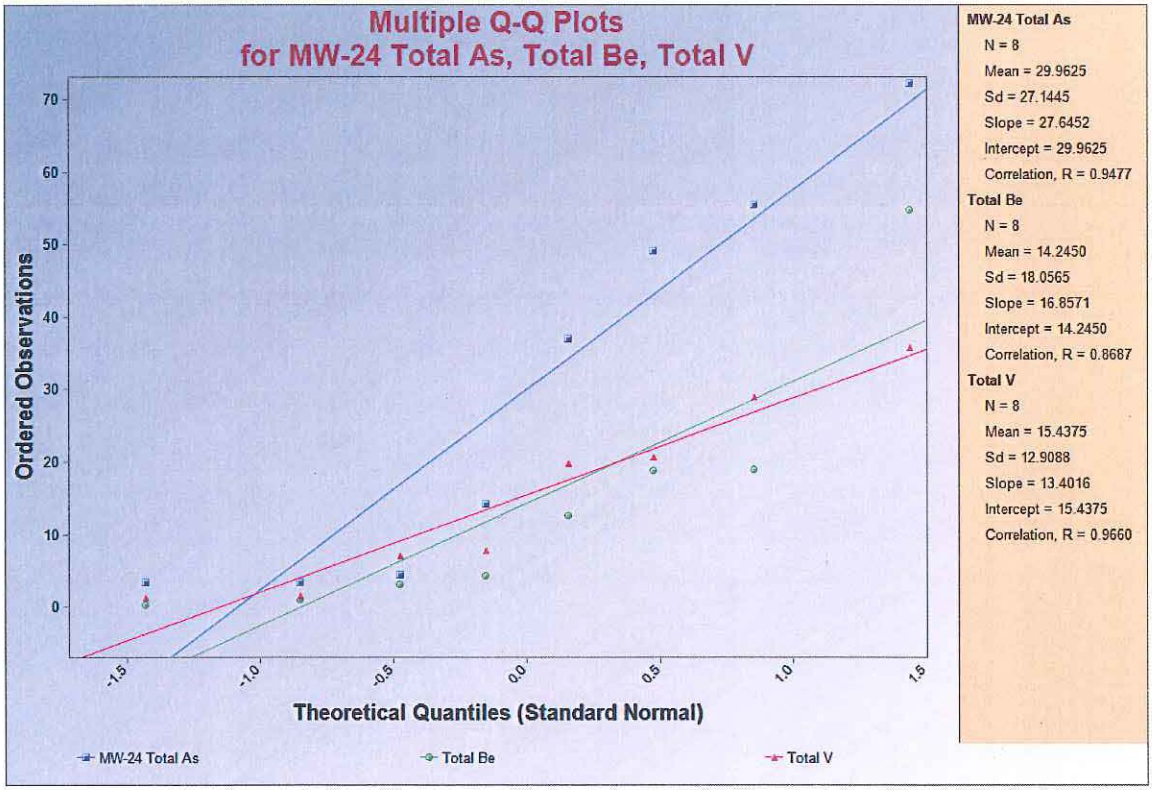

Multiple Q-Q Plots
for MW-24 Total Mg, Total Mn, Total K, Total Na
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total Mg
Total Mn
Total K
Total Na
MW-24 Total Mg
N = 8
Mean = 5170.0000
Sd = 3248.9867
Slope = 3390.6944
Intercept = 5170.0000
Correlation, R = 0.9711
Total Mn
N = 8
Mean = 2656.3750
Sd = 2234.6773
Slope = 2322.3567
Intercept = 2656.3750
Correlation, R = 0.9670
Total K
N = 8
Mean = 2943.7500
Sd = 2099.4213
Slope = 2050.1054
Intercept = 2943.7500
Correlation, R = 0.9087
Total Na
N = 8
Mean = 14535.0000
Sd = 10958.3601
Slope = 10377.8149
Intercept = 14535.0000
Correlation, R = 0.8812


Multiple Q-Q Plots
for MW-24 Total Mg, Total Mn, Total V
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total Mg
Total Mn
Total V
MW-24 Total Mg
N = 8
Mean = 5170.0000
Sd = 3248.9867
Slope = 3390.6944
Intercept = 5170.0000
Correlation, R = 0.9711
Total Mn
N = 8
Mean = 2656.3750
Sd = 2234.6773
Slope = 2322.3567
Intercept = 2656.3750
Correlation, R = 0.9670
Total V
N = 8
Mean = 15.4375
Sd = 12.9088
Slope = 13.4016
Intercept = 15.4375
Correlation, R = 0.9660


Multiple Q-Q Plots
for MW-24 Total Cr, Total Pb, Total Zn
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total Cr
Total Pb
Total Zn
MW-24 Total Cr
N = 8
Mean = 588.5625
Sd = 775.6039
Slope = 719.2582
Intercept = 588.5625
Correlation, R = 0.8629
Total Pb
N = 8
Mean = 436.3500
Sd = 489.4162
Slope = 478.6371
Intercept = 436.3500
Correlation, R = 0.9100
Total Zn
N = 8
Mean = 490.4500
Sd = 394.3040
Slope = 400.5513
Intercept = 490.4500
Correlation, R = 0.9453


Multiple Q-Q Plots
for MW-24 Total Co, Total Cu, Total Ni
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total Co
Total Cu
Total Ni
MW-24 Total Co
N = 8
Mean = 189.6000
Sd = 160.2766
Slope = 163.3296
Intercept = 189.6000
Correlation, R = 0.9482
Total Cu
N = 8
Mean = 130.1125
Sd = 149.5600
Slope = 142.4557
Intercept = 130.1125
Correlation, R = 0.8863
Total Ni
N = 8
Mean = 395.5375
Sd = 414.8895
Slope = 406.6813
Intercept = 395.5375
Correlation, R = 0.9121


Multiple Q-Q Plots
for MW-24 Total As, Total Ba, Total Be, Total V
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total As
Total Ba
Total Be
Total V
MW-24 Total As
N = 8
Mean = 29.9625
Sd = 27.1445
Slope = 27.6452
Intercept = 29.9625
Correlation, R = 0.9477
Total Ba
N = 8
Mean = 146.5500
Sd = 204.4427
Slope = 170.4640
Intercept = 146.5500
Correlation, R = 0.7759
Total Be
N = 8
Mean = 14.2450
Sd = 18.0565
Slope = 16.8571
Intercept = 14.2450
Correlation, R = 0.8687
Total V
N = 8
Mean = 15.4375
Sd = 12.9088
Slope = 13.4016
Intercept = 15.4375
Correlation, R = 0.9660


Multiple Q-Q Plots
for MW-24 Total As, Total Be, Total V
Ordered Observations
Theoretical Quantiles (Standard Normal)
MW-24 Total As
Total Be
Total V
MW-24 Total As
N = 8
Mean = 29.9625
Sd = 27.1445
Slope = 27.6452
Intercept = 29.9625
Correlation, R = 0.9477
Total Be
N = 8
Mean = 14.2450
Sd = 18.0565
Slope = 16.8571
Intercept = 14.2450
Correlation, R = 0.8687
Total V
N = 8
Mean = 15.4375
Sd = 12.9088
Slope = 13.4016
Intercept = 15.4375
Correlation, R = 0.9660