ENERGY FUELS

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DRC-2020-011934

June 24, 2020

Div of Waste Management
and Radiation Control

JUN 26 2020

Sent VIA E-MAIL AND OVERNIGHT DELIVERY

Mr. Ty L. Howard
Director
Division of Waste Management and Radiation Control
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144880
Salt Lake City, UT 84114-4880

Re: Transmittal of Source Assessment Report for MW-31 White Mesa Mill Groundwater Discharge Permit UGW370004

Dear Mr. Howard:

Enclosed are two copies of Energy Fuels Resource (USA) Inc.'s ("EFRI's") Source Assessment Report ("SAR") for MW-31 at the White Mesa Mill. This SAR addresses the constituents that were identified as exceeding the GWCL in the 4th Quarter 2019 as described in the Division of Waste Management and Radiation Control ("DWMRC")-approved Q4 2019 Plan and Time Schedule. EFRI submitted the Plan and Time Schedule for MW-31 on February 27, 2020. DWMRC approval of the Plan and Time Schedule was received by EFRI on March 26, 2020. Pursuant to the Plan and Time Schedule EFRI has prepared this SAR.

This transmittal also includes two CDs each containing a word searchable electronic copy of the report.

If you should have any questions regarding this report please contact me.

Yours very truly,

Kathy Weinel

ENERGY FUELS RESOURCES (USA) INC.
Kathy Weinel
Quality Assurance Manager

CC: David C. Frydenlund
Paul Goranson
Terry Slade
Logan Shumway
Scott Bakken
Stewart Smith (HGC)

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SOURCE ASSESSMENT REPORT FOR MW-31 WHITE MESA URANIUM MILL

Blanding, Utah

Prepared for:

Energy Fuels Resources (USA) Inc.
225 Union Boulevard, Suite 600
Lakewood, Colorado 80228

Prepared by:

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

6000 Uptown Boulevard NE, Suite 220
Albuquerque, New Mexico 87110

June 24, 2020

SOURCE ASSESSMENT REPORT
FOR MW-31
WHITE MESA URANIUM MILL

Blanding, Utah

Prepared for:

Energy Fuels Resources (USA) Inc.
225 Union Boulevard, Suite 600
Lakewood, Colorado 80228

Prepared Under the Supervision of:

____

Bryn E. Kimball, PG
Utah Registration Number 10823695-2250
Expires 03/31/2021

EXECUTIVE SUMMARY

This Source Assessment Report ("SAR") is an assessment of the sources, extent, and potential dispersion of sulfate and total dissolved solids ("TDS") in MW-31 at the White Mesa Mill ("the Mill") as required under State of Utah Groundwater Discharge Permit UGW370004 (the "GWDP") Part I.G.4, relating to violations of Part I.G.2 of the GWDP. Each of these constituents occur naturally at the Mill (INTERA, 2008) and have exhibited exceedances of the applicable Groundwater Compliance Limits ("GWCLs").

MW-31 has been included in multiple recent investigations and reports including the New Wells Background Report (INTERA, 2008), an isotopic investigation (Hurst and Solomon, 2008), and four SAR reports (INTERA, 2012a, 2013, 2015, 2017). Sulfate and TDS in MW-31 were most recently assessed and included in the 2017 SAR. The 2017 SAR concluded that increasing concentrations of sulfate and TDS could be attributed to natural background and site-wide influences (oxidation of pyrite and decreasing pH) or to impacts at the Mill site that are already being addressed with an existing corrective action (nitrate/chloride plume capture). In a letter dated March 20, 2018, the State of Utah Division of Waste Management and Radiation Control ("DWMRC") stated, "it appears that Mill activities are not influencing SAR studied concentrations at monitoring well MW-31." The 2017 SAR and the associated modified GWCLs, as presented in the March 20, 2018 letter from DWMRC, were approved.

Increasing trends in concentrations have continued in MW-31, prompting additional exceedances and out-of-compliance ("OOC") status and resulting in the need for this SAR. Analytical results for constituents included in this SAR exhibit increases in concentrations over time, which are likely due to the location of this well within the nitrate/chloride plume and the result of oxidation of pyrite in the formation around and upgradient of this well. To a lesser extent, increased frequency of sampling and well redevelopment have also likely affected the behavior of constituents in MW-31. In addition, changes in analytical methods and/or changing the analytical laboratory may affect the concentrations of constituents reported for MW-31.

As the results of this analysis will demonstrate, concentrations of sulfate and TDS in MW-31 are within the range of site-wide background and are likely influenced by oxidation of pyrite. Mass balance calculations (**Appendix E**) demonstrate that concentrations in MW-31 are not consistent with impacts from potential tailings system seepage. Once again, this SAR concludes that the exceedances of sulfate and TDS in MW-31 can be attributed to natural background and site-wide influences (oxidation of pyrite and decreasing pH) or to impacts at the Mill site that are already being addressed with an existing corrective action (nitrate/chloride plume capture). The conclusions of this analysis are consistent with conclusions presented in the Background Reports (INTERA 2007a, 2007b, 2008) and other recent analyses.

In accordance with the DWMRC-approved Flowsheet (from INTERA [2007a], included as **Appendix H**), increasing trends necessitate a modified approach for calculation of GWCLs. The modification in this approach uses a more recent dataset (collected after May 2014) and the greater of (1) mean concentration plus two standard deviations (“mean + 2σ”), (2) highest historical value, (3) background x 1.5, (4) the fractional approach, or (5) the upper tolerance limit to determine representative and appropriate GWCLs for trending constituents. Regular revisions to GWCLs for constituents in wells with significantly increasing trends over time due to background is consistent with the United States Environmental Protection Agency’s Unified Guidance (USEPA, 2009). Such revisions account for the trends and minimize unwarranted OOC status in such wells.

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ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
95-UTL	95% upper tolerance limit
Background Reports	*collectively refers to relevant background reports for this well and site*: the Existing Wells Background Report (INTERA, 2007a), the Regional Background Report (INTERA, 2007b), and the New Wells Background Report (INTERA, 2008)
CAP	Corrective Action Plan
CFCs	chlorofluorocarbons
CIR	Contaminant Investigation Report
DF	dilution factor
Director	Director of the Division of Waste Management and Radiation Control
DWMRC	State of Utah Division of Waste Management and Radiation Control
EFRI	Energy Fuels Resources (USA) Inc.
Existing Wells Background Report	INTERA (2007a)
Flowsheet	Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah
GWCL	Groundwater Compliance Limit
GWDP	State of Utah Ground Water Discharge Permit UGW370004
GWQS	Groundwater Quality Standard
INTERA	INTERA Incorporated
mg/L	milligrams per liter
Mill	White Mesa Uranium Mill
New Wells Background Report	INTERA (2008)
OOC	out of compliance
pH Report	INTERA (2012b)
Pyrite Report	HGC (2012a)
Q4 2019 Plan and Time Schedule	plan and time schedule for MW-31 for the fourth quarter of 2019
Q4 2019 Exceedance Notice	exceedance notice submitted by EFRI January 31, 2020
Regional Background Report	INTERA (2007b)
SAR	Source Assessment Report

ACRONYMS AND ABBREVIATIONS (Continued)

TDS	Total Dissolved Solids
THF	Tetrahydrofuran
UAC	Utah Administrative Code
University of Utah Study	Hurst and Solomon, (2008)
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Energy Fuels Resources (USA) Inc. ("EFRI") operates the White Mesa Uranium Mill (the "Mill"), located near Blanding, Utah (**Figure 1**). Groundwater is regulated under the State of Utah Groundwater Discharge Permit UGW370004 (the "GWDP"). This is the Source Assessment Report ("SAR") required under Part I.G.4 of the GWDP, relating to Part I.G.2 of the GWDP with respect to sulfate and total dissolved solids ("TDS") in groundwater compliance monitoring well MW-31. The sulfate and TDS exceedances were addressed in previous SARs, but have exceeded the recalculated groundwater compliance limits ("GWCLs") specified in those SARs due to statistically significant trends noted in those previous studies.

Part I.G.2 of the GWDP provides that an out-of-compliance ("OOC") status exists when the concentration of a constituent in two consecutive samples from a compliance monitoring point exceeds a GWCL in Table 2 of the GWDP. The GWDP was originally issued in March 2005, at which time GWCLs were set on an interim basis, based on fractions of State of Utah Ground Water Quality Standards ("GWQSs") or the equivalent, without reference to natural background at the Mill. The GWDP also required that EFRI prepare a background groundwater quality report to evaluate all historical data for the purposes of establishing background groundwater quality at the Mill site and developing GWCLs under the GWDP. As required by then Part I.H.3 of the GWDP, EFRI submitted the following three "Background Reports" to the Director (the "Director") of the State of Utah Division of Waste Management and Radiation Control ("DWMRC")[1] (the Director was formerly the Executive Secretary of the Utah Radiation Control Board and the Co-Executive Secretary of the Utah Water Quality Board):

- A revised background groundwater quality report: *Existing Wells for Denison Mines (USA) Corp.'s Mill Site, San Juan County, Utah,* October 2007, prepared by INTERA Incorporated (INTERA) (the "Existing Wells Background Report").
- A revised addendum: *Evaluation of Available Pre-Operational and Regional Background Data, Background Groundwater Quality Report: Existing Wells for Denison Mines (USA) Corp.'s Mill Site, San Juan County, Utah,* November 16, 2007, prepared by INTERA (the "Regional Background Report").
- A revised addendum: *Background Groundwater Quality Report: New Wells for Denison Mines (USA) Corp.'s Mill Site, San Juan County, Utah,* April 30, 2008, prepared by INTERA (the "New Wells Background Report").

Based on a review of the Background Reports and other information and analyses, the Director re-opened the GWDP and modified the GWCLs to be equal to the mean concentration plus two standard

[1] Formerly referred to as the State of Utah Division of Radiation Control.

deviations (“mean + 2σ ”) or the equivalent. The modified GWCLs became effective on January 20, 2010. On January 19, 2018, and March 19, 2019, revised GWDPs were issued, which set the revised GWCLs as approved by the Director through SARs. The plans and time schedules and the associated SARs for White Mesa Uranium Mill are summarized in **Table 1:**

Table 1. White Mesa Uranium Mill SARs

Plan and Time Schedule Date	Monitoring Periods Covered	DWMRC Plan and Time Schedule Approval Date	SAR Date	SAR Approval Date	Constituents
6/13/2011	Q1, Q2, Q3, Q4 of 2010, Q1 of 2011	7/12/2012	10/10/2012	4/25/2013	Multiple
9/7/2011	Q2 2011	7/12/2012	10/10/2012	4/25/2013	Multiple
4/13/2012	Multiple	7/12/2012	pH report - 11/9/12 Pyrite Report - 12/7/12	4/25/2013	pH - multiple wells
12/13/2012	Q3 2012	2/4/2013	5/8/2013	7/23/2013	TDS - MW-29
3/15/2013	Q4 2012	5/30/2013	8/30/2013	9/17/2013	Se - MW-31
8/28/2013	Q1 2013	9/17/2013	12/17/2013	1/7/2014	THF - MW-01
9/20/2013	Q2 2013	10/16/2013	1/13/2014	3/10/2014	Gross Alpha - MW-32
12/5/2013	Q3 2013	12/18/2013	3/19/2014	6/5/2014	SO4 - MW-01; TDS - MW-03A
12/4/2014	Q3 2014	1/8/2015	No SAR - OOC due to well damage	No SAR - OOC due to well damage	U - MW-28
5/19/2015	Q1 2015	8/11/2015	Due 12/9/15*	2/19/2016	Se, SO4, TDS, pH - MW-31
9/10/2015	Q2 2015	11/10/2015	No SAR - install packer	No SAR - install packer	Cd, Zn, Be, Ni - MW-03
12/3/2015	Q3 2015	2/25/2016	No SAR - install packer	NO SAR	SO4- MW-3
3/3/2016	Q4 2015	4/4/2016	6/24/2016	12/20/2016	SO4- MW-18 F, Cd, Tl, and pH- MW-24
3/10/2017	Q4 2016	5/23/2017	8/20/2017	3/20/2018	Se, SO4, TDS, and U in MW-31
3/2/2018	Q4 2017	3/30/2018	6/25/2018	7/25/2018	F- MW-14
8/28/2018	Q2 2018	10/18/2018	1/16/2019	7/9/2019	U, Se, pH - MW-30
12/5/2018	Q3 2018	3/5/2019	6/27/2019	9/5/2019**	Tl, Cd, pH - MW-24
2/21/2019	Q4 2018	3/5/2019	6/27/2019	9/5/2019	Mn - MW-11
5/13/2019	Q1 2019	6/26/2019	9/23/2019	11/26/2019	Cd - MW-25
2/27/2020	Q4 2019	3/26/2020			TDS, SO4 - MW-31
5/21/2020	Q1 2020				Se, U - MW-28

Notes: *30-day extension for SAR; ** Installed MW-24A

On January 31, 2020, EFRI submitted a notice (the "Q4 2019 Exceedance Notice") to the Director under Part I.G.1(a) of the GWDP; providing notice that the concentrations of specific constituents in the monitoring wells at the Mill exceeded their respective GWCLs for the fourth quarter of 2019, and indicating which of those constituents had two consecutive exceedances as of that quarter. A plan and time schedule for the fourth quarter of 2019 ("Q4 2019 Plan and Time Schedule") covered new dual exceedances of sulfate and TDS at MW-31. The MW-31 Q4 2019 Plan and Time Schedule was submitted on February 27, 2020, and was approved by the DWMRC in correspondence dated March 26, 2020.

This SAR addresses the constituents that were identified as new dual exceedances or as exceeding the previously revised GWCLs in the Q4 2019 Exceedance Notice as described in the DWMRC-approved Q4 2019 Plan and Time Schedule.

1.1 Source Assessment Report Organization

A description of the approach used for analysis is provided in Section 2, the results of the analysis are presented in Section 3, the calculation of GWCLs is provided in Section 4, and conclusions and recommendations are presented in Section 5. Section 6 lists references cited in the SAR.

The appendices comprise the analyses performed for this Report and are organized in the following manner: **Appendix A** contains a table showing exceedances for Fourth Quarter 2019 under the March 19, 2019 GWDP. **Appendix B** contains the geochemical analysis performed on sulfate and TDS in MW-31. **Appendix C** contains the indicator parameter analysis performed on MW-31. **Appendix D** contains the pH analysis performed on MW-31. **Appendix E** contains mass balance calculations. **Appendix F** contains the *Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah* ("Flowsheet") that was developed based on the United States Environmental Protection Agency's ("USEPA") *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 1989, 1992, 2009). This Flowsheet was approved by DWMRC prior to completion of the Background Reports. **Appendix G** contains analyses of two modified data sets (post October 2012 and post May 2014) to address revising GWCLs for constituents with increasing trends. **Appendix H** is included on the compact disc that accompanies this SAR and contains the electronic input and output files used for statistical analysis.

Statistical analysis was performed using the software package "R." R is a free statistical package that allows the analyst to perform statistical analysis and format and output graphs more effectively than the Statistica software package used in the past. Input and output files included in **Appendix H** can be imported into either R or Statistica to replicate the results presented in this SAR.

1.2 Limitations Statement

This SAR presents the findings and interpretations of INTERA based on, and limited to, the conditions existing at the time of this SAR and the scope of services agreed upon between INTERA and EFRI. The calculations presented herein were completed using industry standard practices and were performed on data received from others. INTERA relies in good faith on information provided for this SAR, including analytical data, measurements, and previous investigations performed at the Mill site, but does not make any warranty, expressed or implied, that the information is accurate and complete.

2.0 CATEGORIES AND APPROACH FOR ANALYSIS

Generally, OOC constituents and wells can be grouped into five categories:

1. Constituents in wells with previously identified rising trends.
2. Constituents in pumping wells.
3. Constituents potentially impacted by decreasing trends in pH across the Mill site.
4. Newly installed wells with interim GWCLs.
5. Other constituents and wells.

This SAR addresses two constituents in one well (sulfate and TDS in MW-31). These constituents fall into category five: other constituents and wells. It is important to note that sulfate and TDS also fall within the first and third categories: constituents in wells with previously identified rising trends and constituents potentially impacted by decreasing trends in pH across the Mill site. The pH is decreasing site-wide, likely due to oxidation of pyrite in the aquifer (HGC, 2012a). Sulfate and increased TDS are also products of pyrite oxidation. Increased sulfate and TDS concentrations may also be due to the location of MW-31 within the downgradient toe of the nitrate/chloride plume (**Figure 2** and **Figure 3**).

Additional factors that may have contributed to a potential change in behavior of groundwater conditions and reported constituent concentrations in MW-31 include the following: (1) the 2011 well redevelopment project, which took place in April and May of 2011 (HGC, 2011); (2) the change in analytical laboratory in 2012; (3) groundwater elevations that increased until 2013 (**Figure 4**) as a result of former wildlife pond seepage (HGC, 2014); (4) groundwater elevations that have decreased since 2013 (**Figure 4**) as a result of cessation of water delivery to the wildlife ponds in 2012 (HGC, 2014); and (5) the addition of several pumping wells under the nitrate/chloride and chloroform Corrective Action Plans ("CAP") subsequent to the fourth quarter of 2012. A more detailed discussion of these variables is presented in Section 3.1 of the 2015 SAR (INTERA, 2015).

2.1 Approach for Analysis

The first step in the analysis is to perform an assessment of the potential sources for the exceedances to determine whether they are due to background influences or Mill activities. If the exceedances are determined to be caused by background influences, then it is not necessary to perform any further evaluations on the extent and potential dispersion of the contamination or to perform an evaluation of potential remedial actions. Monitoring will continue; and, where appropriate, a revised GWCL is proposed to reflect changes in background conditions at the Mill site.

Assessments for potential sources of increasing concentrations of sulfate and TDS in MW-31 have been performed in SARs produced in 2012, 2013, 2015, and 2017 (INTERA, 2012a, 2013, 2015, 2017). Assessment of the site-wide pH trend has been performed in *PH Report White Mesa Uranium Mill, Blanding, Utah* (the "pH Report") and *Investigation of Pyrite in the Perched Zone, White Mesa Uranium Mill Site* (the "Pyrite Report," HGC, 2012a). The analysis performed in this SAR considers all available data to date to help determine if there have been any changes in potential tailings system seepage indicator parameters (e.g., chloride, sulfate, fluoride, and uranium) since the date of the New Wells Background Report and the approved SARs that may suggest a change in the behavior of the groundwater in the well.

As discussed in the Background Reports (INTERA, 2007a, 2007b, 2008), indicator parameters of potential tailings system seepage include chloride, sulfate, fluoride, and uranium. Chloride is the best indicator of potential tailings system seepage; however, chloride is problematic as an indicator parameter for those groundwater monitoring wells at the Mill impacted by the chloride plume (EFRI, 2020). Sulfate and fluoride are useful indicator parameters under geochemical conditions allowing conservative (i.e., non-reactive) behavior. Uranium behavior may range from conservative to non-conservative depending on the geochemical conditions.

Groundwater impacted by any potential seepage from the tailings system would be expected to exhibit increasing concentrations of chloride, sulfate, fluoride, and uranium, among other constituents. While uranium can be the most mobile of trace metals under certain conditions, it is typically retarded behind chloride, fluoride, and sulfate due to possible sorption and precipitation and would likely not show increasing concentrations in groundwater until sometime after chloride, fluoride, and sulfate concentrations had begun to increase (INTERA, 2007a). It is important to note, however, that while the absence of a rising trend in constituent concentrations would indicate that there has been no impact from the tailings system, a rising trend in concentrations could also be due to natural influences (see Section 12.0 of INTERA, 2007a).

The evaluation of SAR parameters and indicator parameters in MW-31 was supported by a statistical analysis that followed the process outlined in the Flowsheet (INTERA, 2007a) attached as **Appendix F.** As discussed in Section 1.1, the Flowsheet was designed based on USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 1989, 1992, 2009), and was approved by DWMRC prior to completion of the Background Reports (INTERA, 2007a, 2007b, 2008).

2.2 Approach for Setting Revised GWCLs

If the preceding approach resulted in the conclusion that the previous analysis in the Background Reports or most recently approved SARs has not changed, or that the OOC status of sulfate or TDS in MW-31 is due to natural or other site-wide influences that are already being addressed by corrective action, then new GWCLs may be proposed for the constituents. In proposing revised GWCLs, INTERA has adopted the approach in the DWMRC-approved Flowsheet, including the last decision of the process that directs the analyst to consider a modified approach to determining a GWCL if an increasing trend is present.

2.3 University of Utah Study

At the request of the DWMRC, T. Grant Hurst and D. Kip Solomon of the Department of Geology and Geophysics of the University of Utah performed a groundwater study (the “University of Utah Study”) at the Mill site in July 2007 (Hurst and Solomon, 2008). The purpose of this study was to characterize groundwater flow, chemical composition, noble gas composition, and age to evaluate whether the increasing and elevated trace metal concentrations in monitoring wells at the Mill, all of which were identified in the Background Reports, may indicate that potential seepage from the tailings system is occurring.

To evaluate sources of solute concentrations at the Mill, low-flow groundwater sampling was used as a method for collecting groundwater quality samples from 15 monitoring wells. In addition, tailings solution and surface water samples were collected from cells 1, 3, and 4A, and two wildlife ponds. Passive diffusion samplers were also deployed and collected to characterize the dissolved gas composition of groundwater at different depths within the wells. Samples were collected and analyzed for the following constituents: tritium, nitrate, sulfate, deuterium and oxygen-18 of water, sulfur-34 and oxygen-18 of sulfate, trace metals (uranium, manganese, and selenium), and chlorofluorocarbons (“CFCs”). The 15 wells sampled included MW-31.

Hurst and Solomon (2008, page iii) concluded generally that,

> *[t]he data show that groundwater at the Mill is largely older than 50 years, based on apparent recharge dates from chlorofluorocarbons and tritium concentrations. Wells exhibiting groundwater that has recharged within the last 50 years appears to be a result of recharge from wildlife ponds near the site. Stable isotope fingerprints do not suggest contamination of groundwater by tailings cell leakage, evidence that is corroborated by trace metal concentrations similar to historically-observed observations.*

With respect to CFC age dating, MW-31 was found to exhibit CFC recharge dates of the 1960s and 1970s, indicating that the water in that well predated construction of the Mill in 1980. Tritium was not detected in MW-31, indicating that impacts from wide-scale atmospheric injection of tritium during aboveground thermonuclear weapons testing in the 1950s and 1960s, expected to be found in surface waters such as solutions in the Mill's tailings system, were not observed in that well.

Hurst and Solomon (2008) also concluded that,

> *[i]n general, the data collected in this study do not provide evidence that tailings cell leakage is leading to contamination of groundwater in the area around the White Mesa Mill. Evidence of old water in the majority of wells, and significantly different isotopic fingerprints between wells with the highest concentrations of trace metals and surface water sites, supports this conclusion. The only evidence linking surface waters to recharging groundwater is seen in MW-27 and MW-19. Measurable tritium and CFC concentrations indicate relatively young water, with low concentrations of selenium, manganese, and uranium. Furthermore, stable isotope fingerprints of ðD and ð^{18}O suggest mixing between wildlife pond recharge and older groundwater in MW-19 and MW-27. D^{34}S-SO_4 and ð^{18}O-SO_4 fingerprints closely relate MW-27 to wildlife pond water, while the exceptionally low concentration of sulfate in MW-27, the only groundwater site to exhibit sulfate levels below 100 mg/L, suggest no leachate from the tailings cells has reached the well.*

It should be further noted that, subsequent to the University of Utah Study, EFRI submitted a *Nitrate Groundwater Contamination Investigation Report, White Mesa Uranium Mill Site, Blanding, Utah*, dated December 30, 2009 (INTERA, 2009) ("CIR"), relating to the nitrate/chloride plume at the Mill site.

3.0 RESULTS OF ANALYSIS

This section describes the potential geochemical influences on groundwater in MW-31 and results of the analysis, summaries of which are provided in **Appendix B-1, Appendix C-1**, and **Appendix D-1.** Supporting analyses are presented in **Appendix E** and **Appendix G.**

3.1 Site-Wide Decreasing pH

A general discussion of the site-wide pH trend is necessary because decreasing pH is one of the most important contributors to increasing concentrations of the SAR parameters. A decreasing trend in pH has been observed in almost every groundwater monitoring well across the Mill site, including upgradient and far downgradient monitoring wells (INTERA, 2012b). The Pyrite Report (HGC, 2012a) attributed the decline in pH across the Mill site to the site-wide existence and oxidation of pyrite in the perched aquifer monitored at the site. This report showed that pyrite was observed in cuttings of at least 14 monitoring wells, including MW-26 (HGC, 2012a), which is upgradient of MW-31 (**Figure 5**).

Pyrite may oxidize according to the following reaction (Williamson and Rimstidt, 1994):

$$FeS_{2(s)} + 7/2O_{2(g)} + H_2O \rightarrow Fe^{2+}_{(aq)} + 2SO_4^{2-}_{(aq)} + 2H^+ \quad \text{(reaction 1)}$$

Reaction 1 will increase hydrogen ion concentrations, which results in decreasing pH. Increasing concentrations of sulfate and TDS may also be a direct result of pyrite oxidation. Sulfate is a product of reaction 1, so increasing sulfate concentrations may be due to increased site-wide pyrite oxidation. The acidity produced during reaction 1 may also lead to increased mineral dissolution overall (Brantley, 2008), which usually leads to increased TDS concentrations.

The likely causes for site-wide oxidation of pyrite include the following: (1) infiltration of oxidized water from the wildlife ponds upgradient of the Mill site; (2) changing water levels and incorporation of oxygen in air-filled pore spaces into groundwater; (3) the introduction of oxygen during pumping related to treatment of the chloride and nitrate plumes; and (4) the introduction of oxygen during increased sampling of monitoring wells (INTERA, 2012b). Oxidation of pyrite and the resulting decrease in pH tends to cause subsequent pH-dependent reactions, some of which are described below.

Pyrite may also oxidize in the presence of bacteria and nitrate according to the following reaction (Hayakawa et al., 2013):

$$5FeS_2 + 15NO_3^- + 10H_2O \rightarrow 15/2N_2 + 10SO_4^{2-} + 5Fe(OH)_3 + 5H^+ \quad \text{(reaction 2)}$$

Reaction 2 could be occurring in the parts of the aquifer impacted by the nitrate plume (**Figure 3**), potentially causing further oxidation and dissolution of pyrite and subsequent decreasing pH and increasing sulfate and TDS concentrations. As discussed in HGC (2017), the stability of nitrate concentrations in MW-30 and MW-31, which are located at the downgradient toe of the nitrate plume, could be due to nitrate degradation through oxidation of pyrite.

Pyrite oxidation by nitrate may occur by another pathway that consumes acid and produces sulfate (Spiteri et al., 2008), as discussed in HGC (2017):

$$5FeS_2 + 14NO_3^- + 4H^+ \rightarrow 7N_2 + 10SO_4^{2-} + 5Fe^{2+} + 2H_2O \qquad \text{(reaction 3)}$$

The relative dominance of pyrite oxidation by dissolved oxygen (producing acid and sulfate by reaction 1) and/or by nitrate (producing acid and sulfate by reaction 2; or producing sulfate but consuming acid by reaction 3) may result in sulfate production with or without a decrease in pH.

3.2 Changes in Groundwater in MW-31

The behavior of groundwater has changed since the time of the Background Reports, but to a lesser extent since recent SAR evaluations. Section 3.1 of the 2015 SAR describes in detail the changes, events, and other factors that may be influencing the behavior of constituents in this well, including:

- Sampling frequency (monthly monitoring commenced in 2010).
- Well redevelopment in 2011.
- Hydraulic influences (**Figure 4**).
- Geochemical influences.
- Analytical changes.

3.3 Indicator Parameter Analysis

Concentrations of parameters monitored in well MW-31 vary from concentrations observed at the time of the Background Reports. The changes in concentrations are most likely attributable to a combination of the influences discussed in Section 3.1 of the 2015 SAR: the proximity to the chloride/nitrate plume and changing hydrologic and geochemical conditions due to pumping wells, increased sample frequency, removal of recharge from the wildlife ponds, well rehabilitation, and the oxidation of pyrite leading to decreasing pH and increasing concentrations. For these reasons, the typical suite of indicator parameters of potential tailings system seepage may be impacted by other processes. A summary of geochemical analysis of indicator parameters is included in **Appendix C-1**. **Appendix C-2** presents a descriptive statistics comparison for indicator parameters from the New Wells Background Report and the 2012, 2013, 2015, and 2017 SARs. Data used in the analysis and data removed prior to analysis are presented in **Appendices C-3** and **C-4**, respectively.

The distribution and identification of outliers and extreme outliers in indicator parameter concentration data sets are demonstrated in the box plots included in **Appendix C-5.** Data from additional monitoring wells were plotted alongside indicator parameters for MW-31 (**Appendix C-6**). The additional wells and the areas they represent are the following: (1) MW-1, MW-18, and MW-19 as upgradient wells; (2) MW-20 and MW-3A as downgradient wells; and (3) MW-22 as a downgradient and far cross-gradient well (grouped with the other downgradient wells). This comparison illustrates that fluoride, sulfate, and uranium concentrations in MW-31 are well within the range of site-wide background concentrations. Chloride concentrations are above the range for site-wide background, consistent with the location of MW-31 within the nitrate/chloride plume. As the mass balance evaluation demonstrates (Section 3.5), the concentrations of constituents that are increasing and/or exceeding GWCLs in MW-31 are not the result of potential tailings system seepage. A Piper diagram, which can be used to distinguish between different waters, is presented in **Appendix C-7.** The diagram illustrates that the geochemical signature of major ions in solution differs between MW-31 and Cell 1.

Chloride concentrations in MW-31 exhibit a statistically significant increasing trend (see **Appendix C-9** for a time series). Fluoride concentrations are decreasing significantly in MW-31. Sulfate and uranium concentrations in MW-31 are relatively low for the Mill site (**Appendix B-8** and **Appendix C-6**), but show significant increasing trends at the time of this SAR. Time series plots with vertical lines to indicate events that may have contributed to observed changes in indicator parameters are included in **Appendix C-10**.

Current sulfate concentrations in MW-31 are among the lowest at the Mill site. A box plot showing sulfate concentrations in all monitoring wells at the Mill site is included in **Appendix B-8**. Other monitoring wells show sulfate concentrations that are three to seven times higher than those in MW-31 (see Table 7 of the 2012 SAR). Sulfate is also significantly increasing in a number of wells at the Mill site, including upgradient and far downgradient wells. See, for example, the indicator parameter analyses for MW-18 included in the 2012 SAR, which show a significantly increasing trend in sulfate and suggest that there are natural influences at the site that can influence sulfate concentrations. Specifically, as noted by DWMRC in their approval letter of the MW-18 SAR, based on review of water level elevations included in the Mill site Quarterly Groundwater Reports, upgradient wells are not likely to be impacted by current Mill activities. The elevations at monitoring wells MW-l, MW-18 and MW-19 are higher than water elevations in the Burro Canyon Aquifer beneath all of the Mill tailings cells. Those monitoring wells are located north and northeast of the tailings cells, and local groundwater flow is to the south-southwest

(DWMRC, 2013). The widespread occurrence of pyrite in the Burro Canyon Formation and the Dakota Sandstone (which host the perched groundwater monitored at the Mill site) can contribute to decreasing pH and increasing sulfate in wells at the Mill site (HGC, 2012a; reaction 1). Increased concentrations of sulfate, as well as chloride and TDS, are expected due to site-wide pyrite oxidation and the location of MW-31 within the nitrate/chloride plume.

Uranium concentration trends are highly variable site-wide. An evaluation of uranium concentrations over time was included for all groundwater monitoring wells at the Mill site in Appendix F of the 2017 SAR (INTERA, 2017). Uranium concentrations in MW-31 are relatively low for the site and exhibit a statistically significant upward trend first identified during the 2015 SAR (INTERA, 2015). Box plots showing uranium in all of the groundwater monitoring wells at the Site are plotted in **Appendix C-6**. These box plots illustrate that uranium concentrations in MW-31 are within the range of background concentrations.

With the exception of chloride, and despite any increasing trends, indicator parameters in MW-31 remain amongst the lowest at the Mill site (**Appendix C-6**) and are not present in concentrations that would be expected if they were due to potential tailings system seepage (Section 3.5).

3.4 pH Analysis

A pH analysis was also performed for MW-31 (**Appendix D**). The pH analysis included creating box plots to identify and omit extreme outliers, performing the Shapiro-Wilk test of normality (Shapiro and Wilk, 1965), and testing for trends using either the least squares regression or the Mann-Kendall trend method (see **Appendices D-1** through **D-5**). The results of the pH analysis in MW-31 show a significant decreasing trend in pH. The data appear to show more variance beginning in 2010 (**Appendix D-5**), which corresponds to the increase in monthly sampling frequency implemented that year.

3.5 Mass Balance Analyses

The 2017 SAR for MW-31 included a mass balance analysis where fluoride concentrations in MW-31 were predicted by assuming a hypothetical situation under which potential tailings system seepage has entered the groundwater and has become diluted during transport before reaching MW-31. Predicted fluoride concentrations were based on the dilution factors calculated for other indicator parameters (uranium, chloride, and sulfate) using average Cell 1 concentrations and current MW-31 concentrations. Because the conditions in MW-31 have not changed substantially since 2017, the mass balance analysis in the 2017 SAR remains valid. This mass balance analysis has been updated with more recent concentration values in this SAR.

The mass balance model is based on current concentrations of fluoride, uranium, chloride, and sulfate in MW-31 and mean concentrations of the same constituents in Cell 1 water. The mean concentrations in Cell 1 were based on data collected between 2003 and 2019 (EFRI 2019). Samples of tailings system water have produced variable results between 2003 and 2019, so average concentrations were used to describe the tailings system water. The model calculates estimated fluoride contributions to MW-31 groundwater from hypothetical tailings system seepage based on measured concentrations of chloride, sulfate, and uranium. The model assumes potential tailings system seepage has entered the groundwater and has become diluted during transport before reaching MW-31 and that this occurred far enough in the past to potentially reach MW-31 at the present time. Therefore, the most recent analyses of MW-31 groundwater were selected to represent modern MW-31 water.

For this mass balance calculation, indicator parameters are assumed to be conservative tracers (INTERA, 2007a) and not subject to attenuation during transport. Therefore, if the tailings are a source of contamination at MW-31, the concentration of fluoride in MW-31 is expected to be proportional to the concentration of uranium, chloride, and sulfate in the tailings system water. Although this model assumes only hypothetical tailings seepage and dilution of natural groundwater at MW-31, recent analyses show that more likely sources of increasing constituent concentrations in this well include the chloride/nitrate plume (discussed below) and oxidization of naturally occurring pyrite associated with decreasing pH.

Model calculations are presented in **Appendix E**. The mass balance calculations are based on dilution factors (DF) computed as the ratio of a particular constituent's current (Q2 2020) concentration in MW-31 to its average concentration in the Cell 1 tailings solution since 2003. The DFs calculated for all indicator parameters based on the ratio of Cell 1 and MW-31 constituent concentrations vary by four orders of magnitude.

Based on the computed DFs for uranium, chloride, and sulfate, the predicted MW-31 fluoride concentrations are 0.087, 35, and 15 milligrams per liter (mg/L), respectively. The most recent observed concentration of fluoride in MW-31 is 0.632 mg/L. The dissimilarity between predicted and observed fluoride concentrations and the large range in calculated dilution factors for the four indicator parameters indicate that potential tailings system seepage is an unlikely contributor to the groundwater chemistry of MW-31. Instead, fluoride concentrations in MW-31 are similar to most natural waters (< 1 mg/L; Hem 1985) and are more consistent with natural processes.

In addition, if the same mass balance methodology is applied to uranium, the predicted MW-31 uranium concentrations range from 112 micrograms per liter (µg/L) (based on the fluoride DF) to 6,179 µg/L (based on the chloride DF). All of the predicted concentrations of uranium substantially exceed the most recent observed uranium concentration of approximately 16 µg/L.

Fluoride concentrations at MW-31 are stable to decreasing (**Appendix C-9**), which is inconsistent with potential tailings system seepage. Because concentrations of chloride are increasing and fluoride is stable to decreasing, the ratio of chloride to fluoride concentrations is increasing (**Figure 6**). If the chloride in MW-31 resulted from a potential tailings solution impact, the MW-31 chloride to fluoride ratio would be decreasing (rather than increasing) because the chloride to fluoride ratio in Cell 1 (approximately 11 based on average concentrations) is much lower than the ratio at MW-31 (595 as of Q2 2020, **Figure 6**). In other words, if chloride to fluoride ratios represent geochemical signatures, then it appears that MW-31 is not inheriting the signature of tailings solution. The increase in the chloride to fluoride ratio at MW-31 is, however, consistent with the position of MW-31 in the downgradient toe of the nitrate/chloride plume and the ongoing downgradient migration of the plume. As discussed in *Nitrate Contamination Investigation Report White Mesa Uranium Mill Site, Blanding, Utah* (INTERA, 2009), the nitrate/chloride plume originated primarily from a pre-Mill source. This source (the historical pond) was located approximately 500 feet upgradient (northeast) of Cell 1 (INTERA, 2009).

Finally, the ratios of other indicator parameters in MW-31 also differ substantially from ratios of the same constituents in Cell 1 solutions. Like the ratio of chloride to fluoride described above (**Figure 6**), the ratios of chloride to sulfate and chloride to uranium are shown for MW-31 and average Cell 1 tailings solution in **Figures 7** and **8**, respectively. The average chloride to average sulfate ratio in Cell 1 is approximately 0.14 while the Q2 2020 ratio in MW-31 is approximately 0.33; the ratio of average chloride to average uranium in Cell 1 is approximately 61 while the Q2 2020 ratio in MW-31 is approximately 24,260. The ratios of both chloride to sulfate and chloride to uranium at MW-31 are increasing (**Figures 7** and **8**).

The increasing chloride to sulfate ratio is inconsistent with a Cell 1 impact because the ratio of chloride to sulfate is lower in Cell 1 (0.14) than in MW-31 (0.33). Therefore, if Cell 1 were potentially contributing chloride and sulfate to MW-31, the trend in the chloride to sulfate ratio would be expected to decrease rather than increase. Likewise, the increasing ratio of chloride to uranium concentrations at MW-31 could not result from a potential Cell 1 impact because the ratio at MW-31 (24,260) is substantially larger than in Cell 1 (61).

Overall, the mass balance analysis indicates that potential tailings system seepage is an unlikely contributor to the groundwater chemistry at MW-31. The nitrate/chloride plume and oxidation of pyrite are the most likely cause of the increase in chloride, sulfate, and TDS measured in MW-31, which is located in the downgradient toe of the plume where such increases would be expected (as indicated above). This conclusion is consistent with previous mass balance analyses that were based on nitrate concentrations within the nitrate/chloride plume as described below.

The nitrate mass balance calculation presented in the December 2009 CIR (INTERA, 2009) suggested that groundwater mounding would occur underneath the tailings system if the nitrate/chloride plume was caused by hypothetical tailings system seepage. The results of this calculation predicted that a 5-foot groundwater mound would be expected if the nitrate/chloride plume was caused by tailings system seepage. This nitrate mass balance calculation was updated in the 2015 SAR (INTERA, 2015, Appendix F-2). Although a substantial groundwater mound was predicted, such a mound has not been identified beneath the tailings cells (**Figure 5**).

3.6 Summary of Results

As the results of the analysis of SAR parameters in MW-31 demonstrate, increasing trends in MW-31 are not consistent with potential tailings system seepage. A summary of conclusions for each SAR parameter is included below.

3.6.1 Sulfate

Sulfate is naturally occurring in groundwater and is released into solution during the oxidation of pyrite (reactions 1 through 3) and dissolution of common sulfate-bearing minerals such as gypsum and anhydrite, both of which have been detected in the perched zone at the Mill (HGC, 2012a). Sulfate concentrations in MW-31 are significantly increasing, although the concentrations remain amongst the lowest at the Mill (**Appendix B-8**). These increasing concentrations are most likely the result of pyrite oxidation.

3.6.2 Total Dissolved Solids

Appendix B-3 presents molar concentrations of the major cations and anions in MW-31 over time. All of the major ions show increasing concentrations over time, and these ions make up the bulk of measured TDS. This increase in TDS is consistent with decreasing pH because mineral dissolution tends to increase with decreasing pH (Brantley, 2008). **Appendix B-3** shows that the most abundant cation is calcium, and the most abundant anions are chloride and sulfate. The source of calcium is likely increased dissolution of calcite, the source of chloride is the chloride/nitrate plume, and the source of sulfate is likely the oxidation of pyrite.

4.0 CALCULATION OF GROUNDWATER COMPLIANCE LIMITS

The findings of analyses discussed above support the conclusions that (1) MW-31 is not being impacted by potential tailings system seepage, and (2) increasing concentrations of constituents in MW-31 are the result of background and/or site-wide influences, such as the nitrate/chloride plume and a site-wide decline in pH. Therefore, revision of GWCLs for SAR parameters in MW-31 is proposed.

4.1 Evaluation of Modified Approaches to Calculation of GWCLs for Trending Constituents

According to the DWMRC-approved Flowsheet (**Appendix F**), if an increasing trend is present, a modified approach should be considered for determining GWCLs. Constituents included in this SAR are exhibiting significantly increasing trends that can be attributed to one or more of the following: (1) natural background conditions; (2) pyrite oxidation in the aquifer, which can decrease pH, increase mobility of metals, and increase sulfate and TDS concentrations; (3) the location of this well within the nitrate/chloride plume, which is actively being remediated according to the CAP (HGC, 2012b); and/or (4) effects of recent events on groundwater in MW-31; such as well redevelopment, increased sampling frequency, change in water levels, and analytical method/laboratory change, as described in Section 3.1 of the 2015 SAR (INTERA, 2015).

Therefore, the following alternative approaches to calculating GWCLs have been considered for constituents in MW-31:

1. 95% Upper Tolerance Limit (95-UTL).

The 95-UTL is one of several options for representing the upper bounds of a given dataset (USEPA, 2009). The 95-UTL gives a 95% confidence that the UTL will contain at least 95% of the distribution of observations in background. UTLs were calculated in USEPA’s free software ProUCL. The ProUCL Version 5.0 Technical Guidance (USEPA, 2015) Chapter 3 describes how the UTL is calculated based on distribution of the data.

2. 1.5 times background concentration as defined in Utah Administrative Code (“UAC”) R317-6-4.3.

The UAC R317-6-4.3 recognizes that “contaminants” may be present as part of naturally occurring background conditions:

> *When a contaminant is present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed the greater of 1.5*

times the background concentration or 0.5 times the ground water quality standard or background plus two standard deviations…

In this rule, background concentration is defined as the "concentration of a pollutant in ground water upgradient or lateral hydraulically equivalent point from a facility, practice or activity which has not been affected by that facility, practice or activity." Background at the Mill has been determined on an intrawell basis, as defined in the Background Reports. Therefore, to be conservative, the mean concentration could be used as background for the purposes of this calculation. The mean concentration would assume all data to date (or a data subset as described below), after following the data quality steps of the Flowsheet.

Multiplying the mean concentration by 1.5 produces a GWCL that is greater than a GWCL determined using mean + 2σ or the highest historical value. A greater GWCL decreases the likelihood of false positives (exceedances) associated with increasing trends related to natural background conditions or site-wide oxidation of pyrite.

3. Using recent data to calculate GWCLs.

This approach follows the DWMRC-approved Flowsheet (**Appendix F**) by taking into account increasing trends and processing the data consistently with previously determined GWCLs. In this approach, the complete data set, which exhibits an increasing trend over the history of the well record, is divided into subsets of data based on identification of a point of inflection where the results have shifted, or have been approved as background by the Director. This approach is appropriate in wells that have been thoroughly investigated and where the causes of increasing trends are not due to potential tailings system seepage or other Mill-related impacts that are not already being addressed. For the purposes of this modified approach and to be consistent with previous SARs, subsets of data from post October 2012 and post May 2014 were used to calculate GWCLs (**Appendix G**).

These modified approaches have been considered for an achievable GWCL for parameters that are increasing in concentration for reasons other than potential tailings system impact. MW-31 has been thoroughly evaluated multiple times in recent years due to unachievable GWCLs. The most appropriate GWCL that is achievable considering increasing trends is the highest of the following: (1) mean + 2σ; (2) highest historical value; (3) fractional approach; (4) 1.5 times background; or (5) the 95-UTL. This approach of choosing the highest value combines elements from the Flowsheet and from previously approved GWCLs (DWMRC, 2016).

4.2 Proposed Revised GWCLs

In accordance with the Flowsheet, the increasing trends identified for sulfate and TDS warrant a modified approach to the calculation of GWCLs. As discussed in detail in Section 3.0 and demonstrated in **Appendices B-11** and **C-10**, the changes observed in groundwater at MW-31 may be attributable to many factors and events, several of which occurred between 2010 and 2014 and correspond to changes in the chloroform CAP in 2014.

Increasing trends in MW-31 over time are not related to potential tailings system seepage. Sulfate and TDS trends present in MW-31 likely result from the nitrate/chloride plume, which is being addressed under a separate CAP, and oxidation of pyrite, which can contribute to increasing sulfate and TDS concentrations while decreasing the pH.

Since the laboratory change in the fourth quarter of 2012, analytical methods and procedures have been performed according to the Quality Assurance Plan. All parameters included in this SAR have been monitored quarterly or monthly, resulting in a robust data set (over 40 N per data set since June 2014). Subsets of data collected since October 2012 and June 2014 were analyzed for trends (**Appendix G**). For all SAR parameters, concentrations are significantly increasing. For this reason, the approach to calculation of GWCLs has been modified by using only data collected after May 2014, and by choosing the greater of (1) mean + 2σ, (2) highest historical value, (3) fractional approach, or (4) 1.5 times background. Flowsheet analysis has been performed for these data subsets and the complete datasets and is summarized in **Appendix B-1.**

GWCLs determined according to the Flowsheet using all data to date, data after October 2012, and data collected after May 2014 are presented in **Appendix B-1.** Based on this analysis, the proposed GWCLs for sulfate and TDS are presented in the column titled "Modified Approach GWCL" in **Table 2**.

Table 2. Proposed GWCLs

Parameter	GWCL[a]	Flowsheet Revised GWCL[b]	Rationale	Modified Approach GWCL[c]	Modified Approach Rationale
Sulfate (mg/L)	993	1150	HHV	1170.5	Background x 1.5
TDS (mg/L)	2132	2650	HHV	2664	Background x 1.5

Notes:
HHV = highest historical value.
a = 2019 GWDP No.UGW370004.
b = GWCL calculated using complete historical data set.
c = Modified Approach calculated in accordance with the Flowsheet using more recent data (6/2014 to 1/2020) and choosing the highest of either the HHV, mean + 2σ, fractional approach, 95-UTL, or 1.5 x background.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Background at the Mill site was thoroughly studied as described in the Background Reports (INTERA, 2007a, 2007b, 2008) and in the University of Utah Study (Hurst and Solomon, 2008). Conditions in MW-31 have been studied more recently as described in the 2012, 2013, 2015, and 2017 SARs (INTERA, 2012a, 2013, 2015, 2017). The Background Reports and the University of Utah Study concluded that groundwater at the Mill site has not been impacted by Mill operations. Those studies also acknowledged that there are natural influences operating at the Mill site that have caused increasing trends and general variability of background groundwater quality at the Mill site. The conclusion of the 2012, 2013, 2015, and 2017 SARs is that groundwater in MW-31 is not impacted by potential tailings system seepage. This conclusion is consistent with the conclusions of the Background Reports and the University of Utah Study. MW-31 is located within the nitrate/chloride plume that was identified in 2009, and is currently being addressed under a separate corrective action (HGC, 2012b). Mass balance calculations have demonstrated that concentrations of SAR parameters, indicator parameters (with the exception of chloride), and pH in MW-31 are consistent with background groundwater concentrations across the Mill site, and not the result of potential tailings system seepage. Chloride is being addressed under a separate corrective action (HGC, 2012b), and is not attributed to potential tailings system seepage.

The focus of this SAR was to identify any changes in the circumstances identified in previous studies. A change in concentrations of parameters in MW-31 can be observed after monthly monitoring started in 2010, after the well redevelopment effort in 2011, after analytical changes in 2012, after the groundwater elevation peak in 2013, and after changes to the chloroform CAP in 2014.

Constituents included in this SAR exhibit significant increasing trends that can be attributed to one or more of the following: (1) natural background conditions; (2) pyrite oxidation in the aquifer, which can decrease pH, increase mobility of metals, and increase sulfate and TDS concentrations; (3) the location of this well within the nitrate/chloride plume, which is actively being remediated according to the CAP (HGC, 2012b); and/or (4) effects of recent events on groundwater in MW-31 such as well redevelopment, increased sampling frequency, changes in water levels, and analytical method/laboratory change, as described in Section 3.1 of the 2015 SAR (INTERA, 2015). A site-wide comparison of concentrations in MW-31 shows that even with significant increasing long-term trends, many of the constituents are present in concentrations less than or within the range of site-wide background concentrations. Thus, increasing sulfate and TDS concentrations in MW-31 over time are likely due to background influences, including the decreasing trend in pH across the Mill site and the location of this well within the existing nitrate/chloride plume, and not to potential tailings system seepage. Findings are summarized on **Table 3.**

Table 3. MW-31 Summary of Findings

Out-of-Compliance Constituent	Summary	Path Forward
Sulfate	Sulfate concentrations are likely due to a combination of the oxidation of pyrite, which releases sulfate, and the location of MW-31 within the nitrate/chloride plume. Sulfate concentrations in MW-31 remain among the lowest at the Mill site.	Modified approach GWCL; continue remedial action on the nitrate/chloride plume.
TDS	TDS concentrations are impacted by the nitrate/chloride plume and increasing dissolved constituents from pyrite oxidation. TDS concentrations in MW-31 are among the lowest at the Mill site.	Modified approach GWCL; continue remedial action on the nitrate/chloride plume.

INTERA recommends adopting the revised GWCLs for MW-31 based on the modified approach to address constituents with increasing trends in accordance with the Flowsheet. Regular revisions to GWCLs for constituents in wells with significantly increasing trends due to background is consistent with the USEPA's Unified Guidance (USEPA, 2009). Such revisions account for the trends and minimize unwarranted OOC status in such wells.

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FIGURES

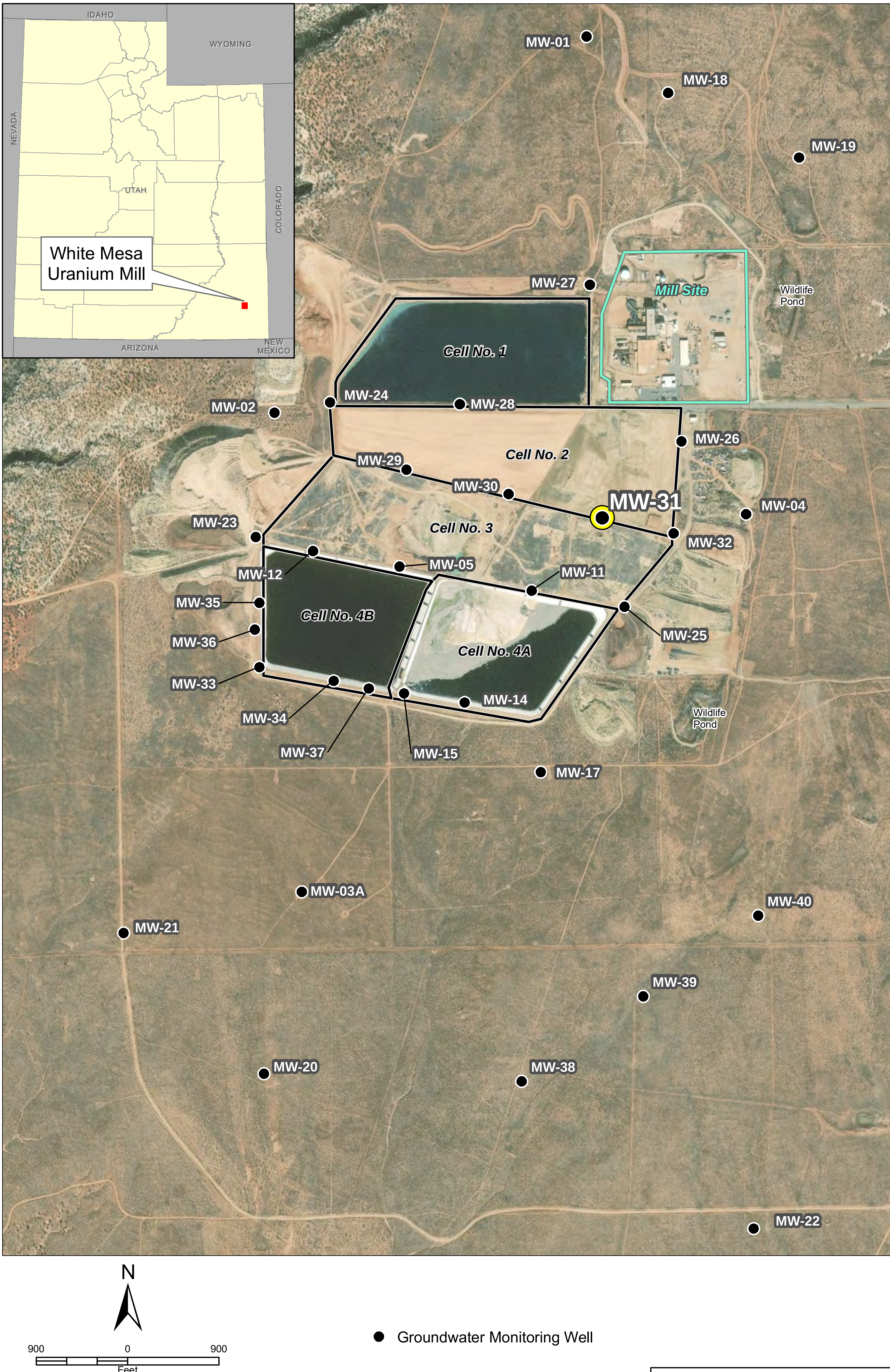
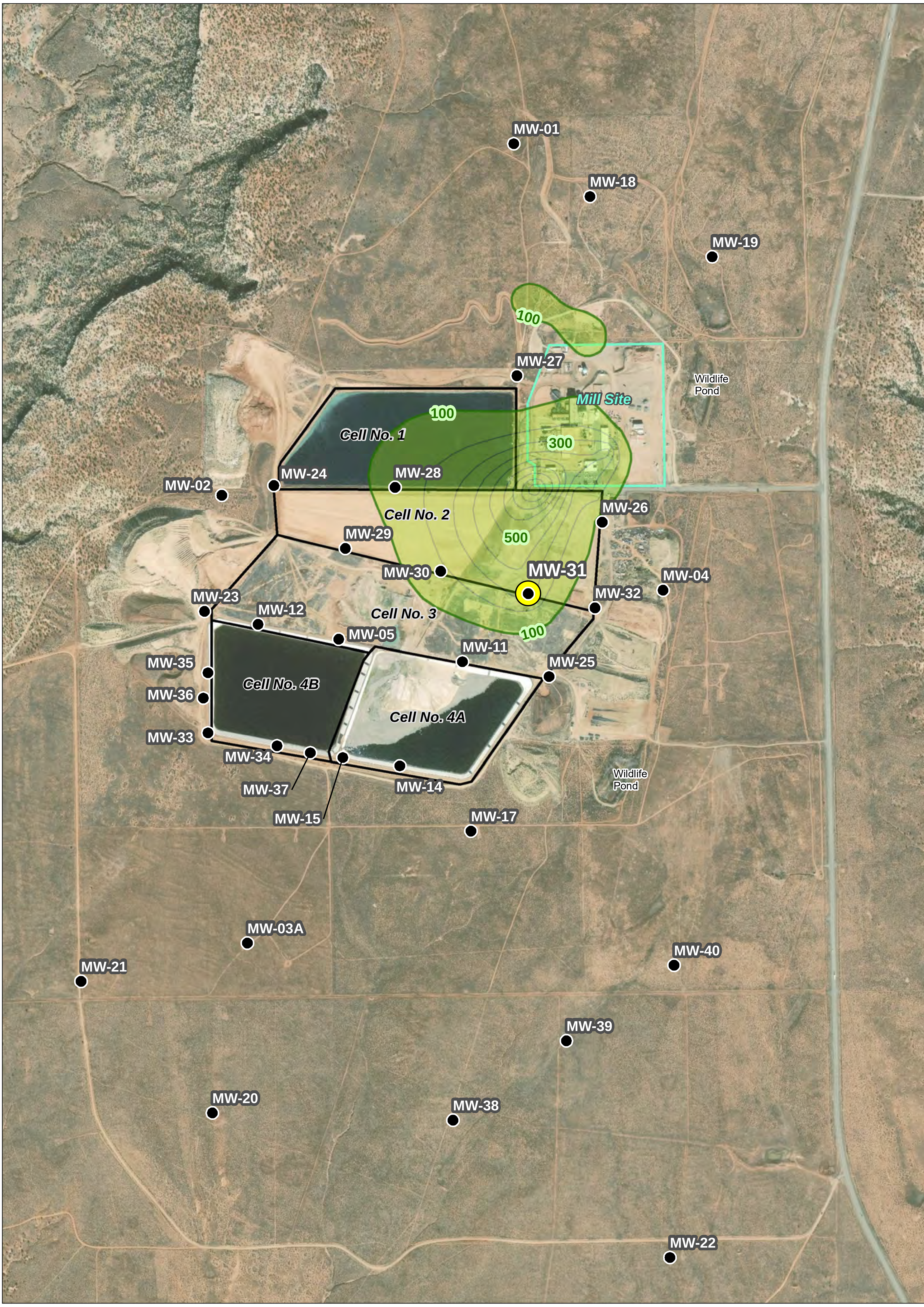


Figure 1
Location of White Mesa Mill Site and Groundwater Monitoring Wells
White Mesa Uranium Mill

INTERA

Source(s): Aerial – ESRI ArcGIS online;
Wells – HGC, Inc., May 2008 report.

S:\ABQ\IUC-001-01-001 Denison Mines\GIS\mapdocs\2020_SARs\MW-31\01_SARMW31_LocationMap.mxd Date: 6/2/2020



N

1,000 500 0 1,000
Feet

Legend

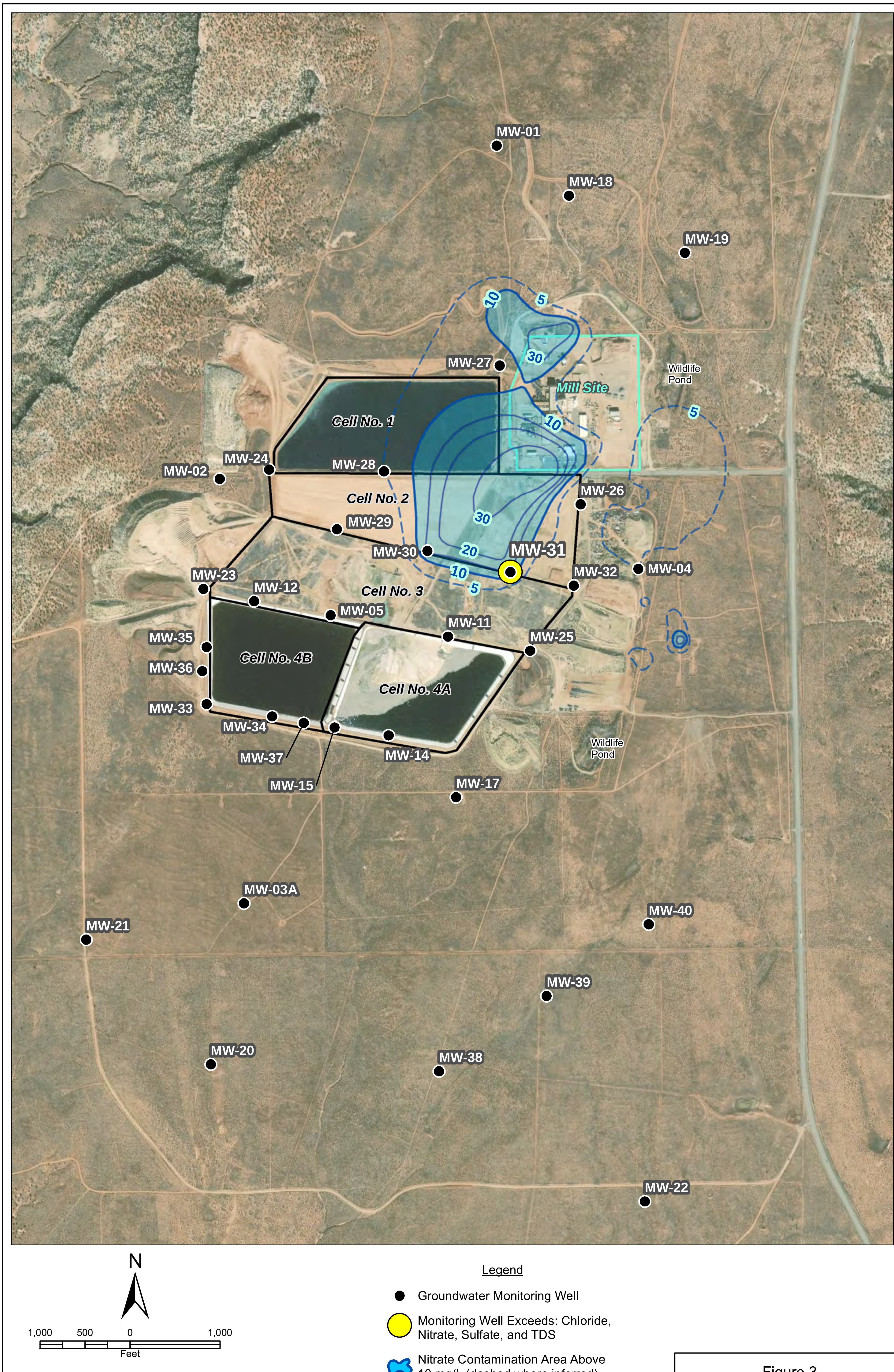
- Groundwater Monitoring Well
- Monitoring Well Exceeds: Chloride, Nitrate, Sulfate, and TDS
- Chloride Contamination Area Above 100 mg/L
- 100 mg/L Chloride Contour

Source(s): Aerial – ESRI ArcGIS online;
Wells – HGC, Inc., May 2008 report;
Nitrate and chloride data collected Q1, 2020.

INTERA

Figure 2
Exceedances and Proximity of MW-31 to Chloride Plume
White Mesa Uranium Mill

S:\ABQ\IUC-001-01-001 Denison Mines\GIS\mapdocs\2020_SARs\MW-31\02_SARMW31_Chloride.mxd Date: 6/3/2020

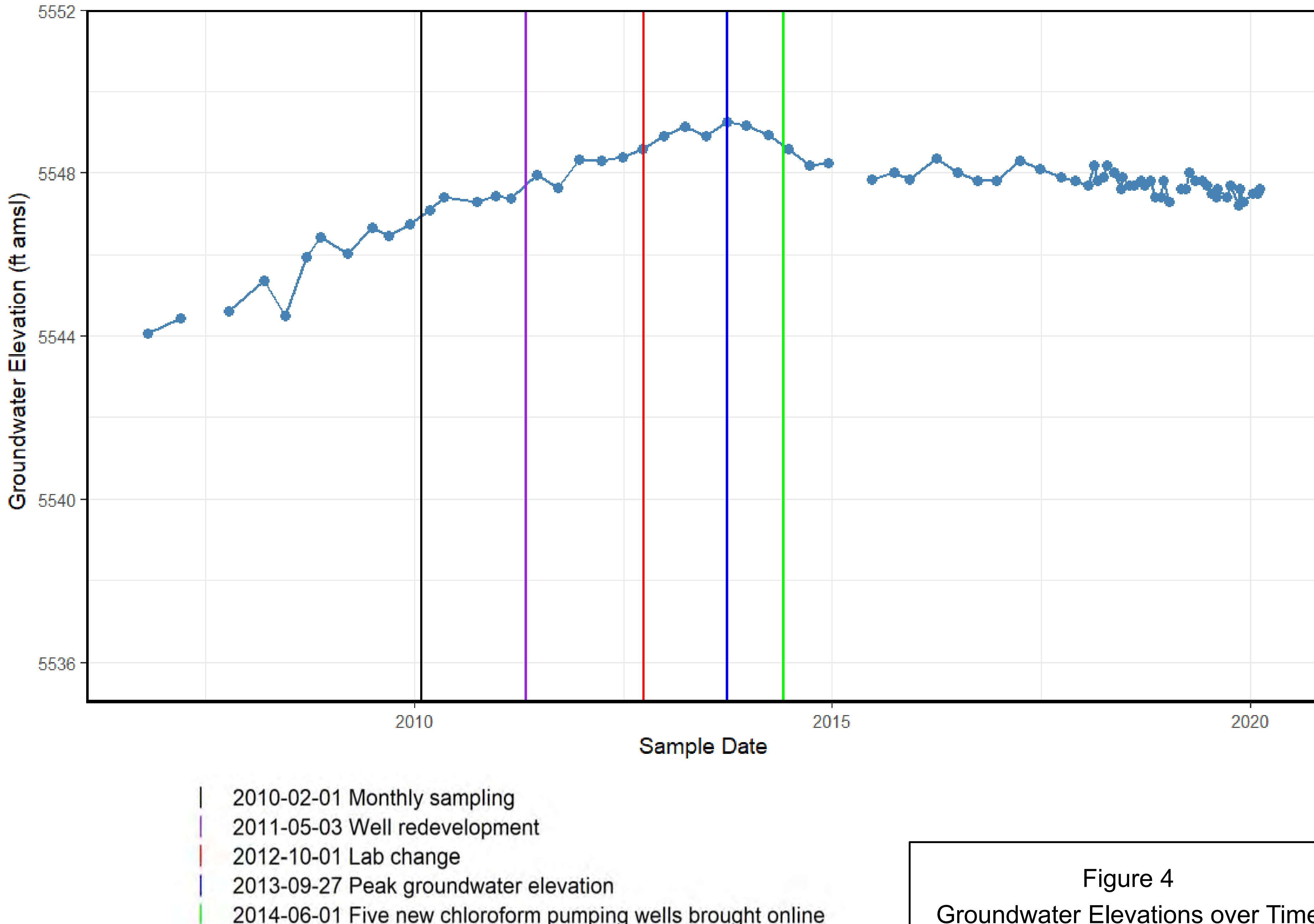


Source(s): Aerial – ESRI ArcGIS online;
Wells – HGC, Inc., May 2008 report;
Nitrate and chloride data collected Q1, 2020.

INTERA

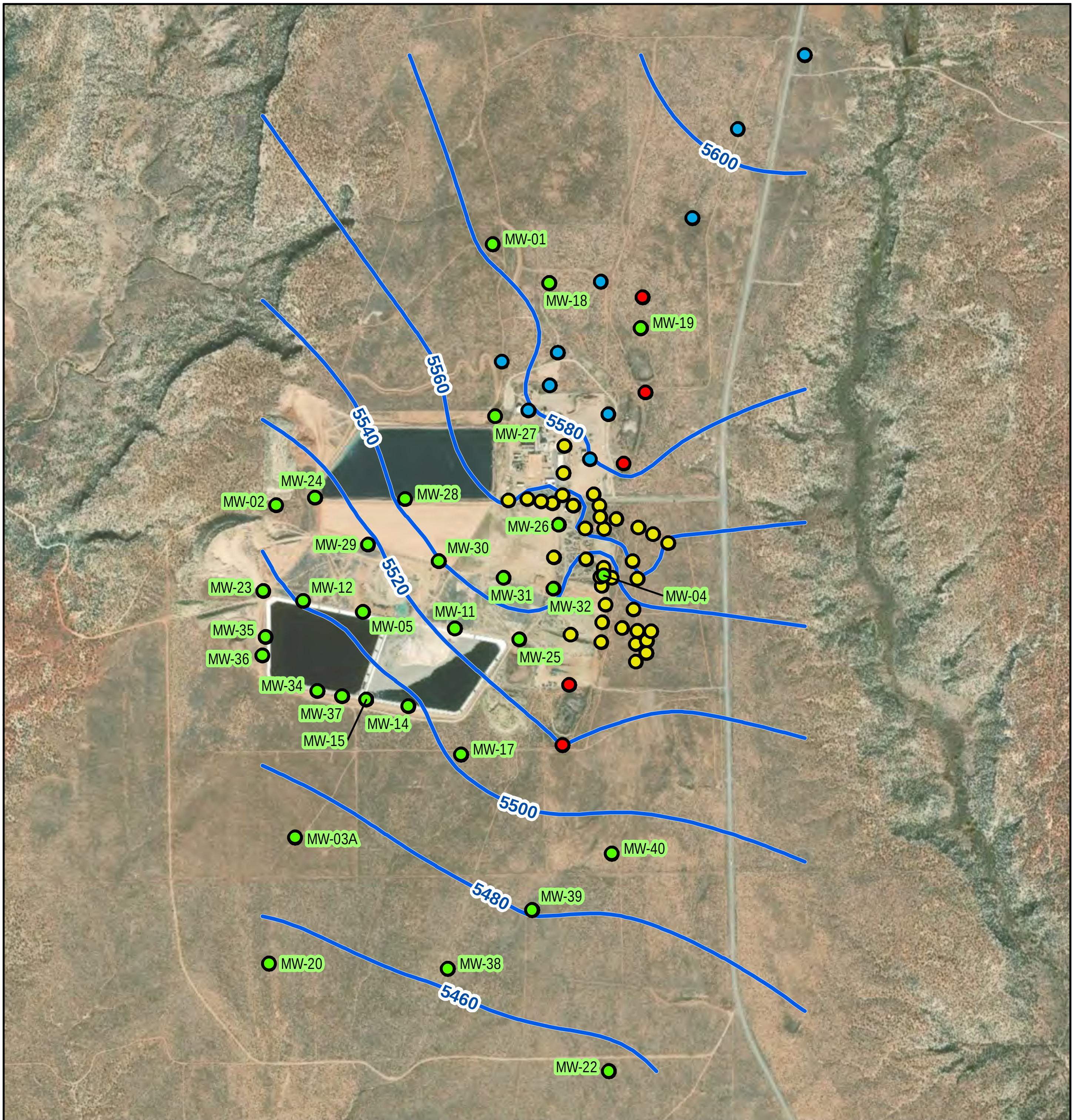
Figure 3
Exceedances and Proximity of MW-31 to Nitrate Plume
White Mesa Uranium Mill

S:\ABQ\IUC-001-01-001 Denison Mines\GIS\mapdocs\2020_SARs\MW-31\03_SARMW31_Nitrate.mxd Date: 6/3/2020



INTERA

Figure 4
Groundwater Elevations over Time at MW-31
White Mesa Uranium Mill



Legend

Well Type

- MW
- PIEZ
- TW4
- TWN
- Groundwater Elevation Contour, ft amsl

N

2,000 0 2,000

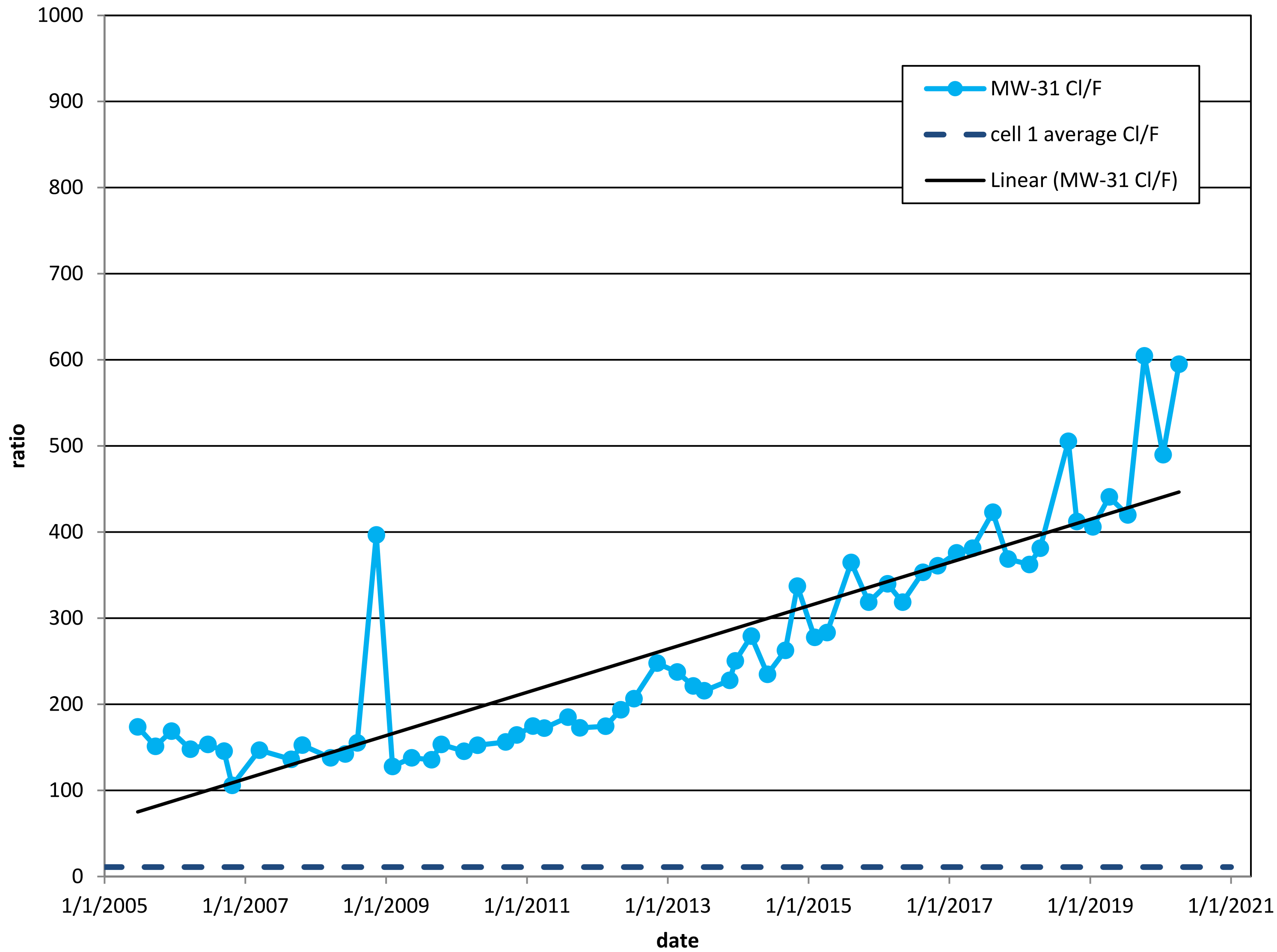
Feet

INTERA

Source(s): Imagery from ArcGIS Online

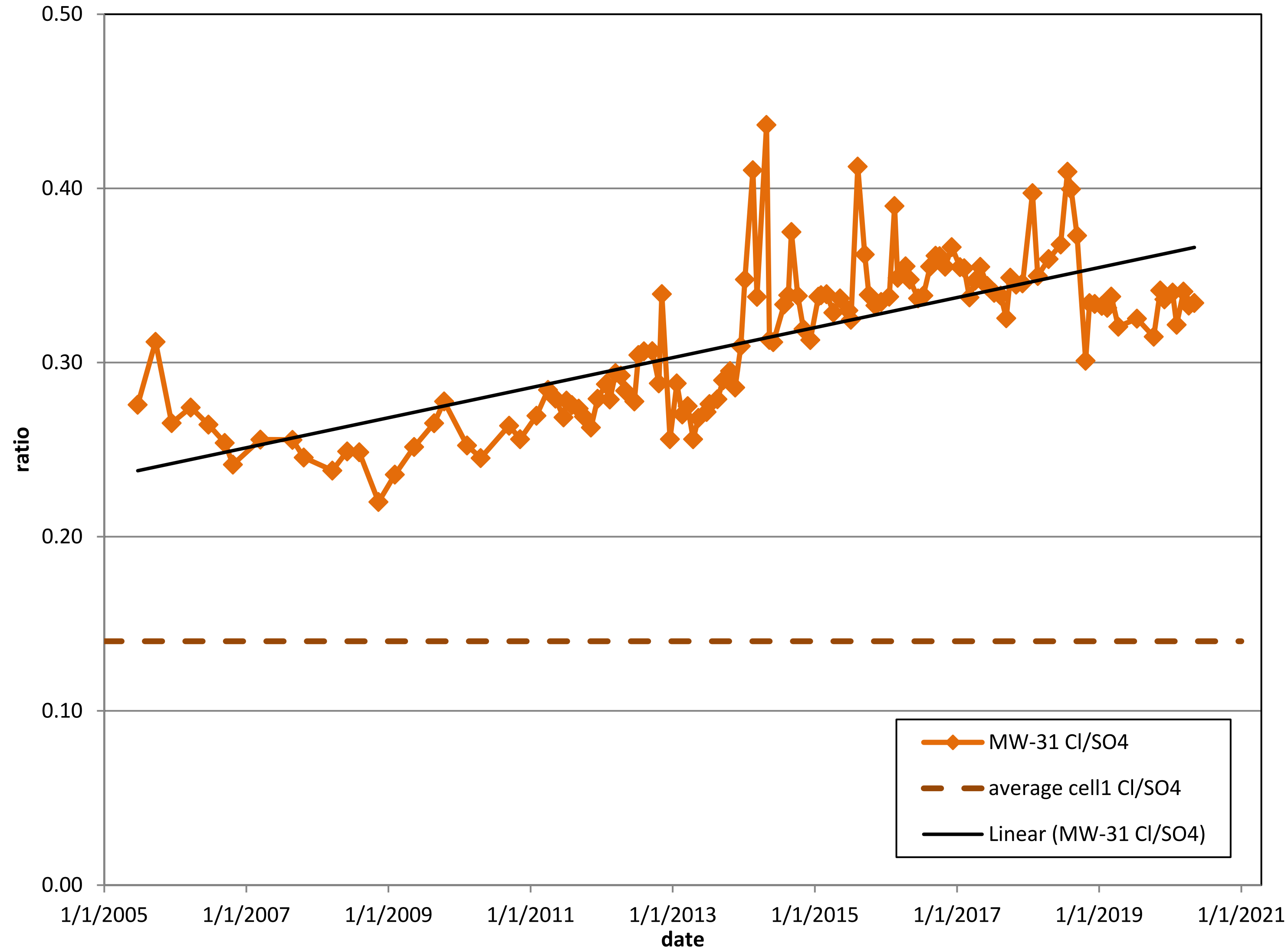
Figure 5
Groundwater Elevation Contours
MW-31 SAR

FILE: S:\ABQ\IUC-001-01-001 Denison Mines\GIS\mapdocs\2020_SARs\MW-31\04_SARMW31_GWelev.mxd Date: 6/2/2020



INTERA

Figure 6
Ratio of Chloride to Fluoride Concentrations in MW-31
White Mesa Uranium Mill



INTERA

Figure 7

Ratio of Chloride to Sulfate Concentrations in MW-31

White Mesa Uranium Mill

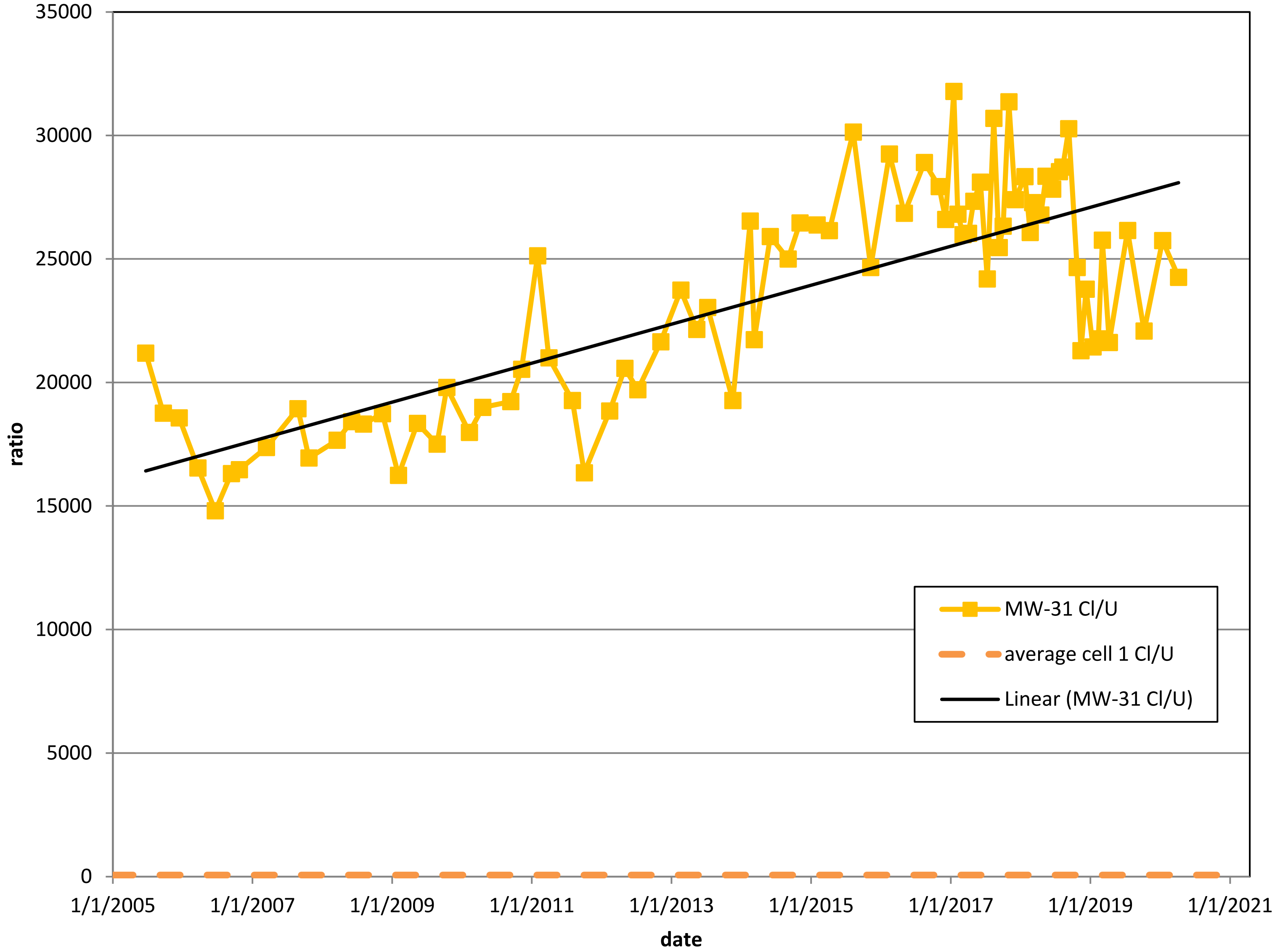


Figure 8

Ratio of Chloride to Uranium Concentrations in MW-31

White Mesa Uranium Mill

INTERA

APPENDIX **A**

GWCL Exceedances for Fourth Quarter 2019

under the March 19, 2019 GWDP

APPENDIX A
GWCL Exceedances for Fourth Quarter 2019 under the March 19, 2019 GWDP

			Q2 2019 Results						Q3 2019 Results						Q4 2019 Results					
Monitoring Well (Water Class)	Constituent Exceeding GWCL	GWCL in March 19, 2019 GWDP	Q2 2019 Sample Date	Q2 2019 Result	May 2019 Monthly Sample Date	May 2019 Monthly Result	June 2019 Monthly Sample Date	June 2019 Monthly Result	Q3 2019 Sample Date	Q3 2019 Result	August 2019 Monthly Sample Date	August 2019 Monthly Result	Sept. 2019 Monthly Sample Date	Sept. 2019 Monthly Result	Q4 2019 Sample Date	Q4 2019 Result	November 2019 Monthly Sample Date	November 2019 Monthly Result	December 2019 Monthly Sample Date	December 2019 Monthly Result
Required Quarterly Sampling Wells																				
MW-11 (Class II)	Chloride (mg/L)	39.16	4/24/2019	34	5/7/2019	NA	6/3/2019	NA	7/16/2019	***48.4***	8/5/2019	NA	9/24/2019	NA	10/15/2019	30.8	11/12/2019	39.1	12/3/2019	35.4
	Sulfate (mg/L)	1309		1160		NA		NA		***1410***		NA		NA		1290		1140		1100
	Manganese (ug/L)	164.67		***181***		***210***		***210***		***199***		***202***		***174***		***185***		***206***		***167***
MW-14 (Class III)	Fluoride (mg/L)	0.22	4/23/2019	<0.100	NS	NA	NS	NA	7/15/2019	***0.248***	NS	NA	NS	NA	10/9/2019	<0.100	11/13/2019	0.127	12/3/2019	0.120
	Sulfate (mg/L)	2330		1780		NA		NA		***2450***		NA		NA		2180		2110		2120
MW-25 (Class III)	Cadmium (ug/L)	1.5	4/10/2019	1.30	5/8/2019	1.41	6/4/2019	1.47	7/15/2019	1.23	8/6/2019	1.37	9/23/2019	1.38	10/9/2019	1.45	11/13/2019	1.36	12/4/2019	1.45
MW-26 (Class III)	Nitrate + Nitrite (as N) (mg/L)	0.62	4/24/2019	***3.00***	5/7/2019	***0.986***	6/4/2019	***3.16***	7/16/2019	***2.06***	8/6/2019	***3.10***	9/24/2019	***1.59***	10/9/2019	***2.35***	11/13/2019	***2.90***	12/4/2019	***2.32***
	Chloroform (ug/L)	70		***4140***		***1140***		***778***		***3110***		***1090***		***1540***		***1710***		***1280***		***1110***
	Chloride (mg/L)	58.31		***82.0***		***73.0***		***72.6***		***75.2***		***83.5***		***62.1***		***73.8***		***62.3***		57.7
	Methylene Chloride (ug/L)	5		4.16		1.69		<1.00		***10.7***		1.12		3.35		2.95		1.73		2.64
	Nitrogen, Ammonia as N	0.92		0.104		0.479		0.0919		0.357		0.164		0.496		0.273		0.178		0.207
MW-30 (Class II)	Nitrate + Nitrite (as N) (mg/L)	2.5	4/9/2019	***18.5***	5/7/2019	***17.9***	6/3/2019	***15.8***	7/16/2019	***19.3***	8/6/2019	***15.8***	9/24/2019	***17.9***	10/8/2019	***18.2***	11/13/2019	***17.2***	12/4/2019	***17.8***
	Chloride (mg/L)	128		***138***		***175***		***165***		***181***		***190***		***176***		***170***		***180***		***185***
	Selenium (ug/L)	47.2		***53.6***		47.1		***49.9***		***48.4***		***50.9***		***49.1***		***56.8***		***47.8***		***56.4***
	Uranium (ug/L)	8.32		***8.62***		8.15		***8.88***		***9.03***		***9.39***		8.12		***8.69***		***9.29***		***8.99***
	Field pH (S.U.)	6.47 - 8.5		7.06		7.00		7.12		6.86		7.42		7.00		7.16		7.21		7.22
MW-31 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5	4/10/2019	***19.7***	5/7/2019	***18.9***	6/3/2019	***19.7***	7/15/2019	***19.8***	8/5/2019	***17.0***	9/23/2019	***19.5***	10/9/2019	***19.8***	11/12/2019	***18.8***	12/3/2019	***18.3***
	Sulfate (mg/L)	993		917		NA		NA		***1150***		NA		NA		***1010***		990		***1020***
	TDS (mg/L)	2132		2080		NA		NA		***2580***		NA		NA		***2280***		***2650***		2030
	Chloride (mg/L)	143		***294***		***346***		***325***		***374***		***372***		***365***		***318***		***338***		***343***
MW-36 (Class III)	Sulfate (mg/L)	3146.21	4/18/2019	2470	5/21/2019	NA	6/3/2019	NA	7/16/2019	***3170***	8/6/2019	NA	9/23/2019	NA	10/8/2019	2850	11/13/2019	2590	12/3/2019	2710
	Field pH (S.U.)	6.49 - 8.5		7.05		6.73		7.01		6.60		7.33		6.92		7.05		7.09		7.24
Required Semi-Annual Sampling Wells																				
MW-12 (Class III)	Uranium (ug/L)	23.5	4/25/2019	23.2	NS	NA	NS	NA	7/11/2019	23.1	NS	NA	NS	NA	10/23/2019	21.6	NS	NA	NS	NA
MW-24 (Class III)	Beryllium (ug/L)	2	5/2/2019	***2.83***	NS	NA	NS	NA	7/18/2019	***2.94***	NS	NA	NS	NA	11/6/2019	***3.25***	NS	NA	NS	NA
	Cadmium (ug/L)	6.43		***8.24***		NA		NA		***8.37***		NA		NA		***9.31***		NA		NA
	Fluoride (mg/L)	0.47		***0.839***		NA		NA		***0.996***		NA		NA		***0.667***		NA		NA
	Nickel (mg/L)	50		***63.9***		NA		NA		***70.6***		NA		NA		***75.4***		NA		NA
	Manganese (ug/L)	7507		7020		NA		NA		NA		NA		NA		***7700***		NA		NA
	Thallium (ug/L)	2.01		***2.73***		NA		NA		***2.61***		NA		NA		***2.88***		NA		NA
	Field pH (S.U.)	5.03 - 8.5		***4.53***		NA		NA		5.03		NA		NA		5.19		NA		NA
MW-27 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5.6	4/23/2019	***6.33***	NS	NA	NS	NA	7/12/2019 8/15/2019	***6.50***	NS	NA	NS	NA	10/22/2019	***6.27***	NS	NA	NS	NA
MW-28 (Class III)	Chloride (mg/L)	105	4/24/2019	***165***	NS	NA	NS	NA	7/12/2019 8/16/2019	***133***	NS	NA	NS	NA	10/22/2019	***149***	NS	NA	NS	NA
	Selenium (ug/L)	11.1		***12.4***		NA		NA		10.6		NA		NA		***16.5***		NA		NA
	Gross Alpha (pCi/L)	2.42		1.94		NA		NA		1.20		NA		NA		<1.00		NA		NA
	Uranium (ug/L)	4.9		***9.60***		NA		NA		***7.83***		NA		NA		***12.4***		NA		NA
MW-32 (Class III)	Chloride (mg/L)	35.39	4/9/2019	34.5	NS	NA	NS	NA	8/15/2019	***35.7***	NS	NA	NS	NA	10/8/2019	35.3	NS	NA	NS	NA
MW-35 (Class II)	Nitrogen, Ammonia as N	0.14	4/18/2019	0.0634	NS	NA	NS	NA	7/11/2019	0.0935	NS	NA	NS	NA	10/8/2019	<0.0500	NS	NA	NS	NA

Notes:

NS= Not Required and Not Sampled
NA= Not Applicable

Exceedances are shown in yellow

APPENDIX B

Geochemical Analysis for SAR Parameters in MW-31

Appendix B-1: Summary of Geochemical Analysis for Out of Compliance Constituents in MW-31

Well	Constituent	Data Set	N	% Non-Detected Values	Mean	Standard Deviation	Shapiro-Wilk Test for Normality		Normally or Lognormally distributed?	Mann Kendall Trend Analysis		Significant Trend	Previously Identified Increasing Trend?	Mean + 2σ	Mean x 1.5	Upper Tolerance Limit (UTL)	Highest Historical Value (HHV)	Current GWCL §	Flowsheet GWCL	Rationale	Modified Approach GWCL*	Modified Approach GWCL Rationale
							W	p		S	p											
MW-31	Sulfate	Complete	126	0	668.9	160.9	0.9468	0.0001	No	6354	0	Increasing	Yes	991	1003.3	1080	1150	993	1150	HHV		
MW-31	Sulfate	Post Sep 2012	85	0	741.2	148.2	0.9660	0.0243	No	2679	0	Increasing	Yes	1038	1111.8	1120	1150	993	1150	HHV		
MW-31	Sulfate	Post May 2014	65	0	780.3	145.8	0.9674	0.0843	Lognormal	1723	0	Increasing	Yes	1071.9	1170.5	1099	1150	993	1071.9	Mean + 2σ	1170.5	Mean x 1.5
MW-31	Total Dissolved Solids	Complete	127	0	1555.3	314	0.9420	0.0000	No	6481	0	Increasing	Yes	2183	2333	2280	2650	2132	2650	HHV		
MW-31	Total Dissolved Solids	Post Sep 2012	85	0	1689.3	300	0.9567	0.0062	No	2870	0	Increasing	Yes	2289	2534	2380	2650	2132	2650	HHV		
MW-31	Total Dissolved Solids	Post May 2014	65	0	1775.7	288	0.9460	0.0068	No	1684	0	Increasing	Yes	2352	2664	2580	2650	2132	2650	HHV	2664	Mean x 1.5

Notes:

σ = sigma
%ND = percent of non-detected values
µg/L = micrograms per liter
mg/L = milligrams per liter

N = number of valid data points
p = probability
W = Shapiro Wilk test value
r^2 = The measure of how well the trendline fits the data where r^2=1 represents a perfect fit.

S = Mann-Kendall statistic
FA= Fraction of GWQS as defined in UAC R317-6
NA= Not Applicable

Distribution = Distribution as determined by the Shapiro-Wilk distribution test for constituents with % Detect > 50% and N>8
Mean = The arithmatic mean as determined for normally or log-normally distributed constituents with % Detect > 50%
Standard Deviation = The standard deviation as determined for normally or log-normally distributed constituents with % Detect > 85%
Highest Historical Value = The highest observed value for constituents with % Detect < 50%
Flowsheet GWCL does not take into account increasing trends
§ = GWCL is based on the GWDP or most recent SARs, where applicable.

Appendix B-2: Comparison of Calculated and Measured TDS in MW-31

Date Sampled	Alkalinity (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	Measured TDS (mg/L)	Calculated TDS (mg/L)	Ratio
8/24/2009	215	169	122	6.0	79.4	92.7	460	1230	1144	93%
10/14/2009	214	170	138	6.1	78.5	93.6	497	1160	1197	103%
2/9/2010	224	170	128	6.2	80.2	92.2	507	1150	1208	105%
4/20/2010	220	162	128	5.8	79.4	91.3	522	1220	1209	99%
9/13/2010	226	164	139	5.7	78.1	91	527	1330	1231	93%
11/9/2010	216	166	138	5.9	77.8	85.4	539	1320	1228	93%
2/1/2011	211	168	145	5.8	79.6	91.6	538	1220	1239	102%
4/1/2011	213	172	143	6.1	80.1	95	503	1370	1212	88%
8/2/2011	199	172	148	5.7	81.2	95.3	537	1300	1238	95%
10/3/2011	202	177	145	5.9	83.3	85.5	539	1320	1238	94%
2/13/2012	203	190	150	6.0	87.9	97.2	538	1240	1272	103%
5/2/2012	208	187	151	7.0	88	87.9	532	1410	1261	89%
7/9/2012	202	189	161	6.0	90.1	98	529	1400	1275	91%
11/6/2012	209.84	182	189	5.7	86.5	92.6	557	1230	1323	108%
2/19/2013	217.16	200	174	6.4	91.6	98.6	644	1390	1432	103%
5/13/2013	212.28	191	169	5.5	90.9	99.2	630	1540	1398	91%
7/9/2013	212.28	199	182	6.1	94.7	105	659	1510	1458	97%
11/18/2013	213.5	194	174	6.0	89.4	94.2	609	1320	1380	105%
3/10/2014	202.52	195	230	5.8	93.9	94.1	681	1490	1502	101%
6/2/2014	209.84	202	173	6.2	101	93.1	555	1520	1340	88%
9/3/2014	223.26	189	210	6.0	95.8	96.5	560	1460	1381	95%
11/4/2014	201.3	201	204	6.2	95.8	93.1	639	1520	1440	95%
2/2/2015	214.72	194	211	6.4	95.4	95	623	1520	1439	95%
4/7/2015	204.96	207	211	6.1	97.6	103	642	1680	1472	88%
8/10/2015	236.68	221	264	6.5	102	99.5	640	1530	1570	103%
11/09/2015	206	224	215	5.8	99.4	96.3	646	1460	1493	102%
2/15/2016	209	238	246	6.0	106	98.5	631	1490	1534	103%
5/3/2016	201	248	243	6.6	115	108	699	1550	1621	105%
8/16/2016	190	246	272	6.8	109	108	766	1710	1698	99%
11/1/2016	190	244	267	7.1	108	104	752	1690	1672	99%
2/7/2017	193	245	266	7.2	117	113	751	1680	1692	101%
5/1/2017	185	254	263	6.7	119	105	741	1820	1674	92%
8/14/2017	211	257	310	6.3	115	102	916	1780	1917	108%
11/1/2017	209	278	292	6.6	135	109	847	1770	1876	106%
2/20/2018	193.98	283	292	6.92	136	108	835	1930	1855	96%
4/17/2018	207.4	299	308	7.33	138	108	857	1980	1925	97%
9/10/2018	206.18	346	333	7.49	159	126	893	2100	2071	99%
10/24/2018	209.84	341	286	7.6	156	124	950	2000	2074	104%
1/15/2019	231.8	321	283	7.42	151	118	851	2030	1963	97%
4/10/2019	214.72	327	294	7.01	146	107	917	2080	2013	97%
7/15/2019	231.8	400	374	7.76	188	130	1150	2580	2482	96%
10/9/2019	225.7	346	318	6.63	167	124	1010	2280	2197	96%
1/14/2020	234.24	367	381	8.31	170	123	1120	2220	2404	108%

Appendix B-3: Charge Balance Calculations for Major Cations and Anions in MW-31

Well	Date	Calcium (meq/L)	Sodium (meq/L)	Magnesium (meq/L)	Potassium (meq/L)	Total Cation Charge (meq/L)	HCO_3 (meq/L)	Chloride (meq/L)	SO_4 (meq/L)	Total Anion Charge (meq/L)	Charge Balance Error
MW-31	6/22/2005	7.78	3.93	6.47	0.14	**18.32**	-2.77	-3.92	-10.49	**17.18**	3.20%
MW-31	3/19/2008	8.03	3.96	6.43	0.16	**18.58**	-3.47	-3.50	-10.85	**17.82**	2.10%
MW-31	6/3/2008	8.13	4.08	6.65	0.15	**19.01**	-3.23	-3.61	-10.70	**17.54**	4.02%
MW-31	8/4/2008	8.98	4.11	7.26	0.16	**20.51**	-3.44	-3.50	-10.39	**17.33**	8.40%
MW-31	11/11/2008	8.98	4.22	6.98	0.16	**20.34**	-3.36	-3.36	-11.26	**17.98**	6.17%
MW-31	2/3/2009	8.43	3.60	6.59	0.14	**18.76**	-3.36	-3.24	-10.16	**16.76**	5.63%
MW-31	5/13/2009	7.29	3.65	5.98	0.13	**17.05**	-3.43	-3.50	-10.26	**17.19**	-0.40%
MW-31	8/24/2009	8.43	4.03	6.53	0.15	**19.15**	-3.52	-3.44	-9.58	**16.54**	7.31%
MW-31	10/14/2009	8.48	4.07	6.46	0.16	**19.17**	-3.51	-3.89	-10.35	**17.75**	3.85%
MW-31	2/9/2010	8.48	4.01	6.60	0.16	**19.25**	-3.67	-3.61	-10.55	**17.84**	3.81%
MW-31	4/20/2010	8.08	3.97	6.53	0.15	**18.74**	-3.61	-3.61	-10.87	**18.08**	1.77%
MW-31	9/13/2010	8.18	3.96	6.43	0.15	**18.71**	-3.70	-3.92	-10.97	**18.60**	0.32%
MW-31	11/9/2010	8.28	3.71	6.40	0.15	**18.55**	-3.54	-3.89	-11.22	**18.65**	-0.28%
MW-31	2/1/2011	8.38	3.98	6.55	0.15	**19.06**	-3.46	-4.09	-11.20	**18.75**	0.83%
MW-31	4/1/2011	8.58	4.13	6.59	0.16	**19.46**	-3.49	-4.03	-10.47	**18.00**	3.91%
MW-31	8/2/2011	8.58	4.15	6.68	0.15	**19.55**	-3.26	-4.17	-11.18	**18.62**	2.46%
MW-31	10/3/2011	8.83	3.72	6.85	0.15	**19.56**	-3.31	-4.09	-11.22	**18.62**	2.45%
MW-31	2/13/2012	9.48	4.23	7.23	0.15	**21.09**	-3.33	-4.23	-11.20	**18.76**	5.86%
MW-31	5/2/2012	9.33	3.82	7.24	0.18	**20.57**	-3.41	-4.26	-11.08	**18.74**	4.65%
MW-31	7/9/2012	9.43	4.26	7.41	0.15	**21.26**	-3.31	-4.54	-11.01	**18.86**	5.97%
MW-31	11/6/2012	9.08	4.03	7.12	0.14	**20.37**	-2.82	-5.33	-11.60	**19.75**	1.56%
MW-31	2/19/2013	9.98	4.29	7.54	0.16	**21.97**	-2.92	-4.91	-13.41	**21.23**	1.70%
MW-31	5/13/2013	9.53	4.31	7.48	0.14	**21.47**	-2.85	-4.77	-13.12	**20.73**	1.73%
MW-31	7/9/2013	9.93	4.57	7.79	0.15	**22.44**	-2.85	-5.13	-13.72	**21.70**	1.67%
MW-31	11/18/2013	9.68	4.10	7.35	0.15	**21.29**	-2.87	-4.91	-12.68	**20.45**	1.99%
MW-31	3/10/2014	9.73	4.09	7.73	0.15	**21.70**	-2.72	-6.49	-14.18	**23.39**	-3.74%
MW-31	6/2/2014	10.08	4.05	8.31	0.16	**22.60**	-2.82	-4.88	-11.55	**19.25**	7.99%
MW-31	9/3/2014	9.43	4.20	7.88	0.15	**21.66**	-3.00	-5.92	-11.66	**20.58**	2.56%
MW-31	11/4/2014	10.03	4.05	7.88	0.16	**22.12**	-2.70	-5.75	-13.30	**21.76**	0.82%
MW-31	2/2/2015	9.68	4.13	7.85	0.16	**21.82**	-2.88	-5.95	-12.97	**21.81**	0.04%
MW-31	4/7/2015	10.33	4.48	8.03	0.16	**22.99**	-2.75	-5.95	-13.37	**22.07**	2.05%
MW-31	8/10/2015	11.03	4.33	8.39	0.17	**23.91**	-3.18	-7.45	-13.32	**23.95**	-0.07%
MW-31	11/09/2015	11.18	4.19	8.18	0.15	**23.69**	-2.77	-6.06	-13.45	**22.28**	3.07%
MW-31	2/15/2016	11.88	4.28	8.72	0.15	**25.04**	-2.80	-6.94	-13.14	**22.88**	4.50%
MW-31	5/3/2016	12.38	4.70	9.46	0.17	**26.70**	-2.70	-6.85	-14.55	**24.11**	5.10%
MW-31	8/16/2016	12.28	4.70	8.97	0.17	**26.11**	-2.56	-7.67	-15.95	**26.18**	-0.12%
MW-31	11/1/2016	12.18	4.52	8.89	0.18	**25.77**	-2.56	-7.53	-15.66	**25.74**	0.05%
MW-31	2/7/2017	12.23	4.92	9.63	0.18	**26.95**	-2.59	-7.50	-15.63	**25.73**	2.32%
MW-31	5/1/2017	12.67	4.57	9.79	0.17	**27.20**	-2.49	-7.42	-15.43	**25.34**	3.55%
MW-31	8/14/2017	12.82	4.44	9.46	0.16	**26.88**	-3.46	-8.74	-19.07	**31.27**	-7.55%
MW-31	11/1/2017	13.87	4.74	11.11	0.17	**29.89**	-3.42	-8.24	-17.63	**29.29**	1.01%
MW-31	2/20/2018	14.12	4.70	11.19	0.18	**30.19**	-3.18	-8.24	-17.38	**28.80**	2.35%
MW-31	4/17/2018	14.92	4.70	11.35	0.19	**31.16**	-3.40	-8.69	-17.84	**29.93**	2.01%
MW-31	9/10/2018	17.27	5.48	13.08	0.19	**36.02**	-3.38	-9.39	-18.59	**31.36**	6.91%
MW-31	10/24/2018	17.02	5.39	12.83	0.19	**35.44**	-3.44	-8.07	-19.78	**31.29**	6.22%
MW-31	1/15/2019	16.02	5.13	12.42	0.19	**33.76**	-3.80	-7.98	-17.72	**29.50**	6.74%
MW-31	4/10/2019	16.32	4.65	12.01	0.18	**33.16**	-3.52	-8.29	-19.09	**30.90**	3.52%
MW-31	7/15/2019	19.96	5.65	15.47	0.20	**41.28**	-3.80	-10.55	-23.94	**38.29**	3.75%
MW-31	10/9/2019	17.27	5.39	13.74	0.17	**36.57**	-3.70	-8.97	-21.03	**33.70**	4.08%
MW-31	1/14/2020	18.31	5.35	13.99	0.21	**37.86**	-3.84	-10.75	-23.32	**37.91**	-0.06%

Notes:

meq/L= milliequivalent per liter

HCO_3 = Bicarbonate

SO_4 = Sulfate

Appendix B-4: Descriptive Statistics for Out of Compliance Constituents in MW-31

Data Set	2020 SAR	2017 SAR	2015 SAR	2012 SAR	2008 Background Report	2020 SAR	2017 SAR	2015 SAR	2012 SAR	2008 Background Report
Analyte	Sulfate	Sulfate	Sulfate	Sulfate	Sulfate	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
% Non-Detects	0	0	0	0	0	0	0	0	0	0
N	126	100	77	39	10	127	100	78	51	10
Distribution	Not normal or lognormal	Not normal or lognormal	Not normal or lognormal	Not normal or lognormal	Not normal or lognormal	Not normal or lognormal	Not normal or lognormal	normal or lognormal	normal or lognormal	Not normal or lognormal
Mean	669	1421	567	517	504	1555	1421	1364	1258	1265
Min. Conc.	436	1150	436	436	436	1150	1150	1150	1110	1150
Max. Conc.	1150	1820	691	552	532	2650	1820	1700	1460	1320
Std. Dev.	161	161	65.1	24.2	27.8	314	161	125	76.5	50
Range	714	670	255	116	96.0	1500	670	550	350	170
Geometric Mean	652	1412	564	517	504	1527	1412	1358	1255	1264
Skewness	1.04	0.35	0.40	-1.3	-1.9	1.18	0.35	0.46	0.34	-1.60
Q25	537	1288	521	503	497	1310	1288	1270	1210	1240
Median	640	1410	541	522	513	1480	1410	1330	1240	1280
Q75	750	1530	630	538	522	1705	1530	1460	1300	1290

Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	6/22/2005	Sulfate	504	mg/l	
MW-31	9/22/2005	Sulfate	436	mg/l	D
MW-31	12/14/2005	Sulfate	509	mg/l	D
MW-31	3/22/2006	Sulfate	485	mg/l	D
MW-31	6/21/2006	Sulfate	522	mg/l	D
MW-31	9/13/2006	Sulfate	516	mg/l	D
MW-31	10/25/2006	Sulfate	526	mg/l	D
MW-31	3/15/2007	Sulfate	516	mg/l	D
MW-31	8/27/2007	Sulfate	532	mg/l	D
MW-31	10/24/2007	Sulfate	497	mg/l	D
MW-31	3/19/2008	Sulfate	521	mg/l	D
MW-31	6/3/2008	Sulfate	514	mg/l	D
MW-31	8/4/2008	Sulfate	499	mg/l	D
MW-31	11/11/2008	Sulfate	541	mg/l	D
MW-31	2/3/2009	Sulfate	488	mg/l	D
MW-31	5/13/2009	Sulfate	493	mg/l	D
MW-31	8/24/2009	Sulfate	460	mg/l	D
MW-31	10/14/2009	Sulfate	497	mg/l	D
MW-31	2/9/2010	Sulfate	507	mg/l	D
MW-31	4/20/2010	Sulfate	522	mg/l	D
MW-31	9/13/2010	Sulfate	527	mg/l	D
MW-31	11/9/2010	Sulfate	539	mg/l	D
MW-31	2/1/2011	Sulfate	538	mg/l	D
MW-31	3/14/2011	Sulfate	531	mg/l	D
MW-31	4/1/2011	Sulfate	503	mg/l	D
MW-31	5/10/2011	Sulfate	512	mg/l	D
MW-31	6/20/2011	Sulfate	540	mg/l	D
MW-31	7/5/2011	Sulfate	532	mg/l	D
MW-31	8/2/2011	Sulfate	537	mg/l	D
MW-31	9/6/2011	Sulfate	541	mg/l	D
MW-31	10/3/2011	Sulfate	539	mg/l	D
MW-31	11/8/2011	Sulfate	552	mg/l	D
MW-31	12/12/2011	Sulfate	530	mg/l	D
MW-31	1/24/2012	Sulfate	539	mg/l	D
MW-31	2/13/2012	Sulfate	538	mg/l	D
MW-31	3/13/2012	Sulfate	517	mg/l	D
MW-31	4/9/2012	Sulfate	547	mg/l	D
MW-31	5/2/2012	Sulfate	532	mg/l	D
MW-31	6/18/2012	Sulfate	497	mg/l	D
MW-31	7/9/2012	Sulfate	529	mg/l	D
MW-31	8/6/2012	Sulfate	571	mg/l	D
MW-31	9/18/2012	Sulfate	561	mg/l	D
MW-31	10/22/2012	Sulfate	545	mg/l	
MW-31	11/6/2012	Sulfate	557	mg/l	
MW-31	12/18/2012	Sulfate	664	mg/l	

Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	1/22/2013	Sulfate	611	mg/l	
MW-31	2/19/2013	Sulfate	644	mg/l	
MW-31	3/19/2013	Sulfate	611	mg/l	
MW-31	4/16/2013	Sulfate	668	mg/l	
MW-31	5/13/2013	Sulfate	630	mg/l	
MW-31	6/24/2013	Sulfate	659	mg/l	
MW-31	7/9/2013	Sulfate	659	mg/l	
MW-31	8/19/2013	Sulfate	656	mg/l	
MW-31	9/17/2013	Sulfate	666	mg/l	
MW-31	10/23/2013	Sulfate	637	mg/l	
MW-31	11/18/2013	Sulfate	609	mg/l	
MW-31	12/17/2013	Sulfate	656	mg/l	
MW-31	1/7/2014	Sulfate	558	mg/l	
MW-31	2/17/2014	Sulfate	480	mg/l	
MW-31	3/10/2014	Sulfate	681	mg/l	
MW-31	4/28/2014	Sulfate	527	mg/l	
MW-31	5/13/2014	Sulfate	639	mg/l	
MW-31	6/2/2014	Sulfate	555	mg/l	
MW-31	7/28/2014	Sulfate	600	mg/l	
MW-31	8/18/2014	Sulfate	620	mg/l	
MW-31	9/3/2014	Sulfate	560	mg/l	
MW-31	10/6/2014	Sulfate	606	mg/l	
MW-31	11/4/2014	Sulfate	639	mg/l	
MW-31	12/9/2014	Sulfate	687	mg/l	
MW-31	1/20/2015	Sulfate	669	mg/l	
MW-31	2/2/2015	Sulfate	623	mg/l	
MW-31	3/3/2015	Sulfate	616	mg/l	
MW-31	4/7/2015	Sulfate	642	mg/l	
MW-31	5/11/2015	Sulfate	668	mg/l	
MW-31	6/23/2015	Sulfate	691	mg/l	
MW-31	7/6/2015	Sulfate	684	mg/l	
MW-31	8/10/2015	Sulfate	640	mg/l	
MW-31	9/15/2015	Sulfate	638	mg/l	
MW-31	10/6/2015	Sulfate	655	mg/l	
MW-31	11/9/2015	Sulfate	646	mg/l	
MW-31	12/8/2015	Sulfate	690	mg/l	
MW-31	1/19/2016	Sulfate	675	mg/l	
MW-31	2/15/2016	Sulfate	631	mg/l	
MW-31	3/2/2016	Sulfate	654	mg/l	
MW-31	4/12/2016	Sulfate	715	mg/l	
MW-31	5/3/2016	Sulfate	699	mg/l	
MW-31	6/15/2016	Sulfate	748	mg/l	
MW-31	7/12/2016	Sulfate	712	mg/l	
MW-31	8/16/2016	Sulfate	766	mg/l	
MW-31	9/13/2016	Sulfate	703	mg/l	

Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	10/4/2016	Sulfate	720	mg/l	
MW-31	11/1/2016	Sulfate	752	mg/l	
MW-31	12/5/2016	Sulfate	748	mg/l	
MW-31	1/17/2017	Sulfate	809	mg/l	
MW-31	2/7/2017	Sulfate	751	mg/l	
MW-31	3/6/2017	Sulfate	741	mg/l	
MW-31	4/4/2017	Sulfate	758	mg/l	
MW-31	5/1/2017	Sulfate	741	mg/l	
MW-31	6/5/2017	Sulfate	808	mg/l	
MW-31	7/11/2017	Sulfate	747	mg/l	
MW-31	8/14/2017	Sulfate	916	mg/l	
MW-31	9/11/2017	Sulfate	762	mg/l	
MW-31	10/2/2017	Sulfate	823	mg/l	
MW-31	11/1/2017	Sulfate	847	mg/l	
MW-31	12/4/2017	Sulfate	825	mg/l	
MW-31	1/24/2018	Sulfate	813	mg/l	
MW-31	2/20/2018	Sulfate	835	mg/l	
MW-31	4/17/2018	Sulfate	857	mg/l	
MW-31	6/18/2018	Sulfate	976	mg/l	
MW-31	7/23/2018	Sulfate	857	mg/l	
MW-31	8/10/2018	Sulfate	841	mg/l	
MW-31	9/10/2018	Sulfate	893	mg/l	
MW-31	10/24/2018	Sulfate	950	mg/l	
MW-31	11/13/2018	Sulfate	841	mg/l	
MW-31	12/10/2018	Sulfate	905	mg/l	
MW-31	1/15/2019	Sulfate	851	mg/l	
MW-31	2/12/2019	Sulfate	893	mg/l	
MW-31	3/5/2019	Sulfate	953	mg/l	
MW-31	4/10/2019	Sulfate	917	mg/l	
MW-31	7/15/2019	Sulfate	1150	mg/l	
MW-31	10/9/2019	Sulfate	1010	mg/l	
MW-31	11/12/2019	Sulfate	990	mg/l	
MW-31	12/3/2019	Sulfate	1020	mg/l	
MW-31	1/14/2020	Sulfate	1120	mg/l	
MW-31	2/4/2020	Sulfate	1150	mg/l	
MW-31	3/10/2020	Sulfate	1080	mg/l	
MW-31	6/22/2005	Total Dissolved Solids	1290	mg/l	
MW-31	9/22/2005	Total Dissolved Solids	1280	mg/l	
MW-31	12/14/2005	Total Dissolved Solids	1290	mg/l	
MW-31	3/22/2006	Total Dissolved Solids	1280	mg/l	H
MW-31	6/21/2006	Total Dissolved Solids	1300	mg/l	
MW-31	9/13/2006	Total Dissolved Solids	1320	mg/l	
MW-31	10/25/2006	Total Dissolved Solids	1220	mg/l	
MW-31	3/15/2007	Total Dissolved Solids	1280	mg/l	
MW-31	8/27/2007	Total Dissolved Solids	1240	mg/l	

Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	10/24/2007	Total Dissolved Solids	1150	mg/l	
MW-31	3/19/2008	Total Dissolved Solids	1220	mg/l	
MW-31	6/3/2008	Total Dissolved Solids	1180	mg/l	
MW-31	8/4/2008	Total Dissolved Solids	1240	mg/l	
MW-31	11/11/2008	Total Dissolved Solids	1220	mg/l	
MW-31	2/3/2009	Total Dissolved Solids	1210	mg/l	
MW-31	5/13/2009	Total Dissolved Solids	1230	mg/l	
MW-31	8/24/2009	Total Dissolved Solids	1230	mg/l	
MW-31	12/2/2009	Total Dissolved Solids	1160	mg/l	
MW-31	2/9/2010	Total Dissolved Solids	1150	mg/l	
MW-31	4/20/2010	Total Dissolved Solids	1220	mg/l	
MW-31	9/13/2010	Total Dissolved Solids	1330	mg/l	
MW-31	11/9/2010	Total Dissolved Solids	1320	mg/l	
MW-31	1/10/2011	Total Dissolved Solids	1240	mg/l	
MW-31	2/1/2011	Total Dissolved Solids	1220	mg/l	
MW-31	3/14/2011	Total Dissolved Solids	1250	mg/l	
MW-31	4/1/2011	Total Dissolved Solids	1370	mg/l	
MW-31	5/10/2011	Total Dissolved Solids	1290	mg/l	
MW-31	6/20/2011	Total Dissolved Solids	1330	mg/l	
MW-31	7/5/2011	Total Dissolved Solids	1280	mg/l	
MW-31	8/2/2011	Total Dissolved Solids	1300	mg/l	
MW-31	9/6/2011	Total Dissolved Solids	1300	mg/l	
MW-31	10/3/2011	Total Dissolved Solids	1320	mg/l	
MW-31	11/8/2011	Total Dissolved Solids	1290	mg/l	
MW-31	12/12/2011	Total Dissolved Solids	1330	mg/l	
MW-31	1/24/2012	Total Dissolved Solids	1360	mg/l	
MW-31	2/13/2012	Total Dissolved Solids	1240	mg/l	
MW-31	3/13/2012	Total Dissolved Solids	1400	mg/l	
MW-31	4/9/2012	Total Dissolved Solids	1380	mg/l	
MW-31	5/2/2012	Total Dissolved Solids	1410	mg/l	
MW-31	6/29/2012	Total Dissolved Solids	1460	mg/l	
MW-31	7/9/2012	Total Dissolved Solids	1400	mg/l	
MW-31	8/6/2012	Total Dissolved Solids	1400	mg/l	
MW-31	9/18/2012	Total Dissolved Solids	1460	mg/l	
MW-31	10/22/2012	Total Dissolved Solids	1320	mg/l	
MW-31	11/6/2012	Total Dissolved Solids	1230	mg/l	
MW-31	12/18/2012	Total Dissolved Solids	1270	mg/l	
MW-31	1/22/2013	Total Dissolved Solids	1270	mg/l	
MW-31	2/19/2013	Total Dissolved Solids	1390	mg/l	
MW-31	3/19/2013	Total Dissolved Solids	1420	mg/l	
MW-31	4/16/2013	Total Dissolved Solids	1260	mg/l	
MW-31	5/13/2013	Total Dissolved Solids	1540	mg/l	
MW-31	6/24/2013	Total Dissolved Solids	1380	mg/l	
MW-31	7/9/2013	Total Dissolved Solids	1510	mg/l	
MW-31	8/19/2013	Total Dissolved Solids	1440	mg/l	

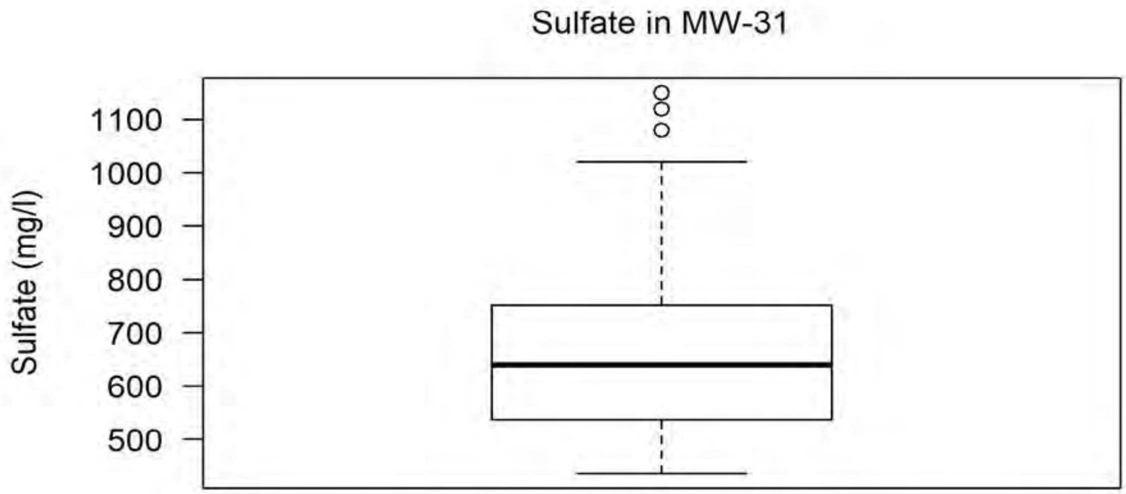
Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	9/17/2013	Total Dissolved Solids	1500	mg/l	
MW-31	10/23/2013	Total Dissolved Solids	1460	mg/l	
MW-31	11/18/2013	Total Dissolved Solids	1320	mg/l	
MW-31	12/17/2013	Total Dissolved Solids	1500	mg/l	
MW-31	1/7/2014	Total Dissolved Solids	1510	mg/l	
MW-31	2/17/2014	Total Dissolved Solids	1460	mg/l	
MW-31	3/10/2014	Total Dissolved Solids	1490	mg/l	
MW-31	4/28/2014	Total Dissolved Solids	1440	mg/l	
MW-31	5/13/2014	Total Dissolved Solids	1510	mg/l	
MW-31	6/2/2014	Total Dissolved Solids	1520	mg/l	
MW-31	7/28/2014	Total Dissolved Solids	1400	mg/l	
MW-31	8/18/2014	Total Dissolved Solids	1410	mg/l	
MW-31	9/3/2014	Total Dissolved Solids	1460	mg/l	
MW-31	10/6/2014	Total Dissolved Solids	1420	mg/l	
MW-31	11/4/2014	Total Dissolved Solids	1520	mg/l	
MW-31	12/9/2014	Total Dissolved Solids	1450	mg/l	
MW-31	1/20/2015	Total Dissolved Solids	1540	mg/l	
MW-31	2/2/2015	Total Dissolved Solids	1520	mg/l	
MW-31	3/3/2015	Total Dissolved Solids	1530	mg/l	
MW-31	4/7/2015	Total Dissolved Solids	1680	mg/l	
MW-31	5/11/2015	Total Dissolved Solids	1700	mg/l	
MW-31	6/23/2015	Total Dissolved Solids	1630	mg/l	
MW-31	7/6/2015	Total Dissolved Solids	1440	mg/l	
MW-31	8/10/2015	Total Dissolved Solids	1530	mg/l	
MW-31	9/15/2015	Total Dissolved Solids	1480	mg/l	
MW-31	10/6/2015	Total Dissolved Solids	1540	mg/l	
MW-31	11/9/2015	Total Dissolved Solids	1460	mg/l	
MW-31	12/8/2015	Total Dissolved Solids	1580	mg/l	
MW-31	1/19/2016	Total Dissolved Solids	1560	mg/l	
MW-31	2/15/2016	Total Dissolved Solids	1490	mg/l	
MW-31	3/2/2016	Total Dissolved Solids	1580	mg/l	
MW-31	4/12/2016	Total Dissolved Solids	1710	mg/l	
MW-31	5/3/2016	Total Dissolved Solids	1550	mg/l	
MW-31	6/15/2016	Total Dissolved Solids	1580	mg/l	
MW-31	7/12/2016	Total Dissolved Solids	1610	mg/l	
MW-31	8/16/2016	Total Dissolved Solids	1710	mg/l	
MW-31	9/13/2016	Total Dissolved Solids	1570	mg/l	
MW-31	10/4/2016	Total Dissolved Solids	1670	mg/l	
MW-31	11/1/2016	Total Dissolved Solids	1690	mg/l	
MW-31	12/5/2016	Total Dissolved Solids	1670	mg/l	
MW-31	1/17/2017	Total Dissolved Solids	1730	mg/l	
MW-31	2/7/2017	Total Dissolved Solids	1680	mg/l	
MW-31	3/6/2017	Total Dissolved Solids	1690	mg/l	
MW-31	4/4/2017	Total Dissolved Solids	1660	mg/l	
MW-31	5/1/2017	Total Dissolved Solids	1820	mg/l	

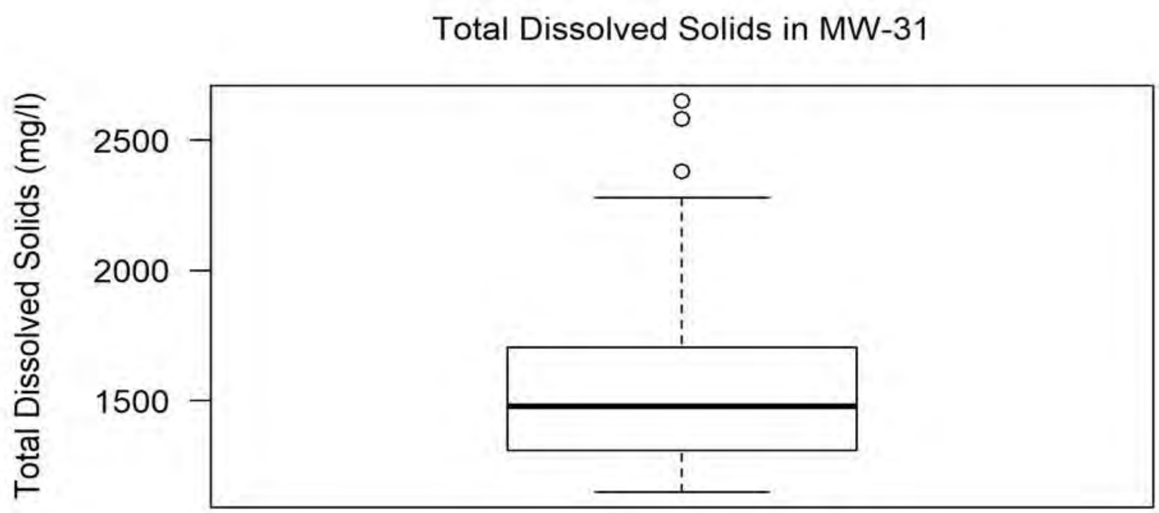
Appendix B-5: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-31	6/5/2017	Total Dissolved Solids	1710	mg/l	
MW-31	7/11/2017	Total Dissolved Solids	1830	mg/l	
MW-31	8/14/2017	Total Dissolved Solids	1780	mg/l	
MW-31	9/11/2017	Total Dissolved Solids	1780	mg/l	
MW-31	10/2/2017	Total Dissolved Solids	1760	mg/l	
MW-31	11/1/2017	Total Dissolved Solids	1770	mg/l	
MW-31	12/4/2017	Total Dissolved Solids	1910	mg/l	
MW-31	1/24/2018	Total Dissolved Solids	1800	mg/l	
MW-31	2/20/2018	Total Dissolved Solids	1930	mg/l	
MW-31	4/17/2018	Total Dissolved Solids	1980	mg/l	
MW-31	6/18/2018	Total Dissolved Solids	2010	mg/l	
MW-31	7/23/2018	Total Dissolved Solids	2000	mg/l	
MW-31	8/10/2018	Total Dissolved Solids	1980	mg/l	
MW-31	9/10/2018	Total Dissolved Solids	2100	mg/l	
MW-31	10/24/2018	Total Dissolved Solids	2000	mg/l	
MW-31	11/13/2018	Total Dissolved Solids	1960	mg/l	
MW-31	12/10/2018	Total Dissolved Solids	2090	mg/l	
MW-31	1/15/2019	Total Dissolved Solids	2030	mg/l	
MW-31	2/12/2019	Total Dissolved Solids	2090	mg/l	
MW-31	3/5/2019	Total Dissolved Solids	2160	mg/l	
MW-31	4/10/2019	Total Dissolved Solids	2080	mg/l	
MW-31	7/15/2019	Total Dissolved Solids	2580	mg/l	
MW-31	10/9/2019	Total Dissolved Solids	2280	mg/l	
MW-31	11/12/2019	Total Dissolved Solids	2650	mg/l	
MW-31	12/3/2019	Total Dissolved Solids	2030	mg/l	
MW-31	1/14/2020	Total Dissolved Solids	2220	mg/l	
MW-31	2/4/2020	Total Dissolved Solids	2240	mg/l	
MW-31	3/10/2020	Total Dissolved Solids	2380	mg/l	

Appendix B-6: Box Plots

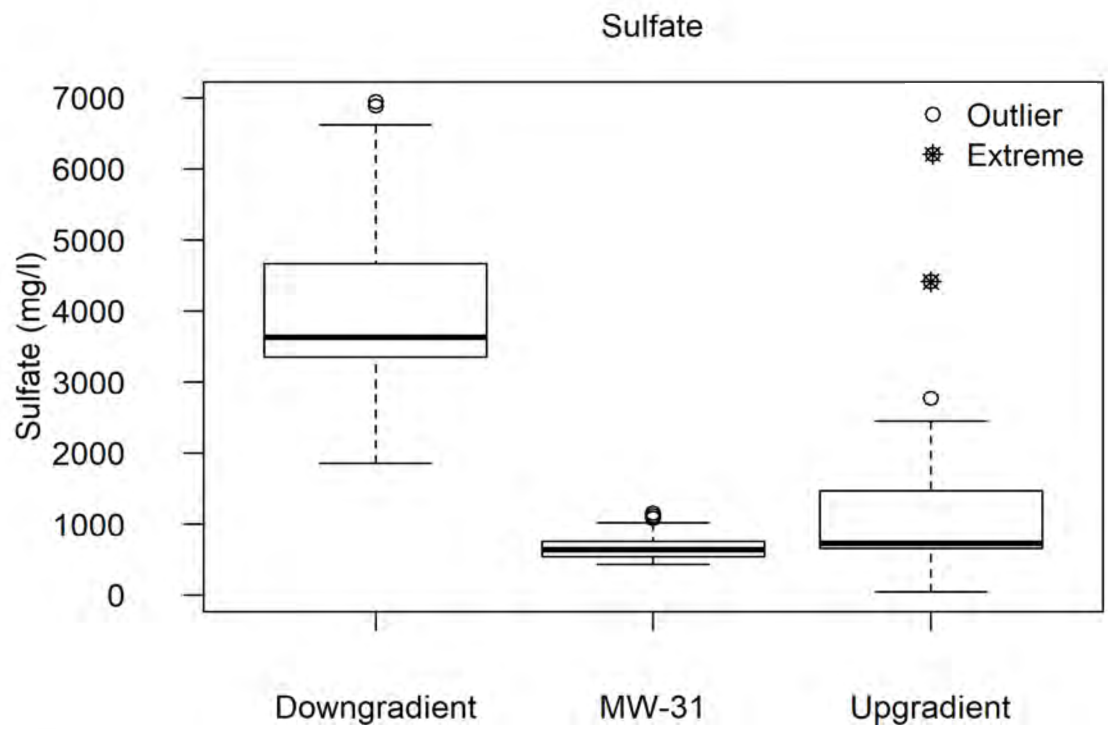


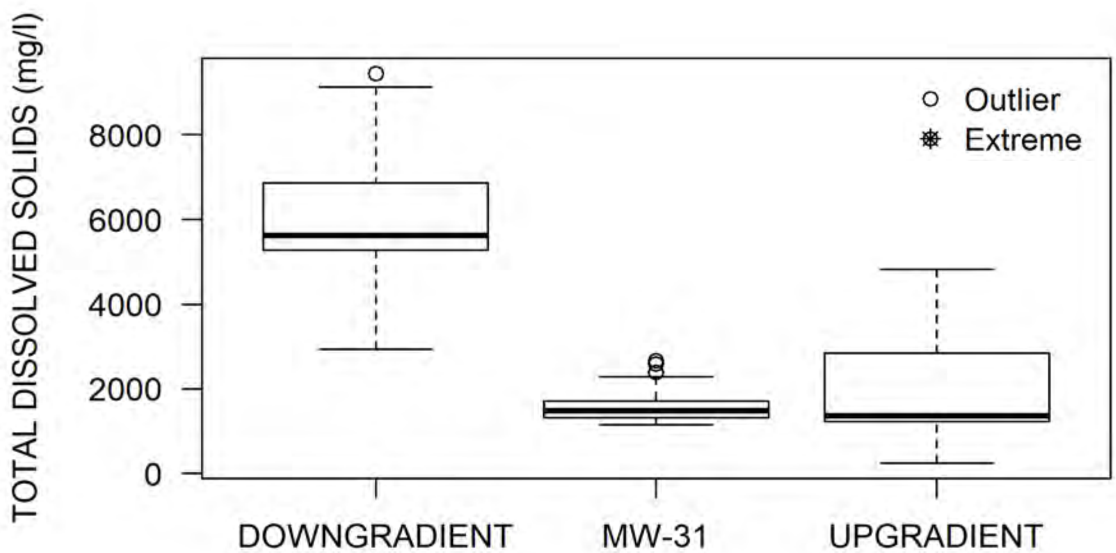
Percent nondetect: 0%
Min: 436, Mean: 668.86, Max: 1150, Std Dev: 160.92
Upper extreme threshold (Q75 + 3xH): 1389.25
Lower extreme threshold (Q25 - 3xH): -101.75



Percent nondetect: 0%
Min: 1150, Mean: 1555.28, Max: 2650, Std Dev: 313.7
Upper extreme threshold (Q75 + 3xH): 2890
Lower extreme threshold (Q25 - 3xH): 125

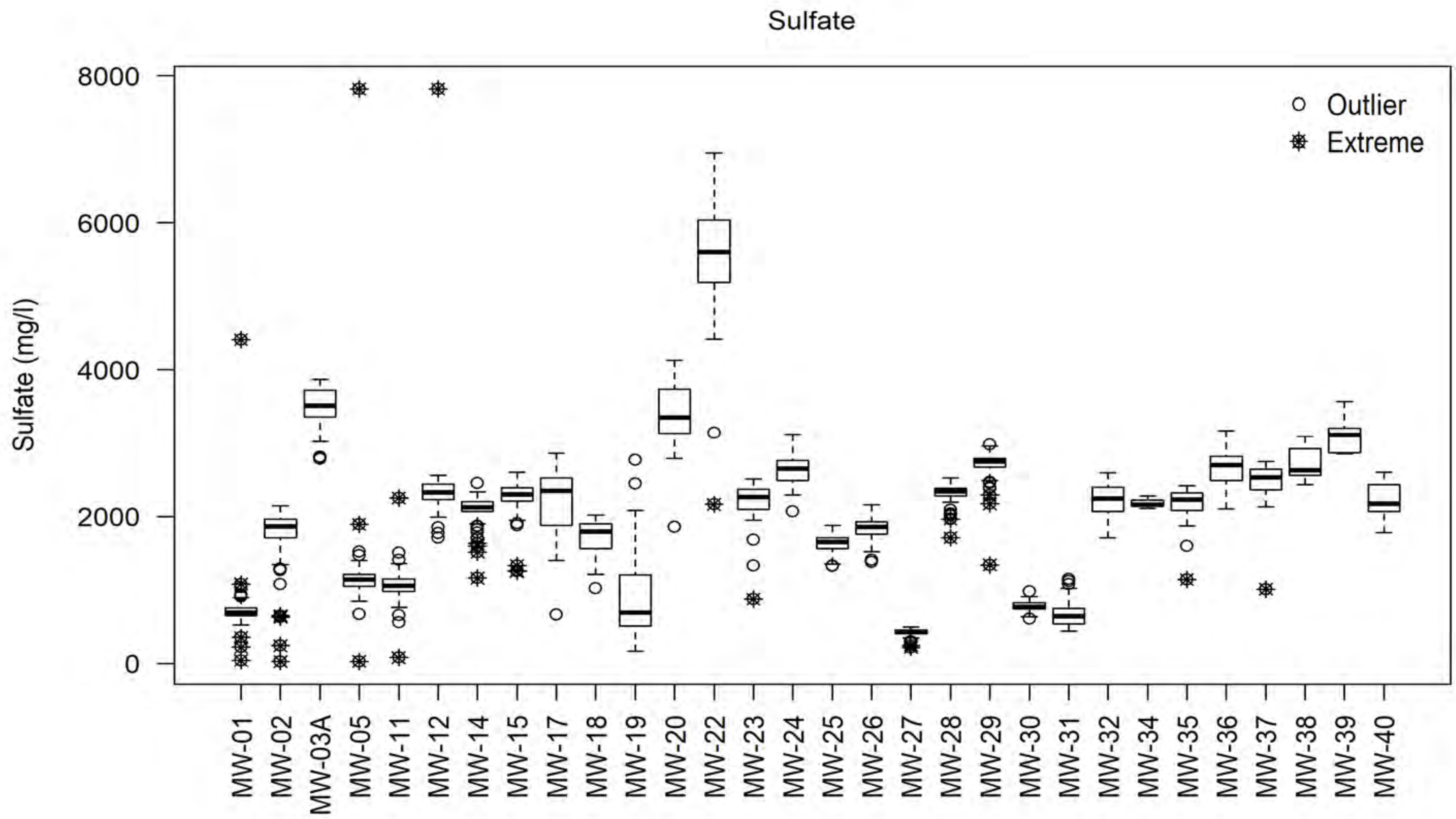
Appendix B-7: Box Plots for MW-31 and Upgradient and Downgradient Wells

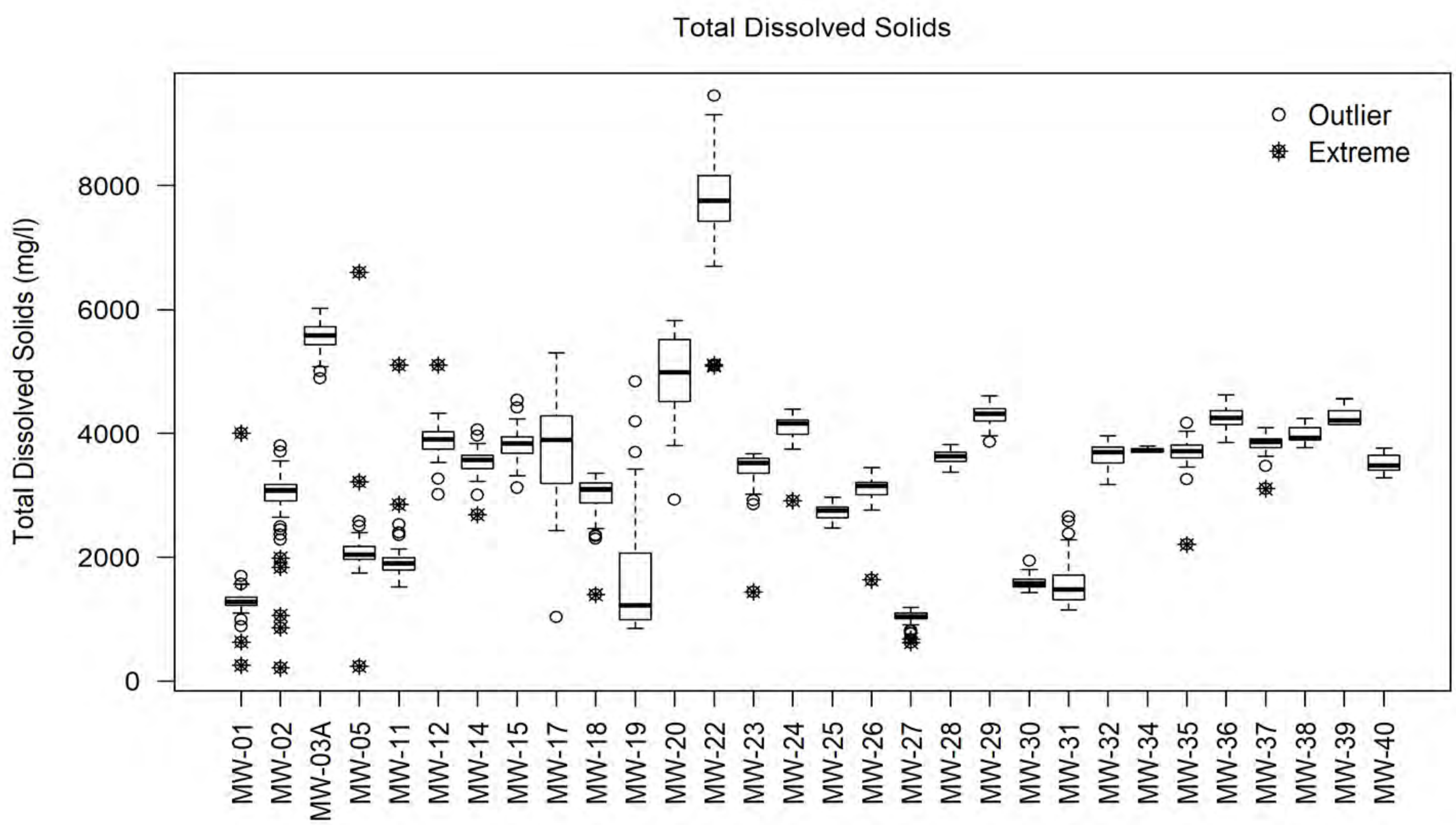




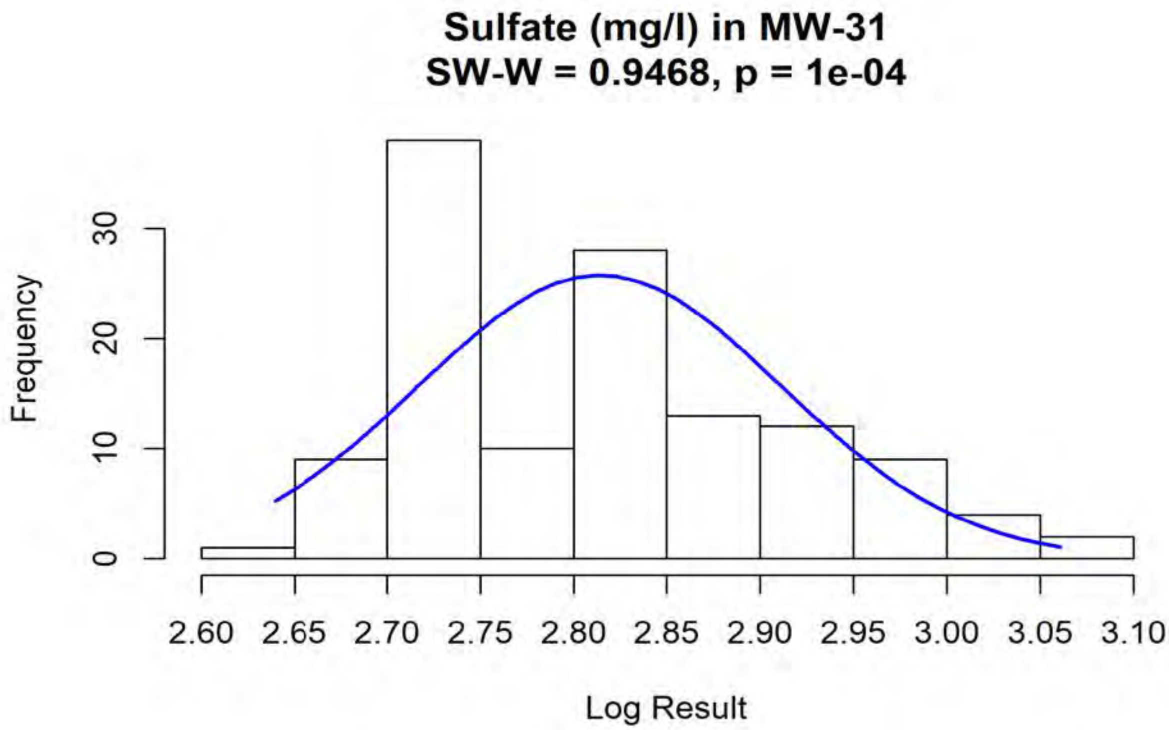
Downgradient wells: MW-3A, MW-20, and MW-22.
Upgradient wells: MW-1, MW-18, and MW-19

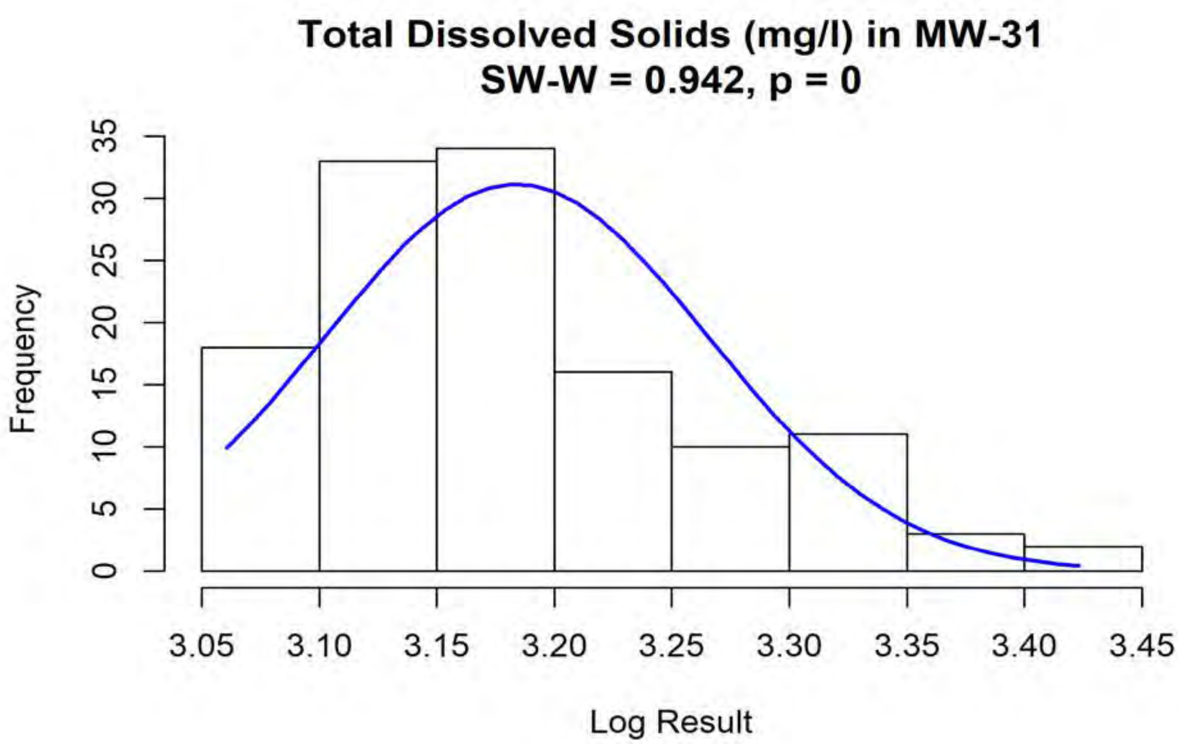
Appendix B-8: Box Plots for SAR Parameters in Groundwater Monitoring Wells



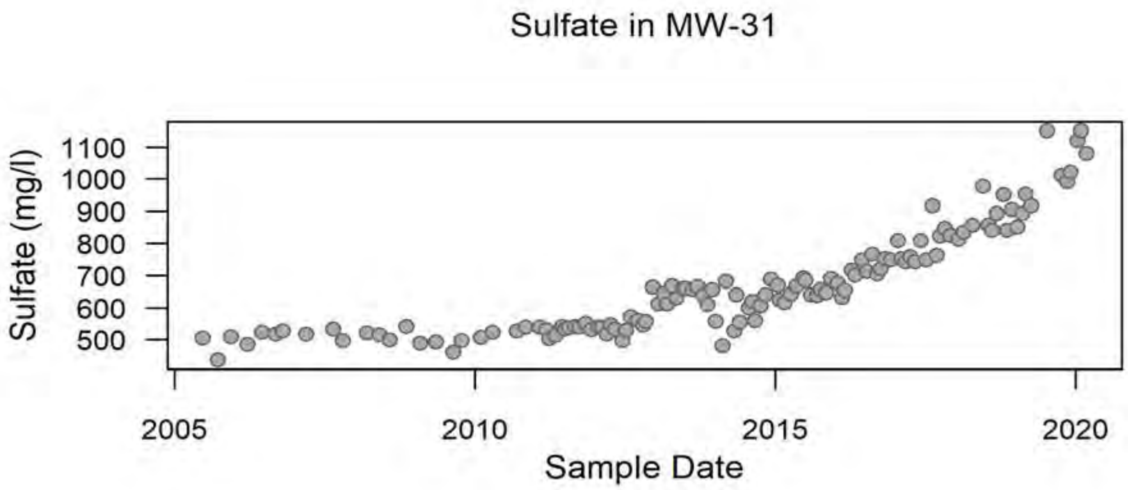


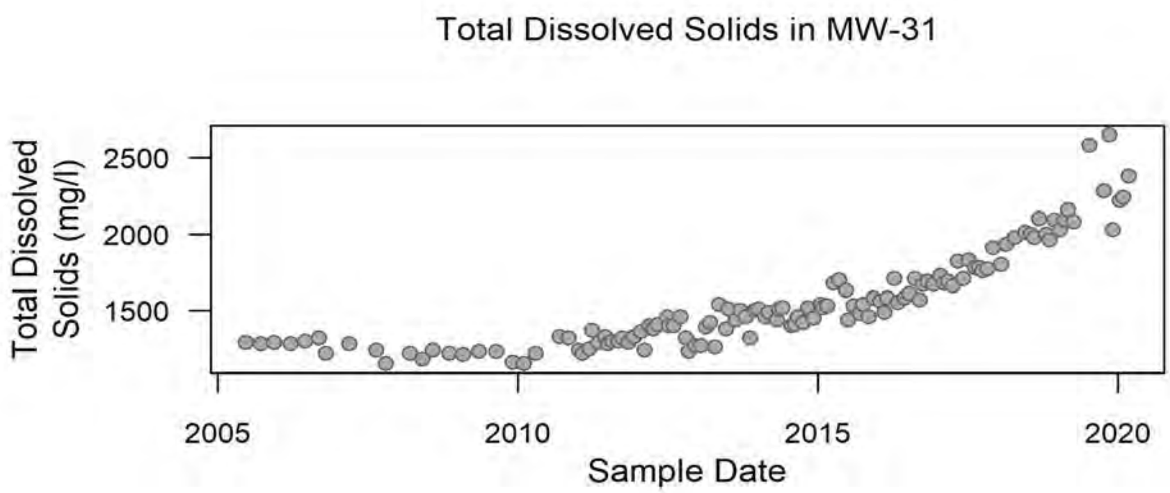
Appendix B-9: Histograms





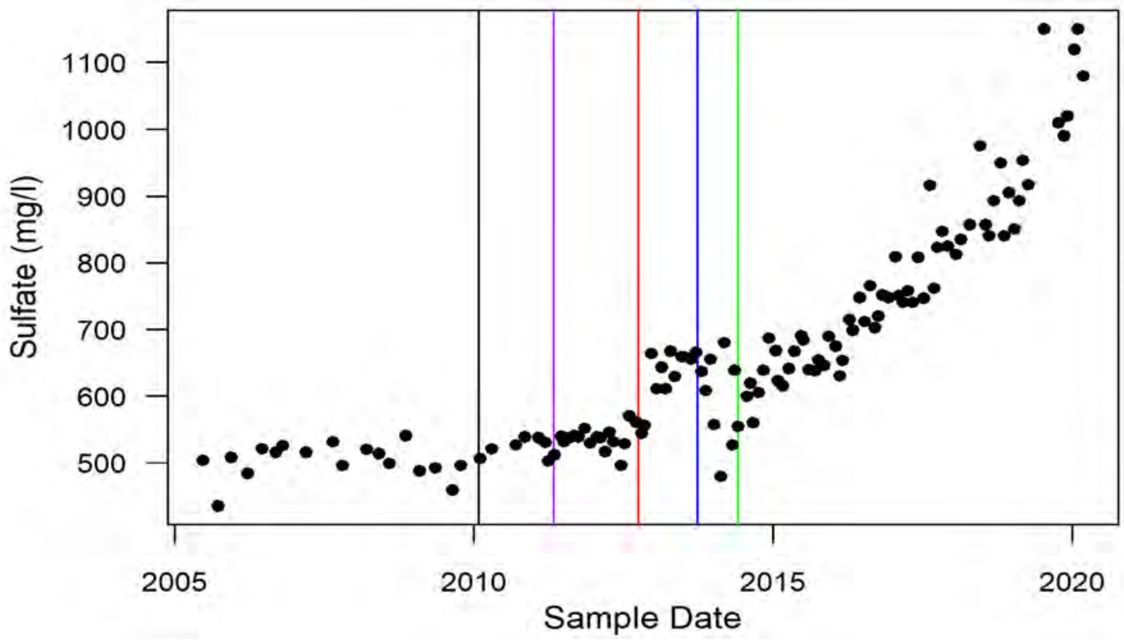
Appendix B-10: Timeseries Plots



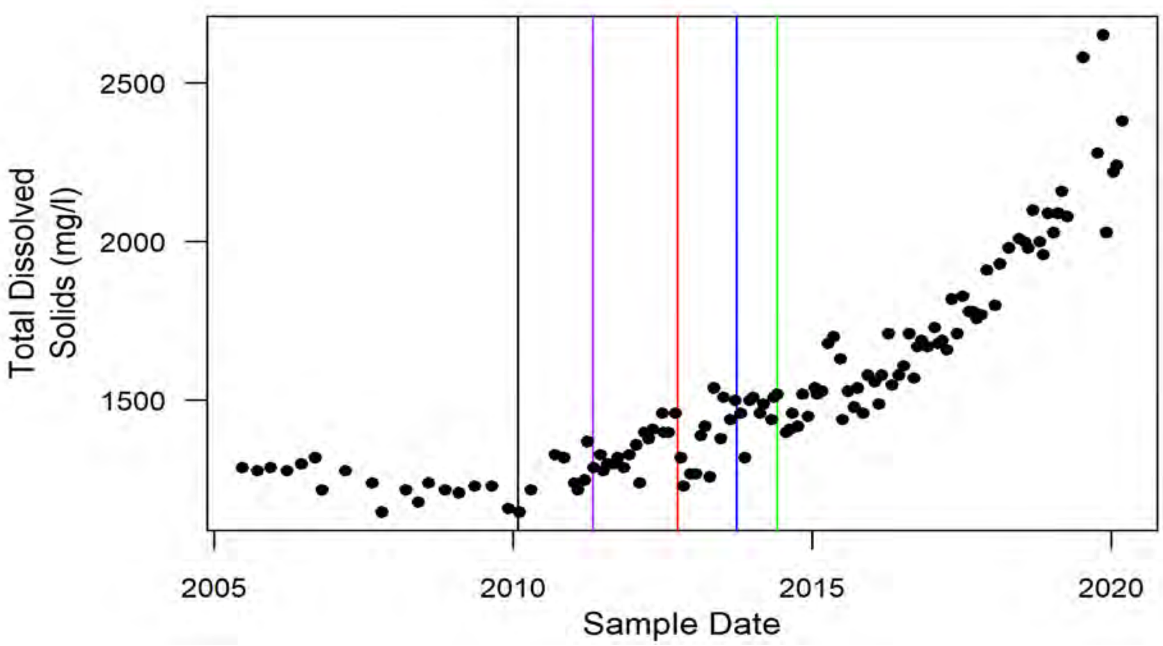


Appendix B-11: Timeseries Plots with Events

Sulfate in MW-31



Total Dissolved Solids in MW-31



| 2010-02-01 Monthly sampling
| 2011-05-03 Well redevelopment
| 2012-10-01 Lab change
| 2013-09-27 Peak groundwater elevation
| 2014-06-01 Five new chloroform pumping wells brought online

APPENDIX C

Geochemical Analysis for Indicator Parameters in MW-31

Appendix C-1: Summary of Geochemical Analysis for Indicator Parameters in MW-31

Well	Constituent	N	% Non-Detected Values	Mean	Standard Deviation	Shapiro-Wilk Test for Normality		Normally or Lognormally distributed?	Least Squares Regression Trend Analysis[a]		Mann-Kendall Trend Analysis[b]		2015 Significant Trend?	2017 Significant Trend?	Background Report Significant Trend?	2020 Significant Trend
						W	p		r^2	p	S	p				
MW-31	Chloride (mg/L)	131	0	220	73.9	0.9532	0.0002	No	NA	NA	7448	0	Increasing	Increasing	No	Increasing
MW-31	Fluoride (mg/L)	59	0	0.809	0.103	0.9689	0.1355	Normal	0.540	3.4E-11	-1046	4.04E-12	Decreasing	Decreasing	No	Decreasing
MW-31	Sulfate (mg/L)	126	0	669	160.9	0.9468	0.0001	No	NA	NA	6354	0	Increasing	Increasing	No	Increasing
MW-31	Uranium (µg/L)	79	0	9.24	2.24	0.9548	0.0070	No	NA	NA	2307	0	Increasing	Increasing	No	Increasing

Notes:

σ = sigma
%ND = percent of non-detected values
µg/L = micrograms per liter
mg/L = milligrams per liter

N = number of valid data points
p = probability
W = Shapiro-Wilk test value
r2 = The measure of how well the trendline fits the data where r2=1 represents a perfect fit.

S = Mann-Kendall statistic

a = A regression test was performed on data that was determined to have normal or log-normal distribution
b = The Mann-Kendall test was performed on data that are not normally or lognormally distributed

Appendix C-2: Descriptive Statistics of Indicator Parameters in MW-31

Data Set	2020 SAR				2017 SAR				2015 SAR				2013 SAR				2008 Background Report			
Analyte	Chloride	Fluoride	Sulfate	Uranium	Chloride	Fluoride	Sulfate	Uranium	Chloride	Fluoride	Sulfate	Uranium	Chloride	Fluoride	Sulfate	Uranium	Chloride	Fluoride	Sulfate	Uranium
Units	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	ug/L
% Non-Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	131	59	126	79	98	47	99	54	76	41	77	42	50	31	47	32	10	10	10	10
Normally or Lognormallly Distributed?	No	Yes	No	No	No	Yes	No	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Mean	219.63	0.81	668.86	9.24	186	0.818	601	7.96	167	0.84	567	7.5	146	0.86	527	7.3	133	0.91	504	7.6
Min. Conc.	115	0.53	436	5.77	115	0.605	436	5.77	115	0.61	436	5.8	115	0.73	436	5.8	122	0.80	436	6.6
Max. Conc.	381	1.18	1150	14.80	287	0.99	809	10.3	264	1.2	691	9.3	189	1.0	630	9.3	139	1.2	532	9.3
Std. Dev.	73.92	0.10	160.92	2.24	47.7	0.080	87.9	1.08	35	0.09	65	0.8	18.1	0.06	34.5	0.74	5	0.12	28	0.75
Range	266.0	0.66	714	9.03	172	0.385	373	4.53	149	0.60	255	3.6	74.0	0.26	194	3.6	17	0.40	96	2.8
Geometric Mean	207.60	0.80	651.61	8.99	180	0.814	594	7.89	163	0.84	564	7.5	145	0.86	526	7.3	133	0.90	504	7.6
Skewness	0.45	0.40	1.04	0.76	0.37	-0.27	0.41	0.43	0.56	0.96	0.40	0.31	0.50	-0.17	0.56	0.73	-1.1	1.9	-1.9	1.2
Q25	149	0.74	537.25	7.34	144	0.763	528	7.14	138	0.78	521	7.0	132	0.83	507	6.9	131	0.85	497	7.2
Median	210	0.81	639.50	8.73	176	0.830	600	7.72	159	0.84	541	7.5	144	0.86	529	7.2	134	0.90	513	7.4
Q75	276	0.87	750.25	10.70	225.75	0.89	665.00	8.75	195	0.90	630	8.0	157	0.90	540	7.7	136	0.90	522	8.0

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	06/22/2005	Chloride	139	mg/l	
MW-31	09/22/2005	Chloride	136	mg/l	
MW-31	12/14/2005	Chloride	135	mg/l	
MW-31	03/22/2006	Chloride	133	mg/l	
MW-31	06/21/2006	Chloride	138	mg/l	
MW-31	09/13/2006	Chloride	131	mg/l	
MW-31	10/25/2006	Chloride	127	mg/l	
MW-31	03/15/2007	Chloride	132	mg/l	
MW-31	08/27/2007	Chloride	136	mg/l	
MW-31	10/24/2007	Chloride	122	mg/l	
MW-31	03/19/2008	Chloride	124	mg/l	
MW-31	06/03/2008	Chloride	128	mg/l	
MW-31	08/04/2008	Chloride	124	mg/l	
MW-31	11/11/2008	Chloride	119	mg/l	
MW-31	02/03/2009	Chloride	115	mg/l	
MW-31	05/13/2009	Chloride	124	mg/l	
MW-31	08/24/2009	Chloride	122	mg/l	
MW-31	10/14/2009	Chloride	138	mg/l	
MW-31	02/09/2010	Chloride	128	mg/l	
MW-31	04/20/2010	Chloride	128	mg/l	
MW-31	09/13/2010	Chloride	139	mg/l	
MW-31	11/09/2010	Chloride	138	mg/l	
MW-31	02/01/2011	Chloride	145	mg/l	
MW-31	04/01/2011	Chloride	143	mg/l	
MW-31	05/10/2011	Chloride	143	mg/l	
MW-31	06/20/2011	Chloride	145	mg/l	
MW-31	07/05/2011	Chloride	148	mg/l	
MW-31	08/02/2011	Chloride	148	mg/l	
MW-31	09/06/2011	Chloride	148	mg/l	
MW-31	10/03/2011	Chloride	145	mg/l	
MW-31	11/08/2011	Chloride	145	mg/l	
MW-31	12/12/2011	Chloride	148	mg/l	
MW-31	01/24/2012	Chloride	155	mg/l	
MW-31	02/13/2012	Chloride	150	mg/l	
MW-31	03/13/2012	Chloride	152	mg/l	
MW-31	04/09/2012	Chloride	160	mg/l	
MW-31	05/02/2012	Chloride	151	mg/l	
MW-31	06/18/2012	Chloride	138	mg/l	
MW-31	07/09/2012	Chloride	161	mg/l	
MW-31	08/06/2012	Chloride	175	mg/l	
MW-31	09/18/2012	Chloride	172	mg/l	
MW-31	10/22/2012	Chloride	157	mg/l	
MW-31	11/06/2012	Chloride	189	mg/l	
MW-31	12/18/2012	Chloride	170	mg/l	
MW-31	01/22/2013	Chloride	176	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	02/19/2013	Chloride	174	mg/l	
MW-31	03/19/2013	Chloride	168	mg/l	
MW-31	04/16/2013	Chloride	171	mg/l	
MW-31	05/13/2013	Chloride	169	mg/l	
MW-31	06/24/2013	Chloride	179	mg/l	
MW-31	07/09/2013	Chloride	182	mg/l	
MW-31	08/19/2013	Chloride	183	mg/l	
MW-31	09/17/2013	Chloride	193	mg/l	
MW-31	10/23/2013	Chloride	188	mg/l	
MW-31	11/18/2013	Chloride	174	mg/l	
MW-31	12/17/2013	Chloride	203	mg/l	
MW-31	01/07/2014	Chloride	194	mg/l	
MW-31	02/17/2014	Chloride	197	mg/l	
MW-31	03/10/2014	Chloride	230	mg/l	
MW-31	04/28/2014	Chloride	230	mg/l	
MW-31	05/13/2014	Chloride	200	mg/l	
MW-31	06/02/2014	Chloride	173	mg/l	
MW-31	07/28/2014	Chloride	200	mg/l	
MW-31	08/18/2014	Chloride	210	mg/l	
MW-31	09/03/2014	Chloride	210	mg/l	
MW-31	10/06/2014	Chloride	205	mg/l	
MW-31	11/04/2014	Chloride	204	mg/l	
MW-31	12/09/2014	Chloride	215	mg/l	
MW-31	01/20/2015	Chloride	226	mg/l	
MW-31	02/02/2015	Chloride	211	mg/l	
MW-31	03/03/2015	Chloride	209	mg/l	
MW-31	04/07/2015	Chloride	211	mg/l	
MW-31	05/11/2015	Chloride	225	mg/l	
MW-31	06/23/2015	Chloride	228	mg/l	
MW-31	07/06/2015	Chloride	222	mg/l	
MW-31	08/10/2015	Chloride	264	mg/l	
MW-31	09/15/2015	Chloride	231	mg/l	
MW-31	10/06/2015	Chloride	222	mg/l	
MW-31	11/09/2015	Chloride	215	mg/l	
MW-31	12/08/2015	Chloride	231	mg/l	
MW-31	01/19/2016	Chloride	228	mg/l	
MW-31	02/15/2016	Chloride	246	mg/l	
MW-31	03/02/2016	Chloride	228	mg/l	
MW-31	04/12/2016	Chloride	254	mg/l	
MW-31	05/03/2016	Chloride	243	mg/l	
MW-31	06/15/2016	Chloride	252	mg/l	
MW-31	07/12/2016	Chloride	241	mg/l	
MW-31	08/16/2016	Chloride	272	mg/l	
MW-31	09/13/2016	Chloride	254	mg/l	
MW-31	10/04/2016	Chloride	260	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	11/01/2016	Chloride	267	mg/l	
MW-31	12/05/2016	Chloride	274	mg/l	
MW-31	01/17/2017	Chloride	287	mg/l	
MW-31	02/07/2017	Chloride	266	mg/l	
MW-31	03/06/2017	Chloride	250	mg/l	
MW-31	04/04/2017	Chloride	263	mg/l	
MW-31	05/01/2017	Chloride	263	mg/l	
MW-31	06/05/2017	Chloride	278	mg/l	
MW-31	07/11/2017	Chloride	254	mg/l	
MW-31	08/14/2017	Chloride	310	mg/l	
MW-31	09/11/2017	Chloride	248	mg/l	
MW-31	10/02/2017	Chloride	287	mg/l	
MW-31	11/01/2017	Chloride	292	mg/l	
MW-31	12/04/2017	Chloride	285	mg/l	
MW-31	01/24/2018	Chloride	323	mg/l	
MW-31	02/20/2018	Chloride	292	mg/l	
MW-31	03/05/2018	Chloride	311	mg/l	
MW-31	04/17/2018	Chloride	308	mg/l	
MW-31	05/14/2018	Chloride	326	mg/l	
MW-31	06/18/2018	Chloride	359	mg/l	
MW-31	07/23/2018	Chloride	351	mg/l	
MW-31	08/10/2018	Chloride	336	mg/l	
MW-31	09/10/2018	Chloride	333	mg/l	
MW-31	10/24/2018	Chloride	286	mg/l	
MW-31	11/13/2018	Chloride	281	mg/l	
MW-31	12/10/2018	Chloride	302	mg/l	
MW-31	01/15/2019	Chloride	283	mg/l	
MW-31	02/12/2019	Chloride	296	mg/l	
MW-31	03/05/2019	Chloride	322	mg/l	
MW-31	04/10/2019	Chloride	294	mg/l	
MW-31	05/07/2019	Chloride	346	mg/l	
MW-31	06/03/2019	Chloride	325	mg/l	
MW-31	07/15/2019	Chloride	374	mg/l	
MW-31	08/05/2019	Chloride	372	mg/l	
MW-31	09/23/2019	Chloride	365	mg/l	
MW-31	10/09/2019	Chloride	318	mg/l	
MW-31	11/12/2019	Chloride	338	mg/l	
MW-31	12/03/2019	Chloride	343	mg/l	
MW-31	01/14/2020	Chloride	381	mg/l	
MW-31	02/04/2020	Chloride	370	mg/l	
MW-31	03/10/2020	Chloride	368	mg/l	
MW-31	06/22/2005	Fluoride	0.83	mg/l	
MW-31	09/22/2005	Fluoride	0.91	mg/l	
MW-31	12/14/2005	Fluoride	0.85	mg/l	
MW-31	03/22/2006	Fluoride	0.90	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	06/21/2006	Fluoride	0.86	mg/l	
MW-31	09/13/2006	Fluoride	0.94	mg/l	
MW-31	10/25/2006	Fluoride	1.18	mg/l	
MW-31	03/15/2007	Fluoride	0.94	mg/l	
MW-31	08/27/2007	Fluoride	0.99	mg/l	
MW-31	10/24/2007	Fluoride	0.85	mg/l	
MW-31	03/19/2008	Fluoride	0.92	mg/l	
MW-31	06/03/2008	Fluoride	0.94	mg/l	
MW-31	08/04/2008	Fluoride	0.85	mg/l	
MW-31	02/03/2009	Fluoride	0.91	mg/l	
MW-31	05/13/2009	Fluoride	0.90	mg/l	
MW-31	08/24/2009	Fluoride	0.89	mg/l	
MW-31	10/14/2009	Fluoride	0.90	mg/l	
MW-31	02/09/2010	Fluoride	0.88	mg/l	
MW-31	04/20/2010	Fluoride	0.84	mg/l	
MW-31	09/13/2010	Fluoride	0.89	mg/l	
MW-31	11/09/2010	Fluoride	0.84	mg/l	
MW-31	02/01/2011	Fluoride	0.83	mg/l	
MW-31	04/01/2011	Fluoride	0.83	mg/l	
MW-31	08/02/2011	Fluoride	0.80	mg/l	
MW-31	10/03/2011	Fluoride	0.84	mg/l	
MW-31	02/13/2012	Fluoride	0.86	mg/l	
MW-31	05/02/2012	Fluoride	0.78	mg/l	
MW-31	07/09/2012	Fluoride	0.78	mg/l	
MW-31	11/06/2012	Fluoride	0.76	mg/l	
MW-31	02/19/2013	Fluoride	0.73	mg/l	
MW-31	05/13/2013	Fluoride	0.76	mg/l	
MW-31	07/09/2013	Fluoride	0.84	mg/l	
MW-31	11/18/2013	Fluoride	0.76	mg/l	
MW-31	02/17/2014	Fluoride	0.81	mg/l	
MW-31	03/10/2014	Fluoride	0.82	mg/l	
MW-31	06/02/2014	Fluoride	0.74	mg/l	
MW-31	09/03/2014	Fluoride	0.80	mg/l	
MW-31	11/04/2014	Fluoride	0.61	mg/l	
MW-31	02/02/2015	Fluoride	0.76	mg/l	
MW-31	04/07/2015	Fluoride	0.75	mg/l	
MW-31	08/10/2015	Fluoride	0.72	mg/l	
MW-31	11/09/2015	Fluoride	0.68	mg/l	
MW-31	02/15/2016	Fluoride	0.72	mg/l	
MW-31	05/03/2016	Fluoride	0.76	mg/l	
MW-31	08/16/2016	Fluoride	0.77	mg/l	
MW-31	11/01/2016	Fluoride	0.74	mg/l	
MW-31	02/07/2017	Fluoride	0.71	mg/l	
MW-31	05/01/2017	Fluoride	0.69	mg/l	
MW-31	08/14/2017	Fluoride	0.73	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	11/01/2017	Fluoride	0.79	mg/l	
MW-31	02/20/2018	Fluoride	0.81	mg/l	
MW-31	04/17/2018	Fluoride	0.81	mg/l	
MW-31	09/10/2018	Fluoride	0.66	mg/l	
MW-31	10/24/2018	Fluoride	0.69	mg/l	
MW-31	01/15/2019	Fluoride	0.70	mg/l	
MW-31	04/10/2019	Fluoride	0.67	mg/l	
MW-31	07/15/2019	Fluoride	0.89	mg/l	
MW-31	10/09/2019	Fluoride	0.53	mg/l	
MW-31	01/14/2020	Fluoride	0.78	mg/l	
MW-31	06/22/2005	Sulfate	504	mg/l	
MW-31	09/22/2005	Sulfate	436	mg/l	D
MW-31	12/14/2005	Sulfate	509	mg/l	D
MW-31	03/22/2006	Sulfate	485	mg/l	D
MW-31	06/21/2006	Sulfate	522	mg/l	D
MW-31	09/13/2006	Sulfate	516	mg/l	D
MW-31	10/25/2006	Sulfate	526	mg/l	D
MW-31	03/15/2007	Sulfate	516	mg/l	D
MW-31	08/27/2007	Sulfate	532	mg/l	D
MW-31	10/24/2007	Sulfate	497	mg/l	D
MW-31	03/19/2008	Sulfate	521	mg/l	D
MW-31	06/03/2008	Sulfate	514	mg/l	D
MW-31	08/04/2008	Sulfate	499	mg/l	D
MW-31	11/11/2008	Sulfate	541	mg/l	D
MW-31	02/03/2009	Sulfate	488	mg/l	D
MW-31	05/13/2009	Sulfate	493	mg/l	D
MW-31	08/24/2009	Sulfate	460	mg/l	D
MW-31	10/14/2009	Sulfate	497	mg/l	D
MW-31	02/09/2010	Sulfate	507	mg/l	D
MW-31	04/20/2010	Sulfate	522	mg/l	D
MW-31	09/13/2010	Sulfate	527	mg/l	D
MW-31	11/09/2010	Sulfate	539	mg/l	D
MW-31	02/01/2011	Sulfate	538	mg/l	D
MW-31	03/14/2011	Sulfate	531	mg/l	D
MW-31	04/01/2011	Sulfate	503	mg/l	D
MW-31	05/10/2011	Sulfate	512	mg/l	D
MW-31	06/20/2011	Sulfate	540	mg/l	D
MW-31	07/05/2011	Sulfate	532	mg/l	D
MW-31	08/02/2011	Sulfate	537	mg/l	D
MW-31	09/06/2011	Sulfate	541	mg/l	D
MW-31	10/03/2011	Sulfate	539	mg/l	D
MW-31	11/08/2011	Sulfate	552	mg/l	D
MW-31	12/12/2011	Sulfate	530	mg/l	D
MW-31	01/24/2012	Sulfate	539	mg/l	D
MW-31	02/13/2012	Sulfate	538	mg/l	D

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	03/13/2012	Sulfate	517	mg/l	D
MW-31	04/09/2012	Sulfate	547	mg/l	D
MW-31	05/02/2012	Sulfate	532	mg/l	D
MW-31	06/18/2012	Sulfate	497	mg/l	D
MW-31	07/09/2012	Sulfate	529	mg/l	D
MW-31	08/06/2012	Sulfate	571	mg/l	D
MW-31	09/18/2012	Sulfate	561	mg/l	D
MW-31	10/22/2012	Sulfate	545	mg/l	
MW-31	11/06/2012	Sulfate	557	mg/l	
MW-31	12/18/2012	Sulfate	664	mg/l	
MW-31	01/22/2013	Sulfate	611	mg/l	
MW-31	02/19/2013	Sulfate	644	mg/l	
MW-31	03/19/2013	Sulfate	611	mg/l	
MW-31	04/16/2013	Sulfate	668	mg/l	
MW-31	05/13/2013	Sulfate	630	mg/l	
MW-31	06/24/2013	Sulfate	659	mg/l	
MW-31	07/09/2013	Sulfate	659	mg/l	
MW-31	08/19/2013	Sulfate	656	mg/l	
MW-31	09/17/2013	Sulfate	666	mg/l	
MW-31	10/23/2013	Sulfate	637	mg/l	
MW-31	11/18/2013	Sulfate	609	mg/l	
MW-31	12/17/2013	Sulfate	656	mg/l	
MW-31	01/07/2014	Sulfate	558	mg/l	
MW-31	02/17/2014	Sulfate	480	mg/l	
MW-31	03/10/2014	Sulfate	681	mg/l	
MW-31	04/28/2014	Sulfate	527	mg/l	
MW-31	05/13/2014	Sulfate	639	mg/l	
MW-31	06/02/2014	Sulfate	555	mg/l	
MW-31	07/28/2014	Sulfate	600	mg/l	
MW-31	08/18/2014	Sulfate	620	mg/l	
MW-31	09/03/2014	Sulfate	560	mg/l	
MW-31	10/06/2014	Sulfate	606	mg/l	
MW-31	11/04/2014	Sulfate	639	mg/l	
MW-31	12/09/2014	Sulfate	687	mg/l	
MW-31	01/20/2015	Sulfate	669	mg/l	
MW-31	02/02/2015	Sulfate	623	mg/l	
MW-31	03/03/2015	Sulfate	616	mg/l	
MW-31	04/07/2015	Sulfate	642	mg/l	
MW-31	05/11/2015	Sulfate	668	mg/l	
MW-31	06/23/2015	Sulfate	691	mg/l	
MW-31	07/06/2015	Sulfate	684	mg/l	
MW-31	08/10/2015	Sulfate	640	mg/l	
MW-31	09/15/2015	Sulfate	638	mg/l	
MW-31	10/06/2015	Sulfate	655	mg/l	
MW-31	11/09/2015	Sulfate	646	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	12/08/2015	Sulfate	690	mg/l	
MW-31	01/19/2016	Sulfate	675	mg/l	
MW-31	02/15/2016	Sulfate	631	mg/l	
MW-31	03/02/2016	Sulfate	654	mg/l	
MW-31	04/12/2016	Sulfate	715	mg/l	
MW-31	05/03/2016	Sulfate	699	mg/l	
MW-31	06/15/2016	Sulfate	748	mg/l	
MW-31	07/12/2016	Sulfate	712	mg/l	
MW-31	08/16/2016	Sulfate	766	mg/l	
MW-31	09/13/2016	Sulfate	703	mg/l	
MW-31	10/04/2016	Sulfate	720	mg/l	
MW-31	11/01/2016	Sulfate	752	mg/l	
MW-31	12/05/2016	Sulfate	748	mg/l	
MW-31	01/17/2017	Sulfate	809	mg/l	
MW-31	02/07/2017	Sulfate	751	mg/l	
MW-31	03/06/2017	Sulfate	741	mg/l	
MW-31	04/04/2017	Sulfate	758	mg/l	
MW-31	05/01/2017	Sulfate	741	mg/l	
MW-31	06/05/2017	Sulfate	808	mg/l	
MW-31	07/11/2017	Sulfate	747	mg/l	
MW-31	08/14/2017	Sulfate	916	mg/l	
MW-31	09/11/2017	Sulfate	762	mg/l	
MW-31	10/02/2017	Sulfate	823	mg/l	
MW-31	11/01/2017	Sulfate	847	mg/l	
MW-31	12/04/2017	Sulfate	825	mg/l	
MW-31	01/24/2018	Sulfate	813	mg/l	
MW-31	02/20/2018	Sulfate	835	mg/l	
MW-31	04/17/2018	Sulfate	857	mg/l	
MW-31	06/18/2018	Sulfate	976	mg/l	
MW-31	07/23/2018	Sulfate	857	mg/l	
MW-31	08/10/2018	Sulfate	841	mg/l	
MW-31	09/10/2018	Sulfate	893	mg/l	
MW-31	10/24/2018	Sulfate	950	mg/l	
MW-31	11/13/2018	Sulfate	841	mg/l	
MW-31	12/10/2018	Sulfate	905	mg/l	
MW-31	01/15/2019	Sulfate	851	mg/l	
MW-31	02/12/2019	Sulfate	893	mg/l	
MW-31	03/05/2019	Sulfate	953	mg/l	
MW-31	04/10/2019	Sulfate	917	mg/l	
MW-31	07/15/2019	Sulfate	1150	mg/l	
MW-31	10/09/2019	Sulfate	1010	mg/l	
MW-31	11/12/2019	Sulfate	990	mg/l	
MW-31	12/03/2019	Sulfate	1020	mg/l	
MW-31	01/14/2020	Sulfate	1120	mg/l	
MW-31	02/04/2020	Sulfate	1150	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	03/10/2020	Sulfate	1080	mg/l	
MW-31	06/22/2005	Uranium	6.56	µg/l	
MW-31	09/22/2005	Uranium	7.25	µg/l	
MW-31	12/14/2005	Uranium	7.27	µg/l	
MW-31	03/22/2006	Uranium	8.04	µg/l	
MW-31	06/21/2006	Uranium	9.32	µg/l	
MW-31	09/13/2006	Uranium	8.03	µg/l	
MW-31	10/25/2006	Uranium	7.71	µg/l	
MW-31	03/15/2007	Uranium	7.60	µg/l	
MW-31	08/27/2007	Uranium	7.18	µg/l	
MW-31	10/24/2007	Uranium	7.20	µg/l	
MW-31	03/19/2008	Uranium	7.02	µg/l	
MW-31	06/03/2008	Uranium	6.95	µg/l	
MW-31	08/04/2008	Uranium	6.77	µg/l	
MW-31	11/11/2008	Uranium	6.35	µg/l	
MW-31	02/03/2009	Uranium	7.08	µg/l	
MW-31	05/13/2009	Uranium	6.76	µg/l	
MW-31	08/24/2009	Uranium	6.97	µg/l	
MW-31	10/14/2009	Uranium	6.97	µg/l	
MW-31	02/09/2010	Uranium	7.12	µg/l	
MW-31	04/20/2010	Uranium	6.74	µg/l	
MW-31	09/13/2010	Uranium	7.23	µg/l	
MW-31	11/09/2010	Uranium	6.72	µg/l	
MW-31	02/01/2011	Uranium	5.77	µg/l	
MW-31	04/01/2011	Uranium	6.81	µg/l	
MW-31	08/02/2011	Uranium	7.68	µg/l	
MW-31	10/03/2011	Uranium	8.87	µg/l	
MW-31	02/13/2012	Uranium	7.96	µg/l	
MW-31	05/02/2012	Uranium	7.34	µg/l	
MW-31	07/09/2012	Uranium	8.17	µg/l	
MW-31	11/06/2012	Uranium	8.73	µg/l	
MW-31	02/19/2013	Uranium	7.33	µg/l	
MW-31	05/13/2013	Uranium	7.63	µg/l	
MW-31	07/09/2013	Uranium	7.90	µg/l	
MW-31	11/18/2013	Uranium	9.03	µg/l	
MW-31	02/17/2014	Uranium	7.65	µg/l	
MW-31	03/10/2014	Uranium	7.96	µg/l	
MW-31	06/02/2014	Uranium	7.72	µg/l	
MW-31	09/03/2014	Uranium	8.40	µg/l	
MW-31	11/04/2014	Uranium	7.71	µg/l	
MW-31	02/02/2015	Uranium	8.00	µg/l	
MW-31	04/07/2015	Uranium	8.07	µg/l	
MW-31	08/10/2015	Uranium	8.76	µg/l	
MW-31	11/09/2015	Uranium	8.72	µg/l	
MW-31	02/15/2016	Uranium	8.41	µg/l	

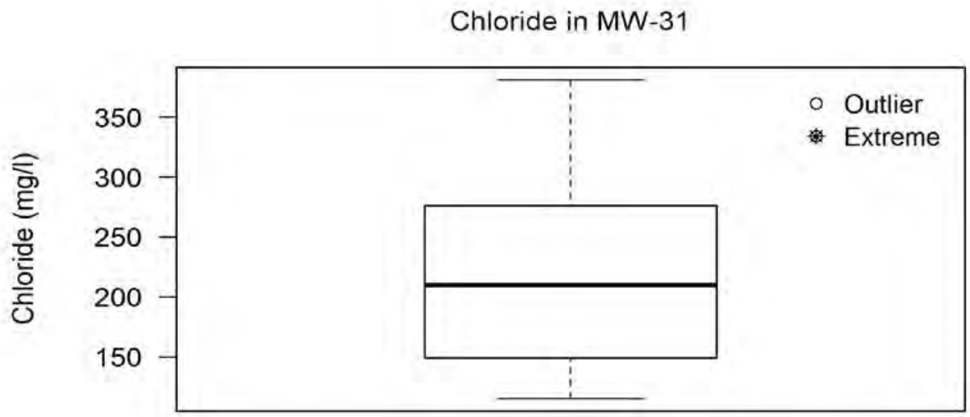
Well	Sample Date	Parameter	Result	Units	Qualifier
MW-31	05/03/2016	Uranium	9.05	µg/l	
MW-31	08/16/2016	Uranium	9.41	µg/l	
MW-31	11/01/2016	Uranium	9.56	µg/l	
MW-31	12/05/2016	Uranium	10.30	µg/l	
MW-31	01/17/2017	Uranium	9.03	µg/l	
MW-31	02/07/2017	Uranium	9.92	µg/l	
MW-31	03/06/2017	Uranium	9.62	µg/l	
MW-31	04/04/2017	Uranium	10.10	µg/l	
MW-31	05/01/2017	Uranium	9.62	µg/l	
MW-31	06/05/2017	Uranium	9.89	µg/l	
MW-31	07/11/2017	Uranium	10.50	µg/l	
MW-31	08/14/2017	Uranium	10.10	µg/l	
MW-31	09/11/2017	Uranium	9.74	µg/l	
MW-31	10/02/2017	Uranium	10.90	µg/l	
MW-31	11/01/2017	Uranium	9.31	µg/l	
MW-31	12/04/2017	Uranium	10.40	µg/l	
MW-31	01/24/2018	Uranium	11.40	µg/l	
MW-31	02/20/2018	Uranium	11.20	µg/l	
MW-31	03/05/2018	Uranium	11.40	µg/l	
MW-31	04/17/2018	Uranium	11.50	µg/l	
MW-31	05/14/2018	Uranium	11.50	µg/l	
MW-31	06/18/2018	Uranium	12.90	µg/l	
MW-31	07/23/2018	Uranium	12.30	µg/l	
MW-31	08/10/2018	Uranium	11.70	µg/l	
MW-31	09/10/2018	Uranium	11.00	µg/l	
MW-31	10/24/2018	Uranium	11.60	µg/l	
MW-31	11/13/2018	Uranium	13.20	µg/l	
MW-31	12/10/2018	Uranium	12.70	µg/l	
MW-31	01/15/2019	Uranium	13.20	µg/l	
MW-31	02/12/2019	Uranium	13.60	µg/l	
MW-31	03/05/2019	Uranium	12.50	µg/l	
MW-31	04/10/2019	Uranium	13.60	µg/l	
MW-31	07/15/2019	Uranium	14.30	µg/l	
MW-31	10/09/2019	Uranium	14.40	µg/l	
MW-31	01/14/2020	Uranium	14.80	µg/l	

Notes: D = field duplicate

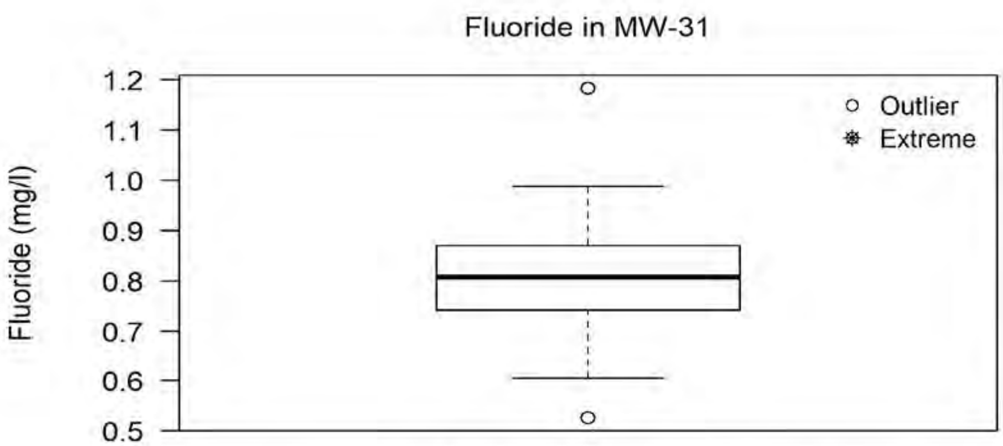
Appendix C-4: Indicator Parameter Data Removed from Analysis

Reason	Location ID	Date Sampled	Parameter Name	Report Result	Report Units
Extreme (Low)	MW-31	11/11/2008	Fluoride	0.32	mg/L

Appendix C-5: Box Plots for Indicator Parameters in MW-31

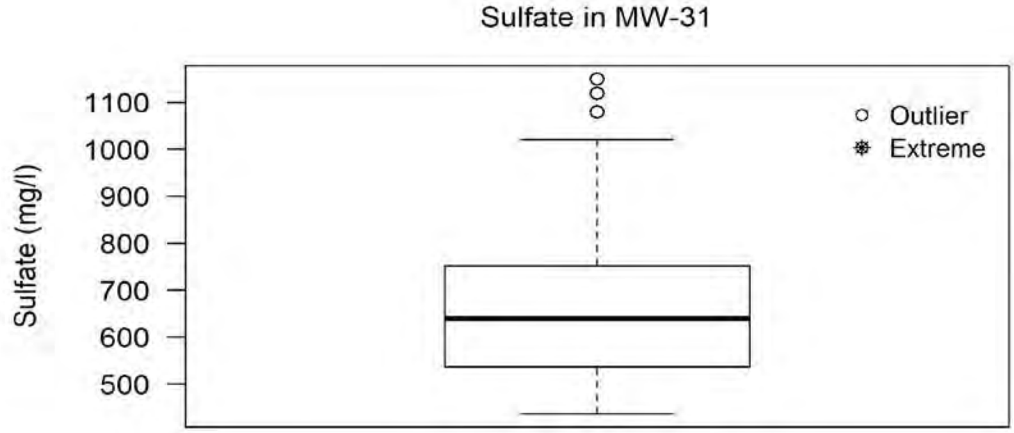


Percent nondetect: 0%
Min: 115, Mean: 219.63, Max: 381, Std Dev: 73.92
Upper extreme threshold (Q75 + 3xH): 657
Lower extreme threshold (Q25 - 3xH): -232

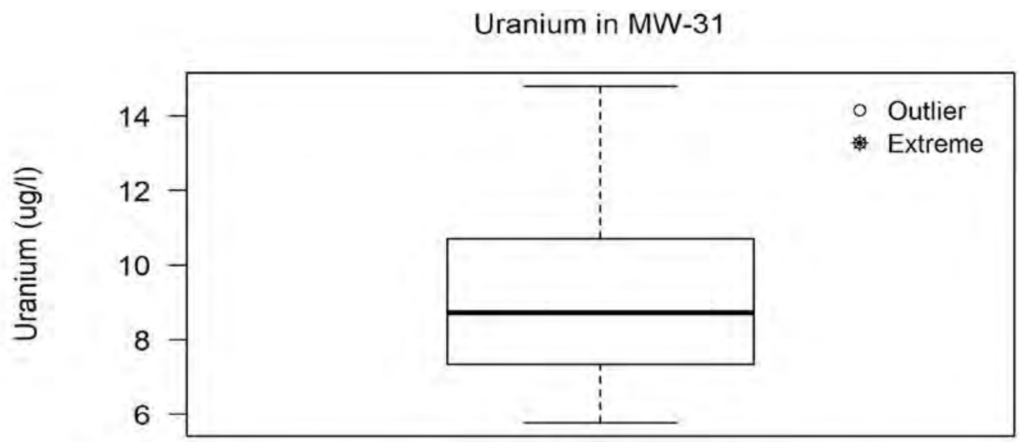


Percent nondetect: 0%
Min: 0.526, Mean: 0.81, Max: 1.183244, Std Dev: 0.1
Upper extreme threshold (Q75 + 3xH): 1.2525
Lower extreme threshold (Q25 - 3xH): 0.36

Appendix C-5: Box Plots for Indicator Parameters in MW-31

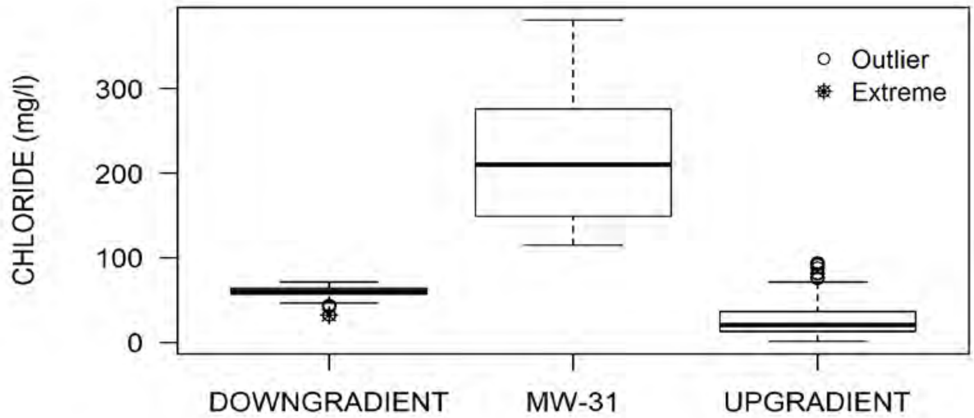


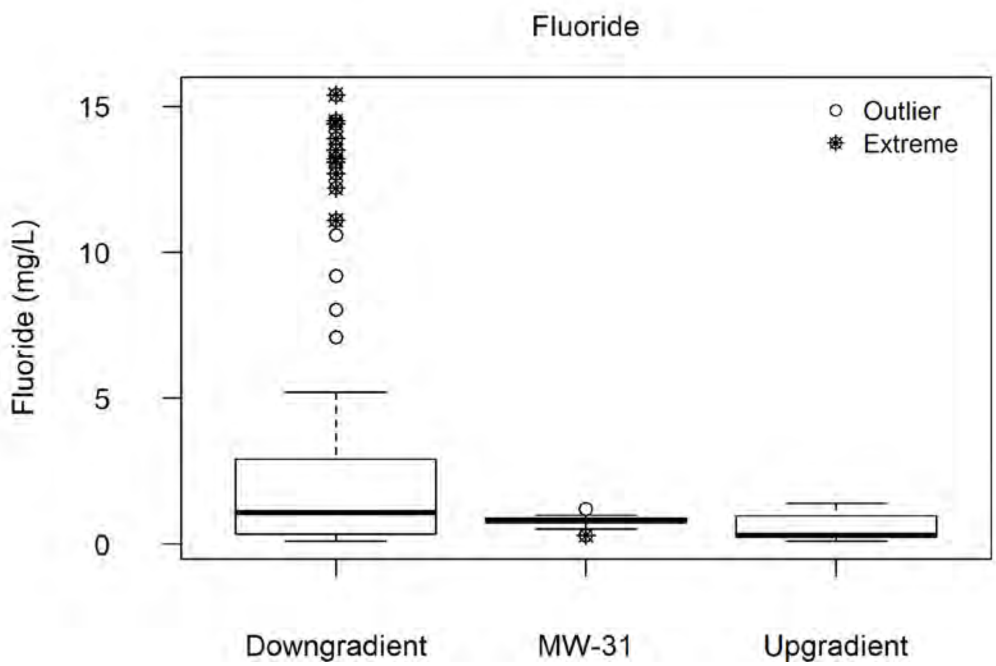
Percent nondetect: 0%
Min: 436, Mean: 668.86, Max: 1150, Std Dev: 160.92
Upper extreme threshold (Q75 + 3xH): 1389.25
Lower extreme threshold (Q25 - 3xH): -101.75



Percent nondetect: 0%
Min: 5.77, Mean: 9.24, Max: 14.8, Std Dev: 2.24
Upper extreme threshold (Q75 + 3xH): 20.795
Lower extreme threshold (Q25 - 3xH): -2.76

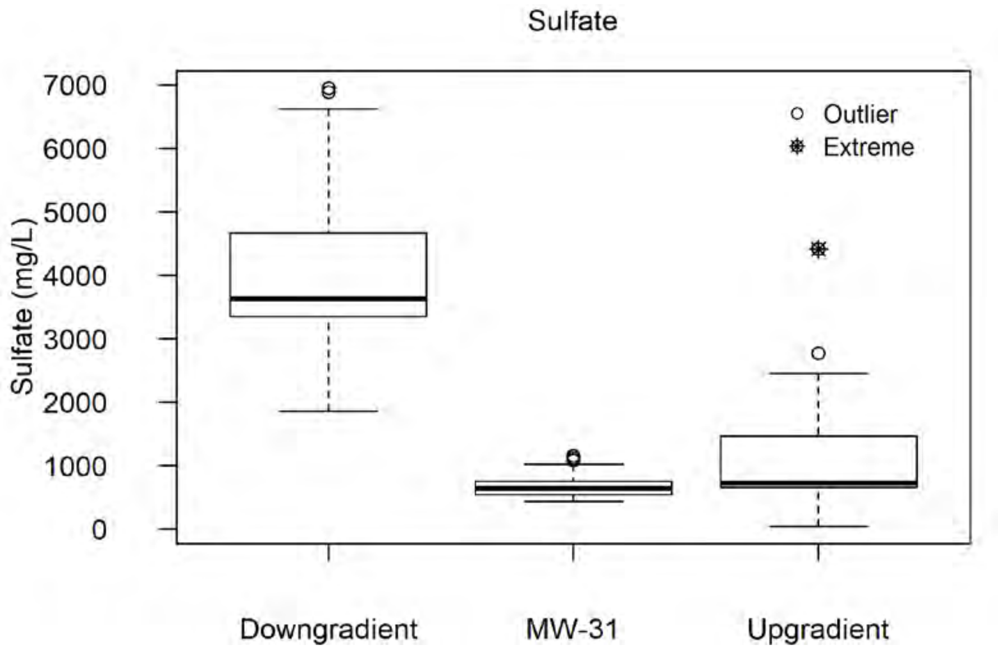
Appendix C-6: Box Plots for Indicator Parameters in MW-31 and Upgradient and Downgradient Wells

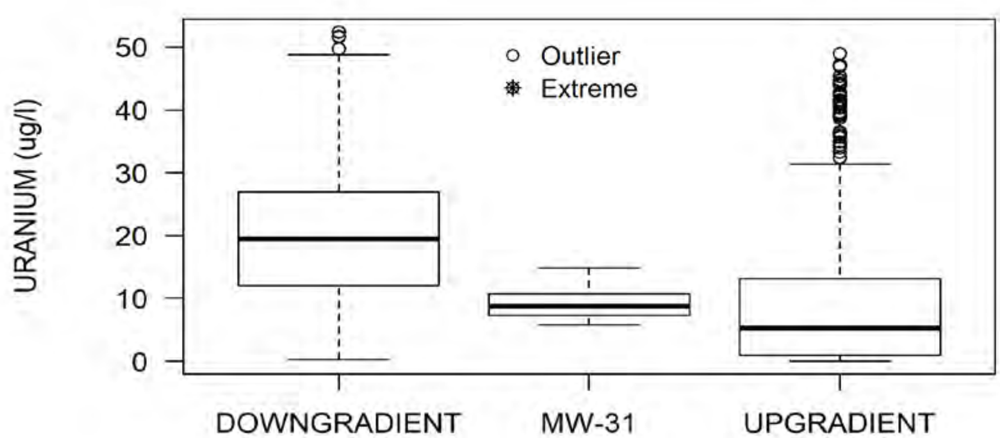




Downgradient wells: MW-3A, MW-20, and MW-22.
Upgradient wells: MW-1, MW-18, and MW-19

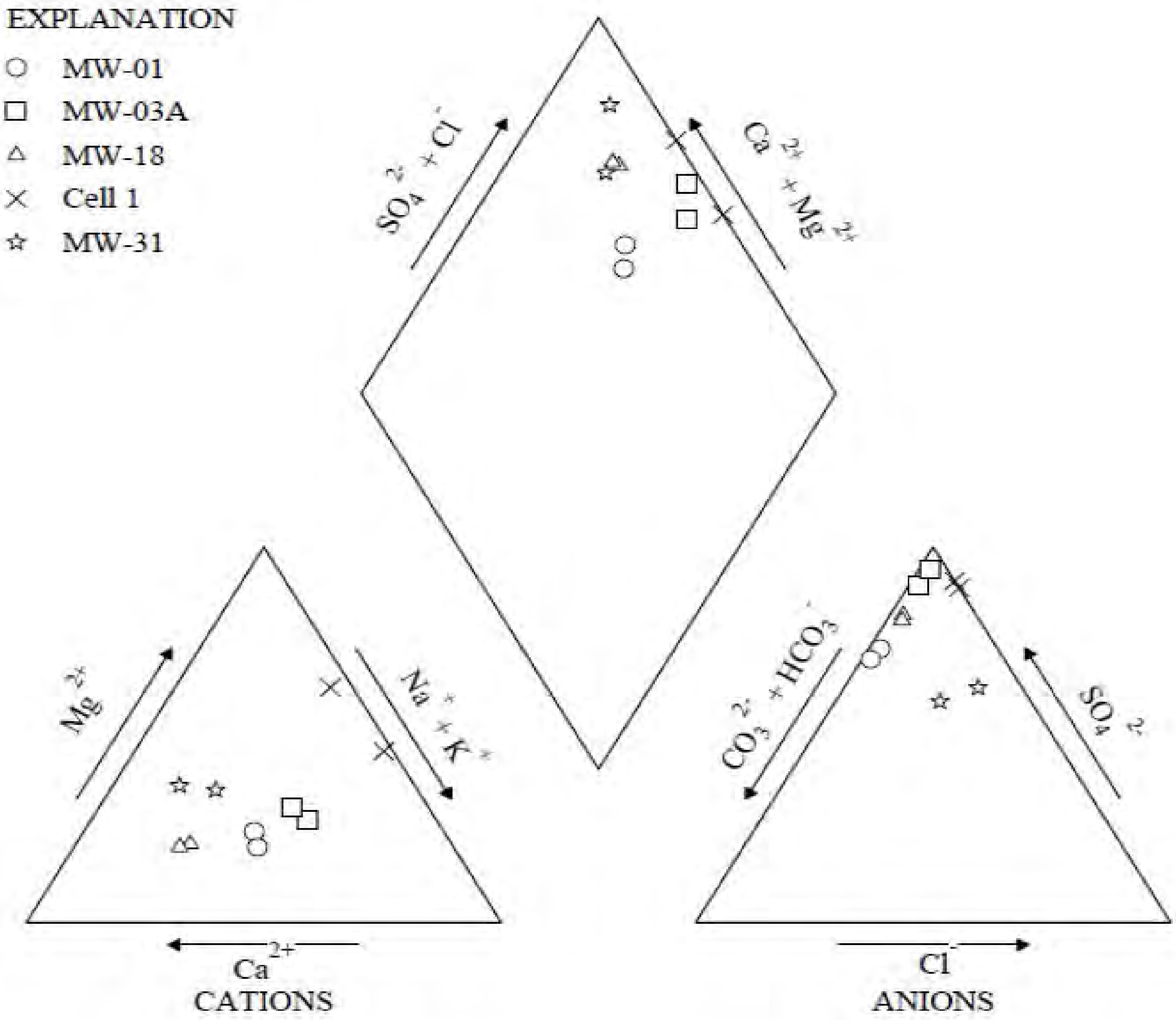
Appendix C-6: Box Plots for Indicator Parameters in MW-31 and Upgradient and Downgradient Wells



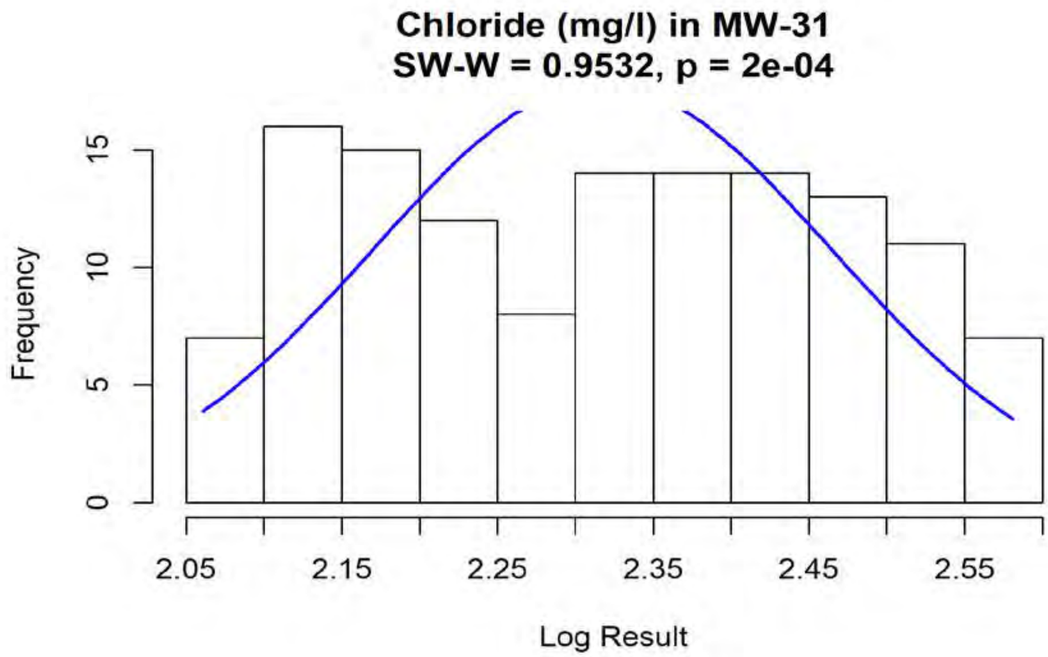


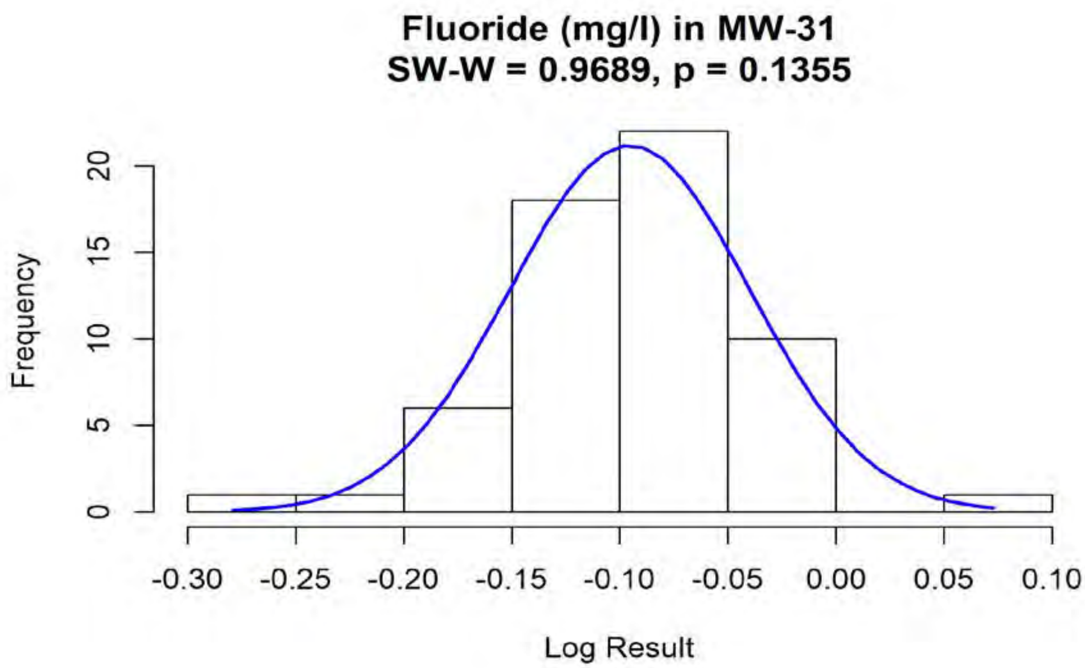
Downgradient wells: MW-3A, MW-20, and MW-22.
Upgradient wells: MW-1, MW-18, and MW-19

Appendix C-7: Piper Diagram for Cell 1, MW-31, and Ugradient and Downgradient Wells

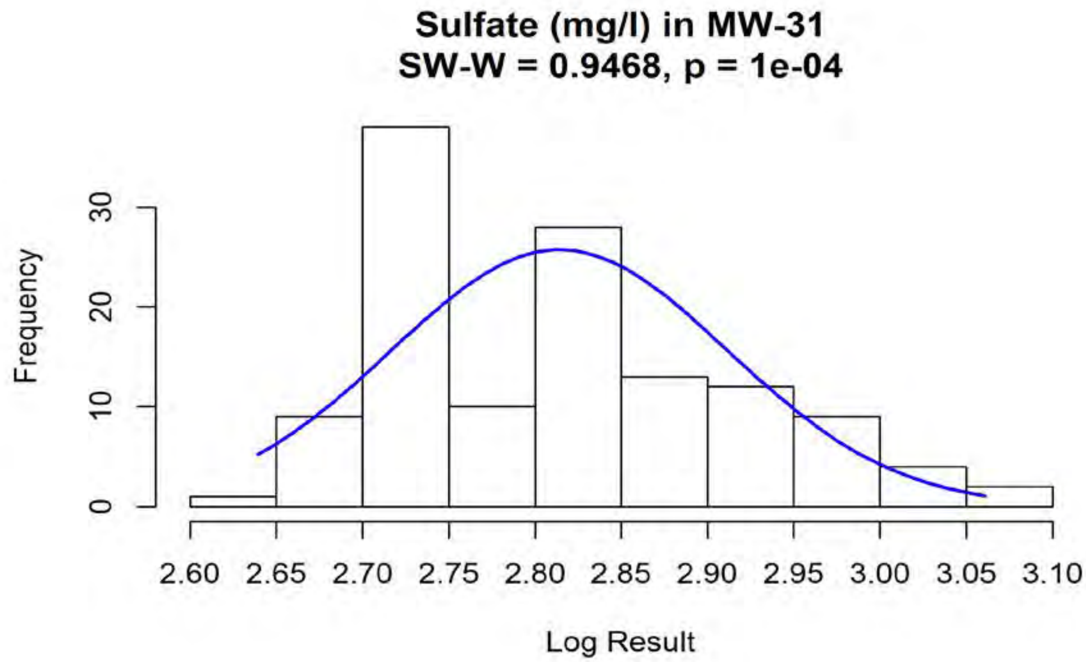


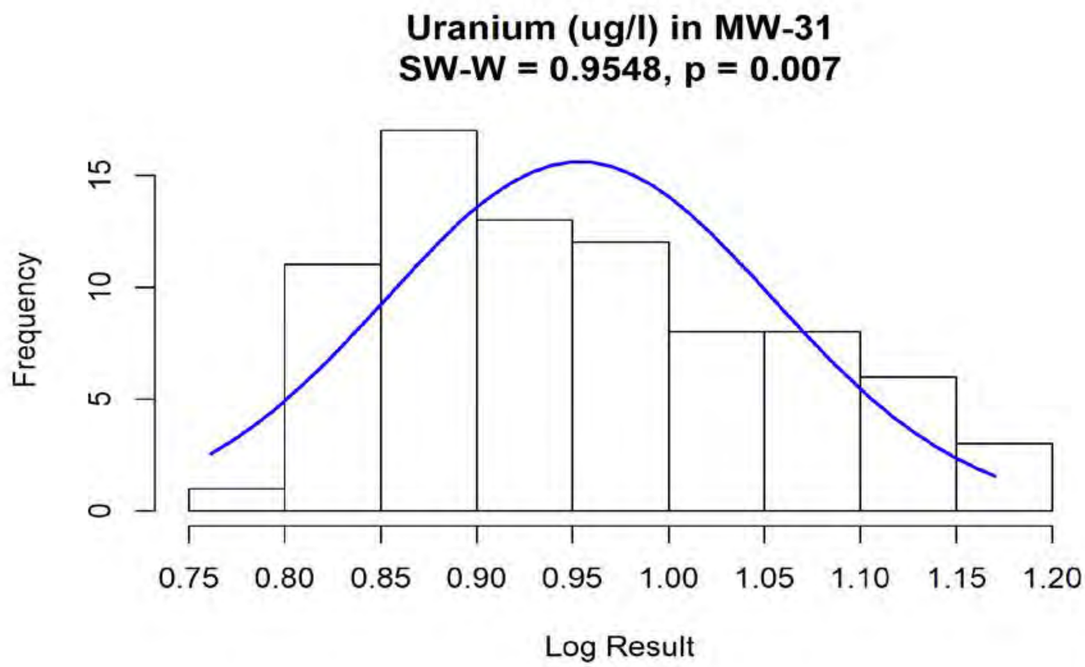
Appendix C-8: Histograms for Indicator Parameters in MW-31



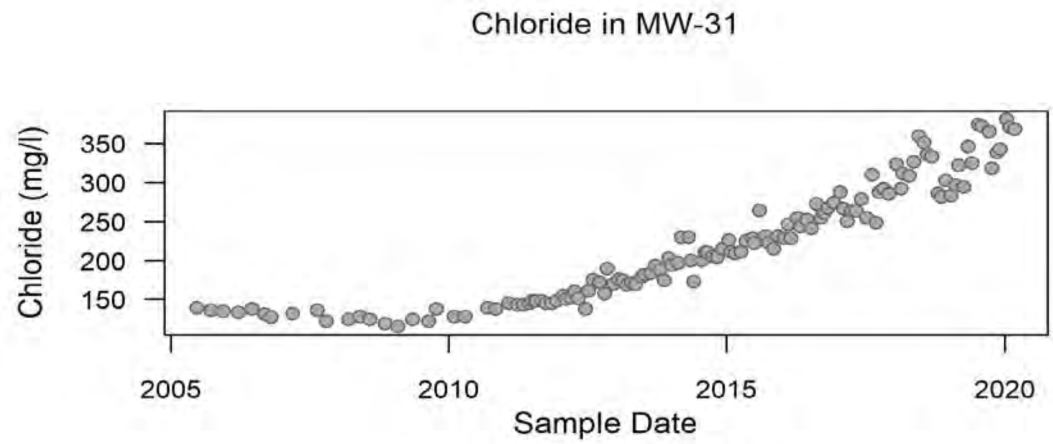


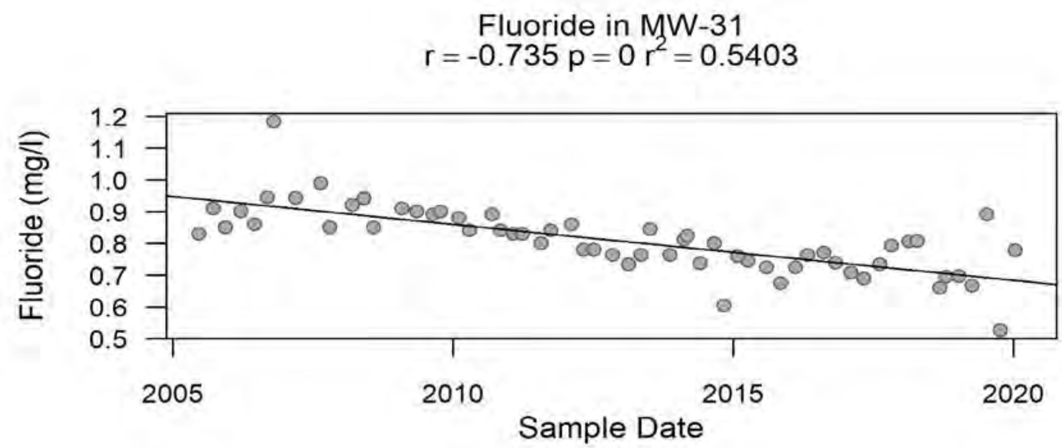
Appendix C-8: Histograms for Indicator Parameters in MW-31

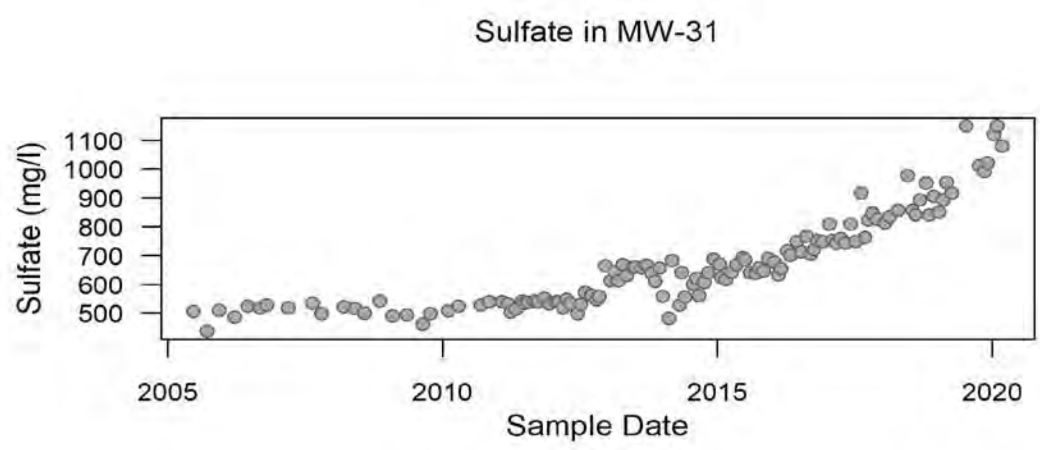




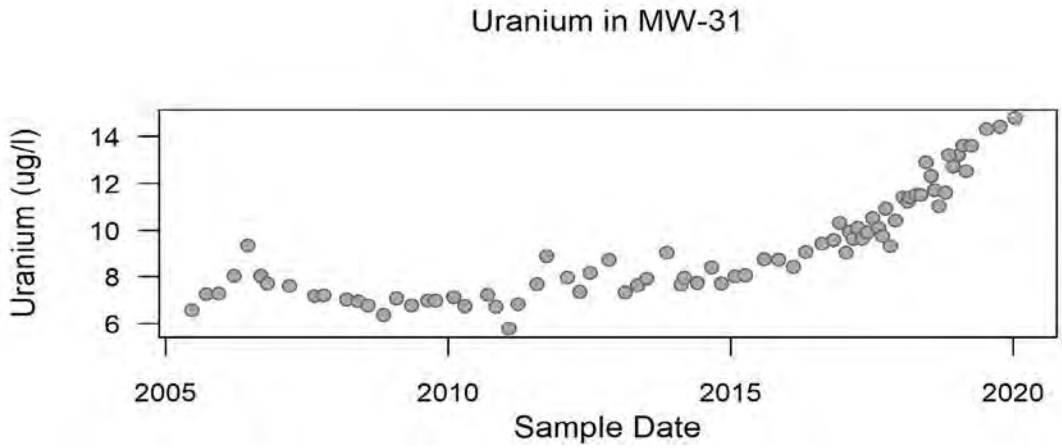
Appendix C-9: Time Series Plots and Linear Regressions for Indicator Parameters in MW-31





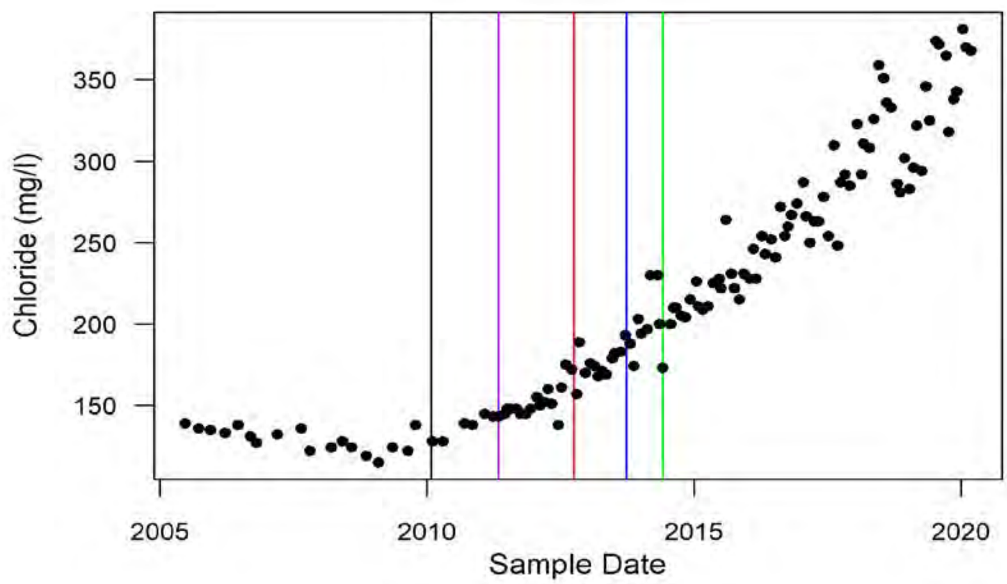


Appendix C-9: Time Series Plots and Linear Regressions for Indicator Parameters in MW-31

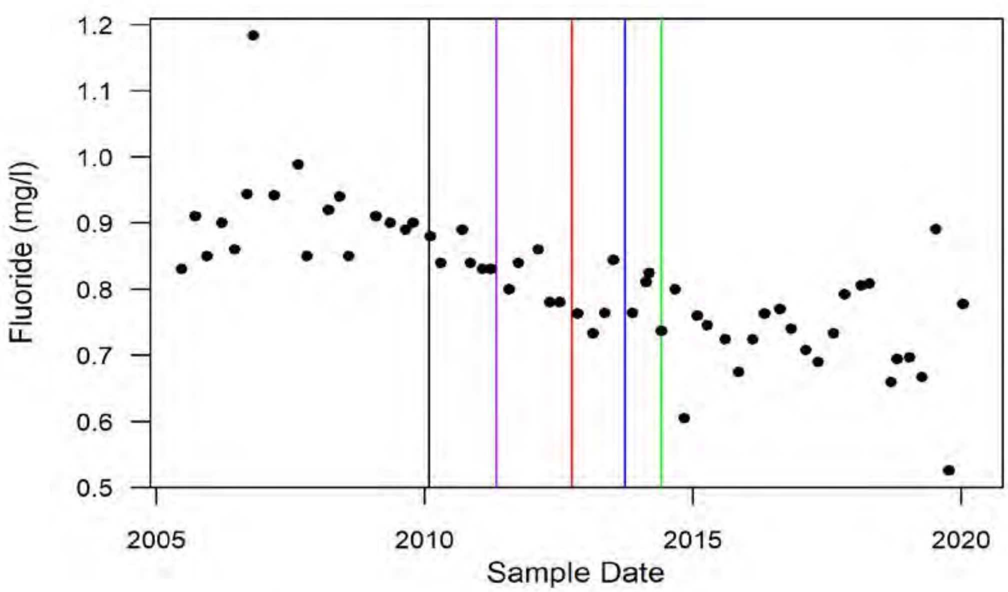


Appendix C-10: Time Series with Events

Chloride in MW-31

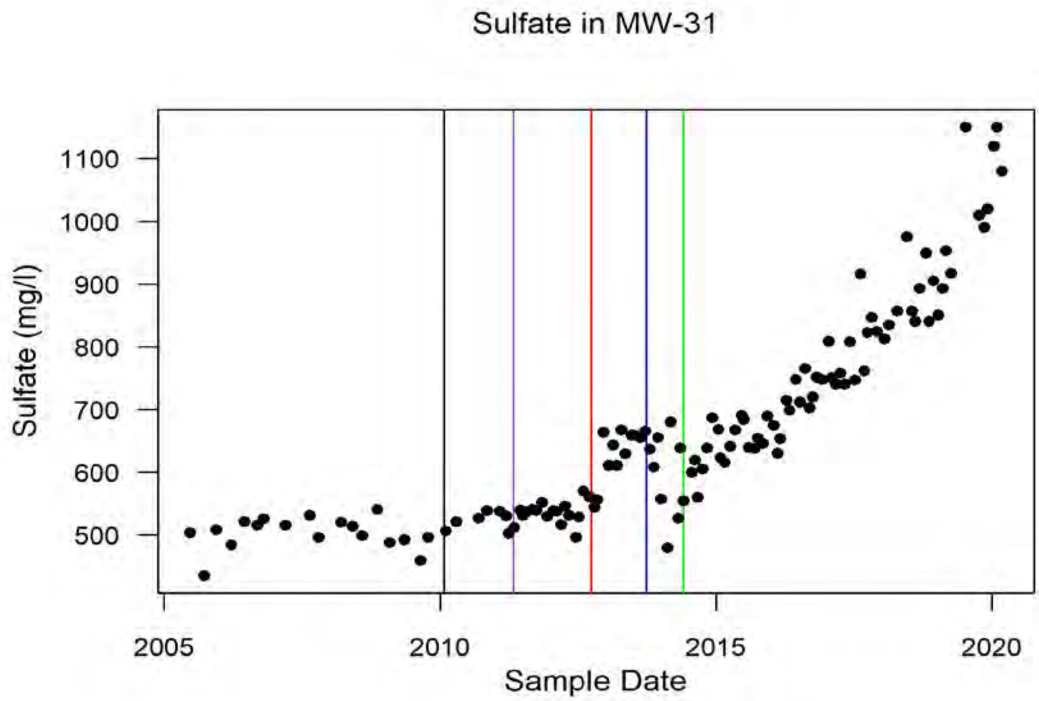


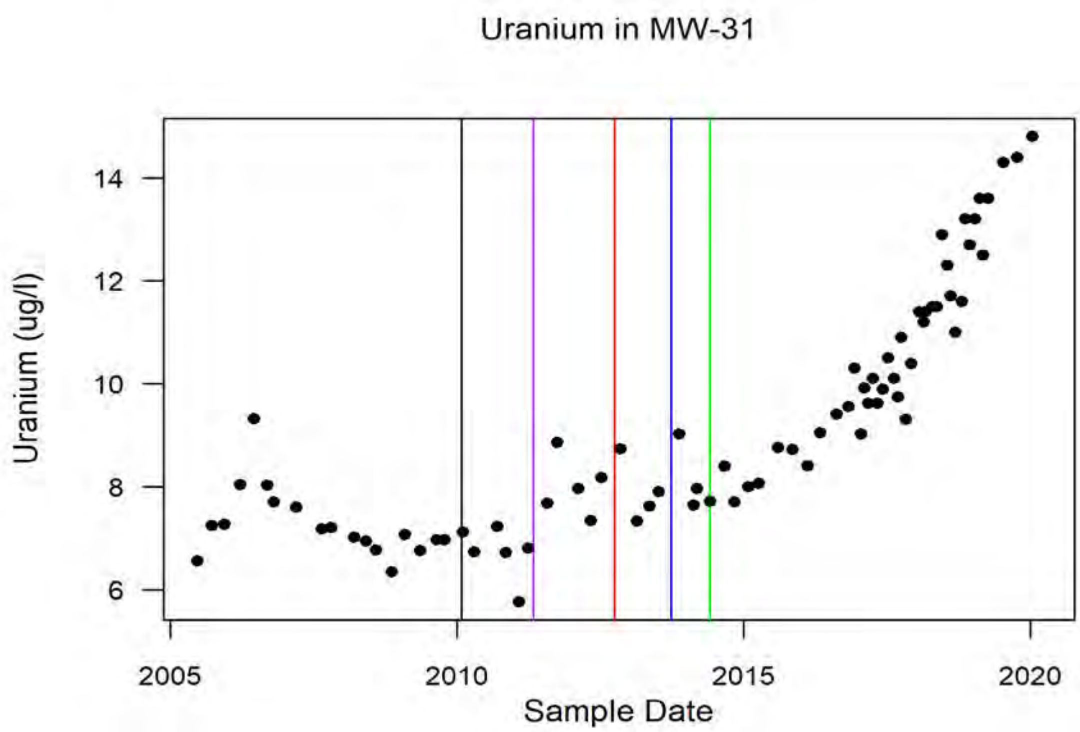
Fluoride in MW-31



2010-02-01 Monthly sampling
2011-05-03 Well redevelopment
2012-10-01 Lab change
2013-09-27 Peak groundwater elevation
2014-06-01 Five new chloroform pumping wells brought online

Appendix C-10: Time Series with Events





2010-02-01 Monthly sampling
2011-05-03 Well redevelopment
2012-10-01 Lab change
2013-09-27 Peak groundwater elevation
2014-06-01 Five new chloroform pumping wells brought online

APPENDIX D

Geochemical Analysis for pH in MW-31

Appendix D-1: pH Analysis Summary Table

Well	Constituent	N	% Non-Detected Values	Mean	Minimum	Maximum	Standard Deviation	Shapiro-Wilk Test for Normality			Mann Kendall Trend Analysis			Significant Trend
								W	p	Normally or Lognormally distributed?	S	p	Trend	
MW-31	pH	142	0	7.02	6.16	8.50	0.37	0.9616	0.0005	No	-1605	0.0023	Decreasing	Yes

Notes:

N = number of valid data points

W = Shapiro Wilk test value

p = probability

S = Mann-Kendall statistic

Appendix D-2: Field pH Measurements Used for pH Analysis

Location ID	Field Parameter	Date Measured	Field Measurement
MW-31	pH	6/22/2005	7.27
MW-31	pH	9/22/2005	7.19
MW-31	pH	12/14/2005	7.30
MW-31	pH	3/22/2006	7.33
MW-31	pH	6/21/2006	7.15
MW-31	pH	9/13/2006	7.31
MW-31	pH	10/25/2006	7.26
MW-31	pH	3/15/2007	7.41
MW-31	pH	8/27/2007	7.08
MW-31	pH	10/24/2007	6.97
MW-31	pH	3/19/2008	6.95
MW-31	pH	6/3/2008	7.20
MW-31	pH	8/4/2008	7.20
MW-31	pH	11/10/2008	7.42
MW-31	pH	2/3/2009	7.30
MW-31	pH	5/13/2009	7.12
MW-31	pH	8/10/2009	7.34
MW-31	pH	8/24/2009	7.18
MW-31	pH	10/14/2009	7.05
MW-31	pH	12/2/2009	7.17
MW-31	pH	2/9/2010	6.96
MW-31	pH	4/20/2010	7.38
MW-31	pH	5/21/2010	6.95
MW-31	pH	6/15/2010	7.01
MW-31	pH	7/21/2010	7.80
MW-31	pH	8/24/2010	7.10
MW-31	pH	9/13/2010	7.66
MW-31	pH	9/21/2010	7.13
MW-31	pH	10/19/2010	6.92
MW-31	pH	11/9/2010	6.98
MW-31	pH	12/14/2010	6.95
MW-31	pH	1/10/2011	6.65
MW-31	pH	2/1/2011	7.21
MW-31	pH	3/14/2011	7.43
MW-31	pH	4/1/2011	7.01
MW-31	pH	5/10/2011	6.73
MW-31	pH	6/20/2011	6.16
MW-31	pH	7/5/2011	6.64
MW-31	pH	8/2/2011	6.67
MW-31	pH	9/6/2011	7.03
MW-31	pH	10/3/2011	7.28
MW-31	pH	11/8/2011	7.01
MW-31	pH	11/29/2011	7.34
MW-31	pH	12/12/2011	7.46

Appendix D-2: Field pH Measurements Used for pH Analysis

Location ID	Field Parameter	Date Measured	Field Measurement
MW-31	pH	1/24/2012	6.78
MW-31	pH	2/13/2012	7.37
MW-31	pH	4/9/2012	7.14
MW-31	pH	5/2/2012	7.19
MW-31	pH	7/9/2012	7.53
MW-31	pH	8/6/2012	6.96
MW-31	pH	9/18/2012	7.10
MW-31	pH	10/22/2012	7.05
MW-31	pH	11/6/2012	7.04
MW-31	pH	12/18/2012	7.10
MW-31	pH	1/22/2013	6.90
MW-31	pH	2/19/2013	7.31
MW-31	pH	3/19/2013	7.22
MW-31	pH	4/16/2013	6.37
MW-31	pH	5/13/2013	7.92
MW-31	pH	6/24/2013	7.12
MW-31	pH	7/9/2013	6.98
MW-31	pH	8/19/2013	7.47
MW-31	pH	9/17/2013	7.09
MW-31	pH	10/23/2013	7.39
MW-31	pH	11/18/2013	6.99
MW-31	pH	12/17/2013	7.23
MW-31	pH	1/7/2014	7.11
MW-31	pH	2/17/2014	6.45
MW-31	pH	3/10/2014	6.53
MW-31	pH	4/28/2014	7.45
MW-31	pH	5/13/2014	6.83
MW-31	pH	6/2/2014	8.50
MW-31	pH	7/28/2014	6.92
MW-31	pH	8/18/2014	7.82
MW-31	pH	9/3/2014	7.11
MW-31	pH	10/6/2014	7.01
MW-31	pH	11/4/2014	6.69
MW-31	pH	12/9/2014	6.75
MW-31	pH	1/20/2015	6.47
MW-31	pH	2/2/2015	6.42
MW-31	pH	3/3/2015	6.35
MW-31	pH	4/7/2015	6.67
MW-31	pH	5/11/2015	6.74
MW-31	pH	6/1/2015	7.23
MW-31	pH	6/23/2015	7.15
MW-31	pH	7/6/2015	7.28
MW-31	pH	8/10/2015	6.80
MW-31	pH	9/15/2015	6.73

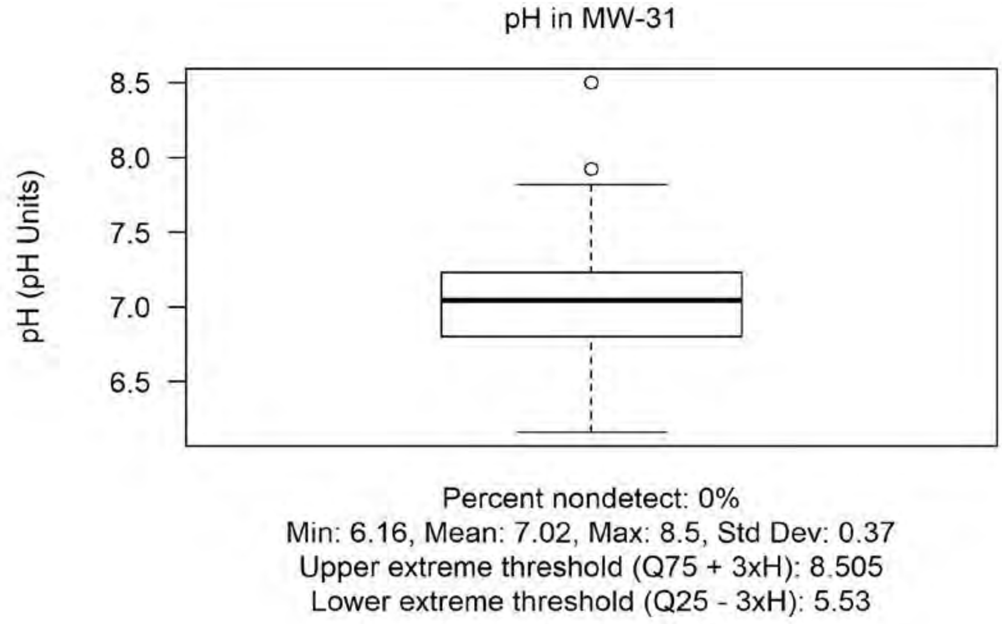
Appendix D-2: Field pH Measurements Used for pH Analysis

Location ID	Field Parameter	Date Measured	Field Measurement
MW-31	pH	10/6/2015	6.47
MW-31	pH	11/9/2015	6.36
MW-31	pH	12/8/2015	6.70
MW-31	pH	1/19/2016	7.04
MW-31	pH	2/15/2016	7.27
MW-31	pH	3/2/2016	6.85
MW-31	pH	4/12/2016	6.93
MW-31	pH	5/3/2016	6.48
MW-31	pH	6/15/2016	7.09
MW-31	pH	7/12/2016	6.49
MW-31	pH	8/16/2016	6.92
MW-31	pH	9/13/2016	6.35
MW-31	pH	10/4/2016	7.05
MW-31	pH	11/1/2016	6.97
MW-31	pH	12/5/2016	6.80
MW-31	pH	1/17/2017	6.75
MW-31	pH	2/7/2017	6.20
MW-31	pH	3/6/2017	6.39
MW-31	pH	4/4/2017	6.16
MW-31	pH	5/1/2017	6.94
MW-31	pH	6/5/2017	6.96
MW-31	pH	7/11/2017	6.97
MW-31	pH	8/14/2017	6.29
MW-31	pH	9/11/2017	6.34
MW-31	pH	10/2/2017	7.01
MW-31	pH	11/1/2017	7.07
MW-31	pH	12/4/2017	7.54
MW-31	pH	1/24/2018	6.32
MW-31	pH	2/20/2018	7.35
MW-31	pH	3/5/2018	6.92
MW-31	pH	4/17/2018	6.75
MW-31	pH	5/14/2018	7.08
MW-31	pH	6/18/2018	7.21
MW-31	pH	7/23/2018	7.17
MW-31	pH	8/10/2018	7.02
MW-31	pH	9/10/2018	7.18
MW-31	pH	10/24/2018	6.59
MW-31	pH	11/13/2018	7.10
MW-31	pH	12/10/2018	7.03
MW-31	pH	1/15/2019	6.86
MW-31	pH	2/12/2019	6.24
MW-31	pH	3/5/2019	7.20
MW-31	pH	4/10/2019	7.30
MW-31	pH	5/7/2019	7.04

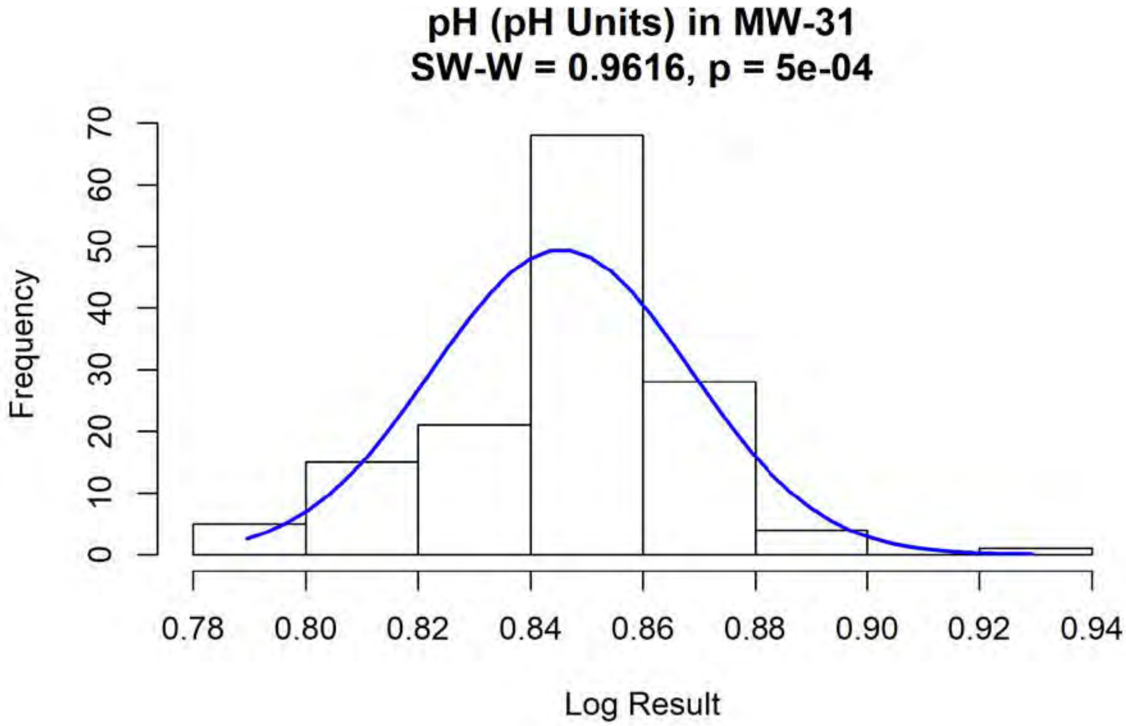
Appendix D-2: Field pH Measurements Used for pH Analysis

Location ID	Field Parameter	Date Measured	Field Measurement
MW-31	pH	6/3/2019	7.04
MW-31	pH	7/15/2019	6.82
MW-31	pH	8/5/2019	7.44
MW-31	pH	9/23/2019	7.24
MW-31	pH	10/9/2019	7.23
MW-31	pH	11/12/2019	7.33
MW-31	pH	12/3/2019	7.30
MW-31	pH	1/14/2020	6.80
MW-31	pH	2/4/2020	7.24
MW-31	pH	3/10/2020	7.15

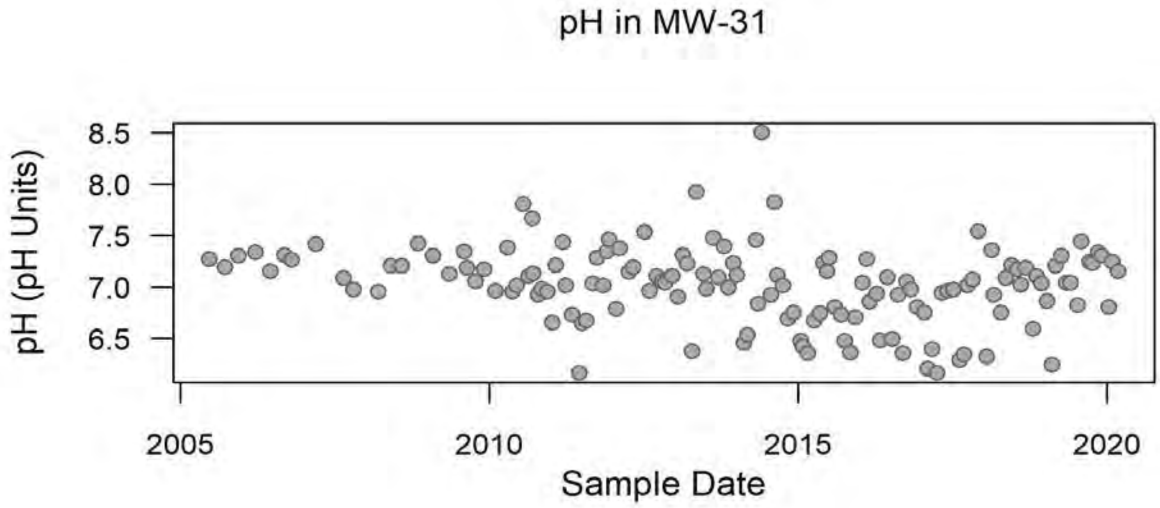
Appendix D-3: Box Plot for pH



Appendix D-4: Histogram for pH



Appendix D-5: Linear Regression for pH



APPENDIX E

Mass Balance in MW-31

Dilution Factors and Predicted Fluoride and Uranium Concentrations

	Fluoride (mg/L)	**Uranium** (ug/L)	**Chloride** (mg/L)	**Sulfate** (mg/L)
MW-31 concentration (04/06/2020)	0.632	15.5	376	1130
Cell 1 concentration (2003 - 2019 average)	2240	398000	24217	169662
Dilution factor (DF) = C_{mw31}/C_{cell1}	2.82E-04	3.89E-05	1.55E-02	6.66E-03

		Fluoride Based on Uranium Dilution (mg/L)	**Fluoride Based on Chloride Dilution** (mg/L)	**Fluoride Based on Sulfate Dilution** (mg/L)
Predicted diluted fluoride ($C_{cell1\ F}$ x DF)	–	0.087	35	15

	Fluoride (mg/L)	**Uranium** (ug/L)	**Chloride** (mg/L)	**Sulfate** (mg/L)
MW-31 concentration (04/06/2020)	0.632	15.5	376	1130
Cell 1 concentration (2003 - 2019 average)	2240	398000	24217	169662
Dilution factor (DF) = C_{mw31}/C_{cell1}	2.82E-04	3.89E-05	1.55E-02	6.66E-03

	Uranium Based on Fluoride Dilution (ug/L)		**Uranium Based on Chloride Dilution** (ug/L)	**Uranium Based on Sulfate Dilution** (ug/L)
Predicted diluted fluoride ($C_{cell1\ U}$ x DF)	112		6,179	2,651

NOTES:

C_{mw31} = latest concentration at MW-31

C_{cell1} = average concentration in Cell 1

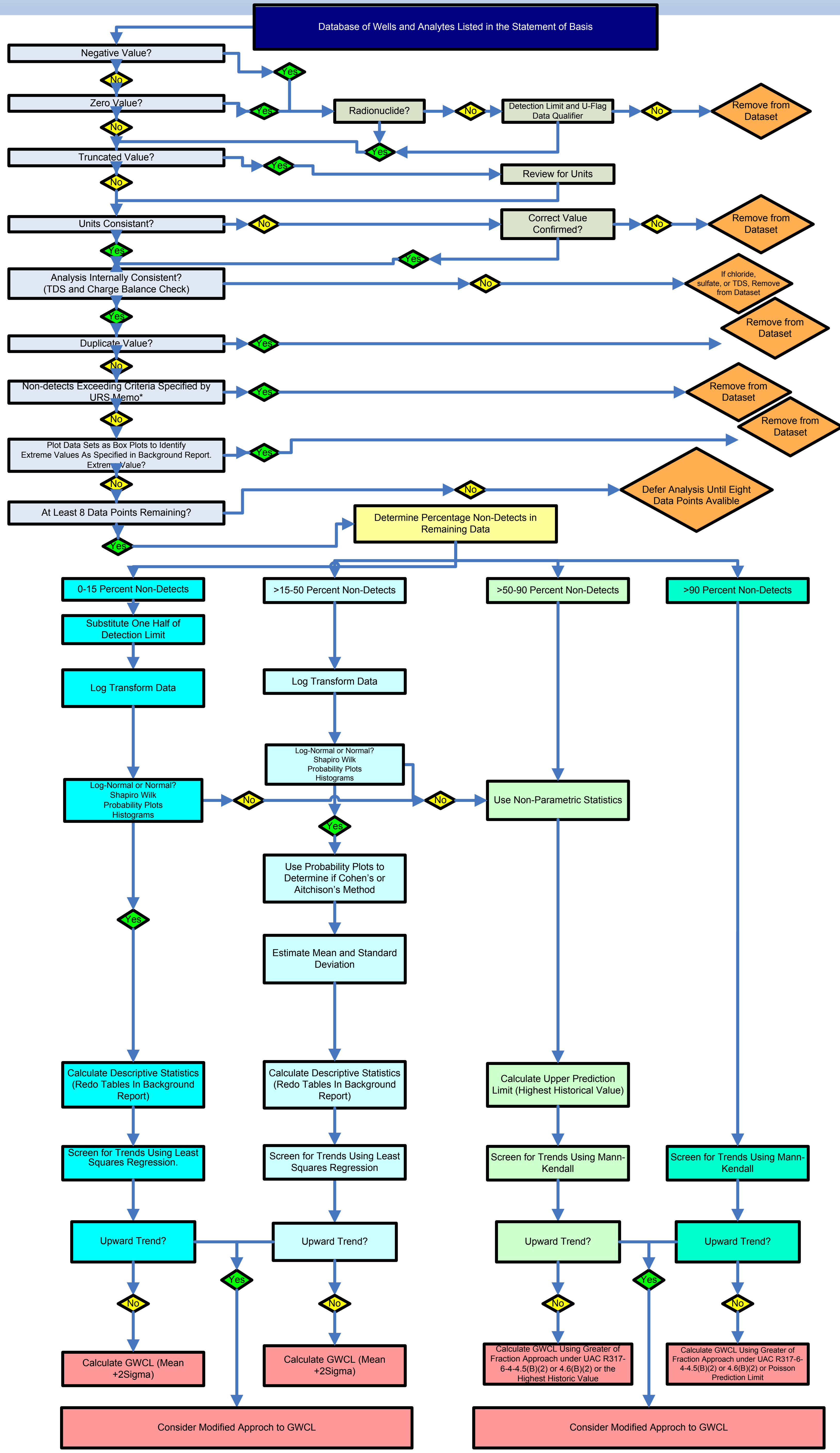
ug/L = micrograms per liter

mg/L = milligrams per liter

APPENDIX F

Flowsheet (Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site [INTERA, 2007a])

Appendix F. Flowsheet
Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah



*A non-detect considered "insensitive" will be the maximum reporting limit in a dataset and will exceed other non-detects by, for example, an order of magnitude (e.g., <10 versus <1.0 µg/L). In some cases, insensitive non-detects may also exceed detectable values in a dataset (e.g., <10 versus 3.5 µg/L).

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APPENDIX G

Flowsheet Analysis for Post-Inflection Data

Appendix G-1: Descriptive Statistics for Modified GWCL Data Set and All Data

Data Set	GWCL Subset Post May 2014	GWCL Subset Post Sep. 2012	ALL 2020 SAR Data		GWCL Subset Post May 2014	GWCL Subset Post Sep. 2012	ALL 2020 SAR Data
Analyte	Sulfate	Sulfate	Sulfate		Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids
Units	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L
% Non-Detects	0	0	0		0	0	0
N	65	85	126		65	85	127
Distribution	normal or lognormal	Not normal or lognormal	Not normal or lognormal		Not normal or lognormal	Not normal or lognormal	Not normal or lognormal
Mean	780	741	669		1776	1689	1555
Min. Conc.	555	480	436		1400	1230	1150
Max. Conc.	1150	1150	1150		2650	2650	2650
Std. Dev.	145.8	148.2	160.9		288	300	314
Range	595	670	714		1250	1420	1500
Geometric Mean	768	728	652		1754	1665	1527
Skewness	0.80	0.93	1.04		1.00	1.04	1.18
Q25	668	639	537		1540	1480	1310
Median	748	691	640		1700	1580	1480
Q75	857	835	750		1980	1830	1705

ALL 2020 SAR Data = All data with extremes removed

GWCL Subset Post 2012 = All data post September 2012

GWCL Subset Post 2014 = All data post May 2014

Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	6/22/2005	Sulfate	504	mg/l
MW-31	9/22/2005	Sulfate	436	mg/l
MW-31	12/14/2005	Sulfate	509	mg/l
MW-31	3/22/2006	Sulfate	485	mg/l
MW-31	6/21/2006	Sulfate	522	mg/l
MW-31	9/13/2006	Sulfate	516	mg/l
MW-31	10/25/2006	Sulfate	526	mg/l
MW-31	3/15/2007	Sulfate	516	mg/l
MW-31	8/27/2007	Sulfate	532	mg/l
MW-31	10/24/2007	Sulfate	497	mg/l
MW-31	3/19/2008	Sulfate	521	mg/l
MW-31	6/3/2008	Sulfate	514	mg/l
MW-31	8/4/2008	Sulfate	499	mg/l
MW-31	11/11/2008	Sulfate	541	mg/l
MW-31	2/3/2009	Sulfate	488	mg/l
MW-31	5/13/2009	Sulfate	493	mg/l
MW-31	8/24/2009	Sulfate	460	mg/l
MW-31	10/14/2009	Sulfate	497	mg/l
MW-31	2/9/2010	Sulfate	507	mg/l
MW-31	4/20/2010	Sulfate	522	mg/l
MW-31	9/13/2010	Sulfate	527	mg/l
MW-31	11/9/2010	Sulfate	539	mg/l
MW-31	2/1/2011	Sulfate	538	mg/l
MW-31	3/14/2011	Sulfate	531	mg/l
MW-31	4/1/2011	Sulfate	503	mg/l
MW-31	5/10/2011	Sulfate	512	mg/l
MW-31	6/20/2011	Sulfate	540	mg/l
MW-31	7/5/2011	Sulfate	532	mg/l
MW-31	8/2/2011	Sulfate	537	mg/l
MW-31	9/6/2011	Sulfate	541	mg/l
MW-31	10/3/2011	Sulfate	539	mg/l
MW-31	11/8/2011	Sulfate	552	mg/l
MW-31	12/12/2011	Sulfate	530	mg/l
MW-31	1/24/2012	Sulfate	539	mg/l
MW-31	2/13/2012	Sulfate	538	mg/l
MW-31	3/13/2012	Sulfate	517	mg/l
MW-31	4/9/2012	Sulfate	547	mg/l
MW-31	5/2/2012	Sulfate	532	mg/l
MW-31	6/18/2012	Sulfate	497	mg/l
MW-31	7/9/2012	Sulfate	529	mg/l
MW-31	8/6/2012	Sulfate	571	mg/l
MW-31	9/18/2012	Sulfate	561	mg/l
MW-31	10/22/2012	Sulfate	545	mg/l
MW-31	11/6/2012	Sulfate	557	mg/l
MW-31	12/18/2012	Sulfate	664	mg/l

Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	1/22/2013	Sulfate	611	mg/l
MW-31	2/19/2013	Sulfate	644	mg/l
MW-31	3/19/2013	Sulfate	611	mg/l
MW-31	4/16/2013	Sulfate	668	mg/l
MW-31	5/13/2013	Sulfate	630	mg/l
MW-31	6/24/2013	Sulfate	659	mg/l
MW-31	7/9/2013	Sulfate	659	mg/l
MW-31	8/19/2013	Sulfate	656	mg/l
MW-31	9/17/2013	Sulfate	666	mg/l
MW-31	10/23/2013	Sulfate	637	mg/l
MW-31	11/18/2013	Sulfate	609	mg/l
MW-31	12/17/2013	Sulfate	656	mg/l
MW-31	1/7/2014	Sulfate	558	mg/l
MW-31	2/17/2014	Sulfate	480	mg/l
MW-31	3/10/2014	Sulfate	681	mg/l
MW-31	4/28/2014	Sulfate	527	mg/l
MW-31	5/13/2014	Sulfate	639	mg/l
MW-31	6/2/2014	Sulfate	555	mg/l
MW-31	7/28/2014	Sulfate	600	mg/l
MW-31	8/18/2014	Sulfate	620	mg/l
MW-31	9/3/2014	Sulfate	560	mg/l
MW-31	10/6/2014	Sulfate	606	mg/l
MW-31	11/4/2014	Sulfate	639	mg/l
MW-31	12/9/2014	Sulfate	687	mg/l
MW-31	1/20/2015	Sulfate	669	mg/l
MW-31	2/2/2015	Sulfate	623	mg/l
MW-31	3/3/2015	Sulfate	616	mg/l
MW-31	4/7/2015	Sulfate	642	mg/l
MW-31	5/11/2015	Sulfate	668	mg/l
MW-31	6/23/2015	Sulfate	691	mg/l
MW-31	7/6/2015	Sulfate	684	mg/l
MW-31	8/10/2015	Sulfate	640	mg/l
MW-31	9/15/2015	Sulfate	638	mg/l
MW-31	10/6/2015	Sulfate	655	mg/l
MW-31	11/9/2015	Sulfate	646	mg/l
MW-31	12/8/2015	Sulfate	690	mg/l
MW-31	1/19/2016	Sulfate	675	mg/l
MW-31	2/15/2016	Sulfate	631	mg/l
MW-31	3/2/2016	Sulfate	654	mg/l
MW-31	4/12/2016	Sulfate	715	mg/l
MW-31	5/3/2016	Sulfate	699	mg/l
MW-31	6/15/2016	Sulfate	748	mg/l
MW-31	7/12/2016	Sulfate	712	mg/l
MW-31	8/16/2016	Sulfate	766	mg/l
MW-31	9/13/2016	Sulfate	703	mg/l
MW-31	10/4/2016	Sulfate	720	mg/l

Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	11/1/2016	Sulfate	752	mg/l
MW-31	12/5/2016	Sulfate	748	mg/l
MW-31	1/17/2017	Sulfate	809	mg/l
MW-31	2/7/2017	Sulfate	751	mg/l
MW-31	3/6/2017	Sulfate	741	mg/l
MW-31	4/4/2017	Sulfate	758	mg/l
MW-31	5/1/2017	Sulfate	741	mg/l
MW-31	6/5/2017	Sulfate	808	mg/l
MW-31	7/11/2017	Sulfate	747	mg/l
MW-31	8/14/2017	Sulfate	916	mg/l
MW-31	9/11/2017	Sulfate	762	mg/l
MW-31	10/2/2017	Sulfate	823	mg/l
MW-31	11/1/2017	Sulfate	847	mg/l
MW-31	12/4/2017	Sulfate	825	mg/l
MW-31	1/24/2018	Sulfate	813	mg/l
MW-31	2/20/2018	Sulfate	835	mg/l
MW-31	4/17/2018	Sulfate	857	mg/l
MW-31	6/18/2018	Sulfate	976	mg/l
MW-31	7/23/2018	Sulfate	857	mg/l
MW-31	8/10/2018	Sulfate	841	mg/l
MW-31	9/10/2018	Sulfate	893	mg/l
MW-31	10/24/2018	Sulfate	950	mg/l
MW-31	11/13/2018	Sulfate	841	mg/l
MW-31	12/10/2018	Sulfate	905	mg/l
MW-31	1/15/2019	Sulfate	851	mg/l
MW-31	2/12/2019	Sulfate	893	mg/l
MW-31	3/5/2019	Sulfate	953	mg/l
MW-31	4/10/2019	Sulfate	917	mg/l
MW-31	7/15/2019	Sulfate	1150	mg/l
MW-31	10/9/2019	Sulfate	1010	mg/l
MW-31	11/12/2019	Sulfate	990	mg/l
MW-31	12/3/2019	Sulfate	1020	mg/l
MW-31	1/14/2020	Sulfate	1120	mg/l
MW-31	2/4/2020	Sulfate	1150	mg/l
MW-31	3/10/2020	Sulfate	1080	mg/l
MW-31	6/22/2005	Total Dissolved Solids	1290	mg/l
MW-31	9/22/2005	Total Dissolved Solids	1280	mg/l
MW-31	12/14/2005	Total Dissolved Solids	1290	mg/l
MW-31	3/22/2006	Total Dissolved Solids	1280	mg/l
MW-31	6/21/2006	Total Dissolved Solids	1300	mg/l
MW-31	9/13/2006	Total Dissolved Solids	1320	mg/l
MW-31	10/25/2006	Total Dissolved Solids	1220	mg/l
MW-31	3/15/2007	Total Dissolved Solids	1280	mg/l
MW-31	8/27/2007	Total Dissolved Solids	1240	mg/l
MW-31	10/24/2007	Total Dissolved Solids	1150	mg/l
MW-31	3/19/2008	Total Dissolved Solids	1220	mg/l

Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	6/3/2008	Total Dissolved Solids	1180	mg/l
MW-31	8/4/2008	Total Dissolved Solids	1240	mg/l
MW-31	11/11/2008	Total Dissolved Solids	1220	mg/l
MW-31	2/3/2009	Total Dissolved Solids	1210	mg/l
MW-31	5/13/2009	Total Dissolved Solids	1230	mg/l
MW-31	8/24/2009	Total Dissolved Solids	1230	mg/l
MW-31	12/2/2009	Total Dissolved Solids	1160	mg/l
MW-31	2/9/2010	Total Dissolved Solids	1150	mg/l
MW-31	4/20/2010	Total Dissolved Solids	1220	mg/l
MW-31	9/13/2010	Total Dissolved Solids	1330	mg/l
MW-31	11/9/2010	Total Dissolved Solids	1320	mg/l
MW-31	1/10/2011	Total Dissolved Solids	1240	mg/l
MW-31	2/1/2011	Total Dissolved Solids	1220	mg/l
MW-31	3/14/2011	Total Dissolved Solids	1250	mg/l
MW-31	4/1/2011	Total Dissolved Solids	1370	mg/l
MW-31	5/10/2011	Total Dissolved Solids	1290	mg/l
MW-31	6/20/2011	Total Dissolved Solids	1330	mg/l
MW-31	7/5/2011	Total Dissolved Solids	1280	mg/l
MW-31	8/2/2011	Total Dissolved Solids	1300	mg/l
MW-31	9/6/2011	Total Dissolved Solids	1300	mg/l
MW-31	10/3/2011	Total Dissolved Solids	1320	mg/l
MW-31	11/8/2011	Total Dissolved Solids	1290	mg/l
MW-31	12/12/2011	Total Dissolved Solids	1330	mg/l
MW-31	1/24/2012	Total Dissolved Solids	1360	mg/l
MW-31	2/13/2012	Total Dissolved Solids	1240	mg/l
MW-31	3/13/2012	Total Dissolved Solids	1400	mg/l
MW-31	4/9/2012	Total Dissolved Solids	1380	mg/l
MW-31	5/2/2012	Total Dissolved Solids	1410	mg/l
MW-31	6/29/2012	Total Dissolved Solids	1460	mg/l
MW-31	7/9/2012	Total Dissolved Solids	1400	mg/l
MW-31	8/6/2012	Total Dissolved Solids	1400	mg/l
MW-31	9/18/2012	Total Dissolved Solids	1460	mg/l
MW-31	10/22/2012	Total Dissolved Solids	1320	mg/l
MW-31	11/6/2012	Total Dissolved Solids	1230	mg/l
MW-31	12/18/2012	Total Dissolved Solids	1270	mg/l
MW-31	1/22/2013	Total Dissolved Solids	1270	mg/l
MW-31	2/19/2013	Total Dissolved Solids	1390	mg/l
MW-31	3/19/2013	Total Dissolved Solids	1420	mg/l
MW-31	4/16/2013	Total Dissolved Solids	1260	mg/l
MW-31	5/13/2013	Total Dissolved Solids	1540	mg/l
MW-31	6/24/2013	Total Dissolved Solids	1380	mg/l
MW-31	7/9/2013	Total Dissolved Solids	1510	mg/l
MW-31	8/19/2013	Total Dissolved Solids	1440	mg/l
MW-31	9/17/2013	Total Dissolved Solids	1500	mg/l
MW-31	10/23/2013	Total Dissolved Solids	1460	mg/l
MW-31	11/18/2013	Total Dissolved Solids	1320	mg/l

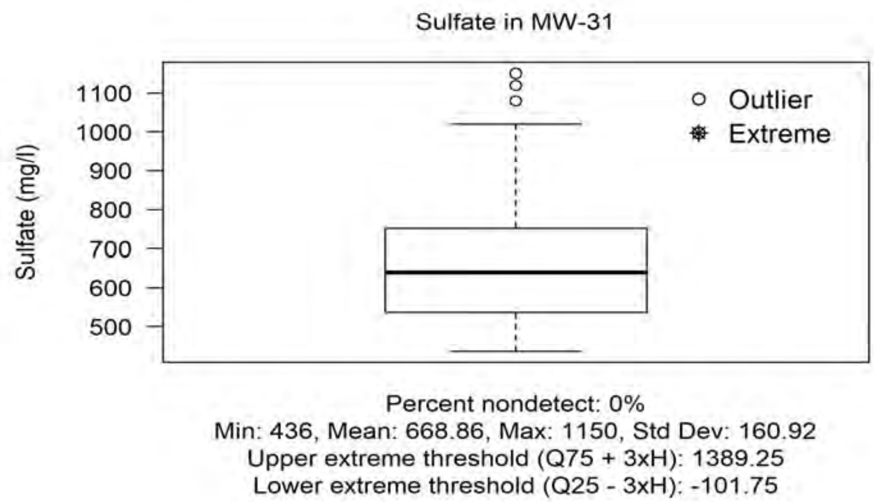
Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	12/17/2013	Total Dissolved Solids	1500	mg/l
MW-31	1/7/2014	Total Dissolved Solids	1510	mg/l
MW-31	2/17/2014	Total Dissolved Solids	1460	mg/l
MW-31	3/10/2014	Total Dissolved Solids	1490	mg/l
MW-31	4/28/2014	Total Dissolved Solids	1440	mg/l
MW-31	5/13/2014	Total Dissolved Solids	1510	mg/l
MW-31	6/2/2014	Total Dissolved Solids	1520	mg/l
MW-31	7/28/2014	Total Dissolved Solids	1400	mg/l
MW-31	8/18/2014	Total Dissolved Solids	1410	mg/l
MW-31	9/3/2014	Total Dissolved Solids	1460	mg/l
MW-31	10/6/2014	Total Dissolved Solids	1420	mg/l
MW-31	11/4/2014	Total Dissolved Solids	1520	mg/l
MW-31	12/9/2014	Total Dissolved Solids	1450	mg/l
MW-31	1/20/2015	Total Dissolved Solids	1540	mg/l
MW-31	2/2/2015	Total Dissolved Solids	1520	mg/l
MW-31	3/3/2015	Total Dissolved Solids	1530	mg/l
MW-31	4/7/2015	Total Dissolved Solids	1680	mg/l
MW-31	5/11/2015	Total Dissolved Solids	1700	mg/l
MW-31	6/23/2015	Total Dissolved Solids	1630	mg/l
MW-31	7/6/2015	Total Dissolved Solids	1440	mg/l
MW-31	8/10/2015	Total Dissolved Solids	1530	mg/l
MW-31	9/15/2015	Total Dissolved Solids	1480	mg/l
MW-31	10/6/2015	Total Dissolved Solids	1540	mg/l
MW-31	11/9/2015	Total Dissolved Solids	1460	mg/l
MW-31	12/8/2015	Total Dissolved Solids	1580	mg/l
MW-31	1/19/2016	Total Dissolved Solids	1560	mg/l
MW-31	2/15/2016	Total Dissolved Solids	1490	mg/l
MW-31	3/2/2016	Total Dissolved Solids	1580	mg/l
MW-31	4/12/2016	Total Dissolved Solids	1710	mg/l
MW-31	5/3/2016	Total Dissolved Solids	1550	mg/l
MW-31	6/15/2016	Total Dissolved Solids	1580	mg/l
MW-31	7/12/2016	Total Dissolved Solids	1610	mg/l
MW-31	8/16/2016	Total Dissolved Solids	1710	mg/l
MW-31	9/13/2016	Total Dissolved Solids	1570	mg/l
MW-31	10/4/2016	Total Dissolved Solids	1670	mg/l
MW-31	11/1/2016	Total Dissolved Solids	1690	mg/l
MW-31	12/5/2016	Total Dissolved Solids	1670	mg/l
MW-31	1/17/2017	Total Dissolved Solids	1730	mg/l
MW-31	2/7/2017	Total Dissolved Solids	1680	mg/l
MW-31	3/6/2017	Total Dissolved Solids	1690	mg/l
MW-31	4/4/2017	Total Dissolved Solids	1660	mg/l
MW-31	5/1/2017	Total Dissolved Solids	1820	mg/l
MW-31	6/5/2017	Total Dissolved Solids	1710	mg/l
MW-31	7/11/2017	Total Dissolved Solids	1830	mg/l
MW-31	8/14/2017	Total Dissolved Solids	1780	mg/l
MW-31	9/11/2017	Total Dissolved Solids	1780	mg/l

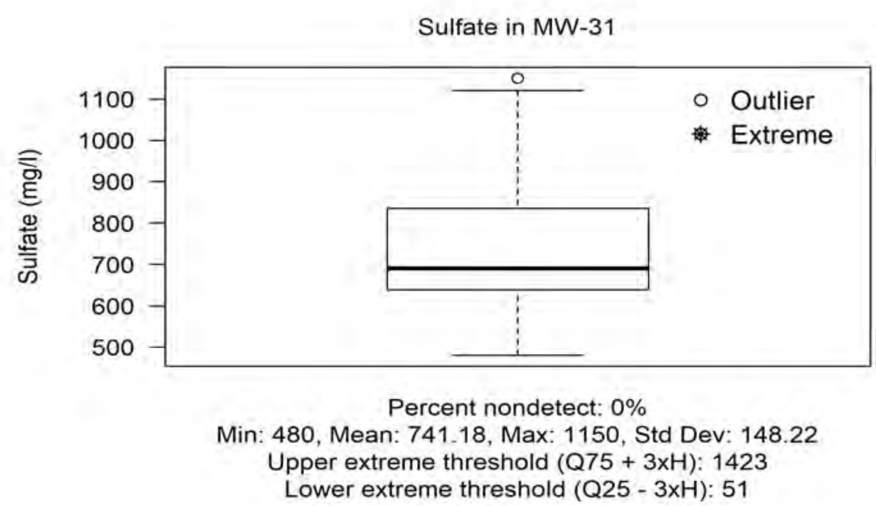
Appendix G-2: MW-31 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-31	10/2/2017	Total Dissolved Solids	1760	mg/l
MW-31	11/1/2017	Total Dissolved Solids	1770	mg/l
MW-31	12/4/2017	Total Dissolved Solids	1910	mg/l
MW-31	1/24/2018	Total Dissolved Solids	1800	mg/l
MW-31	2/20/2018	Total Dissolved Solids	1930	mg/l
MW-31	4/17/2018	Total Dissolved Solids	1980	mg/l
MW-31	6/18/2018	Total Dissolved Solids	2010	mg/l
MW-31	7/23/2018	Total Dissolved Solids	2000	mg/l
MW-31	8/10/2018	Total Dissolved Solids	1980	mg/l
MW-31	9/10/2018	Total Dissolved Solids	2100	mg/l
MW-31	10/24/2018	Total Dissolved Solids	2000	mg/l
MW-31	11/13/2018	Total Dissolved Solids	1960	mg/l
MW-31	12/10/2018	Total Dissolved Solids	2090	mg/l
MW-31	1/15/2019	Total Dissolved Solids	2030	mg/l
MW-31	2/12/2019	Total Dissolved Solids	2090	mg/l
MW-31	3/5/2019	Total Dissolved Solids	2160	mg/l
MW-31	4/10/2019	Total Dissolved Solids	2080	mg/l
MW-31	7/15/2019	Total Dissolved Solids	2580	mg/l
MW-31	10/9/2019	Total Dissolved Solids	2280	mg/l
MW-31	11/12/2019	Total Dissolved Solids	2650	mg/l
MW-31	12/3/2019	Total Dissolved Solids	2030	mg/l
MW-31	1/14/2020	Total Dissolved Solids	2220	mg/l
MW-31	2/4/2020	Total Dissolved Solids	2240	mg/l
MW-31	3/10/2020	Total Dissolved Solids	2380	mg/l

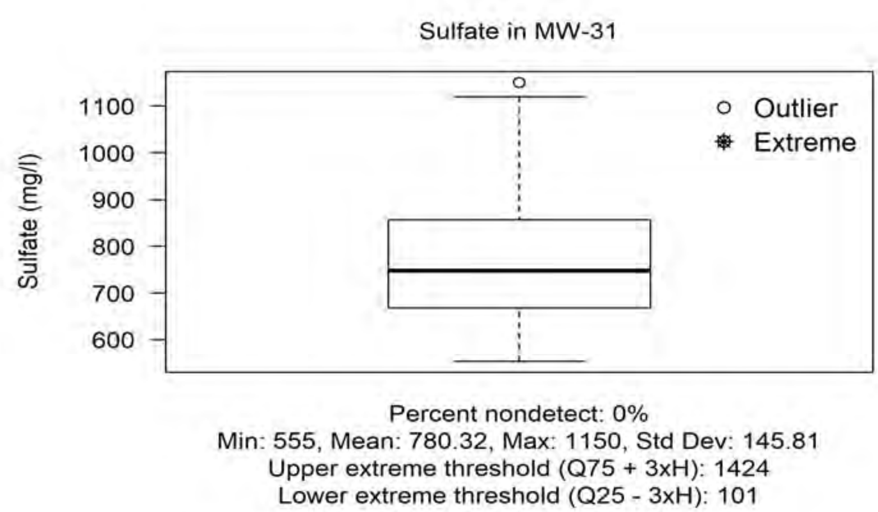
Sulfate in MW-31 for All data



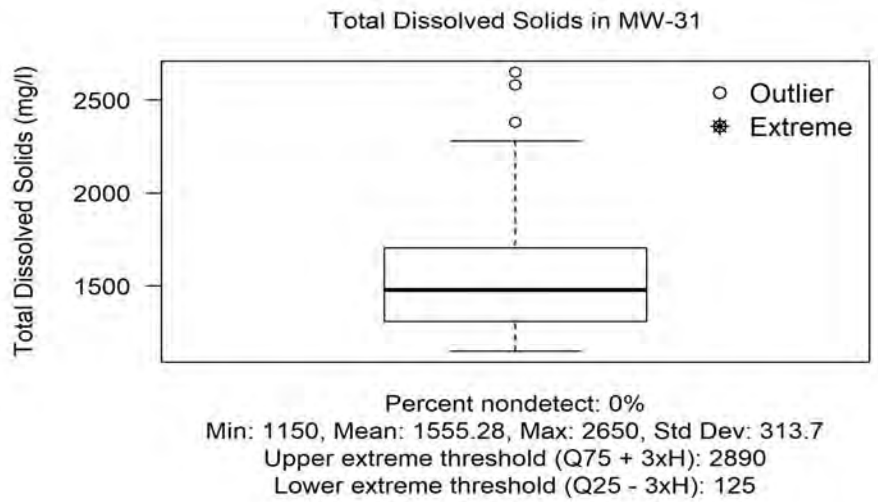
Sulfate in MW-31 Post September 2012



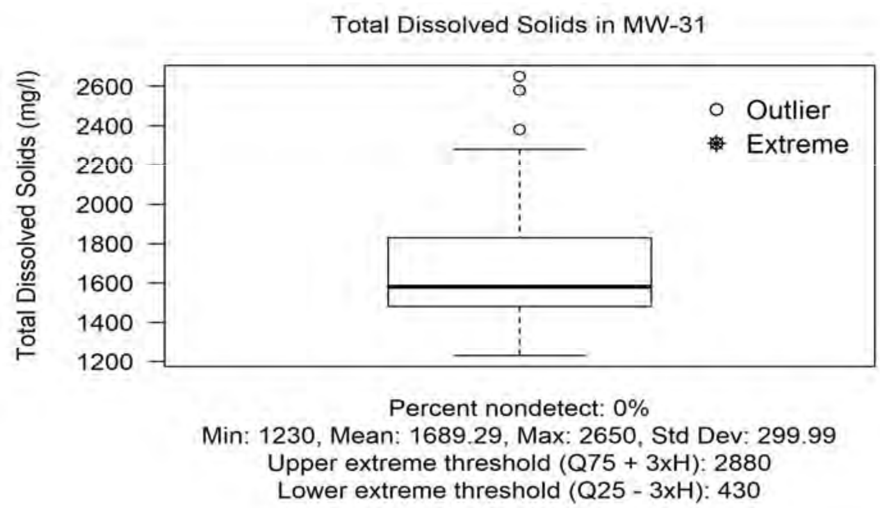
Sulfate in MW-31 Post May 2014



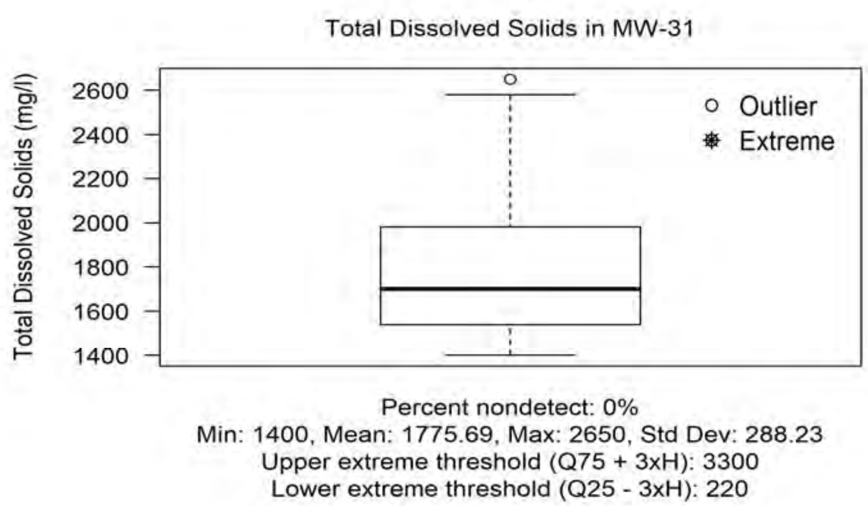
Total Dissolved Solids in MW-31 for All data



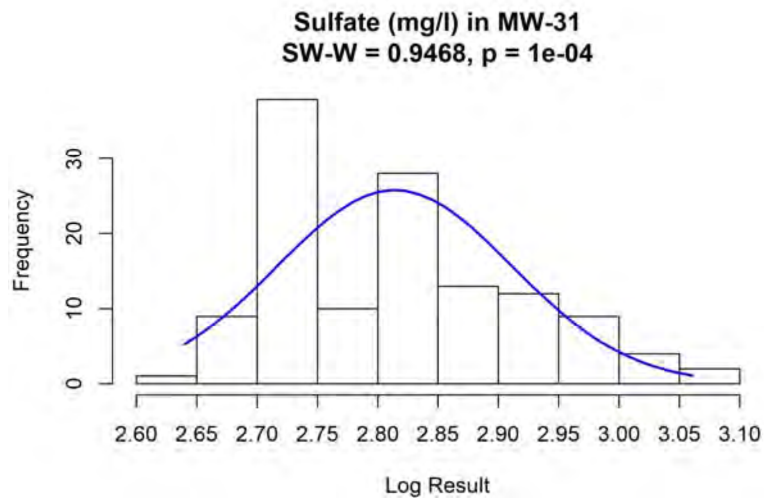
Total Dissolved Solids in MW-31 Post September 2012



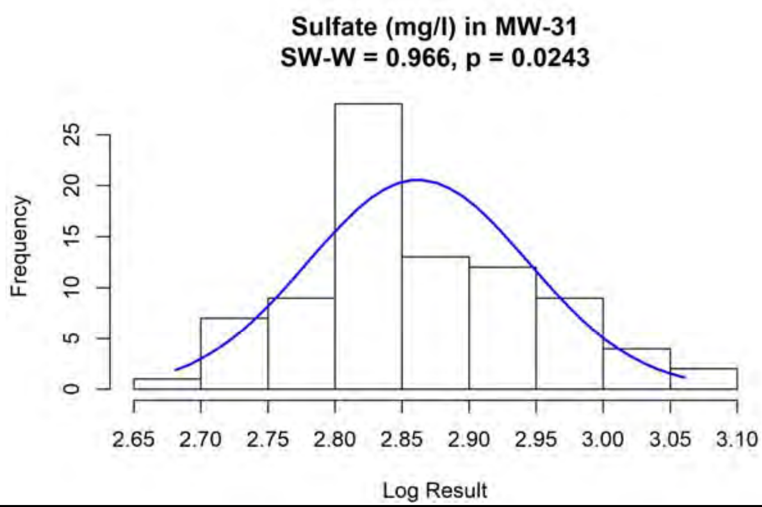
Total Dissolved Solids in MW-31 Post May 2014



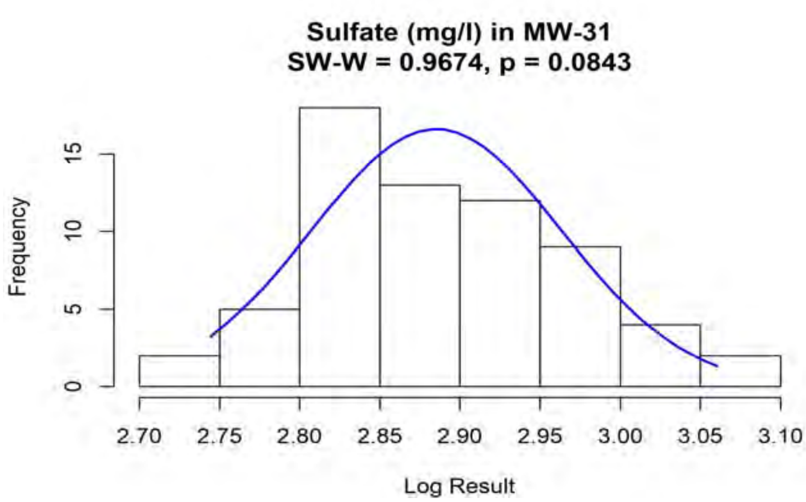
Sulfate in MW-31 for All data



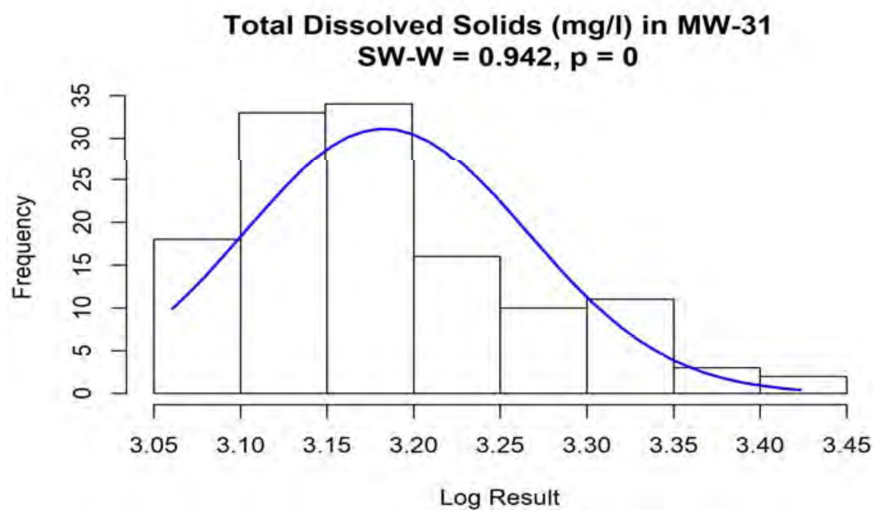
Sulfate in MW-31 Post September 2012



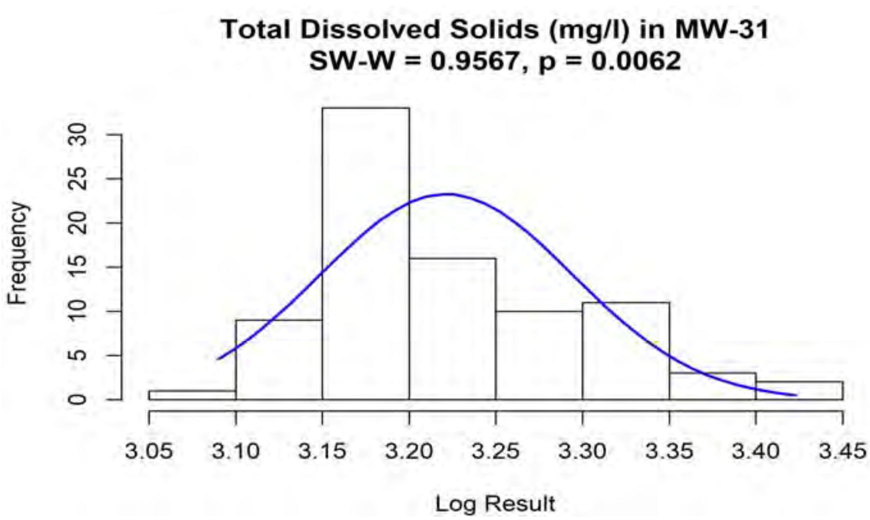
Sulfate in MW-31 Post May 2014



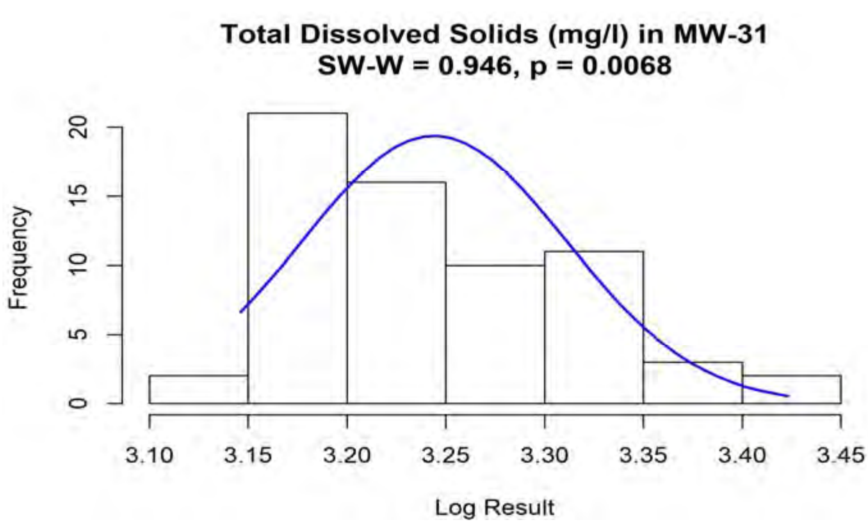
Total Dissolved Solids in MW-31 for All data



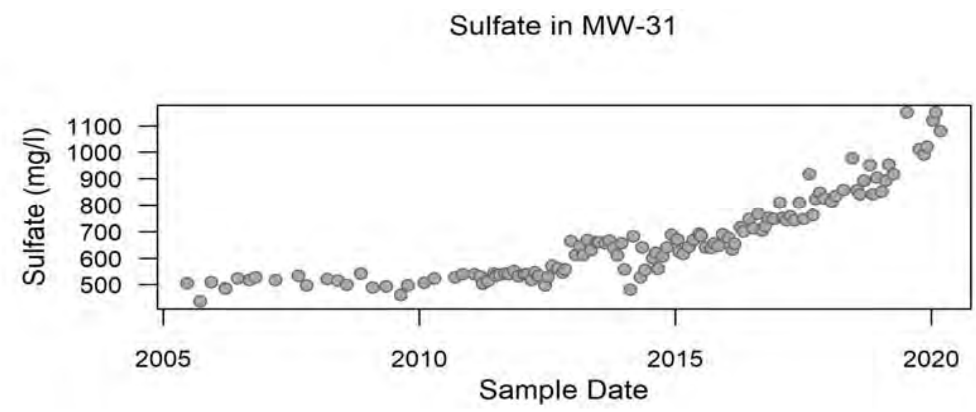
Total Dissolved Solids in MW-31 Post September 2012



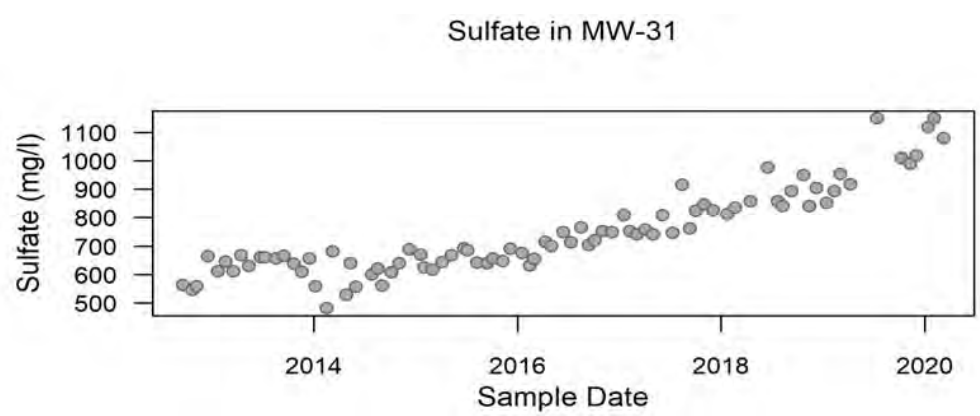
Total Dissolved Solids in MW-31 Post May 2014



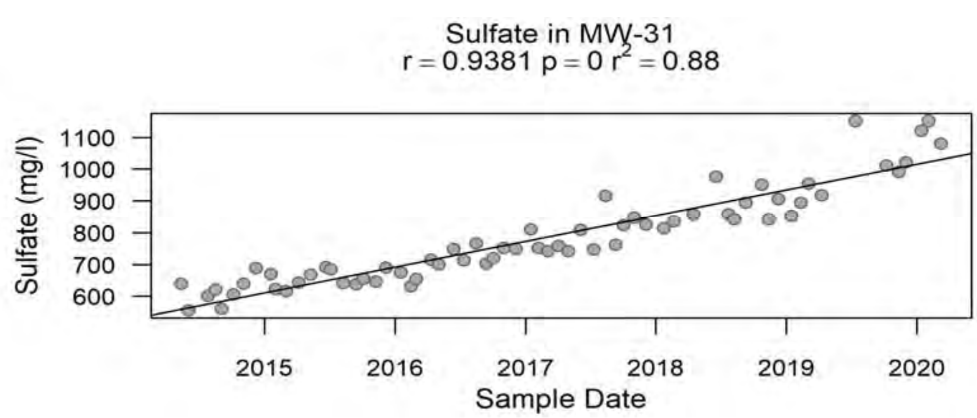
Sulfate in MW-31 for All data



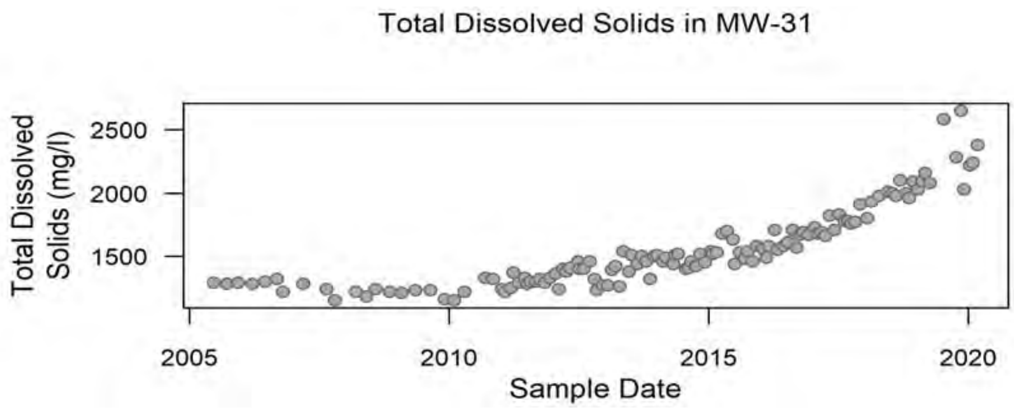
Sulfate in MW-31 Post September 2012



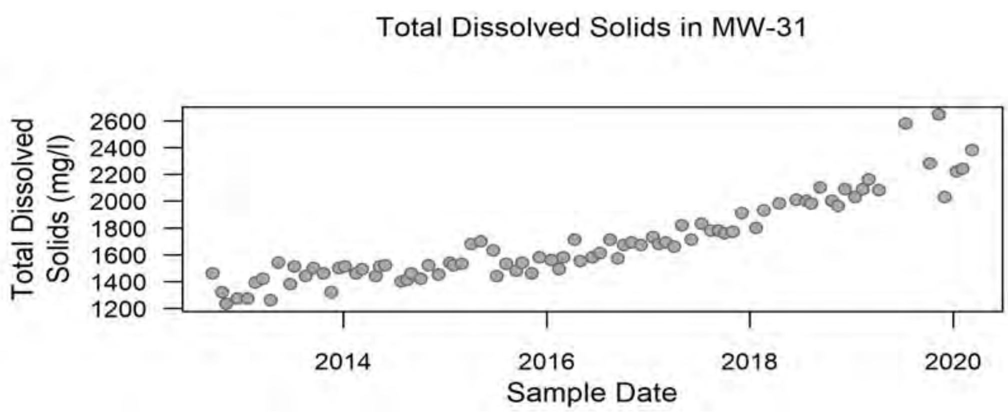
Sulfate in MW-31 Post May 2014



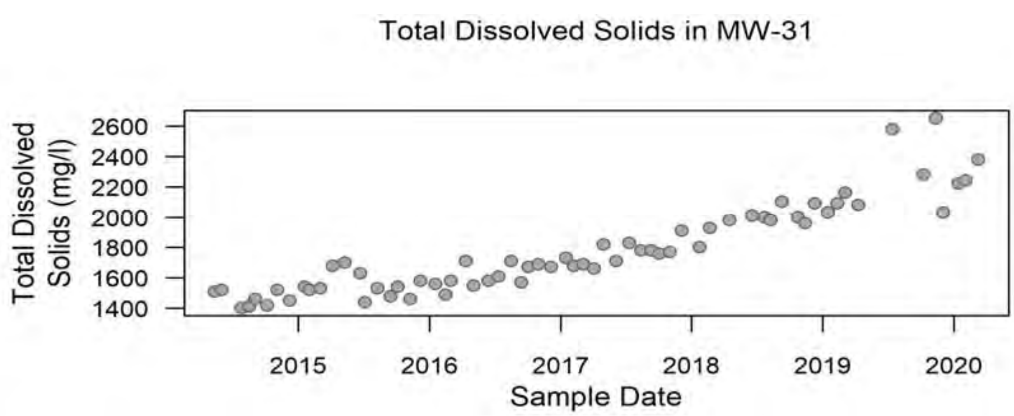
Total Dissolved Solids in MW-31 for All data



Total Dissolved Solids in MW-31 Post September 2012



Total Dissolved Solids in MW-31 Post May 2014



APPENDIX **H**

Input and Output Files (Electronic Only)