

## DRAFT Technical Memorandum

**To:** City of Greeley

**From:** Diana Trejo-Calzada, Allan Foster, E.I., Joel Barber, P.E.

**Reviewed by:** Cortney Brand, PG

**Date:** January 5, 2021

**Project:** 1229GRE20

**Subject:** Terry Ranch Groundwater Quality Characterization - Sampling and Analysis Methods and Results

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### Purpose

The City of Greeley (City) has contracted LRE Water, Inc. (LRE) to assess the production potential and ASR feasibility of the Upper Laramie Aquifer (ULA) underlying the Terry Ranch (TR) in Northern Colorado. To characterize the groundwater quality in the ULA beneath TR, LRE collected groundwater samples from five production wells and two temporary monitoring wells for laboratory water quality analysis of organics, inorganics, radiologicals, and biologicals. LRE also collected samples of Bellvue Water Treatment Plant (WTP) finished water, which is the proposed source water for ASR. This memorandum summarizes the sampling methodology, laboratory analysis results, and comparison to applicable water quality standards.

### Methods

LRE collected water quality samples from the five existing production wells (WWR-1, WWR-2, WWR-3, WWR-4, and WWR-5), and from the two temporary monitoring wells (EB-1 and EB-2). **Figure 1** is a map of the well locations. LRE collected groundwater samples during aquifer testing performed at each well as described in the *Terry Ranch Aquifer Test Analysis and Well Yield Estimates Technical Memorandum*. The samples consisted of three types: (1) composite, (2) depth-specific, (3) packer test, and (4) pilot treatment test. **Appendix A** is a table outlining the samples collected at each well and the corresponding lab analyses conducted on the samples. **Appendix A** is based on the table provided by Brown and Caldwell in the *Groundwater Sampling and Analysis Plan* and modified to represent the actual analyses conducted.

## **Composite Samples**

Composite samples were collected from the discharge line during aquifer testing, and represent the entire screened interval of the aquifer. LRE collected composite samples from wells WWR-1 through WWR-5 at 24 hours and at 48 hours of pumping. Additional composite samples were collected from WWR-1 at 0.75 hours, 69 hours, and 93.5 hours. These additional samples were used to evaluate changes in water quality parameters over a longer period of pumping. Finally, LRE collected composite samples from temporary wells EB-1 and EB-2 during depth-specific sampling. LRE collected the sample from a sampling port along the submersible pump discharge line.

## **Depth-Specific Samples**

Depth-specific samples are representative of a specific screened interval or aquifer zone. These samples were collected to evaluate the vertical variability of certain water quality parameters within the aquifer. LRE collected depth-specific samples at WWR-1, WWR-4, EB-1, and EB-2 after COLOG completed the hydrophysical logs. COLOG obtained the depth-specific samples using either a 2-liter barrel sampler or a Bennet pump, depending on the pump set depth, sample depth, and pumping water level. The interpretation of depth-specific sampling results is discussed in detail in *Terry Ranch Aquifer Zonal Sampling and Analysis Results Technical Memorandum*.

## **Packer Test Samples**

LRE collected samples from EB-2 at various times during the 5-day packer test, which isolated the lower aquifer zone. LRE took the sample from a sampling port along the pump discharge line. For details on the packer testing methodology and water quality mass balance calculations see *Terry Ranch Aquifer Test Analysis and Well Yield Estimates* and *Terry Ranch Aquifer Zonal Sampling and Analysis Results* respectively.

## **Injectate Samples**

LRE collected samples of the proposed injectate water for ASR. The sample was collected from the “Dugens” location near Windsor, which is an access point along Greeley’s finished water transmission line from its Bellvue Water Treatment Plant (WTP). LRE sampled the Bellvue WTP injectate at this location because it is near the proposed juncture of the Terry Ranch transmission line and captures water quality changes that might occur in transit from the Bellvue WTP.

## Pilot Treatment Test Samples

Additionally, LRE collected composite samples from EB-2 during the pilot treatment test. The purpose of the pilot treatment test was to demonstrate the treatability of naturally occurring uranium in the Terry Ranch groundwater. The test was operated for 30 days from late November to early December 2020. Although the treated water analytical results are outside of the scope of this memorandum, composite groundwater samples were collected from EB-2 during testing. The results of laboratory analysis of these composite (FEED) samples are included in this memorandum.

## Sampling Procedures

LRE collected samples following the procedures outlined in Brown and Caldwell's *Groundwater Sampling and Analysis Plan* as summarized below.

1. The laboratories provided LRE with sample containers/bottles, preservatives, and packaging supplies.
2. LRE labeled sample containers with the sample ID (well name), location, client name, date, time, sampler information, and preservative information if applicable. The sample identification convention is: **Well ID –Type –Time – Duplicate Flag**. Sample types included composite (COMP), depth-specific (DS), packer test (PACKER), and pilot treatment test (FEED). Composite and packer test samples are from various times during the test (up to 93.5 hours), so the time elapsed since the start of the test is indicated on the sample ID. If the sample is a field duplicate, then the ID is flagged with a "99".
3. LRE collected field water quality parameters during sampling. These parameters included electrical conductivity, pH, temperature, and dissolved oxygen (DO). The field water quality parameter data are provided in **Table 1**.
4. Each sample container was filled at the inline sample port for composite samples, the benet pump or barrel sampler for depth-specific samples, or from tubing connected to the delivery line at the Dugens sampling location. LRE filled the sample bottles following laboratory specifications for the specific bottle and preservative type.
5. Samples were placed in a cooler lined with ice and kept away from the sun to preserve the samples until they were delivered to the appropriate laboratory or shipment location.

Samples were analyzed for organics, inorganics, microbiologicals, and radiologicals. Seven laboratories were utilized to complete the water quality analyses. Samples were delivered and/or shipped to the laboratory the same day they were collected. The

exceptions were the depth-specific samples collected at EB-2 and WWR-1 due to lab/shipment center hours. Due to these delays, the following parameters were analyzed outside of their hold times: Hexavalent Chromium, Nitrate, and Nitrite. Additionally, two semi-volatile constituents failed hold times for sample ID, Bellvue: Dugens: acrylonitrile and hexachloroethane. Labs analyzed and reported the data for the hold time samples. **Table 2** is a summary of sample/parameter pairs that were analyzed outside hold times.

Initially, gross alpha and gross beta analyses of the 24-hour and 48-hour composite samples were conducted using differing methods. Colorado Analytical sub-contracted radiological composite samples for gross alpha and gross beta to two different labs. The two subcontracted labs, Hazen Research Inc. and Energy Labs, analyzed the samples using two different EPA methods, SM 7110 B and EPA 900.0, respectively. Since the two methods measure different alpha emitters, the results of the 24-hour and 48-hour samples are not directly comparable. The lab corrected this by sending residual samples from Hazen Research, Inc. to Energy Labs to re-test the samples using method EPA 900.0. **Table 3** presents the sample results for gross alpha and gross beta using EPA method 900.0 for composite samples collected at 24 and 48 hours of pumping, excluding the SM 7110 B results.

## 2019 Wingfoot Water Resources Samples

Wingfoot Water Resources (Wingfoot) collected water quality samples from the WWR wells in 2019 as part of well construction and testing. LRE has included in this summary, and the *Greeley GW Data Dashboard*, results from the 2019 Wingfoot water quality sampling and analysis. Wingfoot collected samples from the five production wells after the wells were constructed, developed, and pumped for 72 hours. These 72-hour aquifer test samples varied from the 2020 due diligence testing in duration, pumping rate, pump depth, and discharge configuration. For details on the Wingfoot 72-hour aquifer test samples, see *Terry Ranch Aquifer Test Analysis and Well Yield Estimates Technical Memorandum* or the Wingfoot well construction and pump installation reports.

## Groundwater Sampling Results

In combination, the 2019 Wingfoot and 2020 due diligence sampling efforts evaluated more than 577 unique water quality parameters and 7,509 individual analyses. LRE compiled the Electronic Data Deliverables (EDDs) and uploaded the lab results to the *Greeley GW Data Dashboard*, which facilitates data filtering, sorting, and exporting results to a csv file. Access to LRE's data dashboard is granted by individual request.

The sampling results were compared to the Colorado Department of Public Health and Environment's (CDPHE) Regulation No. 41 (Reg. 41) – The Basic Standards for Groundwater. LRE identified exceedances of Reg. 41 limits for three of the 577 parameters at various wells as outlined below.

- Total uranium concentrations at WWR-1 ranged from 39.5 to 43.0 ug/L in composite samples, which exceed the 30 ug/L federal primary MCL.
- Total uranium concentrations at EB-2 ranged from 30.1 to 33.1 ug/L during the pilot treatment test (samples collected between 8 and 30 days of pumping), which exceed the 30 ug/L federal primary MCL. Uranium concentrations ranged from 17.7 to 29.7 ug/L during the first 8 days of pumping, exceeding the more stringent Regulation 41 health-based limit of 16.8 ug/L but not the federal primary MCL.
- Total uranium concentrations at WWR-2, WWR-3, WWR-4, and EB-1 ranged from 19 to 28 ug/L in composite samples, which exceed the more stringent Regulation 41 health-based limit of 16.8 ug/L but not the federal primary MCL.
- Calculated dissolved manganese concentrations in EB-2 ranged from 50.9 ug/L to 72.7 ug/L in the depth-specific samples, and are estimated to be 66.2 ug/L in composite; exceeding the federal secondary MCL of 50 ug/L (see *Terry Ranch Aquifer Zonal Sampling and Analysis Results Technical Memorandum* for calculations of composite concentration). Secondary limits are in place for water quality parameters that affect water aesthetics and not for public health.
- Gross alpha particle disintegrations ranged from 16.9 to 31 pCi/L at WWR-1, WWR-2, WWR-3, WWR-4, EB-1, and EB-2, and exceed the standard of 15 pCi/L. The elevated gross alpha particle activity is correlated with uranium concentrations in the water.

Since dissolved uranium is not available for all samples, sample results for total uranium are compared to the dissolved uranium water quality standard range listed in Regulation 41. The 2019 Wingfoot sampling data included both total and dissolved uranium, and in all cases the values are comparable, with the total uranium value being insignificantly higher. Therefore, using total uranium is appropriate.

**Table 4** is a summary of the water quality sampling results that exceed Reg. 41 standards with the exclusion of uranium, and **Table 5** shows water quality sample results for total and dissolved uranium that are above 16.8 ug/L, the health-based standard in Reg. 41.

LRE has identified uranium, manganese, and gross alpha particle activity as the key water quality constituents of concern for the project because of the observed exceedances of

state and federal standards. **Figure 2** summarizes the lab results of the constituents of concern for the 48-hour composite samples.

**Figure 3** displays the concentrations of total uranium, gross alpha particle activity, and total manganese with respect to time of pumping. Each site location is color-coded individually for consistency. With the exception of EB-2 and a minor exception for WWR-1, total uranium concentrations decrease with increasing pumping time. Gross alpha particle activity concentrations also decrease as pumping time increases, with the exception at WWR-1. With minor exceptions at wells WWR-2, WWR-3, and WWR-4, total manganese concentrations also decrease with pumping time. These results indicate that the groundwater produced by wells completed in the ULA at Terry Ranch is dynamic, and the concentrations of the key water quality constituents tend to decrease or improve somewhat with pumping time. The later time samples are likely to be more representative of long-term well field operational conditions.

During the pilot treatment test at EB-2, there is a reverse temporal trend in uranium concentrations than observed at the other wells (**Figure 4**). Uranium concentrations in the FEED water samples increased from 12.5 ug/L to just above the federal primary MCL in the first 8 days. For the remainder of the test, the uranium concentration stabilized between approximately 30 and 34 ug/L. The trend of increased uranium concentration over time appears to be unique to EB-2 and is not representative of observed aquifer conditions across Terry Ranch.

## Bellvue WTP Treated Water Sampling Results

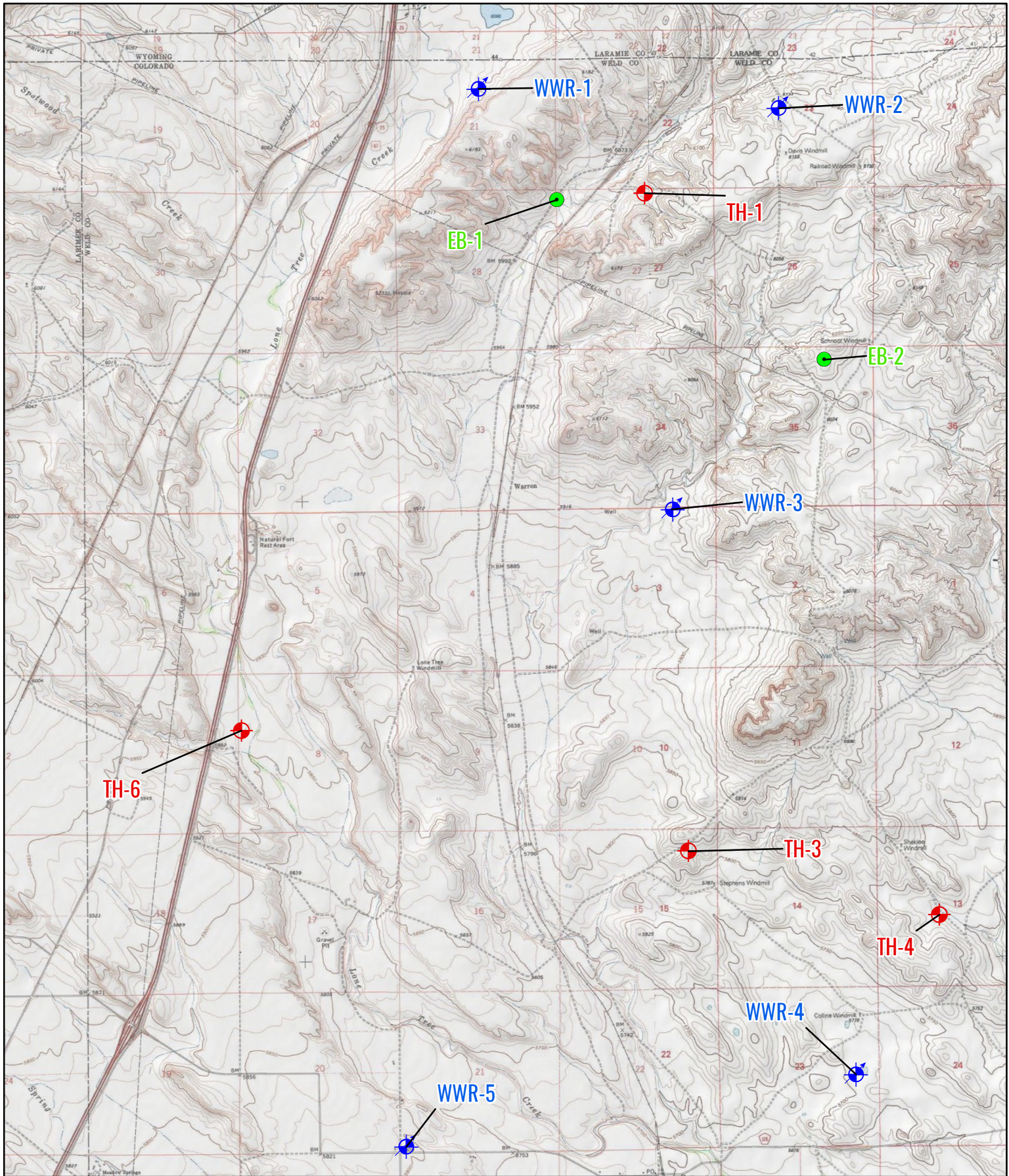
Four disinfection byproducts – Bromodichloromethane, Chloroform, Dichloroacetic acid, and Trichloroacetic acid – exceeded the individual Reg. 41 limits in the Bellvue: Dugens source water sample. Despite the individual exceedances, the Reg. 41 limit for the summation of these compounds, total trihalomethanes (TTHMs), did not exceed the Reg. 41 limit. A minor amount of residual chlorine was also detected in the Bellvue: Dugens water sample. These disinfection byproducts produced from the chlorination and disinfection of the water from the Bellvue WTP have the potential to react with other compounds within the ULA to create other compounds. These reactions are evaluated as part of ASR cycle-testing at well EB-1.

## References

Bauch, N.J., Musgrove, MaryLynn, Mahler, B.J., and Paschke, S.S., 2014, The quality of our Nation's waters — Water quality in the Denver Basin aquifer system, Colorado, 2003–05: U.S. Geological Survey Circular 1357, 100 p., <http://dx.doi.org/10.3133/cir1357>.

## Figures





- EXPLORATORY BOREHOLES
- ⊕ TEST HOLES
- ⊕ WINGFOOT WELLS

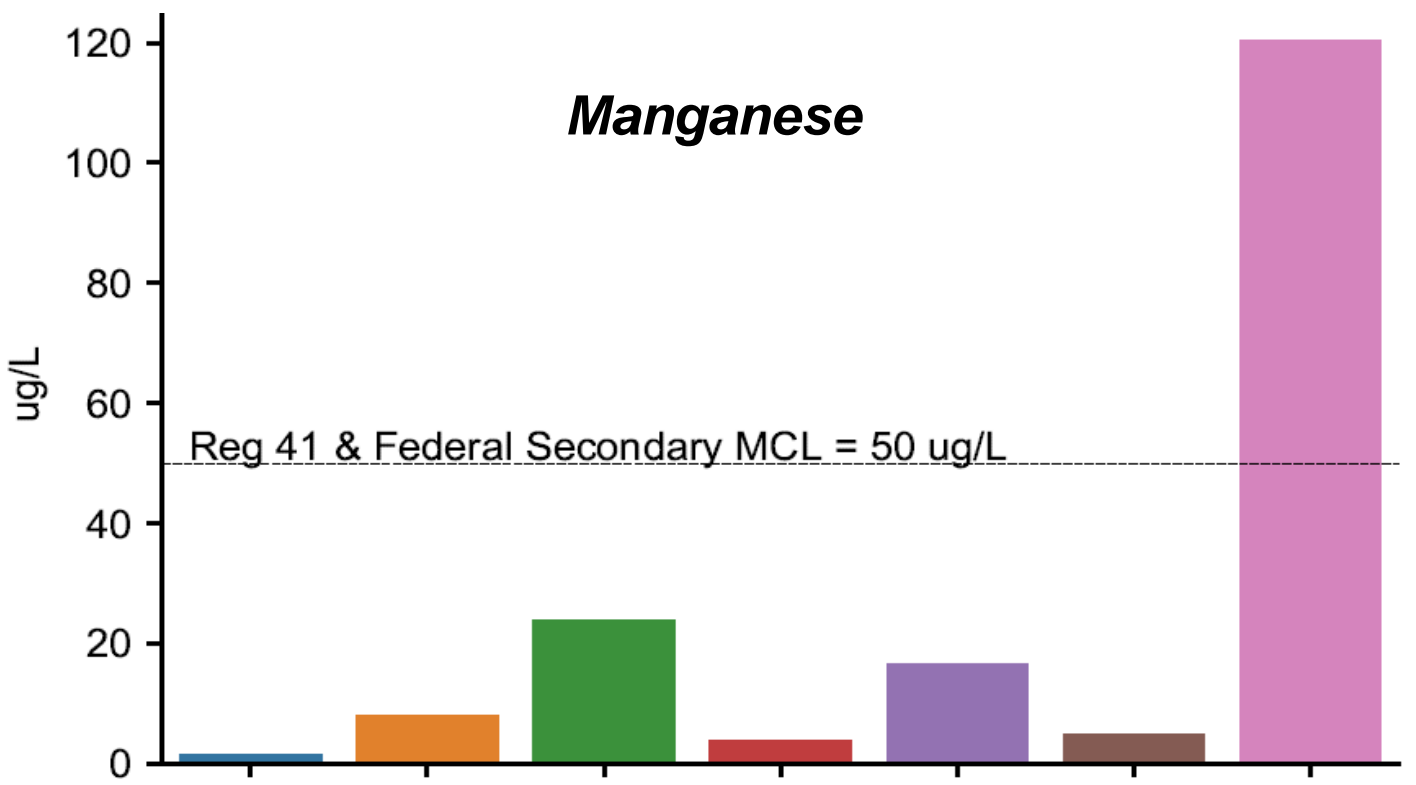
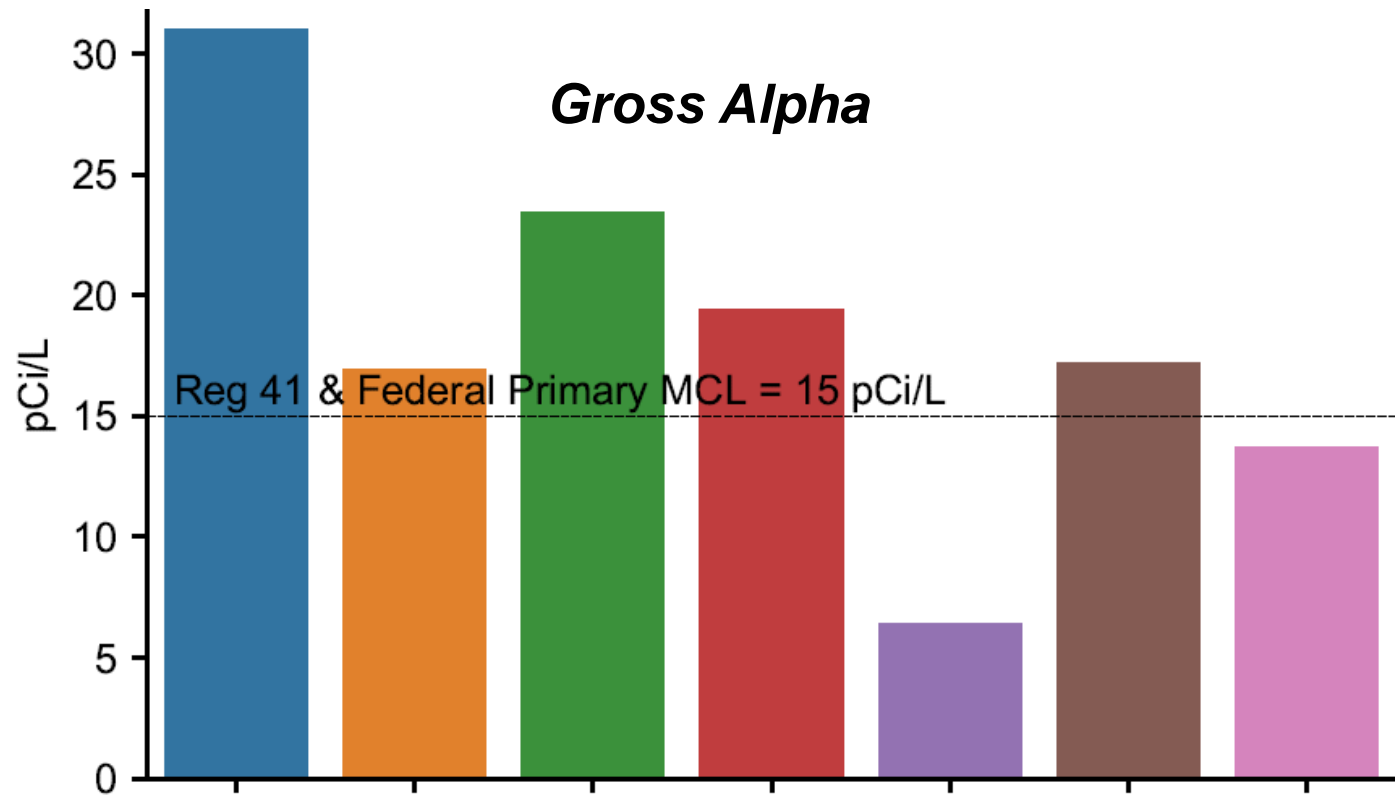
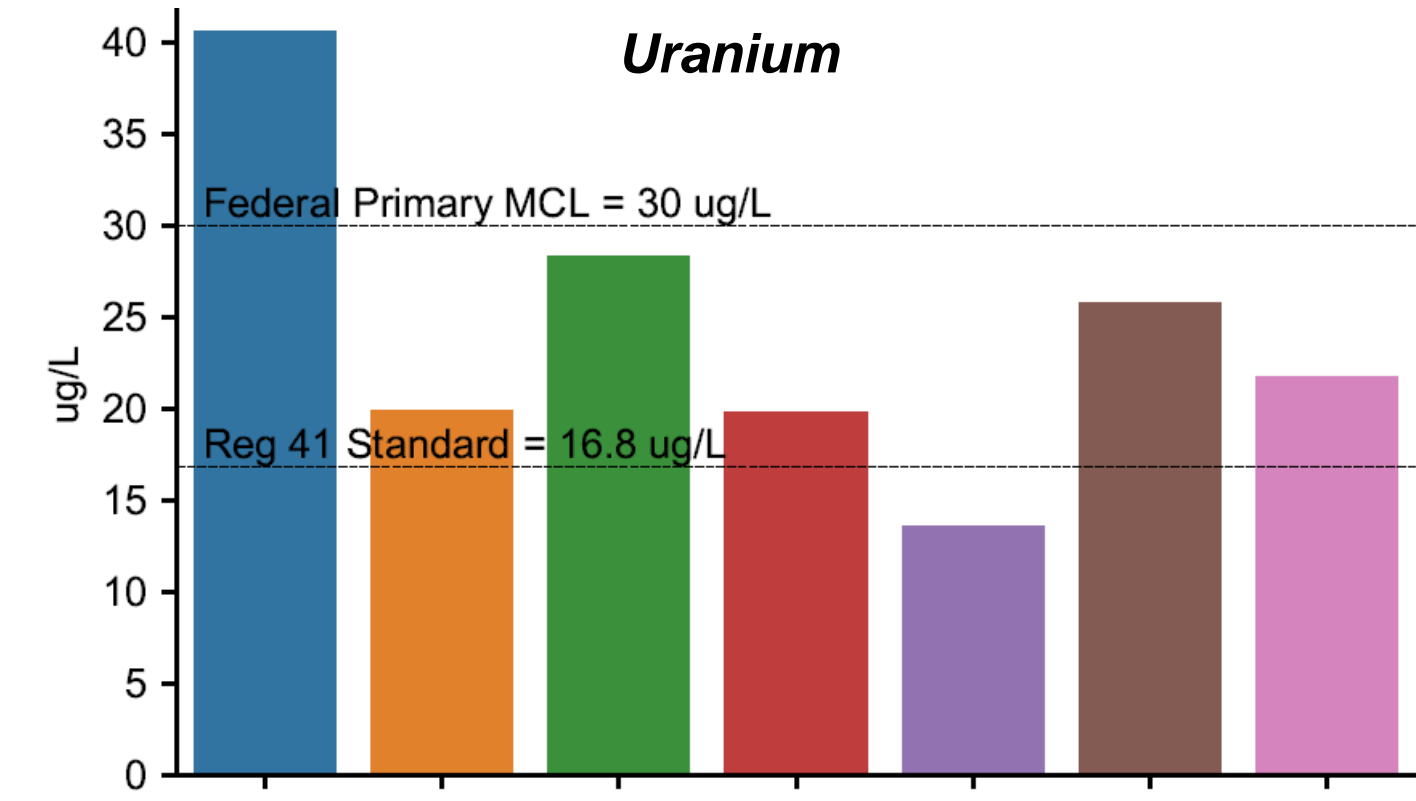
**FIGURE 1**  
WELL LOCATIONS  
(USGS TOPOGRAPHIC  
MAP BACKGROUND)

1229GRE14 | DECEMBER 2020

0 0.25 0.5 0.75 1  
SCALE: 1 INCH = 1 MILES 1:50,000

Miles





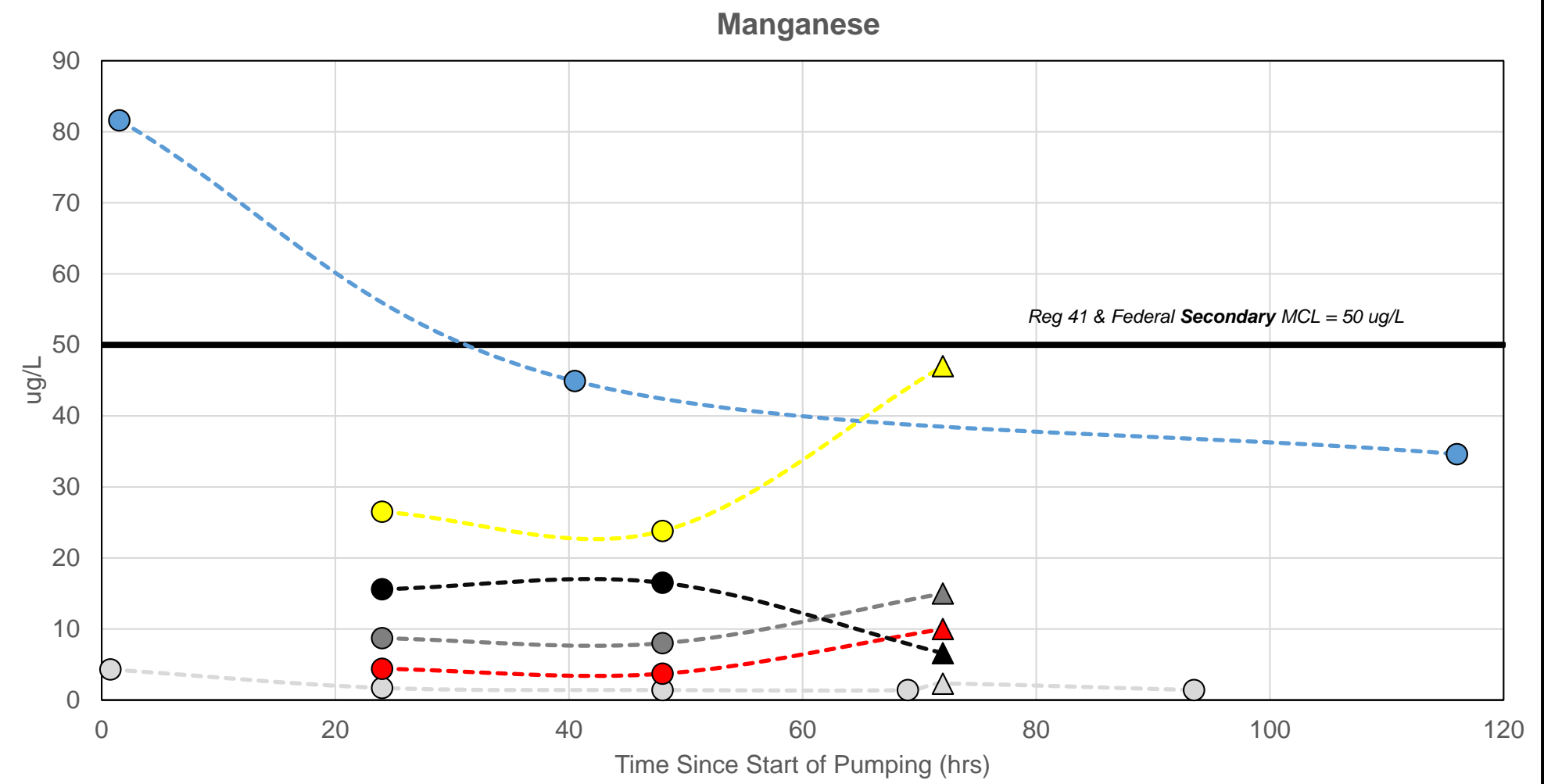
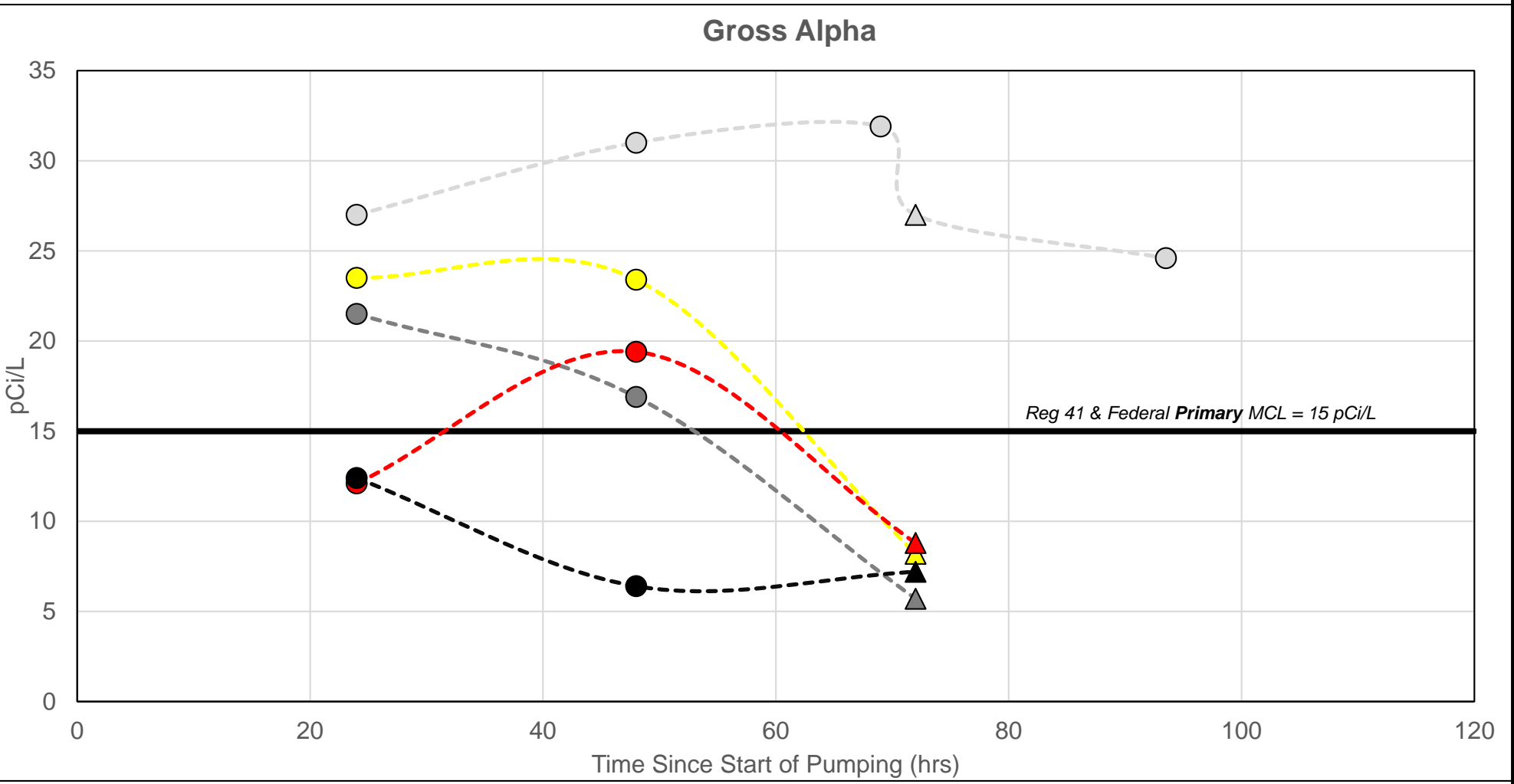
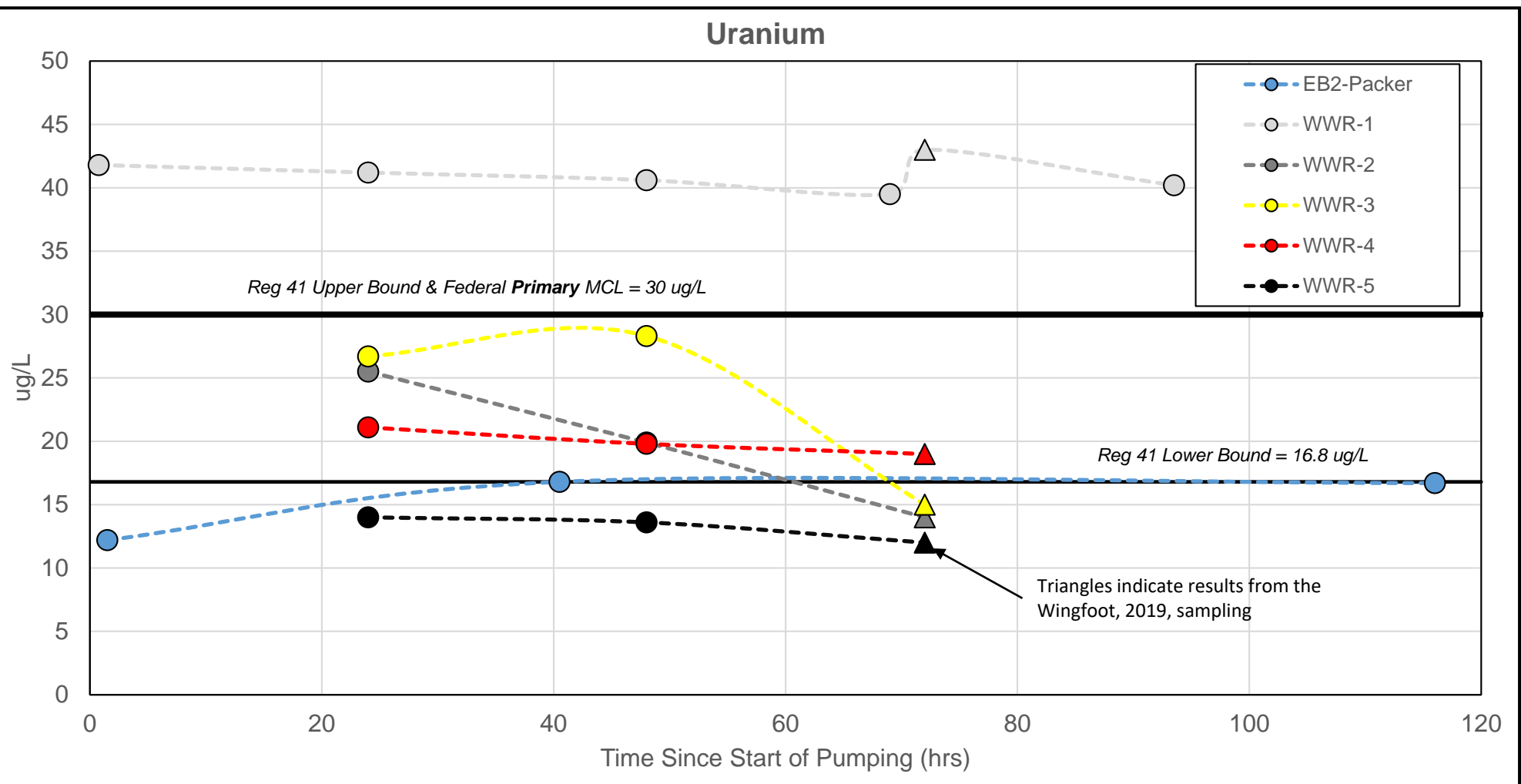
Sample ID

WWR1-COMP-48hr-2020    WWR2-COMP-48hr-2020    WWR3-COMP-48hr-2020    WWR4-COMP-48hr-2020    WWR5-COMP-48hr-2020    EB1-COMP-2020    EB2-COMP-2020

Author: AWF  
Date: Dec. 2020

**Figure 2**  
Summary of Key Water Quality Constituents at  
Select Well Locations from Composite  
Groundwater Samples

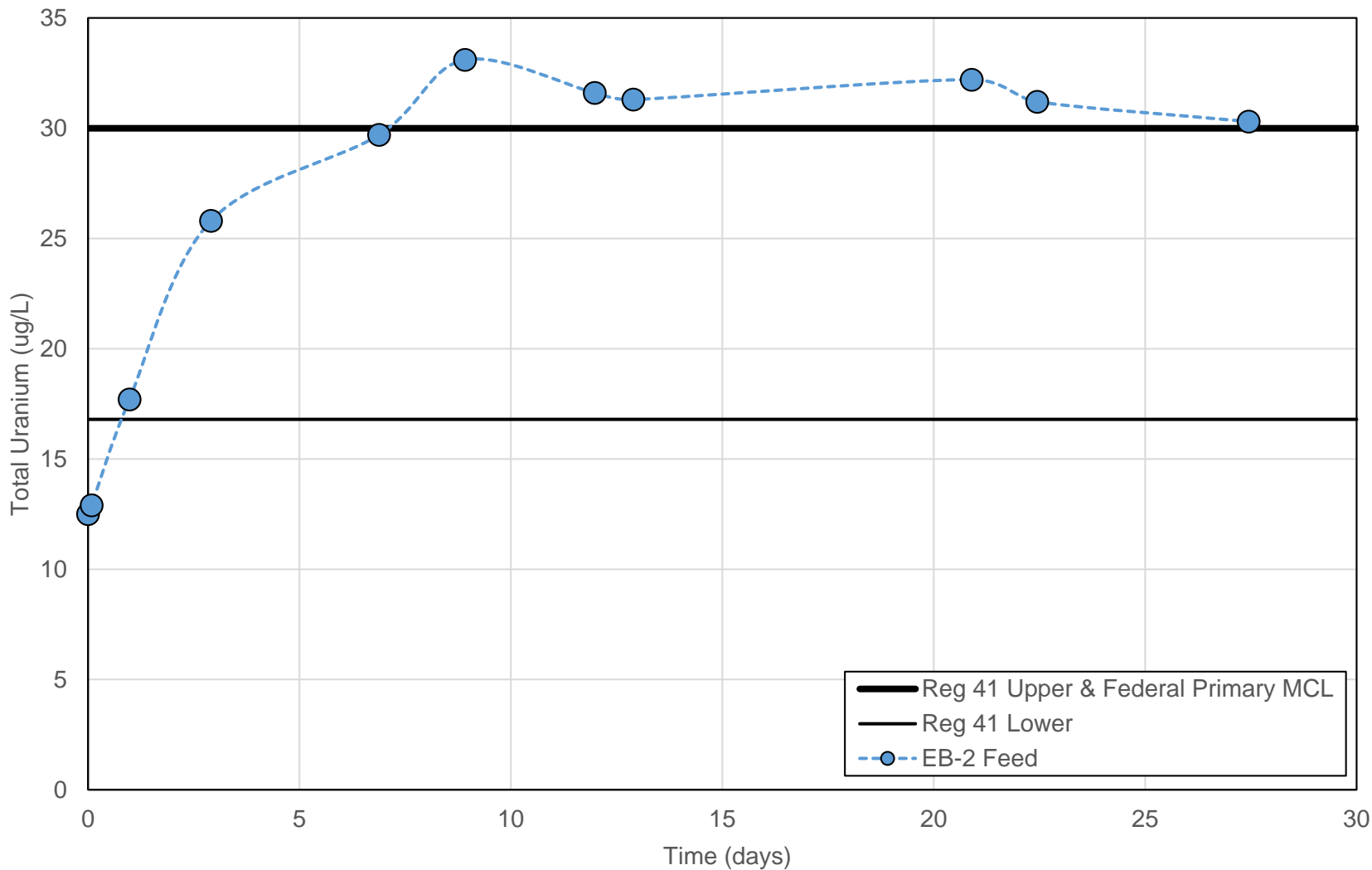




**Figure 3**  
**Concentrations of Constituents of Concern Relative to Time Since Start of Pumping During Pump Tests**

Note: All 72-hr samples were collected by Wingfoot in 2019,  
 All other samples were collected by LRE in 2020

Author: AWF  
Date: Dec. 2020



Author: JDB & AWF  
Date: Dec. 2020

**Figure 4**  
EB-2 Pilot Treatment Test  
Water Quality Sampling Results



## Tables

**Table 1. Field Water Quality Parameter Data**

Well/Sample ID	Date	Time	Temp (C)	DO (%)	DO (mg/L)	SPC (uS/cm)	pH	ORP (mV)†	Turbidity (NTU)†
EB2-COMP	8/31/2020	17:20	16.2	85.6	8.7	338.3	7.1	--	--
EB2-DS-385ft	8/29/2020	15:40	21.2	39.3	3.5	325.9	7.3	--	--
EB2-DS-520ft	8/29/2020	16:45	20.6	43.6	3.9	398.2	7.2	--	--
EB2-DS-570ft	8/31/2020	14:15	21.3	77.8	7.4	411.3	7.2	--	--
EB2-DS-740ft	8/31/2020	15:25	21.1	78.2	6.3	634.5	7.3	--	--
EB2-Packer-1.5hr	9/10/2020	18:30	15.3	15.7	1.6	398.9	7.6	87.5	4.7
EB2-Packer-116hr	9/15/2020	13:00	17.9	17.7	1.7	423.2	7.6	105	22.2**
EB2-Packer-40.5hr	9/12/2020	9:35	17.2	27.3	2.6	432.2	7.6	111.7	20.3**
WWR1-COMP48	9/30/2020	10:30	13.6	125.5*	13	389	7.8	148.7	7.5*
WWR2-COMP24	8/4/2020	11:30	18.3	36.3	3.4	354.5	7.3	--	--
WWR2-COMP48	8/5/2020	9:00	17.4	28.5	2.7	496.3	7.1	81.8	5.3
WWR3-COMP24	8/18/2020	11:15	17.7	75.6	7.1	352.4	7.2	--	--
WWR3-COMP48	8/19/2020	9:00	15.5	99.1*	9.8	395.5	7.4	130.1	9.9*
WWR4-COMP48	7/22/2020	12:25	12.6	11.2	1.2	434.8	7.3	28	1.9
WWR4-COMP24	7/21/2020	12:25							
WWR5-COMP24	7/28/2020	11:25	14.8	27.5	2.8	331.2	7.5	--	--
WWR5-COMP48	7/29/2020	10:15	13.6	12.1	1.3	421.5	7.5	N/A	1.9
†ORP and Turbidity field data were collected at select sites only									
*Air in line causing DO to be high and turbidity spikes									
**Turbidity measurement would not stabilize									

**Table 2. Well Name and Site ID of Samples Collected and Analyzed  
Outside of Hold Times**

<b>Date</b>	<b>Well/Sample Location</b>	<b>Site ID</b>
8/29/2020	EB-2	EB2-ERB
8/29/2020	EB-2	EB2-DS1-385
8/29/2020	EB-2	EB2-DS-520
8/29/2020	EB-2	EB2-DS-520-99
9/10/2020	EB-2	EB2-PACKER 1.5hr
9/25/2020	WWR-1	WWR1-DS2-415
9/25/2020	WWR-1	WWR1-DS3-495
9/26/2020	WWR-1	WWR1-DS4-995
9/26/2020	WWR-1	WWR1-DS5-730
9/26/2020	WWR-1	WWR1-DS6-550
9/26/2020	WWR-1	WWR1-Comp-DS
9/30/2020	Bellvue	Dugens

**Table 3. Gross Alpha and Beta Results**

Date/Time	Well	Sample ID	Depth (ft)	Parameter	Result	Unit	Method	Colorado Regulation 41 Standard
8/21/2020	EB-1	EB1-COMP	--	Alpha, Gross	17.2	pCi/L	E900.0	15
8/21/2020	EB-1	EB1-COMP	--	Beta, Gross	21.4	pCi/L	E900.0	--
8/31/2020	EB-2	EB2-COMP	--	Alpha, Gross	13.7	pCi/L	E900.0	15
9/15/2020	EB-2	EB2-PACKER-116hr	752	Alpha, Gross	15.7	pCi/L	E900.0	15
8/31/2020	EB-2	EB2-COMP	--	Beta, Gross	14.7	pCi/L	E900.0	--
9/15/2020	EB-2	EB2-PACKER-116hr	752	Beta, Gross	10.5	pCi/L	E900.0	--
9/29/2020	WWR-1	WWR1-COMP24	--	Alpha, Gross	27	pCi/L	E900.0	15
9/30/2020	WWR-1	WWR1-COMP48	--	Alpha, Gross	31	pCi/L	E900.0	15
10/1/2020	WWR-1	WWR1-COMP-69Hr	--	Alpha, Gross	31.9	pCi/L	E900.0	15
10/2/2020	WWR-1	WWR1-COMP-93.5Hr	--	Alpha, Gross	24.6	pCi/L	E900.0	15
9/29/2020	WWR-1	WWR1-COMP24	--	Beta, Gross	28.4	pCi/L	E900.0	--
9/30/2020	WWR-1	WWR1-Comp48	--	Beta, Gross	15.6	pCi/L	E900.0	--
10/1/2020	WWR-1	WWR1-COMP-69Hr	--	Beta, Gross	25.8	pCi/L	E900.0	--
10/2/2020	WWR-1	WWR1-COMP-93.5Hr	--	Beta, Gross	22.9	pCi/L	E900.0	--
8/4/2020	WWR-2	WWR2-COMP24	--	Alpha, Gross	21.5	pCi/L	E900.0	15
8/5/2020	WWR-2	WWR2-COMP48	--	Alpha, Gross	16.9	pCi/L	E900.0	15
8/4/2020	WWR-2	WWR2-COMP24	--	Beta, Gross	19	pCi/L	E900.0	--
8/5/2020	WWR-2	WWR2-COMP48	--	Beta, Gross	5.5	pCi/L	E900.0	--
8/18/2020	WWR-3	WWR3-COMP24	--	Alpha, Gross	23.5	pCi/L	E900.0	15
8/19/2020	WWR-3	WWR3-COMP48	--	Alpha, Gross	23.4	pCi/L	E900.0	15

Date/Time	Well	Sample ID	Depth (ft)	Parameter	Result	Unit	Method	Colorado Regulation 41 Standard
8/18/2020	WWR-3	WWR3-Comp24	--	Beta, Gross	21.8	pCi/L	E900.0	--
8/19/2020	WWR-3	WWR3-COMP48	--	Beta, Gross	13.8	pCi/L	E900.0	--
7/21/2020	WWR-4	WWR4-COMP24	--	Alpha, Gross	12.1	pCi/L	E900.0	15
7/22/2020	WWR-4	WWR4-COMP48	--	Alpha, Gross	19.4	pCi/L	E900.0	15
7/21/2020	WWR-4	WWR4-COMP24	--	Beta, Gross	16.9	pCi/L	E900.0	--
7/22/2020	WWR-4	WWR4-COMP48	--	Beta, Gross	12.3	pCi/L	E900.0	--
7/28/2020	WWR-5	WWR5-COMP24	--	Alpha, Gross	12.4	pCi/L	E900.0	15
7/29/2020	WWR-5	WWR5-COMP48	--	Alpha, Gross	6.4	pCi/L	E900.0	15
7/28/2020	WWR-5	WWR5-COMP24	--	Beta, Gross	7.9	pCi/L	E900.0	--
7/29/2020	WWR-5	WWR5-COMP48	--	Beta, Gross	14.2	pCi/L	E900.0	--



**Table 4. Water Quality Exceedances in the Upper Laramie Aquifer based on the Colorado Regulation 41 Water Quality Standards**

Date/Time	Well	Sample ID	Depth-Specific Sampling Depth (ft)	Parameter	Result	Unit	Colorado Regulation 41 Standard
8/21/2020	EB-1	EB1-COMP	--	Alpha, Gross	17.2	pCi/L	15
9/15/2020	EB-2	EB2-Packer 116 hr	752	Alpha, Gross	15.7	pCi/L	15
8/29/2020	EB-2	EB2-DS1-385ft	385	Manganese, Dissolved	50.9	ug/L	50
8/31/2020	EB-2	EB2-DS4-740	740	Manganese, Dissolved	71.8	ug/L	50
9/10/2020	EB-2	EB2-Packer 1.5 hr	752	Manganese, Dissolved	72.7	ug/L	50
5/23/2019	WWR-1	Well WWR-1	--	Alpha, Gross	27	pCi/L	15
9/29/2020	WWR-1	WWR1-COMP24	--	Alpha, Gross	27	pCi/L	15
9/30/2020	WWR-1	WWR1-COMP48	--	Alpha, Gross	31	pCi/L	15
10/1/2020	WWR-1	WWR1-COMP-69Hr	--	Alpha, Gross	31.9	pCi/L	15
10/2/2020	WWR-1	WWR1-COMP-93.5Hr	--	Alpha, Gross	24.6	pCi/L	15
8/4/2020	WWR-2	WWR2-COMP24	--	Alpha, Gross	21.5	pCi/L	15
8/5/2020	WWR-2	WWR2-COMP48	--	Alpha, Gross	16.9	pCi/L	15
8/18/2020	WWR-3	WWR3-COMP24	--	Alpha, Gross	23.5	pCi/L	15
8/19/2020	WWR-3	WWR3-COMP48	--	Alpha, Gross	23.4	pCi/L	15
7/22/2020	WWR-4	WWR4-COMP48	--	Alpha, Gross	19.4	pCi/L	15

**Table 5. Dissolved and Total Uranium Concentrations above Reg 41 Health-Based Standard in the Upper Laramie Aquifer at Terry Ranch**

Date/Time	Well	Sample ID	Depth (ft.)***	Parameter	Result	Unit	Regulation 41 Standard* Range 16.8-30 ug/L	Exceedance**
8/21/2020	EB-1	EB1-DS1-340	340	Uranium, Total	21.2	ug/L	16.8	Yes
8/21/2020	EB-1	EB1-DS2-300	300	Uranium, Total	22.2	ug/L	16.8	Yes
8/21/2020	EB-1	EB1-COMP	--	Uranium, Total	25.8	ug/L	16.8	Yes
8/29/2020	EB-2	EB2-DS1-385ft	385	Uranium, Total	19.9	ug/L	16.8	Yes
8/29/2020	EB-2	EB2-DS2-520ft	520	Uranium, Total	21.9	ug/L	16.8	Yes
8/31/2020	EB-2	EB2-DS3-570	570	Uranium, Total	25.2	ug/L	16.8	Yes
8/31/2020	EB-2	EB2-DS4-740	740	Uranium, Total	18	ug/L	16.8	Yes
8/31/2020	EB-2	EB2-COMP	--	Uranium, Total	20.7	ug/L	16.8	Yes
9/10/2020	EB-2	EB2-PACKER 1.5 hr	752	Uranium, Total	12.2	ug/L	16.8	Yes
9/12/2020	EB-2	EB2-PACKER 40.5 hr	752	Uranium, Total	16.8	ug/L	16.8	Yes
5/23/2019	WWR-1	Well WWR-1	--	Uranium, Dissolved	43	ug/L	16.8	Yes
5/23/2019	WWR-1	Well WWR-1	--	Uranium, Total	43	ug/L	16.8	Yes
9/25/2020	WWR-1	WWR1-DS1-300	300	Uranium, Total	41.5	ug/L	16.8	Yes
9/25/2020	WWR-1	WWR1-DS2-415	415	Uranium, Total	39	ug/L	16.8	Yes
9/25/2020	WWR-1	WWR1-DS3-495	495	Uranium, Total	43	ug/L	16.8	Yes

Date/Time	Well	Sample ID	Depth (ft.) <sup>***</sup>	Parameter	Result	Unit	Regulation 41 Standard* Range 16.8-30 ug/L	Exceedance**
9/26/2020	WWR-1	WWR1-DS4-995	995	Uranium, Total	42.1	ug/L	16.8	Yes
9/26/2020	WWR-1	WWR1-DS5-730	730	Uranium, Total	42.9	ug/L	16.8	Yes
9/26/2020	WWR-1	WWR1-DS6-550	550	Uranium, Total	42.6	ug/L	16.8	Yes
9/26/2020	WWR-1	WWR1-Comp-DS	--	Uranium, Total	41.5	ug/L	16.8	Yes
9/28/2020	WWR-1	WWR1-Comp-0.75hr	--	Uranium, Total	41.8	ug/L	16.8	Yes
9/29/2020	WWR-1	WWR1-COMP24	--	Uranium, Total	41.2	ug/L	16.8	Yes
9/30/2020	WWR-1	WWR1-COMP48	--	Uranium, Total	40.6	ug/L	16.8	Yes
10/1/2020	WWR-1	WWR1-COMP-69Hr	--	Uranium, Total	39.5	ug/L	16.8	Yes
10/2/2020	WWR-1	WWR1-COMP-93.5Hr	--	Uranium, Total	40.2	ug/L	16.8	Yes
8/5/2020	WWR-2	WWR2-COMP48	--	Uranium, Dissolved	22.7	ug/L	16.8	Yes
8/4/2020	WWR-2	WWR2-COMP24	--	Uranium, Total	25.5	ug/L	16.8	Yes
8/5/2020	WWR-2	WWR2-COMP48	--	Uranium, Total	19.9	ug/L	16.8	Yes
8/18/2020	WWR-3	WWR3-COMP24	--	Uranium, Total	26.7	ug/L	16.8	Yes
8/19/2020	WWR-3	WWR3-COMP48	--	Uranium, Total	28.3	ug/L	16.8	Yes

Date/Time	Well	Sample ID	Depth (ft.) <sup>***</sup>	Parameter	Result	Unit	Regulation 41 Standard* Range 16.8-30 ug/L	Exceedance**
3/28/2019	WWR-4	Well WWR-4	--	Uranium, Dissolved	19	ug/L	16.8	Yes
3/28/2019	WWR-4	Well WWR-4	--	Uranium, Total	19	ug/L	16.8	Yes
7/21/2020	WWR-4	WWR4-COMP24	--	Uranium, Total	21.1	ug/L	16.8	Yes
7/22/2020	WWR-4	WWR4-COMP48	--	Uranium, Total	19.8	ug/L	16.8	Yes
8/7/2020	WWR-4	WWR4-DS1	180	Uranium, Total	21	ug/L	16.8	Yes
8/7/2020	WWR-4	WWR4-DS2	310	Uranium, Total	20.6	ug/L	16.8	Yes
8/7/2020	WWR-4	WWR4-DS3	480	Uranium, Total	15.8	ug/L	16.8	Yes

\* Range is only applicable to dissolved concentration.  
 \*\*Total uranium sample results are compared to Reg. 41 standards for dissolved uranium. Per Reg. 41, the federal maximum contaminant level (MCL) for dissolved uranium in drinking water is 30 ug/L, however, because the source water is not yet treated it will be compared to the stringent value of Reg. 41 that being 16.8 ug/L. It is assumed that the sample results for total uranium are representative of the highest uranium concentrations to be found at the Terry Ranch.  
 \*\*\*Values provided only for depth-specific samples. Composite samples depth is indicated as "-- "



## Appendices

Appendix A: Matrix of Samples Collected – Modified from Brown and Caldwell's Groundwater Sampling and Analysis Plan. Terry Ranch Groundwater Sampling and Analysis Plan Anticipated Sampling Plan.

