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Moab UMTRA Project
Groundwater and Surface Water Monitoring Report
January through June 2022

Revision 0

November 2022

U.S. Department of Energy

Office of Environmental Management

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Revision History

Revision	Date	Reason for Revision
0	November 2022	Initial issue.

Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

bgs	below ground surface
CCB	continuing calibration blanks
CCV	continuing calibration verification
CF	configuration
cfs	cubic feet per second
CFR	Code of Federal Regulations
COC	chain-of-custody
DOE	U.S. Department of Energy
EB	equipment blank
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ft	feet or foot
ICB	initial calibration blank
ICV	initial calibration verification
IDL	instrument detection limit
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MESa	Moab Environmental Sampling Database
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
PCOCs	potential contaminants of concern
QA	quality assurance
RIN	report identification number
RL	reporting limit
RPD	relative percent difference
SD	serial dilution
SDG	sample data group
TDS	total dissolved solids
UMTRA	Uranium Mill Tailings Remedial Action
yr	year

1.0 Introduction

1.1 Purpose

The purpose of this semi-annual report is to present results and provide interpretation of data associated with groundwater and surface water samples collected from the U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site during the first half of calendar year 2022.

This report includes data from the Site-Wide Sampling Event. This event included the collection of samples in February/March 2022 from on and off-site monitoring wells and surface water locations. These locations are shown on Figures 1 and 2.

1.2 Scope

This report presents a summary of the sampling event and data assessment, including a summary of the anomalous data generated by the validation process and results for this event. Sampling and analyses were conducted in accordance with the *Moab UMTRA Project Surface Water/Groundwater Sampling and Analysis Plan* (DOE-EM/GJTAC1830). All data validation follows criteria in the *Moab UMTRA Project Standard Practice for Validation of Laboratory Data* (DOE-EM/GJTAC1855).

Appendix A includes the Water Sampling Field Activities Verification and the Trip Report associated with the Site Wide Sampling Event.

The Minimums and Maximums analyses were generated by the Moab Environmental Sampling (MESa) database to determine if the applicable data were within a normal statistical range. The new data set was compared to the historical data to determine if the new data fall outside the historical range. The results are not considered anomalous if: (1) identified low concentrations are the result of low detection limits, (2) the concentration detected is less or more than 50 percent of historical minimum or maximum values, or (3) there were fewer than five historical samples for comparison. Anomalous results are provided in tables in the "Data Assessment" section.

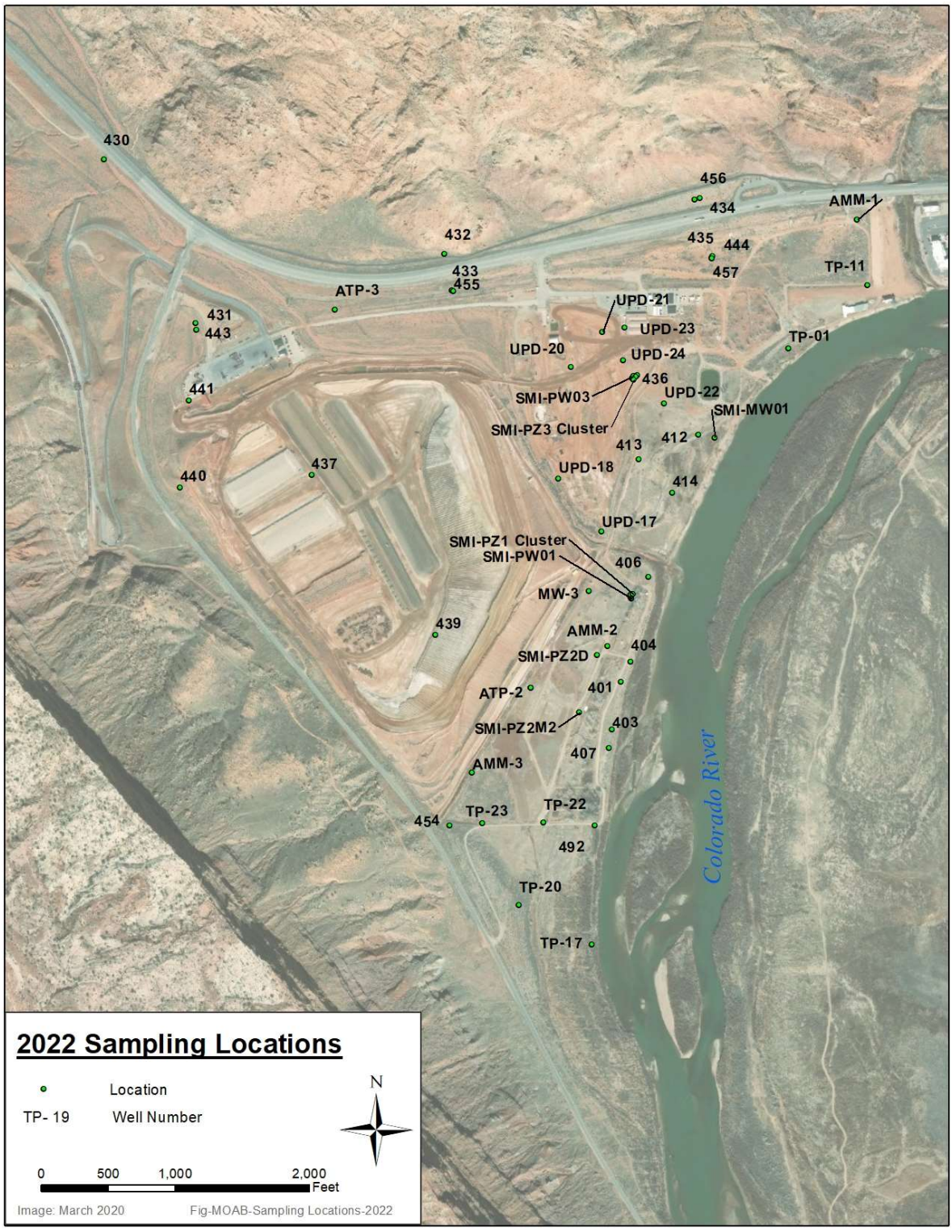

Figure 1. February/March 2022 Site-wide Groundwater Sampling Locations

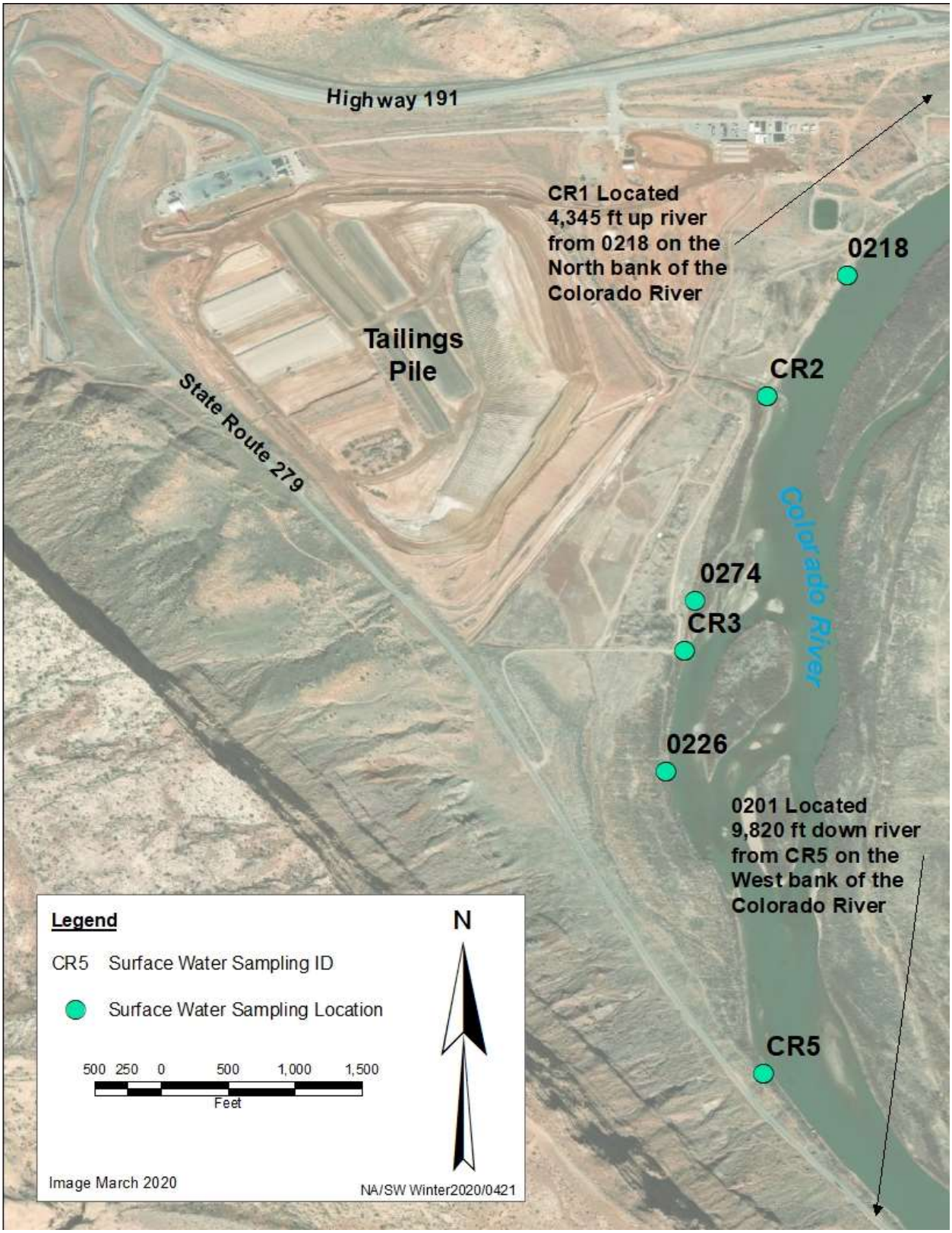

Figure 2. February/March 2022 Surface Water Sampling Locations

1.3 Data Validation Definitions

The following definitions are associated with the data validation process. Details are provided in the following sections of this report.

Method and Calibration Blanks
Method blanks (MBs) are analyzed to assess any contamination that may have occurred during sample preparation. Both initial calibration blanks and continuing calibration blanks are analyzed to assess instrument contamination before and during sample analysis. Depending on method requirements, detected sample results greater than the method detection limit (MDL) or instrument detection limit (IDL) are qualified "J" when the detections are less than five times the blank concentration. Non-detects are not qualified.

Matrix Spike and Replicate Analysis
Matrix Spike (MS) sample analysis, performed at a frequency of one per 20 samples unless otherwise noted, is a measure of the ability to recover analytes in a particular matrix. The MS sample results are required to be within specified recovery limits.

Laboratory Replicate Analysis
The laboratory replicated results demonstrate acceptable laboratory precision. The relative percent difference (RPD) values for the reported matrix spike duplicate (MSD) results for all other analytes should be less than 20 percent for results greater than five times the reporting limit (RL).

Field Duplicate Analysis
Field duplicate samples are collected and analyzed as an indication of the overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory replicates, which measure only laboratory performance. The duplicate results must meet the U.S. Environmental Protection Agency (EPA)-recommended laboratory duplicate criteria of less than 20 RPD for results that are greater than five times the reporting limit (RL).

2.0 February/March 2022 Site-wide Sampling Event

2.1 Summary

Sixty-seven groundwater and surface water samples (including quality assurance (QA) samples) were collected as part of the site-wide event. This event was conducted when the Colorado River was at base flow conditions. All samples were submitted to ALS Global Laboratory for ammonia, uranium, total dissolved solids, arsenic, selenium, copper, and manganese.

2.2 February/March 2022 Site-wide Sampling Event Data Assessment

2.2.1 Laboratory Performance Assessment

This validation was performed according to *Standard Practice for Validation of Laboratory Data.* The procedure was applied at Level 3, Data Deliverables Examination. All analyses were successfully completed.

General Information and Validation Results

RIN 2202134
Laboratory: ALS Analytics, Fort Collins, Colorado
SDG Numbers: 2202217, 2202321, 2202442, 2203045, 2203164
Analysis: Metals and Inorganics
Validator: Liz Moran, Thomas Prichard, James Ritchey
Review Date: October 2022

The samples were prepared and analyzed using accepted procedures as shown in Table 1. Analytical results were qualified as listed in Table 2. Refer to Table 3 for an explanation of the data qualifiers applied.

Table 1. February/March 2022 Site-wide Sampling Event, Analytes and Methods

Analyte	Preparation Method	Analytical Method
Ammonia as N, NH3-N	EPA 350.1	EPA 350.1
Uranium	SW-846 3005A	SW-846 6020A
Arsenic	SW-846 3005A	ICP-MS 6020B
Copper	SW-846 3005A	SW-846 6020B
Manganese	SW-846 3005A	SW-846 6020B
Selenium	SW-846 3005A	ICP-MS 6020B
Sulfate	EPA 300.0	EPA 300.0
Total Dissolved Solids	EPA 160.1	EPA 160.1

Table 2. February/March 2022 Site-wide Sampling Event, Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
2202217 -1 through 16 2202321 -1 through 16 2202442 -1 through 13 2203045 -1 through 11 2203164 -1 through 13	All in each inorganics SDG	Ammonia, Sulfate	J	MSD-1
2202217 -1 through 16 2202321 -1 through 16 2202442 -1 through 13 2203045 -1 through 11 2203164 -1 through 13	All in each metals SDG	Uranium, Manganese, Arsenic, Copper, Selenium	J	SD-1

Notes: "J" indicates results are estimated and becomes "UJ" for analytical results lower than the detection limit.
SDG: Sample Data Group

Table 3. February/March 2022 Site-wide Sampling Event, Reason Codes for Data Flags

Reason Code	Qualifier (Detects)	Qualifier (Non-detects)	Explanation
MSD-1	J	U	No MSD data was included in the narrative.
SD-1	J	U	The metals analysis did not contain a serial dilution.

Notes: "J" indicates results are estimated, U indicates the result is below the detection limit.

Sample Shipping/Receiving
ALS Analytics in Fort Collins, Colorado, received a total of 67 samples for Report Identification Number (RIN) 2202134 in five shipments.

The five sample data groups (SDGs) were accompanied by a Chain of Custody (COC) form that was checked to confirm that all the samples were listed on the form with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. It was noted that five sample bottles labels did not match the COC labels for SDG 2203164. ALS Analytics confirmed correct label information before analysis was performed.

Preservation and Holding Times
All the SDGs were received intact with compliant temperatures. All samples were received in the correct container types and were analyzed within the applicable holding times.

Case Narratives
The case narratives for each SDG were reviewed, and the following sections summarize the results.

Laboratory Instrument Calibration

Method SW-846 6020A, Uranium
The initial calibrations were performed using four calibration standards and one blank, resulting in calibration curves with correlation coefficient (r^2) values greater than 0.995. The values of the calibration curve intercepts for uranium were positive and less than 3 times the IDL.

Initial calibration verification (ICV) and continuing calibration verification (CCV) checks were made at the required frequency. All calibration checks met the acceptance criteria.

Internal standard recoveries were stable and within acceptable ranges.

Method ICP-MS 6020B, Arsenic, Copper, Manganese, and Selenium
The initial calibrations were all performed using four or more calibration standards and one blank, resulting in calibration curves with correlation coefficient (r^2) values greater than 0.995.

Initial calibration verification (ICV) and continuing calibration verification (CCV) checks were made at the required frequency. All calibration checks met the acceptance criteria.

Internal standard recoveries were stable and within acceptable ranges.

EPA 350.1, Ammonia as N
Initial calibrations for ammonia as N were performed using five calibration standards and one

blank. The calibration curve had a correlation coefficient (r^2) value greater than 0.995.

ICV and CCV checks were made at the required frequency. All calibration check results for the SDGs were within the acceptance criteria.

EPA 300.0, Sulfate

Initial calibrations for the sulfate SDGs were performed using five to eight calibration standards and one to six blanks.

ICV and CCV checks were made at the required frequency. Calibration check results for all SDGs were within the acceptance criteria.

Method and Calibration Blanks

Method blanks (MBs) are analyzed to assess any contamination that may have occurred during sample preparation. Both initial calibration blanks (ICB) and continuing calibration blanks (CCBs) are analyzed to assess instrument contamination prior to and during sample analysis.

Several uranium and manganese calibration blanks on SDG 2202217 had a concentration slightly above the detection limit, however, all the associated sample results were greater than 3x the IDL, so no data was flagged. All other initial calibration ICBs and CCBs were checked for each requested analyte and were found to be at or below the detection limit, and so additional data was flagged.

Equipment Blanks

An equipment blank (EB) is a sample of analyte-free media collected from a rinse of non-dedicated sampling equipment used to sample surface water. EBs are collected to document adequate decontamination of non-dedicated equipment. One EB should be prepared with each preparation batch.

One equipment blank (location 2004) was collected after the surface water tubing was decontaminated. All blank results were either at the method detection limit or significantly lower than any analytical results of the surface water samples. No issues were noted.

Matrix Spike Analysis

No issues were noted with the matrix spike for ammonia and sulfate.

Laboratory Replicate Analysis

The laboratory replicate results demonstrate acceptable laboratory precision. The relative percent difference (RPD) values for the reported matrix spike duplicate (MSD) results for all other analytes should be less than 20 percent for results greater than 5 times the reporting limit (RL).

For ammonia and sulfate, there were no matrix spike duplicates for any of the SDGs, so all samples were flagged for MSD-1; lack of matrix spike duplicates.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory replicates, which measure only laboratory performance. Duplicate samples were collected from locations AMM-2, SMI-PZ3M, UPD-24, and 0401. The total dissolved solids (TDS) duplicate for sample AMM-2 had a difference of 59%, while all the other analyte duplicates for AMM-2 met the criteria. The copper duplicate for well SMI-PZ3M

had a difference of 33%, but all other analyses were within range. All other quality criteria were met, so no data was flagged.

The duplicate results met the U.S. Environmental Protection Agency (EPA) recommended laboratory duplicate criteria of less than 20 relative percent relative (RPD) for results that are greater than 5 times the RL. The two duplicates that did not pass the criteria are considered anomalous data. Since all other criteria was met, no samples were flagged.

Laboratory Control Samples
Laboratory control samples (LCS) provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. LCS results were acceptable for inorganic and metal analyses.

Metals Serial Dilution
Since no serial dilution (SD) samples were run on the uranium, copper, manganese, arsenic, or selenium samples in any of the SDGs, all the metals samples were flagged "J" for reason SD-1.

Detection Limits/Dilutions
Dilutions were prepared in a consistent and acceptable manner when they were required. The required detection limits were achieved for all analytes.

Completeness
Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable Files
The Electronic Data Deliverable (EDD) files arrived in March and April 2022. The contents of the EDD were manually examined to ensure all and only the requested data were delivered in compliance with requirements and that the sample results accurately reflected the data contained in the sample data package.

2.2.2 Minimums and Maximums Report and Anomalous Data Review

Based on the definition of an anomalous data point, there were 62 anomalous data points associated with this event (Table 4).

The disposition column in Table 4 summarizes the results for each of the analytes. This sampling event included analytes that have not been sampled routinely since 2002 (copper, arsenic, manganese, selenium), 2009 (sulfate) and 2011 (TDS).

Table 4. Anomalous Data Associated with the February/March Site-wide Sampling Event

Location	Sample Date	Concentration (mg/L)	Historical Min (mg/L)	Historical Max (mg/L)	Disposition
Ammonia Total as N					
0439	03/01/22	0.2	2.158	5310	These ammonia concentrations all represent a historical low. Monitoring will continue to determine if this is a new trend.
SMI-PZ1M	02/14/22	460	640	1590	
SMI-PZ1S	02/14/22	7.6	32	565	
SMI-PZ3M	02/22/22	18	19	97	
UPD-21	03/02/22	0.2	1.4	74	

Table 4. Anomalous Data Associated with the February/March Site-wide Sampling Event (continued)

Location	Sample Date	Concentration (mg/L)	Historical Min (mg/L)	Historical Max (mg/L)	Disposition
Arsenic					
0437	03/01/22	0.0029	0.0001	0.00085	The arsenic concentration is higher at location 0437 and lower at UPD-24. Location UPD-24 typically contains the highest arsenic on-site, so having a historical low value is an improvement. The concentration in well 0437 is not indicative of a major change since it is still below the arsenic standard of 0.05 mg/L.
UPD-24	03/02/22	0.19	0.21	0.26	
Copper					
0401	03/08/22	0.0022	0.0034	0.014	These copper concentrations represent a historical low. Monitoring will continue to determine if this is a new trend.
ATP-2-D	02/09/22	0.00071	0.002	0.51	
SMI-PW01	02/14/22	0.0024	0.0035	0.015	
SMI-PZ1M	02/14/22	0.0031	0.0073	0.035	
TP-17	03/08/22	0.00097	0.0068	0.06	
Manganese					
0404	02/24/22	0.026	0.045	5.5	Most of these manganese results represent historically low concentrations. These locations will be sampled again in spring 2023 and the results will be used to determine if the data in this table is indicative of a trend.
0412	02/08/22	0.00035	0.0028	0.0676	
0413	02/14/22	0.037	0.062	0.437	
0430	02/15/22	0.0018	0.0032	1.04	
0434	02/15/22	0.44	0.48	2.89	
0435	02/15/22	0.54	1.1	1.59	
0436	02/22/22	4.6	3.73	3.9	
0437	03/01/22	0.22	0.24	5.14	
0443	02/28/22	0.00031	0.001	0.209	
0444	02/15/22	2.4	1.7	2.12	
0457	02/15/22	0.64	0.48	0.59	
ATP-2-S	02/09/22	0.027	0.04	6.62	
SMI-PZ3D2	02/22/22	0.18	0.72	5.43	
Selenium					
0403	02/28/22	0.027	0.00015	0.02	Most of the sample results are close to the previous historic maximum and minimum. Monitoring wells 0406 and SMI-PW01 had an increase in selenium.
0406	02/24/22	0.2	0.0098	0.011	
0444	02/15/22	0.00088	0.0001	0.00011	
0456	02/15/22	0.016	0.023	0.0292	
SMI-PW01	02/14/22	0.12	0.017	0.024	
SMI-PZ1M	02/14/22	0.0055	0.008	0.016	
TP-01	02/08/22	0.0015	0.0017	0.0132	

Table 4. Anomalous Data Associated with the February/March Site-wide Sampling Event (continued)

Location	Sample Date	Concentration (mg/L)	Historical Min (mg/L)	Historical Max (mg/L)	Disposition
Sulfate					
0414	02/08/22	5,500	925	2,000	Most of these sample results represent historical maximum sulfate concentrations. These locations will be sampled again in spring 2023 and the results will be used to determine if the data in this table is indicative of a trend.
0440	03/01/22	2,700	2,100	2,500	
0443	02/28/22	500	173	490	
0455	02/28/22	370	320	350	
MW-3	02/14/22	21,000	66	20,400	
SMI-PW03	02/22/22	990	1,600	2,712	
SMI-PZ1S	02/14/22	400	1,200	9,500	
TP-17	03/08/22	6,700	50	6,000	
Total Dissolved Solids					
0406	02/24/22	3,700	6,200	12,000	Most of these sample results represent historical low total dissolved solids. These locations will be sampled again in spring 2023 and the results will be used to determine if the data in this table is indicative of a trend.
0413	02/14/22	4,400	1,900	2,500	
0414	02/08/22	7,600	2,860	3,600	
0432	02/15/22	7,500	1,780	1,850	
0433	02/28/22	2,400	2,550	2,900	
0434	02/15/22	19,000	27,600	31,000	
0435	02/15/22	58,000	75,100	97,000	
0437	03/01/22	7,000	7,330	66,400	
0440	03/01/22	4,200	6,200	6,707	
0456	02/15/22	3,500	5,100	5,600	
0457	02/15/22	4,800	2,900	3,300	
SMI-PZ1S	02/14/22	1,200	3,200	20,000	
SMI-PZ2D	02/10/22	45,000	85,000	90,000	
SMI-PZ2M2	02/10/22	43,000	51,000	80,000	
SMI-PZ3D2	02/22/22	12,000	15,000	21,000	
SMI-PZ3M	02/22/22	3,800	5,260	9,400	
SMI-PZ3S	02/22/22	2,600	2,900	3,720	
TP-01	02/08/22	3,100	4,600	14,800	
TP-11	02/08/22	8,900	13,000	18,000	
Uranium					
SMI-PZ1S	02/14/22	0.12	0.55	4.5	These sample results represent historical low uranium concentrations. These locations will be sampled again in spring 2023 and the results will be used to determine if the data in this table is indicative of a trend.
SMI-PZ3D2	02/22/22	0.69	0.71	7	
SMI-PZ3M	02/22/22	0.27	0.3	1.9	

2.3 Contaminant Distribution

Figures 3 through 7 are maps showing groundwater plumes of ammonia and uranium by well depth. Figures 8 through 10 show shallow groundwater plumes of manganese, selenium, and sulfate plumes. These figures were created using data collected during the February/March 2022 site-wide event. These maps show an approximation of contamination plumes at river base flow. Figures were generated using ArcMap Inverse Distance Weighting (IDW) interpolation with bounding conditions to mimic groundwater flow.

Ammonia
Samples have been analyzed for ammonia consistently since initial characterization of the site because it is one of the two primary (the other being uranium) site contaminants. There are no regulatory groundwater ammonia standards; however, provided in the *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impacts Statement* (EIS) is a proposed standard of 3 milligrams per liter (mg/L) for the site based on dilution factors and surface water impacts. Except for upgradient and other locations beyond the extent of the ammonia plume, groundwater samples collected across most of the site exceed this 3 mg/L ammonia concentration.

The plume maps show in Figures 3 and 4, ammonia concentrations are elevated along the southeast base of the tailings pile. The highest concentrations were detected at sample depths of 50 to 100 feet (ft) below ground surface (bgs). No ammonia concentrations greater than 3 mg/L were detected at depths 100 to 200 ft bgs.

Uranium
All samples collected during this event were analyzed for uranium. Table 5 presents all locations sampled that exceeded the 0.044 mg/L uranium groundwater standard. This standard is based on Table 1 in *Title 40 Code of Federal Regulations Part 192 (40 CFR 192) "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Subpart A, Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites*," assuming uranium-234 and uranium-238 activities are in equilibrium.

Table 5. February/March 2022 Sampling Events, Groundwater Locations Exceeding the 0.044 mg/L UMTRA Uranium Groundwater Standard

Well Number	Date	Location	Sample Depth (ft bgs)	Uranium Concentration (mg/L)
0401	03/08/22	CF2	18	1.8
0403	02/28/22	CF1	18	0.96
0404	02/24/22	CF3	18	1.8
0406	02/24/22	CF1	18	0.67
0407	02/24/22	CF1	18	1.8
0412	02/08/22	NE Uranium Plume Area	9.5	3
0413	02/14/22	NE Uranium Plume Area	10	1.9
0414	02/08/22	NE Uranium Plume Area	7.5	2.8
0437	03/01/22	On Tailings Pile	NA	2.3
0439	03/01/22	On Tailings Pile	NA	1.5
0441	02/23/22	Along SW Site Boundary	53	0.053
0454	02/14/22	Along SW Site Boundary	13	1.1
0492	03/07/22	Along S Site Boundary	18	1.9
AMM-2	02/10/22	Near CF3	48	2
AMM-3	02/10/22	Near Base of the Pile	48	2
MW-3	02/14/22	Near CF5	44	2.7
SMI-MW01	02/08/22	NE Uranium Plume Area	16	2.4
SMI-PW01	02/14/22	CF5 Vicinity	40	1.5
SMI-PW03	02/22/22	NE Uranium Plume Area	60	0.34
SMI-PZ1M	02/14/22	CF5 Vicinity	57	2.6
SMI-PZ1S	02/14/22	CF5 Vicinity	18	0.12
SMI-PZ1D	02/14/22	CF5 Vicinity	73	1.4
SMI-PZ2D	02/10/22	CF5 Vicinity	75	0.67
SMI-PZ3D2	02/22/22	NE Uranium Plume Area	78	0.69
SMI-PZ2M2	02/10/22	CF5 Vicinity	56	2.6
SMI-PZ3M	02/22/22	NE Uranium Plume Area	59	0.28
SMI-PZ3S	02/22/22	NE Uranium Plume Area	25	0.78
TP-01	02/08/22	NE Uranium Plume Area	22	0.041
TP-22	02/09/22	NE Uranium Plume Area	17	0.26
TP-23	02/09/22	NE Uranium Plume Area	25	2.4
UPD-17	02/22/22	NE Uranium Plume Area	14	1.2
UPD-18	02/22/22	NE Uranium Plume Area	13	0.7
UPD-20	02/22/22	NE Uranium Plume Area	17	0.069
UPD-21	03/02/22	NE Uranium Plume Area	25	7.4
UPD-22	02/14/22	NE Uranium Plume Area	9	2.5
UPD-23	03/08/22	NE Uranium Plume Area	26	0.82
UPD-24	03/02/22	NE Uranium Plume Area	27	6.8

Notes: NE = northeastern; SW = southwestern, CF= Configuration

Two plumes are present on-site (Figures 5-6). The highest concentrations form the northeast uranium plume in the shallow ground water (0 – 50 ft bgs) extending from the Atlas building toward the river. The second plume consists of lower concentrations underneath the tailings pile also extending southeast toward the river.

In addition to ammonia and uranium, during the recent site-wide event samples were also analyzed for the six other potential contaminants of concern (PCOCs) (arsenic, copper, manganese, selenium, sulfate and total dissolved solids) that were identified in the screening process and presented in Appendix A-2 of the EIS. While samples collected during previous sampling events have historically been analyzed for ammonia and uranium (and recently arsenic and selenium), copper, magnesium, and sulfate have not been analyzed since 2009. Results for each of these PCOCs are discussed individually below.

Arsenic

Samples collected from select locations (based on historical results) have been analyzed for arsenic since 2019. During this most recent event the samples all sample locations were included arsenic analysis, with one having a concentration that exceeded the 40 CFR 192 Sub A, Table 1 standard of 0.05 mg/L. Table 6 presents the location, sample depth, and result of the single arsenic exceedance.

Table 6. February/March 2022 Groundwater Locations Exceeding the Arsenic 0.05mg/L 40 CFR 192 Sub A Standard

Well Number	Date	Location	Sample Depth (ft bgs)	Arsenic Concentration (mg/L)
UPD-24	03/02/22	NE Uranium Plume Area	27	0.19

Copper

The only applicable groundwater standard for copper is the EPA Action Level of 1.3 mg/L. Samples were collected from 30 locations (based on historical results), and the concentrations ranged from 0.00066 (the detection limit) to 0.049 mg/L. Therefore, none of these exceeded this action level.

Manganese

The only applicable groundwater standard for manganese is an EPA Secondary Drinking Water Regulation of 0.05 mg/L. The groundwater at the Moab Site meets the criteria for limited use as defined in 40 CFR 192 due to TDS above 10,000 mg/L, so the secondary drinking water regulation does not apply to the groundwater but was used to determine the overall quality. Samples were collected from 39 locations during this recent event, and 30 were above the 0.05 mg/L concentration. Table 7 provides the locations, sample depths, and associated results.

There is a plume of high manganese concentrations along the SE base of the tailings pile (Figure 7). Most of the site has naturally elevated manganese concentrations.

Table 7. February/March 2022 Groundwater Locations Exceeding the Manganese 0.05 mg/L EPA Secondary Drinking Water Regulation

Well Number	Date	Location	Sample Depth (ft bgs)	Manganese Concentration (mg/L)
0401	03/08/22	CF2	18	4.2
0403	02/28/22	CF1	18	4
0407	02/24/22	CF1	18	4.2
0414	02/08/22	NE Uranium Plume Area	7.5	0.099
0431	02/28/22	N of Queue	91	0.23
0434	02/15/22	Upgradient of site	80	0.44
0435	02/15/22	Upgradient of site	173	0.54

Table 7. February/March 2022 Groundwater Locations Exceeding the Manganese 0.05 mg/L EPA Secondary Drinking Water Regulation (continued)

0436	02/22/22	NE Uranium Plume Area	197	4.6
0437	03/01/22	On Tailings Pile	NA	0.22
0439	03/01/22	On Tailings Pile	NA	0.28
0444	02/15/22	Upgradient of site	116	2.4
0454	02/14/22	Along SW Site Boundary	13	1.9
0455	02/28/22	Upgradient of site	46	0.072
0457	02/15/22	Upgradient of site	29	0.64
0492	03/07/22	Along S Site Boundary	18	3.6
AMM-2	02/10/22	Near CF5	48	0.8
AMM-3	02/10/22	Base of tailings pile	48	3.1
ATP-2-D	02/09/22	Base of tailings pile	88	1.9
ATP-3	02/15/22	Upgradient of site	51	0.43
MW-3	02/14/22	Base of tailings pile	44	7.8
SMI-MW01	02/08/22	NE Uranium Plume Area	16	0.54
SMI-PW03	02/22/22	NE Uranium Plume Area	60	1.2
SMI-PZ1D	02/14/22	CF5 Vicinity	73	11
SMI-PZ1M	02/14/22	CF5 Vicinity	57	6.1
SMI-PZ1S	02/14/22	CF5 Vicinity	18	0.58
SMI-PZ2D	02/10/22	CF5 Vicinity	75	7.7
SMI-PZ2M2	02/10/22	CF5 Vicinity	56	7.4
SMI-PZ3D2	02/22/22	NE Uranium Plume Area	78	0.18
SMI-PZ3M	02/22/22	NE Uranium Plume Area	59	1.3
TP-01	02/08/22	NE Uranium Plume Area	22	0.61
TP-11	020/8/22	E edge of site	30	1.8
TP-17	03/08/22	CF5 Vicinity	17	2.8
TP-20	02/09/22	S Area of Site	32	0.2
TP-23	02/09/22	S Area of Site	25	4.3
UPD-17	02/22/22	NE Uranium Plume Area	14	1.1
UPD-20	02/22/22	NE Uranium Plume Area	17	0.93
UPD-22	02/14/22	NE Uranium Plume Area	9	0.054
UPD-23	03/08/22	NE Uranium Plume Area	26	0.056
UPD-24	03/02/22	NE Uranium Plume Area	27	0.1

Selenium

Since 2019 samples from select locations were analyzed for selenium and during the site-wide event, all locations were sampled for selenium. Of the 62 samples collected, 25 had selenium concentrations above the 0.01 mg/L standard (40 CFR 192 Sub A, Table 1). These results presented in Table 8.

Table 8. February/March 2022 Groundwater Locations Exceeding the Selenium 0.01 mg/L 40 CFR 192 Sub A Standard

Well Number	Date	Location	Sample Depth (ft bgs)	Selenium Concentration (mg/L)
0401	03/08/22	CF2	18	0.011
0403	02/28/22	CF1	18	0.027
0404	02/24/22	CF3	18	0.012
0406	02/24/22	Moab Wash Area	18	0.2
0412	02/08/22	NE Uranium Plume Area	9.5	0.015
0413	02/14/22	NE Uranium Plume Area	10	0.072
0414	02/08/22	NE Uranium Plume Area	7.5	0.037
0437	02/14/22	On Tailings Pile	97	0.08
0440	02/08/22	Along NW Site Boundary	117	0.06
0441	02/23/22	Support Area	53	0.56
0443	02/28/22	Along N Site Boundary	73	0.011
0454	02/14/22	Along SW Site Boundary	13	0.02
0456	02/15/22	Along N Site Boundary	53	0.016
AMM-1-19	02/08/22	Along N Site Boundary	19	0.012
SMI-MW01	02/08/22	NE Uranium Plume Area	16	0.024
SMI-PW01	02/14/22	Moab Wash Area	40	0.12
SMI-PZ3D2	02/22/22	NE Uranium Plume Area	78	0.063
SMI-PZ3S	02/22/22	NE Uranium Plume Area	25	0.038
TP-23	02/09/22	NE Uranium Plume Area	25	0.016
UPD-17	02/22/22	NE Uranium Plume Area	14	0.094
UPD-18	02/22/22	NE Uranium Plume Area	13	0.058
UPD-21	03/02/22	NE Uranium Plume Area	25	0.12
UPD-23	03/08/22	NE Uranium Plume Area	26	0.062
UPD-24	03/02/22	NE Uranium Plume Area	27	0.09

Selenium concentrations are highest at the northwest corner of the tailings pile (upgradient well 0441, Figure 8). Concentrations are elevated in the NE base of the tailings pile and along the NE uranium plume.

Sulfate

Like manganese, there is only an EPA Secondary Drinking Water Regulation for sulfate, which is 250 mg/L. A total of 58 sample locations exceeded this standard. The sulfate concentration ranged from 140 to 21,000 mg/L, with an average of 3,955 mg/L. The high concentrations can be attributed to the presence of the naturally occurring brine within the groundwater system.

Sulfate concentrations are naturally high due to the brine. Concentrations are elevated along the SE base of the tailings pile (Figure 9).

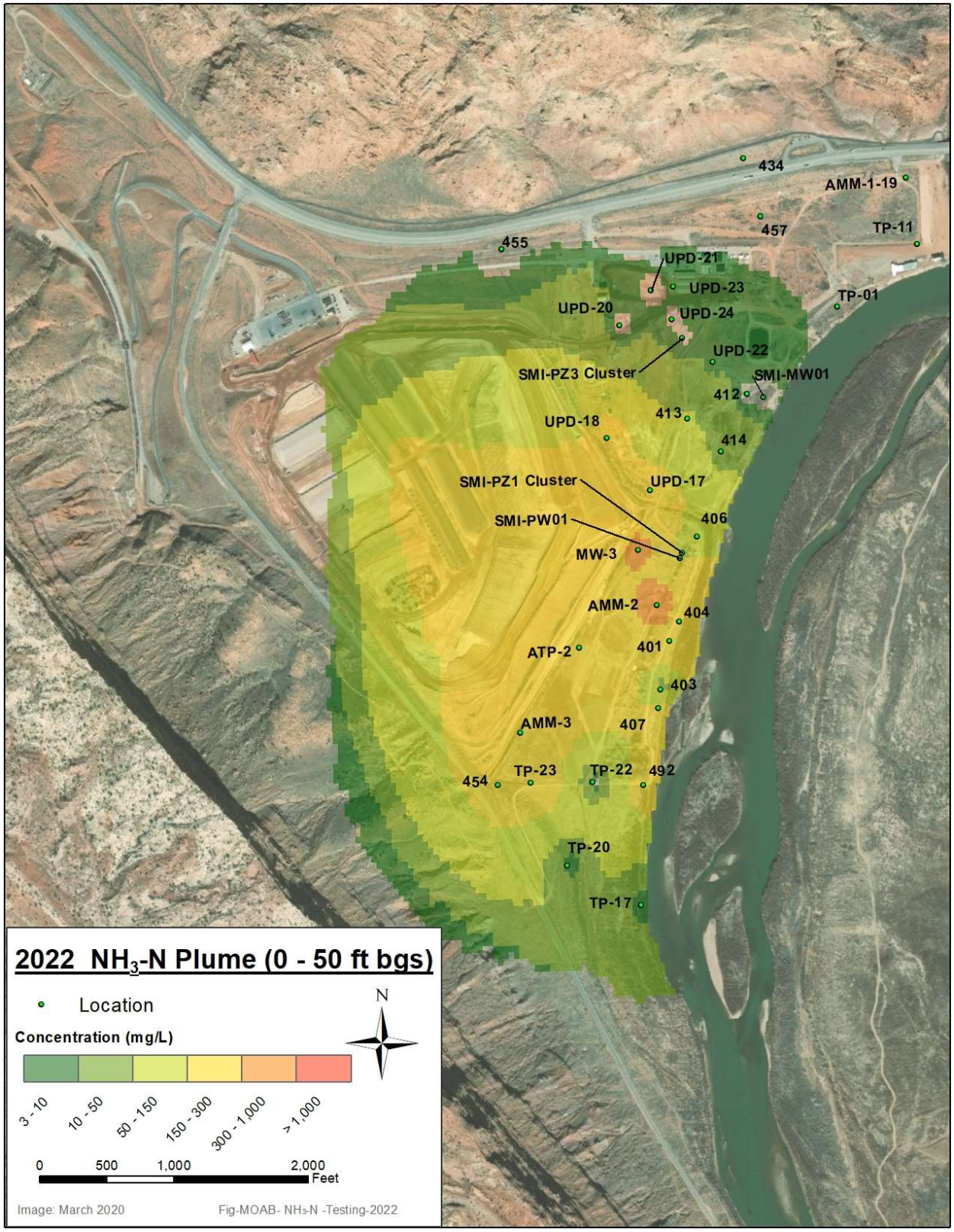

Figure 3. Ammonia Plume in Shallow Groundwater, February/March 2022

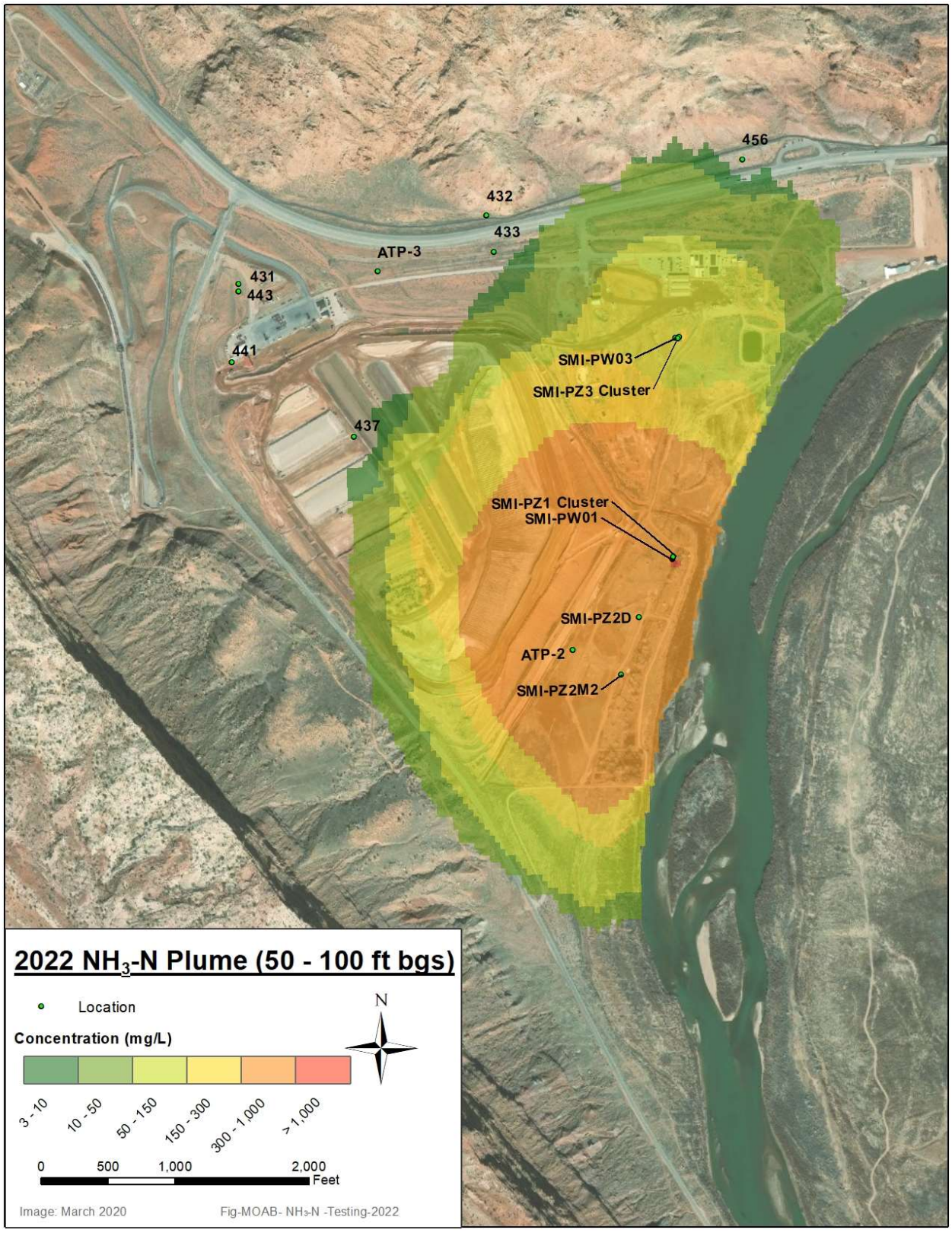

Figure 4. Ammonia Plume in Mid-depth Groundwater, February/March 2022

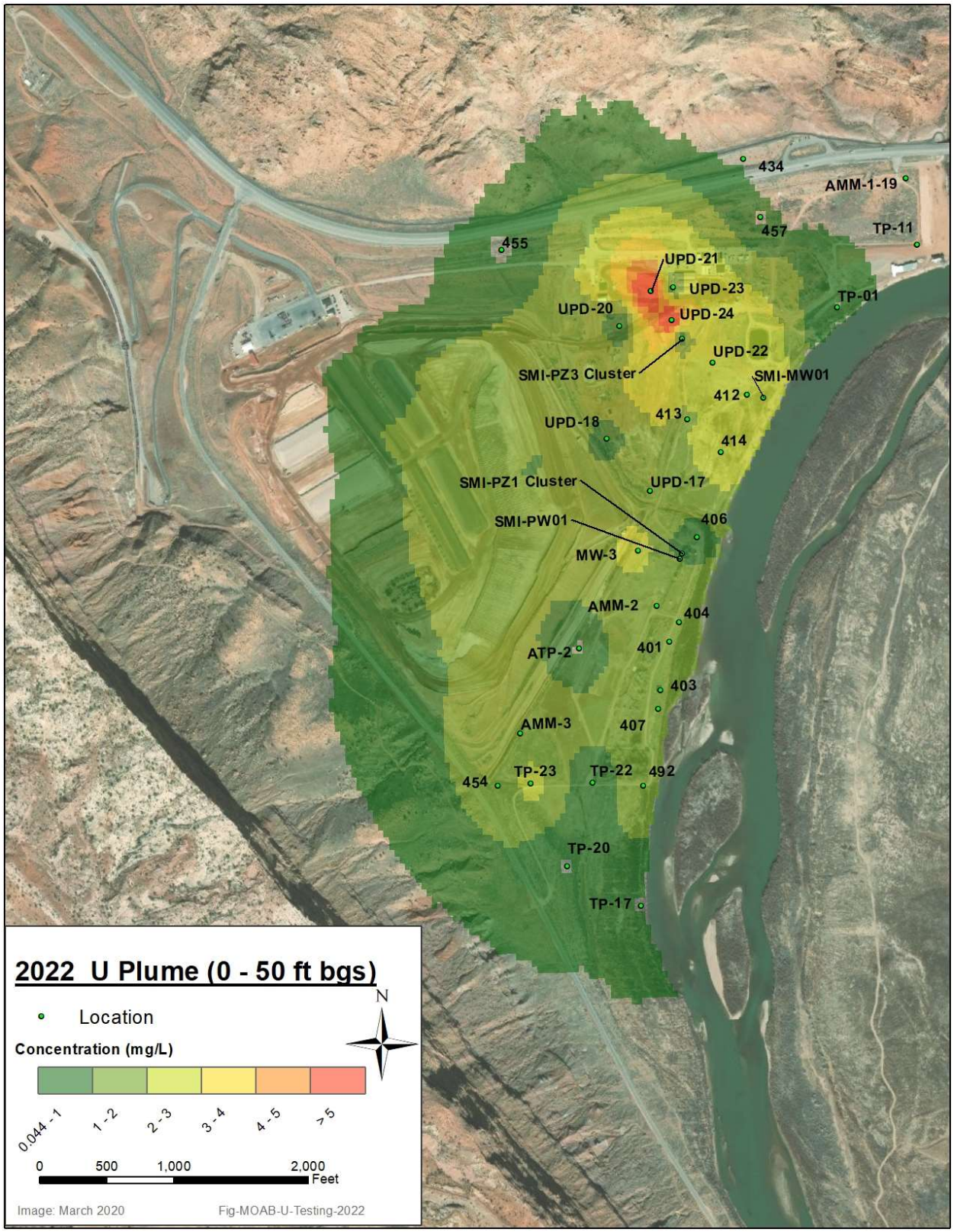

Figure 5. Uranium Plume in Shallow Groundwater, February/March 2022

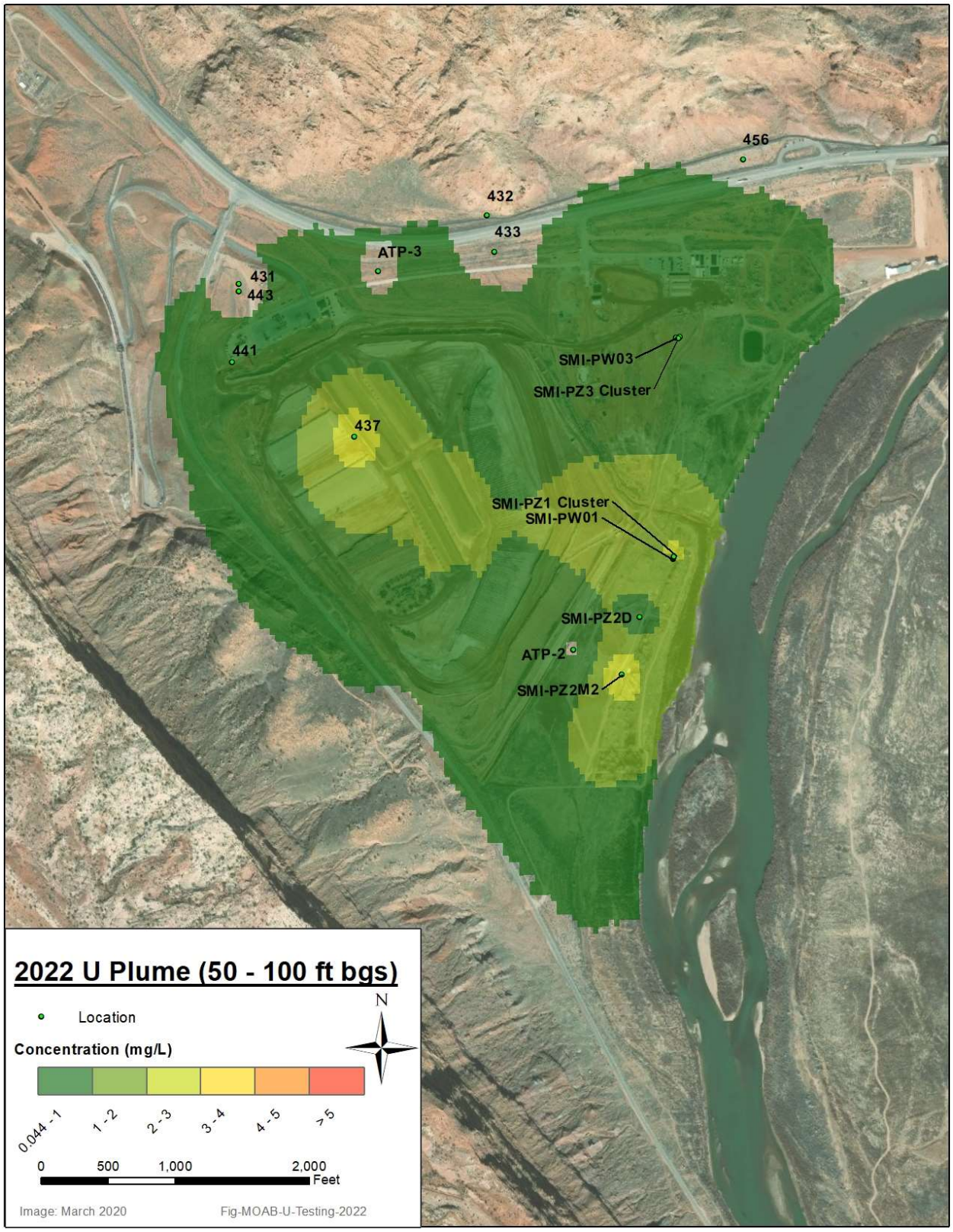

Figure 6. Uranium Plume in Mid-depth Groundwater, February/March 2022

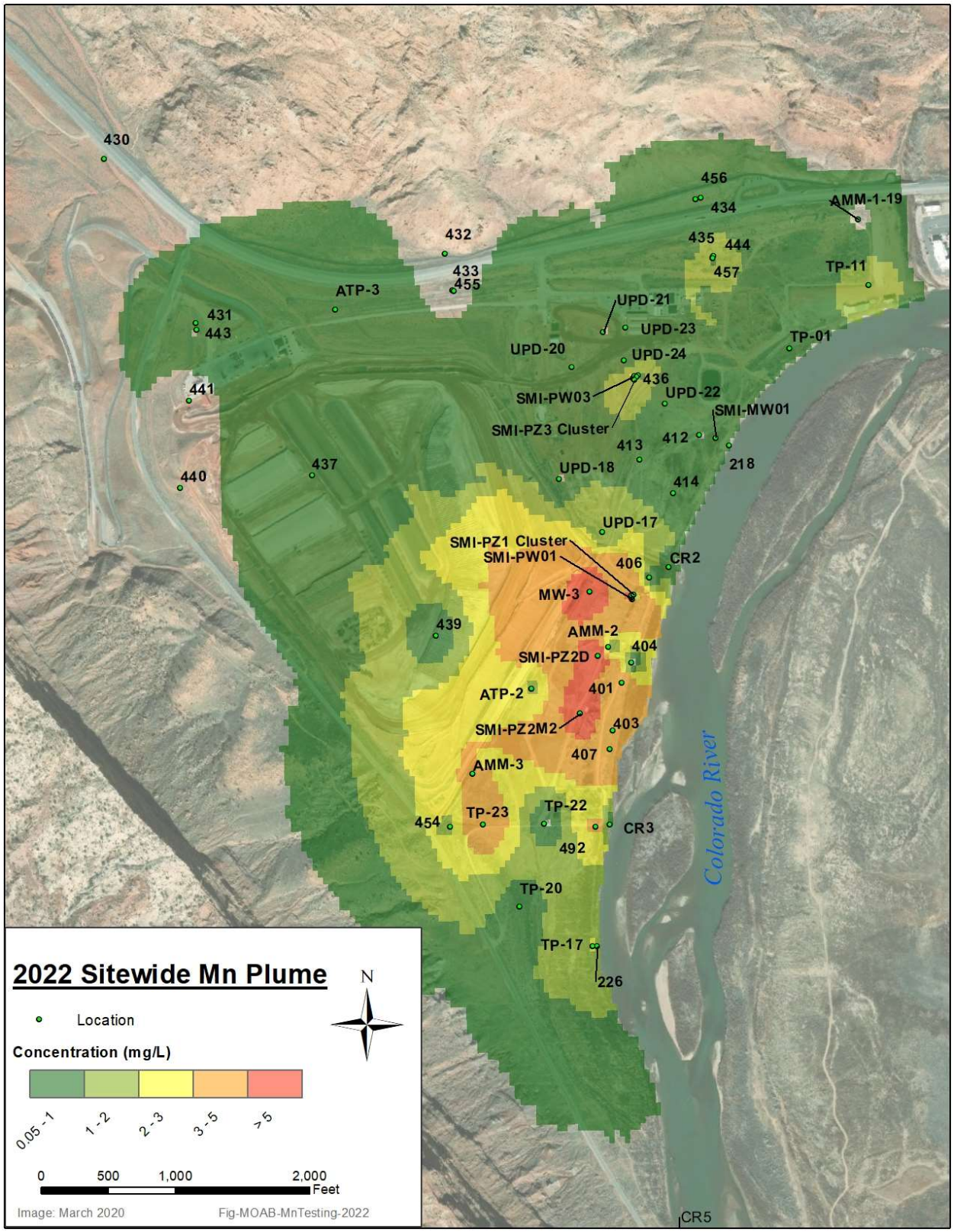

Figure 7. Manganese Plume in Shallow Groundwater, February/March 2022

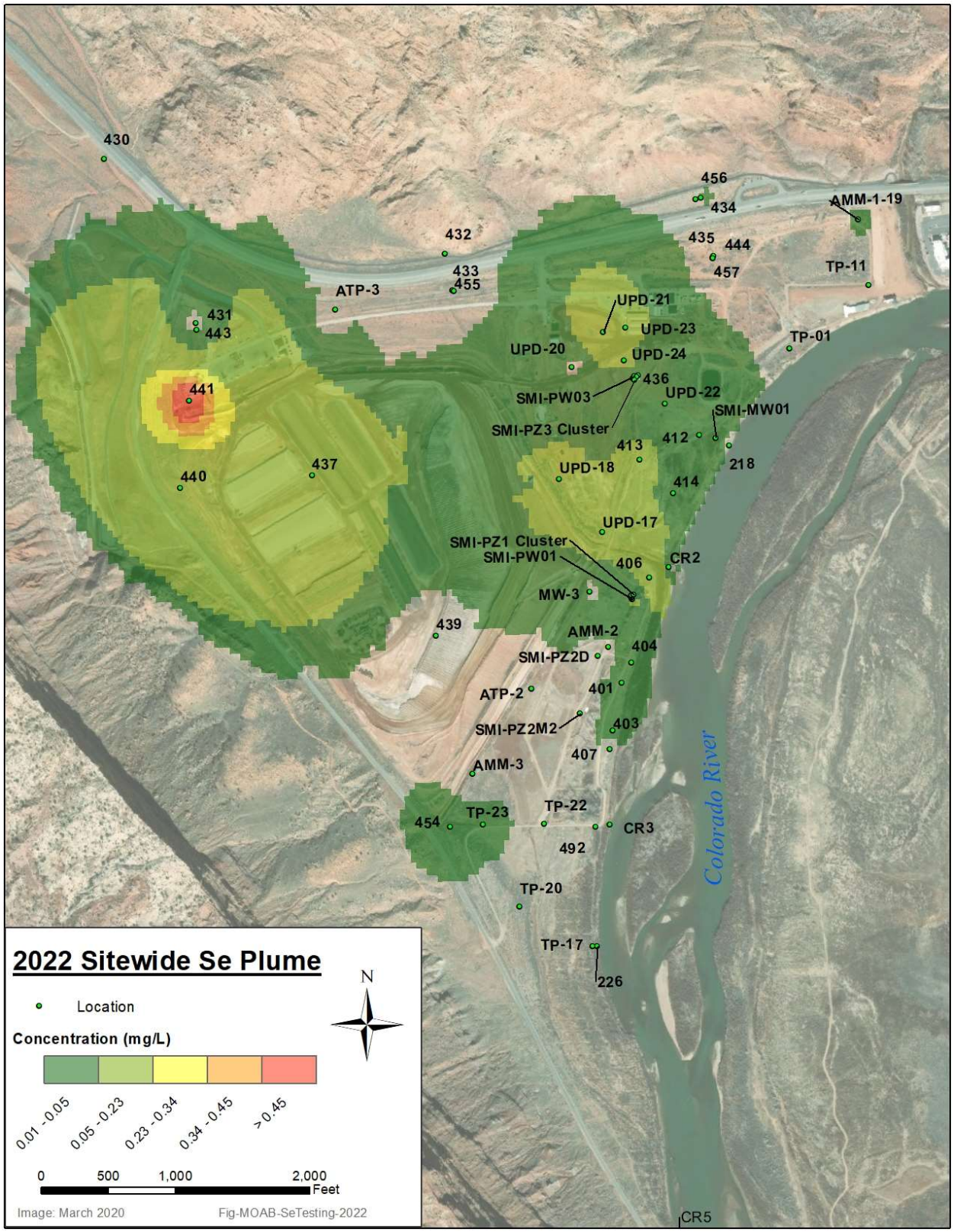

Figure 8. Selenium Plume in Shallow Groundwater, February/March 2022

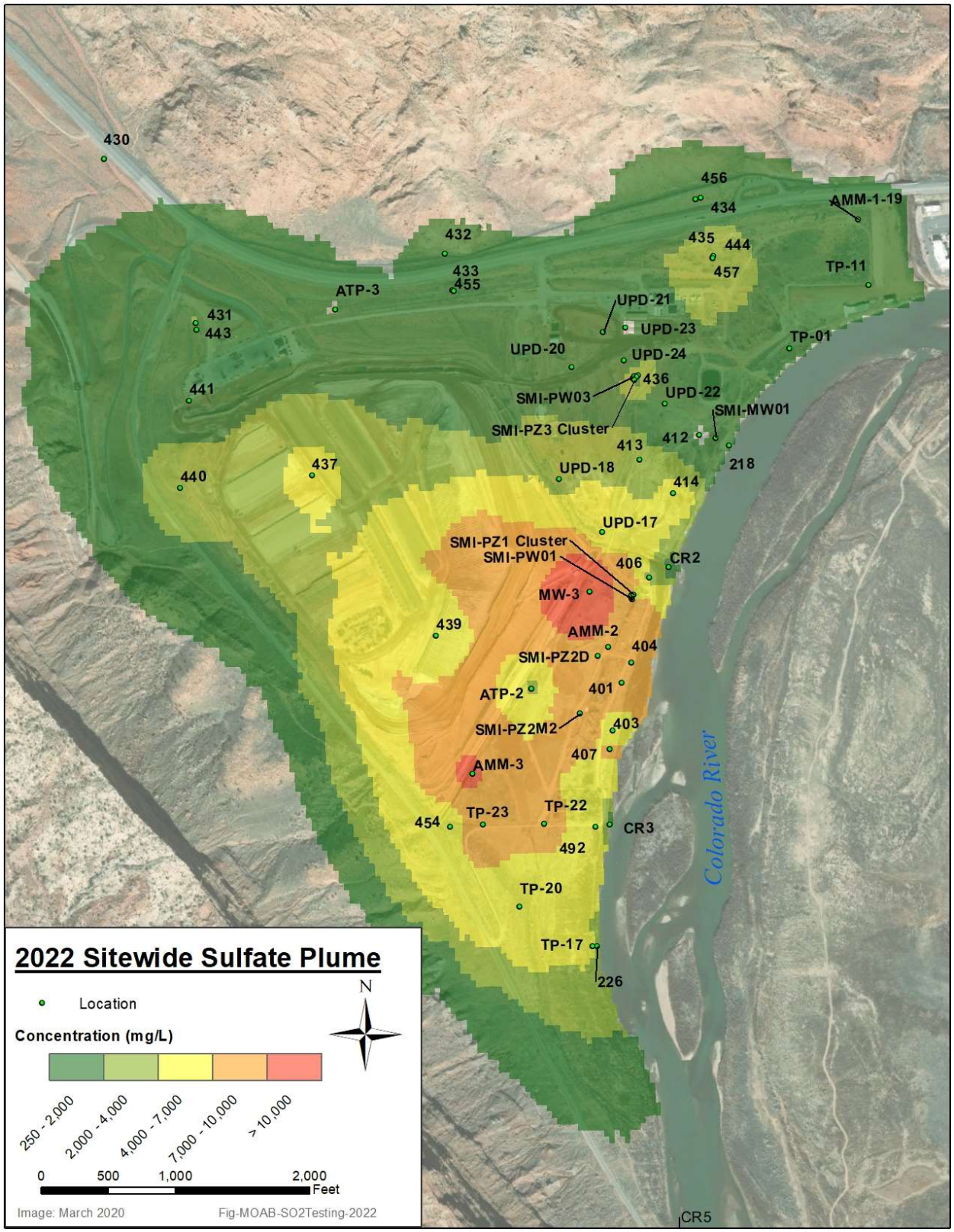

Figure 9. Sulfate Plume in Shallow Groundwater, February/March 2022

2.4 Contaminant Trends

To more easily present the trends observed in the water chemistry for the site-wide locations, the site was divided into six areas. These include:

- The Northeastern Base of the Tailings Pile
- The Northeastern Edge of Uranium Plume Area
- The Southeastern Base of the Tailings Pile
- The Southwestern Site Boundary
- The Site Boundary along the Colorado River
- The Southern and Off-site Areas

Also included is a response to CF5 extraction system activity on nearby monitoring wells SMI-PZ2M2 and AMM-2. All results since 2010 are plotted against the Colorado River flow to determine if the river stage impacts the concentrations. Refer to Figure 3 for the site-wide groundwater sampling locations.

2.4.1 Northeastern Base of Tailings Pile

Figures 10 and 11 are time versus ammonia and uranium concentration plots, respectively, for locations UPD-17 and UPD-18. Because of these location's proximity to the Colorado River and Moab Wash (in which the Colorado River tends to flood during peak runoff), prior to 2019 ammonia concentrations (Figure 10) have displayed a general increasing trend during river base flows and, conversely, a decreasing trend during the spring runoff (or higher flows).

Ammonia concentrations at UPD-17 are more variable and impacted by the river flow than what is seen at UPD-18, but the trendline shows a gradual decrease in ammonia concentrations over time.

Uranium concentrations have remained relatively stable at well UPD-17 but show a gradual decrease in concentration at UPD-18.

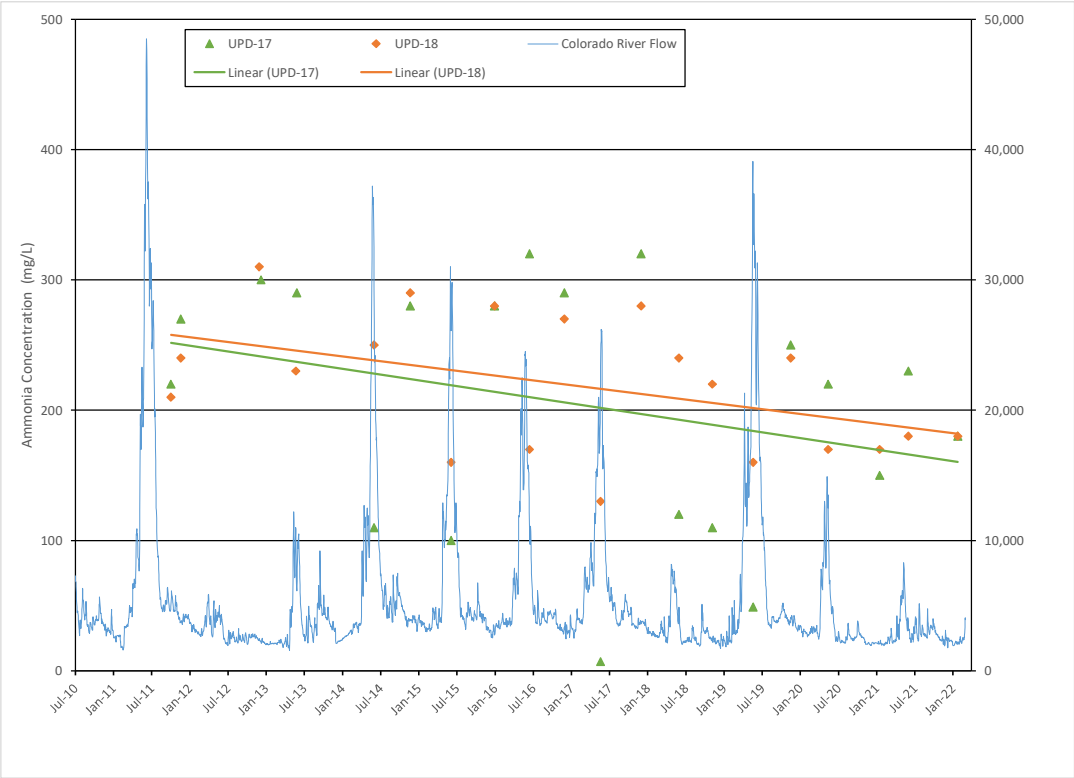

Figure 10. Wells UPD-17 and UPD-18 Time versus Ammonia Concentration Plot

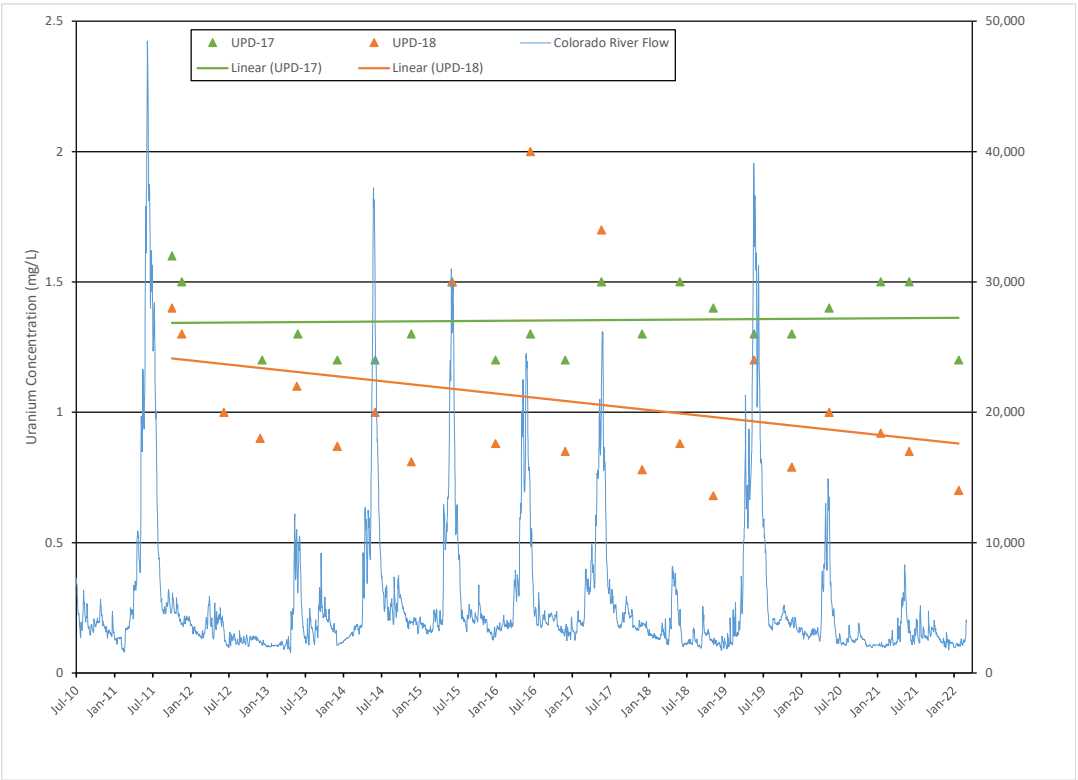

Figure 11. Wells UPD-17 and UPD-18 Time versus Uranium Concentration Plot

2.4.2 Northeastern Uranium Plume Area

Due to the number of wells associated with the northeastern uranium plume, this area of the site was further subdivided into the center of the plume, the vicinity of the Atlas building, and the northeastern edge of the plume area.

Center of Northeastern Uranium Plume Area

Figures 12 and 13 are the time versus ammonia and uranium concentration plots, respectively, for the center of the northeastern uranium plume area, which includes locations UPD-20, 0411, 0413, and 0414 (listed from upgradient to downgradient). It was not possible to collect a sample from 0411 over the past two years due to a lack of recharge.

Well 0413 is approximately 650 ft from the Colorado River, and the ammonia concentrations (Figure 12) collected from this location have been consistently higher since 2011 compared to the samples collected from well 0414. Well 0413 is less susceptible to impacts of the river stage compared to well 0414 (located only 250 ft from the river) when this area is not flooded. Trendlines indicate ammonia concentrations over the past 10 years have steadily increased.

The uranium concentration (Figure 13) in the sample collected from well UPD-20 was just above the 0.044 mg/L standard (as it has been since this well was installed in 2011), with a concentration of 0.069 mg/L. The uranium concentrations in samples collected from wells 0413 and 0414 have generally been similar since June 2013. The trendlines suggest the uranium concentrations in the samples collected from 0413 have generally increased and in 0414 decreased over the past 10 years.

Vicinity of the Atlas Building

The ammonia and uranium concentrations associated with samples collected from locations in the vicinity of the Atlas building are displayed in Figures 14 and 15, respectively. These wells include 0410, UPD-21, UPD-23, and UPD-24, all of which were sampled at a depth of approximately 25 ft bgs. A sample was not collected from well 0410 in 2022 due to a lack of recharge.

As shown in Figure 14, the ammonia concentrations in samples collected from UPD-21, UPD-23, and UPD-24 during this site-wide event were 5 mg/L or less.

Historically this area of the site has had the highest uranium concentrations (Figure 15) in groundwater, particularly in wells UPD-21 and UPD-24. The uranium concentrations in samples collected from wells 0410 and UPD-23 remain lower than 1.0 mg/L and have not significantly changed since 2012, suggesting the uranium plume has not extended to the north/northeast during this time. The trendlines displayed in Figure 15 suggests that the UPD-21 and UPD-24 concentrations have decreased at a similar rate over the past 10 years.

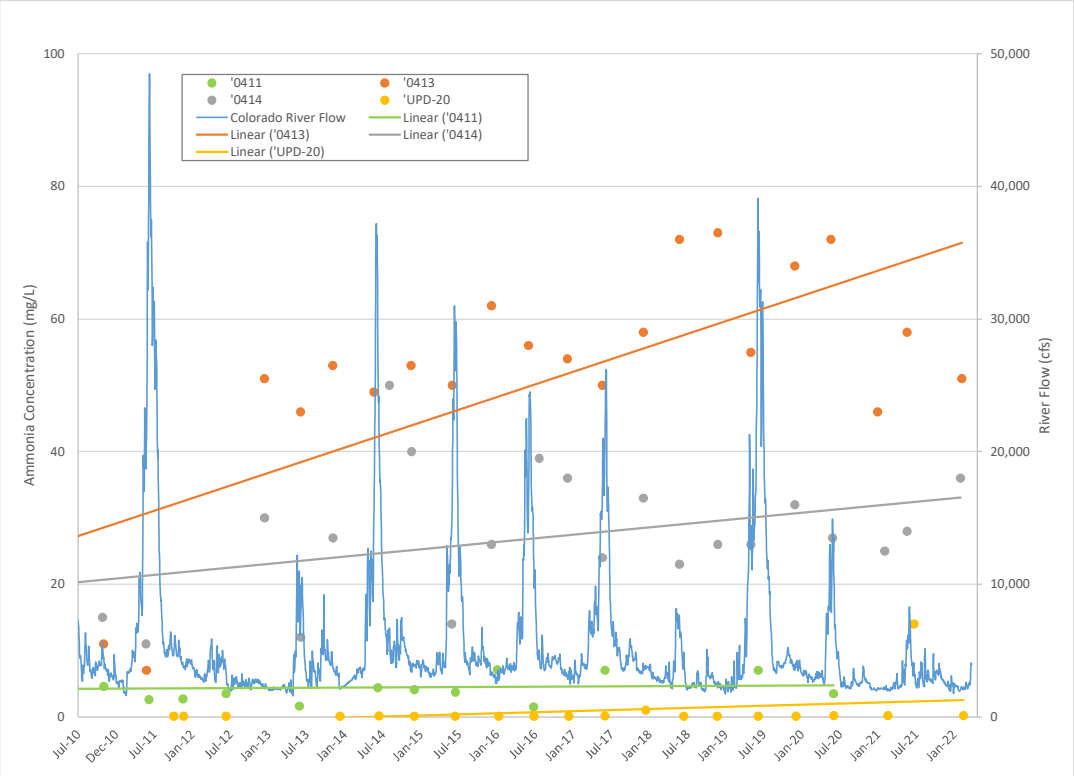

Figure 12. Center of Northeastern Uranium Plume Area Observation Wells 0411, 0413, 0414, and UPD-20 Time versus Ammonia Concentration Plot

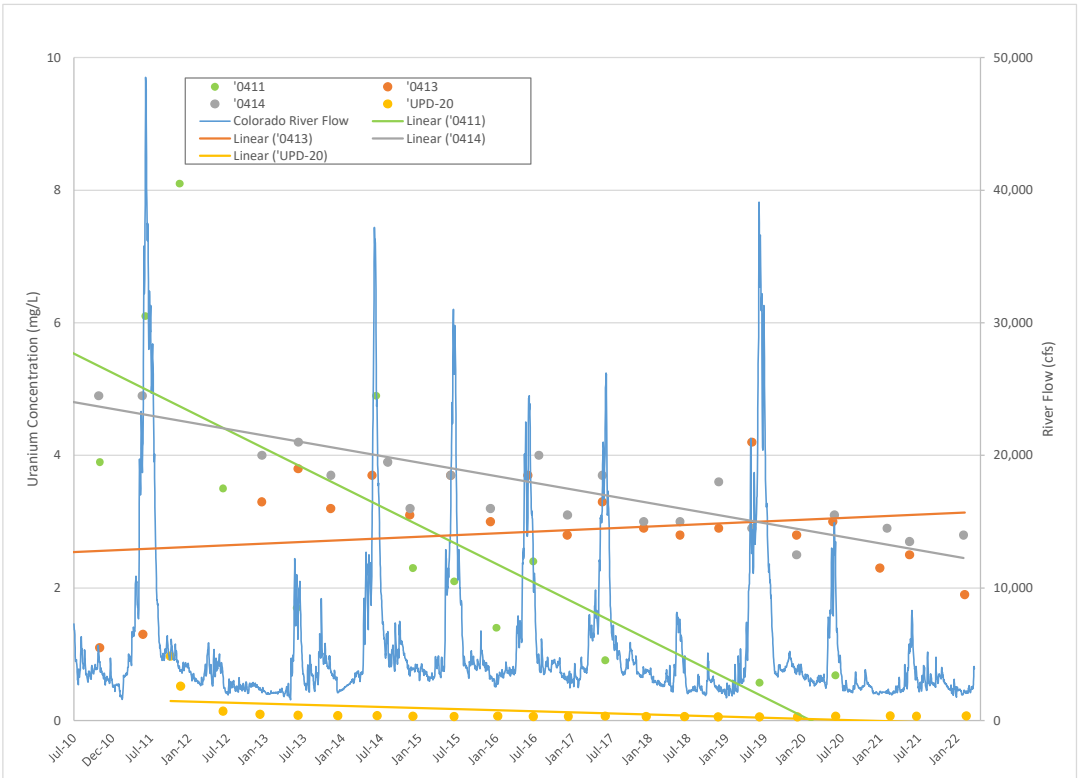

Figure 13. Center of Northeastern Uranium Plume Area Observation Wells 0411, 0413, 0414, and UPD-20 Time versus Uranium Concentration Plot

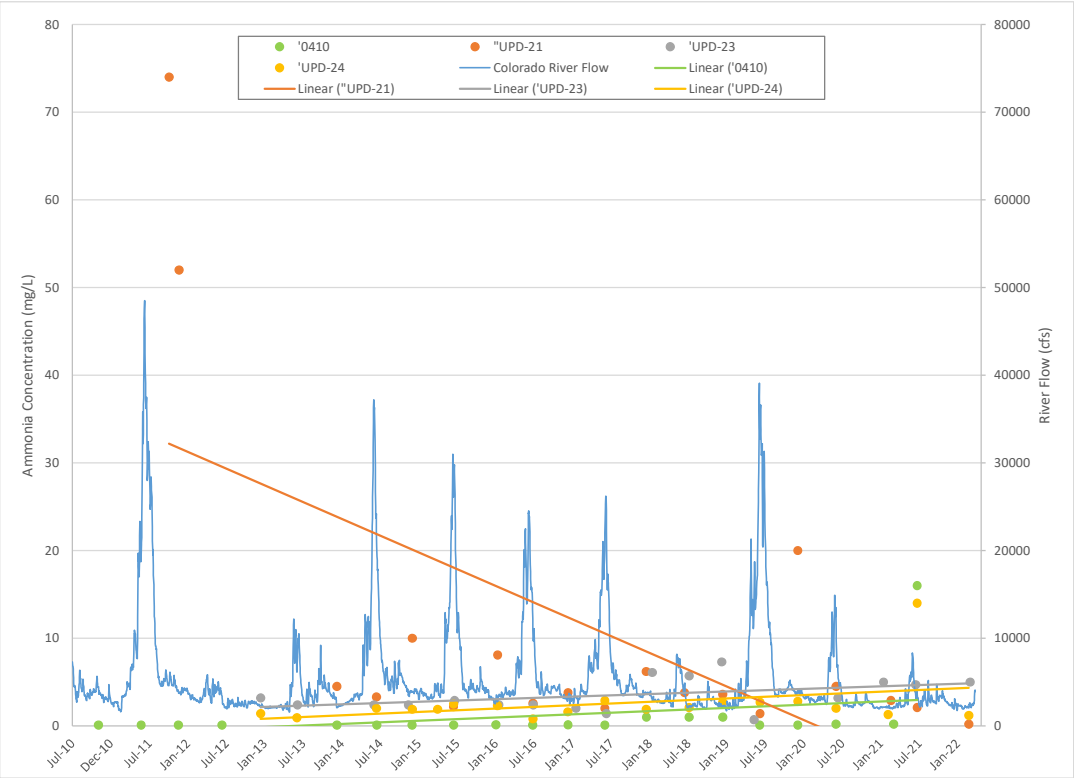

Figure 14. Vicinity of Atlas Building Observation Wells 0410, UPD-21, UPD-23, and UPD-24 Time versus Ammonia Concentration Plot

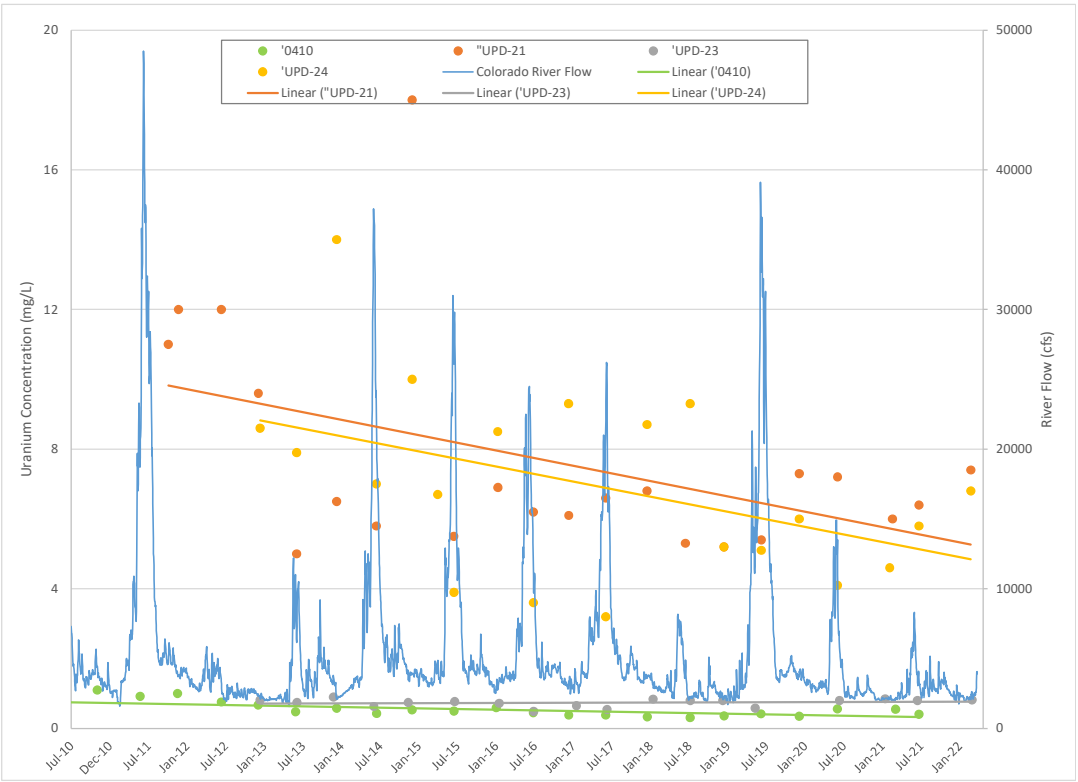

Figure 15. Vicinity of Atlas Building Observation Wells 0410, UPD-21, UPD-23, and UPD-24 Time versus Uranium Concentration Plot

Northeastern Edge of Uranium Plume Area

Figures 16 and 17 display ammonia and uranium concentration data for the wells located in the vicinity of the northeastern edge of the plume area. This includes wells SMI-PZ3S, UPD-22, 0412 and SMI-MW01 (listed from upgradient to downgradient). Well SMI-PZ3S is located approximately 850 ft from the riverbank, and SMI-MW01 is only 50 ft off the bank. Well 0412 is near SMI-MW01, approximately 60 ft upgradient, but the wells are sampled at different depths (11 and 16 ft bgs, respectively).

As Figure 16 exhibits, the ammonia concentrations associated with the sampling of these wells increases moving away from the riverbank. The concentrations measured in the samples collected from SMI-MW01 has remained below 3 mg/L since 2010. Through 2015, the concentrations measured in samples collected from well UPD-22 were below 5 mg/L, increased to nearly 10 mg/L in 2017, and have gradually decreased suggesting some minimal plume movement.

With this set of wells located downgradient of the Atlas Building and former processing area, the uranium concentrations are impacted by the upgradient conditions. However, consistently the uranium concentrations measured in the samples collected from the well closest to the Atlas Building cluster (SMI-PZ3S) are the lowest of this set of wells. Additionally, well SMI-PZ3S is near UPD-22 (approximately 200 ft downgradient), but the concentrations are significantly different (0.78 and 2.5 mg/L, respectively) during this most recent event even though the sample depths are similar (25 and 27 ft bgs). As shown in Figure 17, moving in the southeast (downgradient) direction, concentrations generally increase, with the highest associated with the sample collected from well 0412. The concentration increase in the downgradient direction suggests the uranium plume is being impacted by another source, possibly the remnants of the berm that was in place during mill site operations through 2011.

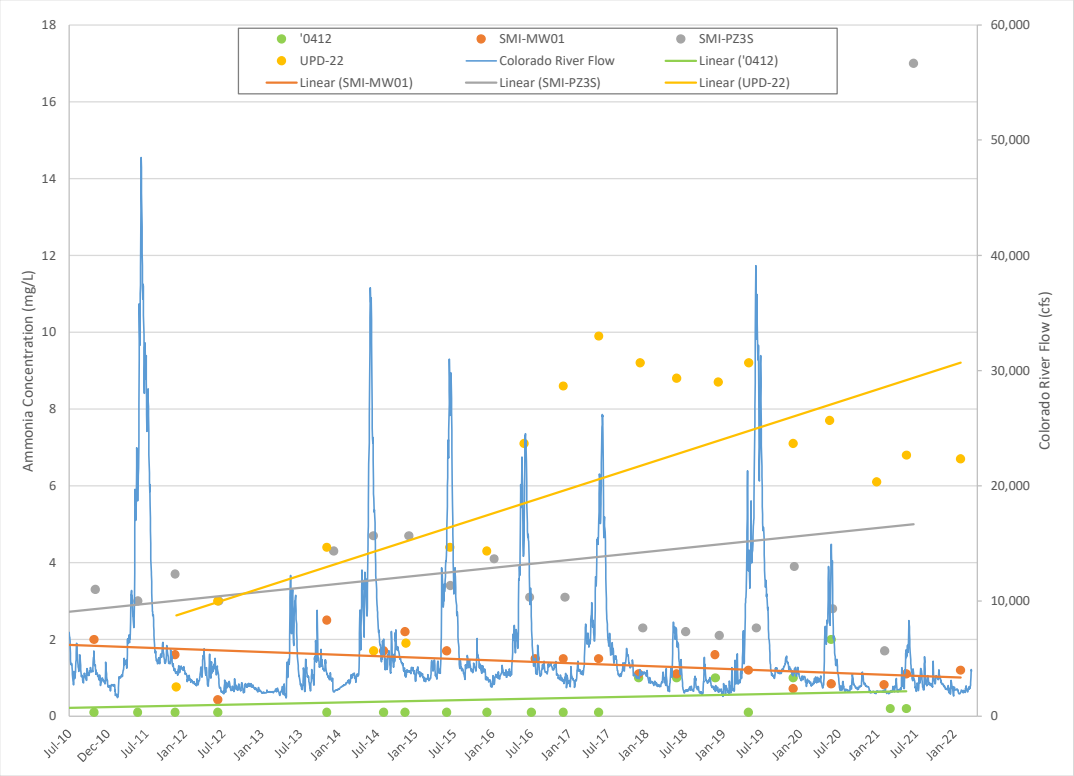

Figure 16. Northeastern Edge of Uranium Plume Area Observation Wells 0412, SMI-MW01, SMI-PZ3S, and UPD-22 Time versus Ammonia Concentration Plot

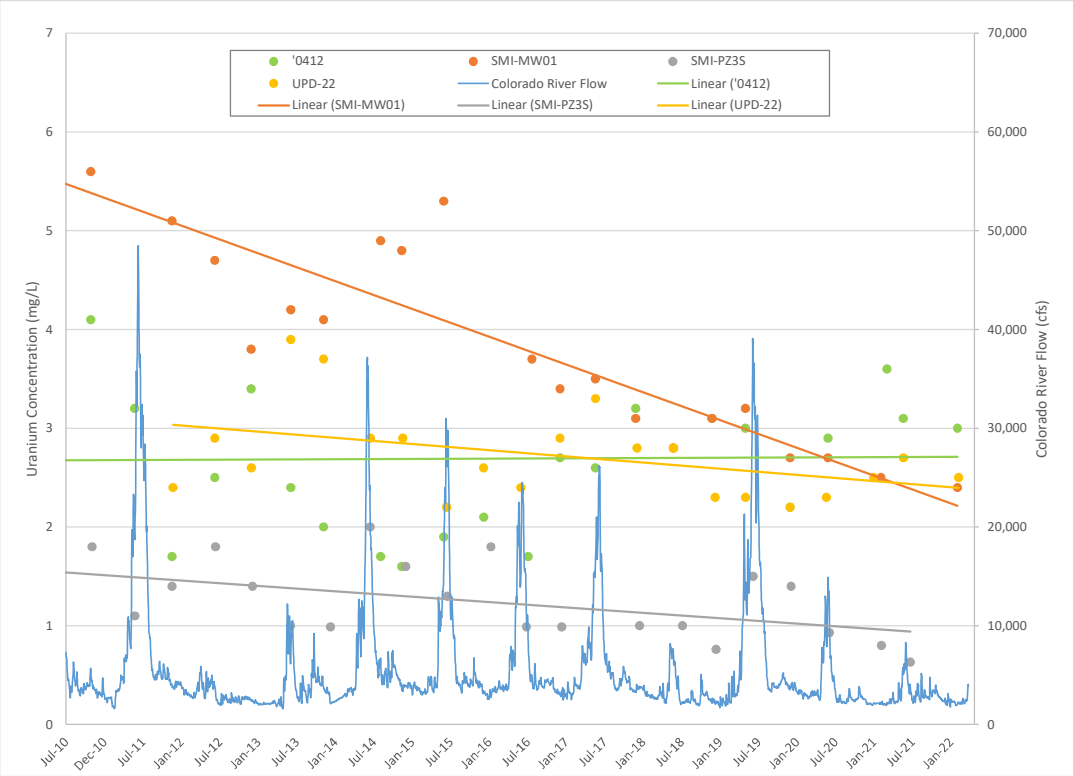

Figure 17. Northeastern Edge of Uranium Plume Area Observation Wells 0412, SMI-MW01, SMI-PZ3S, and UPD-22 Time versus Uranium Concentration Plot

2.4.3 Southeastern Base of Tailings Pile

The time versus ammonia and uranium concentration plots for the area near the base of the tailings pile are presented in Figures 18 and 19 for wells MW-3, ATP-2-S, ATP-2-D, AMM-3, and 0454 (listed from south to north). These wells are sampled over a variety of depths, ranging from 13 to 88 ft bgs. They are also located at approximately the same ground surface elevation.

Trend plots in Figure 18 indicate the ammonia concentration is gradually decreasing at each location except AMM-3. Since samples were collected during baseflow conditions, concentrations would expect to potentially be above the trend plots. This is the case in well ATP-2-S (25 ft bgs), but all other wells were near or below the trend plot. The concentration in well MW-3 (44 ft bgs) was significantly lower than previous samples.

Figure 19 also shows recent results were lower than previous and continue a steady, decreasing uranium concentration, except for well AMM-3 (48 ft bgs). Wells ATP-2-S (25 ft bgs) and ATP-2-D (88 ft bgs) still display low concentrations.

2.4.4 Southwestern Site Boundary

Figures 20 and 21 are time versus concentration plots for ammonia and uranium, respectively, for locations 0441, 0440, 0453, and 0454 (listed from northwest to southeast). These locations are all along the furthest western extent of the alluvial aquifer. Due to the varying topography along this boundary, sample depths range from 13 to 117 ft bgs. The results associated with well 0454 are again presented in this section because in addition to being located along the base of the tailings pile, it is also along the site boundary. Well 0453 was not sampled due to a low water level that would not allow the bladder pump to function properly.

Ammonia trends continue to indicate a decrease at all locations.

The well 0454 uranium trend (Figure 21) indicates a decrease consistent with previous samples. Sample results from wells 0440 and 0441 are very consistent and indicate little change in the northwest corner of the plume. The sample result from well 0441 remains slightly above the 0.044 mg/L uranium UMTRA standard while well 0440 (0.029 mg/L) remains below.

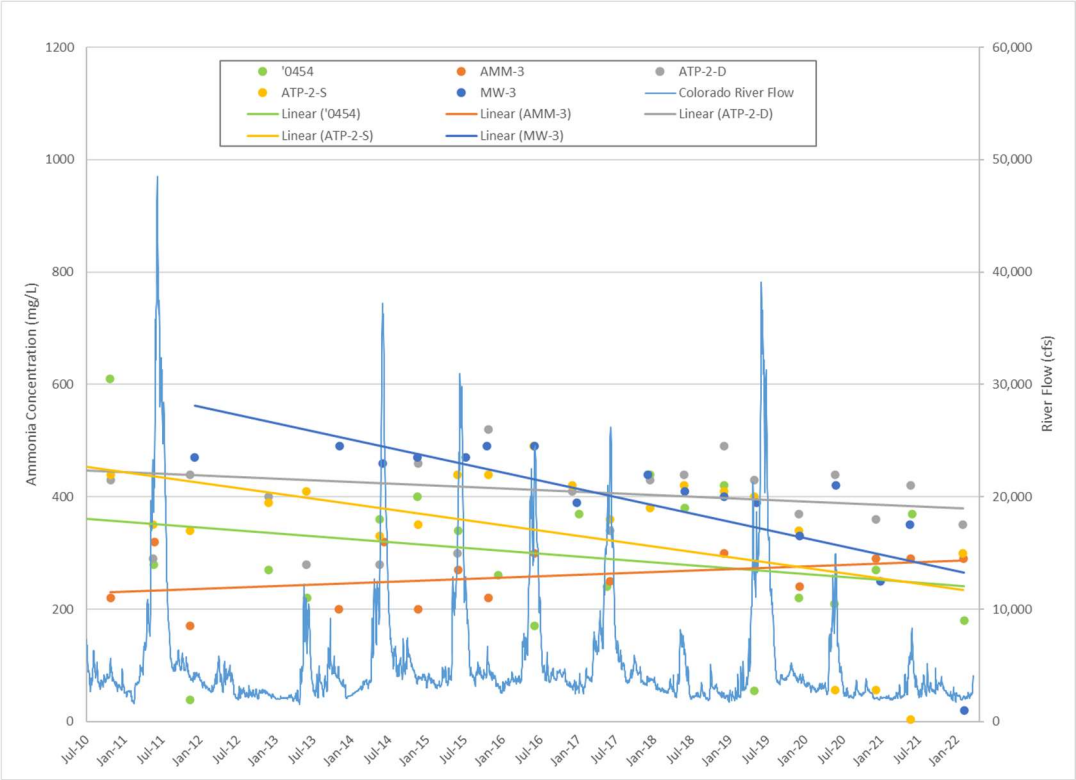

Figure 18. Base of Tailings Pile Observation Wells 0454, AMM-3, ATP-2-S, ATP-2-D, and MW-3 Time versus Ammonia Concentration Plot

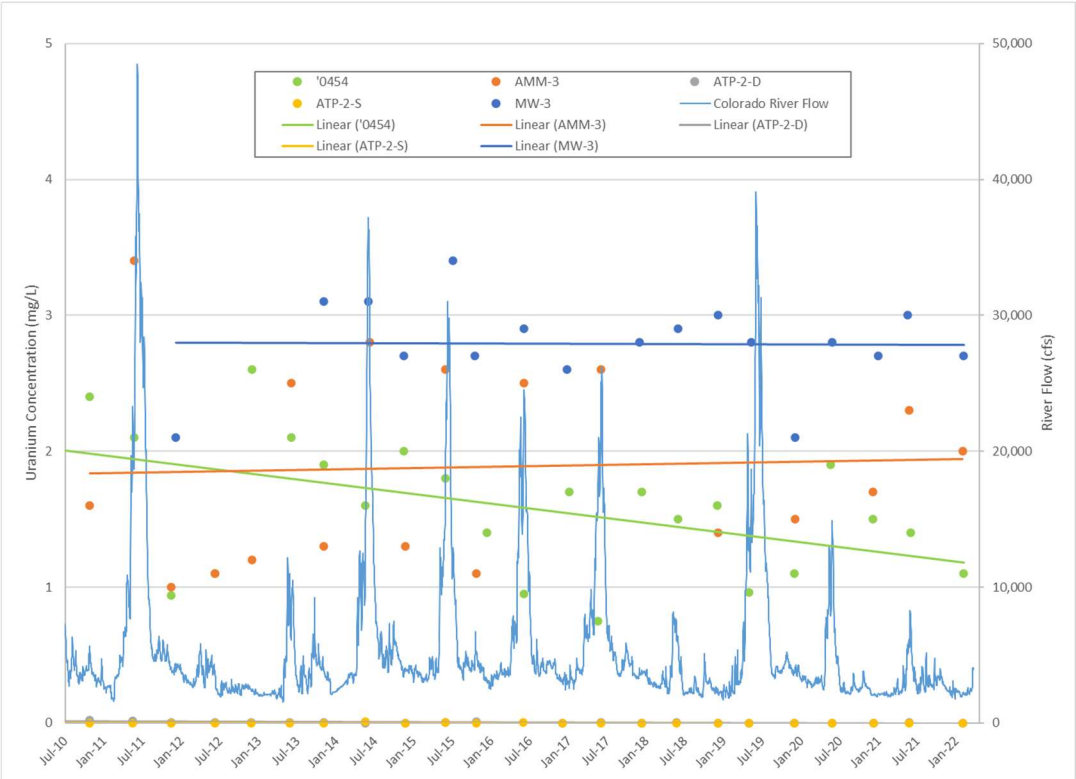

Figure 19. Base of Tailings Pile Observation Wells 0454, AMM-3, ATP-2-S, ATP-2-D, and MW-3 Time versus Uranium Concentration Plot

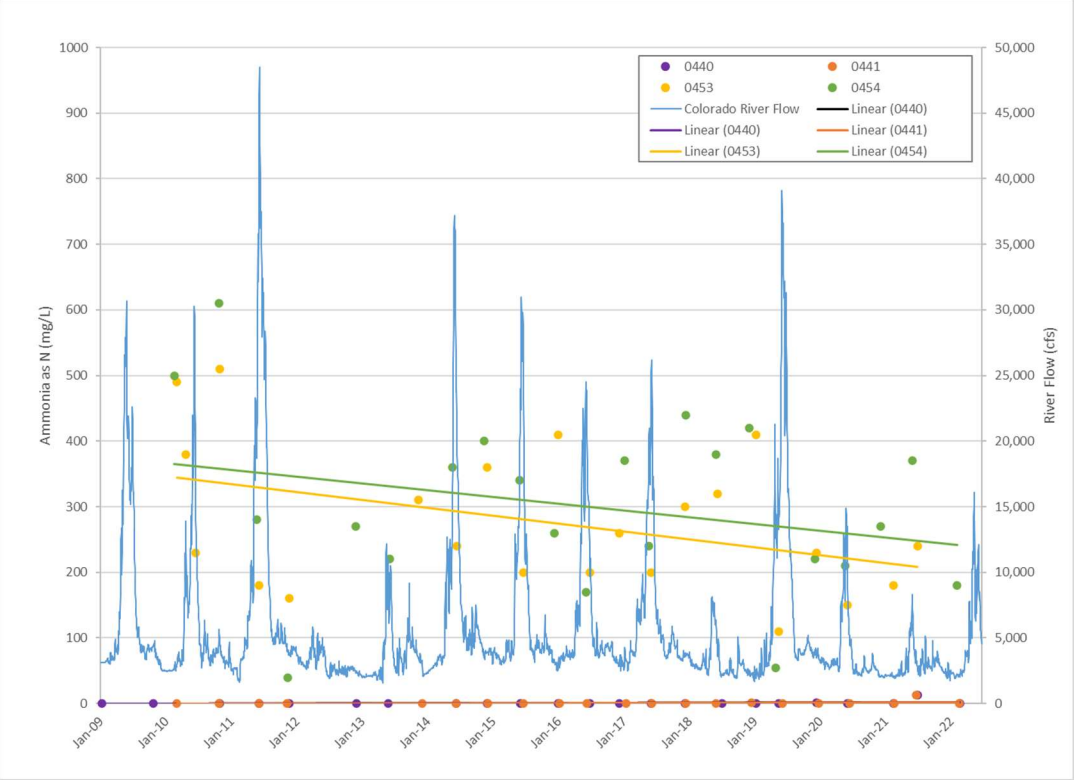

Figure 20. Southwestern Boundary Observation Wells 0453, 0454, 0440, and 0441 Time versus Ammonia Concentration Plot

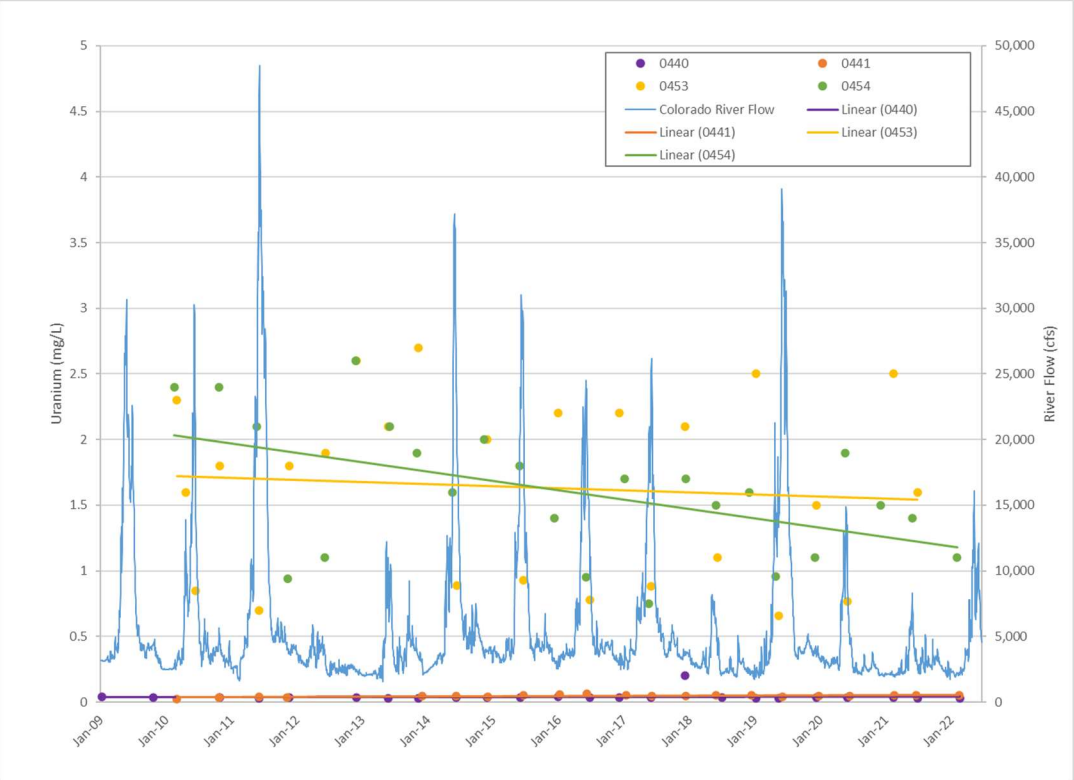

Figure 21. Southwestern Boundary Observation Wells 0453, 0454, 0440, and 0441 Time versus Uranium Concentration Plot

2.4.5 Site Boundary along the Colorado River

Figures 22 and 23 are the time versus ammonia and uranium concentration plots, respectively, for the locations sampled along the riverbank. Wells TP-17, 0492, 0407, 0401, 0404, SMI-MW01, and TP-01 (listed from the south to the north) were sampled from depths ranging from 17 to 28 ft bgs. Because these wells are located along the riverbank, the water chemistry has historically been heavily influenced by the Colorado River stage fluctuations.

The results presented in Figure 22 suggest the ammonia plume has continued to migrate to the south since 2017, based on the sample data collected from well 0492. Between November 2011 and January 2017, the ammonia concentrations associated with this location were below 10 mg/L. Since that time the concentrations have ranged from 16 to 300 mg/L. It is possible that this increase is in response to low river stages between August 2017 and April 2019 (and after 2019), allowing for migration from the upgradient plume source.

Ammonia concentration trends have overall increased in the samples collected from well 0401 and especially well 0404. However, most recent results have decreased in the last couple years. The results for well 0407 indicate a downward trend despite great variability due to river influence. The lowest ammonia concentrations were associated with the samples collected from the wells TP-17, SMI-MW01, and TP-01.

Uranium trends in this area indicate slight increases in wells 0401, 0404, and 0407. Most recent sample results were higher when compared to the last event due to sampling at a lower river stage. The uranium trend for well 0492 indicates a greater increase also consistent with the migration of the ammonia plume. The most significant shift is the decrease in well SMI-MW01 indicating a decline in the uranium plume north of Moab Wash. Wells TP-01 and TP-17 continue to stay consistently low by comparison and remain just at or below the 0.044 mg/L UMTRA standard.

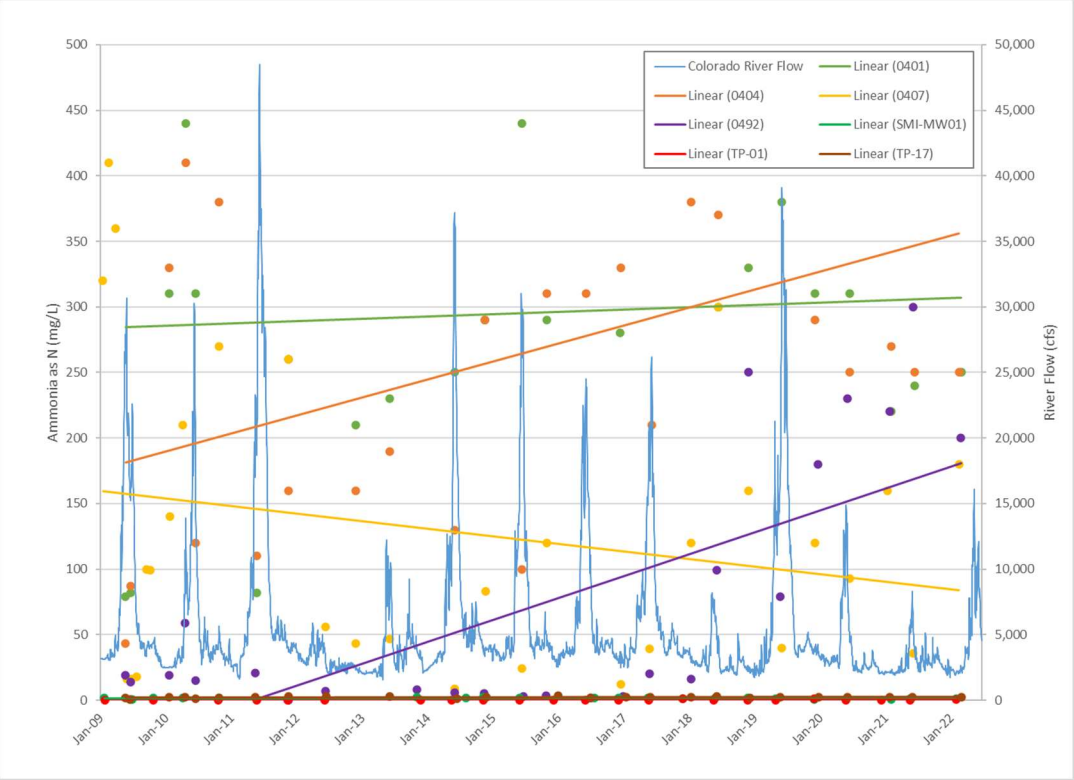

Figure 22. Riverbank Observation Wells TP-17, 0492, 0407, 0401, 0404, SMI-MW01, and TP-01 Time versus Ammonia Concentration Plot

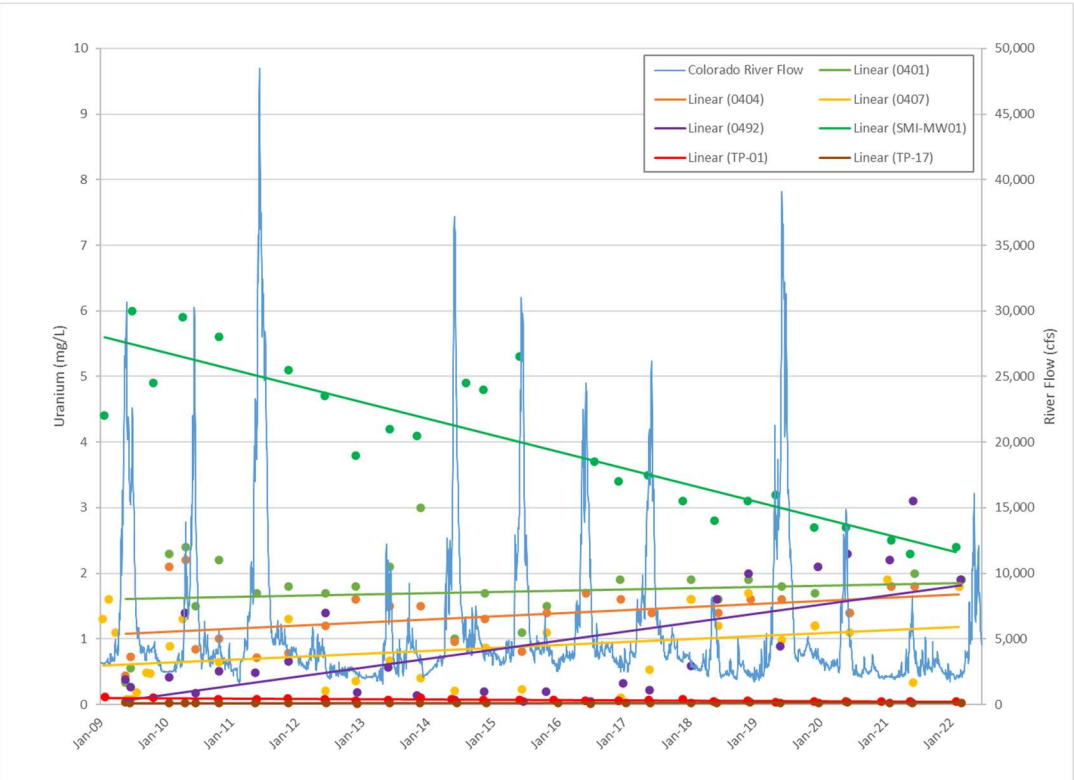

Figure 23. Riverbank Observation Wells TP-17, 0492, 0407, 0401, 0404, SMI-MW01, and TP-01 Time versus Uranium Concentration Plot

2.4.6 Southern and Off-site Areas

Figures 24 and 25 are the plots for four locations sampled at the southern end of the site, wells TP-17, TP-20, TP-23, and 0454. Well TP-17 is located along the riverbank, TP-20 is located approximately 500 ft off the riverbank, and TP-23 and 0454 are located closer to the toe of the tailings pile. Sample depths range from 13 ft bgs (well 0454) to 32 ft bgs (TP-20).

Trend plots for ammonia (Figure 24) and uranium (Figure 25) both indicate well concentrations are decreasing in wells 0454 and TP-23. However, while Figure 25 indicates ammonia concentrations are higher in well 0454 (closer to the tailings pile) than well TP-23, Figure 25 indicates uranium concentrations are higher in well TP-23 (farther from the tailings pile) than well 0454. Wells TP-17 and TP-20 are farther to the south from the tailings pile and consistently have significantly lower ammonia and uranium concentrations.

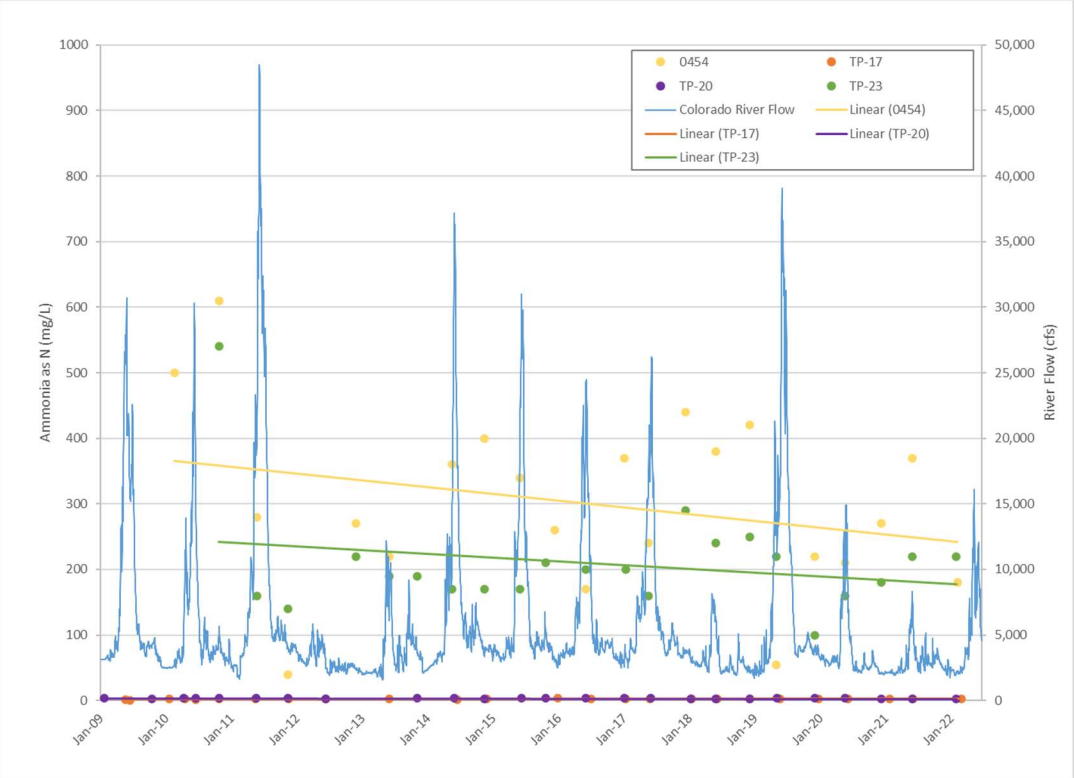

Figure 24. South of Site Observation Wells TP-17, TP-20, TP-23, and 0454 Time versus Ammonia Concentration Plot

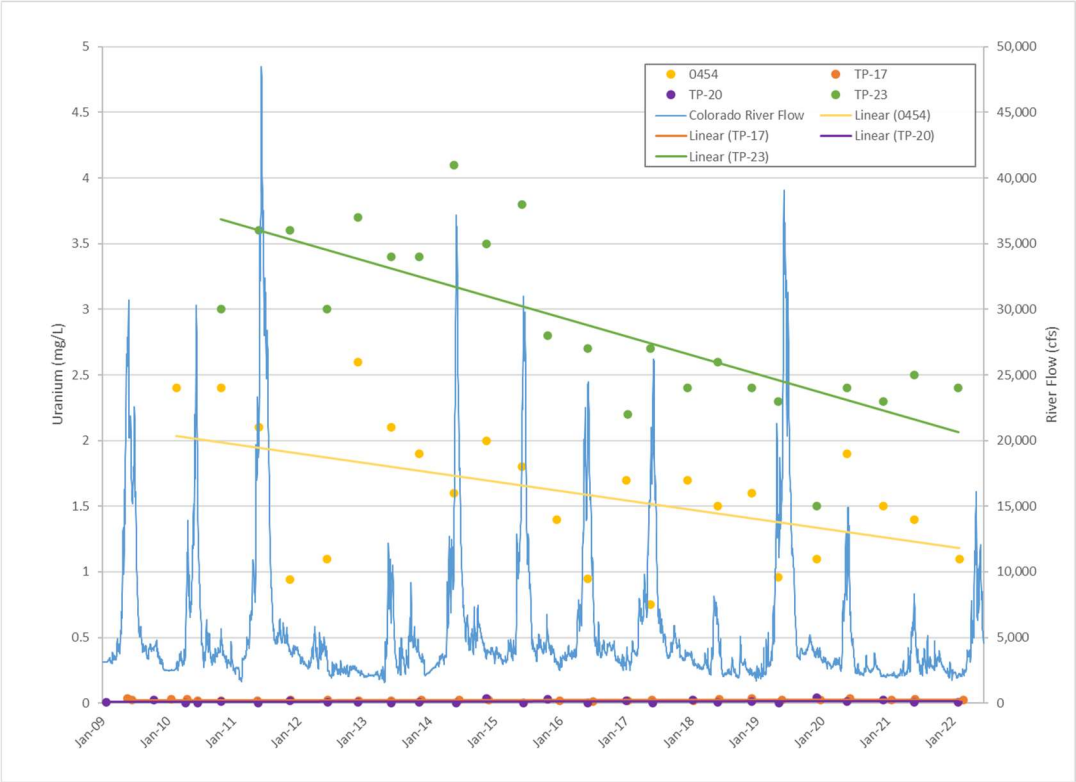

Figure 25. South of Site Observation Wells TP-17, TP-20, TP-23, and 0454 Time versus Uranium Concentration Plot

2.4.7 Response to CF5 Extraction

The sampling of wells AMM-2 and SMI-PZ2M2 provide some insight on how the CF5 extraction wells are impacting the groundwater system. Results from these monitoring wells are presented with the data collected from nearby extraction wells.

Monitoring well AMM-2 is located approximately 100 ft off extraction well 0813, and samples were collected from a depth of 48 ft bgs. Figures 26 and 27 present the ammonia and uranium concentrations (respectively), along with trend lines (linear) associated with the data collected from well AMM-2 and 0813. Figure 26 displays how the concentration fluctuations from the two wells generally are similar since 2009/2010, with the concentrations consistently higher in well AMM-2. Trend line data associated with the AMM-2 data set indicates the ammonia concentrations have on average decreased 17.8 mg/L per year since 2009, while extraction well 0813 has increased on average 1.0 mg/L per year (Figure 26).

Figure 27 displays the uranium concentrations from both wells, and except for the sample collected in May 2018, the AMM-2 concentrations are in general 0.5 mg/L higher compared to 0813. The trend line generated from the AMM-2 data set results in a uranium concentration increase of 0.04 mg/L per year on average, while the 0813 trend line indicates an increase of 0.03 mg/L per year.

Monitoring well SMI-PZ2M2 is within the SMI-PW02 well cluster (less than 20 ft away), and samples were collected from a depth of 56 ft bgs. Figures 28 and 29 present the ammonia and uranium concentrations (respectively) measured from samples collected from extraction well SMI-PW02 and monitoring well SMI-PZ2M2. Also provided on the plot is the linear trend line

associated with the SMI-PZ2M2 data set. The results indicate ammonia concentrations (Figure 28) from both locations have gradually decreased since 2009, with SMI-PZ2M2 generally having the higher concentration. The trend line associated with well SMI-PZ2M2 ammonia concentrations exhibits a decrease in the ammonia concentration of 37.9 mg/L per year, while extraction well SMI-PW02 has decreased on average 17.8 mg/L per year.

Figure 29 is a plot of the uranium concentrations for these locations. Results associated with the sampling from these locations indicate the SMI-PW02 the uranium concentrations are consistently higher compared to the SMI-PZ2M2 concentrations. The trend line associated with the SMI-PZ2M2 data set suggests the uranium concentration has increased on average 0.10 mg/L per year, while the SMI-PW02 concentration on average has not changed significantly (only decreasing 0.007 mg/L per year).

Results from both these monitoring well locations indicate CF5 extraction appears to impact the groundwater system close to the extraction wells, especially regarding ammonia concentrations. Results indicate ammonia concentrations have been gradually decreasing in the samples collected from these monitoring wells, a trend that is not apparent in wells located in areas outside of the influence of the CF5 extraction wells. Uranium concentrations, likely due to geochemical processes, have not displayed the same decrease over time. This trend is also displayed in the extraction well results.

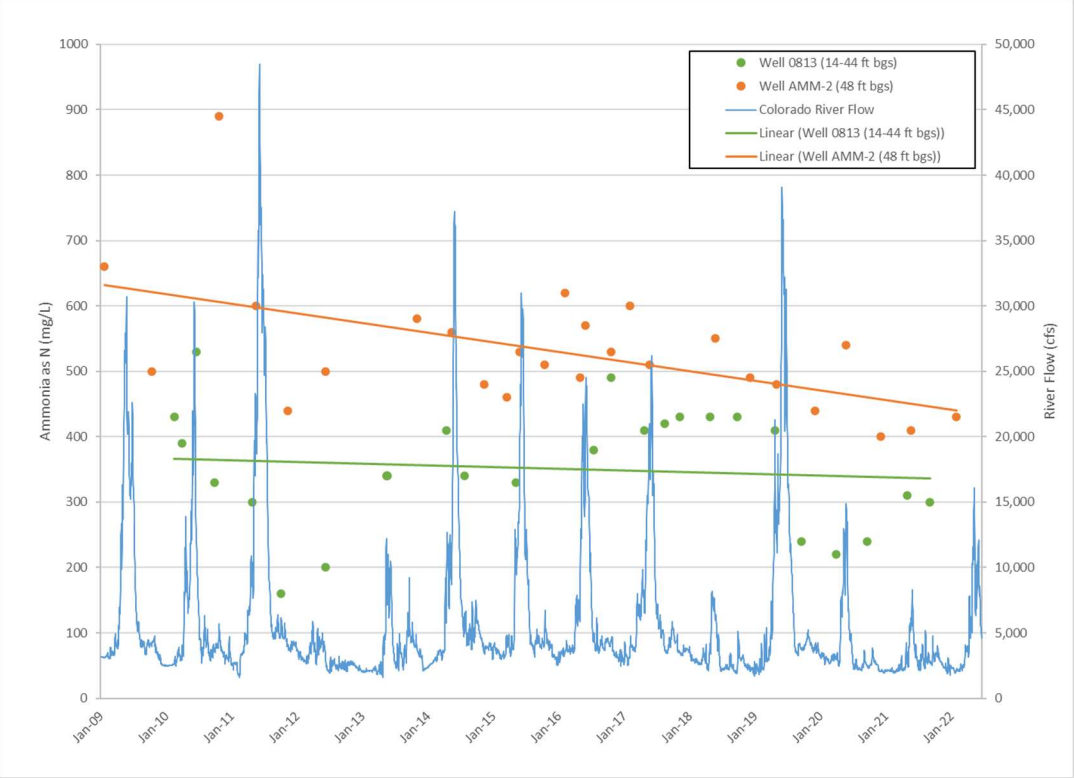

Figure 26. Monitoring Well AMM-2 and Extraction Well 0813 Time versus Ammonia Concentration Plot and Trend Line

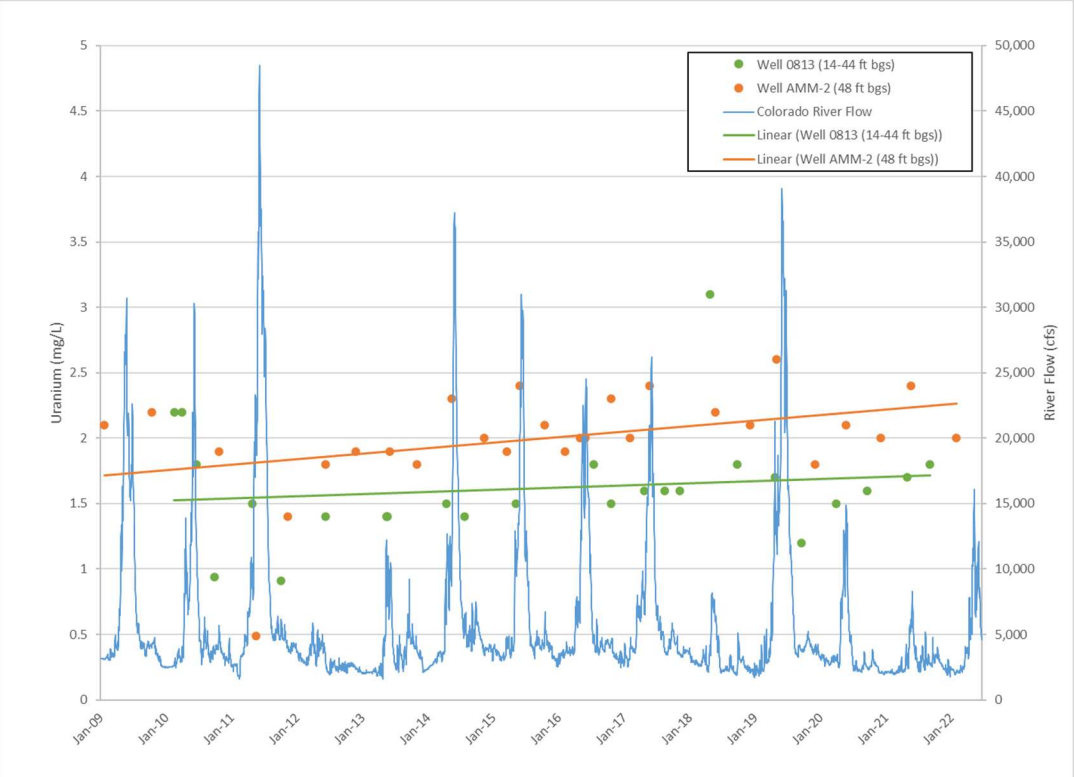

Figure 27. Monitoring Well AMM-2 and Extraction Well 0813 Time versus Uranium Concentration Plot and Trend Line

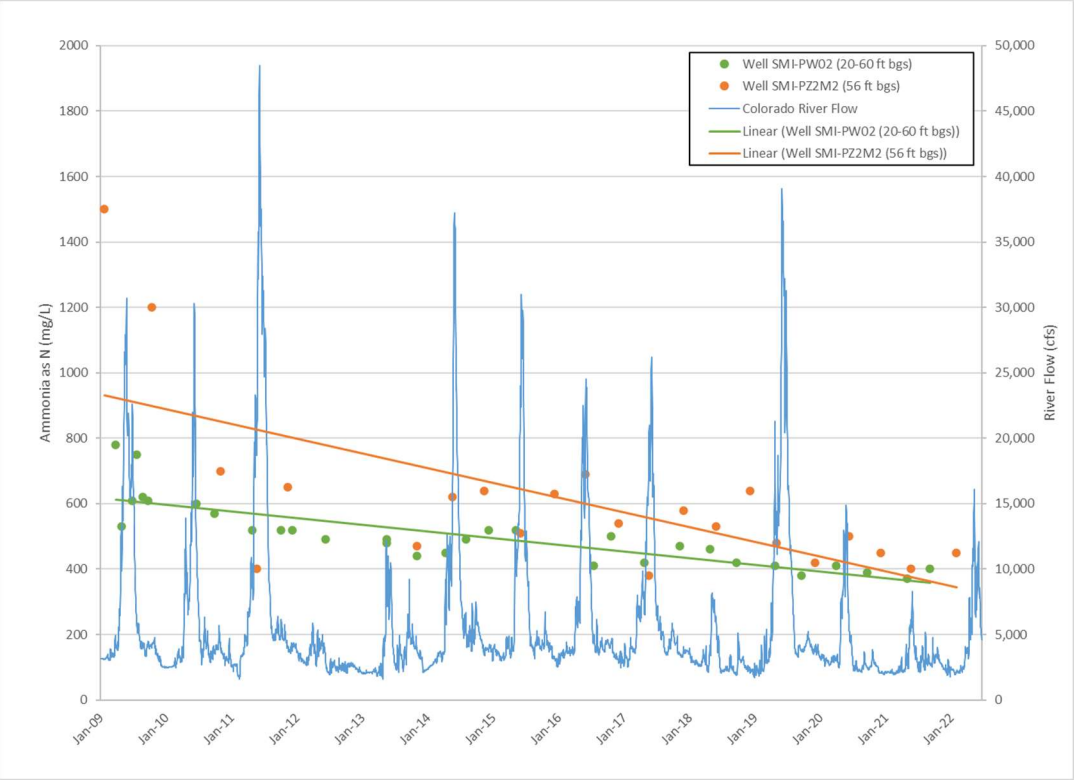

Figure 28. Monitoring Well SMI-PZ2M2 and Extraction Well SMI-PW02 Time versus Ammonia Concentration Plot and Trend Line

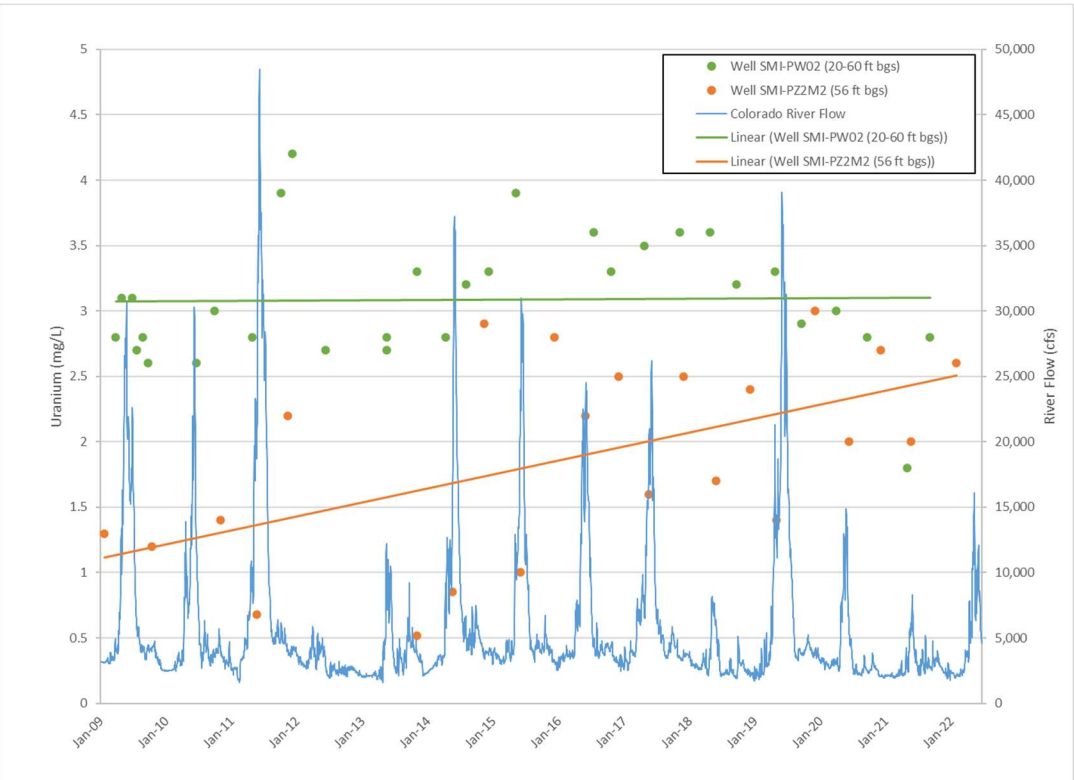

Figure 29. Monitoring Well SMI-PZ2M2 and Extraction Well SMI-PW02 Time versus Uranium Concentration Plot and Trend Line

2.4.8 Surface Water Sampling Results

Table 9 presents the ammonia results from the surface water samples collected in March 2022 from locations 0201, 0218, 0226, CR1, CR2, CR3, and CR5 (as shown in Figure 2). The ammonia results are used along with the temperature and pH data to derive applicable EPA criteria for both acute and chronic levels. These criteria are presented with the ammonia results and represent a snapshot at the time the samples were collected.

Table 9. Site-wide Surface Water Ammonia Concentrations and Comparisons to EPA Acute and Chronic Criteria

Location	Date	Temp (°C)	pH	March 2022 Ammonia as N (mg/L)	EPA - Acute Total as N (mg/L)*	EPA - Chronic Total as N (mg/L)**
0201	03/08/22	6.27	7.38	0.2	24	3.5
0218	03/07/22	7.02	8.01	0.2	8.8	1.8
0226	03/08/22	7.15	8.65	0.2	2.3	0.57
CR1	03/07/22	7.29	7.35	0.2	27	3.5
CR2	03/07/22	8.33	8.08	0.2	7.2	1.7
CR3	03/07/22	12.62	8.43	1.2	3.2	0.65
CR5	03/08/22	6.91	7.73	0.2	13	2.3

Notes: *U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table N.4. Temperature and pH-Dependent Values, Acute Concentration of Total Ammonia as N (mg/L)
**U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table 6. Temperature and pH-Dependent Values, Chronic Concentration of Total Ammonia as N (mg/L)

Six of the seven surface water samples collected resulted in concentrations equal to or lower than the detection limit (0.2 mg/L) and well below the acute and chronic criteria. The result from location CR3 had a concentration of 1.2, which was higher than the calculated chronic criteria for ammonia. This was likely due to low river flow rate and a shallow sample location because of recent sediment deposition from storm events that occurred in Oct 2021. The increased temperature also greatly lowered the chronic criteria, but no dead or stressed fish were observed.

2.5 Groundwater Surface Elevations

Water level data to generate the groundwater surface contour map were collected in February and March 2022. The Colorado River mean daily flows during this time period ranged from 2,040 to 2,630 cubic feet per second (cfs), which translates into a river surface elevation at the southern end of the site of only 3,953 to 3,953.3 ft above mean sea level. These flows were significantly below normal (the average mean daily flows for these dates ranged from 3,110 to 3,460 cfs) in response to continued drought conditions experienced in this region.

Because river elevations fluctuated only 0.3 ft during this time, it was possible to use this water level data collected during this time frame to generate the groundwater surface contour map displayed in Figure 30. This contour map displays how the site groundwater system responds to the river during primarily gaining conditions when groundwater discharges into the river. Groundwater flow direction and the gradient displayed in this contour map are comparable to historical contour maps generated using groundwater data collected during river base flow conditions.

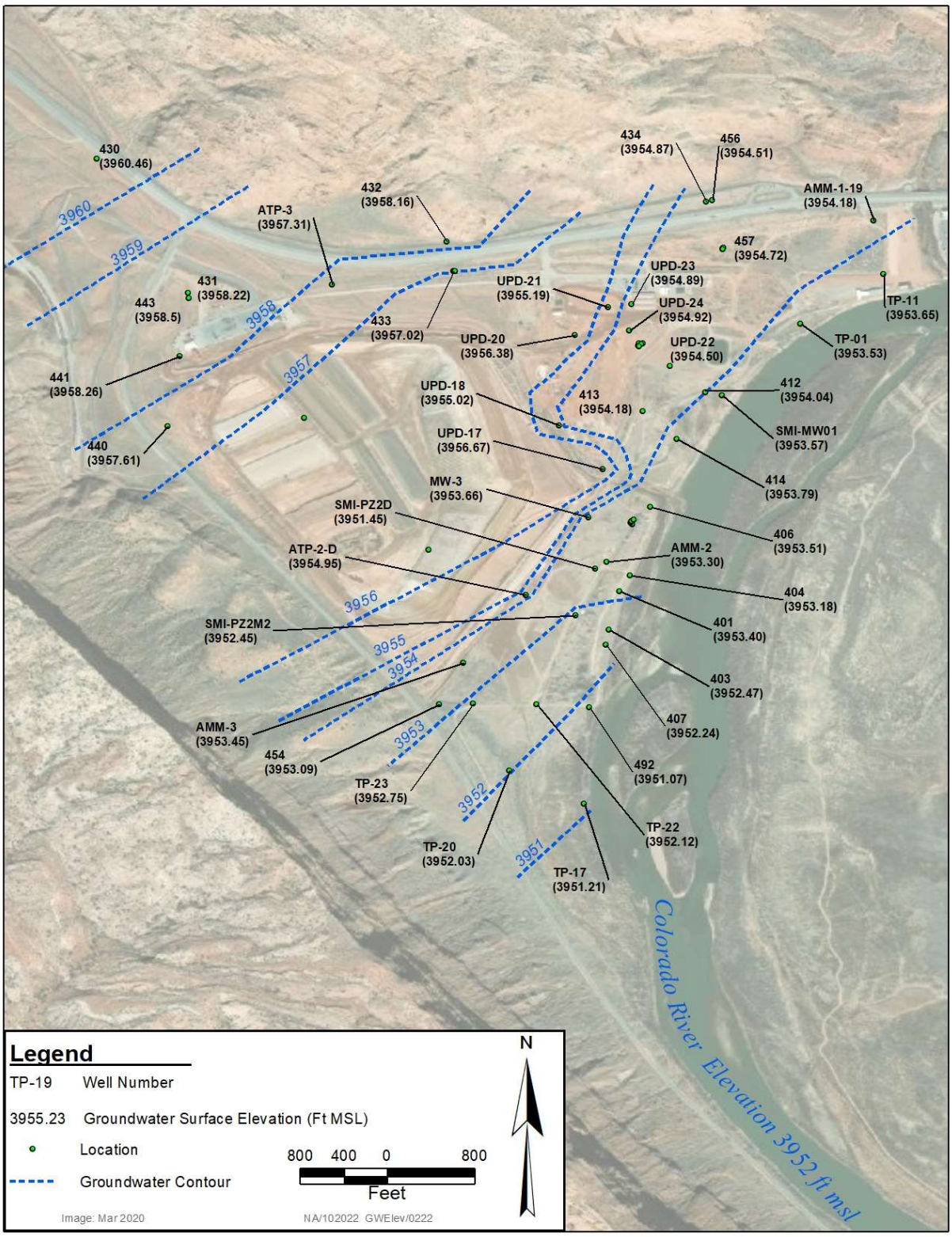

Figure 30. Site-wide Groundwater Elevations, February/March 2022

3.0 Conclusions

3.1 February/March Site-wide Sampling Event

The purpose of the February/March 2022 site-wide sampling event was to collect data from the site during Colorado River base flows and to assess any changes in the contaminant plume migration or trends in the groundwater system water chemistry. Five additional PCOCS were analyzed at all locations. Three of these (arsenic, manganese, and selenium) had result that exceeded 40 CFR 192 Sub A standards.

The river flows were lower than average due to continued drought conditions this region has been experiencing. Surface water sampling was also conducted to assess surface water quality adjacent to the site compared to upstream and downstream water quality.

In general, there was minimal plume migration based on the samples collected from wells located along the plume boundaries. Ammonia concentrations from the seven surface water samples collected during this sampling event were primarily non-detect except for one location that had a higher result above the applicable EPA criteria (for a suitable habitat) for chronic concentrations.

Previous data from the site-wide sampling event in 2021 showed elevated up-gradient ammonia concentrations. Data from the 2022 site-wide sampling event had ammonia data that is more in-line with past ammonia concentrations. This supports the theory that the 2021 elevated background ammonia concentrations were due to a laboratory error. A nonconformance report was completed to document the anomalous data.

4.0 References

40 CFR 192A (Code of Federal Regulations) Subpart A, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites."

DOE (U.S. Department of Energy), *Characterization of Groundwater Brine Zones at the Moab Project Site (Phase 1)* (GJO-2002-333-TAR, GJO-MOA 19.1.2-3).

DOE (U.S. Department of Energy), *Moab UMTRA Project Standard Practice for Validation of Laboratory Data* (DOE-EM/GJTAC1855).

DOE (U.S. Department of Energy), *Moab UMTRA Project Surface Water/Groundwater Sampling and Analysis Plan* (DOE-EM/GJTAC1830).