



Department of Energy  
Washington, DC 20585

December 14, 2017

Dr. Don Benn, Executive Director  
Navajo Nation Environmental Protection Agency  
P. O. Box 339  
Window Rock, AZ 86515

Subject: Analytical Results and Data Validation Record for Groundwater Samples Collected from the Highway 160 Site in Compliance with the El Paso Natural Gas Co. and The Navajo Nation v. United States No. 07-905 (D.D.C) Settlement Agreement

Dear Dr. Benn:

In compliance with the terms of the subject Settlement Agreement, the U.S. Department of Energy (DOE) Office of Legacy Management (LM) facilitated collection of groundwater split samples from the Highway 160 Site during LM's routine semiannual sampling event for the Tuba City, Arizona, Disposal Site in August 2017. LM has received and validated the analytical data for the August sampling event. The analytical results for contaminants of concern (COCs) are summarized below and results for the full analytical suite are provided as Attachment A. Attachment A also provides analytical results for the monitoring wells previously placed for Navajo Nation Environmental Protection Agency (NNEPA) on or near the Tuba City Uranium Mill Tailings Radiation Control Act (UMTRCA) site. Graphs showing the nitrate, sulfate and uranium concentrations over time at the wells of interest are provided in Attachment B. The record of data validation is provided as Attachment C, and the lithology logs and well completion data for the Highway 160 Site wells are provided as Attachment D. These attachments fulfill the submittal requirements described in the Settlement Agreement.

*Summary of Analytical Results for COCs in Groundwater Collected from the Highway 160 Site Wells*

Parameter	Regulatory Value <sup>a,b</sup>	Analytical Results and Data Qualifiers <sup>c</sup> for the Highway 160 Site Wells, August 2017 Sampling Event			
		Well 1420	Well 1421	Well 1422	Well 1423
Chloride	250	52	38	19	18
Molybdenum	0.1	0.012	0.0049	0.0054	0.021
Nitrate, as Nitrogen	10	0.01 (U)	0.01 (U)	0.01 (U)	0.29
Selenium	0.01	0.00066 (U)	0.00066 (U)	0.00066 (U)	0.00066 (U)
Sulfate	250	2.7	21	40	24
Total Dissolved Solids	500	300	270	260	170
Uranium	0.044	0.00017	0.00095	0.0052	0.0018
pH (standard units)	6.5-8.5	7.52	7.76	8.21	7.53

Notes:

<sup>a</sup> Units are milligrams per liter (mg/L) unless otherwise noted.

<sup>b</sup> The reference for molybdenum, nitrate, selenium, and uranium regulatory values is Title 40 *Code of Federal Regulations* Part 192. Regulatory values for chloride, sulfate, total dissolved solids, and pH are based on the Stakeholder Agreement.

<sup>c</sup> The "U" data qualifier for nitrate and selenium indicates that the compound was analyzed for, but was not detected above the sample quantitation limit.



December 14, 2017

In addition to the data submitted with this letter (meeting the requirements of the Settlement Agreement) all of the groundwater sampling and analysis information for the Tuba City site is accessible through the LM website (<https://www.lm.doe.gov/tuba/Sites.aspx>) and the Geospatial Environmental Mapping System (GEMS) at <https://gems.lm.doe.gov>. GEMS provides tools for dynamic mapping and visualization of site features, sample locations, and analytical data. All analytical data, field measurements, and data qualifiers are available for users to export and to compare with applicable standards. Reports and time-concentration graphs can be created. The options and flexibility provided by the GEMS website allows a greater variety of methods for evaluation of environmental data.

The next sampling event for the Tuba City site is scheduled for February 2018, and LM will again facilitate collection of split samples from the Highway 160 Site wells. The NNEPA will be provided with the required notification when firm dates are set.

Please call me at (970) 248-6073 if you have any questions. Please address any correspondence to:

U.S. Department of Energy  
Office of Legacy Management  
2597 Legacy Way  
Grand Junction, CO 81503

Sincerely,



Richard P. Bush  
UMTRCA Program Manager  
Office of Legacy Management

cc:

J. Grant, Jill Grant Law  
V. Blackhat, NNDOJ  
M. Doane, NRC  
B. Lynk, DOJ  
B. Mumme, DOE-GC (e)  
J. Elmer, Navarro (e)  
P. Lemke, Navarro (e)  
File: TUB 0400.02 (records)

**ATTACHMENT A**  
**Groundwater Quality Data for Tuba City, Arizona, Disposal Site**

**Wells 1420, 1421, 1422, 1423 (Highway 160 Site)**  
**and**  
**Wells NMW-1A, NMW-2A, NMW-3A, NMW-4A, NNW-6S, NMW-7D, NMW-8S,**  
**NMW-9D**

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# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: 1420

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	150				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.008		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	15		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	52		0.3		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	1.80				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.29		0.0067		FQ	Y
Magnesium	mg/L	08/23/2017	F	T	3.1		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.22		0.00024		FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.012		0.00032		FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	0.01		0.003	U	FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	-115				FQ	Y
pH	SU	08/23/2017	F	N	7.52				FQ	Y
Potassium	mg/L	08/23/2017	F	T	1.6		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.00066		0.00066	U	FQ	Y
Silica	mg/L	08/23/2017	F	T	13		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	6.2		0.0097		FQ	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: 1420**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	97		0.047		FQ	Y
Specific Conductance	uS/cm	08/23/2017	F	N	526				FQ	Y
Strontium	mg/L	08/23/2017	F	T	0.15		0.00026		FQ	Y
Sulfate	mg/L	08/23/2017	F	N	2.7		0.15		FQ	Y
Temperature	C	08/23/2017	F	N	17.44				FQ	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	300				FQ	Y
Turbidity	NTU	08/23/2017	F	N	2.74				FQ	Y
Uranium	mg/L	08/23/2017	F	T	0.00017		0.000012		FQ	Y
Vanadium	mg/L	08/23/2017	F	T	0.00063		0.00058	J	FQ	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: 1421

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	182				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.0088		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	13		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	38		0.3		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	0.71				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.045		0.0067	J	FQU	Y
Magnesium	mg/L	08/23/2017	F	T	3		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.088		0.00024		FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.0049		0.00032		FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	0.01		0.003	U	FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	-260				FQ	Y
pH	SU	08/23/2017	F	N	7.76				FQ	Y
Potassium	mg/L	08/23/2017	F	T	1.7		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.00066		0.00066	U	FQ	Y
Silica	mg/L	08/23/2017	F	T	12		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	5.8		0.0097		FQ	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: 1421**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	96		0.047		FQ	Y
Specific Conductance	uS/cm	08/23/2017	F	N	494				FQ	Y
Strontium	mg/L	08/23/2017	F	T	0.15		0.00026		FQ	Y
Sulfate	mg/L	08/23/2017	F	N	21		0.15		FQ	Y
Temperature	C	08/23/2017	F	N	16.95				FQ	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	270				FQ	Y
Turbidity	NTU	08/23/2017	F	N	2.54				FQ	Y
Uranium	mg/L	08/23/2017	F	T	0.00095		0.000012		FQ	Y
Vanadium	mg/L	08/23/2017	F	T	0.0015		0.00058	J	FQ	Y



# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: 1422

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	158				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.01		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	9.8		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	19		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	1.18				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.13		0.0067		FQU	Y
Magnesium	mg/L	08/23/2017	F	T	1.9		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.025		0.00024		FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.0054		0.00032		FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	0.01		0.003	U	FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	-167				FQ	Y
pH	SU	08/23/2017	F	N	8.21				FQ	Y
Potassium	mg/L	08/23/2017	F	T	1.1		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.00066		0.00066	U	FQ	Y
Silica	mg/L	08/23/2017	F	T	13		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	6.1		0.0097		FQ	Y

Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: 1422

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	96		0.047		FQ	Y
Specific Conductance	uS/cm	08/23/2017	F	N	483				FQ	Y
Strontium	mg/L	08/23/2017	F	T	0.1		0.00026		FQ	Y
Sulfate	mg/L	08/23/2017	F	N	40		0.15		FQ	Y
Temperature	C	08/23/2017	F	N	17.96				FQ	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	260				FQ	Y
Turbidity	NTU	08/23/2017	F	N	6.05				FQ	Y
Uranium	mg/L	08/23/2017	F	T	0.0052		0.000012		FQ	Y
Vanadium	mg/L	08/23/2017	F	T	0.0014		0.00058	J	FQ	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: 1423

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	98				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.0025		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	28		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	18		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	0.72				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.19		0.0067		FQ	Y
Magnesium	mg/L	08/23/2017	F	T	5.8		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.11		0.00024		FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.021		0.00032		FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	0.29		0.003		FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	-100				FQ	Y
pH	SU	08/23/2017	F	N	7.53				FQ	Y
Potassium	mg/L	08/23/2017	F	T	2.2		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.00066		0.00066	U	FQ	Y
Silica	mg/L	08/23/2017	F	T	10		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	4.8		0.0097		FQ	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-1A

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	78				F	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	F	Y
Arsenic	mg/L	08/23/2017	F	T	0.0019		0.00012		F	Y
Calcium	mg/L	08/23/2017	F	T	35		0.024		F	Y
Chloride	mg/L	08/23/2017	F	N	11		0.06		F	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	7.81				F	Y
Iron	mg/L	08/23/2017	F	T	0.0067		0.0067	U	F	Y
Magnesium	mg/L	08/23/2017	F	T	5.8		0.03		F	Y
Manganese	mg/L	08/23/2017	F	T	0.00024		0.00024	U	F	Y
Molybdenum	mg/L	08/23/2017	F	T	0.00036		0.00032	J	F	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	3.2		0.03		F	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	51.1				F	Y
pH	SU	08/23/2017	F	N	7.80				F	Y
Potassium	mg/L	08/23/2017	F	T	1.3		0.052		F	Y
Selenium	mg/L	08/23/2017	F	T	0.0014		0.00066		F	Y
Silica	mg/L	08/23/2017	F	T	11		0.021		F	Y
Silicon	mg/L	08/23/2017	F	T	5.3		0.0097		F	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-1A**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	10		0.047		F	Y
Specific Conductance	uS/cm	08/23/2017	F	N	270				F	Y
Strontium	mg/L	08/23/2017	F	T	0.3		0.00026		F	Y
Sulfate	mg/L	08/23/2017	F	N	15		0.15		F	Y
Temperature	C	08/23/2017	F	N	20.10				F	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	150				F	Y
Turbidity	NTU	08/23/2017	F	N	1.27				F	Y
Uranium	mg/L	08/23/2017	F	T	0.0014		0.000012		F	Y
Vanadium	mg/L	08/23/2017	F	T	0.011		0.00058		F	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-2A

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/24/2017	F	N	75				FQ	Y
Ammonia Total as N	mg/L	08/24/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/24/2017	F	T	0.0021		0.00012		FQ	Y
Calcium	mg/L	08/24/2017	F	T	32		0.024		FQ	Y
Chloride	mg/L	08/24/2017	F	N	9		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/24/2017	F	N	7.69				FQ	Y
Iron	mg/L	08/24/2017	F	T	0.043		0.0067	J	FQU	Y
Magnesium	mg/L	08/24/2017	F	T	5.3		0.03		FQ	Y
Manganese	mg/L	08/24/2017	F	T	0.00024		0.00024	U	FQ	Y
Molybdenum	mg/L	08/24/2017	F	T	0.00034		0.00032	J	FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	F	N	3		0.03		FQ	Y
Oxidation Reduction Potential	mV	08/24/2017	F	N	121.9				FQ	Y
pH	SU	08/24/2017	F	N	7.71				FQ	Y
Potassium	mg/L	08/24/2017	F	T	1.4		0.052		FQ	Y
Selenium	mg/L	08/24/2017	F	T	0.0013		0.00066		FQ	Y
Silica	mg/L	08/24/2017	F	T	11		0.021		FQ	Y
Silicon	mg/L	08/24/2017	F	T	5.1		0.0097		FQ	Y

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**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-2A**

Report Date: 11/13/2017

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Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/24/2017	F	T	12		0.047		FQ	Y
Specific Conductance	uS/cm	08/24/2017	F	N	265				FQ	Y
Strontium	mg/L	08/24/2017	F	T	0.31		0.00026		FQ	Y
Sulfate	mg/L	08/24/2017	F	N	12		0.15		FQ	Y
Temperature	C	08/24/2017	F	N	16.37				FQ	Y
Total Dissolved Solids	mg/L	08/24/2017	F	N	160				FQ	Y
Turbidity	NTU	08/24/2017	F	N	1.48				FQ	Y
Uranium	mg/L	08/24/2017	F	T	0.0013		0.000012		FQ	Y
Vanadium	mg/L	08/24/2017	F	T	0.01		0.00058		FQ	Y

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# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-3A

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/24/2017	F	N	91				F	Y
Ammonia Total as N	mg/L	08/24/2017	F	N	0.1		0.03	U	F	Y
Arsenic	mg/L	08/24/2017	F	T	0.0021		0.00012		F	Y
Calcium	mg/L	08/24/2017	F	T	32		0.024		F	Y
Chloride	mg/L	08/24/2017	F	N	8.6		0.06		F	Y
Dissolved Oxygen	mg/L	08/24/2017	F	N	7.33				F	Y
Iron	mg/L	08/24/2017	F	T	0.0067		0.0067	U	F	Y
Magnesium	mg/L	08/24/2017	F	T	5.8		0.03		F	Y
Manganese	mg/L	08/24/2017	F	T	0.00024		0.00024	U	F	Y
Molybdenum	mg/L	08/24/2017	F	T	0.00038		0.00032	J	F	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	F	N	3		0.03		F	Y
Oxidation Reduction Potential	mV	08/24/2017	F	N	119.0				F	Y
pH	SU	08/24/2017	F	N	7.84				F	Y
Potassium	mg/L	08/24/2017	F	T	1.4		0.052		F	Y
Selenium	mg/L	08/24/2017	F	T	0.0009		0.00066	J	F	Y
Silica	mg/L	08/24/2017	F	T	11		0.021		F	Y
Silicon	mg/L	08/24/2017	F	T	5.2		0.0097		F	Y



**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-3A**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/24/2017	F	T	10		0.047		F	Y
Specific Conductance	uS/cm	08/24/2017	F	N	276				F	Y
Strontium	mg/L	08/24/2017	F	T	0.37		0.00026		F	Y
Sulfate	mg/L	08/24/2017	F	N	12		0.15		F	Y
Temperature	C	08/24/2017	F	N	18.70				F	Y
Total Dissolved Solids	mg/L	08/24/2017	F	N	110				F	Y
Turbidity	NTU	08/24/2017	F	N	0.96				F	Y
Uranium	mg/L	08/24/2017	F	T	0.0011		0.000012		F	Y
Vanadium	mg/L	08/24/2017	F	T	0.01		0.00058		F	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-4A

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/24/2017	F	N	82				F	Y
Ammonia Total as N	mg/L	08/24/2017	F	N	0.1		0.03	U	F	Y
Ammonia Total as N	mg/L	08/24/2017	D	N	0.1		0.03	U	F	Y
Arsenic	mg/L	08/24/2017	F	T	0.002		0.00012		F	Y
Arsenic	mg/L	08/24/2017	D	T	0.0019		0.00012		F	Y
Calcium	mg/L	08/24/2017	F	T	32		0.024		F	Y
Calcium	mg/L	08/24/2017	D	T	32		0.024		F	Y
Chloride	mg/L	08/24/2017	F	N	9.3		0.06		F	Y
Chloride	mg/L	08/24/2017	D	N	9.2		0.06		F	Y
Dissolved Oxygen	mg/L	08/24/2017	F	N	7.93				F	Y
Iron	mg/L	08/24/2017	F	T	0.021		0.0067	J	FU	Y
Iron	mg/L	08/24/2017	D	T	0.035		0.0067	J	FU	Y
Magnesium	mg/L	08/24/2017	F	T	5.3		0.03		F	Y
Magnesium	mg/L	08/24/2017	D	T	5.3		0.03		F	Y
Manganese	mg/L	08/24/2017	F	T	0.0065		0.00024		F	Y
Manganese	mg/L	08/24/2017	D	T	0.00098		0.00024	J	F	Y
Molybdenum	mg/L	08/24/2017	F	T	0.00032		0.00032	U	F	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-4A

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Molybdenum	mg/L	08/24/2017	D	T	0.00032		0.00032	U	F	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	F	N	4.2		0.03		FJ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	D	N	3.4		0.03		FJ	Y
Oxidation Reduction Potential	mV	08/24/2017	F	N	114.2				F	Y
pH	SU	08/24/2017	F	N	7.84				F	Y
Potassium	mg/L	08/24/2017	F	T	1.9		0.052		F	Y
Potassium	mg/L	08/24/2017	D	T	1.8		0.052		F	Y
Selenium	mg/L	08/24/2017	F	T	0.00092		0.00066	J	F	Y
Selenium	mg/L	08/24/2017	D	T	0.0012		0.00066		F	Y
Silica	mg/L	08/24/2017	F	T	10		0.021		F	Y
Silica	mg/L	08/24/2017	D	T	10		0.021		F	Y
Silicon	mg/L	08/24/2017	F	T	4.7		0.0097		F	Y
Silicon	mg/L	08/24/2017	D	T	4.7		0.0097		F	Y
Sodium	mg/L	08/24/2017	F	T	11		0.047		F	Y
Sodium	mg/L	08/24/2017	D	T	11		0.047		F	Y
Specific Conductance	uS/cm	08/24/2017	F	N	266				F	Y
Strontium	mg/L	08/24/2017	F	T	0.29		0.00026		F	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-4A**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Strontium	mg/L	08/24/2017	D	T	0.29		0.00026		F	Y
Sulfate	mg/L	08/24/2017	F	N	13		0.15		F	Y
Sulfate	mg/L	08/24/2017	D	N	13		0.15		F	Y
Temperature	C	08/24/2017	F	N	17.42				F	Y
Total Dissolved Solids	mg/L	08/24/2017	F	N	90				F	Y
Total Dissolved Solids	mg/L	08/24/2017	D	N	130				F	Y
Turbidity	NTU	08/24/2017	F	N	0.95				F	Y
Uranium	mg/L	08/24/2017	F	T	0.0011		0.000012		F	Y
Uranium	mg/L	08/24/2017	D	T	0.0012		0.000012		F	Y
Vanadium	mg/L	08/24/2017	F	T	0.01		0.00058		F	Y
Vanadium	mg/L	08/24/2017	D	T	0.011		0.00058		F	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-6S

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	77				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.0013		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	38		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	13		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	7.19				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.0067		0.0067	U	FQ	Y
Magnesium	mg/L	08/23/2017	F	T	6.2		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.0024		0.00024	J	FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.00036		0.00032	J	FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	3.4		0.03		FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	49.0				FQ	Y
pH	SU	08/23/2017	F	N	7.65				FQ	Y
Potassium	mg/L	08/23/2017	F	T	1.5		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.0018		0.00066		FQ	Y
Silica	mg/L	08/23/2017	F	T	12		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	5.5		0.0097		FQ	Y

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**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-6S**

Report Date: 11/13/2017

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Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	9.5		0.047		FQ	Y
Specific Conductance	uS/cm	08/23/2017	F	N	282				FQ	Y
Strontium	mg/L	08/23/2017	F	T	0.32		0.00026		FQ	Y
Sulfate	mg/L	08/23/2017	F	N	19		0.15		FQ	Y
Temperature	C	08/23/2017	F	N	17.45				FQ	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	170				FQ	Y
Turbidity	NTU	08/23/2017	F	N	2.20				FQ	Y
Uranium	mg/L	08/23/2017	F	T	0.0012		0.000012		FQ	Y
Vanadium	mg/L	08/23/2017	F	T	0.0089		0.00058		FQ	Y

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**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-7D**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/23/2017	F	N	40				FQ	Y
Ammonia Total as N	mg/L	08/23/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/23/2017	F	T	0.0025		0.00012		FQ	Y
Calcium	mg/L	08/23/2017	F	T	28		0.024		FQ	Y
Chloride	mg/L	08/23/2017	F	N	7.7		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/23/2017	F	N	5.68				FQ	Y
Iron	mg/L	08/23/2017	F	T	0.0067		0.0067	U	FQ	Y
Magnesium	mg/L	08/23/2017	F	T	5.1		0.03		FQ	Y
Manganese	mg/L	08/23/2017	F	T	0.0022		0.00024	J	FQ	Y
Molybdenum	mg/L	08/23/2017	F	T	0.00032		0.00032	U	FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/23/2017	F	N	3		0.03		FQ	Y
Oxidation Reduction Potential	mV	08/23/2017	F	N	54.4				FQ	Y
pH	SU	08/23/2017	F	N	7.44				FQ	Y
Potassium	mg/L	08/23/2017	F	T	1.4		0.052		FQ	Y
Selenium	mg/L	08/23/2017	F	T	0.0011		0.00066		FQ	Y
Silica	mg/L	08/23/2017	F	T	12		0.021		FQ	Y
Silicon	mg/L	08/23/2017	F	T	5.7		0.0097		FQ	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-7D**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/23/2017	F	T	5.6		0.047		FQ	Y
Specific Conductance	uS/cm	08/23/2017	F	N	213				FQ	Y
Strontium	mg/L	08/23/2017	F	T	0.46		0.00026		FQ	Y
Sulfate	mg/L	08/23/2017	F	N	11		0.15		FQ	Y
Temperature	C	08/23/2017	F	N	19.41				FQ	Y
Total Dissolved Solids	mg/L	08/23/2017	F	N	110				FQ	Y
Turbidity	NTU	08/23/2017	F	N	3.04				FQ	Y
Uranium	mg/L	08/23/2017	F	T	0.00083		0.000012		FQ	Y
Vanadium	mg/L	08/23/2017	F	T	0.01		0.00058		FQ	Y



# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-8S

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/24/2017	F	N	75				F	Y
Ammonia Total as N	mg/L	08/24/2017	F	N	0.1		0.03	U	F	Y
Arsenic	mg/L	08/24/2017	F	T	0.002		0.00012		F	Y
Calcium	mg/L	08/24/2017	F	T	32		0.024		F	Y
Chloride	mg/L	08/24/2017	F	N	11		0.06		F	Y
Dissolved Oxygen	mg/L	08/24/2017	F	N	8.14				F	Y
Iron	mg/L	08/24/2017	F	T	0.13		0.0067		FU	Y
Magnesium	mg/L	08/24/2017	F	T	5.2		0.03		F	Y
Manganese	mg/L	08/24/2017	F	T	0.00024		0.00024	U	F	Y
Molybdenum	mg/L	08/24/2017	F	T	0.00032		0.00032	U	F	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	F	N	3.3		0.03		F	Y
Oxidation Reduction Potential	mV	08/24/2017	F	N	95.1				F	Y
pH	SU	08/24/2017	F	N	7.65				F	Y
Potassium	mg/L	08/24/2017	F	T	1.8		0.052		F	Y
Selenium	mg/L	08/24/2017	F	T	0.0012		0.00066		F	Y
Silica	mg/L	08/24/2017	F	T	10		0.021		F	Y
Silicon	mg/L	08/24/2017	F	T	4.7		0.0097		F	Y

**Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site****Location: NMW-8S**

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/24/2017	F	T	11		0.047		F	Y
Specific Conductance	uS/cm	08/24/2017	F	N	267				F	Y
Strontium	mg/L	08/24/2017	F	T	0.27		0.00026		F	Y
Sulfate	mg/L	08/24/2017	F	N	14		0.15		F	Y
Temperature	C	08/24/2017	F	N	17.79				F	Y
Total Dissolved Solids	mg/L	08/24/2017	F	N	90				F	Y
Turbidity	NTU	08/24/2017	F	N	1.19				F	Y
Uranium	mg/L	08/24/2017	F	T	0.0013		0.000012		F	Y
Vanadium	mg/L	08/24/2017	F	T	0.011		0.00058		F	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-9D

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Alkalinity, Total (As CaCO3)	mg/L	08/24/2017	F	N	84				FQ	Y
Ammonia Total as N	mg/L	08/24/2017	F	N	0.1		0.03	U	FQ	Y
Arsenic	mg/L	08/24/2017	F	T	0.00068		0.00012	J	FQ	Y
Calcium	mg/L	08/24/2017	F	T	31		0.024		FQ	Y
Chloride	mg/L	08/24/2017	F	N	10		0.06		FQ	Y
Dissolved Oxygen	mg/L	08/24/2017	F	N	0.74				FQ	Y
Iron	mg/L	08/24/2017	F	T	0.0067		0.0067	U	FQ	Y
Magnesium	mg/L	08/24/2017	F	T	6.2		0.03		FQ	Y
Manganese	mg/L	08/24/2017	F	T	0.0096		0.00024		FQ	Y
Molybdenum	mg/L	08/24/2017	F	T	0.0018		0.00032	J	FQ	Y
Nitrate + Nitrite as Nitrogen	mg/L	08/24/2017	F	N	2.7		0.03		FQ	Y
Oxidation Reduction Potential	mV	08/24/2017	F	N	109.4				FQ	Y
pH	SU	08/24/2017	F	N	6.89				FQ	Y
Potassium	mg/L	08/24/2017	F	T	1.9		0.052		FQ	Y
Selenium	mg/L	08/24/2017	F	T	0.001		0.00066		FQ	Y
Silica	mg/L	08/24/2017	F	T	11		0.021		FQ	Y
Silicon	mg/L	08/24/2017	F	T	5.2		0.0097		FQ	Y

# Groundwater Quality Data by Location For Site TUB01, Tuba City Disposal Site

Location: NMW-9D

Report Date: 11/13/2017

Parameter	Units	Sample Date	Sample Type	Fraction	Result	Uncertainty	MDC/MDL	Lab	Data	QA
Sodium	mg/L	08/24/2017	F	T	14		0.047		FQ	Y
Specific Conductance	uS/cm	08/24/2017	F	N	289				FQ	Y
Strontium	mg/L	08/24/2017	F	T	0.56		0.00026		FQ	Y
Sulfate	mg/L	08/24/2017	F	N	23		0.15		FQ	Y
Temperature	C	08/24/2017	F	N	18.70				FQ	Y
Total Dissolved Solids	mg/L	08/24/2017	F	N	120				FQ	Y
Turbidity	NTU	08/24/2017	F	N	1.31				FQ	Y
Uranium	mg/L	08/24/2017	F	T	0.0013		0.000012		FQ	Y
Vanadium	mg/L	08/24/2017	F	T	0.0042		0.00058		FQ	Y

SAMPLE TYPE: D = Duplicate E = Equipment Blank F = Field Sample FB = Field Blank TB = Trip Blank

FRACTION: D = Dissolved N = NA T = Total

MDC / MDL: MDC = Radiochemical minimum detectable concentration MDL = Non-radiochemical minimum detection limit

LAB QUALIFIERS (details can be found in laboratory report):

\* = One or more quality control criteria failed (e.g., laboratory control sample, surrogate spike, or calibration verification recovery).

B = Blank contamination. The reported result is associated with a contaminated blank.

D = Result is from the analysis of a diluted sample.

H = Holding time was exceeded.

J = The reported result is an estimated value (e.g., matrix interference was observed or the analyte was detected at a concentration outside the quantitation range).

U = Analytical result is below the MDC or MDL.

Z = Laboratory defined qualifier, see case narrative.

DATA QUALIFIERS:

F = Low flow sampling method used.

L = Less than 3 bore volumes purged prior to sampling.

U = Parameter analyzed for, but not detected.

G = Possible grout contamination, pH > 9

Q = Qualitative result due to sampling technique.

X = Location is undefined.

J = Estimated value

R = Rejected, unusable result

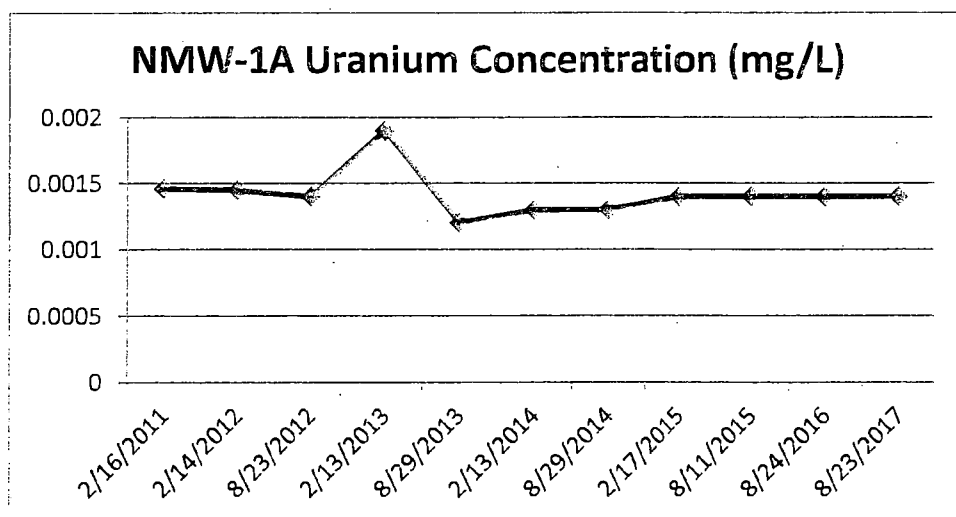
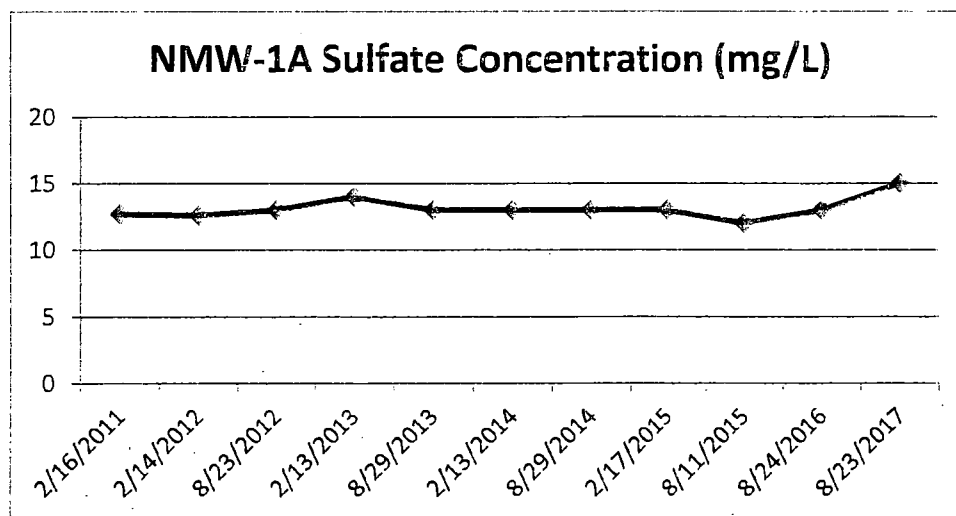
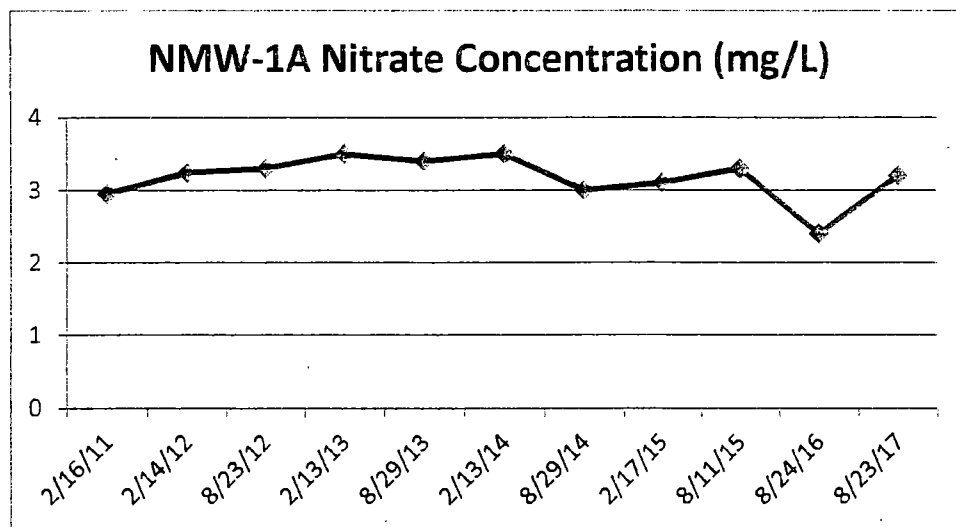
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**ATTACHMENT B**  
**Time-Concentration Graphs for Nitrate, Sulfate and Uranium**  
**Wells NMW-1A, -2A, -3A, -4A, -5A, -6S, -7D, -8S, -9D**

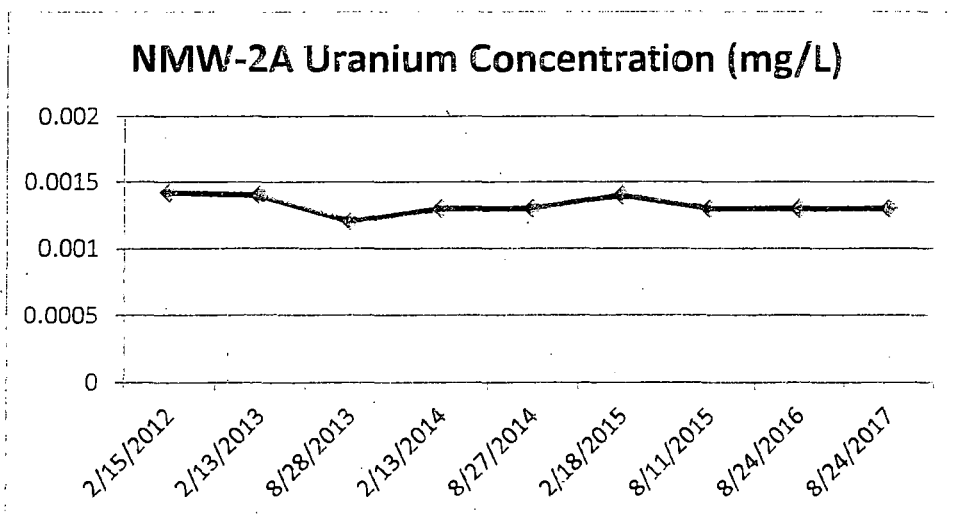
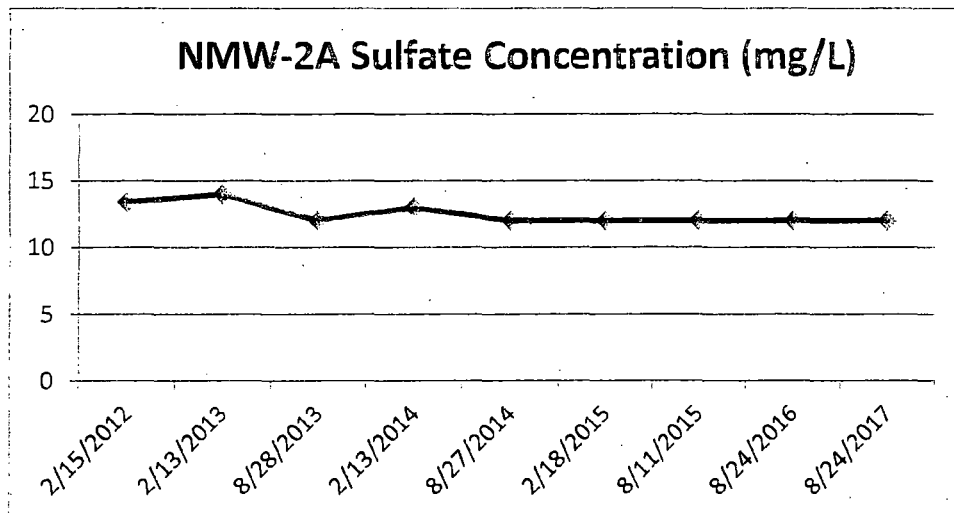
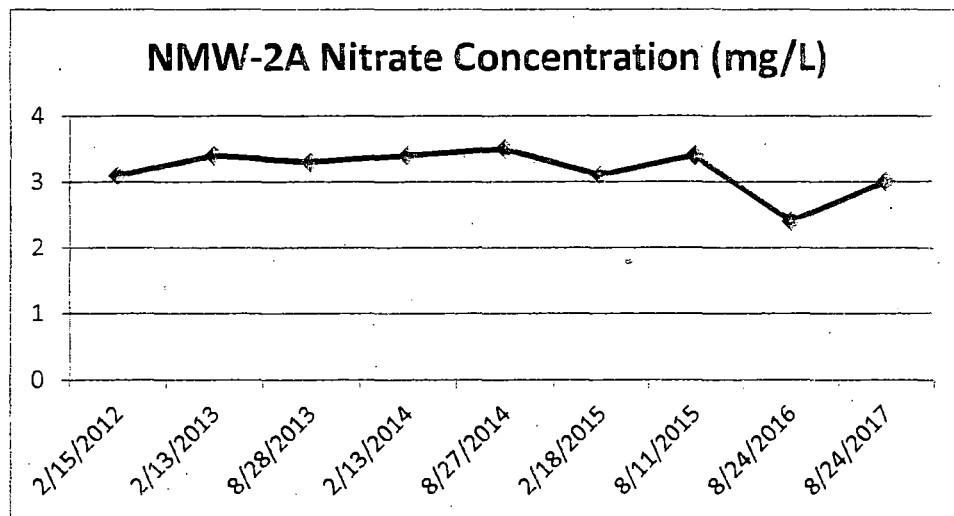
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**Time-Concentration (T-C) graphs for nitrate, sulfate and uranium at Well NMW-1A**

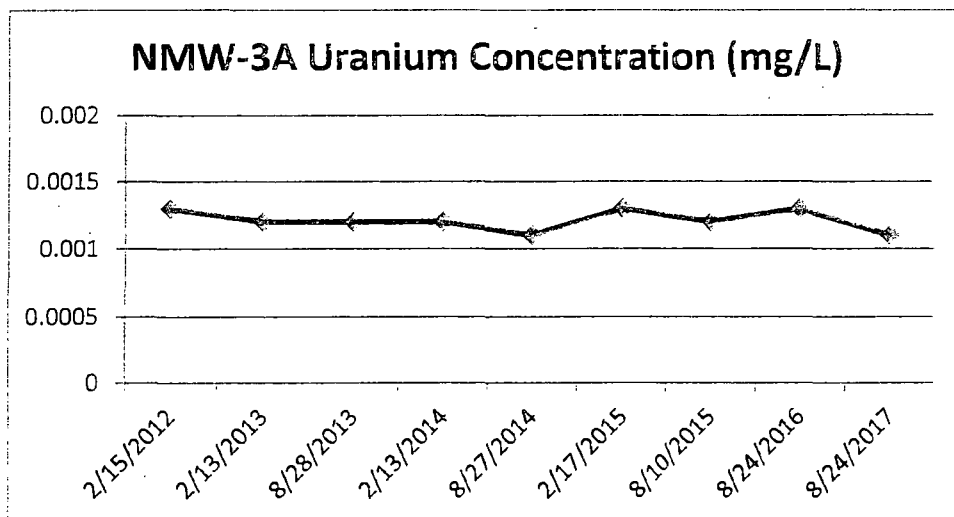
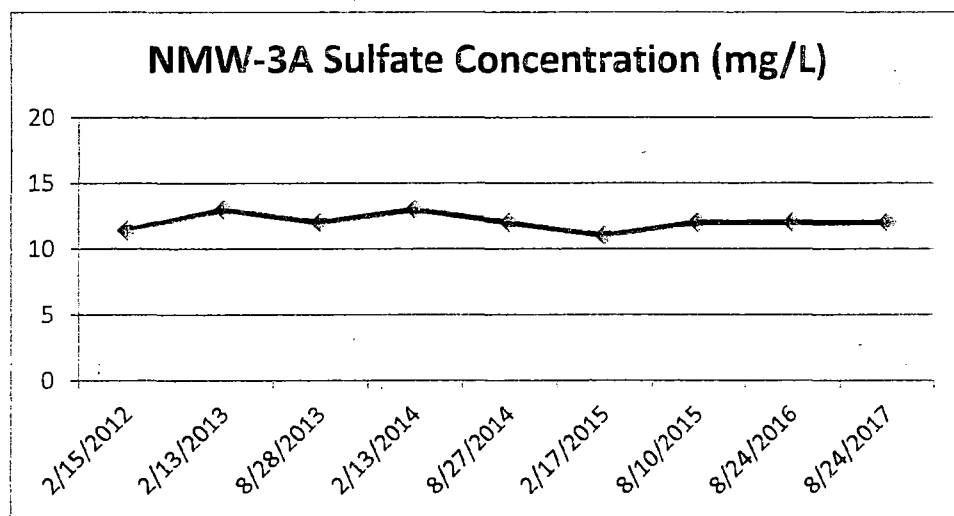
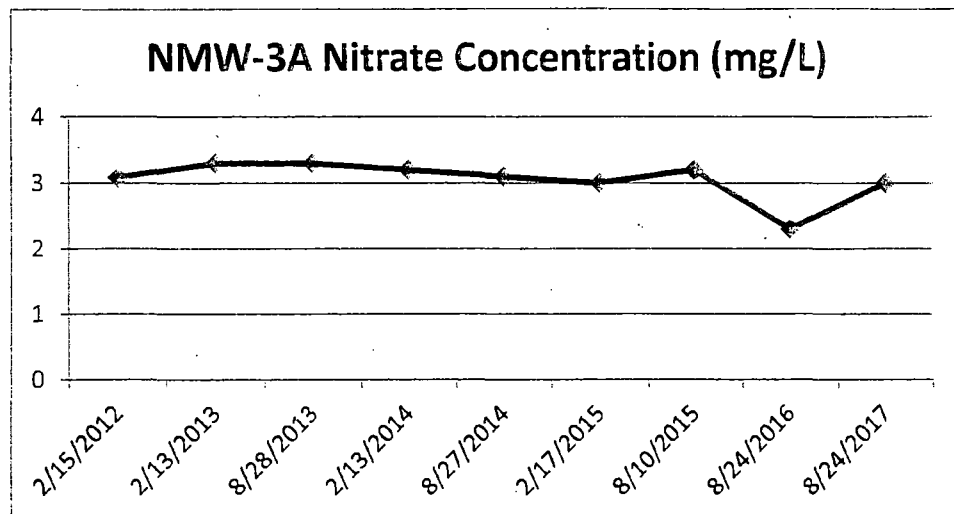




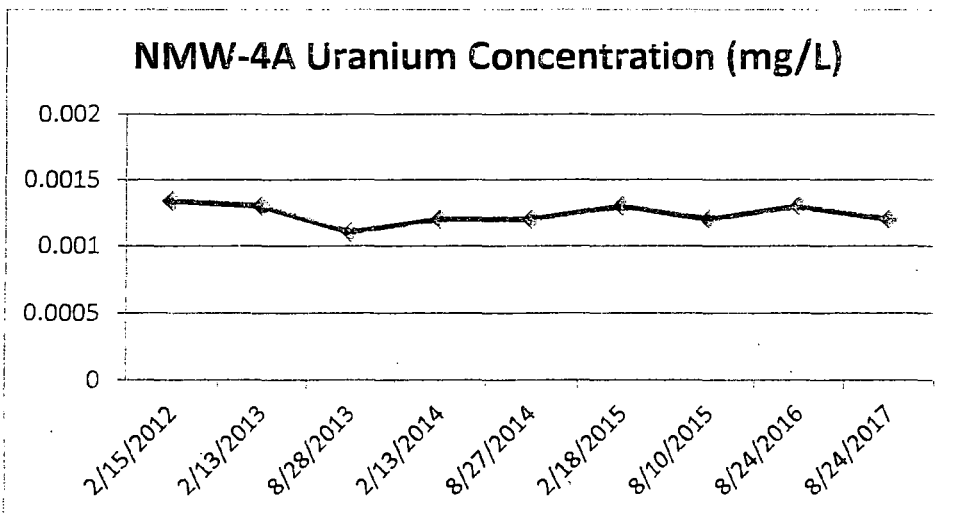
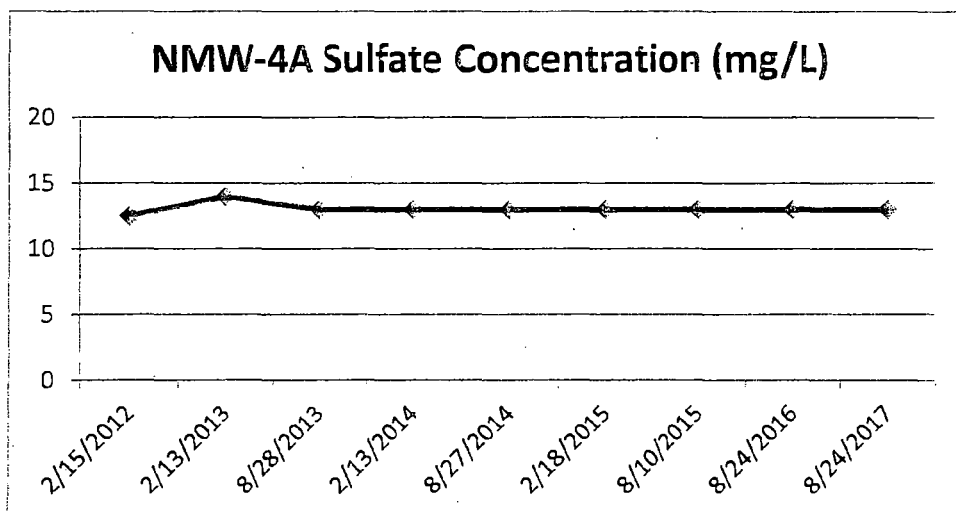
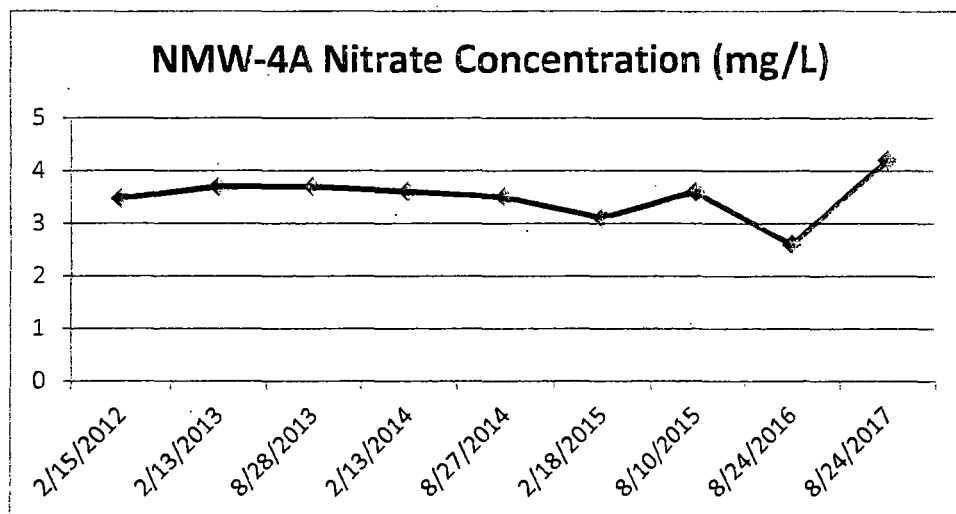
T-C graphs for nitrate, sulfate and uranium at Well NMW-2A



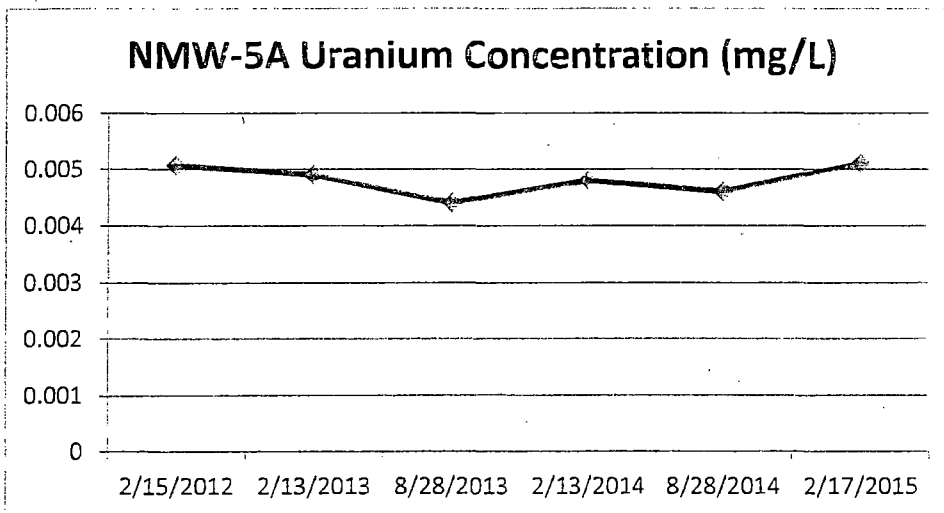
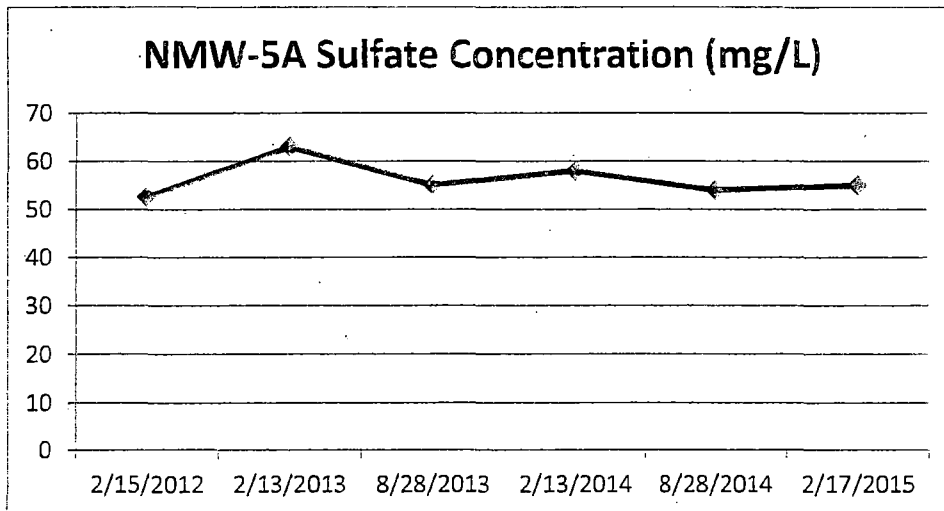
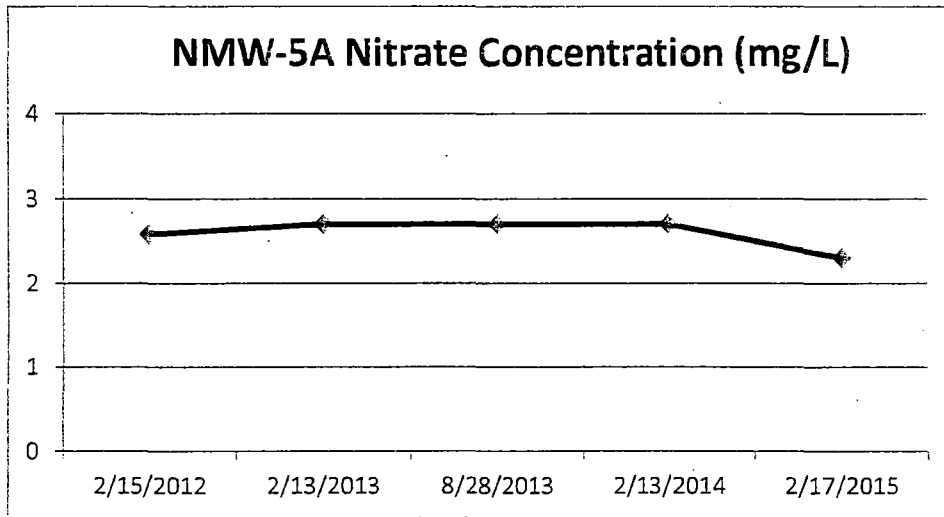
T-C graphs for nitrate, sulfate and uranium at Well NMW-3A



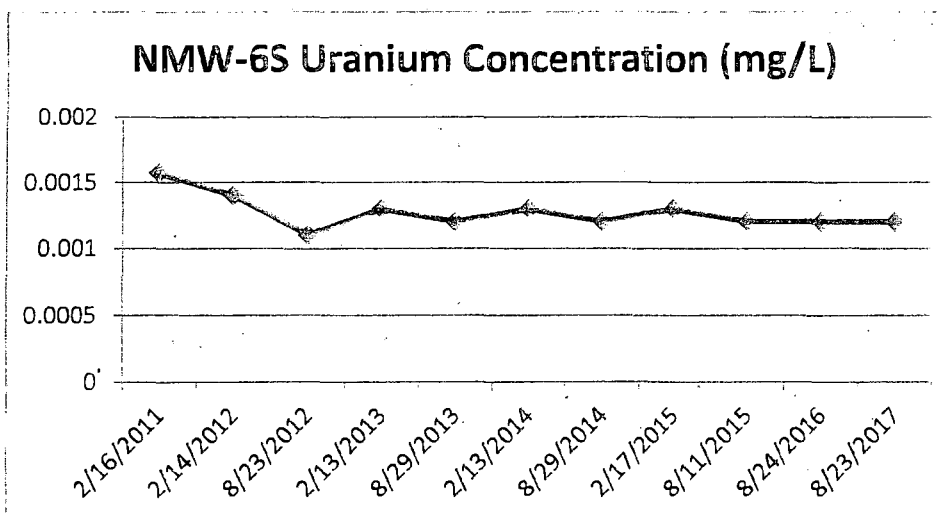
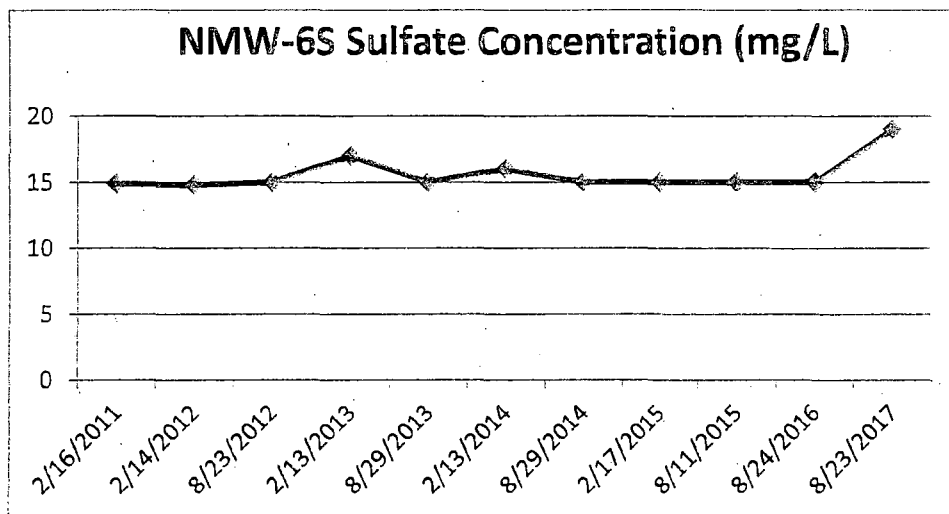
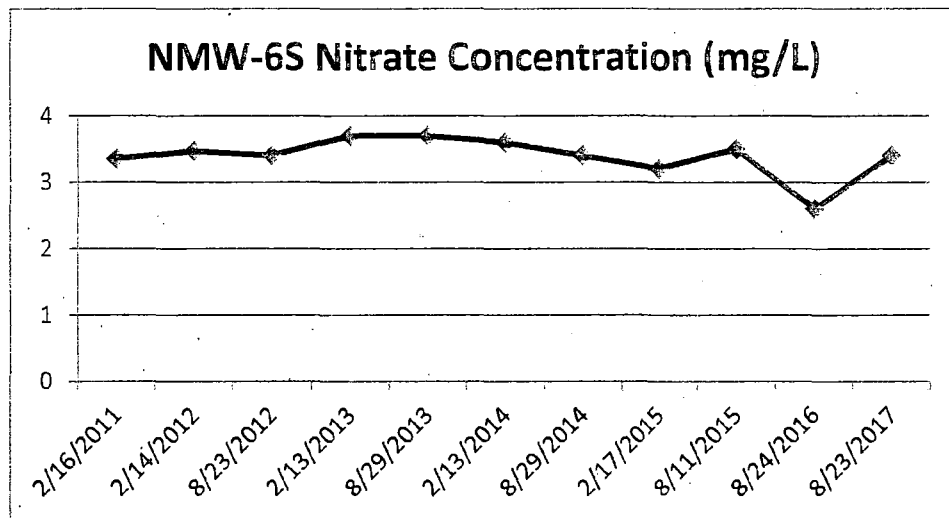
T-C graphs for nitrate, sulfate and uranium at Well NMW-4A



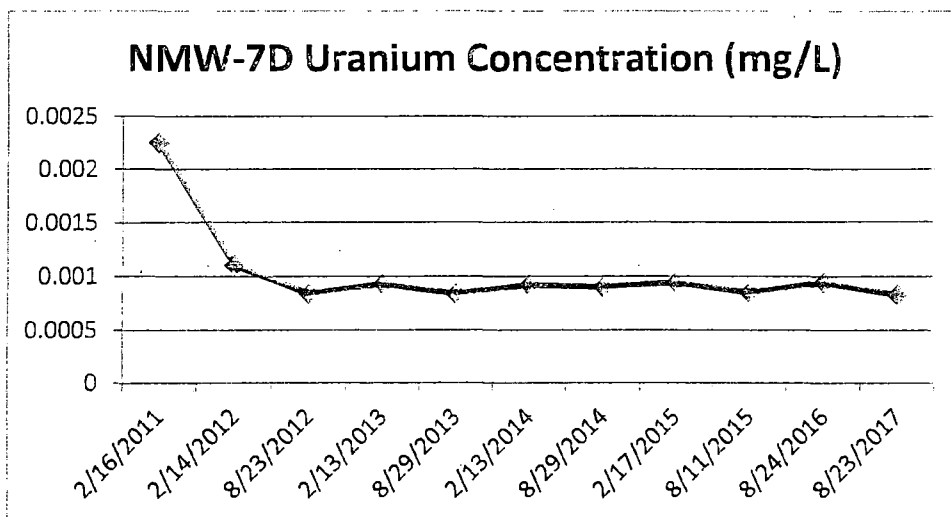
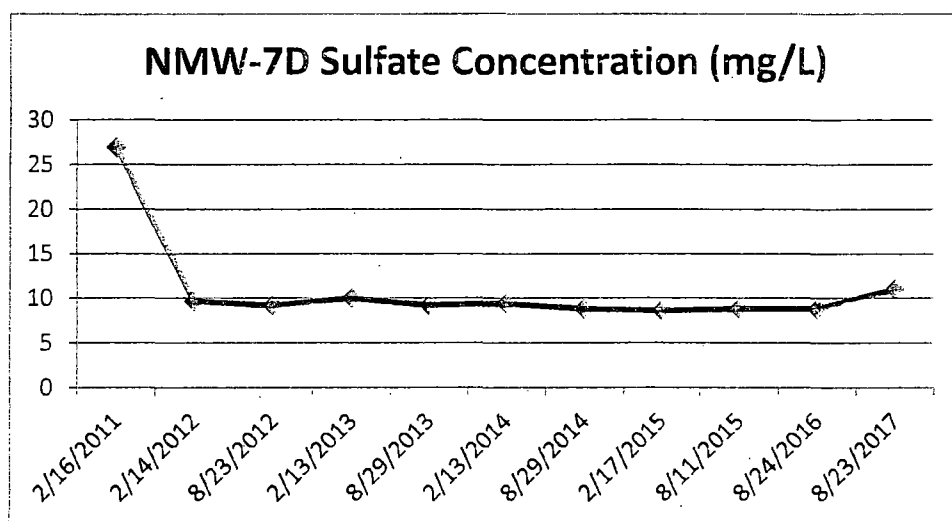
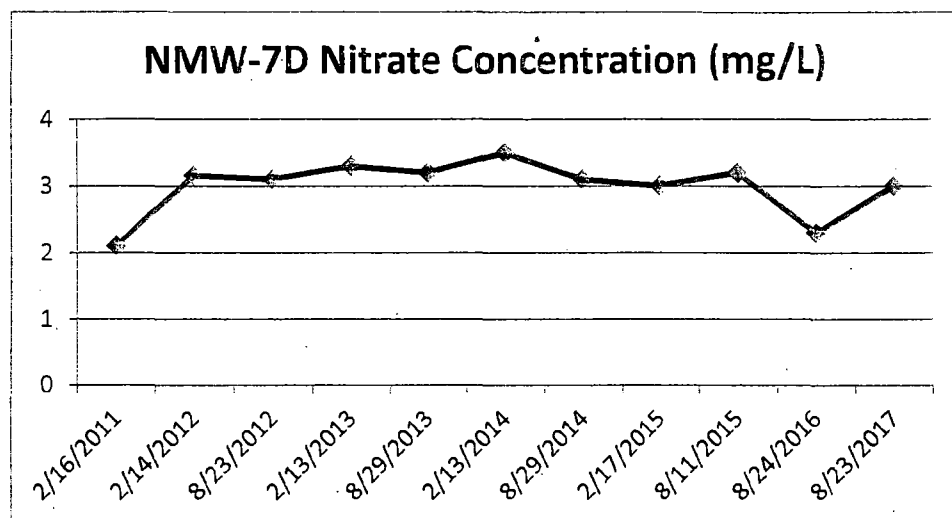
T-C graphs for nitrate, sulfate and uranium at Well NMW-5A



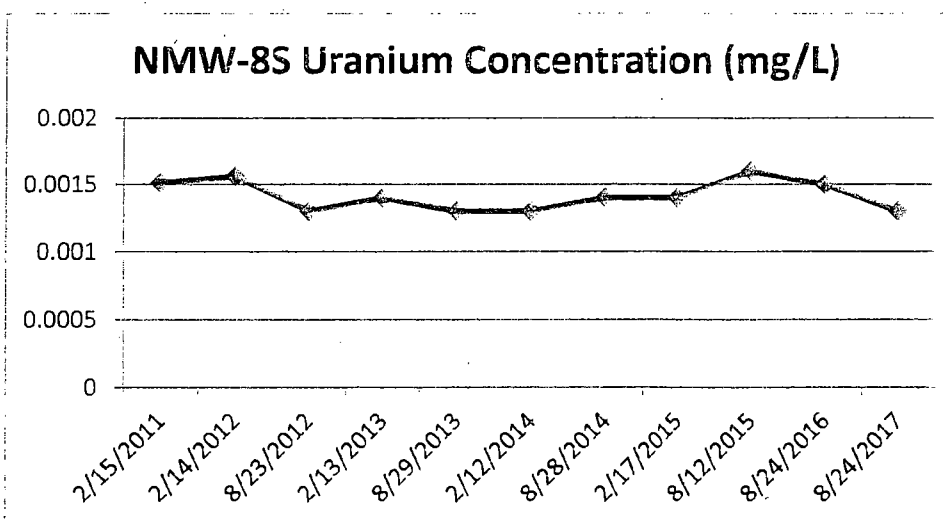
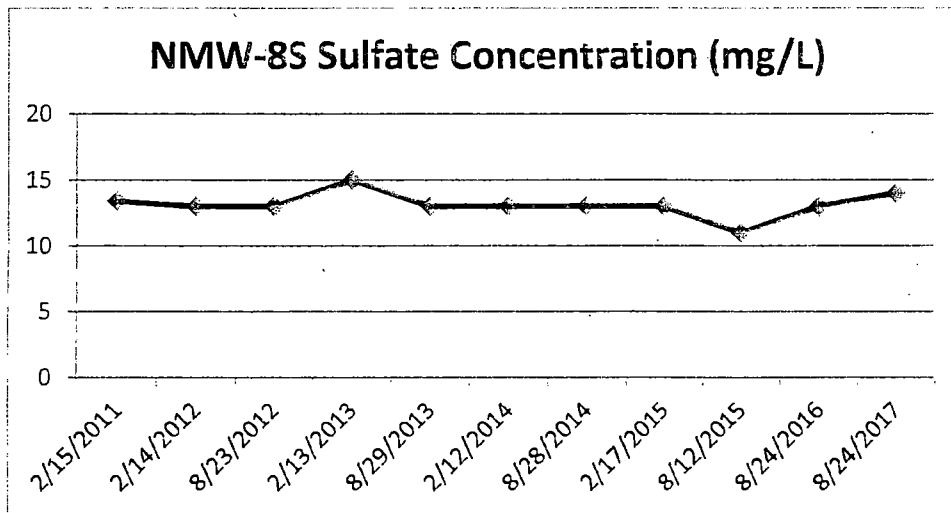
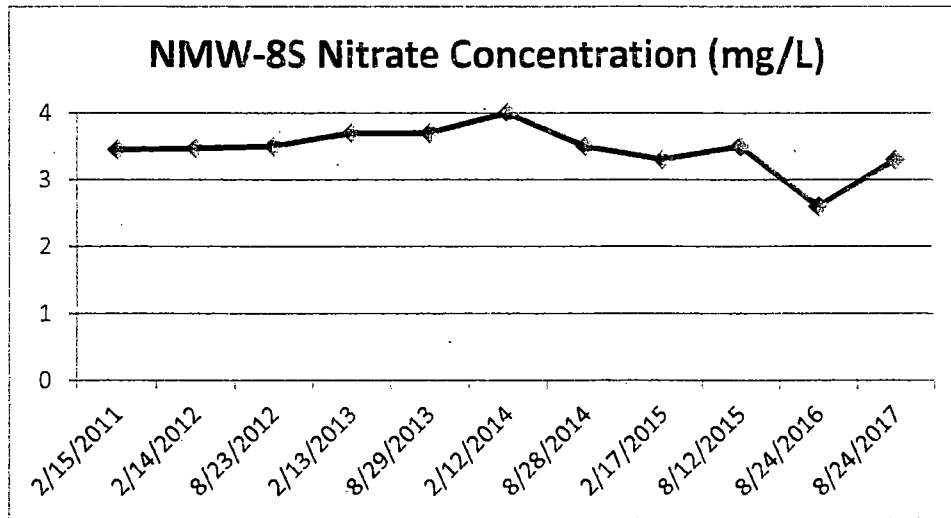
T-C graphs for nitrate, sulfate and uranium at Well NMW-6S



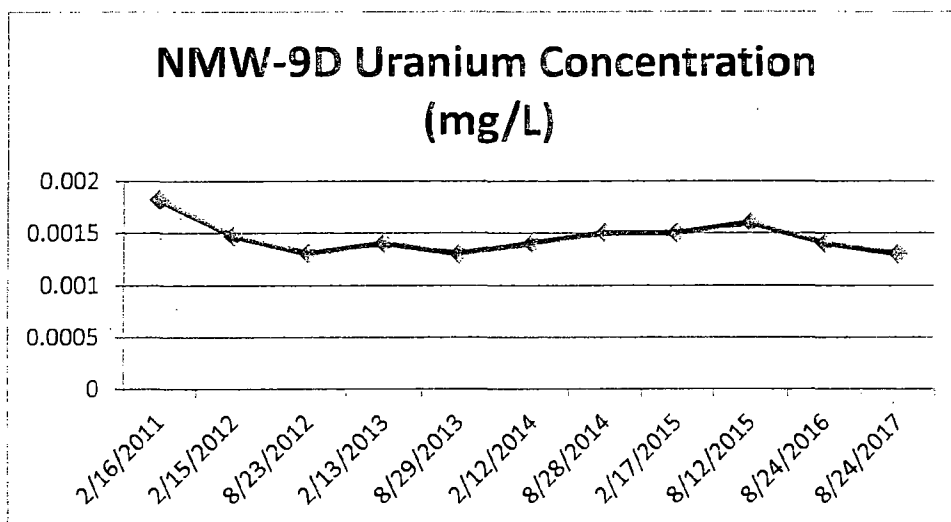
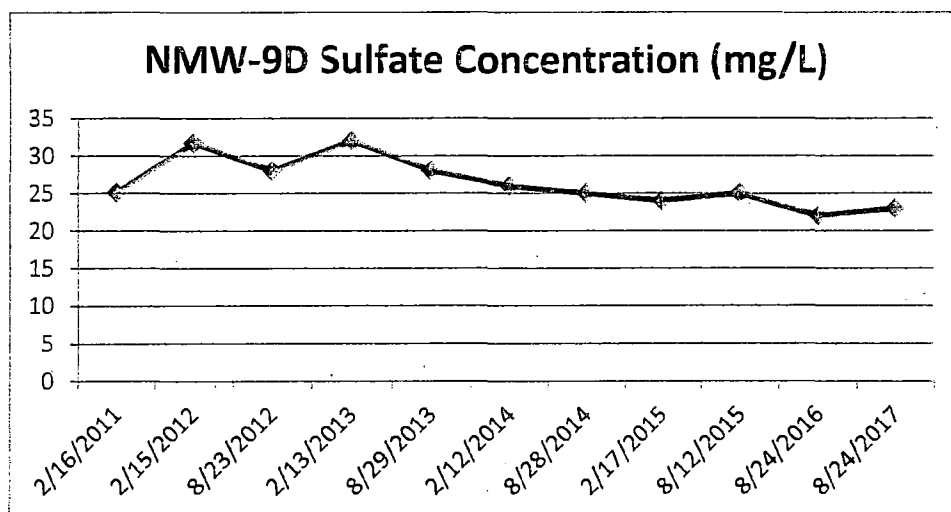
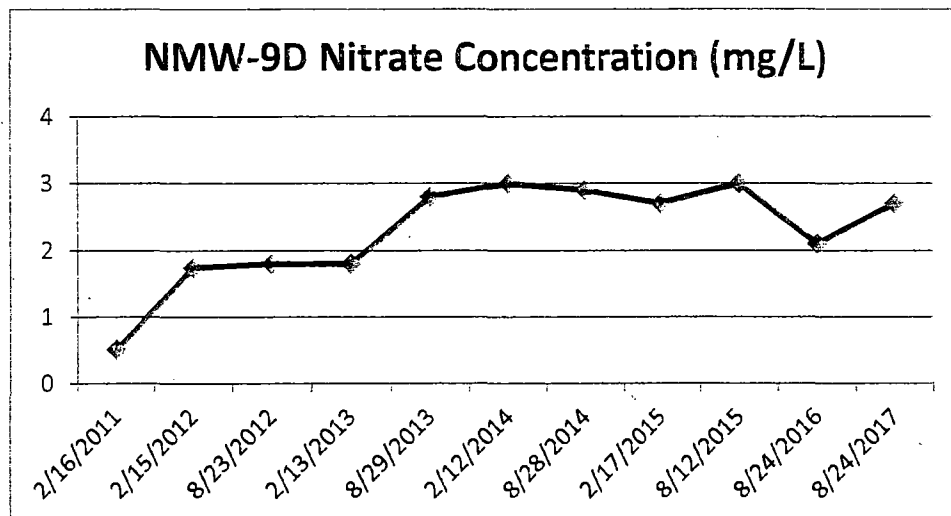
T-C graphs for nitrate, sulfate and uranium at Well NMW-7D



T-C graphs for nitrate, sulfate and uranium at Well NMW-8S



T-C graphs for nitrate, sulfate and uranium at Well NMW-9D





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**ATTACHMENT C**

**Data Validation Memorandum for August 2017 Sampling Event  
Tuba City, Arizona, Disposal Site**

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# NAVARRO

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To: Peter Lemke, Navarro  
From: Stephen Donivan, Navarro  
CC: Janice McDonald, Navarro  
Date: November 3, 2017  
Re: Validation of August 2017 Groundwater and Surface Water Data from Tuba City, Arizona, Disposal Site

Validation of data generated from the August 2017 groundwater and surface water sampling event at the Tuba City, Arizona, Disposal Site has been completed. This Level 3 validation was conducted according to the Standard Practice for Validation of Environmental Data (Environmental Procedures Catalog LMS/POL/S04325, continually updated).

The samples were submitted for analyses identified by Task Code TUB01-01.1708001. Planned monitoring locations are shown in the Sampling and Analysis Work Order (Enclosure 1). Samples were collected at 85 of the 90 planned locations. See the Trip Report (Enclosure 2) for additional details.

All environmental data from this sampling event are considered validated and available for use. Site data are available for viewing with dynamic mapping via the GEMS (Geospatial Environmental Mapping System) website at <http://gems.lm.doe.gov/#>. The Data Assessment Summary (Enclosure 3) includes documentation of the validation. An assessment of anomalous data is included in Enclosure 4. Summaries of Enclosures 3 and 4 are presented below.

## **Sampling and Analysis Work Order (Enclosure 1)**

## **Trip Report (Enclosure 2)**

## **Data Assessment Summary (Enclosure 3)**

### *Verification of Field Activities*

The field activities and field data were reviewed and the review documented on Field Verification Checklists. It was noted that alkalinity was not measured at location 0281 and all stability criteria was not met at location 0901.

### *Laboratory Performance Assessment*

Most laboratory analytical quality control criteria were met, as documented in the Laboratory Performance Assessment. Many of the iron results were qualified as not detected because the iron concentration was less than five times the associated blank concentration.

### *Assessment of Field Quality Control Samples*

An assessment of field quality control samples was conducted. Duplicate samples were collected from locations 0252, 0684, 0910, 0932, and NMW-4A. The relative percent difference (RPD) for duplicate results that are greater than 5 times the PQL should be less than 20 percent. The RPD is not used to evaluate results that are less than 5 times the PQL. For these results, the range should be no greater than the PQL. The duplicate results met the criteria with the following exception. The RPD for nitrate/nitrite as N at location NMW-4A was greater than 20 percent. The associated nitrate/nitrite as N results for this location are qualified with a "J" flag as estimated values.

### **Assessment of Anomalous Data (Enclosure 4)**

Data were identified as potentially anomalous for 19 results (see the Data Validation Outliers Report, Enclosure 4). Notable were the chloride and sulfate results for location 0264. These data also resulted in a charge balance of 44.2% indicating that an analytical error is likely. While screening the anions aliquot of chloride and sulfate concentrations from this location, the analyst noted that the analyte concentrations observed in the anions aliquot were not in agreement with the analyte concentrations in the metals aliquot. It was concluded that the anions aliquot submitted for this location had been mislabeled in the field. The chloride and sulfate results for this location are qualified with an "R" flag as rejected because the identity of the sample could not be assured.

Further review of the data for the remaining outliers did not indicate any laboratory errors. Potential anomalies in the field parameters were also examined. The alkalinity value of 832 mg/L recorded for location 0688 is much greater than the historical maximum of 128 mg/L. This value likely contributed to the cation/anion balance of 49.5%. The alkalinity result for this location is qualified with an "R" flag as rejected.

Enclosures (4)

**Enclosure 1**  
**Sampling and Analysis Work Order**

**NAVARRO**

**Navarro Research and Engineering, Inc.**

August 1, 2017

Task Assignment 103  
Control Number 17-0835

U.S. Department of Energy  
Office of Legacy Management  
ATTN: Richard Bush  
Site Manager  
2597 Legacy Way  
Grand Junction, CO 81503

SUBJECT: Contract No. DE-LM0000421, Navarro Research and Engineering, Inc.  
(Navarro)  
Task Assignment 103 LTS&M-UMTRCA Title I and II Sites, D&D Sites, Other  
Sites, and Other  
August 2017 Environmental Sampling at the Tuba City, Arizona, Disposal Site

REFERENCE: Task Assignment 103, 1-103-1-02-122, Tuba City, Arizona, Disposal Site

Dear Mr. Bush:

The purpose of this letter is to inform you of the upcoming sampling event at Tuba City, Arizona. Enclosed are the map and tables specifying sample locations and analytes for monitoring at the Tuba City disposal site. Water quality data will be collected at this site as part of the routine environmental sampling currently scheduled to begin the week of August 21, 2017.

The following lists show the monitoring wells (with zone of completion), surface locations, and treatment system locations scheduled to be sampled during this event.

**Monitoring Wells\***

251 Na	271 Na	282 Na	687 Na	906 Na	918 Na	943 Na	1422 Na
252 Na	272 Na	283 Na	688 Na	908 Na	919 Na	945 Na	1423 Na
258 Na	273 Na	286 Na	689 Na	909 Na	920 Na	946 Na	NMW-1A Ss
261 Na	274 Na	287 Na	690 Na	910 Na	921 Na	947 Na	NMW-2A Ss
262 Na	275 Na	288 Na	691 Na	911 Na	929 Na	1003 Al	NMW-3A Ss
263 Na	276 Na	289 Na	692 Na	912 Na	930 Na	1004 Al	NMW-4A Ss
264 Na	277 Na	290 Na	695 Na	913 Na	932 Na	1006 Al	NMW-6S Ss
265 Na	278 Na	683 Al	901 Na	914 Na	934 Na	1007 Al	NMW-7D Ss
266 Na	279 Na	684 Al	902 Na	915 Na	940 Na	1420 Nr	NMW-8S Ss
267 Na	280 Na	685 Al	903 Na	916 Na	941 Na	1421 Nr	NMW-9D Ss
268 Na	281 Na	686 Na	904 Na	917 Na			

\*NOTE: Al = alluvium; Na = Navajo sandstone; Ss = sandstone; Nr = No recovery of data for classifying

**Surface Locations**

759      778      1568      1569      1570

2597 Legacy Way - Grand Junction, CO 81503-1789 - Telephone (970) 248-6000 - Fax (970) 248-6040

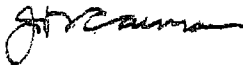
Richard Bush  
Control Number 17-0835  
Page 2

All samples will be collected as directed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. Water levels will be collected from additional wells on site as noted in the attachment.

This August 2017 sampling departs from what is normally required by eliminating those extraction wells that are not in operation because of suspended distillation treatment. Similarly, treatment system locations 1202, 1205, and 1206 will not be sampled. Also, sample collection at a far upgradient location (0965) on Moenkopi Wash will not be conducted because the location is redundant with upgradient location 0778.

Please contact me at (970) 248-6103 or Tim Bartlett at (970) 248-7741 if you have any questions.

Sincerely,



Digitally signed by Jeffrey D.  
Carman  
Date: 2017.08.01 09:51:35  
-06'00'

Peter Lemke  
LMS Site Lead

PL/lcg/csa

Enclosures (3)

cc: (electronic)

Christine Hopper, DOE  
Christina Pennal, DOE  
Jeff Carman, Navarro  
Beverly Cook, Navarro  
Steve Donovan, Navarro  
Lauren Goodknight, Navarro  
Peter Lemke, Navarro  
Sam Marutzky, Navarro  
Diana Osborne, Navarro  
Document Determination  
EDD Delivery  
Records  
File: TUB 400.02(A)



**Sampling Frequencies for Locations  
at Tuba City, Arizona**

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
<b>Monitoring Wells</b>						
251		X				
252		X				
258		X				
261			X			August
262		X				
263		X				
264		X				
265		X				
266		X				
267		X				
268		X				
271			X			August
272		X				
273		X				
274		X				
275		X				
276		X				
277			X			August
278			X			August
279			X			August
280			X			August
281		X				
282		X				
283		X				
284					X	Water level only
285					X	Water level only
286		X				
287		X				
288		X				
289		X				
290		X				
683			X			August
684			X			August
685			X			August
686			X			DATA LOGGER; August
687			X			DATA LOGGER; August
688			X			DATA LOGGER; August
689			X			August
690			X			August
691		X				

**Sampling Frequencies for Locations  
at Tuba City, Arizona**

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
<b>Monitoring Wells</b>						
692			X			August
695			X			August
901			X			August
902			X			
903			X			August
904			X			August
906		X				DATA LOGGER
908		X				DATA LOGGER
909		X				DATA LOGGER
910			X			August
911			X			August
912			X			August
913			X			August
914			X			August
915			X			August
916			X			August
917			X			August
918			X			August
919			X			August
920			X			August
921			X			August
929		X				
930		X				
932		X				
934		X				DATA LOGGER
935		*				Converted to extraction well
936		*				DATA LOGGER
938		*				Converted to extraction well
940		X				DATA LOGGER
941		X				DATA LOGGER
942		*				DATA LOGGER
943			X			DATA LOGGER; August
945			X			August
946			X			DATA LOGGER; August
947			X			August
948					X	Water level only
968					X	Water level only
1003		X				
1004		X				
1005					X	Water level only

**Sampling Frequencies for Locations  
at Tuba City, Arizona**

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
<b>Monitoring Wells</b>						
1006		X				
1007		X				
1008					X	Water level only
1101		*				
1102		*				
1103		*				
1104		*				
1105		*				
1106		*				
1107		*				
1108		*				
1109		*				
1110		*				
1111		*				
1112		*				
1113		*				
1114		*				
1115		*				
1116		*				
1117		*				
1118		*				
1119		*				
1120		*				
1121		*				
1122		*				
1123		*				
1124		*				
1125		*				
1126		*				
1127		*				
1128		*				
1129		*				
1130		*				
1131		*				
1132		*				
1133		*				
1420		X				
1421		X				
1422		X				
1423		X				

**Sampling Frequencies for Locations  
at Tuba City, Arizona**

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
<b>Monitoring Wells</b>						
NMW-1A		X				
NMW-2A		X				
NMW-3A		X				
NMW-4A		X				
NMW-6S		X				
NMW-7D		X				
NMW-8S		X				
NMW-9D		X				
<b>Surface Locations</b>						
759			X			August; Moenkopi wash-downgradient
778			X			August; Moenkopi wash-at Jimmy Spring
1568			X			Cattle trough near 1573 & 1574
1569		X				Evap pond - North
1570		X				Evap pond - South

Semi-annual sampling conducted in February and August; Annual sampling conducted in August.

Sample only active extraction wells. Coordinate with operators to confirm operating wells.

Treatment system monitoring done independently by operators on as-needed basis.

\* Extraction well; sample if extraction system is operating.

### Constituent Sampling Breakdown

Site	Tuba City		Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Analyte	Groundwater	Surface Water			
Approx. No. Samples/yr	143	9			
<i>Field Measurements</i>					
Total Alkalinity	X	X			
Dissolved Oxygen	X				
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
<i>Laboratory Measurements</i>					
Aluminum					
Ammonia as N (NH <sub>3</sub> -N)	X		0.1	EPA 350.1	WCH-A-005
Arsenic	X	X	0.0001	SW-846 6020	LMM-02
Calcium	X	X	5	SW-846 6010	LMM-01
Chloride	X	X	0.5	SW-846 9056	WCH-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron	X	X	0.05	SW-846 6020	LMM-02
Lead					
Magnesium	X	X	5	SW-846 6010	LMM-01
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO <sub>3</sub> +NO <sub>2</sub> )-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	X	X	1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica	X		0.2	SW-846 6010	LMM-01
Sodium	X	X	1	SW-846 6010	LMM-01
Strontium	X		0.2	SW-846 6010	LMM-01
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X	X	10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium	X		0.0003	SW-846 6020	IMM-02
Zinc					
Total No. of Analytes	18	14			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

**Enclosure 2**  
**Trip Report**

# NAVARRO

To: Peter Lemke, Navarro  
From: Jeff Price, Navarro  
Date: August 31, 2017  
CC: Rich Bush, DOE  
Tim Bartlett, Navarro  
Steve Donovan, Navarro  
EDD Delivery  
Re: Sampling Trip Report

Site: Tuba City, Arizona, Disposal Site

Dates of Event: August 21–25, 2017

Team Members: David Atkinson, Kale Carlson, Jeff Price, and Dan Sellers

Number of Locations Sampled: Samples were collected from 85 of the 90 locations identified on the sampling list.

	Sampled Locations	Planned locations	Comments
Monitoring Wells	82	85	Monitoring wells 0283, 0909, and 0918 were dry.
Surface water locations	3	5	Surface locations 0759 and 0778 were dry.

## Location Specific Information:

Location IDs	Comments
1569, 1570	Surface samples collected according to program directive TUB-2015-01.

Quality Control Sample Cross Reference: The following are the false identifications assigned to the quality control samples.

False ID	Sample ID	True ID	Sample Type	Associated Matrix	Associated Samples
2186	TUB01-01.1708001-082	0932	Duplicate	Groundwater	N/A
2187	TUB01-01.1708001-083	0252	Duplicate	Groundwater	N/A
2188	TUB01-01.1708001-084	0684	Duplicate	Groundwater	N/A
2189	TUB01-01.1708001-085	NMW-4A	Duplicate	Groundwater	N/A
2190	TUB01-01.1708001-086	0910	Duplicate	Groundwater	NA

Task Code Assigned: Samples were assigned to TUB01-01.1708001. Field data sheets can be found in \\erowisms\TUB01-01.1708001\FieldData.

Sample Shipment: Samples were delivered to ALS Laboratory by FedEx in two shipments; the first was from the Tuba City office on August 24, 2017, and the second from the Grand Junction office to on August 25, 2017.

**Water Level Measurements:** Water levels were measured in all sampled wells plus a small set of other wells.

**Well Inspection Summary:** All wells were in good condition.

**Sampling Method:** Samples were collected according to the *Sampling and Analysis Plan (SAP) for the U. S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated) and Program Directive TUB-2015-01, which directs the samplers to control solids from the evaporation pond by installing a filter before the flow cell.

**Field Variance:** None. Samples were collected according to the SAP and Program Directive.

**Equipment:** All equipment functioned properly.

**Water Level Transducers:** Transducer data was downloaded and checked for accuracy at the following locations: TUB01-0263, 0264, 0265, 0274, 0286, 0287, 0908, 0929, 0934, 0941, 0943, and 0946. Data has been verified and is being uploaded to the SEE-Pro database under Issue Track #13294.

**Stakeholder/Regulatory/DOE:** None.

**Institutional Controls:**

**Fences, Gates, and Locks:** All gates were locked and in good condition.

**Signs:** No issues were observed.

**Trespassing/Site Disturbances:** None observed.

**Safety Issues:** None.

**Maintenance Issues:** None.

**Access Issues:** None.

**General Information:** Cell phone service is weak at the site. Consider using hand-held radios for communication between teams.

**Future Actions Required or Suggested:** None.



**Enclosure 3**  
**Data Assessment Summary**

## Water Sampling Field Activities Verification Checklist

<b>Project</b>	Tuba City, Arizona, Disposal Site	<b>Date(s) of Water Sampling</b>	August 22-24, 2017
<b>Date(s) of Verification</b>	November 2, 2017	<b>Name of Verifier</b>	Stephen Donovan

	Response (Yes, No, NA)	Comments
1. Is the SAP the primary document directing field procedures?  List any Program Directives or other documents, SOPs, instructions.	Yes	Work Order letter dated August 1, 2017 Program Directive TUB-2015-01.
2. Were the sampling locations specified in the planning documents sampled?	No	Monitoring wells 0283, 0909, 0918 and surface locations 0759 and 0778 were dry.
3. Were field equipment calibrations conducted as specified in the above-named documents?	Yes	Calibrations were performed on August 21, 2017.
4. Was an operational check of the field equipment conducted daily?  Did the operational checks meet criteria?	Yes  Yes	
5. Were the number and types (alkalinity, temperature, specific conductance, pH, turbidity, DO, ORP) of field measurements taken as specified?	No	Alkalinity was not measured at location 0281.
6. Were wells categorized correctly?	Yes	
7. Were the following conditions met when purging a Category I well:  Was one pump/tubing volume purged prior to sampling?	Yes	
Did the water level stabilize prior to sampling?	Yes	
Did pH, specific conductance, and turbidity measurements meet criteria prior to sampling?	No	The pH criteria was exceeded at location 0901.
Was the flow rate less than 500 mL/min?	Yes	

### Water Sampling Field Activities Verification Checklist (continued)

	Response (Yes, No, NA)	Comments
8. Were the following conditions met when purging a Category II well:		
Was the flow rate less than 500 mL/min?	Yes	
Was one pump/tubing volume removed prior to sampling?	Yes	
9. Were duplicates taken at a frequency of one per 20 samples?	Yes	Duplicate samples were collected at locations 0252, 0684, 0910, 0932, and NMW-4A.
10. Were equipment blanks taken at a frequency of one per 20 samples that were collected with non-dedicated equipment?	NA	An equipment blank was not required.
11. Were trip blanks prepared and included with each shipment of VOC samples?	NA	
12. Were the true identities of the QC samples documented?	Yes	
13. Were samples collected in the containers specified?	Yes	
14. Were samples filtered and preserved as specified?	No	The sample from location 0934 was not filtered, but marked as filtered on the COC form.
15. Were the number and types of samples collected as specified?	Yes	
16. Were chain of custody records completed and was sample custody maintained?	Yes	
17. Was all pertinent information documented on the field data sheets?	Yes	
18. Was the presence or absence of ice in the cooler documented at every sample location?	Yes	
19. Were water levels measured at the locations specified in the planning documents?	Yes	Water levels were measured in all sampled wells plus a small set of other wells.

## Laboratory Performance Assessment

### General Information

Task Code: TUB01-011.1708001  
Sample Event: August 22-24, 2017  
Site(s): Tuba City, Arizona  
Laboratory: ALS Laboratory Group, Fort Collins, Colorado  
Work Order No.: 1708561  
Analysis: Metals and Inorganics  
Validator: Stephen Donovan  
Review Date: November 1, 2017

This validation was performed according to "Standard Practice for Validation of Environmental Data" found in Appendix A of *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated, <http://energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites>). The procedure was applied at Level 3, Data Validation.

This validation includes the evaluation of data quality indicators (DQIs) associated with the data. DQIs are the quantitative and qualitative descriptors that are used to interpret the degree of acceptability or utility of data. Indicators of data quality include the analysis of laboratory control samples to assess accuracy; duplicates and replicates to assess precision; and interference check samples to assess bias. The DQIs comparability, completeness, and sensitivity are also evaluated in the sections to follow.

All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Ammonia as N	WCH-A-005	EPA 350.1	EPA 350.1
Arsenic, Molybdenum, Selenium, Uranium, Vanadium	LMM-02	SW-846 3005A	SW-846 6020A EPA 200.8
Calcium, Iron, Magnesium, Manganese, Potassium, Silica, Sodium, Strontium	LMM-01	SW-846 3005A	SW-846 6010B
Chloride, Sulfate	MIS-A-045	SW-846 9056	SW-846 9056
Nitrite + Nitrate as N	WCH-A-022	EPA 353.2	EPA 353.2
Total Dissolved Solids (TDS)	WCH-A-033	EPA 160.1	EPA 160.1

### Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the attached validation worksheets and the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
1708561-1	0258	Magnesium	J	Serial dilution result
1708561-5	0264	Chloride	R	Sample misidentified
1708561-5	0264	Sulfate	R	Sample misidentified
1708561-12	0275	Arsenic	U	Less than 5 times the method blank
1708561-14	0277	Arsenic	U	Less than 5 times the method blank
1708561-15	0279	Arsenic	U	Less than 5 times the method blank
1708561-20	0288	Arsenic	U	Less than 5 times the method blank
1708561-21	0289	Iron	U	Less than 5 times the method blank
1708561-22	0290	Iron	U	Less than 5 times the method blank
1708561-24	0684	Iron	U	Less than 5 times the method blank
1708561-27	0688	Alkalinity	R	Anomalous data, cation/anion balance
1708561-27	0688	Iron	U	Less than 5 times the method blank
1708561-28	0689	Iron	U	Less than 5 times the method blank
1708561-29	0690	Iron	U	Less than 5 times the method blank
1708561-31	0692	Iron	U	Less than 5 times the method blank
1708561-33	0902	Iron	U	Less than 5 times the method blank
1708561-34	0903	Iron	U	Less than 5 times the method blank
1708561-35	0904	Arsenic	U	Less than 5 times the method blank
1708561-38	0915	Arsenic	U	Less than 5 times the method blank
1708561-39	0916	Arsenic	U	Less than 5 times the method blank
1708561-40	0920	Iron	U	Less than 5 times the method blank
1708561-41	0921	Arsenic	J	Matrix spike/spike duplicate results
1708561-41	0921	Molybdenum	J	Matrix spike/spike duplicate results
1708561-41	0921	Selenium	J	Matrix spike/spike duplicate results
1708561-41	0921	Uranium	J	Matrix spike/spike duplicate results
1708561-41	0921	Vanadium	J	Matrix spike/spike duplicate results
1708561-61	1421	Iron	U	Less than 5 times the method blank
1708561-62	1422	Iron	U	Less than 5 times the method blank
1708561-64	0252	Magnesium	J	Serial dilution result
1708561-68	0282	Iron	U	Less than 5 times the method blank
1708561-69	0686	Iron	U	Less than 5 times the method blank
1708561-72	0910	Iron	U	Less than 5 times the method blank
1708561-73	0911	Iron	U	Less than 5 times the method blank
1708561-73	0911	Manganese	U	Less than 5 times the method blank
1708561-74	0912	Iron	U	Less than 5 times the method blank
1708561-77	0919	Iron	U	Less than 5 times the method blank
1708561-77	0919	Manganese	U	Less than 5 times the method blank
1708561-78	0929	Iron	U	Less than 5 times the method blank
1708561-80	NMW-2A	Iron	U	Less than 5 times the method blank
1708561-82	NMW-4A	Iron	U	Less than 5 times the method blank
1708561-82	NMW-4A	Nitrate/Nitrite as N	J	Field duplicate result
1708561-83	NMW-8S	Iron	U	Less than 5 times the method blank
1708561-85	0252	Iron	U	Less than 5 times the method blank
1708561-86	NMW-4A	Iron	U	Less than 5 times the method blank
1708561-86	NMW-4A Duplicate	Nitrate/Nitrite as N	J	Field duplicate result

### Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado, received 90 samples on August 26, 2017, accompanied by a Chain of Custody form. Copies of the air bills were included in the receiving documentation. The Chain of Custody form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The Chain of Custody forms were complete with no errors or omissions.

### Preservation and Holding Times

The sample shipments were received intact with the temperatures inside the iced coolers between 2.8 and 3.1 °C, which complies with requirements. All samples were received in the correct container types and had been preserved correctly for the requested analyses. Samples were analyzed within the applicable holding times.

### Detection and Quantitation Limits

A method detection limit (MDL) is defined in 40 CFR 136 as the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDLs reported by the laboratory were compared to the required MDLs to assess the sensitivity of the analyses and were in compliance with contractual requirements.

The practical quantitation limit (PQL) for an analyte, defined as 5 times the MDL, is the lowest concentration that can be quantitatively measured, and is used when evaluating laboratory method performance in the sections below.

### Laboratory Instrument Calibration

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for the analytes of interest. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis. Initial and continuing calibration standards must be prepared from independent sources to ensure the validity of the calibration. All laboratory instrument calibrations and calibration verifications were performed correctly in accordance with the cited methods.

#### *Method EPA 160.1, TDS*

There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

#### *Method EPA 350.1, Ammonia as N*

Calibrations were performed using five calibration standards on September 18, 2017. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria.

#### *Method EPA 353.2, Nitrate + Nitrite as N*

Calibrations were performed using seven calibration standards on September 12–13, 2017. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria.

#### *Method SW-846 6010B, Metals*

Calibrations for calcium, iron, magnesium, manganese, potassium, silica, and sodium were performed between September 8 and 22, 2017, using three calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range.

#### *Method SW-846 6020A, Metals*

Calibrations for arsenic, molybdenum, selenium, and uranium were performed September 8, 11, and 13, 2017, using four calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria with the exception of CCV3 and CCV6 for arsenic and CCV9 for uranium. None of the samples associated with this task were bracketed by these CCVs. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

#### *Method SW-846 9056, Chloride, Sulfate*

Calibrations were performed using nine calibration standards on August 26, 2017. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria.

#### Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the PQL for all analytes with the exception of CCB6 and CCB7 for arsenic. None of the samples associated with this task were bracketed by these CCBs.

#### Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples are analyzed to verify the instrumental interelement and background correction factors and assess any bias due to interelement interferences. Interference check samples were analyzed at the required frequency with all results meeting the acceptance criteria.

### Matrix Spike Analysis

Matrix spikes are aliquots of environmental samples to which a known concentration of an analyte has been added before analysis. Matrix spike and matrix-spike duplicate (MS/MSD) analysis is used to assess the performance of the method by measuring the effects of interferences caused by the sample matrix and reflects the bias of the method for the particular matrix in question. The method 6020 analyte results for location 0921 did not meet the acceptance criteria. The method 6020 analyte results for this location are qualified with a "J" flag as estimated values.

### Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

### Laboratory Control Samples

Laboratory control samples (LCS) were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. The LCS results were acceptable for all analysis.

### Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All serial dilution data evaluated met the acceptance criteria with the following exception. The magnesium serial dilution result for samples 0252 and 0258 did not meet the acceptance criteria. The magnesium results for those samples are qualified with a "J" flag as estimated values.

### Completeness

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

### Chromatography Peak Integration

The integration of analyte peaks was reviewed for all ion chromatography data. There were no manual integrations performed and all peak integrations were satisfactory.

### Electronic Data Deliverable (EDD) File

The EDD file arrived on September 29, 2017. The EDD was examined to verify that the file was complete and in compliance with requirements. The contents of the file were compared to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.



### Anion/Cation Balance

Environmental water should be electrically neutral. Expressed in milliequivalents per liter (meq/L), the sum of the anions should equal the sum of the cations. The anion/cation balance is calculated as the difference between the anions and cations, divided by the sum of the anions and cations. The anion/cation balance can be useful in finding potential errors in the analytical results. Typically, a charge balance of less than 10 percent is considered acceptable. When a charge balance is greater than 10 percent, the associated data are closely examined for error. Table 3 shows the total anion and cation results from this event and the charge balance.

*Table 3. Comparison of Major Anions and Cations*

Location	Cations (meq/L)	Anions (meq/L)	Charge Balance (%)
0251	2.04	-1.75	7.71
0252	2.10	-1.88	5.64
0258	2.96	-2.62	6.09
0261	2.86	-2.12	14.86
0262	70.60	-55.66	11.84
0263	64.41	-52.50	10.19
0264	5.29	-13.67	-44.20
0265	47.34	-37.43	11.70
0266	2.34	-2.06	6.24
0267	109.83	-97.83	5.78
0268	11.64	-9.76	8.79
0271	2.72	-2.40	6.20
0272	2.81	-2.23	11.55
0273	5.07	-4.07	10.90
0274	2.68	-2.30	7.51
0275	66.11	-52.55	11.43
0276	2.80	-2.48	6.12
0277	2.77	-2.71	1.20
0278	2.40	-2.78	-7.26
0279	2.82	-2.59	4.37
0280	2.93	-4.03	-15.75
0281	NA	NA	NA
0282	15.11	-12.13	10.92
0286	89.65	-70.27	12.12
0287	69.01	-51.34	14.68
0288	10.84	-8.29	13.32
0289	5.13	-4.45	7.07
0290	37.85	-30.16	11.31
0683	2.91	-2.87	0.72
0684	2.81	-2.33	9.31
0685	2.79	-2.35	8.72
0686	3.82	-3.85	-0.38
0687	3.02	-3.57	-8.46
0688	7.39	-21.88	-49.50
0689	2.56	-2.45	2.15
0690	2.47	-2.26	4.49
0691	33.72	-22.97	18.96
0692	2.57	-3.41	-14.17
0695	3.18	-3.90	-10.12
0901	3.20	-3.16	0.52
0902	3.37	-2.87	8.04
0903	5.30	-4.46	8.59
0904	7.29	-7.53	-1.60

Location	Cations (meq/L)	Anions (meq/L)	Charge Balance (%)
0906	102.17	-67.27	20.59
0908	75.65	-61.74	10.13
0910	2.65	-2.11	11.35
0911	2.15	-1.82	8.47
0912	22.29	-18.26	9.93
0913	2.03	-2.00	0.76
0914	1.54	-1.29	8.87
0915	1.45	-1.16	10.84
0916	5.25	-5.17	0.76
0917	2.50	-1.91	13.57
0919	22.97	-24.01	-2.23
0920	2.55	-2.59	-0.80
0921	2.18	-1.86	7.87
0929	3.57	-2.66	14.56
0930	10.28	-8.51	9.43
0932	4.28	-3.45	10.66
0934	103.32	-76.07	15.19
0940	170.77	-146.23	7.74
0941	84.27	-75.01	5.82
0943	3.48	-2.60	14.38
0945	4.25	-3.70	6.97
0946	2.21	-2.03	4.20
0947	2.84	-2.63	3.83
1003	23.41	-21.08	5.23
1004	5.42	-6.92	-12.18
1006	2.45	-1.91	12.60
1007	2.52	-1.84	15.57
1420	5.26	-4.52	7.57
1421	5.11	-5.15	-0.34
1422	4.85	-4.53	3.41
1423	3.32	-2.97	5.64
1568	6.65	-6.67	-0.17
1569	5664.16	-5746.17	-0.72
1570	5705.97	-5725.14	-0.17
NMW-1A	2.69	-2.18	10.45
NMW-2A	2.59	-2.00	12.77
NMW-3A	2.54	-2.31	4.78
NMW-4A	2.56	-2.17	8.17
NMW-6S	2.86	-2.30	10.76
NMW-7D	2.10	-1.25	25.43
NMW-8S	2.55	-2.10	9.62
NMW-9D	2.71	-2.44	5.30

meq/L = milliequivalents per liter

NA = Alkalinity was not measured

Locations 0264 and 0688 had charge balances greater than 40 percent indicating an error had likely occurred. For a discussion regarding these data, see the Outliers Report section below. There were no analytical errors identified during the review of the laboratory data associated with the remaining locations.

# General Data Validation Report

Page 1 of 1

**Task Code:** TUB01-01.1708001   **Lab Code:** PAR   **Validator:** Stephen Donovan   **Validation Date:** 11-01-2017

**Project:** Tuba City Disposal Site

**# Samples:** 90

**Analysis Type:** ☒ General Chemistry ☒ Metals ☐ Organics ☐ Radiochemistry

## Chain of Custody

## Sample

Present: OK   Signed: OK   Dated: OK

Integrity: OK   Preservation OK   Temperature: OK

## Check

## Summary

<b>Holding Times:</b>	All analyses were completed within the applicable holding times.
<b>Detection Limits:</b>	The reported detection limits are equal to or below the contract required limits.
<b>Field Duplicates:</b>	There were 5 duplicates evaluated.

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Arsenic	SW-846 6020	09-09-2017	LCS	92.00		80	120		20	
Arsenic	SW-846 6020	09-09-2017	LCS	93.00		80	120		20	
Arsenic	SW-846 6020	09-09-2017	MB							All method blanks < PQL
Arsenic	SW-846 6020	09-09-2017	MB							
Arsenic	SW-846 6020	09-09-2017	MS	90.00		75	125		20	
Arsenic	SW-846 6020	09-09-2017	MS	88.00		75	125		20	
Arsenic	SW-846 6020	09-09-2017	MSD		90.00	75	125	0	20	
Arsenic	SW-846 6020	09-09-2017	MSD		92.00	75	125	4	20	
Arsenic	SW-846 6020	09-09-2017	R						20	
Arsenic	SW-846 6020	09-09-2017	R						20	
Arsenic	SW-846 6020	09-11-2017	LCS	91.00		80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Arsenic	SW-846 6020	09-11-2017	LCS	93.00		80	120		20	
Arsenic	SW-846 6020	09-11-2017	LCS	90.00		80	120		20	
Arsenic	SW-846 6020	09-11-2017	MB							
Arsenic	SW-846 6020	09-11-2017	MB							
Arsenic	SW-846 6020	09-11-2017	MB							
Arsenic	SW-846 6020	09-11-2017	MS	94.00		75	125		20	
Arsenic	SW-846 6020	09-11-2017	MS	112.00		75	125		20	
Arsenic	SW-846 6020	09-11-2017	MS	92.00		75	125		20	
Arsenic	SW-846 6020	09-11-2017	MSD		92.00	75	125	2	20	
Arsenic	SW-846 6020	09-11-2017	MSD		89.00	75	125	23	20	
Arsenic	SW-846 6020	09-11-2017	MSD		89.00	75	125	3	20	
Arsenic	SW-846 6020	09-11-2017	R						20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tube City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Arsenic	SW-846 6020	09-11-2017	R						20	
Arsenic	SW-846 6020	09-11-2017	R						20	
Calcium	SW-846 6010	09-08-2017	LCS	98.00		80	120		20	
Calcium	SW-846 6010	09-08-2017	LCS	98.00		80	120		20	
Calcium	SW-846 6010	09-08-2017	MB							
Calcium	SW-846 6010	09-08-2017	MB							
Calcium	SW-846 6010	09-08-2017	MS	94.00		80	120		20	
Calcium	SW-846 6010	09-08-2017	MS	96.00		80	120		20	
Calcium	SW-846 6010	09-08-2017	MSD		94.00	80	120	0	20	
Calcium	SW-846 6010	09-08-2017	MSD		95.00	80	120	0	20	
Calcium	SW-846 6010	09-08-2017	R					4	20	
Calcium	SW-846 6010	09-08-2017	R					1	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Calcium	SW-846 6010	09-12-2017	LCS	104.00		80	120		20	
Calcium	SW-846 6010	09-12-2017	MB							
Calcium	SW-846 6010	09-12-2017	MS	105.00		80	120		20	
Calcium	SW-846 6010	09-12-2017	MSD		106.00	80	120	.0	20	
Calcium	SW-846 6010	09-12-2017	R					2	20	
Calcium	SW-846 6010	09-13-2017	LCS	101.00		80	120		20	
Calcium	SW-846 6010	09-13-2017	LCS	96.00		80	120		20	
Calcium	SW-846 6010	09-13-2017	MB							
Calcium	SW-846 6010	09-13-2017	MB							
Calcium	SW-846 6010	09-13-2017	MS	98.00		80	120		20	
Calcium	SW-846 6010	09-13-2017	MS	95.00		80	120		20	
Calcium	SW-846 6010	09-13-2017	MSD		95.00	80	120	1	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Calcium	SW-846 6010	09-13-2017	MSD		94.00	80	120	1	20	
Calcium	SW-846 6010	09-13-2017	R					0	20	
Calcium	SW-846 6010	09-13-2017	R					2	20	
Iron	SW-846 6010	09-08-2017	LCS	102.00		80	120		20	
Iron	SW-846 6010	09-08-2017	LCS	97.00		80	120		20	
Iron	SW-846 6010	09-08-2017	MB							
Iron	SW-846 6010	09-08-2017	MB							
Iron	SW-846 6010	09-08-2017	MS	99.00		80	120		20	
Iron	SW-846 6010	09-08-2017	MS	100.00		80	120		20	
Iron	SW-846 6010	09-08-2017	MSD		103.00	80	120	4	20	
Iron	SW-846 6010	09-08-2017	MSD		101.00	80	120	1	20	
Iron	SW-846 6010	09-08-2017	R						20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference



## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Iron	SW-846 6010	09-08-2017	R						20	
Iron	SW-846 6010	09-12-2017	LCS	94.00		80	120		20	
Iron	SW-846 6010	09-12-2017	MS	94.00		80	120		20	
Iron	SW-846 6010	09-12-2017	MSD		97.00	80	120	3	20	
Iron	SW-846 6010	09-12-2017	R						20	
Iron	SW-846 6010	09-13-2017	LCS	105.00		80	120		20	
Iron	SW-846 6010	09-13-2017	MB							
Iron	SW-846 6010	09-13-2017	MS	95.00		80	120		20	
Iron	SW-846 6010	09-13-2017	MSD		99.00	80	120	4	20	
Iron	SW-846 6010	09-13-2017	R						20	
Iron	SW-846 6010	09-15-2017	LCS	108.00		80	120		20	
Iron	SW-846 6010	09-15-2017	MB							

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Iron	SW-846 6010	09-15-2017	MS	102.00		80	120		20	
Iron	SW-846 6010	09-15-2017	MSD		98.00	80	120	4	20	
Iron	SW-846 6010	09-15-2017	R						20	
Magnesium	SW-846 6010	09-08-2017	LCS	105.00		80	120		20	
Magnesium	SW-846 6010	09-08-2017	LCS	99.00		80	120		20	
Magnesium	SW-846 6010	09-08-2017	MB							
Magnesium	SW-846 6010	09-08-2017	MB							
Magnesium	SW-846 6010	09-08-2017	MS	105.00		80	120		20	
Magnesium	SW-846 6010	09-08-2017	MS	95.00		80	120		20	
Magnesium	SW-846 6010	09-08-2017	MSD		103.00	80	120	1	20	
Magnesium	SW-846 6010	09-08-2017	MSD		94.00	80	120	2	20	
Magnesium	SW-846 6010	09-08-2017	R					4	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Magnesium	SW-846 6010	09-08-2017	R					.3	20	
Magnesium	SW-846 6010	09-12-2017	LCS	99.00		.80	120		20	
Magnesium	SW-846 6010	09-12-2017	MB							
Magnesium	SW-846 6010	09-12-2017	MS	101.00		.80	120		20	
Magnesium	SW-846 6010	09-12-2017	MSD		102.00	.80	120	1	20	
Magnesium	SW-846 6010	09-12-2017	R						20	
Magnesium	SW-846 6010	09-13-2017	LCS	98.00		.80	120		20	
Magnesium	SW-846 6010	09-13-2017	LCS	95.00		.80	120		20	
Magnesium	SW-846 6010	09-13-2017	MB							
Magnesium	SW-846 6010	09-13-2017	MB							
Magnesium	SW-846 6010	09-13-2017	MS	97.00		.80	120		20	
Magnesium	SW-846 6010	09-13-2017	MS	94.00		.80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Magnesium	SW-846 6010	09-13-2017	MSD		96.00	80	120	1	20	
Magnesium	SW-846 6010	09-13-2017	MSD		94.00	80	120	0	20	
Magnesium	SW-846 6010	09-13-2017	R					1	20	
Magnesium	SW-846 6010	09-13-2017	R						20	
Manganese	SW-846 6010	09-08-2017	LCS	98.00		80	120		20	
Manganese	SW-846 6010	09-08-2017	LCS	102.00		80	120		20	
Manganese	SW-846 6010	09-08-2017	MB							
Manganese	SW-846 6010	09-08-2017	MB							
Manganese	SW-846 6010	09-08-2017	MS	101.00		80	120		20	
Manganese	SW-846 6010	09-08-2017	MS	104.00		80	120		20	
Manganese	SW-846 6010	09-08-2017	MSD		100.00	80	120	0	20	
Manganese	SW-846 6010	09-08-2017	MSD		107.00	80	120	3	20	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Manganese	SW-846 6010	09-08-2017	R						20	
Manganese	SW-846 6010	09-08-2017	R						20	
Manganese	SW-846 6010	09-14-2017	LCS	104.00		80	120		20	
Manganese	SW-846 6010	09-14-2017	LCS	105.00		80	120		20	
Manganese	SW-846 6010	09-14-2017	MB							
Manganese	SW-846 6010	09-14-2017	MB							
Manganese	SW-846 6010	09-14-2017	MS	105.00		80	120		20	
Manganese	SW-846 6010	09-14-2017	MS	104.00		80	120		20	
Manganese	SW-846 6010	09-14-2017	MSD		104.00	80	120	1	20	
Manganese	SW-846 6010	09-14-2017	MSD		104.00	80	120	1	20	
Manganese	SW-846 6010	09-14-2017	R						20	
Manganese	SW-846 6010	09-14-2017	R						20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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01-Nov-2017

**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Manganese	SW-846 6010	09-15-2017	LCS	106.00		80	120		20	
Manganese	SW-846 6010	09-15-2017	MB							
Manganese	SW-846 6010	09-15-2017	MS	105.00		80	120		20	
Manganese	SW-846 6010	09-15-2017	MSD		107.00	80	120	2	20	
Manganese	SW-846 6010	09-15-2017	R						20	
Molybdenum	SW-846 6020	09-09-2017	LCS	95.00		80	120		20	
Molybdenum	SW-846 6020	09-09-2017	LCS	95.00		80	120		20	
Molybdenum	SW-846 6020	09-09-2017	MB							
Molybdenum	SW-846 6020	09-09-2017	MB							
Molybdenum	SW-846 6020	09-09-2017	MS	94.00		75	125		20	
Molybdenum	SW-846 6020	09-09-2017	MS	92.00		75	125		20	
Molybdenum	SW-846 6020	09-09-2017	MSD		94.00	75	125	0	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Molybdenum	SW-846 6020	09-09-2017	MSD		94.00	75	125	3	20	
Molybdenum	SW-846 6020	09-09-2017	R						20	
Molybdenum	SW-846 6020	09-09-2017	R						20	
Molybdenum	SW-846 6020	09-11-2017	LCS	89.00		80	120		20	
Molybdenum	SW-846 6020	09-11-2017	LCS	95.00		80	120		20	
Molybdenum	SW-846 6020	09-11-2017	LCS	95.00		80	120		20	
Molybdenum	SW-846 6020	09-11-2017	MB							
Molybdenum	SW-846 6020	09-11-2017	MB							
Molybdenum	SW-846 6020	09-11-2017	MB							
Molybdenum	SW-846 6020	09-11-2017	MS	96.00		75	125		20	
Molybdenum	SW-846 6020	09-11-2017	MS	112.00		75	125		20	
Molybdenum	SW-846 6020	09-11-2017	MS	94.00		75	125		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Molybdenum	SW-846 6020	09-11-2017	MSD		93.00	75	125	3	20	
Molybdenum	SW-846 6020	09-11-2017	MSD		89.00	75	125	24	20	
Molybdenum	SW-846 6020	09-11-2017	MSD		92.00	75	125	1	20	
Molybdenum	SW-846 6020	09-11-2017	R						20	
Molybdenum	SW-846 6020	09-11-2017	R						20	
Molybdenum	SW-846 6020	09-11-2017	R						20	
Potassium	SW-846 6010	09-08-2017	LCS	104.00		80	120		20	
Potassium	SW-846 6010	09-08-2017	LCS	105.00		80	120		20	
Potassium	SW-846 6010	09-08-2017	MB							
Potassium	SW-846 6010	09-08-2017	MB							
Potassium	SW-846 6010	09-08-2017	MS	104.00		80	120		20	
Potassium	SW-846 6010	09-08-2017	MS	105.00		80	120		20	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference



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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Potassium	SW-846 6010	09-08-2017	MSD		104.00	80	120	1	20	
Potassium	SW-846 6010	09-08-2017	MSD		103.00	80	120	2	20	
Potassium	SW-846 6010	09-08-2017	R						20	
Potassium	SW-846 6010	09-08-2017	R						20	
Potassium	SW-846 6010	09-12-2017	LCS	100.00		80	120		20	
Potassium	SW-846 6010	09-12-2017	MB							
Potassium	SW-846 6010	09-12-2017	MS	103.00		80	120		20	
Potassium	SW-846 6010	09-12-2017	MSD		104.00	80	120	0	20	
Potassium	SW-846 6010	09-12-2017	R					1	20	
Potassium	SW-846 6010	09-13-2017	LCS	106.00		80	120		20	
Potassium	SW-846 6010	09-13-2017	LCS	111.00		80	120		20	
Potassium	SW-846 6010	09-13-2017	MB							

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Potassium	SW-846 6010	09-13-2017	MB							
Potassium	SW-846 6010	09-13-2017	MS	109.00		80	120		20	
Potassium	SW-846 6010	09-13-2017	MS	112.00		80	120		20	
Potassium	SW-846 6010	09-13-2017	MSD		108.00	80	120	1	20	
Potassium	SW-846 6010	09-13-2017	MSD		114.00	80	120	1	20	
Potassium	SW-846 6010	09-13-2017	R						20	
Potassium	SW-846 6010	09-13-2017	R						20	
Selenium	SW-846 6020	09-09-2017	LCS	97.00		80	120		20	
Selenium	SW-846 6020	09-09-2017	LCS	91.00		80	120		20	
Selenium	SW-846 6020	09-09-2017	MB							
Selenium	SW-846 6020	09-09-2017	MB							
Selenium	SW-846 6020	09-09-2017	MS	96.00		75	125		20	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Selenium	SW-846 6020	09-09-2017	MS	95.00		75	125		20	
Selenium	SW-846 6020	09-09-2017	MSD		97.00	75	125	1	20	
Selenium	SW-846 6020	09-09-2017	MSD		94.00	75	125	1	20	
Selenium	SW-846 6020	09-09-2017	R						20	
Selenium	SW-846 6020	09-09-2017	R						20	
Selenium	SW-846 6020	09-11-2017	LCS	93.00		80	120		20	
Selenium	SW-846 6020	09-11-2017	LCS	97.00		80	120		20	
Selenium	SW-846 6020	09-11-2017	LCS	93.00		80	120		20	
Selenium	SW-846 6020	09-11-2017	MB							
Selenium	SW-846 6020	09-11-2017	MB							
Selenium	SW-846 6020	09-11-2017	MB							
Selenium	SW-846 6020	09-11-2017	MS	101.00		75	125		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Selenium	SW-846 6020	09-11-2017	MS	116.00		75	125		20	
Selenium	SW-846 6020	09-11-2017	MS	90.00		75	125		20	
Selenium	SW-846 6020	09-11-2017	MSD		93.00	75	125	9	20	
Selenium	SW-846 6020	09-11-2017	MSD		90.00	75	125	25	20	
Selenium	SW-846 6020	09-11-2017	MSD		93.00	75	125	4	20	
Selenium	SW-846 6020	09-11-2017	R						20	
Selenium	SW-846 6020	09-11-2017	R						20	
Selenium	SW-846 6020	09-11-2017	R						20	
Silicon	SW-846 6010	09-08-2017	LCS	105.00		80	120		20	
Silicon	SW-846 6010	09-08-2017	LCS	106.00		80	120		20	
Silicon	SW-846 6010	09-08-2017	MB							
Silicon	SW-846 6010	09-08-2017	MB							

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Silicon	SW-846 6010	09-08-2017	MS	113.00		80	120		20	
Silicon	SW-846 6010	09-08-2017	MS	112.00		80	120		20	
Silicon	SW-846 6010	09-08-2017	MSD		107.00	80	120	1	20	
Silicon	SW-846 6010	09-08-2017	MSD		124.00	80	120	2	20	Sample concentration > 4 times the spike
Silicon	SW-846 6010	09-08-2017	R					2	20	
Silicon	SW-846 6010	09-08-2017	R					1	20	
Silicon	SW-846 6010	09-12-2017	LCS	103.00		80	120		20	
Silicon	SW-846 6010	09-12-2017	MB							
Silicon	SW-846 6010	09-12-2017	MS	111.00		80	120		20	
Silicon	SW-846 6010	09-12-2017	MSD		108.00	80	120	1	20	
Silicon	SW-846 6010	09-12-2017	R					3	20	
Silicon	SW-846 6010	09-13-2017	LCS	100.00		80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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01-Nov-2017

**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Silicon	SW-846 6010	09-13-2017	LCS	97.00		80	120		20	
Silicon	SW-846 6010	09-13-2017	MB							
Silicon	SW-846 6010	09-13-2017	MB							
Silicon	SW-846 6010	09-13-2017	MS	110.00		80	120		20	
Silicon	SW-846 6010	09-13-2017	MS	125.00		80	120		20	Sample concentration > 4 times the spike
Silicon	SW-846 6010	09-13-2017	MSD		98.00	80	120	2	20	
Silicon	SW-846 6010	09-13-2017	MSD		112.00	80	120	2	20	
Silicon	SW-846 6010	09-13-2017	R					1	20	
Silicon	SW-846 6010	09-13-2017	R					2	20	
Sodium	SW-846 6010	09-08-2017	LCS	103.00		80	120		20	
Sodium	SW-846 6010	09-08-2017	LCS	104.00		80	120		20	
Sodium	SW-846 6010	09-08-2017	MB							

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Sodium	SW-846 6010	09-08-2017	MB							
Sodium	SW-846 6010	09-08-2017	MS	101.00		80	120		20	
Sodium	SW-846 6010	09-08-2017	MS	106.00		80	120		20	
Sodium	SW-846 6010	09-08-2017	MSD		100.00	80	120	1	20	
Sodium	SW-846 6010	09-08-2017	MSD		103.00	80	120	2	20	
Sodium	SW-846 6010	09-08-2017	R					10	20	
Sodium	SW-846 6010	09-08-2017	R					1	20	
Sodium	SW-846 6010	09-12-2017	LCS	101.00		80	120		20	
Sodium	SW-846 6010	09-12-2017	MB							
Sodium	SW-846 6010	09-12-2017	MS	104.00		80	120		20	
Sodium	SW-846 6010	09-12-2017	MSD		105.00	80	120	0	20	
Sodium	SW-846 6010	09-12-2017	R					2	20	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Sodium	SW-846 6010	09-13-2017	LCS	105.00		80	120		20	
Sodium	SW-846 6010	09-13-2017	LCS	109.00		80	120		20	
Sodium	SW-846 6010	09-13-2017	MB							
Sodium	SW-846 6010	09-13-2017	MB							
Sodium	SW-846 6010	09-13-2017	MS	108.00		80	120		20	
Sodium	SW-846 6010	09-13-2017	MS	111.00		80	120		20	
Sodium	SW-846 6010	09-13-2017	MSD		107.00	80	120	1	20	
Sodium	SW-846 6010	09-13-2017	MSD		113.00	80	120	1	20	
Sodium	SW-846 6010	09-13-2017	R					1	20	
Sodium	SW-846 6010	09-13-2017	R					0	20	
Strontium	SW-846 6010	09-08-2017	LCS	110.00		80	120		20	
Strontium	SW-846 6010	09-08-2017	LCS	108.00		80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference



## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Strontium	SW-846 6010	09-08-2017	MB							
Strontium	SW-846 6010	09-08-2017	MB							
Strontium	SW-846 6010	09-08-2017	MS	111.00		80	120		20	
Strontium	SW-846 6010	09-08-2017	MS	103.00		80	120		20	
Strontium	SW-846 6010	09-08-2017	MSD		111.00	80	120	0	20	
Strontium	SW-846 6010	09-08-2017	MSD		103.00	80	120	0	20	
Strontium	SW-846 6010	09-08-2017	R					2	20	
Strontium	SW-846 6010	09-08-2017	R					2	20	
Strontium	SW-846 6010	09-12-2017	LCS	98.00		80	120		20	
Strontium	SW-846 6010	09-12-2017	MB							
Strontium	SW-846 6010	09-12-2017	MS	95.00		80	120		20	
Strontium	SW-846 6010	09-12-2017	MSD		100.00	80	120	2	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Strontium	SW-846 6010	09-12-2017	R					1	20	
Strontium	SW-846 6010	09-13-2017	LCS	100.00		80	120		20	
Strontium	SW-846 6010	09-13-2017	LCS	101.00		80	120		20	
Strontium	SW-846 6010	09-13-2017	MB							
Strontium	SW-846 6010	09-13-2017	MB							
Strontium	SW-846 6010	09-13-2017	MS	102.00		80	120		20	
Strontium	SW-846 6010	09-13-2017	MS	102.00		80	120		20	
Strontium	SW-846 6010	09-13-2017	MSD		99.00	80	120	1	20	
Strontium	SW-846 6010	09-13-2017	MSD		99.00	80	120	1	20	
Strontium	SW-846 6010	09-13-2017	R					1	20	
Strontium	SW-846 6010	09-13-2017	R					1	20	
Uranium	SW-846 6020	09-09-2017	LCS	90.00		80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Uranium	SW-846 6020	09-09-2017	LCS	90.00		80	120		20	
Uranium	SW-846 6020	09-09-2017	MB							
Uranium	SW-846 6020	09-09-2017	MB							
Uranium	SW-846 6020	09-09-2017	MS	91.00		75	125		20	
Uranium	SW-846 6020	09-09-2017	MS	94.00		75	125		20	
Uranium	SW-846 6020	09-09-2017	MSD		93.00	75	125	1	20	
Uranium	SW-846 6020	09-09-2017	MSD		93.00	75	125	1	20	
Uranium	SW-846 6020	09-09-2017	R					2	20	
Uranium	SW-846 6020	09-09-2017	R					0	20	
Uranium	SW-846 6020	09-11-2017	LCS	92.00		80	120		20	
Uranium	SW-846 6020	09-11-2017	LCS	94.00		80	120		20	
Uranium	SW-846 6020	09-11-2017	LCS	94.00		80	120		20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Uranium	SW-846 6020	09-11-2017	MB							
Uranium	SW-846 6020	09-11-2017	MB							
Uranium	SW-846 6020	09-11-2017	MB							
Uranium	SW-846 6020	09-11-2017	MS	98.00		75	125		20	
Uranium	SW-846 6020	09-11-2017	MS	123.00		75	125		20	
Uranium	SW-846 6020	09-11-2017	MS	94.00		75	125		20	
Uranium	SW-846 6020	09-11-2017	MSD		96.00	75	125	2	20	
Uranium	SW-846 6020	09-11-2017	MSD		90.00	75	125	22	20	
Uranium	SW-846 6020	09-11-2017	MSD		92.00	75	125	1	20	
Uranium	SW-846 6020	09-11-2017	R					4	20	
Uranium	SW-846 6020	09-11-2017	R					3	20	
Uranium	SW-846 6020	09-11-2017	R					5	20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

# Metals Data Validation Worksheet

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Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Vanadium	SW-846 6020	09-09-2017	LCS	93.00		80	120		20	
Vanadium	SW-846 6020	09-09-2017	LCS	94.00		80	120		20	
Vanadium	SW-846 6020	09-09-2017	MB							
Vanadium	SW-846 6020	09-09-2017	MB							
Vanadium	SW-846 6020	09-09-2017	MS	92.00		75	125		20	
Vanadium	SW-846 6020	09-09-2017	MS	90.00		75	125		20	
Vanadium	SW-846 6020	09-09-2017	MSD		91.00	75	125	1	20	
Vanadium	SW-846 6020	09-09-2017	MSD		92.00	75	125	2	20	
Vanadium	SW-846 6020	09-09-2017	R						20	
Vanadium	SW-846 6020	09-09-2017	R						20	
Vanadium	SW-846 6020	09-11-2017	LCS	89.00		80	120		20	
Vanadium	SW-846 6020	09-11-2017	LCS	91.00		80	120		20	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Vanadium	SW-846 6020	09-11-2017	LCS	91.00		80	120		20	
Vanadium	SW-846 6020	09-11-2017	MB							
Vanadium	SW-846 6020	09-11-2017	MB							
Vanadium	SW-846 6020	09-11-2017	MB							
Vanadium	SW-846 6020	09-11-2017	MS	92.00		75	125		20	
Vanadium	SW-846 6020	09-11-2017	MS	110.00		75	125		20	
Vanadium	SW-846 6020	09-11-2017	MS	89.00		75	125		20	
Vanadium	SW-846 6020	09-11-2017	MSD		90.00	75	125	3	20	
Vanadium	SW-846 6020	09-11-2017	MSD		86.00	75	125	24	20	
Vanadium	SW-846 6020	09-11-2017	MSD		89.00	75	125	1	20	
Vanadium	SW-846 6020	09-11-2017	R						20	
Vanadium	SW-846 6020	09-11-2017	R						20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

## Metals Data Validation Worksheet

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**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Vanadium	SW-846 6020	09-11-2017	R						20	

**QC Types:** LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

**QC Checks:** RPD: Relative Percent Difference

# Wet Chemistry Data Validation Worksheet

Page 1 of 5

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Ammonia Total as N	EPA 350.1	09-18-2017	LCS	103.00		90	110		20	
Ammonia Total as N	EPA 350.1	09-18-2017	LCS	103.00		90	110		20	
Ammonia Total as N	EPA 350.1	09-18-2017	LCS	103.00		90	110		20	
Ammonia Total as N	EPA 350.1	09-18-2017	LCS	103.00		90	110		20	
Ammonia Total as N	EPA 350.1	09-18-2017	LCS	102.00		90	110		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MB							MB < MDL
Ammonia Total as N	EPA 350.1	09-18-2017	MB							MB < MDL
Ammonia Total as N	EPA 350.1	09-18-2017	MB							MB < MDL
Ammonia Total as N	EPA 350.1	09-18-2017	MB							MB < MDL
Ammonia Total as N	EPA 350.1	09-18-2017	MB							MB < MDL
Ammonia Total as N	EPA 350.1	09-18-2017	MS	94.00		75	125		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MS	92.00		75	125		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MS	102.00		75	125		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MS	105.00		75	125		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MS	112.00		75	125		20	
Ammonia Total as N	EPA 350.1	09-18-2017	MSD		113.00	75	125	1	20	
Ammonia Total as N	EPA 350.1	09-18-2017	MSD		105.00	75	125	0	20	
Ammonia Total as N	EPA 350.1	09-18-2017	MSD		103.00	75	125	1	20	
Ammonia Total as N	EPA 350.1	09-18-2017	MSD		93.00	75	125	0	20	
Ammonia Total as N	EPA 350.1	09-18-2017	MSD		95.00	75	125	1	20	
Chloride	SW-846 9056	09-05-2017	LCS	97.00		90	110		15	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference



# Wet Chemistry Data Validation Worksheet

Page 2 of 5

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Chloride	SW-846 9056	09-05-2017	MB							MB < MDL
Chloride	SW-846 9056	09-06-2017	LCS	98.00		90	110		15	
Chloride	SW-846 9056	09-06-2017	MB							MB < MDL
Chloride	SW-846 9056	09-06-2017	MS	96.00		85	115		15	
Chloride	SW-846 9056	09-06-2017	MSD	96.00	96.00	85	115	0	15	
Chloride	SW-846 9056	09-07-2017	LCS	96.00		90	110		15	
Chloride	SW-846 9056	09-07-2017	MB							MB < MDL
Chloride	SW-846 9056	09-07-2017	MS	100.00		85	115		15	
Chloride	SW-846 9056	09-07-2017	MSD		100.00	85	115	1	15	
Chloride	SW-846 9056	09-11-2017	LCS	95.00		90	110		15	
Chloride	SW-846 9056	09-11-2017	MB							MB < MDL
Chloride	SW-846 9056	09-18-2017	LCS	99.00		90	110		15	
Chloride	SW-846 9056	09-18-2017	MB							MB < MDL
Chloride	SW-846 9056	09-19-2017	LCS	101.00		90	110		15	
Chloride	SW-846 9056	09-19-2017	MB							MB < MDL
Chloride	SW-846 9056	09-19-2017	MS	98.00		85	115		15	
Chloride	SW-846 9056	09-19-2017	MS	97.00		85	115		15	
Chloride	SW-846 9056	09-19-2017	MSD		99.00	85	115	1	15	
Chloride	SW-846 9056	09-19-2017	MSD		99.00	85	115	1	15	
Chloride	SW-846 9056	09-20-2017	LCS	98.00		90	110		15	
Chloride	SW-846 9056	09-20-2017	MB							MB < MDL
Chloride	SW-846 9056	09-20-2017	MS	97.00		85	115		15	
Chloride	SW-846 9056	09-20-2017	MSD		97.00	85	115	1	15	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

# Wet Chemistry Data Validation Worksheet

Page 3 of 5

Project: Tuba City Disposal Site

Task Code: TUB01-01 1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	LCS	100.00		90	110		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	LCS	100.00		90	110		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	LCS	101.00		90	110		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	LCS	100.00		90	110		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	LCS	100.00		90	110		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MB							MB < MDL
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MB							MB < MDL
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MB							MB < MDL
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MB							MB < MDL
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MB							MB < MDL
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MS	97.00		75	125		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MS	97.00		75	125		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MS	93.00		75	125		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MS	94.00		75	125		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MS	95.00		75	125		20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MSD		94.00	75	125	0	20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MSD		92.00	75	125	0	20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MSD		91.00	75	125	1	20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MSD		96.00	75	125	1	20	
Nitrate + Nitrite as Nitrogen	EPA 353.2	09-12-2017	MSD		97.00	75	125	0	20	
Sulfate	SW-846 9056	09-05-2017	LCS	101.00		90	110		15	
Sulfate	SW-846 9056	09-05-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-06-2017	LCS	102.00		90	110		15	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

# Wet Chemistry Data Validation Worksheet

Page 4 of 5

Project: Tuba City Disposal Site

Task Code: TUB01-01 1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Sulfate	SW-846 9056	09-06-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-06-2017	MS	104.00		85	115		15	
Sulfate	SW-846 9056	09-06-2017	MSD		104.00	85	115	0	15	
Sulfate	SW-846 9056	09-07-2017	LCS	101.00		90	110		15	
Sulfate	SW-846 9056	09-07-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-07-2017	MS	104.00		85	115		15	
Sulfate	SW-846 9056	09-07-2017	MSD		105.00	85	115	0	15	
Sulfate	SW-846 9056	09-11-2017	LCS	100.00		90	110		15	
Sulfate	SW-846 9056	09-11-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-18-2017	LCS	102.00		90	110		15	
Sulfate	SW-846 9056	09-18-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-19-2017	LCS	102.00		90	110		15	
Sulfate	SW-846 9056	09-19-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-19-2017	MS	98.00		85	115		15	
Sulfate	SW-846 9056	09-19-2017	MS	103.00		85	115		15	
Sulfate	SW-846 9056	09-19-2017	MSD		99.00	85	115	1	15	
Sulfate	SW-846 9056	09-19-2017	MSD		105.00	85	115	1	15	
Sulfate	SW-846 9056	09-20-2017	LCS	103.00		90	110		15	
Sulfate	SW-846 9056	09-20-2017	MB							MB < MDL
Sulfate	SW-846 9056	09-20-2017	MS	103.00		85	115		15	
Sulfate	SW-846 9056	09-20-2017	MSD		103.00	85	115	0	15	
Total Dissolved Solids	EPA 160.1	08-27-2017	LCS	98.00		85	115		5	
Total Dissolved Solids	EPA 160.1	08-27-2017	LCSD	98.00	98.00	85	115	0	5	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

# Wet Chemistry Data Validation Worksheet

Page 5 of 5

Project: Tube City Disposal Site

Task Code: TUB01-01 1708001

Lab Code: PAR

01-Nov-2017

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Total Dissolved Solids	EPA 160.1	08-27-2017	MB							MB < MDL
Total Dissolved Solids	EPA 160.1	08-27-2017	R					0	5	
Total Dissolved Solids	EPA 160.1	08-28-2017	LCS	99.00		85	115		5	
Total Dissolved Solids	EPA 160.1	08-28-2017	LCSD	99.00	99.00	85	115	0	5	
Total Dissolved Solids	EPA 160.1	08-28-2017	MB							MB < MDL
Total Dissolved Solids	EPA 160.1	08-28-2017	R					1	5	
Total Dissolved Solids	EPA 160.1	08-28-2017	R					0	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	LCS	100.00		85	115		5	
Total Dissolved Solids	EPA 160.1	08-29-2017	LCS	100.00		85	115		5	
Total Dissolved Solids	EPA 160.1	08-29-2017	LCSD	101.00	101.00	85	115	2	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	LCSD	101.00	101.00	85	115	1	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	MB							MB < MDL
Total Dissolved Solids	EPA 160.1	08-29-2017	MB							MB < MDL
Total Dissolved Solids	EPA 160.1	08-29-2017	R					1	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	R					1	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	R					1	5	
Total Dissolved Solids	EPA 160.1	08-29-2017	R					0	5	
Total Dissolved Solids	EPA 160.1	08-31-2017	LCS	97.00		85	115		5	
Total Dissolved Solids	EPA 160.1	08-31-2017	LCSD	99.00	99.00	85	115	1	5	
Total Dissolved Solids	EPA 160.1	08-31-2017	MB							MB < MDL
Total Dissolved Solids	EPA 160.1	08-31-2017	R					2	5	
Total Dissolved Solids	EPA 160.1	08-31-2017	R					2	5	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

## **Sampling Quality Control Assessment**

The following information summarizes and assesses quality control for this sampling event.

### **Sampling Protocol**

Sample results for monitoring wells were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method and Category I criteria, with the following exceptions:

- These 48 wells were purged and sampled using the low-flow sampling method and Category II or III criteria: 0251, 0258, 0262, 0263, 0264, 0265, 0266, 0272, 0273, 0274, 0277, 0278, 0280, 0281, 0282, 0286, 0287, 0288, 0289, 0683, 0684, 0690, 0692, 0902, 0906, 0908, 0911, 0912, 0913, 0914, 0915, 0916, 0917, 0919, 0929, 0934, 0940, 0941, 0945, 0947, 1420, 1421, 1422, 1423, NMW-2A, NMW-6S, NMW-7D, and NMW-9D. For these wells, the water level drawdown during the purge did not meet the Category I criterion because these wells produced water at a rate less than the minimum low-flow purging rate. Therefore, these wells were classified as Category II. The sample results for these wells were qualified with a "Q" flag (qualitative), indicating the samples were not collected under the optimal conditions of the Category I stability criteria.

### **Equipment Blank Assessment**

Equipment blanks are prepared and analyzed to document contamination attributable to the sample collection process. An equipment blank was not required for this sampling event.

### **Field Duplicate Assessment**

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 duplicates, which measure only laboratory performance. Duplicate samples were collected from locations 0252, 0684, 0910, 0932, and NMW-4A. The relative percent difference (RPD) for duplicate results that are greater than 5 times the PQL should be less than 20 percent. The RPD is not used to evaluate results that are less than 5 times the PQL. For these results, the range should be no greater than the PQL. The duplicate results met the criteria with the following exception. The RPD for nitrate/nitrite as N at location NMW-4A was greater than 20 percent. The associated nitrate/nitrite as N results for this location are qualified with a "J" flag as estimated values.

# Validation Report: Field Duplicates

Page 1 of 10

01-Nov-2017

Project: Tuba City Disposal Site Task Code: TUB01-01 1708001 Lab Code: PAR

Duplicate: TUB01-01.1708001-082					Sample: TUB01-01.1708001-062 0932						
Analyte	Result	Qualifiers	Uncert	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Ammonia Total as N	0.1	U		1	0.15			1			mg/L
Arsenic	0.0014			10	0.0015			10	6.9		mg/L
Calcium	60			1	57			1	5.1		mg/L
Chloride	16			1	14			5	13.3		mg/L
Iron	0.0067	U		1	0.0067	U		1			mg/L
Magnesium	11			1	10			1	9.5		mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Molybdenum	0.00032	U		10	0.00034	J		10			mg/L
Molybdenum	0.00032	U		10	0.00034	J		10			mg/L
Nitrate + Nitrite as Nitrogen	10			10	9			10	10.5		mg/L
Potassium	1.9			1	1.8			1	5.4		mg/L
Selenium	0.0013			10	0.0019			10			mg/L
Selenium	0.0013			10	0.0019			10			mg/L
Silica	12			1	12			1	0		mg/L
Sodium	13			1	13			1	0		mg/L
Strontium	0.86			1	0.81			1	6.0		mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

## Validation Report: Field Duplicates

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01-Nov-2017

**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

Duplicate: TUB01-01.1708001-082					Sample: TUB01-01.1708001-062 0932						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Sulfate	57			1	47			5	19.2		mg/L
Total Dissolved Solids	260			1	260			1			mg/L
Uranium	0.003			10	0.0027			10	10.5		mg/L
Uranium	0.003			10	0.0027			10	10.5		mg/L
Vanadium	0.0084			10	0.0072			10	15.4		mg/L

**QC Checks:** RPD: Relative Percent Difference    RER: Relative Error Ratio

# Validation Report: Field Duplicates

.Page 3 of 10

01-Nov-2017

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

Duplicate: TUB01-01.1708001-083					Sample: TUB01-01.1708001-002 0252						
Analyte	Result	Qualifiers	Uncert	Dilution	Result	Qualifiers	Uncert	Dilution	RPD	RER	Units
Ammonia Total as N	0.1	U		1	0.1	U		1			mg/L
Arsenic	0.0016			10	0.002			10	22.2		mg/L
Calcium	21			1	23			1	9.1		mg/L
Chloride	5			1	5.9			1	16.5		mg/L
Iron	0.011	J		1	0.0067	U		1			mg/L
Magnesium	4.8			1	5			1	4.1		mg/L
Manganese	0.0003	J		1	0.00024	U		1			mg/L
Manganese	0.0003	J		1	0.00024	U		1			mg/L
Manganese	0.0003	J		1	0.00024	U		1			mg/L
Molybdenum	0.00032	U		10	0.00032	U		10			mg/L
Molybdenum	0.00032	U		10	0.00032	U		10			mg/L
Nitrate + Nitrite as Nitrogen	3.2			10	3.3			10	3.1		mg/L
Potassium	2.5			1	2.5			1	0		mg/L
Selenium	0.00088	J		10	0.00087	J		10			mg/L
Selenium	0.00088	J		10	0.00087	J		10			mg/L
Silica	9.5			1	9.7			1	2.1		mg/L
Sodium	12			1	11			1	8.7		mg/L
Strontium	0.81			1	0.8			1	1.2		mg/L
Sulfate	11			1	13			1	16.7		mg/L
Total Dissolved Solids	100			1	130			1			mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio



## Validation Report: Field Duplicates

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01-Nov-2017

**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

Duplicate: TUB01-01.1708001-083					Sample: TUB01-01.1708001-002 0252							
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units	
Uranium	0.0024			10	0.0025			10	4.1		mg/L	
Uranium	0.0024			10	0.0025			10	4.1		mg/L	
Vanadium	0.0032			10	0.0036			10	11.8		mg/L	

**QC Checks:** RPD: Relative Percent Difference    RER: Relative Error Ratio

# Validation Report: Field Duplicates

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01-Nov-2017

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

	Duplicate: TUB01-01.1708001-084				Sample: TUB01-01.1708001-031 0684						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Ammonia Total as N	0.1	U		1	0.1	U		1			mg/L
Arsenic	0.0025			10	0.0031			10	21.4		mg/L
Calcium	35			1	33			1	5.9		mg/L
Chloride	12			1	12			1	0		mg/L
Iron	0.0067	U		1	0.013	J		1			mg/L
Magnesium	6.5			1	6.3			1	3.1		mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Molybdenum	0.00044	J		10	0.00051	J		10			mg/L
Molybdenum	0.00044	J		10	0.00051	J		10			mg/L
Nitrate + Nitrite as Nitrogen	3			10	3.1			10	3.3		mg/L
Potassium	1.3			1	1.5			1	14.3		mg/L
Selenium	0.0016			10	0.0012			10			mg/L
Selenium	0.0016			10	0.0012			10			mg/L
Silica	12			1	12			1	0		mg/L
Sodium	13			1	14			1	7.4		mg/L
Strontium	0.37			1	0.4			1	7.6		mg/L
Sulfate	19			1	18			1	5.4		mg/L
Total Dissolved Solids	160			1	140			1			mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

## Validation Report: Field Duplicates

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01-Nov-2017

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

Duplicate: TUB01-01.1708001-084					Sample: TUB01-01.1708001-031 0684						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Uranium	0.0013			10	0.0013			10	0		mg/L
Uranium	0.0013			10	0.0013			10	0		mg/L
Vanadium	0.015			10	0.014			10	6.9		mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

# Validation Report: Field Duplicates

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01-Nov-2017

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

Duplicate: TUB01-01.1708001-085					Sample: TUB01-01.1708001-077 NMW-4A						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Ammonia Total as N	0.1	U		1	0.1	U		1			mg/L
Arsenic	0.0019			10	0.002			10	5.1		mg/L
Calcium	32			1	32			1	0		mg/L
Chloride	9.2			1	9.3			1	1.1		mg/L
Iron	0.035	J		1	0.021	J		1			mg/L
Magnesium	5.3			1	5.3			1	0		mg/L
Manganese	0.00098	J		1	0.0065			1			mg/L
Manganese	0.00098	J		1	0.0065			1			mg/L
Manganese	0.00098	J		1	0.0065			1			mg/L
Molybdenum	0.00032	U		10	0.00032	U		10			mg/L
Molybdenum	0.00032	U		10	0.00032	U		10			mg/L
Nitrate + Nitrite as Nitrogen	3.4			10	4.2			10	21.1		mg/L
Potassium	1.8			1	1.9			1	5.4		mg/L
Selenium	0.0012			10	0.00092	J		10			mg/L
Selenium	0.0012			10	0.00092	J		10			mg/L
Silica	10			1	10			1	0		mg/L
Sodium	11			1	11			1	0		mg/L
Strontium	0.29			1	0.29			1	0		mg/L
Sulfate	13			1	13			1	0		mg/L
Total Dissolved Solids	130			1	90			1			mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

## Validation Report: Field Duplicates

Page 8 of 10

01-Nov-2017

**Project:** Tuba City Disposal Site    **Task Code:** TUB01-01.1708001    **Lab Code:** PAR

Duplicate: TUB01-01.1708001-085					Sample: TUB01-01.1708001-077 NMW-4A						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Uranium	0.0012			10	0.0011			10	8.7		mg/L
Uranium	0.0012			10	0.0011			10	8.7		mg/L
Vanadium	0.011			10	0.01			10	9.5		mg/L

**QC Checks:** RPD: Relative Percent Difference    RER: Relative Error Ratio

# Validation Report: Field Duplicates

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01-Nov-2017

Project: Tuba City Disposal Site

Task Code: TUB01-01.1708001

Lab Code: PAR

Duplicate: TUB01-01.1708001-086					Sample: TUB01-01.1708001-048 0910						
Analyte	Result	Qualifiers	Uncert.	Dilution	Result	Qualifiers	Uncert.	Dilution	RPD	RER	Units
Ammonia Total as N	0.1	U		1	0.17			1			mg/L
Arsenic	0.0017			10	0.0016			10	6.1		mg/L
Calcium	30			1	31			1	3.3		mg/L
Chloride	10			1	10			1	0		mg/L
Iron	0.0067	U		1	0.047	J		1			mg/L
Magnesium	5.1			1	5.1			1	0		mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Manganese	0.00024	U		1	0.00024	U		1			mg/L
Molybdenum	0.00052	J		10	0.00054	J		10			mg/L
Molybdenum	0.00052	J		10	0.00054	J		10			mg/L
Nitrate + Nitrite as Nitrogen	2.9			10	3			10	3.4		mg/L
Potassium	1.5			1	1.4			1	6.9		mg/L
Selenium	0.0012			10	0.0013			10			mg/L
Selenium	0.0012			10	0.0013			10			mg/L
Silica	10			1	11			1	9.5		mg/L
Sodium	15			1	15			1	0		mg/L
Strontium	0.3			1	0.3			1	0		mg/L
Sulfate	14			1	14			1	0		mg/L
Total Dissolved Solids	120			1	150			1			mg/L

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

## Validation Report: Field Duplicates

Page 10 of 10

01-Nov-2017

**Project:** Tuba City Disposal Site

**Task Code:** TUB01-01.1708001

**Lab Code:** PAR

Duplicate: TUB01-01.1708001-086					Sample: TUB01-01.1708001-048 0910						
Analyte	Result	Qualifiers	Uncert	Dilution	Result	Qualifiers	Uncert	Dilution	RPD	RER	Units
Uranium	0.0011			10	0.0011			10	0		mg/L
Uranium	0.0011			10	0.0011			10	0		mg/L
Vanadium	0.011			10	0.011			10	0		mg/L

**QC Checks:** RPD: Relative Percent Difference    RER: Relative Error Ratio

**Enclosure 4**  
**Assessment of Anomalous Data**



## Potential Outliers Report

Potential outliers are results that lie outside the historical range, possibly due to transcription errors, data calculation errors, or measurement system problems. However, outliers can also represent true values outside the historical range. Potential outliers are identified by generating the Data Validation Outliers Report from data in the environmental database. The new data are compared to historical values and data that fall outside the historical data range are listed on the report along with the historical minimum and maximum values. The potential outliers are further reviewed and may be subject to statistical evaluation using the ProUCL application developed by the EPA (<https://www.epa.gov/land-research/proucl-software>). The review also includes an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

Data were identified as potentially anomalous for 19 results (see the Data Validation Outliers Report, below). Notable were the chloride and sulfate results for location 0264. These data also resulted in a charge balance of 44.2% indicating that an analytical error is likely. While screening the anions aliquot from this location of chloride and sulfate concentrations, the analyst noted that the analyte concentrations observed in the anions aliquot were not in agreement with the analyte concentrations in the metals aliquot. It was concluded that the anions aliquot submitted for this location had been mislabeled in the field. The chloride and sulfate results for this location are qualified with an "R" flag as rejected because the identity of the sample could not be assured.

Further review of the data for the remaining outliers did not indicate any laboratory errors. Potential anomalies in the field parameters were also examined. The alkalinity value of 832 mg/L recorded for location 0688 is much greater than the historical maximum of 128 mg/L. This value likely contributed to the cation/anion balance of 49.5%. The alkalinity result for this location is qualified with an "R" flag as rejected.

Data Validation Outliers Report - No Field Parameters Report Date: 10/27/2017

Comparison to Historical Data Since: 10/27/2006 12:00:00 AM Fraction: Any

Task: TUB01-01.1708001

Analyte	Location	Analysis Location	Units	Fraction	Result	Type	HistMIN	HistMAX	HistSetSize	5% Critical Value	Test Statistic
Sulfate	0252	LB	mg/L	N	13	> HistMAX	5.9	11	21	0.430	0.765
Chloride	0252	LB	mg/L	N	5.9	> HistMAX	4.3	5.3	21	0.430	0.571
Sulfate	0264	LB	mg/L	N	520	> HistMAX	57	99	20	0.440	0.920
Chloride	0264	LB	mg/L	N	34	> HistMAX	13	16	20	0.440	0.900
Total Dissolved Solids	0271	LB	mg/L	N	130	< HistMIN	160	190	12	0.521	0.600
Chloride	0272	LB	mg/L	N	5.7	< HistMIN	7.44	13	23	0.413	0.622
Sodium	0282	LB	mg/L	T	27	> HistMAX	13	23	19	0.450	0.462
Sulfate	0282	LB	mg/L	N	360	> HistMAX	65	210	19	0.450	0.621
Chloride	0282	LB	mg/L	N	70	> HistMAX	36.4	52	19	0.450	0.625
Sodium	0290	LB	mg/L	D	140	> HistMAX	13	100	17	0.475	0.528
Uranium	0290	LB	mg/L	D	0.13	> HistMAX	0.0014	0.099	18	0.462	0.568
Sulfate	0290	LB	mg/L	N	1100	> HistMAX	19	810	18	0.462	0.483
Iron	0683	LB	mg/L	D	0.27	> HistMAX	0.0032	0.056	11	0.560	0.862
Nitrate + Nitrite as Nitrogen	0690	LB	mg/L	N	7.5	> HistMAX	2.3	4.5	11	0.546	0.872
Sulfate	0906	LB	mg/L	N	2500	> HistMAX	1600	2100	16	0.490	0.500
Iron	0908	LB	mg/L	T	0.77	> HistMAX	0.0049	0.21	19	0.512	0.763
Uranium	0943	LB	mg/L	D	0.033	> HistMAX	0.0053	0.016	13	0.546	0.934
Sulfate	1007	LB	mg/L	N	7.8	< HistMIN	12	14	11	0.546	0.808
Chloride	1007	LB	mg/L	N	5.5	< HistMIN	8.4	10	11	0.546	0.707

FRACTION: D = Dissolved N = NA T = Total

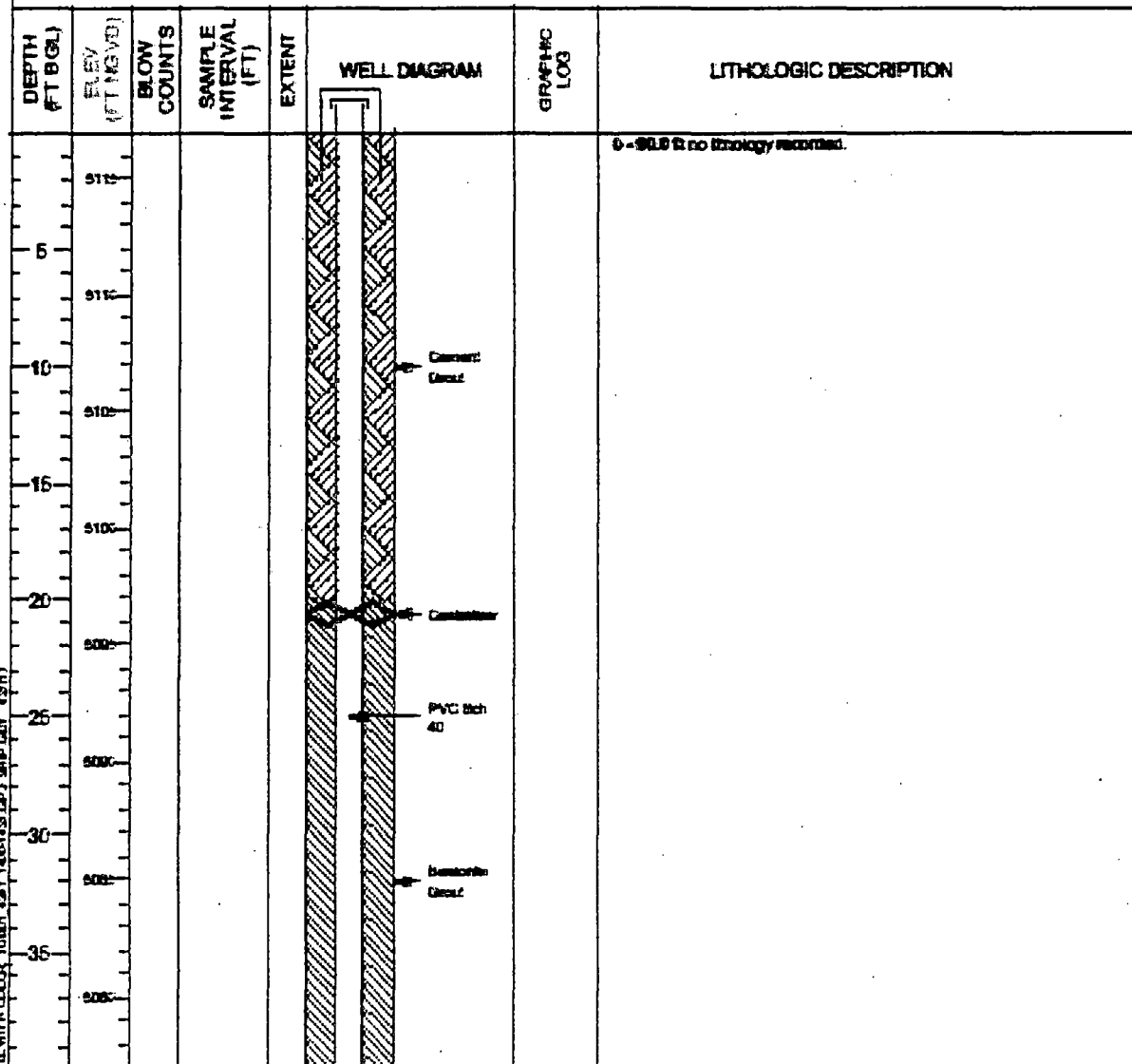
**ATTACHMENT D**

**Lithology and Completion Records for Highway 160 Site  
Wells 1420, 1421, 1422, and 1423**

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# **MONITORING WELL COMPLETION LOG TUB01-1420**

PROJECT	LM	WELL NUMBER	TUB01-1420	DATE STARTED	2/3/2017
LOCATION	Tube City, AZ	NORTH COORD. (FT)	1875083.76	WELL ESTABLISHED	2/3/2017
SITE	Tube City Disposal Site	EAST COORD. (FT)	729787.18	SURFACE ELEV. (FT NGVD)	5118.90
DRILLING METHOD	SONIC	HOLE DEPTH (FT BGS)	90.00	TOP OF CASING (FT)	5118.35
DRILL COMPANY	Yellow Jacket	WELL DEPTH (FT BGS)	90.00	MEAS. FT. ELEV. (FT)	5119.35
RIG TYPE	SONIC	WATER LEVEL (FT BTWC)	68.52	SLOT SIZE (IN)	0.020
		WATER LEVEL DATE	2/1/2017	BIT SIZE(S) (IN)	8.0
		WELL INSTALLATION	INTERVAL (FT BGS)	DRILLER	
SURFACE CASING:		10 in. Steel	-3.0 to 3.0	Wallace, C.	
BLANK CASING:		4 in. dia. PVC Sch 40	-2.45 to 79.0	LOGGED BY	
WELL SCREEN:		4 in. dia. 0.02 Slotted PVC	79.0 to 89.0	Dander, D.	
SUMP/END CAP:		4 in. dia. PVC Sch 40	89.0 to 90.0	SAMPLING METHOD	
GROUT:		Bentonite	20.0 to 73.0	N/A	
SEAL:		1/4" Bentonite Pellets	73.0 to 76.0	DATE DEVELOPED	
UPPER PACK:		#90 Sand	76.0 to 77.0	5/16/2017	
LOWER PACK:		10-20 Slick Sand	77.0 to 90.0	REMARKS	
				0 - 20.0 ft. cement/bentonite grout.	



LM MON WELL WITH H-CL-01, TUB01-1420-1425 (2) 9/16/2017 12:17

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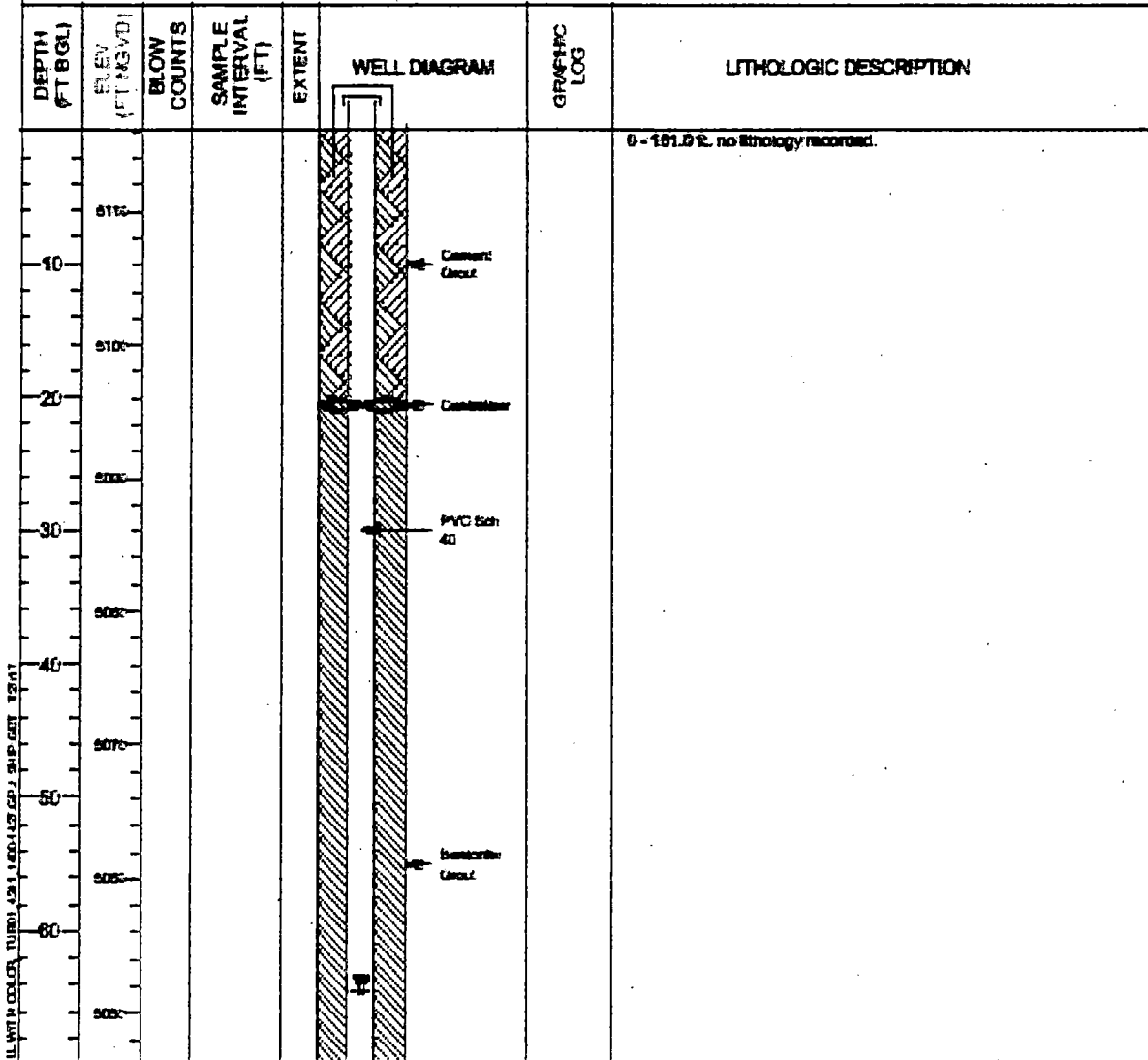
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# **MONITORING WELL COMPLETION LOG TUB01-1421**

<b>PROJECT</b> LM	<b>WELL NUMBER</b> TUB01-1421	<b>DATE STARTED</b> 2/4/2017
<b>LOCATION</b> Tube City, AZ	<b>NORTH COORD. (FT)</b> 1876062.75	<b>WELL ESTABLISHED</b> 2/5/2017
<b>SITE</b> Tube City Disposal Site	<b>EAST COORD. (FT)</b> 729682.65	<b>SURFACE ELEV. (FT NGVD)</b> 5116.07
<b>DRILLING METHOD</b> SONIC	<b>HOLE DEPTH (FT BGS)</b> 151.00	<b>TOP OF CASING (FT)</b> 5116.65
<b>DRILL COMPANY</b> Yellow Jacket	<b>WELL DEPTH (FT BGS)</b> 151.00	<b>MEAS. PT. ELEV. (FT)</b> 5116.65
<b>RIG TYPE</b> SONIC	<b>WATER LEVEL (FT BTCC)</b> 66.98	<b>SLOT SIZE (IN)</b> 0.020
	<b>WATER LEVEL DATE</b> 3/1/2017	<b>BIT SIZE(S) (IN)</b> 6.0

<b>WELL INSTALLATION</b>	<b>INTERVAL (FT BGS)</b>	<b>DRILLER</b> Wallace, C.
<b>SURFACE CASING:</b> 10 in. Steel	-3.0 to 3.0	<b>LOGGED BY</b> Dander, D.
<b>BLANK CASING:</b> 4 in. dia. PVC Sch 40	-2.58 to 140.0	<b>SAMPLING METHOD</b> N/A
<b>WELL SCREEN:</b> 4 in. dia. 0.02 Slotted PVC	140.0 to 150.0	<b>DATE DEVELOPED</b> 5/16/2017
<b>SUMP/END CAP:</b> 4 in. dia. PVC Sch 40	150.0 to 151.0	<b>REMARKS</b> 0 - 20.0 ft. cement/bentonite grout.
<b>GROUT:</b> Bentonite	20.0 to 133.0	
<b>SEAL:</b> 1/4" Bentonite Pellets	133.0 to 138.0	
<b>UPPER PACK:</b> #90 Sand	138.0 to 138.0	
<b>LOWER PACK:</b> 10-20 Silica Sand	138.0 to 151.0	



LM 0004 WELL WITH COLLAR TUB01-1421 (2014) 2017 3/2/17

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# **MONITORING WELL COMPLETION LOG TUB01-1421**

<b>PROJECT</b> <u>LM</u>	<b>WELL NUMBER</b> <u>TUB01-1421</u>
<b>SITE</b> <u>Tube City Disposal Site</u>	<b>DATES DRILLED</b> <u>2/4/2017 to 2/5/2017</u>

*Continued from Previous Page*

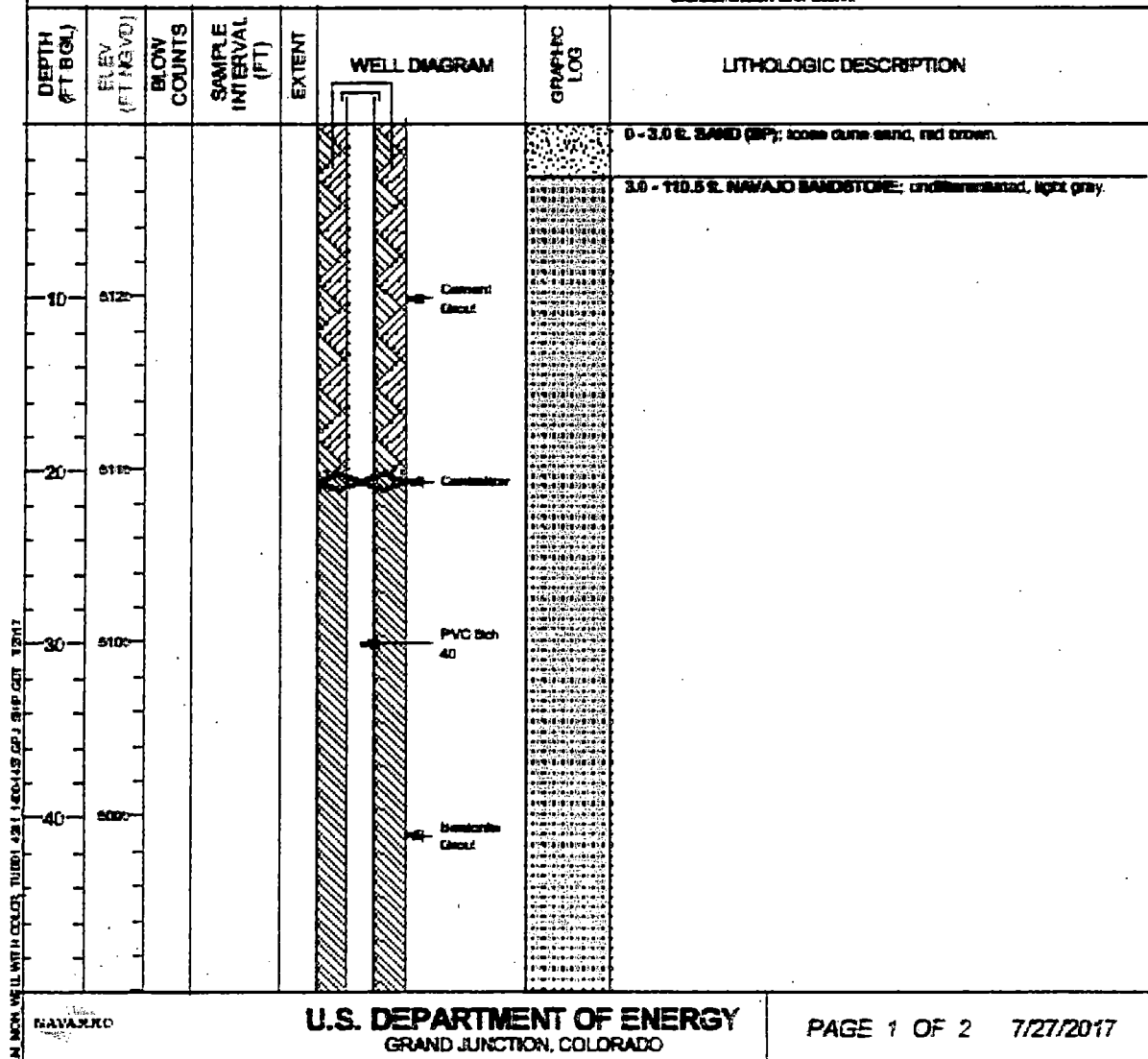
DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
<div style="writing-mode: vertical-rl; transform: rotate(180deg); position: absolute; left: -40px; top: 0px;">IN MON WELL WITH COLOR TUB01-1421 1420.15 GFL 210 GFL 12/07</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 10px;">5040</div> <div style="margin-bottom: 10px;">80</div> <div style="margin-bottom: 10px;">5030</div> <div style="margin-bottom: 10px;">80</div> <div style="margin-bottom: 10px;">5020</div> <div style="margin-bottom: 10px;">100</div> <div style="margin-bottom: 10px;">5010</div> <div style="margin-bottom: 10px;">110</div> <div style="margin-bottom: 10px;">5000</div> <div style="margin-bottom: 10px;">120</div> <div style="margin-bottom: 10px;">4990</div> <div style="margin-bottom: 10px;">130</div> <div style="margin-bottom: 10px;">4980</div> <div style="margin-bottom: 10px;">140</div> <div style="margin-bottom: 10px;">4970</div> <div style="margin-bottom: 10px;">150</div> <div style="margin-bottom: 10px;">4960</div> </div>					<p>The well diagram shows a vertical cross-section of the well. From top to bottom, it includes: a casing with a cement collar at the top; a PVC Sch 40 casing; a screen section labeled '142" Screen'; a pump assembly at the bottom consisting of a pump, a 10-20 screen, and a 0.020" slot PVC. The casing is shown with a hatched pattern, and the screen is shown with a dotted pattern.</p>		
							Total Depth 151.0 ft



# **MONITORING WELL COMPLETION LOG TUB01-1422**

<b>PROJECT</b> LM	<b>WELL NUMBER</b> TUB01-1422	<b>DATE STARTED</b> 1/25/2017
<b>LOCATION</b> Tuba City, AZ	<b>NORTH COORD. (FT)</b> 1875140.01	<b>WELL ESTABLISHED</b> 1/29/2017
<b>SITE</b> Tuba City Disposal Site	<b>EAST COORD. (FT)</b> 730228.47	<b>SURFACE ELEV. (FT NGVD)</b> 5129.88
<b>DILLING METHOD</b> SONIC	<b>HOLE DEPTH (FT BGS)</b> 110.50	<b>TOP OF CASING (FT)</b> 5132.24
<b>DRIEL COMPANY</b> Yellow Jacket	<b>WELL DEPTH (FT BGS)</b> 110.50	<b>MEAS. FT. ELEV. (FT)</b> 5132.24
<b>RG TYPE</b> SONIC	<b>WATER LEVEL (FT BTGC)</b> 78.9	<b>SLOT SIZE (IN)</b> 0.020
	<b>WATER LEVEL DATE</b> 2/28/2017	<b>BIT SIZE(S) (IN)</b> 8.0

<b>WELL INSTALLATION</b>	<b>INTERVAL (FT BGS)</b>	<b>DRIER</b> Wallace, C.
<b>SURFACE CASING:</b> 10 in. Steel	-3.0 to 3.0	<b>LOGGED BY</b> Bartlett, Franzosa, Dander
<b>BLANK CASING:</b> 4 in. dia. PVC Sch 40	-2.36 to 99.5	<b>SAMPLING METHOD</b> CUTTINGS
<b>WELL SCREEN:</b> 4 in. dia. 0.02 Slotted PVC	99.5 to 109.5	<b>DATE DEVELOPED</b> 5/16/2017
<b>SUSPEND CAP:</b> 4 in. dia. PVC Sch 40	109.5 to 110.5	<b>REMARKS</b> 0 - 20.0 ft. cement/bentonite grout.
<b>GROUT:</b> Bentonite	20.0 to 92.5	Difficulty drilling dry + water, rods stuck multiple times.
<b>SEAL:</b> 1/4" Bentonite Pellets	92.5 to 98.5	changed to mud drilling, 9.0 in. override pipe used to
<b>UPPER PACK:</b> #80 Sand	98.5 to 97.5	extract stuck drill stem.
<b>LOWER PACK:</b> 10-20 Silica Sand	97.5 to 110.5	



# **MONITORING WELL COMPLETION LOG TUB01-1422**

<b>PROJECT</b>	LM	<b>WELL NUMBER</b>	TUB01-1422
<b>SITE</b>	Tube City Disposal Site	<b>DATES DRILLED</b>	1/25/2017 to 1/29/2017

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
60	5070					<p>Handwritten lithologic description text, mostly illegible due to scan quality.</p>	
65							
70	5060						
75							
80	5050						
85							
90	5040						
95							
100	5030						
105							
110	5020						
							Total Depth 110.5 ft.

141 MON. WELL WITH COLOR TUBING 421.160M125 GEL 916 GET 12/07

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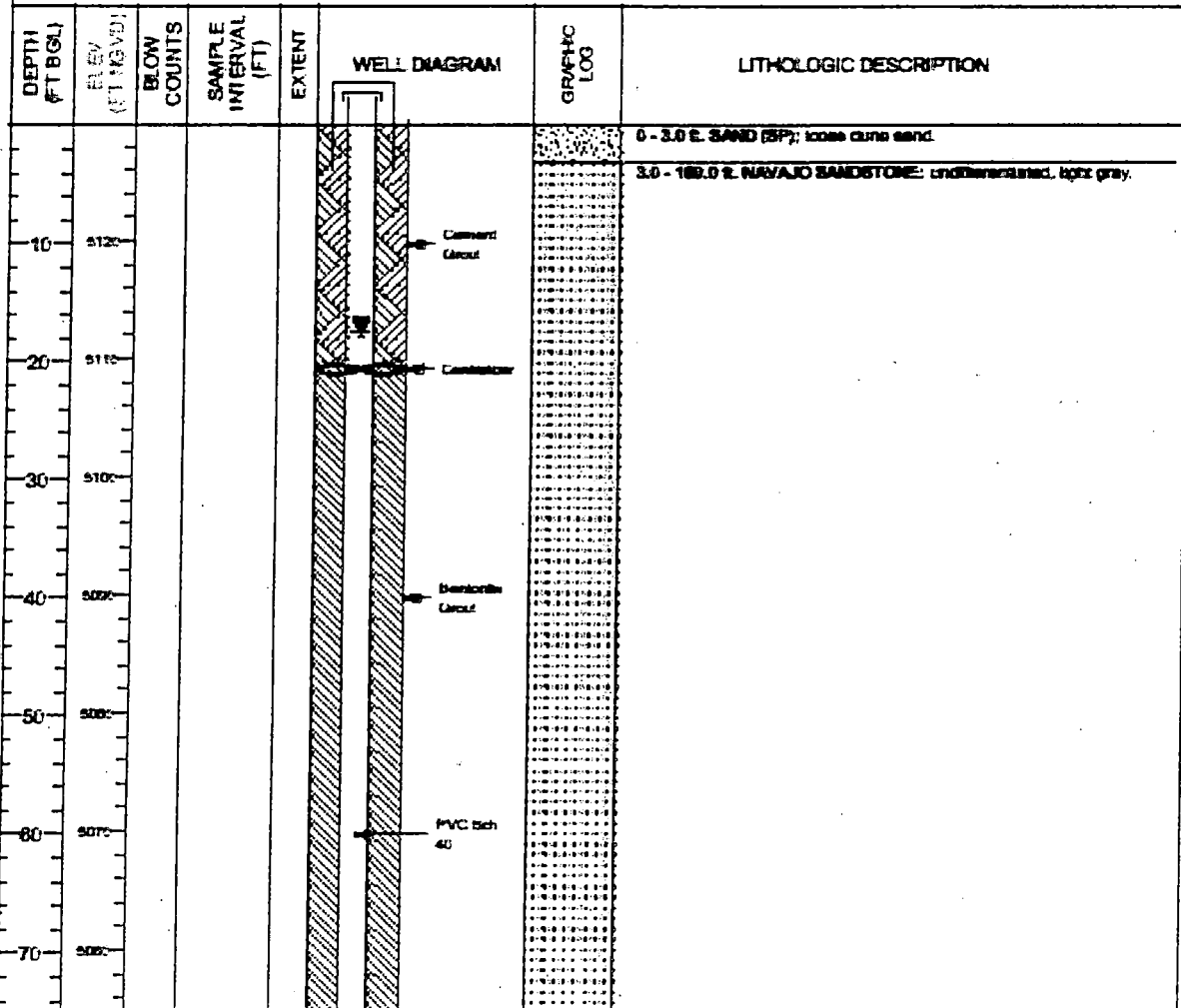
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# **MONITORING WELL COMPLETION LOG TUB01-1423**

<b>PROJECT</b> LM	<b>WELL NUMBER</b> TUB01-1423	<b>DATE STARTED</b> 1/30/2017
<b>LOCATION</b> Tube City AZ	<b>NORTH COORD. (FT)</b> 1875117.16	<b>WELL ESTABLISHED</b> 1/31/2017
<b>SITE</b> Tube City Disposal Site	<b>EAST COORD. (FT)</b> 730184.50	<b>SURFACE ELEV. (FT NGVD)</b> 5129.68
<b>DRILLING METHOD</b> SONIC	<b>HOLE DEPTH (FT BGS)</b> 169.00	<b>TOP OF CASING (FT)</b> 5132.14
<b>DRILL COMPANY</b> Yellow Jacket	<b>WELL DEPTH (FT BGS)</b> 169.00	<b>MEAS. PT. ELEV. (FT)</b> 5132.14
<b>RIG TYPE</b> SONIC	<b>WATER LEVEL (FT BTWC)</b> 19.98	<b>SLOT SIZE (IN)</b> 0.020
	<b>WATER LEVEL DATE</b> 2/28/2017	<b>BIT SIZE(S) (IN)</b> 8.0

<b>WELL INSTALLATION</b>	<b>INTERVAL (FT BGS)</b>	<b>DRILLER</b> Wallace, C.
<b>SURFACE CASING:</b> 10 in. Steel	-3.0 to 3.0	<b>LOGGED BY</b> Dander, D.
<b>BLANK CASING:</b> 4 in. dia. PVC Sch 40	-2.48 to 158.0	<b>SAMPLING METHOD</b> N/A
<b>WELL SCREEN:</b> 4 in. dia. 0.02 Slotted PVC	158.0 to 168.0	<b>DATE DEVELOPED</b> 5/16/2017
<b>SUMPEND CAP:</b> 4 in. dia. PVC Sch 40	168.0 to 169.0	<b>REMARKS</b> 0 - 20.0 ft. cement/bentonite grout. Drilled with mud.
<b>GROUT:</b> Bentonite	20.0 to 151.5	
<b>SEAL:</b> 1/4" Bentonite Pellets	151.5 to 154.5	
<b>UPPER PACK:</b> #90 Sand	154.5 to 155.5	
<b>LOWER PACK:</b> 10-20 Silica Sand	155.5 to 169.0	



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