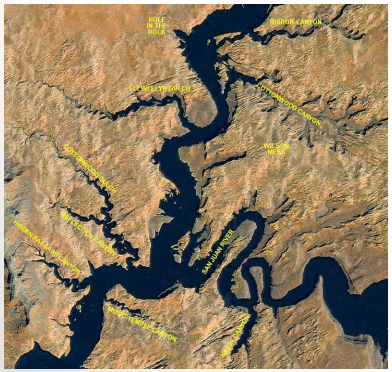
Gold King Mine Release: Utah's Response and Implications for Our Waters



WEAU

November 12, 2015

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Division of Water Quality

Utah Department of Environmental Quality

Presentation Overview

- What happened?
- UDWQ's response
- Immediate effects on Utah's waters
- Long-term monitoring and legacy effects

Acid Mine Drainage

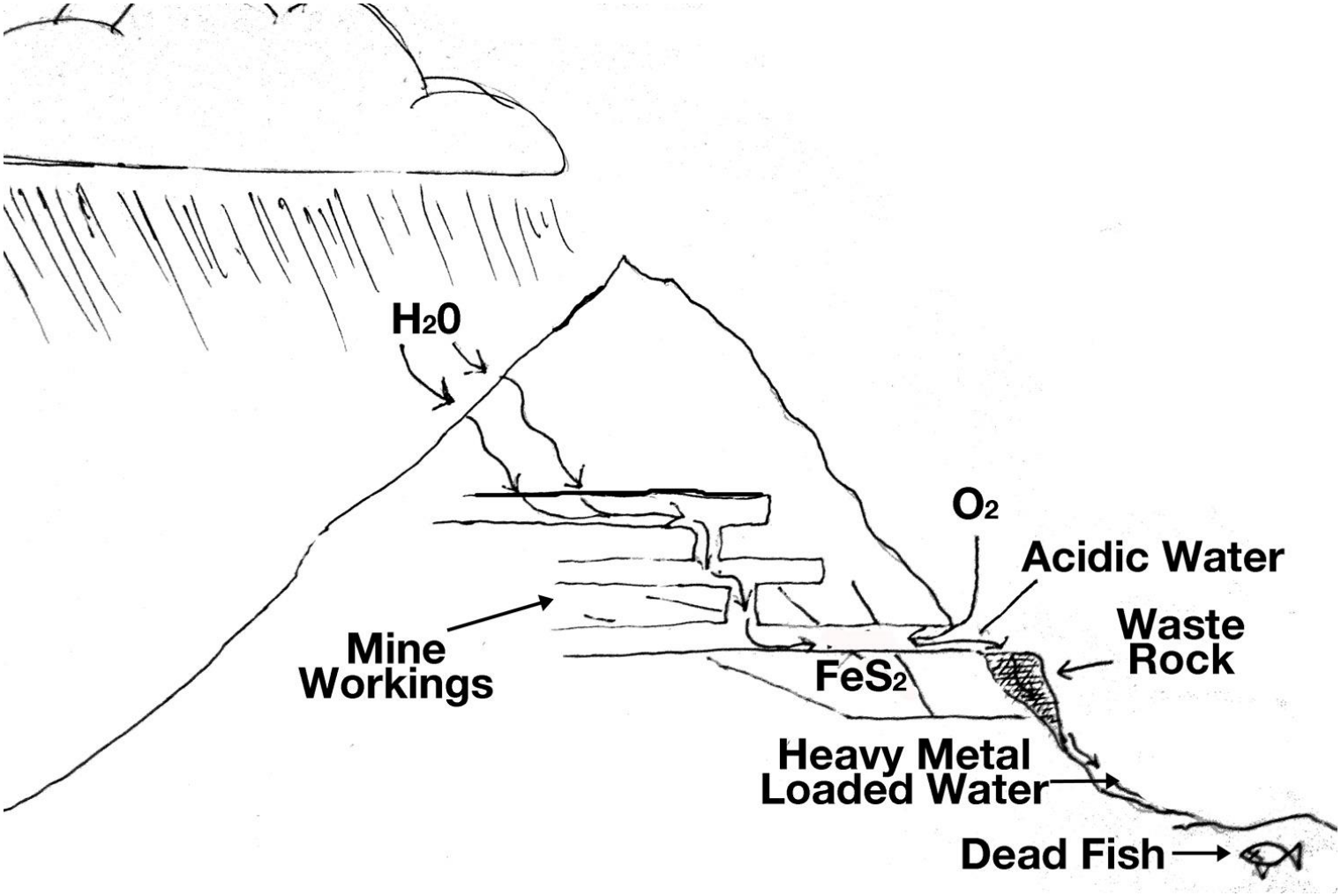


Image source: High Country News

Gold King Mine - 1923

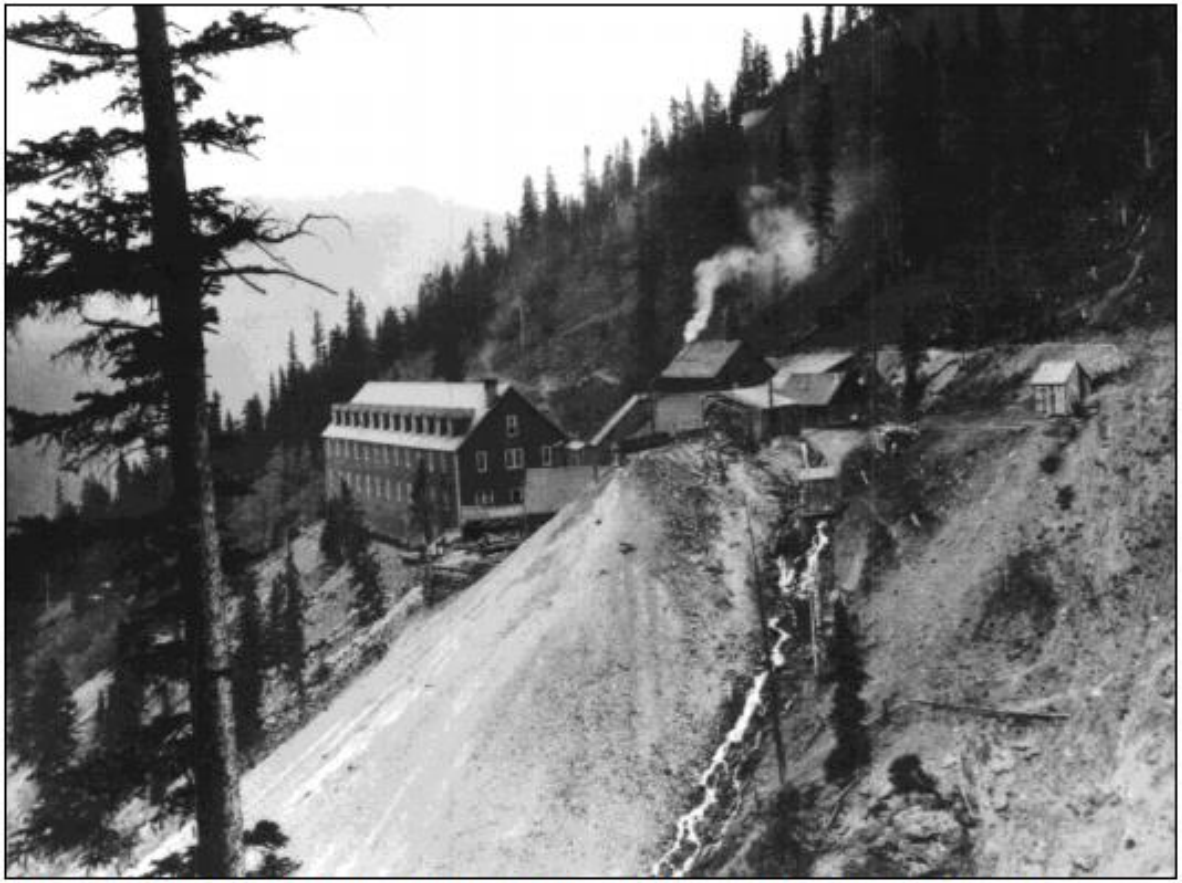
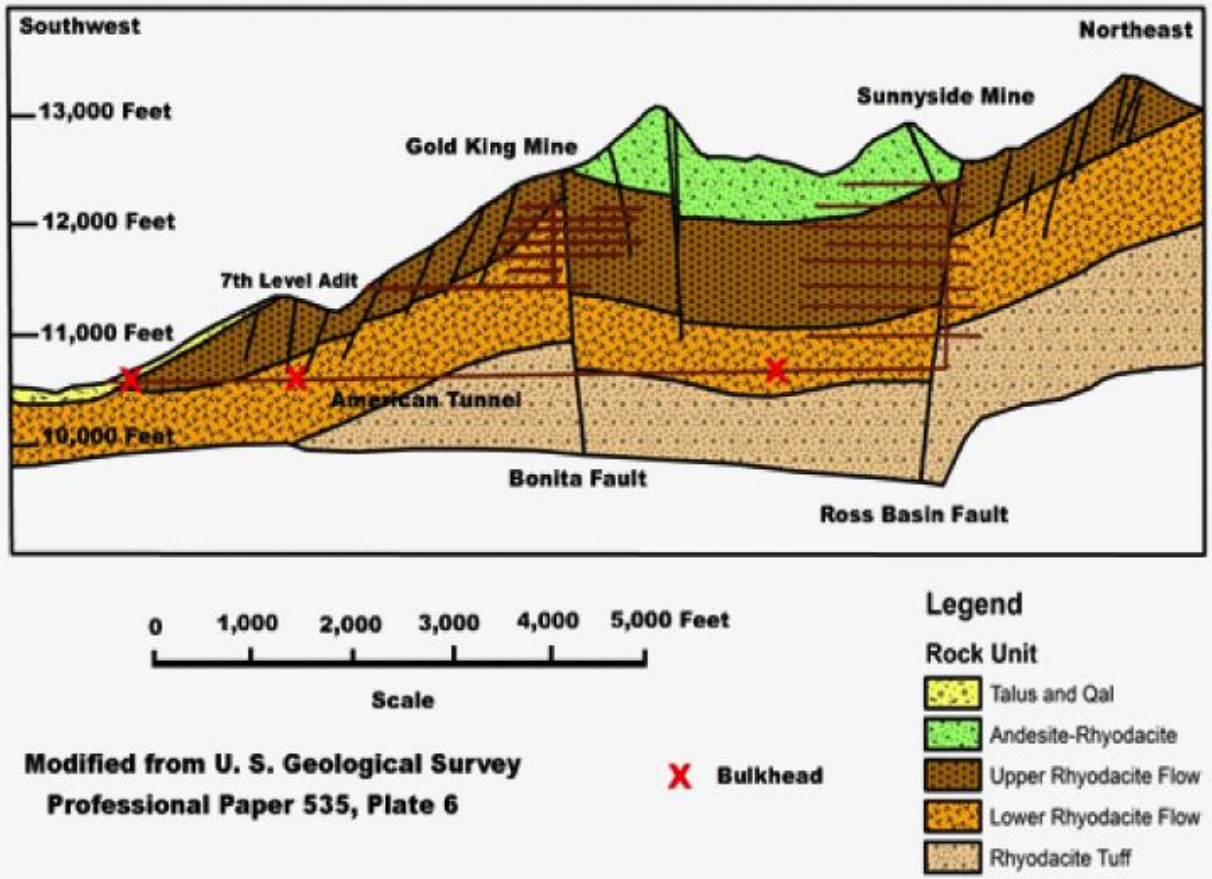
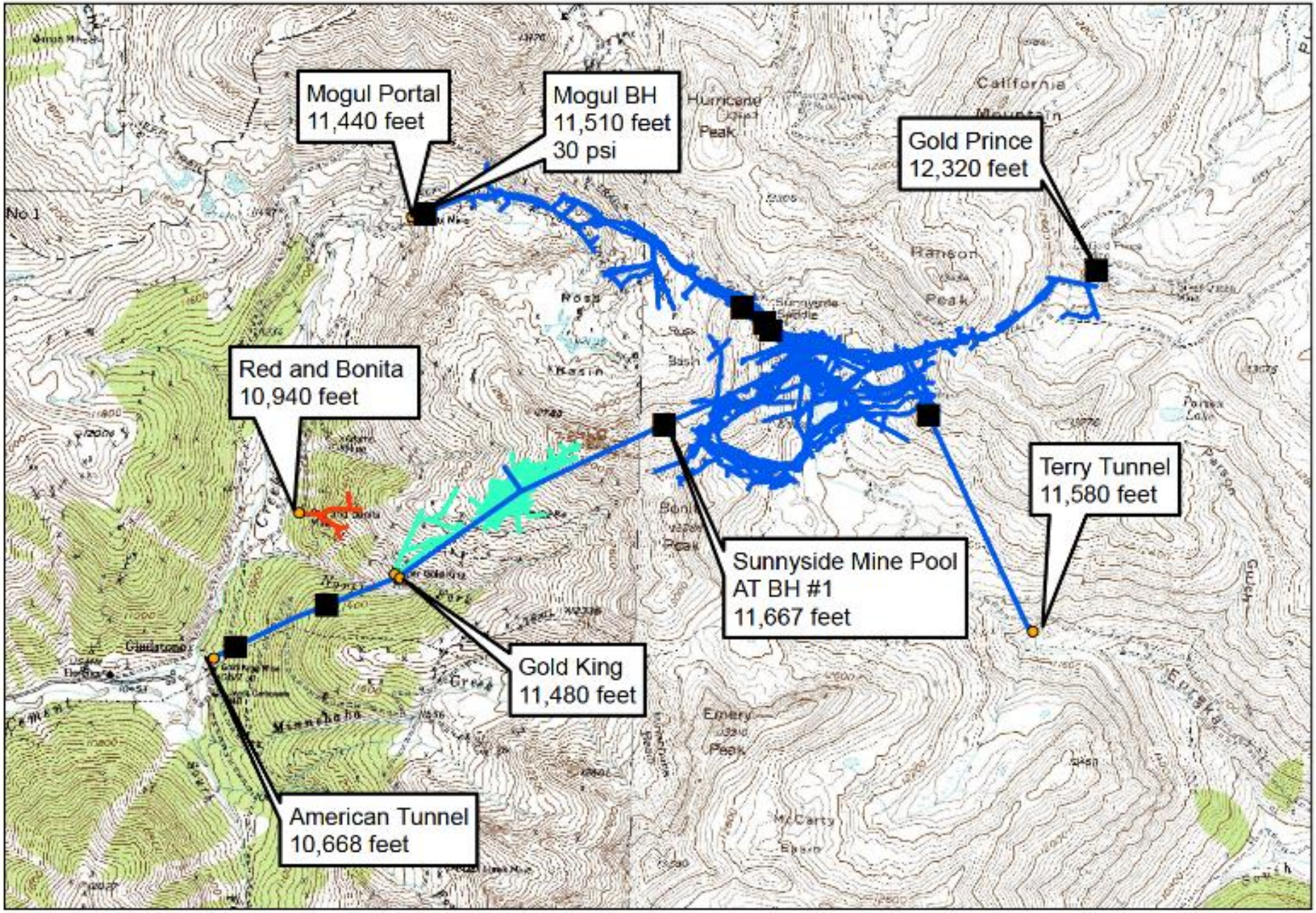


Figure 5.—Historical photograph of the Gold King Mine Level 7 taken prior to the mine closing in 1923. Note the drainage flow down the side of the waste-rock dump.

Anatomy of Gold King Mine



Cross-Section of Gold King and Sunnyside Mines



Mine and Pool Elevations

0 0.15 0.3 0.6 0.9 1.2 Miles

Approximation of Mine Portal Elevations and Mine Pool Elevations
Created for AR&SG
[redacted]
4/17/2014

Gold King Mine Release in 2015

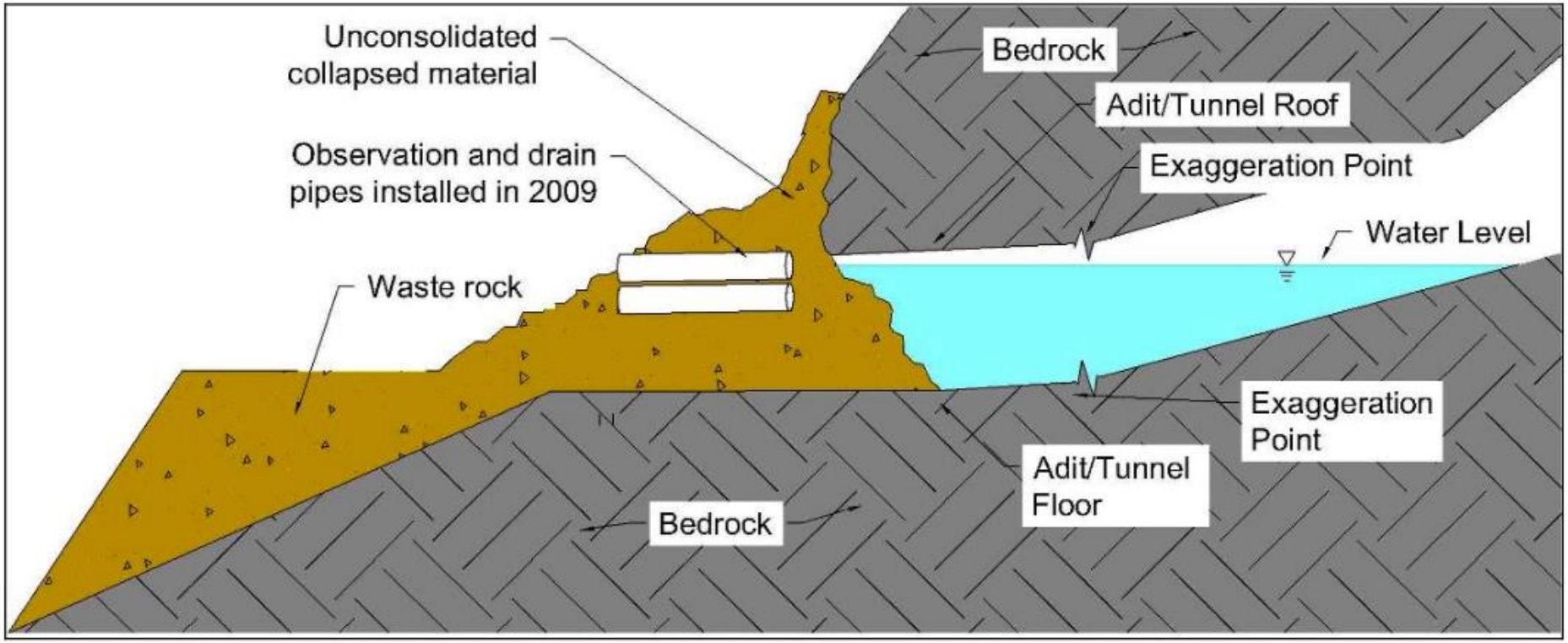


Figure 40.—Cross-section illustration showing the condition of the adit that was assumed by the EPA OSC and the abandoned mine experts from DRMS for use in planning to open the adit (not to scale). The "exaggeration point" means the right side of the drawing has an exaggerated vertical scale in order to show the 1% uphill slope of the adit. If drawn without exaggeration, the uphill slope of the adit would not be obvious on the drawing.

Gold King Mine Release in 2015

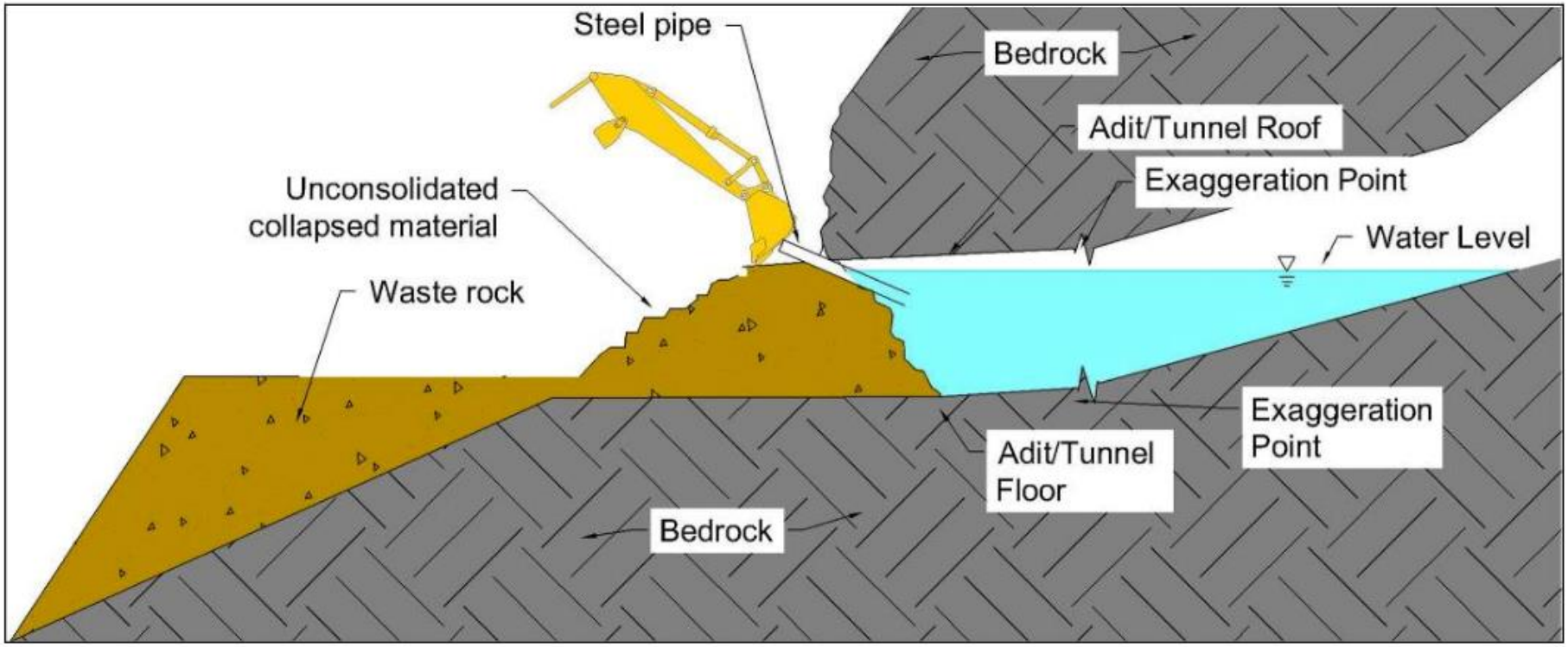


Figure 43.—Cross-section illustration showing step 3 of the plan (not to scale). With the steel pipe fully inserted, contact is made with the water impounded inside the mine.

Gold King Mine Release in 2015

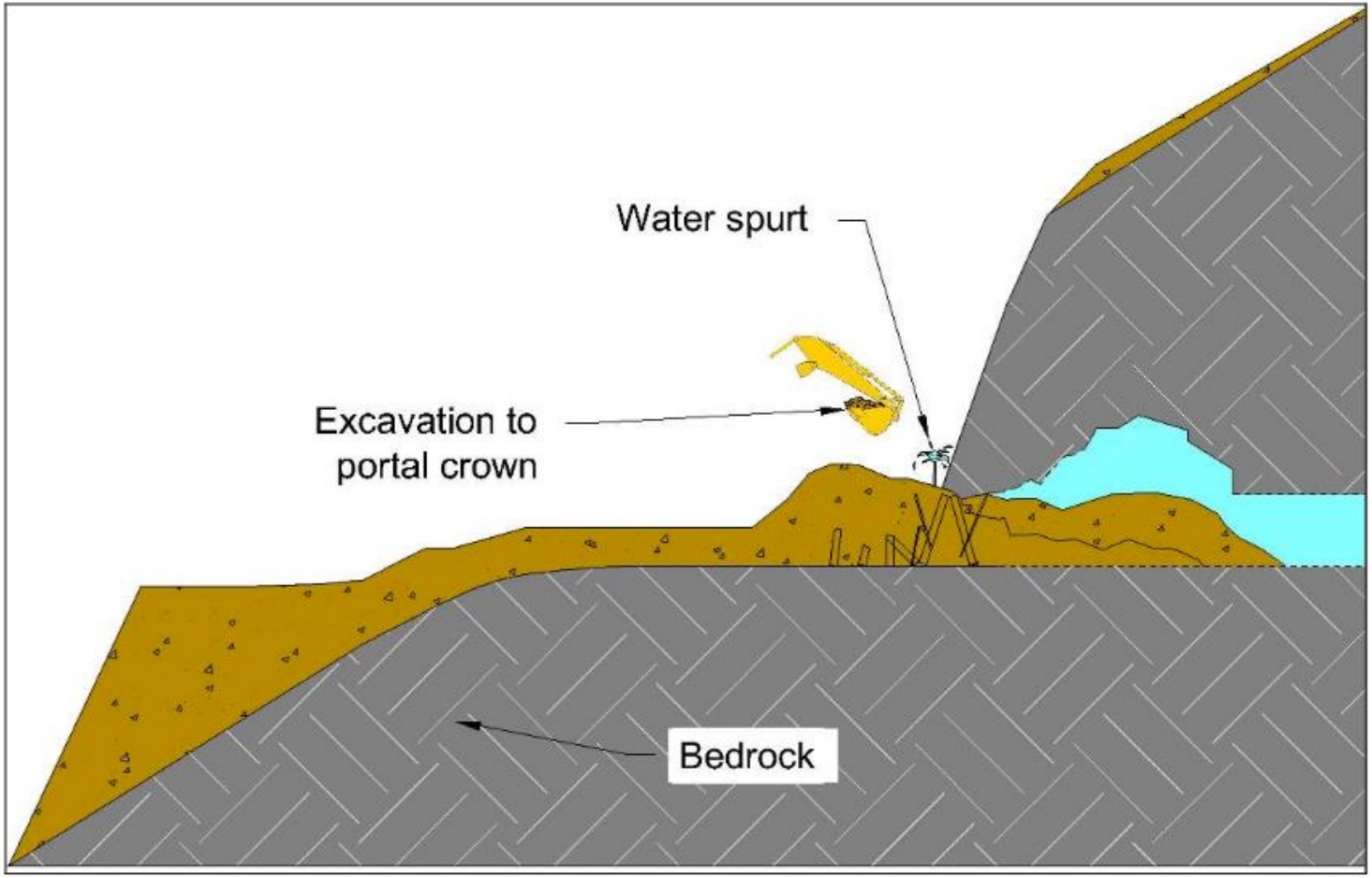


Figure 50.—Cross-section showing BOR's interpretation of the conditions immediately before the blowout as the spurt of water appeared indicating the adit was full and under pressure (not to scale).

Gold King Mine Release in 2015

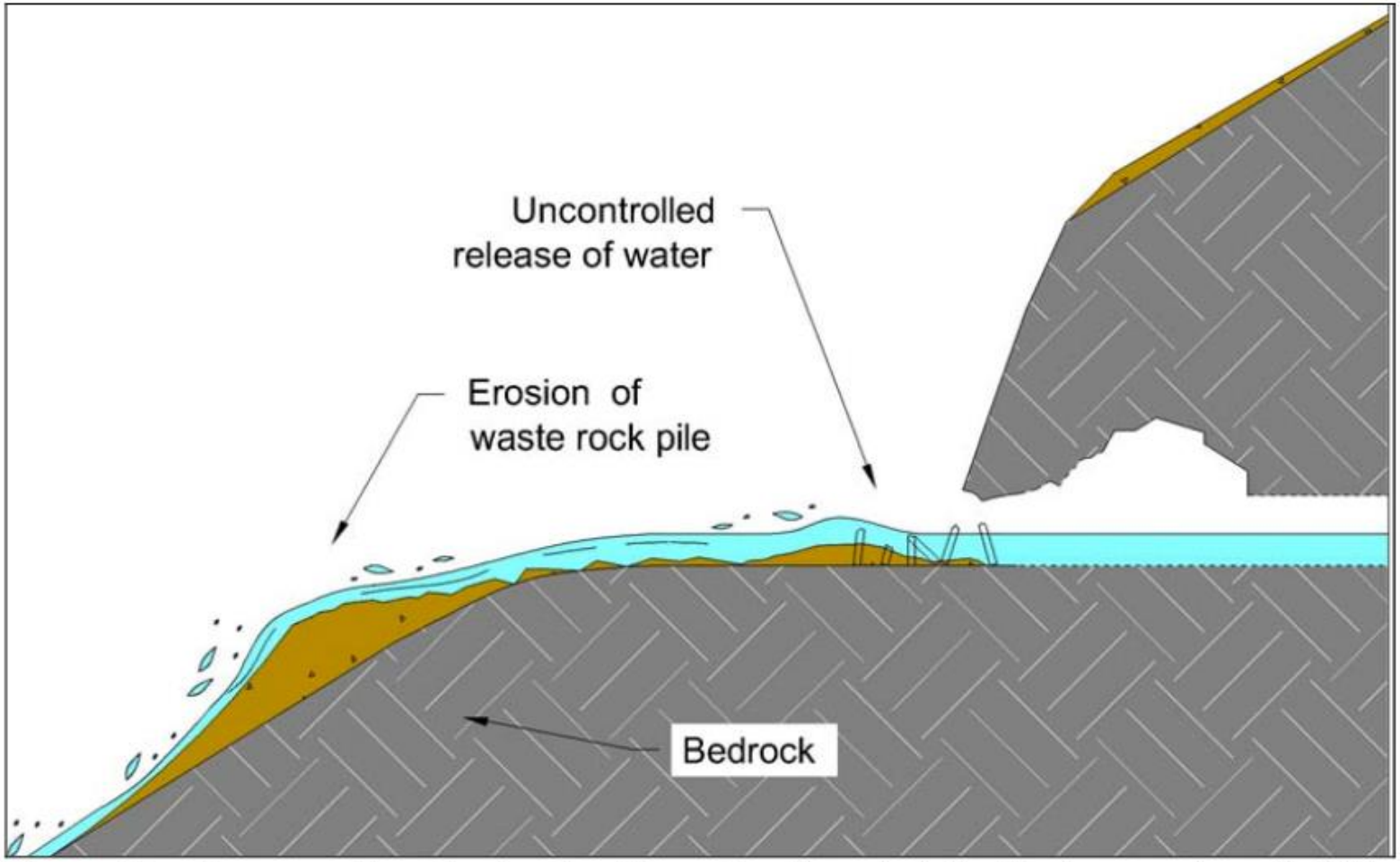


Figure 55.—Cross-section showing the blowout as it eroded the blockage and eroded fill from the waste-rock dump (not to scale).

Independent Evaluation

RECLAMATION
Managing Water in the West

Technical Evaluation of the Gold King Mine Incident

San Juan County, Colorado

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

October 2015

- Release was due to series of events spanning decades
- Final events that led to blowout due to
  - Inadequately designed closure of portal in 2009
  - Misinterpretation of the groundwater conditions in 2015

Treatment Ponds

Gold King Mine Timeline

Aug 5: Gold King Mine Release into Cement Creek

Aug 6: EPA notifies Utah DEQ of a 1 million gallon spill

Aug 7: UDWQ prepares monitoring plan; responds to media requests

Aug 7: BOR increases release of water from Navajo Dam to dilute spill in San Juan River

Aug 8: DWQ crews collect pre-plume samples; EPA modifies release estimate to 3 million gallons

Aug 9: DWQ crew collects samples every 3 hours in attempt to catch leading edge of plume

Aug 10: Samples collected at 4 sites and driven to SLC for analysis

Aug 11: Navajo Nation declares state of emergency and issue "do not use" order for drinking and stock water.

Aug 14: UDAF gives all clear for stock watering

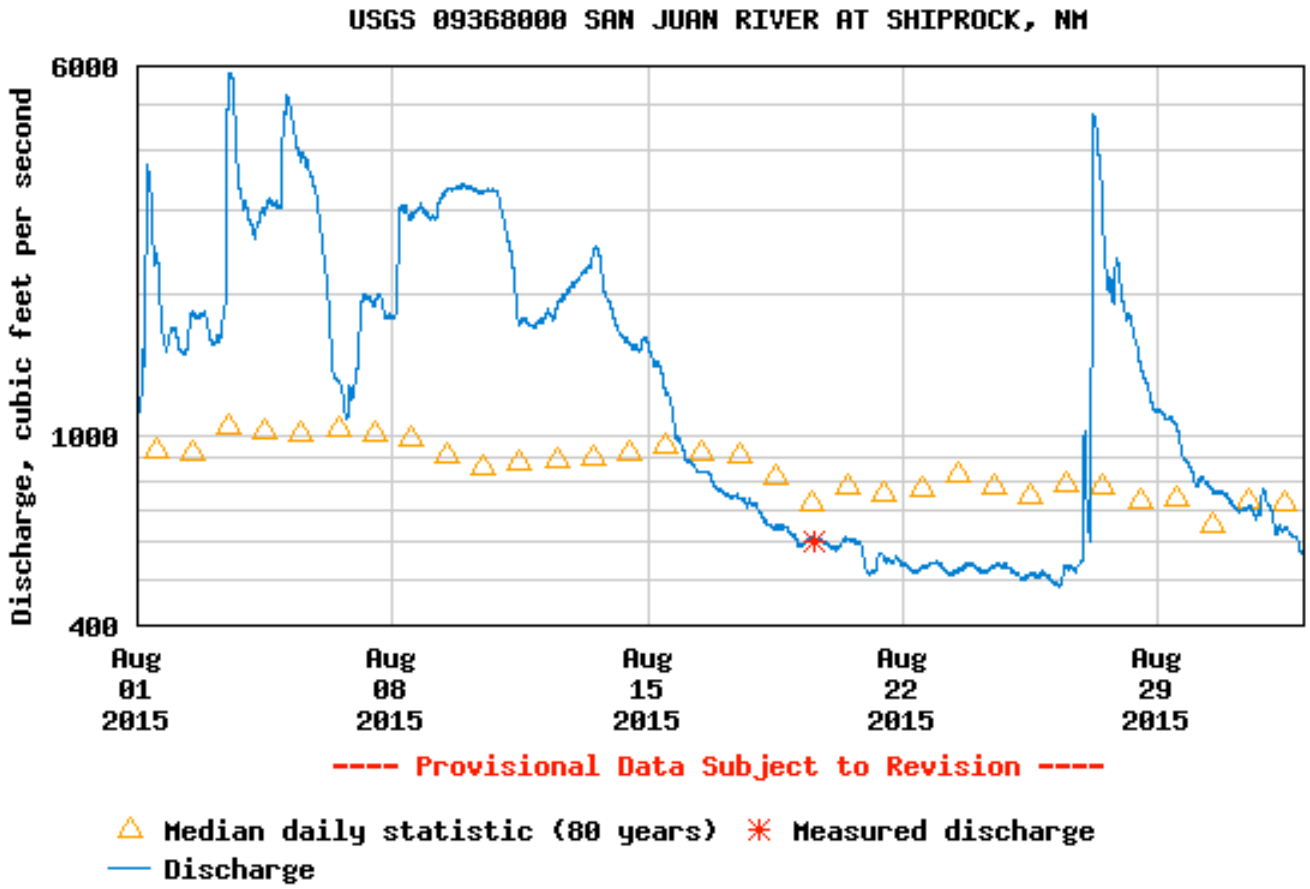
Aug 19 – Analysis of immediate effects released

Governor Herbert declares state of emergency

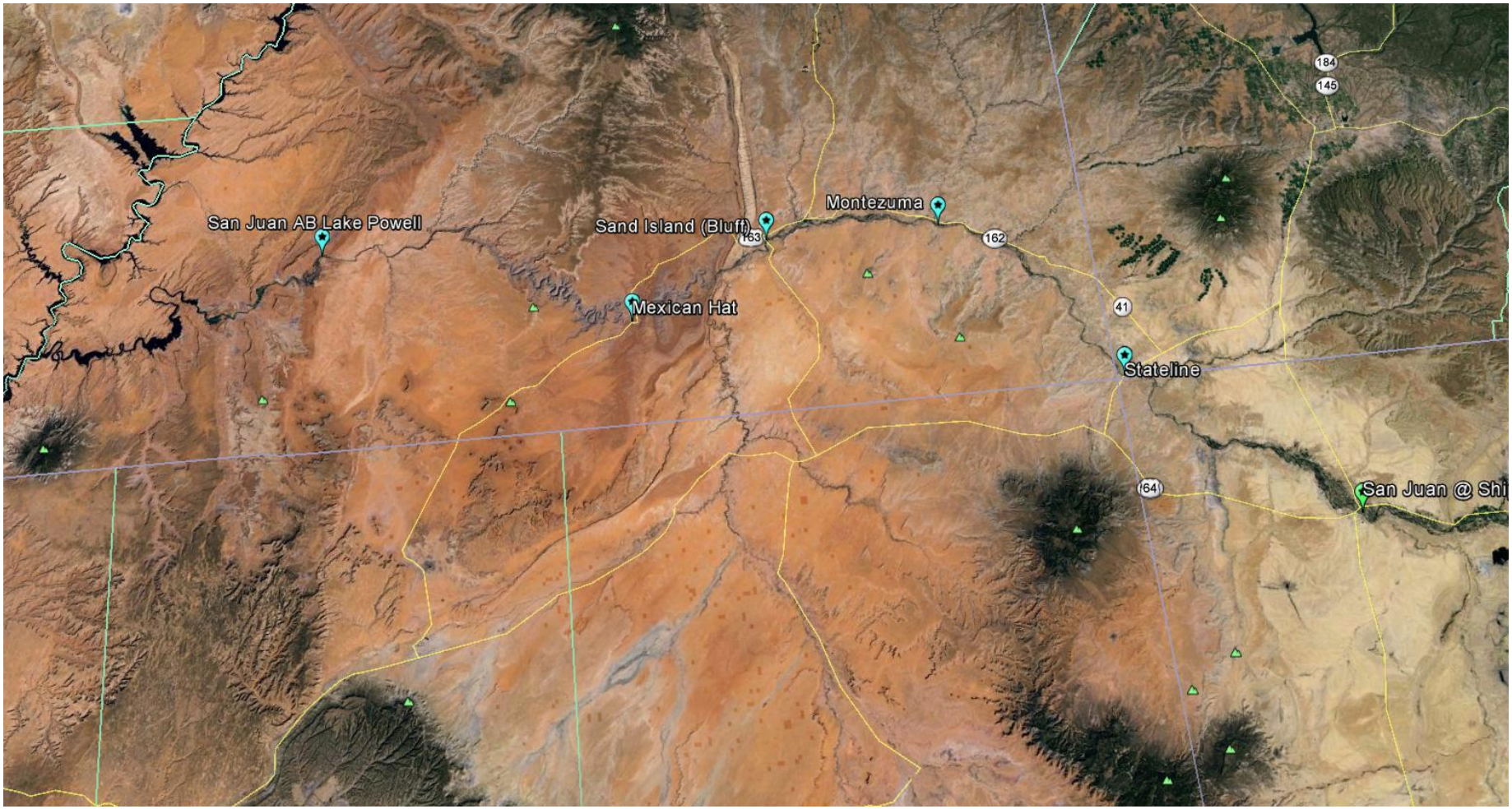
Aug 12 – Aug 24: Daily coordination with DOH, DEM, DDW, DWR, DAF, EPA, Navajo Nation.

8/8/2015 0900 Confluence of Animas and San Juan River Near Farmington, NM

San Juan River Flow at Shiprock

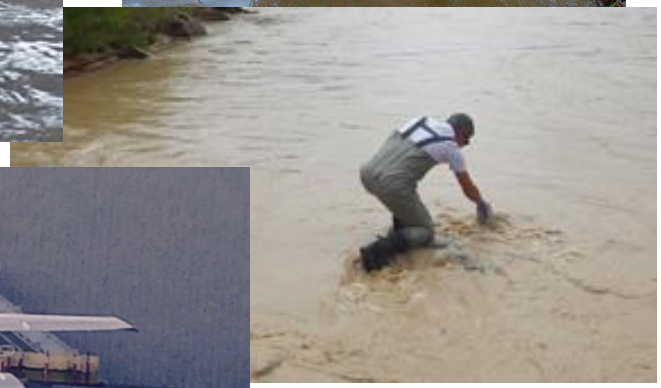


DWQ Sampling Sites



UDWQ Monitoring

- Aug 11 – Aug 21: Daily water quality samples collected and delivered to SLC.
  - Data turnaround time to public in 24 to 36 hours.
- Sediment samples: Pre- and post-plume
- Aug 24 – October 24: Weekly samples for water quality, sediment, and macroinvertebrates



Analysis of Initial Water Quality Data

- Comparison of water quality data to screening values
  - Drinking water
  - Recreation
  - Agricultural
  - Aquatic Life
- Estimating plume arrival time
- Plume signature in Utah (dissolved metals)
- Evaluation of factors interfering with total metals signature

Water Quality Screening

Analyte	CAS #	Units	Drinking Water CV (ppb): Health-Based Comparison Value for Water Ingestion (CV) [Total Metals]	Drinking Water CV (ppb): CV Type and Source	Livestock Water (ug/L)	Irrigation Waters (ug/L) [NAS, 1972]: Long-Term	Irrigation Waters (ug/L) [NAS, 1972]: Short-Term	Utah WQ Standards for San Juan River [Dissolved metals]: 1C (Domestic)	3B (warm water fish) [1-hour]	3B (warm water fish) [4-day]	4 (agriculture)	
Hardness	-	mg/L			180 mg/L (UA)							Hardness
Aluminum	7429-90-5	µg/L	10,000	Child Intermediate EMEG	5,000 (NAS)	5,000	20,000		750	87		Aluminum
Antimony	7440-36-0	µg/L	4	Child RMEG	No Data Available	No Data Available	No Data Available					Antimony
Arsenic	7440-38-2	µg/L	3	Child RMEG & Chronic EMEG	200 (NAS)	100	2,000	10	340	150	100	Arsenic
Barium	7440-39-3	µg/L	2,000	Child Intermediate EMEG	No Data Available	No Data Available	No Data Available	1000				Barium
Beryllium	7440-41-7	µg/L	20	Child RMEG & Chronic EMEG	No Data Available	No Data Available	No Data Available	<4				Beryllium
Cadmium	7440-43-9	µg/L	5	Child Intermediate EMEG	50 (NAS)	10	50	10	2	0.25	10	Cadmium
Calcium	7440-70-2	µg/L	-	No CVs available	500,000 (UA)	No Data Available	No Data Available					Calcium
Chromium	7440-47-3	µg/L	60	Child RSL, non-cancer, Cr(VI)	1,000 (NAS)	100	1,000	50	16 (VI);	11 (VI);	100	Chromium
Cobalt	7440-48-4	µg/L	100	Child Intermediate EMEG	1,000 (NAS)	50	5,000					Cobalt
Copper	7440-50-8	µg/L	100	Child Intermediate EMEG	500 (NAS)	200	5,000		13	9	200	Copper
Iron	7439-89-6	µg/L	14,000	Child RSL, non-cancer	Limit Not Considered Necessary (NAS)	5,000	20,000		1000	1000		Iron
Lead	7439-92-1	µg/L	15	Child non-carcinogenic RSL	100 (NAS)	5,000	10,000	15	65	2.5	100	Lead
Magnesium	7439-95-4	µg/L	-	No CVs available	250,000 (UA)	No Data Available	No Data Available					Magnesium
Manganese	7439-96-5	µg/L	500	Child RMEG	Limit Not Considered Necessary (NAS)	200	10,000					Manganese
Molyebdenum	7439-98-7	µg/L	50	Child RMEG	No Data Available	10	50					Molyebdenum
Nickel	7440-02-0	µg/L	200	Child RMEG	No Data Available	200	2,000		468	52		Nickel
Potassium	7440-22-4	µg/L	-	No CVs available	No Data Available	No Data Available	No Data Available					Potassium
Selenium	7782-49-2	µg/L	50	Child RMEG	50 (NAS)	20	20	50	18.4	4.6	50	Selenium
Silver	7440-22-4	µg/L	50	Child RMEG	No Data Available	No Data Available	No Data Available	50	1.6	-		Silver
Sodium	7440-23-5	µg/L	-	No CVs available	1,000,000 (UA)	No Data Available	No Data Available					Sodium
Thallium	7440-28-0	µg/L	0.2	Child non-carcinogenic RSL	No Data Available	No Data Available	No Data Available					Thallium
Vanadium	7440-62-2	µg/L	100	Child Intermediate EMEG	100 (NAS)	100	1,000					Vanadium
Zinc	7440-66-6	µg/L	3,000	Child Intermediate EMEG	25,000 (NAS)	2,000	10,000		120	120		Zinc
Mercury	7439-97-6	µg/L	0.63	Child non-carcinogenic RSL, elemental Hg, µg/L	10 (NAS)	No Data Available	No Data Available	2	-	0.012		Mercury
TDS		mg/L			1200 (Utah)	500,000-1,000,000 (NAS)						
pH					6.5-9 (Utah)	4.5-9 (NAS)						

RMEG: ATSDR Reference Dose Media Evaluation Guide
EMEG: ATSDR Environmental Media Evaluation Guide
RSL: EPA Regional Screening Level

Finished Drinking Water

Comparison of San Juan River Raw Water Data with Finished Drinking Water Screening Values - Total Metals

	No Exceedence		Above Screening Level		Prior to Plume Arrival					Estimated Plume Arrival						Post Plume Arrival											
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			Health Based Comparison Values for Water Ingestion	10,000	4	3	2,000	20	5	(blank)	60	100		14,000	15	(blank)	500	0.63	50	200	(blank)	50		(blank)	0.2	100	3,000
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	47,400	0.27	12.5	1300	3.42	1.27	336	23.9	22.8	41.4	24,800	44.5	56.3	2,320	0.077	0.76	40.5	12.2	1.09	0.27	38.6	0.41	61.2	147
		8/9/2015	12:02 PM	33,900	0.499	12.3	702	2.62	0.907	108	17.4	16.8	59.3	29,400	151	20.3	1,100	0.07	1.37	23	9.04	1.07	1.09	29.8	0.38	50.5	160
		8/9/2015	3:05 PM	26,700	0.573	13.5	606	2.08	0.734	92.8	14.2	13.5	63	28,600	185	17.2	942	0.063	1.58	18.2	7.53	0.97	1.34	27	0.3	41.6	172
		8/9/2015	6:00 PM	24,600	0.502	10	532	1.8	0.68	86.2	13.7	12.4	47.6	24,100	111	15.8	870	0.045	1.33	16.8	7.04	0.73	0.79	26.1	0.25	37.8	138
		8/9/2015	9:02 PM	31,000	0.416	9.59	554	2.25	0.632	78.8	15.5	14.7	49.7	26,500	83.5	15.3	887	0.048	1.01	18.4	7.18	0.7	0.57	29.5	0.31	41.5	137
		8/10/2015	9:11 AM	39,900	0.163	11	1730	3.97	1.15	90.8	21	24.8	69.6	35,400	73.5	20.2	1,450	0.115	0.53	29.7	8.24	0.94	0.49	36.6	0.39	48.2	668
		8/10/2015	2:06 PM	43,700	0.19	12.3	889	4.04	0.884	86.7	23.7	25.4	69.7	39,100	69.3	20.1	1,390	0.117	0.62	30.8	8.89	0.96	0.42	38.5	0.42	53.4	897
		8/11/2015	8:50 AM	77,000	0.216	19.9	1230	6.66	1.2	109	29.5	37	104	54,800	82.2	24.9	1,930	0.187	0.56	39.4	11.8	1.35	0.57	42.9	0.87	69.4	223
		8/11/2015	1:17 PM	56,900	0.181	14.2	971	4.97	0.916	95	21.8	27.3	76.7	40,300	62.6	20	1,440	0.13	0.61	29.6	9.65	1.08	0.42	37.4	0.68	51.8	159
		8/12/2015	9:50 AM	31,100	0.23	11.1	766	3.16	0.905	164	16.1	18.6	43.7	22,600	47.4	24.7	1,250	0.098	0.77	28.9	7.9	1.04	0.31	32.7	0.46	43.7	131
		8/12/2015	2:04 PM	28,500	0.252	9.21	683	2.52	0.641	146	13.2	14.5	34.3	18,100	35.8	24.5	1,130	0.058	0.48	22	7.37	0.75	0.21	28.7	0.28	41.4	96.2
		8/13/2015	10:01 AM	38,700	0.156	12	1110	5.62	0.941	124	14.9	28.9	79.3	31,100	66.5	22.5	1,670	0.153	0.53	28.9	8.54	1.2	0.4	45	0.58	51	177
		8/14/2015	2:33 PM	44,300	0.413	12.5	918	4.89	0.984	114	23.7	27.1	70.5	39,100	64.3	22.4	1,360	0.148	0.77	34.5	10.4	1.32	0.38	54.8	0.71	60	197
		8/15/2015	12:04 PM	14,200	0.279	4.7	262	1.08	0.366	68.1	8.75	6.18	18.2	12,300	17.4	12.7	368	0.03	1.13	8.78	5.16	0.63	0.14	27.7	0.19	25.7	58.9
		8/16/2015	9:15 AM	9,500	0.837	4.89	358	0.94	0.302	78	6.21	5.69	14.9	10,000	15.8	13.3	338	0.028	1.23	10.3	5.78	0.86	0.35	31.2	0.23	16.1	215
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	67,300	0.395	20.2	1590	6.36	2.49	390	38.8	41.1	82.4	50,400	91.5	59.1	3,010	0.222	1.3	75.8	17.7	1.93	0.66	51.7	1.18	82.8	286
		8/10/2015	10:13 AM	32,300	0.216	11.5	1960	2.72	0.707	93.7	17.3	18.3	56.4	29,700	79.3	20.1	1,130	0.072	0.83	23.5	7.45	0.9	0.52	34.6	0.28	43.8	821
		8/10/2015	2:58 PM	39,100	0.228	11.8	1700	3.71	0.881	97.1	22.1	23.2	67.3	35,800	75.8	22.5	1,400	0.098	0.93	29.6	8.49	1.08	0.75	34.9	0.44	49	658
		8/11/2015	9:44 AM	52,800	0.295	12.6	918	4.27	0.998	99.7	23.1	25.1	67.9	40,200	62.9	22.5	1,410	0.122	0.75	29.3	9.63	1.2	0.6	36.9	0.67	55.2	166
		8/11/2015	2:20 PM	54,700	0.232	15	1060	5.16	1.04	102	24.2	29.1	80.3	44,700	70.2	24	1,570	0.137	0.65	32.4	9.47	1.23	0.45	38.6	0.73	58.4	183
		8/12/2015	10:37 AM	31,500	0.247	10.2	720	3.62	0.855	108	14.7	19.5	51.7	24,400	49.1	18.4	1,190	0.078	0.45	22.7	7.04	1.06	0.48	33	0.46	38.6	131
		8/12/2015	2:57 PM	35,000	0.272	10.7	725	3.97	0.916	130	17	19.5	51.4	26,500	54.1	20.5	1,120	0.112	0.4	27.7	8.29	1.12	0.31	34.5	0.56	40.8	144
		8/13/2015	4:46 PM	23,700	0.156	10.1	722	3.57	0.708	127	9.33	17.3	47.9	17,800	44.3	20.8	1,270	0.103	0.68	19.3	6.73	0.95	0.31	34.2	0.32	34.2	109
		8/14/2015	9:55 AM	62,000	0.443	16	1400	7.03	1.41	153	29.9	39.8	106	54,300	90.8	32.9	2,060	0.247	0.72	48.4	12.7	1.49	0.5	59.5	1.04	76.4	265
		8/15/2015	11:31 AM	29,200	0.329	8.5	566	2.65	0.806	90.2	15.5	15	39.3	24,900	36.5	19.7	862	0.075	1.06	18.7	7.88	0.93	0.25	39.4	0.4	43.3	114
		8/16/2015	10:02 AM	13,600	0.232	5.56	517	1.15	0.305	78.8	7.56	7.12	21.1	13,200	19.5	14.6	435	0.033	1.04	10.1	7.25	0.85	0.16	39.3	0.22	21.6	238
		8/17/2015	4:07 PM	4,160	0.35	2.63	141	0.41	0.254	65.6	2.42	1.87	6.89	3,510	6.05	13.5	150	0.012	1.5	3.06	3.63	0.66	0.11	31	0.14	8.04	20.2
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	55,700	0.436	15.9	1090	5.21	1.99	252	32.4	34.3	80.8	47,800	74.7	33.8	1,700	0.158	1.75	65.8	13.3	2.14	0.63	58.8	1.29	64.7	242
		8/10/2015	11:15 AM	27,000	0.3	13.2	1530	2.3	0.788	104	15.9	15.6	60	28,500	140	21.2	1,090	0.065	1.35	22.1	7.83	1	1.22	30.9	0.26	44.3	664
		8/10/2015	3:58 PM	28,700	0.293	10.7	726	2.61	0.713	99.9	16.1	17.3	54.7	27,700	84.7	20.4	1,170	0.073	0.88	22.3	7.29	0.89	0.53	33.2	0.25	40.9	960
		8/11/2015	10:53 AM	47,800	0.218	11.5	913	3.87	1.01	98.9	21.7	22.6	61.6	37,000	63.5	22.2	1,310	0.113	0.71	27.7	9.34	0.88	0.44	36.4	0.58	52.7	167
		8/11/2015	3:01 PM	48,700	0.272	12	900	4.23	1.04	102	21	23.6	64.2	36,800	63.4	22.4	1,400	0.115	0.86	28	9.46	1.1	0.44	38.2	0.62	51.5	163
		8/12/2015	11:12 AM	45,400	0.202	14.9	971	5.16	0.94	109	20	27.9	76.7	34,600	67.4	21.9	1,670	0.128	0.34	30.3	8.43	1.1	0.38	38.4	0.57	51.4	176
		8/12/2015	5:06 PM	30,600	0.259	10.3	718	3.61	0.712	90.9	13.6	19.2	53.4	23,700	49.1	17.3	1,190	0.08	0.52	21.7	6.84	0.92	0.49	33.2	0.41	38	126
		8/13/2015	11:28 AM	19,300	0.215	8.77	661	2.52	0.744	168	8.79	13.6	33.6	12,900	35.6	22.8	1,190	0.06	0.86	18.8	6.83	1.11	0.45	31.6	0.29	32.9	92.7
		8/14/2015	11:02 AM	66,300	0.545	16.8	1460	7.48	1.4	148	29.8	41.8	116	58,200	96	35.6	2,160	0.27	0.62	49.2	12.5	1.56	0.57	55.7	1.1	77.4	288
		8/15/2015	10:30 AM	37,600	0.394	11.2	826	4.1	0.984	108	20.7	22.2	57.6	32,300	54	23.1	1,230	0.163	1.09	27.8	9.22	1.36	0.51	51	0.63	53.5	160
		8/16/2015	11:06 AM	24,600	0.279	7.87	1360	2.25	0.528	86.1	13.6	12.1	33.8	23,300	31.6	18.8	642	0.063	1.1	18	7.32	1.11	0.55	39.4	0.45	32.5	632
		8/17/2015	3:33 PM	10,200	0.454	5.03	300	0.97	0.286	85	6.25	5.91	17	10,200	17.2	16.7	414	0.03	1.26	10.2	5.05	0.87	0.17	31.8	0.19	17	55.5

Domestic Source Water

Comparison of San Juan River Raw Water Data with Screening Values for Domestic Source Water - Dissolved Metals

No Exceedence			Above Screening Level			Prior to Plume Arrival				Estimated Plume Arrival					Post Plume Arrival												
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			Utah Domestic Source Criteria	(blank)		10	1,000	4	10	(blank)	50	(blank)			15	(blank)		2	(blank)			50		(blank)			
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	217	0.52	1.34	222	0.04	ND	51.5	ND	0.13	2.24	95.8	ND	7.85	2.94	ND	1.87	ND	2.96	0.72	ND	32.2	ND	4.86	15.3
		8/9/2015	12:02 PM	258	0.34	0.63	274	ND	ND	50.6	ND	0.08	2.48	119	ND	6.86	2.69	ND	2.01	ND	2.61	0.56	0.03	28.5	ND	1.76	18.5
		8/9/2015	9:02 PM	329	0.35	0.95	341	0.04	ND	46	ND	0.14	3.47	198	0.27	6.3	4.14	ND	1.94	ND	2.38	0.54	ND	30	ND	2.07	15.4
		8/10/2015	9:11 AM	172	0.46	0.99	233	ND	ND	44.6	ND	0.07	3.21	103	0.39	6.01	1.64	ND	2.03	ND	2.51	0.58	ND	34.1	ND	1.74	19.7
		8/10/2015	2:06 PM	1050	0.71	1.3	220	0.09	ND	44.2	ND	0.41	3.35	732	1.04	6.02	12.8	ND	1.92	0.84	2.72	0.65	0.06	35.1	ND	3.64	18
		8/11/2015	8:50 AM	3290	0.36	1.72	451	0.1	ND	39.8	ND	0.49	4.85	1520	1.1	5.05	19	0.02	1.65	1.19	3	0.97	ND	43.7	ND	3.9	19.1
		8/11/2015	1:17 PM	720	0.05	1.33	334	ND	ND	41.7	ND	0.16	3.03	366	0.27	5.11	5.1	ND	1.58	ND	2.91	0.76	ND	37	ND	2.46	14.9
		8/12/2015	9:50 AM	104	0.59	0.88	178	ND	ND	52.1	ND	0.06	2.39	ND	ND	7.2	ND	ND	1.47	ND	2.79	0.78	0.03	30.3	ND	1.9	14.8
		8/12/2015	2:04 PM	155	0.55	1.21	151	ND	ND	47.9	ND	0.05	2.61	ND	ND	6.97	1.82	ND	1.48	ND	2.74	0.73	ND	27.3	ND	2.87	16.5
		8/13/2015	10:01 AM	257	0.16	1.25	213	0.03	ND	48.3	ND	0.12	3.67	148	0.37	6.48	3.16	ND	1.89	ND	2.87	0.86	ND	42.5	ND	2.1	21.9
		8/14/2015	2:33 PM	64.8	0.42	1.7	72.3	0.04	ND	53.4	ND	0.13	3.86	ND	ND	6.61	1.8	ND	3.65	3.14	3.66	1.1	ND	52.4	0.04	4.11	ND
		8/15/2015	12:04 PM	47.5	0.45	1.36	65.2	ND	ND	52.8	ND	0.05	1.35	ND	ND	7.91	ND	ND	2.25	ND	2.61	0.61	ND	25.9	ND	2.61	ND
		8/16/2015	9:15 AM	54.4	1.12	0.88	179	0.04	ND	53.9	ND	ND	2.91	ND	ND	8.18	ND	ND	1.72	ND	2.54	0.6	0.19	26.1	ND	1.92	12.6
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	136	0.75	1.06	223	0.04	ND	71.5	ND	0.13	2.72	ND	ND	9.92	ND	ND	2.62	0.8	3.84	1.11	0.04	43.5	ND	2.54	21
		8/10/2015	10:13 AM	218	0.66	0.94	262	ND	ND	49.8	ND	0.08	3.24	144	0.46	7.7	3.22	ND	2.03	ND	2.69	0.57	0.05	32.1	ND	2.13	17.3
		8/10/2015	2:58 PM	94.5	1.31	0.93	200	0.03	ND	48.6	ND	0.06	2.48	ND	0.3	7.35	ND	ND	2.32	ND	2.59	0.61	0.25	31.8	ND	1.96	14.6
		8/11/2015	9:44 AM	462	0.57	1.17	314	ND	ND	44.6	ND	0.13	2.66	227	ND	6.49	3.31	ND	1.72	ND	2.64	0.68	0.03	37.1	ND	2.21	12.9
		8/11/2015	2:20 PM	1400	0.14	1.25	298	0.04	ND	44.8	ND	0.24	3.47	668	0.49	6.57	9.99	ND	1.72	0.95	2.96	0.74	ND	38.3	ND	2.73	14.3
		8/12/2015	10:37 AM	67.5	0.8	1.1	202	0.03	ND	48.3	ND	ND	2.49	ND	ND	7.23	ND	ND	1.66	ND	2.67	0.8	0.04	31.9	ND	1.68	13.5
		8/12/2015	2:57 PM	375	0.82	0.91	176	ND	ND	48.9	ND	0.09	4.34	296	ND	7.5	2.28	ND	1.64	ND	2.84	0.72	0.03	33.8	ND	1.99	15.9
		8/13/2015	4:46 PM	330	1.88	1.28	240	0.07	ND	49.4	ND	0.18	3.75	192	ND	8.08	5.3	ND	1.91	0.98	2.62	0.98	0.24	32.9	0.03	3.12	32.7
		8/14/2015	9:55 AM	24.8	0.58	1.27	85.1	0.04	ND	55.1	ND	0.15	3.79	ND	ND	7.81	ND	ND	2.84	1.76	3.51	0.99	0.04	53	0.03	3.07	ND
		8/15/2015	11:31 AM	68.1	0.64	1.58	73.6	0.04	ND	55	ND	0.24	4.38	ND	ND	8.57	3.36	ND	2.43	1.09	3.16	0.89	0.07	35.8	ND	3.54	ND
		8/16/2015	10:02 AM	61.8	0.84	1.17	145	0.06	ND	57.5	ND	0.09	3.01	ND	ND	9.36	ND	ND	1.99	ND	2.96	0.67	0.28	30.3	0.05	2.16	9.78
		8/17/2015	4:07 PM	27.3	0.29	1.17	80.4	ND	ND	60.2	ND	0.14	1.87	ND	ND	11.6	2.4	ND	1.97	ND	2.82	0.63	ND	29.4	ND	2.18	ND
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	214	1.38	1.03	294	0.06	ND	73.7	ND	0.12	3.86	104	ND	9.24	2.55	ND	3.3	1.01	4.11	1.43	0.12	51.2	ND	2.22	19
		8/10/2015	11:15 AM	124	1.24	0.88	192	ND	ND	53.2	ND	0.07	2.07	ND	0.29	8.4	ND	ND	2.38	ND	2.86	0.69	0.25	28.4	ND	1.75	13.7
		8/10/2015	3:58 PM	108	0.57	1.07	184	ND	ND	48.4	ND	0.06	1.96	ND	0.32	7.83	ND	ND	2.26	ND	2.67	0.53	ND	30.6	ND	1.89	13.2
		8/11/2015	10:53 AM	684	1.18	1.23	278	0.06	ND	45.8	ND	0.17	2.87	328	ND	6.93	4.12	ND	1.92	0.78	2.72	0.69	0.27	36.8	0.03	2.55	13.7
		8/11/2015	3:01 PM	158	0.27	1.01	251	ND	ND	45.3	ND	0.09	2.69	89.2	ND	6.65	ND	ND	1.85	ND	2.76	0.67	ND	36.6	ND	2.05	14.9
		8/12/2015	11:12 AM	623	1.08	1.41	205	0.05	ND	46.8	ND	0.15	3.44	310	ND	6.98	4.47	ND	1.93	ND	2.91	0.79	0.06	37.8	ND	2.61	14.5
		8/12/2015	5:06 PM	605	1.78	1.43	260	0.06	ND	46.6	ND	0.16	2.98	314	ND	7.07	5.16	ND	1.81	0.91	2.79	0.78	0.15	33.5	ND	2.32	13.2
		8/13/2015	11:28 AM	509	0.67	1.3	156	0.03	ND	53.6	ND	0.21	3.1	275	ND	8.21	8.9	ND	1.62	ND	2.96	0.68	ND	29.2	ND	3.65	20.4
		8/14/2015	11:02 AM	ND	1.03	2.03	78.6	0.05	ND	53.2	ND	0.13	3.31	ND	ND	8.26	7.02	ND	5.31	2.38	3.27	1.08	0.19	49.5	0.13	5.88	4.87
		8/15/2015	10:30 AM	95.2	1.12	1.84	83.5	0.04	ND	55.7	ND	0.09	2.27	ND	ND	8.4	ND	ND	3.93	0.82	3.46	1.06	0.28	46.7	0.05	3.45	ND
		8/16/2015	11:06 AM	290	0.43	1.23	149	0.04	ND	55.8	ND	0.15	3.89	202	ND	10.2	3.94	ND	1.95	ND	2.91	0.71	0.04	36.3	ND	2.04	10.5
		8/17/2015	3:33 PM	ND	0.41	1.48	87.1	ND	ND	62.4	ND	0.17	2.11	ND	ND	11.2	ND	ND	2.67	1.28	3.13	0.63	ND	30	ND	2.75	ND

Agricultural Water Uses

Comparison of San Juan River Raw Water Data with Screening Values for <u>Agricultural Uses</u> (Stock watering and Irrigation) – Dissolved Metals

	No Exceedence		Above Screening	Prior to Plume Arrival					Estimated Plume Arrival					Post Plume Arrival																
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Sulphate	Total Dissolved Solids
Livestock Water				5,000	(blank)	200	(blank)		50	500	1,000		500	(blank)	100	250,000	(blank)	10	(blank)			50	(blank)	1,000,000	(blank)	100	25,000	(blank)	1,200
Irrigation Water Short-term NAS, 1972				5,000	(blank)	100	(blank)		10	(blank)	100	50	200	5000		(blank)	200	(blank)	10	200	(blank)	20	(blank)			100	2,000	(blank)	500,000
Irrigation Water Long-term NAS, 1972				20,000	(blank)	2,000	(blank)		50	(blank)	1,000	5,000		20,000	10,000	(blank)	10,000	(blank)	50	2,000	(blank)	20	(blank)			1000	10,000	(blank)	
Utah DWQ Agricultural Use Criteria 4						100	(blank)		10	(blank)	100	(blank)	200	(blank)	100	(blank)						50	(blank)						1,200
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	217	0.524	1.34	222	0.04	ND	51.5	ND	0.127	2.24	95.8	ND	7.85	2.94	ND	1.87	ND	2.96	0.72	ND	32.2	ND	4.86	15.3	111	460
		8/9/2015	12:02 PM	258	0.341	0.63	274	ND	ND	50.6	ND	0.0817	2.48	119	ND	6.86	2.69	ND	2.01	ND	2.61	0.56	0.0257	28.5	ND	1.76	18.5	120	400
		8/9/2015	3:05 PM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	112	350
		8/9/2015	6:00 PM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	99.1	410
		8/9/2015	9:02 PM	329	0.347	0.95	341	0.04	ND	46	ND	0.139	3.47	198	0.274	6.3	4.14	ND	1.94	ND	2.38	0.54	ND	30	ND	2.07	15.4	97.3	430
		8/10/2015	9:11 AM	172	0.458	0.99	233	ND	ND	44.6	ND	0.0673	3.21	103	0.391	6.01	1.64	ND	2.03	ND	2.51	0.58	ND	34.1	ND	1.74	19.7	99.7	380
		8/10/2015	2:06 PM	1,050	0.711	1.3	220	0.09	ND	44.2	ND	0.407	3.35	732	1.04	6.02	12.8	ND	1.92	0.84	2.72	0.65	0.0586	35.1	ND	3.64	18	102	490
		8/11/2015	8:50 AM	3,290	0.364	1.72	451	0.1	ND	39.8	ND	0.488	4.85	1520	1.1	5.05	19	0.015	1.65	1.19	3	0.97	ND	43.7	ND	3.9	19.1	100	380
		8/11/2015	1:17 PM	720	0.0516	1.33	334	ND	ND	41.7	ND	0.155	3.03	366	0.27	5.11	5.1	ND	1.58	ND	2.91	0.76	ND	37	ND	2.46	14.9	99.2	290
		8/12/2015	9:50 AM	104	0.586	0.88	178	ND	ND	52.1	ND	0.0614	2.39	ND	ND	7.2	ND	ND	1.47	ND	2.79	0.78	0.0252	30.3	ND	1.9	14.8	118	620
		8/12/2015	2:04 PM	155	0.548	1.21	151	ND	ND	47.9	ND	0.0478	2.61	ND	ND	6.97	1.82	ND	1.48	ND	2.74	0.73	ND	27.3	ND	2.87	16.5	102	450
		8/13/2015	10:01 AM	257	0.158	1.25	213	0.03	ND	48.3	ND	0.122	3.67	148	0.373	6.48	3.16	ND	1.89	ND	2.87	0.86	ND	42.5	ND	2.1	21.9	121	450
		8/14/2015	2:33 PM	65	0.421	1.7	72.3	0.04	ND	53.4	ND	0.133	3.86	ND	ND	6.61	1.8	ND	3.65	3.14	3.66	1.1	ND	52.4	0.0385	4.11	ND	135	720
		8/15/2015	12:04 PM	48	0.445	1.36	65.2	ND	ND	52.8	ND	0.052	1.35	ND	ND	7.91	ND	ND	2.25	ND	2.61	0.61	ND	25.9	ND	2.61	ND	106	580
		8/16/2015	9:15 AM	54	1.12	0.88	179	0.04	ND	53.9	ND	ND	2.91	ND	ND	8.18	ND	ND	1.72	ND	2.54	0.6	0.186	26.1	ND	1.92	12.6	NS	980
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	136	0.747	1.06	223	0.04	ND	71.5	ND	0.13	2.72	ND	ND	9.92	ND	ND	2.62	0.8	3.84	1.11	0.0412	43.5	ND	2.54	21	195	610
		8/10/2015	10:13 AM	218	0.66	0.94	262	ND	ND	49.8	ND	0.0764	3.24	144	0.461	7.7	3.22	ND	2.03	ND	2.69	0.57	0.0529	32.1	ND	2.13	17.3	115	610
		8/10/2015	2:58 PM	95	1.31	0.93	200	0.03	ND	48.6	ND	0.0595	2.48	ND	0.297	7.35	ND	ND	2.32	ND	2.59	0.61	0.251	31.8	ND	1.96	14.6	108	460
		8/11/2015	9:44 AM	462	0.568	1.17	314	ND	ND	44.6	ND	0.127	2.66	227	ND	6.49	3.31	ND	1.72	ND	2.64	0.68	0.0307	37.1	ND	2.21	12.9	110	460
		8/11/2015	2:20 PM	1,400	0.136	1.25	298	0.04	ND	44.8	ND	0.24	3.47	668	0.489	6.57	9.99	ND	1.72	0.95	2.96	0.74	ND	38.3	ND	2.73	14.3	110	620
		8/12/2015	10:37 AM	68	0.799	1.1	202	0.03	ND	48.3	ND	ND	2.49	ND	ND	7.23	ND	ND	1.66	ND	2.67	0.8	0.0397	31.9	ND	1.68	13.5	114	560
		8/12/2015	2:57 PM	375	0.822	0.91	176	ND	ND	48.9	ND	0.0898	4.34	296	ND	7.5	2.28	ND	1.64	ND	2.84	0.72	0.0343	33.8	ND	1.99	15.9	123	460
		8/13/2015	4:46 PM	330	1.88	1.28	240	0.07	ND	49.4	ND	0.18	3.75	192	ND	8.08	5.3	ND	1.91	0.98	2.62	0.98	0.235	32.9	0.025	3.12	32.7	125	370
		8/14/2015	9:55 AM	25	0.582	1.27	85.1	0.04	ND	55.1	ND	0.146	3.79	ND	ND	7.81	ND	ND	2.84	1.76	3.51	0.99	0.0355	53	0.0272	3.07	ND	154	480
		8/15/2015	11:31 AM	68	0.642	1.58	73.6	0.04	ND	55	ND	0.244	4.38	ND	ND	8.57	3.36	ND	2.43	1.09	3.16	0.89	0.0705	35.8	ND	3.54	ND	139	440
		8/16/2015	10:02 AM	62	0.835	1.17	145	0.06	ND	57.5	ND	0.092	3.01	ND	ND	9.36	ND	ND	1.99	ND	2.96	0.67	0.283	30.3	0.0527	2.16	9.78	NS	1,170
		8/17/2015	4:07 PM	27	0.285	1.17	80.4	ND	ND	60.2	ND	0.137	1.87	ND	ND	11.6	2.4	ND	1.97	ND	2.82	0.63	ND	29.4	ND	2.18	ND	NS	790
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	214	1.38	1.03	294	0.06	ND	73.7	ND	0.124	3.86	104	ND	9.24	2.55	ND	3.3	1.01	4.11	1.43	0.123	51.2	ND	2.22	19	226	640
		8/10/2015	11:15 AM	124	1.24	0.88	192	ND	ND	53.2	ND	0.0685	2.07	ND	0.287	8.4	ND	ND	2.38	ND	2.86	0.69	0.252	28.4	ND	1.75	13.7	124	370
		8/10/2015	3:58 PM	108	0.574	1.07	184	ND	ND	48.4	ND	0.0556	1.96	ND	0.315	7.83	ND	ND	2.26	ND	2.67	0.53	ND	30.6	ND	1.89	13.2	118	490
		8/11/2015	10:53 AM	684	1.18	1.23	278	0.06	ND	45.8	ND	0.172	2.87	328	ND	6.93	4.12	ND	1.92	0.78	2.72	0.69	0.269	36.8	0.031	2.55	13.7	114	390
		8/11/2015	3:01 PM	158	0.271	1.01	251	ND	ND	45.3	ND	0.0864	2.69	89.2	ND	6.65	ND	ND	1.85	ND	2.76	0.67	ND	36.6	ND	2.05	14.9	112	360
		8/12/2015	11:12 AM	623	1.08	1.41	205	0.05	ND	46.8	ND	0.154	3.44	310	ND	6.98	4.47	ND	1.93	ND	2.91	0.79	0.0594	37.8	ND	2.61	14.5	112	450
		8/12/2015	5:06 PM	605	1.78	1.43	260	0.06	ND	46.6	ND	0.162	2.98	314	ND	7.07	5.16	ND	1.81	0.91	2.79	0.78	0.152	33.5	ND	2.32	13.2	109	410
		8/13/2015	11:28 AM	509	0.667	1.3	156	0.03	ND	53.6	ND	0.21	3.1	275	ND	8.21	8.9	ND	1.62	ND	2.96	0.68	ND	29.2	ND	3.65	20.4	121	450
		8/14/2015	11:02 AM	ND	1.03	2.03	78.6	0.05	ND	53.2	ND	0.131	3.31	ND	ND	8.26	7.02	ND	5.31	2.38	3.27	1.08	0.193	49.5	0.129	5.88	4.87	146	630
		8/15/2015	10:30 AM	95	1.12	1.84	83.5	0.04	ND	55.7	ND	0.085	2.27	ND	ND	8.4	ND	ND	3.93	0.82	3.46	1.06	0.276	46.7	0.0523	3.45	ND	164	540
		8/16/2015	11:06 AM	290	0.425	1.23	149	0.04	ND	55.8	ND	0.146	3.89	202	ND	10.2	3.94	ND	1.95	ND	2.91	0.71	0.0426	36.3	ND	2.04	10.5	NS	1,020
		8/17/2015	3:33 PM	ND	0.408	1.48	87.1	ND	ND	62.4	ND	0.172	2.11	ND	ND	11.2	ND	ND	2.67	1.28	3.13	0.63	ND	30	ND	2.75	ND	NS	930

Aquatic Life Uses

Comparison of San Juan River Raw Water Data with Screening Values for Aquatic Life Use (Warm-water Fishery) – Dissolved Metals

No Exceedence | Above Screening Level | Prior to Plume Arrival | Estimated Plume Arrival | Post Plume Arrival

				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
Utah Aquatic Life Use Criteria 1-hr				750	(blank)	340	(blank)		2	(blank)	570	(blank)	13	1,000	65	(blank)				468	(blank)	18.4	1.6	(blank)			120
Utah Aquatic Life Use Criteria 4-day				87	(blank)	150	(blank)		0.25	(blank)	74	(blank)	9	1,000	2.5	(blank)		0.01	(blank)	52	(blank)	4.6	(blank)				120
Monitoring Location	Site Description	Collection Date	Collection Time	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4954000	San Juan R @ US160 Xing in CO	8/8/2015	1:23 PM	217	1	1	222	0.04	ND	52	ND	0.13	2.2	96	ND	8	3	ND	1.87	ND	3	0.7	ND	32	ND	5	15
		8/9/2015	12:02 PM	258	0	1	274	ND	ND	51	ND	0.08	2.5	119	ND	7	3	ND	2.01	ND	3	0.6	0	29	ND	2	19
		8/9/2015	9:02 PM	329	0	1	341	0.04	ND	46	ND	0.14	3.5	198	0	6	4	ND	1.94	ND	2	0.5	ND	30	ND	2	15
		8/10/2015	9:11 AM	172	0	1	233	ND	ND	45	ND	0.07	3.2	103	0	6	2	ND	2.03	ND	3	0.6	ND	34	ND	2	20
		8/10/2015	2:06 PM	1,050	1	1	220	0.09	ND	44	ND	0.41	3.4	732	1	6	13	ND	1.92	1	3	0.6	0	35	ND	4	18
		8/11/2015	8:50 AM	3,290	0	2	451	0.10	ND	40	ND	0.49	4.9	1,520	1	5	19	0.02	1.65	1	3	1.0	ND	44	ND	4	19
		8/11/2015	1:17 PM	720	0	1	334	ND	ND	42	ND	0.16	3.0	366	0	5	5	ND	1.58	ND	3	0.8	ND	37	ND	2	15
		8/12/2015	9:50 AM	104	1	1	178	ND	ND	52	ND	0.06	2.4	ND	ND	7	ND	ND	1.47	ND	3	0.8	0	30	ND	2	15
		8/12/2015	2:04 PM	155	1	1	151	ND	ND	48	ND	0.05	2.6	ND	ND	7	2	ND	1.48	ND	3	0.7	ND	27	ND	3	17
		8/13/2015	10:01 AM	257	0	1	213	0.03	ND	48	ND	0.12	3.7	148	0	6	3	ND	1.89	ND	3	0.9	ND	43	ND	2	22
		8/14/2015	2:33 PM	65	0	2	72	0.04	ND	53	ND	0.13	3.9	ND	ND	7	2	ND	3.65	3	4	1.1	ND	52	0.04	4	ND
		8/15/2015	12:04 PM	48	0	1	65	ND	ND	53	ND	0.05	1.4	ND	ND	8	ND	ND	2.25	ND	3	0.6	ND	26	ND	3	ND
		8/16/2015	9:15 AM	54	1	1	179	0.04	ND	54	ND	ND	2.9	ND	ND	8	ND	ND	1.72	ND	3	0.6	0	26	ND	2	13
4953990	San Juan R @ Town of Montezuma	8/8/2015	2:54 PM	136	1	1	223	0.04	ND	72	ND	0.13	2.7	ND	ND	10	ND	ND	2.62	1	4	1.1	0	44	ND	3	21
		8/10/2015	10:13 AM	218	1	1	262	ND	ND	50	ND	0.08	3.2	144	0	8	3	ND	2.03	ND	3	0.6	0	32	ND	2	17
		8/10/2015	2:58 PM	95	1	1	200	0.03	ND	49	ND	0.06	2.5	ND	0	7	ND	ND	2.32	ND	3	0.6	0	32	ND	2	15
		8/11/2015	9:44 AM	462	1	1	314	ND	ND	45	ND	0.13	2.7	227	ND	6	3	ND	1.72	ND	3	0.7	0	37	ND	2	13
		8/11/2015	2:20 PM	1,400	0	1	298	0.04	ND	45	ND	0.24	3.5	668	0	7	10	ND	1.72	1	3	0.7	ND	38	ND	3	14
		8/12/2015	10:37 AM	68	1	1	202	0.03	ND	48	ND	ND	2.5	ND	ND	7	ND	ND	1.66	ND	3	0.8	0	32	ND	2	14
		8/12/2015	2:57 PM	375	1	1	176	ND	ND	49	ND	0.09	4.3	296	ND	8	2	ND	1.64	ND	3	0.7	0	34	ND	2	16
		8/13/2015	4:46 PM	330	2	1	240	0.07	ND	49	ND	0.18	3.8	192	ND	8	5	ND	1.91	1	3	1.0	0	33	0.03	3	33
		8/14/2015	9:55 AM	25	1	1	85	0.04	ND	55	ND	0.15	3.8	ND	ND	8	ND	ND	2.84	2	4	1.0	0	53	0.03	3	ND
		8/15/2015	11:31 AM	68	1	2	74	0.04	ND	55	ND	0.24	4.4	ND	ND	9	3	ND	2.43	1	3	0.9	0	36	ND	4	ND
		8/16/2015	10:02 AM	62	1	1	145	0.06	ND	58	ND	0.09	3.0	ND	ND	9	ND	ND	1.99	ND	3	0.7	0	30	0.05	2	10
		8/17/2015	4:07 PM	27	0	1	80	ND	ND	60	ND	0.14	1.9	ND	ND	12	2	ND	1.97	ND	3	0.6	ND	29	ND	2	ND
4953250	San Juan R @ Sand Island	8/8/2015	4:19 PM	214	1	1	294	0.06	ND	74	ND	0.12	3.9	104	ND	9	3	ND	3.30	1	4	1.4	0	51	ND	2	19
		8/10/2015	11:15 AM	124	1	1	192	ND	ND	53	ND	0.07	2.1	ND	0	8	ND	ND	2.38	ND	3	0.7	0	28	ND	2	14
		8/10/2015	3:58 PM	108	1	1	184	ND	ND	48	ND	0.06	2.0	ND	0	8	ND	ND	2.26	ND	3	0.5	ND	31	ND	2	13
		8/11/2015	10:53 AM	684	1	1	278	0.06	ND	46	ND	0.17	2.9	328	ND	7	4	ND	1.92	1	3	0.7	0	37	0.03	3	14
		8/11/2015	3:01 PM	158	0	1	251	ND	ND	45	ND	0.09	2.7	89	ND	7	ND	ND	1.85	ND	3	0.7	ND	37	ND	2	15
		8/12/2015	11:12 AM	623	1	1	205	0.05	ND	47	ND	0.15	3.4	310	ND	7	4	ND	1.93	ND	3	0.8	0	38	ND	3	15
		8/12/2015	5:06 PM	605	2	1	260	0.06	ND	47	ND	0.16	3.0	314	ND	7	5	ND	1.81	1	3	0.8	0	34	ND	2	13
		8/13/2015	11:28 AM	509	1	1	156	0.03	ND	54	ND	0.21	3.1	275	ND	8	9	ND	1.62	ND	3	0.7	ND	29	ND	4	20
		8/14/2015	11:02 AM	ND	1	2	79	0.05	ND	53	ND	0.13	3.3	ND	ND	8	7	ND	5.31	2	3	1.1	0	50	0.13	6	5
		8/15/2015	10:30 AM	95	1	2	84	0.04	ND	56	ND	0.09	2.3	ND	ND	8	ND	ND	3.93	1	3	1.1	0	47	0.05	3	ND
		8/16/2015	11:06 AM	290	0	1	149	0.04	ND	56	ND	0.15	3.9	202	ND	10	4	ND	1.95	ND	3	0.7	0	36	ND	2	11
		8/17/2015	3:33 PM	ND	0	1	87	ND	ND	62	ND	0.17	2.1	ND	ND	11	ND	ND	2.67	1	3	0.6	ND	30	ND	3	ND

Expected Plume Signature in Utah

- Majority of metals released in the Gold King Mine
- High concentrations in mine release relative to historic concentrations in the lower San Juan River
- High concentrations remain when plume entered San Juan River

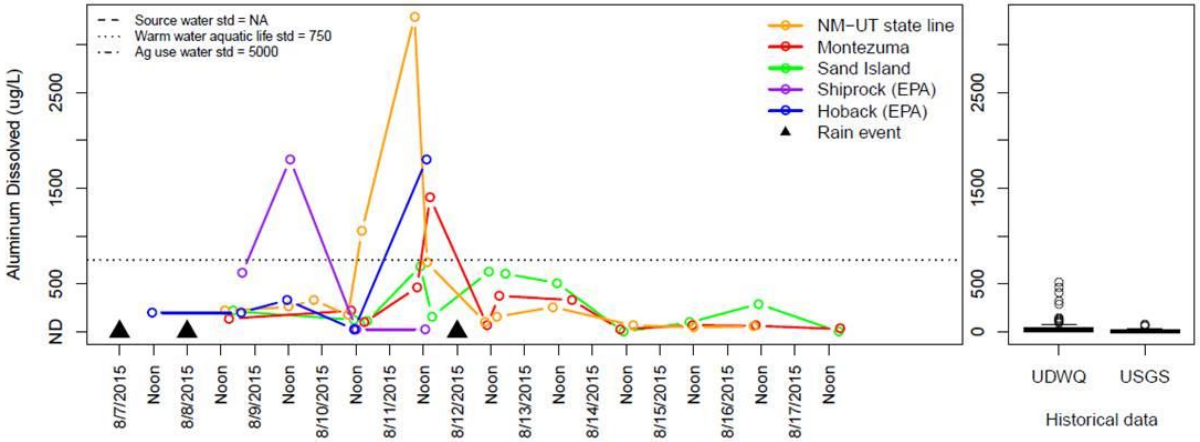
Total Metals (µg/L)

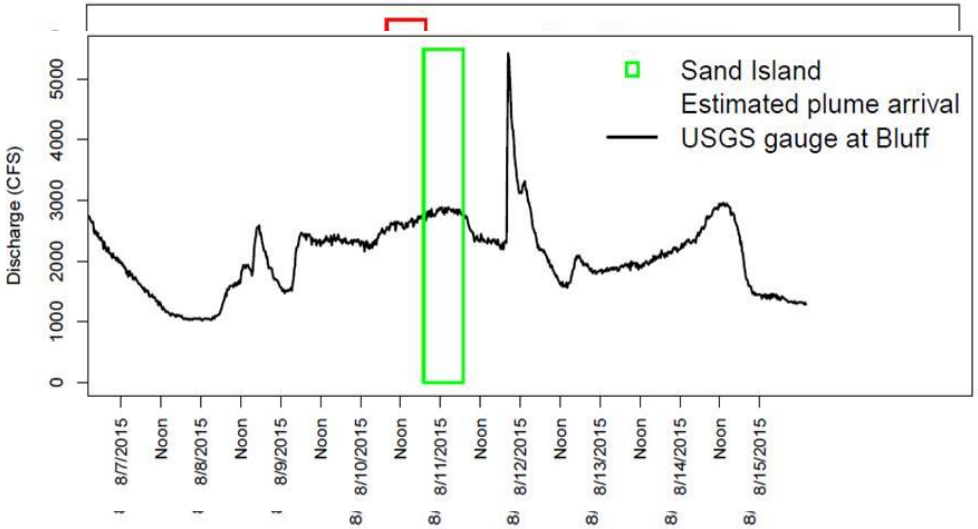
	Cement Creek August 5	Max Value at Utah State Line	Human Health Screening Values
Iron	9,930,000	54,800	14,000
Aluminum	945,000	77,000	10,000
Magnesium	279,000		
Lead	179,000	185	15
Zinc	44,000	897	3,000
Copper	36,700	106	100
Arsenic	8,230	20.2	3
Silver	1,100	1.3	50
Chromium	706	29.9	60
Cobalt	384	39.8	100
Cadmium	165	1.4	5

Dissolved Metals (µg/L)

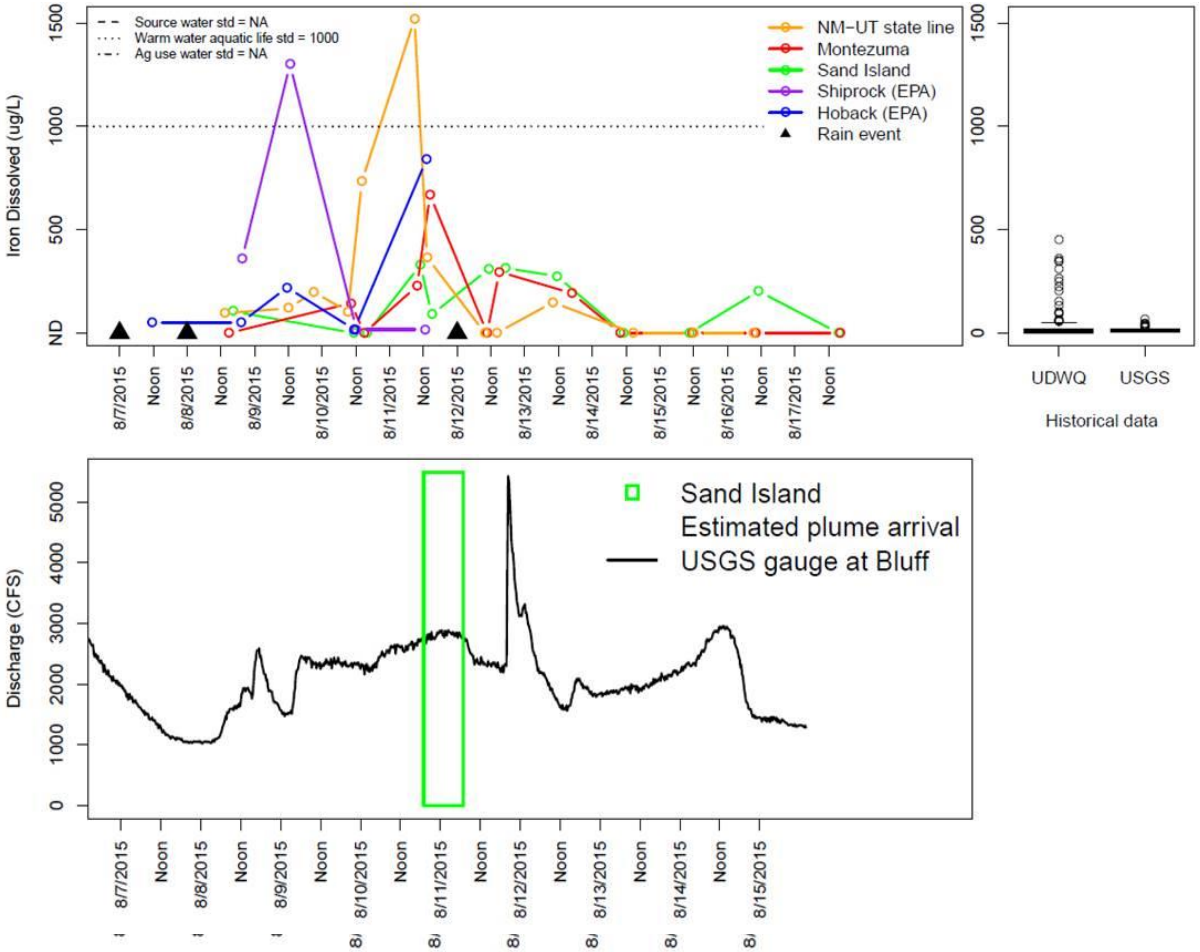
	Cement Creek August 5	Max Value at Utah State Line	Aquatic Life Chronic Criteria
Iron	49,000	1,520	1,000
Aluminum	91,900	3,290	87
Magnesium	36,500		
Lead	150	0.46	2.5
Zinc	26,800	21.9	120
Copper	10,400	3.86	9
Arsenic	5	1.72	150
Silver	5	0.19	
Chromium	10	ND	11(VI)
Cobalt	204	0.49	
Cadmium	98.3	ND	0.25

Dissolved Aluminum

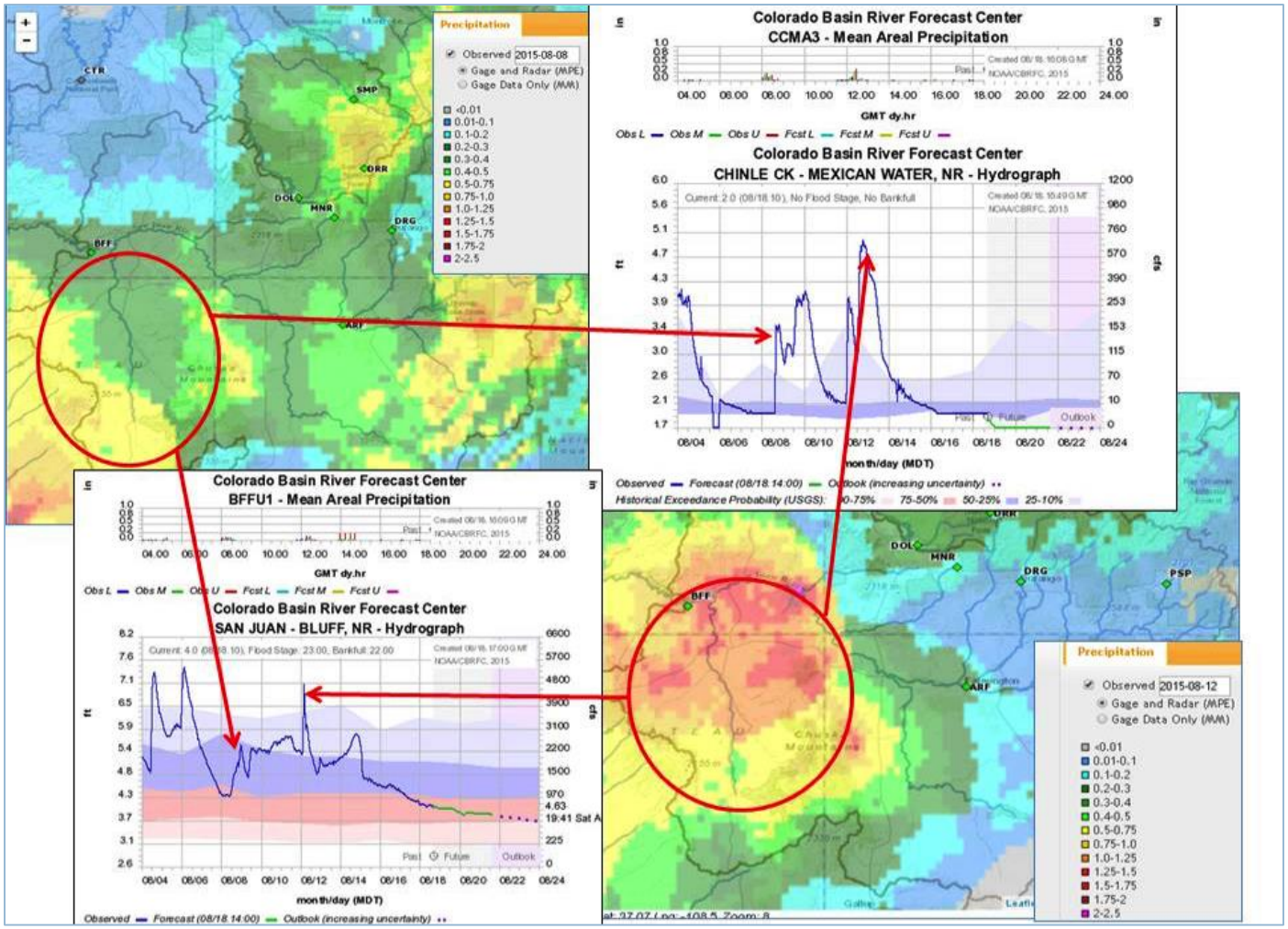




Dissolved Iron

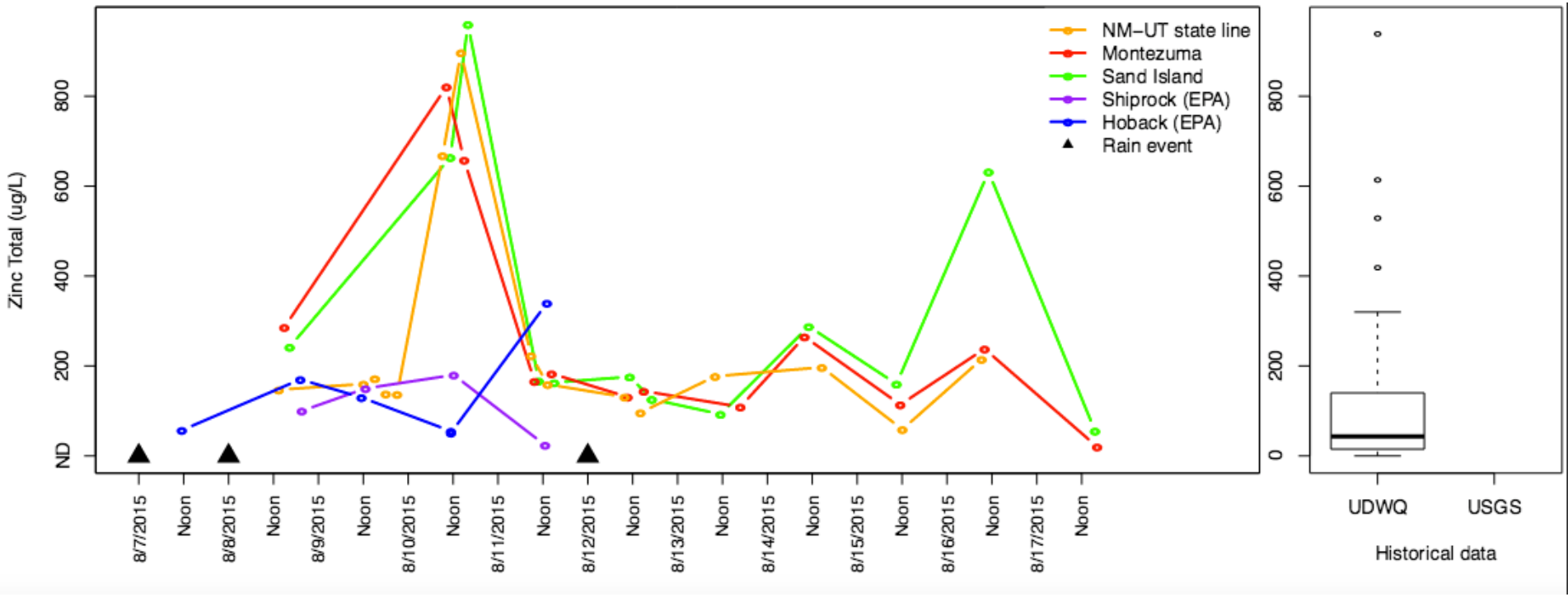


Storm Influence – mask signature of plume



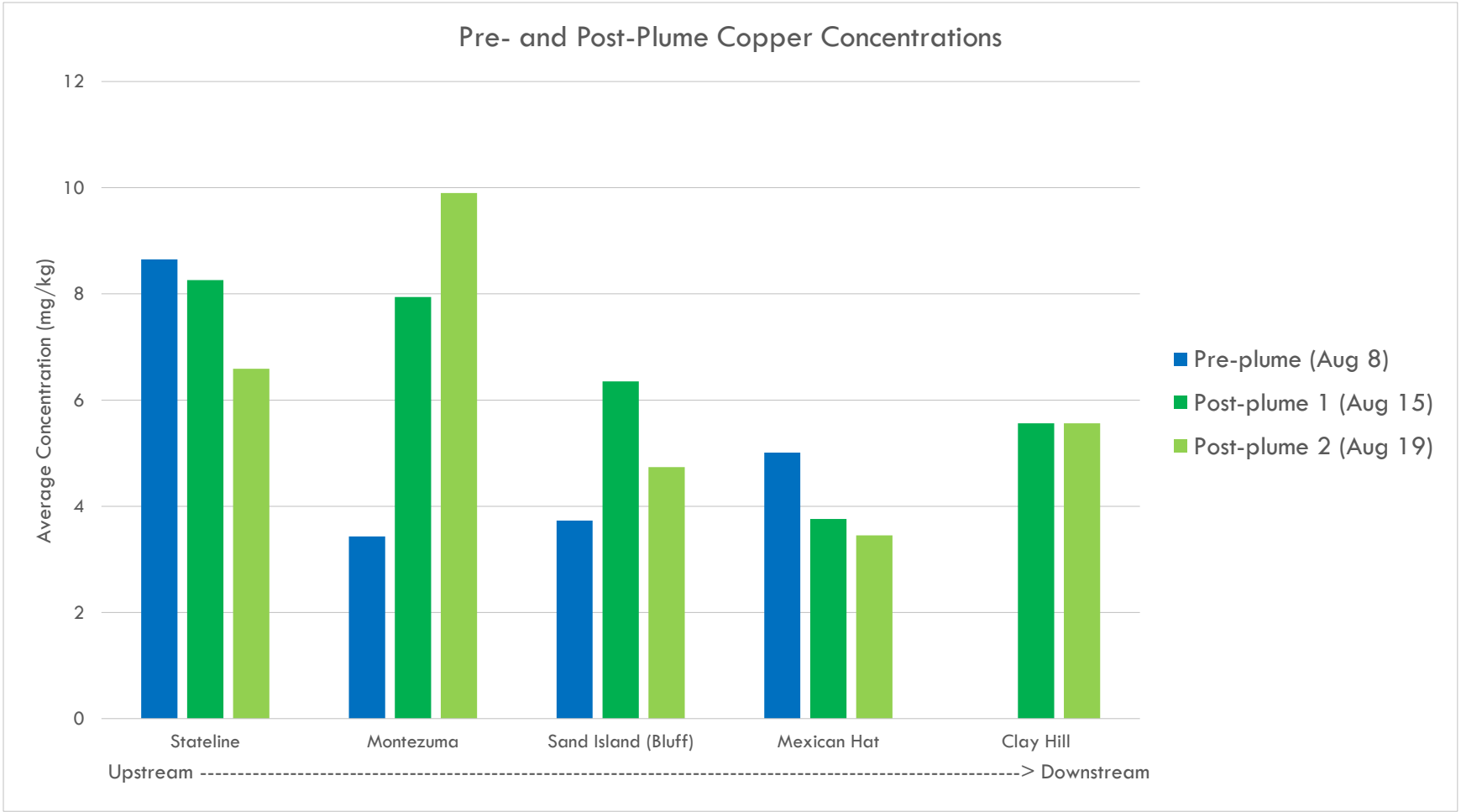
San Juan River – post storm

Total Zinc


Zinc Total (ug/L)
ND
200
400
600
800
NM–UT state line
Montezuma
Sand Island
Shiprock (EPA)
Hoback (EPA)
Rain event
8/7/2015
Noon
8/8/2015
Noon
8/9/2015
Noon
8/10/2015
Noon
8/11/2015
Noon
8/12/2015
Noon
8/13/2015
Noon
8/14/2015
Noon
8/15/2015
Noon
8/16/2015
Noon
8/17/2015
Noon
0
200
400
600
800
UDWQ
USGS
Historical data

Sediment transport

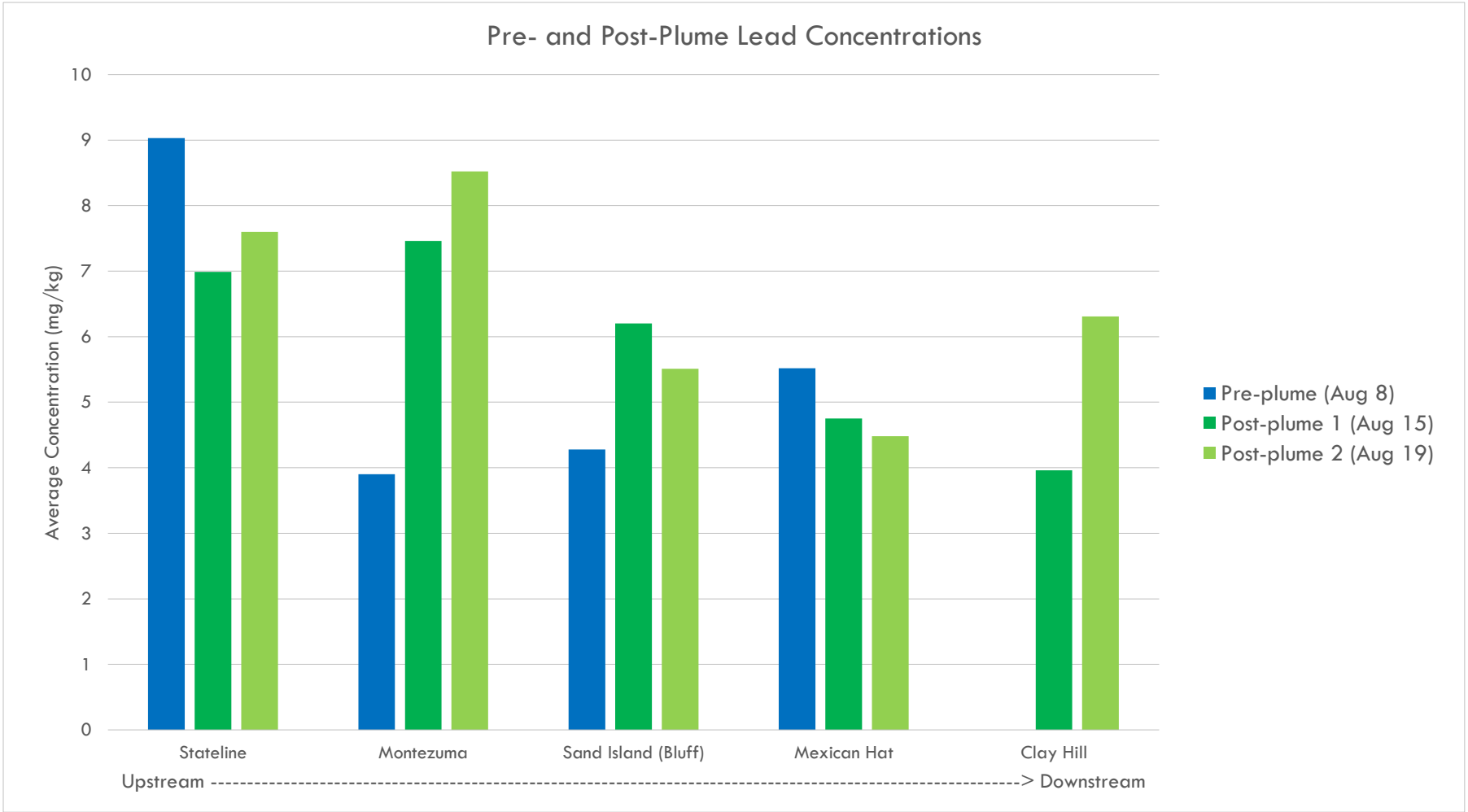
Copper in Sediment



Health based concentration: 500 mg/kg

Aquatic Life screening values: 16 – 30 mg/kg

Lead in Sediment



Health based concentration: 400 mg/kg

Aquatic Life screening value: 37 mg/kg

Sediment Screening

Comparison of San Juan River Sediment Samples with Health Based Screening Values

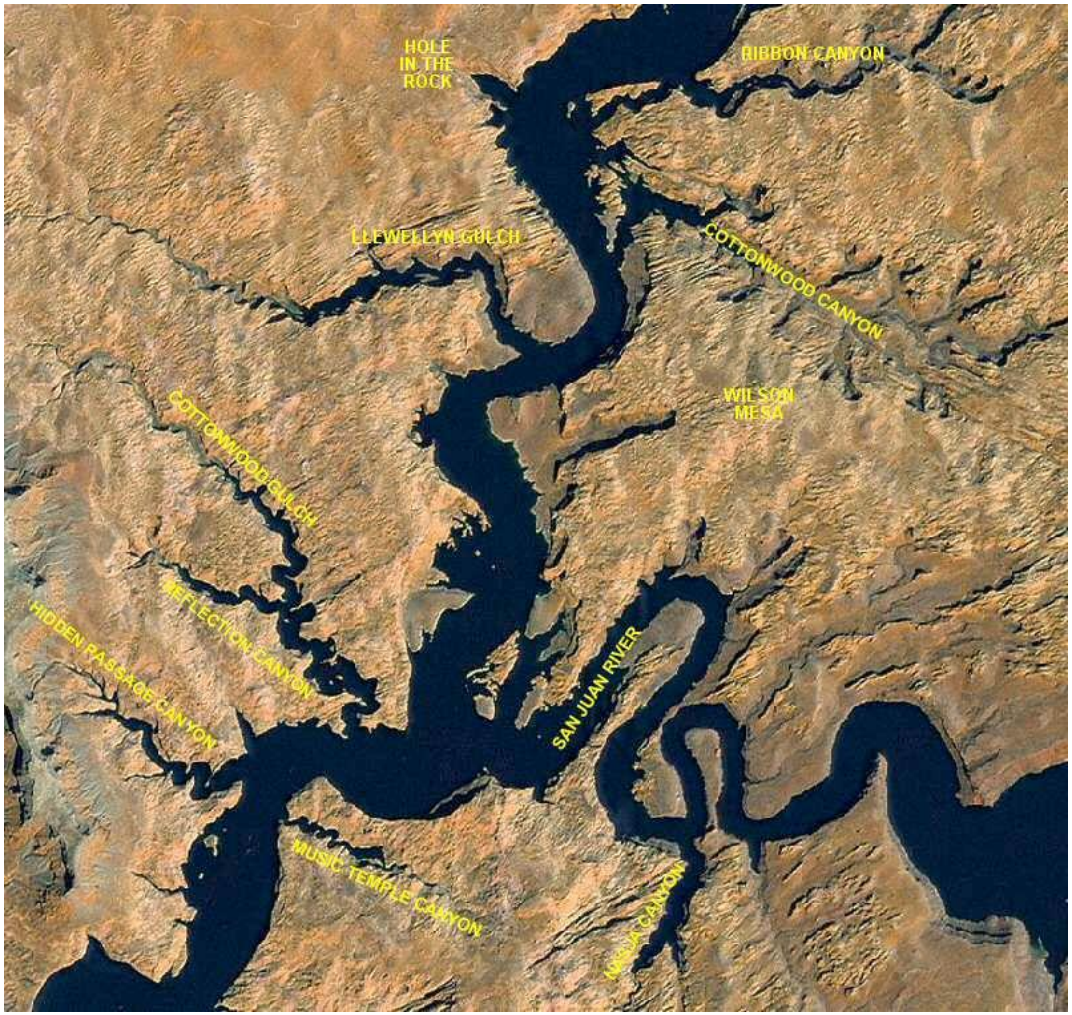
Site Description	Collection Date	Collection Time	Plume Arrival	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Silver	Sodium	Thallium	Vanadium	Zinc	Molybdenum
				Concentration (mg/kg)																					
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
San Juan R @ US160 Xing in CO	8/8/2015	1:33:00 PM	1	16,600	3.76	200	0.68	0.31	21,900	14.2	4.1	8.7	11,400	9.0	7,090	200	0.002	8.11	4,870	0.04	722	0.18	29	40	-
	8/15/2015	9:43:00 AM	3	17,900	3.20	217	0.54	0.20	9,140	12.1	4.1	8.3	11,900	7.0	3,300	240	0.005	6.40	2,660	0.03	344	0.14	25	32	-
San Juan R @ Town of Montezuma	8/8/2015	2:54:00 PM	1	6,140	1.74	279	0.29	0.12	8,470	5.0	1.8	3.4	5,330	3.9	1,990	150		2.90	1,690		146	0.07	14	19	
	8/15/2015	10:20:00 AM	3	11,600	3.15	190	0.57	0.24	11,100	13.0	4.2	7.0	12,100	7.5	3,810	241	0.006	6.67	3,140	0.03	353	0.17	27	33	-
San Juan R @ Sand Island	8/8/2015	4:19:00 PM	1	7,140	2.13	232	0.32	0.13	7,250	5.8	2.1	3.7	6,340	4.3	1,740	198	-	2.85	1,810	0.06	157	0.10	15	19	-
	8/15/2015	11:31:00 AM	3	10,600	2.78	297	0.45	0.17	10,500	9.5	3.2	6.4	9,630	6.2	3,100	223	0.003	4.96	2,540	0.07	277	0.13	23	27	-
San Juan R @ Mexican Hat US163 Xing	8/8/2015	5:40:00 PM	1	8,780	2.70	271	0.42	0.17	6,980	7.7	2.7	5.0	7,630	5.5	2,190	218	-	4.09	2,280	0.07	291	0.13	19	26	0.43
	8/15/2015	12:04:00 PM	3	7,480	2.20	213	0.37	0.15	13,300	8.8	2.5	3.8	7,210	4.8	3,340	192	-	4.50	2,120	0.05	201	0.07	17	25	-
San Juan R @ Clay Hills	8/15/2015	2:30:00 PM	3	5,160	1.50	251	0.31	0.15	16,900	6.3	2.1	2.8	6,040	4.0	3,550	176	0.003	3.68	1,790	-	218	0.07	14	17	-

	No Exceedence
	Above Screening Level
	Prior to Plume Arrival
	Estimated Plume Arrival
	Post Plume Arrival

None of the values collected before or after the plume exceed health based screening values used to evaluate recreational exposures, as discussed in the Statement of Evaluation provided by the Department of Health.

Long-term effects on Utah's waters

- San Juan Arm, Lake Powell
  - Depositional area for historic and current mine releases in San Juan system
- Historic releases:
  - Estimated release of 8.6 million tons of tailings discharged to river system over life of the mines
  - 1974 – 116,000 tons
  - 1978 - 500 million gallon release



SUMMARY REPORT

EPA Internal Review of the August 5, 2015 Gold King Mine Blowout

8/24/2015

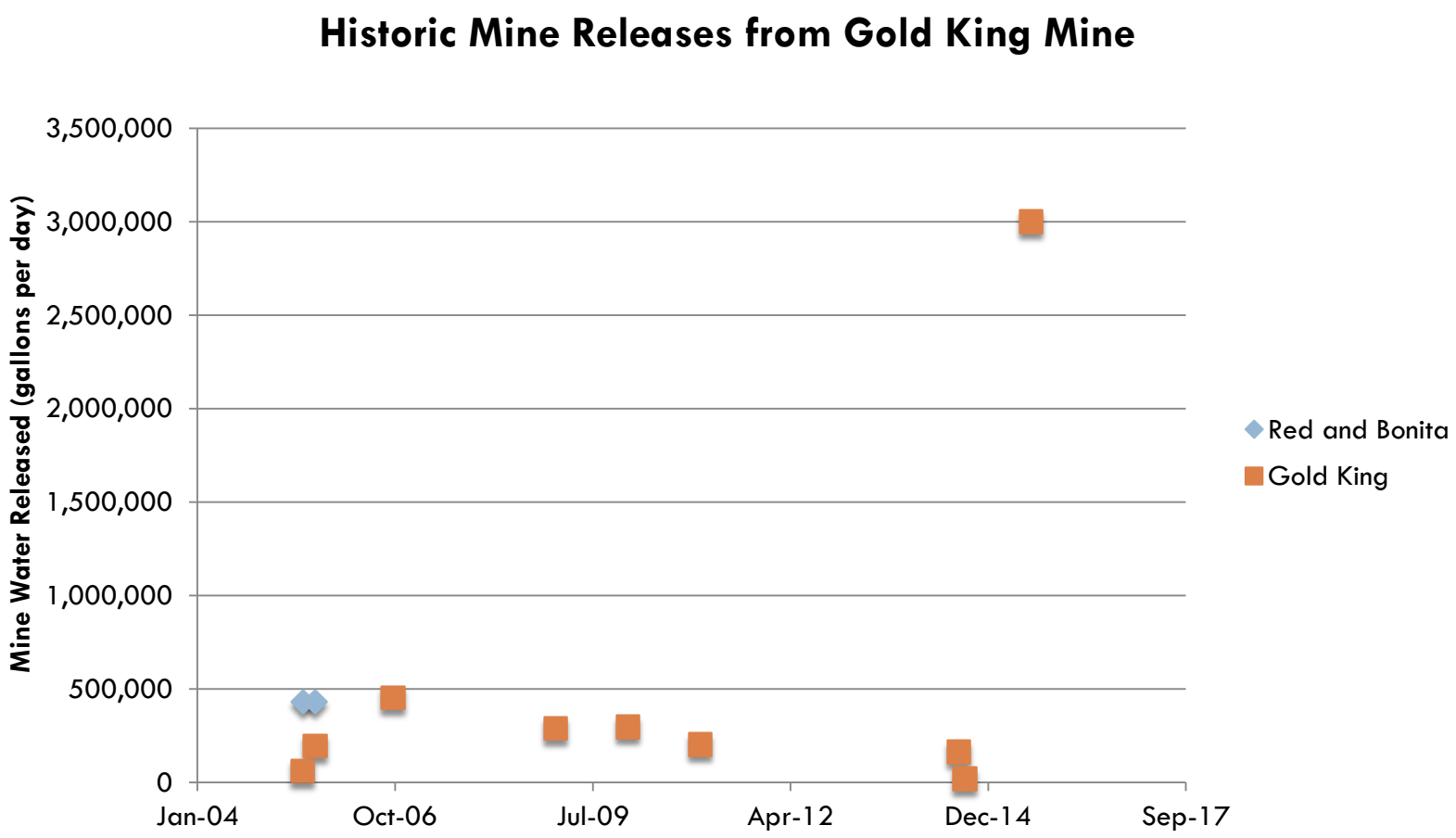
2005 – No documentation of flow for the Adit is available before July 2005. Anecdotal information suggests that the Red and Bonita Mine, which did not have any previously documented mine water discharge, began releasing approximately 300 gpm of water after the American Tunnel closure. The Adit also experienced an increase after the American Tunnel closure from no significant flow to flow rates of approximately 42 gpm in July and 135 gpm in September[1]. (See Attachment E: Gold King Mine Flow Data and Chart)

2006 – Mine water flow rate from the Adit was approximately 314 gpm[1] in October.

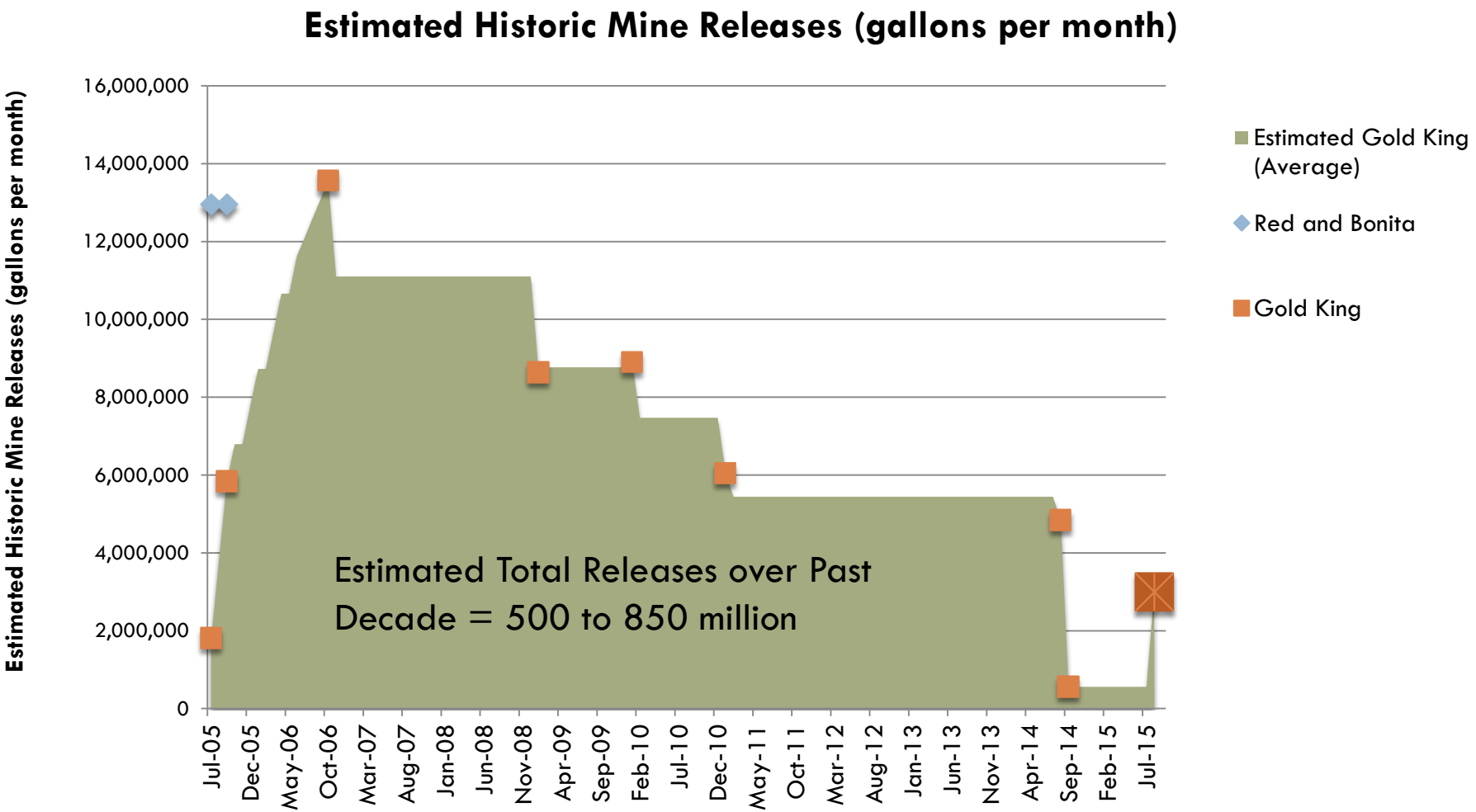
2010 – The average mine water flow rate from the Gold King Level 7 mine was 206 gpm[1].

2011 – The average mine water flow rate from the Gold King Level 7 mine was 140 gpm[1].

Legacy Influence of Silverton Mines



Cumulative Releases Over a Decade



Ongoing Seepage from Silverton mines

Figure 7.—Photograph showing the seepage outflow from the drain pipe at the American Tunnel at Gladstone, Colorado, as it appeared on September 3, 2015, with about 100 gpm of acid water flowing out.

Figure 11.—Photograph showing acid drainage flowing out of the Red and Bonita Mine on September 3, 2015.

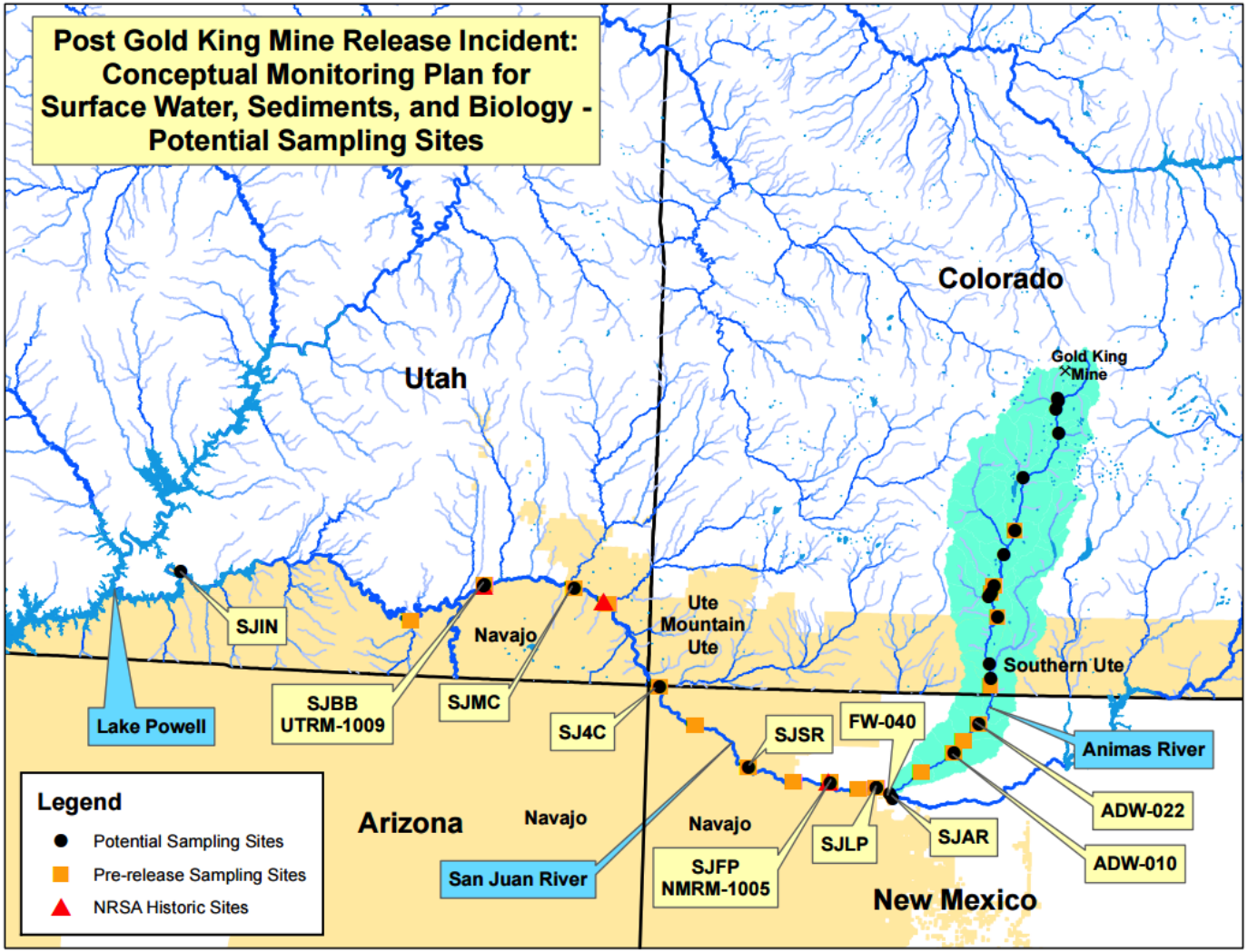
Figure 12.—Photograph taken on September 15, 2015, of drainage from the Silver Ledge Mine, which is located south of the Gold King Mine.

Figure 13. Photograph taken on September 15, 2015, showing acid seepage from the Blackhawk Mine located south of the Gold King Mine.

Long-term Assessment

- Remaining Questions
  - How much mine waste has been deposited into the San Juan Delta of Lake Powell since 2002? Since 1970s?
  - Does this legacy of mine waste have an effect on aquatic life in Lake Powell?
- Mitigating Factors:
  - Underlying chemistry cause metals to settle and attach to particles
  - Mine waste water released constitutes less than 1% of the daily flow in the San Juan River during August event
  - San Juan River carries large amounts of sediment downstream, which should help bury metals in Lake Powell

EPA Long-term Monitoring Plan

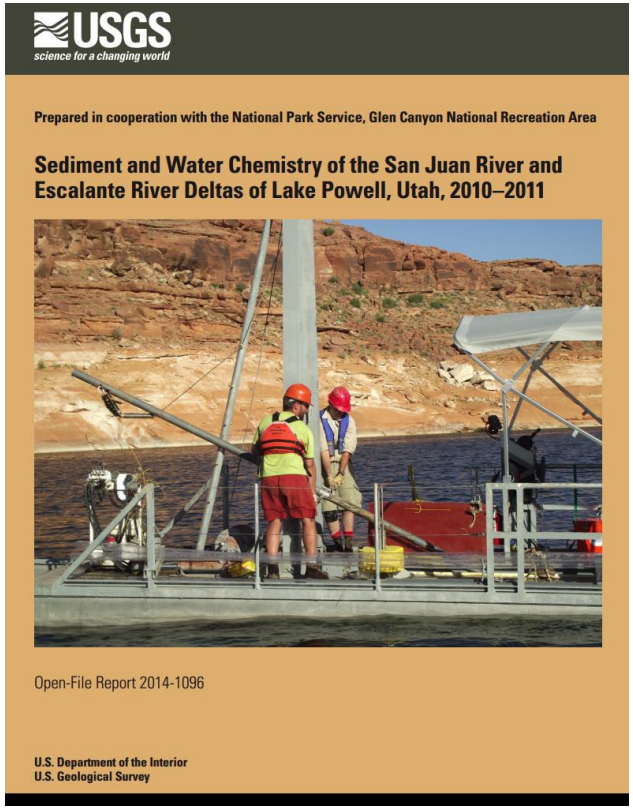


EPA Proposed Long-term Monitoring Plan

Table 1. Sampling and Monitoring Schedule For Potential Sampling Sites Listed in Table 2					
SAMPLING AND MONITORING SCHEDULE:	**FALL 2015**	**MARCH 2016**	**SPRING/ JUNE 2016**	**SUMMER 2016**	**FALL 2016**
WATER COLUMN - dissolved and total recoverable metals[1], dissolved organic carbon (DOC), total organic carbon (TOC), hardness	1 event	1 event: pre-snow melt	1 event: snowmelt runoff		1 event: low flow
SEDIMENT – total recoverable metals	1 event	1 event: pre-snow melt			1 event: low flow
BENTHOS AND FISH TISSUE – metals; Collect and assess in locations where historic data are available so that release effects can be assessed.					1 event: timeframe comparable to historic data
BIOLOGICAL COMMUNITY – benthic macroinvertebrate and fish populations – Collect and assess in locations where historic data are available and State/Tribal assessment methods are developed so that release effects can be assessed.	1 event				1 event
STORMWATER SAMPLING - dissolved and total recoverable metals[1] and dissolved organic carbon (DOC) – Collect at sites on Animas in CO, Southern Ute, NM	1-2 (total across Fall 2015 and Summer 2016)			1-2 (total across Fall 2015 and Summer 2016)	
PHYSICAL HABITAT	Collected once at each site sampled for macroinvertebrates and fish – likely at fall event				
FIELD PARAMETERS –	All sampling events will include field parameters (pH, temperature, dissolved oxygen (DO), conductivity and turbidity) measured with a probe/sonde.				
FLOW –	Flow data will be measured via stream gage if present or by flow meter for all events.				
[1] *Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, uranium, vanadium, and zinc*					

DRAFT

Sediment records from Lake Powell



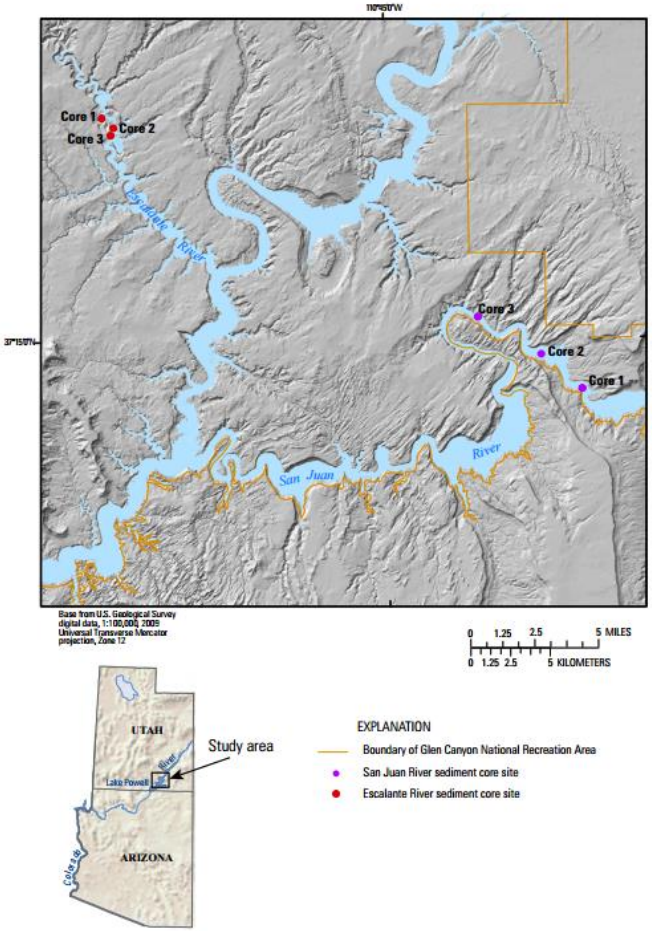


Figure 1. Map showing location of study area and core sampling sites, San Juan River and Escalante River deltas, Lake Powell, southeastern Utah.

BOR Recommendations

RECLAMATION
Managing Water in the West

Technical Evaluation of the Gold King Mine Incident

San Juan County, Colorado

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

October 2015

- Actions leading to blowout are not unique or isolated
  - Inconsistent standards of practice among agencies
  - Guidance includes little attention to engineering complexity of abandoned mines
- Regulations that govern similar situations (SMCRA; dam safety) do not apply to abandoned hardrock mines
- Nearly 100,000 abandoned hardrock mines in Western US

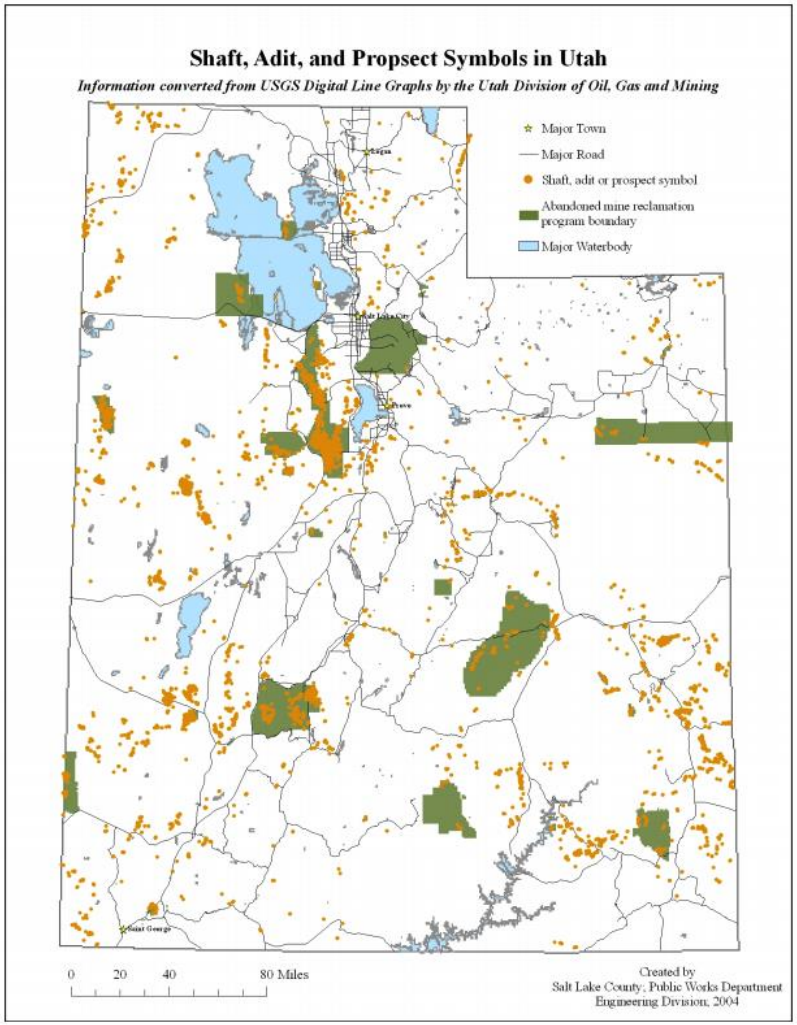
Abandoned Mines in Western US

State	Number of Abandoned Hardrock Mines
Arizona	24,183
California	17,748
Utah	**10,697**
Nevada	10,613
Oregon	5,827
Colorado	5,105
Montana	4,915
New Mexico	3,989
Wyoming	2,336
Washington	1,956

Data source: Abandoned Mine Lands Portal (www.abandonedmines.gov)

Abandoned Mine Management in Utah

- Multiagency management
  - USFS
  - BLM
  - EPA (CERCLA)
  - Division of Oil, Gas, and Mining
  - Division of Water Quality
- Identify streams impacted by abandoned mines through biannual assessment process
- Implement BMPs for safety and to reduce discharge to streams
  - Treatment of contaminants
  - Removal of mine waste
  - Isolation from water
  - Diversion



Summary

- Immediate effects of Gold King Mine release on Utah's waters were not significant
  - Evidence of the plume was seen in dissolved metals
- Long-term questions remain regarding legacy effects of mine waste in San Juan delta of Lake Powell
  - Utah will lead study to evaluate this question with EPA funding
- Abandoned mines continue to threaten water quality around the west
- Coordination between state agencies in response to spill was excellent
- Opportunity to raise awareness about water quality issues in Utah

More Information

deq.utah.gov/Topics/Water/goldkingmine/

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Gold King Mine Release

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Press Releases

PHOENIX (September 3, 2015) – As the Labor Day holiday weekend approaches, Arizona Department of Environmental Quality (ADEQ) officials announced today that their analysis of water entering Lake Powell shows that the lake is safe for normal uses, including swimming and boating.

Scientists and specialists from several Arizona agencies have been and are continuing to monitor and assess data related to the mine spill. Arizona's cooperating agencies agree that Lake Powell and the downstream Colorado River are safe for all uses including recreation and agriculture as well as a drinking water source for public water systems.

Previous Press Releases