Executive Summary

In October 2014, the Surface Water Quality Bureau sampled Cold Spring Creek to determine if there had been negative impacts to water quality following flooding and erosion earlier in the year. Cold Spring Creek is listed as an impaired water of the State due to excessive concentrations of cadmium and lead. Historic mines in the upper watershed are the proximal source of the metal contamination, and the flooding caused significant erosion and mobilization of tailings that lie in the stream channel on both public and private land. The landowner, Ms. Karren Weathers, can no longer cross Cold Spring Creek to access a portion of the property that contains valuable equipment due to deep down cutting between the access road and the building. Ms. Weathers was concerned that any repairs to the road could mobilize additional tailings and sediment causing further water quality degradation. The sampling plan was developed to determine if there was a significant change to water quality following the flooding and erosion and gauge whether emergency repairs would further exacerbate water quality concerns.

The results of the sampling show that the water quality below the impacted area is not significantly worse than prior to the damaging flood events. Just below the area of greatest erosion, the zinc levels are elevated enough to acutely exceed the state water quality standard. However, at sampling stations further downstream where additional tributaries have increased the streamflow volume, the zinc impairment is no longer observed. Comparing same-site data from 2009 and 2014, demonstrates that zinc, lead and cadmium levels have not increased following the Silver Fire in 2013 or the flooding in the summer of 2014.

Based on this sampling run, it does not appear as though a significant degradation of water quality has occurred. Given that a significant amount of mine tailing and sediment has been mobilized by the stream, any repairs to the stream crossing would likely have negligible additional impact. Additionally, the land owner can proceed with emergency repairs to the stream crossing without violating the Clean Water Act as long as the total disturbance is less than $1/10^{th}$ of an acre. Disturbances greater than $1/10^{th}$ of an acre are regulated under the Nationwide Permit #14 for linear transportation projects and would require pre-construction notification to the US Army Corps of Engineers, Las Cruces Field Office. It is advisable to use 'clean fill' while repairing the stream crossing, but that may not be feasible given the tight constraints of the canyon and limited borrow areas.

Introduction

In a July 21, 2014 email, the USDA Forest Service (FS) notified the New Mexico Environment Department (NMED) of flooding in the vicinity of the Royal John Mine (RJM). The Royal John Mine produced primarily zinc and lead, but also small amounts of silver, copper and gold during an operational period spanning 1916- 1969. The RJM is located in the upper reaches of Cold Spring Creek watershed (7,800') on the west side of the Black Mountain Range within the Mimbres River drainage. According to the FS notification, the flooding was caused by intense summer rains and exacerbated by the 2013 Silver Fire which burned portions of the upper watershed. The flood eroded historical mill tailings located in the Cold Spring Creek drainage on both FS administered and private land.

Cold Spring Creek has been recognized as an impaired water of the state since 1996 due to elevated levels of lead and cadmium. In response to this impairment, the NMED funded construction of sediment pond, lined channel and dissipater apron in an effort to reduce the erosion of tailings within the creek

and improve water quality. Construction was completed in 1997 and these BMPs were still in place prior to the 2014 flooding.

On August 19, 2014 staff members from the Ground and Surface Water Bureaus toured the site with the land owner, Ms. Karren Weathers, and US Forest Service personnel from the Silver City Ranger District and the Regional Office. The tour revealed extensive flood damage and erosion on both public and private land with a single, large head-cut moving up the Cold Spring Creek drainage through layers of river alluvium, mining waste rock, and tailings (figures 1 & 2). The pH of the tailings was neutral, but the lead concentrations ranged from 1,000 to 30,000 ppm. The pH and lead concentrations were measured in the field using a soil paste pH kit and portable XRF, respectively. Approximately 200' of the channel up gradient of the FS boundary/Private property line and 200' down gradient contain tailings. Some of the tailings on the FS administered land was transported down gradient onto the private land.

Discussions with Ms. Weathers and the Surface Water Quality Bureau (SWQB) lead to the development of a field sampling plan to test the water quality within the creek both above and below the areas of erosion. The plan also included sampling of perennial water at a mine adit that serves as the domestic water source for Ms. Weathers. The field sampling plan was approved in September 2014, and in October 2014 SWQB staff sampled eight locations (figure 3 & table 1) within the Cold Spring Creek drainage on both public and private land with landowner permission. The goal of the sampling plan was to determine the impacts to water quality that have resulted following the fires and flooding. Results and discussion proceed below and photographs of sampling locations are included at the end of this document.

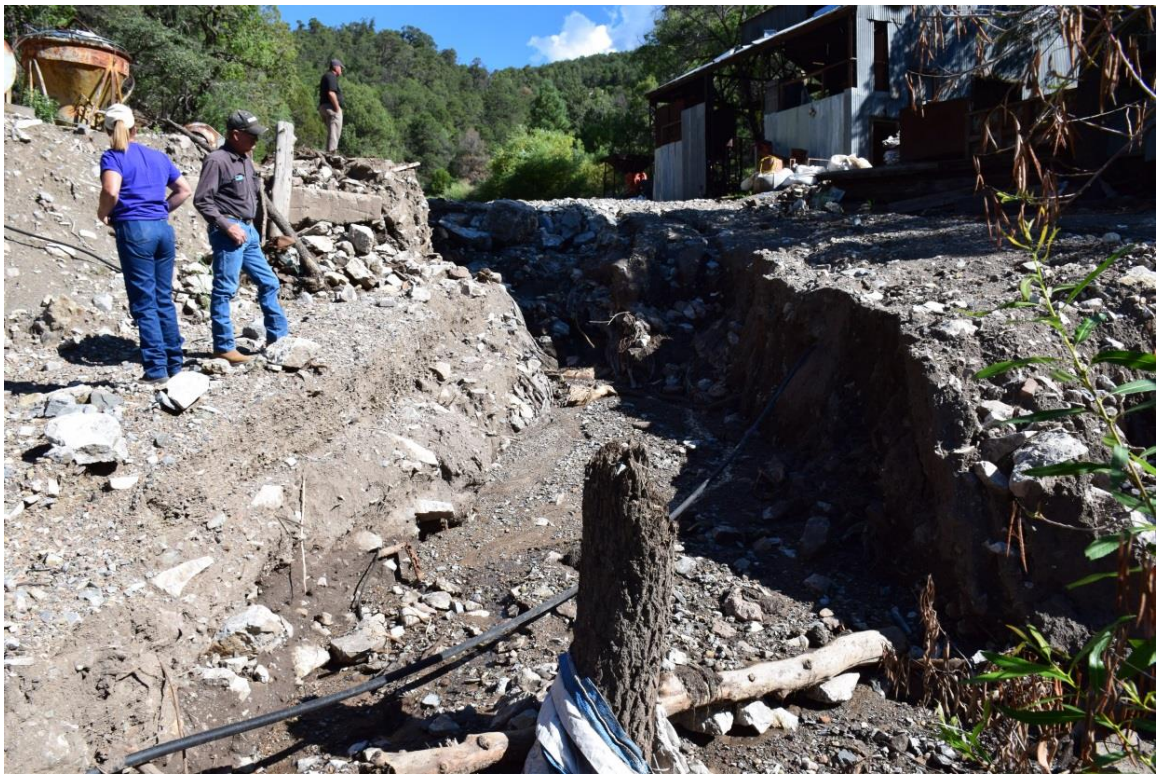


Figure 1. Area of erosion cutting through waste rock, tailings and river alluvium.

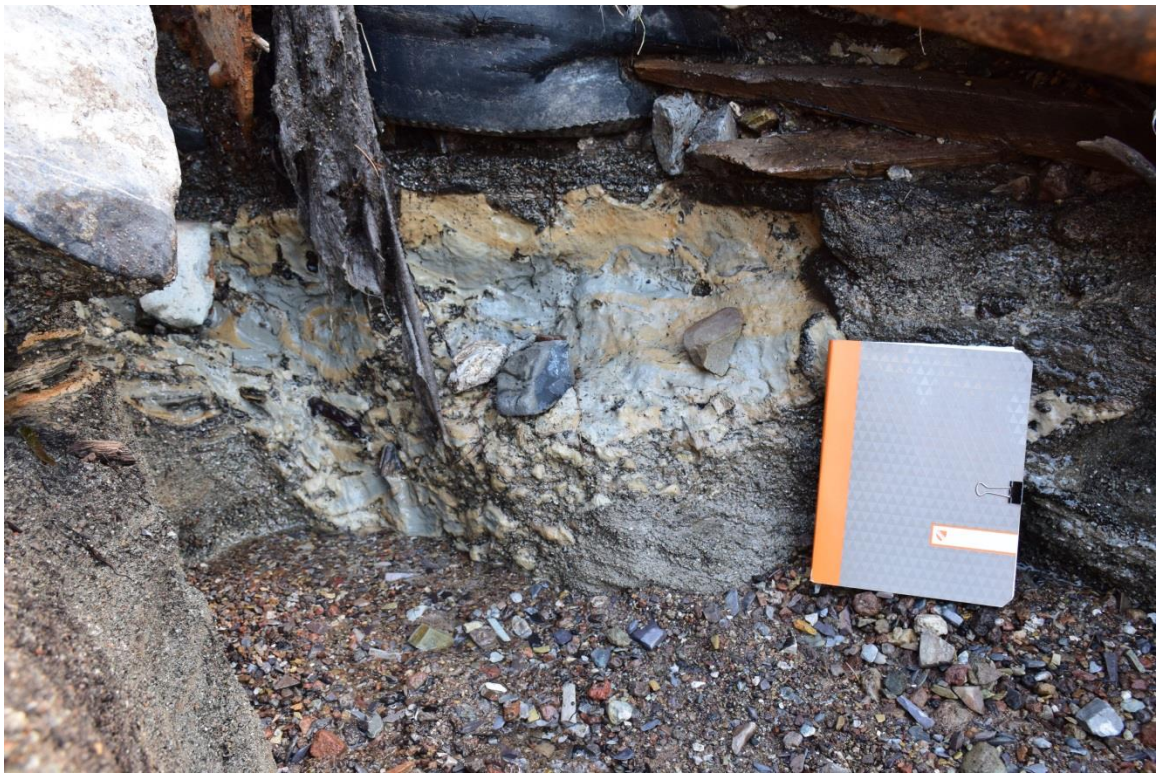


Figure 2. Fine grained tailings with high lead concentrations.

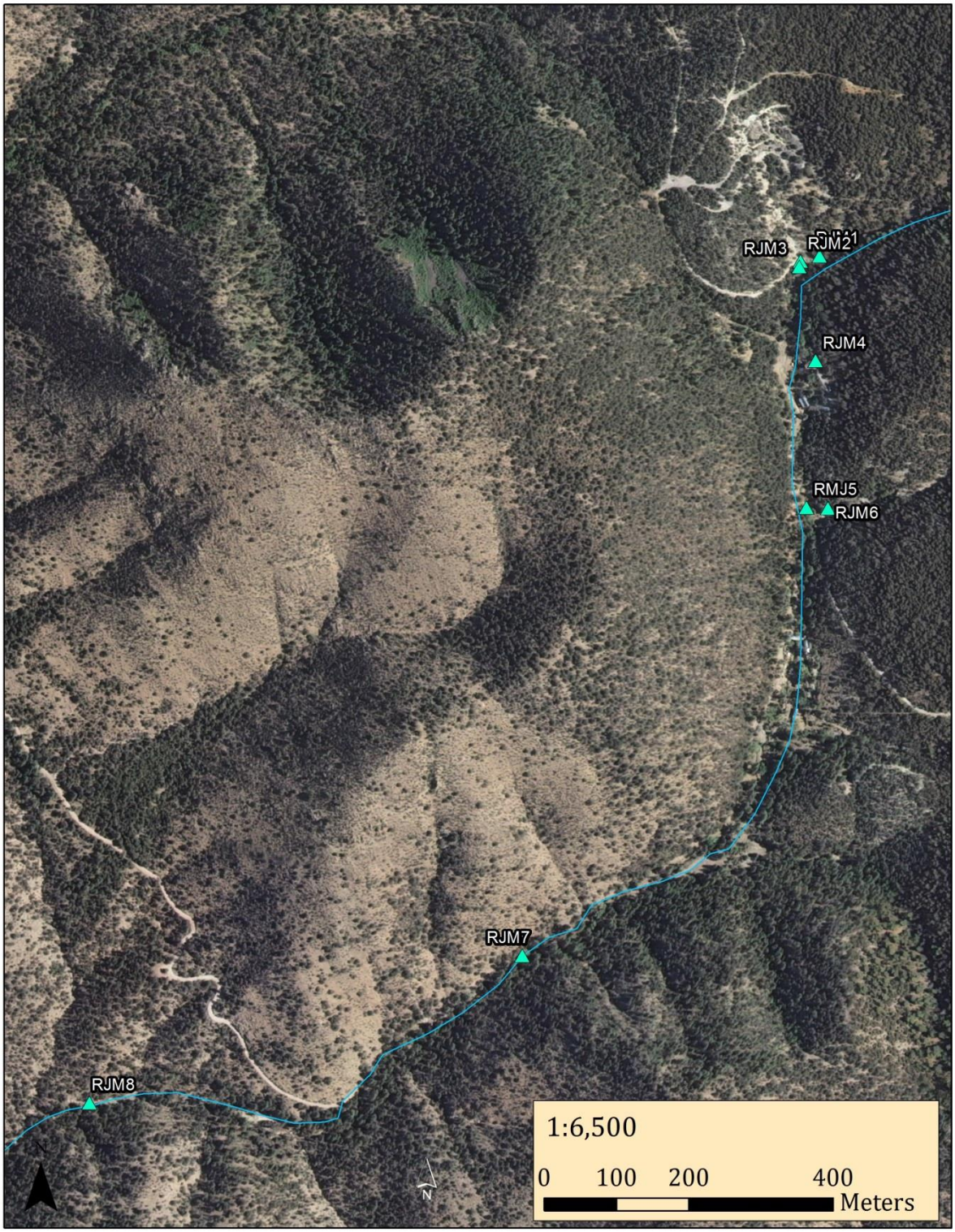


Figure 3. Map of water quality sampling points from October 2014. Areas of erosion and tailings lie between points 3 and 5. Sampling point 4 is Ms. Weathers' domestic water source.

Table 1. Water quality sampling station ID and description for 2014 sampling.

Station ID	Site description
RJM1	Uppermost station on a headwater tributary.
RJM2	Headwater tributary. Drains abandoned mines above.
RJM3	At tributary confluence, main stem of Cold Spring Creek. Some mining impact and erosion.
RJM4	Perennial water from mine adit above Cold Spring Creek. Drinking water source for Ms. Weathers.
RJM5	Main stem, below head cut and erosion area.
RJM6	Tributary of Cold Spring Creek emanating from a nearby spring.
RJM7	Main stem below Royal John Mine and private land. SWQB station from 2009 sampling.
RJM8	Lowermost station. Below downstream tailings area.

Results

Surface water was analyzed for the following dissolved metals-- cadmium, chromium, copper, lead, manganese, nickel, silver, and zinc-- to assess water quality based on cold-water aquatic life standard (NMAC 20.6.4.803). Total recoverable aluminum is used in lieu of dissolved aluminum for state water quality assessments. The water quality standards for all metals are hardness dependent and allow for a higher metal concentration as the hardness of the water increases. Water quality exceedances were recorded for cadmium (RJM5, RJM8) lead (RJM5, RJM7, RJM8) and zinc (RJM5), Table 2. The only acute exceedance recorded was at the RJM5 station just below the area of most significant erosion and head cutting. Further downstream stations do not show a zinc exceedance suggesting that the high zinc content at RJM5 is a localized concern and the additional water inputs from tributaries dilute the zinc concentration found at RJM5 (table 3).

Table 2. Results for dissolved metals (aluminum is total recoverable) at all sampling locations from 2014 sampling. Results in mg/L.

Analyte	RJM1	RJM2	RJM3	RJM4	RJM5	RJM6	RJM7	RJM8
Aluminum	<0.01	0.63	0.26	0.02	0.03	0.03	0.04	0.02
Cadmium	<0.001	<0.001	<0.001	<0.001	*0.003**	<0.001	0.001	*0.001**
Chromium III	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	<0.001	<0.001	0.002	0.004	*0.045**	<0.001	*0.016**	*0.016**
Manganese	<0.001	0.004	<0.001	<0.001	0.087	<0.001	0.014	0.014
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	<0.01	0.01	<0.01	0.04	***0.7+***	<0.01	0.22	0.14
Hardness	471	853	484	260	365	274	316	285

**Chronic exceedance of water quality standards. +Acute exceedance of water quality standard.*

The RJM4 sampling location is at a mine opening above the Cold Spring Creek channel. Perennial water seeps out of the mine and is captured by the landowners for use as drinking water. The water quality analysis for this sample does not exceed either State surface water standards or EPA drinking water

standards. There is a small concentration of lead in the sample (0.004 mg/L) but this is well below the drinking water standard of 0.015 mg/L.

Table 3. Field parameters at each sampling location including streamflow for 2014 sampling.

Parameter	RJM1	RJM2	RJM3	RJM4	RJM5	RJM6	RJM7	RJM8
Temp C˚	4.15	5.32	5.21	4.04	7.38	5.68	7.56	8.03
Conductance (µS/cm)	804	1389	808	515	668	498	544	525
Salinity (ppt)	0.39	0.69	0.4	0.25	0.33	0.24	0.26	0.26
DO (mg/L)	10.89	9.93	9.29	9.6	9.79	9.91	9.2	9.69
DO (sat%)	110.4	104.2	97.1	97.1	107.8	104.6	101.8	108.4
pH	7.73	8.39	8.05	7.94	7.96	7.88	7.97	8.11
Turbidity (NTU)	0.8	2.7	1.5	0	1.6	2.1	6.5	2.1
Streamflow (cfs)	minimal	minimal	0.001	no flow	0.015	0.17	1.08	0.77

In 2009 the Surface Water Quality Bureau sampled Cold Spring Creek at the RJM7 location. This sampling predates the Silver Fire of 2013 and the watershed flooding and erosion in 2014 and lies approximately 0.5 miles downstream of the area of head cutting and erosion seen in figure 1. A direct comparison of these two sampling years at the same station gives an indication of water quality impacts that have resulted following the watershed perturbations in the past two years (table 4).

Table 4. Comparison of 2009 and 2014 sampling runs at the RJM7 sampling station.

Analyte	2009[1]	2014
Cadmium	0.001 mg/L	0.001 mg/L
	0.002 mg/L*	
	0.002 mg/L*	
	0.002 mg/L*	
Lead	0.012 mg/L*	0.016 mg/L*
	0.018 mg/L*	
	0.015 mg/L*	
	0.014 mg/L*	
Zinc	0.13 mg/L	0.22 mg/L
	0.24 mg/L	
	0.17 mg/L	
	0.22 mg/L	

[1]*In 2009 four sampling events occurred at a single location. The events occurred on 3/23, 7/20, 8/24, and 11/17 and capture a broad range of temperature and streamflow conditions. *Chronic exceedance of water quality standards.*

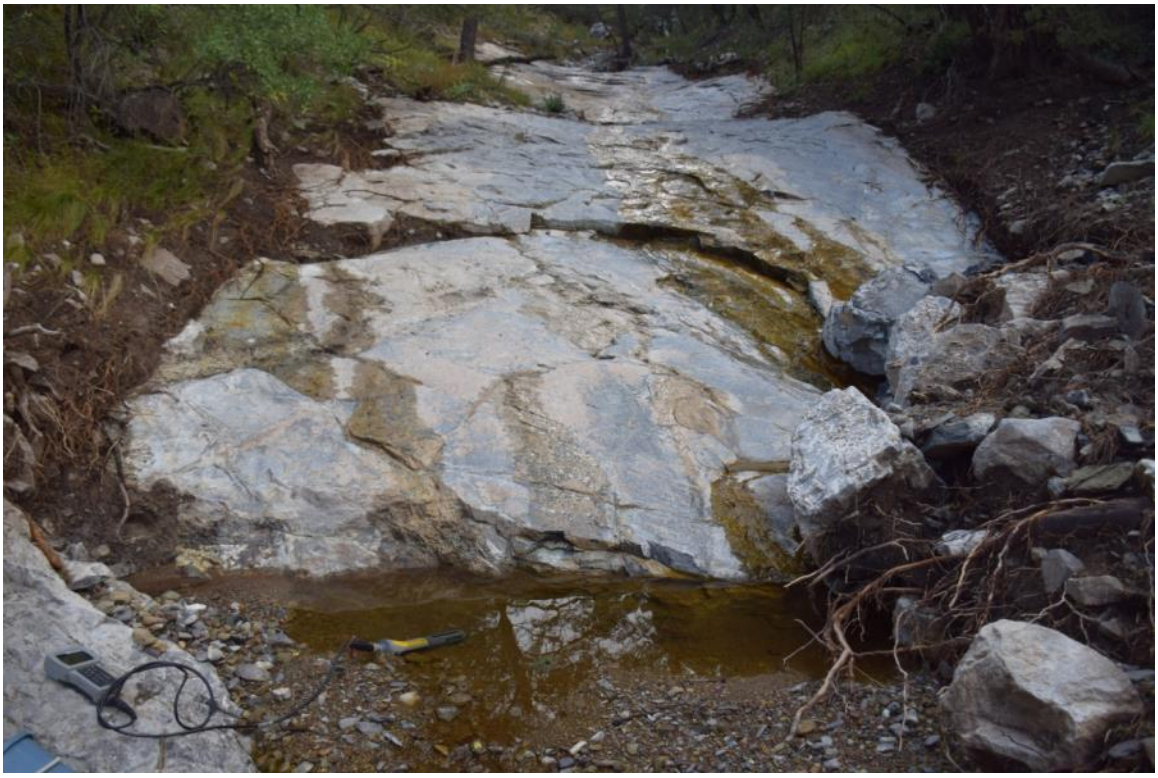
For zinc, lead and cadmium, results from 2014 show that there has not been a significant increase in metal contamination at this sampling location. The 2014 samples are within the range of the 4-sample run in 2009. Zinc and cadmium levels are within the water quality standards, while lead is elevated and represents a chronic exceedance to the standard.

Discussion

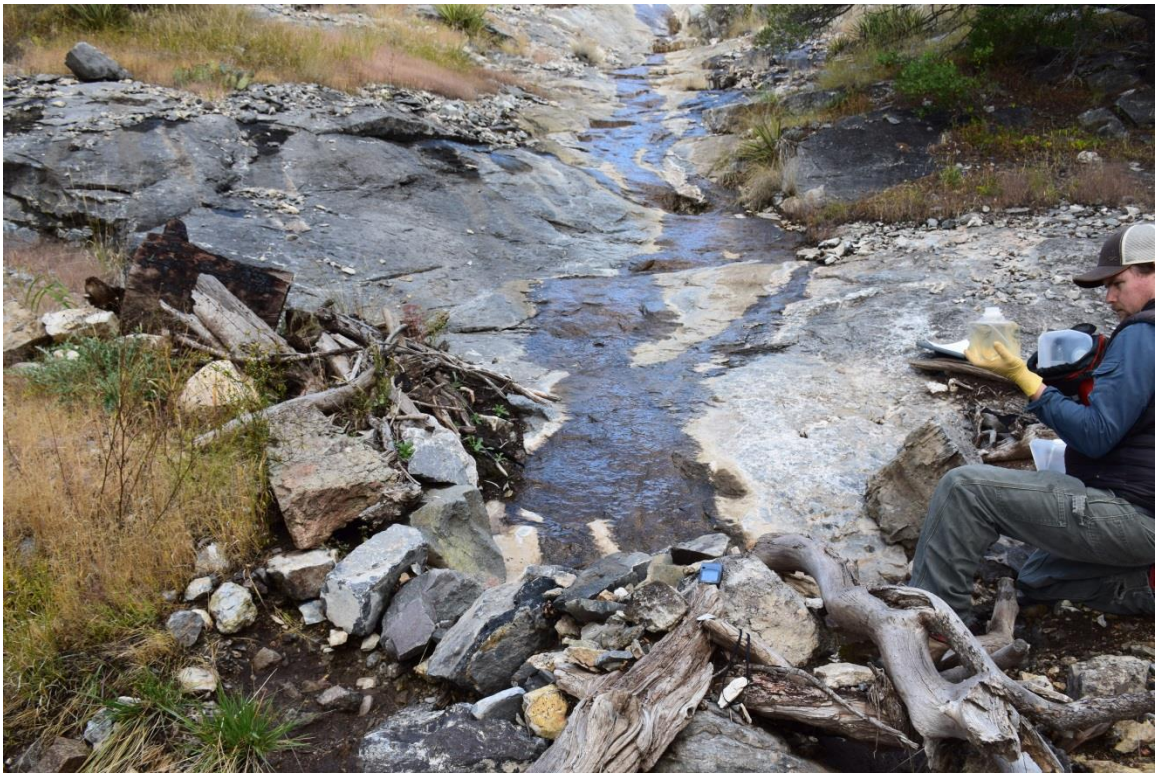
Significant watershed-level disturbances have created a highly unstable situation within the upper watershed of Cold Spring Creek. This has resulted in the failure of a 20 year-old settling pond with concomitant erosion and down cutting of the channel through public and private property. There are several areas of mine tailings that are now being mobilized into the stream channel and downstream. While the physical character of the stream and landscape has been significantly altered, it does not appear that the water quality within the stream has been significantly diminished as compared to conditions prior to 2014. Comparing the water quality data at the same location (RMJ7) in 2009 and 2014, metal contamination in the stream has not increased. At the RJM5 sampling location an acute exceedance of the water quality standard for zinc was recorded, but in downstream locations the zinc is within standards, suggesting that the zinc is a localized concern and not, at this time, a broad concern for residents, recreationists and livestock producers in the greater watershed.

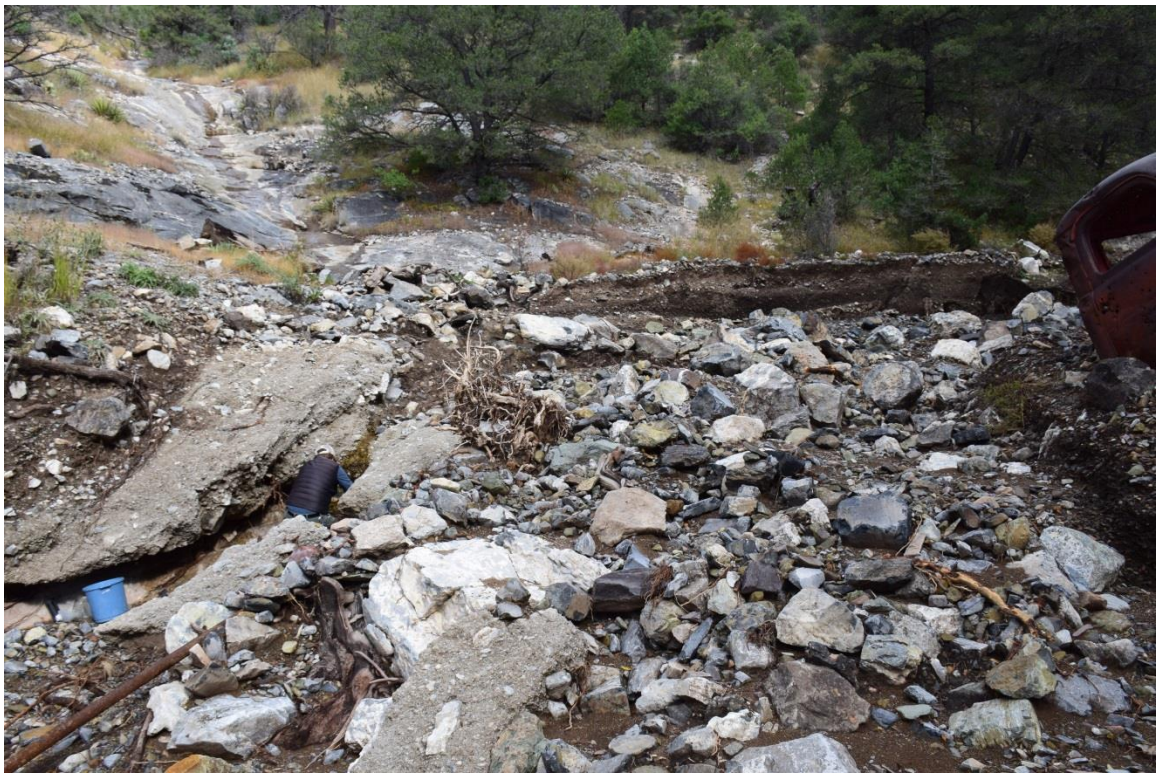
While the New Mexico Environment Department is working with US Forest Service to prepare, fund and complete a comprehensive remediation effort, the timeline for this is still at least 1- 2 years out. In the meantime, the property owner is able to complete whatever construction activities are required to retrieve their equipment. The sampling results do not indicate that additional disturbance will result in deleterious effects on water quality. Construction activities would be covered under the US Army Corps of Engineers Nation-wide Permit #14 for linear transportation projects. If the total disturbance is less $1/10^{th}$ of an acre, the landowner does not need to contact the US Army Corps. Disturbances greater than $1/10^{th}$ of an acre would require pre-construction notification to the Corps at the Las Cruces field office.

Photos of water quality sampling points from October 2014:

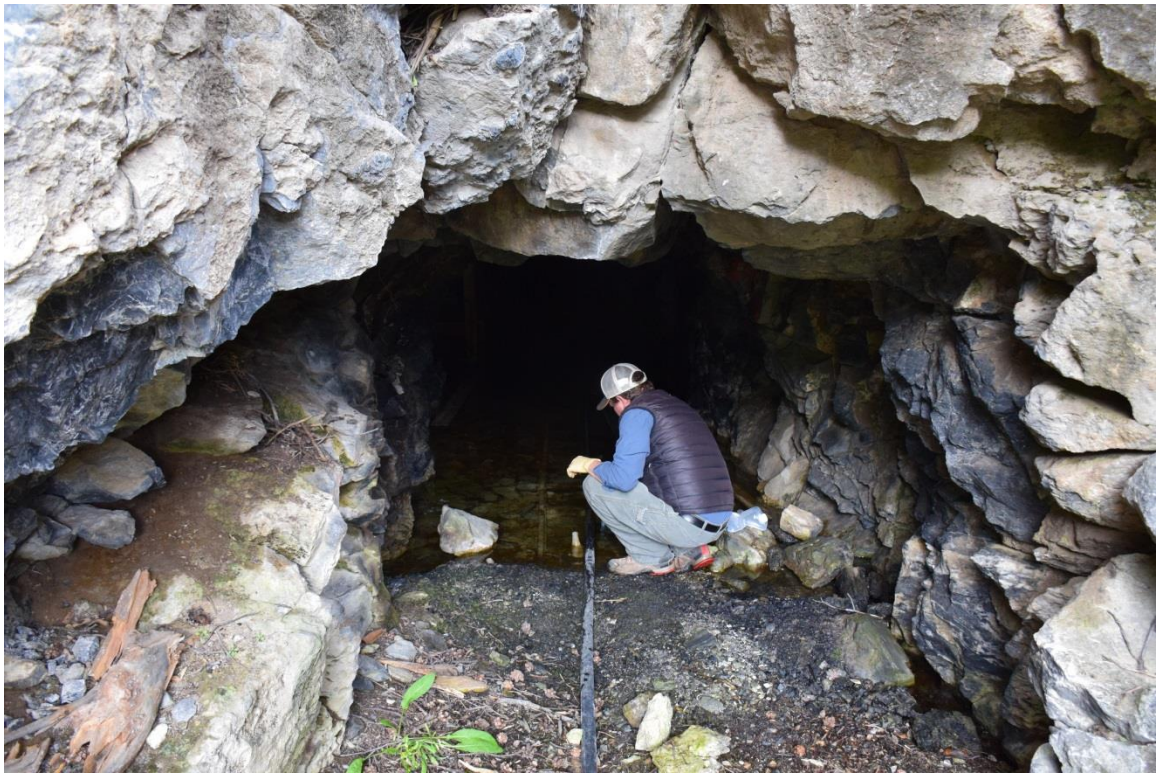


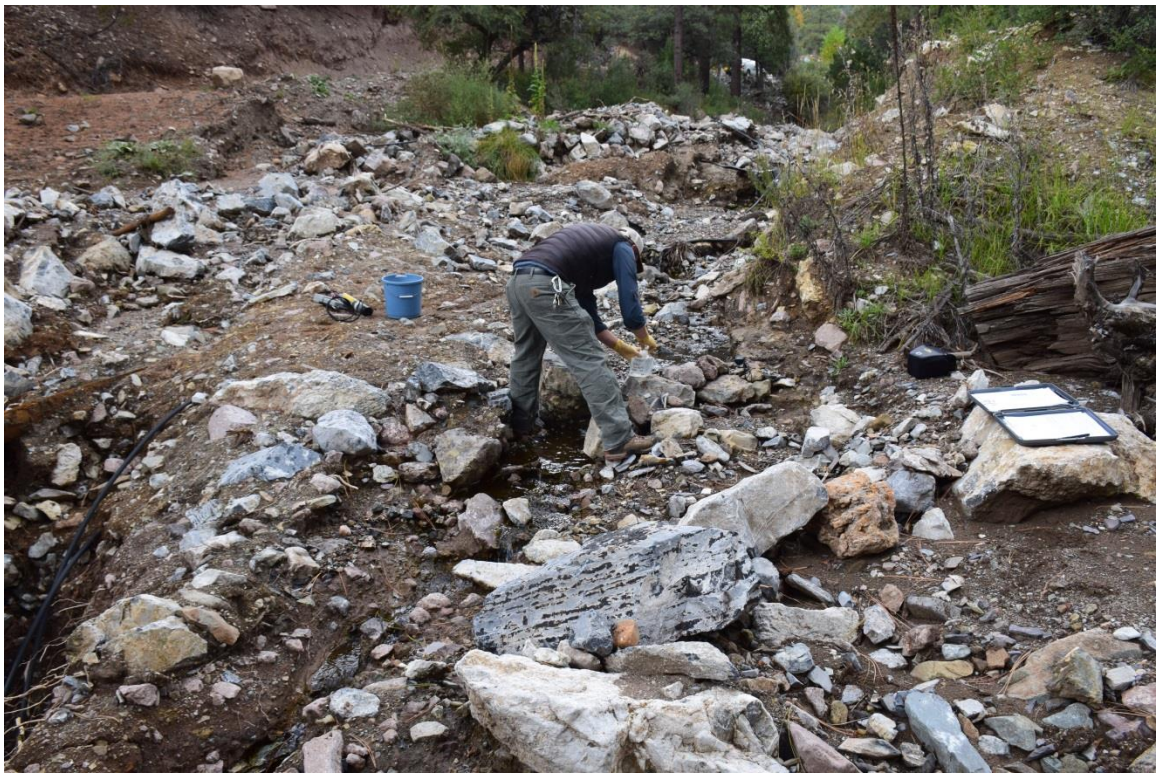
RJM1 above, and RJM 2 below.



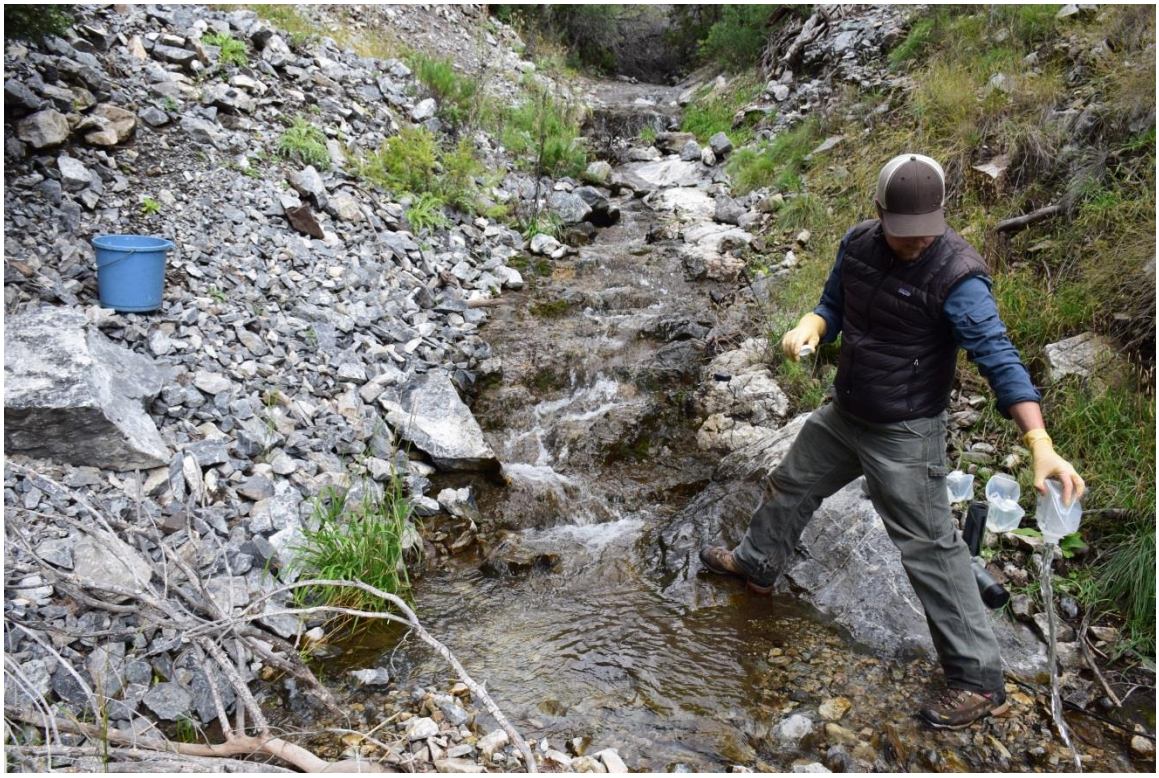


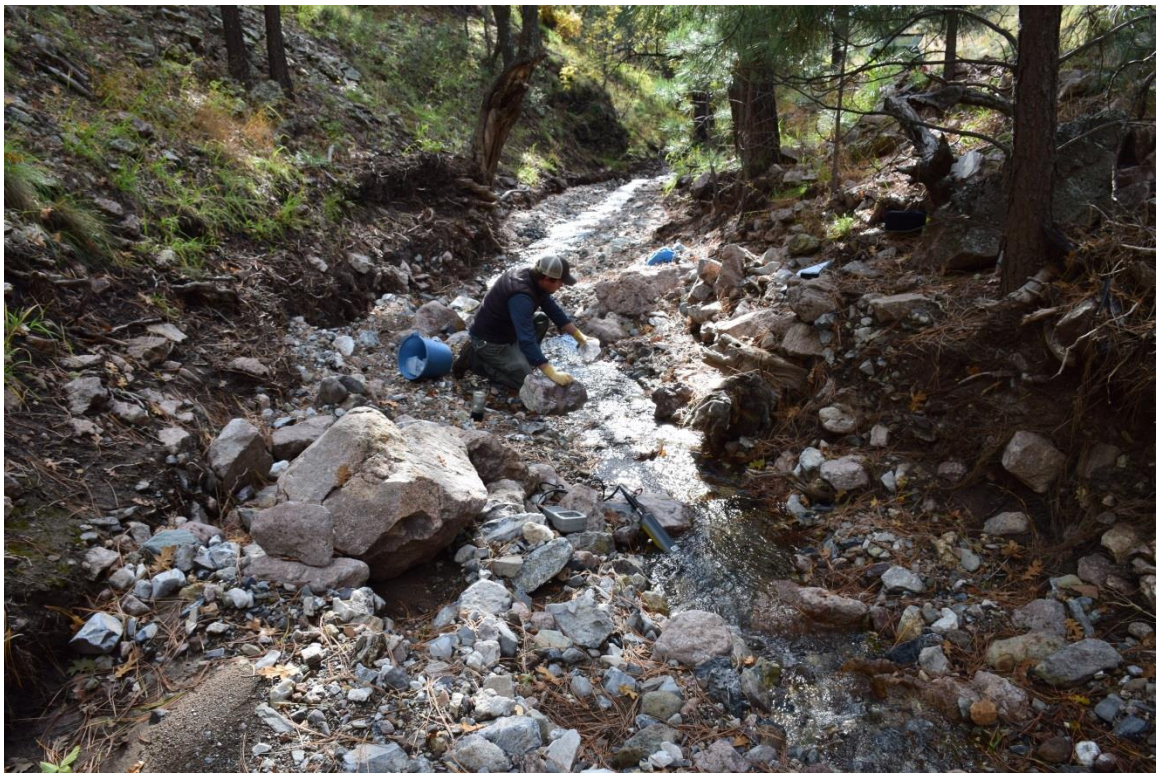
RJM 3 above, RJM4 below.





RJM4 above, RJM 5 below.





RJM 7 above, RJM8 below. Note lower tailings pile on left side of photo below.