

Appendix C

Communiqué from Kennecott Utah Copper Corporation with attached final compliance monitoring reports for Butterfield Creek

From: "Payne, Kelly (KUCC)" <paynek@kennecott.com>
To: "Douglas Bacon" <dbacon@utah.gov>
Date: 2/26/2009 2:17 PM
Subject: FW: Butterfield Creek Canyon
Attachments: Final Report for Compliance Monitoring .doc; 102099BF.doc

From: Vinton, Brian (KUCC)
Sent: Thursday, February 26, 2009 12:12 PM
To: Payne, Kelly (KUCC)
Subject: Butterfield Creek Canyon

Kelly,

Doug left me a message asking questions related to Butterfield Creek Canyon. Please take a look at responses and add information as needed.

Butterfield Waste Rock area:

1. Was any Butterfield Waste rock left in place during the 1992 removal effort? In review of pictures and post-removal sample map, it is apparent that all waste rock was removed from the 1992 removal area. The county road was re-routed after the removal was completed.
2. Was Lark Waste rock used as a base for the county roads? KUCC did not haul any Lark waste rock to make road base for the county. The county/State did use Lark Waste rock as a base for portions of the east-west portion of Highway 111 through Herriman and in some of the Herriman side streets. No Lark waste rock was used by KUCC as a road base during the 1990s which means KUCC did not haul Lark waste rock to the Butterfield Canyon waste rock removal area.

Revere and Yosemite Drainage Areas Soil Removal:

1. When did KUCC remove the two desilting basins that were installed to catch suspended solids for the Revere and Yosemite soil cleanups in/along Butterfield Creek? July 1999. Documentation attached.
2. How long did KUCC monitor suspended solids in Butterfield Creek below the desilting basins? April 1997 through June 1999 and for two additional sampling events before and after spring runoff in 2000 as requested by the agencies. Final report documentation attached.
3. What analysis was performed? TSS, total lead and total arsenic. See attached reports.

I do not have an electronic letter from the agencies regarding sign-off but can likely go find it.

Thanks

Brian

**FINAL REPORT FOR
COMPLIANCE MONITORING
OF
SUSPENDED SOLIDS
IN
BUTTERFIELD CREEK**

Prepared and Submitted by:
Kennecott Utah Copper
Bingham Canyon, UT

January 18, 2002

INTRODUCTION

The following Final Report is submitted in compliance with, and in satisfaction of, the requirements concerning the Butterfield Canyon (Site ID #58.01) Site Status for the South end Environmental Onsite Assessment Sites. The purpose of this report is to present data collected during the years 1997 to 2001 from Butterfield Creek suspended solids compliance monitoring as required under the Butterfield AOC.

SITE LOCATION

Butterfield Canyon is located approximately 15 miles southwest of Salt Lake City, in Salt Lake County, Utah, west and northwest of the community of Herriman in southwest Jordan Valley (Map 451-T-2251). It includes the northern watershed of Butterfield Creek Channel beginning at the Queen Drainage in the west to the point at which Butterfield Creek is diverted into the Herriman irrigation system.

SITE HISTORY

Mining Operations for lead, zinc and silver ores began in and adjacent to Butterfield Canyon in the 1870s and continued until the 1950s. From the 1870s until 1905 several companies operated mills which deposited tailings directly into Butterfield Creek or its tributaries. Much of the tailings material, as well as waste rock from tunneling, found its way into Butterfield Creek and then downstream to be deposited in the flood plain of Butterfield Creek near the community of Herriman. No known milling operations were conducted after 1905 in Butterfield Canyon. Several small companies that conducted these milling operations were subsequently acquired by either United States Smelting Refining and Mining Company or Combined Metals Reduction Company (CMR).

During the construction of the Butterfield Tunnel between 1892 and 1894, waste rock containing low concentrations of lead and arsenic from the tunnel and related tunnel workings was deposited within and adjacent to the south side of Butterfield Creek. CMR continued its mining operations through the Butterfield Tunnel until about 1952. A predecessor in interest to Kennecott acquired the Butterfield Tunnel holdings in 1955, after mining through the tunnel had ceased. Beginning in 1962, and largely following this mining activity, KUC or its predecessors acquired ownership of these mining and milling properties.

Waste rock from the Castro dumps, owned by a predecessor in interest to Kennecott, washed into Butterfield Creek in 1967 as a result of a partial slope displacement in 1979 a partial slope displacement at the Yosemite waste rock dump caused 1200 feet of displacement at the toe of the dump and a mudflow down the gulch at least an additional 1200 feet. The flow was captured by emergency dams located about 500 feet upstream of the confluence of Yosemite gulch with Butterfield Creek. While each of the slope displacements might have contributed lead to the Butterfield Creek drainage the amount added was minimal and the concentrations low.

In late 1996, soil characterization activities were conducted by KUC which identified two sites in the lower reaches of Butterfield Canyon that exhibited evidence of historic mining activity. These were the Revere Mill site at the mouth of Saints Rest drainage and an area at the confluence of Yosemite Gulch with Butterfield Creek. Excavation activities were initiated during the 1997 construction season to remove historic contaminated soils from the two identified sites.

Mining wastes left along the banks and watershed of Butterfield Creek and its tributary gulches can wash downstream especially during flood events. On June 9, 1997 a significant precipitation event occurred in Butterfield Canyon which transported lead and arsenic contaminated material to downstream areas. Sampling indicates that sediments transported in Butterfield Creek during this event exceeded 500 ppm lead.

REGULATORY ACTION

Kennecott Utah Copper entered into two Administrative Order on Consents with the United States Environmental Protection Agency (EPA) to provide for the performance of two removal actions in Butterfield Canyon. Butterfield Waste Rock Site No. R2 CERCLA VIII-91-18 provided for the removal of waste rock from Butterfield Tunnel and Butterfield Canyon Site, SSID No. 08-R2 CERCLA VIII-97-09 provided for the removal of lead contaminated soils from the confluences of Butterfield Creek and the Saints Rest and Yosemite Drainages (451-T-2252 and 451-T-450).

The objectives of the Butterfield Creek Waste Rock and Butterfield Canyon Site removal actions were to relocate the visible mine waste rock, and other lead contaminated soils from the Butterfield Creek drainage, to mitigate the potential of direct public contact with the material, and to reduce the potential threat to creek water quality degradation (KUC, 1997 and KUC, 1991).

Removal criteria for mine waste and associated soils from Butterfield Canyon were based on elevated concentrations of lead identified from total metal analysis. Lead was chosen for the following reasons:

- Elevated concentrations of lead was the most common metal identified during site characterization;
- To remain consistent with soil investigations and removal actions at similar sites on KUC South end facilities;
- Local arsenic concentrations are associated with elevated lead; and
- When soils with elevated levels of lead are removed, past experience and current studies have demonstrated other metal values, if present, have been reduced to acceptable levels.

The mine waste and affected soils were removed on a visually guided basis and using survey data, and confirmed through post-removal sampling. KUC conducted post removal sampling in the areas of excavation once an area was designated "clean" based on field observations, removal depth, or other information. Post removal samples were analyzed for total lead and arsenic.

Approximately 1.4 million tons (800,000 cubic yards) of waste rock covered nearly 15 acres and was relocated to Castro Gulch (EPA, 2001). A concentration of 1000 parts per million (ppm) lead was established by the EPA as a target clean up level (KUC, 1993). A total of 37 composite samples were collected over the Waste Dump Foot print. One sample exhibited a lead level greater than the target level (1000 ppm lead) (KUC, 1993). This area was re-cleaned and re-sampled which showed a lead level less than 1000 ppm. Four samples were also taken in miscellaneous cleanup areas in lower Butterfield Canyon. One sample exhibited a lead level greater than the target level (1000 ppm lead). This area was also re-cleaned and re-sampled which showed a lead level less than 1000 ppm (KUC, 1993). The actual post removal surface averaged 174 ppm lead. All post removal data can be found in the Final Report for Kennecott Work Activities Related to the Administrative Order on Consent for Removal Action Site No. R2, Butterfield Waste Rock Site Removal Action.

A total of 25,050 cubic yards of contaminated soil was removed from the Yosemite and Saints Rest areas and transported to Bluewater 1 Main Repository (KUC, 1998b). A concentration of 1500 ppm lead was established by the EPA as a target clean up level (KUC, 1998a). A total of 51 composite samples were collected over the excavated areas. Eleven samples exhibited a lead level greater than the target level (1,500 ppm lead) (KUC, 1998b). Seven sample sites were deemed clean after additional excavation was conducted and the area re-sampled. The four remaining sample sites were capped (KUC, 1998b). The actual post removal surface averaged 632 ppm lead. All post removal data can be found in the Final Post-Removal Sampling Report of the Final Report for Kennecott Work Activities Related to the Administrative Order on Consent for Removal Action SSID No. 08-R2, Butterfield Canyon Site Removal Action.

SUSPENDED SOLIDS CRITERIA

As part of the requirements for the Butterfield AOC, Kennecott Utah Copper instituted a sampling program at Butterfield Creek to determine the lead and arsenic content in the total suspended solids (TSS) carried by the stream. A concentration of 500 parts per million (ppm) lead had been established by the EPA as a target clean up level (KUC, 1999). The sampling was initiated on April 4, 1997 and continued through June 1999 on a weekly basis. After the EPA and UDERR reviewed the final report, it was requested by UDERR that Kennecott collect two additional rounds of total suspended solids samples before and during spring runoff in 2000 (KUC, 2000 and UDERR, 2001).

SAMPLE COLLECTION AND ANALYSIS

Suspended solids samples were collected at the mouth of Butterfield Canyon at the first irrigation diversion by holding a one-half gallon bottle in the stream flow allowing water and suspended sediments to fill the bottle. During low flows when the stream sediment loads were low, a second one-half gallon bottle was collected at the same time as the first to insure adequate sample size for analyses. Field duplicates were collected by holding a second half-gallon bottle adjacent to the bottle of the sample to be duplicated allowing the bottles to be filled simultaneously. The samples were sent to KUC Environmental

Laboratory (KEL) to be analyzed for lead and arsenic concentrations. The sediment was filtered from the water using a -0.45 micron (μ) membrane filter, dried and digested before analysis.

SAMPLE RESULTS

Results from the Butterfield Creek suspended solids sampling program were submitted to the EPA and UDERR in the documents listed below.

- Kennecott Utah Copper Corporation Butterfield Creek Sediment Sampling Report dated October 1999;
- A letter dated July, 31, 2000 sent to Eva Hoffman, EPA, regarding Sample Results for Compliance Monitoring and Removal of Butterfield Creek Basins; and
- A letter dated November 27, 2001 sent to Utah Department of Environmental Response and Remediation regarding the South end Environmental Onsite Assessment sites and project status.

Sampling results for 1997–1999 demonstrate that the creek at times exceeded 500 ppm lead in the suspended solids (UDERR, 2001). However, the average concentration of lead in the suspended solids dropped from 781 ppm for lead and 72 ppm for arsenic in 1997 to 342 ppm for lead and 61 ppm for arsenic in 1999. The results indicated a decrease of 439 ppm (56%) in the average lead concentration and an 11 ppm (15%) decrease in the arsenic concentration from 1997 to 1999. Sample results and Butterfield Creek flow data are presented in Table 1.

Since the cleanup of Butterfield Creek there have been a number of significant storm events. The average lead concentration data from 1998 and 1999 show that Kennecott has continued to meet the EPA clean up goal of 500 ppm lead (KUC, 1997)(Table 2). This trend continued through 2000 and 2001. Suspended solids data collected in 2000 and 2001 are reported in Table 1.

Table 2: Butterfield Creek TSS - Yearly lead Averages at BTC-3

Year	Sample Results	
	Lead	Arsenic
1997	781	72
1998	458	54
1999	342	61
2000	361	53
2001*	429	70

BTC-3 located in the canyon mouth in Butterfield Creek adjacent to the access gate.

*This is a single sample

QUALITY CONTROL

Field duplicate samples were analyzed at KEL. The analytical results were compared using the calculated relative percent difference (RPD). Field duplicate and RPD data are presented in Table 3.

The data quality objective for the comparison is $\pm 35\%$. Data that exceeds RPDs in excess of 35 % may still be considered usable if the analyte is detected in quantities less than 10 times the detection limit or if both of the samples were well below the target clean up level.

A high variability of the RPDs was expected due to the small sediment sample size, medium of transport, preferred suspended solid transport and laboratory variables. Deposition or transport of suspended particles depends on its settling velocity and the turbulence of the flow, as well as the size, shape and density of the particle. Duplicate sample weights ranged from 0.009 grams to 0.414 grams and sample weights ranged from 0.10 grams to 0.415 grams. Under these circumstances it would be difficult to meet a 90% completeness objective.

A break down of the RPDs calculated to compare the sample against the field duplicate follow:

Lead		
<u>RPD value</u>	<u>No. of Samples</u>	<u>% of Total Duplicates</u>
0-35	50	94
>35-50	1	2
>50-75	1	2
>75- 100	0	0
>100	1	2

- Fifty (94%) of the lead RPDs met acceptable data quality objectives.
- Two of the lead RPDs are acceptable because the analytical results indicate lead concentrations less than 455 ppm.

Arsenic		
<u>RPD value</u>	<u>No. of Samples</u>	<u>% of Total Duplicates</u>
0-35	38	72
>35-50	1	2
>50-75	3	5
>75- 100	2	4
>100	9	17

- Thirty-eight of the arsenic RPDs met acceptable data quality objectives.
- Two of the arsenic RPDs are acceptable because the analytical results indicate arsenic concentrations less than 23.3 ppm.

CONSLUSIONS AND RECOMMENDATIONS

Kennecott's removal of the relic mine waste rock and other mining related soil from Butterfield Canyon drainage has restored this site to better than original conditions. A potential hazard has been eliminated and the water quality of the stream has improved.

The EPA stated in the Record of Decision Kennecott South Zone Site that essentially the Butterfield Canyon removal actions have "already satisfactorily achieved the remedial action goals" by removing sources of potential contamination to Butterfield Creek (EPA, 2001).

Kennecott also believes, and the data supports, that the cleanup goals have been met and is concerned that sampling resources (personnel and analytical costs) can be better used in areas of higher risk within the project site. Therefore, Kennecott requests that this site receive an unconditional NFA status at this time.

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_____, 1998a, Final Report for Kennecott Work Activities Related to the Administrative Order on Consent for Removal Action SSID No. 08-R2 Butterfield Canyon Site Removal Action, March.

_____, 1998b, Final Post-Removal Sampling Report Butterfield Canyon Site Removal Action, Site 08-R2, March.

_____, 1999a, Butterfield Creek Sediment Sampling Report, October.

_____, 1999b, Letter sent to Eva Hoffman, EPA Region VIII, regarding Butterfield Canyon Site Removal Action SSID #R2, Final Report for Compliance Monitoring and Removal of Butterfield Creek Basins, October.

_____, 2000, Kennecott Utah Copper Corporation Butterfield Canyon Site Removal Action-SSID #R2, Sample Results for Compliance Monitoring and Removal of Butterfield Creek Basins, July.

_____, 2001, Letter sent to UDERR regarding the South end Environmental Onsite Assessment sites and project status, November.

Utah Department of Response and Remediation (UDERR), 2001, South end Environmental Onsite Assessment sites and project status, August.

U.S. Environmental Protection Agency (EPA), Region VIII, 1991, Administrative Order on Consent for Butterfield Canyon, Site No. R2, Docket No. CERCLA-VIII-91-18.

_____, Region VIII, 1997, Administrative Order on Consent for Butterfield Canyon, Site No. 08-R2, Docket No. CERCLA-VIII-97-09.

_____, Region VIII, 2001, Record of Decision, Kennecott South Zone Site, Lark Waste Rock and Tailings (OU6), South Jordan Evaporation Ponds (OU7), and Butterfield Mine, Butterfield Canyon and Herriman (OU3), September, p. 54.

Table 1. Total Suspended Solids Data

Sample ID		Arsenic				Lead				Weight of Sample (g)				Creek Flow at BTC-4
Date	Time	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	GPM
4/2/97		4.0	302.1	*	31.5	51.3	121.9	*	827.4	1.226	0.705	*	1.078	*
4/9/97		20.5	70.7	*	37.6	74.5	79.0	*	799.4	1.310	0.801	*	1.401	*
4/10/97		262.8	241.3	*	69.6	85.9	67.4	*	583.8	0.039	0.023	*	0.120	*
4/17/97		459.2	474.9	*	108.9	148.5	66.3	*	489.2	0.044	0.028	*	0.177	*
4/24/97		32.9	48.0	*	78.1	83.6	98.0	*	1137.8	0.243	0.179	*	0.243	*
5/1/97		19.7	46.6	47.0	69.6	77.2	78.3	213.8	491.6	0.310	0.241	0.345	0.407	*
5/8/97		<MDL	<MDL	38.0	<MDL	48.7	54.1	368.1	432.0	0.228	0.174	0.275	0.272	1302
5/15/97		<MDL	<MDL	<MDL	34.6	121.4	132.1	262.8	621.2	0.157	0.120	0.180	0.233	1212
5/22/97		<MDL	161.3	97.9	<MDL	47.9	68.5	270.2	454.4	0.066	0.068	0.102	0.133	1122
5/28/97		*	*	*	*	*	*	*	*	*	*	*	*	942
5/29/97		-	38.6	-	-	83.9	115.9	238.7	543.2	0.063	0.047	0.082	0.092	1032
6/2/97		*	*	*	*	*	*	*	*	*	*	*	*	1077
6/3/97		*	*	*	*	*	*	*	*	*	*	*	*	1077
6/5/97		<MDL	41.6	<MDL	<MDL	95.3	77.5	130.0	523.7	0.073	0.045	0.088	0.080	1077
6/9/97	9:15	*	*	*	*	*	*	*	*	*	*	*	*	1077
6/9/97	9:30	*	*	*	*	*	*	*	*	*	*	*	*	1144
6/9/97	9:45	*	*	*	*	*	*	*	*	*	*	*	*	1144
6/9/97	10:00	*	*	*	*	*	*	*	*	*	*	*	*	1144
6/9/97	10:15	*	*	*	*	*	*	*	*	*	*	*	*	1212
6/9/97	10:30	*	*	*	*	*	*	*	*	*	*	*	*	1607
6/9/97	10:45	*	*	*	*	*	*	*	*	*	*	*	*	6956
6/9/97	11:00	*	*	*	*	*	*	*	*	*	*	*	*	5386
6/9/97	11:15	*	*	*	*	*	*	*	*	*	*	*	*	4219
6/9/97	11:30	*	*	*	*	*	*	*	*	*	*	*	*	2778
6/9/97	11:45	*	*	*	*	*	*	*	*	*	*	*	*	1782
6/9/97	12:00	*	*	*	*	*	*	*	*	*	*	*	*	1077
6/10/97		53.5	<MDL	141.5	149.9	144.8	207.4	2025.8	1892.6	0.137	0.100	0.897	0.934	*
6/12/97		<MDL	<MDL	56.9	75.5	134.5	161.0	1438.7	1455.6	0.099	0.064	0.307	0.633	*
6/19/97		126.8	26.7	87.4	126.2	70.5	138.4	894.9	1004.9	0.095	0.095	0.127	0.164	*
6/26/97		<MDL	284.0	<MDL	76.6	83.0	108.0	672.0	876.1	0.029	0.021	0.075	0.109	808
7/3/97		<MDL	<MDL	<MDL	<MDL	43.7	218.4	890.3	915.9	0.013	0.010	0.027	0.077	853
7/10/97		-	521.7	203.1	83.5	154.0	169.6	679.7	1068.8	0.026	0.012	0.019	0.044	898
7/16/97		<MDL	336.6	<MDL	<MDL	<MDL	<MDL	465.6	717.0	0.035	0.015	0.029	0.034	898
7/23/97		<MDL	<MDL	47.9	5.6	83.8	4.9	652.4	2073.4	0.137	0.052	0.097	0.044	898
7/31/97		-	375.5	57.6	10.6	54.6	<MDL	432.3	1083.5	0.041	0.025	0.075	0.132	942
8/4/97	16:30	-	49.5	113.3	-	46.4	<MDL	543.5	911.8	0.049	0.028	0.072	0.100	1010
8/4/97	16:45	*	*	*	*	*	*	*	*	*	*	*	*	1279
8/4/97	17:00	*	*	*	*	*	*	*	*	*	*	*	*	1966
8/4/97	17:15	*	*	*	*	*	*	*	*	*	*	*	*	2509
8/4/97	17:30	*	*	*	*	*	*	*	*	*	*	*	*	2599
8/4/97	17:45	*	*	*	*	*	*	*	*	*	*	*	*	2419
8/4/97	18:00	*	*	*	*	*	*	*	*	*	*	*	*	2056
8/4/97	18:15	*	*	*	*	*	*	*	*	*	*	*	*	1607
8/4/97	18:30	*	*	*	*	*	*	*	*	*	*	*	*	1346
8/4/97	18:45	*	*	*	*	*	*	*	*	*	*	*	*	1077
8/4/97	19:00	*	*	*	*	*	*	*	*	*	*	*	*	875
8/5/97		12.3	137.2	<MDL	<MDL	124.0	103.8	1215.0	1164.0	0.166	0.094	0.313	0.322	*
8/10/97	22:30	*	*	*	*	*	*	*	*	*	*	*	*	471

Table 1. Total Suspended Solids Data

Sample ID		Arsenic				Lead				Weight of Sample (g)				Creek Flow at BTC-4
Date	Time	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	GPM
8/10/97	22:45	*	*	*	*	*	*	*	*	*	*	*	*	673
8/10/97	23:00	*	*	*	*	*	*	*	*	*	*	*	*	808
8/10/97	23:15	*	*	*	*	*	*	*	*	*	*	*	*	808
8/10/97	23:30	*	*	*	*	*	*	*	*	*	*	*	*	808
8/10/97	23:45	*	*	*	*	*	*	*	*	*	*	*	*	808
8/11/97	24:00	<MDL	<MDL	<MDL	144.0	41.8	215.5	346.0	445.7	0.585	0.289	0.491	0.509	741
8/11/97	24:15	*	*	*	*	*	*	*	*	*	*	*	*	673
8/11/97	24:30	*	*	*	*	*	*	*	*	*	*	*	*	606
8/11/97	24:45	*	*	*	*	*	*	*	*	*	*	*	*	539
8/11/97	1:00	*	*	*	*	*	*	*	*	*	*	*	*	471
8/18/97		-	79.6	86.0	140.7	<MDL	<MDL	880.6	1056.3	0.063	0.031	0.084	0.171	*
8/26/97		271.8	1067.2	87.6	136.3	73.7	35.4	538.5	289.2	0.056	0.027	0.075	0.063	*
9/2/97		135.0	613.3	77.7	100.7	130.6	123.2	335.2	397.0	0.034	0.020	0.053	0.088	*
9/8/97		<MDL	<MDL	31.0	42.1	209.4	188.0	263.1	379.9	0.053	0.023	0.073	0.049	*
9/15/97		81.0	639.4	<MDL	72.2	164.1	208.0	632.2	542.2	0.046	0.023	0.037	0.026	*
9/22/97		65.8	536.4	58.7	68.5	83.6	151.3	294.2	1034.0	0.065	0.036	0.115	0.132	*
9/29/97		<MDL	<MDL	20.8	108.5	94.7	335.0	393.9	500.4	0.021	0.010	0.156	0.132	*
10/6/97		<MDL	678.6	64.7	9.6	<MDL	107.1	263.8	277.2	0.009	0.007	0.090	0.068	*
10/13/97		<MDL	580.3	<MDL	93.8	243.5	231.8	611.1	949.5	0.015	0.033	0.023	0.021	*
10/20/97		584.5	866.4	456.7	74.6	310.8	146.6	346.3	595.7	0.015	0.012	0.023	0.069	*
10/27/97		<MDL	241.6	<MDL	<MDL	131.6	283.6	547.0	399.3	0.010	0.024	0.020	0.041	*
11/3/97		109.6	1372.0	75.8	234.7	148.9	235.1	524.2	2295.8	0.018	0.017	0.046	0.038	*
11/10/97		-	1247.5	43.5	-	163.6	272.3	323.5	514.4	0.022	0.010	0.039	0.066	*
11/17/97		146.9	650.7	150.7	111.7	94.8	150.7	398.8	613.0	0.021	0.027	0.068	0.039	*
11/24/97		<MDL	750.0	74.5	<MDL	<MDL	<MDL	215.4	493.2	0.018	0.011	0.085	0.073	*
12/1/97		68.5	666.7	45.0	-	152.6	38.5	207.7	279.1	0.032	0.016	0.109	0.047	*
12/11/97		<MDL	3238.5	135.3	119.5	<MDL	238.5	304.8	460.4	0.005	0.007	0.101	0.088	*
12/15/97		153.7	875.9	97.2	290.8	149.1	142.1	486.0	714.5	0.022	0.028	0.057	0.038	942
12/22/97		<MDL	430.9	146.0	86.4	46.9	164.9	419.4	558.8	0.025	0.009	0.226	0.098	673
12/29/97		15.6	1141.7	111.3	290.8	53.8	136.4	233.3	714.5	0.029	0.019	0.080	0.038	808
1/6/98		<MDL	4669.4	49.0	161.9	32.4	<MDL	261.3	458.8	0.017	0.006	0.068	0.049	*
1/13/98		<MDL	475.0	111.9	39.3	119.8	168.3	399.3	503.0	0.056	0.030	0.068	0.068	*
1/19/98		<MDL	571.2	44.7	<MDL	-	-	-	-	0.074	0.039	0.071	0.054	*
1/26/98		41.9	2817.6	111.0	307.7	120.9	179.2	256.0	514.8	0.043	0.031	0.153	0.085	*
1/28/98		*	*	*	*	*	*	*	*	*	*	*	*	741
2/2/98		-	967.5	104.1	76.9	80.6	85.8	206.4	560.4	0.057	0.034	0.112	0.107	741
2/9/98		<MDL	978.3	1.7	<MDL	23.6	31.4	251.4	387.1	0.040	0.021	0.088	0.047	942
2/17/98		<MDL	745.0	<MDL	<MDL	53.6	155.8	194.4	322.2	0.035	0.065	0.094	0.055	942
2/23/98		<MDL	154.5	<MDL	<MDL	<MDL	9.1	166.9	248.9	0.029	0.017	0.122	0.093	875
2/24/98		*	*	*	*	*	*	*	*	*	*	*	*	1077
3/3/98		<MDL	480.6	<MDL	<MDL	16.4	102.8	182.4	251.1	0.034	0.018	0.117	0.092	942
3/9/98		<MDL	670.8	75.5	<MDL	77.6	105.0	268.7	360.9	0.029	0.028	0.166	0.102	875
3/16/98		<MDL	<MDL	<MDL	<MDL	326.7	<MDL	399.2	459.5	0.042	0.026	0.203	0.095	942
3/23/98		22.9	287.5	73.0	59.8	101.9	125.4	353.5	522.9	0.103	0.067	0.368	0.273	1077
3/31/98		8.0	234.1	53.3	48.9	108.7	110.6	434.3	686.8	0.056	0.043	0.202	0.228	1212
4/6/98		6.6	126.0	62.2	48.4	98.1	112.4	451.8	655.0	0.128	0.100	0.264	0.315	1346
4/14/98		12.8	89.1	74.7	61.1	89.3	65.0	469.0	698.6	0.090	0.104	0.139	0.092	1346
4/20/98		27.8	213.9	69.9	58.9	98.0	122.9	411.4	525.4	0.045	0.042	0.150	0.144	1279

Table 1. Total Suspended Solids Data

Sample ID		Arsenic				Lead				Weight of Sample (g)				Creek Flow at BTC-4
Date	Time	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	GPM
4/23/98		*	*	*	*	*	*	*	*	*	*	*	*	1517
4/24/98		*	*	*	*	*	*	*	*	*	*	*	*	2056
4/27/98		19.1	28.8	50.4	48.6	104.9	115.8	484.7	631.2	0.207	0.175	0.366	0.314	2244
4/30/98		*	*	*	*	*	*	*	*	*	*	*	*	2778
5/4/98		14.8	23.2	44.3	41.1	83.9	133.4	457.8	509.5	0.721	0.656	0.784	0.836	2958
5/11/98		10.3	<MDL	29.8	22.8	82.8	94.9	299.0	416.4	0.365	0.123	0.213	0.240	2778
5/18/98		2.9	38.3	169.1	53.4	161.3	133.6	414.6	590.2	0.056	0.047	0.083	0.103	2868
5/26/98		38.5	97.2	87.6	60.5	85.4	80.6	364.6	540.8	0.053	0.054	0.081	0.079	2244
6/1/98		7.4	106.1	49.5	53.8	63.8	67.5	227.2	361.4	0.034	0.036	0.145	0.092	2150
6/8/98		<MDL	187.5	90.2	52.9	75.1	88.8	399.5	445.0	0.019	0.015	0.019	0.048	1876
6/15/98		*	*	*	*	*	*	*	*	*	*	*	*	1876
6/22/98		<MDL	<MDL	<MDL	<MDL	387.2	51.0	109.6	23.6	1.015	0.357	0.419	0.068	2244
6/29/98		53.9	150.7	70.1	66.3	112.7	118.2	302.1	468.8	0.052	0.029	0.049	0.053	1876
7/6/98		30.8	196.6	114.1	67.9	101.3	68.4	298.7	440.4	0.023	0.023	0.030	0.060	1782
7/13/98		79.6	337.0	140.1	78.6	<MDL	55.6	480.4	636.5	0.016	0.014	0.038	0.034	1432
7/20/98		120.2	246.8	140.4	106.1	106.6	112.3	507.0	595.5	0.018	0.032	0.036	0.038	1279
7/27/98		48.74	233.15	57.89	67.23	135.22	151.69	341.35	530.30	0.032	0.018	0.067	0.053	1077
8/3/98		51.43	648.76	134.83	117.23	105.71	165.29	404.49	587.92	0.035	0.024	0.053	0.056	1077
8/10/98		38.96	2079.67	106.97	63.53	124.68	251.65	337.09	361.30	0.015	0.018	0.049	0.045	1010
8/17/98		30.86	660.19	94.83	63.13	74.07	155.34	232.76	275.25	0.016	0.010	0.035	0.040	1010
8/24/98		335.82	852.79	72.01	116.00	78.36	119.29	124.32	294.00	0.040	0.020	0.074	0.025	1010
8/31/98		44.18	226.11	63.47	64.27	101.41	124.71	146.44	224.01	0.050	0.043	0.090	0.053	1077
9/8/98		36.62	565.42	77.76	62.63	59.15	144.86	137.43	240.08	0.036	0.021	0.055	0.048	1077
9/14/98		22.03	71.01	146.96	575.30	118.64	287.94	320.95	162.65	0.030	0.051	0.030	0.017	1077
9/22/98		36.05	232.22	65.76	65.53	106.38	135.56	148.44	194.17	0.085	0.045	0.077	0.062	1077
9/28/98		64.67	4190.92	11.42	14.55	85.45	338.77	95.18	152.73	0.043	0.086	0.079	0.083	1077
10/5/98		<MDL	1342.64	151.96	41.19	146.15	203.05	310.46	187.50	0.026	0.020	0.031	0.035	1144
10/12/98		1450.00	167.30	148.15	148.15	123.29	175.00	315.59	481.48	0.015	0.012	0.026	0.014	1077
10/19/98		4469.33	<MDL	605.26	605.26	76.92	263.80	260.87	621.05	0.008	0.016	0.012	0.010	1346
10/26/98		1506.13	188.38	43.31	43.31	126.79	119.63	272.89	570.87	0.021	0.016	0.028	0.013	1212
11/3/98		-	866.14	116.28	<MDL	238.32	141.73	386.05	506.58	0.021	0.013	0.022	0.015	1077
11/9/98		<MDL	432.25	397.23	<MDL	286.54	197.83	343.87	500.00	0.052	0.037	0.025	0.013	1279
11/16/98		<MDL	1703.39	539.55	48.70	187.78	217.51	725.99	568.18	0.022	0.018	0.031	0.015	1279
11/23/98		20.31	1344.12	255.88	81.33	64.06	173.53	497.06	310.24	0.032	0.017	0.037	0.017	1346
11/30/98		1401.82	1084.70	330.60	134.52	103.64	133.88	554.64	469.54	0.028	0.018	0.032	0.020	1279
12/7/98		24.25	1061.40	336.26	157.74	70.90	111.11	456.14	494.05	0.027	0.017	0.032	0.017	1279
12/14/98		11.30	1062.15	508.47	140.52	79.10	118.64	943.50	477.12	0.018	0.013	0.051	0.030	1346
12/22/98		35.71	4875.00	1464.29	136.99	2553.57	946.43	2928.57	493.15	0.006	0.007	0.038	0.022	1966
12/28/98		31.79	646.78	156.48	110.89	75.14	105.01	327.63	411.88	0.035	0.042	0.041	0.051	1607
1/4/99		13.51	473.54	2.70	149.76	75.68	120.37	81.08	463.77	0.037	0.076	0.037	0.021	1346
1/11/99		21.22	909.77	139.53	163.55	259.95	116.54	255.81	467.29	0.038	0.027	0.056	0.021	1346
1/19/99		21.12	567.57	155.94	152.70	93.17	112.27	315.16	502.79	0.081	0.048	0.092	0.054	1517
1/25/99		30.99	1317.39	243.06	189.92	81.69	156.52	377.31	534.88	0.036	0.023	0.043	0.026	1346
2/1/99		28.25	491.62	134.30	125.00	39.55	47.49	281.31	390.00	0.035	0.036	0.055	0.040	1346
2/8/99		22.96	424.87	140.85	74.75	76.53	95.85	322.18	280.81	0.039	0.039	0.057	0.099	1346
2/15/99		19.23	272.73	93.28	77.50	63.46	90.91	267.41	439.64	0.052	0.058	0.080	0.067	1346
2/22/99		12.95	578.95	80.55	60.64	62.13	97.17	231.90	232.27	0.039	0.025	0.123	0.087	1346
3/1/99		36.36	592.21	78.53	71.43	80.99	96.10	213.61	266.23	0.061	0.039	0.096	0.062	1432

Table 1. Total Suspended Solids Data

Sample ID		Arsenic				Lead				Weight of Sample (g)				Creek Flow at BTC-4
Date	Time	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	BTC-1	BTC-2	BTC-4	BTC-3	GPM
3/8/99		15.20	713.33	68.57	125.40	48.63	103.33	170.29	514.47	0.033	0.030	0.175	0.065	1432
3/15/99		7.27	108.16	27.90	24.58	17.58	19.73	61.33	84.36	0.165	0.147	0.362	0.179	1346
3/22/99		14.77	93.59	33.59	26.51	40.34	26.28	82.07	141.20	0.176	0.156	0.396	0.415	1517
3/29/99		31.03	401.57	69.35	67.08	58.62	89.24	189.62	373.75	0.058	0.038	0.206	0.227	1607
4/5/99		6.64	600.00	76.28	71.15	<MDL	78.57	233.31	301.92	0.045	0.028	0.178	0.104	1517
4/12/99		<MDL	750.00	72.59	76.82	70.80	103.66	193.09	368.21	0.023	0.016	0.142	0.076	1692
4/19/99		-	259.51	91.74	82.14	47.14	76.06	206.15	371.51	0.059	0.045	0.133	0.185	1607
4/26/99		19.70	191.68	65.55	72.51	66.60	79.45	233.17	404.29	0.107	0.079	0.227	0.172	1782
5/3/99		14.22	31.00	49.05	50.58	68.59	65.35	264.60	384.90	0.239	0.239	0.300	0.269	2778
5/10/99		14.38	40.35	48.25	55.44	63.16	63.94	252.19	357.50	0.160	0.161	0.091	0.141	2334
5/18/99		-	-	-	-	-	-	-	-	0.071	0.060	0.093	0.071	1966
5/24/99		<MDL	<MDL	<MDL	<MDL	468.66	838.89	375.97	668.11	0.231	0.208	0.183	0.159	2599
6/1/99		<MDL	<MDL	<MDL	<MDL	306.90	288.26	284.60	533.79	0.097	0.087	0.143	0.107	1876
6/7/99		9.21	96.32	33.49	41.88	79.40	75.76	208.02	408.38	0.087	0.092	0.212	0.096	1966
6/14/99		14.65	267.06	71.84	46.07	128.21	183.24	266.51	368.56	0.055	0.051	0.086	0.074	1517
6/22/99		70.06	186.14	62.93	60.57	62.10	85.15	243.97	359.54	0.063	0.051	0.116	0.078	1346
6/29/99		<MDL	280.94	66.12	28.90	60.50	100.33	257.85	308.29	0.028	0.030	0.061	0.052	1517
7/7/99		20.91	604.08	75.35	73.99	94.08	122.45	298.27	544.84	0.029	0.025	0.064	0.045	1517
7/12/99		11.76	346.46	76.42	74.07	85.29	94.49	268.29	427.78	0.034	0.025	0.062	0.054	1607
7/19/99		<MDL	382.78	60.04	50.63	59.93	86.12	217.64	351.90	0.027	0.021	0.053	0.040	1517
7/26/99		7.58	838.24	58.43	43.14	71.97	117.65	185.31	341.18	0.026	0.014	0.060	0.051	1607
8/2/99		9.17	792.45	63.66	51.68	48.93	75.47	195.07	335.92	0.033	0.016	0.049	0.039	1607
8/16/99		16.84	167.29	52.69	36.35	93.26	79.93	161.43	304.81	0.077	0.054	0.089	0.179	1517
3/8/00		28.01	*	*	35.29	47.62	*	*	211.76	0.036	*	*	0.026	*
5/10/00		40.43	*	*	56.82	82.98	*	*	382.43	0.047	*	*	0.229	*
8/22/00		39.47	*	*	67.04	150.38	*	*	487.90	0.027	*	*	9.932	*
5/30/2001**		18.42	*	*	69.61	87.76	*	*	429.35	0.0923	*	*	0.2399	*

BTC-1 Located Up Gradient from Butterfield Tunnel

BTC-2 Located Down Gradient from Butterfield Tunnel

BTC-3 Located at Mouth of Butterfield Canyon

BTC-4 Located at Saints Rest Weir

Analytical results reported in ppm.

* No flow reading/No Sample

**Results were converted from micrograms/mg without removing the effects of the blank, no blank was collected

<MDL- Less than Minimum Detection Limit

-indicates that a negative value was calculated when the blank was removed from the raw data. Due to lab variables.