Standard Mine Site
Sampling Activities Report
2008 ESAT Field Events

Prepared for:

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Distribution List
Sampling Activities Report – Standard Mine Site – Gunnison County, Colorado

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Acronym List

°C	Degrees Celsius
CDOW	Colorado Division of Wildlife
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
DOC	Dissolved Organic Carbon
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
GPS	Global Positioning System
HDPE	High-density Polyethylene
ORP	Oxidation Reduction Potential
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBP	Rapid Bioassessment Protocol
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
TAL	Target Analyte List
USGS	United States Geological Survey

1.0 INTRODUCTION

This document is the Sampling Activities Report (SAR) for a series of toxicity tests and ecological investigations conducted in September of 2008 at the Standard Mine Site (CERCLIS ID# CO0002378230) by Region 8's Environmental Services Assistance Team (ESAT). The site is located outside the town of Crested Butte in Gunnison County, Colorado. Sampling was performed in support of the Remedial Investigation/Feasibility Study (RI/FS) of the Standard Mine. Additionally, data collected in 2008 followed similar protocols to the site investigation fieldwork conducted in 2005 through 2007 in support of the Human Health and Baseline Ecological Risk Assessments (HHRA and BERA) (USEPA 2008).

The 2008 investigations conducted by ESAT included the following activities: habitat assessment, surface water toxicity testing, sediment toxicity testing, and macroinvertebrate identification. Results for the macroinvertebrate identification are included in Appendix A. Surface water and sediment toxicity testing results are included in separate toxicity reports. Appendix B includes the Aquatic Toxicity Testing Report for Standard Mine and Appendix C includes the Sediment Toxicity Testing Report. Additionally, ESAT conducted analysis on surface water, sediment, and pore water samples retrieved by EPA sampling teams in June and September. Analytical results can be seen in Tables 3.0-1 through 3.0-5.

Under United States Environmental Protection Agency (EPA) Contract Number EP-W-06-033, Techlaw, Inc. was issued technical direction to prepare and implement a Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for environmental media contaminated by metals at the Standard Mine site. These investigations were performed in accordance with the requirements outlined in the Final SAP/QAPP for the Standard Mine site (ESAT, 2008).

This sampling activities report includes the following sections: Introduction (Section 1.0); Sampling Activities and Procedures (Section 2.0); Analytical Results (Section 3.0); and References (Section 4.0).

1.1 Site Background and Description

The Standard Mine was part of the Ruby Mining District located in Gunnison County in southwestern Colorado near the town of Crested Butte. Historic mining activities started in 1874, with the most significant operations occurring in 1931. The mine primarily extracted lead, zinc, silver, and gold until 1966 when it was abandoned.

The mine consists of many open unmarked adits and shafts giving access to 8,400 feet of mine workings on six levels. The former mine is near a popular hiking trail and has no access restrictions. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings, as well as seasonably variable amounts of water flowing out of the adits. The site is a mixed ownership site consisting of private claims and United States Forest Service land (USFS). EPA has conducted non-

time critical removal actions at the site that included construction of a mine waste repository on USFS land, removal of the tailings impoundment and waste rock from levels 1, 2, and 3 to the repository.

In 1999, a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was conducted in June 1999 to assess the environmental conditions during the high stream flow regime (spring runoff), and Phase II was conducted in September 1999 to assess the environmental conditions during the low stream flow regime (URS, 2000). The 1999 SI was limited to surface water since, according to the United States Geological Survey ([USGS], 1980), there are no extensive aquifer systems associated with the Ruby Mining District.

SI results revealed elevated concentrations of the following metals during total metals analyses of the surface waters from Coal Creek and its tributaries: aluminum (Al), antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), nickel (Ni), thallium (Tl), and zinc (Zn). In 2005 through 2008, several sampling events were conducted at the site in order to evaluate temporal and geospatial changes in stream contaminant concentrations (surface water, sediment, and pore water), evaluate previously unidentified watershed influences and biological tissue contaminant concentrations, evaluate existing macroinvertebrate assemblage, and evaluate toxicity to benthic and aquatic organisms. This data was utilized for the analysis of site conditions in the Human Health Risk Assessment (HHRA) and Baseline Ecological Risk Assessment (BERA), documents which were finalized in March of 2008 following the response to stakeholder comments on the external review draft.

In 2006 and 2007, EPA Removal activities and preliminary remedial actions took place at the site. These included draining and covering the surface impoundment, removing a dilapidated mill, removing the remaining railroad infrastructure, and diverting Elk Creek to the western side of the site in an effort to reduce inputs from adit drainage.

In 2007, the Remedial program installed a passive treatment bioreactor pilot study to ascertain the effectiveness of this technology at remediating acid mine drainage from the level 1 adit. Additionally, several revegetation test plots were installed on the waste rock located at level 98 to determine the ratio of soil amendments that is most effective for establishing plant growth on mine waste piles.

1.2 Objective

The 2008 investigations were conducted in support of three objectives: to evaluate changes in the temporal and geospatial distribution of contaminants following removal activities that occurred in 2006 through 2008; to determine the surface water contaminants of potential concern in upper wetland areas at Levels 98 and 5; and to support the RI/FS being conducted at the site. The specific dates that sampling activities were conducted are June 16-19, 2008 and September 15-19, 2008. Each event involved sampling at stations previously identified in past site investigations. Results from the

June and September 2008 sampling activities will be compared to results from previous years as part of a biological monitoring program to further the analysis of conditions at the Standard Mine site. The following data was collected by ESAT during the September investigation:

- Habitat assessment
- Toxicity testing – surface water and sediment collected for laboratory toxicity testing

2.0 SAMPLING ACTIVITIES AND PROCEDURES

Field and laboratory activities at the Standard Mine site that involved ESAT participation took place in June and September of 2008. Specific activities included the following:

- Rapid Bioassessment Protocol (RPB) method (Barbour et. al.) habitat assessment
- Sediment collection for toxicity testing
- Surface water collection for toxicity testing
- Analysis of surface water, pore water, and sediment samples collect by the EPA for both sampling events.

2.1 Sample Handling and Identification

Samples collected during the event were identified by the stream name followed by a station number. For example, locations in Coal Creek were identified as Coal – XX, with the station number corresponding to its location along the stream. Likewise, locations along Elk Creek and Splain's Gulch were identified as Elk-XX, SP-XX respectively. Duplicate samples were identified with the letters "DUP" immediately following the sample name/number. Table 2.1-1 includes detailed site descriptions for each sample location. Bulk sediment and surface water samples for toxicity testing were placed on ice and transported by ESAT to the Region 8 laboratory. Macroinvertebrate samples were collected by EPA and transported to the Region 8 laboratory then submitted to Timberline Aquatics, Inc. for sorting, counting, and identification.

2.2 Surface Water and Sediment Sampling for Toxicity Testing

ESAT collected surface water and bulk sediment samples used for toxicity testing. Water samples were collected into multiple 1-gallon HDPE cubitainers, transported on ice to the Region 8 laboratory, and stored at 4°C for use in aquatic toxicity testing. Toxicity testing procedures and results are presented in the Aquatic Toxicity Testing Report for Standard Mine (Appendix B).
Sediment samples used for toxicity testing were placed into 1-liter plastic jars and placed in coolers. All samples were placed on ice throughout the field event and during transport to the EPA Region 8 laboratory. Once at the laboratory, bulk sediment samples were stored a 4ºC until toxicity test initiation. Toxicity testing procedures and results are presented in the Sediment Toxicity Testing Reports for Standard Mine (Appendix C).

3.0 ANALYTICAL RESULTS

Analytical results for surface water, pore water, and bulk sediment are presented in Table 3.0-1 through Table 3.0-5. Macroinvertebrate assemblage data is located in Appendix A. The following sections give a general breakdown of analytical results.

3.1 Surface Water

Results for dissolved metals and hardness, total recoverable metals, and DOC, anions and alkalinity for June surface water are included in Table 3.1-1. Results for dissolved metals and hardness, total recoverable metals, and DOC, anions and alkalinity for September surface water are included in Tables 3.1-2.

3.2 Pore Water

During the September sampling event, pore water samples were collected along Coal Creek, Elk Creek, and Splain's Gulch to evaluate potential ecological impacts to the existing biological agents in the streambed. Samples were collected using a Push Point sampling device fitted with a syringe and flexible tubing, as discussed in the Final Quality Assurance Project Plan and Sampling and Analysis Plan for the Standard Mine Site (ESAT, 2008). Once collected, samples were processed in the same manner as surface water samples. Pore water samples were analyzed for anions, alkalinity, dissolved organic carbon, and dissolved metals using analytical EPA Method 200.7 and EPA Method 200.8.

Results for dissolved metals, total recoverable metals, hardness, DOC, anions and alkalinity for September pore water are included in Table 3.2-3. Dissolved metals results can be seen on Table 3.2-4.

3.3 Sediment

Sediment samples collected during the September event were analyzed for dissolved metals and total recoverable metals (EPA methods 200.7 and 200.8). Results are included in Table 3.3-1.

3.4 Macroinvertebrate Sampling

Macroinvertebrate samples collected during the September event were sent for identification to Timberline Aquatics, Inc., located in Fort Collins, Colorado. Macroinvertebrate identification results are included in Appendix A. Macro-invertebrates were identified to the species level when possible. In addition, results also include summary statistics and metric evaluations for each sample and followed the same protocol established for past bio-monitoring events.

3.5 Habitat Assessment

Habitat assessments were conducted for various sites along Coal Creek, Splains Gulch, and Elk Creek during the September sampling event. Habitat assessment for sites followed RBP methods for high gradient streams. Results are included in Table 3.5-1.

4.0 REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertibrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water; Washington, D.C.

Environmental Services Assistance Team. (2007). *Data Quality Objectives Summary Report – 2007 Sampling Events.* Standard Mine, Gunnison County, Colorado.

Environmental Services Assistance Team. (2007). *Final Sampling Analysis Plan/Quality Assurance Project Plan – 2007 Sampling Events.* Standard Mine, Gunnison County, Colorado.

Tables

Table 3.1-1 June 2008 Surface Water Analytical Results

Dissolved Metals (ug/L) (mg/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc	Hardness
COAL-10	74.9	<1.00U	<2.00U	9.46	<5.00U	<0.200U	5830	<5.00U	<5.00U	<10.0U	<250U	0.393	1040	12.3	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1520	52.7	<0.200U	<20.0UJ	<50.0U	41.7	19
COAL-15	61.1	1.23	<2.00U	9.15	<5.00U	0.288	5900	<5.00U	<5.00U	<10.0U	<250U	0.923	935	11.5	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1360	48.8	<0.200U	<20.0UJ	<50.0U	62.5	19
COAL-15 DUP	60.5	<1.00U	<2.00U	8.80	<5.00U	0.253	5850	<5.00U	<5.00U	<10.0U	<250U	0.807	983	10.2	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1400	47.5	<0.200U	<20.0UJ	<50.0U	56.4	19
COAL-20	83.0	<1.00U	<2.00U	10.1	<5.00U	<0.200U	4130	<5.00U	<5.00U	<10.0U	<250U	<0.200U	766	<5.00U	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1200	41.8	<0.200U	<20.0UJ	<50.0U	<20.0U	13
COAL-25	78.7	<1.00U	3.94	9.66	<5.00U	<0.200U	4480	<5.00U	<5.00U	<10.0U	<250U	<0.200U	805	5.13	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1270	40.7	<0.200U	<20.0UJ	<50.0U	<20.0U	15
COAL-OPP1	62.5	<1.00U	<2.00U	9.14	<5.00U	<0.200U	5720	<5.00U	<5.00U	<10.0U	<250U	0.450	991	6.23	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1420	50.4	<0.200U	<20.0UJ	<50.0U	31.0	18
COP-01	83.0	<1.00U	<2.00U	<5.00U	<5.00U	<0.200U	2740	<5.00U	<5.00U	<10.0U	<250U	<0.200U	576	<5.00U	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1100	18.1	<0.200U	<20.0UJ	<50.0U	<20.0U	9
ELK-00	<50.0U	<1.00U	<2.00U	8.29	<5.00U	0.853	9050	<5.00U	<5.00U	<10.0U	<250U	1.75	992	29.1	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1310	63.9	<0.200U	<20.0UJ	<50.0U	170	27
ELK-05	<50.0U	<1.00U	2.41	9.45	<5.00U	1.07	10400	<5.00U	<5.00U	<10.0U	<250U	3.29	1100	45.1	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1500	62.6	<0.200U	<20.0UJ	<50.0U	207	31
ELK-06	<50.0U	<1.00U	<2.00U	6.32	<5.00U	1.39	7590	<5.00U	<5.00U	<10.0U	<250U	4.82	969	61.7	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1320	47.1	<0.200U	<20.0UJ	<50.0U	258	23
ELK-06 DUP	51.5	<1.00U	<2.00U	6.18	<5.00U	1.46	7590	<5.00U	<5.00U	<10.0U	<250U	4.87	951	62.4	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1300	47.2	<0.200U	<20.0UJ	<50.0U	264	23
ELK-08	<50.0U	<1.00U	<2.00U	6.01	<5.00U	1.36	7090	<5.00U	<5.00U	<10.0U	<250U	5.57	892	80.7	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1240	43.7	<0.200U	<20.0UJ	<50.0U	253	21
ELK-10	<50.0U	<1.00U	<2.00U	6.40	<5.00U	3.36	4860	<5.00U	<5.00U	14.1	<250U	24.4	428	143	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	610	29.6	<0.200U	<20.0UJ	<50.0U	548	14
ELK-29	<50.0U	<1.00U	<2.00U	<5.00U	<5.00U	<0.200U	2440	<5.00U	<5.00U	<10.0U	<250U	4.05	532	<5.00U	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	834	14.8	<0.200U	<20.0UJ	<50.0U	39.2	8
Level 5 Adit	101	<1.00U	<2.00U	23.8	<5.00U	22.9	16900	<5.00U	<5.00U	<10.0U	656	42.9	2860	1660	<10.0U	2.43J	<1000U	<1.00U	<0.500U	2510	122	<0.200U	<20.0UJ	<50.0U	2410	54
SM-00	1050	<1.00U	<2.00U	18.7	<5.00U	80.1	26300	<5.00U	10.1	495	1160	994	3370	3990	<10.0U	7.83J	<1000U	1.22	0.611	1750	216	<0.200U	<20.0UJ	<50.0U	12900	80
SP-00	55.6	<1.00U	<2.00U	5.68	<5.00U	<0.200U	3780	<5.00U	<5.00U	<10.0U	<250U	<0.200U	998	<5.00U	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1600	36.6	<0.200U	<20.0UJ	<50.0U	<20.0U	14
SP-01	50.2	<1.00U	<2.00U	5.36	<5.00U	<0.200U	3380	<5.00U	<5.00U	<10.0U	<250U	0.200	892	<5.00U	<10.0U	<1.00UJ	<1000U	<1.00U	<0.500U	1540	33.9	<0.200U	<20.0UJ	<50.0U	<20.0U	12

Total Recoverable Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc
COAL-10	1210	<5.00UD	<10.0UD	25.6	<5.00U	1.17D	6150	<5.00U	<5.00U	<10.0U	1160	14.6D	931	163	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1390	64.5	3.15D	<20.0U	<50.0U	252J
COAL-15	332	<5.00UD	<10.0UD	13.9	<5.00U	<1.00UD	5970	<5.00U	<5.00U	<10.0U	313	9.72D	655	54.4	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1040	54.9	<1.00UD	<20.0U	<50.0U	207
COAL-15 DUP	359	<5.00UD	<10.0UD	14.8	<5.00U	1.09D	6150	<5.00U	<5.00U	<10.0U	345	20.2D	662	116	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1060	56.0	1.35D	<20.0U	<50.0U	218
COAL-20	231	<5.00UD	<10.0UD	14.5	<5.00U	<1.00UD	4160	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	612	11.4	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1020	46.9	<1.00UD	<20.0U	<50.0U	88.0
COAL-25	227	<5.00UD	<10.0UD	15.6	<5.00U	<1.00UD	4610	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	531	14.4	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	963	49.8	<1.00UD	<20.0U	<50.0U	80.4
COAL-OPP1	263	<5.00UD	<10.0UD	13.7	<5.00U	<1.00UD	5890	<5.00U	<5.00U	<10.0U	<250U	4.25D	710	32.1	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1110	58.5	<1.00UD	<20.0U	<50.0U	137
COP-01	158	<5.00UD	<10.0UD	5.56	<5.00U	<1.00UD	2970	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	329	14.3	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	787	21.7	<1.00UD	<20.0U	<50.0U	83.9
ELK-00	517	<5.00UD	<10.0UD	14.0	<5.00U	1.99D	9420	<5.00U	<5.00U	14.3	556	28.8D	725	153	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1060	69.6	<1.00UD	<20.0U	<50.0U	397
ELK-05	179	<5.00UD	<10.0UD	11.2	<5.00U	1.82D	10400	<5.00U	<5.00U	<10.0U	<250U	10.1D	760	81.8	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1180	63.8	<1.00UD	<20.0U	<50.0U	351
ELK-06	131	<5.00UD	<10.0UD	6.71	<5.00U	2.48D	7710	<5.00U	<5.00U	11.9	<250U	14.4D	635	98.6	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	983	49.1	<1.00UD	<20.0U	<50.0U	459
ELK-06 DUP	136	<5.00UD	<10.0UD	6.72	<5.00U	2.51D	7730	<5.00U	<5.00U	12.2	<250U	13.9D	638	97.2	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1000	49.4	<1.00UD	<20.0U	<50.0U	456
ELK-08	223	<5.00UD	<10.0UD	7.77	<5.00U	2.56D	7120	<5.00U	<5.00U	13.6	257	24.4D	601	134	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	911	45.0	<1.00UD	<20.0U	<50.0U	464
ELK-10	188	<5.00UD	<10.0UD	7.76	<5.00U	3.55D	4570	<5.00U	<5.00U	19.6	<250U	49.2D	428	175	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	564	28.8	<1.00UD	<20.0U	<50.0U	591
ELK-29	150	<5.00UD	<10.0UD	5.77	<5.00U	<1.00UD	2630	<5.00U	<5.00U	<10.0U	<250U	45.7D	265	46.1	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	<500U	17.2	<1.00UD	<20.0U	<50.0U	178
Level 5 Adit	448	<5.00UD	<10.0UD	24.2	<5.00U	27.1D	16200	<5.00U	<5.00U	20.8	1340	607D	2450	1770	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2110	121	<1.00UD	<20.0U	<50.0U	2700
SM-00	1100	<5.00UD	<10.0UD	16.4	<5.00U	77.9D	24400	<5.00U	8.64	525	2630	1180D	2840	3970	<10.0U	8.14D	<1000U	<5.00UD	<2.50UD	1390	207	<1.00UD	<20.0U	<50.0U	12300
SP-00	129	<5.00UD	<10.0UD	8.97	<5.00U	<1.00UD	3870	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	735	5.60	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1170	48.5	<1.00UD	<20.0U	<50.0U	62.4
SP-01	96.2	<5.00UD	<10.0UD	7.63	<5.00U	<1.00UD	3450	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	697	<5.00U	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1230	43.5	<1.00UD	<20.0U	<50.0U	67.5

Dissolved Organic Carbon (mg/L)

Location	DOC
COAL-10	11.6
COAL-15	9.8
COAL-15 DUP	10.8
COAL-20	10.1
COAL-25	11.8
COAL-OPP1	10.1
COP-01	11.8
ELK-00	6.0
ELK-05	7.4
ELK-06	7.8
ELK-06 DUP	7.8
ELK-08	7.4
ELK-10	1.7
ELK-29	6.5
Level 5 Adit	4.7
SM-00	4.3
SP-00	11.3
SP-01	9.6

Wet Chem **(mg CaCO3/L)** **(mg/L)**

Location	Total Alkalinity	Chloride	Fluoride	Sulfate as SO4
COAL-10	15.1	<2.0U	<0.2U	5.6
COAL-15	14.2	<2.0U	<0.2U	5.7
COAL-15 DUP	14.3	<2.0U	<0.2U	6.0
COAL-20	12.6	<2.0U	<0.2U	<5.0U
COAL-25	12.7	<2.0U	<0.2U	<5.0U
COAL-OPP1	14.6	<2.0U	<0.2U	5.2
COP-01	7.84	<2.0U	<0.2U	<5.0U
ELK-00	16.9	<2.0U	<0.2U	11.6
ELK-05	19.5	<2.0U	<0.2U	13.0
ELK-06	12.7	<2.0U	<0.2U	12.0
ELK-06 DUP	12.5	<2.0U	<0.2U	12.0
ELK-08	11.5	<2.0U	<0.2U	11.5
ELK-10	7.07	<2.0U	<0.2U	9.3
ELK-29	5.85	<2.0U	<0.2U	<5.0U
Level 5 Adit	5.04	<2.0U	0.2	53.5
SM-00	<5.00U	<10.0UD	<1.0UD	109D
SP-00	13.7	<2.0U	<0.2U	<5.0U
SP-01	12.2	<2.0U	<0.2U	<5.0U

< - Less than
U - Indicates analyte not detected (result is reported as less than the reporting limit)
J - Indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.1-2 September 2008 Surface Water Analytical Results

Dissolved Metals (ug/L) (mg/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc	Hardness
COAL-10	<50.0U	<1.00U	2.89	19.7	<5.00U	0.382	14400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2000	39.1	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2200	162	<0.200U	<20.0U	<50.0U	90.2	44
COAL-15	<50.0U	1.20	5.93	19.6	<5.00U	0.317	14000	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1580	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1740	165	<0.200U	<20.0U	<50.0U	61.0	41
COAL-15 DUP	<50.0U	<1.00U	6.14	19.7	<5.00U	0.268	14500	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1640	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1800	166	<0.200U	<20.0U	<50.0U	59.3	43
COAL-20	<50.0U	<1.00U	7.65	19.9	<5.00U	<0.200U	10400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1510	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1520	143	<0.200U	<20.0U	<50.0U	<20.0U	32
COAL-25	<50.0U	<1.00U	13.4	18.4	<5.00U	<0.200U	10200	<5.00U	<5.00U	<10.0U	<250U	0.241	1220	19.8	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1140	152	<0.200U	<20.0U	<50.0U	<20.0U	31
COAL-OPP1	<50.0U	<1.00U	4.19	19.6	<5.00U	<0.200U	14900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1840	24.0	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2120	174	<0.200U	<20.0U	<50.0U	34.8	45
ELK-00	<50.0U	<1.00U	2.17	17.2	<5.00U	1.46	26200	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1680	<5.00U	<10.0U	1.09	<1000U	<1.00U	<0.500U	2210	224	<0.200U	<20.0U	<50.0U	262	72
ELK-05	<50.0U	<1.00U	5.73	22.5	<5.00U	1.10	25400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1660	<5.00U	<10.0U	1.04	<1000U	<1.00U	<0.500U	2090	154	<0.200U	<20.0U	<50.0U	217	70
ELK-06	<50.0U	<1.00U	<2.00U	17.9	<5.00U	5.15	36800	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2910	5.56	<10.0U	1.80	<1000U	<1.00U	<0.500U	2330	231	<0.200U	<20.0U	<50.0U	1010	104
ELK-08	<50.0U	<1.00U	<2.00U	15.5	<5.00U	6.02	39300	<5.00U	<5.00U	<10.0U	<250U	0.364	3050	98.1	<10.0U	2.31	<1000U	<1.00U	<0.500U	2370	249	<0.200U	<20.0U	<50.0U	1300	111
ELK-10	<50.0U	<1.00U	<2.00U	33.0	<5.00U	15.5	55200	<5.00U	<5.00U	<10.0U	<250U	4.06	5150	3000	<10.0U	7.19	1320	<1.00U	<0.500U	2600	371	<0.200U	<20.0U	<50.0U	6710	159
ELK-10 DUP	<50.0U	<1.00U	<2.00U	33.3	<5.00U	15.2	53200	<5.00U	<5.00U	<10.0U	<250U	4.24	5010	3010	<10.0U	7.18	1310	<1.00U	<0.500U	2550	372	<0.200U	<20.0U	<50.0U	6750	154
ELK-29	<50.0U	<1.00U	<2.00U	12.4	<5.00U	0.837	9510	<5.00U	<5.00U	<10.0U	<250U	0.559	805	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1200	62.5	<0.200U	<20.0U	<50.0U	158	27
Level 5 Adit	<50.0U	1.20	<2.00U	16.2	<5.00U	28.3	26800	<5.00U	<5.00U	<10.0U	279	12.9	3850	2660	<10.0U	3.49	<1000U	<1.00U	<0.500U	3180	190	<0.200U	<20.0U	<50.0U	3280	83
Level 5 WL-1	4000	<10.0UD	<20.0UD	22.3	<5.00U	59.5D	26100	<5.00U	9.19	148	565	474D	5480	6450	<10.0U	<10.0UD	<1000U	<10.0UD	<5.00UD	3590	172	<2.00UD	<20.0U	<50.0U	7320	88
Level 5 WL-2	475	<1.00U	<2.00U	24.7	<5.00U	8.74	29700	<5.00U	<5.00U	<10.0U	<250U	7.67	5100	3390	<10.0U	4.13	1190	<1.00U	<0.500U	3460	197	<0.200U	<20.0U	<50.0U	1820	95
Level 98	<50.0U	<1.00U	<2.00U	12.4	<5.00U	4.39	9130	<5.00U	<5.00U	<10.0U	358	96.0	844	381	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1200	52.8	<0.200U	<20.0U	<50.0U	803	26
Level 98 WL-1	<50.0U	<1.00U	<2.00U	11.2	<5.00U	0.657	9420	<5.00U	<5.00U	<10.0U	<250U	3.63	1010	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1750	69.3	<0.200U	<20.0U	<50.0U	146	28
Level 98 WL-3	<50.0U	<1.00U	<2.00U	17.6	<5.00U	7.20	10400	<5.00U	<5.00U	18.2	<250U	11.6	937	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1460	60.4	<0.200U	<20.0U	<50.0U	1200	30
Level 98 WL-4	214	<1.00U	<2.00U	38.9	<5.00U	12.8	6620	<5.00U	<5.00U	27.4	<250U	26.8	647	295	<10.0U	2.73	<1000U	<1.00U	<0.500U	1080	40.5	<0.200U	<20.0U	<50.0U	2550	19
Level 98 WL-5	<50.0U	<1.00U	<2.00U	5.77	<5.00U	<0.200U	11400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1260	75.2	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2270	91.2	<0.200U	<20.0U	<50.0U	36.6	34
SM-00	115	<10.0UD	<20.0UD	12.3	<5.00U	154D	80000	<5.00U	15.7	159	368	239D	8810	11400	<10.0U	19.3D	1080	<10.0UD	<5.00UD	3690	656	<2.00UD	<20.0U	<50.0U	26500	236
SP-00	<50.0U	<1.00U	<2.00U	13.4	<5.00U	<0.200U	7720	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1480	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2620	102	<0.200U	<20.0U	<50.0U	<20.0U	25
SP-01	<50.0U	<1.00U	<2.00U	12.2	<5.00U	<0.200U	6660	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1430	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2710	92.6	<0.200U	<20.0U	<50.0U	<20.0U	23

Total Recoverable Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc
COAL-10	64.3	<5.00UD	<10.0UD	19.9	<5.00U	<1.00UD	14000	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1940	40.6	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2170	166	2.72D	<20.0U	<50.0U	85.3
COAL-15	<50.0U	<5.00UD	<10.0UD	20.3	<5.00U	<1.00UD	13600	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1560	5.18	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1770	172	<1.00UD	<20.0U	<50.0U	57.4
COAL-15 DUP	<50.0U	<5.00UD	<10.0UD	19.9	<5.00U	<1.00UD	13600	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1550	5.24	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1740	168	1.18D	<20.0U	<50.0U	55.5
COAL-20	<50.0U	<5.00UD	<10.0UD	20.2	<5.00U	<1.00UD	9780	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1440	6.58	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1510	147	<1.00UD	<20.0U	<50.0U	<20.0U
COAL-25	81.8	<5.00UD	15.7D	19.7	<5.00U	<1.00UD	10100	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1220	28.5	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1150	156	<1.00UD	<20.0U	<50.0U	<20.0U
COAL-OPP1	<50.0U	<5.00UD	<10.0UD	20.3	<5.00U	<1.00UD	14800	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1840	26.1	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2160	179	<1.00UD	<20.0U	<50.0U	34.3
ELK-00	<50.0U	<5.00UD	<10.0UD	17.7	<5.00U	1.59D	26200	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1670	<5.00U	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2240	231	<1.00UD	<20.0U	<50.0U	247
ELK-05	<50.0U	<5.00UD	<10.0UD	22.3	<5.00U	1.20D	25700	<5.00U	<5.00U	<10.0U	<250U	1.13D	1680	<5.00U	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2140	156	<1.00UD	<20.0U	<50.0U	201
ELK-06	<50.0U	<5.00UD	<10.0UD	18.3	<5.00U	5.12D	35400	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	2820	6.78	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2310	234	<1.00UD	<20.0U	<50.0U	942
ELK-08	<50.0U	<5.00UD	<10.0UD	15.9	<5.00U	6.31D	38200	<5.00U	<5.00U	<10.0U	<250U	1.71D	3000	102	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2390	255	<1.00UD	<20.0U	<50.0U	1240
ELK-10	147	<5.00UD	<10.0UD	34.8	<5.00U	27.6D	53100	<5.00U	<5.00U	30.8	<250U	24.6D	4970	3040	<10.0U	7.97D	1310	<5.00UD	<2.50UD	2560	383	<1.00UD	<20.0U	<50.0U	6570
ELK-10 DUP	176	<5.00UD	<10.0UD	34.8	<5.00U	26.9D	53500	<5.00U	<5.00U	31.0	<250U	25.7D	5040	3040	<10.0U	8.41D	1330	<5.00UD	<2.50UD	2600	376	<1.00UD	<20.0U	<50.0U	6550
ELK-29	<50.0U	<5.00UD	<10.0UD	12.4	<5.00U	1.26D	9810	<5.00U	<5.00U	<10.0U	<250U	2.15D	838	<5.00U	<10.0U	6.73D	<1000U	<5.00UD	<2.50UD	1200	62.5	2.42D	<20.0U	<50.0U	150
Level 5 Adit	138	<5.00UD	<10.0UD	16.4	<5.00U	27.7D	27700	<5.00U	<5.00U	<10.0U	1370	395D	3920	2690	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	3180	194	<1.00UD	<20.0U	<50.0U	3160
Level 5 WL-1	4060	<5.00UD	<10.0UD	22.7	<5.00U	60.6D	26400	<5.00U	9.33	151	677	444D	5600	6430	<10.0U	8.85D	<1000U	<5.00UD	<2.50UD	3670	175	<1.00UD	<20.0U	<50.0U	6990
Level 5 WL-2	1540	<5.00UD	<10.0UD	40.3	<5.00U	20.2D	30500	<5.00U	<5.00U	59.9	6470	267D	4970	5110	<10.0U	5.26D	1230	<5.00UD	<2.50UD	3220	209	<1.00UD	<20.0U	<50.0U	2520
Level 98	<50.0U	<5.00UD	<10.0UD	12.6	<5.00U	4.43D	9430	<5.00U	<5.00U	18.2	646	146D	882	357	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1240	53.2	<1.00UD	<20.0U	<50.0U	734
Level 98 WL-1	<50.0U	<5.00UD	<10.0UD	11.2	<5.00U	<1.00UD	9510	<5.00U	<5.00U	<10.0U	<250U	9.39D	1030	5.55	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1760	70.1	<1.00UD	<20.0U	<50.0U	134
Level 98 WL-3	61.1	<5.00UD	<10.0UD	19.9	<5.00U	7.15D	11100	<5.00U	<5.00U	22.2	<250U	42.0D	1000	18.7	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1500	62.2	<1.00UD	<20.0U	<50.0U	1130
Level 98 WL-4	695	<5.00UD	<10.0UD	44.7	<5.00U	13.8D	7030	<5.00U	<5.00U	49.8	271	284D	740	650	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	1120	42.3	<1.00UD	<20.0U	<50.0U	2450
Level 98 WL-5	<50.0U	<5.00UD	<10.0UD	5.76	<5.00U	<1.00UD	11800	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1300	77.8	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2310	90.9	<1.00UD	<20.0U	<50.0U	36.5
SM-00	1620	<10.0UD	<20.0UD	12.5	<5.00U	147D	80900	<5.00U	14.6	426	5020	1470D	8790	11200	<10.0U	18.1D	1110	<10.0UD	<5.00UD	3620	651	<2.00UD	<20.0U	<50.0U	25000
SP-00	<50.0U	<5.00UD	<10.0UD	13.4	<5.00U	<1.00UD	7540	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1440	<5.00U	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2510	103	<1.00UD	<20.0U	<50.0U	<20.0U
SP-01	<50.0U	<5.00UD	<10.0UD	12.3	<5.00U	<1.00UD	6660	<5.00U	<5.00U	<10.0U	<250U	<1.00UD	1420	<5.00U	<10.0U	<5.00UD	<1000U	<5.00UD	<2.50UD	2630	92.3	<1.00UD	<20.0U	<50.0U	<20.0U

Dissolved Organic Carbon (mg/L)

Location	DOC
COAL-10	1.8
COAL-15	1.8
COAL-15 DUP	1.7
COAL-20	2.1
COAL-25	2.4
COAL-OPP1	1.8
ELK-00	1.0
ELK-05	<1.0U
ELK-06	1.3
ELK-08	1.3
ELK-10	2.0
ELK-10 DUP	6.5
ELK-29	1.5
Level 5 Adit	<1.0U
Level 5 WL-1	2.5
Level 5 WL-2	1.9
Level 98	1.8
Level 98 WL-1	1.4
Level 98 WL-3	2.4
Level 98 WL-4	1.7
Level 98 WL-5	1.2
SM-00	<1.0U
SP-00	1.9
SP-01	2.2

Wet Chem **(mg CaCO3/L)** **(mg/L)**

Location	Total Alkalinity	Chloride	Fluoride	Sulfate as SO4
COAL-10	29.2	<2.0U	<0.2U	17.3
COAL-15	27.1	<2.0U	<0.2U	15.6
COAL-15 DUP	26.9	<2.0U	<0.2U	15.7
COAL-20	22.7	<2.0U	<0.2U	11.2
COAL-25	19.2	<2.0U	<0.2U	13.2
COAL-OPP1	31.2	<2.0U	<0.2U	16.1
ELK-00	39.9	<2.0U	<0.2U	35.0
ELK-05	39.9	<2.0U	<0.2U	34.3
ELK-06	26.0	<2.0U	<0.2U	79.1
ELK-08	29.9	<2.0U	<0.2U	83.8
ELK-10	22.5	<2.0U	<0.2U	154
ELK-10 DUP	22.5	<2.0U	<0.2U	156
ELK-29	14.5	<2.0U	<0.2U	15.5
Level 5 Adit	11.0	<2.0U	0.4	88.7
Level 5 WL-1	<5.00U	<2.0U	0.4	159
Level 5 WL-2	<5.00U	<4.0UD	<0.4UD	113D
Level 98	7.49	<2.0U	<0.2U	23.3
Level 98 WL-1	9.83	<2.0U	<0.2U	21.9
Level 98 WL-3	9.29	<2.0U	<0.2U	25.3
Level 98 WL-4	<5.00U	<2.0U	<0.2U	24.4
Level 98 WL-5	12.9	<2.0U	<0.2U	25.9
SM-00	20.9	<4.0UD	<0.4UD	278D
SP-00	29.2	<2.0U	<0.2U	<5.0U
SP-01	27.0	<2.0U	<0.2U	<5.0U

< - Less than
U - Indicates analyte not detected (result is reported as less than the reporting limit)
J - Indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.2-1 September 2008 Pore Water Analytical Results

Dissolved Metals (ug/L) (mg/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc	Hardness
COAL-10	<50.0U	<1.00U	<2.00U	24.3	<5.00U	1.28	16600	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2260	123	<10.0U	1.04	<1000U	<1.00U	<0.500U	2350	153	<0.200U	<20.0U	<50.0U	313	51
COAL-15	<50.0U	1.21	6.32	21.0	<5.00U	0.262	15000	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1730	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1830	164	<0.200U	<20.0U	<50.0U	57.1	45
COAL-15 DUP	<50.0U	<1.00U	6.23	20.7	<5.00U	0.260	14900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1710	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1820	165	<0.200U	<20.0U	<50.0U	57.6	44
COAL-20	<50.0U	<1.00U	<2.00U	21.5	<5.00U	<0.200U	22900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2100	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1980	201	<0.200U	<20.0U	<50.0U	30.7	66
COAL-25	<50.0U	<1.00U	7.77	26.9	<5.00U	<0.200U	11200	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1470	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1390	133	<0.200U	<20.0U	<50.0U	<20.0U	34
COAL-OPP1	<50.0U	<1.00U	3.64	23.6	<5.00U	0.224	16100	<5.00U	<5.00U	<10.0U	<250U	0.241	2070	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2240	172	<0.200U	<20.0U	<50.0U	40.4	49
ELK-00	<50.0U	<1.00U	2.39	18.4	<5.00U	1.33	28300	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1800	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2370	229	<0.200U	<20.0U	<50.0U	263	78
ELK-05	<50.0U	<1.00U	5.66	20.6	<5.00U	0.937	28400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1840	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2320	156	<0.200U	<20.0U	<50.0U	173	79
ELK-06	<50.0U	<1.00U	<2.00U	21.2	<5.00U	4.78	37900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	3000	<5.00U	<10.0U	1.52	<1000U	<1.00U	<0.500U	2480	229	<0.200U	<20.0U	<50.0U	929	107
ELK-08	<50.0U	<1.00U	<2.00U	16.9	<5.00U	6.00	41600	<5.00U	<5.00U	<10.0U	<250U	0.207	3240	36.1	<10.0U	2.16	<1000U	<1.00U	<0.500U	2570	257	<0.200U	<20.0U	<50.0U	1290	117
ELK-10	<50.0U	<1.00U	<2.00U	31.8	<5.00U	22.5	57900	<5.00U	<5.00U	15.1	<250U	1.94	5370	380	<10.0U	5.49	1440	1.09	<0.500U	2790	373	<0.200U	<20.0U	<50.0U	6770	167
ELK-10 DUP	<50.0U	<1.00U	<2.00U	32.5	<5.00U	24.2	58700	<5.00U	<5.00U	15.1	<250U	2.09	5470	389	<10.0U	5.65	1480	<1.00U	<0.500U	2840	377	<0.200U	<20.0U	<50.0U	6640	169
SP-00	<50.0U	<1.00U	<2.00U	13.6	<5.00U	<0.200U	8620	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1610	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2770	104	<0.200U	<20.0U	<50.0U	<20.0U	28
SP-01	<50.0U	<1.00U	<2.00U	13.3	<5.00U	<0.200U	7290	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1530	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2830	93.0	<0.200U	<20.0U	<50.0U	<20.0U	25

Total Recoverable Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc
COAL-10	1740	<5.00UD	15.1D	42.2	<5.00U	3.81D	15400	<5.00U	<5.00U	<10.0U	1990	12.0D	2280	716	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2270	152	<1.00UD	<20.0U	<50.0U	641
COAL-15	394	<5.00UD	10.1D	24.9	<5.00U	1.05D	13700	<5.00U	<5.00U	<10.0U	462	4.37D	1660	47.1	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1730	160	<1.00UD	<20.0U	<50.0U	82.1
COAL-15 DUP	711	<5.00UD	11.1D	29.7	<5.00U	<1.00UD	13800	<5.00U	<5.00U	<10.0U	876	7.67D	1700	106	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1730	161	<1.00UD	<20.0U	<50.0U	120
COAL-20	2320	<5.00UD	17.7D	44.7	<5.00U	<1.00UD	22100	<5.00U	<5.00U	<10.0U	2470	9.30D	2350	181	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2000	201	<1.00UD	39.7	<50.0U	78.5
COAL-25	230	<5.00UD	10.8D	29.3	<5.00U	<1.00UD	10600	<5.00U	<5.00U	<10.0U	292	2.58D	1430	11.9	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1360	131	<1.00UD	<20.0U	<50.0U	<20.0U
COAL-OPP1	360	<5.00UD	<10.0UD	28.2	<5.00U	<1.00UD	15600	<5.00U	<5.00U	<10.0U	445	4.30D	2040	69.8	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2180	167	<1.00UD	<20.0U	<50.0U	66.7
ELK-00	178	<5.00UD	<10.0UD	20.6	<5.00U	2.12D	26200	<5.00U	<5.00U	<10.0U	<250U	16.4D	1690	100	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2230	219	<1.00UD	<20.0U	<50.0U	324
ELK-05	137	<5.00UD	<10.0UD	22.0	<5.00U	1.28D	25500	<5.00U	<5.00U	<10.0U	<250U	6.53D	1700	34.5	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2170	148	<1.00UD	<20.0U	<50.0U	176
ELK-06	1880	<5.00UD	11.9D	38.6	<5.00U	9.58D	35700	<5.00U	<5.00U	59.3	3450	161D	3090	761	<10.0U	<5.00UD	1180	<10.0UD	<2.50UD	2420	229	<1.00UD	24.3	<50.0U	1550
ELK-08	198	<5.00UD	<10.0UD	18.2	<5.00U	6.37D	38400	<5.00U	<5.00U	<10.0U	282	15.1D	3030	135	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2420	243	<1.00UD	<20.0U	<50.0U	1230
ELK-10	421	<5.00UD	<10.0UD	33.6	<5.00U	27.2D	53500	<5.00U	<5.00U	58.8	691	69.6D	5090	660	<10.0U	6.16D	1440	<10.0UD	<2.50UD	2690	360	<1.00UD	<20.0U	<50.0U	6030
ELK-10 DUP	325	<5.00UD	<10.0UD	33.0	<5.00U	25.8D	53600	<5.00U	<5.00U	56.5	592	54.6D	5080	649	<10.0U	6.32D	1430	<10.0UD	<2.50UD	2680	356	<1.00UD	<20.0U	<50.0U	6020
SP-00	583	<5.00UD	<10.0UD	24.0	<5.00U	<1.00UD	8100	<5.00U	<5.00U	<10.0U	689	1.51D	1640	40.0	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2590	105	<1.00UD	25.0	<50.0U	<20.0U
SP-01	2070	<5.00UD	<10.0UD	43.1	<5.00U	<1.00UD	7960	<5.00U	<5.00U	<10.0U	3320	5.94D	1900	171	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2820	108	<1.00UD	55.3	<50.0U	<20.0U

Dissolved Organic Carbon (mg/L)

Location	DOC
COAL-10	1.6
COAL-15	2.1
COAL-15 DUP	2.0
COAL-20	1.3
COAL-25	2.0
COAL-OPP1	1.7
ELK-00	1.1
ELK-05	1.0
ELK-06	1.3
ELK-08	1.2
ELK-10	1.8
ELK-10 DUP	1.8
SP-00	1.9
SP-01	2.2

Wet Chem **(mg CaCO3/L)** **(mg/L)**

Location	Total Alkalinity	Chloride	Fluoride	Sulfate as SO4
COAL-10	32.4	<2.0U	0.2	17.5
COAL-15	26.5	<2.0U	<0.2U	15.3
COAL-15 DUP	27.0	<2.0U	<0.2U	15.3
COAL-20	32.8	<2.0U	<0.2U	29.1
COAL-25	21.8	<2.0U	<0.2U	12.1
COAL-OPP1	30.7	<2.0U	<0.2U	16.4
ELK-00	40.0	<2.0U	<0.2U	34.4
ELK-05	39.7	<2.0U	<0.2U	33.6
ELK-06	25.4	<2.0U	<0.2U	77.4
ELK-08	29.5	<2.0U	<0.2U	82.1
ELK-10	13.7	<2.0U	<0.2U	152
ELK-10 DUP	13.9	<2.0U	<0.2U	157
SP-00	29.1	<2.0U	<0.2U	<5.0U
SP-01	27.1	<2.0U	<0.2U	<5.0U

< - Less than
U - Indicates analyte not detected (result is reported as less than the reporting limit)
J - Indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.2-2 November 2008 Sediment Toxicity Test Spin-Down Pore Water Results

Dissolved Metals - Pore Waters (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Coal 15 SD	26.8	<1.00U	61.5	123	<0.200U	0.292	24.1	1.99	3.79	1.39	6330	8.89	3.47	3.84	<0.500U	<0.200U	7.33	14.9
COAL-20 PP	43.4	<1.00U	27.8	62.4	<0.200U	<0.200U	11.9	0.278	2.07	<0.200U	1440	1.57	2.02	<1.00U	<0.500U	<0.200U	8.44	<5.00U
COAL-OPP	<20.0U	<1.00U	66.0	120	<0.200U	<0.200U	26.1	1.71	2.30	0.848	14700	8.12	4.64	<1.00U	<0.500U	<0.200U	8.51	14.4
ELK-00 PP	<20.0U	<1.00U	<2.00U	38.1	<0.200U	3.48	12.8	0.228	7.23	<0.200U	1240	0.886	2.51	<1.00U	<0.500U	<0.200U	3.67	107
ELK-06 PP	<20.0U	<1.00U	<2.00U	28.4	<0.200U	6.03	12.2	<0.200U	6.37	0.206	146	0.435	2.89	<1.00U	<0.500U	<0.200U	3.44	452
ELK-08 PP	<20.0U	<1.00U	<2.00U	34.8	<0.200U	16.8	15.1	0.219	8.77	<0.200U	1130	0.241	3.34	<1.00U	<0.500U	<0.200U	4.25	996
SP-00 PP	<20.0U	<1.00U	<2.00U	76.9	<0.200U	<0.200U	17.2	0.457	2.20	0.290	2400	1.51	2.31	<1.00U	<0.500U	<0.200U	9.67	<5.00U
SP-01 PP	<20.0U	<1.00U	<2.00U	18.3	<0.200U	<0.200U	8.02	<0.200U	1.26	<0.200U	159	0.309	1.32	<1.00U	<0.500U	<0.200U	2.67	<5.00U

< - Less than
U - Indicates analyte not detected (result is reported as less than the reporting limit)
J - Indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.3-1 September 2008 Sediment Analytical Results

Total Recoverable Metals

	mg/kg dry wt.	ug/kg dry wt.	ug/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	ug/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	ug/kg dry wt.	mg/kg dry wt.	ug/kg dry wt.	ug/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	ug/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.	mg/kg dry wt.
Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc
COAL-10	7740D	<1000UD	67700D	89.9D	<2.46UD	7020D	2390D	<2.46UD	11.8D	17.7D	18000D	601D	2050D	1910D	0.05	<4.92UD	4740D	629D	<1000UD	1970D	<246UD	23.7D	216D	52.5D	<24.6UD	1250D
COAL-15	5380D	<1000UD	73400D	66.2D	<2.50UD	1920D	1970D	<2.50UD	2.98D	14.3D	13800D	445D	1700D	414D	0.06	<5.00UD	2350D	555D	<1000UD	2690D	<250UD	26.6D	<200UD	56.5D	<25.0UD	256D
COAL-15 DUP	5080D	<1000UD	48300D	59.6D	<2.50UD	1530D	1920D	<2.50UD	3.01D	9.06D	13600D	351D	1580D	317D	0.04	<5.00UD	1850D	505D	<1000UD	2690D	<250UD	23.9D	<200UD	47.9D	<25.0UD	243D
COAL-20	7780D	<1000UD	66100D	109D	<2.50UD	390D	3480D	2.63D	4.33D	<5.00UD	14700D	274D	2290D	418D	0.05	<5.00UD	3030D	738D	<1000UD	1910D	<250UD	49.7D	<200UD	47.6D	<25.0UD	89.0D
COAL-OPP1	7020D	<1000UD	54800D	80.0D	<2.50UD	2580D	2640D	<2.50UD	5.18D	11.2D	19300D	437D	2380D	1030D	0.02	<5.00UD	2560D	686D	<1000UD	820D	<250UD	38.0D	<200UD	62.0D	<25.0UD	582D
ELK-00	8000D	<1000UD	31900D	75.6D	<2.46UD	15200D	2580D	<2.46UD	15.3D	84.9D	24000D	244D	3010D	2950D	0.005	<4.93UD	6370D	813D	<1000UD	<500UD	<246UD	20.2D	<200UD	38.5D	<24.6UD	2530D
ELK-05	8680D	<1000UD	46500D	118D	<2.49UD	30800D	2350D	<2.49UD	22.6D	232D	26000D	694D	3010D	5480D	0.007	<4.99UD	7610D	906D	1080D	584D	<249UD	18.4D	206D	41.1D	<24.9UD	3650D
ELK-06	9740D	<1000UD	33900D	130D	<2.49UD	29300D	3790D	<2.49UD	24.7D	208D	30200D	683D	3480D	5600D	0.005	<4.98UD	8330D	861D	<1000UD	<500UD	<249UD	25.4D	210D	45.6D	<24.9UD	3510D
ELK-08	9130D	<1000UD	42800D	82.2D	<2.49UD	34300D	2120D	<2.49UD	26.9D	295D	24200D	1130D	2820D	7240D	0.006	<4.98UD	9220D	861D	1040D	722D	<249UD	17.9D	276D	25.0D	<24.9UD	4210D
ELK-10	8960D	1640D	47800D	85.6D	<2.46UD	28200D	1930D	<2.46UD	22.7D	447D	32600D	2320D	2310D	8100D	0.02	<4.92UD	7670D	852D	3220D	3570D	<246UD	13.4D	278D	13.5D	<24.6UD	4780D
ELK-29	6480D	<1000UD	16200D	74.6D	<2.48UD	7650D	2630D	2.83D	4.73D	38.5D	11200D	728D	1370D	1580D	0.02	<4.97UD	5970D	851D	1110D	596D	<248UD	21.0D	<200UD	11.5D	<24.8UD	1160D
Level 5 WL-1	11800D	<1000UD	8400D	24.9D	<2.49UD	727D	612D	9.08D	2.80D	149D	22400D	537D	3020D	281D	0.09	<4.98UD	5160D	1380D	1610D	14100D	<249UD	8.31D	228D	91.7D	<24.9UD	340D
Level 5 WL-2	3770D	<1000UD	3900D	15.3D	<2.50UD	12500D	3110D	<2.50UD	<2.50UD	222D	17800D	722D	573D	2080D	0.10	<5.00UD	2150D	<500UD	2100D	1070D	<250UD	22.3D	<200UD	<9.99UD	<25.0UD	1510D
Level 98	3750D	6330D	70500D	26.9D	<2.48UD	6070D	601D	<2.48UD	7.39D	362D	32000D	8650D	477D	4510D	0.03	<4.96UD	4040D	571D	2390D	11400D	<248UD	6.14D	200D	<9.91UD	<24.8UD	1600D
Level 98 WL-1	4690D	4610D	26400D	80.7D	<2.49UD	13700D	1450D	<2.49UD	17.7D	134D	15800D	6420D	703D	8290D	0.02	<4.97UD	5550D	540D	1670D	1390D	<249UD	13.2D	214D	<9.94UD	<24.9UD	1390D
Level 98 WL-3	7270D	<1000UD	10100D	45.0D	<2.50UD	4980D	1430D	3.20D	5.08D	199D	13500D	2100D	1490D	1600D	0.03	<5.00UD	4320D	739D	<1000UD	1150D	<250UD	10.4D	<200UD	19.3D	<25.0UD	888D
Level 98 WL-4	8780D	<1000UD	14500D	54.2D	<2.49UD	16100D	1010D	<2.49UD	8.87D	263D	12900D	3310D	1440D	7250D	0.03	<4.99UD	6320D	852D	1260D	1660D	<249UD	8.30D	210D	14.6D	<24.9UD	1060D
Level 98 WL-5	12900D	1220D	37500D	433D	<2.49UD	22800D	2260D	<2.49UD	53.8D	50.3D	28000D	4960D	1550D	8330D	0.03	<4.99UD	10100D	884D	4390D	914D	<249UD	26.5D	1030D	<9.97UD	<24.9UD	2170D
SP-00	5660D	<1000UD	<2000UD	83.9D	<2.50UD	244D	2620D	<2.50UD	4.25D	<5.00UD	17100D	84.20D	2160D	659D	0.01	<5.00UD	1790D	588D	<1000UD	<500UD	<250UD	32.0D	<200UD	93.5D	<25.0UD	40.6D
SP-01	5160D	<1000UD	<2000UD	98.8D	<2.50UD	270D	2520D	<2.50UD	4.16D	<5.00UD	15800D	54.30D	2130D	561D	0.03	<5.00UD	1810D	669D	<1000UD	<500UD	<250UD	41.4D	<200UD	206D	<25.0UD	36.9D

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D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.5-1 September 2008 Satndard Mine Watershed Habitat Assessment

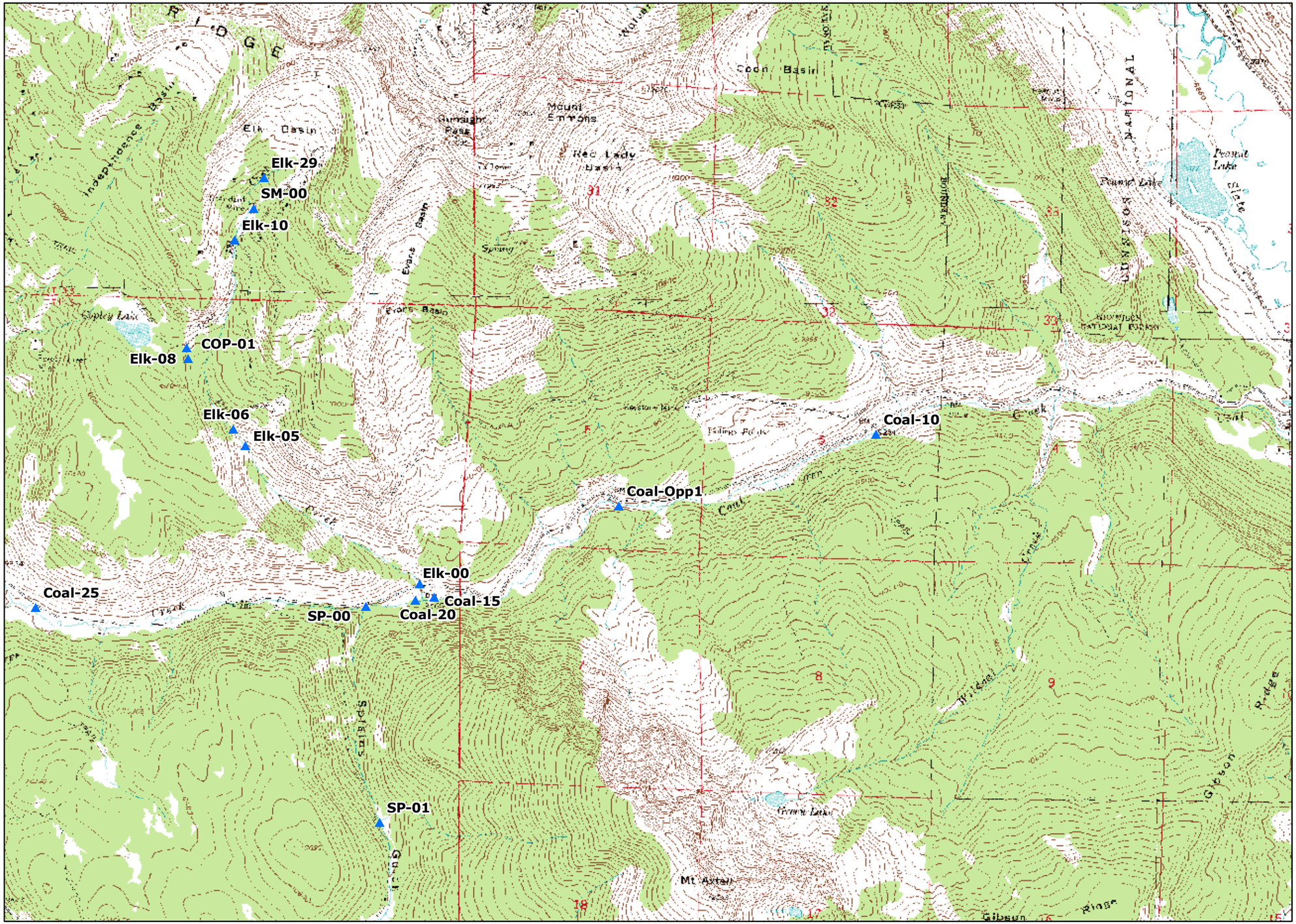
Habitat Parameter	Coal-Opp1	Coal-15	Coal-20	Coal-25	Elk-00	Elk-05	Elk-06	Elk-08	Elk-10	Elk-29	SP-00	SP-01 Reference
Epifaunal Substrate/ Available Cover	18	17	18	18	18	18	24	20	8	11	20	17
Embeddedness	17	20	19	17	20	19	18	17	8	20	20	20
Velocity/Depth Regime	20	20	15	6	10	10	10	10	9	7	10	10
Sediment Deposition	12	20	19	19	20	19	17	17	19	20	17	20
Channel Flow Status	15	18	18	20	15	20	19	16	15	16	20	18
Channel Alteration	20	20	20	19	20	20	20	20	20	20	20	20
Frequency of Riffles or Bends	20	19	19	2	15	19	16	18	19	9	19	19
Bank Stability												
Left Bank	7	9	9	10	10	10	10	9	5	8	10	10
Right Bank	8	8	7	10	10	10	7	10	9	4	9	10
Vegetative Protection												
Left Bank	6	9	9	10	10	9	10	9	5	9	10	10
Right Bank	8	10	10	10	10	9	7	10	9	7	10	10
Riparian Vegetative Zone Width												
Left Bank	8	9	9	10	9	10	10	10	3	10	10	10
Right Bank	9	9	10	10	9	10	10	10	10	10	10	9
Total Score	**168**	**188**	**182**	**161**	**176**	**183**	**178**	**176**	**139**	**151**	**185**	**183**

Notes:

Green Shading = Optimal habitat score
Blue Shading = Suboptimal habitat score
Yellow Shading = Marginal habitat score
Red Shading = Poor habitat score

Figures

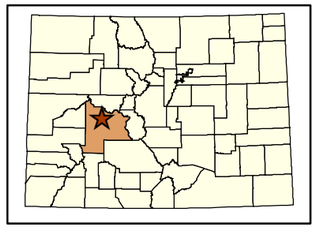
Standard Mine
2008
Sampling Locations
Figure 2.1-1



Legend

▲ Stream Locations

Location of Standard Mine



In Gunnison County, Colorado

N
W E
S

Feet

0 2,000 4,000

UTM, Zone 13 North, NAD 83

July 12, 2007

TechLaw

EPA

Macroinvertebrate Assemblage

Appendix A

Timberline Aquatics, Inc.

January 22, 2009

Mr. Steve Auer
TechLaw
16194 W. 45th Drive
Denver, CO 80403

Dear Mr. Auer,

Enclosed are the results from the analysis of 12 benthic macroinvertebrate samples collected for the Standard Mine Project during the fall of 2008. Data are reported as number of organisms per sample. Please contact me if you have any questions.

Sincerely,

Timberline Aquatics, Inc.

David E. Rees
President

Enc.

/dr

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Standard Mine Macroinvertebrate Data
Site: COAL-10
Sample # 0111
15 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**79**
Baetidae	*Acentrella* sp.	2
Baetidae	*Baetis* (*tricaudatus*)	26
Ephemerellidae	*Drunella doddsi*	2
Ephemerellidae	*Ephemerella dorothea infrequens*	2
Heptageniidae	*Rhithrogena* sp.	42
Ameletidae	*Ameletus* sp.	5
PLECOPTERA		**42**
Capniidae	Capniidae	2
Taeniopterygidae	*Taenionema* sp.	5
Nemouridae	*Zapada oregonesis* gr	8
Chloroperlidae	*Sweltsa* sp.	24
Perlodidae	*Megarcys signata*	3
TRICHOPTERA		**11**
Hydropsychidae	*Arctopsyche grandis*	5
Rhyacophilidae	*Rhyacophila valuma*	6
DIPTERA		**70**
Chironomidae	Chironomidae	63
Simuliidae	*Simulium* sp.	2
Empididae	*Clinocera* sp.	3
Psychodidae	*Pericoma* sp.	2
COLEOPTERA		**191**
Elmidae	*Heterlimnius corpulentus*	189
Elmidae	*Narpus concolor*	2
HYDRACARINA		**3**
Torrenticolidae	Torrenticola sp.	3
ANNELIDA		
OLIGOCHAETA		**53**
Enchytraeidae	Enchytraeidae	
Lumbricidae	Lumbricidae	53

Total Number (#/sample)	443
Number of Taxa	21
Shannon Weaver Diversity (H')	2.80
Hilsenhoff Biotic Index (HBI)	4.30

Total EPT Taxa	13
EPT Index (% of total number of taxa)	61.9%
Ephemeroptera Abundance (% of total number)	17.3%
# Ephemeroptera Taxa	6
# Plecoptera Taxa	5
# Trichoptera Taxa	2
% EPT (% of Total Number)	28.8%
# Intolerant Taxa	11
Tolerant Organisms (% of Total Number)	12.5%
Dominant Taxon (% of Total Number)	42.7%
Filterers (% of Total Number)	1.4%
Scrapers (% of Total Number)	10.8%
# Clinger Taxa	12
Clingers (% of Total Number)	64.4%

Standard Mine Macroinvertebrate Data
Site: COAL-15
Sample # 0084
16 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**7**
Baetidae	*Baetis* (*tricaudatus*)	2
Ephemerellidae	*Ephemerella dorothea infrequens*	1
Heptageniidae	*Rhithrogena* sp.	2
Ameletidae	*Ameletus* sp.	2
PLECOPTERA		**12**
Taeniopterygidae	*Taenionema* sp.	1
Nemouridae	*Zapada oregonesis* gr	3
Chloroperlidae	*Sweltsa* sp.	2
Perlodidae	Perlodidae	5
Perlodidae	*Megarcys signata*	1
TRICHOPTERA		**9**
Brachycentridae	*Micrasema bactro*	3
Hydropsychidae	*Arctopsyche grandis*	1
Limnephilidae	Limnephilidae	1
Apataniidae	*Allomyia* sp.	2
Rhyacophilidae	*Rhyacophila hyalinata* gr	1
Rhyacophilidae	*Rhyacophila valuma*	1
DIPTERA		**7**
Chironomidae	Chironomidae	7
COLEOPTERA		**66**
Elmidae	*Heterlimnius corpulentus*	66
HYDRACARINA		**3**
Lebertiidae	*Lebertia* sp.	2
Torrenticolidae	Torrenticola sp.	1
ANNELIDA		
OLIGOCHAETA		**5**
Lumbricidae	Lumbricidae	5

Total Number (#/sample)	109
Number of Taxa	20
Shannon Weaver Diversity (H')	2.52
Hilsenhoff Biotic Index (HBI)	3.86
Total EPT Taxa	15
EPT Index (% of total number of taxa)	75.0%

Ephemeroptera Abundance (% of total number)	6.4%
# Ephemeroptera Taxa	4
# Plecoptera Taxa	5
# Trichoptera Taxa	6
% EPT (% of Total Number)	25.7%
# Intolerant Taxa	13
Tolerant Organisms (% of Total Number)	7.3%
Dominant Taxon (% of Total Number)	60.1%
Filterers (% of Total Number)	0.9%
Scrapers (% of Total Number)	4.6%
# Clinger Taxa	15
Clingers (% of Total Number)	84.4%

Standard Mine Macroinvertebrate Data
Site: COAL-20
Sample # 0085
16 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**61**
Baetidae	*Acentrella* sp.	2
Baetidae	*Baetis* (*tricaudatus*)	32
Ephemerellidae	*Drunella doddsi*	2
Ephemerellidae	*Ephemerella dorothea infrequens*	3
Heptageniidae	*Rhithrogena* sp.	8
Leptophlebiidae	*Paraleptophlebia* sp.	2
Ameletidae	*Ameletus* sp.	12
PLECOPTERA		**28**
Taeniopterygidae	*Taenionema* sp.	11
Nemouridae	*Zapada oregonesis* gr	9
Chloroperlidae	*Sweltsa* sp.	6
Perlodidae	Perlodidae	2
TRICHOPTERA		**44**
Brachycentridae	*Brachycentrus americanus*	2
Brachycentridae	*Micrasema bactro*	14
Hydropsychidae	*Arctopsyche grandis*	15
Apataniidae	*Allomyia* sp.	5
Rhyacophilidae	*Rhyacophila brunnea*	8
DIPTERA		**64**
Chironomidae	Chironomidae	50
Simuliidae	*Simulium* sp.	9
Empididae	*Clinocera* sp.	2
Psychodidae	*Pericoma* sp.	3
COLEOPTERA		**245**
Elmidae	*Heterlimnius corpulentus*	243
Elmidae	*Zaitzevia parvula*	2
HYDRACARINA		**11**
Lebertiidae	*Lebertia* sp.	3
Sperchontidae	*Sperchon* sp.	6
Torrenticolidae	Torrenticola sp.	2
ANNELIDA		
OLIGOCHAETA		**3**
Enchytraeidae	Enchytraeidae	3

Total Number (#/sample)	449
Number of Taxa	26
Shannon Weaver Diversity (H')	2.75
Hilsenhoff Biotic Index (HBI)	3.78
Total EPT Taxa	16
EPT Index (% of total number of taxa)	61.5%
Ephemeroptera Abundance (% of total number)	13.0%
# Ephemeroptera Taxa	7
# Plecoptera Taxa	4
# Trichoptera Taxa	5
% EPT (% of Total Number)	28.4%
# Intolerant Taxa	14
Tolerant Organisms (% of Total Number)	3.0%
Dominant Taxon (% of Total Number)	54.1%
Filterers (% of Total Number)	5.7%
Scrapers (% of Total Number)	5.3%
# Clinger Taxa	17
Clingers (% of Total Number)	74.5%

Standard Mine Macroinvertebrate Data
Site: COAL-25
Sample # 0095
16 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**111**
Baetidae	*Baetis* (*tricaudatus*)	2
Ephemerellidae	*Drunella doddsi*	17
Ephemerellidae	*Drunella grandis*	11
Ephemerellidae	*Ephemerella dorothea infrequens*	17
Heptageniidae	*Rhithrogena* sp.	34
Leptophlebiidae	*Paraleptophlebia* sp.	17
Ameletidae	*Ameletus* sp.	13
PLECOPTERA		**8**
Capniidae	Capniidae	2
Chloroperlidae	*Sweltsa* sp.	2
Perlodidae	*Megarcys signata*	4
TRICHOPTERA		**26**
Brachycentridae	*Micrasema bactro*	4
Glossosomatidae	*Glossosoma* sp.	4
Hydropsychidae	*Arctopsyche grandis*	6
Hydroptilidae	*Hydroptila* sp.	4
Limnephilidae	Limnephilidae	2
Rhyacophilidae	*Rhyacophila coloradensis*	2
Rhyacophilidae	*Rhyacophila valuma*	4
DIPTERA		**85**
Chironomidae	Chironomidae	66
Simuliidae	*Simulium* sp.	4
Ceratopogonidae	*Bezzia/Palpomyia* sp.	2
Tipulidae	*Dicranota* sp.	2
Tipulidae	*Hexatoma* sp.	2
Psychodidae	*Pericoma* sp.	9
COLEOPTERA		**419**
Dytiscidae	Dytiscidae Hydroporinae	2
Elmidae	*Heterlimnius corpulentus*	415
Elmidae	*Narpus concolor*	2
HYDRACARINA		**2**
Sperchontidae	*Sperchon* sp.	2
ANNELIDA		
OLIGOCHAETA		**7**
Enchytraeidae	Enchytraeidae	6

Lumbricidae	Lumbricidae	1

Total Number (#/sample)	662
Number of Taxa	29
Shannon Weaver Diversity (H')	2.39
Hilsenhoff Biotic Index (HBI)	3.59
Total EPT Taxa	17
EPT Index (% of total number of taxa)	58.6%
Ephemeroptera Abundance (% of total number)	16.8%
# Ephemeroptera Taxa	7
# Plecoptera Taxa	3
# Trichoptera Taxa	7
% EPT (% of Total Number)	22.3%
# Intolerant Taxa	16
Tolerant Organisms (% of Total Number)	1.4%
Dominant Taxon (% of Total Number)	62.7%
Filterers (% of Total Number)	1.6%
Scrapers (% of Total Number)	10.7%
# Clinger Taxa	17
Clingers (% of Total Number)	81.1%

Standard Mine Macroinvertebrate Data
Site: COAL-00P-1
Sample # 0069
15 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**79**
Baetidae	*Acentrella* sp.	4
Baetidae	*Baetis (bicaudatus)*	4
Baetidae	*Baetis* (*tricaudatus*)	13
Ephemerellidae	*Drunella doddsi*	17
Heptageniidae	*Rhithrogena* sp.	30
Ameletidae	*Ameletus* sp.	11
PLECOPTERA		**103**
Pteronarcyidae	*Pteronarcella badia*	2
Capniidae	Capniidae	4
Taeniopterygidae	*Taenionema* sp.	21
Nemouridae	*Zapada oregonesis* gr	24
Chloroperlidae	Chloroperlidae	2
Chloroperlidae	*Sweltsa* sp.	24
Perlodidae	*Megarcys signata*	15
Perlidae	*Hesperoperla pacifica*	11
TRICHOPTERA		**75**
Brachycentridae	*Micrasema bactro*	4
Glossosomatidae	*Glossosoma* sp.	9
Hydropsychidae	*Arctopsyche grandis*	32
Rhyacophilidae	*Rhyacophila valuma*	15
Uenoidae	*Oligophlebodes* sp.	15
DIPTERA		**158**
Chironomidae	Chironomidae	137
Simuliidae	*Simulium* sp.	4
Tipulidae	*Dicranota* sp.	2
Tipulidae	*Hexatoma* sp.	4
Psychodidae	*Pericoma* sp.	11
COLEOPTERA		**210**
Elmidae	*Heterlimnius corpulentus*	208
Elmidae	*Narpus concolor*	2
HYDRACARINA		**6**
Lebertiidae	*Lebertia* sp.	4
Sperchontidae	*Sperchon* sp.	2
ANNELIDA		
OLIGOCHAETA		**15**

Lumbricidae	Lumbricidae	15

Total Number (#/sample)	646
Number of Taxa	29
Shannon Weaver Diversity (H')	3.54
Hilsenhoff Biotic Index (HBI)	3.54
Total EPT Taxa	19
EPT Index (% of total number of taxa)	65.5%
Ephemeroptera Abundance (% of total number)	12.3%
# Ephemeroptera Taxa	6
# Plecoptera Taxa	8
# Trichoptera Taxa	5
% EPT (% of Total Number)	39.7%
# Intolerant Taxa	18
Tolerant Organisms (% of Total Number)	3.3%
Dominant Taxon (% of Total Number)	32.2%
Filterers (% of Total Number)	5.6%
Scrapers (% of Total Number)	14.2%
# Clinger Taxa	18
Clingers (% of Total Number)	64.9%

Standard Mine Macroinvertebrate Data
Site: ELK-00
Sample # 0088
16 Sept. 2008

			REP 1
INSECTA			
EPHEMEROPTERA			**151**
	Baetidae	*Baetis* (*tricaudatus*)	38
	Ephemerellidae	*Drunella doddsi*	101
	Heptageniidae	*Epeorus* sp.	1
	Heptageniidae	*Rhithrogena* sp.	11
PLECOPTERA			**19**
	Nemouridae	*Zapada oregonesis* gr	18
	Perlodidae	*Megarcys signata*	1
TRICHOPTERA			**41**
	Hydropsychidae	*Parapsyche elsis*	18
	Limnephilidae	Limnephilidae	2
	Rhyacophilidae	*Rhyacophila brunnea*	5
	Rhyacophilidae	*Rhyacophila hyalinata* gr	4
	Rhyacophilidae	*Rhyacophila valuma*	1
	Rhyacophilidae	*Rhyacophila vofixa* gr	11
DIPTERA			**33**
	Chironomidae	Chironomidae	23
	Empididae	*Clinocera* sp.	8
	Empididae	*Neoplasta* sp.	2
COLEOPTERA			**3**
	Elmidae	*Heterlimnius corpulentus*	3
HYDRACARINA			**4**
	Sperchontidae	*Sperchon* sp.	4
TURBELLARIA			**1**
	Planariidae	Polycelis coronata	1

Total Number (#/sample)	252
Number of Taxa	18
Shannon Weaver Diversity (H')	2.97
Hilsenhoff Biotic Index (HBI)	1.83
Total EPT Taxa	12
EPT Index (% of total number of taxa)	66.7%
Ephemeroptera Abundance (% of total number)	59.9%
# Ephemeroptera Taxa	4

# Plecoptera Taxa	2
# Trichoptera Taxa	6
% EPT (% of Total Number)	83.7%
# Intolerant Taxa	11
Tolerant Organisms (% of Total Number)	1.6%
Dominant Taxon (% of Total Number)	40.1%
Filterers (% of Total Number)	0.0%
Scrapers (% of Total Number)	44.8%
# Clinger Taxa	13
Clingers (% of Total Number)	71.4%

Standard Mine Macroinvertebrate Data
Site: ELK-05
Sample # 0089
17 Sept. 2008

			REP 1
INSECTA			
EPHEMEROPTERA			**64**
	Baetidae	*Baetis (bicaudatus)*	2
	Baetidae	*Baetis* (*tricaudatus*)	54
	Ephemerellidae	*Drunella doddsi*	4
	Heptageniidae	*Rhithrogena* sp.	2
	Ameletidae	*Ameletus* sp.	2
PLECOPTERA			**58**
	Capniidae	Capniidae	11
	Nemouridae	*Zapada cinctipes*	2
	Nemouridae	*Zapada oregonesis* gr	36
	Chloroperlidae	*Sweltsa* sp.	9
TRICHOPTERA			**41**
	Hydropsychidae	*Parapsyche elsis*	2
	Limnephilidae	Limnephilidae	4
	Apataniidae	*Allomyia* sp.	7
	Rhyacophilidae	*Rhyacophila hyalinata* gr	4
	Rhyacophilidae	*Rhyacophila vofixa* gr	22
	Uenoidae	*Neothremma alicia*	2
DIPTERA			**244**
	Chironomidae	Chironomidae	234
	Simuliidae	*Simulium* sp.	2
	Simuliidae	*Prosimulium* sp.	2
	Empididae	*Clinocera* sp.	2
	Empididae	*Neoplasta* sp.	2
	Psychodidae	*Pericoma* sp.	2
TURBELLARIA			**165**
	Planariidae	Polycelis coronata	165

Total Number (#/sample)	571
Number of Taxa	22
Shannon Weaver Diversity (H')	2.53
Hilsenhoff Biotic Index (HBI)	3.42
Total EPT Taxa	15
EPT Index (% of total number of taxa)	68.2%
Ephemeroptera Abundance (% of total number)	11.2%
# Ephemeroptera Taxa	5
# Plecoptera Taxa	4
# Trichoptera Taxa	6

% EPT (% of Total Number)	28.5%
# Intolerant Taxa	14
Tolerant Organisms (% of Total Number)	0.0%
Dominant Taxon (% of Total Number)	41.0%
Filterers (% of Total Number)	0.7%
Scrapers (% of Total Number)	2.6%
# Clinger Taxa	12
Clingers (% of Total Number)	16.7%

Standard Mine Macroinvertebrate Data
Site: ELK-06
Sample # 0090
17 Sept. 2008

			REP 1
INSECTA			
EPHEMEROPTERA			**10**
	Baetidae	*Baetis* (*tricaudatus*)	2
	Ameletidae	*Ameletus* sp.	8
PLECOPTERA			**16**
	Capniidae	Capniidae	10
	Leuctridae	*Paraleuctra* sp.	2
	Nemouridae	*Zapada oregonesis* gr	2
	Chloroperlidae	*Sweltsa* sp.	2
TRICHOPTERA			**6**
	Hydropsychidae	*Parapsyche elsis*	2
	Limnephilidae	Limnephilidae	2
	Limnephilidae	Psychoglypha sp.	2
DIPTERA			**23**
	Chironomidae	Chironomidae	19
	Ceratopogonidae	*Bezzia/Palpomyia* sp.	1
	Empididae	*Neoplasta* sp.	3
HYDRACARINA			**7**
	Sperchontidae	*Sperchon* sp.	7
TURBELLARIA			**91**
	Planariidae	Polycelis coronata	91

Total Number (#/sample)	153
Number of Taxa	14
Shannon Weaver Diversity (H')	2.23
Hilsenhoff Biotic Index (HBI)	2.10
Total EPT Taxa	9
EPT Index (% of total number of taxa)	64.3%
Ephemeroptera Abundance (% of total number)	6.5%
# Ephemeroptera Taxa	2
# Plecoptera Taxa	4
# Trichoptera Taxa	3
% EPT (% of Total Number)	20.9%
# Intolerant Taxa	8
Tolerant Organisms (% of Total Number)	4.6%
Dominant Taxon (% of Total Number)	59.5%
Filterers (% of Total Number)	0.0%

Scrapers (% of Total Number)	0.0%
# Clinger Taxa	5
Clingers (% of Total Number)	9.8%

Standard Mine Macroinvertebrate Data
Site: ELK-08
Sample # 0091
17 Sept. 2008

			REP 1
INSECTA			
EPHEMEROPTERA			**22**
	Baetidae	*Baetis* (*tricaudatus*)	22
PLECOPTERA			**6**
	Capniidae	Capniidae	1
	Leuctridae	*Paraleuctra* sp.	3
	Chloroperlidae	*Sweltsa* sp.	1
	Perlodidae	Perlodidae	1
TRICHOPTERA			**2**
	Limnephilidae	Psychoglypha sp.	1
	Rhyacophilidae	*Rhyacophila vofixa* gr	1
DIPTERA			**46**
	Chironomidae	Chironomidae	42
	Simuliidae	*Simulium* sp.	3
	Empididae	*Neoplasta* sp.	1
COLEOPTERA			**4**
	Hydrophilidae	Hydrophilidae	1
	Elmidae	*Heterlimnius corpulentus*	3
HYDRACARINA			**3**
	Sperchontidae	*Sperchon* sp.	3
TURBELLARIA			**120**
	Planariidae	Polycelis coronata	120

Total Number (#/sample)	203
Number of Taxa	14
Shannon Weaver Diversity (H')	1.89
Hilsenhoff Biotic Index (HBI)	2.61
Total EPT Taxa	7
EPT Index (% of total number of taxa)	50.0%
Ephemeroptera Abundance (% of total number)	10.8%
# Ephemeroptera Taxa	1
# Plecoptera Taxa	4
# Trichoptera Taxa	2
% EPT (% of Total Number)	14.8%
# Intolerant Taxa	7

Tolerant Organisms (% of Total Number)	1.5%
Dominant Taxon (% of Total Number)	59.1%
Filterers (% of Total Number)	1.5%
Scrapers (% of Total Number)	0.0%
# Clinger Taxa	6
Clingers (% of Total Number)	5.9%

Standard Mine Macroinvertebrate Data
Site: ELK-10
Sample # 0092
17 Sept. 2008

			REP 1
INSECTA			
EPHEMEROPTERA			**4**
	Baetidae	*Baetis* (*tricaudatus*)	4
TRICHOPTERA			**48**
	Limnephilidae	Limnephilidae	44
	Limnephilidae	Psychoglypha sp.	3
	Uenoidae	*Neothremma alicia*	1
DIPTERA			**88**
	Chironomidae	Chironomidae	84
	Empididae	*Clinocera* sp.	1
	Empididae	*Neoplasta* sp.	1
	Psychodidae	*Pericoma* sp.	2
COLEOPTERA			**1**
	Dytiscidae	Dytiscidae (Agabus)	1
TURBELLARIA			**4**
	Planariidae	Polycelis coronata	4
NEMATODA			**1**
	Nematoda	Nematoda	1

Total Number (#/sample)	146
Number of Taxa	11
Shannon Weaver Diversity (H')	1.71
Hilsenhoff Biotic Index (HBI)	5.04
Total EPT Taxa	4
EPT Index (% of total number of taxa)	36.4%
Ephemeroptera Abundance (% of total number)	2.7%
# Ephemeroptera Taxa	1
# Plecoptera Taxa	0
# Trichoptera Taxa	3
% EPT (% of Total Number)	35.6%
# Intolerant Taxa	3
Tolerant Organisms (% of Total Number)	0.7%
Dominant Taxon (% of Total Number)	57.5%
Filterers (% of Total Number)	0.0%
Scrapers (% of Total Number)	0.7%
# Clinger Taxa	1
Clingers (% of Total Number)	30.1%

Standard Mine Macroinvertebrate Data
Site: SP-00
Sample # 0086
16 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**143**
Baetidae	*Baetis* (*tricaudatus*)	22
Ephemerellidae	*Drunella doddsi*	12
Heptageniidae	*Cinygmula* sp.	6
Heptageniidae	*Rhithrogena* sp.	15
Ameletidae	*Ameletus* sp.	88
PLECOPTERA		**28**
Capniidae	Capniidae	5
Nemouridae	*Zapada cinctipes*	1
Nemouridae	*Zapada oregonesis* gr	1
Chloroperlidae	Chloroperlidae	1
Chloroperlidae	*Sweltsa* sp.	12
Perlodidae	Perlodidae	1
Perlidae	*Hesperoperla pacifica*	7
TRICHOPTERA		**6**
Brachycentridae	*Micrasema bactro*	2
Limnephilidae	Ecclisomyia sp.	1
Rhyacophilidae	*Rhyacophila valuma*	1
Uenoidae	*Neothremma alicia*	2
DIPTERA		**72**
Chironomidae	Chironomidae	71
Empididae	*Clinocera* sp.	1
COLEOPTERA		**26**
Elmidae	*Heterlimnius corpulentus*	26
HYDRACARINA		**12**
Lebertiidae	*Lebertia* sp.	5
Sperchontidae	*Sperchon* sp.	6
Torrenticolidae	Torrenticola sp.	1

Total Number (#/sample)	287
Number of Taxa	22
Shannon Weaver Diversity (H')	3.12
Hilsenhoff Biotic Index (HBI)	2.72
Total EPT Taxa	16
EPT Index (% of total number of taxa)	72.7%
Ephemeroptera Abundance (% of total number)	49.8%

# Ephemeroptera Taxa	5
# Plecoptera Taxa	7
# Trichoptera Taxa	4
% EPT (% of Total Number)	61.7%
# Intolerant Taxa	14
Tolerant Organisms (% of Total Number)	4.2%
Dominant Taxon (% of Total Number)	30.7%
Filterers (% of Total Number)	0.0%
Scrapers (% of Total Number)	12.2%
# Clinger Taxa	16
Clingers (% of Total Number)	34.1%

Standard Mine Macroinvertebrate Data
Site: SP-01
Sample # 0087
16 Sept. 2008

		REP 1
INSECTA		
EPHEMEROPTERA		**127**
Baetidae	*Baetis* (*tricaudatus*)	5
Ephemerellidae	*Drunella doddsi*	9
Ephemerellidae	*Ephemerella dorothea infrequens*	79
Heptageniidae	*Rhithrogena* sp.	5
Ameletidae	*Ameletus* sp.	29
PLECOPTERA		**40**
Capniidae	Capniidae	3
Taeniopterygidae	*Taenionema* sp.	2
Nemouridae	*Zapada cinctipes*	7
Nemouridae	*Zapada oregonesis* gr	5
Chloroperlidae	*Sweltsa* sp.	15
Perlidae	*Hesperoperla pacifica*	8
TRICHOPTERA		**6**
Brachycentridae	*Micrasema bactro*	1
Hydroptilidae	*Hydroptila* sp.	1
Lepidostomatidae	*Lepidostoma* sp.	2
Rhyacophilidae	*Rhyacophila brunnea*	1
Uenoidae	*Neothremma alicia*	1
DIPTERA		**60**
Chironomidae	Chironomidae	51
Empididae	*Clinocera* sp.	1
Psychodidae	*Pericoma* sp.	7
Culicidae	*Ochlerotatus* sp.	1
COLEOPTERA		**85**
Elmidae	*Heterlimnius corpulentus*	85
HYDRACARINA		**12**
Lebertiidae	*Lebertia* sp.	7
Sperchontidae	*Sperchon* sp.	5
ANNELIDA		
OLIGOCHAETA		**13**
Lumbricidae	Lumbricidae	13
Total Number (#/sample)		343
Number of Taxa		24

Shannon Weaver Diversity (H')	3.34
Hilsenhoff Biotic Index (HBI)	3.12
Total EPT Taxa	16
EPT Index (% of total number of taxa)	66.7%
Ephemeroptera Abundance (% of total number)	36.9%
# Ephemeroptera Taxa	5
# Plecoptera Taxa	6
# Trichoptera Taxa	5
% EPT (% of Total Number)	50.6%
# Intolerant Taxa	14
Tolerant Organisms (% of Total Number)	7.4%
Dominant Taxon (% of Total Number)	24.8%
Filterers (% of Total Number)	0.3%
Scrapers (% of Total Number)	5.4%
# Clinger Taxa	13
Clingers (% of Total Number)	66.4%

Aquatic Toxicity Testing Report

Appendix B

Standard Mine
Aquatic Toxicity Testing Report
September 2008 Surface Water Collection
Final

Prepared for:

United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation-Program Support
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Acronym List

ºC	Degrees Celsius
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
LC50	50% Lethal Concentration
MHRW	Moderately Hard Reconstituted Water
mL	Milliliter
SI	Site Inspection
RBT	Rainbow Trout
BERA	Baseline Ecological Risk Assessment
QAPP	Quality Assurance Project Plan
mg/L	Milligrams per liter
ms/cm	Millisiemens/centimeter
ug/L	Micrograms per liter
QA	Quality Assurance

1.0 INTRODUCTION

A 96-hour static renewal toxicity test was performed at the United States Environmental Protection Agency (EPA) Region 8 Laboratory to determine the acute toxicity of site water collected from drainages associated with Standard Mine, located in Gunnison County, Colorado. As a quality assurance (QA) measure, a simultaneous reference toxicity test was performed using Moderately Hard Reconstituted Water (MHRW) spiked with zinc sulfate heptahydrate. All tests were performed using rainbow trout (*Oncorynchus mykiss*), with an evaluation endpoint of mortality. This toxicity test report includes a brief background of the Standard Mine area, materials and methods, test results, a discussion of results, and supporting references.

1.1 Background

The Standard Mine was part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity initially began at the Standard Mine around 1874, with the most significant operations beginning in 1931. Operations included the mining of lead, zinc, silver, and gold until 1966, when the mine was abandoned.

The mine consists of many open, unmarked adits and shafts, giving access to 8,400 feet of mine workings on six levels. The former mine is near a popular hiking trail and has no access restrictions. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings, as well as seasonably variable amounts of water flowing out of the adits. Additionally, there is a portion of land owned by the United States Forest Service that used to contain a non-engineered surface impoundment made entirely of highly mineralized waste rock. The unlined impoundment was built to collect metal laden acid mine drainage containing cadmium, copper, lead, and zinc. EPA Removal Program activities during the 2007 construction season included the removal of this site feature. However, there is evidence from previous years of overflow and seepage through the impoundment into Elk Creek, which runs adjacent to the mine. Elk Creek feeds into Coal Creek, which is a drinking water supply for the town of Crested Butte, approximately four miles downstream from the former mine.

In 1999, a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was conducted in June 1999 to assess the environmental conditions during the high stream flow regime, and Phase II was conducted September 1999 to assess the environmental conditions during the low flow regime. The 1999 SI was limited to surface water since, according to the United States Geological Survey, there are no extensive aquifer systems associated with the Ruby Mining District.

SI results revealed elevated concentrations of the following metals from total metals analyses of the surface waters from Coal Creek and its tributaries: aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, nickel, thallium, and zinc. Subsequent investigations performed in 2005 and 2006 confirmed the metals impacted surface water in Elk Creek and Coal Creek.

1.2 Objective

The objective of this toxicity test was to support the yearly monitoring activities at the Standard Mine. Mortality results will be incorporated into a biological monitoring report as an update of site conditions following EPA removal activities that occurred after completion of the Baseline Ecological Risk Assessment.

2.0 MATERIALS AND METHODS

This section outlines the materials and methods employed for testing purposes, including surface water collection procedures, water preparation and delivery, test organisms, food preparation, and test conditions. General test methodologies and testing criteria followed EPA protocol (EPA, 2002) and are included in Table 2.5-1.

2.1 Surface Water Collection

Surface water was collected in September 2008 from locations along Coal Creek, Elk Creek, and Splain's Gulch. Multiple dedicated cubitainers (one-gallon) were used for each site; therefore, equipment decontamination was not necessary. Immediately after collection (September 27, 2008), samples were stored on ice in coolers and transported to the Region 8 laboratory. Once at the laboratory, they were placed in a 4ºC cooler for preservation until test initiation, which took place within 36 hours of the last sample collection.

2.2 Water Preparation and Renewal

MHRW used for reference toxicity testing was prepared in accordance with Smith et al. (1997). Preparation included adding 50 grams of calcium sulfate, 50 grams of calcium carbonate, 30 grams of magnesium sulfate heptahydrate, 96 grams of sodium bicarbonate, and 4 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. Once MHRW was prepared, the batch tank was continuously aerated for the duration of the toxicity test. Water quality was measured to verify that the following parameters had been met: hardness between 90 and 100 milligrams per liter (mg/L), alkalinity between 50 and 70 mg/L, conductivity between 330 and 360 millisiemens/centimeter (ms/cm), and pH between 7.8 and 8.2 (EPA, 2002). Actual results for MHRW batch water are as follows: hardness of 90 mg/L, alkalinity of 54 mg/L, conductivity of 314 ms/cm and pH of 7.6.

MHRW and site water were renewed on a daily basis. One renewal was achieved when at least 90% of the water in each test chamber was replaced (measured volumetrically). Site water used for testing was warmed to 12º C before renewal. Water temperature was held constant during testing by using a heat exchanger and water bath setup.

2.3 Test Organisms

O. mykiss specimens obtained from Trout Lodge, Inc. (located in Sumner, Washington) were used for site water and reference toxicity testing. Once received at the Region 8 laboratory, organisms were held in a 20 gallon holding tank for 5 days until used for testing. Water temperature in the shipping bag and holding tank was equilibrated to 12ºC, equivalent to the testing temperature. Organisms were cultured and shipped using MHRW; therefore, water quality acclimation was not considered a substantial stress to

the organisms. Once temperature equilibration was complete the shipping bag was opened to allow a small amount of MHRW to mix with the shipping water. This procedure was repeated several times through the course of the day until laboratory MHRW and shipping water were well mixed. At the time of testing organisms were 15-30 days post yolk sac absorption, were uniform in size, and had an average organism weight of 0.17 grams.

2.4 Feeding Procedure

Organisms were fed starter trout chow obtained from Nelson's Silver Cup, Inc. in accordance with EPA methodology (EPA, 2002). Organisms were fed twice daily prior to test initiation and once daily thereafter. In order to reduce the accumulation of metabolic wastes, organisms were not fed during the 24 hours directly prior to test initiation.

2.5 Test Procedures

The following sections include the procedures used for the site water toxicity test and reference toxicity tests.

2.5.1 Site Water Toxicity Test

Site water used for testing purposes was obtained from the following eight locations along Coal Creek, Elk Creek, and Splains Gulch: Coal-15, Coal 20, Elk-00, Elk-05, Elk-06, Elk-08, SP-00, and SP-01 (SP-00 and SP-01 are considered reference sites). A duplicate site was collected at Elk-06 and labeled as Elk-06D. A control using MHRW was also tested. Testing chambers consisted of 1-liter glass beakers, which were placed in a water bath to maintain a temperature of 12º C during the experiment. Four replicates were tested for each location, including the control. Testing criteria specified in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater Marine Organisms (EPA, 2002) were followed (Table 2.5-1).

Upon test initiation a total of 10 organisms were added to each testing chamber using a small dip net and a cup, in which organism count was quickly verified. For site waters, a total of 4 replicate chambers were used, with 10 organisms per chamber, and a total of 40 organisms for each specific site.

As previously stated, testing took place over a 96-hour period, with one water renewal occurring each day. For the duration of the test, water quality was measured daily for dissolved oxygen, pH, conductivity, and temperature. On the day of test initiation and test completion, water chemistries were also measured for alkalinity and hardness. On a daily basis, organism mortality in each test chamber was observed, recorded, and all dead organisms removed. Appendix A includes water chemistry and mortality data sheets for the site water toxicity test. Surface water samples were collected and analyzed for total and dissolved metals using EPA Method 200.7/200.8. Results (expressed as micrograms per liter [ug/L]) are included in Table 2.5-2.

2.5.2 Reference Toxicity Test

For QA purposes, a reference toxicity test was performed simultaneously with the site water toxicity test using *O. mykiss*. Using a serial dilution, MHRW was spiked with zinc sulfate heptahydrate. Zinc concentrations were reduced by 50% starting with the highest concentration (for this test, 889 ug/L zinc) until the lowest dilution percentage (6.25%) was reached. The following are the dilutions and zinc concentrations used for this reference test: 100% concentration (889 ug/L), 50% concentration (433 ug/L), 25% concentration (203 ug/L), 12.5% concentration (102 ug/L), 6.25% concentration (47.4 ug/L). Zinc concentrations were verified in the analytical laboratory using EPA Method 200.7/200.8. The reference aquatic toxicity test was performed using the same methodologies outlined in section 2.5.1 (Site Water Toxicity Test). Mortality data for the reference test are included in Appendix B, and laboratory determined zinc concentrations are included in Table 2.5.2.

3.0 RESULTS

This section presents the results for the surface water toxicity testing and reference aquatic toxicity testing. This section also addresses any issues or unforeseen conditions encountered during the testing period.

3.1 Site Water Toxicity Test

Water quality parameters were consistent throughout the site water toxicity test and are listed in Appendix A. Dissolved oxygen was consistently above 6.0 mg/L, and average test chamber temperatures were maintained within +/- 2ºC of the target test temperature (12ºC), which met performance criteria.

Daily mortality numbers were evaluated at the end of the test to determine site water toxicity to the test organisms (Appendix A and Figure 3.1-1). Results show no mortality at reference sites SP-00 and SP-01. No mortality occurred at Coal-15 and minimal mortality occurred at Coal-20 (3% mortality). Mortality results for Elk Creek are as follows: Elk-00 (8% mortality), Elk-05 (5% mortality), Elk-06 (58% mortality), Elk-06D (44% mortality), and Elk-08 (95% mortality). The controls showed no mortality which met performance criteria of 90% survival.

3.2 Reference Toxicity Test

A reference toxicity test was conducted simultaneously with the site water toxicity test. Water Quality parameters were similar in all testing chambers, and water chemistries were within acceptable ranges for temperature, dissolved oxygen, pH, and conductivity for the reference toxicity test (Appendix B). No mortality was observed in the control or 6.25% concentration (47.4 ug/L zinc). The 12.5% concentration (102 ug/L zinc) had 5% mortality, while the 25%, 50%, and 100% concentrations showed 55%, 95%, and 100% mortality, respectively. The Trimmed Spearman-Karber method (Hamilton, 1977) was used to calculate an LC50 value, as well as upper and lower confidence limits. The LC50 value for the reference toxicity test was 199 ug/L with an upper confidence limit of 228 ug/L and a lower confidence limit of 174 ug/L. These data are consistent with previous reference aquatic toxicity tests performed on *O. mykiss* by ESAT in August 2006 and September 2007 using zinc sulfate as the toxicant. LC50 values for those tests ranged

from 214 ug/L to 296 ug/L. Figure 3.2-1 shows historical LC50 data from reference test performed at the Region 8 laboratory.

4.0 DISCUSSION

Results of the site specific surface water toxicity test indicated that the upper reaches along Elk Creek were acutely toxic to *O.mykiss* over a 96-hour time period. Specifically, sites Elk-08, Elk-06, and Elk-06D showed mortality of 95%, 58%, and 44%, respectively. Minimal mortality was observed along the lower reaches of Elk Creek, with less than 10% mortality at Elk-05 and Elk-00. The remaining sites (SP-00, SP-01, Coal-15, and Coal-20) did not show toxic effects based on mortality as an endpoint.

In order to determine the significance of the observed toxic effects, a Dunnett's Multiple Comparison Test was performed. Results indicate that there is a significant toxic effect at sites Elk-06 (t=8.25, p<0.001), Elk-06D (t=6.42, p<0.001), and Elk-08 (t=13.8, p<0.001) when compared to the controls (Attachment A). There was no significant difference between the remaining sites and the controls. A Pearson R coefficient was calculated in order to determine the existence and degree of correlation between 96-hour *O. mykiss* survival rate and the following parameters: distance from mine, cadmium concentration, zinc concentration, and conductivity. Results indicate significant negative correlations between survival rate and cadmium concentration (R=-0.989, p<0.001), zinc concentration (R=-0.993, p<0.001), and conductivity (R=-0.575, p=0.0.041), and a strong positive correlation between survival rate and distance from the mine (R=0.760, p=0.009).

Analysis of site water used for toxicity testing indicated zinc concentrations ranging from 890 ug/L at Elk-06 to 1,650 ug/L at Elk-08 (Table 2.5-2), which were higher than the reference toxicity test zinc LC 50 value of 199 ug/L. As expected those sites were acutely toxic to test organisms. Conversely, sites Elk-05 and Elk-00, which are farther downstream from Elk-06 and are also downstream of Seep-01 (which provides a diluting influence), had zinc concentrations of 162 ug/L and 191 respectively, which are below the reference LC 50 value for zinc. Those sites were not found to be acutely toxic to test organisms. The remaining sites along Coal Creek and Splain's Gulch had zinc concentrations ranging from non-detect to 28.9 ug/L, well below the reference LC 50 value for zinc. As expected, these sites were not acutely toxic to test organisms.

5.0 REFERENCES

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Tables

Table 2.5-1 Summary of Test Conditions

Test Parameter	Criteria
Test Type	Static Renewal
Test Duration	96-Hour
Temperature	12ºC +/- 2ºC
Light Quality	Ambient Laboratory Illumination
Light Intensity	50-100 ft-c
Photo Period	16 Hours Light, 8 Hours Dark
Test Chamber Size	1 liter
Test Solution Volume	900 mL
Renewal of Test Solutions	Daily
Age of Test Organisms	RBT (15-30 Days Post Yolk-Sac Absorption)
No. Replicate Chambers per Concentration	Four
No. Organisms per Chamber	Ten
No. Organisms per Concentration	40
Feeding Regime	Feeding Not Required
Test Chamber Cleaning	Cleaning Not Required
Test Solution Aeration	Not Exceeding 100 Bubbles per Minute
Dissolved Oxygen	6.0 mg/L
Dilution Water	Moderatley Hard Reconstituted Water
End Point	Mortality
Sample Holding Time	36 hours after collection of last sample
Test Acceptibility	90% or greater survival in controls

Table 2.5-2 Analytical Results for Surface Water

Dissolved Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silica (SiO	Silver	Sodium	Strontium	Thallium	Thorium	Titanium	Vanadium	Zinc
Control	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15900	<5.00 U	<5.00 U	<10.0 U	92	<250 U	<0.200 U	12600	<5.00 U		<10.0 U	1.23	2240	<1.00 U		<0.500 U	25900	91.8	<0.200 U		<35.0 U	<50.0 U	<20.0 U
ELK-00	<50.0 U	<1.00 U	2.26	18.3	<5.00 U	0.887	26300	<5.00 U	<5.00 U	<10.0 U	74	<250 U	<0.200 U	2080	<5.00 U		<10.0 U	1.04	<1000 U	<1.00 U		<0.500 U	2650	227	<0.200 U		<35.0 U	<50.0 U	191
ELK-05	<50.0 U	<1.00 U	6.11	22.5	<5.00 U	0.648	25100	<5.00 U	<5.00 U	<10.0 U	72	<250 U	<0.200 U	2190	<5.00 U		<10.0 U	<1.00 U	<1000 U	<1.00 U		<0.500 U	2600	151	<0.200 U		<35.0 U	<50.0 U	162
ELK-06	<50.0 U	<1.00 U	<2.00 U	20	<5.00 U	4.18	36900	<5.00 U	<5.00 U	<10.0 U	106	<250 U	<0.200 U	3330	<5.00 U		<10.0 U	1.8	<1000 U	<1.00 U		<0.500 U	2750	237	<0.200 U		<35.0 U	<50.0 U	890
ELK-06D	<50.0 U	<1.00 U	<2.00 U	19.8	<5.00 U	4.33	36200	<5.00 U	<5.00 U	<10.0 U	104	<250 U	<0.200 U	3330	<5.00 U		<10.0 U	1.71	<1000 U	<1.00 U		<0.500 U	2680	234	<0.200 U		<35.0 U	<50.0 U	877
ELK-08	<50.0 U	<1.00 U	<2.00 U	18.3	<5.00 U	7.08	42200	<5.00 U	<5.00 U	<10.0 U	121	<250 U	<0.200 U	3740	165		<10.0 U	2.49	<1000 U	<1.00 U		<0.500 U	2860	255	<0.200 U		<35.0 U	<50.0 U	1650
COAL-15	<50.0 U	<1.00 U	6.47	17.6	<5.00 U	<0.200 U	13200	<5.00 U	<5.00 U	<10.0 U	40	<250 U	<0.200 U	1800	<5.00 U		<10.0 U	<1.00 U	<1000 U	<1.00 U		<0.500 U	2000	143	<0.200 U		<35.0 U	<50.0 U	28.9
COAL-20	<50.0 U	1.18	7.64	17.4	<5.00 U	<0.200 U	9940	<5.00 U	<5.00 U	<10.0 U	32	<250 U	<0.200 U	1710	<5.00 U		<10.0 U	<1.00 U	<1000 U	<1.00 U		<0.500 U	1950	131	<0.200 U		<35.0 U	<50.0 U	<20.0 U
SP-00	<50.0 U	<1.00 U	<2.00 U	11.2	<5.00 U	<0.200 U	8840	<5.00 U	<5.00 U	<10.0 U	29	<250 U	<0.200 U	1750	<5.00 U		<10.0 U	<1.00 U	<1000 U	<1.00 U		<0.500 U	2930	92.6	<0.200 U		<35.0 U	<50.0 U	<20.0 U
SP-01	<50.0 U	<1.00 U	<2.00 U	10.2	<5.00 U	<0.200 U	6850	<5.00 U	<5.00 U	<10.0 U	24	<250 U	<0.200 U	1720	<5.00 U		<10.0 U	<1.00 U	<1000 U	<1.00 U		<0.500 U	2970	82.6	<0.200 U		<35.0 U	<50.0 U	<20.0 U
Control	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15900	<5.00 U	<5.00 U	<10.0 U	92	<250 U	<0.200 U	12600	<5.00 U		<10.0 U	1.23	2240	<1.00 U		<0.500 U	25900	91.8	<0.200 U		<35.0 U	<50.0 U	<20.0 U
Ref 6.25	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15800	<5.00 U	<5.00 U	<10.0 U	90	<250 U	<0.200 U	12400	<5.00 U		<10.0 U	1.22	2200	<1.00 U		<0.500 U	25300	88.7	<0.200 U		<35.0 U	<50.0 U	47.4
Ref 12.5	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15300	<5.00 U	<5.00 U	<10.0 U	88	<250 U	<0.200 U	12000	<5.00 U		<10.0 U	1.38	2200	<1.00 U		<0.500 U	24600	97.4	<0.200 U		<35.0 U	<50.0 U	102
Ref 25	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15200	<5.00 U	<5.00 U	<10.0 U	87	<250 U	0.318	11900	<5.00 U		<10.0 U	1.64	2190	<1.00 U		<0.500 U	24700	90.7	<0.200 U		<35.0 U	<50.0 U	203
Ref 50	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15600	<5.00 U	<5.00 U	<10.0 U	89	<250 U	<0.200 U	12200	<5.00 U		<10.0 U	1.33	2220	<1.00 U		<0.500 U	25100	92.9	<0.200 U		<35.0 U	<50.0 U	433
Ref 100	<50.0 U	<1.00 U	<2.00 U	<5.00 U	<5.00 U	<0.200 U	15500	<5.00 U	<5.00 U	<10.0 U	89	<250 U	<0.200 U	12300	<5.00 U		<10.0 U	1.25	2040	<1.00 U		<0.500 U	25000	89.8	<0.200 U		<35.0 U	<50.0 U	889

Total Recoverable Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silica (SiO2)	Silver	Sodium	Strontium	Thallium	Thorium	Titanium	Vanadium	Zinc
Control	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	15500	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	13100	<5.00 U		<10.0 U	<5.00 UD	2300	<5.00 UD		<2.50 UD	26500	90.8	<1.00 UD		<20.0 U	<50.0 U	<20.0 U
ELK-00	<50.0 U	<5.00 UD	<10.0 UD	17.4	<5.00 U	1.13 D	26800	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1690	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2310	237	<1.00 UD		<20.0 U	<50.0 U	227
ELK-05	<50.0 U	<5.00 UD	<10.0 UD	22.8	<5.00 U	<1.00 UD	26400	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1730	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2220	161	<1.00 UD		<20.0 U	<50.0 U	209
ELK-06	<50.0 U	<5.00 UD	<10.0 UD	18.3	<5.00 U	4.67 D	37000	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	2890	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2330	245	<1.00 UD		<20.0 U	<50.0 U	955
ELK-06D	<50.0 U	<5.00 UD	<10.0 UD	18.4	<5.00 U	4.58 D	37000	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	2950	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2380	243	<1.00 UD		<20.0 U	<50.0 U	962
ELK-08	<50.0 U	<5.00 UD	<10.0 UD	16.2	<5.00 U	8.31 D	40400	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	3230	174		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2390	256	<1.00 UD		<20.0 U	<50.0 U	1760
COAL-15	<50.0 U	<5.00 UD	<10.0 UD	19.9	<5.00 U	<1.00 UD	13500	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1500	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	1730	167	2.12 JD		<20.0 U	<50.0 U	46.4
COAL-20	104	<5.00 UD	<10.0 UD	21.7	<5.00 U	<1.00 UD	10400	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1420	14.6		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	1550	153	<1.00 UD		<20.0 U	<50.0 U	<20.0 U
SP-00	113	<5.00 UD	<10.0 UD	14.4	<5.00 U	<1.00 UD	8460	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1530	5.9		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2620	111	<1.00 UD		<20.0 U	<50.0 U	<20.0 U
SP-01	<50.0 U	<5.00 UD	<10.0 UD	12.2	<5.00 U	<1.00 UD	7270	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	1410	<5.00 U		<10.0 U	<5.00 UD	<1000 U	<5.00 UD		<2.50 UD	2590	98.2	<1.00 UD		<20.0 U	<50.0 U	<20.0 U
Ref 6.25	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	15100	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	12800	<5.00 U		<10.0 U	<5.00 UD	2270	<5.00 UD		<2.50 UD	25800	90.9	<1.00 UD		<20.0 U	<50.0 U	65
Ref 12.5	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	14700	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	12500	<5.00 U		<10.0 U	<5.00 UD	2290	<5.00 UD		<2.50 UD	25500	92.2	<1.00 UD		<20.0 U	<50.0 U	125
Ref 25	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	15000	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	12600	<5.00 U		<10.0 U	<5.00 UD	2330	<5.00 UD		<2.50 UD	25500	91.3	<1.00 UD		<20.0 U	<50.0 U	246
Ref 50	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	15100	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	13000	<5.00 U		<10.0 U	<5.00 UD	2380	<5.00 UD		<2.50 UD	26400	90.2	<1.00 UD		<20.0 U	<50.0 U	501
Ref 100	<50.0 U	<5.00 UD	<10.0 UD	<5.00 U	<5.00 U	<1.00 UD	14900	<5.00 U	<5.00 U	<10.0 U	<250 U	<1.00 UD	12500	<5.00 U		<10.0 U	<5.00 UD	2120	<5.00 UD		<2.50 UD	25400	88.9	<1.00 UD		<20.0 U	<50.0 U	992

Location	Alkalinity	Chloride	Fluoride	Sulfate as SO4	Dissolved Organic Carbon
Control	58.3	2	<0.2 U	86.2	<1.0 U
ELK-00	39.9	<2.0 U	<0.2 U	34.3	<1.0 U
ELK-05	39.4	<2.0 U	<0.2 U	34.7	<1.0 U
ELK-06	25.6	<2.0 U	<0.2 U	82.2	<1.0 U
ELK-06D	25.6	<2.0 U	<0.2 U	82	<1.0 U
ELK-08	29	<2.0 U	<0.2 U	90.3	<1.0 U
COAL-15	25.6	<2.0 U	<0.2 U	15.3	1.4
COAL-20	22.1	<2.0 U	<0.2 U	11.2	1.7
SP-00	29.5	<2.0 U	<0.2 U	<5.0 U	1.2
SP-01	27.2	<2.0 U	<0.2 U	<5.0 U	1.4
Ref 6.25	58.2	2.1	<0.2 U	87	<1.0 U
Ref 12.5	58.6	2.1	<0.2 U	87.7	<1.0 U
Ref 25	57.4	2.4	<0.2 U	94.4	<1.0 U
Ref 50	56.7	2.2	<0.2 U	87	<1.0 U
Ref 100	55.5	2.1	<0.2 U	86.8	<1.0 U

Notes:
U - indicates analyte not detected (result is reported as less than the reporting detection limit)
J - indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - indicates sample was diluted
mg/L - milligrams per liter
ug/L - micrograms per liter

Table 4.0-1
Standard Mine September 2008
Pearson Correlation

Correlations

		96 Hour Survival Rate	Distance from mine outlet (m)	Cadmium (u/L)	Zinc (u/L)	End Conductivity	End Dissolved O2
96 Hour Survival Rate	Pearson Correlation	1	.760**	-.989**	-.993**	-.575*	.599*
	Sig. (1-tailed)		0.009	0	0	0.041	0.034
	N	10	9	10	10	10	10
Distance from mine outlet (m)	Pearson Correlation	.760**	1	-.784**	-.781**	-.876**	0.163
	Sig. (1-tailed)	0.009		0.006	0.007	0.001	0.337
	N	9	9	9	9	9	9
Cadmium (ug/L)	Pearson Correlation	-.989**	-.784**	1	.997**	.598*	-0.549
	Sig. (1-tailed)	0	0.006		0	0.034	0.05
	N	10	9	10	10	10	10
Zinc (ug/L)	Pearson Correlation	-.993**	-.781**	.997**	1	.589*	-.587*
	Sig. (1-tailed)	0	0.007	0		0.037	0.037
	N	10	9	10	10	10	10
End Conductivity	Pearson Correlation	-.575*	-.876**	.598*	.589*	1	-0.249
	Sig. (1-tailed)	0.041	0.001	0.034	0.037		0.244
	N	10	9	10	10	10	10

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Figures

Figure 3.1-1
Average Mortality for Standard Mine
September 2008 Sampling Event
Rainbow Trout 96 Hour Acute Toxicity Test

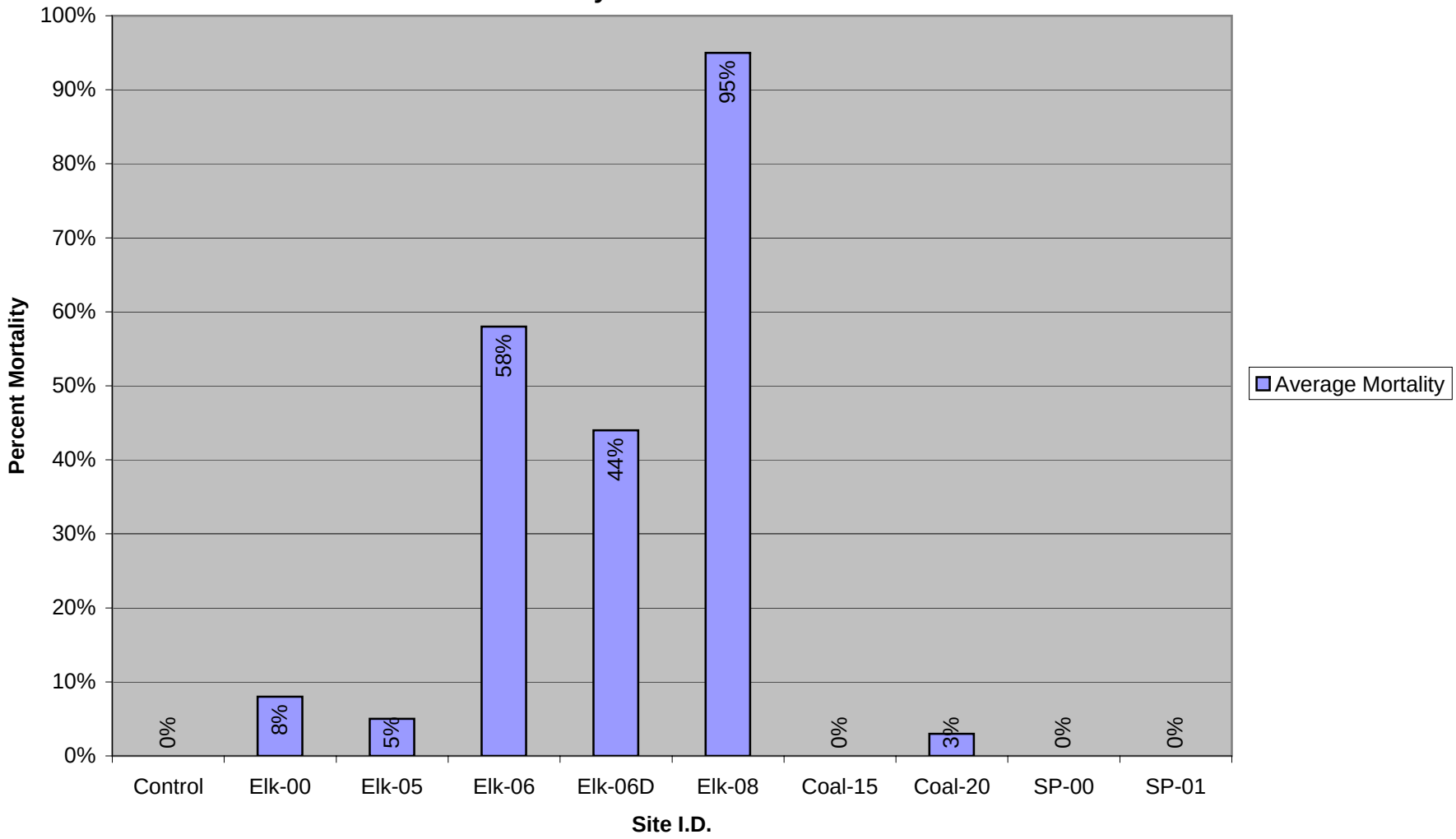


Figure 3.1-2
Average Mortality for Standard Mine
September 2008 Reference Test
Rainbow Trout 96 Hour Acute Toxicity Test

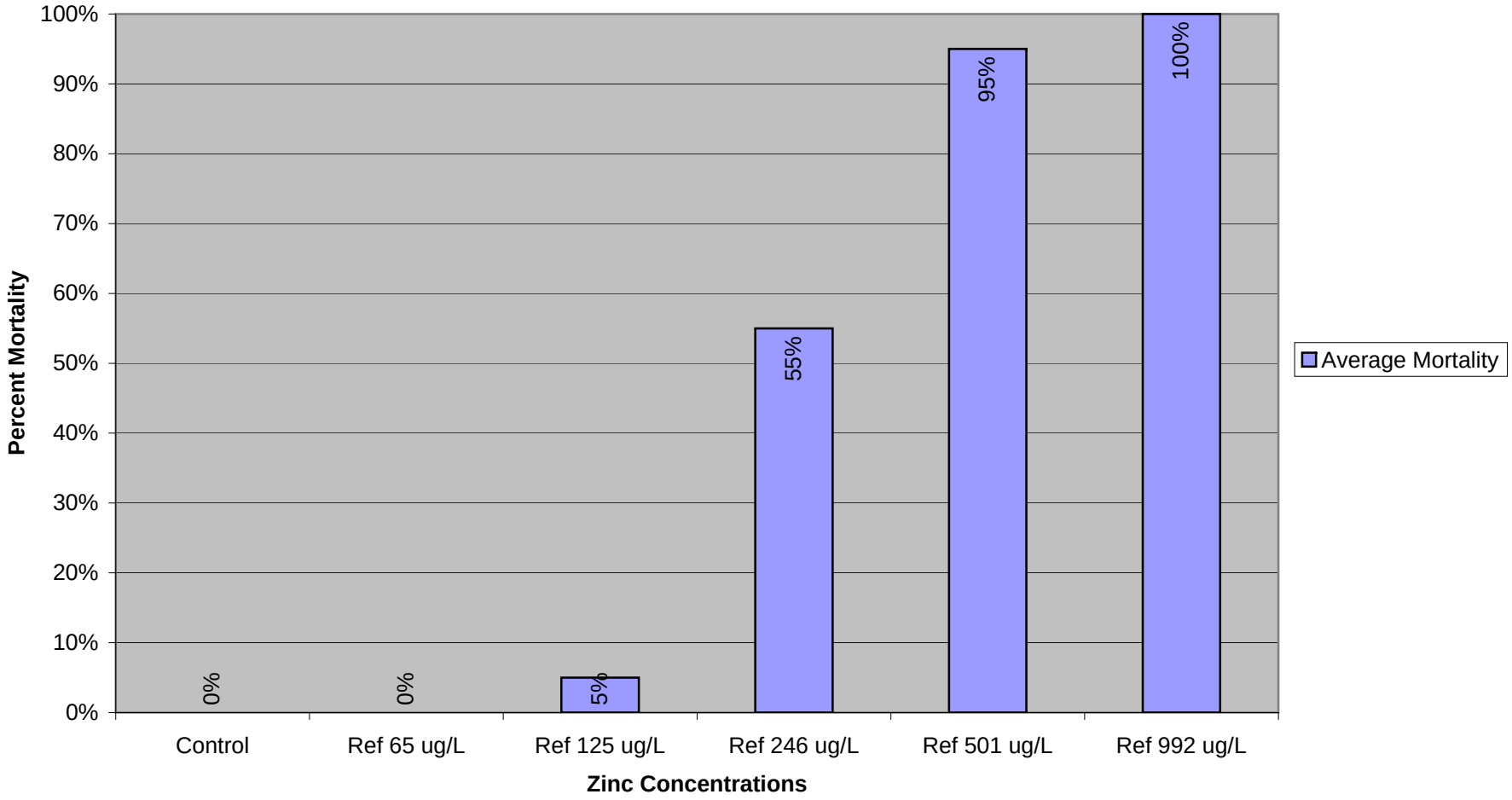
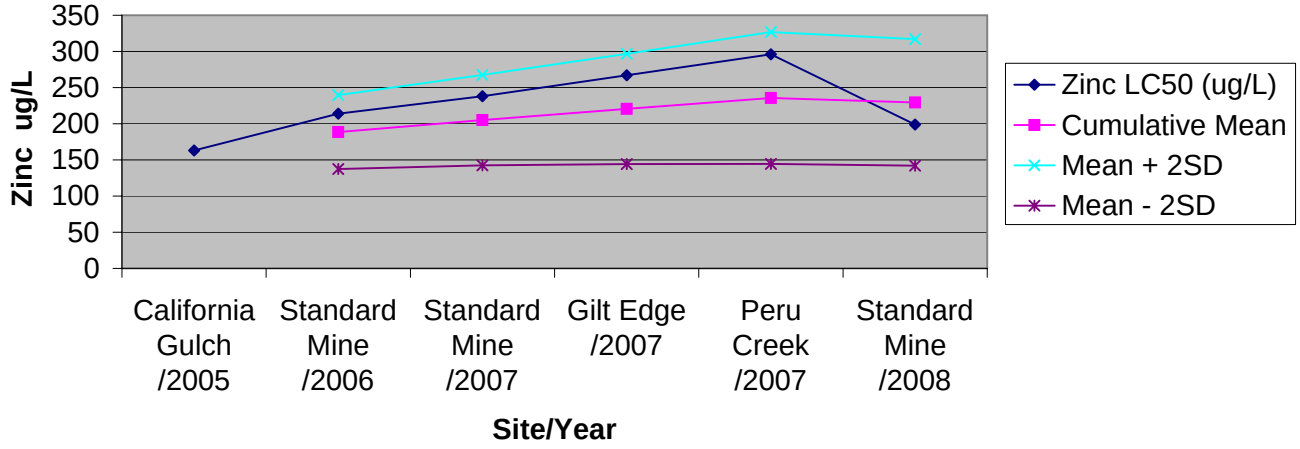


Figure 3.2-1
Zinc LC 50 Reference Chart



Appendix A
2008 Standard Mine
Site Water Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (°C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Control-01	Day 0	7.56	13.33	8.02	314	53.5	88.69	0		
	Day 1	7.72	12.57	6.66	300	n/a	n/a	0		
	Day 2	7.85	12.05	7.99	260	n/a	n/a	0		
	Day 3	7.94	11.47	7.80	289	n/a	n/a	0		
	Day 4	7.49	11.32	7.22	252	55	110.4	0		
Control-02	Day 0	8.12	12.63	8.08	299	53.5	88.69	0		
	Day 1	7.82	12.23	6.61	299	n/a	n/a	0		
	Day 2	7.97	11.86	8.09	264	n/a	n/a	0		
	Day 3	7.95	11.54	7.87	290	n/a	n/a	0		
	Day 4	7.84	11.31	7.39	253	55	110.4	0		
Control-03	Day 0	8.12	12.51	7.98	301	53.5	88.69	0	0	0%
	Day 1	7.88	12.26	6.85	302	n/a	n/a	0		
	Day 2	8.01	11.83	8.15	263	n/a	n/a	0		
	Day 3	7.89	11.56	7.50	289	n/a	n/a	0		
	Day 4	7.85	11.32	7.09	254	55	110.4	0		
Control-04	Day 0	8.10	13.08	7.40	292	53.5	88.69	0		
	Day 1	7.92	12.21	6.94	304	n/a	n/a	0		
	Day 2	7.96	11.88	7.97	262	n/a	n/a	0		
	Day 3	7.87	11.61	7.50	288	n/a	n/a	0		
	Day 4	7.80	11.37	6.66	254	55	110.4	0		
Elk-00-01	Day 0	7.99	13.00	8.38	151	38.75	71.11	0		
	Day 1	7.95	12.04	6.45	170	n/a	n/a	0		
	Day 2	7.89	11.75	7.77	143	n/a	n/a	1		
	Day 3	7.81	11.48	7.48	156	n/a	n/a	0		
	Day 4	7.83	11.13	7.29	149	45	73.6	0		
Elk-00-02	Day 0	8.10	12.44	7.81	155	38.75	71.11	0		
	Day 1	7.89	12.11	6.40	162	n/a	n/a	0		
	Day 2	7.87	11.72	8.14	141	n/a	n/a	1		
	Day 3	7.80	11.58	7.48	155	n/a	n/a	0		
	Day 4	7.79	11.27	7.43	136	45	68	1		
Elk-00-03	Day 0	8.03	12.40	7.95	153	38.75	71.11	0	3	8%
	Day 1	7.84	12.21	6.51	162	n/a	n/a	0		
	Day 2	7.85	11.72	7.88	141	n/a	n/a	0		
	Day 3	7.80	11.57	7.80	156	n/a	n/a	0		
	Day 4	7.77	11.30	7.32	136	45	72.4	0		
Elk-00-04	Day 0	7.99	12.53	8.20	156	38.75	71.11	0		
	Day 1	7.75	12.22	6.73	162	n/a	n/a	0		
	Day 2	7.81	11.73	7.79	141	n/a	n/a	0		
	Day 3	7.80	11.54	7.84	155	n/a	n/a	0		
	Day 4	7.75	11.29	6.73	136	45	72	0		

Appendix A
2008 Standard Mine
Site Water Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (◦C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Elk-05-01	Day 0	7.68	12.32	8.34	155	38.75	69.64	0		
	Day 1	7.81	11.93	6.20	162	n/a	n/a	1		
	Day 2	7.87	11.77	8.09	141	n/a	n/a	1		
	Day 3	7.60	11.82	7.51	155	n/a	n/a	0		
	Day 4	6.88	11.83	7.02	131	40	78	0		
Elk-05-02	Day 0	8.40	12.30	8.33	156	38.75	69.64	0		
	Day 1	7.78	12.06	6.33	163	n/a	n/a	0		
	Day 2	7.82	11.68	8.06	142	n/a	n/a	0		
	Day 3	7.67	11.58	7.48	156	n/a	n/a	0		
	Day 4	7.47	11.39	7.16	135	40	78	0		
Elk-05-03	Day 0	8.11	12.36	8.25	156	38.75	69.64	0	2	5%
	Day 1	7.80	12.26	6.23	162	n/a	n/a	0		
	Day 2	7.83	11.69	7.75	141	n/a	n/a	0		
	Day 3	7.69	11.92	7.33	154	n/a	n/a	0		
	Day 4	7.57	11.36	7.15	136	40	78	0		
Elk-05-04	Day 0	8.05	12.30	7.97	156	38.75	69.64	0		
	Day 1	7.84	12.07	6.91	163	n/a	n/a	0		
	Day 2	7.82	11.72	8.02	141	n/a	n/a	0		
	Day 3	7.70	11.60	7.75	155	n/a	n/a	0		
	Day 4	7.65	11.23	7.24	136	40	78	0		
Elk-06-01	Day 0	7.52	12.22	8.38	232	25	102.51	0		
	Day 1	7.33	12.59	8.01	236	n/a	n/a	3		
	Day 2	7.72	11.70	8.18	207	n/a	n/a	2		
	Day 3	7.27	11.57	7.75	221	n/a	n/a	1		
	Day 4	7.23	11.49	7.03	191	30	119.6	1		
Elk-06-02	Day 0	7.88	12.31	7.92	233	25	102.51	0		
	Day 1	7.39	12.20	6.62	238	n/a	n/a	5		
	Day 2	7.74	11.61	8.06	205	n/a	n/a	1		
	Day 3	7.34	11.44	7.91	222	n/a	n/a	0		
	Day 4	7.36	11.34	6.61	196	30	119.6	0		
Elk-06-03	Day 0	7.83	12.35	7.94	231	25	102.51	0	23	58%
	Day 1	7.45	12.23	6.76	241	n/a	n/a	4		
	Day 2	7.70	11.66	8.06	206	n/a	n/a	3		
	Day 3	7.39	11.41	7.76	225	n/a	n/a	0		
	Day 4	7.40	11.28	7.43	196	30	119.6	0		
Elk-06-04	Day 0	7.82	12.44	8.07	225	25	102.51	0		
	Day 1	7.50	12.17	6.86	241	n/a	n/a	2		
	Day 2	7.64	11.60	8.09	208	n/a	n/a	1		
	Day 3	7.38	11.44	7.80	228	n/a	n/a	0		
	Day 4	7.38	11.24	7.48	198	30	119.6	0		
Elk-06D-01	Day 0	7.65	12.84	8.23	222	25	102.45	0		
	Day 1	7.42	12.22	6.70	236	n/a	n/a	1		
	Day 2	7.59	11.72	7.92	209	n/a	n/a	2		
	Day 3	7.25	11.66	7.58	227	n/a	n/a	1		
	Day 4	6.95	11.78	6.97	191	28.75	108	0		
Elk-06D-02	Day 0	7.67	12.68	8.22	231	25	102.45	0		
	Day 1	7.48	12.19	6.83	239	n/a	n/a	3		
	Day 2	7.61	11.62	8.10	206	n/a	n/a	1		
	Day 3	7.34	11.45	7.31	226	n/a	n/a	0		
	Day 4	7.23	11.41	7.02	197	28.75	108	0		
Elk-06D-03	Day 0	7.69	12.36	8.25	232	25	102.45	0	17	44%
	Day 1	7.50	12.16	7.06	239	n/a	n/a	2		
	Day 2	7.63	11.68	7.99	206	n/a	n/a	0		
	Day 3	7.37	11.43	7.65	228	n/a	n/a	0		
	Day 4	7.29	11.31	7.41	198	28.75	108	0		
Elk-06D-04	Day 0	7.82	12.41	8.39	232	25	102.45	0		
	Day 1	7.49	12.36	6.44	236	n/a	n/a	4		
	Day 2	7.66	11.62	8.09	205	n/a	n/a	3		
	Day 3	7.48	11.52	7.85	223	n/a	n/a	0		
	Day 4	7.38	11.19	7.50	196	28.75	108	0		

Appendix A
2008 Standard Mine
Site Water Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (◦C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Elk-08-01	Day 0	7.62	12.25	8.39	252	28.75	114.39	0		
	Day 1	7.69	12.27	7.38	260	n/a	n/a	5		
	Day 2	7.73	11.60	6.02	223	ND	ND	5		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Elk-08-02	Day 0	7.76	12.24	8.20	255	28.75	114.39	0		
	Day 1	7.67	12.07	6.81	262	n/a	n/a	5		
	Day 2	7.72	11.61	6.62	225	n/a	n/a	4		
	Day 3	7.22	11.86	7.40	241	n/a	n/a	0		
	Day 4	7.45	11.20	6.01	211	30	125.2	0		
Elk-08-03	Day 0	7.75	12.28	8.25	256	28.75	114.39	0	38	95%
	Day 1	7.63	12.19	6.60	261	n/a	n/a	7		
	Day 2	7.77	11.95	7.91	220	ND	ND	3		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Elk-08-04	Day 0	7.72	12.32	8.20	254	28.75	114.39	0		
	Day 1	7.80	12.19	7.01	262	n/a	n/a	7		
	Day 2	7.75	11.59	7.34	223	n/a	n/a	2		
	Day 3	7.34	11.54	7.93	243	n/a	n/a	0		
	Day 4	7.46	11.23	7.24	212	30	125.2	0		
Coal-15-01	Day 0	8.52	12.39	8.62	86	24.25	38.37	0		
	Day 1	7.51	12.27	6.64	93	n/a	n/a	0		
	Day 2	7.52	11.41	7.05	78	n/a	n/a	0		
	Day 3	7.54	11.66	7.67	90	n/a	n/a	0		
	Day 4	7.51	11.33	7.30	76	30	48	0		
Coal-15-02	Day 0	8.25	12.27	8.36	87	24.25	38.37	0		
	Day 1	7.53	12.17	6.52	94	n/a	n/a	0		
	Day 2	7.47	11.56	7.14	80	n/a	n/a	0		
	Day 3	7.52	11.43	7.54	90	n/a	n/a	0		
	Day 4	7.54	11.11	7.33	78	30	48	0		
Coal-15-03	Day 0	8.17	12.26	8.36	87	24.25	38.37	0	0	0%
	Day 1	7.57	12.12	7.01	94	n/a	n/a	0		
	Day 2	7.55	11.63	7.43	80	n/a	n/a	0		
	Day 3	7.50	11.47	7.42	90	n/a	n/a	0		
	Day 4	7.57	11.15	7.25	77	30	48	0		
Coal-15-04	Day 0	8.10	12.32	8.27	87	24.25	38.37	0		
	Day 1	7.73	12.13	6.63	94	n/a	n/a	0		
	Day 2	7.60	12.05	6.87	80	n/a	n/a	0		
	Day 3	7.49	11.49	7.20	91	n/a	n/a	0		
	Day 4	7.55	11.18	7.34	78	30	48	0		

Appendix A
2008 Standard Mine
Site Water Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (◦C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Coal-20-01	Day 0	7.55	12.51	8.09	68	22.5	30.49	0		
	Day 1	7.27	12.35	6.63	77	n/a	n/a	0		
	Day 2	7.45	11.50	6.03	67	n/a	n/a	0		
	Day 3	7.12	11.58	7.55	74	n/a	n/a	0		
	Day 4	7.34	11.23	6.89	61	25	29.6	0		
Coal-20-02	Day 0	7.67	12.21	8.15	71	22.5	30.49	0		
	Day 1	7.43	12.04	6.64	77	n/a	n/a	0		
	Day 2	7.52	11.92	7.07	65	n/a	n/a	0		
	Day 3	7.29	11.42	7.65	74	n/a	n/a	0		
	Day 4	7.39	11.19	7.37	63	25	29.6	0		
Coal-20-03	Day 0	7.67	12.21	8.08	70	22.5	30.49	0	1	3%
	Day 1	7.48	11.99	6.92	78	n/a	n/a	0		
	Day 2	7.53	12.33	6.87	65	n/a	n/a	0		
	Day 3	7.33	11.44	7.82	74	n/a	n/a	0		
	Day 4	7.45	11.16	7.43	64	25	29.6	0		
Coal-20-04	Day 0	7.55	12.25	8.09	71	22.5	30.49	0		
	Day 1	7.53	12.06	7.08	76	n/a	n/a	0		
	Day 2	7.57	11.63	6.62	66	n/a	n/a	0		
	Day 3	7.39	11.39	8.03	74	n/a	n/a	0		
	Day 4	7.46	11.25	7.25	64	25	29.6	1		
SP-00-01	Day 0	7.62	12.40	8.25	58	25	25.37	0		
	Day 1	7.39	12.34	6.90	65	n/a	n/a	0		
	Day 2	7.62	11.44	6.92	57	n/a	n/a	0		
	Day 3	7.25	11.70	7.85	64	n/a	n/a	0		
	Day 4	7.39	11.31	7.01	53	32.5	34	0		
SP-00-02	Day 0	7.80	12.24	8.36	59	25	25.37	0		
	Day 1	7.54	12.14	7.03	65	n/a	n/a	0		
	Day 2	7.67	11.47	7.30	56	n/a	n/a	0		
	Day 3	7.36	11.51	8.11	63	n/a	n/a	0		
	Day 4	7.46	11.19	7.21	54	32.5	34	0		
SP-00-03	Day 0	7.58	12.23	8.42	59	25	25.37	0	0	0%
	Day 1	7.60	12.09	7.30	65	n/a	n/a	0		
	Day 2	7.62	11.79	6.59	56	n/a	n/a	0		
	Day 3	7.43	11.42	7.95	63	n/a	n/a	0		
	Day 4	7.48	11.25	7.09	55	32.5	34	0		
SP-00-04	Day 0	7.40	12.24	8.38	59	25	25.37	0		
	Day 1	7.64	12.09	6.96	65	n/a	n/a	0		
	Day 2	7.64	11.56	6.82	57	n/a	n/a	0		
	Day 3	7.45	11.43	7.77	64	n/a	n/a	0		
	Day 4	7.56	11.17	7.24	55	32.5	34	0		
SP-01-01	Day 0	7.83	12.54	8.17	51	27.5	22.71	0		
	Day 1	7.44	12.30	6.60	61	n/a	n/a	0		
	Day 2	7.66	11.80	7.04	54	n/a	n/a	0		
	Day 3	7.17	11.80	6.63	56	n/a	n/a	0		
	Day 4	7.29	11.44	6.44	49	30	28	0		
SP-01-02	Day 0	7.98	12.32	8.08	53	27.5	22.71	0		
	Day 1	7.53	12.14	6.96	61	n/a	n/a	0		
	Day 2	7.59	11.48	7.32	53	n/a	n/a	0		
	Day 3	7.25	11.47	7.44	59	n/a	n/a	0		
	Day 4	7.36	11.29	7.01	51	30	28	0		
SP-01-03	Day 0	7.94	12.29	8.05	53	27.5	22.71	0	0	0%
	Day 1	7.57	12.12	6.99	61	n/a	n/a	0		
	Day 2	7.57	11.48	6.68	54	n/a	n/a	0		
	Day 3	7.31	11.47	7.72	60	n/a	n/a	0		
	Day 4	7.44	11.16	6.96	51	30	28	0		
SP-01-04	Day 0	6.84	12.26	8.02	53	27.5	22.71	0		
	Day 1	7.60	12.08	7.04	61	n/a	n/a	0		
	Day 2	7.58	11.48	7.17	53	n/a	n/a	0		
	Day 3	7.37	11.51	7.99	58	n/a	n/a	0		
	Day 4	7.47	11.12	7.11	51	30	28	0		

°C - degrees celcius
D.O. - Dissolved Oxygen
mg/L - milligrams per liter
% - percent
ND - No Data
n/a - not applicable

Appendix B
2008 Standard Mine
Reference Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (°C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Ref Control-01	Day 0	8.08	12.74	7.90	299	52.5	88.69	0		
	Day 1	7.92	12.49	6.96	298	n/a	n/a	0		
	Day 2	7.98	11.51	7.47	263	n/a	n/a	0		
	Day 3	7.62	12.73	7.33	277	n/a	n/a	0		
	Day 4	7.68	11.53	7.25	251	60	91.2	0		
Ref Control-02	Day 0	8.09	12.47	7.99	300	52.5	88.69	0		
	Day 1	7.91	12.04	6.99	303	n/a	n/a	0		
	Day 2	7.92	11.91	6.68	261	n/a	n/a	0		
	Day 3	7.82	11.76	7.71	288	n/a	n/a	0		
	Day 4	7.81	11.22	7.71	252	60	91.2	0		
Ref Control-03	Day 0	8.12	12.31	7.83	301	52.5	88.69	0	0	0%
	Day 1	7.88	12.11	6.70	302	n/a	n/a	0		
	Day 2	7.90	11.86	7.45	262	n/a	n/a	0		
	Day 3	7.87	11.70	7.48	288	n/a	n/a	0		
	Day 4	7.86	11.18	7.76	252	60	91.2	0		
Ref Control-04	Day 0	8.12	12.26	8.06	297	52.5	88.69	0		
	Day 1	8.18	12.07	6.75	303	n/a	n/a	0		
	Day 2	7.89	11.73	7.44	262	n/a	n/a	0		
	Day 3	7.86	11.68	7.91	288	n/a	n/a	0		
	Day 4	7.88	11.28	7.24	252	60	91.2	0		
Ref-6.25%-01	Day 0	8.11	12.21	8.07	299	51.5	88.85	0		
	Day 1	8.03	11.95	6.50	303	n/a	n/a	0		
	Day 2	7.98	11.44	7.82	263	n/a	n/a	0		
	Day 3	7.95	11.38	7.57	291	n/a	n/a	0		
	Day 4	7.92	11.09	7.43	252	55	94.8	0		
Ref-6.25%-02	Day 0	8.09	12.18	8.63	301	51.5	88.85	0		
	Day 1	7.90	11.97	6.30	302	n/a	n/a	0		
	Day 2	8.01	11.46	7.93	263	n/a	n/a	0		
	Day 3	7.95	11.36	7.84	290	n/a	n/a	0		
	Day 4	7.93	11.11	7.49	252	55	94.8	0		
Ref-6.25%-03	Day 0	8.10	12.33	8.20	300	51.5	88.85	0	0	0%
	Day 1	7.95	11.93	6.88	301	n/a	n/a	0		
	Day 2	8.01	11.52	7.93	263	n/a	n/a	0		
	Day 3	7.93	11.43	7.61	289	n/a	n/a	0		
	Day 4	7.90	11.12	7.51	252	55	94.8	0		
Ref-6.25%-04	Day 0	8.10	12.32	8.48	301	51.5	88.85	0		
	Day 1	7.98	11.99	6.97	301	n/a	n/a	0		
	Day 2	7.97	11.69	7.47	262	n/a	n/a	0		
	Day 3	7.88	11.51	7.69	289	n/a	n/a	0		
	Day 4	7.90	11.14	7.21	252	55	94.8	0		
Ref-12.5%-01	Day 0	8.08	12.14	8.67	298	50	88.14	0		
	Day 1	8.05	11.83	6.70	302	n/a	n/a	0		
	Day 2	7.96	11.58	7.99	263	n/a	n/a	0		
	Day 3	7.87	11.33	7.46	289	n/a	n/a	0		
	Day 4	7.90	11.02	7.58	252	45	90	0		
Ref-12.5%-02	Day 0	8.14	12.23	8.25	298	50	88.14	0		
	Day 1	8.01	11.97	6.51	303	n/a	n/a	0		
	Day 2	7.95	11.55	7.86	263	n/a	n/a	1		
	Day 3	7.85	11.39	7.64	288	n/a	n/a	0		
	Day 4	7.90	11.11	7.51	251	45	90	0		
Ref-12.5%-03	Day 0	8.16	12.35	8.08	298	50	88.14	0	2	5%
	Day 1	7.95	12.05	6.45	304	n/a	n/a	0		
	Day 2	7.97	11.62	7.96	263	n/a	n/a	1		
	Day 3	7.85	11.45	7.77	288	n/a	n/a	0		
	Day 4	7.91	11.11	7.52	252	45	90	0		
Ref-12.5%-04	Day 0	8.14	12.33	8.13	298	50	88.14	0		
	Day 1	8.05	12.02	6.77	303	n/a	n/a	0		
	Day 2	8.01	11.61	7.93	264	n/a	n/a	0		
	Day 3	7.90	11.46	7.84	289	n/a	n/a	0		
	Day 4	7.94	11.13	7.31	253	45	90	0		

Appendix B
2008 Standard Mine
Reference Toxicity Test
Daily Water Chemistries

Site ID	Test Day	pH	Temp. (°C)	D.O. (mg/L)	Conductivity	Alkalinity	Hardness	Number Dead	Total Number Dead	% Mortality
Ref-25%-01	Day 0	8.42	12.16	7.97	297	52.5	87.88	0		
	Day 1	8.06	11.90	7.36	303	n/a	n/a	5		
	Day 2	8.03	11.44	7.91	261	n/a	n/a	2		
	Day 3	7.93	11.36	7.56	285	n/a	n/a	0		
	Day 4	7.88	11.03	7.34	250	50	92	0		
Ref-25%-02	Day 0	8.37	12.26	7.90	297	52.5	87.88	0		
	Day 1	8.02	12.03	6.20	302	n/a	n/a	3		
	Day 2	8.03	11.52	7.97	261	n/a	n/a	3		
	Day 3	7.90	11.45	7.77	285	n/a	n/a	0		
	Day 4	7.93	11.11	7.60	249	50	92	0	22	55%
Ref-25%-03	Day 0	8.33	12.33	8.05	297	52.5	87.88	0		
	Day 1	7.98	12.09	6.32	304	n/a	n/a	3		
	Day 2	8.00	11.58	7.75	261	n/a	n/a	1		
	Day 3	7.89	11.50	7.76	286	n/a	n/a	0		
	Day 4	7.94	11.16	7.40	250	50	92	0		
Ref-25%-04	Day 0	8.23	12.35	8.01	297	52.5	87.88	0		
	Day 1	7.97	12.11	6.17	289	n/a	n/a	3		
	Day 2	8.00	11.64	7.81	262	n/a	n/a	2		
	Day 3	7.92	11.58	7.66	286	n/a	n/a	0		
	Day 4	7.95	11.26	7.29	250	50	92	0		
Ref-50%-01	Day 0	7.65	12.16	7.77	297	51.25	87.75	0		
	Day 1	7.99	11.89	6.18	301	n/a	n/a	7		
	Day 2	8.04	11.38	8.07	260	n/a	n/a	2		
	Day 3	7.90	11.50	7.53	283	n/a	n/a	0		
	Day 4	7.96	11.04	7.38	249	55	91.6	0		
Ref-50%-02	Day 0	7.87	12.25	7.94	299	51.25	87.75	0		
	Day 1	8.06	11.99	7.22	300	n/a	n/a	8		
	Day 2	8.06	11.48	8.10	259	ND	ND	2		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Ref-50%-03	Day 0	7.94	12.35	8.06	299	51.25	87.75	0	38	95%
	Day 1	8.06	12.08	6.62	302	n/a	n/a	7		
	Day 2	8.07	11.59	8.02	259	n/a	n/a	2		
	Day 3	7.92	11.44	7.62	284	n/a	n/a	0		
	Day 4	7.96	11.14	7.22	249	55	91.6	0		
Ref-50%-04	Day 0	7.98	12.37	8.07	299	51.25	87.75	0		
	Day 1	7.97	12.19	6.61	298	n/a	n/a	7		
	Day 2	8.07	11.66	8.02	260	ND	ND	3		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Ref-100%-01	Day 0	7.95	12.12	8.04	299	52.5	86.78	0		
	Day 1	8.11	11.87	6.45	301	ND	ND	10		
	Day 2	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Ref-100%-02	Day 0	7.97	12.13	8.23	299	52.5	86.78	0		
	Day 1	8.05	11.88	6.71	302	n/a	n/a	9		
	Day 2	8.05	11.48	8.02	258	ND	ND	1		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Ref-100%-03	Day 0	8.00	12.22	8.12	299	52.5	86.78	0	40	100%
	Day 1	8.09	11.97	6.88	301	n/a	n/a	9		
	Day 2	8.03	11.52	8.02	258	ND	ND	1		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		
Ref-100%-04	Day 0	7.87	12.34	8.02	298	52.5	86.78	0		
	Day 1	8.03	12.07	6.80	302	n/a	n/a	9		
	Day 2	8.06	11.58	8.00	258	ND	ND	1		
	Day 3	n/a	n/a	n/a	n/a	n/a	n/a	0		
	Day 4	n/a	n/a	n/a	n/a	n/a	n/a	0		

°C - degrees celcius
D.O. - Dissolved Oxygen
mg/L - milligrams per liter
% - percent
ND - No Data
n/a - not applicable

Attachments

Fish 96-h Acute Survival Test **U.S. EPA Region VIII Laboratory**

Analysis No:	01-2271-1889	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	22 Oct-08 13:51	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes
Test Run No:	11-1844-7021	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	18 Sep-07	**Protocol:**	Not Applicable	**Diluent:**	Deionized Water
Ending Date:	22 Sep-08	**Species:**	Oncorhynchus mykiss	**Brine:**	Not Applicable
Duration:	370d 0h	**Source:**	EPA Duluth	**Age:**	

Sample Code	Sample No	Sample Date	Receive Date	Sample Age	Client Name	Project
CONTROL	13-5002-2087	17 Sep-08		N/A	Internal Lab	Effluent Characterization (
COAL-15	10-2407-7428	17 Sep-08		N/A		
COAL-20	17-8019-5190	17 Sep-08		N/A		
ELK-00	17-5583-9444	17 Sep-08		N/A		
ELK-05	10-1397-1397	17 Sep-08		N/A		
ELK-06	12-1333-6773	17 Sep-08		N/A		
ELK-06D	17-3742-2449	17 Sep-08		N/A		
ELK-08	15-9264-5384	02 Oct-08		N/A		
SP-00	03-0940-7914	17 Sep-08		N/A		
SP-01	10-6266-3231	17 Sep-08		N/A		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
CONTROL	Mining Discharge/Runoff	Standard Mine	NEGATIVE CTRL		
COAL-15	Mining Discharge/Runoff	Standard Mine	COAL-15		
COAL-20	Mining Discharge/Runoff	Standard Mine	COAL-20		
ELK-00	Mining Discharge/Runoff	Standard Mine	ELK-00		
ELK-05	Mining Discharge/Runoff	Standard Mine	ELK-05		
ELK-06	Mining Discharge/Runoff	Standard Mine	ELK-06		
ELK-06D	Mining Discharge/Runoff	Standard Mine	ELK-06D		
ELK-08	Mining Discharge/Runoff	Standard Mine	ELK-08		
SP-00	Mining Discharge/Runoff	Standard Mine	SP-00		
SP-01	Mining Discharge/Runoff	Standard Mine	SP-01		

Comments: STANDARD MINE EFFLUENT/RUNOFF POINT DISCHARGE COMPARISON.

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C <> T	Not Run					15.3%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
CONTROL		COAL-15	0.478	2.86	0.243	0.9990	Non-Significant Effect
		COAL-20	0	2.86	0.243	1.0000	Non-Significant Effect
		ELK-00	1.37	2.86	0.243	0.6730	Non-Significant Effect
		ELK-05	0.895	2.86	0.243	0.9440	Non-Significant Effect
		ELK-06	8.25	2.86	0.243	0.0000	Significant Effect
		ELK-06D	6.42	2.86	0.243	0.0000	Significant Effect
		ELK-08	13.8	2.86	0.243	0.0000	Significant Effect
		SP-00	0	2.86	0.243	1.0000	Non-Significant Effect
		SP-01	0	2.86	0.243	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	5.93066	0.6589622	9	45.4	0.0000	Significant Effect
Error	0.4355969	0.0145199	30			
Total	6.366257	0.6734821	39			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Varianc	1.54	3.07	0.1800	Equal Variances
Distribution	Shapiro-Wilk Normality	0.907		0.0032	Non-normal Distribution

Fish 96-h Acute Survival Test **U.S. EPA Region VIII Laboratory**

Analysis No: 01-2271-1889 **Endpoint:** 96h Survival Rate **CETIS Version:** CETISv1.6.3
Analyzed: 22 Oct-08 13:51 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CONTROL	4	1	1	1	1	1	0	0	0.0%	0.0%
COAL-15	4	0.975	0.956	0.994	0.9	1	0.00928	0.05	5.13%	2.5%
COAL-20	4	1	1	1	1	1	0	0	0.0%	0.0%
ELK-00	4	0.925	0.889	0.961	0.8	1	0.0178	0.0957	10.4%	7.5%
ELK-05	4	0.95	0.912	0.988	0.8	1	0.0186	0.1	10.5%	5.0%
ELK-06	4	0.425	0.353	0.497	0.3	0.7	0.0352	0.189	44.5%	57.5%
ELK-06D	4	0.575	0.497	0.653	0.3	0.8	0.0383	0.206	35.9%	42.5%
ELK-08	4	0.05	0.028	0.072	0	0.1	0.0107	0.0577	115.0%	95.0%
SP-00	4	1	1	1	1	1	0	0	0.0%	0.0%
SP-01	4	1	1	1	1	1	0	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CONTROL	4	1.41	1.41	1.41	1.41	1.41	0	0	0.0%	0.0%
COAL-15	4	1.37	1.34	1.4	1.25	1.41	0.0151	0.0815	5.94%	2.89%
COAL-20	4	1.41	1.41	1.41	1.41	1.41	0	0	0.0%	0.0%
ELK-00	4	1.3	1.24	1.35	1.11	1.41	0.0273	0.147	11.3%	8.28%
ELK-05	4	1.34	1.28	1.39	1.11	1.41	0.0283	0.152	11.4%	5.4%
ELK-06	4	0.709	0.635	0.783	0.58	0.991	0.0361	0.195	27.5%	49.8%
ELK-06D	4	0.865	0.782	0.947	0.58	1.11	0.0403	0.217	25.1%	38.8%
ELK-08	4	0.24	0.204	0.276	0.159	0.322	0.0175	0.0941	39.2%	83.0%
SP-00	4	1.41	1.41	1.41	1.41	1.41	0	0	0.0%	0.0%
SP-01	4	1.41	1.41	1.41	1.41	1.41	0	0	0.0%	0.0%

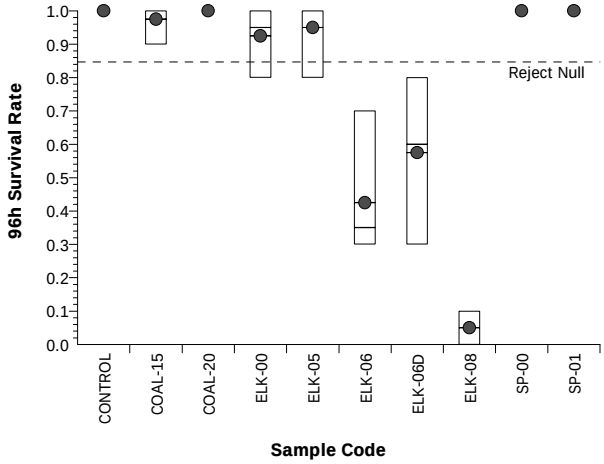
Fish 96-h Acute Survival Test **U.S. EPA Region VIII Laboratory**

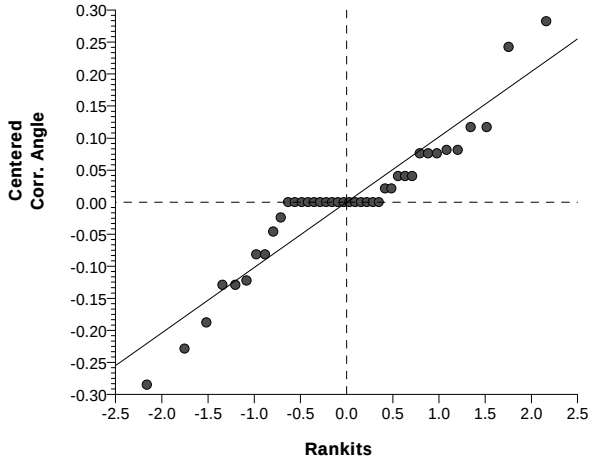
Analysis No: 01-2271-1889 **Endpoint:** 96h Survival Rate **CETIS Version:** CETISv1.6.3
Analyzed: 22 Oct-08 13:51 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
CONTROL	1	1	1	1
COAL-15	1	1	1	0.9
COAL-20	1	1	1	1
ELK-00	1	1	0.9	0.8
ELK-05	1	1	1	0.8
ELK-06	0.7	0.4	0.3	0.3
ELK-06D	0.8	0.6	0.6	0.3
ELK-08	0.1	0.1	0	0
SP-00	1	1	1	1
SP-01	1	1	1	1

Graphics





Sediment Toxicity Testing Report

Appendix C

Standard Mine
Sediment Toxicity Testing Report
September 2008 Sediment Collection
Final

Prepared for:

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Ecosystem Protection and Remediation-Program Support
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April 2009

Contract No. EP-W-06-033
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Acronym List

ºC	Degrees Celsius
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
LC50	50% Lethal Concentration
MHRW	Moderately Hard Reconstituted Water MHRW
mL	Milliliter
ORD	Office of Research and Development
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
YCT	Yeast, Cerophyl, and Trout Chow

1.0 INTRODUCTION

A 10-day flow through sediment toxicity test was performed at the United States Environmental Protection Agency (EPA) Region 8 Laboratory to determine the acute toxicity of sediments collected from drainages associated with the Standard Mine, located in Gunnison County, Colorado. Site sediment tests and a reference test were conducted on the amphipod *Hyalella azteca* (*H. azteca*), with evaluation endpoints of growth and mortality. A 96-hour reference toxicity test was performed as a quality assurance measure using an aqueous stock solution spiked with zinc, with an endpoint of mortality. This toxicity test report includes a brief background of the Standard Mine area, materials and methods, testing results, a discussion of results, and supporting references.

1.1 Background

The Standard Mine was part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity initially began at the Standard Mine in or around 1874, with the most significant operations beginning in 1931. Operations included the mining of lead, zinc, silver, and gold until 1966, when the mine was abandoned.

The mine consists of many open, unmarked adits and shafts, giving access to 8,400 feet of mine workings on 6 levels. The former mine is near a popular hiking trail and has no access restrictions. Wastes at this mining site are estimated to be 53,560 cubic yards of waste rock and 29,340 cubic yards of mill tailings as well as seasonably variable amounts of water flowing out of the adits. Additionally, there is a portion of land owned by the United States Forest Service which used to contain a non-engineered surface impoundment made entirely of highly mineralized waste rock. The unlined impoundment was built to collect metal laden acid mine drainage containing cadmium, copper, lead, and zinc. EPA Removal Program activities during the 2007 construction season included the removal of this site feature. However, there is evidence of overflow and seepage through the impoundment into Elk Creek, which runs adjacent to the mine. Elk Creek feeds into Coal Creek, a drinking water supply for the town of Crested Butte, four miles downstream from the former mine.

In 1999 a two-phase Site Inspection (SI) was conducted of the Ruby Mining District. Phase I was performed in June 1999 to assess the environmental conditions during the high stream flow regime and Phase II in September 1999 to assess the environmental conditions during the low stream flow regime. The 1999 SI was limited to surface water since, according to the United States Geological Survey, there are no extensive aquifer systems associated with the Ruby Mining District.

SI results revealed elevated concentrations of the following metals: aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, nickel, thallium, and zinc from total metals analyses of the surface waters from Coal Creek and its tributaries. Subsequent investigations performed in 2005, 2006, 2007, and 2008 confirmed metals impacted surface waters and identified metals impacted sediments in Elk Creek, and, to a lesser extent, Coal Creek.

1.2 Objective

The objective of this series of toxicity tests was to support the biomonitoring being performed as part of site assessment activities at the Standard Mine. Growth and mortality results will be incorporated into a biological monitoring report as an update of the site conditions that occurred after the completion of the Baseline Ecological Risk Assessment.

2.0 MATERIALS AND METHODS

This section outlines the materials and methodology employed for testing purposes and includes sediment collection procedures, water preparation and delivery, test organisms, food preparation, and testing procedures. General test methods followed EPA methodology (EPA, 2000) and are discussed below. General testing criteria are included in Table 2.0-1.

2.1 Sediment Collection

Site sediment was collected in September 2008 from locations along Elk Creek, Coal Creek, and Splain's Gulch in accordance with the 2008 Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for Standard Mine (ESAT, 2008). Using a Teflon hand trowel, sediment was taken from a depth of 0-6". Composite samples were collected at each location (along a 20 meter stretch) due to limited sediment volume observed in the field. Samples were stored in wide mouth 500 milliliter (mL) plastic containers and excess overlying water was decanted from each sample. The sample containers were placed on ice until received at the Region 8 laboratory and placed in a 4^{o}C cooler for preservation. Sample collection equipment was decontaminated in accordance with the SAP (ESAT, 2008).

2.2 Water Preparation and Delivery

Moderately hard reconstituted water (MHRW) was prepared in accordance with Smith et al. (1997). Preparation included adding 50 grams of calcium sulfate, 50 grams of calcium carbonate, 30 grams of magnesium sulfate, 96 grams of sodium bicarbonate, and 4 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. Once MHRW was prepared, the batch tank was continuously aerated for the duration of the toxicity test. Water quality was measured to verify the following parameters had been met: hardness between 90 and 100 milligrams per liter (mg/L), alkalinity between 50 and 70 mg/L, conductivity between 330 and 360 millisiemens/centimeter, and pH between 7.8 and 8.2 standard units (EPA, 2000). MHRW was delivered at a rate of two volumes of overlying water per day for each test chamber using the Wall Pump (a piston-type pump that delivers water at a low flow rate). One volume is equivalent to 175 mL of MHRW.

2.3 Test Organisms

H. azteca amphipod specimens were obtained from Aquatic Biosystems (Ft. Collins, Colorado) and used for sediment toxicity testing. Once received at the Region 8 laboratory, organisms were kept in their shipping bag and placed in a holding tank for approximately 48 hours for temperature and water quality acclimation. *H. azteca* used for

testing were cultured and shipped in MHRW water; therefore, water acclimation was not considered a substantial stress concern for the organisms. However, to reduce the potential of stress, the shipping bag was opened to allow a small amount of laboratory MHRW to mix with the shipping water. This procedure was repeated several times through the course of one day until laboratory MHRW and shipping water were well mixed. The holding tank was aerated gently and additional MHRW was added for further acclimation of the organisms. At the time of testing organisms were approximately 7 to 10 days old.

2.4 Food Preparation

Organisms were fed a Yeast, Cerophyl, and Trout Chow (YCT) mixture daily. YCT was prepared by adding 5 grams of Trout Chow to 1 liter of deionized water followed by homogenization in a blender. After homogenization the mixture was poured into a 2 liter separatory funnel, aerated, and allowed to digest for one week at room temperature. After the digestion period the aeration apparatus was removed and solid material was allowed to settle out for one hour, after which the supernatant was collected using a 110 mesh Nitex screen. Yeast solution was prepared by adding 5 grams of dry yeast to 1 liter deionized water followed by mixing. Cerophyl was prepared by adding 5 grams of alfalfa pellets to 1 liter of deionized water followed by homogenization in a blender. Equal parts of yeast, Trout Chow (supernatant), and cerophyl solutions were then added to a beaker and homogenized in a blender. The YCT mixture was then stored in a freezer or refrigerator until use. Refrigerated YCT was used within two weeks of storage. Feed dry weights for both the site sediment and reference tests are included in Table 2.4-1.

2.5 Test Procedures

The following sections include the procedures employed for the site sediment and reference toxicity tests.

2.5.1 Site Sediment Toxicity Test

Site sediment was obtained from the following eight locations along Elk Creek, Coal Creek, and Splain's Gulch: Elk-00, Elk-06, Elk-08, Coal-15, Coal-20, Coal-OPP, SP-00, and SP-01. No duplicate samples were taken for this test. For quality assurance purposes, testing was also performed on positive and negative sediment controls. Positive control sediments were spiked with zinc sulfate while negative controls were not spiked. West Bearskin Sediment provided by the EPA Office of Research and Development (ORD) Laboratory (Duluth, Minnesota) was used for control sediment. Eight replicates were tested for each location and each control. Testing chambers consisted of 300 mL beakers filled with 100 mL of sediment and 175 mL of overlying MHRW. Testing chambers were placed in a water bath to maintain a constant temperature of 23^{o}C during the test. Due to an error at the organism source laboratory (Cincinnati, ORD Lab) ESAT did not receive enough organisms to allow 10 per testing chamber. This error was not initially identified when placing organisms in testing chambers, therefore the test had to be stopped and re-started. The test was re-started after receiving organisms from Aquatic Biosystems (Ft. Collins, CO), as indicated in Section

2.3. Site sediments were frozen for 24 hours to kill off test organisms previously added to the sediment previously.

Prior to test initiation, ten organisms were counted and verified in disposable weigh boats, then transferred to test chambers using a pipette. A total of 10 organisms were added to testing chambers below the air-water interface. An additional 74 organisms were removed from the holding tank and dried for 24 hours in an 80 ^{o}C oven to determine an average dry weight per organism (Table 2.4-1).

As previously stated, testing took place over a 10 day period. Overlying water quality (MHRW) was measured daily for dissolved oxygen (DO) and temperature. At test initiation (Day 0) and test completion (Day 10), overlying water was measured for alkalinity, hardness, conductivity, ammonia, and pH (Appendix A). Organisms received 1 mL of YCT per test chamber on a daily basis. At the conclusion of the test, organisms were removed from the sediment (referred to as "picking") using pipettes, sieve, and/or Nitex screen. Before test initiation, personnel that would be involved with picking organisms from the sediment were required to demonstrate proficiency. This procedure was accomplished by capturing at least 90% of organisms placed into"practice" sediment. Only proficient personnel were allowed to participate at test conclusion. After the organisms were collected, they were placed in aluminum weigh boats and were counted. Afterwards, the weigh boats were dried in an oven for 24 hours so that a post-test weight could be obtained for growth evaluation.

2.5.2 Reference Toxicity Test

Reference toxicity testing followed procedures outlined in EPA Method 100.1 and was carried out concurrently with the site sediment toxicity test. Test chambers consisted of 200 mL beakers, filled with MHRW, and Nitex screen (an artificial substrate) and completely submerged. MHRW was spiked with zinc sulfate heptahydrate ($ZnSO_4$) using a serial dilution approach. $ZnSO_4$ concentrations were reduced by 50% starting with the highest concentration (referred to as 100%) until the lowest dilution percentage (6.25%) was reached. For example, the highest concentration (referred to as 100%) of $ZnSO_4$ was 750 ug/L, followed by 500 ug/L (50% dilution), 250 ug/L (25% dilution), 125 ug/L (12.5% dilution), and 62.5 ug/L (6.25% dilution). The endpoint for the reference test was mortality, so no growth data was collected.

3.0 RESULTS

This section presents results for the site sediment and reference toxicity tests and addresses any issues or unforeseen conditions encountered during the testing period.

3.1 Site Sediment Toxicity Testing

Sediments collected from the Elk Creek and Coal Creek drainages appeared similar in their general makeup, with samples described as primarily inorganic with coarse, non-uniform particles. Percent moisture values are shown in Figure 3.1-1 and Table 2.4-1 for sediments used for the toxicity test. Moisture content in sediment from Elk Creek ranged from 6% to 8%, Coal Creek ranged from 8% to 12%, Splains Gulch ranged from 11% to 13%. Control sediment had the highest moisture content ranging from 25% to 30%.

Sediment porewater samples were analyzed for total metals concentrations using EPA Method 200.8; results are listed in Table 3.1-1 and Table 3.1-2.

Testing chambers met performance criteria (Table 2.0-1) for daily water chemistry requirements and are listed in Appendix A. Variability in alkalinity, hardness, conductivity, and pH was less than 25% within each test chamber (method requires less than 50%), and DO was maintained above performance criteria of 2.5 mg/L. The overlying water temperatures did not deviate more than ±2°C from 23°C. On test initiation and test completion a composite sample was obtained from the eight replicates for ammonia analysis using EPA method 350.1. Ammonia was not detected on Day 0 (initial water chemistry) and on Day 9 (final water chemistry) concentrations ranged from 0.18 mg/L NH_3-N to 0.28 mg/L NH_3-N. Ammonia concentrations are shown in Appendix A.

At the end of the test, organism mortality was calculated and averaged for all replicates; results are included in Figure 3.1-2 and Table 3.1-3. The negative control had an average mortality of 43%, while the positive control was 48%, this did not meet the performance criteria of >80% survival. The reference locations (SP-00 and SP-01) showed 23% and 10% mortality, respectively. Sites Coal-15, Coal-20, and Coal-OPP had average mortality rates of 19%, 21%, and 12%, respectively. All Elk Creek sites had high mortality rates. Average mortality for Elk Creek sites are as follows: Elk-00 (71% mortality), Elk-06 (61.25% mortality), and Elk-08 (93.75% mortality).

Surviving organisms were collected at test completion and dry weights were obtained for biomass determination (Table 3.1-3 and Figure 3.1-3). After completion of the test, organisms were captured from sediment and placed in aluminum weigh boats. Effort was made to ensure that debris was not inadvertently added to weigh boats while picking organisms from sediment. An increase in growth when compared to average organism pre-weight was shown at the following sites: Control-N (0.0435 mg), Elk-00 (0.050 mg), SP-00 (0.059 mg), SP-01 (0.049 mg), Coal-15 (0.054 mg), and Coal-Opp (0.036 mg). Average post weights were lower than average organism pre-weight at the following locations: Control-P (0.0191 mg), Elk-06 (0.0340 mg), Elk-08 (0.0000 mg), and Coal-20 (0.0280 mg).

3.2 Reference Toxicity Test

Overlying water quality parameters were consistent throughout the test and are listed in Appendix B. Test chamber temperatures ranged between 21.15°C and 22.98°C during the testing period. Temperatures did not deviate more than 1°C during the course of 24 hours and did not deviate more than 2°C during the testing period. Variability in alkalinity, hardness, conductivity, and pH was less than 50% within each test chamber, and DO levels ranged 4.50 to 7.77 mg/L. Performance criterion for EPA Method 100.1 requires no more than 50% change for alkalinity and hardness. DO must be maintained above 2.5 mg/L.

At test completion, surviving organisms were collected and counted; results are included in Figure 3.2-1. No mortality was observed in the control, (performance criteria requires 80% survival). The following are the dilutions and mortality rates from the reference toxicity test: 62.5 ug/L zinc (23% mortality), 125 ug/L zinc (25% mortality), 250 ug/L

zinc (98% mortality), 500 ug/L zinc and 750 ug/L zinc (100% mortality). An LC50 value of 156 ug/L (upper confidence limit of 188 ug/L zinc and a lower confidence limit of 130 ug/L zinc) was determined using the Trimmed Spearman-Karber method (Hamilton, 1977).

4.0 DISCUSSION

As stated in Section 2.5-1, an error occurred with the number of organisms received from the ORD Laboratory (Cincinnati, Ohio). There were not enough organisms to allow ten per test chamber. The organism shortage was not realized until a majority of test chambers were populated. The test was stopped and sediments were placed in a freezer for 24 hours to euthanize test organisms and the test was re-initiated. All methods and results reflect the re-initiation test.

Results of the site sediment toxicity test indicate that the sites along Elk Creek are acutely toxic to *H. azteca*, with mortality ranging from 61%-94%. Upper reaches along Elk Creek showed more toxic effects to test organisms than the lower sections of Elk Creek. Coal Creek sites did not show substantial mortality and mortality was 21% or less. Splains Gulch showed minimal mortality at sites SP-00 (23%) and SP-01 (10%) and was not acutely toxic to *H. azteca*.

For this test the negative controls did not meet performance criterion of at least 80% of test organisms recovered from sediment. Therefore, all data should be interpreted with caution.

In order to determine the significance of the observed toxic effects, a Dunnetts Multiple Comparison Test was performed. Results indicated that there is a significant toxic effect at sites Elk-00 (t=6.8, p<0.001), Elk-06 (t=5.7, p<0.001), Elk-08 (t=9.7, p<0.001), and negative control (t=3.7, p<0.002) when compared to reference location, SP-01 (Attachment A). There was no significant effect at the remaining sites

Results of the reference toxicity test showed the calculated LC50 value lower than historical LC 50 values for zinc (350 ug/L). The calculated LC50 value was 156 ug/L with upper confidence limits of 188 ug/L and a lower confidence limit of 130 ug/L(CETIS, 2007).

5.0 REFERENCES

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Smith, M.E., Lazorchak, J.M., Herrin, L.E., Brewer-Swartz, S., & Thoney, W.T. (1997). A reformulated, reconstituted water for testing the freshwater amphipod, *Hyalella azteca*. *Environ. Toxicol. Chem.* (Method 100.1), 16: 1229-1233.

United States Environmental Protection Agency. (2000, March). "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates." Method 100.1

United States Environmental Protection Agency, November 1994, Standard Operating Procedure for Sediment Sampling, #2016

Tables

Table 2.0-1
Test Criteria for 10 Day Sediment Toxicity Testing

Parameter	Conditions
Test Type	Whole Sediment toxicity test with renewal of overlying water
Temperature	23 +/- 1 °C
Light Quality	Wide Spectrum flourescent lights
Illuminance	100 to 1000 lux
Photoperiod	16 light 8 dark
Test Chamber	300 mL beaker
Sediment Volume	100 mL
Overlying Water Volume	175 mL
Renewal of Overlying Water	2 volumes per day
Age of Organisms	7-14 day old at start of test
Number of Organisms/chamber	10
Number of Replicate	8 for whole sediment 4 for reference test
Feeding	YCT food fed 1.0 mL per daily to each test chamber
Aeration	None
Overlying Water	Moderately Hard Reconstituted Water
Test Chamber Cleaning	Clean screens if clogged
Overlying Water Quality	Hardness, Alkalinity, Conductivity, pH monitored at beginning and end of test, Temperature and Dissolved Oxygen monitored daily
Test Duration	10 Days
Endpoints	Survival and Growth
Test Acceptability	Minimum mean control survival of 80% and measurable growth of test organisms in the control sediment

Table 2.4-1
Standard Mine Sediment Toxicity Test
Sediment Moisture Content
Organism and Feed Dry Weights

Site ID	Crucible Plus Wet Sediment Weight (g)	Crucible Plus Dry Sediment Weight (g)	Dry Sediment Weight (g)	Percent Moisture
Control-N	96.39	72.64	23.75	25%
Control-P	84.77	59.72	25.05	30%
Elk-00	121.04	113.75	7.29	6%
Elk-06	97.76	90.87	6.89	7%
Elk-08	104.28	95.57	8.71	8%
SP-00	140.9	122.69	18.21	13%
SP-01	95.74	85.66	10.08	11%
Coal-15	118.93	105.21	13.72	12%
Coal-20	105.78	97.39	8.39	8%
Coal-Opp	106.85	94.42	12.43	12%

H. azteca dry weights: Initial

Number of Organisms:	93	organisms
Dry Weight Pan	1.3215E+00	grams
Dry Weight Organism + Pan	1.3305E+00	grams
	9.6774E-05	grams

H. azteca feed dry weight Rep#1

Weigh boat:	1.3184	grams
Weigh boat + 1 ml feed:	2.2882	grams
1 ml wet feed:	0.9698	grams
Weight boat + dry feed:	1.3209	grams
Dry feed :	0.0025	g/ml
Dry feed :	2.5	g/l

Table 3.1-1
Standard Mine Field Porewater Analysis
2008 Sampling Season

Dissolved Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc	Hardness (mg/L)
COAL-10	<50.0U	<1.00U	<2.00U	24.3	<5.00U	1.28	16600	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2260	123	<10.0U	1.04	<1000U	<1.00U	<0.500U	2350	153	<0.200U	<20.0U	<50.0U	313	51
COAL-15	<50.0U	1.21	6.32	21.0	<5.00U	0.262	15000	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1730	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1830	164	<0.200U	<20.0U	<50.0U	57.1	45
COAL-15 DUP	<50.0U	<1.00U	6.23	20.7	<5.00U	0.260	14900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1710	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1820	165	<0.200U	<20.0U	<50.0U	57.6	44
COAL-20	<50.0U	<1.00U	<2.00U	21.5	<5.00U	<0.200U	22900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	2100	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1980	201	<0.200U	<20.0U	<50.0U	30.7	66
COAL-25	<50.0U	<1.00U	7.77	26.9	<5.00U	<0.200U	11200	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1470	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	1390	133	<0.200U	<20.0U	<50.0U	<20.0U	34
COAL-OPP1	<50.0U	<1.00U	3.64	23.6	<5.00U	0.224	16100	<5.00U	<5.00U	<10.0U	<250U	0.241	2070	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2240	172	<0.200U	<20.0U	<50.0U	40.4	49
ELK-00	<50.0U	<1.00U	2.39	18.4	<5.00U	1.33	28300	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1800	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2370	229	<0.200U	<20.0U	<50.0U	263	78
ELK-05	<50.0U	<1.00U	5.66	20.6	<5.00U	0.937	28400	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1840	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2320	156	<0.200U	<20.0U	<50.0U	173	79
ELK-06	<50.0U	<1.00U	<2.00U	21.2	<5.00U	4.78	37900	<5.00U	<5.00U	<10.0U	<250U	<0.200U	3000	<5.00U	<10.0U	1.52	<1000U	<1.00U	<0.500U	2480	229	<0.200U	<20.0U	<50.0U	929	107
ELK-08	<50.0U	<1.00U	<2.00U	16.9	<5.00U	6.00	41600	<5.00U	<5.00U	<10.0U	<250U	0.207	3240	36.1	<10.0U	2.16	<1000U	<1.00U	<0.500U	2570	257	<0.200U	<20.0U	<50.0U	1290	117
ELK-10	<50.0U	<1.00U	<2.00U	31.8	<5.00U	22.5	57900	<5.00U	<5.00U	15.1	<250U	1.94	5370	380	<10.0U	5.49	1440	1.09	<0.500U	2790	373	<0.200U	<20.0U	<50.0U	6770	167
ELK-10 DUP	<50.0U	<1.00U	<2.00U	32.5	<5.00U	24.2	58700	<5.00U	<5.00U	15.1	<250U	2.09	5470	389	<10.0U	5.65	1480	<1.00U	<0.500U	2840	377	<0.200U	<20.0U	<50.0U	6640	169
SP-00	<50.0U	<1.00U	<2.00U	13.6	<5.00U	<0.200U	8620	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1610	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2770	104	<0.200U	<20.0U	<50.0U	<20.0U	28
SP-01	<50.0U	<1.00U	<2.00U	13.3	<5.00U	<0.200U	7290	<5.00U	<5.00U	<10.0U	<250U	<0.200U	1530	<5.00U	<10.0U	<1.00U	<1000U	<1.00U	<0.500U	2830	93.0	<0.200U	<20.0U	<50.0U	<20.0U	25

Total Metals (ug/L)

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Titanium	Vanadium	Zinc
COAL-10	1740	<5.00UD	15.1D	42.2	<5.00U	3.81D	15400	<5.00U	<5.00U	<10.0U	1990	12.0D	2280	716	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2270	152	<1.00UD	<20.0U	<50.0U	641
COAL-15	394	<5.00UD	10.1D	24.9	<5.00U	1.05D	13700	<5.00U	<5.00U	<10.0U	462	4.37D	1660	47.1	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1730	160	<1.00UD	<20.0U	<50.0U	82.1
COAL-15 DUP	711	<5.00UD	11.1D	29.7	<5.00U	<1.00UD	13800	<5.00U	<5.00U	<10.0U	876	7.67D	1700	106	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1730	161	<1.00UD	<20.0U	<50.0U	120
COAL-20	2320	<5.00UD	17.7D	44.7	<5.00U	<1.00UD	22100	<5.00U	<5.00U	<10.0U	2470	9.30D	2350	181	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2000	201	<1.00UD	39.7	<50.0U	78.5
COAL-25	230	<5.00UD	10.8D	29.3	<5.00U	<1.00UD	10600	<5.00U	<5.00U	<10.0U	292	2.58D	1430	11.9	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	1360	131	<1.00UD	<20.0U	<50.0U	<20.0U
COAL-OPP1	360	<5.00UD	<10.0UD	28.2	<5.00U	<1.00UD	15600	<5.00U	<5.00U	<10.0U	445	4.30D	2040	69.8	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2180	167	<1.00UD	<20.0U	<50.0U	66.7
ELK-00	178	<5.00UD	<10.0UD	20.6	<5.00U	2.12D	26200	<5.00U	<5.00U	<10.0U	<250U	16.4D	1690	100	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2230	219	<1.00UD	<20.0U	<50.0U	324
ELK-05	137	<5.00UD	<10.0UD	22.0	<5.00U	1.28D	25500	<5.00U	<5.00U	<10.0U	<250U	6.53D	1700	34.5	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2170	148	<1.00UD	<20.0U	<50.0U	176
ELK-06	1880	<5.00UD	11.9D	38.6	<5.00U	9.58D	35700	<5.00U	<5.00U	59.3	3450	161D	3090	761	<10.0U	<5.00UD	1180	<10.0UD	<2.50UD	2420	229	<1.00UD	24.3	<50.0U	1550
ELK-08	198	<5.00UD	<10.0UD	18.2	<5.00U	6.37D	38400	<5.00U	<5.00U	<10.0U	282	15.1D	3030	135	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2420	243	<1.00UD	<20.0U	<50.0U	1230
ELK-10	421	<5.00UD	<10.0UD	33.6	<5.00U	27.2D	53500	<5.00U	<5.00U	58.8	691	69.6D	5090	660	<10.0U	6.16D	1440	<10.0UD	<2.50UD	2690	360	<1.00UD	<20.0U	<50.0U	6030
ELK-10 DUP	325	<5.00UD	<10.0UD	33.0	<5.00U	25.8D	53600	<5.00U	<5.00U	56.5	592	54.6D	5080	649	<10.0U	6.32D	1430	<10.0UD	<2.50UD	2680	356	<1.00UD	<20.0U	<50.0U	6020
SP-00	583	<5.00UD	<10.0UD	24.0	<5.00U	<1.00UD	8100	<5.00U	<5.00U	<10.0U	689	1.51D	1640	40.0	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2590	105	<1.00UD	25.0	<50.0U	<20.0U
SP-01	2070	<5.00UD	<10.0UD	43.1	<5.00U	<1.00UD	7960	<5.00U	<5.00U	<10.0U	3320	5.94D	1900	171	<10.0U	<5.00UD	<1000U	<10.0UD	<2.50UD	2820	108	<1.00UD	55.3	<50.0U	<20.0U

Dissolved Organic Carbon (mg/L)

Location	DOC
COAL-10	1.6
COAL-15	2.1
COAL-15 DUP	2.0
COAL-20	1.3
COAL-25	2.0
COAL-OPP1	1.7
ELK-00	1.1
ELK-05	1.0
ELK-06	1.3
ELK-08	1.2
ELK-10	1.8
ELK-10 DUP	1.8
SP-00	1.9
SP-01	2.2

Wet Chem **(mg CaCO3/L)** **(mg/L)**

Location	Total Alkalinity	Chloride	Fluoride	Sulfate as SO4
COAL-10	32.4	<2.0U	0.2	17.5
COAL-15	26.5	<2.0U	<0.2U	15.3
COAL-15 DUP	27.0	<2.0U	<0.2U	15.3
COAL-20	32.8	<2.0U	<0.2U	29.1
COAL-25	21.8	<2.0U	<0.2U	12.1
COAL-OPP1	30.7	<2.0U	<0.2U	16.4
ELK-00	40.0	<2.0U	<0.2U	34.4
ELK-05	39.7	<2.0U	<0.2U	33.6
ELK-06	25.4	<2.0U	<0.2U	77.4
ELK-08	29.5	<2.0U	<0.2U	82.1
ELK-10	13.7	<2.0U	<0.2U	152
ELK-10 DUP	13.9	<2.0U	<0.2U	157
SP-00	29.1	<2.0U	<0.2U	<5.0U
SP-01	27.1	<2.0U	<0.2U	<5.0U

< - Less than
U - Indicates analyte not detected (result is reported as less than the reporting limit)
J - Indicates result is an estimated value (refer to analytical data package narrative for discussion)
D - Indicates sample was diluted

mg/L - milligrams per liter
ug/L - micrograms per liter

Table 3.1-2
Standard Mine Porewater Results using pushpoint samplers

Dissolved Metals - Pore Waters

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Coal 15 SD	26.8	<1.00U	61.5	123	<0.200U	0.292	24.1	1.99	3.79	1.39	6330	8.89	3.47	3.84	<0.500U	<0.200U	7.33	14.9
COAL-20 PP	43.4	<1.00U	27.8	62.4	<0.200U	<0.200U	11.9	0.278	2.07	<0.200U	1440	1.57	2.02	<1.00U	<0.500U	<0.200U	8.44	<5.00U
COAL-OPP	<20.0U	<1.00U	66.0	120	<0.200U	<0.200U	26.1	1.71	2.30	0.848	14700	8.12	4.64	<1.00U	<0.500U	<0.200U	8.51	14.4
ELK-00 PP	<20.0U	<1.00U	<2.00U	38.1	<0.200U	3.48	12.8	0.228	7.23	<0.200U	1240	0.886	2.51	<1.00U	<0.500U	<0.200U	3.67	107
ELK-06 PP	<20.0U	<1.00U	<2.00U	28.4	<0.200U	6.03	12.2	<0.200U	6.37	0.206	146	0.435	2.89	<1.00U	<0.500U	<0.200U	3.44	452
ELK-08 PP	<20.0U	<1.00U	<2.00U	34.8	<0.200U	16.8	15.1	0.219	8.77	<0.200U	1130	0.241	3.34	<1.00U	<0.500U	<0.200U	4.25	996
SP-00 PP	<20.0U	<1.00U	<2.00U	76.9	<0.200U	<0.200U	17.2	0.457	2.20	0.290	2400	1.51	2.31	<1.00U	<0.500U	<0.200U	9.67	<5.00U
SP-01 PP	<20.0U	<1.00U	<2.00U	18.3	<0.200U	<0.200U	8.02	<0.200U	1.26	<0.200U	159	0.309	1.32	<1.00U	<0.500U	<0.200U	2.67	<5.00U

Note: Results are expressed in ug/L

Table 3.1-3
Standard Mine 2008 Sediment Toxicity Test
Organism Survival and Weight Data Sheets

Test Type:	Sediment	Weighing Date:	11/13/2008	Sample Source:	Standard Mine, Co
Duration:	10-day	Analysts:	SA/FL	Test Start (day 0):	11/3/2008
Replicates:	Eight	Drying Time:	24 hours	Test End (day 10):	11/13/2008
Organism:	H. azteca	Oven Temperature:	70C	Feed Rate/ Type:	Daily/YCT

Initial weight (mg):	0.0351

Site I.D.	Weight of Oven Dried Pan (g)	Pan + Dried Organisms (g)	Dry Organisms (g)	Number of Survivors	Mean Weight per Survivor (mg)	Sample Mean (mg)
Control-N-1	1.3065	1.3069	0.0004	6	0.067	
Control-N-2	1.3075	1.3077	0.0002	4	0.050	
Control-N-3	1.3094	1.3098	0.0004	8	0.050	
Control-N-4	1.3258	1.3259	1E-04	5	0.020	0.0435
Control-N-5	1.3189	1.3191	0.0002	8	0.025	
Control-N-6	1.3082	1.3084	0.0002	3	0.067	
Control-N-7	1.3163	1.3165	0.0002	10	0.020	
Control-N-8	1.3256	1.3257	0.0001	2	0.050	
Control-P-1	1.3235	1.3233	-0.0002	2	-0.100	
Control-P-2	1.323	1.323	0	4	0.000	
Control-P-3	1.3159	1.3161	0.0002	7	0.029	
Control-P-4	1.3168	1.3169	1E-04	6	0.017	0.0191
Control-P-5	1.3177	1.318	0.0003	5	0.060	
Control-P-6	1.3209	1.321	1E-04	7	0.014	
Control-P-7	1.3229	1.3234	0.0005	5	0.100	
Control-P-8	1.3046	1.3048	0.0002	6	0.033	
Elk-00-1	1.3198	1.3199	1E-04	3	0.033	
Elk-00-2	1.3129	1.313	1E-04	3	0.033	
Elk-00-3	1.3177	1.3177	0	0	0.000	
Elk-00-4	1.3211	1.3212	1E-04	2	0.050	0.050
Elk-00-5	1.3239	1.3241	0.0002	5	0.040	
Elk-00-6	1.3103	1.3105	0.0002	3	0.067	
Elk-00-7	1.318	1.3183	0.0003	4	0.075	
Elk-00-8	1.3039	1.3042	0.0003	3	0.100	
Elk-06-1	1.3236	1.3237	1E-04	6	0.017	
Elk-06-2	1.3243	1.3244	1E-04	3	0.033	
Elk-06-3	1.3195	1.3196	0.0001	4	0.000	
Elk-06-4	1.3253	1.3255	0.0002	2	0.100	0.0340
Elk-06-5	1.3217	1.3218	1E-04	5	0.020	
Elk-06-6	1.3162	1.3163	1E-04	4	0.025	
Elk-06-7	1.3178	1.3179	1E-04	4	0.025	
Elk-06-8	1.3276	1.3278	0.0002	3	0.067	
Elk-08-1	1.3185	1.3185	0	0	0.000	
Elk-08-2	1.3137	1.3137	0	0	0.000	
Elk-08-3	1.3230	1.3228	-0.0002	1	0.000	
Elk-08-4	1.3138	1.3138	0	1	0.000	0.000
Elk-08-5	1.3260	1.326	0	0	0.000	
Elk-08-6	1.3187	1.3187	0	1	0.000	
Elk-08-7	1.3119	1.3119	0	0	0.000	
Elk-08-8	1.3060	1.3060	0	2	0.000	

Table 3.1-3
Standard Mine 2008 Sediment Toxicity Test
Organism Survival and Weight Data Sheets

Test Type:	Sediment	Weighing Date:	11/13/2008	Sample Source:	Standard Mine, Co
Duration:	10-day	Analysts:	SA/FL	Test Start (day 0):	11/3/2008
Replicates:	Eight	Drying Time:	24 hours	Test End (day 10):	11/13/2008
Organism:	H. azteca	Oven Temperature:	70C	Feed Rate/ Type:	Daily/YCT
Initial weight (mg):		0.0351			

Site I.D.	Weight of Oven Dried Pan (g)	Pan + Dried Organisms (g)	Dry Organisms (g)	Number of Survivors	Mean Weight per Survivor (mg)	Sample Mean (mg)
SP-00-1	1.3252	1.3257	0.0005	8	0.063	
SP-00-2	1.3232	1.3233	1E-04	7	0.014	
SP-00-3	1.3185	1.3187	0.0002	5	0.040	
SP-00-4	1.3207	1.3211	0.0004	9	0.044	0.059
SP-00-5	1.3184	1.3192	0.0008	6	0.133	
SP-00-6	1.3238	1.3242	0.0004	9	0.044	
SP-00-7	1.3062	1.3068	0.0006	10	0.060	
SP-00-8	1.3216	1.3221	0.0005	8	0.062	
SP-01-1	1.3179	1.3183	0.0004	9	0.044	
SP-01-2	1.3075	1.3081	0.0006	9	0.067	
SP-01-3	1.3202	1.3205	0.0003	8	0.037	
SP-01-4	1.3203	1.3209	0.0006	8	0.075	0.049
SP-01-5	1.3189	1.3193	0.0004	10	0.040	
SP-01-6	1.3185	1.3190	0.0005	9	0.056	
SP-01-7	1.3216	1.3219	0.0003	10	0.030	
SP-01-8	1.3143	1.3147	0.0004	9	0.044	
Coal-15-1	1.3243	1.3246	0.0003	6	0.050	
Coal-15-2	1.3282	1.3283	1E-04	7	0.014	
Coal-15-3	1.3225	1.3228	0.0003	8	0.037	
Coal-15-4	1.3215	1.3225	0.001	8	0.125	0.054
Coal-15-5	1.3179	1.3183	0.0004	9	0.044	
Coal-15-6	1.3285	1.329	0.0005	8	0.062	
Coal-15-7	1.3247	1.3258	0.0011	10	0.110	
Coal-15-8	1.3140	1.3144	0.0004	9	0.044	
Coal-20-1	1.3187	1.3189	0.0002	5	0.040	
Coal-20-2	1.3232	1.3234	0.0002	11	0.018	
Coal-20-3	1.3233	1.3235	0.0002	9	0.022	
Coal-20-4	1.3295	1.3297	0.0002	10	0.020	0.028
Coal-20-5	1.3256	1.3258	0.0002	5	0.040	
Coal-20-6	1.3205	1.3206	1E-04	5	0.020	
Coal-20-7	1.3212	1.3213	1E-04	10	0.010	
Coal-20-8	1.3175	1.3177	0.0002	9	0.022	
Coal-opp-1	1.3173	1.3174	1E-04	5	0.020	
Coal-opp-2	1.3217	1.3223	0.0006	9	0.067	
Coal-opp-3	1.3151	1.3154	0.0003	9	0.033	
Coal-opp-4	1.3251	1.3253	0.0002	10	0.020	0.036
Coal-opp-5	1.3247	1.3251	0.0004	10	0.040	
Coal-opp-6	1.318	1.3188	0.0008	10	0.080	
Coal-opp-7	1.307	1.3075	0.0005	9	0.056	
Coal-opp-8	1.3204	1.3212	0.0008	8	0.100	

Figures

Figure 3.1-1
Percent Moisture for Site Sediments
Standard Mine 2008 Sampling Event

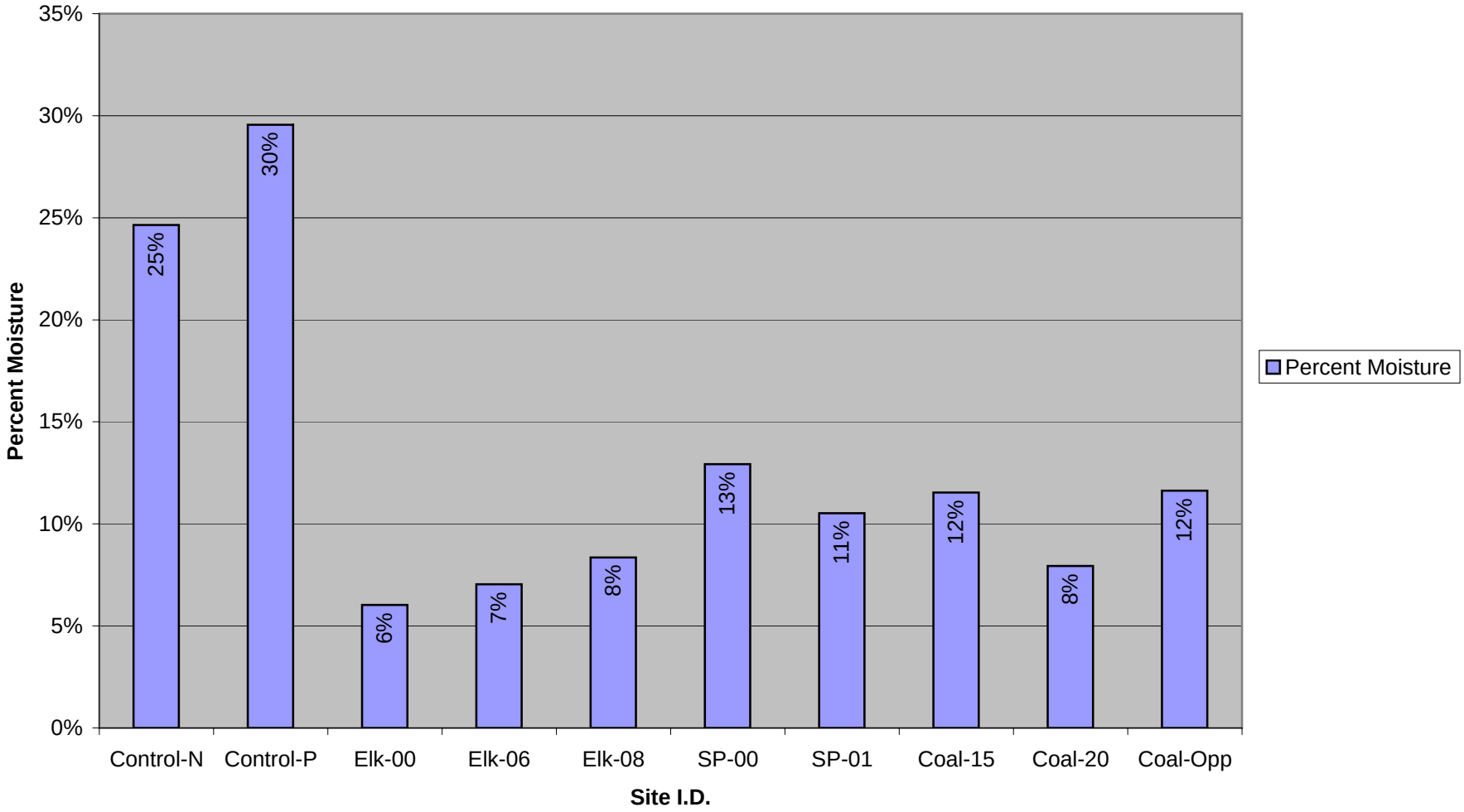
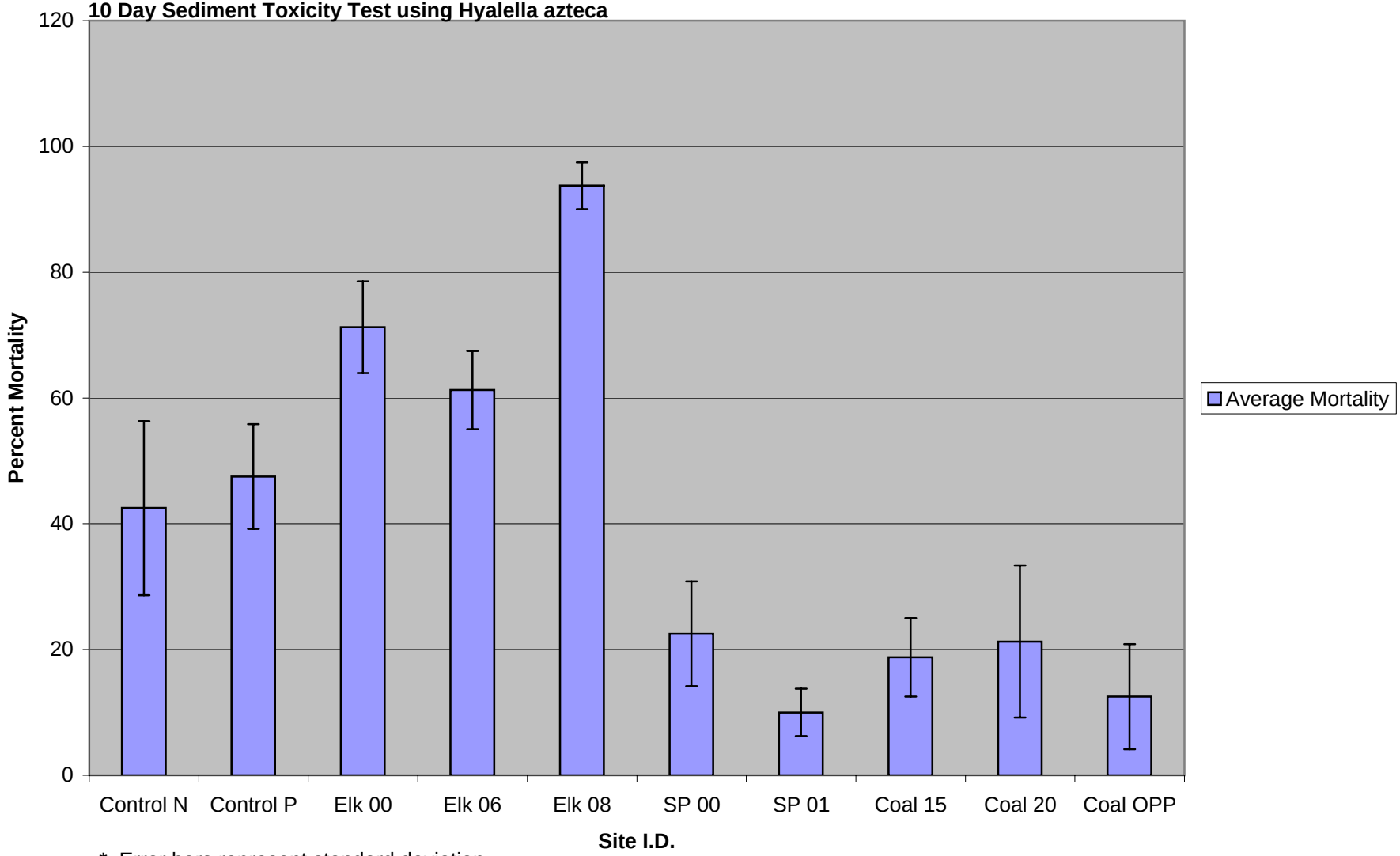
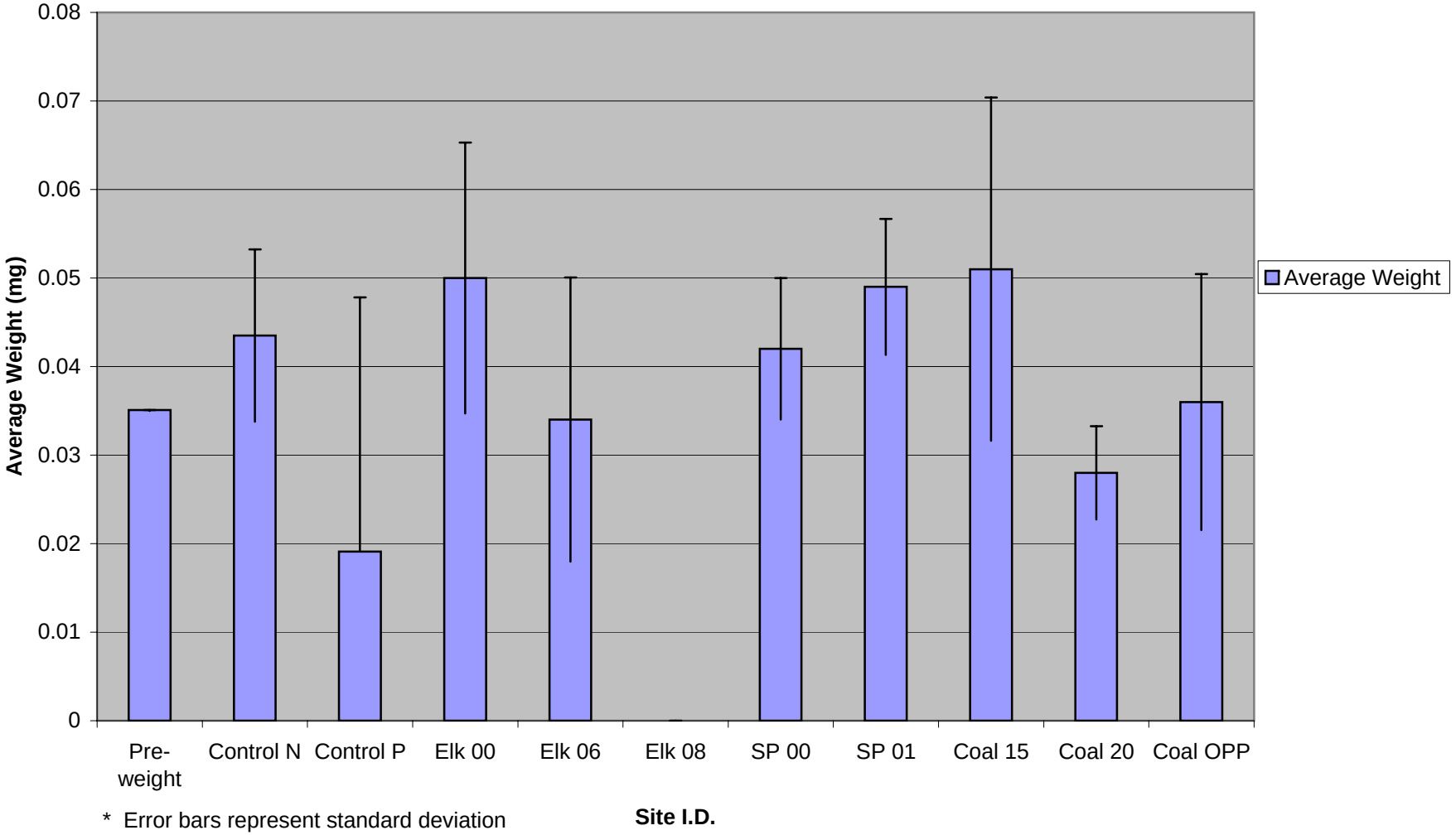


Figure 3.1-2
Average Organism Mortality
Standard Mine 2008 Sampling Event
10 Day Sediment Toxicity Test using Hyalella azteca



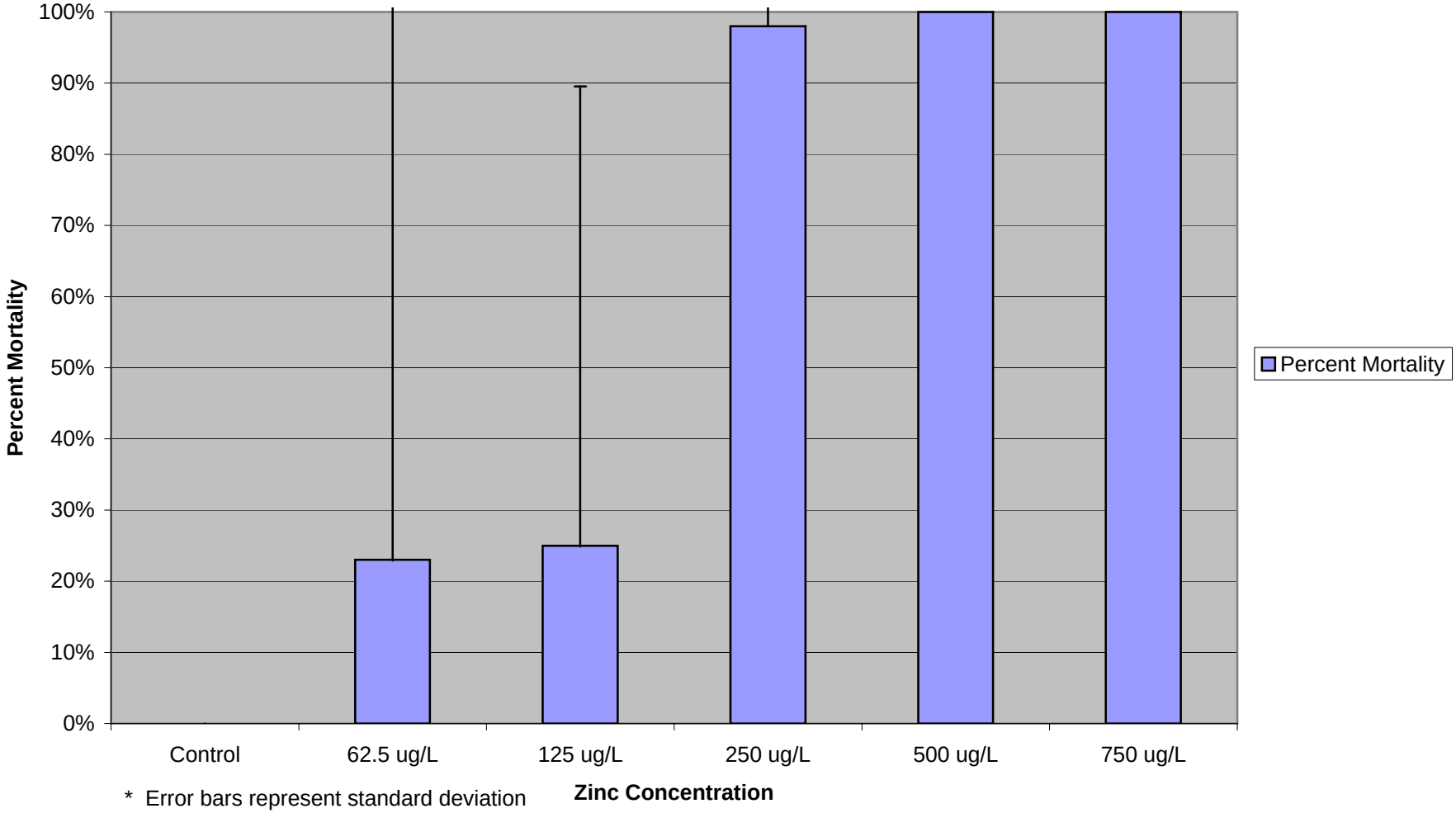
* Error bars represent standard deviation

Figure 3.1-3
Average Organism Weight
Standard Mine September 2008 Sampling Event
10 Day Sediment Toxicity Test using Hyalella azteca



* Error bars represent standard deviation

Figure 3.2-1
Reference Toxicity Test
using *Hyalella azteca*



* Error bars represent standard deviation

Appendix A
Standard Mine 2008 Sediment Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Positive Control-1	pH	7.8									7.81	
Positive Control-1	Conductivity (us/cm)	305									276	
Positive Control-1	D.O. (mg/L)	6.92	5.90	6.01	5.01	3.80	7.56	5.31	3.13	3.03	4.86	5.63
Positive Control-1	Temp (C)	22.67	22.46	21.86	22.01	23.66	23.44	23.12	23.77	23.78	24.79	23.06
Positive Control-1	Hardness	88									86	
Positive Control-1	Alkalinity	45									47.5	
Positive Control-1	Ammonia (mg/L)	ND									0.191	
Positive Control-2	pH	7.7									7.75	
Positive Control-2	Conductivity (us/cm)	295									288	
Positive Control-2	D.O. (mg/L)	6.31	5.87	5.90	5.82	3.92	7.30	6.72	3.63	3.26	4.8	5.66
Positive Control-2	Temp (C)	24.02	22.97	21.93	21.85	23.42	23.73	23.31	23.80	23.76	24.58	23.45
Positive Control-2	Hardness	88									86	
Positive Control-2	Alkalinity	45									47.5	
Positive Control-2	Ammonia (mg/L)	ND									0.191	
Positive Control-3	pH	7.69									7.7	
Positive Control-3	Conductivity (us/cm)	294									286	
Positive Control-3	D.O. (mg/L)	6.47	5.95	5.29	5.01	3.51	7.42	6.12	3.57	3.04	4.79	5.53
Positive Control-3	Temp (C)	23.89	22.95	21.89	21.97	23.51	23.78	23.37	23.71	23.84	24.97	23.43
Positive Control-3	Hardness	88									86	
Positive Control-3	Alkalinity	45									47.5	
Positive Control-3	Ammonia (mg/L)	ND									0.191	
Positive Control-4	pH	7.69									7.67	
Positive Control-4	Conductivity (us/cm)	295									289	
Positive Control-4	D.O. (mg/L)	6.22	5.82	5.96	5.71	3.67	7.38	6.28	3.41	3.27	4.83	5.65
Positive Control-4	Temp (C)	23.93	22.91	21.82	21.92	23.54	23.70	23.41	23.46	23.75	24.77	23.53
Positive Control-4	Hardness	88									86	
Positive Control-4	Alkalinity	45									47.5	
Positive Control-4	Ammonia (mg/L)	ND									0.191	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Positive Control-5	pH	7.7									7.69	
Positive Control-5	Conductivity (us/cm)	294									289	
Positive Control-5	D.O. (mg/L)	6.81	5.86	5.90	4.97	3.35	7.27	5.01	3.49	3.20	4.71	5.34
Positive Control-5	Temp (C)	23.94	22.98	21.64	21.87	23.70	23.65	23.62	23.66	23.63	24.28	23.35
Positive Control-5	Hardness	88									86	
Positive Control-5	Alkalinity	45									47.5	
Positive Control-5	Ammonia (mg/L)	ND									0.191	
Positive Control-6	pH	7.67									7.66	
Positive Control-6	Conductivity (us/cm)	306									300	
Positive Control-6	D.O. (mg/L)	6.81	5.83	5.97	4.86	3.70	7.36	5.17	3.88	3.11	5.12	5.55
Positive Control-6	Temp (C)	23.08	22.78	21.68	21.90	23.62	23.65	23.76	23.72	23.67	22.99	23.51
Positive Control-6	Hardness	88									86	
Positive Control-6	Alkalinity	45									47.5	
Positive Control-6	Ammonia (mg/L)	ND									0.191	
Positive Control-7	pH	7.25									7.69	
Positive Control-7	Conductivity (us/cm)	301									290	
Positive Control-7	D.O. (mg/L)	7.8	5.93	5.96	5.20	3.25	7.55	6.25	3.67	3.65	4.91	5.54
Positive Control-7	Temp (C)	22.97	22.73	21.73	21.76	23.70	23.73	23.91	23.70	23.75	24.65	23.45
Positive Control-7	Hardness	88									86	
Positive Control-7	Alkalinity	45									47.5	
Positive Control-7	Ammonia (mg/L)	ND									0.191	
Positive Control-8	pH	7.42									7.69	
Positive Control-8	Conductivity (us/cm)	302									293	
Positive Control-8	D.O. (mg/L)	6.81	5.88	5.99	5.40	3.94	7.42	6.70	3.61	3.34	ND	5.63
Positive Control-8	Temp (C)	22.76	22.19	21.66	21.84	23.67	23.58	23.57	23.65	23.62	24.09	23.37
Positive Control-8	Hardness	88									86	
Positive Control-8	Alkalinity	45									47.5	
Positive Control-8	Ammonia (mg/L)	ND									0.191	

Appendix A
Standard Mine 2008 Sediment Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Negative Control-1	pH	7.22									7.45	
Negative Control-1	Conductivity (us/cm)	303									304	
Negative Control-1	D.O. (mg/L)	6.45	5.86	5.30	5.69	3.84	7.50	6.01	3.88	3.24	88.8	5.56
Negative Control-1	Temp (C)	22.98	22.63	22.65	22.04	23.58	23.34	22.99	23.60	23.59	47.5	23.02
Negative Control-1	Hardness	90									88.8	
Negative Control-1	Alkalinity	45									47.5	
Negative Control-1	Ammonia (mg/L)	0.077									0.236	
Negative Control-2	pH	7.28										
Negative Control-2	Conductivity (us/cm)	298										
Negative Control-2	D.O. (mg/L)	7.29	5.75	5.87	5.21	3.97	7.01	6.92	4.15	3.25	4.57	5.26
Negative Control-2	Temp (C)	22.81	22.59	22.53	22.08	23.57	23.12	23.01	23.48	23.68	24.48	23.47
Negative Control-2	Hardness	90									88.8	
Negative Control-2	Alkalinity	45									47.5	
Negative Control-2	Ammonia (mg/L)	0.077									0.236	
Negative Control-3	pH	7.33										
Negative Control-3	Conductivity (us/cm)	318										
Negative Control-3	D.O. (mg/L)	6.51	5.83	5.77	5.92	4.10	7.34	6.11	4.07	3.61	4.96	5.44
Negative Control-3	Temp (C)	22.45	22.65	22.56	22.05	23.64	23.19	23.20	23.50	23.58	24.13	23.40
Negative Control-3	Hardness	90									88.8	
Negative Control-3	Alkalinity	45									47.5	
Negative Control-3	Ammonia (mg/L)	0.077									0.236	
Negative Control-4	pH	7.29									7.68	
Negative Control-4	Conductivity (us/cm)	304									286	
Negative Control-4	D.O. (mg/L)	7.05	5.96	5.84	5.17	4.40	7.22	6.70	4.18	3.39	4.52	5.51
Negative Control-4	Temp (C)	22.48	22.98	22.48	22.30	23.63	23.30	23.18	23.53	23.60	24.68	23.47
Negative Control-4	Hardness	90									88.8	
Negative Control-4	Alkalinity	45									47.5	
Negative Control-4	Ammonia (mg/L)	0.077									0.236	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Negative Control-5	pH	7.49									7.73	
Negative Control-5	Conductivity (us/cm)	332									289	
Negative Control-5	D.O. (mg/L)	7.12	5.79	5.84	5.10	4.00	7.41	6.56	3.91	3.42	4.79	5.38
Negative Control-5	Temp (C)	22.55	22.67	22.60	22.05	23.62	23.41	23.51	23.48	23.55	24.08	23.43
Negative Control-5	Hardness	90									88.8	
Negative Control-5	Alkalinity	45									47.5	
Negative Control-5	Ammonia (mg/L)	0.077									0.236	
Negative Control-6	pH	7.54									7.72	
Negative Control-6	Conductivity (us/cm)	299									289	
Negative Control-6	D.O. (mg/L)	6.77	5.88	5.27	5.40	3.94	7.29	7.01	3.96	3.41	4.9	5.59
Negative Control-6	Temp (C)	23.45	22.68	22.61	22.12	23.54	23.41	23.44	23.44	23.57	23.35	23.39
Negative Control-6	Hardness	90									88.8	
Negative Control-6	Alkalinity	45									47.5	
Negative Control-6	Ammonia (mg/L)	0.077									0.236	
Negative Control-7	pH	7.56									7.72	
Negative Control-7	Conductivity (us/cm)	300									289	
Negative Control-7	D.O. (mg/L)	6.71	5.85	5.84	5.30	4.17	7.53	6.81	4.02	3.46	5.05	5.48
Negative Control-7	Temp (C)	23.86	22.94	22.74	22.17	23.37	23.62	23.44	23.64	23.71	24.71	23.61
Negative Control-7	Hardness	90									88.8	
Negative Control-7	Alkalinity	45									47.5	
Negative Control-7	Ammonia (mg/L)	0.077									0.236	
Negative Control-8	pH	7.61									7.72	
Negative Control-8	Conductivity (us/cm)	301									291	
Negative Control-8	D.O. (mg/L)	6.75	5.91	5.92	5.89	4.62	7.32	6.25	3.93	3.25	4.86	5.51
Negative Control-8	Temp (C)	23.94	22.87	22.81	22.10	23.30	23.69	23.72	23.68	23.77	24.48	23.58
Negative Control-8	Hardness	90									88.8	
Negative Control-8	Alkalinity	45									47.5	
Negative Control-8	Ammonia (mg/L)	0.077									0.236	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-Opp-1	pH	7.66									7.75	
COAL-Opp-1	Conductivity (us/cm)	296									287	
COAL-Opp-1	D.O. (mg/L)	6.34	5.79	5.61	5.24	3.94	7.30	6.55	3.77	3.36	4.89	5.65
COAL-Opp-1	Temp (C)	23.18	22.21	21.25	21.57	23.37	22.96	23.21	22.73	22.50	23.27	22.10
COAL-Opp-1	Hardness	97									88.4	
COAL-Opp-1	Alkalinity	60									50	
COAL-Opp-1	Ammonia (mg/L)	ND									0.179	
COAL-Opp-2	pH	7.79									7.72	
COAL-Opp-2	Conductivity (us/cm)	326									294	
COAL-Opp-2	D.O. (mg/L)	6.12	5.81	5.48	5.40	4.20	7.11	6.72	3.97	3.42	4.75	5.41
COAL-Opp-2	Temp (C)	23.23	22.21	21.39	21.97	23.61	23.04	23.10	22.82	22.98	23.94	22.70
COAL-Opp-2	Hardness	97									88.4	
COAL-Opp-2	Alkalinity	60									50	
COAL-Opp-2	Ammonia (mg/L)	ND									0.179	
COAL-Opp-3	pH	7.91									7.74	
COAL-Opp-3	Conductivity (us/cm)	309									292	
COAL-Opp-3	D.O. (mg/L)	6.76	6.50	5.90	4.79	3.89	7.40	7.00	3.89	3.41	5.23	5.48
COAL-Opp-3	Temp (C)	22.96	22.17	21.36	21.60	23.59	22.87	23.08	22.75	22.81	23.48	22.63
COAL-Opp-3	Hardness	97									88.4	
COAL-Opp-3	Alkalinity	60									50	
COAL-Opp-3	Ammonia (mg/L)	ND									0.179	
COAL-Opp-4	pH	7.92									7.74	
COAL-Opp-4	Conductivity (us/cm)	309									287	
COAL-Opp-4	D.O. (mg/L)	6.71	5.72	5.82	4.84	3.74	7.26	7.00	3.98	3.26	5.13	5.57
COAL-Opp-4	Temp (C)	22.53	22.19	21.33	21.70	23.42	22.92	23.21	22.81	22.79	23.31	22.64
COAL-Opp-4	Hardness	97									88.4	
COAL-Opp-4	Alkalinity	60									50	
COAL-Opp-4	Ammonia (mg/L)	ND									0.179	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-Opp-5	pH	7.94									7.73	
COAL-Opp-5	Conductivity (us/cm)	304									296	
COAL-Opp-5	D.O. (mg/L)	7.24	5.47	6.17	6.01	4.24	7.44	6.42	3.90	3.52	5.14	5.45
COAL-Opp-5	Temp (C)	22.34	22.22	21.34	21.99	23.56	22.78	22.99	22.68	22.85	23.21	22.61
COAL-Opp-5	Hardness	97									88.4	
COAL-Opp-5	Alkalinity	60									50	
COAL-Opp-5	Ammonia (mg/L)	ND									0.179	
COAL-Opp-6	pH	7.94									7.75	
COAL-Opp-6	Conductivity (us/cm)	300									299	
COAL-Opp-6	D.O. (mg/L)	6.92	5.54	5.87	5.01	5.44	7.36	6.35	3.94	3.27	5.35	5.48
COAL-Opp-6	Temp (C)	22.69	22.40	21.32	22.02	23.60	22.85	23.02	22.75	22.81	23.07	22.61
COAL-Opp-6	Hardness	97									88.4	
COAL-Opp-6	Alkalinity	60									50	
COAL-Opp-6	Ammonia (mg/L)	ND									0.179	
COAL-Opp-7	pH	7.93									7.76	
COAL-Opp-7	Conductivity (us/cm)	306									291	
COAL-Opp-7	D.O. (mg/L)	6.81	5.25	5.67	4.99	5.33	7.45	5.78	3.61	3.36	4.97	5.59
COAL-Opp-7	Temp (C)	22.92	22.17	21.33	21.79	23.51	23.01	23.02	23.00	22.84	23.85	22.77
COAL-Opp-7	Hardness	97									88.4	
COAL-Opp-7	Alkalinity	60									50	
COAL-Opp-7	Ammonia (mg/L)	ND									0.179	
COAL-Opp-8	pH	7.93									7.76	
COAL-Opp-8	Conductivity (us/cm)	305									303	
COAL-Opp-8	D.O. (mg/L)	6.93	5.92	5.21	5.10	5.12	7.26	6.93	3.71	3.24	4.95	5.61
COAL-Opp-8	Temp (C)	22.92	22.25	21.42	21.90	23.26	22.93	23.07	22.77	22.91	22.39	22.65
COAL-Opp-8	Hardness	97									88.4	
COAL-Opp-8	Alkalinity	60									50	
COAL-Opp-8	Ammonia (mg/L)	ND									0.179	

Appendix A
Standard Mine 2008 Sediment Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-15-1	pH	7.41									7.08	
COAL-15-1	Conductivity (us/cm)	311									280	
COAL-15-1	D.O. (mg/L)	5.82	5.87	5.77	5.54	4.24	6.21	6.03	3.41	4.61	4.26	4.75
COAL-15-1	Temp (C)	23.34	22.52	22.50	22.09	23.56	23.15	22.27	23.27	23.02	24.12	22.55
COAL-15-1	Hardness	103									87.6	
COAL-15-1	Alkalinity	60									52.5	
COAL-15-1	Ammonia (mg/L)	ND									0.2766	
COAL-15-2	pH	7.54									7.4	
COAL-15-2	Conductivity (us/cm)	304									284	
COAL-15-2	D.O. (mg/L)	6.48	5.55	5.57	5.82	5.01	6.24	5.07	4.15	4.89	4.53	5.01
COAL-15-2	Temp (C)	23.39	22.70	22.25	22.12	23.33	23.25	23.05	23.38	23.16	24.06	23.06
COAL-15-2	Hardness	103									87.6	
COAL-15-2	Alkalinity	60									52.5	
COAL-15-2	Ammonia (mg/L)	ND									0.2766	
COAL-15-3	pH	7.62									7.51	
COAL-15-3	Conductivity (us/cm)	300									293	
COAL-15-3	D.O. (mg/L)	6.57	5.94	5.94	5.63	4.20	6.48	5.78	3.91	4.78	23.27	4.74
COAL-15-3	Temp (C)	22.97									87.6	22.91
COAL-15-3	Hardness	103									87.6	
COAL-15-3	Alkalinity	60									52.5	
COAL-15-3	Ammonia (mg/L)	ND									0.2766	
COAL-15-4	pH	7.62									7.55	
COAL-15-4	Conductivity (us/cm)	305									287	
COAL-15-4	D.O. (mg/L)	6.57	5.95	5.87	5.12	4.17	6.68	5.21	3.79	5.10	4.54	5.09
COAL-15-4	Temp (C)	22.82	22.97	22.82	22.34	23.30	23.01	22.97	23.02	22.86	24.09	23.01
COAL-15-4	Hardness	103									87.6	
COAL-15-4	Alkalinity	60									52.5	
COAL-15-4	Ammonia (mg/L)	ND									0.2766	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-15-5	pH	7.63									7.58	
COAL-15-5	Conductivity (us/cm)	309									292	
COAL-15-5	D.O. (mg/L)	5.99	5.93	5.84	5.51	4.65	6.91	5.79	3.57	4.98	4.52	4.78
COAL-15-5	Temp (C)	23.02	22.19	22.33	22.23	23.35	22.87	22.96	23.10	22.93	23.66	22.90
COAL-15-5	Hardness	103									87.6	
COAL-15-5	Alkalinity	60									52.5	
COAL-15-5	Ammonia (mg/L)	ND									0.2766	
COAL-15-6	pH	7.67									7.52	
COAL-15-6	Conductivity (us/cm)	303									318	
COAL-15-6	D.O. (mg/L)	6.48	5.74	5.51	5.39	4.63	6.95	6.28	3.93	5.17	4.17	5.07
COAL-15-6	Temp (C)	23.1	23.36	22.29	22.22	23.43	22.77	23.08	23.20	22.92	24.19	22.92
COAL-15-6	Hardness	103									87.6	
COAL-15-6	Alkalinity	60									52.5	
COAL-15-6	Ammonia (mg/L)	ND									0.2766	
COAL-15-7	pH	7.7									7.64	
COAL-15-7	Conductivity (us/cm)	309									292	
COAL-15-7	D.O. (mg/L)	6.82	5.82	5.88	5.32	4.49	7.03	6.07	4.10	5.12	4.66	4.88
COAL-15-7	Temp (C)	23.02	22.84	22.47	22.30	23.34	23.16	23.21	23.01	23.06	24.34	23.06
COAL-15-7	Hardness	103									87.6	
COAL-15-7	Alkalinity	60									52.5	
COAL-15-7	Ammonia (mg/L)	ND									0.2766	
COAL-15-8	pH	7.74									7.7	
COAL-15-8	Conductivity (us/cm)	300									292	
COAL-15-8	D.O. (mg/L)	6.95	5.88	5.56	5.11	4.38	7.22	6.93	3.81	4.24	4.65	4.90
COAL-15-8	Temp (C)	23.08	22.64	22.29	22.21	23.30	22.95	23.01	23.20	22.87	23.59	23.03
COAL-15-8	Hardness	103									87.6	
COAL-15-8	Alkalinity	60									52.5	
COAL-15-8	Ammonia (mg/L)	ND									0.2766	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-20-1	pH	7.56									7.8	
COAL-20-1	Conductivity (us/cm)	316									278	
COAL-20-1	D.O. (mg/L)	7.34	4.77	5.41	5.87	3.65	7.56	6.07	4.26	4.12	4.88	5.22
COAL-20-1	Temp (C)	22.81	22.72	22.02	22.45	23.79	22.98	23.99	23.25	23.35	24.04	23.21
COAL-20-1	Hardness	94									90	
COAL-20-1	Alkalinity	52.5									50	
COAL-20-1	Ammonia (mg/L)	ND									0.179	
COAL-20-2	pH	7.67									7.75	
COAL-20-2	Conductivity (us/cm)	298									278	
COAL-20-2	D.O. (mg/L)	7.04	5.75	5.72	5.19	4.24	7.45	6.79	4.63	4.09	4.54	5.29
COAL-20-2	Temp (C)	23.3	22.88	22.32	22.45	23.40	23.25	23.29	23.24	23.28	24.52	23.12
COAL-20-2	Hardness	94									90	
COAL-20-2	Alkalinity	52.5									50	
COAL-20-2	Ammonia (mg/L)	ND									0.179	
COAL-20-3	pH	7.79									7.75	
COAL-20-3	Conductivity (us/cm)	300									290	
COAL-20-3	D.O. (mg/L)	6.95	5.94	5.64	5.24	4.45	7.26	6.77	4.53	4.21	4.64	5.37
COAL-20-3	Temp (C)	22.74	22.75	22.34	22.10	23.24	23.26	23.60	23.19	23.29	23.98	23.13
COAL-20-3	Hardness	94									90	
COAL-20-3	Alkalinity	52.5									50	
COAL-20-3	Ammonia (mg/L)	ND									0.179	
COAL-20-4	pH	7.81									7.76	
COAL-20-4	Conductivity (us/cm)	304									291	
COAL-20-4	D.O. (mg/L)	7.59	5.66	5.77	5.18	4.83	7.60	6.93	4.49	4.21	4.85	5.22
COAL-20-4	Temp (C)	22.59	22.63	22.24	22.48	23.81	23.04	23.01	23.12	23.23	23.85	23.12
COAL-20-4	Hardness	94									90	
COAL-20-4	Alkalinity	52.5									50	
COAL-20-4	Ammonia (mg/L)	ND									0.179	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
COAL-20-5	pH	7.82									7.78	
COAL-20-5	Conductivity (us/cm)	297									289	
COAL-20-5	D.O. (mg/L)	6.67	5.98	5.56	5.92	4.63	7.64	6.73	4.41	4.27	4.88	5.41
COAL-20-5	Temp (C)	23.47	22.38	22.44	22.46	23.86	23.33	23.21	23.24	23.37	23.99	22.96
COAL-20-5	Hardness	94									90	
COAL-20-5	Alkalinity	52.5									50	
COAL-20-5	Ammonia (mg/L)	ND									0.179	
COAL-20-6	pH	7.79									7.78	
COAL-20-6	Conductivity (us/cm)	321									293	
COAL-20-6	D.O. (mg/L)	7.44	6.26	5.72	5.88	4.43	7.28	6.77	4.48	3.97	5.22	5.36
COAL-20-6	Temp (C)	23.03	22.36	22.53	22.34	23.75	23.22	23.01	23.24	23.35	24.11	23.09
COAL-20-6	Hardness	94									90	
COAL-20-6	Alkalinity	52.5									50	
COAL-20-6	Ammonia (mg/L)	ND									0.179	
COAL-20-7	pH	7.67									7.78	
COAL-20-7	Conductivity (us/cm)	304									290	
COAL-20-7	D.O. (mg/L)	6.76	5.92	5.85	5.66	4.19	7.38	6.59	4.63	3.95	4.82	5.47
COAL-20-7	Temp (C)	22.98	22.84	22.65	22.60	23.41	23.36	23.92	23.34	23.47	22.94	23.21
COAL-20-7	Hardness	94									90	
COAL-20-7	Alkalinity	52.5									50	
COAL-20-7	Ammonia (mg/L)	ND									0.179	
COAL-20-8	pH	7.82									7.76	
COAL-20-8	Conductivity (us/cm)	300									290	
COAL-20-8	D.O. (mg/L)	6.92	6.25	5.89	5.62	4.84	7.33	6.76	4.31	4.12	4.88	4.85
COAL-20-8	Temp (C)	22.86	22.82	22.59	27.64	23.40	23.41	23.44	23.40	23.50	24.4	23.26
COAL-20-8	Hardness	94									90	
COAL-20-8	Alkalinity	52.5									50	
COAL-20-8	Ammonia (mg/L)	ND									0.179	

Appendix A
Standard Mine 2008 Sediment Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
SP-00-1	pH	7.81									7.77	
SP-00-1	Conductivity (us/cm)	303									288	
SP-00-1	D.O. (mg/L)	6.67	5.96	5.16	5.79	3.54	7.61	6.58	4.10	3.90	4.9	5.50
SP-00-1	Temp (C)	22.46	22.10	22.44	22.80	23.79	23.06	23.05	23.40	23.49	24.34	23.24
SP-00-1	Hardness	97									91.2	
SP-00-1	Alkalinity	54									50	
SP-00-1	Ammonia (mg/L)	ND									0.214	
SP-00-2	pH	7.88									7.78	
SP-00-2	Conductivity (us/cm)	307									288	
SP-00-2	D.O. (mg/L)	6.74	5.99	5.88	5.21	4.20	7.40	6.41	4.39	3.80	4.62	5.62
SP-00-2	Temp (C)	23.59	22.13	22.50	22.41	23.51	23.33	23.56	23.40	23.51	24.62	23.25
SP-00-2	Hardness	97									91.2	
SP-00-2	Alkalinity	54									50	
SP-00-2	Ammonia (mg/L)	ND									0.214	
SP-00-3	pH	7.82									7.79	
SP-00-3	Conductivity (us/cm)	315									297	
SP-00-3	D.O. (mg/L)	6.91	6.14	5.71	5.69	4.16	7.41	6.97	4.21	3.89	5.01	5.79
SP-00-3	Temp (C)	22.73	22.36	22.47	22.70	23.49	23.39	23.41	23.37	23.44	23.54	23.19
SP-00-3	Hardness	97									91.2	
SP-00-3	Alkalinity	54									50	
SP-00-3	Ammonia (mg/L)	ND									0.214	
SP-00-4	pH	7.9									7.81	
SP-00-4	Conductivity (us/cm)	301									291	
SP-00-4	D.O. (mg/L)	6.98	5.88	5.69	5.01	4.56	7.53	6.82	4.38	3.96	4.86	5.31
SP-00-4	Temp (C)	23.11	22.64	22.53	22.31	23.40	23.38	23.41	23.36	23.45	24.05	23.26
SP-00-4	Hardness	97									91.2	
SP-00-4	Alkalinity	54									50	
SP-00-4	Ammonia (mg/L)	ND									0.214	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
SP-00-5	pH	7.82									7.81	
SP-00-5	Conductivity (us/cm)	302									290	
SP-00-5	D.O. (mg/L)	6.41	5.78	4.65	5.11	3.82	7.53	7.01	4.19	3.69	5.16	5.41
SP-00-5	Temp (C)	22.69	22.18	22.43	22.01	23.68	23.35	23.01	23.33	23.35	24.23	23.24
SP-00-5	Hardness	97									91.2	
SP-00-5	Alkalinity	54									50	
SP-00-5	Ammonia (mg/L)	ND									0.214	
SP-00-6	pH	7.91									7.82	
SP-00-6	Conductivity (us/cm)	304									290	
SP-00-6	D.O. (mg/L)	6.24	5.75	5.79	5.42	3.78	7.48	6.52	3.75	3.62	4.97	4.82
SP-00-6	Temp (C)	22.87	22.35	22.53	22.32	23.67	23.46	23.35	23.47	23.56	24.31	23.39
SP-00-6	Hardness	97									91.2	
SP-00-6	Alkalinity	54									50	
SP-00-6	Ammonia (mg/L)	ND									0.214	
SP-00-7	pH	7.97									7.79	
SP-00-7	Conductivity (us/cm)	320									296	
SP-00-7	D.O. (mg/L)	6.91	5.94	5.73	5.17	4.20	6.86	6.70	4.25	3.41	5.12	5.47
SP-00-7	Temp (C)	22.89	22.67	22.63	22.59	23.59	23.60	23.60	23.60	23.69	24.19	23.44
SP-00-7	Hardness	97									91.2	
SP-00-7	Alkalinity	54									50	
SP-00-7	Ammonia (mg/L)	ND									0.214	
SP-00-8	pH	7.92									7.74	
SP-00-8	Conductivity (us/cm)	324									289	
SP-00-8	D.O. (mg/L)	6.53	5.97	5.67	5.92	4.40	7.22	6.63	4.34	3.50	4.7	5.03
SP-00-8	Temp (C)	22.54	22.45	22.75	22.17	23.70	23.56	23.57	23.65	23.73	24.73	23.51
SP-00-8	Hardness	97									91.2	
SP-00-8	Alkalinity	54									50	
SP-00-8	Ammonia (mg/L)	ND									0.214	

Appendix A
Standard Mine 2008 Sediment Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
SP-01-1	pH	7.4									7.78	
SP-01-1	Conductivity (us/cm)	289									278	
SP-01-1	D.O. (mg/L)	6.75	6.19	5.76	5.86	3.90	7.77	6.02	3.43	3.15	4.9	5.62
SP-01-1	Temp (C)	23.31	22.57	22.05	22.11	23.68	23.61	23.09	23.88	23.92	24.9	23.53
SP-01-1	Hardness	101									85.6	
SP-01-1	Alkalinity	55									48.75	
SP-01-1	Ammonia (mg/L)	ND									0.208	
SP-01-2	pH	7.68									7.78	
SP-01-2	Conductivity (us/cm)	304									290	
SP-01-2	D.O. (mg/L)	6.42	6.32	5.88	5.10	4.12	7.83	7.21	3.26	3.16	5.05	5.50
SP-01-2	Temp (C)	23.49	22.56	22.03	22.08	23.45	23.95	23.05	24.09	24.11	24.65	24.02
SP-01-2	Hardness	101									85.6	
SP-01-2	Alkalinity	55									48.75	
SP-01-2	Ammonia (mg/L)	ND									0.208	
SP-01-3	pH	7.79									7.76	
SP-01-3	Conductivity (us/cm)	305									292	
SP-01-3	D.O. (mg/L)	6.31	5.96	5.82	5.17	4.01	7.85	7.00	3.51	3.36	4.91	5.56
SP-01-3	Temp (C)	23.31	22.98	22.05	22.19	23.68	23.94	23.25	24.04	24.03	24.95	23.90
SP-01-3	Hardness	101									85.6	
SP-01-3	Alkalinity	55									48.75	
SP-01-3	Ammonia (mg/L)	ND									0.208	
SP-01-4	pH	7.84									7.78	
SP-01-4	Conductivity (us/cm)	301									291	
SP-01-4	D.O. (mg/L)	6.84	5.85	6.03	5.20	3.78	7.54	6.81	3.59	3.19	4.87	5.67
SP-01-4	Temp (C)	23.92	22.99	21.94	22.13	23.75	23.85	23.51	23.99	24.01	24.87	23.84
SP-01-4	Hardness	101									85.6	
SP-01-4	Alkalinity	55									48.75	
SP-01-4	Ammonia (mg/L)	ND									0.208	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
SP-01-5	pH	7.84									7.78	
SP-01-5	Conductivity (us/cm)	313									291	
SP-01-5	D.O. (mg/L)	6.56	5.97	5.99	5.58	3.98	7.45	6.17	3.55	3.21	4.87	5.49
SP-01-5	Temp (C)	23.87	23.03	21.96	22.06	23.24	23.93	23.80	24.06	24.03	24.87	23.89
SP-01-5	Hardness	101									85.6	
SP-01-5	Alkalinity	55									48.75	
SP-01-5	Ammonia (mg/L)	ND									0.208	
SP-01-6	pH	7.88									7.78	
SP-01-6	Conductivity (us/cm)	331									290	
SP-01-6	D.O. (mg/L)	6.18	6.16	5.90	6.10	4.94	7.61	6.92	3.46	3.31	5.03	5.61
SP-01-6	Temp (C)	23.94	22.94	21.96	22.11	23.45	23.91	23.57	23.99	24.00	24.98	23.85
SP-01-6	Hardness	101									85.6	
SP-01-6	Alkalinity	55									48.75	
SP-01-6	Ammonia (mg/L)	ND									0.208	
SP-01-7	pH	7.97									7.78	
SP-01-7	Conductivity (us/cm)	303									289	
SP-01-7	D.O. (mg/L)	6.85	5.97	6.07	5.93	4.86	7.33	7.01	3.35	2.88	4.87	5.47
SP-01-7	Temp (C)	23.98	22.91	21.98	22.21	23.52	23.91	23.71	24.01	23.96	24.99	23.89
SP-01-7	Hardness	101									85.6	
SP-01-7	Alkalinity	55									48.75	
SP-01-7	Ammonia (mg/L)	ND									0.208	
SP-01-8	pH	7.89									7.78	
SP-01-8	Conductivity (us/cm)	299									289	
SP-01-8	D.O. (mg/L)	6.22	5.86	6.09	5.41	4.74	7.45	6.19	3.49	3.24	4.99	5.51
SP-01-8	Temp (C)	23.87	23.26	21.95	22.08	23.63	23.89	23.69	24.02	23.93	24.96	23.86
SP-01-8	Hardness	101									85.6	
SP-01-8	Alkalinity	55									48.75	
SP-01-8	Ammonia (mg/L)	ND									0.208	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-00-1	pH	7.96									7.86	
ELK-00-1	Conductivity (us/cm)	296									289	
ELK-00-1	D.O. (mg/L)	7.02	5.81	5.82	4.82	3.49	7.53	6.23	3.48	3.18	4.69	5.66
ELK-00-1	Temp (C)	23.85	22.65	21.62	22.03	23.35	23.09	23.10	23.55	23.58	24.47	23.28
ELK-00-1	Hardness	92									87.6	
ELK-00-1	Alkalinity	52.5									50	
ELK-00-1	Ammonia (mg/L)	ND									0.2	
ELK-00-2	pH	7.98									7.84	
ELK-00-2	Conductivity (us/cm)	297									289	
ELK-00-2	D.O. (mg/L)	7.32	5.92	5.95	4.99	3.50	7.47	6.71	4.11	3.49	4.66	5.70
ELK-00-2	Temp (C)	23.88	22.97	21.66	21.98	23.42	23.35	23.11	23.53	23.54	24.71	23.33
ELK-00-2	Hardness	92									87.6	
ELK-00-2	Alkalinity	52.5									50	
ELK-00-2	Ammonia (mg/L)	ND									0.2	
ELK-00-3	pH	7.94									7.88	
ELK-00-3	Conductivity (us/cm)	302									290	
ELK-00-3	D.O. (mg/L)	7.01	5.83	5.96	5.12	3.62	7.76	6.05	3.92	3.34	5.3	5.80
ELK-00-3	Temp (C)	23.67	22.82	21.72	22.05	23.51	23.30	23.05	23.51	23.53	24.7	23.37
ELK-00-3	Hardness	92									87.6	
ELK-00-3	Alkalinity	52.5									50	
ELK-00-3	Ammonia (mg/L)	ND									0.2	
ELK-00-4	pH	8.03									7.88	
ELK-00-4	Conductivity (us/cm)	314									290	
ELK-00-4	D.O. (mg/L)	7.98	5.68	5.90	5.60	4.01	7.46	5.93	3.90	3.33	5.21	5.81
ELK-00-4	Temp (C)	23.05	22.43	21.65	21.97	23.30	23.38	23.12	23.44	23.47	24.21	23.24
ELK-00-4	Hardness	92									87.6	
ELK-00-4	Alkalinity	52.5									50	
ELK-00-4	Ammonia (mg/L)	ND									0.2	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-00-5	pH	8.02									7.88	
ELK-00-5	Conductivity (us/cm)	302									292	
ELK-00-5	D.O. (mg/L)	6.4	6.06	6.64	5.21	3.52	7.70	6.79	3.63	3.10	5.43	5.56
ELK-00-5	Temp (C)	23.6	22.63	21.64	21.98	23.37	23.46	23.27	23.50	23.50	23.98	23.33
ELK-00-5	Hardness	92									87.6	
ELK-00-5	Alkalinity	52.5									50	
ELK-00-5	Ammonia (mg/L)	ND									0.2	
ELK-00-6	pH	8									7.87	
ELK-00-6	Conductivity (us/cm)	308									298	
ELK-00-6	D.O. (mg/L)	6.71	5.92	6.40	4.97	3.80	7.70	6.91	3.58	3.36	4.85	5.62
ELK-00-6	Temp (C)	22.58	22.02	21.58	22.02	23.37	23.47	23.11	23.39	23.44	23.29	23.21
ELK-00-6	Hardness	92									87.6	
ELK-00-6	Alkalinity	52.5									50	
ELK-00-6	Ammonia (mg/L)	ND									0.2	
ELK-00-7	pH	8.01									7.88	
ELK-00-7	Conductivity (us/cm)	305									291	
ELK-00-7	D.O. (mg/L)	7.23	6.45	6.04	5.11	3.71	7.68	5.73	3.88	3.21	4.97	5.65
ELK-00-7	Temp (C)	22.72	22.12	21.70	22.07	23.50	23.48	23.12	23.60	23.64	24.86	23.49
ELK-00-7	Hardness	92									87.6	
ELK-00-7	Alkalinity	52.5									50	
ELK-00-7	Ammonia (mg/L)	ND									0.2	
ELK-00-8	pH	8.05									7.88	
ELK-00-8	Conductivity (us/cm)	305									276	
ELK-00-8	D.O. (mg/L)	6.83	5.99	5.81	5.32	3.45	7.61	4.99	3.85	3.22	4.87	5.59
ELK-00-8	Temp (C)	23.25	22.52	21.56	22.09	23.42	23.59	23.05	23.40	23.50	24.78	23.36
ELK-00-8	Hardness	92									87.6	
ELK-00-8	Alkalinity	52.5									50	
ELK-00-8	Ammonia (mg/L)	ND									0.2	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-06-1	pH	7.78									7.78	
ELK-06-1	Conductivity (us/cm)	307									283	
ELK-06-1	D.O. (mg/L)	6.47	5.82	5.78	5.57	4.49	7.36	6.73	4.77	4.67	4.57	4.69
ELK-06-1	Temp (C)	23.33	22.51	22.53	22.37	23.59	22.95	23.40	23.14	23.04	24.33	22.96
ELK-06-1	Hardness	96									89.2	
ELK-06-1	Alkalinity	55									50	
ELK-06-1	Ammonia (mg/L)	ND									0.2028	
ELK-06-2	pH	7.94									7.84	
ELK-06-2	Conductivity (us/cm)	299									289	
ELK-06-2	D.O. (mg/L)	7.13	5.82	5.67	5.10	4.80	7.71	6.92	4.61	4.48	4.98	
ELK-06-2	Temp (C)	22.22	22.89	22.61	22.34	23.70	23.35	23.31	23.10	23.29	24.07	
ELK-06-2	Hardness	96									89.2	
ELK-06-2	Alkalinity	55									50	
ELK-06-2	Ammonia (mg/L)	ND									0.2028	
ELK-06-3	pH	7.93									7.84	
ELK-06-3	Conductivity (us/cm)	304									291	
ELK-06-3	D.O. (mg/L)	6.76	6.00	5.33	5.27	4.89	7.20	6.41	4.84	4.46	4.95	5.07
ELK-06-3	Temp (C)	23.13	22.43	22.44	22.35	23.80	23.23	23.27	23.10	23.21	24.18	23.02
ELK-06-3	Hardness	96									89.2	
ELK-06-3	Alkalinity	55									50	
ELK-06-3	Ammonia (mg/L)	ND									0.2028	
ELK-06-4	pH	7.86									7.82	
ELK-06-4	Conductivity (us/cm)	310									289	
ELK-06-4	D.O. (mg/L)	7.43	5.95	5.93	5.00	4.92	7.38	6.73	4.57	4.37	4.94	5.02
ELK-06-4	Temp (C)	22.44	22.37	22.54	22.40	23.50	23.26	23.62	23.14	23.22	22.82	23.04
ELK-06-4	Hardness	96									89.2	
ELK-06-4	Alkalinity	55									50	
ELK-06-4	Ammonia (mg/L)	ND									0.2028	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-06-5	pH	7.94									7.86	
ELK-06-5	Conductivity (us/cm)	301									292	
ELK-06-5	D.O. (mg/L)	7.14	6.05	5.84	5.65	4.84	7.70	6.59	4.69	4.38	4.89	5.27
ELK-06-5	Temp (C)	22.29	22.51	22.43	22.41	23.48	23.11	23.01	22.97	23.08	23.43	22.83
ELK-06-5	Hardness	96									89.2	
ELK-06-5	Alkalinity	55									50	
ELK-06-5	Ammonia (mg/L)	ND									0.2028	
ELK-06-6	pH	8									7.89	
ELK-06-6	Conductivity (us/cm)	305									286	
ELK-06-6	D.O. (mg/L)	7.86	5.80	5.98	5.24	5.01	7.63	6.02	4.86	4.36	4.9	4.89
ELK-06-6	Temp (C)	22.86	22.45	22.46	22.43	23.47	23.13	23.17	23.02	23.21	23.07	22.96
ELK-06-6	Hardness	96									89.2	
ELK-06-6	Alkalinity	55									50	
ELK-06-6	Ammonia (mg/L)	ND									0.2028	
ELK-06-7	pH	7.98									7.89	
ELK-06-7	Conductivity (us/cm)	313									297	
ELK-06-7	D.O. (mg/L)	7.26	5.99	5.93	5.46	4.62	7.89	6.91	4.79	4.38	4.82	5.06
ELK-06-7	Temp (C)	22.72	22.46	22.48	22.37	23.40	23.12	23.14	23.04	23.16	23.23	23.02
ELK-06-7	Hardness	96									89.2	
ELK-06-7	Alkalinity	55									50	
ELK-06-7	Ammonia (mg/L)	ND									0.2028	
ELK-06-8	pH	7.93									2.9	
ELK-06-8	Conductivity (us/cm)	325									292	
ELK-06-8	D.O. (mg/L)	6.8	6.06	5.73	5.65	4.50	7.74	6.04	4.49	4.11	4.83	5.14
ELK-06-8	Temp (C)	23.04	22.30	22.61	22.05	23.48	23.21	23.01	23.22	23.33	23.96	23.19
ELK-06-8	Hardness	96									89.2	
ELK-06-8	Alkalinity	55									50	
ELK-06-8	Ammonia (mg/L)	ND									0.2028	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-08-1	pH	7.92									7.8	
ELK-08-1	Conductivity (us/cm)	299									284	
ELK-08-1	D.O. (mg/L)	7.35	5.80	5.82	5.42	3.41	7.76	6.92	3.61	3.44	5.32	5.19
ELK-08-1	Temp (C)	23.06	22.14	21.74	22.12	23.45	23.24	23.25	23.23	23.04	24.42	22.95
ELK-08-1	Hardness	95									90.4	
ELK-08-1	Alkalinity	38									48.75	
ELK-08-1	Ammonia (mg/L)	ND										
ELK-08-2	pH	7.87									7.81	
ELK-08-2	Conductivity (us/cm)	301									288	
ELK-08-2	D.O. (mg/L)	6.13	6.39	5.98	5.60	3.59	7.58	5.72	4.07	3.36	5.21	5.35
ELK-08-2	Temp (C)	22.94	22.17	21.59	21.97	23.44	23.19	23.20	23.17	23.35	24.47	23.04
ELK-08-2	Hardness	95									90.4	
ELK-08-2	Alkalinity	38									48.75	
ELK-08-2	Ammonia (mg/L)	ND										
ELK-08-3	pH	7.91									7.8	
ELK-08-3	Conductivity (us/cm)	303									292	
ELK-08-3	D.O. (mg/L)	7.01	6.43	5.80	4.89	4.11	7.51	6.87	4.38	3.38	4.88	5.54
ELK-08-3	Temp (C)	22.46	22.01	21.60	22.04	23.70	23.21	23.09	23.14	23.24	24.53	23.01
ELK-08-3	Hardness	95									90.4	
ELK-08-3	Alkalinity	38									48.75	
ELK-08-3	Ammonia (mg/L)	ND										
ELK-08-4	pH	7.92									7.8	
ELK-08-4	Conductivity (us/cm)	302									292	
ELK-08-4	D.O. (mg/L)	6.81	5.82	5.98	5.30	4.01	7.52	6.72	3.71	3.34	4.8	5.66
ELK-08-4	Temp (C)	22.46	22.52	21.50	22.10	23.80	23.10	23.17	23.04	23.03	24.51	23.01
ELK-08-4	Hardness	95									90.4	
ELK-08-4	Alkalinity	38									48.75	
ELK-08-4	Ammonia (mg/L)	ND										

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
ELK-08-5	pH	7.95									7.8	
ELK-08-5	Conductivity (us/cm)	301									288	
ELK-08-5	D.O. (mg/L)	6.65	5.32	5.67	5.50	3.43	7.63	6.22	3.77	3.21	4.94	5.49
ELK-08-5	Temp (C)	22.1	22.12	21.57	22.04	23.02	23.17	23.15	23.10	23.24	24.64	23.02
ELK-08-5	Hardness	95									90.4	
ELK-08-5	Alkalinity	38									48.75	
ELK-08-5	Ammonia (mg/L)	ND										
ELK-08-6	pH	7.95									7.81	
ELK-08-6	Conductivity (us/cm)	310									287	
ELK-08-6	D.O. (mg/L)	6.5	5.79	5.81	5.12	3.78	7.50	5.32	4.06	3.18	4.97	5.43
ELK-08-6	Temp (C)	22.57	22.86	21.43	22.30	23.45	23.03	23.12	22.91	23.12	24.39	22.87
ELK-08-6	Hardness	95									90.4	
ELK-08-6	Alkalinity	38									48.75	
ELK-08-6	Ammonia (mg/L)	ND										
ELK-08-7	pH	7.96									7.81	
ELK-08-7	Conductivity (us/cm)	308									290	
ELK-08-7	D.O. (mg/L)	7.04	5.20	5.92	5.60	4.01	7.62	5.71	4.15	3.34	5.16	5.49
ELK-08-7	Temp (C)	22.98	22.57	21.60	22.03	23.50	23.25	23.20	23.12	23.27	24.41	23.14
ELK-08-7	Hardness	95									90.4	
ELK-08-7	Alkalinity	38									48.75	
ELK-08-7	Ammonia (mg/L)	ND										
ELK-08-8	pH	7.96									7.83	
ELK-08-8	Conductivity (us/cm)	320									289	
ELK-08-8	D.O. (mg/L)	6.95	5.72	6.18	5.72	3.51	7.41	6.98	3.93	3.29	4.87	5.35
ELK-08-8	Temp (C)	22.27	22.37	21.47	21.99	23.39	23.12	23.11	23.07	23.02	24.09	22.92
ELK-08-8	Hardness	95									90.4	
ELK-08-8	Alkalinity	38									48.75	
ELK-08-8	Ammonia (mg/L)	ND										

Appendix B
2008 Reference Toxicity Test
Daily Water Chemistries

Test Type:	96 Hour Static Renewal	Water Type:	MHRW	Sample Source:	MHRW
Duration:	96-hour	Analysts:	SA/FL	Test Start (day 0):	11/7/2008
Static/ Flow Through:	static	Test System:	Static Renewal	Test End (day 10):	11/11/2008
Organism:	H. azteca	Replicates:	Four	Feed Rate/ Type:	1 mL YCT

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Mortality			
Control-1	pH	8.19				8.2				
Control-1	Conductivity (us/cm)	371				537				
Control-1	D.O. (mg/L)	5.02	7.77	5.83	4.61	4.59	0			
Control-1	Temp (C)	22.01	21.4	22.18	21.96	21.01				
Control-1	Hardness	99				130				
Control-1	Alkalinity	53				80				
Control-2	pH	8.12				8.2				
Control-2	Conductivity (us/cm)	370				488				
Control-2	D.O. (mg/L)	5.11	7.62	6.01	5.63	4.6	0			
Control-2	Temp (C)	22.07	21.45	22.07	21.96	21.19				
Control-2	Hardness	99				130				
Control-2	Alkalinity	53				80				
Control-3	pH	8.17				8.2				
Control-3	Conductivity (us/cm)	367				467				
Control-3	D.O. (mg/L)	5.86	7.27	6.42	5.17	4.5	0			
Control-3	Temp (C)	22.11	21.44	21.97	21.51	21.27				
Control-3	Hardness	99				130				
Control-3	Alkalinity	53				80				
Control-4	pH	8.2				8.2				
Control-4	Conductivity (us/cm)	362				447				
Control-4	D.O. (mg/L)	5.82	7.26	5.97	5.79	4.71	0			
Control-4	Temp (C)	21.96	21.45	21.97	21.63	21.23				
Control-4	Hardness	99				130				
Control-4	Alkalinity	53				80				
Ref-6.25%-1	pH	7.8				7.85				
Ref-6.25%-1	Conductivity (us/cm)	375				390				
Ref-6.25%-1	D.O. (mg/L)	6.76	6.81	5.36	6.15	6.75	0			
Ref-6.25%-1	Temp (C)	21.23	21.35	24.61	21.73	21.4				
Ref-6.25%-1	Hardness	82				105.2				
Ref-6.25%-1	Alkalinity	50				65				
Ref-6.25%-2	pH	7.9				7.85				
Ref-6.25%-2	Conductivity (us/cm)	381				391				
Ref-6.25%-2	D.O. (mg/L)	6.37	6.48	5.85	6.81	6.52	4			
Ref-6.25%-2	Temp (C)	21.29	21.45	24.91	21.99	21.44				
Ref-6.25%-2	Hardness	82				105.2				
Ref-6.25%-2	Alkalinity	50				65				
Ref-6.25%-3	pH	8.34				8.2				
Ref-6.25%-3	Conductivity (us/cm)	375				498				
Ref-6.25%-3	D.O. (mg/L)	6.06	7.11	5.73	5.18	4.6	5			
Ref-6.25%-3	Temp (C)	22.36	21.39	22.16	21.34	21.34				
Ref-6.25%-3	Hardness	99				133				
Ref-6.25%-3	Alkalinity	53				80				
Ref-6.25%-4	pH	8.32				8.2				
Ref-6.25%-4	Conductivity (us/cm)	341				459				
Ref-6.25%-4	D.O. (mg/L)	6.73	7.03	6.2	5.86	5.29	0			
Ref-6.25%-4	Temp (C)	22.98	21.37	22.01	21.76	21.31				
Ref-6.25%-4	Hardness	99				133				
Ref-6.25%-4	Alkalinity	53				80				

Appendix B
2008 Reference Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Mortality			
Ref-12.5%-1	pH	8.27				8.1				
Ref-12.5%-1	Conductivity (us/cm)	387				482				
Ref-12.5%-1	D.O. (mg/L)	6.17	6.87	5.73	5.1	4.69	2			
Ref-12.5%-1	Temp (C)	21.71	21.3	21.97	21.86	21.34				
Ref-12.5%-1	Hardness	99				135				
Ref-12.5%-1	Alkalinity	53				75				
Ref-12.5%-2	pH	8.28				8.1				
Ref-12.5%-2	Conductivity (us/cm)	363				474				
Ref-12.5%-2	D.O. (mg/L)	5.73	6.78	6.25	5.16	4.99	1			
Ref-12.5%-2	Temp (C)	22.55	21.36	21.86	21.47	21.33				
Ref-12.5%-2	Hardness	99				135				
Ref-12.5%-2	Alkalinity	53				75				
Ref-12.5%-3	pH	8.31				8.1				
Ref-12.5%-3	Conductivity (us/cm)	369				492				
Ref-12.5%-3	D.O. (mg/L)	5.55	6.67	6.73	5.01	4.9	3			
Ref-12.5%-3	Temp (C)	22.53	21.35	21.88	21.68	21.25				
Ref-12.5%-3	Hardness	99				135				
Ref-12.5%-3	Alkalinity	53				75				
Ref-12.5%-4	pH	8.36				8.1				
Ref-12.5%-4	Conductivity (us/cm)	368				481				
Ref-12.5%-4	D.O. (mg/L)	5.68	6.54	6.66	5.7	4.87	4			
Ref-12.5%-4	Temp (C)	22.58	21.34	22.04	21.76	21.24				
Ref-12.5%-4	Hardness	99				135				
Ref-12.5%-4	Alkalinity	53				75				
Ref-25%-1	pH	8.26				8				
Ref-25%-1	Conductivity (us/cm)	377				488				
Ref-25%-1	D.O. (mg/L)	6.19	6.48	6.02	5.17	4.83	10			
Ref-25%-1	Temp (C)	22.06	21.21	22	21.65	21.21				
Ref-25%-1	Hardness	99				134				
Ref-25%-1	Alkalinity	53				80				
Ref-25%-2	pH	8.37				8				
Ref-25%-2	Conductivity (us/cm)	362				485				
Ref-25%-2	D.O. (mg/L)	5.7	6.37	5.73	5.6	4.87	9			
Ref-25%-2	Temp (C)	22.63	21.33	22.05	21.67	21.27				
Ref-25%-2	Hardness	99				134				
Ref-25%-2	Alkalinity	53				80				
Ref-25%-3	pH	8.37				8				
Ref-25%-3	Conductivity (us/cm)	364				492				
Ref-25%-3	D.O. (mg/L)	5.31	6.35	5.63	4.97	4.84	10			
Ref-25%-3	Temp (C)	22.38	21.32	22.21	21.97	21.27				
Ref-25%-3	Hardness	99				134				
Ref-25%-3	Alkalinity	53				80				
Ref-25%-4	pH	8.29				8				
Ref-25%-4	Conductivity (us/cm)	357				468				
Ref-25%-4	D.O. (mg/L)	5.89	6.44	6.01	5.31	4.89	10			
Ref-25%-4	Temp (C)	22.23	21.33	22.03	21.96	21.2				
Ref-25%-4	Hardness	99				134				
Ref-25%-4	Alkalinity	53				80				

Appendix B
2008 Reference Toxicity Test
Daily Water Chemistries

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Mortality			
Ref-50%-1	pH	8.05				7.9				
Ref-50%-1	Conductivity (us/cm)	308				397				
Ref-50%-1	D.O. (mg/L)	6.19	6.19	6.21	5.18	4.88	10			
Ref-50%-1	Temp (C)	21.62	21.27	21.96	21.76	21.26				
Ref-50%-1	Hardness	99				112				
Ref-50%-1	Alkalinity	53				70				
Ref-50%-2	pH	8.16				7.9				
Ref-50%-2	Conductivity (us/cm)	305				392				
Ref-50%-2	D.O. (mg/L)	5.3	6.18	6	5.16	5.04	10			
Ref-50%-2	Temp (C)	22.6	21.33	21.87	21.46	21.31				
Ref-50%-2	Hardness	99				112				
Ref-50%-2	Alkalinity	53				70				
Ref-50%-3	pH	8.14				7.9				
Ref-50%-3	Conductivity (us/cm)	308				395				
Ref-50%-3	D.O. (mg/L)	5.91	6.18	6.24	5.56	4.9	10			
Ref-50%-3	Temp (C)	22.57	21.31	22.41	21.67	21.28				
Ref-50%-3	Hardness	99				112				
Ref-50%-3	Alkalinity	53				70				
Ref-50%-4	pH	8.13				7.9				
Ref-50%-4	Conductivity (us/cm)	302				381				
Ref-50%-4	D.O. (mg/L)	6.22	6.15	5.73	5.22	5.11	10			
Ref-50%-4	Temp (C)	22.32	21.24	21.47	21.56	21.15				
Ref-50%-4	Hardness	99				112				
Ref-50%-4	Alkalinity	53				70				
Ref-100%-1	pH	8.05				8				
Ref-100%-1	Conductivity (us/cm)	308				391				
Ref-100%-1	D.O. (mg/L)	6.19	6.16	5.41	5.26	5.1	10			
Ref-100%-1	Temp (C)	22.3	21.16	22.29	21.67	21.23				
Ref-100%-1	Hardness	99				114				
Ref-100%-1	Alkalinity	53				65				
Ref-100%-2	pH	8.1				8				
Ref-100%-2	Conductivity (us/cm)	302				394				
Ref-100%-2	D.O. (mg/L)	5.63	6.31	5.49	5.17	5.03	10			
Ref-100%-2	Temp (C)	22.69	21.4	21.76	21.71	21.31				
Ref-100%-2	Hardness	99				114				
Ref-100%-2	Alkalinity	53				65				
Ref-100%-3	pH	8.09				8				
Ref-100%-3	Conductivity (us/cm)	302				394				
Ref-100%-3	D.O. (mg/L)	6.19	6.18	6.27	5.08	4.94	10			
Ref-100%-3	Temp (C)	22.51	21.27	22.22	21.76	21.27				
Ref-100%-3	Hardness	99				114				
Ref-100%-3	Alkalinity	53				65				
Ref-100%-4	pH	8.09				8				
Ref-100%-4	Conductivity (us/cm)	302				383				
Ref-100%-4	D.O. (mg/L)	6.32	6.17	5.47	5.21	4.93	10			
Ref-100%-4	Temp (C)	22.52	21.24	21.39	21.66	21.2				
Ref-100%-4	Hardness	99				114				
Ref-100%-4	Alkalinity	53				65				

Attachments

Hyalella 10-d Survival and Growth Sediment Test **U.S. EPA Region VIII Laboratory**

Analysis No:	07-0556-2760	**Endpoint:**	10d Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	20 Feb-09 14:44	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes
Test Run No:	08-7351-5048	**Test Type:**	Growth-Survival (10d)	**Analyst:**	
Start Date:	03 Nov-08 10:16	**Protocol:**	EPA/821/R-02-014 (2002)	**Diluent:**	Soft Synthetic Water
Ending Date:	13 Nov-08	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 14h	**Source:**	Aquatic Biosystems, CO	**Age:**	7-10

Sample Code	Sample No	Sample Date	Receive Date	Sample Age	Client Name	Project
StdMine08SP01	07-8908-1772	21 Sep-08	24 Sep-08	43d 10h (4 °C)	Internal Lab	Effluent Characterization (
SP-00	03-0940-7914	17 Sep-08		47d 10h		
ELK-00	17-5583-9444	17 Sep-08		47d 10h		
ELK-06	12-1333-6773	17 Sep-08		47d 10h		
ELK-08	15-9264-5384	02 Oct-08		32d 10h		
COAL-15	10-2407-7428	17 Sep-08		47d 10h		
COAL-20	17-8019-5190	17 Sep-08		47d 10h		
COAL-OPP	10-2839-2729	21 Sep-08	24 Sep-08	43d 10h (4 °C)		
CONTROL	13-5002-2087	17 Sep-08		47d 10h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
StdMine08SP01	Reference sediment	Standard Mine	SP-01		
SP-00	Mining Discharge/Runoff	Standard Mine	SP-00		
ELK-00	Mining Discharge/Runoff	Standard Mine	ELK-00		
ELK-06	Mining Discharge/Runoff	Standard Mine	ELK-06		
ELK-08	Mining Discharge/Runoff	Standard Mine	ELK-08		
COAL-15	Mining Discharge/Runoff	Standard Mine	COAL-15		
COAL-20	Mining Discharge/Runoff	Standard Mine	COAL-20		
COAL-OPP	Mining Discharge/Runoff	Standard Mine	COAL-OPP		
CONTROL	Mining Discharge/Runoff	Standard Mine	NEGATIVE CTRL		

Sample Code	Sample Comments
StdMine08SP01	Upstream Reference.

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run					20.9%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
StdMine08SP01		SP-00	1.517	2.44	0.2504	0.2719	Non-Significant Effect
		ELK-00	6.838	2.44	0.2504	0.0000	Significant Effect
		ELK-06	5.698	2.44	0.2504	0.0000	Significant Effect
		ELK-08	9.692	2.44	0.2504	0.0000	Significant Effect
		COAL-15	1.126	2.44	0.2504	0.4420	Non-Significant Effect
		COAL-20	1.148	2.44	0.2504	0.4315	Non-Significant Effect
		COAL-OPP	0.1931	2.44	0.2504	0.8374	Non-Significant Effect
		CONTROL	3.658	2.44	0.2504	0.0018	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	7.805565	0.9756957	8	23.08	0.0000	Significant Effect
Error	2.66308	0.0422711	63			
Total	10.46865	1.017967	71			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	14.75	20.1	0.0641	Equal Variances
Distribution	Shapiro-Wilk Normality	0.978		0.2379	Normal Distribution

Hyalella 10-d Survival and Growth Sediment Test **U.S. EPA Region VIII Laboratory**

Analysis No: 07-0556-2760 **Endpoint:** 10d Survival Rate **CETIS Version:** CETISv1.6.3
Analyzed: 20 Feb-09 14:44 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

10d Survival Rate Summary

Conc-µg/L	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
StdMine08SP01	8	0.9	0.8712	0.9288	0.8	1	0.01404	0.07559	8.4%	0.0%
SP-00	8	0.775	0.7115	0.8385	0.5	1	0.03099	0.1669	21.5%	13.9%
ELK-00	8	0.2875	0.2321	0.3429	0	0.5	0.02707	0.1458	50.7%	68.1%
ELK-06	8	0.3875	0.3401	0.4349	0.2	0.6	0.02315	0.1246	32.2%	56.9%
ELK-08	8	0.0625	0.0342	0.0908	0	0.2	0.01382	0.0744	119.0%	93.1%
COAL-15	8	0.8125	0.7651	0.8599	0.6	1	0.02315	0.1246	15.3%	9.72%
COAL-20	8	0.7875	0.6956	0.8794	0.5	1	0.04487	0.2416	30.7%	12.5%
COAL-OPP	8	0.875	0.8115	0.9385	0.5	1	0.03099	0.1669	19.1%	2.78%
CONTROL	8	0.575	0.4698	0.6802	0.2	1	0.05134	0.2765	48.1%	36.1%

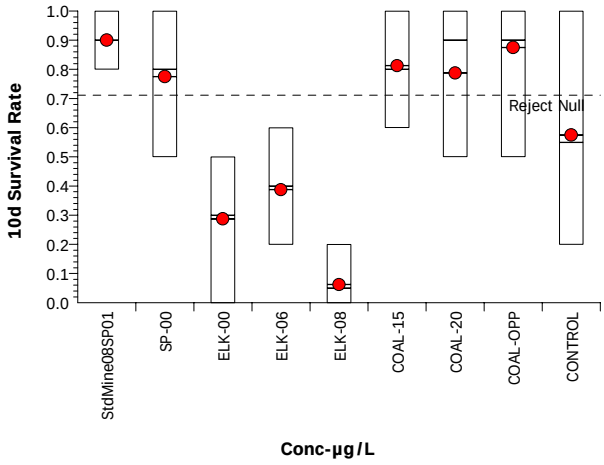
Angular (Corrected) Transformed Summary

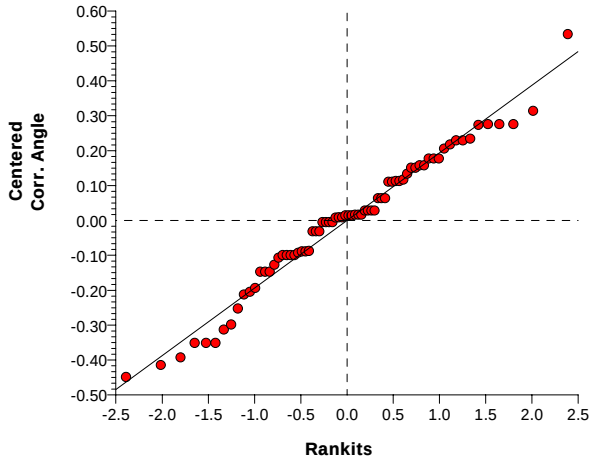
Conc-µg/L	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
StdMine08SP01	8	1.254	1.21	1.298	1.107	1.412	0.02142	0.1154	9.2%	0.0%
SP-00	8	1.098	1.02	1.177	0.7854	1.412	0.03834	0.2065	18.8%	12.4%
ELK-00	8	0.5514	0.4813	0.6215	0.1588	0.7854	0.03421	0.1842	33.4%	56.0%
ELK-06	8	0.6686	0.6189	0.7183	0.4636	0.8861	0.02427	0.1307	19.5%	46.7%
ELK-08	8	0.258	0.214	0.302	0.1588	0.4636	0.0215	0.1158	44.9%	79.4%
COAL-15	8	1.139	1.076	1.201	0.8861	1.412	0.0304	0.1637	14.4%	9.23%
COAL-20	8	1.136	1.023	1.25	0.7854	1.412	0.05539	0.2983	26.3%	9.41%
COAL-OPP	8	1.234	1.154	1.315	0.7854	1.412	0.03927	0.2115	17.1%	1.58%
CONTROL	8	0.8782	0.7582	0.9982	0.4636	1.412	0.05859	0.3155	35.9%	30.0%

10d Survival Rate Detail

Conc-µg/L	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
StdMine08SP01	1	1	0.9	0.9	0.9	0.9	0.8	0.8
SP-00	1	0.9	0.9	0.8	0.8	0.7	0.6	0.5
ELK-00	0.5	0.4	0.3	0.3	0.3	0.3	0.2	0
ELK-06	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.2
ELK-08	0.2	0.1	0.1	0.1	0	0	0	0
COAL-15	1	0.9	0.9	0.8	0.8	0.8	0.7	0.6
COAL-20	1	1	1	0.9	0.9	0.5	0.5	0.5
COAL-OPP	1	1	1	0.9	0.9	0.9	0.8	0.5
CONTROL	1	0.8	0.8	0.6	0.5	0.4	0.3	0.2

Graphics





CETIS Analytical Report

Reference Toxicant 96-h Acute Survival Test **U.S. EPA Region VIII Laboratory**

Analysis No:	13-7333-3884	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	19 Feb-09 10:15	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes
Test Run No:	06-8367-2757	**Test Type:**	Survival	**Analyst:**	Steve Auer
Start Date:	07 Nov-08	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Reconstituted Water
Ending Date:	11 Nov-08	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	96h	**Source:**	Aquatic Biosystems, CO	**Age:**	7-10
Sample No:	08-8049-4164	**Code:**	880494164	**Client:**	Internal Lab
Sample Date:	07 Nov-08	**Material:**	Reference water	**Project:**	DMR-QA Study
Receive Date:		**Source:**	Standard Mine		
Sample Age:	N/A	**Station:**	POSITIVE CTRL		

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC/LC50	95% LCL	95% UCL
Control Threshold	0	22.50%	2.194	0.04048	156.4	129.8	188.4

Survival Rate Summary

			Calculated Variate(A/B)								
Conc-µg/L	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**	**A**	**B**
0	Negative Control	4	1	1	1	0	0	0.0%	0.0%	40	40
62.5		4	0.775	0.5	1	0.04802	0.263	33.9%	22.5%	31	40
125		4	0.75	0.6	0.9	0.02357	0.1291	17.2%	25.0%	30	40
250		4	0.025	0	0.1	0.009129	0.05	200.0%	97.5%	1	40
500		4	0	0	0	0	0		100.0%	0	40
750		4	0	0	0	0	0		100.0%	0	40

Survival Rate Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Negative Control	1	1	1	1
62.5		1	0.6	0.5	1
125		0.8	0.9	0.7	0.6
250		0	0.1	0	0
500		0	0	0	0
750		0	0	0	0

Graphics