Section 319 Nonpoint Source Pollution Control Program

Upper Trail Creek Watershed Project Final Report

By Clear Creek Watershed Foundation

3/13/2013

This project was conducted in cooperation with the State of Colorado and the United States Environmental Protection Agency, Region 8. Grant # C188849 and CDPHE Contract Routing #09 FAA 00248
EXECUTIVE SUMMARY

Project Title: 319 Upper Trail Creek Nonpoint Source Grant

Project Start Date: July 31, 2009  Project Completion Date: March 31, 2013

SUMMARY ACCOMPLISHMENTS

The following Best Management Practices were implemented:

- Waste piles were shaped and graded to prepare for revegetation.
- Waste material was moved inside tailings ponds and then capped.
- Soil amendment was applied to improve highly acidic conditions and promote revegetation.
- Run-on channels were constructed to control metals leaching from storm run-off events.
- A concrete cut-off wall and clay barrier were installed to prevent water from moving under the road along the side of Trail Creek.
- Waste piles entering the creek were pulled back to prevent the creek water from pulling metals from the pile into the creek.

GOALS MET

The Upper Trail Creek reclamation activities contribute to reducing mine waste entering the Trail Creek sub-tributary of Clear Creek and supports the effort to get Trail Creek removed from State of Colorado 303(d) list of impaired waters.
Contents
EXECUTIVE SUMMARY ..................................................................................................................... 2
1.0 INTRODUCTION ................................................................................................................................. 6
2.0 PROJECT GOALS, OBJECTIVES, & ACTIVITIES ............................................................................. 8
  2.1 Goals ................................................................................................................................................. 8
  2.2 Objectives ....................................................................................................................................... 8
  2.3 Activities ....................................................................................................................................... 8
    2.3.1 Pre-Construction Activities ........................................................................................................ 8
    2.3.2 Preliminary Water Quality Monitoring Activities ........................................................................ 10
3.0 BEST MANAGEMENT PRACTICES DEVELOPED ......................................................................... 13
  3.1 Construction Material Detail ........................................................................................................... 13
  3.2 Freeland / Gumtree Mine Site Project ............................................................................................ 13
    3.1.1 Concrete Cut-Off Wall .................................................................................................................. 14
    3.1.2 Clay Cut-Off Trench .................................................................................................................... 15
  3.2 Gumtree Waste Pile Remediation ................................................................................................... 15
  3.3 Freeland Waste Pile Remediation .................................................................................................... 16
  3.4 Brazil Millsite Project ....................................................................................................................... 18
    3.4.1 Access Road Construction .......................................................................................................... 18
    3.4.2 Exploratory Test Pits ................................................................................................................... 18
    3.4.3 Consolidation & Hauling of Debris Fan ....................................................................................... 18
    3.4.4 Excavation and Stockpile of Clean Fill ....................................................................................... 19
    3.4.5 Incorporation of Fertilizer & Organic Material ........................................................................... 19
    3.4.6 Run-On Control Channel .......................................................................................................... 19
    3.4.7 Site Restoration & Revegetation ............................................................................................... 20
4.0 MONITORING RESULTS .................................................................................................................. 20
5.0 BMP EFFECTIVENESS EVALUATIONS ......................................................................................... 25
  5.1 SURFACE WATER IMPROVEMENTS ............................................................................................ 25
  5.2 GROUND WATER ............................................................................................................................ 27
  5.3 OTHER MONITORING ..................................................................................................................... 27
5.4 QUALITY ASSURANCE REPORTING ................................................................. 27
5.5 RESULTS OF BMP OPERATION AND MAINTENANCE REVIEWS ................ 27
6.0 COORDINATION EFFORTS ............................................................................ 28
7.0 SUMMARY OF PUBLIC PARTICIPATION ...................................................... 29
8.0 ASPECTS OF THE PROJECT THAT DID NOT WORK WELL ......................... 31
9.0 FUTURE ACTIVITY RECOMMENDATION .................................................. 31
TABLE OF MAPS, PHOTOS & FIGURES ........................................................... 32
Acknowledgements

This project was made possible by the generous funding of the Colorado Department of Public Health & Environment and the Colorado Division of Reclamation, Mining & Safety. We would like to acknowledge the support and cooperation of the landowners: Buzzard Family, Gumtree Mining Company, Charles Nunnery Trust, Schall Family, and the Victor G. Mosch Foundation whose Consent for Access and/or Quitclaim Deed made this project possible. We would also like to thank Clear Creek County staff for their cooperation and guidance. The Clear Creek Watershed Foundation was fortunate to contract with Frontier Environmental Services, Inc. for the project construction.

This project supports, Managing Stormwater to Protect Water Resources in Mountainous Regions of Colorado, prepared for Clear Creek County by Colorado Geological Survey, as well as Best Practices in Abandoned Mine Land Reclamation: The Remediation of Past Mining Activities, released by the Colorado Division of Minerals and Geology in 2002 (DRMS).
1.0 INTRODUCTION

The 1859 discovery of gold in Clear Creek had many positive economic benefits. The activities related to the mining boom also resulted in some significant water quality impacts. When the silver markets crashed, most mining works were abandoned leaving approximately 2,000 “orphan” or inactive sites within the Clear Creek/Gilpin mineralized area immediately west of Denver, Colorado and few potentially responsible parties (HUC Code 10190004). This historic mining in the Clear Creek Watershed has impacted the health of the river. The Clear Creek Watershed Foundation (CCWF), with support and funding from the State of Colorado Nonpoint Source Program and the Colorado Energy & Mineral Impact Assistance Fund, is addressing many of these mining related impacts through mine remediation projects.

Back in the late 1800s, the Upper Trail Creek area, including numerous claims around the Lamartine Mining District and the town of Freeland, was a very productive mining center. Although there are no active mines today, many former workings exist in the drainage. Water quality is degraded by sediments and metal contamination from mine tailings, waste rock dumps, and draining mines. Due to its degraded stream channel conditions, Trail Creek is limited in terms of its potential for supporting aquatic life. Because of these traits, this stream segment is on the State of Colorado’s 303(d) list for the trace metals – cadmium (Cd) and pH. These metals impact aquatic life and are of concern to downstream drinking water users. Also, because of its impaired quality, Trail Creek was designated as a separate stream segment for continuous monitoring.

The Upper Trail Creek Project was a reclamation effort in the 3.6 square mile Trail Creek drainage. Trail Creek is a perennial stream, with higher flows during snowmelt and summer thunderstorms. It is a steep mountain stream with an average channel gradient of 11 percent. The Trail Creek sub-watershed ranges in elevation from over 11,000 ft-MSL near Ute Mountain down to 7,680 ft-MSL at the confluence with Clear Creek. A county road, with sections built on top of mine waste, follows Trail Creek upstream.
approximately three miles from the mouth up to the Lamartine Mine area. The road passes the Phoenix Mine (an operating tourist attraction), several residences, and the ghost town of Freeland.

During 2006, a supplemental trace metals characterization study, funded by CCWF, was implemented by Clear Creek Consultants, Inc.; including monthly ambient water quality sampling and field measurements, flow data, and storm runoff events. This water quality/hydrologic data collection study focused on Trail Creek and the lower reach of stream segment 2 and upper segment of stream segment 11 (mainstem Clear Creek segments). Trail Creek is a supplemental study to the Clear Creek trace-metals monitoring program and has been under continuous monitoring from 2006 to the present.

Combining information from historic Trail Creek water quality data, Trail Creek Technical Report Water Quality Monitoring Results from 2006 through 2009, and the Clear Creek County GIS mapping system, CCWF identified three primary target mine orphanage zones in the Trail Creek sub watershed; the Lamartine, Freeland, and Great Western. This information was used to refine water quality data collection.

Site visits to Upper Trail Creek during the 2010 season resulted in a revised water quality monitoring program bracketing locations identified as loading areas for zinc and copper. Interpretation of the data generated by the revised monitoring program validated source prioritization for Best Management Practices (BMPs) in the Lamartine orphanage to address zinc loading and the Freeland orphanage to address copper loading. The Great Western orphanage was removed from consideration for remediation.
Upon grant approval, project activities commenced which included land surveys to determine property ownership, obtaining consent for property access, securing a quitclaim deed, project engineering and design, and BMP construction. The Freeland Orphanage BMPs were separated into two primary construction areas, the Gumtree Remediation, and the Freeland Remediation. The Lamartine Orphanage BMP targeted the Brazil Millsite.

2.0 PROJECT GOALS, OBJECTIVES, & ACTIVITIES

2.1 Goals
- Reclaim blighted mined land in an effort to get Trail Creek removed from State of Colorado 303(d) list of impaired waters
- Educate the community and visitors on abandoned mine nonpoint source water issues

2.2 Objectives
- Reduce total metal loading in Trail Creek
- Get Trail Creek removed from State of Colorado 303(d) list of impaired waters

2.3 Activities

2.3.1 Pre-Construction Activities
In November of 2006 CCWF submitted an Upper Trail Creek Nonpoint Source Grant Proposal to the Colorado Department of Public Health & Environment (CDPHE) Nonpoint Source Review Committee. CCWF received Notice of Grant Approval from CDPHE in March 2007 with the caveat that EPA funds for the grant were pending. In July of 2008 CCWF submitted the Upper Trail Creek Project Implementation Plan (PIP), the Quality Assurance Project Plan (QAPP), and the Upper Trail Creek Water Quality Sampling and Analysis Plan (SAP). Final PIP approval was received by CCWF in March of 2009. Final QAPP/SAP approval was received by CCWF in April of 2009. The grant contract for the Upper Trail Creek Project was signed as executable on July 31, 2009.
Once the contract was signed, CCWF began field reconnaissance activities to prioritize sites to be included in the project and determine BMPs for those sites. CCWF conducted landowner research activities and commenced on-going solicitation of public comment for the proposed work. The actual construction and BMP implementation work took place in 2011.

Site visits to Upper Trail Creek after grant approval resulted in a revised 2010 water quality monitoring program to bracket locations identified as loading areas for zinc and copper. Interpretation of the data generated by the revised monitoring program validated source prioritization for BMP actions which focused on the Freeland Orphanage area targeting copper reduction and the Lamartine Orphanage targeting zinc reduction. The Clear Creek Watershed Foundation, Frontier Environmental Engineering, Inc., Summit Geology & Consulting, LLC, and Clear Creek Consultants hydrology contractor followed water quality monitor findings with a series of site visits to determine next actions and preliminary BMP design concepts.

A land survey plat was created by Clear Creek Surveying for the Freeland Lode, M.S. No. 653 Am. and a portion of the Dumont Placer, M.S. No. 794 within the Trail Creek Mining District to inform construction activities in the Freeland Orphanage area.

Trenching was completed in the Freeland Orphanage land survey plat area which identified the ground water path causing mobilization of copper into Trail Creek. Ground water was flowing from Trail Creek under the county road and back into Trail Creek. The road was built on the Freeland waste pile. County land, in the form of the road, was identified as a copper contributor. CCWF initiated discussion with several departments of the local county government to determine access, right-of-way and permitting requirements in order to proceed with reclamation design.

More site visits were scheduled in August of 2010 to discuss and refine the Freeland Orphanage conceptual engineering design and assess the after effects of a July 30, 2010 storm event. Follow-up site visits were held with the Clear Creek County Community Projects Director and Road & Bridge Engineer.

Based on the post storm event site visits and trenching discovery, Upper Trail Creek Freeland Orphanage Reclamation Project design was revised and presented October, 2010 during a Clear Creek County Board of County Commissioners / Road & Bridge Department Work Session. The outcome of this session was the creation of a draft Memorandum of Understanding (MOU) for future projects to be contracted between CCWF and Clear Creek County. The MOU was submitted to the Clear Creek County Legal Department for input and revisions in November of 2010.

While awaiting a final version of the MOU, it was agreed between CCWF and Clear Creek County that a signature sheet would be used in the interim as an incremental project review document for projects in the CCWF queue for Clear Creek County, including the Upper Trail Creek Orphanage Reclamation Project.

In January of 2011 design review with all local, state, and federal stakeholders in the Freeland Orphanage Project commenced. Material analysis was conducted on lime beet by-product for use in the revegetation amendment. Revisions to the Freeland engineering design were made based on
stakeholder input. A traffic control plan was created and a construction notice was distributed to local residents. Additional meetings were held with Dumont Placer and Freeland Parcel land owners for review of the revised design.

A Notice-To-Proceed on the Freeland Orphanage was issued on April 15, 2011. Frontier Environmental Services, Inc. mobilized personnel and equipment to the site to begin performance of this scope of work on April 18, 2011. Construction was substantially complete on May 25, 2011.

Characterization work also began in January 2011 on the Brazil Millsite within the Lamartine Orphanage of Upper Trail Creek. Research was conducted on land ownership and a land survey was completed by Clear Creek Surveying. An unpatented claim was discovered and actions were taken to secure a quitclaim deed.

The Brazil Millsite Quitclaim was secured, notarized, and submitted to Clear Creek County and a release of environmental covenants was awarded for the site. Design engineering began and a Brazil Millsite Site Management Agreement was drafted between the Clear Creek Watershed Foundation and Clear Creek County. The Agreement was reviewed, revised, and approved by the Clear Creek County Legal Department and Board of County Commissioners.

A Notice-To-Proceed with BMP construction activities at the Brazil Millsite in the Lamartine Orphanage was issued on June 6, 2011. Frontier Environmental Services, Inc. mobilized personnel and equipment to the site to begin performance of this scope of work on June 13, 2011. Final project clean-up, equipment removal and completion took place on August 3, 2011.

2.3.2 Preliminary Water Quality Monitoring Activities

A surface water monitoring program was started in 2006 on Trail Creek, a tributary to Clear Creek near Idaho Springs, Colorado, to assess metal concentrations and sediment loads related to historical mining. This monitoring program was conducted by Clear Creek Consultants on behalf of the Clear Creek Watershed Foundation.

The 2006 Trail Creek monitoring program consisted of the following principle components.

- Ambient monthly water quality sampling at four locations: upper and lower Trail Creek; and Clear Creek upstream and downstream from the confluence
- Automated storm event sampling at Trail Creek near mouth (Station CC-31) and Clear Creek upstream of Trail Creek (Station CC-32)
- Continuous 10-minute flow and precipitation recording at Trail Creek CC-31
- Radio telemetry communication between CC-31 and CC-32 for automated storm event sampling
- Monthly audits, data downloading, calibration, and maintenance
- Lamartine Mine field water quality survey

The Trail Creek monitoring program in 2007 and 2008 consisted of the same principal principle components as in 2006 with the addition of another monitoring station in the vicinity of the Freeland
The monitoring program was further expanded in 2010 such that it consisted of the following components:

- Ambient monthly water quality sampling at six locations from upstream to downstream in Trail Creek; and Clear Creek upstream of the confluence (CC-32) and downstream (CC-40).
- Establishment of a new Trail Creek sampling location below the slag pile area (CC-31BS).
- Two sampling surveys in the Trail Run tributary drainage.
- Automated storm event sampling at Trail Creek near mouth (CC-31) and Clear Creek upstream of Trail Creek (CC-32).
- Continuous 10-minute flow and precipitation recording at Trail Creek mouth (CC-31).
- Radio telemetry between CC-31 and CC-32 for automated storm event sampling.
- Turbidity and flow recording at downstream Clear Creek Station CC-40.
- Monthly station audits, data downloading, calibration, and maintenance.

### 2.3.2.1 Pre BMP Hydrological Monitoring

Streamflow near the mouth of Trail Creek (CC-31) was estimated using a broad-crested weir equation adjusted for variable stage-discharge conditions. Continuous data recording at CC-31 consisted of average 10-minute stream stage height (feet) using a submersible pressure transducer, and 10-minute total precipitation (inches) using a tipping bucket rainfall intensity gauge. These sensors were recorded using a Campbell Scientific programmable data logger. The data acquisition system was housed in a weatherproof enclosure with power supplied by a solar panel and sealed rechargeable battery.
The 2006 flows ranged from about 0.3 cfs (baseflow) to maximum flows of about 1.8 cfs. Peak snowmelt flows occurred in late May and early June at about 0.8 cfs. Peak storm event flows ranged from 1 to 2 cfs. Total precipitation during the July to September 2006 period was 3.7 inches. Only one event (19-Aug) had rainfall intensity equal to or exceeding 0.1 inches over a 10-minute period (0.13-in.).

The 2008 flows ranged from about 0.5 to 4 cubic feet per second (cfs) during the summer monitoring period, similar to 2006 conditions. A total of four storm runoff events occurred in July and August 2008, similar to 2007 conditions. Total precipitation during the July to September 2008 period was 3.80 inches compared to 3.30 inches over the same period in 2007.

The 2010 flows ranged from a base flow of about 0.4 cubic feet per second (cfs) to peak flows ranging from 4 to 5 cfs during snowmelt runoff. These are consistent with 2009 flows. Storm runoff events occurred in June with peak flows ranging from 4 to 6 cfs. A large runoff event on July 30 produced an estimated peak flow of 125 cfs. This flow event generated significant sediment transport and dislodged the transducer, which was re-installed in August. Otherwise, low-flow conditions (<1 cfs) persisted in Trail Creek through September 2010.

2.3.2.2 Pre BMP Water Quality

At total of eight monthly ambient samples were collected at CC-31, CC-31A, CC-32, and CC-33 from March to October 2006. Field water quality parameters including pH, conductivitiy, temperature and flow also were measured. Three storm events were sampled in 2006.

Eight monthly samples were collected from March to October in 2007 and 2008 on Trail Creek at Stations CC-31A, 31B, 31C, 31D, and CC-31; and on Clear Creek at CC-32 and CC-40. Two storm runoff events were also sampled in 2008.

Six monthly samples were collected from April to September 2010 at Trail Creek Stations CC-31A, 31B, 31BS, 31C, 31D, and CC-31; and in Clear Creek at Stations CC-32 and CC-40. Trail Creek Station CC-31BS was added to assess metal contributions from the slag pile in the Great Western Orphanage area above the Freeland tailings pile. A conductivity survey was conducted in this reach on April 27, 2010 to assess metal contributions.

Samples were also collected from Trail Run, a tributary to Trail Creek draining in the Freeland Mine area, in July and September. Trail Creek stream pH ranged from 6.5 to 7.9 with a slight decreasing trend from upstream to downstream. Specific conductance ranged from a low of 50 uS at background Station 31A to 270 uS at CC-31 generally increasing with distance downstream during most months.
3.0 BEST MANAGEMENT PRACTICES DEVELOPED

The Upper Trail Creek Reclamation Project was awarded to Frontier Environmental Services, Inc. (FESI) as part of a Master Services agreement with the Clear Creek Watershed Foundation. A Notice-To-Proceed on the Freeland / Gumtree Mine project site was issued on April 15, 2011. FESI mobilized personnel and equipment to the site to begin performance on April 18, 2011. Construction was substantially complete at the Freeland Orphanage on May 25, 2011. A Notice-To-Proceed to the Lamartine Orphanage was issued on June 14, 2011. FESI mobilized personnel and equipment to the site to begin performance of this scope of work on June 15, 2011. Construction was substantially complete on August 3, 2011. All aspects of the project were coordinated with Clear Creek County, Colorado Division of Reclamation, Mining, and Safety and the Colorado Department of Public Health and Environment. All construction activities were documented in the form of daily project reports.

3.1 Construction Material Detail

- Lime amendment for the purposes of this project refers to sugar beet by-product available through Clean Energy of Longmont.
- Lime application rate was 22 dry tons/1000 tons of soil. This equates to approximately 82 tons per acre for the lime amendment material.
- Incorporation of amendments was performed with an in-situ mixer capable of uniformly blending materials, using the ALLU SMH 3-17-80X.
- Fertilizer, 18-46-0, incorporated at a rate of 300 lbs per acre.
- Organic material for the purposes of this project refers to wood chips provided as a donation from the Clear Creek County Transfer Station.
- Organic material applied at a rate of 225 tons/acre.
- Mulch consisting of certified weed free straw applied to all disturbed areas at a rate of 2 tons per acre.
- Permanent vegetative cover consisting of the mix noted in the design plan broadcast seeded at 17.3 pounds of pure live seed per acre.
- Erosion control blanket Curlex II double net by American Excelsior Company

3.2 Freeland / Gumtree Mine Site Project

On April 18, 2011 FESI mobilized a CAT 436C extend-a-hoe backhoe loader to the project site. Traffic control signage and cones were set-up to provide a safe working environment for FESI personnel and county residents. All aspects of the project were coordinated with Clear Creek County Road and Bridge Department as well as the County Engineer.

Utility locates were called in as required by state law. Qwest Communications was the only utility to have operating lines with-in the project worksite. The marked utilities were carefully located by hand excavation and exposed to protect during construction. An unmarked 100 pair phone line was encountered during excavation and had to be repaired by Qwest personnel.
3.1.1 Concrete Cut-Off Wall
The CAT 436 backhoe was used to excavate the earthen trench for the concrete cut-off wall. The cut-off wall was intended to direct subsurface ground water flows back into the stream channel. The trench alignment was determined in the field in conjunction with CCWF Project Management, Colorado Division of Reclamation, Mining, & Safety staff, and the County Engineer. Once alignment was determined, excavation depth was maintained at the point of refusal/competent rock. The trench excavation material was extremely unstable with large cobble being the majority fraction. This resulted in trench walls that sloughed in and had to be continuously mucked out. The resulting trench was wider than anticipated and used more concrete than originally planned. 57 cubic yards of lean fill concrete was supplied by Everist Materials out of Silverthorne, CO. The lean fill has a maximum strength of 2500 psi and is comprised of 2 sacks of cement and 3 sacks of fly ash.
3.1.2 Clay Cut-Off Trench

A clay cut-off trench was installed along the road edge and Trail Creek. It is intended to provide a barrier to subsurface flows. Historically Trail Creek road was constructed out of mine waste from the Freeland Mine waste pile. Remnant channels under the road provide a conduit for subsurface flows to saturate the waste material and pick up heavy metals. The clay cut-off trench is intended to minimize this interaction. The design called for a 12-inch trench to be excavated to bedrock and then back filled with clay. Originally the project called for 135 tons of clay to be used. As a result of the road being constructed in mine waste, the trench was full of debris and waste rock which caused for unstable trench walls. This resulted in a wider trench than anticipated and required 188.05 tons of clay to be imported to the site. In total 255 linear feet of compacted clay trench was constructed.

3.2 Gumtree Waste Pile Remediation

Site access to the Gumtree was provided through an existing historical mining access road adjacent to the site. This road had seen little to no maintenance and required modification for safe equipment operations. Trees had to be limbed and the road had to be widened and graded to allow for equipment passage. A CAT 436C extend-a-hoe with 4-wheel drive was used to perform road access maintenance tasks. Several trees had to be felled to provide access to the Gumtree Waste Pile.

The excavator was used to regrade the Gumtree waste pile. The lower Gumtree pile had suffered an historical blow out which resulted in the release and deposition of mine waste into Trail Creek. This blow out was repaired and regraded. All materials were consolidated and regraded for positive drainage.
The mine waste piles were amended with sugar beet lime by-product and fertilizer to stabilize pH and limit the mobility of heavy metals. The design application rate was 80 tons per acre of sugar beet lime by-product and 300 pounds per acre of 18-46-0 fertilizer. Approximately 20 tons of the by-product and 75 pounds of fertilizer were spread on the Gumtree waste pile. Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator.

The mine waste piles were then amended on a second pass with compost/organic material which was donated from the Clear Creek County transfer station. The compost provides a growth media to the waste piles to assist with the revegetation process. The design application rate was 360 cubic yards per acre. Approximately 90 cubic yards of organic material were spread on the Gumtree waste pile. Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator. Amendments are mixed in place and waste rock was simultaneously culled out.

3.3 Freeland Waste Pile Remediation

On April 25, 2011, Frontier mobilized a CAT 325 hydraulic excavator with thumb attachment to the project site. The excavator was used to regrade the Freeland Waste Pile. The side slopes of the pile were pulled up and consolidated on the top of the pile to lessen the angle of the slopes along the road edge. In addition, an orphan waste pile along Trail Creek was excavated away.
from the edge of the creek and hauled to the top of the Freeland Waste Pile. All materials were consolidated and regraded for positive drainage.

The mine waste piles were amended with sugar beet lime by-product and fertilizer to stabilize pH and limit the mobility of heavy metals. The design application rate was 80 tons per acre of lime and 300 pounds per acre of 18-46-0 fertilizer. Approximately 60 tons of sugar beet lime by-product and 225 pounds of fertilizer were spread on the Freeland waste pile. Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator.

Amendments are mixed in place and waste rock was simultaneously culled out.

The mine waste piles were then amended on a second pass with compost/organic material which was donated from the Clear Creek County transfer station. The compost provides a growth media to the waste piles to assist with the revegetation process. The design application rate was 360 cubic yards per acre. Approximately 270 cubic yards of organic material were spread on the waste pile.

Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator. Amendments are mixed in place and waste rock was simultaneously culled out.

A run-on control channel was constructed along the upgradient side of the Freeland waste pile. It was constructed to drain off in both directions from a central high point. This channel is intended to capture clean run-off and overland flow and divert it around the waste pile.

Site reclamation and revegetation activities consisted of regrading the waste piles for positive drainage, placement of 2 tons an acre of certified weed free straw, and seed. All disturbed areas of the project were seeded with the appropriate DRMS seed mix. Seed was broadcast at a rate of 18.9 pls lbs per acre. In addition, culled rock was placed over the top of the dump to discourage driving on the waste pile and to create microenvironments for seed protection. Also a buck and rail fence was erected across a former ATV path.
3.4 Brazil Millsite Project
On June 16, 2011, FESI mobilized equipment and personnel to the Brazil Mill project site. A mobile tool trailer was delivered to the site to store hand tools and safety equipment. A CAT 325 DL excavator was delivered to the intersection of Stanley Road and Trail Creek. The excavator had to be tracked the 4.5 miles up the road to the project site. Utility locates were called in as required by state law. No utilities were encountered on the project except for the overhead power lines.

3.4.1 Access Road Construction
Site access to the Brazil Millsite was provided through an existing historical mining access road adjacent to the site. This road had seen little to no maintenance and required modification for safe equipment operations. Trees had to be limbed and the road had to be widened and graded to allow for equipment passage. A CAT 325 excavator was used to perform road access maintenance tasks. Several major ruts had to be filled at the top of Trail Creek Road to safely access the site.

3.4.2 Exploratory Test Pits
FESI utilized a CAT 325 hydraulic excavator with thumb attachment to dig six test pits throughout the aspen grove at the base of the tailings pile. The test pits were used to determine the depth of the tailings that had historically breached from the upper tailings ponds. The depth profiles all indicated several feet of tailings deposition.

3.4.3 Consolidation & Hauling of Debris Fan
A CAT 966 Wheel Loader with a 5.2 CY bucket was used to haul tailings from the area below the tailings pond and consolidate them into the upper ponds. Based on the results of the test pits, it was determined that the depth of the debris fan would not allow for the cost effective hauling of all of the material from the lower tailings areas. Instead, it was determined that the most cost effective course of action was to scrape, excavate, and haul the “hot spots” of heavily concentrated metals and place them into the upper ponds, and do a deeper treatment (12 inches instead of 6 inches) on the remaining tailings in place. An access road was built around the base of the ponds to allow for the excavation and transport of tailings. The excavator was
used to excavate out the “hot spots” and the loader hauled and consolidated 115 loads or approximately 600 cubic yards of material.

The excavator and the loader were used to regrade and consolidate the Brazil Millsite Ponds. All of the abandoned trash and debris from the site was buried in the first of two ponds. The excavated materials were also delivered to the first pond to eliminate the historic ponding on the top. The second pond was also regraded to provide some positive drainage away from the site.

3.4.4 Excavation and Stockpile of Clean Fill
The excavator and loader were utilized to remove and stockpile the clean berm that went around the perimeter of the pile. This material was stockpiled until the ponds had been filled and regraded. The larger rock was screened out of the material and further segregated for dispersal over the top of the piles at the completion of treatments. The finer clean material was then distributed across the top of the cells to assist in the reclamation process.

3.4.5 Incorporation of Fertilizer & Organic Material
The tailings piles were amended with sugar beet lime by-product and fertilizer to stabilize pH and limit the mobility of heavy metals. The design application rate was 80 tons per acre of lime and 300 pounds per acre of 18-46-0 fertilizer. Approximately 195 tons of lime and 750 pounds of fertilizer were spread on the Brazil Millsite. Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator.

The tailings piles were then amended on a second pass with compost/organic material which was donated from the Clear Creek County transfer station. The compost provides a growth media to the waste piles to assist with the revegetation process. The design application rate was 260 cubic yards per acre. In total 650 cubic yards of compost was trucked to the site. Amendments were incorporated into the top 12” of the pile utilizing a 2 cubic yard Allu mixing bucket attachment on the 325 excavator. Amendments are mixed in place and waste rock was simultaneously culled out.

3.4.6 Run-On Control Channel
A run-on control channel was constructed along the upgradient side of the Brazil Millsite. It was constructed to drain off in both directions from a central high point. This channel is intended to capture clean run-off and overland flow and divert it around the tailings pile. Approximately 700 LF of channel was installed and covered with erosion control blanket.
3.4.7 Site Restoration & Revegetation

Site reclamation and revegetation activities consisted of regrading the waste piles for positive drainage, placement of 2 tons an acre of certified weed free straw, and seed. A total of 250 bales of certified weed free straw were delivered to the site. All disturbed areas of the project were seeded with the appropriate DRMS seed mix. Seed was broadcast at a rate of 18.9 pls lbs per acre. In addition, culled rock was placed over the top of the dump to discourage driving on the tailings pile and to create microenvironments for seed protection. Access to the site was further limited by the placement of large rock at the entrances to the site. A locking gate and posts were installed at the main entrance.

4.0 Monitoring Results

A surface water monitoring program was started in 2006 on Trail Creek, a tributary to Clear Creek near Idaho Springs, Colorado. The purpose of the monitoring program was to assess trace-metal concentrations and sediment loads related to historical mining and associated remediation efforts, and to evaluate potential impacts to Clear Creek water quality. Baseline water Quality Characterization of Trail Creek was conducted over the period from 2006 to 2010. Sample results available for CC-31 from 2005 to 2011 are used for comparison to the 2012 results. A complete presentation of the all water quality data measured in the field and from samples analyzed by the ESAT federal Laboratory is included as part of this report. The actual data and meta-data have been entered into the AWQMS system and are now part of the Data Sharing Network.

The 2010 metal concentrations were consistent with previous results, with dissolved copper averaging about 0.05 mg/L and dissolved zinc averaging about 0.7 mg/L. These data show a slight seasonal fluctuation in both dissolved zinc and copper with lower concentrations during the June-September low-flow period and higher concentrations during April-May spring runoff period.

Storm event sample results show much lower dissolved metal concentrations, indicating dilution from storm runoff flows in Trail Creek. However, total concentrations of zinc and copper were significantly greater (by as
much as one order of magnitude) during storm runoff events in Trail Creek. Dissolved lead at CC-31 showed a similar seasonal pattern as copper and zinc, with lower concentrations during storm events and under low-flow conditions. Dissolved manganese showed the inverse with higher concentrations during storm event runoff and low flow conditions in 2010. These results suggest dissolved manganese is mobilized during higher flow conditions.

The Trail Creek CC-31 dissolved and total recoverable copper and zinc results show that dissolved and total concentrations are similar during ambient (non-runoff) conditions in Trail Creek, especially for zinc. Most or all of the zinc is in soluble form, whereas copper results indicate about 50 to 80 percent is soluble. The difference between ambient and storm event total metal concentrations at CC-31 can be more than an order of magnitude for copper and zinc. Total arsenic, cadmium, iron, lead, manganese, nickel, and silver concentrations were also up to one order of magnitude higher during storm runoff when compared to ambient conditions in Trail Creek.

The Colorado Department of Public Health & Environment Water Quality Control Division lowered the standards for copper and zinc significantly in 2009. In previous years, Trail Creek concentrations typically met the chronic standard for copper and zinc. With the new standards all samples exceeded the chronic criteria. The acute table value standards (TVS) for Trail Creek remained similar to previous years. Slightly higher concentrations were measured in August and September 2010. Data indicates that ambient concentrations were not flow dependent, but instead may be source dependent. The storm event total metal concentrations from July 30 were much higher than previous measurements.
Copper was at or below standards upstream of the Freeland Tailings. Concentrations increased dramatically at CC-31C (below Freeland tailings). Concentrations decreased between Freeland and the mouth of Trail Creek. The 2010 monthly dissolved zinc and copper results show low metal concentrations at upstream Station CC-31A, which is representative of background water quality in Trail Creek.

Dissolved copper concentrations were low both upstream (31A) and downstream (31B) of the Lamartine, indicating only minimal copper loading from this area. The largest increase in copper was measured throughout the year downstream of the Freeland Tailings (31C), which generally showed the highest concentrations in Trail Creek. Concentrations decreased substantially downstream of Freeland.
during all months except May, indicating relatively minor dissolved copper contributions from the lower Trail Creek area.

Additional copper concentrations in May could have been contributed by Trail Run, although this tributary was not sampled in May. Ambient dissolved copper and zinc concentrations at all downstream stations (31B to 31) Trail Creek locations were generally higher in August and September 2010. These results suggest the possibility of residual metals mobilization following the large storm runoff event on July 30, which transported significant amounts of sediment down Trail Creek.

The ambient copper and zinc loading results for each of the six monthly Trail Creek sampling events show the greatest copper load increase was measured in reach 31BS to 31C (Freeland Tailings) from April through July. Increases ranged from 80% in May to 91% in July. This shifted to reach 31A to 31B (Lamartine) in August and September. This shift in loading could have been caused by an increase in metal-laden sediment deposited in Trail Creek following the large storm runoff event on July 30, 2010. There was a loss of copper load in downstream reach 31C to 31D in April, June, and September. Trail Run contributed dissolved copper load to Trail Creek each month but this did not increase concentrations or loads at downstream locations in Trail Creek. One possible exception is May when Trail Creek showed a load increase in reach 31C to 31D, but Trail Run was not sampled and no data is available for confirmation.

The July 30, 2010 runoff event produced very high total metals concentrations in Trail Creek. High concentrations were also measured at Clear Creek CC-40 during this event. These metals are largely in particulate form as sediment that is eventually deposited in downstream areas of the watershed.

Total Trail Creek suspended solids (TSS) and total phosphorus (TP) concentrations have been shown to be positively correlated in Trail Creek and Clear Creek samples, especially during storm runoff event conditions. Results show that high total phosphorus concentrations are associated with high suspended solids. The highest TP concentration in Clear Creek (6.0 mg/L) was measured during the July 30, 2010 storm event with a TSS concentration of 7,620 mg/L. Ambient TSS in Clear Creek is typically less than 5 mg/L. The TP concentration in Trail Creek was 27 mg/L associated with a TSS concentration of 25,000 mg/L. Storm event concentrations exceeded the TP standard of 0.11 mg/L. The high TSS concentrations also correlate positively with total metal concentrations. The total sediment load in Trail Creek can be a large percentage or even exceed the load in Clear Creek (see previous reports); indicating Trail Creek can contribute substantial TP and metal loads to Clear Creek during storm runoff conditions. Additional water quality data was gathered on Trail Run, a sub-tributary of Trail Creek that enters Trail Creek just below the Freeland Orphanage. This monitoring was added to determine if Trail Run is a contributor to the copper and zinc loads in Trail Creek.

Total Trail Creek streamflow in 2010 was generally higher than 2009 with peak snowmelt flows in May and June ranging from 4 to 6 cfs. Low flows were normal at less than 0.5 cfs.

- A large storm runoff event in Trail Creek measured on July 30, 2010 had an estimated peak flow of 125 cfs at Station CC-31 and turbidity greater than 4,000 NTU.
- Trace metal concentrations in Trail Creek were similar to previous years, except in upper Trail Creek were copper concentrations were higher in August and September 2010.
- New chronic water quality standards promulgated in 2009 are lower for Trail Creek, resulting in copper and zinc exceedences for all samples.
- The Lamartine Mine area contributed most of the zinc to Trail Creek.
- The Freeland Tailings area and Trail Run contributed most of the copper to Trail Creek.
- Metal loads in Trail Creek comprised less than 5 percent of the metal load in Clear Creek during ambient conditions.
- Copper and zinc concentrations in Clear Creek were below water quality standards.
- Total metal concentrations were high in Trail Creek runoff and in Clear Creek during the July 30, 2010 storm event, including arsenic, lead, nickel, and silver.
- High total suspended solids concentrations were correlated with high phosphorus in Trail Creek and Clear Creek storm event samples, exceeding the phosphorus water quality standard.
5.0 BMP EFFECTIVENESS EVALUATIONS

5.1 SURFACE WATER IMPROVEMENTS
As noted above, baseline water quality characterization was conducted for the Upper Trail Creek Project from 2006 through 2010. Monitoring during project activities was conducted from April through August.
of 2011. Post construction monitoring occurred during the fall of 2011 and through 2012. Summary findings based on data collected from March through October 2012 are as follows:

- Trail Creek stream flows in 2012 were depressed even further than in 2011 due to the continuing drought-induced conditions. A greatly diminished 2011-2012 snowpack produced peak snowmelt flows in late May that reached a mere 100 gallons per minute (1 cfs in 2011 and 4 to 6 cfs in 2010). Ambient flows at CC-31 (Trail Creek mouth) during 2012 averaged 65 to 70 gpm.

- Trail Creek pH @ CC-31 ranged from a low of 6.4 to a high of 7.0 with the variability mostly due to the extremely low flows which are suspected of concentrating acidity. Instream pH values for the lower gulch (CC-31C and CC-31D) were in a comparable range with the mouth of Trail Creek (CC-31).

- Specific conductance (SC) at the mouth of Trail Creek @ CC-31 ranged between 270 uS and 300 uS. SC recorded at CC-31C and CC-31D ranged between 230 uS and 300 uS, generally consistent with 2010 and 2011 ambient data.

- Copper and zinc concentrations (ambient) in Trail Creek near mouth (CC-31) exceeded State of Colorado (CDPHE) chronic table value standards (TVS) established in 2009. Trail Creek is also identified as “impaired” for cadmium and pH under Section 303 (d).

- Copper and zinc loading at the mouth of Trail Creek (CC-31) was significantly diminished in 2012 due to the low flow regime. Maximum loading of copper and zinc (0.05 lbs per day Cu/0.7 lbs/day zinc) at the mouth of Trail Creek (CC-31) occurred during the May 31st sampling (maximum flow for year-100 gpm). All other sampled dates representing 2012 ambient conditions were far below the above stated loading values. To put this year into perspective, the hi-flow (May 31) loading values for copper and zinc were diminished by 90 % from the same month in 2011. Loading is further decreased by the absence of surface flow in Trail Run, a major metal-contributing tributary which has dried up due to drought conditions.

- Ambient water quality sampling was performed in lower Trail Creek on the following dates in 2012: 3/29/2012; 4/26/2012; 5/31/2012; 6/28/2012; 7/26/2012; 8/28/2012, and 10/2/2012. No storm events were monitored and/or sampled in 2012. At the time of this letter, data has been received for the March through July, 2012.

- Storm/ambient water quality monitoring between the years 2005 and 2010, and post project ambient water quality monitoring in 2011 and 2012 indicate mostly predictable conditions for ambient discharges with trace metal loading determined mainly by hydrology (flow rates). However, metals levels were generally lower during the post project monitoring period as shown below in the comparison of key metals from 2006-2011 and post project in 2012.

- Storm events with elevated discharges remain the greatest contributor of metals from the Trail Creek drainage, both dissolved and suspended, into the greater Clear Creek watershed. This indicates that both erosion and sediment control are the best management practices (BMP’s) for Trail Creek.
A comparison of key metals from 2006-2011 and post project in 2012

<table>
<thead>
<tr>
<th>Trail Ck Sites</th>
<th>Site Descriptions</th>
<th>Cadmium (diss.) ug/L</th>
<th>Copper (diss.) ug/L</th>
<th>Zinc (diss.) ug/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>31A</td>
<td>Abv Lamartine</td>
<td>0.3</td>
<td>0.1</td>
<td>5.2</td>
</tr>
<tr>
<td>31B</td>
<td>Blw Lamartine</td>
<td>1.6</td>
<td>1.7</td>
<td>9.0</td>
</tr>
<tr>
<td>31C</td>
<td>Blw Frelanad</td>
<td>2.8</td>
<td>1.5</td>
<td>101.0</td>
</tr>
<tr>
<td>31D</td>
<td>Abv Phoenix</td>
<td>3.4</td>
<td>2.5</td>
<td>49.0</td>
</tr>
<tr>
<td>31</td>
<td>Abv Mouth</td>
<td>3.1</td>
<td>3.1</td>
<td>59.0</td>
</tr>
</tbody>
</table>

Figure 4: Comparison Key Metals 2006-2011, post project 2012

5.2 GROUND WATER
Groundwater within the Upper Trail Creek project area is near-surface colluvial and alluvial in origin. No measurements of groundwater quality were made as part of this project. The BMPs that were installed are designed to promote runoff from revegetated surfaces and to minimize infiltration if meteoric water into contaminated mine waste, thus protecting near surface groundwater.

5.3 OTHER MONITORING
Surface water and mine waste sampling was conducted as part of the Upper Trail Creek Project.

5.4 QUALITY ASSURANCE REPORTING
Extensive quality assurance reporting was provided by the field sampling crews and the ESAT Laboratory that performed all chemical analysis. All water quality data and meta-data has been entered into the AWQMS data management system. The extensive laboratory quality assurance information is available from ESAT and is included in the project file system at the Foundation office.

5.5 RESULTS OF BMP OPERATION AND MAINTENANCE REVIEWS
Numerous post-project field visits have been taken to the Upper Trail Creek project area to evaluate slope stability, channel stability and the success of revegetation. The BMPs installed as part of this project are properly functioning as of the date of this project close-out report.
### 6.0 COORDINATION EFFORTS

The Upper Trail Creek Remediation Project was a cooperative endeavor from the outset, involving federal, state and local government agencies, as well as private companies, landowners, student volunteers, academic researchers and local residents. The following list of primary contributors to the Upper Trail Creek Remediation effort includes those who played direct roles in various aspects of the project and who helped in project coordination, authorization, funding, oversight, technical implementation. There were literally hundreds of coordinative points-of-contact during the project development and implementation phases over the entire 6-year process.

<table>
<thead>
<tr>
<th>Agency/Entity</th>
<th>Contact</th>
<th>Affiliation</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>Marcella Hutchinson</td>
<td>Colorado Watershed Coordinator/Non Point Source Project Officer</td>
<td><a href="mailto:hutchinson.marcella@epa.gov">hutchinson.marcella@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td>Nicole Plescia</td>
<td>Non Point Source Project Officer</td>
<td><a href="mailto:plescia.nicole@epa.gov">plescia.nicole@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td>Mike Holmes</td>
<td>Central City/Clear Creek Super fund Project Manager</td>
<td><a href="mailto:Holmes.Michael@epamail.epa.gov">Holmes.Michael@epamail.epa.gov</a></td>
</tr>
<tr>
<td>WQCD</td>
<td>Lucia Machado</td>
<td>Nonpoint Source Workgroup Lead</td>
<td><a href="mailto:Lucia.Machado@dphe.state.co.us">Lucia.Machado@dphe.state.co.us</a></td>
</tr>
<tr>
<td></td>
<td>Kathleen Riley</td>
<td>Project Officer</td>
<td>Retired</td>
</tr>
<tr>
<td></td>
<td>Curtis Hartenstine</td>
<td>Project Officer</td>
<td><a href="mailto:Curtis.Hartenstine@dphe.state.co.us">Curtis.Hartenstine@dphe.state.co.us</a></td>
</tr>
<tr>
<td>DRMS</td>
<td>Loretta Pineda</td>
<td>Director</td>
<td><a href="mailto:Loretta.Pineda@state.co.us">Loretta.Pineda@state.co.us</a></td>
</tr>
<tr>
<td></td>
<td>Bruce Stover</td>
<td>Supv. Reclamationist</td>
<td><a href="mailto:Bruce.Stover@state.co.us">Bruce.Stover@state.co.us</a></td>
</tr>
<tr>
<td></td>
<td>Julie Annear</td>
<td>Project Officer</td>
<td><a href="mailto:Julie.Annear@state.co.us">Julie.Annear@state.co.us</a></td>
</tr>
<tr>
<td></td>
<td>Deb Zack</td>
<td>Project Manager</td>
<td><a href="mailto:Deb.Zack@state.co.us">Deb.Zack@state.co.us</a></td>
</tr>
<tr>
<td>Clear Creek County (CCC)</td>
<td>JoAnn Sorenson</td>
<td>Land Use Division Director</td>
<td><a href="mailto:jsorensen@co.clear-creek.co.us">jsorensen@co.clear-creek.co.us</a></td>
</tr>
<tr>
<td></td>
<td>Matt Taylor</td>
<td>GIS Director</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tim Allen</td>
<td>Road&amp;Bridge Director</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tim Vogel</td>
<td>Transfer Station Mgr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CCC Commissioners</td>
<td>CCC officials</td>
<td></td>
</tr>
<tr>
<td>Colorado School of Mines</td>
<td>Josh Sharp, PhD., P.E.</td>
<td>Mine Drainage Treatment</td>
<td><a href="mailto:Professor.figueroa@gmail.com">Professor.figueroa@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Tom Wildman, PhD.</td>
<td>Geochemistry</td>
<td>Retired</td>
</tr>
<tr>
<td>Frontier Environ. Services (FESI)</td>
<td>Brent Scarbrough, P.E.</td>
<td>Construction Mgr.</td>
<td><a href="mailto:brent@frontierenvironmental.net">brent@frontierenvironmental.net</a></td>
</tr>
<tr>
<td>EME Solutions</td>
<td>John Jankousky, P.E.</td>
<td>Design Engineer</td>
<td><a href="mailto:jlj@eme-solutions.com">jlj@eme-solutions.com</a></td>
</tr>
<tr>
<td>Clear Creek Consultants</td>
<td>Mike Crouse</td>
<td>Water Sampling and Analysis</td>
<td><a href="mailto:mike.crouse@clearcr.com">mike.crouse@clearcr.com</a></td>
</tr>
<tr>
<td>Summit Geology</td>
<td>Randy Streufert, PG</td>
<td>Water Sampling and Analysis</td>
<td><a href="mailto:randall@summitgeology.com">randall@summitgeology.com</a></td>
</tr>
<tr>
<td>Landowner</td>
<td>Gumtree Mining Corporation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charles Nunnery Trust</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jessie Elizabeth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Agency/Entity | Contact | Affiliation | Contact Information
---|---|---|---
Conwell | Shirley Strom | George & Janette Schall | Richard & Jean Buzzard

## 7.0 SUMMARY OF PUBLIC PARTICIPATION

Public participation was a priority of the Upper Trail Creek Nonpoint Source Project, which was reflected in the budget and project implementation effort. This activity began well before funding for the project was approved. The landowners, in particular, were brought into the project planning process before an application for funding was submitted. Many issues were addressed with them first and incorporated into the earliest project plans. The landowners continued to play an active, creative and constructive role from the beginning to the end of the project. They are very pleased with the results.

The initial project selection process coordinated by WQCD was, in effect, a public involvement effort, involving Nonpoint Source Program stakeholders from the entire state in the selection and approval of this project from a large pool of other deserving projects. WQCD, DRMS and EPA representatives attended project kickoff meetings, ribbon cutting ceremonies, and project filed meetings throughout the period of performance.

The Clear Creek County Commissioners heard formal presentations about the Upper Trail Creek Remediation Effort in 2008, 2009 and 2010, as the project plan was developing and later during implementation in 2011.

The Upper Clear Creek Watershed Association, which is a §208 Management Agency, was kept apprised throughout the project development and implementation phases of the project. A field trip was organized for UCCWA members in October 2010.

A Field Practicum trip was conducted for Colorado School of Mines University students on 8-15-2011.

Multiple field trips were conducted during the project period of performance for project oversight purposes with DRMS WQCD and EPA agency officials.

The Upper Trail Creek Project was featured at a poster presentation during the 2009 Sustaining Watersheds Conference and during the Standley Cities Source Water Protection Open House celebration on 7-30-2009.
As part of the public outreach efforts under this grant, CCWF conducted four CLEAR CREEK WATERSHED FESTIVALS:

- September 12, 2009, 10am-4pm | 23 Passport Stations | approximately 500 participants
- September 18, 2010, 10am-3pm | 29 Passport Stations | approximately 700 participants
- September 17, 2011, 10am-3pm | 33 Passport Stations | approximately 800 participants
- September 15, 2012, 10am-3pm | 30 Passport Stations | approximately 850 participants

The Upper Trail Creek Project was featured in the CCWF’s booth during each of the Clear Watershed Festivals. The overall intent of the festivals has been to increase public and stakeholder awareness of watersheds in general, and the Clear Creek Watershed specifically. This is a youth / family-oriented event designed to increase understanding and appreciation of this special place. Dozens of fun, hands-on, kid-friendly activities and displays highlight the amazing array of natural resources, recreational activities, and sustainable living opportunities in the Clear Creek Watershed.

This premier environmental event is designed for educators, students, and families to check out dozens of WATERSHED PASSPORT STATIONS with environmental information, activities, and demonstrations by groups like Trout Unlimited, USFS / Clear Creek Ranger District, NREL mini wind turbine, panning with Gold Prospectors of the Rockies, and more.

Although the festival is free to the public, participants have to EARN their prizes by learning about the watershed. All participants, kids and adults, are encouraged to make the full circuit of PASSPORT STATIONS, actively engage in each interactive activity/game/craft, and have all the sections in their WATERSHED PASSPORT stamped. Overall it has proven to be a fun-filled day for kids, families, educators, and the general public.

The festival offers an out-of-the-classroom learning opportunity and the information lends itself to interesting in-classroom and in-home discussions/lessons on watersheds, natural resources, water science, sustainable living, as well as thought-provoking dialogue on how we use natural resources in our everyday lives and what “green” living, sustainable watershed management, environmental stewardship and responsible consumerism really mean.

This event and creekside venue provide a wonderful opportunity for watershed stakeholder organizations to share their message and educate participants as to the valuable natural resources, recreational activities, sustainable living opportunities, and the important balance between them all in the Clear Creek Watershed.
8.0 ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

One of the major contaminant contributing sites in the Upper Trail Creek Project area is the Lamartine mine area. Despite numerous attempts to gain consent for entry and for project approval, the owners of the site and their legal representatives would not budge. Unfortunately, this site is at the headwaters of Trail Creek, so that the Creek becomes contaminated, and remains so, for almost its entire length as shown in the differences between water quality at site 31A and 31B for all sampling events.

9.0 FUTURE ACTIVITY RECOMMENDATION

While the post-project water quality sampling results were encouraging, Trail Creek still has quite elevated levels of metals, particularly during storm events. There are many sources of exposed mine waste in the drainage area that should be controlled using similar BMPs as were employed for the Upper Trail Creek Project. While these BMPs are generally expected to be stable, once established, periodic inspections should be conducted to confirm this expectation. Longer-term water quality monitoring at the established stations is highly desirable. Presently, there is no budget for future site inspections or water quality monitoring.
**TABLE OF MAPS, PHOTOS & FIGURES**

Map 1 Clear Creek Watershed Location ........................................................................................................... 6
Map 2 Freeland and Gumtree Waste Piles Aerial with Claims .................................................................................. 7
Map 3 Brazil Millsite Aerial ...................................................................................................................................... 8
Map 4 Trail Creek WQ Monitoring Locations ......................................................................................................... 11

Photo 1 CC-31 Weir and Staff Gauge ..................................................................................................................... 11
Photo 2 CC-31 Data Acquisition & Auto Sampler ....................................................................................................... 12
Photo 3 Freeland Concrete Cut-Off Wall ................................................................................................................ 14
Photo 4 Freeland Clay Cut-Off Trench ................................................................................................................... 15
Photo 5 Gumtree Access Road ................................................................................................................................ 15
Photo 6 Gumtree Gradient Upper Pile ..................................................................................................................... 15
Photo 7 Gumtree Berm ......................................................................................................................................... 16
Photo 8 Freeland Waste Pile Regraded ................................................................................................................... 16
Photo 9 Soil Amendment Mixing in Allu Bucket .................................................................................................... 16
Photo 10 Freeland Run-On Control Channel ........................................................................................................ 17
Photo 11 Freeland Revegetation .......................................................................................................................... 17
Photo 12 Brazil Millsite Access Road ................................................................................................................... 18
Photo 13 Brazil Millsite “Hot Spot” ..................................................................................................................... 18
Photo 14 Brazil Millsite Debris .................................................................................................................................. 19
Photo 15 Brazil Millsite Run-On Control Channel .................................................................................................. 19
Photo 16 Brazil Millsite Revegetation .................................................................................................................. 20

Figure 1 Trail Creek Dissolved Copper & Zinc 2005 - 2010 .................................................................................... 20
Figure 2 Trail Creek Total Rec Copper, Manganese, Zinc 2010 ............................................................................ 22
Figure 3 Trail Creek Streamflow & Precipitation 2009, 2010 ................................................................................. 25
Figure 4 Comparison Key Metals 2006-2011, post project 2012 ........................................................................... 27