

SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM

ASSESSMENT/PLANNING PROJECT FINAL REPORT

Alta Fen Rehabilitation

By

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Sponsored by Salt Lake County Flood Control and Engineering

August 28, 2012

This project was conducted in cooperation with the State of Utah and the United States Environmental Protection Agency, Region 8.

Grant # 0709WQ  
State (DEQ) Contract #081959  
Salt Lake County Contract #PV08102C

*Alta Fen Rehabilitation-Final Report*

## **EXECUTIVE SUMMARY**

**PROJECT TITLE: ALTA FEN REHABILITATION**

**PROJECT START DATE 12/01/2007 PROJECT COMPLETION  
DATE 08/22/2012**

**FUNDING: TOTAL BUDGET \$145,833**

**TOTAL EPA GRANT \$87,500**

**TOTAL EXPENDITURES  
OF EPA FUNDS \$12,402.24**

**TOTAL SECTION 319  
MATCH ACCRUED \$21,922.11**

**BUDGET REVISIONS <\$74,000>**

**TOTAL EXPENDITURES \$34,24.25**

### **SUMMARY ACCOMPLISHMENTS:**

Salt Lake County and the Alta Fen Rehabilitation Project accomplishments for this grant between 2008 through 2012 entails: Identification of two (2) potential sites to expand the Alta Fen for operation in perpetuity; identified redirecting the flow to the Wasatch Drain Tunnel as a potential option of treatment and verified this is a not an option due to Water Rights Contracts; held three (3) Stakeholder Meeting; multiple various meetings with stakeholders and agencies; sampled soil of the current Trial Alta Fen; performed routine monthly sampling since 2010; performed specific monitoring to identify the site of the drainage post Spring 2010 slide; performed macroinvertebrate sampling above and below the drainage into Little Cottonwood Creek; surveyed the channel for the limestone channel conceptual design; and created and finalized the limestone channel conceptual design.

## **1.0 INTRODUCTION**

For several years, Little Cottonwood Creek from the town of Alta to Tanners Flat has been listed as impaired for zinc. This section of Little Cottonwood Creek has been given a 3A beneficial use designation, which requires that this reach be “protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain” (DWQ, 2002). This project seeks to implement recommendations from the 2002 Little Cottonwood Creek TMDL study and the 2009 Salt Lake Countywide Water Quality Stewardship Plan (WaQSP) in order to meet zinc standards and support the coldwater fishery in Little Cottonwood Creek. The TMDL included the following recommendations: 1) “Expand the Alta Fen wasteload allocation for the Howland Tunnel to take additional flow, if not all of the flow from the Howland Tunnel”, 2) “Develop a flow delivery system that will allow the Fen to operate the entire year, not just during the summer months”, and 3) “Establish a program to monitor flows and chemistry from the Howland Tunnel and from the Fen over an entire year” (Shepherd Miller, 2002). Salt Lake County is currently working with the Little Cottonwood Abandoned Mine Coalition to accomplish these recommendations; however, siting of the Fen and liability issues are currently unresolved. Additionally, two (2) monitoring programs were recommended in the TMDL study that included: 1) a water monitoring program to further validate or define loading sources, and to monitor responses to implementation actions and 2) a macroinvertebrate study to gauge stream response to implementation actions. Both of these monitoring programs are performed by Salt Lake County Watershed Planning & Restoration Program.

### **1.1 Water Quality Priority**

Past mining activities in Little Cottonwood Canyon have left behind numerous shafts, adits, mine waste dumps and drain tunnels. In 1994, the Utah Division of Water Quality (DWQ) and Salt Lake City conducted a joint study of Little Cottonwood Creek. The results of their study indicated that the Creek has excessive amounts of zinc from the Metropolitan Water Treatment Plant to the headwaters (Map 1). They also found excess amounts of Total Dissolved Solids (TDS) from the confluence with the Jordan River to the Forest Service boundary.

In order to quantify the major sources of mine drainage to the creek, the United States Geological Survey (USGS), under contract with the United States Forest Service (USFS), conducted a synoptic tracer injection study in September of 1998. The study showed that most of the metal loading to the creek could be attributed to four surface-water inflows and three subsurface inflows. One of the major surface-water sources of metals in Little Cottonwood Creek was the Howland Tunnel (Figure 1 and Map 2). The Howland Tunnel was constructed in the late 1800’s as a drainage tunnel for dozens of silver mine shafts in the Emma Hill portion of the Alta Mining district.

In the 1998 study, the USGS noted that natural attenuation of all metals resulted from the formation of colloidal solids, sorption of some metals, and accumulation onto the streambed. An additional study was conducted in 1999 that focused on the level of water within the Wasatch Drain Tunnel (Shepherd Miller, 2002). The study showed that the lowering in the Wasatch-Drain Tunnel did not change the zinc concentration of Little

Cottonwood Creek water below the tunnel outfall, but changed the pathways in which the water enters the creek.

As a result, Little Cottonwood Creek was placed on the 303(d) list of impaired waters for high levels of zinc in the upper reaches and TDS in the lower reaches in 2000. The TMDL study was conducted by Shepherd Miller consulting firm and was completed in 2002. Two significant and discrete point sources of zinc loading to Little Cottonwood Creek were identified in the 2002 TMDL, the Howland Tunnel and the Wasatch Drain Tunnel. Although these are described as Point Discharges in the TMDL document, both the Howland Tunnel and the Wasatch Drain Tunnels drain a large network of mine tunnels in the Emma Mining District. Therefore, the source of zinc is ultimately nonpoint in nature. Notably, due to this nonpoint source designation, a discharge permit is not required for the Howland Tunnel or the Wasatch Drain Tunnel.

In the implementation section of the TMDL document, several suggestions are made that directly implicate the Alta Fen. First, it was suggested that the Alta Fen be expanded to accommodate additional flow from the Howland Tunnel. Second, it was recommended that a flow delivery system be developed to allow the Alta Fen to operate throughout the entire year, not just during the summer months. Finally, it was recommended that a program should be established to monitor flows and chemistry from the Howland Tunnel and set fourth Alta Fen for an entire year. In order to achieve the zinc load allocations as set forth by the Little Cottonwood Creek TMDL, it is necessary to rehabilitate the Alta Fen and establish regulatory relationships to assure the Fen's operation in perpetuity.

### **Alta Fen Project**

Prior to the 303(d) listing of Little Cottonwood Creek, in 1995 Salt Lake County applied for and received \$102,000 from Region VIII of the Environmental Protection Agency, through the Rocky Mountain Headwaters Mine Waste Initiative for the construction and monitoring of the Alta Fen Project (Figures 1-3). The purpose of the pilot project was to determine the effectiveness of metals removal through a passive system.

The Fen was designed to use three (3) wetland pond cells (Figure 2). These cells used adsorption and bioaccumulation to reduce metals loads and neutralize pH. The creation of an independent three (3) cell system with common sub-surface lateral flow distribution allowed for examination of vertical, horizontal, and longitudinal biogeochemical processes in all three compartments of the aquatic environment.

Water diverted from the Howland Tunnel entered the Fen at its base and subsequently percolated up through the Fen where adsorption and bioaccumulation reduced metal loads. The Fen was originally planned to accommodate approximately 0.005 to 0.04 cfs of flow from the Howland Tunnel. The flows near the point of diversion to the Fen were separated into two discreet culverts. The Fen flow was diverted through the use of a simple pull-gate weir on the intake pipe.



The Fen lies between the Peruvian Lodge and the Goldminer's Daughter Parking lot in Alta, Utah (Map 2). The Fen is approximately 30,000 cubic feet in size and is located at the base of a hill, which is ramped with snow to depths ranging from 10-20 feet.

As indicated in Tables 1 and 2, studies conducted in both 1999 and 2000 indicated that the Fen was highly effective in the removal of metals and neutralization of pH levels.

**Table 1. Water Chemistry Data for Alta Fen** (June 20, 1999 – September 30, 1999 mg/L) Average)

Parameter	Intake	Cell 1	Cell 2	Cell 3	% Reduction
pH	5.96	6.58	6.57	6.7	
Sulfate	125	98.8	79.7	59.1	52.7
CaCO <sub>3</sub>	134	190	234	491	
Cadmium	0.039	0.002	0.005	0.0006	98.5
Copper	0.981	0.116	0.128	0.017	98.3
Lead	0.12	0.02	0.008	0.02	83.3
Zinc	5.14	0.59	0.58	0.11	97.9

**Table 2. Water Chemistry Data for Alta Fen** (May 30, 2000 – September 28, 2000 mg/L) Average)

Parameter	Intake	Cell 1	Cell 2	Cell 3	% Reduction
pH	4.61	6.57	6.57	6.73	
Sulfate	128	93.82	68.04	49.1	61.6
CaCO <sub>3</sub>	131	163	258	419	
Cadmium	0.045	0.0045	0.00263	0	100.0
Copper	1.38	0.1158	0.0698	0	100.0
Lead	0.211	0.0149	0.0138	0	100.0
Zinc	5.47	1.044	0.464	0	100.0
TOC	1.79	6.91	23.21	2408	

Although the Fen operated effectively for five (5) years, the initial project was pilot in nature and was discontinued at the end of four (4) years. Consequently, in October 2006, Salt Lake County contracted with the United States Geological Survey (USGS) to develop an OTEQ model of the Fen to determine if: 1) it could be reinstated to treat the entire Howland Tunnel Mine Drainage, and 2) to determine if Little Cottonwood Creek needs the Fen to meet zinc standards. Results of the USGS study indicated that not only could the Fen be expanded to treat the entire discharge, but also that Little Cottonwood Creek cannot meet zinc standards without operation of the Fen. Salt Lake County, in conjunction with numerous coalition partners thereupon requested \$87,500 to expand and reinstate the Alta Fen.

## 2.0 PROJECT GOALS, OBJECTIVES, AND ACTIVITIES

The original goal of the Alta Fen Rehabilitation Project was to improve water quality in LCC by reducing metal loads from abandoned mine discharges in the headwaters region of the sub-basin. However, a slope failure in the Spring of 2010 blocked the outflow from the Howland Tunnel resulting in a temporary dam. After the dam was destroyed, officials noted the flow had been redirected. The new flow path was not discovered, but a hypothesis had been proposed by experts that the Howland flow was ending up in the Wasatch Drain Tunnel. Since there was no longer discharge from the tunnel to the original fen location, that makes the Alta Rehabilitation Project impractical at that location.

Due to the sequence of events, this project shifted to: 1) Monitor and sample six locations to determine the new location of the mine drainage (Map 2); 2) Remediate the trial Alta Fen and restore the area to the previous condition; 3) provide public information and education to the Alta community about the project; and 4) Once the location of the drainage has been determined, work with identified stakeholders (Appendix C) of the Alta Wetland Fen to create a permanent solution to the mine drainage problem in Little Cottonwood Canyon. This included identifying an appropriate Best Management Practice (BMP) to reduce Zinc levels to Little Cottonwood Creek and seek funding to implement the identified BMP.

### 2.1 Objectives and Tasks

<b>Objective 1: Sample &amp; Monitor Site to Determine New Location of Mine Drainage</b>	
Task 1:	Sample five locations to determine location of discharge(\$8,632.80-Match)
Task 2:	Sample current Trial Fen to determine levels of metals (\$2,528.60-Match)
Task 3:	Monthly sampling and physical inspection (\$1,399.20-Match)
Task 4:	Annual Macroinvertebrate Sampling (\$1,093.20)
Product:	Determine location of discharge to help determine next steps.
Cost:	\$13,653.80 (Match)
<b>Objective 2: Remediate Trail fen</b>	
Task 5:	Excavate Trial Fen
Task 6:	Add top soil if needed
Task 7:	Revegetate to previous condition
Product:	Remediate trial Fen and put area back to previous condition for Property Owner-Still to be completed)
Cost:	\$49,000 (Estimate-To be done by Salt Lake County)
<b>Objective 3: Develop Conceptual Design of Limestone Channel</b>	
Task 8:	Conceptual Limestone Channel Design
Product:	Conceptual Limestone Channel Design to work in conjunction with another form of treatment
Cost:	\$2,569.97 (\$1,541.98 Grant, \$1,027.99 Match)

<b>Objective 4:</b>	<b>Monitor Project for Alternate Solutions to Mine Drainage</b>
Task 9:	Continue stakeholder involvement to help determine next steps.
Product:	Share data with stakeholders to help determine solution to mine drainage.
Cost:	\$18,100.58 (\$10,860.35 Grant, \$7,240.35)

## 2.1 PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Task	Accomplishment
1. Present updates to established groups.	Ongoing
2. Sample various locations to determine location of discharge (Discharge returned to original site)	Monthly for one year
3. Sample Current Trial Fen soil	Once
4. Excavate Trial Fen	TBD
5. Add topsoil if needed	TBD
6. Revegetate to previous condition	TBD
7. Provide Education to Alta Community	Ongoing
8. Inform Alta Community of Importance of Wetlands	Ongoing
9. Continue Stakeholder Involvement	Annual/Ongoing
10. Share Data with Stakeholders to help determine solution	Ongoing
11. Monthly Sampling	Monthly

[illegible]

## 2.2 EVALUATION OF GOAL ACHIEVEMENT

The original goal of the Alta Fen Rehabilitation Project was to improve water quality in LCC by reducing metal loads from abandoned mine discharges in the headwaters region of the sub-basin. However, the project stalled due to location issues of the proposed Fen. In spring 2010 a slope failure 2010 blocked the outflow from the Howland Tunnel resulting in a temporary dam. After the dam was destroyed, officials noted the flow had been redirected. Even with sampling, the new flow was not discovered. In summer 2011 the flow returned to the Howland Tunnel, albeit at a reduced flow rate. A stakeholder meeting occurred on September 3, 2011 to determine how to proceed. During the

meeting, it was decided to rehabilitate the current Trial Fen and use it in conjunction with a limestone channel. Salt Lake County would rehabilitate the Fen as well as develop the limestone channel design, while Snowbird would actually install the limestone when they do work in that area. It was also determined that the current Trial Fen needed sampling to ensure it did not surpass the MCL. This occurred on October 14, 2011 and the results showed either very low levels or Non Detect, therefore well below the MCL.

Spring 2012 Salt Lake County surveyed the Howland Tunnel (Figures 4-5) to initiate the conceptual design as well as meet with crews who would help in the rehabilitation of the Trial Fen. A stakeholder meeting was held on June 6, 2012. The result of the meeting was both Salt Lake City and Snowbird Service District were opposed to the rehabilitation of the Trial Fen due to the use of turkey manure. It was ultimately decided to redirect the flow of the Howland Tunnel into the Wasatch Drain Tunnel and therefore diluting the discharge. However it was discovered this would potentially violate water right contracts and therefore not a viable option.

Due to the sequence of events, this project resulted in: 1) Monitor and sample six locations to determine the new location of the mine drainage (Map 2); 2) Remediate the trial Alta Fen and restore the area to the previous condition (*pending due to contract*); 3) provide public information and education to the Alta community about the project; 4) create a conceptual Limestone Channel, which is intended to work in conjunction with another form of treatment and requires routine maintenance; and 5) work with identified stakeholders of the Alta Wetland Fen to create a permanent solution to the mine drainage problem in Little Cottonwood Canyon. This includes identifying an appropriate Best Management Practice (BMP) to reduce Zinc levels to Little Cottonwood Creek and seek funding to implement the identified BMP. Furthermore, since at the time of the project there was no clear solution to reduce the Zinc levels, it was determined to transfer \$74,000 of the grant funds to another 319 Nonpoint Source Project in the state, which was already close to completion.

## **Appendix A**

### **Figures of Alta Fen Rehabilitation Project**

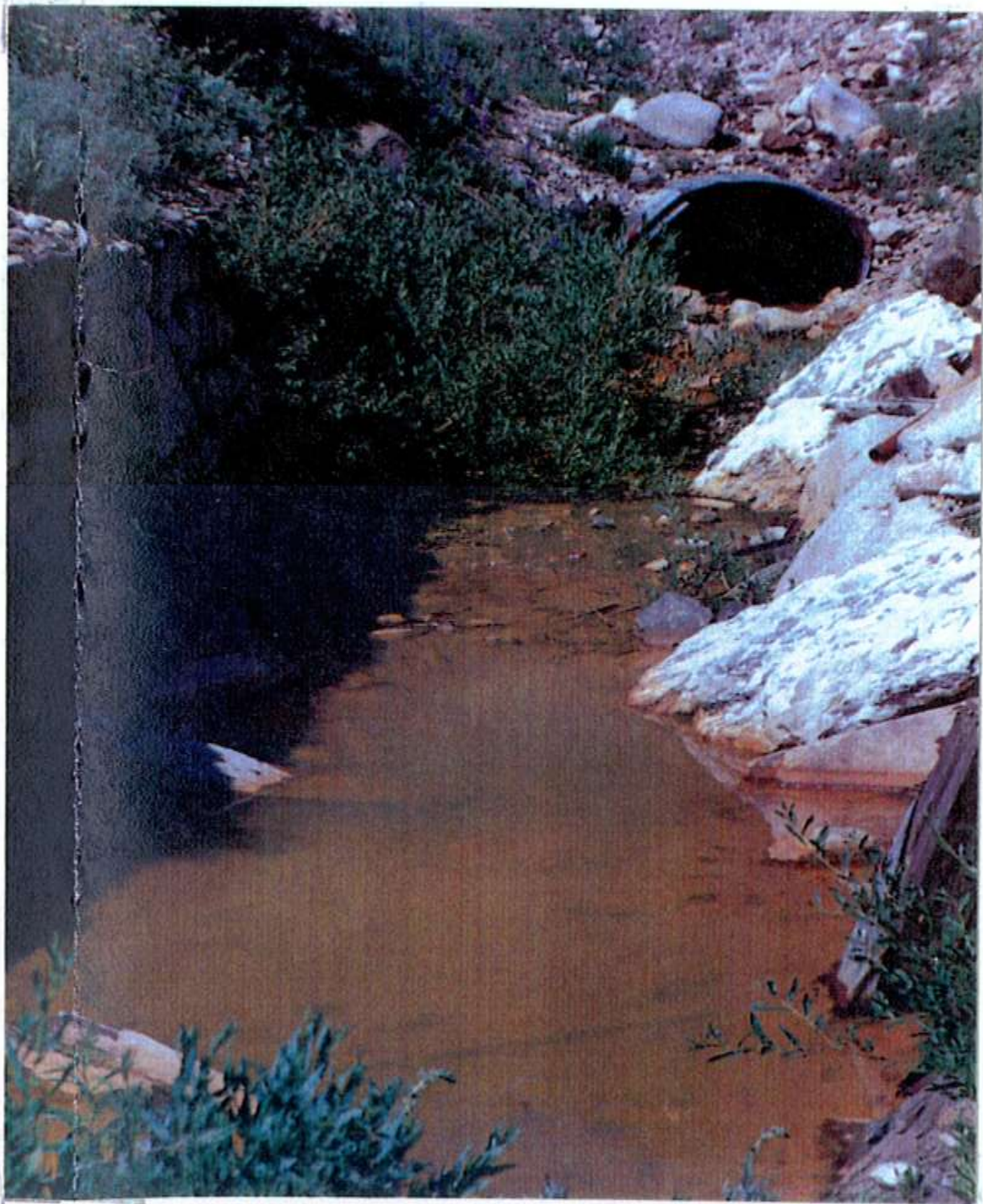
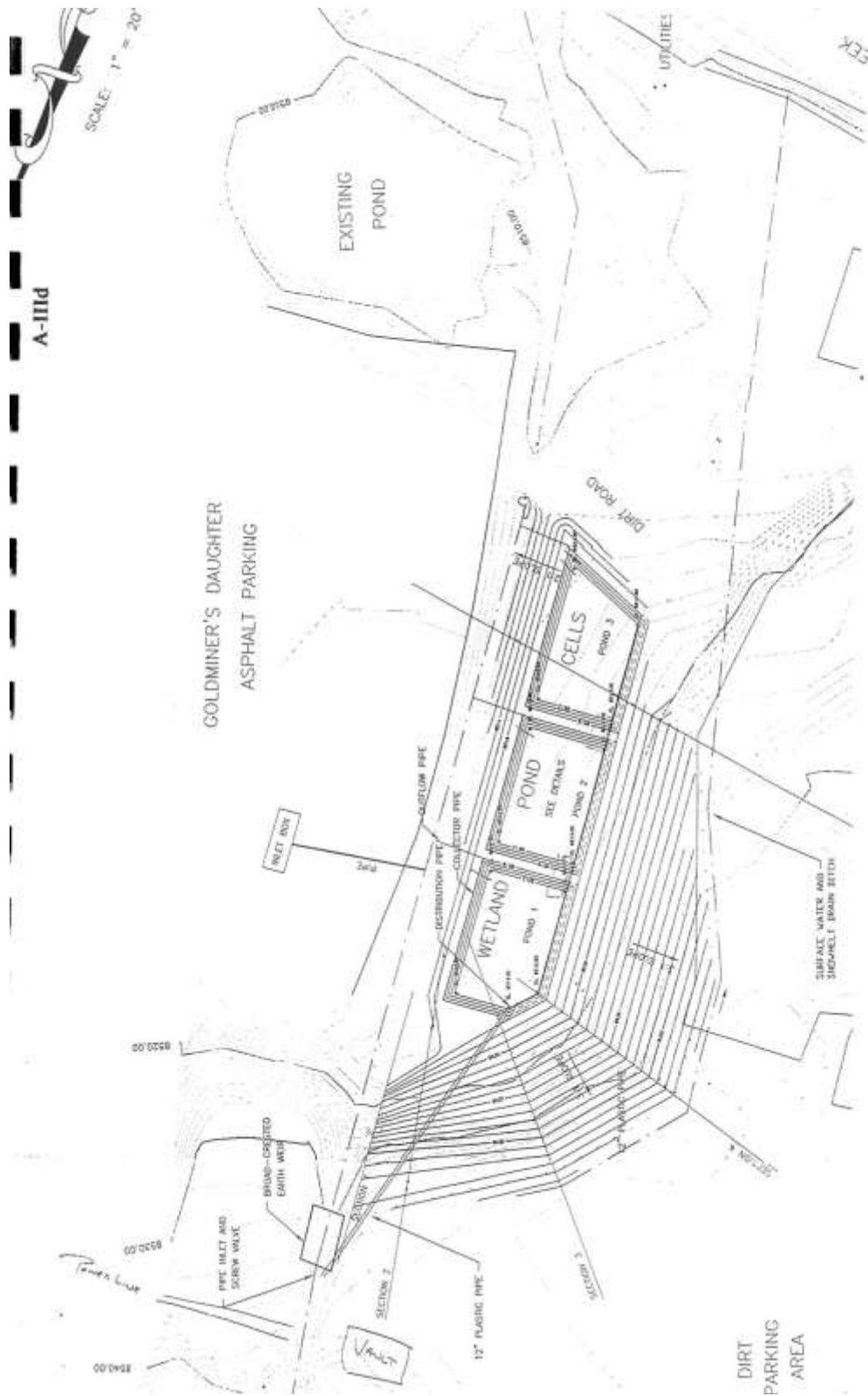


Figure 1: Howland tunnel drainage circa 1992.





**Figure 2:** Original Alta Wetland Fen 1996 directly after planting. 3 wetland pond cells run bottom to top of page.



**Figure 3:** Conceptual design plan of the Original Fen.





**Figure 4-5:** Survey of Drainage Area for Conceptual Limestone Channel.

## **Appendix B**

### **Maps of Alta Fen Rehabilitation Project**

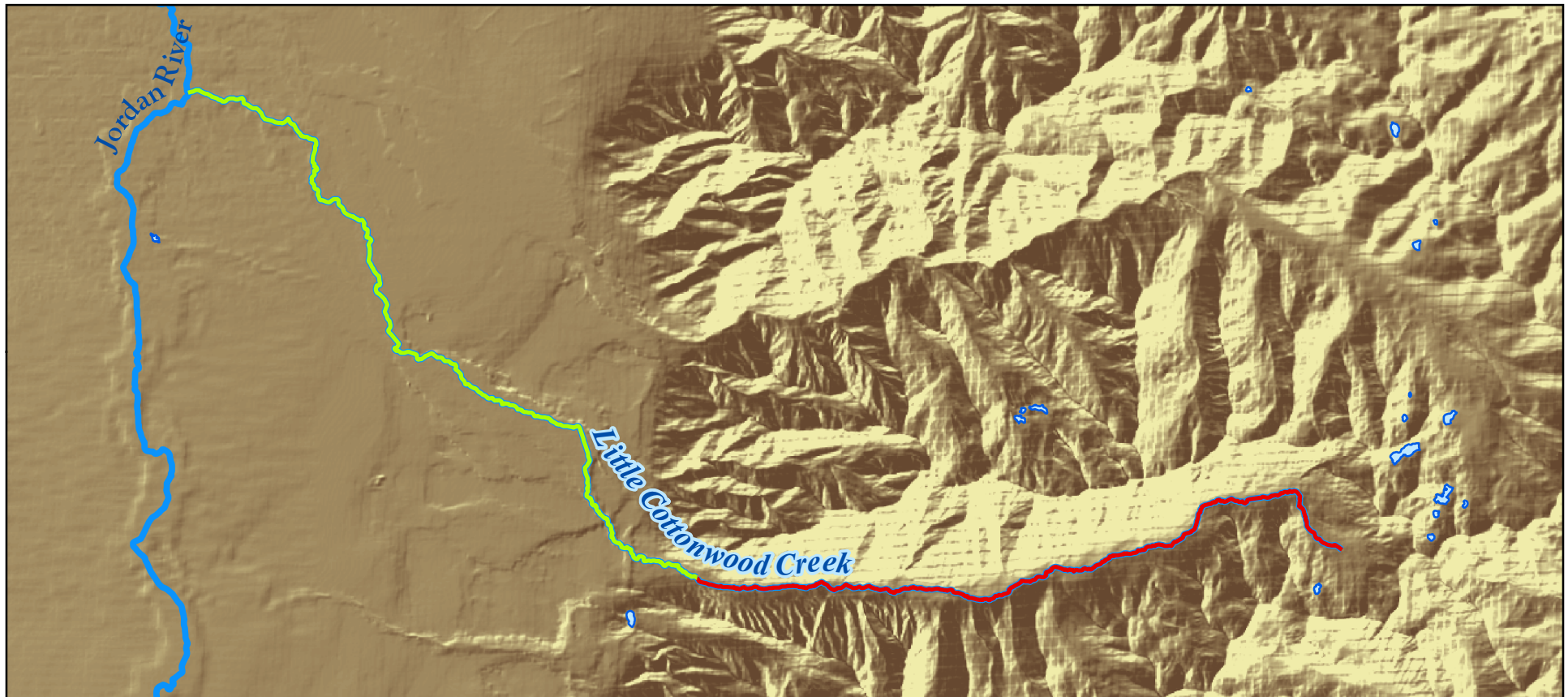
# Map I: Water Quality Impairments in Little Cottonwood Creek

## Legend

### Impairments

#### Impairment

- TDS\_temperature
- metals\_zinc
- slcopub.SLCO.JordanRiver



Updated: January 2011

Prepared by: Salt Lake County Flood Control & Water Quality Division  
Data Sources: Salt Lake County; Utah's State Geographic Information Database





# Map 2: Fen Location and Drainage

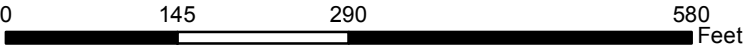
## Legend

- Howland\_drainage
- Road
- Trial\_fen
- Streams: Order 3



Updated: January 2011

Prepared by: Salt Lake County Flood Control & Water Quality Division  
Data Sources: Salt Lake County; Utah's State Geographic Information Database

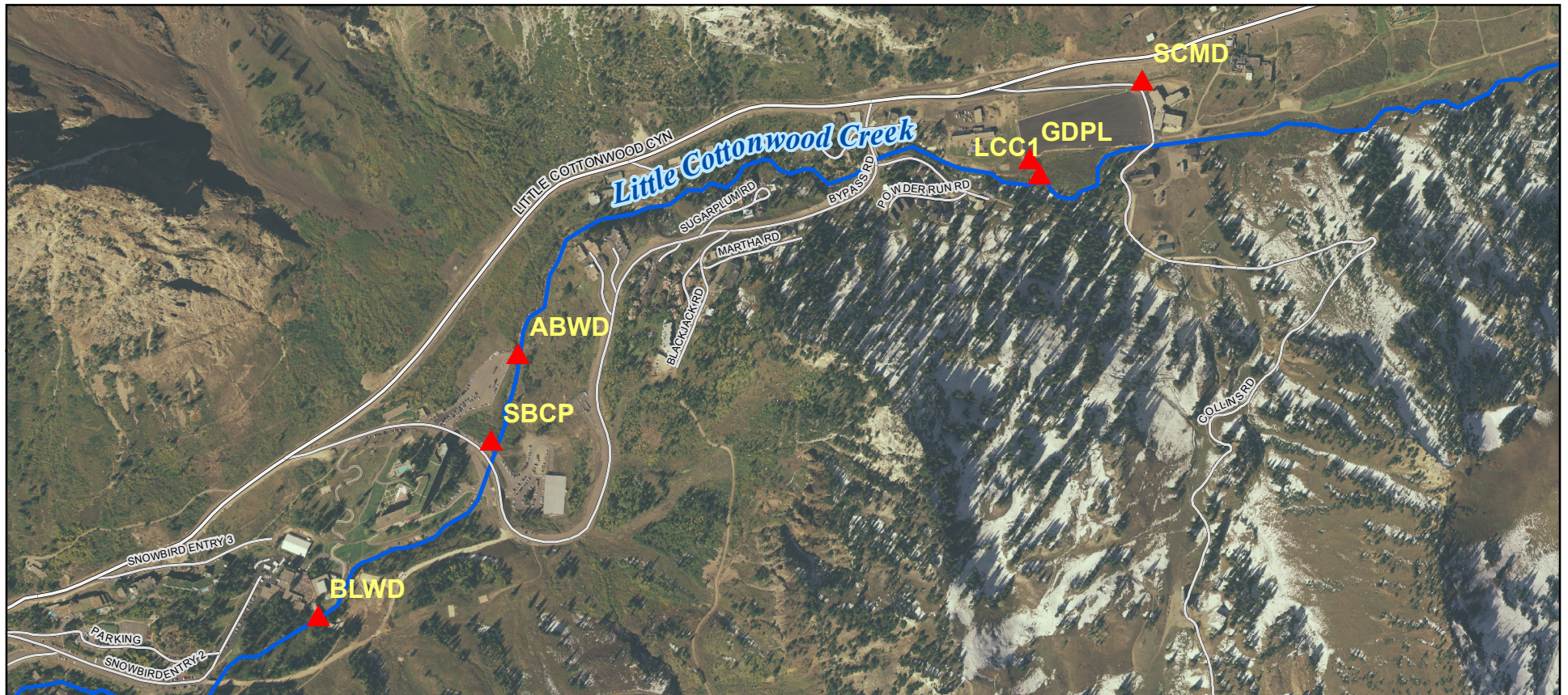




# Map 3: Sampling Locations

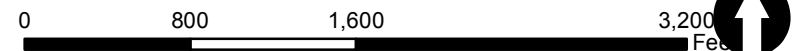
## Legend

- ▲ Metals\_LCC
- Road
- Streams: Order 3



Updated: January 2011

Prepared by: Salt Lake County Flood Control & Water Quality Division  
Data Sources: Salt Lake County; Utah's State Geographic Information Database



## **Appendix C**

### **List of Stakeholders**

# Alta Fen Stakeholder Information

Project # FV 08 0001

June 8 2012

Updated:

Name	Title	Organization	Address	City, State Zip	Email	Phone	Notes
Al Turnbridge	Mountain Manager	Alta Ski Area	P.O. Box 8007	Alta, UT 84092	al@alta.com	801.742.3333 #290	
Buck Boley		Alta Ski Area	P.O. Box 8007	Alta, UT 84092	<a href="mailto:bucksuiaalta.com">bucksuiaalta.com</a>	801.231.2348	
Maura Olivos	Environmental Coordinator	Alta Ski Area	P.O. Box 8007	Alta, UT 84092	<a href="mailto:molivos@alta.com">molivos@alta.com</a>	801.832.7582	
Onno Wieringa	General Manager	Alta Ski Area	P.O. Box 8007	Alta, UT 84092	<a href="mailto:onno@alta.com">onno@alta.com</a>	801.799.2260	
Gary Kleeman		EPA			kleeman.gary@epa.gov	(303) 312-6246	
Chris Mikell		Friends of Alta			<a href="mailto:chris_mikell@msn.com">chris_mikell@msn.com</a>	801.647.9185	
Jen Clancy		Friends of Alta			jclancy@friendsofalta.org	(801) 742-9719	
Pat Shea		Friends of Alta			pas@patrickashea.com	(801) 305-4184	
Doug Johnson		Peruvian Lodge	P.O. Box 8017	Alta, UT 84092	<a href="mailto:doug@altaperuvian.com">doug@altaperuvian.com</a>	801.742.3000	
John Cahill	Owner Peruvian	Peruvian Lodge			e-mail via Todd Collins		
Todd Collins	General Manager-John Kayhil's son-in-law and runs Peruvian	Peruvian Lodge	P.O. Box 8017	Alta, UT 84092	<a href="mailto:todd@altaperuvian.com">todd@altaperuvian.com</a>	801.742.3000	
Florence Reynolds		Salt Lake City Public Utilities	1530 S. West Temple	Salt Lake City, UT 84115	florence.reynolds@slcgov.com	(801) 483-6864	
Laura McIndoe Briefer	Special Project Manager	Salt Lake City Public Utilities	1530 S. West Temple	Salt Lake City, UT 84115	<a href="mailto:Laura.Briefer@slcgov.com">Laura.Briefer@slcgov.com</a>	801.483.6741	
Tracie Kirkham		Salt Lake City Public Utilities	1530 S. West Temple	Salt Lake City, UT 84115	<a href="mailto:tracie.kirkham@slcgov.com">tracie.kirkham@slcgov.com</a>	801.483.6750	
Bob Thompson	Watershed Scientist/Planner	Salt Lake County Flood Control & Water Quality	2001 South State Street, Suite N-3100	Salt Lake City, UT 84192	<a href="mailto:rthompson@slco.org">rthompson@slco.org</a>	801.468.3645	
Dan Drumiler	Program Manager	Salt Lake County Flood Control & Water Quality	2001 South State Street, Suite N-3100	Salt Lake City, UT 84190	<a href="mailto:ddrumiler@slco.org">ddrumiler@slco.org</a>	801.468.2619	
Marian Hubbard	Watershed Scientist/Planner	Salt Lake County Flood Control & Water Quality	2001 South State Street, Suite N-3100	Salt Lake City, UT 84191	<a href="mailto:mhubbard@slco.org">mhubbard@slco.org</a>	801.468.2714	
Rich Judson		Salt Lake County Flood Control & Water Quality			<a href="mailto:rjudson@slco.org">rjudson@slco.org</a>	801.9712143	



Scott R. Baird	Director	Salt Lake County Flood Control & Water Quality	2001 South State Street, Suite N-3100	Salt Lake City, UT 84192		801.468.2711	
Keith Hanson	General Manager	Salt Lake County Service Area #3	P.O. Box 920067	Snowbird, UT 84092	keith@canyonwater.com	(801) 278-9660	
Steve MacIntosh		Salt Lake County Service Area #3	P.O. Box 920067	Snowbird, UT 84092	<a href="mailto:steve@canyonwater.com">steve@canyonwater.com</a>	801.278.9660	
Ronald Lund		SLVHD			<a href="mailto:RLund@slco.org">RLund@slco.org</a>	801-313-6694	
Jim Baker	Director of Mountain Planning & Development	Snowbird Ski Resort	P.O. Box 929000	Snowbird, UT 84092-9000	<a href="mailto:jbaker@snowbird.com">jbaker@snowbird.com</a>	801.933.2232	Also represents the mining company
		Thomas excavating	P.O. Box 8013	Alta, UT 84092		801.485.0541	
Claire Runge	Assistant Town Adminstrator	Town of Alta			cer@townofalta.com	801.363.5105	
John Guldner	Town Administor	Town of Alta			jhg@townofalta.com	(801) 363-5105	
Kate Black	Administrator	Town of Alta			<a href="mailto:kswb@townofalta.com">kswb@townofalta.com</a>	801-742-3522	
Tom Pollard	Mayor	Town of Alta	PO Box 8016	Alta, UT 84092	<a href="mailto:tom@rustlerlodge.com">tom@rustlerlodge.com</a>	801.742.3522	
Charles Condrat	Hydrologist	U.S. Forest Service	8236 Federal Building, 125 South State Street	Salt Lake City, UT 84138	ccondrat@fs.fed.us	801.236.3439	
Jim Bowcutt	Environmental Scientist	UDWQ	P.O. Box 144870	Salt Lake City, Utah 84114-4870	<a href="mailto:jbowcutt@utah.gov">jbowcutt@utah.gov</a>	(801) 536-4336	
Carl Adams	Watershed Protection Section Manager	Utah Division of Water Quality	P.O. Box 144870	Salt Lake City, Utah 84114-4870	carladams@utah.gov	(801) 536-4330	
Hilary Arens	Watershed Protection Specialist	Utah Division of Water Quality	P.O. Box 144870	Salt Lake City, Utah 84114-4870	hilaryarens@utah.gov	(801) 536-4332	



## **Appendix D**

### **Conceptual Plan Limestone Channel**