**EPA/ROD/R08-05/046**
**2005**

# EPA Superfund
# Record of Decision:

**RICHARDSON FLAT TAILINGS**
**EPA ID: UTD980952840**
**OU 1**
**PARK CITY, UT**
**07/06/2005**

# Richardson Flat Tailings Site
# Park City, Utah

# Record of Decision

# DECLARATION OF THE RECORD OF DECISION

## SITE NAME AND LOCATION

The Richardson Flat Tailings Site (Site) is located is located 1.5 miles northeast of Park City, Utah, and is part of a 650 acre property owned by United Park City Mines (UPCM) Company. The Site is a tailings impoundment that covers 160 acres in the northwest comer of the UPCM property, a small portion of the much larger Upper Silver Creek Watershed. The U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation and Liability Information system (CERCLIS) Site Identification Number is UT980952840.

## STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedy for the Richardson Flat Tailings Site. This ROD has been developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, 42 U.S. Code (USC) §9601 et. seq. as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan(NCP), 40 CFR Part 300. The decision is based on the Administrative Record for the Site.

This remedy was selected by EPA Region 8. The Utah Department of Environmental Quality (UDEQ) concurs with the selected remedy.

## ASSESSMENT OF THE SITE

The response action selected in the ROD is necessary to protect public health and the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health or welfare or the environment.

## DESCRIPTION OF THE SELECTED REMEDY

The selected remedy addresses mine tailings located in several areas of the Site, including the main impoundment, a section south of the diversion ditch, and the wetlands below the embankment. Other media addressed through the selected remedy are sediments and surface water located within the Site boundary. The mine tailings and other media are not considered principal threat waste; therefore, appropriate remedial actions for the waste include excavation of the tailings and containment of the tailings through capping. Additionally, the selected remedy allows for future disposal of mine tailings from the Park City area within the tailings impoundment and placement of restrictions on future land and groundwater use.

### *Major Components*

- Tailings in critical areas outside the impoundment (Area B) are excavated and moved inside the impoundment
- Existing soil cover is augmented to achieve a depth of at least 18 inches of soil above tailings
- Sediments in diversion ditch are covered with clean gravel
- Contaminated sediments and soils in the wetland below the embankment are excavated and material is placed within the impoundment. Wetlands will be restored.
- Mine waste from the Park City area is placed within the impoundment and covered with 18 inches of soil above the tailings. Disposal of mine waste will cease once the remedy has been implemented
- Embankment is fortified to prevent catastrophic failure
- Institutional controls (easements and land use restrictions) are implemented to protect soil cover and prevent ground water use
- Surface water monitoring is ongoing

## STAUTORY DETERMINATIONS

The selected remedy is protective of human health, and welfare, and the environment, complies with federal and state requirements that are applicable or relevant and appropriate for the remedial action, is cost effective and utilizes permanent solutions and alternative treatment technologies to the extent practicable.

Because this remedy will result in hazardous substances or pollutants or contaminants remaining on Site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

## ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this Site.

- Chemicals of Concern (COC's) and their respective concentrations. (Section 7.1.1 and Section 7.2.1)

- Baseline risk represented by the COCs. (Section 7)

- Cleanup levels established for COCs and the basis for the levels. (Section 7.2.5)

- Whether source materials constituting principal threats are found at the Site. (Section 11)

- Current and reasonably anticipated future land use assumptions and current and beneficial uses of groundwater used in the baseline risk assessment and ROD. (Section 6)

- Potential land and groundwater use that will be available at the Site as a result of the selected remedy. (Section 12.4)

- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected. (Section 12.3)

- Key factors that led to selecting the remedy. (Section 12.1)

## AUTHORIZING SIGNATURE

This Record of Decision documents the selected remedial action to address the contamination at the Richardson Flat Tailing site.

The following authorized official at EPA Region 8 approves the selected remedy as described in this ROD.

Max H. Dodson 7/6/05

Max H. Dodson Date
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U.S. Environmental Protection Agency, Region 8

The following authorized official at the State of Utah concurs with the selected remedy for the Richardson Flat Tailings site as described in this ROD.

Dianne R. Nielson 7/29/05

Dianne R. Nielson, Ph.D. Date
Executive Director
Utah Department of Environmental Quality

# CONTENTS

| | | | |
|---|---|---|---|
| **THE DECLARATION OF THE RECORD OF DECISION** | | | i |
| LIST OF TABLES | | | vi |
| LIST OF FIGURES | | | vii |
| **DECISION SUMMARY** | | | |
| **SECTION 1** | **SITE NAME, LOCATION, AND DESCRIPTION** | | l |
| **SECTION 2** | **SITE HISTORY AND ENFORCEMENT ACTIVITIES** | | 2 |
| | 2.1 | HISTORICAL LAND USE | 2 |
| | 2.2 | INVESTIGATION HISTORY | 3 |
| | 2.3 | ENFORCEMENT HISTORY | 3 |
| **SECTION 3** | **COMMUNITY PARTICIPATION** | | 4 |
| **SECTION 4** | **SCOPE AND ROLE OF OPERABLE UNITS** | | 5 |
| **SECTION 5** | **SUMMARY OF SITE CHARACTERISTICS** | | 6 |
| | 5.1 | SITE CONCEPTUAL MODEL | 6 |
| | 5.2 | OVERVIEW OF THE RICHARDSON FLAT TAILINGS SITE | 6 |
| | | 5.2.1 Site Features | 6 |
| | | 5.2.2 Hydrogeology | 8 |
| | 5.3 | SAMPLING STRATEGY | 9 |
| | 5.4 | KNOWN AND SUSPECTED SOURCES OF CONTAMINATION | 11 |
| | 5.5 | TYPES OF CONTAMINATION AND AFFECTED MEDIA | 11 |
| | 5.6 | LOCATION OF CONTAMINATION AND POTENTIAL ROUTES OF MIGRATION | 13 |
| | | 5.6.l Surface Water and Sediments | 13 |
| | | 5.6.2 Ground water | 14 |
| | | 5.6.3 Soils | 14 |
| **SECTION 6** | **CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES** | | 5 |
| **SECTION 7** | **SUMMARY OF SITE RISKS** | | 17 |
| | 7.1 | HUMAN HEALTH RISK ASSESSMENT | 17 |
| | | 7.1.1 Identification of Chemicals of Concern | 17 |
| | | 7.1.2. Exposure Assessment | 17 |
| | | 7.1.3 Toxicity Assessment | 18 |

7.1.4 Risk Characterization 20
7.1.4.1 Evaluation of Carcinogenic Risk 20
7.1.4.2 Evaluation of Noncarcinogenic Risk 21
7.1.4.3 Evaluation of Risk from Lead 21
7.1.5 Assessment of Uncertainties 22
7.2 ECOLOGICAL RISK ASSESSMENT 23
7.2.1 Identification of Contaminants of Concern 24
7.2 2 Exposure Assessment 24
7.2.3 Ecological Effects Assessment 25
7.2.4 Risk Characterization 27
7.2.5 Ecological Cleanup Levels 30
7.2.6 Ecological Risk Uncertainties 30
7.3 HUMAN HEALTH AND ECOLOGICAL RISK CONCLUSIONS 31

**SECTION 8 REMEDIAL ACTION OBJECTIVES** 32
8.1 NEED FOR REMEDIAL ACTION 32
8.2 REMEDIAL ACTION OBJECTIVES 32

**SECTION 9 DESCRIPTION OF ALTERNATIVES** 33
9.1 DESCRIPTION OF REMEDY COMPONENTS 33
9.1.1 Alternative 1- No Action 33
9.1.2 Alternative 2-Soil Cover, Institutional Controls 33
9.1.3 Alternative 3- Source Removal, Soil Cover and Wedge 33
9.1.4 Alternative 4- Excavation, Treatment and Off-Site Disposal 34
9.1.5 Alternative 4- Excavation, Treatment and On-Site Disposal 34
9.2 COMMON ELEMENTS AND DISTINGUISHING FEATURES OF EACH ALTERNATIVE 35
9.3 EXPECTED OUTCOMES OF EACH ALTERNATIVE 35

**SECTION 10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES** 37
10.1 QUALITATIVE EVALUATION OF EACH ALTERNATIVE 37
10.2 SUMMARY AND RANKING TABLE 40

**SECTION 11 PRINCIPAL THREAT WASTE** 41

SECTION 12 THE SELECTED REMEDY 42
12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY 42
12.2 DETAILED DESCRIPTION OF THE SELECTED REMEDY 42

| | | |
|---|---|---|
| 12.3 | SUMMARY OF THE ESTIMATED REMEDY COSTS | 44 |
| 12.4 | EXPECTED OUTCOMES OF THE SELECTED REMEDY | 44 |
| **SECTION 13** | **STATUTORY DETERMINATIONS** | 46 |
| 13.1 | PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT | 46 |
| 13.2 | COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS | 47 |
| 13.3 | COST-EFFECTIVENESS | 47 |
| 13.4 | UTILIZATION OF PE ENT SOLUTIONS AND ALTERNATIVE TREATMENT (OR RESOURCE RECOVERY) TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE | 48 |
| 13.5 | PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT | 48 |
| 13.6 | FIVE YEAR REVIEW REQUIREMENTS | 48 |

**APPENDICES**

A FIGURES
B TABLES
C RESPONSIVENESS SUMMARY

**TABLES**

7-1 Summary of Chemicals of Concern and Medium Specific Exposure Point Concentrations in Sediment
7-2 Summary of Chemicals of Concern and Medium Specific Exposure Point Concentrations in Surface Water
7-3 Summary of Chemicals of Concern and Medium Specific Exposure Point Concentrations in Soil and Tailings
7-4 Cancer Toxicity Data Summary
7-5 Non-Cancer Toxicity Data Summary
7-6 Risk Characterization Summary- Carcinogens: Low Intensity Recreational User
7-7 Risk Characterization Summary- Carcinogens: High Intensity Recreational User
7-8 Risk Characterization Summary- Non-Carcinogens: Low Intensity Recreational User
7-9 Risk Characterization Summary- Non-Carcinogens: High Intensity Recreational User
7-10 Occurrence, Distribution, and Selection of Chemicals of Concern: Surface Water
7-11 Occurrence, Distribution, and Selection of Chemicals of Concern: Bulk Sediment
7-12 Occurrence, Distribution, and Selection of Chemicals of Concern: Sediment Porewater
7-13 Occurrence, Distribution, and Selection of Chemicals of Concern: Sediment
7-14 Occurrence, Distribution, and Selection of Chemicals of Concern: Soil Tailings
7-15 Ecological Exposure Pathways of Concern
7-16 Summary of Uncertainties

**TABLES (continued)**

10-1 Summary of Comparative Analysis of Alternatives
10-2 Ranking of Final Alternatives
10-3 Chemical, Location and Action Speci6c s
12-1 Cost Alternative 3
12-2 Present Worth Cost Alternative 3
13-1 Cost Alternative 2
13-2 Cost Alternative 4
13-3 Cost Alternative 5
13-4 Cost Alternative 3

**FIGURES**

1 Site Location Map
2 Site Vicinity Map
3 Significant Drainages
4 Site Features
5 Conceptual Site Model
6 Conceptual Site Model for Recreational Exposures to COPC's
7 Richardson Flat Ecological Site Conceptual Model

# DECISION SUMMARY

## SECTION 1

## SITE NAME, LOCATION AND DESCRIPTION

The Richardson Flat Tailings (RFT) site (Site) is located 1.5 miles northeast of Park City, Utah, and is part of a 650 acre property owned by United Park City Mines (UPCM) Company (Figure 1). The Site is a tailings impoundment that covers 160 acres in the northwest corner of the UPCM property, a small portion of the much larger Upper Silver Creek Watershed (Figure 2). Silver Creek is the primary surface water source found in the area and is comprised of runoff from three significant drainages in the watershed, including Ontario Canyon, Empire Canyon and Deer Valley (Figure 3). Silver Creek is currently listed on Utah's 303(d) list for zinc and cadmium and is targeted for total maximum daily load (TMDL) development. Historic mining activities in the canyons )eft behind six active Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) sites, including Empire Canyon, Silver Creek Tailings, and Silver Maple Claims, each one impacting Silver Creek in some way. While zinc and cadmium are the primary heavy metals found in Silver Creek, lead and arsenic are the main contaminants in the sediments and soils of the watershed. Because of the volume of mining activity throughout the district and the dynamics of the watershed hydrogeology, it is difficult to target any one site as the main source of contamination affecting Silver Creek and the environmental media within the watershed. The overall remedial goal for the watershed is to clean up the surrounding sites, including the Site, thereby eliminating current and future hazards to human health and welfare and the surrounding environment,

The RFT site is a geometrically closed basin, bound by highway 248 to the north, a main embankment to the west, and diversion ditches to the south and the northeast (Figure 4). Silver Creek can be found on the northwest border of the Site, separated from the Site by a small stretch of wetlands and riparian vegetation. The impoundment was used as a mine tailings reservoir prior to 1950. The Site now houses approximately seven million tons of sand-sized carbonaceous particles and minerals containing zinc, silver, lead, and other metals. Use of the Site by UPCM ended in 1982. To date, the Site is not listed on the National Priorities List (NPL). The Site was considered for listing in both 1988 and 1992. UPCM, the primary potentially responsible party (PRP), has taken responsibility for funding the majority of the remedial action at the Site.

# SECTION 2

# SITE HISTORY AND ENFORCEMENT ACTIVITIES

## 2.1 HISTORICAL LAND USE

ln 1953, UPCM was formed through the consolidation of Silver King Coalition Mines Company and Park Utah Consolidated Mines Company. At that time, the Site was already being used as an impoundment for mine tailings consisting primarily of sand-sized carbonaceous particles and minerals containing lead, zinc, silver and other metals. Additionally, tailings were transported to and placed in several distinct low elevation areas in the southeast portion of the Site just outside of the main impoundment.

In 1970, with renewed mining activity in the area, Park City Ventures (PCV), a joint venture partnership between Anaconda Copper Company and American Smelting Company (ASARCO), entered into a lease agreement with UPCM. This agreement allowed PCV to deposit additional mine tailings at the Site; however, the Site had to be partially reconstructed. Dames and Moore provided PCV with design, construction and operation specifications which were approved by the State of Utah. These specifications included installation of a large embankment along the western edge of the impoundment, and construction of containment dike structures along the southern and eastern borders of the Site for additional tailings storage. PCV also created a diversion ditch system along the higher slopes north of the impoundment and outside of the containment dikes along the east and south perimeters of the impoundment to collect surface run off. As part of the approval process for the renewed use of the Site, the State of Utah required installation of groundwater monitoring wells near the base of the main embankment.

Over the course of PVC's use of the Site, about 450,000 tons of tailings were deposited at the Site through a slurry pipeline that originated at their mill facility. Dames and Moore had recommended that the tailings be deposited around the perimeter of the Site, moving towards the center of the Site over time. However, PVC chose to deposit the tailings from the slurry pipeline in one constant area in the center of the impoundment, creating a steep, cone-like structure in the middle of the impoundment. After PVC discontinued their use of the Site in 1982, high winds caused tailings from the cone-shaped feature to become airborne, creating a potentially significant exposure pathway. These operations shaped the topography of the impoundment which still exists today.

From l980 to 1982, Noranda Mining, Inc, leased the mining and milling operations and placed an additional 70,000 tons of tailings at the Site, Since then no further use of the Site has occurred, but UPCM began taking actions aimed at improving environmental conditions of the Site almost immediately after operations stopped. This work continued intermittently through the mid-1990s. These actions are described in the Site Characteristics Section of this Record of Decision (ROD).

## 2.2 INVESTIGATION HISTORY

EPA became aware of the Site in the mid-1980s. After initial site assessment work, EPA proposed the Site for listing on the NPL in 1988. After considering public comment, EPA did not pursue the Site for listing on the NPL. By 1992, the Hazard Ranking System (HRS) had been revised and EPA again proposed the Site for listing on the NPL. Ultimately, EPA decided not to pursue final listing on the 5FPL, and the Site remains proposed for the NPL at this time.

Subsequent to the second NPL proposal, the EPA Region 8 Superfund Emergency Response Branch conducted an investigation under the “Make Sites Safe” Initiative in 1993. This investigation concluded that conditions of the Site did not warrant emergency removal actions, but may present unacceptable risks to human health and the environment and should be addressed through long-term remedial action.

Throughout the 1990s, EPA and the Utah Department of Environmental Quality (UDEQ) were hoping UPCM would address the Site through the Utah Voluntary Cleanup Program. UPCM decided against this, but at the same time continued to voluntarily take steps to improve environmental conditions at the Site. Additionally, UPCM began collecting hydrogeologic data, which was used to better understand the groundwater flow and depth of tailings at the Site.

In 1999, EPA, UDEQ, UPCM, Park City Municipal Coq»ration, and other stakeholders formed the Upper Silver Creek Watershed Stakeholder’s Group (USCWSG). This community-based organization was formed to help EPA address Superfund-related environmental issues in the Park City area in a cooperative fashion, including issues related to the Site. The USCWSG has been very successful and several investigations and cleanups have occurred in Park City as a result. Early in USCWSG’s history, UPCM and EPA agreed to address the Site as an “NPL equivalent” site, using the same process for investigation and cleanup that is required for a NPL Site.

## 2.3 ENFORCEMENT HISTORY

EPA and UPCM signed an Administrative Order on Consent (AOC) on September 28, 2000 which called for UPCM to conduct a Remedial Investigation/Focused Feasibility Study (RI/FFS) for the Site. EPA and UPCM have continuously worked well together since the inception of the USCWSG, and because of this, EPA was able to employ increasingly reduced oversight for the RJ/FFS as it progressed. The RI/FFS conducted by UPCM provided the data and information used in this ROD.

EPA conducted two Potentially Responsible Party (PRP) Searches for the Site that identified several parties that may have some liability for cleanup of the Site. The Site owner, UPCM, has conducted the RI/FFS pursuant to an Administrative Order on Consent (AOC). EPA has been facilitating the allocation of costs of investigation and cleanup been the PRP’s and UPCM has indicated its willingness to enter into a Consent Decree (CD) with EPA for conduct of remedial design and remedial action.

# SECTION 3

# COMMUNITY PARTICIPATION

EPA recently published a Proposed Plan describing the preferred remedy at the Site. The Proposed Plan, released for public comment on September 4, 2004, was followed by a public meeting held on September 28, 2004. The public comment period on the proposed plan ran from September 5, 2004 to October 4, 2004. All comments received during this period are addressed in the Responsiveness Summary of this ROD

Throughout the ] 980's and early 1990s, there was significant opposition to cleanup of the Site under CERCLA authority. Public participation consisted primarily of comments on the proposed listings and letters to EPA urging that neither site be listed on the NPL.

Since the formation of the USCWSG in 1999, community participation in Park City has increased and improved. The USCWSG meets regularly, in well-advertised open meetings. The participants receive updates on individual sites in the watershed and discuss issues in a cooperative format. The USCWSG has developed a web-site, funded by UPCM, which details actions related to the environmental investigations and cleanup. The EPA project manager discusses the Site periodically with the local radio talk show and the local newspaper reporter. An information repository, which includes the Administrative Record (AR) for the Site, was established at the Park City Library and Education Center. Numerous public meetings have occurred on both general issues and to fulfill requirements for particular sites in the watershed. Fact Sheets are produced annually with updates on progress. Throughout conduct of the RI/FFS at the Site, UPCM and EPA have provided information to the public through all of these routes.

# SECTION 4

# SCOPE AND ROLE OF RESPONSE ACTION

The Site is one of several historic mining sites in the Upper Silver Creek Watershed. At present, six of these sites are listed in the CERCLIS database, and several more are being considered for f4ture Superfund action. The past and present impacts to surface water and sediment in Silver Creek result from the cumulative contributions of these sites over decades. Because of the high density of sites in a relatively small area, as well as the long history involved, it is often difficult to apportion specific problems to a particular site or time period. For example, sites upstream of Richardson Flat, such as Empire Canyon or Prospector Square, have impacted surface water and sediment conditions at and below Richardson Flat. However, it is difficult to determine exactly what contribution each made. For this reason, EPA has sought to investigate and remediate the Upper Silver Creek Watershed as a who)e, rather than trying to investigate each site separately. This ensures that remedies selected for the individual sites are complementary fo each other and work toward the goal of cleaning up the entire watershed. This ROD addresses only the actions necessary to address actual and potential impacts specific to the Site, but it is part of a broader strategy to clean up the entire Silver Creek Watershed in a consistent, efficient manner.

The remedy selected by EPA and documented in this ROD includes remedial actions necessary to protect human health or welfare or the environment. The ROD is based primarily upon information set forth in the RI/FFS recently conducted by UPCM. An important purpose of the RI/FFS and associated risk assessment was to evaluate the efficacy of these voluntary actions and the risks posed by the Site in its current condition. For instance, there is a soil cover across the tailings impoundment that was put in place by UPCM in the 1990s. The RI/FFS evaluated the soil cover and showed it protects groundwater and other media at the site from becoming heavily contaminated. The risk assessment determined that under the current conditions, threats to human health are low. However, it is clear that in the absence of this soil cover, both human and ecological receptors would be exposed to high concentrations of heavy metals and contaminants would be free to migrate from the Site, thereby increasing the risk to human health and the environment. Thus, decisions on remedial actions must consider not only the risks posed by current conditions, but also the risks posed if current conditions changed. The selected remedy will enhance and ensure the integrity of the soil cover, reinforce the tailings embankment, and protect surface and ground waters from additional metals loading by containing the low level threat waste, thereby mitigating and abating the actual and potential risks to human health or welfare or the environment at the Site. Further, institutional controls will minimize potential, future, uncontrolled, human contact with contamination in any of the Site media.

# SECTION 5

# SUMMARY OF SITE CHARACTERISTICS

This section summarizes the information obtained through the investigations and feasibility studies. It includes a description of the Site conceptual model on which the investigations, risk assessments and response actions are based. The major characteristics of the Site and the nature and extent of contamination are summarized below. More detailed information is available in the Administrative Record for the Site.

## 5.1 SITE CONCEPTUAL MODEL

The illustrated site conceptual model depicted in Figure 5 is a representation of the location, and movement of contamination at the Site and any potential impacts that may occur to human health, the environment, or beneficial uses of resources. Presently, the tailings in the main impoundment (Area A) and the tailings south of the diversion ditch (Area B) are considered the primary waste sources. Impacted media at the Site include sediments in the south diversion ditch and the wetland area, and the surface waters. Surface water sources include the wetlands area, Silver Creek, the site pond, and intermittent flow in the diversion ditches and unnamed drainages. Seasonally, accumulated precipitation and snow melt can be found on the surface of the main impoundment. There is a clay layer underlying the tailings in Area A and Area B, so infiltration of groundwater into the underlying aquifer is limited. Additionally, heavy metal releases from the tailings are currently contained to a certain degree by a low permeability soil cap that was placed there by UPCM in the 1990's. Therefore, potential exposure to future Site users including high and low-intensity recreational visitors is limited. However, these possible exposure pathways include ingestion of soils/tailings and sediment, dermal exposure to surface water, and inhalation of particulates in air. The ecological exposure pathways and receptors are described in detail in Section 7.2, Ecological Risk.

## 5.2 OVERVIEW OF THE RICHARDSON FLAT TAILINGS SITE

The Site is located in a broad valley with undeveloped rangeland. The Site is about 6,570 feet above mean sea level and is characterized by a cool, dry, semi-arid climate (RMC, 2003). Meteorological stations located in Park City, Utah and Kamas, Utah estimate an annual precipitation of about 20 inches of water, an average low temperature of about 30ºF, and an average high temperature of about 57ºF (RMC, 2003).

### 5.2.1 Site Features

As described in the Site History, mine tailings have been deposited at the Site since l950. For two decades, tailings were systematically deposite4 in the impoundment via a slurry line and eventually filled in all low lying areas (Area A). In 1970, PCV took ever the use of the impoundment, which required several structural changes and improvements, including enlargement of the main embankment in the northwestern corner of the Site, construction of containment dikes along the southern and eastern borders of the impoundment, and construction of a diversion ditch system outside the impoundment along the east and south perimeters. On the south end of the impoundment, the diversion ditch was cut through an area of existing tailings, resulting in some tailings being located outside (south of) the present day boundaries of the impoundment (Area B). These additions, as well as the tailings south of the diversion ditch, make up the main surface features of the Site. The Study Area Boundary includes the tailings south of the diversion ditch and the main impoundment. The Site characteristics can be found in Figure 4.

### *Impoundment and Containment Dikes*

The majority of the tailings at the Site are contained in the impoundment basin, with a large earth embankment in place along the western edge of the Site (Area A). The "main embankment" is vegetated and is approximately 40 feet wide at the top, 800 feet long, and has a maximum height of 25 feet. A series of man-made dikes contain the tailings along the southern and eastern perimeter of the impoundment. The northern edge of the impoundment is naturally higher than the perimeter dikes.

### *Off-Impoundment Tailings*

Additional tailings materials are present outside and to the south of the current impoundment area (Area B). During historic operations of the tailings pond, tailings accumulated in three naturally low-lying areas adjacent to the impoundment. Starting in l983, UPCM covered these off-impoundment tailings with a low-permeability, vegetated soil cover. However, recent surveys of off-impoundment cover soils indicate that, st some locations, soil cover is thin or absent, leaving exposed surface tailings (RMC, 2001a). In addition to these off-impoundment tailings deposits, prevailing winds from the southeast carried tailings from the main impoundment and deposited them in the surrounding areas.

### *Diversion Ditches and Drainages*

A diversion ditch system borders the north, south, and east sides of the impoundment to prevent surface water runoff from the surrounding land from entering the impoundment. Precipitation falling on the impoundment area creates a limited volume of seasonal surface water. The north diversion ditch collects snowmelt and storm water runoff from upslope, undisturbed areas north of the impoundment and carries it in an easterly direction towards the origin of the south diversion ditch. An unnamed ephemeral drainage to the southeast of the impoundment also enters the south diversion ditch at this point. Additional water from spring snowmelt and storm water runoff enters the south diversion ditch from other areas lying south of the impoundment at a point near the southeast corner of the diversion ditch structure.

### *Site Wetlands and Pond*

Water in the south diversion ditch flows from east to west and ultimately empties into Silver Creek near the north border of the Site. Before its confluence with Silver Creek, water from the south diversion ditch enters a small one acre pond (RMC, 2003). Water exiting the pond flows in a discrete channel where it mixes with flow from Silver Creek in a wetlands area below the main embankment (RMC, 2003). Near the northwestern comer of the wetlands area, Silver Creek flows into the wetland beneath the rail trail bridge. Water flow exits the wetlands area back into Silver Creek via a concrete box culvert under State Highway 248 (RMC, 2003).

***Silver Creek***

Silver Creek flows approximately 500 feet from the main embankment along the west edge of the Site. The headwaters of Silver Creek are comprised of three significant drainages in the Upper Silver Creek Watershed; the Ontario Canyon, the Empire Canyon and Deer Valley. Flows from Ontario and Empire Canyons occur in the late spring to early summer months in response to snowmelt and rainfall, while Deer Valley flows appear to be perennial and originate from snowmelt and springs (RMC, 2000b). The largest contributor to water flow in Silver Creek near the Site is the Pace-Homer (Dority Springs) Ditch, which derives most of its flow from ground water (USEPA, 2001). The outflow from the Pace-Homer Ditch enters Silver Creek at several locations below the Prospector Square area. Significant riparian zones and wetlands exist near the Site in areas that consist of accumulated tailings piles.

### 5.2.2 Hydrogeology

Ground water of concern at the Site occurs in shallow aquifers below the original ground surface.

These aquifers are primarily fed from local surface water recharge and are small and local in nature. They generally flow from southeast to northwest toward Silver Creek. Below these shallow aquifers, at varying depths, lies the bedrock aquifer of the Keetley Volcanics, which contains varying amounts of ground water depending upon local conditions. The hydraulic gradient in all aquifers is generally upward, but the connection between the bedrock aquifer and the shallow aquifers is weak.

The Site is located in a low gradient valley surrounded by small hills. The erosion and weathering of these hills, also part of the Keetley Volcanics, formed the original soil surface upon which the tailings were placed, as well as the soils used to cover the impoundment after its closure. These soils are rich in clay and exhibit a very low permeability, making them very important to the ground water and surface water hydrology of the Site. Beneath the tailings, the original ground surface acts as a confining unit for ground water movement, preventing water in the tailings from infiltrating downward into the shallow aquifers, as well as preventing water in the shallow aquifers from moving upward into the tailings. On the surface, the soils used to cover the tailings function as a nearly impenetrable cap, effectively preventing infiltration of surface water into the tailings. The tailings are effectively encapsulated above and below by low permeability, clay rich soil. At present, the surface of the impoundment is convex and forms a closed basin, so precipitation that falls directly on the impoundment remains there until it evaporates or is used by plants. Spring snow melt and heavy rains cause a large, temporary area of ponded water on the east side of the impoundment. This ponded area remains for a significant duration after snow melt, with little recharge from precipitation, which shows the effectiveness of the cover soil in preventing significant infiltration into the tailings. The very small amount of water that does infiltrate into the tailings eventually seeps through the main embankment into a small wetland.

The diversion ditch is also critical to the Site's hydrology. The diversion ditch serves as a barrier to both surface water and shallow ground water and captures water that flows toward the impoundment. The captured water is channeled around the impoundment, through a small retention pond, and into the small wetland at the foot of the main embankment. Here it mixes with water from Silver Creek and the small amount of water seeping through the embankment. All of this water is eventually used by plants in the wetland or flows north away from the Site as surface water or shallow ground water in the alluvium of Silver Creek.

## 5.3 SAMPLING STRATEGY

Sampling events for the RI took place in 2001 and 2002. The RI was designed to augment existing data that were collected in previous Site investigations and to collect additional data for the Ecological Risk Assessment. During these events each media was sampled as a separate entity. Samples were collected from the various site media, including surface water, ground water, Area A and B tailings, Area A and 8 soil cover, and lastly, sediments in the south diversion ditch and wetlands area.

### *Surface and Ground Water Sources*

#### *Surface water*

Sample locations were chosen to provide sufficient data to characterize seasonal water quality and quantity in the South Diversion ditch and the two unnamed drainages flowing into the South Diversion Ditch, and Silver Creek. Data were also collected to determine the effects of the Site on Silver Creek and the metal concentrations in the surface water of the South Diversion Ditch. When sampling was not limited due to lack of flow, data was collected monthly at each location through one complete seasonal time period. All dissolved metal concentration data were screened against Utah Water Quality Standards. The most stringent of these standards are the Class 3A Aquatic Wildlife Chronic Criteria (AWCC). These standards are dependent on hardness and are adjusted appropriately for an average hardness measured at each sample location.

#### *Ground water*

Due to the amount of historic ground water data, additional data collection required the addition of two new monitoring wells which were installed adjacent to Silver Creek up and down gradient of the Site. These were established to determine any shallow alluvial groundwater impacts caused by the tailings. Samples were also taken from established wells close to the South Diversion ditch to determine the metals concentrations within the ground water associated with the Area 8 tailings, and to determine the hydraulic gradient

### *Tailings*

#### *Area A*

Three test pits were created within Area A to sample the tailings. The test pits allowed for observation and documentation of the physical characteristics and spatial configuration of the interface. Additionally, at each location, five discrete samples were collected at one foot vertical increments to a depth of five feet below the soil cover. Acid/base potential data was used to assess the geochemical characteristics of the tailings materials.

***Area B***

Sampling in this area was completed first to determine the extent of the tailings outside of the main impoundment. The sample data were used in combination with areal photographs and historical information to determine the study area boundary. Backhoe test pits (63 total) and a series of hand tool excavations were completed in order to gather analytical and visual samples. Visual samples were used to establish the location of the tailings/clay layer interface. This sample data was also used to assess the thickness of the soil cover on top of the tailings in Area B. Analytical data was used to confirm the visual data. At seven sample locations one sample was taken from the tailings and one sample was taken from the clay layer below the tailings.

### *Soil cover*

***Area A***

Soil samples (41 samples total, 0-2" each) were collected for analysis. The holes were dug down until tailings were collected from below the main impoundment soil cover to determine the depth of the soil cover and the chemistry of the surface soils. Samples were analyzed for lead and arsenic while 20% of the samples were analyzed for RCRA metals plus copper and zinc.

***Area B***

The same excavation and hand tool sampling techniques that were described in the Area B tailings section were used to determine soil cover thickness in this area. Additionally, this area was sampled to assess the extent and impact of windblown tailings. A series of samples were collected from three transects (28 total) and analyzed for lead and arsenic.

### *South Diversion Ditch Sediments*

Six locations were chosen for sediment sample collection. Data were used to identify the source of zinc loading to the surface water found in the diversion ditch and to evaluate ecological risk.

### *Background Soils*

Background sm face soil samples (0-2") were collected from areas that have not been affected by tailings, found at least a mile away from the Site in all directions. All samples were analyzed for lead and arsenic, while 2 samples were analyzed for RCRA metals plus copper and zinc.

### *Study Area Boundary*

Study area boundary samples were collected from two areas south of the tailings found outside the impoundment, and on the west and east perimeter of the main impoundment. These samples analyzed for lead and arsenic to aid in determining the study area boundary.

### *Ecological Sampling*

Additional sampling was necessary to facilitate the completion of a thorough ecological risk assessment. Surface water and sediment sample data were collected from locations in the wetland area, site pond, and South Diversion Ditch. Vegetation samples and fish and macroinvertebrate samples were also taken. An analysis of these samples was necessary to complete the ecological risk assessment.

## 5.4 KNOWN AND SUSPECTED SOURCES OF CONTAMINATION

As previously described, the Silver Creek watershed is contaminated with heavy metals resulting from years of heavy mining activity in the Park City District. Surface water from the Site enters Silver Creek after passing through a wetland area in the northwest corner of the Site. There are three main sources of contamination at the Site: (1) the tailings contained within the tailings impoundment (Area A), (2) the tailings south of the diversion ditch (Area B) and (3) the tailings within the wetland area.

Metal contamination resulting from wind blown tailings distribution was investigated. Soil samples were taken along three transects (running west to east) that were oriented perpendicular to the prevailing wind direction. One transect was located north of the impoundment while the remaining two were located south of the impoundment. These samples were collected to determine the extent of wind blown tailings contamination and to aid in the study area boundary determination. The samples were analyzed for arsenic and lead and for eight RCRA metals, including zinc. Samples taken along transect two (south of the impoundment) had higher concentrations of lead than transects one and three. It is possible that these sample locations were not covered with top soil, while the other sample locations were. Sample locations with the highest concentrations of lead are included in the study area boundary.

## 5.5 TYPES OF CONTAMINATION AND AFFECTED MEDIA

The Site is contaminated with heavy metals, primarily zinc, lead and arsenic which are associated with the tailings found in the three locations described in Section 5.4. The media that are affected by these metals include the sediments and surface water of the south diversion ditch, the site wetland, and Silver Creek.

***Surface water***
Conclusions drawn from the sample data show that zinc exceeds the water quality criteria in some parts of the South Diversion Ditch, however, surface water zinc concentrations are be)ow the criteria where the diversion ditch meets the wetland area. A Comparison of surface water data collected from Silver Creek to the AWCC shows that zinc exceeds the criteria at both sample locations. Peak concentrations of zinc appear during spring run-off conditions.

***Ground water***
Data gathered from the monitoring wells were used to determine the metals concentrations within the ground water associated with the Area B tailings, and to determine the hydraulic gradient. After data gathered from these two areas were compared to Primary and Secondary Drinking Water Standards (PDWS and SDWS) and Treatment Technology Requirement (TTR) they were a)so compared to each other to determine whether the Site tailings are contributing zinc or other metals to the Silver Creek alluvial aquifer. Results show that ground water within the Area B tailings had lower concentrations of metals than the Silver Creek alluvial aquifer. Dissolved zinc concentrations from the Area B tailings are approximately 500 times lower than the zinc concentrations measured in the up gradient Silver Creek alluvial aquifer. Lastly, there is no hydraulic connection between ground water stored in the Area A tailings and the underlying aquifers.

## *Tailings Metals Concentrations*

### *Area A*

The average lead concentration in the Area A tailings was 4,530 ppm, while the average arsenic value was 265 ppm.

### *Area B*

The average lead and arsenic concentrations in the tailings above the clay layer were 10,434 ppm and 412 ppm respectively, while the average lead and arsenic concentrations in the clay layer below the tailings were 52 ppm and 9 ppm. Average lead and arsenic concentrations in the clay layer below the tailings in Area B are well below the background soil concentration.

Area A and B tailings data analysis Based on the data presented above it appears that there are higher metals concentrations in the tailings in Area B as compared to Area A. However, metal concentrations in the clay layer below the tailings in Area B are lower than in background soil concentrations. Furthermore, the composition of the clay layer below Area B tailings is the same as the composition of the clay layer below the main impoundment. This lead to the conclusion that the clay layer below the tailings is serving as an adequate barrier to metals migration in Area B and A.

## *Soil Cover*

### *Area A*

Sample data indicate that the range of thickness of the soil cover is 0.5 to 4 feet. Analytical results show the average lead concentration to be 385 ppm, while the average arsenic concentration was 22 ppm. As there are no regulatory criteria for metals in soils, this data was used to analyze the risk of surficial soil exposure to recreational users and ecological receptors at the Site.

### *Area B*

A series of samples were collected from three transects (28 total) and analyzed for lead and arsenic. Five of the samples were analyzed for eight RCRA metals plus zinc and copper. In conclusion, Transect 2 had a higher average concentration of lead and arsenic (1,446 ppm Pb, 75 ppm As) than transects 1 and 3, however, samples taken from this area may not have been covered by soil, causing the results to represent concentrations of lead and arsenic associated with the tailings that were already there, rather than concentrations associated with windblown tailings.

## *South Diversion Ditch Sediments*

Analytical results show that the average concentrations for lead, arsenic and zinc are 2,578 ppm, 138 ppm and 7,878 ppm respectively. Concentrations are highest in the sample location found in the lower portion of the diversion ditch just east of the site pond.

## *Background Soils*

The average lead concentration for the background soils is 43.3 ppm. The average arsenic concentration is 9 ppm. None of the background soil samples had elevated metals concentrations.

***Study Area Boundary***
Study area boundary samples were collected from two areas south of the tailings found outside the impoundment, and on the west and east perimeter of the main impoundment. These were analyzed for lead and arsenic to aid in determining the study area boundary. Analytical sample results were used to delineate the Study area Boundary. The boundary is drawn where background lead concentrations appear in the sample results.

***Ecological Sampling***
Additional sampling was necessary to facilitate the completion of a thorough ecological risk assessment. Surface water and sediment sample data was collected from locations in the wetland area, Site pond, and South Diversion Ditch. Vegetation samples and fish and macroinvertebrate samples were also taken. The resulting data was used to determine risk to ecological receptors in the Site area. A summary of the Ecological Risk Assessment including the findings from the ecological sampling is presented in section 7.2.

## 5.6 LOCATION OF CONTAMINATION AND POTENTIAL ROUTES OF MIGRATION

### 5.6.1 Surface water and Sediments

Sediments and surface water impacted by the tailings in Area A and B are found in the South Diversion Ditch and in the Wetland area. The contamination in these media is potentially affecting ecological receptors found in the area. Importantly, metal concentrations in the surface water of Silver Creek are lower than metals concentrations found in the surface water of the diversion ditch. Therefore, contaminated surface water found within the wetland is not adversely affecting Silver Creek.

***South Diversion Ditch***
Elevated concentrations of lead, arsenic, zinc and some cadmium were found in al) water and sediment samples taken. The South Diversion Ditch is a dynamic environment, where elevated concentrations of metals, particularly zinc, fluctuate with seasonal runoff and correspond with peak groundwater elevation. Likely sources of elevated metals concentration found in surface water and sediments in the Diversion Ditch include the tailings located in the bottom if the ditch, the small pond area south of the Site, or from the tailings in Areas A or B.

***Wetlands***
Although concentrations of metals in the surface water and sediment of the wetland area are lower than those of the South Diversion Ditch, they are very likely to have impacts on the ecological environment at the Site. The average concentrations of lead, arsenic and zinc are just below those in the South Diversion Ditch. There is a mixing of surface waters that occurs in the wetland area; while water from Silver Creek enters the northern portion of the wetland, surface water also flows in from the Diversion Ditch in the southern portion of the wetland. Sample results indicate that water entering the wetland area from Silver Creek contains higher metals concentrations than the surface water of the South Diversion Ditch.

### 5.6.2 Ground water

- Ground water sampling results indicate that the Site ground water has much lower concentrations of metals than the ground water within the Silver Creek alluvial ground water. A large amount of this ground water is captured in the South Diversion Ditch. Based on this data, it does not appear that the Site ground water is impacting the Silver Creek alluvial aquifer.
- As a result of the native clay layer found beneath the Area A tailings there is no hydraulic connection between the ground water associated with these tailings and the shallow alluvial aquifers or the underlying Keetley Volcanic aquifers.
- Sample results from ground water within the wetland area indicate that there are no significant impacts from the contamination found in the wet)and, the embankment or the Area A tailings.

### 5.6.2 Soils

In the previous sections on Background Soils and Soil Cover (Section 5.5) it is made clear that impacts to the soils at the Site are minimal. Most contamination is in the form of tailings that were deposited within Area A and in some small areas within Area B. Migration of metals away from these small areas within Area B is extremely limited. Most of the small tailings deposits within Area B have been previously covered with topsoil. Amy soils within Area B that have high concentrations of metals are included in the Study Area Boundary are addressed by the selected remedy.

# SECTION 6

# CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section describes the current and reasonably anticipated future land uses and current and potential beneficial ground and surface water uses at the Site.

### *Current Land Use*

The Site is located in a rural area within a broad valley of mostly undeveloped rangeland within the Silver Creek Watershed, approximately two mites outside the Park City limits. The Deer Valley and Park City ski resorts sit at the top of the watershed and serve as recreational use areas for skiers in the winter and bikers/hikers in the warmer months. As Silver Creek passes through Park City and into the surrounding suburban areas, the land use is primarily residential and commercial, changing to recreational and agricultural in the areas surrounding Richardson Flat. Most of the land around the Site is undeveloped open space.

Mining activities at the Site ceased in 1982. Since that time, the Site has not been used and has remained open space. A small recreational trail skirts the Site along Silver Creek. There are a few small industrial operations in the vicinity of the Site, including a concrete plant on a nearby parcel. Park City and other resort-like residential developments are expanding in the general area, but none are closer than one mile away.

### *Reasonably Anticipated Future Land Use*

The Site, and much of the surrounding area, is privately owned by UPCM. UPCM has consistently indicated a desire to retain title and limit future use to recreational activities at the Site. While no final decision has been made, uses that range from open space wildlife habitat to athletic fields are currently being discussed. Any type of recreational use is consistent with surrounding land uses, and both Park City and Summit County have indicated general agreement with recreational proposals. Park City is proactive in obtaining and preserving open space. There is no indication that higher uses of the land, such as residential, are reasonably foreseeable.

### *Ground and Surface Water Uses*

The surface water features at the Site, including the south diversion ditch, the wetlands area below the embankment, the Site pond and Silver Creek are used as habitat by a limited number of vegetative species, fish, and wildlife. All of the surface water and shallow ground water on the Site eventually discharges to Silver Creek. Silver Creek is classified by the State of Utah as a potential drinking water source, a recreational use feature, a cold water fishery, and a potential irrigation source. At present, Silver Creek is used for irrigation and recreational fishing only, and no changes are expected. The State of Utah is considering issuing an advisory against fishing due to elevated metal levels in Silver Creek. Silver Creek is listed on the State's Clean Water Act

Section 303(d) list of impaired water bodies because zinc and cadmium levels exceed chronic standards for protection of aquatic wildlife.

Silver Creek has been impacted by the legacy of mining activities, though the remedial investigation confirmed that the Site is not, at present, a significant contributor of metals to the creek. The goal is to remediate the entire watershed, improving the ecological quality of the area, thereby allowing for continued beneficial use of the watershed and the Site by a variety of living organisms.

Ground water in the immediate area is used only for private wells, and no wells are known to be located within a half mile of the Site. Most area drinking water wells are finished in the deeper consolidated sedimentary rocks that can sustain aquifers and produce sufficient yields for culinary wells. In the Site area, these formations are very deep and are covered by the Keetley volcanics. The volcanic rocks are generally not suitable to sustain aquifers and serve as more of a confining unit. The shallow ground water at the Site is generally associated with the alluvial system of Silver Creek. This water is very high in solids and is also often contaminated due to water quality in Silver Creek and tailings that are present along the Creek in many areas. There are no known uses for this water at this time.

# SECTION 7

# SUMMARY OF SITE RISKS

A baseline human health risk assessment (BHHRA) and a baseline ecological risk assessment (BERA) were performed to evaluate the potential for adverse human health and ecological effects that might occur from exposure to Site-related contaminants. Current and future risks were estimated for the baseline scenario (i.e., risks that might exist if no remediation or institutional controls were applied). The BHHRA and the BERA aided in drafting the remediation goals by providing a basis for taking action at the Site. The Chemicals of Concern and the exposure pathways were also identified through these risk assessments.

## 7.1 HUMAN HEALTH RISK ASSESSMENT

### 7.1.1 Identification of Chemicals of Concern

The BHHRA identified two contaminants, lead and arsenic, as chemicals of potential concern (COPC’s) at the Site through a four step selection process. Risks to human health posed by exposure to these chemicals have been studied extensively through risk assessments completed at other Superfund sites in Utah and throughout the country. Currently, the Site has a soil cover that has a depth of 4 feet in some areas. Because of this soil cover, exposure pathways to these COPC s are limited or interrupted. However, if the integrity of this soil cover were threatened in any way by forces of nature or human intervention, the exposure pathways could become complete. Because of the high human health risk associated with lead and arsenic, and because of the potential exposure to recreational Site visitors if a remedy were not in place, lead and arsenic were selected as chemicals of concern (COC’s) and risk drivers for the Site. The COC's are summarized in Tables 7-1,7-2, and 7-3.

### 7.1.2 Exposure Assessment

The exposure assessment identifies scenarios through which people could be affected by the COCs in Site media and estimates the extent of exposure Site users could endure. The conceptual site model illustrates the media and exposure pathways that were evaluated in the BHHRA (Figure 5). Media selected for evaluation in the B were soil/tailings, surface water, sediment, and air particulates. Because land use will be limited to recreational visitors, two separate recreational use scenarios were considered. An evaluation of the exposure pathways is also presented in Figure 6.

***Low intensity User***

The first scenario includes low intensity users, such as hikers, bikers and picnickers, ranging in age from young children to adults. Exposure pathways evaluated were ingestion of soil/tailings, surface water and sediment, dermal exposure to surface water and inhalation of particulates in air.

***High Intensity User***
Scenario two includes high intensity users such as horseback riders, ATV users, dirt bikers and team sports players. High intensity users were assumed to exclude younger children and include teenagers and adults. The exposure pathways a high intensity user may be subjected to include ingestion of soil/tailings and inhalation of particulates in air.

### 7.1.3 Toxicity Assessment

The purpose of the toxicity assessment is to review and summarize the potential for each COC to cause adverse effects in exposed individuals. The toxic effects of a chemical generally depend on the inherent toxicity of a chemical, the route of exposure (ingestion, inhalation, and dermal), and the duration of exposure (subchronic, chronic or lifetime).

There is a positive relationship between dose (chemical intake through an exposure pathway), and adverse effect, so as dose increases the type and severity of adverse response also increases. Chemical toxicological information derived from either animal or human studies is used to estimate toxicity criteria which are numerical expressions between dose (exposure) and response (adverse health effects). Toxicity criteria are developed for the assessment of carcinogenic and non-carcinogenic health effects. Toxicity criteria include the EPA online Integrated Risk Information System (IRIS) and EPA's Health Effects Assessment Summary Tables (HEAST).

Toxicity criteria for carcinogens are provided as cancer slope factors (CSF's) in units of risk per milligram of chemical per kilogram of body weight per day (mg/kg day). CSF's are based on the assumption that no threshold exists for carcinogenic effects and that any dose is associated with some finite carcinogenic risk. The chemical-specific CSF is multiplied by the estimated chemical intake to provide an upper-bound estimate of the increased likelihood of cancer resulting from exposure to the chemical. This risk would be in addition to any background risk of developing cancer over a lifetime due to other causes. Consequently, the risk estimates in the BHHRA are referred to as incremental or excess lifetime cancer risks. Based on data from IRIS and other published data, arsenic is classified as a known human carcinogen (EPA weight of Evidence A). Tab)e 7-4 shows the cancer toxicity criteria for ingestion of arsenic. Lead toxicity is evaluated using other methodologies such as the Integrated Exposure Uptake Biokinetic (IEUBK) model. Estimated blood lead levels are compared to target blood-lead concentrations to assess possible risks.

Toxicity criteria for noncarcinogens are provided as reference doses (RfDs) and represent the daily exposure to a chemical that would be without adverse effects, even if the exposure occurred continuously over a lifetime. The RfD is provided in units of milligrams per kilogram per day (mg/kg4ay) for comparison with chemical intake into the body. Chemical intakes that are less than the RfD are not likely to be of concern even to sensitive individuals. Chemical intakes that are greater than the RfD indicate a possibility for adverse effects. Noncancer toxicity values for COCs for ingestion/dermal exposures are presented in Table 7-5.

EPA has not published toxicity criteria for lead. This is because available data suggest that there is no threshold for adverse effects even at exposure levels that might be considered background. Any significant increase in exposure above background levels could represent a cause for concern. Instead of evaluating risk using typical intake calculations and toxicity criteria, EPA has developed other methodologies for evaluating lead exposures. One such methodology is the Integrated Exposure Uptake Biokinetic (IEUBK) model, a computer model used to predict blood-lead levels in children exposed to lead from a variety of sources, including soil, dust, ground water, air, diet, lead-based paint, and maternal blood. Estimated blood-lead levels are compared to target blood-lead concentrations to assess possible risks. The IEUBK model is intended for use only for children up to the age of seven, as these are the most sensitive receptors to lead exposure, The model assumes daily exposure in a residential setting.

There are circumstances in which adjustments to toxicity criteria should be made to account for the relative bioavailability of a chemical due to its chemical form or its reactive form or the particular medium in which it is found. The issue of bioavailability is especially important when dealing with media from mining sites because metals in these media may exist in insoluble media. These chemical and physical properties may tend to influence (usually decrease) the adsorption or bioavailability of the metals when ingested. Because no site specific data are available for the bioavailability of arsenic in soils/tailings the default value of 0.8 was applied to the arsenic toxicity criteria.

## *Adverse Effects of Arsenic Exposure*

### *Noncancer Effects*

Oral exposure to acute and chronic ingestion of lower levels of arsenic often include diarrhea, vomiting, decreased blood cell formation, injury to blood vessels, damage to kidney and liver, and impaired nerve 5mction. The most diagnostic sign. of chronic arsenic exposure is an unusual pattern of skin abnormalities, including dark and white spots and a pattern of small "corns," especially on the palms and soles (ATSDR 1991).

### *Carcinogenic Effects*

There have been a number of epidemiological studies in humans which indicate that chronic inhalation exposure to arsenic is associated with increased risk of lung cancer (USEPA 1984, ATSDR 1991). In addition, there is strong evidence from a number of human studies that oral exposure to arsenic increases the risk of skin cancer (USEPA 1984, ATSDR 1991). The most common type of cancer is squamous cell carcinoma, which appears to develop from some skin corns. Although the evidence is limited, there are some reports which indicate that chronic oral arsenic exposure may also increase risk of internal cancers, including cancer of the liver, bladder and lung, and that inhalation exposure may also increase risk of gastrointestinal, renal or bladder cancers (ATSDR 199l).

## *Adverse Effects of Lead Exposure*

### *Noncancer Effects*

Excess exposure to lead can result in a wide variety of adverse effects in humans. Chronic low-level exposure is usually of greater concern for young children than older children or adults. The effect of lead that is usually considered to be of greatest concern in children is impairment of the nervous system. The effects of chronic low-level exposure on the nervous system are subtle and normally cannot be detected in individuals, but only in studies of groups of children. Common measurement endpoints include various types of tests of intelligence, attention span, hand-eye coordination, etc. Such effects on the nervous system are long-lasting and may be permanent.

Additionally, studies in animals reveal that high blood lead levels during pregnancy can cause fetotoxic and teratogenic effects. Further, a characteristic effect of chronic high lead exposure is anemia stemming from lead-induced inhibition of heme synthesis and a decrease in red blood cell life span.

***Cancer Effects***
Studies in animals indicate that chronic oral exposure to very high doses of lead salts may cause an increased frequency of tumors of the kidney (USEPA 1989b, ACGIH 1995). However, there is only limited evidence suggesting that lead may be carcinogenic in humans, and the noncarcinogenic effects on the nervous system are usually considered to be the most important and sensitive endpoints of lead toxicity (USEPA 1988).

### 7.1.4 Risk Characterization

The BHHRA characterized the risk to low and high intensity recreational users through exposure to the COCs at the Site.

#### 7.1.4.1 Evaluation of Carcinogenic Risk

For carcinogens, risks are generally expressed as the probability of an individual developing cancer over a lifetime as a result of exposure to the Site-related contaminants. This is described as “excess lifetime cancer risk” because it is an addition to the risk of cancer from other causes. Exposure to Site COPCs was evaluated by multiplying chemical specific exposure estimates (i.e. average lifetime dose) by the chemical and route specific CSF. The result was a unitless measure of probability (e.g., 1E-4) of an individual developing cancer as e result of chemical exposures at the Site. A cancer risk of 1E-04 refers to an increased chance of one in ten thousand of developing cancer as a result of site related exposure to a carcinogen over the expected duration. Typically, the USEPA considers remedial action at a site when estimated total excess cancer risk to any current or future population exceeds the range between one in ten thousand (1E-04) and one in a million (1E-06). Estimated carcinogenic risks for reasonable maximum exposure (RME) scenarios are presented in tables 7-6 and 7-7. Estimates of average risks are presented in the BHHRA.

***Low Intensity Users***
RME excess cancer risks were calculated for potential low intensity recreational users, which include hikers, bikers and picnickers. Risks were evaluated for the ingestion, inhalation and dermal exposure pathways. Risk from inhalation and ingestion of sediments, soil/tailings and surface water and dermal exposure to surface water were estimated to fall below EPA’s threshold cancer risk of 1E-06. Risk from ingestion of soil/tailings was estimated to be 2E-05 for the RME scenario. This risk falls into EPA’s acceptable range of 1E-04 and 1E-06.

***High Intensity Users***
RME excess cancer risks were calculated for high intensity recreational users which include horseback riders, ATV users, dirt-bikers, and sports (soccer, baseball) players. Risks were evaluated for the ingestion of soil/tailings and the inhalation of soil as dust exposure pathways, Risk from inhalation of soil as dust was estimated to fall well below the threshold cancer risk of

1E-06. Risk from ingestion of soil/tailings was estimated to be 1.1E-05, which falls into EPA's acceptable range of 1E-04 and 1E-06.

#### 7.1.4.2 Evaluation of Noncarcinogenic risks

The potential for noncarcinogenic effects due to exposure to a particular chemical is expressed as the hazard quotient (HQ). An HQ was calculated by dividing the dose (estimated chernical intake) of a chemical by the RfD. The HQ calculation assumes that there is a threshold level of exposure below which no adverse effects will occur. An HQ less than one indicates that there is little potential for adverse noncancer effects, even in sensitive individuals, while an Hg greater than one indicates the potential for adverse noncancer effects. The hazard index (HI) is equal to the sum of all the HQs. A HI less than one indicates there is little potential for adverse effect from exposure to all COCs at a site. An HI greater than one indicates the potential for adverse noncancer effects from exposure to all COCs, assurning that all chemicals have the same toxic effect and that toxic effects would be additive. Estimated RME noncancer hazards for populations evaluated in the BRA are presented in Tables 7-8 and 7-9. Please refer to the BHHRA for estimates of average noncancer hazards across the Site.

***Low Intensity Users***

Noncancer hazards were quantified for exposure to arsenic via ingestion of soils/tailings, surface water and sediment. The risk associated with inhalation of soil as dust and dermal contact with surface water was also considered. The HI was the sum of all HQs associated with the Site for the low intensity user. The RME HI was 9.2E-02 related to arsenic exposure through the various pathways. This falls below EPA's acceptable range for exposure to non-carcinogenic contaminants, which means that it is not a human health concezn by BPA's standards

***High Intensity Users***

Noncancer hazards were quantified for exposure to arsenic via ingestion of soils/tailings, and inhalation of soil as dust for the high intensity recreational user. The HI, the sum of the HQs, HI was 5.8E-02, which falls below EPA's acceptable range for exposure to non-careinogenic contaminants, which means that it is not a human health concem by EPA's standards

#### 7.1.4.3 Evaluation of Risks from Lead

Risks from lead are usually evaluated by estimation of the blood levels in exposed individuals and compared to blood lead levels within an appropriate health based guideline. The USEPA and CDC have set a goal that there should be no more than a 5% chance that a child should have a blood level over 10 μg/dL. The BHHRA used the IEUBK model to first evaluate risks to a hypothetical nearby resident of a child's age (0-6 years). Second, risks to a residential child engaged in low-intensity recreational activities at the Site were evaluated. The risk to residential children engaged in recreational activity is higher than the risk to children who live nearby but don't engage in recreational activity. However, the geometric mean values are relatively low, and children engaging in recreational activities have less than a 5% chance of exceeding a blood lead level of 10 μg/dL.

Risks for exposure to lead in Site media were also evaluated for teenage and adult recreational visitors using the Bowers model. Low and high intensity recreational visitor exposure scenarios were examined. Results showed that high or low-intensity recreational use at this Site is not predicted to cause high blood lead levels which exceed a target concentration of 11.1 µg/dL. The 11.1 µg/dL standard is a health criterion based on the blood lead concentration that is acceptable for a pregnant adult.

### 7.1.5 Assessment of Uncertainties

Several assumptions used in the evaluation of lead risks at this Site may introduce uncertainty into the presented findings. Although in most cases, assumptions employed in the risk assessment process to deal with uncertainties are intentionally conservative; that is, they are more likely to lead to an overestimate rather than an underestimate of risk, it is nevertheless important to take these uncertainties into account when interpreting the risk conclusions derived for this Site. Uncertainties presented in the risk assessment include: uncertainty in lead concentrations estimates, uncertainty in lead absorption from soil, and uncertainty in the modeling approach.

#### *Uncertainty in Lead Concentration Estimates*

Evaluation of human health risk at any particular location requires accurate information on the average concentration level of a COPC at that location. Because estimating the mean is more difficult when aggregating data over a large exposure area, such as the Site, the true mean could be underestimated. Here, the 95$^{th}$ Upper Confidence Limit soil lead concentration was used to evaluate risks from lead. This approach is reasonable for use at the Site where lead concentrations in onsite soil/tailing materials range from 14 to 5,875 mg/kg. This conservative approach for estimating exposure to lead at the site may *overestimate* the acted risks from lead for the Site, ensuring that all of the risk estimates are more likely to be high than low.

Risks from exposure to lead were evaluated based on surficial soil data. This decision was based on the assumptions that recreational users are most likely to be exposed to surficial soils based on their activities. Based on the depth distribution observed for lead, risks from exposure to subsurface soils will be similar or less than those observed for surface soils. However, if concentrations for lead are ever found to increase as a function of depth, the risks based on surface soil exposure will *underestimate* risks for those individuals exposed to buried materials. The maximum lead concentration in soil/tailings observed at the Site at any depth is 21,380 mg/kg.

#### *Uncertainty in Lead Absorption from Soil*

Another important source of uncertainty regarding the risk from lead in soil is the degree of absorption (RBA) within the gastrointestinal tract. For the risk assessment performed at the Site, a default relative bioavailability factor for lead of 0.60 has been applied. This introduces uncertainty, and causes either an over or underestimation of risk because the selected value is not based on actual measurements for site soils. Soils are complex by nature and may have numerous attributes which influence overall absorptions characteristics.

### *Uncertainty in Modeling Approach*

All predictive models, including the IEUBK model and the ISE model, are subject to a number of limitations. First, there is inherent difficulty in providing the models with reliable estimates of human exposure to lead-contaminated media. For example, exposure to soil and dust is difficult to quantify because human intake of these media is likely to be highly variable, and it is very difficult to derive accurate measurements of actual intake rates. Second, it is often difficult to obtain reliable estimates of key pharmacokinetic parameters in humans (e.g., absorption fraction, distribution and clearance rates), since direct observations in humans are limited. Finally, the absorption, distribution and clearance of lead in the human body is an extremely complicated process, and any mathematical model intended to simulate the actual processes is likely to be an over-simplification. Consequently, model calculations and predictions are generally rather uncertain.

The Bowers model used to assess lead exposures in youths and adults requires a composite toxicokinetic parameter (the biokinetic slope factor) to predict the effect of exposure on blood lead levels. This value is derived mainly from studies in adult males, and it is not certain that the value is accurate for youths or for women (especially pregnant women). Also, the exposures being modeled with the Bowers model are intermittent rather than continuous, so blood lead levels in the exposed populations are expected to show temporal variability. Toxicity data are not adequate to estimate the level of health risk associated with occasional (rather than continuous) elevations im blood lead level due to intermittent exposures to elevated lead levels in the environment. However, since the observed lead levels in soil/tailings result in predicted blood lead levels that are well below the established level of concern, these uncertainties in the modeling approach do not cast serious doubt on the accuracy of the conclusion that lead levels at this Site are not of concern to older children or adults.

## 7.2 ECOLOGICAL RISK ASSESSMENT

Tailings released to the environment from ore milling operations generally contain metals that can, depending on the concentration and level of exposure, be toxic to ecological receptors. In accord with the eight-step process recommended by USEPA for evaluating ecological risks the ecological risk assessment process at this Site was initiated by performing a Screening-Level Ecological Risk Assessment (SLERA) (USEPA, 2003a), which was followed by the Baseline Ecological Risk Assessment (BERA, January, 2004). These ecological risk assessments were completed to describe the likelihood, nature, and extent of adverse effects to ecological receptors resulting from present and potential exposure to the COCs at the Site. The SLERA was intended to provide a preliminary evaluation of the potential for adverse effects to three classes of ecological receptors (aquatic, terrestrial, wildlife). Because a SLERA normally uses a number of simplifying assumptions and approaches and is intentionally conservative, the SLERA was not intended to support any final quantitative conclusions about the magnitude of the potential ecological risks. The SLERA was also used to identify additional data that needed to be gathered in order to complete the BERA. Once the additional data was compiled it became possible to perform a more complete risk assessment, addressing the COC's and the risks posed through the various ecological exposure pathways within the exposure areas of the Site. The BERA was conducted using the problem formulation approach, which is an iterative process that allows risk assessors to refine the assessment as new information becomes available and to make qualitative conclusions about Site risks by using a weight of evidence evaluation. The various methods used to assess exposure and risk under the problem formulation approach as well as a description of the combined results of the SLERA and the BERA are described in the sections that follow.

### 7.2.1 Identification of Chemicals of Concern

Chemicals of concern (COCs) at the Site were identified through a weight of evidence evaluation that began in the SLERA. In this process, the maximum concentration of each detected metal was compared to the screening level benchmark (SL) for that metal. If this concentration was greater than the SL, the chemical was considered a chemical of potential concern (COPC) and was retained for further evaluation in the BERA. Additionally, the Site was divided into exposure areas for the purpose of the risk assessment. These areas are based on the Site characteristics and include Silver Creek (upstream and downstream), Site diversion ditches, the wetlands area, Site pond, and Area A and Area B tailings. By examining the ecological receptors and the COPCs associated with the environmental media within each exposure area, a risk management decision was made to determine the COCs for the Site. As a result of this approach, the following COCs are described based on the environmental media and the ecological receptor associated with that media. Cadmium and zinc (dissolved) were the COCs identified for surface water and aquatic receptors at the Site. Within the bulk sediment, cadmium, copper, mercury and zinc were considered COCs if benthic organisms were the receptors. Lead associated with the sediment was found to be a COC if waterfowl were the ecological receptors. The COCs, arsenic and zinc (dissolved), associated with sediment porewater could be toxic to benthic organisms. Lastly, aluminum, lead, mercury and zinc were named COCs and considered toxic to plants and soil invertebrates in contact with the soils and tailings at the Site. The COCs are summarized in Tables 7-10 through 7-14. These COC’s have the potential to adversely affect growth, diversity, reproduction and survival of the various species that populate the Site.

### 7.2.2 Exposure Assessment

When examining exposure to ecological receptors at the Site it is important to note that in accordance with the State of Utah surface water code, the Weber River from the Stoddard diversion to its headwaters (including Silver Creek) is classified as a cold water fishery (3A) and is protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in the food chain. Because the Site provides possible habitat for fish, aquatic invertebrates, terrestrial plants, terrestrial invertebrates, mammals, birds, reptiles and amphibians, those were the receptors included in the SLERA.

Figure 7 presents the ecological conceptual site model (CSM) for the Site. As indicated in the Ecological CSM, ecological receptors that may be exposed at the Site include aquatic receptors (fish and benthic macroinvertebrates), amphibians and reptiles, terrestrial receptors (plants and soil invertebrates), and wildlife receptors (birds and mammals). Each receptor class may be exposed to chemical contamination via contact with one or more environmental media, including surface water, sediment, seeps, aquatic food items, soil/tailings, and terrestrial food items. However, not all of these exposure pathways are likely to be of equal concern. Pathways that were supported by adequate data became the primary focus of the BERA and were included in the quantitative risk evaluation. An explanation of the elimination of certain pathways can be found in the BERA and for the purposes of this ROD, only the pathways of high ecological concern are described below.

***Aquatic Receptors (Fish)***

The main pathways of exposure for fish and benthic invertebrates are direct contact with surface water and sediment. Each of these pathways were evaluated quantitatively.

***Terrestrial Receptors (Plants and Invertebrates)***

The primary exposure pathway for both terrestrial plants and soil invertebrates is direct contact with contaminated soils. This pathway was evaluated in the SLERA; however, additional data were not collected for the BERA, so further analysis of this pathway was not conducted. It is assumed from the SLERA that direct contact with contaminated soils is a complete pathway and one of potentially high risk to terrestrial receptors.

***Wildlife Receptors (Birds and Mammals)***

Birds and mammals may be exposed by ingestion of food web items (either from the terrestrial environment and/or from the aquatic environment). Wildlife receptors may also ingest soil or sediment during feeding, especially for soil- or sediment-dwelling prey items. Although these exposure pathways are complete and of potential concern (USEPA, 2003a), no new data are available for contaminant concentrations in soil or in terrestrial food items, and it is expected that remedial actions planned for the site will largely address potential risks to terrestrial (upland) wildlife receptors from exposures to contaminants on the main impoundment and in off impoundment areas (RMC, 2003). Therefore, quantitative risk characterization for the BERA focused on exposures of aquatic/semi-aquatic wildlife receptors in the wetlands area, and risks to upland terrestrial wildlife receptors were not re-evaluated in the BERA.

### 7.2.3 Ecological Effects Assessment

Assessment and measurement endpoints are part of the problem formulation approach used to examine ecological risk at the Site. Again, the problem formulation method is an approach to risk assessment that is designed to provide risk managers with adequate qualitative and quantitative information. As a result, risk managers can make decisions that lead to protection of the ecological environment.

Assessment endpoints are explicit statements of the characteristics of the ecological system that are to be protected. Assessment endpoints are either measured directly or are evaluated through indirect measures. Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (USEPA 1992, 1997).

Table 7-15 presents the assessment and measurement endpoints used to interpret potential ecological risks for the Site that were evaluated in the BERA. These measurement endpoints can be divided into three basic categories: (1) hazard quotients (HQs), (2) site-specific toxicity tests, and (3) observations of population and community demographics.

***Hazard Quotients***

Hazard Quotients (HQ's) are generally used by the EPA to determine whether remedial action is warranted. For example, in human health risk assessment for non-carcinogenic effects, remedial action is warranted if the HQ for a COC is greater than 1 for a particular site user. However, for the purposes of the BERA, HQs were used as one part of the weight-of-evidence evaluation along with the other factors including toxicity testing and population observations. A HQ is the ratio of the estimated exposure of a receptor at the Site to a "benchmark" exposure that is believed to be without significant risk of unacceptable adverse effect:

HQ = Exposure / Benchmark

Exposure may be expressed in a variety of ways, including:

- Concentration in an environmental medium (water, sediment, soil, diet)
- Concentration in the tissues of an exposed receptor
- Amount of chemical ingested by a receptor

In all cases, the benchmark toxicity value must be of the same type as the exposure estimate.

If the value of an HQ is less than or equal to 1, risk of unacceptable adverse effects in the exposed individual is judged to be acceptable. If the HQ exceeds l, the risk of adverse effect in the exposed individual is of potential concern.

When interpreting HQ results for ecological receptors, it is important to remember that the assessment endpoint is usually based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. In these cases, population risk is best characterized by quantifying the fraction of all individuals that have HQ values greater than 1 and by the magnitude of the exceedances. In interpreting HQ values and distributions of HQ values, it is always important to bear in mind that the values are predictions, and are subject to the uncertainties that are inherent in both the estimates of exposure and the estimates of toxicity benchmarks. Therefore, HQ values should be interpreted as estimates rather than highly precise values and should be viewed as part of the weight-of-evidence along with the results of site-specific toxicity testing and direct observations on the structure and function of the aquatic community (see below).

***Site-Specific Toxicity Tests***

Site-specific toxicity tests measure the response of receptors that are exposed to Site media. This may be done either in the field or in the laboratory using media collected on the site. The chief advantage of this approach is that site-specific conditions which can influence toxicity are usually accounted for. A potential disadvantage is that, if toxic effects once when test organisms are exposed to a Site medium, it is usually not possible to specify which chemical or combination of chemicals is responsible for the effect. Rather, the results of the toxicity testing reflect the combined effect of the mixture of chemicals present in the Site medium. In addition, it is often difficult to test the full range of environmental conditions which may occur at the Site across time and space, either in the field or in the laboratory, so these studies are not always adequate to identify the boundary between exposures that are acceptable and those that are not.

***Population and Community Demographic Observations***

A third approach for evaluating impacts of environmental contamination on ecological receptors is to make direct observations on the receptors in the field, seeking to determine whether any receptor population has unusual numbers of individuals (either lower or higher than expected), or whether the diversity (number of different species) of a particular category of receptors (e.g., plants, benthic organisms, small mammals, birds) is different than expected. The chief advantage of this approach is that direct observation of community status does not require making the numerous assumptions and estimates needed in the HQ approach. However, there are also a number of important limitations to this approach. The most important of these is that both the abundance and diversity of an ecological population depend on many site-specific factors (habitat suitability, availability of food, predator pressure, natural population cycles, meteorological conditions, etc.), and it is often difficult to know what the expected (non-impacted) abundance and diversity of an ecological population should be in a particular area. This problem is generally approached by seeking an appropriate "reference area" (either the site itself before the impact occurred, or some similar site that has not been impacted), and comparing the observed abundance and diversity in the reference area to that for the site.

### 7.2.4 Risk Characterization

As noted above, each of the measurement endpoints has advantages but also has limitations. For this reason, conclusions based on only one method of evaluation may be misleading. Therefore, the best approach for deriving reliable conclusions is to combine the findings across all of the methods for which data are available, taking the relative strengths and weaknesses of each method into account. If the methods all yield similar conclusions, confidence in the conclusion is greatly increased. If different methods yield different conclusions, a careful review must be performed to identify the basis of the discrepancy and to decide which approach provides the most reliable information.

***Risk to Aquatic Receptors***

As discussed above, aquatic receptors (fish, benthic invertebrates) may be exposed to Site contaminants in surface water and sediment at a number of exposure areas including Silver Creek, the south diversion ditch, the wetlands area, Site pond, and an unnamed drainage which flows into the south diversion ditch. Evaluation of potential risks by the HQ approach, site-specific toxicity testing, and population surveys are summarized below.

| Risk to Aquatic Receptors | | |
|---|---|---|
| **Exposure Pathway** | **Line of Evidence** | **Findings** |
| Direct Contact with Surface Water | Estimated HQs from measured surface water concentrations | Surface water concentrations of cadmium and zinc in Silver Creek are probably adversely impacting aquatic receptors. Zinc may also be of concern to aquatic receptors in the Site diversion ditch and wetlands area. Concentrations of several metals may be above a chronic level of concern in the unnamed drainage which flows into the Site diversion ditch. |
| Direct Contact with Sediment | Estimated HQs from measured bulk sediment concentrations | Wide-spread, and potentially severe, toxicity to benthic invertebrates may be occurring in Silver Creek, the site diversion ditch, the wetlands area, and the site pond due to multiple metals in bulk sediment. |
| | Estimated HQs from measured sediment porewater concentrations | Sediment porewater concentrations of arsenic and zinc (antimony, cadmium and lead to a lesser extent) in the wetlands area, especially in the northern portion of the wetlands, may be of concern to benthic invertebrates. |
| | Sediment toxicity tests (*Hyalella azteca*) | Statistically significant decreases in survival were seem for 5 of 8 stations in the wetlands area. 100% mortality was seen in 3 sampling stations located in the northern part of the wetlands area. |
| All exposure pathways combined | Tissue burden evaluation | Measured tissue levels of zinc suggest that benthic invertebrates and snails in the wetlands area may be adversely impacted due to site exposures. Fish in the Site pond may also be adversely impacted based on the elevated tissue levels of aluminum, lead, and zinc. |
| | Aquatic community evaluation | No recent data are available. |

*Weight of evidence conclusions*
Based on these lines of evidence, metals in the wetlands area and the Site diversion ditch are probably having an adverse effect en aquatic receptors (fish and aquatic invertebrates). Antimony, arsenic, cadmium, lead, and zinc found in sediment, sediment porewater or surface water may adversely impact the aquatic receptors in the exposure areas mentioned above.

For Silver Creek, dissolved metals (especially cadmium and zinc) are likely to pose a significant risk to aquatic receptors. Because risks are elevated in surface water collected upstream of the Site, it is evident that sources in addition to the Site contribute to the toxicity. The headwaters of

Silver Creek originate in the mountains south of Park City, a location that is influenced by several historic mining operations such as the Little Bell and My Mines. According to the findings of the Upper Silver Creek watershed evaluation (USEPA, 2001a), the Silver Maple Claims (Pace-Horner Ditch) was the largest contributor of zinc for the lower reaches of Silver Creek. Zinc loads from the Site south diversion ditch are reported to contribute only 0.03 lbs/day to Silver Creek (USEPA, 2001a). Based on this information, it appears that the Site is currently only a minor contributor to the current level of metal contamination in Silver Creek. However, if the metals present in sediments and/or surface water are reduced in Silver Creek as a result of off site clean up activities, it may be possible that discharges from the Site could recontaminate these media and become a more dominant influence on metal loading in the future.

***Risk to Wildlife Receptors***

The SLERA evaluated risks to terrestrial and aquatic/semi-aquatic wildlife and concluded that ingestion exposures from most media were potentially above a level of concern. Because no new data are available for contaminant levels in soils or terrestrial food web items, and because it is expected remedial activities will address concerns over soil-related pathways, terrestrial (upland) wildlife exposures were not re-evaluated. New data for surface water, sediment, and aquatic food web items were gathered, therefore, exposures of aquatic/semi-aquatic wildlife from these pathways were quantitatively evaluated as described below.

*Selection of representative species*
It is not feasible to evaluate exposures and risks for each aquatic/semi-aquatic avian and mammalian species potentially present at the Site. For this reason, several species were selected to serve as representative species (surrogates) of several different semi-aquatic feeding guilds. Selection criteria for representative wildlife species include trophic level, feeding habits, and the availability of life history information. Representative wildlife receptors selected for the Site include:

| **Wildlife Receptors and Exposure Pathways Evaluated** | | |
|---|---|---|
| **Feeding Guild** | **Representative Species** | **Exposure Pathways Evaluated** |
| Mammalian piscivore | Mink | Ingestion of surface water, sediment, and fish |
| Avian piscivore | Belted Kingfisher | |
| Avian omnivore | Mallard Duck | Ingestion of surface water, sediment, aquatic invertebrates, and aquatic plants |
| Avian insectivore | Cliff Swallow | Ingestion of surface water, sediment, and emerging aquatic insects |

*Weight of evidence conclusions*
Based on the estimated HQs and Hazard Indexes (HIs) from ingested dose, it was concluded that incidental ingestion of lead, manganese and zinc in sediments from the wetlands area, the south

diversion ditch, and Site pond are likely to be causing adverse effects in waterfowl and other birds which feed in these areas. Concentrations of lead, and possibly zinc and manganese, in aquatic food items may also cause adverse effects in birds that consume fish, aquatic invertebrates, or aquatic plants from the Site

| **Risk to Wildlife Receptors** | | |
|---|---|---|
| **Exposure Pathway** | **Line of Evidence** | **Findings** |
| Ingestion of surface water, sediment, and aquatic food items | Estimated HQs and HIs from ingested dose (calculated from measured data) | Risks to birds are likely to be of potential concern in the wetlands, diversion ditch, and pond, primarily from lead in sediment and also from these lead in aquatic food items.<br><br>Risks to the cliff swallow may be above a level of concern from manganese and zinc in aquatic invertebrates and sediment. However, correlation of manganese in sediment compared to manganese in invertebrates is inconsistent, so predicted risks may not be site-related or may reflect an overly conservative TRV. |

### 7.2.5 Ecological Cleanup Levels

A review of the lines of evidence and numerical calculations presented in the BERA suggests that lead is a clear driver of ecological risk at the RFT Site. HIs for incidental ingestion of lead in sediment by wildlife receptors (primarily waterfowl) are generally higher than those for other COCs, pathways, and receptors. In this regard, lead can be used to establish a cleanup standard that is conservative. Rather than establishing cleanup levels for all COCs, a cleanup level that is protective relative to incidental ingestion of lead in sediment by wildlife is considered sufficiently protective of other COCs, pathways, and receptors.

EPA selected an ecological cleanup level of 310 ppm lead in, sediment. This value is based on a low-end threshold Toxicity Reference Value (TRV) from the species sensitivity distribution (SSD) for all birds, and hence it is likely to be the most appropriate value to ensure protection of all waterfowl. This approach assumes that the variability in TRVs between different species of waterfowl is similar to the variability for other types of birds. While there is considerable uncertainty, it is expected that attainment of this numerical level would reduce HI's for lead in sediment to less than one.

### 7.2.6 Uncertainties

Quantitative evaluation of ecological risks is generally limited by uncertainty regarding a number of important data. This lack of knowledge is usually circumvented by making estimates based on whatever limited data are available, or by making assumptions based on professional judgment when no reliable data are available. Because of these assumptions and estimates, the results of the risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment. Uncertainties related to the BERA are summarized in Table 7-16.

## 7.3 HUMAN HEALTH AND ECOLOGICAL RISK CONCLUSIONS

The BHHRA, which is based on present conditions at the Site, determined there are currently no unacceptable risks from lead and arsenic to the targeted use population (recreational visitors) at the Site. However, remedial action is necessary to maintain and improve the soil cover that was placed on the tailings. Disturbances to the present soil cover could allow for exposure to the underlying tailings.

There is substantial risk to ecological receptors at the Site from exposure to zinc, cadmium, lead and arsenic found in the various environmental media at the Site. Exposure pathways include direct contact with the sediments within the South Diversion Ditch and the wetlands area. These exposure areas also present risks to ecological receptors through contact or ingestion of surface water and sediment porewater found at the Site.

# SECTION 8

# REMEDIAL ACTION OBJECTIVES

## 8.1 NEED FOR REMEDIAL ACTION

The measures undertaken voluntarily by UPCM over the past two decades have significantly reduced the risks presented by contaminants at the Site. These measures, while incomplete, have effectively isolated most of the contaminated materials from the environment and generally made the Site safe for recreational use. However, the ecological risks identified and described in the previous sections, along with the physical conditions present at the Site, necessitate additional remedial action. In its current state, the Site presents unacceptable risks to aquatic wildlife receptors, both in the wetland below the embankment and in the south diversion ditch. Similarly, the Site's physical characteristics create the potential for significant migration of heavy metals off the Site and into Silver Creek, as well as the potential for future exposure to recreational users. The Remedial Action Objectives (RAOs) for the Site focus on mitigating existing ecological risks and maintaining or improving the physical conditions to prevent or minimize future releases and exposures.

## 8.2 REMEDIAL ACTION OBJECTIVES

To address the existing and potential risks, as well as accommodate the anticipated future recreational and ecological use of the Site, EPA has developed nine RAOs:

1. Reduce risks to wildlife receptors in the wetland area and south diversion ditch such that hazard indexes for lead are less than or equal to one.
2. Ensure that recreational users, including children, continue to have no more than a 5% chance of exceeding a blood lead level of 10 micrograms per deciliter from exposure to lead in soils
3. Ensure that recreational users, including children, continue to have no more than $1 \times 10^{-4}$ chance of contracting cancer from exposure to arsenic in soils.
4. Eliminate the risk of catastrophic failure of the tailings impoundment.
5. Ensure that surface water discharged from the Site meets applicable Utah water quality standards.
6. Eliminate the possibility of future ground water use and withdrawal at the Site.
7. Allow for a variety of future recreational uses.
8. Allow for future disposal of mine tailings from the Park City area within the tailings impoundment until the remedy is complete.
9. Minimize post-cleanup disturbance of tailings and contaminated soil. Provide controls that ensure any necessary disturbance at the Site follows prescribed methods.

# SECTION 9

# DESCRIPTION OF ALTERNATIVES

In the FFS, four specific alternatives for remedial action, as well as a No Action alternative, were brought forward for detailed analysis. These alternatives are described in the subsections below.

## 9.1 DESCRIPTION OF REMEDY COMPONENTS

### 9.1.1 Alternative 1- No Action

It is a requirement of CERCLA and the NCP that the EPA evaluate the consequences of taking no action at the Site. This alternative is designed to establish a baseline of current conditions upon which other alternatives cen be compared. Alternative 1 does not provide any additional protection of human health or the environment.

### 9.1.2 Alternative 2- Soil Cover, Institutional Control and Wedge Buttress

Alternative 2 entails increasing the depth of cover over tailings in the Study Area, implementing institutional controls to manage human contact with Site materials, and installing a wedge buttress to a portion of the main embankment of the tailings impoundment. The South Diversion Ditch and wetland areas will be left undisturbed.

***Major Components***

- All tailings are left in current location
- Existing soil cover is augmented to achieve a depth of at least l8 inches of soil above tailings both inside and outside the impoundment
- Embankment is fortified to prevent catastrophic failure
- Institutional controls (easements and land use restrictions) to protect soil cover and prevent ground water use
- Ongoing surface water monitoring
- Mine waste from the Park City area will be placed inside the impoundment before the soil cover is augmented.

### 9.1.3 Alternative 3- Source Removal, Soil Cover and Wedge Buttress

Alternative 3 includes source removal and covering of Area B tailings, placing clean soil over the tailings impoundment, installation of a wedge buttress, covering of contaminated sediments in the diversion ditch, removing contaminated sediments in the wetland, and placing of restrictions on future land and groundwater use.

***Major Components***

- Tailings in critical areas outside the impoundment (Area B) are excavated and moved inside the impoundment
- Existing soil cover is augmented to achieve a depth of at least 18 inches of soil above tailings
- Sediments in diversion ditch are covered with clean gravel
- Contaminated sediments and soils in the wetland below the embankment are excavated and material is placed within the impoundment
- Mine waste from the Park City area is placed within the impoundment during implementation of the remedy
- Embankment is fortified to prevent catastrophic failure
- Institutional controls (easements and land use restrictions) to protect soil cover and prevent ground water use
- Ongoing surface water monitoring

### 9.1.4 Alternative 4- Excavation, Treatment and Offsite Disposal

This alternative entails excavating the contaminated material from the impoundment and from an area south of the diversion ditch, stabilizing it onsite, and disposing of it in a non-hazardous waste (Subtitle D) or hazardous waste (Subtitle C) landfill. Following treatment, the material would be tested using Toxicity Characteristic Leaching Procedure (TCLP) methods and disposed of in the proper landfill depending on its classification as either hazardous or non-hazardous waste. Once treatment and disposal processes are complete the site would be reclaimed by grading the area, applying six inches of topsoil and seeding the new soil with a native mix.

***Major Components***

- All tailings are excavated
- Tailings treated on-site through stabilization process to limit release of metals
- Tailings disposed of at off-site landfill

### 9.1.5 Alternative 5- Excavation, Treatment and Onsite Disposal

This alternative would include excavating the contaminated material from the impoundment and south of the diversion ditch and stabilizing it in a temporary treatment facility located adjacent to the impoundment. The treated materials would then be disposed of in a repository space within the impoundment. Upon completion of treatment and disposal activities the impoundment would be reclaimed. The Site will be graded to prevent surface water accumulation, thus reducing infiltration. Following the remedial activities, 18 inches of soil will be applied, including 12 inches of a low permeability soil and 6 inches of top soil. The top soil will be seeded with a native mix.

***Major Components***

- All tailings are excavated
- Tailings treated on-site through stabilization process to limit release of metals
- Tailings replaced into impoundrnent and covered with 18 inches of soil
- Institutional controls (easements and land use restrictions) to protect soil cover and prevent ground water use
- Ongoing surface water monitoring

## 9.2 COMMON ELEMENTS AND DISTINGUISHING FEATURES OF EACH ALTERNATIVE

Alternatives 1, 2, and 3 all involve managing the tailings in place to varying degrees, with altematives 2 and 3 adding increased levels of response. The RI has shown that the existing soil cover and the Site's hydrogeologic setting have effectively isolated the tailings from the environment, so it is clear that each of these altematives, even the No Action Alternative, will be effective to some degree. This type of managed repository for low-toxicity mine wastes is standard industry practice and can be considered a presumptive remedy. The design requirements for all alternatives are small and the time to implement each alternative is no more than two years.

Alternative 3 is distinguished from Alternative 2 by the increased protectiveness and risk reduction achieved by (1) excavating wastes in critical areas outside the impoundment, and (2) covering the diversion ditch sediments with gravel. Both alternatives 2 and 3 provide the opportunity for placement of mine waste from other locations in the Upper Silver Creek Watershed at the Site.

Alternatives 4 and 5 both involve excavation and treatment of all contaminated materials. These alternatives add additional protectiveness and limit future maintenance and management requirements such as monitoring. The design requirements for these alternatives are larger, involve significant bench and pilot testing, and the time to implement these alternatives are in excess of five years. Alternative 5 is distinguished from Alternative 4 in that treated wastes will remain on-site, as opposed to being disposed of in an off site landfill.

## 9.3 EXPECTED OUTCOMES OF EACH ALTERNATIVE

### *Alternative 1 - No Action*

- Immediately safe for recreational use
- Ecological risks not addressed
- Potential for increased future releases and exposures, including catastrophic failure of embankment
- No additional improvements in water quality
- Potential for unacceptable future ground water exposures

*Alternative 2 - Soil Cover, Institutional Controls and Wedge Buttress*

- Ready for recreational use in approximately two years
- Ecological risks not addressed
- Potential for catastrophic failure of embankment eliminated
- Site could be used for disposal of mine waste from other locations in the Watershed during implementation of the remedy
- Limited additional improvements in water quality
- Future ground water use restricted and potential for future exposures eliminated
- Ongoing monitoring and management required

*Alternative 3 - Source Removal, Soil Cover and Wedge Buttress*

- Ready for recreational use in approximately two years
- Ecological risks mitigated
- Potential for catastrophic failure of embankment eliminated
- Site could be used for disposal of mine waste from other locations in the Watershed during implementation of the remedy
- Significant improvements in water quality
- Future ground water use restricted and potential for future exposures eliminated
- Ongoing monitoring and management required

*Alternative 4 - Excavation, Treatment and Offsite Disposal*

- Ready for unlimited use no sooner than five years
- Ecological risks mitigated
- Potential for catastrophic failure of embankment eliminated
- Significant improvements in water quality
- Potential for future ground water exposures eliminated
- No future Site management or monitoring

*Alternative 5 - Excavation, Treatment and Onsite Disposal*

- Ultimate land-use potential unknown, but no use sooner than five years
- Ecological risks mitigated
- Potential for catastrophic failure of embankment eliminated
- Significant improvements in water quality
- Potential for future ground water exposures likely eliminated
- Limited Site management and monitoring required

# SECTON 10

# SUMMARY OF COMPARATIVE ANALYSIS

The NCP sets forth nine criteria for use in a detailed, comparative analysis of alternatives. This section summarizes the detailed analysis found in the FFS with specific discussion for each criterion followed by a summary and ranking table (10-1, 10-2).

## 10.1 QUALITATIVE EVALUATION OF EACH CRITERION

### *Overall Protection of Human Health and the Environment*

This criterion addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled.

Alternatives 1 and 2 do not provide adequate protection of human health and the environment. Neither alternative addresses risks posed by contaminated sediments in the diversion ditch and wetland areas. Alternative 1 also does not improve physical conditions at the Site, making future releases and exposures likely.

Alternatives 3, 4, and 5 all provide adequate protection of human health and the environment. Alternative 3 addresses risks posed by contaminated sediments in the diversion ditch and wetland areas through a combination of source removal and containment. Alternatives 4 and 5 provide additional protectiveness through treatment of contaminated wastes and soils. Alternatives 3, 4, and 5 also improve physical conditions at the Site, minimizing or eliminating the potential for future releases. Alternative 3 accomplishes this with a wedge buttress, soil cover, and institutional controls to better contain the tailings. Alternatives 4 and 5 accomplish this primarily through treatment of contaminated wastes and soils.

### *Compliance with Applicable or Relevant and Appropriate Requirements*

Section 121(d) of CERCLA and NCP Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)(4).

*Applicable requirements* are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified in a timely manner and that are more stringent than federal requirements may be applicable.

*Relevant and appropriate requirements* are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, they nonetheless address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well-suited to the particular site. Again, only those State standards that are identified in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

Site ARAR's are summarized in Table 10-3. Alternatives 1 and 2 will not comply with all of the ARAR's, while alternatives 3, 4 and 5 will. Additionally, the Action Specific hazardous waste ARAR's dealing with federally-defined hazardous wastes under RCRA are not applicable to Bevill-exempt waste, but may be relevant and appropriate. The majority of the mine waste at Richardson, and most mining waste that is transported from other Park City mining areas is considered Bevill-exempt under federal exemptions. Therefore, the action specific ARAR's apply to any waste associated with the site that is not Bevill-exempt.

### Long-Term Effectiveness and Permanence

*Long-term effectiveness and permanence* refers to expected residual risk and the ability of the remedy to maintain reliable protection of human health and the environment over time, once cleanup levels are met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Due to UPCM's prior voluntary efforts, each alternative provides some degree of long-term protection, though Alternatives 1 and 2 do not adequately address all risks posed by the Site. Alternatives 2 and 3 improve upon Alternative 1 through the use of physical improvements and institutional controls to reduce the risk of future releases from the Site, with Alternative 3 including provisions that address the risks posed by the diversion ditch and wetlands. However, both these alternatives require on-going institutional controls and monitoring to ensure their continued efficacy. Alternatives 4 and 5 largely eliminate this concern through treatment of all contaminated wastes and soils.

### Reduction of Toxicity, Mobility, or Volume through Treatment

*Reduction of toxicity, mobility, or volume through treatment* refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Only Alternatives 4 and 5 contain provisions for active treatment. Both alternatives would reduce, though not eliminate, the toxicity and mobility of the contaminants through stabilization treatment technologies in a similar fashion. The technologies considered are proven for mine wastes, but their effectiveness varies from site to site based upon the physical characteristics of the waste. However, neither alternative would reduce the volume of material required to be managed, which may actually increase slightly due to the addition of necessary reagents.

### *Short-Term Effectiveness*

*Short-term effectiveness* addresses the period of tune needed to implement the remedy and any adverse impacts that may be posed to the workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Each alternative can be implemented safely with proper engineering controls, though the degree of short-term risk varies considerably among the alternatives.

Alternatives 2 and 3 can be completed in a relatively short-time period of approximately two or three construction seasons. These alternatives involve only limited on-site earthmoving and any risks would be limited to workers and trespassers. These risks are easily controlled through institution of safe work practices and engineering controls.

Alternatives 4 and 5 would take substantially more time to complete - perhaps in excess of ten years. Both alternatives not only include more earthwork than Alternatives 2 and 3, but both also involve the operation of treatment systems and the use of slightly toxic reagents. These factors serve to increase the risk to workers. Alternative 4 also involves off-site transportation and disposal, which increases the risk to the community as waste is hauled via highway. Again, these risks could be managed, though not as easily, or likely as effectively, as those in Alternatives 2 and 3.

### *Implementability*

*Implementability* addresses the technical and administrative feasibility of a remedy from design through construction and operations.

All of the alternatives involve technology that is relatively basic. Alternatives 2 and 3 involve only on-site earth moving, and all of the resources are available locally. Alternatives 4 and 5 are somewhat more difficult to implement due to the inclusion of treatment technologies. However, these technologies are well established, and all of the resources necessary for implementation are readily available.

### *Cost*

The estimated present worth costs for the alternatives, not including Alternative 1, range from $2,295,398 for Alternative 2 to $343,234,058 for Alternative 5. Alternatives 4 and 5 both involve on-site treatment, are considerably more expensive than Alternatives 2 and 3, which do not involve treatment. Cost summaries are found in Tables 10-2.

### *State Acceptance*

The UDEQ has expressed its support for Alternatives 3, 4, and 5. However, UDEQ also recognizes that Alternatives 4 and 5 are significantly more costly.

### *Community Acceptance*

This criterion considers whether or not the local community agrees with EPA's analyses and preferred remedial alternative. Comments received on the Proposed Plan are important indicators of community acceptance. This is a balancing criterion.

During the Proposed Plan public comment period, one set of written comments was received that related to the transportation of waste from other areas within the Watershed to the Site. Specifically, the comments were directed to the chosen transportation route. Some comments on the preferred alternative were made by Utah Department of Fish and Wildlife and they are addressed in the Responsiveness Summary. All verbal questions raised at the public meeting were addressed at the meeting by EPA staff. A transcript of the meeting is available on the website and in the information repository.

## 10.2 SUMMARY AND RANKING TABLE

A comparison summary and the rankings are found in table 10-1 and 10-2.

# SECTION 11

# PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address principal threats posed by a site wherever practical. A principal threat concept is applied to the characterization of "source material" at a Superfund site, A source material is material that includes or contains hazardous substances or pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

The waste at the Site is considered a high volume, low toxicity source material in that the risk levels at the Site under the current conditions are near or within the acceptable range. This is true for existing conditions, as well as for reasonably anticipated future recreational land uses. Similarly, past experience at similar mining-related sites has shown that low-toxicity mine wastes can be reliably contained. As such, though treatment was considered as an alternative, no materials at the Site were considered principle threat wastes.

# SECTION 12
# THE SELECTED REMEDY

## 12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

Several basic questions guide the development of the ROD and the ultimate selection of a remedy:

- What risks does the Site present?
- To what degree and how will those risks be mitigated?
- Which alternative best meets the nine remedy selection criteria set forth by the NCP?

EPA has considered these questions, as set forth in the previous sections of the ROD and in the supporting FFS, and has determined that Alternative 3, "Source Removal, Soil Cover and Wedge Buttress," is the selected remedy for the Site. Alternative 3 mitigates risks to a sufficient degree, meets all threshold standards and criteria, and has the best balance of tradeoffs with respect to balancing and modifying criteria. Alternatives 1 and 2 do not sufficiently mitigate risks and are not satisfactory candidates for a final remedy. Alternatives 4 and S sufficiently mitigate risks, meet all threshold standards and criteria, and offer increased protection of human health and the environment, but the costs of implementation are dramatically higher than Alternative 3. The greater costs are not justified by the relatively small improvements in overall protection of human health and the environment offered by Alternatives 4 and 5.

## 12.2 DETAILED DESCRIPTION OF THE SELECTED REMEDY

The selected remedy has several key components that are described in detail below:

### *Source Removal*

Tailings and contaminated soils in Area B and in the wetland below the main embankment will be excavated and relocated to the low-lying area within the impoundment. The areas of concern will be over-excavated by 6 inches or to the depth required for removal of visible mine tailings and materials with lead concentrations greater than 310 ppm lead. Areas selected for excavation include: (1) contaminated materials in low-lying portions (subject to seasonal ponding or interaction with shallow ground water) of Area B, and (2) all of the sediments in the wetland below the impoundment. The wetland will not be excavated until upstream source areas along Silver Creek, specifically Empire Canyon, Silver Maple Claims, and the "flood plain" tailings just above the Site, are remediated. This is to ensure that clean areas are not re-contaminated, and is consistent with the overall cleanup plan for the Upper Silver Creek Watershed.

### *Soil Cover*

A minimum 12 inch thick low permeability soil cover will be placed on all areas where tailings or contaminated materials are left in-place, including the impoundment. The cover will build upon the existing soil cover and utilize similar materials. The cover would be placed in 6 inch lifts and compacted. Upon completion of the impermeable soil cover, 6 inches of topsoil cover will be added to provide for an l8 inch soil cover in total. The final surface would be graded to control surface storm water runoff and drainage and re-vegetated with a native seed mix to minimize erosion. Drainage swales and runoff channels may be installed where required to direct surface runoff toward the diversion ditch. Where applicable storm water runoff control structures will be constructed using erosion resistant materials such as geotextile fabric and rip-rap.

***Wedge Buttress***

A wedge buttress will be installed along the over-steepened portion of the embankment (for about 400 feet of the total embankment length of 800 feet). Fill will be placed along the toe of the embankment to a height of approximately 10 feet above the toe and extending horizontally out from the embankment face approximately 30 feet, or to other dimensions designed to provide an increase in stability of at least 50/o. Prior to construction, the upper soil and existing vegetation and organic matter will be removed. Drain material and a filter blanket (if required) will be placed prior to the buttress fill. Seep water currently emanating from the embankment will be diverted to the South Diversion Ditch. The buttress fill material will be compacted to at least 95% of the maximum dry density as determined by ASTM D-698 at moisture content within two (2) percent of optimum. At the end of construction the buttress fill will be protected from erosion by re-vegetation.

***Sediment Cover***

Clean gravel (12 inches) will be placed over sediments in the south diversion ditch.

***Institutional Controls***

Two primary institutional controls (ICs) will be implemented to mitigate potential risks and ensure the long-term efficacy of the remedy:

1. Ground water use restrictions within the Site boundary. The goal is to preclude any use of shallow ground water, as well as eliminate any significant alteration of the existing hydrogeologic system, such as mixing of aquifers. This IC will be in the form of a deed restriction and will be the responsibility of the owner of the Site,

2. Land use restrictions within the Site boundary. The goal is to preclude non-recreational uses and to ensure the soil cover, or similar protections, are maintained. This IC will be in the form of an Environmental Covenant and will be the responsibility of the owner of the Site.

***Placement of Additional Mine Waste at the Site***

There are several reasons why the Richardson Flat Site is an appropriate location for the placement and consolidation of mine wastes from cleanups conducted at other locations in the Watershed. First, the nature of the mine wastes found throughout the watershed is similar.

Second, the volume of waste from other locations is extremely small relative to the volume of wastes already present in the impoundment. The impacts from such a small contribution would be negligible. Lastly, the RI has shown that the mine tailings at the Site are well contained and present no unacceptable risks to human health. The selected remedy will ensure conditions remain this way and that all other Site risks are addressed. These factors make the Site an acceptable long term repository, and, in conjunction with these factors an off-site rule determination was made and agreed upon in date.

### *Monitoring*

Water quality samples will be collected at the mouth of the diversion ditch quarterly for two years after construction completion to ensure discharges into Silver Creek meet applicable water quality standards.

## 12.3 SUMMARY OF THE ESTIMATED REMEDY COSTS

A summary of the selected remedy costs can be found in table 12-1. The present worth cost of this remedy is $3,675,868 and is presented in detail in table 12-2.

## 12.4 EXPECTED OUTCOMES OF THE SELECTED REMEDY

### *Land Use*

The selected remedy allows for a variety of recreational uses. Such uses may include low intensity uses, such as open space, or more high-intensity uses such as athletic fields. Any construction/development activities occurring on the soil cover must be designed to maintain at least 18 inches of clean soil (12 inches of low permeability soil plus 6 inches of topsoil) between the tailings and the surface and minimize infiltration through the use of low-permeability clay or other engineering controls. Future changes in land use may be contemplated but would require a reassessment of risk.

In the short-term, the selected remedy allows for placement of mine wastes from other cleanup locations in the Watershed at the Site. This will reduce the cost to implement other cleanups (by eliminating the need to haul wastes to a landfill) and aid in the overall cleanup of the watershed. Only select locations in the impoundment (generally low spots that require fill) will be used for this purpose.

### *Ground Water and Surface Water Use*

The selected remedy restricts ground water use only within the impoundment. This shallow ground water is very low in volume and of poor quality and will not be considered a potential drinking water source. Deeper ground water below and around the impoundment that may be considered a future drinking water source is not affected.

All surface water from the Site discharges to Silver Creek and is expected to be acceptable for all designated uses of the creek. No drinking water uses are expected.

### *Final Cleanup Levels and Residual Risk*

Several media are affected at the Site, but the nature of the Site and the remedy mean that most cleanup decisions were based upon physical characteristics of the Site rather than media-specific concentrations of COCs:

- In surface water, discharges from the south diversion ditch are expected to be consistently below the appropriate water quality standards for protection of aquatic wildlife. For zinc, the most critical metal, this value is dependent upon water hardness, but is generally between 0.1 and 0.8 ppm. Water discharging from the Site is expected to continue to be of be5er quality than Silver Creek, and will create a net improvement in water quality downstream. Surface water conditions in the wetland are contingent upon upstream remediation activities and are impossible to predict at this time. No human health risk is associated with surface water from the Site.

- In sediments, all contaminated sediments are expected to be addressed. AR sediments in the diversion ditch will be covered with clean fill. All sediments in the wetland will be excavated and replaced with clean fill as necessary. Again, this is based upon the physical dimensions of these features, rather than on concentrations within the media. To ensure that all contaminated sediments are removed in the wetland, a remediation goal of 310 ppm lead was established. Soils will be over-excavated, and sampling will be conducted to ensure no sediments remain with concentrations of greater than 310 ppm lead. This is expected to bring all HI’s for aquatic wildlife below one. It is impossible to predict eventual sediment concentrations as the system comes to equilibrium over time, but they are expected to be of equal quality or of improved quality than sediments in Silver Creek and protective of aquatic wildlife.

- In soils, all contamination (e.g. the entire impoundment and a few small areas outside of the impoundment) will be covered with at least eighteen inches of clean soil (12 inches of low permeability soil plus 6 inches of topsoil), so there should be no appreciable residual human health risk due to incidental exposure if the soil cover is maintained. As an additional measure, soils will be sampled and no soils with concentrations greater than 500 ppm lead will be left exposed. Such a level is far below any calculated remediation goals for recreational uses. Some risks will be associated with potential disturbance of buried tailings, but these are considered minimal and manageable with ICs.

- In ground water, only water within the impoundment is affected. This water is not expected to be used as a drinking water source, but IC's will prevent any exposure.

### *Socioeconomic Impacts*

- No significant socioeconomic impacts are expected.

# SECTION 13

# STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions to the extent practicable: In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

## 13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy ensures both short-term and long-term protection of human health and the environment in several ways:

### *Protection of Human Health*

- The baseline human health risk assessment, as discussed in Section 7 of this ROD, shows that the Site, under current and reasonably anticipated future uses, presents no unacceptable risks to human health.

- Remedial actions wilt ensure that these conditions are not significantly altered in the future. The existing soil cover will be enhanced to ensure that the mine tailings do not migrate and that future exposure to mine tailings does not occur. The impoundment wall will be buttressed to ensure that no catastrophic failure occurs. Institutional controls will be established to ensure that only recreational uses are allowed, that ground water within the impoundment is not extracted, and that the sail cover remains intact.

- Implementation of the remedy is simple and straightforward, and engineering controls will be implemented to ensure that workers are protected.

### *Protection of the Environment*

- The RI showed that surface water discharged from the Site currently meets the appropriate Utah Water Quality Standards for all metals. The Site is only a minor contributor to metal loading in Silver Creek. Remedial actions will ensure that metals discharged from the Site will be further reduced, helping to further enhance water quality in Silver Creek. Area 8 tailings, which apparently influence water quality in the diversion ditch, will be excavated and placed inside the impoundment. The impoundment will be graded to further reduce infiltration into tailings.

- The BERA, as discussed in Section 7 of this ROD, showed that contaminated sediments in the wetland and diversion ditch present unacceptable risks to aquatic receptors and wildlife. In the diversion ditch, the sediments will be covered with clean fill material, breaking the exposure pathway. In the wetland, which is a natural and critical habitat, the contaminated sediments in the entire wetland will be removed and the wet)and restored. These actions are expected to reduce risks to acceptable levels.
- Future land uses, all recreational in nature, are expected to largely preserve the habitat value the Site provides.
- Engineering controls will be established to ensure no cross-media contamination during implementation. Remedial actions will ensure no future migration of contamination, either within or between media. The existing Site conditions and enhanced soil cover will isolate and contain the tailings. The buttress on the impoundment will ensure no catastrophic failures and release occur. A well-ban will ensure no cross contamination of aquifers or discharge of contaminated water.

## 13.2 COMPLIANCE WITH APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy is compliant with all ARARs associated with the Site. Site ARARs are summarized in Table 10-1. The Action Specific hazardous waste ARAR's are not applicable to Bevill-exempt waste. The majority of the mine waste at Richardson, and any mine waste that is transported from other Park City mining areas to the Site most likely is or will be Bevill-exempt. Therefore, the action specific hazardous waste ARAR's apply to any waste associated with the site that is not Bevill-exempt.

## 13.3 COST EFFECTIVENESS

The NCP mandates that the selected remedy be cost-effective. It does not mandate that the most cost-effective alternative be selected, only that the alternative that is selected meets a few basic criteria for cost-effectiveness. The nature of the Site (high volume of waste, low toxicity waste, limited number of suitable cleanup technologies) makes this determination somewhat simple. The five alternatives evaluated can be broken down into three basic categories:

- No Action (Alternative 1)
- Containment-Based (Alternatives 2 and 3)
- Treatment-Based (Alternatives 4 and 5)

Alternatives 1 and 2 did not meet minimum standards for protectiveness, and hence cannot be considered cost effective. Alternatives 4 and 5, while adding increased protectiveness and satisfying the statutory preference for treatment, increase the costs relative to Alternative 3 up to two orders of magnitude – hundreds of millions of dollars. The relatively small increase in protectiveness for such a large cost increase is not warranted. Alternative 3 is somewhat more expensive than Alternative 2, but addresses all Site risks. lt is simple to implement and the basic technology is consistently used for tailings pile closures. The overall effectiveness of Alternative

3 is clearly proportional to its overall effectiveness. Tables l3-1, 13-2, 13-3 and l3-4 summarize the costs of each alternative besides alternative 1, the No Action Alternative.

## 13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT FOR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE (MEP)

The selected remedy represents the best balance of trade-offs among the alternatives evaluated. Because the waste at the Site is comprised of naturally occurring inorganic minerals and metals, it is impossible to completely rid it of toxicity through treatment. It cannot be burned or significantly altered. Because of this, some degree of containment must be contemplated for the materials whether they are treated or not – either on-site or off site containment. All of the alternatives, with the exception of the No Action alternative, include containment components, and are thus not fundamentally different in this regard. Alternatives 4 and 5, while they may be considered slightly more “permanent” than Alternative 3 because of the reduction in toxicity and use of a managed, off-site landfill, are far more costly to implement, Clearly, on-site containment is the most permanent solution that is practicable.

No resource recovery technologies are applicable for the Site. The tailings have already been processed for metal recovery during initial mining, and current economic conditions do not warrant further metal recovery at the very high cost such actions would require.

## 13.5 PREFERENCE FOR TREATMENT AS A PRINCIPLE ELEMENT

As stated in Section 11, there are no principle threat wastes present at the Site. The waste is high volume, low toxicity. As such, there is no waste that is particularly critical to treat. The waste can be treated, but the exceedingly high cost with relatively low reduction in toxicity is not warranted. Because of this, treatment is not a principle element of the selected remedy.

## 13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because the selected remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure the remedy is, or will be, protective of human health and the environment. Such reviews will continue every five years indefinitely to ensure the remedy remains protective over time.

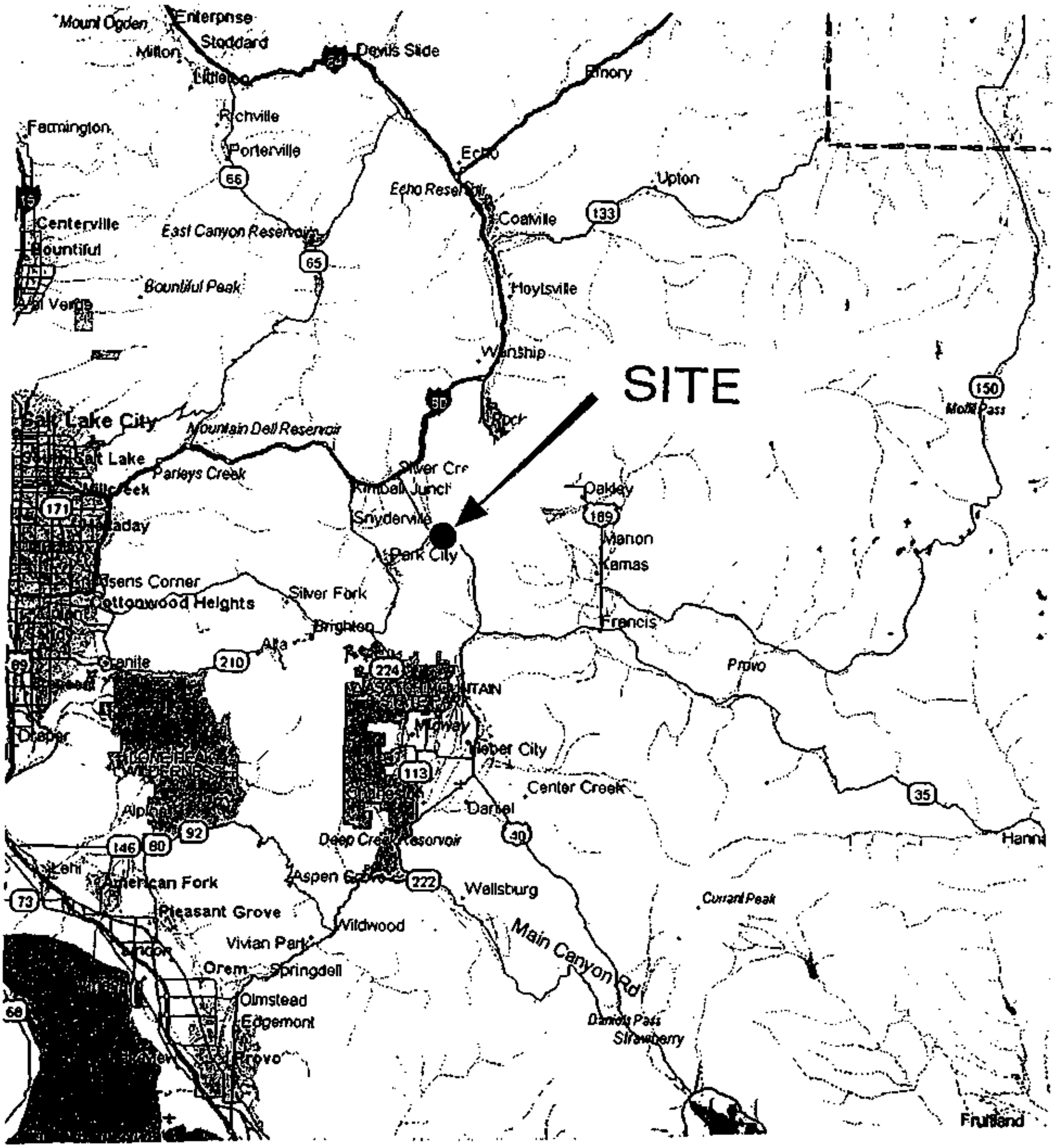
# SECTION 14

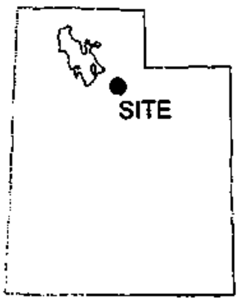
# DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan was released for public comment in September of 2004. It identified as the preferred alternative the same alternative as the selected remedy identified in this ROD. This remedy includes removing small potions of tailings in Area B and disposing of them within the impoundment, installing a wedge buttress to support the main embankment, removal of sediments within the wetland area and finally capping the main impoundment. The preferred alternative did not change between the issuance of the proposed plan and the ROD.

# APPENDIX A

# FIGURES FOR THE RECORD OF DECISION




NOT TO SCALE

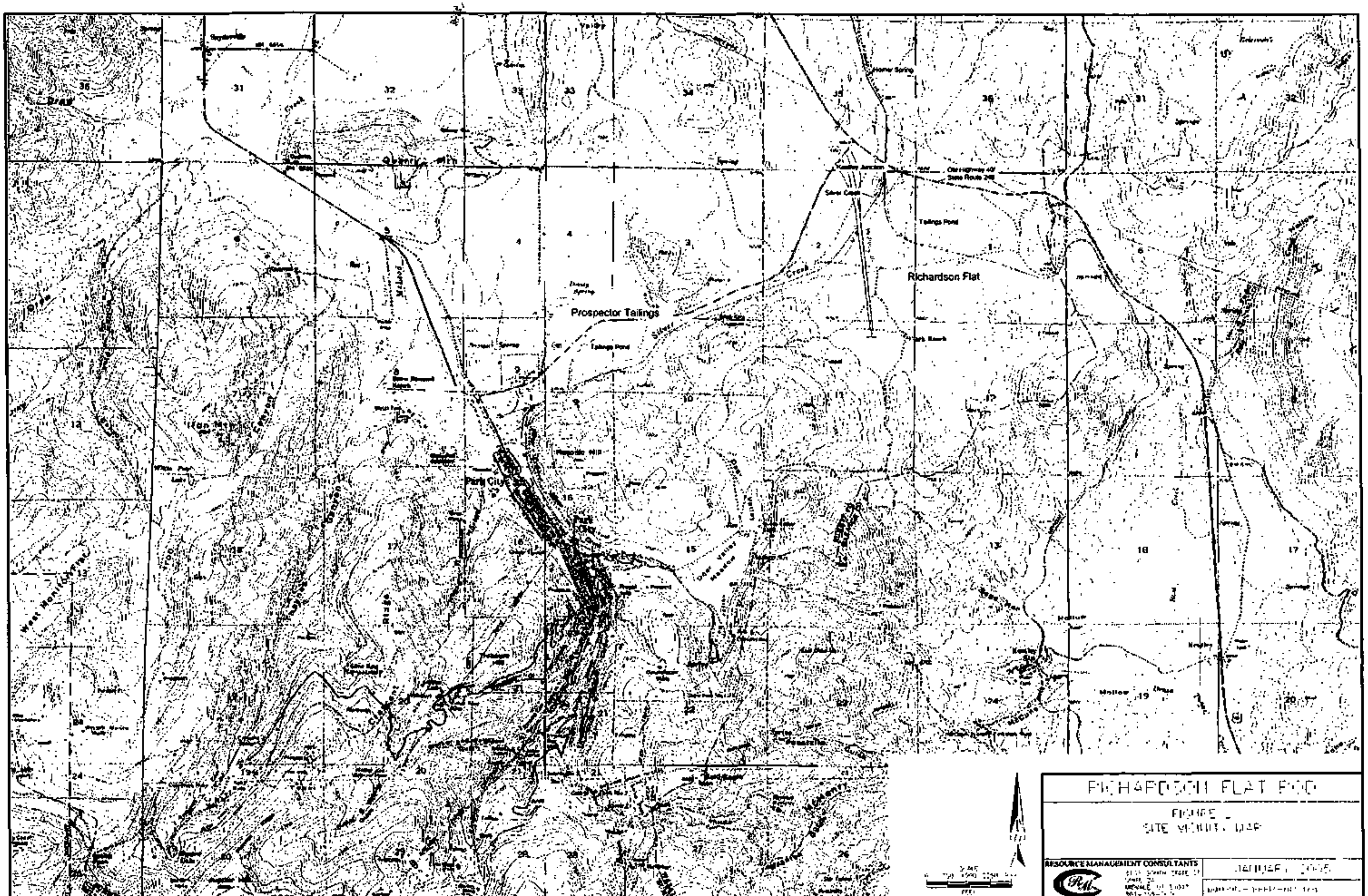
# RICHARDSON FLAT RI

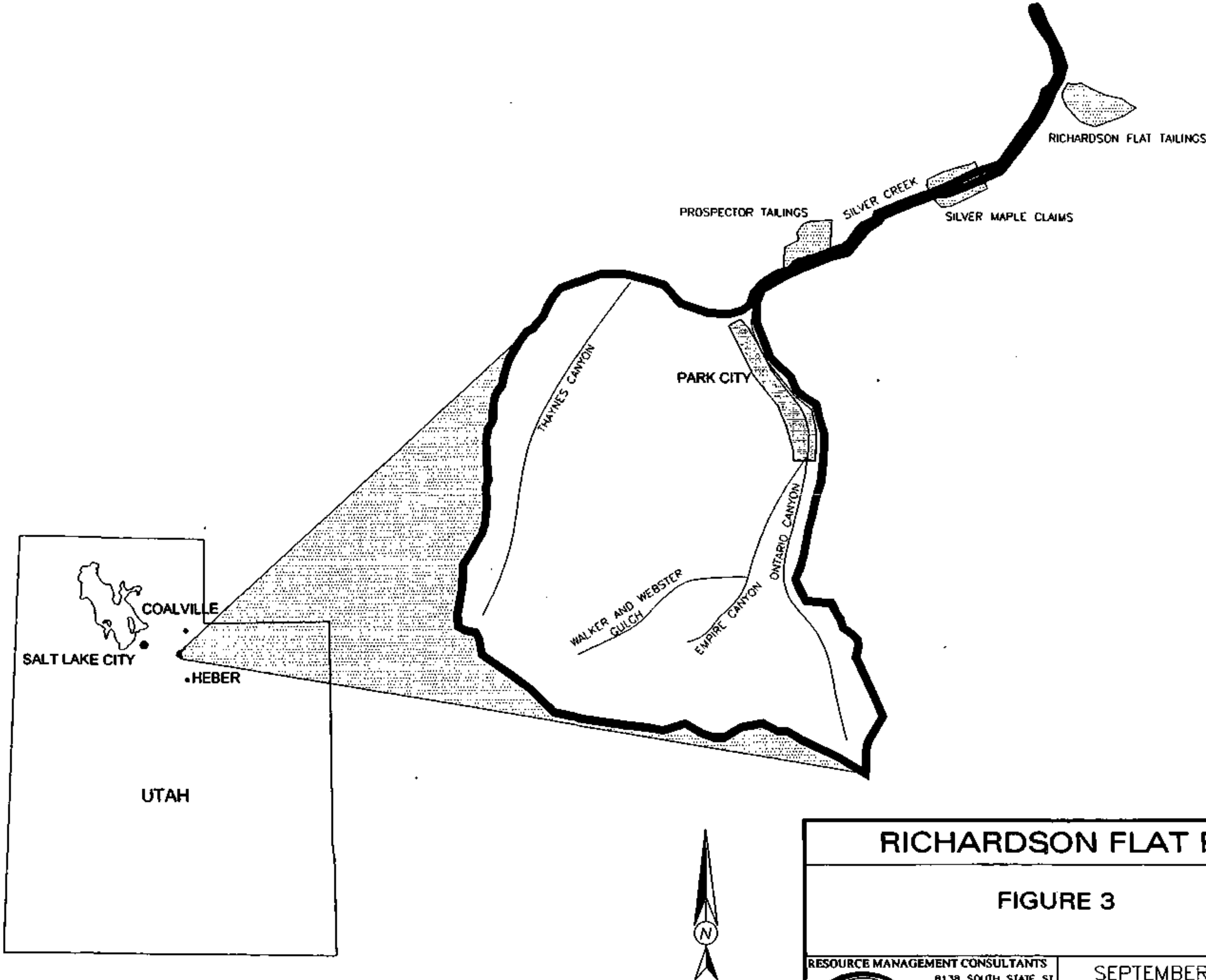
FIGURE 1
SITE LOCATION MAP

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

SEPTEMBER 2004

ri-site-location-map-dwg


Richardson Flat
Prospector Tailings
Tailings Pond
Park City
Old Highway 40
State Route 248
RESOURCE MANAGEMENT CONSULTANTS



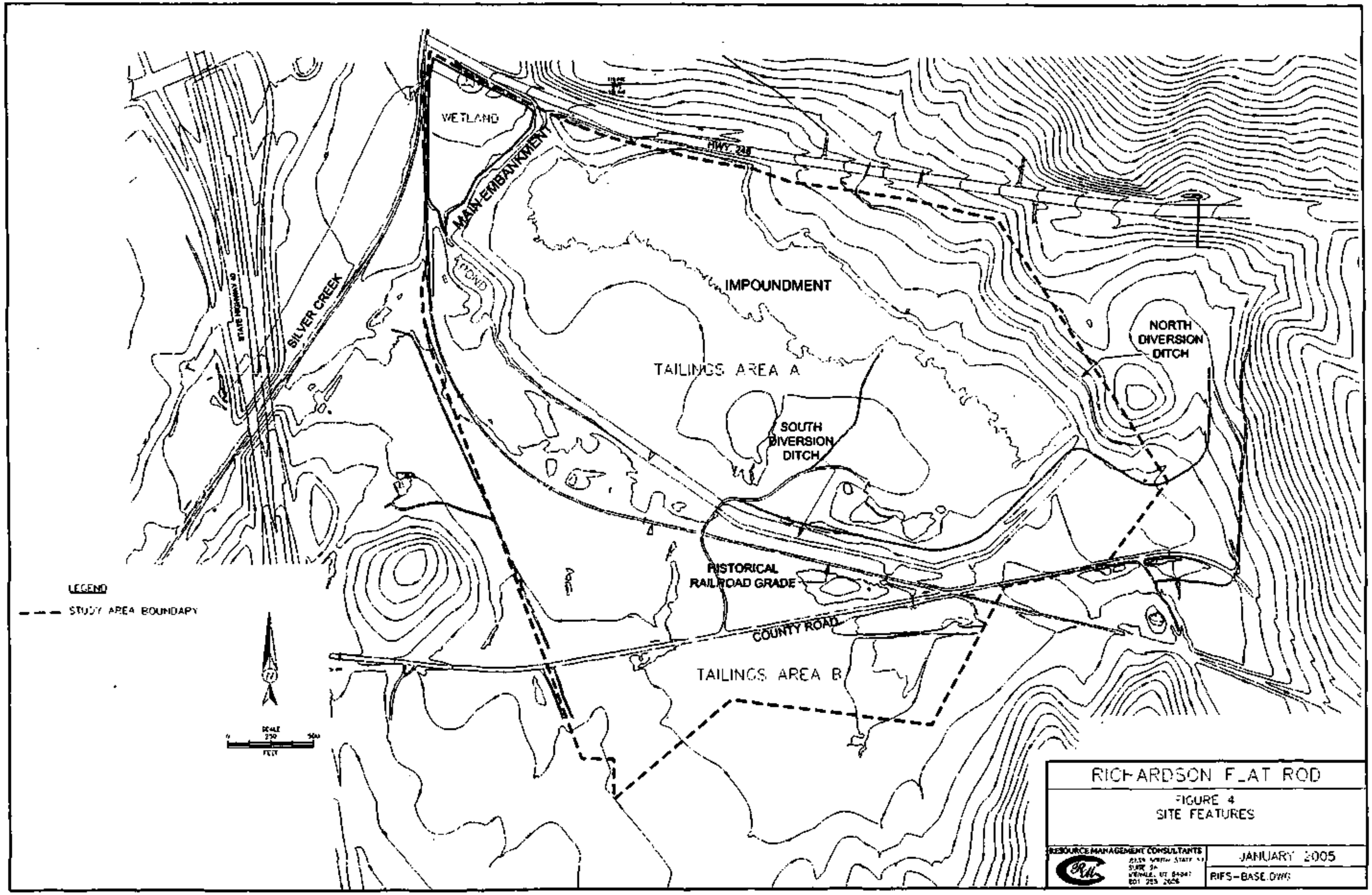

RICHARDSON FLAT RI

FIGURE 3

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

SEPTEMBER 2004

UTAH.DWG


WETLAND
HWY. 248
MAIN EMBANKMENT
POND
IMPOUNDMENT
SILVER CREEK
NORTH DIVERSION DITCH
TAILINGS AREA A
SOUTH DIVERSION DITCH
HISTORICAL RAILROAD GRADE
COUNTY ROAD
TAILINGS AREA B
LEGEND
STUDY AREA BOUNDARY
RICHARDSON FLAT ROD
FIGURE 4
SITE FEATURES
RESOURCE MANAGEMENT CONSULTANTS
JANUARY 2005
RIFS-BASE.DWG

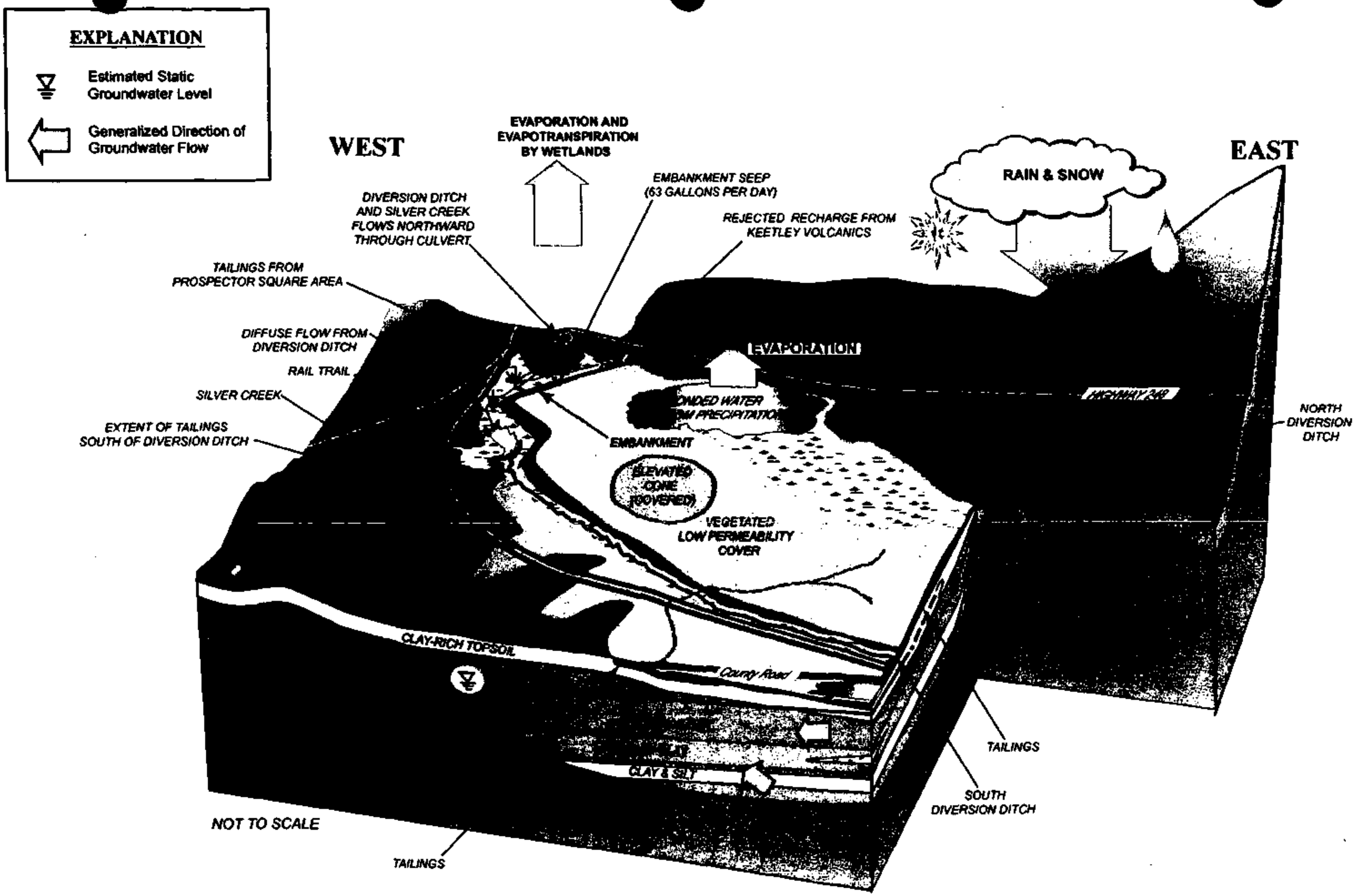
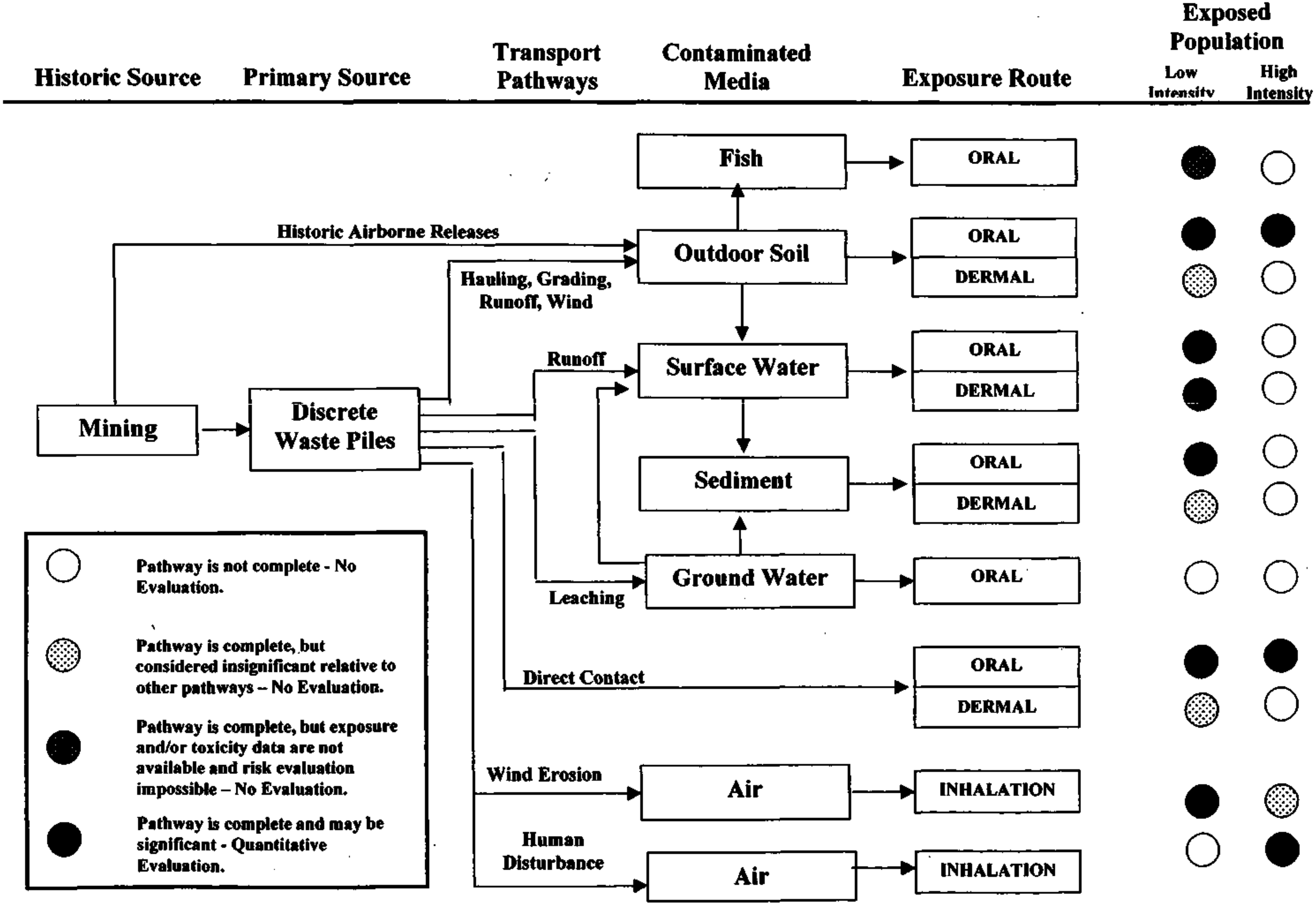


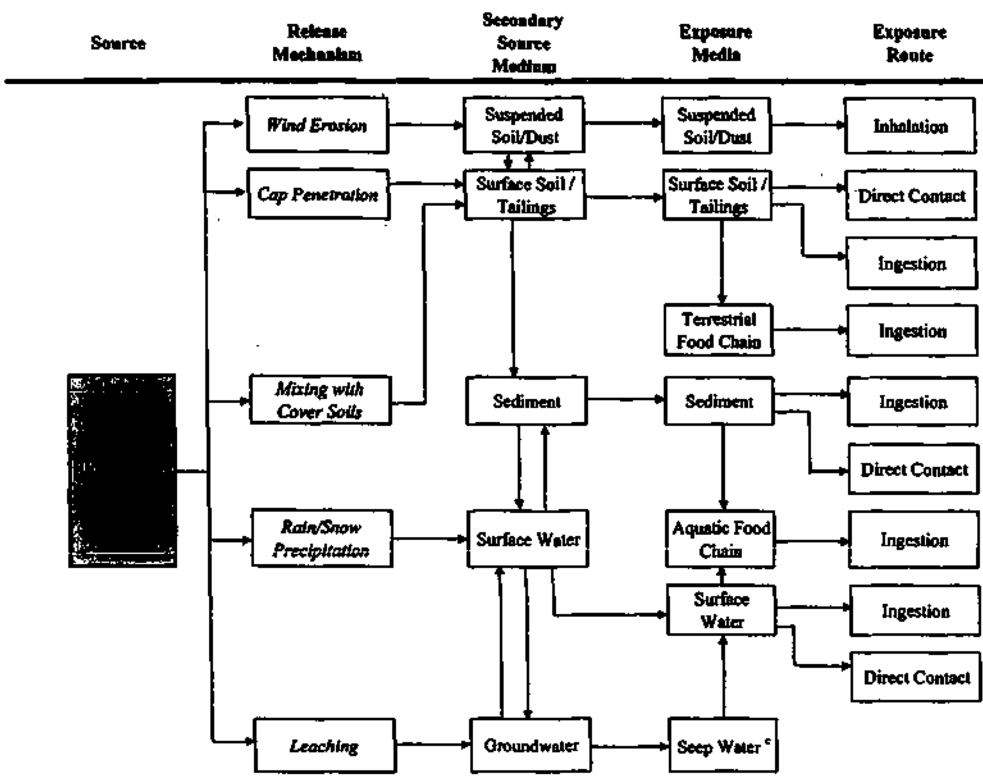

FIGURE 5

**UNITED PARK CITY MINES COMPANY**
**CONCEPTUAL SITE MODEL**
**RICHARDSON FLAT**

**Figure 6: Conceptual Site Model for Recreational Exposure to COPCs**



# Fig 7
## Richardson Flat Ecological Site Conceptual Model




| Exposure Media | Exposure Route | Aquatic Receptors | Amphibians, Reptiles | Birds, Mammals | Plants & Soil Inverts |
|---|---|---|---|---|---|
| | | **Ecological Receptors** | | | |
| Suspended Soil/Dust | Inhalation | | X | X | |
| Surface Soil / Tailings | Direct Contact | | O | X | ●[a] |
| Surface Soil / Tailings | Ingestion | | O | ●[a] | |
| Terrestrial Food Chain | Ingestion | | O | ●[a] | |
| Sediment | Ingestion | X | O | ● | |
| Sediment | Direct Contact | ● | O | X | |
| Aquatic Food Chain | Ingestion | X | O | ●[b] | |
| Surface Water | Ingestion | X | O | X[d] | |
| Surface Water | Direct Contact | ● | ● | X | |

**LEGEND:**

| | |
|---|---|
| (blank) | Pathway not complete - no evaluation |
| X | Pathway complete, but considered insignificant relative to other pathways of concern |
| O | Pathway complete, but exposure/toxicity data are not available and quantitative risk characterization is not possible |
| ● | Pathway complete and exposure/toxicity data are adequate for quantitative risk characterization |

**Footnotes:**

a Terrestrial exposures for plants & soil invertebrates and wildlife will not be evaluated further in the Baseline ERA based on the expectation that additional remedial activities will address potential exposure pathways.

b Measured aquatic food item concentrations (fish, benthic invertebrates/snails, aquatic plants) are available.

c Water seeping from the toe of the main embankment may influence the wetlands area.
Measured surface water and sediment data from the wetlands area will be used to assess potential impacts from seep water in the wetlands.

d Risks to wildlife from ingestion of surface water are expected to be minor based on results provided in the SLERA.
However, because new surface water data are available, this pathway will be included in the quantitative risk characterization.

# APPENDIX B

# TABLES FOR THE RECORD OF DECISION

## Table 7-1
## Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

**Scenario Timeframe:** Current
**Medium:** Sediment
**Exposure Medium:** Sediment

| Exposure Point | Chemical of Concern | Concentration Detected | | Units | Frequency of Detection | Exposure Point Concentration | Exposure Point Concentration Units | Statistical Measure |
|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | |
| Sediment: Ingestion | Arsenic | 101 | 310 | mg/kg | 12/12 | 200 | mg/kg | 95% UCL |
| | Lead | 1,880 | 6,520 | mg/kg | 12/12 | 3,500 | mg/kg | AM |

**Key:**

mg/kg: milligrams per kilogram
95% UCL: 95% Upper Confidence Limit of Arithmetic Mean
MAX: Maximum Concentration
AM: Arithmetic Mean

## Table 7-2
## Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

**Scenario Time frame:** Current
**Medium:** Surface Water
**Exposure Medium:** Surface Water

| Exposure Point | Chemical of Concern | Concentration Detected | | Units | Frequency of Detection | Exposure Point Concentration | Exposure Point Concentration Units | Statistical Measure |
|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | |
| Surface Water - Ingestion/ dermal exposure | Arsenic | 0.025 | 0.75 | mg/L | 99/291 | 0.012 | mg/L | 95% UCL |
| | Lead | 260 | 0.0015 | mg/L | 211/425 | 0.13 | mg/L | AM |

**Key**

mg/L: milligrams per liter
95% UCL: 95% Upper Confidence Limit
MAX: Maximum Concentration

## Table 7-3
## Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

**Scenario Time frame:** Current
**Medium:** Soil & Tailings
**Exposure Medium:** *Soil & Tailings*

| Exposure Point | Chemical of Concern | Concentration Detected | | Units | Frequency of Detection | Exposure Point Concentration | Exposure Point Concentration Units | Statistical Measure |
|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | | |
| Soil& Tailings: Ingestion | Arsenic | 2.5 | 2400 | mg/kg | 59/64 | 55 | mg/kg | 95% UCL |
| | Lead | 14 | 5900 | mg/kg | 62/62 | 660 | mg/kg | AM |

**Key**

mg/kg: milligrams per kilogram
95% UCL: 95% Upper Confidence Limit
AM: Arithmetic Mean

## Table 7-4
## Cancer Toxicity Data Summary

**Pathway:** Ingestion

| Chemical of Concern | Oral Cancer *Slope* Factor | Slope Factor *Units* | Weight of Evidence/Cancer *Guideline Description* | Source | Date |
|---|---|---|---|---|---|
| Arsenic | 1.5 | (mg/kg)/day | A | Region 3 RBC Table | 8/28/2001 |
| Lead | NA | NA | NA | NA | NA |

**KEY**

**EPA Group:**
A- Human carcinogen
B1 -Probable human carcinogen - Indicates that limited human data are available
B2 -Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans
C -Possible human carcinogen
D -Not classifiable as a human carcinogen
E -Evidence of noncarcinogenicity

RBC- Risk Based Concentration
NA: Not Applicable

## Table 7-5
## Non-Cancer Toxicity Data Summary

Pathway: Ingestion

| Chemical of Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Dermal RfD | Primary Target Organ | Combined Uncertainty/ Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ |
|---|---|---|---|---|---|---|---|---|
| Arsenic | Chronic | 3.0E-04 | mg/kg-day | — | skin | — | Region 3 RBC Table | 8/28/01 |
| Lead[a] | — | — | — | — | — | — | — | — |

**Key**

(1) The dermal RfD was assumed to equal the oral RfD. No adjustment factor was applied

(2) Toxicity values were pulled from the EPA Region 3 RBC Table

a There are no established criteria for lead; evaluation is made using blood lead levels

## Table 7-6
## Risk Characterization Summary – Carcinogens

**Scenario Timeframe:** Future
**Receptor Population:** Low Intensity Recreational User
**Receptor Age:** Child-Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Carcinogenic Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil/Tailings | Soil/Tailings | Ingestion | Arsenic | 2E-05 | --- | NE | 2E-05 |
| | Dust | Inhalation | Arsenic | --- | 3.5E-10 | NE | 3.5E-10 |
| | | | | | | **Soil risk total=** | **2E-05** |
| Sediment | Sediment | Ingestion | Arsenic | 3E-06 | --- | NE | 3E-06 |
| | | | | | | **Sediment Risk Total=** | **3E-06** |
| Surface Water | Surface Water | Ingestion | Arsenic | 1.8E-07 | NA | --- | 2.0E-07 |
| | | Surface Water Direct Contact | Arsenic | --- | NA | 3E-08 | 3.0E-08 |
| | | | | | | **Surface Water Risk Total** | **4E-07** |
| | | | | | | **Total Risk =** | **2E-05** |

**Key**
NA: Route of exposure is not applicable to this medium.
NE: Not evaluated

## Table 7-7
## Risk Characterization Summary – Carcinogens

**Scenario Timeframe:** Future
**Receptor Population:** High Intensity Recreational User
**Receptor Age:** Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Carcinogenic Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil/Tailings | Soil/Tailings | Soil On-site-Direct Contact | Arsenic | 1.1E-05 | -- | NE | 1.1E-05 |
| | Dust | Soil on-site inhalation of soil as dust | Arsenic | -- | 6.1E-07 | NE | 6.1E-07 |
| | | | | | | **Total Risk =** | **1.1E-05** |

**Key**
NE: Not Evaluated

## Table 7-8
## Risk Characterization Summary - Non-Carcinogens

**Scenario Timeframe:** Future
**Receptor Population:** Low Intensity Recreational User
**Receptor Age:** Child-Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Primary Target Organ | Non-Carcinogenic Hazard Quotient | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil/ Tailings | Soil/ tailings | Ingestion | Arsenic | Liver | 8.0E-02 | N/A | --- | 8.0E-02 |
| | Dust | Inhalation | Arsenic | Liver | --- | 1.0E-07 | --- | 1.0E-07 |
| | | | | | | | **Soil/tailings Hazard Index Total =** | **8.0E-02** |
| Sediment | Sediment | Ingestion | Arsenic | Liver | — | — | — | 1.0E-02 |
| | | | | | | | **Sediment Hazard Index Total** | **1.0E-02** |
| Surface Water | Surface Water | Ingestion | Arsenic | Liver | 9.0E-04 | N/A | ---- | 9.0E-04 |
| | | Dermal contact | Arsenic | Liver | ---- | N/A | 2.0E-04 | 2.0E-04 |
| | | | | | | | **Surface Water Hazard Index Total =** | **1.1E-03** |
| | | | | | | | **Total Risk=** | **9.0E-02** |

**Key**

— : Toxicity criteria are not available to quantitatively address this route of exposure.
N/A: Route of exposure is not applicable to this medium.

## Table 7-9
## Risk Characterization Summary –Non-carcinogens

**Scenario Timeframe:** Future
**Receptor Population:** High Intensity Recreational User
**Receptor Age:** Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Carcinogenic Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil/Tailings | Soil/Tailings | Ingestion | Arsenic | 6.0E-02 | -- | NE | 6.0E-02 |
| | Dust | Inhalation | Arsenic | -- | 3.0E-04 | NE | 3.0E-04 |
| | | | | | | Total Risk = | 6.0E-02 |

**Key**
N/A: Route of exposure is not applicable to this medium.

## Table 7-10
## Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

**Exposure Medium:** Surface Water, Dissolved (Aquatic Receptors)

| Chemical of Potential Concern | Min Conc.[1] (ug/L) | Max Conc.[1] (ug/L) | Mean Conc. (ug/L) | 95 % UCL of the Mean [2] (ug/L) | Bkg Conc. (ug/L) | Screening Toxicity Value (ug/L) | Screening Toxicity Value Source [3] | HQ Value [4] | COC Flag (Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| Cadmium | 1.0 | 46.3 | 4.3 | 5.2 | N/A | 0.22 [5] | NAWQC Chronic | 210 | Y |
| Zinc | 10 | 83,000 | 1,143 | 1,749 | N/A | 103 [5] | NAWQC Chronic | 806 | Y |

**Key**
Conc. = Concentration
N/A = Not Applicable

**Notes**
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] NAWQC Chronic = USEPA National Ambient Water Quality Criteria for chronic exposures.
[4] Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.
[5] Chronic NAWQC value is hardness-dependent; calculated based on the lowest measured hardness in site surface water samples (85 mg/L).

## Table 7-11
## Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

**Exposure Medium:** Bulk Sediment (Benthic Invertebrates)

| Chemical of Potential Concern | Min Conc.[1] (mg/kg) | Max Conc.[1] (mg/kg) | Mean Conc. (mg/kg) | 95 % UCL of the Mean (mg/kg) | Bkg Conc. (mg/kg) | Screening Toxicity Value (mg/kg) | Screening Toxicity Value Source [3] | HQ Value [4] | COC Flag (Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| Cadmium | 0.78 | 179 | 47.2 | 96.7 | N/A | 0.99 | TEC | 181 | Y |
| Copper | 20 | 2,559 | 440 | 681 | N/A | 32 | TEC | 80 | Y |
| Mercury | 0.05 | 6.2 | 1.5 | 2.9 | N/A | 0.18 | TEC | 34 | Y |
| Nickel | 9.0 | 97 | 25 | 29 | N/A | 23 | TEC | 4.2 | N |
| Zinc | 118 | 44,560 | 9,538 | 19,302 | N/A | 121 | TEC | 368 | Y |

**Key**
Conc. = Concentration
N/A = Not Applicable

**Notes**
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] TEC = Consensus-based Threshold Effect Concentration (MacDonald et al., 2000)
[4] Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.

## Table 7-12
## Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

**Exposure Medium:** Sediment Porewater, Dissolved (Benthic organisms)

| Chemical of Potential Concern | Min Conc.[1] (ug/L) | Max Conc.[1] (ug/L) | Mean Conc. (ug/L) | 95 % UCL of the Mean [2] (ug/L) | Bkg Conc. (ug/L) | Screening Toxicity Value (ug/L) | Screening Toxicity Value Source [3] | HQ Value [4] | COC Flag (Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 11 | 720 | 254 | 720 [5] | N/A | 150 | NAWQC Chronic | 4.8 | Y |
| Zinc | 230 | 2,700 | 1,310 | 2,700 [5] | N/A | 342 | NAWQC Chronic | 7.9 | Y |

**Key**
Conc. = Concentration
N/A = Not Applicable

**Notes**
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] NAWQC Chronic = USEPA National Ambient Water Quality Criteria for chronic exposures.
[4] Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.
[5] 95UCL on the mean is greater than the maximum, maximum value is shown.
[6] *Chronic NAWQC value is hardness-dependent; calculated based on the lowest measured hardness in site sediment porewater samples (351 mg/L).*

## Table 7-13
## Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

***Exposure Medium:*** *Sediment (Waterfowl)*

| Chemical of Potential Concern | Min Conc.[1] (ppm) | Max Conc.[1] (ppm) | Mean Conc. (ppm) | 95 % UCL of the Mean [2] (ppm) | Bkg Conc. (ppm) | Screening Toxicity Value (mg/kg/d) | Screening Toxicity Value Source [3] | HQ Value [4] | COC Flag (Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| Lead | 641 | 42,990 | 6,407 | 9,641 | N/A | 1.63 | EcoSSL Avian TRV | 93 [5] | Y |

**Key**
Conc. = Concentration
N/A = Not Applicable

**Notes**
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] Selected Ecological Soil Screening Level (EcoSSL) Toxicity Reference Value (TRV) for birds.
[4] Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.
[5] Ingested Dose from sediment (mg/kg/d) calculated from maximum sediment concentration using exposure factors for the mallard duck.

## Table 7-14
## Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

**Exposure Medium:** Soil/Tailings (Plants, Soil Invertebrates)

| Chemical of Potential Concern | Min Conc.[1] (ppm) | Max Conc.[1] (ppm) | Mean Conc. (ppm) | 95 % UCL of the Mean [2] (ppm) | Mean Bkg Conc. (ppm) | Screening Toxicity Value (ppm) | Screening Toxicity Value Source [3] | HQ Value [4] | COC Flag (Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 813 | 32,700 | 10,662 | 18,066 | N/A | 50 | Plant SSL | 654 | Y |
| Lead | 13 | 31,600 | 1,666 | 3,206 | 42 | 50 | Plant SSL | 632 | Y |
| Mercury | 0.11 | 85 | 5 | 7.3 | 0.08 | 0.1 | Invert. SSL | 850 | Y |
| Zinc | 47 | 33,800 | 4,085 | 15,255 | 104 | 50 | Plant SSL | 676 | Y |

**Key**
Conc. = Concentration
N/A = Not Applicable

**Notes**
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] Soil Screening Level (SSL), lowest of plant SSL or soil invertebrate SSL.
[4] *Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.*

**Table 7-15**
**Ecological Exposure Pathways of Concern**

| Exposure Medium | Sensitive Environment Flag (Y or N) | Receptor | Endangered/ Threatened Species Flag (Y or N) | Exposure Routes | Assessment Endpoints | Measurement Endpoints |
|---|---|---|---|---|---|---|
| Sediment/Sediment porewater | N | Benthic organisms | N | Ingestion and direct contact with chemicals in sediment | Protection of aquatic invertebrates and fish from adverse effects related to exposure to chemicals in surface water and sediment | · Comparison of sampling location-specific chemical concentrations in sediment to benthic macroinvertebrate toxicity benchmarks.<br>· Comparison of sampling location-specific chemical concentrations in sediment porewater to benthic macroinvertebrate toxicity benchmarks.<br>· Evaluate the toxicity of site sediment to *Hyalella azteca* (growth and survival) through laboratory testing. |
| Surface Water | N | Fish | N | Ingestion and direct contact with chemicals in surface water | | · Comparison of sampling location specific chemical concentrations in surface water to National Ambient Water Quality Criteria. |
| Soil/Tailings | N | soil invertebrates | N | Ingestion and direct contact with chemicals in wetland soils | Survival of terrestrial invertebrate community | · Comparison of sampling location specific chemical concentrations in soil to terrestrial toxicity benchmarks |
| | | Terrestrial plants | N | Uptake of chemicals via root systems | Maintenance/enhancement of native site vegetation | |
| Dietary Intake | N | Wildlife (birds and mammals) | N | ingestion of food chain items | Protection of wildlife from adverse effects to growth, reproduction, or survival related to exposure to chemicals in surface water, sediment, and aquatic food items. | · Comparison of reach-specific chemical doses estimated from exposure point concentrations (EPCs) in surface water, sediment, and aquatic food items to toxicity reference values (TRVs) for wildlife. |

## Table 7-16
## Summary of Uncertainties

| Assessment Component | Description | Likely Direction of Error | Likely Magnitude of Error |
|---|---|---|---|
| Nature and Extent of Contamination | Samples collected may not be fully representative of variability in space or time, especially if the number of samples is small. | Unknown | Probably small |
| | Analytical results may be imprecise. | Unknown | Probably small |
| Exposure Assessment | Some exposure pathways were not evaluated. | Underestimate of risk | Probably small |
| | Some chemicals were not evaluated because chemical was never detected, but detection limit was too high to detect the chemical if it were present at a level of concern. | Underestimate of risk | Usually small |
| | Exposure parameters for wildlife receptors are based on studies at other sites. | Unknown | Probably small |
| | Exposure point concentrations for wildlife receptors are based on a conservative estimate of the mean concentration in the exposure area. | Overestimate of risks | Possibly significant |
| | Absorption from site media is assumed to be the same as in laboratory studies. | Overestimate of risks | Possibly significant |
| Toxicity Assessment | Many chemicals lack reliable toxicity benchmarks for some receptors for some media; these chemicals are not evaluated. | Underestimation of risk | Probably small in most cases |
| | Available toxicity benchmarks are often based on limited data, and values must be extrapolated across species. | Unknown | Unknown, could be significant |
| | Wildlife receptors selected as representative species may not capture the full range of sensitivities in site receptors. | Unknown | Probably small |
| | Aquatic toxicity benchmarks are based on a wide range of species, some of which do not occur at this site. | Likely to overestimate risk | Probably small |
| Risk Characterization | Interactions between chemicals are difficult to account for; effects of one chemical may increase, decrease, or have no effect on other chemicals. | Unknown | Unknown, but probably small |
| | Estimation of population-level effects from HQ calculations is difficult and subject to professional judgement. | Unknown | Unknown, probably small in most cases |

**Table 10-1**
**Summary and Comparative Analysis of Final Alternatives**

| Criteria | Alternative 1<br>No Action | Alternative 2<br>Soil Cover/Institutional Controls and Wedge Buttress | Alternative 3 Soil Cover/Source Removal and Wedge Buttress | Alternative 4 Excavation, treatment and Offsite Disposal | Alternative 5 Excavation, Treatment and Onsite Disposal |
|---|---|---|---|---|---|
| **OVERALL PROTECTIVENESS** | | | | | |
| Human Health- Direct contact and inhalation. | Based on results of BHHRA human health exposures at the Site are within acceptable limits. | The cover reduces direct contact, inhalation and ingestion of contaminated soil and meets human health requirements. | The cover reduces direct contact, inhalation and ingestion of contaminated soil and meets human health requirements. Potential for contact reduced by a reduction in extent of tailings. Some protection to total environment by partial source removal. | Removal, treatment and offsite disposal of contaminated material reduces and eliminates the risk of direct contact, inhalation and ingestion of contaminated soil and meets human health requirements | Removal, treatment and onsite disposal of contaminated material reduces and potentially eliminates the risk of direct contact, inhalation and ingestion of contaminated soil and meets human health requirements |
| Environmental Protection | Site exposures remain. There is likely to be some attenuation over time in water. | The soil cover reduces some ecological risk and will help to reduce surface water infiltration into the contaminated material and hence will improve groundwater quality. The source material stays in place | The soil cover reduces some ecological risk and will help to reduce surface water infiltration into the contaminated material. Most material will be located in the geometrically confined impoundment. Removal of groundwater and surfacewater contamination source areas will improve water quality. | Site contamination is removed and the environmental quality of Site is improved. | Site contamination is treated and the environmental quality of Site is improved. |
| **COMPLIANCE WITH ARARS** | | | | | |
| Chemical-specific ARAR | Not satisfied | Environmental protection is met, however all contamination remains onsite. | Air quality protection is met, however all contamination remains onsite but is located in a centralized location in a closed impoundment. Surface water and groundwater quality is improved. | Air quality protection is met and all contamination is removed from the Site. Surface water and groundwater standards are met. | Air quality protection is met and contamination is treated onsite. Surface water and groundwater standards are met. |
| Location-specific ARAR | Not satisfied | Location-specific ARARs are met | Location-specific ARARs are met | Location-specific ARARs are met | Location-specific ARARs are met |
| Action-specific ARAR | Not applicable | Federal and State regulations will be met during remedial activities | Federal and State regulations will be met during remedial activities | Federal and State regulations will be met during remedial activities | Federal and State regulations will be met during remedial activities |
| Other criteria/guidance | Would allow contact, however human health risks are within acceptable limits. | protects against inhalation/direct contact. | Same as Alternative 2. | Same as Alternative 2. | Same as Alternative 2. |
| **LONG-TERM EFFECTIVENESS AND PERMANENCE** | | | | | |
| Magnitude of residual risk | Source not removed. Existing risk will remain. | Source not removed. Existing risk will be reduced by the soil cover. | Source is partially removed. Existing risk will remain but will be reduced as most materials will be placed in centralized location in a confined impoundment and covered. Surface water and groundwater quality is improved. | Contaminated materials are removed from the Site. No residual risk. | Contaminated materials are treated and left onsite. Magnitude of residual risk is significantly reduced. No residual risk |
| Adequacy and reliability of controls | No controls over remaining contamination. No reliability. | Soil cover integrity will be maintained by institutional controls and monitoring. Reliability will be maximized through cover design and enforcement of institutional controls. | Soil cover integrity will be maintained by institutional controls and monitoring. Reliability will be maximized through design and enforcement of institutional controls as well as placement of tailings in geometrically confined impoundment. | None required, contaminated material will be removed from Site. | Site and treated materials will be monitored to insure that Site is not affecting human health and the environment. |
| **REDUCTION OF TOXICITY, MOBILITY OR VOLUME** | | | | | |
| Treatment process used | None used | None used | None used | Stabilization/fixation | Stabilization/fixation |
| Amount destroyed or treated | None | None | None | 2,847,087 cubic yards | 2,847,087 cubic yards |
| Reduction of toxicity, mobility or volume treatment | None | Mobility is reduced by soil cover. | Mobility is reduced by moving most contaminated materials into the geometrically confined impoundment with a soil cover. Remaining materials will be covered. | Mobility is reduced by treatment and disposal in a regulated facility. Increase in volume with a decrease in toxicity. | Mobility is reduced by treatment. Increase in volume with a decrease in toxicity. |
| Statutory preference for treatment | Does not satisfy | Does not satisfy | Does not satisfy | Satisfied | Satisfied |
| **SHORT TERM EFFECTIVENESS** | | | | | |
| Community protection | Risk not increased by remedy implementation. | Risk not increased by remedy implementation | Risk not increased if action specific ARARs are met during remediation. | Risk not increased if action specific ARARs are met during remediation. Transportation may increase community risks due to increase in truck traffic. | Risk not increased if action specific ARARs are met during remediation. |
| Worker protection | No risk to workers | Risk is minimal since contaminated material is not being handled. | Workers will be handling contaminated material during onsite transport, contact with contaminated fugitive dust is possible during excavation and disposal | Workers will be handling contaminated material during onsite transport and treatment, contact with contaminated fugitive dust is possible during excavation and disposal | Workers will be handling contaminated material during onsite transport and treatment, contact with contaminated fugitive dust is possible during excavation and disposal |
| Environmental impacts | Continued impact from existing conditions | Dust generated during remedial activities. | Dust generated during remedial activities. | Dust generated during remedial activities. Potential effects from ditch excavation. | Dust generated during remedial activities. Potential effects from ditch excavation. |
| Time until action is complete | N/A | One to two construction seasons. | One to two construction seasons. | One to two construction seasons. | One to two construction seasons. |
| **IMPLEMENTABILITY** | | | | | |
| Ability to construct and operate | No construction or operation required. | Standard excavation and transportation technologies are easily implemented. Standard institutional controls easily implemented. Cover soil is stockpiled onsite and available locally. | Standard excavation and transportation technologies are easily implemented. Remedial contractors are locally available. Cover soil is stockpiled onsite and available locally. | Standard excavation and transportation technologies are easily implemented. Remedial contractors are locally available. Cover soil is stockpiled onsite and available locally. Bench-scale testing will need be conducted. Treatment contractors and disposal facilities are available. | Standard excavation and transportation technologies are easily implemented. Remedial contractors are locally available. Cover soil is stockpiled onsite and available locally. Bench-scale testing will need be conducted. Treatment contractors and disposal facilities are available. |
| Ease of additional remediation, if needed | Easy, as no remediation has been done in this alternative. | Would impact original remedy. | Would impact original remedy. | Would impact original remedy. | Would impact original remedy. |
| Ability to monitor effectiveness | No monitoring required. | Periodic monitoring required. | Periodic monitoring required. | Periodic monitoring required until verification that site is not affecting human or environmental health. | Periodic monitoring required until verification that site is not affecting human or environmental health. |
| Ability to obtain approval from other agencies | Very difficult to obtain "no action" from agencies. | Difficult to obtain approval since ground water source contamination is left in place. High level of coordination with state and federal agencies will be required for long-term monitoring and compliance. | Less difficult than Alternative 2 since ground water source contamination is removed. Moderate level of coordination with state and federal agencies will be required for long-term monitoring and compliance. | Less difficult than Alternatives 2 and 3 since contamination is removed. Moderate level of coordination with state and federal agencies will be required for short-term monitoring and compliance. Agency coordination will be required for disposal. | More difficult than Alternatives 3 and 4 since contamination remains onsite. Moderate level of coordination with state and federal agencies will be required for short-term monitoring and compliance. Agency coordination will be required for disposal and site closure. |
| Availability of services and capacities | No services or capacities required. | No disposal required. All services available. | No disposal required. All services available. | Disposal types and capacities need to be determined, but should be available. Large scale transportation logistics will be required. | Final volumes need to be determined, but buildup of impoundment height should provide sufficient volume capacity. |
| Availability of technology | None required | Required technology available. | Required technology available. | Specialized treatment technology is required but available. | Specialized treatment technology is required but available. |
| **COST** | | | | | |
| Direct Capital Cost | $0 | $1,849,281.00 | $3,509,476.50 | $289,561,330 | $121,902,705.25 |
| Indirect Costs (includes O&M) | $0 | $444,116.99 | $753,253 | $53,672,828 | $22,806,000 |
| Total Cost | $0 | $2,293,397.99 | $4,262,729.65 | $343,234,037.85 | $144,708,705.72 |

Notes
A - Will be evaluated during the CERCLA required Public Comment period
ARAR - Applicable or Relevant and Appropriate Requirements
O&M - Operations, maintenance and monitoring

Table 10-2

Ranking of Final Alternatives

| Criteria | Ranking Weight (1) | Alternative 1 No Action | | Alternative 2 Soil Cover/ Institutional Controls | | Alternative 3 Source Removal, Soil Cover and Wedge Buttress | | Alternative 4 Excavation, Treatment and Offsite Disposal | | Alternative 5 Excavation, Treatment and Onsite Disposal | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OVERALL PROTECTIVENESS | | Rank (2) | Weight Factored Rank (3) | Rank (2) | Weight Factored Rank (3) | Rank (2) | Weight Factored Rank (3) | Rank (2) | Weight Factored Rank (3) | Rank (2) | Weight Factored Rank (3) |
| Human Health | 10 | 1 | 10 | 4 | 40 | 4 | 40 | 5 | 50 | 5 | 50 |
| Environmental protection | 10 | 1 | 10 | 2 | 20 | 4 | 40 | 5 | 50 | 5 | 50 |
| COMPLIANCE WITH ARARS | | | | | | | | | | | |
| Chemical-specific ARAR | 8 | 1 | 8 | 2 | 16 | 3 | 24 | 5 | 40 | 5 | 40 |
| Location-specific ARAR | 5 | 1 | 5 | 2 | 10 | 4 | 20 | 5 | 25 | 4 | 20 |
| Action-specific ARAR | 5 | 1 | 5 | 3 | 15 | 4 | 20 | 5 | 25 | 4 | 20 |
| Other criteria/guidance | 5 | 1 | 5 | 2 | 10 | 2 | 10 | 5 | 25 | 4 | 20 |
| LONG-TERM EFFECTIVENESS AND PERMANENCE | | | | | | | | | | | |
| Magnitude of residual risk | 9 | 1 | 9 | 3 | 27 | 4 | 36 | 5 | 45 | 5 | 45 |
| Adequacy and reliability of controls | 8 | 1 | 8 | 3 | 24 | 4 | 32 | 5 | 40 | 5 | 40 |
| REDUCTION OF TOXICITY, MOBILITY OR VOLUME | | | | | | | | | | | |
| Treatment process used | 5 | 1 | 5 | 1 | 5 | 1 | 5 | 5 | 25 | 5 | 25 |
| Amount destroyed or treated | 5 | 1 | 5 | 1 | 5 | 1 | 5 | 4 | 20 | 4 | 20 |
| Reduction of toxicity, mobility or volume treatment | 7 | 1 | 7 | 2 | 14 | 3 | 21 | 5 | 35 | 4 | 28 |
| Statutory preference for treatment | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 5 | 50 | 5 | 50 |
| SHORT TERM EFFECTIVENESS | | | | | | | | | | | |
| Community protection | 5 | 1 | 5 | 4 | 20 | 4 | 20 | 1 | 5 | 2 | 10 |
| Worker protection | 4 | 1 | 4 | 4 | 16 | 4 | 16 | 1 | 4 | 2 | 8 |
| Environmental impacts | 5 | 1 | 5 | 2 | 10 | 4 | 20 | 1 | 5 | 2 | 10 |
| Time until action is complete | 2 | 1 | 2 | 4 | 8 | 3 | 6 | 1 | 2 | 2 | 4 |
| IMPLEMENTABILITY | | | | | | | | | | | |
| Ability to construct and operate | 9 | 5 | 45 | 4 | 36 | 4 | 36 | 1 | 9 | 2 | 18 |
| Ease of additional remediation, if needed | 5 | 4 | 20 | 3 | 15 | 4 | 20 | 5 | 25 | 1 | 5 |
| Ability to monitor effectiveness | 6 | 5 | 30 | 3 | 18 | 5 | 30 | 5 | 30 | 4 | 24 |
| Ability to obtain approval from other agencies | 5 | 1 | 5 | 2 | 10 | 4 | 20 | 5 | 25 | 4 | 20 |
| Availability of services and capacities | 3 | 4 | 12 | 3 | 9 | 4 | 12 | 5 | 15 | 2 | 6 |
| Availability of equipment, specialists and materials | 3 | 4 | 12 | 5 | 15 | 4 | 12 | 5 | 15 | 2 | 6 |
| Availability of technology | 3 | 4 | 12 | 5 | 15 | 4 | 12 | 5 | 15 | 2 | 6 |
| RANKING TOTALS | | 43 | 239 | 65 | 368 | 79 | 467 | 94 | 580 | 80 | 525 |
| COST | | | | | | | | | | | |
| Present worth cost | | $0.00 | | $2,295,397.99 | | $4,262,729.65 | | $343,234,057.85 | | $144,708,705.72 | |

(1) - Each criteria has been ranked on an overall project importance weight of 1-10 with 1 signifying the least importance and 10 signifying the greatest importance.

(2) - The compliance of each criteria has been ranked on an alternative by alternative basis on a scale of 1-5 with 1 signifying the least compliance and 5 signifying the greatest compliance.

(3) - Ranking weight multiplied by the compliance rank for each alternative.

**Table 10-3**
**Chemical Specific ARARs**

| Requirement | Citation | Description | Determination | Comment |
|---|---|---|---|---|
| Definitions and General Requirements of Utah Water Quality Act | UAC R317-1 | Provides definitions and general requirements for waste discharges to waters of the State of Utah | Applicable | Substantive standards are applicable to point source discharges of contaminants into Silver Creek (if any), but permitting requirements would be preempted by operation of 42 USC 9621(e)(1). |
| Utah Surface Water Quality Standards | UAC R317-2-6<br>UAC R317-2-13<br>UAC R317-2-14 | Establishes use designations for Silver Creek (as tributary to the Weber River):<br>Class 1C - Protected for domestic purposes with prior treatment processes as required by Utah Div. of Drinking Water.<br>Class 2B - Protected for secondary contact recreation such as boating, wading.<br>Class 3A - Protected for cold water species of game fish and aquatic life.<br>Class 4 - Protected for agricultural uses and stock watering | Applicable | Substantive standards are applicable to point source discharges of contaminants into Silver Creek (if any), but permitting requirements would be preempted by operation of 42 USC 9621(e)(1). |
| Groundwater Quality | UAC R317-6 | Establishes state groundwater quality standards | Applicable | Substantive standards are applicable to discharges of contaminants to ground water discharges (if any), but permitting requirements would be preempted by 42 USC 9621(e)(1). |
| Solid and Hazardous Waste | UAC R315-2-4(b)(7) | Criteria for the Identification and Listing of Hazardous Waste | Applicable | Mine tailings are not a solid waste and a hazardous waste if they do not cause a public health hazard or are otherwise determined to be a hazardous waste. |
| Solid and Hazardous Waste | UAC R311-211-3 | Corrective Action Cleanup Standards Policy -UST and CERCLA sites | Applicable | RPM will establish appropriate cleanup standards based on the factors set forth in R311-211-3. |
| Utah Storm Water Rules | UAC R317-8-3.9 | Establishes state storm water requirements | Applicable | Requires implementation of best management practices to address storm water management at the Site. |

**Table 10-3 (continued)**
**Location Specific ARARs**

| Requirement | Citation | Description | Determination | Comment |
|---|---|---|---|---|
| Protection of Wetlands | 33 USC § 1344 | Prohibits discharge of dredged or fill materials into waters of the United States. | Relevant and Appropriate | Although 404 permit is not required, the remedy should seek to avoid, restore, or mitigate impacts to jurisdictional wetlands as appropriate. |
| Historic Sites, Building and Antiquities Act | 16 USC §§ 461-467 | Requires protection of landmarks listed on National Registry | Applicable | Proposed activities will not adversely affect any listed landmark |
| National Historic Preservation | 16 USC § 470 | Requires protection of district, site, building, structure or object eligible for inclusion in national register of historic places | Applicable | Proposed activities will not adversely affect any such district, site, building, structure or object |
| Archeological and Historic Preservation Act | 16 USC § 469 | Requires preservation of significant historical and archeological data | Applicable | Proposed activities will not adversely affect archeological data or landmarks |
| Fish and Wildlife Coordination Act | 16 USC § 662 | Requires that actions taken in areas that may affect streams and rivers be undertaken in a manner that protects fish and wildlife | Applicable | USFWS has been consulted with regard to actions impacting Silver Creek |
| Endangered Species Act | 16 USC § 1531 | Requires protection of endangered and threatened species | Applicable | USFWS has been consulted with regard to protection of endangered and threatened species. |
| Migratory Bird Treaty Act | 16 USC § 703 *et seq* | Requires protection of migratory nongame birds | Applicable | USFWS has been consulted with regard to protection of migratory nongame birds. |
| RCRA Subtitle D Solid Waste Requirements | UAC R315-303-3(4) | Establishes closure requirements for permitted solid waste landfills. | Relevant/Appropriate | Relevant and appropriate to onsite repository under Alternatives 3 and 5, to the extent technically practicable. |
| Air Quality | UAC R307-205-6 | Emission Standards | Applicable | Requires management practices to limit fugitive emissions from tailings piles. |

**Table 10-3 (continued)**
**Action Specific ARARs**

| Requirement | Citation | Description | Determination | Comment |
|---|---|---|---|---|
| | | | | |
| Abandoned wells | UAC R655-4 | Standards for drilling and abandonment of wells. | Applicable | Applicable to the drilling or closing of wells that are abandoned or installed as part of the remedy. |
| Utah Storm Water Rules | UAC R317-8-3.9 | Establishes state storm water requirements | Applicable | Requires implementation of best management practices to address storm water management at the Site. |
| Criteria for Classification of Solid Waste and Disposal Facilities and Practices | 40 CFR Part 257.3 | Establishes Criteria for use in determining which solid waste facilities and practices could adversely affect human health and the environment | Applicable | |
| Standards Applicable to Generators of Hazardous Waste | 40 CFR Part 262 | Establishes Standards for Generators of Hazardous Waste | Applicable | Applicable to any waste that is not Bevill-exempt. |
| General Facilities Standards | UAC R315-8-2 | Location Standards | Applicable | Applicable to any waste that is not Bevill-exempt. |
| Closure and Post Closure | UAC R315-8-6 | Closure Plan/Performance Standards | Applicable | Applicable to any waste that is not Bevill-exempt. |

**Table 10-3 (continued)**
**Action Specific ARARs**

| | | | | |
|---|---|---|---|---|
| Waste Piles | UAC R315-8-12 | Waste piles performance standards | Applicable | Applicable to any waste that is not Bevill-exempt. |
| Landfills | UAC R315-8-14 | Performance standards for landfills | Applicable | Applicable to any waste that is not Bevill-exempt. |
| Risk Based Closure Standards | UAC R315-101 | Establishes risk-based closure and corrective action standards | Applicable | Applicable to any waste that is not Bevill-exempt. |
| Corrective Action Cleanup Standards Policy | UAC R311-211 | Lists general criteria in Establishing clean up standards | Applicable | |
| OSHA | 29 USC § 651 | Regulates workers health and safety | Applicable | |
| Utah Ground Water Quality Protection Rules | UAC R317-6 | Contaminants that remain on site must not present a leaching threat to ground water | Applicable | |
| Standards Applicable to Hazardous Waste Transporters | 40 CFR Part 263 | Regulates Transportation of Hazardous Waste | Applicable | Relevant and appropriate to any waste that is not Bevill-exempt. |

Table12-1
Cost Alternative 3
Source Removal/ Soil Cover and Wedge Buttress

| Direct Capital Costs | Quantity | Unit | Cost | Total Cost |
|---|---|---|---|---|
| **Diversion Ditch** | | | | |
| Place 1' gravel cover | 956 | cyd | $12.00 | $11,472.00 |
| Signs | 20 | sign | $50.00 | $1,000.00 |
| | | **Subtotal** | | **$12,472.00** |
| **Tailings South of Diversion Ditch** | | | | |
| Site preparation (clearing, grubbing .) | 50 | ac | $1,000.00 | $50,000.00 |
| Excavate and haul to impoundment (partial source removal) | 178,266 | cy | $5.75 | $1,025,029.50 |
| Place soil cover (bring up to 12", haul, spread, compact) | 27,492 | cy | $4.80 | $131,961.60 |
| Place topsoil (.5') excavated and covered areas | 40,062 | cy | $4.80 | $192,297.60 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Reconstruct tributary channel | 1,481 | cy | $7.50 | $11,107.50 |
| Grading (stormwater runoff control) | 24 | hrs | $140.00 | $3,360.00 |
| Revegetation | 50 | ac | $500.00 | $25,000.00 |
| | | **Subtotal** | | **$1,453,456.20** |
| **Wetland** | | | | |
| Place fill for trackhoe access | 3,040 | cy | $4.80 | $14,592.00 |
| Excavate and haul to impoundment | 13,440 | cy | $5.75 | $77,280.00 |
| Restoration | 10,400 | cy | $10.00 | $104,000.00 |
| Silver Creek diversion | 500 | cy | $7.50 | $3,750.00 |
| Revegetation | 7 | ac | $500.00 | $3,250.00 |
| | | **Subtotal** | | **$202,872.00** |
| **Impoundment** | | | | |
| Site preparation (clearing, grubbing..) | 115 | ac | $1,000.00 | $115,000.00 |
| Place tailings from TSDD and Wetland (grade and compact) | 191,742 | cy | $1.50 | $287,613.00 |
| Place soil cover (bring up to 12", haul, spread, compact) | 136,853 | cy | $4.80 | $656,894.40 |
| Construct drainage channel (to SDD) | 1,556 | cy | $7.50 | $11,670.00 |
| Place topsoil (.5') | 79,218 | cy | $4.80 | $380,246.40 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Grading (stormwater runoff control) | 80 | hrs | $140.00 | $11,200.00 |
| revegetation | 115 | ac | $500.00 | $57,500.00 |
| | | **Subtotal** | | **$1,534,823.80** |
| **Embankment (wedge buttress)** | | | | |
| Site preparation (clearing, grubbing..) | 0.75 | ac | $1,000.00 | $750.00 |
| Place drain material | 1,210 | cy | $8.00 | $9,680.00 |
| Place buttress material (includes compaction of lifts) | 7,200 | cy | $6.00 | $43,200.00 |
| Dust control | 6 | days | $735.00 | $4,410.00 |
| Erosion protection (stormwater runoff control) | 300 | cy | $7.50 | $2,250.00 |
| Revegetation | 0.75 | ac | $750.00 | $562.50 |
| | | **Subtotal** | | **$60,852.50** |
| **Long-Term Operation and Maintenance Costs** | | | | |
| O&M | 15 | yr | $4,000.00 | $60,000.00 |
| Annual Sampling | 15 | yr | $2,000.00 | $30,000.00 |
| Reporting | 15 | yr | $5,000.00 | $75,000.00 |
| Develop Institutional Controls | 1 | | $5,000.00 | $5,000.00 |
| Institutional Controls Monitoring and Repair (fencing, signs) | 15 | yr | $5,000.00 | $75,000.00 |
| | | **Subtotal** | | **$245,000.00** |
| | | | **Total Direct Costs** | **$3,509,476.50** |
| **Indirect Capital Costs** | | | | |
| Engineering Design and Project Administration | | | | $50,000.00 |
| Monitoring Plan | | | | $4,000.00 |
| Construction Oversight (2.5 % of Direct Capital Cost) | | | | $87,736 91 |
| Contingency (15 % of Direct Capital Cost) | | | | $526,421.48 |
| Health and Safety (1 % of Capital Costs) | | | | $35,094.77 |
| EPA Oversight | | | | $50,000 00 |
| | | **Subtotal** | | **$753,253.15** |
| | | | **Total Indirect Costs** | **$753,253.15** |
| | **TOTAL COSTS** | | | **$4,262,729.65** |

**Table 12-2**
**Present Worth Cost**
**Alternative 3**

| Year | Capitol Costs | Annual O&M Costs | Periodic Costs | Total Costs | Discount Factor at 7% | Total Present Value Cost at 7% |
|---|---|---|---|---|---|---|
| 0 | 803,546.00 | | 5,000.00 | 808,546.00 | 1.00 | 808,546.00 |
| 1 | 803,546.00 | 16,000.00 | | 819,546.00 | 0.94 | 766,275.51 |
| 2 | 803,546.00 | 16,000.00 | | 819,546.00 | 0.87 | 715,463.66 |
| 3 | 803,546.00 | 16,000.00 | | 819,546.00 | 0.82 | 668,749.54 |
| 4 | 803,546.00 | 16,000.00 | | 819,546.00 | 0.76 | 625,313.60 |
| 5 | | 16,000.00 | | 16,000.00 | 0.71 | 11,408.00 |
| 6 | | 16,000.00 | | 16,000.00 | 0.67 | 10,656.00 |
| 7 | | 16,000.00 | | 16,000.00 | 0.62 | 9,968.00 |
| 8 | | 16,000.00 | | 16,000.00 | 0.58 | 9,312.00 |
| 9 | | 16,000.00 | | 16,000.00 | 0.54 | 8,704.00 |
| 10 | | 16,000.00 | | 16,000.00 | 0.51 | 8,128.00 |
| 11 | | 16,000.00 | | 16,000.00 | 0.48 | 7,600.00 |
| 12 | | 16,000.00 | | 16,000.00 | 0.44 | 7,104.00 |
| 13 | | 16,000.00 | | 16,000.00 | 0.42 | 6,640.00 |
| 14 | | 16,000.00 | | 16,000.00 | 0.39 | 6,208.00 |
| 15 | | 16,000.00 | | 16,000.00 | 0.36 | 5,792.00 |
| | | | | | | |
| Total | 4,017,730.00 | 240,000.00 | 5,000.00 | 4,262,730.00 | | 3,675,868.30 |

assumes spreading the capitol costs over 5 years
15 years of O&M

Table 13-1
Cost Alternative 2
Soil Cover/Insitutional Controls

| Direct Capital Costs | Quantity | Unit | Cost | Total Cost |
|---|---|---|---|---|
| **Diversion Ditch** | | | | |
| Place 1' gravel cover | 956 | cyd | $12.00 | $11,472.00 |
| Signs | 20 | sign | $50.00 | $1,000.00 |
| | | Subtotal | | $12,472.00 |
| **Tailings South of Diversion Ditch** | | | | |
| Site preparation (clearing, grubbing..) | 50 | ac | $1,000.00 | $50,000.00 |
| Place soil cover (bring up to 12") | 40,062 | cy | $5.75 | $230,356.50 |
| Place topsoil (.5') | 40,062 | cy | $4.80 | $192,297.60 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Reconstruct tributary channel | 1,481 | cy | $7.50 | $11,107.50 |
| revegetation | 50 | ac | $500.00 | $25,000.00 |
| | | Subtotal | | $523,461.60 |
| **Impoundment** | | | | |
| Site preparation (clearing, grubbing..) | 115 | ac | $1,000.00 | $115,000.00 |
| Place soil cover (bring up to 12") | 79,218 | cy | $5.75 | $455,503.50 |
| Place topsoil (.5') | 79,218 | cy | $4.80 | $380,246.40 |
| Construct drainage channel (to SDD) | 1,667 | cy | $7.50 | $12,502.50 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Grading (stormwater runoff control) | 80 | hrs | $140.00 | $11,200.00 |
| revegetation | 115 | ac | $500.00 | $57,500.00 |
| | | Subtotal | | $1,046,662.40 |
| **Embankment (wedge buttress)** | | | | |
| Site preparation (clearing, grubbing..) | 0.75 | ac | $1,000.00 | $750.00 |
| Place drain material | 1,170 | cy | $8.00 | $9,360.00 |
| Place buttress material (includes compaction of lifts) | 7,200 | cy | $6.00 | $43,200.00 |
| Dust control | 6 | days | $735.00 | $4,410.00 |
| Erosion protection (stormwater runoff control) | 300 | cy | $12.00 | $3,600.00 |
| Revegetation | 0.75 | ac | $500.00 | $375.00 |
| | | Subtotal | | $61,695.00 |
| **Long-Term Operation and Maintenance Costs** | | | | |
| O&M | 15 | yr | $4,000.00 | $60,000.00 |
| Annual Sampling | 15 | yr | $2,000.00 | $30,000.00 |
| Reporting | 15 | yr | $5,000.00 | $75,000.00 |
| Develop Institutional Controls | 1 | | $10,000.00 | $10,000.00 |
| Institutional Controls Monitoring and Repair (fencing, signs) | 15 | yr | $2,000.00 | $30,000.00 |
| | | Subtotal | | $205,000.00 |
| | | | Total Direct Costs | $1,849,281.00 |
| **Indirect Capital Costs** | | | | |
| Engineering Design and Project Administration | | | | $50,000.00 |
| Monitoring Plan | | | | $4,000.00 |
| Construction Oversight (2.5 % of Direct Capital Cost) | | | | $46,232.03 |
| Contingency (15 % of Direct Capital Cost) | | | | $277,392.15 |
| Health and Safety (1 % of Capital Costs) | | | | $18,492.81 |
| EPA Oversight | | | | $50,000.00 |
| | | Subtotal | | $446,116.99 |
| | | | Total Indirect Costs | $446,116.99 |
| TOTAL COSTS | | | | $2,295,397.99 |

Table 13-2
Cost Alternative 4
Excavation, Treatment and Offsite Disposal

| **Direct Capital Costs** | Quantity | Unit | Cost | Total Cost |
|---|---|---|---|---|
| **Diversion Ditch (removal)** | | | | |
| *Remove sediments and tailings haul to treatment* | 232,636 | cy | $6.00 | $1,395,816.00 |
| revegetation | 2 | ac | $500.00 | $1,000.00 |
| | | **Subtotal** | | **$1,396,816.00** |
| ***Tailings South of Diversion Ditch*** | | | | |
| Site preparation (clearing, grubbing..) | 50 | ac | $1,000.00 | $50,000.00 |
| Excavate and haul to treatment/loadout (tails, base and exs. cover) | 394,744 | cy | $5.75 | $2,269,778.00 |
| Place topsoil | 40,062 | cy | $4.80 | $192,297.60 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| *Reconstruct tributary channel* | 1,481 | cy | $7.50 | $11,107.50 |
| Grading (reclamation and stormwater runoff control) | 40 | hrs | $140.00 | $5,600.00 |
| revegetation | 50 | ac | $500.00 | $25,000.00 |
| | | **Subtotal** | | **$2,568,483.10** |
| **Impoundment** | | | | |
| Site preparation (clearing, grubbing..) | 115 | ac | $1,000.00 | $115,000.00 |
| Excavate tailings, base and existing cover, haul to loadout | 2,353,609 | cy | $5.75 | $13,533,251.75 |
| Place topsoil | 93,993 | cy | $4.80 | $451,166.40 |
| *Reconstruct original channel* | 3,911 | cy | $7.50 | $29,332.50 |
| Dust control | 30 | days | $735.00 | $22,050.00 |
| Grading (stormwater runoff control) | 40 | hrs | $140.00 | $5,600.00 |
| revegetation | 115 | ac | $500.00 | $57,500.00 |
| | | **Subtotal** | | **$14,213,900.65** |
| **Embankment** | | | | |
| excavate and haul | 65,290 | cy | $5.75 | $375,417.50 |
| Dust control | 8 | days | $735.00 | $5,880.00 |
| Erosion protection (stormwater runoff control) | 500 | cy | $7.50 | $3,750.00 |
| Revegetation | 2 | ac | $500.00 | $1,000.00 |
| | | **Subtotal** | | **$386,047.50** |
| **Wetland** | | | | |
| Place fill for trackhoe access | 3,040 | cy | $4.80 | $14,592.00 |
| Excavate and haul to treatment/loadout | 13,440 | cy | $5.75 | $77,280.00 |
| Wetland restoration | 10,365 | cy | $10.00 | $103,650.00 |
| Silver Creek diversion | 500 | cy | $7.50 | $3,750.00 |
| | | **Subtotal** | | **$199,272.00** |
| **Stabilization and disposal - ECDC** | | | | |
| Dust control | 30 | days | $735.00 | $22,050.00 |
| Erosion protection (stormwater runoff control) | 1,000 | cy | $7.50 | $7,500.00 |
| Stabilization | 2,980,988 | cy | $30.00 | $89,429,640.00 |
| Load to trucks | 4,471,482 | cy | $1.50 | $6,707,223.00 |
| Haul to landfill (43 ton belly dump trucks) | 4,471,482 | cy | $9.00 | $40,243,338.00 |
| disposal fees | 4,471,482 | cy | $30.00 | $134,144,460.00 |
| Sample analysis | 250 | sample | $150.00 | $37,500.00 |
| | | **Subtotal** | | **$270,591,711.00** |
| **Long-Term Operation and Maintenance Costs** | | | | |
| O&M | 15 | yr | $4,000.00 | $60,000.00 |
| Annual Sampling | 15 | yr | $2,000.00 | $30,000.00 |
| Reporting | 15 | yr | $5,000.00 | $75,000.00 |
| Develop Institutional Controls | 1 | | $10,000.00 | $10,000.00 |
| Institutional Controls Monitoring and Repair | 15 | yr | $2,000.00 | $30,000.00 |
| | | **Subtotal** | | **$205,000.00** |
| | | | **Total Direct Costs** | **$289,561,230.25** |
| **Indirect Capital Costs** | | | | |
| Engineering Design and Project Administration | | | | $50,000.00 |
| Monitoring Plan | | | | $4,000.00 |
| Construction Oversight (2.5 % of Direct Capital Cost) | | | | $7,239,030.76 |
| Contingency (15 % of Direct Capital Cost) | | | | $43,434,184.54 |
| Health and Safety (1 % of Capital Costs) | | | | $2,895,612.30 |
| EPA Oversight | | | | $50,000.00 |
| | | **Subtotal** | | **$53,672,827.60** |
| | | | **Total Indirect Costs** | **$53,672,827.60** |
| | **TOTAL COSTS** | | | **$343,234,057.85** |

Table 13-3
Cost Alternative 5
Onsite Treatment and Disposal

| Direct Capital Costs | Quantity | Unit | Cost | Total Cost | |
|---|---|---|---|---|---|
| **Diversion Ditch** | | | | | |
| Remove sediments and tailings haul to treatment | 232,636 | cy | $6.00 | $1,395,816.00 | |
| revegetation | 2 | ac | $500.00 | $1,000.00 | |
| | | **Subtotal** | | **$1,396,816.00** | |
| **Tailings South of Diversion Ditch** | | | | | |
| Site preparation (clearing, grubbing..) | 50 | ac | $1,000.00 | $50,000.00 | |
| Excavate and haul to treatment (tails and exs. cover) | 394,744 | cy | $5.75 | $2,269,778.00 | |
| Place topsoil | 40,062 | cy | $4.80 | $192,297.60 | |
| Dust control | 20 | days | $735.00 | $14,700.00 | |
| Reconstruct tributary channel | 1,481 | lf | $7.50 | $11,107.50 | |
| Grading (reclamation and stormwater runoff control) | 40 | hrs | $140.00 | $5,600.00 | |
| revegetation | 50 | ac | $500.00 | $25,000.00 | |
| | | **Subtotal** | | **$2,568,483.10** | |
| **Impoundment** | | | | | |
| Site preparation (clearing, grubbing..) | 115 | ac | $1,000.00 | $115,000.00 | |
| Excavate tailings and existing cover, haul to loadout | 2,353,609 | cy | $5.75 | $13,533,251.75 | |
| Place topsoil | 93,993 | cy | $4.80 | $451,166.40 | |
| replace treated materials | 4,471,482 | cy | $1.50 | $6,707,223.00 | |
| construct drainage channel (center to SDD) | 3,911 | cy | $7.50 | $29,332.50 | |
| Dust control | 30 | days | $735.00 | $22,050.00 | |
| Grading (stormwater runoff control) | 40 | hrs | $140.00 | $5,600.00 | |
| revegetation | 115 | ac | $500.00 | $57,500.00 | |
| | | **Subtotal** | | **$20,921,123.65** | |
| **Embankment** | | | | | |
| excavate and haul | 65,290 | cy | $5.75 | $375,417.50 | |
| Dust control | 8 | days | $735.00 | $5,880.00 | |
| Erosion protection (stormwater runoff control) | 500 | cy | $7.50 | $3,750.00 | |
| Revegetation | 2 | ac | $500.00 | $1,000.00 | |
| | | **Subtotal** | | **$386,047.50** | |
| **Wetland** | | | | | |
| Place fill for trackhoe access | 3,040 | cy | $4.80 | $14,592.00 | |
| Excavate and haul to treatment/loadout | 13,440 | cy | $5.75 | $77,280.00 | |
| Wetland restoration | 10,365 | cy | $10.00 | $103,650.00 | |
| Silver Creek diversion | 500 | cy | $7.50 | $3,750.00 | |
| | | **Subtotal** | | **$199,272.00** | |
| **Stabilization and Disposal - Onsite** | | | | | |
| Dust control | 60 | days | $735.00 | $44,100.00 | |
| Erosion protection (stormwater runoff control) | 1,000 | cy | $7.50 | $7,500.00 | |
| Stabilization | 2,980,988 | cy | $30.00 | $89,429,640.00 | |
| Load to trucks, haul to impoundment | 4,471,482 | cy | $1.50 | $6,707,223.00 | |
| Sample analysis | 250 | sample | $150.00 | $37,500.00 | |
| | | **Subtotal** | | **$96,225,963.00** | |
| **Long-Term Operation and Maintenance Costs** | | | | | |
| O&M | 15 | yr | $4,000.00 | $60,000.00 | |
| Annual Sampling | 15 | yr | $2,000.00 | $30,000.00 | |
| Reporting | 15 | yr | $5,000.00 | $75,000.00 | |
| Develop Institutional Controls | 1 | | $10,000.00 | $10,000.00 | |
| Institutional Controls Monitoring and Repair | 15 | yr | $2,000.00 | $30,000.00 | |
| | | **Subtotal** | | **$205,000.00** | |
| | | | **Total Direct Costs** | | **$121,902,705.25** |
| **Indirect Capital Costs** | | | | | |
| Engineering Design and Project Administration | | | | $50,000.00 | |
| Monitoring Plan | | | | $4,000.00 | |
| Construction Oversight (2.5 % of Direct Capital Cost) | | | | $3,047,567.63 | |
| Contingency (15 % of Direct Capital Cost) | | | | $18,285,405.79 | |
| Health and Safety (1 % of Capital Costs) | | | | $1,219,027.05 | |
| EPA Oversight | | | | $200,000.00 | |
| | | **Subtotal** | | **$22,806,000.47** | |
| | | | **Total Indirect Costs** | | **$22,806,000.47** |
| | **TOTAL COSTS** | | | | **$144,708,705.72** |

Table13-4
Cost Alternative 3
Source Removal/ Soil Cover and Wedge Buttress

| Direct Capital Costs | Quantity | Unit | Cost | Total Cost |
|---|---|---|---|---|
| **Diversion Ditch** | | | | |
| Place 1' gravel cover | 956 | cyd | $12.00 | $11,472 00 |
| Signs | 20 | sign | $50.00 | $1,000.00 |
| | | **Subtotal** | | **$12,472.00** |
| **Tailings South of Diversion Ditch** | | | | |
| Site preparation (clearing, grubbing..) | 50 | ac | $1,000.00 | $50,000.00 |
| Excavate and haul to impoundment (partial source removal) | 178,266 | cy | $5.75 | $1,025,029.50 |
| Place soil cover (bring up to 12", haul, spread, compact) | 27,492 | cy | $4 80 | $131,961.60 |
| Place topsoil (.5') excavated and covered areas | 40,062 | cy | $4.80 | $192,297.60 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Reconstruct tributary channel | 1,481 | cy | $7.50 | $11,107 50 |
| Grading (stormwater runoff control) | 24 | hrs | $140.00 | $3,360.00 |
| Revegetation | 50 | ac | $500.00 | $25,000.00 |
| | | **Subtotal** | | **$1,453,456.20** |
| **Wetland** | | | | |
| Place fill for trackhoe access | 3,040 | cy | $4.80 | $14,592.00 |
| Excavate and haul to impoundment | 13,440 | cy | $5.75 | $77,280.00 |
| Restoration | 10,400 | cy | $10.00 | $104,000.00 |
| Silver Creek diversion | 500 | cy | $7.50 | $3,750.00 |
| Revegetation | 7 | ac | $500.00 | $3,250.00 |
| | | **Subtotal** | | **$202,872.00** |
| **Impoundment** | | | | |
| Site preparation (clearing, grubbing..) | 115 | ac | $1,000.00 | $115,000.00 |
| Place tailings from TSDD and Wetland (grade and compact) | 191,742 | cy | $1.50 | $287,613.00 |
| Place soil cover (bring up to 12", haul, spread, compact) | 136,853 | cy | $4 80 | $656,894.40 |
| Construct drainage channel (to SDD) | 1,556 | cy | $7.50 | $11,670.00 |
| Place topsoil (.5') | 79,218 | cy | $4.80 | $380,246.40 |
| Dust control | 20 | days | $735.00 | $14,700.00 |
| Grading (stormwater runoff control) | 80 | hrs | $140.00 | $11,200.00 |
| revegetation | 115 | ac | $500.00 | $57,500.00 |
| | | **Subtotal** | | **$1,534,823.80** |
| **Embankment (wedge buttress)** | | | | |
| Site preparation (clearing, grubbing..) | 0.75 | ac | $1,000.00 | $750.00 |
| Place drain material | 1,210 | cy | $8.00 | $9,680.00 |
| Place buttress material (includes compaction of lifts) | 7,200 | cy | $6.00 | $43,200.00 |
| Dust control | 6 | days | $735.00 | $4,410.00 |
| Erosion protection (stormwater runoff control) | 300 | cy | $7.50 | $2,250.00 |
| Revegetation | 0.75 | ac | $750.00 | $562.50 |
| | | **Subtotal** | | **$60,852.50** |
| **Long-Term Operation and Maintenance Costs** | | | | |
| O&M | 15 | yr | $4,000.00 | $60,000.00 |
| Annual Sampling | 15 | yr | $2,000.00 | $30,000.00 |
| Reporting | 15 | yr | $5,000.00 | $75,000.00 |
| Develop Institutional Controls | 1 | | $5,000.00 | $5,000.00 |
| Institutional Controls Monitoring and Repair (fencing, signs) | 15 | yr | $5,000.00 | $75,000.00 |
| | | **Subtotal** | | **$245,000.00** |

| | |
|---|---|
| **Total Direct Costs** | **$3,509,476.50** |

| Indirect Capital Costs | |
|---|---|
| *Engineering Design and Project Administration* | $50,000.00 |
| Monitoring Plan | $4,000.00 |
| Construction Oversight (2.5 % of Direct Capital Cost) | $87,736.91 |
| Contingency (15 % of Direct Capital Cost) | $526,421.48 |
| Health and Safety (1 % of Capital Costs) | $35,094.77 |
| EPA Oversight | $50,000.00 |
| **Subtotal** | **$753,253.15** |

| | |
|---|---|
| **Total Indirect Costs** | **$753,253.15** |
| **TOTAL COSTS** | **$4,262,729.65** |

# APPENDIX C

# RESPONSIVENESS SUMMARY

## 1.1 Stakeholder Issues and EPA Responses

During the Public Comment Period for the Proposed Plan, comments were received from UPCM, the Marsac Corridor Association and Utah Department of Fish and Wildlife. Their comments and EPA's response to these comments are in the following sections.

### 1.1.2 Comments Received From United Park City Mines

Remedy Selection. United Park supports the remedy selected in the Proposed Plan. Like EPA, United Park believes that Alternative 3 provides more than adequate protection of human health and the environment, will prove to be effective (both in the long and short terms), will be cost-effective, and will otherwise address the remaining environmental conditions necessary to achieve final closure of the Site.

Possible Wetlands Operable Unit. The Proposed Plan states that the timing of remediation as to the small wetland area between the impoundment and Silver Creek will be delayed until upstream remediation and reclamation efforts are complete. United Park's understanding is that the wetland area will be remediated following remediation of several upstream areas, some of which are located on United Park property. In any event, because the timing for the remediation of the wet)and area will not be linked to the remediation process for the remainder of the Site, United Park suggests that EPA consider designating the wetland area as a separate operable unit. EPA has the discretion to designate multiple operable units with respect to the Site. Doing so here makes sense in part because it will facilitate negotiation of the anticipated Consent Decree, enabling EPA and United Park to define construction completion as to each operable unit.

*EPA Response: While EPA understands this is an option that would allow the Site to be archived by OU more quickly, EPA feels strongly that the timing of cleanup throughout the Watershed will work to everyone's advantage. By cleaning up the upstream sites along Silver Creek in a time efficient manner, the Site wetlands can then be excavated according to the plan set forth in this ROD. It is critical to EPA that the entire Silver Creek Watershed be addressed and by further dividing sites by OU or through some other approach, EPA believes this will slow the process down rather that expedite it.*

Site Impacts on Silver Creek. There are a number of statements in the Proposed Plan suggesting that the Site is presently having a significant impact on water quality in Silver Creek. See page A-2 (first paragraph) (linking Site to other sites that are all impacting Silver Creek); page A-3 and A-4 (remediation of Site will play direct role in watershed remediation), United Park finds these statements confusing. The Remedial Investigation ("RI") for the Site determined that surface waters leaving the Site present no significant impact on water quality in Silver Creek. While it is true that surface waters in areas upstream of the south diversion ditch exhibit elevated metal concentrations, the water in the south diversion ditch outfall has consistently met surface water quality standards. The remedial action proposed for the Site is more appropriate)y described at addressing *potential future* impacts the Site may have on Silver Creek. While

United Park recognizes that many of the issues addressing Silver Creek arose generally from historic mining operations, United Park believes it is inappropriate to group the Site with other areas in the Silver Creek Watershed that may have actual present impacts on water quality in Silver Creek.

*EPA Response: EPA recognizes that the data from the Remedial Investigation relating to the Site's impact on Silver Creek support this statement. It was written in the Proposed Plan that historic mining activities throughout the Upper Silver Creek Watershed have adversely affected Silver Creek In Section 12, The Selected Remedy, and in Section 5, Summary of Site Characteristics, it is made clear that water from the Site that enters Silver Creek is of better quality than Silver Creek itself. It is accurate to state that the selected remedy will be protective of human health and the environment in that it will minimize any future exposures or impacts contamination at the Site may present.*

Human and Ecological Risks. United Park believes that the Proposed Plan mischaracterizes the results and findings of the human health and ecological risk assessments relating to the Site. More specifically, the discussion in the Proposed Plan under Human Health Risks (page A-4) states that "if the necessary cleanup action is not taken... there is a risk to future recreational users at the Site because of lead and arsenic present in the tailings." In fact, the Baseline Human Health Risk Assessment ("BHHRA") conducted by EPA concluded no significant risk to recreational users of the Site from the existing soils and mine tailings unless the soil cover is somehow disturbed. With respect to the ecological risk assessment discussion, the Proposed Plan states that the Ecological Risk Assessment ("ERA") determined that ecological receptors are potentially exposed to metals in several ways, as summarized in the chart on page A-4 of the Proposed Plan. It would be more accurate te state that the ERA concluded contaminated sediment in the wetland area is the primary ecological risk driver, although surface water in a portion of the south diversion ditch may also present some risk, to a lesser degree. This conclusion is supported by Table 7-8 in the ERA.

*EPA Response: Again, if is EPA 's intent to make it clear that if the necessary remedial actions are not taken at the Site, which include both enhancing the soil cover and ensuring that it will remain intact in the future, potential risks to human health and the environment exist. EPA agrees with the comment addressing sediments as the primary risk driver at the Site.*

Future Consolidation of Material. United Park understands the practical benefits that could arise from the future use of the Site as a consolidation area for mining materials and impacted soils. However, United Park notes the potential complications related to defining completion of construction for purposes of the remedial action described in the Proposed Plan. United Park suggests that one way to address this concern would be for EPA to provide in the ROD that: (i) any materials so consolidated at the Site during implementation of the remedial action will simply be incorporated into the remedial action and covered with the required amount of clean cover material and revegetated; and (ii) any material to be consolidated after completion of construction will be subject to institutional controls requiring that mine wastes or impacted soils consolidated at the Site after the remedial action is completed would be covered with the required amount of clean material and revegetated. This will allow United Park to achieve a state of completion with the remediation while providing maximum flexibility for the future consolidation of material from the Watershed and any potential reuse of the property.

*<u>EPA Response</u>: EPA agrees with this comment; evidence of incorporation of this comment into the ROD can be found in the Remedy Selection section.*

### 1.1.3 Comments Received from the Marsac Corridor Association

One component of the remedy allows for waste to be transported from Empire Canyon and deposited at Richardson Flat. The Marsac Corridor Association (MCA) is a group of homeowners that live in the neighborhood through which trucks carrying the waste would drive. The members of the MCA had two specific comments: 1) The waste in Empire Canyon should be left in place, and 2) If the waste must be moved, it should be transported up the Mine Road and down Royal Street, rather than using only the Mine Road and Lower Marsac.

*<u>EPA Response</u>: EPA understands MCA 's concerns and has considered its comments. It is our perspective that the waste may be left in place or moved to Richardson Flat. Factors such as space to contain the waste, the cost of transportation, and potential migration of waste left in place will be considered by the parties involved in order to make a decision about the fate of the waste in Empire Canyon. EPA understands that this is a local issue and one that will be resolved through discussion and consideration amongst the stakeholders. These stakeholders include Park City, UPCM MCA and other concerned public. A public hearing will be held by Park City in the upcoming future to resolve this issue.*

### 1.1.4 Comments Received from United States Fish and Wildlife Service (the Service) Utah Field Office

The Service submitted comments concerning the remedy's protectiveness in relation to ecological receptors at the Site. The Service's primary concern is that the sediments found in the South Diversion Ditch, the pond at its terminus and in the wetland at the base of the embankment are not being addressed in a manner efficient enough to substantially minimize risk to ecological receptors at the site. The Service proposes excavation of the sediments in all three areas.

<u>EPA Response</u>: The sediments within the wetland area will be excavated and placed within the impoundment through the selected remedy. EPA understands that the wetland is a naturally occurring ecological phenomenon that existed before the impoundment was created. Therefore, the remedy should allow for the restoration of the wetland as a habitat for ecological receptors at the Site. However, the diversion ditch and small pond are engineered features at the site that were constructed to help contain the tailings in the impoundment and minimize groundwater infiltration from Area B info the main impoundment. Therefore, these areas will be sufficiently remediated through the described mechanisms (placement of 18 inches of gravel over contaminated sediments). While this action does not create habitat or restore habitat, if will minimize risk to ecological receptors at the Site. The requirements set forth in the NCP are met. Lastly, this does not preclude continued negotiation concerning the restoration of these features between UPCM and EPA surrounding Natural Resource Damages. These damages are currently being addressed and they are a complicated issue. It is possible these damages could be mitigated through the restoration of other areas within the Watershed. So, until a settlement concerning these damages has been reached the exposure pathways will be interrupted with gravel and risk to ecological receptors will be minimized in the diversion ditch and the pond at its terminus as it is described in the selected remedy.