BLACKBIRD MINE
SUPERFUND SITE
RECORD OF DECISION

LEMHI COUNTY
IDAHO

Prepared by

Office of Environmental Cleanup
EPA Region 10

February 2003

PART I: THE DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

The Blackbird Mine Site (Site) is an inactive mine located in Lemhi County, Idaho, approximately 13 miles south of the Salmon River and 25 miles west of Salmon, Idaho.   The Blackbird Mine Site covers approximately 830 acres of private patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. Mining activities began in the late 1800s and continued until 1982.   The EPA identification number is IDD980725832.

STATEMENT OF BASIS AND PURPOSE

The decision document presents the selected remedy for the Blackbird Mine site. This Record of Decision (ROD) has been developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 USC § 9601 *et seq.*, as amended, and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record for the Blackbird Mine site.

The remedy was selected by the U.S. Environmental Protection Agency. The State of Idaho concurs with the selected remedy contained in this ROD subject to the States' comments previously provided to EPA's Proposed Plan. In accordance with a 1995 Memorandum of Understanding between the EPA and US Forest Service, EPA requested concurrence on the ROD. The U.S. Forest Service also provided a letter of concurrence. The States' and Forest Services' concurrence letters are provided in Appendix C.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or 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, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

A number of early actions have been implemented at this Site. The selected remedy provides for maintenance of the early action elements and addresses the remaining threats posed by the Site. This ROD addresses contaminated soils (i.e. overbank deposits), groundwater, surface water and instream sediments at the Blackbird Mine site. The selected remedy requires long-term operation and maintenance and includes the following in each drainage basin.

Blackbird Creek Drainage Basin

The remedial actions in the Blackbird Creek basin include:

- Collection and treatment of upper Meadow Creek seeps
- Continued operation of the water treatment plant
- Construction of a soil cover over the West Fork Tailings Impoundment
- Collection and treatment of seepage from the West Fork Tailings Impoundment
- Removal of overbank deposits with armoring of selected deposits
- Removal of in-stream sediments and overbank deposits in the vicinity of the Panther Creek Inn (PCI)
- Establishing institutional controls and physical restrictions
- Natural recovery of Blackbird Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

Bucktail Creek Drainage Basin

The Remedial Actions in the Bucktail Creek basin include:

- Collection and treatment of Bucktail Creek groundwater seeps
- Continued operation of the Water Treatment Plant
- Diversion of Bucktail Creek
- Establishing institutional controls and access restrictions
- Natural recovery of Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

Panther Creek Drainage Area

The remedial actions in the Panther Creek drainage include:

- Selective removal of overbank deposits
- Establishing institutional controls
- Natural recovery of Panther Creek sediments
- Operation and maintenance of all facilities
- Five year reviews

STATUTORY DETERMINATIONS

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The source materials at the Blackbird Mine site could be considered a principal threat waste as defined in EPA guidance.

Because the remedy will result in hazardous substances, pollutants, or contaminants 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 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 ROD. Additional information can be found in the Administrative Record for the Blackbird Mine site.

- Chemicals of concern (COCs) are provided in Section 7.
- Baseline risk represented by the COCs is provided in Section 7.
- Cleanup levels for COCs and the basis for the levels are provided in Section 8.
- Current and future land and groundwater use assumptions used in the baseline risk assessment are provided in Sections 6 and 7.
- Whether source material constitutes principal threats is found in Section 11.
- Estimated capital, annual 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 are provided in Section 12.
- Key factors that led to selecting the remedy are provided in Section 12.

AUTHORIZING SIGNATURE

Michael F. Gearheard, Director
Environmental Cleanup Office, Region 10
U.S. Environmental Protection Agency

3 March 2003
Date

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ABBREVIATIONS AND SYMBOLS

AERA	Aquatic Ecological Risk Assessment
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ARD	Acid Rock Drainage
AWQC	Ambient Water Quality Criteria
bgs	Below ground surface
BMP	Best Management Practices
BMSG	Blackbird Mine Site Group
BRCP	Biological Restoration and Compensation Plan
CCC	Criteria Continuous Concentration (chronic criteria)
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CMC	Criteria Maximum Concentration (acute criteria)
COC	Chemical of Concern
COPEC	Chemical of Potential Ecological Concern
CRP	Community Relations Plan
CSM	Conceptual Site Model
CWA	Clean Water Act
cy	Cubic Yards
DEQ	Department of Environmental Quality
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ESA	Endangered Species Act
ESD	Explanation of Significant Difference
ESV	Ecological Screening Value
FS	Feasibility Study
gpm	gallons per minute
HEAST	Health Affects Assessment Summary Table
HI	Hazard Index
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HR	Home range
IC	Institutional Controls
IDEQ	Idaho Department of Environmental Quality
IRIS	Integrated Risk Information System

ABBREVIATIONS AND SYMBOLS (continued)

IWQS	Idaho Water Quality Standard
LOAEL	Lowest observed adverse effect level
MCL	Maximum Contaminant Level
MBTA	Migratory Bird Treaty Act
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOEC	No observed effect concentration
NOAEL	No observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
O&M	Operation and Maintenance
PCI	Panther Creek Inn
PEC	Probable effects concentration
PRP	Potentially Responsible Party
PRG	Preliminary Remediation Goal or Preliminary Removal Goal
RA	Risk Assessment
RAO	Remedial Action Objective
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROC	Receptor of Concern
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SF	Slope Factor
SRB	Sulfate-reducing bacteria
TERA	Terrestrial Ecological Risk Assessment
TEC	Threshold Effects Concentration
TEL	Threshold Effects Level
TOC	Total organic carbon
TRV	Toxicity Reference Value
UAA	Use Attainability Analysis
UCL	Upper Confidence Limit
UTL	Upper Tolerance Level
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey

ABBREVIATIONS AND SYMBOLS (continued)

WQS	Water quality standard
WTP	Wastewater Treatment Plant
XRF	X-ray fluorescence

PART II: DECISION SUMMARY

SECTION 1

INTRODUCTION

This Decision Summary provides a description of the site specific factors and analysis that led to the selection of the remedy for the Blackbird Mine Superfund Site. It includes information about the Blackbird Mine Site background, the nature and extent of contamination, the assessment of human health and environmental risks, and the identification and evaluation of remedial alternatives.

This Decision Summary also describes the involvement of the public throughout the process, along with the environmental programs and regulations that may relate to or affect the alternatives. The Decision Summary concludes with a description of the selected remedy in this Record of Decision (ROD) and a discussion of how the selected remedy meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended.

Documents supporting this Decision Summary are included in the Administrative Record for the Blackbird Mine site. Key documents include the Remedial Investigation, the Feasibility Study, the Human Health Risk Assessment, the Aquatic Ecological Risk Assessment, the Terrestrial Ecological Risk Assessment, and the Proposed Plan.

1.1 SITE NAME, LOCATION AND DESCRIPTION

The Blackbird Mine Site is an inactive mine located in Lemhi County, Idaho, approximately 13 miles south of the Salmon River and 25 miles west of Salmon, Idaho (See Figure 1-1). The Frank Church River of No Return Wilderness Area is located approximately 5 miles north of the mine site. A portion of the mine is located within a roadless area. The closest permanent resident is approximately 2 miles from the mine area. The identification number is IDD980725832.

The Blackbird Mine Site covers approximately 830 acres of private, patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. The mine is situated on a large copper and cobalt deposit. Elevations at the mine range from approximately 6,600 feet to 8,000 feet above sea level. Mining activities began in the late 1800s and continued until 1982. Mining activity resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock deposited in numerous piles, and 2 million tons of tailings disposed of at a tailings impoundment.

The Blackbird Mine site spans two drainages: Bucktail Creek and Meadow/Blackbird Creeks. These drainages flow into Panther Creek, which flows into the main stem of the Salmon River (see Figure 1-1). Acid rock drainage from the waste rock piles, the underground workings, the tailings impoundment, and tailings deposited along area creeks have resulted in the release of elevated levels of hazardous substances to the environment (groundwater, surface water, soils), including but not limited to copper, cobalt and arsenic. These releases have contributed to elevated levels of dissolved copper and cobalt in Panther Creek and its tributaries. Contaminated soil, sediments, waste rock and tailings were also released from the Blackbird Mine site during high water flows from thunderstorms and snowmelt and deposited in soil along the banks of downstream creeks (referred to as overbank deposits/soil) including Panther Creek and its tributaries. Investigations show that irrigation also spread contaminated material along Panther Creek in the overbank soil as well as in pastures. The fisheries and aquatic resources downstream of the Blackbird Mine have been impacted by arsenic, copper and cobalt releases. Dissolved copper concentrations in area creeks downstream from the mine frequently exceed the State of Idaho water quality standard (WQS) for copper for protection of aquatic life.

Natural features of the Site that require special consideration include endangered species, floodplains and wetlands. Historically, the Panther Creek drainage is reported to have supported runs of anadromous chinook salmon and steelhead trout. The Snake River spring/summer chinook salmon (Onchorynchus tshawytscha), known to have historically used this basin, has been designated as threatened under the Endangered Species Act (ESA). Snake River steelhead (Onchorynchus mykiss) and Columbia Basin bull trout (Salvelinus confluentus) are also listed as threatened. Floodplains and wetlands may be present in the riparian zone of area creeks and streams.

Cultural resource surveys have been performed for the Site. No sites listed on the National Historic Register were identified and no other historic properties have been identified.

The U.S. Environmental Protection Agency (EPA) is the lead agency at this site. The support agency is the Idaho Department of Environmental Quality (IDEQ). There are several other agencies that have been actively involved at this site and that have provided extensive input and guidance to EPA; these agencies are collectively known as the natural resource trustees. These include the U.S. Forest Service (USFS), the National Marine Fisheries Service (NMFS), and the National Oceanic and Atmospheric Administration (NOAA). The U.S. Fish and Wildlife Service (USFWS) and NMFS have also been involved during consultations concerning endangered species. Investigations and Early Actions at this site have been conducted under EPA oversight by the Blackbird Mine Site Group (BMSG) which represents the Potentially Responsible Parties (PRPs). The BMSG is composed of the current owner, Noranda Mining, Inc., and former owners and operators M. A. Hanna Company, Hanna Services Company, and Intalco (formerly Alumet Corporation).

SECTION 2

SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE HISTORY

The Blackbird Mine is located at one of North America's largest cobalt deposits. The Blackbird area was discovered in 1893, when the Blackbird Copper-Gold Mining Company consolidated several small prospects and conducted the first significant mining activities from 1893 until 1907. From about 1917 until 1920, the Haynes-Stellite Company mined and milled approximately 4,000 tons of ore from a site located along the east side of Blackbird Creek approximately 1.2 miles downstream of the present Blackbird Mine.

Mining activity slowed until 1938 when the Uncle Sam Mining Company reopened two old adits and built a 75-ton/day flotation mill at the present Blackbird Mine site. The Calera Mining Company (a subsidiary of Howe Sand, which was also actively involved in the mining operations) purchased the Blackbird Mine property in 1943. Full-scale mining activity was initiated in 1949 and was expanded during the 1950s and included the construction of a 1000 ton/day mill.

In 1954, Calera initiated open pit activities in the Blacktail Pit. Excavation of the open pit resulted in the deposition of approximately 3.8 million tons of waste rock in the headwaters of Blackbird and Bucktail Creeks. Prior to full-scale mining, tailings from the mining operation were deposited directly in Blackbird Creek. After 1950, tailings were deposited behind the West Fork Tailings Impoundment, but some tailings "spills" are known to have occurred. It is estimated that 20,000 cubic yards of tailings were deposited or spilled along Blackbird Creek, and an estimated 2 million cubic yards of tailings are impounded behind the West Fork Tailings Impoundment. Underground mining operations during this period also resulted in the formation of a number of waste piles outside mine adits, totaling approximately 1 million tons. Subsequent to mining operations, debris flows, erosion, and acid rock drainage (ARD) have resulted in the spreading of arsenic, cobalt, and copper from the original mining waste disposal areas to downstream locations.

The Calera Mining Company suspended mining operations and sold its interest in the Blackbird Mine to Machinery Center Company in 1963. Between 1963 and 1967, Machinery Center produced copper from the mine primarily through leasing operations. Machinery Center sold controlling interest to the Idaho Mining Company, a subsidiary of the Hanna Mining Company, in 1967. For the next few years, the Idaho Mining Company engaged in an exploration program on the property and initiated meetings with state and federal agencies to obtain authorizations to re-open the mine.

In 1977, Noranda Exploration entered into an option agreement with the Idaho Mining Company, allowing Noranda to explore and acquire interest in the mine property. In December 1979, Noranda Mining, Inc. and Hanna Services Company created the Blackbird Mining Company, a limited partnership, wherein Noranda Mining became the general partner responsible for re-opening the mine. During this same time period, Idaho Mining Company sold all its real and personal property to Hanna Services Company. Noranda Exploration and then the Blackbird Mining Company conducted exploration activities from 1978 to 1982. Exploratory drilling activity included increases to the main Haynes-Stellite Adit openings in order to allow exploration equipment to access the interior of the adit. The Blackbird Mining Company conducted pilot activities at the mine from 1980 to 1982 to determine the feasibility of full-scale operation of the mine. A wastewater treatment plant (WTP) was constructed in 1981 to treat mine drainage from the 6850-foot level of the mine. The Blackbird Mining Company also diverted mine drainage from the 7400, 7200, and 7100-foot levels to the 6850-foot level for treatment by the wastewater treatment plant.

In 1981, the Blackbird Mining Company suspended all pilot operations at the Blackbird Mine and in 1982 ceased all underground activities upon completion of the pilot program. Poor market conditions were identified as the reason that full-scale re-opening of the mine was not pursued by the Blackbird Mining Company.

2.2 SUMMARY OF ENFORCEMENT ACTIONS

Several enforcement actions have been conducted at the Blackbird Mine site to address the releases of contaminants. These include: actions under a Natural Resource Damage claim; emergency response actions to address imminent releases from the West Fork Tailings Impoundment; non time-critical removal actions (the Early Actions) conducted in the Bucktail Creek basin and in the Meadow/Blackbird Creek basin to address water quality and along Panther Creek to address human health concerns; and investigations and studies to complete the Remedial Investigation/Feasibility Study (RI/FS).

2.2.1 Natural Resource Damage Claim

In 1983 the State of Idaho initiated a Natural Resource Damage Assessment (NRDA) for the Blackbird Mine and clean up pursuant to CERCLA. In 1992, the State of Idaho initiated a Natural Resource Damage Assessment (NRDA) for the Blackbird Mine, filing a natural resource damage claim pursuant to CERCLA. Subsequently, the United States joined the suit. In 1995, a Consent Decree (No. 83-4179 *State of Idaho, et al. v. The M.S. Hanna Company et al.*) was lodged committing the defendants (the BMSG) to implementing a restoration plan, meeting water quality standards by a specified date, and implementing the final CERCLA remedy and other response actions selected by EPA through separate consent decrees or administrative orders.

2.2.2 Emergency Response Actions at West Fork Tailing Impoundment

Emergency Response Actions were conducted in 1993 at the West Fork Tailings Impoundment to minimize the potential for release of tailings into Blackbird and Panther Creeks (Figure 2-1). These actions were taken pursuant to an Administrative Order on Consent (AOC) issued by EPA to the BMSG in July 1993 (EPA Docket No. 1093-07-04-106). Prior to these actions, West Fork Blackbird Creek flowed through a buried concrete culvert beneath the tailings pile and there was concern that mass failure of the tailings storage facility was possible if the culvert became plugged. The Emergency Response Actions included the following:

- Construction of a spillway excavated through bedrock and designed and constructed with steps to effectively dissipate kinetic energy and to pass the 500-year flood peak.

- Construction of a new channel for the West Fork of Blackbird Creek over the top of the impoundment to the spillway, which consists of: a riprap-lined flood-flow channel designed to pass the 500-year flood peak; a low-flow channel of reinforced, prefabricated, half-round concrete sections; and a 2-foot-thick compacted clay liner installed beneath the low-flow and riprap-lined flood-flow channel to minimize infiltration into the tailings.

- Installation of a slurry cutoff trench into bedrock near the upstream end of the impoundment to minimize alluvial groundwater discharge into the tailings.

- Filling the existing concrete drainage culvert beneath the tailings with pea gravel to provide drainage of water entering the tailings, thereby maintaining unsaturated tailings in the impoundment.

2.2.3 Non Time-Critical Removal Actions (the Early Actions)

Non time-critical removal actions (the Early Actions) were initiated during the summer of 1995 and were continued in five phases each year through 2001. These actions were conducted pursuant to an AOC issued by EPA to the BMSG in June 1995 (EPA Docket No. 10-95-0083). From 1995 through 1998, the Phases I, II, and III Early Actions were focused on controlling sources of acid rock drainage that were impacting water quality. Generally, Phase I facilities were built during the 1995 construction season, Phase II facilities were built during the 1996 and 1997 construction seasons, and Phase III structures were initiated during the 1997 construction season and completed during the summer of 1998.

Phases IV and V Early Actions have consisted of overbank deposit removal actions, which have been conducted along Panther Creek and Blackbird Creek to mitigate potential risk to human health associated with elevated levels of arsenic present in mine related deposits. These actions have also reduced potential risk to terrestrial and aquatic ecological receptors. Phase IV activities were initiated in 1998 and completed in 1999. Phase V activities were initiated in 1999; however, the forest fire during 2000 caused delays and Phase V was not completed until 2001. Figure 2-2 depicts the Early Action facilities at the mine site.

During the fall of 2002, additional Early Actions were performed under the 1995 AOC to collect waters in the Bucktail Creek and Meadow Creek drainage basins that were not intercepted during previous actions.

In Meadow/Blackbird Creek, the Early Actions included the following:

- Construction of the 7100 level earthen clay-core dam to collect and store water draining from the waste rock dumps in the Meadow Creek drainage basin before treatment. The 7100 level dam is approximately 88 feet high, and impounds a reservoir with a maximum surface area of 2.56 acres and a maximum storage capacity of 49 acre-feet.

- Pipelines from the 7100 level dam to the water treatment plant and replacement of piping and instrumentation between the bulkhead at the 6850 adit and the water treatment plant. The bulkhead allows for storage of up to 50 acre-feet of water in the mine workings.

- Upgrade to and expansion of the existing water treatment plant, which is located approximately 1,200 feet downstream from the confluence of Meadow Creek and Blackbird Creek. The upgraded treatment plant has a normal maximum treatment capacity of 800 gallons per minute (gpm) and discharges treated water to Blackbird Creek.

- Installation of a sludge pipeline from the water treatment plant to the Hawkeye Ramp workings to dispose of sludge generated by the water treatment plant.

- Construction of a contaminated water collection system below the 7800 waste rock pile. The collection system is composed of ditches and pipelines to collect and transport contaminated water to the 7100 level dam reservoir.

- A series of clean water ditches and pipelines to divert clean water around the contaminated areas and the 7100 level dam reservoir, and transport clean water downstream of the 7100 dam.

- Relocation of waste rock from the canyon walls of Meadow Creek and Blackbird Creek and from Hawkeye Gulch. The relocated waste rock was deposited upstream of the 7100 level dam in the 7400 level waste rock dump, or placed in the Meadow Creek and Blackbird Creek bottoms.

- The waste rock in the Meadow Creek and Blackbird Creek bottoms was covered with a clean earth cover. Drains were installed beneath the cover to collect contaminated groundwater and transport it to the water treatment plant.

- Concrete channels were constructed across the top of the capped waste rock to convey Meadow Creek and Blackbird Creek to a discharge point in Blackbird Creek downstream of the water treatment plant.

- Construction of a groundwater cutoff wall in upper Blackbird Creek about 300 feet upstream of the water treatment plant to intercept contaminated groundwater flowing through the waste rock beneath the cover. The contaminated groundwater is piped to the water treatment plant.

- Construction of a temporary sediment control basin to settle out sediment generated during and after construction activities. The sediment control basin is located at the downstream end of the Blackbird Creek concrete channel.

- Removal of visually obvious, erodible tailings from overbank deposits at several locations along Blackbird Creek between the confluence of Blackbird Creek and Panther Creek.

- Construction of three sediment basins along Blackbird Creek. One of these basins is located near the West Fork Tailings Impoundment, and the other two basins are located upstream of the confluence of Blackbird Creek and Panther Creek, just upstream of the Panther Creek Road.

Within the Bucktail Creek drainage, the Early Actions included the following:

- Construction of an earth fill clay-core dam (7000 level dam) and pipeline and open-channel spillway to collect, store, and divert contaminated water to the water treatment plant via the 6930 level adit to the underground mine workings. The 7000 level dam is approximately 70 feet high and impounds a reservoir with a maximum surface area of 0.52 acre and a maximum storage capacity of 5.85 acre-feet.

- Construction of a new adit at elevation 6930 to connect to the 6850 level of the old mine workings. The 6930 level adit extends approximately 1,300 feet into the mountain and is used to transport the contaminated water from the Bucktail Creek basin into the mine, where it can be conveyed to the water treatment plant.

- Construction of a pump station and pipeline located downstream of the 7000 level dam. The pump station and pipeline is used to collect and convey springs and dam seepage and pump it to the 6930 adit for transport through the mine to the water treatment plant.

- Relocation of waste rock piles, with disposal in the Blacktail Pit.

- A waste rock repository (Blacktail Pit), including a foundation drainage system to drain water entering the former pit into the old mine workings and to the water treatment plant.

- A series of clean water ditches and pipelines to divert clean water around the waste rock dumps and the 7000 level dam reservoir, and transport the clean water to Bucktail Creek downstream of the 7000 level dam.

- The 7200 level collection ditch to collect contaminated water from the remainder of the West Lobe waste rock dump and direct the contaminated water toward upper Bucktail Creek upstream of the 7000 level dam.

- A series of sediment control ditches within the waste rock to remain in place.

- Debris traps located in the Bucktail Creek channel to reduce the risk of debris flows.

- Two temporary sediment control dams to settle out sediment generated during construction activities and sediments from residual debris flow materials along Bucktail Creek. The upper sediment control dam is located just upstream of the upper access road crossing of Bucktail Creek and downstream of the pump back station. The lower sediment control dam is located just upstream from the lower access road crossing of Bucktail Creek.

- Relocation of a portion of the debris flow material along Bucktail Creek between the upper and lower sediment dams. This debris flow material was disposed of in the Blacktail Pit.

- Rehabilitation of the 6850 level to allow for the transport of contaminated water from the Bucktail drainage to the water treatment plant and allow for ingress/egress of men and materials to the 6850 bulkhead.

Beginning in late 1998 and continuing from 1999 through 2001, overbank deposit removal actions were conducted along portions of Panther Creek. These actions were primarily focused on removal of mine-related materials containing elevated concentrations of arsenic, concluded by EPA to pose an unacceptable risk to human health. The removal actions have also reduced any risk that these materials may have posed to terrestrial and aquatic ecological receptors. The overbank deposit removal actions included the following:

- Removal of the contaminated materials until testing indicates that the underlying soils are below the Preliminary Removal Goals (PRGs), or until the water table is reached.

The PRGs varied from 100 mg/kg arsenic for a residential exposure scenario, 280 mg/kg arsenic for a camping scenario, and 590 mg/kg arsenic for a day-use recreational exposure scenario.

- Removed materials were hauled to the West Fork Tailings Impoundment for disposal.

- Following removal, clean soils were used to backfill the excavated areas. The depth of clean soils depended on site conditions and the amount of material removed. The soils were generally replaced to the original lines and grades. The soils were replaced to a minimum depth of 6 inches. If materials exceeded the PRG at the water table, the minimum depth of soil replacement was 12 inches.

- The top 6 inches of replacement soils where composed of topsoil to act as a growth medium. The topsoils were then revegetated to match the pre-removal vegetation (either native species or pasture grasses).

Removal Actions were completed at the following areas:

- Panther Creek Inn (PCI) and the PCI campground area for ¼ mile downstream along Panther Creek.

- The Riprap Bar area approximately 1 mile downstream from the Cobalt Townsite.

- The Sillings/Fernandez area located approximately 2 miles downstream from the Cobalt Townsite.

- Deep Creek Campground located just upstream of the confluence of Deep Creek and Panther Creek.

- The Bevan property located about 5.5 miles upstream from the confluence of Panther Creek and the Salmon River.

- The Cobalt Townsite and the adjacent pasture area immediately downstream of the Cobalt Townsite. Additional work to improve juvenile rearing habitat for salmonids was also conducted as part of the Biological Restoration and Compensation Plan (BRCP).

- At the Napias Creek area just upstream from the confluence of Napias and Panther Creeks.

In the fall of 2002, ongoing Early Actions were performed in Meadow Creek and Bucktail Creek, including the following:

Upper Meadow Creek Facilities

In the fall of 2002, work was initiated in upper Meadow Creek including the construction of:

- The 7560 Detention Dam and Piping. The facilities include a small earthfill detention dam and piping system that will convey clean water around the existing 7350 Detention Dam and into the 7100 West Diversion System.

- The 7560 Access Road and Ditch. A new road and diversion ditch will be built between the 7350 Detention Dam and 7560 Detention Dam.

- The 7350 Detention Dam piping modifications. The piping in the area of the existing 7350 Detention Dam will be modified to separate clean water from water with high metals concentrations.

Phase 1 Bucktail Creek Facilities

In the fall of 2002, Phase 1 Bucktail Creek facilities were constructed upstream from the existing Bucktail Creek pump station, including construction of:

- The East Fork Bucktail Cutoff Wall. The cutoff wall will intercept the flow of alluvial groundwater in Bucktail Creek and convey it by gravity to the existing vault at the Bucktail Pump Station.

- The BTSW-3C discrete seep collection facility. A seep identified as BTSW-3C, located just upstream of the existing Bucktail Pump Station, contributes significant copper and cobalt loading to Bucktail Creek. A discrete seep collection system will be installed to collect and convey the waters of this seep to the Bucktail Pump Station.

- A new pipeline from the Bucktail Pump Station to the 6930 Portal to provide for additional flows captured by the cutoff wall and seep collection facility. Pipeline modifications will include construction of a new 4-inch diameter pumpback pipeline, buried in a trench parallel to the existing 3-inch diameter pipeline.

2.2.4 Remedial Investigation/Feasibility Study (RI/FS)

The RI/FS activities have been conducted pursuant to an AOC issued by EPA to the BMSG in November 1994 (U.S. EPA Docket No. 10-94-0222). The RI was initiated in 1995; however, much of the data collection (especially water quality data) concentrated on the period after Phases I through III of the Early Actions were completed in 1998. The Early Actions improved water quality in the area creeks downstream from the mine, and the focus of the RI was to address contamination remaining after completion of the Early Actions. The RI was completed in November 2001. The results of the RI are summarized in Section 5 of this ROD. The FS evaluated alternatives to address the contamination remaining after the Early Actions were completed. The FS was completed in June 2002. The results of the FS are summarized in Section 9 of this ROD.

SECTION 3

COMMUNITY PARTICIPATION

This section summarizes the community involvement activities undertaken by EPA during the remedy selection process. EPA developed a Community Relations Plan (CRP) in April 1995. The CRP is designed to promote public awareness of cleanup activities and investigations and to involve the public in the decision-making process. Community participation activities throughout the RI/FS and Early Actions have included personal interviews, public meetings and distribution of fact sheets, newspaper ads, and public notices.

The RI/FS Reports and Proposed Plan for the Blackbird Mine Site were made available to the public in August 2002. These documents, along with others that form the basis for the cleanup decisions for the Blackbird Mine Site, can be found in the Administrative Record located at the the EPA Region 10 Superfund Records Center at 1200 Sixth Avenue in Seattle Washington, the EPA Region 10 Idaho Operations Office at 1435 N. Orchard in Boise Idaho, and the Salmon Public Library at 204 Main Street in Salmon, Idaho. Notice of the availability of these documents was published in the Salmon Recorder-Herald and the Challis Messenger on August 8 and 22, 2002.

A fact sheet summarizing the Proposed Plan was mailed to approximately 400 individuals on the Site mailing list.

A public comment period was held from August 12 to October 10, 2002. Initially, the public comment period was to end on September 10, 2002 but was extended to October 10, 2002 in response to two requests for an extension. The comment period extension was published in the two local newspapers on September 19, 2002. A public meeting to present the Proposed Plan was scheduled for August 26, 2002. The public meeting was canceled due to EPA concerns about maintaining public safety and security in light of a threat to disrupt the meeting. The public meeting was not rescheduled because only two people requested it. These people were contacted and were provided an opportunity to ask questions and communicate their concerns to EPA.

Comments were received during the public comment period. A responsiveness summary is provided as part of this ROD.

SECTION 4

SCOPE AND ROLE OF RESPONSE ACTION

Early Actions have been implemented at the Site as described in Sections 2.2.2 and 2.2.3 of this ROD, and are incorporated into the final remedial action for the Site. The Blackbird Mine ROD is the final action for the Site and addresses soils, groundwater, sediment and surface water at the Blackbird Mine Site.

The remedy selected by EPA and documented in this ROD includes remedial actions necessary to protect human health and the environment. The human health risk assessment determined that exposure to soils along the banks of Panther Creek (overbank deposits) poses a potential risk from arsenic to humans under a future residential use scenario. In addition, small localized areas of soil along the banks of Blackbird Creek with elevated arsenic concentrations may pose unacceptable acute (short-term) or chronic (long-term) risks during recreational use. The selected remedy is intended to mitigate or abate the risks posed by the Blackbird Mine site to humans. Contaminated overbank deposits will either be removed and/or institutional controls will be put in place to prevent future contact with contaminated soils. In addition, removal of contaminated overbank deposits along Blackbird Creek will reduce the potential for mobilizing the soils during high runoff events and deposition of soils on downstream properties along Panther Creek.

The aquatic risk assessment determined that there was a potential risk to aquatic life from copper and cobalt in surface water and copper, cobalt and arsenic in sediments in Blackbird Creek, Bucktail Creek, South Fork of Big Deer Creek, Big Deer Creek and Panther Creek. The selected remedy is intended to mitigate or abate the risks posed by the Blackbird Mine site to aquatic life. This will be accomplished by collection of groundwater and surface water for treatment at the existing water treatment plant, removal of overbank deposits along Blackbird Creek and natural recovery of instream sediments. In addition, in order to achieve State Water Quality Standards in South Fork of Big Deer Creek, Bucktail Creek will be diverted around South Fork of Big Deer Creek.

The terrestrial risk assessment determined that there were risks to terrestrial sub-populations only in the Blackbird Creek riparian areas. However, the population-level risks along Blackbird Creek were considered negligible. The sub-population and population-level risks to terrestrial receptors of concern at all other areas of the Site were considered negligible. Thus, the selected remedy does not include actions specifically to address terrestrial life.

Given the uncertainties associated with the effectiveness of the remedy selected in this ROD there may be the need for contingency actions in the future which, if necessary, will be documented in a future ESD or ROD amendment. Potential contingent actions are described in Section 12 of this ROD.

SECTION 5

SUMMARY OF SITE CHARACTERISTICS

5.1 SITE CHARACTERIZATION

This section provides an overview of the Site and a summary of the remaining contamination to be addressed through remedial actions. This includes descriptions of the conceptual site model, physical setting, habitat impacts, remedial investigation sampling results, and a summary of remaining sources.

5.2 CONCEPTUAL SITE MODEL

The Conceptual Site Models (CSM) for human, aquatic, and terrestrial receptors are shown respectively in Figures 5-1 through 5-3. The potential human receptors of concern include recreational users and future residents. The primary sources of contamination for human receptors are overbank tailings and soils that contain elevated concentrations of arsenic along Blackbird Creek at the mine and along Panther Creek downstream of the mine. The potential aquatic receptors of concern include benthic macroinvertebrates and anadromous and resident salmonid species (including several threatened or endangered species) in creeks within the mine and downstream of the mine. The primary contamination sources include tailings and waste rock that discharge elevated concentrations of cobalt and copper through springs and seeps to the surface waters. The potential terrestrial receptors include a variety of species that inhabit and visit the site. The primary sources of contamination include waste rock and overbank tailings and soils that contain elevated concentrations of arsenic.

5.3 PHYSICAL SETTING

Descriptions of the physical setting at the Site, including topography, geology, meteorology, surface water hydrology, and hydrogeology are summarized below.

5.3.1 Topography

The Blackbird Mine Site covers approximately 830 acres of private patented mining claims and 10,000 acres of unpatented mining claims within the Salmon-Challis National Forest. Mining activity within the site resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock in numerous piles, and two million tons of tailings disposed of at a tailings impoundment.

The mine site lies within two primary drainages: Meadow/Blackbird Creek and Bucktail Creek. Figure 5-4 shows the primary features in these drainage areas. The Blacktail Open Pit was part of the Bucktail Creek drainage basin but has been partially filled with waste rock, removed as part of Early Actions described in Section 2, and now drains to the underground mine workings.

Meadow Creek is the southern drainage of the mine site. This basin formerly contained the surface mine facilities. Waste rock from the Blacktail Pit was disposed at the 7800 dump at the headwaters of Meadow Creek and waste rock from underground adits was disposed along the valley sides and bottom. Meadow Creek extends from the basin boundary near an approximate elevation of 7,800 feet for 1.5 miles to its confluence with Blackbird Creek near the wastewater treatment plant at an elevation of 6,800 feet. The basin area is very steep, as is the Meadow Creek channel, which exhibits an 11 percent grade.

The Blackbird Creek basin is separated into two portions by the clean water reservoir. The upper section of the basin, located west of Meadow Creek and upstream of the dam, has not been impacted by mining activities. Flows from the upper Blackbird Creek basin flow into the Blackbird Creek channel at a point approximately ¼ mile upstream of the water treatment plant. Blackbird Creek (below the clean water reservoir) and Meadow Creek are conveyed in a concrete channel constructed as part of Early Actions. The channel runs from below the 7100 dam to just downstream of the water treatment plant, and was constructed on top of a clean soil cover, which was installed as part of the Early Actions to cover waste rock in the valley bottom. Blackbird Creek discharges to its normal channel at a culvert located immediately downstream of the treatment plant. From the mine site, Blackbird Creek flows for approximately 3 miles where it is joined by the West Fork Blackbird Creek. The West Fork Tailings Impoundment is located at the confluence of Blackbird Creek and West Fork Blackbird Creek. Blackbird Creek then flows approximately 2 miles downstream of West Fork Blackbird Creek to its confluence with Panther Creek. The Blackbird Creek drainage basin covers approximately 23 square miles, which includes the Meadow Creek and West Fork Blackbird Creek drainage basins.

Prior to Early Actions, Bucktail Creek drained an area of approximately 1.7 square miles, which included the northern portion of the mine area and several sub-basins. The headwaters of Bucktail Creek originated just below the Blacktail Pit. Following completion of the Early Actions described in Section 2, the flow from the upper section of Bucktail Creek below the waste rock dumps is now collected at the 7000 dam and downstream pumpback station and diverted to the underground mine, from where it is withdrawn for treatment and discharge to Blackbird Creek. Downstream of the 7000 dam, Bucktail Creek flows north approximately 1.8 miles to its confluence with the South Fork Big Deer Creek. Downstream of the 7000 dam, the high gradient creek drops approximately 1500 feet to an elevation of about 5500 feet at the confluence with the South Fork Big Deer Creek. The South Fork Big Deer Creek flows about 0.5 miles to its confluence with Big Deer Creek. Big Deer Creek then flows east about 2.8 miles to its confluence with Panther Creek, about 8 miles upstream from the Salmon River.

Panther Creek is a major tributary of the Salmon River, which in turn flows into the Snake River. The Panther Creek drainage consists of steep, rocky slopes and is characterized by

V-shaped canyons. Panther Creek drains approximately 533 square miles, and is approximately 44 miles long from its headwaters to the Salmon River confluence. Elevation ranges from about 3,280 feet at the mainstem confluence to about 10,000 feet at the headwaters.

5.3.2 Geology

The geological setting of the Blackbird Site is dominated by metasedimentary rocks, with relatively thin alluvial deposits in the active stream channels. Bedrock in the mine area consists primarily of the Proterozoic Yellowjacket formation. Within the Blackbird Mountain quadrangle, the Yellowjacket Formation is divided into two major mapping units, a lower "phyllite" member and an upper "quartzite" member. Rocks in the mine area are thinly laminated and bedded micaceous quartzites, which generally dip 45 degrees north-northeast. Within the mine area, any stratigraphic correlation of more than a few feet is reportedly difficult because of intense structural deformation and metamorphism.

Major structural features in the mine area include the White Ledge shear zone and the Slippery Creek fault, which bound the occurrence of mineralization. The Blackbird Structural Block is defined as the area between these features. The White Ledge shear zone is a series of northerly trending faults in the Blackbird Mine area, and marks the western boundary of mineralization in the area. It is visible as a massive shearing zone in the Blacktail Pit. The Slippery Creek fault marks the eastern boundary of mineralization in the Blackbird Mine area. The fault is north-northwest trending and is distinguished by a lithological change, with schistose units on the west side and massive quartzite on the east. The fault crosses Blackbird Creek about 1 mile downstream from the Water Treatment Plant and extends northward through Hawkeye Gulch.

5.3.3 Meteorology

The annual average temperature at the Blackbird Mine Site is 36 degrees F. Average maximum temperature ranges from 25 degrees F in January to 75 degrees F in July. The average minimum temperatures range from 5 degrees F in January to 42 degrees F in July. The summer season climate is described as cool, dry, with occasional thunderstorms and relative humidity less than 25%.

The average annual precipitation at the mine site, based on a 10-year period, is 20 inches. The highest mean precipitation occurs in June and the lowest occurs in September. More than half of the precipitation occurs in the spring and winter months, and 30% occurs during spring alone. The greatest precipitation recorded in one month at the mine site was recorded in May at 5.3 inches and the highest annual total was 25 inches. Snow depth on the ground during January and February ranges from 5 to 17 inches.

Prevailing winds are from the west; however, they are altered by the surrounding terrain in the area of the mine site. Canyons and ridges in the area tend to channel the winds. Winds on the Blackbird Creek side of the site tend to be channeled upslope and winds on the Bucktail Creek side tend to be channeled downslope. The data record for the mine site indicated that winds less than 11 mph occurred more than 64% of the time and high wind occurrences, consisting of wind speeds in excess of 30 mph, were recorded less than 2% of the time.

5.3.4 Surface Water Hydrology

The snowpack runoff volume, rate, and distribution in time were evaluated during the Early Actions to establish hydrologic design criteria for the site. Runoff from the 500-year 24-hour storm was used to determine peak flows as the design criteria for conveyance facilities. The 100-year snowmelt hydrograph was used as the design basis for determining the amount of storage and treatment capacity needed. The 500-year precipitation was established as 3.15 inches in 24 hours, with an SCS Type II temporal distribution.

Stream gauging was conducted from 1995 through 2002 as part of both Early Action and RI activities at several stations in Blackbird Creek, Panther Creek, South Fork Big Deer Creek, and Big Deer Creek. Continuous gauging was conducted during snowmelt runoff through base flow conditions in the fall. Transducers were removed prior to the onset of winter to prevent damage from freezing.

5.3.5 Hydrogeology

Groundwater at the Blackbird Site occurs both in unconsolidated surficial deposits and as fracture-controlled bedrock systems. Hydrologic communication exists between these two flow systems and with area surface waters. Groundwater discharge to the surface water via several adits associated with the mine workings occurred prior to the implementation of Early Actions. These adit discharges were controlled as part of the Early Actions. Groundwater also discharges as seeps and springs.

5.3.5.1 Groundwater Flow in Unconsolidated Surficial Deposits

Alluvial deposits in stream valleys and deposits of mine waste both serve as local, surficial pathways for groundwater flow and potential contaminant transport. Hydrologic communication between surface water, alluvial deposits, mine waste material, and bedrock occurs within the mine area. Many seeps are located at the foot of waste piles and may represent both discharge of infiltrated precipitation and groundwater discharge occurring underneath the waste pile. Most of these were controlled as part of Early Actions. Groundwater seeps not controlled by Early Actions were investigated as part of the RI.

Several monitoring wells were installed within alluvial deposits during investigations conducted prior to the RI, including upstream and downstream of the Slippery Creek Shear Zone and downstream of the West Fork Tailings Impoundment. These wells were monitored during the RI and are shown on Figure 5-4.

Meadow Creek/Upper Blackbird Creek Area

Alluvial groundwater in Meadow Creek and the upper portion of Blackbird Creek flows through waste rock in the valley bottom that was capped as part of Early Action activities. Following completion of Early Actions, the alluvial groundwater has been intercepted by a cutoff wall near the Water Treatment Plant and transported to the plant for treatment. Downstream of the cutoff wall, alluvial groundwater eventually discharges to Blackbird Creek.

Bucktail Creek Area

Alluvial deposits in this area are relatively thin. Upward gradients of 0.3 to 0.9 are present within nested bedrock wells (BTMW-03B and BTMW-03C) on the east side of Bucktail Creek, indicating that groundwater discharge to the thin alluvial deposits associated with Bucktail Creek, and ultimately to the creek itself, is likely in this area. On the west side of Bucktail Creek, water level data from BTMW-04B and BTMW-04C indicate that a low downward hydraulic gradient to no gradient (0.1 to 0.0) is present.

The source of the remaining loads in Bucktail Creek is likely from the groundwater system that is expressed between the 7000 Dam and station BTSW-01.6. This is supported by the data from the monitoring wells and the synoptic surface water sampling (see Section 5.3.5). The source of the metals in the deep groundwater system cannot be established with certainty, but could be the result of waste rock or the mine workings.

West Fork Tailings Impoundment

Eleven monitoring wells were installed in and adjacent to the West Fork Tailings Impoundment during the spring of 1993. Nine of the wells are completed in alluvial materials and two are completed in bedrock. Based on water level and pump test data from the wells, it was concluded that:

- Static water levels indicate that the tailings are dewatered and well drained;
- The unconfined alluvial aquifer and the bedrock aquifer are hydraulically connected; and
- Hydraulic conductivity within the alluvial aquifer ranges from 1.0×10^{-4} cm/s to 3.5×10^{-5} cm/sec.

Groundwater seepage from the West Fork Tailings Impoundment discharges to Blackbird Creek downgradient of the dam.

5.3.5.2 Groundwater Flow in Bedrock

Bedrock groundwater flow is controlled by structural features, including faults, fractures, joints, and mining related features. Primary permeability of the rock is assumed to be very low. Northwest trending fractures and faults between the White Ledge shear zone and the Slippery Creek fault have likely controlled groundwater flow and associated hydrothermal ore emplacement. The RI reported that the major fracture pattern strikes N10 degrees W to N50 degrees W and dips from 25 degrees to 60 degrees east. The RI also noted that at the 6850-foot level, groundwater was observed flowing to the adit along fractures, supporting the conclusion that the fractures are the primary pathway for groundwater movement. The RI suggests that the direction of groundwater flow follows the northeast dip of the ore bodies, based on tracer experiments conducted in diamond drillholes within the mine.

Field data from monitoring wells and drillholes indicate that the upper portion of Meadow Creek (near the 7100 Portal) loses water to the groundwater system, while further downstream, near the water treatment plant, Meadow Creek is gaining water from the groundwater system.

Numerical groundwater flow modeling was performed to evaluate the influence of the Blackbird Site workings on the regional groundwater flow system and to evaluate the potential for water losses to groundwater during use of the mine for water storage. Based on the field data and on the results of all the numerical modeling simulations, the following conclusions were made:

- The Blackbird Site workings significantly alter the regional groundwater flow system by creating a large area of drawdown. Upward hydraulic gradients are present below the mine workings. The upward gradients persist when the mine water level is elevated from 6850 feet to 7120 feet.

- Groundwater recharge and discharge into Meadow Creek are controlled by mine water levels, and an increase in mine water levels would be expected to reduce the length of Meadow Creek losing water to the groundwater system.

None of the modeling scenarios predicted flow from the mine area into the Little Deer Creek drainage. In fact, the presence of the mine workings induces flow from east of the topographic divide between Meadow Creek and Little Deer Creek into the mine workings.

5.3.5.3 Groundwater at the Mine Site

Groundwater at the mine site has been characterized during the RI by collection of water quality samples from 11 monitoring wells – two wells in the Blackbird Creek drainage, three wells in the Bucktail Creek drainage, and six wells at the West Fork Tailings Impoundment.

Blackbird Creek Drainage

Two sets of nested wells have been monitored during the RI in the Blackbird Creek drainage. Well set BBMW-01 is located about 700 feet downstream from the water treatment plant. It consists of three wells (A, B and C) screened respectively at 11 to 16 feet, 25 to 35 feet, and 51 to 61 feet. Well set BBMW-02 is located across the Blackbird Creek channel from the water treatment plant. It also consists of three wells (A, B and C) screened respectively at 12 to 17 feet, 40 to 50 feet, and 85 to 95 feet.

Bucktail Creek Drainage

Three monitoring wells have been sampled in the Bucktail Creek drainage during the RI. Well BTMW-03B is located just downstream from the upper sediment dam. It is screened in the shallow bedrock at 37 to 47 feet below ground surface (bgs). The other two monitoring wells are located at the West Lobe removal area. Monitoring well BTMW-9601 is located downgradient from the removal area and is screened at 7.5 to 27.5 feet bgs. Monitoring well BTMW-9602 is located upgradient from the removal area and is screened at 15 to 35 feet bgs.

West Fork Impoundment Area

Six monitoring wells were sampled in the vicinity of the West Fork Impoundment during the RI. Three of these wells (WFMW-1, 2 and 4) are located downgradient from the West Fork Dam. Three of the wells (WFMW-6, 11 and 13) are located within the tailings impoundment itself. Screening depths below ground surface are not known because many of the well casings were altered subsequent to the drilling of the wells in 1993. Screened intervals were generally 15 or 20 feet in depth and were placed to characterize the groundwater within the bedrock and in the materials above the bedrock.

Sampling Results

Ranges of COCs measured from monitoring well sampling for the various locations are shown in Table 5-1a. These data were collected in 1995, 1999 and 2000.

Table 5-1a Summary of Monitoring Well Data at the Mine Site				
Contaminant of Concern	**Blackbird Creek Wells (mg/L)**	**Bucktail Creek Wells (mg/L)**	**West Lobe Wells (mg/L)**	**West Fork Impoundment Wells (mg/L)**
Arsenic	0.001 to 0.070	0.001 to 0.020	0.002U to 0.04U[a]	0.006 to 0.0945
Cobalt	0.003U to 3.05	0.003U to 12.2	0.004 to 0.223	0.005U to 21.2
Copper	0.003U to 1.13	0.048 to 42.1	0.003U to 0.075	0.003 to 0.972

U = Non-detect
[a] All samples were non-detect.

5.3.5.4 Groundwater in Private Water Supply Wells

In addition to the monitoring wells sampled at the Blackbird Mine, one round of sampling was conducted at five residential water supplies in the vicinity of the mine during 1995. The Panther Creek Inn (PCI) Well No. 1 was sampled in June 1995 and the other water supplies were sampled in late September 1995. A second well was constructed at the PCI property in 2000. Both Panther Creek Inn wells (Nos. 1 and 2) were sampled in September 2002. Residential wells and water supplied by springs to private residences in the vicinity of the Blackbird Mine Site are shown on Figure 5-4.

Results of analyses are presented in Table 5-1b. Arsenic was detected at concentrations exceeding the new Safe Drinking Water Act (SDWA) maximum contaminant limit of 0.010 mg/L in samples collected from the George Fernandez water supply, the Warburton well, and at PCI Well No. 2. The arsenic concentration in the Fernandez water supply was 0.078 mg/L. However, the low levels of cobalt and manganese detected in the Fernandez water supply indicate that this source is not likely to have been impacted by the mine site (the mine waters are typically elevated in cobalt and manganese). In addition, the Fernandez water supply is a spring located several hundred feet above the elevation of Panther Creek. The elevated arsenic concentration apparently results from natural mineralization in the area and is not a result of the Blackbird Mine Site. Arsenic in the Warburton well was 0.023 mg/L. However, the low levels of cobalt and manganese in the well waters indicate that this source is not likely impacted by the mine site. The arsenic in PCI Well No. 2 was 0.016 mg/L. However, the manganese in PCI Well No. 2 is significantly higher than would be expected from mining-related sources. In addition, the overall groundwater chemistry, the odor, and color in the water from this well indicate a localized source. EPA has recommended that PCI Well No. 2 be abandoned and plugged.

5.4 REMEDIAL INVESTIGATION SAMPLING RESULTS

Remedial investigations were conducted from 1995 through 2001 and are described in detail in the *Final Blackbird Mine Site Remedial Investigation Report* and in the *Remedial Investigation Addendum - 2001 Sample Results*. Remedial investigations included studies to determine the nature and extent of contamination in waste rock deposits, tailings deposits, surface waters, in-stream sediments, overbank soils, and groundwater at the Blackbird Mine site and surrounding area. These investigations included an evaluation of the quantity and concentrations of metals (mass loading) released from known or potential sources during various hydrologic conditions. The Early Actions have resulted in a reduction in dissolved metals transported in surface water from the mine area. A major focus of the investigations was to determine the mass loading of metals from residual and remaining sources following implementation of the Early Actions.

The RI investigations conducted during 1995 included comprehensive investigations to evaluate the nature and extent of contamination prior to implementing Early Actions. Post-Early Action investigations to evaluate improvements to water quality began in the Spring of 1998 for the portion of the Site that includes Meadow and Blackbird Creeks, and in the Fall of 1998 for the portion of the Site that includes Bucktail, South Fork Big Deer, and Big Deer Creeks.

Information developed during the RI was also used to complete both human health and ecological risk assessments. The summaries of the risk assessments are included in Section 7 of this ROD. The sampling results for each of the media at the Site are summarized in the following sections.

5.4.1 Waste Rock Deposits

Table 5-2 summarizes the available concentration data for waste rock in the areas remaining after Early Actions. The data reflect waste rock encountered in test pits and boreholes completed in known waste rock deposits. Table 5-2 reports the range, mean, and median concentrations of arsenic, copper, and cobalt (where available) in each area. Median concentrations are discussed here because in some areas the mean values were artificially elevated by single samples with unusually high (but presumably valid) concentrations. Cobalt concentrations were generally not reported because most of the samples tested below the detection limit for cobalt of the x-ray fluorescence (XRF) instrument (detection limit is1,500 mg/kg cobalt).

Among the remaining waste rock that was sampled, the waste rock in the eastern portion of the West Lobe has the highest median concentrations for both copper (1,850 mg/kg) and arsenic (1,155 mg/kg). However, the maximum sampled concentrations for copper (20,200 mg/kg) and arsenic (5,900 mg/kg) were located in the 7800 Waste Rock Dump. The Haynes-Stellite area had the lowest median copper concentration and the second lowest median arsenic concentration from among the sampled areas.

5.4.2 Tailings Deposits

Approximately two million tons of tailings were deposited in the West Fork Tailings Impoundment during the active mining operations. An unknown quantity of tailings were also deposited in overbank areas along the streams downstream from the mine during high flow events.

5.4.2.1 West Fork Tailings Impoundment

Soil sampling was conducted on the surface of the West Fork Tailings Impoundment following completion of 2001 removal activities. Sampling was conducted along five transects across the impoundment with four samples collected from each transect. Transect 1 was located near the dam, with the other four transects spaced about 300 feet apart between the dam and the upstream limit of the impoundment. The samples were composited and analyzed using the XRF instrument. The results of the sampling are included in Table 5-3. Transect 1 (nearest the dam) had the highest arsenic and iron concentrations (554 and 39,900 mg/kg, respectively). Transect 5 (near the upstream end of the impoundment) had the highest copper concentration at 650 mg/kg.

5.4.2.2 Overbank Deposits

Overbank tailings and waste rock materials were deposited along Bucktail Creek, Big Deer Creek, at the Panther Creek Inn (PCI) and along Panther Creek downstream from the Panther Creek Inn. Many of these deposits were removed as part of the Early Actions. Details of the removal actions are provided in Section 2 of this ROD.

<u>Bucktail Creek</u>

A significant debris flow occurred in Bucktail Creek due to a large thunderstorm on July 31, 1994. The debris flow transported soil and mine waste along the length of the creek to its confluence with South Fork Big Deer Creek. A significant portion of the debris flow materials were removed during the Early Actions; however, it was not practical to remove many of the smaller deposits. Following the removals, debris and waste rock samples were collected along the valley bottom along lower Bucktail Creek between the Upper and Lower Bucktail Creek Sediment Control Dams. The results of the sampling are shown in Table 5-4. Additional discussion of overbank deposits along Bucktail Creek is included in Section 5.3.4.

Big Deer Creek

Along Big Deer Creek and South Fork Big Deer Creek, no removal actions have occurred. The maximum sampled copper, cobalt, and arsenic concentrations along South Fork Big Deer Creek were 42,000 mg/kg, 1,600 mg/kg, and 820 mg/kg, respectively (see Table 5-5). The corresponding median concentrations were 7,450 mg/kg, 750 mg/kg, and 605 mg/kg. The samples with the highest concentrations were obtained from areas where copper precipitates were observed. Along Big Deer Creek, the maximum sampled copper and arsenic concentrations were 17,200 mg/kg and 268 mg/kg, respectively. The maximum sampled cobalt concentration along Big Deer Creek was 619 mg/kg in laboratory samples. Additional discussion of overbank deposits along South Fork Big Deer Creek is included in Section 5.3.4.

Blackbird Creek

Along Blackbird Creek, a number of overbank deposits were removed during 1999 Early Actions, and these areas were sampled for post-removal confirmation. Other areas were sampled in 1995, but have not yet been removed. In addition to the 1995 and 1999 sampling, extensive sampling was conducted in 2001 along Blackbird Creek downgradient of the mine in order to better characterize overbank deposits.

For overbank deposits in areas along Blackbird Creek where no removal has taken place, the maximum sampled concentrations for copper, cobalt, and arsenic were 41,000, 97,700, and 138,000 mg/kg, respectively (see Table 5-5). The corresponding median concentrations were 540, 750, and 2100 mg/kg. The relatively small median values (up to two orders of magnitude smaller than the corresponding maximum values) indicate that a large number of the sampled concentrations were significantly smaller than the maximum values.

Overbank deposits in areas along Blackbird Creek, where removal has taken place, had maximum sampled concentrations for copper and arsenic of 3,000 and 20,270 mg/kg, respectively. No results are available for cobalt. The corresponding median concentrations are 570 mg/kg and 970 mg/kg.

Panther Creek Inn

A major portion of the overbank deposits in the area of the Panther Creek Inn were removed during 1998. As originally planned, the overbank materials were excavated to a depth of approximately 1 foot. If visually obvious tailings materials were encountered at a depth greater than 1 foot, the excavation continued until native soils were encountered or until the water table was reached. Testing with the XRF instrument generally indicated that there were contaminated materials over most of the area at depth down to the water table. Thus, excavation generally proceeded to the water table throughout the Panther Creek Inn and associated campground areas.

Table 5-5 includes results of samples in areas where removal did not take place. For these samples, the maximum sampled copper, cobalt, and arsenic concentrations were 116, 94, and 64 mg/kg, respectively. Table 5-5 also includes post-removal sampling results in areas where removal occurred. The maximum sampled concentrations were 4,500 and 1,900 mg/kg for copper and arsenic, respectively (cobalt results were not reported since all results were below the XRF detection limit for cobalt). All the samples containing higher metal concentrations were collected at the water table and have been covered with a minimum of 1 foot of clean fill and topsoil.

Additional surface soil sampling was conducted in fall 2002 in the Panther Creek Inn area to characterize areas not removed during the Early Actions and to characterize areas that have been disturbed since the Early Actions. Additional risk evaluations will be conducted based on this sampling to determine if additional actions are required at the Panther Creek Inn area.

<u>Panther Creek Downstream from Panther Creek Inn</u>

Removal actions were conducted between 1999 and 2001 downstream from the Panther Creek Inn. These removal actions are summarized in Section 2 of this ROD. Removal actions along Panther Creek were conducted to meet preliminary removal goals (PRGs) established by EPA. Following removal, the backfilled soil was seeded with native vegetation or pasture grasses. The PRGs varied from 100 mg/kg arsenic for a residential exposure scenario to 590 mg/kg arsenic for a recreational exposure scenario.

In several cases, samples exceeding PRGs were not removed because removing them would have required significant alteration to the existing stream channel, would have caused significant damage to local vegetation, or would have adversely affected the stability of an adjacent soil slope. These samples were typically covered with a minimum of 12 inches of fill and topsoil and were then seeded.

The *Site-Wide Human Health Risk Assessment* concluded that the risks were acceptable under the current use scenario for the Rogers, Rufe, and Strawn properties (see Figure 5-5 for the locations of these properties). No removals were conducted as part of the Early Actions at these properties. However, under the future residential scenario, the risks are estimated to be unacceptable for these areas (see Section 7.1 of this ROD). The overbank soil sampling results for these areas are summarized on Figures 5-6 through 5-9. Screening level sampling at the Hade property indicated that there may be unacceptable risks at this property. However, the sampling was not sufficient to adequately characterize the risks. Access for additional sampling on the Hade property has been denied by the property owner. Therefore, the EPA is unable to fully evaluate the risks for this property.

Contamination Remaining Along Panther Creek Following the Early Actions

During the Early Actions, the depth of excavation of soils at the removal areas at the PCI and along Panther Creek generally went either to the water table or the PRGs, whichever came first. Therefore, arsenic concentrations in some of the subsurface soils at the water table, below clean backfill, are higher than the site-specific PRGs established for each area. An evaluation was performed on the potential risks associated with exposure to the subsurface soils if they are brought to the surface in the future through such actions as utility trenching, fence post hole digging, or erosion. This evaluation involved comparing the arsenic concentrations measured in the post-removal subsurface samples against the site-specific PRG. The results of this evaluation are summarized below. A discussion of the need for Institutional Controls based on these results is provided in Section 12 of this ROD.

The following sites had no exceedances of their site-specific PRGs in the subsurface soils; therefore, there is essentially no risk that PRGs would be exceeded if the subsurface soils are brought to the surface in the future.

- Riprap Bar 6
- USFS Property adjacent to Bevan
- Sillings Middle Pasture Island
- Noranda Pasture 1

The following sites had some exceedances of the PRG in the post-removal subsurface soils; however, the average arsenic concentration in the subsurface soils was less than the PRG. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is unlikely that the average arsenic concentrations would be above the PRG.

- Riprap Bars 2 and 4
- Bevan 2/2
- Sillings Middle Pasture
- Napias 1A and 1B (private and USFS)

The following sites had exceedances of the PRG in the post-removal subsurface soils, and the average arsenic concentration in the subsurface soils was less than twice the PRGs. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is possible that the average arsenic concentrations would be above the PRG.

- Riprap Bar 1
- Deep Creek Campground 2
- Bevan 2/1
- Sillings 1 (Ditch Area)
- Fernandez Low Bar 2

- Noranda Pasture 3
- Cobalt 1, 4, and 5

Based on the post-removal sampling results, the following sites had exceedances of the PRG in the post-removal subsurface soils, and the average arsenic concentration in the subsurface soils was greater than twice the PRGs. In the event that subsurface soils are brought to the surface, in the vicinity of the disturbance it is likely that the average arsenic concentrations would be above the PRG.

- Panther Creek Inn area
- Riprap Bar 3 and 5
- Sillings Lower Pasture (Sillings 4/1 and 4/2)
- Sillings Upstream Low Bar
- Fernandez Low Bar 1
- Noranda Pasture 2B
- Cobalt 2 and 3

5.4.3 Roads and Other Soils

A number of potentially mine impacted soil samples have been collected from areas that are not considered to be within waste rock dumps, debris flows, or overbank deposits. Table 5-6 summarizes available soils data for Panther Creek Road, the mine road in the Meadow Creek Basin, the mine road in the Bucktail Creek Basin, areas surrounding the waste-rock dumps, and in diversion ditches near the waste rock dumps. The respective maximum sampled arsenic concentrations are 67 mg/kg, 1,040 mg/kg, 2,430 mg/kg, 3,500 mg/kg, and 3,800 mg/kg. Corresponding median arsenic concentrations are 40 mg/kg, 702 mg/kg, 1,320 mg/kg, 310 mg/kg, and 75 mg/kg.

5.4.4 In-stream Sediments

In 1995, stream bottom sediments were sampled in Blackbird Creek, South Fork Big Deer Creek, Big Deer Creek, and Panther Creek. The purpose of the sediment sampling was to characterize metal concentrations in the different sediment types and to provide the basic information necessary to estimate the areal extent and mass of metals contained in stream bottom sediments. Forty-three sediment samples were analyzed for metals onsite by XRF. Metal analytes included As, Co, Cu, Fe, and Mn.

Sediment sampling was conducted again during 2000 and 2001 to provide information following completion of the Early Actions. Sampling was conducted in Panther Creek, Big Deer Creek, and South Fork Big Deer Creek at approximately half the locations that were sampled in 1995. Within Blackbird Creek, approximately one-quarter of the locations sampled in 1995 were sampled during 2000 and 2001. Sampling locations were spread throughout the entire length of each stream below potential mine impacts.

Table 5-7 compares sediment concentrations at locations that were sampled during both 1995 and 2000. Table 5-8 compares sediment concentrations at locations that were sampled during 2000 and 2001. A statistically valid comparison of pre-Early Action sediment values and post-Early Action sediment values is difficult because of the heterogeneity of the sediments and the variability from year to year due to downstream sediment transport. However, it appears that arsenic, copper and cobalt concentrations in sediments have generally been reduced since completion of the Early Actions.

Geochemical modeling was conducted to determine the potential for significant releases of metals to the water column in area streams. Except in the Bucktail Creek and the South Fork Big Deer Creek, it was determined that the potential for significant releases of metals from sediments was low. This is because the metals are mostly in the form of secondary minerals with strong adsorption to iron and manganese oxyhydroxides in the sediments. Desorption from iron and manganese oxyhydroxides in Big Deer and Panther Creeks may result in some trace metal loading. However, desorption profiles are generally smooth indicating a very slow release of metals as a new equilibrium is reached between the aqueous and adsorbed phases. The observed decrease in total sediment metal concentrations between pre and post-Early Action sediment data may be attributable to physical sediment transport, that is to say, the scouring and mobilization of fine-grained sediments downstream combined with reduced loading to the sediments as a result of improvements in water quality.

There are metals in the in-stream sediments and adjacent overbank deposits (including debris flow deposits) along Bucktail Creek. Most of these metals are in the form of copper carbonates which have been deposited in the past. These copper carbonates can be comparatively easily re-dissolved and re-mobilized under conditions of reduced metals concentrations in the overlying water column. If the copper concentrations in Bucktail Creek waters are substantially reduced, it is likely that the copper carbonates in the sediments will re-dissolve and be released to the surface waters. In addition, the copper carbonates in the overbank deposits are likely to be easily re-dissolved and flushed into Bucktail Creek during rainfall and/or snowmelt. The amount and duration of the potential releases from the Bucktail Creek sediments and overbank deposits is not known. Downstream from the lower Sediment Dam, there are deposits of debris flow materials along the old channels of Bucktail Creek. Limited sampling in these materials indicates elevated concentrations of metals. The amount and duration of potential releases from these debris flow deposits is not known.

In South Fork Big Deer Creek, trace metal release from sediments is believed to be primarily responsible for the current observed increases in copper and sulfate concentrations between SFSW-02 and SFSW-01. Copper carbonate dissolution is believed to be the primary mechanism responsible for dissolved copper loading. Sulfate loading is likely the result of desorption or sulfate mineral dissolution. There is also evidence of copper carbonate deposits in the overbank areas adjacent to the South Fork Big Deer Creek (ex. historic stream channels), which could be readily re-dissolved and flushed into South Fork Big Deer Creek during rainfall and/or snowmelt. The amount and duration of potential releases from these overbank deposits is not known.

5.4.5 Surface Waters

The surface waters at the Site were sampled at different times of the year using a variety of methodologies to characterize the variations in water quality. The surface water sampling results summarized below include only data collected since the completion of the Early Actions. The primary purpose of the surface water sampling was to determine the remaining sources of metals loading that need to be addressed through remedial actions. The surface water sampling included diel sampling, periodic sampling, storm sampling, and synoptic sampling. The sampling locations are shown on Figure 5-4.

5.4.5.1 Diel Sampling Results

Diel sampling was conducted over a 24-hour period in both the Blackbird Creek basin and in the Big Deer Creek basin during spring runoff to determine if there were significant variations in water quality during the day.

Diel sampling was conducted at the mouth of Blackbird Creek (BBSW-01A) on April 30 and May 1, 1998. There was almost no variation in total or dissolved cobalt and dissolved copper concentrations. There was an increase in total copper that lasted from about 6:00 p.m. to midnight on April 30. By 8:00 a.m. on May 1, the total copper returned to concentrations comparable to the beginning of the sampling period even though flows were significantly higher. The highest total copper concentrations were apparently associated with an increase in turbidity and total suspended solids that corresponded with the increasing flows for the samples collected between 6:00 p.m. and midnight.

A round of diel sampling was conducted in the Big Deer Creek drainage at stations SFSW-04, SFSW-01, BDSW-04, and BDSW-03 from May 23 to May 24, 2000. The May 23/24 diel sampling was conducted during peak seasonal flow on Big Deer Creek (as measured at BDSW-03) and just prior to peak flows on South Fork Big Deer Creek (measured at SFSW-01). Though slight variations in metals concentrations and loading were observed during the event, no conclusive diel variation was observed. The observed runoff during this sampling event did not follow an “ideal” diel pattern of flow increases that correspond to melt during the day followed by flow decreases that result from cooler night temperature.

5.4.5.2 Periodic Sampling Results

Post-Early Action water quality sampling was conducted periodically at selected stations during spring runoff to evaluate variability (i.e., rising and falling limbs of the hydrograph) and to identify periods of maximum concentrations and loading. This section summarizes results from selected stations.

In Blackbird Creek, weekly sampling was conducted at BBSW-01A, which is located near the mouth of Blackbird Creek, between March 27 and June 2, 2000. Between April and late May, flow in Blackbird Creek generally increased as the result of snowmelt runoff. From late May to early June, flow generally decreased. Cobalt concentrations generally declined as flow increased. This is an indication that base flow discharges from the West Fork Tailings Impoundment are the likely source of much of the cobalt loading observed. These discharges are diluted by snowmelt runoff resulting in higher flows. Copper behavior was observed to be different than that of cobalt. Copper concentrations generally increased as flow increased between late March and mid-May. Copper concentrations then declined as flow declined.

Samples were also collected weekly at Panther Creek stations PASW-10, PASW-11, PASW-09, PASW-04 and PASW-05 (March 27 to June 2, 2000). In general, cobalt and copper concentrations followed the same trends as those observed at BBSW-01A. Weekly samples were also collected during the 1999 spring runoff at BBSW-01A, PASW-10 and PASW-04. In general, the 1999 results were similar to those described for the 2000 weekly sampling.

Sampling was conducted intermittently from April 6 through May 24, 2000 (six sampling events) at the following stations in the Big Deer Creek drainage basin: SFSW-04, SFSW-01, BDSW-04, and BDSW-03. Panther Creek stations PASW-05 and PASW-04 were also sampled in conjunction with periodic sampling on Big Deer and South Fork Big Deer creeks. Stations SFSW-04 and BDSW-04 are the background stations for South Fork Big Deer and Big Deer Creeks, respectively. Downstream stations SFSW-01, BDSW-04 and PASW-04 exhibited similar trends over this period. At all three stations, increases in copper and cobalt loading were observed with increases in flow.

Intermittent periodic sampling was also conducted in 1999 at several of the stations in the Big Deer Creek drainage basin. However, there were only three sampling events, and not all stations were sampled during each event. Therefore, the results of this periodic sampling were inconclusive.

Periodic sampling was conducted monthly at BBSW-01A and PASW-9 during 2001 and 2002 to better define the variations in cobalt concentrations throughout the year. The results of this sampling are included in Table 5-9. In general, cobalt concentrations in Blackbird and Panther Creeks peak during the winter and early spring. The concentrations decrease with increasing flows during spring runoff, then slowly begin increasing again as flows decrease following spring runoff.

5.4.5.3 Storm Sampling Results

Storm event sampling was conducted to evaluate metals loading during and immediately following storm events. In 1998, two storm events in the Blackbird drainage (June and September) were sampled. Samples for these storm events were collected manually at BBSW-07, BBSW-03A and BBSW-01A. Results of this sampling were inconclusive. Therefore, in 1999, flow-actuated automated samplers were installed at BBSW-01A and SFSW-01 to capture storm events in the Blackbird and Bucktail drainages, respectively.

On August 28, 1999, a storm event in the Blackbird drainage triggered the automatic sampler at BBSW-01A. The August 28, 1999 storm was likely typical of a small summer storm. Sampling began during the initial peak in streamflow. Analytical results indicated an increase in dissolved copper, cobalt and manganese concentrations of between 70% and 260% in comparison to the most recent sampling event prior to the storm. Maximum total metals loading rates (calculated as daily load) were 13.4 kg/day cobalt, 6.97 kg/day copper and 6.56 kg/day manganese. Tailings removal was occurring along Blackbird Creek immediately prior to this storm event. Observed loading during this storm are likely partially attributable to flushing of sediments disturbed during tailings removal. Loading rates for both total and dissolved metals as a result of the storm event were considerably less than the loading during the spring 1999 runoff.

There were no storm events that triggered the automated samplers in the Bucktail Creek drainage in 1999 or 2000. The storm samplers were able to capture a storm event on July 30-31, 2001. Samples were collected at three stations: BTSW-02, BTSW-01.1, and SFSW-01. Precipitation during this storm event was 0.6 inches over a 24-hour period, which represents a small to moderate storm event.

Due to a sampler failure, total metals data are not available at BTSW-02 (just downstream from the upper sediment dam). Dissolved metals did not show significant variability at this station during the storm.

At station BTSW-01.1 (just upstream from the lower sediment pond in the Bucktail Creek drainage), a large increase in total copper concentration was observed (from 1.25 to 7.03 mg/L) approximately two hours after the beginning of the storm. The large increase in total copper concentrations was likely due to the scouring of sediments high in copper carbonates due to the increase in stream flows. The total copper concentrations slowly decreased until reaching pre-storm concentrations at the end of the storm event. Overall, dissolved copper concentrations, total cobalt concentrations, and dissolved cobalt concentrations remained relatively stable at this station throughout the storm event.

In the Bucktail Creek drainage, both dissolved and total copper and cobalt concentrations at downstream station SFSW-01 remained fairly stable throughout the storm event. The large increase in total copper concentrations seen at BTSW-01.1 was not observed at SFSW-01, probably due to settling of suspended sediments high in copper carbonates in the lower sediment pond. A gradual increase in total copper was observed during the course of the storm event, from 0.098 to 0.153 mg/L. Dissolved copper also increased slightly during the storm event, from 0.086 mg/L to 0.093 mg/L. These concentrations are comparable to the spring synoptic dissolved copper concentration of 0.080 mg/L and the fall synoptic concentration of 0.092 mg/L. Dissolved cobalt exhibited a slight increase during the storm event, from 0.104 to 0.124 mg/L.

5.3.5.4 Synoptic Sampling Results

Synoptic sampling was conducted during the rising limb of the snowmelt runoff hydrograph and during base flow conditions to determine the remaining sources of metals loading. In synoptic sampling, an attempt is made to sample the same parcel of water as it moves downstream. Synoptic sampling is conducted by collecting the first sample at the most upstream point of interest on the stream and then sampling the downstream stations sequentially while taking into account the travel time of the water based on flow velocity. Sampling in this manner allowed comparison between specific reaches of the stream to determine whether the stream between the stations is a gaining or losing reach in terms of both flow and metals loading.

Spring and fall synoptic sampling were conducted to characterize post-Early Action conditions in the Meadow/Blackbird Creek basin in each year from 1998 through 2001. Because Early Actions were not completed in the Bucktail/Big Deer Creek basin until 1998, the spring and fall synoptic sampling was conducted from 1999 through 2001. While there was variability among the years, primarily due to changing hydrologic conditions, the synoptic sampling results were fairly consistent from year to year. The synoptic sampling results for the spring and fall 2000 sampling events are most representative of the period of sampling and are discussed below. Complete results of all synoptic sampling events are included in the RI and the Addendum to the RI.

<u>Meadow/Blackbird Creek Spring Synoptic Sampling</u>

Results for the Meadow Creek spring synoptic sampling for 2000 for copper and cobalt are presented on Figures 5-10 and 5-11. Between locations MCSW-EA04.35 and MCSW-EA04, a significant increase in copper loading was observed. Concentrations of dissolved copper increased from 0.039 mg/L to 3.62 mg/L, and total copper increased from 0.048 mg/L to 3.73 mg/L. Dissolved cobalt concentrations increased in a similar manner from 0.155 mg/L to 1.510 mg/L. These increases are likely due to ground and surface water passing through a debris deposit near the foot of the 7800 Waste Rock Dump, and then entering Meadow Creek via the 7100 West Diversion System. These waters bypass the 7800 Collection System.

Blackbird Creek spring synoptic sampling results for 2000 for copper and cobalt are provided on Figures 5-12 and 5-13. Similar results were obtained during the spring synoptic sampling in 1999 and 2001. Cumulative loading from the Meadow Creek/Upper Blackbird Creek area is best measured at station BBSW-07A. Dissolved copper and cobalt loading at station BBSW-07A were 1.64 kg/day, with a corresponding concentration of 0.447 mg/L, and 1.42 kg/day, with a corresponding concentration of 0.387 mg/L, respectively. Total copper and cobalt loads were 4.70 kg/day, with a corresponding concentration of 1.280 mg/L, and 1.46 kg/day, with a corresponding concentration of 0.398 mg/L.

When compared to station BBSW-07A, at BBSW-07 concentrations of dissolved copper declined (from 0.447 mg/L to 0.260 mg/L). Although concentrations declined, dissolved loading increased during increasing flow to 2.41 kg/day. Total copper loading increased to 8.06 kg/day, with a corresponding concentration of 0.867 mg/L. Dissolved and total cobalt concentrations and loading increased between stations BBSW-07A and BBSW-07, primarily as a result of wastewater treatment plant discharges (0.935 mg/L dissolved cobalt). Dissolved cobalt was 0.387 mg/L at BBSW-07A and 0.782 mg/L at BBSW-07. Loading increased from 1.42 kg/day at BBSW-07A to 7.27 kg/day at BBSW-07, of which 4.2 kg/day was contributed by the wastewater treatment plant discharge. Dissolved and total copper concentrations and loading generally decreased along Blackbird Creek downstream of BBSW-07, whereas cobalt concentrations decreased but loading increased.

Downstream of BBSW-07, concentrations of dissolved copper generally declined to the mouth of Blackbird Creek, with the exception of an increase between stations BBSW-02 (0.050 mg/L) and BBSW-01.5 (0.054 mg/L). Dissolved copper concentrations decline overall between stations BBSW-07 and BBSW-01A from 0.260 mg/L to 0.044 mg/L, respectively, with load following a similar trend decreasing from 2.41 kg/day to 1.42 kg/day.

Overall, dissolved cobalt concentrations declined between BBSW-07 and BBSW-01A, from 0.782 mg/L to 0.387 mg/L. However, there are some areas of increased cobalt loading. A small amount of cobalt loading (0.59 kg/day, with a corresponding concentration decrease of 0.021 mg/L) was observed between BBSW-07 and BBSW-06. A load increase between BBSW-03A and BBSW-02 of 7.09 kg/day (with a corresponding concentration decrease of 0.09 mg/L) was measured, with most of the loading attributable to discharges from the West Fork Tailings Impoundment area.

<u>Meadow/Blackbird Creek Fall Synoptic Sampling</u>

The results of the fall 2000 synoptic sampling for copper and cobalt on the Meadow Creek drainage are presented on Figures 5-14 and 5-15. As in the spring, an increase in copper concentration and loading was observed between locations MCSW-EA04.35 and MCSW-EA04. Concentrations of dissolved copper increased from 0.020 mg/L to 0.815 mg/L, and total copper increased from 0.023 mg/L to 1.05 mg/L. Dissolved cobalt concentrations increased in a similar manner from 0.118 mg/L to 0.822 mg/L. These results are similar to the spring results, suggesting there is likely a source of metals loading between these locations, which is likely debris-flow materials below the 7800 Waste Rock Dump and/or seepage that is not being collected for treatment by the 7800 Collection System.

The dissolved copper loading in the Meadow Creek basin during the fall 2000 sampling event was significantly lower than that observed during the spring synoptic event. The dissolved copper concentration was 0.815 mg/L and loading was 0.06 kg/day at MCSW-04. Dissolved cobalt was 0.822 mg/L and loading was 0.06 kg/day at this station. Although flow increased from 0.03 cfs to 0.04 cfs, dissolved copper and cobalt concentrations and loading decreased to 0.436 mg/L and 0.043 kg/day copper and 0.472 mg/L and 0.0463 kg/day cobalt at the 7100 Bypass, which is the next station downstream of MCSW-04. Station MCSW-03 and other discharge points along Meadow Creek were dry during the fall round; therefore, loading results from the 7100 Bypass represent all loading from the Meadow Creek drainage. Dissolved and total copper loading decreased between the 7100 Bypass and BBSW-07A and cobalt remained relatively unchanged. This suggests there is no additional source of metals loading downstream of the upper Meadow Creek basin and that copper may be precipitating/sorbing in the concrete channel.

The synoptic sampling results for fall 2000 for the Blackbird drainage are presented on Figures 5-16 and 5-17. Similar results were obtained during the fall synoptic sampling in 1999 and 2001. The dissolved copper concentration at BBSW-07 increased to 0.183 mg/L and loading was 0.23 kg/day. Dissolved cobalt was 0.193 mg/L and loading was 0.246 kg/day. Flow increased from 0.4 cfs to 0.52 cfs between stations BBSW-07A and BBSW-07. This increase in flow and metals concentrations and loading downstream of BBSW-07A may be due to groundwater discharges.

Between stations BBSW-07 and BBSW-01A, upstream of the mouth of Blackbird Creek, dissolved copper concentrations and loading declined, with dissolved copper concentration at BBSW-01A of 0.010 mg/L and loading of 0.058 kg/day. Minor inputs of copper between these stations during the fall sampling event included the cumulative groundwater input of the West Fork Tailings Impoundment, which showed an increase in dissolved copper loading from 0.140 kg/day at BBSW-03A to 0.192 kg/day at BBSW-02, although dissolved copper concentrations decreased from 0.063 mg/L to 0.044 mg/L. Downstream of BBSW-02, as noted for other sampling events, dissolved copper was converted to total copper and co-precipitated with iron oxides, resulting in a decrease in copper concentrations downstream of the West Fork Tailings Impoundment.

Dissolved cobalt concentrations downstream of BBSW-07 increased to 0.298 mg/L at BBSW-03A, which is attributable to discharges from several seeps including: BBSP-11/11A, BBSP-03, BBSP-09, and BBSP-27 containing cobalt ranging from 0.453 mg/L to 1.11 mg/L cobalt. Between stations BBSW-03A and BBSW-02, increased concentrations and loading were observed for cobalt, sulfate, iron and manganese as a result of discharges from the West Fork Tailings Impoundment. Cobalt concentrations increased to 0.878 mg/L with a load increase of 3.16 kg/day from BBSW-03A to BBSW-02.

Bucktail/Big Deer Creek Spring Synoptic Sampling

In the summer of 2000 significant portions of the vegetation in Bucktail/Big Deer Creek basins were burned in the Clear Creek fire. The effects of this have resulted in a marked loss of evapro-transpiration from the larger old growth deep-rooted forest and a faster spring and storm runoff.

The spring 2000 synoptic sampling results in the Bucktail/Big Deer Creek basin for copper and cobalt are presented in Figures 5-18 and 5-19. Results were similar during the 1999 and 2001 synoptic sampling events.

The uppermost sampling locations on Bucktail Creek were two adjacent seeps that discharge into the Upper Sediment Pond, designated BTSW-03A and BTSW-03B. These samples represent seepage below the 7000 Dam on upper Bucktail Creek.

The cumulative flow from these seeps was 0.03 cfs, providing a measured cumulative dissolved copper load of 0.61 kg/day, with a corresponding combined concentration of 20.4 mg/L, above the Upper Sediment Pond. Copper loading increased between these locations and location BTSW-02 to 0.92 kg/day, with a corresponding concentration of 23.40 mg/L, indicating that groundwater containing copper in higher concentrations is discharging between the locations. Other metals showed similar increases in concentration and loading between these locations.

Water quality at BTSW-02 is used to assess the effectiveness of all Early Actions in upper Bucktail Creek. Dissolved copper concentration was 23.4 mg/L and loading was 0.92 kg/day in 2000, compared to13.8 mg/L and 6.08 kg/day in 1999. Dissolved cobalt was 6.42 mg/L with a load of 0.25 kg/day in 2000, compared to 1999 results (4.43 mg/L and 1.95 kg/day). These represent significant load reductions for both copper and cobalt. Remaining loading is likely either due to leakage from the 7000 Dam or groundwater discharges to Bucktail Creek.

Between BTSW-02 and BTSW-01.6, dissolved copper loading nearly triples from 0.91 kg/day to 2.69 kg/day due to increased flow. The dissolved copper concentration was significantly lower at BTSW-01.6 (12.5 mg/L) than at BTSW-02 (23.4 mg/L). Dissolved and total cobalt concentrations at BTSW-1.6 were 4.44 mg/L and 3.86 mg/L, respectively, with corresponding loading of 0.96 kg/day and 0.83 kg/day. BTSP-01 accounts for 0.43 kg/day of the dissolved copper loading (19.6 mg/L of the dissolved copper concentration) and 0.13 kg/day of the dissolved cobalt loading (5.71 mg/L of the dissolved cobalt concentration). Between stations BTSW-01.6 and BTSW-01.4, metals concentrations and loading decline significantly due to mineral precipitation.

Loading results at BTSW-01 are used to assess the effectiveness of all Early Actions in the upper and lower portions of the Bucktail Creek drainage. Dissolved copper was 1.12 mg/L with loading of 0.38 kg/day, showing a decrease since 1999 when concentrations were 4.68 mg/L and loading was 8.8 kg/day. As observed in past years, copper precipitation is probably the mechanism for continued declines from upstream stations. Dissolved cobalt concentration was 1.54 mg/L with loading of 0.9 kg/day.

SFSW-02 is located downstream of the confluence with Bucktail Creek. Dissolved copper was 0.088 mg/L with a load of 0.52 kg/day. Dissolved cobalt was 0.08 mg/L with a load of 0.51 kg/day. At station SFSW-01 at the mouth of South Fork Big Deer Creek, the concentration of dissolved copper increased to 0.129 mg/L from 0.088 mg/L at SFSW-02.

BDSW-03 is downstream of the confluence of South Fork Big Deer Creek. The dissolved copper concentration was 0.006 mg/L and loading at this station was 0.62 kg/day. The dissolved cobalt concentration was 0.006 mg/L with a load of 0.62 kg/day.

During the spring 2002 synoptic sampling, there was a significant increase in dissolved copper concentration between BDSW-03 and BDSW-01 (from 0.011 to 0.023 mg/L). Flows were not measured at BDSW-01 during the spring 2002 sampling, thus loads cannot be calculated. This increase in dissolved copper in Big Deer Creek had not been observed during previous synoptic sampling. Because this increase in dissolved copper concentrations may indicate a previously unidentified loading source, more detailed synoptic sampling in Big Deer Creek was conducted during fall 2002, and will be conducted during the spring 2003 synoptic sampling. If this more detailed synoptic sampling indicates significant metals sources along Big Deer Creek, contingency measures will be evaluated to address these sources.

PASW-04 is located in Panther Creek downstream of the confluence with Big Deer Creek and was sampled during the Bucktail synoptic sampling event. Dissolved copper concentration was 0.006 mg/L and dissolved cobalt was 0.019 mg/L. Concentrations of these metals in PASW-05, which is located upstream of Big Deer Creek, were the same for copper and dissolved cobalt was 0.020 mg/L. On this date, Panther Creek streamflow was measured at 297 cfs, giving loading for dissolved copper at 4.36 kg/day and dissolved cobalt at 13.83 kg/day.

Bucktail/Big Deer Creek Fall Synoptic Sampling

The results of the fall 2000 synoptic sampling in the Bucktail/Big Deer Creek basin for copper and cobalt are presented on Figures 5-20 and 5-21. Results were similar during the 1999 and 2001 synoptic sampling events.

As in the spring, the West Fork of Bucktail Creek, which typically has been the uppermost location sampled during the Bucktail synoptic sampling event, was dry. Therefore, the uppermost sampling locations were two adjacent seeps, designated BTSW-03A and BTSW-03B, that discharge into the Upper Sediment Pond. Dissolved copper concentrations were 10.1 mg/L at BTSW-03A, and 3.7 mg/L at BTSW-03B, and cobalt was 3.74 mg/L and 2.25 mg/L, respectively. Cumulative dissolved copper loading was 0.06 kg/day and dissolved cobalt loading was 0.03 kg/day, total copper and cobalt loading for these seeps was 0.07 kg/day and 0.03 kg/day respectively.

Dissolved copper loading increases between BTSW-03 and BTSW-01.6. The increase in loading was 1.82 kg/day. Along this reach, BTSP-01 contributes significant copper loading (17.5 mg/L and 0.381 kg/day). Between BTSW-01.6 and BTSW-01.4, both dissolved and total copper concentrations and loads declined by 89% and 58% and 48% and 54%, respectively. The proportionally greater decline in dissolved copper is attributed to the precipitation of copper minerals.

Between stations BTSW-03A/BTSW-03B and BTSW-01.6, dissolved cobalt concentrations decreased by 2.95 mg/L and loading increased by 0.63 kg/day. Between BTSW-01.6 and BTSW-01, copper and cobalt concentrations and loading decline. The ratio of dissolved load to total load for copper and cobalt all also decline, indicating these constituents are participating in either mineral precipitation or adsorption reactions. Concentrations at BTSW-01 were 0.492 mg/L (dissolved copper), 1.20 mg/L (dissolved cobalt), 0.18 mg/L (dissolved manganese) and 148 mg/L (sulfate).

Between SFSW-02 and SFSW-01, dissolved copper loading increased from 0.173 kg/day to 0.285 kg/day with an increase in concentration from 0.058 mg/L to 0.104 mg/L. Total copper loading increased from 0.19 kg/day to 0.31 kg/day. Total and dissolved cobalt had similar load and concentrations between these stations.

The dissolved copper concentration at BDSW-03 was 0.021 mg/L with a measured load of 0.359 kg/day. Dissolved cobalt concentration was 0.011 mg/L and loading was 0.19 kg/day. At PASW-05 located upstream of Big Deer Creek, dissolved copper was not detected (Detection limit = 0.003 mg/L). At PASW-04, downstream of Big Deer Creek, the dissolved copper concentration was also below detectable limits. Dissolved cobalt was 0.026 mg/L in PASW-05 and 0.023 mg/L in PASW-04.

Panther Creek Spring Synoptic Sampling

A round of synoptic sampling was conducted during spring 2000 at Panther Creek stations PASW-11, PASW-10, PASW-09.5, PASW-09, and PASW-08A. The purpose of this sampling was to determine whether there were any increases in loading through the area of the Cobalt Townsite and Noranda Pasture property which may be attributed to metal release from sediments or overbank deposits. Results are presented on Figures 5-22 and 5-23.

Station PASW-11 characterizes water quality in Panther Creek prior to inputs from Blackbird Creek. At PASW-11, Panther Creek metals results were below detectable limits for copper and cobalt and total and dissolved manganese concentrations were 0.003 and 0.004 mg/L, respectively.

Station PASW-10 is located downstream of the confluence of Blackbird Creek and Panther Creek. Dissolved copper concentration at PASW-10 was 0.005 mg/L, with a load of 1.24 kg/day, and dissolved cobalt was 0.056 mg/L with a load of 13.8 kg/day. At PASW-9.5, located upstream of the Cobalt town site, the dissolved copper concentration was 0.020 mg/L and cobalt was 0.060 mg/L. This represents a slight increase in cobalt concentration from station PASW-10, and a significant increase in copper concentration.

At PASW-9, concentrations of dissolved copper and cobalt were 0.007 mg/L and 0.053 mg/L, respectively, with corresponding loading of 1.68 kg/day dissolved copper and 12.7 kg/day cobalt. Dissolved manganese results decreased slightly from 0.039 mg/L at PASW-9.5 to 0.038 mg/L.

At PASW-8A, concentrations of dissolved copper increased slightly from station PASW-9 to 0.010 mg/L and cobalt concentrations remained at 0.053 mg/L. A lower flow was measured at PASW-8A, resulting in a lower load for cobalt of 11.3 kg/day. Dissolved copper concentration and loading increased from 0.007 mg/L and 1.67 kg/day to 0.010 mg/L and 2.13 kg/day between these stations. The decrease in flow between station PASW-09 and PASW-08A suggests this is a losing reach. Flow decreased between these stations from 97.9 cfs to 87.1 cfs in 2000.

<u>Panther Creek Fall Synoptic Sampling</u>

Panther Creek stations PASW-11, PASW-9.5, PASW-09, and PASW-08A were sampled during the fall 2000. Concentrations and loading results for copper and cobalt in Panther Creek are presented on Figures 5-24 and 5-25.

Loading calculations between PASW-11 and PASW-8A were conducted to study possible metal loading from overbank deposits. As seen during previous sampling sessions, during the fall synoptic sampling, a flow decrease from 38.3 cfs at PASW-9.5 to 29.6 cfs at PASW-8A was recorded. Dissolved copper concentrations were less than the detection limit (0.003 mg/L) at all stations. Cobalt concentrations at these stations varied from 0.053 mg/L (PASW-9.5) to 0.055 mg/L (PASW-08A).

Synoptic sampling conducted in the reach of Panther Creek between PASW-11 and PASW-8A during several other years during both spring and fall conditions proved inconclusive. Aside from the slight variations in flow between stations, there is no significant change in metals loading in this reach, indicating that there is no source for metals contribution in this reach.

5.4.6 Background

During the RI, background samples were collected for surface water, in-stream sediments, and soils. The background sampling is summarized below.

5.4.6.1 Surface Water

Background surface water samples were collected at several reference stations at area creeks. The background stations include:

- PASW-11: Panther Creek upstream from Blackbird Creek
- BBSW-08: Blackbird Creek upstream from the Clean Water Reservoir
- SFSW-03: South Fork of Big Deer Creek upstream from Bucktail Creek
- SFSW-04: South Fork of Big Deer Creek upstream from SFSW-03. The background station for South Fork Big Deer Creek was moved upstream in 2000 to avoid possible influences from the spillway at the lower Sediment Dam
- BDSW-04: Big Deer Creek upstream from the South Fork Big Deer Creek
- ICSW-01: Indian Creek (a tributary to Big Deer Creek)
- EFBTSW-01: East Fork of Bucktail Creek
- WFSW-02.5: West Fork Blackbird Creek upstream from the West Fork Tailings Dam

The concentrations of cobalt, copper and iron measured at these background stations are summarized in Table 5-10. Concentrations of dissolved cobalt ranged from non-detect to 0.007 mg/L, concentrations of dissolved copper ranged from non-detect to 0.02 mg/L, and concentrations of dissolved iron ranged from non-detect to 0.9 mg/L. Values greater than the detection limit for dissolved copper were recorded in spring 1999 in the QA/QC equipment blank samples. Additional QA/QC efforts were employed after the anomalous results of 1999 and to date dissolved copper at these locations since 1999 has remained at or below the detection limit.

5.4.6.2 In-stream Sediments

Background samples for in-stream sediments were collected at stations PASW-11, BBSW-08, SFSW-04, and BDSW-04. In addition, sediment data collected by Bennett in 1977 and the USGS in 2001 were also reviewed in determining background for in-stream sediments. The samples collected by Bennett and the USGS indicated the presence of naturally occurring metals in some of the creeks in the vicinity of the Blackbird Mine. Appendix B of the Aquatic Ecological Risk Assessment includes an evaluation of these data to develop a 95 percent upper tolerance level (UTL) for arsenic, cobalt, copper and iron for in-stream sediments. Different 95 percent UTLs were developed for in-stream sediments in areas that were considered to be mineralized and for in-stream sediments in areas that were considered to be non-mineralized. The 95 percent UTLs are summarized in Table 5-11. The 95 percent UTLs for mineralized areas were considered to be applicable to Blackbird Creek, Bucktail Creek, and South Fork Big Deer Creek. The 95 percent UTLs for non-mineralized areas were considered to be applicable to Big Deer Creek and Panther Creek.

5.4.6.3 Soils

Background soils data were collected by several entities prior to the RI. These background soils data are summarized in Table 5-12. The background concentrations of arsenic, cobalt, and copper from these data ranged from <5 to 900, <5 to 700, and 4 to 2400 mg/kg, respectively. Background soils data were also collected for the RI. These data are summarized in Table 5-13. The background concentrations of arsenic, cobalt, and copper from these data ranged from 4.9 to 637.5, 4 to 314, and 9.7 to 1425 mg/kg, respectively. The higher concentrations of arsenic, cobalt, and copper in soils generally represent background samples collected at the Blackbird Mine and at other mineralized areas in the vicinity. Statistical analyses were not conducted on these data to develop the 95 percent UTL for background soils concentrations.

Arsenic is the primary contaminant of concern in terms of human contact with soils. As part of the human health risk assessment process, a 95 percent UTL background value for arsenic in soils was developed. Soil samples were evaluated from the background data set that had been collected for the RI and also for the Early Actions. The areas represented in this arsenic background data set primarily represent riparian areas and areas along Panther Creek that have not been impacted by mining or mining related activities. The areas along Panther Creek were the focus of this data set because these areas include the primary public use areas in the vicinity of the Blackbird Mine. Three data sets were included in the evaluation of the 95 percent UTL for arsenic background in soils:

- Thirty seven samples collected from borrow areas at the Cobalt Townsite

- Nine samples collected during 1998 overbank sampling along Panther Creek

- Five samples collected in 1995 from riparian areas near Blackbird Creek and Panther Creek

The background data used for calculating the 95 percent UTL for arsenic in soils are summarized in Table 5-14. A statistical analysis of these data was performed in the Human Health Risk Assessment for Panther Creek Overbank Deposit Areas. This analysis indicated that the background level for arsenic in riparian soils and in areas along Panther Creek is 100 mg/kg.

5.4.7 Remaining Sources of Metals Loading

The results of all of the surface water sampling were analyzed to determine the significant sources of post-Early Action metals loading. This analysis was primarily based on the synoptic sampling because this allows comparison between specific reaches of the streams to determine whether the stream between stations is a gaining or losing reach in terms of both flow and metals loading.

The remaining significant metals sources to Meadow Creek, Blackbird Creek and Panther Creek downstream of Blackbird Creek include:

- *Meadow Creek Waste Rock*. Seepage from below the 7800 waste rock dump and debris flow materials, which is bypassing the collection system and is not being collected for treatment, is a source of residual copper loading during spring runoff. During the spring 2000 synoptic sampling event, this area (measured at the 7100 bypass) contributed 2.85 kg/day of copper. Areas where waste rock was removed from the east side of Meadow Creek contributed 0.25 kg/day of copper during the Blackbird spring synoptic sampling event. Waste rock in Meadow Creek does not contribute a significant amount of cobalt loading (< 1 kg/day), nor does it contribute significant copper loading (0.04 kg/day) during low flow conditions.

- *Wastewater Treatment Plant Discharge*. The water treatment plant discharge is an insignificant source of dissolved copper loading (<0.08 kg/day during spring 2000 sampling). The wastewater treatment plant contributed 4.2 kg/day of dissolved cobalt to Blackbird Creek during the 2000 spring synoptic sampling event, which was 30% of the dissolved cobalt loading at the mouth of Blackbird Creek (BBSW-01A). Changes were made to the operating mode of the treatment plant in 2000 that significantly improved the removal efficiencies for cobalt. The wastewater treatment plant is no longer a significant cobalt loader to Blackbird Creek. During the spring 2001 synoptic sampling event, the wastewater treatment plant contributed 0.2 kg/day of dissolved cobalt to

Blackbird Creek, which represented less than 2 percent of the dissolved cobalt loads at the mouth of Blackbird Creek.

- *Hawkeye Gulch*. Hawkeye Gulch surface water runoff contributes an insignificant percentage of the dissolved copper (4%) and dissolved cobalt load (1%) measured at BBSW-07 during spring runoff. Hawkeye Gulch is dry during low flow conditions.

- *Groundwater discharge in upper Blackbird Creek downstream of the cutoff wall*. It appears that groundwater discharges to upper Blackbird Creek may have contributed a small amount of copper and cobalt, as evidenced by the unaccounted increase in loading between BBSW-07A and BBSW-07 during 2000 sampling. During the 2000 Spring synoptic sampling event there was an unaccounted load increase of about 0.6 kg/day of dissolved copper and 1.54 kg/day of cobalt, representing 25% of the dissolved copper load and 21% of the dissolved cobalt load at BBSW-07. During the fall of 2000, the unaccounted load increase was about 0.2 kg/day for both copper and cobalt, representing 88% of the dissolved copper load and 93% of the dissolved cobalt load at BBSW-07. The seeps and other loading sources in upper Blackbird Creek and Meadow Creek that contribute load during the spring are mainly dry at low flow. During 2001, a blockage of the pipeline that collects groundwater upstream of the cutoff wall was discovered. This blockage caused head to build up behind the wall and seepage to occur around a pipe which had not been sealed properly where it exited the manhole upstream of the cutoff wall. It is likely that this blockage contributed to loading that was observed at BBSW-07 during 2000. The blockage was removed and a seal was installed around the pipe prior to conducting the 2001 spring synoptic sampling. During the 2001 spring synoptic sampling event, the unaccounted dissolved copper load at BBSW-07 was 0.37 kg/day (15% of the load at BBSW-07) and the dissolved cobalt load was 0.2 kg/day (10% of the load at BBSW-07). During low flow conditions in 2001, the unaccounted load increase between BBSW-07A and BBSW-07 was 0.19 kg/day for dissolved copper (83% of the load measured at BBSW-07) and the unaccounted dissolved cobalt load was 0.2 kg/day (80% of the load at BBSW-07). During spring 2002, significant seepage was observed entering the Blackbird Creek channel upstream from the cutoff wall. This seepage was due to high groundwater in this vicinity. During June 2002, the BMSG constructed additional groundwater drains adjacent to the channel upstream from the cutoff wall to intercept this water for treatment at the water treatment plant. These additional drains should reduce the metals loads that have been previously observed in this stretch of Blackbird Creek.

- *Seeps BBSP-03, 09, and 45 discharging to Blackbird Creek between BBSW-04 and BBSW-03*. These seeps contributed a combined 0.63 kg/day of dissolved copper and 1.43 kg/day of cobalt during the Spring 2000 synoptic round of sampling. However, copper precipitation is also occurring in this reach as concentrations decrease and there was a net loss of copper between stations BBSW-04 and BBSW-03 when all measured sources are counted. Discharges from these seeps were minimal (less than 0.1 kg/day for both copper and cobalt) during the Fall 2000 round of sampling. There was a decrease in dissolved copper concentration and a reduction in load of 29% between stations BBSW-04 and BBSW-03. Cobalt concentrations increased from 0.166 mg/L to 0.298 mg/L in this reach and load increased from 0.4 kg/day to 0.66 kg/day (67%) during the Fall 2000 sampling. Seeps were not sampled in 2001.

- *West Fork Tailings Impoundment*. Loading from the West Fork Tailings Impoundment vary seasonally and from year to year. During low flow conditions (when concentrations are highest in Panther Creek), the West Fork Tailings Impoundment contributes about 70% (3 kg/day) of the cobalt loading from Blackbird Creek to Panther Creek as measured at BBSW-01A. Approximately 50% (7 kg/day) of the cobalt loading was due to the West Fork Tailings Impoundment during the Spring 2000 synoptic sampling event. The West Fork Tailings Impoundment contributes only small loading of copper, which is more than offset by the influence of the iron discharges from the impoundment. Copper sorbs to the iron hydroxides which causes a reduction in dissolved copper concentrations downstream of the impoundment.

- *Overbank Deposits along Blackbird Creek*. With the possible exception of contributions from seeps discussed previously, tailings and overbank deposits between Station BBSW-07 and the West Fork Tailings Impoundment do not appear to contribute dissolved copper load to Blackbird Creek, but may contribute a small cobalt load. There was a small increase of dissolved cobalt loading between Stations BBSW-07 and BBSW-06 (0.59 kg/day) during the Spring 2000 synoptic sampling event. During the Fall 2000 sampling event, small increases in cobalt loading were observed at each station from BBSW-07 to BBSW-03A, with a cumulative load increase of about 0.4 kg/day. From the West Fork Tailings Impoundment to the mouth of Blackbird Creek (Stations BBSW-02 to BBSW-01A), there was a net loss of dissolved copper load during both spring and fall sampling. Cobalt loading also declined between these stations during the Spring 2000 sampling, but cobalt loading increased by 0.85 kg/day between these stations during the Fall 2000 sampling. Stability of the overbank deposits and in-stream sediments and their potential for erosion was evaluated as part of the RI. The evaluation concluded that some areas of overbank deposits and in-stream sediments in Blackbird Creek upstream of the West Fork Tailings Impoundment have the potential for erosion. Some of the mine-related materials that were dredged by the USFS and piled on the bank can be accessed during peak flows. In some locations, surface water accumulates on the upslope of materials causing surficial erosion where it overtops the material. A 500-year design storm would likely result in mobilization of materials that contain elevated concentrations of metals. These materials would have the potential to be deposited in downstream areas at concentrations greater than the PRGs established for those areas.

The remaining sources of metals loading to Bucktail Creek, South Fork Big Deer Creek, and Big Deer Creek and Panther Creek downstream of Big Deer Creek include:

- *Bucktail Creek Seeps*. Groundwater discharge to Bucktail Creek between the 7000 dam and BTSW-01.6 is the primary source of remaining copper loading to Bucktail Creek. Synoptic sampling indicated that the overbank materials and in-stream sediments downstream from BTSW-01.6 do not appear to contribute significant metals loading under current conditions. However, if the groundwater sources upstream from BTSW-01.6 were to be remediated, there is a possibility that the debris flow materials and/or in-stream sediments downstream from BTSW-01.6 could begin to release metals through dissolution/desorption processes and therefore become sources.

- *Sediments and overbank material in South Fork Big Deer Creek*. During both the spring and fall synoptic sampling events there was an observed increase in dissolved copper concentrations between station SFSW-02 (downstream of Bucktail Creek) and SFSW-01 (upstream of confluence with Big Deer Creek). Sulfate concentrations also increased between these stations; however, there was no observed increase in cobalt. During the Spring 2000 synoptic sampling event, dissolved copper concentrations increased from 0.088 to 0.129 mg/L. During the fall event, the concentrations increased from 0.058 to 0.104 mg/L. These increases are likely due to either dissolution/desorption of precipitates from sediments or discharges from groundwater. Geochemical modeling indicates that dissolution of copper carbonates is likely occurring along this reach. While groundwater discharge is another possible source of these metals, there was no observed increase in flow between SFSW-02 and SFSW-01. However, accurate flow measurements are difficult to obtain in South Fork Big Deer Creek.

  During the spring 2002 synoptic sampling event there was an apparent increase in copper loading to Big Deer Creek between South Fork of Big Deer Creek and Panther Creek. This apparent copper loading was not observed during the fall of 2002 synoptic sampling event. Detailed synoptic sampling will be conducted during the spring 2003 synoptic event to further define the nature and extent of this apparent copper loading.

5.4.8 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates were sampled in area streams prior to the Early Actions in 1993, and subsequent to the Early Actions in 1998 through 2001. Benthic populations are continuing to show signs of recovery from impacts caused by metals, especially within Panther Creek. Recovery within Big Deer Creek is less pronounced. Blackbird and South Fork Big Deer Creeks exhibit much less recovery, although the total number of invertebrates within Blackbird Creek has increased since the Early Actions and a number of taxa were present in South Fork Big Deer Creek during 2000 and 2001, which previously had been devoid of invertebrates. Evidence for recovery is provided in a number of metrics evaluated, including the presence of metals sensitive species in areas downstream of mine discharges. During 2000, some individual metrics were higher at downstream stations in Panther Creek than they were at the upstream reference station. Recovery was observed at all stations between 1998 and 2001 and in comparison to 1993 pre-Early Action data. However, the downstream stations generally continue to have lower numbers of insects and lower densities than the reference stations.

Although there were increases in numbers of some species during 2000 (i.e., Hydroptila sp.), there were reductions in overall populations in most Panther Creek stations including the reference station in 2000 as compared to 1999. Ephemeroptera populations especially declined by large numbers during 2000. Increases in overall populations between 2000 and 2001 were observed at all Panther Creek stations except one. Additionally, Ephemeroptera populations improved at all Panther Creek stations except one. Although there were dramatic increases in numbers of some species between 1999 and 2000 (i.e., Hydroptila sp.), similar increases were seen only at the five uppermost Panther Creek stations between 2000 and 2001. Fewer Hydroptila sp. were seen at the other downstream stations in 2001 when compared to 2000 results. Year-to-year community composition variation may be attributed to a number of factors including: antecedent environmental and hydrological conditions (i.e., algal blooms, drought, flooding, water temperature, etc.); fluctuations in the life cycles of various invertebrate populations; and the effects of a large fire known as the Clear Creek Fire that occured in the area in 2000.

There is concern that ongoing recovery of invertebrates over the next several years may be affected by impacts from the Clear Creek Fire on hydrology and water quality. Numerous studies on the effects of fire on benthic macroinvertebrate populations have been conducted. The 2000 sampling round may only have been affected by very short-term effects related to the Clear Creek Fire and it is likely that additional impacts will occur over the next several years.

SECTION 6

CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section discusses the current and reasonably anticipated future land uses and current and potential beneficial groundwater uses at the Blackbird Mine site, and discusses the basis for future use assumptions. This information forms the basis for reasonable exposure assessment assumptions and risk characterization conclusions in Section 7.

6.1 LAND USES

6.1.1 Current Land Use

The Blackbird Mine is currently inactive. Workers at the mine are associated with operating the water treatment plant and performing long-term operations and maintenance of the facilities. Access to the mine is restricted by a gate; however, the mine area can be accessed on foot or by horseback. The Blackbird Mine is surrounded by National Forest land. The former Cobalt townsite is located on Panther Creek road approximately 8 miles from the mine and has no permanent residences. The closest inhabited town is Salmon which is located approximately 25 miles from the mine. The Lemhi County seat is located in Salmon. The closest permanent residence, the Panther Creek Inn is located 2 miles from the mine gate at the confluence of Blackbird Creek and Panther Creek (see Figure 1-1). The Panther Creek drainage basin downstream of the mine is rural and sparsely populated with seasonal and year round residences. The area surrounding the mine is used for recreational purposes including hunting, fishing and camping.

6.1.2 Future Land Use

The expected future use of the Blackbird Mine is to either remain abandoned or re-open mining activities. In January 2001 Formation Capital Corporation U.S. submitted a Plan of Operations to the Salmon-Challis National Forest for the proposed Idaho Cobalt Project which is located within a portion of the Blackbird Mine site. The Forest Service is currently preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) for the Idaho Cobalt mine proposal. Future receptors at the mine are expected to be mine workers, USFS personnel, recreational users, and trespassers. The expected future use of the surrounding area is recreational with seasonal and year-round residential use downstream of the mine in the Panther Creek drainage basin.

6.2 GROUND AND SURFACE WATER USES

The groundwater at the mine is not currently used. The groundwater underlying the mine and associated waste management areas is remotely located and is not expected to be used for domestic water supply. There is no water supply at the former town of Cobalt. The closest residence, the Panther Creek Inn, uses private water supply wells. Other residences in the area obtain water from private water supply wells or springs. It is expected that the wells along the Panther Creek drainage will continue to be used for private water supply.

Surface water downstream of the mine is currently used for irrigation and recreational purposes such as fishing, tubing, kayaking and camping. After surface water quality is restored by the remedial action in this ROD, the Natural Resource Trustees plan to reintroduce salmon in Panther Creek as part of a Natural Resource Damage settlement with the BMSG. In the future, it is expected that fishing in Panther Creek and other creeks will substantially increase.

SECTION 7

SUMMARY OF SITE RISKS

Human health and ecological risk assessments (aquatic and terrestrial) were conducted to evaluate the potential for current and future impacts of contaminants on receptors inhabiting, working or visiting in areas impacted by the Blackbird Mine. The baseline risk assessments estimate what risks the Blackbird Mine site poses if no further action was taken. They provide the basis for taking action and identifying the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessments for the Blackbird Mine site.

7.1 HUMAN HEALTH RISK ASSESSMENT

The Site-Wide Human Health Risk Assessment (HHRA) addressed areas that were not evaluated in the previous HHRAs performed for the Early Actions and included addenda to the previous HHRAs based on site characterization data and post-removal sampling data collected after the Early Actions were conducted. The summary provided in the following sections is for the Site-Wide HHRA, including the addenda to the Panther Creek Inn and Panther Creek Overbank Deposits HHRAs.

7.1.1 Identification of Chemicals of Concern (COC)

Chemicals evaluated in the human health risk assessment include those chemicals that exceeded background levels representative of the areas around the Site that are undisturbed by mining activities, and EPA risk-based screening concentrations (Region 9 PRGs). Based on these comparisons to background levels and screening levels, five COCs were identified for the Site (arsenic, cobalt, copper, iron, and manganese). Based on the findings of the human health risk assessment, arsenic was determined to be the primary COC.

7.1.2 Conceptual Exposure Model

A conceptual exposure model was developed that describes the potential exposure pathways associated with the soil, mine wastes, sediment, and surface water at the mine and along the creeks (see Figure 5-1). The receptors chosen for evaluation are based on knowledge of current and projected future use scenarios for the Blackbird Mine Site. The media chosen for consideration are those potentially impacted by historical mining activities for which there is a potential for human exposure.

7.1.3 Exposure Assessment

The objectives of the exposure assessment are to identify potential exposure scenarios by which humans could contact contaminants of concern in Site media and to quantify that potential exposure. The conceptual exposure model described in Section 7.1.2 shows that workers and persons who engage in recreational activities (i.e., day-users and campers) could potentially be exposed to contamination through the following exposure routes:

- Incidental ingestion of surface soil or mine wastes
- Dermal contact with surface soil or mine wastes
- Inhalation of re-suspended dust from the surface soil or mine wastes
- Incidental ingestion of sediment and dermal contact with sediment
- Incidental ingestion of surface water and dermal contact with surface water

The areas of the Blackbird Mine Site that were sampled from 1995 to 2000 were grouped into the following seven exposure areas based on receptor activity and the site conditions (i.e., proximity to the mine, stream reach, restricted access by the mine gates or fences):

- **Blackbird Mine Exposure Area**: The area at the Blackbird Mine

- **Upper Blackbird Creek Exposure Area**: The area along Blackbird Creek from the water treatment plant at the mine downstream to the Ludwig Gulch gate

- **Lower Blackbird Creek Exposure Area**: The area along Blackbird Creek from the Ludwig Gulch gate downstream to the Panther Creek Inn

- **West Fork Blackbird Creek Exposure Area**: The area surrounding the West Fork Blackbird Creek confluence with Blackbird Creek, including the West Fork Tailings Dam

- **Bucktail Creek Exposure Area**: The area along Bucktail Creek just below the upper sediment dam downstream to the confluence with South Fork Big Deer Creek

- **South Fork Big Deer Creek and Big Deer Creek Exposure Area**: The area along the South Fork Big Deer Creek and Big Deer Creek downstream to the confluence with Panther Creek (including the Slavins Pond area)

- **Panther Creek Exposure Area**: The area from the confluence with Blackbird Creek along Panther Creek, including the Panther Creek Inn

The seven exposure areas are considered in the HHRA because they are areas that have been potentially impacted by past mining activities at the Blackbird Mine; where waste rock, overburden, and sediment were deposited; and areas that were impacted by runoff or flooding. The impacted environmental media include soil, instream sediments, groundwater, and surface water. For the mine and along the creeks, it was assumed that current and future scenarios (i.e., operation and maintenance of the water treatment system, camping, and day-use of the areas) are the same and that the mine will not reopen.

The current Forest Plan indicates that the Forest Service property along the Panther Creek area will remain as a recreational resource in the future. It is assumed that exposure of people involved in recreational activities is predominantly to surface soil, sediments, and surface water. Because construction activities that would bring subsurface soil to the surface are not anticipated for Forest Service property, the risks associated with such a scenario were not calculated.

Some private property along Panther Creek is used for residential purposes. It was assumed that the present residential use would continue and that some additional future residential use could be anticipated.

Although existing land use will likely remain the same as the current use into the foreseeable future, significant changes may occur. If land use changes significantly at the mine or along the creeks in the exposure areas, the exposure scenario assumptions may need to be reviewed.
To calculate risk estimates for the COCs, the magnitude of exposure was first estimated. The exposure assumptions for the exposure scenarios are summarized in Tables 7-1, 7-2, and 7-3.

7.1.4 Exposure Point Concentrations

Exposure point concentrations were calculated for each exposure area. The exposure point concentration should represent the "average" concentration of each COC that a person may contact over the period of exposure. According to EPA guidance, the exposure point concentrations are the 95 percent upper confidence limit (95 UCL) on the mean concentration, assuming either a normal or a log-normal distribution. The exposure point concentrations for COCs in the exposure areas are presented in Tables 7-4 through 7-6.

7.1.5 Toxicity Assessment

The toxicity assessment seeks to develop a reasonable appraisal of the associations between the degree of exposure to a chemical and the possibility of adverse health effects. The toxicity assessment consists of two components: 1) hazard identification and 2) dose-response evaluation. Hazard identification is the process of determining what adverse human health effects, if any, could result from exposure to a particular chemical. Dose-response evaluation is a quantitative examination of the relationship between the level of exposure and the probability of adverse health effects in an exposed population.

Health effects are divided into two categories: non-cancer and cancer effects. The division is based on the different mechanisms of action associated with each category. Risks of developing cancer due to a site exposure are evaluated based on toxicity factors (slope factors) published by EPA. Quantification of non-cancer effects relies on published reference doses (RfDs). The slope factors (SFs) and RfDs are derived from either Integrated Risk Information System (IRIS), Health Effects Assessment Summary Table (HEAST), or the National Center for Environmental Assessment (NCEA). Chemicals with non-cancer effects may have cancer effects as well. Arsenic is the only COC for the Site that exhibits both cancer and non-cancer effects; cobalt, copper, and iron exhibit only non-cancer effects. The estimation of risk resulting from ingestion of arsenic-contaminated surface soil/mine wastes or sediment included an adjustment based on the estimated bioavailability (i.e., percentage of arsenic in soil that is available for human uptake). Based on studies performed to quantify the percentage of arsenic uptake, EPA Region 10 has utilized a 60 percent relative bioavailability of arsenic if the source of arsenic is mining activities such as those that occurred at the Blackbird Mine.

7.1.6 Risk Characterization

The EPA toxicity values described above were used in this risk assessment along with the exposure information to estimate the potential risks from contacting COCs in surface soil/mine wastes, sediment, and surface water. Risk estimates were calculated for current and likely exposure scenarios under current environmental conditions.

The potential for carcinogenic effects is evaluated by estimating excess lifetime cancer risk. Excess lifetime cancer risk is the incremental increase in the probability of developing cancer during one's lifetime over the background probability of developing cancer if no exposure to site-related contaminants occurred. For example, a 1×10^{-6} excess lifetime cancer risk means that for every 1 million people exposed to the chemical at the defined exposure conditions averaged over a lifetime, the average incidence of cancer is increased by one case of cancer. EPA uses the general range of 1×10^{-6} to 1×10^{-4} as a "target range" for total excess lifetime cancer risks within which the agency strives to manage risks.

Non-cancer risk is assessed by comparing the estimated daily intake of a contaminant to its reference dose (RfD). The resulting ratios are termed Hazard Quotients (HQ). The HQs from the various exposure routes (i.e., incidental ingestion, dermal contact, and inhalation) are then summed to give a Hazard Index (HI). When the HI exceeds 1 (i.e., the intake of the chemical is greater than the RfD), there is potential for health concern.

7.1.6.1 Site-Wide HHRA

Potential exposures to surface soil/mine wastes, sediment, and surface water were evaluated in the Site-Wide HHRA. Table 7-7 summarizes the cancer and non-cancer risks assuming reasonable maximum exposure (RME) and central tendency exposure (CTE) conditions for surface soil/mine wastes. There are no RME scenarios with estimated cancer risks greater than 1×10^{-4}. Most of the RME scenarios result in estimated cancer risks greater than 1×10^{-6}, with approximately one-third of the scenarios greater than 1×10^{-5}. The highest estimated cancer risk, 3×10^{-5}, is for the age-adjusted day-user at the Upper Blackbird Creek and West Fork Blackbird Creek exposure areas and the adult worker at the Blackbird Mine exposure area. There are no RME scenarios that have an RME non-cancer HI equal to or greater than 1.

The risks for exposure to sediment and surface water are within or below the NCP acceptable risk range. The highest estimated cancer risk for sediment, 1×10^{-5}, and highest HI, 0.09, were estimated for the age-adjusted day-user for the Lower Blackbird Creek exposure area, and the child day-user for the West Fork Blackbird Creek exposure area, respectively. The highest estimated cancer risk for surface water, 1×10^{-5}, and highest HI, 0.07, were estimated for the adult worker and adult day-user for the Blackbird Mine exposure area. Tables 7-8 and 7-9 summarize the non-cancer risks assuming RME and CTE conditions for sediment and surface water, respectively.

The results of this risk assessment indicate that the risks of exposure to contaminated surface soil/mine wastes, surface water, and sediment do not exceed the acceptable risk range for carcinogenic effects (i.e., 1×10^{-4} to 1×10^{-6}) or for noncarcinogenic effects (i.e., HI > 1). Table 7-10 shows the estimated cumulative risk (i.e., summing the risks of exposure to each medium) by receptor. None of the estimated cumulative cancer risks are greater than 1×10^{-4}. The adult worker at the Blackbird Mine exposure area has the highest estimated cumulative cancer risk, 4×10^{-5}. None of the estimated non-cancer HIs are greater than 1.

Arsenic is the predominant risk driver (parameters that represent the majority of the risk are referred to as risk drivers), contributing 100 percent of the cancer risk estimates, as the only carcinogenic COC identified, and generally between 80 and 100 percent of the non-cancer HI. Although the risks from exposure to contaminated media in the exposure areas do not exceed the acceptable risk range, there are locations within the Blackbird Creek exposure areas that may present unacceptable acute or chronic risks if the exposure is limited to a small area.

7.1.6.2 Addendum to the Panther Creek Inn HHRA

There is an area along Blackbird Creek adjacent to the Panther Creek Inn that was not cleaned up as part of the Early Actions. This area is between the Panther Creek Road bridge and the Blackbird/Panther Creek confluence and between the existing berms that parallel Blackbird Creek. This area includes overbank materials and in-stream sediments with elevated arsenic concentrations. Potential risks associated with exposure to these in-stream sediments were estimated using a site-specific residential scenario (i.e., exposure frequency and exposure time for exposure to sediments in the creek were adjusted for seasonal conditions). The risk estimate for the in-stream sediments exceed EPA's acceptable risk level for noncarcinogenic effects with a Hazard Index of 3.

In addition, several surface soil samples collected along the banks of Blackbird Creek channel (i.e., overbank deposits) in the vicinity of the Panther Creek Inn, inside the berm, have elevated arsenic. Potential risks associated with exposure to the soils between the berms were shown to be 7×10^{-4} to 2×10^{-3} for cancer risks and Hazard Indices ranging from 3 to 30 for noncarcinogenic effects under a residential use scenario.

7.1.6.3 Addendum to the Panther Creek Overbank Deposits HHRA

In the Panther Creek Overbank Deposit HHRA addendum, a discussion of the Early Actions performed along Panther Creek, the additional site characterization work, and an update to the risk calculations for potential exposure to the Panther Creek Overbank Deposits were presented. Early actions that involved removal of material with concentrations greater than the established cleanup levels were completed between 1999 and 2001 at the sites along Panther Creek that posed a potential risk under current use conditions. Areas that posed a potential risk under a future use scenario were deferred to the final remedial action. Based on the additional site characterization samples, risks for three private properties (Rogers, former Strawn/Bowman, and Rufe) still exceed EPA's acceptable risk range for the future residential scenario. Areas on the Roger's property showed cancer risks from 2×10^{-4} to 4×10^{-4} and Hazard Indices ranged from 2 to 7 for noncarcinogenic effects. The Strawn property showed a cancer risk of 3×10^{-4} and a Hazard Index of 3 for noncarcinogenic and the Rufe property showed a cancer risk of 3×10^{-4} and Hazard Indices from 2 to 6 for noncarcinogenic.

Although the risk estimates for current exposure scenarios exceed EPA's acceptable range for the Hade property, additional samples were not collected. During the completion of the 1999 HHRA, it was recommended that more sampling be conducted to adequately characterize this exposure area. However, the property owner has denied access for further sampling. Consequently, there are uncertainties associated with use of the limited data set (comprised of two discrete samples) for estimating risk and for evaluating the need for remedial action at the Hade property.

Between 1995 and 1998, nine soil samples were collected from, or near, the Panther Creek Road, between Blackbird Creek and Napias. None of the metals analyzed in these samples collected along the road exceed the USEPA Region 9 PRG for a residential exposure scenario, with the exception of arsenic. However, none of the collected arsenic samples exceed the background concentration level for arsenic.

7.1.6.4 Groundwater at the Blackbird Mine

Potential risks associated with drinking water from a future groundwater source at the mine site (i.e., a well) were evaluated. This evaluation assumed that workers at the mine site were the receptors of concern, and that these workers would be at the site for 167 days per year for 25 years and that they would consume 2 liters of water per day from a groundwater source. The potential risks were evaluated based on existing data from groups of monitoring wells from four different areas at the site. The data used to perform the risk evaluation are summarized in Table 5-1a. The potential risks were estimated by using the maximum detected concentrations of arsenic, cobalt and copper in each group of monitoring wells. The potential risks and Hazard Quotients are as follows:

Blackbird Creek Drainage Wells
Arsenic Potential risk = 5×10^{-4}
Cobalt HQ = 2
Copper HQ = 0.4

Bucktail Creek Drainage Wells
Arsenic Potential risk = 1×10^{-4}
Cobalt HQ = 8
Copper HQ = 10

West Lobe Bucktail Creek Drainage Wells
Arsenic not detected
Cobalt HQ = 0.1
Copper HQ = 0.02

West Fork Impoundment Wells
Arsenic Potential risk = 7×10^{-4}
Cobalt HQ = 10
Copper HQ = 0.3

In addition, groundwater at the Blackbird Mine exceeds the Maximum Contaminant Level (MCL) of 10 ug/L for arsenic in Blackbird Creek drainage and at the West Fork Tailings Impoundment.

7.1.6.5 Summary of Risks

Based on the results of the Site-Wide Human Health Risk Assessment (including addenda to the two previous risk assessments for the Panther Creek Overbank Deposit Areas and the Panther Creek Inn), the potential risks for the following areas of the Blackbird Mine Site exceed EPA's acceptable risk range:

- Small localized areas of soil along the banks of Blackbird Creek (i.e., overbank soil/deposits) with elevated arsenic concentrations that may present unacceptable acute (short-term) or chronic (long-term) risks during recreational use.

- In-stream sediments and overbank deposits along the bank of Blackbird Creek adjacent to the Panther Creek Inn downstream from where Panther Creek Road crosses Blackbird Creek show a potential risk to residents who live at the Inn.

- Three private properties along Panther Creek (Rogers, former Strawn/Bowman, and Rufe) have potential risks that exceed EPA's acceptable range for hypothetical future residential use.

- Groundwater in the Blackbird Creek and Bucktail Creek drainages and at the West Fork Tailings Impoundment exceed EPA's acceptable risk range and exceeds the MCL for arsenic in the Blackbird Creek drainage and at the West Fork Tailings Impoundment.

7.1.7 Tailing Deposits and Remobilization of In-stream Sediments Along Blackbird Creek

Tailing deposits and in-stream sediments along Blackbird Creek also are of concern due to potential remobilization and recontamination of Blackbird Creek and Panther Creek during major storm events.

7.1.8 Uncertainties

A number of uncertainties are associated with each step of the risk assessment process. The key uncertainties are briefly described below.

In the data evaluation and exposure assessment steps, available sampling data may not completely characterize an "exposure area." An exposure area is that portion of the property that is contacted on a daily basis by workers or recreational users. It is possible that some people may limit their activities on a daily basis in exposure areas designated in the risk assessment (e.g., children who regularly play in a small area directly adjacent to the creek). However, the actual daily exposure of people may extend over a larger area than the exposure areas considered in the risk assessment. The actual exposure areas may include areas that have not been affected by activities at the mine. Because samples were generally collected in areas where the impact from the mine is most probable (e.g., in areas of visible tailings), for some receptors it is likely that the exposure point concentrations for the exposure areas are overestimated. Consequently, the risk estimates for the exposure areas and exposure scenarios considered in this risk assessment are conservative.

The exposure scenarios addressed in this risk assessment are based on an assumption that the existing mine is not open and that a proposed cobalt mine is not opened in the same ore body. If a mine is opened in the same ore body, the assumptions used to estimate exposure would likely change. For example, exposure frequency and duration would likely increase for workers.

The exposure scenarios are based on the assumptions that exposure occurs over a large area. Unacceptable acute and chronic risks may potentially exist from exposure to hotspots or other areas smaller than the exposure areas with elevated concentrations. Under certain exposure conditions, the estimated risks to receptors to these smaller areas may exceed the acceptable risk range.

The exposure assumptions that were used in the risk assessment (e.g., exposure frequency and duration) were based on assumptions of how receptors used the areas. These assumptions are supported by limited interviews with persons who use the areas that were sampled, local residents, and USFS personnel who have general knowledge about recreational use of the area.

Uncertainties are also associated with the toxicity values that were used to calculate the risk estimates. This uncertainty is due, in part, to the deficiencies identified in the various studies performed on populations exposed to arsenic, either as a result of workplace exposure or environmental exposure. There is also uncertainty associated with the provisional oral RfD for iron. However, in general, the methods used to derive slope factors and RfDs are intended to be conservative in recognition of the uncertainties associated with most epidemiologic or toxicologic data sets.

The estimation of risk resulting from ingestion of arsenic-contaminated surface soil/mine wastes and sediment included an adjustment based on the estimated bioavailability (i.e., percentage of arsenic in soil that is available for human uptake). Based on studies performed to quantify the percentage of arsenic uptake, EPA Region 10 recommends assuming a 60 percent relative bioavailability of arsenic if the source of arsenic is mining activities such as those that occurred at the Blackbird Mine.

7.2 AQUATIC ECOLOGICAL RISK ASSESSMENT

This section summarizes the results of the aquatic ecological risk assessment for the Blackbird Mine site. The objectives of the assessment were to evaluate the potential adverse effects to ecological receptors from contaminants being released from the site under current conditions after implementation of Early Actions. The risk assessment focused on identifying and evaluating risks to the aquatic ecosystems of Blackbird Creek, Panther Creek, Bucktail Creek, South Fork of Big Deer Creek, and Big Deer Creek.

The risk assessment followed the protocol developed by the EPA for performing ecological risk assessments (EPA, 1992; 1998) and was consistent with the requirements for ecological risk assessment at Superfund sites (EPA, 1997). The risk assessment consists of four steps:

- Problem Formulation includes the site description, identification of chemicals of potential ecological concern (COPEC), assessment and measurement endpoints, conceptual site model, and a summary of the data used in the risk assessment.

- Exposure Assessment which describes the exposure to benthic invertebrates and fish.

- Effects Assessment which identifies the physiological and toxicological interactions of the COPECs with the aquatic ecosystem and its inhabitants.

- The last step is the Risk Characterization whereby the results of the Effects Assessment are linked with the Exposure Assessment to provide an estimate of risks to the aquatic environment.

7.2.1 Ecological Setting

The fisheries and aquatic resources downstream of the influence of the Blackbird Mine have undergone significant alteration since large-scale operation of the mine began in the 1940s. Prior to the implementation of Early Actions, dissolved copper concentrations in Panther Creek and Big Deer Creek frequently exceeded the Idaho water quality standard for the protection of aquatic life by a factor of 10 or more. Historically, the Panther Creek drainage is reported to have supported runs of anadromous chinook salmon and steelhead trout. Water quality impacts from the mine contributed to the significant declines in chinook salmon and steelhead runs in Panther Creek. The Snake River spring/summer chinook salmon (Onchorynchus tshawytscha), known to have historically used this basin, has been designated as threatened under the Endangered Species Act. Snake River steelhead (Onchorynchus mykiss) and Columbia Basin bull trout (Salvelinus confluentus) are also listed as threatened.

Resident fish populations are not present in Blackbird, South Fork Big Deer, or Big Deer creeks downstream of the mine influence. Blackbird Creek is currently considered to be uninhabitable by most aquatic life in the zone of influence of the mine, but resident trout (species unknown) are present above the influence of the mine and in the freshwater reservoir. In Big Deer Creek, one salmonid species (resident rainbow trout) is known to occur upstream of the mine discharges, with other species potentially present. Above the mine inflow into South Fork Big Deer Creek, NOAA reported in 1994 that rainbow trout were present at population levels approximately equal in density to similar streams in the drainage basin. However, subsequent information has not indicated the presence of fish in this reach of the South Fork Big Deer Creek. Additional information is needed to determine if fish are present in this reach. Bucktail Creek likely never supported significant fish populations due to the high gradient and low flow.

The structure of the benthic macroinvertebrate community in Panther Creek and the tributary streams was also impacted by the mine. Benthic invertebrates are a main food supply for salmonids and are important indicators of stream impairment. Overall populations of benthic macroinvertebrates, with the exception of pollution tolerant chironomids, had been reduced in aquatic habitats downstream of the mine. Prior to implementing Early Actions, sensitive species of mayflies, caddis flies, and stoneflies, which are principal components of the diet of salmonids, were mostly absent within the zone of influence of water quality impacts from the mine. The Early Actions have resulted in improved water quality and the benthic macroinvertebrate community has shown signs of recovery, especially in Panther Creek. However, the benthic macroinvertebrate community is still impacted when compared to reference stations.

7.2.2 Identification of Chemicals of Concern

The Blackbird Mine Site investigations determined that there were six chemicals of potential ecological concern (COPEC): arsenic, cobalt, copper, manganese, nickel, and zinc. These metals were compared to the federal Ambient Water Quality Criteria (AWQC), the background surface water concentration, and the maximum surface water concentration. Based on this comparison, cobalt and copper were identified as COPECs for surface water for the aquatic risk assessment. Zinc, nickel, and manganese were below risk screening levels and, therefore, were not carried through into the risk assessment as COPECs. Iron concentrations at the site exceed the AWQC.

A comparison similar to that performed for surface water was also performed for sediments to identify COPECs. Applicable and relevant sediment screening criteria were reviewed for each metal to determine whether the metal should be considered a COPEC and evaluated further in the risk assessment. Based on the comparison of sediment data to screening criteria from the literature, arsenic, cobalt, copper, and iron were further evaluated as COPECs in sediments.

7.2.3 Conceptual Exposure Model

A conceptual exposure model was developed that describes the potential exposure pathways associated with the soil, mine wastes, sediment, and surface water at the mine and along the creeks (see Figure 5-2). The conceptual model describes the sources of contamination at this site. It describes the major transport pathways by which contamination moves from the point of origin to a point where ecological receptors become exposed. The conceptual model also identifies the major exposure media and the receptors of concern. There are two exposure media evaluated. These are surface water and sediment. Groundwater is also evaluated but as a transport pathway to surface water and sediments. Receptors are species of aquatic life that contact exposure media contaminated by site-related metal contamination.

7.2.4 Data Used in Risk Assessment

The maximum dissolved surface water concentrations at each sampling location were used in the risk assessment as the Exposure Point Concentrations (EPC) for the basis of the risk estimates; the exception was iron, where the maximum total surface water concentration was used since the ecological criteria for iron are based on total concentrations.

Sediment data were collected from various locations from streams in the Blackbird Mine vicinity during 2000. The maximum sediment concentrations on a dry-weight basis at each sampling location were used in the risk assessment as the EPCs as the basis of the risk estimates.

Benthic invertebrates were evaluated as a food source for salmonids. The dietary exposure pathway was evaluated by estimating the dietary exposure to salmonids from eating benthic invertebrates. Dietary exposure was estimated by predicting tissue concentrations in benthic invertebrate food items and comparing the modeled dietary concentration to concentrations from the literature where no effect and adverse effects levels were identified. The dietary exposure pathway was evaluated for salmonids only.

7.2.5 Effects Assessment

The Effects Assessment consisted of identifying the potential adverse effects that release of copper, cobalt, arsenic, or iron could have on aquatic receptors in the aquatic ecosystem. Toxicity information in the form of toxicity data reported in the literature for COPECs for surface water and sediments, site-specific testing (bioassays and other testing), and screening levels were reviewed for each metal. Toxicity reference values (TRV) formed the basis of the risk estimates and included the AWQC for surface water, EPA Region V (EPA, 1999) Ecological Screening Values (ESV), and National Oceanic and Atmospheric Administration (NOAA) Coastal Protection and Restoration Division (Buchman, 1999) benchmarks for sediments, as well as values derived from the peer-reviewed and site-specific literature. Effects on benthic macroinvertebrates, a primary food supply for salmonids, were also addressed directly by evaluating benthic invertebrate community data.

The TRVs are the values used in conjunction with data from the exposure assessment to perform risk characterization. The use of TRVs as the basis for calculating the Hazard Quotients (HQ), or ratio of the EPC to the appropriate TRV, is only one line of evidence that was evaluated in the aquatic risk assessment. The TRVs were chosen after review of literature, the relevant and appropriate site-specific toxicity studies, and existing screening levels (ecological criteria and guidance) for the COPECs and media of concern (i.e., surface water and sediment).

7.2.5.1 Surface Water TRVs

The surface water TRV values are derived from the Idaho Water Quality Standards (WQS) where available. Due to the considerable amount of information reviewed and integrated in developing the WQS, they were chosen as the most appropriate TRVs for analysis of risks to aquatic life. WQS were available for copper and iron.

For cobalt, a state or federal criterion does not currently exist, thus the cobalt TRVs were based on peer-reviewed or regulatory literature and site-specific testing. A cobalt TRV likely to be protective of all forms of aquatic life was obtained from Suter and Tsao (1996), and includes toxicity data for various species of invertebrates, amphibians, and fish. Data suggest that salmonids may be more tolerant of cobalt toxicity than invertebrates; thus, a TRV protective of salmonids only was developed for cobalt as well. Table **7-**11 presents the TRVs for surface water.

Table 7-11
Surface Water TRVs

COPEC	TRV (mg/L)[1]	Source
Cobalt (aquatic life)	0.023	Chronic Tier II value (Suter and Tsao, 1996)
Cobalt (salmonids)	0.038	Weight-of-evidence for literature and site-specific testing
Copper	varies[2] 0.0035 at a hardness of 25 mg/L	IDAPA 58.0102.210
Iron	1	CFR, 1999

1 Dissolved cobalt or copper in surface water; total iron in surface water.
2 The TRV for copper is corrected for hardness when comparing to site-specific data.

7.2.5.2 Sediment TRVs

A review of the benthic macroinvertebrate data indicates that the health of the benthic invertebrate community is improving. Because of the naturally high mineralization of the area and the possibility of adaptation of the benthic community to elevated metal concentrations, it is possible that populations of benthic macroinvertebrates may survive at concentrations higher than indicated in the literature. Site-specific toxicity data were also considered when evaluating potential sediment TRVs; levels producing no effects in site-specific testing were below the TRVs, and adverse effect levels were above the selected sediment TRVs. This suggests that the TRVs are adequately protective, but not overly conservative.

The sediment TRV values are the threshold effects concentration (TEC) or levels producing no adverse effects from other sources. The sediment TRVs are summarized in Table 7-12.

Table 7-12 Sediment Toxicity Reference Value (TRV) Selection				
COPEC	**EPA Region V ESL (EPA, 1999) (mg/kg)**	**NOAA Squirt Table (Buchman, 1999) (mg/kg)**	**TEC (MacDonald *et al.*, 2000)[3] (mg/kg**	**Sediment TRV Selected (mg/kg)**
Arsenic	6	61	9.79	9.79
Cobalt	50	NA	NA	50
Copper	16	362	31.6	31.6
Iron	NA	40000	NA	40,000

1 Based on the Threshold Effects Level (TEL).
2 Upper Effects Threshold (UET), no TEL was reported for these metals.
3 The TEC is the preferred value. In the absence of a TEC, the lowest available value was used.
NA - not available

7.2.6 Risk Characterization and Determination

The potential risks to ecological receptors were predicted with an HQ. The HQ is a ratio of the EPC to the TRV for water or sediment exposure, or the ratio of the modeled dietary concentration to the appropriate dietary TRV. An HQ in excess of 1 indicates a potential for risk, whereas an HQ below 1 indicates little potential for adverse effects.

Background concentrations which are discussed in Section 5 are used for comparative purposes in the following summary of aquatic ecological risks for each creek.

7.2.6.1 Blackbird Creek

All the lines of evidence indicate that metals in surface water and sediment in Blackbird Creek have potential for adversely affecting the aquatic ecosystem. Surface water HQs for the protection of aquatic life and salmonids were consistently greater than 10 for copper and cobalt during high flow. During low flow, they were generally greater than 10 for both copper and cobalt. The sediment HQs were greater than 50 to100 for arsenic, and concentrations were up to 38 times higher than background levels of arsenic. The sediment HQs for copper were nearly 50 to more than 100; copper concentrations in Blackbird Creek were 2 to 5 times higher than background. Cobalt HQs ranged from 7 to 10, and were greater than background by a factor of 2. The benthic community data also indicate that there is the potential for adverse effects to the aquatic system since the downstream station does not resemble the reference stations.

7.2.6.2 Panther Creek

Panther Creek has shown improvements in water quality with the implementation of the Early Actions. The lines of evidence reflect this improvement; however, there is still potential for adverse effects to the aquatic ecosystem. Chronic and acute surface water HQs for copper during high flow ranged from 2 to 6. During low flow, surface water HQs were less than 1 for copper, indicating low potential for adverse effects during this period. Surface water HQs for cobalt ranged from 1 to 3 during both high and low flow periods, based on protection of aquatic life. Based on protection of salmonids, cobalt HQs ranged from less than 1 to 2. Sediment HQs for all metals ranged between 1 and 21, and metal concentrations were <1 to 6 times higher than background. The highest metal concentrations above background in sediments were found at station PASW-08A. The benthic stations along Panther Creek are beginning to resemble the Panther Creek reference station but still show impacts due to metals.

The comparison to background, the surface water and sediment HQs, and the benthic community data suggest continuing effects on the aquatic ecosystem, although improvement has been observed due to implementation of the Early Actions.

7.2.6.3 Bucktail Creek

Bucktail Creek continues to have very poor water quality. HQs for surface water were the highest along this creek and exceeded 2000 for copper.

7.2.6.4 South Fork of Big Deer Creek

The lines of evidence for the South Fork of Big Deer Creek indicate there is potential for adverse affects due to mine wastes. Surface water HQs were lower in 2000 than 1999; this may reflect continued improvements as a result of implementation of Early Actions. Surface water HQs for copper range from 4 to 66 during high flow and up to 13 during low flow. Surface water cobalt HQs protective of aquatic life range from 2 to 9 during high flow and from 2 to 4 during low flow. Surface water cobalt HQs for the protection of salmonids were 2 in the year 2000. Sediment HQs ranged from less than 1 to 203. Arsenic concentrations were 5 times higher than background conditions, and copper concentrations were 10 times higher than background conditions. The benthic community along South Fork of Big Deer Creek continued to be impacted, with most of the indices evaluated at the downstream stations not resembling those at the reference station.

7.2.6.5 Big Deer Creek

The lines of evidence for Big Deer Creek indicate some improvements in water quality. Surface water HQs for copper improved between 1999 and 2000 and ranged from 2 to 4. The improvement in surface water HQs between 1999 and 2000 may reflect the implementation of Early Actions. Surface water HQs for cobalt were below 1 for all the sampling events, indicating low potential for adverse affects due to cobalt. Sediment HQs ranged from <1 at the reference location to 12 at BDSW-01 for copper; HQs for arsenic, iron, and cobalt were <1 at the reference location and downgradient areas. Cobalt sediment concentrations were two times higher than background, and copper sediment concentrations were four times higher than background. The benthic community is beginning to resemble the reference station for several indices; however, effects due to metals are still being observed.

7.2.6.6 Uncertainties

Surface Water

The surface water matrix is well mixed and more homogenous than the sediment matrix. Thus, there are fewer potential variables introduced on the basis of matrix composition alone.

The surface water TRVs for copper and iron are based on Idaho WQS, which in turn are based on a large database and, as such, are relatively certain. The cobalt criterion is based on a more limited data set, and as such is more uncertain, but is corroborated by site-specific toxicity testing. The surface water TRVs may underestimate or overestimate toxicity at the Blackbird Mine Site.

Sediment

Many factors contribute to the uncertainty in assessing the ecological risk due to exposure to contaminated sediments. There is a limited data set for sediment, which increases the uncertainty. The sediment matrix is highly variable physically, which allows metals concentrating in fines to accumulate in low-flow (i.e., pool) areas to a greater extent than in high-flow (i.e., ripple) areas. Total organic carbon (TOC) can decrease toxicity, and TOC tends to accumulate in low-flow as opposed to high-flow areas as do the fines. Thus, toxicity can be the same in areas with fines and high TOC as in areas with larger-grain sizes and low TOC. This increases the uncertainty in the sediment TRVs, since toxicity is influenced by sediment factors. This also increases uncertainty in the exposure estimates, since physical variables also can influence exposure.

The sediment matrix is also variable chemically, and various inorganics such as calcium, magnesium, and other elements are distributed heterogeneously. Metals adsorbed to sediment particulates also are distributed heterogeneously; thus, sediments from different locations can exhibit widely different chemical characteristics although located spatially close to one another. This increases the uncertainty in evaluating exposure by aquatic receptors in contact with sediments, since concentrations vary spatially. The chemical characteristics of sediments increase uncertainty, since they can affect toxicity and bias the risk assessment results either high or low.

The sediment TRVs contain uncertainty because they are developed from data from other stream systems, with different benthic communities and with different sediment characteristics. However, the sediment TRVs represent the most current and comprehensive evaluation available for addressing sediment toxicity. The sediment TRVs may overestimate or underestimate toxicity at the Blackbird Mine Site. There are also uncertainties associated with the statistical tests that were performed to determine the UTL of the background sediment data set. A data set representing pre-mining conditions does not exist. The PRGs based on sediment background may overestimate or underestimate the background UTLs. The UTLs for Panther Creek and Big Deer Creek do not account for the contribution of the mineralized ore body and therefore, may underestimate the background UTL.

The availability of limited site-specific data helps reduce uncertainty in the risk assessment estimates and the TRVs used to make those estimates. The benthic community data evaluated in the Aquatic Ecological Risk Assessment (AERA) indicated that all streams downgradient of metal impacts had corresponding impacts on the benthic community. Panther Creek, with generally the lowest sediment HQs, also exhibited the most minimal benthic community impacts. Thus, the data corroborate the risk analysis. In addition, site-specific toxicity test results indicated that the sediment toxicity-based TRVs were appropriate for the Blackbird Mine Site, since TRVs were lower than measured adverse effect levels in Panther Creek.

7.3 TERRESTRIAL ECOLOGICAL RISK ASSESSMENT

A terrestrial ecological risk assessment (TERA) was conducted as part of the RI/FS of the Blackbird Mine Site. The purpose of this risk assessment was to determine the risk to populations of receptors of concern (ROC) from mine-related deposits within the riparian zones of Blackbird Creek, Panther Creek, Bucktail Creek, South Fork Big Deer Creek, and Big Deer Creek. Several wildlife and plant communities are present in the greater Blackbird Mine area, which is comprised of several drainages: Panther Creek, Bucktail Creek, South Fork Big Deer, and Big Deer Creeks. The primary habitat type within the impacted areas of these drainages is riparian. Potential risks to ROC populations due to exposures within waste rock piles and tailing impoundment areas were also evaluated. Reference areas included the riparian zones upstream of Panther Creek, West Fork Blackbird Creek upstream of the mine and tailings impoundment, and Big Deer Creek upstream of South Fork Big Deer Creek

COPECs were identified using a screening process that included metals that occurred at higher concentrations than reference areas. Arsenic, copper, and cobalt were determined to be COPECs for terrestrial resources in the greater Blackbird Mine area. Two management goals were identified and focused on the protection of populations of ROC rather than individuals: 1) habitat suitability and community structure adequate to support healthy populations of ROC within the study area; and 2) food resource quality adequate to support healthy populations of ROC within the study area. The risk characterization was based on the overall weight of evidence produced by several measured and modeled responses. The lines of evidence included measured responses of the plant community and small mammals along the COPEC concentration gradient, the modeled effects of mine-related deposits on habitat suitability for each ROC, the relative spatial extent of changes in habitat suitability, measured tissue concentrations, site-specific bioaccumulation factors, impact on home ranges (HR), the abundance of food resources, and Tier 1, Tier 2, and Tier 3 HQ values. Tier 1 HQs were based on exposure estimates using maximum soil concentration and a no observed adverse effect level

(NOAEL). Tier 2 HQs based exposure on a 95 percent UCL of the mean soil concentration and the lowest observed adverse effect level (LOAEL). In Tier 3, HQs were based on a mean soil concentration and an LOAEL. The evaluation of lines of evidence was hierarchical, in ascending order of spatial resolution (i.e., individual-level risks using point estimates of exposure, risks at the subpopulation level, and risks at the population- evel). Weight of evidence was then related to the ecological management goals.

A summary of the terrestrial risk for each creek follows.

7.3.1 Blackbird Creek

Risks along Blackbird Creek were identified for individuals and sub-populations of deer mice, shrews, and ground squirrels living in the riparian zone. Individual robins were also identified as being at risk based on high Tier 2 and Tier 3 HQs and changes in habitat suitability. Tier 3 HQs for arsenic for the shrew and the robin were 2 and 5, respectively. Tier 3 HQs for cobalt ranged from 13 to 35 for all four receptors. Although sub-population risks to these receptors were identified in riparian habitat along Blackbird Creek, population-level risks for all ROC in the Blackbird Creek drainage were considered negligible.

7.3.2 Panther Creek

The weight of evidence from all measured and modeled data for Panther Creek indicated that population and sub-population risks were generally negligible. Individual risks exist, however, for deer mice, shrews, ground squirrels, and robins because Tier 2 (95 percent UCL exposure exceeded the LOAEL) or Tier 3 (mean exposure exceeded the LOAEL) HQs were greater than 1 for deer mice, shrews, and robins in particular areas and because of changes in habitat suitability in a number of home ranges for these ROCs.

7.3.3 Bucktail and South Fork of Big Deer Creek

COPECs in media from Bucktail and South Fork of Big Deer Creeks were found to pose potential risks to individual deer mice, shrews, robins, and ground squirrels due to both changes in habitat suitability and food resource quality. Risks to sub-populations and populations of deer mice, shrews, ground squirrels, and robins along Bucktail and South Fork Big Deer Creeks were considered negligible because of the very small number of home ranges affected (unlikely to represent a sub-population) and because of the minimal changes in habitat quality.

7.3.4 Big Deer Creek

Risks to individual deer mice, shrews, and robins exist along Big Deer Creek because of changes in food resource quality. Risks to populations and sub-populations of deer mice, robins, and shrews along Big Deer Creek were considered negligible because Tier 3 HQs were approximately 1, and because there were no significant changes in habitat quality.

7.3.5 Waste Rock Piles and Tailings Impoundment Area

The qualitative analysis of information on the waste rock piles and tailings impoundment area indicated that although the waste rock piles may provide suitable breeding and hibernation sites for pikas and ground squirrels, they contain no vegetation. Thus, the suitability of these areas with respect to food resources is low for all ROCs evaluated in this study. Based on the lines of evidence, risks to ROC populations from the waste rock piles or tailings impoundment area were considered negligible.

7.3.6 Uncertainties

Four principle areas of uncertainty were identified. These include natural variability in the ecological measures, model uncertainty, measurement error, and data errors.

Natural variability is both spatial and temporal. Only spatial variability was addressed in the assessment because only one field season of data was collected. Spatial variability reflects variation within and between habitat types.

Model uncertainty refers to models such as the HQ calculations. High uncertainty exists in the calculation of HQs because of wide variation of COPEC concentrations across each study site, unknown exposure time for each receptor within an exposure category, unknown bioaccumulation factors, assumed diet composition of receptors, assumed food ingestion rates, derived NOAELs and LOAELs, and limited toxicity and measured site data for various COPECs.

Specifically, inputs such as soil moisture contribute to high uncertainty. In general, soil is assumed to be in dry weight. For the purposes of this assessment, soil was converted to wet weight using a soil moisture of 50 percent. This value was noted to be estimated from field soil moisture measurements and is unusually high. This will likely underestimate risk. Similarly, toxicity values from various studies were averaged to obtain the mammalian NOAELs and LOAELs for arsenic and cobalt as well as avian NOAELs and LOAELs for arsenic used in the HQ calculations. Avian NOAELs and LOAELs for copper and cobalt, however, were based on single studies. This procedure may underestimate or overestimate risk.

Uncertainty also exists within the relative amount of data, measurement error, and data errors. Data sets differed in breadth; consequently, some areas had more robust data sets than other sites evaluated in the risk assessment. Measurement error was minimized by using Standard Operating Procedures, as were data errors by using a quality control procedure.

7.4 Summary of Risks

An overall summary of the risk is presented in Table 7-13 by media and whether there is a potentially unacceptable risk for human, aquatic, or terrestrial receptors for each drainage. An "X" on the table indicates a potential risk has been shown for that media and receptor group.

Table 7-13
Summary of Areas of Unacceptable Risk

Drainage	Media	HHRA	Aquatics	Terrestrial
Blackbird Creek	Soil	X (As)	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
	Groundwater	X (As, Co)		
	Stability/Recontamination issues	X	X	-
Panther Creek	Soil	X (As)	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
Bucktail Creek	Soil	-	-	-
	In-stream Sediments	-	-	-
	Surface Water	-	-	-
	Groundwater	X (Co, Cu)		
Big Deer Creek	Soil	-	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-
South Fork of Big Deer	Soil	-	-	-
	In-stream Sediments	-	X (As, Co, Cu)	-
	Surface Water	-	X (Co, Cu)	-

SECTION 8

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of medium-specific or location-specific goals for protecting human health and the environment. This section presents the RAOs for soil, groundwater, surface water, and sediment at the Blackbird Mine site. It outlines the risks identified in Section 7 and provides the basis for evaluating the cleanup options presented in Section 9.

8.1 NEED FOR REMEDIAL ACTION

The mining operations at the Blackbird Mine site have resulted in contaminated groundwater at the mine, contaminated surface water and sediments in creeks at and downstream from the mine, and contaminated overbank deposits along creeks downstream from the mine including Blackbird Creek and Panther Creek. Key COCs at the Blackbird Mine site identified in the human health and ecological risk assessment include arsenic for human health concerns; copper and cobalt for aquatic organisms in surface water; and copper, cobalt and arsenic for aquatic organisms in sediments. Based on the results of the Human Health Risk Assessment and the Aquatic Ecological Risk Assessment, the response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

The cleanup levels (i.e., remediation goals) are driven by either background, ARARs, or risk based concentrations. The NCP states that remediation goals shall establish acceptable exposure levels that are protective of human health and the environment and shall be developed by considering the following:

> Applicable or relevant and appropriate requirements under federal environmental or state environmental or facility siting laws.
>
> For systemic toxicants, acceptable risk-based exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety.
>
> For known or suspected carcinogens, acceptable risk-based exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6} using information on the relationship between dose and response.

For the Blackbird Mine site, human health cleanup levels are based on a 1 x 10^{-4} cancer risk because there is only one carcinogenic chemical of concern (arsenic) for humans, and there is no potential for additive effects resulting from exposure to multiple chemicals. For systemic toxicants (non-cancer effects), cleanup levels are based on concentrations equal to or less than a Hazard Index of 1.

The following sections outline the remediation objective and cleanup levels for each area of the Blackbird Mine site.

8.2 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of what the cleanup action will accomplish. The RAOs for this site are provided in Table 8-1:

Table 8-1
Remedial Action Objectives for Blackbird Site

Media	Receptors of Concern	Remedial Action Objectives
Surface Soils	Human Receptors	Reduce direct contact (i.e., ingestion and dermal contact) with surface soils containing contaminants of concern in excess of the cleanup levels. Reduce migration of surface soils and overbank deposits to downstream areas that would deposit concentrations of contaminants of concern in excess of the cleanup levels established at those downstream areas.
	Aquatic Receptors	Reduce migration of metals into the water column of the streams so that the cleanup levels for the contaminants of concern established for the streams are not exceeded. Reduce migration of the surface soils to in-stream sediments so that the cleanup levels for the contaminants of concern established for in-stream sediments are not exceeded
Groundwater	Human Receptors	Prevent use of contaminated groundwater underlying waste management areas.

Media	Receptors of Concern	Remedial Action Objectives
Surface Water	Human Receptors	Maintain water quality for protection of human health.
	Aquatic Receptors	Reduce direct contact with surface water containing contaminants of concern in excess of the cleanup levels. Restore and maintain water quality and aquatic biota conditions capable of supporting all life stages of resident salmonids and other fishes in South Fork of Big Deer Creek and Big Deer Creek. Restore and maintain water quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek. Reduce concentrations of contaminants of concern in Blackbird Creek to improve water quality such that cleanup levels are not exceeded in Panther Creek and to support some aquatic life in Blackbird Creek. Reduce concentrations of contaminants of concern in Bucktail Creek to improve water quality such that cleanup levels are not exceeded in South Fork of Big Deer and Big Deer Creeks.
Sediments	Aquatic Receptors	Reduce direct contact with in-stream sediments containing contaminants of concern in excess of the cleanup levels. Reduce migration of in-stream sediments to downstream areas so that the cleanup levels for the contaminants of concern established for in-stream sediments at those downstream areas are not exceeded. Restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident salmonids and other fishes in South Fork of Big Deer Creek and Big Deer Creek. Restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek. Reduce concentrations of contaminants of concern in Blackbird Creek to improve sediment quality such that cleanup levels are not exceeded in Panther Creek and to support some aquatic life in Blackbird Creek. Reduce concentrations of contaminants of concern in Bucktail Creek to improve sediment quality such that cleanup levels are not exceeded in South Fork of Big Deer and Big Deer Creeks.

8.3 CLEANUP LEVELS

8.3.1 Human Health Cleanup Levels For Surface Soils and In-stream Sediments

The primary contaminant of concern for human health at this Site is arsenic. As discussed in Section 7, the risks to human health from arsenic were evaluated based on knowledge of current and projected future use scenarios for each area of the site. The different use scenarios ranging from recreational to residential result in different cleanup levels which are discussed below.

8.3.1.1 Upper Blackbird Creek and Lower Blackbird Creek to Panther Creek Road

As noted in Section 7, there are localized areas of soil along Blackbird Creek that have concentrations of arsenic more than an order of magnitude greater than the upper-bound average concentrations used as the EPCs in the risk calculations (e.g., concentrations of arsenic up to 138,000 milligrams per kilogram [mg/kg]). If receptors limit their activities to localized areas with unusually high concentrations of arsenic and do not spend time over the entire exposure area, there may be unacceptable potential acute (short-term) or chronic (long-term) risks associated with their exposure to the localized areas.

In addition, there are significant quantities of materials in overbank deposits and other material in Blackbird Creek channel containing elevated levels of arsenic that could become mobilized during high flow events, transported downstream and potentially deposited in recreational and residential use areas (particularly along Panther Creek).

The remedial action objective for protection of human health for this portion of Blackbird Creek is to reduce exposure to soils in areas of localized, elevated concentrations of arsenic in soil along Blackbird Creek and to reduce the threat to downstream receptors of concern from mobilization and deposition of material in downstream areas.

The cleanup levels for arsenic in soil were calculated using a risk-based analysis for a recreational scenario for the Upper and Lower Blackbird Creek exposure areas. The cleanup levels are based on a combination of standard default exposure assumptions and site-specific adjustments. The cleanup levels are based on incidental ingestion, inhalation of soil particulates, and dermal contact exposure routes (see Table 8-2). The cleanup levels are based on non-cancer effects for the child recreational use scenario because it is more protective than cleanup levels based on cancer risk. The cleanup level for arsenic based on non-cancer effects for the child scenario is 4,300 mg/kg (for 14 days per year and 2 hours per day of exposure) for Lower Blackbird Creek, and 8,500 mg/kg (for 7 days per year and 2 hours per day of exposure) for Upper Blackbird Creek. The exposure frequency is based on site-specific conditions and interviews with local residents and Forest Service staff. Blackbird Creek has limited use, and access to Blackbird Creek above the West Fork Tailings Impoundment is controlled with a gate.

8.3.1.2 Blackbird Creek Downstream from Panther Creek Road

The area along Blackbird Creek, between the existing berms adjacent to the Panther Creek Inn, between the Panther Creek road bridge and the Blackbird/Panther Creek confluence, contains overbank materials and in-stream sediments with elevated arsenic concentrations. The Panther Creek Inn has year-round residents; therefore, risk-based soil and in-stream sediment cleanup levels are based on residential use.

The risk estimate for the in-stream sediments exceed EPA's acceptable risk level for non-cancer effects with a Hazard Index of 3. In addition, several surface soil samples collected along the banks of Blackbird Creek channel (i.e., overbank deposits) in the vicinity of the Panther Creek Inn, inside the berm, have elevated arsenic. Potential risks associated with exposure to the soils between the berms were shown to be 7×10^{-4} to 2×10^{-3} for cancer risks and Hazard Indices ranging from 3 to 30 for non-cancer effects.

For the overbank deposits, the cleanup level is 100 mg/kg arsenic, which is based on background concentrations of arsenic in soil. The calculated risk based residential cleanup level for arsenic is 42 mg/kg for arsenic, which would be below naturally occurring background levels.

Cleanup levels were also developed for potential exposure to contaminated sediment in Blackbird Creek adjacent to the Panther Creek Inn by adult and child residents. The cleanup levels are based on the residential exposure scenario for an adult or a child playing in the in-stream sediments and assumes the following exposure routes: incidental ingestion, inhalation of sediment (soil) particulates, and dermal contact exposure routes. The arsenic cleanup level was developed using age-adjusted factors (i.e., parameters based on an adult and a child receptor) to address carcinogenic effects and child factors to address noncarcinogenic effects. These factors result in the most protective cleanup level (i.e., lowest values) for cancer and non-cancer effects, respectively. The cleanup level calculations for the non-cancer effects results in the lowest of these values, 488 mg/kg. Rounding up, a value of 490 mg/kg arsenic is selected as the cleanup level for in-stream sediments in Blackbird Creek between the Panther Creek Road bridge and the confluence of Panther Creek.

8.3.1.3 Panther Creek

Four private properties along Panther Creek (Rogers 2, Rogers 3, Strawn, and Rufe pasture) exceed EPA's acceptable risk range for the future residential scenario. Risk estimates for the Hade property also exceed EPA's acceptable range for the full-time resident, but is based on a limited data set. The property owner denied access for further sampling. The residential use cleanup level of 100 mg/kg arsenic is used for overbank soils based on background concentrations of arsenic in soil.

8.3.2 Human Health Cleanup Levels For Groundwater

The primary contaminant of concern in the groundwater for protection of human health at this Site is arsenic as well as risk-based concentrations of copper and cobalt. As discussed in Sections 5 and 7, there are areas within the Site where groundwater levels exceed the Maximum Contaminant Level (MCL) of 10 ug/L for arsenic. Although the MCL establishes threshold contaminant levels for community drinking water systems and, as such, is not applicable to this Site, the MCL is relevant and appropriate in considering cleanup levels for groundwater.

(55 Fed. Reg. 8753, March 8, 1990) The cleanup levels for copper and cobalt are 3,060 ug/L and 1,530 ug/L, respectively, and are based on an HI of 1 for non-cancer effects. The cleanup levels are based on site-specific assumptions for worker exposure (167 days per year assuming drinking 2 liters of water per day).

CERCLA and the NCP provide that groundwater should be returned to its beneficial uses within a reasonable timeframe wherever practicable. When restoration of groundwater is not practicable, then it is necessary to prevent further migration of the plume and to prevent exposure to the contaminated groundwater. 40 C.F.R.300.430(a)(2). The NCP provides that groundwater cleanup levels should generally be attained throughout the contaminated plume. However, the NCP recognizes that groundwater may remain contaminated at and beyond the edge of the waste management area when waste is left in place (55 Fed. Reg. 8712, 8753, March 8, 1990).

8.3.2.1 Upper Blackbird Creek and Lower Blackbird Creek to Panther Creek Road

The Blackbird Creek drainage and the West Fork Tailings Impoundment have elevated levels of arsenic in the groundwater that exceed the MCL and risk-based concentrations of copper and cobalt. Since the groundwater in most of the Blackbird Creek drainage is underlying waste management areas where tailings and other materials are being managed, the point of compliance for groundwater will be beyond this area downgradient of the Panther Creek Road.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.2.2 Blackbird Creek Downstream from Panther Creek Road

The Panther Creek Inn drinking water wells have not shown elevated levels of mine-related arsenic, copper or cobalt. However, to the extent that groundwater in this area is contaminated by mine related activities and is a potential source of drinking water, it must be cleaned up to meet MCLs for arsenic and risk-based cleanup levels for copper and cobalt.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.2.3 Panther Creek

The Panther Creek drinking water wells have not shown elevated levels of mine-related arsenic, copper or cobalt. However, to the extent that groundwater in this area is contaminated by mine related activities and is a potential source of drinking water, it must be cleaned up to meet MCLs for arsenic and risk-based cleanup levels for copper and cobalt.

Groundwater that discharges through seeps or springs that adversely impacts surface water must be managed so that the cleanup levels for surface water for protection of human health and the environment will be met in the surface water.

8.3.3 Human Health and Aquatic Cleanup Levels for Surface Water

The cleanup levels for arsenic, copper and iron in surface water are based on standards established under applicable or relevant and appropriate requirements (ARARs). The cleanup levels for cobalt are derived from a risk-based analysis.

Surface Water Cleanup Levels Derived From ARARs

Section 121 of CERCLA, 42 U.S.C. Section 9621(d), requires attainment of Federal and State ARARs. "Applicable requirements" are those requirements that specifically address a hazardous substance remedial action, location or other circumstance found at the Site. (40 C.F.R. 300.5) "Relevant and appropriate requirements" are those requirements that, while not "applicable", address problems or situations sufficiently similar to those at the Site that their use is well suited to the Site. (40 C.F.R. 300.5)

Section 121(d)(2)(A) of CERCLA, 42 U.S.C. § 9621(d)(2)(A), specifically identifies the water quality criteria established under section 303 or 304 of the Clean Water Act (CWA) as potentially relevant and appropriate depending on the circumstances of the release or threatened release. To determine whether or not the water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the release or threatened release, EPA is required to consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available. (42 U.S.C. §9621(d)(2)(B)(i))

For the contaminants of concern at this Site, the State of Idaho standards differ from the current Clean Water Act ambient water quality criteria. To reconcile this difference, the following discussion identifies the available Idaho standards as "applicable" and considers the federal ambient water quality criteria (AWQC) established under the Clean Water Act to determine whether it is relevant and appropriate to the circumstances of the release.

Arsenic Cleanup Level

The State of Idaho has established a water quality standard for arsenic of 50 µg/L for protection of human health and the environment. This standard is applicable to the surface water at this

Site. In addition, EPA has determined that the Federal AWQC is relevant and appropriate for evaluating surface water quality for protection of human health at a 10^{-4} risk level based on "consumption of organisms only" in those creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek).

In reaching this decision, EPA reviewed the 2002 National Recommended Water Quality Criteria which establish two separate values for the protection of human health: (1) when contaminated organisms and water are consumed, 2) when contaminated organisms are consumed.

First, EPA reviewed the AWQC for protection of human health based on "consumption of water and organisms" and found that this AWQC is not relevant and appropriate based on the site-specific human health risk assessment. The Blackbird Mine Site Human Health Risk Assessment found that recreational contact to and ingestion of surface waters in the creeks containing elevated levels of arsenic does not present an unacceptable risk to recreational visitors or workers at the mine.

Second, EPA reviewed the Federal AWQC for protection of human health based on "consumption of organisms only" and found that the AWQC of 14 ug/L for arsenic is potentially relevant and appropriate for the purposes of reducing risk of human exposure based on consumption of organisms in Panther Creek, South Fork Big Deer Creek and Big Deer Creek. However, the AWQC is not currently relevant and appropriate for Blackbird Creek and Bucktail Creek since these creek are not presently protected for aquatic life.

Since Panther Creek, Big Deer Creek and South Fork Big Deer Creek are protected for aquatic life, the AWQC of 14 ug/L for arsenic is relevant and appropriate. EPA has reviewed the post-Early Action surface water monitoring data for Panther Creek, Big Deer Creek and South Fork Big Deer Creek to determine whether these creeks meet this criteria. There have been occasional exceedances of the arsenic AWQC criterion of 14 ug/L for the unfiltered samples in Panther Creek and South Fork Big Deer Creek. There have been no exceedances of the arsenic AWQC criterion in Big Deer Creek. For Panther Creek and South Fork Big Deer Creek, EPA applied a 95% UCL to the unfiltered sample data and concluded that the 95% UCLs for both Panther Creek and South Fork Big Deer Creek do not exceed the AWQC criteria of 14 ug/L.

The surface water cleanup level for arsenic in Panther Creek, Big Deer Creek and South Fork Big Deer Creek is 14ug/L. The surface water cleanup level for arsenic in Blackbird Creek is 50 µg/L. There is no surface water cleanup level for arsenic in Bucktail Creek.

Copper Cleanup Level

The State of Idaho has adopted water quality standards for copper for protection of aquatic life. This standard is listed in IDAPA 58.01/02.210. This standard is applicable to the surface water at this Site.

Based on its evaluation of the elements set forth above and the limited information that is available, EPA has determined that the AWQC is not currently relevant and appropriate for copper under the circumstances of the release at this site. This decision is based on information provided by the State of Idaho in their comments on the Proposed Plan which included 1) a review of several studies of the effects of copper toxicity test to relevant species which would occur at the Site and 2) a literature review of salmonid copper toxicity tests which indicates that the Idaho copper criteria would be protective of the coldwater aquatic life at the Site. EPA may re-evaluate this determination during the five year review process.

For this Site, the difference between the AWQC and the Idaho WQS is most apparent in streams where the hardness is below 25 mg/L CaCO3 such as in Big Deer Creek. For those streams such as Panther Creek whose hardness values are at or above 25 mg/L, there is little difference between the 1999 AWQC and the Idaho copper standard.

The Idaho WQS currently has a cap at a low end hardness value of 25 mg/L. Therefore, when the ambient hardness is lower than 25mg/L, the Idaho WQS is still calculated using a hardness value of 25 mg/L. The following tables provide the equations for calculating the Idaho water quality standard for copper and show the values that are derived from the equations over the range of hardness found at the Site.

Table 8-3
Hardness-dependent Aquatic Life Criteria for Dissolved Copper in Idaho

Metal	CMC Equation (µg/L)	CCC Equation (µg/L)
Copper	$\text{CMC} = 0.960 \times e^{(0.9422 \times \text{in(hardness)} - 1.464)}$	$\text{CCC} = 0.960 \times e^{(0.8545 \times \text{in(hardness)} - 1.465)}$

Source: IDAPA 58.0102.210
CMC is the 1-hour average concentration that is not to be exceeded more than once in a three-year period.
CCC is the 4-day average concentration that is not to be exceeded more than once in a three-year period.

Table 8-4 Criteria Calculated Over a Range of Hardness Values That Commonly Occur in the Blackbird Mine Site								
Metal	**CMC (µg/L)**				**CCC (µg/L)**			
Hardness (mg/L)	25	30	50	100	25	30	50	100
Copper	4.6	5.5	8.9	17.0	3.5	4.1	6.3	11.4

Iron

Based on its evaluation of the elements set forth above, EPA has also determined that the AWQC is not relevant and appropriate for iron based on the circumstances of the release at this site. This decision is based on a review of the iron criterion (which was promulgated in 1976) and more recent scientific publications on the ecotoxicity of iron. (Feasibility Study Appendix C). As a result, EPA has not established a cleanup level for iron in surface water.

<u>Surface Water Cleanup Levels Derived From Risk-Based Analysis</u>

For cobalt, there is no existing Federal national ambient water quality criterion (AWQC) nor Idaho WQS. Therefore, the cobalt cleanup level in surface water is risk-based.

In the absence of an established State WQS and AWQC, a weight of evidence approach was used to select an appropriate toxicity reference value (TRV) which was used to establish the cleanup level for cobalt. Available literature data, site-specific testing data, and screening criteria were all considered. The goal of the TRV selection process was to establish a cobalt TRV protective of individual threatened or endangered salmonids, and to be protective of populations of all other aquatic life. Although the available data are limited, there are sufficient studies by which to establish the toxicity of cobalt to aquatic life and salmonids.
The cobalt cleanup level considered the following types of information:

- The available federal, state, and other governmental criteria or guidelines; however, these are influenced by Daphnia values and are likely overly conservative;

- Published studies with invertebrates and fish, particularly studies with species likely to occur in Blackbird/Panther Creek drainages;

- Site specific data.

Salmonid-specific studies were used in development of the salmonid cleanup level. The most appropriate values are chronic (i.e., long-term) studies, resulting in a mortality, morbidity, or reproductive “no effects” endpoint. A no observed effect concentration (NOEC) endpoint is likely to be protective of both populations and individuals in the field. The existing salmonid NOECs from site-specific data were short-term (14 days) or had methodology problems (i.e., used resistant strain of trout). Therefore, a value protective of threatened salmonids would have to be lower than the measured site-specific NOECs. The toxicity values used to develop the cleanup level are presented in Table 8-3. It is important to note that all of the salmonid TRVs in Table 8-5 are similar, although they are derived from different sources and by different methods. Because all of the TRVs are so similar, a median value is appropriate for the cobalt TRV. The median represents the 50th percentile and, as a statistic, is resistant to the effects of outliers; because the TRVs converge toward a value between 0.3 and 0.4 mg/L, the uncertainty in the cobalt TRV is less than in any of the studies individually.

The cleanup level for cobalt for all salmonid species is 0.038 mg/L. This value should be adequately protective of individual special status salmonids, since it incorporates the chronic NOEC and other data. It should be adequately protective of populations of salmonids as well. This value is expected to be adequately protective, but not overly conservative.

Table 8-5
Summary of Salmonid Cobalt TRVs

Endpoint	Co (mg/L)	Source	UF	Co TRV (mg/L)
LC01	0.038	Birge et al., 1980	None	0.038
LC01	0.034	Birge et al., 1978	None	0.034
28-d LC50	0.47	Birge et al., 1978	ACR	0.041
28-d LC50	0.49	Birge et al., 1980	ACR	0.043
60-d NOEC	0.213	HydroQual, 1996	6	0.036
14-d NOEC	0.125	RCG Hagler Bailly (1995)	6	0.021
96-h LC20	0.533	RCG Hagler Bailly (1995)	ACR	0.046
Median				0.038

Note: Site-specific ACR = 11.5 HydroQual, 1999
mg/L values are dissolved
UF = uncertainty factor

8.3.3.1 Blackbird Creek

The State of Idaho has determined that Blackbird Creek and its tributaries should be protected for a beneficial use of secondary contact recreation. In 1997, the State of Idaho completed a use attainability analysis (UAA) and removed the beneficial use designation for aquatic life. EPA has reviewed and approved this use attainability analysis. As a result, there is not a State water quality standard for aquatic life in Blackbird Creek. A review of the secondary contact recreation standards (IDAPA 58.01.02) indicates that arsenic is the only contaminant at the site that could be of concern. The State's secondary contact recreation standard is for dissolved arsenic and is 50 µg/L. A non-numeric narrative cleanup goal is provided below for copper and cobalt instead of a numeric cleanup level.

> *The remedial goal for Blackbird Creek is to improve water and sediment quality such that cleanup levels are not exceeded downstream in Panther Creek. In addition, the remedial goal for Blackbird Creek is to support aquatic life at levels similar to that of nearby reference streams, although not necessarily to support salmonids or metals-sensitive macroinvertebrate taxa.*

8.3.3.2 Bucktail Creek

The State of Idaho has performed a use attainability analysis for Bucktail Creek which removed the beneficial use designations for aquatic life and recreation from this segment. EPA has reviewed and approved this use attainability analysis. As noted in the use attainability analysis, Bucktail Creek is too small to have any real likelihood of contact recreation such as wading, fishing, and swimming. Physical conditions related to the natural features of Bucktail Creek, such as steep gradient and small size and flow, likely precluded its pre-mining use by fish. In addition, limited habitat conditions result in minimum potential for significant contribution of benthic invertebrates to the overall food supply in the Big Deer Creek drainage. Therefore, a non-numeric cleanup level for Bucktail Creek is provided below.

> *The remedial goal for Bucktail Creek is to improve water and sediment quality such that cleanup levels are not exceeded downstream in South Fork Big Deer Creek or in Big Deer Creek.*

8.3.3.3 South Fork of Big Deer, Big Deer and Panther Creeks

The surface water cleanup levels for the protection of aquatic life in South Fork of Big Deer Creek, Big Deer Creek and Panther Creek are a combination of the ARAR for copper and a risk-based weight of evidence approach for cobalt in surface water and copper and cobalt in sediments.

The surface water cleanup levels established for copper, cobalt and arsenic must be met in South Fork of Big Deer Creek, Big Deer Creek and Panther Creek. In accordance with the Clean Water Act and the State of Idaho Water Quality Standards, point source discharges may allow a mixing zone. A mixing zone is an allocated impact zone where the cleanup levels can be exceeded. The Idaho Water Quality Standards provide the criteria for evaluating the size, configuration and location of a mixing zone. This evaluation includes a determination that the mixing zone does not cause unreasonable interference with or danger to beneficial uses and provides guidance regarding the size of the mixing zone. (IWQS 58.01.02.060). Monitoring is necessary to ensure that the mixing zone does not interfere with beneficial uses.

For the purposes of meeting water cleanup levels for copper and cobalt in Panther Creek, a mixing zone has been established at the confluence with Blackbird Creek for the remedy selected in this ROD. This mixing zone has been developed as part of the applicable National Pollutant Discharge Elimination System (NPDES) requirements for establishing effluent limitations for the point source discharges from the water treatment plant and the West Fork Tailings Impoundment. The effluent limitations for these point sources must take into consideration the potential impacts to water quality in Panther Creek which is protected for aquatic life. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

For the purposes of meeting the cleanup level for copper in Big Deer Creek, a mixing zone has been established for the discharge of diverted surface water from Bucktail Creek for the selected remedy in this ROD. This mixing zone has been developed as a relevant and appropriate NPDES requirement. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

8.3.4 Aquatic Cleanup Levels For Sediments In Panther Creek, Big Deer Creek and South Fork of Big Deer Creek

This section describes the toxicity criteria and exposure assumptions used to calculate the sediment cleanup levels for the protection of aquatic life in Panther Creek, Big Deer Creek and South Fork of Big Deer Creek. Benthic invertebrates dwell within the sediments and form the basis of the aquatic food web. Salmonids and other fish lay eggs in sediments. Metals are known to be toxic to benthic invertebrates, and may be toxic to salmonid eggs. Resuspended sediments serve as a potential source of exposure because fish and invertebrates can then ingest them from the water column during feeding.

Aquatic receptors consisting of anadromous and resident salmonids, other fish, and benthic invertebrates could inhabit Panther Creek in the absence of metal contamination from the Blackbird Mine site. Consequently, sediment cleanup levels for aquatic life were established for Panther Creek by considering bioaccumulation, toxicity, and background conditions.

A weight of evidence approach was taken in establishing sediment cleanup levels. A dietary cleanup level, toxicity-based probable effects concentration (PEC), and background concentrations were considered in establishing the sediment cleanup level. If the background concentration falls above the toxicity-based PEC or dietary cleanup level, background is the cleanup level. If background falls below the toxicity-based PEC or dietary cleanup level, the PEC is the cleanup level.

The sediment cleanup levels are presented in Table 8-6 below.

Table 8-6 Sediment Cleanup Levels for Big Deer and Panther Creeks				
COPEC	**Background (mg/kg)**	**Dietary Level (mg/kg)**	**PEC (mg/kg)**	**Cleanup Level (mg/kg)**
Arsenic	34.8	76.29	33	34.8
Cobalt	39	No TRV; PRG cannot be determined	Cannot be determined; site-specific data suggest 80.3	80
Copper	637	536.5	149	637

Note: All values are in mg/kg dry weight.

South Fork of Big Deer Creek has different background concentrations and the sediment clean up levels are presented in Table 8-7.

Table 8-7 Sediment Cleanup Levels for South Fork of Big Deer Creek				
COPEC	**Background (mg/kg)**	**Dietary Level (mg/kg)**	**PEC (mg/kg)**	**Cleanup Level (mg/kg)**
Arsenic	34.8	76.29	33	34.8
Cobalt	436	No TRV; PRG cannot be determined	Cannot be determined; site-specific data suggest 80.3	435
Copper	637	536.5	149	637

Note: All values are in mg/kg dry weight.

Below is a summary table of the cleanup levels for each creek.

Table 8-8
Summary of Sediment and Surface Water Health and Aquatic Life Cleanup Levels by Drainage

Drainage	Media	Arsenic	Cobalt	Copper
Panther Creek	In-stream Sediments	35 mg/kg	80 mg/kg	149 mg/kg
	Surface Water	0.014 mg/l	0.038 mg/l	IWQS
South Fork of Big Deer Creek	In-stream Sediments	35 mg/kg	436 mg/kg	637 mg/kg
	Surface Water	0.014 mg/l	0.038 mg/l	IWQS
Big Deer Creek	In-stream Sediments	35 mg/kg	80 mg/kg	149 mg/kg
	Surface Water	0.014 mg/l	0.038 mg/l	IWQS
Blackbird Creek	In-stream Sediments	See Narrative Goal	See Narrative Goal	See Narrative Goal
	Surface Water	0.050 mg/l	See Narrative Goal	See Narrative Goal
Bucktail Creek	In-stream Sediments	See Narrative Goal	See Narrative Goal	See Narrative Goal
	Surface Water	See Narrative Goal	See Narrative Goal	See Narrative Goal

Note: All values are in mg/kg dry weight
The values for surface water mg/l are dissolved except for arsenic which is total

SECTION 9

DESCRIPTION OF ALTERNATIVES

Many technologies were considered to clean up the Blackbird Mine site. Appropriate technologies were identified and screened for applicability to site conditions. The potential technologies were then assembled into alternatives. Potential remedial alternatives for the Blackbird Mine site were identified, screened, and evaluated in the Feasibility Study (FS). The range of alternatives developed included no action, institutional controls, containment, treatment, and disposal. The alternatives are identified by numbers used in the FS. The alternatives are numbered to correspond with the numbers in the FS Report. The numbers are not sequential because they are the alternatives that were carried forward to the detailed analysis and the other alternatives were screened out earlier in the FS report.

Because the Blackbird Mine affects three different drainages, the alternatives for the Blackbird Mine Site have been divided into the following remediation areas:

- Blackbird Creek: this area includes sources and affected surface water, groundwater, overbank deposits and in-stream sediments in Meadow Creek, Blackbird Creek and the West Fork Tailings Impoundment;

- Bucktail Creek: this area includes sources and affected surface water, groundwater, and in-stream sediments in Bucktail Creek, South Fork of Big Deer and Big Deer Creek;

- Panther Creek: this area includes overbank deposits on Panther Creek and in-stream sediments in Panther Creek.

The Blackbird Creek and Bucktail Creek alternatives address sources that affect water quality and sediments in tributaries in their respective drainages as well as water quality and sediments downstream in Panther Creek

<u>BLACKBIRD CREEK DRAINAGE ALTERNATIVES</u>

9.1 COMMON ELEMENTS OF EACH BLACKBIRD CREEK DRAINAGE ALTERNATIVE

The following elements are included in all of the Blackbird Creek drainage alternatives except the No Further Action alternative.

- Institutional controls (ICs) will be required for all alternatives. ICs are legal and administrative measures such as easements, restrictive covenants and enforcement tools. The ICs will preclude activities that would interfere with the remedy. In addition, ICs will be implemented to prevent the use of groundwater as drinking water for groundwater underlying the waste management areas in the Blackbird Creek drainage.

- Physical restrictions include gates to restrict vehicle traffic and fencing. There is currently a gate located on the Blackbird Creek road a short distance upstream of the Ludwig Gulch Road, which restricts vehicular access to most of the mine area.

- Continued operation of the existing lime precipitation and air oxidation water treatment plant to treat copper and cobalt in water collected by the Early Actions and for treatment of additional contaminated water collected as part of the Remedial Actions.

- Removal of overbank deposits along Blackbird Creek and in-stream sediments adjacent to the PCI that are above cleanup levels. The area would be periodically monitored to determine if it has become recontaminated, and additional removal conducted if future monitoring determines that there is an unacceptable risk to human health.

- Meadow Creek seep collection includes revising the drainage systems in upper Meadow Creek to collect contaminated water and treat the water that was not intercepted as part of the Early Actions at the existing water treatment plant. The contaminated water will be collected behind the 7100 dam and clean water will be diverted around the dam by pipes and a ditch (see Figure 9-1). The construction of this element was started in the fall of 2002 as a modification to the Early Action.

- Soil cover on the West Fork Tailings Impoundment (see Figure 9-2). The cover material will consist of soil that was removed from the overbank deposits along Blackbird Creek and Panther Creek during the Early Actions and any overbank deposits removed from along Blackbird Creek and Panther Creek during the Remedial Actions. The cover will be graded to drain to the creek channel, and will be seeded to establish vegetation. The cover will reduce the amount of cobalt that leaches from the impoundment into groundwater and downstream surface water.

- Monitoring will be required to maintain facilities, evaluate effectiveness of actions at meeting cleanup levels and to document recovery of benthic invertebrate and fish populations. In addition, monitoring will be conducted of various components of the remediation system to ensure effectiveness. This monitoring will include selected overbank areas along Panther Creek (including near the Panther Creek Inn) following significant run-off events to ensure that these areas do not exceed human health cleanup levels due to remobilization of Blackbird Creek sediments and any overbank deposits not addressed by the remedy in this ROD. Monitoring will also be conducted to evaluate whether run-off from the Tailings Impoundment has any impact on water quality. In addition, as part of the Clean Water Act, NPDES substantive requirements monitoring of the water treatment plant discharges (i.e., effluent limits) and monitoring to evaluate the protectiveness of the mixing zone analysis will be conducted. This monitoring may include but not be limited to surface water, sediments, benthic macroinvertebrates, and fish.

- Operation and maintenance of the Early Action and Remedial Action facilities.

- Natural recovery of in-stream sediments includes a variety of natural, physical, chemical and biological processes that result in the concentration of contaminants in sediments being reduced over time without taking active measures (such as dredging) to achieve cleanup levels in sediments. For example, metal concentrations are reduced by metals dissolving back to the water column, and by physical sediment transport from scouring and mobilization of fine-grained sediments until concentrations in sediments are reduced to cleanup levels. It is not possible to accurately predict how long it will take for natural recovery of in-stream sediments.

- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions.

9.2 DESCRIPTION OF THE BLACKBIRD CREEK DRAINAGE ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above.

Based on the narrative cleanup goal for Blackbird Creek, the various remediation alternatives have been developed to improve water and sediment quality in Blackbird Creek, and are evaluated for meeting cleanup levels within Panther Creek.

9.2.1 Alternative BB-1 - No Further Action

Estimated Capital Cost: $0
Estimated Operations and Maintenance Cost: $ 1.2 Million
Estimated Total Present Worth Cost: $ 1.2 Million
Estimated Construction Time Frame: None

Under this alternative no further actions would be implemented, other than the Early Actions that already have been completed. Monitoring as described under common elements, and operation and maintenance of the existing Early Action facilities would continue.

9.2.2 Alternative BB-4 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $ 2.1 Million
Estimated Operations and Maintenance Cost: $ 2 Million
Estimated Total Present Worth Cost: $ 4.2 Million
Estimated Construction Time Frame: 1 to 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also includes physical stabilization of overbank deposits by armoring with rock and limited removal of overbank deposits along Blackbird Creek (see Figure 9-3). The overbank deposits that are removed will be used in the cover at the West Fork Tailings Impoundment as described under common elements. The cover at the West Fork Tailings Impoundment would be used to address cobalt leaching from the impoundment. However, there is uncertainty concerning how long it would take to achieve the cobalt cleanup level in Panther Creek and whether the cobalt cleanup level would ever be achieved with the cover on the West Fork Tailings Impoundment. The distinguishing characteristics of this alternative include the following:

Physical Stabilization with Selective Removal of Blackbird Creek Overbank Deposits

Overbank deposits that have the potential for mobilization by the design 500-year flood would be physically stabilized against mobilization by armoring. Armoring of overbank deposits would be accomplished by placing angular riprap armor rock. The armor riprap would be installed along exposed banks of mine-related sediments from the bottom anticipated scour depth to above the water surface elevation predicted for the design flood. The armor rock would be sized to resist mobilization during the design flood. In a few selected areas (e.g., where the creek flows around a rock outcrop), armoring would be difficult and less reliable than removal. For these selected areas, overbank deposits would be removed rather than armored.

In addition to armoring, overbank deposits with arsenic concentrations above human health cleanup levels would be removed. No further action would be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be difficult.

In some locations, overbank deposits are blocking overland runoff from upland watershed areas. In these areas, stormwater run-off accumulates behind the overbank deposits. In some locations, where the runoff has been unable to get around or over the deposits, the accumulated water has broken through the overbank deposits and washed out some of the deposits. To address this, where necessary, one or both of the following would be performed:

- Drainage pathways would be excavated through the piles to provide natural drainage of accumulated water, or the piles would be re-graded to minimize the potential for accumulation.

- Diversion ditches would be used to route surface water runoff around the overbank deposits.

9.2.3 Alternative BB-5 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Stabilization with Selective Removal of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $3.2 Million (*in-situ* passive water treatment), $ 4.7 Million (*in-situ*, pre-designed water treatment), $5.3 Million (ex-situ pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $3.2 Million (*in-situ* passive), $ 4.8 Million (*in-situ*, pre-designed), $ 4.5 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 6.4 Million (*in-situ* passive), $ 9.5 Million (*in-situ*, pre-designed), $ 9.9 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also includes physical stabilization by armoring with rock and limited removal of overbank deposits along Blackbird Creek as in Alternative BB-4, plus collection and treatment of cobalt in groundwater seepage from the West Fork Tailings Impoundment (see Figure 9-4). The treatment of cobalt would provide for timely achievement of the cobalt cleanup level and certainty that the cleanup level would be achieved. The distinguishing characteristics of this alternative includes the collection and treatment of West Fork Tailings Impoundment seepage.

Collection and Treatment of West Fork Tailings Impoundment Seepage

The seepage from the West Fork Tailings Impoundment is high in metals, particularly cobalt. The seepage from the tailings impoundment typically accounts for over half of the cobalt loads measured at the mouth of Blackbird Creek. Under this alternative, the seepage would be intercepted and treated.

Three options are considered for treating cobalt in the water from the impoundment. The options are: pump water to the existing water treatment plant; *in-situ* treatment by installing a pre-designed (packaged) water treatment plant (e.g., lime precipitation); or *in-situ* passive treatment which could be accomplished in a variety of ways including a sorption cell, an apatite treatment bed, anaerobic sulfate-reducing bacterial (SRB) cell, a pH increasing process. All three process options include installation of groundwater interception systems. Treatability studies would be performed for both the *in-situ* treatment option and the ex-situ pre-designed water treatment plant option.

9.2.4 Alternative BB-6 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $2.7 Million
Estimated Operations and Maintenance Cost: $ 1.9 Million
Estimated Total Present Worth Cost: $ 4.6 Million
Estimated Construction Time Frame: 1 to 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also consists of primarily removing overbank deposits along Blackbird Creek with limited physical stabilization by armoring with rocks. The removal of overbank deposits would reduce the amount of copper and cobalt leaching into Blackbird and Panther Creek more than Alternative BB-4 which primarily leaves the contaminated overbank deposits in place with stabilization. The deposits that are removed would be used in the cover at the West Fork Tailings Impoundment. The cover at the West Fork Tailings Impoundment would be used to address cobalt leaching from the impoundment. However, there is uncertainty concerning how long it would take to achieve the cobalt cleanup level in Panther Creek and concerning whether the cobalt cleanup level would ever be achieved with the cover at the West Fork Tailings Impoundment (see Figure 9-5). The distinguishing characteristic of this alternative includes the removal with selective armoring of Blackbird Creek overbank deposits.

Removal with Selective Armoring of Blackbird Creek Overbank Deposits

Designated overbank deposits would be excavated and hauled to the Tailings Impoundment or the Blacktail Pit for disposal. Excavation would be conducted to the former slope or angle of repose, to natural ground surface, or to the water table as indicated for the individual deposits. Following excavation, the removal area would be graded as necessary for stormwater drainage.

Where possible, excavation and loading would be performed from the roadside (i.e., without crossing the creek). However, equipment would need to cross the creek in some locations. In these locations, direct creek crossing may be performed, or a temporary bridge constructed. Temporary bridges would be removed on completion of the work.

In a few selected areas, armoring would be used instead of removal. In addition, armoring would be added in removal areas where residual concentrations exceed the human health cleanup level, or where EPA determines that armoring is required to prevent significant remobilization of affected sediments.

No further action would be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be difficult. Removal in the talus slopes would also destabilize the hillside, potentially increasing erosion of overbank deposits into the creek.

9.2.5 Alternative BB-7 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Removal with Selective Stabilization of Overbank Deposits; Natural Recovery for In-Stream Sediments

Estimated Capital Cost: $3.7 Million (*in-situ* passive), $ 5.2 Million (*in-situ*, pre-designed), $5.3 Million (ex-situ pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $3 Million (*in-situ* passive), $ 4.5 Million (in-situ, pre-designed), $ 4.4 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 6.8 Million (*in-situ* passive), $ 9.9 Million (*in-situ*, pre-designed), $ 10.3 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements. This alternative also consists of primarily removing overbank deposits along Blackbird Creek with limited physical stabilization by armoring with rocks as in Alternative BB-6 plus collection and treatment of cobalt in water from the West Fork Tailings Impoundment as described under Alternative BB-5 (see Figure 9-6). The treatment of cobalt would provide for timely achievement of the cobalt cleanup level and certainty that the cleanup level would be achieved.

9.2.6 Alternative BB-8 – Meadow Creek Seep Collection; Cover West Fork Tailings Impoundment and Treat Tailings Impoundment Seepage; Complete Removal of Overbank Deposits and In-Stream Sediments

Estimated Capital Cost: $ 49.1 Million (passive), $ 50.5 Million (*in-situ*, pre-designed), $ 51.2 Million (*in-situ* pump-back to existing water treatment plant)

Estimated Operations and Maintenance Cost: $ 3.7 Million (*in-situ* passive), $ 5.3 Million (in-situ, pre-designed), $ 5 Million (ex-situ pump-back to existing water treatment plant)

Estimated Total Present Worth Cost: $ 52.7 Million (*in-situ* passive), $ 55.8 Million (*in-situ*, pre-designed), $ 56 Million (ex-situ pump back to existing water treatment plant)

Estimated Construction Time Frame: 2 years

This alternative contains all the elements that are described above under the common elements and includes treatment at the West Fork Tailings Impoundment as described under Alternative BB-5. This alternative differs from the other Blackbird Creek alternatives in that it includes complete removal of both overbank deposits and in-stream sediments in Blackbird Creek (see Figure 9-7). Removal would extend from the existing road to the valley wall across from the road. Because separation of natural and mine-related in-stream sediments is not practical, all sediments in the stream channel would be removed to bedrock including sediments below the water table. The removed material would be placed at a new disposal repository in the mine site area. Following excavation, sufficient backfill would be placed in and around the stream channels to provide riparian habitat, and the backfill would be revegetated.

BUCKTAIL CREEK DRAINAGE ALTERNATIVES

9.3 COMMON ELEMENTS FOR EACH BUCKTAIL CREEK DRAINAGE ALTERNATIVE

The following elements are included in all of the Bucktail Creek drainage alternatives, except the No Further Action alternative:

- Institutional controls
- Monitoring
- Continued operation of the existing wastewater treatment plant as described under Blackbird Creek alternatives
- Construction of contaminated groundwater and seep collection facilities in Bucktail Creek (Phase 1 Bucktail Creek Facitities as described in the FS) was begun in the fall of 2002 as a modification to the Early Action
- Operation and maintenance of all facilities
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions

9.4 DESCRIPTION OF THE BUCKTAIL CREEK DRAINAGE ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above or in a previous alternative.

Based on the narrative cleanup goal for Bucktail Creek, the various remediation alternatives have been developed to improve water and sediment quality in Bucktail Creek, and are evaluated for meeting cleanup levels within South Fork Big Deer, Big Deer, and Panther Creeks. Predictions of copper and cobalt concentrations were not performed for impacts of the Bucktail Creek Alternatives on Panther Creek. This is because the goal of the Bucktail Creek alternatives is to meet water quality cleanup levels in Big Deer Creek. Assuming that water quality cleanup levels are met in Big Deer Creek, there would be no negative impacts on Panther Creek waters. The estimates do not include any improvements due to natural recovery of sediments.

9.4.1 Alternative BT-1 – No Further Action

Estimated Capital Cost: $0
Estimated Annual Operations and Maintenance Cost: $ 1.2 Million
Estimated Present Worth Cost: $ 1.2 Million
Estimated Construction Time Frame: None

Under this alternative, no further actions would be implemented, other than the Early Actions that already have been completed. Monitoring, and operations and maintenance of the existing Early Action facilities would continue.

9.4.2 Alternative BT-3 – Seep Collection and Treatment; Natural Recovery of Sediments

Estimated Capital Cost: $ 2 Million
Estimated Annual Operations and Maintenance Cost: $ 2.4 Million
Estimated Present Worth Cost: $ 4.4 Million
Estimated Construction Time Frame: 2 years

This alternative provides groundwater seep collection and treatment. Groundwater seeping into Bucktail Creek below the 7000 dam would be intercepted and pumped back for treatment at the existing water treatment plant or treated at a passive *in-situ* facility (e.g., a sorption wall). Seeps have been observed entering the creek upstream of the upper sediment pond and in an area upstream of BTSW-01.6. The primary source of seepage is believed to be immediately below the 7000 dam and an area around BTSP-01. There may be other, yet unidentified, sources of seepage containing metals. This alternative would involve installation of one or more interception trenches to collect affected groundwater (see Figure 9-8).

Initially, one groundwater cutoff wall and a seep collection system would be installed below the 7000 dam. Collected water would flow by gravity to the existing pump-back station, pumped to the 6930 adit, then routed through the mine workings to the existing wastewater treatment plant in the Blackbird Creek drainage. The construction of this element was started in the fall of 2002 as a modification to the Early Action.

After construction of the initial seepage collection with the groundwater cutoff wall and seep collection system, additional seepage collection would be implemented downstream (unless it is determined unnecessary after the initial seepage collection system is constructed). Gravel would be placed in the creek bed to create a gravel drain, and a surface water channel constructed above the gravel. The intent would be to provide a clean water flow channel for stormwater, and to separately collect and treat the underlying seepage. If the metal loads in the groundwater were relatively low, then passive *in-situ* treatment (e.g., a sorption wall) would be considered. If the metal loads were too high for cost-effective *in-situ* treatment, a second groundwater cutoff wall would be installed downstream from BTSP-01 to intercept the groundwater collected by the gravel drain beneath the creek bed. A new pump station downgradient from this cutoff wall would be constructed to pump water to the existing pump station for pumping to the 6930 adit. As an alternative, a series of extraction wells may be utilized to collect the contaminated groundwater downgradient from the initial cutoff wall. The water collected by the extraction wells would be pumped to an upgraded Bucktail pumpback station, then pumped to the 6930 adit. The extraction wells would be utilized only if it can be demonstrated that they are as effective at removal of metals loads as the gravel drain with downstream barrier in Bucktail Creek.

The Upper Sediment Pond on Bucktail Creek would be removed during implementation of seep collection. The Lower Sediment Pond near the mouth of Bucktail Creek would be retained to minimize the potential for Bucktail sediments to be carried into South Fork Big Deer Creek until it is determined not to be necessary.

The groundwater seep collection system will not be able to intercept all the metals in groundwater. Therefore, the predicted concentrations of metals remaining in Bucktail Creek below the groundwater seep collection system will still be elevated enough to prevent South Fork of Big Deer Creek water quality goals from being met.

Stream sediments in Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek would be cleaned up by natural recovery. The time required to achieve water quality cleanup levels in South Fork of Big Deer and Big Deer Creeks depends on the time for metals to be released from sediments through natural recovery after construction of the groundwater seepage collection system is completed. The metals release from South Fork Big Deer Creek sediments would mostly likely be complete in several years or more. Big Deer Creek sediments are expected to achieve sediment cleanup levels in several years or more. Bucktail Creek sediments at present are not releasing metals to surface water. However, after the groundwater seep collection is completed, the Bucktail Creek sediments could begin to release metals to the surface water. If this happens, the time required for Bucktail Creek sediments to naturally recover to levels that will allow meeting water quality goals in Big Deer Creek is several years or more. Following construction of the groundwater seep collection, monitoring and further evaluations will be performed to determine if further actions to achieve water quality goals are needed in the future.

9.4.3 Alternative BT-4 – Seep Collection and Treatment; South Fork Big Deer Creek Sediment Removal; Natural Recovery of Remaining Sediments

Estimated Capital Cost: $ 2.6 Million
Estimated Operations and Maintenance Cost: $ 2.4 Million

Estimated Total Present Worth Cost: $ 5 Million
Estimated Construction Time Frame: 2 to 3 years

This alternative has groundwater seep collection and treatment as well as natural recovery for Bucktail Creek and Big Deer Creek stream sediments as described under BT-3. This alternative also includes removal of in-stream sediments in South Fork Big Deer Creek for onsite disposal at the Blacktail Pit (see Figure 9-9).

By removing sediments in the South Fork of Big Deer Creek, copper and cobalt water quality cleanup levels are still not predicted to be met. The only benefit from removing the South Fork of Big Deer Creek sediments is that the sediment cleanup levels in the creek would be met for a short period of time. However, South Fork of Big Deer Creek sediments could become recontaminated from Bucktail Creek sediments. In addition, there would be short-term impacts from the disruption of riparian habitat.

9.4.4 Alternative BT-5 – Seep Collection and Treatment; Diversion of Bucktail Creek; Natural Recovery of Sediments

Estimated Capital Cost: $2.3 Million
Estimated Operations and Maintenance Cost: $ 2.4 Million
Estimated Total Present Worth Cost: $ 4.7 Million
Estimated Construction Time Frame: 2 years

This alternative has groundwater seep collection and treatment as well as natural recovery for stream sediments as described under BT-3. This alternative includes diverting Bucktail Creek in a pipeline or ditch around South Fork Big Deer Creek to discharge directly into Big Deer Creek. As described under BT-3, the groundwater seep collection will not intercept all of the groundwater and Bucktail Creek would still have elevated metals which would prevent water quality goals from being met in South Fork of Big Deer Creek. By diverting Bucktail Creek around South Fork of Big Deer in a pipeline or ditch, water quality goals in both South Fork of Big Deer and Big Deer Creeks could be met with this alternative (see Figure 9-10). Concentrations of copper in Bucktail Creek are not expected to cause water quality exceedances in Big Deer Creek after mixing.

Diverting Bucktail Creek surface water around South Fork of Big Deer Creek would decrease metals entering South Fork of Big Deer Creek to a level that water quality cleanup levels would be expected to be met in South Fork of Big Deer Creek (after natural recovery of sediments). Since South Fork of Big Deer Creek would no longer receive metals from Bucktail Creek, the natural recovery process for the sediments should be accelerated, such that the sediment cleanup levels would likely be met sooner in South Fork of Big Deer Creek (estimated to be 2 to 5 years). The amount of time it would take for Big Deer Creek sediments to naturally recover to sediment cleanup levels could be several years or more.

9.4.5 Alternative BT-6 – Seep Collection and Treatment; Complete Sediment Removal

Estimated Capital Cost: $ 8.4 Million
Estimated Operations and Maintenance Cost: $ 2.9 Million
Estimated Present Worth Cost: $ 11.3 Million
Estimated Construction Time Frame: 3 to 5 years

This alternative has groundwater seep collection and treatment as described under BT-3. This alternative also includes removal of sediments from Bucktail, South Fork Big Deer and Big Deer Creeks to be disposed of on-site (see Figure 9-11). The groundwater seep collection will not intercept all the metals in water. Therefore, elevated levels of copper and cobalt in Bucktail Creek would prevent water quality cleanup levels from being met in South Fork of Big Deer Creek, likely for centuries. However, this alternative could result in meeting water quality cleanup levels in Big Deer Creek. Sediment cleanup levels in South Fork of Big Deer Creek and Big Deer Creek would be met through removal. However, there is the potential for recontamination of sediments since the groundwater seep collection system will not intercept all the metals in water. Complete removal of in-stream sediments would destroy existing wildlife riparian habitat, which would take years to a decade or more to re-establish. In addition, this alternative would require much more extensive construction activities and truck traffic than the other alternatives, resulting in greater risks to the community and site workers.

<u>PANTHER CREEK DRAINAGE ALTERNATIVES</u>

9.5 COMMON ELEMENTS FOR EACH PANTHER CREEK ALTERNATIVE

- Institutional controls (ICs) will be required for all alternatives except where contaminated materials are removed to clean up levels for unrestricted use. ICs are legal and administrative measures such as easements, restrictive covenants and enforcement tools that are used to provide notice to current and future landowners of remaining contamination on the property, to limit the use of the property, and restrict residential or other activities that could result in unacceptable exposure to remaining contamination.

- Natural recovery of Panther Creek in-stream sediments is included in all the alternatives as described under common elements for Blackbird Creek Drainage alternatives.

- Operation and maintenance of all facilities
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of the cleanup actions

9.6 DESCRIPTION OF THE PANTHER CREEK ALTERNATIVES

The description of each alternative below includes a detailed description of distinguishing elements of the alternative that have not been described under common elements above or in a previous alternative.

Improved water quality in Panther Creek is dependent on the alternatives selected for Blackbird and Bucktail Creeks.

9.6.1 Alternative P-1 – No Further Action

Estimated Capital Cost: $0
Estimated Annual Operations and Maintenance Cost: $ 0
Estimated Present Worth Cost: $ 0
Estimated Construction Time Frame: None

Under this alternative, no action would be taken for those properties where a potential risk is shown for a future residential use. Arsenic concentrations exceed the future residential human health cleanup level in some overbank areas along Panther Creek. Currently, these areas do not pose a potential risk based on frequency of exposure to the areas. However, there is a potential for changes in future land use that could increase frequency of exposure.

9.6.2 Alternative P-2 – Institutional Controls with Natural Recovery of Panther Creek Sediments

Estimated Capital Cost: $ 0.1 Million
Estimated Operations and Maintenance Cost: $ 0.26 Million
Estimated Total Present Worth Cost: $ 0.364 Million
Estimated Construction Time Frame: 1 to 2 years to implement enforceable ICs

Under this alternative, institutional controls would be used for private property along Panther Creek where arsenic concentrations in soil exceed potential future residential cleanup levels. Institutional controls would be used at the Rogers, Rufe, former Strawn, and Hade (if necessary) properties where arsenic concentrations in overbank areas exceed the cleanup level. The institutional controls, such as conservation easements, would exclude residential development and use in the vicinity of the overbank deposits on these properties. The institutional controls would restrict land use, thereby reducing human exposure above acceptable risk based levels. Obtaining acceptance by private property owners and the easement grantee are necessary for this alternative. In-stream sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek (in several years or more (see Figure 9-12).

At some of the private properties where overbank soil was removed as part of the Early Actions, elevated concentrations of arsenic remain beneath the clean backfill at the water table. Institutional controls are needed to address activities that might result in exposure to the contaminated subsurface soils in the water table at the following properties: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, Bevan 2/1, Sillings 1 (Ditch Area), Sillings Lower Pasture (Sillings 4/1 and 4/2), Sillings Upstream Low Bar, Fernandez Low Bar 1, Fernandez Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, Panther Creek Inn area.

Operations and maintenance includes administration and monitoring of institutional controls for properties addressed either as Early Action or Remedial Action.

9.6.3 Alternative P-3 – Selective Overbank Deposit Removal; Natural Recovery of In-Stream Sediments

Estimated Capital Cost: $1.4 Million
Estimated Annual Operations and Maintenance Cost: $ .173
Estimated Total Present Worth Cost: $ 1.6 Million
Estimated Construction Time Frame: 1 year

Under this alternative, selected overbank deposits with arsenic concentrations in soil above the cleanup level would be removed at the Rogers, Rufe, former Strawn, and Hade (if necessary) properties along Panther Creek (see Figure 9-13). The removal of overbank deposits above the residential arsenic cleanup level would eliminate the potential future risks associated with those deposits and avoid the need for institutional controls, except for any remaining contaminated subsurface soils. Institutional controls will be needed at properties where contaminated subsurface soils are left at the water table. In-stream sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek (in several years or more).

This alternative includes administration and monitoring of institutional controls for properties with remaining contamination that could present a potential future risk as described above. In addition, monitoring and maintenance will be performed on selected overbank areas along Panther Creek (including near the Panther Creek Inn) following significant run-off events to ensure that these areas do not exceed human health cleanup levels due to remobilization of Blackbird Creek sediments and any overbank deposits not addressed by the remedy in this ROD.

SECTION 10

COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP requires that each remedial alternative analyzed in detail in the FS be evaluated according to specific criteria. This section evaluates the relative performance of the alternatives with respect to the nine evaluation criteria so that the relative advantages and disadvantages of each are clearly understood, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they are the threshold criteria (protection of human health and the environment and compliance with Federal or State statutes and regulations) or balancing criteria.

For a summary of the comparative analysis see Tables 10-1 to 10-3.

10.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion evaluates whether an alternative achieves and maintains adequate protection of human health and the environment.

10.1.1 Blackbird Creek Drainage

Human Health: Alternative BB-1 (the No-Further Action alternative) would not prevent direct contact with Blackbird Creek overbank deposits containing arsenic concentrations above the human health cleanup levels and therefore would not be considered protective of human health.

Alternatives BB-4 through BB-8 would all reduce direct contact with the Blackbird Creek overbank deposits through removal and/or stabilization. In addition, Alternatives BB-4 through BB-8 would reduce the potential for deposition downstream along Panther Creek at concentrations exceeding the arsenic cleanup levels. Therefore, Alternatives BB-4 through BB-8 would be protective of human health.

Environment: Alternatives BB-1, BB-4 and BB-5 are not predicted to consistently meet the copper or cobalt water quality cleanup levels in Panther Creek or the narrative cleanup goals for Blackbird Creek. Alternative BB-6 is predicted to consistently meet the copper water quality cleanup level in Panther Creek and narrative goals in Blackbird Creek. However, there is considerable uncertainty whether Alternative BB-6 could achieve the cobalt cleanup level in Panther Creek and, if it does, whether it would occur in a reasonable time period (it could take years to tens of years). Alternatives BB-7 and BB-8 are predicted to consistently meet the copper and cobalt water quality cleanup levels in Panther Creek and narrative goals in Blackbird Creek in a reasonable time period and provide the greatest degree of certainty that cleanup levels in Panther Creek will be achieved. Sediments in Blackbird Creek are expected to improve through natural recovery under all of the alternatives. Alternative BB-8 would meet cleanup narrative goals in Blackbird Creek sediments and possibly water quality more quickly but does not provide any benefit over BB-7 in achieving Panther Creek water quality cleanup levels. BB-8 would result in extensive disruption of the stream channel and habitat along Blackbird Creek that would take years to recover.

Based on the above, Alternatives BB-7 and BB-8 provide the highest degree of certainty that they would be protective of the environment in Panther Creek and meet narrative goals in Blackbird Creek.

10.1.2 Bucktail Creek Drainage

Human Health: No human health risks were shown in the Bucktail Creek Drainage.

Environment: Alternative BT-5 is the only alternative that could meet water quality and sediment cleanup levels in South Fork Big Deer and Big Deer Creeks. Alternatives BT-3, BT-4 and BT-6 could achieve water quality and sediment cleanup levels in Big Deer Creek. However, these alternatives would not achieve water quality cleanup levels in South Fork Big Deer Creek within a reasonable time frame (not likely for centuries) because of the length of time required for the metals to leach from source materials (impacted water from waste rock above the 7000 dam that will not be intercepted by seep collection). Under BT-5 sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek.

10.1.3 Panther Creek Drainage

Human Health: The evaluation of overall protectiveness for the Panther Creek alternatives is focused on human health. Under current land use, overbank deposits do not pose an unacceptable risk to human health. However, if land use changes so that the frequency of exposure increases, there could be a potential risk in the future.

Alternative P-1 (No Further Action) does not provide monitoring or institutional controls of any future changes in land use. Therefore, under Alternative P-1, changes in future land use could result in unacceptable human health risks due to exposure to arsenic. Alternatives P-2 and P-3 both address potential future land use. Removal (P-3) is generally considered more reliable and permanent than monitoring and institutional controls which, if not properly enforced, could lead to human exposure to contaminants.

Alternative P-1 is not protective of human health. Alternative P-2 would be protective of human health as long as enforceable institutional controls can be implemented and properly maintained. Alternative P-3 would be protective of human health.

Environment: Water quality standards in Panther Creek will be achieved by selection of suitable alternatives for Blackbird and Bucktail Creeks. For Alternatives P-1, P-2 and P-3, sediment quality in Panther Creek would improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA and 40 CFR 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate requirements (ARARs). There are a number of ARARs that the selected remedial action must attain, but the requirements of the Clean Water Act, including the NPDES requirements, are the ARARs that result in differentiation among the alternatives. As a result, the following comparative analysis regarding ARARs will focus on the ability of each alternative to protect the designated beneficial use, to attain the Idaho water quality standards for copper and to attain the NPDES discharge requirements for all pollutants (e.g., copper and cobalt). The NPDES analysis allows a mixing zone so long as it is protective of designated beneficial uses.

10.2.1 Blackbird Creek Drainage

The State of Idaho's designated beneficial use for Blackbird Creek is secondary contact recreation and the designated beneficial use for Panther Creek into which Blackbird Creek flows is cold water biota. The designation of Panther Creek for protection of cold water biota necessitates that the selected remedial actions achieve the Idaho water quality standard for copper in Panther Creek.

The Idaho water quality standard for copper for Panther Creek is not predicted to be consistently met by Alternatives BB-1, BB-4 and BB-5, especially during spring runoff. Alternatives BB-6, BB-7 and BB-8 will provide greater reductions in copper loading to Blackbird Creek and are predicted to consistently meet the Idaho water quality standard for copper in Panther Creek throughout the year.

The point source discharges from the water treatment plant, the West Fork underdrain culvert, and the other waste areas are subject to the substantive requirements of the National Pollutant Discharge Elimination System (NPDES) established by the Clean Water Act. These discharges must be limited so as to protect the designated beneficial use for Blackbird Creek of secondary contact recreation (not cold water biota) and the designated beneficial use for Panther Creek of cold water biota, as well as the cobalt risk based cleanup level for protection of cold water biota. To determine whether the discharges to Blackbird Creek are protective of the cold water biota in Panther Creek, a mixing zone analysis was performed to calculate the amount of pollutant (e.g., copper and cobalt) loading from Blackbird Creek that can mix with Panther Creek waters in a manner that is protective of cold water biota. The State of Idaho guidelines provide for a maximum mixing zone of 25%; however, this can be expanded through a site-specific mixing zone analysis. The extent to which EPA and the State determine that a larger mixing zone is protective of cold water biota affects the ability of the various alternatives to comply with the substantive requirements of the Clean Water Act.

The remaining sources for copper and cobalt along Blackbird Creek are different. There are several different copper sources, while the primary source for cobalt loading is the West Fork Tailings Impoundment. This means that copper and cobalt behave differently in terms of the mixing zones in Panther Creek. The mixing zone analysis performed in the FS revealed that the amount of contaminated overbank deposits left in place along Blackbird Creek affects the amount of the post-remediation copper loads and, therefore, the size of the mixing zone for copper. The mixing zone analysis showed that Alternatives BB-6, BB-7 and BB-8 would result in a smaller mixing zone for copper than Alternatives BB-4 and BB-5 because these alternatives remove more overbank deposits along Blackbird Creek than Alternatives BB-4 and BB-5. A mixing zone analysis was also conducted for cobalt in Panther Creek. This analysis indicated that Alternatives BB-5, BB-7 and BB-8 would generally result in smaller mixing zones than Alternatives BB-4 and BB-6 because these alternatives rely upon treatment of groundwater at the West Fork Tailings Impoundment, which provides greater and more reliable cobalt reduction. A smaller mixing zone is preferred.

The mixing zone analysis for copper utilized data from the spring and fall synoptic sampling events. For Alternatives BB-4 and BB-5, the mixing zone analysis indicated that, under worst case conditions, the copper water quality standard would not be met even with 100% mixing in the spring. In the fall, a mixing zone requiring approximately 53% of the width of Panther Creek would be required. For Alternatives BB-4 and BB-5 under average case conditions, the mixing zone requirement for copper would vary from approximately 48% of the width of Panther Creek in the spring to approximately 30% of the width of Panther Creek in the fall. For Alternatives BB-6, BB-7 and BB-8, the analysis indicated that, under worst case conditions, a mixing zone for copper of 62% of the width of Panther Creek would be required in the spring. In the fall a mixing zone requiring approximately 50% of the width of Panther Creek would be required. For Alternatives BB-6, BB-7 and BB-8, under average case conditions, the mixing zone requirement for copper would be approximately 30% of the width of Panther Creek in the spring and in the fall. It should be noted that, due to physical constraints in Panther Creek in the vicinity of the Blackbird Creek confluence, the minimum mixing zone that could be achieved (regardless of alternative) under worst case is 50% of the width of Panther Creek. Under average conditions, the minimum width of the mixing zone is 30%.

The worst and average cases are included in the copper mixing zone analysis to provide both the maximum and average mixing zone conditions in Panther Creek. By definition, the worst case scenario flows would occur less than 5% of the time. In addition, in natural streams the highest copper concentrations do not occur during the lowest flows, as modeled in the worst case scenario. The combination of these two unlikely events implies that the worst case scenario would occur much less than 5% of the time. The average case is more representative of the system because it matches average copper concentrations with average flows. Therefore, the comparative analysis is based on the average case.

A mixing zone analysis for cobalt, utilizing the synoptic sampling data, would not provide meaningful results. This is because cobalt behaves differently than copper in the Blackbird and Panther Creek systems. Copper concentrations tend to be at a maximum during the spring runoff and at a minimum during low flow periods. Cobalt concentrations tend to be at a maximum during low flow periods (fall, winter, and early spring) and at a minimum during late spring and summer periods when flows are higher in Panther Creek. Thus, an analysis of the potential mixing zones required in Panther Creek for cobalt must use a different data set than the synoptic spring and fall sampling. A mixing zone analysis was developed using monthly cobalt data that were collected from December 2001 through November 2002. These data are shown in Table 5-9. This analysis utilized these data and average cobalt reductions for each of the alternatives presented in the FS to predict the mixing zones that would be required in Panther Creek to meet the cobalt cleanup level of 38 μg/L. This analysis indicated the following:

- Alternative BB-4 would have required mixing zones of about 30 to 55 percent during late spring through summer (the minimum mixing zone is 30 percent due to hydraulic conditions in Panther Creek). The required mixing zones would range from about 55 to 100 percent during the rest of the year. The cobalt cleanup level would be exceeded, even with 100 percent mixing, during significant portions of the year.

- Alternative BB-5 would require mixing zones of about 30 to 45 percent during late spring through summer. The required mixing zones would range from about 45 to 85 percent during the rest of the year.

- Alternative BB-6 would require mixing zones of about 30 to 40 percent during late spring through summer. The required mixing zones would range from about 40 to 100 percent during the rest of the year.

- Alternative BB-7 would require mixing zones of about 30 percent (the minimum mixing zone) during late spring through summer. The required mixing zones would range from about 30 to 70 percent during the rest of the year.

- Alternative BB-8 would require mixing zones of about 30 percent (the minimum mixing zone) during late spring through summer. The required mixing zones would range from about 30 to 65 percent during the rest of the year.

A statistical analysis of stream flows and hydraulic modeling was not conducted for the cobalt mixing zone analysis. Thus, the mixing zones noted for each of the alternatives are more likely to represent average case conditions than worst case conditions.

The cobalt data collected during March 2001 and 2002 indicated that there were anomalously high cobalt concentrations in Panther Creek for about a three to four week period. These anomalously high concentrations could have been due to several possibilities. These include:

- Rapid melting of frozen springs and seeps at the West Fork Impoundment. Surface discharges at these springs and seeps could have frozen during the course of the winter and built up ice deposits high in cobalt. When these ice deposits thawed in March, they could have discharged a slug of cobalt to the surface water system.

- Discharges of high concentrations of cobalt from overbank deposits along Blackbird Creek. Snowmelt and rainfall during March could have infiltrated through the overbank deposits, resulting in higher than normal cobalt loads being discharged to Blackbird Creek.

- Unusually high groundwater flows and/or cobalt concentrations from the West Fork Tailings Impoundment. A mechanism that would cause unusually high flows or concentrations has not been identified.

Additional monitoring will be conducted to determine if the anomalously high cobalt concentrations are a recurring phenomenon. If so, additional investigations will be conducted to determine the source of these cobalt loadings. If the anomalously high cobalt concentrations are a recurring phenomenon, the alternatives that include treatment at the West Fork Impoundment (Alternatives BB-5, BB-7 and BB-8) would be more likely to be able to address the situation. This is because the collection and treatment systems could be designed to intercept the increased cobalt loads, unless the loads are coming from the overbank deposits. If the increased cobalt loads are coming from the overbank deposits, then the alternatives that include overbank deposit removal (Alternatives BB-6, BB-7 and BB-8) would be more likely to address the increased loads.

Under average case conditions, Alternatives BB-7 and BB-8 are more likely than Alternatives BB-4, BB-5 and BB-6 to attain a mixing zone for both copper and cobalt that could be protective of cold water biota. The selected response action will be monitored to determine if the mixing zone is protective of cold water biota or if contingent actions will be needed to comply with the NPDES requirements.

Chemical discharge limits have not been set for the existing water treatment plant and for the West Fork underdrain culvert. The discharge limits cannot be set at the present time because the discharge limits must be set for total recoverable metals concentrations. Virtually all of the existing data for discharges from the existing water treatment plant are in terms of total recoverable metals. However, all of the loading analyses and the mixing zone analyses have been conducted using dissolved metals. This means that a metals translator must be used to calculate the dissolved/total recoverable metals ratios and to set the discharge limits. Since the data do not currently exist to develop statistically valid site-specific dissolved/total recoverable metals ratios, these data must be collected. These data will be collected and the discharge limits will be set once the data are available.

Other ARARs would be met by all action alternatives.

10.2.2 Bucktail Creek Drainage

The No-Further Action alternative (BT-1) would not meet the Idaho water quality standard for copper in either South Fork Big Deer or Big Deer Creeks. Alternatives BT-3, BT-4 and BT-6 would meet Idaho water quality standards for copper in Big Deer Creek, but not in South Fork Big Deer Creek. Alternative BT-5 is the only alternative that can meet ARARs in Big Deer Creek and South Fork Big Deer Creek in a reasonable time frame. However, it is possible that groundwater discharges into South Fork Big Deer Creek could prevent consistently meeting water quality goals even with the Bucktail Creek diversion. If this is the case, contingencies to address the groundwater discharges would be evaluated for the South Fork Big Deer Creek.

The discharge of the diverted Bucktail Creek into Big Deer Creek must be limited so as to protect the designated beneficial use for Big Deer Creek of cold water biota. The NPDES requirements and the mixing zone provisions of the Clean Water Act and the State of Idaho Water Quality Standards are relevant and appropriate for analyzing the effect of this discharge. To determine whether this discharge is protective of cold water biota in Big Deer Creek, a mixing zone analysis was performed to calculate the amount of copper loading from Bucktail Creek that can mix with Big Deer Creek in a manner that is protective of cold water biota. A mixing zone analysis for cobalt is not necessary because cobalt in Big Deer Creek is significantly below the water quality cleanup level of 38 µg/L under existing conditions.

The mixing zone analysis for copper indicated that all of the action alternatives (BT-3 through BT-6) would be essentially comparable in terms of mixing zone requirements in Big Deer Creek. Because of physical constraints in Big Deer Creek near its confluence with the South Fork, there would be no essential difference between Alternative BT-5 and the other alternatives in terms of the mixing zone in Big Deer Creek. The analysis indicated that, under worst case conditions, the copper water quality standard would not be met in Big Deer Creek for any of the action alternatives, even with 100% mixing in both the spring and fall. Under average case conditions, the entire width (100%) of Big Deer Creek would be required for mixing. However, the copper water quality predictions were based on the conservative assumption that 65% of the copper loads discharging to Bucktail Creek would be collected and treated. If 80% copper load removal is assumed, the mixing zone requirement for all of the action alternatives would be 100% of the width of Big Deer Creek under worst case conditions in the spring and 91% of the width of Big Deer Creek in the fall. Under the average case conditions, 70% of the width of Big Deer Creek would be required for mixing in both spring and fall. It should be noted that 70% of the width of Big Deer Creek is the minimum mixing zone that could be achieved, regardless of alternative and upstream copper load reductions. This is due to physical constraints in the vicinity of the confluence of South Fork and Big Deer Creeks.

The worst and average cases are included in the mixing zone analysis to provide both the maximum and average mixing zone conditions in Big Deer Creek. By definition, the worst-case scenario flows would occur less than 5% of the time. In addition, in natural streams the highest copper concentrations do not occur during the lowest flows, as modeled in the worst-case scenario. The combination of these two unlikely events implies that the worst-case scenario would occur much less than 5% of the time. The average case is more representative of the system because it matches average copper concentrations with average flows. Therefore, the comparative analysis is based on the average case.

Other ARARs would be met by all alternatives.

10.2.3 Panther Creek Drainage

All of the alternatives for Panther Creek would comply with ARARs.

10.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion evaluated the ability of an alternative to maintain protection of human health and the environment over time. The following factors were considered in the evaluation of long-term effectiveness:

- Magnitude of the residual risks remaining at the completion of remedial activities.

- Adequacy and long-term reliability of management and technical controls for providing continued protection from the residual risks.

10.3.1 Blackbird Creek Drainage

<u>Human Health</u>: All the alternatives except BB-1 would prevent direct contact with contaminated soils above cleanup levels and minimize remobilization of contaminated soils downstream. Removal of most of the overbank deposits (Alternatives BB-6, BB-7 and BB-8) would provide greater reliability and permanence than physical stabilization in Alternatives BB-4 and BB-5.

<u>Environment</u>: Alternative BB-1 (No Further Action) would not make any improvements to water quality, and does not provide for long-term effectiveness. Alternatives BB-4 and BB-5 are rated lower than other alternatives for long term effectiveness. These alternatives leave more contaminated material in place by primarily utilizing stabilization to address Blackbird Creek overbank deposits. The contaminated soils left in place leach copper and cobalt to surface water which results in these alternatives being less likely to meet the copper water quality cleanup level during spring runoff. Alternatives BB-6, BB-7 and BB-8, that primarily utilize removal to address Blackbird Creek overbank deposits, provide the highest degree of effectiveness because they have greater certainty of achieving the copper water quality cleanup level in Panther Creek on a consistent basis. Alternatives BB-6, BB-7 and BB-8 are essentially comparable in terms of copper water quality predictions in Panther Creek; but predicted cobalt concentrations vary among these alternatives.

Alternative BB-1 is rated lowest for long-term effectiveness at reducing cobalt concentrations in Panther Creek. Alternatives BB-4 and BB-6, that rely upon the West Fork Tailings Impoundment cover, are not predicted to be effective at consistently meeting the cobalt cleanup level in Panther Creek during the periods of highest cobalt concentrations (fall, winter, and early spring). Alternatives BB-5, BB-7 and BB-8, that rely upon treatment at the Tailings Impoundment, are predicted to have greater certainty of achieving the cobalt cleanup level in Panther Creek. However, during the periods of highest cobalt concentrations, Alternative BB-5 may not consistently achieve the cobalt cleanup level because more overbank deposits are left in place and stabilized.

Alternatives BB-7 and BB-8 provide the highest degree of effectiveness because they are the only alternatives that are predicted to consistently achieve the copper and cobalt cleanup level in Panther Creek. However, the extensive sediment removals under Alternative BB-8 would provide no discernable benefit to cobalt water quality in Panther Creek. Sediments in Blackbird Creek are expected to improve through natural recovery under all of the alternatives.

Alternative BB-4 has the highest residual risks because it would utilize the cover to address cobalt releases from the West Fork Tailings Impoundment and primarily stabilization through armoring to address overbank deposit risks. Alternative BB-6 has the next highest residual risk because it utilizes only the cover at the impoundment which is judged less reliable to address cobalt releases. BB-5 has less residual risk than BB-6 because it includes treatment for the cobalt releases at the impoundment. However, Alternative BB-5 would utilize primarily armoring for Blackbird Creek overbank deposits which would leave considerable contaminated material in place. Alternative BB-7 has a lower residual risk since it utilizes treatment to address the cobalt releases and would address the overbank deposit risks primarily through removal. Alternative BB-8 has the least residual risk because it primarily utilizes treatment to address the cobalt releases (which has greater certainty of effectiveness) and would eliminate the overbank deposit risks through complete removal.

All of the alternatives are judged to be comparable in terms of permanence. All of the alternatives depend on proper operation and maintenance of the facilities, ICs and monitoring. As long as the operation and maintenance is properly performed in the future, all of the facilities are considered permanent. However, alternatives BB-6, BB-7 and BB-8 are considered more permanent than other alternatives in addressing the overbank deposits because they utilize primarily removal. Alternative BB-8 is considered the most permanent in addressing overbank deposits but provides no additional environmental benefit for achieving water quality cleanup levels.

10.3.2 Bucktail Creek Drainage

Alternative BT-5 is judged to have the best long-term effectiveness because it is predicted to meet the copper and cobalt water quality and sediment cleanup levels in South Fork of Big Deer and Big Deer Creeks in a reasonable time frame.

All of the other action alternatives (BT-3, BT-4, and BT-6) would be essentially equivalent in terms of long-term effectiveness. They would all achieve water quality cleanup levels in Big Deer Creek; however, South Fork of Big Deer Creek water quality cleanup levels would not be met for centuries. The primary difference among Alternatives BT-3, BT-4 and BT-6 is the time to achieve sediment cleanup levels. Alternatives BT-4 and BT-6 would meet sediment cleanup levels in South Fork Big Deer Creek upon completion of remedial actions. Alternative BT-6 would meet sediment cleanup levels in both South Fork of Big Deer and Big Deer Creeks upon completion of remedial actions. However, since not all the groundwater will be intercepted by the seep collection system, there is the potential for re-contamination of sediments from Bucktail Creek water and sediments. Alternative BT-3 would require years to a decade or more to achieve sediment cleanup levels in South Fork of Big Deer Creek and Big Deer Creek. Alternative BT-5 would require a few years to achieve sediment cleanup levels in South Fork Big Deer Creek and years to a decade or more to achieve sediment cleanup levels in Big Deer Creek. Under BT-5, sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek. Meeting sediment cleanup levels in Big Deer Creek is not as time critical for improvement of aquatic habitat as meeting surface water cleanup levels. Benthic communities in Big Deer Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Big Deer Creek until sediment cleanup levels are achieved. Therefore, the time to achieve sediment cleanup levels is not expected to affect the long-term effectiveness. The sediment removals in BT-4 and BT-6 would reduce the time to achieve sediment cleanup levels in South Fork of Big Deer Creek; however, there would be the potential for recontamination of the sediments and the removal would cause considerable short-term disruption of the stream channels and riparian habitat with no environmental gain to water quality.

Alternative BT-6 has the lowest level of residual risks because all the sediments would be removed. This would eliminate the potential for metals to leach from the sediments and remobilize and deposit downstream during large storm events. All of the action alternatives (BT-3, BT-4, BT-5 and BT-6) would be essentially equivalent in terms of reliability of controls and permanence. As long as the operation and maintenance of these facilities is properly performed, any of the Bucktail Creek action alternatives would provide a permanent remedy.

10.3.3 Panther Creek Drainage

Alternatives P-2 and P-3 both address potential future land use. Removal (P-3) is generally considered more reliable and permanent than institutional controls which, if not properly followed and enforced, could lead to unacceptable human health risks due to exposure to contaminants.

For Alternatives P-1, P-2 and P-3, sediment quality in Panther Creek would improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther

Creek. Meeting sediment cleanup levels in Panther Creek is not as time critical for improvement of aquatic habitat quality as is meeting the surface water cleanup levels in Panther Creek. The reason is that most of the current measured sediment concentrations are below known probable toxic levels; thus, benthic communities in Panther Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Panther Creek despite the current exceedances of the sediment cleanup levels. Therefore, the time to achieve sediment cleanup levels is not expected to affect the long-term effectiveness.

10.4 REDUCTION OF TOXICITY, MOBILITY AND VOLUME THROUGH TREATMENT

CERCLA states a preference for selecting remedial actions that principally employ treatment technologies to permanently and significantly reduce toxicity, mobility or volume of the hazardous substances at the site. See Section 11 for a discussion of principal threat waste at the site.

10.4.1 Blackbird Creek Drainage

All of the alternatives include treatment of contaminated water at the existing Water Treatment Plant. Alternative BB-1 involves continued operation of the existing WTP at existing flow rates. Alternatives BB-4 and BB-6 add treatment of additional seepage to be collected from Meadow Creek. Alternatives BB-5, BB-7 and BB-8 provide treatment of both Meadow Creek seepage and Tailings Impoundment seepage.

10.4.2 Bucktail Creek Drainage

Alternative BT-1 would provide treatment of only waters intercepted as part of the Early Actions. Alternatives BT-3, BT-4, BT-5 and BT-6 would provide the same reduction in toxicity, mobility and volume through treatment of the collected Bucktail Creek groundwater.

10.4.3 Panther Creek Drainage

Since none of the Panther Creek alternatives involve treatment, there is no difference among these alternatives for this criterion.

10.5 SHORT-TERM EFFECTIVENESS

The short-term impacts of alternatives were assessed by considering the following: (1) short-term risks that might be posed to the community during implementation of an alternative; (2) potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; (3) potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and (4) time until protection is achieved.

10.5.1 Blackbird Creek Drainage

Alternative BB-1 is rated highest for short-term effectiveness because it would not result in risks to workers or the community and would have no short-term environmental impacts associated with remedial actions. Alternatives BB-4, BB-5, BB-6 and BB-7 are essentially comparable in terms of risks to the community and workers during construction and short-term environmental risks. Each of these four alternatives could be completed within 1 to 2 years. Alternatives BB-5 and BB-7, that involve treatment to address cobalt, would improve water quality much more rapidly than Alternatives BB-4 and BB-6 that rely upon covering the impoundment for cobalt reductions. Alternative BB-8 is rated lowest for short-term effectiveness. This alternative would extensively disturb the stream channel and vegetation requiring a decade or more to re-establish growth. The removal and construction activities would create more short-term risk to the community, site workers and the environment than the other alternatives.

10.5.2 Bucktail Creek Drainage

Alternative BT-1 is rated highest for short-term effectiveness since there would be no short-term impacts to the environment, workers or the community. Alternatives BT-3 and BT-5 are rated next highest for short-term effectiveness and BT-3 has a slight edge because it involves less construction.

Both alternatives would have minimal risks to the community, acceptable construction risks, minimal unavoidable short-term environmental risks, and could be implemented within 2 years. Alternative BT-4 is rated lower than Alternatives BT-3 and BT-5 because the sediment removal in South Fork Big Deer Creek would result in greater construction risks and considerable disruption of the stream channel and riparian habitat. Alternative BT-6 is rated lowest because the extensive sediment removal could result in greater construction risks, and extensive disruption of stream channels and riparian habitat, and a much longer construction period.

10.5.3 Panther Creek Drainage

Alternative P-3 may take longer to implement than Alternative P-2, depending on the time to implement enforceable institutional controls. Removal would create short-term risks to the community and site workers due to truck traffic and excavation equipment, and short-term disruption of ecological habitat. Alternative P-3 would require 1 to 2 years to implement.

10.6 IMPLEMENTABILITY

The implementability of the alternatives was assessed by considering, as appropriate, the following factors: (1) technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy; (2) administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions); and (3) availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

10.6.1 Blackbird Creek Drainage

Alternative BB-1 is rated highest for technical implementability since no further actions would be required. Alternative BB-6 is rated next highest for technical implementability, since this alternative would not involve design and construction of collection and treatment facilities. Alternative BB-4 is rated next highest because there may be difficulties locating sufficiently sized armoring materials. Alternative BB-7 is rated next highest for technical implementability because this alternative includes collecting and treating. Alternative BB-5 is rated lowest because this alternative includes armoring plus collecting and treating.

10.6.2 Bucktail Creek Drainage

Alternatives BT-3 and BT-5 are essentially comparable since both alternatives would utilize standard construction techniques. Alternative BT-4 is rated lower due to the need for stream diversion, dewatering and sediment control during the sediment removal. Alternative BT-6 is rated lowest because of the need for stream diversion, dewatering and sediment control during the sediment removal, the need to site, design and maintain an on-site repository, and the uncertainty of approval for construction of an access road along Big Deer Creek. All of the alternatives are rated comparable in terms of implementing institutional controls on lands administered by the Forest Service.

10.6.3 Panther Creek Drainage

Alternative P-2 requires a long-term monitoring program and institutional controls. Administratively, this alternative would be the most difficult to implement of the Panther Creek Alternatives because it depends upon the acceptance of land use restrictions by the property owners, and acceptance by an independent third party as grantee of the land restriction easements. Alternative P-3 would be more difficult to physically implement than Alternative P-2 because of the effort involved in removing overbank deposits.

10.7 COST

This criterion includes estimated capital and operation and maintenance costs as well as present worth costs. Cost estimates are expected to be accurate within a range of +50 to -30 percent. Table 10-4 presents a comparative summary of the total capital costs, the present worth of O&M cost, and the total present worth costs for all the alternatives including the discount rate and the number of years used in the estimate.

10.7.1 Blackbird Creek Drainage

Alternative BB-7 is the least costly of the alternatives that are protective of human health and the environment by meeting both the copper and cobalt water quality cleanup levels in Panther Creek with certainty and in a reasonable time period. Alternatives BB-4 through BB-6 are less costly than BB-7; however, they are not predicted to meet water quality cleanup levels with as much certainty and in a reasonable time period. Alternative BB-8 would not provide any substantial improvements to water quality in Panther Creek compared to Alternative BB-7. Therefore, the substantial difference in costs associated with Alternative BB-8 would not be justified, especially considering the extensive short-term environmental impacts and difficulty in implementing this alternative.

10.7.2 Bucktail Creek Drainage

Alternative BT-3 is the least costly; however, this alternative will not achieve sediment cleanup levels and would not meet the Idaho water quality standard for copper in South Fork of Big Deer in a reasonable time frame. Alternative BT-5 costs approximately $300,000 more than BT-3 and would meet water quality cleanup levels and ARARs in both South Fork Big Deer Creek and Big Deer Creek. The other action alternatives (BT-4 and BT-6) would be considerably more costly.

10.7.3 Panther Creek Drainage

The estimated cost for Alternative P-2 is lower than for Alternative P-3, although there is some uncertainty in the costs of implementing and monitoring institutional controls.

10.8 STATE ACCEPTANCE

The State of Idaho has been involved in the development of the Remedial Investigation and Feasibility Study that supports the ROD. The State's concurrence letter which supports the remedy selected in the ROD is provided in Appendix C.

10.9 COMMUNITY ACCEPTANCE

This criterion evaluates whether the local community agrees with EPA's analyses and preferred alternative that was put out for public comment in the Proposed Plan.

EPA has carefully considered all comments submitted during the public comment period and taken them into account during the selection of the remedy for the Blackbird Mine site. EPA's responses to comments received during the public comment period are included in the attached Responsiveness Summary (Appendix D). Some of the comments support EPA's preferred alternative put out for public comment and some of the comments do not support EPA's preferred alternative.

SECTION 11

PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the 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, pollutants or contaminants that act as a reservoir for migration of contaminants to groundwater, 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. In determining an appropriate range of alternatives for sites with high volume/low risk waste, EPA has stated its position in the NCP as well as guidance documents. Specifically, EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable [40 CFR 300.430(a)(iii)(B)]. In addition, EPA Guidance for Conducting RI/FS under CERCLA, Interim Final (EPA, 1988) states "Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low concentrated wastes such as some municipal landfills and mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved."

Mining activity within the Blackbird Mine resulted in about 14 miles of underground workings, a 12-acre open pit, 4.8 million tons of waste rock in numerous piles, and two million tons of tailings disposed of at a tailings impoundment. The waste rock and tailings contain high concentrations of metals that are released to the environment through acid rock drainage or erosion. These source materials could be considered a principle threat waste as defined above.

Treatment technologies for the source materials (waste rock and tailings) were considered in the screening of technologies in the Analysis of Alternatives reports for the Early Actions and in the FS. The treatment technologies that were considered were biological, thermal and chemical fixation. The technologies were screened out and not carried forward in the detailed analysis of alternatives because they were deemed to be not effective or have poor effectiveness and be less implementable and significantly more costly than other options.

The selected alternative in this ROD does utilize treatment of contaminated surface water and groundwater that has been impacted by metals leaching from source materials.

SECTION 12

THE SELECTED REMEDY

The selected remedy is BB-7 for the Blackbird Creek Drainage, BT-5 for the Bucktail Creek Drainage and a combination of P-2 and P-3 for the Panther Creek Drainage. These remedies are discussed more fully below. The selected remedy meets the requirements of the two mandatory threshold criteria: protection of human health and the environment, and compliance with ARARs, while providing the best balance of benefits and tradeoffs among the five balancing criteria: long-term effectiveness; short-term effectiveness; implementability; reduction in toxicity, mobility and volume through treatment; and cost. The selected remedy also provides for meeting the remedial action objectives and remediation goals presented in Section 8.

12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

The key factors upon which the remedy decision is based are presented below along with a description of how the selected remedy meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria.

12.1.1 Blackbird Creek Drainage Area

The selected remedy for the Blackbird Creek drainage area is BB-7 which is comprised of the following:

- Collection of Meadow Creek seeps
- Covering the West Fork Tailings Impoundment and treating tailings impoundment seepage
- Removal with selective stabilization of overbank deposits along Blackbird Creek
- Natural recovery of in-stream sediments in Blackbird Creek
- Institutional controls
- Operations, maintenance and monitoring
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

The selected remedy is expected to be protective of human health and the environment and is expected to meet all ARARs. The selected remedy is expected to have a smaller mixing zone for both copper and cobalt in Panther Creek to meet the NPDES substantive requirements than other alternatives that rely on primarily stabilizing overbank deposits and only covering the West Fork Tailings Impoundment.

The selected remedy incorporates the Early Actions, including the collection and treatment of Meadow Creek seeps which will reduce the amount of copper being released from waste rock.

The selected remedy utilizes covering the West Fork Tailings Impoundment and treating groundwater seeping from the impoundment. Treatment has the greatest degree of certainty and is the most effective means of achieving cobalt water quality cleanup levels in Panther Creek during all times of the year. There is uncertainty whether alternatives that rely on only the cover at the West Fork Tailings Impoundment will ever achieve cobalt water quality cleanup levels and if so how long it would take (could take years to tens of years). With treatment of groundwater at the West Fork Tailings Impoundment, the cobalt water quality cleanup level should be achieved within 1 to 2 years following completion of construction.

The selected remedy will reduce human health risks from direct contact to arsenic in the Blackbird Creek overbank deposits (soils and tailings) by removing large volumes of deposits and stabilizing in place only a limited amount of areas. Removal of large volumes of overbank deposits will provide greater reliability and permanence than alternatives that primarily stabilize the material in place. Removal of the overbank deposits also will be more reliable at reducing the potential for remobilization of arsenic contaminated soil/tailings during large runoff events and depositing the material downstream on the banks of Panther Creek. In addition, removal of large volumes of overbank deposits will contribute to meeting copper and cobalt water quality cleanup levels because the contaminated materials will not be present to leach copper and cobalt to surface water. Alternatives that rely on primarily stabilizing the overbank deposits are not predicted to achieve the copper water quality goal in Panther Creek during all times of the year.

Residual risk is low for the selected remedy because it utilizes treatment to address copper and cobalt releases to surface water and, primarily, removal to address risks from overbank deposits to humans.

The selected remedy can be implemented using standard construction techniques. Designing, installing, and operating the collection and treatment system for Tailings Impoundment seepage would be more difficult than alternatives that do not include treatment. However, the difficulties are outweighed by the significant environmental benefits.

12.1.2 Bucktail Creek Drainage Area

The selected remedy for the Bucktail Creek Drainage area is BT-5 and is comprised of the following elements:

- Groundwater seep collection and treatment
- Diversion of Bucktail Creek
- Natural recovery of sediments
- Institutional controls
- Operations, maintenance and monitoring
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

Phase 1 of the seep collection system is being performed as a modification to the Early Action. Phase II of the groundwater interception will be implemented as part of the selected remedial action, unless EPA determines that Phase II is not necessary. No unacceptable human health risks were shown in the Bucktail Creek drainage.

The selected remedy is expected to be protective of the environment. This alternative is expected to meet the copper and cobalt cleanup levels in Big Deer Creek and South Fork of Big Deer Creek. Other alternatives do not include the diversion pipeline around South Fork of Big Deer Creek and, therefore, will not meet the copper and cobalt cleanup levels in South Fork of Big Deer Creek. A mixing zone analysis was performed for Big Deer Creek in accordance with the NPDES requirements and all the alternatives have similar mixing zones for copper.

Bucktail Creek flows in excess of the capacity of the diversion pipeline (10-year storm event) would overflow into South Fork Big Deer Creek. However, this overflow is expected to occur during times of increased flow in South Fork Big Deer Creek as well as Bucktail Creek. The increased flows would provide additional dilution in both creeks, such that the effects of overflow on water quality and sediments would be expected to be minimized and of short duration.

The construction of the diversion pipeline would mean that the sediments in South Fork Big Deer Creek would no longer be consistently subjected to the metals in the Bucktail Creek flows. This should speed the natural recovery process for the sediments, such that the sediment cleanup levels would be met in South Fork Big Deer Creek more rapidly than other alternatives that do not include the pipeline.

Sediment quality in Big Deer Creek would be expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Big Deer Creek. Meeting sediment cleanup levels in Big Deer Creek is not as time critical for improvement of aquatic habitat quality as meeting surface water cleanup levels. Benthic communities in Big Deer Creek should not exhibit high levels of impact due to sediment exposure. Salmonids are not expected to be directly impacted by sediment concentrations, and the food supply for salmonids provided by the benthic community should improve with improving water quality in Big Deer Creek despite the current exceedances of the sediment cleanup levels.

12.1.3 Panther Creek Drainage Area

The selected remedy is a combination of Alternatives P-2 and P-3. The contaminated areas at the Rufe and former Strawn properties are relatively small. Therefore, soil in overbank deposits will be removed at the Rufe and former Strawn properties to the human health cleanup level for arsenic. The contaminated overbank deposits at the Rogers property are large areas. These areas will have ICs if acceptance of the property owner can be obtained. If acceptance of the property owner cannot be obtained, then the overbank deposits will be removed to the human health cleanup level. In addition to Institutional Controls, operations, maintenance and monitoring are also elements of this selected remedy. Five year reviews will also be conducted to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions.

Institutional controls will also be needed at some of the private properties where overbank deposits have been removed as an Early Action to preclude unacceptable future exposure if underlying soils with elevated arsenic concentrations are brought to the surface (as a result of erosion, digging or construction activities). The Early Action properties that will require ICs for underlying soils are: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, Bevan 2/1, Sillings 1 (Ditch Area), Sillings Lower Pasture (Sillings 4/1 and 4/2), Sillings Upstream Low Bar, Fernandez Low Bar 1, Fernandez Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, and the Panther Creek Inn area.

Human health would be protected by preventing human exposure to arsenic concentrations above the human health cleanup level for future residential use via selective removal of overbank deposits and/or institutional controls. There were no unacceptable environmental risks associated with the overbank soils. Water quality in Panther Creek is dependent on the alternatives selected for Blackbird and Bucktail Creeks. Sediments are expected to improve through natural recovery such that sediment cleanup levels would eventually be achieved in Panther Creek.

This alternative would meet all ARARs.

The selected remedy provides for a reliable and permanent remedy with removal of all soils above the residential arsenic cleanup level at some of the properties, such that, if land uses change to residential in the future, this alternative would prevent potential human health risks. Monitoring would be conducted following significant runoff events that might mobilize sediments from Blackbird Creek.

If acceptable to the property owner at the Rogers property, ICs with proprietary controls, such as conservation easements that would exclude residential development in the vicinity of the overbank deposits, would be implemented. The proprietary controls would be layered with informational devices implemented by EPA. The grantee of the easements would be an independent third party, preferably a government entity. Institutional controls are effective and reliable if they are maintained and enforced.

Removal would take no more than one construction season, except at the Rogers property, where removal could take more than one season.
This alternative is feasible both technically and administratively. This alternative could be implemented using standard construction techniques. For properties with ICs, obtaining acceptance by property owners and the Grantee are the primary implementation difficulties associated with this alternative. The willingness of the private property owners to grant the easements is uncertain. In addition, an independent third party that is willing to accept the grants of easement has not been identified.

DESCRIPTION OF THE SELECTED REMEDY

12.2 BLACKBIRD CREEK DRAINAGE BASIN

The cleanup levels for the selected remedy described below are provided in Section 8.

The remedial actions in the Blackbird Creek basin are shown in Figure 9-5 and will include the following:

- Collection and treatment of upper Meadow Creek seeps
- Continued operation of the water treatment plant
- Construction of a soil cover over the West Fork Tailings Impoundment
- Collection and treatment of seepage from the West Fork Tailings Impoundment
- Removal of overbank deposits with armoring of selected deposits
- Removal of in-stream sediments and overbank deposits in the vicinity of the PCI
- Establishing institutional controls and physical restrictions
- Natural recovery of Blackbird Creek sediments
- Operations and maintenance of Early Actions and remedial actions
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.2.1 Collection and Treatment of Upper Meadow Creek Seeps

In the upper reaches of Meadow Creek, a number of seeps have been observed between the toe of the 7800 waste rock dump and the 7350 detention basin. Water chemistry analyses have shown metals loading in this area that contributes to elevated concentrations observed in Blackbird and Panther Creeks during spring runoff. A seep collection system was constructed in this area during the Early Actions; however, the data indicate that additional actions are required in this area to achieve water quality cleanup levels. The further actions are being performed as a modification to the Early Actions. The further actions will involve revising the drainage systems below the 7800 waste rock dump to collect contaminated water via the Meadow Creek channel. The intent is to separate clean water in the upper creek from lower creek water affected by seepage containing elevated metals. Currently, this portion of upper Meadow Creek discharges into the existing 7350 detention basin, and is then routed to the 7100 West Clean Water Pipeline. The existing 7350 diversion structure will be modified so that Meadow Creek will discharge into the 7100 reservoir for treatment in the Water Treatment Plant. This will provide collection for storage and treatment of seeps containing high levels of metals from the area below the toe of the 7800 waste rock dump and debris flow deposits. Clean water from the upper creek will be intercepted by a clean water diversion ditch and piped to the existing 7100 West Clean Water Pipeline.

12.2.2 Continued Operation of the Water Treatment Plant

The continued operation of the existing Water Treatment Plant (WTP) will be necessary for treatment of waters collected by the Early Actions and for treatment of additional contaminated waters collected as part of the Remedial Actions. The WTP is a lime precipitation plant that currently treats water from the 7100 dam, the underdrain flows below the Meadow Creek cover, and the 6850 Portal (mine waters and Bucktail Creek waters transported through the mine). The WTP is located in the upper part of Blackbird Creek near the location of the previous mill and office buildings, approximately 7 miles upstream from the confluence of Blackbird Creek and Panther Creek. The WTP currently treats a yearly average of about 300 gallons per minute (gpm) with a maximum monthly average of about 650 gpm. The design capacity is 800 gpm with maximum hydraulic capacity of 1,000 gpm.

Under CERCLA, a National Pollutant Discharge Elimination System (NPDES) permit is not required for on-site actions that are necessary for implementation of the response action where the discharge receiving water is in the area of contamination or other areas that are in close proximity. Current discharges from the WTP are regulated under an NPDES permit, #ID-002525-9, which expired on October 30, 1989. A new permit application was submitted to EPA; however, EPA deferred action on the new permit application until completion of the RI/FS and ROD process. The NPDES permit will not be renewed for treatment of water covered under these CERCLA actions. Instead, the substantive NPDES requirements will be applied to the WTP and other point source discharges.

To meet the water quality based requirements, the point source discharges from the WTP, from the West Fork underdrain culvert, and other waste areas must be limited so as to avoid causing or contributing to exceedances of the water quality criteria established for the designated beneficial use for Blackbird Creek of secondary contact recreation (not cold water biota) and for the designated beneficial use for Panther Creek of cold water biota. In accordance with the NPDES program, the water quality based requirements are established by calculating the amount of pollutant loading from Blackbird Creek that can mix with Panther Creek in a manner that is protective of cold water biota. The State of Idaho guidelines provide for a maximum mixing zone of 25% of the width of the receiving stream; however, this can be expanded through site-specific mixing zone analysis. Section 10 provides the results of the mixing zone analyses for the selected remedy.
Effluent discharge limits have not been set for the existing water treatment plant and for the West Fork underdrain culvert. The discharge limits cannot be set at the present time because the discharge limits must be set for total recoverable metals concentrations. Virtually all of the existing data for discharges from the existing water treatment plant are in terms of total recoverable metals. However, all of the loading analyses and the mixing zone analyses have been conducted using dissolved metals. This means that a metals translator must be used to calculate the dissolved/total recoverable metals ratios and to set the discharge limits. Since the data do not currently exist to develop statistically valid site-specific dissolved/total recoverable metals ratios, these data must be collected. These data will be collected during spring 2003, and

the effluent discharge limits will be established in an explanation of significant difference (ESD) after the additional data are collected.

12.2.3 Construction of a Soil Cover Over the West Fork Tailings Impoundment

The West Fork Tailings Impoundment has been used as a repository for the materials removed from overbank areas along Blackbird Creek and Panther Creek since the overbank removals began in 1998. The overbank materials are much lower in arsenic and metals than the tailings that were deposited at the impoundment during the mining operations. Thus, the overbank materials can serve as an effective cover for the tailings. The overbank deposits removed from Panther Creek during the Early Actions have been spread over the portion of the impoundment south of the West Fork Blackbird Creek Channel. The additional overbank materials that will be removed from Blackbird Creek and Panther Creek during the Remedial Actions will be spread over the surface of the impoundment on both sides of the channel. The thickness of cover over the tailings will be at least 10 feet south of the channel, and at least 1 foot north of the channel. The cover will be graded to preclude drainage to the creek channel, and will be seeded to establish vegetation. The post-remediation water quality monitoring program will include stations immediately upstream and downstream from the cover area in the West Fork of Blackbird Creek. If the monitoring indicates that unacceptable levels of metals or sediments are being generated by the cover, contingency measures will be evaluated and implemented in the future.

12.2.4 Collection and Treatment of Seepage from the West Fork Tailings Impoundment

The seepage from the West Fork Tailings Impoundment is high in metals, particularly cobalt. The seepage from the tailings impoundment typically accounts for over half of the cobalt loads measured at the mouth of Blackbird Creek. The seepage comes from one discrete and multiple non-discrete sources. The discrete source is from a 42-inch culvert underdrain constructed at the bottom of the tailings impoundment. This culvert was originally constructed to serve as a bypass for the West Fork of Blackbird Creek. After the bypass channel was constructed on top of the tailings impoundment in 1993, this culvert was filled with gravel, and now serves as a drain for groundwater within the tailings. The non-discrete sources are multiple springs and seeps that issue from the vicinity of the toe of the tailings dam.

Groundwater affected by the Tailings Impoundment will be intercepted and treated. The treatment will result in a decrease in downstream cobalt concentrations in Panther Creek, such that the cobalt cleanup level of 38 μg/L can be consistently achieved in Panther Creek with acceptable mixing zones. EPA may consider a staged implementation which would allow for further cobalt toxicity analysis and biological testing, to determine if another cleanup level for cobalt is protective, before requiring treatment of groundwater from the Tailings Impoundment. This staged implementation would be scheduled so that the acceptable cobalt levels are achieved at the same time that acceptable copper levels are achieved. Through this approach, EPA could determine that another cobalt cleanup level is protective.

Three options are being considered for the collection and treatment: 1) a collection trench with pump back to the existing water treatment plant, 2) a collection trench with in-situ active treatment using a packaged water treatment plant, and 3) a slurry wall barrier with in-situ passive treatment. Each is described below.

- Collection trench with pump back to the existing water treatment plant (see Figure 12-1). A gravel-filled collection trench would be constructed with conventional excavation equipment to a depth of approximately 15 feet. The depth to bedrock in this area is approximately 20 feet or deeper. A collection trench 15 feet deep should collect the majority of seepage. The existing culvert underdrain would be extended to connect to the collection trench. A clay trench cap would be used to minimize surface water infiltration. The collection trench would drain to a vault and pump station containing two pumps. The collected water would be pumped to the 7100 dam for storage, with treatment at the existing water treatment plant. Three booster pump stations would be needed between the West Fork Impoundment and the 7100 dam. Storage vaults would be installed to buffer flows between the pump stations and to provide storage to allow draining the pipeline. Each pump station would have a backup generator, control equipment, and telemetry.

- Collection trench with in-situ active treatment using a packaged water treatment plant (see Figure 12-1). In this option, Tailings Impoundment seepage would be collected as described in the preceding section. Instead of pumping to the existing WTP, a pre-designed packaged treatment plant would be installed near the Tailings Impoundment. The treatment plant would provide lime treatment and air oxidation similar to the existing WTP. Treated water would be discharged to Blackbird Creek immediately downstream of the West Fork of Blackbird Creek.

- Slurry wall barrier with in-situ passive treatment (see Figure 12-2). In this option, a slurry wall would be constructed below the dam to intercept seepage into Blackbird Creek. A collection drain system would direct the seepage into subsurface treatment vaults. Two vaults would be constructed in the wall. Each vault would contain sorption material capable of sorbing cobalt under site conditions. A potential sorption material would be apatite. Apatite has been used for sorption of copper, zinc, and other metals discharging from mine tailings. It is believed it would work for cobalt as well, but this would need to be established via a treatability study before use. A treatability study evaluating apatite and other potential sorption media will, therefore, be conducted to determine the effectiveness and establish design criteria for an in-situ passive treatment system.

As noted in Section 10.2.1, data collected during March 2001 indicated that there were anomalously high cobalt concentrations in Panther Creek for a three to four week period. Additional monitoring will be conducted to determine the source of these high cobalt concentrations. If the high cobalt concentrations are associated with the West Fork

Impoundment, it may be necessary to evaluate additional measures (e.g., larger and/or more efficient collection and treatment systems) to address the source of the high cobalt concentrations.

12.2.5 Removal of Blackbird Creek Overbank Deposits with Armoring of Selected Deposits

Many of the overbank deposits along Blackbird Creek between the WTP and the Blackbird Creek/Panther Creek confluence pose risks to human health and the environment. These risks include those deposits where the arsenic concentrations are currently above the human health cleanup levels and those deposits that could be re-mobilized during high flow events with downstream deposition at in-stream or overbank areas.

Most of the overbank deposits requiring action will be excavated and hauled to the West Fork Tailings Impoundment or the Blacktail Pit for disposal. Excavation will be conducted to the former slope or angle of repose, to natural ground surface, or to the water table, as appropriate for the individual deposits. Following excavation, the removal area will be graded as necessary for proper stormwater drainage. In a few selected areas, armoring will be used instead of removal. In addition, armoring will be added in removal areas where residual concentrations exceed the human health cleanup level or where EPA determines that there is unacceptable risk because of re-mobilization (with downstream deposition) during high flow events. Armoring of overbank deposits will generally be accomplished by placing angular riprap armor rock. The armor riprap will be installed along exposed banks of mine related sediments from the bottom anticipated scour depth to above the water surface elevation predicted for the 500-year design flood. The armor rock will be sized to resist mobilization during the 500-year design flood. See Figures 6-13a through 6-13x in the Feasibility Study for planned removal and armoring areas.

No action will be taken for overbank deposits in talus slopes. The talus rock already provides armoring, and removal would be very difficult. Removal in the talus slopes would also tend to destabilize the hillside, increasing erosion of overbank deposits into the creek.

In-stream sediments in Blackbird Creek would be addressed through natural recovery.

12.2.6 Removal of In-stream Sediments and Overbank Deposits in the Vicinity of the Panther Creek Inn

Due to the proximity to the Panther Creek Inn (PCI), the residential human health cleanup level of 100 mg/kg for arsenic will be applied to the Blackbird Creek overbank deposits between the existing berms from the Panther Creek road bridge to the Blackbird/Panther Creek confluence. In addition, overbank deposits that were not addressed during the Early Action and are found to exceed cleanup levels will be removed. Overbank deposits will be removed to the water table or the cleanup level, whichever comes first. The excavated areas will be backfilled with clean material to the pre-removal grade. In-stream sediments within the Blackbird Creek channel will be removed to the cleanup level of 490 mg/kg for arsenic or to a depth of three feet, whichever comes first. If the arsenic cleanup level is reached, backfilling within the channel will not be required. If the cleanup level is not reached, the excavated channel will be backfilled with a minimum of one foot of clean backfill material. Backfill material within the channel will be gravel or talus material with gradation similar to the removed materials.

The actions to remove and selectively stabilize overbank deposits upstream along Blackbird Creek will reduce the potential for re-contaminating the areas near the PCI where removal is conducted. In addition, the existing sediment ponds in Blackbird Creek upstream of the PCI area will be maintained and will provide additional protection. The sediment ponds were designed to store the volume of sediments that would be generated from 10 year/24-hour storm events, although not all the sediment would settle out in the ponds. To further lessen the potential for recontamination, the channel between the road and the mouth of Blackbird Creek will be deepened so that normal spring runoff will not overflow onto the overbank deposits adjacent to Blackbird Creek.

Following removal, the area will be periodically monitored to determine if the area has become re-contaminated; additional removals will be conducted if future monitoring determines that the arsenic cleanup levels for overbank and/or in-stream sediments are exceeded.

12.2.7 Establishing Institutional Controls and Physical Restrictions

Institutional controls are required to protect the remedy and to preclude uses (such as ingesting the groundwater at the mine and residential use) that would result in unacceptable risks of exposure to contaminants. All private properties along Blackbird Creek are owned by the companies that comprise the BMSG. Institutional controls for the private properties would be accomplished using an enforcement tool (a Consent Decree) with language to preclude activities on the private properties that could interfere with the remedy or cause unacceptable exposure risks. Institutional controls would be made more permanent through the use of proprietary controls, such as restrictive easements, to preclude uses that might result in unacceptable risks. Governmental controls are anticipated for the Forest Service lands along Blackbird Creek to prevent land uses and activities that may interfere with the remedy or that could lead to unacceptable risk exposures.

Re-opening the mine or new mining activities within the Blackbird Mine cleanup area needs to be performed consistent with the selected remedy and not compromise the cleanup levels established in this ROD. Any mining activity that takes place in this area will be subject to applicable regulatory requirements including obtaining and complying with all necessary permits.

Physical restrictions on Blackbird Creek would include continued maintenance of the existing fence and gate on the Blackbird Creek road upstream of the Ludwig Gulch Road and the fencing and gate that controls access from Ludwig Gulch Road to the West Fork Tailings Impoundment. The BMSG maintains control of the gate and requires persons entering the site to sign in and sign out. Foot and horse access are not precluded; however, the frequency and duration of such activities is expected to be very limited. The gate on the Blackbird Creek road controls access to the only road to Bucktail Creek and will also limit access to the northern portion of the Blackbird Mine Site.

12.3 BUCKTAIL CREEK DRAINAGE BASIN

The Remedial Actions in the Bucktail Creek basin are shown in Figure 9-10 and include:

- Collection and treatment of Bucktail Creek groundwater seeps
- Continued operation of the Water Treatment Plant
- Diversion of Bucktail Creek
- Establishing Institutional Controls and Access Restrictions
- Operations and maintenance of early actions and remedial actions
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.3.1 Collection and Treatment of Bucktail Creek Seeps

Significant metals loads enter Bucktail Creek between the 7000 dam and surface water monitoring station BTSW-01.6 (approximately 0.4 mile downstream from the 7000 dam). These loads are due to discrete and non-discrete groundwater seepage and springs. The actions to address the seepage and springs include groundwater collection, with transport to the 6930 adit that drains to the existing WTP in Blackbird Creek drainage for treatment.

The seep collection will be conducted in phases. Phase 1 (which is being performed as a continuation of the Early Actions) consists of installing a groundwater interception trench below the 7000 dam. Collected water will flow by gravity to the existing pumpback station. A new discharge pipe will be installed between the pump station and the 6930 adit. The new discharge pipe will allow the existing pumps to handle the increased flows.

Under Phase 2, additional collection of groundwater will be performed. If water quality monitoring subsequent to completion of the Phase1 construction indicates that sufficient metals loads have been removed to achieve water quality cleanup levels in Big Deer Creek at all times, then Phase 2 construction would not be required. Downstream from the existing pump station, the bottom of the streambed will be filled with drainage rock and covered with a liner to create two layers in the stream. The bottom drainage layer will collect the current base flow of Bucktail Creek as groundwater. The clean surface water will flow in a pipeline over the liner. The pipeline will be perforated to allow collection of the clean surface water As an alternative, a series of extraction wells may be utilized to collect the contaminated groundwater downgradient from the initial cutoff wall. The water collected by the extraction wells would be pumped to an upgraded Bucktail pumpback station, then pumped to the 6930 adit. The extraction wells would be utilized only if it can be demonstrated that they are as effective at removal of metals loads as the gravel drain with downstream barrier in Bucktail Creek.

If the groundwater flows and metal loads in the groundwater are relatively low, passive in-situ treatment (i.e., a sorption wall) will be implemented. If the groundwater flows and/or metals loads are too high for cost-effective in-situ treatment, an interception trench will be installed to collect the groundwater from the lower layer. A pump station near this collection trench will pump water to the existing pump station for pumping to the 6930 adit. Additional and/or larger pumps will be installed at the existing pump station to handle the increased flows.

The upper sediment pond on Bucktail Creek will be removed. Materials used to construct the upper sediment dam will be hauled to the Blacktail Pit or the 7400 waste rock dump for disposal. The lower sediment pond will be retained during construction.

12.3.2 Continued Operation of Water Treatment Plant

If passive treatment is not utilized to treat the Bucktail Creek seeps, then the collected waters will be pumped to the 6930 adit, where they will be transported through the mine workings, with eventual treatment at the existing water treatment plant. The continued operation of the existing water treatment plant is described in Section 12.2.2 above.

12.3.3 Diversion of Bucktail Creek

Flows in Bucktail Creek will be diverted around South Fork Big Deer Creek, with discharge directly into Big Deer Creek. The diversion will accelerate the recovery of South Fork Big Deer Creek sediments and allow water quality cleanup levels and the copper ARAR to be met in South Fork Big Deer Creek. To divert Bucktail Creek, a pipeline will be installed from the vicinity of the Bucktail Creek Lower Sediment Dam to the discharge into Big Deer Creek just downstream from the confluence of South Fork Big Deer and Big Deer Creeks. At the discharge, a diffuser will be constructed in Big Deer Creek as necessary to minimize the mixing zone within Big Deer Creek. Pressure reducing facilities will be constructed as necessary prior to the discharge to Big Deer Creek. The pipeline will be designed to handle flows up to the 10-year design event in Bucktail Creek. Flows in excess of the pipe carrying capacity will be allowed to overflow into South Fork Big Deer Creek. The design criteria for the pipeline will use conditions prior to the Clear Creek fire in 2000. Until vegetation has become re-established in the burned areas (estimated at 5 to 15 years for undergrowth), the overflows into South Fork Big Deer Creek may be more frequent than the 10-year design assumption. During flow events as large as the 10-year event in Bucktail Creek, flows in South Fork Big Deer Creek should also be large, which should provide considerable dilution of the Bucktail Creek flows during the short duration of the overflows (the 10-year design event is a thunderstorm event). As much as feasible, the pipeline will be constructed within or parallel to the existing roadway along South Fork Big Deer Creek to minimize environmental disruption and tree cutting.

12.3.4 Establishing Institutional Controls and Access Restrictions

The Institutional Controls will be similar to those noted for the Blackbird Creek drainage basin in Section 12.2.7 above. Vehicular access will be controlled because the only road into the Bucktail Creek basin comes from the Blackbird Creek basin through the mine site. This road is controlled by the fence and gate on Blackbird Creek near Ludwig Gulch. A foot and horse trail follows Big Deer Creek. The trail can be used to access the Bucktail Creek area. Foot and horse travel will not be controlled.

12.4 PANTHER CREEK DRAINAGE AREA

The selected response action is a combination of Alternatives P-2 and P-3. The remedial actions in the Panther Creek drainage include:

- Selective removal of overbank deposits
- Establishing institutional controls
- Natural recovery of Panther Creek sediments
- Five year reviews to evaluate the protectiveness of cleanup levels and the effectiveness of cleanup actions

12.4.1 Selective Removal of Overbank Deposits

Selected overbank deposits will be removed at the Rufe, Straun/Bowman, and Rogers properties (see Figure 12-3). These properties are located at approximately 4.5, 5.5, and 7 miles, respectively, from the mouth of Panther Creek. Soils will be removed to meet human health cleanup levels for potential future residential use (100 mg/kg arsenic). Contaminated material will be removed to the cleanup level or the water table, whichever comes first. Excavated areas will be backfilled with clean soils to the natural grade. Removal of soils would avoid the need for institutional controls at these properties unless contaminants are left at the water table above levels that pose a potential risk if subsurface soils are brought to the surface. To protect the remedy at these properties, monitoring will be conducted following significant runoff events to ensure that these properties do not become re-contaminated due to remobilization of upstream sediments (particularly Blackbird Creek sediments).

12.4.2 Establishing Institutional Controls

At some or all of the overbank deposits at the Rogers property (and Hade, if necessary) institutional controls may be utilized to protect human health under the future residential scenario. These institutional controls would include land use restrictions to preclude future residential use of this property. Proprietary controls, such as a conservation easement, would be established on all or portions of the contaminated overbank deposits at this property. The proprietary controls would be layered with informational devices implemented by EPA. The grantee of the easement would be a third party, preferably a government entity, that would ensure that the land is not developed for residential uses in the future.

If the current property owner is not willing to grant the easement, or if a third party is not identified that is willing to accept the easement, then it would not be possible to implement institutional controls at the Rogers property. In this case, removal would be conducted similar to that described in Section 12.4.1 above.

At some of the private properties where overbank soil was removed as part of the Early Actions, elevated concentrations of arsenic remain beneath the clean backfill at the water table. Institutional controls are needed to address activities that might result in exposure to the contaminated subsurface soils in the water table at the following properties: Riprap Bar 1, Riprap Bars 3 and 5, Deep Creek, Campground 2, Bevan 2/1, Sillings 1 (Ditch Area), Sillings Lower Pasture (Sillings 4/1 and 4/2), Sillings Upstream Low Bar, Fernandez Low Bar 1, Fernandez Low Bar 2, Noranda Pasture 3, Cobalt 1, 4, and 5, and the Panther Creek Inn area.

12.4.3 Natural Recovery of Panther Creek Sediments

Panther Creek sediments will be addressed through natural recovery.

12.5 LONG-TERM OPERATION AND MAINTENANCE

Long-term operation and maintenance (O&M) will be required for the facilities included in both the Early Actions and the Remedial Actions described above. Several O&M manuals have been prepared for the various features of the Early Actions that specify protocols to assure that the facilities are properly operated and maintained. Similar O&M manuals will be prepared for the Remedial Actions. O&M will be required in perpetuity.

12.6 MONITORING

Monitoring will be required to maintain facilities, evaluate effectiveness of Early Actions and Remedial Actions at meeting water quality and sediment goals, and to document recovery of benthic invertebrate and fish populations. Water quality monitoring will be conducted at the water treatment plant(s) discharge and the West Fork Tailings Impoundmenat treatment discharge and in the various streams. In addition, monitoring will be conducted of various components of the remediation system to ensure effectiveness. This monitoring will include selected overbank areas along Panther Creek following significant runoff events to ensure that these areas do not exceed human health cleanup levels because of remobilization of upstream sediments (particularly Blackbird Creek sediments).

Details of the overall monitoring plan will be established as part of the Remedial Design/ Remedial Action. The monitoring plan will be developed in consultation with the State and Trustees. From a biological standpoint, the goals of the monitoring plan will be to assure that the sediment and surface water cleanup levels are met on a consistent basis. In addition, the monitoring plan will include elements to assure that the remedial actions are as effective as assumed, that the NPDES and mixing zone requirements are sufficient to support beneficial uses, and that the zones of passage adjacent to the mixing zones are adequate for fish passage.

12.7 SUMMARY OF ESTIMATED COSTS

The total present worth cost of the Selected Remedy is $15,400,000 based on a present worth discount rate of 7% and 30-year O & M. This value is for the combined costs for the Blackbird Creek Drainage Alternative BB-7, Bucktail Creek Drainage Alternative BT-5 and Panther Creek Drainage Alternative Combined P-2/P-3. The costs are summarized in Tables 12-1 through 12-5.
The cost summary provided is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.8 CONTINGENT ACTIONS FOR BLACKBIRD CREEK, BUCKTAIL CREEK DRAINAGE AREA AND PANTHER CREEK DRAINAGE

There is uncertainty whether some of the components of the remedial action will be effective in meeting the RAOs and cleanup levels. Therefore, monitoring and evaluations are needed after construction of the remedial alternative. Based on the monitoring results and further evaluations, contingent actions may be necessary for some areas of the site in the future if cleanup levels are not met. These actions could include, but would not necessarily be limited to:

- Actions to reduce the hydraulic head upstream of the cutoff wall on upper Blackbird Creek to reduce seepage through the wall and metals loading from groundwater discharging to Blackbird Creek. As an alternative, groundwater could be intercepted downgradient from the cutoff wall and pumped to the existing WTP for treatment.

- Increases to the water storage and/or treatment capacity, and/or revisions to the treatment schedule, if there is insufficient capacity to meet water storage and treatment needs.

- Additional removal of overbank deposits along Blackbird Creek.

- Run-on/run-off controls for the cover on the West Fork Tailings Impoundment, if monitoring indicates excessive erosion or water quality impacts from runoff.

- Measures to reduce the water table beneath the West Fork Tailings Impoundment, if the water table begins to rise to a level that threatens the stability of the dam.

- Additional collection and treatment of Bucktail Creek seeps, if they result in unacceptable metals loading to Big Deer Creek.

- Removal of Bucktail Creek sediments and/or overbank materials, or installation of a passive (or semi-passive) treatment system near the confluence of the South Fork Big Deer Creek and Big Deer Creek, if water quality goals in Big Deer Creek are not achieved because of metals leaching from sediments/overbank materials along Bucktail Creek.

- Alternatives to address metals discharges to South Fork Big Deer Creek from groundwater and/or overbank materials if water quality goals in South Fork Big Deer Creek are not achieved.

- Additional removals along Panther Creek if monitoring following storm events result in deposition of overbank deposits that exceed remediation goals.

- Monitoring the selected response action to determine if the mixing zone for the copper water quality standard and cobalt cleanup level is protective of cold water biota to meet the substantive NPDES requirements for both Panther Creek and Big Deer Creek. If monitoring indicates that the mixing zones are not protective of cold water biota, alternatives will be evaluated to meet the substantive NPDES mixing zone requirements.

- Alternatives to address metals loads to Big Deer Creek downstream from South Fork Big Deer Creek if monitoring indicates that these loads result in exceedances of water quality goals in Big Deer Creek.

12.9 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The remedial action is expected to reduce human health risks in overbank deposits along Blackbird Creek and Panther Creek. Water quality and aquatic biota conditions are expected to be protective of all life stages of resident and anadromous salmonids and other fishes in Panther Creek and resident salmonids and other fishes in South Fork of Big Deer and Big Deer Creeks. In addition, the remedial action is expected to restore and maintain sediment quality and aquatic biota conditions capable of supporting all life stages of resident and anadromous salmonids and other fishes in Panther Creek and resident salmonids and other fishes in South Fork of Big Deer and Big Deer Creeks. In Blackbird Creek and Bucktail Creek, the remedial action is expected to achieve the non-numeric narrative goals provided in Section 8.

SECTION 13

STATUTORY DETERMINATIONS

Under Section 121 of CERCLA and the NCP, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements, are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum 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 the statutory requirements.

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will protect human health and the environment in each of the drainage areas as follows:

Blackbird Creek Drainage Basin

- Collection and treatment of water, including the upper Meadow Creek seeps and seepage from the West Fork Tailings Impoundment will reduce concentrations of copper and cobalt in Blackbird and Panther Creeks so that the water quality in Panther Creek meets cleanup levels protective for aquatic organisms, including endangered species, and the non-numeric narrative cleanup goal for Blackbird Creek is met.

- Operation of the Water Treatment Plant will be continued to meet water quality cleanup levels.

- Capping and grading the West Fork Tailings Impoundment will reduce direct contact with tailings, reduce surface water transport of tailings and reduce storm water infiltration so that risks to human health are reduced; and to support meeting water quality cleanup levels in Panther Creek protective for aquatic organisms and the non-numeric narrative cleanup goal for Blackbird Creek.

- Collection and treatment of seepage from the West Fork Tailings Impoundment so that the water quality in Panther Creek meets cleanup levels protective for aquatic organisms, including endangered species, and the non-numeric narrative cleanup goal for Blackbird Creek is met.

- Removal and stabilization of overbank deposits will reduce direct contact with tailings and will reduce surface water transport of tailings so that risks to human health downstream are reduced.

- Removal of Blackbird Creek in-stream sediments and overbank deposits in the vicinity of the Panther Creek Inn (PCI) will reduce direct contact with contaminated material so that risks to human health are reduced.

- Establishing institutional controls and access restrictions will prevent uses that are inconsistent with or interfere with the remedy.

- Natural recovery of sediments will meet sediment cleanup levels.

Bucktail Creek Drainage Basin

- Collection and treatment of Bucktail Creek groundwater seeps below the 7000 dam will reduce the concentrations of copper and cobalt in Bucktail Creek, South Fork Big Deer Creek and Big Deer Creek so that the water quality in South Fork Big Deer Creek and Big Deer Creek meets cleanup levels protective for aquatic organisms and the non-numeric narrative cleanup goal for Bucktail Creek is met.

- Operation of the Water Treatment Plant will be continued to meet water quality cleanup levels in Bucktail Creek.

- Diversion of Bucktail Creek to Big Deer Creek will reduce the concentrations of copper in South Fork Big Deer Creek without causing exceedances in Big Deer Creek so that water quality in South Fork Big Deer Creek can achieve Idaho WQS and the cobalt cleanup level.

- Establishing institutional controls and access restrictions will prevent uses that are inconsistent with or interfere with the remedy.

- Natural recovery of Bucktail Creek, South Fork of Big Deer Creek and Big Deer Creek sediments will meet sediment cleanup levels.

Panther Creek Drainage Area

- Selective removal of overbank deposits will reduce human exposure to arsenic contaminated material so that risks to human health are reduced.

- Establishing institutional controls will reduce human exposure to arsenic contaminated material so that risks to human health are reduced.
- Natural recovery of Panther Creek sediments will meet sediment cleanup levels.

13.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The selected remedy will comply with all action-specific, chemical-specific and location-specific Federal and State ARARs that have been identified. These ARARs are listed below.

Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02). These rules designate uses that are to be protected in waters of the State of Idaho and establish standards of water quality protective of those uses.

The State of Idaho rules designate Panther Creek, Big Deer Creek and South Fork of Big Deer Creek for all uses, including protection of cold water aquatic life, salmonid spawning and secondary contact recreation. The State of Idaho has removed the designated aquatic life uses (through a use attainability analysis(UAA)) for Lower Blackbird and West Fork Blackbird Creeks (downstream of the clean water reservoir). These UAAs were approved by EPA. These waters have only secondary contact recreational use. The State has removed the aquatic life and recreational use designations from Bucktail Creek with a UAA which was also approved by EPA.

The State of Idaho rules establish water quality standards that are to be protective of the designated uses. The Idaho WQS for copper and arsenic that were submitted to EPA prior to May 30, 2000, and any changes adopted by Idaho and approved by EPA between May 30, 2000 and the date of this ROD, are applicable to the selected remedial action.

Clean Water Act Section 304 - Federal Ambient Water Quality. Section 304(a)(1) of the Clean Water Act requires EPA to develop, publish and revise criteria for water quality. Section 121(d)(2)(A) of CERCLA provides that the remedial action shall attain the water quality criteria established pursuant to Section 304 of the Clean Water Act. Section 121(d)(2)(B) of CERCLA provides that, "In determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the release or threatened release, the President shall consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available." EPA has reviewed EPA's published National Recommended Water Quality Criteria dated November 2002 (AWQC) and has found that the AWQC for human health based on "consumption of organisms only" is relevant and appropriate for evaluating arsenic in the creeks that are designated for protection of aquatic life (i.e., Panther Creek, South Fork Big Deer Creek and Big Deer Creek). In evaluating this AWQC for these creeks, EPA utilized the AWQC of 10^{-4} risk level for arsenic of 14 ug/L. EPA has reviewed the data on these creeks and has determined that the 95% UCLs for both Panther Creek, South Fork Big Deer Creek and Big Deer Creek do not exceed the AWQC criteria of 14 ug/L.

Clean Water Act National Pollutant Discharge Elimination System (NPDES) Permit (40 CFR 122-125, 40 CFR 440). All point source discharges, including those associated with the water treatment plant, the West Fork Tailings Impoundment, and other waste areas, must meet the substantive requirements of the NPDES regulations. These regulations establish a national permit program for discharges to waters of the United States. These regulations identify specific effluent limitation guidelines for discharges within specific industrial categories. The

NPDES regulations also require, where a discharge causes or has the reasonable potential to cause or contribute to an excursion of water quality standards, that effluent limitation be established to meet beneficial uses. Such water quality based effluent limits are calculated based on achieving water quality criteria in the receiving water.

In accordance with the Clean Water Act and the State of Idaho WQS, point source discharges may allow a mixing zone. A mixing zone is an allocated impact zone where the cleanup levels can be exceeded. The Idaho WQS provide the criteria for evaluating the size, configuration and location of a mixing zone. This evaluation includes a determination that the mixing zone does not cause unreasonable interference with or danger to beneficial uses and provides guidance regarding the size of the mixing zone. (IWQS 58.01.02.060) Monitoring is necessary to ensure that the mixing zone does not interfere with beneficial uses.

The requirements for point source discharges established under the NPDES regulations and the Idaho regulations, including the mixing zone guidelines, are applicable to the point source discharges into Blackbird Creek. The effluent limitations for these point sources must take into consideration the potential impacts to water quality in Panther Creek which is protected for aquatic life. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

The requirements for point source discharges established under the NPDES regulations and the Idaho regulations, including the mixing zone guidelines establish relevant and appropriate guidelines for the diversion of Bucktail Creek into Big Deer Creek. Surface water cleanup levels can be exceeded within the mixing zone, but must not be exceeded at the edge of the mixing zone.

Clean Water Act Stormwater Multi-Sector General Permit for Industrial Activities (65 FR 64746-64880 and 40 CFR 122.26). The substantive requirements of the Stormwater Multi-Sector General Permit for Industrial Activities apply to elements of the selected remedy that result in discharges of stormwater from “industrial activities”. “Industrial activities” include inactive mining facilities as well as the construction and operation of mine waste repositories. Best management practices (BMPs) must be used, and appropriate monitoring performed, to ensure that stormwater runoff does not exceed state water quality standards.

National Primary Drinking Water Standards (40 CFR 141). These regulations, promulgated pursuant to the Safe Drinking Water Act, address contamination in community drinking water systems. These regulations are not applicable because there are no community drinking water systems within the Site. However, the regulations are relevant and appropriate for any groundwater associated with the Site that has mining related contaminants and is used as a source of drinking water. By final rule effective February 22, 2002, EPA lowered the MCL for arsenic from 0.05 mg/L to 0.01 mg/L (66 FR 7061). While community water systems have until January 2006 to comply with the new MCL for arsenic, EPA has determined that the new MCL is relevant and appropriate presently for ensuring that drinking water is protective of human health.

State of Idaho Drinking Water Regulations (IDAPA 58.01.08.050). The purpose of these regulations is to control and regulate the design, construction, operation, maintenance, and quality of public drinking water systems in order to protect public health. These regulations are essentially equivalent to the federal primary and secondary drinking water regulations of 40 CFR 141 and 40 CFR 143, respectively. These regulations are not applicable, but are relevant and appropriate for groundwater associated with the Site that has mining related contaminants and is used as a source of drinking water.

Safety of Dams, State of Idaho Rules and Regulations (Chapter 17, Section 42-1714, Idaho Code and provisions of Section 42-1709 through 42-1721, Idaho Code). These requirements are intended to provide a guide for the establishment of acceptable standards for the construction of and safety evaluation of new or existing dams. These rules are considered applicable to response activities at the Blackbird site that include the use of dams for surface water impoundment because these rules apply to all new dams, to existing dams being altered or repaired and maintenance activities to existing dams as provided in the rules.

Idaho Mine Tailings Impoundment Structure Rules and Regulations (Chapter 17, Section 42-1714, Idaho State Code). These rules and regulations apply to structures constructed, enlarged, or altered after July 1, 1978, used for the purpose of storing mine tailings slurry, that are more than 30 feet in height from toe to the maximum crest. These regulations are relevant and appropriate to response actions, including disposal of additional materials and alteration of the West Fork Tailings Impoundment.

State of Idaho Stream Channel Alteration (IDAPA 37, Title 03, Chapter 07). The objectives of regulations under IDAPA 37, Title 03, Chapter 07 are to protect stream channels and their associated environments against alteration so that fish and wildlife habitat, aquatic life, recreation, aesthetics and water quality are also protected. Substantive portions of these requirements are applicable to response actions at the Blackbird site that involve alteration of stream channels.

Endangered Species Act (16 USC 1531 et seq.) This law and implementing regulations identify threatened and endangered species and establish requirements necessary for their protection. The ESA and implementing regulations are applicable to activities of the Selected Remedy that could affect federally designated threatened or endangered species and/or their habitat. EPA has prepared a Biological Assessment for the selected remedy. Consistent with the Section 7 consultation requirements of the Endangered Species Act, EPA has provided the National Marine Fisheries Service and US Fish and Wildlife Service with a copy of the Biological Assessment.

The Biological Assessment prepared by EPA concluded that the selected remedy is not likely to adversely affect any threatened or endangered species. In a letter dated November 25, 2002, the US Fish and Wildlife Service notified EPA that it has designated critical habitat for bull trout in the Panther Creek drainage. In the same letter, the US Fish and Wildlife Service concurred with EPA's "may affect, not likely to adversely affect" determination relating to the bald eagle, gray wolf and lynx. However, the US Fish and Wildlife Service letter indicates that a determination of "may affect, likely to adversely affect" is appropriate for bull trout in Panther Creek and Big Deer Creek due to concerns about construction related releases, concerns about the two mixing zones and a need for a specific monitoring plan. In a letter dated December 17, 2002, the National Marine Fisheries Service (NMFS) expressed similar findings that a determination of "may affect, likely to adversely affect" is appropriate for Snake River spring/summer chinook salmon and steelhead, designated critical habitat and essential fish habitat due to concerns about construction related releases, concerns about the mixing zones and a need for a specific monitoring plan.

EPA will continue to work with US Fish and Wildlife Service and the National Marine Fisheries Service ("Services") to address their concerns and to meet the requirements of the Endangered Species Act. EPA intends to proceed with selection of this remedial action in accordance with Section 7(d) which provides that the Federal agency shall not make any irreversible or irretrievable commitment of resources which has the effect of foreclosing the formulation or implementation of any reasonable and prudent measures. In the event that the Services propose reasonable and prudent alternatives for the remedial action and/or conservation recommendations, EPA will work with Services to implement such measures and will evaluate the need for modification to the selected remedy through an ESD or amendment to this ROD.

Rivers and Harbors Act, Section 10 regulations (33 CFR Parts 320 through 330). These regulations are applicable to activities in or near navigable waters. They prohibit unauthorized obstruction or alteration of navigable waters.

Clean Water Act, Section 404 (40 CFR 230, 33 CFR 320-330). Section 404 of the Clean Water Act and associated regulations prohibit discharge of dredge or fill material to wetlands. The Army Corps of Engineers implements the Section 404 permit program which provides guidelines for the identification of wetlands and implements protective requirements for actions involving wetlands. Section 404 is applicable if regulated wetlands are identified and potentially impacted by the selected remedy.

Executive Order 11990, Protection of Wetlands. This Executive Order requires federal agencies to avoid adversely impacting wetlands, minimize wetland destruction and preserve the value of wetlands. EPA policy for implementing this Executive Order is promulgated in 40 CFR 6. This Executive Order and regulations are applicable to remedial activities that could affect wetlands.

Executive Order 11988, Floodplain Management. This Executive Order requires federal agencies to evaluate the potential effects of actions that take place in floodplains and to avoid adverse impacts. EPA policy for carrying out the provisions of this Executive Order is promulgated in 40 CFR 6. This Executive Order and regulations are applicable to remedial activities within the floodplains along creeks and streams.

Fish and Wildlife Coordination Act (16 USC 661 et seq.) This statute requires federal agencies to consider the effect projects may have on fish and wildlife and to mitigate loss or damage to these resources. This statute is applicable to the selected remedy.

Migratory Bird Treaty Act (MBTA) (16 USC 703 - 712). The MBTA makes it unlawful to pursue, capture, hunt or take actions adversely affecting a broad range of migratory birds. The MBTA and its implementing regulations are relevant and appropriate to remedial activities that could affect any protected migratory birds. The selected remedy will be carried out in a manner that avoids taking or killing of protected migratory bird species, including individual birds or their nests.

Idaho Classification and Protection of Wildlife (IDAPA 13.01.06). These regulations are relevant and appropriate to remedial activities that could affect wildlife species protected by the State of Idaho.

USFS Regulations for Public Land Closures (36 CFR 261.50). These regulations authorize the Regional Forester to issue orders which close or restrict use of areas, roads or trails on National Forest System lands. This regulation is applicable to the closures or use restrictions of areas, roads, or trails on National Forest System lands.

USFS Regulations for Special Use Authorization (36 CFR 251.53). These regulations govern the issuance of special use authorizations for National Forest System land. Special use authorizations are applicable to rights-of way, reservoirs, canals, ditches, pipes and pipelines, for the impoundment, storage and transportation of water and for system and related facilities for generation, transmission and distribution of electricity. The substantive requirements of these regulations are applicable for remedial actions that require any of these facilities on National Forest System land.

USFS Regulations for Roadless Areas (36 CFR 294.12(b)(2). These regualtions govern the construction of roads in inventoried roadless areas and specifically authorize the constuction of roads when needed to conduct a response action under CERCLA. To the extent that road construction is conducted in an inventoried roadless areas, any substantive requirements of these regulations are applicable to such construction activities.

<u>To Be Considered</u>

The following requirements are to be considered during the design and implementation of the remedial action.

USFS Policies. The US Forest Service policies that are to be considered during implementation of the remedial action on US Forest Service land include those requirements that govern public health and pollution control facilities (FSM 7400) and that govern water storage and transmission (FSM 7500).

13.3 COST EFFECTIVENESS

The selected remedy is cost-effective. In making this determination, the following definition set forth in the NCP was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 430(f)(1)(ii)(D)). Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides "overall effectiveness" in terms of balancing the long-term effectiveness and permanence; short-term effectiveness and reduction in toxicity, mobility and volume. The "overall effectiveness" of the selected remedy was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this selected remedy represents a reasonable value for the money spent.

The estimated present worth cost of the selected remedy is $15.4 million. Although other alternatives are less expensive, the cobalt contamination in Blackbird Creek and Panther Creek and the copper contamination in South Fork of Big Deer Creek are not addressed. The selected remedy's additional cost for treatment of the seeps from the West Fork Tailings Impoundment to reduce cobalt concentrations in Blackbird Creek and Panther Creek provides a significant increase in protection of the environment and is cost effective relative to this environmental benefit. In addition, the selected remedy's additional cost for bypassing loadings to South Fork Big Deer Creek provides a significant increase in protection of the environment and is cost effective relative to the environmental benefit.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment and disposal and considering State and community acceptance.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy utilizes alternative treatment (or resource recovery) technologies to the maximum extent practicable for this site. The remedy utilizes treatment of contaminated surface water and groundwater that has been impacted by metals leading from source materials. Treatment of the remaining threats, waste rock and tailings, was not found to be practicable due to the large volume.

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants 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 that the cleanup levels are protective and that the remedy is, or will be, protective of human health and the environment.

SECTION 14

DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy has not significantly changed from the proposed plan. However, there have been some changes in the ROD from the proposed plan that are provided below.

- The cleanup level for copper in surface water has been changed to the State WQS from the federal AWQC (see Section 8).

- The cleanup level for arsenic in Blackbird Creek is based on the State of Idaho water quality standard of 50 µg/L. The cleanup level for arsenic in Panther Creek, Big Deer Creek and South Fork Big Deer Creek is 14µg/L. This cleanup level of 14 µg/L is based on the AWQC at 10^{-4} for protection of human health from "consumption of organisms". (Section 8)

- Groundwater cleanup levels at the mine have been established (see Section 8).

- A mixing zone analysis for cobalt in Panther Creek has been provided (see Section 10).

- NPDES requirements have been determined to be an ARAR in Big Deer Creek (see Sections 9 and 13).