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EPA Superfund
Record of Decision:

TRIUMPH MINE TAILINGS PILES
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RECORD OF DECISION

Triumph Mine Tailings Piles Site
Blaine County, Idaho

March 1998

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THE DECLARATION

Site Name and Location

Triumph Mine Tailings Piles Site
Blaine County, Idaho

Statement of Basis and Purpose

This decision document presents the remedial action selected by the Idaho Division of Environmental Quality (DEQ) for the Triumph Mine Tailings Piles Site in Triumph, Idaho. The remedy was developed in accordance with CERCLA, as amended by SARA, and, to the extent practicable the National Contingency Plan as outlined in the 1994 Memorandum of Agreement between DEQ and the U.S. Environmental Protection Agency. This decision is based on the administrative record for this site.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

Residential Soils. The selected remedy calls for the excavation of residential soil to a depth where the Remediation Goal (RG) of 300 mg/kg arsenic will be achieved or to one foot, whichever occurs first (excavation to one foot is anticipated to remove most of the soil containing arsenic above the 300 mg/kg cleanup level). Excavated soil will be placed on the tailings piles and graded to allow surface water to drain. Uncontaminated soil will be placed in the residential excavations and vegetated. Excavation of contaminated soil materials and replacement with uncontaminated materials will also occur on unpaved roads and road shoulders. In most residential yards removal of soil above 300 mg/kg arsenic in the top foot of a yard will be a total removal of contaminated soil. These yards will not need any Community Protection Measures (CPMs) to ensure the barrier is maintained. The CPMs will be applied to those yards and other capped areas that have material remaining above the RG at depths below one foot. In yards with contaminated soil below the top foot, garden areas will be provided two feet of uncontaminated soil to grow garden produce.

Tailings Piles. The tailings piles will serve as the disposal location for contaminated soils in residential areas. There are small isolated piles located adjacent to the main piles. These will be consolidated onto the two larger piles. The piles will be graded to ensure runoff and capped with a minimum of six inches of soil as necessary to maintain a vegetative cover. The cap will serve as a barrier to reduce exposures and contaminant migration including capillary rise to acceptable levels. A twelve inch soil cap buffer will be created on the tailings piles that are directly adjacent to residential yards and where there is no physical barrier like a road or fence between the residential yard and the tailings pile. The width of the buffer will be determined on a case by case basis.

Process Area. The concrete foundations in the process areas not associated with unacceptable risks may be demolished as part of remedial action. The waste rock and process areas will be graded (as necessary) and covered to eliminate the exposure pathway. Erosion/seismic concerns will be considered in the final design. A six inch vegetative cover or other alternative covers could be used (rock, gravel, retaining wall) to eliminate direct exposure and airborne emissions from the area. Alternative caps may be needed in this area because of the steep slopes and the difficulty in placing and holding soil on such steep slopes. See the discussion on alternative caps below.

Waste Rock Pile. The waste rock pile will be recontoured to create stable slopes and capped with six inches of soil and revegetated. Alternative caps may be needed in this area because of the steep slopes and the difficulty in placing and holding soil on such steep slopes. See the discussion on alternative caps below.

Wetlands. Visible tailings will be removed from wetlands areas and disposed on the tailings piles. Areas of barren soil that pose a risk of erosion and are above the arsenic RG will be excavated or capped. The criteria for identifying the barren areas will be developed during remedial design and will be based on presence of contaminants, size of area, likelihood of the area creating a wind or water erosion problem, and amount of damage that would occur to the wetlands to perform such removal. An objective of the remedial action is to protect the wetlands from negative impacts created by the remediation. The wetlands have been found to be functioning and performing important metal absorbing and habitat purposes at the site.

Triumph Tunnel Drainage Ditch. The Triumph Tunnel drainage ditch will be excavated to a depth where the RG of 300 mg/kg arsenic will be achieved or to one foot, whichever occurs first. A soil cover will be placed in the ditch if soil containing COCs above the RG remains. This ditch is expected to revegetate over time as the contaminated water is either eliminated via the mine plug or treated prior to discharge into the ditch. The materials excavated from the ditch will be disposed on the tailings pile within a lined cell to ensure these materials do not leach.

House Dust. House dust will be addressed through source control via capping of contaminated soils and tailings. Routine housecleaning by residents post remediation will effectively reduce the metal loading within the home. Follow up monitoring will be performed to demonstrate house dust levels are within acceptable limits.

Community Protection Measures. This portion of the remedy will include CPMs for the soil remediation unit and the wetlands. CPMs will be developed for residential yards, residential developments, and other excavation activities located on capped tailings (or soils that still have arsenic levels greater than 300 mg/kg below the one foot soil cap). The purpose of the CPMs will be to allow the property owner to use their property as they determine appropriate but ensure that any exposed tailings materials or contaminated soils are properly handled, disposed, or capped. An example of the CPMs that could be implemented are to create an overlay zone that would provide information to the property owner regarding the way contaminated soils and tailings would need to be handled and disposed. A disposal location will be established and maintained as part of the successful implementation of CPMs.

The selected remedy includes CPMs to address future residential risks posed by COCs in wetlands soil. These future risks are related to garden produce ingestion. The type of CPMs will be similar to those outlined above for capped areas. The purpose of the CPMs will be to allow the property owner to use their property as they determine appropriate but ensure that any tailings materials or contaminated soils are properly handled, disposed, or capped to ensure that vegetable gardens are not planted in contaminated soil.

Alternative Caps. Other caps may be utilized but they must be comparable in permanence to the six inches of vegetated soil and address the aesthetic concerns of the community. Irrigation may be necessary to establish a vegetative cover that resists erosion. The vegetated covers or other caps will be managed to ensure they continue to provide protection against erosion, fugitive dust, and direct contact exposures.

Water Management.
Water management will be implemented to minimize erosion impacts on any soil caps installed as part of the remedy. Water from the springs in the upper tailings pile will be drained through appropriate techniques such as a french drain or diversion ditches. All water management practices including draining ponds and water diversions will require use of Best Management Practices during construction to minimize sedimentation. Caps, tailings recontouring, and water management systems will be designed to withstand high precipitation events and high water years.

Additional Consolidation as Needed. During remedial design it may be determined that additional consolidation of the waste rock pile, process areas materials, and upper tailings pile is appropriate to ensure stable slopes, minimize encroachment on adjacent properties, or help meet soil cover supply needs.

Triumph Tunnel Water. The selected remedy for the Triumph Tunnel Water is MP-5 (as described in the Feasibility Study), Mine Plug, In-Line Aeration, and Wetlands Treatment, implemented in a phased approach as necessary to meet ARARs. The first step will be the installation of the mine plug in combination with monitoring to predict potential discharges at other portals. Additionally, the plug will be inspected for leakage and stability and a comprehensive reconnaissance will be conducted in the area on a regular basis to locate seeps and discharges caused by the plugging. A reconnaissance of current seeps and discharges will be necessary prior to plugging to establish baseline conditions. Contamination related to discharges will be addressed through collection, treatment, excavation, or other appropriate measures to address the contamination caused by the discharge. The in-line component of MP-5 will be implemented if monitoring indicates the need to treat waters impounded within the mine behind the plug. The trigger for installation of the in-line component will be based on time-pressure curves that show the depth of water as the mine fills, overflow of the mine pool at another surface opening, the development of discharges or seeps, or a combination of these factors. Similarly, the wetlands portion of MP-5 will be implemented if analytical results for samples of in-line aeration indicate non-compliance with ARARs, including water quality standards.

Community drinking water wells will be monitored to determine if the mine plug is having any impact on drinking water quality. Appropriate mitigation measures will be implemented to address site related contamination that is identified through this monitoring. Mitigation may include source control, implementation of Triumph Tunnel water treatment, and provision of alternative water source on a temporary or permanent basis.

Groundwater. The elevated manganese levels in groundwater downstream of the lower tailings pile will be addressed primarily through source control and CPMs to prevent ingestion of the groundwater. Natural attenuation is also expected to provide additional benefit. Groundwater will be monitored to determine the effectiveness of source control and natural attenuation. If manganese levels do not reach the RG after source control, DEQ will determine the appropriate next steps to take to be protective of human health and the environment. Controlling sources as required by the selected remedy would be consistent with any foreseen appropriate next steps. Review of the progress toward reaching the RG will occur at least every five years as part of the five year review. If there is residential development in the wetland area and the groundwater does not meet drinking water standards, an alternative source will be provided.

CPMs for groundwater will be established to prevent ingestion of impacted groundwater that is downstream of the lower tailings piles. The purpose is to protect potential future residents from drinking the water with elevated manganese concentrations during the interim until manganese levels are reduced to below the risk based concentration of 840 μg/l via source control and other COCs are below drinking water standards.

Five Year Reviews. Five year reviews will be required at Triumph because contaminants will remain on-site and may pose potential risk. All caps will be subject to five year review as well as routine operation and maintenance. House dust metal concentrations may also be reviewed to determine the effectiveness of source control in reducing house dust metal loadings. Additionally, groundwater quality in the area including downstream drinking water wells will be subject to review.

Cost.
The capital costs for the selected remedy range between $3.5M to $5.9M depending upon the phases that will need to be implemented to address the Triumph Tunnel Water. The 30 year present value operation and maintenance costs will range between $1.3M and $2.5M again depending upon the phases implemented for Triumph Tunnel Water. Therefore, total cost for the remedy ranges between $4.8M. and $8.3M

Declaration of Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies, to the maximum extent practicable for this Site. However, because treatment of metals contaminated soil and ground water was not found to be practicable and treatment of portal water is utilized only if source control actions do not meet remedial goals, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial actions to ensure that the remedy continues to provide adequate protection of human health and the environment.

Wallace N. Cory
Wallace N. Cory, PE.
Administrator
Idaho Division of Environmental Quality

3/19/98
Date

RECORD OF DECISION
TRIUMPH MINE TAILINGS PILES
SITE

DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 Site Name and Location

The Triumph Mine Tailings Piles Site is located in Blaine County in east-central Idaho in the bottom of a valley within the Pioneer Mountains. Most of the Site is at an elevation of 6,000 feet. The East Fork of the Wood River is located along the southern edge of the valley within the Site. The East Fork of the Wood River drains into the Big wood River approximately 5 miles downstream of the Triumph Site (Figure 1).

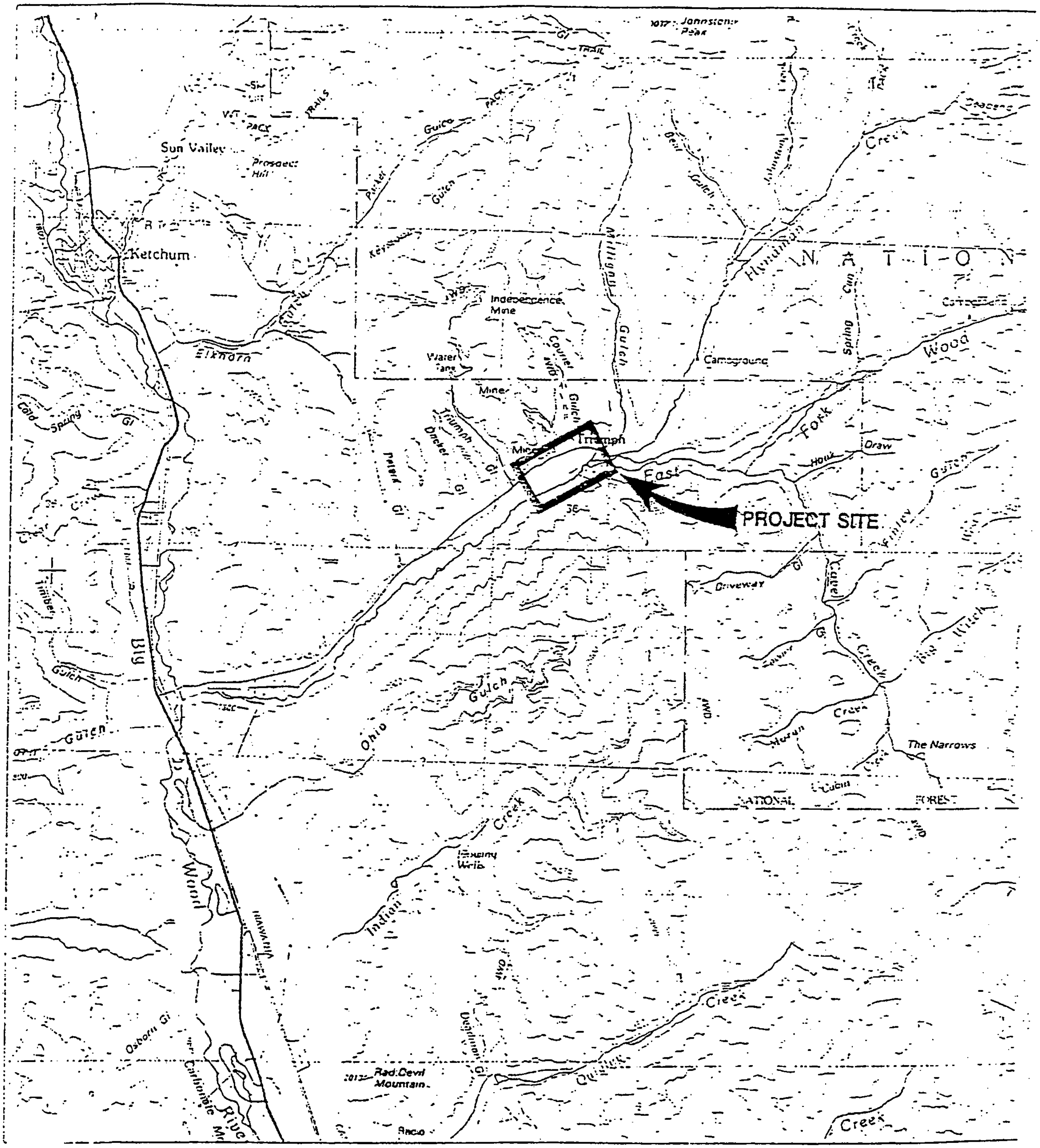
1.2 General Site Description

The Triumph Site consists primarily of two mill tailings piles associated with former lead, zinc, and silver mining and milling areas. Also included are a Mine portal and former processing area lands adjacent to the tailings piles (Figure 2). There are about 20 residences located in adjacent to these areas which make up the unincorporated town of Triumph.

The two tailings piles are located on the valley floor immediately north of the East Fork of the Wood River. These tailings piles are broad, flat features that are dark in color, sparsely vegetated, and rise 10 feet or more above the valley floor. The upper tailings pile occupies approximately 6 acres and the lower tailings pile occupies about 22 acres. Using an estimated tailings depth of 15 feet, the approximate total volume of both piles is 680,000 cubic yards. The lower tailings pile contains two permanent ponds. Although, the southern pond has been called the “Ephemeral Pond” it is actually permanent. The Triumph Mine portal is situated on the south-facing hillside above the tailings piles, and a waste rock pile extends below the portal to the base of the valley floor.

Approximately 65 people reside in the town of Triumph. Houses are located along the northwestern boundary of the upper tailings pile and along the eastern boundary of the lower tailings pile.

The Triumph Mine produced ore containing lead, zinc, and silver from 1882 to 1957. The mining operations used a flotation process that concentrated lead and zinc from residual waste material (tailings). Tailings were pumped as a slurry into two piles (upper and lower tailings piles). The upper tailings were deposited from 1882 to 1930, and the lower tailings from 1930 to 1957.



SCALE 1:100,000

0 1 2 3 4 5

APPROXIMATE SCALE IN KILOMETERS
CONTOUR INTERVAL 40 METERS

REFERENCES: USGS TOPOGRAPHIC 30 X 60 MINUTE
METRIC QUADRANGLE: SUN VALLEY, IDAHO 1992

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Kennedy/Jenks Consultants

TRIUMPH MINE TAILINGS PILES SITE
TRIUMPH, ID

SITE LOCATION

946091.01/P6SK001

Areas impacted by metal contamination are the tailings piles, process area, residential properties, and wetlands adjacent to the tailings piles. The Mine is also discharging slightly acidic water from the portal at a rate of 90 to 190 gpm.

1.3 Ecology

Habitats within the valley include coniferous forest on the steep mountains to the southeast and scrub-shrub grasslands on the slopes of the mountains to the northwest of the valley. The valley includes a riparian zone along the fluvial plain of the East Fork of the Wood River, with several types of wetlands present. These wetlands provide different habitats for a potentially wide range of mammals, birds, reptiles, amphibians, fish, invertebrates, and plants.

1.4 Geology

The local physiography consists of an east west-trending alpine valley bounded on the north and south by bedrock upland mountains. Rocks exposed in the vicinity of the Site include the Wood River Formation (south side of the valley) and the Milligen Formation (north side of the valley). The two formations are bounded by a thrust fault contact.

The Wood River Formation has an upper member consisting of calcareous and siliceous sandstones with interbeds of conglomerate and limestone. The lower member consisted of thinly bedded limestone overlying heavily bedded blue sandy limestone with a massive conglomerate in the basal portion.

The Milligen Formation consists of a gray and black carbonaceous argillite with interbeds of limestone and quartzite. The Milligen Formation is the host for the ore deposits of the Triumph-Parker Mine Mineral Belt. The three main ore-bearing minerals are argentiferous galena, sphalerite, and argentiferous tetrahedrite. Host rock consists mainly of argillite, locally carbonaceous, with interbeds of limestone, siltite, and minor quartzite.

The unconsolidated sediments consist of alluvial deposits varying in grain size from clay to cobbles. The south side of the valley is currently undergoing erosion and deposition caused by the East Fork of the Wood River.

1.5 Groundwater Hydrology

Groundwater at the Site generally occurs under unconfined conditions within the alluvial valley fill. The flow of the groundwater within this alluvial valley fill generally parallels the flow of surface water.

The upper aquifer at the Site is a perched groundwater zone known as the saturated zone. The saturated zone is limited to the lower tailings pile, and possible occurs discontinuously in the upper tailings pile. The groundwater is perched on a clay layer that underlies a large portion of both tailings piles. This saturated zone is recharged by surface water from the ponds on the lower pile and the spring on the upper pile. The northern pond in the lower tailings pile is likely made up of both surface water and ground water. The southern pond is believed to be entirely made up of surface water run on. Downward seepage of the water within the tailings saturated zone into the gravel aquifer likely occurs to a greater degree at the base of the western and southern portions of the lower tailings pile where the clay layer is absent.

The lower aquifer in which the community water supply wells are screened is called the gravel aquifer. The groundwater in the gravel aquifer occurs under confined conditions wherever the clay layer is present. (Figure 3).

1.6 Surface Water Hydrology

The main surface water body in the vicinity of the Site is the East Fork of the Wood River, which runs along the south side of the valley floor. Surface water is also present in the wetlands in the valley adjacent to the tailings piles and the river, particularly in the area upstream of the upper tailings pile. A spring emerges along the northern boundary of the upper tailings pile. Water from the spring flows through a drainage channel in the upper tailings pile, where it enters the wetlands as a channel that flows into the East Fork of the Wood River.

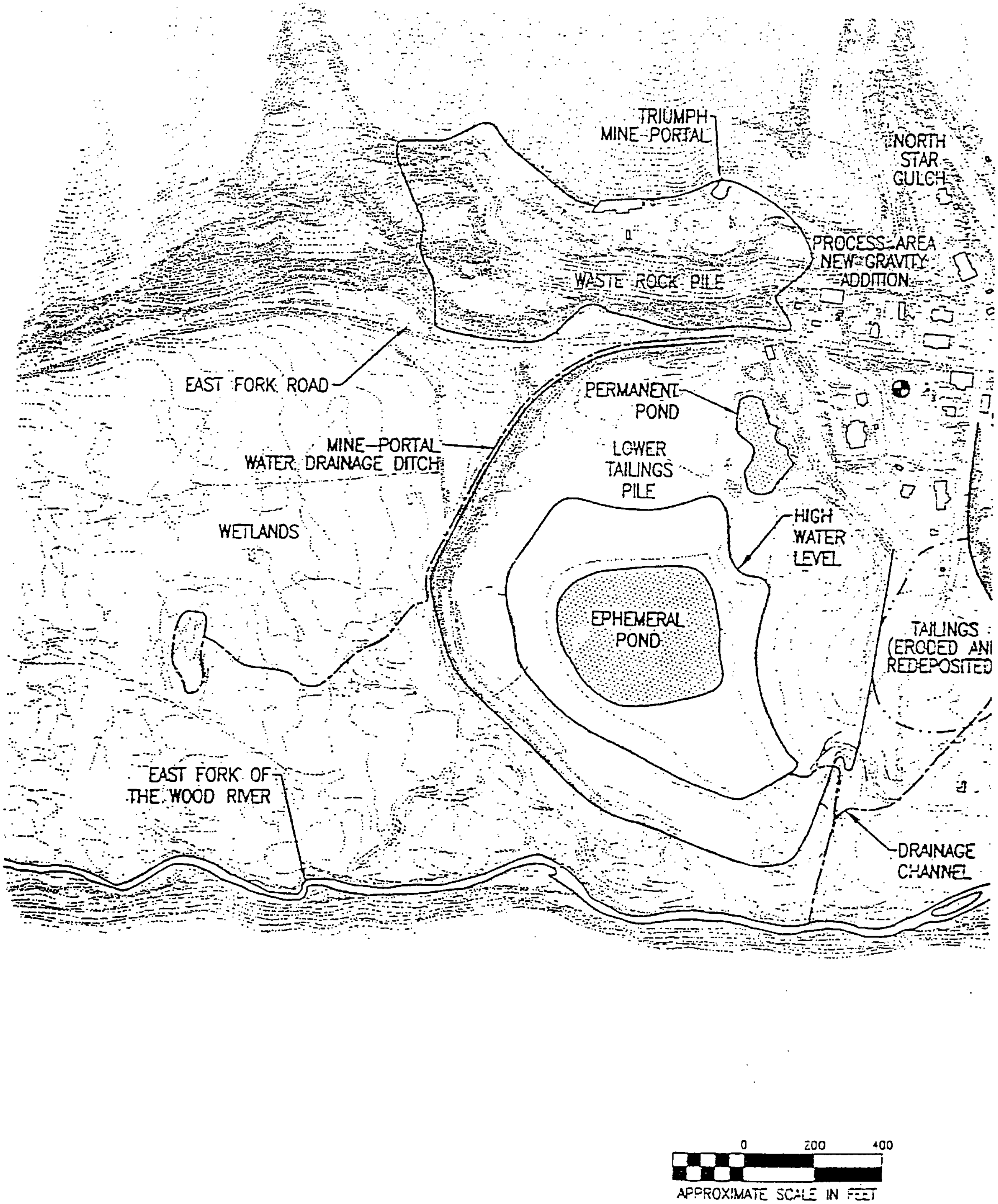
The Triumph Tunnel water also forms a surface water feature at the Site. Water emerges from the Mine portal where it enters holding ponds before being piped downhill through plastic drainage pipes. At times this water is not contained in the pipes and runs down the road or seeps into the waste rock pile. Water is discharged from the drainage pipes into a ditch then enters a culvert and crosses the East Fork road, where it enters an unlined ditch. The water flows in a southerly direction along the western edge of the lower tailings pile, where the ditch is less well defined. Ultimately the water disperses in the wetlands and toward a small pond west of the tailings pile.

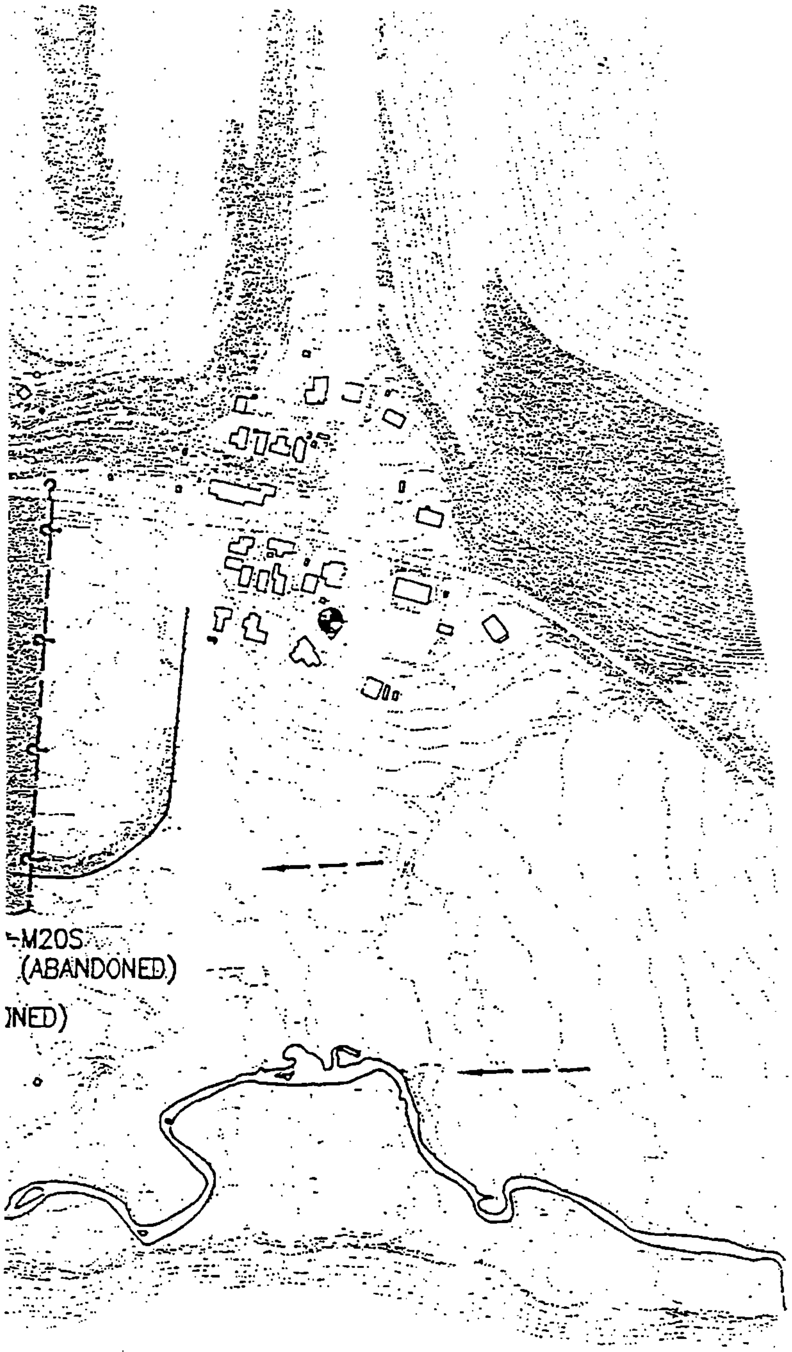
2.0 Site HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

The Triumph Mine produced ore containing lead, zinc, and silver from 1882 to 1957. During processing, the ore was crushed and ground. The ground material resulted from a gravity process in the original mill and a floatation process in the new mill. Both mills produced concentrates containing high concentrations of lead, zinc, and silver and a residual waste material (tailings). Tailings were conveyed as a slurry into two piles (the upper tailings pile and lower tailings pile).

Wooden flumes conveyed the tailings to the tailings piles. The flumes terminated near the outer edges of the tailings piles. Coarser particles generally were deposited near the flume outlet (close to the perimeter of the piles), and finer particles were transported further from the outlet (toward the interior of the tailings piles).


TRIUMPH MINE PORTAL
NORTH STAR GULCH
PROCESS AREA
NEW GRAVITY ADDITION
WASTE ROCK PILE
EAST FORK ROAD
PERMANENT POND
MINE-PORTAL WATER DRAINAGE DITCH
LOWER TAILINGS PILE
HIGH WATER LEVEL
WETLANDS
EPHEMERAL POND
TAILINGS (ERODED AN REDEPOSITED
EAST FORK OF THE WOOD RIVER
DRAINAGE CHANNEL
0
200
400
APPROXIMATE SCALE IN FEET



LEGEND

- COMMUNITY WATER SUPPLY WELL
- TEMPORARY SAMPLING INSTALLATIONS BY EG&G, SUBSEQUENTLY ABANDONED
- NEWLY INSTALLED GROUNDWATER MONITORING WELLS
- NEWLY INSTALLED GROUNDWATER PIEZOMETER
- ESTIMATED EXTENT OF CLAY PERCHING LAYER
- ASSUMED FLOW DIRECTION OF DRINKING WATER AQUIFER

NOTES:

1) ALL LOCATIONS ARE APPROXIMATE.

2) CONTOUR INTERVAL IS 2 FEET. (NOT ALL CONTOURS ARE SHOWN ON STEEP HILLSIDES)

MW-1B

BASE MAP REFERENCE:

TOPOGRAPHIC BASE MAP PRODUCED BY INLAND AERIAL MAPPING OF BOISE, IDAHO FOR ECOLOGY AND ENVIRONMENT, 1993.

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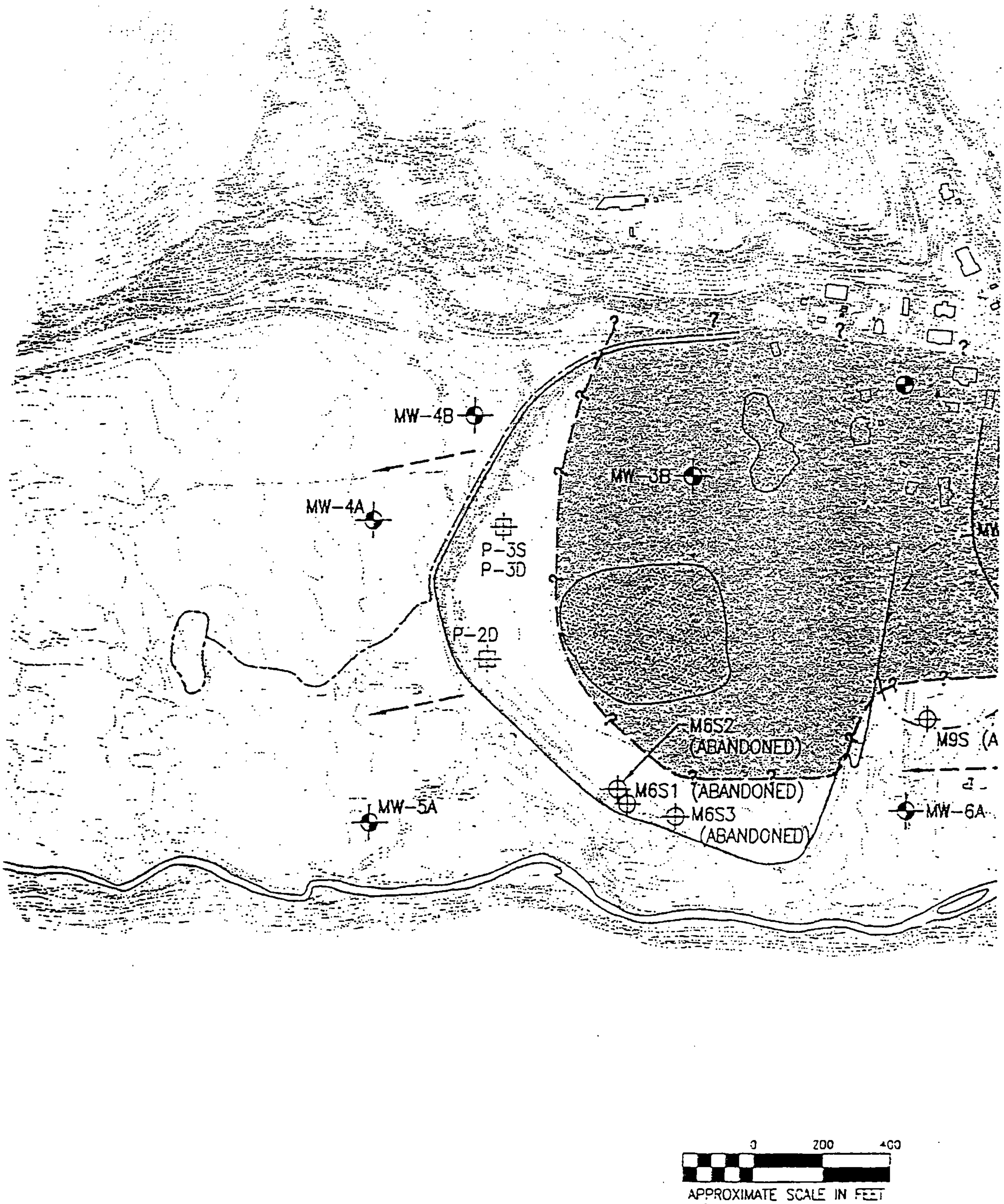
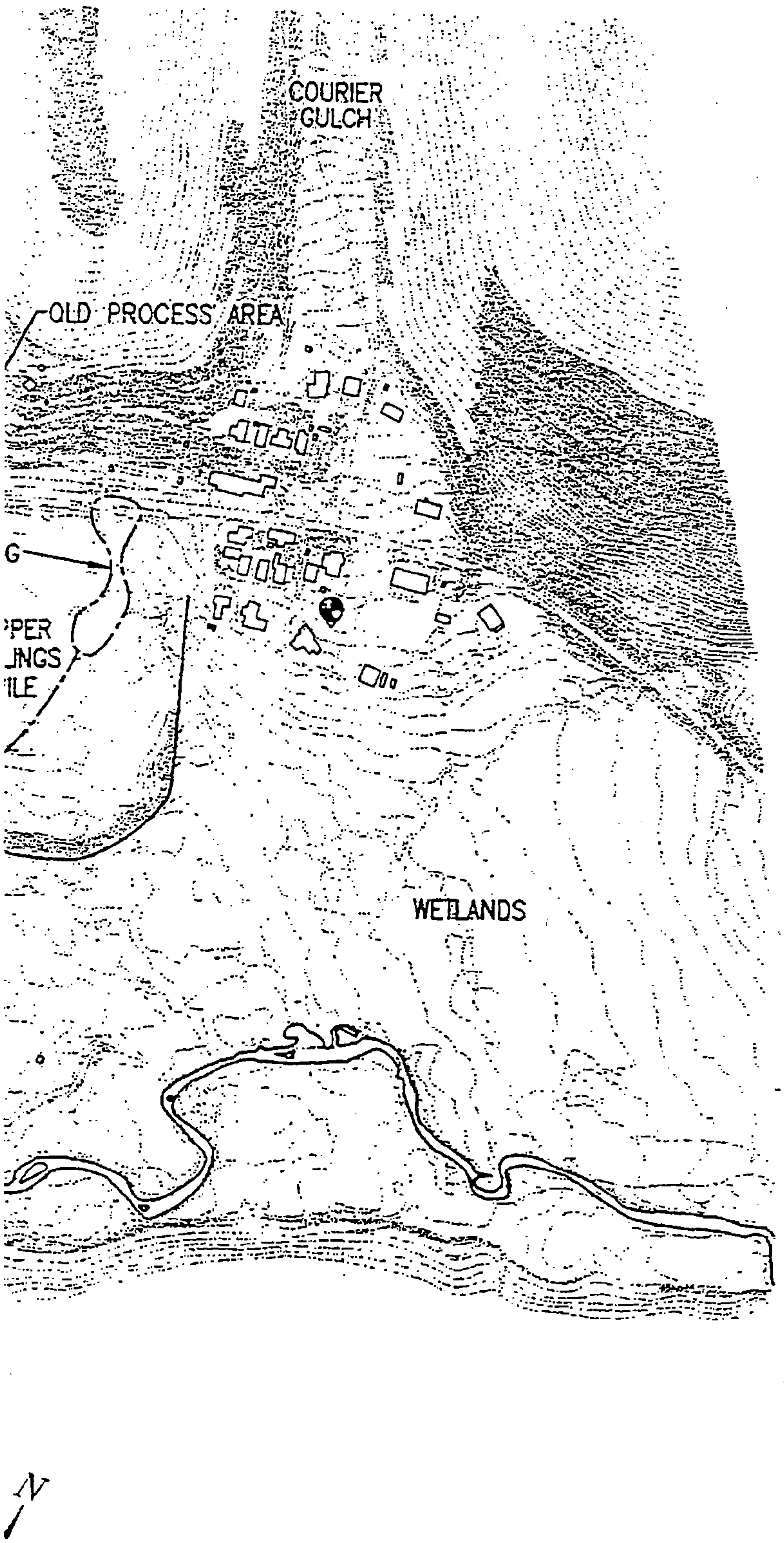
TRIUMPH MINE TAILINGS PILES SITE
TRIUMPH, ID

ESTIMATED EXTENT OF CLAY PERCHING LAYER

946091.01/P6SK022



MW-4B
MW-4A
MW-3B
P-3S
P-3D
P-2D
M6S2
(ABANDONED)
M6S1
(ABANDONED)
M6S3
(ABANDONED)
MW-5A
M9S
MW-6A
0
200
400
APPROXIMATE SCALE IN FEET



LEGEND

COMMUNITY WATER SUPPLY WELL

BASE MAP REFERENCE:

TOPOGRAPHIC BASE MAP PRODUCED BY INLAND AERIAL MAPPING OF BOISE, IDAHO FOR ECOLOGY AND ENVIRONMENT, 1993.

Kennedy/Jenks Consultants

TRIUMPH MINE TAILINGS PILES SITE
TRIUMPH, ID

SITE PLAN

946091.01/P6SK002

The upper tailings, primarily gravity processed, were deposited between 1882 and 1947, and the lower tailings, primarily flotation processed, were deposited from 1951 to 1957. The upper tailings pile consists of waste material generated at the original mill, the North Star Mill (old process area), before it was destroyed by fire. The new flotation mill near the Triumph portal replaced the original mill. The lower tailings pile consists of the waste material generated by the new flotation mill. Because of milling improvements, particle sizes in the lower tailings pile are generally finer (fine sand to clay) than those in the upper tailings (coarse sand to clay) pile.

2.2 Regulatory History

In 1988, DEQ performed a Preliminary Assessment of the Site. DEQ found elevated concentrations above background of arsenic, manganese, and zinc in surface water in the Triumph Tunnel drainage ditches near the lower tailings pile and the East Fork of the Big Wood River. EPA completed a Site Inspection in September of 1991. EPA continued with additional site assessment work in 1992 and 1993. In May of 1993, EPA proposed to add the Site to the federal National Priorities List (NPL). General Notice letters were sent out in June of 1993 to Triumph Minerals, Asarco, and the Idaho Department of Lands (IDL). Snyder Mines, Inc. and the Bureau of Land Management were also notified of potential liability.

Significant community opposition to the potential listing of Triumph on the NPL resulted in a Memorandum of Agreement (MOA) between EPA and DEQ. This 1994 agreement defers remediation responsibility from EPA to DEQ regulatory authorities. The agreement states that DEQ response activities will be conducted consistent with CERCLA as amended, the NCP, and Idaho state laws and regulations. DEQ entered into a Consent Order with Asarco and IDL in January, 1994 to perform a Remedial Investigation/Feasibility Study for the Site. The Remedial Investigation was completed in January, 1997. DEQ completed the Baseline Ecological Risk Assessment in May, 1997 and the Baseline Human Health Risk Assessment in August, 1997. The MOA calls for a second Consent Order that would require implementation of the remedial action. Upon execution of the second Consent Order, EPA will proceed with withdrawal of the proposal to list the Site on the NPL.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

DEQ and the community developed a Community Relations Plan (CRP) for the Site in April of 1995. The CRP identified representatives from the community who would serve as primary contacts for the project. These people were identified as liaisons. The plan called for reimbursing the community liaisons’ costs for attending and participating in meetings where their presence is requested by DEQ. The CRP also provide for a listing of the documents that the liaisons would review and the time frame for their review. Included in the list of documents were drafts of the following documents:

Sampling and Analysis Plan
Site Health and Safety Plan

Baseline Risk Assessment Plans
Baseline Ecological Risk Assessment Report
Baseline Human Health Risk Assessment Report
Remedial Investigation
Feasibility Study

Copies of these documents were provided to the liaisons. Additionally, a Site repository was established at the Hailey Public Library.

About 20 public meeting have been held since the MOA between DEQ and EPA was signed. Included in these meetings is the November 6, 1997 where the Proposed Plan was explained and released to the public for comment. The formal public hearing on the plan was held November 18, 1997. The public comment period for the Proposed Plan and the RI/FS went from November 6 to December 8, 1997.

DEQ has kept EPA involved throughout the process. EPA participation increased during the RI/FS review and proposed plan stages.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

The remedy selected by DEQ and documented in this ROD includes all of the remedial actions deemed necessary for the Site to protect human health and the environment. It was assumed by DEQ and the PRPs that the tailings piles, Triumph Tunnel water and ditch, and the process area all presented unacceptable risk and would be addressed through appropriate remedial action. Therefore, these sources were not evaluated in the baseline risk assessments. The remaining sources were evaluated in the risk assessments. Addressing the assumed unacceptable risks (from the tailings piles, Triumph Tunnel water and ditch, and the process area) and those found to be unacceptable via the risk assessments has resulted in a comprehensive remedial strategy for the Site.

5.0 SUMMARY OF SITE CHARACTERISTICS

A Remedial Investigation was performed to determine the nature and extent of contamination at the Site and provide sufficient data for the risk assessment. The Remedial Investigation sampling plan was developed based on filling data gaps and utilizing results from previous studies. Samples were collected from impacted soils, tailings, ground water, and surface water. The Remedial Investigation field work was performed between May 1995 and October 1996. Two additional ground water wells were constructed in a nested pattern in June of 1997. The primary sources of contamination are the tailings piles, mine process area, the portal water, and to a lesser degree the waste rock pile. Site characteristics and the nature and extent of contamination are summarized below.

5.1 Chemicals of Concern

Samples of environmental media were collected and analyzed during several investigations from 1990 through 1995. Chemicals of concern (COCs) for the Site are antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc. Indicator chemicals (chemicals whose presence indicates that there is likely other Mine related contamination in a media) for the residential soil investigation are arsenic and lead. In the discussion below, the term “elevated concentrations” means concentrations greater than or equal to three times concentrations in background soil or groundwater samples.

5.2 Impacted Media

5.2.1 Tailings Piles

Elevated concentrations of several COCs were detected in the tailings material samples collected from the upper and lower piles (Table 1). Arsenic levels ranged from 40 to 18,900 mg/kg. Lead levels ranged from 2,561 to 17,060. The pH of the tailings was about 7. The acid-neutralization potential was greater than the acid-generation potential in eight of nine tailings samples. The source of the acid-neutralization potential is the limestone interbeds in the host rock. Tailings leach tests showed some leaching of arsenic, antimony, cadmium, lead, manganese, and zinc. Elevated concentrations of COCs were detected in samples of the clay layer that underlies about 70 percent of the tailings piles. This indicates the clay layer is sorbing COCs as they are transported through the unsaturated zone.

5.2.2 Triumph Tunnel Water, Drainage Ditch Water, and Ditch Sediments

Elevated concentrations of several COCs were detected in samples collected from the Triumph Mine portal water, which had a measured discharge rate varying from approximately 90 to 190 gallons per minute. The Mine water once out of the portal has a distinct reddish-orange color. Arsenic levels ranged from 2,610 to 5,200 ppb (Table 2). Manganese levels ranged from 4,300 to 10,300 ppb. Zinc concentrations ranged from 2,800 to 10,900 ppb.

Elevated concentrations were also identified in the Triumph Tunnel water ditch sediment samples. Concentrations of manganese were typically 20,000 to 40,000 mg/kg with a maximum concentration of 221,000. Concentrations of metals in the sediments decreased as distance from the portal increased. Concentrations of COCs in water samples collected from the drainage ditch generally decreased with distance downstream of the portal. As water emerges from the Mine portal and flows through the drainage ditch into the wetlands, COCs precipitate out and deposit along the ditch. This was evidenced by the decrease in As concentrations in the water at the portal from a range of 2,610 to 5,200 ppb to a range of 2 to 9 ppb. Manganese concentrations, however, remained relatively unchanged.

Table 1. Sample Results from the Remedial Investigation, 'Tailings Piles, Waste Rock, Process Area Soils, Residential Soils, Wetland Soils, and Ditch and River Sediments, mg/kg

	Tailings Piles		Waste Rock		Process Area Soils		Residential Soils		Wetland Soils		Ditch Sediments		River Sediments	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Antimony	39	420	<12	79	12	3,110	12	335	12	506	<12	242	<4.6	<20.9
Arsenic	40.3	18,900	2,154	5,287	26	22,860	9	1,085	26	1,500	16	38,560	<9.2	184
Cadmium	36	101	28	98	1.5	259	7.1	55	2	892	3.5	250	<0.4	<4.4
Copper	154	517	131	251	32	4,554	46	476	5.3	1,147	19	449	7.2	20.3
Lead	2,561	17,060	1,940	7,378	59	52,410	49	22,790	20	28,740	24	20,480	5	177
Manganese	939	33,370	1,418	7,693	9.8	4,792	483	27,840	168	105,700	884	221,000	NA	NA
Mercury	0.44	1.26	<0.1	0.39	0.07	11.6	0.1	0.28	<0.1	2.7	<0.1	0.64	<0.04	0.08
Nickel	37	78	66	144	<10	108	37	174	<10	674	10	638	11.1	25.4
Selenium	8	9.9	7	19	<1.0	30	1.3	40	<1.0	15	<1.0	8.7	<13.9	<19.3
Silver	18	82	15	50	<2.0	115	2.2	153	<2.0	76	<2.0	102	<0.22	2.2
Vanadium	44	119	110	265	28	414	69	223	24	209	16	108	NA	NA
Zinc	3,971	16,340	4,131	13,210	264	23,520	778	22,060	122	74,640	150	41,470	36.1	461

Table 2. Sample Results from the Remedial Investigation, Triumph Tunnel Water, Drainage Ditch, Waste Rock Seeps, and Tailings Ponds, µg/kg

	Triumph Tunnel Water		Waste Rock Seeps		Drainage Ditch*		Tailings Ponds		Drinking Water Standards	AWQC	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	MCLs, SMCLs, MCLGs, or ALs**	Chronic	Acute
Antimony	<60	<60	5.8	11	<30	<30	<30	<30	6	NA	NA
Arsenic	2,610	5,200	23	1,034	2	9	9	65	50	190	360
Cadmium	<2.0	6	<2.0	6.5	<.5	27	<2.0	10	5	1	3.7
Copper	<4.0	6	<4.0	5.9	<4	6	5	5	1,000	11	17
Lead	<1.0	2	<1.0	<1.0	<1	5.1	1.0	5	15	2.5	65
Manganese	4,300	10,300	<3.0	5,674	440	26,000	150	4,300	50	NA	NA
Mercury	<2.0	<2.0	<2.0	<2.0	<2.0	0.25	<0.2	<0.2	2	0.012	2.1
Nickel	26	72	37	44	<10	120	<10	19	100	160	1400
Selenium	<1.0	<3.0	<1.0	36	<1.0	<3.0	<3.0	3	50	5	20
Silver	<4.0	23	<4.0	<4.0	<0.5	5	<4.0	<4.0	100	NA	3.4
Vanadium	17	48	<5.0	<5.0	21	23	13	15	NA	NA	NA
Zinc	2,800	10,900	1,222	4,385	320	13,000	<10	170	5,000	100	110

*Includes data from other studies than just the Remedial Investigation

**Maximum Contaminant Level, Secondary Maximum Contaminant Level, Maximum Contaminant Level Goal, Action Levels

5.2.3 Waste Rock

Elevated concentrations of COCs were detected in samples collected from the waste rock pile (Table 1). Concentrations were lower than those found in the tailings piles. For example, the maximum arsenic concentration in the waste rock was 5,287 mg/kg compared to 18,900 in tailings. This pile is estimated to have a maximum volume of 615,000 cubic yards. Leach tests showed some leaching of most COCs. Water from small seeps at the base of the waste rock pile showed concentrations of arsenic, cadmium, selenium and zinc above ambient water quality criteria. Maximum manganese concentrations in the seeps were found to 12 µg/L compared to over 5,000 µg/L in the mine portal water. The source of these seeps is Mine portal water, hillside seeps, or a combination of both.

5.2.4 Process Area

Elevated concentrations of COCs were detected in tailings material collected from within the process areas and in soils samples collected from outside the process area (Table 1). In general, concentrations of COCs tend to decrease with distance from the process areas and with depth. Highest metal concentrations were comparable to those found in the tailings piles.

5.2.5 Residential Soil

Elevated concentrations of arsenic, lead and other COCs were detected in samples collected from residential yards at the Site (Table 1). In most yards concentrations were less than those found in the tailings. Yards with concentrations comparable to those found in the tailings are located directly on the tailings. Generally, COCs were detected at elevated concentrations when arsenic and lead were detected at elevated concentrations. Both COC concentrations and the depths to which elevated COC concentrations were detected tended to decrease with distance from the tailings piles and process areas. The lowest concentrations of COCs were detected in samples collected from the residences located at the eastern portion of the Site.

5.2.6 Groundwater

Elevated concentrations of lead in the west community drinking water well was a significant concern in the early studies. However, these elevated concentrations were qualified because results were not reproducible over time or in duplicate samples. In April 1992 seven samples were taken with the goal of establishing a statistically based confidence interval for lead concentration in the water. The result was 3.0 ppb lead which is less that the 15 ppb Action Level for drinking water (Table 3). Additional samples were taken at the tap of residences and at some of the private wells by the local health department in 1996. These results showed that water quality met drinking water standards.

Elevated concentrations of COCs were detected in samples from the tailings saturated zone during past investigations. Low concentrations of some dissolved COCs were detected in groundwater samples from the gravel aquifer beneath and down gradient

Table 3. Sample Results from the Remedial Investigation, Ground Water Monitoring Wells, Community Drinking Water Wells, East Fork River Water, Wetlands Surface Water, µg/kg

	Groundwater Monitoring Wells		Community Drinking Water Wells	East Fork River Water		Wetlands Surface Water	Drinking Water Standards	AWQC	
	Minimum	Maximum	Maximum	Minimum	Maximum	Result	MCLs, SMCLs, MCLGs, or ALs*	Chronic	Acute
Antimony	<5.0	7	25	<30	<30	<30	6	NA	NA
Arsenic	<2.0	19	1.1	<2.0	25	60	50	190	360
Cadmium	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	5	1	3.7
Copper	<4.0	68	447	<0.2	12	<4.0	1,000	11	17
Lead	<1.0	7.3	3	<0.35	2	<1.0	15	2.5	65
Manganese	<3.0	4,663	15	3.6	98	19	50	NA	NA
Mercury	<2.0	<2.0	0.1	<0.2	<0.2	<0.2	2	0.012	2.1
Nickel	<10	67	10	<12	<12	<10	100	160	1,400
Selenium	<1.0	5.6	5	<1.0	5	3	50	5	20
Silver	<4.0	<4.0	3.5	<4.0	<4.0	<4.0	100	NA	3.4
Vanadium	<5.0	17	6.5	<5	12	11	NA	NA	NA
Zinc	<2.0	191	1,480	<3.0	38	18	5,000	100	110

* Maximum Contaminant Level, Secondary Maximum Contaminant Level, Maximum Contaminant Level Goal, Action Levels

from the tailings piles. In general, groundwater quality shows little impacts by COCs except manganese. The clay layer and organic matter beneath the tailings piles, in the wetlands, and in the Triumph Tunnel water drainage ditch appear to be providing reservoirs for sorption of COCs that are being transported from source areas at the Site. Manganese levels in certain wells down-gradient from the tailings are well above background concentrations. The primary source for the manganese in the groundwater appears to be the Mine portal water and surface water drainage from the tailings piles, although leaching from the tailings could also contribute.

5.2.7 River Water, Seeps, and River Sediments

Dissolved manganese was detected in the river water samples collected from the East Fork of the Wood River downstream from the tailings piles (Table 3). Dissolved manganese concentrations were slightly above background concentrations. River water quality met Ambient Water Quality Criteria (AWQC) in almost all cases. A background sample upstream of the site exceeded the chronic AWQC for copper in the August/September 1995 sampling event with a concentration of 12 ppb. The chronic AWQC is 11 ppb copper. Low concentrations of dissolved COCs were detected in water samples collected from seeps entering the East Fork of the Wood River. Dissolved arsenic, manganese, vanadium, and zinc concentrations detected in these water samples were greater than background concentrations. No river water or seep sample concentrations exceeded acute AWQC. Results from the Beneficial Use Reconnaissance Project indicated that benthic and fish communities were not impaired at the Site.

COCs were detected in a few sediment samples collected from the East Fork of the Wood River both upstream and downstream from the tailings piles during a previous investigation. One sample collected down gradient from the tailings piles exceeded preliminary conservative ecological screening levels for arsenic, lead, silver, and zinc. Fewer exceedances of the conservative screening levels were observed at the next down gradient sampling location (500 feet). Samples collected 1,000 feet and greater down gradient of the tailings piles did not exceed these screening criteria.

5.2.8 Other Mine Adits

Water was observed discharging from one collapsed adit at the Independence Mine which is connected with the Triumph Mine workings. This adit is located in a side drainage to the East Fork of the Wood River at a higher elevation than the Triumph Tunnel. Elevated concentrations of dissolved cadmium and zinc were detected in the water samples from this adit. The discharge rate for this minor flow was about one gallon per minute. As water discharges from this adit, it enters a small excavated pond where it evaporates or infiltrates. Water from this adit was not observed to be discharging to the wetlands or to other natural surface water features. Waste rock from other adits in the area is derived from the same geologic material as that found at the Triumph adit. Results from the Triumph waste rock can be considered to be representative of the metal content of the waste rock at these other adits.

5.2.9 Wetland Soils

Elevated concentrations of COCs have been detected in soil samples collected from wetland areas surrounding the tailings piles, primarily to the south and west of the piles (Table 1). In general, sample concentrations tended to decrease with distance away from the tailings piles and depth. There are visually identifiable tailings deposition areas in the wetlands. These appear to be water deposited tailings with some contribution from wind blown materials. Highest concentrations of COCs were associated with these deposits.

5.2.10 Particulate Air Sampling

Elevated concentrations of COCs were detected from air particulate samples taken downwind from the tailings piles. Maximum concentrations were associated with the lower tailings pile.

5.2.11 House Dust

Previous studies found that house dust showed elevated COC (primarily arsenic and lead) concentrations in house dust. Concentrations were typically below those found in residential soils.

5.3 Contaminant Migration

Contaminants resulting from mine operations at the Site have largely been confined to the immediate area of the mine operations. This includes the tailings piles, process area, waste rock pile, mine adit, and adjacent soils and wetlands. Groundwater has been impacted down gradient of the tailings piles. Surface water as ponds or seeps associated with the mine portal water, tailings and waste rock pile have also been impacted. The East Fork of the Big Wood River has been largely unaffected as have the drinking water wells currently used by the Triumph community.

The tailings piles are a source of contaminant migration via airborne transport, surface water through overland flow, channels, and seeps, and leaching into the groundwater. Contaminants carried by surface water and fugitive dust are the primary sources of contamination to the adjacent soils and wetlands. Overland flow, channels, and seeps carry water from the tailings piles to the wetlands toward the river. However, the river shows no significant impact from this contaminant transport route. It appears that the wetlands serve as an effective buffer between the tailings and the river.

Data show that the metals in the tailings are not leaching to a large extent. This has been attributed to the clay layer underlying much of the tailings piles and the presence of carbonates in the geology that inhibits acidification which increases metal solubility. The only metal that is above risk levels for down gradient groundwater is manganese. The location of the wells with the highest manganese levels suggests that the most significant manganese source is the Triumph Tunnel water and not the tailings piles.

The waste rock pile and process areas are a source of contaminant migration via fugitive dust and surface water runoff. The waste rock piles also produce seeps of contaminated water. Contaminants that exceed AWQC are zinc, cadmium, and selenium. The Triumph Tunnel water is ponded near the adit prior to being conveyed down to the valley floor. This ponded water could be the source of the waste rock pile seeps. Once at the valley floor the Triumph Tunnel water is conveyed to the wetlands. The location of the ditch that carries the Triumph Tunnel water through the wetlands correlates with the locations of the wells with concentrations of manganese above risk levels. The conveyance system used for the Triumph Tunnel water has not been maintained and there are times when the water runs down to the valley floor in an uncontrolled manner.

6.0 SUMMARY OF SITE RISKS

6.1 Human Health Risk Assessment

6.1.1 Contaminants of Concern

The Baseline Human Health Risk Assessment for the Triumph Mine Tailings Site identified arsenic as the primary COC in soils. Other contaminants that were determined to be above acceptable risk levels in soils are lead, antimony, cadmium, and manganese. The chemicals of concern (COCs) for the Site that were evaluated in the risk assessment are antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc. Some sources were not evaluated in the Risk Assessment because of an agreement between DEQ and the PRPs that it would be assumed that the Triumph Tunnel water and ditch sediments, the tailings piles, and process area would present unacceptable risk and require remediation. This strategy to streamline the risk assessment is termed the "assumed remedy" approach.

6.1.2 Toxicity Assessment

The toxicity assessment evaluates each chemical's potential to cause health effects based on available toxicological information. Toxicity information was obtained from U.S. EPA toxicity databases, including Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST).

Each chemical was quantitatively evaluated on the basis of its non-carcinogenic and/or carcinogenic potential. For each detected chemical, a brief toxicological profile, which discusses the chemical's non-carcinogenic and carcinogenic effects based upon human and/or laboratory animal exposure, can be found in Appendix C of the Baseline Human Health Risk Assessment for the Triumph Site.

Table 4 presents the toxicity values used for evaluating exposure to chemicals with noncarcinogenic effects, defined as the oral reference dose (RfD) and the inhalation reference concentration (RfC), and the critical effects of that chemical. Some chemicals have more than one critical effect. The RfD is an estimate (with uncertainty

Table 4. Reference Doses, Slope Factors, and Uncertainty Factors

Chemical	Oral Chronic RfD (mg/kg-day)	Oral Slope Factor $(mg/kg\ day)^{-1}$	Inhalation RfC (mg/m^3)	Unit Risk Factor $(ug/m^3)^{-1}$	Uncertainty Factor	Cancer Weight of Evidence[a]	Critical Effect	Source
Antimony	0.0004				1000		Decreased lifespan, altered blood chemistry	IRIS 1995
Arsenic	0.0003	1.5		0.0043	3	A	Hyperpigmentation, keratosis	IRIS 1995
Barium	0.07		0.0004		3		Hypertension	IRIS 1995
Beryllium	0.005	4.3		0.0024	100	B2	Body weight changes	IRIS 1995
Cadmium(food)	0.001				10		Renal necrosis, proteinuria	IRIS 1995
Cadmium(water)	0.0005				10		Renal necrosis, proteinuria	IRIS 1995
Cadmium				0.0018		B1	Renal necrosis, proteinuria	IRIS 1995
Chromium (VI)	0.005			0.012	100	A	Renal tubular necrosis	IRIS 1995
Copper	0.037						Gastrointenstinal disturbance	IRIS 1995
Manganese(water)	0.005				1		CNS effects	HEAST 1995
Manganese(soil)	0.14						CNS effects	HEAST 1995
Mercury	0.0003		0.0003		1000		CNS effects	IRIS 1995
Nickel	0.02			0.00024	300	A	Decreased body weight; dermatitis	IRIS 1995
Selenium	0.005				3		Selenosis	IRIS 1995
Silver	0.005				3		Argyria	IRIS 1995
Thallium	0.00008				300		Hepatic pathology	IRIS 1995
Vanadium	0.007				100		Anemia; respiratory	IRIS 1995
Zinc	0.3				3		Decrease in erythrocyte superoxide dismutase	IRIS 1995

[a] Cancer weight of evidence codes:
A = human carcinogen
B1 = probable human carcinogen (limited human evidence)
B2 = probable human carcinogen (sufficient evidence in animals, no human evidence)

spanning perhaps an order of magnitude or greater) of the daily exposure to the human population, including sensitive sub-populations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Table 4 also displays the assigned uncertainty associated with the experimental procedure supporting the RfD. The RfC differs from the RfD in that it is expressed as a concentration in air (mg/m^3) instead of a dose.

For trace elements with carcinogenic effects, Table 4 also includes the carcinogenic oral slope factor (SF) and inhalation unit risk factor (URF) and its associated potential for carcinogenicity in humans, as expressed by the U.S. EPA weight-of-evidence classification. The SF represents a plausible upper-bound estimate of the probability of response per unit intake of a chemical over a lifetime. The SF is based on a dose-response curve using available carcinogenic data for a given chemical. Mathematical models are used to extrapolate from high experimental doses to the low doses expected for human contact in the environment. These models assume that there is no concentration below which the probability of a carcinogenic response is zero. This mechanism for carcinogenesis is referred to as “nonthreshold”. The URF is the risk per concentration unit ($\mu g/m^3$) in air.

6.1.3 Risk Characterization for Sources and Pathways

The conceptual Site model for human exposure is shown in (Figure 4.). This model identifies the sources, release mechanisms, exposure routes, and receptors that make up the exposure pathways that were considered at the Site. The future land uses at the site are expected to be the same as the current residential and recreational uses.

The exposure routes and scenarios associated with the unacceptable risks are identified in the Remedial Action Objectives (RAOs). It was assumed in the risk assessment that risks generated from all exposure pathways associated with the mine drainage, tailings piles, mine process area, and the mine portal ditch would be eliminated. Therefore, pathways associated with the sources that will be addressed through the assumed remedies were not addressed in the risk assessment. The results of the risk assessments are discussed below.

Soils - Ingestion, Dermal, and Garden Produce

Arsenic, lead, and antimony concentrations in soil are above acceptable risk levels for the soil ingestion exposure route. Cadmium and manganese are above acceptable risk levels for the garden produce ingestion exposure route. Arsenic concentrations in soil are above acceptable risk levels for the dermal exposure route.

Arsenic is the strongest risk driver for Site soils because it has the highest carcinogenic and non-carcinogenic risks at the Site (Table 5). The carcinogenic risk for arsenic for the soil ingestion exposure route ranges from 1 to 5 in 10,000 depending upon arsenic bioavailability. (The arsenic bioavailability ranges are between 16 and 80 percent based on the results of different studies and metal contaminant sources). Acceptable levels for carcinogenic risk are 1 in 10,000 to 1 in 1,000,000. Noncarcinogenic risk is

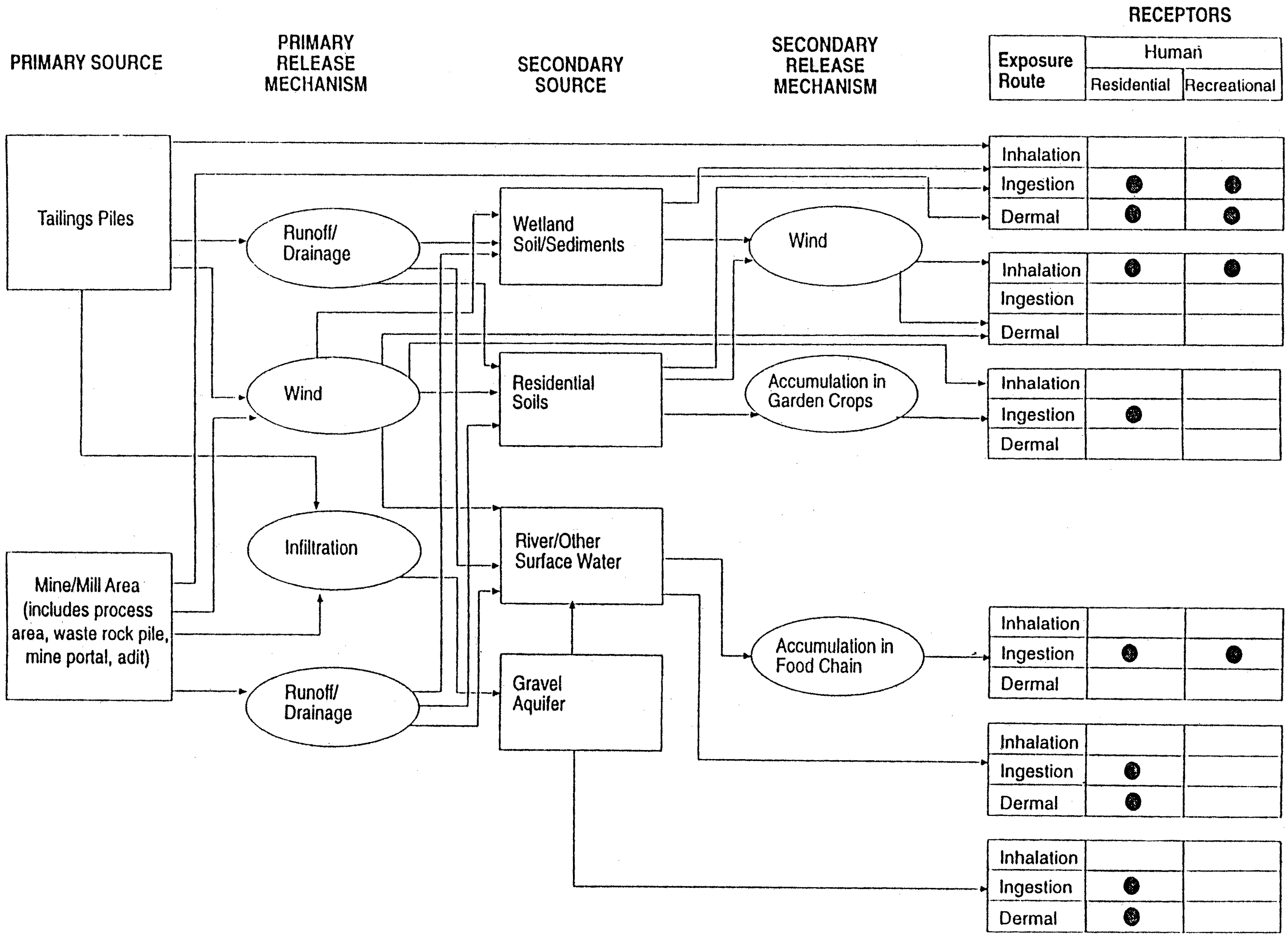


Figure 4. Conceptual Model of Exposure Pathways

Table 5. Sum of Risk Estimates by Chemical for All Exposure Routes										
	Current Residential Scenario				Future Residential Scenario				Recreational Scenario	
	Cancer		Noncancer		Cancer		Noncancer		Cancer	Noncancer
	Adult	Children	Adult	Children	Adult	Children	Adult	Children	Adult	Adult
Antimony			1.52	4.41			2.40	6.46		0.00
Arsenic	$3x10^{-3}$	$2x10^{-3}$	16.60	41.71	$2x10^{-3}$	$1x10^{-3}$	13.65	34.82	$1x10^{-4}$	0.74
Barium			0.09	0.20			0.05	0.12		0.001
Beryllium	$3x10^{-5}$	$2x10^{-5}$	0.004	0.01	$2x10^{-5}$	$1x10^{-5}$	0.002	0.01	$3x10^{-8}$	0.00000
Cadmium	$5x10^{-7}$	$1x10^{-7}$	1.00	2.49	$5x10^{-7}$	$1x10^{-7}$	0.97	2.40	$2x10^{-8}$	0.00
Chromium	$4x10^{-6}$	$1x10^{-6}$	0.05	0.16	$4x10^{-6}$	$1x10^{-6}$	0.02	0.10	$1x10^{-7}$	0.0001
Copper			0.25	0.62			0.07	0.20		0.0002
Manganese			0.82	2.23			7.30	17.36		0.001
Mercury			0.11	0.26			0.03	0.09		0.0000
Nickel	$2x10^{-7}$	$4x10^{-8}$	0.12	0.29	$2x10^{-7}$	$4x10^{-8}$	0.07	0.17	$5x10^{-9}$	0.0002
Selenium			0.02	0.05			0.04	0.09		0.0001
Silver			0.16	0.40			0.05	0.14		0.000
Thallium			0.62	1.63			2.59	6.24		0.001
Vanadium			0.05	0.25			0.05	0.24		0.001
Zinc			0.05	0.20			0.04	0.18		0.001

quantified by hazard quotients. Hazard Quotients (HQs) above 1.0 are considered to be potentially above acceptable risk and should be further evaluated. The soil ingestion HQs for arsenic and antimony for children under current and future residential scenarios are 9.25 and 1.11, respectively. (Table 6).

Summaries of HQs and carcinogenic risk for the Site are shown in Tables 5, 6, 7, 8, and 9.

The garden produce ingestion and dermal exposure risk calculations have greater uncertainty than soil ingestion and inhalation exposure routes. The garden produce uncertainty at Triumph is related to the small number of gardens, the short growing season, and the amount of produce actually utilized in the diet. Uncertainties associated with the dermal exposure routes include extrapolation of ingestion toxicity values to the dermal exposure route and the exposure factors used to calculate the dose. Additionally, garden produce ingestion and dermal exposure risk exposure routes are generally not considered to be of comparable concern for health impacts as soil ingestion and inhalation. Therefore, the garden produce and dermal exposure routes were considered *qualitatively* to increase risk above the 1 to 5 in 10,000 risk associated with soil ingestion and inhalation.

Soil lead concentrations in or near residential yards range from 49 to 22,790 mg/kg in the top 18 inches of soil. Several yards have lead concentrations greater than the EPA soil lead screening level of 400 mg/kg.

Arsenic Remediation Goal. The arsenic RG for the Triumph Site was established at 300 mg/kg arsenic in soil. This concentration in soil is protective of human health at the 1 in 10,000 target carcinogenic risk level and equates to a HQ of 1 for noncarcinogenic risk. It is also protective whether arsenic bioavailability is assumed to be 16, 28, or 60 percent.

The 300 mg/kg RG is based on soil ingestion and inhalation as the most significant routes for exposure. However, a 300 mg/kg arsenic level in soils also adds an element of protectiveness to account for the dermal and garden produce ingestion exposure routes. Dermal and garden produce ingestion exposure routes are associated with large uncertainty and were used as modifiers in this risk management decision.

Mine tailings and wastes are the sources for heavy metals at the Site. Soils heavily impacted by tailings show elevated concentrations of several contaminants of concern. The result is that soils contaminated with arsenic are also contaminated with lead, cadmium, antimony, and manganese. Since arsenic is the contaminant with the greatest risk and since it is a pervasive contaminant whose presence is indicative of the presence of other metals, the arsenic RG can be used as the primary determinant for soil remediation. Risks associated with other metals are expected to be reduced to protective levels by cleaning up soils identified above RGs for arsenic.

Table 6. Non-cancer Hazard Quotients: Children

Current residential scenario

medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal		soil waste rock ingestion	soil waste rock dermal	groundwater community ingestion	sw river ingestion	sediment river dermal
Antimony	1.11				0.22			0.30		3.23	0.08	
Arsenic	9.25	9.52	21.89		3.44	3.54		7.10	7.30	0.20	0.08	0.77
Barium	0.04		0.08	0.02	5.E-03					0.06	1.E-03	
Beryllium	1.E-03		2.E-04		2.E-04			2.E-04		0.01	2.E-04	
Cadmium	0.19	4.E-03	2.09		0.10	2.E-03		0.15	3.E-03	0.19	4.E-04	2.E-04
Chromium	0.05				0.01			0.01		0.11	9.E-04	
Copper	0.04		0.44		0.01			0.01		0.14	2.E-04	
Manganese	0.41		1.72		0.15			0.08		0.08	0.02	
Mercury	0.01		0.22	5.E-05	2.E-03			2.E-03		0.02	6.E-04	
Nickel	0.02		0.24		0.01			0.01		0.02	5.E-04	
Selenium	0.01				4.E-03			0.01		0.04	2.E-03	
Silver	0.04		0.33		0.01			0.01		0.03	6.E-04	
Thallium	0.10				1.07			0.01		1.30	0.23	
Vanadium	0.18		0.02		0.02			0.05		0.04	2.E-03	
Zinc	0.12				0.05			0.07		0.08	3.E-04	

Future residential scenario

medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal	soil wetland vegetables	soil waste rock ingestion	soil waste rock dermal	groundwater all data ingestion	sw river ingestion	sediment river dermal
Antimony	1.11				0.22			0.30		5.27	0.08	
Arsenic	9.25	9.52	8.76		3.44	3.54	13.56	7.10	7.30	1.64	0.08	0.77
Barium	0.04		0.03	0.02	5.E-03		0.02			0.04	1.E-03	
Beryllium	1.E-03		9.E-05		2.E-04		7.E-05	2.E-04		5.E-03	2.E-04	
Cadmium	0.19	4.E-03	0.84		0.10	2.E-03	1.75	0.15	3.E-03	0.45	4.E-04	2.E-04
Chromium	0.05				0.01			0.01		0.04	9.E-04	
Copper	0.04		0.18		0.01		0.12	0.01		0.04	2.E-04	
Manganese	0.41		0.69		0.15		1.06	0.08		15.87	0.02	
Mercury	0.01		0.09	5.E-05	2.E-03		0.06	2.E-03		0.02	6.E-04	
Nickel	0.02		0.10		0.01		0.12	0.01		0.03	5.E-04	
Selenium	0.01				4.E-03			0.01		0.08	2.E-03	
Silver	0.04		0.13		0.01		0.07	0.01		0.03	6.E-04	
Thallium	0.10				1.07			0.01		5.91	0.23	
Vanadium	0.18		0.01		0.02		0.00	0.05		0.06	2.E-03	
Zinc	0.12				0.05			0.07		0.05	3.E-04	

Table 7. Non-cancer Hazard Quotients: Adult (Page 1 of 2)												
Current residential scenario												
medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal		soil waste rock ingestion	soil waste rock dermal	groundwater community ingestion	sw river ingestion	sediment river dermal
Antimony	0.12				0.02			0.03		1.38	0.02	
Arsenic	0.99	5.66	9.38		0.37	2.11		0.76	4.34	0.09	0.02	0.46
Barium	4.E-02		0.04	0.02	5.E-04					0.03	2.E-04	
Beryllium	2.E-04		1.E-04		3.E-05			2.E-05		3.E-03	4.E-05	
Cadmium	0.02	2.E-03	0.90		0.01	1.E-03		0.02	2.E-03	0.08	9.E-04	1.E-04
Chromium	0.01				9.E-04			7.E-04		0.05	2.E-04	
Copper	0.00		0.19		8.E-04			1.E-03		0.06	4.E-05	
Manganese	0.04		0.74		0.02			0.01		0.03	4.E-03	
Mercury	1.E-03		0.10	5.E-05	2.E-04			3.E-04		0.01	1.E-04	
Nickel	3.E-03		0.10		8.E-04			1.E-03		0.01	1.E-04	
Selenium	1.E-03				5.E-04			6.E-04		0.02	5.E-04	
Silver	0.00		0.14		6.E-04			1.E-03		0.01	1.E-04	
Thallium	0.01				0.11			6.E-04		0.56	0.05	
Vanadium	0.02		0.01		3.E-03			0.01		0.02	5.E-04	
Zinc	0.01				0.01			0.01		0.03	6.E-05	
Future residential scenario												
medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal	soil wetland vegetables	soil waste rock ingestion	soil waste rock dermal	groundwater all data ingestion	sw river ingestion	sediment river dermal
Antimony	0.12				0.02			0.03		2.26	0.02	
Arsenic	0.99	5.66	3.75		0.37	2.11	5.81	0.76	4.34	0.70	0.02	0.46
Barium	4.E-03		0.01	0.02	5.E-04		0.01			0.02	2.E-04	
Beryllium	2.E-04		4.E-05		3.E-05		3.E-05	2.E-05		2.E-03	4.E-05	
Cadmium	0.02	2.E-03	0.36		0.01	1.E-03	0.75	0.02	2.E-03	0.19	9.E-04	1.E-04
Chromium	0.01				9.E-04			7.E-04		0.02	2.E-04	
Copper	0.00		0.08		8.E-04		0.05	1.E-03		0.02	4.E-05	
Manganese	0.04		0.30		0.02		0.46	0.01		6.80	4.E-03	
Mercury	1.E-03		0.04	5.E-05	2.E-04		0.02	3.E-04		0.01	1.E-04	
Nickel	3.E-03		0.04		8.E-04		0.05	1.E-03		0.01	1.E-04	
Selenium	1.E-03				5.E-04			6.E-04		0.03	5.E-04	
Silver	0.00		0.06		6.E-04		0.03	1.E-03		0.01	1.E-04	
Thallium	0.01				0.11			6.E-04		2.53	0.05	
Vanadium	0.02		0.00		3.E-03		0.00	0.01		0.02	5.E-04	
Zinc	0.01				0.01			0.01		0.02	6.E-05	

Table 7. Non-cancer Hazard Quotients: Adult (Page 2 of 2)

Recreational scenario

medium				soil	soil	soil		soil	soil		sw	sediment
location					wetland	wetland		waste rock	waste rock		river	river
route				inhalation	ingestion	dermal		ingestion	dermal		ingestion	dermal
Antimony					0.00			0.00			5.E-04	
Arsenic					0.05	0.29		0.11	0.61		5.E-04	0.03
Barium				7.E-04	7.E-05						6.E-06	
Beryllium					4.E-06			3.E-06			1.E-06	
Cadmium					2.E-03	2.E-04		0.00	2.E-04		3.E-05	6.E-06
Chromium					1.E-04			1.E-04			6.E-06	
Copper					1.E-04			2.E-04			1.E-06	
Manganese					0.00			1.E-03			1.E-04	
Mercury				2.E-06	3.E-05			4.E-05			4.E-06	
Nickel					1.E-04			1.E-04			3.E-06	
Selenium					7.E-05			8.E-05			1.E-05	
Silver					8.E-05			2.E-04			4.E-06	
Thallium					0.02			8.E-05			1.E-03	
Vanadium					4.E-04			8.E-04			1.E-05	
Zinc					8.E-04			1.E-03			2.E-06	

Table 8. Cancer Risk: Children

Current residential scenario												
medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal		soil waste rock ingestion	soil waste rock dermal	groundwater community ingestion	sw river ingestion	sediment river dermal
Arsenic	4.E-04	4.E-04	8.E-04	1.E-05	1.E-04	1.E-04		3.E-04	3.E-04	8.E-06	3.E-06	3.E-05
Beryllium	3.E-06		4.E-07	5.E-09	4.E-07			3.E-07		1.E-05	3.E-07	
Cadmium				1.E-07								
Chromium				1.E-06								
Nickel				4.E-08								
Future residential scenario												
medium location route	soil residential ingestion	soil residential dermal	soil residential vegetables	soil inhalation	soil wetland ingestion	soil wetland dermal	soil wetland vegetables	soil waste rock ingestion	soil waste rock dermal	groundwater all data ingestion	sw river ingestion	sediment river dermal
Arsenic	4.E-04	4.E-04	3.E-04	1.E-05	1.E-04	1.E-04	5.E-04	3.E-04	3.E-04	6.E-05	3.E-06	3.E-05
Beryllium	3.E-06		2.E-07	5.E-09	4.E-07		1.E-07	3.E-07		9.E-06	3.E-07	
Cadmium				1.E-07								
Chromium				1.E-06								
Nickel				4.E-08								

Table 9. Cancer Risk: Adult												
Current residential scenario												
medium	soil	soil	soil	soil	soil	soil		soil	soil	groundwater	sw	sediment
location	residential	residential	residential	res/road/wr	wetland	wetland		waste rock	waste rock	community	river	river
route	ingestion	dermal	vegetables	inhalation	ingestion	dermal		ingestion	dermal	ingestion	ingestion	dermal
Arsenic	2.E-04	9.E-04	1.E-03	6.E-05	6.E-05	3.E-04		1.E-04	7.E-04	1.E-05	3.E-06	7.E-05
Beryllium	1.E-06		7.E-07	2.E-08	2.E-07			1.E-07		3.E-05	3.E-07	
Cadmium				5.E-07								
Chromium				4.E-06								
Nickel				2.E-07								
Future residential scenario												
medium	soil	soil	soil	soil	soil	soil	soil	soil	soil	groundwater	sw	sediment
location	residential	residential	residential	res/road/wr	wetland	wetland	wetland	waste rock	waste rock	all data	river	river
route	ingestion	dermal	vegetables	inhalation	ingestion	dermal	vegetables	ingestion	dermal	ingestion	ingestion	dermal
Arsenic	2.E-04	9.E-04	6.E-04	6.E-05	6.E-05	3.E-04	9.E-04	1.E-04	7.E-04	1.E-04	3.E-06	7.E-05
Beryllium	1.E-06		3.E-07	2.E-08	2.E-07		2.E-07	1.E-07		2.E-05	3.E-07	
Cadmium				5.E-07								
Chromium				4.E-06								
Nickel				2.E-07								
Recreational scenario												
medium				soil	soil	soil		soil	soil		sw	sediment
location				res/road/wr	wetland	wetland		waste rock	waste rock		river	river
route				inhalation	ingestion	dermal		ingestion	dermal		ingestion	dermal
Arsenic				2.E-06	8.E-06	5.E-05		2.E-05	9.E-05		7.E-08	4.E-06
Beryllium				7.E-10	3.E-08			2.E-08			8.E-09	
Cadmium				2.E-08								
Chromium				1.E-07								
Nickel				5.E-09								
res/road/wr = weighted average (by area) of concentrations in residential, road, and waste rock areas												

The arsenic RG will be applied to all contaminated soil materials and house dust at the Site that contribute to unacceptable risk for current residential scenarios. These include residential yards and dust sources to residential yards which are the process area, tailings piles, and the waste rock pile. Additionally, the arsenic RG would be applied to the wetlands for future residential uses.

Residual Lead Concentrations. After remediation of yards based upon the arsenic RG of 300 in the top foot of soil, a few yards that will not have action triggered by the arsenic RG will have lead levels in the surface foot of soil above the 400 mg/kg EPA screening level. The 400 mg/kg lead EPA screening level is calculated with the Integrated Exposure Uptake Biokinetic (IEUBK) Model. Review of the Remedial Investigation data show that there will be three residential yards and a field adjacent to a residential yard with lead concentrations above 400 mg/kg. The lead concentrations for these yards are shown below.

	Lead Concentrations at depth, inches		
Yard #	0-1	1-6	6-12
3	505	240	171
21	391	414	243
22	512	546	546
23 field	495	752	197

Once yards are remediated due to arsenic contamination, the arithmetic and geometric mean lead levels for the community will be 163 mg/kg and 136 mg/kg, respectively. This calculation assumes that replacement soils will have lead levels of 100 mg/kg.

The lead concentrations remaining in residential soils after cleanup for arsenic at Triumph will be within the range of cleanup levels of 500 mg/kg to 1200 mg/kg lead used at other sites and would not pose residual unacceptable risk.

Groundwater
DEQ has determined that there are no unacceptable risks associated with the groundwater *currently* being consumed by Site residents. There were unacceptable non-carcinogenic risks identified for ingestion of groundwater under *future* residential scenarios down-gradient from the lower tailings pile.

Groundwater - Current Use
Risk assessment for groundwater ingestion found that concentrations of antimony and thallium are above risk-based levels for the current residential scenario. The HQs for antimony for adults and children are 1.38 and 3.23, respectively. The HQ for thallium was 1.3 for children. However, DEQ has determined that these levels do not pose risk at levels significant enough to warrant remedial responses. The rationale for this determination is discussed below. All other HQs for the current residential scenario were below 1.0, the level where potential excess risk may exist.

The Site Inspection Report for the Triumph Parker Mine Dump Site produced by Ecology and Environment in 1991 indicated that thallium concentrations found in environmental samples could not be attributed to the Site. This statement is apparently based on analytical results of the tailings that did not find appreciable concentrations of thallium. Additionally, the HQ for thallium is based on conservative assumptions and has an uncertainty factor of 3000. (An uncertainty factor of 1 indicates full certainty about the risk factors used to calculate the HQ). The combination of built in conservatism and an HQ that is above 1.0 but below 10 indicates that the risks associated with thallium are not significant. The indication that thallium risk is not significant, together with the finding that thallium is not attributable to the Site means that no response action is required to address thallium.

Antimony concentrations at times exceeded the Maximum Contaminant Limit (MCL) of 6 ppb but were typically below the MCL with maximum concentrations of 15 ppb. (MCLs are the limits used for determining if water is safe for drinking.). Antimony has a risk uncertainty factor of 1000. The HQs associated with antimony for adults and children are 1.38 and 3.23, respectively. Given the conservatism associated with calculation of these HQs and that the HQs are less than 10, the risks associated with antimony are insufficient to warrant remedial response.

Groundwater - Future Use

Risk assessment for groundwater ingestion found that concentrations of manganese, arsenic, thallium, and antimony are above risk-based levels for the future residential scenario.   Future residential scenarios assume that groundwater down gradient from the tailings piles would be used for drinking water. The HQs for these elements are shown below.

	HQ	
	Adult	Children
Manganese	6.8	15.9
Arsenic	0.7	1.6
Antimony	2.3	5.3
Thallium	2.5	5.9

Manganese, the chemical with the highest HQ, is the primary chemical of concern for groundwater. Risks posed by manganese in groundwater need to be addressed by appropriate response actions to be protective of human health for future residential exposure.

The arsenic HQ of 1.6 exceeds the 1.0 HQ used for identifying potential excess risks. Arsenic has an uncertainty factor of 3 indicating that there is fairly strong certainty in the HQ calculation. Arsenic concentrations found in the groundwater are typically 5 to 10 times below the MCL for arsenic (50 ppb) which is the limit used for drinking water systems. In no cases did the arsenic concentration exceed the MCL for the wells installed for the Remedial Investigation. It is possible for risks to be identified for some elements like arsenic even when the concentrations are below the MCL. This is because of the different assumptions and exposure factors that are used in calculating HQs in Site specific risk assessments. Given that the HQ is still relatively low (1.6) and that the concentrations in the groundwater have consistently been below the MCL, there are no unacceptable risks associated with arsenic in groundwater in the future residential scenario that would trigger remediation.

The discussion for thallium and antimony under the current use scenario is applicable to the future use scenario. The HQs are low enough given the high uncertainty associated with these elements that there is no unacceptable risk that requires remedial action.

Manganese Remediation Goal in Groundwater
Manganese is the only contaminant of concern that demonstrates an excess risk for groundwater. Since there is no MCL for manganese a risk based concentration was developed to use as the RG for manganese. Using current EPA guidelines on the health effects of manganese in drinking water, DEQ determined that a level of 840 ppb would be used as the RG for manganese in groundwater. A concentration of 840 ppb manganese equates to an HQ of 1.

Surface Water
No unacceptable risks were identified for ingestion of water in the East Fork of Wood River. Risks associated with other surface water in the Site will be addressed through the assumed remedy approach. Other surface waters are the mine drainage and the ponds on the tailings piles.

Air
No unacceptable risks were identified for inhalation of fugitive dust from residential soils, roads, and the waste rock pile. The assumed remedy will address dust emissions from the tailings piles and process area soils.

6.2 Ecological Risk Assessment

The Ecological Risk Assessment for the Site found no unacceptable risks to ecological receptors that would warrant remedial action. The Ecological Risk Assessment addressed the East Fork of the Wood River and the wetlands. Other areas were excluded from the assessment because of the agreement that these areas would be remediated under the assumed remedy approach. Two sensitive species are associated with the East Fork of the Wood River area. The Wood River sculpin is a BLM sensitive species and a USFWS species of concern. The wolverine is a USFS and BLM sensitive species and a USFWS watch species. The wolverine, however, is very unlikely to be found in the wetland areas at Triumph because of its preference for heavily forested habitat.

A food chain model was used to assess risk for the wetland area. The model characterized exposure via the ingestion route, which includes the consumption of food, water, and soil. Three different target species were chosen based on the their representativeness to the wetland ecosystem. For each species (meadow vole, moose, and red-tailed hawk) contaminant doses were calculated using concentrations in soil, water, and diet (plants and prey species) and ingestion rates from scientific literature. Hazard quotients were calculated to estimate risk. All HQs were below one except for arsenic in meadow vole where an HQ of 2.2 was calculated.

Field-collected data were used to qualitatively assess ecological risk to rainbow trout, Wood River Sculpin, and benthic macroinvertebrates. The data included reconnaissance surveys for the abundance of fish and benthic macroinvertebrates and surface water quality data. The Wood River Sculpin has been identified as a Priority Species of Special Concern by the Idaho Department of Fish and Game. Analysis of the data indicated that there was no impairment in the river.

7.0 REMEDIAL ACTION OBJECTIVES

The overall objective of remedial actions at the Triumph Site is to provide effective response actions that protect human health and the environment from contaminated soil, tailings, surface water, and groundwater. To address the potential risks from the Site, the following cleanup objectives were developed:

7.1 Sources Evaluated in Risk Assessments

Soils (including soils in yards, gardens, road shoulders, roads within and adjacent to residential properties and the waste rock area)
Prevent human ingestion and/or inhalation of and direct contact with contaminated soil and dust above acceptable risk levels. Prevent human consumption of garden produce grown in soils above acceptable risk levels under both current and future residential scenarios.

Groundwater
Prevent human ingestion of groundwater at levels above acceptable risk levels for future residential scenarios

Wetlands
Prevent human consumption of garden produce grown in soils above risk levels for future residential scenarios.

7.2 Sources Addressed Via Assumed Remedies

Tailings Piles
Prevent human ingestion and inhalation of, and direct contact with tailings and fugitive dust above acceptable risk levels. Prevent human ingestion of surface water on the

tailings ponds. Prevent contaminant migration and exposures to ponds on the tailings piles that would result in unacceptable risk to human health and the environment.

Process Area
Prevent human ingestion and inhalation of, and direct contact with contaminated soil and dust above acceptable risk levels. Prevent contaminant migration that would result in unacceptable risk to human health and the environment.

Mine Portal Water
Prevent human ingestion of mine portal water and prevent contaminant migration through mine water discharges that would result in unacceptable risk to human health and the environment

Mine Portal Ditch
Prevent human ingestion and direct contact with ditch sediments above acceptable risk levels.

8.0 DESCRIPTION OF ALTERNATIVES

Each of the remediation alternatives in this section was developed as a way to mitigate the risks from contamination on the Site. The Feasibility Study evaluated a range of alternatives for the Soil Remediation Unit and the Mine Portal-Water Unit. Measures to address groundwater contamination would be natural attenuation and source control via containing or treating the Triumph Tunnel water and capping and contouring the tailings piles. Groundwater monitoring to measure success of the source control and measures to control risk by limiting future use of contaminated groundwater for drinking is covered in the Soil Remediation Unit alternatives. Capital costs, operation and maintenance (O&M) costs calculated using a 30 year present work value, and total costs for each alternative are also provided.

8.1 Soil Remediation Unit

8.1.1 Alternative TS-1: No Action

Capital Cost: $0
O&M Cost: $0
Total Cost: $0
No action would be taken to reduce chemical concentrations in soil in this alternative.

8.1.2 Alternative TS-2: Community Protection Measures (CPMs)

Capital Cost: $ 33,000
O&M Cost: $311,000
Total Cost: $344,000
The CPMs are non-engineering measures that may reduce exposure to COCs. CPMs would include, for example, educational programs, groundwater monitoring,

contaminated soil disposal locations, guidance for ways to perform excavation where COCs above RG levels still exist. Restrictions in developing new drinking water wells in the area of the wetlands would also be potentially included.

8.1.3 Alternative TS-3: Residential Soil Replacement/Ditch Sediments and Tailings Piles Vegetative Cover/CPMs

Capital Cost: $2,377,000
O&M Cost: $ 446,000
Total Cost: $2,823,000

Residential soil would be excavated to a depth where the RG would be achieved or to one foot, whichever would occur first (excavation to one foot is anticipated to remove most of the soil containing arsenic above the 300 mg/kg cleanup level). Excavated soil would be placed on the tailings piles and graded. Clean soil would be placed in the residential excavations and vegetated. The Triumph Tunnel drainage ditch would be graded and capped with the vegetative cover.

Approximately 10 percent of the tailings piles would be consolidated to combine smaller piles located adjacent to the main piles in the existing wetlands and to reduce erosion. The piles would be graded to improve runoff and capped with the vegetative cover. Water management would be considered as necessary and as determined during design.

This alternative would also include CPMs.

8.1.4 Alternative TS-4a: Residential Soil Replacement/Tailings, Process Areas, and Waste Rock Vegetative Cover/Ditch Sediments Excavation and Offsite or Onsite Disposal/CPMs

Capital Cost: $3,027,000
O&M Cost: $ 813,000
Total Cost: $3,840,000

Residential soil and the tailings piles would be addressed as in TS-3.

The concrete foundations in the process areas may be demolished. The waste rock and process areas would be graded (as necessary) and covered to eliminate the exposure pathway. Erosion/seismic concerns will be considered in the final design. A vegetative cover is assumed for cost-estimating purposes although alternative covers could be used (rock, gravel, retaining wall) to eliminate direct exposure and airborne emissions from the area. Water management would be considered as necessary and as determined during design.

The Triumph Tunnel drainage ditch would be excavated to a depth where the PRAOs would be achieved or to one foot, whichever would occur first. A soil cover would be placed in the ditch if soil containing COCs above the PRAOs remains. Excavation to one foot and onsite disposal are assumed for estimating costs.

This alternative would also include CPMs for the soil remediation unit and for groundwater and the wetlands.

8.1.5 Alternative TS-4b: Residential Soil Replacement/Upper Tailings Piles, Process Areas, and Waste Rock Vegetative Cover/Lower Tailings Pile Wet Closure/Ditch Sediments Excavation and Offsite or Onsite Disposal/CPMs

Capital Cost: $3,101,000
O&M Cost: $ 609,000
Total Cost: $3,710,000

This alternative is similar to Alternative TS-4a except the existing wetlands would be graded to channel surface water to a concrete weir structure located southeast of the lower tailings pile. The weir would maintain a constant level of water on the lower tailings pile. Excess water would be directed to the East Fork of the Wood River. A pond would be constructed, and inflow to the pond would be augmented as necessary to maintain the water level. A vegetative cover appropriate for Site conditions would be planted in areas of the lower tailings pile that would not usually be covered with water. Seasonal wetlands vegetation would be planted in locations where low water conditions may reduce the size of the water cover.

8.1.6 Alternative TS-5a: Residential Soil Replacement/Tailings, Process Areas, and Waste Rock One-Foot Cover/Ditch Sediments Excavation and Onsite or Offsite Disposal/ CPMs

Capital Cost: $4,177,000
O&M Cost: $ 657,000
Total Cost: $4,834,000

This alternative is similar to TS-4a except that it calls for a one-foot cover over the tailings piles.

8.1.7 Alternative TS-5b: Residential Soil Replacement/Tailings Multi-Layer Cover/Process Areas and Waste Rock One-Foot Cover/Ditch Sediments Excavation and Onsite or Offsite Disposal/CPMs

Capital Cost: $6,401,000
O&M Cost: $ 657,000
Total Cost: $7,058,000

This alternative is similar to Alternative TS-4a except a multi-layer cover would be placed on the tailings.

8.1.8 Alternative TS-6a: Residential Soil Replacement/Consolidation of Process Areas and Waste Rock with Tailings/Tailings One-Foot Cover/Ditch Sediments Excavation and Onsite or Offsite Disposal/CPMs

Capital Cost: $8,924,000
O&M Cost: $ 580,000
Total Cost: $9,504,000

This alternative is similar to TS-5a except that the visually contaminated material in process area and the waste rock pile would be consolidated on the tailings piles.

8.1.9 Alternative TS-6b: Residential Soil Replacement/Consolidation of Process Areas and Waste Rock with Tailings/Tailings Multi-Layer Cover/Ditch Sediments Excavation and Onsite or Offsite Disposal/CPMs

Capital Cost: $11,248,000
O&M Cost: $ 580,000
Total Cost: $11,828,000

This alternative is similar to Alternative TS-6a except a multi-layer cover would be placed on the tailings.

8.1.10 Alternative TS-7: Offsite Disposal

Capital Cost: $166,065,000
O&M Cost: $ 0
Total Cost:: $166,065,000

All soil, including residential soil, process areas, waste rock, and the Triumph Tunnel water drainage ditch sediments would be excavated to a depth where the PRAOs would be achieved, or to native material, whichever occurs first. Removal to native material is assumed for cost estimating. Excavated soil would be disposed offsite. The residential areas would be backfilled and revegetated.

8.2 Triumph Tunnel Water Remediation Unit

8.2.1 Alternative MP-1: No Action

Capital Cost: $0
O&M Cost: $0
Total Cost: $0

No action would be taken to reduce chemical concentrations in water discharging from the Triumph adit in this alternative.

8.2.2 Alternative MP-2: CPMs

Capital Cost: $ 33,000
O&M Cost: $173,000
Total Cost: $206,000

This alternative would include CPMs as described in Alternative TS-2

8.2.3 Alternative MP-3: Mine Plug

Capital Cost: $486,000
O&M Cost: $498,000
Total Cost: $984,000
This alternative would involve installing a concrete plug inside the Triumph Mine adit.

8.2.4 Alternative MP-4: Mine Plug and In-Line Aeration

Capital Cost: $1,400,000
O&M Cost: $1,125,000
Total Cost: $2,525,000
This alternative would include installing the mine plug described in alternative MP-3, but the mine plug would be used to modulate flow. Modulating flow would reduce the size of or potentially eliminate treatment components. The plug would maintain a relatively constant flow of 100 gpm. Treatment in this alternative would include an in-line aeration system.

8.2.5 Alternative MP-5: Mine Plug, In-Line Aeration, and Wetlands Treatment

Capital Cost: $2,859,000
O&M Cost: $1,644,000
Total Cost: $4,503,000
This alternative would include installing the mine plug described in alternative MP-3, but the mine plug would be used to modulate flow. Modulating flow-would reduce the size of or potentially eliminate treatment components. The plug would maintain a relatively constant flow of 100 gpm. This alternative would include the in-line aeration system and the wetlands treatment system.

8.2.6 Alternative MP-6: Mine Plug and Chemical Treatment

Capital Cost: $2,133,000
O&M Cost: $6,552,000
Total Cost: $8,685,000
This alternative would include installing the mine plug described in alternative MP-3, but the mine plug would be used to modulate flow. Modulating flow would reduce the size of or potentially eliminate treatment components. The plug would maintain a relatively constant flow of 100 gpm. This alternative would include chemical treatment.

9.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Consistent with Superfund regulations, DEQ used the nine criteria summarized below to evaluate and compare alternatives. An alternative must meet criteria 1 and 2 known as “threshold” criteria,” in order to be recommended. Criteria 3 through 7 are called “balancing criteria,” are used to determine which cleanup method provides the best overall solution. After public comment, DEQ may alter its preference on the basis on community acceptance and comments from EPA (criteria 8 and 9). The Superfund criterion relating to State acceptance was modified to reflect EPA's role at Triumph.

9.1 Overall protection of human health and the environment. ***Determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.***

Soil Remediation Unit - TS-1 would not be protective of human health and the environment. TS-2 would be more protective than TS-1 but would less protective than engineering controls. TS-3 would be more protective than TS-2 in areas where engineering controls are implemented. Alternatives TS-4a, TS-5a and b, TS-6a and b would all be protective of human health and the environment. TS-4b would most likely not be protective of human health and the environment because of the water quality of the surface water on the tailings that is part of the wet closure. In addition, the risk to ecological receptors is unknown because a baseline risk assessment was not performed because of the Assumed Remedy Approach.

Triumph Tunnel Water Remediation Unit - MP-1 would not be protective of human health and the environment. MP-2 would be more protective but would be less protective than engineering controls. MP-3 would be protective if plugging proves to be successful. Treatment option MP-4 for Triumph Tunnel water may be protective dependent upon efficacy of treatment. Treatments options MP-5 and MP-6 would be protective.

9.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). ***Evaluates whether the alternative meets State and Federal environmental and facility siting laws and regulations that pertain to the Site or, if not a waiver is justified.***

Soil Remediation Unit - Primary ARARs that impact the Soil Remediation Unit are related to dust control for air quality standards, disposal regulations for mine waste materials, and water quality standards. TS-1 would not meet ARARs. TS-2 would meet some ARARs but not all. TS-3 would meet ARARs in areas where engineering controls are implemented. Alternatives TS-4a, TS-5a and b, TS-6a and b would meet ARARs. TS-4b would not meet water quality ARARs for surface water on the tailings pile that is part of the wet closure.

Triumph Tunnel Water Remediation Unit - Primary ARARs that impact the Triumph Tunnel Water Remediation Unit are related to water quality standards, discharges to public waters, and sludge disposal. MP-1 and MP-2 would not meet ARARs. MP-3 would meet ARARs if plugging proves to be successful. Alternatives MP-4, 5, and 6 would meet ARARs by treating water to meet water quality standards.

9.3 <u>Long-term effectiveness and permanence.</u> ***Considers the ability of an alternative to maintain protection of human health and the environment over time, and the reliability of such protection.***

Soil Remediation Unit - All alternatives meet this criterion except TS-1 and TS-2. The alternatives with thicker covers, TS-5a, TS-5b, TS-6a, and TS-6b would have somewhat greater long-term effectiveness than TS-4a but the difference is not significant. Thicker caps on the tailings piles would not provide additional benefit to groundwater contamination because the tailings are sitting in groundwater. A comprehensive monitoring plan will need to be implemented to evaluate the success of source control actions to address groundwater.

Triumph Tunnel Water Remediation Unit - All alternatives meet this criterion except MP-1 and MP-2. MP-3 would potentially best meet this criteria if proven to be successful because operation and maintenance requirements would be less than those associated with treatment alternatives (MP-4, 5, and 6).

9.4 <u>Reduction of toxicity, mobility, or volume through treatment or recycling.</u> ***Evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of residual contamination remaining.***

Soil Remediation Unit - None of the alternatives contains any form of treatment. However, the capping alternatives (TS-3, TS-4a and b, TS-5a and b, TS-6a and b) do reduce mobility of contaminants.

Triumph Tunnel Water Remediation Unit - Alternatives MP-4, 5, and 6 all call for treatment of contaminated Triumph Tunnel water. The treatments would reduce the contamination in the water to meet water quality standards.

9.5 <u>Short-Term effectiveness.</u> ***Considers how fast the alternative reaches the cleanup goal and the risks the alternative poses to workers, resident, and the environment during construction or implementation of the alternative.***

Soil Remediation Unit - Alternative TS-4a would require the least amount of dirt work to excavate and/or cap most contaminated soil materials on Site. Alternatives with thicker caps (TS-5a and TS-5b) would require greater dirt work but would not take appreciably longer than TS-4a. Alternatives TS-6a and TS-6b both require extensive amounts of dirt work to consolidate contaminated soil materials. These alternatives were also estimated to take longer to complete.

Triumph Tunnel Water Remediation Unit - Alternatives MP-3,4,5, and 6 all include mine plugging. The short term impacts of the plugging are expected to be minimal and would in the short term eliminate flows from the mine.

9.6 Implementability. ***Considers the technical and administrative feasibility of implementing the alternative, such as relative availability of goods and services. This criterion also considers whether the technology has been used successfully at other similar sites.***

Soil Remediation Unit - Local topsoil availability is an issue for TS-4a, TS-5a and b, TS-6a and b. No other technical barriers would affect the implementation of these alternatives. Administrative actions would need to be implemented for the CPMs.

Triumph Tunnel Water Remediation Unit - Mine plugging has been implemented at other sites with varying levels of success. The geology and the hydrology of the Triumph Mine suggest that it can be effectively implemented at this Site. However, extensive monitoring will need to be conducted to evaluate the effects of flooding the upper portion of the mine. The treatment technologies in MP-4, 5, and 6 have all be used at other sites with success. Administrative actions would need to be implemented for the CPMs.

9.7 Cost. ***Includes estimated capital and operation and maintenance costs, as well as present worth costs. Present work cost is the total cost of an alternative over time in terms of today's dollars.***

Soil Remediation Unit - The least costly alternative that meets the threshold criteria is TS-4a. The most expensive alternative is TS-7, offsite disposal.

Triumph Tunnel Water Remediation Unit - The least costly alternative that meets the threshold criteria is MP-3, if proven to be effective. The most costly alternative is the chemical treatment of the Triumph Tunnel water, MP-6.

9.8 State (EPA acceptance). ***Considers whether EPA agrees with the State's analyses and recommendations of the RI/FS and Proposed Plan.***

EPA has reviewed and commented on DEQ's selected remedy. DEQ has incorporated EPA comments.

9.9 Community acceptance. ***This criterion considers community interest and concerns as a factor in selecting a cleanup plan. It will be addressed after consideration of comments submitted during the public comment period.***

There was general community support for the proposed remedy. The community presented considerable concern about the loss of the pond on the lower tailings pile. The community liaisons were consulted prior to finalizing the selected remedy. It was decided at the meeting that the selected remedy was acceptable, although the loss of the pond will be a community loss.

10.0 SELECTED REMEDY

The future land uses at the site are expected to be the same as the current residential and recreational uses. The selected remedy is, therefore, based on residential and recreational use scenarios.

10.1 Soil Remediation Unit

Alternative TS-4a, Residential Soil Replacement/Tailings, Process Areas, and Waste Rock Vegetative Cover/Ditch Sediments Excavation and Offsite or Onsite Disposal/CPMs, with some modifications would be most protective and best meet the required criteria to address unacceptable risks for contaminated soil materials and tailings. The modifications include requiring a minimum six inch soil cover as necessary to create the vegetative barrier on the tailings pile and not the option of using amending three inches of soil mixed with tailings. They also include creating a 12 inch barrier as a buffer between tailings piles and residences. These modifications are discussed in greater detail below.

10.1.1 Soils in Residential Areas

TS-4a calls for the excavation of residential soil to a depth where the RG of 300 mg/kg arsenic will be achieved or to one foot, whichever occurs first (excavation to one foot is anticipated to remove most of the soil containing arsenic above the 300 mg/kg cleanup level). Excavated soil will be placed on the tailings piles and graded to allow surface water to drain. Uncontaminated soil will be placed in the residential excavations and vegetated. Excavation of contaminated soil materials and replacement with uncontaminated materials will also occur on unpaved roads and road shoulders. In most residential yards removal of soil above 300 mg/kg arsenic in the top foot of a yard will be a total removal of contaminated soil. These yards, will not need any CPMs to ensure the barrier is maintained. The CPMs will be applied to those yards and other capped areas that have material remaining above the RG at depths below one foot. In yards with contaminated soil below the top foot, garden areas will be provided two feet of uncontaminated soil to grow garden produce.

10.1.2 Tailings Piles

The tailings piles will serve as the disposal location for contaminated soils in residential areas. There are small isolated piles located adjacent to the main piles. These will be consolidated onto the two larger piles. The piles will be graded to ensure runoff and capped with a minimum of six inches of soil as necessary to maintain a vegetative cover. The cap will serve as a barrier to reduce exposures and contaminant migration including capillary rise. A twelve inch soil cap buffer will be created on the tailings piles that are directly adjacent to residential yards and where there is no physical barrier like a road or fence between the residential yard and the tailings pile. The width of the buffer will be determined on a case by case basis.

10.1.3 Process Area

The concrete foundations in the process areas not associated with unacceptable risks may be demolished as part of remedial action. The waste rock and process areas will be graded (as necessary) and covered to eliminate the exposure pathway. Erosion/seismic concerns will be considered in the final design. A six inch vegetative cover or other alternative covers could be used (rock, gravel, retaining wall) to eliminate direct exposure and airborne emissions from the area. Alternative caps may be needed in this area because of the steep slopes and the difficulty in placing and holding soil on such steep slopes. See the discussion on alternative caps below.

10.1.4 Waste Rock Pile

The waste rock pile will be recontoured to create stable slopes and capped with six inches of soil and revegetated. Alternative caps may be needed in this area because of the steep slopes and the difficulty in placing and holding soil on such steep slopes. See the discussion on alternative caps below.

10.1.5 Wetlands

Visible tailings and soil hot spots will be removed from wetlands areas and disposed on the tailings piles. Areas of barren soil that pose a risk of erosion and are above the arsenic RG will be excavated or capped. The criteria for identifying hot spots and the barren areas will be developed during remedial design and will be based on presence of contaminants, size of area, likelihood of the area creating a wind or water erosion problem, and amount of damage that would occur to the wetlands to perform such removal. An objective of the remedial action is to protect the wetlands from negative impacts created by the remediation. The wetlands have been found to be providing important metal absorbing and habitat functions at the Site.

10.1.6 Triumph Tunnel Drainage Ditch

The Triumph Tunnel drainage ditch will be excavated to a depth where the RG of 300 mg/kg arsenic will be achieved or to one foot, whichever occurs first. A soil cover will be placed in the ditch if soil containing COCs above the RG remains. This ditch is expected to revegetate over time as the contaminated water is either eliminated via the mine plug or treated prior to discharge into the ditch. The materials excavated from the ditch will be disposed on the tailings pile within a lined cell to ensure these materials do not leach.

10.1.7 House Dust

House dust will be addressed through source control via capping of contaminated soils and tailings. Routine housecleaning by residents post remediation is expected to reduce the metal loading within the home. Follow up monitoring will be performed to demonstrate house dust levels are within acceptable limits.

10.1.8 Community Protection Measures

This portion of the remedy will include CPMs for the soil remediation unit and the wetlands. CPMs will be developed for residential yards, residential developments, and other excavation activities located on capped tailings (or soils that still have arsenic levels greater than 300 mg/kg below the one foot soil cap). The purpose of the CPMs will be to allow the property owner to use their property as they determine appropriate but ensure that any exposed tailings materials or contaminated soils are properly handled, disposed, or capped. An example of the CPMs that could be implemented are to work with Blaine County to create an overlay zone that would provide information to the property owner regarding the way contaminated soils and tailings would need to be handled and disposed. A disposal location will be established and maintained as part of the successful implementation of CPMs.

The selected remedy includes CPMs to address future residential risks posed by COCs in wetlands soil. These future risks are related to garden produce ingestion. The type of CPMs will be similar to those outlined above for capped areas. The purpose of the CPMs will be to allow the property owner to use their property as they determine appropriate but ensure that any tailings materials or contaminated soils are properly handled, disposed, or capped to ensure that vegetable gardens are not planted in contaminated soil.

10.1.9 Alternative Caps

Other caps than a vegetated soil cover may be utilized but they must be comparable in permanence to the six inches of vegetated soil and address the aesthetic concerns of the community. An example of an alternative cap would be rock cover. Irrigation may be necessary to establish a vegetative cover that resists erosion. The vegetated covers or other caps will be managed to ensure they continue to provide protection against erosion, fugitive dust, and direct contact exposures.

10.1.10 Water Management

Water management will be implemented to minimize erosion impacts on any soil caps installed as part of the remedy. Water from the springs in the upper tailings pile will be drained through appropriate techniques such as a french drain or diversion ditches. All water management practices including draining ponds and water diversions will require use of Best Management Practices during construction to minimize sedimentation. Caps, tailings recontouring, and water management systems will be designed to withstand high precipitation events and high water years.

10.1.11 Additional Consolidation as Needed

During remedial design it may be determined that additional consolidation of the waste rock pile, process areas materials, and upper tailings pile is appropriate to ensure stable slopes, minimize encroachment on adjacent properties, or help meet soil cover supply needs.

10.2 Triumph Tunnel Water

The selected remedy for the Triumph Tunnel Water is MP-5, Mine Plug, In-Line Aeration, and Wetlands Treatment, implemented in a phased approach as necessary to meet ARARs. The first step will be the installation of the mine plug in combination with monitoring to predict potential discharges at other portals. Additionally, the plug will be inspected for leakage and stability and a comprehensive reconnaissance will be conducted in the area on a regular basis to locate seeps and discharges caused by the plugging. A reconnaissance of current seeps and discharges will be necessary prior to plugging to establish baseline conditions. Contamination related to discharges will be addressed through collection, treatment, excavation, or other appropriate measures to address the contamination caused by the discharge. The in-line component of MP-5 will be implemented if monitoring indicates the need to treat waters impounded within the mine behind the plug. The trigger for installation of the in-line component will be based on time-pressure curves that show the depth of water as the mine fills, overflow of the mine pool at another surface opening, the development of discharges or seeps, or a combination of these factors. Similarly, the wetlands portion of MP-5 will be implemented if analytical results for samples of in-line aeration indicate non-compliance with ARARs, including water quality standards.

Community drinking water wells will be monitored to determine if the mine plug is having any impact on drinking water quality. Appropriate mitigation measures will be implemented to address Site related contamination that is identified through this monitoring. Mitigation may include source control, implementation of Triumph Tunnel water treatment, and provision of alternative water source on a temporary or permanent basis.

10.3 Groundwater

The elevated manganese levels in groundwater downstream of the lower tailings pile will be addressed primarily through source control and CPMs to prevent ingestion of the groundwater. Natural attenuation is also expected to provide additional benefit. Groundwater will be monitored to determine the effectiveness of source control and natural attenuation. If manganese levels do not reach the RG after source control, DEQ will determine the appropriate next steps to take to be protective of human health and the environment. Controlling sources as required by the selected remedy would be consistent with any foreseen appropriate next steps. Review of the progress toward reaching the RG will occur at least every five years as part of the five year review. If there is residential development in the wetland area and the groundwater does not meet drinking water standards, an alternative source will be provided.

CPMs for groundwater will be established to prevent ingestion of impacted groundwater that is downstream of the lower tailings piles. The CPMs will likely include restricting construction of drinking water wells in the impacted groundwater using Idaho

Department of Water Resources authorities. The purpose is to protect potential future residents from drinking the water with elevated manganese concentrations during the interim until manganese levels are reduced to below the risk based concentration of 840 µg/l via source control and other COCs are below drinking water standards.

10.4 Five Year Reviews

Five year reviews will be required at Triumph because contaminants will remain onsite and may pose potential risk. All caps will be subject to five year review as well as routine operation and maintenance. House dust metal concentrations may also be reviewed to determine the effectiveness of source control in reducing house dust metal loadings. Additionally, groundwater quality in the area including downstream drinking water wells be subject to review.

10.5 Cost

The capital costs for the selected remedy range between $3.5M to $5.9M depending upon the phases that will need to be implemented to address the Triumph Tunnel Water. The 30 year present value operation and maintenance costs will range between $1.3M and $2.5M again depending upon the phases implemented for Triumph Tunnel Water. Therefore, total cost for the remedy ranges between $4.8M and $8.3M

11.0 STATUTORY DETERMINATIONS

Since DEQ is overseeing this cleanup consistent with CERCLA, DEQ's primary responsibility is to ensure that remedial actions are undertaken which protect human health, welfare, and the environment. In addition, Section 121 of CERCLA, 32 U.S.C. §9621, establishes cleanup standards which require that the selected remedial action complies with all ARARs established under federal and state environmental law. The selected remedy must be cost effective and must utilize permanent solutions, alternative treatment technologies, or source recovery technologies to the maximum extent practicable. The following sections discuss how the selected remedy meets these requirements.

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action and is cost effective.

11.1 Protection of Human Health and the Environment

The remedy will be protective of human health and the environment by eliminating exposure to tailings and contaminated soils. Contaminated soils and tailings will be remediated through excavation and disposal of tailings and contaminated soil and constructing clean soil barriers that eliminate direct contact, fugitive dust, and surface water exposure pathways for metals. Elimination of these dust sources also eliminates the loading source for house dust. Routine house cleaning by homeowners are expected to reduce metals load in the house once the dust sources are controlled.

The remedy will be protective for groundwater consumption by implementing CPMs to restrict construction of drinking water wells in the impacted groundwater. Source control with additional benefits from natural attenuation will be used to reduce the levels of COCs, specifically manganese. Monitoring will be conducted to determine the progress of reaching the RG for manganese. If source control with benefits of natural attenuation do not reduce COC concentrations to acceptable levels, DEQ will re-evaluate the selected remedy. A time frame has not been established for determining if additional steps will be needed because additional data is needed. A time frame will be established prior to the first five year review based upon monitoring information and other information gathered during remedial design and action.

Risks associated with the Triumph Tunnel water will be addressed through source control or treatment.

Protections created by the remedies will be preserved through implementation of CPMs, re-evaluation of remedy effectiveness through future reviews, and ongoing maintenance requirements.

As mentioned above, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

11.2 Applicable or Relevant and Appropriate Requirements

Since the Triumph Site is not a Superfund Site it will be necessary to obtain permits for applicable requirements at the site. These applicable requirements are expected to include a 404 Permit from the US Army Corps of Engineers to allow work in the wetlands. The work that would trigger this requirement are expected to be surface water management activities and removal of tailings and contaminated soil in barren areas from the wetlands and cleaning tailings out of the Triumph Tunnel ditch. If treatment of the Triumph Tunnel water is required an National Pollution Discharge Elimination System permit will be required. It will also be necessary to develop Storm water and Pollution Prevention Plans. Depending upon the source of soil materials and the types of hauling trucks, it may be necessary to obtain commercial hauling permits for some communities.

The list of ARARs and a description of the requirement and how it relates to the selected remedy is shown in Table 10.

11.3 Cost Effectiveness

The selected remedy provides overall effectiveness at a reasonable cost. Reprocessing or offsite disposal of tailings and contaminated soil would be more expensive and cause greater short-term risks without significant benefits in long-term protections compared to the overall remedy.

TABLE 10 - COMPLIANCE OF SELECTED REMEDY WITH ARARs: SOIL REMEDIATION UNIT CHEMICAL-SPECIFIC

Federal or State Citation	Description	Selected Remedy[a]
40 CFR[b] 50.6 and .12 IDAPA[c] 16.01.01161 IDAPA 16.01.01577	Ambient air quality standards for particulate matter and lead. Control of toxic substances in air. Ambient air quality standards.	Controlling fugitive dust during remedial action will likely prevent violations of standards.
CWA Section 304	Includes non-enforceable criteria for protection of health and welfare (including fish, shellfish, wildlife, plant life, beaches, esthetics and recreation) from pollutants in bodies of water.	Remedial Action likely to have positive effect on chemical concentrations in surface water. However some water quality criteria may be exceeded in ponded water on lower tailings pile.
IDAPA 16.01.02250	Maximum allowable concentrations of chemicals and other characteristics in surface waters designated for recreation, aquatic life, and domestic water supplies.	Remedial action likely to have positive effect on chemical concentrations in surface water.
40 CFR 141.11 40 CFR 141.51 40 CFR 143.3	Maximum contaminant levels (MCLs) Maximum contaminant level goals (MCLGs) Secondary maximum contaminant levels (SMCLs)	Remedial action likely to have positive effect on chemical concentrations in surface water runoff.

Notes:

(a) Description of Selected Remedy:

Alternative TS-4a: Residential Soil Replacement/Tailings, Process Areas, and Waste Rock Vegetative Cover/Ditch Sediment Excavation and Offsite or Onsite Disposal/CPMs.

(b) CFR = Code of Federal Regulations.

(c) IDAPA = Idaho Administrative Procedures Act.

TABLE 10 (cont.) COMPLIANCE OF SELECTED REMEDY WITH ARARs: TRIUMPH TUNNEL WATER REMEDIATION UNIT ACTION-SPECIFIC

Federal or State Citation	Description	Selected Remedy
		Mine Plug, In-Line Aeration and Wetands Treatment
29 CFR[a] 1910.210	General safety and health standards for workers.	Significant effort may be required to rehabilitate mine and install plug. Otherwise, corkers can be adequately protected.
40 CFR 122 and 125	NPDES[b] program conditions, standards, and limitations for individual and general permits.	Treatability results and knowledge of permit conditions necessary for evaluation.
40 CFR 131.12 IDAPA[c] 16.01.02051	Antidegradation policy and general surface water quality standards.	Remedial action likely to have positive effect on quantity of contaminated mine-portal water that eventually will discharge to wetlands. Treatment will have positive effect on concentrations of chemicals of concern (COCs) in mine-portal discharge. Wetlands polishing step may help to achieve ARAR[d].
IDAPA 16.01.02080	Violation of water quality standards.	Remedial action likely to have positive effect on quantity of contaminated mine-portal water that eventually will discharge to wetlands. Treatment will have positive effect on concentrations of COCs in mine-portal discharge. Wetlands polishing may help to achieve ARAR.
IDAPA 16.01.02400	Rules governing point source discharges.	If plug allows discharge of mine-portal water, discharge may not meet water quality criteria, depending on monitoring location. Unable to assess ability of treatment process to meet water quality criteria without treatability testing and knowledge of permit conditions. Created wetlands not subject to application of renewal water quality; based on site-specific criteria and standards (.04).
IDAPA 16.01.02401	Point source wastewater treatment requirements.	Ability to comply depends on regulatory requirements. Physical characteristic requirements (e.g., temperature) likely can be achieved. Wetlands polishing may help to achieve ARAR.
IDAPA 16.01.02800	Hazardous and deleterious material storage near waters of the state.	Sludge can be stored without significant threat to state waters.
40CFR 262.12 and .30-.34 IDAPA 16.01.05006	Requirements for generators of hazardous waste.	Can meet requirements.
40 CFR 263.30 and .31 49 CFR 171-177 IDAPA 16.01.05007	Transportation regulations and law for hazardous materials and waste.	Can meet requirements.
40 CFR 268 IDAPA 16.01.05011	Land disposal restrictions.	Offsite disposal of sludge can meet requirements.
IDAPA 20.03.02140.07	Regulations governing minimum criteria for settling ponds.	Settling ponds will be designed to meet criteria.

Notes:

(a) CFR = Code of Federal Regulations.

(b) NPDES = National Pollutant Discharge Elimination System.

(c) IDAPA = Idaho Administrative Procedures Act.

(d) ARAR = Applicable or relevant and appropriate requirement.

TABLE 10 (cont.) COMPLIANCE OF SELECTED REMEDY WITH ARARs: TRIUMPH TUNNEL WATER REMEDIATION UNIT CHEMICAL-SPECIFIC

Federal or State Citation	Description	Selected Remedy
		Mine Plug, In-Line Aeration and Wetands Treatment
CWA Section 304	Includes non-enforceable criteria for protection of human health and aquatic life.	Remedial action would have positive effect by eliminating or reducing flow. In addition, treatment would significantly reduce concentrations of chemicals of concern (COCs) in mine-portal water. Testing required to assess compliance with ARAR[b]. Additional treatment (i.e., wetlands) may help achieve ARAR
IDAPA[c] 16.01.02250	Maximum allowable concentrations of chemicals and other characteristics in surface waters designated for recreation, aquatic life, and domestic water supplies.	Remedial action would have positive effect by eliminating or reducing flow. In addition, treatment would significantly reduce concentrations of COCs in mine-portal water. Testing required to assess compliance with ARAR. Additional treatment (i.e., wetlands) may help achieve ARAR.
40 CFR[d] 141.11 40 CFR 141.51 40 CFR 143.3	Maximum contaminant levels (MCLs) Maximum contaminant level goals (MCLGs) Secondary maximum contaminant levels (SMCLs)	Remedial action would have positive effect by eliminating or reducing flow. In addition, treatment would significantly reduce concentrations of COCs in mine-portal water. Testing required to assess compliance with ARAR. Additional treatment (i.e., wetlands) may help achieve ARAR.

Notes:

(a) CWA = Clean Water Act.

(b) ARAR = Applicable or relevant and appropriate requirement.

(c) IDAPA = Idaho Administrative Procedures Act.

(d) CFR = Code of Federal Regulations.

TABLE 10 (cont.) COMPLIANCE OF SELECTED REMEDY WITH ARARs: SOIL REMEDIATION UNIT ACTION-SPECIFIC

Federal or State Citation	Description	Selected Remedy[(a)]
29 CFR[(b)] 1910.210	General safety and health standards for workers.	Workers can be adequately protected.
40 CFR 131.12 IDAPA[(c)] 16.01.02051 IDAPA 16.01.02200	Antidegradation policy and general surface water quality standards.	Remedial action likely to have positive effect on chemical concentrations on surface water.
IDAPA 16.01.02080	Violation of surface water quality standards.	Remedial action likely to have positive effect on chemical concentrations on surface water.
IDAPA 16.01.02350	Rules governing non-point source discharges.	Covering tailing piles, waste rock, and process areas likely to improve concentrations in non-point discharge.
40 CFR 262.12, and 30-.34 IDAPA 16.01.05006	Requirements for generators of hazardous waste.	Can meet requirements.
40 CFR 263.30 and .31 49 CFR 171-177 IDAPA 16.01.05007	Transportation regulations for hazardous materials and wastes.	Can meet requirements.
40 CFR 268 IDAPA 16.01.05011	Land disposed restrictions.	Ditch sediments would likely require treatment before offsite disposal.
IDAPA 20.03.02140.06	Regulations governing disposal of mining wastes in area other than mine excavation.	NA

Notes:

(a) Description of Selected Remedy:

Alternative TS-4a: Residential Soil Replacement/Tailings, Process Areas, and Waste Rock Vegetative Cover/Ditch Sediment Excavation and Offsite or Onsite Disposal/CPMs.

(b) CFR = Code of Federal Regulations.

(c) IDAPA = Idaho Administrative Procedures Act.

TABLE 10 (cont.) COMPLIANCE OF SELECTED REMEDY WITH ARARs: SOIL REMEDIATION UNIT LOCATION-SPECIFIC

Federal or State Citation	Description	Selected Remedy[a]
40 CFR[b] 6, Appendix A 40 CFR 6.302	Action to avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values in wetlands.	Placing contaminated soil on tailings is not expected to impact wetlands. Consolidating and capping tailings and other contaminated soil will enhance wetlands by reducing potential for contamination of stormwater.
40 CFR 230 33 CFR 320-330	Requirements describing disposal of dredge and fill material within waters of the U.S.	Placing contaminated soil on tailings and capping the tailings are not expected to impact wetlands. Consolidation of tailings in the wetlands area will enhance wetlands.
40 CFR 6.302	Action to protect fish or wildlife.	Placing contaminated soil on tailings and capping the tailings are expected to slightly improve environmental conditions for fish and wildlife by reducing the opportunity for exposure to COCs.

Notes:

(a) Description of Selected Remedy:

Alternative TS-4a: Residential Soil Replacement/Tailings, Process Areas, and Waste Rock Vegetative Cover/Ditch Sediment Excavation and Offsite or Onsite Disposal/CPMs.

(b) CFR = Code of Federal Regulations.

TABLE 10 (cont.) COMPLIANCE OF SELECTED REMEDY WITH ARARs: TRIUMPH TUNNEL WATER REMEDIATION UNIT LOCATION-SPECIFIC

Federal or State Citation	Description	Selected Remedy
		Mine Plug, In-Line Aeration and Wetlands Treatment
40 CFR[(a)] 6, Appendix A 40 CFR 6.302 40 CFR 6.302	Action to avoid adverse effedts, minimize potential harm, and restore and preserve natural and beneficial values in wetlands. Actions to protect fish and wildlife.	Plug may eliminate or reduce discharge to wetlands, thereby avoiding or reducing potential future impacts. Treatment would reduce chemical concentrations in discharge to wetlands, thereby avoiding or reducing future impacts.
40 CFR 230 33 CFR 320-330	Requirements describing disposal of dredge and fill material within waters of the U.S.	If treatment system is located on tailings, excavated tailings will be placed on adjacent tailings; therefore, no adverse effects in wetlands are anticipated.

Notes:

(a) CFR = Code of Federal Regulations.

Utilization of source control with CPMs to eliminate risk with additional benefits from natural attenuation is a cost effective method to address the manganese contamination in groundwater. The costs of a treatment system for the groundwater would be high based upon experience at other sites without a strong certainty that it would be successful. Capping of the tailings with an impermeable liner would approximately double the costs of closing the tailings piles, but would not provide significantly greater protections to exposure pathways including groundwater ingestion than a recontoured vegetated surface.

11.4 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 alternative treatment technologies can be utilized in a cost-effective manner at the Site. Innovative treatment technologies in the form of constructed wetlands may be used as a secondary treatment to address Triumph Tunnel Water if source control and in-line aeration treatment efforts do not meet remedial action objectives.

Reprocessing of tailings is costly and unproven and represents a short-tem hazard and nuisance to the community. Solidification or fixation techniques are also costly and increase volumes of the materials that have to be managed in the long-term without any significant environmental benefit. Source control and containment combined with appropriate operation and maintenance are appropriate permanent solutions for large volume wastes generated by mining operations.

11.5 Preference for Treatment as a Principal Element

The selected remedy utilizes alternative treatment technologies to the maximum extent practicable for Triumph Tunnel Water treatment. However, because treatment of the remaining threats of the Site was not found to be practicable, the selected remedy does not satisfy the statutory preference for treatment as a principal element.

12.0 RESPONSIVENESS SUMMARY

Comment #1: There were many comments regarding the pond on the lower tailings pile. Some commentors wanted to retain the pond as part of the remediation. The commentors indicated that the pond is used by wildlife and is an asset to the community. Others were concerned about keeping the pond because of the potential impacts of leaching metals through the tailings into the groundwater. a commentor asked that costs be evaluated for putting a liner under the pond only as part of a capping remedial alternative. Finally, one commentor didn't want to keep the pond because it is a breeding area for mosquitos.

Response: DEQ evaluated alternatives to maintain the pond on the lower tailings pile. The evaluation included costing out placement of a liner under the pond only. The basic condition is that the tailings pond can be remediated cost effectively to protect human health and the environment by regrading the pile so it will drain water, capping it with soil and revegetating it. Remedial Investigation data show that leaching through the tailings pile has not had a major impact on groundwater quality (with the possible exception of manganese). This is due to several factors one of which is that the absorption by the underlying clay layer has reduced contaminant leaching into the ground water. The absorption capacity of this layer is not unlimited and could be exhausted over time. Therefore, it is important to remove hydraulic head as a driving forces for leaching by draining the pond.

To retain the pond and remove the driving force would require placing a liner under the pond. The cost of placing a liner under the pond only would be an additional $300,000 compared to the DEQ's selected alternative. This cost includes purchasing and placing the liner material and covering it with six inches of soil. This soil cover on the liner is required to protect the liner material. The costs do not include significant operation and maintenance costs that would be associated with managing water levels to maintain the pond and costs of repair and eventual replacement of the liner.

Additionally, the water quality in the pond does not meet State water quality standards. Therefore, as part of the remediation, DEQ is required to ensure that the water in the pond meets water quality standards or is eliminated.

Comment #2: Some commentors indicated that they wanted a vegetative cover on the Waste Rock Pile and tailings piles and indicated that the vegetation will need to be irrigated.

Response: DEQ's selected alternative calls for vegetated soil covers over the Waste Rock Pile, tailings piles, and the process area. However, the selected alternative allows for utilization of other caps. To address the concerns raised in this comment DEQ has included Section 10.1.10 Alternative Caps in the ROD which states "Other *caps may be utilized but they must be comparable in permanence to the six inches of vegetated soil <u>and address the aesthetic concerns of the community</u>. Irrigation may be necessary to establish a vegetative cover that resists erosion. The vegetated covers or other caps will be managed to ensure they continue to provide protection against erosion, fugitive dust, and direct contact exposures" (underlining added for this response). Vegetated soil caps will utilize native plant species to help ensure a self-sustaining vegetative community. This should also reduce the need for irrigation.*

Comment #3: Commentors indicated that they wanted community drinking water wells and drinking water wells downstream of the Site monitored. Additionally, they wanted a commitment to address drinking water contamination identified through this monitoring.

Response: Section 10.2 in the ROD includes the following language: "Community drinking water wells will be monitored to determine if the mine plug is having any impact on drinking water quality. Appropriate mitigation measures will be implemented to address Site related contamination that is identified through this monitoring. Mitigation may include source control, implementation of Triumph Tunnel water treatment, and provision of alternative water source on a temporary or permanent basis." Downstream drinking water wells will be subject to "five year reviews."

Comment #4: Comments stated that moving the waste rock pile and upper tailings pile to the lower tailings pile is ill-advised. Consolidation also may create a "mountain" that is not consistent with the valley floor topography.

Response: DEQ's selected alternative does not call for consolidation of wastes onto the lower tailings pile. The reasons for this are that the environmental benefit does not out weigh the negative impacts that the work would have on the community. The ROD does, however, allow for some consolidation of wastes as needed to meet remedial objectives. Section 10.1.12 Additional Consolidation as Needed states "During remedial design it may be determined that additional consolidation of the waste rock pile, process areas materials, and upper tailings pile is appropriate to ensure stable slopes, minimize encroachment on adjacent properties, or help meet soil cover supply needs."

Comment #5: The tailings cap should not be tailings mixed with soil as discussed in the Feasibility Study. a thicker cover would be better. a one foot thick cap with 6 inches of soil over 6 inches gravel or 4 inches of shale would be best.

Response: DEQ agrees that the amended soil mixed with tailings is inadequate to ensure a durable soil cap. a one foot thick cap would provide more durability. However, DEQ believes a six inch soil cover can sustain a vegetative community and with operation and maintenance will meet the permanency requirements.

Comment #6: There was concern that the wetlands may be damaged during remediation.

Response: The selected remedy does calls for removal of visible tailings deposition areas and contaminated barren soil areas and excavation in the Triumph Tunnel water ditch in the wetlands. This would be the limit of physical disruption of the wetlands. Surface water management activities including draining the lower tailings piles pond(s) is not expected to create water shortages in the wetlands. The area groundwater is shallow and the entire area is impacted by springs such that no water shortage impacts would be expected.

Comment #7: All of the work at this Site is based on potential risk and there have been no real problems associated with this Site.

Response: The Remedial Investigation and Risk Assessments are based on accepted scientific standards and practices. DEQ's responsibility is to use these standards and practices to develop a Site remedy that is protective of human health and the environment from current and potential future risks. We are fortunate that at this Site existing nearby population is law and there has been little evidence of current exposures to mine related contamination. To ensure that exposures do not increase, DEQ's selected remedy needs to be implemented. It is important to note that the requirements in the ROD for addressing the tailings piles, waste rock pile, the process area, and the mine drainage are consistent with closure requirements that modern day mining operations would be required to implement for a mine closure.

Comment #8: The upper tailings pile should be moved because it may leach metals even with a cap.

Response: The RI indicated that there was little leaching of metals from either tailings pile. Regrading the upper pile to drain and capping it with a vegetated soil cover and conveying the upper pile spring in a manner that eliminates contact with the tailings will satisfactorily address human health and environment threats posed by the pile.

Comment #9: The upper pile should be recontoured to lower their impact on the view

Response: The upper pile will be regraded to allow water to run off of the pile. Additionally, the pile will be revegetated. These steps are required to protect human health and the environment. As a side benefit, they will also have an aesthetic benefit.

Comment #10: What will be the disposition of tailings around portal, abandoned cars, trucks, and equipment, timbers around mine portal.

Response: As part of the process area closure the tailings, abandoned cars and trucks, equipment, and various structures will most likely have to be moved. This would in some cases be addressed by the property owners or those who own any of the equipment. Some of the structure may be left in place if it does not restrict implementation of the Site remedy.

Comment #11: Will East Fork Lane be remediated?

Response: East Fork Lane is a dirt road in the residential portion of the community and would, therefore, be remediated.

Comment #12: When will the water management activities including channeling the upper tailings pile spring occur? When will the road work at end of East Fork Lane and the trash pile be removed?

Response: The water management activities are expected to occur in the summer of 1998. Removal of the trash pile is not a requirement of the selected remedy. Removal off the trash piles is the responsibility of the landowner.

Comment #13: There was concern from one commentor about ensuring her yard would be returned to its original condition. The commentor also had concerns related to the details of yard remediation. Several subjects were broached. Each is responded to below.

a. Source of topsoil for garden and yard.

Response: The replacement soil for yards and gardens will be required to be productive to support lawn and gardening uses.

b. Dates for when work will be done on her property.

Response: Property owners will be notified prior to any work beginning on their property. Each property owner whose yard needs to be remediated will be approached to develop remediation plans specific to their yard so that the yard is replaced with comparable features.

c. Wanting to be present during work and compensated for lost wages.

Response: Yard remediations have been performed at several places around the country. The work plan for each property is worked out before work is begun and the property has full input during the development of this plan. Therefore, it is not necessary for the property owner to be present for the remediation to be conducted safely. Property owners have not been compensated for lost wages if they decide to be *home during the remediation work. Nor will property owners be compensated for lost wages at the Triumph Site.*

d. Fences replacement, protection of utilities, warranty for work and damages

Response: These issues will be handled on a case-by-case basis. The contractors doing the work and the responsible parties will be responsible for damages caused by their activities.

e. Workman comp liability for property owner

Response: The contractor and responsible parties will be required to carry the proper insurance for their workers.

f. Remediation crew sanitation
Response: Proper sanitation facilities for the workers will be provided by the contractor.

g. Want house cleaned after remediation

Response: Experience from yard remediation work around the country has shown that with proper care and dust control efforts, there is no need to perform additional house cleaning because of the remediation.

h. Statement that her property is free of contamination and the DEQ and EPA will state that her property will not be considered for listing in any environmental cleanup program

Response: The Memorandum of Agreement sets the framework for declaration that the Site has been satisfactorily remediated. This is accomplished through what is called "certification" that the Site is cleaned up. The certification would cover the Site and not be performed for each individual property. The MOA calls for EPA to de-propose the Site. It is DEQ's intent that this remedy will be the final action needed to address contamination at an individual residential property other than the application of CPMs for properties that still reside on tailings.

I. Request that property owners will not have to pay the cost for cleanup

Response: DEQ does not intend to require any residential property owner to pay for the cost of cleanup. Residential owners whose property will still have tailings after remediation at depths greater than this ROD requires and are excavating soil in their yards will be required to manage those materials in ways to avoid exposures and recontamination. In these cases, the requirements to handle the material in a controlled manner and dispose of the material in appropriate disposal locations.

Comment # 14: Water management for high water must be a significant component of remedy.

Response: The ROD includes language to address this in Section 10.1.11. Details would be developed during remedial design.

Comment #15: There was concern about what the result of excavating the mine portal ditch excavation would be.

Response: Contaminated sediments will be cleaned out of ditch above risk-based arsenic levels and capped if necessary. The ditch would be expected to revegetate quickly once the contaminants have been removed and contaminated water from the mine is either eliminated or treated. The CPMs would be applied to areas where contaminants remain above the arsenic action level.

Comment Note: Several comments were received regarding alternatives presented in the Proposed Plan that were not DEQ's preferred alternative. The portions of these comments that relate to the selected remedy are addressed in the Responsiveness Summary. Comments not relating to the preferred alternative are not addressed.

Comment #16: How will any of the proposals, TS-1--TS-6b, guarantee surface water quality?

Response: One of the objectives of the water management plan is to ensure that surface water meets State water quality standards. This will largely be accomplished by segregating existing surface water bodies from the tailings and other mine wastes as much as possible. This requires removing the pond which creates a head over the lower tailings pile, re-routing or channeling springs so that they do not come into contact with the tailings, capping over the tailings and waste areas to prevent direct contact with water, and cutting off or treating the mine water.

Comment #17: What are "applicable or relevant and appropriate requirements"?

Response: Applicable or Relevant and Appropriate requirements also called ARARS is a term used in Superfund to refer to other State and Federal laws and regulations that might apply to remediation activities. For example, State water quality standards are an ARAR for the Site.

Comment #18: In-line aeration should be triggered by overflow or seepage from the plugged adit.

Response: The area around the mine plug will be monitored for leakage.

Comment #19: What are the “community protection measures” to prevent human ingestion of manganese in the wetlands groundwater?

Response: The CPMs to prevent ingestion of manganese from the wetlands groundwater would be prohibitions on drilling drinking water wells until remediation action goals are reached.

Comment #20: One commentor read DEQ’s preferred alternative to indicate that the wetlands would be filled to reduce risk.

Response: The section of the Proposed Plan that talks about filling in the wetlands refers to the filling that would be necessary from a construction standpoint if someone were otherwise authorized to construct a residence in the wetland. DEQ’s selected alternative does not call for any filling of the wetland. The point that was being made was that there is no reason to fill the wetlands now since they do not present a current risk. However, if in the future someone were to put in residences in the wetlands (that have contaminants above risk levels) they would essentially implement there own remedy by having to bring in fill to simply construct a home.

Comment #21: What is the width and where would Buffer Strips be required?

Response: Buffer Strips would consist of a twelve inch soil cap buffer on the tailings piles that are directly adjacent to residential yards and where there is no physical barrier like a road or fence between the residential yard and the tailings pile. The width of the buffer will be determined on a case by case basis.

Comment #22: What criteria will be used for determining if removal is necessary in areas of barren soils in the wetlands.

Response: The criteria for identifying the barren areas will be developed during remedial design and will be based on presence of contamination, size of area, likelihood of the area creating a wind or water erosion problem, and amount of damage that would occur to the wetlands to perform such removal. An objective of the remedial action is to protect the wetlands from negative impacts created by the remediation. The wetlands have been found to be performing important metal absorbing and habitat functions at the Site.

Comment #23: What will CPMs be on private and state land?

Response: The purpose of the CPMs will be to allow the property owner to use their property as they determine appropriate but ensure that any exposed tailings materials or contaminated soils are properly handled, disposed, or capped. An example of the CPMs that could be implemented are to create an overlay zone that would provide *information to the property owner regarding the way contaminated soils and tailings would need to be handled and disposed. a disposal location will be established and maintained as part of the successful implementation of CPMs. The CPMs will be developed over the course of Remedial Design and Remedial Action.*

Comment #24: There were comments about the possibility of getting utilities (gas and electricity) installed during the remediation.

Response: DEQ has been in contact with some of the utilities. It will of course be the decision of the utilities as to whether they chose to provide service or bury their service during remediation. However, DEQ will inform them of the opportunity that is created for them during remediation and that the remediation project is ready to cooperate with any in-ground installation work.

Comment #25: There was concern about trucks on East Fork Road regarding safety and road condition.

Response: This concern was also identified in the Feasibility Study. Efforts to locate soil materials in the local area will be made to reduce the amount of traffic on East Fork Road. For hauling that will be necessary on East Fork Road, the contractor will be required to use trucks that are appropriate for the road and ensure safety for residents and other road users.

Comment #26: Where will the water from the pond and other surface water source go during remediation.

Response: Disposition of water during remediation will in large part depend upon the quality of water that is being managed. In most cases the water will be discharged into the wetlands and eventually make it into the East Fork of the Wood River. Best Management Practices will be required to reduce sediment load to minimize impact on the river.

Comment #27: What would be the soil sources?

Responses: Local areas are being evaluated to serve as soils sources. Property owned by some Triumph residents which is in the area is expected to provide adequate soil volumes for the soil covers. Soil for residential yards will be imported to ensure the higher quality that is needed for this use.