EPA/ROD/R08-94/102
1994

EPA Superfund
Record of Decision:

SILVER BOW CREEK/BUTTE AREA
EPA ID: MTD980502777
OU 03
BUTTE, MT
09/29/1994

ADMINISTRATIVE RECORD

RECORD OF DECISION

BUTTE MINE FLOODING OPERABLE UNIT
SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE, MONTANA

September 29,1994

United States Environmental Protection Agency
Region VIII - Montana Office
Federal Building, 301 South Park, Drawer 10096
Helena, MT 59626-0096
(Lead Agency)

Montana Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
2209 Phoenix Avenue
P.O. Box 200901
Helena, MT 59620-0901
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RECORD OF DECISION

MINE FLOODING OPERABLE UNIT

SILVER BOW CREEK/BUTTE AREA SITE

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Montana Department of Health and Environmental Sciences (MDHES) present the Record of Decision (ROD) for the Mine Flooding Operable Unit (OU) of the Silver Bow Creek/Butte Area National Priorities List (NPL) site. The ROD is based on the Administrative Record for the site, the Remedial Investigation/Feasibility Study (RI/FS), the Proposed Plan, the public comments received (including those from the potentially responsible parties (PRPs) and local government), and EPA and MDHES response to these comments. The ROD presents a brief outline of the RI/FS, actual and potential risks to human health and the environment, and the selected remedy. EPA guidance was used in preparation of the ROD **1**. The ROD has the following three purposes:

1. To certify that the remedy selection process was carried out in accordance with the requirements of the Comprehensive Environmental, Response, Compensation and Liability Act (CERCLA) 42 U.S.C. §§ 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP);

2. To outline the engineering components and remediation requirements of the selected remedy; and

3. To provide the public with a consolidated source of information about the site history, characteristics, and risk posed by the conditions at the Mine Flooding OU, as well as a summary of the cleanup alternatives considered, their evaluation, and the rationale behind the selected remedy.

The ROD is organized into three distinct sections:

1. The Declaration functions as an abstract for the key information contained in the ROD and is the section of the ROD signed by the EPA Regional Administrator and the MDHES Director;

2. The Decision Summary provides an overview of the site characteristics, the alternatives evaluated, and the analyses of those options. The Decision Summary also identifies the selected remedy and explains how the remedy fulfills statutory requirements. The Decision Summary includes, as an Appendix, the final applicable or relevant and appropriate requirements (ARARs) for the site and waivers of any of these ARARs; and

3. The Responsiveness Summary addresses public comments received on the Proposed Plan, the RI/FS, and other information in the Administrative Record, which were not responded to previously.

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1 Guidance on Preparing Superfund Decision Documents: The Proposed Plan, the Record of Decision, Explanation of Significant Differences, the Record of Decision Amendment, Interim Final, EPA/540/G-89/007, July 1989

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Silver Bow Creek/Butte Area NPL Site
Butte, Montana
Butte Mine Flooding Operable Unit

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy for the Butte Mine Flooding Operable Unit (BMFOU) of the Silver Bow Creek/Butte Area site in Butte, Montana. The selected remedial action was chosen by EPA, with the concurrence of the Montana Department of Health and-Environmental Sciences (the State), in accordance with the requirements of CERCLA, as amended, and the NCP. This decision is based on the Administrative Record for the site. The State of Montana has played a significant role during the remedy selection process for this site and concurs with EPA on the selected alternative as indicated by co-authorship of this ROD and co-signature.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE SELECTED REMEDY

The remedy selected by EPA, with the concurrence of the State, addresses contaminated water in the Berkeley Pit and associated underground mine workings. The alternative selected is a modification of Alternative 6/7 presented in the BMFOU Feasibility Study (FS). The primary objective of the remedy is to protect human health and the environment from threats posed by the rising contaminated waters in the Butte Mine Flooding Operable Unit. To meet the primary objective stated above, the remedy is intended to maximize control of inflow, thereby slowing the Pit flooding in a cost-effective manner; maintains the water level in the bedrock system to prevent the release of contaminants into the alluvial aquifer and the Silver Bow Creek drainage basin; institutes a comprehensive monitoring program to insure that discharges to the alluvial groundwater system and Silver Bow Creek do not occur, and; promotes the development of innovative treatment and/or metals recovery processes in the future. The selected alternative has the following major components:

<u>INFLOW CONTROL</u>

1. Immediate control of the Horseshoe Bend surface water flow to the Berkeley Pit (currently averaging 2.4 million gallons per day (mgd)). No surface flows, except on a short-term emergency basis, shall be discharged to the Berkeley Pit. EPA and the State will consider alternate inflow control [2] measures for control of Horseshoe Bend surface water inflow if such measures are equally effective.

2. Immediate control of contaminated groundwater in the Horseshoe Bend drainage area. EPA and the State will consider alternate inflow control measures for the control of Horseshoe Bend groundwater flow if such measures are equally effective.

<u>WATER TREATMENT</u>

3. Treatment of surface water (e.g., Horseshoe Bend) and groundwater in the Horseshoe Bend drainage area during active mining may be accomplished by integrating the flow into the Montana Resources (MR) mining process or by treatment in a newly constructed treatment plant.

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[2] Inflow control is defined as the interception or pumping of surface water or ground water to prevent this water from entering the East Camp and West Camp mine systems.

4. When water in the Pit System reaches the elevation of 5,260 feet (USGS datum), or 24 months prior to projected mine closure **3**, a focused review of treatment technologies shall be conducted to evaluate alternatives to the treatment technology selected during the FS. This focused FS shall use the applicable EPA FS guidance in effect at that time. A final decision concerning the technology to employ shall be made by EPA, in consultation with the State, at that time.

5. Upon suspension of mining **4** or upon mine closure and regardless of water levels in the Berkeley Pit/East Camp System, contaminated surface water (including all Horseshoe Bend surface inflow) and Horseshoe Bend area subsurface inflows shall be captured and treated. Treatment shall be hydroxide precipitation/ aeration followed (if necessary) by reverse osmosis as a polishing treatment to meet standards for discharge to surface waters. EPA and the State will consider alternate inflow control and treatment measures if such measures are equally effective. If alternate inflow measures are used, a minimum of 2.4 MGD shall be treated. Additionally, all significant surface flows from uncontaminated drainages (e.g., Yankee Doodle Creek, Silver Bow Creek, North, East, and West drainages), within the Berkeley Pit drainage shall be diverted around the East Camp/Berkeley System.

6. If inflow control cannot be accomplished through integration of inflows into the mining process, or upon suspension of mining or mine closure, design and construction for a treatment facility shall begin immediately and be completed on a schedule approved by EPA in consultation with the State. In the event that integration of inflow into the mining process cannot be accomplished, this inflow may be discharged, on a short-term and temporary basis, to the Berkeley Pit. Treatment shall be a two stage hydroxide precipitation and aeration process followed (if necessary) by reverse osmosis as a polishing treatment to meet standards for discharge to surface waters. Alternate treatment technology that meets discharge standards and objectives will be considered by the agencies. Treated water shall be discharged to the Silver Bow Creek drainage or used for other water supply purposes.

7. Integration of Horseshoe Bend water into the MR tailing circuit is contingent upon maintaining earthquake structural integrity and stability of the Yankee Doodle Tailings Pond Dam as outlined in the Harding Lawson Associates Report (Seismic Stability Evaluation - Yankee Doodle Tailings Dam - Butte, Montana, Harding Lawson Associates, April 9, 1993). If integration of Horseshoe Bend flow into the tailings circuit is instituted, all recommendations outlined in this report shall be followed. In the event that the Yankee Doodle Tailings Pond/MR tailing circuit cannot accept this inflow control water and maintain earthquake structural integrity and stability, there shall be an immediate cessation of placement of inflow control water into the MR tailings circuit. In the event that the Pond cannot accept the inflow control water, on a short-term and temporary basis, this inflow may be discharged to the Berkeley Pit. Concurrently, the design and construction of a treatment facility (aeration/hydroxide precipitation) shall begin immediately as provided in paragraph 6. For a period of six (6) months, starting upon initial integration of "inflow control" water into the MR tailings circuit, weekly phreatic data shall be collected to evaluate compliance with the dam earthquake structural integrity and stability requirements. This data shall be collected monthly after this initial six-month period. If pumping of Horseshoe Bend water to the Yankee Doodle Tailings Pond continues after suspension of mining or mine closure, these monitoring requirements shall also be met.

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[3] For the purposes of this ROD, mine closure is defined as: "when the mill operation is shut down (i.e., no concentrate production) for at least a six (6) month period and no minable reserves are left that could be mined at a profit even if economic factors become more favorable. If EPA, in consultation with the State, determines that, based on forecasts, assessments of reserves, or other information, that closure of the mine may occur within 24 months. EPA, in consultation with the State, may trigger this requirement by written notice to the PRPs."

[4] For the purposes of this ROD, suspension of mining is defined as: "when the will operation is shut down (i.e., no concentrate production) for at least a six (6) month period with minable reserves left that could be mined at a profit when economic factors become more favorable."

SLUDGE DISPOSAL

8. Any sludge(s) generated by a treatment process shall be disposed of in an onsite disposal facility or in the Berkeley Pit in compliance with pertinent requirements. Because the precise chemical nature of the sludges and quantity is not certain at this time, the exact method and location of disposal of any such sludge(s) is not specified in this ROD. After final determination of a method of treatment and prior to design of a treatment facility, a focused review of sludge disposal issues shall be done, assuming sludge disposal is a necessary part of the treatment scheme. Such a review shall determine the sludge(s) chemical characteristics and compatibility for disposal in either the Berkeley Pit or in an onsite disposal facility. EPA and the State will develop a scope of work (SOW) to direct this focused review. Sludge disposal must be in accordance with ARARs or appropriate waivers and shall not be allowed in the Pit unless EPA approval is granted after consultation with the State.

9. If disposal of sludge(s) into the Berkeley Pit is selected, an equivalent volume of Berkeley Pit/East Camp System water shall be pumped and treated sufficient to offset the volume that the sludge is displacing. The objective of this requirement is to establish a zero (0) net inflow from the disposal of sludge(s) into the Berkeley Pit.

MONITORING PROGRAM

10. A comprehensive monitoring program, including both surface water and groundwater (alluvial and bedrock), shall be employed to track the elevation and quality of the waters in the East, West, and outer Camps. This monitoring program is described in more detail in Appendix 3. Data generated from this program will be used to ensure that treatment facilities are in place and operating prior to the time when the mine waters approach the established critical water levels (CWLs) and also to ensure the protectiveness of the CWLs. EPA and MDHES will coordinate yearly updates, in the form of a written report, that incorporates the new data with existing data. This report will include, at a minimum, the data gathered from the previous twelve months, and an updated prediction of the time when the CWL for the Berkeley Pit/East Camp System will be approached. Every three (3) years EPA and MDHES will review the monitoring program's completeness. This three year review is to adjust, as determined by EPA and the State, the requirements of the monitoring program.

WATER LEVELS

11. Water levels in the Berkeley Pit/East Camp System and the Travona/West Camp System shall not be allowed to rise above the established critical water levels (CWLs) of 5,410 and 5,435 feet (USGS datum), respectively. In addition, water levels in the East Camp shall be kept below West Camp water levels. These levels and requirements are established to prevent existing hydraulic gradients from changing and thus to prevent releases of contaminated water from the Pit System into the alluvial aquifer or Silver Bow Creek drainage. The points of compliance for determining water levels for Berkeley Pit/East Camp System CWL shall be: the Berkeley Pit, Anselmo, Belmont, Granite Mountain, Kelley, and Steward shafts, bedrock monitoring wells installed as part of the RI/FS or monitoring program (i.e., those wells within the cone of influence of the East Camp System), and wells DDH-1, DDH-5, and DDH-8 (taken in tandem and treated as one data point). As there is the potential for collapse/failure of existing shafts and thus their loss as monitoring locations for points of compliance, EPA, in consultation with the State, will evaluate and direct alternative existing shafts as replacement points of compliance as necessary. If no satisfactory alternative shafts exist, EPA, in consultation with the State, will direct the installation of bedrock monitoring wells to replace the lost/failed shaft. The points of compliance for determining water levels for Travona/West Camp System CWL shall be: the Travona, Emma and Ophir shafts, and any additional monitoring wells for the Travona/West Camp System installed as part of the monitoring program.

12. When the monitoring program and yearly update reports, described in paragraph 10 above, indicate the CWL may be approached within eight years, design of the final water treatment facility shall begin, with construction to be completed four (4) years prior to the projected date for water in the East Camp system to reach the CWL. This treatment plant shall be capable of maintaining the water level in the East Camp System below the 5,410-foot elevation.

WEST CAMP/TRAVONA

13. EPA took action to control the water level of the West Camp/Travona Shaft System in 1988 by pumping and treating Travona shaft water (West Camp/Travona Shaft System Expedited Response Action). The action taken to control the West Camp water is still appropriate; it is, therefore, integrated and incorporated into this remedy for the BMFOU. The water level in the West Camp shall continue to be maintained below the CWL of 5,435 (USGS datum) feet by the ongoing pumping to the Butte publicly-owned treatment works (Butte Metro Plant). If the Metro Plant cannot continue to accept this water, an alternative treatment plant shall be used (newly constructed if necessary) to handle this flow.

INSTITUTIONAL CONTROLS

14. Institutional controls, including controls on groundwater use, shall be implemented to ensure that there is no inappropriate use of contaminated bedrock groundwater which threatens human health and the environment. EPA and the State plan to request implementation of this program by local governmental entities.

These actions will provide containment of contaminated water in the East and West Camp Systems, and will prevent the release of contaminated water to the alluvial aquifer and Silver Bow Creek. As long as surface water and groundwater inflows to the Pit System are controlled as outlined above and water quality standards for treated water discharged to the Silver Bow Creek drainage are met, EPA and the State will maintain flexibility with respect to alternate methods for control, treatment, and discharge of this volume of water.

Implementation of the selected remedy is intended to prevent the primary threat of exposure to contaminated bedrock groundwater and surface water by humans and aquatic life. The monitoring and control of the water levels in the East and West Camp Systems is intended to ensure that the CWLs are not exceeded, that there is no reversal of hydraulic gradients, and that contaminated water does not discharge to the alluvial aquifer or Silver Bow Creek. Treatment of pit water and surface water inflows is intended to ensure that water discharged to the Silver Bow Creek drainage meets State of Montana water quality standards and other applicable or relevant and appropriate requirements (ARARs). Implementation of institutional controls associated with the use of contaminated bedrock aquifer water is intended to ensure the protection of public health from the dangers posed by direct ingestion of the contaminated groundwater.

STATUTORY DETERMINATION

The selected alternative is protective of human health and the environment through the containment of contaminated water within the BMFOU, treatment of the contaminated water prior to discharge to the Silver Bow Creek drainage, and the control of inappropriate use of contaminated bedrock groundwater. The selected alternative will meet all Federal and State requirements (i.e., ARARs) except the Federal and State groundwater quality standards (See Appendix 1 - ARARs for the Butte Mine Flooding OU and Appendix 3 - Technical Impracticability evaluation) for the bedrock aquifer. EPA is waiving these requirements based on the determination that compliance with these standards is technically impracticable from an engineering perspective. Treated water discharged to the Silver Bow Creek drainage will meet discharge requirements. Any sludge produced from treatment will be disposed of in compliance with applicable solid and hazardous waste regulations or an appropriate waiver of these requirements. Although the selected alternative has higher associated costs than the other alternatives evaluated which protect human health and the environment, the additional cost is outweighed by the fact that the selected alternative mandates the immediate and permanent control of water inflows to the Pit System. This immediate and permanent control of inflows slows down the Pit flooding, allowing for greater opportunity to address unforseen contingencies and to develop alternative innovative technology, which may reduce sludge generation and/or allow the recovery of metals. The selected alternative uses permanent solutions to the maximum extent practicable for this operable unit and promotes the development of alternate treatment technologies. It also satisfies the statutory preference for remedies that reduce the toxicity, mobility, or volume of contamination through treatment.

Since hazardous substances above health-based levels will remain onsite, reviews will be conducted within each five year period after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

William Yellowtail — Date
Regional Administrator
United States Environmental Protection Agency
Region VIII

Robert J. Robinson — Date
Director
Montana Department of Health and Environmental Sciences

DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

Silver Bow Creek/Butte Area NPL Site
Mine Flooding Operable Unit
Butte, Montana

The Butte Mine Flooding OU is part of the Silver Bow Creek/Butte Area NPL site and is located in and near the cities of Butte and Walkerville, Montana. It consists of waters within the Berkeley Pit, the underground mine workings hydraulically connected to the Berkeley Pit, the associated alluvial and bedrock aquifers, and other contributing sources of inflow to the Berkeley Pit/East Camp System (including surface runoff, leach pad and tailings slurry circuit overflows) and the Travona/West Camp System. For more information about these systems, refer to the Technical Impracticability (TI) evaluation (Appendix 2). The boundaries of the OU are approximately the Continental Divide to the east, Metro Storm Drain/Silver Bow Creek to the south, Missoula Gulch to the west, and the Yankee Doodle Tailings Pond watershed drainage system to the north. The OU is within the Butte mining district in the upper Silver Bow Creek drainage, and covers about 23 square miles (Figure 1).

Butte residents have access to drinking water through the Butte municipal water system which acquires water from the Big Hole River and the upper Silver Bow Creek drainage (Moulton Reservoir). These water supplies are not impacted by contamination in the Butte Mine Flooding OU or by remedial action taken at this OU. However, the Private Well Inventory revealed that there are currently more than 800 private and municipal alluvial wells in the Butte area. There are approximately 140 alluvial wells in close proximity to the Butte Mine Flooding OU that could potentially be impacted by mine flooding waters. The public does not have access to the few bedrock wells within this OU.

The Berkeley Pit/East Camp System (the Pit System) is located in the northern and eastern portions of the OU (Figure 1). The Berkeley Pit is the major feature of the OU, and it is 1,780 feet deep, encompassing an area of 675 acres and a volume of 26 billion gallons of contaminated water. This system also encompasses more than 3,000 miles of underground mine workings. The West Camp System is located in the southwest corner of the OU and includes the Travona, Emma, and Ophir mines and their associated underground workings. These two systems are separated by bulkheads installed in the late 1950s and are considered to be separate hydrologic systems; however, the bulkheads may be leaking, thereby allowing water to flow from the West Camp System to the Pit System.

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An important component of the current mining operation is the leach pads area, which is located northeast of the Berkeley Pit and covers an area of 775 acres. The pads consist of low-grade ore and waste rock. An acidic leaching solution is pumped from the MR Precipitation Plant and distributed to the pads. This solution percolates through the pads, leaching copper from the ore. The "pregnant" (copper-laden) solution is collected and piped to the Precipitation Plant for extraction of the dissolved copper.

A major seepage area originates in the Horseshoe Bend area, located in the northwest corner of the Precipitation Plant area. Acidic water discharging (about 2.4 mgd) in the Horseshoe Bend area is routed to a storage pond located immediately west of the Precipitation Plant. A portion of the acidic Horseshoe Bend water (about 0.9 mgd) is presently routed to the Precipitation Plant, mixed with the leaching solution, and pumped to the leach pads area or the tailings pond. The remaining acidic Horseshoe Bend water is channeled past the

Precipitation Plant area and discharged into the Berkeley Pit. Tailings from the milling process at the MR Concentrator are pumped as slurry to the Yankee Doodle Tailings Pond. The tailings pond is a settling basin used to decant water from the tailings slurry. Decanted water in the pond is then pumped back to the concentrator for use in the milling operation. The tailings pond occupies an area of about 960 acres.

The MR Concentrator is located near the south rim of the Berkeley Pit. Currently only ore (approximately 50,000 tons/day) from the Continental Pit, located east of the Berkeley Pit, is milled and processed at the concentrator. The milling process uses water decanted from the tailings pond, imported water from the Silver Lake pipeline, and excess water pumped from the Continental Pit area.

Silver Bow Creek is the main stream drainage within the Butte Mine Flooding OU. Originally the creek flowed from its origin in the mountains northeast of the tailings pond through the area presently altered by mining activities. Mining and other activities in the area have greatly changed the original channel alignment. Surface water flow above the tailings pond is intercepted by the tailings pond and used as makeup water in the milling process. From the tailings pond to the MR Concentrator, the original Silver Bow Creek channel no longer exists. Surface water in the active mining area is controlled by a series of ditches and ponds which convey runoff and mine process water to various locations, including the Berkeley Pit, leach pads, and concentrator area (Figure 2). From the MR Concentrator to the confluence with Blacktail Creek, the former creek has been reconfigured and is known as the Metro Storm Drain. Currently, Silver Bow Creek begins at the confluence of the Metro Storm Drain and Blacktail Creek, from which it receives the majority of its flow. From there, the creek flows west and then north, terminating at Warm Springs Ponds.

The principal geologic rock units within the Butte Mine Flooding OU are the alluvium and the bedrock. The alluvium is a sedimentary deposit consisting of unconsolidated and discontinuous layers of sand, silt, clay, and gravel. The alluvium thickness ranges from 130 feet near the leach pads to 600 feet or more southeast of the Berkeley Pit. Underlying the alluvium is igneous bedrock consisting primarily of quartz monzonite. The upper 100 to 200 feet of the bedrock is weathered (oxidized and decomposed) to a clayey material interspersed with rock fragments.

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The two main aquifers in the area are the bedrock, which underlies the entire OU, and the alluvium, which was deposited over the bedrock in valleys and drainages. Groundwater in the bedrock occurs in fractures, joints, and mine workings. Currently, groundwater levels in the surrounding bedrock aquifer are higher than the water level in the Berkeley Pit, resulting in radial flow of groundwater from the bedrock toward the Pit (Figure 2).

Groundwater in the alluvium flows south from the leach pads area and then west toward the Berkeley Pit (Figure 3). An alluvial groundwater divide exists approximately one mile south of the Berkeley Pit. North of this divide, groundwater flows toward the Pit; south of the divide, groundwater flows parallel to the Metro Storm Drain toward Silver Bow Creek.

The Berkeley Pit is filling with water originating from the surrounding bedrock and alluvial aquifers and also from surface inflows. The water accumulating in the Berkeley Pit and in the bedrock aquifer is acidic and contains high concentrations of metals (Table 1). The source of the contamination is AMD1 from the bedrock in the mine workings, waste rock dumps, and leach pads. Presently, because all bedrock groundwater flow in the area is toward the Berkeley Pit, contaminated mine water is being contained in the East and West Camps (refer to TI evaluation - Appendix 2). However, if water levels continue to rise uncontrolled, the hydraulic gradient could change and contaminated water could begin to flow out of the East and West Camps into the surrounding alluvial groundwater and eventually to Silver Bow Creek. To prevent this from occurring, EPA and the State determined that the water levels in the OU must not rise above the CWLs (East Camp - 5,410 feet, West Camp - 5,435 feet (USGS datum)).

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Underground mining of silver and copper began in Butte in the late 1800s. By 1950, over 400 underground mines, consisting of several thousand miles of interconnected mine 1 AMD (acid mine drainage) results from the oxidation of sulfide minerals such as pyrite exposed to oxygen in air and water forming iron hydroxide, sulfate, and free hydrogen ions.

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TABLE I

AVERAGE CONCENTRATION OF CONSTITUENTS IN BERKELEY PIT, BEDROCK WELL, AND SHAFT WATER AND ESTABLISHED STANDARDS
BUTTE MINE FLOODING OPERABLE UNIT

Constituent	Berkeley Pit Water1 (µg/L)	Bedrock Well Water² (µg/L)	Shaft Water3 (µg/L)	MCLs4 (µg/L)	WQC5(µg/L)	
					Acute	Chronic
Aluminum	270,000	244	675	None	750	87
Arsenic6	710	52	211	50p	360	190
Cadmium	1,790	2.4	100	5p	3.9	1.1
Calcium	440,000	127,610	276,321	None	None	None
Chloride	26,200	4,400	NA	250,000s	19	11
Copper	167,000	26.4	1,581	1 ,300s	18	12
Iron	897,000	9,231	50,094	300s	1,000	1,000
Lead	87	2.4	9.0	15P	82	3.2
Magnesium	395,000	33,400	83,046	None	None	None
Manganese	161,000	2,306	31,503	5,000s	None	None
Potassium	22,700	14,523	12,232	None	None	None
Sodium	71,400	62,200	43,975	None	None	None
Sulfate	16,800,000	577,800	840,583	None	None	None
Zinc	476,000	844	40,375	5s	120	110
pH	3.0-3.3 SU7	5.8-7.6 SU	5.7-7.3 SU	6.5-8.5s SU	None	6.5-9.0 SU

Source: ARCO 1994a

1 Average concentration values are weighted averages of 1991 data based on pit volume.
2 Average concentration values for bedrock monitoring wells A, B, C, D-2, E, and F.
3 Average concentration values for the Chester, Hebgen, Parrot, Anselmo, Belmont, Emma, Granite Mountain, Kelley, Lexington, Margaret Ann, Orphan Boy, and Steward mine shafts.
4 Maximum Contaminant Levels (i.e., primary and secondarys drinking water standards).
5 Acute and chronic aquatic Water Quality Criteria; all values are based on a hardness of 100 mg/L $CaCO_3$ except arsenic and aluminum which are not hardness dependent.
6 Arsenic values are for arsenic 3. Note: State of Montana Water Quality Bureau standard for arsenic (WQB-7) is 3.18 µg/L.
7 Range of pH values in Standard Units.
NC = Not Calculated.
NA = Not Analyzed.

<missing text> workings, had operated or were operating in Butte. In July 1955, the Anaconda Copper Mining Company began open pit mining in the Berkeley Pit. In 1963, the Weed Concentrator (now known as the MR Concentrator) became operational. Ore from the Berkeley Pit was processed at this facility, and concentrates were transported to Anaconda, Montana for smelting. The Atlantic Richfield Company (ARCO) purchased the Anaconda Copper Mining Company in 1977 and owned the Pit and associated property until it was sold to Dennis Washington/Montana Resources, Inc. (MRI) in 1985. In 1989, a partnership known as Montana Resources (MR) was formed between MRI and AR Montana Corporation, a subsidiary of American Smelting and Refining Company (ASARCO). MR was formed to own and operate the property.

Mining in the Berkeley Pit was discontinued in 1983. Since July 1986, open pit mining has been conducted in the East Continental Pit, located east of the Berkeley Pit. Ore from this pit is transported to the MR Concentrator for milling.

To allow underground and later open pit mining in the Butte area, groundwater was lowered by pumping. In latter years, the pumping system was located in the Kelley Mine shaft, just west of the Berkeley Pit. In 1982, pumping was discontinued. As a result, the artificially lowered groundwater level in the area has been rising toward its pre-mining level in the underground mines and the Berkeley Pit. The Pit filling rate is decreasing with time and as the water level rises. For example, the 1988 filling rate was estimated to be 7.6 mgd; the Pit is currently estimated to be filling at a rate of 5 mgd. In December 1993, the elevation of the water in the Pit was 5,062.67 feet (USGS datum) and was increasing by about 2 feet per month. It is currently projected that the CWL of 5,410 feet (USGS datum) for the East Camp/Berkeley Pit System will be reached around the year 20132, if no remedial actions are taken.

The history of pollution problems associated with mining activities in the Butte area led to listing of the Silver Bow Creek Site on the NPL in September 1983. Tailings released from early Butte milling operations and solids eroded from waste rock dumps had covered much of the floodplain of Silver Bow Creek. Another major source of contamination was discharge of metal-enriched mine waters from the Weed Concentrator to the creek. RI/FS work for the Silver Bow Creek site began in late 1984.

During the course of the Silver Bow Creek RI/FS, the importance of Butte as the source of the contamination of Silver Bow Creek was formally recognized. The original listing on the NPL characterized the Silver Bow Creek Site as approximately 28 stream miles beginning at the Metro Storm Drain and extending downstream to Deer Lodge. The EPA proposed modifying the existing Silver Bow Creek NPL Site to include the Butte area. Preliminary results from the Silver Bow Creek RI/FS indicated that sources upstream of the storm drain were partly responsible for the contamination observed in the creek. After a thorough analysis of the relationship between the two areas (Butte and Silver Bow Creek), EPA concluded that the geographical relationship of the headwaters of Silver Bow Creek and the portion of the creek downstream of the city of Butte favored treating these areas as one site under CERCLA (EPA 1986). The site was expanded as proposed to include the Butte area and the formal name of the site was changed to the Silver Bow Creek/Butte Area Site in July 1987 (52 Fed. Reg. 1987).

The Silver Bow Creek/Butte Area site has been divided into seven OUs: Mine Flooding, Priority Soils, Non-Priority Soils, Active Mining Area, Warm Springs Ponds, Rocker, and Streamside Tailings. EPA is the lead agency for the first six OUs, and the State of Montana is the lead agency for remedial activities at the last OU.

Preliminary Butte Mine Flooding OU RI/FS forward planning studies began during the summer of 1987. In support of the Butte Mine Flooding OU, EPA conducted an evaluation of mine flooding in the Berkeley Pit and West Camp (Camp Dresser and McKee, Inc. [CDM] 1988a, b), and an evaluation of the Pit water chemistry (CDM 1988c). These evaluations indicated that it would be necessary to control the rate of Pit filling to prevent impact to the alluvial aquifer and Silver Bow Creek. The evaluations further demonstrated the need to treat the Pit water prior to discharge to Silver Bow Creek.

ENFORCEMENT HISTORY AND ACTIONS

A removal action was implemented in the West Camp area to control potential impacts of rising mine waters. The purpose of the removal action was to prevent flooding of basements and discharge of contaminated groundwater to Silver Bow Creek. An Engineering Evaluation/Cost Analysis (EE/CA) of potential response alternatives was conducted by EPA in support of the West Camp removal action (CDM 1989).

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[2] Assumes current inflow rates and that the water level in the Anselmo Mine remains 20 feet above the Berkeley Pit water level.

On March 31, 1989, EPA entered into an Administrative Order on Consent (AOC) with ARCO and Dennis Washington (the consenting PRPs) pursuant to Section 106(a) of CERCLA as amended by SARA in connection with the West Camp removal action (Table 2). The West Camp order required the consenting PRPs to convey water from the Travona Shaft to the Butte Metro Plant for treatment and discharge to Silver Bow Creek. In the event that the Metro Plant could not accept this water, the consenting PRPs would be required to construct a treatment plant for treatment of Travona Shaft effluent prior to discharge to Silver Bow Creek. This AOC established a preliminary CWL for the West Camp and required the consenting PRPs to maintain water level elevation below 5,435 feet (USGS datum).

A unilateral Order was issued to the non-consenting PRPs (Table 2) to install the pipeline which carried Travona shaft water to the Butte-Silver Metro Sewer Plant line. The non-consenting PRPs complied with this Order.

EPA completed the RI/FS Work Plan for the Butte Mine Flooding OU in April 1990 (CDM 1990). This document outlined the work to be conducted during the RI/FS, the schedule for the work, and the parties responsible for each portion of the work. EPA and the State then entered into an AOC with the consenting PRPs to implement the major portion of this work plan (Table 2). This AOC directed the PRPs to conduct the work according to the Work Plan with EPA and MDHES oversight. The AOC also established a preliminary CWL of 5,410 feet (USGS datum) for the East Camp/Berkeley Pit System and required the PRPs to maintain the water elevation below this level. A unilateral Order was also issued to the non-consenting PRPs to implement a small portion of the RI/FS work plan. The RI/FS was conducted from July 1990 through January 1994. Site investigations, results, and remedial alternative development and evaluation are presented in the Draft RI Report (ARCO 1994a) and the Draft FS Report (ARCO 1994b).

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public participation is required by CERCLA Sections 113 and 117. These sections require that before adoption of any plan for remedial action to be undertaken by EPA, by a State (MDHES), or by an individual (PRP), the lead agency shall:

1. Publish a notice and brief analysis of the Proposed Plan and make such plan available to the public; and

2. Provide a reasonable opportunity for submission of written and oral comments and an opportunity for a public meeting at or near the site regarding the Proposed Plan and any proposed findings relating to cleanup standards. The lead agency shall keep a transcript of the meeting and make such transcript available to the public. The notice and analysis published under item #1 shall include sufficient information to provide a reasonable explanation of the Proposed Plan and alternative proposals that were considered.

Additionally, notice of the final remedial action plan adopted must be published and the plan must be made available to the public before commencing any remedial action. Such a final plan must be accompanied by a discussion of any significant changes to the preferred remedy presented in the Proposed Plan along with the reasons for the changes and a response (Responsiveness Summary) to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the public comment period.

EPA has conducted the required community participation activities through presentation of the RI/FS and Proposed Plan, a 90-day public comment period (after a public request for extension), three informational meetings, a formal public hearing, and a presentation of the Selected Remedy in this ROD. Specifically included with this ROD is a Responsiveness Summary that summarizes public comments and EPA responses.

The RI/FS and proposed Plan for the Butte Mine Flooding OU were released for public comment on January 27, 1994. The RI/FS and Proposed Plan were made available to the public in the Administrative Record located at the EPA Record Center (Helena, Montana), the Butte EPA Office (Butte, Montana), and the Montana Tech Library (Butte, Montana). The notice of availability of the RI/FS and the Proposed Plan was published in the Butte newspaper, The Montana Standard, on January 23 and 27, 1994. A formal public comment period was designated from January 27, 1994 to March 14, 1994. After a request from the Clark Fork Pend Orielle Coalition and others, this public comment period was extended an additional 45 days to April 29, 1994.

The Proposed Plan was mailed to all individuals on the Silver Bow Creek/Butte Area NPL mailing list on January 27, 1994. This list includes 1,000 individuals, the majority residing in Butte, Montana. The RI and FS were supplied to all individuals requesting those documents.

TABLE 2
ENFORCEMENT ACTION ORDERS
BUTTE MINE FLOODING OPERABLE UNIT

ACTION	DATE	DOCKET NO.	ISSUED TO
Administrative Order on Consent for the West Camp/Travona Shaft	March 31, 1989	CERCLA-VIII-89-19	1) ARCO 2) Dennis Washington
Administrative Order (UAO) for the West Camp/Travona Shaft	March 31, 1989	CERCLA-VIII-89-18	1) New Butte Mining Inc. 2) Tzarina-Travona Mining Corp.
Administrative Order on Consent for the Remedial Investigation/ Feasibility Study	May 17, 1990	CERCLA-VIII-90-09	1) Atlantic Richfield Company 2) Mr. Dennis Washington 3) Montana Resources Inc. 4) AR Montana Corporation 5) ASARCO, Inc. 6) Montana Resources
Administrative Order (UAO) for the Remedial Investigation/ Feasibility Study	May 17, 1990	CERCLA-VIII-90-10	1) Central Butte Mining Co. 2) North Butte Mining Company 3) Tzarina-Travona Mining Corp. 4) Mountain Con Mining Co. 11) New Butte Mining, Inc.

EPA held an informational meeting in Butte on January 27, 1994 to explain the RI/FS process, outline the Proposed Plan and the preferred alternative, and to answer questions regarding the alternatives. A press conference and meeting of elected officials was also held on January 27, 1994. At this press conference, EPA explained the Proposed Plan, the preferred alternative, and answered questions from the press and public officials. EPA held an informational meeting in Butte on February 1, 1994 to explain technical information relating to the RI/FS, the Proposed Plan, and the preferred alternative. Another informational meeting was held by EPA in Butte on March 8, 1994. The March 8th meeting was informal in nature and allowed for one-on-one discussions with EPA, MDHES, and PRP officials. A notice of each meeting was published in the Butte newspaper, The Montana Standard, (January 27; February 1; March 8, 1994).

In addition to the formal meetings, EPA made presentations, answered questions, and discussed the Proposed Plan and RI/FS with several groups, including the Citizens Technical Environmental Committee (CTEC), Clark Fork Pend Orielle Coalition, the Butte-Silver Bow Council of Commissioners, the Silver Bow Kiwanis, and the Big Butte Kiwanis. The EPA Project Manager discussed the Proposed Plan, RI/FS, and preferred alternative on a radio call-in show (Party Line--February 22, 1994) and a television public affairs show (Focus-- March 13, 1994).

A formal public hearing was held in Butte on April 26, 1994. At this hearing, representatives from EPA answered questions about remedial alternatives under consideration, as well as the preferred remedy. A portion of the hearing was dedicated to accepting formal oral comments from the public. A court reporter transcribed the formal oral comments and EPA made the transcript available by placing it in the Administrative Record. A response to comments received during the public comment period is included in the Responsiveness Summary, which is part of this ROD. Also, community acceptance of the selected remedy is discussed in Section 9 (Summary of Comparative Analysis of Alternatives) of this Decision Summary.

4. SCOPE AND ROLE OF THIS OPERABLE UNIT WITHIN SITE STRATEGY

EPA has identified seven OUS within the Silver Bow Creek/Butte Area site. These are: Mine Flooding, Priority Soils, Non-Priority Soils, Active Mining Area, Warm Springs Ponds, Streamside Tailings, and Rocker. EPA is the lead agency for remedial activities at the first five OUs, and the State of Montana is the lead agency for the Streamside Tailings and Rocker OUS.

Actions at the Silver Bow Creek/Butte Area site OUS are concerned with the impacts of mining activities on surface waters, groundwater and soils and the potential health effects resulting from mining activities in the areas of Butte and Silver Bow Creek. The Butte Mine Flooding OU is located in the upstream portion of the Silver Bow Creek/Butte Area site and, thus, a release of contamination from this OU would cause further detrimental impacts to surface water and groundwater in downstream OUS. Remediation in the Butte Mine Flooding OU is considered a priority by EPA because of the rate of flooding (currently 5 mgd) and extremely high toxicity to aquatic life of the water contained in the bedrock system and the potential downstream impacts and risks to human health and the environment which would be caused by the release of the contaminated waters. Remedial actions undertaken in the Mine Flooding OU will complement future actions in the other Silver Bow Creek/Butte Area site OUS. Significant cleanup actions have already been initiated for other OUS at this site to improve water quality in Silver Bow Creek and the Clark Fork River. The action described herein will ensure that contamination in the Butte Mine Flooding OU will not contribute to the degradation of Silver Bow Creek or the Clark Fork River.

The Butte Mine Flooding RI/FS was conducted by the PRPs with EPA and State oversight from 1990 to 1994 to identify and evaluate the nature and extent of contamination associated with mine flooding and to identify and evaluate potential remedial alternatives. The major objectives of the RI/FS were:

1. To establish safe elevations below which the water in the Berkeley Pit/East Camp and Travona/West Camp Systems must be maintained in order to contain contaminated water in these systems;

2. To identify and evaluate alternatives that protect the alluvial aquifer and Silver Bow Creek from contaminated bedrock system waters;

3. To evaluate alternatives that would maintain the water levels in the OU below the safe water levels;

4. To develop alternatives to ensure that treated water discharged to the Silver Bow Creek drainage meets Federal and State standards.

The remedy presented in this ROD represents the final remedial actions for the Butte Mine Flooding OU. The purpose of the remedy is to contain contaminated water within the East and West Camp Systems by keeping the water levels below the established CWLs. This is intended to prevent the release of contaminated water to the alluvial aquifer and Silver Bow Creek. All water treated in conjunction with this remedy shall meet

Silver Bow Creek discharge standards. These actions are intended to prevent the exposure of human and aquatic life to contaminated groundwater and surface water. The remedy for the Butte Mine Flooding OU is intended to be consistent with remedial action objectives identified for and remedial actions undertaken at other site OUS.

5. SUMMARY OF SITE CHARACTERISTICS

Water in the Berkeley Pit, surrounding bedrock aquifer, and the shafts contains high levels of toxic metals and arsenic as a result of water levels rising in the mine workings, and from contaminated surface water inflows (see Table 1). The source of the contamination is AMD which results from the oxidation of sulfide minerals (in the presence of oxygen) to form iron hydroxide, sulfate, and free hydrogen ions. Water in the alluvial aquifer between the leach pads and Pit is also contaminated with high levels of metals as a result of seepage from the leach pads. Due to the presence of the Berkeley Pit and a groundwater divide located south of the Pit, all groundwater in the OU is presently flowing toward the Pit and contaminated water has not migrated offsite.

The preliminary CWLs have been established by EPA to contain the contaminated water in the Berkeley Pit and West Camp Systems. If either CWL is exceeded, there is the potential for the present hydraulic gradient to change, resulting in the flow of contaminated water away from the OU. This water could potentially move in the alluvial aquifer or on the ground surface toward Silver Bow Creek and could result in the potential exposure of human and aquatic life to contaminants.

REMEDIAL INVESTIGATION

During the RI, the Inflow Control Investigation collected data on the mine operation and Pit water balance. This information was used in the FS to evaluate alternatives for controlling the rate of Pit filling. The Neutralization Investigation collected chemical information on the Berkeley Pit water for evaluating treatment alternatives. The Alluvial Aquifer Investigation in the area of the leach pads evaluated the impact of the leach pads on the alluvial aquifer. The Bedrock Aquifer Investigation ascertained the quality and level of water in the deeper aquifer, determined flow direction, and assessed the potential impact of the rising bedrock aquifer on the alluvial aquifer. The major findings of the RI are as follows:

- The preliminary CWLs corresponding to the 5,410 foot elevation (USGS datum) for the Pit System and 5,435 foot elevation (USGS datum) for the West Camp System were confirmed as being protective of Silver Bow Creek/Blacktail Creek and the associated alluvial aquifer from contaminated bedrock aquifer waters. These water levels are considered safe levels (i.e., protective of human health and the environment) because the alluvial water elevations adjacent to the Pit are at least 50 feet higher than these CWLs.

- The Inflow Control Investigation found that the average rate of surface inflow to the Berkeley Pit is 1.68 mgd, the majority of which comes from the Horseshoe Bend area. The investigation further determined that outflow from the seeps in the Horseshoe Bend area average 2.4 mgd, part of which flows to the Pit (1.54 mgd), and part of which is re-used in the leach pads operation and integrated into the tailings circuit (0.86 mgd) (Figure 4). The quality of the Horseshoe Bend water was similar to the quality of the Berkeley Pit water. It was determined that if surface water in the Horseshoe Bend area is controlled and prevented from entering the Berkeley Pit, the water level in the Pit System (East Camp) would not reach the CWL until after the year 2025 [3]. Total inflow into the East Camp System is about 5 mgd. About half of this flow is uncontrollable bedrock recharge and about 0.58 mgd is uncontrollable flow from the alluvial aquifer.

- The Bedrock Aquifer Investigation and monitoring program confirmed that the contaminated bedrock aquifer groundwater is moving toward the Berkeley Pit. Bedrock aquifer water in unmined areas at the periphery of the East Camp cone of depression showed low concentrations of metals, while samples from mine shafts exhibited elevated metals concentrations.

- The Leach Pads Area Alluvial Aquifer Investigation demonstrated that the alluvial aquifer in the leach pads area has been contaminated by the leach pads operation.

  This investigation also showed that flow in the alluvial aquifer in the leach pad area is presently toward the Berkeley Pit. Alluvial water levels in the area adjacent to the Pit were found to be at least 50 feet higher than the CWL.

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[3] Assumes Anselmo Mine water level remains 20 feet above the Berkeley Pit water level.

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- The Neutralization Investigation was conducted to evaluate the feasibility of using alkaline mine tailings to treat acidic water present in the Berkeley Pit. Samples of Pit water were collected to characterize Pit water chemistry. Results showed that the Pit water is an acidic, moderately oxidizing, sulfate solution with elevated concentrations of numerous constituents, including aluminum, arsenic, copper, iron, lead, manganese, and zinc. Levels of aluminum, copper and zinc are more than 1,000 times greater than the chronic water quality criteria for the protection of aquatic life. Iron is also significantly greater (more than 900 times) than the water quality criteria. Primary maximum contaminant levels (MCLs) were exceeded for arsenic, copper, lead and cadmium.

FEASIBILITY STUDY

The FS was conducted to identify, screen, develop, and evaluate remedial alternatives designed to reduce or eliminate the human health and/or environmental risks identified during the RI. Phase I of the FS included the initial evaluation and screening of treatment technologies; Phase II included treatability testing and evaluation of treatment technologies which survived the initial screening process; and Phase III included the detailed analysis of remedial alternatives. Three primary treatment technologies and 5 polishing treatment technologies survived the initial evaluation and screening (Phase I) and 10 technologies were eliminated. The Phase II testing/evaluation narrowed the technology range to hydroxide precipitation for primary treatment and reverse osmosis for polishing treatment. These technologies were then assembled with several flow/process options to form 19 alternatives for further evaluation. After further screening of alternatives, seven alternatives were carried through the Phase III detailed analysis of alternatives. These seven alternatives were narrowed down to the preferred alternative presented in the proposed plan.

The specific alternatives evaluated in the FS are presented in Section 8 and details of this evaluation are presented in Section 9 of this ROD. Significant findings of the Treatability Study are as follows:

- The addition of tailings slurry to the Berkeley Pit to neutralize the acidic Pit water was found to be infeasible due to the excessive volume of tailings slurry required for neutralization. The addition of the necessary volume of slurry to the current volume of water in the Pit would significantly reduce the time to reach the CWL.

- Water Quality Standards for Silver Bow Creek can be met through a two-stage hydroxide precipitation and aeration process followed (if necessary) by a reverse osmosis polishing step.

6. SUMMARY OF SITE RISKS

A baseline Risk Assessment (RA) was conducted by EPA to evaluate potential future human health and environmental risks associated with mine flooding if no remedial actions are undertaken at the OU (CDM Federal 1993). The RA was prepared in accordance with EPA guidance documents (see the RA report for a listing of the specific guidance).

It is important to note that the PRPs have an agreement with EPA (see Enforcement History and Action section) that directs them to maintain the water level below the 5,410 foot elevation in the Berkeley Pit and at other designated points in the East Camp System. EPA and MDHES believe that this agreement precludes any direct impacts on the alluvial aquifer and/or Silver Bow Creek from contamination originating from the Pit System. However, in the absence of compliance with this agreement and any remedial actions, contaminated water in the Pit System could eventually flow into the alluvial aquifer (with eventual flow into Silver Bow Creek) or may overflow to Silver Bow Creek. In this evaluation of the no-action alternative, it was assumed that the CWL in the Pit System would be exceeded. The risks associated with the no-action alternative must be evaluated as a basis for comparison with other remedial alternatives.

<u>CONTAMINANTS OF CONCERN</u>

The contaminants of concern (COCs) in groundwater and surface water that were considered in the human health RA were arsenic, cadmium, lead, sulfate, and zinc. The COCs considered in the evaluation of ecological risks were aluminum, arsenic, cadmium, copper, iron, lead and zinc. These contaminants exhibit carcinogenic and/or toxic characteristics.

They are found at elevated levels in the Berkeley Pit water. The estimated future concentrations of the COCs on which the RA was based are presented in Table 3.

HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment was developed from surface water and groundwater concentrations measured during the RI for three future discharge scenarios:

1. A drinking water well located in the alluvial aquifer containing water discharged from the Berkeley Pit,

2. Surface water in Silver Bow Creek resulting from discharge of Pit water to the alluvial aquifer and eventually to the creek, and

3. Surface water in Silver Bow Creek resulting from Pit overflow directly into the creek.

HUMAN EXPOSURE ASSESSMENT

Exposure assessment is the estimation of magnitude, frequency, duration, and route of exposure to COCs. This includes the estimation of exposure point concentrations and the development of chemical intake estimates.

Since current exposure pathways do not exist, current exposure scenarios were not evaluated in the RA. However, exposure could occur to future residents of the area if there was a release of water from the contaminated bedrock system into the alluvial system and Silver Bow Creek. A future residential scenario was developed for the RA that assumes no restriction of access to Silver Bow Creek or the alluvial aquifer as a source of drinking water. Receptors evaluated in the RA included lifetime residents and children. Exposure pathways included 1) direct ingestion of contaminated drinking water (groundwater or surface water), 2) incidental ingestion of contaminated surface water during recreational activities, and 3) dermal absorption of contaminated surface water during recreational activities.

Exposure point concentrations were developed previously for the three discharge scenarios (Table 3). The magnitude of exposure was then estimated by calculating chronic daily intakes (CDIs) for each exposure pathway. To calculate CDIs, many assumptions were made in accordance with EPA guidance. These intakes were then compared to toxicity values to quantify risks for each exposure pathway. Lead intake estimates for children were estimated using the Integrated Exposure/Uptake/Biokinetic (IEUBK) lead model.

HUMAN TOXICITY ASSESSMENT

The toxicity assessment examined the potential for each COC to cause adverse effects in exposed individuals. The assessment also provided an estimate of the dose-response relationship between the degree of exposure to a COC and adverse effects. Criteria for carcinogens are presented as cancer slope factors and criteria for noncarcinogens are presented as reference doses, with the exception of lead, which was evaluated using the EPA IEUBK lead model. A thorough explanation of the health effect criteria for potential carcinogens and non-carcinogens and the toxicity profiles for the COCs are presented in the Baseline Risk Assessment (CDM Federal 1993). A summary of these is presented below.

Health Effects Criteria For Potential Carcinogens

Cancer slope factors are developed by EPA's Carcinogen Assessment Group (CAG) for potentially carcinogenic chemicals. In the case of arsenic, the slope factor was derived from the results of human epidemiological studies. The cancer slope factor describes the increase in an individual's risk of developing cancer over a 70-year lifetime per unit of exposure. When the cancer slope factor is multiplied by the lifetime average dose of a potential carcinogen, the product is the upper-bound lifetime individual cancer risk associated with exposure at that dose. This calculated risk is an estimate of the increased likelihood of cancer resulting from exposure to a COC. These estimates of the upper limits on lifetime risk are unlikely to underestimate risks. Therefore, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using a cancer slope factor, they could be considerably lower.

EPA also assigns weight-of-evidence classifications to potential carcinogens. Under this system, arsenic is classified as a Group A chemical, or a human carcinogen. This classification indicates that there is sufficient evidence to support the causal association between exposure to arsenic in humans and cancer. Cadmium has been classified as a Group B1 or probable human carcinogen for inhalation exposure only. This classification is for chemicals with sufficient evidence of carcinogenicity in animals but limited evidence in humans. Lead has been classified as a Group B2 or probable human carcinogen. This means that there is sufficient evidence of carcinogenicity in animals, but inadequate evidence of carcinogenicity in humans. Zinc has been assigned classification D, which indicates that the evidence for carcinogenicity in animals is inadequate.

TABLE 3

ESTIMATED FUTURE CONCENTRATIONS IN THE ALLUVIAL AQUIFER DOWNGRADIENT OF THE BERKELEY PIT AND IN SILVER BOW CREEK GIVEN THREE PIT WATER DISCHARGE SCENARIOS

		Chemical Concentrations									
Discharge Scenario	Flow Regime	Aluminum (µg/L)	Arsenic (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)	Sulfate (mg/L)	pH (Standard Units
Scenario No. 1 Alluvial Drinking Water Well	Not Applicable	262,000	1,070	2,020	177,00	1,021,500	134	526,000	2,764	6,530	3.2
Scenario No. 2 Discharge to Alluvial Aquifer	Chronic1	27,840	118	210	18,810	94,050	10	55,830	412	783	5.17
	Acute²	49,540	206	380	33,440	176,810	10	99,380	630	1361	4.94
Scenario No. 3 Pit Overflow	Low Flow3-Chronic	80,750	332	620	54,540	302,470	20	162,140	941	2192	4.65
	Low Flow-Acute	122,300	500	940	82,600	473,580	30	245,570	1359	3293	4.30
	High Flow4-Chronic	100,430	412	770	67,800	383,110	20	201,440	1139	2712	4.48
	High Flow-Acute	143,750	587	1,110	97,090	558,470	30	288,590	1547	3866	3.98

Source: CDM Federal 1993.

1 Chronic refer to potential in-stream concentrations during average streamflow conditions (14.1 cfs).
2 Acute refers to potential in-stream concentrations during the 7-day, 10-year low flow event (7.23 cfs).
3 Low Flow refers to the lower end of the discharge range estimated for the Berkeley Pit overtopping scenario (4 mgd=6.2 cfs).
4 High Flow refers to the upper end of the discharge range estimated for the Berkeley Pit overtopping scenario (5.6 mgd=8.6 cfs).

Bold print in flow regime represents the concentrations used in the risk assessment for discharge to the alluvial aquifer and pit overflow into Silver Bow Creek.

µg/L = micrograms per liter
mg/L = milligrams per liter
CFS = cubic feet per second
mgd = million gallons per day

Health Effects Criteria For Noncarcinogens

Health effects criteria for chemicals exhibiting noncarcinogenic effects are generally developed using reference doses (RfDs) developed by the EPA RfD Work Group, or RfDs obtained from Health Effects Assessment Summary Tables (HEAST). The chronic RfD is an estimate of the daily exposure to the human population (including sensitive subpopulations) that is likely to be without an appreciable risk of deleterious effects during a lifetime. These RfDs are usually derived either from human studies involving workplace exposures or from animal studies, and are adjusted using uncertainty factors. The uncertainty factors used in developing RfDs use conservative assumptions based on the differences between the environmental human exposure situation and the animal bioassay from which the data were derived. Due to the conservative nature of these factors, a margin of safety is implicit in their use. The RfD provides a benchmark to which chemical intakes by various routes (e.g., via exposure to contaminated environmental media) may be compared.

Human Toxicity Profiles

The major adverse health effects associated with lead are alterations in blood and nerves. Exposure to high levels of lead will result in severe lead poisoning, which may cause coma, convulsions, profound and irreversible mental retardation, seizures, and even death. Less severe effects at lower dosages include damage to receptor nerves, anemia, delayed cognitive development, reduced IQ, high blood pressure, and impaired hearing. Even smaller dosages have been implicated in enzyme inhibition, changes in red blood cell chemistry, interference with Vitamin D metabolism, cognitive dysfunction in infants, changes in the ability of nerves to transmit signals, and reduced childhood growth. Because their nervous systems are still developing, fetuses and children 0-3 years of age are most affected by the lower doses and are, therefore, the most sensitive population.

Arsenic is also a well-known poison and human carcinogen. Chronic oral exposure of humans to arsenic can produce toxic effects on the entire nervous system, age spots and warts, thickening and darkening of the skin, skin lesions, blood damage, and cardiovascular damage. Ingestion of arsenic has been linked to a form of skin cancer and more recently to bladder, liver, and lung cancer.

Cadmium, when ingested, has been shown to be associated with kidney disease, bone damage, high blood pressure, anemia, and suppression of the immune system.

Ingestion of large amounts of sulfate can result in diarrhea, catharsis; and possible dehydration. Infants appear to be a sensitive subpopulation.

Acute toxicity of ingested zinc results in gastrointestinal distress and diarrhea. Long-term zinc ingestion may result in copper deficiency and anemia. Liver and kidney effects have been observed in experimental animals after chronic exposure to zinc.

HUMAN HEALTH RISK CHARACTERIZATION

Risks from all exposure routes and pathways were combined to provide an estimate of total carcinogenic and noncarcinogenic health risks. A detailed analysis of the risks for these pathways is presented in the RA. It should be noted, however, that the direct ingestion of contaminated drinking water is the predominant exposure pathway. Incidental ingestion and dermal contact were much less significant pathways. For lead, estimated blood lead levels were compared to blood lead levels considered to be of concern to human health.

Carcinogenic Risks

The RA estimated the excess lifetime cancer risk from exposure to arsenic at the BMFOU. EPA's acceptable cancer risk range for Superfund sites is from one in 10,000 (1E-04) to one in 1,000,000 (1E-06) additional probability that an individual may develop cancer over a 70-year lifetime. EPA's (Superfund guidance) maximum acceptable risk probability is one in 10,000 (1E-04). A risk of one in 10,000 means that one person out of 10,000 could develop cancer as a result of a lifetime exposure to the site contaminants. This refers to the incremental risk that is above and beyond the chance that an individual may develop some form of cancer from other sources.

The estimated lifetime arsenic cancer risks for the exposure pathways evaluated in the RA are summarized in Table 4. Under both the reasonable maximum exposure (RME) and the central tendency exposure (CTE), the RA (CDM Federal 1993) predicted that all future exposure scenarios would result in cancer risks from arsenic that exceed EPA's maximum risk probability of 1E-04. The RME is the maximum exposure that is reasonably expected to occur for an individual while the CTE uses exposure parameters that represent average exposure.

TABLE 4

SUMMARY OF POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISK
BUTTE MINE FLOODING OPERABLE UNIT

Future exposure Pathways and Contaminant Sources	Carcinogenic Risk1	Noncarcinogenic Risk[2]
Lifetime Reasonable Maximum Exposure (RME)		
Drinking Alluvial Groundwater plus the Incidental Ingestion of Surface Water (source: alluvial groundwater discharge)	5.27E-03	3.93E+02
Drinking Surface Water (source: alluvial groundwater discharge) plus the Incidental Ingestion of Surface Water (source: alluvial groundwater discharge)	5.81E-04	4.35E+01
Drinking Surface Water (source: Berkeley Pit overflow) plus the Incidental Ingestion of Surface Water (source: Berkeley Pit overflow)	2.03E-03	1.56E+02
Drinking Alluvial Groundwater plus the Incidental Ingestion of Surface Water (source: Berkeley Pit overflow)	5.27E-03	3.96E+02
Lifetime Central Tendency Exposure (CTE)		
Drinking Alluvial Groundwater plus the Incidental Ingestion of Surface Water (source: alluvial groundwater discharge)	1.01E-03	2.16E+02
Drinking Surface Water (source: alluvial groundwater discharge) plus the Incidental Ingestion of Surface Water (source: alluvial groundwater discharge)	1.11E-04	2.33E+01
Drinking Surface Water (source: Berkeley Pit overflow) plus the Incidental Ingestion of Surface Water (source: Berkeley Pit overflow)	3.89E-04	8.33E+01
Drinking Alluvial Groundwater plus the Incidental Ingestion of Surface Water (source: Berkeley Pit overflow)	1.01E-03	2.16E+02

Source: CDM Federal 1993.

1 Arsenic carcinogenic risk.
2 Each figure is the total hazard index and represents the sum of the individual risks from arsenic, cadmium, sulfate and zinc for the specific pathway/source combination.

Noncarcinogenic Risks

To evaluate the potential for adverse noncarcinogenic effects, CDIs were compared to reference dose values. A CDI:RfD ratio (hazard quotient) exceeding one indicates that adverse effects could occur. A Hazard Index (HI) is equal to the sum of the hazard quotients for all COCs for a specific pathway/source. When the HI exceeds one, there is a potential for adverse health effects to occur for that pathway/source combination.

Noncarcinogenic risks from exposure to arsenic, cadmium, sulfate, and zinc are also summarized in Table 4. The RA showed the HI to exceed one for all receptors and exposure pathways evaluated, indicating the potential for future adverse health effects. These were found to be mainly associated with exposure to arsenic and cadmium.

Lead Exposure

Lead exposure was evaluated by estimating future blood-lead levels in children using EPA's IEUBK Lead Model. EPA's acceptable level is 95 percent of the exposed population with a blood-lead level below 10 micrograms per deciliter (μg/dl). The RA showed that if contaminated bedrock aquifer water was discharged to the alluvial groundwater and used as drinking water, over 50 percent of the exposed children would have a blood-lead level greater than 10μg/dl. Predicted percentages of children with blood-leads greater than 10μg/dl for the incidental ingestion of surface water from the alluvial groundwater and the Pit overflow discharge scenarios were 0.7 and 2.25 percent, respectively.

ECOLOGICAL RISK ASSESSMENT

The ecological risk assessment qualitatively evaluated potential risks to aquatic receptors by comparing potential surface water metals concentrations to Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life.

POTENTIAL ECOLOGICAL RECEPTORS

Aquatic Communities

Silver Bow Creek adjacent and downstream from the BMFOU does not support a fisheries population. Westslope cutthroat trout and bull trout are reported to have once been caught in the vicinity of Butte prior to intensive mining activities. Mining related wastes still prevent the establishment of a fishery in Silver Bow Creek.

Five species of trout have been recorded within the Silver Bow Creek watershed and, therefore, were selected as potential ecological receptors. These include the westslope cutthroat trout, rainbow trout, brook trout, bull trout, and brown trout. Although no trout species are found in Silver Bow Creek due to historical metals contamination in this area, there is potential for these species to occur if water quality in Silver Bow Creek improves due to their presence in associated tributaries to Silver Bow Creek. A viable aquatic community, including fish, does occur in Blacktail Creek, a tributary to Silver Bow Creek just above the study area. Blacktail Creek contributes the largest flow to the creation of Silver Bow Creek. Fish and other aquatic animals may move downstream from Blacktail Creek into the study area.

Benthic invertebrate communities have re-established themselves within Silver Bow Creek since the cessation of direct mine process waste water discharges. Mayflies, caddis, and stoneflies have been collected, although they demonstrate low density and limited diversity. The Aquatic Resources Injury Assessment Report for Upper Clark Fork River Basin (June, 1993) stated that the U.S. Fish and Wildlife Service (USFWS) and University of Wyoming (1992) measured hazardous substances in benthic invertebrates in Silver Bow Creek near Warm Springs Ponds. Although the concentrations of hazardous substances in the macroinvertebrates collected were high, macroinvertebrates would be expected to flourish in a remediated Silver Bow Creek, as they are found in nearby tributaries which are not contaminated with mining wastes.

Aquatic vegetation and algae have been observed in and collected from Silver Bow Creek. A survey conducted in 1984 indicated the presence of an emergent aquatic grass, downstream of the BMFOU in Silver Bow Creek. However, the current status of aquatic vegetation is not known.

Terrestrial Communities

Although terrestrial ecological risks were not evaluated in the RA, the environmental setting for terrestrial communities is presented in the RA. No terrestrial communities within the BMFOU have been identified as critical habitat or communities of special concern. No rare or endangered plants were identified within the BMFOU or downstream of this area. Vegetation growing adjacent to Silver Bow Creek within the study area is limited to common willows and grasses. Shrubs indicative of dry conditions are found throughout the study area. The USFWS has stated that there are no threatened or endangered wildlife species present in the BMFOU or in the near vicinity. Although no wildlife surveys have been conducted within the BMFOU, it is anticipated that wildlife typical of disturbed and rural residential areas would be found. This could include medium-sized mammals such as rabbits and foxes, and small mammals that are commonly found in disturbed areas such as field mice and rats. Also included in this category would be songbirds, waterfowl, and birds of prey. Downstream of the study area, as the impacts from human activities decrease, larger mammals such as elk, deer, and coyote may be found.

ECOLOGICAL EXPOSURE PATHWAYS

The RA evaluated the potential risk to aquatic receptors in Silver Bow Creek and in offsite reference locations in the event that contaminated Berkeley Pit System water discharged to Silver Bow Creek. In the event that the water level in the Pit System was allowed to rise unrestricted, this contaminated water could reach Silver Bow Creek by flowing through the alluvial aquifer and/or by overflowing the Pit rim. Under either scenario, the contaminated water entering Silver Bow Creek would have approximately the same concentration of contaminants as the Berkeley Pit System water.

The primary exposure route for aquatic receptors is ingestion of surface water/sediment, aquatic vegetation, and contaminated prey such as macroinvertebrates. In accordance with EPA guidance, sediment and surface water were considered as an integrated exposure pathway because of the complex chemical equilibrium between these two media. However, for risk assessment, only surface water was evaluated as a potential exposure pathway for aquatic life. This is sufficient to demonstrate the severity of the problems that this contaminated water presents to ecological receptors.

POTENTIAL EXPOSURE CONCENTRATIONS AND REGULATORY CRITERIA.

Table 3 presents the predicted concentrations of the COCs in Silver Bow Creek water under the combination of flow regimes (average [chronic] and low [acute]) and the ranges of water flow rates from the Berkeley Pit System. For example, if the Berkeley Pit were to discharge at a high rate and the flow in Silver Bow Creek was at the 7-day, 10-year low, then the concentration of copper in the creek is predicted to be 97,090 µg/L.

ECOLOGICAL RISK CHARACTERIZATION

Table 5 compares the estimated concentrations of the COCs in Silver Bow Creek if Berkeley Pit System water discharged to the creek to the EPA hardness-adjusted Ambient Water Quality Criteria (AWQC). The two discharge scenarios used were discharge through the alluvium and from the Pit overflowing. Impacts to the aquatic ecosystem were evaluated in the RA (CDM Federal 1993) for the alluvial discharge scenario by comparing the Silver Bow Creek surface water concentrations under average (i.e., chronic) flows to the hardness-adjusted acute and chronic AWQC. For the Pit overflow scenario, the estimated high flow from the Berkeley Pit was combined with the average Silver Bow Creek flow and then compared to the hardness-adjusted acute and chronic AWQC.

Results of the RA indicate that if Berkeley Pit System water were allowed to discharge to Silver Bow Creek the concentration of the COCs in the creek would exceed the AWQC (Table 5). The impact to the down gradient aquatic ecosystems under either discharge scenario would be catastrophic in both nature and extent. Trout are particularly sensitive to copper and zinc (see Toxicity section of the RA). If Pit water discharged through the alluvium to Silver Bow Creek the copper (18,810 µg/L) and zinc (55,830 µg/L) concentrations in the creek could be more than 480 and 164 times the chronic AWQC, respectively. This concentration of copper and zinc would preclude the establishment of a viable fishery in Silver Bow Creek.

HUMAN HEALTH AND ENVIRONMENTAL RISK ASSESSMENT SUMMARY

The RA focused on the potential risks associated with alluvial groundwater and surface water contaminated with Berkeley Pit water in a future residential scenario, and on potential risks to aquatic life. The results of the RA showed that future risks to human health and the environment exist above the level considered acceptable to EPA if no remedial actions are taken for this OU. The major future health risk to area residents is associated with the ingestion of contaminated groundwater or surface water. The major future ecological risk is associated with exceedences of standards intended to protect aquatic life. The results of the RA indicate that to protect human health and the environment, it will be necessary to prevent water in the Pit System from escaping through the alluvial aquifer, or by overland flow, and ultimately discharging into Silver Bow Creek.

TABLE 5

ESTIMATED FUTURE CONCENTRATIONS IN SILVER BOW CREEK AND HARNESS-ADJUSTED AMBIENT WATER QUALITY CRITERIA
BUTTE MINE FLOODING OPERABLE UNIT

Discharge	Flow Regime	Chemical Concentrations						
		Aluminum (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Zinc (µg/L)	Hardness (mg/L)
Through the Alluvial Aquifer	Chronic1	27,840	210	18,810	94,050	10	55,830	412
From Pit Overflow	High Flow-Chronic1	100,430	770	67,800	383,110	20	201,440	1139
Ambient Water Quality Criteria	Acute AWQC	750	19	65	1,000	477	380	400[2]
	Chronic AWQC	87	3.4	39	1,000	19	340	400[2]

Source: CDM Federal 1993 and EPA Ambient Water Quality Criteria.

1 Chronic refers to potential in-stream concentrations during average streamflow conditions (14.1 cfs).
High Flow refers to the upper end of the discharge range estimated for the Berkeley Pit overtopping scenario (5.6 mgd=8.6 cfs).
2 The maximum allowable hardness for AWQC adjustment is 400 mg/L.

µg/L = micrograms per liter
mg/L = milligrams per liter
cfs = cubic feet per second
mgd = million gallons per day

7. REMEDIAL ACTION OBJECTIVES

EPA and the State's overall remedial action objective for this OU is to prevent human and aquatic exposure to contaminated groundwater and surface water. This objective was developed based on evaluations of the site RA and ARARs and will be met by accomplishing the following specific remedial action objectives:

1. Ensuring that the CWLs (i.e., the safe water levels) for the Pit System (5,410 feet, USGS datum) and the West Camp System (5,435 feet, USGS datum) are not exceeded so that contaminated mine water is contained and does not discharge to the alluvial aquifer or Silver Bow Creek,

2. Ensuring that treated water discharged to the Silver Bow Creek drainage meets State of Montana and other pertinent water quality standards,

3. Implementing institutional controls on the public's access to contaminated bedrock aquifer water to ensure the protection of public health, and

4. Implementing a comprehensive monitoring program to verify the protectiveness of the CWLs and to ensure that contaminated water is being contained.

8. DESCRIPTION OF ALTERNATIVES

Nineteen remedial alternatives for addressing the mine flooding problem were evaluated in the screening portion of the FS. Seven of these remedial alternatives (1, 2/3, 4/5, 6/7) for addressing the mine flooding problem were retained for detailed analysis in the FS. The other 11 alternatives were eliminated because of exorbitant costs or implementability limitations.

The alternatives were developed based on water treatment technologies and flow options that were selected via the initial screening process and subsequent treatability testing. Each alternative was divided into time periods that included current mining, post-mining, and the period after which the CWL is approached in the Pit System. For the purpose of the FS analysis, current mining was assumed to continue until 2005; and the post-mining period was assumed to extend from 2006 to the time when the CWL is approached for the specific remedial alternative. These assumptions are in no way meant to be a prediction of future mining, rather they are used as uniform assumptions that allow the comparative evaluation of remedial alternatives.

The estimated costs presented for each alternative reflect the net present value of capital and annual operating and maintenance (O&M) costs. With the exception of the no-action alternative, capital costs include the costs for constructing a treatment facility and sludge disposal area, and purchasing the required pumps and piping. O&M costs for the alternatives (excluding no-action) include costs for the monitoring programs, maintaining the treatment facility, pumps and pipelines, and purchasing treatment supplies and chemicals.

It should be noted that costs associated with the alternatives presented in the FS do not include the cost of controlling the West Camp System (Present Worth of $1.7 million). An alternatives analysis (Engineering Evaluation/Cost Analysis - CDM 1989) and decision document (Action Memorandum - see Enforcement History and Actions section) for mitigating the West Camp was prepared by EPA.

Each alternative includes institutional controls (ICs). These ICs include local government land use and development regulations and controls on groundwater access. For the post-mining period, institutional controls are the same as listed above and should complement dedicated development and mine reclamation. Currently, Butte-Silver Bow County Government is developing an institutional control package for all Superfund activities within the. EPA and the State plan to work with Butte-Silver Bow in the development of these institutional controls to ensure that there is no inappropriate use of contaminated bedrock aquifer water that would threaten human health or the environment. It is EPA's and the State's preference that any needed institutional controls be implemented through local government. In the event that ICs cannot be implemented through local government, state and federal authority to implement needed ICs will be examined. The public will be included in all discussions concerning implementation of ICs.

A comprehensive monitoring program would be implemented under all alternatives. This program would monitor surface water and groundwater (alluvial and bedrock) quality and levels in the Pit System and the West Camp System in shafts and other designated monitoring points. Based on this information, the Agencies will ensure that water levels do not rise above the CWLs. Monitoring program data would be used to ensure that treatment facilities are in place and operating prior to mine waters reaching the CWL and to provide information for assessing the impact of the rising waters. Monitoring program data will be used to verify the protectiveness of the CWLs.

Each alternative, except the no-action alternative, contains variations of pumping and/or treatment schemes necessary to maintain the Pit System and West Camp System waters below the CWLs. The alternatives are summarized below.

ALTERNATIVE 1: No Action

TOTAL COST: $0

Under this alternative, no remedial actions would be taken to control mine flooding. During the current mining period, about 1.5 mgd of water from Horseshoe Bend would flow to the Berkeley Pit, and 0.9 mgd would be pumped to the leach pads or tailings pond. In the post-mining period, 2.4 mgd of Horseshoe Bend water would flow to the Pit, and the Pit System CWL would be approached in the year 2015. Evaluation of this alternative is required by the NCP and is evaluated only as a basis for comparison as it does not provide protection of human health and the environment. The risks to human health and the environment are summarized in Section 6 of the ROD.

ALTERNATIVE 2/3: No Change in the Current Flow Regime During Active Mining; No Control of Horseshoe Bend Water During Post Mining; A Comprehensive Monitoring Program; Treatment as the Pit System CWL is Approached.

TOTAL COST: Disposal of Treatment Sludge in Berkeley Pit (Alternative 2) - $35.91 million
Disposal of Treatment Sludge Onsite (Alternative 3) - $42.7 million

Under this combined alternative, limited actions would be taken to control mine flooding during the mining and post-mining periods. A comprehensive monitoring program and institutional controls would be implemented. As with Alternative 1, the Pit System CWL would be approached in 2015, at which time water from the Pit System and Horseshoe Bend would be pumped to a treatment plant for primary treatment by hydroxide precipitation and aeration, followed, if necessary, by polishing treatment by reverse osmosis. A total of 8.48 mgd (2.4 mgd from Horseshoe Bend and 6.08 mgd from the Pit System) would be pumped for treatment. Treated water would be discharged to Silver Bow Creek, and treatment sludge would be disposed of in the Pit or in an onsite disposal facility. The water level in the Pit System would be maintained below the CWL.

The differences in the costs for this alternative are dependent upon the option chosen for disposal of treatment sludge. If the disposal option involves an onsite facility, less water (only 4.35 mgd) would need to be pumped to stabilize the water level in the Pit System.

ALTERNATIVE 4/5: Change Flow Scheme to Control Horseshoe Bend Water During Active Mining; No Control of Horseshoe Bend Water During Post-Mining, A Comprehensive Monitoring Program; Treatment as the Pit System CWL is Approached.

TOTAL COST: Disposal of Treatment Sludge in Berkeley Pit (Alternative 4) - $27.63 million
Disposal of Treatment Sludge Onsite (Alternative 5 - $32.33 million

Under this combined alternative, 2.4 mgd of Horseshoe Bend water would be pumped to Yankee Doodle Tailings Pond during active mining operations. Lime would be added to the tailings at the MR Concentrator prior to discharge into the pond in order to increase the neutralization capacity of the tailings for the Horseshoe Bend water. A comprehensive monitoring program and institutional controls would be implemented.

During the post-mining period, no actions would be taken to control mine flooding, and 2.4 mgd of Horseshoe Bend water would flow to the Pit. The Pit System CWL would be approached in the year 2018, at which time water from the Pit System and Horseshoe Bend would be pumped to a treatment plant as described for Alternative 2/3. The water level in the Pit System would be kept below the CWL.

The differences in the costs for this alternative are dependent upon the disposal choice. Treatment sludge would be disposed of in the Pit or in an onsite disposal facility.

ALTERNATIVE 6/7: Permanent Control and Treatment of Horseshoe Bend Water; A Comprehensive Monitoring Program; Treatment Initiated Upon Suspension of Mining; Expanded Treatment as the Pit System CWL is Approached.

TOTAL COST: Disposal of Treatment Sludge in Berkeley Pit (Alternative 6) - $41.82 million
Disposal of Treatment Sludge in an Onsite Facility (Alternative 7) - $52.77 million

Under this combined alternative, 2.4 mgd of Horseshoe Bend water would be pumped to the Yankee Doodle Tailings Pond during mining, as described for Alternative 4/5. Primary and polishing treatment (of Horseshoe Bend water only) would begin during the post-mining period at a newly constructed treatment plant, with treated water discharged to Silver Bow Creek and treatment sludge disposed of in the Pit or in an onsite facility. Treatment would be in two steps: hydroxide precipitation and aeration would remove most metals, followed, if necessary, by reverse osmosis as a polishing treatment to meet State of Montana surface water quality standards.

The Pit System CWL would be approached in 2022, at which time water from the Pit System (6.08 mgd) would also be treated at an expanded treatment facility. The water level in the Pit System would be kept below the CWL.

The differences in the costs for this alternative are dependent upon the selected place for disposal of treatment sludge.

9. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP requires that each alternative be evaluated in terms of nine criteria, which are divided into three categories as listed below.

The first category includes the threshold criteria:

1. Overall protection of human health and the environment; and

2. Compliance with ARARs.

The second category includes the primary balancing criteria:

3. Long-term effectiveness and permanence;

4. Reduction of toxicity, mobility, or volume through treatment;

5. Short-term effectiveness;

6. Implementability; and

7. Costs.

The third category includes the modifying criteria:

8. State acceptance; and

9. Community acceptance.

The selected alternative must meet the first two criteria and provide the best balance of the five primary balancing criteria. EPA and the State evaluated and compared the seven remedial alternatives described in Section 8 based upon their expected compliance with these criteria. EPA and the State believe that all the alternatives (except the no-action alternative) meet the above criteria to some degree and provide a reasonable range of options for addressing the mine flooding problem. EPA and the State selected Alternative 6/7 with modification as the remedy for the Butte Mine Flooding OU. This evaluation is briefly described below.

<u>CRITERION 1: OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</u>

This criterion addresses whether a remedy is protective of human health and the environment. It also describes how potential no-action alternative risks estimated for each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

All the alternatives, except Alternative 1, are protective of human health and the environment through the containment of contaminated water in the OU, treatment of the contaminated water prior to discharge to Silver Bow Creek, and the control of access to contaminated groundwater.

<u>CRITERION 2: COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS</u>

This criterion addresses whether a remedy will comply with identified Federal and State environmental laws and regulations and/or whether there is a basis for a waiver from any of these laws. Applicable requirements must be met to the full extent required by the law.

Alternative 1 does not meet Federal and State ARARs. The remaining alternatives will meet Federal and State ARARs, except Federal Primary Drinking Water Standards and State groundwater quality standards for the bedrock aquifer. EPA intends to waive these requirements based on the determination that compliance with these standards is technically impracticable from an engineering perspective (see Technical Impracticability evaluation - Appendix 2). Treated water discharged to Silver Bow Creek will meet State discharge requirements. Sludge produced would be disposed of in compliance with State solid and hazardous waste regulations.

CRITERION 3: LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once remediation goals have been met.

Alternatives 4/5 and 6/7 achieve the greatest degree of long-term effectiveness and permanence because Horseshoe Bend water is kept from entering the Pit. Alternative 6/7 provides greater long-term effectiveness than the other alternatives because water control and treatment will be implemented on a permanent basis. The treatment component would be implemented 10 to 13 years sooner than for Alternatives 2/3 and 4/5, and the water control component would be implemented almost 20 years sooner than for Alternative 2/3. Alternative 4/5 is a "stop-gap" alternative that involves control of Horseshoe Bend water during mining, but no control of this water until the Pit System CWL is approached. The no-action alternative provides neither long-term effectiveness nor permanence.

CRITERION 4: REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

This criterion refers to the degree that an alternative reduces toxicity, mobility, and volume of contamination.

All alternatives (except the no-action alternative) provide for the active treatment of contaminated water and ensure that the water levels in the Pit and West Camp Systems are maintained below the CWLs. Negative impacts to the environment at the OU would not occur unless CWLs are reached or exceeded. Assuming maximum inflow to the Pit System from the bedrock and alluvial aquifers, all the alternatives would be equally effective at reducing the toxicity, mobility, or volume of contaminated water. However, if additional post-mining inflow controls (e.g., control of clean upgradient flows) are employed and bedrock aquifer inflow does decline as predicted, Alternative 6/7 has the potential to stabilize the Pit System water at a lower elevation compared to the other alternatives. In this way, Alternative 6/7 would be more effective at reducing the total volume of contaminated water accumulating in the Pit System than the other alternatives.

CRITERION 5: SHORT-TERM EFFECTIVENESS

This criterion addresses the period of time needed to complete the alternative and any adverse impacts on human health and the environment that may be posed during the construction and implementation period. None of the alternatives would result in adverse short-term effects.

CRITERION 6: IMPLEMENTABILITY

Implementability refers to the technical and administrative feasibility of an alternative, including availability of materials and services needed to implement a particular option. All the alternatives are readily implementable. However, EPA and the State believe that Alternative 6/7 is more implementable than the other alternatives. Construction, startup, and operation of a smaller, expandable treatment plant to handle contaminated water when mining operations are suspended allows for greater opportunity to address unknown contingencies (i.e., unanticipated flow patterns or release from the bedrock system), rather than waiting to build a larger treatment plant when the Pit System CWL is approached.

CRITERION 7: COSTS

Cost evaluates the estimated capital costs and O&M costs of each Alternative for 30 years. Alternative 4/5 is the least expensive ($27.6-32.3 million), while 6/7 ($41.8-52.8 million) has the highest associated costs. Alternative 4/5 is less expensive because it involves handling of Horseshoe Bend water within the mining process and does not mandate control of Horseshoe Bend water if mining is suspended until the Pit System CWL is approached. In contrast, Alternative 6/7 mandates the immediate and permanent control of Horseshoe Bend inflow (currently 2.4 mgd) to the Pit System.

CRITERION 8: STATE ACCEPTANCE

This criterion indicates the State's preferences regarding the various alternatives. Alternative 6/7 has a higher level of State acceptance than the other alternatives. The State has indicated general support for the major objective of Alternative 6/7 because it involves early and continual/permanent control (i.e., control during any suspension of mining plus post-mining control) of 2 mgd of water inflow to the Berkeley Pit System. However, the State has recommended flexibility in the specifics of Alternative 6/7, such as method of treatment, discharge point, point of control, etc.

CRITERION 9: COMMUNITY ACCEPTANCE

Public comment indicated that the community preferred Alterative 6/7 over the other final five (5) alternatives. EPA and the State received considerable public comment opposing certain aspects of the preferred alternative presented in the Proposed Plan. The major comments revolved around 3 issues: 1) the designated critical water level (CWL); 2) the treatment of water sooner rather than later; and 3) the use of innovative treatment/metals recovery technology. The public generally commented that a lower critical water level is necessary to account for uncertainties relating to the impact of the rising water in the system.

Considerable comment was also received concerning the use of innovative treatment/metals technology. Numerous commenters expressed concern about the amount of sludge generated by the hydroxide precipitation/aeration treatment process selected and voiced their opinion that a technology which reclaims metals from the Berkeley Pit System is preferable.

SYNOPSIS OF ALTERNATIVES

Alternative 6/7, the alternative selected by EPA and the State (with modifications) utilizes technologies that are readily available and requires typical construction techniques. During construction, risks to workers, to the community, and to the environment would be reduced by employing engineering, health, and safety controls.

Protecting human health, including offsite protection, at the OU is achieved by: 1) maintaining the water levels in both the Pit System and the West Camp System below the CWLs and treating any water to be discharged; 2) implementing a comprehensive monitoring program; and 3) implementing institutional controls to prevent water use.

Overall compliance with most ARARs at the OU would be met by the selected alternative. Chemical-species ARARs for water discharged to Silver Bow Creek would be met; however, Federal and State groundwater quality standards would not be met for the bedrock aquifer because of technical impracticability. Action-specific ARARs would be met for this alternative by standard industry controls and monitoring programs during operation. The location-specific ARARs would be met for this alternative by eliminating the potential migration of contaminated water from the OU and by meeting the discharge criteria for treated water prior to discharge to Silver Bow Creek.

In summary, the selected alternative:

- Protects human health and the environment;
- Is implementable and creates no unacceptable short-term impact;
- Complies with ARARs, with the exception of Federal and State groundwater quality standards for the bedrock aquifer (a Technical Impracticability evaluation has been issued for these standards - see Appendix 2);
- Is cost-effective relative to the benefits and in comparison to the other alternatives evaluated;
- Encourages flexibility for water management and treatment;
- Utilizes permanent solutions;
- Satisfies the statutory preference for treatment as a principal element of the remedy; and
- Has State acceptance.

10. THE SELECTED REMEDY

The selected alternative should achieve the remedial action objectives and goals, provide protection to human health and the environment, and meet Federal and State requirements designated as applicable or relevant and appropriate for this OU except those for which a waiver has been granted in accordance with CERCLA and the NCP. EPA and the State believe that this alternative provides the best balance of tradeoffs among the alternatives with respect to the five primary balancing criteria. It combines the components of a comprehensive monitoring program (to ensure that the safe water levels are not exceeded), institutional controls, inflow controls, extraction of Pit System water, onsite external primary and polishing water treatments, and disposal of sludges in either an onsite disposal facility or the Berkeley Pit.

The selected alternative provides greater long-term effectiveness and permanence, eliminates the potential for migration of water from the OU, meets short-term effectiveness criteria, is cost effective, and has equivalent or greater implementability than the other three alternatives. This alternative is also preferred by the State over the other alternatives.

Although the selected alternative is more costly (50%) than Alternative 4/5, it is more cost effective because the positive aspects of this alternative (i.e., greater long-term effectiveness and permanence, greater implementability, reduced volume of contaminated water) outweigh the increased cost.

We also acknowledge that there was significant public opposition to certain aspects of the preferred alternative presented in the Proposed Plan. Many citizens generally favored establishment of a lower critical water level and employment of alternative treatment/metals recovery technology in lieu of the technology proposed.

The public generally commented that a lower critical water level is necessary to account for uncertainties relating to the impact of the rising water in the system. EPA and the State believe that the established critical water levels are safe water levels. By allowing the system to recover to the maximum extent practical (with a safety buffer) without allowing a discharge to the alluvial system, the long-term acid mine drainage (AMD) production is reduced. Several steps have been incorporated into the ROD (see Declaration) to account for future uncertainty. All such comments are addressed in more detail in the RS (Appendix 4).

1. The ROD requires that the critical water level of 5,410 feet apply to the entire East Camp system, not just for the Pit. Currently, alluvial groundwater levels are at least 50 feet above the 5,410 foot elevation (i.e., current alluvial groundwater levels are no lower than 5,460 feet). This is a 50 foot safety buffer between the bedrock and alluvial aquifers. For the bedrock aquifer to discharge to the alluvial aquifer, bedrock aquifer water would have to rise above 5,460 feet. The water level in the Anselmo Mine (which is the point of compliance furthest from the Pit) is currently 40 feet above the Berkeley Pit. If this groundwater gradient remains there will be a buffer of 90 feet between the Berkeley Pit and the surrounding alluvial aquifer levels (5,460 feet). Even with a reduction in the water gradient between the Anselmo Mine and the Berkeley Pit, a buffer of at least 50 feet is guaranteed between the East Camp System and the alluvial aquifer.

2. The ROD requires the inflow of water to be reduced significantly to allow a much slower rise in the system water level. This allows much more time for the Agencies to react to any unanticipated impacts.

3. The ROD requires a comprehensive monitoring program to be employed to thoroughly monitor the system and act as an early warning system in the event that current assumptions are proven incorrect.

4. The ROD has a requirement to have construction of a final treatment plant completed 4 years prior to when the water in the East Camp system is predicted to reach the CWL. This allows for plant testing and early start-up if necessary.

5. EPA and the State retain authority under applicable Federal and State law to establish a lower CWL or take alternative action if necessary to address unanticipated threats to human health or the environment.

6. Although not formally part of the ROD, EPA and the State are evaluating alternative financial assurances from the PRPs such as bonding to reduce uncertainties associated with the funding of the long-term components of this remedy.

Considerable comment was also received concerning the use of innovative treatment/metals recovery technology. Numerous commenters expressed concern about the amount of sludge generated by the hydroxide precipitation/aeration treatment process selected and voiced their opinion that a technology which reclaims metals from the Berkeley Pit System is preferable.

The hydroxide/aeration treatment technology is presently the most cost effective, proven technology available for this action. EPA and the State recognize that employment of this technology generates large volumes of sludge. The final treatment plant may generate from 500 - 1000 tons per day of sludge (40% solids). However, the amount of sludge generated is only 1-2% of the tailings generated daily by the current mining operation. This amount of sludge can be managed effectively. Large areas are available in the active mine area for disposal of this material. If sludge disposal in the Berkeley Pit is selected, an equivalent volume of Berkeley Pit/East Camp System water will be pumped and treated to ensure that there is no net rise in the Pit water elevation.

We do recognize, however, the public's concern about the sludge generated by the selected technology and their preference for a technology which would recover metals. To address these issues we have taken several steps:

1. The ROD requires that Montana Solid Waste Disposal regulations or a waiver based on the attainment of an equivalent standard of performance be met for any waste repository utilized.

2. EPA and the State are actively involved in a consultative role (the Technical Coordinating Committee) with the U.S. Department of Energy (DOE) resource recovery project which is actively pursuing demonstration of innovative water treatment/metals recovery technologies using the Berkeley Pit waters as a test media.

3. EPA and the State remain flexible in the implementation of alternate treatment/metals recovery technology proposed jointly by the developers of that technology and the PRPs, if that technology meets the performance (discharge) standards established for this action.

4. The ROD requires (see Declaration) that a reevaluation of treatment technology be conducted when the water level of the Pit reaches the 5260' (presently projected in 2009). This reevaluation is to assess alternative technologies to hydroxide precipitation with emphasis on innovative treatment and/or metals recovery technologies developed in the interim.

5. EPA Region VIII and the State will actively pursue Federal monies for research and development of innovative treatment/metals recovery technology for Berkeley Pit water.

In summary, the selected alternative is protective of human health and the environment by accomplishing the following: permanently controlling major surface inflows into the Pit thereby slowing the present rate of flooding by over 40%; maintaining the water level in the Pit System below the CWL elevation of 5,410 feet and the West Camp CWL elevation of 5,435 feet, thereby preventing discharge of contaminated bedrock aquifer water into the alluvial aquifer and Silver Bow Creek; treating all discharges of water to Silver Bow Creek to "I" classification standards thereby improving water quality in the Creek and enhancing the quality of the aquatic environment; disposing of sludges generated by treatment processes in accordance with appropriate Montana Solid Waste Disposal regulations, thereby preventing any threats to the environment from sludge disposal practices; implementing a comprehensive monitoring program which provides the basis for ongoing assessment of the mine flooding condition in the future; providing for monitoring and design criteria for operation of Yankee Doodle Tailings Pond to provide further assurances that there is no catastrophic failure of the dam; providing an institutional control program that restricts inappropriate use of any of the contaminated bedrock aquifer water.

The remedy also provides flexibility in the method used to control inflow, method of treatment, bedrock water withdrawal point, and use of collected and/or treated water to most cost effectively address the mine flooding problem yet meets the identified remedial action objectives; encourages development of innovative treatment/metals recovery technology and requires a reevaluation of such technology in the future, thereby allowing for potential application of innovative technology in the future; requires that construction of a treatment plant, capable of maintaining the Pit System below the CWL, be completed 4 years prior to the projected date that the water level in that system reaches the CWL; and provides yearly updates for the public concerning the ongoing monitoring and water level projections, thereby keeping the public well informed on any developments that may occur.

11. PERFORMANCE STANDARDS

Performance standards for this action are defined in the declaration (see 14 components) and the accompanying documents including the ARARs analysis (Appendix 1) and the Post-ROD monitoring program (Appendix 3). These performance standards revolve around the following subjects: maximum allowable groundwater elevations (CWL), "I" classification discharge standards, sludge disposal standards, Yankee Doodle Tailings Pond design and operating standards, inflow control minimum flow standards, and ground water and surface water monitoring requirements. More detailed standards addressing specific construction and operating requirements will be developed during the remedial design phase. Design of a water treatment and sludge disposal facility must be approved by EPA in consultation with the State; and the construction and operation and maintenance of the facility will be monitored by EPA and/or the State. The facility must be designed to meet State and Federal water quality standards. Design, construction, maintenance, and monitoring of the facility will be conducted according to the engineering standards established during remedial design, and must be approved by EPA in consultation with the State.

12. STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve the overall protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that, when complete, the remedial action selected for this site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and must utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatments that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances as a principal element. The following subsections discuss how the selected alternative meets these statutory requirements.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected alternative is protective of human health and the environment through the containment of contaminated water in the OU, treatment of the contaminated water prior to discharge to Silver Bow Creek, and the control of access to contaminated groundwater.

COMPLIANCE WITH ARARS

The selected alternative is expected to meet Federal and State requirements that are legally applicable or relevant and appropriate, except Federal and State groundwater quality standards for the bedrock aquifer. Specifically, Maximum Contaminant Levels (MCLs) for arsenic, cadmium, copper, and lead may not be met. These requirements are waived based on the determination that compliance with these standards is technically impracticable from an engineering perspective (See Technical Impracticability evaluation - Appendix 2). Treated water discharged to Silver Bow Creek shall meet all state discharge requirements ("I" classification discharge standards). Sludge produced shall be disposed of in compliance with Federal and state solid waste regulations. Appendix 1 provides a list of the ARARs for the selected remedy.

COST EFFECTIVENESS

The selected alternative is cost effective compared to the other alternatives evaluated. Based on an analysis of costs, the selected alternative has the highest associated costs of the final 7 alternatives evaluated (present worth (PW) value of $45 to 55 million). This increased cost is outweighed by the fact that the selected alternative mandates the immediate and permanent control of water inflows into the Pit System thereby making this alternative more cost effective. The selected alternative has a much lower cost than any alternative that seeks to stabilize the Pit System at its current level (PW of $180 to 215 million) or seeks to drain the Pit System (PW in excess of $300 million). EPA and the State believe that there is not a significant reduction in threat to human health and the environment if the Pit System is stabilized at its current level or drained rather than allowed to approach the CWL.

UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES)

The selected alternative uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. EPA and the State have determined that the selected remedy provides the best balance in terms of long-term effectiveness and permanence; reduction of toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; and cost, while also considering the statutory preference for treatment as a principal element, and State and community acceptance.

The selected remedy will be designed as a permanent solution. Adherence to the performance standards for the remedy will ensure the continued safety of the surrounding population and environment. Although resource recovery (metals recovery) is not presently an element of the action, the ROD calls for reevaluation of innovative treatment/metals recovery technology when the water level in the Pit reaches the 5260' elevation. At that time EPA, in consultation with the State, will determine if the selected remedy should be modified to include innovative water treatment/metals recovery technology.

PREFERENCE FOR TREATMENT AS PRINCIPAL ELEMENT

The selected remedy combines inflow control and wastewater treatment as two of the most important elements of the action. The remedy reduces acid mine drainage (AMD) and treats the residual AMD. This satisfies the statutory preference for remedies that reduce the toxicity, mobility, or volume of contamination through treatment.

13. DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of any significant changes to the selected alternative as presented in the Proposed Plan, which was made available for public comment. In developing the final remedy, five (5) significant changes were made to the Proposed Plan (see Declaration for details). These changes are as follows:

1. The ROD requires that construction of a treatment plant, capable of maintaining the East Camp/Berkeley Pit System below the CWL, be completed 4 years prior to the projected date that the water level in that system reaches the CWL. This addition to the proposed plan was in response to significant public comment, including the Butte-Silver Bow government (BSB), which requested that a treatment plant be on-line (and that a "shake-down" or testing program be completed) before the CWL was approached.

2. The ROD requires a reevaluation of innovative treatment/metals recovery technology when the water level in the Berkeley Pit reaches the 5260' elevation, presently projected in the year 2009. This addition to the proposed plan is in response to public comment, including the Butte Silver Bow Government who believe that additional evaluation of treatment technology which produces less sludge or recovers metals is needed, especially since the final expanded treatment plant may not be necessary for at least 25 years. This addition to the ROD formally institutionalizes this reevaluation.

3. The ROD requires additional evaluation of the potential effects of placing large volumes of sludge in a body of water with the chemistry of Berkeley Pit water. This change was in response to technical comments received. The commenters noted that placement of hydroxide sludges in an acidic body of water this large has never been done before. They hypothesized that placement of treatment plant sludge in the Pit might produce some unexpected negative geochemical impacts. EPA and the State, however, do not want to completely preclude this option at this time because there are also some potential benefits of placing the sludge in the Pit (neutralization benefits, cost savings, etc.).

4. The ROD requires capturing groundwater as well as all surface water in the Horseshoe Bend drainage area. This addition is in response to the public's desire to not limit the capture of inflow to only surface water.

5. As was expressed earlier in this document, there was significant public comment concerning the need for additional research, development, and demonstration of innovative treatment/metals recovery technology. EPA and the State agree that this additional R&D is appropriate to advance technology in this area. Although not formally a binding or enforceable part of the ROD, EPA and the State, in cooperation with local government and the PRPs, are committed to pursuing additional funding for this effort.

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ARCO 1994a. Draft Remedial Investigation Report, Butte Mine Flooding Operable Unit Remedial Investigation/Feasibility Study, prepared for ARCO, Anaconda, Montana by Canonie, January 1994.

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IDENTIFICATION AND DESCRIPTION OF
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

APPENDIX 1
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

TABLE OF CONTENTS

SECTION PAGE

LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency of Toxic Substances and Disease Registry
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BPCTCA	Best Practicable Control Technology Currently Available
BPJ	Best Professional Judgment
BTCA	Best Technology Currently Available
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DNRC	Department of Natural Resources and Conservation (Montana)
DSL	Department of State Lands (Montana)
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HWM	Hazardous Waste Management
LNAPL	Light Non-aqueous Phase Liquid
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDHES	Montana Department of Health and Environmental Sciences
MGWPCS	Montana Groundwater Pollution Control System
MPDES	Montana Pollutant Discharge Elimination System
NCP	National Contingency Plan
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NPL	National Priorities List
NPDES	National Pollutant Discharge Elimination System
PAH	Polynuclear Aromatic Hydrocarbon
PCP	Pentachlorophenol
POHC	Principal Organic Hazardous Constituents
POTW	Public Owned Treatment Works
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SHPO	State Historic Preservation Officer (Montana)
SIP	State Implementation Plan
TBC	To Be Considered
TU	Turbidity Unit
UIC	Underground Injection Control
WQB-7	Circular Water Quality Bureau 7

INTRODUCTION

Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), certain provisions of the current National Contingency Plan (the NCP), 40 CFR Part 300 (1990), and guidance and policy issued by the Environmental Protection Agency (EPA) require that remedial actions taken pursuant to Superfund authority shall require or achieve compliance with substantive provisions of applicable or relevant and appropriate standards, requirements, criteria, or limitations from state environmental and facility siting laws, and from federal environmental laws at the completion of the remedial action, and/or during the implementation of the remedial action, unless a waiver is granted. These requirements are threshold standards that any selected remedy must meet. See Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4); 40 CFR § 300.430(f)(1). EPA calls standards, requirements, criteria, or limitations identified pursuant to section 121(d) "ARARs," or applicable or relevant and appropriate requirements.

ARARs are either applicable or relevant and appropriate. Applicable requirements are those standards. requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site. Factors which may be considered in making this determination are presented in 40 CFR § 300.400(g)(2). Compliance with both applicable and relevant and appropriate requirements is mandatory.[1]

Each ARAR or group of related ARARs identified here is followed by a specific statutory or regulatory citation, a classification describing whether the ARAR is applicable or relevant and appropriate, and a description which summarizes the requirements, and addresses how and when compliance with the ARAR will be measured (some ARARs will govern the conduct of the implementation of the remedial action, some will govern the measure of success of the remedial action, and some will do both).[2] The descriptions given here are provided to allow the user a reasonable understanding of the requirements without having to refer constantly back to the statute or regulation itself. However, in the event of any inconsistency between the law and the summary provided in this document, the applicable or relevant and appropriate requirement is ultimately the requirement as set out in the law, rather than any paraphrase of the law provided here.

Also contained in this list are policies, guidance or other sources of information which are "to be considered" in the selection of the remedy and implementation of the ROD. Although not enforceable requirements, these documents are important sources of information which EPA and the State of Montana Department of Health and Environmental Sciences (MDHES) may consider during selection of the remedy, especially in regard to the evaluation of public health and environmental risks; or which will be referred to, as appropriate, in selecting and developing cleanup actions.[3]

Finally, this list contains a non-exhaustive list of other legal provisions or requirements which should be complied with during the implementation of this ROD.

ARARs are divided into contaminant specific, location specific, and action specific requirements, as described in the NCP and EPA guidance. For contaminant specific ARARs, ARARs are listed according to the appropriate media.

Contaminant specific ARARs include those laws and regulations governing the release to the environment of materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Contaminant specific ARARs generally set health or risk based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

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[1] See CERCLA Section 121(d)(2)(A), 42 U.S.C. Section 9621(d)(2)(A).

[2] 40 CFR Section 300.435(b)(2); Preamble to the Proposed NCP, 53 Fed. Reg. 51440 (December 21, 1988); Preamble to the Final NCP, 55 Fed. Reg. 8755-8757 (March 8. 1990). The Atlantic Richfield Company (ARCO), the named liable party for the site, argues that this NCP requirement is not consistent with the CERCLA statute. However, ARCO did not challenge the NCP in the District of Columbia Court of Appeals in a timely manner, and therefore have waived the right to assert this argument. See Section 113(a) of CERCLA, 42 U.S.C. Section 9613(a).

[3] 40 CFR Section 300.400(g)(3); 40 CFR Section 300.415(i); Preamble to the Final NCP, 55 Fed. Reg. 8744-8746 (March 8, 1990).

Location specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location specific ARARs relate to the geographic or physical position of the site, rather than to the nature of the site contaminants.

Action specific ARARs are usually technology or activity based requirements or limitations on actions taken with respect to hazardous substances.

Only the substantive portions of the requirements are ARARs.[4] Administrative requirements are not ARARs and thus do not apply to actions conducted entirely on-site. Administrative requirements are those which involve consultation, issuance of permits, documentation, reporting, record keeping, and enforcement. The CERCLA program has its own set of administrative procedures which assure proper implementation of CERCLA. The application of additional or conflicting administrative requirements could result in delay or confusion.[5] Provisions of statutes or regulations which contain general goals that merely express legislative intent about desired outcomes or conditions but are non-binding are not ARARs.[6]

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by EPA and the states, such as the requirements of the federal Clean Water Act and the Montana Water Quality Act. The preamble to the new NCP states that such a situation results in citation to the state provision as the appropriate standard, but treatment of the provision as a federal requirement. ARARs and other laws which are unique to state law are identified separately by the State of Montana.

This list constitutes EPA's and MDHES' detailed identification and description of ARARs for use in the implementation of the remedy at the Butte Mine Flooding Operable Unit. The major response actions designated in the ROD revolve around treatment of contaminated groundwater before discharge to the Upper Silver Bow Creek drainage. Primary ARARs therefore revolve around discharge standards and sludge disposal requirements.

The ARARs analysis is based on section 121(d) of CERCLA. 42 U.S.C. § 9621(d); CERCLA Compliance with Other Laws Manual, Volumes I and II, OSWER Dirs. 9234.1-01 and-02 (August 1988 and August 1989, respectively); various CERCLA ARARs Fact Sheets issued as OSWER Directives; the Preamble to the Proposed NCP, 53 Fed. Reg. 51394 et seq. (December 21, 1988); the Preamble to the Final NCP, 55 Fed. Reg. 8666-8813 (March 8, 1990); and the Final NCP, 40 CFR Part 300 (55 Fed. Reg. 8813-8865, March 8, 1990).

It should be noted that EPA has granted a waiver of ground water standards for this action because of technical impracticability of remediating the bedrock aquifer from an engineering perspective, as allowed by 40 CFR § 300.430(f)(1)(ii)(C). The National Primary Drinking Water Standards (40 CFR Part 141)[7], better known as maximum contaminant levels and maximum contaminant level goals (MCLs and MCLGs) and the state Ground Water Quality Standards (ARM 16.20.1003) are ARARs for the bedrock groundwater that are waived for this action. EPA and the State of Montana recognize that, because of the size and complexity of the underground mining system (3000 miles of workings reaching over 5000 feet in depth), the bedrock aquifer within the Mine Flooding Operable Unit (East Camp/Berkeley Pit and West Camp systems) can not be fully remediated to these groundwater standards. The federal Safe Drinking Water Act MCLs and the state Ground Water Quality Standards are, therefore, waived with respect to the bedrock aquifer, because of the technical impracticability of remediating the bedrock aquifer within the foreseeable future. This waiver applies only to the bedrock aquifer for the area outlined on the map shown as Figure 2 in the Technical Impracticability Evaluation attached as Appendix 2 of the Record of Decision. These standards have not been waived in respect to discharges from the bedrock aquifer within the TI waiver area into the alluvial aquifer. It should be noted, however, that the remedy does not allow such a discharge because it requires eventual pumping of the system to maintain an inward hydraulic gradient.

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[4] 40 CFR Section 300.5. See also Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8,1990).

[5] Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8, 1990); Compliance with Other Laws Manual, Vol. 1, pp. 1-11 through 1-12.

[6] Preamble to the Final NCP, 55 Fed. Reg. 8746 (March 8, 1990).

[7] 42 U.S.C. Sections 300f et seq.

FEDERAL ARARS

I. FEDERAL CONTAMINANT SPECIFIC REQUIREMENTS

A. Groundwater Standards - Safe Drinking Water Act

Although the Safe Drinking Water Act MCLs and MCLGs are relevant and appropriate requirements, these regulations have been formally waived for the bedrock aquifer because of the technical impracticability of meeting these standards in the bedrock aquifer in the foreseeable future. However, MCL and non-zero MCLG standards, 40 CFR Part 141, promulgated under the Safe Drinking Water Act are relevant and appropriate for the alluvial aquifer and the bedrock aquifer outside the TI waiver area. Contaminated water from the TI waiver area of the bedrock aquifer, therefore, cannot discharge and contaminate the alluvial aquifer or the bedrock aquifer outside the TI waiver area in concentrations above MCLs and non-zero MCLGs. The remedy is structured to preclude such a discharge by keeping an inward gradient towards the bedrock aquifer waiver area by an inflow control, and a pump and treat system.

See the end of the introduction for more discussion on this issue.

B. Air Standards - Clean Air Act (Applicable)

Considerable construction activities, including construction of a sludge disposal area, will occur at the site. Fugitive dust therefore will need to be controlled during construction and operation of any treatment and disposal facilities. The following standards, promulgated pursuant to section 109 of the Clean Air Act,[8] are applicable to any releases into the air from Mine Flooding Operable Unit cleanup activities.

1. Lead: No person shall cause or contribute to concentrations of lead in the ambient air which exceed 1.5 micrograms per cubic meter (µg/m3) of air, measured over a 90-day average.

These standards are promulgated at ARM 16.8.815 as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, §§ 75-2-101 et seq, MCA. Corresponding federal regulations are found at 40 CFR § 50.12.[9]

2. PM-10: No person shall cause or contribute to concentrations of PM-10 in the ambient air which exceed:

   - 150 micrograms per cubic meter of air, 24 hour average, no more than one expected exceedence per calendar year;

   - 50 micrograms per cubic meter of air, annual average.

These regulations are promulgated at ARM 16.8.821 as part of a federally approved SIP, pursuant to the Clean Air Act of Montana, §§ 75-2-101 et seq., MCA. Corresponding federal regulations are found at 40 CFR § 50.6.

Ambient air standards under section 109 of the Clean Air Act are also promulgated for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, and ozone. If emissions of these compounds were to occur at the site in connection with any cleanup action, these standards would also be applicable. See ARM 16.8.811 - 16.8.820 and 40 CFR Part 50.

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[8] 42 U.S.C. §§ 7401 et seq.

[9] The ambient air standards established as part of Montana's approved State Implementation Plan in many cases provide more stringent or additional standards. The federal standards by themselves apply only to "major sources", while the State standards are fully applicable throughout the state and are not limited to "major sources" See ARM 16.8.808 and 16.8.811-.821. As part of an EPA-approved State Implementation Plan, the state standards are also federally enforceable. Thus, the state standards which are equivalent to the federal standards are identified in this section together with the federal standards. A more detailed list of State standards, which includes standards which are not duplicated in federal regulations, is contained in the State ARAR identification section.

C. Surface Water - Ambient and Point Source Discharges.

CERCLA and the NCP provide that federal water pollution criteria that match designated or anticipated surface water uses are the usual surface water standards to be used at Superfund cleanups, as relevant and appropriate standards, unless the state has promulgated surface water quality standards pursuant to the delegated state water quality act. The State of Montana has designated uses for Silver Bow Creek and the Clark Fork River, and has promulgated specific standards accordingly. Those standards and their application to the Mine Flooding Operable Unit, as well as other surface water standards, are included in the state ARARs identified below. These standards are the primary standards driving this action and will be applied to all point source discharge of contaminants of concern identified in the Mine Flooding Operable Unit remedial investigation.

II. FEDERAL LOCATION SPECIFIC REQUIREMENTS

A. Fish and Wildlife Coordination Act (Applicable)

These standards are found at 16 U.S.C. §§ 1531 - 1566 and 40 CFR § 6.302(g). They require that federally funded or authorized projects ensure that any modification of any stream or other water body affected by a funded or authorized action provide for adequate protection of fish and wildlife resources. Compliance with this ARAR necessitates consultation with the U.S. Fish and Wildlife Service and the State of Montana Department of Fish, Wildlife, and Parks. Further consultation with these agencies will occur during cleanup design and implementation, and specific mitigative or other measures may be identified to achieve compliance with this ARAR.

B. The Endangered Species Act (Applicable)

This statute and implementing regulations (16 U.S.C. §§ 1531 - 1543, 50 CFR Part 402, and 40 CFR § 6.302(h)) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.

Compliance with this requirement involves continued consultation with USFWS, on the topic of whether any proposed activities will impact such wildlife or habitat.

C. The National Historic Preservation Act (Applicable)

This statute and implementing regulations (16 U.S.C. § 470, 40 CFR § 6.310(b), 36 CFR Part 800) require federal agencies or federal projects to take into account the effect of any federally assisted undertaking or licensing on any district, site building, structure, or object that is included in, or eligible for, the Register of Historic Places. If effects cannot be avoided reasonably, measures should be implemented to minimize or mitigate the potential effect. In order to comply with this ARAR, EPA, MDHES, and the PRPs may consult with the State Historic Preservation Officer (SHPO), who can assist in identifying listed or eligible resources, and in assessing whether proposed cleanup actions will impact the resources and any appropriate mitigative measures. Additionally, in April 1992, ARCO, EPA, MDHES, SHPO, the National Council on Historic Preservation, and local governments entered into a Programmatic Agreement to ensure the appropriate consideration of cultural and historical resources in a systematic and comprehensive manner throughout the Clark Fork Basin, in connection with response actions at the four Clark Fork Basin Superfund sites. A Second Programmatic Agreement was agreed upon in September 1994. The results of the Programmatic Agreements may provide additional consideration of the factors to be addressed under this ARAR and the two historical ARARs described below.

D. Archaeological and Historic Preservation Act (Applicable)

The statute and implementing regulations (16 U.S.C. § 469, 40 CFR § 6.301(c)) establish requirements for evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of federal construction projects or a federally licensed activity or program. If eligible scientific, prehistorical, or archaeological artifacts are discovered during site activities, they must be preserved in accordance with these requirements.

E. Historic Sites, Buildings, and Antiquities Act (Applicable)

This requirement states that "in conducting an environmental review of a proposed EPA action, the responsible official shall consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks. The Programmatic Agreement activities described above should aid all parties in compliance with this ARAR.

F. Migratory Bird Treaty Act (Applicable)

This requirement (16 U.S.C. §§ 703 et seq.) establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the U.S. FWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement.

G. Bald Eagle Protection Act (Applicable)

This requirement (16 U.S.C. §§ 668 et. seq.) establishes a federal responsibility for protection of bald and golden eagles, and requires continued consultation with the U.S. FWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald and golden eagle. Specific mitigative measures may be identified for compliance with this requirement.

H. Resource Conservation and Recovery Act (Relevant and Appropriate)

Any discrete waste units created by the Mine Flooding cleanup, especially those related to sludge disposal, must comply with the siting restrictions and conditions found at 40 CFR § 264.18(a) and (b). These sections require management units to be designed, constructed, operated, and maintained to avoid washout, if they are within or near the 100 year flood plain.

III. FEDERAL ACTION SPECIFIC REQUIREMENTS

A. Solid Waste (Applicable) and RCRA (Relevant and Appropriate) Requirements

Sludge generated in the treatment of mine waters in the Mine Flooding Operable Unit using the technology described in the ROD may not be RCRA characteristic hazardous waste, although EPA reserves its rights to make a more formal determination in this regard at a later date. For this reason, certain RCRA regulations, although considered to be potentially relevant and appropriate, are not employed substantively in this action. The State and EPA have indicated that development of alternate innovative technology for the treatment of the Berkeley Pit water is encouraged. If the ROD is amended to employ an alternate treatment process or metals recovery process, the sludge generated by any other process may be hazardous. If this is the case or if the technology selected in the ROD produces a characteristic hazardous waste, the RCRA regulations (or the corresponding State hazardous waste regulations) are applicable and will be fully utilized. The ROD indicates that possible disposal of sludges in the Berkeley Pit will be considered by the agencies when sludge disposal becomes necessary. In considering options for disposal, the agencies will determine whether certain of the otherwise applicable hazardous or solid waste requirements may be waived on the basis that such disposal will attain a standard of performance that is equivalent to that required under the otherwise applicable standard or requirement through use of another method or approach, as provided in 40 CFR § 300.430(f)(1)(ii)(C)(4).

At a minimum (i.e., assuming the sludges are not characteristic hazardous waste), any disposal of sludge shall comply with the following regulations pertaining to the operation of solid waste disposal facilities.

1. Requirements described at 40 CFR Part 257.3, which preclude negative impacts on floodplains, surface water, and ground water.

2. Requirements described in 40 CFR Part 258, Subparts B, C, D, E, and F, which describe location restrictions, and ground water monitoring, operating, design, and closure criteria.

3. RCRA regulations found at 40 CFR §§ 264.116 and .119 (governing notice and deed restrictions), 264.228(a)(2)(i) (addressing de-watering of wastes prior to disposal), and 264.228(a)(2)(iii)(B), (C), and (D) and .251(c), (d), and (f) (regarding run-on and run-off controls), are relevant and appropriate requirements for any waste management units created or retained at the Mine Flooding Operable Unit.**10**

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[10] As noted earlier, federal RCRA regulations are incorporated by reference into applicable State Hazardous Waste Management Act regulations. See ARM 16.44.702. Use of select RCRA regulations to mining waste is appropriate when discrete units are addressed by a cleanup and site conditions are distinguishable from EPA's generic determination of low toxicity/high volume status, for mining waste. See Preamble to the Final NCP, 55 Fed. Reg. 8763 - 8764 (March 8, 1990), CERCLA Compliance with Other Laws, Manual, Volume II (August 1989 OSWER Dir. 9234.1-02) p. 6-4; Preamble to Proposed NCP, 53 Fed. Reg. 51447 (Dec. 21, 1988), and guidance entitled" Consideration of RCRA Requirements in Performing CERCLA Responses at Mining Waste Sites," August 19, 1986 (OSWER).

B. Point Source Water Discharges (Applicable)

Clean Water Act standards would be applicable for all point source discharges of water containing contaminants associated with remedial activities in the Mine Flooding Operable Unit. The regulations are discussed in the contaminant specific ARAR section in the State of Montana identification of ARARs. Point source discharges created by the Mine Flooding Operable Unit remedial action must meet certain effluent standards for industrial categories. 40 CFR Part 440 establishes effluent limits for mines that produce copper, lead, zinc, gold or molybdenum. In most cases the State "I" classification discharge standards will be more strict than these industrial category standards but depending on the previous "one-half of the mean instream concentration," the industrial category discharge standard could be more stringent. 40 CFR § 440.104 **11** lists effluent limits for new sources based on the application of the best available demonstrated technology (BADT). These standards are as follows:

Parameter	Average Daily	Maximum Daily
TSS	20.0 mg/l	30 mg/l
Copper	0.15 mg/l	0.3 mg/l
Zinc	0.75 mg/l	1.5 mg/l
Lead	0.3 mg/l	0.6 mg/l
Mercury	.001 mg/l	.002 mg/l
Cadmium	0.05 mg/l	0.1 mg/l
Ph	from 6.0 to 9.0	

C. Underground Injection Control (Applicable)

Requirements found at 40 CFR Part 144, promulgated pursuant to the Safe Drinking Water Act, allow the re-injection of treated groundwater into the same formation from which it was withdrawn for aquifers such as the bedrock aquifer in the Mine Flooding Operable Unit, and address injection well construction, operation, maintenance, and capping/closure. These regulations would be applicable to any reinjection of treated groundwater.

D. Transportation of Hazardous or Contaminated Waste (Relevant and Appropriate)

40 CFR Part 263 establishes regulations for the transportation of hazardous waste. These regulations would govern any on-site transportation of material. Any off-site transportation would be subject to applicable regulations.

IV. TO BE CONSIDERED DOCUMENTS (TBCs)

The use of documents identified as TBCs is addressed in the introductory portion of the ARAR identification. A list of TBC documents is included in the Preamble to the NCP, 55 Fed. Reg. 8765 (March 8, 1990). Those documents, plus any additional similar or related documents issued since that time, will be considered by EPA and MDHES during remedy implementation.

V. OTHER FEDERAL LAWS (NON-EXCLUSIVE LIST)

CERCLA defines as ARARs only federal environmental and state environmental and siting laws. Remedial design, implementation, and operation and maintenance must nevertheless comply with all other applicable laws, both state and federal, if the remediation work is done by parties other than the federal government or its contractors.

There are "other laws" which are legally applicable requirements for actions being conducted at the Mine Flooding Operable Unit. They are not included as ARARs because they are not "environmental or facility siting laws." An example is the federal Occupational Health and Safety Act regulations found at 29 CFR § 1910.95 which are applicable to worker protection during conduct of remedial activities, including operation and maintenance activities.

Section 121(e) of CERCLA exempts removal or remedial actions conducted entirely on-site from federal, state, or local permits. This exemption is not limited to environmental or facility siting laws, but applies to other permit requirements as well.

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[11] This requirement is also incorporated as a state MPDES standard at ARM 16.20.923.

STATE OF MONTANA ARARS

As provided by Section 121 of CERCLA, 42 U.S.C. § 9621, only those state standards that are more stringent than any federal standard and that have been identified by the state in a timely manner are appropriately included as ARARs.

The State has not identified as ARARs for this operable unit those requirements applicable to reclamation of mining areas. Such requirements are not included for this operable unit because the scope of the operable unit is confined to issues relating to mine flooding and the treatment of discharges of water from specific mining impacted areas. Other ARARs, including reclamation requirements, may be included in the ARARs identified for related operable units, such as the Active Mine Area Operable Unit.

VI. MONTANA CONTAMINANT SPECIFIC REQUIREMENTS

A. WATER QUALITY

1. Surface Water Quality Standards (Applicable)

Under the state Water Quality Act, §§ 75-5-101 et seq. MCA, the state has promulgated regulations to protect, maintain, and improve the quality of surface waters in the state. The requirements listed below are applicable water quality standards with which any remedial action must comply.

ARM 16.20.604(1)(b)[12] (Applicable) provides that Silver Bow Creek (mainstem) from the confluence of Blacktail Deer Creek to Warm Springs Creek is classified "I" for water use.

The "I" classification standards are contained in ARM 16.20.623 (Applicable) of the Montana water quality regulations. This section states:

> [T]he goal of the state of Montana is to have these waters fully support the following uses: drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

These beneficial uses are considered supported when the concentrations of toxic, carcinogenic, or harmful parameters in these waters do not exceed the applicable standards specified in department circular WQB-7 for aquatic life and human health when stream flows equal or exceed the stream flows specified in ARM 16.20.631(4) (10-year 7-day low flow, i.e., minimum consecutive 7-day average flow which may be expected to occur on the average of once every 10 years). Alternatively, for aquatic life standards, site-specific criteria may be developed using procedures given in the Water Quality Standards Handbook (USEPA, Dec. 1983), provided that other routes of exposure to toxic parameters by aquatic life are addressed.

To allow a gradual attainment of these requirements in already impacted streams, the I classification allows point source discharges to be permitted at the higher concentration of: (1) the applicable standards specified in department circular WQB-7, (2) the site-specific standards, or (3) one-half of the mean instream concentrations [13] immediately upstream of the discharge point. The effect of this requirement is to require eventual attainment of the circular WQB-7 levels or site-specific standards in the stream, while allowing consideration of the current, impacted stream quality (a graduated reduction of point source discharge concentrations based on the mean instream concentration where the stream is substantially degraded). As the quality of the stream improves due to control of other sources, including cleanup of non-point source areas, point source dischargers must improve the quality of their discharges down to the instream standards (either WQB-7 or, for aquatic life only, site-specific standards).[14]

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[12] Unless otherwise specified, all regulatory citations are to the Administrative Rules of Montana.

[13] Mean instream concentration is the monthly mean instream concentration, as defined by the MDHES Water Quality Bureau.

[14] With respect to at least one parameter, arsenic, it may not be possible to attain the WQB-7 level. The level for arsenic, 18 mg/l, is substantially below the common current detection limit, at approximately 3.18 µg/l. Thus attainment of this level may be impossible to verify from an analytical perspective and, for arsenic, the detection limit may be viewed as the closest practical substitute for the applicable WQB-7 standard. Therefore, under the I class standard, the applicable standard for arsenic may practically be regarded as one half the monthly mean in the stream, reduced, as instream quality is improved, down to the detection limit.

It should be noted that, because of the ability of the PRPs to integrate flows mandated to be controlled by this action into the active mining operation, a point source discharge from this operable unit may not occur for several years. The "I" classification discharge standards therefore will be upgraded every 3 years even if no discharge occurs. Specific discharge standards applicable for the first three years of this action, effective on the date of the signature of this ROD (assuming a discharge within 3 years of the ROD into Silver Bow Creek below the Colorado Tailings) are shown in Table 1 of this ARARs analysis.

Additional "I" classification standards also include the following criteria:

1. Dissolved oxygen concentration must not be reduced below 3.0 milligrams per liter.

2. Hydrogen ion concentration (Ph) must be maintained within the range of 6.5 to 9.5.

3. No increase in naturally occurring turbidity, temperature, concentrations of sediment and settleable solids, oils, floating solids, or true color is allowed which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife.

4. No discharges of toxic or deleterious substances may commence or continue which lower or are likely to lower the overall water quality of these waters.

Additional restrictions on any discharge to surface waters are included in:

ARM 16.20.633 (Applicable), which prohibits discharges containing substances that will:

(a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;

(b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life;

(e) create conditions which produce undesirable aquatic life.

ARM 16.20.925 (Applicable), which adopts and incorporates the provisions of 40 C.F.R. Part 125 for criteria and standards for the imposition of technology-based treatment requirements in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125 are applicable, i.e., for toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case by case basis using best professional judgment (BPJ). See CERCLA Compliance with Other Laws Manual, Vol. 1, August 1988. p. 3-4 and 3-7.

<u>2. Groundwater Pollution Control System (Applicable)</u>

ARM 16.20.1002 (Applicable) classifies groundwater into Classes I through IV based on the present and future most beneficial uses of the groundwater, and states that groundwater is to be classified according to actual quality or actual use, whichever places the groundwater in a higher class. Class I is the highest quality class; class IV the lowest.

ARM 16.20.1003 (Applicable) establishes the groundwater quality standards applicable with respect to each groundwater classification. Concentrations of dissolved substances in Class I or II groundwater (or Class III groundwater which is used as a drinking water source) may not exceed the human health standards listed in department circular WQB-7. Concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to public health. Maximum allowable concentration of these substances also must not exceed acute or chronic problem levels that would adversely affect existing or designated beneficial uses of groundwater of that classification. ARM 16.20.1003 specifies certain references that may be used as a guide in determining problem levels unless local conditions make these values inappropriate.

ARM 16.20.1011 (Applicable) provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless the board is satisfied that a change is justifiable for economic or social development and will not preclude present or anticipated use of such waters.

The groundwater quality standards of ARM 16.20.1003, above, have been waived for a portion of the bedrock aquifer, because of the impracticability of remediating the bedrock aquifer (see discussion at the end of the introduction section) in the foreseeable future. However, state ground water quality standards as well as the state non-degradation standards are applicable for the alluvial aquifer and the bedrock aquifer outside the TI waiver area. These standards prohibit discharge of contaminated water from the TI waiver area of the bedrock aquifer to the alluvial aquifer or the bedrock aquifer outside the TI waiver area. The remedy is structured to preclude such a discharge by keeping an inward gradient towards the bedrock aquifer waiver area by an inflow control, and a pump and treat system. An additional concern with respect to ARARs for groundwater is the impact of bedrock groundwater upon the alluvial groundwater system or surface water. The remedy mandated by the ROD precludes any discharge of contaminated groundwater from the East Camp Berkeley Pit and West Camp systems into the alluvial aquifer and the upper Silver Bow Creek drainage. Any discharge of groundwater will be through a point source discharge where such a discharge meets all "1" class standards.

B. AIR QUALITY

In addition to the standards identified in the federal contaminant-specific ARARs above, the State of Montana has identified certain air quality standards in the action-specific section of the State ARARs below.

VII. MONTANA LOCATION SPECIFIC REQUIREMENTS

A. Solid Waste Management Regulations (Applicable)

Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 et seq., MCA, specify requirements that apply to the location of any solid waste management facility (sludge disposal facility).**15** Under ARM 16.14.505 (Applicable), a facility for the treatment, storage or disposal of solid wastes:

(a) may not be located in a 100-year floodplain;

(b) may be located only in areas which will prevent the pollution of ground and surface waters and public and private water supply systems; and

(c) must be located to allow for reclamation and reuse of the land.

Additional State Waste Management Regulations are identified below in the State Action Specific requirements.

VIII. MONTANA ACTION SPECIFIC REQUIREMENTS

In the following action-specific ARARs, the nature of the action triggering applicability of the requirement is stated in parentheses as part of the heading for each requirement.

A. WATER QUALITY

1. Groundwater Act (Applicable) (Construction and maintenance of groundwater wells)

Section 85-2-505, MCA, (Applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater. This requirement would apply to the numerous monitoring wells (alluvial and bedrock) employed in the project.

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[15] These requirements apply, inter alia, to the treatment, storage, or disposal of solid waste. See ARM 16.14.50-(17). While "solid waste" does not include mining wastes regulated under the mining and reclamation laws administered by the Department of State Lands, see § 75-10-203(11), MCA. DSL has not adopted regulations addressing the disposal of sludges or wastes from a water treatment facility such as that proposed for the Mine Flooding Operable Unit. Also, the current permits issued by DSL for mining operations at this facility do not address disposal of these sludges. Therefore, these requirements are applicable to the treatment, storage and disposal of these sludges or wastes. If these requirements were not viewed as applicable, they would be relevant and appropriate requirements for the disposal of these sludges.

2. Water Quality Act (Applicable) (Discharge to POTW)

Section 75-5-602, MCA, empowers MDHES to require the owner or operator of any point source or of any facility that discharges to a municipal sewage system to which this chapter's pretreatment standards apply to keep records, make reports, install, use, and maintain monitoring equipment and to sample effluent using specified monitoring methods at designated locations and intervals. This requirement would apply because of the use of the municipal waste water treatment plant in controlling the West Camp system.

3. Montana Surface Water Quality Regulations (Applicable) (Sampling Activities)

ARM 16.20.635 (Applicable) provides standards for sampling and analysis of water to determine quality.

ARM 16.20.642 (Applicable) requires that bioassay tolerance concentrations be determined in a specified manner.

4. Public Water Supply Regulations (Applicable) (Reconstruction or modification of public water or sewer lines on the site)

If remedial action at the site requires any reconstruction or modification of any public water supply line or sewer line, the construction standards specified in ARM 16.20.401(3) (Applicable) must be observed.

B. AIR QUALITY

1. Air Quality Regulations (Applicable) (Excavation/earth-moving/construction; transportation)

Dust suppression and control of certain substances likely to be released into the air as a result of earth moving, transportation and similar actions may be necessary to meet air quality requirements. Certain ambient air standards for specific contaminants and particulates are set forth in the federal contaminant-specific section above and the state regulations below.

ARM 16.8.814 (Applicable) specifies that no person shall cause or contribute to concentrations of hydrogen sulfide in the ambient air which exceed the following standard: hourly average--0.05 parts per million, not to be exceeded more than once per year.

ARM 16.8.815 (Applicable) specifies that no person shall cause or contribute to concentrations of lead in the ambient air which exceed the following: 90-day average--1.5 micrograms per cubic meter of air, 90 day average, not to be exceeded.

Additional air quality regulations under the state Clean Air Act, §§ 75-2-101 et seq., MCA, are discussed below.

ARM 16.8.1302 (Applicable) lists certain wastes that may not be disposed of by open burning [16], including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of 16.8.1307 or 1308.

ARM 16.8.1401(1) and (2) (Applicable) provides that no person shall cause or authorize the production, handling, transportation or storage of any material; or cause or authorize the use of any street, road, or parking lot; or operate a construction site or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken. Emissions of airborne particulate matter must be controlled so that they do not "exhibit an opacity of twenty percent (20%) or greater averaged over six consecutive minutes." ARM 16.8.1401(1) and (2) (Applicable) and ARM 16.8.1404 (Applicable).

ARM § 16.8.818 (Applicable) provides an ambient air quality standard for settled particulate matter. Particulate matter concentrations in the ambient air shall not exceed the following 30-day average: 10 grams per square meter.

The Butte area has been designated by EPA as non-attainment for total suspended particulates, as well as PM-10. State requirements associated with this designation are discussed below.

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[16] 'Open burning' means combustion of any material directly in the open air without a receptacle, or in a receptacle other than a furnace, multiple chambered incinerator or wood waste burner..." ARM 16.8.1301(5).

ARM 16.8.1401(4) (Applicable) requires that any new source of airborne particulate matter that has the potential to emit less than 100 tons per year of particulates shall apply best available control technology (BACT); any new source of airborne particulate matter that has the potential to emit more than 100 tons per year of particulates shall apply lowest achievable emission rate (LAER). The BACT and LAER standards are defined in ARM 16.8.1430. A significant source of the non-attainment for particulates and PM-10 in the Butte area is road dust. Accordingly, special precautions should be taken in this area to limit dust emissions from remedial activities.

ARM 26.4.761 (Relevant and Appropriate) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of these measures could be considered relevant and appropriate to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of the remedy at the site. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

2. Control of Odors

ARM § 16.8.1427 (Applicable). If a business or other activity (i.e. treatment facility) will create odors, those odors must be controlled, and no business or activity may cause a public nuisance.

3. Monitoring

ARM 16.8.807 (Applicable) states the methods that must be followed in all ambient air monitoring.

ARM 16.8.809 (Applicable) specifies that sampling, data collection, recording and data analysis must be performed as specified in this section.

C. SOLID WASTE MANAGEMENT

Preliminary treatability studies have indicated that the sludge generated by the treatment process designated by the ROD may not be a characteristic hazardous waste. While certain hazardous waste regulations could arguably be identified as relevant and appropriate requirements, the applicable state solid waste management regulations (ARM 16.14.500 et. seq.) have been determined to be appropriate regulations for the management of sludges that are not characteristic hazardous waste. It is possible that the sludges produced may be characteristic hazardous waste, either because an alternate treatment system is ultimately utilized or because the process identified in the ROD, once implemented, actually generates characteristic hazardous sludges. If this is the case, the state hazardous waste regulations will be applicable.

Solid Waste Management Act (Applicable)

Regulations promulgated under the Solid Waste Management Act, §75-10-201 et. seq., MCA, place restrictions and requirements on the ultimate disposition of sludges to be generated by this action:

ARM 16.14.504 (applicable) restricts those various types of wastes that disposal sites may handle.

ARM 16.14.505 (applicable) sets forth standards that all solid waste disposal sites must meet.

ARM 16.14.506 (Applicable) sets forth the applicable criteria for design of a landfill repository.

ARM 16.14.520 and 521 (applicable) set forth the general and specific operation and maintenance requirements for solid waste management systems.

ARM 16.14.523 (applicable) specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from a transport vehicle.

ARM 16.14.530 and 531 (applicable) set forth the requirements for closure of a landfill repository and the requirements for post-closure care.

The ROD indicates that possible disposal of sludges in the Berkeley Pit will be considered by the agencies when sludge disposal becomes necessary and the composition of the sludge is known. In considering options for disposal, the agencies will determine whether certain of the otherwise applicable hazardous or solid waste requirements may be waived on the basis that such disposal will attain a standard of performance that is equivalent to that required under the otherwise applicable standard or requirement through use of another method or approach, as provided in 40 CFR § 300.430(f)(1)(ii)(C)(4).

D. MONTANA DAM SAFETY ACT (Applicable)

Regulations pursuant to the Dam Safety Act,17 §§ 85-15-101 et. seq. MCA, are discussed below. "Dams", as used in the act and these regulations includes any artificial barrier used to impound or divert water with an impounding capacity of 50 acre feet or greater.

ARM 36.14.202 (applicable) states that all dams and reservoirs which divert or store water must be constructed in a secure, thorough, and substantial and safe manner.

ARM 36.14.501 (applicable) states that all high hazard dams must comply with the criteria given.

ARM 36.14.502 (applicable) states that all high hazard dams must be able to safely pass the flood calculated from the inflow design flood.

IX. OTHER MONTANA LAWS

The following "other laws" are included here to provide a reminder of other legally applicable requirements for actions being conducted at the site. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ARARs because they are not "environmental or facility siting laws." As applicable laws other than ARARs, they are not subject to ARAR waiver provisions. Section 121(e) of CERCLA exempts removal or remedial actions conducted entirely on an NPL site from federal, state or local permit requirements, and this exemption is considered broad enough to cover even permits required under "other laws."

> [Identification of these requirements as ARARs does not impair, alter or affect the regulatory jurisdiction or authority of the Montana Department of State Lands or Department of Natural Resource and Conservation over the Active Mine Area, including the Yankee Doodle Tailings Dam.]

A. Groundwater Act

Section 85-2-516, MCA, states that within 60 days after any well is completed a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

B. Occupational Health Act, §§ 50-70-101 et seq., MCA.

ARM § 16.42.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.95 applies.

ARM § 16.42.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.

C. Montana Safety Act

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

D. Employee and Community Hazardous Chemical Information Act

Sections 50-78-201, 202, and 204, MCA, state that each employer must post notice of employee rights, maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used. Employees must be informed of the chemicals at the work place and trained in the proper handling of the chemicals.

I CLASSIFICATION LIMITATIONS FOR WATER DISCHARGED TO SILVER BOW CREEK BELOW THE COLORADO TAILINGS FROM THE MINE FLOODING OPERABLE UNIT

		Total Recoverable Concentrations (µg/L)					
Discharge Limitations		Arsenic	Cadmium	Copper	Lead	Zinc	Iron
January	Monthly Average	4.5d	1.6b	124d	9.5d	431d	1000b
	Daily Maximum	6.75e	5.0a	188e	15a	647e	1500e
February	Monthly Average	4.5d	1.6b	98d	5.6b	416d	1000b
	Daily Maximum	6.75e	5.0a	147e	15a	624e	1500e
March	Monthly Average	6.5d	1.6b	132d	5.6b	448.5d	1000b
	Daily Maximum	9.75e	5.0a	197e	15a	673a	1500e
April	Monthly Average	6.5d	1.6b	129d	5.6b	444d	1000b
	Daily Maximum	9.75e	5.0a	194e	15a	666e	1500e
May	Monthly Average	6.1d	1.6b	115d	5.6b	443.5d	1000b
	Daily Maximum	9.15e	5.0a	173a	15a	665e	1500e
June	Monthly Average	5.5d	1.6b	112d	5.6b	482d	1000b
	Daily Maximum	8.25e	5.0a	168e	15a	723e	1500e
July	Monthly Average	6.75d	1.6b	118d	13d	492d	1000b
	Daily Maximum	10.13e	5.0a	176e	15a	738e	1500e
August	Monthly Average	6d	1.6b	95d	5.6b	476d	1000b
	Daily Maximum	9.00e	5.0a	143e	15a	714e	1500e
September	Monthly Average	4.5d	2.9d	150f	11.8d	750f	1000b
	Daily Maximum	6.75e	5.0a	225e	15a	1125e	1500e
October	Monthly Average	4d	1.6b	98.5d	5.6b	445d	1000b
	Daily Maximum	6.00e	5.0a	148e	15a	668e	1500e
November	Monthly Average	6d	1.6b	132d	7.25d	465d	1000b
	Daily Maximum	9.00e	5.0a	197e	15a	698e	1500e
December	Monthly Average	5.5d	1.6b	130d	7.5d	442d	1000b
	Daily Maximum	8.25e	5.0a	195e	15a	663e	1500e

a Primary Drinking Water Standard (Safe Drinking Water Act).
b Chronic Water Quality Criteria
c Acute Water Quality Criteria
d One-half Monthly Mean (Table 2)
e 150 percent of the Monthly Average Discharge Limitation
f Effluent Limitation (40 C.F.R. 440.102)

NOTE: Presently, there is no specific discharge criteria for sulfate. However, a maximum contaminant level (MCL) for sulfate is expected to be proposed within the next 18 months. This health-based MCL will become an enforceable discharge standard at that time.

TECHNICAL IMPRACTICABILITY EVALUATION

APPENDIX 2
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

Technical Impracticability Evaluation
Bedrock Aquifer
Butte Mine Flooding Operable Unit

Page

1.0 Introduction

1.1 Executive Summary

In this report the U.S. Environmental Protection Agency (EPA) and the Montana Department of Health and Environmental Sciences (MDHES) present the technical support for the application of a Technical Impracticability (TI) Waiver for the bedrock aquifer present in the East and West Camp areas of the Butte Mine Flooding Operable Unit (BMFOU). The ground water Applicable or Relevant and Appropriate Requirements (ARARs) for the bedrock aquifer include the National Primary Drinking Water Standards (40 C.F.R Part 141) and the Montana Ground Water Quality Standards (ARM 16.20.1003). The ground water present in the bedrock aquifer shows concentrations of arsenic, lead, cadmium, and copper at levels exceeding MCLs and state ground water quality standards. Although many other metals are found in the bedrock aquifer of the TI zone at elevated levels, compared to background, only these four exceed a primary drinking water standard. The exceedances and elevated concentrations are a result of the presence of oxygen, water, and the massive source of sulfidic minerals (i.e., the native ore) present in the bedrock, mobilization of which has been enhanced by past mining activities (ARCO, 1994a).

The cause of the contamination within the TI zone is acid mine drainage. Acid Mine Drainage (AMD) requires three things: water, oxygen, and a source of sulfur. At this site, the source of sulfur is the native mineralized ore, such as pyrite (iron disulfide FeS_2) in the bedrock.

The oxidation of sulfidic and mineralized ore in the presence of water, releasing the metals to the water and lowering the pH of the water is a natural process. Examples of naturally occurring acid rock drainage, or ARD, can be found in the United States. However, this same natural process is magnified by the activities of man, such as mining; thus the term acid mine drainage. Further, the acidic water gradually dissolves more sulfides in the bedrock, which in turn contribute more dissolved metals and sulfate to the ground water; a sort of "snowball" effect.

To stop or control AMD requires limiting or eliminating one of the three factors: water, oxygen, or source material.

The bedrock aquifer within this site, the Butte Mine Flooding Operable Unit, requires a TI waiver **1** because:

- From a practical standpoint, it is not feasible to use source removal to remediate the ground water to attain the prescribed ARARs. The sheer size of the source, calculated to be 27 billion cubic yards, would leave an open pit about 62 times larger than the current Berkeley Pit, would eliminate the historic city of Butte, and would have untold environmental consequences;

- Engineering controls to limit or eliminate water flow into and within the bedrock aquifer by conventional or innovative methods on a site of this size and nature has never been attempted, final ability to attain ARARs is debatable, and cost calculations place the attempt at 7 to 10 billion dollars. The site is complicated by the anastomotic **2** nature of the mine workings. There are no less than three thousand (3000) miles of interconnecting underground mine workings within the 6.75 mile TI zone;

- Lowering the ground water level in the bedrock aquifer via pumping would exacerbate (degrade) the existing water quality by elevating acidity (lower pH) and increasing concentrations of metals. Further, lowering the ground water level would perpetuate the problem as pumping only exposes more source material to oxidation and acid generation; and

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[1] This TI waiver relates only to this specific operable unit and is not an indication of intent or policy with respect to any other operable unit or site. This TI waiver does not affect the requirements of any other federal, state, or local regulation; nor is the waiver an allowance to permit further degradation of the bedrock aquifer. The contamination of the bedrock aquifer at the Butte Mine Flooding Operable Unit is a unique situation and may not be analogous to any other site. All of the points and issues presented in this introduction section will be discussed further in the Technical Impracticability Evaluation.

[2] Anastomotic means "not without a connection". With the extensive mine workings and fractures in the TI zone, the bedrock with respect to water is accurately described as anastomotic.

- The selected remedy proposed for the BMFOU, maintaining the Berkeley Pit as a hydraulic sink, will effectively prevent migration of contaminated bedrock ground water within the TI zone from impacting the Silver Bow Creek/Blacktail Creek drainages and the associated alluvial aquifer. Similarly, ground water controls to be implemented at the Travona Shaft will prevent off-site migration of contaminated bedrock ground water from the West Camp to Silver Bow Creek. However, the selected remedy for the site will not meet ARAR requirements for ground water.

1.2 Site Description and History

The area to be considered for the TI waiver is located in southwestern Montana in and near the City of Butte (Figure 1). The TI zone (shown in Figure 2) is within the Butte mining district in the upper Silver Bow Creek (SBC) drainage and covers an area of approximately 6.75 square miles. There are two distinct hydrologic systems within the TI zone, the East and West Camp systems. The West Camp system is located in the west-central portion of the city of Butte and includes the Travona, Ophir and Emma shafts and associated underground mine workings. The East Camp system is located in the east-northeast portion of the Butte mining district and consists of the Berkeley Pit and related underground mine workings. The two systems are separated hydraulically by bulkheads installed in mine shaft drainage levels during the late 1950s. However, the integrity of the bulkheads is not known, and they may be subject to deterioration and possibly failure (CDM FPC, 1990).

Extensive underground and open pit mining activities have been prevalent throughout the TI zone since gold was first discovered in Butte in 1864. Underground mining began in the 1880s and by 1964, several thousand miles of underground workings had been driven into the bedrock. Estimates of the extent of mine workings range from 3000 miles for major shafts, levels, and drifts, to 10,000 miles for total workings within the 6.75 square miles of the TI zone (James, 1980). This extensive network of mine workings has created an anastomotic condition; an analogy might be made to a heavily riddled swiss cheese. Table 1 lists the underground mines located within the Butte Mining District. When underground mining stopped in 1982, the workings had descended to below 1500 feet above mean seal level (ft msl)[United States Geological Survey (USGS) datum]. The surface elevation within the TI zone ranges from about 5400 ft mls to about 6200 ft msl.

Large scale open pit (the Berkeley Pit) mining began in 1955. When mining was discontinued in 1982, the bottom of the pit was at an elevation of 4,265 ft msl. The total depth of the pit from the bottom to the highest point on the rim is 1,780 feet. The pit encompasses approximately 675 acres (1.06 square miles) and has a volume of approximately 1.18 x 1010 cubic feet from the base to the rim at an elevation of 5,543 ft msl (ARCO, 1994a). The Pit would contain just under 89 billion gallons of contaminated water if allowed to fill unregulated to this rim.

To facilitate mining activities, the naturally occurring ground water level was lowered approximately 4,200 feet from pre-mining levels via pumping. With the cessation of active mining in the Berkeley Pit in 1982, the pumping system ceased operating and the underground mines and the Berkeley Pit began to flood. The presence of water in the mine workings during and after mining, in combination with the oxidation of the naturally occurring sulfide minerals has resulted in generation of acidic solutions and the releasing of metals and sulfate into the bedrock aquifer. If the two hydrologic systems (mine workings and pit) were allowed to flood, recovering to natural pre-mining conditions without regulatory intervention, there would be a release of the contaminated waters (AMD) from the TI zone and into Silver Bow Creek and the Butte alluvial aquifer. However, the selected remedy will permanently manage water levels in the two systems, with the focus being the Berkeley Pit maintained as a sink for the AMD.

2.0 Evaluation of Technical Impracticability

In accordance with CERCLA Section 121(d)(4)(C) and the National Contingency Plan, 40 CFR §300.430(f)(1)(ii)(C)(3), EPA may select a remedial action that does not attain an ARAR if compliance with that ARAR is technically impracticable from an engineering perspective. This section presents an evaluation of the components for a TI waiver in accordance with "Guidance for Evaluating the Technical Impracticability of Ground Water Restoration" (EPA. 1993).

2.1 Waiver of Ground Water ARARs

The ground water Applicable or Relevant and Appropriate Requirements (ARARs) for the bedrock aquifer include the National Primary Drinking Water Standards (40 C.F.R. Part 141) and the Montana Ground Water Quality Standards (ARM 16.20.1003). Within the TI zone, these ARARs are waived for the following constituents: arsenic, cadmium, lead, copper, and sulfate if a primary MCL is established for sulfate. These are the only site-related ground-water contaminants that exceed ARARs. Table 2 lists the metal constituents for which the ARAR waiver is invoked, along with the applicable water quality standard. Table 2 also gives the mean and highest value of water quality data for other elevated constituents within the shafts (mine workings) and bedrock monitoring wells (fracture zone) of the TI area.

In cases where it is not practicable to return usable ground water to its beneficial uses within a time frame that is reasonable given the particular circumstances of a site, EPA expects to a) prevent migration of contaminated water from the TI zone, b) prevent exposure to contaminated ground water within the TI zone, and c) evaluate further risk reduction (40 C.F.R § 300.430 (a) (1) (iii) (F)). Because it is not technically practicable from an engineering perspective to attain these groundwater quality standards in the designated area within the bedrock aquifer, a waiver is invoked for these ground water ARARs.

2.2 Definition of Technical Impracticability Zone

The horizontal extent of the TI zone is defined primarily by the extent of underground mine workings and/or extent of documented influence of mine workings on the bedrock aquifer. The vertical extent of the TI zone is defined by the elevation of the lowest underground mine workings which has been determined to be approximately 1500 ft msl (AIME, 1968). Additionally, the TI zone represents the outer boundary of the area(s) within the cone of influence of the historically dewatered East and West Camp hydrologic systems (see Section 1.1).

The area to be included in the bedrock aquifer TI zone is shown in Figure 2. This area represents the potential contaminated bedrock aquifer and encompasses the area of underground mine workings. However, major landmarks (roads) were utilized to assist in the subsequent institutional controls that will follow a TI waiver. This area covers both the East and West Camp areas of the Butte Mining District and is approximately 6.75 square miles in area.

2.3 Site Description and Conceptual Model

2.3.1 Geology and Hydrogeology

To develop a site conceptual model of the bedrock aquifer, three topics require consideration to evaluate this TI waiver: the geology, hydrogeology, and mining's impact on the bedrock aquifer.

2.3.1.1 Geology of the Bedrock Aquifer

The Butte area is underlain by igneous rocks of the Boulder Batholith, which consists primarily of quartz monzonite that has been intruded by rhyolite and porphyry dikes (AIME, 1968). This bedrock contains disseminated ore vein deposits of copper and other metals, primarily in sulfide form. The area was and continues to be of interest to the mining industry.

The bedrock can be subdivided into a weathered zone and a competent bedrock zone. Weathered bedrock is native ore that has oxidized in place over geologic time and is "incapable" of producing an acid rock drainage. Where present, the weathered bedrock is 100 to 200 feet thick and consists of clay interspersed with 1 to 10 inch fragments of monzonite. Frequently, the weathered bedrock functions as a confining layer, limiting water and oxygen movement between the alluvium and the deeper competent bedrock. The competent bedrock consists of unoxidized quartz monzonite and is encountered in the TI zone at depths ranging from 250 to more than 750 feet below the ground surface as documented by logs of diamond drill holes (DDHs), mine shafts, and monitoring wells installed as part of the Remedial Investigation (RI) (ARCO, 1994a).

There is limited alluvial material within the TI zone. What alluvial material there is in the TI zone is confined to the eastern and southeastern region of the Berkeley Pit. This is the historic flood channel of Silver Bow Creek, pre-Berkeley Pit. North and west of the Berkeley Pit, only very thin deposits of alluvial material can be found; frequently it is non-existent.

2.3.1.2 Hydrogeology of the Bedrock Aquifer

The flow of water within the TI zone is dependent on the extent of mine workings associated with any portion of the area. Flow within the area west of the Berkeley Pit, especially those areas associated with the Kelley Mine workings which are connected to the Berkeley Pit, is best characterized by a pipe network model (Ralston, 1994). Pipe network models are typically used to evaluate water distribution systems for cities and plants. These models use the length and size of pipes and friction factors to relate flow rates to water pressure and friction losses. Application of a network model to the mine workings best simulated experimental data (Ralston, 1994). Areas with less workings and/or caving of workings, plus the remainder of the TI zone, have flow best characterized by a fractured media model. Ground water within the TI zone is primarily stored within fractures. However, the thousands of miles of open and caved underground workings increase the amount of aquifer storage by about 13 percent.

Based on geophysical logging data, localized fracture zones within the competent bedrock extend at least as deep as 350 feet below the weathered/competent bedrock interface (Canonie, 1992). These fractures contain ground water, most of which is encountered in the upper 1000 feet of the bedrock. The yield of water from bedrock wells ranges from less than 1 to more than 50 gpm (CDM FPC, 1990). The equivalent fracture porosity of the bedrock aquifer is estimated to be 1 percent (ARCO, 1994a). Previous investigations at the site calculated a fracture porosity for the bedrock in a shallow and highly fractured area of 5 percent (Metesch, 1990). This value represents an upper limit for the site. The TI zone, as a general description, is best characterized as a large fractured crystalline system. Literature citations for fractured crystalline rock (in the range of 1 percent porosity) were used as a reasonable value for the site.

Hydraulic properties of the bedrock aquifer were determined from rising-head and constant discharge tests (see Section 6.4 of RI (ARCO, 1994a) for complete discussion of bedrock aquifer characterization). The rising-head test data (seven wells tested) showed that hydraulic conductivity values range from 7.1 x 10-6 to 3.46 x 10-4 centimeters per second (cm/sec) with an average of 1.34 x 10-4 cm/sec. Aquifer transmissivity, as estimated from constant discharge test data, ranges from 9.9 gallons per day per foot (gpd/ft) to 99.0 gpd/ft.

As discussed in Section 2.3.1.1, the alluvium in the TI zone is essentially limited to an area east and southeast of the Berkeley Pit. A complete characterization of the alluvial aquifer can be found in Section 7.4 of the RI (ARCO, 1994a). The primary direction of ground water flow in the alluvial aquifer is southwest of the Leach Pads Area (northeast of the Pit) and then west towards the Berkeley Pit (see Figure 3). A ground water divide exists in the alluvial aquifer south of the Berkeley Pit. North of the divide, ground water flows towards the Berkeley Pit. A numerical ground water flow model developed for the RI (Section 11) indicates that this pattern of ground water flow will continue even as the water in the Berkeley Pit approaches 5410 ft msl (see Section 2.3.3.2 for significance of this elevation).

2.3.1.3 Mining's Impact on the Bedrock Aquifer

To facilitate underground and open pit mining the bedrock aquifer was dewatered via pumping. In addition to temporal dewatering, mining activities resulted in the excavation of no less than 3,000 miles (James, 1968) of underground workings in the bedrock. This has resulted in an extensive network of drainage galleries and conduits and has significantly elevated the storage capacity of the bedrock aquifer throughout the TI zone (over 900 million cubic feet or 6.8 billion gallons (Stephenson, 1994)).

Figures 4 and 5 show the underground mine workings in plan view and cross section, respectively. As shown on Figure 4 the underground mine network is more extensive in the East Camp than in the West Camp. As shown on Figure 5, several of the mine shafts and drifts directly intersect the Berkeley Pit. Thus, the hydraulic connection between the pit and the bedrock aquifer consists of both the mine workings network and to a lesser degree by the bedrock fracture system.

Prior to bedrock aquifer dewatering, the regional ground water flow in the bedrock was approximately from north to south with discharge to alluvium along Silver Bow Creek (SBC). Mine dewatering created a large cone of depression in the original potentiometric surface. When mining and dewatering operations ceased in 1982, the ground water began rising toward its premining equilibrium condition.

The influence of the underground workings on the hydraulic conditions within the bedrock aquifer can be seen by comparing the extent of underground workings (Figure 4) with the current configuration of the bedrock aquifer potentiometric surface as shown in Figure 6. Comparison of these figures shows that a hydraulic cone of depression is centered about the Berkeley Pit which is acting as a hydraulic sink. The shape of the cone of depression is elongated over the area containing underground workings, reflecting hydraulic influence (drainage) of the workings.

2.3.2 Source, Volume, and Quality of Ground Water

2.3.2.1 Ground Water and Contamination Sources

The source of water in the TI area is shown in Figure 7. The Inflow Control Investigation of the RI found that the average rate of flooding to the Berkeley Pit is about 5 million gallons per day (mgd) (ARCO, 1994a). Inflow to the Berkeley Pit from all surface water flows averages 1.68 mgd, the majority of which comes from the Horseshoe Bend area. Alluvium contributes 0.58 mgd. The bedrock aquifer accounts for 2.49 mgd of the inflow (49%). The origin of this bedrock inflow water is predominately precipitation/runoff and is the natural recovery of a dewatered system. A 0.30 mgd component of inflow to the Berkeley Pit is a combination of direct precipitation, adjacent runoff, and evaporation.

The source of contamination to the ground water in the bedrock aquifer is sulfidic and mineralized rocks (i.e., natural ore). This source is the massive ore body within the TI zone and the source produces contaminants when oxygen and water are available. The volume of the source is estimated to be approximately 736 billion cubic feet[3] or about 27 billion cubic yards. However, due to current and progressing flooding of the underground workings with water (natural inundation or flooding), the source of contaminants is gradually being removed as a source. As oxygen in the water has been consumed by AMD reactions, the water is "oxygen poor" and AMD reactions are greatly slowed, i.e., the source is removed from AMD production.

2.3.2.2 Ground Water Volume

Ground water in or hydraulically connected to the bedrock aquifer is present in three storage systems which are interconnected throughout the area of the TI zone and cover an area of 6.75 square miles.

- The first storage system is the Berkeley Pit which, as of July 1994 (ARCO, 1994a), contains about 24 billion gallons of impacted water. The Berkeley Pit is approximately 5.280 feet wide and 1,780 feet deep at its deepest point. The area of the pit is approximately 675 acres or 1.06 square miles. Based on the pit dimensions, the volume of water contained within the pit at the CWL of 5,410 ft msl is estimated to be 64 billion gallons (ARCO, 1994a).

- The second storage system consists of underground openings from past mining. Mining within the TI zone has resulted in approximately 3,000 miles of workings (James, 1968) which are documented or assumed to be connected with the Berkeley Pit. The volume of ground water which may be present in old mine workings is assessed to be approximately 6.8 billion gallons (Stephenson, 1994).

- The third storage system is the ground water in fractures throughout the area of TI zone. The bedrock within the TI zone is highly fractured and jointed as a result of ore-body formation, weathering, and mining-induced fracturing and caving. The total volume of ground water contained in the fractured portion of the bedrock aquifer can be estimated by taking the total bedrock aquifer volume within the TI zone, subtracting the estimated volume of underground workings and the Berkeley Pit, and multiplying the result by an average fracture porosity. Considering that the TI zone encompasses 6.75 square miles (Figure 2), with a fracture porosity of the bedrock of 1 percent (ARCO, 1994a) and a lower boundary of TI zone of 1,500 ft msl, the volume of water stored in fractures is approximately 54.3 billion gallons.

A comparison of volumes of ground water present in the three storage systems in the bedrock aquifer is shown in Figure 8. The calculations of the bedrock aquifer volume contained within the TI zone bedrock aquifer are presented in Appendix A. The total volume of ground water stored in the bedrock aquifer in natural or man-made features within the area for which the TI waiver is granted is approximately 125 billion gallons.

2.3.2.3 Ground Water Quality

The ground water present within the bedrock aquifer displays a different chemical makeup depending on the storage system in which the water is present. Table 2 summarizes the range of concentrations for the four constituents (arsenic, cadmium, copper, and lead) for which the ARAR waiver is being sought. Table 2 also gives the mean and highest value of water quality data of other elevated constituents within the shafts (mine workings) and bedrock monitoring wells (fracture zone). Figure 9 presents location specific water quality data for the bedrock monitoring wells, mine shafts, and the Berkeley Pit.

As shown in Table 2, water quality of the Berkeley Pit shows high levels of all the constituents. The water quality within the pit is a result of inflow from the bedrock aquifer, the alluvial aquifer, surface run-off, and discharge of mill process water (tailings slurry water occasionally discharged to the Berkeley Pit as the result of tailings pipeline failure). Surface inflow (i.e., Horseshoe Bend water) has a chemical makeup very similar to Berkeley Pit Water. As presented previously, this inflow component accounts for one-third of the current inflow (historically, over 45%) to the Berkeley Pit. The quality of water in the Berkeley Pit does not show an improving trend based on five sampling events from 1984 to 1991 (ARCO, 1994a).

[3] The volume of source has been estimated by: [Volume in TI zone] - [Volume of underground workings] - [Volume of Berkeley Pit] - [Volume of fractures in bedrock]. Volume of TI zone was estimated as surface area (6.75 sq. miles) times depth (4000 feet). See Attachment 1 for complete calculations.

The quality of the ground water present in the underground workings (shafts) within the TI zone also show elevated concentrations of constituents (see Table 2). Ground water quality present in the underground workings has been determined from samples taken from 12 shafts (ARCO, 1994a). The quality of ground water stored in mine workings shows a trend of improving water quality. For example, the concentration of copper in the pumped waters from several mines (in the early 1960s) varied between 155 milligrams per liter (mg/L) and 592 mg/L; average of 363 mg/L. The RI showed copper concentrations ranging from a minimum of 0.24 mg/L (Anselmo Mine shaft), to 0.965 mg/L (Steward Mine shaft), to 1.28 mg/L (Granite Mtn. Mine shaft). The improvement is due to the fact that flooding of the workings is restricting the amount of oxygen contacting the mineralized portion of the bedrock thus preventing the continued generation of acid mine drainage.

The ground water quality of the fractured bedrock as determined from bedrock monitoring wells shows low concentrations of the four constituents with few exceedances. Ground water quality trends in the fractured bedrock have been determined from samples taken from bedrock monitoring wells during RI (ARCO, 1994a). Note, these bedrock monitoring wells are located away from mine workings and frequently are on the outer boundary of the TI zone. Although these wells indicate a cleaner water than that which would be found closer to the Berkeley Pit, a well placed in this area and having sufficient production capacity, could be expected to pull contaminants towards the well. The systems (Berkeley Pit, mine workings, and fractures) are connected to each other within the TI zone.

2.3.3 Contaminant Transport Pathways

For contaminants to be transported from the TI zone into the Butte alluvial aquifer and Silver Bow Creek drainage, two conditions must be met. First - a connection (pathway) between the TI zone and the Butte alluvial aquifer and Silver Bow Creek drainage must exist. This condition exists for the bedrock aquifer and alluvial aquifer. Second - a hydraulic gradient must exist to facilitate ground water flow out of the bedrock aquifer and into the alluvial aquifer. For the bedrock aquifer within the TI waiver area this condition is not met at present and will not be met in the future because of proposed ground water level controls, which will preclude any movement of contaminated bedrock ground water to areas outside of the TI waiver zone. See Section 2.5, Alternative Remediation Strategy, for a summary of the selected remedy.

2.3.3.1 Current Hydraulic Control

Under current conditions, the bedrock aquifer ground water in East and West Camp does not migrate beyond the boundaries of the TI zone because the Berkeley Pit is acting as a hydraulic sink. A map showing positioning of the water levels in the bedrock aquifer in the East Camp demonstrating flow into the Berkeley Pit is shown in Figure 6. Figure 5 presents a cross-section showing the current ground water flow conditions into the pit.

2.3.3.2 Future Hydraulic Control

East Camp System

In the development and negotiations of the Administrative Order on Consent [Docket No. CERCLA VIII-90-09 (EPA, 1990)] (AOC) for the BMFOU RI/FS the potentially responsible parties (PRPs) agreed to maintain the water level in the Berkeley Pit/East Camp system below a preliminary Critical Water Level (CWL) of 5,410 ft msl. This elevation corresponds to the lowest documented occurrence of ground water in the alluvial aquifer of the Summit Valley (i.e., the alluvial valley south and southwest of the Berkeley Pit). Consequently, maintaining this level will prevent any future migration of water from the Berkeley Pit into the Silver Bow Creek, the Metro Storm Drain and Blacktail Creek. EPA and MDHES have determined that the CWL will be protective of the alluvial aquifer and surface flows. However, to ensure that an inward gradient is maintained within the bedrock aquifer, monitoring of future water levels will be conducted. As illustrated in Figure 5, maintaining the ground water below the CWL will ensure that a hydraulic gradient toward the Berkeley Pit in the bedrock aquifer exists over the East Camp section of the TI zone.

West Camp System

Water levels in the bedrock aquifer in the West Camp are significantly higher than those in the East Camp (approximately 5,420 ft msl vs 5,060 ft msl based on July 1994 data, respectively). This difference is the result of hydraulic separation of these two sections by a system of bulkheads in the mine workings. The approximate locations of the bulkheads are shown in Figure 4. In the future, the water levels will be controlled, utilizing the Travona Shaft as the control/pumping location, at or below a level of 5,435.6 ft msl (EPA, 1990).

2.4 Bedrock Aquifer Remediation Potential

This section presents an evaluation of the remediation potential of the bedrock aquifer. The remediation potential of the bedrock aquifer is addressed in terms of the nature and extent of ground water with concentrations of contaminants exceeding ARARs, and the applicable conventional and innovative remedial technologies. Four technologies are evaluated: pump-and-treat, inundation, grouting, and injection of acid neutralizing fluids.

The results of the evaluation indicate that it is technically impracticable to remediate the bedrock aquifer in the TI zone. However, mandated ground water controls will be implemented that will prevent off-site migration and impact to the Silver Bow Creek/Blacktail Creek drainages and the associated alluvial aquifer (see Section 2.5).

2.4.1 Source Control Measures

As described in Section 2.3.2 the occurrence of metals in the bedrock water is a result of geochemical reactions with the metal sulfides present within the naturally mineralized veins of the bedrock. Therefore, the source of metals and sulfate loading to the bedrock aquifer within the TI zone is the highly mineralized bedrock which is exposed to oxygen and water. This source volume has been estimated to be 736 billion cubic feet and cannot be removed or contained. Removal would leave an open pit about 62 times larger than the current Berkeley Pit, would eliminate the historic city of Butte, and would have untold environmental consequences.

2.4.2 Remediation Potential Evaluation

This section presents an evaluation of the remediation potential for the bedrock aquifer, based on current knowledge of technologies for ground water remediation at mine sites. Four methods were evaluated as potential remediation techniques. They are: pump-and-treat, inundation, grouting, and injection of acid neutralizing fluids. Ability to meet ARARs, specifically groundwater ARARs, is also evaluated.

2.4.2.1 Pump-and-Treat

Pump-and-treat systems for remediation of AMD at a mine site, although capable of extracting contaminated ground water from the bedrock aquifer, would not enable cleanup of the ground water in the bedrock aquifer. Pump-and-treat systems would reverse the currently observed improving trend (see Section 2.3.2.3) in the quality of the ground water in the bedrock. Lowering of the water level will reintroduce oxygen to the bedrock, reexposing the sulfide ore to oxidation, generating acid and thereby raising the concentrations of metals in the bedrock aquifer within the TI zone. The consequences of this fact are greater cost in treatment plant operation (i.e., increased reagent cost to treat the more grossly contaminated water), extended time to completely oxidize all sulfidic and mineralized-ore, greater volumes of sludge from the treatment plant with its associated handling cost and environmental impact, and loss of ore-body for future, albeit a low potential for this site, extraction of metals.

Finally, a pump-and-treat system would not meet ARARs for groundwater remaining in the TI zone. As discussed previously, pump-and-treat actually degrades the quality of the groundwater.

2.4.2.2 Inundation

Inundation, or flooding, is the only generally accepted method applicable to this situation of abating acid generation of the material containing pyrite (Kleinmann, 1991). Research by Watzlaf (1992) indicated that maintaining pyritic coal refuse under water virtually stops pyrite oxidation. In fact, mine waste with 10 percent pyrite placed under water did not form acidity, aluminum, iron, and sulfate contamination.

According to Watzlaf (1992), the metals mining industry has had success using under-water disposal of pyritic wastes, as discussed by Ritcey (1991), Balins et al. (1991), Rescan Environmental Services Limited (1990) and Bell (1987). Watzlaf (1992) quotes from Bell (1987) that "at the current time, the only practical and proven long-term approach to controlling the formation of acid in sulphide tailings is to limit the availability of oxygen as a reactant by maintaining the waste in a saturated or submerged condition". The authors acknowledged the use of capping as a remediation technique. However, they concluded that the long term maintenance of capping technology make it less attractive as a closure or remediation technique when compared to water closure.

Because of the demonstrated success of subaqueous disposal of pyritic mine waste, inundation is considered the best available technology economically achievable for new mine development in Quebec, Canada (Filion et al., 1994) and for dealing with mine wastes from uranium mines in eastern Germany (Feasby et al., 1994). Sulfidic tailings and waste rock at a zinc-copper mine in Sweden were also decommissioned by flooding (Broman and Goransson, 1994). Flooding was considered to be the safest and most effective option for the mine.

Although current flooding is reducing contaminant concentrations in deep bedrock groundwater (see Section 2.3.2.3), the selected remedy may not meet ARARs for groundwater within a reasonable timeframe.

2.4.2.3 Grouting

To be effective, grouting of the bedrock would have to seal, at a minimum, the entire underground workings contained within the TI zone. This is due to the highly interconnecting nature of the site. There are no less than three thousand (3000) miles of underground mine workings within the 6.75 square mile TI zone. The volume of grout needed to seal the underground mine workings is estimated to be a minimum of 6.8 billion gallons. For comparison, this volume of grout is over seven times the volume of concrete used to construct the Hoover Dam in Nevada.

Grouting does have the potential of meeting ARARs for the bedrock aquifer. Grouting has been used successfully at other mine sites outside of the U.S. but on a smaller scale.

2.4.2.4 Injection of Acid Neutralizing Fluids

Injection of acid neutralizing fluids involves injecting an alkaline solution through boreholes from the surface into the target area producing AMD. Previous studies suggest that addition of alkalinity to underground mine pools may have the potential to neutralize stored acidity, precipitate metals from solution, and reduce further pyrite oxidation. Also, since the precipitates from and remain in situ, the problem of sludge disposal would be less severe.

The Bureau of Mines (Aljoe and Hawkins, 1993) has experimented with injection of alkaline fluids into the subsurface to neutralize acidic discharges from abandoned coal mines. Application was down boreholes into flooded mine pools. However, this method has had little success at abandoned flooded or flooding sites, and its general application to a large scale site is questionable. Problems associated with this method include: inefficient mixing of the acid neutralizing agent and the ground water, surface coatings of iron hydroxides on the acid neutralizing agent which would inhibit neutralizing reactions, inability to completely access the underground workings, and difficulty in controlling flow of injection fluids in the fracture and mine working zones. This latter aspect affects cost by doubling the number of wells required to achieve adequate distribution of neutralizing fluid.

This method has, in theory, the potential to meet ARARs. However, this method has had limited success at smaller sites; its applicability at such a large site as this project makes the chances for meeting ARARs questionable.

2.4.3 Cost Consideration

2.4.3.1 Pump-and-Treat

In response to public comments on the proposed plan, the cost of pumping the Berkeley Pit "dry" (over an eleven year period) was calculated and ranged from $346 million to $462 million **4**.

2.4.3.2 Inundation

Cost calculations for inundating the bedrock system under several flow conditions can be found in the FS (ARCO, 1994b). The no action alternative (uncontrolled flooding and flow alternatives with and without active mining at the site were calculated. Cost ranged from $27 million to $213 million. Accelerated flooding cost were not calculated but should fall within the lower end of this range. The selected remedy may be considered an inundation program but the selected remedy controls the rate of inundation (i.e., "controls flooding").

Cost used for the purpose of this TI evaluation represents the selected alternative cost which are $41.8 million or $52.8 million depending on location of sludge disposal, i.e., into the Berkeley Pit or into a constructed repository located elsewhere in the active mine area.

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[4] Cost calculations were based on FS (ARCO, 1994b) values for treatment plant capital costs and operation and maintenance costs. Pumping the Berkeley Pit "dry" in 11 years with sludge disposal into the Pit had a associated cost of $346 million to $388 million. Sludge disposal on an onsite facility had an associated range of $412 million to $462 million.

2.4.3.3 Grouting

The assumptions made to estimate the cost of complete grouting of the underground workings in an attempt to abate the source of contamination to the bedrock aquifer are:

1) To deliver grout to the underground workings, **5** grout borings per acre would be drilled to an average depth of 2,500 feet below the ground surface. Over the area of the TI zone (6.75 square miles) the total linear footage that would need to be drilled would be over 54 million feet and represents 21,600 drill holes (six inch diameter). Assuming an average cost of drilling to be $100 per foot for the first 1000 feet of drilling and $50 per foot for the remainder5, the total cost of drilling the grout borings will be approximately $3.78 billion.

2) The total volume of grout needed to completely fill the underground workings void space is, at a minimum, approximately 920 million cubic feet ([21,600 holes X 6 inches per hole X 2,500 feet per hole] + volume of mine workings). The cost of the grout **6** to fill this void is estimated to be $2.2 to $3.0 billion.

3) A water treatment plant to treat the displaced mine drainage would cost $20.3 million, based on the parameters used for the Feasibility Study (FS) (ARCO, 1994b).

4) Water treatment would operate for 8 years at a rate of 6.8 MGD. The O&M cost of treatment and sludge disposal would be estimated at $113.3 million (ARCO, 1994b).

5) The ground water displaced by the grout would be pumped from 10 existing mine shafts. The cost of refurbishing the 10 shafts for ground water extraction is estimated to be $162.5 million.

6) The annual O&M cost for pumping the 10 shafts is assumed to be 15 percent of the capital cost. For a period of 8 years, this O&M would amount to $195.0 million.

7) Contingencies for grouting are assumed to be 30 percent of the total cost. The contingencies amount to $2 billion to $2.3 billion.

In summary, the cost of grouting the underground workings is estimated to be $9 billion (± $.5 billion).

2.4.3.4 Injection of Acid Neutralizing Fluids

In order to estimate the cost of injecting acid neutralization fluids to remediate the bedrock aquifer in an attempt to attain ARARs, the following assumptions were made:

1) To deliver acid neutralizing fluids to the underground workings, 10 injection borings per acre would be drilled to an average depth of 2,500 feet below the ground surface. Over the area of the TI zone (6.75 square miles) the total linear footage that would need to be drilled would be over 108 million feet. Assuming an average cost of drilling to be $100 per foot for the first 1000 feet of drilling and $50 per foot for the remainder, the total cost of drilling the grout borings will be approximately $7.56 billion.

2) Assuming lime and barium oxide would be needed to neutralize the acidic ground water and to precipitate metals, the total amount of lime and barium oxide to treat the bedrock aquifer ground water within the TI zone is estimated to be 17.8 million tons, at a cost of $1.1 billion.

3) A water treatment plant to treat the displaced mine drainage during injection would cost $20.3 million based on the parameters used in the FS (ARCO, 1994b).

4) Water treatment would operate for 8 years at a rate of 6.8 MGD. The O&M cost of treatment and sludge disposal would be $113.3 million (ARCO, 1994b).

5) The ground water displaced by injection would be pumped from 10 existing mine shafts. The cost of refurbishing the 10 shafts for ground water extraction is estimated to be $162.5 million.

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[5] Cost estimates are based on price quotes by local drilling contractor who installed bedrock monitoring wells as part of the RI and who has extensive experience in drilling deep bedrock wells at the site.

[6] Cost of grout is based on a $2.40 per cubic foot for cement-based grout and $3.25 for clay based grout. The latter is a price quote from a contractor supplying grout at $6.50 per cubic foot for a Montana AMD remediation project. The supplier stated that for a project requiring such a large amount of grout, the cost per cubic yard would be reduced by fifty percent (50%).

6) The annual O&M cost for pumping the 10 shafts is assumed to be 15 percent of the capital cost. For a period of 8 years, this O&M would amount to $195.0 million.

7) Contingencies for injection are assumed to be 30 percent of the total cost. The contingencies amount to $2.6 billion.

In summary, the cost of injecting acid neutralization fluids is estimated to be $11.8 billion.

2.5 Alternative Remediation Strategy

In cases where it is not practicable to return usable ground water to its beneficial uses within a time frame that is reasonable given the particular circumstances of a site, EPA expects to a) prevent migration of contaminated water from the TI zone, b) prevent exposure to contaminated ground water within the TI zone, and c) evaluate further risk reduction (40 CFR §300.430(a)(1)(iii)(F)). Because it is not technically practicable from an engineering perspective to attain these groundwater quality standards in the designated area within the bedrock aquifer, a waiver is invoked in the Record of Decision for the ground water ARARs.

The selected remedy consists of inundation of the mine workings along with other measures, as outlined below. However, the selected remedy controls the rate of inundation (controlled flooding). The remedy selected for this OU will protect human health and the environment, and will meet the NCP expectations for non-ARAR-compliant remedies as outlined in (a) through (c) above.

The selected remedy also provides the greatest balance of tradeoffs among the nine remedy selection criteria, as discussed in the FS (and the ROD?). The major components of the selected remedy are provided below:

1) Inflow Control: The remedy requires immediate control and treatment of surface water as well as immediate control and treatment of subsurface flow in the east alluvial aquifer. This action will slow the present rate of Berkeley Pit flooding by over 40%. The selected remedy also requires diversion of clean flows, presently used by current mining operation, around the Pit once mining is discontinued.

2) Water Levels: The remedy does not allow water levels to rise in the Berkeley Pit/East Camp system and the Travona/West Camp system above the established levels of 5410 and 5435 ft msl, respectively. EPA and the State believe these are levels at which human health and the environment will be protected.

3) Water Treatment Technology and Sludge Generation/Disposal: Aeration with two-stage hydroxide precipitation and reverse osmosis (if necessary) has been chosen as the treatment technology for this action. Any sludge disposal repository will meet Montana solid waste regulations. The declaration portion of the ROD directs disposal of sludge in a repository in the mine area or in the Berkeley Pit. However, the selected treatment technology must be reevaluated when the water in the Berkeley Pit/East Camp system reaches 5260 ft msl. The agencies remain flexible in the use of other technologies proposed jointly by the responsible parties and developers of technology, if it meets stream discharge standards. For a complete discussion of the water treatment technology and sludge generation/disposal issue, see the declaration and decision portions of ROD.

4) Construction of the Water Treatment Facility: Design will begin no less than eight years prior to the projected date when the Berkeley Pit/East Camp system could reach the critical water level. The facility will be completed four years prior to reaching that level.

5) Performance Standards: The design, construction, operation and maintenance of the water treatment and sludge disposal facility will be approved and monitored by EPA and the State. Discharged water will meet State water quality standards. Sludge disposal activities will meet state and federal solid waste disposal regulations.

6) Comprehensive Water Monitoring Program: This will be used to track water elevation and quality in the TI zone. The data will be used to ensure that a water treatment facility is in place and operating before reaching the critical water levels. The agencies will produce yearly written reports with the collected data and updated predictions of when the critical water levels will be reached. Every three years the agencies will review the entire monitoring program and make adjustments.

7) Dam Stability: The selected remedy provides monitoring and design criteria for the Yankee Doodle Tailings Pond to ensure that the dam does not fail.

8) Groundwater Use Restrictions: Institutional controls will be employed to ensure that there is no inappropriate use of contaminated bedrock groundwater.

9) Travona/West Camp System Water: EPA took action in 1988 to control the water level of this system by pumping and treating Travona Shaft water. This remedy is still appropriate, and is integrated into the Mine Flooding selected remedy.

10) Flexibility: There is flexibility in the way surface water inflow is controlled, the method used to treat contaminated water, the bedrock water withdrawal point, and the use of collected and/or treated water.

11) Five Year Review: Since hazardous substances will remain on site at levels above those that would allow unlimited use and unrestricted exposure, the remedy will be reviewed no less often than every five years after initiation of the remedial action. EPA and the State retain authority, under applicable federal and state law, to establish lower water levels, or take other actions as necessary to deal with unanticipated threats to human health and the environment.

The monitoring program is comprised of 13 bedrock monitoring wells (9 existing and 4 new), eight mine shafts, 15 existing wells completed in bedrock, and the Berkeley Pit, for a total of 37 bedrock monitoring locations. Also, there is over ten years of water level data for many of these locations plus additional water-level data is being added monthly to the data base (see Figure 10 for monitoring point locations). The monitoring program has an extensive data base on water chemistry with additional water quality data to be collected. The selected remedy requires a three year review of the program, retaining flexibility to adjust the program as needed. The current monitoring network (with the addition of new monitoring wells in the West Camp and the flexibility to require additional wells if needed) will assure the agencies and the public that ground water flow towards the Berkeley Pit/East Camp will be maintained.

3.0 Conclusions

Attainment of ARARs in the bedrock aquifer within the TI zone is technically impracticable from an engineering perspective. The principal reasons for this are: 1) the extremely large horizontal and vertical extent of the contamination problem: 2) the potentially applicable remediation technologies are not proven in conditions similar to this site; and 3) even if one of the potentially applicable technologies were used. the cost of remediation would be inordinately high. Additional clarification and conclusions are provided below. Table 3 summaries and provides a comparison of the four remediation techniques evaluated in Section 2.4 above.

- It is infeasible to remove the contamination sources. Removal of the source, which consists of approximately 34 billion cubic yards of partially mined-out bedrock, would leave an open pit approximately 68 times larger than the current Berkeley Pit and would eliminate the historic city of Butte;

- Implementation of pump-and-treat methods will cause progressive deterioration of the ground water quality and reverse the currently observable trends of improving bedrock ground water quality by exposing more source material to oxygen;

- The ability to effectively deliver grout or acid neutralizing fluids to the subsurface is very uncertain from an engineering standpoint due to the extremely large extent of underground workings and the improbability of reaching all of the mine workings;

- Both grouting of the underground workings and injection of acid neutralizing fluids are prohibitively expensive methods given the conditions at the site (estimated at $9 to $11.8 billion, respectively);

- The volume of contaminated ground water contained within the bedrock aquifer of the TI area (Figure 2) is approximately 125 billion gallons. Environmental and economic Effects of treatment of such a volume of ground water are not possible to predict;

- Inundation of the bedrock aquifer with control of migration is the only reliable and available means to control and improve the quality of the bedrock ground water within the TI zone. However, the selected remedy, considered to be an inundation program, will not meet ground water ARARs.

- Since hazardous substances will remain on site at levels above those that would allow unlimited use and unrestricted exposure, the remedy will be reviewed no less often than every five years after initiation of the remedial action. EPA and the State retain authority, under applicable federal and state law, to establish lower water levels, or take other actions as necessary to deal with unanticipated threats to human health and the environment.

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Table 1
Butte Mines within the Butte Mining District

Adventure	East Colusa	Maria	Rescue
Alexander	East Grayrock	Marie Louise	Rialto
Alex Scott	Edith May	Martha	Robert Emmet
Alice	Ella Clark	Mayflower	Rocker
Alisbury	Ella Ophir	Michael Devitt	Rock Island
Allie Brown	Elm Orlu	Midnite	Rockwell
Amapore	Emma	Mill Site	Rooney
Amy Silversmith	Estrella	Milwaukee	Ryan
Annie and Ida	Excelsior	Minnie Healy	St. Clair
Anselmo	Flag	Minnie Irvin	St. Lawrence
Argonaut	Fraction	Minnie Jane	Samantha
Atlantic	Free-for-all	Missoula	Saukie East
Aurora	Gabriella	Modoc	Saukie West
Ausania	Gagnon	Molly Murphy	Silver Bow
Avery	Gambetta	Moonlight	Silver Buillon
Badger	Gem	Moose	Silver Chief
Badger State	Gemania	Morning Star	Silver Lick
Balaklava	Glangarry	Moulton	Silver Smith
Belk	Goldsmith	Mountain Central	Sister
Belcher	Grabella	Mountain Chief	Smoke House
Bell	Granite Mountain	Mountain Flag	Snowball
Belle of Butte	Gray Eagle	Mountain Rose	Snow Drift
Bellona	Gray Rock East	Mountain View	Sooner
Belmont	Gray Rock West	Nellie	Speculator
Berkeley	Great Republic	Nettie	Star West
Black Chief	Greenleaf	Neversweat	Stewart
Black Rock	Green Mountain	Night Hawk	Sun Dog
Blue Bird	Hattie Harvey	Nipper	Sunrise
Blue Jay	Hawkeye	North Berlin	Surprise
Blue Wing	Hibemian	North Star	Tramway
Bob Ingersoll	High Ore	Ophir	Transit
Buck Placer	Jamestown	Original	Travonia
Buffalo	Jersey Blue	Orphan Boy	Tully
Burke	Jessie Wingate	Orphan Girl	Tuolumme
Burlington	Josephine	P-80	Valdemere
Champion	Kansas Chief	Pacific Slope	Vulcan
Chattanooga	Kanuck	Parnell	Wake-Up Jim
Chicago	Kelley	Parrot	Walkerville
Chinook	La Plata	Pauline	Wappelo
Clark's Colusa	Later Acquisition	Paymaster	West Colusa
Colorado	Leonard	Pennsylvania	West Grayrock
Colusa Parrot	Lexington	Piccolo	West Mayflower
Comanche	Little Minah	Pittsmont	West Steward
Cora	Liquidator	Plover	Wild Pat
Curry	Lone Tree	Poser	Yankee Boy
Cut Hand	Maggie Bell	Rainbow	Zella
Czarromah	Magna Charta	Ramsdell's Parrot	Zeus
Darling Fraction	Magnolia	Rarus	
Diamond	Manhattan	Read	
Dixon	Margaret Ann	Ready Cash	

TABLE 2
AVERAGE AND HIGHEST CONCENTRATION VALUES OF CONSTITUENTS IN BERKELEY PIT, BEDROCK WELL, AND SHAFT WATER AND ESTABLISHED STANDARDS
BUTTE MINE FLOODING OPERABLE UNIT

Constituent	Berkeley Pit Water1 (µg/L)	Bedrock Well Water² (µg/L)		Shaft Water3 (µg/L)		MCLs4 (µg/L)
		Mean	Highest Value	Mean	Highest Value	
Aluminum	270,000	244	726	675	3,010	None
Arsenic6	710	52	254	211	1,380	50P
Cadmium	1,790	2.4	3.7	100	547	5P
Calcium	440,000	127,610	172,000	276,321	573,000	None
Chloride	26,200	4,400	2,600	NA	NA	250,000s
Copper	167,000	26.4	129	1,581	20,800	1,300s
Iron	897,000	9,231	17,600	50,094	307,000	300s
Lead	87	2.4	7.3	9.0	49.9	15P
Magnesium	395,000	33,400	47,400	83,046	190,000	None
Manganese	161,000	2,306	4,170	31,503	129,000	5,000S
Potassium	22,700	14,523	22,300	12,232	29,600	None
Sodium	71,400	62,200	169,000	43,975	128,000	None
Sulfate	16,800,000	577,800	980,000	840,583	2,870,000	None
Zinc	476,000	844	2,660	40,375	215,000	5s
pH	3.0-3.3 SU7	5.8-7.6 SU	5.84-7.59 SU	5.72-7.33	SU5.72-7.33 SU	6.5-8.5s SU

Source: ARCO 1994a

1 Average concentration values are weighted averages of 1991 data based on Pit volume.
2 Average concentration values for bedrock monitoring wells A, B, C, D-2, E, and F.
3 Average concentration values for the Chester, Hebgen, Parrot, Anselmo, Belmont, Emma, Granite Mountain, Kelley, Lexington, Margaret Ann, Orphan Boy, and Steward mine shafts.
4 Maximum Contaminant Levels (i.e., primary and secondaryS drinking water standards).
5 Acute and chronic aquatic Water Quality Criteria; all values arc based on a hardness of 100 mg/L $CaCO_3$ except arsenic and aluminum which are not hardness dependent.
6 Arsenic values are for arsenic-3. Note: State of Montana Water Quality Bureau standard for arsenic (WQB-7) is 3.18 µg/L.
7 Range of pH values in Standard Units.
NC = Not Calculated.
NA = Not Analyzed.

TABLE 3

COMPARISON OF REMEDIATION TECHNIQUES FOR MEETING GROUNDWATER ARARs
BUTTE MINE FLOODING OPERABLE UNIT

REMEDIATION TECHNIQUES	COST CONSIDERATIONS		POTENTIAL TO MEET GROUNDWATER ARARs	ENGINEERING UNCERTAINTIES	COMMENTS
	TOTAL COST	RELATIVE COST TO SR			
Pump-and-Treat	400 million[2]	8x	No[6]	No	Conventional; Perpetuates problem.
Inundation[1]	50 million[3]	1	No	No	Conventional; Selected Remedy is a “controlled flooding."
Grout	9 billion[4]	18,000x	Yes	Yes	Innovative; Cost and access issues for drilling are limiting factors.
Injection of Acid Neutralizing Fluids	11.8 billion[5]	24,000x	Yes[7]	Yes	Innovative; Most experimental and unproven.

1 One regime of inundation is the Selected Remedy (SR) presented in Section 2.5 Alternative Remediation Strategy.
2 Based on middle range of cost ($346-$462 million) and Berkeley Pit pumped "dry" in 11 years; see Section 2.4.3.1.
3 Based on Selected Remedy cost range of $42-$50 million; see Section 2.3.4.2.
4 See Section 2.4.2.3.
5 See Section 2.4.2.4.
6 This method actually degrades existing groundwater quality.
7 This method has, in theory, the potential to meet ARARs; however, its applicability at such a large site makes this method questionable.

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ATTACHMENT 1

VOLUME CALCULATIONS

Volume Comparison of Water within the East Camp Area

Purpose: The purpose of this calculation is to compare the volumes of water contained in the Berkeley pit, the underground workings, and the fractured rock in the east camp area.

Method: Table P.1 (attached) was used to calculate the volume of water in the Berkeley pit. The table is a summary of the calculated Berkeley pit water level projections. The water level used for the volume calculation was the critical water level of 5,410 ft msl. Since the table does not provide a volume for the elevation of 5,410 ft msl, linear interpolation was used.

The underground workings volume was calculated based on information provided by Sam Stephenson of ARCO. Mr. Stephenson had previously prepared information for a public presentation when the pumps were turned off in Kelley shaft. The presentation included overheads with the following information:

From Mt. Con sump to 2,195 ft msl, void volume = 40,748,400 ft3
From 2,195 ft msl to 4,320 ft. msl, void volume = 432,369,504 ft3

These volumes accounted for void volume in fill. For example, 30 percent void volume was assumed for slime fill and 20 percent void volume was assumed for mine (gob) fill.

The void volume from the bottom of the pit to the surface was not calculated; however, it would be a conservative estimate that the same ratio of void space was present as in the 2,195 ft msl to 4,320 ft msl interval. The total of these three void volumes is equal to the volume of underground workings. Since the underground mine workings are beneath the current bedrock aquifer elevation, the volume of the workings is equal to the volume of water contained in the mine workings.

The volume of ground water within the fractured rock was calculated by assuming a site area of 6.75 sq. miles (EPA, 1994). Multiplying this area by the total height of water from the lowest mine workings elevation to the critical water level elevation provided the total water volume contained within the site. The lowest mine workings are at 1,500 ft msl and the critical water level is 5,410 ft msl. In order to obtain the volume of water within the fractured rock, the volume of water in the Berkeley pit and the volume of water in the underground workings were subtracted from the total volume. This volume was then multiplied by 1% since it was assumed that 1% of the remaining volume was open fractured rock.

Conclusion:

	Berkeley Pit	Underground Workings	Fractured Rock
Volume (billion gallons)	64.3	6.8	54.3

Figure 1 (attached) represents a visual comparison of the water volume contained in each area of interest. The total volume of water in the site from the critical water level elevation (5,410 ft msl) to the lowest mine workings (1,500 ft msl) and assuming a site area of 6.75 sq. miles is 105 billion gallons. Based on these large volumes of water, a pump and treat treatment technology would not be the most feasible or economical remedial alternative to use for remediation purposes.

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<IMG SRC 0894102AQ>
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TABLE P.1

Calculation of Berkeley Pit Water-Level Projection for Scenario No. 1

Butte Mine Flooding Operable Unit RI/FS

	Inflows to the Berkeley Pit (in mgd)				Total Inflows to the Berkeley Pit (in mg)		Predictions for Berkeley Pit Cumulative Inflow Volume		Water Level
Year	Surface	Alluvium	Bedrock	P/R/E	Daily	Yearly	(mg)	(ft3)	(ft msl)
1-Jul-1993	----	----	----	----	----	----	21,347	2.8534E+09	5,049.6
31-Dec-1993	1.68	0.58	2.49	0.30	5.05	929.2	22,276	2.9783E+09	5,064
31-Dec-1994	1.68	0.58	2.49	0.30	5.05	1.844.5	24,120	3.2249E+09	5,088
31-Dec-1995	1.68	0.58	2.49	0.30	5.05	1,844.5	25,965	3.4715E+09	5,110
31-Dec-1996	1.68	0.58	2.49	0.30	5.05	1.844.5	27,809	3.7181E+09	5,131
31-Dec-1997	1.68	0.58	2.49	0.30	5.05	1.844.5	29,654	3.9647E+09	5,150
31-Dec-1998	1.68	0.58	2.49	0.30	5.05	1.844.5	31,498	4.2113E+09	5,169
31-Dec-1999	1.68	0.58	2.49	0.30	5.05	1.844.5	33,343	4.4579E+09	5,187
31-Dec-2000	1.68	0.58	2.49	0.30	5.05	1,844.5	35,187	4.7045E+09	5,204
31-Dec-2001	1.68	0.58	2.49	0.30	5.05	1,844.5	37,032	4.9512E+09	5,220
31-Dec-2002	1.68	0.58	2.49	0.30	5.05	1,844.5	38,876	5.1978E+09	5,236
31-Dec-2003	1.68	0.58	2.49	0.30	5.05	1,844.5	40,721	5.4444E+09	5,251
31-Dec-2004	1.68	0.58	2.49	0.30	5.05	1,844.5	42,565	5.6910E+09	5,266
31-Dec-2005	1.68	0.58	2.49	0.30	5.05	1,844.5	44,410	5.9376E+09	5,280
31-Dec-2006	2.40	0.58	2.49	0.30	5.77	2,107.5	46,517	6.2194E+09	5,295
31-Dec-2007	2.40	0.58	2.49	0.30	5.77	2,107.5	48,625	6.5011E+09	5,310
31-Dec-2008	2.40	0.58	2.49	0.30	5.77	2,107.5	50,732	6.7829E+09	5,325
31-Dec-2009	2.40	0.58	2.49	0.30	5.77	2,107.5	52,840	7.0647E+09	5,339
31-Dec-2010	2.40	0.58	2.49	0.30	5.77	2,107.5	54,947	7.3465E+09	5,353
31-Dec-2011	2.40	0.58	2.49	0.30	5.77	2,107.5	57,055	7.6282E+09	5,366
31-Dec-2112	2.40	0.58	2.49	0.30	5.77	2,107.5	59,162	7.9100E+09	5,380
31-Dec-2013	2.40	0.58	2.49	0.30	5.77	2,107.5	61,270	8.1918E+09	5,392
31-Dec-2014	2.40	0.58	2.49	0.30	5.77	2,107.5	63,377	8.4736E+09	5,405
31-Dec-2015	2.40	0.58	2.49	0.30	5.77	2,107.5	65,485	8.7553E+09	5,417

Notes:

1 Scenario assumes the current mine surface inflows continue for the life of the mine (until 2005) and then increases to include only the Horseshoe Bend area flows; The alluvium and bedrock discharges, and the net precipitation/runoff/evaporation remain constant.

2 mgd = Million gallons per day.

3 mg = Million gallons; mg = cubic feet (ft3) x 7481E.6.

4 P.R.E. = Net precipitation/runoff/evaporation.

5 Daily total inflow to pit = surface inflow + alluvium discharge + bedrock discharge + P/R/E.

6 Yearly total inflow to pit = daily total inflow x 365.25 days, except for period from July 1 to December 31, 1993 which is 184 days.

7 Cumulative inflow volume for pit for July 1, 1993 base on current pit water level of 5,049.61 feet above mean sea level (ft msl) (USGS datum) and is calculated based on the following equation from Canonie (1993a):

$$Y = -5.6640E11 + (3.8472E8 \times X) - (8.7388E4 \times X \times X) + (6.6391 \times X \times X \times X)$$

Where: Y = Pit volume, in ft3, and
X = Pit elevation, in ft msl.

8 Water level projection for the years 1994 through 2015 are based on the yearly cummulative inflow volumes and are calculated based on the following from Canonie (1993a):

$$X = 4.227.8 - (1.0007E-7 \times Y) - (2.0462E-2 \times (\text{square root of } Y) - (1.9726E-18 \times Y \times Y)$$

Where: X = Pit elevation, in ft msl, and
Y = Pit volume, in ft3.

References

TITAN Environmental

Telephone Call Record

TO: Name: Jack Majerison Project Number: 3101-005

Company: ARCO - Anaconda Project Name: Technical Impracticality

Phone Number: 406-563-5211 Date: August 26, 1994

FROM: Name: Anne Lewis-Russ Time: 1:45 pm

Company: TEC

Phone Number:

Jack called me back after I called to ask if he had obtained any information about bedrock void volume in the Butte area. Jack had Sam Stephenson with him, who worked for Anaconda for a number of years. Sam had worked with Ed Schneider (now with ESA) on preparing information for public presentation when the pumps were turned off in Kelley shaft. Sam had an overhead from the presentation with the following information:

From the Mt. Con sump to elevation 2195 (this and other elevations reference Anaconda datum) void volume was 40,748.400 ft3. (information from an earlier study when part of the underground workings were flooded.

From elev. 2195 (elevation of Kelley pumps) to 4320 (bottom of Berkeley Pit), void volume was calculated at 432,369,504 ft3. This volume was determined from digitizing information in old stope books and took into account void volume in fill. For example, 30 percent void volume was assumed for slime fill and 20 percent void volume was assumed for mine (gob) fill.

The void volume from the bottom of the pit to surface was not calculated; however, it would be a conservative estimate that the same ratio of void space was present as in the 9195 to 4390 ft interval.

The calculations did not include a factor for natural void space such as fractures. The void space is pretty well connected, but is about an order of magnitude less than the space occupied by the Berkeley Pit.

This information has been public knowledge, and DSL and EPA should have it. Sam can be used as a reference, if needed.

BUTTE'S

MEMORY BOOK

by

Don James

Pictures by
C. Owen Smithers, Sr.

<IMG SRC 0894102AS>

THE CITY

City views belong to different generations, each particularly conscious of it own vistas, and each in later years remembering how it was. Cities have been built, changed, and destroyed by man. They have been destroyed by nature. They have been destroyed simply by time.

So Butte has changed. Yesterday's Butte is not today's, nor will today's be tomorrow's. Because this book is essentially a trip back through nostalgia, we are including very few contemporary pictures of Butte. Possibly, in a way, we are depicting a city of another time.

Nevertheless, every generation, including today's youngest, will recognize places and buildings and streets and houses that still defy weather, time, and even man.

It takes a strong city of character to do that!

BUTTE

The "greatest mining camp on earth" built on "the richest hill in the world". That hill, which has produced over two billion dollars worth of gold, silver, copper and zinc, is literally honeycombed with drifts, winzes and stopes that extend beneath the city.

There are over 3,000 miles of workings, and shafts reach a depth of 4,000 feet.

This immediate country was opened as a placer district in 1864. Later Butte became a quartz mining camp and successively opened silver, copper and zinc deposits.

Butte has a most cosmopolitan population derived from the four corners of the world. She was a bold, unashamed, rootin', tootin', hell-roarin'camp in days gone by and still drinks her liquor straight.

Ore Deposits of the United States 1933-1967

THE GRATON-SALES VOLUME

John D. Ridge, editor

FIRST EDITION
Sponsored by The Rocky Mountain Fund

Volume II

Published by

The American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.

NEW YORK 1968

Reprinted 1970

<IMG SRC 0894102AT>

MONITORING PROGRAM

APPENDIX 3
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

BUTTE MINE FLOODING OPERABLE UNIT

MONITORING PROGRAM REQUIREMENTS

WATER LEVEL/FLOW MONITORING:

1. Wells AMC-6, AMC-8, AMC-23, AMC-24, A, C, G, H, D-1, D-2. Parrott Park, LP-1, LP-7, LP-12, LP-13, LP-14, and LP-16 will be required with automatic depth recorders (i.e., continuous monitoring).

2. Wells AMC-5, AMC-10, AMC-11, AMC-12, AMC-13, AMC-15, AMC-21, B, E, F, DDH-1, DDH-2, DDH-4, DDH-5, DDH-8, and the remaining LP wells will be monitored monthly for water levels.

3. Water levels in the Berkeley Pit will be surveyed monthly for water level.

4. The following mine shafts will be monitored monthly for water levels: Anselmo, Belmont, Emma, Granite Mountain, Kelley, Marget Ann, Orphan Boy, Steward, and Travona. After one year, Marget Ann and Orphan Boy will be monitored quarterly. Additional mine shafts that may require monthly monitoring are the Badger, Lexington, Mt. Con, and Original.

5. Residential and municipal wells in the general area bounded by Cobban Street on the south, 2nd Street on the north, south and west of Continental Drive, and east of Montana Street, (also delineated in the Remedial Investigation Report, Section 8 - Private Well Inventory (Task 6)) wishing to participate in a water level monitoring program will be monitored monthly for water levels.

6. The following surface flows/stations will be monitored monthly for water flows: SS-07 (also designated as SF-7 (Silver Bow Creek below Colorado Tailings) in Upper Clark Fork Long-Term Monitoring Program), SS-04 (also designated as SF-4 (Blacktail Creek above confluence with Metro Storm Drain) in Upper Clark Fork Long-Term Monitoring Program), and seep adjacent to Green Lake.

7. The following surface flows/stations will be monitored continuously for surface water discharge/flows to the Berkeley Pit: Stations 3B and 5D as delineated in Remedial Investigation Report. The method used to monitor Station 3B may be altered from that used in the BMFOU RI. It is the objective of monitoring Station 3B to quantify frequency, duration, and volume of tailings slurry overflow from the McQueen Booster Station.

8. QA/QC shall follow Butte Mine Flooding Operable Unit Sampling and Analysis Plans (SAPs) unless otherwise specified.

WATER QUALITY MONITORING:

1. Wells AMC-5, AMC-6, AMC-8, AMC-12, AMC-13, AMC-15, AMC-21, AMC-23, AMC-24, A, B, C, D-1, D-2, E, F, G, H, LP-8, LP-9, LP-10, LP-11, LP-12, LP-14, LP-15, LP-16, and LP-17 will be sampled semiannually for water quality. Wells AMC-10 and AMC-11 will be sampled semiannually for water quality if current conditions change. After two years (i.e., four sampling events) Wells AMC-12, AMC-13, AMC-15, AMC-23, and AMC-24 will be sampled annually but subject to EPA/MDHES review.

2. The following mine shafts will be sampled semiannually for water quality: Anselmo, Belmont, Granite Mountain, Kelley, Marget Ann, and Orphan Boy. The Travona will be sampled (maximum of one monthly sample) during pumping activity. After two years (i.e., four sampling events) sampling frequency will be annually (except for the Travona, but subject to EPA/MDHES review.

3. The following surface flows/stations will be sampled monthly for water quality (metal parameters shall be analyzed for total and dissolved concentrations): SS-07 (also designated as SF-7 (Silver Bow Creek below Colorado Tailings) in Upper Clark Fork Long-Term Monitoring Program), SS-04 (also designated as SF-4 (Blacktail Creek above confluence with Metro Storm Drain) in Upper Clark Fork Long-Term Monitoring Program), and seep adjacent to Green Lake.

4. The following surface flow/station that discharges to the Berkeley Pit will be sampled monthly for water quality (metal parameters shall be analyzed for total and dissolved concentrations): Station 5D as delineated in Remedial Investigation Report. After one year (i.e., twelve sampling events) sampling frequency will be semiannually.

5. Parameters for water quality lab analysis include: As, Ca, Cd, Cu, F, Fe, Ni, Mn, Pb, SO4, Zn, pH, SC, TDS, Temp, Hardness, Alkalinity, and Nitrate.

6. QA/QC shall follow Butte Mine Flooding Operable Unit Sampling and Analysis Plans (SAPs) unless otherwise specified.

YANKEE DOODLE TAILINGS DAM MONITORING REQUIREMENTS:

1. The monitoring plan, as developed in the Harding Lawson Associates report, "Seismic Stability Evaluation, Yankee Doodle Tailings Dam, Butte, Montana," shall be developed and implemented.

2. The phreatic surface requires greater definition. The phreatic surface shall be found at different distances u.s. of the embankment and in the embankment. The phreatic surface level shall then be modeled for enlarged facility. Monitoring devices shall be installed to determine if the phreatic surface is following the model. Contingencies shall be developed to take care of the situation of the phreatic surface rising above that level developed in the model. Note, Borehole 92-2B is missing from Plates 14 and 15, and the depth to tailings from borehole 92-2B appears inconsistent with the depth to tailings in the same vicinity as presented in Plates 14 and 15. Once the phreatic surface and depth to tails is reconciled, the stability shall be reexamined.

3. More data is needed in the bench material where future up stream lifts will be founded. This data collection requirement shall include at a minimum: SPT and/or CPT values on several alignments extending up stream on the beach from the existing u.s. face to the limits of the future u.s. lifts; density and moisture profiles on the same sort of alignments to depths of at least 100 feet below the existing surface; strength characteristics such as friction angle, cohesion, and consolidation of the tailing beach material should be determined for the various tailing material discovered in the above mentioned study area. Also geophysical investigations (i.e., EM, siesmigraph, etc.) of the beach, embankment, and downstream structures shall be conducted.

4. The strength and other physical characteristics, including void space, of the construction material shall be determined. Contingencies shall be developed to deal with the material during construction if the material characteristics are not as predicted. A QA/QC program shall be developed to inspect, test, and report construction material characteristics.

FUTURE MONITORING AND ADDITIONAL MONITORING WELL REQUIREMENTS:

1. Four bedrock-monitoring wells shall be installed as part of the monitoring program. These bedrock-monitoring wells are for the Travona/West Camp System. These four wells will be sited in the locations as depicted in the attached map.

2. MDHES will coordinate yearly updates, in the form of a written report, that incorporates the new data gathered from the previous twelve months, and an updated report on the prediction of when the CWL for the Berkeley Pit/East Camp System will be reached.

3. Every three years EPA and MDHES shall review the monitoring program's completeness. The three year review is to adjust, as determined by EPA and MDHES, the requirements of the monitoring program. Based on this review, additional monitoring wells may be required.

4. Any new monitoring well shall be equipped with automatic depth recorders (i.e., continuous monitoring) for a period of no less than three years but subject to EPA/MDHES review.

5. Any new monitoring well shall be sampled semiannually for water quality (metal parameters shall be analyzed for total and dissolved concentrations); after two years (i.e., four sampling events) sampling frequency will be annually but subject to EPA/MDHES review.

<IMG SRC 0894102AU>

RECORD OF DECISION

BUTTE MINE FLOODING OPERABLE UNIT
SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE, MONTANA

September 29, 1994

United States Environmental Protection Agency
Region VIII- Montana Office
Federal Building, 301 South Park, Drawer 10096
Helena, MT 59626-0096
(Lead Agency)

Montana Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
2209 Phoenix Avenue
P.O. Box 200901
Helena, MT 59620-0901
(Support Agency)

VOLUME II OF III

RECORD OF DECISION COMPONENT LOCATOR PAGE
(Components in bold are in this volume)

RESPONSIVENESS SUMMARY
APPENDIX 4
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION
TABLE OF CONTENTS

SECTION PAGE

LIST OF ABBREVIATIONS, ACRONYMS, AND INITIALISMS

AMC	Anaconda Minerals Company
AMD	Acid Mine Drainage
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
ASARCO	American Smelting and Refining Company
BEPA	Bald Eagle Protection Act of 1940
BSB	Butte-Silver Bow
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFC	Clark Fork - Pend Oreille Coalition
cfs	cubic feet per second
CTEC	Citizens Technical Environmental Committee
CWL	Critical Water Level
DSL	Montana Department of State Lands
DNRC	Montana Department of Natural Resources and Conservation
DOE	U.S Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
Eh	oxidation-reduction potential
EPA	U.S Environmental Protection Agency
EQC	Environmental Quality Council
ESD	Explanation of Significant Differences
ET	Evapotranspiration
FS	Feasibility Study
FSR	Feasibility Study Report
ft	feet/foot
ft msl	feet mean sea level
gpm	gallons per minute
HLA	Harding Lawson Associates
IC	Institutional Control
m2/sec	meters squared per second
MBMG	Montana Bureau of Mines and Geology
MBTA	Migratory Bird Treaty Act of 1918
MCA	Montana Codes Annotated
MCE	maximum credible earthquake
MCL	Maximum Contaminant Level
MDHES	Montana Department of Health and Environmental Sciences
MFOU	Mine Flooding Operable Unit
mgd	million gallons per day
mg/l	milligrams per liter
MR	Montana Resources
MRI	Montana Resources, Inc.
MSHA	Montana Safety and Health Act
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRD	Natural Resource Damage
O&M	Operation and Maintenance
OTA	Office of Technological Assessment Congressional Study Group
OSHA	Occupational Safety and Health Act
OSWER	Office of Solid Waste and Emergency Response (EPA)
Ph	negative log of the hydrogen ion concentration
Pit	Berkeley Pit
ppb	parts per billion
PRP	Potentially Responsible Party
psi	pounds per square inch
PSOU	Priority Soils Operable unit
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Alternative
RFP	Reasonable Further Programs
RI/FS	Remedial Investigation/Feasibility Study
RO	Reverse Osmosis
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act of 1986

SITE	Superfund Innovative Technology Evaluation
SX/EW	Solvent Extraction/Electrowinning
SU	Standard Units
TDS	Total Dissolved Solids
WQC	Water Quality Criteria

1.0 INTRODUCTION

1.1 SITE BACKGROUND

Butte historically has been an important mining, milling, and smelting district. Gold was first discovered near Butte in 1864. Placer and quartz mining for gold was the primary mining activity in Butte for several years after gold was first discovered. Copper and silver, which were also discovered along with gold in the 1860s, became the primary focus of miners in 1874. By 1884, there were over 300 operating copper and silver mines, 4,000 posted claims, nine silver mines and eight smelters. During the course of mining activities, over 500 mines and shafts were developed resulting in an estimated 3,000 miles of underground workings and 150 major waste rock dumps containing an estimated 9.85-million cubic yards of waste covering 350 acres. Eleven silver mills and three major smelting operations also resulted in soil contamination throughout the Butte Hill mining area.

In July 1955, the Anaconda Copper Mining Company began open pit mining in the Berkeley Pit. In 1963, the Weed Concentrator (now known as the MR Concentrator) became operational. Ore from the Berkeley Pit processed at this facility, and concentrates were transported to Anaconda, Montana for smelting. The Atlantic Richfield Company (ARCO) purchased the Anaconda Copper Mining Company in 1977 and owned the pit and associated property until it was sold to Dennis Washington/Montana Resources, Inc. (MRI) in 1985. In 1989, a partnership known as Montana Resources (MR) was formed between MRI and AR Montana Corporation, a subsidiary of American Smelting and Refining Company (ASARCO). MR was formed to own and operate the property.

Mining in the Berkeley Pit was discontinued in 1983. Since July 1986, open pit mining has been conducted in the East Continental Pit, located east of the Berkeley Pit. Ore from this pit is transported to the MR Concentrator for milling.

To allow underground and then open pit mining in the Butte area, groundwater was lowered by pumping. The pumping system was located in the Kelley Mine shaft, just west of Berkeley Pit. In 1982, pumping was discontinued. As a result, the artificially lowered groundwater level in the area has been rising toward its pre-mining level in the underground mines and Berkeley Pit. The pit filling rate is decreasing with time and as the water level rises. For example, the 1988 filling rate was estimated to be 7.6 million gallons per day (mgd); and the pit is currently estimated to be filling at a rate of 5 mgd. In December 1993, the elevation of the water in the pit was 5,062.67 feet (ft). It is currently projected that the critical water level (CWL) of 5,410 feet for the Pit System will be reached around the year 2015 if no remedial actions are taken.

In 1983, the U.S. Environmental Protection Agency (EPA) designated Silver Bow Creek and contiguous portions of the Upper Clark Fork River as a Superfund site by placing it on the National Priorities List (NPL). The site was amended in 1986 to include source areas in and around Butte, and the site became known as the Silver Bow Creek/Butte Area Site.

Preliminary Mine Flooding Operable Unit (MFOU) Remedial Investigation/Feasibility Study (RI/FS) forward planning studies began during the summer of 1987. In support of the MFOU, EPA conducted an evaluation of mine flooding in the Berkeley Pit and West Camp and an evaluation of the pit water chemistry. These evaluations indicated that it would be necessary to control the rate of pit filling to prevent any further impact to Silver Bow Creek. The evaluations further demonstrated the need to treat the pit water prior to discharge to Silver Bow Creek.

A removal action was implemented in the West Camp area to control potential impacts of rising mine waters. The purpose of the removal action was to prevent flooding of basements and discharge of contaminated groundwater to Silver Bow Creek. An Engineering Evaluation/Cost Analysis (EE/CA) of potential response alternatives was conducted by EPA in support of the West Camp removal action.

On March 31, 1989, EPA entered into an Administrative Order on Consent (AOC) with ARCO and Dennis Washington (the consenting PRPs) pursuant to Section 106(a) of CERCLA as amended by SARA in connection with the West Camp removal action. The West Camp order required the consenting PRPs to convey water from the Travona Shaft to the Butte Metro Plant for treatment and discharge to Silver Bow Creek. In the event that the Metro Plant could not accept this water, the consenting PRPs would be required to construct a treatment plant for treatment of Travona Shaft effluent prior to discharge to Silver Bow Creek. This AOC established a preliminary CWL for the West Camp and required the consenting PRPs to maintain water level elevation below 5,435 feet (USGS datum).

A unilateral Order was issued to the non-consenting PRPs to install the pipeline which carried Travona shaft water to the Butte-Silver Metro Sewer Plant line. The non-consenting PRPs complied with this Order.

EPA completed the RI/FS Work Plan for the Mine Flooding OU in April 1990. This document outlined the work to be conducted during the RI/FS, the schedule for the work, and the parties responsible for each portion of the work. EPA and the State then entered into an AOC with the consenting PRPs to implement the major portion of this work plan. This AOC directed the PRPs to conduct the work according to the Work Plan with EPA and MDHES oversight. The AOC also established a preliminary CWL of 5,410 feet (USGS datum) for the East Camp/Berkeley Pit System and required the PRPs to maintain the water elevation below this level. A unilateral Order was also issued to the non-consenting PRPs to implement a small portion of the RI/FS work plan. The RI/FS was conducted from July 1990 through January 1994. Site investigations, results, and remedial alternative development and evaluation are presented in the Draft RI and FS Reports.

The RI/FS was conducted from 1990 to 1994, and included an inflow control investigation, a characterization of the bedrock aquifer, an investigation of the leach pads area alluvial aquifer system, sampling of the Berkeley Pit, treatability testing, evaluation of the water balance in the MFOU, a risk assessment, and development and evaluation of remedial alternatives. Site investigations, results, and remedial alternative development and evaluation are presented in the Preliminary Draft RI Report and the Preliminary Draft FS Report.

EPA, with the concurrence of MDHES, released a Proposed Plan for the site in January 1994. A public comment period was held from January 27 to April 29, 1994. An informational meeting was held on January 27, 1994 and a technical meeting was held on February 1, 1994 to explain the Proposed Plan and the potential alternatives. On March 8, 1994, EPA held a public hearing to allow the public to submit formal oral comments. This Responsiveness Summary presents EPA's and MDHES's responses to the comments received.

1.2 COMMUNITY INVOLVEMENT BACKGROUND

EPA has conducted community involvement activities for the MFOU RI/FS in accordance with state and federal laws and EPA Superfund guidance documents. Additionally, EPA's philosophy is that the citizens of Montana, and especially residents living on or near Superfund sites, will be most affected by the decisions of the agency and therefore should have the opportunity to be actively involved in the decision making process.

A Community Relations Plan was first developed for the Silver Bow Creek/Butte Area site in 1983 and was revised several times. After extensive interviews of local citizens and community leaders, this document was last revised in September 1991.

1.2.1 PUBLIC MEETING PUBLICITY

News releases were sent to the media mailing list periodically before public meetings and to announce public comment periods. The media mailing list includes all print and electronic media in Butte. In addition, these meetings were advertised in local papers and/or on a local radio station. Print advertisements were display style, conspicuously large (at least two columns by five inches) in a widely read section of the local paper, the Montana Standard.

1.2.2 ADMINISTRATIVE RECORD

The Administrative Record is the set of documents identified for the site upon which the selection of the remedy is based. The Administrative Record is required by CERCLA.

The Administrative Record for the site is available at the Montana Tech Library in Butte and the EPA Montana Office in Helena. In addition, important site-related documents are available at the Butte EPA Office located in the basement of the County courthouse in Butte, Montana.

1.2.3 DOCUMENT REPOSITORIES

Site documents and other information have been, and will continue to be, made available to the public EPA has established repositories for site documents at the Montana Tech Library, the Butte EPA Office, and the EPA Montana Office in Helena, Montana. EPA adds documents to the repository as quickly as possible after publication.

1.2.4 CITIZEN GROUPS

In 1992, the Citizens Technical Environmental Committee (CTEC) received an EPA $50,000 technical assistance grant for the Silver Bow Creek/Butte Area site. CTEC has regular monthly meetings that often include activities connected to the MFOU RI/FS. EPA and MDHES site staff attend these meetings and are also available by phone or in person as questions arise. The EPA Remedial Project Manager (RPM) for this action is located in Butte and is regularly available to the public.

EPA and MDHES have also worked closely with the Clark Fork-Pend Oreille Coalition of Missoula, Montana. In late 1992, the Coalition hired a staff member who works on upper Clark Fork River issues in an office in

Butte. EPA and MDHES stay in regular contact with this staff member about MFOU RI/FS issues. This staff member also became a member of the CTEC board of directors in Spring 1993 and was recently elected Vice President of CTEC.

1.2.5 PROGRESS REPORTS AND FACT SHEETS

EPA publishes progress reports and fact sheets containing information on recently released documents, upcoming meetings, site activities, completion of projects, sampling results, etc. These reports are sent to people whose names are on the site mailing lists. Extra copies are distributed to pamphlet racks at a number of public locations and are maintained in the Butte EPA office.

1.2.6 MAILING LIST

EPA actively maintains the site mailing list on a computer database and updates the list periodically. EPA actively solicits additions to the mailing list in the progress reports and at public meetings.

1.3 CHRONOLOGY OF COMMUNITY RELATIONS ACTIVITIES

1990

Prepared and distributed a May 1990 fact sheet regarding the RI/FS Work Plan.

Two separate display advertisements were placed in the Montana Standard announcing the AOC. Unilateral Order and Work Plan for the MFOU RI/FS and public meetings scheduled to discuss these issues.

EPA conducted an informational meeting (May 8, 1990) and a formal hearing (May 30, 1990) regarding the Work Plan and RI/FS.

1991

Two separate display advertisements were placed in the Montana Standard announcing an MFOU RI/FS update meeting subsequently held on April 25, 1991.

Two display advertisements were placed in the Montana Standard announcing an MFOU RI/FS update meeting subsequently held on May 6, 1991.

Two display advertisements were place in the Montana Standard announcing an MFOU RI/FS update meeting subsequently held on October 30, 1991.

1992

Two separate display advertisements were placed in the Montana Standard announcing a MFOU RI/FS update meeting subsequently held on July 30, 1992.

1993

Two separate display advertisements were placed in the Montana Standard announcing a MFOU RI/FS update meeting subsequently held on April 23, 1993.

1994

January

Two display advertisements were placed in the Montana Standard announcing the availability of the Proposed Plan and the public comment period, and outlining upcoming meetings regarding the MFOU RI/FS.

The Proposed Plan was distributed via first class mail to a mailing list consisting of more than 1,000 names.

An informational briefing for the media and other officials was held on January 27, 1994.

An informational public meeting was also held on January 27, 1994.

February

A technical public meeting was held on February 1, 1994 to discuss the MFOU RI/FS.

Met with Clark Fork Pend Oreille Coalition twice in February 1994 to discuss MFOU RI/FS.

On February 9, 1994, EPA gave an informational presentation to the Butte-Silver Bow (BSB) Council of Commissioners.

EPA attended at CTEC meeting on February 10, 1994, at which the MFOU RI/FS was discussed.

On February 22, 1994, EPA RPM discussed the Proposed Plan, the RI/FS, and the preferred alternative on a radio call-in show "Party Line".

March

On March 8, 1994, EPA conducted an informational meeting on the MFOU RI/FS and the Proposed Plan at Montana Tech where a class of 50 was required to attend.

On March 13, 1994, EPA RPM discussed the Proposed Plan, the RI/FS, and the preferred alternative on a television public affairs show "Focus".

April

A formal public hearing was held on April 26, 1994.

In addition to the formal meetings throughout the entire four-year process, EPA made presentations, answered questions, and discussed the Proposed Plan and RI/FS with several groups, including CTEC, Clark Fork Pend Oreille Coalition, BSB Council of Commissioners, the PRPs, the Silver Bow Kiwanis, and the Big Butte Kiwanis.

1.4 EXPLANATION OF RESPONSIVENESS SUMMARY

Comments were received during the public comment period from various parties, which are identified in Attachment 1. Two types of comments were received by EPA: (1) oral comments which were presented at the formal public hearing on April 26, 1994 (Attachment 2) and (2) written comments (Attachment 3). The comments presented at the public hearing were recorded and transcribed by a court reporter. In addition, some commenters at the public hearing submitted written materials for the record which are included in Attachment 2.

2.0 SUMMARY OF WRITTEN AND ORAL COMMENTS RECEIVED ON THE PROPOSED PLAN FOR THE MFOU RI/FS

The responses to comments on the Proposed Plan are prepared jointly by EPA and MDHES. The word "we" in the responses to comments refers to EPA and MDHES. The comments are organized into the following parts:

Part I: Non-Technical Comments (Section 3.0), which include summaries of remarks made by citizens, local government, environmental organizations, MDHES, as well as some PRP comments. Each comment is followed by EPA's and MDHES's response. Policy comments are generally included in this section.

Part II: Technical Comments (Section 4.0), which provide a comprehensive set of technical and legal comments and EPA's and MDHES's detailed responses. These comments include summaries of the remarks made by the PRP, environmental organizations, and citizens. The comments include comprehensive discussions concerning the preferred alternative.

Section 5.0, which include responses to the Clark Fork - Pend Oreille Coalitions' (CFC) comments dated June 30, 1994.

As much as possible, comments in Sections 3.0 and 4.0 have been summarized and grouped to provide an overview of the comments and to give a sense of which general topics generated the most interest or concerns. Each comment is followed by a note in parentheses, which identifies the party or parties making the comment. Attachment I contains a list of each source used in this Responsiveness Summary.

It should be noted that, while only formal public comments are presented and responded to in this Responsiveness Summary, EPA and MDHES have also considered other information in the remedy selection process. EPA and MDHES have considered information from meetings held among EPA, MDHES, ARCO (and other PRPs), BSB, and other parties during the MFOU RI/FS process.

All comments received, including those provided to EPA outside the comment period, have been reviewed and considered by EPA and MDHES in the decision-making process and are addressed in this Responsiveness Summary.

3.0 PART I: NON-TECHNICAL COMMENTS

3.1 CRITICAL WATER LEVEL

Comment 1-1: An assumption underlying all discussions and plans regarding the Pit has been the concept of the CWL.

- How did this concept come to be the officially sanctioned key to the solution of the Pit System problem?
- How was the CWL determined?
- By what definition is it "protective" as a final remedy?
- If groundwater modeling specialists are skeptical about any predictions more than five or ten years into the future, why isn't a greater safety factor built into the calculation of the final remedy? (G 1)

Response: In the negotiations with the PRPs for the MFOU RI/FS, a preliminary CWL of 5,410-ft elevation was established. This agreement specified stipulated penalties of $25,000 per day if this level was ever exceeded. The preliminary CWL was established at this elevation because this was the water level in Silver Bow Creek at the west end of the Colorado Tailings where the alluvial system constricts and upwells into the Rocker canyon.

EPA and the State viewed this level as the maximum allowable water level for the Pit System (not just the Pit), and it would be lowered, if necessary, based on the findings of the RI. The RI was designed to investigate the alluvial and bedrock water levels and gradient throughout the area. After completion of the RI, the data were assimilated and the 5,410-ft level was determined to be protective and deemed the official CWL. The RI conclusively showed that the alluvial water levels in the Upper Basin are higher than the CWL and that the Pit/East Camp System cannot discharge to the higher alluvial system if the Pit System is kept below the 5,410-ft level. This level is, therefore, protective. The 5,410-ft level is at least 50 ft lower than the alluvial water levels at the alluvial groundwater divide south of the Pit. Additionally, the highest level in the East Camp is 40 ft higher than the present Pit level. If this gradient between the Anselmo and the Pit remains or the even becomes 20 ft less, the Pit level will be at least 70 ft below the alluvial groundwater divide adjacent to the Pit.

The skepticism expressed by groundwater modeling experts pertains to the predicted hydrologic impact that the rising bedrock system may have on the alluvial system flow patterns. We acknowledge the limitations of the existing model applications in trying to make such predictions; however, EPA and the State still believe that the inward gradient will contain the contaminated Pit and bedrock aquifer waters. We believe that the impact of rising bedrock waters on shifting additional alluvial waters presently flowing toward the Pit down the Metro Storm Drain, or rises in the alluvial water level in the Metro Drain area, will be minor.

In light of the uncertainty in trying to model this impact, we are planning to provide further assurances in two ways. First, the monitoring system is set up with a very high density of alluvial wells in the upper Metro Storm Drain area where we would observe any increased flow or contaminant loading if it occurred. We would be able to react to any such changes immediately. Second, EPA plans to design the Upper Metro Storm Drain remedial action for the Priority Soils Operable Unit, which must address alluvial groundwater problems to accommodate flow and contaminant loading increases that might occur due to this "diversion" of the alluvial flow away from the Pit and down the Metro Storm Drain.

Comment 1-2: Comment expressed the need for assurances that the critical water level (CWL) is never approached. (BSB 2)

Response: The Record of Decision (ROD) and subsequent enforcement action will provide these assurances. EPA and the State have integrated a specific time schedule into the ROD. Construction of a treatment plant capable of holding the entire East Camp System below the CWL must be completed four years prior to the projected water level reaching the highest point within the East Camp. Currently the highest water level is at the Anselmo Mine, which is about 40 ft above the current Pit water level. It is presently projected that the CWL will not be reached until the year 2025 (assuming 2.4 million gallons per day (mgd) inflow control and the Anselmo water level 20 ft above the Pit level). Construction of the final treatment facility therefore would have to be completed by 2021. These dates will be revised every three years based on the growing water level database.

Comment 1-3: The CWL is wrong or unacceptable and should be lowered to a more protective level. (BSB 4-B, BSB 7, I 1, I 3, I 43, BSB 12-B, BSB 12-A, T 5, I 4)

Response: EPA and the State believe that the CWL is protective, based on the following:

1) Alluvial water level adjacent to the Pit is 50 ft higher than the CWL.

2) The CWL will be measured at the highest point in the East Camp System, presently the Anselmo mine, which is 40 ft above the Pit level. This provides an additional safety margin.

3) The comprehensive monitoring program would act as an early warning system.

4) Construction must be completed four years prior to reaching the CWL at the highest point in East Camp.

Comment 1-4: It was suggested in comments submitted by BSB to provide additional protection by requiring that a treatment plant be built three years prior to reaching the CWL. (BSB 4-K)

Response: We believe that four years will be necessary to "shakedown" the facility and will allow time to react to unanticipated contingencies (i.e., sludge handling or dewatering problems, solids settling problems, metals removal efficiency difficulties, unanticipated impacts on groundwater systems, etc.) during the final critical time period for implementation of the remedy. This four-year time frame will also allow for an in-depth assessment of the characteristics of the sludge to be generated by this facility and for input into sludge disposal design decisions in advance of mandating operation of the treatment facility.

Comment 1-5: Commenter supports the CWL and states that something should be done at the Pit long before it is absolutely necessary. (T 4)

Response: See response to Comment 1-4, Section 3.1.

Comment 1-6: CWL cannot be changed. (BSB 4-N)

Response: The CWL can be changed if in the future the monitoring data shows that there is threat to public health or the environment by allowing the water level in the System rise to the 5,410-ft elevation.

Comment 1-7: Construction schedule should begin when the water level in the Berkeley Pit reaches 5,260 ft. (BSB 8)

Response: EPA and the State believe that this general idea of allowing plenty of time for design, construction, and shake down of a treatment facility before the CWL is reached is appropriate, although we do not believe that a specific elevation should dictate the construction schedule. The ROD dictates a schedule (see response to Comment 1-1, Section 3.1), that requires design and construction to be completed in four years prior to the CWL being reached. This schedule is to be updated every three years based on the highest water level at the established East Camp monitoring points (presently the Anselmo Mine).

Comment 1-8: CWL should be set at 25-billion gallons and stick to it. (I 8)

Response: EPA and the State believe that a numerical volume limit of 25 billion gallons serves no purpose and has no technical justification.

Comment 1-9: The water level in the pit should be maintained at the bottom because:

- Very large volumes of low-cost, clean, drinkable water can be made available for the community of Butte-Silver Bow for both its present and future needs:

- Large amounts of inexpensive electricity can be utilized by the community or sold at a profit to Montana Power Company;

- Storm water runoff, as well as the sewage of the community, can be processed into a clean water supply that meets the Safe Drinking Water Act requirements;

- Metals that now pose a health risk in our aquifer can be processed at a profit;

- Large amounts of garbage can be processed, thereby reducing demand on the current new landfill by as much as 50 percent;

- It will spawn a system to provide a vast array of high-tech, high paying jobs that will be sorely needed after EPA, MDHES, and ARCO leave the community;

- The process can be utilized in other areas of the world to benefit mankind while practically eliminating the cover-up and Institutional Controls that are some of the possible "remedies" of present and future Superfund sites; and,

- It eliminates need for degradation of Big Hole River water, as well as Silver Lake water, that could instead be utilized for future needs of the citizens of the State of Montana. (I 50)

Response: Although some of the benefits espoused in this comment would occur (large volumes of clean water, jobs, potential reduction of Big Hole and Silver Lake water use), draining the Pit would also produce increased flows and metals loadings to be treated and is a much more expensive option than allowing the water to slowly approach the CWL. Given these increased flows, metals loadings, and treatment costs, EPA and the State do not believe that draining the Pit is the correct solution to the Pit System problem.

Comment 1-10: Did the EPA, MDHES, and the PRPs know beforehand that allowing the Berkeley Pit to fill up to the 5,410 ft elevation with toxic water would result in the bedrock aquifer being written off? If so, why wasn't it explained much sooner to the people of Butte-Silver Bow and CTEC? (I 50)

Response: Yes, EPA, MDHES, and the PRPs knew beforehand that the waiver of State groundwater standards would be necessary for the bedrock aquifer. The fact that cleanup of the bedrock aquifer was technically infeasible was stated in the RI/FS Work Plan in 1990 and should be of no surprise to anyone following the project, and we assumed no further explanation was necessary. The 5,410-ft level is of no relevance to this issue. It is infeasible to repair the bedrock aquifer regardless of the elevation the CWL. The water in the shaft system has shown improvement as the underground workings have become progressively inundated, and EPA and the State believe that this improvement will continue as the water level rises and more underground workings are inundated. Therefore, maximum water quality benefits are achieved by allowing the water level to rise as high as possible without threatening the alluvial aquifer.

Comment 1-11: Stop calling it the "critical water level" and start calling it instead the "safe water level." (T 10)

Response: In retrospect, it would have been wise to call the "critical water level" the "safe water level" because EPA and the State believe that the 5,410-ft level is safe and an adequate buffer zone exists above this elevation to provide an additional margin of safety. We have identified this level, however, as the CWL and we believe that it would not be productive to change the name at this point in time.

Comment 1-12: As the CWL is reached, how much of a margin of safety is left? (I 4)

Response: The alluvial water level adjacent to the Pit is 50 ft higher than the CWL. We also expect the highest level in the East Camp to be the Anselmo Mine, which is presently 40 ft above the Pit level. The CWL will be measured at the highest point in the East Camp which will not be the Pit. This provides an additional margin of safety.

Comment 1-13: The observed water levels in some monitoring wells are very close to the CWL of 5,410 feet mean sea level (ft msl). For example, the AMC-5 well has measured an observed water level of 5,436.7 ft msl. That is only 26.7 ft above the CWL. That is a small margin of safety. (I 4)

Response: AMC-5 is well within the Pit cone of depression where the alluvial system drains toward the Pit. The water level in the System has to get above the alluvial groundwater divide (which is near Continental Drive) before discharge to the alluvial system from the Pit can occur. This groundwater divide is at least 50 ft above the CWL and provides a margin of safety of at least 50 ft. It is technically inappropriate to make this conclusion about alluvial water levels within this cone of depression. The water levels within the cone of depression are expected to be lower than the water level at the groundwater divide because the alluvial water within the cone of depression is draining toward the Pit.

Comment 1-14: There is no room for a catastrophic event or deepening of the water level in the alluvial aquifer. The rationale for acceptance of the CWL of 5,410 ft msl was that model predicted little or no impact when the water in Berkeley Pit reached the CWL. Given the small margin of safety that leaves along with current aquifer levels and the lack of data to establish the maximum lowest alluvial aquifer water level, I believe the CWL of 5,410 ft msl is too high. (I 4)

Response: EPA and the State believe that there is an adequate safety margin as expressed in the proceeding responses to comments. We also believe that there is not a lack of data concerning the lowest alluvial levels. The water levels and groundwater gradients in the alluvial system were thoroughly defined utilizing dozens of wells showing water throughout the area.

3.2 USE OF OTHER TECHNOLOGIES FOR TREATMENT

Comment 2-1: "Why is this Record of Decision not defective if the authors did not survey the same kinds of available technologies and offer the opportunity to demonstrate what really can be achieved? We see that the study was a paper thinking, reading, speculating, and skewing the process to reach a preordained solution." (T 12)

Response: The Preferred Alternative was not preordained. The FS process cannot take all potential technologies through bench-scale or pilot-scale demonstration in the time frame allocated for making this decision. This FS is not envisioned to be research and development which offers an opportunity to demonstrate technology. However, EPA and the State are completely open to the implementation of other technologies brought forward collectively by the developers of such technologies and the PRPs, if they meet the project's performance criteria (discharge standards and flow rates). In response to public comment such as this one, the ROD dictates that a reevaluation of technologies must occur when the water level in the Pit reaches 5,260-ft level (presently projected to occur in 2009 or when mining is suspended, whichever is earlier). We are hopeful that additional technologies will be demonstrated by that time.

There are also other avenues for the testing of various technologies specifically for the Berkeley Pit. The U.S. Department of Energy (DOE) Resource Recovery Project, presently being run in Butte through MSE is such an avenue. The results of this project will be helpful to EPA, the State, and the PRPs in the reevaluation process and in the decisions associated with the implementation of new and innovative technology. EPA Region 8 and the State are also committed to pursue additional Federal funding for development and demonstration of innovative treatment/metals recovery technologies.

Comment 2-2: "Nobody asserts that reverse osmosis technology is an appropriate technology for the level of contamination of the Berkeley, Pit water as the first stage of an overall treatment solution; however, it might well have role to play in the final step of a process that solves the problem." (T 12)

Response: EPA and the State agree with this statement. Reverse osmosis (RO) was never envisioned to be a primary treatment process for the Pit waters, but rather a polishing step for sulfate removal and achieving very low metals discharge standards.

Comment 2-3: The technology suggested is very old. The commenter quoted a paper written by William Clark dated 1902 and a paper by the Anaconda Company dated 1941. (T 7)

Response: The technology chosen in the FS is an old technology (hydroxide precipitation and aeration), but the application is quite sophisticated when utilized to reach very low metals concentrations such as those dictated by State water quality standards for Silver Bow Creek. It is the most common technology used for the wastewater containing metals and acid mine drainage. It is employed in many similar instances at mines throughout the country, including the Yak Tunnel, Leadville Tunnel, and the Iron Mountain Mine.

Comment 2-4: Surely there are less antiquated processes available in 1994 than those in the current plan. Can new technologies like Chelation Chromatography be used now to begin the cleanup" (I 38)

Response: There are newer technologies available; however, EPA and the State believe that the proposed technology is the most cost-effective, proven technology available which will meet the project's performance standards. EPA and the State are open to the implementation of alternate technology if brought forward collectively by the PRPs (who will ultimately pay for the costs of the project and be responsible for meeting discharge standards) and the developers of the innovative technology. EPA and the State believe that it is important to evaluate technologies in the future as they become more proven. The ROD, in response to comments such as this one, requires a reevaluation of technologies when the water level in the Pit reaches the 5,260-ft level (presently projected to be reached in the year 2009).

Comment 2-5: The wrong technology has been chosen and the wrong solution has been chosen both by the EPA and ARCO. (T 7)

Response: EPA and the State disagree with this statement. See the previous response.

Comment 2-6: It seems to me that the technology that is available now is much better as it not only leaves no sludge but utilizes everything and also reduces cost. I don't understand how the people of Butte can see this way and ARCO and EPA cannot." (I 40)

Response: EPA and the State disagree with the statement that alternate technologies reduce costs. Many of these alternate technologies also generate significant amounts of byproducts that, if they cannot be marketed, must be disposed of as a sludge. We are hopeful that some of these technologies will be shown to be cost-effective in the future. As was previously stated, EPA and the State are open to the implementation of alternative technology if proposed collectively by the PRPs. The ROD dictates that reevaluation of treatment technology must occur when the water reaches the 5,260-ft level or if mining is suspended, whichever occurs earlier.

Comment 2-7: I therefore ask that the proposed plan be rejected at this time because it has not considered adequately this new technology (Chelation Chromatography). This technology is capable of treating water to nondetectable levels of copper, manganese, zinc, and arsenic. It is quite likely that the proposed plan has not appropriately or adequately considered other technologies which would work in conjunction with any modern process that would treat this water. (T 6)

Response: EPA and the State will not reject the Proposed Plan on this basis. We believe that the FS did adequately consider numerous technologies, which for various reasons outlined in the FS were rejected.

Comment 2-8: "The City of Butte should buy the water from Silver Lake, then pay for it by mining the copper and lead out of the wastes. The Concentrator could use the water out of the dam behind the Pit, after cleaning it. This is the water leaking into the Pit now. Then put up a few Hydroelectric Pumps to make electricity to sell to the Montana Power." (I 46)

Response: The City of Butte is not a PRP for this project and has no responsibility for the cleanup of the Pit. EPA and the State encourage commercial ventures that would aid in this project. These commercial ventures should be financially viable on their own and not depend on Superfund funding or authority to be financially viable.

Comment 2-9: "An innovative alternative approach would be to allow ARCO to delay construction for some agreed upon time (e.g., 10 years) and invest the savings of this delay in a research and development fund that would pay for research into alternative technologies to treat the pit water." (I 3)

Response: The EPA/State plan requires construction to treat inflows into the Pit in the near future. We believe that the most cost-effective way to handle this flow is to integrate it into the mining process, and this will likely require some construction. Construction of a treatment plant is not required to be completed until four years before the CWL is approached or after mining is suspended. This should not occur for nearly 30 years if inflows are controlled in the interim. During this time period, there is considerable time for research and development. There are a considerable number of technology demonstration projects planned by the DOE Resource Recovery Project. The ROD also requires a reevaluation of technology when the Pit reaches the 5,260-ft level.

3.3 METALS RECOVERY

Comment 3-1: "People think that metals recovery should be considered as an offset to the cost of good cleanup." (T 9)

Response: EPA and the State would also prefer the metals to be recovered, but only if it can be done in a cost-effective manner. We believe that the value of the metals recovered would not cover the capital costs and operation and maintenance costs of a conventional metals recovery facility and would not reduce treatment costs significantly.

Comment 3-2: "The purpose of hydroxide precipitation is to tie up the heavy metals and metalloids (arsenic) in insoluble forms to prevent the spread of contamination in surface and groundwater. Once the sludge is produced, the metals are essentially unrecoverable should future metals recovery technology become feasible. Thus, the hydroxide precipitation option precludes the future recovery of a mass of metals that represents a significant economic resource. (BSB 2)

Response: This statement is correct, but EPA and the State believe that the hydroxide precipitation and aeration option is the most technically effective, cost-effective, and proven treatment method currently available. The fact that the metals will not be easily recovered in the future is not a criterion used in our evaluation of treatment alternatives.

Comment 3-3: "The selected technology is at odds with metals recovery. Again, what we see here is the heavy metals being turned into a sludge which does not solve the problem, it just relocates the problem to a new location. The hydroxide precipitation technology has been described very eloquently as an old technology notwithstanding any claims for newness that have been made."
(T 12)

Response: This technology is an old technology which will be applied in an innovative treatment train. EPA and the State disagree with the assertion that this process "just relocates the problem." This treatment method effectively ties up metals (to the point that they are hard to recover) preventing them from leaching into the groundwater. Any repository will be built to State of Montana solid waste disposal site standards to ensure that the problem is not "relocated."

Comment 3-4: "Our philosophy is to recycle the metals." (BSB 4)

Response: EPA and the State would also prefer recycling of metals, but only if it can be done in a cost-effective manner as compared to conventional wastewater treatment methods.

Comment 3-5: "Why was only one treatment technology for metals recovery (copper cementation) evaluated during the final screening? Other newer technologies (e.g., those of Metannetix and Tetra Tech) have been tested in actual cleanups with some success. Metals recovery from Pit water has a great potential to turn a current liability into a long-term economic asset. This section should have been one of the most extensive in the FS. Instead, metals recovery technology received a perfunctory examination." (BSB 3)

Response: These technologies were evaluated in the screening portion of the FS and were eliminated for specific reasons stated in that document. Metals recovery, although a benefit, by itself is not a primary criteria evaluated for decision making. The primary criteria used in the screening report were treatment effectiveness, costs, and implementability. The ROD does require that there be a reevaluation of treatment technology when the Pit reaches the 5,260-ft level. EPA and the State are also hopeful that the developers of such technology and the PRPs collectively propose metals recovery technologies or other innovative treatment technologies that can be implemented for this project before a final treatment plant has to be constructed.

3.4 MORE MONITORING WELLS-ENHANCED MONITORING PROGRAM

Comment 4-1: The number of monitoring wells does not seem adequate. (I 1, I 3, BSB 4-H, I 53, I 54)

Response: With the addition of two bedrock monitoring wells and one alluvial well for the East Camp and four monitoring wells for the West Camp, EPA and the State feel that there is adequate coverage of the MFOU. However, if future information should indicate a need for additional monitoring wells in the MFOU, then EPA and the State will have the ability and authority to install these monitoring wells. The current monitoring wells (with the new additions) and future flexibility to require additional wells assure the Agencies and the public that groundwater monitoring will be adequate.

Comment 4-2: "A well is useless if it is improperly placed. Based on the complex faulting and fracturing of the area, more wells are necessary to get a complete understanding of the hydrology." (I 1)

Response: EPA and the State believe that additional wells are required in both the East and West Camp and have required the installation of these wells (see comment 4-1, Section 3.4). After installation of these wells are completed, we believe that the post-ROD monitoring program provides adequate coverage with 9 RI/FS bedrock monitoring wells (7 existing and 2 new), 8 mine shafts. 15 "existing/historic" wells completed in bedrock, and the Berkeley Pit (37 total - 33 bedrock monitoring locations as of this date, with 4 additional monitoring wells in the bedrock of the West Camp/Travona System required as part of the ROD), plus over ten years of data for many of these locations and additional monthly water-level data being added to the database. As water flows downhill and given the 3000 miles of interconnected mine workings in the MFOU that cut through and into the "complex faulting and fracturing of the area," EPA and the State do not believe this "complex faulting and fracturing of the area" is a confounding issue to the overall hydrology of the operable unit. EPA and MDHES are convinced that groundwater flow within the East Camp is towards the Berkeley Pit.

Comment 4-3: "Monitoring wells should have been part of the remedial investigation, not specified as part of the remedy." (T 9)

Response: Numerous monitoring wells (7 bedrock monitoring wells, 16 alluvial monitoring wells, 6 piezometers and 43 private wells) were part of the remedial investigation. Six "new" bedrock monitoring wells and one alluvial well are being installed or will be required as part of the ROD. These additional wells were not needed in the RI to make the remedial decision, but were needed to monitor the future rising water levels. It is possible that additional monitoring wells will be required in the future; however, current data does not support more wells. The ROD will incorporate language that allows the Agencies to require the installation of additional wells if the data support such a finding.

Comment 4-4: The remedy would address contamination after the fact, it is not preventive. (T 9)

Response: We believe that the remedy is preventative. It requires significant inflow control and requires that contamination never be allowed to enter the alluvial aquifer. The MFOU is an issue of preventing acid mine drainage (AMD) from entering the Summit Valley aquifer and contaminating that aquifer.

We cannot prevent the generation of contaminants in this care. By allowing the Pit System to rise as high as possible without discharge, the rate of acid mine drainage generation can be reduced.

Comment 4-5: The County acknowledges that the Monitoring Program outlined in Appendix I of the RI is reasonable. However, to provide the highest level of assurance to the County and its citizens, the County would recommend that additional monitoring be included in the plan, as follows:

- Two new monitoring wells should be drilled in the region southeast of the Berkeley Pit; the objective of these wells would be to extend the bedrock aquifer contours through the linear path of the Berkeley Pit and Well C. These wells would provide further verification that mine flooding problems are not migrating south and east.

- A monitoring point should be located adjacent to the East Continental Pit to monitor that Pit's influence on the bedrock aquifer. (BSB 2, T 8, G 2, I 54)

Response: EPA and the State agree with the general intent of the comment. As noted previously, two additional bedrock monitoring wells are being installed in the area discussed by the County. These walls should be completed before the end of 1994. One of these wells is located between the Berkeley Pit and Well C/East Continental Pit area. Further, this well should be in the area of the lowest point for weathered bedrock. The second well will be located south of Well C/East Continental Pit area and east of Walnut Street/Continental Drive.

Comment 4-6: "The County would request that these monitoring points should be installed during the summer field season of 1994. Further, the County would pledge to work closely with the EPA and PRPs to locate these monitoring points to acquire the most useful data." (BSB 2)

Response: The wells should be completed before the end of 1994. The County was allowed the opportunity to work with EPA and the State and did contribute on the siting of these wells.

Comment 4-7: In the ROD, EPA must commit itself and the PRPs to developing a comprehensive program to educate local citizens on the flooding of the Berkeley Pit and any potential contamination problems. Information must be widely disseminated on a regular basis and in terms that are clearly understood by the average citizen. Butte-Silver Bow stands ready and willing to assist in developing a such an education program. (BSB 2, BSB 4-K)

Response: The monitoring program will call for yearly updates to be given to the public through MDHES and the Montana Bureau of Mines and Geology (MBMG). This update will include information on water levels, water quality, Berkeley Pit flooding rate, and future date projections of reaching the CWL. Butte-Silver Bow is welcome to work with the State through MDHES and MBMG on the yearly updates.

Comment 4-8: "One of the positive aspects of the RI/FS is the requirement of additional wells." (BSB 7)

Response: EPA and the State acknowledge the comment. We also think the flexibility of requiring additional monitoring wells in the future, as new data may indicate, is also a very important aspect.

Comment 4-9: Further research needs to take place to establish a more adequate margin of safety. All Final Alternatives contain groundwater monitoring provisions that begin immediately. Continued monitoring of alluvial water levels over many more years will increase the confidence of the predictions of the maximum deepest alluvial aquifer level. As the confidence of the predictions of the alluvial aquifer water level increases, periodic readjustments of the CWL should be mode. (I 4, I 53)

Response: EPA and the State believe current information, as found in the RI, does establish an "adequate" margin of safety. The ROD establishes comprehensive guidelines pinpointing when future actions are to take place prior to the water levels reaching the CWL for the East Camp/Berkeley Pit System and West Camp/Travona System. Further, there is no less than a 50-ft water level elevation difference between the East Camp/Berkeley Pit System CWL and the alluvial aquifer in the region. Also, the monitoring program (as recognized in the comment) will gather data to confirm the accuracy of the CWL(s). Finally, if new data collected during the monitoring program demonstrates that the CWLs are not protective, the Agencies have the authority to react and take whatever action is necessary, including lowering the CWLs.

Comment 4-10: "Our judgement is that there will never be enough wells to satisfy everyone's curiosity. Since the wells cost $80,000 each, good common sense should also tell us all that at some point no new wells need to be drilled for curiosity sake". (BSB 8)

Response: EPA and the State agree with the comment. However, we will require installation of wells if any new data indicates a need for additional wells, EPA and the State will have the flexibility and authority to direct their installation.

Comment 4-11: "The Proposed Preferred Alternative has suggested $100,000 be spent on monitoring and public education. Our judgement is that this amount should be more than enough to cover monitoring and public education. We do not believe this money should be spent to hire 'Activists' who have their own agenda to pursue." (BSB 8)

Response: The dollar figure given in the Proposed Plan for Post-RI/FS monitoring is an estimation. The figure did not include monies for educational efforts. Also, the first years (about two) of the monitoring program will cost more than subsequent years. Finally, EPA and the State encourage the PRPs to work with the State (i.e., MBMG through MDHES) to conduct the monitoring program; however, the Agencies cannot force the PRPs to use the State.

Comment 4-12: "One suggestion that I would like to put forward is about funding of the comprehensive monitoring program. I think that advantage should be taken of sources other than EPA and ARCO. There are funding programs available through the National Science Foundation, and others internationally, where large grants are given for environmental projects." The commenter also suggests EPA coordinate a grants application scheme with local institutions and others. (I 53)

Response: The MFOU is an enforcement action against designated PRPs, notably ARCO and MR. PRPs are financially responsible for the minimum requirements of the monitoring program as outlined in the RI. Additional monies for basic research projects cannot be forced on the PRPs. EPA and MDHES encourage the academic community to pursue additional external monies to conduct original research on acid mine drainage and related topics using the Berkeley Pit as a "test bed". EPA and the State will encourage the PRPs to facilitate these research efforts.

3.5 TAKE ACTION NOW

Comment 5-1: Future generations are going to be saddled with maintaining a pumping and treatment facility in perpetuity under any plan. The least we can do is get the remedy in place now, not shove that off to them as well. (T 9, T 11, BSB 12-C, I 21, I 2, I 3, I 32, I 29, G 1)

Response: EPA and the State believe that much of remedy will be implemented in the near future. The PRPs will be required to control 40 percent of the flow that has, since 1982, gone to the Pit. They can do this through integration of this flow into the mining process or construction of treatment plant.

Comment 5-2: Please get a pumping plant for the Pit now and take actions to get new technologies that don't produce so much sludge. Please get them into operation within the next few years. (G I, I 30, I 17, I 14, I 3)

Response: See response to Comment 5-1, Section 3.5. Although the technology chosen produces significant amounts of sludge, the volume generated daily is only about one to two percent of the amount of tailings generated daily by the current mining operation. There is considerable acreage in the active mining area where sludge disposal can occur with no threat to human health or the environment. The ROD requires a reevaluation of technologies when the water level in the Pit reaches the 5,260-ft level. Some of these technologies may generate less sludge than the hydroxide precipitation treatment method called for in the ROD. EPA and the State are also committed to seeking additional Federal funding for development and demonstration of innovative technologies in this area.

Comment 5-3: The EPA must begin the process of physically addressing the problem of 27-billion gallons of toxic water now, rather than putting it off for 20 or 30 years. (BSB 15, I 45, I 44, I 47, I 41, I 40, I 38, I 36, I 48, I 34,I 23, I 27, I 26, I 25, I 18, I 20, I 16, I 14, I 12, I 10, I 9, BSB 4-E, BSB 6, I 3, T 3, I 1)

Response: The Agencies' near term goal is to reduce inflow into the Pit. We believe that inflow can approach the CWL (allowing in excess of 50-billion gallons to accumulate) before any risks are posed to health and the environment.

Comment 5-4: Caution in this case means beginning today to formulate a plan of action based on the best available technology, that being the technology that works best. The commenter also suggests the following:

- Begin immediately and take two or three years to solicit technical solutions to cleaning up the water;
- Within three years, using market forces, have someone screen the proposals and choose two or three to put into a pilot program;
- Test for three years;

- Fifth or sixth year, begin pumping plant with the best available technology and work out bugs in the system; and,

- Seventh or eighth year, project established. (BSB 15, I 12, I 3, I 36)

Response: EPA and the State agree with many aspects of the proposal. We believe that we are implementing the most cost-effective proven technology; and we are going to solicit other technical solutions as the project advances. We do not believe that it is necessary, however, to have a treatment facility, other than one to control surface inflows, to be on line in seven to eight years. We believe that, as long as the water level is kept below the CWL throughout the East Camp, no risk is posed and final construction completion of a treatment facility to treat Pit water should be tied to the CWL.

Comment 5-5: "Please consider a treatment plan now, or alternatively, some of the mineral extraction possibilities mentioned by various companies in recent newspaper articles." (I 39)

Response: See response to Comment 5-4, Section 3.5,

Comment 5-6: This valuable resource could be available to the community for industry and other purposes. The sooner these efforts are set into motion, the earlier clean water could be available to this area. (I 9, G 1)

Response: EPA and the State agree that the water in the Pit is a potentially valuable resource; however, the goal of the Superfund remedial process is not to make the resource (water) available to the area sooner but to protect human health and the environment. We believe the plan outlined in the ROD does meet this remedial goal.

Comment 5-7: Please stop arguing about this issue and start reassuring the general population and start fixing this problem. At least begin by slowing the rise of water. Action is needed." (I 7)

Response: EPA and the State support "stopping the arguing." The first step in fixing the problem is controlling the inflow and the plan outlined in the ROD accomplishes this task.

Comment 5-8: "There is a conflict of interest because we want something done now and at the same time we want to see some innovative technology used. If we do something now, the technology that will be used will create sludge." (BSB 4-N)

Response: There is a conflict here, but EPA and the State believe that it is important that inflows to the Pit are halted in the near future and that the PRPs have a clear path to follow, enforced through federal court, regarding the Pit problem. This path includes a hydroxide precipitation treatment plant, a process that creates significant amounts of sludge where the precipitated metals are hard to recover. We believe, however, that this technology is the most proven, Cost effective treatment presently available. EPA and the State are open to other more innovative and newer technologies if proposed collectively by the PRPs and the developers of such technology. We are also calling for a reevaluation of technologies when the Pit reaches the 5,260-ft level.

Comment 5-9: Reduce the amount of water in the Pit now and clean it up now. (BSB 4-J, BSB 6, T 9)

Response: EPA and the State do not believe that reducing the amount of water in the Pit is the correct alternative from the technical or cost perspectives. Although reducing the amount of water in the Pit would reduce the volume of contaminated water in storage, the amount needing treatment on a daily basis is more if the East Camp level is lowered. The groundwater gradient increases resulting in an increase in flow toward the Pit. The loading of metals to be removed on a daily basis is also increased if the East Camp water level is lowered because of the increase in acid production and acid mine drainage that would occur. Inundating the shafts decreases oxygen circulation, acid production, and metals loading.

Comment 5-10: Residents of Butte and the Silver Bow Creek drainage have been frustrated by the lack of progress by the EPA in developing a plan that will adequately, treat the contaminated water and protect the environment and citizens of the area from the potential threat to the alluvial aquifer surrounding Butte." (BSB 7)

Response: We acknowledge the frustration, however, the Superfund law dictates that EPA and the State follow certain steps, including public participation, before a decision is made. The RI/FS took about three years to complete as was projected in 1990. This is a relatively short period of time to move through the Superfund process for a project of this magnitude and develop a plan for addressing this problem.

Comment 5-11: "It is time to holler (and loud) to EPA about the Pit cleanup! I think there are still too many question marks left as it stands now." (I 22)

Response: The public comment period allows anyone to voice their concerns and questions. This responsiveness summary is in response to these questions and concerns.

3.6 COMMENTS RELATED DIRECTLY TO THE PROPOSED PLAN

A. DISAGREE WITH EPA PROPOSED PLAN

Comment 6A-1: Many commenters disagreed with EPA's Preferred Alternative for the cleanup of the Berkeley Pit. (I 10, I 33, I 12, T 9, P 1, I 40, I 38, I 39, I 32, I 19, I 28, I 24, I 21, I 15, I 13, I 11)

Response: We conducted a detailed and thorough MFOU RI/FS to determine the most appropriate response action for this operable unit given the data and the applicable technology currently available. We believe that the Preferred Alternative, with modifications based on public comment, is the best response action alternative for this operable unit.

Comment 6A-2: The plan to let the Pit fill for 28 years is short-sighted. It doesn't take into account the effect that this has on Butte. (I 4, I 12, I 15, I 13)

Response: We believe that allowing the Pit to approach the CWL will not threaten human health and the environment. This action does not take into account socio-economic effect to Butte and we do not have the authority under Superfund to take such effects into account.

Comment 6A-3: The plan doesn't seem to care about short-term adversities, such as doubling contamination, and it doesn't leave room for entertaining holistic approaches to Pit cleanup, approaches that could provide many benefits to the community. (T 9, P 1)

Response: We acknowledge that the remedy outlined in the ROD allows for the Pit water level to rise and that this would correspond to an increase in the volume of contaminated water; however, the daily flow and metals loading generated will be reduced if the Pit is allowed to approach the CWL. We do not believe that this will increase the risks to human health or the environment since the CWL will never be reached. As stated previously, the remedy can accommodate new recovery and/or treatment technologies if and when they become available.

Comment 6A-4: People say that the plan would create new contamination and a nuisance that would decrease their quality of life in substantial ways-including environmentally, economically, socially-and that it creates new threats to human health, including mental health. (P 1, I 39)

Response: We acknowledge that the remedy allows for an increase in the volume of contaminated water; however, this will not increase the risks to human health or the environment because discharge to the alluvial aquifer on Silver Bow Creek will not be allowed. The Preferred Alternative allows for new technologies to be implemented should the developer of such technology and the PRPs wish to do so. In this way, the Preferred Alternative allows the Pit water to be of economic benefit to the community.

Comment 6A-5: "I disagree with the preferred alternative. It is my understanding, this has been tried at Jefferson City and it did not work because of extreme temperature changes typical in Montana. Was a treatability study done that supports this alternative? If not is one planned?" (I 37)

Response: Hydroxide precipitation works well in a wide range of climates and we anticipate no problems using this technology in Butte. It is presently being used successfully in Leadville, Colorado, which has a climate similar to that in Butte.

Comment 6A-6: "I do not believe that the EPA-ARCO plan for cleaning up the Berkeley Pit is adequate to meet the requirements of Superfund law." (I 35)

Response: In selecting the Preferred Alternative, we have met all legal requirements for the Superfund (CERCLA as amended by SARA) program. This includes the regulations set forth under the National Contingency Plan (NCP).

B. AGREE WITH EPA PROPOSED PLAN

Comment 6B-1: "The local government has gone on record, with a lot of reservation and concern about the preferred alternative, but also in support of some modifications to the preferred alternative that the local government might find more acceptable as they relate to the preferred alternatives as it addresses the problem with the Berkeley Pit. It is the first time local government has gone to the extent of conducting their own public hearings to receive input to forward to the EPA, and the first time local government has formally gone on record and has drafted a resolution that sets forth their comments relative to the preferred alternative." (T 8)

Response: We acknowledge this comment.

Comment 6B-2: One commenter feels that the proposal is a viable solution. This person is frightened by the decision that is being made and supports it, with some reservations, because it is the best offer now. (BSB 12-I, BSB 4-N)

Response: We acknowledge this comment and believe that this is the best and most flexible alternative at the current time.

Comment 6B-3: "I agree with your findings, there is no quick solution." (I 49)

Response: We acknowledge this comment.

Comment 6B-4: "Regarding EPA's Proposed Plan, I lean towards Alternative 6/7 with reservations. Some aspects of the pumping and cleaning the water should be done as soon as possible." (I 31)

Response: Although contaminated Berkeley Pit System water will not be pumped and treated during the initial stage of this response action, surface water flowing into the Pit at Horseshoe Bend will be captured and pumped to the Yankee Doodle Tailings Pond.

Comment 6B-5: A number of speakers saw no scientific or technical basis to challenge the plan. Lacking such basis, they saw no reason not to allow it to go forward. (G 1)

Response: We acknowledge these comments.

Comment 6B-6: One commenter is proposing that the community scope be what is best for the community and feels that because of the Superfund Act, this whole issue has been forced. His concern is that EPA has come up with technical information. "We need to put our efforts toward the best result that is available to us." (BSB 4-N)

Response: We believe that, overall, the preferred primary treatment technology is currently the best process for removing the bulk of the metals from Pit System water. In order to consider innovative technologies that may be developed in the near future, the response action includes a re-evaluation of available technologies when the water elevation reaches 5,260-ft level. Based on that evaluation, a different technology may be implemented that would generate less sludge than lime precipitation.

Comment 6B-7: The commenters generally accept Preferred Alternative 6/7 as presented in the Plan. However, they believe that in one critical respect the Plan fails to provide for the necessary flexibility inherent in the long-term nature of this Plan. They believe that with a modification of this and other more minor points, Alternative 6/7 will ensure that the overall goals of the Berkeley Pit remediation process will be met. ARCO and a variety of other parties, EPA, MDHES, BOM, and MRI are in agreement with the study. (PRP 1, T 4, BSB 4-K)

Response: We acknowledge this comment and have tried to provide flexibility concerning treatment technology, points for withdrawing contaminated waters, and final water uses.

3.7 COST

Comment 7-1: "The Proposed Plan will save ARCO a bundle. Butte miners say the stainless steel pumps at the Kelley cost $60 million about 20 years ago. Cost of this 'eternal cleanup' would be less: $42-53 million." (G 2)

Response: EPA and the State question the validity of the $60,000,000 figure. Costs developed by the Agencies to install pump(s) and piping in the Kelley Shaft is approximately $16,000,000, in 1994 dollars. Following installation, the cost of remedy is considerably more than the costs of the pumps in the Kelley. Regardless, we believe the costs of pumps are irrelevant as compared to the cost of the remedy.

Comment 7-2: Please do not choose a remedy that appears to give the greatest weight to cost or to threats of litigation from PRPs. (P 1, BSB 7)

Response: The two threshold criteria used to make this decision are: (1) overall protection of human health and the environment, and (2) overall compliance with regulations and standards. EPA and the State believe that several of the alternatives proposed in the FS equally meet these basic criteria. To determine which alternative is preferred, the balancing criteria are employed.

Cost is one of these criteria and plays a major role when the costs of one alternative is inordinately more expensive. Threats of litigation play no role in the decision, but the Agencies must be cognizant of the fact that the decision must be based on an objective weighing of these criteria and not be arbitrary and capricious.

Comment 7-3: The cost factor needs careful consideration. There are two ways of calculating cost: (1) What is the cheapest plan of action or (2) What are the goals we are trying to achieve and, after the goals have been established, what is the most cost-effective way of achieving these goals. In devising a remedy for the Pit we must not select the cheapest solution but the solution which will maximize the protection of human health and the environment. We must select a cleanup solution. (I 51)

Response: EPA and the State agree with this statement and the FS did just as the commenter stated in Comment 7-2. No alternatives were considered that did not protect human health and the environment, meet state and federal requirements, and have long-term effectiveness and permanence to the highest degree possible.

Comment 7-4: "The community must itself put up a financial contribution to the clean-up perhaps 1 to 10% of the cost. This is only fair since the community benefitted as well as suffered." (I 49)

Response: Butte-Silver Bow is not a PRP for this operable unit and bears no responsibility to share in the financing of the remedy.

Comment 7-5: "Costs need to be broken down when they are so high and include contingency costs." (I 37)

Response: The costs in the FS do include contingency costs, as well as maintenance costs and a safety factor, to cover unanticipated costs that vary according to market prices (chemical costs).

Comment 7-6: The proposal appears to be written more in the interests of ARCO than in the interests of the citizens. It even allows ARCO to escape the necessity of having to create a trust fund now so that we are assured that we are not left holding the bag. We simply cannot trust ARCO to treat that water in perpetuity. EPA must think that the people in Butte have no memory of all the corporate flight that took place during the past 15 years. (I 13, I 5, T 9)

Response: All parties need to realize that there are several PRPs, including Montana Resources (MR), ASARCO, Dennis Washington, ARCO, and several smaller companies which are held responsible for the MFOU. The Superfund regulations and guidance contain several methods for PRPs to provide financial assurances. However, based on comments such as these from the public and Butte-Silver Bow and the long time frame needed to implement the remedy, EPA and the State believe that bonding (or a similar financial instrument) is appropriate. EPA is, therefore, presently evaluating the potential for requiring bonding.

Comment 7-7: The preferred remedy must state clearly and completely exactly how these costs will be covered, including the possibility that ARCO declares bankruptcy at some time in the future. The preferred alternative must also include the cost of reconstructing or renovating the water treatment system in perpetuity, as well as allowing for the cost of installing new technologies should they become available. (I 5, I 16)

Response: See response to Comment 7-6, Section 3.7. The cost in the FS includes the routine maintenance and replacement cost of the treatment system. The financial assurance assessment will also include this cost in perpetuity. We cannot, under Superfund, demand that inclusion of the cost for installing new technology be included in this assurance.

Comment 7-8: "Because any remedy for this OU will require treatment in eternity, why are the funds to do so not provided up front in a trust fund administered by EPA or another governmental agency instead of allowing ARCO to self insure that they will do the perpetual care, operation and maintenance?" (G 2)

Response: See response to Comment 7-6, Section 3.7.

Comment 7-9: "Two bonds should be established immediately to pay for the cost of the remedial efforts. The first should cover the initial building costs and predicted operating and maintenance costs. The second bond should be a special fund for upgrading the physical plant in the future." (I 4)

Response: EPA and the State are evaluating the potential for requiring bonding of long-term capital expenditures and long-term operation and maintenance costs.

Comment 7-10: "A mechanism should be set up to decide which new treatments should be implemented and which are not worthy. I recommend setting up the bonds now to hedge off future uncertainties such as interest rate fluctuations, changes in the cost of the project and responsible parties folding." (I 4)

Response: See response to Comment 7-6, Section 3.7.

Comment 7-11: "Presently, all the alternatives fail to address what will happen after 30 years. Who will pay for the treatment after 30 years to eternity? What is the life expectancy of the treatment system in Alternative 6/7? I believe any alternative that can't effectively address these questions, can't be trusted to be cost-effective in the future." (I 4)

Response: The typical replacement period for equipment and structures for such a treatment facility is 20 years (five percent per year) and the replacement costs were calculated into the annual operation and maintenance costs in the FS. The costs in the FS for the various alternatives were calculated for 30 years (per Superfund guidance) so that the cost of the various alternatives could be compared. The bonding provisions for implementing the remedy will take into account the cost of running and maintaining the plant in perpetuity.

Comment 7-12: Presently, responsible parties exist to pay for remediation, yet even the most expensive alternative (19) does little more than any of the other alternatives to keep from pushing this problem onto future generations. All the proposed 19 alternatives are stop-gap measures, yet this is not how they present themselves in the report. In fact, Alternative 6/7 was picked for its higher long-term effectiveness over the cheaper Alternative 4/5 (Feasibility Study, 1994). The higher long-term effectiveness is that the Pit water level will stabilize at a lower level than Alternative 4/5. By choosing the more expensive Alternative 6/7 for this reason, the authors and the State of Montana are placing a high value on having a lower stabilized Pit level. Why? What difference does it make, the work objective only required the level to be below the CWL, why waste $15-20 million to have a lower Pit level?" (I 4)

Response: Both Alternatives 4/5 and 6/7 equally meet the two threshold criteria. The balancing criteria must be weighed to decide which alternative is preferable. As was expressed in this comment, there is a potential, if Alternative 6/7 is employed, for the water level in the System to come to homeostatic conditions before reaching the CWL. It is not definitively known whether this would occur. There are positives and negatives to this occurring. We do believe that there is value in allowing the water level in the System to rise as high as possible without endangering the alluvial aquifer to reduce acid mine drainage.

On the other hand, there has been significant public comment wanting a lower CWL. Regardless, we do believe that Alternative 6/7 will significantly slow down the rate of rise in the System as compared to Alternative 4/5 and that there is significant value in slowing the Pit flooding down. First, it allows a greater period of time before a full scale treatment system has to be installed and for additional technology to be developed. Second, it allows more time for unexpected contingencies and glitches long before the CWL is approached. Third, it potentially avoids significant expansion of the plant in the future if the System does come to homeostatic conditions. Fourth, it provides continuous control of inflows while Alternative 4/5 does not. We believe that continuous control of inflow contributes to the implementability and continuity of the project.

Alternative 6/7 is more expensive (about 50 percent more) than Alternative 4/5; but in light of the benefits, we believe that these increased costs are worth the benefits. On the other hand, the Agencies believe that similar benefits derived from some of the other alternatives are not worth the several hundred percent increase in cost over Alternative 4/5.

Comment 7-13: What is the basis for EPA having put a lid of $60 million on the amount of dollars that could be spent for the perpetual remedy for this site? The Preferred Plan says that reducing the water in the Pit was not considered because it would be too costly. As cost is only one of the nine criteria for evaluating remedies, we recommend EPA go back and develop a plan that reduces contaminated water in the pit-what is preferred by the overwhelming majority of affected residents-and then evaluate its cost effectiveness along with its ability to reduce mobility, toxicity, and volume of contamination, its short-term effects, its community acceptance, and its permanence. (G 2)

Response: We set a $60-million cutoff as the line between moderate costs and high costs in the comparisons of the alternatives in the FS. A line must be drawn somewhere to enable the comparative analysis required in the FS. This line was completely subjective and could have been higher or lower.

We believe that the benefits of reducing the Pit level below the existing level are not worth the costs. Although the volume of contaminated water in storage would be less (a potential benefit), the volume of acid mine drainage generated on a daily basis and the loading of metals in the acid mine drainage would increase if the Pit level is lowered. The higher the water level in the System is maintained, the greater the inundation of the underground workings. This reduces the oxygen supply to the System, thereby reducing acid production and metals going into solution, thereby reducing toxicity. Keeping the water level in the System as high as possible also reduces the size of the cone of depression around the Pit. The reduction of the groundwater gradiant also reduces the flow of uncontaminated bedrock water from the periphery of the System from getting into the Pit, reducing the daily and long term cumulative volume which needs treatment. Both alternatives are equally permanent in that both will require treatment in perpetuity.

Comment 7-14: CERCLA is supposed to reduce the amount of pollution in the area. ARCO is saving money by not treating the contaminated water in the Pit now. I recommend that ARCO be required to quantify the money not being spent and that this money be used to: (1) pay for more monitoring wells to better understand the system and protect human health, and (2) research and develop the new technology that will allow the profitable removal of the valuable metals from the Pit." (I 1)

Response: The ROD requires that a reevaluation of treatment technologies be performed when the water level in the Pit reaches the 5,260-ft level. We have also requested that the PRPs install three additional wells to further define the alluvial and bedrock groundwater system east and south of the Pit and ARCO has agreed to install these wells. We have also required an additional four wells to be placed in the West Camp System. We believe that these tasks are necessary to meet the objectives of the project and are not tied to the cost of treatment.

Comment 7-15: What is being proposed is not a solution, it is a postponement that has to be dealt with down the line, therefore it will cost more money. If there is a permanent solution now that is as cost-effective or even a little more expensive, then is it not worth getting involved with it? Why does it have to be more cost-effective? (BSB 4-R)

Response: The plan described in the ROD is a permanent solution. All alternatives require treatment in perpetuity regardless of the level at which the East Camp is maintained. By allowing the water level higher in the East Camp, significant monies are saved because: (1) the avoided operational and maintenance expenses of not having to run a full scale treatment plant until the water approaches the CWL; (2) the reduced flow to be treated at that time, the selected metals loading which needs to be treated; and (3) the value of unspent capital accrues over time.

Comment 7-16: The term cost-effective is constantly being used. What does cost-effective mean to the people of this community ten years down the road? Does it mean that after the metals are taken, we are dealing with today's dollars or ten years from now dollars? (BSB 4-Q)

Response: An alternative is considered to be cost-effective if the alternative meets the objective of the project (i.e., protection of human health and the environment) and meets all State and Federal requirements for less cost than other alternatives. The FS uses 1991 dollars as a baseline for any cost comparisons. The baseline year is not important, as long as alternatives are compared in terms of the same baseline.

Comment 7-17: The EPA made a grave mistake in 1981 when they did not force ARCO to keep the pumps running when ARCO decided to abandon the Pit. The water should never have been allowed to flow through the shafts and into the Pit. The cost would have been much less than the cleanup is costing now, or will cost when it finally does happen. (I 15)

Response: EPA had no authority in 1981 to force ARCO to keep the pumps running. The overall cost of the cleanup is much less if the water level in the System is allowed to approach the CWL than if it had been controlled since 1982. See response to Comment 7-16, Section 3.7.

Comment 7-18: The EPA/ARCO plan doesn't adequately consider the fact that this country has only been around 200 years. It doesn't consider the possibility of a future economic depression that might take dollars away from maintaining the Pit at its full sign. It doesn't consider the possibility of social upheaval or war. It doesn't appear to have adequate fail-safes built in case of a breakdown of the nuts-and-bolts plants that would have to be maintained forever." (T 9)

Response: The plan outlined in the ROD accounts for costs in perpetuity, including operation, maintenance, and replacement of components of a treatment plant.

Comment 7-19: Cost is not the major factor in Superfund decisions. Cost is secondary to protecting human health and the environment. Under Superfund, human health must be protected from potential threats regardless of cost. The cleanup plan and its end result should be simply protecting human health and that should determine cost, not the other way around. So in devising a remedy for the Berkeley Pit, we must not select the cheapest solution but the solution which will maximize the protection of human health and the environment. (T 1, T 9)

Response: See response Comment 7-3, Section 3.7.

Comment 7-20: "Chelation Chromatography is a low-cost solution because it provides marketable metals, it provides drinking quality or better water. Will ARCO accept or entertain a zero cost treatment for cleanup alternatives?" (T 6)

Response: We do not believe that this technology is presently the "low-cost solution." This technology, or other technologies which recover metals, may eventually become the low cost solution. The ROD requires a reevaluation of technologies when the Pit level reaches 5,260-ft. Technologies are also being demonstrated in the DOE Resource Recovery Project Using Berkeley Pit waters. Information from that program may eventually aid in the implementation of metals recovery or other innovative technologies. We are also encouraging the PRPs and developers of such technologies to collectively come to us with innovative technologies that they believe are more appropriate than hydroxide precipitation.

We also do not believe that Chelation Chromatography will create a zero cost option at the present time. The value of copper and zinc in the Berkeley Pit water is about $2.75-$3.00 per 1,000 gallons at current (June 1994) metal prices, based on average concentration of 170 mg/l copper and 355 mg/l zinc. The cost of the selected remedy which raises the pH and removes dissolved salts is about $4.20 to $5.60 per 1,000 gallons depending on the total volume of treated water. If the latter costs are incurred in addition to the cost of metals removal by the Chelation Chromatography process, the value of the metals in the water will not cover the cost of treatment and will not create a zero cost option as suggested by the commenter.

Comment 7-21: "What trust fund or funding means will be available to treat water during the 'post mining' period and when does this period start? This is too open ended." (I 52)

Response: We do not know when the post mining period will be. We see no way to predict this period. EPA is presently evaluating the potential for requiring the PRPs to provide bonding to cover treatment costs the post-mining period.

Comment 7-22: "If the cleanup funds were available in advance could EPA require quicker action toward cleanup of the water that is now in the pit instead of waiting up to 28 years? (G 2)

Response: EPA and the State would not "require" the Pit to be pumped sooner unless technical information is developed that indicates that pumping is necessary to protect human health and the environment. On the other hand, we would not disallow parties from pumping the Pit at any time in the future if those parties meet discharge standards. We do see a possibility for this happening. For instance, if a high flow rate commercial metals recovery facility was developed or if the underground workings were dewatered to start underground mining again.

3.8 CONTROL INFLOW

Comment 8-1: All surface water inflows-from streams, precipitation, snowpack, etc.-be diverted from entering the Berkeley Pit. This would prevent wasteful contamination of clean water and prevent the Pit from filling as fast as it is. (I 43, I 34, I 4, I 1, G 1)

Response: The ROD does require diversion of the Horseshoe Bend flow in the near future and clean inflows from the Pit System after mining has been suspended. All clean waters presently going into Yankee Doodle Tailings Pond will be diverted around the Pit System. Currently that water is used in the MR process. MR needs a minimum amount of soft water in their operation. If these clean waters are diverted around the System, an increase in the import of Silver Lake drainage water would be necessary to make up the difference.

The underlying and primary objective of the selected remedy is to maximize control of inflow to the Berkeley Pit in a cost-effective manner, thereby minimizing the rate of rise in the Pit System. The selected remedy does not require 100 percent control of all surface inputs as this would be impossible and unreasonable. Water balance additions to the MFOU during current and active mining are allowed as they are used within the tailings water circuit. However, when mining stops, these additions (specifically the West, North, East, Yankee Doodle Creek, and Silver Bow Creek Drainage) will be diverted from the MFOU.

Comment 8-2: "More description on flow of Horseshoe Bend water would be extremely pertinent and helpful." (I 37)

Response: Horseshoe Bend is a discharge of contaminated alluvial system water from the old Silver Bow Creek stream channel in the northeast area of the Pit, in the vicinity of the Precipitation Plant. The average flow of this discharge is about 2.4 mgd of which about .9 mgd is presently being integrated into the

MR tailings circuit and 1.5 mgd is discharged to the Pit. There are several sources of this water, including natural recharge from melting snow and rain and seepage from the leach pads and Yankee Doodle Tailings Pond. The amount of flow from the various sources is unknown.

The RI describes the Horseshoe Bend water as acidic water originating from seeps at the base of the slopes at the north end and northwest corner of the Precipitation Plant area. The pregnant solution and Horseshoe Bend water are both acidic (pH ranging from 2.5 to 3.2 SU), have similar concentrations of barium, cadmium, calcium, copper, manganese, potassium, silver, sodium, chloride, fluoride, and silicon, and have similar parameters of acidity, alkalinity, hardness, temperature, and Eh. The difference between the two is that the pregnant solution has concentrations of aluminum, arsenic, chromium, iron, magnesium, nickel, zinc, acidity, sulfate, total dissolved solids (TDS), and conductivity that are a magnitude greater than those of the Horseshoe Bend water. The outflows from the Horseshoe Bend area averaged 2.40 mgd (1,667 gpm or 3.72 cfs [cubic feet per second]). These outflows include 1.54 mgd (1,069 gpm or 2.38 cfs) of water to the Berkeley Pit and 0.86 mgd (597 gpm or 1.33 cfs) of water to the Precipitation Plant.

Comment 8-3: "The MR Concentrator should not bring in any clean water from outside sources like Silver Lake. Silver Lake water should be replaced completely with contaminated water from Horseshoe Bend that will be diverted to the tailings pond. The cumulative effect of removing the clean water from the system and stopping the concentrator from dumping in the Pit will lower the costs of treatment in the future." (I 4)

Response: MR requires some Silver Lake water to meet their soft water needs. They have the water rights for this water. Diverting the clean water out of the Berkeley System now will not lower the overall cost of the project because of the cost of treating Pit water to meet MR's needs.

Complete elimination of Silver Lake water is not possible. Silver Lake water is required for efficient and cost-effective operation of the MR Concentrator (a.k.a., Weed Concentrator). It is not as simple as a one to one replacement of Silver Lake water with another water source. The chemical characteristics of the two waters must be considered. Silver Lake water is a high quality, soft water. Currently, there is not a consistent and adequate supply that meets these requirements in the MFOU. To achieve such high quality soft water with existing MFOU waters would require the construction of a treatment plant. Silver Lake water is owned by MR and, as such, is less expensive than water from a treatment plant. To require the construction of a water treatment plant to replace the Silver Lake water would not be cost-effective It should be noted that MR has verbally committed to minimize the use of Silver Lake water and use alternative water sources when feasible.

Comment 8-4: "One of the positive aspects of the RI/FS is the treatment of Horseshoe Bend Water." (BSB 7)

Response: We also believe that this is a major positive aspect of the plan. This control of inflow slows the rate of rise in the Pit considerably.

Comment 8-5: "All clean water entering the area should be diverted around the operable unit and discharged to Silver Bow Creek. Clean water should not be allowed to enter the pit or be diverted to the Yankee Doodle Tailings Pond. The pond was not designed for this purpose and the greater level of water in the pond would increase its instability in the event of an earthquake. In addition, putting more water in the pond increases the likelihood that contaminated water will leak from this pond and further contaminate groundwater and Silver Bow Creek. Water used by the existing mining operation should be treated to Montana State Water Quality Standards and discharged to Silver Bow Creek. The existing mining operation should not be allowed to contribute to the problem at the Superfund site." (I 3)

Response: See response to Comment 8-1, Section 3.8. The Pond was designed to receive this flow where it mixes with the tailings circuit water and recycles back to the concentrator. The Pond dam meets the standards set by the Montana Department of Natural Resources and Conservation (DNRC) and Department of State Lands (DSL). If this upper basin water was routed around the Pond, then additional makeup water would need to be added at the concentrator. There would be no net change of water in the System. If any new water input to Yankee Doodle Tailings Pond were to alter the phreatic surfaces within the dam, this import would then have to stop. The PRPs are required to monitor and maintain the phreatic surfaces within the dam to design specifications to insure its stability under the test parameters outlined in the Harding Lawson Associates (HLA) report.

The input of "treated Horseshoe Bend" water will approximately match the inflow into the Yankee Doodle Tailings Pond. MR is working to minimize the input of Silver Lake water by offset to the tailings circuit.

The import of "treated Horseshoe Bend" water to Yankee Doodle Tailings Pond should not increase the discharge to the alluvium underlying the Yankee Doodle Tailings Pond because of the concurrent minimization of often makeup water in the tailings circuit. However, if this import does result in increased flow, this flow is likely to be captured by the ROD requirement to pump and treat groundwater in the Horseshoe Bend area. There is no discharge of alluvial groundwater in the Yankee Doodle Tailings Pond area to Silver Bow Creek. All alluvial groundwater within this area east of the Berkeley Pit is captured (within the cone of influence) by the Pit.

Currently, there is no discharge of water outside the permitted area by MR. If a discharge of waters from the MFOU is required, the discharge will be required to meet applicable or relevant and appropriate requirements (ARARs), including "I" class discharge standards.

Comment 8-6: "Beyond controlling Horseshoe Bend water as part of an inflow control regime, please consider long-term options for dewatering upstream of the contaminated ground water, rerouting everything possible and reducing the need for perpetual treatment. If stasis in the mine flooding can be achieved at an earlier date without the need for long-term treatment and attendant sludge generation, or any other expensive, long-term treatment needs, everyone wins. Intercept the water before it gets to the contaminated areas on the hill. Reduce its rate of filling to next to nothing." (T 10)

Response: See responses to Comments 8-1 and 8-5, Section 3.8. We agree with this statement, and in response to public comment, the ROD has been designed to reduce inflows as much as practical. This means control of Horseshoe Bend surface water and subsurface drainage that discharge to the Pit during mine operations. Upgradient, uncontaminated surface water will be required to be diverted after mining has been suspended. However, complete dewatering of contaminated water is not practical. Therefore, long term treatment of the horseshoe bend flow will be required. Treatment cost can be reduced however by reducing clean upgradient inflows as much as possible as required by the ROD.

3.9 COMMENTS DIRECTLY RELATED TO EPA'S NINE CRITERIA

<u>A. REDUCTION OF TOXICITY, MOBILITY, AND VOLUME</u>

Comment 9A-1: The EPA-ARCO "remedy" would allow doubling of the volume of contamination now in the Pit from 25 to 56-billion gallons before any Pit water is cleaned. Superfund law reads "reduce" not "increase." (G 2, I 30, I 23, I 13, BSB 5, T 1, T 9)

Response: From present conditions until the CWL for the Pit System (5,410 ft) is reached (potentially up to 30 years) there will be a doubling of impounded acid mine drainage or contaminated water. Only after the sulfide ores/soils have oxidized will acid mine drainage stop. To minimize the total acid mine drainage (contaminated water) in the future, the Pit System should be flooded to the highest level possible. By doing this the volume of impounded acid mine drainage doubles. Pumping the Berkeley Pit dry or keeping water levels at current conditions increases both the volume of acid mine drainage and the metals loading in the acid mine drainage generated on a daily basis.

Comment 9A-2: I cannot believe at this point in time, that the people of the United States, State of Montana, Butte-Silver Bow and the stockholders of the PRPs would allow such a catastrophe of a high degree and volume of toxic waste and water. (I 50)

Response: EPA and the State believe that the natural recharging of this man-made dewatered area (i.e., the MFOU) is not a "catastrophe." EPA and the State are taking action that will prevent the recharging (flooding) waters from ever being a threat to the Summit Valley and Silver Bow Creek.

Comment 9A-3: The Office of Technology Assessment has concluded that the Superfund program has too often settled for remedy technologies which would not reduce the "toxicity, mobility, or volume" of the hazardous waste. All too often Superfund has settled for remedies short of cleanup. Given the serious nature of the contaminants at the Pit, we cannot allow any remedy short of cleanup. (BSB 5, T 1)

Response: The use of the word "cleanup" for this operable unit is arguably a misnomer. The objective of the project is to "control mine flooding" and prevent a release to Summit Valley and Silver Bow Creek of acid mine drainage (contaminated water). To drain the Berkeley Pit or keep waters at current levels only increases the generation of acid mine drainage on a daily basis and does not cleanup the operable unit. Using the word cleanup has the implication that some act can be performed and the "problem" goes away; thus, allowing one to walk away without further consideration or threat. This is not the case for the MFOU; there is no such act that can be performed (the solution) that allows no further consideration. Acid mine drainage and the recharging operable unit are natural phenomenon. Only after acid mine drainage stops and the area has recharged will there be an end to the potential threat to Summit Valley and Silver Bow Creek.

Comment 9A-4: A number of people expressed their unhappiness with the plan's downgrading of the Superfund "balancing criterion" which requires the remedy to "reduce toxicity, mobility, and volume" of contaminants. Defense of this strategy based on long term vs short-term protectiveness failed to appease these participants. (G 1)

Response: There was no "downgrading" of the balancing criteria. The "reduction in toxicity, mobility, and volume of contaminants" is only one of five balancing criteria and was taken into consideration by EPA and the State. Although the selected remedy will have a greater amount of acid mine drainage in storage than would draining the Pit or keeping it at its current level, allowing the System to recover to a higher level reduces the long-term generation of acid mine drainage. Keeping the Pit System at its current level, or "draining" the Pit System, would increase the long term total amount of acid mine drainage.

Comment 9A-5: How does the Preferred Remedy reduce toxicity, mobility, and volume of contamination? We see that it increases the volume of contaminated water and groundwater in the short-term and doubles it in the long-term and permanently. We see that it creates greater toxicity, and that the pounds per square inch (psi) increases the probability of mobilization through fractures in the bedrock. It is also mobilized as it climbs to the 5,410-ft CWL. (G 2, T 9)

Response: The "problem" at the MFOU is an acid mine drainage problem. For acid mine drainage to occur, three factors are needed: sulfide ores/soils, water, and oxygen. The total amount of acid mine drainage is a direct correlation to the total amount of sulfide ores/soils. It is not feasible or possible to prevent water from entering an area the size of the MFOU. The only way to reduce the amount of acid mine drainage is to deny the sulfide ores/soils oxygen. Allowing the water level in the System to recover as much as possible by inundating the exposed ore bodies is one method to reduce acid mine drainage because the flooding eliminates, at depth, oxygen from the ore body.

For the Pit System, there are four situations, with respect to water, that may be considered: (1) immediately filling/flooding the Pit, (2) "draining" the Pit, (3) keeping it at its current water level, or (4) slowly filling the Pit. Immediately filling/flooding the Pit and slowly filling the Pit will double the impounded volume of acid mine drainage. Draining the Pit or keeping it at current levels will keep constant or reduce the impounded volume of acid mine drainage. Further, immediately filling the Pit would minimize the total amount of acid mine drainage generated; draining the Pit would maximize the total amount of acid mine drainage generated; slowly filling the Pit will generate a greater amount of acid mine drainage than immediate filling (yet less than keeping the Pit at its current level); and keeping the Pit at its current water level would have the second greatest total amount of acid mine drainage. The doubling of impounded acid mine drainage does not create a "greater toxicity," it only doubles the volume of impounded acid mine drainage.

The comment concerning the increased psi is incorrect. There are two issues in this comment that require discussion: diffusion forces and hydraulic forces. First, the Pit System is a dewatered system. Until the System is recharged, there will be flow of water from all directions, including at depth and at the bottom of the Pit. Contaminants would have to move (diffuse) "outward" against this gradient. This is not possible. To illustrate, "[d]iffusion in solutions is the process whereby ionic or molecular constituents move under the influence of their kinetic activity in the direction of their concentration gradient. Diffusion occurs in the absence of any bulk hydraulic movement of the solution" (Freeze, R.A. and Cherry, J.A. 1979, Ground Water, Prentice-Hall, Inc., Englewood Cliffs, page 103) (Underlined for emphasis).

The kinetic force "outward" for the "contaminant" will always be less than the hydraulic force "inward" of water recharging a dewatered system. For the Berkeley Pit, the hydraulic force/movement of water is out of the bedrock and alluvial aquifers, preventing upgradient ("uphill") migration of contaminants. Mathematically, the forces which drive groundwater towards the Berkeley Pit are one million times greater than the forces of diffusion (e.g., transmissivity might be approximately 0.01 meters squared per second (m2/sec) versus a diffusion coefficient of 0.00000001 m2/sec).

B. CONCERNS ABOUT SUPERFUND PROCESS IN GENERAL

Comment 9B-1: "Should primary remedial action objectives be listed as preliminary action goals?' (I 37)

Response: We believe that the objectives were correctly listed as such.

Comment 9B-2: "Given the considerable scientific uncertainty about the pit, more weight should be given to community acceptance of the Remedial Plan since they are being asked to take the risks." (I 3)

Response: Community acceptance is a modifying criterion according to the NCP. It is used to modify a decision reached by an agency based on threshold and balancing criteria. While community acceptance of a proposed remedy is desirable, and will play an important role, its weight in decision-making will remain the same. Community acceptance cannot overrule the other criteria. We do not believe that there is "considerable scientific uncertainty" about the Pit; there are differences in opinion. In the ROD, EPA has modified the preferred alternative presented in the Proposed Plan to accommodate these concerns as much as we believe possible.

Comment 9B-3: "Community acceptance should be given an extremely high priority when sciences, such as hydrology and geochemistry of a very complex system, which are inexact sciences at best, set public policy." (I 1)

Response: We do not believe that the information we have gained about the Pit hydrogeologic system is based on "inexact science." While professionals may differ in their analysis of information, we have weighed those opinions and settled on the specified remedy. However, despite the scientific basis of EPA's decision, we still listened closely over the last four and one-half years to citizen concerns, and modified our analysis and preferred remedy based on those concerns.

Comment 9B-4: "A missed objective of the RI/FS is to protect human health and the environment." (I 37)

Response: We do not list protection of human health and the environment in our RI/FS objectives in the Proposed Plan because this is an underlying objective of all actions. More important to the Butte populace is: "How is human health and the environment to be protected? This is discussed thoroughly in the Proposed Plan.

Comment 9B-5: The purpose of Superfund is to clean up sites of contamination, permanent cleanup remedy, not moving contaminants to another site. The law directs EPA to protect citizens and make Superfund sites clean. Any remedy for the Pit should be a cleanup remedy. The Superfund law emphasizes: (1) cleanup, (2) to reduce toxicity, volume, and mobility of hazardous substances and pollutants at the site, (3) must be permanent, (4) must not move hazardous material, and (5) cost should not be a major factor. (BSB 4-A, BSB 5)

Response: EPA and the State believe that we are reducing the risks to human health and the environment with the remedy as detailed in this ROD.

Comment 9B-6: The Berkeley Pit Mine Flooding is a unique problem that will require unique and creative solutions, both in technology and in the implementation/administrative process. "Business as usual" will not solve the problems nor render the most innovative solutions to this critical community problem. The Butte-Silver Bow local government, through its Chief Executive and Council of Commissioners, submitted comments on the Berkeley Pit RI/FS and Proposed Plan in hopes of fostering the level of innovation and creativity needed to meet the concerns and needs of our citizens. (BSB 2)

Response: Comment acknowledged.

Comment 9B-7: On speaker expressed hope that this exhaustive process, with all its fits, starts, and mistakes, would help make the subsequent phases of the decision-making process at these sites more efficient and effective. (G 1)

Response: Comment acknowledged.

C. SHORT-TERM EFFECTIVENESS CONCERNS

Comment 9C-1: Does the Preferred Plan have any short-term adverse effects? (G 2, I 12)

Response: No, we do not believe that there are any increased short term adverse effects associated with the preferred plan versus the other alternatives.

Comment 9C-2: "The short term effectiveness has curiously been defined in terms of the damage that would occur from the active remediation efforts. Again, I am sure the RI/FS report followed correct procedures in defining the short term effectiveness of its alternatives in this way. Short term effectiveness should refer to alternatives that are effective in the near future. Using this logical definition of short term effectiveness, Alternatives 18/19 are the only ones that take effective actions in the short term to stabilize the Pit water level." (I 4)

Response: EPA and the State do not believe that the time for stabilizing the Pit is related to short-term effectiveness. The Pit water level cannot be "stabilized" without pumping forever. The MFOU is a man-made dewatered system. Only when or if the System has recharged will the System be "stabilized." Alternative 18/19 increases the total amount of acid mine drainage generated. Alternative 18/19 would reduce the volume of impounded acid mine drainage.

Comment 9C-3: "It is stated that all the alternatives have short-term effectiveness because none result in adverse short-term effects. We believe short-term effectiveness means how effective the remedy is in the short-term and if it deals with the problem quickly. None of the alternatives deal with the problem quickly, rather the alternatives attempt to justify putting off cleanup for decades. Why does EPA not recognize the increased volume of contamination as a short-term effect for example? " (G 2)

Response: See response to Comment 9C-2, Section 3.9C. EPA and the State acknowledge that in the short term there would be a doubling in the volume of impounded acid mine drainage; however, it must be realized that there are no negative health or environmental impacts due to the mine flooding problem until water discharge to the alluvial system on the upper Silver Bow Creek drainage. The Preferred Alternative prevents this from happening.

D. LONG-TERM EFFECTIVENESS CONCERNS

Comment 9D-1: "The claims of long term effectiveness of all the alternatives are circumspect because the objective on which they are based is not ambitious enough to ensure human health and environmental safety in perpetuity. The claims are based on fulfilling the objective from the work plan to prevent discharge of mine water to the adjacent alluvial aquifer and Silver Bow Creek and to maintain the flow of ground water toward the Pit by keeping the water level below the critical water level (CDM Federal Programs Corporation, 1990). All the alternatives, except one, meet this limited objective.

"The objective should be to establish a truly permanent solution that doesn't require maintenance into eternity. The work plan should request an RI/FS that outlines real alternatives that could lead to permanent solutions, not just a gradient of treatment options and timelines. If the original work plan would have outlined a more ambitious work plan that required the examination of permanent closure options and treatment options then a reasonable decision could be made in terms of costs. " (I 4)

Response: See response to Comments 9A-3, Section 3.9A and 9C-2, Section 3.9C. EPA and the State believe that there is not a significant increased threat by stabilizing the Pit at a lower level. Pumping the Pit immediately (Alternative 18/19) does not significantly reduce threat nor does it reduce acid mine drainage. Short-term effectiveness, therefore, is not increased. We believe that the objectives established in the MFOU RI/FS Work Plan were appropriate under the regulations set forth in the NCP. Specifically, EPA and the State believe that from the perspective of what is logistically practicable to accomplish, the Preferred Alternative provides the greatest degree of long term effectiveness as compared to the other alternatives. The Preferred Alternative will safeguard human health and the environment through permanent water control and treatment. The MFOU is a man-made dewatered system and a problem of acid mine drainage. There is no "quick fix" to the System. Until acid mine drainage has stopped, there will be requirements for treating contaminated water. An altering of the original work plan would not change the laws of nature. We acknowledge that neither the Agencies nor the PRPs will be able to "walk away" from the potential problems presented by these contaminated waters, but believe that the Preferred Alternative combines the best balance among EPA's nine evaluation criteria.

E. OTHER ALTERNATIVES

Comment 9E-1: "I recommend that Alternative 18/19 be adopted because of short term effectiveness (as I define it) and best long term effectiveness of the options presented, i.e. it will have the lowest stabilized water level. This will leave the least burden upon future generations and establish the largest margin of safety." (I 4)

Response: We do not believe that Alternative 18/19 combines the best balance between the nine evaluation criteria. A significant lowering of the water level in the Berkeley Pit at the present time would increase the amount of acid mine drainage generated and would increase the metals concentration in the acid mine drainage. We believe that minimizing the volume of Pit System water at this time would create additional problems and would not reduce the threats to human health or the environment more than the Preferred Alternative.

F. PERMANENT CLEANUP

Comment 9F-1: "How is this solution of creating a 50 billion gallon plus body of toxic water good for the State of Montana or the people of Butte-Silver Bow? Is it only the PRPs that will benefit from this solution?" (T 2)

Response: We believe the Preferred Alternative combines the best balance between the nine EPA evaluation criteria. Please refer to responses to Comments 6A-3 and 6A 4, Section 3.6A and 9E-1, Section 3.9E.

Comment 9F-2: "How many years will the State of Montana and the people of Butte-Silver Bow have to live with this very large amount of toxic water, 1200 years, 1,000 years or forever?" (T 2)

Response: A permanent fix that would allow the PRPs and the Agencies to "walk away" from this problem does not exist. We will implement a response action that provides the best combination of currently available technologies to eliminate potential risks to human health and the environment from the Pit System water. We will remain flexible about how the response action will be implemented so that newly developed (and proven) technologies can be implemented to best manage this large volume of contaminated water.

Comment 9F-3: The plan needs to have stronger emphasis on eventual permanent cleanup.(T 1, I 51)

Response: Refer to responses to Comments 9F-1 and 9F-2, Section 3.9F.

Comment 9F-4: The EPA plan will saddle future generations with worries about the pit level always at the 'full ' mark." (G 2)

Response: The Preferred Alternative combines the best balance of currently available technologies among all the alternatives evaluated. The Preferred Alternative is also flexible in its implementation and provides for a re-evaluation of new technologies in the future. We realize that the contaminated water in the Berkeley Pit is likely to always be a concern to the citizens of Butte. We believe that the CWL of 5,410 ft is not a "full" mark. There is at least 50 ft of additional volume before discharge out of the Pit System could occur.

Comment 9F-5: "The Pit is certainly a hazardous waste site. Does the proposed plan really call for a cleanup of the Pit? Is this a cleanup solution when it leaves in place a lake of poison? Is this a cleanup solution when it leaves Butte in a state of perpetual environmental crisis?" (I 51)

Response: We do not believe that this leaves Butte in a state of perpetual environmental crisis. Regardless of the solution employed, perpetual treatment will be necessary. There is no technical solution for "eliminating" the problem regardless of the volume of contaminated water left in the Pit.

G. PROTECT AGAINST RELEASE AND THREAT OF RELEASE

Comment 9G-1: "To say that contaminated mine water is being contained in this OU is false. Contaminants hove migrated into the vadose zone, and soils, and other surface waters outside of this OU." (I 37)

Response: A thorough review of the available data by EPA, the State, and ARCO indicates that all contaminated bedrock groundwater in this operable unit is flowing toward, and being contained in, the Berkeley Pit/East Camp System. Contaminated water will fill presently unsaturated areas, but contaminated waters cannot migrate out of the Pit System.

Comment 9G-2: "How does the Preferred Remedy protect against the release and the threat of release of contamination given the fact that water can indeed move through bedrock of the pit and contaminated mine water currently enters Silver Bow Creek from the bedrock aquifer at the end of the Colorado Tailings where it is a gaining stream?" (G 2)

Response: The currently available data indicate that the bedrock alluvial aquifer gradient is toward the Berkeley Pit/East Camp System. The water elevation in this System is currently between 5,080 ft and 5,118 ft and the elevation at the west end of the Colorado Tailings is approximately 5,410 ft. Therefore, Pit System water cannot be discharging to Silver Bow Creek. Gaining conditions in Silver Bow Creek in the area of the Colorado Tailings are due to the influx of alluvial and bedrock groundwater that is not in contact with the Pit System water.

H. CONCERNS ABOUT THE PROPOSED PLAN

Comment 9H-1: "More graphics in the Proposed Plan would have aided the reader to understand the nature ant extent of the problem. Figure 1 was terrible. One can barely read the map. It would be helpful to depict Horseshoe Bend water and flow." (I 37)

Response: Comment acknowledged. Copy quality of maps varied significantly.

Comment 9H-2: "Include a postage paid comment sheet to the back of the Proposed Plan addressed to Russ Forba." (I 37)

Response: We provide numerous opportunities for public comment. We do not feel a postage-paid comment sheet is a cost-effective way of generating public comment.

Comment 9H-3: "The Proposed Plan was not written objectively. The Proposed Plan must present each alternative in equal light throughout the plan, with the exception of the 'Discussion of the preferred alternative' section. " (I 37)

Response: EPA and the State disagree. The Proposed Plan was an objective document that strived to make clear that EPA and the State had a preferred alternative.

Comment 9H-4: "When presenting the preferred alternative use 'would' instead of 'will. ' We, the public, want to feel as if an alternative has not yet been chosen and that our comments count for something." (I 37)

Response: Our intent with language use is to make a document as readable and understandable as possible. We assert often that public comment is encouraged on all alternatives and that the preferred alternative is indeed subject to change depending on public comment.

Comment 9H-5: "Is the preferred alternative considered a 'Final Action, ' a 'Limited Action' or an 'Interim or Preliminary' Action? This was never clear. Nor was it clear how this OU is rolled into the Silver Bow Creek/Butte Area NPL site." (I 37)

Response: EPA Montana Office proposed plans indicate when an action is interim or limited. We do not feel it is necessary to specify that an action is final; that is the assumption at the end of an RI/FS and completion of a ROD.

Comment 9H-6: "This plan is weak in mentioning analytical results. What is the extent of contamination in terms of ppb?" (I 37)

Response: ID interviews and informal discussions with the public, we have been told time and time again that public information should be as clear and non-technical as possible. Thus, level (not extent, which indicates spread rather than level, of contamination) is not as important to people as is what we intend to do at a site. The RI/FS is available to the public, free of cost, if this information is important to them.

Comment 9H-7: "Should key elements of the Preferred Alternatives include Protection of the Aquifer and Institutional Controls?" (I 37)

Response: We listed key elements that are active aspects of the preferred remedy. Protection of the (alluvial) aquifer is a goal, not an element; institutional controls are an element discussed in the plan. It could be listed as a key element.

Comment 9H-8: "Other neutralizing agents" is too vague, as is "or by a treatment in a newly constructed treatment plans." The treatment train should be part of the Preferred Alternative. Must be more specific on how it is treated. To evaluate costs effectively a "preferred treatment train" must be assumed for each alternative. Flexibility can be written into the proposed plan that says something to the effect that treatment by an on-site treatment plans has been assumed unless something more efficient and cost-effective can be found. (I 37)

Response: Comment acknowledged.

<u>1. PUBLIC PARTICIPATION</u>

Comment 9I-1: The solution to the Pit problem must show sensitivity to public input. The best environmental policy decisions and outcomes are achieved through public discussion and through public debate. The public has a right and a duty to subject the opinions of so-called 'experts' to intense criticism. The final Berkeley Pit decision must clearly demonstrate and show not only that public input was heard but that it was listened to, and that public input had some impact, that it had some efficaciousness in arriving at the final decision about how to deal with the Berkeley Pit. (T 1, 1 51)

Response: EPA and the State agree that environmental decisions should be made with public input. For the last four and one-half years EPA has gone to the public at least every six months to discuss the ongoing RI/FS. We have listened closely to public concerns. We believe that our Preferred Alternative is better than it might have been precisely because of public input, and the ROD reflects community input. However, if EPA's public involvement program is judged by whether EPA makes only those decisions that please a public group, then our image must suffer. We listen to the public and use that information to modify decisions that are based on scientific and technical information.

Comment 9I-2: "Public involvement in the Berkeley Pit clean up is extremely difficult due to the immense amount of technical information involved. Few people have the time or expertise to wade through the hundreds and hundreds of pages included in the RI/FS. If the public is really going to be involved in this process. EPA must make a more concerted effort to interpret these volumes of information. However, the information should come from an independent, objective source; someone who has not already aligned him/herself with a specific alternative. Additionally, the public should be brought in at a point more conducive towards participation in this decision making process. Although the state was included from the beginning, the public was brought in at the last possible moment." (I 5)

Response: We agree that is difficult to assimilate all the technical information involved but it is incorrect to state that the public was brought in at the last possible moment. As for the "independent, objective source," EPA funded a Technical Assistance Grant in 1991 to a group in Butte (CTEC) who were to read and interpret the documents and disseminate information to the public. This is a group that is not aligned with either EPA or the PRPs. We have worked with CTEC and other members of the public, in public forums, for almost five years.

Comment 9I-3: I recommend that the written quality of the public documents be improved to make them understandable to the public and to facilitate, rather than discourage public involvement. (I 43)

Response: Comment noted. We constantly strive to improve the readability of our public documents, while balancing the need to get technical information disseminated. Our goal in writing these documents is to facilitate public involvement.

J. SOCIAL AND ECONOMIC ISSUES

Comment 9J-1: "The EPA plan doesn't look at what it is doing to property values in Butte today, and especially near the Pit." (T 9)

Response: EPA is mandated to protect human health and the environment. We are not charged with examining social or economic impacts. In general, however, Superfund cleanups have improved property values (e.g., Anaconda near the proposed golf course).

Comment 9J-2: We hope that the plan that is being put forth will take into account not only the health and welfare of the community, but also the economic development of the community. (T 3, BSB 12-G, BSB 6, BSB 7)

Response: EPA and MDHES have shown their willingness to work with a community toward a mutually agreeable cleanup plan (e.g., Lower Area One in Butte, the Old Works in Anaconda). If a remedy can create economic benefit, everyone benefits. However, some remedies are limited by cost-effectiveness; the remedy cannot be tied to economic benefit without increasing the costs unreasonably.

Comment 9J-3: The EPA/State of Montana Preferred Remedy actually harms Butte's economy by flooding off access of historic underground resources. The plan will surely cause disastrous economic and social consequences. We need reasons for businesses and professionals to relocate here, not the world 's largest body of toxic liquid to drive the folks we have away. We don't believe it is good policy to pass our problems on to our kids and theirs and theirs. We need innovative thinking, nor a Remedy that fits the old adage of cutting off one's nose to spite one's face. (I 50)

Response: We acknowledge that flooding the underground mine will make underground mining more expensive to resume. Superfund allows the Agencies only to address human health and environmental impacts, not socioeconomic impacts.

Comment 9J-4: "My main concern is the economic impact any delays would have on the growth and attractiveness of Butte to outside interests. Right now it's nil. Mining is terminal, is Butte?" (I 31)

Response: See response to Comment 9J-3, Section 3.9J.

3.10 PETITION

The Clark Fork Pend Oreille Coalition circulated a petition, which was signed by 3,690 citizens. Some individuals sent the language of the petition directly to EPA in Helena based on an advertisement in the Montana Standard. The language of the petition was:

Comment 10-1: "I/We, the Undersigned Citizen(s) of Montana, hereby petition the United States Environmental Protection Agency to reduce the water level in the Berkeley Pit and clean it up now.

I/We don't want Butte to have what would probably be the largest body of toxic water in the world. EPA's plan to let the pit fill for the next 30 years will harm Butte's social and economic future. A full pit poses a perpetual threat of release of contamination. It passes our problems on to future generations to worry about forever." (P 1 through P 12)

Response: EPA and the State respect the position of the petitioners and can understand the support for the petition. EPA and the State believe that to "reduce the water level in the Berkeley Pit," would not "clean it up now" and is not more protective of human health and the environment. EPA and the State are mandated to make remedial decisions using nine criteria. Public acceptance is one of the two modifying criteria and EPA and the State believe that reducing the water level in the Pit is not the correct remedy when assessing all nine criteria together.

In addition, the Clark Fork Coalition submitted a letter with the petition which included the following comments:

Comment 10-2:	"Enclosed is a Berkeley Pit petition signed by 3,690 affected citizens. Of these 3,470 are residents of Butte-Silver Bow County. The balance are concerned Anacondans and other residents of the Clark Fork watershed, as well as a few Montanans from nearby cities and towns.

The people who have signed this petition make up over 10.3% of the population of Butte-Silver Bow. Their number is about the same as those who voted in the recent school board election. The number of signatures is significant in that the petition was 'worked' for parts of the day on only three Saturdays in one store in Butte (about 2,000 signatures); a small donated newspaper ad received an amazing 2.6% response rate (286 mailed-in petitions); petitions were out for about a week in six retail establishments, and the balance came in from people who asked to take petitions from K-Mart for their friends to sign. We believe that over 95% of those in Butte who were asked to sign the petition did so. Those who didn't were usually in a rush; very few refused. The point is, this was something the citizens of Butte-Silver Bow were able to agree on wholeheartedly. They often said, 'thank you!' and 'bless you,' and expressed the wish they had time to get more involved." (P 1)

Response:	See the response to Comment 10-1, Section 3.10.

3.11 MISCELLANEOUS ISSUES

A. SCIENTIFIC STUDY OF PIT

Comment 11A-1:	The environmental situation in the MFOU Berkeley Pit System offers a tremendous opportunity for scientific study which should not be lost, and which will certainly be useful to others in future times and other places. There are presently similar situations internationally where detailed investigations have been in place for some years; but these do not appear even to have been identified during the feasibility study, let alone taken as example. In the near future other mine operators will need to deal with situations similar to those at the Berkeley Pit and a well-documented activity will be appreciated. In the immediate future the WISMUT mines in Germany (especially the Ronneburg Pit) will commence to flood and will take about 15 years to fill. (I 53)

Response:	We acknowledge this comment and add that MSE is currently conducting a five-year pilot scale program to test innovative technologies for the treatment of Berkeley Pit water. This program solicited technologies from throughout the world and, therefore, is testing the most promising technologies currently available anywhere.

B. UPDATING DATA AFTER RECORD OF DECISION

Comment 11B-1:	"[T]he County would recommend that the ROD include specific language that clearly articulates the process for updating the data from the RI/FS, particularly if any data or information used to decide on the preferred alternative proves to be incorrect or inaccurate. The County and its citizenry need to know:

a) how the agency and PRPs will respond to new and/or better information that emerges from actual data collected, particularly if this new information has any impact on the environment or public health;

b) how and under what conditions the decisions in the ROD will be changed, based on updated information; and

c) how the County or an independent party designated by the community can be directly involved in the decision-making process throughout the monitoring period and the implementation of the remedy." (BSB 2)

Response:	The following points address the specific questions outlined above:

a) EPA and the State intend to produce yearly updates concerning the monitoring information that is generated, as well as a more in depth analysis of information and data every three years. This analysis would include updates of the water level increases in the System, recalculations of the remedial design, and construction completion trigger dates, as well as updates in "I" classification discharge standards. Also these updates would present new monitoring data, which might dictate changes in the monitoring system, the CWL, or schedules for construction of a treatment facility.

b) The revised schedules derived from updating the predictive fill rate model will not necessitate a ROD amendment because this activity is a routinely planned update anticipated in the ROD. To enact more significant changes, such as significant changes in technology to be employed or changes to the CWL, will necessitate a ROD amendment or an "explanation of significant differences (ESD)." Both of these processes require a public participation step.

c) EPA and the State would like to actively involve local government in the yearly update and the three year data analysis process. We plan to discuss methods for their involvement with Butte-Silver Bow. We also envision the MBMG, currently located in Butte, to head up the technical portion of these activities. We believe this local involvement will aid in communicating progress and updates to the general public.

3.12 INSTITUTIONAL CONTROLS/APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A. INSTITUTIONAL CONTROL ISSUES

Comment 12A-1: "Butte-Silver Bow has a contract with ARCO whereby they agreed to create some yet-to-be-defined Institutional Controls that appear to include well bans. To what extent, if any, does the Preferred Remedy rely on Butte-Silver Bow bring able to condemn some wells and forbid drilling others?" (G 2)

Response: It should be noted that, regardless of the engineered remedy that is implemented, the bedrock aquifer cannot be cleaned up. Under the remedy espoused in the ROD, the quality will improve in the future, but the water quality will not meet drinking water standards in much of the area in the foreseeable future. There is no alternative to this fact. The engineered remedy does not rely on Butte-Silver Bow to condemn wells or forbid drilling. However, the remedy does rely on institutional controls (ICs) to protect citizens from exposure to contaminated bedrock waters within the area outlined in the ROD. We believe that local management of the ICs by local government is prudent and appropriate. The local government would be compensated for running any such program.

These ICs could prevent the use of wells drilled into the bedrock aquifer of the MFOU if the levels of contaminants pose a threat to human health and the environment.

Comment 12A-2: "Please define the geographic area expected to be affected along with the types of restrictions anticipated for each." (G 2)

Response: The geographic area is shown in the ROD (Technical Impracticability ARARs Waiver - Attachment 2).

We anticipate the ICs to require testing of any bedrock well within this area to confirm the presence or lack of contamination and allow usage accordingly. The development of a specific program will occur after the issuance of the ROD.

Comment 12A-3: "Please state if the property owners involved were aware of these potential restrictions before close of the public comment period for this Preferred Plan." (G 2)

Response: Many property owners probably were not aware of the potential for these restrictions, even though it was general public knowledge throughout the process. Institutional controls have always been presented as part of the MFOU RI/FS remedy and language were included as part of the Proposed Plan. It should be noted that, because the impaired bedrock aquifer cannot be restored to drinking water standards in the foreseeable future regardless of the technical remedy employed, the ICs are independent of the remedy and do not impact the remedy selection process.

B. ARARs

Comment 12B-1: "List the ARARs (see the NCP & Proposed Plan guidance)." (I 37)

Response: The primary ARARs are discussed in the Proposed Plan. A complete listing of ARARs is too lengthy to include in the Proposed Plan. They are included is the FS (which EPA can supply to anyone upon request), and they will be updated in the ROD.

Comment 12B-2: The Migratory Bird Treaty Act of 1918 (MBTA), as amended, 16 U.S.C 703, et seq., and the Bald Eagle Protection Action of 1940 (BEPA), as amended, 16 U.S.C. 668, et seq., are not listed in the ARARs in Appendix Y of the FS report. Similar to the Endangered Species Act, both the MBTA and BEPA are federal location-specific ARARS and should be included in the appropriate section. (GOV 1)

Response: Comment noted. This regulation will be included in the ROD.

Comment 12B-3: We agree that if the "ultimate" ARAR for all projects relating to discharge of waters to Silver Bow Creek are "Gold Book" criteria, including chronic water quality criteria, (FS, Appendix Y, p. 30), the proposed remedy will be protective of the Silver Bow Creek aquatic environment. We would recommend that the Mine Flooding remedy design be coordinated with the remedy for the Streamside Tailings and Lower Area One Operable Units so that the Mine Flooding Discharge will not affect the Silver Bow Creek channel. (GOV 1)

Response: Comment noted. EPA and the State plan to coordinate the implementation of all of these projects to maximize water quality benefits.

C. WATER FOWL

Comment 12C-1: Considering the very brief and rudimentary nature of the study conducted by Biosystems Analysis Inc., the potential cumulative effects from heavy concentrations of six different heavy metals, and the lack of information regarding the effect of these toxins to waterfowl specifically, it is of primary importance that the Preferred Alternative incorporate a plan for effectively preventing access to the Berkeley Pit water by waterfowl. This will ensure that the Preferred Alternative complies with the Bird Migratory Act. (I 5)

Response: EPA and the State will be coordinating with the U.S. Department of Interior to mitigate potential impacts on waterfowl in a cost-effective method.

D. INTERACTION OF PLAN WITH NATURAL RESOURCE DAMAGE ACTIONS

Comment 12D-1: "How does this Superfund cleanup anticipate restoration work to be done as required in the Natural Resource Damage Act portion of CERCLA? Because both are in the CERCLA law, a reasonable man would expect the one to be a jumping off point for the other." (G 2)

Response: We are unable to anticipate the restoration work to be done under the Natural Resource Damage (NRD) program. The NRD program will be able to plan their restoration activities more precisely following the ROD.

The selected remedy is a remediation response to protect human health and the environment. Restoration (the "natural resource damage" portion and action) is a separate issue. The commenter is correct, restoration takes over where remediation "ends."

Comment 12D-2: "Resource damage recovery suit placed in jeopardy." (BSB 7)

Response: We do not believe that the proposed remedy places the NRD suit in jeopardy. On the contrary, it gives the trustees a clear indication of the scope of the remedial action to use as the baseline for restoration work.

Neither action - remediation or restoration - jeopardizes the other.

E. IMPACTS TO SILVER BOW CREEK

Comment 12E: Has the issue of cumulative impacts in the Silver Bow Creek/Butte Mine Flooding operable unit been considered in the RI, FS, and Proposed Plan?" (I 43)

Response: Yes, the cumulative impact has been considered. That is one of the reasons that Gold Book Water Quality Criteria (WQC) **1** have been used as a goal for this project. Using Gold Book WQC as the goals dictates that water discharged from a treatment plant meet all water quality goals, including support of a cold water fishery and drinking water.

F. FUTURE LAND USE

Comment 12F-1: How does this solution return the land to the minimum required "recreational use," i.e., backfill and revegetation? (I 52)

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[1] On August 11, 1994 Montana Water Quality Bureau Circular 7 (WQB-7) Standard replaced "Gold Book" standards as enforceable standards for water quality issues in the State of Montana.

Response: Superfund regulations do not require that a pit formed by hardrock mining be returned to a minimum recreational use. The Montana Hardrock Mining Act does have requirements for such things as waste rock dumps, leach pads, and tailings ponds but not specifically for pits. The Act's variance for pits was ruled unconstitutional by Judge Thomas Honzel on September 2, 1994. Regardless, the reclamation issue is independent of the scope of this action, which deals with groundwater contamination. This issue needs to be revisited in the Active Mine Area operable unit, which will address reclamation standards.

G. GROUND COVER

Comment 12G-1: "Stabilize mine waste and ground cover, i.e., grass, etc." (I 34)

Response: The stabilization of surface mining-related wastes was not part of the MFOU RI/FS. The stabilization of these materials is currently subject to State of Montana regulations and is defined in MR's active mining permit.

This action does not include the reclamation of mine waste in the active mining area. The Montana Hardrock Mining Act, administered by DSL, does require this reclamation. DSL is currently working with MR to develop a reclamation plan for the entire active mine area.

H. DUST

Comment 12H-1: Several individuals expressed concern about the blowing dust around the Pit area not being fully addressed in the EPA plan. (BSB 4-M, BSB 4-J, I 13, I 42)

Response: The action does not address blowing dust which we believe is independent of the groundwater problem being addressed through this action. Dust problems are handled through the DSL operating permit and reclamation program.

I. WINTER FOG

Comment 12I-1: "We understand that winter fog from the Berkeley Pit caused a pilot to be unable to land at the Butte airport three years ago and that he was subsequently killed after running out of gas enroute to another airport. How does EPA propose to eliminate this type of permanent nuisance with a remedy that will eventually widen the pit water to nearly 500 acres, an increase of at least two times over that present when the cited accident took place?" (G 2)

Response: EPA and the State have no evidence that the incident was is any way related to fog from the Berkeley Pit. EPA and the State do not plan to eliminate any potential fog problem. There is a question of how much the Berkeley Pit will contribute to winter fog. A Masters thesis paper prepared by Dave Klemp of Montana Tech (May 9, 1994) concluded that the Pit does not contribute significantly to fog formation. The Pit is also frozen over during the months of December through March, which precludes fog formation for most of winter.

J. MDHES REPORT TO ENVIRONMENTAL QUALITY COUNCIL

Comment 12J-1: One individual requested that "the Montana Department of Health and Environmental Services make periodic reports to the Environmental Quality Council on the progress of the cleanup of the Berkeley Pit and the protection of alluvial aquifers underlying the Silver Bow Creek Superfund Site" in accordance with House Joint Resolution 20. (BSB 7)

Response: MDHES will, upon request, respond to any Environmental Quality Council (EQC) request for reports on the Berkeley Pit, MFOU, or any other issue. Further, MDHES (through the monitoring program) will be preparing yearly reports, which will be available to the public, on the data (water quality and levels) with the State's interpretations on water flows and updated/future dates for approaching the Pit System CWL.

3.13 INNOVATIVE TECHNOLOGIES

Comment 13-1: Appropriate new technologies should be developed and used as they become available in the cleanup of the Pit. (T 1, BSB 12-K, I 31, I 22, I 28, I 24, I 16, I 15, G 1, BSB 8, BSB 7, BSB 6, BSB 5, BSB 4-P, BSB 4-K, BSB 4-I, T 5, I 51)

Response: The ROD specifies that a technology reevaluation be undertaken when the Berkeley Pit reaches the 5,260-ft level. This does not preclude independent evaluations in the meantime. EPA and the State are open to amending the ROD to employ new technology if the technology meets all water quality standards and is proposed collectively by the PRPs and the developers of such technology.

Comment 13-2: The ROD should require the use of innovative technologies to supplement or replace the hydroxide plant and ensure that the "best available. proven technology is used at the time of implementation, thus avoiding the problems with hydroxide precipitation, such as:

1) Sludge disposal in the Pit or new repository;

2) Future contamination from leaving billions of gallons of poison water in the Pit; and

3) The loss of the ore body, an enormous economic resource made into a long-term community liability. (BSB 2, T 8)

Response:

1) EPA and the State will encourage the use of new and innovative technology which reduces potential problems associated with hydroxide precipitation sludges. However, we will not require the PRPs to use new technology if the costs are considered to be excessive as compared with existing convention treatment technology that meets discharge standards. A large portion of the costs related to this project are associated with sludge handling and disposal. We are hopeful that technology is demonstrated that significantly reduces sludge handling and disposal costs, thereby making the new technology cost-effective.

2) Under the plan outlined in the ROD, approximately 55-billion gallons of contaminated water will be stored in the Pit. We believe that this water will not pose a threat to human health and the environment because it will not be allowed to rise above the CWL.

3) The economic impact of the flooding ore body is outside the scope of the Superfund decision-making process.

Comment 13-3: Use of new technologies, regardless of cost. (G 2, BSB 12-D, I 19, I 14, I 23, BSB 7)

Response: See response to Comment 13-2, Section 3.13.

Comment 13-4: EPA should create a partnership with the PRPs and the County to set a firm goal to develop a comparable remedy of equal effectiveness that is sensitive to cost. (BSB 2, T 8)

Response: EPA and the State are not planning to specifically form a partnership with the PRPs. However, EPA, the State, and the PRPs are members of the advisory committee for the DOE Resource Recovery Project, which is demonstrating several innovative technologies using Berkeley Pit waters. The ROD also requires a reevaluation of the remedial technology when the water level in the Pit reaches the 5,260-ft level.

Comment 13-5: ARCO generally agrees with the treatment technology proposed for any necessary post-mining treatment plant, but would like to emphasize that the "hydroxide precipitation with aeration process" developed by Dr. Huang at Montana Tech is an innovative technology. Accordingly, this technology, like many others underlying the remedy, will need to be continually evaluated as the appropriate treatment time approaches. Again, the Plan would be better tailored to the realities of the Pit situation, and would better serve the public interest, if it emphasized that flexibility and ongoing evaluation would be necessary for treatment plant matters. (PRP 1)

Response: EPA and the State have emphasized flexibility in the methods of inflow control, bedrock aquifer withdrawal points, and treatment technology in the ROD. The ROD also requires a reevaluation of technology when the Pit water level reaches the 5,260-ft level.

Comment 13-6: Regarding innovative technology and timing, EPA should go forward from today, not backward from the year 2022. Here is a plan that most of Butte would likely find acceptable. Butte-Silver Bow County has asked EPA to find research dollars in their S.I.T.E., Site Program, or another of their research programs. It could be used to help come up with newer cost-effective technologies. Adding dollars to DOE funding of the Resources Recovery Project of Montana Technologies Company in Butte, would mean technologies could be tested in a shorter time period. One idea is to have the project send out a call internationally for new technologies. Let competition and market forces prevail. Interested companies and/or MSE could test their ideas. EPA could require that within the following five years, a pumping plant be designed and constructed. Within seven or eight years, we could have clean water running down Silver Bow Creek (T 9, G 2, BSB 14, BSB 6)

Response: EPA and the State presently plan to pursue additional federal funding for technology development programs for the Berkeley Pit. The ROD does not require specific technology development and demonstration except for the reevaluation of technology when the Berkeley Pit reaches the 5,260-ft level.

This does not preclude such program funding in the future independent of this ROD and subsequent enforcement action. EPA has, however, funded numerous projects through the Mine Waste Pilot Program coordinated by MSE and Montana Tech. This program, as well as the DOE Resource Recovery Program, have the ability to test innovative technologies.

Comment 13-7: "We specifically want to draw attention to the Call for Action on innovative technologies in Paragraph 3.1 in which the local government takes a position that the RI/FS is defective because the remedial technologies were not considered in combinations. It is preordained results for the analysis to have been made in the manner as reflected in that draft document." (T 12)

Response: EPA and the State disagree with the conclusion that the RI/FS is defective or that the results were preordained. We believe that the proposed treatment scheme is the most straightforward, cost-effective treatment available. We expect new technologies, variations of this conventional technology, and combinations of technologies to be developed in the future. This decision can be amended if such technology is developed and proposed collectively by the PRPs and the developers of such technologies.

Comment 13-8: "Because of cost, EPA did not consider condensation or other newer technologies that could be made available soon." (T 8)

Response: These technologies were considered in the scoping portion of the FS. Some of these technologies were rejected because of costs, which were considered to be excessive as compared to conventional treatment costs. Relative costs are considered to be one of the three criteria used for scoping of alternatives, along with effectiveness and implementability.

Comment 13-10: "The solution that's been proposed no matter what anyone says is the cheapest and not the best. There are way better technologies out there if we would look at these technologies and try to use some of those technologies. The best thing we can do as a community without question is to figure out a way to mine that water, take the resources from that water and, most importantly, turn the water back to water. The most valuable asset in the Berkeley Pit today, I believe, is the water." (T 5)

Response: The term "best" needs to be clarified. There are technologies which may produce less sludge, recover metals, etc., and may be considered "best" by some people. EPA and the State believe that the proposed technology is the "best" balance between costs, effectiveness, and implementability. All of these criteria, including costs, are required to be considered in our evaluation of technologies.

Comment 13-11: I think that the only way this problem is ever going to be solved is by some independent third agency or some independent third body. I do not believe ARCO and EPA are going to solve this problem. This problem is going to be solved by Metanetix, Montana Technologies Company, or some other similar company. (T 5, BSB 13)

Response: EPA and the State would be pleased if a third party solved the Berkeley Pit problem and reduced costs of the solution through a market driven process (i.e., metals recovery for profit). As was previously stated, EPA and the State are open to new, innovative, cost-effective technology if proposed collectively by the developers of such technology and the PRPs.

Comment 13-12: "Either putting the sludge in the Pit or creating a new tailings dump will have serious, potentially harmful effects on both human health and the environment. The goal should be to keep the production of sludge to a minimum." (I 51)

Response: Management of sludge from a treatment facility is not an overwhelming obstacle. Sludge will be managed to eliminate the potential for harmful effects to human health and the environment. However, the management of sludge is a significant portion of the expense of the remedy outlined in the ROD. Reducing or eliminating sludge generation will reduce the overall cost of the project. The cost savings associated with sludge reduction may eventually make alternative innovative treatment technology cost-effective.

Comment 13-13: "What type of advertisement has the EPA, MDHES, and PRPs done so far for the solicitation of innovative ideas for the Berkeley Pit toxic water issue - or was this solicitation process given to only a select few for their ideas? (I 50)

Response: EPA and the State did not solicit ideas for any type of technology during the FS. The FS screening process evaluated technologies commonly utilized for these types of projects as prescribed by EPA guidance.

Comment 13-14: What type of funding and inquiry mechanism for innovative ideas will the EPA, MDHES, and the PRPs put into place for the solicitation of innovative ideas? If funding is available, could a panel of experts, as well as people from the community, mining, timber, agricultural, and recreational industry, sit on a panel for the adoption or the declination of innovative ideas? (I 50)

Response: EPA and the State plan to pursue additional federal funding for development and demonstration of innovative treatment of Berkeley Pit waters. These types of removal and design programs usually include some type of solicitation of ideas and a process for adopting or declining ideas. Hopefully, local residents, as well as experts, would be involved in this process. EPA has previously funded various treatment demonstration projects through programs, such as the SITE Program and the Mine Waste Technology Pilot Project. These programs are not designed specifically to address Berkeley Pit issues, but are designed to demonstrate treatment technology in general.

Comment 13-15:   "The proposal to dump lime into the Pit and leave the accumulated sludge there forever ignores the technologies now available for treating the water. Folks who maintain that ARCO has been given the 'cheapest' alternative make a good case here. EPA should be helping communities find the latest technologies to deal with their environmental disasters, not just the ones that are cheapest for the responsible parties." (I 13)

Response: We believe that sludge management is not an overwhelming technical obstacle and that it can be managed in a manner that presents no threat to human health or the environment. The technology proposed in the ROD to treat Berkeley Pit waters is the most cost-effective, implementable, and effective treatment technology presently available. This technology was selected using the criteria set forth in the NCP.

Comment 13-16:   "Everyone who has a plan should be allowed to prove their technology, and we should start immediately to halt further degradation of the pit problem. It should take no more than 5 years to choose the best plan and have that plan in place, instead of allowing 28 years to pass before attempting to treat the water." (I 15)

Response: There are programs available, such as the SITE Program, the DOE Resource Recovery Project, and the Mine Waste Technology Pilot Project, where developers of technology can demonstrate their technology. The ROD requires that there be a reevaluation of technology when the Pit level reaches the 5,260-ft level. This new technology may be developed to the point that it meets the Superfund criteria better than the existing conventional treatment technology. We believe that the Pit does not pose a threat until the water in the East Camp approaches the 5,410-ft level. It is not necessary, therefore, to have a treatment plant to treat Pit water until that time period. The ROD does require immediate inflow control and treatment of that inflow.

Comment 13-17:   Most of the technologies required to turn the present catastrophe of a highly contaminated area into an asset for our community are currently achievable. Now is the time in the Superfund process to put these technologies into place for beneficial uses by this community and the State of Montana. (I 50)

Response: We assume that the author of this comment is referring to metals recovery processes. There are technologies available that could recover metals from the Berkeley Pit waters. We believe, however, that the overall combined cost-effectiveness, technical effectiveness, and implementability are greater for the conventional technology outlined in the ROD than the metals recovery processes currently available.

Comment 13-18:   "The EPA needs to allow competition and market forces to compete for workable solutions." (I 14)

Response: We also believe that competition and market forces will eventually allow for innovative treatment technology to be developed for the Berkeley Pit. Sludge management is a major cost for the selected technologies and technologies which are able to meet discharge standards and reduce sludge management costs are likely to be prime alternatives or additions to the conventional technology outlined in the ROD.

Comment 13-19:   One commenter asked if innovative technology had to be proven by April 29, 1994. (BSB 4-C)

Response: No, innovative technology does not have to be proven by that date. EPA and   the State are willing to entertain any new technologies presented collectively by the PRPs and the developers of that technology if that technology meets the performance standards established for this project.

Comment 13-20:   "The preferred alternative as proposed by the EPA and MDHES should be unacceptable by this governing body and this community. We can't totally rely on expert opinion on this issue because nowhere else in the world has a cleanup of this magnitude taken place before." (BSB 4-G)

Response: The Berkeley Pit project is a large project, but wastewater treatment projects much larger than this project are common, and mine drainage projects approaching this magnitude have been completed (i.e., Yak Tunnel - Colorado, Leadville Tunnel - Colorado).

Comment 13-21.   "The County would suggest that the ROD be written to require the use of innovative technologies to supplement or replace the hydroxide plant and ensure that the best available, proven technology is used at the time of implementation. Further, the ROD should require the EPA, based on a thorough technology assessment and review over the next twenty years, to verify the suitability of the selected technology. The EPA should join forces with the PRPs and set a goal to develop alternative technologies that offer a comparable remedy of equal effectiveness that is sensitive to cost. The ROD should clearly allow for sufficient access to the Pit water and provide needed indemnification from Superfund liability for those parties interested in proving the viability of alternative technologies. In the absence of such provisions, it would appear that any language in the ROD about the possibility of using innovative technology in the future is purely gratuitous." (BSB 2)

Response: The ROD requires that a reevaluation of treatment technology be conducted when the water level in the Pit reaches the 5,260-ft level. Although technology demonstration is not a component of the ROD, we believe that considerable innovative treatment technology testing will occur before the water reaches that level through one of several technology demonstration programs or through developers of such technologies. EPA and the State are committed to pursue additional federal funding for the development and demonstration of innovative technology.

Comment 13-22: "Although the County believes a firm schedule and trigger point should be established to build a treatment plant, a greater goal is to develop an alternative technology solution to preclude construction of a conventional treatment plant. Even under the most conservative scenario for plant construction, the County believes there is an ample window of opportunity to develop reliable technology alternatives." (BSB 2)

Response: We believe that a conventional treatment plant will meet the Superfund goal of protecting human health and the environment; however, we also believe that there is ample time to develop alternate technologies or improve on existing conventional technology that may produce less sludge or recover metals economically.

Comment 13-23: "A firm commitment by EPA, MDHES, and the PRPs to investigate and implement innovative technologies is needed to spur action toward this development objective." (BSB 2)

Response: The ROD requires a reevaluation of innovative technologies when the Pit reaches the 5,260-ft level.

Comment 13-24: The commenter suggests that, "for those who feel that other technologies would be more appropriate, they provide to the responsible parties and to the agencies proof, credible, scientific facts that show that the technology they are purporting is both scientifically sound and at least as equally cost-effective if not more cost-effective than what is currently on the table." (T 4)

Response: EPA and the State also believe that to select an innovative treatment technology there must be a strong scientific basis for that technology and the technology should be cost-effective as compared to conventional technology.

Comment 13-25: The commenter believes that in the 10 to 20 years that will ensue before the large Berkeley Pit treatment plan needs to be built, there will be ample time for additional technology development. (T 4)

Response: EPA and the State also believe that there is ample time for the development and evaluation of new technology. The ROD specifies that a reevaluation of technology be conducted when the Pit reaches the 5,260-ft level.

Comment 13-26: "Will the preferred alternative enhance mining in our area or make less the amount of minerals that can be taken from this ore body by allowing the water table to rise? Will the preferred alternative create more or less jobs in our community? Will the preferred alternative enhance our community image as a great cleanup project that will have a multitude of institutional controls? Controls that could prevent the people of this community the benefit to utilize a natural resource of clean water and easy accessibility to the mineral deposit in our area. I would like to know if the EPA, MDHES, and PRPs are willing to go the extra mile to turn our community into a model of a highly productive alternative project that could be used for future clean up projects all over the world. In the past, there has been seed money for other projects in our community by the PRPs. Would the PRPs also provide seed money to create a panel of not only experts, but also people in mining, agricultural, timber, recreational and industry? This panel would decide on the adoption of innovative ideas that could be cost-effective and also a unique alternative to a massive cleanup problem we are all now facing." (I 50)

Response: We do not have replies to many of these questions and even if we could reply the responses would have no bearing on the remedial decision because these factors cannot be used as criteria in the decision making process. We do realize that allowing the water level in the East Camp to rise will probably discourage underground mining because of the increased costs placed on mining companies to dewater the mines and meet discharge standards. The NCP does not allow this factor to be integrated into our decision. Mining companies can still dewater the mines and apply for a discharge permit, but they would bear the financial burden of treatment. The objective of Superfund is to protect human health and the environment. Enhancement of image and economic viability of a community is not an objective. Sometimes image and economic viability are enhanced by completed Superfund projects, but EPA and the State have no authority to force the PRPs or use fund monies to specifically meet these objectives.

Comment 13-27: "The toxic water is a threat to the health of the people in this community. An all out effort should be made now and develop technologies to recover valuable minerals and to purify whatever is unusable." (I 44)

Response: EPA and the State do not believe that a threat is posed to the health of the people in Butte until the water level in the East Camp exceeds the 5,410-ft level. The ROD dictates that the water level must be kept below this level, thereby never allowing the people's health to be directly impacted. Innovative technology development, including metals recovery technology, is not required under the ROD. The ROD does require reevaluation of technologies when the Pit reaches the 5,260-ft level. Development and demonstration of technologies need to occur outside of the ROD and associated enforcement process through programs such as the DOE Resource Recovery Project and demonstration by developers of such technology.

3.14 SLUDGES

Comment 14-1: The sludge should not be disposed of in the Pit. The Preferred Alternative perpetuates and increases the problem instead of solving the problem. (T 12, BSB 4-F)

Response: EPA and the State believe that sludge disposal in the Pit should not be discounted. However, additional study is necessary before disposal of sludge in the Pit will be allowed.

Comment 14-2: If Alternative 7 is chosen, repository siting for Pit sludge must begin now. Several repository sites have already been identified in a 1992 study ("Mining & Milling Waste Disposal Area Siting Study"). An off-site repository for sludge will have unique requirements. Each of the possible repository sites already identified should be evaluated for possible sludge disposal. (BSB 3)

Response: EPA and the State agree with this statement. Several of the repository sites are in the active mining area and are convenient to the Berkeley Pit. We plan to have the repository sited following the design of the inflow control and Horseshoe Bend/tailings circuit integration. This siting process should start by 1996.

Comment 14-3: Discourage EPA from simply moving waste (sludge) from one spot to another. (I 51, BSB 5, T 1)

Response: The plan outlined in the ROD calls for placing sludge in a secure repository or in the Pit (contingent on additional studies). We do not believe that this constitutes "moving wastes (sludge) from one spot to another."

Comment 14-4: How can a solution which increases the problem be lawful? (T 12)

Response: EPA and the State believe the plan presented in the ROD protects human health and the environment as required by the law and will ultimately reduce the acid mine drainage from the present generation rate.

Comment 14-5: We would suggest to EPA and MDHES in their final decision-making that the question of sludge disposal is best left until the final design is done for the technology for the final treatment and not try to be determined right now. (T 4)

Response: We believe that this is a good suggestion, except repository areas need to be identified in the near future. Several issues need to be resolved (see response to Comment 8-2, Section 4.8) concerning Pit disposal of sludge and the specific sludge characteristics before the Pit disposal option can be approved.

Comment 14-6: If treatment sludge was added to the Pit, it would dramatically affect the Pit sediment and the reactions occurring in the sediment and surrounding groundwater and perhaps deep groundwater. These possibilities should at least be considered and preferably investigated in some detail in a pilot experiment that could be carried out on site. (I 53)

Response: Although we do not want to preclude disposal of sludge in the Pit, we agree that these issues should be evaluated before sludge is placed in the Berkeley Pit. The ROD specifies that the potential impacts be more thoroughly evaluated before sludge disposal in the Pit is approved.

Comment 14-7: One commenter expressed dissatisfaction with the solutions of liming the polluted water in the Pit and creating sludge. This is not cleaning up the contamination, it only serves to maintain or create another Superfund site. (I 8)

Response: EPA and the State believe the sludges generated by the technologies proposed in the ROD can be managed without creating new hazards.

Comment 14-9: We realize that the Proposed Plan is generic and that the detailed construction design will be done during RD/RA after signing of the ROD. However, we recommend that the treatment sludge disposal facility be designed to prevent exposure of migratory birds to the sludge. This sludge will contain elevated metals and arsenic concentrations, and any water ponding on the surface may attract waterfowl and shorebirds. (GOV 1)

Response: Comment noted. Any repository would include a design to prevent ponding and placement of surface soil precluding exposure to waterfowl.

Comment 14-10: The commenter generally agrees that sludge disposal location must be left open and requests that this point be made explicit in the plan. The sludge disposal question of whether sludge goes "into the pit" or "into a repository" does not need to be answered today. Much more testing needs to be performed in the future on innovative technologies, as well as pilot scale testing on the hydroxide precipitation process design by Dr. Huang. The point in time when treatment plant design actually begins is the best time to make the determination of where best to dispose of sludge. (PRP 1)

Response: EPA and the State generally agree with this statement except that identifying the location for the repository should begin in the near future. The specific design of the repository should wait until the sludge characteristics are more thoroughly evaluated. There are also several issues regarding disposal of sludge in the Pit which must be evaluated before this option can be approved (see Comment 8-2, Section 4.8).

Comment 14-11: The need for flexibility to account for evolving innovative technology is particularly pertinent to the sludge issue. Once sludge is placed in an out-of-pit repository, the metals on the sludge will never be extracted because of the manner in which metals are bound up as metal hydroxides and the added costs associated with extracting the metals. However, if the sludge is returned to the Berkeley Pit, there is a much greater chance that metals will be available for extraction in the future by an innovative technology and will become more concentrated as more sludge is added to the Pit. (PRP 1)

Response: EPA and the State agree with this statement. However, this would not be a major criterion used for evaluating the choice between landfilling sludge and disposing of sludge in the Pit. Protection of human health and the environment would be the major objective.

Comment 14-12: How long do you perceive that land disposal of sludges would be required before new technology might be approved by you that produces no sludges? How much area would be required for land disposal of those sludges? (G 2)

Response: EPA and the State are uncertain how long a time period sludge disposal may be required. We are hopeful that technologies that generate usable products instead of sludges will eventually become cost-effective. We believe that it will take from 1.25 to 2.5 acres of land per year to dispose of sludges generated by the process outlined in the ROD, assuming a repository depth of 60 ft.

Comment 14-13: What long-term assurance does this plan provide the community that the sludge generation associated with the preferred alternative treatment technology will not itself become another Superfund-type problem down the road? (G 1, BSB 5)

Response: The sludge generated from the selected treatment technology will be an alkaline, lime-based material chemically similar to the tailings presently generated by the mining operation. The daily sludge generation for a full scale treatment plant will be only one to two percent of the volume of tailings that is produced in the mining operation. Any sludge repository will have to be designed to reduce precipitation infiltration, leachate generation, and leachate migration. It is likely that this repository would be built in the active mine area which naturally drains to the Pit System. The Pit would, therefore, act as a natural collection system for the minimal amount of leachate that might ever escape from the repository. Any small amount of leachate that would be collected would be treated in this facility because a treatment plant is necessary, regardless of the remedial alternative or CWL selected.

3.15 WATER TREATMENT FACILITY

Comment 15-1: There has always been an engineering, construction, and shakedown period of about two years built into the RI/FS. This period should be written into the order. (BSB 8)

Response: Comment noted. On the basis of this and similar comments, the ROD was written to require construction of a treatment plant, capable of meeting discharge standards and maintaining the water level in the East Camp System below the 5,410-ft level, to be completed four years prior to the projected water level reaching the CWL as measured at the highest water level with the East Camp System (presently the Anselmo Mine).

Comment 15-2: Commenters requested assurances on the scheduling of the construction of the plant. The proposed plans should document a firm schedule about the conservative trigger point to plant construction to provide greater assurances that the CWL is never approached. (T 8, BSB 2, BSB 4-D)

Response: See response to Comment 15-1, Section 3.15.

Comment 15-3: The EPA and PRPs should proceed with haste to develop and implement plans and design criteria for a facility to treat contaminated water before it reaches the alluvial aquifers surrounding the Berkeley Pit. (BSB 7, I 1, BSB 2, BSB 4-D, BSB 13, I 13, I 1, G 1, BSB 6)

Response: See response to Comment 15-1, Section 3.15.

Comment 15-4: Rather than wait nearly 30 years and hope and wish for new, inexpensive technology for cleaning Pit water, and rather than complain with no solution, let's force new technology to come forward now. There is nothing like a deadline to get things off dead center. Competition, capitalism, and market forces can bring forward the needed cost-effective technology and get it up and running within eight years. (BSB 14, G 2, BSB 4-N)

Response: EPA and the State have set deadlines based on the CWL which is dictated by the rate of flooding in the System. The ROD, therefore, emphasizes inflow control because, by controlling and treating inflow, the time frame for building a full scale treatment plant is delayed and significant monies are saved. This strategy provides a significant amount of time to allow development and demonstration of new technologies.

3.16 WATER ISSUES

A. BEDROCK AQUIFER

Comment 16A-1: The Proposed Plan "writes off" the bedrock aquifer as irremediably contaminated. What are the proposed boundaries of the "written off" bedrock aquifer (3 dimensional) and what assurances does the community have that these boundaries will not change over time?

Response: A map is attached to the ROD which defines the boundary for which the "waiver" of State groundwater standards applies. The boundaries include areas within the lateral extent of the underground mine workings in the East and West Camps. Significant amounts of information are available which outline the lateral extent of the underground workings in the East and West Camps. The map depicts the areal boundary and is not three dimensional. It should be noted that this "waiver" and the corresponding boundaries had to be established regardless of the remedial option employed or the level at which the Pit is maintained. No assurances can be provided that the boundaries will not change over time because the final water quality in this area cannot be predicted. The water quality should improve in some areas as the System rises and this may decrease the area where bedrock water quality does not meet state groundwater standards.

Comment 16A-2: On the issue of bedrock aquifer, EPA is suggesting that it is impractical to fix, and the commenter agrees. The wells that are drilled at the Pit cost $100,000 each and we question where this is the type of aquifer that is the source of water for the community. (BSB 4-K)

Response: EPA and MDHES acknowledge the comments. This type of aquifer is not typically used to supply water to a large population because individual well yields are generally small. There are, however, wells in the bedrock aquifer which are large enough to supply smaller local needs (e.g., Hebgen Park well).

Comment 16A-3: Initially, greater volumes of water were entering the Berkeley Pit each day than are at present, and less is expected in the future. We understand this is because the gradient decreases as the water rises. Anyone can realize that the balance of the contaminated bedrock water has to going some where. Please tell us where. (G 2)

Response: As the water rises in the Pit, the gradient decreases and the cone of depression surrounding the Pit decreases. Some of the water that was originally draining into the underground workings is no longer draining in that direction. This water is being held in storage in previously unsaturated bedrock: or moving away from the East Camp System adding to the regional bedrock flow which eventually contributes to the general Clark Fork basin flow. We believe that the majority of this bedrock water is very good quality, but becomes contaminated when it enters the underground workings. By raising the water level, less clean water is allowed from the periphery of the System to enter the underground workings and the Pit and becomes contaminated. This fact is borne out when looking at the bedrock water quality in wells at the periphery of the East Camp which have good water quality.

B. WATER QUALITY

Comment 16B-1. Regarding the 25 billion gallons of toxic water now captured in the Berkeley Pit which would be 56 billion before any is cleaned and discharged to the creek about 28 years from now under the preferred plan, to what beneficial use is that water being applied? There is a fixed amount of water on this earth. Why could 56 billion gallons be tied up in perpetuity? That is what this preferred remedy would do and that is unacceptable. (T 8, G 2, 1 13)

Response: It is true that significant amounts of water will accumulate in the Pit. However, the Superfund remedial process is designed to protect human health and the environment and not to completely restore a resource. Natural resource impacts are more properly addressed in NRD claims such as the one now underway between ARCO and the State of Montana.

Comment 16B-2: EPA's preferred plan would divert the water from the Horseshoe Bend away from the Pit, but that won't be cleaned for our use for many, many years. Once in the Pit, EPA and ARCO say the toxic water cannot leave. It is true Silver Bow Creek, Metro Storm Drain is mostly dry through town, but that does not mean the water is not leaving. Berkeley Pit water can leave the Pit. And contrary to what EPA and ARCO tell us, there is strong empirical evidence that it is leaving the Pit System. You don't need a hydrology degree to understand that it would not have been possible for the Anaconda Company to dewater the mines and the Pit if water could not move through the bedrock aquifer. (T 9)

Response: EPA and the State disagree that water is leaving the Berkeley Pit and there is no evidence ("strong empirical" or otherwise) indicating anything but flow of bedrock water to the Berkeley Pit within the code of influence. The MFOU RI fully supports this conclusion. Silver Bow Creek and the Metro Storm Drain are outside the cone of influence of the Pit System.

C. BERKELEY PIT FILLING RATE

Comment 16C-1: If the water level in the Pit levels off and stops rising, it should be assumed that the Pit is discharging water and pumping should start immediately. In addition, the $25,000 fine should come into effect as the environment is being degraded. A water budget is needed that addresses how much water needs to be pumped out, if water is leaking out. It is important to realize the difficulty in proving that water is exiting the Pit, and not from some other source. In a system monitored by people, people and science can and do make mistakes. A contingency plan must address this real possibility. (I 1, I 3)

Response: It should not be assumed that if the Pit stops rising that a discharge is occurring. There is a possibility that with enough inflow control (including upper Yankee Doodle and Silver Bow Creeks and East Ridge and other surface drainages), decreased bedrock flow due to the constricted Pit cone of depression, and increased evaporation from the larger Pit surface area, that a homeostatic level may be reached in the Pit. There would still be a need, however, for a permanent facility to treat Horseshoe Bend water. The Pit would continue to fill if the pumping/treatment requirements for Horseshoe Bend Water were stopped. As for the contingency plan, EPA and the State have the ability to order the PRPs or use fund monies to take action (including construction of a treatment plant) if an unanticipated threat arose or was discovered through the monitoring program.

Comment 16C-2: People are worried about induced infiltration where contaminated water from the Hill or in the Pit could travel south and contaminate wells. People hope that the existence of contact between Butte-Silver Bow County and ARCO for post Superfund well bans isn't being considered by EPA and preferring to let the Pit fill. People worry that putting off cleaning Pit water for up to 28 years will affect the ability to get other sites cleaned up soon; for example, steam bed sediments in Silver Bow Creek. (T 9)

Response: We believe that induced infiltration is impossible south of the Pit. The entire alluvial aquifer would have to be drained, including the draining of Blacktail Creek, before this induced infiltration could occur. Institutional controls will be necessary for the bedrock aquifer regardless of whether the Pit is allowed to fill or if it is drained. The selected remedy will prevent the migration of contaminated water from the MFOU towards the Summit Valley. The monitoring program is the constant check on the findings of the MFOU RI.

The ability of EPA and the State to respond to unknown/unforeseen issues is not compromised by the selected remedy. The ICs drilling private bedrock wells is a response to protect human health from exposure to contaminated water within the bedrock aquifer of the MFOU. This need for ICs is independent of the selection of a preferred engineered remedy. If the System is not allowed to fill further, then there would be no bedrock aquifer water to "tap into" above 5,000 ft. With surface topography in the MFOU ranging from 5,500 ft to 6,200 ft, this would mean drilling from 500 ft to 1,200 ft to reach water. Few are willing to drill private wells to this depth and spend the amount of monies this would require.

The selected remedy has no negative effects on other operable unit remediation plans. We believe that the ability to clean up other sites, including streambed sediments in Silver Bow Creek, is not impacted by allowing the water level in the Pit to rise to the 5,410-ft level. To prevent impact to the other sites, the contaminated East Camp water must be kept out of the alluvial system. This is accomplished by keeping the water level in the East Camp below the CWL.

D. DOMESTIC WELL WATER QUALITY

Comment 16D-1: Why not start now to clean up the Pit? You are not protecting my well or the safety of our drinking water supply by allowing the water in the Pit to near a critical level that could (no one knows for sure that it will or it won't) cross into the alluvium aquifer. From my kitchen sink I can look out the window and see Berkeley Pit. I look from there to the water and wonder how will I know when and if the water will become unsafe to drink. Why must I live with the threat of the water leaving the Pit and entering the alluvium aquifer? You are a federal agency that is mandated by law to protect me and my family from such a treat. I only ask that you do what you are charged by law to do. (I 23, I 41, I 8, BSB 4-F, I 33)

Response: EPA and the State believe that, by keeping the water level below the 5,410-ft level, the drinking water in the alluvial aquifer is protected. We believe that pumping the Pit to a lower level is not cost-effective or the technically proper response. If the Pit rises to the highest level possible, it will thereby reduce acid mine drainage production and total daily metals loadings to the System. Any contamination (future or current) to domestic wells will not be a result of contaminated bedrock aquifer waters from the MFOU. The citizens of Butte-Silver Bow are not living with a threat of water leaving the Pit. EPA and the State are protecting the human health and the environment with the selected remedy.

E. DRAIN THE PIT

Comment 16E-1: Why doesn't the Proposed Plan call for draining the Pit? (G 1)

Response: The Proposed Plan does not call for draining the Pit for three reasons:

1) EPA believes that draining the Berkeley Pit is not necessary to achieve protection of human health and the environment than letting the Pit rise to higher level.

2) Although the volume of water in storage is less if the Pit is drained, the volume of water treated on a daily basis is considerably more (up to 2 mgd more) and the quality of water to be treated will be worse than if the Pit is allowed to rise higher.

3) The estimated cost of draining the Pit ($350-450 million) is considerably more than the preferred alternative ($50 million), even though EPA believes draining the Pit provides no significant increase in protectiveness.

F. FLOOD THE PIT

Comment 16F-1: If flooding of the Pit as fast as possible is a good idea (which was suggested by the State), why not use all available resources and fill it right away, such as Silver Bow Creek, diverting Big Hole Water, etc? (G 1)

Response: If the reduction of the total volume of acid mine drainage was the only criteria for selecting a remedial response, then the immediate filling/flooding of the Pit would be selected. However, this is only one of five balancing criteria. As the MFOU FS pointed out, filling/flooding the Pit faster increases the cost of the remedy. We also believe that it is prudent to allow the Pit to rise slowly so the impact of the rising bedrock aquifer can be completely evaluated as it occurs.

Comment 16F-2: If the determination of what is best for the Pit is to let it reach the static level or another level that would take years to reach, why not pump the Silver Bow Creek into it for a couple of years? Not only to get closer to the permanent solution, but also to perform reclamation on Silver Bow Creek while it is dry. (I 6)

Response: See response to Comment 16F-1, Section 3.16F.

G. WATER ESCAPING PIT

Comment 16G-1: "I recommend that EPA and MDHES publicly acknowledge that the assumption that no water is escaping out of the Pit is exactly that: an assumption. It is based on theory, not fact. I found the public documents to be misleading on this point, making it seem as though the hydraulic gradient is a known measurement." (I 43)

Response: The conclusion that bedrock aquifer water is not leaving the MFOU but flowing towards the dewatered Pit System is based on the science of hydrogeology with large amounts of data to support this conclusion. The science of hydrogeology is a long standing discipline based on research and peer review. The statement that the findings of the MFOU RI are based on "theory, not fact" is an unsubstantiated criticism that can be said about anything

Comment 16G-2: The EPA-ARCO plan wouldn't absolutely assure toxic water isn't leaving the pit. Instead, it would provide new wells to catch it after the fact. If ARCO and EPA are sure contaminated water can't leave the pit, how did Butte miners pump all the water out of the bedrock aquifer? (G 2)

Response: Butte miners were able to pump water out of the bedrock aquifer because of the law of nature: water flows downhill. This same truth is what assures EPA and the State that the selected remedy is correct.

Comment 16G-3: After $10 million of study done over 10 years, ARCO and EPA rely on theories and their opinions in stating that water isn't leaving. They do not know what is happening at depth, no one knows for sure. Their preferred plan for the Pit and mine flooding is based on hydrology theory and guesses, not facts. The fact is: Bedrock aquifer water is entering Silver Bow Creek at the west end of town where the bedrock rises to the surface. We know this is true because Silver Bow Creek has a gaining stream at that point. MDHES Superfund manager for the Pit Mine Flooding OU said that the water entering the creek from the bedrock is poor-quality, water. (T 9)

Response: See response to Comment 16G-1, Section 3.16G. The bedrock aquifer water entering Silver Bow Creek at the Colorado Tailings is bedrock aquifer water outside the cone of influence of the MFOU (see Figures 6-8 and 14-1 of the RI). This is neither East Camp or West Camp water. The bedrock aquifer in the Priority Soils Operable Unit (PSOU) and outside the MFOU will be investigated further during Phase II of RI for the PSOU. Its quality is not impacted by the MFOU.

H. USE OF TREATED HORSESHOE BEND WATER

Comment 16H-1: Since July 1986, MR has been operating open pit mining in the East Continental Pit. In the milling process, they are using water imported from Silver Lake Pipeline. After the ore has been milled, the outflow from the MR concentrator is being pumped via the McQueen Booster Station up to the Yankee Doodle Tailings Pond. Along the way, some of the tailings slurry are being released into the Berkeley Pit.

In essence, MR is using clean water from the Silver Lake Pipeline, contaminating it in the milling process, and releasing it into an established Superfund site. Clearly, this situation must not continue and it must be addressed in the preferred remedy. Not only does it contradict Superfund criteria which calls for a remedy which will reduce the volume of contaminants, it also contradicts the criteria that calls for short term effectiveness. MR must be required to treat its own effluent to State Water Quality Standards and release it into Silver Bow Creek.

This holds true for all aspects of MR's current mining operations. Current mining practices must not be allowed to delay or compound the clean up process.

One possible alternative with regard to a water supply for current mining operations is to have MR negotiate for the use of treated Horseshoe Bend water. (I 5)

Response: The remedy outlined in the ROD has control of Horseshoe Bend water as one of the major components. We believe that the most cost-effective method for accomplishing this task is to integrate this flow into the tailings circuit. If the PRPs choose to control the Horseshoe Bend flow in this manner, the amount of Silver Lake water needed at the concentrator will decrease. See response to Comments 8-3 and 8-5, Section 3.8.

I. WEST CAMP WATER/TRAVONA

Comment 16I-1: Why was the contaminated bedrock aquifer water which enters Silver Bow Creek at the end of the Colorado Tailings not identified as a release of contamination in the RI/FS or Preferred Plan? Will a study be done to identify how much of this water is of the (worst) East Camp quality and how much is of West Camp quality? What exactly are the levels of contaminants in the water over all? (You will recall it was identified by the State in a recent public meeting as being of "poor quality"). (G 2, T 8)

Response: See response to Comment 16G-3, Section 3.16G.

Comment 16I-2: What will be done with the West Camp water if the Metro Sewer is unable to meet discharge standards due to contaminant loading from the mine discharge? (G 1, G 2)

Response: The West Camp water is very different chemically from the Pit System water and is presently being treated in the Metro Treatment Plant. If the Metro Plant is no longer able to handle this flow, the PRPs are required by past orders with EPA to build a facility to treat this water. This treatment plant has already been designed and these plans are available for public review. EPA believes that the West Camp water may be compatible with the Colorado Tailings groundwater and that these streams may be combined for efficient treatment in the future.

Comment 16I-3: What will happen if, at some future date, deep bedrock contaminants are transported into outlying alluvium (outside the defined boundaries of the written off aquifer). An example is the known vertical upgradient flow from the bedrock aquifer to the alluvial aquifer under the Colorado Tailings. What data, assumptions, and calculations have been made to ensure that the contaminant transport cannot happen via this known hydraulic system or similar undiscovered mechanisms? (G 1)

Response: EPA believes that this cannot happen between the Pit System and the alluvial system as long as we maintain the negative gradient between the presently dewatered system and the alluvial system. The bedrock in the Colorado Tailings area has not been dewatered. There is continuous saturation from the surface soils down through the bedrock. In fact, the ultimate remedy for the residual groundwater contaminants in the Colorado Tailings groundwater, after the tailings removal is completed will probably include pumping and treating the alluvial groundwater and the stream. In the dewatered Pit System there already exists a negative gradient between the Pit System and the alluvial system and our plan will be to continue to maintain this gradient. The primary assumption is made to ensure that contaminants transport will not occur revolves around keeping a gradient from the alluvial system toward the underground workings and the Berkeley Pit.

Comment 16I-4: Additional information is needed on the West Camp to further define the water level fluctuations over time. To protect the West Camp area from flooding, it would be prudent to perform additional monitoring in locations hydraulically lower than the Travona and, at a minimum, reconstruct Well 21 to obtain more reliable data. (BSB 3)

Response: EPA and the State acknowledge and agree with the comments. Currently, there is weekly water level monitoring for the Travona, Emma, Ophir, and AMC-21. The selected remedy calls for four additional monitoring wells to be constructed in the "shallow bedrock" at those locations that had surface discharge as a result of the uncontrolled flooding/filling of the mid 1960s. Further, a "new" AMC-21 monitoring well will be installed. Reconstruction of AMC-21 is not considered feasible.

Comment 16I-5: Can EPA assure residents that "treated" Travona mine water contaminants of concern - copper, zinc, cadmium, lead, etc. - are not going to become remobilized downstream through forces of nature? (G 2)

Response: Any disposal of sludges from the treatment of Travona Mine waters would be regulated by current federal and State laws.

J. OUTER CAMP/LONG-TERM VIABILITY

Comment 16J-1: How can the division of the Mine Flooding OU from the non-priority soils (outer Camp seeps and flows) be justified when each is affected by the dam hydrologic system (i.e., rising groundwater levels resulting from discontinuation of pumping)? (G 1)

Response: This point is well taken but not for the reason stated. The Outer Camp has been at homeostatic conditions and has been discharging to the surface for many years. It has not to this point been affected by the cessation of pumping in the Pit System and will not be affected for many more years. The water levels in the Outer Camp shafts have not responded to the discontinuation of pumping as you have suggested in your question. The water level in the Outer Camp is at about the 5,580-ft level, which is over 500 ft above the present level in the East camp system and 170 ft above the CWL. EPA and the State do see the need to evaluate the Outer Camp and the impact of the existing discharge in its own right. In retrospect, it would have been better to tie the Outer Camp in with the East and West Camp evaluations. The proposed monitoring plan includes several monitoring points in the Outer Camp and the potential threats existing in the Outer Camp will be addressed at a later time.

Comment 16J-2: What is the effect of Pit contamination on the outer part of the camp? (I 51)

Response: See response to Comment 16J-1, Section 3.16J. EPA and the State do not believe there is an "effect" from the Pit System on the Outer Camp bedrock aquifer system.

Comment 16J-3: Is contaminated water entering groundwater and Silver Bow Creek from areas such as the Green Lake seep, the Orphan Girl shaft, etc. in the Outer Camp area? (G 2)

Response: There is a possibility that Outer Camp water is entering the Silver Bow Creek drainage. This issue, which is unrelated to the Berkeley Pit flooding, will be addressed as part of the Non-Priority Soils Operable Unit RI.

Comment 16J-4: Some members of the community believe we should also call for deep "quality" monitoring wells at Rocker and possibly at a low point mid-valley, as determined by depth-sounding equipment. We understand depth to bedrock is unknown in both locations. (BSB 6)

Response: EPA and the State do not agree that an investigation on "deep" (in excess of 5,000 ft below surface level) bedrock aquifer water is needed. Further, EPA and the State do not believe that the two locations sited in the comment would have any connection to the bedrock aquifer of the MFOU.

Comment 16J-5: Long-term viability of the plan was questioned by one party in terms of vast unknowns at the boundary of this operable unit with the Outer Camp (Non-Priority Soils Operable Unit) (G 1)

Response: The long-term "viability" (correctness?) of the selected remedy will be continually checked by the monitoring program.

3.17 EFFECTS OF EARTHQUAKE ON BERKELEY PIT

Comment 17-1: Insure dam safety at Yankee Doodle Tailings Pond. There is a possibility that an earthquake could release saturated tailings from the Yankee Doodle Tailings Pond into the Pit. Thus, to provide public assurances, it would seem prudent to provide a buffer of 10 ft (to 5,340 ft) to accommodate the tailings that could flow into the Pit after a large earthquake.

Note: The analysis done by HLA is not the worst-case scenario. Liquefaction is predicted to occur in the top 50 feet of the dam after an earthquake equivalent to 6.5 magnitude. No effort was made to characterize the material at the base of the dam, which former Anaconda Mineral Company employees have called casually deposited, random fill material (at the time there were no dam design plans comparable to those now required under the active mine permit). Several recommendations are made by HLA to "beef up" and monitor the dam. These recommendations (which should be incorporated into MR's permit revision issued by DSL) also must be included as requirements in the final ROD to insure future dam stability. (BSB 2, BSB 3, BSB 4-N, G 2, BSB 8,I 14, I 29, I 1, I 51, T 9, I 45, I 36)

Response: The HLA report was reviewed by the Dam Safety Section of the DNRC and the Hard Rock Bureau of DSL. It was the consensus of the technical staff of DNRC and DSL that the dam is currently stable, would be stable during an earthquake (a maximum credible earthquake (MCE) for this area), and will be stable during the dam's enlargement as long as the recommendations in the HLA report are followed. As the HLA report evaluated the dam's stability under a maximum credible earthquake for this area, there is no basis for providing a "buffer of 10 ft" in the CWL to accommodate tailing flowing into the Pit.

The comment that the report was "not the worst-case scenario" is arguably incorrect. Although an earthquake of unlimited magnitude can be theorized, the reasonable question is "what is the maximum credible earthquake" that this area is likely to experience. The HLA report evaluated this question and then evaluated the dam stability question accordingly. The HLA investigation did evaluate the history of dam construction and existing dam conditions at depth. Although the HLA report did discuss a possible liquefaction in the upper portions of the dam, this liquefaction possibility was limited to the upstream side (north side) of the dam in a limited area with no release of tailing from the impoundment. The recommendations in the HLA report for expansion of the dam, plus additional monitoring requirements from DNRC and DSL, are included in the ROD and associated monitoring program.

Comment 17-2: Will the pumping and treatment plant for the Berkeley Pit water withstand a sizable earthquake? (G 2)

Response: The selected remedy will require that the design of any treatment plant be able to withstand an earthquake equivalent to the maximum credible earthquake for this area.

3.18 ARCO'S RESPONSIBILITY

Comment 18-1: There were many comments on ARCO's responsibilities and commitment to cleanup of the Berkeley Pit and future financial obligations. The commenters believe that EPA must take a firm stand on enforcement of the Superfund law and that ARCO pay for the cleanup. (T 13, I 40, I 8, I 21, I 33, G 2, I 33, I 38, BSB 12-E, I 18, I 12, BSB 7, I 30)

Response: EPA and the State expect ARCO and other responsible parties, including the Montana Resources group, to pay for the cleanup of the MFOU. We expect to use whatever enforcement authority is necessary to accomplish this goal.

3.19 MINING-RELATED COMMENTS

The following comments have been divided into two groups: (A) potential problems with the Continental Pit, and (B) present and future mining.

<u>A. POTENTIAL CONTINENTAL PIT PROBLEMS</u>

Comment 19A-1: "I recommend that the current mining operation be prohibited from discharging contaminated water from their mining activities into the Berkeley Pit System. This current discharge is only adding to contamination of a Superfund site that is on the National Priorities List for cleanup, which seems to be in violation of the goals of CERCLA." (I 43)

Response: The ROD will not allow such discharges, except for upset conditions and during shut down of operations, before a treatment plant can be constructed. These conditions should only be for a relatively short time frame and would not appreciably add to the volume of water in the Pit.

The only surface waters flowing directly into the Berkeley Pit are the waters from the Horseshoe Bend area and occasional "upset" waters from a failure in the tailings lines. The origin or source of the Horseshoe Bend waters are part of the ARCO vs. MRI lawsuit currently in litigation. EPA and the State make no determination on the origin and source of these waters. However, these waters become surface flows on and at the south face of the Horseshoe Bend. ARCO and MR have "joint and several liability" for the cleanup remedy. The selected remedy of the ROD requires that all surface flows be captured and "treated."

Comment 19A-2: "Montana Resources must stop dumping millions of gallons into the Pit. (I 49)

Response: See response to Comment 19A-1, Section 3.19A.

Comment 19A-3: What about the East Ridge Pit; who is going to clean that mess up when MRI is through with it? (I 47)

Response: The Continental Pit is hydraulically connected to the Berkeley Pit although flow between them is impeded by soils and bedrock with relatively low permeability. The Continental Pit, therefore, will eventually flood as the Berkeley Pit rises if it is not dewatered to enable mining to continue. The ROD does not allow the water level in the Continental Pit to exceed the CWL because the Continental Pit is part of the East Camp.

Reclamation of surface disturbance is subject to the current permit closure requirements. The DSL sets closure requirements in accordance with State law.

<u>B. PRESENT AND FUTURE MINING</u>

Comment 19B-1: "The clean-up scheduled should not be tied to the cessation of the mining operation. The PRPs should start taking responsibility for the clean-up now." (I 1)

Response: The cleanup schedule is not tied to cessation of mining except for the requirement to bypass clean upgradient water around the System. While mining is active, this water is used in the process. It must be bypassed around the System upon suspension of mining. We do not believe that bypass of this water during mining is appropriate because MR would import Silver Lake basin water to replace this soft water. On the other hand, immediate control of Horseshoe Bend water must take place regardless of mining. We do believe, however, that this control can be cost-effective if this flow is integrated into the tailings circuit. Likewise, the water level in the East Camp Pit System must be maintained below the CWL regardless of mining activities.

Comment 19B-3: One commenter stated that the CWL is the real issue, but we cannot change it, so we should look for the next best thing, which is to come up with another solution to the problem. This commenter further stated that the electricity involved in pumping will be the major expense in EPA 's present proposal - EPA and ARCO have ignored this. It is important that EPA knows that we support active mining. (BSB 12-A)

Response: The CWL can be changed if information is generated that, by allowing the Pit to rise to the 5,410-ft level, a threat to human health and the environment exists. Information received by EPA and the State to date indicates that no threat exists until the water level gets well above the 5,410-ft level. EPA and the State recognize that pumping costs will be a major expense in the remedy. This fact is recognized in the FS. Although EPA's and the State's main objective is to protect human health and the environment from threats posed by the mine flooding problem, we are cognizant of the benefits to the community that active mining contributes and we have tried to make the remedy the most cost-effective solution possible.

Comment 19B-4: One commenter stated that EPA must be very cognizant of the people who rely on the mining jobs. The water level was addressed, while coming up with a solution that will protect the best interest of Butte. He supports the resolution. (BSB 12-N)

Response: EPA and the State acknowledge the statements that the commenter supports active mining and supports the BSB resolution. The prime objective of EPA and the State is to protect human health and the environment from threats posed by the mine flooding problem. We are also cognizant that the mining operation is a valuable asset to the community. EPA and the State have tried to design the remedy outlined in the ROD to be cost-effective and accommodate the active mining operation.

Comment 19B-5: "I also testified at the public hearing that I felt a strong statement should be made in the resolution indicating the importance of the continuation of active mining. As elected officials we are forced to walk a fine tight rope when it comes to making decisions in which we have to balance one of our main economic resources against the safety of our community. Every attempt should be made throughout the process to assure the continuation of active mining. Every attempt should also be made to assure the economic, social and environmental safety of this community. I regret Montana Resources did not support the legislation I proposed during the last two legislative sessions. This legislation would have provided the important safety net this community is now so desperately seeking." (BSB 13)

Response: See response to Comment 19B-4, Section 3.19B.

Comment 19B-6: "Will the proposed plan end mining in Butte?" (I 51)

Response: No, we do not believe that the Proposed Plan will end mining in Butte. See response to Comment 19B-4, Section 3.19B.

Comment 19B-7: A loss future resources assessment has been performed, i.e., dumping sludge into Pit could preclude future mining. (I 52)

Response: There are technical issues which need to be evaluated before disposal of sludges in the Pit can occur, but EPA and the State believe that placing sludge in the Pit will not preclude future mining.

The selected remedy (controlled flooding of the Berkeley Pit) and disposal of sludges in the Pit do not preclude future mining. The flooding of the Berkeley Pit and associated underground mine workings and disposal of sludges in the Pit do not eliminate the "resource" (i.e., the mineralized ore body) from being mined in the future. The flooding is a natural recharging of the man-made dewatered area. There is nothing foreign in having to dewater an area and remove overburden ("sludges") to mine a mineralized ore body.

Comment: State when "after the suspension of mining" is. (I 37)

Response: Suspension of mining shall be defined for this action as "when mill operation is shut down (i.e., no concentrate production) for a six (6) month period with concurrent economically minable reserves left that could be mined at a profit when economic factors become more favorable."

Comment 19B-9: The Berkeley Pit and its surroundings pose many environmental, economic, and social problems for the community of Butte. But, mining is our heritage and our future. We need to learn from our past mistakes and misuses, not perpetuate the indifference and short-sighted attitudes which led us up to this point. The mining barons that bore into this hill, erected the smelters, and ultimately poisoned the valley, over the last century did so in the name of greed and progress. Greed lined the pockets of the barons, the bosses, the miners and the politicians and progress made us blind to anything unsavory around us. They knew that there would be hell to pay. Someday. But, someone else would pay it, not they.

Well, we as a society grew up - a little. We became a little less indifferent, we learned from the past - a little. Your agency was created and you have a job to do: levy whatever force is necessary to insure that this environmental problem is eliminated. Yes, they will kick and scream and cry, "It's not our fault!" But that was the bed they made when they purchased the Anaconda operations." (I 18)

Response: EPA and the State believe that the selected remedy protects the Butte community, Silver Bow Creek, the Summit Valley. EPA and the State will pursue enforcement of the remedy upon issuance of the ROD. EPA and the State believe that the first stage of the remedy will be implemented in 1996 with control of surface flows.

Comment 19B-10: Continuation of mining a major concern as is the ARCO/MRI lawsuit. (BSB-7)

Response: EPA and the State believe that the selected remedy will not cause a suspension of current mining. Regardless, EPA and the State must take action to protect human health and the environment from the threat of the MFOU. The ARCO/MRI lawsuit was not a factor in the remedy selection or EPA and the State action. ARCO and MR have "joint and several liability" (i.e., they are collectively and/or individually responsible) for the cleanup remedy. Accordingly, and regardless of the outcome of the lawsuit, EPA and the State hold both responsible for the liability/cost of the "cleanup."

Comment 19B-12: One commenter is concerned that we can affect the current active mining and it is in our best interest to concentrate on the best type of cleanup possible. (BSB 4-N)

Response: EPA and the State believe that the selected remedy is the best balance of all factors (i.e., the nine criteria) and protects the Butte community Silver Bow Creek, the Summit Valley groundwater. See response to Comment 19B-4, Section 3.19B.

Comment 19B-13: "What is the contingency plan if mining does not cease in 2006?" (G 2)

Response: The FS used the year 2006 as a date for suspension of mining as a baseline to compare the costs of alternatives. The various tasks outlined as part of the remedy in the ROD must be implemented regardless of when mining ceases.

Comment 19B-14: "What role has present and future mining played in the selection of this alternative?" (G 1)

Response: Present and future mining plans have played only a minor role in the remedy selection. EPA and the State believe that if mining was not ongoing, the Agencies would still prescribe the same CWL, the same final treatment scheme, and the same inflow control strategy. The only portions of the remedy which are impacted by the ongoing mining operations are:

1) The proposed plan integrates the Horseshoe Bend water into the tailings circuit because EPA believes that this alternative is much less expensive, and while mine operations continue, as effective as treatment of the Horseshoe Bend water in an independent treatment facility; and

2) The plan does not require upper basin clean water diversions because of the need for this flow as makeup water in the mining operation.

4.1 USE OTHER TECHNOLOGIES FOR TREATMENT

Comment 1-1: The Metanetix technology is a technology that's been developing since 1980. We hold 19 patents in the chelation area, 5 patents in the engineering area, and we have seven patents pending, some of them that actually pertain to the Berkeley Pit water.

This technology now has $35.5 million behind it in its development. We are here in Butte on a commercial operation to take metals from the mine water and the Pit and convert these to metal products. We now, on our first scale of this operation, are processing more than 500,000 gallons a day, not too far from the million that has been mentioned.

This technology has been tested for plutonium by Battelle Laboratory, Dutch Independent Laboratories, and Bateman Corporation. Nalco Corporation spent 10 and a half - or 11 months - and $10.5 million testing in Canada for cleaning of harbor sediments. The EPA came in, reviewed the study and in a publication that is now out from the EPA, November 1993, saying that this technology successfully cleaned contaminated soil from heavy metals, soil from a lead smelter removing the lead, the harbor bottom sediments, sewage sludge, and sewage sludge hash. The technology is now removing the metals from the Berkeley Pit water and the mines.

The Metanetix technology will "reduce the waste and be a permanent solution. It uses all the metals that it retrieves for product and it cleans the water and puts out clean water." It was not "considered by ARCO" and in fact was rejected by ARCO. (T 7)

Response: EPA and the State recognize that metals can be removed successfully using this type of technology. We do not believe that chelation processes in general are cost-effective as compared to the conventional treatment technology proposed in the ROD. We are open to amending the ROD if the developers of such technology and the PRPs collectively propose alternative processes that meet the performance standards for this project. The ROD also requires the reevaluation of technologies, including chelation of metals, when the water in the Pit reaches the 5,410-ft level.

Comment 1-2: What I would like to do is turn to a section of the RI/FS and it is Section 5.1.10 titled, "Chelation Chromatography." In this review, the PRPs sponsored an analysis of technologies, which are available for treatment of acid mine water. Chelation Chromatography describes the type of separations process, which is also being sold in the marketplace by competitors of Chromatochem Company, such as Dow and Roman Hause. It is a recognized technology, generically, and Chromatochem's patent is recognition of an improvement of this technology in its cost-effectiveness and the cleanliness of the water it produces. (T 6)

Response: See response to Comment 1-1, Section 4.1.

Comment 1-3: Paragraph 2 of Section 5.1.10 (RI/FS) states: "Recent research efforts have successfully conducted laboratory scales tests on new synthetic resins to improve the selectivity, of the resins." (Jones and Grinstead, 1977). These are not recent results which were reported or discussed in this analysis of new technology. The statement goes on: "However, the new process has not been demonstrated successfully on a pilot- or full-scale basis." That sentence is incorrect. Roman Hause and Dow chelating resins are deployed for treating millions of gallons of water everyday as a well-known process. (T 6)

Response: We stand corrected. There has been deployment of chelating resins to treat wastewaters. However, we believe that the application of chelation chromatography in mine waste water treatment applications is in the study and demonstration stage of development. We believe, therefore, that more work needs to be done concerning the technical and commercial implementability of this process. Regardless, the ROD requires a reevaluation of technology, including metals chelation, when the water level in the Pit reaches the 5,260-R level.

Comment 1-4: The RI/FS says, "Effectiveness: Chelation Chromatography has been tested in limited pilot skill application. Preliminary data indicate that this method of ion absorption is not quantitative, i.e., repeatable over time." I refer to the paper I have submitted to the record that shows this process was demonstrated to be repeatable over time of 1,500 cycles of use. Development subsequent to the publication of that paper have increased the stability and reproduced stability in that product and that process. (T 6)

Response: We stand corrected. This information is included in the administrative record. See response to Comment 1-3, Section 4.1.

Comment 1-5 The RI/FS says, "Preliminary data also appeared to indicate a degradation of a thin film of chelating aging over time." That sentence is incorrect in that we demonstrated that after this 1,500 cycles of use, that over 80 percent of the original material's capacity still remains, so that the Chelation Chromatography is not a material or a process which is sensitive to changes or process variation. (T 6)

Response: See response to Comments 1-3 and 1-4, Section 4.1.

Comment 1-6: The RI/FS says, "It has not been proven on a large-scale operation and is not technically feasible for treating 1.5- to 2.3- million gallons per day of waste water during remedial action." Incorrect. Chelation chromotography is in use with other commercial resins on a project of that scale and we have proposals outstanding for treatment processes that are in the tens of millions of gallons per day in size. It is a scalable technology. (T 6)

Response: See response to Comments 1-1 and 1-2, Section 4.1.

Comment 1-7: The RI/FS says, "Implementation of this process technology would require relatively moderate to high capital costs." That is incorrect. The capital costs of a Chelation Chromatography system deployed for Berkeley Pit water cleanup to the drinking water stage of recovery of the metals is less than any of the capital costs in any of the plans presented in the RI/FS, except for the No Action Plan. (T 6)

Response: EPA and the State have no information to prove that this point is true. We assume that the capital costs for such a process would be similar to those costs with technologies which have a relatively similar methods of water handling and processing equipment (e.g., ion exchange columns) which also have moderate to high capital costs.

Comment 1-8: The combination of Freeze Concentration and Multiple Effect Evaporation was not evaluated to determine if Butte's dry, cold climate could be used to advantage. Freeze concentration was dismissed because of energy requirements. No effort was made to evaluate the potential for using the cold weather that dominates Butte for six months each year to reduce man-made energy needs. Nor was any effort made to evaluate the possibility of using sunny and semi-arid climate in Butte to see if solar energy could be used to run (or supplement energy needed to run) the evaporation units required for Multiple Effect Evaporation. (BSB 3)

Response: Typically the FS utilizes an analysis of energy costs based on the cost of conventional energy sources. This is done for all treatment alternatives because there are usually too many variables which cannot be precisely defined before the design period. It is especially difficult to explore the potential downside costs of innovative technology at this stage of analyzing alternatives; we, therefore, use conservative cost figures which are well defined.

Comment 1-9: The commenter included a paper entitled "Chemical Interactions in Sulfide Mineral Tailings." (I 53)

Response: This paper has been included in the Administrative Record for this operable unit.

Comment 1-10: The commenter included a paper entitled "Water Purification Project." (I 50)

Response: This paper has been included in the Administrative Record for this operable unit.

Comment 1-11: The commenter included a paper, "SITE Technology Profiles Sixth Edition, Toronto Harbour Commission (Soil Recycling)." (BSB 9)

Response: This paper has been included in the Administrative Record for this operable unit.

Comment 1-12: The commenter included a paper, "Powershaft Limited. (BSB 10)

Response: This paper has been included in the Administrative Record for this operable unit.

Comment 1-13: The commenter requested that a full treatability study be done with the application of his process. (G 3)

Response: The information presented by the commenter indicates that this particular process (GYP-SIX) may have some beneficial application to the treatment of the Berkeley Pit water. There are several avenues for demonstration of this technology, including the DOE Resource Recovery Project and the EPA SITE Program.

4.2 MONITORING PROGRAM

Comment 2-1: How can data generated from a comprehensive monitoring program ensure treatment facilities are in place and operating prior to mine waters reaching the CWL? (I 37)

Response: There will be yearly evaluations of the data from the monitoring program that will calculate/predict when the CWL will be reached. Also, the RI established a predictive model on future date predictions for when the CWL would be reached. This model will also be updated yearly using the new data. This information, coupled with other triggers in the declaration for the ROD, will ensure that treatment facilities are in place and operating properly prior to the CWL being reached.

Comment 2-2: A downflow of water over geologic time is evidenced by the Anaconda Company maps (McClave, 1973, Figures K-1 to K-3) showing the position of the zone of supergene enrichment which lay in the volume that is now the Pit itself, and still exists in surrounding areas. These diagrams show a downward extension of the enriched zone at faults and veins (e.g., to levels at an elevation of 3,800 ft in the Middle Fault at the Kelley shaft), where there would have been a downflow of surface water. A downflow of Pit water (beneath the Pit) will still be present and will be furthering the supergene enrichment process and carrying reduced solutions with lower metal ion concentrations to greater depths where enormous dilution will occur with circulation to depths of 1-2 miles (Blackwell and Robertson, 1973). "Contaminated" water from the MFOU may never influence surface ground waters. (I 53)

Response: EPA and MDHES acknowledge the comments.

Comment 2-3: The commenter makes the following recomendations regarding the monitoring program:

- That a Pit sediment study be part of the monitoring program;
- That a microbiological study be a part of the monitoring program;
- That there be detailed consideration of geochemical and microbiological interactions in the Pit System;

- That an overall monthly water balance be used to assess both upgradient water control and recycle possibilities;

- That system-outflow water quantities and patterns be assessed, with some monitoring, to support any conclusions;

- That in considering chemical treatment options, due consideration be given to recycling of "contaminated" waters, as well as the integration of waters from different sources; and,

- That all of the above activities be supported by an expert "advisory-and-review" panel consisting of persons outside the commercial consultant organization. (I 53)

Response: EPA and MDHES acknowledge the comments. EPA and MDHES received several technical comments pointing out unknowns relating to the disposal of sludge in the Pit and the Pit sediments. These comments have prompted the Agencies to reevaluate the Pit sludge disposal issue. Given the unknowns we have decided that additional study related to the geochemical impacts of such disposal must be done before any disposal of treatment plant sludge in the Pit can occur. Although the scope of such investigations have not been developed, we plan to include a wide range of "experts" to advise us in this area. Many of the other comments are research/academic endeavors requiring many years of investigation and likely requiring other investigations prior to being settled and would not change the outcome of the selected remedy. EPA and MDHES encourage the separate academic pursuit of such inquiries as mentioned by the commenter.

Comment 2-4: The commenter suggests that a monitoring system be established west of the Butte Hill to identify any irregularities in water flow and quality. The commenter suggests the installation of wells in the following drainages: Bull Run Creek; Oro Fino/Beef Straight; Brown's Gulch; Whiskey Gulch; and Gimlet Gulch/Rocker. The commenter also suggests upgrading the existing gauging stations at Colorado Tailings and Miles Crossing, the inclusion of the Orphan Girl Shaft in future (MBMG) water level monitoring, and water level monitoring in either the Nettie or the Norwich mines. (I 54)

Response: EPA and MDHES believe that the addition of two bedrock monitoring wells for the East Camp and four monitoring wells in the West Camp to the existing monitoring network will be adequate to discern whether contaminated groundwater could exit the MFOU. The Agencies have the ability and authority to install additional wells if future data indicate that the present monitoring system might be inadequate. Additional monitoring in the area, suggested by the commenter, will be further evaluated in the Non-Priority Soils RI/FS where the "Outer Camp" will be investigated.

4.3 COST

Comment 3-1: There should never be $0 for No Action - No Action can still be the required monitoring associated with an NPL site or institutional controls. This was a BAD mistake. Read the NCP. (I 37)

Response: This is not a requirement of the NCP. The publication Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, October 1988, (OSWER Directive 9355.3-01) states that "[a]lthough a no-action alternative may include some type of environmental monitoring, actions taken to reduce exposure (e.g., site fencing, deed restrictions) should not be included as a component of the no action alternatives. Such minimal actions should constitute a separate 'limited' action alternative. Monitoring costs are available in the FS, and in retrospect could have been included under the No-Action Alternative. However, we believe that the annual monitoring cost of approximately $100,000 is inconsequential for selection of the remedy for this particular project. These costs are relatively minor as compared to the costs of the alternatives necessary to protect human health and the environment and to meet the ARARs.

Comment 3-2: You cannot screen an option based on cost alone as was done for the people-preferred alternative through pumping. Check the NCP. (I 37)

Response: This statement is incorrect; alternatives were never screened on cost alone. They were screened on effectiveness, implementability, and cost. This particular alternative was rejected because of our determination that there were inordinately high costs as compared to other alternatives with no increase in effectiveness.

Comment 3-3: The costs in the FS are in present value figures. This type of financial analysis rewards proposals that delay taking action till the latest possible time. This has the effect of pushing the costs upon future generations. The Preferred Alternative should minimize the costs in the future by having the responsible parties pay the full bill now. Then, actions that reduce future costs would be preferred, because it would lower the amount of money that responsible parties would have to put up to cover future costs. (I 4)

Response: The commenter is correct in the fact that the analysis presented emphasizes the present value of money and rewards proposals that delay capital expenditures and ongoing operation and maintenance costs as much as possible. However, since the NCP and Guidance for Conducting Remedial Investigations and Feasibility, Studies under CERLA, October 1988 (OSWER directive 9355.3-01) require that cost analysis be calculated in this way, EPA will calculate the costs based on present value.

4.4 CONTROL INFLOW

Comment 4-1: The proposal to recycle Horseshoe Bend water to the Yankee Doodle Tailings Pond is a good start to water control, but it also presents the possibility of additional chemical control. There will be chemical (and biological) reactions between the recycled water and the tailings sediment and this could lead to a positive outcome. An investigation of these reactions should be part of the Comprehensive Monitoring Program. (I 53)

Response: The incorporation of the Horseshoe Bend water into the tailings circuit will require significant lime addition to neutralize the water and precipitate metals so the water is suitable for concentrator use. MR has already incorporated 900,000 gallons per day of Horseshoe Bend water into the tailing circuit. MR indicated to EPA and the State that additional evaluation needs to be done concerning the incorporation of the additional 1.5 mgd from Horseshoe Bend. This would include the evaluation of the resulting water quality for use in their process or for discharge.

Comment 4-2: Besides the 2.4 mgd from Horseshoe Bend, what other potentially controllable inflows contribute to the rising Pit water? What control measures were considered for these sources during the RI/FS? What are the maximum potential reductions of inflow that were calculated as part of the RI/FS? How much water can be diverted from entering the Pit after mining ceases, thus reducing the volume of water that needs to be treated? (G 1)

Response: The other controllable inflows into the System include Upper Yankee Doodle Creek, Upper Silver Bow Creek, the East Ridge flow, other minor upper basin flows, and the Silver Lake pipeline flow. Upper Yankee Doodle Creek, Upper Silver Bow Creek, East Ridge, and other upper basin flows are about 1.5 mgd each and about 4.5 mgd is delivered through the Silver Lake pipeline. Approximately 0.5 mgd are consumed in the MR concentrator process, 3.1 mgd is stored as in-situ water in the tailings, and about 0.2 mgd lost to evaporation.

All of the Horseshoe Bend water, the Upper Silver Bow and Yankee Doodle Creeks, and the East Ridge flows can be diverted after mine closure. Based on comments received from the public, these diversions after cessation of mining are expressly required by the ROD.

EPA evaluated these inflows and the potential for reducing or eliminating them. However, all of these flows are needed and used as makeup water for the concentrator with the water rights owned by MR. Even though the Silver Lake import is likely to be reduced because of the integration of the Horseshoe Bend water, reducing the other upper basin clean water sources would likely be replaced by increased Silver Lake flow because there are minimum total and soft water needs at the concentrator. EPA, therefore, included only the Horseshoe Bend water as controllable water in the FS during active mining.

Comment 4-3: The most critical aspect of the Plan that requires clarification and/or modification surrounds requirements for control of surface water flow, both before and after mining. The Plan in numerous places refers to surface water inflow as synonymous with and equal to Horseshoe Bend flow. See, e.g. p. 2 (referring to treatment of "surface water inflows (i.e., Horseshoe Bend)"). Apparently drawing from RI/FS data indicating that the average flow of Horseshoe Bend is 2.4 mgd, the Plan seems to imply that a total of 2.4 mgd surface inflow must be treated regardless of future actual surface flow rates at Horseshoe Bend.

On this point, ARCO believes that EPA has attempted to set a rigid volume for treatment and/or water diversion where more flexibility is needed. EPA states throughout the Plan that it will maintain flexible position with respect to actual methods of controlling and treating surface waters. See. e.g., Plan at p. 2. In contrast, EPA 's apparent designation of an arbitrary treatment volume is not only counterproductive, but ignores the evolutionary and dynamic nature of the Berkeley Pit situation and surrounding mining activities.

First, adoption of the 2.4 mgd figure assumes without any supporting data that the Horseshoe Bend flow will remain in a steady state once mining ceases. Since EPA's Plan assumes that the predominant surface water contribution will be Horseshoe Bend water, the Plan needs to be tailored to the actual amount of Horseshoe Bend flow over time. For instance, upon suspension of mining activities, ARCO believes that Horseshoe Bend flow may well diminish significantly over time. Thus, by arbitrarily designating a 2.4 mgd treatment requirement, EPA may actually require that water be pumped up from the Pit for treatment where Horseshoe Bend flow is insufficient to account for this volume. Such a program would increase dramatically remediation costs without contributing to the overall goal of preventing Berkeley Pit overflow to alluvial systems. (PRP 1)

Response: The selected remedy does not require a 2.4 mgd of inflow control and treatment unless an alternate inflow control site (i.e., a shaft) is used rather than capturing Horseshoe Bend water. It mandates a permanent control and treatment of contaminated surface inflow, including all of the Horseshoe Bend water which is currently 2.4 mgd. It also requires permanent control and treatment of subsurface flow in the Horseshoe Bend area and upgradient diversions of uncontaminated flows after mining is suspended or the mine closes.

4.5 WORK PLAN ISSUES

A. WORK PLAN TOO NARROW

Comment 5A-1: The CDM Federal Programs Corporation work plan provided the objectives and CERCLA and CFR provided the framework for the RI/FS. The RI/FS were completed in an excellent fashion following these guiding documents; however, I feel the work plan has defined the problem of human health and environmental risk from the Operable Unit too narrowly which, therefore, led to a RI that was too narrow in scope and recommendations that are inadequate to protect human health and the environment from the threats within the Mine Flooding Operable Unit.

The work plan limited the scope of analysis of dangers from "off-site emission" to water only. This ignores a very important threat from airborne contaminants. The only mention of this important threat to human health in the RI/FS comes in relation to disturbed soils during construction of remedial efforts, which was determined to be insignificant.

I recommend that a new work plan be developed that is broader in scope - that addresses not only the threat to groundwater contamination, but airborne contaminants, habitat qualities, and aesthetic values. (I 4)

Response: The commenter is correct in stating that the work plan addressed only the groundwater issues. The potential dust problems associated with the permitted mining areas and the mining operation are not evaluated in the MFOU RI/FS. Potential dust problems associated with ongoing mining activities are regulated by the DSL through MR's mining permit. DSL also requires reclamation of disturbed areas after closure of the mine. This reclamation should curb any potential dust problems associated with the active mine area. EPA plans to work with the State (MDHES and DSL) in the development of the specifications for this final reclamation.

Comment 5A-2: The walls of Berkeley Pit are probably a significant source of airborne contaminants. Different alternatives will affect whatever remediation might eventually be prescribed for the walls. Therefore, it is unwise to delay considering the impact of the Pit walls on human health. Any mine flooding alternative should consider the Pit walls at the same time. A study of the effects of the Pit walls and recommendations for remediation should be included in a new work plan. (I 4)

Response: EPA and the State believe that the Pit walls are not a source of significant airborne contaminants. Air studies done in the active mining complex do not indicate that the Pit walls are a significant source of airborne contamination.

Comment 5A-3: Another important area of consideration that was left out of the work plan includes reclamation for aesthetic values including re-establishment of habitat qualities. I believe that aesthetic values could be reclaimed by establishing a mandate to study options for ground cover of exposed areas and attempt to reestablish riparian areas. At the very least, the five natural drainages to the north, east, and west of the Yankee Doodle Tailings Pond could be redirected around the site to prevent the clean water in these streams from becoming contaminated. Redirecting these streams will create some aquatic and riparian habitats to replace the portion of the original Silver Bow Creek channel that was destroyed by mining activities between the Tailings Pond and the MR Concentrator. (I 4)

Response: The remedy outlined in the ROD requires that the uncontaminated upgradient drainages be bypassed around the Pit System. The DSL mining permit calls for the final use of the reclaimed mining area to be wildlife habitat, although not specifically riparian habitat. We believe that establishing riparian habitat in the active area is outside the scope of the MFOU action and should be addressed either in the Active Mine Area operable unit or through the DSL permit.

B. NEED FOR FLEXIBILITY

Comment 5B-1: As you know, ARCO was responsible for preparation of the RI and FS for the MFOU, which serve as the basis for the alternatives reviewed in the Plan for addressing Berkeley Pit waters.

Accordingly, ARCO is intimately familiar with the various details, complications, and uncertainties involved in developing a remediation plan for Berkeley Pit waters. In particular, ARCO has grappled with the many difficult issues presented by the fact that the remedy will evolve over a course of decades and is largely dependent upon the timing and evolution of onsite mining activities and associated water discharges, as well as future Berkeley Pit filling rates. Due to this unusual situation, ARCO believes that the Plan must balance certainty and concreteness against the inherent need for flexibility as the situation unfolds. (PRP 1)

Response: EPA and the State generally agree with this statement. We recognize that flexibility is needed to operate the mine. We openly acknowledge in the ROD flexibility in the potential type of treatment technology to be used, the withdrawal point of water into the System, and the use of the water. Specific performance standards which must be met are: (1) control of Horseshoe Bend flow or 2.4 mgd of other water in the System during mining, (2) control of 2.4 mgd post-mining water, and (3) the ability of any technology used to meet "I" classification discharge standards.

C. HOW WILL WE KNOW THE PLAN WORKS

Comment 5C-1: Since so much of the Proposed Plan is based on predictive models, the plan must clearly provide a definite safety factor. Human error of calculation or operation must not produce an environmental catastrophe. What if EPA/MDHES predictions are faulty? Can remedial action be undertaken quickly enough to avert an environmental disaster? (I 51, T 1)

Response: The monitoring program is a significant aspect of the selected remedy that constantly checks the correctness of the remedy. If new data collected during the monitoring program demonstrates that the remedy is not protective, the Agencies have the authority to react and take whatever action is necessary to assure protection to human health and the environment.

Comment 5C-2: We are dealing with complex hydrologic and geologic structures along with countless other variables. What are our assurances when even the experts are in disagreement about the dangers? (BSB 15, I 36)

Response: The fundamentals of the selected remedy, such as keeping the East Camp/Berkeley Pit System as a contaminated water sink, the validity of the CWLs, the accuracy of the science of hydrogeology, etc., are generally agreed upon by scientists and engineers from EPA, the State and the PRPs, and other experts in these fields. The selected remedy protects human health and the environment. Should new data collected during the monitoring program demonstrate that the remedy is not protective, the Agencies have the authority to react and take whatever action is necessary to assure protection.

Comment 5C-3: The Butte Hill, of which the Berkeley Pit is part, is very complex. Do we really know what is going on? Are we relying excessively on models and predictions which could be found to be inadequate? (I 51)

Response: See response to Comment 5C-2, Section 4.5.

Comment 5C-4: I recommend that some action be taken to increase confidence in the direction of groundwater flow at depth in the MFOU, whether it be in deep well drilling, sediment testing, or improved monitoring from existing wells and mine shafts. If no action is taken to accomplish this, I recommend that the CWL be lowered for a greater margin of safety. (I 43)

Response: EPA and MDHES believe the findings of the RI are accurate, the selected remedy is protective, and the monitoring program will gather the required information to confirm these points. A lowering of the CWLs is not justified at this time.

Comment 5C-5: We need more water in this valley. We could have it if the contaminated water were pumped and cleaned. To come to its opinions and preferred remedy, EPA and ARCO did what is called "modeling" of underground water flows. In these, they assume a constant head pressure. Scientists tell us that such an assumption would allow one to create any result they desired. EPA must review their modeling and dismiss conclusions from it. (T 9)

Response: As the MFOU is a man-made dewatered body, until it is recharged it will only continue to serve as a sink. This sink will be maintained in perpetuity and kept artificially below the natural recharged level by the pumping and treating requirements. The Natural Resource Damage provisions in CERCLA and the State's action in this area will address the issue of the lost resource.

Comment 5C-6: Once the ROD is finalized, what tangible evidence will indicate that the problem has been solved? What parameters are envisioned as indicators of success or failure? (G 1)

Response: This project is different from other projects because the Agencies are trying to prevent a problem from occurring rather than remedying an existing condition. The objective is to prevent the degradation of the alluvial system by contaminated mine waters, and the primary indicators that the problem is solved will be: (1) that the CWL will never be reached, and (2) there will be no degradation of the alluvial system from the Pit System. The proposed monitoring network will monitor both the water levels and the water quality throughout the area. In other words, the tangible evidence will be the absence of degradation.

4.6 PIT SEDIMENTS

Comment 6-1: An important aspect of Pit System chemistry relates to the reactions that are occurring in the sediment that is forming on the Pit bottom, submerged benches, and previously connected old underground mine workings. The sediment thickness at the Pit bottom (1993) was said to be possibly 200 ft. The sediment generally will almost certainly be becoming sulfidized by a variety of chemical interactions, but there appears never to have been the suggestion of an investigation of sediment in the Berkeley Pit, apart from my own in 1993.

There is other evidence of sulfidation actually occurring in the Pit: Lead weights used to anchor a sampling platform in the Pit were noticed to be blackened on recovery (personal communication: J. Medish, MBMG). This was probably due to the presence of a coating of PbS formed by sulfidation; a copper bar lowered onto the Pit sediment in September 1993 had a sulfide coating when recovered one month later (personal observation).

Due to sediment sulfidation it is likely that an oxidation-reduction boundary has already developed in Berkeley Pit sediment, near the sediment surface, so that the quality of water on the reduction side of the boundary will differ from that in the Pit itself, which will be oxidized with respect to the HS/SO42- interface. An oxidation-reduction boundary could separate the dissolved ionic species in the Pit water from those in the underlying groundwater (but allowing downflow, reduction and sulfidation) such that the lower groundwater would be of better quality due to the decreased solubility of metal ions from a reduced sulfide environment. The oxidation-reduction boundary is likely to have developed in the Pit sediment due to both the interaction of pore water with underlying sulfidic minerals and solutions and the likely microbiological reduction of sulfate to form sulfides. The formed process is similar to supergene enrichment in sulfide ore bodies where descending solutions from surface oxidation react with the lower levels of hypogene sulfidic mineralization to form a region of enriched sulfides. Some ores, which have been mined economically, are attributed to this enrichment process (this includes part of the original Butte ore body as described by McClave (1973). The proposition of oxidation and supergene enrichment of sulfide ore bodies started with the work of Whitenes (1855), and by the 1960s the paragenesis of oxidized and enriched ores was well established. Accounts of the process have been published by Bateman (1950) and Anderson (1955). More recent treatments of the hydrology and geochemistry of these processes are presented by Brimhal, et al (1985) and Brimhall and Crear (1987), and some related chemistry for tailings interactions was proposed by Robins (1992).

A complete understanding of geochemistry in the Berkeley Pit needs information from a sediment study. (I 53)

Response: We acknowledge that there are several unanswered questions concerning the sediment geochemistry in the sediment Pit including the impact of placing sludges over that sediment. We believe that it is necessary to address some of these issues before disposal of sludges can be approved.

Comment 6-2: In the RI no data were collected to characterize the geochemistry of current Pit sediments. Consequently, the feasibility of sulfide precipitation was not fully evaluated as a possible remedy. Pit sediments must be better understood before any consideration is given to sludge disposal in the Pit. (BSB 3, I 53)

Response: See response to Comment 6-1, Section 4.6.

4.7 INNOVATIVE TECHNOLOGIES

Comment 7-1: The water treatment technology associated with the Preferred Alternative creates substantial amounts of sludge that must be disposed of. Alternative technologies exist which recover metals, thus reducing the amount of sludge requiring disposal. Why were these not part of the Proposed Plan? (G 1)

Response: Many of the proven common metals recovery technologies, such as copper cementation and solvent extraction/electrowinning (SX/EW), would not significantly reduce the amount of sludge generated. The amount of sludge generated is largely dependent on the pH of the wastewater. With the Pit water having a pH of 3.0, large amounts of neutralizing agents are necessary to bring the pH up to a satisfactory level for discharge regardless of metals concentrations. The basic conclusion of the FS concerning these metals recovery technologies is that the value of the metals does not offset the capital and O&M costs for the metals recovery facility and that there are still significant waste water treatment costs after the metals are recovered (and significant amounts of sludge generated). EPA and MDHES are hopeful that cost-effective innovative metals recovery technologies will be developed in the future that will reduce sludge volumes. Some are being explored presently in Butte. EPA and MDHES would encourage the development of such technology and would amend any decision to include such technology if the PRPs and the developers of the technology would collectively propose a viable alternative.

Comment 7-2: Aside from ARCO touting age-old precipitation methods as the cleanup instrument, new technologies which yield far better results such as chelation chromatography are currently employed to perform this type of cleanup. This method could be used immediately, not 20 or 20 years down the road. (I 18)

Response: See response to Comment 7-1, Section 4.7.

Comment 7-3: In the RI/FS, each of the 19 remedial technologies was evaluated individually and not in combinations. Thus, no effort was made to determine whether certain combinations of technologies might achieve some synergistic benefit that does not occur with just a single technology. The County would suggest that an evaluation of combined technologies could become part of the "innovative technology" research on waste remediation being done in Butte through a variety of business ventures. In general, the County believes that all of the questions that could be asked and answered through this evaluation would lend increased assurance to Butte citizens that the "right" choice will be made at the time of implementation. (BSB 2)

Response: To a certain degree, technologies were evaluated in combinations. This was done by looking at the ability of each technology for metals recovery and primary and polishing treatment purposes. In fact the remedy outlined in the ROD calls for a combination of alkaline precipitation and aeration for primary treatment, and reverse osmosis for polishing. We do agree, however, that additional evaluation in this area is merited, especially in light of the likelihood that new or innovative technologies may be demonstrated. A reevaluation of technology is required by the ROD when the Pit level reaches the 5,260-ft level. EPA and the State will encourage the evaluation of combinations of technologies in upcoming independent demonstration projects.

Comment 7-4: There has been much discussion and debate on the use of technologies for the Berkeley Pit treatment. ARCO is in total agreement with the remedy as specified by EPA and the State of Montana. The lime aeration technology that was chosen for this remedy is indeed an innovative technology, and is an innovative technology developed here in Butte at Montana Tech. Never before has lime aeration been used in a cleanup treatment with the types of volumes being looked at. (T 4)

Response: EPA and the State believe that the selected technology is a reliable, proven, and conventional treatment technology. The proposed treatment train is innovative in that the technology proposed is tailored for this specific wastewater in a two-step precipitation and aeration process.

Comment 7-5: Mechanical Vapor Recompression Evaporation - This report gives a cost of $2 to $4 per 1,000 gallons of water. I seriously question this dollar amount when a few added energy enhancements could create a clean drinkable water supply for $.50 per 10,000 gallons of water. Is this the cost of the plant that will produce 1,000 gallons of water, or is this the cost to clean up 1,000 gallons of water? If the Cost of $2 to $4 per 1,000 gallons is both what would the cost be to treat the 1,000 gallons of water after the plant is constructed? What type of energy sources are needed for this type of plant's operational cycle? How many gallons of water per day is this type of plant able to produce? Could we see a set of plans on this type of unit? (I 50)

Response: Costs for treatment are routinely reported on a "per 1000 gallon" basis. This cost range covers a range of treatment unit sizes producing significant quantities of water (usually in the hundreds of thousands, or millions of gallons per day range). The costs include amortization, operational, and maintenance costs of such a treatment unit. We do not have a set of plans for such a unit.

Comment 7-6: Freeze Concentration - It states in this report the use of refrigeration to freeze water. Did the expert on this process take into consideration the fact that at certain times of the year (due to our location), Mother Nature would freeze this water for nothing? It is a fact that very large bodies of water can be frozen by Mother Nature in a short time frame. It takes larger amounts of energy to turn cold water into ice and also large amounts of energy to turn ice back into water. As I stated earlier, Mother Nature will do it for nothing. (I 50)

Response: No, we did not take into account that the climatic conditions in Butte could lower energy costs. We do not believe, however, that the differences in climatic conditions (as compared to conditions in other parts of the country) will be significant enough to drastically lower the cost of treatment.

4.8 SLUDGES

Comment 8-1: Sludges from the proposed treatment process must be stabilized or they will contain RCRA metals. (I 52)

Response: The sludges produced by the treatment process outlined in the ROD (aeration and hydroxide precipitation) produce a stable sludge, and preliminary studies have shown it to be nonhazardous waste. If a treatment technology is utilized which produces a characteristically hazardous waste, all Federal and State hazardous waste regulations must be met.

Comment 8-2: Alternative 6 is cheaper than Alternative 7 because it dumps the sludge and brine waters from the treatment process into the Pit rather than dewatering and landfilling the wastes in a RCRA Subtitle D landfill. Sludge disposal into the Berkeley Pit is not a proven technology (FS, 1994). Treatability testing done by Canonie (1993) has found the sludge to be non-toxic. The authors assume the sludge is stable enough not to break down when placed in Berkeley Pit's water. However, the report recommends more research be conducted to determine if the sludge is stable enough to not break down in the Pit's murky depths. Until it has been studied in more detail and conclusive results found, the landfill is the only logical option. If it is found that the sludge breaks down and releases metals, which would concentrate the contamination of the Pit's water, the sludge should be landfilled. (I 4)

Response: Based on public comment, EPA and the State have decided to require additional evaluations of this disposal option before it can be implemented. We do not want to completely preclude this option, however, because there may be significant benefits, such as in situ neutralization, as a result of this disposal method.

Comment 8-3: Questions and concerns were raised about the sludges that would be generated through application of the Preferred Alternative:

1) If they are disposed of in the Pit, wouldn't they generate more oxygen, thus perpetuating the acid-generating oxidation cycle?

2) Will disposal of sludge into the Pit result in increased concentrations of contaminants?

3) Any remedy that seems to make the problem worse by generating sludges that will have to be dealt with by future generations as another Superfund-type problem does not seem like much of a remedy. (G 1)

Response:

1. We do not believe that the introduction of oxygen in the treatment plant sludge will perpetuate the AMD cycle. The dissolved oxygen in the sludge will not add enough oxygen to the much larger Pit volume to appreciably increase acid production, and the alkalinity and excess lime will more than offset the acid generation.

2. We do not know whether or not the placement sludges in the Pit will increase the long-term metals concentrations in the Pit water. We believe that the addition of excess lime, and the resulting increase in pH and precipitation of metals, will more than offset the potential redisolution of metals in the System. Because the Pit water is saturated by many of the metals, there cannot be an increase in metals unless the pH is further reduced regardless of the level of metals in the sludge. However, if the alkaline sludge input was stopped the continued input of acid underground waters could lower the pH and dissolve some of the precipitated metals, potentially increasing metals levels at that time.

3. The Pit problem will have to be dealt with by future generations because a treatment plant will have to operated in perpetuity. The management of sludges will be done in a manner that will allow for final disposal and ensure that future generations will not have to address them. The sludges will be disposed of in a manner consistent with Federal and State solid waste disposal regulations.

Comment 8-4: Based on input from several mining professionals residing in Butte, it appears that using the Pit itself as a hydroxide sludge disposal facility is unwise, inefficient, and ultimately counter-productive. Much time and money will be spent to raise the pH of the Pit water by adding lime in a treatment plant. It is expected that the sludge produced will have a pH of 7. If sludge is disposed of in the Pit, it will be re-solubilized. Thus, the same metals will be treated over and over. Disposing the sludge in the Pit would also cause the CWL to be reached sooner. For these reasons, disposing of any sludge in the Pit is unacceptable (Alternative 6, Preferred Alternative). (BSB 2)

Response: Based on public comment, EPA and the State are requiring such questions associated with metals becoming resoluble, geochemical reactions, etc., to be answered before any approval of Pit disposal would be made. We do not, however, want to completely preclude this option because there may be significant benefits, such as in-situ neutralization, due to this disposal method. If sludge disposal were to occur in the Pit, a corresponding increase in the flow rate treated would be required so that there would be no net increase in the fill rate of the Pit.

Comment 8-5: Hydroxide precipitation with reverse osmosis polishing would generate from 500 to 1,000 tons of sludge every day. Using the assumptions in Appendix A of the FS, about 0.2 mgd of sludge would result in a volume of 2,867 cubic ft of sludge to be disposed of each day. The County estimates that if this volume of sludge were piled 12 ft deep, it would require about two acres of land each year for disposal. Thus, in 50 years, a 100-acre repository would hold about 52,322,750 cubic ft of sludge that would have to be monitored for leaks in perpetuity. (BSB 2)

Response: As the commenter noted, a significant amount of sludge will be generated by the treatment process outlined in the ROD. Monitoring will need to be conducted for a long period of time. We believe that this program is very manageable. The present tailings pond holds a larger volume of materials than any potential sludge disposal facility, which will also have to be monitored.

Preliminary testing of the sludge generated from this treatment technology indicates that it will not be a hazardous waste but an alkaline, lime-based material chemically similar to the tailings presently generated by the mining operation.

The daily sludge generation for a full-scale treatment plant will be only 1-2 percent of the volume of tailings produced in the mining operation. Any sludge repository will have to be designed to reduce precipitation infiltration, leachate generation, and leachate migration. It is likely that this repository would be built in the active mine area which naturally drains to the Pit System. The Pit would, therefore, act as a natural collection system for the minimal amount of leachate that might ever escape from the repository.

Comment 8-6: Building a Subtitle D RCRA repository would be expensive, given the need for the installation of liners and leachate collection systems. Also, a sizeable amount of County property would be needed for the actual repository, as well as additional acreage for a buffer zone surrounding the repository. In addition, the County may, at the request of the PRPs, assume responsibility to monitor the repository and perform routine O&M (with PRP funding).

Although these activities are challenging, a non-Pit repository appears preferable, given the disadvantages of using the Pit. In any event, the FS does not adequately assess the tasks of sitting and designing a non-Pit repository, which seems to infer that a decision to use the Pit has already been made. (BSB 2)

Response: We believe that a sludge repository (Subtitle D facility) could be accommodated easily within the active mining area and that the biggest factor affecting the repository location is the future mine plans. The exact location, which would be designated, and the specific design of the repository would be done during the Remedial Design process following the ROD. The decision to use the Pit as a repository has not been made. Public comment has prompted EPA and the State to further evaluate the option. Additional evaluation of the impact that the sludge may have on the Pit needs to be done before this sludge disposal option is approved.

4.9 WATER TREATMENT FACILITY

Comment 9-1: Plant construction/operations lead time. Most industry experts estimate a three-year "shakedown" period is needed to make a treatment plant fully operable. As for linking this "shakedown" period to a point in time in the future, the County suggests the following:

> Currently, the Pit water level rises 25 ft per year; however, the predictive model indicates this fill rate should decrease over time. In light of these facts, the County recommends using the fill rate at the time the water reaches 5,260 ft as the timing indicator to determine when plant construction should commence.
>
> For example, according to the model and data for the Preferred Alternative 6/7, the 5,260-ft level will be reached in the year 2009, and the fill rate that year is expected to be about 10 ft. If the model holds true, then a three-year shakedown period would equate to 30 ft (3 x 10 ft), and plant construction would commence when the CWL reaches 5,310 ft (5,340 ft minus 30 ft), predicted to be in the year 2014.
>
> Again, the actual fill rate when the water reaches 5,260 ft will determine when the plant construction would begin. If the fill rate proves to be more or less than 10 ft at that time, the timing of the shakedown period would be adjusted accordingly.

Thus, the recommended level that triggers action to establish a construction schedule should be set at 5,260 ft and the treatment plant should be guaranteed to be fully operable by the time the water reaches the 5,340-ft level. This schedule would leave 70 ft of free board below the current CWL. The 5,260-ft level is also within range of the original CWL of 5,216 ft, which is the contact between the alluvium and bedrock, thus providing added assurance that the trigger point for action is sufficiently protective. (BSB 2)

Response: The Agencies have structured the ROD to meet the objectives of the program outlined above because of public comment. The ROD will require construction completion of a treatment facility, capable of treating a flow rate that will keep the Pit at a static level, four years before the water level reaches the CWL as measured at the highest point in the East Camp System (presently the Anselmo Shaft). It should be noted that the water level in the Anselmo is presently 40 ft above the Pit water level. Using current projections, assuming inflow control of 2.4 mgd starting in 1996, and assuming that the water level in the Anselmo will be 20 ft higher than Pit water level, the present construction completion date is projected to be in the year 2021. This construction completion date will be updated every three years based on the water level data generated.

Comment 9-2: The importance of flexibility in surface water inflow treatment volume directly ties into the design and construction of any future treatment plant. The appropriate parties will be in a much better position to design a useful, cost efficient treatment plant for Horseshoe Bend water rather than a potential mix of Horseshoe Bend and other waters needed solely to reach the 2.4-mgd figure.

EPA's Plan, as written, seems to suggest that the parties must design a plant in the relatively near future that accounts for a 2.4-mgd volume that may not exist at the time the plant becomes operational. Again, ARCO has shown, in developing the RI/FS and accepting the general contours of Alternative 6/7 (which is more expensive than other feasible options presented in the FS), that it is willing to work within a very conservative and proactive framework to prevent Berkeley Pit water from reaching the CWL. Yet, by mandating the 2.4-mgd inflow threshold, EPA threatens to require the parties to incur unnecessary costs based on a "snapshot" analysis of water flows, where absolutely no additional protection to human health and the environment is afforded by these costs. (PRP 1)

Response: The selected remedy does not require a 2.4 mgd of inflow control and treatment unless an alternate inflow control site (i.e., a shaft) is used rather than capturing Horseshoe Bend water. It mandates a permanent control and treatment of contaminated surface inflow, including all of the Horseshoe Bend water which is currently 2.4 mgd. It also requires permanent control and treatment of subsurface flow in the Horseshoe Bend area and upgradient diversions of uncontaminated flows after mining is suspended or the mine closes.

4.10 WATER ISSUES

A. BEDROCK AQUIFER

Comment 10A-1: EPA has announced in public meetings that the Agency will be issuing a waiver (as part of the ROD) for restoration of the contaminated part of the bedrock aquifer. This decision means that no effort will be made to remediate the contaminated portion of the bedrock aquifer because it is technically and economically infeasible to do so.

This waiver will set a precedent for Superfund cleanup on the Clark Fork and allow EPA to ignore one of the main criteria for cleanup: reducing the volume, mobility, and toxicity of contamination. When EPA issues the waiver as part of the ROD, it is assumed the requirements of "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration. (OSWER Directive 9234.2-2S) will be followed. (G 2, BSB 2, I 13, BSB 6, BSB 7, T 5, I 51, T 9, T 8, I 43, I 37)

The County's concern is the specific language of this waiver. The County would request full involvement in the review of the document. The County's interest will be to ensure that a full evaluation has been done and that no linkage is made between the contaminated bedrock aquifers and other aquifers that would allow additional waivers in the future. In addition, the boundaries of the contaminated bedrock aquifer must be clearly delineated on a map, and explicit language must be included in the waiver to explain restrictions on future uses of the contaminated groundwater. (BSB 2, G 1)

Response: EPA and the State recognize BSB's concern about the waiver of the State groundwater standards. A map clearly delineating the area is included in the Technical Impracticability Waiver concerning the boundaries of the waiver area. BSB will be involved in this issue and will be an active participant in the development of the institutional controls required to go along with this waiver. Specific restrictions and implementation of those restrictions will be discussed during the development of the Institutional Control program.

Comment 10A-2: Considerable alarm was expressed by several commenters about the Plan's treatment of deep bedrock aquifer:

- The plan gives no assurances about the dynamics of contaminated water over the long term in the deep bedrock aquifer, we just don't know enough about it.

- What we do know about old mining works in the bedrock aquifer concerns some people with underground mining experience; they refer to 'bad ground' to the east and southeast, where unpredictable water flow dynamics were always a concern to mining operations (G 1)

Response: EPA and MDHES believe the information gathered during the RI is complete and the issues adequately investigated. The monitoring program will continue to collect data that will check the accuracy of the conclusions of the RI. We believe that there will be little transport of contaminants in the deep regional bedrock system because: (1) the rate of regional bedrock flow is very slow, (2) the relative size of the contaminated bedrock system is small compared to the regional system, (3) the regional system has a large attenuation capacity, (4) the water quality in the periphery of the East Camp is quite good, and (5) the water quality in the shafts throughout the area has improved as the shafts have inundated.

We have also heard reliable reports of the "bad" groundwater where perched groundwater is encountered in the undergrounds. MR personnel have reported similar phenomenon where perched groundwater is encountered and quickly drained. This is not unexpected but poses no particular concern as far as contaminant transport is concerned. We expect these areas to become resaturated as water levels come up; however, we do not expect Pit water to be transported to the upper Silver Bow/Blacktail Creek alluvial system through these areas because the gradient will always remain toward the Pit.

Comment 10A-3: Based on the data in the RI, a critical saddle point in the top of weathered bedrock exists near the southeast edge of the Pit at the 5,350-ft level. Water reaching this alluvium level could behave unpredictably, i.e., short-term rises in water level, due to the density differences in the alluvium and the weathered bedrock, could potentially yield a short-term change of gradient for this locale, thus allowing water to flow away from (and not toward) the Pit. Therefore, the County believes it would seem reasonable to consider this level as a starting point to trigger action. (BSB 2)

Response: EPA and the State disagree with the conclusion of this comment. While we agree that this change in stratigraphy could cause changes in rise rates, the water levels in the alluvium at the groundwater divide south of the Pit are at least at the 5,460-ft level and saturated down to the decomposed bedrock. Pit water, therefore, cannot escape the System through the alluvium until the water level in the alluvium gets much higher than 5,350 ft. We acknowledge that there is a potential for the migration of water eastward from the Berkeley Pit toward the Continental Pit, if the level in the Berkeley Pit gets above the dewatering level in the Continental. Water will still not be able to get out of the East Camp System, however, because the overall gradient will be inward toward the Berkeley and/or the Continental Pits. Additionally, as part of the monitoring program, a bedrock monitoring well is being installed in this area. This additional bedrock monitoring well evaluated with data from existing wells will further address the issue.

Comment 10A-4: What is the quality of the bedrock aquifer in the middle of the valley, near the airport? What is the groundwater quality at depth where the bedrock drops off toward Rocker? Could a new industry using high volumes of water in Butte or in Rocker cause induced infiltration to contaminate existing wells? (T 2)

Response: The aquifers referred to in this comment are outside the influence of the Berkeley Pit East Camp System. The quality of water in the bedrock aquifer near the airport is unknown. The depth of the alluvium in the that area is also unknown but probably in excess of 1,000 ft and no wells have been put down to bedrock. The bedrock aquifer water quality north of this area is quite good based on the results of water quality sampling done during the RI. We would assume, therefore, that the water quality of the bedrock aquifer is very good in this area.

A water user with a well pumping such high volumes of water to cause an "induced infiltration of contaminant" from the MFOU would first cause a dewatering of the surrounding bedrock and/or alluvial aquifers (and an associated loss to water well users in the influence of the new well). We do not believe that "induced infiltration" could be massive enough to draw contaminated East Camp/Berkeley Pit water into these areas.

<u>B. WATER QUALITY</u>

Comment 10B-1: In the Proposed Plan there is the suggestion that there is an upflow of deep groundwater from the bedrock into the MFOU. Perhaps a groundwater model was the source of that idea, but I wonder if it is realistic. There are simple experimental procedures that could be used here to add to a realistic water balance. (I 53)

Response: EPA and MDHES believe there is upflow into the Berkeley Pit from the surrounding bedrock (deep or otherwise) and this is believed to be based on several separate arguments. There is a connection between the Pit and the associated mine workings surrounding and "under" the Pit. Flow has been observed entering the Pit from the current operations at the Kelley Mine Shaft. The water level data from deep bedrock wells, such as the DDH wells, support this belief.

Comment 10B-2: It is suggested that the Berkeley Pit and surrounding areas could become enveloped by a sulfidic barrier such that the underlying groundwater is in a reduced condition where the metal ion concentrations will be considerably lower than in the Pit water. There is some evidence that this is the case (MBMG data). In the West Camp the Travona shaft water is sulfidic, and although the groundwater at that location is more or less cross-gradient to the Pit, it shows that the condition of reduced groundwater does exist. It also suggests the use of West Camp water (or similar water) to sulfidise other waters in the system.

Water samples from the Belmont mine shaft, which is downgradient of the Pit, show metal ion concentrations considerably lower than in Pit water. Water samples pumped from the upgradient Kelley Mine shaft (MBMG, 1992) indicated that both pH and E decreased with depth (pH: 5 to 3, and E :380 to 360mV), which could mean that the Kelley is isolated from the Pit by a redox (ox/red/ox) barrier. Cation concentrations in the Kelley appear to be generally higher than in the Pit, but this is probably due partly to enhanced and localized oxidation caused by a more elevated temperatures which exist in the deeper water levels. (I 53)

Response: As pointed out in the previous response, the Pit is not isolated from its associated mine workings; and, flow has been observed entering the Pit from the current operations at the Kelley Mine Shaft. Also, it should be noted that the current operations at the Kelley Mine Shaft have water rights to appropriate water from the Berkeley Pit by way of these connections.

Comment 10B-3: Another consideration is the influence of the MFOU groundwater on deep groundwater, and the fate of that water. A complete water balance on the whole Pit System is not reported, but could add perspective to understanding the likely outcome of any chosen remedial action. For example, the maximum average monthly (June) precipitation of 2.42 inches in the catchment of the Pit system (about 19.5 square miles) could result in the generation of about 27 mgd of water (data from Botz, 1969), which would have been accommodated (pre-mining) by stream flow, groundwater flow and evapotranspiration. Presently the only additional water into the system is 6.2 mgd of Silver Lake water to the MR concentrator. In all months other than June the precipitation is less than in June by more than the 6.2 mgd from Silver Lake. Actual measurements of monthly evapotranspiration would be more accurate than using calculations such as the CFR 40 Ch.1 (7-1-93). Upgradient water control, as in fact partly exists with the Yankee Doodle Tailings Dam, should be carefully integrated with recycling, to result in the appropriate water balance for contamination control. (I 53)

Response: The commenter is correct in the calculation of total maximum daily precipitation input into the upper basin (27 mgd). As is pointed out, this is not the total ending up in the Pit, however, because of the evapotranspiration (ET) losses. ET measurements would add to the knowledge base concerning the water balance in the basin, but we do not believe that conducting ET measurements would help in inflow (upgradient) control decisions. Only certain upgradient surface flows are controllable. These have been identified and the relative flow rates assessed. Precipitation entering the alluvial or bedrock groundwater system cannot be kept out of the Pit System very efficiently, except at the alluvial system discharge point at Horseshoe Bend.

Comment 10B-4: The likely mediation of sedimentary reactions by microorganisms depends to some extent on the presence of organic carbon, although there are other energy sources that support the wide range of organisms that are encountered in the reduction of sulfate to sulfide. To date it appears that no analysis of Berkeley Pit water (or any other waters in the MFOU) has included the determination of organic carbon, although it is likely to be present from various sources, which include a huge vegetated water catchment (greater than 5 square miles) to the north in which humic substances are certainly being generated. Algal blooms which occur regularly in the water at the North of the Yankee Doodle tailings are evidence of organic material, which in that region at least could support bioreduction of metal ions. Recycle of contaminated water to part of this tailings area in order to form sulfides is worth consideration. In the Pit itself it has been said (without any evidence) that there is not likely to be any bioreduction due to the "extreme" conditions in the water (acidity and metal ion concentrations). This is not correct, and in similar mine waste pits, such as at Rum Jungle in Australia, reducing organisms have been reported at deep submerged sediment (Babij, et al, 1980). (I 53)

Response: The Agencies have chosen a technology to implement which we believe is the most cost effective proven technology available (aeration/hydroxide precipitation). The potential for bioreduction of metal ions in the System has not been evaluated by EPA and the State. The use of natural, in situ or unit process sulfide precipitation is an intriguing innovative technology worthy of additional research. The ROD mandates that a reevaluation of treatment technology be conducted when the water level in the Pit reaches the 5,260-ft level. This technology is likely to be one of the technologies reevaluated at that time.

Comment 10B-5: What NEPA documentation has been compiled to date that allows the aired discharge of treated water to Silver Bow Creek? At which levels can water be discharged to the Creek? I hope MCLs are mentioned somewhere for each contaminant of concern. (I 37)

Response: Silver Bow Creek has been classified by the State of Montana as an "I" Class water. This classification recognizes the impacted nature of the water body. Discharge limits to Silver Bow Creek are determined by calculating the minimum monthly means from the data from a three-year period prior to discharge. The discharge values are recalculated every three years and eventually will reach "Gold Book" values (chronic water quality limits). These chronic water quality values are more restrictive than MCLs. The treatability studies of the FS demonstrated that these values could be reached.

C. WATER USERS AND RIGHTS

Comment 10C-1: Was a water right given to the PRPs to take over 5.5 cubic ft of water per second or 2,468.4 gallons per minute of the State of Montana's groundwater with or without the approval of the state legislature?

If the PRPs have the approval of the state legislature for this amount of groundwater, what was the beneficial use described to the State legislature in order to obtain this permit?

The Metal Mine Reclamation Act (MCA § 83-4-30) states: "Recovery of damages for a water loss in quantity and quality is provided for if an investigation establishes that a hard rock mining operation is responsible for the loss." What I would like to know is: Is this a lump sum fine or payment on the total amount of water that is being contaminated or on the amount of water per year that is being contaminated? Also, what would the amount of damages be for 25 billion gallons or 50 billion gallons? (T 2)

Response: No water right permit is required at this time for the filling of the Berkeley Pit because there is no diversion of water for a beneficial use. In Montana, private parties can receive a water right only for "diversions" of water, which are then applied to a beneficial use. See MCA § 85-2-102. Rising water levels in the Berkeley Pit are not considered a diversion, but are caused by natural groundwater recovering after cessation of underground mine dewatering. Also, the PRPs are not currently applying the water in the Pit to beneficial use.

Please note that MCA § 83-4-30 does not exist. Assuming the comment is referencing MCA § 824-355, this section allows a user of groundwater to sue a licensed mine operator for loss in quality or quantity of groundwater caused by the mining operation. The groundwater user must first file a complaint with the DSL. DSL is required to conduct an investigation of valid complaints and issue a finding of the cause of the water loss. Any damages awarded in a subsequent lawsuit would probably be in an amount designed to compensate the groundwater user for actual losses.

D. BERKELEY PIT FILLING RATE

Comment 10D-1: The importance of focusing surface inflow controls on future Horseshoe Bend flows, as opposed to an arbitrary 2.4 mgd figure, is underscored by uncertainty surrounding Pit infilling rates. In 1993, ARCO issued a study which suggested that Berkeley Pit waters would not reach the CWL under current conditions until at least 40 years from now, and that, if Horseshoe Bend was properly controlled, the CWL would never be reached. "Preliminary Modeling of Future Berkeley Pit Water-Level Elevations and Inflow Rates," February, 1993. Certainly, if such predictions were to materialize, ARCO would seek a reexamination of the need to build any treatment plan for Horseshoe Bend waters. In the meantime, EPA has pushed for, and ARCO has accepted, a very conservative and proactive approach to ensure that Berkeley Pit waters are contained. Adopting this approach, EPA was unwilling to use Pit infilling rates reflected in the 1993 study, and projected in the Plan Pit infilling dates of 2015, if no remedial actions are taken, and 2022, if Horseshoe Bend is controlled.

By virtue of its years of intensive study of this problem, ARCO believes that Pit infilling rates will continue to diminish. Yet, the extensive monitoring program included within Alternative 6/7 will eliminate this "crystal ball" aspect of the remedy by providing ongoing data necessary to calculate Pit filling dynamics. ARCO believes that there is a significant chance that the rerouting and permanent control or treatment of Horseshoe Bend waters, regardless of their exact volume, will likely result in stabilization of the Pit such that the goal of protectiveness will be accomplished. It seems unreasonable and illogical given this potential for stabilization to establish a 2.4 mgd figure which may not reflect future surface flow conditions. When viewed in light of the uncertainties surrounding Pit infilling rates, mandating such a figure may result in the requirement that waters actually be pumped from the Berkeley Pit notwithstanding that the Pit has already reached a steady state.

In this regard, EPA notes that one alternative that was screened and rejected during the FS process was the immediate pumping of Berkeley Pit water to maintain or lower the water level in the Pit System. EPA rightfully points out that this much more costly option provided no increased protection of human health and the environment, because the Alternative 6/7 was more than sufficient to prevent reaching the CWL. ARCO believes that this exact rationale applies to the arbitrary designation of the 2.4 mgd figure representing Horseshoe Bend flow, when Horseshoe Bend flow may not continue at that threshold. Accordingly, ARCO requests that the Plan be rewritten to state the up-to-2.4 mgd, as reflected by ongoing Horseshoe Bend sampling and actual site conditions, along with other surface flows, be controlled or treated as outlined in Alternative 6/7. (PRP 1)

Response: The selected remedy does not require a 2.4 mgd of inflow control and treatment unless an alternate inflow control site (i.e., a shaft) is used rather than capturing Horseshoe Bend water. It mandates a permanent control and treatment of contaminated surface inflow, including all of the Horseshoe Bend water which is currently 2.4 mgd. It also requires permanent control and treatment of subsurface flow in the Horseshoe Bend area and upgradient diversions of uncontaminated flows after mining is suspended or the mine closes.

Comment 10D-2: Use of averages (RI, FIG 3-2) is an inadequate representation of water that must be diverted from the Pit and could result in underestimation of Pit fill rate. (BSB 3)

Response: The Pit filling rate will be recalculated yearly as part of the monitoring program. "Hard" or actual data will be used to predict when the CWL will be reached.

Comment 10D-3: Regional recharge, evaporation, precipitation, and runoff data are excluded from the Pit inflow calculations in Section 3 in the RI and result in the incorrect assumption that the Pit is a "closed system". (BSB 3)

Response: Regional recharge, evaporation, precipitation, and runoff water were not excluded from the RI. EPA and MDHES believe that all water in the Berkeley Pit/East Camp System have been accounted for and that the Pit is the low point or "sink" for water in the system (i.e., all water is flowing to the Pit).

Comment 10D-4: The assumption made by BSB on the fill rate as the level approaches 5,410 ft is based on 25 ft/year which should be more in the range of 2-8 ft/year.(BSB 8)

Response: As the Pit continues to fill, the rate of fill (i.e., rise in feet per year) will decrease. There are several reasons for this decrease, e.g., increase in water surface in the Pit which results in increased evaporation, the decreased recovery rate, etc. The Agencies plan to use a fill rate that is routinely updated for future predictions based on actual measurements.

Comment 10D-5: Several assumptions made in the groundwater modeling are flawed: (1) the Pit aquifer is not isotropic and homogeneous; (2) no rationale is given for selecting many of the boundary conditions; (3) impacts to the alluvial water table as a result of water rising in the bedrock aquifer are not addressed, and (4) inconsistencies were noted in the sensitivity analyses for wells GS-28 and GS-29s. (BSB 3)

Response: The bedrock aquifer associated with the Berkeley Pit/East Camp System and the associated mine workings has been functioning as a homogeneous unit. This has been demonstrated through a statistical analysis performed by the State on selected shafts, bedrock wells, and the Pit. The selection of the boundary conditions (if the comment is referring to the boundary for the area of influence of the Pit System) was determined using current and historic information. Boundary condition parameters are described in detail in Section 11.4.4 of the RI report. EPA and MDHES believe the groundwater model to be accurate.

Inconsistencies in the sensitivity analysis were deemed insignificant to the general results of the modeling. The RI and associated CWL for the Berkeley Pit/East Camp System were limited to the bedrock aquifer. Rising water levels in the bedrock aquifer and the coinciding impact on the overlying alluvial aquifer were preliminarily investigated in the RI. This numerical model predicted a minimal effect on the alluvial aquifer. The monitoring program will track this issue with the collection of hard data.

E. WEST CAMP WATER/TRAVONA

Comment 10E-1: The Preferred Plan allows the Travona water to go as high as 5,435 ft in elevation. It's at 5,427 ft now before it is pumped. That water may also contribute to the poor quality entering Silver Bow Creek from the bedrock aquifer, particularly since where it is pumped is 25 ft higher than where the creek becomes a gaining stream. EPA must lower the level at which that water is pumped. Also regarding Silver Bow water, arsenic and iron currently exceed water quality standards after dilution at the Metro Sewer Plant. EPA and the State must insist in the ROD on meeting the applicable standard instead of creating early precedents for waiving legal requirements. (T 9, G 2)

Response: EPA and MDHES believe the 5,435-ft CWL for the West Camp is appropriate. The points of compliance for the Travona/West Camp System CWL shall be: the Emma and Ophir shafts and the additional monitoring wells for the Travona/West Camp System installed as part of the monitoring program. This will maintain flow in this System to the Travona mine shaft. No legal requirements have been waived for iron and arsenic in the Metro Plant discharge. The requirements for the Metro Plan discharge are set by the MDHES Water Quality Bureau not the EPA or State Superfund programs.

Comment 10E-2:   Regarding the Travona Mine water, which is pumped to the BSB Metro Sewer and diluted before discharge to Silver Bow Creek, how do EPA and MDHES justify not meeting State water quality standards for arsenic and iron in this "treatment"? This commenter ask that EPA and MDHES not set an early precedent for waiving water quality standards during Superfund cleanup of the headwaters of the Clark Fork River. (G 2)

Response: The BSB Metro Sewer discharge is regulated and must meet Silver Bow Creek discharge limits. At present they meet the State's discharge limits. As the cleanup of Silver Bow Creek continues, BSB may no longer be able to accept this mine pump water and still meet discharge limits. Existing orders establish that if BSB cannot or will not accept these mine waters, a treatment facility will be constructed that will meet Silver Bow Creek discharge standards.

4.11 MINING-RELATED COMMENTS

The following comments have been divided into three groups: (A) loss of the ore body, (B) potential problems with the Continental Pit, and (C) present and future mining.

A. LOSS OF THE ORE BODY

Comment 11A-1:   Another ramification of the use of the Pit as a sludge repository is the loss of the underground ore body. Allowing water to approach the 5,410-ft level means the loss of potentially tens of billions of dollars in gross revenues from the sale of metals and tens of millions of dollars in lost tax revenues to the County, State, and Federal governments. Valuable ore that could provide jobs and tax revenues and insure the economic future of BSB for years to come is being written off in advance as contamination. The ore body must be considered a long-term, strategic economic resource, not potential contamination.

The following scenario has been developed from historical data collected by Anaconda Copper Mining Company and New Butte Mining to illustrate some of the potential economic benefits to be derived from protecting and mining the ore bodies underlying the Butte Hill.

Shallow ore reserves are 122,786,894 tons containing 0.88% copper and 0.33 oz/ton silver. Using the assumption that: (1) 100% of the reserves would be mined, (2) 80% of the copper and silver and 70% of the molybdenum would be recovered from the ore mined, and (3) the copper is worth $1/lb, the silver is worth $4/oz and the moly $0.50/lb, the copper in the shallow reserves is worth $1,728,839,467, and the silver is worth $129,662,960. Shallow reserves represent a combined value of $1,858,502,427.

Deep reserves are 2,231,034,219 tons of 0.06% copper, 0.21oz/ton gold, and 0.028% molybdenum. Using the assumptions above, the value of the copper is $21,417,929,000; the silver is worth $1,499,254,995; and the molybdenum is worth $437,282,707. Deep reserves represent a value of $23,354,467,000. Using the assumptions above, the combined value of shallow and deep ore reserves is $25,212,969,000.

These conservative estimates are based on proven reserves delineated by AMC and reported by Richard N. Miller, Chief Geologist, in the document "Ore Reserves and Resources: The Anaconda Mineral Company, Butte District, Montana to January 1, 1978." According to this AMC report, significant deposits of manganese, zinc, and lead also remain to be mined under and adjacent to the Berkeley Pit. If continued flooding is allowed in the Pit, and worse, if the Pit is used as a sludge repository, this ore body would essentially be lost or rendered considerably less valuable for future generations. Worse yet, an enormous economic resource would be written off in advance as a liability to be treated with lime and disposed of in sludge. (BSB 2)

Response: EPA and the State believe that sludge disposal in the Pit will not render the ore body unminable. The flooding of the Berkeley Pit and associated underground mine workings and disposal of sludges in the Pit do not eliminate the "resource" (i.e., the mineralized ore body) from being mined in the future. We do realize that allowing the East Camp System to rise to the 5,410-ft level will inundate much of the ore reserves and that the cost of dewatering the System will be high and may discourage underground mining. The remedy outlined in the ROD will place no restrictions on underground mining.

Comment 11A-2:   This commenter acknowledges the previous comment but goes on to talk about the potential for mining the water in the Berkeley Pit. The commenter point is that studies are underway to assess technologies for extracting metals from this water. MSE and the Resources Recovery Program issued a worldwide RFP, which went out to more than 200 companies in the major industrial nations of the world. There were over 32 responses to that RFP. The decision process narrowed those 32 responses down to 10. The final selection process is underway right now. Those proof of technologies on actual Berkeley Pit water at treatment-scale levels could be occurring as early as September of this year. (T 12)

Response: EPA and the State believe that programs such as the DOE Resource Recovery Program will aid in the development of technology, which may contribute to more cost-effective solutions to the mine flooding problem. The ROD specifies that there must be a reevaluation of the available technologies when the Pit level reaches the 5,260-ft level. We expect technologies, such as those being demonstrated by the Resource Recovery Project, to be evaluated at that time.

B. POTENTIAL CONTINENTAL PIT PROBLEMS

Comment 11B-1: Present generations should pay for the best available treatment option, if a permanent non-treatment solution is not available, to establish a precedent of paying the true price of commodities like metal. Then public support would be strong to prevent mining that doesn't have a permanent remediation solution and a large enough bond to properly close the site. For example, what remediation efforts, if any, are in place for the Continental Pit once mining ceases? Will we allow the mining company to turn off the pumps and let that pit fill and become a big problem like we did at the Berkeley Pit? If no permanent solution exists that can eliminate danger and cost to future generation, then we should ban this type of mining until adequate permanent solutions are developed. (I 4)

Response: The Continental Pit is part of the East Camp System and we expect the water level in the Continental Pit to be similar to the water level in the Berkeley Pit and the rest of the East Camp. By controlling the level of the East Camp as specified in the ROD, regardless of the withdrawal point, the level of the Continental Pit will be maintained at a level which precludes migration out of the system.

It should also be noted that DSL is currently conducting a review of the existing reclamation plan at MR pursuant to the Metal Mine Reclamation Act (MCA § 8-24-337). In its review, DSL is evaluating the need for a permanent water treatment plan as pan of an updated MR reclamation plan. An updated plan is due to be submitted to DSL on January 1, 1995.

DSL will review the updated plan, evaluating the quality and quantity of water that can be expected to report to the Continental Pit from all sources. A decision must then be made on whether to allow that water to accumulate in the Continental Pit and if so, to what level. MR's plan will include specific plans for water management. DSL must review the proposed plans and also evaluate alternatives. The decision maker must select an alternative for implementation. The alternative selected would have to meet the standards established in the Water Quality Act and the Metal Mine Reclamation Act. Bond would be assessed based on the plan selected by the decision maker.

DSL permitted and bonded for permanent water treatment at MR in 1993. That bond calculation and methodology is similar to that used for other mine site in Montana with an open pit. The level of water in the Continental Pit would be limited to the capacity of a sump which would be designed to hold water that accumulates in the Continental Pit over winter. Water would be treated the following spring, summer, and fall. Thus, no more than six months of water would be allowed to accumulate at any one time.

Permanent water treatment is both an operational requirement and a contingency plan to be used once reclamation limits the amounts of water needed to be treated. The goal of reclamation is to minimize the volume of water needing treatment. If the remaining seepage is more than the environment can absorb or evaporate without off site impacts to water quality, a contingency water treatment plan is needed.

Bonds are posted as surety bonds which are converted to trust funds at the end of mine life. Trust fund bonds include the costs of constructing treatment plants, operating and maintaining the plants, and costs of replacing the plants every 20 years. DSL must assume that the mining company would leave the unreclaimed site and DSL would have to step in and initiate reclamation and water treatment if necessary.

Comment 11B-2: First, why haven't EPA and MDHES prohibited the nearby mine currently in operation from dumping their wastewater into the Berkeley Pit? If this a federal Superfund site, shouldn't polluters be prohibited from increasing the contamination? The current mining operation is not only adding to the contamination in the Berkeley Pit; it is also adding to the surface water inflows to the Pit - inflows that might have been clean water but have been degraded by the current mining operation. According to CERCLA, as amended by SARA, the aim of Superfund is to reduce contamination, not to add to it. Why have none of EPA 's alternatives considered prohibiting the current mining operation from continuing the practice of dumping their wastewater into the Pit? (I 43)

Response: Several statements in this comment are incorrect. The current operator is not dumping their wastewater into the Berkeley Pit. Waters from the concentrator are placed in the Yankee Doodle Tailings Pond. Then "decant" water is taken from the Pond and returned to the concentrator. As the RI demonstrates, there is a "closed loop" in the water balance of the current operator. (Also see response to Comments 19A-1 and 19A-3, Section 3.19A.)

EPA does not have the authority, outside of Superfund, to control surface water inputs to the Pit. The Pit is considered to be a giant holding lagoon which is not regulated under the Clean Water Act. Discharges out of the "lagoon" are regulated under the Clean Water Act but these type of discharges will not occur for many years. Under Superfund, however, EPA is allowed to take additional actions necessary protect human health and the environment. To take this action the Agency must follow the NCP and go through the RI/FS, ROD, and associated enforcement processes as is currency being done.

C. PRESENT AND FUTURE MINING

Comment 11C-1: In the Preferred Alternative, treatment of the Berkeley Pit water will not occur until present mining operations cease. The year 2005 has been used for calculation purposes in the RI/FS. This figure is purely arbitrary, yet the RI/FS offers no beyond the year 2005. Apparently, MR can wait until the CWL is reached before they even begin to construct a water treatment system. A water treatment system generally requires at least a two year 'shake down' period before it is on-line and fully functional.

According to the Preferred Alternative, the CWL may be reached by the year 2022. MR has estimated that the ore body in the East Continental Pit area will last until 2015-2025. As both of these figures are estimates, it is clear that an unacceptable situation could arise. EPA must include a contingency plan in the Preferred Alternative that addresses this situation. (I 5)

Response: EPA and the State have included provisions in the ROD, because of public comments such as this, that dictate that construction of a treatment plant, capable of maintaining the water level in the East Camp System below the CWL and meeting discharge standards, be completed four years prior to when the water level in the system is projected to reach the CWL regardless of whether or not mining continues.

Comment 11C-2: If mining doesn't cease in 2006, there should be a plan to adjust to this to maintain the Pit level below the CWL. Alternative 6/7 uses mining procedures in its treatment of Horseshoe Bend water until these waters are routed to primary treatment in the post-mining stage (FS, 1994). If mining continues longer than expected, will the reroute of the Horseshoe Bend water to primary treatment still take place in 2006 or is it dependant upon mining activities? If mining does continue and Horseshoe Bend water isn't diverted to primary treatment as per the plan, the final stabilized Pit water level could change. This should be evaluated and described before a plan is picked and initiated so that target water levels can be set and success measured appropriately. (I 4)

Response: If mining doesn't cease in 2006, the ROD dictates that control of Horseshoe Bend water must continue and the construction of a treatment facility, capable of maintaining the water level below the CWL, must be completed four years prior to the water level in the East Camp System reaching the CWL.

Comment 11C-3: The role of the existing mining operations should be completely clear. They should not be allowed to follow any practices that worsen the condition or delay the cleanup. Currently, the MR Concentrator overflow ditch is contributing 0.14 million gallons of water per day to the Berkeley Pit. This is an unnecessary accelerator to Pit filling that must be stopped. Any water used by the existing mining operation should be treated at their expense at the treatment plant at the concentrator and discharged into the Metro Storm Drain or Silver Bow Creek. (I 4)

Response: The ROD requires that Horseshoe Bend flow be controlled. There will be allowances for upset conditions or overflows. This will be limited however to fairly limited flows and circumstances. EPA and the State expect all costs associated with treatment of waters associated with the MFOU to be paid collectively by the PRPs. The arrangements between these parties for costs, including the costs of treatment for contributions to the Pit during these upset conditions, will be left up to the PRPs to decide.

4.12 HUMAN HEALTH

Comment 12-1: Perhaps on issues that have perpetual implications, you should give greater weight to opinions of parents than you do to intimidated short-term public officials, because when it comes to human health and the environment, mothers and fathers know what is best for their kids and future generations. (I 30)

Response: The CERCLA process requires that any citizen, whether a private citizen or a public official, has the right to voice their opinion and concerns regarding the proposed remedy. This is the purpose of the required public comment period for the Proposed Plan. One of the nine criteria which EPA uses to evaluate proposed remedies is Community Acceptance, which requires EPA to evaluate the issues and concerns the public may have regarding each of the alternatives. Therefore, EPA is required to consider and respond to all comments received from all parties during the public comment period.

Comment 12-2: We are writing in opposition to the current EPA-ARCO remedy plan for the Berkeley Pit for the following reasons. We are concerned regarding the danger to public health due to the risk of contaminants getting into the aquifer. We do not feel our children should inherit our problems - such a legacy as the problem of the Pit is too drastic to pass on to a future generation(s). (I 19)

Response: EPA and the State believe that the remedy outlined in the ROD is protective of human health and the environment and contaminants will not migrate into the alluvial aquifer. We also believe that treatment will be required in perpetuity regardless of the type of treatment employed or the level at which the Pit is maintained.

Comment 12-3: Have the synergistic effects of pollutants been considered with the RI, FS, and Proposed Plan? (I 43)

Response: The MFOU risk assessment examined the potential affects on human health and the environment from exposure to aluminum, arsenic, cadmium, copper, iron, lead, sulfate, and zinc and in the absence of any remedial response action. Each contaminant was evaluated separately since a reliable method for evaluating the synergistic health risks from exposure to these contaminants is not currently available.

Comment 12-4: More emphasis should be on the "worker" scenario because mining operations are still continuing. A chart summarizing risks would be helpful. Was arsenic the only contamination that exceeded the carcinogenic range? If not, describe others. (I 37)

Response: Direct contact to the Pit water or the Horseshoe Bend water poses insignificant risks to workers. This water would have to be ingested to pose a significant risk. We believe that ingestion of this water by workers is an impossibility, hence it was not evaluated. Mine worker safety falls under the authority of such regulations as the Occupational Safety and Health Act (OSHA) and the Montana Safety and Health Act (MSHA); therefore, a "mine worker" scenario was not evaluated by EPA during the MFOU risk assessment. During the construction of any water conveyance or treatment facility pursuant to the MFOU ROD, worker safety from exposure to the contaminants of concern will be ensured through adherence to health and safety procedures. These procedures will be documented in the remedial design/action work plans.

Arsenic and cadmium are the contaminants of concern with respect to potential carcinogenic risks. Based on the risk assessment, only arsenic would present a potential future threat to human health. This risk, however, will not occur since EPA has an agreement with the PRPs (AO - Docket No. CERCLA VIII-90-10) that requires the PRPs to maintain the elevation of the Pit water below 5,410 ft. This provision ensures that contaminated Pit water will not be released to the alluvial aquifer or Silver Bow Creek.

Comment 12-5: One commenter said if the Berkeley Pit water is contaminated, what about the miners who worked there. He wants to know what is being done for former copper workers. (BSB 4-L)

Response: Regulations set forth under the NCP do not address past occupational health issues; therefore, these issues were not considered during the conduct of the MFOU RI/FS. Since contaminated water is only a threat to human health if its ingested, it is unlikely that a mine worker would have been exposed to these metals.

Comment 12-6: The primary concern is not who pays and how much, but is rather the health of our citizenry and of the watershed, which are inextricably intertwined. (BSB 15, I 36)

Response: The ROD dictates that the East Camp/Berkeley Pit be kept below the 5,410-ft elevation and in the West Camp System below the 5,435-ft elevation. Water from the system must be treated to State discharge standards. This action precludes any direct impact to the alluvial aquifer or Silver Bow Creek from contamination in the Pit System. This remedial response action also includes institutional controls restricting the use of contaminated groundwater. Together these actions will protect human health and the environment.

Comment 12-7: A summarization of chemical analysis should be included - state maximum peaks, etc. (I 37)

Response: Complete chemical analysis of groundwater samples are shown in the RI report. The complete analysis of potential human and environmental health threats is presented in the Baseline Risk Assessment. These documents are available at the Superfund information centers in Helena, the Butte Superfund Community Involvement office, the Montana Tech library, and the BSB library.

Comment 12-8: According to the NCP, the purpose of a Baseline Risk Assessment is "to characterize current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to the air, leaching through the soil, remaining in the soil, and bioaccumlating in the food chain." The Baseline Risk Assessment that was completed by the EPA and MDHES addressed the risks posed by ingesting contaminated surface or groundwater. However, it does not address the risk to human hearth from dust blowing off of the barren, exposed walls of the Berkeley Pit. In fact the Pit walls have been placed with the Active Mining Operable Unit. This operable unit will not be addressed until mining operations have discontinued.

A study by Luoma and Moore (1990) discovered a higher incidence of disease in Butte than in comparable cities. This was found in both men and women indicating that the exposure route was environmental rather that occupational. It is likely that windblown dust may be a contributing factor. Stabilizing the Pit walls should be addressed in the MFOU, not in the Active Mining Operable Unit. This unhealthful situation must not be ignored until active mining ceases. (I 5)

Response: The MFOU action addresses only the problems related with contaminated groundwater associated with the flooding underground workings and the Pit. Reclamation and blowing dust is addressed by the DSL operating permit and the future RI/FS activities for other operable units.

Comment 12-9: Moore and Luoma (1990) compiled several studies on disease-related mortality in the Clark Fork Basin, including Butte. They found that Butte, compared to cities of similar population, ranked highest in all disease related deaths for 1945-51 and 1959-61 and was first among "other diseases than heart and kidney" for the periods 1959-61 and 1969-71. Great Falls and Billings, for comparison, ranked between 350-450 in all categories.

Trachea, bronchial, and lung cancer from 1970-79 were especially high in areas of "primary contamination." Silver Bow County had a mortality rate from lung, trachea, and bronchial cancer per 100,000 of 55.3 compared to Montana's 31.1, North Dakota's 20.5, Idaho's 22.9, Wyoming's 26.7 (Data from Riggan, et al., 1983 in Moore and Luoma, 1990). Moore and Luoma (1990) also found that by looking at female mortality rates that the cancer deaths did not appear to be solely from occupational sources. They found that during the same 1970-79 period that overall cancer rates for Silver Bow County women fell within the highest four percent for all U.S. Counties (Data from Riggan, et al., 1983 in Moore and Luoma, 1990).

The work plan assumes that the only threat to humans is from drinking contaminated waster from groundwater. Since past Institutional Controls have stopped the citizens of Butte from drinking the groundwater, yet these abnormally high cancer rates persist, it can be assumed that other environmental factors are putting people at risk. The work plan should have commissioned a more comprehensive RI/FS that addresses the other hazards to human health including airborne contaminants. (I 4)

Response: See response to Comment 12-8, Section 4.12.

Comment 12-10: Please see the attached by Luoma and Moore on health hazards in the Upper Clark Fork due to mining. Please advise how this Preferred Plan addresses air contaminants, given the high incidence of lung disease, even among women, recorded for this area. Will the Agency for Toxic Substances Disease Registry review this research to attempt to identify long-term causes of the high rates per capita for all diseases, heart disease, etc. (G 2)

Response: See response to Comment 12-8, Section 4.12.

Comment 12-11: The commenter includes a paper entitled, "Hazardous Wastes from Large-scale Metal Extraction: The Clark Fork Waste Complex, MT" by Johnnie Moore and Samuel Luoma (BSB 6)

Response: The paper is include in the Administrative Record for this operable unit.

5.0 RESPONSES TO COALITION COMMENTS

This section provides EPA and MDHES responses to comments by the Clark Fork River - Pend reille Coalition on June 30, 1994 in a document entitled Alternate Plan and Rationale for Berkeley Pit and Mine Flooding Operable Unit. EPA and MDHES have broken the responses to issues in this document into 2 parts. First, we respond to the "big picture" as presented by the Alternative Plan presented in the "General Response" Section. We then respond to the individual points in the document.

GENERAL RESPONSE:

EPA and the State appreciate the comments received from the Clark Fork - Pend Oreille Coalition (CFC) and recognize the large amount of thought and work that went into this document. Even though we do no agree with all the points made in the document, this document, along with other comments we have received, has impacted our decision in numerous ways. Our response to the major points of the plan and the impacts on the original proposed plan are outlined in this section.

Major Points of Proposal:

1. Project Structure and Schedule
2. Need for additional data
3. Inflow Control
4. More Protective Critical Water Level
5. Treatment technology to Drive Final Pit Level
6. West Camp
7. Financing

1. Project Structure and Schedule

The CFC plan calls for an interim ROD produced now with a final ROD produced after further data gathering and treatment technology development. EPA and the State see no major benefit in producing an interim ROD. Additional data will be gathered in the future through the post ROD monitoring program, additional studies, and technology development programs. EPA and the State will amend the ROD (or issue an ESD) if this information causes significant differences in elements of the ROD (e.g., alternate treatment technology, alternate CWL).

2. Additional Data

The CFC plan calls for a large data gathering effort. Many of the proposed studies and data gathering efforts have valid scientific merit and provide additional assurances of the protectiveness of the remedy. After reviewing public comment, we recognize that additional analysis of the impact of placing sludge in the Pit is necessary as well as some additional groundwater monitoring. We believe, however, that much of the data gathering effort is unnecessary for making this remedial decision.

3. Inflow Control

The CFC plan calls for maximum inflow control. The Proposed plan emphasized Inflow Control and the ROD continues to emphasize this element. To strengthen this component of the remedy the ROD requires that subsurface flow in the Horseshoe Bend area be collected and treated and that, after mining is suspended or the mine is closed, upgradient diversion of all major surface flows presently used in the mining operation be diverted.

4. More Protective Water Level

EPA and the State strongly believe that the CWL is a safe water level and protects human health and the environment. We understand the uncertainties expressed and the anxiety that the public has concerning this issue. We have responded to these uncertainties in the following ways:

a. The ROD requires that the critical water level of 5,410 ft apply to the entire East Camp system, not just the Pit. The water level in the Anselmo Mine is currently about 40 feet above the Pit water level. Therefore, if this gradient remains there would be a buffer of 90 feet between the Pit and the level at which Pit water can discharge into the alluvial system (5,460 ft). A buffer of at least 50 ft is guaranteed even if this gradient between the Pit and the Anselmo shaft is reduced.

b. The ROD requires that the inflow of water be reduced significantly to allow a much slower rise in the system water level. This allows much more time to react to any unanticipated impacts.

c. The ROD requires that a comprehensive monitoring program be employed to thoroughly monitor the system and act as an early warning system.

d. The ROD has a requirement to have construction of a final treatment plant completed 4 years prior to when the water in the East Camp system reaches the CWL. This allows for early start-up if necessary.

e. EPA and the State retain authority identified under Federal and State law to establish a lower CWL or take alternative action if necessary to address unanticipated threats to human health or the environment.

5. Treatment technology to Drive Final Pit Level

The CFC plan calls for a specific schedule to develop and implement innovative treatment technology which would drive the final Pit level. EPA and the State do not believe that treatment technology should drive the final mandatory maximum Pit level. We do believe however that innovative treatment/metals recovery technology development is important. We received considerable comment from the public concerning the volume of sludge that will be generated by the aeration/hydroxide precipitation technology proposed and the public's view that a technology that would recover metals is much preferable. We believe that these are valid points and have sought to address these issues in the ROD in the following ways:

a. EPA and the State are actively involved in an advisory role with the DOE resource recovery project which is actively pursuing demonstration of or acting as a testing ground for both treatment and metals recovery technologies using the Berkeley Pit waters.

b. EPA and the State remain flexible in the implementation of alternate treatment/metals recovery technology proposed jointly by the developers of that technology and the PRPs, if that technology meets the performance (discharge) standards established for this action.

c. The ROD requires that a reevaluation of treatment technology be conducted when the water level of the Pit reaches the 5,260-ft level (presently projected in 2009).

d. EPA Region VIII and the State will actively pursue federal monies for research and development of innovative treatment/metals recovery technology for Berkeley Pit water.

6. West Camp

The basic recommendations from the CFC plan calls for: a) lowering the CWL for the West Camp to 5,410-ft level; b) evaluation of the bulkhead integrity; and c) construction of a treatment facility for the West Camp water.

a. EPA and MDHES believe that the 5,435-ft CWL for the West Camp is appropriate. We have not observed any impact in Silver Bow Creek in this area which would indicate significant seepage. We will be installing four additional wells, however, to better define the bedrock water levels immediately adjacent to the southern boundary of the West camp system. The CWL will be adjusted, if necessary, based on the information generated from the installation of these wells and subsequent monitoring.

b. EPA and the State do not believe that the integrity of the bulkheads needs to be evaluated. The failure of the bulkheads would actually lower the level in the West Camp to the lower East Camp level and would make a discharge to Silver Bow Creek even less likely.

c. The commenter indicates that the PRPs benefit by their contract with Butte Silver Bow by diluting the arsenic in the West Camp water (the majority of the iron is removed by the treatment process) with sewage to meet discharge standards. This situation is correct. The "I" classification allows this flexibility for existing permits (as opposed to new permits). The requirements for the Metro Plant discharge are set by the MDHES Water Quality Bureau, not the EPA or State Superfund programs. The BSB Metro Sewer discharge is regulated and must meet Silver Bow Creek discharge limits. At present the plant meets the State's discharge limits. As the cleanup of Silver Bow Creek continues, BSB may no longer be able to accept this mine pump water and still meet discharge limits. Existing orders establish that if BSB cannot or will not accept these mine waters, a treatment facility will be constructed that will meet Silver Bow Creek discharge standards. EPA and the State do not believe that building a treatment plant at this time is a wise decision. We believe that construction of a treatment facility for the West Camp water should be coordinated with Lower Area 1 treatment plant construction.

7. Financing

The CFC plan calls for additional assurances for the long-term financing of this action in the form of bonding. The evaluation of the mechanism for financing this project is not part of the ROD, but rather it is closely tied to the enforcement of the decision. The ROD, therefore, does not directly address this issue. Regardless, EPA and the State received considerable comment concerning the financing of this project. Many parties indicated that, because of the length of time until a final treatment plant may be necessary and the fact that this treatment plant will need to be run in perpetuity, additional financial assurance is necessary. We understand this issue and the public concern and we are presently evaluating our options concerning bonding or other financial assurance possibilities.

PLAN AND RATIONALE FOR

BERKELEY PIT AND MINE FLOODING OPERABLE UNIT

FROM THE CLARK FORK - PEND OREILLE COALITION

Presented to: U.S. Environmental Protection Agency

Date: June 30, 1994

Introduction

EPA's Preferred Plan for remediation of the Berkeley Pit and Mine Flooding Operable Unit is unacceptable to the people of Butte and to the Clark Fork-Pend Oreille Coalition. Major points of disagreement are the elevation at which the Pit would be allowed to remain in perpetuity, and the future unfriendly idea of waiting 30 more years to initiate any pumping and cleaning of toxic Pit water. Disagreement emanates not just from uncertainties associated with the Plan, but also the certainties certainty that the perpetual elevation for toxic Pit water would leave a heritage of impending crisis to all future residents.

In consultation with residents who are knowledgeable about the Hill, the economy and the social system of Butte. Coalition scientists and technical people have prepared the following Community-Based Alternative to the EPA Preferred Plan. It combines much of Butte-Silver Bow County's recommendations, with revised elevations and time schedules. The Plan grows out of the need for new treatment technology now, and it relies on the proven impetus of deadlines, American know-how, and market forces to bring forth that technology. It allows EPA to move forward with most of the work suggested in its Preferred Plan, but asks that this occur under an Interim Record of Decision. In that way, the new monitoring wells and other needed investigative work can occur under an Extended Remedial Investigation. The new, effective technologies that everyone unanimously agrees are needed can be addressed under an Extended Feasibility Study. It allows that the Final Preferred Plan and Record of Decision not be issued until after specific technical and legal data gaps are filled-and that the Pit be pumped and treated at the earliest possible time, considered to be the year 2002.

Recognizing the EPA requires technical or legal reasons to deviate from its Preferred Plan, the Coalition has documented some of the inadequacies on which that Plan is based. These are summarized in an Appendix, "Reliance on Assumptions, Theories and Speculation," for that is the one thread that runs through all the complexities of the Preferred Plan and it is core to the public's problem with the Plan. A tremendous number of unsupported assumptions, opinions, models and estimates creates an unacceptable cumulative margin for error in Butte's one-and-only chance for remedy of the Pit and Mine Flooding. Evidence is presented that the Preferred Plan disregards some of EPA's own criteria for remedy selection (pg. 14, e.g., Toxic Volume Reduction, Short and Long Term Effectiveness, Cost, some air and water ARAR's (Applicable Relevant and Appropriate Regulations) and Community Acceptance). Questions and concerns presented here were filtered from those of Coalition scientists and staff. Butte's EPA grant-funded CTEC (Citizens' Technical Environmental Committee), Butte-Silver Bow County scientists, plus students and others who have followed this issue closely.

It is also significant to note that a 30-year postponement causes a great deal of current on-the-ground and underground expertise and understanding of the situation to be lost (death, relocation, etc.), resulting in reliance on documentation as opposed to first hand experience. Because future generations may have less understanding than we have at present, today's generation is in a better position to move forward with a solution.

The Coalition believes that, through a thoughtful review of the Appendix, EPA will become convinced of the validity of the community outpouring that the Preferred Plan is unacceptable. The Coalition proposes the following Plan that combines the best aspects of the EPA Plan, plus removes some of the uncertainties to which citizens object.

A COMMUNITY-BASED ALTERNATIVE

The Coalition believes that it is in the long-term best interest of the citizens of Butte-Silver Bow and all its downstream neighbors, as well as the environmental health of the Clark Fork River Basin that contaminated water in the Berkeley Pit begin to be pumped and treated as soon as technically possible, utilizing treatment that minimizes waste sludges while freeing clean water for permanent, beneficial uses. It is hoped this can eventually include decreasing the volume of toxic materials currently in the Pit to provide a greater margin of safety to future generations. The need for decreasing toxic volume from today's levels could be determined based on any increase in confidence from the community after data gaps (discussed below and in Appendix) are filled.

The following alternative plan, like the EPA alternative 18/19, holds the Pit level at its elevation at the time the remedy is implemented. The plan agrees with many of the Butte-Silver Bow County recommendations, but employs a lower protective Pit water level based on earliest possible implementation, which is considered to be the year 2002. This allows some time to develop more effective treatment technology. The plan also emphasizes management of water inflows.

The process for implementation of an alternative plan would include:

- An Interim ROD now (Record of Decision) specifying need for additional information which would be accomplished under an

  - Extended RI-FS (Remedial Investigation-Feasibility Study), then a

  - Final Preferred Plan and

  - Final ROD could be issued as soon as an adequate treatment technology is found.

The Coalition recommends that implementation not be tied to any specific Pit water elevation, but to the need for soonest possible implementation of treatment, recognizing the need for responsible action from today's generation.

The following paper outlines the important components of this community-based alternative.

A. Additional Data

1. Data Gaps Must be Eliminated to the Extent Possible: A Sensitivity Analysis is requested of all the "soft" data and assumptions (see Appendix) that have gone into the RI-FS and on which the Preferred Plan is based. While normally associated with economic projections for decision-making, this type of exercise would be valuable to both the community and to EPA in justifying whatever decision is finally deemed appropriate. This analysis should be accomplished first: then this year's Interim ROD would delineate what new data must be generated over the next year to fill-in the most critical data gaps. Areas which appear to require new data immediately include:

- Immediate implementation of monitoring wells southeast of the Berkeley Pit and in the West Camp as specified in the Butte-Silver Bow recommendations and by Rowling Technical Services, plus consideration of a deep quality well at Rocker.

Response: EPA and MDHES believe that the wells and monitoring points shown in the monitoring plan attached to the ROD are adequate to monitor the bedrock aquifer. This includes three new wells in the East Camp and four new wells in the West Camp. The County has worked with EPA and MDHES and has contributed to the siting of the additional East Camp wells. EPA and MDHES do not believe that an additional bedrock monitoring well at Rocker will provide useful data. EPA and the State will install wells and monitoring points as necessary in the future based on the ongoing evaluation of the monitoring program. Also see responses to comments in Sections 3.4, 3.16J-4 and 4.2.

- A more accurate water budget and thorough analysis of potentially slowing inflows. From these, the volume of water necessary to pump in the year 2002 can be more reliably projected. A total water budget must include municipal leakage and, importantly, fate of outflow (including at the Colorado Tailings). If the water level stops rising, incoming water is going somewhere. If less water needs to be pumped in succeeding years, PRP's (Potentially Responsible Parties) must prove it is not leaving the Pit to create a new problem.

Response: The water budget for the Berkeley Pit/East Camp and West Camp Systems was thoroughly studied during the RI. All projections are made on a very conservative basis. We believe that further fine tuning of the water balance is more of a an academic exercise and that monitoring the rise of water levels over time will provide better information for future projections and decisions. The current data indicate that all water is being contained within these systems. The bedrock monitoring system ensures that contaminated water will be detected before it could exit the hardrock systems. Also, see responses to comments in Sections 3.16C, 3.16G. 3.16J-4, and 4.10-B.

- More definitive ground water modeling to include:

  thermal influences
  conservative expectations of cone of depression influence on Pit and tunnels

  potential East Continental Pit influences on contamination migration

  determination of exact locations of ground water divides: possibilities of flow reversals.

Response: EPA and MDHES believe that the thorough groundwater modeling conducted as part of the RI/FS was adequate to characterize the location of the groundwater divides. Additional groundwater modeling will be conducted if EPA and MDHES feel that it is warranted. EPA and MDHES acknowledge that contaminated groundwater may migrate eastward toward the Continental Pit if dewatering in that Pit lowers the surrounding groundwater such that the cone of influence reaches the Berkeley Pit/East Camp System water. However, groundwater will still be contained within the Berkeley Pit/East Camp System. See responses to comments in Section 4.10D.

- Quality of inflow and outflow due to mine flooding must be stated in the Mine Flooding O/U (Operable Unit) to assure that all contamination releases are addressed. This should include characterization of sources of bedrock aquifer contamination releases at the end of the Colorado Tailings with remedy for same addressed under this O/U.

Response: The quality of all sources of groundwater in the MFOU are adequately characterized in the RI/FS. The bedrock groundwater entering Silver Bow Creek in Lower Area One is from shallow sources not connected or related to the bedrock aquifers within the Berkeley Pit/East Camp System. See responses to comments in Sections 3.16B and 4.10B.

- Pit microbiological and geochemical studies.

Response: Additional evaluation concerning the geochemical impact of sludge disposal in the Pit are deemed necessary before approval of sludge disposal in the Pit will be approved. Additional microbiological and geochemical studies may be considered in the future if deemed necessary by the Agencies to make decisions. See also responses to comments in Sections 4.2 and 4.6.

- Pit bottom sediments studies to determine Geochemistry of sediments and whether sediments could be sealing the Pit bottom.

Response: A complete examination of Berkeley Pit sediments may be a worthwhile exercise but is beyond the objectives and scope of this decision. Additional evaluation associated with the disposal of sludge in the Pit are necessary. The scope of this evaluation has not been determined. See also responses to comments in Sections 3.14, 4.4, 4.5C, 4.6 and 4.8.

- Development of downstream landowner program for monitoring of "new springs" between Butte and Garrison Junction.

Response: Several monitoring points in the Outer Camp are included in the post-ROD monitoring program. This area will also be evaluated in the Non-Priority Soils Operable Unit RI/FS. EPA and MDHES believe that there is presently no necessity to make provisions for the monitoring of potential "new springs" between Butte and Garrison as part of this RI/FS. This issue will be reevaluated upon completion of the Outer Camp studies in future RI/FS work.

- Studies of relationship between saturated bedrock and potential rise of alluvial aquifer.

Response: The RI modeled the potential impact of the rising bedrock aquifer on the alluvial aquifer and we believe that impact will be relatively minor. Regardless, the monitoring program has been set up to monitor the future impact. We have included numerous monitoring points in the areas where the largest and earliest impacts will occur if, in fact, any impacts can be observed.

- A plan for preventing loss of the many bulkheads between East and West Camps and/or a contingency plan for dealing with the loss if it occurs. It would include analysis of East vs. West hydraulic heads, relationship of locations/elevations of bulkheads to one another and possible to Orphan Girl area, Green Lake Seep, etc.

Response: EPA and MDHES believe that the hydraulic relationships between the West Camp System and the Berkeley Pit/East Camp System is well characterized for this action. The setting of the CWL at a higher elevation in the West Camp compared to East Camp System is to ensure that the groundwater gradient is toward the East Camp System. Failure of a East Camp/West Camp bulkhead will lower the water in the West Camp posing no risk to human health and the environment.

- Identification of any additional contaminants within the OU with risk analysis and public information (e.g., organic contaminants within current mining lands and leach pads).

Response: Contaminants other than the arsenic and the metals are considered negligible and are therefore not addressed by this RI/FS.

- Initiation of air quality epidemiologic investigations (possibly by the Agency for Toxic Substance Disease Registry) and if necessary, feasibility of stabilizing Pit walls.

Response: Air quality was included in the human health risk assessment conducted for this RI/FS and was not found to be a significant threat to human health. Stabilizing the Pit walls is beyond the scope of this action which addresses only groundwater issues. See also responses to comments in Section 4.12.

2. Public information Data Gaps: Better public information and involvement is needed throughout the process so new information (e.g., risk assessment; epidemiologic study) is made available in a way that is both accessible and understandable by the general public. Particular gaps would be filled:

- A public comment period on EPA proposal to "write off" the bedrock aquifer

- A published list of wells (private, public) affected by mine flooding, with more open and proactive EPA communication of implications-where well bans might occur, etc.

Response: EPA and MDHES have gone well beyond the requirements of CERCLA to keep the public informed and to listen and consider public comments. Please see Sections 1.2, 1.3 and 3.91. We do not believe that a formal public comment period associated with the waiver of ARARs for the bedrock aquifer for the East and West Camps is appropriate. However, public involvement is encouraged especially in the institutional controls development associated with the waiver. We plan to initiate a formal public information and update process, which includes involvement by the MBMG. We are hopeful to have Butte-Silver Bow involved in this process to provide an additional avenue for information dissemination.

B. Inflow Control

Interim ROD Must Emphasize the Diversion of an Controllable Water from the Pit: Source control and pollution prevention should always be the first steps in pollution control. In addition to Horseshoe Bend water currently planned for diversion, any increases to the Horseshoe Bend flow must be diverted. Storm water entering mine shafts must be diverted. Leaks in the municipal water delivery system must be repaired. Pit inflow from current mining operation spills and any possible from planned expansion of the Yankee Doodle tailings dam must be more adequately addressed.

Response: The objectives of the selected remedy are clear - maximize control of inflow to the Berkeley Pit. See other responses to comments in Sections 3.8 and Section 4.4. The ROD spells out the additional requirements associated with the Yankee Doodle Tailings Pond operation and expansion.

C. A More Protective Water Level

1. Potential Future Events-Effect on Pit Filling Rate: EPA must identify the types of future events that could cause either a shutdown of Pit pumping and treatment or a need for an increased rate of pumping and treatment. A probability value could be assigned to each, including the number of same occurrences possible

in perpetuity. Some of those events include:

- Earthquake effects on Yankee Doodle Tailings Dam at higher than 6.5 Richter, and re-evaluating distance from Dam, depth, dispersal and attenuation factors
- Possible increased flow of Horseshoe Bend water as a result of adding 60 more feet of tailings to the Yankee Doodle tailings pond
- Earthquake effects on operability of pumping and treatment plan
- Earthquake effects on Pit from collapse of Kelley Mine wall
- Earthquake effects on manmade diversion structures designed to control Pit filling
- Effects on availability of funds for perpetual operation in event of depression
- Potential ARCO bankruptcy effects on availability of funds for perpetual operation
- Acts of War that may shutdown facilities
- Potential for changes in government negating maintenance contracts with County
- Increased cost of pumping and/or treatment maintenance
- Availability of newer, more permanent treatment technology with higher costs.

Response	EPA and MDHES believe that the selected CWL will allow ample time to respond to any future event. Please refer to General Response Points number 4 and 7 in Section 5 for additional assurances provided in the ROD to address such uncertainties as listed here.

2. Margin of safety: A lower Pit level provides a larger buffer against disruption of treatment of catastrophic events that may cause a sudden rise in Pit level. In addition, the lowest Berkeley Pit water level possible would be desired by future generations because if initial treatment becomes too costly or ineffective, future generations will search for another solution, probably a more permanent solution that doesn't require perpetual care. The less water they are faced with cleaning up, the fewer made to implement a non-treatment solution.

Response:	EPA and MDHES believe that there already is "a larger buffer" (see response to Section 5 Section C, response to item 1 and responses to comments in Section 3.1); and we have provided other assurances concerning the construction of a facility well ahead of when the CWL is approached. EPA and MDHES also believe that no valuable purpose will be served by lowering the Pit water level at this time. See responses to comments throughout the Responsiveness Summary, particularly in Sections 3.1, 3.5, 3.9, 3.15, 3.16, and 4.10.

3. Obligation to Accept Responsibility: The Coalition believes that the present generation must provide the best available treatment option and implement it as soon as possible.   All 19 alternatives considered by EPA shift the burden of responsibility from the present generation to future generations. This is not good public policy. Also cumulative effects may be untenable, economically and environmentally, for continuation of the quality of life present generations enjoy. The present generation should implement an effective solution and then not permit the Pit water level to rise farther.

Response:	EPA and MDHES acknowledge this comment and would add that the Preferred Alternative combines the best components of the evaluation criteria. In regard to the Pit water level see previous response.

4. Therefore, the present generation must implement an alternative that holds the Pit at the level it is at when the soonest possible effective solution can be implemented. This option provides time for testing and designating a more effective treatment technology than the currently specified method of hydroxide precipitation.

Response:	EPA and the State do not believe that lowering the Pit to a lower level significantly decreases threats to human health and the environment. See response to comment in Section 5, section C, response to item 2.

D. Treatment Technology to Drive Final Pit Level

1. Deadlines to be Specified in Interim ROD. Rather than wait nearly 30 years hoping and wishing for new, inexpensive technology for cleaning of Pit water, new technology can be encouraged now by employing entrepreneurial American competitiveness, capitalism and market forces. Deadlines drive action and innovation just as they did in the space race's moon landing. The race to restore and conserve our planet needs deadlines, too. Waiting thirty years shows blatant disregard for our children and grandchildren. An Interim ROD issued in 1994 would require cleanup go forward today, not backward from 2022.

> Response: EPA and MDHES do not believe that an interim ROD will expedite remedial activity in this operable unit. An amendment to the ROD (or an ESD) can be done if changes are necessary. See responses to comments in Section 3.11B, 3.2 and 3.3.

2. Soonest Operation date to be Specified in Interim and Final Record of Decision: The interim ROD would specify that the pumping and treatment facility be designed, constructed and tested to accomplish full operation by 2002. It allows that the pumping facility can be addressed first, immediately after a water balance budget determines the maximum capacity for the facility, because a pumping plant would not have to change depending on the treatment technology chosen. The Interim ROD would also specify the schedule for the treatment facility in order to accomplish the fully operational end date of 2002.

> Response: EPA and MDHES believe that an interim ROD which called for a treatment facility to be operational by the year 2002, would not be more protective than the Preferred Alternative. See responses to comments in Sections 3.5, 3.9 and 4.9.

3. Technology Development Process: The U.S. Department of Energy is currently funding a public-private partnership to test treatment technologies for remediation of Berkeley Pit water (plus other applications). Efforts would be made immediately to obtain additional funding from EPA's SITE program or other research grantors so more than the current two to three technologies per year can be evaluated. The Interim ROD issued in the fall of 1994 would specify that such a research group work with EPA and an oversight council (or community working group) in the Extended FS stage:

- In late 1994, to call for new technologies internationally. Any organization interested in benefitting from extraction of metals from Butte's mine flooding:

  > must come forward with their bench-tested technology and results by a date no later than two years from date of the invitation (fall, 1994); or those who cannot afford to test and cannot find investors must quickly submit their technology to the research organization(s) for possible evaluation and testing (during the same two years) if the process shows potential.

- By end of the third year, the top one, two or three treatment technologies will have been selected from all submissions.

- By end of the fifth year, these top entries will have been pilot tested and further cost analyzed, with the most effective one technology selected and specified in the Final Preferred Plan and Final ROD issued in 1999.

- The Interim ROD will have specified that by the end of the fifth year (1999), the pumping plant will have been designed and constructed and that, in years six and seven (2000-2001), the treatment facility is designed and constructed.

- In year eight (2002), pumping and treatment begin. By the end of that year, de-bugging is completed and full pumping and treatment operations take place to hold the Pit water level at its 2002 elevation (or to reduce the elevation if that was required due to earlier sensitivity analyses).

> Response: EPA Region VIII and MDHES will be advocating additional Federal funding for innovative treatment/metals recovery technology development and demonstration. The ROD also calls for a reevaluation of treatment/metals recovery technology when the Pit level reaches the 5,260-ft level. We also participate in a consultative role in the DOE Resource Recovery Project, which is currently testing treatment technologies at MSE, Inc. in Butte. We do not believe that a time line for forced implementation of unspecified technology, as is suggested in the CFC plan, is appropriate.

E. West Camp

1. The Critical Water level in the West Camp's Travona Shaft should be set lower than the Silver Bow Creek level of 5,410' where it exits the Summit Valley. EPA's Preferred Plan would make permanent the Travona shaft's 5,435' CWL (critical water level). Therefore, the contaminated water in this shaft would tend to flow toward Silver Bow Creek because the creek is lower and there are no bulkheads to prevent it from flowing there.

It may be important for water in the West camp to be kept at the same level as that in the East camp to prevent the Pit water level from rising in the future if water pressure deteriorates one of the many flooded concrete bulkheads dividing the camps. These bulkheads were designed to save pumping costs by allowing West camp waters to rise while dewatering continued for operations in the East camp. There may be no bulkheads on upper levels. On lower elevations, depending on hydraulic head, they may not be adequate to withstand a water pressure reversal from rising of the more voluminous East Camp water.

Until the additional data is made available on locations of bulkheads and the stresses to them, the Interim ROD should at least require that the Critical Water Level in the Travona shaft (presently set by EPA at 5,435') be lowered to an elevation less than Silver Bow Creek's 5,410' elevation where it leaves the Summit Valley. The Interim ROD should specify that, depending on new data to be generated in the Extended RI, the Travona may immediately be pumped down farther and be maintained at the elevation of water in the East Camp.

Response: EPA and MDHES believe that the West Camp System CWL of 5,435 ft will ensure that bedrock water in this system continues to flow toward the Travona Shaft. This CWL establishes a gradient from the West Camp toward the Berkeley Pit/East Camp System thereby ensuring that water from neither camp exits the operable unit. See responses to comments in Section 4.10E.

2. Water Quality: Treated mine water must comply with water quality regulations, Since 1989, EPA-DHES (Montana's Department of Health and Environmental Sciences) have allowed contaminated water to be pumped from the Travona to the Butte Metro Sewer (under a contract between the County and PRP's). State water quality exceedances for arsenic and iron are thereby diluted through mixing with sewage. Under the Preferred Plan, the Agencies would continue this arrangement until the County finds they cannot comply with increasing standards for Silver Bow Creek and opts out of the contract. The Coalition believes the Agencies must insist on compliance rather than setting a bad precedent for potentially relaxing other water quality standards that may be important to recovery of a fishery. A treatment plant has already been designed as a contingency and should be put into operation as a requirement of the Interim ROD.

Source of contaminated water west of Butte in the Green Lake seep would be determined now. Quality sampling immediately should determine if that water is from the East or the West Camp, thereby helping to verify if East Camp water from the northwest portion of the Hill is, as the Agencies hope, draining toward the Berkeley Pit.

Response: The Travona Shaft PRPs are required by past orders with EPA to build a facility to treat West Camp water to water quality standards if it can no longer be treated in the Metro Plant. We do not believe that construction of a treatment facility at this time is appropriate. We believe that this construction should be coordinated with the Lower Area One groundwater treatment plant design and construction. Investigatory work on the Green Lake seep is beyond the scope of the current RI/FS; this may be addressed in activities of the Non-Priority Soils Operable Unit.

F. Financing

1. PRP's Must Provide Bonds Up-front for initial building costs, and to endow perpetual operation and maintenance, plus a special fund for upgrading treatment facilities.

Response: EPA and MDHES will use whatever enforcement authority is necessary to ensure that the PRPs pay all the remediation costs. We are presently evaluating whether or not such bonding is possible or practical.

2. Investment of Short-Term Savings in Treatment Technology Research and Development: Clean ups should proceed immediately after issuance of the ROD. In some extraordinary cases like the Berkeley Pit, it may be advisable to delay clean up for a reasonable time to actively develop new technologies (not wait hopefully for their development). When such a delay is detected, the savings on operating and maintaining a conventional treatment plant, and the interest earned on what would have been spent on construction, should be collected from the PRP and invested in developing new technology. If a new technology is developed that

is wholly or partially funded by the PRP, the PRP would benefit from other applications.

The money that is saved annually from delay of clean up should be invested in reducing inflow to the Pit and researching and developing new technologies.

Response: The idea of collecting monies from the PRPs as soon as a ROD is issued and then investing it in developing new cleanup technologies is not possible under current Superfund regulation.

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The Coalition calls on Montana's legislative delegation and leaders to help convince EPA to look seriously at this proposal. It reflects the thinking of dedicated engineers and scientists who have been involved with the Mine Flooding O/U for years, plus the wishes of affected residents, as clearly evidenced by over 10% of Butte citizens having signed a petition that EPA reduce the water in the Berkeley Pit and clean it up now.

Document/Task	Completion Date
Call for New Treatment Research Funding	July, 1994
List of Private Wells/Implications	July, 1994
Sensitivity Study of Existing Data by EPA	August, 1994
Issue Alternative Plan for Public Comment	September, 1994
Issue Interim ROD (required items below)	October, 1994
Call for New Treatment Technologies	October, 1994
Comprehensive Monitoring Program Implementation Begins	October, 1994
Additional Inflow Controls Implementation Begins	October, 1994
New Data Generated as in "A" above re. water budget, modeling, sediments, etc.	October, 1996
All Bench Tested Technologies Received	October, 1997
Top Treatment(s) Selected for Pilot Testing	October, 1997
Pumping Facility Design and Construction Starts	October, 1997
One Treatment Selected for Preferred Plan	September, 1999
Issue Extended RI-FS	September, 1999
Issue Final Preferred Plan	November, 1999
Public Comment	
Issue Final Record of Decision	December, 1999
Design and Construction Starts for Treatment Facility	January, 2000
Completion of Pumping Facility begun in 1997	December, 2001
Completion of Treatment Facility	December, 2001
De-bugging of Pumping and Treatment Plant	
Pump and Treat Plant Fully Operable	December, 2002

Appendix

EPA Reliance on Assumptions, Theories and Speculation

As EPA knows, the extreme complexity of the Butte Hill defies easy answers to remediation of contaminated waters flooding the underground mines and the Berkeley Pit. EPA has investigated the problem almost from the day ARCO discontinued the centuries-old pumping of the mine tunnels on Earth Day, 1982. However, EPA's RI-FS and Preferred Plan documents unveiled January 27, 1994 lack community support. Volume of contamination allowed in the Berkeley Pit in perpetuity is likely the most serious issue to face Butte. People lack confidence in EPA's Plan because of its fundamental reliance on assumptions, theories and speculation, cumulative effects of which could be catastrophic to the community and the headwaters of the Clark Fork River.

Response: The Preferred Alternative selected by EPA and MDHES is based on thorough studies in the areas of hydrogeology, geochemistry, geophysics, and process engineering. The selection process also involved a detailed fiscal analysis of all the potential alternatives. During the RI/FS, all site data were analyzed by scientists and engineers working for EPA and MDHES in order to thoroughly evaluate the known and potential environmental and human health problems. All the ideas developed about groundwater contamination are based on the available data and the use of state-of-the-art scientific and engineering principles.

Some people fail to recognize the magnitude of the groundwater contamination problem and therefore still contend that the groundwater can be permanently remediated. Uninformed individuals have not grasped the fact that the bedrock aquifer in the Berkeley Pit/East Camp System will be contaminated forever due to the impossibility of preventing groundwater from entering the greater than 3,000 miles of tunnels and shafts (and the Pit) and contacting sulfide- and metal-rich rock. This contaminated groundwater will never be "cleaned up"; it will need to be treated in perpetuity. In fact, allowing the highest water level possible in the System without allowing a discharges out of the System will reduce the amount of acid mine drainage generated (see Section 3.9).

A. Butte's Concerns

The people of Butte assumed that designation as a Superfund clean up site meant EPA would conduct a "clean up" to decrease volumes of toxic water and then discharge cleaned water in a timely manner. While watching the elevation of the Pit water rise, the people criticized EPA for taking ten years for the studies. They were amazed to learn in April 1994 ads by the Clark Fork Coalition that EPA's preferred remedy would allow the elevation of contaminated water to rise to within feet of their basements before any of it would begin to be cleaned and discharged - in the year 2022 - another 28 years off. The people of Butte assumed that EPA would take into consideration their concerns:

- Decrease in values of homes near a 500 acre toxic lake; inability to sell homes
- Concern for purity of water from existing wells (without instituting well bans)
- Loss of the economic benefits of drilling one's own well; loss of rights
- Potential flooding of basements from possible saturation of alluvial aquifer
- Hazard to car and plane passengers as fogs spill out from the Pit
- Constant worry about land stability as the mines fill
- By remedy time in 30 years, much current knowledge about the site will be gone as old-timers die
- Future-unfriendly decision to require the next generation to implement a remedy
- Unfriendliness of saddling all future generations with a very short time in which to react to potential operation stoppages, whether due to economic collapse, social upheaval, war, weather, earthquake, etc.
- Potential benefits of developing a holistic approach to Pit remediation
- Loss of future minerals extraction opportunities as Pit floods
- Possible adverse effect on ability to attract new industries and health, etc. professionals
- Perpetual worries of downstream folks that toxic ground water will migrate there
- Downstream sites not cleaned up for over 30 years because of Pit delay.

Response: The Coalition wrongly asserts that EPA has not taken citizen's concerns into account in the selection of the Preferred Alternative. EPA and MDHES have considered all public concerns and have used the comments that are based on sound scientific, engineering and fiscal principles in the screening and selection processes. Many of the issues raised above are socioeconomic issues which EPA cannot address under Superfund. Section 1.2 demonstrates how EPA and MDHES have kept the public informed and how the public has made significant contributions throughout the RI/FS process. Please refer to Sections 3.0 and 4.0 for responses to the bullet list of concerns present here.

B. Assumptions, Theories and Data Gaps

EPA bases its Proposed Plan on its claim that all water that enters the Berkeley Pit is and will be contained permanently in the Pit. This claim is not a fact, but is an assumption.

The Coalition strongly urges that before a Record of Decision is issued, serious attention be given to the cumulative effects of the countless guesstimates, data gaps, assumptions, predictions, scientific and technical inadequacies, reliance on theories and opinions, and selective disregard for some of the nine legal criteria for choice of remedy that are employed in documents produced for this Operable Unit (O/U).

The Coalition believes the potential for error is vastly multiplied because of the great number of variables involved in the studies, lack of some data that could be made available, and near-exclusive reliance on Potentially Responsible Party (PEP) contractors vs. truly independent, highly qualified expertise. Although EPA is only required to protect human health and the environment from toxins, EPA must assume responsibility for causing individual and community economic hardships and creating a perpetual crisis mentality. EPA's preferred "remedy" to allow the Pit to reach 5,410' elevation and to wait 30 more years before treating water from the Pit and mine flooding (other than Horseshoe Bend) appears to be gravely flawed.

Some of the data that must be evaluated in the Sensitivity Analysis requested in the Community-Based Alternative Plan is listed below:

Response: All the ideas pertaining to the nature and extent of contamination of this operable unit and the selection of the Preferred Alternative were developed following an exhaustive examination of the existing data by experts in the fields of hydrogeology, geochemistry and geophysics, process engineering, human and environmental risk assessment, and finance. EPA and MDHES have used these professionals to develop the most effective and pragmatic approach for preventing the spread of contaminated water. The Agencies believe that the Preferred Alternative combines the best components of all the alternatives to produce the most effective and implementable remedy.

Each stage in the RI/FS process was carefully monitored by the RPM (EPA) and the Project Officer (MDHES) to ensure that all pertinent data were considered in an impartial manner and that all decisions were made in accordance with Superfund regulations. The Agencies used independent contractors to verify PRP results and to draw their own conclusions. Data interpretations are rewritten by the PRPs based on the Agencies' independent interpretation of the data.

EPA and MDHES believe that the Coalition's assertion that the Preferred Alternative will bring economic hardship to Butte is untrue.

1. Groundwater- Pit Dynamics

- Modeling of ground water flow assumes constant head pressure at depth, a possible assumption given Butte's intricate 3,500 miles of tunnels extending over a mile down from surface, along with elevated water temperatures at most deep levels, none at others (Neversweat shaft), and Butte's surface seasonal temperature effects on Pit water. Hydrology students employed by the Citizens' Technical Environmental Committee (CTEC) have cautioned that EPA does not have adequate information for modeling assumptions made. They have also provided EPA with cautionary information regarding limitations of models in decision-making and degree of dependability of models. A better idea of what is occurring at depth could have been obtained through computer modeling based on actual mine "stope" books. Despite a 10-year study that cost $10 million, these factual data were not reviewed.

Response: EPA and MDHES fully understand the limitations of the groundwater modeling used in this RI/FS. The Agencies believe that the results of groundwater modeling are reasonable and accurate for their intended uses. EPA and MDHES are grateful to CTEC (and others) for providing valuable input to the understanding of Pit dynamics.

- Write-off of bedrock aquifer: Public information on the decision to write off the bedrock aquifer has been inadequate. The intention not to clean up the water wasn't clearly conveyed to the community; justifications have not been provided to the Coalition, CTEC or other interested citizens. EPA evidently assumed that the public did not need to know about this loss in perpetuity of rights to aquifer water resources. The Coalition believes a public comment opportunity is necessary, especially since the decision originates from a new, organic contaminant-based EPA guideline that the Surgeon General's office indicated was to be rarely used. It would set a precedent for mining-related waste remediation. Many Butte people conjecture that this write-off is a critical link in ARCO's ability to allow the Berkeley Pit to fill and remain full forever. Modeling of the deep bedrock water was not adequate (assumed constant head pressure), and without additional knowledge of the dynamics of that aquifer, it is premature to write it off. Additionally, water in the Berkeley Pit portion is not ground water, but an EPA creation of a surface water impoundment. As such, it may not be subject to the "ground water" write-off guideline.

Response: EPA and MDHES have not "written-off" the water in the Berkeley Pit. We have determined that the bedrock aquifer waters will not meet State and Federal regulations (MCLs). This is the case regardless of the CWL or the technology employed. Remediating the bedrock aquifer is technically impracticable. Bedrock groundwater is, and will always be, flowing into the more than 3,000 miles of tunnels and shafts and becoming contaminated with arsenic and metals. We expect better water quality in the bedrock aquifer if the Pit is allowed to approach the CWL than if it is stabilized at current levels or lowered. This water is being addressed by the Preferred Alternative.

- Contamination releases ignored by EPA in RI-FS and Preferred Plan: EPA neglected to inform the community in the RI-FS or Preferred Plan for this O/U that contaminated bedrock water is exiting the Summit Valley via a "gaining" stream at the end of the Colorado Tailings.

EPA and DHES (Montana Department of Health and Environmental Sciences) state that as the Pit rises, water enters is more slowly. Inflow began at about 7,000 gpm, and is not at 5,000 gpm. But the agencies were unable to satisfactorily answer comment period questions about where the other 2,000 gallons go. EPA/DHES stated, "water cannot leave the Berkeley Pit," "water is pulled into the Berkeley Pit cone of depression and cannot exit." However, they recently acknowledged to the Coalition, "yes, poor quality water is upwelling from bedrock below the Colorado Tailings, but is probably not from the East Camp or the Pit In our opinion. "The Bureau of Mines estimates that 95% of the water entering Silver Bow Creek at the point comes from the bedrock aquifer. The Coalition estimates that the Pit/East Camp bedrock makes up 90% of the Mine Flooding O/U. It includes a large cadmium plume according to data generated by the Natural Resources Damage Program.

The Silver Bow Creek Phase II RI Work Plan of 3/31/89 for the Area One O/U states on page 5 that the bedrock ground water system at the Colorado Tailings would be evaluated under Mine Flooding studies. This evaluation was not done. The Coalition was recently told that studies of water quality at the end of the Colorado Tailings are not thorough enough nor recent enough to determine whether or not Pit system water is involved, or if releases might be related to increased elevation/saturation of mine flooding. The Coalition is now told this mine flooding release does not exit within the Mine Flooding O/U, so would not be addressed until some future time under both Priority Soils and Streamside Tailings O/U's.

The Mine Flooding RI states that alluvial contamination follows ground water flow patterns; that ground water south of the Berkeley Pit flows toward Silver Bow Creek. The alluvial aquifer is contaminated along the length of the Metro Storm Drain and both north and south of it. Contaminated ground water from mine flooding is, therefore, being released into Silver Bow Creek at its confluence with Blacktail Creek. Releases due to mine flooding must be addressed under the Mine Flooding O/U and must be completely researched.

Response: The Coalition contention that contaminated bedrock aquifer water is exiting the operable unit because Silver Bow Creek is a gaining stream is not supported by the available data. Groundwater divides for both the bedrock and alluvial aquifers exist between Silver Bow Creek and the MFOU. Groundwater on the north side of the divide flow toward the Berkeley Pit/East Camp System while groundwater on the south side flow in the direction of Silver Bow Creek. Thus, groundwater contributions to Silver Bow Creek do not come from the Pit System; they are from the aquifers to the South of the groundwater divides.

- Assumption that rate of Pit filling is decreasing is not proven by data; Equilibrium is not evident: If the Pit does stop rising, then water is escaping somewhere. Data from the Montana Bureau of Mines shows that water in the Berkeley Pit rose over two feet more during the one year period May-April 1994 than it did during the same period ending a year earlier (24.5' from 5/92 to 4/93 vs. 26.64' from 5/93 to 4/94). These numbers do not consider widening of the Pit as water rises, so even more water actually entered the Pit in the last year. Pit filling is not decreasing and water in the Pit could require pumping in less than ten years.

Response: As the Pit level increases, groundwater inflow decreases because of a decrease in hydraulic gradient and the increased storage volume in the Pit. The long term impact will be a slowing down in the rise rate of the Pit. This decrease may vary depending on the precipitation for that year and the degree of inflow control for that year. The higher more recent rise rate can be expected because 1993 was a very wet year and Horseshoe Blend is not yet under control.

- Accuracy of Water Balance is questionable: Use of averages in RI-FS may cause underestimation of true amounts of water necessary to be diverted to control inflow. The 2.5 mgd (million gallons per day) from leaking municipal water supplies was not included in the water balance. Horseshoe Bend water was at a higher volume in 1989 than today (4 mgd then: 2.4 mgd in RI) and is said to have increased recently. The possibility of increased water discharge due to Planned expansion of the Yankee Doodle Tailings Dam another 60' in height has not been explored. The actual volume of water in the Berkeley Pit is unknown; therefore, there is no check on what amount of water is possibly leaving the Pit through ground water. Unless an accurate water balance is developed, leakage would go undetected. If water is escaping now, large volumes could escape before the start of pumping. If it is impossible to develop a good water balance, it becomes critical that early precautions be taken - pumping and treating water as soon as possible.

Response: EPA and MDHES used conservatively high water inflow figures during the FS. The Agencies believe that the water balance developed during the FS was adequate to select the Preferred Alternative. Using higher inflow figures would not have changed the treatment approach. Also, the PRPs are aware that they will be held legally responsible under the ROD for treating the volume of water necessary to stabilize the Pit level, even if this volume increases significantly from the present estimates.

- Arbitrariness of location of East vs. West Camp water divide: Without monitoring wells, the location of the water divide is unknown. For example, experts at the Bureau of Mines are not convinced the Moose drainage concludes in the East Camp. Decisions based on location of this divide should be questioned.

Response The ROD will contain a provision for the installation of new bedrock wells in the West Camp, which will give us additional knowledge concerning the divide. However, EPA and MDHES believe that the groundwater divide has been adequately located and that pin-pointing its exact location would not cause the Agencies to alter the Preferred Alternative.

- Condition of bulkheads between East and West Camp is not known: yet EPA Plans to rely in perpetuity on these concrete barriers to keep water at higher elevations in the West Camp from breaking through to the East Camp and flowing into the Pit.

Response: EPA and MDHES realize that the condition of the bulkheads may deteriorate and have purposely set the CWL in the West Camp System above that of the Berkeley Pit/East Camp System so that the groundwater gradient will be toward the Pit System. Failure of this bulkhead will lower the West Camp and will not create at threat to human health and the environment.

- Cones of Depression influences not projected: The Berkeley Pit cone of depression, combined with the one being created by the East Continental Pit, may create an exponentially larger cone of depression that can have enormous effects on ground water under neighborhoods not yet affected by contamination or dewatering. Loss of stream water near the Country Club would affect landowners there. Owners of homes built on formerly swampy land that dried after the Berkeley Pit began operating in the 1950s (e.g., St. Ann Street) fear that saturation of the bedrock aquifer may bring an influx of alluvial water to flood basements. Projected mining company Plans should be investigated to determine their potential to affect Berkeley Pit contaminant ground water migration. Without contingency planning, at some point, control of Mine Flooding waters could be lost.

  The area of influence of the Berkeley Pit cone of depression is said to take in the entire East Camp, or about 90% of the Mine Flooding O/U. The public was never given clear, scientifically sound data to explain EPA's position that the cone of depression's influence extends throughout mine tunnels that are lower than the surface elevation of the Pit water, let alone beneath the bottom of the Pit. In fact, the gradient into the Pit is unknown below the surface of Pit water.

Response: EPA and MDHES believe that the cone of depression that currently exists in the Pit System is adequately characterized. Estimating the potential impacts of possible future mining operations on the cone of depression is beyond the scope of the RI/FS.

The Coalition's contention that EPA did not provide the public with clear, scientifically sound data regarding the fact that the cone of depression extends to tunnels below the surface of the Pit is untrue. Discussions of these data have been presented in the RI/FS documents and this information has been present and discussed extensively during public meetings.

- Impacts to alluvial aquifer largely ignored: Other than concern for migration of contaminants from the Pit, EPA/DHES have either assumed the alluvial aquifer will not be impacted by rising ground water, or they do not feel it is relevant to the remedy. Ted Duaime states that when the Bureau of Mines provided the Agencies with its opinion of the safety of the bedrock aquifer for the Preferred Plan, they were not asked to give an opinion on hydrologic impact to the alluvium. While they have no data to refute safety of the 5,410 elevation for the bedrock aquifer, they have no idea how the alluvial aquifer will react to having a saturated bedrock aquifer. Again, there is a possibility of wet basements.

Response: Modeling conducted during the RI/FS indicated only minor impacts on the alluvial aquifer and we do not expect large impacts on alluvial water levels. We do, however, understand the limitations on such modeling; and we are, therefore, relying on a very comprehensive monitoring program to follow the hydraulic impact of the rising bedrock aquifer on the alluvial aquifer. There is high concentration of monitoring wells in the area (Upper Metro Storm Drain) where the earliest impact (if any) would occur. The Priority Soils operable unit RI/FS also will address this issue and the alternative for addressing contaminated alluvial groundwater in the Metro Storm Drain.

- Induced infiltration potential is not adequately addressed in the documents. Can contaminated water from the hill or the cadmium plume beneath the old Silver Bow Creek bed travel south and contaminate private wells? If a new industry requiring high volumes of ground water came to Butte, could it pull contaminated water toward other wells?

Response: Contaminated water outside the cone of influence of the Pit System will be addressed during the conduct of the Priority Soils RI/FS. Such pumping as described could not draw contaminated bedrock waters into the alluvial aquifer.

- Potential Mine Flooding-related well bans were not clearly delineated. Though well bans were alluded to in the FS, in meetings held prior to the end of the public comment period for this O/U, there was no information about where such bans might be enacted, nor about any private wells possibly being closed. Consequently, affected residents could not comment on potential wells bans. Some addresses of private wells tested are listed in RI. In May, after close of the comment period, a GIS (Geographic Information Systems) map was shown to members of the County Water Quality Task Force, delineating contaminated alluvial aquifers. Two addresses listed in the RI as having exceedances of cadmium, among other metals, are outside the mapped boundary of alluvial contamination (1920 Elm, 1940 Oregon). It appears that data are still incomplete or inaccurate and, unless they are contacted individually, residents will remain unaware of any potential closure or ban on new wells.

  EPA's Preferred Plan either assumes community acceptance or, as implied in the FS, a County zoning ordinance may implement ARCO-initiated well bans on private property. An ARCO-County contract calls for Institutional Controls such as Superfund-related well bans. Under it, ARCO provided seed monies for the County to establish a task force to recommend whether or not a Water Quality District should be formed to deal with post-Superfund well bans among other issues. After close of the comment period, the task force was shown the contamination map, but it was stated that no residential wells were expected to be affected. Without site-specific information, the community could not possibly have commented on well bans during the comment period for "community acceptance" criteria.

Response: EPA and MDHES plan to fully discuss the ramifications of the ARARs waiver for the bedrock aquifer with Butte-Silver Bow and the public. A full public discussion of the institutional controls needed to protect human health and the environment is necessary before any decisions on IC implementation can be forthcoming.

- Adequacy of studies is questioned by Dr. Bob Robins, an international expert on arsenic chemistry and environmental impacts of mine wastes. Dr. Robins' major points are:

  The Comprehensive Monitoring Program "should have been in place before now ..."

  Sediment study of the Pit is needed

  Strong microbiological study should be included in comprehensive monitoring program

  A complete water balance on the whole Pit system is needed.

Dr. Robins states that data are not available to show the influence of ground water on deep ground water. He does not believe a suggested upflow of deep groundwater from the bedrock into the Pit is realistic; rather, he believes a downflow of Pit water will be present.

Response: This comment is addressed under the responses to Section A "Additional Data".

2. Legal - Unwarranted Waivers of EPA's Own Remedy Selection Criteria

Short-Term Effects

An increase in contamination volume, toxicity and mobility from today's 25 billion gallons to $6 billion in 2022 is certainly notable.

Impounding between 25 and 56 billion gallons of surface water in a toxic state over the next 30 years adversely affects in-stream flow.

Massive impoundment may adversely effect potential uses by water rights holders. The Clark Fork River Basin is closed to new water rights because it is so short of water; yet, here water would be impounded and made severely contaminated.

Berkeley Pit water impoundment created by the Preferred Plan should have a beneficial use. None is evident. Pit water is not used by the active mining operation. It is surface "waters of the State of Montana" and should not be allowed to become more contaminated.

Technical expertise and site-specific knowledge would now be unavailable at remedy time 30 years from now (due to human life span), requiring high cost of educating new players and higher potential for error.

Short-term disregard for intent and meaning of the term "clean up, " as in "Superfund Clean up" vs. generation of a 56 billion gallon toxic lake. Preferred Plan is a postponement, not a clean up.

Nothing is cleaned for 30 years.

Response: We believe that reduction of the AMD generation rate and the concentration of metals in the AMD will be reduced by allowing the water level in the System to approach the CWL. We believe that these reductions are more important than reducing the volume stored in the System Many of these comments are related to water rights issues and not related to protection of human health and the environment. EPA and MDHES believe that these issues should be addressed as Natural Resource Damage issue and not a remediation issue. See Section 3.9.

Long-Term Effectiveness

Perpetual effectiveness of a lowered Pit level was not adequately researched due to assumption of excess cost (statement in Preferred Plan document).

Cost of Preferred Plan may be underestimated: At under $60 million, it is less than the reported cost in 1973 of the pumping Plant in the Kelley Shaft which is now underwater.

None of the alternatives address what will occur after 30 years.

None of the alternatives discuss life span of the pumping and treating system and Acts of God, etc. that might interfere with operation in perpetuity.

Use of the metro sewage Plant to treat contaminated water from West Camp Mine Flooding disregards Long-term effectiveness requirements.

Response: EPA and MDHES believe that a lower Pit water level will not significantly decrease risks to human health or the environment; therefore, lowering the Pit water level is not recommended.

The costs presented in the FS were thoroughly reviewed by independent contractors for EPA and MDHES with expertise in constructing and operating these types of water treatment facilities. EPA and MDHES believe that these costs are within the accuracy for their intended purposes. Costs were projected for a 30-year period as specified in Superfund guidance for cost comparison purposes. The actual cost for running a treatment facility in perpetuity will be more than the cost stated in the FS.

The "reported" cost of the Kelley Shaft pumps is irrelevant to the cost of the alternative. EPA and the State question the validity of the 1973 $60,000,000 figure. Costs developed by the Agencies to install pump(s) and piping in the Kelley Shaft is approximately $16,000,000, in 1994 dollars. The cost of remedy is considerably more than the costs of the pumps in the Kelley. Regardless, we believe the costs of pumps are irrelevant as compared to the cost of the remedy.

West Camp System water will be treated in perpetuity in the Metro Plant and a subsequently constructed plant. See responses to comments in Section 6.16I.

- Water Quality ARAR's (Applicable Relevant and Appropriate Regulations) for Travona Mine exceedances and for bedrock aquifer discharges to Silver Bow Creek are not met.

Response: Travona water is treated in the Metro Plant and when the Metro Plant discharges water to Silver Bow Creek it meets State water quality regulations.

- Reduction of Volume, Toxicity and Mobility is ignored by allowing the doubling of Pit water volume, increasing toxic contamination and allowing water to reach the 5,410' elevation.

Response: See responses to comments in Section 3.9.

- Threat of Contamination Release is increased, not reduced, at 5,410' level through potential energy of that volume, and weight of contaminated water seeking lower pressure outlets.

Response: EPA and MDHES believe that the threat of release will not be increased by allowing the Pit level to rise to below the 5,410-ft level.

- Visibility standards of the Clean Air Act were not investigated for fog emanating from the Pit and its effect on safety of auto and air traffic.

Response: See responses to comments in Section 3.12I.

- Assessment of negligible impact of water fowl resting on the Pit water relies on inadequate amount of research data and does not project impact when Pit is 500 acres and near surface level.

Response: See responses to comments in Section 3.12C.

- New remedy selection criteria developed: Avoidance of litigation with PRP's joins cost to drive clean up decisions. EPA representatives have stated that ARCO threats of litigation prohibited them from changing their preferred remedy.

Response: This statement is untrue. The Preferred Remedy was selected by EPA and MDHES and will be modified by the Agencies based on important new information or comments received during the public comment period. Threats of litigation will not influence the Agencies' decision. The decision must not be, however, arbitrary and capricious.

- Community Acceptance - Inadequate communication with the public: EPA assumed that citizens would spend whole evenings at technical meetings to learn about the Pit clean up Preferred Remedy. They assumed the media would accurately present the story to the public even though KXLF-TV reporters immediately complained (January 27 presentation to Butte Silver Bow County Commissioners) that they did not know how to report on the Pit flooding when they were unable to understand it themselves.

  EPA meetings emphasized diversion of Horseshoe Bend water, which is only a small part of clean up. They downplayed Pit water rising for 30 more years - the only thing most folks really care about. It took two of the three months of the comment period for CTEC and Coalition members to attain a fair understanding of the phenomenal amount of data released simultaneously on January 27 for public comment, and questions continue to be asked. The Coalition wrote EPA asking that they communicate on the few areas of greatest concern to the community, using prepared television messages and talk show appearances. EPA used the no cost shows, but the message continued to divert attention away from delayed clean up of the rising Pit. People were surprised to learn the truth about the Pit from Coalition and CTEC media interviews and from Coalition telephone polls, ads, handouts, posters, speeches and events. A petition circulated by the Coalition was signed by over 10% of County residents through little more than three days effort. Whatever comment EPA received prior to the end of the official public comment period is undoubtedly slight compared to what it could have been if EPA had truly valued public input. EPA stared at the outset that they would not change their Preferred Plan without solid technical or legal reasons to do so; thereby shutting out comment from all but a small elite group of engineers and mining professionals. Affected residents' opinions were not considered worthy by EPA. EPA wrongly assumes the public has the time, money and expertise to technically challenge a Preferred Plan they do not accept.

Response: EPA and MDHES provided the public with numerous opportunities to ask questions regarding any aspect of the Mine Flooding RI/FS process (see Section 1.2 and 1.3). Because of the tremendous size of this contamination problem and the importance of it to the Butte community, EPA and MDHES went far beyond their legal requirements for public participation - which requires only one public meeting during an RI/FS. One of the most significant examples of this was the creation of CTEC and issuance of a TAG grant from EPA to disseminate technical information to the public.

3. Inadequate Treatment Technology

- The Coalition believes that hydroxide precipitation should be eliminated from consideration immediately for lack of effectiveness. It would either inefficiently re-treat the same minerals perpetually (Pit disposal) or generate a new Superfund toxic waste site with only 5% to 7% less waste volume than the original volume before treatment. Inadequate consideration was given in the screening phase to other effective treatment technologies, apparently because cost was given predominance over effectiveness. The cost estimating process relied on one individual's "best guesses," some of which have been challenged as artificially high. The review did not comprehensively evaluate alternate combinations of treatment phases. ARCO states new technologies are welcome only if they cost less than the 1800s-era lime treatment, encoding the impression that EPA weights cost more than other criteria. Ultimately, the people of Butte must take on the burden of finding the most effective, cost-sensitive technology. EPA must rescind their choice of lime treatment and insist that ARCO and Montana Resources accommodate public and private research by providing on-site access to Pit and Mine Flooding waters and indemnify those pursuing solutions today.

Response: Costs were not given dominance over effectiveness. EPA and MDHES believe that hydroxide precipitation is currency the most effective primary treatment. The best potential innovative technologies for water treatment/metal recovery are being tested by MSE, Inc. in Butte. A treatment technology other than that identified in the ROD may be used if a subsequent evaluation finds that it is significantly more effective and/or cost less then hydroxide precipitation. See also responses to comments in Sections 3.2, 3.3, 3.9, 3.15, 4.7, and 4.9.

4. Inflow Control

- Inadequate Plan for diverting clean water inflow from Mine Flooding and Pit: Horseshoe Bend's 2.4 mgd of acidic water is the only inflow to be diverted from the Pit and Mine Flooding in the Preferred Plan. Approximately 2.5 mgd of clean water is leaking from the municipal water system, but was ignored in percolation assessments and remediation Plans. Precipitation runoff from the Butte Hill is being diverted to the East Camp/Pit under Expedited Response Action by EPA. Water presently runs down the Moose drainage and settles on top of the Green Mountain mine shaft which is inadequately covered. While storm water runoff is part of another O/U, the above named waters are part of, or are purposely being diverted to, the Mine Flooding O/U by EPA. These and any other controllable inflows should be cleaned and discharged under the Mine Flooding O/U rather than waiting many additional years to be addressed under Priority Soils.

Response: EPA and MDHES agree that all significant inflows to the Pit should be diverted if possible. It is unknown what portion of the water leaking from the municipal water system is entering either the West Camp or Berkeley Pit/East Camp System. The Agencies will encourage Butte-Silver Bow to make improvements to their water distribution system. Water in the Moose area does collect near the Green Mountain Shaft but it is unclear if any runoff water enters to the shaft. This issue will be investigated during the Priority Soils RI/FS. The amount of water that could enter the shaft is considered negligible compared to the 2.4 mgd entering the Pit at Horseshoe Bend. The Agencies appreciate these comments and will consider them further during the completion of the ROD.

5. Human Health Concerns

- Organic contaminants under leach pads not addressed in RI-FS or Plan. Former Anaconda Company employees have indicated that the dumping grounds for Company-generated contaminants are now covered by leach pads in the active mining operation. These contaminants include solvents, acids, used grease and oil, and other organics. Given the gradient toward the Berkeley Pit from the leach pads, these contaminants are likely to be entering the Mine Flooding system, yet, have not been investigated in the RI-FS. The Agencies have assumed that the contaminants are diluted and, therefore, not significant. More likely, they are DNAPL (dense, non-aqueous phase liquids), seek low elevations, and have sunk to the bottom of the Pit.

Response: EPA and MDHES are aware of the presence of certain organic compounds at the MFOU. The Agencies made a decision to exclude organic contamination from the risk assessment after a preliminary examination of data revealed very low concentrations. See responses to comments in Section 4.12.

- Air Quality investigations were not conducted in the RI. Studies in the later part of this century have shown that human health in the headwaters of the Clark Fork River has suffered from long-term disease designations of "highest in the nation per capita " for "all diseases," "lung disease" and "heart disease" as cited in Luoma and Moore's 1990 paper **1**. A high incidence of lung disease was found in women as well as men, indicating air quality problems outside of the mines. There are no very recent studies, so it is not know if high incidence of disease continues. If disease is related to metals particulate, should sources of dust, such as Pit walls, be sealed or capped? Regardless of the water level ultimately left in the Pit, there would still be bare soil. EPA's RI also did not address citizen inquiries listed in a 1990 Mine Flooding Responsiveness Summary concerning possibility of toxic gas emanating from rising toxic mine and Pit water.

Response: Previous air quality studies of the Butte area indicated that air quality exceedances were caused by wood smoke and dust caused by trucks during the mining in the Berkeley Pit. Based on the available air quality data, the Agencies do not feel that the air associated with this operable unit presents a potential health hazard to the public. There is no indication that "toxic" gas is emanating from the Pit.

6. Future Discounted

- Inadequate consideration for perpetual technology requirements, operation and maintenance: Given the comparatively short 200-year history of the United States and the burden of pumping and treating water forever, EPA's Preferred Remedy appears not to have sufficiently weighed the following assumptions:

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[1] "Hazardous Wastes From Large-scale Metal Extraction: The Clark Fork Waste Complex, Mt," Johnnie Moore, Dept, of Geology, Univ. of Montana, Missoula and Samuel N. Luoma, U.S. Geological Survey, Menlo Park, CA; V.J. Watson (ed.) - Proc. 1990 Clark Fork River Symposium, Montana Academy of Sciences, pgs. 163-188.

Assumes money will be available for perpetual operation and maintenance by allowing ARCO to self-insure forever; assumes this relatively young corporation will exist forever.

In selecting the remedy, EPA considers only the first 30 years' costs; yet, the remedy would not be implemented until after that 30 years. EPA assumes that dollars will be adequate for perpetual operation.
Assumes no earthquake impacts to the perpetually operation treatment Plant.

Claiming to protect human health, this remedy makes it undesirable for humans to continue to live in their traditional homes within blocks of the nation's largest body of toxic water.

Response: EPA is evaluating whether or not alternative financial assuredness (e.g., bonding) is appropriate and practical because of the many comments received concerning long-term financial assurances and the fact that this remedy will require significant funding in the future. We acknowledge that the Preferred Alternative assumes that the current PRPs, or their successors, will be financially able to pay for the perpetual treatment of contaminated water. See responses to comments in Section 3.18.

The costing procedures used were consistent with Superfund guidance and the Agencies believe that they were adequate to select the most appropriate remedial alternative. The total (or actual) cost of each alternative was not nearly as important as the relative costs. The FS was adequate in this regard. See responses to comments in Sections 3.7 and 4.3.

The Coalition suggests that it is dangerous to live near the Berkeley Pit; this statement is without merit. The Risk Assessment found that there would be a health threat if persons ingested Pit or contaminated groundwater. The Preferred Alternative will ensure the protection of those persons living adjacent to the Pit. See responses to comments in Section 4.12.

- Variables that could cause uncontrolled filling of the Pit in the future:

Assumes that maintaining the Pit at 5,410 feet, only 50 feet below the problem level, is an adequate margin of safety. This allows only two years (at the current fill rate) for future generations to recover from Acts of War, Acts of God, economic, or other disasters before toxic water reached the alluvium.

Response: See responses to comments in Section 3.1.

Assumes negligible earthquake impact on Yankee Doodle Tailings Dam from a 6.5 Richter maximum earthquake. With three faults passing under this Dam, and EPA reliance on a questionable dam safety study, this assumption is considered foolhardy by many observers who believe it is more responsible to assure future residents that Pit void space is not displaced by tailings from a higher than average earthquake.

Response: See responses to comments in Section 3.17.

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IDENTIFICATION OF COMMENTS RECEIVED

APPENDIX 4, ATTACHMENT 1
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

The comments made in the non-technical (Section 3.0) and technical sections (Section 4.0) of this Responsiveness Summary were summarized based on all the comments received. The commenters were identified with a note in the parentheses at the end of each comment. The following identifies the sources used in this Responsiveness Summary.

1. The Transcript of the Proceedings from the public meeting for MFOU RI/FS held on April 26, 1994. The commenter and the number identifying each commenter listed in this Responsiveness Summary are listed below:

T 1	John Ray
T 2	Albert Molignoni
T 3	Dan Harrington
T 4	Sandy Stash, ARCO
T 5	Fritz Daily
T 6	Dr. Richard Hammen
T 7	Dr. I.W. DeVoe
T 8	Jack Lynch
T 9	Mary Kay Craig
T 10	Bill MacGregor
T 11	Edus Giavomin
T 12	John Resing
T 13	Jim Keane

2. Group Comments

G 1 CTEC comments regarding MFOU RI/FS and Proposed Plan. These consist of letters dated February 24, 1994, April 29, 1994, May 13, 1994, and EPA responses to comments dated April 19, 1994.

G 2 Clark Fork Pend Oreille Coalition public comments o Berkeley Pit and MFOU RI/FS Preferred Plan prepared by Mary Kay Craig, Upper River Field Representative, on April 29, 1994.

G 3 Robertson Technologies Corporation Public Comment to Preliminary Draft Feasibility Study Report submitted by Andy MacG. Robertson, Chairman on April 27, 1994.

3. PRP Comment

PRP 1 ARCO comments regarding the Proposed Plan prepared by S.M. Stash, Montana Facilities Manager, on April 29, 1994.

4. Government Agency Comments

GOV 1 Fish and Wildlife Service comments on the MFOU RI/FS and Proposed Plan, prepared by Kemper McMaster, Field Supervisor, on February 23, 1994.

5. Butte Silver Bow (BSB) submitted several documents which they marked Exhibit A1, A2, and B1-B12. These documents and comments are listed separately, but retain BSB's markings for clarity.

BSB 1 Council Resolution No. 1635.

BSB 2 BSB Local Government Comments on Berkeley Pit RI/FS and Proposed Plan (A1).

BSB 3 BSB Technical Comments on Berkeley Pit Mine Flooding RI/FS, which includes letter from Dr. Robert G. Robins dated February 25, 1994 (A2).

BSB 4 Excerpts of Council of Commissioners Regular Meeting April 26, 1994 (B1). Individuals providing input are identified as follows:

BSB 4-A	Jack Lynch
BSB 4-B	Fritz Daily
BSB 4-C	Dr. Irving DeVoe, Metanetix

BSB 4-D Joe Quilici
BSB 4-E Dr. George Waring
BSB 4-F Rose Brock
BSB 4-G Albert Molignoni
BSB 4-H Bob Pavlovich
BSB 4-I Barbara Archer
BSB 4-J Mary Kay Craig, Clark Fork Pend Oreille Coalition
BSB 4-K Sandy Stash, ARCO
BSB 4-L James Riley
BSB 4-M Eileen LaBreche
BSB 4-N Dave Curry
BSB 4-O Mike Thatcher
BSB 4-P Charlie O'Leary
BSB 4-Q Mike Kerns
BSB 4-R Ms. DeVoe
BSB 4-S Tom Brophy

BSB 5 Written comments from Dr. John Ray to BSB (B2).

BSB 6 Berkeley Pit County Resolution from the Clark Fork Pend Oreille Coalition dated April 11, 1994 (B3).

BSB 7 Written comments from Fritz Daily dated April 6, 1994 (B4).

BSB 8 Berkeley Pit Comments from Ray Tilman (Montana Resources) March 25, 1994 (B5).

BSB 9 Written comments from Dr. Irving DeVoe (Metanetix) dated November 1993 (B6).

BSB 10 Written comments from Albert Molignoni dated February 11, 1994 (B7).

BSB 11 ARCO's response to BSB's draft comments on MFOU RI/FS dated April 6, 1994. (B8)

BSB 12 Excerpts of Council of Commissioners Regular Meeting April 20, 1994 (B9).
Individuals providing input are identified as follows:

BSB 12-A Fritz Daily
BSB 12-B Mark Kay Craig, Clark Fork Pend Oreille Coalition
BSB 12-C Frank Quilici
BSB 12-D Dr. John Ray
BSB 12-E Dr. George Waring
BSB 12-F Matt Casick
BSB 12-G Tom Brophy
BSB 12-H Mike Kerns
BSB 12-J Mike Thatcher
BSB 12-J Artie Lararmie
BSB 12-K Jack Lynch

BSB 13 Written comments from Fritz Daily dated April 19, 1994 (B10).

BSB 14 Written comments from Clark Fork Pend Oreille Coalition dated April 20, 1994 (B11).

BSB 15 Written comments from Barbara Archer dated april 10, 1994 (B12).

6. Individual Comments

I 1 Carla Abrams, Missoula, Montana, May 4, 1994
I 2 Elaine Roberts, Missoula, Montana, April 29, 1994
I 3 Vicki Watson, Missoula, Montana, April 29, 1994
I 4 Steve Mietz, Missoula, Montana, March 30, 1994
I 5 Bonnie Gestring, Missoula, Montana, March 25, 1994
I 6 Gary Murphy, Ramsay, Montana, April 21, 1994
I 7 Maureen Markovich, Butte, Montana, April 29, 1994
I 8 Mary Duran, Butte, Montana, April 29, 1994
I 9 John and Shirley Walsh, Butte, Montana, April 29, 1994
I 10 Steve Schombel, Missoula, Montana, May 2, 1994
I 11 Pia Gregan, Butte, Montana, April 29, 1994
I 12 Theresa Marie Craig, Butte, Montana, April 29, 1994

I 13 George Waring, Butte, Montana, April 29, 1994
I 14 Marian Conklin, Butte, Montana, April 29, 1994
I 15 Colette Cook, Butte, Montana, April 29, 1994
I 16 Lou Eveland, Rocker, Montana, April 29, 1994
I 17 Esme LaBauhe & James R. LaBreche, Butte, Montana, April 29, 1994
I 18 Kevin and Cindy McGreevy, Butte, Montana, April 28, 1994
I 19 Clifford and Rita Bradley, Butte, Montana, April 28, 1994
I 20 Margaret Small, Butte, Montana, April 28, 1994
I 21 Mickey Boysza, Butte, Montana, April 29, 1994
I 22 Frank Moriarty, Deer Lodge, Montana, April 29, 1994
I 23 Rose Brock, Butte, Montana, April 23, 1994
I 24 Gray Davis, Butte, Montana, April 29, 1994
I 25 Bonnie and Walter Immonen, Walkerville, Montana, April 29, 1994
I 26 Audrey Daly, Butte, Montana, April 29, 1994
I 27 Robert and Dorothy Forsell, Butte, Montana, April 29, 1994
I 28 Walter and Barbara Kelley, Butte, Montana, April 29, 1994
I 29 Catherine Couture, Butte, Montana, April 29, 1994
I 30 Sue Gassenberg, Butte, Montana, April 29, 1994
I 31 Dan O'Neill, Harrison Avenue, Butte, Montana, March 10, 1994
I 32 Lynda Hill, Butte, Montana, April 29, 1994
I 33 Kenneth P. Cunningham, Butte, Montana, April 8, 1994
I 34 Dan O'Neill, Monroe Avenue, Butte, March 28, 1994
I 35 Mary Mulcaire-Jones, Butte, Montana, April 29, 1994
I 36 Barbara Archer and Tom Tully, Butte, Montana, April 26, 1994
I 37 Amy Lientz, Rigby, Idaho, May 2, 1994
I 38 Mike and Debra Evankovich, Butte, Montana, April 27, 1994
I 39 Kay Joslyn, Butte, Montana, April 27, 1994
I 40 Lola Evidi, Butte, Montana, April 29, 1994
I 41 Frank and Ruth Rosch, Butte, Montana, April 27, 1994
I 42 Annette Gustafson, Butte, Montana, April 26, 1994
I 43 Mary Miller, Missoula, Montana, April 15, 1994
I 44 Patricia and Bruce von Alten, Butte, Montana, April 25, 1994
I 45 June Corbitt, Butte, Montana, April 14, 1994
I 46 Frank Green, Butte, Montana, April 11, 1994
I 47 Herbert James Ellenburg, Butte, Montana, April 7, 1994
I 48 Michael and Hia Chapin, Butte, Montana, April 8, 1994
I 49 W.T., Butte, Montana, April 8, 1994
I 50 Albert Molignoni, Rocker, Montana, February 11, 1994 (includes 50A through 50G)
I 51 John Ray, Butte, Montana, April 26, 1994
I 52 Dan Battleson, Butte, Montana, March 25, 1994
I 53 Dr. Robert Robins, Australia, February 25, 1994
I 54 Mel Rowling, Butte, Montana

7. Petition from Clark Fork Pend Oreille Coalition submitted with a letter dated April 28, 1994. Several individuals also sent petitions directly to EPA and are listed below.

P 1 Petition and letter dated April 28, 1994.
P 2 Francis & Caroline Peterson
P 3 Ruth B. Cooney
P 4 Kenneth R. DeBue
P 5 Sue and Joe Toth
P 6 Gary and Janet Beals
P 7 Pete Yerkich
P 8 Mike Muzzolini
P 9 Marie Martin
P 10 Carol Junkert
P 11 Mary S. Beer
P 12 Mary J. Kahn

Responses to Comments from Transcript of Public Meeting, Groups, PRP's & Government
Part I - Non-technical Comments

Identifier			3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16				
Transcript																						
T 1	John Ray								♦		♦				♦		♦					
T 2	Albert Molignoni									♦												
T 3	Dan Harrington						♦				♦											
T 4	Sandy Stash, ARCO		♦				♦						♦	♦								
T 5	Fritz Daily	♦											♦									
T 6	Dr. Richard Hammen		♦				♦						♦									
T 7	Dr. I.W. DeVoe																					
T 8	Jack Lynch			♦					♦				♦		♦	♦						
T 9	Mary Kay Craig				♦		♦ ♦	♦	♦	♦	♦											
T 10	Bill MacGregor		♦						♦													
T 11	Edus Giavomini					♦																
T 12	John Resing		♦	♦									♦	♦								
T 13	Jim Keane																	♦				
Groups																						
G 1	CTEC	♦			♦	♦		♦	♦				♦ ♦	♦	♦			♦				
G 2	Clark Fork Pend Oreille Coalition						♦		♦			♦			♦	♦	♦	♦	♦	♦	♦	♦
G 3	Robertson Technologies																					
PRPs																						
PRP 1	ARCO					♦							♦ ♦									
Government																						
GOV 1	Fish & Wildlife Service												♦		♦							

Responses to Comments from Butte-Silver Bow
Part I - Non-technical Comments

Identifier	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16				
BSB 1 Council Resolution No. 1635																				
BSB 2 BSB Local Government Comments	♦		♦	♦					♦		♦									
BSB 3 BSB Technical Comments on RI/FS			♦										♦		♦	♦				
BSB 4 Excerpts of Council of Commissioners meeting 4/6/94			♦																	
BSB 4-A Jack Lynch								♦												
BSB 4-B Fritz Daily	♦																♦			
BSB 4-C Dr. I.W. DeVoe											♦									
BSB 4-D Joe Quilici													♦							
BSB 4-E George Waring			♦																	
BSB 4-F Rose Brock												♦		♦						
BSB 4-G Albert Molignoni												♦								
BSB 4-H Bob Pavlovich			♦																	
BSB 4-I Barbara Archer											♦									
BSB 4-J Mary Kay Craig, Coalition					♦						♦									
BSB 4-K Sandy Stash, ARCO	♦			♦			♦						♦			♦				
BSB 4-L James Riley																				
BSB 4-M Eileen LeBreche											♦									
BSB 4-N Dave Curry	♦				♦	♦							♦		♦		♦			
BSB 4-O Mike Thatcher																				
BSB 4-P Charlie O'Leary												♦								
BSB 4-Q Mike Kerns						♦														
BSB 4-R Ms. DeVoe						♦														
BSB 4-S Tom Brophy																	♦			
BSB 5 John Ray								♦				♦	♦							
BSB 6 Mary Kay Craig, Clark Fork Pend Orielle Coalition				♦								♦	♦	♦						
BSB 7 Fritz Daily	♦			♦	♦	♦		♦	♦			♦	♦		♦			♦	♦	
BSB 8 Ray Tilman	♦			♦								♦	♦		♦					
BSB 9 Irving DeVoe																				
BSB 10 Albert Molignoni																				
BSB 11 Sandy Stash, ARCO																				
BSB 12 Excerpt from Council of Commissioners Meeting 4/20/94																				
BSB 12-A Fritz Daily	♦															♦				
BSB 12-B Mary Kay Craig, Clark Fork Pend Oreille Coalition	♦																			
BSB 12-C Frank Quilici			♦																	
BSB 12-D John Ray												♦								♦
BSB 12-E George Waring																				
BSB 12-F Matt Casick																				
BSB 12-G Tom Brophy								♦												
BSB 12-H Mike Kerns																	♦			
BSB 12-I Mike Thatcher				♦																

BSB 12-K	Jack Lynch		♦				
BSB 12-J	Artie Laramie						
BSB 13	Fritz Daily		♦	♦			♦
BSB 14	Clark Fork Pend Oreille Coalition				♦	♦	
BSB 15	Barbara Archer	♦					

Responses to Comments from Individuals and Petition Supporters
Part I - Non-technical Comments

Identifier		3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16
Individuals																	
I 1	Clara Abrams	♦	♦	♦		♦		♦	♦					♦	♦	♦	♦
I 2	Elaine Roberts				♦												
I 3	Vickie Watson	♦	♦	♦	♦			♦	♦						♦		
I 4	Steve Mietz	♦	♦		♦	♦		♦	♦							♦	
I 5	Bonnie Gestring						♦			♦			♦				♦
I 6	Gary Murphy													♦			
I 7	Maureen Markovich				♦												
I 8	Mary Duran	♦										♦		♦		♦	
I 9	John & Shelly Walsh			♦													
I 10	Steve Schombel				♦	♦											
I 11	Pia Gregan				♦												
I 12	Theresa Craig				♦	♦			♦								♦
I 13	George Waring						♦	♦		♦			♦	♦		♦	♦
I 14	Marian Conklin				♦							♦					
I 15	Colette Cook				♦	♦						♦					
I 16	Lou Eveland			♦		♦						♦					
I 17	Esme LaBauhe, James LeBreche				♦												
I 18	Kevin & Cindy McGreevy				♦											♦	♦
I 19	Cliff & Rita Bradley					♦						♦					
I 20	Margaret Small				♦												
I 21	Mickey Boysza				♦	♦											♦
I 22	Frank Moriarty				♦							♦					
I 23	Rose Brock			♦				♦			♦			♦			
I 24	Gary Davis				♦						♦						

Responses to Comments from Individuals and Petition Supporters
Part I - Non-technical Comments

Identifier	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16
	Section Number															
I 25 Mr. & Mrs. Walter Immonen				♦												
I 26 Audrey Daly				♦												
I 27 Bob & Dorothy Forsell				♦												
I 28 Walter & Barbara Kelley				♦						♦						
I 29 Catherine Couture			♦										♦			
I 30 Sue Gassenberg				♦				♦							♦	
I 31 Dan O'Neill (Harrison Avenue)					♦			♦			♦					
I 32 Lynda Hill			♦	♦												
I 33 Kenneth Cunningham					♦								♦		♦	
I 34 Dan O'Neill (Monroe Avenue)				♦			♦			♦						
I 35 Mary Mulcaire-Jones					♦											
I 36 Barbara Archer/Tom Tully			♦										♦			
I 37 Amy Lientz				♦	♦		♦	♦		♦						♦
I 38 Mike & Debra Evankovich	♦		♦	♦										♦		
I 39 Kay Joslin			♦	♦												
I 40 Lola Evidi	♦		♦	♦										♦		
I 41 Frank & Ruth Rosich				♦									♦			
I 42 Annette Gustafson									♦							
I 43 Mary Miller	♦						♦	♦		♦				♦		♦
I 44 Patricia & Bruce von Alten				♦							♦					
I 45 June Corbit				♦										♦		
I 46 Frank Green		♦														
I 47 James Ellenburg			♦												♦	
I 48 Michael & Hia Chapin				♦												
I 49 W.T.					♦	♦										♦

Responses to Comments from Individuals and Petition Supporters
Part I - Non-technical Comments

Identifier	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16		
I 50A through 50G Albert Molignoni	♦							♦				♦						
I 51 John Ray					♦			♦				♦	♦		♦	♦	♦	
I 52 Dan Battleson						♦						♦						♦
I 53 Dr. Robert Robins				♦						♦				♦				
I 54 Mel Rowling				♦														
Petition Supporters																		
P 1 Letter & petition with 3,690 signatures					♦	♦												
P 2 Francis & Caroline Peterson									♦									
P 3 Ruth Cooney									♦									
P 4 Kenneth DeBue									♦									
P 5 Sue & Joe Toth								♦										
P 6 Gary Beals									♦									
P 7 Pete Yerkich									♦									
P 8 Mike Muzzolini								♦										
P 9 Marie Martin									♦									
P 10 Carol Junkery									♦									
P 11 Mary Beer								♦										
P 12 Mary Kahn								♦										

Responses to Comments from Transcript of Public Meeting, Groups, PRPs & Government
Part II - Technical Comments

Identifier	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12
Transcript												
T 1 John Ray					♦							
T 2 Albert Molignoni									♦			
T 3 Dan Harrington												
T 4 Sandy Stash, ARCO						♦						
T 5 Fritz Daily										♦		
T 6 Dr. Richard Hammen		♦										
T 7 Dr. I.W. DeVoe		♦										
T 8 Jack Lynch									♦			
T 9 Mary Kay Craig						♦						
T 10 Bill MacGregor												
T 11 Edus Giavomini												
T 12 John Resing											♦	
T 13 Jim Keane												
Groups												
G 1 CTEC					♦	♦	♦		♦		♦	
G 2 Clark Fork Pend Oreille Coalition										♦		♦
G 3 Robertson Technologies		♦										
PRP's												
PRP 1 ARCO					♦	♦			♦	♦		
Government												
GOV 1 Fish & Wildlife Service												

Responses to Comments from Butte-Silver Bow
Part II - Technical Comments

Identifier		Section Number 4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12
BSB 1	Council Resolution No. 1635					♦							
BSB 2	BSB Local Government Comments							♦		♦	♦	♦	♦
BSB 3	BSB Technical Comments on RI/FS		♦					♦			♦		
BSB 4	Excerpts of Council of Commissioners meeting 4/6/94												
BSB 4-A	Jack Lynch												
BSB 4-B	Fritz Daily												
BSB 4-C	Dr. I.W. DeVoe												
BSB 4-D	Joe Quilici												
BSB 4-E	George Waring												
BSB 4-F	Rose Brock												
BSB 4-G	Albert Molignoni												
BSB 4-H	Bob Pavlovich												
BSB 4-I	Barbara Archer												
BSB 4-J	Mary Kay Craig, Coalition												
BSB 4-K	Sandy Stash, ARCO												
BSB 4-L	James Riley												♦
BSB 4-M	Eileen LeBreche												
BSB 4-N	Dave Curry												
BSB 4-O	Mike Thatcher												
BSB 4-P	Charlie O'Leary												
BSB 4-Q	Mike Kerns												
BSB 4-R	Ms. DeVoe												
BSB 4-S	Tom Brophy												
BSB 5	John Ray												♦

Responses to Comments from Butte-Silver Bow
Part II - Technical Comments

Identifier		Section Number 4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12
BSB 6	Mary Kay Craig, Clark Fork Pend Oreille Coalition										♦		
BSB 7	Fritz Daily									♦			
BSB 8	Ray Tilman										♦		
BSB 9	Irving DeVoe	♦											
BSB 10	Albert Molignoni		♦										
BSB 11	Sandy Stash, ARCO												
BSB 12	Excerpt from Council of Commissioners Meeting 4/20/94												
BSB 12-A	Fritz Daily												
BSB 12-B	Mary Kay Craig, Clark Fork Pend Oreille Coalition												
BSB 12-C	Frank Quilici												
BSB 12-D	John Ray												
BSB 12-E	George Waring												
BSB 12-F	Matt Casick												
BSB 12-G	Tom Brophy												
BSB 12-H	Mike Kerns												
BSB 12-I	Mike Thatcher												
BSB 12-J	Artie Laramie												
BSB 12-K	Jack Lynch												
BSB 13	Fritz Daily												
BSB 14	Clark Fork Pend Oreille Coalition												
BSB 15	Barbara Archer						♦						
												♦	

Responses to Comments from Individuals and Petition Supporters
Part II - Technical Comments

Identifier	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12	
I 1 Carla Abrams													
I 2 Elaine Roberts													
I 3 Vickie Watson													
I 4 Steve Mietz				♦		♦		♦				♦	♦
I 5 Bonnie Gestring										♦	♦		
I 6 Gary Murphy													
I 7 Maureen Markovich													
I 8 Mary Duran							♦						
I 9 John & Shelly Walsh													
I 10 Steve Schombel													
I 11 Pia Gregan													
I 12 Theresa Craig													
I 13 George Waring										♦			
I 14 Marian Conklin													
I 15 Colette Cook													
I 16 Lou Eveland													
I 17 Esme LaBauhe, James LeBreche													
I 18 Kevin & Cindy McGreevy							♦						
I 19 Cliff & Rita Bradley												♦	
I 20 Margaret Small													
I 21 Mickey Boysza													
I 22 Frank Moriarty													
I 23 Rose Brock													
I 24 Gary Davis													

Responses to Comments from Individuals and Petition Supporters
Part II - Technical Comments

Identifier		4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12
I 25	Mr. MRs. Walter Immonen												
I 26	Audrey Daly												
I 27	Bob & Dorothy Forsell												
I 28	Walter & Barbara Kelley												
I 29	Catherine Couture												
I 30	Sue Gassenberg											♦	
I 31	Dan O'Neill (Harrison Avenue)												
I 32	Lynda Hill												
I 33	Kenneth Cunningham												
I 34	Dan O'Neill (Monroe Avenue)												
I 35	Mary Mulcaire-Jones												
I 36	Barbara Archer/Tom Tully						♦						♦
I 37	Amy Lientz			♦	♦						♦		♦
I 38	Mike & Debra Evankovich												
I 39	Kay Joslin												
I 40	Lola Evidi												
I 41	Frank & Ruth Rosich												
I 42	Annette Gustafson												
I 43	Mary Miller						♦				♦	♦	♦
I 44	Patricia & Bruce von Alten												
I 45	June Corbitt												
I 46	Frank Green												
I 47	James Ellenburg												
I 48	Michael & Hia Chapin												
I 49	W.T.												

Responses to Comments from Individuals and Petition Supporters
Part II - Technical Comments

Identifier		Section Number											
		4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12
I 50A through 50G	Albert Molignoni		♦					♦					
I 51	John Ray				♦					♦			
I 52	Dan Battleson												
I 53	Dr. Robert Robins		♦	♦		♦			♦			♦	
I 54	Mel Rowling			♦									

Petition Supporters

P 1 Letter & petition with 3,690 signatures
P 2 Francis & Caroline Peterson
P 3 Ruth Cooney
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RECORD OF DECISION

BUTTE MINE FLOODING OPERABLE UNIT
SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE, MONTANA

September 29, 1994

United States Environmental Protection Agency
Region VIII - Montana Office
Federal Building, 301 South Park, Drawer 10096
Helena, MT 59626-0096
(Lead Agency)

Montana Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
2209 Phoenix Avenue
P.O. Box 200901
Helena, MT 59620 0901
(Support Agency)

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TRANSCRIPT OF PUBLIC HEARING

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BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

SILVER BOW CREEK/BUTTE AREA SITE

H E A R I N G

MINE FLOODING OPERABLE UNIT
REMEDIAL INVESTIGATION FEASIBILITY STUDY
PROPOSED PLAN

TRANSCRIPT OF PROCEEDINGS

Taken at:

Montana Tech Auditorium
West Park Street
Butte, Montana
April 26, 1994

ROBERT L. SOLOMON, presiding

NORDHAGEN COURT REPORTING
KIMBERLY JOHNSON
Registered Professional Reporter
1734 Harrison Avenue
Butte, Montana 59701
(406) 494-2083

Conference Room
1734 Harrison Avenue

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EXPEDITED RESPONSE ACTION, PROPOSED PLAN

APRIL 26, 1994; BUTTE, MONTANA

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CHAIRMAN SOLOMON: At this time we will go on the record. My name is Robert L. Solomon. I have been retained as an independent party to conduct the public hearing this evening. For the record and to the best of my knowledge, I am not an employee or member of any of the governmental agencies, private companies, or public or membership organizations involved in discussions or proposals related to the matter about to be heard.

At this time we will let the record show that this is the time and place for the hearing to receive public comment on the Proposed Plan of the Mine Flooding Operable Unit (Berkeley Pit and Underground Mine Workings) at the Silver Bow Creek/Butte Area NPL Site located in Butte and Walkerville, Montana. The United States Environmental Protection Agency (EPA) and the Montana Department of Health and Environmental Sciences (MDHES) published notice to hold a public comment period on the Remedial Investigation/Feasibility Study (RI/FS) report and the Proposed Plan for the Mine Flooding Operable Unit.

The public comment period was to be a period of 90 days from January 27, 1994, to April 29, 1994. The public hearing for Mine Flooding was noticed to be held at this time and place to provide the public the opportunity to give formal comments to EPA and MDHES.

In addition, anyone wishing to make oral public comments was offered the opportunity to come into the Butte EPA Office in the Silver Bow County Courthouse from 9:00 a.m. to 5:00 p.m. on Monday or Tuesday, April 25 or 26, 1994, for the purpose of recording their comments into a tape recorder. The comments received in this manner will be transcribed, will become a part of the official record, and will be responded to in the Responsiveness Summary. Officials of the EPA were available to answer questions during that two-day period. Written comments may be submitted to Russ Forba, Remedial Project Manager, US-EPA, 310 South Park, Drawer 10096, Helena, Montana, 59626, until the close of the comment period on April 29, 1994.

The ground rules for this evening are as follows: This is a hearing to receive public comment and information. It is not adversarial in nature, and questioning or cross-examination by the public will not be permitted. The presiding officer may ask questions in order to clarify statements or information being presented. Persons making presentations may submit comments orally or in writing. The name of the person to speak and the person to make the next presentation will be announced by the presiding officer. When you come to the microphone, please begin by stating your name and then spelling it, your address, and any organization or group that you may be representing this evening.

Present your information in a manner that is most comfortable for you. You may speak extemporaneously, you may summarize your comments, or you may read them into the record. If you have prepared a written statement, it will be appreciated if a copy can be given to the presiding officer or the reporter to assist in the preparation of the transcript of this hearing. All written materials received this evening will be given the same consideration as oral comments and will be responded to in the Responsiveness Summary. EPA has indicated to me that this will be completed in late summer or early fall.

Due to the number of persons wishing to provide comments this evening, limits will have to be imposed on the length of time available to each speaker. You will be given an indication that your allotted amount of time is nearing an end, and then you will be required to wrap up your comments, and as discussed earlier before we went on the record, we will look at a time of around 10 - 12 minutes, if that is agreed. If you continue to speak beyond the allotted time period, you will be asked to terminate your presentation. Your cooperation in holding to the time constraints will offer all those who wish to speak the opportunity to do so. Recesses will be called by the presiding officer at appropriate intervals.

The record will show that the ground rules for this hearing have been made part of the record. The Invitation for Public Comment on this matter has been made part of the record as well. All written documents and oral comments received prior to this evening are by this reference made a part of this proceeding.

We will now begin the public comment portion of this hearing, and at this time I will call upon John W. Ray, and, Albert, you will be next up.

STATEMENTS

BY-MR. RAY: T 1

My name is John W. Ray, R-A-Y, and I am a member of the Board of Directors of the Montana Environmental Information Center.

A major principal of Roman Law was that the people's safety is the highest law. The purpose of Superfund is to protect the people's safety, particularly the people's health, from dangers presented by hazardous waste sites which must be cleaned up because they present a major threat to human health and the environment.

Remedies under Superfund should provide a permanent cleanup remedy, not temporary containment or simply removal to another site. Simply, "cleanup" is defined as the act of cleaning up, and the term "clean'' means to make pure, free from dirt, and free from contamination, free from impurities.

According to the EPA Publication Superfund Environmental Progress, the purpose of Superfund is to achieve, and I quote: "Long-term cleanup goals for sites to remove contamination from the environment."

The document further states that the law, and I quote: "directs EPA to protect public health by meeting strict cleanup standards at each site." And again quoting, "Reduced to its environmental essence, the new Superfund mission is to make sites safe, make sites clean, and bring new technology to bear upon the problem."

According to Superfund law, any remedy for the Pit must be a cleanup remedy. If one examines the major Superfund laws, CERCLA, SARA, and the NCP, one finds that they all emphasize the following: First, cleanup is the primary goal of any Superfund activity; two, the reduction of toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site is another important criteria; third, cleanup remedies must be permanent.

Senator George Mitchell, Democrat of Maine, has argued that "permanent treatment" means the EPA cleanup plans must result in a permanent and major reduction in the toxicity, volume, and mobility of hazardous substances, pollutants and contaminants at a site, and that this reduction must be to the lowest achievable levels. Senator Mitchell stated: "In addition to the quantitative reduction implied, significant reduction in this context also means the minimization of volume, toxicity, and mobility of such substances to the lowest levels achievable with available technologies."

Four, Superfund law discourages EPA from simply moving waste from one spot to another. For example, is this what would be done with the sludge which will result from treating Pit water? Fifth, cost is not the major factor in Superfund decisions. Cost is secondary to protecting human health and the environment. Under Superfund, human health must be protected from potential threats regardless of cost.

Any solution, then, to the problem of the Berkeley Pit must emphasize the above criteria. It is in light of the above five criteria that the solution to the problem of the Berkeley Pit has to be evaluated. If we examine these criteria, should we be comfortable with a proposed plan that would allow the volume of toxic contaminated water in the Pit to more than double before anything is done from the present 25 billion gallons of toxic water to 56 billion gallons? Should we be comfortable with a proposed plan that leaves a Berkeley Pit filled with toxic water to exist and be treated in perpetuity? This proposed plan would allow a surface area of contaminated water of approximately 500 acres.

Is this a cleanup remedy? Is this a remedy that reduces the toxicity, mobility, and volume of hazardous waste? Is this a permanent remedy or a remedy that will leave us with a perpetual environmental crisis?

All too often in the past, Superfund has not cleaned up sites it was supposed to. Superfund activities have not met the goals of permanent cleanup. The Office of Technology Assessment has concluded that Superfund remains largely ineffective and inefficient, and "is not working environmentally." The Office of Technology Assessment has concluded that the Superfund program has too often settled for remedy technologies that do not reduce toxicity, mobility and volume of hazardous waste. All too often, Superfund has settled for remedies short of cleanup. Given the serious nature of the contaminants of the Berkeley Pit, we can not allow any remedy short of cleanup. We must clean up the problem of the Berkeley Pit so that future generations don't have to deal with it.

Now I would like to offer a few specific comments on the EPA proposed plan. First, I think it needs to have stronger emphasis on eventual permanent cleanup. Second, it needs to express in unequivocal terms that appropriate, new technologies will be used as they become available in the cleanup of the Pit. Third, since so much of the proposed plan is based on predictive models, the plan must clearly provide a definite safety factor. Human error of calculation or operation must not produce an environmental catastrophe. Fourth, the cost factor needs careful consideration and reevaluation. There are two ways of calculating cost: You can do what is cheapest; or two, you can set the goals that you are trying to achieve and after the goals have been established, decide what is the most cost-effective way of achieving those goals.

According to Superfund law, we are not looking for the cheapest remedy, but once we have decided on the plan we want to implement, to protect human health and the environment in a permanent way, we have to decide what is the most cost-effective way to accomplish that plan. Under Superfund, cost does not determine which plan is accepted or the end result desired of a cleanup plan. The cleanup plan and its end result should be simply protecting human health, and that should determine cost, not the other way around.

Senator John H. Chafee, Republican of Rhode

Island, has commented on the Superfund's consideration of cost, and I quote:

"The extent to which a particular technology or solution is feasible or practicable is not a function of cost. A determination," he says, "that a particular solution is not practicable because it is too expensive would be unlawful."

So in devising a remedy for the Berkeley Pit, we must not select the cheapest solution but the solution which will maximize the protection of human health and the environment. We need to protect a -- we need to adopt a cleanup solution and then find the most cost-effective way of achieving that.

Fifth and my final comment, the solution to the Pit problem must show sensitivity to public input. As processed, democracy demands that the public participate in the formulation and execution of public policy. This is particularly true in the case of each of agency rule-making such as is exemplified by the decision-making processes related to the Berkeley Pit. Such agency rule-making is inherently undemocratic because the people who are making the rules were not elected by the people, and they are only very indirectly accountable to the people. Rule-making is only legitimate in a democracy if the public has ample opportunities for meaningful participation in the decision-making process, and "meaningful participation" means that the public really has an efficacious impact on the content of a Superfund decision.

It is contrary to democratic practice to seek to substitute the opinions of a few so-called "experts" for public decision-making. The best environmental policy decisions and outcomes are achieved through public discussion and through public debate. The reason for this conclusion is that the answers to most environmental policy questions, as to most public policy questions in general, cannot be determined with the exactitude and the certainty of a mathematical or scientific theorem. Rather, the answer to public policy questions exists in the realm of the probable or the contigent. Given the complexity of society and the complicated nature of most environmental issues, no one individual, not even a scientific expert, knows with absolute certainty what is the best public policy. And, of course, there are numerous examples of where the experts have been just plain wrong.

Because of this contingency and complexity, the best environmental policy answers are found through public discussion and by having the so-called "expert" submit his or her conclusions to critical public scrutiny and approval. The public has a right and a duty to subject the opinions of so-called "experts" to intense criticism. If an attempt is made to substitute completely the opinions of the technical person for the opinions of the public, neither the public interest nor the demands of good public policy-making are being served. The final Berkeley Pit decision must clearly demonstrate and show not only that public input was heard but that it was listened to, and that public input had some impact, that it had some efficaciousness in arriving at the final decision about how to deal with the Berkeley Pit. Thank you.

CHAIRMAN SOLOMON: Thank you. Albert Molignoni and to be followed by Mr. Harrington.

BY-MR. MOLIGNONI: T 2

Good evening, ladies and gentlemen. My name is Albert Molignoni. That's spelled M-O-L-I-G-N-O-N-I. I am here this evening representing myself and also the County Water and Sewer District of Rocker, Montana. I have several questions here I would like to read into the record, and I will give a copy of my questions to the reporter.

My issue has to do with the water rights of the

State of Montana. My first question is: Was a water right given to the PRPs to take over 5.5 cubic feet of water per second or 2,468.4 gallons per minute of the State of Montana's ground water with or without the approval of the state legislature?

Number 2: If the PRPs have the approval of the state legislature for over this amount of ground water, what was the beneficial use described to the state legislature in order to obtain this permit?

Number 3: The Metal Mine Reclamation Act (82-4-30 MCA) states:

> "Recovery of damages for a water loss in quantity and quality is provided for if an investigation establishes that a hard rock mining operation is responsible for the loss."

What I would like to know is: Is this a lump sum fine or payment on the total amount of water that is being contaminated or on the amount of water per year that is being contaminated? Also, what would the amount of damages be for 25 billion gallons or 50 billion gallons?

Number 4: How many years will the State of Montana and the people of Butte-Silver Bow have to live with this very large amount of toxic water, 100 years, 1,000 years or forever?

Five: How is this solution of creating a 50 billion gallon plus body of toxic water good for the State of Montana or the people of Butte-Silver Bow? Is it only the PRPs that will benefit from this solution?

Six: Is the State of Montana, the EPA, and the PRPs aware of the fact that keeping the volume of toxic water to 5 billion gallons in the Berkeley Pit, over 42 billion kilowatt hours of electric power per year could be generated? This water could also irrigate over 6,000 acres of land with 12 inches of water per year.

The attached documents might show a better way to solve the problem with the Berkeley Pit. Please enter my questions and statements and documents into the record. Thank you very much.

CHAIRMAN SOLOMON: Thank you. We will acknowledge receipt of a packet of materials and they will be entered into the record at this time.

Mr. Harrington to be followed by Ron Pelzmen.

BY-MR. HARRINGTON: T 3

Thank you. Dan Harrington, H-A-R-R-I-N-G-T-O-N. State Representative, District 68, Butte.

To speak to the record, it has been 12 years since the pumps were shut off that have started this emotion, the fact that the problems that are going to be facing this county. We are faced with many serious problems, and I hope that the plan that is being put forth will take into account not only the health and welfare of the community, but also the economic development of the community. I think all of these things are so very, very important that we have to recognize the fact.

There's been many meetings held, there's been much said concerning what problems we are going to be faced with. There have been many different theories that have been put forward over this period of time. I feel that it is very, very important that this plan that is being put forward and that it is studied very carefully that each and every one of these groups, ARCO, and the EPA, all of these people take into account the very important facts as to what direction because the fate of this community is at stake in this, and I would hope that the study will continue on and that we will move for newer and better ways in which we could implement the plan. Thank you very much.

CHAIRMAN SOLOMON: Thank you, sir. Ron Pelzmen, to be followed by Sandy "Trash".

Ron Pelzmen? Sandy, would you like to speak at this time? Mr. Daily, you will be next. Sandy?

MS. STASH: My name is Sandy Stash.

CHAIRMAN SOLOMON: I am sorry, I beg your pardon.

SANDY STASH: It was a good slip, though.

BY-MS. STASH: T 4

I represent ARCO. ARCO is one of the potential responsible parties, the address is 307 East Park, Anaconda, Montana. I am here this evening to speak in support of the EPA proposed remedy, that being Alternative 67. ARCO believes that this remedy as chosen by EPA and the State of Montana best represents the balance between the Superfund criteria; namely, effectiveness, permanence, and cost-effectiveness.

Something else I think that is noteworthy that seems to be somewhat lost in the debate that's gone on for the last couple of months is that it's perhaps the first time in this community on the Superfund issues that you see such agreement between all of the players: The Environmental Protection Agency, the State of Montana, the Bureau of Mines, and two companies that will be asked to pay for this cleanup, namely ARCO and Montana Resources.

This is very noteworthy and I think very key when you get that much expertise and that many parties in total agreement on the remedy. Never before has this type of agreement been reached. On the specifics of the plan, ARCO specifically supports the critical water level as determined by the EPA and the State of Montana. Again, an important factor I think sometimes lost in this discussion is the critical water level includes ample design factors to assure the people who live here that something will be done at the Pit long before it is absolutely necessary. In addition, this will be assured in that commitments will be made and have been made to the agencies that the situation at the Berkeley Pit will continue to be monitored very aggressively as it has been for the last couple of years. In that any changes that would determine a different critical water level being necessary could be made.

Thirdly, there's been much discussion and debate on the use of technologies for the Berkeley Pit treatment. There again, ARCO is in total agreement with the remedy as specified by EPA and the State of Montana. Again, I think something is lost in these discussions. The lime aeration technology that was chosen for this remedy is indeed an innovative technology and is an innovative technology developed here in Butte, Montana, at Montana Tech. Never before has lime aeration been used in a cleanup treatment with the types of volumes you are looking at.

I think secondly and very importantly for those who feel that other technologies would be more appropriate, we suggest again as one of the parties who will be asked to pay for this cleanup that those folks need to provide to the responsible parties and to the agencies proof, credible, scientific facts that show that the technology they are purporting is both scientifically sound and at least as equally as cost-effective if not more cost-effective than what is currently on the table.

We believe that in ten to twenty years that will ensue before the large Berkeley Pit treatment plant needs to be built, there will be ample time for additional technology development. We look forward to the work of the Resources Recovery Project located here in Butte, Montana, to help us to develop a better or a modification to the remedy that's been chosen.

Fourthly and finally gets to the issue of sludge disposal. Again, much debate on the subject. We would suggest to EPA and the State of Montana in their final decision-making that the question of sludge disposal is best left until the final design is done for the technology for the final treatment and not try to be determined right now. Thank you.

CHAIRMAN SOLOMON: Thank you very much, and again, my apologies.

Mr. Daily to be followed by Dr. Hammen, next speaker.

BY-MR. DAILY: T 5

My name is Fritz Daily, D-A-I-L-Y, and I am a state representative representing Butte in House District No. 69. On May 30, 1990, I presented testimony on the work plan that led up to this RI/FS that has now just been completed. The testimony I gave back then, I think, is even more pertinent today than it was back then. After carefully studying the RI/FS, attending numerous meetings, making numerous presentations, the only thing that I see different today on this very date is the fact that the water is now 110 feet deeper, and there is an additional 9 billion gallons of poison in the Berkeley Pit. That's the only difference.

The issue back then was the establishment of the critical water level. The issue today is the establishment of the critical water level. As is stated in the work plan, the primary objective of the entire RI/FS was to establish the critical Pit water level. That's the primary objective of the entire RI/FS. However, that critical water level was established and, I might add, in closed-door negotiations between ARCO, EPA, and the State of Montana before the RI/FS even started. They established the critical water level without the benefit of the RI/FS. That's unbelievable to me.

The critical water level was wrong then and it's wrong now, and as Sandy just stated, it's the first time really that all of the groups have agreed with this RI/FS, but if you look back on the establishment of that critical water level, all of the groups agreed then, too; and again it was wrong then, it's wrong now.

As most of you know that have heard people -- that have heard me make a presentation, I like to use analogies when I try to make a point or try to explain a point. And a good analogy to use in this situation goes back to our budget deficit, the budget deficit that this country is now facing. And in 1963, John F. Kennedy presented a budget to Congress that was out of balance by only $10 million. Today, that budget -- we now have a budget deficit of over $300 trillion and each and every one of us in this room owes $17,000 toward that budget deficit.

When you deal with the Berkeley Pit and the Butte mine flooding issue, as I stated a few minutes ago, the water is now 110 feet deeper and it now contains 9 billion gallons more and that's since May of 1990. The Berkeley Pit actually, today, is 807 feet deep and it contains 22 billion gallons of water, or the 22 billion gallons of poison, however you want to look at it.

I would like to place in the record two resolutions that were introduced in the 1993 legislature. The first resolution is a resolution which was drafted by a committee, an environmental committee, in the Montana legislature and does not contain one name of a representative from Butte. The resolution was drafted because of legislation that I presented that was supported by the rest of the members of my delegation. And the resolution deals with what we are talking about here tonight. It deals with the flooding of the Berkeley Pit and it deals with the actions that were taken up to that point by the Environmental Protection Agency. And if you read this resolution, you can see that they were not very happy with the actions of the Environmental Protection Agency.

The other resolution is a resolution which I sponsored which was cosponsored by all of the members of the Butte/Anaconda Legislative Delegation or the entire Southwestern Montana Legislative Delegation, and it supports the new Waste Tech Center that has now been located in Butte, Montana. I think that the only way this problem is ever going to be solved is by some independent third agency or some independent third body. I have finally reached that conclusion. I do not believe that ARCO and EPA are going to solve this problem. This problem is going to be solved by Metanetix, Montana Technologies Company, or some other similar company. That's how it's going to be solved.

We as a community, we as a state, have to encourage as strongly as we possibly can that we support new and innovative technologies and that we encourage these people to continue working to solve this problem because, ladies and gentlemen, believe me, that's the only way the problem is going to be solved. And I will offer these two resolutions. I also have three other documents that I would like to present and offer for the record, and let me just first of all maybe just go over one of these. And these are the problems that I see with the RI/FS as it has been presented.

First of all, I think that the Record of Decision, the decision that's going to be made from this information, is one of the very most important decisions that will ever be made in Butte-Silver Bow. It may be the very most important decision. The fate of our community, as Representative Harrington has stated, the fate of our community is at stake and it's important that we get a responsible solution to this problem. As I stated earlier, the critical water level is too high and it was not properly established. The solution that's been proposed no matter what anyone says is the cheapest and not the best. There are way better technologies out there if we would look at those technologies and try to use some of those technologies. The best thing we can do as a community without question is to figure out a way to mine that water, take the resources from that water and, most importantly, turn the water back to water. The most valuable asset in the Berkeley Pit today, I believe, is the water. The bedrock aquifer has been abandoned in this RI/FS. That is not a good decision. That's a decision that's going to affect us for many years to come.

The fate of the community, as I have stated here tonight, as Representative Harrington has stated here tonight, is truly placed in jeopardy as a result of this RI/FS. I appreciate the opportunity to be here tonight. I realize this is probably the last hearing that we'll have, I guess, on this critical important issue, and I guess I would hope that as many people as possible would step forward. And I know it's difficult to do sometimes, and I have a difficult time myself doing it, but it's really important that the EPA and ARCO and Montana Resources and the Montana Department of Health, it's really important that they know how we, as a community, feel. And I guess I would ask everyone to step forward if they could. I think that would be very beneficial. Thank you.

CHAIRMAN SOLOMON: Thank you and we will acknowledge those materials and place them in the record, please.

Dr. Hammen to be followed by John Resing.

BY-MR. HAMMEN: T 6

Thank you. My name is Dr. Richard F. Hammen, H-A-M-M-E-N. I am the President of Chromatochem Inc., C-H-R-O-M-A-T-O-C-H-E-M, Incorporated. The address is 2837 Fort Missoula Road, Missoula, Montana, 59801.

Thank you for the chance, Mr. Chairman, of being able to present or speak at this meeting. I represent a company which has developed a technology that is applicable to the cleanup of the Berkeley Pit. I would like to talk a little bit about that technology and how it interacts with respect to the Proposed Record of Decision which will go down here this evening.

First of all, I would like to just state my qualifications because I will make a couple of exceptions to some of the scientific conclusions that are presented in the RI/FS that I have read. I was a boy from Montana, Southern University of Montana Professor, but I have been educated at Stanford University, PhD at the University of Wisconsin, post-doctoral scholarship at UCLA, employment at Stanford Research Institute and California Institute of

Technology Jet Propulsion Laboratory. After that, I founded Chromatochem and moved the company to Montana with encouragement from funding by the State of Montana Science and Technology, Montana State Science and Technology Alliance, which is in the business of investing in and encouraging the development of new high-technology companies.

In January of 1991, Chromatochem submitted a proposal to EPA to use our technology for a study of treatment of Berkeley Pit water with the objective of recovering the water with purity that exceed Rule Book Standards and recovering the metals in a form that is applicable or appropriate for processing and selling these metals into the commercial marketplace and not presenting the metals as a sludge. This project was funded by the EPA, and I would like to enter into the record a paper titled, "Acid Mine Water Processing and Metal Recovery by Fast Solid Phase Extraction", that was published in January of 1993, Mine Engineering Research.

In addition to that paper which has been published, I have given numerous talks nationally and also in Butte regarding this technology and its application to acid mine water treatment, and this fall I will be chairing a session at the National American Chemical Society meeting -- the American Chemical Society meeting in Atlanta, discussing innovative technologies for hazardous waste treatment. This technology has been granted a US patent which was issued in August of 1993, so the technology has been acknowledged by the federal patent offices as being good.

At present, the company has made a proposal to the Resource Recovery Project that MSE is sponsoring under Department of Energy dollars. We have done this proposal or made this proposal in conjunction with a company called the International Technology Corporation which is one of the leading hazardous waste cleanup technology companies in the country and is presently involved in some rather large contracts at Hanford Superfund site totaling 200 million and another one for 400 million. They are partners in this program and we have recently been notified by the Department of Energy that we are still in the running or we are among the finalists in this competition for a technology demonstration project that will take Berkeley Pit water, extract the metals, present them as concentrate in forms appropriate for sale into the commercial market, and have an objective of having water which will exceed drinking water standards.

That's a bit of the background of what we have done with Chromatochem. What I would like to do is turn to a section of the RI/FS and it is Section 5.1.10 titled, "Chelation Chromatography". In this review, the PRPs sponsored an analysis of technologies which are available for treatment of acid mine water. Chelation Chromatography is a phrase which I developed and I first coined and brought into the world, but it describes the type of separations process which is also being sold in the marketplace by competitors of Chromatochem Company such as Dow and Roman Hause. It is a recognized technology, generically, and Chromatochem's patent is recognition of an improvement of this technology in its cost-effectiveness and the cleanliness of the water it produces. I would like to read some lines from this statement in the RI/FS and enter into the record of this meeting some corrections that I would like to make in it.

Paragraph 2 of Section 5.1.10 states: "Recent research efforts have successfully conducted laboratory scales tests on new synthetic resins to improve the selectivity of the resins." Jones and Grinstead, 1977. 1977 was 27 years ago. These are not recent results which were reported or discussed in this analysis of new technology.

The statement goes on: "However, the new process has not been demonstrated successfully on a pilot or full-scale basis." That sentence is incorrect. Roman Hause and Dow chelating resins are deployed for treating millions of gallons of water everyday as a well-known process.

Now, it goes on. Let me draw your attention to Paragraph 3. It says: "effectiveness, Chelation Chromatography has been tested in limited pilot skill applications." Preliminary data indicate that this method of ion absorption is not quantitative, i.e., repeatable over time.

I refer to the paper I have submitted to the record that shows this process was demonstrated to be repeatable over time of 1500 cycles of use. Development subsequent to the publication of that paper have increased the stability and reproduced stability in that product and that process.

The second sentence of Paragraph 3 states: "Preliminary data also appeared to indicate a degradation of a thin film of chelating aging over time." That sentence is incorrect in that we demonstrate that after this 1500 cycles of use, that over 80 percent of the original material's capacity still remains, so that the Chelation Chromatography is not material or process which is sensitive to changes or process variations. It goes on to state: "Therefore, based on its early phase of development, Chelation Chromatography has been removed from further consideration." And that is the conclusion.

Now it says: "Chelation Chromatography is implementable on a technical basis using conventional construction methods." Correct. "It has not been proven on large scale operation and is not technically feasible for treating 1.5 to 2.3 million gallons per day of waste water during remedial action." Incorrect. Chelation Chromatography is in use with other commercial resins on project of that scale and we have proposals outstanding for treatment processes that are in the tens of millions of gallons per day in size. It is a scalable technology. Those are the changes that I would like -- excuse me. I have other corrections, too, and I am not done on this.

The final paragraph titled "Cost" says: "Implementation of this process technology would require relatively moderate to high capital costs." That is incorrect. The capital costs of Chelation Chromatography system deployed for Berkeley Pit water cleanup to the drinking water stage of recovery of the metals is less than any of the capital costs in any of the plans presented in the RI/FS except for the No Action Plan. I don't know what the cost of the No Action Plan is. ONM costs are not estimated because reliability and durability of this technology has not been established.

I would like to annotate that by saying that although our papers, our work, has been presented and is known and published we were not contacted by any of the PRPs or by the consulting groups for questioning or further information with respect to this. I would like to further remark, again, that this technology was demonstrated with the use of Environmental Protection Agency funds, and apparently the EPA has not used its own internal data or even noticed its own internal data in its recommendations.

That ends my comments with respect to the written remarks about technology that our company has developed. In approximately 6 months this technology will be demonstrated on a pilot scale and I think that, again, I would like to state that there are two issues that are important: One is the issue that industry's remarks are that treatment to high standards of purity in water to the levels of low parts per billion is exceedingly expensive and therefore cost-prohibitive.

Being in industry, I agree that no cost-prohibitive measures should be included or should be considered seriously. This technology is capable of treating water to nondetectable levels of copper, manganese, zinc, and arsenic. I therefore ask that the proposed plan be rejected at this time because it has not considered adequately this new technology and it is quite likely that it has not appropriately or adequately considered other technologies which would work in conjunction with any modern process that would treat this water. The process of precipitation and aeration is very, very old technology and I think that some changes have been made, and the city of Butte deserves better treatment of its water and its resources in its future.

I request that the EPA consider the data that have come from our sponsor grants -- three more minutes -- and I request that in light of the new data which is being entered into the record at this hearing that the proposed plan of action be reconsidered.

I have some questions to enter into the record. The first question is: Did the Environmental Protection Agency in any fashion review the accuracy or the validity of the comments about modern water treatment technology which were made in this report? If it did, then what happened to the analysis of Chelation Chromatography?

The second question that I have is, relates to the issue of costs on this matter: Chelation Chromatography is a low-cost solution because it provides marketable metals, it provides drinking quality or better water. Will ARCO accept or entertain a zero cost treatment for cleanup alternative?

Thank you very much.

CHAIRMAN SOLOMON: Thank you, sir.

John Resing?

You will submit written materials. Thank you.

I.W. Devoe to be followed by Jon Sesso.

BY-DR. DEVOE:

My name is Dr. Irving W. Devoe. I live at 1104 Broadway in Butte. I, too, will state my qualifications. I have a doctorate from the University of Oregon Medical School, I have been an Associate Research Scientist at the Atomic Energy Commissions Laboratories in Illinois, I was Professor and Chairman of the Department of Microbiology and Immunology of Infectious Diseases at McGill University in Montreal, and I have since been head of three corporations, the current one being Metanetix Corporation, headquartered here in Butte, Montana. I am here to protest and object to the accepted remedy for the Berkeley Pit. That is a precipitation technology for metals which are sludged and put into landfills of one kind or another.

I have in my hand a paper entitled, "The Precipitation of Copper from Mine Water in the Butte District." This is a paper from the office of William Clark and it's dated 1902, and in fact this is the United States patent on that process dated June 10, 1902. Now I didn't bring the other one tonight which is also a paper by the same company, this is the Anaconda Company, 1941, in which it's suggested that the metals be sludged and converted into carbonates with lime. This happens to be calcium hydroxide used here, a quicklime. The second one refers to liming the metals in the Pit and, of course, these are for collections of metals commercially and they are to go into the smelter.

But this is not a new technology, and in fact this paper has to skirt around some other patents prior to this of the same technology. Dr. Hammen has just talked about Chelation Chromatography. I didn't coin that term, but he knows that in this field I go back a ways myself. But we don't -- neither one of us go back as far as microbes do because all living cells use chelation technology to handle metals. And the Metanetix technology is a technology that's been developing since 1980. We hold 19 patents in the chelation area, we hold 5 patents in the engineering area, and we have 7 patents pending, some of them that actually pertain to the Berkeley Pit water.

This technology now has $35.5 million behind it in its development. We are here in Butte on a commercial operation to take metals from the mine water and the Pit and convert these to metal products. These products have been developed since we have been here in Butte over the last year, we have arrangements to move these products, we have negotiated in the last or have started negotiations in the last week for rail facilities to be available to our company to ship the products. We now, on our first scale of this operation, are processing more than 500,000 gallons a day, not too far from the million that has been mentioned.

This technology has been tested by -- I should say, first of all, the technology started using a clearing radioactive metals from water, Cesium 137, Cobalt 60, Strontium 90, plutonium, uranium, and others. It was tested by the Batelle Laboratory for plutonium, it was tested by the Dutch Independent Laboratories, it was tested by Bateman Corporation, Edward L. Bateman from South Africa. It's been tested independently by the Nalco Corporation, it just spent 10 and a half -- or 11 months and $10.5 million being tested in Canada for cleaning of harbor sediments. The US-EPA came in, reviewed the study and a publication is now out from the US-EPA, November 1993, saying that this technology successfully cleaned contaminated soil from heavy metals, soil from a lead smelter removing the lead, the harbor bottom sediments, sewage sludge, and sewage sludge hash. The technology is now removing the metals from the Berkeley Pit water and the mines. We are pumping it out of the Kelley Mine at the present time.

It has been stated by the first speaker that the best technology will not only clean up the water, it will reduce the waste and be a permanent solution. The Metanetix technology has no waste. It uses all of the metals that it retrieves for products and it cleans the water and puts out clean water. This technology, as well as that of Dr. Hammen's, was also not considered by ARCO and in fact was rejected by ARCO.

In summary, I would like to protest as a citizen and also as a resident of Butte and also as a head of a company here in Butte that the wrong technology has been chosen and the wrong solution has been chosen both by the EPA and ARCO. Thank you.

CHAIRMAN SOLOMON: Jon Sesso to be followed by Mary Kay Craig, next speaker.

MR. LYNCH: I might begin by clarifying I am not Jon Sesso.

CHAIRMAN SOLOMON: And also, Mr. Lynch, would you please spell your name for the court reporter.

T 8

BY-MR. LYNCH:

I will. My name is Jack Lynch, L-Y-N-C-H, and I am Chief Executive of Butte-Silver Bow. Mr. Sesso signed in as I was unavailable at the time this hearing started, and again I wouldn't be here.

Basically, I would like to go over three positions that the local government has taken relative to the preferred alternative being proposed by the EPA for the Berkeley Pit and mine of Flooding Operable Units. What we undertook to do in this instance had a unique approach to it that we scheduled our own public hearings on this preferred alternative and we conducted those public hearings with the Council of Commissioners over the past several weeks and concluded in a formal public hearing last week. And what the local government has done as a result of that public input, and we did receive a great deal of public input that covers all of the possibilities of the spectrum, is that the local government has gone on record, I guess, with a lot of reservation and concern about the preferred alternative, but also in support of some modifications to the preferred alternative that the local government might find more acceptable as they relate to the preferred alternatives as it addresses the problem with the Berkeley Pit.

I think that this is the first time in a preferred alternative when the local government has gone to the extent of conducting our own public hearings to receive input to forward to the EPA, and I think it's the first time in any of the Superfund-related items that we have dealt with in this community that the local government has formally gone on record and has drafted a resolution that sets forth their comments relative to the preferred alternative.

There are four main issues that the local government would like to address. First of all, the Berkeley Pit mine flooding is a unique problem that will require unique and creative solutions both in technology and in the implementation of the administrative processes. Business as usual will not solve the problem and to render in the innovative solutions is the critical community problem. Butte-Silver Bow local government, through its Chief Executive and Council of Commissioners, have submitted the following comments on the Berkeley Pit Remedial Investigation/Feasibility Study and the proposed plan in the hopes of fostering the motivation and creativity needed to meet the concerns of the citizens of Butte-Silver Bow.

Number 1: Assurances on the scheduling of the construction of the plant. The proposed plans should document a firm schedule about the conservative trigger point to plant construction to provide greater assurances that the critical water level is never approached.

Second, enhanced monitoring in public education. The County proposes the immediate installation of two new wells southeast of the Berkeley Pit and one of the monitoring wells will function near the east Continental Pit, coupled with the comprehensive education program, will ensure that information is disseminated regularly in terms clearly understood by the average citizen. Also needed is a clear process on how the data from this RI/FS will be updated, particularly if any new data indicates any impact on the environment or human health thus triggering changes in the preferred plan.

Number 3 relates to innovative technology which the county has termed "Call to Action". The Record of Decision should require the use of innovative technologies to supplement or replace the hydroxide plans and ensure that the best available proven technology is used at the time of implementation, thus avoiding problems with hydroxide precipitation such as the sludge disposal at the Pit or at a newly created depository that the future contamination that could result from leaving billions of gallons of contaminated water in the Pit, the loss of the ore body, an enormous economic resource made in the long-term community liability if the sludge is redeposited in that ore body.

The EPA should create a partnership with the PRPs and set the county and the county -- to set a firm goal to develop a comparable remedy with equal effectiveness that is sensitive to cost. We also make note to waive the requirement to restore the bedrock aquifer. Butte-Silver Bow must be ensured that there is no linkage between waive or righting of this contaminated bedrock aquifer of the Pit and other aquifers along the Clark Fork Basin.

We will, before the prior deadline, submit both the four priority points to the government along with documents in detail why this position was implemented along with the formal resolution from the Council of Commissioners to our Congressional Delegation and to the Environmental Protection Agency. And we will see that these are available for credit.

We have gone to great extremes, the Government has found themselves in a very difficult position. We have to balance both the criteria under which the EPA must operate along with what we consider an extreme social and economical impact that this might have on the community. With all formal documentation and comments of the government resolution will be submitted and admitted in written form. Thank you.

CHAIRMAN SOLOMON: Mary Kay Craig to be followed by Bill Macgregor.

T 9

BY-MARY KAY CRAIG:

My name is Mary Ray Craig, C-R-A-I-G. I live at

715 West Park in Butte. My qualifications are that I am a Butte kid and I am a Butte native. I live here and I expect to live here for the rest of my life. I am the upper river field representative for the Clark Fork Pend Oreille Coalition. The coalition is a nonprofit, nonpartisan membership-supported public interest group with a mission to protect and restore the water quality in the Clark Fork River watershed.

My dad taught me that the headwaters of the Clark Fork River was here in Butte, Silver Bow Creek, not at Warm Springs Ponds. Silver Bow Creek starts in the mountains northeast of Butte and it runs through the valley, at least it did until that portion of the creek was renamed Metro Storm Drain, perhaps for those who hope not to have to clean it up.

Nonetheless, my dad said someday perhaps it would be cleaned up so kids could play in it like kids do in other towns that have creeks running through them. Instead, Silver Bow creek now runs into the Yankee Doodle Tailings Dam. Water from there and from leach pads enters the Berkeley Pit as groundwater or as Horseshoe Bend water. EPA's preferred plan would divert the water from the Horshoe Bend away from the Pit, but that won't be cleaned for our use for many, many years. Once in the Pit, EPA and ARCO say the toxic water cannot leave. It is true Silver Bow Creek, Metro Storm Drain is mostly dry through town, but that does not mean the water is not leaving. Berkeley Pit water can leave the Pit. And contrary to what EPA and ARCO tell us, there is strong empirical evidence that it is leaving the Pit system. You don't need a hydrology degree to understand that it would not have been possible for the Anaconda Company to dewater the mines and the Pit if water could not move through the bedrock aquifer.

After a $10 million study done over 10 years, ARCO and EPA rely on theories and their opinions in stating that water isn't leaving. They do not know what is happening at depth, no one knows for sure. Their preferred plan for the Pit and mine flooding is based on hydrology theory and guesses, not facts. The fact is: Bedrock aquifer water is entering Silver Bow Creek at the west end of town where the bedrock rises to the surface. We know this is true because Silver Bow Creek has a gaining stream at that point. The State Department of Health and Environmental Science Superfund manager for the Pit mine flooding operable unit said last Thursday night at a meeting that the water entering the creek from the bedrock is poor-quality water.

Why is that poor-quality water allowed to enter the creek just below the Colorado tailings? This is not even discussed in the mine flooding remedial investigation. It has surely contaminated mine flooding operable unit waters, but appears to have been ignored. If the Pit water is allowed to rise higher, we will see -- will we see, question, will we see an increase in the amount of water entering the creek from the bedrock aquifer? Obviously. Monitoring, wells should have been part of the remedial investigation, not specified as part of the remedy. The remedy would address contamination after the fact, not preventive.

The preferred ban allows the travona water to go as high as 5,435 feet in elevation. It's at 5,427 now before it is pumped. That water may also contribute to the poor quality entering Silver Bow Creek from the bedrock aquifer, particularly since where it is pumped is 25 feet higher than where the creek becomes a gaining stream. EPA must lower the level at which that water is pumped. Also regarding Silver Bow water, arsenic and iron currently exceed water quality standards after dilution at the Metro Sewer Plant. EPA and the State must insist in the Record of Decision on meeting the applicable standard instead of creating early precedents for waiving legal requirements.

Regarding the 25 billion gallons of toxic water now captured in the Berkeley Pit which would be 56 billion before any is cleaned and discharged to the creek about 28 years from now under the preferred plan, to what beneficial use is that water being applied? There is a fixed amount of water on this earth. Why could 56 billion gallons be tied up in perpetuity? That is what this preferred remedy would do and that is unacceptable. I have heard many concerns of the community in attending meetings over the past couple of years, reasons that they do not favor this plan including legal, technical, cost, environmental, economic, and social issues.

Cost issues: The people of Butte expected EPA to require the water level in the Pit be lowered. Because of cost alone, EPA said they did not consider that a potential remedy. Where did EPA come up with the $60 million lid they have established for this cleanup? A cleanup for perpetuity. Miners tell us that that is what it cost to put pumps into the Kelley Mine Shaft twenty years ago. It just does not appear to be adequate. People would have preferred EPA take a business approach and ask: What needs to be done and what is the most efficient way to do it? Because of cost, EPA did not consider condensation or other newer technologies that could be made available soon. People think that metals recovery should be considered as an offset to the cost of good cleanup. Also, people wonder why ARCO should not be required to put up the money up front instead of relying on their self-insurance status. In this town we have heard of perpetual care before and from a very trustworthy and well-intentioned source, yet it fell through. We don't want to have to trust ARCO for perpetual cure of the Berkeley Pit forever.

Legally, people aren't real happy that EPA is getting rid of the threat of release of contamination from the Pit -- EPA is not getting rid of the threat of release of the contamination from the Pit. That's what we thought their job was. Under this plan, the threat will remain in perpetuity. The law says EPA should reduce mobility, toxicity, volume, of contamination. Folks wonder, how come the volume of contaminated water can be allowed to double in the Pit before any is cleaned? It creates more toxicity as well and it increases probability of mobility through fractures in the bedrock as it mobilizes upward through this plan, all the way to 5,410 feet. People don't know why Butte should not be treated as well as other towns where contaminated water is cleaned up for their use. The idea of writing off the bedrock aquifer, setting a precedent for mining site, is not acceptable.

An aquifer is a vessel, a dish that holds water. The water is the product. We need more water in this valley. We could have it if the contaminated water were pumped and cleaned. To come to its opinions and preferred remedy, EPA and ARC0 did what is called "modeling" of underground water flows. In these, they assume a constant head pressure. Scientists tell us that such an assumption would allow one to create any result they desired. EPA must review their modeling and dismiss conclusions from it.

People are worried about induced infiltration where contaminated water from the Hill or in the Pit could travel south and contaminate wells. People hope that the existence of contact between Butte-Silver Bow County and ARCO for post Superfund well bans isn't being considered by EPA and preferring to let the Pit fill. People worry that putting off cleaning Pit water for up to 28 years doesn't affect the ability to get other sites cleaned up soon; for example, stream bed sediments in Silver Bow Creek. Regarding innovative technology and timing, EPA should go forward from today, not backward from the year 2022. Here is a plan that most of Butte would likely find acceptable. Butte-Silver Bow County has asked EPA to find research dollars in their S-I-T-E, Site Program, or another of their research programs. It could be used to help come up with newer cost-effective technologies. If these dollars could be added to those provided by the Department of Energy in its funding of the

Resources Recovery Project of Montana Technologies Company in Butte, it would mean more technologies could be tested in a shorter period of time. One idea is to have the project send out a call internationally for new technologies. Let competition and market forces prevail. Companies wanting a piece of the mineral's pie in Butte could get investors to help test their ideas. Others could take a chance that MSE would choose their's to test. Within two to three years MSE could specify 1, 2, or 3 cleanup processes and have them go into pilot runs. EPA could require that within the following five years, a pumping plant be designed and constructed. By the end of the total of seven or eight years, we could have clean water running down Silver Bow Creek.

Young people are wondering about future shock. They are not happy to hear EPA and ARCO want to put off cleanup of Pit water until it nears the full mark. Future generations are going to be saddled with maintaining a pumping and treatment facility in perpetuity under any plan. The least we can do is get the remedy in place now, not shove that off to them as well.

The EPA/ARCO plan doesn't adequately consider the fact that this country has only been around 200 years. It doesn't consider the possibility of a future economic depression that might take dollars away from maintaining the Pit at its full sign. It doesn't consider the possibility of social upheaval or war. It doesn't appear to have adequate fail-safes built in case of a breakdown of the nuts-and-bolts plants that would have to be maintained forever.

It doesn't look at the worst case scenario, in case of an earthquake. It doesn't look at what it is doing to property values in Butte today, and especially near the Pit. It doesn't seem to care about short-term adversities such as doubling contamination, and it doesn't leave room for entertaining holistic approaches to Pit cleanup, approaches that could provide many benefits to the community. What it does do is attempt to control contaminants, not clean them up. What it does do is give ARCO the least costly option, one that the next generation of ARCO and EPA employees and Butte-Silver Bow citizens would have to address, not today's folks who have studied the site.

Butte folks just don't think that's fair. The people of Butte need to be heard by EPA, not ignored. We obtained over 2,000 signatures in just three days' effort at K-Mart and others have come flying in. We have got over 3,000 signatures on a petition where the Butte people are asking EPA to lower the level of the Berkeley Pit and take action now for cleaning it up.

It is noteworthy that this is the first time this community has come forward in great numbers and in strong agreement on an environmental, social, economic issue: The Berkeley Pit and mine flooding preferred plan. The people of Butte are saying that the preferred plan is not acceptable and that it should be rejected. Thank you.

CHAIRMAN SOLOMON: Thank you.

Bill Macgregor and to be followed by Edus Giavomin.

BY-MR. MACGREGOR: T 10

My name is Bill Macgregor that is M-A-C-G-R-E-G-O-R, and I am the Technical Assistance Grant Coordinator for CTEC. I would like to read this evening a letter I have written to Russ Forba, Remedial Project Manager, as my official comments not on behalf of CTEC, but on behalf of myself as someone who has followed this process for the last five years as a citizen of Butte.

I run a small train of pedigrees as some of the predecessors here. My doctorate is in words, not in science, and my view of the problem is as a semantics problem at least as much as a technology problem. At the last meeting of the Citizens Technical Environmental Committee on April 21, I eluded to a term that seems appropriate to the situation we find ourselves in now. I would like to recapitulate that term and briefly explain how it embodies the current predicament faced by all of us involved in contributing our energies to helping solve the problems of the Mine Flooding Operable Unit at Butte-Silver Bow Creek Superfund site.

The writer, Paul Dickson, coined the term, the verb, "to Neckar", N-E-C-K-A-R, to identify a phenomenon he says describes one aspect of life in the last quarter of the 20th century. To neckar: To test or try something in such a way as to invite disaster; as in, "He neckared the brakes on his new Ford by racing up close to a brick wall and then slamming down on the pedal at the last moment."

The term comes from the river of the same name in West Germany where the prime example of modern neckarism took place in 1979. The US Army helped German authorities test a new bridge spanning the river by driving 34 of its heaviest fully manned M60 tanks onto the structure. It sagged, but did not collapse. I have a photo of 34 tanks on a bridge crossing the Neckar River. They are still there. The attached page shows the photo of that moment which no doubt represents a moment of pride for certain German civil engineers and immense relief for the commander of that column of tanks.

Like Dickson, I am a student and an engineer of words, not of concrete, stone, steel, water and engineering. The source of alarm I felt for the five years I have followed EPA's work toward a solution of the Berkeley Pit Mine Flooding Operable Unit is in the semantics used by the agencies who are charged with protection of the health of this community and its environment.

EPA's definition of the problem and its solution have always centered on the notion of a Critical Water Level. In fact, this assumption has become so ingrained that it has received the great honor of being added to EPA,s list of acronyms, the Critical Water Level; that's the CWL.

What's always bothered me about the CWL as it is now known is not the precise level. Representative Daily and others have always argued about where ought to be, but that's not my issue. My issue has always been that EPA's reliance on what it calls a "critical water level" is a perfect case of neckaring Butte's future. What I mean by that is that the solution of the problem of the rising water in the mine system beneath Butte has been to play footsie with disaster, even at the semantic level.

The argument that EPA can't enforce control of the water without showing probability of its release into the environment is shallow at best, and at worst shows cynical disregard for the opposite argument which says that without such control, the release of contaminated water is certain to occur. Both of those are admitted positions but the second one is disregarded. Facing the absolute certainty of such eventual releases into the environment if no action is taken, the community is left to wonder what kind of solution is it that tells us to wait until the situation is approaching a crisis stage that is in critical, crisis stage before action will be taken. And then the action proposed involves perpetual effort and expense such that mining which has always been Butte's pride is destined to become its curse.

I have two tangible requests to make at this final moment in the public comment period at this opportunity. First is very simple: A semantic request, and it may sound trivial to some, but I am serious. If the water level EPA has set is indeed safe for Butte and all the communities downstream, say that. Stop calling it the "critical water level" and call it instead the "safe water level" and we will hold you to that promise. That way when somebody asks me about EPA's goal for Butte cleanup operations, I can say, "To keep us safe," instead of, "To keep us in perpetual crisis."

Second, a common sense but technical request: Beyond controlling Horseshoe Bend water as part of a inflow control regime, please consider long-term options for dewatering upstream of the contaminated ground water, rerouting everything possible and reducing the need for perpetual treatment. If stasis in the mine flooding can be achieved at an earlier date without the need for long-term treatment and attendant sludge generation, or any other expensive, long-term treatment needs, everyone wins. Cleanup costs drop exponentially, water otherwise destined to join the contaminated reservoir -- I should say clean water is kept clean and usable -- and we will all be able to point with pride to the solution when our grandchildren and our great grandchildren ask us about the world we have left them here in this area.

Intercept the water before it gets to the contaminated areas on the hill. Reduce its rate of filling to next to nothing. Avoid the need for treatment altogether. Is this too simple or too low-cost a solution to be considered? At the very least, avoid the kind of disaster-orientation scenarios that seem to motivate so much to have Federal Government's actions. Don't let your proposed plan -- don't let your proposed plan neckar Butte's future. Thank you.

CHAIRMAN SOLOMON: Thank you, Dr. Macgregor. Edus Giavomin, next speaker.

EDUS GIAVOMIN: I think I made a mistake. I signed a paper that was out on the table, and is that where we were to sign up to speak?

CHAIRMAN SOLOMON: That's what that was for.

EDUS GIAVOMIN: I didn't know that. I thought it was here attending this meeting. I am sorry, but I would like to say something.

BY- MS. GIAVOMIN: T 11

I am a native of Portland, Oregon, and arrived here in Butte in 1980, and I tend to stay here. My children are here, my grandchildren are here, and I hope my great grandchildren will be here. And I remember my grandmother in 1898 when she walked the streets of Butte with her tambourine and she was a Salvation Army Lady and she sang songs and she said you could make more money in the bars singing because there were a lot of bars in Butte, Montana, and you could fill your tambourine or whatever to take it back to the Salvation Army. She told my mother and I remember stories about Montana and, of course, this area of Butte and how beautiful it was, how beautiful Montana was in the Deer Lodge Valley and the clean, clean water. And I would like to thank everyone who is here who has attended and the speakers have been wonderful. I hope that all of this attention will be -- somebody will listen and we will be able to do that for our future generations here in Butte, Montana. Thank you.

CHAIRMAN SOLOMON: Thank you. Is there anyone else who wishes to speak at this time?

MR. RESING: Yes. I am John Resing, representing Chromatochem.

CHAIRMAN SOLOMON: Spell your last name.

MR. RESING: R-E-S-I-N-G, J-O-H-N.

BY-MR. RESING: T 12

Chromatochem does not have the final draft of the local government stating their position. I am working from a draft dated March 21, 1994, and I have no information that there's any subsequent difference included. We specifically want to draw attention to the Call for Action on innovative technologies in Paragraph 3.1 in which the local government takes a position that the RI/FS is defective because the remedial technologies were not considered in combinations. It is a preordained result for the analysis to have been made in the manner as reflected in that draft document.

Nobody asserts that reverse osmosis technology is an appropriate technology for the level of contamination of the Berkeley Pit water as the first stage of an overall treatment solution; however, it might well have a role to play in the final step of a process that solves the problem.

Second paragraph, 3.2: The selected technology is at odds with metals recovery. Again, what we see here is the heavy metals being turned into a sludge which does not solve the problem, it just relocates the problem to a new location. The hydroxide precipitation technology has been described very eloquently as an old technology notwithstanding any claims for newness that have been made.

Paragraph 3.3: The sludge disposal not in the Pit, the County has accurately described in that paragraph the chemistry that prevails; that chemistry should be apparent. Anybody that's had a couple of college level classes in chemistry, it is ludicrous the position that is being taken in the preferred alternative to perpetuate and increase the problem instead of solving the problem. And I guess the question for the EPA is: How can a solution which increases the problem be lawful?

Paragraph 4: A better analysis of the non-Pit Sludge Repository Options. We obviously acknowledge this argument and want to point out that the technology described by Dr. Devoe as well as the technology described by Dr. Hammen produced no sludges. It is not necessary to think about sludges anymore, ladies and gentlemen.

3.5 deals with the loss of the ore body for future generations, the point that was made that this an economic resources. The phrase was used "to mine the water". That is what the technologies that have been developed in the period in which the authors of this study, I guess were absent without leave since they seem to have quit in 1977. The essential report to make is that MSE and the Resources Recovery Program issued a worldwide RFP, went out to more than 200 companies in all major industrial nations of the world. There were over 32 responses to that RFP. The decision process narrowed that 32 group down to 10. The final selection process is underway right now. Those proof of technology on actual Berkeley Pit water at treatment-scale levels could be occurring as early as September of this year.

And I guess the question would be again: Why is this Record of Decision not defective if the authors of the Record of Decision did not survey the same kinds of available technologies and offer the opportunity to demonstrate what really can be achieved? What we see in reading that study is a paper thinking, reading, speculating, and really, skewing the process to reach a preordained solution as has been referred to many times.

Our previous speaker, Dr. Macgregor, I thought was very noteworthy in pointing out that the semantic analytical framework that has been adopted from Day One apparently is there isn't any way to solve the problems, so let's put it off at the least cost. Again, Chromatochem would challenge a decision to proceed with the preferred technologies here in the absence of proof that these alternative technologies here and now, not to be developed in ten years, but here and now, are not lesser cost that creates water, that could be used for drinking purposes, let alone agricultural purposes or any other community needs. The Pit and the ore represents there is an economic benefit and it can be mined. Thank you.

CHAIRMAN SOLOMON: Thank you. Is there anyone else who wishes to comment at this time?

BY-MR. KEANE: T 13

My name is Jim Keane, K-E-A-N-E. I live at 2131 Wall Street located south of the Berkeley Pit. It is important to recognize the parties here, we have spent years and years doing this. On April 24, 1982, ARCO committed the crime against this community of shutting off the pumps in Butte. Each of us as citizens of the United States are guaranteed to be held accountable for things we do with malice and forethought if it causes a problem to someone else.

In 1982, ARCO, with malice and forethought, shut the pumps off. What would have happened if they didn't do that? They could have been doing what these gentlemen are talking about for the past twelve years by mining the water which they have done from the early parts of this century. But they chose to walk away from the underground mines by closing the pumps off.

After that time, we got into the Superfund laws, which they were held accountable. Our people, our judges and protectors in this society are the agencies that protect us from people who do deeds with malice and forethought. In this case, it's the EPA. ARCO has committed environmental murder to this community. EPA is responsible to this country to stop that. The issue is: Why should they be negotiating with ARCO to allow them the least possible cost when ARCO has chosen that course itself? It's time that the Environmental Protection Agency turned to the opinions of the public, not take the resources of ARCO studies and accept them, not negotiate away our future, not negotiate away our environment, not say that we are going to double what the Pit is, everything is going to be okay.

The judge here is the EPA, the person who committed the crime is ARCO, and we are the victims. This must be stopped and the resources available to correct this. Why continue to harm the environment? Let's get on with the problem of doing what our forefathers did and mine millions and millions of dollars from this community which raised our children, which built the schools, which created a healthy working environment and good wages. We can go back to that, but we can't do it by dumping sludge in the Pit. Let's protect the environment. Let's get back to create good jobs and make ARCO pay for what it has done.

CHAIRMAN SOLOMON: Thank you.

Is there anyone else who wishes to comment at this time? Once again, we will ask: Is there anybody else who wishes to comment at this time?

At this time let's have the record indicate that there is no one else who has come forward to speak this evening, and so before we call this hearing to a close, I will remind you once again that comments may be submitted in writing and you can transmit them by the US mail or electronic means to Russ Forba, Remedial Project Manager, US-EPA, 310 South Park, Drawer 10096, Helena, Montana, 59626, until the close of the comment period on April 29, 1994.

Yes?

UNIDENTIFIED SPEAKER: It's 301, not 310. 301 South Park.

CHAIRMAN SOLOMON: Okay. For the record, there is an error in my material, and so that stands corrected. There being no one else to come before this hearing this evening, this portion of the proceeding is now closed.

(The hearing concluded at 9:00 p.m.)

* * * * *

<IMG SRC 0894102AV>

C E R T I F I C A T E

STATE OF MONTANA)
) ss.
County of Silver Bow)

I, Kimberly Johnson, Registered Professional Reporter for the County of Silver Bow, State of Montana, and Notary Public, do hereby certify:

That the public hearing was taken before me at the time and place herein named; that the hearing was reported by me in machine shorthand and later transcribed by computer, and that the foregoing sixty-one (61) pages contain a true record of the testimony of the witnesses, all done to the best of my skill and ability.

IN WITNESS WHEREOF, I have hereunto set my hand this day of , 1994.

Notary Public residing
in Butte, Montana.

(NOTARIAL SEAL)

OPENING STATEMENT BY PRESIDING OFFICER

My name is Robert L. Solomon. I have been retained as an independent party to conduct the public hearing this evening. For the record and to the best of my knowledge, I am not an employee or member of any of the governmental agencies, private companies, or public or membership organizations involved in the discussions or proposals related to the matter about to be heard.

Let the record show that this is the time and place for hearing to receive public comment on the Proposed Plan of the Mine Flooding Operable Unit (Berkeley Pit and Underground Mine Workings) at the Silver Bow Creek Area NPL Site located in Butte and Walkerville, Montana. The United States Environmental Protection Agency (EPA) and the Montana Department of Health and Environmental Sciences (MDHES) published notice to hold a public comment period on the Remedial Investigation/Feasibility Study (RI/FS) report and the Proposed Plan for the Mine Flooding Operable Unit. The Public Comment Period was to be a period of 90 days from January 27, 1994 to April 29, 1994. The public hearing for Mine Flooding was noticed to be held at this time and place to provide the public the opportunity to give formal comments to EPA and MDHES.

In addition, anyone wishing to make oral public comments was offered the opportunity to come into the Butte EPA Office in the Silver Bow County Courthouse from 9:00 am to 5:00 pm on Monday or Tuesday April 25 or 26, 1994, for the purpose of recording their comments into a tape recorder. The comments received in this manner will be transcribed, will become a part of the official record, and will be responded to the Responsiveness Summary. Officials of the EPA were available to answer questions during that two day period. Written comments may submitted to Russ Forba, Remedial Project Manager, US EPA 301 S. Park, Drawer 10096, Helena, MT 59626, until the close of the comment period on April 29, 1994.

The ground rules for this evening are as follows: This is a hearing to receive public comment and information. It is not adversarial in nature, and questioning or cross examination by the public will not be permitted. The presiding officer may ask questions in order to clarify statements or information being presented. Persons making presentations may submit comments orally, or in writing. The name of the person to speak and the person to make the next presentation will be announced by the presiding officer. When you come to the microphone, please begin by stating your name, address, and any organization or group that you may be representing this evening. Present your information in a manner that is most comfortable to you. You may speak extemporaneously, you may summarize your comments, or you may read them into the record. If you have prepared a written statement, it will be appreciated if a copy can be given to the presiding officer or the reporter to assist in the preparation of the transcript of this hearing. All written materials received this evening will be given the same consideration as oral comments and will be responded to in the Responsiveness Summary. (Added info)

Due to the number of persons wishing to provide comments this evening, limits will have to be imposed on the length of time available to each speaker. You will be given an indication that your allotted amount of time is nearing an end, and that you will be required to wrap up your comments. If you continue to speak beyond the allotted time period, you will be asked to terminate your presentation. Your cooperation in holding to the time constraints will offer all who wish to speak the opportunity to do so. Recesses will be called by the presiding officer at appropriate intervals.

The record will show that the ground rules for this hearing have been made part of the record. The Invitation for Public Comment on this manner has been made a part of the record as well. All written documents and oral comments received prior to this evening are by this reference made a part of the of this proceeding.

We will now begin the public comment portion of the hearing.

917 West Broadway
Butte, Montana 59701

April 26, 1994

Russ Forba, RPM
U.S. E.P.A.
301 South Park
Helena, Montana 59626

Dear Russ:

At the last meeting of the Citizens' Technical Environmental Committee (April 21), I alluded to a term that seems appropriate to the situation we find ourselves in now. I'd like to recapitulate that term, and briefly explain how it embodies the current predicament faced by all of us involved in contributing our energies to helping solve the problem of the Mine Flooding Operable Unit at the Silver Bow Creek / Butte Area Superfund Site. My statements tonight, as always, are my own, and though I have actively followed developments associated with this aspect of local Superfund issues (as part of CTEC), I speak only for myself, not CTEC, in what follows.

Paul Dickson coined the verb "to Neckar" to identify a phenomenon he says describes one aspect of life in the last quarter of the 20th century:

> NECKAR. To test or try something in such a way as to invite disaster: "He neckared the brakes on his new Ford by racing up close to a brick wall and then slamming down on the pedal at the last moment." The term comes from a river of the same name in West Germany, where the prime example of modern neckaring took place in 1979. The U.S. Army helped German authorities test a new bridge spanning the river by driving 34 of its heaviest fully manned M60 tanks onto the structure. It sagged but did not collapse.

The attached page shows a photo of that moment, which no doubt represents a moment of pride for certain German Civil Engineers, and relief for the commander of that column of tanks.

Like Dickson, I am a student and an engineer of words, not of concrete, stone, or steel. And the source of alarm I have felt for the five years I have followed EPA's work toward a solution at the Berkeley Pit (the Mine Flooding Operable Unit) is in the semantics used by the agencies who are charged with protection of the health of this community and its environment. EPA's definition of the problem, and its solution, have always centered on the notion of a Critical Water Level; in fact, this assumption has become so ingrained that it has received the great honor of being added to EPA's list of acronyms. What has always bothered me about the CWL, as it is now known, is not the precise level (5410' ... 5435'... the arguments on both sides for different levels sound reasonable to me). What has bothered me for five years of discussions about the Pit, and what bothers me now is that EPA's reliance on what it calls a Critical Water Level is a perfect case of neckaring Butte's future.

The solution to the problem of the rising water in the mine system beneath Butte has been to play footsie with disaster, even at the semantic level. The argument that EPA can't enforce control of the water without showing probability of its release into the environment is shallow at best, and at worst shows cynical disregard for the opposite argument, which says that, without such control, the release of contaminated water is certain to occur. Facing the absolute certainty of such eventual releases into the environment if no action is taken, the community is bound to wonder: "what kind of solution is it that tells us to wait until the situation is approaching a crisis stage before action will be taken... and then the action proposed involves perpetual effort and expense, such that mining, which has always been Butte's pride, is destined to become its curse."

I have two tangible requests to make at this final moment in the public comment period for this operable unit.

1) a semantic issue: if the water level you have set is indeed safe for Butte, and all the communities downstream, say that. Stop calling it the critical water level, and call it instead the safe water level. That way, when someone asks me about EPA's goal for Butte cleanup operations, I can say "to keep us safe," instead of "to keep us in perpetual crisis."

2) a commonsense, but technical request: Beyond controlling horseshoe bend water as part of an inflow control regime, please consider long-term options for dewatering upstream of the contaminated groundwater, rerouting everything possible, and reducing the need for perpetual treatment. If stasis in the mine-flooding can be achieved at an earlier date, without the need for long-term treatment and attendant sludge generation, everyone wins: cleanup costs drop exponentially, water otherwise destined

to join the contaminated reservoir is kept clean and usable, and we will all be able to point with pride to this solution when our grandchildren and great grandchildren ask us about the world we've left them.

Intercept the water before it gets to the contaminated areas on the Hill; reduce the Pit's rate of filling to next to nothing; and avoid the need for treatment altogether. Is this too simple or low-cost a solution to be considered?

At the very least, avoid the kind of disaster-orientation scenarios that seem to motivate so much of the federal government's actions. Don't let your proposed plan neckar Butte's future.

Sincerely,

Dr. William B. Macgregor
CTEC TAG Coordinator

<IMG SRC 0894102AW>

WRITTEN COMMENTS

APPENDIX 4, ATTACHMENT 3
BUTTE MINE FLOODING OPERABLE UNIT
RECORD OF DECISION

Citizens' Technical Environmental Committee
P.O. Box 593
Butte, Montana 59703

CTEC

May 13, 1994

Mr. Russ Forba, Project Manager
U.S. Environmental Protection Agency
301 S. Park
Helena, MT 59626

ENVIRONMENTAL
PROTECTION AGENCY

MAY 16 1994

MONTANA OFFICE

Re: Berkeley Pit and Mine Flooding O/U

Dear Russ:

Because CTEC was unable to develop a position on the BP&MFOU by end of the comment period April 29, I spoke to Pam Hillary on May 2 and she indicated that a consensus statement from CTEC would still be desired by E.P.A. I asked if it could wait until our regular May 12 membership meeting and Pam indicated that would work. As it turned out, the regular meeting was substituted with a Board meeting. Five of six Board members "agreed" with the consensus statement. The sixth chose not to respond to the question as worded." None "disagreed." Following is the approved statement which will be reflected in the Minutes of the Board meeting of May 12, 1994.

It is my opinion that the Berkeley Pit and Mine Flooding remedy should be properly directed toward immediate treatment of the Berkeley Pit itself as separate from Horseshoe Bend treatment which would start soon). I believe it is in the best interests of the affected citizens and future residents of Butte-Silver Bow County for contaminated water in the Berkeley Pit itself to be pumped and treated as soon as possible, utilizing technology that does not produce massive amounts of waste sludges, and making clean water available in the very near future for permanent, beneficial uses, thereby decreasing the volume of toxic material in the pit.

Today we are mailing the statement to all our members for their responses. We will forward the results of that vote by the full membership to you as soon as it becomes available.

Thank you for your kind consideration of this statement as public comment consensus from Butte's Citizens' Technical Environmental Committee.

Yours very truly,

Mary Kay Craig
Vice President, CTEC

cc: Pam Hillary, U.S.EPA
Tom Malloy, President, CTEC
Brian Tierney, Secretary, CTEC
Bill MacGregor, Coordinator, CTEC

CTEC

Citizens' Technical Environmental Committee
P.O. Box 593
Butte, Montana 59703
(406) 496-4433

April 29, 1994

Russ Forba, RPM
USEPA
301 South Park
Helena, Montana 59626

SUBJECT: - RESPONSES TO MINE FLOODING OPERABLE UNIT PROPOSED PLAN, RECORDED FROM CTEC MEETING

At CTEC's April 21 meeting, the following questions & comments from those in attendance were taken, for submission to EPA regarding its Proposed Plan for the Mine Flooding Operable Unit. We submit them for consideration as part of the public record.

- Long term viability of the plan was questioned by Mel Rowling in terms of vast unknowns at the boundary of this operable unit with the Outer Camp (Non-priority soils operable unit). His detailed questions were submitted in writing.

- Albert Molignoni submitted written comments and questions, the key element to which was a request that the final remedy should be flexible enough to incorporate innovative remedies as they are discovered, and that the final remedy should NOT be locked into EPA's preferred treatment (hydroxide precipitation).

- Several other questions were asked about the value of public participation:

    - one participant wondered if the "deal" hadn't already been signed between the involved parties (the reference was to the Consent Decree about the critical water level); the questioner felt that public input was pointless

    - another questioner expressed concern that public input that did not demonstrate technical expertise was not heeded as highly as was input from scientists, engineers, and other, more technically expert parties; the concern was that the average member of the public was destined to be kept out of the decision-making process

    - a skeptical questioner wondered how public input figured into the decision-making process; "how much does it count for? how many points does it get?"

    - Several questions were asked about the 5410' critical water level:

        - how was it determined?
        - by what definition is it "Protective" as a final remedy?
        - if groundwater modeling specialists are specialists about any predictions more than five or ten years into the future, why isn't a greater safety factor built into the calculation of the final remedy?

    - A number of people expressed their unhappiness with the plan's downgrading of the Superfund "balancing criterion" which requires the remedy to "reduce toxicity, mobility, and volume" of contaminants. Defenses of this strategy based on long-term vs. short-term protectiveness failed to appease these participants.

    - If flooding of the Pit as fast as possible is a good idea (which was suggested by the State), why not use all available resources and fill it right away? --Silver Bow Creek Water, diverted Big Hole Water, etc.?

    - A number of questions / concerns were raised about the sludges that would be generated through application of the preferred treatment alternative:

        - if they are disposed in the Pit, wouldn't they generate more oxygen, thus perpetuating the acid-generating oxidation cycle?
        - will disposal of sludge into the Pit result in increased concentrations of contaminants?

- any remedy that seems to make the problem worse by generating sludges that will have to be dealt with by future generations as another Superfund-type problem does not seem like much of a remedy

- One participant expressed concern that rival theories about long-term Pit chemistry should not be taken for more than what they are: theories, and that as a consequence, the plan should maintain as much flexibility as possible in allowing new technologies to be applied when they become available.

- Several speakers expressed amazement, disappointment, and concern that more aggressive measures to restrict flow into the Pit are not figured into the proposed plan. They consider the control of Horseshoe Bend water to be the absolute minimum, but they preferred to see measures taken that would intercept all waters in the system before they reach the contaminated zones, thus (at least potentially) removing altogether the need to treat the water.

- A number of speakers saw no scientific or technical basis to challenge the plan, and lacking such basis, they saw no reason not to allow it to go forward.

- Considerable alarm was expressed by several speakers about the plan's treatment of the deep bedrock aquifer.

  - the plan gives no assurances about the dynamics of contaminated water over the long term in the deep bedrock aquifer, we just don't know enough about it

  - what we DO know about old mining works in the bedrock aquifer concerns some people with underground mining experience; they refer to "bad ground" to the east and southeast, where unpredictable water-flow dynamics were always a concern to mining operations

  - One speaker expressed hope that this exhaustive process, with all its fits, starts, and mistakes, would help make the subsequent phases of the decision-making process at these sites more efficient and effective.

  - In relation to the earlier-discussed bedrock aquifer issues, the final speaker expressed hope that the plan would conceive of, and implement throughout the entire basin, a Headwater Alert System, which would monitor water flows in and around all known zones of contamination, so that unexpected escapes of contaminants could be detected and responded to before they become disastrous.

Please enter these comments and questions into the record, and respond to them as part of your process of working toward your Record of Decision at the Mine Flooding Operable Unit.

Sincerely,

Dr. Bill Macgregor
CTEC TAG Coordinator

CTEC Citizens' Technical Environmental Committee Environmental Committee
P.O. Box 593
Butte, Montana 59703

February 24, 1994

Russ Forba, Project Coordinator
U.S. EPA/Montana Office
Federal Building
301 South Park, Drawer 10096
Helena, MT 59626

Dear Russ,

The purpose of this communication is to request more time for public comment on the recently released Draft Remedial Investigation Report and Feasibility Study for the Butte Mine Flooding Operable Unit. These documents, the result of several years of work on the part of the agencies and the PRPs, contain a great deal of information which the public is being asked to digest in a short amount of time. While the public and technical meetings have been beneficial, they indicate the need for further study in order. It is CTEC's understanding that an extension of undetermined length will be granted. In order for the public to understand the implications of these studies, we would request that it be long enough (until the end of April?) to ensure that adequate time is given for the consumption and analysis of the information.

Sincerely,

Melvin Rowling

CTEC President

Citizens' Technical Environmental Committee
CTEC
P.O. Box 593
Butte, Montana 59703
(406) 486-4433

Questions frequently asked about the MFOU Proposed Plan:

Why doesn't the proposed plan call for draining of the Pit?

The Proposed Plan "writes off" the bedrock aquifer as irremediably contaminated. What are the defined boundaries of the "written off" bedrock aquifer (3-dimensional) and what assurances does this community have that these boundaries will not change in time?

Once the ROD is finalized, what tangible evidence will indicate that the problem has been solved? What parameters are envisioned as indicators of success or failure?

What will happen if, at some future date, deep-bedrock contaminants are transported into outlying alluvium (outside the defined boundaries of the written-off bedrock aquifer). An example is the known vertical upgradient flow from the bedrock aquifer to the alluvial aquifer under the Colorado Tailings. What data, assumptions, and calculations have been made to ensure that contaminant transport cannot happen via this known hydraulic system, or similar undiscovered mechanisms?

How can the division of the Mine Flooding Operable Unit from the Non-Priority Soils (outer camp seeps and flows) be justified when each is affected by the same hydrogeological system (i.e. rising groundwater levels resulting from the discontinuation of pumping).

What role has present and future mining played in the selection of this remedy?

Besides the 2.4 MGD from horseshoe bend, what other potentially controllable inflows contribute to rising Pit water? What control measures were considered for these sources during the RI/FS? What are the maximum potential reductions of inflow that were calculated as part of the RI/FS? How much water can be diverted from entering the Pit system after mining ceases, thus reducing the volume of water that needs to be treated?

An assumption underlying all discussions and plans regarding the Pit has been the concept of a "critical water level". How did this concept come to be the officially sanctioned key to the solution to the Pit System Problem. How was the Critical Water Level established?

The water treatment technology associated with the preferred alternative creates substantial amounts of sludge that must be disposed of. Alternative technologies exist which recover metals-thus reducing the amount of sludge requiring disposal. Why were these not part of the proposed plan?

What long-term assurance does this plan provide to the community that the sludge generation associated with the preferred alternative treatment technology will not itself become another Superfund-type problem down the road.

What will be done with West Camp water if Metro Sewer is unable to meet discharge standards due to contaminant loading from the mine discharge?

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
<IMG SRC 0894102AX> REGION VIII, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0098

Ref: 8MO

April 19, 1994

Mr. Kyle Scott VIA FACSIMILE
CTEC
P.O. Box 593
Butte, MT 59703

Dear Kyle:

This letter is in response to the questions posed in your April 14, 1994 letter to me concerning the Mine Flooding project. If you have any further questions or need additional information, please call me at 449-56720.

Sincerely,

Russell W. Forba
Remedial Project Manager

cc: James Scott, MDHES
Bob Fox, 8MO

EPA RESPONSES TO
APRIL 14, 1994 CTEC QUESTIONS

1. Why doesn't the proposed plan call for draining the Pit?

The proposed plan does not call for draining the Pit for three reasons: 1) EPA believes that draining the Berkeley Pit is not more protective of human health and the environment than letting the Pit rise to higher level; 2) Although the volume of water in storage is less if the Pit is drained, the volume of water treated is considerably more (up to 2 mgd more) and the quality of water to be treated will be much worse than if the Pit is allowed to rise higher; and 3) the estimated cost of draining the Pit ($350-450 million) is considerably more than the preferred alternative ($50 million) even though EPA believes draining the Pit provides no significant increase in protectiveness.

2. The proposed plan "writes off" the bedrock aquifer as irremediably contaminated. What are the proposed boundaries of assurances does the community have that these boundaries will not change over time?

EPA plans to provide a map in association with the ROD which defines the boundary for which the "waiver" of State groundwater standards applies. Present plans will place the boundaries to include areas within the lateral extent of the underground mine workings in the East and West Camps. Significant amounts of information are available which outline the lateral extent of the underground workings in the East and West Camps. This will be an areal boundary and not three dimensional. It should be noted that this "waiver" and the corresponding boundaries need to be established regardless of the remedial option employed or the level at which the pit is maintained. No assurances can be provided that the boundaries will not change over time,
because the final water quality in this area can not be predicted. The water quality should improve in some areas as the system rises and this may decrease the area where bedrock water quality do not meet state groundwater standards.

3. Once the ROD is finalized, what tangible evidence will indicate that the problem has been solved? What parameters are envisioned as indicators of success or failure?

This project is different from other projects because the Agency is trying to prevent a problem from occurring rather than remedying an existing condition. Because the objective is to prevent the degradation of the alluvial system by contaminated mine waters, the primary indicator that the problem is solved will be that the critical water level will never be reached and that there will be no degradation of the alluvial system from the Pit System. The proposed monitoring network will monitor both the water levels and water quality throughout the area. In other words the tangible evidence will be the absence of degradation.

4. What will happen if, at some future date, deep bedrock contaminants are transported into outlying alluvium (outside the defined boundaries of the written off aquifer). An example is the known vertical upgradient flow from the bedrock aquifer to the alluvial aquifer under the Colorado Tailings. What data, assumptions and calculations have been made to ensure that the contaminant transport cannot happen via this known hydraulic system or similar undiscovered mechanisms?

EPA believes that this cannot happen between the Pit System and the alluvial system as long as we maintain the negative gradient between the presently dewatered system and the alluvial system. The bedrock in the Colorado Tailings area has not been dewatered. There is continuous saturation from the surface soils down through the bedrock. In fact, the ultimate remedy for the residual groundwater contaminants in the Colorado Tailings groundwater after the tailings removal is completed, will probably include a pump and treat system which establishes a negative gradient between the alluvial groundwater and the stream. In the dewatered Pit System, there already exists a negative gradient between the Pit System and the alluvial system and our plan will be to continue to maintain this gradient. The primary assumption made to ensure that contaminant transport will not occur revolves around keeping a gradient from the alluvial system toward the underground workings and the Berkeley Pit.

5. How can the division of the Mine Flooding Operable Unit from the non-priority soils (outer Camp seeps and flows) be justified when each is affected by the same hydrologic system (i.e. rising groundwater levels resulting from discontinuation of pumping)?

This point is well taken but not for the reason stated. The Outer Camp has been at homostatic conditions and has been discharging to the surface for many years. It has not to this point been affected by the cessation of pumping in the Pit System and will not be affected for many more years. The water levels in the Outer Camp shafts have not responded to the discontinuation of pumping as you have suggested in your question. The water level in the outer camp is at about the 5580 level which is over 500 feet above the present level in the East Camp system and 170 feet above the critical water level. EPA does see the need to evaluate the Outer Camp and the impact of the existing discharge in its own right. In retrospect, it would have been better to tie the Outer Camp in with the East and West Camp evaluations. The proposed monitoring plan includes several monitoring points in the Outer Camp and the potential threats existing in the outer Camp will be addressed at a later time.

6. What role has present and future mining played in the selection of this alternative?

Present and future mining plane have played only a minor role in this remedy selection. EPA believes that if mining was not ongoing the Agency would still prescribe the same critical water level, the same final treatment scheme, and the same inflow control strategy. The only areas which are impacted by the ongoing mining operations are: 1) the proposed plan integrates the Horse Shoe Bend water into the tailings circuit because EPA believes that this alternative is much more cost effective than having to treat the Horse Shoe Bend water in an independent treatment facility; and 2) the plan does not require upper basin clean water diversions because of the need for this flow as makeup water in the mining operation.

7. Besides the 2.4 mgd from Horseshoe Bend, what other potentially controllable inflows contribute to the rising Pit water? What control measures were considered for these sources during the RI/FS? What are the maximum potential reductions of inflow that were calculated as part of the RI/FS? How much water can be diverted from entering the Pit after mining ceases, thus reducing the volume of water that needs to be treated?

The other controllable inflows into the system include Upper Yankee Doodle Creek, Upper Silver Bow Creek, the East Ridge flow, other minor upper basin flows, and the Silver Lake pipeline flow. Upper Yankee Doodle Creek, Upper Silver Bow Creek, East Ridge, and other upper basin flows are about 1.5 mgd; and about 4.5 mgd is delivered through the Silver Lake pipeline. Approximately .5 mgd are consumed in the process, 3.1 mgd is stored as insitu water in the tailings, and about .2 mgd lost to evaporation. EPA evaluated these inflows and the potential for reducing or eliminating them. However all of these flows are needed and used as makeup water for the concentrator with the water rights to owned by MR. Even though the Silver Lake import is likely to be reduced because of the integration of the Horseshoe Bend water, reducing the other upper basin clean water sources would likely be replaced by increased Silver Lake flow because there are minimum total and soft water needs at the concentrator. EPA therefore included only the Horseshoe Bend water as controllable water in the FS. All of the Horseshoe Bend water, Upper Silver Bow and Yankee Doodle Creeks and East Ridge flows can be diverted after mine closure and EPA anticipates including these diversions as part of the ROD.

8. An assumption underlying all discussions and plans regarding the Pit has been the concept of a critical water level." How did this concept come to be the officially sanctioned key to the solution to the Pit System Problem? How as the critical water level established?

In the negotiations with the PRPs for the Mine Flooding RI/FS a preliminary critical water level (CWL) of 5410' elevation was established. This agreement specified stipulated penalties of $25,000 per day, if this level was ever exceeded. The preliminary CWL was established at this elevation because this was the water level in Silver Bow Creek at the west end of the Colorado Tailings where the alluvial system constricts and upwells into the Rocker canyon. EPA viewed this level as the maximum allowable water level for the Pit system (not just the Pit) and it would be lowered if necessary based on the findings of the RI. The RI was designed to investigate the alluvial water levels and gradient throughout the area. After completion of the RI the data was assimilated and the 5410' level was determined to be protective and deemed the official CWL. The RI conclusively showed that the alluvial water levels in the upper basin are higher than the CWL and that the Pit/East Camp system cannot discharge to the higher alluvial system if the Pit system is kept below the 5410' level. The 5410' level is at least 50 feet lower than the alluvial water levels at the alluvial ground water divide to the south of the Pit.

9. The water treatment technology associated with the preferred alternative creates substantial amounts of sludge that must be disposed of. Alternative technologies exist which recover metals-thus reducing the amount of sludge requiring disposal. Why were these not part of the proposed plan.

Many of the proven common metals recovery technologies, such as copper cementation and solvent extraction/electrowinning (SX/EW) would not significantly reduce the amount of sludge generated. The amount of sludge generated is largely dependent on the pH of the wastewater. With the Pit water having a pH of 3.0, large amounts of neutralizing agents are necessary to bring the pH up to satisfactory pH for discharge regardless of metals concentrations. The basic conclusion of the FS concerning these metals recovery technologies is that the value of the metals does not offset the capital and O&M costs for the metals recovery facility and that there are still significant wastewater treatment costs after the metals are recovered (and significant amounts of sludge generated). EPA is hopeful that cost-effective innovation metals recovery technologies will be developed in the future that will reduce sludge volumes. Some are being explored presently in Butte. EPA would encourage that development of such technology and would amend any decision to include such technology if the PRPs and the developers of the technology would collectively propose a viable alternative.

10. What long-term assurance does this plan provide the community that the sludge generation associated with the preferred alternative treatment technology will not itself become another Superfund-type problem down the road?

The sludge generated from this treatment technology will not be a hazardous waste but an alkaline, lime-based material chemically similar to the tailings presently generated by the mining operation. The daily sludge generation for a full scale treatment plant will be only 1-2% of the volume of tailings that is produced in the mining operation. Any sludge repository will have to be designed to reduce precipitation infiltration, leachate generation, and leachate migration. It is likely that this repository would be built in the active mine area which naturally drains to the Pit system. The Pit would therefore act as a natural collection system for the minimal amount of leachate that might ever escape from the repository. Because it is necessary for a treatment plant to be operated in perpetuity, regardless of the remedial alternative or critical water level selected, any small amount of leachate that would be collected would be treated in this facility.

11. What will be done with the West Camp water if the Metro Sewer is unable to meet discharge standards due to contaminant loading from the mine discharge?

The West camp water is very different chemically from the Pit System water and is presently being treated in the Metro Treatment Plant. If the Metro Plant is no longer able to handle this flow, the PRPs are required by past orders with EPA, to build a facility to treat this water. This treatment plant has already been designed and these plans are available for public review. EPA believes that the West Camp water may be compatible with the Colorado Tailings groundwater and that these streams may be combined for efficient treatment in the future.

Acid mine water processing and metal recovery by fast solid phase extraction

Richard F. Hammen, David C. Pang, Lori Stepan Van Der Sluys,
Ralph C. Judd and Eric Loftsgaarden.

Mineral extraction from sulfide ore deposits usually leads to the combined action of oxygen and water on the newly exposed ore. The result is acid mine drainage, a low pH solution of various metal sulfate salts and sulfuric acid.

Paradoxically, the valuable metals dissolved in acid mine water are a liability because they are too toxic for discharge but too dilute to recover economically. The expense of compliance with water quality release standards has reduced the profitability of many mining operations

Solid phase extractions (SPE) columns have been developed to extract metals from acid mine water. These columns are designed to remove the toxic elements from water and recover

Richard F. Hammen is president, David C. Pang is manager of production development, Lori Stepan Van Der Sluys is scientist and Eric Loftsgaarden is laboratory technician, all with Chromatochem, Inc., 2837 Ft. Missoula Road, Missoula, MT 59801. Ralph C. Judd is professor of microbiology, University of Montana.

Table 1)) Metal concentrations

Ion	ppm
Copper	174
Iron	437
Manganese	202
Aluminum	277
Cadmium	2
Zinc	543
SO4	7462
Sodium	85
Calcium	480
Magnesium	421

the metals as purified factions. This article describes the results of a Phase 1 bench-scale project to test the performance of the SPE columns. The tests were conducted with water collected from the abandoned Berkeley Pit copper mine in Butte, MT.

Solid phase extraction and displacement chromatography

The SPE columns contain large particle silica of 105 micron average diameter. The silica surface is modified by covalently bonding with a proprietary long, hydrophilic, chemically stable linker molecule. The terminus of the linker is activated and then derivitized with appropriate chelating groups. The results described were obtained with columns containing immobilized polyethyleneimine (PEI).

Solid phase extraction and displacement chromatography involves four steps (Fig. 1).

· Step 1-Load. The acid mine water is pumped through a column containing a HiPAC-PEI silica. The chelating PEI molecules tightly bind the metal ions by coordinate covalent bonds. Because the binding constant for many chelation reactions exceeds 10-9L/mole. the water exiting the column has levels of metal with molar concentrations of less than 10-9 moles/L (less than 10 ppb for copper). As the process continues, the number of metal ions pumped into the column approaches the number of chelating groups available to bind the metal, and the column becomes saturated. rated.

· Step 2-Displacement. When the column becomes saturated with the

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metals. continued pumping of the same feed stream causes the more tightly binding metals (iron) to displace the less strongly bound manganese, zinc, aluminum and copper. This results in fractions enriched for the less strongly binding metals. Depending on the nature of the feed stream and the resulting displaced metal concentrations in the fractions, the metal fractions may be recovered by electrowinning or precipitation. Alternatively, the fractions may be pumped through a second SPE column for additional concentration and separation.

· Step 3))Elute. The tightly bound metals are stripped from the column by pumping a dilute sulfuric acid solution through it. The acid displaces the metal ions, releasing them from the column as a concentrate.

· Step 4))Recycle. The column is then regenerated for another use cycle by pumping a dilute solution of base (pH 10-11 ammonia) through the column. The ammonium sulfate can then be recycled to ammonia and sulfuric acid, using bipolar membrane technology. A flow diagram of the process is shown in Fig. 2.

Ion content of Berkeley Mine water. Water samples were obtained from the Berkeley Pit on May 22, 1991 from a depth of 0.6 to 0.9 m (2 to 3 ft). The samples were analyzed by inductively coupled plasma (ICP) spectroscopy. The results are reported in Table 1.

Displacement chromatography

A 19-ml SPE column was equilibrated and Berkeley Pit water was pumped into the column. Fractions (10 ml, 0.5 bed volumes [BV]) were collected and analyzed by ICP. The metal analyses by fraction for manganese (Mn), zinc (Zn), aluminum (Al), copper (Cu) and iron (Fe) shown are in Fig. 3.

Bed volume O in Fig.3 is the concentration of the metals in the feed soluti The first four BV of water exiting the column had undetectable amounts of the heavy metals measured (Mn Zn, Cd, Al, Cu, Fe and As). The column was then saturated with the chelated metals and the metals eluted in the sequence Mn, Zn, Al and Cu. Ferric ions were then eluted from the column by stripping with 0.1 molar sulfuric acid.

To measure the relative separations of the respective metals, the ratios of concentrations of the metals were calculated for each fraction in the sequence elution. Figures 4-6 show these ratios. The ratio chromatograms show that a metal eluting from the column will be well separated from the metals that elut in subsequent fractions from the column. For example, Mn elutes first from

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the column. The first pan of the Mn fraction has very low concentrations of other metals in it. It is therefore possible to isolate a highly purified fraction of Mn.

When the Zn begins to elute from the SPE column, the column has no capacity for Mn. The concentration of the Mn in the eluate is close to the concentration of Mn in the feed solution.

The purity of the Mn (the concentration of Mn divided by the concentration of the Mn plus Zn) in the eluate therefore begins to diminish. By the time the Fe elutes from the column, the Mn purity has resumed to the same level as in the feed solution.

The metal purities are diagrammed in Fig. 7. The data in the fraction analyses for Mn and Zn are conservative because the ICP instrument was saturated at 1000 ppm Mn and 5000 ppm Zn. respectively. The actual purities of the Mn and Zn fractions were greater than indicated.

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Metal adsorption capacity and total capacity

The capacity of the SPE columns to extract metals from solution was measured by pumping a solution of 100 ppm Cu sulfate at 9.6 BV/minute through a column until Cu appeared in the effluent (the breakthrough point). The concentration of the metal in the column effluent was monitored by an optical absorbance flow detector. When the copper concentration reached 5 ppm, the experiment was terminated.

The quantity of Cu adsorbed was 0.1 millimoles/ml of bed volume. The total ion exchange capacity of the silica was measured by acid-base titration to be 0.3 millimoles of base equivalents per ml. The experiments described with Berkeley Pit mine water were conducted with silica of 0.1 millimole/ml Cu dynamic adsorption capacity. Subsequent improvements in the silica manufacturing process are now producing SPE columns with 0.3 millimole/ml Cu adsorption capacity and 0.9 millimole/ml base equivalents.

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Adsorption kinetics with acid mine water

To determine the operating flow rate for a SPE process used for heavy metal extraction, it is necessary to measure t kinetics of metal adsorption. The adsorption kinetics will determine the flo rate or bed volumes per minute at which the SPE column can be operated.

Earlier results with copper and nic adsorption kinetics (unpublished) showed the dynamic capacity of the SPE column was unaffected by flow rates from 1.2 - 9.6 BV/min. These same experiments were conducted with mine water to determine whether complex solutions would behave the same as simple metal solutions.

A 4.6- x 50-mm (0.18- x 2-in.) SPE column was equilibrated and then loaded with Berkeley Pit water at 1.2, 2.4, 4.8 and 9.6 BV/min. The column effluent

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was monitored at 280 nm to detect the breakthrough of metals. The digitized data from the four chromatographic runs were then normalized from absorbance as a function of time to absorbance as a function of Bed Volumes of acid mine water. The normalized data are shown in Fig. 8.

The overlapping uptake curves shown in Fig. 8, which show equivalent performance from 1.2 to 9.6 BV/min, were surprising in view of the usual performance of chromatography media. n general, the rate of extraction of solutes by adsorption columns is limited by the rate of diffusion of the solute molecules to the surface of the adsorption media.

For example, the metal chelating resin manufactured by Rohm and Haas, IRA 718, operates in a range of 0.13 - 0.5 BV/min. At flow rates above 0.5 BV/min, the metal extraction efficiency will decrease. It can be seen from the data in Fig. 8 that the kinetics of metal extraction by the SPE media are significantly faster than with conventional media.

To test whether the results in Fig. 8 were a result of the proprietary linker used to immobilize the chelating agent to the silica support, a control experiment was conducted by preparing a polyethylene imine SPE medium, but without the proprietary long linker. The same experiments were performed with the nonproprietary chemistry support. The results are shown in Fig. 9.

In the case of the nonproprietary chemistry, the dynamic capacity of the SPE column decreased with increasing flow rate. Such a result is consistent with conventional performance of chromatographic media. To compare the proprietary and nonproprietary columns more directly, the dynamic capacities (BV to saturation) were plotted for the two columns in Fig. 10. In Figure 11, the productivity (BV of water processed per unit time) is graphed as a function of flow rate. The productivity of the nonproprietary SPE column did not increase with increased flow. This was due to the limitations of diffusion to the adsorbing surface. On the other hand, the productivity of the proprietary column did increase linearly with flow rate.

SPE column durability studies

For the SPE-displacement chromatographic process to be profitable, it is necessary for the value of the metals recovered to exceed the incremental costs of the SPE process. An SPE column was, therefore, subjected to repeated use cycles to determine its operational life under conditions of processing Berkeley Pit water. The operational cycle of the column was established to take advantage of the metal separation observed with the metal displacement chromatography.

A fresh 4.6- x 50-mm (0.18- x 2-in.) SPE column was packed with media and its Cu adsorption capacity was measured. The processing cycles were then initiated at 9.6 BV/min. After appropriate periods of time, the process was interrupted and the Cu capacity was measured again. The logarithm of the Cu capacity data are plotted against number of cycles in Fig. 12.

The column lifetime data were plotted semilogarithmically under the assumption that the SPE column's capacity would decrease by first order kinetics. Although more extensive data (more cycles of operation) would be needed to rigorously test this hypothesis, the results collected from 1500 cycles are consistent with first order deterioratio

Based on these results, it is reasonable to expect that an SPE unit will be able to tolerate at least 1500 cycles of use and will, therefore, be capable of processing at least 22,500 BV of acid mine water from the Berkeley Pit.

Summary

The technology of modifying silica surfaces with hydrophilic linker molecules was developed to increase the adsorption kinetics for the solid phase extraction of metal ions from solutions pumped through the column. The silica's resistance to acid and base degradation was increased by optimizing the technology. The high durability of the sili media allows hundreds to thousands of use cycles and improved economy of operation. Thus, the linker technology contributes several new dimensions to conventional immobilized chelators used in extractive metallurgy.

The SPE process accomplishes:

. removal of heavy metals from acid mine water streams and

· the separation of the metals into fractions, allowing recovery of the metals by precipitation or electrowinnning.

Work is in progress to determine th economics of SPE and to extend its applications to other metal-containing solutions. ♦

Acknowledgment

This research was supported in part by EPA SBIR Phase I Proposal No. 68D10038.

Testimony on Proposed Plan, Mine Flooding Operable Unit

Berkeley Pit 4/26/94

Submitted by: John W. Ray, 915 West Galena St., Butte, MT 59701

The purpose of Superfund is to clean up hazardous waste sites which are a threat to human health and the environment. Remedies under Superfund should provide a permanent cleanup remedy not temporary containment or simply removal to another site. Simply, cleanup is the "act of cleaning up: and the term clean means "pure, free from dirt, contamination, impurities." According to the EPA publication entitled Superfund: Environmental Progress the purpose of Superfund is to achieve "long-term cleanup goals for sites" and to remove "contamination from the environment." (p. 1) The document further states that "the law directs EPA to protect public health by meeting strict cleanup standards at each site." and "Reduced to its environmental essence, the New Superfund mission is 'make sites safe, make sites clean, and bring new technology to bear on the problem." (p. 3) According to the Superfund law, any remedy for the Pit should be a cleanup remedy.

If one examines the major Superfund laws and regulations, CERCLA, SARA, and the NCP, one finds that they All emphasize:

1. Cleanup as the primary goal of any Superfund activity.

2. The reduction of toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site.

3. Permanent cleanup remedies. Senator George Mitchell (D-Maine) has argued that permanent treatment means that EPA cleanup plans must result in a permanent and major reduction in the toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site and that this reduction must be to the 'lowest levels achievable.' He stated: "In addition to the quantitative reduction implied, significant reduction in this context means the minimization of volume, toxicity and mobility of such substances to the lowest levels achievable with available technologies." 132 Cong. Rec. S. 14914 (daily ed. Oct. 3, 1986)

4. Discourage EPA from simply moving waste from one spot to another. For example, is this what will be done with the sludge which will result from treating Pit water?

5. Cost is not the major factor. Cost is secondary to protecting human health and the environment. Under Superfund, human health must be protected from potential threats regardless of cost. Any solution to the problem of the Berkeley Pit must emphasize the above criteria. It is in light of the above five criteria that the solution to the problem of the Berkeley Pit must be judged.

In light of the above criteria, should we be comfortable with a proposed plan which would allow the volume of toxic/contaminated water in the Pit to more than double before anything is done? (From 25 billion gallons to 56 billion gallons) Should we be comfortable with a proposed plan which leaves a Berkeley Pit filled with toxic water to exist and be treated in perpetuity? This proposed plan would allow a surface area of contamination of 487 acres. Is this a cleanup remedy? Is this a remedy which reduces the toxicity, mobility, and volume of hazardous waste? Isthis a permanent remedy or a remedy which will leave us with a perpetual environmental crisis?

Unfortunately, past Superfund efforts have not met these goals of permanent cleanup. The Office of Technology Assessment (OTA) has concluded that Superfund "remains largely ineffective and inefficient: and "is not working environmentally." OTA has concluded that the Superfund program has too often settled for remedy technologies which would not reduce the "toxicity, mobility or volume" of the hazardous waste. All too often Superfund has settled for remedies short of cleanup. Given the serious nature of the contaminants in the Berkeley Pit, we cannot allow any remedy short of cleanup. We must clean up the problem so that future generations don't have to deal with it.

Specific comments on EPA proposed plan:

1. Needs to have a stronger emphasis on eventual permanent cleanup.

2. Needs to express in unequivocal terms that appropriate/new technologies will be used, as they become available, in the cleanup of the Berkeley Pit. The proposed plan's call for the use of innovative technologies is too vague. This vagueness is particularly true with the problem of sludge disposal. Either putting the sludge in the Pit or creating a new tailings dump will have serious, potentially harmful effects on both human health and the environment. The goal should be to keep the production of

sludge to a minimum.

3. Since so much of the proposed plan is based on predictive models, the plan must clearly provide a definite safety factor. Human error of calculation or operation must not produce an environmental catastrophe.

4. The cost factor needs careful consideration. There are two ways of calculating cost: (1) What is the cheapest plan of action or (2) What are the goals we are trying to achieve and, after the goals have been established, what is the most cost effective way of achieving those goals. According to Superfund, we are not looking for the cheapest remedy but, once we have decided on the plan we want to implement to protect human health and the environment in a permanent way by reducing the toxicity, mobility, and volume of hazardous contamination, what is the most cost effective way to accomplish that plan. Under Superfund, cost does not determine which plan is accepted or the end result desired of a cleanup plan, the cleanup plan and its end result, which should be protecting health, determines cost. Senator John H. Chafee (R-RI) has commented on Superfund's consideration of cost: "The extent to which a particular technology or solution is feasible or practicable is not a function of cost. A determination that a particular solution is not practicable because it is too expensive would be unlawful." 132 Cong. Rec. S. 14925 (daily ed. Oct. 3, 1986) In devising a remedy for the Pit we must not select the cheapest solution but the solution which will maximize the protection of human health and the environment. We must select a cleanup solution.

5. The solution to the Pit problem must show sensitivity to public input. As process, democracy demands that the public participate in the formulation and execution of public policy. This is particularly true in the case of agency rulemaking, as exemplified by the decision making processes associated with the Berkeley Pit. Such rulemaking is inherently undemocratic because the people making the rules were not elected by the people and are only very indirectly accountable to the people. Rulemaking is only legitimate in a democracy if the public has ample opportunities for meaningful participation in the decision making process. Meaningful participation means that the public really has an efficacious impact on the content of Superfund decisions.

It is contrary to democratic practice to seek to substitute the opinions of a few so called experts for public decision making. The best environmental policy outcomes are achieved through public discussion and debate. The reason is that the answers to most environmental policy questions, as to most public policy questions in general, cannot be determined with the exactitude of a mathematical or scientific theorem or law. Rather, the answers to public policy questions exist in the realm of the probable or contingent. Given the complexity of society and the complicated nature of most environmental issues, no one individual, not even a scientific expert, knows with absolute certain what is the best public policy. (Or course, there are numerous examples of where the experts were just plain wrong.) Because of this contingency and complexity, the best environmental policy answers are found through public discussion and by having the so-called expert submit his or her conclusions to critical public scrutiny and approval. The public has a right and a duty to subject the opinions of so-called experts to intense criticism. If an attempt is made to substitute completely the opinions of the technical person for the opinions of the public, neither, the public interest nor the demands of good policy making are served. The final Pit decision must clearly demonstrate and show how public input was efficacious in influencing the final decision of the EPA.

Additional Questions about the Proposed Plan-Mine Flooding Operable Unit:

1. Superfund calls for the cleanup of hazardous waste sites. The Pit is certainly a hazardous waste site. Does the proposed plan really call for a cleanup of the Pit. Is this a cleanup solution when it leaves in place a lake of poison? Is this a cleanup solution when it leaves Butte in a state of perpetual environmental crisis?

2. The Butte Hill of which the Berkeley Pit is a part is very complex. Do we really know what is going on? Are we relying excessively on models and predictions which could be found to be inadequate?

3. The proposed cleanup plan sets a bad precedent. It writes off the bedrock aquifer as permanently contaminated. No attempt is made to deal with this significant contaminated area.

4. Will the contaminated bedrock aquifer limit Butte's future growth by limiting water supplies.

5. Will the proposed plan end mining in Butte?

6. What if the EPA/DHES predictions are faulty. Can remedial action be undertaken quickly enough to avert an environmental disaster?

7. What would be the effect of an earthquake on the tailings pond and on the Pit? Will the water treatment plant be so constructed so as to survive a major earthquake?

8. What is the effect of pit contamination on the outer part of the camp?

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BERKELEY PIT QUESTIONS

1. Did the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's know beforehand that allowing the Berkeley pit to fill up to the 5,410 elevation with toxic water - the bedrock aquifer would also have to be written off? If so, why wasn't it explained much sooner to the people of Butte Silver Bow and C.T.E.C?

2. What type of advertisement has the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's done so far for the solicitation of innovated ideas for the Berkeley pit toxic water issue - or was this solicitation process given to only a select few for their ideas?

3. What type of funding and inquiry mechanism for innovated ideas will the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's put into place for the solicitation of innovated ideas (if you can build a better mouse trap, I'll look at it Russ Forba)?

4. If the answer to funding is yes, could a panel of experts as well as people from the community, mining, timber, agricultural and recreational industry sit on this panel for the adoption or the declination of innovated ideas?

5. Finally, I can not believe at this point in time, that the people of the United States, State of Montana, Butte Silver Bow and the stock holders of the P.R.P's would allow such a catastrophe of a high degree and volume of toxic waste and water to be allowed in this area. This may be the point in time the community should seek national news coverage similar to the reporting on the oil spill in Alaska some years ago. Believe me, this issue has for greater effects to a natural resource than the oil spill did to Alaska.

ALBERT MOLIGNONI

Albert Molignoni
Rocker, MT 59701
February 11, 1994

BERKELEY PIT WATER
Benefits for the Community from
Maintaining Water Levels at the Bottom of the Pit:

1. Very large volumes of low-cost, clean, drinkable water can be made available for the community of Butte-Silver Bow for both its present and future needs.

2. Large amounts of inexpensive electricity can be utilized by the community or sold at a profit to Montana Power Company.

3. Storm water run-off, as well as the sewage of the community, can be processed into a clean water supply that meets the Safe Drinking Water Act requirements.

4. Metals that now pose a health risk in our aquifer can be processed at a profit.

5. Large amounts of garbage can be processed, thereby reducing demand on the current net landfill by as much as 80%.

6. It will spawn a system to provide a vast array of high-tech, high paying jobs that will be sorely needed after EPA, MDHES and ARCO leave the community.

7. The process can be utilized in other areas of the world to benefit mankind while practically eliminating the cover-up and Institutional Controls that are some of the possible "remedies" of present and future Superfund sites.

8. It eliminates need for degredation of Big Hole River water, as well as Silver Lake water, that could instead be utilized for future needs of the citizens of the State of Montana.

Summary

Most of the technologies required to turn the present catastrophe of a highly contaminated area into an asset for our community are currently achievable. Now is the right time in the Superfund process to put these technologies into place for beneficial uses by this community and the State of Montana.

OFFICE OF THE GOVERNOR
STATE OF MONTANA

MARC RACICOT <IMG SRC 0894102BO> STATE CAPITOL
GOVERNOR HELENA, MONTANA 59620-0801

March 3, 1994

Albert Molignoni
Rocker MT 59701

Dear Mr. Molignoni:

Thank for your information regarding the situation at the Berkeley Pit.

I agree that there are some exciting new technologies that can turn a problem (degraded water in the pit) into a solution (not only clean water, but mineral extraction from the polluted water). In fact, I have taken a tour of some of the facilities and been briefed on the research involving the pit, and share your optimism in the new and innovative solutions expanded and applied on a larger scale.

The Department of Health and Environmental Sciences (DHES) has state authority over this issue, and I have taken the liberty of forwarding your information to them for their review and comment.

Thank you again for taking the time to send me your fact sheet. If I can be of additional help in this or other issues, please don't hesitate to contact me.

Sincerely,

MARC RACICOT
Governor

cc: Bob Robinson, DHES

TELEPHONE: (406) 444-3111 FAX: (406) 444-5529

<IMG SRC 0894102BP> MOLIGNONI MANUFACTURING, INC.
Route 2, Rocker * Butte, Montana 59701

March 15, 1994

The Honorable Marc Racicot
Governor of Montana
State Capitol
Helena, MT 59601

Re: Butte's Berkeley Pit

Dear Governor:

This replies to your letter of March 3, 1994 and provides you with further information concerning the types of innovative technologies that might be employed at the Berkeley Pit In lieu of the EPA/State of Montana "Preferred Remedy" to allow the pit to fill and remain full in perpetuity.

As an officer on the Board of Directors of CTEC (Butte's Citizen's Technical Environmental Committee funded by EPA grants to help the community express it's Superfund concerns), like you. I have been made aware of a tremendous number of innovative technologies that can be considered for resource recovery (water and metals) at the pit. What has been missing until now is for anyone to come forward worth a comprehensive plan for utilizing the complex nature of the Berkeley Pit for beneficial and productive purposes.

The attached document presents the beginnings of what could be termed a "holistic" approach to treating the interactive, multiple ills of the Berkeley Pit and mine flooding in Butte. This means the legal mandate given EPA to protect human health and the environment need not be the only benefit to be derived from a cleanup plan. As in the unique alternative attached, the Remedy could be a self-supporting Water Purification System that includes aspects of electrical generation reforestation, water recycling, metals recovery, harnessing garbage power - and at the same time create hundreds of sorely needed jobs on a sustainable basis.

The EPA/State of Montana "Preferred Remedy" actually harms Butte's economy by flooding off access of historic underground resources. Ignoring the requirement to "reduce volume of contamination," it does the opposite - doubling of the toxic pit water and the amount of contaminated bedrock aquifer around the pit. The Remedy scares the hell out of youngsters and oldsters alike. People imagine a lot of terrible things that could befall them with a full pit- from houses sinking and basements flooding and well contamination to the possibility that an economic depression 100 or 1,000 years from now could halt pumping and allow the pit to overflow. No one really knows for sure what the consequences of a full pit may be. That's because the proposed remedy is based on hydrogeologic theories, not facts. It's as if the people of Butte are guilty until they prove themselves innocent by coming up with technologic data sufficient to sway the State and EPA away from this "remedy" and the disastrous economic and social consequences it is sure to cause. We need reasons for businesses and professionals to relocate here, not the world's largest body of toxic liquid to drive the folks we have away. We don't believe it is good policy to pass our problems on to our kids and theirs and theirs. We need innovative thinking, not a Remedy that fits the old adage of cutting off one's nose to spite one's face.

Why not go on record as supporting the rights of the people to determine their own fate and the fate of their town? The EPA/State of Montana Remedy will likely put Butte right out of business as a livable community. Ideas such as the one attached deserve the light of day.

I'm not the only affected resident who knows there's got to be a better way. We need your help to assure we don't look only at the least expensive options and shortchange our future. Ideas that include social and economic issues must be brought to light so the Remedy doesn't leave future generations with a perpetual unresolved crisis.

Thank you for your sincere interest and care for the people of Butte-Silver Bow.

Yours very truly,

Albert Molignoni
Molignoni Manufacturing, Inc.

AM/hs

cc: Senator Max Baucus
Senator Conrad Burns
Rep. Pat Williams
Ms. Carol Browner, EPA
Mr. Bill Yellowtail, EPA
Mr. Jack Lynch, Butte-Silver Bow
Mr. John Wardell, EPA
Mr. Bob Robinson, DHES
Mr. Neil Marsh, DHES
Mr. Russ Forba EPA
Mr. Jim Scott, DHES
Mr. Fritz Daily
Members of Butte Legislative Delegation
Butte-Silver Bow Council of Commissioners
Clark Fork Coalition
CTEC

WATER PURIFICATION PROJECT

by

Albert Molignoni

TREES

Trees are one of the main ingredients in the water purification process. This natural phenomenon takes places all over the world's top soil. By looking at the area of Butte Silver Bow County we can see vast tracts of land that can be utilized for a large tree growing project. The trees would add to the attractiveness of our area by covering up the baring soil left over from past mining and smelting operations. The tree growing process has several unique features when it is growing.

1. Supplies our planet oxygen.

2. Takes moisture from the soil for the plants growth. It also evaporates some of this moisture into the atmosphere by the tree needles or leaves.

3. The tree also helps purge or purify the soil by absorbing the impurities through the tree root system.

4. The tree is a solar collector that absorbs solar energy when the tree is growing. This solar energy is converted into heat energy by burning the tree after the tree is harvested. An interesting fact is that every year many thousands of cords of wood are burned in our forest from this region in the form of slash piles that are left over from logging operations. This is a waste of heat energy that could be utilized if burned efficiently.

5. The tree or wood from a tree has the ability to absorb large amounts of water. For example, a piece of wood 2" x 4" x 8' feet long may contain as much as three gallons of water, or from 30 to 300 percent of moisture. This is a fact due to the cell structure of wood like a sponge. This same fact also gives the wood the ability to absorb impurities in water.

6. The same wood product can be made into charcoal for a water polishing agent to purify water to a higher standard. (Example: a carbon filter). After the carbon filters have served their usefulness and the impurities in the water cannot be absorbed by the filters, they are removed from the water system operation and new ones installed to take their place. The old filters, some of them high metals, are burned at very high temperature in a combustion chamber where the metals are melted and collected to be sold. The residue left over from the combustion process are mixed with other materials to make a soil conditioner to help the trees grow. The high temperature gases from this burning process are used to heat impure water into a water vapor.

7. The cost of tree planting and tree harvesting is very low in man hours because of the highly mechanized machinery used in today’s planting and harvest operation. This operation will create new employment in our area. Also, the type of tree used for this operation can be of small diameter which will shorten the time frame from tree planting to harvest. The demand for this tree product will give property owners, public or private, an incentive to grow this commodity to produce an income when the trees are harvested.

BERKELEY PIT

This enormous deep hole can be tuned into one of the best assets in our community. I will now try to describe in simple terms its cycle of operation. The sooner this project is put into operation, the greater the benefits will be for our community.

1. Start a massive tree planting operation in our area to supply the water purification plant with one of the main ingredients for the water plant cycle of operation. After 25 years some of the trees can be harvested on an annual basis to provide the water plant its energy and purification material needed for its operation cycle.

2. Create a large water and ice storage reservoir above the town of Walkerville. This high elevation reservoir will supply our community with a cheap abundant supply of clean high pressure water for domestic and fire protection. Also some of this water supply can be used for tree growing, agriculture, mining, recreation, and industry.

3. Design and build a water purification plant that will process fifty million gallons of water per day. With over twenty billion gallons currently in the Berkeley Pit, it will take about 25 years to drain the pit. The lowering of the pit water will improve the water project.

4. Take all of the water from the metro sewer plant as well as the storm water runoff that is now going into Silver Bow creek. Install a water main from this water supply over to and down the Berkeley Pit wall to the present water elevation of the pit. Because the pit water elevation at the present time is much lower than the metro sewer plants water outlet, the water will siphon into the pit. Put a hydroelectric generator on a large barge, the reason for this is as the water table drops in the pit additional water main can be added thereby creating a higher water pressure source to generate more electric power to be used by the community or sold at a profit to the Montana Power Company. After this water leaves the hydroelectric generator it is captured in a large floating vessel and put through the water purification plant. A note of interest is the current cost of electricity to pump water from the Big Hole River at Divide, Montana into Butte, Montana (about $150.00 per million gallons). If we pump an average of eight million gallons per day, the cost is $1200.00 per day or $438,000.00 per year. With the Berkeley pit water project this cost is eliminated.

WATER PURIFYING PLANT

A simple, very tall, highly insulated vessel like an immense thermos bottle can be installed at an angle near the present water elevation of the Berkeley Pit up to the highest point of the pit wall. Wood chips or wood shavings are gravity fed by a hopper into the vessel about one hundred feet from the bottom of the vessel. Near this same point the contaminated water is inserted into the vessel. Near the bottom of the vessel, hot clean gases from the combustion process of dry wood chips and the air dried carbon filters that were removed from the water purifying system are inserted into this vessel. The combustion gases are kept below the burning point of wood or about 250 degrees Fahrenheit. Water is preheated by the combustion process to keep the combustion gases at 250 degrees Fahrenheit. This is the same water that is inserted into the vessel. As the hot gases are driven up through the vessel the high in moisture wood chips are separated from moisture by evaporation. The hot gases and heated water vapor will continue to rise in the vessel to the top of the pit wall at its highest point and at this point of discharge from the vessel a condenser is installed. This condenser or heat exchanger has cold liquid ammonia in it. The hot gases and vapor heat the liquid ammonia enclosed in pipes to a high pressure gas or vapor. This action turns the hot gases to cold gases and hot water vapor to cold water. The hot high pressure ammonia vapor is used to drive a turbine or engine to generate electricity to pump the condensed water to the high elevation reservoir, pump contaminated water into the water purifying vessel and to run the air blowers of the water plants system. At the very bottom of the vessel the hot dry wood chips with the contaminate in them are taken to the combustion chamber.

Some of the water from the high elevation reservoir can be brought by pipeline to and down a mine shaft close to the water elevation in the mine shaft. A water turbine can be installed to generate electricity because of the high pressure water from the reservoir. If this water has oxygen put into it to produce acid that will solubilize the metals in the ore body of our area. After many years of this water mining the contamination of metals to our ground water should be eliminated. If this water that is high in metals goes into the Berkeley Pit it can be processed in the water purifying plant.

THE USE OF SOLAR AND WIND ENERGY

1. Trees can be planted around the Berkeley Pit walls at each bench level. The trees will absorb solar energy and moisture from the soils. After many years of growing, the trees can be harvested on an annual basis in this area. This factor will reduce the transportation cost from tree farm to water purifying plant.

2. Solar collectors and solar cells can also be used for a heat enhancer and to generate more electricity. The glass products needed to make solar collectors can be taken from the garbage waste that now goes to the landfill. This glass product can be manufactured locally creating more jobs for this area. A note of interest, large amounts of copper are used to make solar collectors and arsenic is used in solar cell construction.

3. Because our area of this community is surrounded by tall mountains, wind turbines can be installed on the tops of these regions that can he used as an electrical supply for the melting of glass and metals used in the solar collector and solar cell manufacturing process.

4. Many other combustible products can be taken from our garbage waste stream such as paper, tires and used motor oil. Also, the many plastic products can be used for insulation products and material products for solar collectors construction.

EFFICIENCY CYCLE WINTER AND SUMMER

By changing the flow path of the ammonia liquid and vapor this water purifying plant will have an efficiency rating of over eighty percent. The wood product will cost about fifty cents per one hundred thousand B.T.U. This efficiency rating will give us 10,000 gallons of clean water at the high elevation reservoir for $ .50. The people of the present water system pay close to $2.00 per thousand gallons of water.

SUMMARY

The sooner the E.P.A., MDHES, Arco and the communities of Anaconda and Butte Silver Bow accept the project design and ideas I have described in this text the sooner the region can have the vast array of high-tech, high paying jobs that are now needed in our area.

POWERSHAFT LIMITED

Proposal by:
Albert J. Molignoni

I. Creation of Water Storage Systems

II. Creation of High Efficiency Electric Generation

I. Creation of Water Storage Systems

Introduction

While living and traveling in the state of Montana, I have witnessed the exploitation of the state's mineral and fossil fuel resources. From these observations, I have concluded that the inevitable depletion of these natural resources will result in a considerable reduction in the state's wealth. The following proposal has been educed as an alternative source of monetary and energy needs for the state of Montana Development of this concept was derived only after extensive research on wind energy, solar energy, and thermodynamics.

The project I propose is the creation of a water storage system. This system will utilize Montana's land, water, wind, cold and heat, to ultimately provide a renewable energy source. Its success can be achieved with the combined efforts of the federal state, and local governments. Farming, ranching, timber, mining and recreational groups will also be required to participate in the development of this project

Land

The state of Montana has a very unusual land situation. Many of its areas are mountainous terrain; therefore, there are land sites in the state that are not suitable for agricultural production or recreational purpose. Areas of non productive soils, such as those left over from mining, commonly take up one hundred acres or more in this state Timber areas and other smaller sites can also be utilized for the creation of this project.

Water

Water is a natural resource that this state has a great abundance of in certain times and very little of during a drought period. The controlling of this resource in the past has been with the use of dams streams, where water freezes from the top downward. When the water is frozen from the bottom up, the ice structure created is one of the most stable forms for the storage of the water. The benefits of storing water in this time frame and manner are

1. Water used to create the ice storage units in the winter months can be supplied by lakes, rivers, streams or wells. In this time frame the demand for the states water is at its lowest level.

2. If the water used to create the ice storage units is supplied by a underground pipe line, or a self draining pipe line and stored at high elevations, it will create a water line with high head pressure when the ice melts in the spring and summer months. This energy source can be used for hydroelectric and high pressure sprinkler systems.

3. By using a geothermic water supply, the thermodynamic principle, and cold air temperatures, an energy source is created to supply the pumping of water in this time frame. Solar can also be used as a heat source.

4. These large stable ice units can be used in the winter months with now cover for such winter time activities as skiing and snowmobiling.

5. Storing water in this manner will provide a gradual water discharge during the spring and summer months for the support of agricultural, timber, mining, recreation, industrial and domestic needs.

Heat

The last natural resource that is needed to complete the project design is heat. The heat energy source will accrue during the spring and summer months. This will provide the means of melting the ice storage systems. Therefore, an ample water supply will be created for the growth of our state. The heat from the sun in the spring and summer months, coupled with the cold water from the ice storage units, benefits in creating a energy source by the use of the thermodynamics principle. It will also be noted that if a high precipitation period occurs during the winter and spring months, the excess water will be induced into the state's aquifer for storage. The water can then be used at a later date when needed, such as in the fall during the non-productive months of the ice storage systems.

Summary

Upon reading the previous text on the general description of the projects design, it can be understood by the average lay person that this process is already taking place in our state with the four seasons of spring, summer, fall and winter. With the added technology of the state's university system and people with the expertise on the project design and development, the project goal is obtainable. The spin off of high-tech as well as other jobs associated with the project design and constriction are too numerous to mention. The additional benefits of the project are:

1. An increase tax base for the state due to the taxable valuation of the projects components and additional soil under cultivation by the water.

2. An industry created to design and produce the components of this project design to other areas that have the same or similar geographical location and climatic condition.

3. The abundant supply of jobs to maintain the system as well as other jobs associated with the increase of water and energy supply.

II. Creation of High Efficiency Electric Generation

Introduction

The prime sources of electrical generation in Montana are hydroelectric and stream. Wind generation has also been used in small quantities to produce electricity.

Hydroelectric production is solely reliant on mother nature to produce enough moisture from the snow and rainfall to fill the reservoirs with water for generation. In addition to providing a clean supply of electrical energy, hydroelectric dams manage the water supply to the consumers in the state.

Steam generation is produced by the burning of our state's coal supply. The efficiency of this type of electrical generation is around thirty percent. This means that seventy percent of the coal's heat energy is wasted. Coal is not the only type of fossil fuel that is used inefficiently in Montana. Gasoline and diesel fuels in today's internal combustion engines, such as automobiles, trucks, tractors and trains very seldom reach a efficiency of forty percent.

Montana's extreme temperature variations, seen throughout an annual period, is another source of clean energy. Water, cold weather in the below freezing months, and hot weather in the late spring and summer months, are the basic resources needed to create massive amounts of energy inexpensively. For the past several years, I have designed and patented a unique high efficiency engine and heat exchanging system. This system design, with the usage of ammonia or Freon, produces a efficiency of eighty percent. Adoption of this type of energy system, in conjunction with the ice storage units, would produce extensive amounts of water and energy cheaply. The following text will give examples of how this type of system can be used in our state.

Cities and Towns

Present sewer and garbage disposal systems are abundant supplies of energy needed to make the system successful. The heat energy needed for the system would be derived from warm waste water in community sewer disposal systems, and the higher temperature heat source that can be supplied by ether incinerating garbage or the burning of methane gas produced by our sewer plants. Cold air is the condensing agent needed to complete the energy cycle of operation during the cold weather months. Processed water from the sewer plant during the cold weather operation will be used in the ice storage system. This cold water supply is used as a condensing agent during the hot weather cycle of operation. Local governments could realize additional income by selling the vast amounts of electricity and water produced by the system.

Timber Industry

The wasted wood products that are not used in our state's forests is unbelievable. The simple economic reason is the wasted wood products that are created from logging, timber thinning, and trees that insects destroy are not in demand. Present use of waste wood is by home owners to help heat their dwellings. The high cost of home heating created the demand for this type of wood burning.

New technology for clean burning of wood products, combined with the high efficiency energy system design would create a large demand for wasted wood products. The lumber industry already has the equipment needed to bring the wasted wood to a mill or a convenient site for the burning of this product in the high efficiency energy system. Adoption of this system design would create an abundant supply of cheap electricity, jobs, and additional cash flow to the timber industry

Agricultural Industry

Farming and ranching industries face a very unfavorable growth period in Montana because of the increased demand for water by agricultural, commercial and recreational groups. The state's present water policy is unfavorable because added storage was not develop to insure a adequate supply of water for the growth of agriculture. Ranch and farm industries already have enough problems with drought, insects, low prices and high taxes to make their business unprofitable.

A mobile unit can be used for this type of energy production. The unit can be moved from one location to another for the ice energy production. Also, if there is a major malfunction with the energy unit, a different unit can be brought in to produce the energy while the original unit is being repaired. The automated unit would require very little time and effort from the operator, thereby releasing the person for other duties that are required for the farming and ranching operation. Additional cash flow from the sale of electricity from the unit would insure the usage of this system during high periods of precipitation to increase the water table of the state's aquifer.

Utility - Public and Private

The vast untouched natural resource of Montana's heat and cold is almost impossible to described. We have failed in the past to utilize this abundant source of energy. Public and private utilities of this state, with the system design, would be able to produce large blocks of electrical energy that can be sold to other states, thereby increasing the cash flow into our state. If exportation of electrical energy is taxed, the added income would benefit this state. The sale of this energy at a reduced rate within the state would entice industry, that consume large amounts of electrical energy, into this state.

Mining Industry

Mining concerns have one of the best potentials for the system design. Energy generation and ice storage will create an abundant supply of inexpensive electricity and water for mining. The increase of demand for lime and phosphate for fertilizer by the agricultural industry would reopen old mines and create new ones. Copper and aluminum industries are also great benefactors, because of the large amounts of copper and aluminum metals in the energy system's parts.

Recreational Industry

The added water supply would insure a increase in the recreational industry in Montana. A sufficient water supply would increase the feed products for the big game and fishing industries. Additional quantities of water would also benefit such industries as boating skiing, and other related activities heavily reliant on an adequate water supply. The potential of the state's ice storage units is 20 million or more in acre feet of water.

Summary

Upon the states adoption of this type of ice storage and high efficiency energy system, a meeting should be set up with a group of professional people with the expertise on this subject matter. The meeting would have to be held in strict confidence because of many ideas I have on the subject matter that may be patentable. Compensation is also a factor that has to be dealt with due to the many years of time, effort, and expense that were necessary to create this system.

HOUSE JOINT RESOLUTION NO. 20

INTRODUCED BY KNOX, RANEY, GILBERT,
SWANSON, FELAND, STOVALL, SCHWINDEN,
WAGNER, BIRD, TUNBY, ORR
BY REQUEST OF THE HOUSE NATURAL RESOURCES COMMITTEE

A JOINT RESOLUTION OF THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE STATE OF MONTANA STRONGLY URGING THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND THE UNITED STATES CONGRESS TO GIVE HIGHEST PRIORITY TO CLEANUP OF THE BERKELEY PIT AND TO PROTECTION OF ALLUVIAL AQUIFERS UNDERLYING THE SILVER BOW CREEK SUPERFUND SITE.

WHEREAS, the Berkeley Pit, located at the headwaters of the Columbia River, is included in the nation's largest Superfund complex, which includes the Silver Bow Creek Site/Butte Addition Site, and is the site of the world's largest mine flooding; and

WHEREAS, mining activity for the past 112 years has resulted in soil and water contamination and changes in the way ground water and surface water flow in and near Butte; and

WHEREAS, mining companies installed an elaborate pumping and bulkhead system during the active mining period to dewater the underground mines and the Berkeley Pit; and

WHEREAS, when active mining ended, the pumps were turned off on April 22, 1982, and the underground mines, and subsequently the Berkeley Pit, began to flood, with water rising 2,918 feet in the mines and to a depth of 774 feet in the pit; and

WHEREAS, ACCORDING TO THE MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES, the Berkeley Pit currently contains approximately 20 billion gallons of water and fills at an average rate of 5 million to 7.5 million gallons a days; and

WHEREAS, mine flooding in the Butte area is of significant concern because the water is highly acidic and contains high concentrations of iron, manganese, arsenic, lead, cadmium, copper, zinc, and sulfates that far exceed state and federal standards, conditions that prevented water in the pit from freezing even when temperatures fell to minus 40 degrees Fahrenheit in 1989; and

WHEREAS, water in the West Camp of the Butte mining area did discharge into the Silver Bow Creek alluvium and into basements in the central Butte area when the West Camp was sealed off with bulkheads in 1959; and

WHEREAS, ACCORDING TO THE MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES, water in the Berkeley Pit rose 30.5 feet in 1989, 33.2 feet in 1990, 32.8 feet in 1991, and 25.2 feet in 1992 and the water in the pit is within

199 feet of contacting the alluvium on the east wall of the pit; and

WHEREAS, many citizens of Butte believe that the United States Environmental Protection Agency has ignored preliminary documentation indicating that the surrounding aquifers may be contaminated in the near future, but the agency instead has negotiated an administrative order on consent that sets water level targets well above previously established levels; and

WHEREAS, despite these alarming developments, residents of Butte and the Silver Bow Creek drainage have been frustrated by the lack of progress by the United States Environmental Protection Agency is developing a plan that will adequately treat the contaminated water and protect the environment and citizens of the area from the potential threat to the alluvial aquifer surrounding Butte; and

WHEREAS, the Montana Department of Health and Environmental Sciences is also involved in the cleanup of the Berkeley Pit and has in the past reported to the Environmental Quality Council on the progress of that cleanup.

NOW, THEREFORE, BE IT RESOLVED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE STATE OF MONTANA:

(1) That the United States Environmental Protection

Agency and the United States Congress be strongly urged to give the Silver Bow Creek, Butte Area Superfund Site the highest priority for cleanup and action to prevent disastrous environmental damage and human health problems.

(2) That the United States Environmental Protection Agency and potentially responsible parties proceed with haste to develop and implement plans and design criteria fo a facility to treat contaminated water before it reaches th alluvial aquifers surrounding the Berkeley Pit.

(3) That the Montana Department of Health and Environmental Sciences make periodic reports to the Environmental Quality Council on the progress of the cleanu of the Berkeley Pit and the protection of alluvial aquifers underlying the Silver Bow Creek Superfund Site.

(4) That copies of this resolution be sent by the Secretary of State to the President of the United States, the Administrator of the United States Environmental Protection Agency, the Director of the Montana Environmenta Protection Agency Office, the Governor of the State of Montana, and the Montana Congressional Delegation.

-End-

HOUSE JOINT RESOLUTION NO. 11

INTRODUCED BY DAILY, LYNCH, QUILICK, MARPEN, PIPINICH HARRINGTON, PAVLOVICH, NARP, MCCLERMAN, JACOBSON, D. BROWN, VAN VALKENBURG, MCCARTHY, VOGEI., FORRESTER, TOOLE, GAGE, DRISCOLL, GILBERT, BECK, FAGG, MENAHAN, LARSON, CRIPPEN, SWISGOOD, DOHERTY, ENDY, KENNEDY, TASM, SMITH

A JOINT RESOLUTION OF THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE STATE OF MONTANA RECOGNIZING AND URGING CONTINUED SUPPORT FOR THE NATIONAL ENVIRONMENTAL WASTE TECHNOLOGY TESTING EVALUATION CENTER IN BUTTE.

WHEREAS, the National Environmental Waste Technology Testing Evaluation Center (NEWTTEC) was established in Butte, Montana, to investigate, develop, and demonstrate cost-effective treatment technologies for mining, energy, defense-related, and other environmental wastes; and

WHEREAS, the United States Congress and federal agencies are providing increased financial and technical support for NEWTTEC in order to meet the critical national need to develop and test environmental waste remediation technology; and

WHEREAS, NEWTTEC provides increased economic benefits to Montana and environmental benefits to communities around the world that are adversely affected by waste and pollution;
global environment.

and

WHEREAS, NEWTTEC intends to provide facilities necessary for environmentally sound technology development in accordance with all applicable environmental requirements; and

WHEREAS, NEWTTEC promotes technology transfer to the private and public sectors and encourages the participation of industry, government agencies, the scientific community, and the public in activities at the Center; and

WHEREAS, NEWTTEC will examine and evaluate technologies to minimize the volume and toxicity of environmentally damaging waste currently being produced by industry; and

WHEREAS, there is a critical need for new environmental remediation technology; and

WHEREAS, NEWTTEC has a nucleus of scientific personnel drawn from government agencies, private industry, and institutions of higher education in Montana; and

WHEREAS, the further development of NEWTTEC can contribute significantly to environmental cleanup and economic development in the region, especially with regard to developing technology-based industries and associated opportunities; and

WHEREAS, the State of Montana wishes to be an important participant in the development of environmental technologies contributions to a cleaner United States.

NOW, THEREFORE, BE IT RESOLVED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE STATE OF MONTANA:

(1) That the Legislature acknowledge and support the creation and development of the National Environmental Waste Technology Testing and Evaluation Center in Butte, Montana, and recognize the importance of continued support for its further development.

(2) That the Legislature urge the United States Congress and appropriate federal agencies to continue full funding for the growth and development of NEWTTEC at the United States Department of Energy Component Development and Integration Facility in Butte, Montana.

(3) That copies of this resolution be sent by the Secretary of State to members of the Montana Congressional Delegation, to the Administrator of the United States Environmental Protection Agency, and to the Secretaries of the United States Department of Energy, Defense, and the Interior.

-End-

THE
Clark Fork
Pend Oreille
COALITION

April 29, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 02 1994

MONTANA OFFICE

Mr. Russ Forba, Project Manager
U.S. EPA
301 S. Park
Helena, MT 59262

Re: Public Comment: Berkeley Pit & Mine Flooding RI/FS/Preferred Plan

Dear Russ:

The Coalition requests that EPA respond to each of the following concerns and questions concerning the Berkeley Pit and Mine Flooding RI/FS and Preferred Plan:

Legal Questions

- How does the Preferred Remedy protect against the release and the threat of release of contamination given the fact that water can, indeed, move through bedrock of the pit (e.g., the mines and pit were dewatered) and contaminated mine water currently enters Silver Bow Creek from the bedrock aquifer at the end of the Colorado Tailings where it is a gaining stream?

- How does the Preferred Remedy reduce mobility, toxicity or volume of contamination? We see that it increases volume of contaminated water and groundwater in the short-term and doubles it in the long-term and permanently. We see that it creates greater toxicity and that the psi increases probability of mobilization through fractures in the bedrock. It is also mobilized as it climbs to the 5,410 CWL.

- Because any remedy for this O/U will require treatment in eternity, why are the funds to do so not provided up-front in a trust fund administered by EPA or another governmental agency instead of allowing ARCO to self-insure that they will do the perpetual care, operation and maintenance? (We understood EPA required Butte-Silver Bow or Anaconda-Deer Lodge county government involvement in maintenance of other perpetual remedies because of your determination that government entities are expected to last longer than private firms. Also, many people of Butte are sorely disappointed in a similar plan where, despite excellent intentions and a most trustworthy religious organization holding funds, "Perpetual Care" of some cemeteries here had to be abandoned due to unforeseen circumstances. ARCO appears to have lost much trust from the people here due to their initiation of the mine flooding without notice in 1982.)

- If the cleanup funds were available in advance, could EPA require quicker action toward cleanup of the water that is now in the pit instead of waiting up to 28 years?

- Is it legal for EPA to allow the PRP's to impound up to 56 billion gallons of water in perpetuity without a "beneficial" purpose for having done so? There will never be more water on the planet than is presently available. Perhaps EPA should obtain public comment from affected water users downstream before going forward with this plan.

- What is the basis for EPA having put a lid of $60 million on the amount of dollars that could be spent for the perpetual remedy for this site? The public document showing the Preferred Plan says that reducing the water in the pit was not considered because it would be too costly. As cost is only one of the nine criteria for evaluating remedies, we recommend EPA go back and develop a plan that reduces contaminated water in the pit - what is preferred by the overwhelming majority of affected residents - and then evaluate its cost effectiveness along with its ability to reduce mobility, toxicity and volume of contamination, its short-term effects, its community acceptance, and its permanence.

- It is stated that all the alternatives have short-term effectiveness because none result in adverse short-term effects. We believe short-term effectiveness means how effective the remedy is in the short-term and if it deals with the problem quickly. None of the alternatives deal with the problem quickly; rather, the alternatives attempt to justify putting off cleanup for decades. Why does EPA not recognize the increased volume of contamination as a short-term effect, for example?

- Regarding the Travona Mine water which is pumped to the B-SB Metro Sewer and diluted before discharge to Silver Bow Creek, how do EPA and Montana DHES justify not meeting State water quality standards for Arsenic and Iron in this "treatment?" The Coalition asks that you not set an early precedent for waiving water quality standards during Superfund cleanup of the headwaters of the Clark Fork River.

- The Coalition believes Butte should be treated as well as other cities throughout the nation where contaminated aquifers are pumped and treated and clean water discharged. The aquifer can be seen as a vessel that holds the valuable water resource. Butte needs more water resources for economic development. Additionally, it is neither good public policy, nor in the best interest of the watershed for you to allow a mining industry precedent to be set by writing off the aquifer. If you do not feel you are able to change this portion of your preferred remedy, please state why.

- How does this Superfund cleanup anticipate restoration work to be done as required in the Natural Resources Damage Act portion of CERCLA? Because both are in the CERCLA law, a reasonable man would expect the one to be a jumping off point for the other.

Technical Questions

- Why was the contaminated bedrock aquifer water which enters Silver Bow Creek at the end of the Colorado Tailings not identified as a release of contamination in the RI/FS or Preferred Plan? Will a study be done to identify how much of this water is of the (worse) East Camp quality and how much is of West Camp quality? What exactly are the levels of contaminants in that water over all? (You will recall it was identified by the State in a recent public meeting as being of "poor quality").

- Initially, greater volumes of water were entering the Berkeley Pit each day than are at present, and less is expected in the future. We understand this is because the gradient decreases as the water rises. Anyone can realize that the balance of the contaminated bedrock water has to going some where. Please tell us where.

- More wells are needed in the area south of the Pit to confirm that the low level in Well C is caused by drawdown in that area and is not indicative at a larger area of lower groundwater. ARCO indicates EPA has to prove if the CWL should be lower than 5,410 feet. Well C is enough proof that there is ground water with a head below 5,410 feet. ARCO should prove that the groundwater is not lower further south by providing adequate additional wells.

- What is the water quality of the bedrock aquifer in the middle of the valley, say near the airport? What is the ground water quality at depth where the bedrock drops off toward Rocker? Could a new industry using high volumes of water in south Butte or in Rocker cause induced infiltration to contaminate existing wells?

- Butte-Silver Bow has a contract with ARCO whereby they agreed to create some-yet-to-be-defined Institutional Controls that appear to include well bans. To what extent, if any, does the Preferred Remedy rely on Butte-Silver Bow being able to condemn some wells and forbid drilling others? Please define the geographic area expected to be affected along with the types of restrictions anticipated for each. Please state if the property owners involved were aware of these potential restrictions before close of the public comment period for this Preferred Plan.

- Is contaminated water entering groundwater and Silver Bow Creek from areas such as the Green Lake Seep, the Orphan Girl Shaft, etc. in the Outer Camp area?

- What is the contingency plan if mining does not cease in 2,006?

- Will the pumping and treatment plant for the Berkeley Pit water withstand a sizable earthquake?

- Should not the worst possible case have been considered in prudently evaluating the ability of the Yankee Doodle Tailings Dam to withstand a sizable earthquake? A seismic event of 6.5 may not be an adequate estimate.

- Will the Yankee Doodle Tailings Dam move south in future construction plans? We understand from those who initiated construction of the dam that it has saturated tailings at its very near base, and that construction was of waste rock with some bentonite clay. There are three faults in the area and the Continental Fault runs through the east portion of the dam. Were all of these considerations known to the engineering company that reviewed the integrity of the dam?

- Can EPA assure residents that "treated" Travona mine water contaminants of concern - copper, zinc, cadmium, lead, etc. - are not going to become remobilized downstream through forces of nature?

- Why is construction of the already designed treatment plan for Travona Mine water not required in the Preferred Plan?

- The Critical Water Level for the Travona Mine is set at 5,435 feet in the Preferred Plan. This is approximately 25 feet higher than alluvial and surface water immediately down gradient (and well GS -27 was at 5,413.9 feet in February, 1994). How can EPA assure contaminants are not being released with such a high CWL elevation at the Travona? ARCO should have to prove water cannot leak through to streams with a lower head than 5,435 before the Travona CWL is set above the level of Silver Bow Creek at its lowest elevation in the Butte Valley.

- We assume that most treatment facilities are only designed to last about 30 years without some major overhaul or redesign. So a pumping and treating facility for pit water should be put in place as soon as possible that uses the best current technology. Every 20 or 30 years it should be redesigned to incorporate the latest technology. Better, proven technologies than that in the Proposed Plan (and which do not generate massive amounts of waste sludges) already exist. Hence, there is no validity to the argument to wait for better technology. If you always wait for next year's model, you never buy the product you need. Buying something will create markets for more and better technology. A plant should be designed now that lends itself to easy retrofitting or redesigning for newer technologies that may be implemented at later dates.

- How long do you perceive that land disposal of sludges would be required before new technology might be approved by you that produces no sludges? How much area would be required for land disposal of those sludges?

Human Health Concerns

- Please see the attached paper by Luoma and Moore on health hazards in the Upper Clark Fork due to mining. Please advise how this Preferred Plan addresses air contaminants, given the high incidence of lung disease, even among women, recorded for this area. Will the Agency for Toxic Substance Disease Registry review this research to attempt to identify long-term causes of the extremely high rates per capita for all diseases, heart disease, etc.

- We understand that winter fog from the Berkeley Pit caused a pilot to be unable to land at the Butte airport three years ago and that he was subsequently killed after running out of gas enroute to another airport. How does EPA propose to eliminate this type of permanent nuisance with a remedy that will eventually widen the pit water to nearly 500 acres, an increase of at least two times over that present when the cited accident took place?

Russ, we realize this is a very complex site and greatly appreciate the hard work and concern shown by both yourself and Jim Scott of DHES in answering our questions over the past many months.

Thank you for your careful consideration and answers to the above questions.

Yours very truly,

Mary Kay Craig
Upper River Field Representative

Attachment

cc: Senator Max Baucus
Senator Conrad Burns
Representative Pat Williams
Ms. Carol Browner, U.S. EPA
Mr. Bill Yellowtail, U.S. EPA Region VIII
Governor Marc Racicot
State Representatives
B-SB Chief Executive Jack Lynch
Mr. Neil Marsh, DHES
Mr. Jim Scott, DHES

THE
Clark Fork
Pend Oreille
COALITION

April 29, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 02 1994

MONTANA OFFICE

Mr. Russ Forba, Project Manager
U.S. EPA
301 S. Park
Helena, MT 59262

Re: Public Comments, Berkeley Pit & Mine Flooding RI/FS/Preferred Plan

Dear Russ:

Attached are Berkeley Pit research and comment papers the Coalition has received from Environmental Studies students at the University of Montana in Missoula. They are Steve Mietz, Bonnie Gestring, Carla Abrams and Molly Miller.

Please review the papers and include in the Responsiveness Summary answers to the concerns and questions raised by these students.

Thank you.

Yours very truly,

Mary Kay Craig
Upper River Field Representative

Attachments

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406/542-0539

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Butte MT 59702
406/723-4061

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Sandpoint, ID 83864
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Alternate Plan and Rationale For

Berkeley Pit and Mine Flooding Operable Unit

From the Clark Fork - Pend Oreille Coalition

Presented to: U.S. Environmental Protection Agency
Date: June 30, 1994

Introduction

EPA's Preferred Plan for remediation of the Berkeley Pit and Mine Flooding Operable Unit is unacceptable to the people of Butte and to the Clark Fork - Pend Oreille Coalition. Major points of disagreement are the elevation at which the Pit would be allowed to remain in perpetuity, and the future unfriendly idea of waiting 30 more years to initiate any pumping and cleaning of toxic Pit water. Disagreement emanates not just from uncertainties associated with the Plan, but also the certainties - the certainty that EPA doesn't require anything be done to clean Pit water for another 30 years, and the certainty that the perpetual elevation for toxic Pit water would leave a heritage of impending crisis to all future residents.

In consultation with residents who are knowledgeable about the Hill, the economy and the social system of Butte, Coalition scientists and technical people have prepared the following Community-Based Alternative to the EPA Preferred Plan. It combines much of Butte-Silver Bow County's recommendations, with revised elevations and time schedules. The Plan grows out of the need for new treatment technology now, and it relies on the proven impetus of deadlines. American know-how, and market forces to bring forth that technology. It allows EPA to move forward with most of the work suggested in its Preferred Plan, but asks that this occur under an Interim Record of Decision. In that way, the new monitoring wells and other needed investigative work can occur under and Extended Remedial Investigation. The new, effective technologies that everyone unanimously agrees are needed can be addressed under an Extended Feasibility Study. It allows that the Final Preferred Plan and Record of Decision not be issued until after specific technical and legal data gaps are filled-and that the Pit be pumped and treated at the earliest possible time, considered to be the year 2002.

Recognizing that EPA requires technical or legal reasons to deviate from its Preferred Plan, the Coalition has documented some of the inadequacies on which that Plan is based. These are summarized in an Appendix, "Reliance on Assumptions, Theories and Speculation," for that is the one thread that runs through all the complexities of the Preferred Plan and it is core to the public's problem with the Plan. A tremendous number of unsupported assumptions, opinions, models and estimates creates an unacceptable cumulative margin for error in Butte one-and-only chance for remedy of the Pit and Mine Flooding. Evidence is presented that the Preferred Plan disregards some of EPA's own criteria for remedy selection (pg. 14; e.g., Toxic Volume Reduction, Short and Long Term Effectiveness, Cost, some air and water ARAR's [Applicable Relevant and Appropriate Regulations] and Community Acceptance). Questions and concerns presented here were filtered from those of Coalition scientists and staff, Butte's EPA grant-funded CTEC (Citizens' Technical Environmental Committee), Butte-Silver Bow County scientists, plus students and others who have followed this issue closely.

It is also significant to note that a 30-year postponement causes a great deal of current on-the-ground and underground expertise and understanding of the situation to be lost (death, relocation, etc.), resulting in reliance on documentation as opposed to first hand experience. Because future generations may have less understanding than we have at present, today's generation is in a better position to move forward with a solution.

The Coalition believes that, through a thoughtful review of the Appendix, EPA will become convinced of the validity of the community outpouring that the Preferred Plan is unacceptable. The Coalition proposes the following Plan that combines the best aspects of the EPA Plan, plus removes some of the uncertainties to which citizens object.

A Community-Based Alternative

The Coalition believes that it is in the long-term best interest of the citizens of Butte-Silver Bow and all its downstream neighbors, as well as the environmental health of the Clark Fork River Basin that contaminated water in the Berkeley Pit begin to be pumped and treated as soon as technically possible, utilizing treatment that minimizes waste sludges while freeing clean water for permanent, beneficial uses. It is hoped this can eventually include decreasing the volume of toxic materials currently in the Pit to provide a greater margin of safety to future generations. The need for decreasing toxic volume from today's levels could be determined based on any increase in confidence from the community after data gaps (discussed below and in Appendix) are filled.

The following alternative plan, like the EPA alternative 18/19, holds the Pit level at its elevation at the time the remedy is implemented. The plan agrees with many of the Butte-Silver Bow County recommendations, but employs a lower protective Pit water level based on earliest possible implementation, which is considered to be the year 2002. This allows some time to develop more effective treatment technology. The plan also emphasizes management of water inflows.

The process for implementation of an alternative plan would include:

- an Interim ROD now (Record of Decision) specifying need for additional information which would be accomplished under an
- Extended RI-FS (Remedial Investigation - Feasibility Study); then a
- Final Preferred Plan and
- Final ROD could be issued as soon as an adequate treatment technology is found.

The Coalition recommends that implementation not be tied to any specific Pit water elevation, but to the need for soonest possible implementation of treatment, recognizing the need for responsible action from today's generation.

The following paper outlines the important components of this community-based alternative.

A. Additional Data

1. Data Gaps Must be Eliminated to the Extent Possible: A Sensitivity Analysis is requested of all the "soft" data and assumptions (see Appendix) that have gone into the RI-FS and on which the Preferred Plan is based. While normally associated with economic projections for decision-making, this type of exercise would be valuable to both the community and to EPA in justifying whatever decision is finally deemed appropriate. This analysis should be accomplished first; then this year's Interim ROD would delineate what new data must be generated over the next year to fill-in the most critical data gaps. Areas which appear to require new data immediately include:

- Immediate implementation of monitoring wells southeast of the Berkeley Pit and in the West Camp as specified in the Butte-Silver Bow recommendations and by Rowling Technical Services plus consideration of a deep quality well at Rocker.

  A more accurate water budget and thorough analysis of potentially slowing inflows. From these. the volume of water necessary to pump in the year 2002 can be more reliably projected. A total water budget must include municipal leakage and, importantly, fate of outflow (including at the Colorado Tailings). If the water level stops rising, incoming water is going somewhere. If less water needs to be pumped in succeeding years. PRP's (Potentially Responsible parties) must prove it is not leaving the Pit to create a new problem.

- More definitive ground water modeling to include:
  - thermal influences
  - conservative expectations of cone of depression influence on Pit and tunnels
  - potential East Continental Pit influences on contamination migration
  - determination of exact locations of ground water divides: possibilities of flow reversals

- Quality of inflow and outflow due to mine flooding must be stated in the Mine FloodingO/U (Operable Unit) to assure that all contamination releases are addressed. This should include characterization of sources of bedrock aquifer contamination releases at the end of the Colorado Tailings with remedy for same addressed under this O/U.

- Pit microbiological and geochemical studies

- Pit bottom sediments studies to determine Geochemistry of sediments and whether sediments could be sealing the Pit bottom

- Development of downstream landowner program for monitoring of "new springs" between Butte and Garrison Junction

- Studies of relationship between saturated bedrock and potential rise of alluvial aquifer

- A plan for preventing loss of the many bulkheads between East and West Camps and/or a contingency plan for dealing with the loss if it occurs. It would include analysis of East vs. West hydraulic heads, relationship of locations/elevations of bulkheads to one another and possibly to Orphan Girl area, Green Lake Seep, etc.

- Identification of any additional contaminants within the O/U with risk analysis and public information (e.g., organic contaminants within current mining lands and leach pads)

- Initiation of air quality epidemiologic investigations (possibly by the Agency for Toxic Substance Disease Registry) and if necessary, feasibility of stabilizing Pit walls.

2. Public Information Data Gaps: Better public information and involvement is needed throughout the process so new information (e.g., risk assessment; epidemiologic study) is made available in a way that is both accessible and understandable by the general public. Particular gaps would be filled:

- a public comment period on EPA proposal to "write off" the bedrock aquifer

- a published list of walls (private, public) affected by mine flooding, with more open and proactive EPA communication of implications - where well bans might occur, etc.

Interim ROD Must Emphasize the Diversion of all Controllable Water from the Pit: Source control and pollution prevention should always be the first steps in pollution control. In addition to Horseshoe Bend water currently planned for diversion, any increases to the Horseshoe Bend flow must be diverted. Storm water entering mine shafts must be diverted. Leaks in the municipal water delivery system must be repaired. Pit inflow from current mining operation spills and any possible from planned expansion of the Yankee Doodle tailings dam must be more adequately addressed.

C. A More Protective Water Level

1. Potential Future Events - Effect on Pit Filling Rate: EPA must identify the types of future events that could cause either a shutdown of Pit pumping and treatment or a need for an increased rate of pumping and treatment. A probability value could be assigned to each, including the number of same occurrences possible in perpetuity. Some of those events include:

- Earthquake effects on Yankee Doodle Tailings Dam at higher than 6.5 Richter, and re-evaluation distance from Dam, depth, dispersal and attenuation factors
- Possible increased flow of Horseshoe Bend water as a result of adding 60 more feet of tailings to the Yankee Doodle tailings pond
- Earthquake effects on operability of pumping and treatment plan
- Earthquake effects on Pit from collapse of Kelley Mine wall
- Earthquake effects on manmade diversion structures designed to control Pit filling
- Effects on availability of funds for perpetual operation in event of depression
- Potential ARCO bankruptcy effects on availability of funds for perpetual operation
- Acts of War that may shutdown facilities
- Potential for changes in government negating maintenance contracts with County
- Increased cost of pumping and/or treatment maintenance
- Availability of newer, more permanent treatment technology with higher costs

2. Margin of Safety: A lower Pit level provides a larger buffer against disruption of treatment or catastrophic events that may cause a sudden rise in Pit level. In addition, the lowest Berkeley Pit water level possible would be desired by future generations because if initial treatment becomes too costly or ineffective, future generations will search for another solution, probably a more permanent solution that doesn't require perpetual care. The less water they are faced with cleaning up, the fewer costs will be incurred when a decision is made to implement a non-treatment solution.

3. Obligation to Accept Responsibility: The Coalition believes that the present generation must provide the best available treatment option and implement it as soon as possible. All 19 alternatives considered by EPA shift the burden of responsibility from the present generation to future generations. This is not good public policy. Also cumulative effects may be untenable, economically and environmentally, for continuation of the quality of life present generations enjoy. The present generation should implement an effective solution and then not permit the Pit water level to rise farther.

4. Therefore the present generation must implement an alternative that holds the Pit at the level it is at when the soonest possible effective solution can be implemented. This option provides time for testing and designating a more effective treatment technology than the currently specified method of hydroxide precipitation.

D. Treatment Technology to Drive Final Pit Level

1. Deadlines to be Specified in Interim ROD: Rather than wait nearly 30 years hoping and wishing for new, inexpensive technology for cleaning of Pit water, new technology can be encouraged now by employing

entrepreneurial American competitiveness, capitalism and market forces. Deadlines drive action and innovation just as they did in the space race's moon landing. The race to restore and conserve our planet needs deadlines, too. Waiting thirty years shows blatant disregard for our children and grandchildren. An Interim ROD issued in 1994 would require clean up go forward today, not backward from 2022

2. Soonest Operation Date to be Specified in Interim and Final Record of Decision: The Interim ROD would specify that the pumping and treatment facility be designed, constructed and tested to accomplish full operation by 2002. It allows that the pumping facility can be addressed first immediately after a water balance budget determines the maximum capacity for the facility, because a pumping plant would not have to change depending on the treatment technology chosen. The Interim ROD would also specify the schedule for the treatment facility in order to accomplish the fully operational end date of 2002.

3. Technology Development Process: The U.S. Department of Energy is currently funding a public private partnership to test treatment technologies for remediation of Berkeley Pit water (plus other applications). Efforts would be made immediately to obtain additional funding from EPA's SITE program or other research grantors so more than the current two to three technologies per year can be evaluated. The Interim ROD issued in the fall of 1994 would specify that such a research group work with EPA and an oversight council (or community working group) in the Extended FS stage:

- In late 1994, to call for new technologies internationally. Any organization interested in benefitting from extraction of metals from Butte's mine flooding must come forward with their bench-tested technology and results by a date no later than two years from date of the invitation (fall, 1996); or those who cannot afford to test and cannot find investors must quickly submit their technology to the research organization(s) for possible evaluation and testing (during the same two years) if the process shows potential.

- By end of the third year, the top one, two or three treatment technologies will have been selected from all submissions.

- By end of the fifth year, these top entries will have been pilot tested and further cost analyzed, with the most effective one technology selected and specified in the Final Preferred Plan and Final ROD issued in 1999.

- The Interim ROD will have specified that by the end of the fifth year (1999), the pumping plant will have been designed and constructed and that, in years six and seven (2000-2001), the treatment facility is designed and constructed.

- In year eight (2002), pumping and treatment begin. By the end of that year, de-bugging is completed and full pumping and treatment operations take place to hold the Pit water level at its 2002 elevation (or to reduce the elevation if that was required due to earlier sensitivity analyses).

E. West Camp

1. The Critical Water Level in the West Camp's Travona Shaft should be set lower than the Silver Bow Creek level of 5,410' where it exits the Summit Valley. EPA's Preferred Plan would make permanent the Travona Shaft's 5.435' CWL (critical water level). Therefore, the contaminated water in this shaft would tend to flow toward Silver Bow Creek because the creek is lower and there are no bulkheads to prevent it from flowing there.

It may be important for water in the West Camp to be kept at the same level as that in the East Camp to prevent the Pit water level from rising in the future if water pressure deteriorates one of the many flooded concrete bulkheads dividing the camps. These bulkheads were designed to save pumping costs by allowing West Camp waters to rise while dewatering continued for operations in the East Camp. There may be no bulkheads on upper levels. On lower elevations, depending on hydraulic head, they may not be adequate to withstand a water pressure reversal from rising of the more voluminous East Camp water.

Until the additional data is made available on locations of bulkheads and the stresses to them, the Interim ROD should at least require that the Critical Water Level in the Travona shaft (presently set by EPA at 5,435') be lowered to an elevation less than Silver Bow Creek's 5,410' elevation where it leaves the Summit Valley. The Interim ROD should specify that, depending on new data to be generated in the Extended RI, the Travona may immediately be pumped down farther and be maintained at the elevation of water in the East Camp.

2. Water-Quality: Treated mine water must comply with water quality regulations. Since 1989, EPA-DHES (Montana's Department of Health and Environmental Sciences) have allowed contaminated water to be pumped from the Travona to the Butte Metro Sewer (under a contract between the County and PRP's). State water quality

exceedences for arsenic and iron are thereby diluted through mixing with sewage. Under the Preferred Plan, the Agencies would continue this arrangement until the County finds they cannot comply with increasing standards for Silver Bow Creek and opts out of the contract. The Coalition believes the Agencies must insist on compliance rather than setting a bad precedent for potentially relaxing other water quality standards that may be important to recovery of a fishery. A treatment plant has already been designed as a contingency and should be put into operation as a requirement of the Interim ROD.

Source of contaminated water west of Butte in the Green Lake seep would be determined now. Quality sampling immediately should determine if that water is from the East or the West Camp, thereby helping to verify if East Camp water from the northwest portion of the Hill is, as the Agencies hope, draining toward the Berkeley Pit.

F. Financing

1. PRP's Must Provide Bonds Up-front for initial building costs, and to endow perpetual operation and maintenance, plus a special fund for upgrading treatment facilities.

2. Investment of Short-Term Savings in Treatment Technology Research and Development: Clean ups should proceed immediately after issuance of the ROD. In some extraordinary cases like the Berkeley Pit, it may be advisable to delay clean up for a reasonable time to actively develop new technologies (not wait hopefully for their development). When such a delay is selected, the savings on operating and maintaining a conventional treatment plant, and the interest earned on what would have been spent on construction, should be collected from the PRP and invested in developing new technology. If a new technology is developed that is wholly or partially funded by the PRP, the PRP would benefit from other applications.

The money that is saved annually from delay of dean up should be invested in reducing inflow to the Pit and researching and developing new technologies.

The Coalition calls on Montana's legislative delegation and leaders to help convince EPA to look seriously at this proposal. It reflects the thinking of dedicated engineers and scientists who have been involved with the Mine Flooding O/U for years, plus the wishes of affected residents, as clearly evidenced by over 10% of Butte citizens having signed a petition that EPA reduce the water in the Berkeley Pit and clean it up now.

G. Proposed Schedule to Reach a Final ROD

Document/Task	Completion Date
Call for New Treatment Research Funding	July, 1994
List of Private Wells/Implications	July, 1994
Sensitivity Study of Existing Data by EPA	August, 1994
Issue Alternate Plan for Public Comment	September, 1994
Issue Interim ROD (requires items below)	October, 1994
Call for New Treatment Technologies	October, 1994
Comprehensive Monitoring Program Implementation Begins	October, 1994
Additional Inflow Controls Implementation Begins	October, 1994
New Data Generated as in "A" above Re. water budget, modeling, sediments, etc.	October, 1996
All Bench Tested Technologies Received	October, 1996
Top Treatment(s) Selected for Pilot Testing	October, 1997
Pumping Facility Design and Construction Starts	October, 1997
One Treatment Selected for Preferred Plan	September, 1999
Issue Extended RI-FS	September, 1999
Issue Final Preferred Plan	November, 1999
Public Comment	
Issue Final Record of Decision	December, 1999
Design and Construction Starts for Treatment Facility	January, 2000
Completion of Pumping Facility begun in 1997	December, 2001
Completion of Treatment Facility	December, 2001
De-bugging of Pumping and Treatment Plant	
Pump and Treat Plant Fully Operable	December, 2002

Appendix

EPA Reliance on Assumptions, Theories and Speculation

As EPA knows, the extreme complexity of the Butte Hill defies easy answers to remediation of contaminated waters flooding the underground mines and the Berkeley Pit. EPA has investigated the problem almost from the day ARCO discontinued centuries-old pumping of the mine tunnels on Earth Day, 1982. However, EPA's RI-FS and Preferred Plan documents unveiled January 27, 1994 lack community support. Volume of contamination allowed in the Berkeley Pit in perpetuity is likely the most serious issue to face Butte. People lack confidence in EPA's plan because of its fundamental reliance on assumptions, theories and speculation, cumulative effects of which could be catastrophic to the community and the headwaters of the Clark Fork River.

A. Butte's Concerns

The people of Butte assumed that designation as a Superfund clean up site meant EPA would conduct a "clean up" to decrease volumes of toxic water and then discharge cleaned water in a timely manner. While watching the elevation of the Pit water rise, the people criticized EPA for taking ten years for studies. Then they were amazed to learn in April 1994 ads by the Clark Fork Coalition that EPA's preferred remedy would allow the elevation of contaminated water to rise to within feet of their basements before any of it would begin to be cleaned and discharged - in the year 2022 - another 28 years off. The people of Butte assumed that EPA would take into consideration their concerns:

- Decrease in values of homes near a 500 acre toxic lake; inability to sell homes
- Concern for purity of water from existing wells (without instituting well bans)
- Loss of the economic benefits of drilling one's own well; loss of rights
- Potential flooding of basements from possible saturation of alluvial aquifer
- Hazard to car and plane passengers as fogs spill out from the Pit
- Constant worry about land stability as the mines fill
- By remedy time in 30 years, much current knowledge about the site will be gone as old-timers die
- Future-unfriendly decision to require the next generation to implement a remedy
- Unfriendliness of saddling all future generations with a very short time in which to react to potential operation stoppages, whether due to economic collapse, social upheaval, war, weather, earthquake, etc.
- Potential benefits of developing a holistic approach to Pit remediation
- Loss of future minerals extraction opportunities as Pit floods
- Possible adverse effect on ability to attract new industries and health, etc. professionals
- Perpetual worries of downstream folks that toxic ground water will migrate there
- Downstream sites not cleaned up for over 30 years because of Pit delay.

B. Assumptions, Theories and Data Gaps

EPA bases its proposed Plan on its claim that all water that enters the Berkeley Pit is and will be contained permanently in the Pit. This claim is not a fact, but is an assumption.

The Coalition strongly urges that before a Record of Decision is issued, serious attention be given to the cumulative effects of the countless guesstimates, data gaps, assumptions, predictions, scientific and technical inadequacies, reliance on theories and opinions, and selective disregard for some of the nine legal criteria for choice of remedy that are employed in documents produced for this Operable Unit (O/U).

The Coalition believes the potential for error is vastly multiplied because of the great number of variables involved in the studies, lack of some data that could be made available, and near-exclusive reliance on Potentially Responsible Party (PRP) contractors vs. truly independent, highly qualified expertise. Although EPA is only required to protect human health and the environment from toxins, EPA must assume responsibility for causing individual and community economic hardships and creating a perpetual crisis mentality. EPA's preferred "remedy" to allow the Pit to reach 5,410' elevation and to wait 30 more years before treating water from the Pit and mine flooding (other than Horseshoe Bend) appears to be gravely flawed.

Some of the data that must be evaluated in the Sensitivity Analysis requested in the Community-Based Alternative Plan is listed below:

1. Ground Water - Pit Dynamics

- Modeling of ground water flow assumes constant head pressure at depth, a possibly naive assumption given Butt's intricate 3,500 miles of tunnels extending over a mile down from surface, along with elevated water temperatures at most deep levels, none at others (Neversweat shaft), and Butte's surface seasonal temperature effects on Pit water. Hydrology students employed by the Citizens' Technical Environmental Committee (CTEC) have cautioned that EPA does not have adequate information for modeling assumptions made. They have also provided EPA with cautionary information regarding limitations of models in decision-making and degree of dependability of models. A better idea of what is occurring at depth could have been obtained through computer modeling based on actual mine "stope" books. Despite a 10 year study that cost $10 million, these factual data were not reviewed.

- Write-off of bedrock aquifer: Public information on the decision to write off the bedrock aquifer has been inadequate. The intention not to clean up the water wasn't clearly conveyed to the community; justifications have not been provided to the Coalition, CTEC or other interested citizens. EPA evidently assumed that the public did not need to know about this loss in perpetuity of rights to aquifer water resources. The Coalition believes a public comment opportunity is necessary, especially since the decision originates from a new, organic contaminant-based EPA guideline that the Surgeon General's office indicated was to be rarely used. It would set a precedent for mining-related waste remediation. Many Butte people conjecture that this write-off is a critical link in ARCO's ability to allow the Berkeley Pit to fill and remain full forever. Modeling of the deep bedrock water was not adequate (assumed constant head pressure), and without additional knowledge of the dynamics of that aquifer, it is premature to write it off. Additionally, water in the Berkeley Pit portion is not ground water, but an EPA creation of a surface water impoundment. As such, it may not be subject to the "ground water" write-off guideline.

- Contamination releases ignored by EPA in RI-FS and Preferred Plan: EPA neglected to inform the community in the RI-FS or Preferred Plan for this O/U that contaminated bedrock water is exiting the Summit Valley via a "gaining" stream at the end of the Colorado Tailings.

EPA and DHES (Montana Department of Health and Environmental Sciences) state that as the Pit rises, water enters it more slowly. Inflow began at about 7,000 gpm, and is now at 5,000 gpm. But the agencies were unable to satisfactorily answer comment period questions about where the other 2,000 gallons go. EPA/DHES stated, "water cannot leave the Berkeley Pit, "water is pulled into the Berkeley Pit cone of depression and cannot exit." However, they recently acknowledged to the Coalition, "yes, poor quality water is upwelling from bedrock below the Colorado Tailings, but is probably not from the East Camp or the Pit in our opinion." The Bureau of Mines estimates that 95% of the water entering Silver Bow Creek at that point comes from the bedrock aquifer. The Coalition estimates that the Pit/East Camp bedrock makes up 90% of the Mine Flooding O/U. It includes a large cadmium plume according to data generated by the Natural Resources Damage Program.

The Silver Bow Creek Phase II RI Work Plan of 3/31/89 for the Area One O/U states on page 5 that the bedrock ground water system at the Colorado Tailings would be evaluated under Mine Flooding studies. This evaluation was not done. The Coalition was recently told that studies of water quality at the end of the Colorado Tailings are not thorough enough nor recent enough to determine whether or not Pit system water is involved, or if releases might be related to increased elevation/saturation of mine flooding. The Coalition is now told this mine flooding release does not exit within the Mine Flooding O/U, so would not be addressed until some future time under both Priority Soils and Streamside Tailings O/U's.

The Mine Flooding RI states that alluvial contamination follows ground water flow patterns; that ground water south of the Berkeley Pit flows toward Silver Bow Creek. The alluvial aquifer is contaminated along the length of the Metro Storm Drain and both north and south of it. Contaminated ground water from mine flooding is, therefore, being released into Silver Bow Creek at its confluence with Blacktail Creek. Releases due to mine flooding must be addressed under the Mine Flooding O/U and must be completely researched.

- Assumption that rate of Pit filling is decreasing is not proven by data: Equilibrium is not evident: If the Pit does stop rising, then water is escaping somewhere. Data from the Montana Bureau of Mines shows that water in the Berkeley Pit rose over two feet more during the one year period May-April 1994 than it did during the same period ending a year earlier (24.5' from 5/92 to 4/93 vs. 26.64' from 5/93 to 4/94). These numbers do not consider widening of the Pit as water rises, so even more water actually entered the Pit in the last year. Pit filling is not decreasing and water in the Pit could require pumping in less than ten years.

- Accuracy of Water Balance is questionable: Use of averages in RI-FS may cause underestimation of true amounts of water necessary to be diverted to control inflow. The 2.5 mgd (million gallons per day) from leaking municipal water supplies was not included in the water balance. Horseshoe Bend water was at a higher volume in 1989 than today (4 mgd then: 2.4 mgd in RI) and is said to have increased recently. The possibility of increased water discharge due to Planned expansion of the Yankee Doodle Tailings Dam another 60' in height has not been explored. The actual volume of water in the Berkeley Pit is unknown; therefore, there is no check, on what amount of water is possibly leaving the Pit through ground water. Unless an accurate water balance is developed, leakage would go undetected. If water is escaping now, large volumes could escape before the start of pumping. If it is impossible to develop a good water balance, it becomes critical that early precautions be taken - pumping and treating water as soon as possible.

- Arbitrariness of location of East vs. West Camp water divide: Without monitoring wells, the location of the water divide is unknown. For example, experts at the Bureau of Mines are not convinced the Moose drainage concludes in the East Camp. Decisions based on location of this divide should be questioned.

- Condition of bulkheads between east and West Camp is not known; yet EPA Plans to rely in perpetuity on these concrete barriers to keep water at higher elevations in the West Camp from breaking through to the East Camp and flowing into the Pit.

- Cones of Depression influences not projected: The Berkeley Pit cone of depression, combined with the one being created by the East Continental Pit, may create an exponentially larger cone of depression that can have enormous effects on ground water under neighborhoods not yet affected by contamination or dewatering. Loss of stream water near the Country Club would affect landowners there. Owners of homes built on formerly swampy land that dried after the Berkeley Pit began operating in the 1950's (e.g., St. Ann Street) fear that saturation of the bedrock aquifer may bring an influx of alluvial water to flood basements. Projected mining company Plans should be investigated to determine their potential to affect Berkeley Pit contaminant ground water migration. Without contingency Planning, at some point, control of Mine Flooding waters could be lost.

The area of influence of the Berkeley Pit cone of depression is said to take in the entire East Camp, or about 90% of the Mine Flooding O/U. The public was never given clear, scientifically sound data to explain EPA's position that the cone of depression's influence extends throughout mine tunnels that are lower than the surface elevation of the Pit water, let alone beneath the bottom of the Pit. In fact, the gradient into the Pit is unknown below the surface of the water.

- Impacts to alluvial aquifer largely ignored: Other than concern for migration of contaminants from the Pit. EPA/DHES have either assumed the alluvial aquifer will not be impacted by rising ground water, or they do not feel it is relevant to the remedy. Ted Duaime states that when the Bureau of Mines provided the Agencies with its opinion of the safety of the bedrock aquifer for the Preferred Plan, they were not asked to give an opinion on hydrologic impact to the alluvium. While they have no data to refute safety of the 5.410 elevation for the bedrock aquifer, they have no idea how the alluvial aquifer will react to having a saturated bedrock aquifer. Again, there is a possibility of wet basements.

- Induced infiltration potential is not adequately addressed in the documents. Can contaminated water from the hill or the cadmium plume beneath the old Silver Bow Creek bed travel south and contaminate private wells? If a new industry requiring high volumes of ground water came to Butte, could it pull contaminated water toward other wells?

- Potential Mine Flooding-related well bans were not clearly delineated. Though well bans were alluded to in that is in meetings held prior to the end of the public comment period for this O/U, there was no information about where such bans might be enacted, nor about any private wells possibly being closed. Consequently, affected residents could not comment on potential well bans. Some addresses of private wells tested are listed in the RI. In May, after close of the comment period, a GIS (Geographic Information Systems) map was shown to members of the County Water Quality Task Force, delineating contaminated alluvial aquifers. Two addresses listed in the RI as having exceedances of cadmium, among other metals, are outside the mapped boundary of alluvial contamination (1920 Elm, 1940 Oregon). It appears that data are still incomplete or inaccurate and, unless they are contacted individually, residents will remain unaware of any potential closure or ban on new wells.

EPA's Preferred Plan either assumes community acceptance or, as implied in the FS, a County zoning ordinance may implement ARCO-initiated well bans on private property. An ARCO-County contract calls for Institutional Controls such as Superfund-related wells bans. Under it, ARCO provided seed monies for the County to establish a task force to recommend whether or not a Walter Quality District should be formed to deal with post-Superfund well bans among other issues. After close of the comment period, the task force was shown the contamination map, but it was stated that no residential wells were expected to be affected. Without site-specific information, the community could not possibly have commented on well bans during the comment period for "community acceptance" criteria.

- Adequacy of studies is questioned by Dr. Bob Robins, an international expert on arsenic chemistry and environmental impacts of mine wastes. Dr. Robins' major points are:
  The Comprehensive Monitoring Program "should have been in place before now..."
  Geochemistry and hydrology are not completely understood at present
  Sediment study of the Pit is needed
  Strong microbiological study should be included in the comprehensive monitoring program
  A complete water balance on the whole Pit system is needed.

Dr. Robins states that data are not available to show the influence of the ground water on deep ground water. He does not believe a suggested upflow of deep groundwater from the bedrock into the Pit is realistic; rather, he believes a downflow of Pit water will be present.

<u>2. Legal - Unwarranted Waivers of EPA's Own Remedy Selection Criteria</u>

- Short-Term Effects
  An increase in contamination volume, toxicity and mobility from today's 25 billion gallons to 56 billion in 2022 is certainly notable.
  Impounding between 25 and 56 billion gallons of surface water in a toxic state over the next 30 years adversely affects in-stream flow.
  Massive impoundment may adversely effect potential uses by water rights holders. The Clark Fork River Basin is closed to new water rights because it is so short of water yet, here water would be impounded and made severely contaminated.
  Berkeley Pit water impoundment created by the Preferred Plan should have a beneficial use. None is evident. Pit water is not used by the active mining operation. It is surface "waters of the State of Montana" and should not be allowed to become more contaminated.
  Technical expertise and site-specific knowledge would now be unavailable at remedy time 30 years from now (due to human life span), requiring high cost of educating new players and higher potential for error.

Short-term disregard for intent and meaning of the term "clean up," as in "Superfund Clean up" vs. generation of a 56 billion gallon toxic lake. Preferred Plan is a postponement, not a clean up. Nothing is cleaned for 30 years.

- Long-term Effectiveness:
  Perpetual effectiveness of a lowered Pit level was not adequately researched due to assumption of excess cost (statement in Preferred Plan document).
  Cost of Preferred Plan may be underestimated: At under $60 million, it is less than the reported cost in 1973 of the pumping Plant in the Kelley Shaft which is now underwater.
  None of the alternatives address what will occur after 30 years.
  None of the alternatives discuss life span of the pumping and treating system and Acts of God, etc. that might interfere with operation in perpetuity.
  Use of metro sewage Plant to treat contaminated water from West Camp Mine
  Flooding disregards Long-term effectiveness requirements

- Water Quality ARAR's (Applicable Relevant and Appropriate Regulations) for Travona Mine exceedances and for bedrock aquifer discharges to Silver Bow Creek are not met

- Reduction of Volume, Toxicity and Mobility is ignored by allowing the doubling of Pit water volume, increasing toxic contamination and allowing water to reach the 5,410' elevation.

- Threat of Contamination Releases is increased, not reduced, at 5,410' level through potential energy of that volume, and weight of contaminated water seeking lower pressure outlets.

- Visibility standards of the Clean Air Act were not investigated for fog emanating from the Pit and its effect on safety of auto and air traffic.

- Assessment of negligible impact to water fowl resting on the Pit water relies on inadequate amount of research data and does not project impact when Pit is 500 acres and near surface level.

- New remedy selection criteria developed: Avoidance of litigation with PRP's joins cost to drive clean up decisions. EPA representatives have stated that ARCO threats of litigation prohibited them from changing their preferred remedy.

- Community Acceptance - Inadequate communication with the public: EPA assumed that citizens would spend whole evenings at technical meetings to learn about the Pit clean up Preferred Remedy. They assumed the media would accurately present the story to the public even though KXLF-TV reporters immediately complained (January 27 presentation to Butte-Silver Bow County Commissioners) that they did not know how to report on the Pit flooding when they were unable to understand it themselves.

EPA meetings emphasized diversion of Horseshoe Bend water, which is only a small part of clean up. They downplayed Pit water rising for 30 more years - the only thing most folks really care about. It took two of the three months of the comment period for CTEC and Coalition members to attain a fair understanding of the phenomenal amount of data released simultaneously on January 27 for public comment, and questions continue to be asked. The Coalition wrote EPA asking that they communicate on the few areas of greatest concern to the community, using prepared television messages and talk show appearances. EPA used the no cost shows, but the message continued to divert attention away from delayed clean up of the rising Pit. People were surprised to learn the truth about the Pit from Coalition and CTEC media interviews and from Coalition telephone polls ads, handouts, posters, speeches and events. A petition circulated by the Coalition was signed by over 10% of County residents through little more than three days effort. Whatever comment EPA received prior to the end of the official public comment period is undoubtedly slight compared to what it would have been if EPA had truly valued public input. EPA dated at the outset that they would not change their Preferred Plan without said technical or legal reasons to do so; thereby shutting out comment from all but a small elite group of engineers and mining professionals. Affected residents' opinions were not considered worthy by EPA. EPA wrongly assumes the public has the time, money and expertise to technically challenge a Preferred Plan they do not accept.

3. Inadequate Treatment Technology

- The Coalition believes that hydroxide precipitation should be eliminated from consideration immediately for lack of effectiveness. It would either inefficiently re-treat the same minerals perpetually (Pit disposal) or generate a new Superfund toxic waste site with only 5% to 7% less waste volume than the original volume before treatment. Inadequate consideration was given in the screening phase to other effective treatment technologies, apparently because cost was given predominance over effectiveness. The cost estimating process relied on one individual's "best guesses," some of which have been challenged as artificially high. The review did not comprehensively evaluate alternate combinations of treatment phases. ARCO states new technologies are welcome only if they cost less the 1800's-era lime treatment, lending the impression that EPA weights cost more than other criteria. Ultimately, the people of Butte must take on the burden of finding the most effective, cost-sensitive technology. EPA must rescind their choice of lime treatment and insist that ARCO and Montana Resources accommodate public and private research by providing on-site access to Pit and Mine Flooding waters and indemnify those pursuing solutions today.

4. Inflow Control

- Inadequate Plan for diverting clean water inflow from Mine Flooding and Pit: Horseshoe Bend's 2.4 mgd of acidic water is the only inflow to be diverted from the Pit and Mine Flooding in the Preferred Plan. Approximately 2.5 mgd of clean water is leaking from the municipal water system, but was ignored in percolation assessments and remediation Plans. Precipitation runoff from the Butte Hill has being diverted to the East Camp/Pit under Expedited Response Action by EPA. Water presently runs down the Moose drainage and settles on top of the Green Mountain mine shaft which is inadequately covered. While storm water runoff is part of another O/U, the above named water are part of, or are purposely being diverted to, the MineFlooding O/U by EPA. These and any other controllable inflows should be cleaned and discharged under the Mine Flooding O/U rather than waiting many additional years to be addressed under Priority Soils.

5. Human Health Concerns:

- Organic contaminants under leach pads not addressed in RI-FS or Plan: Former Anaconda Company employees have indicated that the dumping grounds for Company-generated contaminants are now covered by leach pads in the active mining operation. These contaminants include solvents, acids, used grease and oil, and other organics. Given the gradient toward the Berkeley Pit from the leach pads, these contaminants are likely to be entering the Mine Flooding system, yet, have not been investigated in the RI-FS. The Agencies have assumed that the contaminants are diluted and, therefore, not significant. More likely, they are DNAPL (dense non-aqueous phase liquids), seek low elevations, and have sunk to the bottom of the Pit.

- Air Quality investigations were not conducted in the RI. Studies in the latter part of this century have shown that human health in the headwaters of the Clark Fork River has suffered from long-term disease designations of "highest in the nation per capita" for "all diseases," "lung disease" and "heart disease," as cited in Luoma and Moore's 1990 paper **1**. A high incidence of lung disease was found in women as well as men, indicating air quality problems outside of the mines. There are no very recent studies, so it is not known if high incidence of disease continues. If disease is related to metals particulate, should sources of dust, such as Pit walls, be sealed or capped? Regardless of the water level ultimately left in the Pit, there would still be bare soil. EPA's RI also did not address citizen inquiries listed in a 1990 Mine Flooding Responsiveness Summary concerning possibility of toxic gas emanating from rising toxic mine and Pit water.

6. Future Discounted

- Inadequate consideration for perpetual technology requirements, operation and maintenance: Given the comparatively short 200-year history of the United States and the burden of pumping and treating water forever, EPA's Preferred Remedy appears not to have sufficiently weighted the following assumptions: Assumes money will be available for perpetual operation and maintenance by allowing ARCO to self-insure forever; assumes this relatively young corporation will exist forever.

In selecting the remedy, EPA considers only the first 30 years' costs; yet, the remedy would not be implemented until after that 30 years. EPA assumes that dollars will be adequate for perpetual operation. Assumes no earthquake impacts to the perpetually operating treatment Plant Claiming to protect human health, this remedy makes it undesirable for humans to continue to live in their traditional homes within blocks of the nation's largest body of toxic water.

- Variables that could cause uncontrolled filling of the Pit in the future:
  Assumes that maintaining the Pit at 5,410 feet, only 50 feet below the problem level, is an adequate margin of safety. This allows only two years (at the current fill rate) for future generations to recover from Acts of War, Acts of God, economic, or other disasters before toxic water reaches the alluvium.
  Assumes negligible earthquake impact on Yankee Doodle Tailings Dam from a 6.5 Richter maximum earthquake. With three faults passing under this Dam and EPA reliance on a questionable dam safety study, this assumption is considered foolhardy by many observers who believe it is more responsible to assure future residents that Pit void space is not displaced by tailings from a higher than average earthquake.

The Preferred Remedy relies on an enormous number of individual assumptions, predictions, estimates, models and opinions that could be wrong in varying degrees. The cumulative effect of relying on an overwhelming number of non-absolutes could be disastrous to the Butte community. While the Coalition would like to support a good Plan, it is not convinced EPA's Preferred Remedy is a satisfactory answer. An alternative that reduces water in the Pit is wanted by Butte residents: the Community-Based Alternative at least assures positive progress toward remedy beginning in 1994.

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[1] "Hazardous Wastes From Large-scale Metal Extraction: The Clark Fork Waste Complex, MT," Johnnie Moore, Dept. of Geology, Univ. of Montana, Missoula and Samuel N. Luoma, U.S. Geological Survey, Menlo Park, CA; V.J. Watson (Ed). Proc. 1990 Clark Fork River Symposium, Montana Academy of Sciences, pgs. 163-188.

DEPARTMENT OF HEALTH AND
ENVIRONMENTAL SERVICES

REPORT NUMBER RTC5003

BUTTE MINE FLOODING OPERABLE UNIT
REMEDIAL INVESTIGATION / FEASIBILITY STUDY

Public Comment to Preliminary Draft Feasibility Study Report

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Robertson Technologies Corporation

April 27, 1994
Project Number RTC5003

The Superfund Program
State of Montana
Department of Health and
Environmental Services
Steamboat Block Building
616 Helena Avenue
R302-Helena, MT 59620

Attention: Mr. James O. Scott
Environmental Specialist

Dear James:

RE: BUTTE MINE FLOODING OPERABLE UNIT REMEDIAL INVESTIGATION / FEASIBILITY STUDY

Further to your discussions with Rhino Rohrs, please find enclosed our report, as a public response to the above mentioned feasibility study. Would you please forward this document to the correct party.

Yours truly,

ROBERTSON TECHNOLOGIES CORPORATION

Andy MacG. Robertson, P. Eng.
Chairman

AMG:ctw

ENCLOSURE

Report Number RTC5003

BUTTE MINE FLOODING OPERABLE UNIT
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Public Comment to Preliminary Draft Feasibility Study Report

Prepared for:

The Superfund Program, State of Montana
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APRIL, 1994

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INTRODUCTION

Robertson Technologies Corporation, by submitting this response, would like to raise public comment regarding the BMFOU Remedial Investigation/Feasibility Study Preliminary Draft Report compiled by Canonie Environmental Services Corporation. The report identifies eight potential treatment technologies which survived the initial screening process. These treatment technologies were then subjected to a treatability study and final screening.

The conventional treatment for acid mine drainage is correctly identified as neutralisation only in the report, most often with lime, and more specifically a two stage lime/limestone precipitation process including aeration.

This treatment results in a saturated solution of calcium sulphate which is highly scaling and which poses a serious risk to subsequent polishing processes. In this regard, the selection of reverse osmosis, as a primary candidate for the polishing technology, involves serious complications.

Firstly, it is necessary to include a softening process step in order to pretreat the effluent to prevent scaling of the membranes.

Furthermore, additional pretreatment in the form of pH adjustment, chlorination dechlorination and filtration would be required in order to avert damage to the membrane surfaces and a corresponding drop in performance, resulting in possible failure after only a short lifetime of duty. All these factors add a major incremental component to the cost of pretreatment and treatment.

In the extreme case, if pretreatment is not conducted correctly, it will be necessary to replace membranes at frequent intervals, thereby incurring substantial operating, replacement and maintenance costs. In addition to this, the process performs poorly, with low water recovery and product water quality. We therefore suggest that reverse osmosis is unsuitable as a polishing treatment step.

PROCESS DEVELOPMENT

We would like to introduce an ion exchange process that was developed in South Africa specifically to deal with problematic chemical effluents arising from acid mine drainage situations.

An intensive research and development study was undertaken by Johannesburg Consolidated Investment Ltd. ("JCI"), (a major mining company) at an operating mine, in order to address this specific problem. The initial approach taken for this study was similar to that outlined in the feasibility study draft report.

After considerable experience had been gained with reverse osmosis technology on pilot scale it was finally rejected for the reasons given above, being mainly the additional cost of feed pretreatment and membrane replacement. Instead JCI concurrently pursued the development of a new technology, and this has now been tested exhaustively on pilot scale. This process is now at a technically advanced stage, ready to be applied at full scale in a reference plant.

The outcome of this intensive R & D campaign is the newly patented GYP-CIX process. GYP-CIX was specifically developed to overcome the problem of acid mine drainage by bulk desalination of the effluent. This had hitherto not been technically successful, due to the scaling effect of calcium sulfate or the cost of pretreatment to get the solution into an acceptable quality in order to desalinate by reverse osmosis.

The GYP-CIX process is therefore specifically designed to suit the treatment technology required for the Berkeley Pit water. In the GYP-CIX process, the costs are held to a minimum by the use of cheap and readily available lime and sulphuric acid as reagents to regenerate the anionic and cationic resins for recycling through the process.

PROCESS TECHNOLOGY

GYP-CIX technology is based on a continuous counter current ion exchange process and has been developed for the purpose of addressing the problem of calcium sulphate saturated effluents. The Feasibility Study Preliminary Draft Report states that "ion exchange was rejected because the same level of treatment could be achieved with reverse osmosis, but at a lower cost".

This statement would ordinarily be correct for the polishing step only (not for overall treatment). However, the novelty of the GYP-CIX process lies in the use of alternative regeneration reagents, specifically lime and sulphuric acid, which are low cost reagents, used to regenerate the ionic resins for recycling through the process. This innovation for resin regeneration has considerably reduced the cost of ion exchange treatment, so that the overall operating and maintenance cost are lower than those of reverse osmosis, when used as a polishing step (which requires softening and other steps mentioned above to reduce the plugging index to within acceptable limits).

The use of lime, only, as a neutralisation medium for acidic mine effluents results in a highly scaling effluent that cannot be reused as process water and, if discharged to the environment, results in an unacceptably high salt load being discharged into the natural water course. To date this method has been the only solution for acid mine drainage, as the existing desalination processes available have either failed technically or been too costly. The GYP-CIX process has been developed specifically to address the problem of saturated calcium sulphate effluents generated in the mining industry.

The process also simultaneously removes metals and other dissolved salt contaminants commonly present in acidic mine effluents and which are not removed to satisfactory levels by the current liming method. Residual metals and radioactive contaminants, such as radium and uranium, (and other elements, e.g., strontium, arsenic and manganese) are also simultaneously reduced substantially, usually to levels below that required by the Drinking Water Standard.

The patented GYP-CIX process has successfully shown that the problem of pollution from acid mine water can be controlled by the bulk desalination of the effluent at low cost. This has been proven by the operation of a 1 m3/hr pilot plant which has been tested and proved on actual mine waters over a period of some three years.

THE GYP-CIX PROCESS

The conventional ion exchange process for the purification of waters and the normal requirements for expensive reagents such as NaOH and HCI for resin regeneration, as well as the undesirable production of concentrated soluble waste products, is well known and is the reason that ion exchange was rejected in the Canonie report.

We wish to present new technology that can be applied specifically to acid mine drainage, including a description of the key factors of this technology, which avoids the problems mentioned, and which make the GYP-CIX process worthy of inclusion in a test program for both technical and economic reasons.

The process, which is continuous, uses counter current ion exchange technology (CIX) for resin loading, while resin regeneration is conducted on a batch basis. The use of sulphuric acid and lime for resin regeneration enables a low cost approach to mine effluent desalination, which, coupled with a high water recovery is an economic solution to the problem of scaling effluents.

The use of alternative chemicals such as sulfuric acid and lime would present the lowest cost method for regeneration. However, the use of these chemicals has been precluded in the past as a consequence of the practical problems arising from fouling of the resin with calcium sulfate, eventually reducing the useful life of the resin to such an extent that resin replacement would become too expensive.

The problems associated with the use of these chemicals have been overcome by the use of a specially designed fluidised bed that enables the deliberate precipitation of gypsum in the regeneration reaction, without fouling of the resin ion exchange beads. The chemical reactions in the GYP-CIX process are shown in Fig. 1 for the loading and regeneration steps of cation and anion resins loaded with calcium and sulphate respectively.

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With the use of the low cost chemicals mentioned above, the production of gypsum in the saturated regeneration solution, and the unique properties of the expanded fluidised bed of resin to be regenerated, the process has been successfully chemically engineered. It has been extensively tested in long run tests to prove fouling does not occur, and the process is now patented.

The production of gypsum during regeneration allows for the discharge of the waste product as a slurry, thereby reducing disposal problems. With a high water recovery and hence, a low volume of waste to be disposed, zero discharge conditions are attainable.

PILOT PLANT TESTING

To evaluate the long cycle effects on the process, a pilot plant with a capacity of 24 m3/day was commissioned and has been operated successfully on acid mine waters from an underground mine for almost three years. A flow diagram of the pilot plant is given in Fig. 2.

Resin Loading

The feed water is pumped to the cation loading section, where it flows by gravity through multiple upflow fluidised bed contactors or stages. The strong acid cation resin (SAC) is airlifted between stages counter-current to the water flow. The number of stages employed depends on the concentration of salts to be removed and on the level of purity of the product water required. The dacationized and decarbonated water is then pumped to the anion loading section which contains multiple fluidised stages of weak base anion resin (WBA). The mechanical operation of this section is the same as for the cation loading section. The use of fluidised beds in the loading section enables unfiltered feed water to be used in the process. The flow of feed and product water is continuous and uninterrupted.

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The continuous counter-current technique used for cation and anion loading is well known, commercially proven, cost effective and very suitable for the treatment of large volumes of water. The use of the horizontal loading cascade enables easy plant maintenance, while plant control is facilitated. Maintenance of the loading cascade can easily be carried out by passing the particular loading contactor or stage, without interrupting the plant operation.

The resulting product water is at a neutral pH, low in calcium (« 100 mg/l) and sulfate (« 250 mg/l) and other heavy metal ions and is non scaling and meets effluent discharge specifications. It is possible to engineer the process to produce a water quality of Gold Book or Drinking Water quality Standard Regeneration of Loaded Resins

The novelty of the GYP-CIX process is in the resin regeneration technique and the planned production of gypsum as a solid waste product. A single stage batch regenerator is used, while regenerants are recycled to achieve maximum utilisation of chemicals.

Cation Resin Regeneration

The fully loaded cation resin is airlifted out of the loading section into a batch regenerator, where it is contacted with a 5% sulfuric acid solution, seeded with gypsum crystals, which is recirculated from a stirred tank. The acid strength in the regeneration solution is controlled by a conductivity controller, linked to a concentrated acid dosing pump.

The solubility of calcium sulfate is low and as soon as the solubility limit is reached calcium sulfate will precipitate as gypsum. The precipitation of gypsum is enhanced by adding gypsum crystals as seeds to act as precipitation nuclei to avoid the formation of supersaturated solutions.

When the resin regeneration is completed, the precipitated gypsum slurry is washed out of the resin bed by a clarified overflow from the settler. The gypsum precipitate is concentrated in the settler and discharged from the settler underflow as a thick slurry.

The washed resin is transferred to a resin rinse vessel, where the regeneration solution is rinsed from the resin pores using fresh feed water. The resin rinse can be conducted on the twice used principle in a conventional packed bed in order to conserve rinse water. The regenerated and rinsed resin is then resumed to the product end of the cation loading section.

Anion Resin Regeneration

The regeneration of the loaded anion resin is achieved with lime. To overcome the low solubility of lime a 2% lime slurry is used, which is again seeded with gypsum crystals. This slurry is recirculated from a regenerant tank, in which the strength of the lime slurry is controlled by a pH controller that is used to dose 10 % lime slurry from a bulk regenerant tank.

The anion regeneration also produces gypsum which is removed from solution by settling and finally discharged as a slurry waste. The continuous precipitation of gypsum in solution in both the anion and cation sections, allows the regeneration solution to be reused for subsequent regenerations without a build up of the stripped ion in solution, which further minimises reagent consumption.

The anion resin is washed using clarified overflow from a settler to remove precipitated solids and is then rinsed using final product water in a similar fashion to the cation resin. The freshly regenerated resin is then returned to the anion loading section at the product end.

RESULTS OF PILOT PLANT OPERATION

The feed water to the pilot plant consists of acid mine water from a producing mine pumped from underground, which has been limed and clarified. The feed water has the typical salt concentration given in Table 1:

TABLE 1
Typical Feed and Product Water Concentrations

Parameter	FEED	PRODUCT
TDS	3000 mg/l	500 mg/1
TSS	25 NTU	25 NTU
pH	6 - 8	6 - 8
Calcium	500 mg/l	< 50 mg/l
Magnesium	100 mg/l	< 20 mg/l
Sodium	400 mg/l	< 100 mg/l
Potassium	10 mg/l	< 5 mg/l
Sulfate	1200 mg/l	<200 mg/l
Chloride	250 mg/l	< 50 mg/l
Nitrate	60 mg/l	< 10 mg/l
Phosphate	5 mg/l	< 1 mg/l
Fluoride	10 mg/l	< 5 mg/l
Alkalinity	200 mg/l	< 50 mg/l
Radium	30 pC/l	< 1 pC/l
Uranium	1000 ppb	< 20 ppb

Resin Fouling

Irreversible resin fouling by iron, silica, and organics would add substantially to the operating coat and limit the desalination performance of such a process. After the equivalent of one year of continuous operation, no detrimental signs of resin fouling have been detected. The expected lifetime of the resin is 10 years or a replacement rate of 10 % per annum.

Calcium Sulfate Scaling of Resin Beads

Electromicrographic examination of the resin beads show no presence of calcium sulfate either on the surface or inside the beads after 500 cycles of loading and regeneration.

Resin Capacity

The total capacity (Figs. 3a & 3b) as well as the loading kinetics (Figs. 4a & 4b) for the resin beads were tested at regular intervals and no drop in performance was noted. The working capacity of the strong acid cation resin was typically 55% and for the weak base anion resin 85% of the total capacity respectively. These values are typical for continuous ion exchange processes.

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Resin Loss/Breakage

On average the rate of resin loss due to breakage of beads was about 10% per annum for the macroporous styrenic cation resin and approximately 5% per annum for the acrylic anion resin.

The higher loss for the cation resin was as expected due to the bead having less resistance to attrition. This resin loss is normal and well within the limits for counter-current ion exchange applications.

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Product Water

The typical plant product water analysis is given in Table 1. In addition to the low levels of calcium and sulfate, a significant reduction in radioactive elements such as radium and uranium was achieved. Residual metal values, such as iron and manganese were also removed to low levels in the plant.

Water Recovery

The pilot plant achieved an average water recovery above 90%. This figure could be further improved if recycle of waste supernatant is employed.

COMPUTER MODELING

A computer model has been designed, based on data accumulated from the pilot plant study. This model has been found to simulate the performance of the pilot plant accurately. The computer model has been run for the full scale application for 2.40 and 8.48 mgd on Horse Shoe Bend and Berkeley Pit water analyses supplied in the Canonie Environmental Treatability Sampling and Benchscale Testing Report', in order to assess the reagent requirements and technical performance data, where the operating cost comparison is important.

The GYP-CIX plant requires a minimum of pretreatment, only liming of the effluent to pH 10.2 is considered necessary, as per test work conducted by Canonie Environmental and the Montana State Department of Health and Environmental. The other requirements of feed filtration, pH adjustment and chlorination are not critical and may not be necessary at all.

The water quality after liming to pH 10.5, the required feed to the GYP-CIX plant and the water quality after treatment are given in Table 2.

The product water from the GYP-CIX plant will meet Gold Book criteria and hence no further treatment would be required.

It is suggested that the water quality achieved will be sufficient to reuse the water as a potable water quality resource. The water can also be reused as process water or as a drinking water supply for which a dollar value can be determined to cover the cost of treatment and, depending on local water costs, should offer a profit margin.

The model predicts that a water recovery in excess of 92 % can be achieved, however this can be further improved if waste recycle is employed.

TABLE 2

Plant Feed and Product Water Quality

Parameter	FEED LIMED pH 10.3	GYP-CIX PRODUCT
TDS	4500 mg/l	500 mg/l
TSS	25 NTU	25 NTU
pH	10.2	8 - 8.5
Calcium	1220 mg/l	< 150 mg/l
Magnesium	17 mg/l	< 17 mg/l
Sodium	73 mg/l	< 70 mg/l
Potassium	7.5 mg/l	< 5 mg/l
Sulfate	3147 mg/l	< 500 mg/l
Chloride	25 mg/l	< 25 mg/l
Nitrate	26 mg/l	< 10 mg/l
Alkalinity	100 mg/l	< 50 mg/l

METAL RECOVERY AND WASTE PRODUCT DISPOSAL

Due to the low concentration of base metals in the Berkeley Pit water and the low commodity value of these metals, no economic opportunity for recovery of valuable metal products would appear viable. Therefore the technology to recover metals has not has been examined. The metal values would report to the sludge as a precipitate. The water that can be recovered from the Pit is considered to be the most valuable commodity and it is here that efforts will be concentrated to recover economic value.

The only waste product produced by the process is the gypsum sludge generated in the regeneration reaction. Approximately 415 000 gpd of gypsum sludge will be produced by the plant. The gypsum sludge is a highly immobile salt form, due to the very low solubility of gypsum in water. The gypsum sludge can be filtered to a moist cake, if required, and disposed to a scheduled site, where it is anticipated that an impoundment liner will not be required.

The wet gypsum sludge from the underflow of the regeneration clarifier can be disposed of directly back into the pit, if acceptable, where it would not resolubilise. This would be a very inexpensive option for disposal.

NEED FOR DEMONSTRATION

The novelty of the GYP-CIX technology lies in the use of alternative cheap reagents, sulphuric acid and lime for regeneration of the resin, thereby limiting the overall treatment cost. The cost of reagents contributes more the half (70 %) of the final overall treatment cost. The process produces a solid waste, which considerably eases disposal problems. Many other novel aspects are included in the detail of the process design, and a complete systems approach has been adopted.

The process has been fully demonstrated on an integrated pilot plant operation over three years. This operation was successful in that no fouling of the ion exchange resin was observed and the plant performed within the design parameters. It is therefore considered that an additional pilot plant stage is not required and that the process is ready for commercial application.

It is, however necessary to introduce a reference plant, so that the technology can be demonstrated on a large scale to successfully desalinate acid mine water. The Berkeley Pit water limed to pH 10.2 is ideally suited for the process demonstration.

PROPOSAL

We propose that a full feasibility study be commissioned for a GYP-CIX reference plant to be constructed to demonstrate the technology on the Berkeley Pit water.

This feasibility study could include Horseshoe Bend water, the alluvium or run off water to delay the time that the Critical Water Level is reached.

LEGAL AND BUSINESS ISSUES

Patent Status

Johannesburg Consolidated Investments Limited is a publicly listed company in South Africa with diverse interests in gold, platinum, uranium and coal mining as well as commercial and industrial ventures. They are one of the five large mining groups with an asset base in excess of $1,000 million.

Chemical Effluent Treatment Process (Pty.) is a wholly owned subsidiary of JCI.

The Technology for the GYP-CIX process is the property of:

CHEMICAL EFFLUENT TREATMENT (PTY.) LIMITED [CHEMMEFFCO]
Cnr. Fox & Harrison Streets
Johannesburg, South Africa

A patent for the proprietary technology used in the GYP-CIX process has been granted in South Africa.

A patent has been applied for in the USA. This patent application has been allowed.

Other Contracts or License Agreements

ROBERTSON TECHNOLOGIES CORPORATION is the exclusive licensed distributor of the GYP-CIX technology for Canada, the United States of American and Mexico.

Robertson Technologies Corporation is a 100 percent owned subsidiary of Steffen, Robertson and Kirsten International Group of Companies, an international mining, geotechnical and environmental consulting group. In the USA, SRK has branches in Reno. Nevada; Denver, Colorado; Redmond, Washington; and Columbia, South Carolina.

This report, Project Number RTC5003, Butte Mine Flooding Operable Unit Remedial Investigation/Feasibility Study, has been prepared by:

ROBERTSON TECHNOLOGIES CORPORATION
Andy MacG. Robertson, P. Eng., Chairman

APPENDIX A

Cost Estimate for Full Scale Application

FULL SCALE COST ESTIMATE

The cost estimate is based on the designs and cost estimates completed for four different plant sizes. From these estimates a regression formula was derived, whereby the capital cost of the plant could be estimated for any plant size and any salt load. Furthermore, the capability exists to do design studies and cost estimates for any plant size for any application, where the feed and capacity can be defined.

OPERATING COST

The operating cost has been estimated using the available commercial information for the cost of chemicals, power, labour etc. The operating cost has been estimated as follows, broken down by subheading:

1.	Chemicals			2.40
	Sulphuric acid	(6.8 kg/m3)	$ 50/ton	
	Lime	(4.8 kg/m3)	$ 60/ton	
2.	Resin replacement			0.18
	Cation resin	$ 2000 /m3		
	Anion resin	$ 5000 /m3		
3.	Power	$ 0.04 /kWhr		0.19
	TOTAL	$/1000 US gal		2.77

For 2.4 million gallons per day (gpd) this amounts to an annual cost of US $2.43 million pa. This estimate excludes the cost of neutralisation pretreatment.

Labour for the plant can be provided on a shared basis with one operator and one supervisor required per shift. The maintenance costs are likely to be low as the plant consists primarily of tanks, pumps and valves.

CAPITAL COST

This figure includes allowances for the following items:

- Full hardware inventory design, procurement and erection;
- All computer software to run the plant;
- An initial resin inventory; and
- Engineering design.

The total cost of the complete 2.4 million gallon per day installation would be approximately US $7.0 million without contingency. This order of magnitude cost estimate has been verified by an independent cost estimate by Kilborn Engineering Pacific Ltd. which in included in Appendix B.

This estimate is an order of Magnitude estimate (OME) and is accurate to with + 25% - 10%.

The total cost of the complete plant for a total of 8.48 million gallons per day would be approximately US $10.0 million.

APPENDIX B

Mine Water Treatment Project
Order of Magnitude Cost Estimate
by
Kilborn Engineering Pacific Ltd.

1.0 CAPITAL COST ESTIMATE

1.1 CAPITAL COST SUMMARY

The estimated initial capital costs required for the proposed plant are $ 8,473,000.

This figure has been rounded to the nearest thousand dollars. Details of the estimate are presented at the end of this section. The estimate was prepared for Robertson Technologies Corporation (RTC) by Kilborn Engineering Pacific Ltd. (Kilborn). The opinions, judgements and assumptions provided herein are based in part on information provided by RTC. While Kilborn has used its best efforts to provide relative costs based on the information provided. It should be understood that this is considered to be an Order Of Magnitude Estimate with an accuracy to within ±25% at the summary level. All costs are expressed in second quarter 1994 US dollars without inflation allowance.

1.2 BASIS OF PRELIMINARY ESTIMATE - INITIAL CAPITAL COSTS

1.2.1 Scope Definition

The work scope for the capital cost estimate is based on preliminary drawings and quantity take-offs from a similar plant in South Africa, adjusted to climatic conditions in Butte, Montana. Kilborn has allowed for a pre-engineered building over the process area to prevent freeze-up in winter and to protect drives and motors. Battery limit is considered to be the fenced area shown on Drawing HBA130040009 REV A.

The estimate covers capital costs beginning with the start of detail engineering and continuing until the completion of the initial construction and start-up of the facility.

1.2.2 Material Quantities

Equipment sizes & quantities as well as quantities for construction materials were extracted from the quantity take-off provided by RTC for a similar plant in South Africa. Kilborn has added a building over the process area. Where it was not possible to develop quantities from the information provided, allowances were made based on Kilborn's experience on similar projects and adjustments were made to reflect the most current information on this project.

1.2.3 Pricing Basis

Unit prices for constructed facilities were developed based on Kilborn's experience on similar projects and adjusted to this project scope, location and date.

All equipment and materials are assumed to be purchased new.

1.2.4 Labor Rates

For the purpose of this preliminary estimate the average composite project labor rate is assumed to be $ 35.- per hour. This includes supervision, small tools, overhead & profit and is based on a standard work week of 40 hrs with no allowance for overtime. It is assumed that all work will be done by qualified Contractors on a continuous construction program with no work interruptions.

1.2.5 Construction Indirects

The estimated construction indirect costs cover:

- Contractors' mobilization and demobilization;
- Contractors' bonding and insurance;
- General site costs and clean-up requirements;

1.2.6 Engineering, Procurement and Construction Management

The cost for engineering procurement and construction management is factored on the direct costs for this project based on average costs for these services.

1.2.7 Contingency

Contingency is included in the preliminary capital cost estimates at 20 % of total estimated cost.

The contingency is intended to cover the cost of items included in the scope of this study which cannot be specifically delineated at this stage of project development. It is not an allowance for scope changes, or price escalation. In our estimation, the contingency allowance will be spent.

1.2.8 Qualifications

The estimate is based on construction work being executed by qualified contractors mainly through firm price contracts.

1.2.9 Exclusions

Specific exclusions from the estimate are:

- Cost of financing and interest during construction;
- Provisions for future expansion;
- Specific exclusions as defined in the line items of the estimate details.
- Primary power supply, substation and feeder to the electrical room.
- Water supply to the plant.
- Feed line of mine water to the plant.
- Discharge lines for product water and gypsum slurry from the plant.
- Any settlement or holding ponds which may be required.
- Telephone system.
- Sewage treatment and discharge lines.
- Owners costs (such as management costs, land costs, permits, etc.)

1.3 INITIAL CAPITAL COST ESTIMATE DETAILS

The estimate details for the initial capital costs begin overleaf.

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1380 Burrard Street
Vancouver, B.C.
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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
MAJOR AREA SUMMARY REPORT

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AREA	ITEM	DESCRIPTION	TOTAL MHRS	LABOR COST	MATERIAL COST	SUBCONTRACT COST	TOTAL COST
100	DIRECT COSTS		32,945	1,153,085	2,258,798	1,721,600	5,133,483
700	INDIRECTS		0	0	750,000	1,177,000	1,927,000
800	INDIRECTS		0	0	0	0	0
900	CONTINGENCY		0	0	0	1,412,000	1,412,000
		PROJECT TOTAL	32,945	1,153,085	3,008,798	4,310,600	8,472,483

Kilborn Engineering Pacific Ltd. MINE WATER TREATMENT PLANT 22 April 94
1380 Burrard Street ORDER OF MAGNITUDE CAPITAL COST ESTIMATE Page:
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9999-99 AREA SUMMARY REPORT C:SRK-WT_1.DBF

AREA	ITEM	DESCRIPTION	TOTAL MANHOURS	LABOR COST	MATERIAL COST	SUBCONTRACT COST	TOTAL COST
DIRECT COSTS							
20	CIVIL		4,413	154,458	140,978	0	295,436
30	STRUCTURAL AND BUILDINGS		7,035	246,208	508,595	1,309,000	2,063,803
50	MECHANICAL EQUIPMENT		1,555	54,425	326,100	0	380,525
60	PLATEWORK		14,857	519,987	867,910	0	1,387,897
70	PIPING		3,396	118,857	215,915	0	334,772
80	ELECTRICAL		1,690	59,150	199,300	0	258,450
90	INSTRUMENTATION		0	0	0	412,600	412,600
		SUB - TOTAL	32,945	1,153,085	2,258,798	1,721,600	5,133,483
INDIRECTS							
710	CONSUMABLES		0	0	750,000	0	750,000
720	CONSTRUCTION INDIRECTS		0	0	0	308,000	308,000
730	EPCM		0	0	0	719,000	719,000
740	STARTUP & COMMISSIONING		0	0	0	150,000	150,000
		SUB - TOTAL	0	0	750,000	1,177,000	1,927,000
INDIRECTS							
800	OWNER'S COSTS		0	0	0	0	0
		SUB - TOTAL	0	0	0	0	0
CONTINGENCY			0	0	0	1,412,000	1,412,000
900		CONTINGENCY					
		SUB - TOTAL	0	0	0	1,412,000	1,412,000

AREA	ITEM	DESCRIPTION	TOTAL MANHOURS	LABOR COST	MATERIAL COST	SUBCONTRACT COST	TOTAL COST
		PROJECT TOTAL	32,945	1,153,085	3,008,798	4,310,600	8,472,483

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

22 April
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AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBCONTRA UNIT COST	
CIVIL											
20	1.00	GRADING & CLEARING SURFACE AREA	2,520	M2	0.040	101	3,528	0.90	2,268		5,796
20	2.00	EXCAVATE .2MD FOUNDS BY M/C	210	M3	0.150	32	1,103	4.00	840		1,943
20	3.00	EXTRA OVER TO EXCAVATE IN ROCK	28	M3	0.400	11	392	20.00	560		952
20	4.00	EXCAVATE - 1M FOUNDS BY HAND	275	M3	1.400	385	13,475				13,475
20	5.00	15MPA 50 MM THICK BLINDING	145	M2	0.250	36	1,269	11.00	1,595		2,864
20	6.00	25MPA REINFORCED CONCRETE FLOOR ON GROUND	305	M3	5.000	1,525	53,375	209.00	63,745		117,120
20	7.00	200 MM BLOCK WALL FOR CONTROL ROOM	295	M2	1.600	472	16,520	36.00	10,620		27,140
20	8.00	DOORS, WINDOWS, FINISHES, ETC. FOR CONTROL ROOM	1	SUM	30.000	30	1,050	5,000.00	5,000		6,050
20	9.00	30 MPA REINFORCED SUSPENDED CONCRETE FLOOR	32	M3	8.000	256	8,960	250.00	8,000		16,960
20	10.00	30 MPA REINFORCED CONCRETE WALL	54	M3	7.000	378	13,230	240.00	12,960		26,190
20	11.00	50 MM THICK BITUMEN LAYER ON CONCRETE	36	M2	0.300	11	378	15.00	540		918

Kilborn Engineering Pacific Ltd. MINE WATER TREATMENT PLANT
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Vancouver, B.C. FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA Run Time: 11:33:13
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AREA	ITEM	DESCRIPTION	QTY UNIT	LABOR	TOTAL	LABOR	MATERIAL	MATERIAL	SUBC		
				UNIT MHRS	MHRS	COST			UNIT COST	COST	UNIT CO
20	12.00	MS INSERTS & EMBEDDED STEEL	2,700 KG	0.070	189		6,615		3.60	8,100	14,715
20	13.00	20MMD x 500 MM FOUNDATION BOLTS		375 NO	0.500	188	6,563		30.00	11,250	
20	14.00	SECURITY FENCE SURROUNDING THE PLANT AREA NOT INCLUDED									
20	15.00	WASHROOM ALLOWANCE	2 SUM	150.000	300	10,500	4,000.00			8,000	18,50
20	16.00	PRELIMINARY & GENERAL INCLUDING SITE LAYOUT AND SURVEYING	1 SUM	500.000	500		17,500	7,500.00		7,500	25,000
				CIVIL TOTAL	4,413		154,458		140,978		295,436
STRUCTURAL AND BUILDINGS											
30	1.00	ACCESS PLATFORM AND STAIRWAYS SUPPORT STEEL WORK ASSESSED TONNAGE STRUCTURAL SUPPORT STLWORK	14.0 TONNE	27.000	378			13,230	2,200.00	30,800	44,03
30	2.00	STRUCTURAL SUPPORT STEELWORK (MEDIUM)		151.0 TONNE	24.000	3,624		126,840	2,100.00	317,100	443,940
30	3.00	OVERHEAD PIPE BRIDGE @ 60KG/M MASS		11.0 TONNE	22.000	242		8,470	2,000.00	22,000	30,470

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBC UNIT COST	COST	COST
CIVIL												
30	4.00	PLATFORMS WALKWAYS SUSPENDED @ 60KG/M2	16.0	TONNE	22.000	352	12,320	2,000.00	32,000			44,326
30	5.00	STAIRS C/W HANDRAILING	70	M	15.000	1,050	36,750	1,060.00	74,200			110,956
30	6.00	EGGCRATE FLOORING BUTDIP AW38 40X4.54MM	262	M2	1.000	262	9,170	95.00	24,890			34,060
30	7.00	HANDRAIL GALV. C/W TUBULAR BALL TYPE STANCHIONS- 990MM	225	M	3.300	743	25,988	21.00	4,725			30,713
30	8.00	PAINT STRUCTURAL STEELWORK SB 1P.2EIN	192.0	TONNE	2.000	384	13,440	15.00	2,880			16,326
30	9.00	PRE-ENGINEERED BUILDING ALLOWANCE INCLUDING FOUNDATIONS, BUILDING, HEATING, VENTILATION AND LIGHTING	1,870	M2						700.00	1,309,000	1,309,000
		STRUCTURAL AND BUILDINGS TOTAL				7,035	246,208		508,595		1,309,000	2,063,803
50	1.00	PP-01 FEED WATER PUMP ACT. VOL 500M3 @ 15M HEAD x 22 KW WATER PUMP 150 x 150NB C/W 30KW MOTOR	1	NO	40.000	40	1,400	5,500.00	5,500			6,900
50	2.00	PP-02 DEGAS TOWER PUMP ACT. VOL 500 M3 @ 15M HEAD HANDLING PH2 WATER ACID PUMP 150 x 150NB C/W 30 KW MOTOR	1	NO	40.000	40	1,400	6,500.00	6,500			7,900

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	UNIT COST	COST	COST	
50	3.00	PP-03 CATION RINSE WATER PUMP ACT, VOL 100M3/HR @ 20M HEAD PUMP 200 X 150NB 5.5KW MOTOR	1	NO	45.000		45		1,575	6,000.00	6,000		
50	4.00	PP-04 CATION WASH PUMP ACT. VOL. 250M3/HR @ 12M HEAD - ACIDIC WATER PUMP 11 KW	1	NO	45.000		45		1,575	6,000.00	6,000		7
50	5.00	PP-05 ACID DOSING PUMP ACT. VOL. 1M3/HR @ 5M HEAD - CONCENTRATED ACID 98% H2SO4 DOSATROW ACID PUMP	1	NO		20.000	20		700	2,500.00	2,500		3,200
50	6.00	PP-06 CATION REQEM PUMP ACT. VOL. 250M3/HR @ 15M HEAD - ACID SLURRY ACID PUMP 15KW MOTOR	1	NO		40.000	40		1,400	5,500,00	5,500		6,90
50	7.00	PP-07 CATION SLUDGE PUMP ACT. VOL 25 M3/HR @ 5M HEAD HANDLING ACID SLURRY PUMP C/AIR DRIVEN	1	NO		30.000	30		1,050	3,000.00	3,000		4,05
50	8.00	PP-08 ANION FEED PUMP ACT. VOL 500M3/HR @ 15M HEAD HANDLING WATER @ PH2 ACID PUMP 150 x 150NB C/W 30KW MOTOR	1	NO		40.000	40		1,400	6,500.00	6,500		7,90
50	9.00	PP-09 ANION RINSE WATER PUMP ACT. VOL 250M3/HR @ 20M HEAD, PUMP 15 KW	1	NO		40.000	40		1,400	6,000.00	6,000		7,40
50	10.00	PP-10 ANION WASH PUMP ACT. VOLV250M3/HR @ 12 M HEAD - ALKALINE LIQUID, PUMP 15 KW	1	NO		40.000	40		1,400	5,500.00	5,500		6,90

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MINE WATER TREATMENT PLANT
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DETAIL REPORT

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CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SU	UNIT COST	COST	COST
50	11.00	PP-11 LIME DOSING PUMP ACT. VOL 23M3/HR @ 5M HEAD, HANDLING LINE SLURRY, PUMP 3 KW	1	NO	30.000	30	1,050	3,300.00			3,300		4
50	12.00	PP-12 ANION REQEN PUMP ACT. VOL 250M3/HR @ 12M HEAD HANDLING LIME SLURRY, PUMP 15KW	1	NO	40.000	40	1,400	5,500.00	5,500				
50	13.00	PP-13 ANION SLUDGE PUMP ACT. VOL 25M3/HR @ 5M HEAD HANDLINGLIME SLURRY, PUMP C/AIR DRIVEN	1	NO	30.000	30	1,050	3,000.00			3,000		4,
50	14.00	PP-14 SUMP DISCHARGE PUMP ACT. VOL 25M3/HR @ 10M HEAD, 40MMD GALIGHER V/S PUMP 1L/S 10M H 3 KW	1	NO		35.000	35	1,225		4,000.00	4,000		5,225
50	15.00	FA-01 DEGASSER TOWER FAN UNIT, 3KW FAN			1 NO	20.000	20	700		1,800.00	1,800		2,500
50	16.00	AG-01 CATION REGEN. AGITATOR 20M3 AGITATOR 20M3 C/W 5.5KW MOTOR			1 NO	40.000	40	1,400		15,500.00	15,500		16,900
50	17.00	AG-02 LIME TANK AGITATOR 20M3 AGITATOR 20M3 C/W 5.5KW MOTOR			1 NO	50.000	50	1,750		15,500.00	15,500		17,250
50	18.00	AG-03 ANION REGEN. AGITATOR 20M3 AGITATOR 20M3 C/W 5.5 KW MOTOR			1 NO	50.000	50	1,750		15,500.00	15,500		17,250
50	19.00	SB-01 CATION SIEVE BEND 300 MICRON APERTURE WEDGE WIRE TYPE. SIZE 2000 x 1500 SEIVEBEND	1	NO	30.00	30	1,050	5,500.00	5,500				

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CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBC UNIT COST	SUBC COST	COST
50	20.00	SB-02 ANION SIEVE BEND 300 MICRON APERTURE WEDGE WIRE TYPE SIZE 2000 x 1500 SEIVEBEND	1	NO	30.000	30	1,050	5,500.00	5,500			6,550
50	21.00	SC-01 CATION PRODUCT SCREEN 300 MICRON APERTURE STATIC SCREEN 2000 x 1500	1	NO	25.000	25	875	6,000.00	6,000			6,875
50	22.00	SC-02 ANION PRODUCT SCREEN 300 MICRON APERTURE STATIC SCREEN 2000 x 1500	1	NO	25.000	25	875	6,000.00	6,000			
50	23.00	SC-03 CATION WASH SCREEN 300 MICRON APERTURE STATIC SCREEN 2000 x 4000	1	NO	35.000	35	1,225	8,000.00	8,000			9,225
50	24.00	SC-04 ANION WASH SCREEN 300 MICRON APERTURE STATIC SCREEN 1000 x 4000	1	NO	35.000	35	1,225	8,000.00	8,000			9,225
50	24.00	SERVICE ITEMS INCLUDING SUMP PUMP, AIR COMPRESSOR, DRYER, RECEIVER, FILTERS, HEATING ETC.	1	SUM	400.000	400	14,000	90,000.00	90,000			104,0
50	25.00	OVERHEAD CRANE & MAINTENANCE HOISTS	1	SUM	300.000	300	10,500	65,000.00	65,000			75,500
50	26.00	SPARES @ 6% OF EQUIPMENT VALUE	1	SUM				15,000.00	15,000			15,000
		MECHANICAL EQUIPMENT TOTAL				1,555	54,425		326,100			380,525

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CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBC UNIT COST	COST	COST
PLATEWORK												
60	1.00	1K-01 FEED WATER TANK - ACT. VOLUME 50M3 3500 DIA. x 5500 HIGH C/W THREE NOZZLES ALL PLASTIC, WATER TANK	1	NO	40.000	40	1,400	11,000.00	11,000			12,400
60	.00	TK-02 TO 07 - CATION LOADING CONTACTOR 4000 DIA x 3000 WALL HEIGHT FLAT BOTTOMED WITH 1M TEGNALLY MOULDED FLGED INLET NOZZLE & 100 WIDE ESCAPSULATED FLOOR SUPPORT RING 500 UP FROM BOTTOM LOOSE CORR. PERF. 4000 DIA TOWER FLOOR CYLINDER STEPP	6	NO	45.000	270	9,450	14,000.00	84,000			93,450
60	.00	TK-08 CATION PRODUCT TANK ACT. VOL. 20M3 2200 DIA x 5500 x THREE NOZZLES ALL PLASTIC TANK	1	NO	30.000	30	1,050	7,000.00	7,000			8,050
60	.00	TK-09 CATION CONDITIONING TANK ACT. VOL. 20M3 2200 DIA x 5500 x THREE NOZZLES ALL PLASTIC TANK	1	SUM	30.000	30	1,050	7,000.00	7,000			8,050
60	1.00	TK-10 CATION OVERFLOW TANK ACT. VOL. 20M3 2200 DIA x 5500 x THREE NOZZLES ALL PLASTIC TANK	1	SUM	30.000	30	1,050	7,000.00	7,000			8,050
60	6.00	TK-11 CATION BATCH REGENERATOR ACT. VOL. 38M3 4000 DIA x 3000 HIGH ALL IN GRP MATL C/W FOUR NOZZLES - TANK	1	SUM	45.000	45	1,575	15,000.00	15,000			16,575
60	7.00	TK-12 SULPHURIC ACID TANK - ACT. VOL 15M3 x 2600 DIA x 3200 HIGH, THREE NOZZLES, ALL IN PLASTIC,	1	SUM	30.000	30	1,050	6,500.00	6,500			7,550

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBCONT UNIT COST	COST	COST
	TANK											
60	8.00	TK-13 CATION REGENERANT TANK - ACT VOL. 20M3 3000 x 3000 x FOUR NOZZLES ALL PLASTIC TANK	1	SUM	30.000	30	1,050	7,200.00	7,200			8,250
60	9.00	TK-14 CATION CATCH POT 4000 x 500 WALL M WITH 3500 D 60 DEG CONICAL BOTTOM WITH INTEGR MOULDED FLGED OUTLET & DRAWOFF NOZZLES ON GRP KNUCKLE RING SUPPORT 300 D x 500 W RING, 4200 x 200 D LAUNDER FLGED. OUT 75 WITH INTEGR. MOULDED O/F NOZZLE	1	SUM	45.000	45	1,575	10,500.00	10,500			12,075
60	10.00	TK-15 TO 20 ANION LOADING CONTRACTOR AS ABOVE CONTRACTORS BUT 4700 DIA. x 3000 WALL H WITH FLOOR SUPPORT RING 500 UP FROM BOTTOM ET AND SURROUNDED BY 5000 DIA x 200 D GRP LAUNDER AS PER SKETCH TK 15 TO 20 ETC. CONTACTOR	1	SUM	95.000	95	3,325	17,000.00	17,000			20,325
60	11.00	TK-21 ANION PRODUCT TANK ACT VOL. 30M3 EACH 2600 DIA. x 6000 HIGH x THREE NOZZLES ALL IN PLASTIC TANK	1	SUM	45.000	45	1,575	9,000.00	9,000			10,575
60	12.00	TK-22 ANION CONDITIONING TANK ACT. VOL. 30M3 EA 2600 DIA. x 6000 H x THREE NOZZLES ALL IN PLASTIC TANK	1	SUM	45.000	45	1,575	9,000.00	9,000			10,575
60	13.00	TK-23 ANION OVERFLOW TANK ACT. VOL 20M3 2200 x 5500 X THREE NOZZLES ALL PLASTIC TANK	1	SUM	30.000	30	1,050	7,000.00	7,000			8,050

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CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUB UNIT COST	SUB COST	COST
60	14.00	TK-24 ANION BATCH REGENERATOR ACT VOL 52M3 4700 DIA. x 3000 H x THREE NOZZLE ALL GRP CONTACTOR	1	SUM	80.00	80	2,800	15,000.00	15,000			17,800
60	15.00	TK-25 LIME MIXING TANK ACT VOL. 20M3 2500 x 4500 x THREE NOZZLE ALL IN PLASTIC, TANK	1	SUM	30.000	30	1,050	77,000.00	77,000			78,050
60	16.00	TK-26 ANION REGENERANT TANK ACT. VOL 20M3 2500 x 4500 x THREE NOZZLES ALL IN PLASTIC, TANK	1	SUM	30.000	30	1,050	7,000.00	7,000			8,050
60	17.00	TK-27 ANION CATCH POT 4000 x 500 WALL H WITH 3500 D 60 DEG CONICAL BOTTOM WITH INTEGR MOULDED FLGED OUTLET & DRAWOFF NOZZLES ON GRP KNUCKLE RING SUPPORT 300 D x 500 W RING, 4200 x 200 D LAUNDER FLGED. OUT 75 WITH INTEGR. MOULDED O/F NOZZLE	1	SUM	45.000	45	1,575	10,500.00	10,500			12,075
60	18.00	TK-28 DEGASSING TOWER COMPRISING OF 3000 DIA x 3000 H FLAT BOTTOMED FLGE OPEN TOPPED TK C/W INTERNAL 2500 DIA. X 2500 WALL OPEN FLGED TOP STILLING CHAMBER/OVERFLOW WEIR & CENTRAL 1500 x 10000 H FLGED TOWER. 1500 x 2000 flged spool PIECE WI	1	SUM	70.000	70	2,450	14,000.00	14,000			16,450
60	19.00	EXTRA FOR GRP COWL TO SUIT TOWER INCL. ERECTION ETC.	1	SUM	30.000	30	1,050	3,000.00	3,000			4,050
60	20.00	YE-01 CATION TRANSFER VESSEL ACT. VOL. 12M3 2000 DIA x 3200 H x SIX NOZZLES ALL IN M.S.	2,555	KG	0.020	51	1,789	3.00	7,665			

Kilborn Engineering Pacific Ltd.
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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBCON UNIT COST	SUBCON COST	COST
60	21.00	250MM DIA TANK NOZZLE (R/L)	6	NO	8.000	48	1,680	120.00	720			2,400
60	22.00	RUBBER LINING PLATEWORK	33	M2	3.500	116	4,043	70.00	2,310			6,353
60	23.00	VE-02 ANION TRANSFER VESSELACT. VOL 12 M3 2000 DIA x 3200 H x SIX NOZZLES ALL IN M.S.	2,555	KG	0.020	51	1,789	3.00	7,665			9,454
60	24.00	250MM DIA TANK NOZZLE (R/L)	6	NO	8.000	48	1,680	120.00	720			2,400
60	25.00	RUBBER LINING PLATEWORK	33	M2	3.500	116	4,043	70.00	2,310			6,353
60	26.00	CM-01 CATION WASH COLUMN - 1500 DIA x 4500 C/W 3000 DEEP 60 DEG CONICAL BOTTOM C/W LAUNDERS AND NOZZLES	1	NO	40.000	40	1,400	11,000.00	11,000			12,400
60	27.00	CM-02 ANION WASH COLUMN - 1500 DIA x 4500 C/W 3000 DEEP 60 DEG CONICAL BOTTOM C/W LAUNDERS AND NOZZLES	1	NO	35.000	35	1,225	11,000.00	11,000			12,225
60	28.00	SE-01 CATION SETTLER 14000 DIA x 2000 C/W 12000 DEEP 60 DEG CONICAL BOTTOM C/W 500 DIA x 10000 STILLING CHAMBER & 2000 DIA TO 5400 DIA x 2500 DEEP BAFFLE FABRICATED IN M.S.	84.0	TONNE	35.000	2,940	102,900	2,100.00	176,400			279,300
60	29.00	250 MM DIA TANK NOZZLE (R/L)	2	NO	8.000	16	560	120.00	240			800

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DETAIL REPORT

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBC UNIT COST	SUBC COST	COST
60	30.00	RUBBER LINING PLATEWORK	1,228	M2	3.000	3,684	128,940	60.00	73,680			202,620
60	31.00	SE-02 ANION SETTLER 14000 DIA x 2000 C/W 12000 DEEP 60 DEG CONICAL BOTTOM C/W 500 DIA x 10000 STILLING CHAMBER & 2000 DIA to 5400 DIA x 2500 DEEP BAFFLE FABRICATED IN M.S.	84.0	TONNE	35.000	2,940	102,900	2,100.00	176,400			279,300
60	32.00	250MM DIA TANK NOZZLE (R/L)	2	NO	8.000	16	560	120.00	240			800
60	33.00	RUBBER LINING PLATEWORK	1,228	M2	3.000	3,684	128,940	60.00	73,680			202,620
60	34.00	PAINT PLATEWORK SB 1P 2FIN	15.O	TONNE	1.500	23	788	12.00	180			968
		PLATEWORK TOTAL				14,857	519,987		867,910			1,387,897

PIPING

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	SUBC UNIT COST	SUBC COST	COST
70	1.00	PLANT FEED AND DISCHARGE PIPING NOT INCLUDED										
70	1.00	EMERGENCY SHOWER SS C/W EYE WASH	2	NO	30.000	60	2,100	2,100.00	4,200			6,300
70	2.00	POLYPROP PIPING 250NB	510	M	1.500	765	26,775	80.00	40,800			67,575
70	3.00	POLYPROP PIPING 200NB	135	M	1.300	176	6,143	60.00	8,100			14,243

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

C:SRK-WT_1.DBF

CODE		DESCRIPTION	QTY	UNIT	LABOR	TOTAL	LABOR	MATERIAL	MATERIAL			
AREA	ITEM				UNIT MHRS	MHRS	COST	UNIT COST	COST	UNIT COST	COST	COST
70	4.00	POLYPROP PIPING 150NB	235	M	1.000	235	8,225	45.00	10,575			18,8
70	5.00	POLYPROP PIPING 80NB	18	M	0.800	14	504	30.00	540			1,044
70	6.00	POLYPROP PIPE FITTINGS	1	SUM	480.000	480	16,800	11,000.00	11,000			27,800
70	7.00	COMPRESSED AIR PIPING 20NB MED SABS 62 MS	120	M	1.000	120	4,200	35.00	4,200			8,400
70	8.00	POTABLE WATER PIPING 25NB MED WT SABS 62 CS GALV PIPING	200	M	1.000	200	7,000	45.00	9,000			16,000
70	9.00	20MM SABS 62 CS GALV PIPING	65	M	1.000	65	2,275	40.00	2,600			4,875
70	10.00	GATE VALVES 250NB CI VOSA	14	NO	7.000	98	3,430	2,000.00	28,000			31,430
70	11.00	200MM NB PUMP SHUT-OFF VALVE	7	NO	6.000	42	1,470	2,000.00	14,000			15,470
70	12.00	150MM NB PUMP SHUT-OFF VALVE	6	NO	5.000	30	1,050	1,500.00	9,000			10,050
70	13.00	100MM NB PUMP SHUT-OFF VALVE	4	NO	4.000	16	560	800.00	3,200			3,760
70	14.00	80MM NB PUMP SHUT-OFF VALVE	1	NO	3.000	3	105	500.00	500			605

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
60	30.00	RUBBER LINING PLATEWORK	1,228	M2	3.000	3,684	128,940	60.00	73,680			202,620
60	31.00	SE-02 ANION SETTLER 14000 DIA x 2000 C/W 12000 DEEP 60 DEG CONICAL BOTTOM C/W 500 DIA X 10000 STILLING CHAMBER & 2000 DIA TO 5400 DIA x 2500 DEEP BAFFLE FABRICATED IN M.S.	84.0	TONNE	35.000	2,940	102,900	2,100.00	176,400			279,30
60	32.00	250MM DIA TANK NOZZLE (R/L)	2	NO	8.000	16	560	120.00	240			800
60	33.00	RUBBER LINING PLATEWORK	1,228	M2	3.000	3,684	128,940	60.00	73,680			202,6??
60	34.00	PAINT PLATEWORK SB 1P 2FIN	15.0	TONNE	1.500	23	788	12.00	180			968
		PLATEWORK TOTAL				14,857	519,987		867,910			
		PIPING										
70	1.00	PLANT FEED AND DISCHARGE PIPING NOT INCLUDED										
70	1.00	EMERGENCY SHOWER SS C/W EYE WASH	2	NO	30.000	60	2,100	2,100.00	4,200			6,300
70	2.00	POLYPROP PIPING 250NB	510	M	1.500	765	26,775	80.00	40,800			67,575
70	3.00	POLYPROP PIPING 200NB	135	M	1.300	176	6,143	60.00	8,100			14,243

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

C:SRK-WT_1.DBF

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
70	4.00	POLYPROP PIPING 150NB	235	M	1.000	235	8,225	45.00	10,575			18,800
70	5.00	POLYPROP PIPING 80NB	18	M	0.800	14	504	30.00	540			1,044
70	6.00	POLYPROP PIPE FITTINGS	1	SUM	480.000	480	16,800	11,000.00	11,000			27,800
70	7.00	COMPRESSED AIR PIPING 20NB MED SABS 62 MS	120	M	1.000	120	4,200	35.00	4,200			8,400
70	8.00	POTABLE WATER PIPING 25NB MED WT SABS 62 CS GALV PIPING	200	M	1.000	200	7,000	45.00	9,000			16,000
70	9.00	20MM SABS 62 CS GALV PIPING	65	M	1.000	65	2,275	40.00	2,600			4,875
70	10.00	GATE VALVES 250NB CI VOSA	14	NO	7.000	98	3,430	2,000.00	28,000			31,430
70	11.00	200MM NB PUMP SHUT-OFF VALVE	7	NO	6.000	42	1,470	2,000.00	14,000			15,470
70	12.00	150MM NB PUMP SHUT-OFF VALVE	6	NO	5.000	30	1,050	1,500.00	9,000			10,050
70	13.00	100MM NB PUMP SHUT-OFF VALVE	4	NO	4.000	16	560	800.00	3,200			3,760
70	14.00	80MM NB SHUT-OFF VALVE	1	NO	3.000	3	105	500.00	500			605

CODE AREA	ITEM	DESCRIPTION	QTY UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
70	15.00	50MM NB PUMP SHUT-OFF VALVE	1 NO	2.000	2	70	200.00	200			27
70	16.00	250MM NB RESIN FLOW CONTROL VALVE	4 NO	10.000	40	1,400	3,000.00	12,000			13,40
70	17.00	MISC. PIPING, VALVES & FITTINGS ALLOWANCE	1 SUM	800.000	800	28,000	52,000.00	52,000			80,000
70	18.00	PIPING SUPPORTS, HANGERS, INSULATION ETC	1 SUM	250.000	250	8,750	6,000.00	6,000			14,750
		PIPING TOTAL			3,396	118,857		215,915			334,770
ELECTRICAL											
80	1.00	POWER SUPPLY TO MCC & PLANT NOT INCLUDED	1 SUM								
80	1.00	MCC FOR 15 MOTORS (TOTAL 172KW)	1 SUM	40.000	40	1,400	14,000.00	14,000			15,400
80	2.00	POWER DISTRIBUTION TO MOTORS INCLUDING STARTERS, CONTROL AND POWER WIRING	1 SUM	1,000.00	1,000	35,000	112,000.00	112,000			147,000
80	3.00	LIGHTING INCLUDED IN BUILDING COST									
80	4.00	INSTRUMENT DISTRIBUTION BOARD 40 WAY	2 SUM	20.000	40	1,400	6,500.00	13,000			14,400
80	5.00	YARD FLOODLIGHTING	1 SUM	90.000	90	3,150	8,000.00	8,000			11,150

CODE AREA	ITEM	DESCRIPTION	QTY UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
80	6.00	15A WEATHER PROOF PLUG BOX INCLUDING WIRING	15 NO	10.000	150	5,250	100.00	1,500			
80	7.00	63 AMP WELDING OUTLET INCLUDING WIRING	6 NO	10.000	60	2,100	300.00	1,800			3,900
80	8.00	GROUNDING ALLOWANCE	1 SUM	80.000	80	2,800	4,000.00	4,000			6,800
80	9.00	SECONDARY TRANSFORMERS	1 SUM	40.000	40	1,400	20,000.00	20,000			21,400
80	10.00	AIR CONDITIONING UNIT FOR CONTROL ROOM	1 NO	40.000	40	1,400	5,000.00	5,000			6,400
80	11.00	EMERGENCY LIGHTS & POWER SUPPLY	1 SUM	100.00	100	3,500	12,000.00	12,000			15,500
80	12.00	MISC. POWER AND WIRING	1 SUM	40.000	40	1,400	7,000.00	7,000			8,400
80	13.00	FIRE EXTINGUISHERS	1 SUM	10.000	10	350	1,000.00	1,000			1,350
		ELECTRICAL TOTAL			1,690	59,150		199,300			258,450
INSTRUMENTATION											
90	1.00	SOLENOID VALVES	12 NO						1,000.00	12,000	12,000
90	2.00	CATION LOADING FEEDPUMP FLOW INDICATOR 250NB	1 NO						1,600.00	1,600	1,600

Kilborn Engineering Pacific Ltd. MINE WATER TREATMENT PLANT
1380 Burrard Street ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
Vancouver, B.C. FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
9999-99 DETAIL REPORT C:SRK-WT_1.DBF

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
90	3.00	CATION REGEN PUMP FLOW INDICATOR 250NB	1	NO						1,600.00	1,600	1,600
90	4.00	CATION WASH PUMP FLOW INDICATOR 100NB	1	NO						1,000.00	1,000	1,000
90	5.00	CATION RINSE PUMP FLOW INDICATOR 200NB	1	NO						1,400.00	1,400	1,400
90	6.00	DEGASSER FEEDPUMP FLOW INDICATOR 250NB	1	NO						1,600.00	1,600	1,600
90	7.00	ANION LOADING FEEDPUMP FLOW INDICATOR 250NB	1	NO						1,600.00	1,600	1,600
90	8.00	ANION REGEN PUMP FLOW INDICATOR 250NB	1	NO						1,600.00	1,600	1,600
90	9.00	ANION WASH PUMP FLOW INDICATOR 200NB	1	NO						1,400.00	1,400	1,400
90	10.00	ANION RINSE PUMP FLOW INDICATOR 200NB	1	NO						1,400.00	1,400	1,400
90	11.00	PLANT 200NB FEED FLOW TOTALISER	2	NO						800.00	1,600	1,600
90	12.00	FEEDWATER TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	13.00	CATION REGEN TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

C:SRK-WT_1.DBF

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	COST	COST
90	14.00	CATION OF TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	15.00	CATION COND. TANK HIGH LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	16.00	CATION COND. TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	17.00	CATION CLNG HIGH LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	18.00	DEGASSER LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	19.00	DEGASSER HIGH LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	20.00	ANION REGEN LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	21.00	ANION REGEN TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	22.00	ANION O/F TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	23.00	ANION COND. TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	24.00	ANION COND. TANK HIGH LEVEL SENSOR	1	NO						1,200.00	1,200	1,200
90	25.00	ANION PROD. TANK LOW LEVEL SENSOR	1	NO						1,200.00	1,200	1,200

Kilborn Engineering Pacific Ltd. MINE WATER TREATMENT PLANT
1380 Burrard Street ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
Vancouver, B.C. FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA Run Time: 11:33:13
9999-99 DETAIL REPORT C:SRK-WT_1.DBF

CODE DESCRIPTION QTY UNIT LABOR TOTAL LABOR MATERIAL MATERIAL S
AREA ITEM UNIT MHRS MHRS COST UNIT COST COST UNIT COST COST COST

90	26.00	ANION ALNG HIGH LEVEL SENSOR	1	NO	1,200.00	1,200	1,200
90	27.00	CATION LOAD CONT. 1. LEVEL DETECTOR	1	NO	5,000.00	5,000	5,000
90	28.00	ANION LOAD CONT. 1 LEVEL DETECTOR	1	NO	5,000.00	5,000	5,000
90	29.00	CATION REGEN TANK COND. INDICATOR CONTROLLER	1	NO	3,500.00	3,500	3,500
90	30.00	ANION REGEN TANK PH INDICATOR CONTROLLER	1	NO	3,500.00	3,500	3,500
90	31.00	WASH COLUMN RESIN OUTLET PHOTOELECTRIC CELL 250NB	2	NO	3,000.00	6,000	6,000
90	32.00	ASCO THREE-WAY SOLENOIDS VALVE ACTUATOR	21	NO	1,200.00	25,200	25,200
90	33.00	RESIN OUT CBR CONTROL VALVE 250NB	1	NO	3,000.00	3,000	3,000
90	34.00	DRAIN CBR 100NB VALVE	1	NO	1,500.00	1,500	1,500
90	35.00	DRAIN CCP 100NB VALVE	1	NO	1,500.00	1,500	1,500
90	36.00	RESIN OUT CCP 250NB VALVE	1	NO	3,000.00	3,000	3,000

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	S COST	COST
90	37.00	RESIN OUT CWC 250NB VALVE	1	NO						3,000.00	3,000	3,000
90	38.00	OVERFLOW CTV 100NB VALVE	1	NO						1,500.00	1,500	1,500
90	39.00	RESIN OUT CTV 250NB VALVE	1	NO						3,000.00	3,000	3,000
90	40.00	RESIN WATER TO CTV 150NB VALVE	1	NO						2,000.00	2,000	2,000
90	41.00	1 USED RESIN TO CTV 150NB VALVE	1	NO						2,000.00	2,000	2,000
90	42.00	1 USED RESIN TO CCT 150NB VALVE	1	NO						2,000.00	2,000	2,000
90	43.00	SPENT RESIN TOCBR 150NB VALVE	1	NO						2,000.00	2,000	2,000
90	44.00	RESIN OUT ABR 250NB CONTROL VALVE	1	NO						3,000.00	3,000	3,000
90	45.00	RESIN OUT ACP 250NB VALVE	1	NO						3,000.00	3,000	3,000
90	46.00	RESIN OUT AWC 250NB VALVE	1	NO						3,000.00	3,000	3,000
90	47.00	RESIN OUT ATV 250NB VALVE	1	NO						3,000.00	3,000	3,000
90	48.00	OVERFLOW ATV 100NB VALVE	1	NO						1,500.00	1,500	1,500

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MINE WATER TREATMENT PLANT
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FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR	TOTAL UNIT MHRS	LABOR MHRS	MATERIAL COST	MATERIAL UNIT COST	S COST	UNIT COST	COST	COST
90	49.00	RESIN WATER TO ATV 200NB VALVE	1	NO							2,500.00	2,500	2,500
90	50.00	1 USED RESIN TO ATV 200NB VALVE	1	NO							2,500.00	2,500	2,500
90	51.00	1 USED RESIN TO ACT 200NB VALVE	1	NO							2,500.00	2,500	2,500
90	52.00	RINSE RECYCLE TO FWT 200NB VALVE	1	NO							2,500.00	2,500	2,500
90	53.00	SPENT RINSE WATER 200NB VALVE	1	NO							2,500.00	2,500	2,500
90	54.00	DEGASSER RECYCLE 100NB CONTROL VALVE	1	NO							3,000.00	3,000	2,500
90	55.00	CATION LOADING FEED PUMP CONTROL VALVE 250NB	1	NO							1,000.00	1,000	1,000
90	56.00	CATION REGEN PUMP CONTROL VALVE 250NB	1	NO							3,000.00	3,000	3,000
90	57.00	CATION WASH PUMP CONTROL VALVE 200NB	1	NO							2,500.00	2,500	2,500
90	58.00	CATION RINSE PUMP CONTROL VALVE 200NB	1	NO							2,500.00	2,500	2,500
90	59.00	DEGASSER FEED PUMP CONTROL VALVE 250NB	1	NO							3,000.00	3,000	3,000

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

Run Time: 11:33:13
C:SRK-WT_1.DBF

CODE DESCRIPTION QTY UNIT LABOR TOTAL LABOR MATERIAL MATERIAL S
AREA ITEM UNIT MHRS MHRS COST UNIT COST COST UNIT COST COST COST

90	60.00	ANION LOADING FEED PUMP CONTROL VALVE 250NB	1	NO	3,000.00	3,000	3,000
90	61.00	ANION REGEN PUMP CONTROL VALVE 200NB	1	NO	2,500.00	2,500	2,500
90	62.00	ANION WASH PUMP CONTROL VALVE 200NB	1	NO	2,500.00	2,500	2,500
90	63.00	ANION RINSE PUMP CONTROL VALVE 200NB	1	NO	2,500.00	2,500	2,500
90	64.00	PRESSURE INDICATORS	5	NO	400.00	2,000	2,000
90	65.00	PLC SYSTEM	1	SUM	170,000.00	170,000	170,000
90	66.00	CONVERTORS E69F TYPE	9	NO	1,000.00	9,000	9,000
90	67.00	WATER TRAP ASSEMBLY	1	NO	600.00	600	600
90	68.00	FEED WATER CONDUCTIVITY METER	3	NO	4,000.00	12,000	12,000
90	69.00	TESTING, MISC. WIRING, SUPPORTS, ETC	1	SUM	50,000.00	50,000	50,000
		INSTRUMENTATION TOTAL				412,600	412,600

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MINE WATER TREATMENT PLANT
ORDER OF MAGNITUDE CAPITAL COST ESTIMATE
FOR 10ML/DAY PLANT NEAR BUTTE, MONTANA
DETAIL REPORT

CODE AREA	ITEM	DESCRIPTION	QTY	UNIT	LABOR UNIT MHRS	TOTAL MHRS	LABOR COST	MATERIAL UNIT COST	MATERIAL COST	S UNIT COST	S COST	COST
CONSUMABLES												
710	1.00	CATION RESIN	100	M3				2,500.00	250,000			250,000
710	2.00	ANION RESIN	100	M3				5,000.00	500,000			500,000
		CONSUMABLES TOTAL							750,000			750,000
CONSTRUCTION INDIRECTS												
720	1.00	CONSTRUCTION INDIRECTS ALLOWANCE	1	SUM						308,000.00	308,000	308,000
		CONSTRUCTION INDIRECTS TOTAL									308,000	308,000
EPCM												
730	1.00	ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT ALLOWANCE	1	SUM						719,000.00	719,000	719,000
		EPCM TOTAL									719,000	719,000
STARTUP & COMMISSIONING												
740	1.00	STARTUP & COMMISSIONING INCLUDING VENDOR REPS, CONTRACTOR ASSISTANCE, STARTUP SUPPLIES AND PARTS AND ENGINEERING ASSISTANCE	1	SUM						150,000.00	150,000	150,000

CODE DESCRIPTION QTY UNIT LABOR TOTAL LABOR MATERIAL MATERIAL S
AREA ITEM UNIT MHRS MHRS COST UNIT COST COST UNIT COST COST COST

STARTUP & COMMISSIONING TOTAL 150,000 150,000

OWNER'S COSTS

800 1.00 OWNER'S COST NOT INCLUDED

OWNER'S COSTS TOTAL

CONTINGENCY

900 1.00 CONTINGENCY @ 20% 1 SUM 1,412,000.00 1,412,000 1,412,000

CONTINGENCY TOTAL 1,412,000 1,412,000

PROJECT TOTAL 32,945 1,153,085 3,008,798 4,310,600
8,472,483

ARCO 307 East Park Street, Suite 400
Anaconda Montana 59711
Telephone 406 563-5211
Facsimile 406 563-8269

April 29, 1994

CERTIFIED-RETURN
RECEIPT REQUESTED

Mr. Russ Forba
EPA Project Coordinator
Butte Mine Flooding Operable Unit
EPA Montana Operations Office
Federal Building
301 South Park Street, Drawer 10096
Helena, Montana 59626-0096

Joe Santarella, Jr., Esq.
Office of Regional Counsel
Environmental Protection Agency
One Denver Place
999 18the Street, Suite 500
Denver, Colorado 80202-2405

Duane Robertson, Chief
Solid and Hazardous Waste Bureau
Montana Department of Health and
Environmental Sciences
Cogswell Building
Helena, Montana 59620

William B. Kirley, Esq.
Legal Division
Montana Department of Health
and Environmental Sciences
Cogswell Building
Helena, Montana 59620

Re: Mine Flooding Order on Consent, Docket No. CERCLA VIII-90-09

Dear Sirs:

ARCO submits the enclosed comments regarding the Proposed Plan for the Mine Flooding Operable Unit issued by EPA on January 20, 1994.

If you have any questions or would like to discuss any of the comments, please contact Mr. Dave Sinkbeil at 406-563-5211.

Yours truly,

S.M. Stash, P. E.
Montana Facilities Manager

SMS/jb

cc: D. E. Sinkbeil
File: 70.01.110.1
File: 70.01.110.2

Atlantic Richfield Company

COMMENTS OF THE ATLANTIC RICHFIELD COMPANY
ON MINE FLOODING PROPOSED PLAN
DATED JANUARY 20, 1994

I. INTRODUCTION AND OVERVIEW.

The Atlantic Richfield Company ("ARCO") submits the following comments regarding the Mine Flooding Proposed Plan ("Plan") issued by EPA on January 20, 1994 for addressing contaminated water in the Berkeley Pit and surrounding areas, which make up the Butte Mine Flooding Operable Unit ("Mine Flooding OU") of the Silver Bow Creek/Butte Area Superfund Site.

As you know, ARCO was responsible for preparation of the Remedial Investigation ("RI") and Feasibility Study ("FS") for the Mine Flooding OU, which serve as the basis for the alternatives reviewed in the Plan for addressing Berkeley Pit waters. Accordingly, ARCO is intimately familiar with the various details, complications and uncertainties involved in developing a remediation plan for Berkeley Pit waters. In particular, ARCO has grappled with the many difficult issues presented by the fact that the remedy will evolve over a course of decades and is largely dependent up the timing and evolution of on-site mining activities and associated water discharges, as well as future Berkeley Pit filling rates. Due to this unusual situation, ARCO believes that the Plan must balance certainty and concreteness against the inherent need for flexibility as the situation unfolds.

In working through these complications and difficulties, ARCO and EPA seem to have arrived at a common goal of developing a preferred alternative and supporting Plan for the Mine Flooding OU which ensures that Berkeley Pit waters will be contained and that no release to the alluvial aquifer will occur. With that overall goal in mind, ARCO has strived to develop alternatives in the FS which take a conservative and proactive approach to preventing any such release. However, where water treatment or pumping options present no additional benefit to human health in the environment, but result in additional costs or other problems, ARCO has screened out such measures as unnecessary and counterproductive.

After carefully reviewing the Plan, ARCO generally accepts Preferred Alternative 6/7 as presented in the Plan. However, ARCO believes that in one critical respect the Plan fails to provide for the necessary flexibility inherent in the long-term nature of this Plan. ARCO believes that with a modification of this and other more minor points, Alternative 6/7 will ensure that the overall goals of the Berkeley Pit remediation process will be met.

As a final introductory point, ARCO notes that the evolving nature of the remedy suggests that additional components of the Plan may be developed in subsequent remedial design or implementation documents. To the extent that such additional components, such as the precise design of bedrock well monitoring points, are not expressly presented in this Plan but are reserved for later description, ARCO expects to be afforded the opportunity to comment on these documents and reserves all rights in this regard.

II. VOLUME OF SURFACE WATER FLOW TO BE TREATED.

The most critical aspect of the Plan that requires clarification and/or modification surrounds requirements for control of surface water flow, both before and after mining. The Plan in numerous places refers to surface water inflow as synonymous with and equal to Horseshoe Bend flow. See, e.g. p. 2 (referring to treatment of "surface water inflows (i.e., Horseshoe Bend)"). Apparently drawing from RI/FS data indicating that the average flow of Horseshoe Bend is 2.4 MGD, the Plan seems to imply that a total of 2.4 MGD surface inflow must be treated regardless of future actual surface flow rates at Horseshoe Bend.

On this point, ARCO believes that EPA has attempted to set a rigid volume for treatment and/or water diversion where more flexibility is needed. EPA states throughout the Plan that it will maintain a flexible position with respect to actual methods of controlling and treating surface waters. See, e.g., Plan at p. 2. In contrast, EPA's apparent designation of an arbitrary treatment volume is not only counterproductive, but ignores the evolutionary and dynamic nature of the Berkeley Pit situation and surrounding mining activities.

First, adoption of the 2.4 MGD figure assumes without any supporting data that the Horseshoe Bend flow will remain in a steady state once mining ceases. Since EPA's Plan assumes that the predominant surface water contribution will be Horseshoe Bend water, the Plan needs to be tailored to the actual amount of Horseshoe Bend flow over time. For instance, upon suspension of mining activities, ARCO believes that Horseshoe Bend flow may well diminish significantly over time. Thus, by arbitrarily designating a 2.4 MGD treatment requirement, EPA may actually require that water be pumped up from the Pit for treatment where Horseshoe Bend flow is insufficient to account for this volume. Such a program would increase dramatically remediation costs without contributing to the overall goal of preventing Berkeley Pit overflow to alluvial systems.

Second, the importance of flexibility in surface water inflow treatment volume directly ties into the design and construction of any future treatment plant. The appropriate parties will be in a much better position to design a useful, cost-efficient treatment plant for Horseshoe Bend water rather than a potential mix of Horseshoe Bend and other waters needed solely to reach the 2.4 MGD figure. EPA's Plan as written seems to suggest that the parties must design a plant in the relatively near future to account for a 2.4 MGD volume that may not exist at the time the plant becomes operational. Again, ARCO has shown in developing the RI/FS, and accepting the general contours of Alternative 6/7 (which is much more expensive than other feasible options presented in the FS), that it is willing to work within a very conservative and proactive framework to prevent Berkeley Pit water from reaching the critical water level. Yet, by mandating the 2.4 MGD inflow threshold, EPA threatens to require the parties to incur unnecessary costs based on a "snapshot" analysis of water flows, where absolutely no additional protection to human health and the environment is afforded by these costs.

Third, the importance of focusing surface inflow controls on future Horseshoe Bend flows, as opposed to an arbitrary 2.4 MGD figure, is underscored by uncertainty surrounding Pit infilling rates. In 1993, ARCO issued a study which suggested that Berkeley Pit waters would not reach the critical water level under current conditions until at least 40 years from now, and that, if Horseshoe Bend was properly controlled, the critical water level would never be reached. "Preliminary Modeling of Future Berkeley Pit Water-Level Elevations and Inflow Rates," February, 1993. Certainly, if such predictions were to materialize, ARCO would seek a reexamination of the need to build any treatment plant for Horseshoe Bend waters. In the meantime, EPA has pushed for, and ARCO has accepted, a very conservative and proactive approach to ensure that Berkeley Pit waters are contained. Adopting this approach, EPA was unwilling to use Pit infilling rates reflected in the 1993 study, and projected in the Plan Pit infilling dates of 2015, if no remedial actions are taken, and 2022, if Horseshoe Bend is controlled.

By virtue of its years of intensive study of this problem, ARCO believes that Pit infilling rates will continue to diminish. Yet, the extensive monitoring program included within Alternative 6/7 will eliminate this "crystal ball" aspect of the remedy by providing ongoing data necessary to calculate pit filling dynamics. ARCO believes that there is a significant chance that the rerouting and permanent control or treatment of Horseshoe Bend waters, regardless of their exact volume, will likely result in stabilization of the Pit such that the goal of protectiveness will be accomplished. It seems unreasonable and illogical given this potential for stabilization to establish a 2.4 MGD figure which may not reflect future surface flow conditions. When viewed in the light of the uncertainties surrounding pit infilling rates, mandating such a figure may result in the requirement that waters actually be pumped from the Berkeley Pit notwithstanding that the Pit has already reached a steady state.

In this regard, EPA notes that one alternative that was screened and rejected during the FS process was the immediate pumping of Berkeley Pit water to maintain or lower the water level in the Pit system. EPA rightfully points out that this much more costly option provided no increased protection of human health and the environment, because the Alternative 6/7 was more than sufficient to prevent reaching the critical water level. ARCO believes that this exact rationale applies to the arbitrary designation of the 2.4 MGD figure representing Horseshoe Bend flow, when Horseshoe Bend flow may not continue at that threshold. Accordingly, ARCO requests that the Plan be written to state that up to 2.4 MGD, as reflected by ongoing Horseshoe Bend sampling and actual site conditions, along with other surface flows, be controlled or treated as outlined in Alternative 6/7.

III. TREATMENT TECHNOLOGY

ARCO generally agrees with the treatment technology proposed for any necessary post-mining treatment plant, but would like to emphasize that the "hydroxide precipitation with aeration process" developed by Dr. Huang at Montana Tech is an innovative technology. As we understand it, aeration has not been utilized together with hydroxide precipitation at these high flow rates. Accordingly, this technology, like many others underlying the remedy, will need to be continually evaluated as the appropriate treatment time approaches. Again, the Plane would be better tailored to the realities of the Pit situation, and would better serve the public interest, if it emphasized that flexibility and ongoing evaluation would be necessary for treatment plant matters.

IV. SLUDGE DISPOSAL

In the same vein, ARCO generally agrees that sludge disposal location must be left open, and requests that this point be made explicit in the Plan. The sludge disposal question of whether sludge goes "into the pit" or "into a repository" does not and should not be answered today. Much more testing needs to be performed in the future on innovative technologies, as well as pilot scale testing on the hydroxide precipitation process developed by Dr. Huang. The point in time when treatment plant design actually begins is the best time to make the determination of where best to dispose of sludge.

The need for flexibility to account for evolving innovative technology is particularly pertinent to the sludge issue. Once sludge is placed in an out-of-pit repository, the metals in the sludge will never be extracted because of the manner in which metals are bound up as metal hydroxides, and the added costs associated with extracting the metals. However, if the sludge is returned to the Berkeley Pit, there is a much greater chance that metals will be available for extraction in the future by an innovative technology, and will become more concentrated as more sludge is added to the Pit.

ARCO appreciates the opportunity to comment on the Plan and to work with EPA and other parties to resolve these and other issues that may arise as the remedial plan evolves.

<IMG SRC 0894102BW> GOV

United States Department of the Interior <IMG SRC 0894102BX>

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
FEDERAL BUILDING, US COURTHOUSE
301 S PARK
P O BOX 10023
HELENA MT 59626

IN REPLY REFER TO:
10,152 D

February 23, 1994

Mr. Russell W. Forba
Remedial Project Manager
U.S. Environmental Protection Agency
Region VIII, Montana Office
Federal Bldg., 301 S. Park, Drawer 10096
Helena, MT 59626-0096

Dear Russ:

As part of Interagency Agreement DW14932668-01-3 in which the U.S. Fish and Wildlife Service (Service) provides technical assistance to the U.S. Environmental Protection Agency, we have reviewed the Butte Mine Flooding Operable Unit Preliminary Draft Feasibility Study Report (FSR) and the Nine flooding Operable Unit Proposed Plan, and we have the following comments.

The Migratory Bird Treaty Act of 1918 (MBTA), as amended, 16 U.S.C. 703 et seq and the Bald Eagle Protection Act of 194Q (BEPA), as amended, 16 U.S.C. 668 et seq are not listed in the Draft Screening and Description of Potential Applicable or Relevant and Appropriate Requirements (ARARs) in Appendix Y of the FSR. Similar to the Endangered Species Act, both the MBTA and BEPA are federal location-specific ARARs and should be included in the appropriate section.

We realize that the proposed plan is generic and that the detailed construction design will be done during Remedial Design\Remedial Action after signing of the Record of Decision. However, we recommend that the treatment sludge disposal facility be designed to prevent exposure of migratory birds to the sludge. This sludge will contain elevated metals and arsenic concentrations, and any water ponding on the surface may attract waterfowl and shorebirds.

We agree that if the "ultimate ARAR for all projects relating to discharge of waters to Silver Bow Creek . . . are "Gold Book" criteria including chronic water quality criteria" (FSR, Appendix Y, page 30), the proposed remedy will be protective of the Silver Bow Creek aquatic environment. We would recommend that the Mine Flooding remedy design be coordinated with the remedy for the Streamside Tailings and Lower Area One Operable Units so that the Mine Flooding discharge will not affect the Silver Bow Creek channel.

These comments are provided as technical assistance only and do not constitute a position the Department may take in the future regarding possible injury to natural resources.

If you have any questions concerning our response to your letter, please contact Bill Olsen at (406) 449-5225. We look forward to working with you during the cleanup at the Berkeley Pit.

Sincerely

Kemper McMaster
Field Supervisor
Montana Field Office

cc: Environmental Contaminant Coordinator, ES, Region 6, F#S, Denver, CO (Attn: Patty Stevens)
Regional Environmental Officer, Office of Environmental Affairs, DOI, Denver, CO

ENVIRONMENTAL
PROTECTION AGENCY

MAR - 1 1994

MONTANA OFFICE

BSB

BUTTE-SILVER BOW
Courthouse
BUTTE, MONTANA 59701

OFFICE OF
CHIEF EXECUTIVE

AREA CODE 406
PHONE 723-8262

DATE April 27, 1994

TO: U.S. Environmental Protection Agency
Russ Forba, Remedial Project Manager

FROM: Butte-Silver Bow Local Government
Chief Executive Jack Lynch and Council of Commissioners

RE: Attached are the documents that represent Butte-Silver Bow's comments on the Berkeley Pit Remedial Investigation/Feasibility Study and Proposed Plan

1) Council Resolution No. 1635
-- Authorizing submission of formal comments

A) Exhibit A (to Resolution)

A1) Formal comments as reviewed and approved by the Council and Chief Executive (eight-page document, including one-page summary)

A2) Technical comments -- as a supplement to the formal comments of the Council addressing several specific details regarding the RI/FS; attached is a 2/25/94 letter to Forba/EPA from Dr. Robert G. Robins

B) Exhibit B (to Resolution)
– All public comments, letters, and documents received by the County, both in response to the County's formal position paper as well as the RI/FS & Proposed Plan, including:

B1 Excerpts from minutes of Council of Commissioners Regular Meeting, 4/6/94;

B2 Written testimony, John W. Ray, Butte, MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners;

B3 April 11, 1994 letter from Mary Kay Craig, Clark Fork Coalition, Butte, MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners; also includes a technical paper, Hazardous Wastes from Large-scale Metal Extraction: The Clark Fork Waste Complex, MT, by Johnnie Moore, University of Montana, and Samuel N. Luoma, USGS, Menlo Park, CA;

B4 Written testimony, Rep. Fritz Daily, District 69. Montana Legislature, Butte. MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners: also includes a copy of House Joint Resolution No. 13. Montana Legislature re: support for the National Environmental Waste Technology Testing and Evaluation Center in Butte;

B5 Written comments to Jack Lynch, from Ray Tilman, Montana Resources, in response to first draft of County position paper

B6 Technology Profiles Sixth Edition, Superfund Innovative Technology Evaluation, as submitted by Irving W. DeVoe, Metanetix, Butte, MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners;

B7 Written comments, Albert Molignoni, Rocker, MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners; also includes a POWERSHAFT LIMITED proposal on the creation of water storage systems and high efficiency electric generation with Pit water;

B8 Written comments, letter to Jack Lynch and Council, from Ms. Sandy Stash, ARCO, Anaconda, MT, as a supplement to oral remarks made at 4/6 meeting of Commissioners:

B9 Excerpts from minutes of Council of Commissioners Regular Meeting, 4120194;

B10 April 20, 1994 letter to Jack Lynch and Council, from Rep. Fritz Daily, Butte, MT, as a supplement to oral remarks made at 4/20 meeting of Commissioners;

B11 April 20, 1994 letter to Jack Lynch and Council, from Mary Kay Craig, Clark Fork Coalition, Butte, MT, as a supplement to oral remarks made at 4/20 meeting of Commissioners;

B12 April 20, 1994 letter from Barbara Archer, Butte, MT, submitted as written testimony at 4/20 meeting of Commissioners:

GEORGE H. WARING
518 WEST GRANITE ST.
BUTTE, MONTANA 58701

Mr. Russ Forba April 6, 1994
U.S. EPA
301 South Park Street
Helena, MT 59626

Dear Mr. Russ Forba:

I have been asking my colleagues in the Humanities/Social Sciences Department to sign the Clark Fork Coalition's petition opposing your agency's proposed solution to the clean-up of the Berkeley Pit in Butte. I can honestly report to you that among my colleagues--who possess to a person graduate degrees--there is a deep distrust of the EPA's solution. The most common response to this proposal to allow the Pit to continue to fill up with acidic water for another twenty plus years is "That is just what ARCO wants. What else could you expect of the EPA?"

I have lived in Butte since 1967. I have heard stories from my neighbors, students and friends about the way in which federal funds for the Model Cities Program made their way into the pockets of a variety of special interest groups who knew how to the work the political process better than the citizens who lived in the affected neighborhoods. Now, I am hearing the same stories about the way the "high-and-the-mighty" have put in "the fix" to protect their economic interests at the expense of the health and welfare of this community.

I believe the EPA's proposed solution simply adds to a growing feeling among average citizens that our political system, our government, and the agencies that should be protecting the public interest have all been "bought." As an individual who has, since reaching adulthood, worked within the two-party system to make democracy work, I am more than disappointed with the EPA's proposal. If we are forced to accept the filling of the Pit still further over decades, the last shred of my youthful idealism will vanish. Perhaps the cynics are right. The "system" is so corrupt that nothing but fundamental reforms are required to make the government responsive. It is almost as if the EPA was working with Ross Perot to convince Americans that their government has been taken captive by the lobbyists of the multinationals.

I can only hope that you--in your privileged position--will be guided by the real health and welfare interests of this old mining town. As a resident of Helena, it is expected here that you will never have to face responsibility should that water contaminate all the ground water in this area and the headwaters of rivers that flow to the Pacific. As a resident of Helena, it is feared that you will have no empathy for the folks who live "downstream" from the Pit. As a resident of Helena, it is expected that the lobbyists for the corporate barons have your ear. You have the magnificent opportunity--a once-in-a-lifetime chance--to prove these expectations mistaken and that the government can act ethically.

Sincerely,

George H. Waring

ENVIRONMENTAL
PROTECTION AGENCY

APR - 8 1994

MONTANA OFFICE

April 29, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

Mr. Russ Forba, U.S. EPA
301 S. Park
Helena, MT 59626

Dear Mr. Forba,

I want the EPA to do something about the Berkeley Pit NOW. We need to begin processing the pit water NOW. There are too many unknowns to wait until 2022.

The EPA needs to allow competition and market forces to compete for workable solutions.

The EPA must look at new technologies, regardless of their cost. There are so many unknown hidden variable costs connected with allowing the pit water to continue to rise that the only way to really save money is to do something constructive NOW.

Please! Please! Take action now to find a solution to the rising contaminated water in the Berkeley Pit.

Sincerely,

Marian C. Conklin
4400 Western Blvd.
Butte, MT 59701

(406) 494-3902

M. CONKLIN
4400 Western Blvd.
BUTTE, MT 59701

MR. RUSS FORBA, U.S. EPA
301 S. PARK
HELENA, MT 59626

<IMG SRC 0894102BY>
<IMG SRC 0890102BZ>
<IMG SRC 0894102C>
<IMG SRC 0894102CA>
<IMG SRC 0894102CB>
<IMG SRC 0894102CC>

April 28, 1994

ENVIRONMENTAL
PROTECTION AGENCY
MAY 03 1994
MONTANA OFFICE

Kevin and Cindy McGreevy
2709 Bayard
Butte, MT 59701

Mr. Russ Forba
U.S. EPA
301 S. Park
Helena, MT 59626

Dear Mr. Forba:

We protest and object to the proposed plan for the Berkley Pit. We feel that the plan is inadequate and that immediate action should be taken to resolve this serious problem. We are alarmed that procrastination is considered a viable option in addressing this problem. It is our understanding that the EPA was formed to PROTECT the environment as well as the inhabitants thereof. Procrastination is NOT protection.

ARCO entered into the minerals business with the same short-term, immediate profit motives that applied to their oil/gas operations. They picked up the Anaconda properties for a song, with no long term commitments to that operation in mind. Well, mining is a long term investment, and unfortunately, the effects of mineral extraction are even longer- as ARCO is now finding out.

When the Butte operations were terminated, the bottom line dictated that it was no longer profitable to perform mineral extraction. So let it sit in the ground until the economic climate changes. Their attitude was one of: It isn't going anywhere. So shut it down. We'll take it later. But, ARCO, in purchasing the Anaconda properties, became the steward of those properties. Now those properties are harming my town, my valley, and my state.

You and your agency are mandated by your charter to PROTECT our environment. We, as taxpayers, require that you do so! We require ARCO to act immediately in preparing a site plan for total cleanup of the Berkley Pit toxic waters. This plan will include actions to prevent future contaminations from their properties.

Aside from ARCO touting age-old precipitation methods as the cleanup instrument, new technologies which yield far better results such as kelation chromatography are currently employed to perform this type of cleanup. This method could be used IMMEDIATELY, not twenty or thirty years down the road.

The Berkley pit and its surrounds pose many environmental, economic and social problems for the community of Butte. But, mining is our heritage and our future. We need to learn from our past mistakes and misuse, not perpetuate the indifference and short-sighted attitudes which led us up to this point. The mining barons that bore into this hill, erected the smelters, and ultimately poisoned the valley over the last century did so in the name of greed and progress. Greed lined the pockets of the barons, the bosses, the miners and the politicians and progress made us blind to anything unsavory around us. They knew that there would be hell to pay. Someday. But, someone else would pay it, not they.

Well, we as a society grew up- a little. We became a little less indifferent, we learned from the past- a little. Your agency was created and YOU have a job to do: LEVY WHATEVER FORCE IS NECESSARY TO INSURE THAT THIS ENVIRONMENTAL PROBLEM IS ELIMINATED. Yes, they will kick and scream and cry, "It's NOT our fault!" But that was the bed they made when they purchased the Anaconda operations.

This is our home, protect it.

Sincerely,
Kevin and Cindy McGreevy

<IMG SRC 0894102CD>

Clifford and Rita Bradley
1923 Argyle Street, Butte, Montana 59701

April 28, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

Russ Forba
301 S. Park
Helena, MT 59626

Dear Mr. Forba:

We are writing in opposition to the current EPA-ARCO remedy plan for the Berkeley Pit for the following reasons. We are concerned regarding the danger to public health due to the risk of contaminants getting into the aquifer. We do not feel our children should inherit our problems--such a legacy as the problem of the Pit is too drastic to pass on to a future generation(s). We want to be sure there is room for new and more innovative technologies in the plan. These technologies could turn out to be cost-effective. However, irregardless of these costs, the long-term costs in terms of danger to human health and the environment cannot easily be put into dollar terms.

We urge you to re-consider the current plan to address the Berkeley Pit. Thank you for your consideration of this important matter.

Sincerely,

Clifford Bradley

Rita Bradley

Bradley
1923 Argyle St.
Butte, MT 59701

Russ Forba
U.S. EPA
301 S. Park
Helena, MT 59626

<IMG SRC 0894102CE>
<IMG SRC 0894102CF>
<IMG SRC 0894102CG>
<IMG SRC 0894102CH>
<IMG SRC 0894102CI>
<IMG SRC 0894102CJ>

April 27, 1994

Mike and Debra Evankovich
3207 Amherst
Butte, MT 55701

ENVIRONMENTAL
PROTECTION AGENCY

APR 29 1994

MONTANA OFFICE

Mr. Russ Forba
U.S. EPA
301 S. Park
Helena, MT 59626

Dear Mr. Forba:

We protest and object to the proposed plan for the Berkeley Pit. We feel that the plan is inadequate and that immediate action should be taken to resolve this serious problem. We are alarmed that procrastination is considered a viable option in addressing this problem.

As members of this community, we expect ARCO to take responsibility and commit to total cleanup of the toxic pool which has accumulated to date. We feel strongly that measures should be taken to prevent further contamination.

Surely there are less antiquated processes available in 1994 than those in the current plan. Can new technologies like Kelation Chromatography be used NOW to begin the cleanup?

The Pit poses many problems for the community of Butte including environmental, economic and social issues. We find it unacceptable to plan for perpetual care of a hazardous situation, a poison pool, a potential disaster waiting to happen. IT IS ESSENTIAL THAT CLEANUP BEGIN IMMEDIATELY!

Sincerely,

Mike and Debra Evankovich

ENVIRONMENTAL
PROTECTION AGENCY

APR 29 1994

MONTANA OFFICE

April 27, 1994

Mr. Russ Forba
EPA
301 S. Park
Helena, MT 59626

Dear. Mr. Forba:

I have been to several hearings and reviewed the documents pertaining to the EPA and ARCO's remedy for the Berkley Pit.

I oppose the plan to let the fit pill to the proposed critical level and not build a treatment plant until the next century. What this does is create a 600-acre waste pile that does not assure protection of the local aquifer, Silver Bow Creek and downstream resources. It puts off a solution to the problem and continues to threaten the viability of Butte. The result is that people and businesses are discouraged from locating here. More seriously, it shows a lack of concern for the health and safety of Butte people.

To begin to create a solution now would be good for the environment, the economy and the peace of mind of all Butte residents. Please consider a treatment plant now, or alternatively, some of the mineral extraction possibilities mentioned by various companies in recent newspaper articles.

Sincerely,

Kay Joslin
114 S. Jackson
Butte, MT 59701

<IMG SRC 0894102CK>
<IMG SRC 0894102CL>
<IMG SRC 0894102CM>

ENVIRONMENTAL
PROTECTION AGENCY

APR 28 1994

MONTANA OFFICE

2328 Grand Avenue
Butte, Montana 59701
April 27, 1994

Mr. Russ Forba
Environmental Protection Agency
310 So. Clark St.
Drawer 3016
Helena, MT. 59601

Dear Sir:

At our attendance last night of the meeting to discuss the future of the Berkeley Pit in Butte, we were informed that we might express our feelings in this manner, by writing to you before April 29.

Our home is located relatively close to the Pit, and we have a well which supplies us with drinking water as well as watering for our lawn and garden. If the water in the pit is allowed to rise to the "critical water level" it would be within 50 feet of when water would discharge into the alluvial aquifer, thereby posing a most dangerous position for those of us who pump water in this area. We were informed a few years ago of a person who lives within six blocks of our home who already has been restricted in well digging because of the condition of the water. Therefore, we are standing on the feeling that it is dangerous to wait until the level reaches 5410 feet. Let us do something in the immediate future to protect the health and welfare of the citizens of Butte. It cannot be too soon.

Yours truly

<IMG SRC 0894102CN>
<IMG SRC 0894102CO>
<IMG SRC 0894102CP>

Frank L. and Ruth L. Rosich
2328 Grand Avenue
Butte, MT 59701

Mr. Russ Forba
Environmental Protection Agency
310 S. Clark St.
Drawer 3016
Helena, MT 59601

<IMG SRC 0894102CQ>

CHEMICAL INTERACTIONS IN SULFIDE TAILINGS

The ferric ion will also oxidise the sulfide minerals. The overall reactions without showing intermediates can be represented:

Chalcocite: $Cu2S + 10Fe3- + 4H2O = 2Cu - 10Fe^{2} - - HSO - H$

Covellite: $CuS + 8Fe3- + 4H2O = Cu^{2} - 8Fe3 - HSO - 7H$

Chalcopyrite: $CuFeS2 + 16Fe3- - 8H2O = Cu^{2}- + 17Fe3- + 2HSO - 14H$

Bornite: $Cu\ FeS4\ \_\ 36Fe3- - 16H2O = 5Cu^{2}- - 37Fe^{2}- - 4HSO4 - 28H$

The pH of these reactions of the ferric ion with sulfides has been assumed here to be below pH = 2 where the SO2/4 HSO equilibrium exists. Above pH = 2 the equations would involve SO2/4 rather than HSO . It is likely that several intermediate steps are involved in each reaction and, as with bornite oxidation4, intermediate solid phases (Cu3FeS4) may be formed and may slow the overall reaction. Also elemental sulfur may form as an intermediate but this is possible only at low pH, high sulfate concentration and low metal ion concentration in solution. This latter situation sometimes occurs in sulfide tailings. The reactions of the ferric ion with sulfides also involves the action of oxygen in the air which will oxidize ferrous ion back to ferric species:

$4Fe^{2}- + O2 + 4H = 4Fe + 2H2O$

$4Fe^{2}- + 3O2 + 2H2O = 4FeOOH$

These reactions are accelerated many orders of magnitude by the influence of bacteria such as Thiobacillus ferrooxidans3. The presence of ferric sulfate can lead to precipitation of basic ferric sulfates (and jarosites with Na-, K- etc.)

$3Fe3- + 2SO2/4- + 6H2O = HFe3(SO4)2(OH) + 5H$

$3Fe3- + 2SO2/4- + 6H2O + K- = KFe3\ (SO4)2(OH) + 6H$

The mineral goethite (α-FeOOH) which is shown as a product in several of the above reactions is in fact ferrihydrite15 which is a less crystalline material with large surface area and capable of forming a broad range of iron bearing materials (gossans). Thus the supergene alteration of sulfides allows the binding of cations of Cu, Co, Ni, Pb, Zn, Cd, etc.16 and at lower pH the anions of As, Se, Sb, etc. These reactions result in the formation of laterites with numerous poorly crystalline and amorphous phases and are thus "scavengers" which collect and accumulate metals from the solution which may migrate through the laterite. Adsorption plays a very important part in the first stages of these reactions.

Reactions in the Reduced Zone in Sulfide Tailings

There has been virtually no investigation of the reasons which occur in the reduced zone of a tailings heap. It has been assumed that metal ions liberated in the oxidised zone will reprecipitate as sulfides in the reduced zone but that eventually she oxidation front will proceed to the bottom of the tailings. In the reduced zone of a sulfide tailings heap (or pond) the anoxic conditions will lead to the generation of soluble sulfides (mediated by the action of microorganisms). It was mentioned earlier in this paper that there were the soluble complexes of iron. Fe(HS)2 and Fe(HS)3. It is also known that many other metal sulfide complexes exist (see Table 11) and that metal sulfide minerals are soluble (to some extent) in sulfide solutions. Khodakovskiy has discussed the transport of heavy metals in the form of hydrosulphides, giving specific data for the solubilities of the sulfides of Fe, Zn, Pb, Ag, Cu, Co, Cd and Hg.

The solubility of gold and silver in high temperature sulfide solutions has been widely investigated also to explain transport in ore forming solutions. The solubility of copper sulfides in sulfide solutions has been studied by several authors8-20. In 1959 a number of papers on the solubility of metal sulfides in sulfide solution and the various thiocomplexes involved were published together in the journal Geoinimica et Cosmochimica Acta21. Although most of the published work has been conducted at elevated temperature, it has indicated that there is an appreciable solubility of metal sulfides in sulfide solutions at ambient temperature. Some of the metal thiocomplexes that have been proposed together with free energies of formation are given in Table 11. The influence of the polysulfide ions S1/2-, S1/3-, S1/4-, S1/5-, and S2/ - on the solubilities of sulfide minerals has also been considered to be appreciable18.

TABLE II
Some metal thiocomplexes and polysulfides and their free energies of formation as given in Naumov et al.12

Species	▲G keal	Species	▲G keal
AgHSu	-2.1	Hg(HS)	-6.4
Ag(HS)2	-1.0	HgS	-10.0
CdHS	-29.6	Pb(HS)	-20.9
Cd(HS)	-35.4	Pb(HS)	-19.8
Cd(HS)	-35.5	Zn(HS)	-49.8
Cd(HS)	-35.6	Zn(HS)	-48.5
Co(HS)	-18.3		
Co(HS)	-19.6	Si	-19.0
Cu(HS)	-11.1	Si	-17.6
Fe(HS)	-28.5	Si	-16.5
Fe(HS)	-28.4	Si	-15.7

In a sulfide tailings heap it is considered that there is an oxidised zone and a reduced zone. The reactions leading to the oxidised zone were discussed in the previous section of this paper. The reactions in the reduced zone have not been considered in the usual models for determining the chemical stability of tailings. At the interface of the two zones there will be interactions between dissolved oxygen and dissolved sulfide and these interactions will almost certainly be mediated by microorganisms. Jorgensen and Revsbech22 have shown the influence of the colourless sulfur bacteria Berggiatoa spp. and Thiovulum spp. at the oxygen-sulfide interface in sediments. This interface was shown to exhibit very sharp oxygen and sulfide gradients above and below it, and it is likely that the same generals conditions will exist in sulfide tailings. Davidson23 has reviewed what has been reported as measured solubilities of ferrous sulfide in natural waters, and claims that there is an apparent increase in the solubility product with depth for the reaction:

FeS - H = Fe - HS

which is probably due to the associated potential gradient. The solubility of FeS in sulfide solution can be simply considered in terms of the pH dependent equation above and can be illustrated by reference to Figure 1 However, the existence of the proposed ferrous sulfide complexes leads to additional solubility equations:

FeS - H2S = Fe(HS)

FeS - H2S0 - HS = Fe(HS);

The dissolution of pyrite in the reduction zone is likely to be more complex and to involve polysulfide ions:

FeS2 - H = Fe^{2}- - HS2

FeS2 - 3HS- - H = Fe(HS)3 + HS2

Similar sulfide complexes proposed19 to explain the solubility of covellite lead to the equations:

CuS + H2S0 + HS- = Cu(HS)3

CuS + 3HS- = CuS(HS)

Shea and Heltz20 have interpreted covellite solubility data in terms of the complexes CuS(HS)½- and CuS(HS)3/3-, and the polysulfide complexes Cu(S5)3/2-. Cu(S4)(S5)3- and CuS(S5)2- for which they give stability constants. Arsenic is often present in sulfide mineral assemblages in the form of the individual arsenic minerals shown in Table I and many others. The solubility of these minerals in sulfide solutions has not been directly measured but the solubility of orpiment in sulfide solution has had considerable attention as reviewed by Spycher and Reed24. Stability constants have been proposed variously for HAsS0/2 AsS2-, H2As2S0/4, HAs2S4-, As2S2/4-, H3As3S0/6, H2As3S6-, and As2S2/4-, and well documented solubility measurements on As2S3 in sulfide solutions show extremely high values in the neutral to alkaline region.

The author has calculated a number of solubility diagrams (log activity vs. pH) for some of the sulfide minerals in sulfide solution using free energy data from the literature cited above. The diagrams were generated using the program DIASTAB26 which is one of many which are available for that purpose. These diagrams indicate that the solubilities in some cases are small, but sufficient to generate solute ions in the reduction zone of wet tailings. The solubilities (in activity units) of iron sulfides in sulfide solution are shown in Figure 3 and those for copper sulfides in Figure 4. In these diagrams pε7 values, decreasing from pε7 = -4, relate to a decreasing potential in the reduction zone. On a pεpH diagram the pε7 value indicates the position of a solubility scan on a line which is parallel to the SO2/4-HS- interface. For example the scan at pε- = -4 is a line passing through pε = - 4 at pH = 7 and its position is shown on Figure 1.

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The solubility region for the copper sulfides in sulfide solutions as shown in Figure 4 as indicated on the pε-pH diagram for the copper-sulfur-water system in Figure 2 as a hatched area. This solubility region was not generated by the pε-pH computer calculation due to the "predominant ion" limitation which applies to the particular program used here (this limitation exists in most programs which generate potential-pH diagrams).

It is assumed here that the reduction zone lies below the sulfate-bisulfide inter-face. However, it is likely that the real redox interface is kinetically controlled and so may relate to the S2O2/3- HS- couple with an influence from other sulfoxy anions and polysulfides.

The above brief discussion on the solubility of sulfide minerals in sulfide solutions and the likely mediation of the associated reactions by microorganisms leads to an obvious application to the chemistry in sulfide tailings. These considerations have not previously been put forward in modeling the chemistry of such tailings.

Attempts to model the chemical reactions in sulfide tailings have had to deal with the complex chemistry which is very much simplified above. In most of the models the oxidation of pyrite to produce acid is taken as the controlling reaction and rate equations based on the Singer and Stumm proposals18 have been used. It has further been assumed that oxidation will commence at the top of a tailings deposit and proceed to the bottom and that the solutions generated will percolate to the bottom and if allowed to escape could carry the solutes into ground water.

A CASE STUDY

A very detailed study has been conducted of the sulfide tailings left at Anaconda. Montana, USA after more than 100 gears of copper smelter operations26. Today these tailings consist of about 150 million cubic metres of material covering a total area of 2,500 hectares (about 9 square miles) at an average depth of tailings of 6 metres. In this study more than 100 wells were inserted through the tailings, some into the alluvium below the tailings. Although the mineralogical characterisation of the tailings was difficult a good indication of solid phase concentrations of selected metals was obtained. Solute concentrations in the tailings pore water and in the groundwater were measured and a geohydrologic characterisation of the site determined.

The geochemistry report on the Anaconda tailings predicted future water quality conditions within beneath and downgradient of the tailings. The predictions were made primarily with geochemical models including MINTEQ22 and groundwater transport models and additional models developed to simulate leachate generation from the tailings. Acid production in the tailings was determined from the simulation of pyrite oxidation with a rate constant which was "based on the literature reviewed." The executive summary in this report stated that model predictions indicate that the oxidising zone will move downward until it eventually reaches the bottom of the tailings ponds" and went on further to say that this would take a period of 10,000 to 50,000 years depending on the locality. During this oxidation period it was predicted that the major ions such as calcium and sulfate would move through the reduced zone into the groundwater, but that arsenic, cadmium, copper, lead and zinc would precipitate as metal sulfides in the reduced zone and be further retarded by adsorption.

In the Anaconda tailings study no consideration has been given to the possibility of leaching in the reduced zone due to the formation of sulfide complexes of the metals, yet there is very strong evidence of that having happened. Early in 1985 eighteen boreholes were drilled through the tailings to penetrate the underlying alluvium and continuous cores were taken in these boreholes. Ten of the boreholes were completed as screened wells in the tailings for future water sampling. The cores were logged and sealed in tubes to await analysis. All aspects of the investigation were well prepared and competently executed and the thorough reports on the project are an excellent source of information for future study. However, many assumptions were made and the conclusions reached in several areas are not based on a complete understanding of tailings chemistry. The chemical analysis of core samples has been well documented and supported with excellent indicators of quality assurance and quality control.

The chemical analysis of the core samples from the Anaconda wells is shown graphically in the final geochemistry report with bar charts of element concentration versus depth from the tailings surface, extending in some instances into the alluvium. These analyses have not been extensively examined to obtain information about chemical interactions but there is obvious evidence for the loss of certain metals in the reduced zone of the tailings together with a loss in sulfide sulfur. This gives support to the proposal that the solubility of sulfides in the reduced zone are a very important aspect of the chemical model for sulfide tailings. Figure 5 is a diagram illustrating the general trend of some of the element concentrations (x axis) with depth (y axis) in the Anaconda tailings well-cores. It is a trend which is exhibited by other elements in many of the analyses reported, and a more detailed examination of the results should be conducted.

CHEMICAL MODELS

A knowledge of the various species present in tailings and an understanding of the chemical reactions likely to occur would enable very useful predictions in terms of environmental impact.

The calculation of trace element speciation using mathematical models based on thermodynamic and kinetic concepts has become popular during the past twenty years and some complex and very useful computer codes have been developed. Some of these codes have been applied to the calculation of the formation and movement of trace metal species in saturated and unsaturated zones of tailings and the chemical interactions that occur with sediments, alluvium and bedrock. The application of these models to complex systems clearly presents some problems; in particular the presence of unknown solutes or complex ions that have not been thermodynamically characterised, interactions with complex organic materials (humic and fulvic substances) and the presence of colloidal material of uncertain mineralogy. As a result of these problems the application of the various codes to a complex system such as tailings cannot be expected to give precise answers, but can certainly indicate likely trends.

Table III indicates some of the computer codes which include chemical speciation modeling that have been developed over the past thirty years. A review of those codes which are currently of interest has been published by Waite[28] and there are several chapters on these codes in the book "Chemical Modeling in Aqueous Systems II"[29]. The program which seems to be used most widely at the present time is MINTEQA2 and version 3 is now available[30] with capabilities which will allow adsorption processes to be considered. The complexities which are introduced by considering the adsorption of different species onto other mineral add further to the inaccuracy of model predictions.

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CHEMICAL INTERACTIONS IN SULFIDE TAILINGS

TABLE III
Some of the Computer Codes Involving Chemical Modeling of Aqueous Systems

LETAGROP	(1962)	MINTEO	(1983)
HALTAFALL	(1967)	MICROOL	(1979)
COMICS	(1967)	CHEMEQUIL	(1986)
COMPLEX	(1976)	EQ3/6	(1979)
SIAS	(1977)	SOLVEQ	(1982)
WATCHEM	(1973)	PHREEQE	(1980)
WATEQ	(1974)	THERMOCHEM	(1987)
WATSPEC	(1977)	RIVEQL	(1982)
SOLMNEQ	(1973)	MEXAMS	(1985)
REDEQL	(1972)	FIESTA	(1982)
MINEQL	(1976)	TRANQL	(1986)
REDEQL UMD	(1984)	DYNAMIC	(1986)
GEOCHEM	(1980)		

CONCLUSIONS

The generation of tailings from the processing of sulfide minerals has led to various environmental problems which are mostly related to groundwater contamination. Many of the metal contaminants in these waters have been identified and are often monitored continually, but the precursor chemical reactions are not fully understood and many of the chemical species involved have not been identified. Attempts to predict the future chemistry of tailings has to date been very inaccurate. The computer programs that have been developed for this purpose will give good indications for simple systems of known chemistry but for complex systems involving tailings the predictions are poor. Problems of adsorption further complicate any predictions.

In order to design tailings systems for mineral processing wastes prior to mine development, the tailings materials must be evaluated for their potential to release acid and metal solutes. The use of existing data from similar tailings disposal areas (such as the Anaconda data) can provide a good indicator of drainage quality, but such data have not been adequately examined in terms of the actual chemical reactions occurring. Investigations similar to those conducted at Anaconda should be continued, and re-examined with a more fundamental approach since the data from those studies are rarely available.

Due to the various uncertainties mentioned above it is really necessary to conduct predictive tests with a new to sitting and construction of a tailings disposal area in relation to the potential environmental impact. Solid phase characterisation and dissolution experiments should be undertaken. Solid phase characterisation can be performed fairly quickly using such techniques as x-ray diffraction, optical and electron microscopy, electron probe microanalysis (and others) combined with chemical analysis.

Techniques useful in predicting mine waste drainage problems have been discussed by Lapakko and Ferguson and Erickson31. The use of shake-flask leach and humidity cells tests have been recommended32, but the best simulation is obtained in column tests23. Column tests allow for the formation of stratified zones which are similar to those which form in a real tailings situation, but most of these tests have been conducted in columns that are too short in relation to the height of the proposed dump and do not allow for the formation of a reduced zone in the lower section. The column test is not an accelerated test and hence does not reveal long term interactions, but such tests should be set up and run for many years to observe the chemical changes that will occur in tailings.

Short term testing for the leachability of metals from wastes needs also to be considered. In the United States in 1989 the Environmental Protection Agency introduced the EPA leaching procedure Method 131234, with a rather arbitrary protocol using sulphuric acid/nitric acid pH = 4.2, to initially characterise wastes.

The prediction of long-term behaviour from these tests is not possible. It is obvious that there is enormous uncertainty in relation to the chemical speciation, reactions, and prediction of behaviour of metal sulfide tailings. These areas all need much further investigation.

The references cited here are a select list of books, proceedings, reports and papers which provide some further information about the subject which has been addressed here.

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ADMINISTRATIVE RECORD

April 21, 1994

U.S. Environmental Protection Agency
Butte, MT Office

Montana Department of Health &
Environmental Sciences
Helena, MT

Citizens Technical Environmental Committee
Butte, MT

Ref: Butte, MT
Mine Flooding

Dear Ladies and Gentlemen:

The following are my comments and concerns about the rising water in the Berkeley Pit, the Butte Hill and the surrounding area:

I recognize the fact that the Berkeley Pit and the old underground workings of the Butte Hill are acting as an inverted cone (cone of influence).

I am in favor of the proposed additional monitoring wells in the southeast quadrant of the Butte Hill. Hopefully the question of concern about possible migration of waters away from the Berkeley Pit in this area can be answered.

The question in my mind for this area is whether or not because of heat and pressure, the Berkeley Pit water may be moving in a south-south easterly direction and if so, are these waters being influenced by the Continental fault and old mine workings?

I believe that a outer water monitoring system west of the Butte Hill - Summit Valley aquifer should be implemented to identify any irregularities as to water flow and what elements are contained within these waters. I would like to see quarterly monitoring and a quarterly reporting of those results.

Because of the geological complexity of the Butte area having large land areas influenced by old mine workings, faults, vein structures, aplite and rhyolite dikes west of Butte, the following location would be my recommendation for a Headwater Alert System:

- The Bull Run Creek Drainage flow monitoring and testing station.
  Located in the Northeast Quarter of the Northeast Quarter (NE1/4 NE1/4), Section Thirty Two (32), Township Four (4) North, Range Eight (8) West, P.M.M.
- The Oro Fino/Beef Straight Drainage flow monitoring and testing station.
  Located in the Northwest Quarter of the Southeast Quarter (NW1/4 SE1/4), Section Six (6), Township Three North, Range Eight (8) West, P.M.M.
- The Browns Gulch Drainage flow monitoring and testing station.
  Located in the Northwest Quarter of the Southwest Quarter (NW1/4 SW1/4), Section Fourteen (14), Township Three (3) North, Range Nine (9) West, P.M.M.
- The Whiskey Gulch Drainage flow monitoring and testing station.
  Located in the Northwest Quarter of the Northeast Quarter (NW1/4 NE1/4), Section Twenty Two (22), Township Three (3) North, Range Eight (8) West, P.M.M.
- The Gimlet Gulch/Rocker Drainage North flow monitoring and testing station.
  Located in the Southeast Quarter of the Southwest Quarter (SE1/4 SW1/4), Section sixteen (16), Township Three (3) North, Range Eight (8) West, P.M.M.

ALSO

- The existing gaging station at the Colorado Tailings and at Miles Crossing should be upgraded for said flow monitoring and testing of waters and be incorporated into the above mentioned Head Water Alert System, ALSO

- In addition to the water levels monitoring conducted by the Montana Bureau of Mines & Geology, I would like to see the Orphan Girl Shaft placed on their elevation comparison data sheet.

- I would like to see either the Nettie or Norwich Mine water levels monitored. By this action, water levels can be checked east and west of the Whiskey Gulch fault.

It is my belief that this fault system may shed some light to possible water discharge from the Butte Hill aquifer.

The intent of my proposal is to have, in place, a way of checking whether or not these drainages are gaining or losing in water flow and whether or not these waters may be contaminated.

Because of the complexity of the Butte Hill's geology and two billion tons of ground disturbance, the outer limits of the potentiometric surface is truly not known.

By having this Headwater Alert System in place, it may give our community some time to correct problems if they should arise.

Respectfully yours,

cc:file
MR:sr

Recreational Industry

The added water supply would insure a increase in the recreational industry in Montana. A sufficient water supply would increase the feed products for the big game and fishing industries. Additional quantities of water would also benefit such industries as boating, skiing, and other related activities heavily reliant on an adequate water supply. The potential of the state's ice storage units is 20 million or more in acre feet of water.

Summary

Upon the states adoption of this type of ice storage and high efficiency energy system, a meeting should be set up with a group of professional people with the expertise on this subject matter. The meeting would have to be held in strict confidence because of many ideas I have on the subject matter that may be patentable. Compensation is also a factor that has to be dealt with due to the many years of time, effort, and expense that were necessary to create this system.

OUTER CAMP
Water Quality
2/15/1994

DISSOLVED CONCENTRATION

SITE	Lab Analysis	DATE (mm/dd/yy)	TIME (HRS)	Fe (mg/l)	Mn (mg/l)	HC03 (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	Al (ug/l)	Cd (ug/l)	Cr (ug/l)	Cu (ug/l)	Pb (ug/l)	Zn (ug/l)	As (ug/l)
ORPHAN BOY	MBMG	1/27/1987	14:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MBMG	5/28/1987	12:40	.25	8.84	905	14.5	702	13	<30	<2	<2	12	N/A	10	90.0
	MBMG	6/25/1987	11:25	.27	8.18	N/A	N/A	N/A	N/A	<30	<2	<2	<2	N/A	22	18.0
	MBMG	5/31/1988	17:10	.57	7.67	939	14.5	638	.06	<30	<2	<2	<2	N/A	29	12.0
	MBMG	6/29/1988	17:10	.46	8.04	915	14.5	648	.07	<30	<2	<2	<2	<40	46	175.0
	MBMG	11/8/1989	15:50	.24	7.28	854	14.5	587	.07	<40	<5	<5	<4	50	24	6.1
	MSE	5/29/1991	14:51	.10	6.28	1020	N/A	507	.70	123	0	8	18	1	11	32.3
	MSE	9/3/1991	15:05	1.73	5.79	561	N/A	554	3.60	204	3	5	39	2	296	21.8
SURFACE	MSE	5/29/1991	17:15	1.10	6.48	N/A	N/A	492	.60	101	0	8	17	1	95	4.9
SEEP	MSE	9/6/1991	15:11	1.19	6.58	561	N/A	635	.90	181	3	5	33	3	41	2.9

BERKELEY PIT QUESTIONS

1. Did the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's know beforehand that allowing the Berkeley pit to fill up to the 5,410 elevation with toxic water - the bedrock aquifer would also have to be written off? If so, why wasn't it explained much sooner to the people of Butte Silver Bow and C.T.E.C?

2. What type of advertisement has the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's done so far for the solicitation of innovated ideas for the Berkeley pit toxic water issue - or was this solicitation process given to only a select few for their ideas?

3. What type of funding and inquiry mechanism for innovated ideas will the E.P.A., Montana Department of Health and Environmental Sciences and the P.R.P's put into place for the solicitation of innovated ideas (if you can build a better mouse trap, I'll look at it Russ Forba)?

4. If the answer to funding is yes, could a panel of experts as well as people from the community, mining, timber, agricultural and recreational industry sit on this panel for the adoption or the declination of innovated ideas?

5. Finally, I can not believe at this point in time, that the people of the United States, State of Montana, Butte Silver Bow and the stock holders of the P.R.P's would allow such a catastrophe of a high degree and volume of toxic waste and water to be allowed in this area. This may be the point in time the community should seek national news coverage similar to the reporting on the oil spill in Alaska some years ago. Believe me, this issue has for greater effects to a natural resource than the oil spill did to Alaska.

ALBERT MOLIGNONI

EVALUATION BY CANONIE

4.2.15 Mechanical Vapor Recompression Evaporation

This report gives a cost of $2 to S4 per 1,000 gallons of water. I seriously question this dollar amount when a few added energy enhancers could create a clean drinkable water supply for .50¢ per 10,000 gallons of water.

1. Is this the cost of the plant that will produce 1,000 gallons of water or is this the cost to clean up 1,000 gallons of water? If the cost of S2 to $4 per 1,000 gallons is both - what would the cost be to treat the 1,000 gallons of water after the plant is constructed?

2. What type of energy sources are needed for this type of plants operational cycle?

3. How many gallons of water per day is this type of plant able to produce?

4. Could we see a set of plans on this type of unit?

FREEZE CONCENTRATION

1. It states in this report the use of refrigeration to freeze water. Did the expert on this process take into consideration the fact that at certain times of the year (due to our location) mother nature would freeze this water for nothing? It is a fact that very large bodies of water can be frozen by mother nature in a short time frame. It takes large amounts of energy to turn cold water into ice and also large amounts of energy to turn ice back into water. As I stated earlier, mother nature will do it for nothing.

SUMMARY

Will the preferred alternative enhance mining in our area or make less the amount of minerals that can be taken from this ore body by allowing the water table to rise? Will the preferred alternative make more or less toxic water for this area? Will the preferred alternative create more or less jobs in our community? Will the preferred alternative enhance our community image as a great clean up project or a project that will have a multitude of institutional controls? Controls that could prevent the people of this community the benefit to utilize a natural resource of clean water and easy accessibility to the mineral deposit in our area.

I would like to know if the E.P.A., Montana Department of Health and Environmental Sciences and P.R.P's are willing to go the extra mile to turn our community into a model of a highly productive alternative project that could be used for future clean up projects all over the world.

In the past, there has been seed money for other projects in our community by the P.R.P's. Would the P.R.P's also provide seed money to create a panel of not only experts, but also people in mining, agricultural, timber, recreational and industry? This panel would decide on the adoption of innovated ideas that could be cost effective and also a unique alternative to a massive clean up problem we are all now facing.

<IMG SRC 0894102CT> MOLIGNONI MANUFACTURING, INC.

ROUTE 2, ROCKER ! BUTTE, MONTANA 59701

March 17, 1994

Mr. Russ Forba, Project Manager
U.S. E.P.A.
301 South Park
Helena, MT 59626

Dear Russ:

Will you please include the attached letter to Governor Marc Racicot and the attached water purification System information as part of the public comment that will be responded to for the Berkeley Pit.

Thank you,

Yours very truly,

Albert Molignoni

M/hs

Attachment

ENVIRONMENTAL
PROTECTION AGENCY

MAR 21 1994

MONTANA OFFICE

<IMG SRC 0894102CU> MOLIGNONI MANUFACTURING, INC.

ROUTE 2, ROCKER ! BUTTE, MONTANA 59701

March 15, 1994

The Honorable Marc Racicot
Governor of Montana
State Capitol
Helena, MT 59601

MAR 21 1994

MONTANA OFFICE

Re: Butte's Berkeley Pit

Dear Governor:

This replies to your letter of March 3, 1994 and provides you with further information concerning the types of innovative technologies that might be employed at the Berkeley Pit in lieu of the EPA/State of Montana "Preferred Remedy" to allow the pit to fill and remain full in perpetuity.

As an officer on the Board of Directors of CTEC (Butte's Citizen's Technical Environmental Committee funded by EPA grants to help the community express it's Superfund concerns), like you, I have been made aware of a tremendous number of innovative technologies that can be considered for resource recovery (water and metals) at the pit. What has been missing until now is for anyone to come forward with a comprehensive plan for utilizing the complex nature of the Berkeley Pit for beneficial and productive purposes.

The attached document presents the beginnings of what could be termed a "holistic" approach to treating the interactive, multiple ills of the Berkeley Pit and mine flooding in Butte. This means the legal mandate given EPA to protect human health and the environment need not be the only benefit to be derived from a cleanup plan. As in the unique alternative attached, the Remedy could be a self-supporting Water Purification System that includes aspects of electrical generation, reforestation, water recycling, metals recovery, harnessing garbage power - and at the same time create hundreds of sorely needed jobs on a sustainable basis.

The EPA/State of Montana "Preferred Remedy" actually harms Butte's economy by flooding off access of historic underground resources. Ignoring the requirements to "reduce volume of contamination," it does the opposite - doubling of the toxic pit water and the amount of contaminated bedrock aquifer around the pit. The Remedy scares the hell out of youngsters and oldsters alike. People imagine a lot of terrible things that could befall them with a full pit - from houses sinking and basements flooding and well contamination to the possibility that an economic depression 100 or 1,000 years from now could halt pumping and allow the pit to overflow. No one really knows for sure what the consequences of a full pit may be. That's because the proposed remedy is based on hydrogeologic theories, not facts. It's as if the people of Butte are guilty until they prove themselves innocent by coming up with technologic data sufficient to sway the State and EPA away from this "remedy" and the disastrous economic and social consequences it is sure to cause. We need reasons for businesses and professionals to relocate here, not the world's largest body of toxic liquid to drive the folks we have away. We don't believe it is good policy to pass out problems on to our kids and theirs and theirs. We need innovative thinking, not a Remedy that fits the old adage of cutting off one's nose to spite one's face.

Why not go on record as supporting the rights of the people to determine their own fate and the fate of their town? The EPA/State of Montana Remedy will likely put Butte right out of business as a livable community. Ideas such as the one attached deserve the light of day.

I'm not the only affected resident who knows there's got to be a better way. We need your help to assure we don't look only at the least expensive options and shortchange our future. Ideas that include social and economic issues must be brought to light so the Remedy doesn't leave future generations with a perpetual unresolved crisis.

Thank you for your sincere interest and care for the people of Butte-Silver Bow.

Yours very truly,

Albert Molignoni
Molignoni Manufacturing, Inc.

AM/hs

cc: Senator Max Baucus
Senator Conrad Burns
Rep. Pat Williams
Ms. Carol Browner, EPA
Mr. Bill Yellowtail, EPA
Mr. Jack Lynch, Butte-Silver Bow
Mr. John Wardell, EPA
Mr. Bob Robinson, DHES
Mr. Neil Marsh, DHES
Mr. Russ Forba, EPA
Mr. Jim Scott, DHES
Mr. Fritz Daily
Members of Butte Legislative Delegation
Butte-Silver Bow Council of Commissioners
Clark Fork Coalition
CTEC

Albert Molignoni
Rocker, MT 59701
February 11, 1994

BERKELEY PIT WATER
Benefits for the Community from Maintaining Water Levels at the Bottom of the Pit:

1. Very large volumes of low-cost, clean, drinkable water can be made available for the community of Butte-Silver Bow for its present and future needs.

2. Large amounts of inexpensive electricity can be utilized by the community or sold at a profit to Montana Power Company.

3. Storm water run-off, as well as the sewage of the community, can be processed into a clean water supply that meets the Safe Drinking Water Act requirements.

4. Metals that now pose a health risk in our aquifer can be processed at a profit.

5. Large amounts of garbage can be processed, thereby reducing demand on the current new landfill by much as 80%.

6. It will spawn a system to provide a vast array of high-tech, high-paying jobs that will be sorely needed after EPA, MDHES and ARCO leave the community.

7. The process can be utilized in other areas of the world to benefit mankind while practically eliminating the cover-up and Institutional Controls that are some of the possible "remedies" of present and future Superfund sites.

8. It eliminates need for degradation of Big Hole River water, as well as, Silver Lake water, that could instead be utilized for future needs of the citizens of the State of Montana.

Summary

Most of the technologies required to turn the present catastrophe of a highly contaminated area into an asset for our community are currently achievable. Now is the right time in the Superfund process to put these technologies into place for beneficial uses by this community and the State of Montana.

OFFICE OF THE GOVERNOR

STATE OF MONTANA

MARC RACICOT <IMG SRC 0894102CV> STATE CAPITOL
GOVERNOR HELENA, MONTANA 59620-0801

March 3, 1994

Albert Molignoni
Rocker MT 59701

Dear Mr. Molignoni:

Thank for your information regarding the situation at the Berkeley Pit.

I agree that there are some exciting new technologies that can turn a problem (degraded water in the pit) into a solution (not only clean water, but mineral extraction from the polluted water). In fact, I have taken a tour of some of the facilities and been briefed on the research involving the pit, and share your optimism in the new and innovative solutions expanded and applied on a larger scale.

The Department of Health and Environmental Sciences (DHES) has state authority over this issue, and I have taken the liberty of forwarding your information to them for their review and comment.

Thank you again for taking the time to send me your fact sheet. If I can be of additional help in this or other issues, please don't hesitate to contact me.

Sincerely,

MARC RACICOT
Governor

cc: Bob Robinson, DHES

TELEPHONE: (406) 444-3111 FAX: (406) 444-5529

WATER PURIFICATION PROJECT

by

Albert Molignoni

TREES

Trees are one of the main ingredients in the water purification process. This natural phenomenon takes places all over the world's top soil. By looking at the area of Butte Silver Bow County we can see vast tracts of land that can be utilized for a large tree growing project. The trees would add to the attractiveness of our area by covering up the baring soil left over from past mining and smelting operations. The tree growing process has several unique features when it is growing.

1. Supplies our planet oxygen.

2. Takes moisture from the soil for the plants growth. It also evaporates some of this moisture into the atmosphere by the tree needles or leaves.

3. The tree also helps purge or purify the soil by absorbing the impurities through the tree root system.

4. The tree is a solar collector that absorbs solar energy when the tree is growing. This solar energy is converted into heat energy by burning the tree after the tree is harvested. An interesting fact is that every year many thousands of cords of wood are burned in our forest from this region in the form of slash piles that are left over from logging operations. This is a waste of heat energy that could be utilized if burned efficiently.

5. The tree or wood from a tree has the ability to absorb large amounts of water. For example, a piece of wood 2" x 4" x 8' feet long may contain as much as three gallons of water, or from 30 to 300 percent of moisture. This is a fact due to the cell structure of wood like a sponge. This same fact also gives the wood the ability to absorb impurities in water.

6. The same wood product can be made into charcoal for a water polishing agent to purify water to a higher standard. (Example: a carbon filter). After the carbon filters have served their usefulness and the impurities in the water cannot be absorbed by the filters, they are removed from the water system operation and new ones installed to take their place. The old filters, some of them high metals, are burned at very high temperature in a combustion chamber where the metals are melted and collected to be sold. The residue left over from the combustion process are mixed with other materials to make a soil conditioner to help the trees grow. The high temperature gases from this burning process are used to heat impure water into a water vapor.

7. The cost of tree planting and tree harvesting is very low in man hours because of the highly mechanized machinery used in todays planting and harvest operation. This operation will create new employment in our area. Also, the type of tree used for this operation can be of small diameter which will shorten the time frame from tree planting to harvest. The demand for this tree product will give property owners, public or private, an incentive to grow this commodity to produce an income when the trees are harvested.

BERKELEY PIT

This enormous deep hole can be turned into one of the best assets in our community. I will now try to describe in simple terms its cycle of operation. The sooner this project is put into operation, the greater the benefits will be for our community.

1. Start a massive tree planting operation in our area to supply the water purification plant with one of the main ingredients for the water plant cycle of operation. After 25 years some of the trees can be harvested on an annual basis to provide the water plant its energy and purification material needed for its operation cycle.

2. Create a large water and ice storage reservoir above the town of Walkerville. This high elevation reservoir will supply our community with a cheap abundant supply of clean high pressure water for domestic and fire protection. Also some of this water supply can be used for tree growing, agriculture, mining, recreation, and industry.

3. Design and build a water purification plant that will process fifty million gallons of water per day. With over twenty billion gallons currently in the Berkeley Pit, it will take about 25 years to drain the pit. The lowering of the pit water will improve the water project.

4. Take all of the water from the metro sewer plant as well as the storm water runoff that is now going into Silver Bow creek. Install a water main from this water supply over to and down the Berkeley Pit wall to the present water elevation of the pit. Because the pit water elevation at the present time is much lower than the metro sewer plants water outlet, the water will siphon into the pit. Put a hydroelectric generator on a large barge, the reason for this is as the water table drops in the pit additional water main can be added thereby creating a higher water pressure source to generate more electric power to be used by the community or sold at a profit to the Montana Power Company. After this water leaves the hydroelectric generator it is captured in a large floating vessel and put through the water purification plant. A note of interest is the current cost of electricity to pump water from the Big Hole River at Divide, Montana into Butte, Montana (about $150.00 per million gallons). If we pump an average of eight million gallons per day, the cost is $1200.00 per day or $438,000.00 per year. With the Berkeley pit water project this cost is eliminated.

WATER PURIFYING PLANT

A simple, very tall, highly insulated vessel like an immense thermos bottle can be installed at an angle near the present water elevation of the Berkeley Pit up to the highest point of the pit wall. Wood chips or wood shavings are gravity fed by a hopper into the vessel about one hundred feet from the bottom of the vessel. Near this same point the contaminated water is inserted into the vessel. Near the bottom of the vessel, hot clean gases from the combustion process of dry wood chips and the air dried carbon filters that were removed from the water purifying system are inserted into this vessel. The combustion gases are kept below the burning point of wood or about 250 degrees Fahrenheit. Water is preheated by the combustion process to keep the combustion gases at 250 degrees Fahrenheit. This is the same water that is inserted into the vessel. As the hot gases are driven up through the vessel the high in moisture wood chips are separated from moisture by evaporation. The hot gases and heated water vapor will continue to rise in the vessel to the top of the pit wall at its highest point and at this point of discharge from the vessel a condenser is installed. This condenser or heat exchanger has cold liquid ammonia in it. The hot gases and vapor heat the liquid ammonia enclosed in pipes to a high pressure gas or vapor. This action turns the hot gases to cold gases and hot water vapor to cold water. The hot high pressure ammonia vapor is used to drive a turbine or engine to generate electricity to pump the condensed water to the high elevation reservoir, pump contaminated water into the water purifying vessel and to run the air blowers of the water plants system. At the very bottom of the vessel the hot dry wood chips with the contaminate in them are taken to the combustion chamber.

Some of the water from the high elevation reservoir can be brought by pipeline to and down a mine shaft close to the water elevation in the mine shaft. A water turbine can be installed to generate electricity because of the high pressure water from the reservoir. If this water has oxygen put into it to produce acid that will solubilize the metals in the ore body of our area. After many years of this water mining the contamination of metals to our ground water should be eliminated. If this water that is high in metals goes into the Berkeley Pit it can be processed in the water purifying plant.

THE USE OF SOLAR AND WIND ENERGY

1. Trees can be planted around the Berkeley Pit walls at each bench level. The trees will absorb solar energy and moisture from the soils. After many years of growing, the trees can be harvested on an annual basis in this area. This factor will reduce the transportation cost from tree farm to water purifying plant.

2. Solar collectors and solar cells can also be used for a heat enhancer and to generate more electricity. The glass products needed to make solar collectors can be taken from the garbage waste that now goes to the landfill. This glass product can be manufactured locally creating more jobs for this area. A note of interest, large amounts of copper are used to make solar collectors and arsenic is used in solar cell construction.

3. Because our area of this community is surrounded by tall mountains, wind turbines can be installed on the tops of these regions that can be used as an electrical supply for the melting of glass and metals used in the solar collector and solar cell manufacturing process.

4. Many other combustible products can be taken from our garbage waste stream such as paper, tires and used motor oil. Also, the many plastic products can be used for insulation products and material, products for solar collectors construction.

EFFICIENCY CYCLE WINTER AND SUMMER

By changing the flow path of the ammonia liquid and vapor this water purifying plant will have an efficiency rating of over eighty percent. The wood product will cost about fifty cents per one hundred thousand B.T.U. This efficiency rating will give us 10,000 gallons of clean water at the high elevation reservoir for $ .50. The people of the present water system pay close to $2.00 per thousand gallons of water.

SUMMARY

The sooner the E.P.A., MDHES, Arco and the communities of Anaconda and Butte Silver Bow accept the project design and ideas I have described in this text the sooner the region can have the vast array of high-tech, high paying jobs that are now needed in our area.

POWERSHAFT LIMITED

Proposal by
Albert J. Molignoni

I. Creation of Water Storage Systems

II. Creation of High Efficiency Electric Generation

I. Creation of Water Storage Systems

Production

While living and traveling in the state of Montana, I have witnessed the exploitation of the state's mineral and fossil fuel resources. From these observations, I have concluded that the inevitable depletion of these natural resources will result in a considerable reduction in the state's wealth. The following proposal has been educed as an alternative source of monetary and energy needs for the state of Montana. Development of this concept was derived only after extensive research on wind energy, solar energy, and thermodynamics.

The project I propose is the creation of a water storage system. This system will utilize Montana's land, water, wind, cold and heat, to ultimately provide a renewable energy source. Its success can be achieved with the combined efforts of the federal, state, and local governments. Farming, ranching, timber, mining and recreational groups will also be required to participate in the development of this project.

Land

The state of Montana has a very unusual land situation. Many of its areas are mountainous terrain; therefore, there are land sites in the state that are not suitable for agricultural production or recreational purpose. Areas of non productive soils, such as those left over from mining, commonly take up one hundred acres or more in this state. Timber areas and other smaller sites can also be utilized for the creation of this project.

Water

Winter is a natural resource that this state has a great abundance of in certain times and very little of during a drought period. The controlling of this resource in the past has been with the use of dams conservation. These methods of water management worked in the past, but present and future demands for water will increase if our state is to continue a growth period for such industries as agriculture, timber, mining, recreation, industrial and domestic. The following paragraphs on wind, cold and heat will give a general description on how the project can be successful.

Wind

This resource of energy is one of the primary sources that will be used to place the water on the land mass that was described earlier in the text (See Land). The reasons for using this energy source are the following:

1. To supply electrical energy for pumping the water from a supply source to the land storage area.

2. To supply electrical energy in the non-producing water storage months that can be sold, or used as a credit at a later date for pumping of water to the land storage in the producing months. This circumstance will occur when the wind energy is not sufficient to produce electrical energy during the water storage months.

3. Wind is one of the most reliable energy sources that Montana has. This is proven by past studies conducted for the state on wind energy.

Cold

A natural event that takes place in out state at certain times of the year during our fall and winter months. Some people curse it and others think its wonderful, but it is also one of the main ingredients for the project design. With the cold, wind, water and land, massive ice storage systems can be created for our state to insure an adequate water supply for future use. The system design will place the water on the land storage area (See Land). The massive blocks of ice are created by putting the water on the land when the air temperature is below freezing. In return, the water will freeze from the bottom up. This process is unlike the one that takes place on lakes, rivers or streams, where water freezes from the top downward. When the water is frozen from the bottom up, the ice structure created is one of the most stable forms for the storage of the water. The benefits of storing water in this time frame and manner are:

1. Water used to create the ice storage units in the winter months can be supplied by lakes, rivers, streams or wells. In this time frame the demand for the states water is at its lowest level.

2. If the water used to create the ice storage units is supplied by a underground pipe line, or a self draining pipe line and stored at high elevations, it will create a water line with high head pressure when the ice melts in the spring and summer months. This energy source can be used for hydroelectric and high pressure sprinkler systems.

3. By using a geothermic water supply, the thermodynamic principles and cold air temperatures, an energy source is created to supply the pumping of water in this time frame. Solar can also be used as a heat source.

4. These large stable ice units can be used in the winter months with snow cover for such winter time activities as skiing and snowmobiling.

5. Storing water in this manner will provide a gradual water discharge during the spring and summer months for the support of agricultural, timber, mining, recreation, industrial and domestic needs.

Heat

The last natural resource that is needed to complete the project design is heat. The heat energy source will accrue during the spring and summer months. This will provide the means of melting the ice storage systems. Therefore, an ample water supply will be created for the growth of our state. The heat from, the sun in the spring and summer months, coupled with the cold water from the ice storage units, benefits in creating a energy source by the use of the thermodynamics principle. It will also be noted that if a high precipitation period occurs during the winter and spring months, the excess water will be induced into the state's aquifer for storage. The water can then be used at a later date when needed, such as in the fall during the non-productive months of the ice storage systems.

Summary

Upon reading the previous text on the general description of the projects design, it can be understood by the average lay person that this process is already taking place in our state with the four seasons of spring, summer, fall and winter. With the added technology of the state's university system and people with the expertise on the project design and development, the project goal is obtainable. The spin off of high-tech as well as other jobs associated with the project design and construction are too numerous to mention. The additional benefits of the project are:

1. An increase tax base for the state due to the taxable valuation of the projects components and additional soil under cultivation by the water.

2. An industry created to design and produce the components of this project design to other areas that have the same or similar geographical location and climatic condition.

II. Creation of High Efficiency Electric Generation

Introduction

The prime sources of electrical generation in Montana are hydroelectric and steam. Wind generation has also been used in small quantities to produce electricity.

Hydroelectric production is solely reliant on mother nature to produce enough moisture from the snow and rainfall to fill the reservoirs with water for generation. In addition to providing a clean supply of electrical energy, hydroelectric dams manage the water supply to the consumers in the state.

Steam generation is produced by the burning of our state's coal supply. The efficiency of this type of electrical generation is around thirty percent. This means that seventy percent of the coal's heat energy is wasted. Coal is not the only type of fossil fuel that is used inefficiently in Montana. Gasoline and diesel fuels in today's internal combustion engines, such as automobiles, trucks, tractors and trains very seldom reach a efficiency of forty percent.

Montana's extreme temperature variations, seen throughout an annual period, is another source of clean energy. Water, cold weather in the below freezing months, and hot weather in the late spring and summer months, are the basic resources needed to create massive amounts of energy inexpensively. For the past several years, I have designed and patented a unique high efficiency engine and heat exchanging system. This system design, with the usage of ammonia or freon, produces a efficiency of eighty percent. Adoption of this type of energy system, in conjunction with the ice storage units, would produce extensive amounts of water and energy cheaply. The following text will give examples of how this type of systems can be used in our state.

Cities and Towns

Present sewer and garbage disposal systems are abundant supplies of energy needed to make the system successful. The heat energy needed for the system would be derived from warm waste water in community sewer disposal systems, and the higher temperature heat source that can be supplied by ether incinerating garbage or the burning of methane gas produced by our sewer plants. Cold air is the condensing agent needed to complete the energy cycle of operation during the cold weather months. Processed water from the sewer plant during the cold weather operation will be used in the ice storage system. This cold water supply is used as a condensing agent during the hot weather cycle of operation. Local governments could realize additional income by selling the vast amounts of electricity and water produced by the system.

Timber Industry

The waste wood products that are not used in our state's forests is unbelievable. The simple economic reason is the wasted wood products that are created from logging, timber thinning, and trees that insects destroy are not in demand. Present use of waste wood is by home owners to help their dwellings. The high cost of home heating created the demand for this type of wood burning.

New technology for clean burning of wood products, combined with the high efficiency energy system would create a large demand for wasted wood products. The lumber industry already has the equipment needed to bring the wasted wood to a mill or a convenient site for the burning of this product in the high efficiency energy system. Adoption of this system design would create an abundant supply of cheap electricity, jobs, and additional cash flow to the timber industry.

Agricultural Industry

Farming and ranching industries face a very unfavorable growth period in Montana because of the increased demand for water by agricultural, commercial and recreational groups. The state's present water policy is unfavorable because added storage was not develop to insure a adequate supply of water for the growth of agriculture. Ranch and farm industries already have enough problems with drought, insects, low prices and high taxes to make their business unprofitable.

A mobile unit can be used for this type of energy production. The unit can be moved from one location to another for the ice and energy production. Also, if there is a major malfunction with the energy unit a different unit can be brought in to produce the energy while the original unit is being repaired. The automated unit would require very little time and effort from the operator, thereby releasing the person for other duties that are required for the farming and ranching operation. Additional cash flow from the sale of electricity from the unit would insure the usage of this system during high periods of precipitation to increase the water table of the state's aquifer.

Utility - Public and Private

The vast untouched natural resource of Montana's heat and cold is almost impossible to described. We have failed in the past to utilize this abundant source of energy. Public and private utilities of this state, with the system design, would be able to produce large blocks of electrical energy that can be sold to other states, thereby increasing the cash flow into our state. If exportation of electrical energy is taxed, the added income would benefit this state. The sale of this energy at a reduced rate within the state would entice industry, that consume large amounts of electrical energy, into this state.

Mining Industry

Mining concerns have one of the best potentials for the system design. Energy generation and ice storage will create an abundant supply of inexpensive electricity and water for mining. The increase of demand for time and phosphate for fertilizer by the agricultural industry would reopen old mines and create new ones. Copper and aluminum industries are also great benefactors, because of the large amounts of copper and aluminum metals in the energy system's parts.

ENVIRONMENTAL
PROTECTION AGENCY

APR 28 1994

MONTANA OFFICE

734 Locust
Missoula, Montana 59802
April 15, 1994

Russ Forba, Remedial Project Manager
U.S. Environmental Protection Agency
301 South Park
Helena, Montana 59626

Dear Russ Forba:

I am writing to comment on EPA's and MDHES's potential alternatives and Proposed Plan for addressing contaminated water in the Mine Flooding Operable Unit of the Silver Bow Creek/Butte Area Superfund site. I have a number of questions on the Butte Mine Flooding documents on this subject, and some recommendations for ways that I, as a concerned member of the community, would like to see the Butte Mine Flooding documents and the alternatives improved.

Questions

- First, why haven't EPA and MDHES prohibited the nearby mine currently in operation from dumping their wastewater into the Berkeley Pit? If this is a federal Superfund site, shouldn't polluters be prohibited from increasing the contamination? The current mining operation is not only adding to the contamination in the Berkeley Pit; it is also adding to the surface water inflows to the Pit--inflows that might have been clean water but have been degraded by the current mining operation. According to the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), the aim of Superfund is to reduce contamination, not to add to it. Why have none of EPA's alternatives considered prohibiting the current mining operation from continuing the practice of dumping their wastewater into the Pit?

- Secondly, has the issue of cumulative impacts in the Silver Bow Creek/Butte Mine Flooding operable unit been considered with the RI, FS, and Proposed Plan?

- Thirdly, have the synergistic effects of pollutants been considered with the RI, FS, and Proposed Plan?

- Finally, why is it that the Proposed Plan only diverts Horseshoe Bend surface water inflow away from the Pit? Why doesn't the Plan divert all clean water inflow from the Pit? This would keep the Pit from filling up as fast and save clean water from being contaminated.

Recommendations

- I recommend that the written quality of the public documents be improved, to make them understandable to the public and to facilitate, rather than discourage, public involvement.

- I recommend that EPA and MDHES publicly acknowledge that the assumption that no water is escaping out of the Pit is exactly that: an assumption. It is based on theory, not fact. I found the public documents to be misleading on this point, making it seem as though the hydraulic gradient is a known measurement.

- I recommend that some action be taken to increase confidence in the direction of groundwater flow at depth in the Butte Mine Flooding operable unit, whether it be in deep well drilling, sediment testing, or improved monitoring from existing wells and mine shafts. If no action is taken to accomplish this, I recommend that the CWL be lowered for a greater margin of safety.

- I recommend that the Plan ultimately decided upon by EPA and MDHES be flexible in addressing the possibility of groundwater contamination at depth, and include a contingency plan if it is discovered that contaminated water is leaking into regional groundwater flow. I recommend that precautionary measures be taken to keep this from happening, to prevent having to rely on emergency measures after it's too late.

- I recommend that both the CWLs - - for the Pit System and the West Camp System - - be lowered. According to EPA's Proposed Plan, the 5,410-foot CWL for the Pit System is fifty feet below the alluvial aquifer. Fifty feet below the alluvial aquifer doesn't seem to me like a sufficient measure of safety. If floods and/or soil sloughing into the Berkeley Pit were to cause a sudden rise in the Pit's water level, the water level could exceed the present CWL.

- I recommend that all surface water inflows - - from streams, precipitation, snowpack, etc. - - be diverted from entering the Berkeley Pit. This would prevent wasteful contamination of clean water and prevent the Pit from filling as test as it is.

- I recommend that the current mining operation be prohibited from discharging contaminated water from their mining activities into the Berkeley Pit System. This current discharge is only adding to contamination of a Superfund site that is on the National Priorities List for cleanup, which seems to be in violation of the goals of CERCLA.

Sincerely,

Mary E. Miller
Missoula, Montana

cc: Mary Kay Craig, Upper River Representative/
Clark Fork Pend Oreille Coalition

<IMG SRC 0894102CW>
<IMG SRC 0894102CX>
<IMG SRC 0894102CY>
<IMG SRC 0894102CZ>
<IMG SRC 0894102D>
<IMG SRC 0894102DA>

Rose Brock
7300 Trenton
Butte, Montana 59701

To the Environmental Protection Agency

I write your full name to remind you of your responsibility. Your are not the big business protection agency (BBPA) nor the Toxic Dump Monitoring Agency (TDMA) nor the Let's protect the future of mining agency (LPFMA).

Environmental Protection Agency. The law is clear: reduce and protect. You are doing neither with the proposed solution to the problems of the Berkeley Pit in Butte, Montana.

Why not start now to clean up the pit? You are not protecting my well mor the safety of our drinking water supply by allowing the water in the pit to near a crucial level that could (no one knows for sure that it will or it won't) cross into the alluvium aquifer. From my kitchen sink I can look out the window and see Berkeley Pit. I look from there to the water and wonder how will I know when and if the water will become unsafe to drink. Why must I live with the threat of the water leaving the Pit and entering the alluvium aquifer? You are the Federal Agency that is mandated by law to protect me and my family from such a threat. I only ask that you do what you are charged by law to do.

Who put the stipulation on the cost of clean-up and treatment? Why does ARCO have the right to say that the method of treatment must be cheaper or equal to the lime treatment? If I break someone's window, I must fix it. I cannot say that I will use plastic because that is the cheapest way to fix it now. The owner has a right to have it returned to the way it was not just fixed in the cheapest way possible. As custodians of this planet we are responsible for this water, it can be cleaned, we must do it right.

I urge you, on behalf of my children, not to let this act of violence take place in our community. Do not let us live with the threat of the increasing volume of toxic water entering our water supply. Do not allow ARCO to treat the water with lime. Drill more wells to monitor the flow of toxic water. Do not wait until 2022 to act on this problem.

Thank you,

Rose Brock

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

<IMG SRC 0894102DB>
<IMG SRC 0894102DC>
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It's time to holler about plan for pit

(Editor's Note - Mary Kay Craig of Butte is associated with the Clark Fork-Pend Oreille Coalition.)

As a youngster, I was delighted when my brother Tony offered to let me help him wash walls and ceilings. It looked like fun. Tony, on the stepladder in the kitchen with a roaster pan of soapy water, asked me for a broom. Tony placed the heavy pan of water against the ceiling and held it in place with the broom. Then he backed down the ladder, keeping the broom against the pan. He said I'd be a big help by holding the broom in place until he returned. Well, I was a happy assistant ... until I realized that dear Tony was curled up in the living room with a funny book!

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Butte has some dirty water hanging over it: The Berkeley Pit. And it's time to holler.

EPA wants you to tell them - with a postmark no later than today - what we think of their plan for cleanup of the contaminated water in the pit and flooded mines.

Some say, "What's the use? We're ignored." Others are burned out from years of studies and meetings. Now is the "official public comment period." Now's the time EPA must listen. "Community acceptance" must be considered in Superfund decisions. In some countries, when you don't speak up, you're saying you don't like the proposal. Not here. You can lose a lot by not letting EPA know your opinion. And there's plenty to say.

The EPA-ARCO "remedy" would:

! Allow doubling of volume of contamination now in the pit, from 25 to 56 billion gallons, before any pit water is cleaned. Superfund law reads "reduce" - not "increase."

<IMG SRC 0894102DI> Mary Kay Craig

Let's look for better solutions

! Tie up that amount of water in the pit forever - without it being used for any good purpose. Legal?

! Allow ARCO to self-insure its financial ability to maintain a pumping and treatment plant in perpetuity, rather than putting the money in a trust fund up-front. "Perpetual care" for some local cemeteries didn't work; yet, we're to trust ARCO.

! Set a precedent by "writing off" the bedrock aquifer. Other towns in similar circumstances get their aquifer water pumped and cleaned. Perhaps Jack Nicklaus couldn't design an 18" mineshaft" golf course as ARCO's present to Butte for leaving 100 percent of contamination in place. (So where's our pretty present in lieu of cleanup?)

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It's time to holler. Write (with today postmark) to Mr. Russ Forba, U.S. EPA 301 S. Park, Helena 59626.

<IMG SRC 0894102DJ>
<IMG SRC 0894102DK>

CATHERINE COUTURE
3005 NETITE
BUTTE, MT 59701

<IMG SRC 0894102DL>

To: Mr. Bill Clinton President
Mr. Al Gore, Vice President
Sen. Max Baucus
Sen. Conrad Burns
Rep. Pat Williams
Ms. Carol Browner, EPA Administrator
Mr. Bill Yellowtail, EPA Reg. Administrator
Gov. Marc Racicot
Mr. John Wardell, EPA MT Dir.
Mr. Bob Robinson, Dir, MT DHES
Mr. Russ Forba, EPA Project Mgr

"Community Acceptance" is part of Superfund decision-making criteria.

WE, THE UNDERSIGNED CITIZEN(S) OF BUTTE-SILVER BOW COUNTY, MONTANA, HEREBY PETITION THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY TO REDUCE THE WATER LEVEL IN THE BERKELEY PIT AND CLEAN IT UP NOW.
WE DON'T WANT BUTTE TO HAVE WHAT WOULD PROBABLY BE HE LARGEST OF TOXIC WATER IN THE WORLD. EPA'S PLAN TO LET THE PIT FILL FOR THE NEXT 30 YEARS WILL HARM OUR SOCIAL AND ECONOMIC FUTURE. A FULL PIT POSES A PERPETUAL THREAT OF RELEASE OF CONTAMINATION IT PASSES OUR PROBLEMS ON TO OUR KIDS AND FUTURE GENERATIONS TO

RESPECTIVELY,
NAME
ADDRESS
CITY/STATE/ZIP

(Paid by Butte friends & Members of the Clark Fork - Pend Oreille Coalition, a non-profit, non-partisan, membership-supported public inter

Another view

It's time to holler about plan for pit

Editor's Note - Mary Kay Craig of Butte is associated with the Clark Fork-Pend Oreille Coalition.)

<IMG SRC 0894102DM>

Mary Kay Craig

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! Saddle future generations with worries about the pit level always at the "full" mark.

The EPA-ARCO plan wouldn't:

! Absolutely assure toxic water isn't leaving the pit. Instead, it would provide new wells to catch it after the fact. Yet, Superfund law says we are to be protected from the "threat" of release of contamination. If ARCO and EPA are sure contaminated water can't leave the pit, how did Butte miners pump all the water out of the bedrock aquifer?

! Have any short-term adverse effects? EPA can't think of a one. Can you? Creation of the nation's largest poison lake, and more?

EPA must proceed from today, not backward from 2022. Butte-Silver Bow has asked EPA to find research dollars to help develop newer, cost effective technologies. Added to MSE's funding from the Department of Energy, more than two or three technologies per year could be tested. Set a deadline from companies who want a piece of the minerals pie here to submit technologies to MSE's Resource Recovery Program. Competition and market forces could bring the best solutions forward. Within, say, two years, one or more technologies could go into pilot runs and a pumping and treatment plant could be designed and constructed. By the end of a total of seven or eight years, cleaned Pit water could run down Silver Bow Creek, or be available to attract new industry to Butte.

It's time to holler. Write (with today's postmark) to Mr. Russ Forba, U.S. EPA, 301 S. Park, Helena 59626.

1031 Utah Avenue
Butte, Montana 59701
April 29, 1994

Russ Forba
U.S. EPA
301 S. Park St.
Helena, Montana 59626

Dear Mr. Forba

The Berkeley Pit would not have been a problem if ARCO had not turned off the pumps in the mines without even giving anyone a chance to do anything else. The "Company" had a deal with the Miner's Union that they would never turn off the pumps, but they did anyway.

I agree with the speaker at the oral comment meeting who said that we and our children are the victims in this. ARCO turned off the pumps with malice and forethought. You, EPA, are the judge and jury. Nobody in this town wants to see the pit fill with 56 billion gallons of poison. We want the poison in there reduced, and reduced is what we understand EPA is told to do by the Superfund law.

Please do not be intimidated by ARCO's threats of lawsuits against the EPA -- citizens could threaten a class action lawsuit, too. People do get intimidated. Many people in Butte are not willing to speak up on this issue because of the economic interests in this town -- meaning Dennis Washington's Montana Resources. The County Commissioners were given a tour his ongoing mine in Butte and were told it would not be good for them to ask for a better clean up than the one you and they agreed to with ARCO. The Commissioners were shown all the numbers on taxes and wages paid and how those dollars might move through the retail stores in Butte. The word was spread around town that MRI might go bankrupt or stop mining in Butte. MRI was asked to put their situation forward publicity but did not. It is your part to listen to the wishes of the majority of the people in town.

Perhaps on issues that have perpetual implications, you should give greater weight to opinions of parents than you do to intimidated short-term elected officials, because when it comes to human health and the environment, mothers and fathers know whats best for their kids and for future generations.

Please get designing a pumping plant for the pit now and take actions to get new technologies that don't produce so much sludge. Please get them into operation within the next few years.

Sincerely,

Sue Gassenberg

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

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<IMG SRC 0894102DO>
<IMG SRC 0894102DP>
<IMG SRC 0894102DQ>

ENVIRONMENTAL
PROTECTION AGENCY

Kenneth P. Cunningham
2920 Amherst
Butte, Montana 59701

APR 11 1994
MONTANA OFFICE

April 8, 1994

Russ Forba
301 South Park
Helena, MT 59701

Russ:

This letter is to inform you that the Cunningham Family of Butte oppose your E.P.A. and Arco plans to let the Berkeley Pit water rise to unacceptable heights.

Arco and the Oil industry in this great country of ours completely destroyed the Copper Industry in the U.S.A. In my opinion this was done for Tax Relief purposes by the Oil Industry. They would rather destroy a whole Industry to gain Tax Relief from their huge oil profits. My opinion is that, if the Oil Industry paid their fair share of taxes this clean-up could have been taken care of.

Arco came into Butte with a promise to stay for three years and do minor improvements. They did this and also sold equipment and property which they made huge profits from. It was Arco's own decision to flood the Butte Hill and again gain Tax Relief Benefits. I am sure they figured they could buy their way out of their clean-up responsibilities.

It is my opinion this is being done by controlling the E.P.A. and other government agencies.

I have been a lifelong resident of Butte, Montana and I do not trust Anaconda Company, Arco Oil Company, or the E.P.A. for which my taxes are being used to finance.

I have no faith in you Russ, the E.P.A. or Arco's woman's representative in Montana - Sandy Stash.

I do not know where you were born and raised and educated, but I know it was not in Montana. I can tell by your beliefs.

Russ I had a well drilled on my property so that I can have good drinking water and it has almost paid for itself.

Due to ill health the past four years I am retired and cannot afford to wait for pure water. My well is tested every three months by the State of Montana. If the pit causes any problems to our well water there is going to be trouble for someone.

Sincerely,

Kenneth P. Cunningham

<IMG SRC 0894102DR>
<IMG SRC 0894102DS>

ENVIRONMENTAL
PROTECTION AGENCY

APR 28 1994

MONTANA OFFICE

April 26, 1994

To: Russ Forba, EPA Remedial Project Manager
From: Barbara J. Archer, Thomas M. Tully, 802 Galena, Butte, MT 59701
RE: Clean-up of the Berkeley Pit

The primary concern regarding the remediation of the Berkeley Pit is not who pays and how much, but is rather the health of our citizenry and of the watershed, which are inextricably intertwined.

The EPA must begin the process of physically addressing the problem of 27 billion gallons of toxic water now, rather than putting it off for 20 or 30 years on the premise that experts have assured them and us that the pit water is not a problem and won't be until a certain critical water level is reached. That critical level has somehow been established through modeling and interpolation of data and if incorrect, may have dire and permanent consequences on the ground water system of the entire valley.

Some experts have also assured us that the Yankee Doodle Tailings Dam, holding back up to 600 feet of wet tailings, would be sound in the event of an earthquake of around 6.0 on the Richter scale. It is my understanding that this dam was never designed or engineered to contain the volume now behind it; furthermore, it is my understanding that while the top of the dam is designed to contain the tailings, that it is built on an inadequate base that is not toed into stable materials. Given that the Continental fault runs very near the dam and given that Butte is squarely in the Intermountain seismic zone, it would seem that the prudent course of action would be to reduce the potential for disaster as quickly and thoroughly as possible. So as to assure you that I am not merely crying wolf about the possibility of a seismic event which could have severe ramifications on the Berkeley Pit. I quote from the Roadside Geology of Montana by David Alt and Donald W. Hyndman regarding the Continental fault where it runs through Butte, on page 174:

On first thought, it might seem that the Continental fault is simply slipping, a type of movement that should cause little trouble except continued substance of Butte. But there are no signs of surface slippage where the highway and other roads cross the fault. Therefore, it seems more likely that the fault is stuck, and the earth's crust is gradually bending, accumulating strain energy like a slowly drawn bow. If that is the case, then the fault will eventually slip suddenly, and release the accumulated energy in an earthquake, possibly a large earthquake.

Too many times "experts" have been proved wrong. We are dealing with complex hydrologic and geologic structures along with countless other variables. What are our assurances that the EPA's preferred plan for remediation will be adequate when even the experts are in disagreement about the dangers?

It is always easy to use 20-20 hindsight to determine how to rectify miscalculations and erroneous hypotheses. But 20-20 foresight is best achieved by erring on the side of caution. Caution in this case means beginning today to formulate a plan of action based on the best available technology; that being the technology that works best.

A suggestion:

(1) begin immediately and take 2 or 3 years to solicit technical solutions to cleaning up the water.
(2) within 3 years, using market forces, have someone (MSE?) screen the proposals and choose 2 or 3 to put into a pilot program.
(3) test for three years
(4) fifth or sixth year, begin pumping plant with the best available technology and work out bugs in the system.
(5) seventh or eighth year, project established

To begin doing what needs to be done by the end of the century is a realistic goal. If we have the technology and resources to send people to the moon, if we can commit $500 billion to bailing out the S & L's, surely we can come up with a workable solution for remediation of the water in the Berkeley pit this century.

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<IMG SRC 0894102DY>

May 2, 1994

Russ Forba
EPA Project Manager
301 S. Park Ave.
Helena, Mt. 59626

Dear Mr. Forba:

I disagree strongly with your preferred alternative for the cleanup of the Berkeley Pit. There is no reason to wait thirty years. The pit should not be allowed to fill with toxic water. The cleanup should start soon and the water level should remain at or below where it is now. Other alternatives besides lime treatment should be considered. You should be more concerned about the health and safety and quality of life of citizens of Butte and downstream instead of so focused on what a proper cleanup will cost. We citizens deserve this and we don't want a giant body of toxic water upstream from us.

Thank you,

Steve Schombel

ENVIRONMENTAL
PROTECTION AGENCY

MAY 04 1994

MONTANA OFFICE

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Another view

It's time to holler about plan for pit

(Editor's Note - Mary Kay Craig of Butte is associated with the Clark Fork-Pend Oreille Coalition.)

<IMG SRC 0894102EB>

Mary Kay Craig

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April 29, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

Mr. Russ Forba, Project Manager
U.S. E.P.A.
301 S. Park
Helena, MT 59626

RE: Public Comments - Berkeley Pit and Mine Flooding Plan

Dear Russ:

Please note that as a citizen of Butte, Montana, I am not pleased with the EPA's proposal for the cleanup of the Berkeley Pit.

It came as a huge surprise to me and to everyone I know to find out that EPA wasn't going to cleanup the pit. By that I mean, we thought you were going to do something to reduce the amount of contamination in it. Instead you want to let it increase and stay that way in eternity!! Some cleanup remedy!

It is obvious that the only ones to benefit from this are economic interests such as ARCO. They bought the liabilities and the assets of the Anaconda Company and have made out pretty well as a result. They pulled a real fast one on this town when they turned off the pumps in the manner without giving anyone a chance to think out other options. THEY ARE RESPONSIBLE TO DO A GOOD CLEANUP. It is outrageous that EPA bows to their wishes in this one and only chance we get for a cleanup!

I do not want to live with a full pit within blocks of our house. I believe the plan to let the pit fill for the next 28 years is very short-sighted. It doesn't take into account the effect this has on our town. I suppose most of the work EPA does is on sites that are NEAR cities or in small areas within cities. But in our case we are surrounded by and have to live in the middle of millions of acres of contamination - - the worst of which is the Berkeley Pit. That deserves some kind of special care when you are valuating what the best remedies should be.

I understand the law requires cleanup and that EPA is supposed to consider the short term effects. Why aren't you looking at that?

I WANT THE BERKELEY PIT CLEANED UP NOW! Start work now. Reduce the water level. Let's have clean water out of our own aquifer within the next six to eight years. Anything less is unacceptable.

Sincerely,

Theresa Marie Craig

<IMG SRC 0894102EC>

GEORGE H. WARING
518 WEST GRANITE ST.
BUTTE, MONTANA 59701

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

April 29, 1994

Mr. Russ Forba
US EPA
301 South Park St.
Helena, MT 59626

Dear Mr. Forba:

I have reviewed the EPA-ARCO proposal to deal with the Berkeley Pit here. I find several things quite disturbing:

1. The proposal actually makes the toxic site worse by allowing the volume of acidic water in the Pit to double. How can EPA justify a remedy - that actually worsens this community's environmental situation. That toxic water needs to be reduced, not increased!

2. The proposal denies Butte the use of the water in the Pit forever! At a time when this community is facing severe water problems, a remedy that does not treat the Berekely Pit water quickly so that it can be made available for usage in Butte incomprehensible!

3. The proposal appears to be written more in the interests of ARCO than in the interests of the citizens. It even allows ARCO to escape the necessity of having to create a trust fund now so that we are assured that we are not left holding the bag. I simply cannot trust ARCO to treat that water in perpetuity. EPA must think that the people in Butte have no memory of all the corporate flight that took place during the past 15 years.

4. How can this proposal ignore such a crucial item as the cleaning up of the bedrock aquifer? This would seem a self-evident requirement of any remedy EPA would agree to.

5. The proposal to dump lime into the Pit and leave the accumulated sludge there forever ignores the technologies now available for treating the water. Folks who maintain that ARCO has been given the "cheapest" alternative make a good case here. EPA should be helping communities find the latest technologies to deal with their environmental disasters, not just the ones that are cheapest for the responsible parties.

6. Every day you can see dust blowing south from the area surrounding the pit on to the Flat. Your proposal must require that the sides of that giant dump be planted--shrubs, trees, grasses. We in Butte wish to live in a beautiful community, not simply survive amongst the rubble of the polluters.

Yours sincerely,

George H. Waring

Butte-Silver Bow Local Government
Comments on
Berkeley Pit Remedial Investigation/Feasibility Study
and Proposed Plan

The Berkeley Pit mine flooding is a unique problem that will require unique and creative solutions, both in technology and in the implementation/administrative process. "Business as usual" will not solve the problems nor render the most innovative solutions to this critical community problem. The Butte-Silver Bow local government, through its Chief Executive and Council of Commissioners, submits the following comments on the Berkeley Pit Remedial Investigation/Feasibility Study and Proposed Plan in hopes of fostering the level of innovation and creativity needed to meet the concerns and needs of our citizens.

1. Assurances\Scheduling for construction of treatment plant

The Proposed Plan should document a firm schedule with a conservative trigger point for plant construction to provide greater assurances that the critical water level is never approached.

2. Enhanced Monitoring Program/Public Education

The County proposes the immediate installation of two new wells southeast of the Berkeley Pit and one new monitoring location near East Continental Pit, coupled with a comprehensive education program that ensures information is disseminated regularly in terms clearly understood by the average citizen. Also needed is a clear process on how the data from the RI/FS will be updated, particularly if any new data indicates any impact on the environment or human health, thus triggering changes in the preferred plan.

3. Innovative Technology: Call to Action

The ROD should require the use of innovative technologies to supplement or replace the hydroxide plant and ensure that the "best available" proven technology is used at the time of implementation, thus avoiding the problems with hydroxide precipitation, such as:

- sludge disposal in the Pit or at a new repository;
- future contamination from leaving billions of gallons of poison water in the Pit;
- the loss of the orebody, an enormous economic resource made into a long-term community liability.

EPA should create a partnership with the PRPs and the County to set a firm goal to develop a comparable remedy of equal effectiveness that is sensitive to cost.

4. Waiver of requirement to restore the bedrock aquifer

There must be no linkage between a waiver writing off the contaminated bedrock aquifer of the Pit and other aquifers in the Clark Fork Basin.

1. Scheduling for construction of treatment plant.

The Critical Water Level (CWL) has been set at 5410 feet by the regulatory agencies and the PRP's based on a scientific model. There is an administrative order in place that dictates the water shall never exceed this level. However, there have been no absolute guarantees that the predictive model will match what will actually happen in terms of water movement, flows, etc. Thus, the County would contend that a more important task is to develop and document an appropriate plan to provide greater assurances that the CWL is never even approached.

In this regard, the County believes a firm schedule for building a treatment plant should be made a part of the Record of Decision (ROD) to alleviate the genuine concerns of our citizens. Towards that end, the County believes the following factors should be considered in developing a conservative schedule that 1) addresses the possibility of unforseen events and non-absolute assumptions made in the RI, and 2) will allow a reasonable amount of time to bring a treatment plant on line well in advance of any crisis:

- Weathered bedrock. Based on data in the RI, a critical saddle point in the top of weathered bedrock exists near the southeast edge of the Pit at 5350 foot level. Water reaching this alluvium level could behave unpredictably, i.e., short term rises in water level, due to the density differences in the alluvium and the weathered bedrock, could potentially yield a short-term change of gradient for this locale, thus allowing water to flow away from (and not toward) the Pit. Therefore, the County believes it would seem reasonable to consider this level as a starting point to trigger action.

- Insure dam safety at Yankee Doodle Tailings Pond (YDTP). There is a possibility that an earthquake could release saturated tailings from the Yankee Doodle Tailings Pond into the Pit. Thus, to provide public assurances, it would seem prudent to provide a buffer of 10 feet - to 5340 feet - to accommodate the tailings that could flow into the Pit after a large earthquake.

  - - Note: The analysis done by Harding Lawson Associates (HLA) is not the worst-case scenario. Liquefaction is predicted to occur in the top 50 feet of the dam after an earthquake equivalent to 6.5 magnitude. No effort was made to characterize the materials at the base of the dam, which former ACM employees have called casually deposited, random fill material (at the time there were no dam design plans comparable to those now required under the active mine permit). Several recommendations are made by HLA to "beef up" and monitor the dam. These recommendations (which should be incorporated into MR's permit revision issued by DSL) also must be included as requirements in the final ROD to insure future dam stability.

- Plant construction/operations lead time. Most industry estimates indicate a three-year "shakedown" period is needed to make a treatment plant fully operable. As for linking this "shakedown" period to a point in time in the future, the County suggests the following:

  Currently, the Pit water level rises 25' per year; however, the predictive model indicates this fill rate should decrease over time. In light of these facts, the County recommends using the fill rate at the time the water reaches 5260' as the timing indicator to determine when plant construction should commence.

  For example, according to the model and data for the Preferred Alternative 6/7, the 5260' level will be reached in the year 2009, and the fill rate that year is expected to be about 10'. If the model holds true, then a three-year shakedown period would equate to 30' (3 x 10'), and plant construction would commence when the CWL reaches 5310'(5340' minus 30'), predicted to be in the year 2014.

  Again, the actual fill rate when the water reaches 5260' will determine when plant construction would begin. If the fill rate proves to more or less than 10' at that time, the timing of the shakedown period would be adjusted accordingly.

Thus, the recommended level that triggers action to establish a construction schedule should be set at 5260' and the treatment plant should be guaranteed to be fully operable by the time the water reaches the 5340' level. This schedule would leave 70' of free board below the current CWL. The 5260' level is also within range of the original CWL of 5216' which is the contact between the alluvium and bedrock, thus providing added assurance that the trigger point for action is sufficiently protective.

2. Enhanced Monitoring Program/Public Education.

The County acknowledges that the Monitoring Program outlined in Appendix I of the RI is reasonable. However, to provide the highest level of assurance to the County and its citizens, the County would recommend that additional monitoring be included in the plan, as follows:

- Two new monitoring wells should be drilled in the region southeast of the Berkeley Pit; the objective of these wells would be to extend the bedrock aquifer contours through the linear path of the Berkeley Pit and Well "C". These wells would provide further verification that mine flooding problems are not migrating south and east.

- A monitoring point/station should be located adjacent to the East Continental Pit to monitor that pit's influence on the bedrock aquifer.

The County would request that these monitoring points should be installed during the summer field season of 1994. Further, the County would pledge to work closely with the EPA and PRPs to locate these monitoring points to acquire the most useful data.

Equally important to an expanded monitoring program is educating and informing the public about these activities. In the ROD, EPA must commit itself and the PRP's to developing a comprehensive program to educate local citizens on the flooding of the Berkeley Pit and any potential contamination problems. Information must be widely disseminated, on a regular basis, and in terms that are clearly understood by the average citizen.

Towards this end, Butte-Silver Bow stands ready and willing to assist in developing a program (multi-media, computer graphics, etc.) to insure that the citizens of the County are kept well informed on results from the monitoring program, progress of treatment plant construction, and other issues related to flooding of the

Berkeley Pit.

Finally, the County would recommend that the ROD include specific language that clearly articulates the process for updating the data from the RI/FS, particularly if any data or information used to decide on the preferred alternative proves to be incorrect or inaccurate. The County and its citizenry need to know:

a) how the agency and PRPs will respond to new and/or better information that emerges from actual data collected, particularly if this new information has any impact on the environment or public health;
b) how and under what conditions the decisions in the ROD will be changed, based on updated information; and
c) how the County or an independent party designated by the community can be directly involved in the decision-making process throughout the monitoring period and the implementation of the remedy.

3. Innovative Technology: Call to Action.

Although the County believes a firm schedule and trigger point should be established to build a treatment plant, a greater goal is to develop an alternative technology solution to preclude construction of a conventional treatment plant. Even under the most conservative scenario for plant construction, the County believes there is an ample window of opportunity to develop reliable technology alternatives.

A firm commitment by EPA, DHES and the PRPs to investigate and implement innovative technologies is needed to spur action toward this development objective. As outlined below, this commitment and resulting success has the potential to save money in the remediation process, and would help avoid what are viewed as flaws of the selected technology in the preferred remedy 6/7 (hydroxide precipitation).

3.1 Technology alternatives.

In the RI/FS, each of the 19 remedial technologies was evaluated individually and not in combinations. Thus, no effort was made to determine whether certain combinations of technologies might achieve some synergistic benefit that does not occur with just a single technology. The County would suggest that an evaluation of combined technologies could become part of the "innovative technology" research on waste remediation being done in Butte through a variety of business ventures. In general, the County believes that all of the questions that could be asked and answered through this evaluation would lend increased assurance to Butte citizens that the "right" choice will be made at the time of implementation.

3.2 Selected technology at odds with metals recovery.

The purpose of hydroxide precipitation is to tie up the heavy metals and metalloids (arsenic) in insoluble forms to prevent the spread of contamination in surface and groundwater. Once the sludge is produced, the metals are essentially unrecoverable should future metals recovery technology become feasible. Thus, the hydroxide precipitation option precludes the future recovery of a mass of metals that represents a significant economic resource.

3.3 Sludge disposal - Not in the Pit.

Based on input from several mining professionals residing in Butte, it appears that using the Pit itself as a hydroxide sludge disposal facility is unwise, inefficient, and ultimately counter-productive. Much time and money will be spent to raise the pH of Pit water by adding lime in a treatment plant. It is expected that the sludge produced will have a pH near 7. If sludge is disposed of in the Pit, it will be re-introduced into extremely acidic water (pH $\approx$ 2-4) and the metals in the sludge will be re-solubilized. Thus, the same metals will be treated over and over. Disposing the sludge in the Pit would also cause the CWL to be reached sooner. For these reasons, disposing of any sludge in the Pit is unacceptable (Alternative 6, Preferred Alternative).

3.4 Better analysis of non-Pit, sludge repository options.

Hydroxide precipitation with reverse osmosis polishing would generate from 500 to 1000 tons of sludge each day. Using the assumptions in Appendix A of the FS, about 0.2 MGD of sludge would result in a volume of 2867 cubic feet of sludge to be disposed of each day. The County estimates that if this volume of sludge were piled 12 feet deep, it would require about 2 acres of land each year for disposal. Thus, in 50 years, a 100-acre repository would hold about 52,322,750 cubic feet of sludge that would have to be monitored for leaks in perpetuity.

Building a Subtitle D RCRA repository would be expensive, given the need for the installation of liners and leachate collection systems. Also, a sizeable amount of County property would be needed for the actual repository as well as additional acreage for a buffer zone surrounding the repository. In addition, the

County may, at the request of the PRP's, assume responsibility to monitor the repository and perform routine Operations and Maintenance (with PRP funding).

Although these activities are challenging, a non-Pit repository appears preferable, given the disadvantages of using the Pit. In any event, the FS does not adequately assess the tasks of siting and designing a non-Pit repository, which seems to infer that a decision to use the Pit has already been made.

3.5 Loss of orebody for future resource development.

Another ramification of the use of the Pit as a sludge repository is the loss of the underground orebody. Allowing water to approach the 5410' level means the loss of potentially tens of billions of dollars in gross revenues from the sale of metals and tens of millions of dollars in lost tax revenues to the County, State, and Federal governments. Valuable ore that could provide jobs and tax revenues and insure the economic future of Butte-Silver Bow for years to come is being written off in advance as contamination. This orebody must be considered a long-term, strategic economic resource, not potential contamination.

The following scenario has been developed from historical data collected by the Anaconda Copper Mining Company and New Butte Mining to illustrate some of the potential economic benefits to be derived from protecting and mining the orebodies underlying the Butte Hill.

- Shallow ore reserves are 122,786,894 tons containing 0.88% copper and 0.33 oz/ton silver. Using the assumptions that 1) 100% of these reserves would be mined; 2) 80% of the copper and silver and 70% of the molybdenum would be recovered from that ore mined; and 3) the copper is worth $1/lb, the silver is worth $4/oz and the moly 50¢/lb, the copper in shallow reserves is worth 51,728,839,467 and the silver is worth $129,662,960. Shallow reserves represent a combined value of $1,858,502,427.

- Deep reserves are 2,231,034,219 tons of 0.06% Cu, 0.21 oz/ton Ag, and 0.028% Mo. Using the assumptions above, the value of the copper is $21,417,929,000; the silver is worth $1,499,254,995; and the molybdenum is worth $437,282,707. Deep reserves represent a value of $23,354,467,000. Using the assumptions above, the combined value of shallow and deep ore reserves is $25,212,969,000.

These conservative estimates are based on proven reserves delineated by the Anaconda Company and reported by Richard N. Miller, Chief Geologist, in the document "Ore Reserves and Resources: The Anaconda Company, Butte District, Montana to January 1, 1978." According to this ACM report, significant deposits of manganese, zinc, and lead also remain to be mined under and adjacent to the Berkeley Pit. If continued flooding is allowed in the Pit, and worse, if the Pit is used as a sludge repository, this orebody would essentially be lost or rendered considerably less valuable for future generations. Worse yet, an enormous economic resource would be written off in advance as a liability to be treated with lime and disposed of in sludge.

3.6 Conclusion re: Innovative Technology

The central issue is that the expense and operational complexity of either sludge disposal option appears to justify greater emphasis on innovative technologies that would reduce or eliminate the production of sludge. Likewise, the goal of any treatment option should be to reduce or eliminate all waste streams, not simply to solve one problem and pass along another to the next generation.

The County would suggest that the ROD be written to require the use of innovative technologies to supplement or replace the hydroxide plant and ensure that the best available, proven technology is used at the time of implementation. Further, the ROD should require the EPA, based on a thorough technology assessment and review over the next twenty years, to verify the suitability of the selected technology. The EPA should join forces with the PRPs and set a goal to develop alternative technologies that offer a comparable remedy of equal effectiveness that is sensitive to cost.

The County would also suggest that the ROD clearly allow for sufficient access to the Pit water and provide needed indemnification from Superfund liability for those parties interested in proving the viability of alternative technologies. In the absence of such provisions, it would appear that any language in the ROD about the possibility of using innovative technology in the future is purely gratuitous.

4. Waiver of requirement to restore the bedrock aquifer.

EPA has announced in public meetings that the agency will be issuing a waiver (as part of the ROD) for restoration of the contaminated part of the bedrock aquifer. This decision means that no effort will be made to remediate the contaminated portion of the bedrock aquifer because it is technically and economically infeasible to do so.

This waiver will set a precedent for Superfund cleanup on the Clark Fork and allow EPA to ignore one of the main criteria for cleanup: reducing the volume, mobility, and toxicity of contamination. When EPA issues the waiver as part of the ROD, it is assumed the requirements of "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration" (OSWER Directive 9234.2-25) will be followed.

The County's concern is the specific language of this waiver. The County would request full involvement in the review of this document. The County's interest will be to ensure that a full evaluation has been done and that no linkage is made between the contaminated bedrock aquifer and other aquifers that would allow additional waivers in the future. In addition, the boundaries of the contaminated bedrock aquifer must be clearly delineated on a map, and explicit language must be included in the waiver to explain restrictions on future uses of the contaminated groundwater.

Butte-Silver Bow County Technical Comments on Berkeley Pit Mine Flooding RI/FS

Remedial Investigation

1. Additional information is needed on the West Camp to further define the water level fluctuations over time. To protect the West Camp area from flooding, it would be prudent to perform additional monitoring in locations hydraulically lower than the Travona and, at a minimum, reconstruct Well 21 to obtain more reliable data.

2. If Alternative 7 is chosen, repository siting for Pit sludge must begin now. Several repository sites have already been identified in a 1992 study ("Mining & Milling Waste Disposal Area Siting Study"). An off-site repository for sludge will have unique requirements. Each of the possible repository sites already identified should be evaluated for possible sludge disposal.

3. Use of averages (RI, Fig 3-2) is an inadequate representation of water that must be diverted from Pit and could result in underestimation of Pit fill rate.

4. A discrepancy between "average" and "valid" slurry data results in underestimating the volume of water arriving at Yankee Doodle Tailings Pond by 13%. Thus, the recommendations made by Harding Lawson Associates for the Yankee Doodle Tailings Dam must be implemented immediately to insure public safety.

5. Regional recharge, evaporation, precipitation, and runoff data are excluded from the Pit inflow calculations in Section 3 in the RI and result in the incorrect assumption that the Pit is a "closed system."

6. Several assumptions made in the groundwater modeling are flawed: 1) the Pit aquifer is not isotropic and homogeneous; 2) no rationale is given for selecting many of the boundary conditions; 3) impacts to the alluvial water table as a result of water rising in the bedrock aquifer are not addressed, and 4) inconsistencies were noted in the sensitivity analyses for wells GS-28 and GS-29s.

Feasibility Study

1. In the Remedial Investigation no data were collected to characterize the geochemistry of current Pit sediments (see attached comments of Dr. Bob Robins). Consequently, the feasibility of sulfide precipitation (which may already be occurring on a large scale in Pit sediments) was not fully evaluated as a possible remedy. Pit sediments must be better understood before any consideration is given to sludge disposal in the Pit.

2. The combination of Freeze Concentration and Multiple Effect Evaporation was not evaluated to determine if Butte's dry, cold climate could be used to advantage. Freeze concentration was dismissed because of energy requirements. No effort was made to evaluate the potential for using the cold weather that dominates Butte for 6 months each year to reduce man-made energy needs. Nor was any effort made to evaluate the possibility of using the sunny and semi-arid climate in Butte to see if solar energy could be used to run (or supplement energy needed to run) the evaporation units required for Multiple Effect Evaporation.

3. Why was only one treatment technology for metals recovery (copper cementation) evaluated during the final screening? Other newer technologies (e.g., those of Metanetix and Tetra Tech) have been tested in actual cleanups with some success. Metals recovery from Pit water has a great potential to turn a current liability into a long-term economic asset. This section should have been one of the most extensive in the FS. Instead, metals recovery technology received a perfunctory examination.

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25 February 1994

Mr. Russ Forba
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301 South Park
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U.S.A.

Dear Mr. Forba,

COMMENT: Proposed Plan, Mine Flooding Operable Unit,
Berkeley Pit, Butte, Montana.

I am a retired academic, having been Foundation Head of the Department of Mineral Processing and Extractive Metallurgy at the University of New South Wales in Sydney, Australia until the end of 1989. I visited Butte in 1979 at the invitation of the Anaconda Company, and saw the Berkeley Pit for the first time (operating) I have since visited Butte on many occasions - perhaps 20 times, have spent several sabbatical attachments at Montana Tech, and in 1993 spent 9 months working with the Mine Waste Technology Pilot Project team in Butte. I have also reviewed several Superfund documents for U.S. EPA Region 8 (Ref: Mike Bishop). My field of expertise is in the general area of aquatic chemistry, particularly related to the environmental impacts of mining and processing of minerals.

I have read the Proposed Plan, Mine Flooding Operable Unit (Berkeley Pit) dated January 1994, and some of the associated documents, and would like to make several comments on the proposals.

Firstly let me say that I agree completely with the proposed introduction of a "Comprehensive Monitoring Program" which is a part of most of the remedial alternatives. I believe that this monitoring should have been in place before now, and should be well underway (with the interpretation of many results) before any major treatment procedures are established. This comment is made because of my belief that a complete understanding of the present geochemistry and hydrology of the Berkeley Pit System is not at hand, and that a better understanding could influence treatment options. I have seen the results of a little of the monitoring work being conducted by the Montana Bureau of Mines and Geology (MBMG: 1991-1993) and the Atlantic Richfield Company (ARCO: 1992) and the work reported by Davis and Ashenberg: 1989.

An important aspect of pit-system chemistry relates to the reactions that are occurring in the sediment that is forming on the pit bottom, submerged benches, and previously connected old underground mine workings. The sediment thickness at the pit bottom (1993) was said to be possibly 200 ft. The sediment generally will almost certainly be becoming sulfidized by a variety of chemical interactions, but there appears never to have been the suggestion of an investigation of sediment in the Berkeley Pit, apart from my own in 1993.

A complete understanding of geochemistry in the Berkeley Pit needs information from a sediment study.

Due to sediment sulfidation it is likely that an oxidation-reduction boundary has already developed in Berkeley Pit sediment, near the sediment surface, so that the quality of water on the reduction side of the boundary will differ from that in the pit itself, which will be oxidized with respect to the HS/SO interface. An oxidation-reduction boundary could separate the dissolved ionic species in the pit water from those in the underlying groundwater (but allowing downflow, reduction and sulfidation) such that the lower groundwater would be of better quality due to the decreased solubility of metal ions from a reduced sulfide environment. The oxidation-reduction boundary is likely to have developed in the pit sediment due to both the interaction of pore water with underlying sulfidic minerals and solutions, and the likely microbiological reduction of sulfate to form sulfides. The former process is similar to supergene enrichment in sulfide ore bodies where descending solutions from surface oxidation react with the lower levels of hypogene sulfidic mineralisation to form a region of enriched sulfides. Some ores which have been mined economically are attributed to this enrichment process (this includes part of the original Butte orebody as described by McClave: 1973). The proposition of oxidation and supergene enrichment of sulfide ore bodies started with the work of Whitney: 1855, and by the 1960's the paragenesis of oxidized and enriched ores was well established. Accounts of the process have been published by Bateman: 1950, and Anderson: 1955. More recent treatments of the hydrology and geochemistry of these processes are presented by Brimhall et al: 1985, and Brimhall and Crear: 1987, and some related chemistry for tailings interactions was proposed by Robins: 1992.

The likely mediation of sedimentary reactions by microorganisms depends to some extent on the presence of organisms carbon, although there are other energy sources that support the wide range of organisms that are encountered in the reduction of sulfate to sulfide. To date it appears that no analysis of Berkeley Pit water (or any other waters in the OU) has included the determination of organic carbon, although it is likely to be present from various sources, which include a huge vegetated water catchment (> 5 square miles) to the north in which humic substances are certainly being generated. Algal blooms which occur regularly in the water at the North of the Yankee Doodle tailings are evidence of organic material, which in that region at least could support bioreduction of metal ions. Recycle of contaminated water to part of this tailings area in order to form sulfides is worth consideration. In the pit itself it has been said (without any evidence) that there is not likely to be any bioreduction due to the "extreme" conditions in the water (acidity and metal ion concentrations). This is not correct, and in similar mine waste pits, such as at Rum Jungle in Australia, reducing organisms have been reported at deep submerged sediment (Babij et al: 1980)

The comprehensive monitoring program which is being proposed should include strong microbiological study.

So, it is suggested here that the Berkeley Pit and surrounding areas could become enveloped by a sulfidic barrier such that the underlying groundwater is in a reduced condition where the metal ion concentrations will be considerably lower than in the pit water. There is some evidence that this is the case (MBMG data, courtesy Ted Duaime). In the West Camp the Travona shaft water is sulfidic, and although the ground water at that location is more or less cross-gradient to the Pit, it shows that the condition of reduced ground water does exist. It also suggests the use of West Camp water (or similar water) to sulfidise other waters in the system. Water samples from the Belmont mine shaft, which is downgradient of the pit, show metal ion concentrations considerably lower than in pit water. Water samples pumped from the up-gradient Kelley Mine shaft (MBMG:1992) indicated that both pH and E, decreased with depth (pH: 5 to 3, and E : 380 to 360mV), which could mean that the Kelley is isolated from the Pit by a redox (ox/red/ox) barrier. Cation concentrations in the Kelley appear to be generally higher than in the pit, but this is probably due partly to enhanced and localized oxidation caused by the more elevated temperates which exist in the deeper water levels.

There is other evidence of sulfidation actually occurring in the Pit : Lead weights used to anchor a sampling platform in the Pit were noticed to be blackened on recovery (personal communication: J. Medish, MBMG). This was probably due to the presence of a coating of PbS formed by sulfidation; A copper bar lowered onto the pit sediment in September 1993 had a sulfide coating when recovered one month later (personal observations).

Another consideration is the influence of the OU groundwaters on deep groundwater, and the fate of that water. A complete water balance on the whole pit system is not reported, but could add perspective to understanding the likely outcome of any chosen remedial action. For example, the maximum average monthly (June) precipitation of 2.42 inches[1] in the catchment of the Pit system (about 19.5 square miles) could result in the generation of about 27 MGD of water (data from Botz: 1969), which would have been accommodated (pre-mining) by stream flow, groundwater flow and evapotranspiration. Presently the only additional water into the system is 6.2 MGD of Silver Lake water to the MR concentrator. In all months other than June the precipitation is less than in June by more than the 6.2 MGD from Silver Lake. Actual measurements of monthly evapotranspiration would be more accurate than using calculations such as in CFR 40 Ch.1 (7-1-93). Up-gradient water control, as in fact partly exists with the Yankee Doodle tailings dam, should be carefully integrated with recycle, to result in the appropriate water balance for contamination control.

The proposal to recycle Horseshoe Bend water to the Yankee Doodle Tailings is a good start to water control, but it also presents the possibility of additional chemical control. There will be chemical (and biological) reactions between the recycle water and the tailings sediment, and this could lead to a positive outcome. An investigation of these reactions should be a part of the Comprehensive Monitoring Program.

In the Proposed Plan there is the suggestion that there is an upflow of deep groundwater from the bedrock into the OU. Perhaps a groundwater model was the source of that idea, but I wonder if it is realistic. There are simple experimental procedures that could be used here to add to a realistic water balance.

A downflow or water over geologic time is evidenced by the Anaconda Company maps (McClave: 1973, Figures K-1 to K-3) showing the position of the zone of supergene enrichment which lay in the volume that is now the Pit itself, and still exists in surrounding areas. These diagrams show a downward extension of the enriched zone at faults and veins (eg. to levels at an elevation of 3800 ft in the Middle Fault at the Kelley shaft), where there would have been a downflow of surface water. A downflow of pit water (beneath the pit) will still be present and will be furthering the supergene enrichment process and carrying reduced solutions with lower metal ion concentrations to greater depths where enormous dilution will occur with circulation to depths of 1-2 miles (Blackwell and Robertson:1973) "Contaminated" water from the OU may never influence surface ground waters.

[1] Butte station, 30 yr average annual precipitation (1951-1981) was 11.73 inches.

My comments on the preceding pages lead to the following eight recommendations:

1. That a comprehensive monitoring program be quickly set in place.

2. That a pit sediment study be part of the monitoring program.

3. That a microbiological study be a part of the monitoring program.

4. That there be detailed considerations of geochemical and microbiological interactions in the pit system.

5. That an overall monthly water balance be used to assess both up-gradient water control and recycle possibilities.

6. That system-outflow water quantities and patterns be assessed, with some monitoring to support any conclusions.

7. That in considering chemical treatment options, due consideration be given to recycle of "contaminated" waters as well as the integration of waters from different sources.

8. That all of the above activities be supported by an expert "advisory-and-review" panel consisting of persons outside the commercial consultancy organizations.

Most of these recommendations relate to the proposed "comprehensive monitoring program" which, if carefully planned, could well lead to the formulation of a more cost-effective strategy (embodying in-situ immobilization of contaminant metals) than for Alternative 6/7.

I have not addressed the detail of the treatment methods (chemistry) that are proposed to be introduced at the time of suspension of mining. These methods are fairly standard and reasonably well understood. However there is one aspect that is not understood at all, and that relates to the interactions of treatment sludges with the environment into which the sludge is disposed, particularly if that was to be the pit itself. If treatment sludge was added to the pit it would dramatically affect the pit sediment and the reactions occuring in the sediment and surrounding groundwaters and perhaps deep groundwater. These possibilities should at least be considered, and preferably investigated in some detail in a pilot experiment that could be carried out on site.

The environmental situation in the Berkeley Pit Operable Unit System offers a tremendous opportunity for scientific study which should not be lost, and which will certainly be useful to others in future times and other places. There are presently similar situations internationally, where detailed investigations have been in place for some years, but these do not appear even to have been identified during the feasibility study, let alone taken as example. In the near future other mine operators will need to deal with situations similar to those at the Berkeley Pit and a well documented activity will be appreciated. In the immediate future the WISMUT mines in Germany (especially the Ronneburg Pit) will commence to flood and will take about 15 years to fill.

One further suggestion that I would like to put forward is about funding of the comprehensive monitoring program. I think that advantage should be taken of sources other than EPA and ARCO. There are funding programs available through the National Science Foundation, and others internationally, where large grants are given for environmental projects. Locally, there is at the present a call for submissions to a "Reclamation and Development Grants Program" from the Montana Department and Conservation. EPA should coordinate a grants application scheme with the local institutions and others. My close association with the Academics at Montana Tech, over more than ten years, makes me realize that there is a great potential for more involvement in the OU problems than at present.

I will be in Butte from 5th March to 9th March 1994 and will attend the public meeting to be held at Montana Tech on the evening of 8th March. I would enjoy talking with you or any of your colleagues during my stay, and in the meantime I could be contacted through the Research Office at Montana Tech (406) 496 4102.

Yours sincerely,

Bob Robins

Attachment: References to publications cited.
inclusion: Paper on sulfide tailings.

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Excerpts of Council of Commissioners Regular Meeting
April 6, 994

SECTION V PUBLIC HEARING
COMMUNICATION NO. 7891

FOR THE PURPOSE OF OBTAINING CITIZEN INPUT ON THE REMEDIAL PLAN PROPOSED FOR THE BERKELEY PIT BY EPA. Proof of publication was presented and placed on file.

Mr. Lynch invited anyone who wished to address this Council to step forward to the microphone, and limit their comments to five minutes. Mr. John Ray stated that the purpose of Superfund is to clean up sites of contamination, permanent cleanup remedy, not moving contaminants to another site. The
BSB 4-A law directs EPA to protect citizens and make superfund sites clean. Any remedy for the pit should be a cleanup remedy. The superfund law emphasizes (1) cleanup, (2) to reduce toxicity volume and mobility of hazardous substances and pollutants at the site, (3) must be permanent, (4) must not move hazardous material, and (5) cost should not be a major factor.

Mr. Fritz Daily supports a cleanup of the Berkeley Pit and congratulates the Council for presenting this resolution to EPA. The Berkeley Pit issue is the most serious issue facing this community. It has the potential to destroy this community as corrective action is not being taken. This
BS 4-B decision that is being made regarding the Berkeley Pit is one of the most important decisions that will ever be made. He feels there is no doubt that the critical water level, as established by the EPA and ARCO, is wrong. At the last Legislature, we passed two resolutions about the Berkeley Pit issue and I have passed them out to you. We need to turn this liability into an asset with the help of private companies. To strengthen this resolution, he wants to include something in the document that addresses active mining and to say that active mining continues. He would also like the Council to consider the treatment of Horseshoe Bend Water.

Dr. Irving DeVoe of Metanetix spoke on the proposal by the EPA. He said that chemists knew about this sludge treatment in 1820, and that this technology is so old, our dumps are filled with sludge all over the world. His company is looking at cleaning up these dumps in the future. To start another
BSB 4-C one here is not the answer. We received another private grant which will allow us, in a commercial operation, to take the materials from the mine water with zero waste. This technology has been accepted by the Czech government as the technology to clean up the Czech Republic soil. According to an article in the SITE Technology Profiles, Sixth Edition, the comments that state the technology that we moved into Butte with the heavy metal process effectively treated samples of contaminated soil from the Port Industrial Area, lead contaminated soil, from a lead smelter site, harbour sediments, municipal sewage sludge. These soils could then be taken back to their original sites and these materials could be recycled. Our philosophy is to recycle the metals.

Representative Joe Quilici said he spent time today at and talked about mining waste. There are some things in the EPA proposed plan that are good. There are problems with the EPA plan and those problems were addressed in this proposed resolution, and he encourages the Commissioners to adopt this resolution. If we can get the parties involved together, then

BSB 4-D we can resolve the difference between the two documents and
then the problem with the pit can be resolved. We do need a
definite date on the treatment plant, and we need answers to
these questions and the people of Butte-Silver Bow need to be
protected.

George Waring said he is involved in a petition drive for the
Clark Fork Coalition. People are very willing to sign this
petition and that people are fearful that EPA and ARCO are
doing something bad to our community. People, who are signing
BSB 4-E his petition that he is circulating for the Clark Fork
Coalition, want something done now about the pit, not wait 25
years to have something done. People want something done now
and they do not like the EPA solution.

Rose Brock stated that there are many wells in her
neighborhood and she would like a guarantee that the well
water is as clear in the future as it is now, and feels we
need to address the aquifer issue. She objects to filling the
BSB 4-F pit with sludge. She drew a parallel between the situation in
Utah, Nevada, and Idaho, after facing many years of nuclear
testing and being told it was okay, and now find that there
are different results. She applauds the efforts of the Council.

Albert Molignoni passed out two documents and said there are
other preferred alternative other than what EPA presents for
this community. There are more innovative ideas. The
preferred alternative as proposed by the EPA and MDHES should
BSB 4-G be unacceptable by this governing body and this community. We
can't totally rely on expert opinion on this issue because
nowhere else in the world has a cleanup of this magnitude
taken place before. A little common sense will go a lot
further on this cleanup issue.

Representative Bob Pavlovich said that one person who deserves
a lot of credit is Mr. Fritz Daily, as Mr. Daily has fought
BSB 4-H hard at the State Legislature for this issue. Mr. Pavlovich
owns a business and there are 7 wells on his property
monitoring the gas station across the street and yet we only
have 5 wells monitoring the Berkeley Pit. We need the two new
wells in this town. We need to clean this area up, and soon
and we need help from the State Legislature and we need your
help to do it.

Barbara Archer said we need to use the best technology, look
at new and better technology, and to begin the treatment in
BSB 4-I the pit and we need to do it now.

At 8:55 p.m., the Public Hearing recessed and reconvened at
9:10 p.m. Roll call was taken and there were 10 present and
2 absent.

Mary Kay Craig of the Clark Fork Coalition, said that she very
much supported this plan. She would like to add two ideas to
the plan, and that is that we reduce the amount of water in
the pit now and clean it up now. Ms. Craig read a petition,
that she circulated at one store in one day and collected 750
signatures, to the Council which asks the support of President
BSB 4-J Clinton, and Congressional Delegation to reduce the water
level in the Berkeley Pit and to reduce it now. Dust is an
area that hasn't been addressed and the air quality was just
one of her concerns that is not addressed in the EPA plan.
Mr. Lynch asked for a copy of the petition, and she said she
will provide a copy of this petition with signatures when they
have finished circulating it.

Sandy Stash of ARCO said one point that has been missed is that we have a solution on the table and a $6 million study and that there were a variety of parties in agreement with the study. She stated that ARCO is one of the two companies that will be asked to pay for the cleanup. ARCO is in favor of the plan that was prepared by the EPA, and other supporters include the Department of Health and Environmental Sciences, the Bureau of Mines, and Montana Resources, Inc. and ARCO. There is agreement and disagreement on this whole issue. As far as the critical water level, the critical water level includes a 50 foot safety factor. An appropriate time frame
BSB 4-K will require a couple of years to get a plant built, and that two years before the critical water level is reached is the time to start construction of the plant. This should not be triggered by a water level. By the time the pit reaches the critical water level, it will not be rising at the same rate, but will be far less. It rises at a level less and less each year. We need to tie the extra level of protection into the number of years rather than the water level. Regarding the wells on monitoring one more well makes sense if it is properly placed. We have done much in the way of public education on a very difficult subject, and we agree that public education is a key issue and we will work with you on getting this done and doing a better job on public education. The technology that EPA has accepted is proven and this particular technology is a Butte solution that was developed at Montana Tech and, at this time, is the only technology that meets all the superfund criteria and we tested 19. This is the technology we have in the current plan. We have a great deal of time to look at other innovative technologies. If someone can come up with a technology that is proven and cost effective we will certainly be willing to accept it. On the issue of the bedrock aquifer, EPA is suggesting that it is impractical to fix, and we agree. The wells that are drilled at the pit cost $100,000 each, and we question whether this is the type of aquifer that is the source of water for the community. ARCO commends the Council for making the effort on this issue.

James Riley worked at the Anaconda Company for 36 years and
BSB 4-L feels we could run the tailings through the precipitation plant. He said if the Berkeley Pit water is contaminated, what about the miners who worked there. He wants to know what is being done for former copper workers.

Eileen LaBreche lives on Texas Avenue and wants the Council to know what it is like to live by the pit. The dust in the morning is horrible. While considering digging a well, they were discouraged because of the close proximity of the pit.
BSB 4-M They cannot sell the house because of the proximity to the pit. We need to do something now, not when it becomes critical.

Dave Curry has a few comments and suggestions. He feels there is a conflict of interest because we want something done now and at the same time we want to see some innovative technology used. If we do something now, the technology that will be used will create the sludge and he doesn't feel the people want that. He suggests that we do something that is best for the community as a whole. He feels we should try to recover
BSB 4-N those minerals and sell them. He feels the document was extremely well written. We have discussed an earthquake, but just how large an earthquake would affect the pit. The plant is likely to be destroyed in the pit from an earthquake. The water level in the pit is set in concrete by EPA, but Mr. Forba told him that the Council could address the socio-economic issue. As far as the treatment plant he feels we should adopt a hurry up and wait attitude. The cleaning up

now is not going to be a permanent cleanup. We will be creating sludge ponds. He feels we need the right technology and should give Metanetix and MSE enough time to come up with a plan for the technology. It is in our best interest to try and force a permanent cleanup. We need to be sure the right technology is used. He is concerned that we can affect the current active mining and it is in our best interest to concentrate on the best type of clean-up possible.
Mike Thatcher felt we don't need to compromise and this

BSB 4-O position is premature and feels the Commissioners' role is to let EPA know how we feel. Our proposal is well substantiated and doesn't feel we should throw the towel in.

Mr. Curry is proposing that the community scope be what is best for the community and feels that because of the Environmental Protection Agency Act, this whole issue has been
BSB 4-N forced. His concern is that EPA has come up with technical information. We need to put our efforts toward the best result that is available to us.

Mr. O'Leary placed a question to Mr. Russ Forba of the EPA in Helena. If a new technology comes along in the next few
BSB 4-P years, how will this new technology be used? Mr. Forba responded that they would like to see the market forces control this. If there is innovative technology that can do the cleanup more cost effectively, in terms of recovering materials, and in meeting specific discharge standards into Silver Bow Creek, or for use in the concentrator, we will be the first people to amend our proposal. It will be the responsibility of those companies and the PRP's coming forth to us and saying that they have something better. We will then amend the order in public court.

Mr. Thatcher asked about the time parameters relative to dialogue tonight for a final decision. Mr. Forba said public comment ends April 29, a formal public hearing is scheduled on April 26. They will also schedule a day long recording for
BSB 4-O people who want to comment but won't get up in front of a big crowd. It will then take several months to go through all the public comments, make the necessary changes, and will be ready hopefully before October 1.

Mr. Kerns said that the term cost effective is constantly being used. What does cost effective mean to the people of
BSB 4-Q this community ten years down the road, does it mean that after the metals are taken, that we are dealing with today's dollars or ten years from now dollars?

Mr. Forba would like to see it market driven. The actual cost involved is unknown, because we don't know the cost of some of the technology because they aren't proven. The present dollar we are using is the 1992 dollar. Mr. Kerns asked if there was an escalation factor built into the cost of the plant. Mr. Forba said yes there was.

Dr. DeVoe asked if innovative technology has to be proven by
BSB 4-C April 29 of this year? Mr. Forba said they can amend anything in the future. They will be a proponent of anything that is cost effective.

Ms. DeVoe said that what is being proposed is not a solution, it is a postponement that has to be dealt with down the line,
BSB 4-R therefore it will cost more money. If there is a permanent solution now that is as cost effective or even a little more expensive then is it not worth getting involved with it. Why does it have to be more cost effective?

Since there were no more comments, Mr. Lynch thanked everyone for coming and speaking and taking the time to listen. said he and the Planning Department staff will review the comments of this Public Hearing. We will present this draft to the EPA in a resolution form. The draft put forth by Butte-Silver Bow has been given a lot of thought. If the goal for innovative technology can be realized, the plant may never have to be built. He said he finds disposal of sludge in the pit as totally unacceptable and hopes that the community agrees with him. There has to be a better way of disposing of the sludge. Our objective in putting together this draft is to involve the community, to seek and get together in how to solve this problem. We need to give this community some assurances. We have legitimate concerns and needs. He has asked that the recording secretaries make this public comment in transcription form and that it will be presented to the EPA at the Public Hearing.

Mr. Brophy said we are here to listen to these people. The matter of mining and the safety and health of our citizens can be compatible. He moved that we request the Chief Executive
BSB 4-S and his staff to prepare the comments of this meeting, revise Butte-Silver Bow's document accordingly, and submit them to the Committee of the Whole on April 13th for review so that the final document can be submitted to the Council on April 20th, and a resolution of support be passed at that time, and that Communication No. 7891 be placed on file. Mr. Kerns seconded. The motion passed with Mike Sheehy opposing.

The purpose of Superfund is to clean up hazardous waste Sites which are a threat to human health and the environment. Remedies under Superfund should provide a permanent cleanup remedy not temporary containment or simply removal to another site. Simply cleanup is the "act of cleaning up:" and the term clean means "pure, free from dirt, contamination, impurities." According to the EPA publication entitled Superfund: Environmental Progress the purpose of Superfund is to achieve "long-term cleanup goals for sites" and to remove "contamination from the environment." p. 1. The document further states that "the law directs EPA to protect public health by meeting strict cleanup standards at each site," and "Reduced to its environmental essence, the New Superfund mission is make sites safe, make sites clean, and bring new technology to bear on the problem." p. 3 According to the law any remedy for the Pit should be a cleanup remedy.

If one examines the major Superfund laws and regulations (1. CERCLA-Comprehensive Environmental Response, Compensation and Liability Act, 2. NCP- National Contingency Plan and, 3. SARA-Superfund Amendments and Reauthorization Act), one finds that they All of the above emphasize:

1. Cleanup.

2. The reduction of toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site.

3. Cleanup remedies must be permanent.

4. Discourage EPA from simply moving waste for one spot to another. Is this what will be done with the sludge which will result from treating Pit water?

5. Cost is not the major factor. Cost is secondary to protecting human health and the environment.

In light of the above should we be comfortable with a proposed plan which would allow the volume of toxic/contaminated water in the pit to more than double before anything is done (from 25 billion gallons to 56 billion gallons). This proposed plan would allow a surface area of contamination of 487 acres. Is this a clean up remedy? Is this a remedy with reduces the toxicity, mobility, and volume of hazardous waste? Is this a permanent remedy or a remedy with will leave us with a perpetual environmental crisis?

Unfortunately, past Superfund efforts have not met these goals of permanent cleanup. The Office of Technology Assessment (OTA) has concluded that Superfund "remains largely ineffective and inefficient: and "is not working environmentally." OTA has concluded that the Superfund program has too often settled for remedy technologies which would not reduce the "toxicity, mobility or volume" of the hazardous waste. All too often Superfund has settled for remedies short of cleanup. Given the serious nature of the contaminants at the Pit we cannot allow any remedy short of cleanup. We must clean up the problem so that future generations don't have to deal with it.

Specific comments on Butte Plan:

1. Needs to be stronger on demand for cleanup

2. Needs to spell out what appropriate/new technologies need to be considered. Now it is too vague. Relates to real cleanup.

3. Sludge disposal-Need to also be concerned that if we dispose of sludge near the Pit that we are not creating a new Superfund site of the future. How would this near site sludge removal meet requirements of cleanup listed above?

John W. Ray 915 West Galena St. Butte, Montana 59701

Clark Fork
Pend Oreille
COALITION

<IMG SRC 0894102ED>

April 11, 1994

Mr. Jack Lynch
Chief Executive
Butte-Silver Bow County
Butte, MT 59701

Butte-Silver Bow Council of Commissioners
Butte, MT 59701

Re: Berkeley Pit County Resolution

Dear Jack and Commissioners:

Butte people appear to be very unhappy over EPA's disregard for their Berkeley Pit concerns.

Enclosed is a packet of 2203 signed petitions requesting the U.S. EPA reduce the water level In the Berkeley Pit and clean it now. Butte-Silver Bow residents total 2136 signatures; the remainder are concerned Anacondans and residents of other cities. Approximately ___ Butte High school students signed the petition yesterday. The petition now has a life of its own. We estimate another thousand or two will come in before end of the comment period even if we did nothing more toward gathering community input. Note that some of the attached signatories are youngsters who listed their ages to convey their desire not to have to worry over unforeseen full-pit problems in the year 2,022.

The strong desire of the people of Butte can be known by the fact that most of these petitions (about 1,400) were gathered in less than two days at K-Mart (Saturdays, April 2nd and 9th). I believe somewhere between 90 and 98 percent of those who were asked did sign the petition. Those who did not were usually in a hurry. As you look through the petition sheets, you'll find many of your friends and your constituents believe a lowered pit level is best for Butte, and that cleanup should start quickly.

Butte-Silver Bow's draft resolution is very well done. It has Coalition support for the most part. We understand the reason it focuses mainly on technical issues is in answer to EPA's challenge that this must be done to obtain any changes. However, social and economic issues of a

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Missoula, MT 59807
406/542-0539

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Butte, MT 59702
406/723-4061

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Sandpoint, ID 83864
208/263-0347

BERKELEY PIT

This enormous deep hole can be turned into one of the best assets our community has. I will now try to describe in simple terms its cycle of operation. The sooner this project is put into operation, the greater the benefits will be for our community.

1. Start a massive tree planting operation in our area to supply the water purification plant with one of the main ingredients for the water plant cycle of operation. After 25 years some of the trees can be harvested on an annual basis to provide the water plant its energy and purification material needed for its operation cycle.

2. Create a large water and ice storage reservoir above the town of Walkerville. This high elevation reservoir will supply our community with a cheap abundant supply of clean high pressure water for domestic and fire protection. Also some of this water supply can be used for tree growing, agriculture, mining, recreation, and industry.

3. Design and build a water purification plant that will process fifty million gallons of water per day. With over twenty billion gallons currently in the Berkeley Pit, it will take about 25 years to drain the pit. The lowering of the pit water will improve the water project.

4. Take all of the water from the metro sewer plant as well as the storm water runoff that is now going into Silver Bow creek. Install a water main from this water supply over to and down the Berkeley Pit wall to the present water elevation of the pit. Because the pit water elevation at the present time is much lower than the metro sewer plants water outlet, the water will siphon into the pit. Put a hydroelectric generator on a large barge, the reason for this is as the water table drops in the pit additional water main can be added thereby creating a higher water pressure source to generate more electric power to be used by the community or sold at a profit to the Montana Power Company. After this water leaves the hydroelectric generator it is captured in a large floating vessel and put through the water purification plant. A note of interest is the current cost of electricity to pump water from the Big Hole River at Divide, Montana into Butte, Montana (about $150.00 per million gallons). If we pump an average of eight million gallons per day, the coat is $1200.00 per day or $438,000.00 per year. With the Berkeley pit water project this cost is eliminated.

WATER PURIFICATION PLANT

A simple, very tall, highly insulated vessel like an immense thermos bottle can be installed at an angle near the present water elevation of the Berkeley Pit up to the highest point of the pit wall. Wood chips or wood shavings are gravity fed by a hopper into the vessel about one hundred feet from the bottom of the vessel. Near this same point the contaminated water is inserted into the vessel. Near the bottom of the vessel, hot clean gases from the combustion process of dry wood chips and the air dried carbon filters that were removed from the water purifying system are inserted into this vessel. The combustion gases are kept below the burning point of wood or about 250 degrees Fahrenheit. Water is preheated by the combustion process to keep the combustion gases at 250 degrees Fahrenheit. This is the same water that is inserted into the vessel. As the hot gases are driven up through the vessel; the high in moisture wood chips are separated from moisture by evaporation. The hot gases and heated water vapor will continue to rise in the vessel to the top of the pit wall at its highest point and at this point of discharge from the vessel a condenser is installed. This condenser or heat exchanger has cold liquid ammonia in it. The hot gases and vapor heat the liquid ammonia enclosed in pipes to a high pressure gas or vapor. This action turns the hot gases to cold gases and hot water vapor to cold water. The hot high pressure ammonia vapor is used to drive a turbine or engine to generate electricity to pump the condensed water to the high elevation reservoir, pump contaminated water into the water purifying vessel and to run the air blowers of the water plants system. At the very bottom of the vessel the hot dry wood chips with the contaminate in them are taken to the combustion chamber.

Some of the water from the high elevation reservoir can be brought by pipeline to and down a mine shaft close to the water elevation in the mine shaft. A water turbine can be installed to generate electricity because of the high pressure water from the reservoir. If this water has oxygen put into it to produce acid that will solubilize the metals in the ore body of our area. After many years of this water mining the contamination of metals to our ground water should be eliminated. If this water that is high in metals goes into the Berkeley Pit it can be processed in the water purifying plant.

THE USE OF SOLAR AND WIND ENERGY

1. Trees can be planted around the Berkeley Pit walls at each bench level. The trees will absorb solar energy and moisture from the soils. After many years of growing, the trees can be harvested on an annual basis in this area. This factor will reduce the transportation cost from tree farm to water purifying plant.

2. Solar collectors and solar cells can also be used for a heat enhancer and to generate more electricity. The glass products needed to make solar collectors can be taken from the garbage waste that now goes to the landfill. This glass product can be manufactured locally creating more jobs for this area. A note of interest, large amounts of copper are used to make solar collectors and arsenic is used in solar cell construction.

3. Because our area of this community is surrounded by tall mountains, wind turbines can be installed on the tops of these regions that can be used as an electrical supply for the melting of glass and metals used in the solar collector and solar cell manufacturing process.

4. Many other combustible products can be taken from our garbage waste stream such as paper, tires and used motor oil. Also, the many plastic products can be used for insulation products and material products for solar collectors construction.

EFFICIENCY CYCLE WINTER AND SUMMER

By changing the flow path of the ammonia liquid and vapor this water purifying plant will have an efficiency rating of over eighty percent. The wood product will cost about fifty cents per one hundred thousand B.T.U. This efficiency rating will give us 10,000 gallons of clean water at the high elevation reservoir for $ .50. The people of the present water system pay close to $2.00 per thousand gallons of water.

SUMMARY

The sooner the E.P.A., MDHES, Arco and the communities Anaconda and Butte Silver Bow accept the project design and ideas I have described in this text the sooner the region can have the vast array of high-tech, high paying jobs that are now needed in our area.

POWERSHAFT LIMITED

Proposal by
Albert J. Molignoni

I. Creation of Water Storage Systems

II. Creation of High Efficiency Electric Generation

I. Creation of Water Storage Systems

Production

While living and traveling in the state of Montana, I have witnessed the exploitation of the state's mineral and fossil fuel resources. From these observations, I have concluded that the inevitable depletion of these natural resources will result in a considerable reduction in the state's wealth. The following proposal has been educed as an alternative source of monetary and energy needs for the state of Montana. Development of this concept was derived only after extensive research on wind energy, solar energy, and thermodynamics.

The project I propose is the creation of a water storage system. This system will utilize Montana's land, water, wind, cold and heat, to ultimately provide a renewable energy source. Its success can be achieved with the combined efforts of the federal, state, and local governments. Farming, ranching, timber, mining and recreational groups will also be required to participate in the development of this project.

Land

The state of Montana has a very unusual land situation. Many of its areas are mountainous terrain; therefore, there are land sites in the state that are not suitable for agricultural production or recreational purpose. Areas of non productive soils, such as those left over from mining, commonly take up one hundred acres or more in this state. Timber areas and other smaller sites can also be utilized for the creation of this project.

Water

Winter is a natural resource that this state has a great abundance of in certain times and very little of during a drought period. The controlling of this resource in the past has been with the use of dams conservation. These methods of water management worked in the past, but present and future demands for water will increase if our state is to continue a growth period for such industries as agriculture, timber, mining, recreation, industrial and domestic. The following paragraphs on wind, cold and heat will give a general description on how the project can be successful.

Wind

This resource of energy is one of the primary sources that will be used to place the water on the land mass that was described earlier in the text (See Land). The reasons for using this energy source are the following:

1. To supply electrical energy for pumping the water from a supply source to the land storage area.

2. To supply electrical energy in the non-producing water storage months that can be sold, or used as a credit at a later date for pumping of water to the land storage in the producing months. This circumstance will occur when the wind energy is not sufficient to produce electrical energy during the water storage months.

3. Wind is one of the most reliable energy sources that Montana has. This is proven by past studies conducted for the state on wind energy.

Cold

A natural event that takes place in out state at certain times of the year during our fall and winter months. Some people curse it and others think its wonderful, but it is also one of the main ingredients for the project design. With the cold, wind, water and land, massive ice storage systems can be created for our state to insure an adequate water supply for future use. The system design will place the water on the land storage area (See Land). The massive blocks of ice are created by putting the water on the land when the air temperature is below freezing. In return, the water will freeze from the bottom up. This process is unlike the one that takes place on lakes, rivers or streams, where water freezes from the top downward. When the water is frozen from the bottom up, the ice structure created is one of the most stable forms for the storage of the water. The benefits of storing water in this time frame and manner are:

1. Water used to create the ice storage units in the winter months can be supplied by lakes, rivers, streams or wells. In this time frame the demand for the states water is at its lowest level.

2. If the water used to create the ice storage units is supplied by a underground pipe line, or a self draining pipe line and stored at high elevations, it will create a water line with high head pressure when the ice melts in the spring and summer months. This energy source can be used for hydroelectric and high pressure sprinkler systems.

3. By using a geothermic water supply, the thermodynamic principles and cold air temperatures, an energy source is created to supply the pumping of water in this time frame. Solar can also be used as a heat source.

4. These large stable ice units can be used in the winter months with snow cover for such winter time activities as skiing and snowmobiling.

5. Storing water in this manner will provide a gradual water discharge during the spring and summer months for the support of agricultural, timber, mining, recreation, industrial and domestic needs.

Heat

The last natural resource that is needed to complete the project design is heat. The heat energy source will accrue during the spring and summer months. This will provide the means of melting the ice storage systems. Therefore, an ample water supply will be created for the growth of our state. The heat from, the sun in the spring and summer months, coupled with the cold water from the ice storage units, benefits in creating a energy source by the use of the thermodynamics principle. It will also be noted that if a high precipitation period occurs during the winter and spring months, the excess water will be induced into the state's aquifer for storage. The water can then be used at a later date when needed, such as in the fall during the non-productive months of the ice storage systems.

Summary

Upon reading the previous text on the general description of the projects design, it can be understood by the average lay person that this process is already taking place in our state with the four seasons of spring, summer, fall and winter. With the added technology of the state's university system and people with the expertise on the project design and development, the project goal is obtainable. The spin off of high-tech as well as other jobs associated with the project design and construction are too numerous to mention. The additional benefits of the project are:

1. An increase tax base for the state due to the taxable valuation of the projects components and additional soil under cultivation by the water.

2. An industry created to design and produce the components of this project design to other areas that have the same or similar geographical location and climatic condition.

II. Creation of High Efficiency Electric Generation

Introduction

The prime sources of electrical generation in Montana are hydroelectric and steam. Wind generation has also been used in small quantities to produce electricity.

Hydroelectric production is solely reliant on mother nature to produce enough moisture from the snow and rainfall to fill the reservoirs with water for generation. In addition to providing a clean supply of electrical energy, hydroelectric dams manage the water supply to the consumers in the state.

Steam generation is produced by the burning of our state's coal supply. The efficiency of this type of electrical generation is around thirty percent. This means that seventy percent of the coal's heat energy is wasted. Coal is not the only type of fossil fuel that is used inefficiently in Montana. Gasoline and diesel fuels in today's internal combustion engines, such as automobiles, trucks, tractors and trains very seldom reach a efficiency of forty percent.

Montana's extreme temperature variations, seen throughout an annual period, is another source of clean energy. Water, cold weather in the below freezing months, and hot weather in the late spring and summer months, are the basic resources needed to create massive amounts of energy inexpensively. For the past several years, I have designed and patented a unique high efficiency engine and heat exchanging system. This system design, with the usage of ammonia or freon, produces a efficiency of eighty percent. Adoption of this type of energy system, in conjunction with the ice storage units, would produce extensive amounts of water and energy cheaply. The following text will give examples of how this type of systems can be used in our state.

Cities and Towns

Present sewer and garbage disposal systems are abundant supplies of energy needed to make the system successful. The heat energy needed for the system would be derived from warm waste water in community sewer disposal systems, and the higher temperature heat source that can be supplied by ether incinerating garbage or the burning of methane gas produced by our sewer plants. Cold air is the condensing agent needed to complete the energy cycle of operation during the cold weather months. Processed water from the sewer plant during the cold weather operation will be used in the ice storage system. This cold water supply is used as a condensing agent during the hot weather cycle of operation. Local governments could realize additional income by selling the vast amounts of electricity and water produced by the system.

Timber Industry

The waste wood products that are not used in our state's forests is unbelievable. The simple economic reason is the wasted wood products that are created from logging, timber thinning, and trees that insects destroy are not in demand. Present use of waste wood is by home owners to help their dwellings. The high cost of home heating created the demand for this type of wood burning.

New technology for clean burning of wood products, combined with the high efficiency energy system would create a large demand for wasted wood products. The lumber industry already has the equipment needed to bring the wasted wood to a mill or a convenient site for the burning of this product in the high efficiency energy system. Adoption of this system design would create an abundant supply of cheap electricity, jobs, and additional cash flow to the timber industry.

Agricultural Industry

Farming and ranching industries face a very unfavorable growth period in Montana because of the increased demand for water by agricultural, commercial and recreational groups. The state's present water policy is unfavorable because added storage was not develop to insure a adequate supply of water for the growth of agriculture. Ranch and farm industries already have enough problems with drought, insects, low prices and high taxes to make their business unprofitable.

A mobile unit can be used for this type of energy production. The unit can be moved from one location to another for the ice and energy production. Also, if there is a major malfunction with the energy unit a different unit can be brought in to produce the energy while the original unit is being repaired. The automated unit would require very little time and effort from the operator, thereby releasing the person for other duties that are required for the farming and ranching operation. Additional cash flow from the sale of electricity from the unit would insure the usage of this system during high periods of precipitation to increase the water table of the state's aquifer.

Utility - Public and Private

The vast untouched natural resource of Montana's heat and cold is almost impossible to described. We have failed in the past to utilize this abundant source of energy. Public and private utilities of this state, with the system design, would be able to produce large blocks of electrical energy that can be sold to other states, thereby increasing the cash flow into our state. If exportation of electrical energy is taxed, the added income would benefit this state. The sale of this energy at a reduced rate within the state would entice industry, that consume large amounts of electrical energy, into this state.

Mining Industry

Mining concerns have one of the best potentials for the system design. Energy generation and ice storage will create an abundant supply of inexpensive electricity and water for mining. The increase of demand for time and phosphate for fertilizer by the agricultural industry would reopen old mines and create new ones. Copper and aluminum industries are also great benefactors, because of the large amounts of copper and aluminum metals in the energy system's parts.

Recreational Industry

The added water supply would insure a increase in the recreational industry in Montana. A sufficient water supply would increase the feed products for the big game and fishing industries. Additional quantities of water would also benefit such industries as boating, skiing, and other related activities heavily reliant on an adequate water supply. The potential of the state's ice storage units is 20 million or more in acre feet of water.

Summary

Upon the states adoption of this type of ice storage and high efficiency energy system, a meeting should be set up with a group of professional people with the expertise on this subject matter. The meeting would have to be held in strict confidence because of many ideas I have on the subject matter that may be patentable. Compensation is also a factor that has to be dealt with due to the many years of time, effort, and expense that were necessary to create this system.

ARCO

BSB

April 6, 1994

Mr. Jack Lynch
Chief Executive
Butte-Silver Bow County
Courthouse
Butte, Mt. 59701

Council of Commissioners
Butte-Silver Bow County
Courthouse
Butte, Mt. 59701

Re: Response to Butte/Silver Bow Government's Draft Comments on the Mine Flooding Remedial Investigation/Feasibility Study (RI/FS)

Dear Jack and Commissioners:

The following are ARCO's responses to Butte/Silver Bow Government's (BSB) draft comments on the Mine Flooding RI/FS. ARCO's responses follow the same four headings that BSB's comments addressed as follows:

1. Assurances/Scheduling for Construction of Treatment Plant

Comment: BSB states that there is "no absolute guarantee" that the Critical Water Level (CWL) of 5,410 will never be reached and as a result, a firm schedule for building a treatment plant should be made a part of the Record of Decision (ROD).

Response: There is indeed a very definite "absolute guarantee" that the CWL will never be exceeded because the PRPs have signed a consent order in which they have agreed never to allow the water level to exceed the 5,410 elevation or violation of that order would result in penalties of $25,000.000 per day. Additionally, the EPA, as part of its Remedial Design/Remedial Action (RD/RA) process which will immediately follow the ROD, will require the development of a detailed schedule for treatment plant design, construction and a shake-down period. It's important to remember too that the 5,410 CWL already includes a 50 foot safety factor.

Comment: BSB believes that a reversal in gradient and ground water flow could occur at a weathered bedrock saddle at the 5,350 level and therefore, this level should be used as a starting point to trigger action.

Response: ARCO suggests that rather than basing this "trigger action" on an elevation such as the 5,350 foot level (a point at the top of weathered bedrock as suggested by BSB), it should be based on a given period of time (i.e., 3-5 years at the then current rate of water level rise) to allow enough time for design, construction and shakedown of the treatment plant.

Comment: An additional buffer of 15 feet should be added to the CWL to accommodate the tailings that could flow into the Pit after a large earthquake.

Response: The RI/FS analysis performed by Harding Lawson Associates on the Yankee Doodle Tailings Pond (YDTP) determined that a release of tailings to the pit should not happen even under the "maximum credible earthquake" scenario. The State of Montana, specifically DNRC, will monitor the YDTP to ensure its safe operation into the future.

Comment: The CWL should be lowered an additional 75 feet to take into account the period of time needed to make a treatment plant fully operable.

Response: ARCO agrees that a "shakedown" period is needed to make the treatment plant fully operational; however, the two year period will vary depending on the type of treatment plant chosen. Also, the water level rise in the future will be much slower than the current rate of 25 feet per year because the hydraulic gradient will continue to decrease and the volume of the pit available for filling will continue to increase. Also, see response to the second comment above.

2. Enhanced Monitoring Program/Public Education

Comment: BSB recommends that two additional monitoring wells be drilled in the region southeast of the Berkeley Pit and one adjacent to the East Continental Pit.

Response: ARCO agrees that the bedrock aquifer contours need to be extended south and east of Well "C". However, ARCO believes that one additional bedrock well, if properly located, will provide verification to the bedrock aquifer contours that no water is migrating south and east of the Berkeley Pit. During a recent conversation with BSB representatives, it appears that the second well requested near the East Continental Pit is no longer necessary because two monitoring points already exist, a shaft and a sump, in which Montana Resources monitors water levels both at the north and south ends of their operation. ARCO does not agree with the basis for the third well requested between the Berkeley Pit and the East Continental Pit because it falls inside the outer wells verifying the inward gradient, including the new Well "G" southeast of Well "C".

3. Innovative Technology: Call to Action

3.1 Technology Alternatives

Comment: BSB suggests that an evaluation of combinations of the 19 remedial technologies evaluated individually in the RI/FS could become part of the "innovative technology" research on waste remediation being done in Butte through a variety of business ventures.

Response: ARCO believes that any combination or two or more technologies that individually did not work (for one reason or another) will still result in a combined technology that would be screened out in accordance with Superfund criteria.

3.2 Selected Technology at Odds with Metals Recovery.

Comment: BSB does not like hydroxide precipitation because it precludes future recovery or metals.

Response: The fact that a hydroxide precipitation treatment technology was selected as the basis for the RI/FS costs does not mean that this type of treatment plant will be constructed in the future. The RI/FS process only requires that a technology exists to meet all of the current discharge requirements. However, ARCO is interested in any available technology, future or present, if it is more cost effective than the technology found to be adequate in the RI/FS.

3.3 Sludge Disposal - Not in the Pit

Comment: BSB says sludge disposal in the pit is unacceptable.

Response: ARCO is open to other options for disposal of sludges that are equally effective. However, there will be many regulatory and legal "hoops" to jump through, which will involve local government's help and leadership, to find another suitable location.

3.4 Better Analysis of Non-pit, Sludge Repository Options

Comment: BSB wants the FS to better define the tasks of siting and designing a non-pit repository.

Response: ARCO agrees that it is not easy to site a repository for treatment plant sludges. However, until a treatment plant technology is finally decided upon and pilot scale tests have been conducted, no decision should be made at this time.

3.5 Loss of Orebody for Future Resource Development

Comment: BSB is concerned about the loss of future tax revenues.

Response: Any future mining of the Berkeley Pit has to include the costs of dewatering and treating water to discharge standards along with other mining costs, just as any other mining company does when they develop a new ore body.

3.6 Conclusion re: Innovative Technology

Comment: BSB suggests that the use of innovative technologies be written into the ROD.

Response: To date, any proposed "innovative technology" has failed to meet the Superfund screening criteria or implementability, effectiveness and cost. ARCO is not opposed to using an innovative technology if it meets all of these and other criteria used to select the best alternative. ARCO is always open to looking at cost effective treatment alternatives that protect human health and the environment.

4. Waiver of Requirement to Restore the Bedrock Aquifer.

Comment: BSB does not want additional waivers for restoration of contaminated aquifers.

Response: The EPA has stated that it is technically and economically infeasible to remediate the contaminated bedrock aquifer. In addition, it may be appropriate for no remediation of the bedrock aquifer to occur for the following reasons:

1. the bedrock is a tight system and doesn't yield sufficient quantities of water suitable for well development;
2. the bedrock is very expensive to drill for domestic well purposes;
3. the bedrock aquifer has not been utilized in the past and is not earmarked for use in the future; and
4. given the adequate surface water and groundwater supply in the region and the relatively flat population growth, the current water supply is more than adequate for any reasonable foreseeable future growth.

If you have any questions or comments on these responses, please feel free to give me or David Sinkbeil a call at 563-5211.

Yours truly,

Sandra M. Stash, P. M.
Montana Facilities Manager

cc. D. E. Sinkbeil, P. E.
R. K. Mueller, Esq.

Excerpts of Council of Commissioners Regular Meeting
April 20, 1994

7. COUNCIL RESOLUTION NO. 1635

A RESOLUTION AUTHORIZING THE SUBMISSION OF FORMAL COMMENTS TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY REGARDING THE REMEDIAL INVESTIGATION AND FEASIBILITY STUDY FOR THE MINE FLOODING OPERABLE UNIT, WHICH INCLUDES THE BERKELEY PIT AND UNDERGROUND MINE WORKINGS; AND PROVIDING FOR AN EFFECTIVE DATE HREREIN. Chairman Brophy moves that Resolution No. 1635 be place on its final passage and passed. Commissioner Heard seconded the motion.

At this point of the amending motion, Chairman Brophy moved that the Council amend page 5 of Exhibit A or Resolution No. 1635 in accordance with the attached memo from Jon Sesso, Steve Blodgett, and Mike Fitzgerald. The motion was seconded by Commissioner Heard.

Jon Sesso requested to add the italicized paragraph on the attached memo and also requested that No. 3 not be associated with Resolution No. 1635. He also noted that several items on the reverse side of the attached memo are cause for concern. It is his intent, on behalf of the county, to submit these additional comments and questions to the EPA before the comment period is closed.

Representative Fritz Daily addressed the Council and stated that the Critical Water Level is the real issue, but we cannot
BSB 12-A change it, so we should look for the next best thing, which is to come up with another solution to the problem. Mr. Daily further stated that the electricity involved in pumping will be the major expense in EPA's present proposal - - EPA and ARCO have ignored this. It is important that EPA knows that we support active mining.

Mary Kay Craig of the Clark Fork Coalition stated that she thinks we can change the Critical Water Level. Ms. Craig
BSB 12-B requested to submit 4 documents. The 4 documents are as follows:

1. An ad, which was run in the Montana Standard on April 8, 1994, called "Clean Up the Berkeley Pit", as it lists some of the community's concerns.

2. An invitation to the children of Butte to the Pit Rally, on Sunday, April 24, 1994 at 1:00 p.m. in the parking lot of the Pit.

3. A letter from Barbara Archer addressing her concerns about the Berkeley Pit.

4. A letter on addition, which Ms. Craig read to the Council. She would like to recommend a new plan on the Pit Resolution.

Frank Quilici addressed the Council and stated that he thinks
BSB 12-C we should fix the Pit for our young people, we should clean it up.

Dr. John Ray stated that we need a strong statement regarding the use of innovative technologies. Dr. Ray also stated that
BSB 12-D he thinks there is too much emphasis on cost rather than clean up. Dr. Ray also urged the Council to leave the strong wording in the Resolution.

Stephanie Jennings from the EPA addressed the Council to inform them that there would be a public hearing in the Butte EPA office, Monday, April 25, and Tuesday, April 26, 1994 with an open microphone for anyone who wishes to make a public comment.

Dr. George Waring addressed the Council and stated that the only people who are able to have any influence are the elected officials. He used to teach Commissioner Laramie at Montana Tech, and that he was a little jealous of him for being able to cast a vote on such an important matter. Dr. Waring also stated that he feels that the Council is being swayed by the PRP's.

BSB 12-E

Matt Casick addressed the Council and requested that each Commissioner state how they intended to vote on this Resolution.

BSB 12-F

Commissioners Heard, Curry, Brophy, Kerns, Thatcher, Laramie, McClafferty, Lee, Kerner, and Donaldson all stated that they are in favor of Resolution No. 1635.

Commissioner Heard is for the proposal that is prepared for the Commissioners by Mr. Sesso. It is the best route to take. Commissioner Curry supports the resolution as it is the best offer. Chairman Brophy said they are concerned with the future, and that they had to add a little common sense and good judgment. They are also concerned with the economic welfare of this community, and have tried to balance their decisions. He makes no apology for voting in favor of this resolution.

BSB 12-G

Commissioner Kerns stated that they must be very cognizant of the people who rely on the mining jobs. The water level was addressed, while coming up with a solution that will protect the best interest of Butte. He supports the resolution.

BSB 12-H

Commissioner Thatcher feels that the proposal is a viable solution. He is frightened by the decision that is being made, and he supports with some reservations, because it is the best offer now.

BSB 12-I

Commissioner Laramie supports this resolution, due to the fine planning of the staff, the input of the public, but also has some reservations. Commissioner McClafferty supports the resolution, as this is the best solution now. Commissioner Lee feels the major issues are addressed as far as the clean up.

BSB 12-J

Commissioner Kerner supports the resolution as presented by the staff. She feels the new amendment leaves the cleanup open ended. Commissioner Donaldson will vote in favor of the resolution, and agrees with Commissioner Heard's comments. He said that Mr. Forba mentioned cost-effectiveness three times, and he does have a problem with this. This resolution addresses those concerns.

Chief Executive Jack Lynch stated that the situation calls for enhanced monitoring and innovative technologies. Mr. Lynch further stated that we do not want to force an issue that will result in the closure of Montana Resources, Inc.

BSB 12-K

Commissioner Heard stated that he feels confident that the Council of Commissioners accepted the best available technology information and that it is a misconception that the Council did not look at all the information.

County Attorney Bob McCarthy suggested that the Commissioners consider amending exhibit A, on page 5. Mr. McCarthy stated that if it meets with the Council's approval that the words 'and proposed plan' be added after the word study on page one, lines 3, 11, and 20, page two line 23, and on page 3, line 10.

Also he suggested adding the words 'City and County of' in front of Butte-Silver Bow on line 24, of page three.

Chairman Brophy moved that the amendments be passed. Commissioner Heard seconded and the motion passed with 11 ayes and 0 nays.

Chairman Brophy moved to include the bold and italicized portion of the attached memo in Resolution No. 1635. Commissioner Heard seconded and the motion passed with 11 ayes and 0 nays.

There being no further business to come before the Regular meeting of the Council of Commissioners, it was moved by Commissioner Brophy, seconded by Commissioner Heard and carried by unanimous vote to Rise to the Call of the Chair.

The meeting adjourned at 2:05 p.m.

APPROVED BY THE COUNCIL OF COMMISSIONERS THIS DAY OF
, 1994.

CHIEF EXECUTIVE

ATTEST:

CLERK AND RECORDER

<IMG SRC 0894102EF> The Big Sky Country BSB

MONTANA HOUSE OF REPRESENTATIVES

REPRESENTATIVE FRITZ DAILY
HOUSE DISTRICT 69
HELENA ADDRESS
CAPITOL STATION

HOME ADDRESS:
1057 W STEEL
BUTTE, MONTANA 59701

April 19, 1994

Jack Lynch, Chief Executive
Butte-Silver Bow Courthouse
Butte, MT 59701

Dear Jack:

I am writing this letter in response to the revised county resolution concerning the Berkeley Pit RI/FS. I would like to still go on record as being supportive of the general thrust of the resolution. However, I would like to address some of the changes that were made, and also to readdress some of the suggestions I made at the public hearing.

My main area of concern has to do with the changes made to the section dealing with the construction of the treatment plant. The primary objective of the RI/FS was to establish the critical water level. However as you know, the critical water level was established at an elevation of 5410 feet before the RI/FS was ever started. While this level may or may not be accurate, it probably will not be changed without the benefit of another scientific study. This number was established with a consent decree, and truly is the only decision that is cast in stone. I would advise the local government against getting caught up in the numbers game the PRPs and the agencies so admirably play. I believe your original decision to have a construction plan available when the water reaches the bedrock-alluvial interface is still the best and safest solution for the community.

I am sad to say, but I have reached the conclusion, the only way this problem will ever be solved is with the benefit of an independent party. Eventually Metanetics, Montana Technologies or some other similar company, will develop a method to turn the liability into an asset.

It is also stated the scientific work performed by the Montana Bureau of Mines indicates the community is safe for the next several years. I have been advised by the administration of Montana Tech and personnel from the Bureau, that they are not decision makers, but information providers. The information they provide is used by the various parties to make the decisions. If you have documentation which indicates the Bureau supports the conclusions of the RI/FS, please let me know.

I also testified at the public hearing that I felt a strong statement should be made in the resolution indicating the importance of the continuation of active mining. As elected officials we are forced to walk a fine tight rope when it comes to making decisions in which we have to balance one or our main economic resources against the safety of our community. Every attempt should be made throughout the process to assure the continuation of active mining. Every attempt should also be made to assure the economic, social and environmental safety of this community. I regret Montana Resources did not support the legislation I proposed during the last two legislative sessions. This legislation would have provided the important safety net this community is now so desperately seeking.

Again, I commend you for the protective roll you and the commissioners are taking. I would make myself available to answer questions or concerns you might have. I look forward to continuing our work in trying to develop a responsible solution to this very difficult problem.

Sincerely,

Fritz Daily

cc Council of Commissioners
Don Peoples
Frank Gardner

Clark Fork
Pend Oreille
COALITION

BSB

April 20, 1994

<IMG SRC 0894102EG>

Mr. Jack Lynch
Chief Executive
Butte-Silver Bow County
Butte, MT 59701

Butte-Silver Bow Council of Commissioners
Butte, MT 59701

Re: Berkeley Pit County Resolution - - Addition

Dear Jack and Commissioners:

The Resolution you have before you tonight in many respects simply puts a schedule to the EPA-ARCO plan to delay until 2.022 cleaning and discharging pit water to Silver Bow Creek. Our calculations from the information in the Resolution presented last Wednesday indicate it will be 2.017 before anything would happen under the Butte-Silver Bow Resolution. Perhaps that is the same schedule ARCO and EPA would choose. Your Resolution does not take a stand in favor of action now - - it simply asks folks not to focus on that. The people of Butte, especially youngsters, prefer quicker action and would like you to advocate such for them.

So, rather than wait nearly 30 years and hope and wish for new, inexpensive technology for cleaning the pit water, and rather than complain with no solution, let's force new technology to come forward now. There is nothing like a deadline to get things off dead center. Competition, capitalism and market forces can bring forward the needed cost effective technology and get it up and running within eight years. Here is an alternate plan for you which appears satisfy technical and non-technical citizens of Butte:

P.O. Box 7593
Missoula, MT 59807
406/542-0539
P.O. Box 4718
Butte, MT 59702
P.O. Box 1096
Sandpoint, ID 83864
208/263-0347

An Acceptable Plan:

Require that the cleanup work forward from today, not backward from 2,022. The Record of Decision could call for EPA to work with the Department of Energy and Butte's MSE Pit Resource Recovery Program. MSE could send out a call immediately, internationally, that any organization interested in a piece of the Butte minerals pie must come forward with their technology by a deadline date -- within two to three years Companies can obtain investors to help them refine their technologies now. If they are unable to finance the needed work, they can take a chance that MSE will choose their idea, for testing, using dollars from the Department of Energy and, possibly, the new research dollars that Butte-Silver Bow, asks EPA to provide. By the two or three-year deadline. MSE would have decided which -- one, two, or more -- technologies should go forward into a pilot program. Also at that time, work should begin on the pumping plant, because it would not have to be changed depending on the technology selected. Within the following five years, the best technology would have been selected and implemented -- so that by the end of a total of seven or eight years, a pumping and treatment facility would be operational for the Berkeley Pit in Butte.

We continue to receive Pit Petitions daily and could easily obtain any number of signatures -- at least 90% of all Butte citizens want to sign it. We believe the over 2300 signatures we gave you last week proves that point, since more than 1400 came from the two days we had it at K-Mart. Your constituents and their children have exhibited great concern that the EPA plan is not adequately protective of human health and the environment in that it poses a perpetual threat of release of contamination. They want the water to begin to be cleaned at the earliest possible time. And they need your help. Please include in your Resolution a request that EPA work today - not in-2022 - to cleanup the Berkeley Pit.

You are invited to a Pit Rally this Sunday, April 24th at 1:00 p.m. at the Berkeley Pit. Children and parents will sign a "Get Well SOON" card for the Berkeley Pit which will be presented to EPA.

Yours truly,
Mary Kay Craig
Upper River Field Representative

cc MT Congressional Delegation

BSB

April 10, 1994

To: Council of Commissioners
From: Barbara J. Archer, 802 W. Galena, Butte, MT 59701
RE: Clean-up of the Berkeley Pit

The primary concern is not who pays and how much but is rather the health of our citizenry and of the watershed, which are inextricably intertwined.

The EPA must begin the process of physically addressing the problem of 27 billion gallons of toxic water now, rather than putting it off for 20 or 30 years on the premise that experts have assured them and us that the pit water is not a problem and won't be until a certain critical water level is reached. That critical level has somehow been established through modeling and interpolation of data and if incorrect, may have dire and permanent consequences on the groundwater system of the entire valley.

Too many times "experts" have been proved wrong. We are dealing with a complex hydologic structure and countless other variables. What are our assurances when even the experts are in disagreement about the dangers?

It is always easy to use 20-20 hindsight to determine how to rectify miscalculations and erroneous hypotheses. But 20-20 foresight is best achieved by erring on the side of caution. Caution in this case means beginning today to formulate a plan of action based on the best available technology, that being the technology that works best.

A suggestion:

(1) begin immediately and take 2 or 3 years to solicit technical solutions to cleaning up the water.
(2) within 3 years, using market forces, have someone (MSE??) screen the proposals and choose 2 or 3 to put into a pilot program.
(3) test for three years
(4) fifth or sixth year, begin pumping plant with the best available technology and work out bugs in the system.
(5) seventh or eighth year, project established.

To begin doing what needs to be done by the end of the century is a realistic goal. If we can go to the moon, etc., if we can commit $500, billion to bailing out the S & L surely we can come up with a workable solution to the water in the Berkeley pit this century.

ENVIRONMENTAL
PROTECTION AGENCY

MAY 6 1994

MONTANA OFFICE

Carla Abrams
4820 Trails End Road
Missoula, MT 59803
May 4, 1994,

Pam Hillery
U.S. Environmental Protection Agency
Federal Office Building
Drawer 10096
300 South Park
Helena, MT 59626-0026

Dear Ms. Hillery:

Thank you for returning my draft report regarding the Berkeley Pit. Mary Kay had sent it along, not realizing that the entire report was not supposed to go to the EPA. I hope that you will accept these comments on the Mine Flooding Operable Unit of the Silver Bow Creek/Butte Area Superfund site, in lieu of the report. Thanks again.

I interviewed a number of scientists regarding the operable unit: these include Johnnie Moore and Bill Woessner at the University of Montana, and Mary Miller and Ted Duaine at Montana Tech. I interviewed Representative Fritz Daily. Steve Blodgett, a CERCLA technical specialist. Bruce Farling of Trout Unlimited, and Mark Shapley, a private hydrology consultant. After discussing the Berkeley Pit with these people. I have the following recommendations based on their concerns and comments.

RECOMMENDATIONS:

- That the precautionary approach and a wide margin of safety be used to protect human health and the environment. After 100 years of mining and blasting a complex geologic area, it seems that there is some agreement that the CWL should have a wider margin of safety than 5,410. At this time, the number of monitoring wells does not seem adequate. A well is useless if it is improperly placed. Based on the complex faulting and fracturing of the area, more wells are necessary to get a complete understanding of the hydrology.

- The potential exists for contaminated water from the Yankee Doodle Tailings Pond to pollute the Silver Bow Valley. Slow migration or ground water could be a problem, if the flow lines straighten out in this area. The dam may also be unsafe. Water should not be discharged into the tailings pond.

- All clean water and waste water from the mining operation should be kept out of the tailings pond and the Berkeley pit. Protecting the environment should mean that any clean water be kept from contamination. Under CERCLA, contamination is to be reduced. Contaminated mine water should not be discharged into the pit.

- If the water level in the Pit levels off and stops rising, it should be assumed that the pit is discharging water and pumping should start immediately in addition, the $25,000 fine should come into effect, as the environment is being degraded. A water budget that addresses how much water is flowing into the water is leaking out. It is important to realize the difficulty in proving that water is exciting the PIT, and not from some other source. In a system monitored by people, people and science can and do make mistakes. A contingency plan must address this real possibility.

- ARCO should either begin the treatment plant NOW, or place a bond up that includes the price of the treatment plant. The citizens of Butte deserve the assurance that the PRPs will have the money when it's needed. A bond is that assurance. The interest should be used to defray the costs of more monitoring wells.

- CERCLA is supposed to reduce the amount of pollution in the area. The area is still being degraded. ARCO is saving money by not treating the contaminated water in the Pit now. I recommend that ARCO be required to quantify the money not being spent and that this money be used to:
  1) pay for more monitoring wells to better understand the system and protect human health, and
  2) research and develop the new technology that will allow the profitable removal of the valuable metals from the Pit.

- The clean-up schedule should not be tied to the cessation of the mining operation. The PRPs should start taking responsibility for the clean-up now.

- Community acceptance should be given an extremely high priority when sciences, such as hydrology and geochemistry of a very complex system, which are inexact sciences at best, set public policy.

Sincerely,

Carla Abrams

cc: Clark Fork Coalition

<IMG SRC 0894102EH>

ENVIRONMENTAL
PROTECTION AGENCY

MAY 6 1994

MONTANA OFFICE

Russ Forba
Project Manager
Berkeley Pit Operable Unit
Environmental Protection Agency
Helena, MT

April 29, 1994

Dear Mr. Forba:

I would like to submit the following comments on the Remedial Plan for the Berkeley Pit Mine Flooding Operable Unit. The following comments are based on interviews with a large number of hydrogeologists, geologists and engineers who are familiar with the pit.

A precautionary approach with a wide margin of safety should be used in setting the critical water level for the pit. Based on discussions with numerous hydrogeologists, geologists and engineers, I am convinced that the number, kinds and location of wells used in the RI were inadequate to understand the complex faulted and disturbed hydrology of the pit area. Hence there is considerable uncertainty as how pit water will interact with the surrounding alluvial and bedrock groundwater as the water level in the pit approaches the apparent surface water table level. A more cautious approach is advised, such as maintaining the pit level below the bottom of the alluvial aquifer. Given the considerable scientific uncertainty about the pit, more weight should be given to community acceptance of Remedial Plan since they are being asked to take the risks. The technical experts interviewed unanimously agreed that several critical wells were needed to refine understanding of pit hydrology and that the current CWL was set prematurely without this information. Given the importance of the CWL to protection of the area and the controversy, requiring these wells is not arbitrary and capricious. If ARCO wants this 5410' CWL, they should be willing to pay for the wells to justify it. If they do not want to pay for the wells, they must settle for a more cautious CWL.

All clean water entering the area should be diverted around the operable unit and discharged to Silver Bow Creek. Clean water should not be allowed to enter the pit or be diverted to the Yankee Doodle Tailings Pond. The pond was not designed for this purpose and the greater level of water in the pond would increase its instability in the event of an earthquake. In addition, putting more water in the pond increases the likelihood that contaminated water will leak from this pond and further contaminate groundwater and Silver Bow Creek. Water used by the existing mining operation should be treated to Montana State Water Quality Standards and discharged to Silver Bow Creek. The existing mining operation should not be allowed to contribute to the problem at the superfund site.

If the water level in the pit stops rising without pumping from the pit, then the water is escaping somewhere and the $25000/day fine should go into effect until pumping starts removing the amount of water estimated to be entering the pit. A careful water budget is needed to determine how much water is entering the pit. This amount should be pumped and treated. Once again, if the pit level stops rising before pumping begins, the Law of Conservation of Mass says that contaminated water is escaping and the fine should be imposed until pumping and treatment corrects this.

The clean up schedule for the pit should not be tied to the shutdown of existing mining (which cannot be predicted) but should be based on meeting the Superfund mandate to prevent increasing environmental contamination at abandoned hazardous sites. A timetable should be established now to build as soon as possible a treatment system based on the best technology currently available. New technologies will always be coming or line, and we cannot wait to clean up sites until some future technology is developed because we could always wait longer for a still more advanced future technology. When a new better technology becomes available, the treatment process will be modified to incorporate that technology. Existing treatment plants are modified to take advantage of new, more economical technologies as they become available. We would never treat any waste stream if we argued that we must wait until the next generation of technology becomes available.

It is not arbitrary and capricious to require treatment now to prevent an increase in contamination at this site and to reduce the chance that contamination will spread. ARCO should be required to begin the planning and construction of a treatment plant now or to post a bond now for the cost of such a plant. This bond will be earning interest to pay for such a plant if unforeseen circumstances removes ARCO from the picture in the future. An innovative alternative approach would be to allow ARCO to delay construction for some agreed upon time (e.g., 10 years) and invest the savings of this delay in a research and develop ment fund that would pay for research into alternative technologies to treat the pit water. It is not arbitrary and capricious to require ARCO to act NOW to solve this problem. The action could be immediate construction of a treatment plant, or a similar amount of money spent on developing alternative treatment approaches. Delaying addressing this problem for an undetermined period (until mining ceases) does not meet the mandate of the superfund legislation.

Sincerely,

Vicki Watson, Associate Professor
Biology and Env. Studies
University of Montana (for identification only)

30 March 1994

Russ Forba
Remedial Project Manager
US EPA
301 South Park
Helena, MT 59626

Steve Mietz
624 South 3rd West
Missoula, MT 59801
(406) 549-3513

Dear Mr. Forba,

Enclosed is my comments to the Butte Mine Flooding Operable Unit's RI/FS. I hope you find them useful in your decision-making process.

I recently heard that similar reports were released regarding the Streamside Tailings and Priority Soils in the Silver Bow Creek area. I am interested in commenting on these projects as well and would be appreciate if you could send me information about these projects.

Thanks for your help in this matter.

Sincerely,

Steve Mietz
Environmental Impact Analysis
Professor Vicki Watson

Comments on Remedial Investigation/Feasibility Study for
Butte Mine Flooding Operable Unit

INTRODUCTION

There are three major areas of concern with the choice of Alternative 6/7 as the preferred alternative for remediation of the Mine Flooding Operable Unit. The first area of concern is in the CDM Federal Program Corporation work plan (1990), the assumptions and objectives that are derived from that plan, and the subsequent Remedial Investigation. Another concern is the small margin of safety that the current critical water level creates. The third major area of concern is that Alternative 6/7 does not provide a long term remedial action that is permanently "fixes" the problem, rather than simply degrees of treatment, nor does it address long term remediation and funding after the year 2025.

WORK PLAN TOO NARROW IN DEFINITION

The CDM Federal Program Corporation work plan provided the objectives and CERCLA and CFR provided the framework for the Remedial Investigation and Feasibility Study. The Remedial Investigation and Feasibility Study were completed in an excellent fashion following these guiding documents, however, I feel the work plan has defined the problem of human health and environmental risk from the Operable Unit too narrowly, and therefore led to a Remedial Investigation that was too narrow in scope and recommendations that are inadequate to protect human health and the environment from the threats within the Mine Flooding Operable Unit.

The work plan limited the scope of analysis of dangers from "off-site emission" to water only. This ignores a very important threat from airborne contaminants. The only mention of this important threat to human health in the Remedial Investigation/Feasibility Study comes in relation to disturbed soils during construction of remedial efforts, which was determined to be insignificant.

Moore and Luoma (1990) compiled several studies on disease-related mortality in the Clark Fork Basin, including Butte. They found that Butte, compared to cities of similar population, ranked highest in all disease related deaths for 1949-51 and 1959-61 and was first among "other diseases than heart and kidney" for the periods 1959-61 and 1969-71. Great Falls and Billings, for comparison, ranked between 350-450 in all categories

Trachea, bronchus, and lung cancer from 1970-1979 were especially high in areas of "primary contamination". Silver Bow County had a mortality rare from lung, trachea, and bronchial cancer per 100,000 of 55.3 compared to Montana's 31.1. North Dakota's 20.5. Idaho's 22.9, and Wyoming's 26.7. Data from Riggan et al, 1983 in Moore and Luoma, 1990). Moore and Luoma (1990) also found that by looking at female mortality rates that the cancer deaths did not appear to be solely from occupational sources. They found that during the same 1970-79 period that overall cancer rates for Silver Bow County women fell within the highest 4 percent for all U.S. Counties (Data from Riggan et al, 1983 in Moore and Luoma, 1990).

The work plan assumes that the only threat to humans is from drinking containment water from ground water. Since past Institutional Controls have stopped the citizens of Butte from drinking the ground water, yet these abnormally high cancer rates persist, it can be assumed that other environmental factors are putting people at risk. The work plan should have commissioned a more comprehensive Remedial Investigation/Feasibility Study that addresses the other hazards to human health including airborne contaminants.

The walls of Berkeley Pit are probably a significant source of airborne contaminates. Different alternatives will affect whatever remediation might eventually be prescribed for the walls. Therefore, it is unwise to delay considering the impact of the pit walls on human health. Any mine flooding alternative should consider the pit walls at the same time. A study of the effects of the pit walls and recommendations for remediation should be included in a new work plan.

Another important area of consideration that was left out of the work plan includes reclamation for aesthetic values including re-establishment of habitat qualities. I believe that aesthetic values could be reclaimed by establishing a mandate to study options for ground cover of exposed areas (which would also stabilize loose soils and decrease particulate pollution) and attempt to reestablish riparian areas. At the very least, the 5 natural drainages to the north, east, and west of the Yankee Doodle Tailings Pond could be redirected around the site to prevent the clean water in these streams from becoming contaminated. Redirecting these streams will create some aquatic and riparian habitat to replace the portion of the original Silver Bow Creek channel that was destroyed by mining activities between the Tailings Pond and the MR Concentrator.

I recommend that a new work plan be developed that is broader in scope - that addresses not only the threat to ground water contamination, but airborne contaminates, habitat qualities, and aesthetic values.

CRITICAL WATER LEVEL - MARGIN OF SAFETY

All Final Alternatives allow the pit water level to approach the critical water level. There is no plan to address what happens if there is a catastrophic event such as an earthquake or fire and the treatment and/or other remediation efforts are damaged or stopped. The Remedial Investigation never describes how long the treatment can be stopped before degradation of the alluvial aquifer begins. As the critical water level is reached, how much of a margin of safety is left?

The Remedial Investigation (1994) includes the results from two runs of the numerical ground water flow model. The first model simulation was run with a pit water level of 5,050 ft msi feet above mean sea level) to evaluate the current alluvial ground water flow system. The simulated ground water levels were sufficiently near the observable well monitoring points that the model has proven it is a good tool to determine the critical water level. The second model simulation was run with the pit level at the currently proposed critical water level of 5,410 ft msl. The conclusion from this run of the model was that 5,410 ft msl was an adequate level to prevent the alluvial aquifer from being significantly impacted by pit water. However, the model wasn't run to determine at what level the alluvial aquifer would be affected.

The observed water levels in some monitoring wells are very close to the critical water level of 5,410 ft msl. For example, the AMC-5 well has measured an observed water level of 5,436.7 ft msl. That is only 26.7 feet above the critical water level. That is a small margin of safety.

It is important to determine the maximum depth of the alluvial aquifer to decide how high the critical water level can be set. If the maximum depth of the aquifer is below the critical water level, contamination of the aquifer would be likely. The model's predictions of alluvial aquifer water level are based on monthly sampling of well water levels taken since December 1991. This is not a long enough period of time to assure that the observed water levels recorded are reflective of the alluvial water level's maximum depth. Temporary effects like drier than normal sections in the last few years could affect the data making it appear that the maximum depth of the alluvial aquifer higher than it truly is. The model second run was run using current water levels which may not be reflect true aquifer levels and probably doesn't reflect what the lowest possible aquifer level could be. Therefore, the model's prediction of no or little effect upon the alluvial aquifer at the current critical water level could be false.

The margin of safety of the current proposed critical water level is unacceptable. There is no room for a catastrophic event or deepening of the water level in alluvial aquifer. The rational for acceptance of the critical water level of 5,410 ft msl was that model predicted little or no impact when the water in Berkeley Pit reached the critical water level (Remedial Investigation, 1994). Given the small margin of safety than leaves along with current aquifer levels and the lack of data to establish the maximum lowest alluvial aquifer water level. I believe the critical water level of 5,410 ft msl is too high.

Further research needs to take place to establish a more adequate margin of safety. All Final Alternatives contain around water monitoring provisions that begins immediately. Continued monitoring of alluvial water levels over many more years will increase the confidence of the predictions of the maximum deepest alluvial aquifer level. As the confidence of the predictions of the alluvial aquifer water level increases, periodic readjustments of the critical water level should be made.

The Remedial Investigation (1994) describes the tailings pond dam as safe up to a Richter magnitude of 6.5, but what if a larger earthquake happens such as the 6.6 in California and the dam breaks and all the pond water goes into the Pit? Also, Alternative 6/7 plans to divert Horseshoe Bend water to the tailings ponds during mining. The additional water will put more pressure on the dams and dump more water into the pit if they fail. Since the critical water level will be approached with Alternative 6/7, there is a large danger that the alluvial aquifer will become contaminated if the dam fails. Alternatives 18/19 do not let the Berkeley Pit water level to approach the critical water level and therefore are the best alternatives for protection from catastrophic events that cause pit filling.

LONG TERM EFFECTIVENESS QUESTIONED

The claims of long term effectiveness of all the alternatives are circumspect because the objective on which they are based is not ambitious enough to ensure human health and environmental safety in perpetuity. The claims are based on fulfilling the objective from the work plan to prevent discharge of mine water to the adjacent alluvial aquifer and Silver Bow Creek and to maintain the flow of ground water toward the Pit by keeping the water level below the critical water level (CDM Federal Programs Corporation, 1990). All the alternatives, except one, meet this limited objectives.

The objective should be to establish a truly permanent solution that doesn't require maintenance into eternity. The work plan should request an Remedial Investigation/Feasibility Study that outlines real alternatives that could lead to permanent solutions, not just a gradient of treatment options and timelines. If the original work plan would have outlined a more ambitious work plan that required the examination of permanent closure options and treatment options then a reasonable decision could be made in terms of costs. For example, there is no option to drain the Pit and cement the sides. This may be unreasonably expensive, but at least it could be an option to compare. I am not an engineer and cannot design elaborate permanent solutions to this problem, but I am sure they exist, just not in this Feasibility Study.

Presently, all the alternatives tail to address what will happen after 30 years. Who will pay for the treatment after 30 years to eternity? What is the life expectancy of the treatment system in Alternative 6/7? I believe any alternative that can't effectively address these questions, can't be trusted to be cost-effective in the future. Long term effectiveness would ideally be not to have to deal with the Pit after the remediation efforts. This has not even been addressed in any of the 19 alternatives.

Presently, responsible parties exist to pay for remediation, yet even the most expensive alternative (19) does little more than any of the other alternatives to keep from pushing this problem onto future generations. All the proposed 19 alternatives are stop gap measures, yet this is not how they present themselves in the report. In fact, Alternative 6/7 was picked for its higher long term effectiveness over the cheaper Alternative 4/5 (Feasibility Study, 1994). The higher long term effectiveness is that the Pit water level will stabilize at a lower level than Alternative 4/5. By choosing the more expensive Alternative 6/7 for this reason, the authors and the State of Montana are placing a high value on having a lower stabilized Pit level. Why? What difference does it make, the work objective only required the level to be below the critical water level, why waste 14 - 20 million dollars to have a lower Pit level?

The State of Montana and the authors both realize, but don't state directly, that having a lower pit level will be desirous in future remediation efforts that will have to take place when the treatment efforts become too costly or ineffective. In addition, a lower pit level will give a larger buffer against a disruption of treatment or catastrophic events that may cause pit filling. The lowest Berkeley Pit water level possible would be desired by future generations because if treatment becomes too costly or ineffective then future generations will search for another solution, probably a more permanent solution that doesn't require constant care. The less water they are faced with cleaning up the fewer costs they will incur when they attempt to implement a non-treatment solution. All 19 alternatives shift the burden of responsibility from the present living generations to future generations. Given this situation, which I believe is inappropriate and immoral, the present generation should implement the Alternatives that keeps the Pit level the lowest, i.e. Alternatives 18/19.

Present generations should pay for the best available treatment option, if a permanent non-treatment solution is not available, to establish a precedent of paying the true price of commodities like metal. Then public support would be strong to prevent mining that doesn't have a permanent remediation solution and a large enough bond to properly close the site. For example, what remediation efforts, if any, are in place for the Continental Pit once mining ceases? Will we allow the mining company to turn off the pumps and let that pit fill and become a big problem like we did at the Berkeley Pit? If no permanent solution exists that can eliminate the danger and costs to future generations, then we should ban this type of mining until adequate permanent solutions are developed.

SHORT TERM EFFECTIVENESS

The short term effectiveness has curiously been defined in terms of the damage that would occur from the active remediation efforts. Again, I am sure the Remedial Investigation Feasibility Study report followed correct procedures in defining the short term effectiveness of its alternatives in this way. Short term effectiveness should refer to alternatives that are effective in near future. Using this logical definition of short term effectiveness. Alternative 18/19 are the only ones that take effective actions in the short term to stabilize the Pit water level.

ALTERNATIVE 6 VS ALTERNATIVE 7 - TO DUMP OR NOT TO DUMP THAT IS THE QUESTION

Alternative 6 is cheaper than Alternative 7 because it dumps the sludge and brine wastes from the treatment process into the Pit rather than dewatering and landfilling the wastes in a RCRA Subtitle D landfill. Sludge disposal into Berkeley Pit is not a proven technology (Feasibility Study, 1994). Treatability testing done by Canonie (1993) has found the sludge to be non-toxic. The authors assume the sludge is stable enough not to break down when placed in Berkeley Pit's water. However, the report recommends more research be conducted to determine if the sludge is stable enough to not break down in the Pit's murky depths. Until it has been studied in more detail and conclusive results found, the landfill is the only logical option. If it is found that the sludge breaks down and releases metals, which would concentrate the contamination of the Pit's water, the sludge should be landfilled.

CURRENT MINING OPERATIONS - MORE PROBLEMS THAN SOLUTIONS

The role of the existing mining operation should be completely clear. They should not be allowed to follow any practices that worsen the condition or delay the clean-up. Currently, the MR Concentrator overflow ditch is contributing 0.14 million gallons of water per day to the Berkeley Pit. This is an unnecessary accelerator to pit filling that must be stopped. Any water used by the existing mining operation should be treated at their expense at the treatment plant at the concentrator and discharged into the Metro Storm Drain or Silver Bow Creek.

All clean water sources should be diverted away from the Mine Flooding Operable Unit. The MR Concentrator should not bring in any clean water from outside sources like Silver Lake. Silver Lake water should be replaced completely with contaminated water from Horseshoe Bend that will be diverted to the tailings pond. Other sources of clean water should be diverted around the area to avoid contamination. The cumulative effect of removing the clean water from the system and stopping the concentrator from dumping in the Pit will lower the costs of treatment in the future.

If mining doesn't cease in 2006, there should be a plan to adjust to this to maintain the Pit level below the critical water level. Alternative 6/7 uses mining procedures in its treatment of Horseshoe Bend water till these waters are routed to primary treatment in the post-mining stage (Feasibility Study, 1994). If mining continues longer than expected, will the reroute of the Horseshoe Bend water to primary treatment still take place in 2006 or is it dependent upon mining activities? If mining does continue and Horseshoe bend isn't diverted to primary treatment as per the plan, the final stabilized Pit water level could change. This should be evaluated and described before a plan is picked and initiated so that target water levels can be set and success measured appropriately.

MONEY - PAYING THE PIPER

The preferred remedy must state exactly how future maintenance and operation of treatment facilities will be paid for. All responsible parties should be found now and formal structures of payment should be designed. I recommend that a bond be set up that will cover the initial capital requirements for construction of remediation efforts and for maintenance in perpetuity. The amount of the bond should be equal to the present value, as it is currently calculated for the alternatives. In addition, a separate bond should be set up to aid in the development and implementation of new remediation technologies. This will ensure that the remediation efforts at the Mine Flooding Operable Unit remain state-of-the-art. A mechanism should be set up to decide which new treatments should be implemented and which are not worthy. I recommend setting up the bonds now to hedge off future uncertainties such as interest rate fluctuations, changes in the cost of the project, and responsible parties folding.

The costs in the Feasibility Study are in present value figures. This type of financial analysis rewards proposals that delay taking action till the latest possible time. This has the effect of pushing the costs upon future generations (Merton, 1990). The preferred alternative should minimize the costs in the future by having the responsible parities pay the full bill now. Then actions that reduce future costs would be preferred, because it would lower the amount of money that responsible parties would have to put up to cover future costs.

CONCLUSION

The present Remedial Investigation/Feasibility Study contains two major problem areas that both arise from an inappropriate work plan objective. At the present time. I recommend expanding the work plan to include a more comprehensive human health and environmental protection objective and to expand the alternatives available for review to include some that are permanent solutions that do not require care and funding forever.

I recommend that Alternative 18/19 be adopted because of short term effectiveness (as I define it) and best long term effectiveness of the options presented, i.e. it will have the lowest stabilized water level. This will leave the least burden upon future generations and establish the largest margin of safety. If the pit sludge proves to be stable enough not to re-dissolve into the water of the pit then Alternative 18 would be preferred on a cost basis.

Two bonds should be established immediately to pay for the cost of the remedial efforts. The first should cover the initial building costs and predicted operating and maintenance costs. The second bond should be a special fund for upgrading the physical plant in the future.

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2312 Hillview #1
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March 25, 1994

E.P.A.
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Dear Mr. Forba,

I appreciate the opportunity to offer my comments on the proposed plan for the Mine Flooding Operable Unit.

1) Since July 1986, Montana Resources has been operating open pit mining in the East Continental Pit. In the milling process, they are using water imported from the Silver Lake Pipeline. After the ore has been milled, the outflow from the MR Concentrator is being pumped via the McQueen Booster Station up to the Yankee Doodle Tailings Pond. Along the way, some of the tailing slurry are being released into the Berkeley Pit. In essence, MR is using clean water from the Silver Lake Pipeline, contaminating it in the milling process, and releasing it into an established Superfund Site. Clearly, this situation must not continue and it must be addressed in the preferred remedy. Not only does it contradict Superfund criteria which calls for a remedy which will reduce the volume of contaminants, it also contradicts the criteria that calls for short term effectiveness. MR must be required to treat its own effluent to State Water Quality Standards and release it into Silver Bow Creek.

This holds true for all aspects of MR's current mining operations. Current mining practices must not be allowed to delay or compound the clean up process. One possible alternative with regards to a water supply for current mining operations is to have MR negotiate for the use of treated Horseshoe Bend Water.

2) In the preferred alternative, treatment of the Berkeley Pit water will not occur until present mining operations cease. The year 2005 has been used for calculation purposes in the RI/FS. This figure is purely arbitrary, yet the RI/FS offers no contingency plans in the event that mining operations continue beyond the year 2005. Apparently, MR can wait until the CWL is reached before they even begin to construct a water treatment system. A water treatment system generally requires at least a two year "shake down" period before it is on-line and fully functional.

According to the preferred alternative, the CWL may be reached by the year 2022. MR has estimated that the ore body in the East Continental Pit area will last until 2015-2025. As both of these figures are estimates, it is clear that an unacceptable situation could arise. EPA must include a contingency plan in the preferred alternative that addresses this situation.

3) According to the National Contingency Plan, the purpose of a Baseline Risk Assessment is "to characterize current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water releasing to the air, leaching through the soil, remaining in the soil, and bioaccumulating in the food chain." The BRA that was completed by the EPA and DHES addresses the risks posed by ingesting contaminated surface or groundwater. However, it does not address the risk to human health from dust blowing off of the barren, exposed walls of the Berkeley Pit. In fact, the pit walls have been placed with the Active Mining Operable Unit. This Unit will not be addressed until mining operations have discontinued. A study by Luoma and Moore (1990) discovered a higher incidence of disease in Butte than in comparable cities. This was found in both men and women indicating that the exposure route was environmental rather than occupational. It is likely that windblown dust may be a contributing factor. Stabilizing the Pit walls should be addressed in the Butte Flooding Operable Unit, not in the Active Mining Operable Unit. This unhealthful situation must not be ignored until active mining ceases.

4) In addition to assessing the risk to human health, the BRA must also assess the risk to waterfowl. The surveys that were done by Biosystems Analysis Inc. indicated that waterfowl usage of the Berkeley Pit ranged from 0 to 26 birds per day. According to a report prepared by the USFWS, the elements found in the Berkeley Pit water (with the exception of lead) ranged from one half to four orders of magnitude greater than the recommended safe concentration of the elements in the drinking water of livestock and poultry.

Considering the very brief and rudimentary nature of the study conducted by Biosystems Analysis Inc., the potential cumulative effects from heavy concentrations of six different heavy metals, and the lack of information regarding the effect of these toxins to waterfowl specifically, it is of primary importance that the preferred alternative incorporates a plan for effectively preventing access to the Berkeley Pit water by waterfowl. This will ensure that the preferred alternative complies with the Bird Migratory Act.

5) The preferred alternative calls for pumping and treating the Berkeley Pit water in perpetuity. How this will be paid for is of obvious concern to the public. With a company as large as ARCO, it seems likely that the EPA will allow them to cover the costs on an annual basis.

The preferred remedy must state clearly and completely exactly how these costs will be covered - including the possibility that ARCO declares bankruptcy at some time in the future. The preferred alternative must also include the cost of reconstructing or renovating the water treatment system in perpetuity as well as allowing for the cost of installing new technologies should they become available.

6) Public involvement in the Berkeley Pit clean up is extremely difficult due to the immense amount of technical information involved. Few people have the time or the expertise to wade through the hundreds and hundreds of pages included in the RI/FS. If the public is really going to be involved in this process, EPA must make a more concerted effort to interpret these volumes of information. However, the interpretation should come from an independent, objective source; someone who has not already aligned him/herself with a specific alternative. Additionally, the public should be brought in at a point more conducive towards participation in this decision making process. Although the state was included from the beginning, the public was brought in at the last possible moment.

Sincerely,

Bonnie Gestring

COMMENTS

1) Since July 1986, MR has been operating open pit mining in an area to the east of the Berkeley Pit known as the East Continental Pit. Ore from the East Continental Pit is transported to the MR concentrator for milling. In the milling process, MR uses water imported from the Silver Lake Pipeline, excess water from the Continental Pit area, and return water from the Tailings Pond (Canonie, 1994).

After the ore has been milled, the overflow, or tailings slurry, from the MR concentrator is pumped via the McQueen Booster Station up to the Tailings Pond. In the process, some of the tailings slurry are released into the Berkeley Pit (See map). From July 1991 to June 1993, the average net outflow to the Berkeley Pit was 0.14 mgd (Canonie, 1994).

MR estimates the body around the East Continental Pit area to last another 2-3 decades (Ray Tillman, personal communication). In this amount or time, another ½ billion gallons or contaminated material would be added to the pit.

In essence, MR is using clean water from the Silver Lake Pipeline, contaminating it in the milling process and releasing it into an established Superfund Site. Clearly, this situation must not continue and it must be addressed in the preferred remedy. Not only does it contradict Superfund criteria which calls for a remedy which will reduce the volume of contaminants, it also contradicts the criteria that calls for short term effectiveness. MR must be required to treat its own effluent to State Water Quality Standards and release it into Silver Bow Creek.

This holds true for all aspects of MR's current mining operations. Current mining practices must not be allowed to delay or compound the clean up process.

One possible alternative with regards to a water supply for current mining operations is to have MR negotiate with EPA to use treated Horseshoe Bend Water in the milling process rather than water from the Silver Lake Pipeline.

2) In the preferred alternative, treatment of the Berkeley Pit water will not occur until present mining operations cease. The year 2005 has been used for calculation purposes in the RI/FS. This figure is purely arbitrary, yet the RI/FS offers no contingency plans in the event that mining operations continue beyond the year 2005. In fact, according to Jim Scott of the DHES, MR can wait until the CWL is reached before they even begin to construct a water treatment system (personal communications). Steve Blodgett of B-SB states that a water treatment system generally requires at least a two year "shake down" period before it is on-line and fully functional (personal communication).

According to the preferred alternative the CWL may be reached by the year 2022. MR has estimated that the ore body in the East Continental Pit area will last another 2 to 3 decades. As both of these figures are estimates, it is clear that an unacceptable situation could arise. EPA must include a contingency plan in the preferred alternative that addresses this situation.

3) According to the National Contingency Plan, the purpose of a Baseline Risk Assessment (BRA) is "to characterize current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to the air, leaching through the soil, remaining in the soil, and bioaccumulating in the food chain (Canonie, 1994). The BRA that was completed by the EPA and DHES addresses the risks posed by ingesting contaminated surface or groundwater. However, it does not address the risk to human health from dust blowing off of the barren, exposed walls of the Berkeley Pit. In fact, the pit walls have been placed with the Active Mining Operable Unit (Russ Forba, personal communication). This Unit will not be addressed until mining operations are discontinued.

A study-by Luoma and Moore (1990) discovered a higher incidence of disease in Butte than in comparable cities. This was found in both men and women indicating that the exposure route was environmental rather than occupational. It is likely that windblown dust may be a contributing factor. Stabilizing the Pit walls should be addressed in the Butte Flooding Operable Unit, not in the Active Mining Operable Unit. This unhealthful situation must not be ignored until active mining ceases.

4) In addition to assessing the risk to human health, the BRA must also assess the risk to waterfowl. At the request of the EPA and the U.S. Fish and Wildlife Service (USFWS), a study was conducted to assess the use of the Berkeley Pit by waterfowl. These studies were conducted by Biosystems Analysis, Inc. for ARCO.

Biosystems Analysis Inc. observed the Berkeley Pit periodically throughout the spring, summer, and fall of 1993. Each survey consisted of three 4-hour observation periods conducted over two consecutive days. The surveys indicated that waterfowl usage of the Berkeley Pit ranged from 0 to 26 birds per day (Canonie, 1994).

According to a report prepared by the USFWS, the elements found in the Berkeley Pit water (with the exception of lead) ranged from one half to four orders of magnitude greater than the recommended safe concentration of the elements in the drinking water of livestock and poultry (CDM, FPC, 1994) (See Table).

Considering the very brief and rudimentary nature of the study conducted by Biosystems Analysis Inc., the potential cumulative effects from heavy concentrations of six different heavy metals, and the lack of information regarding the effects of these toxins to waterfowl specifically, it is of primary importance that the preferred alternative incorporates a plan for effectively preventing access to Berkeley Pit water by waterfowl. This will ensure that the preferred alternative complies with the Migratory Bird Act.

5. Public involvement in the Berkeley Pit clean up is extremely difficult due to the immense amount of technical information involved. Few people have the time or the expertise to wade through the hundreds and hundreds of pages included in the RI/FS. If the public is really going to be involved in this process, EPA must make a more concerted effort to interpret these volumes of information. However, the interpretation should come from an independent, objective source; someone who has not already aligned themself with a specific alternative. Additionally, the public should be brought in at a point more conducive towards participation in this decision making process. Although the state was included from the beginning, the public was brought in at the last possible moment.

6. The preferred alternative calls for pumping and treating the Berkeley Pit water in perpetuity. How this will be paid for is of obvious concern to the public. Jim Scott of DHES has indicated that the PRPs must either provide a certain amount of money up front so that the compound interest from this money will continue to cover the cost, or prove that they have the wherewithal to cover 100% of the cost on a year to year basis. With a company as large as ARCO, it is likely that EPA will allow them to cover the costs on an annual basis (Jim Scott, personal communication). The preferred remedy must state clearly and completely exactly how these costs will be covered - including the possibility that ARCO declares bankruptcy at some time in the future. The preferred alternative must also include the cost of reconstructing or renovating the water treatment system in perpetuity as well as allowing for the cost of installing new technologies should they become available.

COUNCIL RESOLUTION NO. 1635

A RESOLUTION AUTHORIZING THE SUBMISSION OF FORMAL COMMENTS TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY REGARDING THE REMEDIAL INVESTIGATION AND FEASIBILITY STUDY AND PROPOSED PLAN FOR THE MINE FLOODING OPERABLE UNIT, WHICH INCLUDES THE BERKELEY PIT AND UNDERGROUND MINE WORKINGS; AND PROVIDING FOR AN EFFECTIVE DATE HEREIN.

WHEREAS, the Berkeley Pit mine flooding is a unique problem that will require unique and creative solutions, both in terms of technology and in the implementation process; and

WHEREAS, on January 27, 1994, the U.S. Environmental Protection Agency released the Remedial Investigation and Feasibility Study and Proposed Plan for the Mine Flooding Operable Unit, which includes the Berkeley Pit and Underground Mine Workings; and on said date the U.S. Environmental Protection Agency opened the public comment period, until April 29, 1994, to provide an opportunity for public involvement in the final remedy decision; and

WHEREAS, at the March 23, 1994 meeting of the Council of Commissioners, local government staff presented a draft set of comments regarding the Remedial Investigation and Feasibility Study and Proposed Plan for the Mine Flooding Operable Unit; said comments were drafted to serve as the local government's formal submission to the

U.S. Environmental Protection Agency regarding the Superfund action; and

WHEREAS, on March 23, 1994, after their initial review and consideration, the Council did approve the immediate release of the DRAFT comments to the general public and all interested parties; and

WHEREAS, the Council did schedule and hold a special public hearing on April 6, 1994 to solicit input from the general public and all interested parties about the DRAFT comments; and at this meeting, the Council received both verbal and written input for consideration in reviewing the comments; and

WHEREAS, upon receipt of public comments, the Council of Commissioners instructed the staff to prepare a final version of the comments incorporating any necessary revisions based on the expressed views of the Commissioners, the public input from the April 6 hearing, and other information submitted to the local government and;

WHEREAS, the Council of Commissioners of the City and County of Butte-Silver Bow, State of Montana, after due discussion and deliberation, and in hopes of fostering the level of innovation and creativity needed to meet the concerns and needs of its citizens, find that it is in the best interests of the City and County of Butte-Silver Bow, State of Montana, to submit formal comments on the Remedial Investigation and Feasibility Study and Proposed Plan for the Mine Flooding Operable Unit to the U.S. Environmental Protection Agency by the deadline of April 29, 1994.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF COMMISSIONERS OF THE CITY AND COUNTY OF BUTTE-SILVER BOW, STATE OF MONTANA:

SECTION 1: That the Council of Commissioners of the City and County of Butte-Silver Bow, State of Montana, does hereby find and determine that it is in the best interests of the City and County of Butte-Silver Bow, State of Montana, to prepare and pass a formal resolution establishing the County's formal comments regarding the Remedial Investigation and Feasibility Study and Proposed Plan for the Mine Flooding Operable Unit, including the Berkeley Pit and Underground Mine Workings, thus responding to the call for public comments in this matter; and to authorize the Chief Executive to sign and submit the formal comments, herein attached as Exhibit A, to U.S. Environmental Protection Agency on behalf of the local government at the Agency's public hearing on April 26, 1994.

SECTION 2: That all public input from the April 6, 1994 hearing before the Council of Commissioners, and any other information submitted previously or subsequently to the local government on this matter be attached as Exhibit B and made a part of the formal submission by the City and County of Butte-Silver Bow to the U.S. Environmental Protection Agency.

SECTION 3: That the Clerk send a copy of this Resolution to the following: United States Senators Max Baucus and Conrad Burns, and United States Representative Pat Williams; Governor Marc Racicot; Butte-Silver Bow representatives to the Montana Legislature; William Yellowtail, Region 8 Director of the U.S. Environmental Protection Agency; Bob Robinson, Director, Montana Department of Health and Environmental Sciences; Clark Fork Coalition; ARCO; Montana Resources; and all those persons who provided input at the April 6, 1994 public hearing before the Council.

SECTION 4: That this Resolution shall be in full force and effect from and after passage and approval.

PASSED this 20th day of April, 1994.

CHAIRMAN OF THE COUNCIL OF COMMISSIONERS

APPROVED this 20th day of April, 1994.

CHIEF EXECUTIVE

ATTEST:

CLERK RECORDER

APPROVED AS TO FORM:

COUNTY ATTORNEY

CHAIRMAN, JUDICIARY COMMITTEE

APRIL 21, 1994

ENVIRONMENTAL
PROTECTION AGENCY

MAY 03 1994

MONTANA OFFICE

GARY MURPHY
BOX 44
RAMSAY, MT 59748

ATTENTION: Russ Forba
EPA COMMENTS

DEAR MR. FORBA:

IF THE DETERMINATION OF WHAT IS BEST FOR THE PIT IS TO LET IT REACH THE STATIC LEVEL OR ANOTHER LEVEL THAT WOULD TAKE YEARS TO REACH, WHY NOT PUMP THE SILVER BOW CREEK INTO IT FOR A COUPLE OF YEARS? NOT ONLY TO GET CLOSER TO THE PERMANENT SOLUTION, BUT ALSO TO PERFORM RECLAMATION ON SILVER BOW CREEK WHILE IT IS DRY.

I TALKED WITH THE WATER RIGHT HOLDERS ON THE CREEK AND HAVE SCHEDULED A MEETING WITH THE NATURAL RESOURCE DAMAGE PROGRAM, THE CLARK FORK COALITION AND THESE WATER RIGHT HOLDERS: MAY 17, 1994, at 7:00 P.M.

THIS MEETING WILL BE HELD AT THE Butte LOCAL DEVELOPMENT CENTER. IF YOU THINK A DRY CREEK BED WOULD AID IN RECLAMATION YOU ARE WELCOME TO ATTEND ALSO.

SINCERELY YOURS,

GARY J. MURPHY
(406) 782-5131

<IMG SRC 0894102EI>
<IMG SRC 0894102EJ>
<IMG SRC 0894102EK>
<IMG SRC 0894102EL>
<IMG SRC 0894102EM>
<IMG SRC 0894102EN>
<IMG SRC 0894102EO>
<IMG SRC 0894102EP>
<IMG SRC 0894102EQ>

Berkeley Pit Petition

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Mr. Al Gore, Vice President
Sen. Max Baucus
Sen. Conrad Burns
Rep. Pat Williams
Ms. Carol Browner, EPA Administrator
Mr. Bill Yellowtail, EPA Reg. Administrator
Gov. Marc Racicot
Mr. John Wardell, EPA MT Dir.
Mr. Bob Robinson, Dir. MT DHES
Mr. Russ Forba, EPA Project Mgr

"Community Acceptance" is part of Superfund decision-making criteria.

I/WE, THE UNDERSIGNED CITIZEN(S) OF BUTTE-SILVER BOW COUNTY, MONTANA, HEREBY PETITION THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY TO REDUCE THE WATER LEVEL IN THE BERKELEY PIT AND CLEAN IT UP NOW.

I/WE DON'T WANT BUTTE TO HAVE WHAT WOULD PROBABLY BE THE LARGEST BODY OF TOXIC WATER IN THE WORLD. EPA'S PLAN TO LET THE PIT FILL FOR THE NEXT 30 YEARS WILL HARM OUR SOCIAL AND ECONOMIC FUTURE. A FULL A PIT POSES A PERPETUAL THREAT OF RELEASE OF CONTAMINATION. IT PASSES OUR PROBLEMS ON TO OUR KIDS AND FUTURE GENERATIONS TO WORRY ABOUT FOREVER.

RESPECTIVELY,

NAME

ADDRESS

CITY/STATE/ZIP PHONE

(Paid by Butte friends & Members of the Clark Fork - Pend Oreille Coalition, a non-profit, non-partisan, membership-supported public interest)

<IMG SRC 0894102ER>

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<IMG SRC 0894102ES>

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Respectively,

Name
SUE and JOE TOTH
Address Harmony Circle Court
Missoula, MT 59802
City/ST/Zip

<IMG SRC 0894102ET>
<IMG SRC 0894102EU>

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<IMG SRC 0894102EV>

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Let's tell EPA...
Clean Up The Berkeley Pit Now!

After years of study, EPA, and ARCO want to put off cleaning Berkeley Pit under water another 30 years. By then, the 25 billion gallons of toxic soup now in the pit will have more than doubled to 58 billion gallons. The surface area will cover nearly 500 acres. They would divert some inflow now, so it takes off 2,022 before the pit hits the "critical" level, 5,410 feet, where it can stay forever.

EPA and ARCO say the water won't leave the pit, but they won't give absolute assurance.

Your Opinion Counts! Here's what you "CAN DO!"

1. SEND THE PETITION BELOW TODAY
2. WRITE your Pit opinion by April 29, 1994 to Mr. Russ Forba, U.S. EPA 301 S. Park, Helena, MT 59626
3. SPEAK UP! Get your oral comments recorded - April 26, 7:00 p.m., Montana Tech Auditorium
4. CALL your elected city, state and federal representatives.

Clip And Mail NOW! To: Mary Kay Craig,
P.O. Box 4718, Butte, MT 59702 (Phone 723-4061)

Some Community Concerts...
The EPA-ARCO plan:

* creates a perpetual "threat" of release of contamination: it passes off an unresolved crisis and eyesore to our children and theirs, forever
* increases contamination; doubles toxic pit water volume before any is pumped and treated
* retards economic growth; historic underground resources become inaccessible; property values may decrease; ability to attract new employers maybe retarded; well restrictions may shut out new industries that use high volumes of water
* makes for a less-livable city; brings potential for some wet basements; worries community about potential earthquake impacts
* may cause further delays of downstream cleanups: for fear of recontamination, some projects might not be addressed until after pit remedy is in place
* has unresolved technical problems; no schedule for building & testing a water treatment plant; simply dilutes west camp pollutants before discharge to creek; eventually uses thousands of acres for sludge landfill, or if sludge goes back in the pit, retreats the same contaminants over and over forever.

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MAY 03 1994

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City/ST/Zip

CURRENTS

Berkeley Pit Petition

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<IMG SRC 0894102EX>

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CURRENTS

<IMG SRC 0894102EY>
<IMG SRC 0894102EZ>

REQUEST TO EXTEND COMMENT PERIOD

The
Clark Fork
Pend Oreille
COALITION
<IMG SRC 0894102F>

February 10, 1994

Mr. Russ Forba Project Manager
U.S.E.P.A.
301 So. Park, Drawer 10096
Helena, MT 59626

Re: Public Comment for Butte Mine Flooding Operable Unit

Dear Russ:

This is formal request for extension of the Public Comment period for the Butte Mine Flooding O/U. At least an additional 45 days will be necessary for the community to become familiar with the materials, to ask questions and

weigh technological, and future economic and social implications of remediation at this O/U.

The Coalition is very concerned the public be given adequate opportunity to address the E.P.A. remedy proposal. It is our understanding that there is usually a 30 to 60 day Public Comment period following completion of all RI, another 30 to 60 day Public Comment period after the issuance of an FS, and then a like period for the public to comment on a Proposed Remedy. In this case, with the RI/FS and Proposed Remedy unveiled simultaneously, there's simply not enough time to have a meaningful review and dialog on all alternatives for remedy.

In the meantime, it would help us to have a copy of an alternatives Scoping Document for reference in answering questions.

Our initial feedback indicates there is strong interest on the part of the community. It's the one Superfund issue the entire community is very concerned about, but unfortunately, one for which they do not presently seem to feel they have adequate technical expertise to be able to understand, let alone to comment. We believe a major effort on the part of the E.P.A. to isolate issues most important to the public and to communicate them in simplified terms would seem to be in order. As Mary Kay mentioned to you last evening at the Council of Commissioner's meeting, this would possibly mandate a media effort from E.P.A. in language that all the citizens of Butte-Silver Bow can understand.

We believe you should consider separating issues into two categories:

The first category should continue what you are presently doing in talking to those folks who have followed the issue or other Superfund issues right along (such as CTEC and Butte-Silver Bow's technical staff), and are educated or exposed to enough scientific information to be able to comment on the RI/FS and such issues as where wells should be placed, adequacy of modeling regarding constant head pressure, use of numerical regression and other

P.O. Box 7593
Missoula, MT 59807
406/542-0539

P.O. Box 4718
Butte, MT 59702
406/723-4061

P.O. Box 1096
Sandpoint, ID 83864
208/263-0347

<IMG SRC 0894102FA>
<IMG SRC 0894102FB>
<IMG SRC 0894102FC>
<IMG SRC 0894102FD>

Testimony on Proposed Plan, Mine Flooding Operable Unit

Berkeley Pit 4/26/94

Submitted by: John W. Ray, 915 West Galena St., Butte, MT 59701

The purpose of Superfund is to clean up hazardous waste sites which are a threat to human health and the environment. Remedies under Superfund should provide a permanent cleanup remedy not temporary containment or simply removal to another site. Simply, cleanup is the "act of cleaning up: and the term clean means "pure, free from dirt, contamination, impurities." According to the EPA publication entitled Superfund: Environmental Progress the purpose of Superfund is to achieve "long-term cleanup goals for sites" and to remove "contamination from the environment." (p. 1) The document further states that "the law directs EPA to protect public health by meeting strict cleanup standards at each site," and "Reduced to its environmental essence, the New Superfund mission is make sites safe, make sites clean, and bring new technology to bear on the problem." (p. 3) According to the Superfund law, any remedy for the Pit should be a cleanup remedy.

If one examines the major Superfund laws and regulations, CERCLA, SARA, and the NCP, one finds that they All emphasize:

1. Cleanup as the primary goal of any Superfund activity.

2. The reduction of toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site.

3. Permanent cleanup remedies. Senator George Mitchell (D-Maine) has argued that permanent treatment means that EPA cleanup plans must result in a permanent and major reduction in the toxicity, volume, and mobility of hazardous substances, pollutants, and contaminants at a site and that this reduction must be to the "lowest levels achievable." He stated: "In addition to the quantitative reduction implied, significant reduction in this context means the minimization of volume, toxicity and mobility of such substances to the lowest levels achievable with available technologies." 132 Cong. Rec. S. 14914 (daily ed. Oct. 3, 1986)

4. Discourage EPA from simply moving waste from one spot to another. For example, is this what will be done with the sludge which will result from treating Pit water?

5. Cost is not the major factor. Cost is secondary to protecting human health and the environment. Under Superfund, human health must be protected from potential threats regardless of cost. Any solution to the problem of the Berkeley pit must emphasize the above criteria. It is in light of the above five criteria that the solution to the problem of the Berkeley Pit must be judged.

In light of the above criteria, should we be comfortable with a proposed plan which would allow the volume of toxic/contaminated water in the Pit to more than double before anything is done? (From 25 billion gallons to 56 billion gallons) Should we be comfortable with a proposed plan which leaves a Berkeley Pit filled with toxic water to exist and be treated in perpetuity? This proposed plan would allow a surface area of contamination of 487 acres. Is this a cleanup remedy? Is this a remedy which reduces the toxicity, mobility, and volume of hazardous waste? Is this a permanent remedy or a remedy which will leave us with a perpetual environmental crisis?

Unfortunately, past Superfund efforts have not met these goals of permanent cleanup. The Office of Technology Assessment (OTA) has concluded that Superfund remains largely ineffective and inefficient: and "is not working environmentally." OTA has concluded that the Superfund program has too often settled for remedy technologies which would not reduce the "toxicity, mobility or volume" of the hazardous waste. All too often Superfund has settled for remedies short of cleanup. Given the serious nature of the contaminants in the Berkeley Pit, we cannot allow any remedy short of cleanup. We must clean up the problem so that future generations don't have to deal with it.

Specific comments on EPA proposed plan:

1. Needs to have a stronger emphasis on eventual permanent cleanup.

2. Needs to express in unequivocal terms that appropriate/new technologies will be used, as they become available, in the cleanup of the Berkeley Pit. The proposed plan's call for the use of innovative technologies is too vague. This vagueness is particularly true with the problem of sludge disposal. Either putting the sludge in the Pit or creating a new tailings dump will have serious, potentially harmful effects on both human health and the environment. The goal should be to keep the production of sludge to a minimum.

3. Since so much of the proposed plan is based on predictive models, the plan must clearly provide a definite safety factor. Human error of calculation or operation must not produce an environmental catastrophe.

4. The cost factor needs careful consideration. There are two ways of calculating cost: (1) What is the cheapest plan of action or (2) What are the goals we are trying to achieve and, after the goals have been established, what is the most cost effective way of achieving those goals. According to Superfund, we are not looking for the cheapest remedy but, once we have decided on the plan we want to implement to protect human health and the environment in a permanent way by reducing the toxicity, mobility, and volume of hazardous contamination, what is the most cost effective way to accomplish that plan, Under Superfund, cost does not determine which plan is accepted or the end result desired of a cleanup plan, the cleanup plan and its end result, which should be protecting health, determines cost. Senator John H. Chafee (R-RI) has commented on Superfund's consideration of cost: "The extent to which a particular technology or solution is feasible or practicable is not a function of cost. A determination that a particular solution is not practicable because it is too expensive would be unlawful." 132 Cong. Rec. S. 14925 (daily ed. Oct. 3, 1986) In devising a remedy for the Pit we must not select the cheapest solution but the solution which will maximize the protection of human health and the environment. We must select a cleanup solution.

5. The solution to the Pit problem must show sensitivity to public input. As process, democracy demands that the public participate in the formulation and execution of public policy. This is particularly true in the case of agency rulemaking, as exemplified by the decision making processes associated with the Berkeley Pit. Such rulemaking is inherently undemocratic because the people making the rules were not elected by the people and are only very indirectly accountable to the people. Rulemaking is only legitimate in a democracy if the public has ample opportunities for meaningful participation in the decision making process. Meaningful participation means that the public really has an efficacious impact on the content of Superfund decisions.

It is contrary to democratic practice to seek to substitute the opinions of a few so called experts for public decision making. The best environmental policy outcomes are achieved through public discussion and debate. The reason is that the answers to most environmental policy questions, as to most public policy questions in general, cannot be determined with the exactitude of a mathematical or scientific theorem or law. Rather, the answers to public policy questions exist in the realm of the probable or contingent. Given the complexity of society and the complicated nature of most environmental issues, no one individual, not even a scientific expert, knows with absolute certainty what is the best public policy. (Of course, there are numerous examples of where the experts were just plain wrong.) Because of this contingency and complexity, the best environmental policy answers are found through public discussion and by having the so-called expert submit his or her conclusions to critical public scrutiny and approval. The public has a right and a duty to subject the opinions of so-called experts to intense criticism. If an attempt is made to substitute completely the opinions of the technical person for the opinions of the public, neither, the public interest nor the demands of good policy making are served. The final Pit decision must clearly demonstrate and show how public input was efficacious in influencing the final decision of the EPA.

Additional Questions about the Proposed Plan-Mine Flooding Operable Unit:

1. Superfund calls for the cleanup of hazardous waste sites. The Pit is certainly a hazardous waste Site. Does the proposed plan really call for a cleanup of the Pit. Is this a cleanup solution when it leaves in place a lake of poison? Is this a cleanup solution when it leaves Butte in a state of perpetual environmental crisis?

2. The Butte Hill of which the Berkeley Pit is a part is very complex. Do we really know what is going on? Are we relying excessively on models and predictions which could be found to be inadequate?

3. The proposed cleanup plan sets a bad precedent. It writes off the bedrock aquifer as permanently contaminated. No attempt is made to deal with this significant contaminated area.

4. Will the contaminated bedrock aquifer limit Buttes future growth by limiting water supplies.

5. Will the proposed plan end mining in Butte?

6. What if the EPA/DHES predictions are faulty. Can remedial action be undertaken quickly enough to avert an environmental disaster?

7. What would be the effect of an earthquake on the tailings pond and on the Pit? Will the water treatment plant be so constructed so as to survive a major earthquake?

8. What is the effect of pit contamination on the outer part of the camp?

<IMG SRC 0894102FE>

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25 February 1994

Mr. Russ Forba
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Dear Mr. Forba,

COMMENT: Proposed Plan, Mine Flooding Operable Unit
Berkeley Pit, Butte, Montana.

I am a retired academic, having been Foundation Head of the Department of Mineral Processing and Extractive Metallurgy at the University of New South Wales in Sydney, Australia until the end of 1989. I visited Butte in 1979 at the invitation of the Anaconda Company, and saw the Berkeley Pit for the first time (operating). I have since visited Butte on many occasions - perhaps 20 times, have spent several sabbatical attachments at Montana Tech, and in 1993 Spent 9 months working with the Mine Waste Technology Pilot Project team in Butte. I have also reviewed several Superfund documents for U.S. EPA Region 8 (Ref: Mike Bishop). My field of expertise is in the general area of aquatic chemistry, particularly related to the environmental impacts of mining and processing of minerals.

I have read the Proposed Plan, Mine Flooding Operable Unit (Berkeley Pit) dated January 1994, and some of the associated documents, and would like to make several comments on the proposals.

Firstly let me say that I agree completely with the proposed introduction of a "Comprehensive Monitoring Program" which is a part of most of the remedial alternatives. I believe that this monitoring should have been in place before now, and should be well underway (with the interpretation of many results) before any major treatment procedures are established. This comment is made because of my belief that a complete understanding of the present geochemistry and hydrology of the Berkeley Pit System is not at hand, and that a better understanding could influence treatment options. I have seen the results of a little of the monitoring work being conducted by the Montana Bureau of Mines and Geology (MBMG: 1991-1993) and the Atlantic Richfield Company (ARCO: 1992) and the work reported by Davis and Ashenberg: 1989.

An important aspect of pit-system chemistry relates to the reactions that are occurring in the sediment that is forming on the pit bottom, submerged benches, and previously connected old underground mine workings. The sediment thickness at the pit bottom (1993) was said to be possibly 200 ft. The sediment generally will almost certainly be becoming sulfidized by a variety of chemical interactions, but there appears never to have been the suggestion of an investigation of sediment in the Berkeley Pit, apart from my own in 1993.

A complete understanding of geochemistry in the Berkeley Pit needs information from a sediment study.

Due to sediment sulfidation it is likely that an oxidation-reduction boundary has already developed in Berkeley Pit sediment, near the sediment surface, so that the quality of water on the reduction side of the boundary will differ from that in the pit itself, which will be oxidized with respect to the HS^-/SO_4^{2-} interface. An oxidation-reduction boundary could separate the dissolved ionic species in the pit water from those in the underlying groundwater(but allowing downflow, reduction and sulfidation) such that the lower groundwater would be of better quality due to the decreased solubility of metal ions from a reduced sulfide environment. The oxidation-reduction boundary is likely to have developed in the pit sediment due to both the interaction of pore water with underlying sulfidic minerals and solutions, and the likely microbiological reduction of sulfate to form sulfides. The former process is similar to supergene enrichment in sulfide ore bodies where descending solutions from surface oxidation react with the lower levels of hypogene sulfidic mineralisation to form a region of enriched sulfides. Some ores which have been mined economically are attributed to this enrichment process (this includes part of the original Butte orebody as described by McClave: 1973). The proposition of oxidation and supergene enrichment of sulfide ore bodies started with the work of Whitney: 1855, and by the 1960's the paragenesis of oxidized and enriched ores was well established. Accounts of the process have been published by Bateman: 1950, and Anderson: 1955. More recent treatments of the hydrology and geochemistry of these processes are presented by Brimhall et al: 1985, and Brimhall and Crear: 1987, and some related chemistry for tailings interactions was proposed by Robins: 1992.

The likely mediation of sedimentary reactions by microorganisms depends to some extent on the presence of organic carbon, although there are other energy sources that support the wide range of organisms that are encountered in the reduction of sulfate to sulfide. To date it appears that no analysis of Berkeley Pit water (or any other waters in the OU) has included the determination of organic carbon, although it is likely to be present from various sources, which include a huge vegetated water catchment (>5 square miles) to the north in which humic substances are certainly being generated. Algal blooms which occur regularly in the water at the North of the Yankee Doodle tailings are evidence of organic material, which in that region at least could support bioreduction of metals ions. Recycle of contaminated water to part of this tailings area in order to form sulfides is worth consideration. In the pit itself it has been said (without any evidence) that there is not likely to be any bioreduction due to the "extreme" conditions in the water (acidity and metal ion concentrations). This is not correct, and in similar mine waste pits, such as at Rum Jungle in Australia, reducing organisms have been reported at deep submerged sediment (Babij et al: 1980)

The comprehensive monitoring program which is being proposed should include a strong microbiological study.

So, it is suggested here that the Berkeley Pit and surrounding areas could become enveloped by a sulfidic barrier such that the underlying groundwater is in a reduced condition where the metal ion concentrations will the considerably lower than in the pit water. There is some evidence that this is the case (MBMG data, courtesy Ted Duaime). In the West Camp the Travona shaft water is sulfidic, and although the ground water at that location is more or less cross-gradient to the Pit, it shows that the condition of reduced ground water does exist. It also suggests the use or West Camp water (or similar water) to sulfidise other waters in the system. Water samples from the Belmont mine shaft, which is downgradient of the pit, show metal ion concentrations considerably lower than in pit water. Water samples pumped from the up-gradient Kelley Mine shaft (MBMG:1992) indicated that both pH and Ea decreased with depth (pH: 5 to 3, and Ea: 380 to 360mV), which could mean that the Kelly is isolated from the Pit by a redox (ox/red/ox) barrier. Cation concentrations in the Kelley appear to be generally higher than in the pit, but this is probably due partly to enhanced and localised oxidation caused by the more elevated temperates which exist in the deeper water levels.

There is other evidence of sulfidation actually occuring in the Pit: Lead weights used to anchor a sampling platform in the Pit were noticed to be blackened on recovery (personal communication: J. Medish, MBMG). This was probably due to the presence of a coating of PbS formed by sulfidation; A copper bar lowered onto the pit sediment is September 1993 had a sulfide coating when recovered one month later (personal observations).

Another consideration is the influence of the OU groundwaters on deep groundwater, and the fate of that water. A complete water balance on the whole pit system is not reported, but could add perspective to understanding the likely outcome of any chosen remedial action. For example, the maximum average monthly (June) precipitation of 2.42 inches[1] in the catchment of the Pit system (about 19.5 square miles) could result in the generation of about 27 MGD of water (data from Botz: 1969), which would have been accommodated (pre-mining) by stream flow, groundwater flow and evapotranspiration. Presently the only additional water into the system is 6.2 MGD of Silver Lake to the MR concentrator. In all months other than June the precipitation is less than in June by more than the 6.2 MGD from Silver Lake. Actual measurements of monthly evapotranspiration would be more accurate than using calculations such as in CFR 40 Ch.1 (7-1-93). Up-gradient water control, as in fact partly exists with the Yankee Doodle tailings dam, should be carefully integrated with recycle, to result in the appropriate water balance for contamination control.

The proposal to recycle Horseshoe Bend water to the Yankee Doodle Tailings is a good start to water control, but it also presents the possibility of additional chemical control. There will be chemical (and biological) reactions between the recycle water and the tailings sediment, and this could lead to a positive outcome. An investigation of these reactions should be a part of the Comprehensive Monitoring Program.

In the Proposed Plan there is the suggestion that there is an upflow of deep groundwater from the bedrock into the OU. Perhaps a groundwater model was the source of that idea, but I wonder if it is realistic. There are simple experimental procedures that could be used here to add to a realistic water balance.

A downflow of water over geologic time is evidenced by the Anaconda Company maps (Mcclave: 1973, Figures K-1 to K-3) showing the position of the zone of supergene enrichment which lay in the volume that is now the Pit itself, and still exists in surrounding areas. These diagrams show a downward extension of the enriched zone at faults and veins (eg. to levels at an elevation of 3800 ft in the Middle Fault at the Kelley shaft), where there would have been a downflow of surface water. A downflow of pit water (beneath the pit) will still be present and will be furthering the supergene enrichment process and carrying reduced solutions with lower metal ion concentrations to greater depths where enormous dilution will occur with circulation to depths of 1-2 miles (Blackwell and Robertson: 1973). "Contaminated" water from the OU may never influence surface ground waters.

[1] Butte station, 30 yr average annual precipitation (1951-1981) was 11.73 inches.

My comments on the preceding pages lead to the following eight recommendations:

1. That a comprehensive monitoring program be quickly set in place.

2. That a pit sediment study be part of the monitoring program.

3. That a microbiological study be a part of the monitoring program.

4. That there be detailed considerations or geochemical and microbiological interactions in the pit system.

5. That an overall monthly water balance be used to assess both up-gradient water control and recycle possibilities.

6. That system-outflow water quantities and patterns be assessed, with some monitoring to support any conclusions.

7. That in considering chemical treatment options, due consideration be given to recycle of "contaminated" waters as well as the integration of waters from different sources.

8. That all of the above activities be supported by an expert "advisory-and-review" panel consisting of persons outside the commercial consultancy organizations.

Most of these recommendations relate to the proposed "comprehensive monitoring program" which, if carefully planned, could well lead to the formulation of a more cost-effective strategy (embodying in-situ immobilisation of contaminant metals) than for Alternative 6/7.

I have not addressed the detail of the treatment methods (chemistry) that are proposed to be introduced at the time of suspension of mining. These methods are fairly standard and reasonably well understood. However there is one aspect that is not understood at all, and that relates to the interactions of treatment sludges with the environment into which the sludge is disposed, particularly if that was to be the pit itself. If treatment sludge was added to the pit it would dramatically affect the pit sediment and the reactions occurring in the sediment and surrounding groundwaters and perhaps deep groundwater. These possibilities should at least be considered, and preferably investigated in some detail in a pilot experiment that could be carried out on site.

The environmental situation in the Berkeley Pit Operable Unit System offers a tremendous opportunity for scientific study which should not be lost, and which will certainly be useful to others in future times and other places. There are presently similar situations internationally, where detailed investigations have been in place for some years, but these do not appear even to have been identified during the feasibility study, let alone taken as example. In the near future other mine operators will need to deal with situations similar to those at the Berkeley Pit and a well documented activity will be appreciated. In the immediate future the WISMUT mines in Germany (especially the Ronneburg Pit) will commence to flood and will take about 15 years to fill.

One further suggestion that I would like to put forward is about funding of the comprehensive monitoring program. I think that advantage should be taken of sources other than EPA and ARCO. There are funding programs available through the National Science Foundation, and others internationally, where large grants are given for environmental projects. Locally, there is at the present a call for submissions to a "Reclamation and Development Grants Program" from the Montana Department and Conservation. EPA should coordinate a grants application scheme with the local institutions and others. My close association with the Academics at Montana Tech, over more than ten years, makes me realise that there is a great potential for more involvement in the OU problems than at present.

I will be in Butte from 5th March to 9th March 1994 and will attend the public meeting to be held at Montana Tech on the evening of 8th March. I would enjoy talking with you or any of your colleagues during my stay, and in the meantime I could be contacted through the Research Office at Montana Tech (406) 496 4102.

Yours sincerely,

Bob Robins

Attachment: References to publications cited.
Inclusion: Paper on sulfide tailings.

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Mineral Processing and Extractive Metallurgy Review, 1993, Vol. 12, pp. 1-17
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Printed in the United States of America

Chemical Interactions in Sulfide Mineral Tailings*

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This paper reviews some of the work that has attempted to identify species which exist, or are formed, in sulfide mineral tailings, indicating that the resultant chemical reactions, combined with physical properties of the tailings and their surrounds, can explain movement and attenuation of metal concentrations. Additionally, it introduces the consideration of the reactions and speciation which occur in the reduction zone of a sulfide tailings heap, which is a subject that has previously received little attention. As evidence for reductive dissolution of sulfides in tailings, an investigation of the Anaconda Tailings (in Montana, U.S.A.) is cited.

The contention that chemical modeling provides an accurate basis for predicting tailings chemistry is refuted. Attempts to model the effects of chemical interactions in sulfide tailings have to date been distinctly inaccurate. The use of various computer codes to aid modeling of the chemical reactions in these tailings has become widely adopted, but the success of the computer techniques relies on the choice of appropriate chemical species that may be influencing the interactions. In many instances the particular species involved may not have been characterised thermodynamically or it may not even be known.

INTRODUCTION

The management of mineral wastes requires careful attention because of the need to maintain a cleaner environment. Mining and processing wastes often contain many metals which are in the form of sulfides, and the leaching of these wastes in open environments can lead to contamination of ground waters due to weathering and acid production. The identification and characterisation of the chemical species present in an existing tailings storage area is essential to being able to predict the likely chemical reactions and possible release rates for soluble and often complex metal ions.

In order to design mine tailings disposal facilities prior to the development of a mine, it is also essential to evaluate the potential of the wastes to release trace metals and acid. Solid phase characterisation in conjunction with dissolution experiments for prediction of drainage quality are essential pre-development activities1.

*This paper is based on a presentation by the author at the Mine Waste Management and Remediation Conference. Fairmont Hot Springs, Montana, USA. July 7-10, 1992.

The United States Environmental Protection Agency has instituted a Resource Conservation and Recovery Act (RCRA) with regulations to cover remedial action to minimise contamination from both abandoned and operating mine and mineral processing operations. More recently they have published draft rules which require the submission of plans for closure and post-closure care of mine wastes prior to mine development.

To obtain pre-development mine waste management plans, the geochemistry of the system containing the wastes be estimated together with an assessment of quantity and quality of the drainage in the system that is likely to be generated by the wastes. System mineralogy and hydrology are therefore important studies to be undertaken in an overall assessment.

This paper, however, will only deal with aspects of geochemical modeling which can be related to a sulfide tailings system without considering the influences of surface and groundwater hydrology, other than the chemistry of these waters. The difficulties in modeling such a system relate mostly to the lack of information on the chemical species present, and when kinetic data are required, the problem is greatly increased.

CHEMISTRY AND SPECIES IN SULFIDE TAILINGS

The number of minerals present in sulfide tailings together with the many complex ions that can exist make it impossible to cover the whole field of chemistry and speciation in this short paper. To enable an abbreviated discussion on the subject only four elements will be considered here: namely copper, iron, sulfur and arsenic. These four elements alone account for more than sixty minerals, of which the more common are shown in Table 1. Most of these minerals have been identified in the ores which are mined for copper production and many find their way into the tailings from the processing of such ores. Of course many other complex metal sulfides are also found in such an ore deposit, but these will not be considered here.

TABLE I

The more common minerals in the Cu-Fe-As-S system[2].

Cu2S	Chalcocite	(Cu,Fe) S5	digenite
Cu S	djurleite	Cu4 Fe S4	bornite
Cu S	digenite	Cu4 Fe S	x-bornite
Cu S	anilite	Cu4 Fe S4	idaite
Cu S	b.r. covellite	Cu1 Fe S4	fukuchilite
Cu S	covellite	Cu Fe S2	chalcopyrite
		Cu Fe4 S3	cubanite
As S	realgar	Cu Fe S10	(several)
As2 S	orpiment	Cu4 Fe4 S	haycockite
Fe S	troilite	Cu As S	luzonite
Fe S	mackinawite	Cu1As4S	enargite
Fe S	pyrrhotites(9)	Cu As4 S	sinnerite
Fe S	gamma sulfide	Cu12 As S	tennantite
Fe S	smythite	Cu As S	lautite
Fe S	greigite		
Fe S2	pyrite	Fe As S	arsenopyrite
Fe S	marcasite		

CHEMICAL INTERACTIONS IN SULFIDE TAILINGS

The presence of water in most sulfide tailings disposal sites means that the system under consideration is aqueous and so here the reference is the Cu-Fe-As-S-H_2O system. A convenient and concise method for both interpreting and predicting the complex equilibria and likely reaction paths that exist in such aqueous systems is by the use of various thermodynamic stability diagrams. The potential-pH (or p∊-pH) diagram is particularly useful and Figures 1 and 2 show such diagrams which will be referred to later. These diagrams can be easily generated by computer provided the standard free energies of formation for all of the components in the system are known. This last consideration is a very real problem for complex systems as many of the species are still unknown let alone having been characterised by stability constants (or free energies of formation). Having obtained a p∊-pH diagram, the misinterpretation of the diagram is common.

Probably the best elementary text-book coverage of stability diagrams for mineral systems is still that authored by Garreis and Christ. The compilation of "Eh-pH Diagrams for Geochemistry" in the book by Brookins[4] is more recent but many errors lead to a general uncertainty about using his diagrams. Diagrams for very complex systems can be derived and some of these have been published and are invaluable as a general guide to the likely chemical conditions of tailings.

Reactions in the Oxidized Zone in Sulfide Tailings

The generation of acid in a sulfide tailings material is commonly attributed to the oxidation of pyrite in the presence of water, oxygen, and naturally occurring bacteria such as Thiobacillus ferrooxidans5. There is extensive literature on this process but it relates mostly to acid generation in sulfidic coal spoils where the sulfide mineral is predominantly pyrite FeS2 and its dimorph, marcasite, Numerous reaction mechanisms have been proposed for the oxidation of pyrite and in general the overall reactions are given by the following equations:

$$(pH > 2)\ FeS2 + 7/2\ O2 + H2O = Fe^{2} + 2SO24- + 2H-$$

$$(pH < 2)\ FeS2 + 7/2\ O2 + H2O = Fe^{2} + 2HSO-4$$

$$Fe^{2}- + 1/4O2 + H- = Fe3 + \tfrac{1}{2}\ H2O$$

$$Fe3 + 2H2O = FeOOH + 3H-$$

but it is also proposed that the first reaction above is electrochemical where the anodic oxidation of pyrite is coupled with the cathodic reduction of oxygen on the pyrite surface. A detailed study of oxygen reduction at mineral sulfide surfaces6 indicated that pyrite together with copper sulfides and pentlandite (Fe,Ni)9S8 are good catalysts for oxygen reduction which will occur at about + 0.4 volts (SHE) in acid solutions (independently of pH). In the electrochemical model the half reaction below pH = 2 is given as:

$$Fe\ S2 + 8H2O = Fe^{2} + 2HSO-2 + 14H- + 14e-$$

with a theoretical potential in volts (SHE):

$$E = 0.35 - 0.0592\ pH + .0085\ \log HSO-4 + .0042\ \log Fe^{2}-$$

The generation of acid in tailings heaps is far more complex but studies based on the electrochemical reactions at pyrite surfaces are still being conducted in an attempt to explain the reactions in pyritic wastes5.

An excellent review of the oxidation of pyrite has been written by Lawson. The Singer and Stumm model for pyrite oxidation is now widely quoted and adopted for predicting acid generation in sulfide wastes. This model was improved by Moses et al. who have shown that sulfoxyanions, (particularly thiosulfate) are intermediates in the oxidation of pyrite. Another recent study by Moses and Herman proposes a mechanism for the oxidation at near-neutral pH which involves adsorption of Fe(II) onto the surface of FeS2 and then its oxidation with dissolved oxygen to Fe(III) which reacts at the FeS2 surface to regenerate Fe(II). These studies have improved the understanding of the chemistry and the mechanism of pyrite oxidation but the rate of oxidation cannot be accurately predicted. It is reported that laboratory studies have shown variations in the rate of oxidation of pyrite of many orders of magnitude11.

The potential-pH diagram for the Fe-S-H2O system shown in Figure 1 can be used to illustrate the regions where pyrite is oxidised and the likely course of reactions. The accuracy of the diagram depends on the use of reliable thermodynamic data for all of the species involved, but despite the depth of knowledge for this system, there are still many unknowns. For example, there have been a number of ferrous-sulfide complexes such as Fe(HS)02 and Fe(HS)3- which have been proposed and for which there are free energy data in the thermodynamic data compilation of Naumov et al.12. These sulfide complexes as well as the polysulfide anions S2/2-, S2/3-, S2/4-, S2/5- and S2/6- were not taken into account when generating Figure 1, but will have an influence on the reactions of pyrite in an anoxic environment as is discussed later.

The oxidation reactions of the copper sulfides can similarly be explained with a potential-pH diagram as shown in Figure 2. An excellent review of copper sulfide leaching in dumps and in-situ, has been authored by Murr13. In this review the chemistry of the leaching of both oxidised and sulfide copper minerals is presented showing various likely reactions. A set of reactions which is more reasonable than that given by Murr is shown here.

The oxidised copper minerals react with acid generated by the oxidation of some of the sulfide minerals present (such as pyrite):

Tenorite: $CuO + 2H- = Cu^{2}- + H2O$
Cuprite: $Cu2O + \tfrac{1}{2}\ O2 + 4H- = 2Cu^{2}- + 2H2O$
Azurite: $Cu(OH)2\text{-}2CuCO3 + 6H- = 3Cu^{2}- + 2CO2 + 4H2O$
Malachite: $Cu(OH)2\text{-}CuCO3 - 4H- = 2Cu^{2}- + CO2 + 3H2O$

and also with ferric ion produced by oxidation of iron sulfides:

Tenorite: $2CuO - Fe3- - H- = 2Cu^{2}- + FeOOH$

Cuprite: $Cu2O + 2Fe3- -2H- = 2Cu^{2}- + 2Fe^{2}- + H2O$

<IMG SRC 0894102FF>
<IMG SRC 0894102FG>

Albert Molignoni
Rocker, MT 59701
February 11, 1994

BERKELEY PIT WATER
Benefits for the Community from
Maintaining Water Levels at the Bottom of the Pit:

1. Very large volumes of low-cost, clean, drinkable water can be made available for the community of Butte-Silver Bow for both its present and future needs.

2. Large amounts of inexpensive electricity can be utilized by the community or sold at a profit to Montana Power Company.

3. Storm water run-off, as well as the sewage of the community, can be processed into a clean water supply that meets the Safe Drinking Water Act requirements.

4. Metals that now pose a health risk in our aquifer can be processed at a profit.

5. Large amounts of garbage can be processed, thereby reducing demand on the current new landfill by as much as 80%.

6. It will spawn a system to provide a vast array of high-tech, high-paying jobs that will be sorely needed after EPA, MDHES and ARCO leave the community.

7. The process can be utilized in other areas of the world to benefit mankind while practically eliminating the cover-up and Institutional Controls that are some of the possible "remedies" of present and future Superfund sites.

8. It eliminates need for degredation of Big Hole River water, as well as Silver Lake water, that could instead be utilized for future needs of the citizens of the State of Montana.

Summary

Most of the technologies required to turn the present catastrophe of a highly contaminated area into an asset for our community are currently achievable. Now is the right time in the Superfund process to put these technologies into place for beneficial uses by this community and the State of Montana.

<IMG SRC 0894102FH> UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

Ref: 8MO

February 16, 1994

Mr. Albert Molignoni
Rocker, MT 59701

Dear Albert:

This letter is in response to your inquiry concerning the effect of inundating the mines on the metals concentrations in the mine water. As I described to you in our February 10th meeting, the concentration of metals should drop because there is less oxygen available to produce acid which solubilizes metals as the mine waters rise.

Attached is an old (1960) AMC record which shows the concentration of copper in the pumped waters from several mines to vary between 155 mg/l and 592 mg/l with an average of 363 mg/l. Our remedial investigation sampling showed copper concentrations ranging from a minimum of .024 mg/l (Anselmo) to .965 mg/l (Steward) and 1.28 mg/l (Granite Mtn.). As you can see, concentrations have dropped significantly. We believe that this reduction in metals concentration is due to the inundation of the shafts which limits the availability of oxygen.

If you have any questions concerning this subject, please call me at 449-5720.

Sincerely,

Russell W. Forba
Remedial Project Manager

cc: James Scott, MDHES

should be added to total Mt. Con production. The 2200 water, although not measured and sampled, amounts to 60 - 70 gallons. If sampled and measured, this copper credit should be added to the Mt. Con production.

If the above plan were adopted, the following tabulation shows the distribution of copper recovered at the Butte Precipitation Plant during October, 1960:

Mine	Gallons/ Min.	Gallons/ Month	Sol. Cu Ga/Liter	Gross Total Pounds (Theoretical)	% of Total	Recovered Pounds
Anselmo	200R	0				
Badger	150	5,134,500	0.1547	6,620.2	1,371	6,100
Belmont	0	-	-	-	-	-
Kelley	0	-	-	-	-	
Leonard	2,442	83,589,660	0.5919	412,367.2	85,426	379,955
Lexington	75RR					
Mt. Con	820	22,068,600	0.1547	36,190.5	7.497	33,346
Original	100R	-	0			
Pittamont	0	-	0			
Steward	846	28,958,580	0.1141	27,538.9	5.706	25.374
3800 Total	4,258	154,752,830		483,716.8	100.000	444,775

The weir measurement at surface exceeds that of the combined measurements of the 3800 level by 699 gallons/minute, averaging 0.363 grams/liter, and since this water is from upper levels and considered to be mainly from the Mt. Con area, this contained copper amounting to 84,177 recovered pounds should be credited to the Mt. Con. Also, the copper in Mt. Con water recirculated

R Included in Steward
RR Included in Mt. Con

<IMG SRC 0894102FI>

Montana Bureau of Mines & Geology

Butte Mine Flooding
Outer Camp Water Level Data
MBMG Data
Green Lake Seep Elevation - 5560 ft (USGS*)

Date (ddmmyy)	Orphan Boy SWL (ft)	Elevation* (ft)
	5700.00	
1/ 7/1992	122.43	5577.57
2/ 4/1992	122.66	5577.34
3/ 4/1992	122.64	5577.36
4/ 2/1992	122.75	5577.25
5/ 5/1992	123.06	5576.94
6/ 1/1992	123.21	5576.79
7/ 1/1992	122.70	5577.30
8/ 3/1992	121.96	5578.04
9/ 1/1992	121.56	5578.44
10/ 1/1992	121.31	5578.69
11/ 9/1992	120.88	5579.12
12/ 2/1992	121.02	5578.98
1/ 6/1993	121.12	5578.88
2/ 3/1993	121.34	5578.66
3/ 4/1993	121.55	5578.45
4/ 5/1993	120.99	5579.01
5/ 3/1993	120.76	5579.24
6/ 3/1993	120.69	5579.31
7/ 7/1993	120.02	5579.98
8/ 4/1993	119.34	5580.66
9/ 2/1993	118.29	5581.71
10/ 4/1993	116.82	5583.18
11/ 3/1993	115.77	5584.23
12/ 1/1993	115.53	5584.47
1/ 4/1994	115.41	5584.59
2/ 3/1994	115.61	5584.39

* Elevation data is based upon USGS topo map interpretation

ER CAMP
Dates Quality
2/15/94

SITE	Lab Analysis	DATE (mm/dd/yy)	TIME (HRS)	DISCHARGE (GPM)	SWL (FT)	FIELD SAMPLE DEPTH	PH	SC (UMHOS	TEM (C)	EH (MV)	LAB PH	SC (UMHOS	HARDNES (MG/L)	ALKALINITY (MG/L)
							PHYSICAL PARAMETERS							
ORPHAN BOY	MBMG	1/27/1987	14:00		124.4		6.44	2400	24.0	N/A	N/A	N/A	N/A	N/A
	MBMG	5/28/1987	12:40		127.5		6.47	N/A	17.6	N/A	7.2	2260	N/A	N/A
	MBMG	6/25/1987	11:25		125.5		6.62	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MBMG	5/31/1988	17:10		124.0		6.52	1701	25.0	N/A	7.0	2261	1114.0	770.1
	MBMG	6/29/1988	17:10		124.1		6.33	2210	18.2	-267	7.0	2232	1133.1	750.5
	MBMG	11/ 8/1989	15:50		124.2		6.60	2190	18.5	N/A	7.5	2080	1115.2	700.4
	MSE	5/29/1991	14:51		N/A		6.96	2089	26.0	-267	N/A	N/A	N/A	1020.0
	MSE	9/ 3/1991	15:05		N/A		6.72	2200	23.5	-215	N/A	N/A	961.0	730.0
SURFACE	MSE	5/29/1991	17:15				6.87	1837	16.1	3	N/A	N/A	N/A	709.0
SEEP	MSE	9/ 6/1991	15:11				6.65	2015	15.5	186	N/A	N/A	711.0	561.0

THE
CLARK FORK
PEND OREILLE
COALITION

April 28, 1994

Mr. Russ Forba, Project Manager
<IMG SRC 0894102FJ>U.S.E.P.A.
301 S. Park
Helena, MT 59626

Re: 3,690 Public Comments on the Berkeley Pit and Mine Flooding Preferred Plan

Dear Russ:

Enclosed is a Berkeley Pit petition signed by 3,690 affected citizens. Of these, 3,470 are residents of Butte-Silver Bow County. The balance are concerned Anacondans and other residents of the Clark Fork watershed, as well as a few Montanans from nearby cities and towns.

The people who have signed this petition make up over 10.3% of the population of Butte-Silver Bow. Their number is about the same as those who voted in the recent school board election. The number of signatures is significant in that the petition was "worked" for parts of the day on only three Saturdays in one store in Butte (about 2,000 signatures): a small donated newspaper ad received an amazing 2.6% response rate (286 mailed-in petitions); petitions were out for about a week in six retail establishments, and the balance came in from people who asked to take petitions from K-Mart for their friends to sign. We believe that over 95% of those in Butte who were asked to sign the petition did so. Those who didn't were usually in a rush; very few refused. The point is, this was something the citizens of Butte Silver Bow were able to agree on wholeheartedly. They often said, "thank you!" and "bless you," and expressed the wish they had time to get more involved.

Please consider that many, if not most, of the folks petitioning you to start work on cleaning the pit water now seemed to be really upset about it. We often heard people say they "can't believe EPA would let this happen to Butte." What the majority seem care about are not the technical complexities, and not the Horseshoe Bend water, but rather the Pit itself; e.g., that EPA would allow ARCO"...to wait nearly 30 years to pump and clean the water," "...to let the pit fill and stay that way forever," "...not to reduce the amount of contaminated water!"

Please consider the overwhelming non-acceptance by the community of the preferred plan - despite massive influx of ARCO PR dollars to this rural area over the past few years. People say the plan would create new contamination and a nuisance that would decrease their quality of life in substantial ways - including environmentally, economically, socially - and that it creates new threats to human health, including mental health. Please consider that this massive Superfund site is part of the neighborhood in this community, not separate from citizens and homes and families. Please consider the people who live here today, those who hope to live here tomorrow and future generations who will have to live with EPA's Record of Decision.

P.O. Box 7593
Missoula, MT 59807
406/542-0539

P.O. Box 4718
Butte, MT 59702
406/723-4061

P.O. BOX 1096
Sandpoint, ID 83864
208/263-0347

Please do not chose a remedy that appears to give greatest weight to cost or to threats of litigation from Potentially Responsible Parties.

Thank you, Russ, for all your help and hard work on this project. Hopefully, information will have come forward during the Public Comment Period that will enable EPA to respond appropriately to the grave concerns of the people who live on top of and next to this Superfund site.

Yours very truly,

Mary Kay Craig
Upper River Field Representative

Enclosure

cc: President Bill Clinton
Vice President Al Gore
Senator Max Baucus
Senator Conrad Burns
Representative Pat Williams
Governor Marc Racicot
Ms. Carol Browner, U.S. EPA Administrator
Mr. Bill Yellowtail, U.S. EPA Reg. Administrator
Mr. John Wardell, U.S. EPA Montana Director
Mr. Bob Robinson, Director, Montana DHES
Mr. Jack Lynch, Butte-Silver Bow County Chief Executive