STATE OF MONTANA

DEPARTMENT OF STATE LANDS

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SCHOOL LANDS

A RESOURCE FOR THE PRESENT
AN OPPORTUNITY FOR THE FUTURE

December 19, 1975

DEC 22 1975
ENVIRO... QUALITY

Attached is a Final Environmental Impact Statement (E.I.S.) for the proposed approval of a mining permit for the Anaconda Company's Continental complex in Silver Bow County, Montana. The Anaconda Company has requested that a mine waste dump be located upon an area immediately east of the City of Butte, Montana. The permitted area is 500 acres in size, approximately 90 of which are expected to be disturbed during the next year.

The New Hard Rock Mining Law (Chapter 12, Title 50, R.C.M. 1947) specifies that within sixty days following the receipt of a complete application for an operating permit, the Department shall either issue the permit or notify the applicant of where his application is deficient. Failure to so act within the 60 days allotted, constitutes approval of the application and the permit must be issued promptly thereafter. With this stiff time frame, the Department has complied to the fullest extent possible with the Montana Environmental Policy Act (Chapter 65, Title 69, R.C.M. 1947). Hence, no Draft E.I.S. was prepared for Anaconda's proposed operation and there was no opportunity for public comment. A Departmental decision on whether or not to grant the operating permit will be made within the next week.

All materials submitted to the Department by Anaconda Company as part of their application for an operating permit pursuant to the New Hard Rock Mining Law are on file and available for public review in the Department's offices in Helena.

Sincerely,

Charles van Hook

Charles van Hook
Reclamation Division

jw
Encl.

ENVIRONMENTAL IMPACT STATEMENT

CONCERNING

THE ISSUANCE OF A MINING PERMIT

TO

THE ANACONDA COMPANY

OF BUTTE, MONTANA

BY

THE STATE OF MONTANA

DEPARTMENT OF STATE LANDS

HELENA, MONTANA

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INTRODUCTION

The Department of State Lands is vested with the responsibility of the administration of Title 50, Chapter 12, R.C.M., 1947; The New Hard Rock Law. The purposes of this act are to provide: (i) that the usefulness, productivity and scenic values of all lands and surface waters involved in mining and mining exploration within the boundaries and lawful jurisdiction of the state will receive the greatest reasonable degree of protection and reclamation to beneficial use; (ii) authority for cooperation between private and governmental entities in carrying this act into effect; (iii) for the recognition of the recreational and aesthetic values of land as a benefit to the State of Montana; and (iv) priorities and values to the aesthetics of our landscape, waters and ground cover. Although both the need for and the practicability of reclamation will control the type and degree of reclamation in any specific instance, the basic objective will be to establish, on a continuing basis, the vegetative cover, soil stability, water condition and safety condition appropriate to any proposed subsequent use of the area.

This act requires that the Department evaluate applications for exploration, development and operating permits in accordance with the reclamation standards prescribed. The issuance of mining permits and regular inspections of such permitted activities is further provided by the act.

Every agency of the State of Montana is further directed by Title 69, Chapter 65, R.C.M., 1947; The Montana Environmental Policy Act, to incorporate the following directives in their routine administrative activities:

(1) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment;

(2) identify and develop methods and procedures, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations;

(3) include in every recommendation or report on proposals for projects, programs, legislation and other major actions of state government significantly affecting the quality of the

human environment, a detailed statement on

(i) the environmental impact of the proposed action,

(ii) any adverse environemtnal effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The Department of State Lands has received an application for a mining permit to establish a mine waste dump upon an area immediately east of the City of Butte, Montana. The Anaconda Company has submitted this application in an effort to continue the development of ore bodies adjacent to the proposed area of use.

It is the purpose of this impact statement to describe the nature and location of the proposed mining related disturbance. There will also be discussion of resources in the area of the proposed disturbance and the effect of this disturbance on those resources. The human resources will be considered in light of area history, economics, employment and quality of life relative to mining and related activities. Due to the long term history of mining and smelting in this area, many resources such as vegetation and wildlife have been significantly reduced long ago and have therefore received little attention from resource analysts. However, every resource will be described in accordance with data available in an effort to satisfy MEPA directives.

HISTORY OF COPPER MINING IN THE AREA

The mining of metals in Western Montana has been occurring for approximately 100 years. Many mines exist today, and other areas, known to hold valuable metal resources have not yet been developed. The following brief history of the Anaconda Company is based partly upon the writings of Dr. K. Ross Toole, noted Montana Historian.

> "From 1880 to 1900 the wondrously productive and ingeniously managed Anaconda Copper Mining Company, a local corporation partly owned and entirely operated by Montanans, extended itself into every facet of the lives of the western inhabitants. It was the most productive copper enterprise in the world. It owned millions of acres of timber; it owned municipal water works, stores, hotels, newspapers - utlimately all but one of the seven major dailies. It owned street railway systems, railroads, great sawmills, brickyards, and scores of other enterprises. By 1900 Anaconda was employing nearly three quarters of the wage earners of the state . . . But when the Standard Oil Company purchased the Anaconda Company in 1899, it formed a holding company, the Amalgamated Copper Company. Under the umbrella of this vast device it reached out for other companies and allied enterprises in Montana.
>
> [concerning the Butte copper operation]
>
> "The wealth of the area was enormous. In 1899, Montana produced 61 percent of the copper in the United States and 23 percent of the production of the world. By 1910 Montana's non-ferrous mines employed 20,000 wage earners who produced $55,000,000 worth of raw wealth. But copper was the cornerstone. Although only thirty-five operators were involved, they employed more than 13,000 people, amounting to about three-fifths of the wage earners of the entire state.
>
> "In 1909 alone, the copper mines produced $46,000,000 worth of raw wealth. And the giant among them was the Anaconda Copper Mining Company, which was gobbling up competitors with a voracious appetite in the early years of the new century . . . There

> were many Montanans who had literally grown up with its cities, and the cities themselves had sprung almost literally from the raw wilderness. A schoolboy in Butte as of 1880, say, when the 'camp' had a flotsam-like population of approximately 3,400, could now, in his twenty-fifth year, look out over a boisterous, roaring conglomeration of 30,470 souls. When, under intense federal pressure in 1915, Amalgamated dissolved itself and Standard Oil got out of Montana, the operating company, Anaconda, took over."

The "Butte Hill" was indeed one of the richest deposits of copper in the owrld. Initially, mining was conducted underground. Numerous shafts were excavated along the enriched veins created by extensive faulting and subsequent mineralization. The entire Butte area was underlain by an intricate honeycomb of underground works. Eventually, the enriched veins were depleted to the point where the Anaconda Company began developing methods for mining less concentrated ore by a block caving method. Block caving was initiated in underground works in the early 1950s. Improved smelting and concentrating technology allowed the utilization of ore of a lesser quality. In 1955 the first of such lower quality ore was extracted from the area now known as Berkley Pit. This pit has continued to grow in depth and width. As mining proceeded to lower elevations in the pit the quality of the ore has decreased.

Again, only through continued improvement in ore concentrating and smelting methods has the pit remained a viable operation. The concentration of ore is now .45 to .5 percent copper. Small amounts of other precious metals are also extracted at the smelter.

The Company began mining ore from a more shallow "blanket deposit" east of the city late in 1973. This deposit may offer an alternative to the marginal economics of the Berkley Pit operation. The underground operations came to a complete halt in the fall of 1975. Aside from copper mining, the Anaconda Company has operated smelting facilities in the nearby town of Anaconda since the early 1900s.

The mining and smelting of copper in Butte and in the nearby town of Anaconda was the reason for their establishment and has remained by far, the primary economic concern for these adjoining communities. The environmental, social and economic problems associated this these activities have been studied, written about, and litigated for decades.

DESCRIPTION OF PROPOSED ACTIVITY

A large portion of the materials submitted to the Department of State Lands in support of the Anaconda Company Operating Permit Application will be presented in this section. It is commonly known that vast areas near Butte have been mined by the Anaconda Company for decades. These areas have also been subject to much mining and exploration activity prior to Anaconda's dominance in the area.

The presentation of the permit material allows more complete and accurate public disclosure of the nature of this particular proposed operation. However, this operation, though requiring separate review, is an extension of other, ongoing activities. And, as stated in the company submittals, the future extent of disturbance in this area relies heavily upon various factors such as the continued operation of Anaconda Company mining activities in the area, utilization of alternate ore deposits of different quantity and quality, and the possibility of eventual access to the Central Business District area in Butte. However, the current downward trend in copper prices and increased operating costs have caused company recognition of an immediate need for a reduction in the cost of hauling mine waste materials. The present Berkley Pit mine waste materials are being hauled at a longer distance to an elevated dumping area. The proposed Initial South Dump area is nearer to the pit and primarily downhill. Transporting mine waste to this area from the Berkley Pit will reduce operating costs through reduction of fuel consumption and haul truck maintenance per unit of operation.

The following material consists of information submitted by the Company as required by the New Hard Rock Law and rules and regulations adopted pursuant to the law. Explanatory narratives will be included:

1. Department of State Lands' Map of Continental Complex

For use in this impact statement this map was reproduced with the overlay attached.

For administrative purposes, this map shows the locations and boundaries of several "Permit Areas." Permit No. 00030 is the first permit granted to the Anaconda Company. This permit (not entirely covered by this map) includes the Berkley Pit and other concentrating, processing and maintenance facilities. Permit No. 00041 was granted in 1973 and is referred to as the Continental East Pit. This mining operation has been completed and reclamation work continues. The permit being applied for at this time covers 500 acres of land divided into two segments; one area is north of 00041 and the other area is south of 00041. The permit being applied for would carry the number 00041A, not shown on this map but referred to in the Mining and Reclamation Plans to follow. Grey shaded areas on the map indicate land areas not presently owned or controlled by the Anaconda Company with one exception. A small area centrally located in the south portion has been acquired by the company since this map was prepared. This particular location will be incorporated into the proposed area of disturbance.

2. Outline of Continental Mining Complex. This outline illustrates the location of the proposed Initial South Dump, and is referred to as Overlay No. 2 in the Reclamation Plan. The outline allows easy identification of the areas covered in the proposed permit by delineating the boundaries between present and proposed permits.

3. Continental Complex Mining Plan - 00041A.

This document contains a description of the activities associated with establishing the Initial South Dump.

4. South Dump Cross Sections.

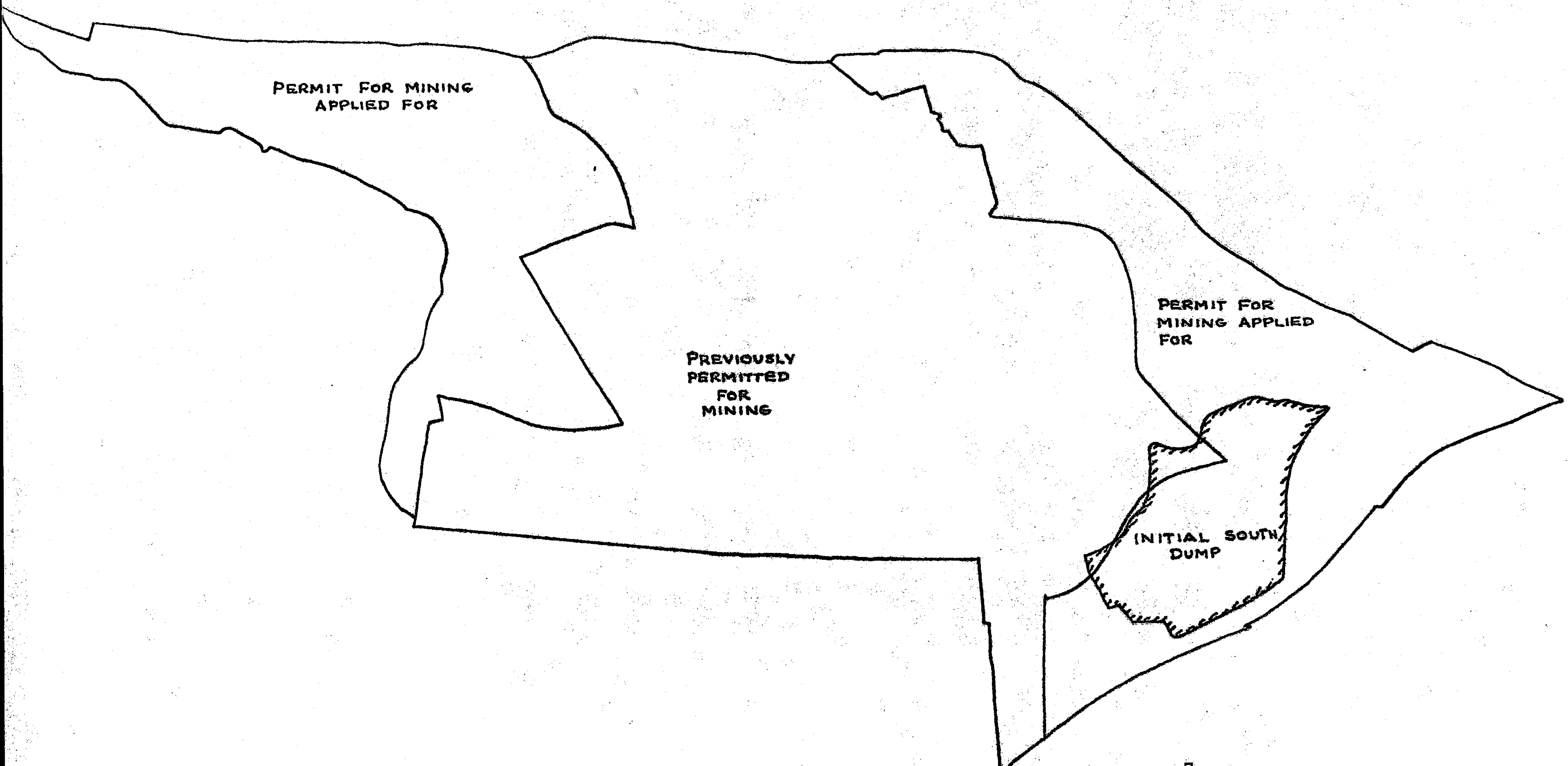
These cross sections illustrate the shape and size of the proposed dump illustrated on Overlay No. 2.

5. Reclamation Plan, Continental Complex - 00041A.

This document describes the work which will be done by the Company pursuant to the reclamation of the Initial South Dump project.

The outline of information is dictated by the New Hard Rock Law. The reclamation commitments made by the Company will be legally binding if the plan is accepted by the State.

OUTLINE OF CONTINENTAL MINING COMPLEX
DELINEATING AREA DESCRIBED
FOR
PRESENT AND PENDING
MINING PERMITS




DRAINAGE TO EXISTING LEACH DUMP
TOE OF EXISTING LEACH DUMP
ELEVATION OF SADDLE 6472 FT.
CONTOUR ELEVATION 6420 FT. BASED ON ANACONDA'S ELEVATION VALUES
Elk Park Pass
U.S. 15
PERMIT NO. 00030
CONTINENTAL FAULT
RIGHT OF WAY U.S. 91
PERMIT NO. 00041
WEST RIGHT OF WAY LINE OF INTERSTATE HIGHWAY 15
NORTH RIGHT OF WAY BURLINGTON NORTHERN R.R. (Main Line)
NORTH SIDE OF MONTGOMERY AVENUE
EAST RIGHT OF WAY BURLINGTON NORTHERN R.R. (Main Line)
OVERLAY NO. 1
AREA PREVIOUSLY BONDED
LAND NOT OWNED OR CONTROLLED BY THE ANACONDA COMPANY
BOUNDARY OF CONTINENTAL COMPLEX
T.3N., R.7W.
T3N., R.7W.
DEPT. OF STATE LANDS MAP OF CONTINENTAL COMPLEX
SCALE: 1 Inch = 400 Feet
NOVEMBER 1974

CONTINENTAL COMPLEX

Mining Plan - 00041A

The Company plans to initially use the southwest portion of the area to establish the initial south dump. A haul road from the present continental east haul road will be constructed to the dump area. All available topsoil will be removed and grading and surfacing will be carried out. A ditch will be constructed with the haul road to collect surface runoff water. Topsoil from the road area and from the Initial South Dump will be placed in the area so indicated southwest of the haul road.

After topsoil removal the Initial South Dump will receive approximately 17.4 million tons of waste material (waste rock and alluvial material) from the present Berkley Pit operation. This material will be delivered to the area in the period of approximately one year. The dump will cover approximately 90 acres. The top of the dump will be flat at an elevation of 5,800 feet msl. Berms will be placed around the dump in order to control drainage and provide access for further reclamation activities. See Cross Sections E-W and N-S. The terraces will be 75 feet apart (vertically) and 20 feet wide. The sides of the dump between each berm will lie at the angle of repose, (approximately 37 to 38 degrees). Precipitation on the dump surface will be carried by ditches inside each berm to a collection point on the northwest corner of the dump. Surface water draining from up slope will be intercepted in two ways:

1. Near the dump, water will be collected by the dump drainage system. The upslope perimeter of the dump sur-

face will match the natural topographic contour.

2. Drainage from further upslope reporting to the dump area will be intercepted by a main surface water diversion ditch. Primary drainage features feeding this area consist of China and Tramway gulch. This ditch will deliver water to an existing storm drainage facility running parallel to the BN Railroad fill. The adjacent slopes moving east and north may receive further expanded use as a dump area. The future use of this area relies upon the nature and location of future mining operations.

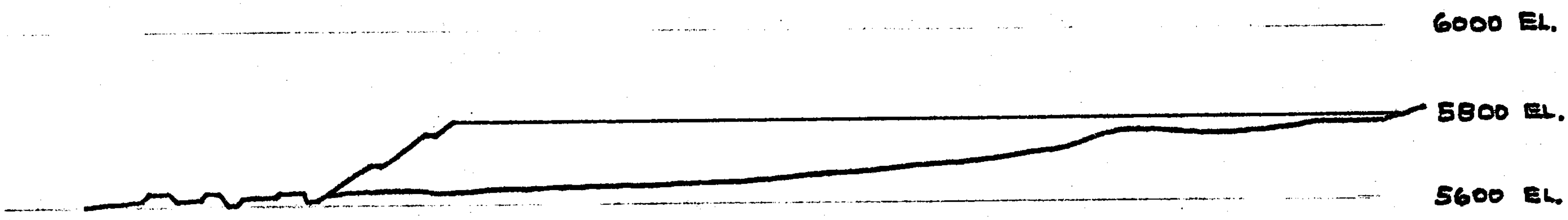
The south pit, not in this proposed permit area (previously permitted) is envisioned to contribute waste material to the above mentioned waste dump area. However, the economics of developing the south pit are as yet undetermined. The eastern edge of the south portion of the proposed permit area would logically be utilized as a topsoil storage area and waste disposal area. However, the use of this area relies upon expansion of the presently permitted east continental pit and south pit operations.

Other activities associated with the development of the initial south dump include:

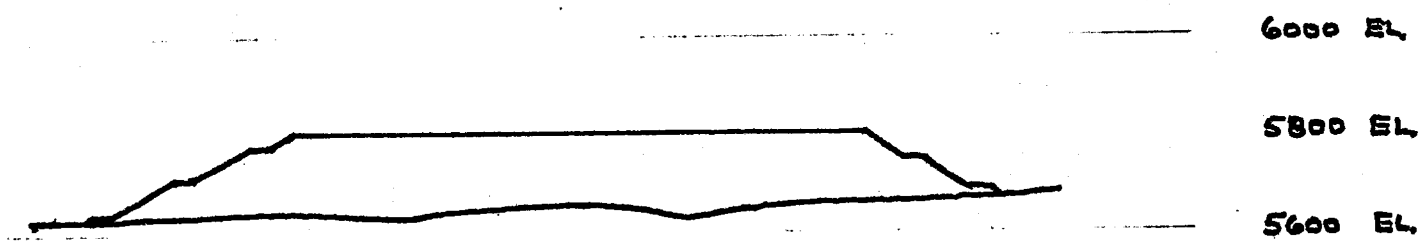
1. Rerouting the present 100 KV powerline extending NW from the bottom of the proposed permit area. This line will be rerouted around the western perimeter of the dump.

2. A small vehicle access road for maintenance of drainage system and powerline maintenance will be constructed on the western and southern borders of the initial south dump.

SOUTH DUMP CROSS SECTIONS



E-W SECTION



N-S SECTION

DECEMBER 1975
SCALE : 1" =400'

THE ANACONDA COMPANY

Reclamation Plan
Continental Complex - 0041A

Rule 5A

A-1 The current use of the Continental Complex (#00041A area) is for watershed protection, small mammal and bird habitat.

A-2 The present use of the area is watershed protection, small mammal and bird habitat. The southwest area adjacent to the proposed mining area is used for residential, commercial, industrial, utilities and transportation activities. The adjacent area to the southeast, north and east of the proposed mining area is used for watershed, minimal wildlife, and transportation activities.

The proposed use of the adjacent lands will be guided by the planning data which is available upon termination of mining activity

Upon termination of mining and associated disturbance the Company will consider offering the land for other uses.

A-3 (a) Climatological Data

The average annual rainfall as compiled by the U.S. Weather Bureau at the Butte Airport is 11.48 inches, nearly 66 percent of which falls during the spring and summer months.

A-3 (b) Stream Flow

No permanent streams are present in the proposed permit area. Runoff interception and diversion are addressed elsewhere in this plan. All wastewaters emanating from the disturbed area will be collected and treated in accordance with requirements of State Department of Health and Environmental Sciences Water Quality Bureau requirements for an MPDES discharge permit.

A-3 (c) Soils

The soils of the Continental Complex area are typical of those derived in place from igneous intrusive materials such as quartz monzonite. The depth ranges from rock outcrops to twenty feet, but averages only 2-3 feet over most of the area. Little evidence of A or B horizons remains, and only C horizons are prevalent. Sheet erosion has caused the depressions and drainage channels to become filled with the A and B horizon material, and these locations exhibit the greatest soil depth.

A-3 (d) Wildlife

There are no concentrations of big game animals in the vicinity of the proposed Continental Complex. However, some animals may cross Interstate 15 and visit the area on isolated occasions. The area of the mining development does, however, support resident populations of small mammals and birds. (See the cross sections for initial topography of the area, configuration of the proposed disturbances, adjacent topographic features, and final configuration of the Initial South Waste Dump.)

B. The proposed topography of the reclaimed land is shown on overlay C.C. # 2 of the Continental Complex and accompanying cross-sections. Waste material from the Butte Complex operations will be hauled to the Initial South waste dump and deposited in 75' vertical lifts to a top elevation of 5800' with benched terraces 20' wide. Waste dump slopes will lie at the natural angle of repose (approximately 38^{o}). The east end of the waste dump will blend topographically with the existing contours. All dump slopes and lifts are designed for maximum stability based on the Continental East Dump area experience. Drainage is provided as shown for (1) perimeter interceptor ditches; (2) terrace bench ditching, and (3) drainage of surface waters that are not naturally directed to the base of the dump area. Rock lined, ditches are to be used for channelways, however closed conduit or concrete chutes may be used as necessary if engineering dictates.

All available soils materials shall be salvaged and stockpiled as shown on the overlay.

C. Since the quantity of topsoil is limited in the permit area, it is anticipated that a floral support medium may have to be synthesized for portions of the disturbed areas. Available topsoil will be stockpiled for veneering of dump surfaces or replacement on pit excavations. Dump slopes will be veneered with alluvium or overburden from the Continental Complex and will be conditioned as necessary to provide a growing horizon. Selection of grasses, shrubs and trees for establishment on synthetic veneers will be compatible with recommendations of the USFS under an agreement through the auspices of SEAM. Topsoil will also be utilized for establishment of tree and shrub parks.

Prior to re-spreading of topsoil, alluvium or overburden capable of supporting plants on leach dump top surfaces or slopes, limestone will be applied as dictated by the Barium Chloride Triethynolamine (Handbook of Soil Analysis.) method as a barrier against acid percolation into the "A" horizon.

Irrigation is planned only during the period of plant community establishment and will not be perpetuated beyond the initial growing season.

D. (1) The Company will provide for the construction of earth dams or other devices to control water drainage. The construction of such impoundments will not interfere with other landowners' rights or contribute to water pollution (as defined in the Montana Water Pollution Control Act as amended).

(2) All water, tailings or spoil impounding structures will be equipped with spillways or other devices that will protect against washouts during a one-in-a-hundred-year flood.

(3) All applicable county, state and federal laws regarding solid waste disposal will be complied with. All refuse shall be disposed of in a manner which will prevent water pollution or deleterious effects upon the revegetation efforts.

(4) Upon abandonment, water from the mining activities will be diverted or treated in a manner designed to control siltation, erosion or other water pollution damage to streams and natural water courses.

(5) All access, haul and other support roads will be located, constructed and maintained in such a manner as to control and minimize channeling and other erosion.

(6) All operations will be conducted so as to avoid range and forest fires and spontaneous combustion.

(7) Archaeological and historical values in the area to be disturbed will be given appropriate protection.

(8) Provisions will be made to avoid accumulation of stagnant water in the disturbed area which may serve as a breeding ground for noxious insect life.

(9) All final grading will be made with non-noxious, non-flammable, noncombustible solids unless approval has been granted by the Board for a supervised sanitary fill.

(10) Proper precautions will be taken to assure that exposed cuts and fills, tailings or spoil disposal areas do not become a public nuisance due to wind erosion or the air-borne detritus becomes a detriment to the flora and fauna of the area.

E. No solid wastes other than overburden will result from this development. Treatment of waste dumps is addressed under B above. Tailings from ore processing shall be disposed of via the existing system in the Butte Complex.

F. (See overlay C.C. # 2) To prevent contamination of surface runoff resulting from precipitation on the watershed above the permit area, an interceptor system, sized to a computed one-in-a-hundred-year flood, will be constructed to connect with an existing storm drainageway.

G. No permanent streams exist in the proposed permit area.

H. (See the Map and Overlay #2) The outline of intended revegetation areas is the outline of the disturbed areas. The Company is currently experimenting in cooperation with the USFS (SEAM) on revegetation techniques under given conditions and results of this work will be coordinated with the Department to achieve an effective reclamation program.

I. Reclamation will be concurrent with development or mining operations and shall be completed within two years or a reasonable length of time as provided by the Board after completion or abandonment of mining. Revegetation shall be accomplished in the first appropriate season after necessary preparation in accordance with accepted agricultural or reforestation practices.

J. There is no open pit mining planned in this proposed permit area.

Chapter 12, Title 50, R.C.M. 1947

1. The map outlines the specific area to be disturbed and the boundaries of the land which will be disturbed; topographic detail, the location and names of all drainages, roads (trails), railroads, and utility lines on or immediately adjacent to the area; location of proposed roads and haulageways to be built and the ownership of all lands to the extent known to the Comapny.

2. The primary access road and haul road is a single road leading from the Montgomery Street crossing to the initial South Dump and will continually be used for dumping. An access road will also be located along the outside of the waste dump and used for maintenance of the power line. Both roads will be graded to approximate contours of the waste dump as it is reclaimed. The roads will be graded and seeded upon abandonment.

The following is a listing of plant species to be utilized for revegetation of the Initial South Dump area:

SPECIES IN STOCK			Lbs./acre
1) Grasses	1)	NORDAN CRESTED WHEATGRASS	5
	2)	TALL WHEATGRASS	4
	3)	CREEPING RED FESCUE	5
	4)	TALL FESCUE	4
	5)	FALL RYEGRASS	6
	6)	TIMOTHY	3
	7)	CLOVER	3
			30#/A
2) Shrubs			
	1)	THIN-LEAVED ALDER	Alnus incana
	2)	SAGE, BIG	Artemesia tridentata
	3)	PURPLE VIRGINS BOWER	Clematis columbiana
	4)	RED-OSIER DOGWOOD	Cornus stolonifera
	5)	CHOKE CHERRY	Prunus virginiana
	6)	SKUNK SUMAC	Rhus trilobata
	7)	WOODS ROSE	Rosa woodsii
	8)	SNOW BERRY	Symphoricarpos alba
3) Trees			
	1)	ROCKY MTN. JUNIPER	Juniperus scopularum
	2)	SCOTCH PINE (Limited quant.)	(Quaker asp cuttings)
	3)	MTN. HEMLOCK	Tsuga mertensiana
	4)	QUAKEN ASP (Sprigs & Cuttings)	
	5)	DOUGLAS FIR	Pseudotsuga menziesii var glauca
	6)	ENGLEMAN SPRUCE	Picea englemannii
	7)	PONDEROSA PINE	Pinus ponderosa

Special S.E.A.M. (containerized)

1) WOODS ROSE
2) WINTERFAT
3) GREASEWOOD
4) MTN. MAHOGANY
5) RUBBER RABBITBRUSH
6) CLIFFROSE

APPROVED BY:

____

Ted Schwinden, Commissioner
Department of State Lands

December 22, 1975
DATE

GEOLOGY

One of the major tectonic features of southwestern Montana is the Boulder Batholith of Upper Cretaceous age. Butte is situated in the southwestern corner of this pluton, where much of the hydrothermal ore deposition associated with its emplacement occurred.

The Boulder Batholith is a composite feature whose several intrusives were emplaced in stages. The primary rock type is the Butte Quartz Monzonite, flanked to the north and south (in the general areas of Helena and Twin Bridges) by earlier granodiorite and, in the north, mafic intrusives. A second, younger stage of quartz monzonite intrusion is represented by irregular bodies in the extreme north and extreme south of the batholith. Late-magmatic alaskite-aplite bodies are found in all major intrusives, but are primarily associated with the Butte Quartz Monzonite.

The center of Anaconda's mining activity in the Butte District is divided in two by the Continental Fault, a major structural feature which runs north-south through Butte and gradually curves to the southeast south of the city. Anaconda's mining operations have historically been centered west of the fault in an area of highly fractured, faulted, and mineralized quartz monzonite.

Primary ore deposition in this area occurred in two stages, called Main Stage and pre-Main Stage. The latter occurred at deep levels in an area centered near the Anaconda shafts and is characterized primarily by quartz-molybdenite veinlets. Chalcopyrite and pyrite are also present along with a variety of non-metallic minerals. Veinlets rarely persist for more than a few feet and tend to have random dips and strikes.

Main Stage mineralization, which began later than but does overlap the pre-Main Stage, represents the bulk of primary ore masses. It appears that the structural grain of the district was established prior to the Main Stage, and Sales (1913) divided the ore-bearing veins into two units based on orientation and age. The first of these - called the Anaconda System - comprises east-west striking features of which five principal veins, along with a number of smaller veins, have been extensively mined. The second system - the Blue Veins - are predominantly oriented NW-SE and consistently displace the Anaconda System with left-lateral offset. Displacement appears most intense near the center of the mining district, becoming less apparent towards peripheral areas. Oreshoots on the Blue Veins are about 5-20 feet wide and 1000 to 2400 feet long. Although not as productive as veins of the Anaconda System, much ore has been removed from Blue Veins. A third, less important set of veins and faults is the Steward System, which shows a northeast strike.

Reno Sales (1913) divided mineralization into three roughly concentric zones: (1) a central zone "occupying an area of altered granite in which the ores are characteristically free from sphalerite and manganese minerals"; (2) an intermediate zone "in which the ores are predominantly copper but are seldom free from sphalerite; and (3) a peripheral zone "in which copper has not been found in commercial quantities." These three zones are actually situated along an axis of symmetry striking about N60W and extending from somewhere in the vicinity of the Pittsmont Shaft to the Mountain Con Shaft (Meyer et al, 1968). Copper minerals in the central and intermediate zones include bornite, covellite, enargite, chalcocite, and chalcopyrite. The last increases outward towards the edge of the intermediate zone. The peripheral zone has been mined for manganese (rhodochrosite), silver (native), and zinc (sphalerite).

A supergene enrichment blanket overlies the hypogene mineralization from the area of the Berkley Pit eastward past the Continental Fault. This blanket is the result of strong attack by sulfuric acid generated by oxidation of pyrite. The dominant supergene mineral is chalcocite with some covellite located mainly near the bottom of the oxidation zone. The thickness of the blanket varies considerably due to vein and fault control of solution flow but, in general, oxidation terminates at depths of between 200 and 300 feet.

Continental Areas

The main host rock east of the Continental Fault is Butte Quartz monzonite, with lesser amounts of aplite-granoaplite as dikes and sills, and quartz porphyry dikes. Pre-Main Stage, Main Stage, and supergene mineralization are found east of the Continental Fault. Vertical displacement along the latter is greater than 1500 and possibly greater than 4000 feet (Ratcliff, 1973), as a result of which the core of molybdenum mineralization projects above the present ground surface some 1500 feet east of the Continental Fault (Figure 2). Molybdenum mineralization is primarily as molybdenite in quartz veins. The veins are generally less than an inch in thickness, averaging about 1/4 inch.

The molybdenite zone is, in the main, bounded on the east by the Klepper Fault (Figure 2). Displacement along this fault is primarily vertical, but also has a left-lateral horizontal component of about 1500 feet.

The Chalcocite enrichment blanket is much thinner in the Continental area than in the area west of the Continental Fault except for the zone immediately under the footwall. Movement along the fault has elevated the blanket as much as 500 feet. Enrichment occurred in two stages: replacement of chalcopyrite by chalcocite-covellite and coating of pyrite grains. There has been some remobilization and partial leaching of the higher sections of the blanket with copper removed to lower sections.

That portion of the enrichment blanket in the Continental area is contiguous with the blanket west of the Continental Fault, but the Klepper Fault forms a discontinuity between blanket portions in the Continental and East Continental areas (Figure 3).

The zone of oxidation overlying the enrichment blanket is typified by the following oxide minerals: malachite, tenorite-melaconite, chrysocolla, medmontite, kurzite, and lesser amounts of cuprite, turquoise, and native copper. Important reserves in the oxidation zone average about 35 to 50 feet in thickness.

Hypogene copper mineralization comprises primarily Main Stage disseminated chalcopyrite, with minor occurrences of bornite localized mostly adjacent to the Continental Fault. Some vein chalcopyrite is found. Copper grade drops significantly in the aplite-granoaplite dikes. The highest grade of hypogene copper is in the northern part of the Continental Area, with decrease in grade both laterally and vertically (figures 2 and 3).

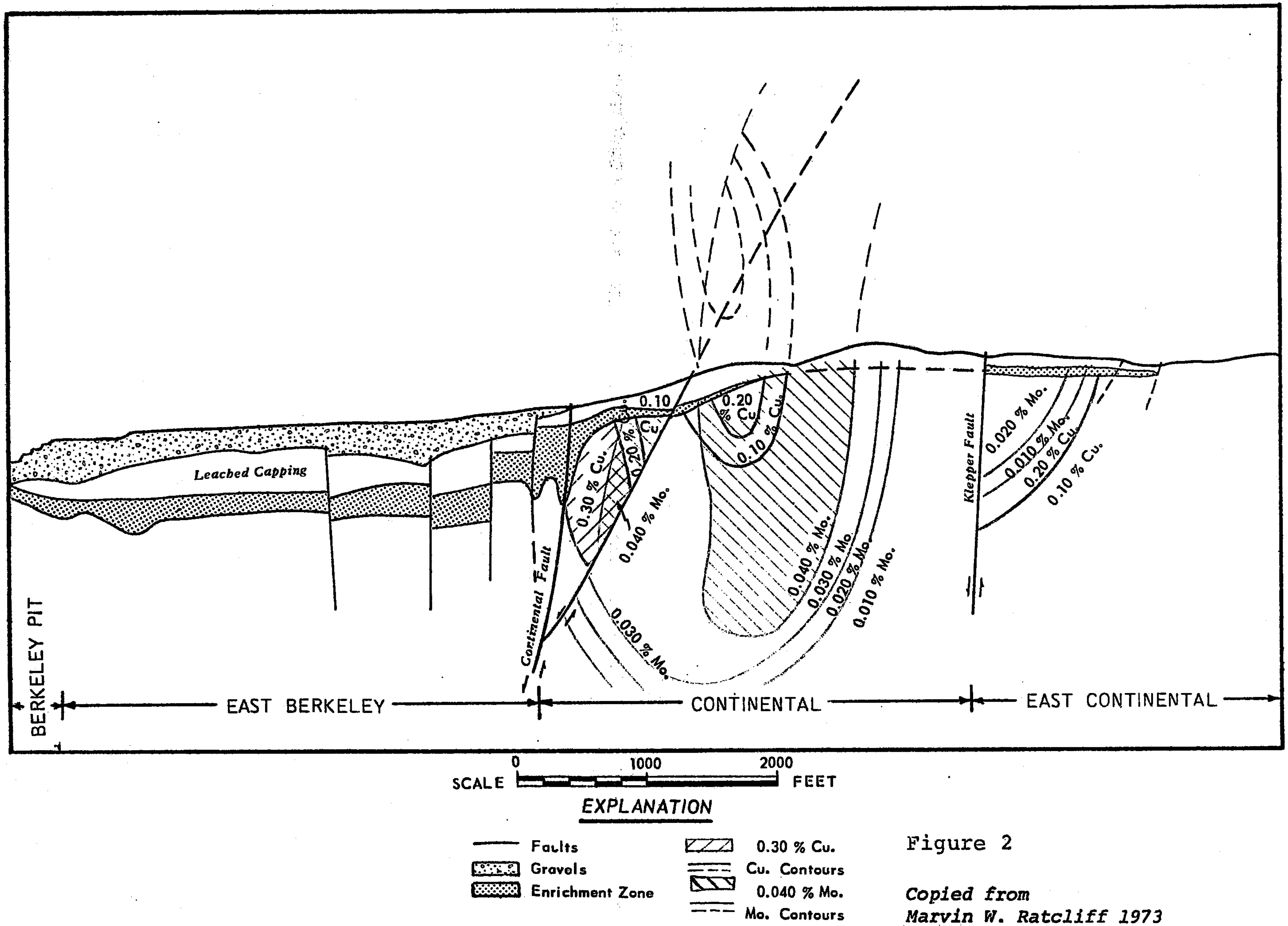


Figure 2

Copied from
Marvin W. Ratcliff 1973

E–W Cross Section through East End of the district looking North.

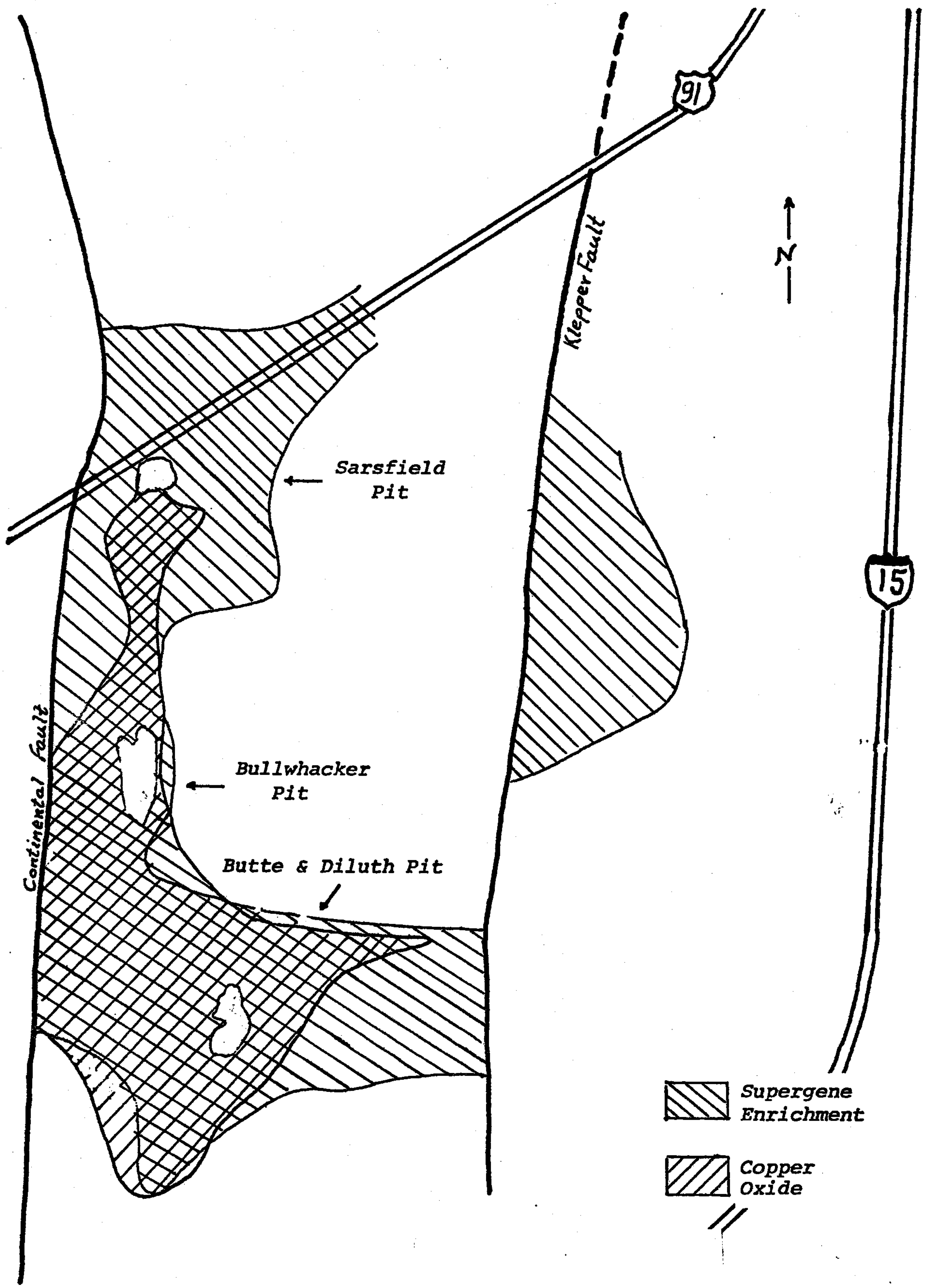


Figure 3
Distribution of Copper Ore Concentrations
East of the Continental Fault
Copied from Marvin W. Ratcliff 1973

SOILS

The Soil Conservation Service prepared a survey of the soils found in the area of the proposed operation. This survey is general in nature and requires on site inspection of any specific area proposed for any type of management. The soil survey is primarily for use by urban planning activities. There is no range site data included which would correlate these soils to specific vegetation. Figure 4 is copied from the larger Soil Conservation Service (SCS) map. The soil types found in the proposed area of operation are indexed by number to a description of various characteristics useful in land use planning. See Table 1.

Of greatest concern in mining activities is the disturbance of the soil profile. Such disturbance destroys the delicate chemical and biological relationships established through centuries of weathering, deposition, and plant-soil interaction. These soils demonstrate an acid character resulting from the pyrite associated with the parent material in the area. However, there are all degrees of acidic circumstances involved in the Butte mining area. The ore body and overburden east of the Continental fault are known to contain less pyrite and hence pose less problems in that area. The topsoil in the drainage bottoms is often deep and of good quality. However, there is not a sufficient supply available to cover large areas of mining disturbance. If mining or piling of materials is done in the area of proposed operation, it is absolutely essential that every possible bit of topsoil be salvaged and stockpiled. Carrying out a program of topsoil salvage requires observation and mapping, and chemical analysis. The information needed is more detailed than that found in the presently existing soil survey.[2]

The Company has submitted the following soils information:

> Soil characteristics of the Continental Complex are considered poor. Normal "A" and "B" horizons are found only over about 40 percent of the area, with the "A" horizon varying in depth from 0" - 16". Site conditions are highly variable, brought about by differences in slope aspect, snow collection, soil texture, depth and fertility. The soil is generally a sandy loam with coarse material scattered throughout. These soils are derived from metamorphic rock or deposited by alluvial accumulation in drainages. Soil pH ranges from slightly to extremely acidic. These conditions support a few bunchgrasses (primarily slender wheatgrass) interspersed with trees and shrubs (wood rose and sage). Where moisture retention is sufficient (drainages) a few quaken aspen are found. The north slope of Woodville Gulch supports a coniferous cover.

Figure 4
Soil Survey of Proposed Mining Area
Copied from
Soil Survey and Interpretations for Resource Planning
and
Urban Development in the Area of Butte, Montana
Soil Conservation Service

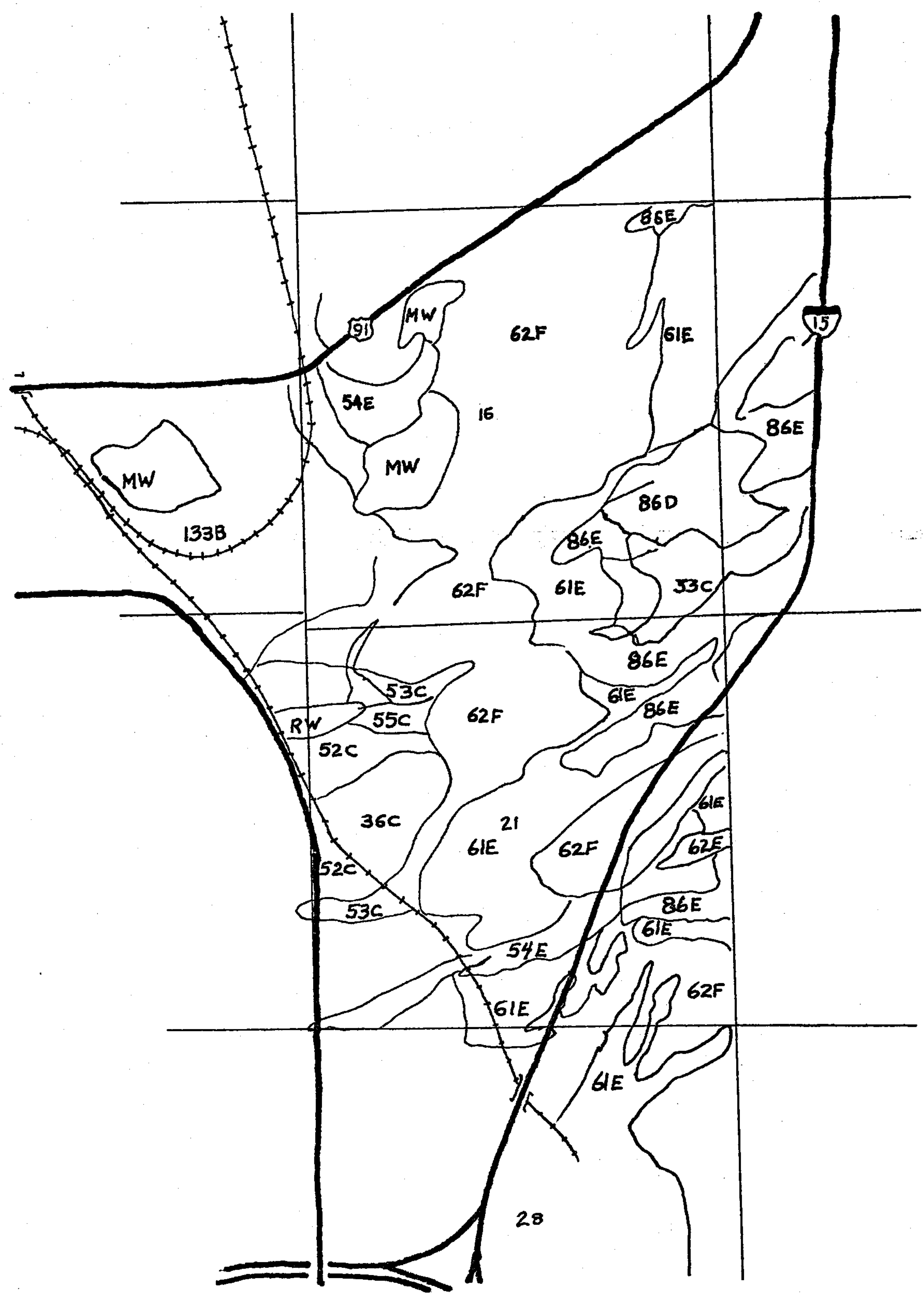


TABLE 1 ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES

MAPPING UNITS			Corrosivity			Suitability as a source of:		
Symbol	NAME	Septic Tank Filter Fields	Concrete	Steel	Lawns and Landscaping	Sanitary Land Fill	Topsoil	Road Fill (Sub-grade)
36C	Philipsburg loam	Moderate 3,6d	Low	Low	Slight	Slight	Fair 7	Fair to Good
52C	Basin Cr. Gravelly loam	Severe 11	Moderate 10	Low	Moderate 13	Slight	Fair 7	Good
153B	Kanspur coarse loamy sand overwash	Moderate 3	Low	Low	Slight	Slight	Poor	Fair 8
54E	Kanspur stony loam	Severe 3	Low	Low	Severe 3,4,12	Severe 3	Poor 12	Poor to Good
55C	Lucky loam	Severe 5	Low	Low	Moderate 5	Severe 5	Fair 7	Good
*61E	Carbol & Lucky soils	Severe 3	Moderate 10	Low	Severe 3,4,5	Severe 3,5	Fair 7	Good
*62E	Rock outcrop-Carbol complex	Severe 3,5	Moderate 10	Low	Severe 3,4,5	Severe 3,4,5	Fair 7	Good
*62F	Rock outcrop-Carbol complex	Severe 3,5	Moderate 10	Low	Severe 3,4,5	Severe 3,4,5	Fair 7	Good
86D	Wood rock stony complex	Severe 3	Moderate 10	Low	Severe 3	Severe 3	Fair 7	Good
86E	Wood rock stony complex	Severe 3	Moderate 10	Low	Severe 3	Severe 3	Fair 7	Good
MW	Mine & Smelter waste	Severe 3,12	High 10	High 10	Severe 4,7, 10,12	Moderate 4, 12	Poor 7,10,12	Fair to Good
RW	Riverwash	Severe 1,11	High 10	High 2,10	Severe 1,7, 10,12	Severe 1,11	Poor 7,12	Fair to Good

NOTE:
On site investigations are needed for specific design and construction.

LIMITING SOIL PROPERTIES AND HAZARDS INDICATED BY NUMBER IN TABLE 1

1. Frequency of flooding or surface ponding
2. Seasonal ground water table within 3 feet
3. Slope gradient -
4. Relief
5. Depth to bedrock
6. Permeability rate:
   a. Less than 0.06 inches per hour
7. Surface layer less than 6 inches thick
8. High organic matter content
9. Frost action potential
10. Soil acidity (pH) and toxic salts
11. Ground water pollution
12. Coarse fragments (gravel,cobble or stones)
13. Depth to loose sand or sand and gravel

Taken from Soil Survey and Interpretations for Resource Planning & Urban Development, SCS

VEGETATION

The vegetation in this area to our knowledge has not been surveyed. However, the history of the area in terms of land use, other data from surrounding areas and cursory observations can offer some description.

The Company in recent correspondence with the Department submitted the following information[3]:

> Soil pH ranges from slightly to extremely acidic. These conditions support a few bunch grasses (primarily slender wheatgrass) interspersed with trees and shrubs (wood rose and sage). Where moisture retention is sufficient (drainages) a few quaking aspen are found. The north slope of Woodville Gulch supports a coniferous cover. Other species in the area include red-osier dogwood, caragana, yellow sweet clover, snowberry and Idaho fescue.

The proposed permit area ranges in elevation from 5590 feet to 6500 feet m.s.l. Such a range in elevation extends from the valley bottom to a point on steeper slopes of western exposure. Though the elevational differences are only 910 feet, the differences in slope gradient will offer differing types of vegetation habitat. The more prominent drainage features on this slope accomodate moist alluvial sites with variations in north and south exposures.

At the present time there is only one stand of conifers on the north facing slope of Woodville Gulch. Large areas of this slope contain dense stands of quaking aspen in an area midway to the head of the gulch. Other small stands composed primarily of aspen are found randomly scattered in the gulches. There are stands of willow found in moist gulch bottoms.

Grassland species and sagebrush are more dominant in the lower, more level areas at the base of the slopes. The past use of this area as a vegetation resource is not well know. It is probable that early settlers removed timber to build homes, and for use as fuel. Mining and railroad construction required large amounts of timber for ties and mine timbers.

Large amounts of timber were also used in the early smelting operations. Such operations, according to historical accounts created episodes of intense air pollution, killing both people and vegetation[3]. This early smelting method and later sources of air pollution will have had a significant effect on the vegetation in the immediate area of the Butte and Anaconda communities.

The lack of long term quantative observation concerning the use and changing status of the vegetation make it very difficult to evaluate the present vegetative communities with accuracy.

The determination of vegetative habitat types is a standard land management practice in the Deerlodge National Forest. The definition used for "Habitat Type" in the performance of this work is as follows:

Habitat Type - A collective term for those areas that support or can support the same plant association or did support it prior to its destruction or modification by fire, flood, grazing, logging, epidemics, etc. It is the physical environment of a particular association. A taxonomic unit and a mapping unit.

Examination of Figure 5 Vegetative Habitat Types, and accompanying glossary, will illustrate the relationship of these types in the area.[4]

Glossary of Scientific Names

Tree Species:

(DF)	Douglas-fir	Pseudotsuga menziesii
(AF)	Subalpine fir	Abies lasiocarpa

Shrub Species:

(LIPO)	Twinflower	Linnaea borealis
(VASC)	Grouse whortle-berry	Vaccinium scoparium
(JUCO)	Common juniper	Juniperus communis

Grass and Grass-like Species:

(FEID)	Idaho fescue	Festuca idahoensis
(CARU)	Pinegrass	Calamagrostis rubescens

For a more detailed description of these vegetative types see Appendix A.

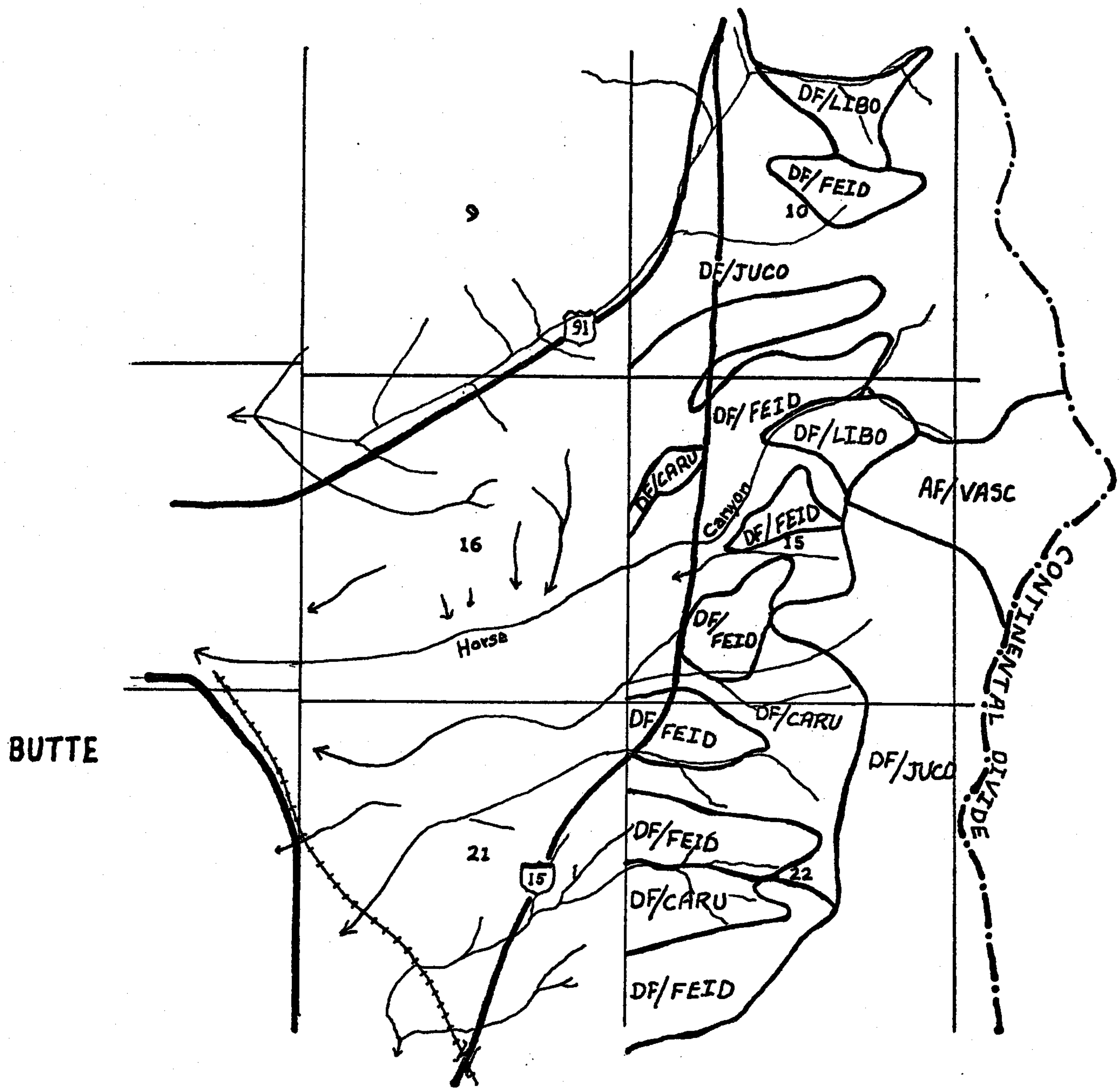


Figure 5

Vegetative Habitat Types
from
Map prepared by R. M. Siemens
Butte District
Deerlodge National Forest

The deliniation of habitat types goes only to the eastern edge of sections 9, 16 and 21. This is the study boundary for the Butte Ranger District. Correspondence to the Department from the Butte Ranger District indicates that it may be safely assumed that these habitat types extend westward beyond the section line.[5]

The simplified map illustrates the change of types relative to north or south exposure in the prominant drainage features and a transition with elevation. As indicated in the above definition, these types reflect potential vegetation. The area in question does not offer great similarity on the ground to the ecological concept on the map.

It is generally believed that due to several decades of fire suppression and reduction in air pollution, that the vegetation in this area is moving in a direction toward regeneration. However, there are numerous impacts in this area aside from the past mining disturbances which remain. Vehicles travel throughout the area, topsoil has been removed from drainage bottoms. Dumps have been established for local use. A number of homes and businesses still exist in the area causing varying degrees of disturbance. A more detailed description of the habitat types found in this area may be found in Appendix A.

HYDROLOGY

The proposed area of permitted disturbance lies generally upon a west facing slope immediately east of the city of Butte. This slope is dissected by four drainages; Woodville Gulch, Horse Canyon, China Gulch and Tramway Gulch. The only drainage containing a perennial stream is Horse Canyon (Horse Creek). Woodville Gulch contains a small stream the discharge from which often does not reach the lower elevations in the form of surface water. The alluvial deposits common to the lower Butte valley bottom extend upward into these drainages. In China Gulch and Tramway Gulch, where surface flow is intermittent, the bottom land soils support a vegetation type which indicates the presence of subsurface water. The Horse Creek area has already been disturbed by previously permitted mining activity.

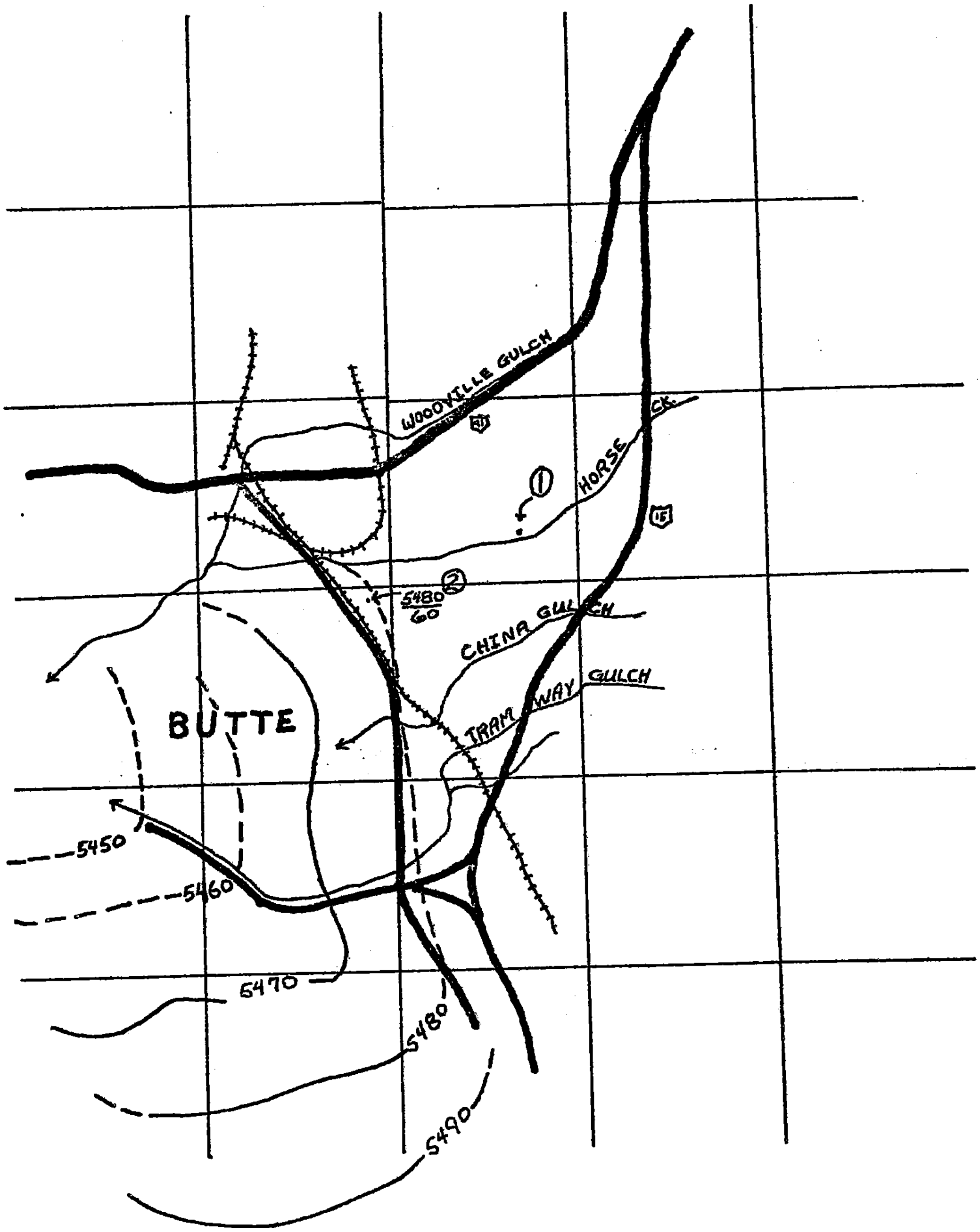
Those areas of steeper topography at higher elevations with less alluvium exhibit outcrops primarily composed of quartz monzonite. The extensive faulting in the area, particularly the Continental and Klepper faults, has resulted in fracturing throughout the granitic strata. Such fracturing has accomodated the movement of water in some areas and confined it in other areas. Underground mining operations have intercepted water sources ranging from continuous to isolated pockets. Such fractures in the structure unerlying the proposed area of disturbance probably provide a continuous recharge of water which passes through the drainage bottom alluvial deposits. The Continental and Klepper fault zones exhibit various ranges of permeability, thereby affecting the subsurface flow patterns and depths of groundwater moving down this slope below the alluvium. For location of these faults refer to Figure 6. The above information was obtained primarily from Montana Bureau of Mines and Geology Bulletin 75.[6]

The following information has been submitted to the Department by the Anaconda Company concerning hydrology and water quality.

> Patterns of mineralization in this zone are characteristic of an environment with low total sulphides. Structure in the area is dominated by strong, north-south trending, steep, normal faults, while veins generally have an east-west trend.
>
> Due to irregular fractures in these fault zones, aquifers are scattered and subsurface water is unevenly distributed throughout the entire area. Recharge rate of the Continental-East operation is approximately 40-50 gpm.

Figure 6

Sampling Points and Generalized Contours of the Water Table in the Proposed Mining Area



Water Table Contour - ~~~5490 - - -

Horse Canyon Ck. Water Qual. Sample - ①

Well Sampling Point - ②

$\frac{5480}{60}$ = $\frac{\text{Elevation of Water Table}}{\text{Depth from Surface}}$

Copied from Plate 2

Montana Bureau of Mines and Geology. Bulletin 75

In conjunction with exploration drilling in a portion of the Continental-South area, drill holes were cased and pumping tests were conducted. The area influenced by the pumping was approximately 18 acres and a sustained yield of about 200 gpm of water was produced by the well field. The exact area of this aquifer to be disturbed at any one time is presently unknown and any attempt at this time to predict ultimate recharge of ground water to any open pit mine in this area is subject to considerable speculation. The following is a summary of analyses of drill hole water collected during the exploration period February - October, 1974.:

	mg/l			
Date	pH	Fe	Cu	Zn
2/24-26/74				
Average	-	.32	3.92	1.24
Range	-	.05-.95	1.6-6.5	.93-1.55
4/1/74				
Average	-	.05	15.1	1.74
Range	5.2-8.09	-	.11-62.0	.05-5.2

	mg/l		
Date	Tot SO_4	Total Hardness @ $CaCO_3$	Special Condition (u mhos/cm)
2/24-26/74			
Average	-	-	-
Range	-	-	-
4/1/74			
Average	277	270	595
Range	226-337	140-380	510-688

WATER QUALITY

The proposed placement of a waste dump in the South Continental area will require water management facilities to both divert waters from higher elevations and to catch water leaching from within, or running off of, the dump. Water eminating from the dump will require treatment similar to other drainage collected from other dumps composed of mine wastes from the Berkley Pit operation. Furthermore, any future mining of the blanket deposit immediately north of the proposed dump will require expansion of water management facilities in this area. The following analysis by Casney and Botz completed in July of 1975 is the most recent description of water quality problems associated with this proposed and other related current and past operations in the Silver Bow Creek drainage. The section concerning Silver Bow Creek describes the nature and effectiveness of water treatment efforts made by the Anaconda Company and the chemical-biological nature of the streams receiving waste from the industrial operation as well as from the local communities.[7]

Silver Bow Creek

Silver Bow Creek (Figure 7) has had pollution problems since placer mining first commenced in Butte in the 1860's. Start of the Anaconda smelter in 1883 added to the problems (Weisel, 1972). Municipal discharges from the cities of Butte and Anaconda were disposed of into Silver Bow Creek. Over the years, the Anaconda Company has invested several million dollars to treat their mining and smelting waste discharges. The Butte operation presently is developing a zero discharge system with complete recycle of process water. Prior to the fall of 1972, the Butte operations' treatment system consisted of a tailings pond used to settle out solid waste material and lime feeders to adjust pH, thus causing chemical precipitation of most dissolved metals. Approximately 25 mgd (million gallons per day) of water were discharged to Silver Bow Creek from the operation. Additional treatment occurred in the Warm Springs pond system where lime additions precipitated additional metals. Approximately 25 mgd also were discharged from the Anaconda smelter at Anaconda. The smelter discharge received initial treatment in the Opportunity ponds where evaporation, seepage and some settling occurred (Figure 8). The discharge was then decanted to the Warm Springs treatment ponds where lime was added to precipitate metals. The flow diagram for the Anaconda Smelter and reduction works is shown in Figure 8. On September 29, 1972, the Butte operation of the Anaconda Company completed installation of a new water pollution control system based on recycle of process water (Higgins, 1974). The process water is treated in the tailings ponds, decanted and recycled through the concentrator as shown in Figure 9. Underground mine water is used as makeup water in the system along with some fresh water. Approximately 4-1/2 mgd of fresh water are used for gland seal on pumps, fire control and sanitary facilities. Between four and six million gallons per day of process water are discharged to Silver Bow Creek along with approximately 0.01 mgd from the Continental East Pit operation. Additional emergency pond capacity has been constructed to facilitate any spills which may occur in the operation. Butte Metro's sewage treatment plant discharges six to ten mgd of treated sewage to Silver Bow Creek. Weekly, they dump sludge into the stream. Sludge dumping will be discontinued as soon as an alternate disposal method has been developed. Storm drains in Butte also add significant amounts of metals to Silver Bow Creek. A survey of storm sewers conducted by the Water Quality Bureau in cooperation with the Anaconda Company during 1974 - 75 showed storm drains and collection ditches contribute the majority of the iron, copper and zinc entering Silver Bow Creek in Butte (Table 2). A drain ditch from the Colorado tailings contributes a large metals load to Silver Bow Creek. Apparently, groundwater is continually leaching from these old mill tailings.

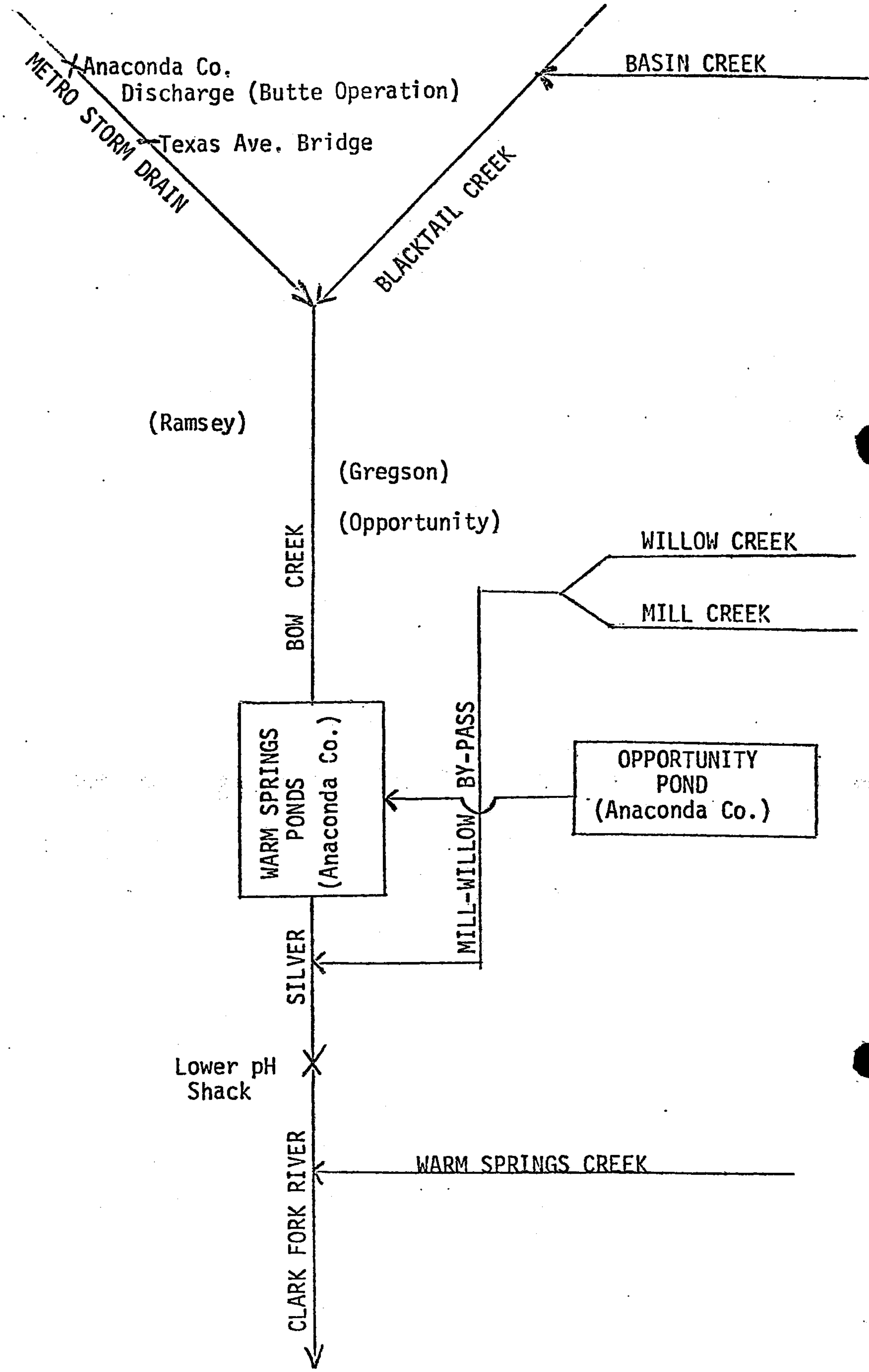


FIGURE 7. SCHEMATIC OF SILVER BOW CREEK DRAINAGE

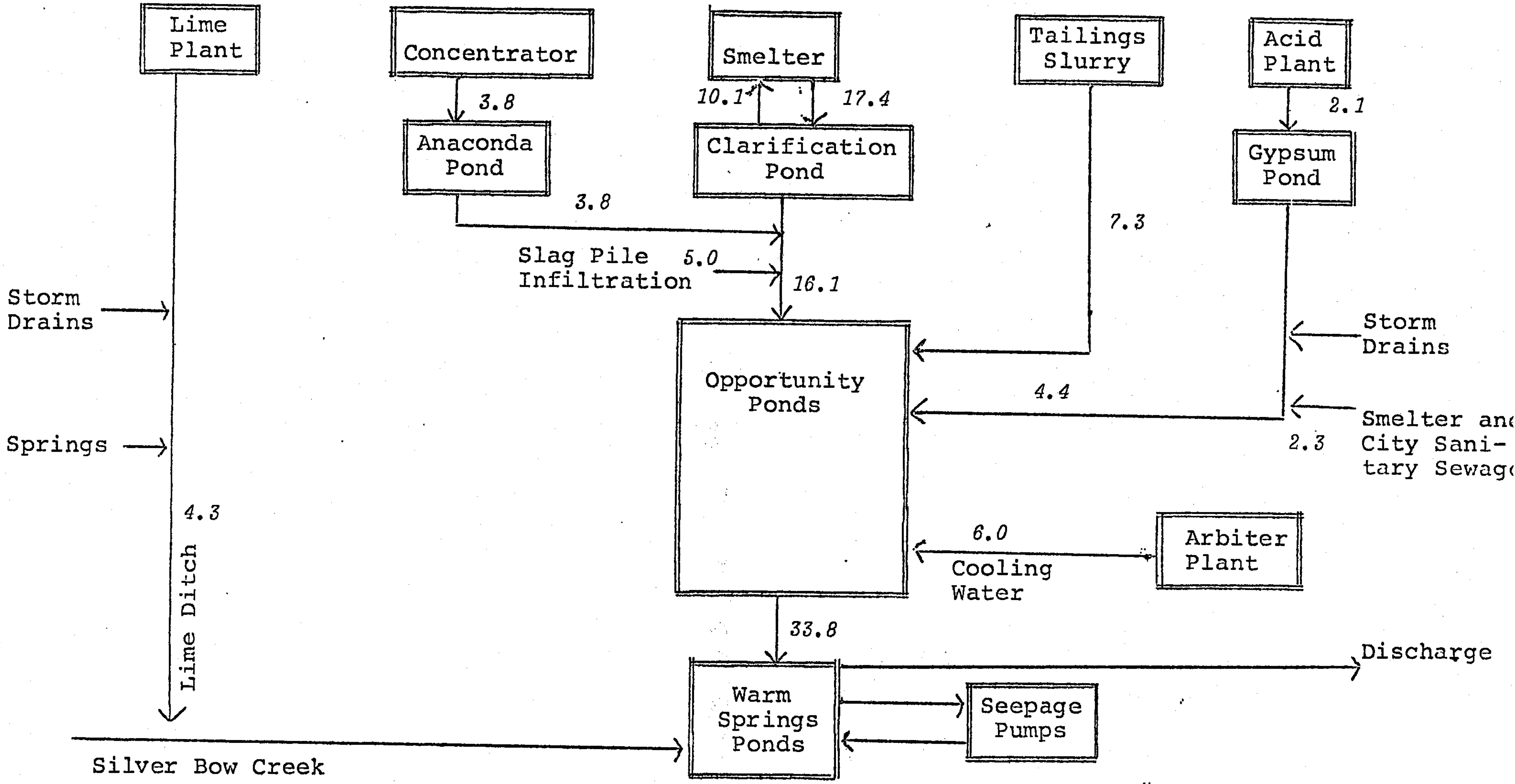


FIGURE 8 . ANACONDA REDUCTION WORKS TREATMENT SYSTEM
(flows expressed in million gallons per day)

EFFECTIVE JUNE 1975 *(Anaconda Company Information)*

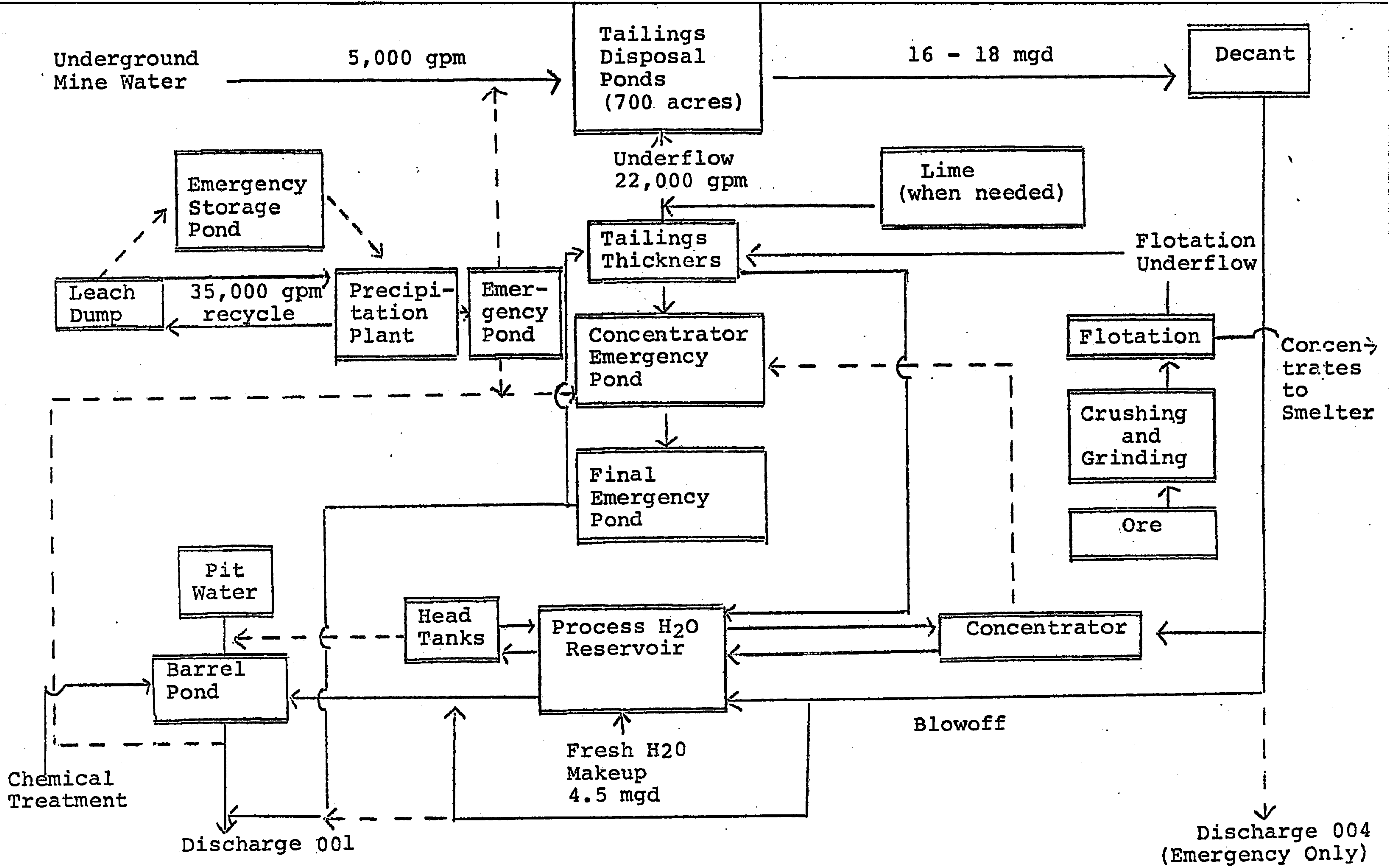


FIGURE 9. BUTTE OPERATION WASTE TREATMENT SYSTEM
(Anaconda Company Information)

TABLE 2. BUTTE AREA SOURCE CONTRIBUTORS TO METAL LOAD IN SILVER BOW CREEK - 1974

Source	Fe	Cu	Zn	Mn	Cd	Pb	As
	(pounds per year total metals)						
ANACONDA COMPANY							
[1]Butte Operations	8700	4900	7100	NM[5]	3700	1000	900
[2]Continental East	100	100	100	NM	INS[6]	INS	INS
TOTAL	8800	5000	7200	NM	3700	1000	900
[3]Butte METRO STP	10,300	1300	4900	2800	INS	900	NM
[4]Storm Sewers	54,600	7500	31,600	9200	100	700	600
TOTAL	73,700	13,800	43,700	12,000	3800	2600	1500

1. Anaconda Company data.
2. Assuming full year operation, although discharge began in mid-year 1974 - Anaconda Company data.
3. Water Quality Bureau data collected March 12, 1975.
4. Total recoverable metals.
5. NM = not measured
6. INS = insignificant

The present condition of Silver Bow Creek has been described by Weisel (1972) as a "biological desert." Recent biological studies by the Environmental Protection Agency (Fox, 1972) and Montana College of Mineral Science and Technology (Gless, 1973) has shown the stream to be almost void of invertebrates from Butte to the Warm Springs ponds. This is primarily due to metal loads and the lack of a substrate suitable for aquatic organisms. Silver Bow Creek tributaries also were investigated by Fox and Gless. Blacktail Creek and Basin Creek form the headwaters of Silver Bow Creek. Benthic samples of Blacktail Creek collected by Gless showed the diversity index to gradually decrease downstream but to remain good overall. The decrease is thought to be due to a decreased stream gradient in the metropolitan area of Butte (Gless, 1973). Channelization in the lower reaches of the stream also may influence diversity. The chemical condition of the stream is good. Total coliform counts were well within water quality standards for a $B\text{-}D_1$ stream. Basin Creek showed a low diversity index of less than two near the confluence with Blacktail Creek. Basin Creek has been found to have extremely high total and fecal coliform counts near the confluence with Blacktail Creek (Gless, 1973).

These coliform counts are above acceptable levels for a $B\text{-}D_1$ stream.

The stream in Horse Canyon, although presently not classified by current Montana water quality standards, is a small stream originating in the Columbia Gardens area and reaching the Metro storm drain (Silver Bow channel) near the Butte concentrator. Fecal and total coliform counts in the stream below Columbia Gardens were above acceptable $B\text{-}D_1$ levels when tested in 1972. Anaconda Company began discharging mining wastewater into the creek during the late summer of 1974. (The influence of the discharge on stream quality has not been evaluated.) Browns Gulch and German Gulch, both tributaries of Silver Bow Creek, contain diverse populations of invertebrates with many pollution sensitive organisms. German Gulch exemplifies a good trout stream with an ideal substrate and a high diversity index of greater than four (Fox, 1973). The lower reach of Browns Gulch is badly dewatered during the irrigation season.

The upper portions Mill, Willow, and Warm Springs Creeks are high quality streams with good diversity indices. The water quality deteriorates near the Anaconda Company Opportunity and Warm Springs treatment ponds. Miller (1974) found the specific conductivity to increase in Mill-Willow bypass and Warm Springs Creek, indicating possible seepage from the Anaconda treatment ponds. Species diversity indicated an unhealthy situation with a monoculture of diptra in the Mill-Willow bypass near Warm Springs and the same situation in Warm Springs Creek downstream from Highway 10 (Gless, 1974).

An examination of the streambed by Gless (1973) at the lower pH shack below ponds showed no invertebrates. The Water Quality Bureau collected a sample in the same vicinity in May, 1974 and found one pteronarcella (stonefly nymph) and two hydrotsychidae (caddis fly larvae), (both pollution sensitive organisms), and a dozen less sensitive midge larvae. This indicated a recovery trend in the stream.

There is a downstream increase in total metals and sulfates in Silver Bow Creek (Table 3). This apparently is due to leaching of old sediments deposited along the stream. Typical flow data and concentration data were not available for the same time period. Flow data from 1972 - 1973 were used with concentration data from 1974.

The validity of this method is substantiated by the following flow data comparison:

(1) Montana Tech. reported an average 151 cfs at the lower pH shack during 1972 - 1973 compared with 157 cfs reported by the WQB during 1974.

(2) Anaconda Company measured 85 cfs at Opportunity during seven months in 1974. The flow during the remaining five months would easily bring the flow to 130 cfs as reported by Montana Tech. during 1972 - 1973.

Sediment leaching was not found by Diebold (1974) during laboratory studies; (he found metals in solution decrease when contacted with Silver Bow Creek sediments), however, Diebold was measuring dissolved metals, not total metals.

Table 4 shows the change in metal load through the Warm Springs pond system and the metal removal efficiencies. The ponds removes 75 - 90 percent of the iron, copper, zinc, cadmium, and arsenic entering the ponds in Silver Bow Creek and excluding the smelter. Preliminary information indicates that the metal loads observed at the lower pH shack are about twice the load actually discharged from the ponds (Table 3). Groundwater seepage is apparently the reason for the difference in loads. The specific conductivity survey of Mill and Willow bypass by Montana Tech. in November, 1972, indicated an underflow through the levies of Warm Springs pond two and three (Miller, 1974). A similar survey on Warm Springs Creek indicated pond seepage from the Opportunity ponds entering the creek commencing two miles west of the state hospital (Miller, 1974). A thorough survey of the dynamics of the pond seepage situation is needed to determine metal load contribution from this source on the Clark Fork River.

A major question is allowing Silver Bow Creek to bypass the Warm Springs ponds untreated. To estimate the impact on the Clark Fork River, metal loads in Silver Bow Creek at Opportunity were used to determine if these loads, when diluted in the Clark Fork River, would violate Montana water quality standards set for the river. Copper, zinc and arsenic concentrations exceeded the standards (Table 5). Contribution from the ponds would likely cause iron and cadmium concentrations to also exceed the standards. Based on this information, it appears unlikely that the ponds can be bypassed. However, this discussion was based on average load and does not mean that part of the year it may be possible to bypass without violation.

TABLE 3. TOTAL METAL AND SULFATE LOADS IN SILVER BOW CREEK, 1974

LOCATION	Fe	Cu	Zn	Cd	Pb	As	SO_4
				(pounds per year)			
Texas Ave. Bridge	41,700	13,500	25,700	700	3600	3600	7.56 x 10^7
Confluence Blacktail Cr.	184,000	46,900	123,000	1500	3300	3000	10.1 x 10^7
Ramsay	441,000	85,800	173,000	1100	6600	15,300	7.46 x 10^7
Gregson	564,000	134,000	270,000	2900	14,600		11.0 x 10^7
Opportunity	508,000	142,000	301,000	4100	6700	6900	9.5 x 10^7
Warm Springs pond discharge	55,000	15,100	22,200	1000	3400	1450	2.7 x 10^7
Lower pH Shack	116,000	27,000	57,000	1800	5700	4800	10.6 x 10^7

Load calculated using 1974 Anaconda Company concentrations and 1972 - 1973 Montana Tech. flows.

TABLE 4. METAL REMOVAL EFFICIENCY IN WARM SPRINGS PONDS

	Fe	Cu	Zn	Cd	Pb	As
Metal load in Silver Bow Creek at Opportunity, MT (Table 3.) lbs/yr.	508,000	142,000	301,000	4100	6700	6900
Metal load in Silver Bow Creek at lower pH shack (Table 3.) lbs/yr.	116,000	27,000	57,000	1800	5700	4800
Removal efficiency (%)	89	90	93	76	49	79

TABLE 5*. CALCULATED CONCENTRATION OF METALS IN CLARK FORK RIVER ASSUMING METAL LOADING AT OPPORTUNITY IS DILUTED BY CLARK FORK RIVER.

	Fe	Cu	Zn	Cd	Pb	As
Calculated total metal concentration (mg/l) in the Clark Fork River	1.1	0.3	0.7	0.009	0.015	0.015
Montana water quality standards (mg/l)	1.3	0.09	0.3	0.019	0.10	0.01

*Note. This table was developed by converting metal loads in Silver Bow Creek at Opportunity (Table 3) to concentrations in the Clark Fork River at Warm Springs assuming a flow of 228 cfs and no metal input from Warm Springs Creek.

A metal concentration limit could be established for Silver Bow Creek at Opportunity and when metal levels are below these limits, the ponds could be bypassed. A load limit cannot be established until seepage characteristics of the ponds are understood and described. It will also be necessary to know the contribution of the Anaconda's Smelter on the metal load reaching Silver Bow Creek. Additional emergency storage systems must be provided upstream to eliminate accidental spills and/or slugs of poor quality water.

A metal concentration limit could be established with a monitoring station in the Clark Fork River near Warm Springs and developing baseline data on metal loads in the river. These data could be compared to Silver Bow Creek data at Opportunity to establish the feasibility of pond bypassing. If it appeared feasible, then an automated sampling and flow diversion program could be established in which a number of key parameters could be monitored both upstream and at Warm Springs.

SOCIAL ECONOMIC CONDITIONS

The economic condition of Butte, Montana, remains greatly dependent upon the mining and smelting operation of the Anaconda Company. The international market price of copper has and continues to control the viability of the industry. Other factors including costs of mining equipment, labor, land and water reclamation, smelter operation, power and transportation become significant especially as they rise due to continuing price inflation trends. The copper industry in Montana, like most other industries, has evolved continually away from labor intensive methods and towards increased mechanization. It is not clear at this time how significant the proposed new mining operation will be compared to the Berkley Pit operation. It is also not knwon whether the Continental area ore blanket deposit will replace of complement the rate of ore production in other areas. Therefore, the proposed operation's impact on employment is unknown. Development of the Continental area resource, if continued, will, however, insure continued employment and production. The quality of the ore affected by the permit is not believed to be significantly better than that which is currently being extracted. However, the viability of the proposed mining operation both influences and is influenced by the overall viability of the Montana operations of the Anaconda Company.

Economic conditions relative to the Company and the Butte area have been studied and published by economic consultants, research institutes and local planning agencies. Selected portions of these publications will be presented in this section and in Appendix B. A brief summary of a study done for the Anaconda Company by Frank R. Lanou (November 1974) illustrates the company's position.[8]

Economic Impact of Anaconda's Copper Operations in Montana

Summary and Findings

This report presents detailed facts regarding the importance of Anaconda's copper mining operations at Butte, its smelter operations at Anaconda, and its refinery and wire and cable plants at Great Falls, to the economy of Montana and the three counties in Montana where these operations are situated: Silver Bow, Deer Lodge, and Cascade. The report finds that Anaconda plays a crucial role in employment and income in Silver Bow and Deer Lodge Counties, and a lesser role in Cascade County.

It appears probable that closure of the Anaconda smelter would create a situation of endemic economic blight in Silver Bow and Deer Lodge Counties. Anaconda states that the copper mine could not sustain operation without the existence of the nearby smelting facility at Anaconda. So, closure of the smelter would mean closure of the mine. The report finds that large numbers of workers idled by a closure of the Anaconda operations would not find other jobs in the area. They would face living on Federal, state, or local assistance, or moving to another area. Moreover, since Anaconda pays much higher wages and salaries than other employers in the area, the economic loss would be greater than if the loss of jobs occurred among lower paid employees. Anaconda also states that closure of the mine and the smelter would force closure of the Great Falls operations. In the total of the three cities, Anaconda presently employs over 5,000 people. The study finds that approximately 9,400 other jobs in the area are indirectly attributable to Anaconda's operations. Anaconda's closure would eliminate about $72 million of direct personal income to its employees and another $93 million of income to workers indirectly dependent on Anaconda, for a total loss of personal income of $164 million.

Tax revenues would also be dealt a severe blow by Anaconda's closure. The State Department of Revenue would lose about 7.5 percent of its tax collections. Because about 70 percent of the property taxes in Silver Bow and Deer Lodge Counties are ultimately dependant upon Anaconda, the repercussions of a closure on these counties' revenues would be most serious.

Closure becomes an issue for the Anaconda Company if the Company is requested to make unreasonably large capital expenditures. The Company, which was dealt a severe financial blow by the expropriation of its profitable Chilean copper mines in 1971,[1] was also hurt by the recession of 1970-1971.

Through intensive programs to improve efficiency, the company managed to show a profit in 1972. The economic recovery and the increase in copper prices helped boost profits in the copper industry. But in 1973 and 1974 Anaconda's profit rate, expressed as a percentage return to common equity, continued to be only mediocre, compared to other firms in the industry. In the most recent recession, Anaconda has been badly hit again.

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1 Including this extraordinary item, Anaconda lost $333 million in 1971.

A comparison with others in the industry of Anaconda's profits and operating statistics is shown in the table 1, Appendix B. Profits are shown excluding extraordinary items in order to gain a clear view of actual conditions in the business. As the table shows, Anaconda went from a minus 0.7-percent rate of return on common equity in 1971 to 4.5 percent in 1972, thanks, in part to a 6-percent reduction in work force. As economic recovery strengthened in 1973, Anaconda showed only a 6.6-percent rate of return to common equity, as against 14.6 percent for ASARCO, 15.3 percent for Kennecott, and 13.4 percent for Phelps Dodge. In 1974, Anaconda rate of return to common equity was only 8.4 percent, while the other companies maintained high returns. During that year the price of copper rose to a high of 86.3 cents per pound. In the first half of 1975, Anaconda lost $22.9 million, while their competitors all made profits, despite a drop in copper prices to a level of about 60 cents per pound. The rates of return to common equity for all copper producers in the sample are down for the 12 months ending 30 June 1975.

But, while the competition was able to maintain about a 7-percent equity return, Anaconda's dropped to 2 percent.

The financial results for Anaconda compared to its competition appears to indicate a problem for Anaconda. Anaconda accounts for about 10 percent of U. S. production of refined copper from its Montana operations. The Montana operation is Anaconda's largest production facility for copper, by a substantial margin. Although production costs are a closely guarded secret in the copper industry, it appears that Anaconda's poor financial showing, compared to its competition, indicates that its copper production facilities are higher cost than those of the competition. In view of Anaconda's strenuous efforts to improve efficiency and cut costs in the last few years, the conclusion may be drawn that factors beyond management's control, such as low-grade ore, depth of the ore deposits, long haulages, and like factors, combine to make Anaconda a higher cost producer than the competition. This in turn indicates that large, added financial burdens on Anaconda's Montana operations cast doubt on their continued viability. Anaconda's management clearly has to face the possibility of closing the Montana operation as an alternative to production at even higher costs than today's relatively unprofitable levels.

In 1973 the Columbia Research Institute completed a study of the Butte-Silver Bow County area, which illustrated the economic and demographic changes in the area. Since this study was completed the Anaconda Company has closed its underground operation and laid off a substantial number of employees. However, the following C.R.I. description of conditions in 1973 are probably still accurate. [9]

Changing Character of the Area

> The history of Butte and of Silver Bow County, together with their social and economic characteristics, are closely tied to the history of mining in the area. Following a great boom, mining has been steadily declining in employment for many years. This decline continues, as reflected by the employment data for 1960 and 1970 in Table 2, Appendix B.
>
> The decline in mining employment has been accompanied by a decline in total employment at a time when total employment in the State and Nation has been increasing, also shown by Table 2, Appendix B. At the same time, as might be expected, population has declined. As shown by Table 3, Appendix B, the City of Butte has declined in population in every U. S. census since 1920 and, in fact, has been declining at an increasing rate until the 1970 census, when the rate stabilized at minus 16.2 percent, the same rate of decline as between 1950 and 1960.
>
> This decline is all the more dramatic when it is realized that there has been a natural population growth, that is, the number of births has exceeded the number of deaths, as shown by Table 4, Appendix B. In other words, the decline in population has been wholly attributable to people leaving the area.
>
> Median income in the area is also low, as shown by Table 5, Appendix B. Although median income is a little higher in Silver Bow County than in Butte or the State, it is eight percent lower for families in the County than in the Nation.
>
> Despite this, the percentage of families below the poverty level, as defined by the Bureau of the Census according to a complex formula, is lower in both Butte and Silver Bow County than in either the State or Nation.* The percent of unrelated

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*This may have changed due to recent closure of underground operations.

individuals (i.e. persons not related to anyone else in the household) below the poverty level, however, is higher in both Butte and Silver Bow County than in either the State or Nation.

Age composition of the population is shown in Table 6, Appendix B. In both Butte and Silver Bow County, but especially Butte, a larger portion of the residents are of retirement age -- 65 and older - - than in either the State or the Nation.

Employment statistics supplied by the company for 1950-75 indicate a pattern of fluctuations and general decline for all Montana operations (Table 7, Appendix B). The company has also published the average earnings per employee for a period 1963 to 1975. The average earnings have increased from $7,596 to $14,035 during that period for Montana Employees. The breakdown of wage categories is unknown.

The company has summarized the taxes paid to the State and three counties for the period 1969 to 1975 relative to their copper operations (Table 8, Appendix B). The grand total for 1975 was $13,632,000. It is of special interest to note that the payments to the resource indemnity fund for 1974 and 1975 are $382,000 and $519,000, respectively. Total property taxes, license fees and net proceeds taxes paid to Silver Bow County in 1975 amount to $5,686,000. If the Anaconda copper operations are closed at any time in the near future, the reduction in revenue will be seriously felt by Silver Bow and Deer Lodge Counties.

Though the present Berkley Pit operation and the proposed Continental operation may serve to maintain the company's status quo ore production, it is common knowledge that far better ore values are found nearby. The city of Butte sits astride the richest ore deposit in the area; the central business district sits squarely over the copper. With declining economy, employment and population, the City of Butte is trying to plan a relocation of the central business district. Also, disincorporation of the city is being considered. The following conclusions and recommendations concerning the relocation are taken from a recent report by the Butte-Silver Bow City County Planning Board, entitled Butte Central Business District. [10]

Conclusions

The planning covered by this report are concerned with the preparation of a redevelopment plan for the Butte Central Business District. Based on the data developed during the course of this study and the analysis of that data, the strategy and plan were developed. Some of the conclusions reached and specific recommendations are as follows:

Uptown Butte is in serious trouble, but not just from the expansion of the Berkley Pit.

The Butte Metropolitan Area is overbuilt for its retail market, and as such, uptown Butte can only survive as long as rents are extremely low as they are now.

Uptown Butte is old and many of its buildings are badly deteriorated to the point that rehabilitation will be very costly and uneconomical.

The overall economy of Butte depends on the mining operations of the Anaconda Company and major mineral reserves are in the hill under uptown Butte.

A redevelopment program, depending solely on rehabilitation and moderate revitalization budget, will not work in Butte because of the physical dispersal of comparison goods facilities, and the necessity for extensive demolition and new construction. If such demolition and new construction is necessary, prudence indicates that in view of the overall economy of Butte and its dependence on a single basic industry, new construction should take place at a different location.

It is apparent that uptown Butte will decline in future years for several reasons: the market conditions of the area, the fact that some major uptown uses will move out, and the fact that the Berkley Pit will expand even closer to the Central Business District. In addition, the uptown is no longer central to the growth patterns of the city. It is also apparent that there is now and will continue to be an exodus from uptown and that if no plan exists for the orderly withdrawal and development of a new central business district, business will scatter in all directions and Butte will have no defined business core.

Recommendations

With these conclusions in mind and the data developed in the report, the following recommendations are strongly made for immediate consideration by the City-County Planning Board, the City of Butte, Silver Bow County, and the citizens of the Butte Metropolitan Area.

Immediately adopt this program which calls for redevelopment, on a phased withdrawal basis, of the present uptown area and the development of a new community to contain facilities for a new central business district and new housing.

Organize as soon as possible a development authority to undertake the planning and implementation of the new community program and an uptown rehabilitation program.

Seek support from business and citizens in the community and at all levels of government, federal, state and local.

The Columbia Research Institute report discusses the disincorporation of Butte as an alternative method to initiate the reorganization of the community. Their statement follows.[9]

Disincorporation of Butte

Montana law presently provides that a city or town of less than 500 population may be disincorporated upon a petition of two-thirds of the resident freeholders. There is the possibility that legislation may be considered by the 1973 Legislature to allow disincorporation of any debt-free city. If such a measure becomes law, disincorporation of Butte would be possible.

Butte does not appear to be a viable unit of government for the future. That is the underlying reason for this study. One alternative, therefore, would be to dissolve the existing unit and seek to provide services by other means. These could include reliance on the County and special districts or the incorporation of a new city with more realistic boundaries.

Open to question is the disposition of City property -- land, buildings and equipment. This would depend on the provisions of the new legislation. Present law provides for such property to pass to the County, but the only other provision regarding the property is that it is to be sold to liquidate municipal indebtedness. The law is silent as to the County making use of the property otherwise or making it available to other units of government.

To plan and implement such large scale adjustments will surely require money which is not commonly available in a depressed area. If massive federal financial input were available, the viability of the restructured community would still depend upon the viability of the company's copper operation.

Other social and economic factors will tend to promote or impede the future of Butte. The question of area aesthetics is an appropriate consideration in this situation. It cannot be expected that future generations or incoming citizens would choose to live in an area so scarred by mining and related activites unless there were overwhelming economic incentives.

The reclamation of the slopes overlooking the city would be a challenging and costly effort unlikely to be accomplished with local funding. The recent changes in reclamation laws insure that attempts will be made by the industry in current operations but no assurance of an aesthetically pleasing result can be made. The true beautification or restoration of past and present mining disturbances rests primarily upon the initiative of the Anaconda Company.

DISCUSSION OF ENVIRONMENTAL IMPACTS

ALTERNATIVES AND MITIGATIONS

The social, economic and environmental problems surrounding the Anaconda Company operations in the Butte area are easily defined by history, the present extent of land disturbance, and the economic status of the community. The marginal economic position of the company has been documented by the company by its continual reduction of work force and other cost reduction efforts. The condition of the community is illustrated by high unemployment, outward migration and the excess of retail facilities. The condition of the local ecosystem is illustrated by thousands of acres of scarred land which supports minimal vegetation and wildlife. The poor quality of water in the areas downstream from Butte speaks not only of present activities but of a long past of contamination.

The town and the company have grown up together over a period of many decades. Mining is not only a way of life, it is the primary source of personal income as well as tax revenue for the local governments. The interdependence between town and company remains critical. The movement toward mechanization has and would continue to cause a reduction in the human work force, unless the magnitude of the operation were increased. The decision to grant or deny a permit for the disturbance of more land will entail numerous considerations concerning the people, the community, the land, the company, and the future.

The Significance of Granting a Permit:

The establishment of a mine waste dump approximately 90 acres in size involves:

1. Disturbance of a land area to an extent greater than its present level of disturbance.

2. Increased potential for leaching of polluted water similar to other dumps of like nature.

3. Creating an environment hostile to the establishment of vegetation.

4. Extending the effects of noise, dust, and negative aesthetic visual impacts of mining activity upon the community.

5. Commitment of this area and contiguous areas to long term use as a mine waste dump.

6. Reduction of operating costs to the company, thereby offering potential for their further short term viability.

7. Continued short term employment.

8. Continued short term community stability via personal income and revenue.

9. Uncertainty of the economic viability of the company's future.

The Anaconda Company has initiated efforts at land reclamation which show an ability to establish vegetation on disturbed land. These reclamation efforts have not yet indicated the ability to establish long term, self sustaining vegetative cover. The salvaging of topsoil is now being practiced in an effort to increase reclamation potential. It is very probable that the quantities of topsoil available are not sufficient to achieve the necessary cover of all disturbed areas. These mitigating circumstances though positive in nature will not supply assurance of good reclamation.

The law under which this operation would be regulated guarantees that reclamation will be attempted but does not guarantee success.

The increased responsibility of water quality management required by the disturbance of new land areas will be assumed by the company and carried out at their present level of capability. This increased responsibility will add to the overall burden upon the state should the Anaconda Company abandon the Montana copper operation.

Prior to the expansion of activities beyond what has been described in the company submittals, the Department will review any new plans. It is believed that expansion of the waste dump and mining of the adjacent ore deposit are very possible.

The significance of denying a permit.

1. The 90 acre area of the proposed waste dump would not be disturbed nor would the other associated impacts occur.

2. The company would continue hauling mine waste to the presently used area or haul to other available locations.

3. Operating costs may continue at a higher than

acceptable level thereby reducing the viability of the overall operation.

4. Mining may begin at another location or cease all together.

5. Employment may decline further.

6. The viability of the local community may be reduced by reduction in personal income and revenue.

The significance of granting or denying the proposed permit may be of a very minor nature when compared to the overwhelming economic and ecological impact of external forces such as the market price of copper. The company can continue present operations without the presently applied for area, and use of the area will not guarantee the company's future. The situation in Butte has overtones of far greater complexity than simple consideration of the use of the proposed area.

As described previously, the position of the company and the community hang in a delicate balance at this time. The best, most economically attractive ore deposit in the area sits under the Central Business District of the City. If the City, with outside funding, can move the business core, the company may be able to begin extraction of this ore. The proposed method of extraction may ultimately involve less surface disturbance than mining the blanket deposit east of the Continental fault. The higher grade ore would tend to insure the future of local mining operations to a greater extent. The present and recent mining activities involve the use of low grade ore, which, if continued offer dim prospects for the future.

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INDIVIDUALS CONTRIBUTING TO THE PREPARATION OF THE IMPACT STATEMENT

This environmental Impact Statement was written in a period of two weeks, by Charles van Hook. This could not have been done without the considerable editing and other clerical work generously given by Evie Pippett and Jeryl Waling. Numerous persons quoted in the text are listed in the bibliography. The cooperation of the Anaconda Company is appreciated.

APPENDIX A

Description of Habitat Types

Douglas-fir/Pinegrass (DF/Caru)

(This H.T. includes those areas formerly typed as Douglas-fir/kinnikinnick.)

I. Site Features

This habitat type is a cool and relatively dry site which occurs on dry ridges on east to northwest aspects at lower elevations and on south and west aspects at higher elevations. Adjacent types include all of the Douglas-fir climax series at lower elevations the drier types in the subalpine fir climax series at higher elevations. This habitat type is generally the highest elevational extension of the Douglas-fir climax series.

II. Plant Succession

Pinegrass and elk sedge are the most common understory species which occur in this type; however, kinnikinnick, meadow rue, heartleaf arnica, Oregon grape, bunchgrasses, snowberry, and sprea are not uncommon. Lodgepole pine is the major seral dominant throughout much of the range of this habitat type. At climax, this type takes on a park-like aspect of mature, well spaced Douglas-fir with an almost pure understory of pinegrass.

In the more moist regimes of this habitat type, pinegrass and elk sedge sometimes form a dense sod following disturbance of overstory vegetation. Fire in the type usually leads to lodgepole pine as the seral dominant and a dense stand of pinegrass.

Douglas-fir/Bluebunch Wheatgrass (DF/Agsp)

Includes (DR/Feid)

I. Site Features

This habitat type represents the warm dry extreme of the Douglas-fir climax series. Reproduction and maintenance of all vegetational components is difficult due to the low available moisture and warmer temperature conditions in which this habitat type occurs. The habitat type occurs in two basic situations: a steep, southerly exposure at mid-elevations and gentle to moderate slopes on all exposures at lower elevations. Adjacent types usually are Douglas-fir/pinegrass, Douglas-fir/snowberry and bunchgrass. In addition, this type may be found as small enclaves in the subalpine fir zone on west and southfacing aspects.

II. Plant Succession

Seral stages of this habitat type range from savanna-like aspects of young, scattered Douglas-fir and/or ponderosa pine in a basic bunchgrass-forb vegetative type to mature Douglas-fir stands with a sparse understory. An important seral community, especially east of the Continental Divide, is the mixed Douglas-fir/shrub/bunchgrass type. Key elements of the latter community include young to middle age class Douglas-fir, sagebrush and/or bitterbrush, and a variety of forb species. Major understory species include bluebunch wheatgrass, Idaho fescue, rough fescue, arrowleaf balsamroot, prairie smoke, sticky geranium, and miscellaneous prairie forbs.

Fire in this habitat type tends to hold vegetation in a grassland aspect. Plant succession in this type is a slow process. Overgrazing by large herbivores tends to favor the development of the Douglas-fir/shrub/bunchgrass seral community.

Douglas-fir/Common Juniper (DR/Juco)

I. Site Features

This type is generally restricted to "east side distribution on the Deerlodge. It is limited to south and west aspects at lower elevations. The typical site is on dry, rocky, moderately steep slopes. Adjacent types include Douglas-fir/bunchgrass and Douglas-fir/pinegrass.

II. Plant Succession

Lodgepole pine is the seral dominant in this type, while common juniper is dominant in both seral and climax communities. This is probably the driest habitat type of the Douglas-fir climax series which grows lodgepole pine. Although kinnikinnick and pinegrass may also be present, these are poorly represented and the type normally has a poor ground cover.

Douglas-fir/Twinflower (DF/Libo)

I. Site Features

This habitat type occurs on moist, cool sites at lower to middle elevations on the Deerlodge. It is found on northerly aspects on a variety of slopes and in narrow "stringer" situations in drainage bottoms. Adjacent types on mesic sites are subalpine fir/twinflower and spruce/twinflower while those adjacent on drier sites include Douglas-fir/snowberry, Douglas-fir/pinegrass and Douglas-fir/kinnikinnick. The type occurs on a small acreage on the Deerlodge, but is widespread in distribution.

II. Plant Succession

This type is quite variable in vegetational aspect. Both Douglas-fir and lodgepole pine occur in seral stages. Understory vegetation is relatively lush, composed of moist-site forbs, pinegrass, spirea, and/or snowberry. In any case, twinflower is always common. This type is probably the most productive type in the Douglas-fir climax series on the Deerlodge. Fire is uncommon in the type; however, when it occurs, fire is likely to be intense.

Subalpine Fir/Grouse Whortleberry (AF/Vasc)

I. Site Features

This type is probably the most abundant type on the Deerlodge Forest. It occurs on cool, dry sites on north slopes at lower elevations and all aspects at higher elevations. The most common sites are on dry benches, broad ridges and relatively gentle slopes. Adjacent types include Douglas-fir/pinegrass and all types in the subalpine fir climax series.

II. Plant Succession

Lodgepole pine is the seral dominant and very few climax stands of this type occur on the Forest. Grouse whortleberry is always dominant in the understory and in some cases, forms nearly the entire understory composition.

On drier aspects all understory vegetation is sparse and has a low stature. On the more moist aspects, grouse whortleberry is abundant and pinegrass and elk sedge are absent. This habitat type is very much influenced by fire and appears to burn often.

APPENDIX B

Table 1. Financial comparison: Anaconda Company vs three other major copper producers.

Company	1971	1972	1973	1974	1st Half 1975	12 Months 30 June 1975
Rate of Return to Common Equity (%)[1]						
Anaconda	(0.7%)	4.5%	6.6%	8.4%		2.0%
ASARCO	6.8%	7.2%	14.6%	14.6%		7.0%
Kennecott Copper	7.2%	7.3%	15.3%	11.3%		7.3%
Phelps Dodge	10.4%	10.9%	13.4%	12.6%		7.4%
Sales ($ millions)						
Anaconda	$ 947	$1,012	$1,343	$1,673	$494.7	
ASARCO	657	814	1,068	1,344	490.2	
Kennecott Copper	1,053	1,166	1,426	1,692	733.4	
Phelps Dodge	704	766	962	1,026	368.2	
Profits ($ millions)[1]						
Anaconda	(6)	$ 44	$ 69	$ 107	$(22.9)	
ASARCO	46	49	113	126	20.0	
Kennecott Copper	85	87	159	169	32.5	
Phelps Dodge	74	82	109	113	24.5	
Number of Employees						
Anaconda	27,481	25,907	26,177	24,760		
ASARCO	13,300	14,800	14,700	15,300		
Kennecott Copper	30,400	29,100	30,400	32,300		
Phelps Dodge	15,500	15,800	16,200	14,900		
Price of Copper, N.Y. ¢/lb						
High	53.0¢	52.6¢	66.6¢	86.3¢	63.6¢	
Low	50.4¢	50.3¢	52.4¢	68.7¢		

1 Excluding extraordinary items.

SOURCE: 1971-1974 data from Moody's Investors Service.
1975 from Standard and Poor's Corporation.
Copper price 1975 from Wall Street Journal, 7 November 19[illegible].

Table 2. Employment in mining and all industries Butte, Silver Bow County, Montana, and the United States 1960 and 1970.

Place	Employment 1960	Employment 1970	Change Number	Change Percent
Butte				
Mining	1,988	1,684	(304)	(15.3%)
Total Employment	9,408	7,926	(1,482)	(15.8%)
Silver Bow County				
Mining	3,294	2,970	(324)	(9.8%)
Total Employment	15,399	14,543	(856)	(5.6%)
Montana				
Mining	6,782	5,689	(1,093)	(16.1%)
Total Employment	231,270	248,342	17,072	7.4%
United States				
Mining	712,000	622,000	(90,000)	(12.6%)
Total Employment	65,778,000	78,627,000	12,849,000	19.5%

( ) Indicates decrease

Source: U.S. Bureau of the Census, *U.S. Census of Population: 1960; Characteristics of Population, Montana* (Washington, D.C., 1963), *U.S. Census of Population: 1970; General Social and Economic Characteristics, Montana* (Washington, D.C., 1971); *Statistical Abstract of the United States: 1971* (Washington D.C., 1971).

Table 3. Butte Population 1910-1970

Year	Population	Change From Preceeding Census Number	Percent
1910	39,165	8,695	28.5
1920	41,611	2,446	6.2
1930	39,532	(2,079)	(5.0)
1940	37,081	(2,451)	(6.2)
1950	33,251	(3,830)	(10.3)
1960	27,877	(5,374)	(16.2)
1970	23,368	(4,509)	(16.2)

( ) Indicates decrease

Source: U.S. Bureau of the Census, *U.S. Census of Population: 1970; Number of Inhabitants, Montana* (Washington, D.C., 1971).

Table 4. Births and deaths, Silver Bow County 1961 through 1968

Year	No. of Births	No. of Deaths	Natural Increase
1961	1,131	570	561
1962	1,141	545	596
1963	1,136	501	635
1964	1,139	559	580
1965	1,098	549	549
1966	1,130	585	545
1967	1,028	559	469
1968	914	522	392

Source: Howard, Needles, Tammen and Bergendoff, *Butte-Silver Bow, Montana, Population and Economic Inventory and Analysis* (Kansas City, Missouri, 1971).

Table 5. Selected data on personal income. Butte, Silver Bow County, Montana, and the United States, 1969

Income Characteristics	Butte	Silver Bow County	Montana	United States
Median Income				
Families	$8,121	$8,671	$8,152	$9,433
Unrelated Individuals	$2,129	$2,279	$2,127	$2,931
Income Less Than Poverty Level				
Percent of Families	9.4%	7.8%	10.4%	9.7%
Percent of Unrelated Indiv.	45.5%	43.5%	40.4%	32.7%

Source: U.S. Bureau of the Census, *U.S. Census of Population: 1970; General Social and Economic Characteristics, Montana* (Washington, D.C., 1971); *Statistical Abstract of the United States: 1971* (Washington, D.C., 1971).

Table 6. Percent of population by age groups: 1970. Butte, Silver Bow County, Montana and the United States

Age Group	Butte	Silver Bow County	Montana	United States
Less than 25	42.7%	44.5%	47.5%	45.9%
25 - 64	42.9%	43.6%	42.6%	44.2%
65 and older	14.4%	11.9%	9.9%	9.9%

Source: U.S. Bureau of the Census, *U.S. Census of Population: 1970; General Social and Economic Characteristics, Montana* (Washington, D.C., 1971); *Statistical Abstract of the United States: 1971* (Washington, D.C., 1971); Montana Department of Planning and Economic Development, *Emuneration District Data: 1970, Silver Bow County* (Helena, Montana).

Table 7. Anaconda's Montana copper operations employment, 1950 - 1970.

Year	Anaconda[1]	Butte	Great Falls Refinery[2]	Great Falls Wire & Cable	BA&P	Total
1950	2,605	5,193	1,397	123	423	9,741
1960	2,144	2,421	972	109	394	6,040
1961	1,765	2,379	1,002	139	436	5,721
1962	1,705	2,398	1,010	126	350	5,589
1963	1,450	2,881	974	126	305	5,736
1964	1,237	3,504	1,020	157	240	6,158
1965	1,149	3,749	1,110	198	192	6,398
1966	1,368	3,915	1,228	210	211	6,932
1967	1,040	2,599	818	222	132	4,811
1968	1,113	1,797	937	161	106	4,114
1969	1,445	2,358	1,195	161	176	5,335
1970	1,554	2,771	1,275	125	217	5,942
1971	1,193	2,340	1,052	144	164	4,893
1972	1,656	3,049	1,040	116	141	6,002
1973	1,680	3,305	650	109	159	5,903
1974	1,658	3,347	645	57	191	5,898
1975[3]	1,527	2,713	638	48	170	5,096

1 Includes Arbiter plant starting in 1974.
2 Includes East Helena plant and Great Falls zinc plant, which both closed in 1972.
3 Estimate, based on average employment levels during first 10 months and projected levels for November and December.

SOURCE: The Anaconda Company.

Table 8: Anaconda's Montana copper operations.
Taxes paid to State of Montana and three major counties, 1969-1975.

	1969	1970	1971	1972	1973	1974	1975
	(thousands of dollars)						
Business Taxes and Licenses:							
State of Montana:							
Metalliferous mines	$ 728	$1,438	$1,975	$1,311	$1,828	$ 2,247	$ 3,095
Resources indemnity[2]	--	--	--	--	--	382	519
Corporation tax	--	9	37	25	24	250	1,010
Unemployment insurance tax	367	618	413	348	441	722	494[3]
Consumers council tax[2]	--	--	--	--	--	1	3
Subtotal	$1,095	$2,065	$2,425	$1,684	$2,293	$ 3,602	$ 5,121
Silver Bow County:							
Net proceeds	$1,354	$1,354	$2,506	$1,153	$ 588	$ 1,563	$ 2,695
Licenses	18	14	12	11	16	16	16
Subtotal	$1,372	$1,368	$2,518	$1,164	$ 604	$ 1,579	$ 2,711
Deer Lodge County:							
Licenses	$ 4	$ 5	$ 5	$ 5	$ 11	$ 39	$ 23
Cascade County:							
Licenses	1	1	1	1	1	1	1
Total Business Taxes and Licenses	$2,472	$3,439	$4,949	$2,854	$2,909	$ 5,221	$ 7,856
Property Taxes - 3 Major Counties							
Silver Bow	$1,685	$2,174	$1,961	$1,751	$2,315	$ 2,978	$ 2,975[3]
Deer Lodge	1,051	1,232	1,230	1,332	1,690	1,919	2,228[3]
Cascade	745	869	868	877	709	491	573[3]
Total Property Taxes 3 Major Counties	$3,481	$4,275	$4,059	$3,960	$4,714	$ 5,388	$ 5,776
Total Taxes Paid - State of Montana and 3 Major Counties	$5,953	$7,714	$9,008	$6,814	$7,623	$10,609	$13,632

1 Includes taxes paid for Butte Water Company.
2 Assessed starting in 1973.
3 Estimate.

SOURCE: The Anaconda Company.