APPENDIX C

HARDROCK MINERAL RESOURCES
REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

INTRODUCTION

Purpose

The purpose of the reasonably foreseeable development scenario (RFD) is to provide a model that anticipates the level and type of future hardrock mineral activity in the planning area; and will serve as a basis for cumulative impacts analysis. The RFD first describes the main legal framework of hardrock development, the Mining Law of 1872. Next a is discussion of the steps involved in developing a mineral deposit, with presentation of several hypothetical mining operations. The current activity levels are briefly addressed. Future trends and assumptions affecting mineral activity are then discussed, followed by predictions and identification of anticipated mineral exploration and development. The RFD is based on the current management situation. A section that describes variations in the RFD by alternative is included.

Scope

The RFD is based on the known or inferred mineral resource capabilities of the lands involved, and applies the conditions and assumptions discussed under Future Trends and Assumptions. Changes in available geologic data and/or economic conditions would alter the RFD, and some deviation is to be expected over time.

The development scenario is limited in scope to the planning area. The types of land included is restricted to federal, or federal minerals only, administered by the BLM. Activities on private, state, or Forest Service lands are included when BLM lands or minerals are nearby and may be involved or affected.

The mineral commodities dominating activity are gold and silver, though there is some minor activity for sapphires in the Yogo Gulch area. The RFD will pay special attention to precious metal mining since this activity coincides with large amounts of BLM land ownership.

Bentonite development has been discussed in Management Common to All Alternatives, and a reasonably foreseeable development model will not be developed.

Resource Area Description

A detailed description of planning area geology and mining history can be found in Chapter 3. A brief discussion follows.

The areas with the highest levels of both current activity and future mineral development potential are the alkalic igneous intrusive centers in the planning area, mainly the Judith Mountains, the North and South Moccasin Mountains, and the Little Rocky Mountains. Diverse types of significant epithermal gold mineralization occurs at these intrusive centers. The mineralization took place during the late stages of igneous activity during the Tertiary period. Gold mineralization ranges from igneous hosted stockworks or fracture sets (Zortman-Landusky) and breccia pipes (Moccasin Mountains) to replacement zones in the flanking and upturned Madison Group limestones (Giltedge and Kendall districts). The latter are mostly localized by intraformation solution breccias in the upper Madison, near the porphyry contacts. Gold occurs as auriferous pyrite, sylvanite, or in native form. Mineralization is accompanied by varying amounts of silver, base metal and tellurides, with quartz, fluorite, carbonate and barite (Giles, 1982).

THE MINING LAW

History

The General Mining Law of 1872 (17 Stat. 91) is the authorizing act for hardrock mineral exploration and development in the planning area. The origin of the Mining Law can be traced to the 16th century, and reflects close ties to English and Spanish traditions.

Early American colonial charters contained outright grants of mineral land to settlers, however, these grants were accompanied by certain permanent reservations of precious metals to the sovereign. This formed the basis for the early traditions and customs regarding mineral rights for the colonies in the eastern part of the United States until the early 1800's.

In the western states, and especially in the Southwest, mining customs and traditions were derived from the Royal Code of 1783. This code formed the basis for acquisition of mineral rights by miners, and settlement of disputes between claimants.

In 1849 there was no formal mining law in the United States. Congress passed several leasing or sales acts of limited duration for gold, silver, lead and iron. These acts were administered by the War Department. In 1849, when the California gold rush started, miners were technically in mineral trespass when they located claims on the public domain. The gold rush brought into conflict the two mining traditions. In 1860, the silver strike in the Comstock Lode in Nevada started a second mining rush to the West, opening up further conflict between the two mining traditions. As eastern interests were financing the Comstock Lode as well as the California Mother Lode, the question of security of title and tenure became a major political issue in Congress.

From 1865 to 1885, congressional policy for the public lands focused on encouraging westward migration of people to settle and develop the West. In furthering this policy a series of statutes was passed including various homestead acts, agricultural entry laws, soldier compensation acts and several acts designed to emphasize mineral exploration and development.

On July 26, 1866, the first mining law was passed as the Lode Law of 1866 (14 Stat. 251). This act provided for the entry and location of lode claims, assessment work and patents for lode claims.

The Placer Act was passed on July 9, 1870. It provided for the entry and location of placer claims on non-agricultural land, for location by legal description, and for patent.

These two acts were consolidated, with amendments, into the General Mining Law of May 10, 1872. This statue is the basis for appropriation of hardrock mineral resources from the public domain today.

Principles

The Mining Law consists of five basic elements: discovery of a valuable mineral, location of mining claims, recordation of claims, maintenance - performance of annual requirements on claims, and patenting of the mineral, and possibly surface, estate to the claimant.

Discovery

There is no federal statutory definition of what constitutes a valuable mineral deposit. Several judicial and administrative rulings or declarations on the subject have been made. In 1894 in the case of Castle v. Womble, the Department of the Interior established the "prudent man rule." This rule states:

> "...where minerals have been found and the evidence is of such a character that a person of ordinary prudence would be justified in the further expenditure of his labor and means, with a reasonable prospect of success in developing a valuable mine, the requirements of the statutes have been met."

This definition was approved by the United States Supreme Court in 1905.

In 1968 in the case of U.S. v. Coleman, the Supreme Court approved the marketability test as a complement to the prudent man rule. This test requires a showing of marketability to confirm that a mineral could be mined, removed and marketed at a profit. In other words, the marketability test takes into account economics, requiring the claimant to show that there is a reasonable prospect of selling material from a claim or a group of claims. It is not necessary that the material has been sold or is selling at a profit, but that there is a reasonable likelihood that it could be sold at a profit. Demonstrating an established market is not difficult for precious metal commodities.

Location

Mining claims may be located only by citizens of the United States, persons who have declared an intention to become citizens, and corporations organized under any State law. Mining claims may only be located on federal lands open to mineral entry under the mining laws, and only for mineral commodities considered to be "locatable". A complete list of locatable mineral commodities would be exhaustive. Basically a mineral is locatable if it is in the public domain, and is a metallic mineral, or one of uncommon variety valuable chiefly for chemical, rather than physical properties. Mining claims may be located before or after discovery of a valuable mineral, on unappropriated public domain land. This claim grants the locator an exclusive possessory right to the mineral deposit. This possessory right allows the locator to continue to develop the claim as provided for by law. It is valid against the United States and other claimants only if a valuable mineral deposit has been discovered.

There are two types of mining claims; lode, and placer. Lode claims are located on indurated bedrock; while placer claims are usually located on loosely consolidated materials such as mineral bearing sands and gravels. Two additional types of mining claims may be located under the mining law: mill sites, and tunnel sites. A mill site may be located on unappropriated public domain land that is nonmineral in character. It is used for the erection of a mill or reduction works, or for other uses reasonably incident to a mining operation. A tunnel site may be located on a plot of land where a tunnel is run to develop a vein or lode, or for the purpose of intersecting unknown veins or lodes.

The actual location of a mining claim in Montana involves posting a notice of location at the discovery point; and erecting corner posts, or monuments, on the ground to insure that the claim boundaries are readily identifiable.

Recordation

Prior to the Federal Land Policy and Management Act (FLPMA), claimants were required to file their location and assessment notices only in the office of the County Recorder, or County Clerk, in the county in which the claim was located. Since enactment of FLPMA, notices of location and other notices must be filed with the BLM state office, as well as the appropriate county recorder. This requirement has allowed BLM to know the number and types of claims located on public land and their current status. Failure to file these documents with the BLM is considered abandonment of a mining claim.

Maintenance

The General Mining Law of 1872 requires performance of an annual minimum of $100 worth of labor or improvements to retain a possessory interest in the claim. An affidavit of assessment work must be filed with both the county recorder, and with the BLM state office. Owners of mill and tunnel sites are not required to file assessment work, but are required to file a notice of intent to hold the site.

Exploration and mining activities on BLM administered lands are subject to regulation under 43 CFR 3802 and 43 CFR 3809. These regulations require that an operator prevent unnecessary or undue degradation and perform reasonable reclamation.

Patents

It is not necessary to have a patent to mine and remove minerals from a mining claim. In fact, it is not even necessary to have a mining claim at all if the land is open to mineral entry. However, a patent gives the owner exclusive title to the locatable minerals and, in most cases, to the surface estate. In order to obtain patent the claimant must have performed at least $500 worth of development work per claim; had a mineral survey and plat prepared at their expense; show they hold possessory rights by chain of title documents; publish a notice for potential adverse claimants to assert their claims; and demonstrate discovery of a valuable mineral deposit within the meaning of the Mining Law.

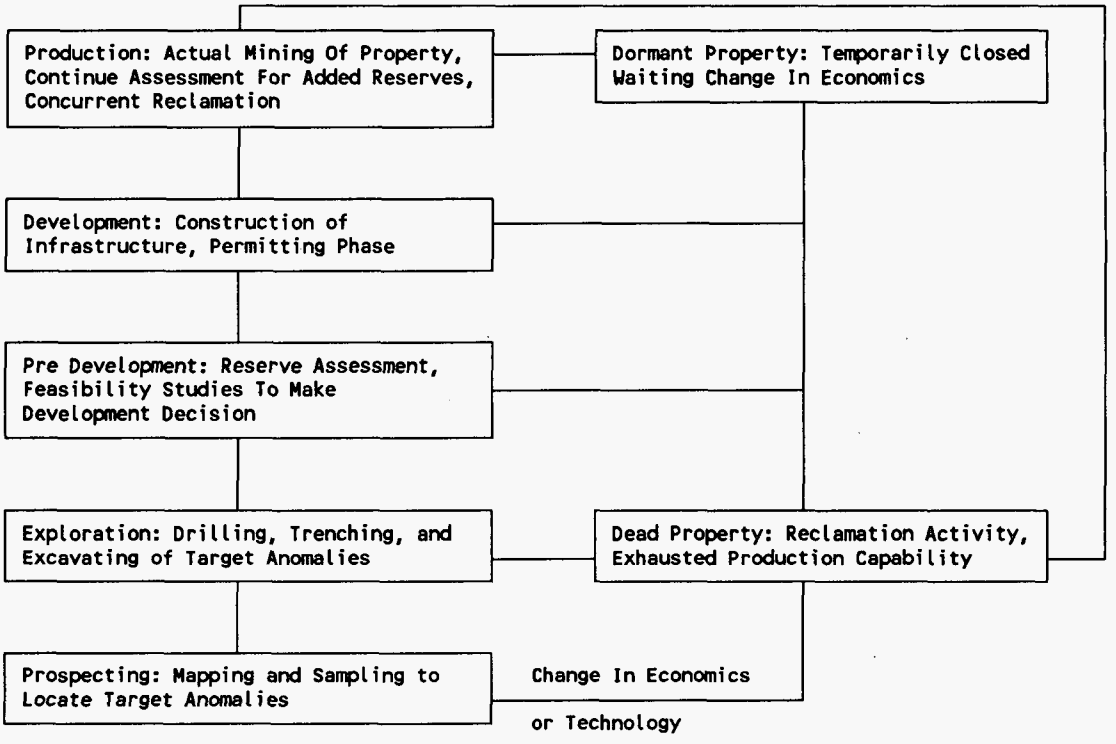
Upon satisfactory completion of the above requirements the claimant is given the opportunity to purchase the mining claim(s) at $2.50 per acre for placer claims and $5 per acre for lode claims.

DEVELOPMENT OF A MINE

The development of a mine from exploration to production can be divided into six stages. Each stage requires the application of more discriminating (and more expensive) techniques over a successively smaller land area to identify, develop, and produce an economic mineral deposit.

A full sequence of developing a mineral project involves the following stages: appraisal of a large region, reconnaissance of selected parts of the region, detailed surface investigation of a target area, three dimensional physical sampling of the target area, development of the mine infrastructure and actual production. These can be grouped into four categories: Reconnaissance, Prospecting, Exploration, and Mine Development. A diagram showing the relationship of these various stages in the life of a mine is shown in Figure C.1.

FIGURE C.1 - MINE LIFE CYCLE DIAGRAM



Source: BLM, 1990

Reconnaissance

Reconnaissance level activity is the first stage in exploring for a mineral deposit. This activity involves initial literature search of an area of interest, using available references such as publications, reports, maps, aerial photos, etc. The area of study can vary from hundreds to thousands of square miles.

Activity that will normally take place includes large scale mapping, regional geochemical and geophysical studies, and remote sensing with aerial photography or satellite imagery. These studies are usually undertaken by academic or government entities, or major corporations.

The type of surface disturbing activity associated with reconnaissance level mineral inventory is usually no more than occasional stream sediment, or soil and rock, sampling. Minor off-road vehicle use may be required.

Prospecting

As the result of anomalous geochemical or geophysical readings, unique geologic structure or feature, occurrence of typical mineral bearing formations, or a historical reference to past mineral occurrence, the prospecting area of interest is identified through reconnaissance. This area may range from a single square mile to an entire mountain range of several hundred square miles.

Activity that will take place in an effort to locate a mineral prospect include more detailed mapping, sampling, geochemical and geophysical study programs. Also this is the time when property acquisition efforts usually begin, and most mining claims are located in order to secure ground while trying to make a mineral discovery. Prospecting on an annual basis is considered a minimum requirement, under the mining laws, to secure a claim.

Types of surface disturbing activity associated with prospecting would involve more intense soil and rock chip sampling using mostly hand tools, frequent off-road vehicle use, and placement and maintenance of mining claim monuments. This activity is normally considered "casual use" (43 CFR 3809.1-2) and does not require BLM notification or approval.

Exploration

Upon location of a sufficiently anomalous mineral occurrence, or favorable occurrence indicator, a mineral prospect is established and is subjected to more intense evaluation through exploration techniques.

Activities that take place during exploration include those utilized during prospecting but at a more intense level in a smaller area. In addition activities such as road building, trenching, and drilling are conducted. In later stages of exploration an exploratory adit or shaft may be driven. If the prospect already has underground workings these may be sampled, drilled, or extended. Exploration activities utilize mechanized earth moving equipment, drill rigs, etc., and may involve the use of explosives.

A typical exploration project in the planning area would require construction of approximately 5,000 feet of access road, establishment of about a dozen drill sites, with several holes at each site drilled to less than 500 feet deep, and possibly several trenches 200 feet by 8 feet by 6 to 8 feet deep. If initial results are encouraging, the exploration program will be expanded to determine the limits of the deposit. Most surface disturbance associated with exploration projects amounts to less than 5 acres and is conducted under a Notice (43 CFR 3809.1-3) and requires the operator to notify BLM 15 days before beginning activity.

Mine Development

If exploration results show that an economically viable mineral deposit may be present, activity will intensify to obtain detailed knowledge regarding reserves, possible mining methods, and mineral processing requirements. This will involve applying all the previously utilized exploration tools in a more intense effort. Once enough information is acquired a feasibility study will be made to decide whether to proceed with mine development and what mining and ore processing methods will be utilized.

Once the decision to develop the property is made the mine permitting process begins. Upon approval, work begins on development of the mine infrastructure. This includes construction of the mill, offices and laboratory; driving of development workings if the property is to be underground mined, or prestripping if it is to be open pit mined; and building of access roads or haulage routes, and placement of utility services. During this time additional refinement of ore reserves is made.

Once enough facilities are in place actual mine production begins. Concurrent with production often are "satellite" exploration efforts to expand the mine's reserve base and extend the project life. Upon completion of, or concurrent with mining, the property is reclaimed. Often subeconomic resources remain unmined and the property is dormant, waiting for changes in commodity price or production technology that would make these resources economic (see Figure C.1).

Activities that occur on these lands include: actual mining, ore processing, tailings disposal, waste rock placement, solution processing, metal refining, and placement of support facilities such as repair shops, labs, and offices. Such activities

involve the use of heavy earthmoving equipment and explosives for mining and materials handling, exploration equipment for refinement of the ore reserve base, hazardous or dangerous reagents for processing requirements, and general construction activities.

The size of mines vary greatly and not all mines would require all the previously mentioned facilities and equipment. Acreage involved can range from several single acres to several hundred, with most projects disturbing more than 5 acres and requiring an approved Plan of Operations (43 CFR 3809.1-4).

HYPOTHETICAL MINING OPERATIONS

Table C.1 shows three hypothetical mining operations that are somewhat representative of possible future development. These operations were derived from known mines and geologic conditions in the area. They are presented only to illustrate the possible variations in mine operations that could occur, and are not intended to be definitive as to mine size, type, processing, or economics. The data in the table is approximated and is presented to illustrate the variety of factors that are involved when evaluating the feasibility of a mining project.

The first two operations are open-pit, gold-silver mines using a cyanide heap leaching process. Two different sizes are shown, one with one million tons of reserves, and another with 10 million tons of reserves. The ore material is placed on lined leach pads and sprinkled with a dilute cyanide solution which dissolves the gold and silver from the ore. The solution is then recovered and the precious metals extracted using zinc precipitation or carbon adsorption, after which the solution is reused. The life of these projects, from discovery to reclamation, is estimated at nine years, with about six years of metal production.

The third operation shown is a small underground mine with an ore deposit of approximately 200,000 tons. The mining rate is 100 tons per day. Mineral processing would include crushing and grinding, with flotation and/or cyanide leaching in tanks or vats. Tailings from the operation would be placed in a lined impoundment. The project life is estimated at 10 years, from discovery to reclamation. Continued exploration in the area could result in additional reserves and extend the mine life.

PLAN OF OPERATIONS APPROVAL PROCESS

The Montana Department of State Lands (DSL), Hard Rock Reclamation Bureau, is the state permitting authority for hardrock operations in Montana. All Plans of Operations required by BLM are reviewed and approved in coordination with DSL.

Often before submitting a proposed Plan of Operation to BLM, or an Operating Permit Application to DSL, the operator will contact the agencies for guidance on specific information or data that should be included in the application. The application is then filed with both agencies who coordinate staffing needs and agency roles for permit review.

Upon receipt the application is reviewed for completeness. A "completeness review" involves identifying any additional data that the operator must provide to allow assessment of impacts, or commitments that must be made by the operator to reduce potential impacts and eliminate unnecessary or undue degradation. Guidance and authorities used during the completeness review process include; FLPMA, RMP, BLM regulations 43 CFR 3809, BLM Reclamation Handbook, and the Montana Cyanide Management Plan. The deficiencies identified during a completeness review are provided to the applicant within 30 days. The applicant then revises their operating plan as appropriate and resubmits it to the agencies for another completeness review. The cycle of completeness review by the agencies, with subsequent modification of the operating plan by the applicant, continues until the application is declared "complete". It is during this process that many mitigating measures get built into the mine plan.

After a complete application is received the environmental analysis is prepared in accordance with both MEPA and NEPA requirements. Depending on the anticipated impacts of the proposal this may be either an EA or an EIS. Typically (but not always) three alternatives are analyzed in the document: the operator's proposal, the operator's proposal with additional agency imposed modifications (usually the preferred alternative), and the no action alternative.

Public comment may be solicited at any time during the process. A public comment period is provided after release of the environmental document. This may vary from as little as 15 days, to more than 90 days, depending on the issues and

interest. Public meetings for scoping and/or comment are held as appropriate.

After the environmental analysis is complete, and the public comments have been considered, the agencies make an approval decision. Conformance with the modified mining and reclamation plans, plus any additional mitigating measures, are conditions of approval.
A reclamation bond amount is calculated based on an engineering evaluation of what it would cost the agencies to reclaim the operation per the approved reclamation plan. The bond must be posted before on the ground disturbance can begin.

Amendments to existing Operating Permits, or Plans of Operations, are processed in a similar manner.

TABLE C.1
HYPOTHETICAL MINING OPERATIONS

	Open Pit #1	Open Pit #2	Underground
Capital Investment Mine	$6,000,000	$18,000,000	$2,300,000
Capital Investment Mill	1,500,000	5,500,000	2,300,000
Total Capital Investment	$7,500,000	$23,500,000	$4,600,000
Reserves (Tons)	1,000,000	10,000,000	200,000
Tons/day	1,000	10,000	100
Grade Au	0.06	0.03	0.35
Grade Ag	0.25	0.15	5.00
Recovery Au	0.70	0.70	85
Recovery Ag	0.40	0.40	0.80
Mine Production Years	4.00	4.00	8.00
Metal Production Years	6.00	6.00	8.00
Days/year operating	270	270	270
Price Au	$400	$400	$400
Price Ag	$6	$6	$6
Operating Costs/Ton Ore	$7	$4	$90
Total Production			
Au (oz)	42,000	210,000	59,500
Ag (oz)	100,000	600,000	800,000
Total Gross Revenue	$17,400,000	$87,600,000	$28,600,000
Average Annual Gross Revenue	$2,900,000	$14,600,000	$3,575,000
Total operate costs	$7,000,000	$40,000,000	$18,000,000
Average Annual Operating Costs	$1,166,667	$6,666,667	$2,250,000
Total Net Revenue	$10,400,000	$47,600,000	$10,600,000
Annual Net Revenue	$1,733,333 (6 yrs.)	$7,933,333 (6 yrs)	$1,325,000 (8 yrs)
Production Employment	25	70	55
Average Annual Wage	$34,900	$34,900	$34,900
Total Annual Wages	$872,500	$2,443,000	$1,919,500
Avg Annual Resource Indemnity Tax	$14,500	$73,000	$17,875
Average Annual Gross Proceeds Tax	$26,363	$69,559	$32,499
Average Annual Metal Mines License Tax	$38,160	$206,640	$54,164
Average Annual Property Tax	$101,197	$169,072	$54,101
Average Annual Total Taxes	$180,220	$518,271	$158,639

Year 1: development of infrastructure
Year 2: mining, pad constr., ore loading
Year 3: ore loading, first Au/Ag production
Year 4: ore loading, Au/Ag production
Year 5: ore loading, Au/Ag production
Year 6: leaching, Au/Ag production
Year 7: leaching, Au/Ag production
Year 8: leaching, Au/Ag production
Year 9: Reclamation

Year 1: Development work & construction
Years 2-9: Ore production
Year 10: Reclamation

Source: BLM, 1990

CURRENT ACTIVITIES

For additional information on current activity see Chapter 3. The number of mining claims in the planning area is given in Table 3.2 in Chapter 3. These numbers include claims located for bentonite. However, bentonite exploration and development is not discussed in this appendix.

It is important to note that while there are over 3,000 mining claims located in the planning area only a small portion (about 10%) of these claims will have any activity above the prospecting level. Many claims are adjacent to known mineralized areas and serve to secure the property from potential rivals. Many of the claims overlap and might cover the same portion of ground. Often blocks of claims are located to serve as a basis for exploration projects. These blocks will naturally cover more area than the initial geology indicates is warranted so as to provide room for possible expansion should the mineral prospects be favorable.

Current Exploration Activity

Little Rocky Mountains

There are currently 12 active exploration projects in the immediate area of the Little Rocky Mountains. Some of these projects are connected with efforts to expand ore reserves for the Zortman and Landusky gold-silver mines. Recently two additional exploration projects were conducted just south of the Little Rocky Mountains in the Thornhill Butte area for precious metals. South of the Little Rocky Mountains there has been prospecting and minor exploration work for diamonds and industrial abrasives, on the diatremes that extend from Thornhill Butte to the Missouri Breaks.

Judith Mountains

There are currently 10 exploration projects active in the Judith Mountains. All are believed to be primarily interested in gold-silver deposits. These projects are in various stages of activity. Several are just proposed and have not initiated on-the-ground disturbances. Others have been reclaimed and are waiting for reclamation bond release. Several are in the process of making a development decision.

North and South Moccasin Mountains

There are two exploration projects active in the North Moccasins. One is adjacent to the active Kendall Mine and would attempt to expand the mines reserves. The other is located away from the mine in the central part of the mountains. In the South Moccasin Mountains BLM records do not show any exploration type disturbance activity being permitted on public lands. There are mining claims located on these lands and several companies are known to be interested in the area. However, activity that is currently taking place is probably limited to mapping, sampling, and survey work, or exploration work on private surface.

Little Belt Mountains

The tracts located in the Yogo Creek area are adjacent the Yogo Sapphire Mine, and have probably been prospected or explored for sapphires fairly recently. Of the BLM lands located along the front of the Little Belt Mountains, from just north of Hughsville east to Yogo Creek, none have any record of permitted exploration activity in recent time. Some level of prospecting activity for precious metals has probably occurred.

Current Mining Activity

Little Rocky Mountains

Mining in the Little Rocky Mountains began in the late 1800s and proceeded intermittently until the 1970s. In 1979 large scale mining began in the Little Rocky Mountains. The ore was found extremely amenable to the cyanide heap leaching process. This is due primarily to the finely disseminated gold particles occurring along natural fractures in the rock, allowing contact between the cyanide and gold without requiring crushing.

The heap leaching process, as used at the Zortman and Landusky mines, involves construction of retaining dikes in

ephemeral drainages, lining the impoundment area with bentonitic shale and PVC, loading mined ore onto the liner, spraying the ore with a weak cyanide solution (0.05%), recovering the gold bearing (pregnant) cyanide solution, and removing the gold from the leachate using either the Merril Crowe or carbon adsorption method (see Figure C.2).

The current operator of the Zortman and Landusky mines is Zortman Mining Inc., a wholly owned subsidiary of Pegasus Gold Corporation of Spokane, Washington. Production from 1979 to present is approximately 900,000 ounces gold and over two million ounces silver, with over 140 million tons or ore mined (see Table C.2).

The Zortman mine consists of 8 valley fill leach pads containing an estimated 20 million tons of ore grading 0.028 opt gold and 0.171 opt silver. Total disturbed acres at the Zortman mine is calculated at approximately 450 acres; about 25% of which is on BLM managed lands.

The Landusky mine consist of 9 valley fill leach pads containing over 120 million tons of ore. One leach pad, constructed in 1987 contains some 40 million tons of ore. Another leach pad to be completed in the next 2 to 3 years will contain 50 million tons of ore. The average ore grade at Landusky is slightly lower than Zortman. Mined ore to date averages 0.022 opt gold and 0.125 opt silver. Total disturbed area at the Landusky mine is calculated at approximately 810 acres; over two-thirds of which occurs on BLM managed lands.

TABLE C.2
LITTLE ROCKIES MINING DISTRICT

Estimated Gold and Silver Production in Troy Ounces

Time Period	Placer Gold	Vein Gold	Vein Silver	Disseminated Deposits Gold	Disseminated Deposits Silver
1860-1905	N/A	N/A	N/A	N/A	N/A
1893-1908	N/A	47,500	N/A	N/A	N/A
1908-1923	N/A	189,500	N/A	N/A	N/A
1928-1948	326	N/A	N/A	N/A	N/A
1924-1942	N/A	123,000	N/A	N/A	N/A
1946-1977	N/A	20,000	est; 1,500,000	10,500	est; 25,000
1979-1987	-	-	-	543,900	1,214,600
1988	-	-	-	111,100	247,400
1989	-	-	-	106,400	223,800
1990	-	-	-	109,600	652,170
Total	326	380,000	1,500,000	881,500	2,362,970

Total Gold Produced: 1,261,826 Troy Oz. *Total Gold Value (current $): $504,730,400
Total Silver Produced: 3,862,970 Troy Oz. *Total Silver Value (current $): $23,177,820

N/A: Not Available
* Assumes Gold @ $400/Tr.Oz. & Silver @ $6/Tr.Oz.

Source: Table Modified from Krohn and Weist, 1977; & Rogers and Enders, 1982.
Zortman Mining, Inc., 1991

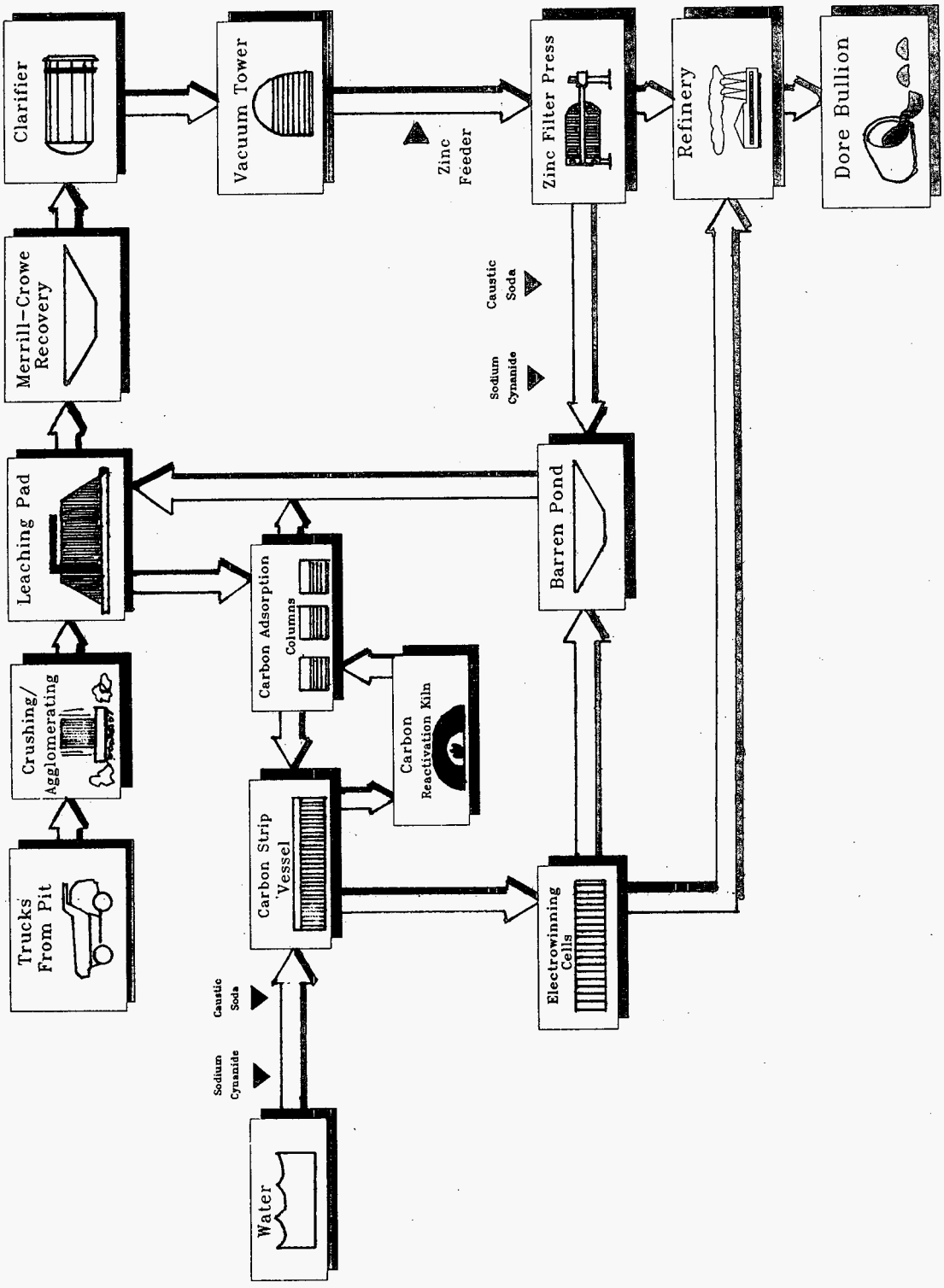
Judith Mountains

Active mining in the Judith Mountains currently consists of the Gies Mine in the upper reaches of Ford's Creek operated by Blue Range Mining Company. Other mines in the Judith Mountains are either temporarily abandoned, or in the early development and permitting phase.

North and South Moccasins

The Kendall Mine, in the North Moccasin Mountains, is an open pit, cyanide heap leach, gold and silver operation recently permitted in the historic Kendall mining district. Approximately 12 million tons of ore will be heap leached in the next 8 years.

Figure C.2 Heap Leaching Flow Sheet



Little Belt Mountains

Sapphire mining in the Yogo Gulch area is conducted intermittently by Roncor Inc. This property is currently under litigation but is continuing operations on a small limited basis.

FUTURE TRENDS and ASSUMPTIONS

This section discusses anticipated future trends and assumptions that will be made when predicting future hardrock activity in the planning area.

Commodities Produced

The major commodity of interest will continue to be the precious metals, gold and silver. This is based on a combination of price (especially gold), and favorable geology for mineral occurrence.

Minor base metal production will occur in association with precious metals but is not expected to be a significant factor in mine economics (this assumption does not include development of the metalliferous Heath oil shale for two reasons: one it's low development potential, and two, it is not a hardrock mineral occurrence within the meaning of this study).

Sapphires from the Yogo area will continue to be a commodity of interest. The diatreme structures in Phillips County will continue to attract the interest of explorationists searching for diamond occurrences and other possible associated mineralization.

Technology

Advances in technology will have a substantial affect on future mineral exploration and development. Advances in geophysical and geochemical survey methods and procedures will take place at a rapid rate. Computerization of exploration data will increase with more sophisticated geologic modeling methods being available to the average user. Large advances in satellite imagery, and utilization of remote sensing data, will be made as more and better equipment are placed into orbit. The effect of these advances will be a more accurate and rapid evaluation of regional and local areas with better discrimination of target areas, and a more accurate assessment of the deposits potential.

Mining and mineral processing efficiency will continue to improve in the future. This is due to advances in general technology being made available to the mining industry. A large amount of knowledge will continue to be gained with experience. This is especially true in the area of heap leaching technology which is barely two decades old. A large amount of metallurgical research is currently being done both by industry, and government agencies, such as the federal and state bureau of mines. The results are expected to improve leaching efficiency and recovery rates; and develop methods for recovery from ores that are currently not amenable to leaching.

Reclamation has come of age in the last 15 years in response to growing environmental concern among the public. Reclamation science will continue to advance due to experience and research. More detailed design effort will be placed on reclamation of mined lands in the future. This will result in an overall increase in reclamation costs. These costs should pay dividends in the long-term with increased reclamation success.

Commodity Markets

The economics of mining in the planning area will be driven by the relationship between gold production costs and market price. Though more silver is often produced than gold it is the relatively high unit value of gold that will be critical in establishing the economic viability of mining. While production costs can be controlled, or anticipated, through management and technology, the big unknown will be in the price of gold. The overall profitability of an operation, and hence the level of activity at the prospecting, exploration, and mining phases, for development of gold ore bodies will be closely related to the price of gold.

The price of gold and silver has varied considerably in the past (see Table C.3 and Figure C.3). This is due to the deregulation of government price controls letting the commodities adjust to their true market values.

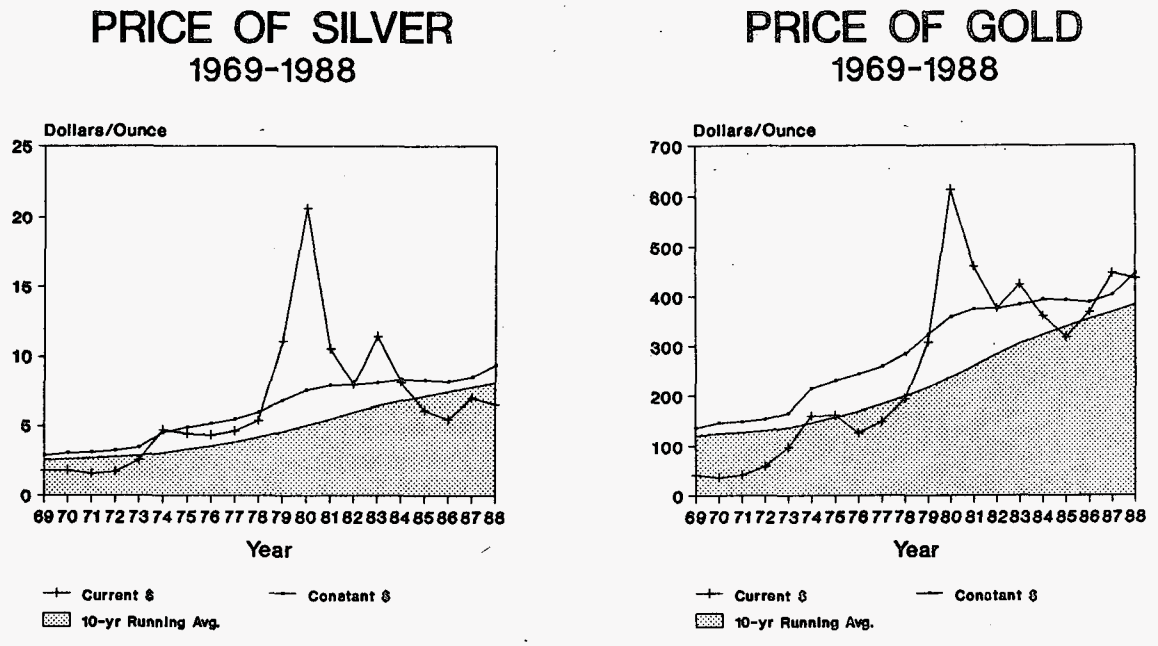
TABLE C.3
GOLD AND SILVER PRICES

		Gold Prices 1960 - 1988				Silver Prices 1960 -1988		
Year	PPI* (Metals)	Gold (Cur $)	Gold (Con $)	10-yr Avg.	Year	Silver (Cur $)	Silver (Con $)	10-yr Avg.
1960	0.306	35.00	115.06		1960	0.91	2.43	
1961	0.305	35.00	114.68		1961	0.91	2.42	
1962	0.302	35.00	113.56		1962	1.09	2.40	
1963	0.303	35.00	113.93		1963	1.28	2.41	
1964	0.311	35.00	116.94		1964	1.29	2.47	
1965	0.320	35.00	120.32		1965	1.29	2.54	
1966	0.328	35.00	123.33		1966	1.29	2.61	
1967	0.332	35.00	124.84		1967	1.55	2.64	
1968	0.340	41.39	127.84		1968	2.15	2.70	
1969	0.360	41.30	135.36	120.59	1969	1.79	2.86	2.55
1970	0.387	36.18	145.52	123.63	1970	1.77	3.08	2.61
1971	0.394	41.01	148.15	126.98	1971	1.55	3.13	2.68
1972	0.409	58.40	153.79	131.00	1972	1.68	3.25	2.77
1973	0.440	97.60	165.44	136.15	1973	2.56	3.50	2.88
1974	0.570	160.01	214.33	145.89	1974	4.71	4.53	3.08
1975	0.615	161.21	231.25	156.98	1975	4.42	4.89	3.32
1976	0.650	125.34	244.41	169.09	1976	4.35	5.17	3.57
1977	0.693	148.32	260.57	182.67	1977	4.62	5.51	3.86
1978	0.753	193.53	283.14	198.19	1978	5.42	5.98	4.19
1979	0.860	307.62	323.37	217.00	1979	11.09	6.83	4.59
1980	0.950	612.51	357.21	238.16	1980	20.63	7.55	5.03
1981	0.996	459.62	374.51	260.80	1981	10.52	7.92	5.51
1982	1.000	376.01	376.01	283.02	1982	7.95	7.95	5.98
1983	1.018	423.83	382.78	304.76	1983	11.44	8.09	6.44
1984	1.048	360.29	394.06	322.73	1984	8.14	8.33	6.82
1985	1.044	317.30	392.55	338.86	1985	6.14	8.30	7.16
1986	1.032	367.84	388.04	353.22	1986	5.47	8.20	7.47
1987	1.071	446.41	402.71	367.44	1987	7.00	8.51	7.77
1988	1.187	436.07	446.32	383.76	1988	6.56	9.43	8.11
1989	--	382.69			1989	5.55		

* Producer Price Indexes from Statistical Abstract of United States 1989

Source: Gold and silver prices from EM&J (Handy & Harmon, NY)

Figure C.3 Price of Gold and Silver.



Source: Gold and silver prices from EM&J (Handy & Harmon, NY)

The supply and demand for gold, and ultimately the price, are determined by many factors. On the supply side, production costs must be lower than price for firms to earn a profit. Relatively low-grade deposits, which were previously uneconomical to mine, have become profitable resources to develop due to the emergence of new production techniques in the past 15 years. Thus supply has been increasing while the relative cost of production generally has declined. However, the profitability of these mining processes has increased the number of suppliers worldwide and made the market more competitive.

The demand for gold, primarily for jewelry/investment purposes, has been increasing over the same time period. Factors influencing the demand for gold, both nationally and internationally, include the growth of disposable income, inflationary expectations, international stock market activity, the value of the US dollar relative to other currencies, and political events such as increased instability in Eastern Europe and the Middle East. Thus the demand for gold is volatile and difficult to predict with any certainty.

There are several issues which will most likely contribute to strong gold prices in the 1990s, though to what extent is unknown. First, the evolution toward more democratic rule in Eastern Bloc countries will likely play a role both in future demand and supply. Additionally, the creation of a unified European Community in 1992 that eliminates trade barriers between western European countries may also play a part. "Finally, the growth in the eastern European markets and speculation about a new monetary role for Soviet supplied gold will help stimulate a bull market." (E&MJ, March 1990).

The increasing price trend shown in Table C.3 is expected to continue, but at a slower pace. For the purposes of the analysis the price of gold is assumed to remain near, or somewhat above, about $400 per troy ounce in 1990 dollars. Silver is assumed to remain between $5 and $7 per troy ounce in 1990 dollars.

Legislative Changes

There are several areas of legislative change that may affect how the hardrock mineral resources in the planning area are developed.

The first is the on going effort to amend, repeal, or reform the Mining Law of 1872. This could result in anything from simply leaving it as is, to a complete restructuring into a leasing/royalty system similar to that now used for coal or oil and gas. The effect of major changes in the mining law on mineral activity would be a decrease in the amount of exploration activity undertaken by small operators if the right of self initialization is lost. Another perhaps more extensive affect would be a decrease in the ultimate number and size of mines that could be developed. This is because a royalty on mineral production would generate a corresponding increase in operating costs which in turn would raise the cut-off ore grade making some currently economic deposits uneconomic, or reducing the size or minable depth of other deposits.

Changes in the way mining property and production is taxed could also have a substantial effect on the viability of individual operations. No changes in state tax schedules are anticipated. No federal royalty is assumed in this analysis.

Another area of possible legislative change is in environmental laws or regulations which would affect exploration and mining activity. There is an increased level of public awareness on environmental matters which is expected to continue into the future. This will result in stricter compliance and enforcement of existing regulations by state and federal agencies. New regulations are proposed by EPA that would regulate mining wastes under Subtitle D of the Resource Conservation and Recovery Act (RCRA). This new program is expected to go into effect sometime in the mid 1990s. This would increase mine permitting costs and operation. It also may cause some marginal operations to become uneconomic.

For purposes of analysis it is assumed that the mining law could be changed, but the right of self initialization will be maintained, and there will be no federal royalty system imposed. It is also assumed that permitting procedures and compliance requirements will be stricter in the future. State taxation schedules will remain constant.

DEVELOPMENT AND ACTIVITY POTENTIAL

Supplemental Color Maps J, K and L at the conclusion of the Appendices shows the development potential for hardrock mineral resources in the Little Rocky Mountains, Judith and Moccasin Mountains, Little Belt Mountains and Yogo Gulch

Area. The areas are classified into four categories for development potential: very low, low, moderate, and high. The term development potential as used in this document refers to the potential of the lands to support actual mine development. It is dependent on a variety of factors which include geology, engineering, and economics. It should not be confused with occurrence potential which indicates only whether the geology is favorable for mineral occurrence in anomalous amounts. All of the lands in the moderate and high development potential areas have high occurrence potential for hardrock mineral resources.

The development potential of these lands can be correlated with the types of activity and mine life cycle diagram Figure C.1 and discussed under Development Of A Mine. A description of development potential and associated level of activity follows.

Very Low or Unknown Development Potential/Reconnaissance Level Activity

The vast majority of lands in the planning area are in this category and have either little, or unknown potential, for hardrock mineral development. Geologic conditions are not favorable for mineral occurrence, or geologic data is insufficient to support a determination. Activities that will occur on these lands is at the reconnaissance level as described under: Development Of A Mine-Reconnaissance. There is usually negligible surface disturbance associated with this level of activity.

Low Development Potential/Prospecting Level Activity

Lands in this category have geologic conditions moderately favorable for mineral resource occurrence, or have recent claim staking or property acquisition activities. These lands may contain mineral resources but cannot be put into a moderate or high development potential category due to lack of evidence indicating mineralization, in either quality or quantity, that would warrant further consideration for development. Prospecting activities will occur on these lands as described under: Development Of A Mine-Prospecting. If prospecting identifies sufficiently anomalous mineral conditions these lands move into the moderate development potential category.

Moderate Development Potential/Exploration Level Activity

Lands in this category exceed the requirements for Low Development Potential by having recent or anticipated exploration activity and/or a prospect identified requiring more intense exploration methods. These lands have high to very high mineral occurrence potential. Activities that will occur on these lands can involve use of mechanized earthmoving equipment and is described under: Development Of A Mine-Exploration. Targets typically remain in this category only briefly. If an exploration program is unsuccessful the lands drop back to the prospecting level until a new prospect is generated or economic conditions change. If an exploration program is successful further exploration will follow, and the lands may eventually be placed in a high development potential category.

High Development Potential/Mining Level Activity

Lands in this category exceed the requirements for moderate development potential and contain proven, probable or inferred ore reserves and/or are within, or potential additions to, the permit area of a proposed or operating mine. Activities that will occur on these lands are described under: Development Of A Mine-Mine Development and can vary greatly in type and size.

Once an ore body has been recovered from a property final reclamation is completed; or the property is placed on standby, awaiting changes in technology or economic conditions, that may allow for further development.

FUTURE ACTIVITY

Exploration Projections

This section estimates the number of exploration projects that could occur in specific geographic areas.

Little Rocky Mountains

In the foreseeable future 40 exploration projects are anticipated for the Little Rocky Mountains and surrounding area. These projects would consist of road building and drilling similar to that performed in the past. The activity would not all occur simultaneously. At any one time an estimated 10 to 12 projects will be in one of the following stages: initial evaluation, actual construction and drilling, held open for study, or in the reclamation phase. Average disturbance would be less than 5 acres per project. This would amount to a total disturbance of about 200 additional acres due to exploration in the Little Rocky Mountains. The intent of exploration will vary: to evaluate new mineral prospects identified by surface study, to expand resource delineation on existing projects, and to expand reserve delineation adjacent to the existing mines.

It is estimated that 85% of the exploration activity would occur within the high and moderate development potential areas shown in Supplemental Color Map J located at the conclusion of the Appendices. The remaining 15% could occur in the area having low development potential.

Judith Mountains

In the foreseeable future 40 exploration projects are anticipated for the Judith Mountains. These projects would consists of road building and drilling similar to that performed in the past. Several would involve driving of exploration adits in new or existing underground workings. The activity would not all occur simultaneously. At any one time an estimated 8 to 10 projects will be in one of the following stages: initial evaluation, actual construction and drilling, held open for study, or in the reclamation phase. Average disturbance would be less than 5 acres per project. This would amount to a total additional disturbance of about 200 acres due to exploration in the Judith Mountains. The intent of exploration will vary: to evaluate new mineral prospects identified by surface study, to expand resource delineation on existing projects, and to expand reserve delineation adjacent to the existing mines.

It is estimated that 85% of the exploration activity would occur within the high and moderate development potential areas shown in Supplemental Color Map K located at the conclusion of the Appendices. The remaining 15% could occur in the area having low development potential.

North and South Moccasins

Twenty future exploration projects are anticipated for the North and South Moccasin Mountains. The majority of the activity is expected to be concentrated in the North Moccasins, though it is expected at least several fairly intense exploration projects would be targeted in the South Moccasins. The projects would consists of road building and drilling similar to that performed in the past. The activity would not all occur simultaneously. At any one time an estimated 5 projects would be in one of the following stages: initial evaluation, actual construction and drilling, held open for study, or in the reclamation phase. Average disturbance would be less than 5 acres per project. This would amount to an additional disturbance of about 100 acres due to exploration. The goal of the activity will vary: to evaluate new mineral prospects identified by surface study, to expand resource delineation on existing projects, and to expand reserve delineation adjacent to the existing Kendall Mine.

It is estimated that 80% of the exploration activity would occur within the high and moderate development potential areas shown in Supplemental Color Map K located at the conclusion of the Appendices. The remaining 20% could occur in the area having low development potential.

Little Belt Mountains

About 10 exploration projects are anticipated for the BLM lands adjacent the Little Belt Mountains. Most of the activity will be concentrated in the Yogo Gulch area, trying to expand the known occurrence area of sapphires. Other exploration for metal deposits is anticipated on the tract north of Hughsville. These projects would consist of road building and drilling to evaluate metal potential of the several tracts along the front of the mountains. Other projects would use earthmoving equipment such as bulldozers or backhoes to explore the area near the sapphire mines for additional reserves. This activity would not all occur simultaneously. At any one time an estimated 2 to 4 projects would be in one of the following stages: initial evaluation, actual construction and drilling, held open for study, or in the reclamation phase. Average disturbance would be less than 5 acres per project. This would amount to a total additional

disturbance of about 50 acres due to exploration in the area. The intent of the exploration will vary: to evaluate new mineral prospects identified by surface study, to expand resource delineation on existing projects, and to expand reserve delineation adjacent to the existing mines.

It is estimated that 80% of the exploration activity would occur within the high and moderate development potential areas shown in Supplemental Color Map L located at the conclusion of the Appendices. The remaining 20% could occur in the area having low development potential.

Mining Projections

This section projects the number of mines that could be expected to develop as a result of prospecting and exploration activity. It includes expansion of existing mines, development of known resource occurrences, and development of as yet undiscovered ore bodies. The hypothetical mine types shown in Table C.1 could be applicable when considering development of new deposits.

Little Rocky Mountains

Future mining projections include development of the mineralized sulphide (nonoxidized) ore underlying the currently mined oxide ore at both the Zortman and Landusky operations. This could require a change in operation by addition of a crushing and grinding circuit, processing of ore using flotation cells and agitation leach tanks, and disposal of mill tailings in impoundments. The existing heap leach facilities would also be greatly expanded as the majority of the sulphide material would be heap leached in a manner similar to that used for the oxidized ore.

Foreseeable development at the Zortman and Landusky operations would occur in the same general area as the existing mines. Long-term development of the unoxidized mineral resources would occur in two stages. The Zortman Mine would be expanded first, followed in 2 to 5 years by expansion at the Landusky Mine. These expansions could extend the mine-life of the projects by 20 years (Zortman Mining, 1990).

The existing mine pits would be expanded and deepened. Additional drilling is needed to determine ultimate reserves and pit limits. As a result of mining the unoxidized ore, additional, interspersed, oxide ore would also be mined. Mine production would be at about 50,000 tons/day for 350 days per year and employ the same mining techniques presently in use.

If unoxidized ore were to be milled it would be crushed to minus 5-8" and screened. Oversized screen material would be crushed again to minus 1/2" and heap leached. Fines would be fed to a mill and ground to 80% minus 150 mesh, then sent to a flotation circuit. In the flotation circuit chemicals are added that allow selective attachment of air bubbles to the unoxidized minerals in the ore slurry. The bubbles, with the minerals attached, rise to the top of the flotation cell and are collected as concentrate. This concentrate would either be sold directly to the smelter, or undergo further processing (oxidation) to allow on site recovery of the gold. The tailings from the flotation section would proceed to standard cyanide agitation leach tanks for recovery of residual gold values. The tailings from the agitated leach circuit would require placement in a tailings impoundment.(Zortman Mining, 1990)

The addition of a mill would require an increase of workforce of less than 50 workers (Zortman Mining, 1990). Presumably if the two mills were to operate simultaneously an additional 100 employees may be required.

Zortman Operation

Several leach pad sites would be required to contain anticipated ore. A capacity of 80 to 110 million tons is estimated. This would cover about 160 to 280 acres. A tailings impoundment would be needed to contain the tails from the agitation leach circuit. This would cover about 100 acres. A new plant/mill facility would be constructed on about 30 acres. Waste rock storage for 60 million tons of material over about 130 acres is necessary. Expansion of this mine would also involve construction of process ponds, ore conveyors, pipelines, access roads, and maintenance facilities.

Two additional oxide ore bodies in the Zortman Mine area have been identified for possible development in conjunction with the nonoxidized ore. Development of the Antoine Butte deposit could take place in approximately 5 years. This deposit occurs in fractured porphyry intrusive and Precambrian gneiss. Some 6 to 8 million tons of potentially minable

material has been identified in this area. In the Pony Gulch area 1.5 to 2 million tons of potentially minable material has been identified in the Paleozoic limestones (Zortman Mining, 1990).

Landusky Operation

Additional leach pad capability would be required to contain anticipated ore at the Landusky Mine. A capacity of about 40 million tons is needed, with additional area dependent on development drilling. This would cover about 100 to 150 acres. A tailings impoundment would be needed to contain the tails from the agitation leach circuit. This would cover about 50 acres. A new plant/mill facility would be constructed in the West August pit area. Waste rock storage for 30 million tons of material over about 95 acres is also necessary. Expansion of this mine would also involve construction of process ponds, ore conveyors, pipelines, access roads, and maintenance facilities.

There is also potential for the discovery of new ore bodies in the Little Rocky Mountains, apart from the existing mines, that would require new development facilities. Assuming a fairly optimistic success rate of 10% for the anticipated 40 exploration projects would result in development of 4 new ore bodies, two adjacent existing operations and two somewhere in the Little Rocky Mountains vicinity. These deposits would most likely all be developed by open-pit mining methods.

The future for mining in the Little Rocky Mountains is shown in Table C.4.

TABLE C.4
FUTURE MINING IN THE LITTLE ROCKY MOUNTAINS

Continued existing mines	2	Zortman & Landusky mines
Sulphide ore development	2	Zortman & Landusky mines
Known oxide development	2	Antoine Butte & Pony Glch
New oxide ore discoveries	2	Adjacent existing mines
New ore discoveries	2	Beyond current mine areas
Total	10	Expanded or newly developed ore bodies

Source: BLM, 1990

It should be noted that of the 10 mining projects anticipated during the study period only two are expected to occur beyond the currently active mining areas. The other 8 represent continued or expanded operation near the Zortman and Landusky mines.

It is expected that 80% of the future mine development listed in Table C.4 would take place within the area shown in Supplemental Color Map J (located at the conclusion of the Appendices) as having high development potential. The remaining 20% of new development would be expected to occur somewhere in that area having moderate development potential. Mine development in the areas identified as low development potential could still occur, but would not be very probable.

Judith Mountains

Mining in the Judith Mountains will expand in the future. Ongoing underground precious metal mining will resume at the Spotted Horse Mine in Maiden Canyon, and the Gies Mine in upper Ford's Creek. Other mining projects expected to be brought into production soon are Blue Range's Virgin Gulch Mine in the Giltedge area, and the AMAX Linster Peak project.

Blue Range Mining Company operated two mines and a mill in the area. The Gies Mine is a 150 tpd underground gold and silver mine that employs about 36 people. The ore is shipped to the mill located at Heath for processing. The Virgin Gulch Mine is a 250 tpd underground gold and silver mine that is not yet in full operation pending permit approval. This mine would employ 17 people. Ore from this mine would also be shipped to the mill at Heath for processing. A cyanide circuit was added to improve recovery. Tailings from the Heath mill are disposed of in the old underground workings of the adjacent gypsum mine. This mill will employ 20 people (Blue Range Mining Co.LP, 1989). These operations are currently suspended but are expected to reopen in the future and will rely on continued exploration to maintain ore reserves.

In the historic Giltedge area mining is expected to resume with additional open pit development.

The Spotted Horse Mine has a history of operating on an intermittent basis. It is currently shut-down due to financial difficulties. During its last period of operation the mine was to produce 50 tpd (actual production may have been lower) of gold and silver ore. The mine employed approximately 58 people (Chelsea Resources, 1988). It is expected that this operation will restart in the future, and perhaps exceed past production levels.

The Linster Peak project is in an area that has seen historic mining activity. Recent exploration has outlined an ore body that is a likely target for underground mining. This project is expected to be developed, probably within 1 to 2 years. The ultimate size and life of the mine is not known, and is dependent on further exploration. The mine would probably be in the 100 tpd range, and employ more than 50 people.

Additional mining projects that could be generated from exploration activity would also occur. Based on a fairly optimistic success rate of 10% for the anticipated 40 exploration projects, four new ore bodies would be identified. Of the four future discoveries one, and possibly two, would require open pit mining methods for development. The future for mining in the Judith Mountains is therefore anticipated as shown in Table C.5.

TABLE C.5
FUTURE MINING IN THE JUDITH MOUNTAINS

	1	Gies Mine, reopen underground
	1	Spotted Horse Mine, reopen, underground
	1	Giltedge, reopen, open-pit
	1	Virgin Gulch , new underground
	1	Linster Peak, new underground
	4	Future unknown mines from discoveries (2 open-pit, 2 underground)
Total	9	Developed ore bodies.

Source: BLM, 1990

The nine development projects anticipated do not include the Heath mill. This mill is expected to operate in conjunction with mining by the Blue Range Mining Company and could be used as a custom mill for ore mined from other properties in the area.

It is expected that 80% of the mine development listed in Table C.5 would take place within the area shown in Supplemental Color Map J (located at the conclusion of the Appendices) as having high development potential. The remaining 20% would be expected to occur somewhere in that area having moderate development potential. Mine development in the areas identified as low development potential could still occur, but would not be very probable. Activity in the low development potential areas would most likely remain at the exploration level.

North and South Moccasin Mountains

Mining at the Kendall mine in the North Moccasins is expected to continue throughout the study period. The recently approved Plan of Operations for the mine was a comprehensive life-of-mine plan representing optimum geologic and economic conditions. The mine plan should not require major modification for 5 to 8 years unless conditions change considerably. Some very tentative production estimates supplied by CR Kendall, the mine operator, are as shown in Table C.6.

TABLE C.6
PRODUCTION ESTIMATES FOR THE KENDALL MINE

Year(s)	Gold (tr.oz.)	Silver (tr.oz.)
1981-87(total)	5,000	5,000
1988	4,350	11,500
1989	30,000	23,000
1990	34,000	34,000
1991-97 (annual)	50,000	25,000
1998-2000 (annual)	15,000	7,500
2001-2005 (annual)	5,000	2,500

Source: CR Kendall, 1992

There is also the potential for the discovery of new ore bodies in the North and South Moccasins. If an optimistic success rate of 10% is assumed for the anticipated 20 exploration projects then two new ore bodies would be discovered and developed. These two new projects can be hypothetically located with one occurring in the North Moccasins, and another in the South Moccasins. This development would most likely take place in the areas identified in Supplemental Color Map J (located at the conclusion of the Appendices) as having high or moderate development potential. These deposits would probably require open pit mining methods for development.

Small scale placer work on the west side of the North Moccasins is expected to continue on an intermittent basis during the study period. No major change in operation is anticipated for these deposits.

Little Belt Mountains

Sapphire mining in the Yogo Creek area of the Little Belt Mountains is expected to continue on an intermittent basis throughout the study period. If an optimistic success rate of 10% is assumed for the anticipated 10 exploration projects then one new ore body would be discovered and developed. This would probably expand the area of mining in the gulch along the trend of the yogo dike, to the east. No mining activity is anticipated for the BLM tract north of Hughesville, and the tract in Running Wolf Creek (see Supplemental Color Map K located at the conclusion of the Appendices). Activity on these lands is expected to be at the exploration level.

VARIATION BY ALTERNATIVE

The previous projections of exploration and development activity were based on the current management of the planning area or Alternative A. This section shows the variation in number and type of exploration and mining projects that are anticipated under each of the other alternatives and how those differ from that under current management.

Alternative B

The activity levels that are predicted under Alternative B are essentially the same as would occur under Alternative A (see Table C.7).

TABLE C.7
PROJECTIONS OF EXPLORATION AND DEVELOPMENT ACTIVITY

	Alt. B	Alt. C	Alt. D	Alt. E
Little Rocky Mountains				
Exploration projects	40	40	16	40
Existing open pit operations (Zortman & Landusky Mines)	2	2	2	2
New sulphide ore developments, open pit	2	2	2	2
Known oxide ore developments (Antoine Butte & Pony Gulch)	2	2	2	2
New oxide open pit discoveries near existing mines	2	2	1	2
New unknown discoveries, open pit, new areas	2	2	1	2
Judith Mountains				
Exploration projects	40	30	7	35
Gies Mine with Heath Mill, reopen underground	1	1	1	1
Spotted Horse Mine, Reopen, underground	1	1	1	1
Giltedge, reopen, open-pit	1	1	1	1
Virgin Gulch , new underground development	1	1	1	1
Linster Peak, new underground development	1	1	1	1
Future unknown mines from discoveries (open-pit)	2	1	0	1
Future unknown mines from discoveries (underground)	2	1	0	2
North and South Moccasins				
Exploration projects	20	20	10	20
Existing open pit operation (Kendall Mine)	1	1	1	1
Future unknown open-pit mine from discovery in North Moccasins	1	1	1	1
Future unknown open-pit mine from discovery in South Moccasins	1	0	0	1
Little Belt Mountains				
Exploration projects	10	10	10	10
Expand existing sapphire mining operation	1	1	1	1

Source: BLM, 1990

Alternative C

About the same development level as in Alternatives A and B. The general nature of the restrictions would account for timing delays which will slow exploration and mine permitting, and could seriously affect project feasibility (see Table C.7).

Alternative D

This alternative would be the most restrictive on hardrock mineral exploration and development with 60% of the high development potential lands, and 72% of the moderate development potential lands, in the Judith RA closed to mineral entry. In the Phillips RA most of the high development potential areas would remain open, but 36% of the moderate development potential lands would be closed. In the Judith Mountains 97% of high development potential lands withdrawn. 81% of moderate development potential lands withdrawn. Severe impact on existing operations and on any future exploration. In the North and South Moccasins 28% of the moderate development potential lands are withdrawn in the North Moccasins and 77% of the moderate development potential lands are withdrawn in the South Moccasins. All closures would be subject to valid existing rights.

Alternative E (Preferred Alternative)

Key designations include the Judith Mountains Scenic Area ACEC. The general nature of the restrictions would account for timing delays which will slow exploration and mine permitting, and could seriously affect project feasibility. Five exploration projects could possibly be forgone in the Judith Mountains. One potential large scale open-pit mine could possibly be forgone in the Judith Mountains Scenic Area ACEC. (see Table C.7).