# FIRE CREEK PROJECT
Lander County, NV

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Geology, Ore Reserves,
Production Cost Estimates,
& Feasibility Study

#3

April 27, 1987

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ITEM:
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KLONDEX MINES LTD.
14 KNOLLWOOD ROAD
EASTCHESTER, N. Y. 10709

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# 2.0 INTRODUCTION

## 2.1 Project Description

The Fire Creek Project is a small gold deposit in Lander County, Nevada, about six miles northwest of the settlement of Crescent Valley. It is currently leased by Alma American Mining Corporation (AAMC). The ore occurs in a steep-dipping argillized, silicified shear/fault/fissure zone in Tertiary andesite. The zone strikes about N 15° W and extends over a known distance of some 3,000 feet.

The deposit is located on an 810-acre property comprised of 656 acres of unpatented lode claims, 94 acres of owned fee minerals and surface, and a 60-acre lease of surface and minerals. The property is controlled by Klondex Gold and Silver Mining Co., from whom AAMC has a mining lease.

Elevations range from about 5,500 to 6,500 feet across the property. The topography is mostly gentle-to steep-sided hills and valleys. Fire Creek, which originates from springs near the west edge of the property and disappears near the easternmost property block, is the only perennial stream. The valley of Fire Creek is the dominant physiographic feature. The weather is reported to be somewhat milder than the average for northern high plains, with severe winter temperatures and snowfall usually occurring sporadically in the months of December, January, and February.

Drilling by AAMC and previous operators has delineated shallow ore grade mineralization in five steep-dipping zones over a 1,500-feet length, with some potential for extensions. Prior mining and leaching tests have demonstrated a potential for profitable open pit mining and heap leaching.

A small pit, leach pad, water tank and ponds, and roads are all that remain from previous operators. Klondex controls water rights for all of the Fire Creek flow, adequate for a small leach operation. Access to the property is by five miles of unimproved dirt road west from County Highway 306. The nearest habitations are in Crescent Valley; the only other surface use on or near the property is livestock grazing.

## 2.2 Property Situation and Terms

The earliest claim of record (Big Ox Lode) was staked on the deposit in 1933, apparently covering land staked preceding the Railroad land grant in Section 15. Since overstaked and held by the Red Hills claim, the land is U. S. Government land, even though it lies in a railroad land grant section.

Subsequent lode claims were staked and recorded in the area by various parties from 1960 through 1983. During the period from 1979 through 1983, Klondex Gold and Silver Mining Co. acquired by assignment, purchase, lease, staking and quiet title action, control of the entire Fire Creek Project. A preceding owner, Dead Broke Mining Co. (DBMC), retained a royalty interest ($1,000.00 per month, minimum advance royalty and 5% NSR production royalty) on certain Yes claims.

Klondex leased its entire Fire Creek holdings to AAMC in July, 1986, subject to the following terms and conditions:

a) Payment to Klondex of an initial advance minimum royalty payment of $25,000. Creditable against production royalties.

b) A minimum development expenditure of $100,000 (which has been performed).

c) March, 1987, through June, 1988: Payment to Klondex of a minimum monthly advance royalty equal to the value of 10 ounces of gold (average London p.m. price fix for previous month). Creditable against production royalties.

d) July, 1988, onward: Payment to Klondex of a minimum monthly advance royalty equal to the value of 15 ounces of gold, (average London p.m. price fix for previous month). Creditable against production royalties.

e) Beginning March 1, 1987: Payment to DBMC of a minimum advance royalty of $1,000.00 per month. Creditable against production royalties from production on DBMC claims.

f) Production royalties:

-To Klondex - on non-DBMC claims

| Gold Price ($1 oz.) | Gross Royalty |
|---|---|
| <$375 | 5% |
| 375-399.99 | 7-1/2% |
| 400-424.99 | 10% |
| 425-499.99 | 12-1/2% |
| >500 | 15% |

-To Klondex on DBMC Yes claims: 2-1/2% of NSR
-To DBMC on DBMC Yes claims: 5% of NSR

g) Instead of the royalty in (f), Klondex has the option to take a flat 5% gross royalty, plus 30% of net profits, if it elects to contribute 30% of project capital requirements.

Subsequent to the Klondex-AAMC lease agreement, Klondex leased a 60 acre tract of fee land (the McCarthy Lease) in the N1/2SE1/4 Section 15. This lease has been assigned to AAMC. Minimum advance royalty is $1,000.00 per year for the first 3 years, $2,000.00 per year for the next 3 years. Production royalty is 2 1/2% of net returns, payable to the McCarthys.

The Klondex-AAMC lease also includes 30 acres of fee land in the SE1/4 of Section 23, about 3/4 miles east of the main Fire Creek Property; and 2 lots in the Crescent Valley townsite; and grants AAMC the right to use Klondex's water rights on Fire Creek.

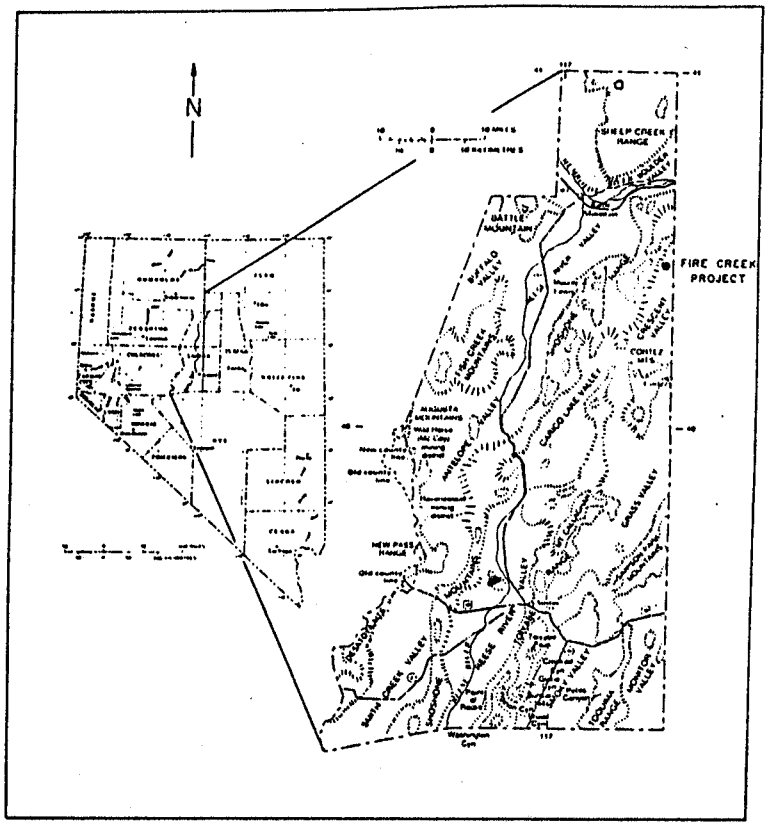
In January, February and March, 1987, Klondex and AAMC, between them, staked lode claims covering all of Section 26, southeast of the Fire Creek Property. Although includeable in the project at AAMC's option, this land has not been formally incorporated at present into the Fire Creek Property; no production is presently anticipated, and this block of claims is not included in the study on which this report is based.

The Fire Creek Property, as defined for this report, is listed below and shown in Figure 2.2 on page 6.

| Description | Location (1) | Acres (approx.) |
|---|---|---|
| Klondex Unpat. Lode Claims | Sections 22 & 15 | 576 |
| DBMC Unpat. Lode Claims | Section 22 | 80 |
| Klondex Fee Land | Section 15 | 64 |
| Klondex Fee Land | Section 23 | 30 |
| McCarthy Fee Land | Section 15 | 60 |
| Townsite Lots | (Not included in acreage) | -- |
| TOTAL | | 810 |

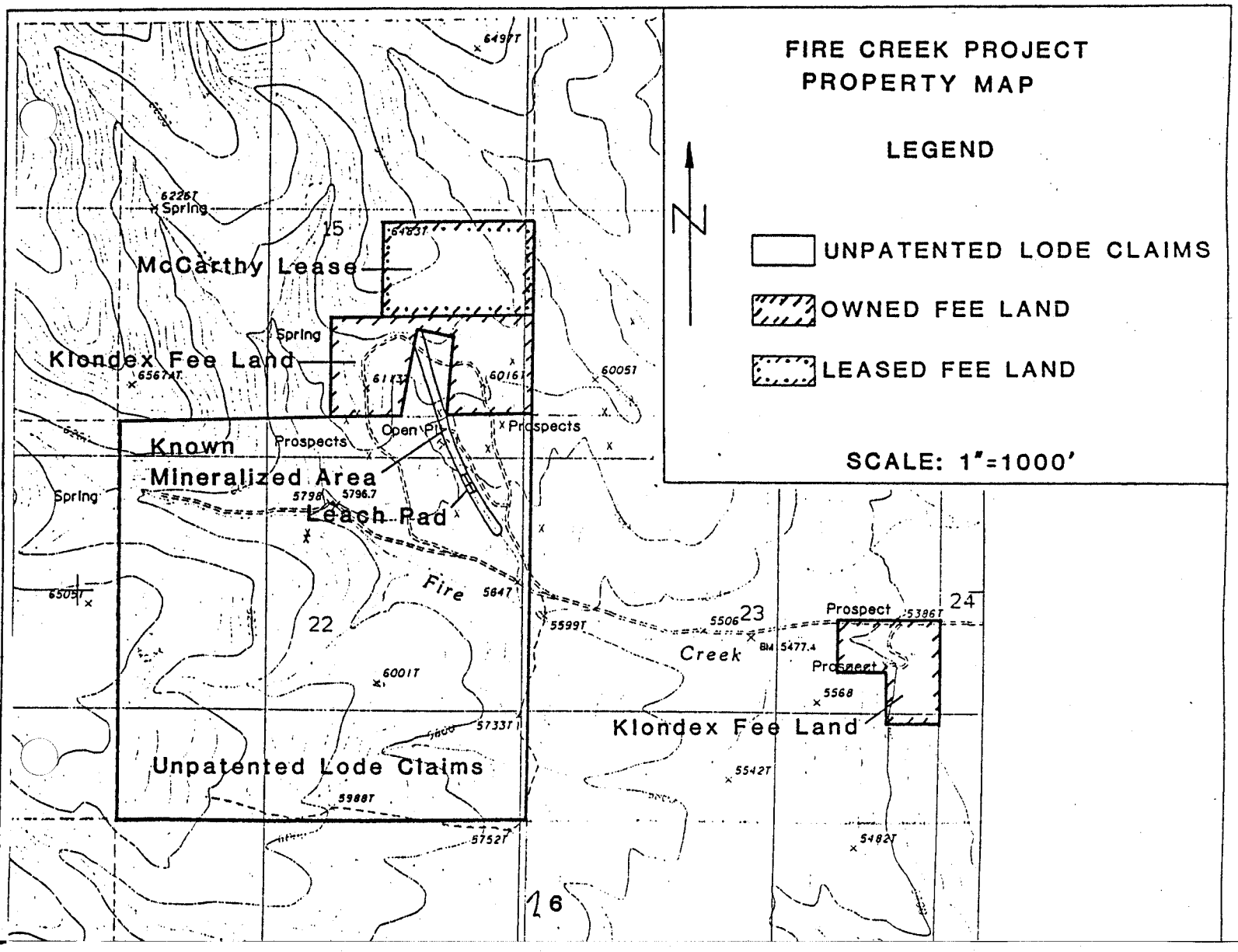
(1) All located in Township 30 North, Range 47 East, Lander County, Nevada.

It is expected that all of the ore production covered by this feasibility study would come from Klondex's Red Hills claim in the SE1/4 Section of 15, and would involve production royalty payments only to Klondex.




LOCATION MAP

FIG. 2.2



## 2.3 Development History

Our knowledge of exploration and development work prior to 1975 is sketchy. It is recorded that two short exploration adits were driven in the mineralized trend; one in the vicinity of the Minex pit and one, still visible, was collared where the collar of drill hole 86-09 is located. These adits were driven, apparently, to explore for and hopefully develop vein type ore bodies for underground mining. A small stope in the upper one was reported by George Meschi of Klondex.

The Union Pacific Railroad (?) cored two deep holes (in 1967/68?) for which we have logs but no locations. Both holes intersected gold mineralization.

In 1975 apparently 22 normal circulation vertical rotary holes were drilled (for Dead Broke?) in and around the known mineralized area. We obtained assay logs for 18 of them from Klondex.

In 1979 and 1980 Klondex drilled about 60 normal circulation vertical rotary holes in, around, and to the south of the known mineralized area.

In 1982 Klondex ran a pilot heap leach test, from which they reported a leach recovery of 69% on 2,100 tons of run-of-mine ore at a grade of .057 ounces per ton Au.

Following the pilot leach test, Klondex leased the property to Minex Resources, Inc. In 1983 Minex drilled mine control holes on 20- to 40-ft. centers in an area near the southeast end of the known mineralized zone. In 1983 this area was mined and segregated run-of-mine "ore" was placed on a heap leach pile. In late 1983, and early summer, 1984, Minex leached the pile. We estimate that about 30,000 tons of run-of-mine ore and waste averaging .032 ounces per ton Au (less than half the expected grade) were leached, with a recovery of 92%.

In 1984 Minex drilled some 13 reverse circulation vertical rotary holes near the north end of the known mineralization. They subsequently abandoned their lease, apparently discouraged by their results and at odds with Klondex.

Since leasing the property in July, 1986, AAMC has completed the following development work:

a) Obtained photogrammetric topographic base maps on 1"=50'and 1"=200' of parts of the property likely to be involved in a mining/leaching project.

b) Established new survey control and resurveyed and replotted all of the old holes which could be found in the field.

c) Drilled in Sept. and Oct., 1986, 31 holes, totaling 4,717 feet, of 4-1/2" reverse circulation angled (-45° to -60° from horizontal) rotary drill holes in and around the known mineralized area to establish reliable ore reserves. Drill cuttings samples were fire assayed for gold and silver.

d) Conducted about 34,500 feet of VLF-EM survey traverses across the mineralized trend over the known mineralized area and along trend for about 2,000 feet southward to determine responses and explore for extensions of the mineralized trend. These traverses are shown on the map in Appendix 2.3.

e) Conducted about 11,200 feet of magnetometer traverse lines across the mineralized trend over and south of the known mineralized area with objectives similar to the VLF-EM surveys.

f) Carried out limited geologic mapping and sampling across the surface over the known mineralized area and in the Minex pit.

g) Drilled in Oct., 1986, and Jan. and Feb., 1987, seven holes, totaling 1,435 feet of reverse circulation angled rotary drilling, searching for extensions of the known mineralized area to the north and south.

h) Contracted laboratory metallurgical testing, in December, 1986, through mid-April, 1987, by Kappes Cassiday and Associates: about 150 cyanide centrifuge leach tests on drill hole cuttings and 3 column leach tests on agglomerated ore.

i) In Feb., 1987, sampled by backhoe trenching the Minex heap leach pile.

j) Performed 3 bulk density field tests on ore and mineralized material from the Minex pit and mineralized outcrops.

## 2.4 Salient Favorable & Unfavorable Features of the Project

The operational feasibility of heap leaching agglomerated Fire Creek ore has been sufficiently demonstrated, in our opinion. Open pit mining of the ore appears likewise feasible, but it will require an unusually high degree of careful ore mining control.

The small size, compactness, relative isolation, lack of competing land use, and previous leaching operations should make permitting and operation relatively easy. Topography and climate are, relatively, somewhat negative factors affecting the proposed operation.

The ready availability of an adequate water supply is an additional plus for the project, as is the average grade of expected production: .06 - .07 ounces per ton Au.

The principal negative factor affecting project viability is related to the relatively narrow, steep dipping ore zones. This geometry causes stripping ratios to increase rapidly with depth, severely limiting the depth to which the ore may be economically mined by open pit methods; this in turn reduces ore reserves. Previous investigators and operators do not appear to have recognized the steep dipping, narrow configuration of the ore zones and, as a result, did not explore, estimate reserves, or mine on this basis.

Recognition of, exploration for, and reserve estimation on the basis of, the narrow, steep dipping ore zones by AAMC has provided the first rational and reliable reserve estimates for the project. However, application of this geometry, together with the use of a higher tonnage factor, derived by AAMC's study, has reduced estimates of economically-recoverable ore reserves to on the order of 150,000 tons or less.

This small reserve size limits our ability to justify and/or amortize large capital expenditures solely for Fire Creek. It appears that, for project development to be economically attractive, AAMC will be required either to use rented, leased, or contracted equipment and facilities, or to have the ability to amortize major capital expenditures over additional future projects and ore reserves.

Improved gold prices or production costs, compared to those used in this study, may improve the ore reserve picture somewhat for Fire Creek; but neither this possibility nor the potential for discovering additional shallow ore on the property is thought to be significant. AAMC's drilling and surface exploration has given negative indications in this latter regard.

## 2.5 Purpose, Viewpoint and Limitations of Report

The purpose of this report, and the feasibility study on which it is based, is to provide: (1) a detailed description of development work done to date on the Fire Creek Project; (2) salient data, results and conclusions from this work; (3) an estimate of economically - recoverable ore reserves; (4) a discussion of technology, equipment and scheduling alternatives considered and those selected; (5) estimates of capital and operating costs resulting from the selected plan of development; (6) an economic analysis of the expected profitability and net cash flows of the project under various conditions; and (7) conclusions as to project economic viability and a recommendation as to whether and how to proceed with development.

The study and report were prepared by management and staff of Alma American Mining Corporation for its internal use in determining whether to proceed with development of the project.

The data used as a basis for this study and report are regarded as sufficiently reliable and accurate for this purpose; and the use and interpretation of this data as well as ore reserve and cost estimates made herein are believed done rationally and in accordance with commonly accepted industry practice. Nevertheless, Alma American does not warrant the accuracy and reliability of either the data or the study. Third parties should rely only on their own study of data and estimates of project economics and feasibility.

Finally, it should be noted that the size of the Fire Creek Project does not warrant the detailed study and degree of engineering estimates which would be justified by a larger project. The study and report have been limited to examination of only those factors which were believed essential to a judgment of project feasibility.

# 3.0 GEOLOGY OF THE DEPOSIT

## 3.1 General & Regional Geology

The Fire Creek Project is located in the Basin & Range Physiographic Province, on the eastern flank of the Shoshone Range, which is one of the block-faulted mountain ranges in Nevada which trends about north-northeasterly. Lithology in this area is dominated by a series of Tertiary volcanic flows which occur in a belt about 18 miles long and 5 miles wide. Below the volcanic cover are likely Paleozoic clastics, as the Devonian Slaven Chert and Ordovician Valmy Formation occur widespread westerly across the Shoshone Range. The only other major lithologic units found in the Fire Creek area are Quaternary Alluvial fan deposits which fill the drainages and cover the pediment plain. The Fire Creek area is within the Antler Orogenic Belt, which is evidenced by the many thrust faults which occur in the Paleozoic rocks several miles to the west.

## 3.2 Host Rocks

The volcanic series in the Fire Creek area has been referred to in the literature as basaltic andesites, with K-Ar age dating of 16 million years. The series is made up of numerous flows, some of which have a distinguishing platy jointing. The basaltic andesites range from reddish-gray, platy, flow-banded to massive, slightly vesicular lava, typically gray to black. The basaltic andesites host the ore mineralization at Fire Creek. At flow contacts a porphyritic texture has been noted. The porphyritic texture is a feature of differentiation of lava, and is generally restricted to a narrow zone at the base of the flows. A thin veneer of post-mineral (Quaternary?) olivine basalt flow is found unconformably above the basaltic andesite. This contact is well exposed at the north rim of the present pit. The olivine basalt is massive, somewhat vesicular, dark-gray rock superficially resembling the massive vesicular andesitic basalt. Phenocrysts of plagioclase and a few of pyroxene and olivine are visible in most specimens. The olivine basalt is chemically dissimilar to the andesite basalt, indicating a different origin.

## 3.3 Structure

The structures in the project area are not well known, due to the limited amount of observable outcrop, some post mineral cover, no well defined marker horizons, and limited exploration to date.

There are believed to be two major structural trends in the area. The known zones of ore mineralization occur in and along a north northwesterly trending fault/shear/fissure zone which strikes about N 15° W and dips steeply (60-70°) to the west. A few faults in this trend have been observed to dip easterly; however, no ore mineralization has been noted in these. Direction of movement and displacement in this northerly trending system has not been determined. This structural trend appears correlative with a system of north-northwesterly striking faults which have been mapped several miles to the northwest.

A second system of normal faults trending generally N 80° E and dipping to the south is believed to exist in the project area. Although there is no direct observation of them at this time, their presence is postulated on the basis of aerial photo and topographic interpretation and regional geologic maps of the county. Presently, it is believed that this system is post mineral in age and may have caused an apparent left lateral movement of the mineralized zone, where possibly it is cut by one or two N 80° E faults.

No exploration of this N 80° E fault system for mineralization has been done to date, although exploration drilling may have penetrated a northeast trending structure in two northern holes which intersected argillic alteration to clay, but no ore mineralization.

## 3.4 Alteration & Oxidation

Previous operators have not reported on alteration and oxidation in the Fire Creek mineralized zone, and AAMC has made only a general study of, and observations regarding, the subject. Nevertheless, the deposit appears to exhibit most of the characteristics of a large number of shallow hot springs gold deposits in northern Nevada: extreme argillization of host rock along structures, an opalite/silica/sinter cap; and, probably, predominant disseminated free gold mineralization. These characteristics, plus our observations of the alteration lead to the following description and hypothesis regarding alteration and oxidation in the mineralized zone.

The N 15° W structural zone has almost certainly acted as an irregular conduit for rising hot waters which have, to various degrees, argillized the andesite host rock and removed iron minerals from slightly to completely, depending on distance from major solution conduits and permeability, as in extensively fractured zones or vesicular andesite flow contacts.

Contemporaneously and later, these hot waters introduced silica, forming siliceous veinlets, pods, and stockworks in the argillized zone, and a siliceous and opalite cap and stratified deposits in the upper reaches of the mineralized area (at its northern higher end).

In the deeper reaches of the mineralized zone, under reducing conditions, the hydrothermal solutions probably deposited pyrite, in both restricted vein-type deposits, as well as disseminated mineralization. In the upper zones of the deposit, in oxidizing conditions, limonite was deposited.

Recent downward-percolating groundwaters (probably slightly acidic) have extended the argillization, oxidation, and iron leaching process in the mineralized zone above the redox contact, which is generally about 150-200 feet below the ground surface.

## 3.5 Ore Mineralization

The only ore mineral known to be of commercial interest at Fire Creek is gold. The silver content of Fire Creek ore averages about half the gold content, probably less than .05 opt Ag; and is of negligible value. Anomalous mercury is present in the area, but its presence has not been evaluated. Other ore minerals frequently associated with gold elsewhere are not believed to be present in commercial quantities at Fire Creek.

No petrographic studies have been done on the ore to date, so no detailed understanding of ore mineralogy is available. The discussion which follows is based on fire assays and microscopic examinations of drill hole cuttings, on cyanide leaching tests, and on a brief study of the geology of the deposit, as related to other similar deposits.

It appears most likely that the gold in the oxidized interval occurs almost entirely as microscopic particles of native gold, or as an electrum with silver. In the deeper unoxidized zone gold is probably associated with pyrite. There is a general tendency for cyanide leach recoveries to decrease with depth. None of the Fire Creek ore reserves are in the unoxidized zone.

Clay is the dominant mineral in and around the ore zones, particularly for ore grades less than .07 opt Au. Silica content of ore samples is most often less than 10%, regardless of grade, although there is a tendency towards more frequent silica contents of 10-50% in samples containing over .07 opt Au. There is strong evidence of silica encapsulation of gold values in an upper level opalite zone at the north end of the known mineralized area. This phenomenon reduced gold recovery to about 43% in a cyanide leach test of a bulk sample from the area.

No easily discernible association with color, lithology or structure is apparent within the mineralized trend, as a guide to exploration or mining. Both ore and waste can range in color from light cream to deep red or purple. And both clay and opalite can be either ore or waste. Close assay control appears necessary to distinguish ore, and often assays of splits of the same sample vary widely in grade, due to an apparent "nugget effect".

Based on an analysis of 5-ft. drilled intercepts from AAMC drilling, the frequency distribution of ore grades is as shown in Figure 3.5 on the following page. The highest grade interval we intersected was 5 ft. at 1.60 opt Au about 190 ft. deep in the G Zone. Previous operators recorded several 5-ft. drilled intervals of 2-3 opt Au 200-250 ft. deep, probably in the G Zone also.

## 3.6 Deposit Geometry And Description

Exploration to date has disclosed a single mineralized zone on the property. A length of about 3,000 feet is projected thus far on the basis of drilling and surface indications. The zone extends generally south southeast from the vicinity of the northwest corner of the Red Hills claim to a point in the draw some 500 feet downstream from the Minex barren pond.

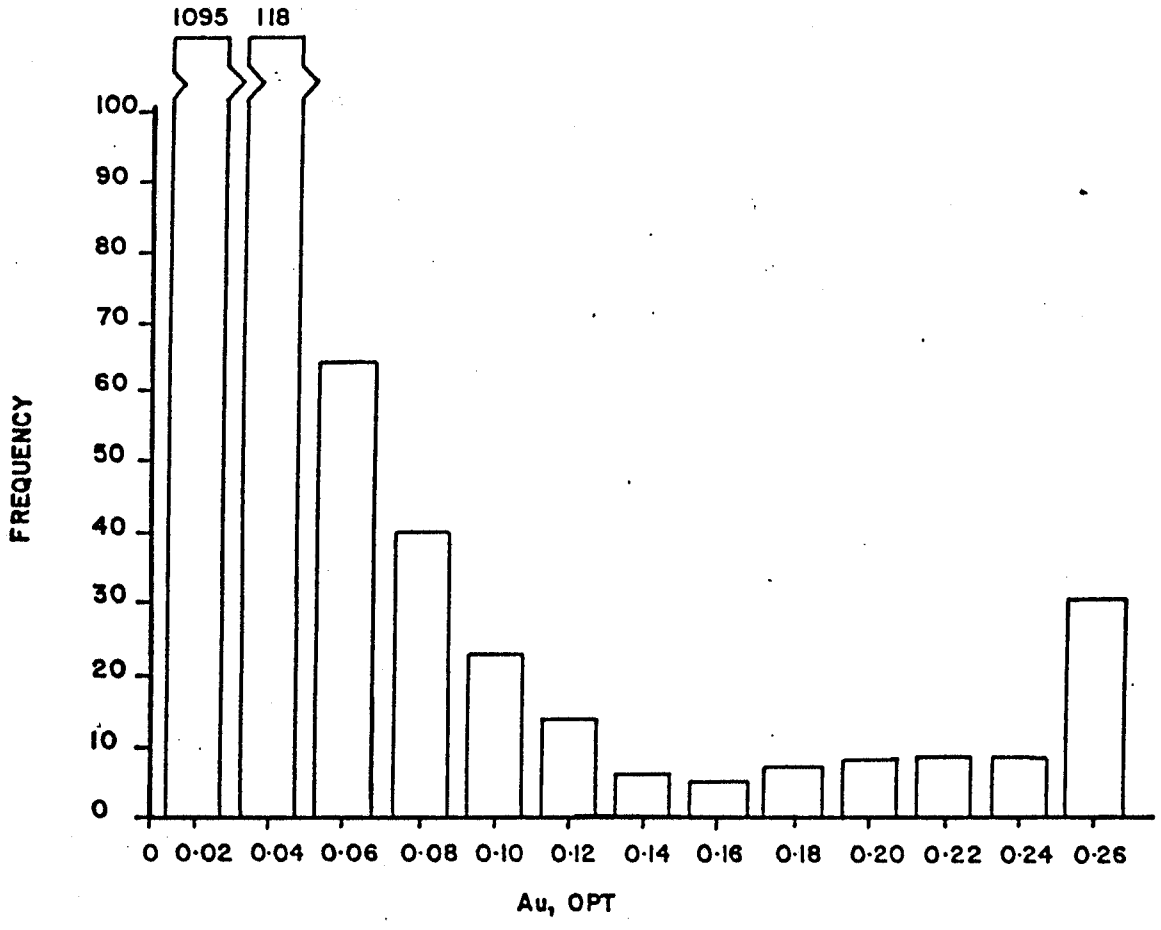
About 1,500 feet of this zone, from the north face of the Minex pit to the northwest corner of the Red Hills claim, has been shown by drilling to contain ore grade mineralization.

In this vicinity the mineralized zone strikes generally N 15° W. We infer that it consists of multiple zones of argillic alteration and silicification which follow the fault/shear/fissure trend previously discussed. As such, it has extremely irregular dimensions and cannot be precisely defined. (See examples on the geologic cross sections in Appendix 3.6).

Within the zones of argillic alteration and silicification, gold mineralization occurs quite irregularly. We believe, however, that drilling results favor the designation of five major zones of higher grade gold content which have a fairly regular and continuous geometry and can be correlated into distinct identifiable ore zones.

# FIGURE 3·5

## HISTOGRAM OF FIRECREEK ASSAYS




| SAMPLE INTERVAL | FREQUENCY |
|---|---|
| 0.00-0.02 | 1095 |
| 0.02-0.04 | 118 |
| 0.04-0.06 | 64 |
| 0.06-0.08 | 40 |
| 0.08-0.10 | 23 |
| 0.10-0.12 | 14 |
| 0.12-0.14 | 6 |
| 0.14-0.16 | 5 |
| 0.16-0.18 | 7 |
| 0.18-0.20 | 8 |
| 0.20-0.22 | 8 |
| 0.22-0.24 | 8 |
| 0.24-0.26+ | 30 |

These ore zones have been identified, from west to east, as zones D, E, F, G, and H. Their occurrence, grade characteristics and geometry are summarized in the following table, Figure 3.6, and on the cross sections and longitudinal section in Appendix 3.6. They commonly dip 65-75° westerly. The usual intervals between the principal ore zones are: E to F: 10-20 ft.; F to G: 20-40 ft.; G to H: 0-30 ft.

The AAMC drilling to date has been aimed primarily at evaluating the shallow open pit minable ore, so it does not provide much information deeper than about 200 feet. But what information we do have indicates a persistent redox contact at about 150-200 feet depth, with the ore in and below this interval being somewhat more restricted to narrow, higher grade intervals.

FIGURE 3.6
GENERAL THICKNESS AND GRADE CHARACTERASTICS
OF ORE ZONES

| SECTION | ZONE D | | E | | F | | G | | H | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HOR TH | GRADE | HOR TH | GRADE | HOR TH | GRADE | HOR TH | GRADE | HOR TH | GRADE |
| 6450 | | | | | 17 | 0.047 | | | | |
| 6400 | | | 5 | 0.156 | 9 | 0.057 | | | | |
| 6350 | | | 4 | 0.050 | 10 | 0.050 | | | | |
| 6300 | | | 9 | 0.036 | 40 | 0.082 | | | | |
| 6250 | | | 9 | 0.049 | 30 | 0.080 | | | | |
| 6200 | | | 17 | 0.072 | 14 | 0.130 | | | 15 | 0.100 |
| 6150 | | | 15 | 0.057 | 14 | 0.130 | 12 | 0.184 | 15 | 0.100 |
| 6100 | | | | | 23 | 0.114 | 8 | 0.063 | 15 | 0.100 |
| 6050 | 5 | 0.043 | 10 | 0.081 | 10 | 0.128 | 5 | 0.276 | | |
| 6000 | | | 17 | 0.031 | 15 | 0.097 | | | | |
| 5950 | | | 10 | 0.070 | 8 | 0.052 | 7 | 0.098 | | |
| 5900 | | | 10 | 0.052 | 18 | 0.063 | 14 | 0.100 | | |
| 5850 | | | 10 | 0.035 | 18 | 0.065 | 14 | 0.068 | | |
| 5800 | 12 | 0.043 | 13 | 0.046 | 15 | 0.044 | 13 | 0.104 | | |
| 5750 | 8 | 0.043 | 8 | 0.044 | 22 | 0.048 | 20 | 0.104 | | |
| 5700 | 7 | 0.043 | 8 | 0.041 | 35 | 0.051 | 9 | 0.056 | | |
| 5650 | | | 4 | 0.046 | 40 | 0.059 | | | | |
| 5600 | | | 4 | 0.052 | 40 | 0.067 | | | | |
| 5550 | | | 4 | 0.039 | 7 | 0.052 | | | | |
| 5500 | | | | | 7 | 0.045 | | | | |
| 5450 | | | | | 10 | 0.070 | | | | |
| 5400 | | | | | | | | | | |

HOR TH=APPROXIMATE HORIZONTAL THICKNESS OF ZONE IN FT.

GRADE=APPROXIMATE AVERAGE GRADE OF ZONE IN OUNCES PER TON, AU.

## 3.7 Geologic Potential

Drilling to the northwest of the presently defined ore zones has found a 20-foot intercept of ore in a location not previously identified, which could possibly be the fault-offset continuation of the main ore zone. Drilling to the southeast has so far been unsuccessful, although there are some surface indications yet to be pursued. In addition, several drill hole intercepts indicate the possibility of sporadic deep high grade vein deposits which might warrant further exploration.

However, based on AAMC's work to date, we have concluded that the potential for additional shallow ore should be considered minimal, and not a positive factor in considering project feasibility. Further, we believe that any additional shallow ore bodies discovered are likely to be of the same nature as the presently-developed reserve. i.e., steep dipping with minable grades averaging .06-.07 opt Au, and with similar stripping ratios. This assumption has been used in analyzing project economic potential in the event ore reserves are increased.

## 4.0 EXPLORATION & DEVELOPMENT WORK TO DATE

### 4.1 Surveying & Base Maps

Klondex had created an assortment of base maps showing drilling and topographic details on several scales. These were determined to be too incomplete and inaccurate for use in detailed development drilling, mine engineering, and project planning.

AAMC, therefore, engaged Delta Aerial Surveys to produce two photogrammetric topographic base maps covering those portions of the property which were believed to be the areas most likely involved in a mining and leaching project. Copies of these maps showing development drilling and project layout are included in Appendices 4.4 and 6.2. They are:

| Map | Scale | Contour Interval | Coverage | Purpose |
|---|---|---|---|---|
| No.1 | 1"=50' | 5 Feet | N 4,000 to N 7,000<br>E 13,000 to E 15,000 | Development drilling<br>Detailed pit planning<br>Some leach pile planning |
| No.2 | 1"=200' | 10 Feet | N 2,700 to N 8,300<br>E 9,300 to E 16,400<br>(Approx. north half of property) | Overall project layout & planning<br>Exploration |

Delta Aerial Surveys also established basic survey control for their topographic maps, tying their control points and coordinate grid to control points and coordinates established by Klondex (except 10,000 ft. was added to eastings, to avoid the necessity of using negative coordinates in part of the mapped area).

Using Theodolite and EDM, AAMC then surveyed a number of intermediate control points, all of the pre-1986 drill holes which could be located, and all of the AAMC 1986 and 1987 drill holes. With few exceptions, surveyed control point and drill hole locations and elevations agree well with the topographic map data; map accuracy is considered adequate for project development.

To the above referenced base maps we have added approximate property boundaries where appropriate. We have also created a new set of cross sections on which to depict drilling, ore, and pit designs in the main drilled area; the location and orientation of these sections have been added to the 1"=50' map.

## 4.2 Geologic Mapping & Geochemical Sampling

Because of the relatively monolithic geology of Fire Creek, the lack of outcrops and exposures, and broad alluvial cover, a detailed geologic map of the entire project area has not been constructed. The opalite zones have been generally mapped in the main mineralized area; the post mineral volcanic flow has also been mapped. These features are shown on the map in Appendix 4.4.

Klondex provided a detailed map showing contoured values (probably Au) of geochemical analyses from a sampling program in and around the known mineralized area. This map shows several anomalous areas not yet tested by drilling, but the sampling and analysis methods and validity are unknown and must be checked by further geochemical sampling before the anomalous values can be relied on to guide further drilling.

In December, 1987 Alma American personnel ran two geochemical soil sample traverses across the proposed leach-pad area on the slope immediately southwest of the existing leach pad and ponds. Purpose of this survey was to avoid construction of a leach facility over a possible ore body. Results indicate the proposed leach-pad area is relatively unmineralized. Of the 30 geochemical samples taken only two were even weakly anomalous (51 & 46 ppb Au). Samples were taken on 50 foot increments. Results of this survey indicate that no commercial gold mineralization has been found in the proposed leach-pad area. Mineralized structures may traverse this location but such structures are likely too narrow to be of economic interest.

## 4.3 Geophysical Exploration

Prior to AAMC's leasing of the Fire Creek property, another company (unknown) had done a magnetometer survey across the known mineralized area and to the south and north of this area covering several thousand feet in length. The only known data from this survey is an 8x11 xerox of a magnetic contour map. The raw data was not available to AAMC and the spacing of the readings from the survey was not known. Although two magnetic lows were determined from the survey, the information was not included in our analysis because of too many uncertainties.

Alma American conducted a VLF survey across the known ore zone to evaluate and use the EM-16 as a prospecting tool. Thirty lines at an approximate spacing of 200 feet were run with the unit. To date, the northernmost line runs through the survey point TP-8 while the southernmost line runs through survey point 906. Most of the lines have a bearing of N 80° E and readings were taken every 25 feet, facing west. The transmitting station used was Seattle, Washington, station code NLK with a transmitting frequency of 24.8 kHz.

The raw data was filtered utilizing the Frazer filter and the in-phase components were plotted and contoured. The results indicated several anomalous zones, one of which is the known mineralized area.

At the end of Alma's first drilling program, two of the newly discovered anomalies were drilled. In both cases, no ore was found and in one case the drilling indicated a flow contact which was magnetite rich. The resulting conductive difference apparently caused the anomaly.

After this initial drilling of the two contoured VLF anomalies was unsuccessful, the VLF data was reviewed further. It was found that the unfiltered VLF data showed a strong positive anomaly over the flow contact, and a strong negative anomaly over the mineralized zone. This negative VLF anomaly was supplemented by a negative magnetic anomaly from a magnetic survey traverse.

The VLF and magnetometer surveys showed corresponding negative anomalies in an area just east of the Minex leach pad. This area was drilled in January and February, 1987. A wide argillized zone was encountered, but no ore was intersected.

The usefulness of the VLF and magnetometer surveys is, therefore, debatable at this time. They can find the argillized zones, which is important for locating target areas; however, more information is necessary to determine the presence of ore. It has also been noted that the post-mineral basaltic cap tends to mask any zones it covers thus narrowing the usefulness further.

## 4.4 Exploration And Development Drilling & Sampling

Several drilling programs have been done on the property in the past. So far as can be determined, drilling done in 1975, 1979, and 1980, was all vertical holes drilled with conventional rotary rigs. Sampling intervals were mostly 10 feet with a few holes sampled at 5-foot intervals. Drilling done in 1984 by Minex was reported to be reverse circulation drilling in vertical holes, sampled on 5 foot intervals.

The results of the 1975, 1979 and 1980 drilling were suspect on three counts. First, samples from open rotary holes may be subject to contamination, particularly in wet material as at Fire Creek. Secondly, 10-foot sampling intervals can exaggerate intercept widths by mixing thin high grade zones with waste. Thirdly, there was an indication from the Minex test mining program that either assaying done by Northern Nevada Laboratories and Monitor geochemical may have erred on the high side, or that the vertical drilling was responsible for overstated reserve indications.

A summary of the drill hole data available to, and used by, AAMC to assess geologic potential and compile ore reserve estimates is summarized below. The drill holes are shown on the map in Appendix 4.4.

Figure 4.4a

DRILLING DATA SUMMARY

| Year | For | Apparent No. Of Holes Drilled | No. of Holes Data Available From | Methods Used |
|---|---|---|---|---|
| 1975 | Dead Broke Mining Co | 22 | 18 | Normal Circulation; Vertical; 5-10 ft. sample intervals. |
| 1979 | Klondex | 5 | 4 | Normal Circulation; Vertical; 5 ft. sample intervals. |
| 1980 | Klondex | 59 | 59 | Normal Circulation; Vertical; 10 ft. sample intervals. |
| 1984 | Klondex | 13 | 13 | Reverse Circulation Vertical; 5 ft. sample intervals. |
| 1986/ 1987 | AAMC | 38 | 38 | Reverse circulation Angled at 45-60 from horizontal; 5 ft. sample intervals. |

It appears that the AAMC drilling did, in fact, confirm that the earlier drilling data tended to overstate the ore bodies to a significant degree. Our analysis and use of the drilling data from the various programs are explained in Section 5.2.

Beginning in September of 1986, AAMC undertook a drilling program to better define the geometry, tonnage, and grade of the ore. Drilling was done with a track mounted drill rig. Four and one-quarter inch reverse circulation angled holes were drilled. Hole orientations were approximately N 80° E to N 75° E at -45° to -60° from horizontal.

Sampling utilized a series of Jones splitters, allowing 1/4 of the sample to be gathered for laboratory analysis. When drilling dry, the 3/4 reject was bagged and marked. No rejects were collected when drilling with water. Sampling interval for all holes was 5 feet. The 1/4 splits were sent to Analytical Services in Elko, NV. where four 100-mesh, 400 gram pulps were made. One of these pulps was sent to AAMC's lab in Fairplay ,CO, for fire assay. For selected samples (generally .02 opt Au or better), check assays were done by AAMC on two of the remaining splits and Kappes-Cassiday ran a cyanide centrifuge leach test on the third. The 3/4 split rejects were left in the field.

Relatively coarse gold was apparently a problem on a small portion of the samples, as indicated by the wide divergence of assays on separate splits. These samples were check assayed 3-6 times. As a test, a number of pulps were screened into +115 and -115 mesh fractions to check for coarse gold. This procedure indicated that coarse gold is not a widespread problem. Additionally, pulps were sent to Cone Geochemical of Lakewood, CO, to monitor AAMC's fire assaying. The results are presented in figure 4.4b. AAMC's average was slightly lower than Cone's, but the correlation between the two labs was excellent, with a correlation coefficient of over 98%.

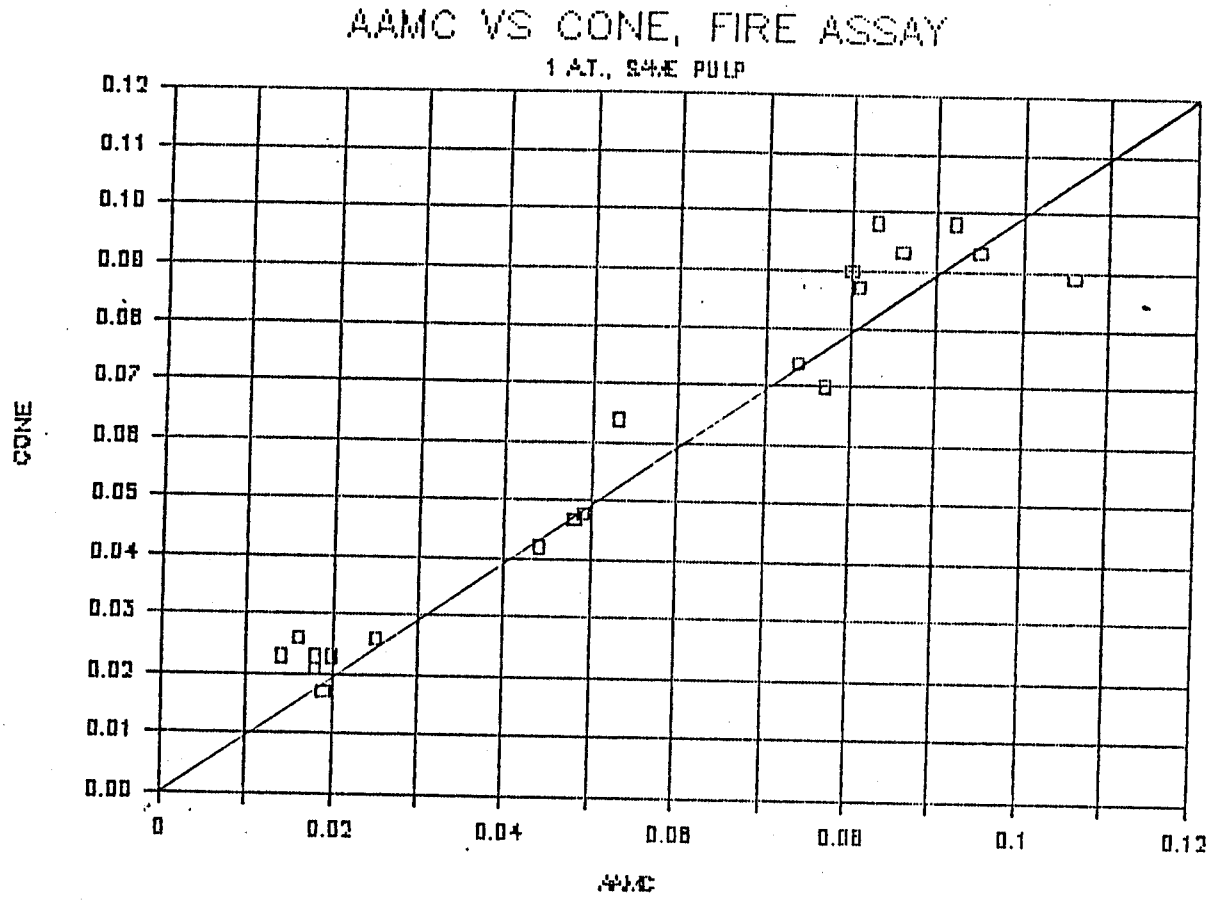
## 4.5 Laboratory Leach Tests

Once analysis determined a drill hole intercept of interest, a split held by Analytical Services was sent to Kappes, Cassiday and Associates for cyanide centrifuge testing to determine cyanide leaching characteristics of the ore. About 150 samples were analyzed in this manner. Results are discussed in Section 5.7. Details of all Kappes Cassiday lab testing procedures and results are contained in Appendix 5.7.

A 2-ton bulk sample was dug from the road cut near drill hole 86-23 and sent to KCA for column leach testing. Two test columns were set up, one for a minus 2" crush and one for a minus 3/4" crush. Both tests were agglomerated and studies done for binder requirements.

Leach recoveries from these tests were very low showing about a 43% recovery at the end of a 60 day leach cycle. It was determined that this bulk sample contained an inordinately high amount of silica, which was probably encapsulating the gold, thus not allowing the cyanide to dissolve it.

## FIGURE 4.4b




FIRE CREEK CHECK ASSAY, AAMC VS CONE

| AAMC | CONE |
|---|---|
| 0.019 | 0.017 |
| 0.018 | 0.021 |
| 0.018 | 0.021 |
| 0.014 | 0.023 |
| 0.020 | 0.023 |
| 0.018 | 0.023 |
| 0.016 | 0.026 |
| 0.025 | 0.026 |
| 0.044 | 0.042 |
| 0.048 | 0.047 |
| 0.049 | 0.048 |
| 0.053 | 0.064 |
| 0.077 | 0.07 |
| 0.074 | 0.074 |
| 0.081 | 0.087 |
| 0.106 | 0.089 |
| 0.080 | 0.09 |
| 0.095 | 0.093 |
| 0.086 | 0.093 |
| 0.083 | 0.098 |
| 0.092 | 0.098 |
| 0.214 | 0.223 |
| 0.206 | 0.238 |
| 0.217 | 0.25 |

Regression Output:

| | |
|---|---|
| Constant | -0.00142 |
| Std Err of Y Est | 0.009193 |
| R Squared | 0.982446 |
| No. of Observations | 24 |
| Degrees of Freedom | 22 |
| X Coefficient(s) | 1.094270 |
| Std Err of Coef. | 0.031184 |
| AVE AAMC | 0.073 |
| AVE CONE | 0.079 |

In January, 1987, another bulk sample was taken from the road cut near drill hole 84-12 to get a sample more representative of the deposit. This present sample is now being column leached, crushed to minus 3/4" and agglomerated. Preliminary results are quite satisfactory. After 40 days of leaching, 82% of the gold had been recovered.

## 4.6 Test Mining & Heap Leaching

In 1982 Klondex mined a small amount of material from the general vicinity of the present Minex pit area and conducted a cyanide heap leach test on run-of-mine ore. They reported a leach recovery of 68.6% in 30 days on 2,100 tons of ore averaging .057 ounces per ton of Au.

In 1983, after drilling some 32 pit control holes on 20-to-40 ft. centers, Minex mined an estimated 33,500 tons of "ore" and placed it, uncrushed and unagglomerated, in a 10-ft. thick leach pile just south of the Minex pit. This material was leached in September, October and November, 1983, and again in May, June and July, 1984. It had been expected to average .071 opt Au, but samples of the material as it was placed in the leach pile averaged "about .03 opt", according to the project manager, Nolan Barnum, who also stated that he believed the 33,500 ton estimate was based on an in situ tonnage factor of 17 cu.ft. per ton.

Klondex has reported that Minex recovered 884 ounces of gold from their leach test. AAMC, based on its measurements and estimates of the volume and density of the Minex leach pile, as well as its backhoe trench samples of the grade of the leached material, has made these estimates:

| | |
|---|---|
| Weight of ore in pile: 29,900 dry tons | (Material ranging from clay to unaltered andesite. Size range: about 8" x 0"). |
| Gold recovered: | 884 ounces |
| Calculated Recovered grade: | .0296 opt Au |
| Estimated grade of leached ore: | .0027 opt Au |
| Calculated grade of ore prior to leaching: | .0323 opt Au |
| Estimated leach recovery: | 91.6% |

The previously described ore zones are not outlined by lithologic changes or a decrease to zero gold content. They are based on a general assay cut-off boundary of .030 opt Au; with only minor exceptions (where correlation or mining considerations dictate), material assaying below .030 opt Au was excluded from the ore zones and ore reserves.

This assay cut-off grade was based on the rough preliminary economic determination shown in Figure 5.2c; although this proved to be slightly optimistic, there appeared to be insufficient justification for revising it.

Figure 5.2c

Ore Cut-off Grade Calculation

Assume:

| | $/Ton |
|---|---|
| Mining Cost | $ 2.00 |
| Crush & Agglomerate | 3.00 |
| Leaching & Recovery | 2.00 |
| Egr'g & Ore Control, Lab | .50 |
| Supervision & G & H | 2.00 |
| Total Direct Oper Cost | $ 9.50 |
| Gold Price | 400 / oz. |
| Royalty | 10% |
| Leach Recovery | 80% |

G = Cut-off Grade: Grade at which net recoverable value equals direct operating costs.

Calculation:

$$(400)(G)(.8)(1-.10) = 9.50$$
$$288G = 9.50$$

$$G = \frac{9.50}{288} = .033 \text{ opt Au; Use } .030$$

We have incorporated into the AAMC reserve estimate the assumption of a mining loss of a one-ft. thick envelope of ore around each ore zone boundary and introduction of an equal amount of diluting material, at an average grade of .005 opt Au. These are judgment factors, based on similar mining conditions and experience elsewhere; we believe they are both reasonable and conservative. A brief survey of assay grades of material around the ore zones indicates that possibly the dilution grade might be around .018 opt Au rather than .005. This would make our estimate of diluted grades about 2-5% low. (See Appendix 5.6).

## 5.7 Heap Leach Recovery

As for most heap leach projects, the estimated cyanide leach recovery at Fire Creek is a key parameter in forecasting project economics. Previous tests, as well as AAMC analyses, have produced a wide range of results, from which it has been necessary to make a qualified judgment of heap leach recovery. Details of test results and leach recovery estimates are contained in Appendix 5.7.

Kappes Cassiday's cyanide centrifuge leach tests on pulps of AAMC drill cuttings (Figure 5.7) show an unusable spread of leach recoveries. We believe this is partly because of the effects of siliceous and pyritic ore on leach recovery on some of the samples, but mostly because of the "nugget effect" errors introduced by determining head grade from one small split of a drilling sample and leach-recovered grade from another split. Nevertheless, most of the test results fall within a "trend envelope", the midpoint of which indicates that cyanide leach recoveries will, on the average, be acceptable.

AAMC's drilling and testing have indicated that most of the ore is predominantly clayey, with a silica content of less than 10%. There is a tendency toward more frequent silica contents of 10-50% for ore grades over .07 opt Au; and a small portion of the ore reserve, at it's upper north end, is predominately silica, in and around an opalite zone.

Kappes Cassiday ran two column leach tests on this high-silica ore for AAMC, crushed to -3/4" and to 2" and agglomerated. After 60 days only 43% of the gold had been recovered. This indicated that the silica had "encapsulated" the gold, hindering leaching. Kappes Cassiday reports that this phenomenon was restricted to a near surface effect at another property. We believe that leachability of less than 10% of the reserve will be seriously affected by silica encapsulation.

Kappes Cassiday ran a third column leach test for AAMC on ore averaging .073 opt Au, crushed to -3/4" and agglomerated. After 40 days leaching, about 82% of the gold was recovered.

Klondex reported a leach recovery in 30 days of about 69% on a test heap leach of 2,100 tons of run-of-mine ore, containing .057 opt Au.

Minex, by our estimates, leached 29,900 tons of run-of-mine clayey ore averaging .032 opt Au for roughly five months and recovered about 92% of the gold.

Based on the foregoing test results, AAMC believes that it would be justified for a commercial operation to crush the ore to about -3/4" and agglomerate it, to obtain optimum leach recovery, which can be reasonably expected to be in the 75-80% range. These assumptions have been incorporated into this study.

## 5.8 Economic Depth Cutoffs

At Fire Creek, as for any deposit minable by open pit methods, there is a depth beyond which the ratio of waste stripping to ore mined will render further open pit mining uneconomic. This depth, the economic depth cutoff, is variable, depending on ore body geometry and grade, pit geometry, mining methods, production costs, process recovery, product prices, and desired profits.

In order to obtain an initial approximation of an economic pit depth cutoff, AAMC used a mathematical formula which incorporates the above parameters into an economic analysis on a section by section basis. For each cross section, and for a given set of parameters, the formula calculated an economic depth cutoff. These theoretical pit depths were then plotted on a long-section of the pit and, by a process of comparison and adjustment between cross sections, an economic pit floor depth was determined.

An example of the geometry, derivation, and use of this economic cutoff formula is shown in Appendix 5.8. For the formula, the following parameters were used:

| | |
|---|---|
| Gold price: | $400 per oz. |
| Leach recovery: | 70% |
| Royalty rate: | 10% |
| Ore mining cost: | $1.50 per ton |
| Stripping cost: | $1.00 per cy |
| Leaching cost: | $5.70 per ton |
| G & A cost: | $1.00 per ton |
| Pit wall design: | 40 ft. vert. between catch benches; 20 ft. wide; 1/2:1 (H:V) pit wall slope. |
| Profit desired: | Net recoverable value equal to 110% of direct operating costs. |

## 5.9 Economically Minable Reserves

Using the economic depth cutoff formula as described above produced an ore reserve with an average stripping ratio of 5.74 CY/Ton and a pit floor elevation of 5915 ft. Subsequent study indicated that some areas of high stripping ratio ore (about 15% of the total, at 11.83 CY/Ton) could be eliminated from the ore reserve and substantially improve the profitability of the remaining reserve, which was selected as the Fire Creek economically minable reserve for purposes of this study.

It was also determined that about 50,000 tons of ore was a feasible increment of production for the first year of the project, based on our estimate of a reasonably attainable mining schedule; a recoverable grade and stripping ratio were calculated for this reserve.

Estimated grades for each of the reserve quantities estimated for purposes of this report are based on Kriging, in order to reduce by a geostatistical approach the bias introduced by non-representative assays. Kriged values, however, agreed well with ore grades determined from cross section estimates.

A number of drilled intercepts included assays in excess of 0.2 opt Au, which may be spurious, resulting in erroneously high grades if included in the grade calculations. Two sets of reserve grades were calculated: one with unadjusted (uncut) grades, and one with high grade values reduced (cut) to 0.2 opt Au. It is believed these two sets of grades reflect the likely range of ore grades for the economically minable reserve.

Based on the foregoing assumptions and parameters, the economically minable ore reserve estimated for purposes of this report is shown below:

## Figure 5.9

## Economically Minable Ore Reserve

| Production Schedule (Ore Processed) Year | Diluted Tons | Diluted Grade Range (opt Au) Cut | Uncut | Range of oz. Au | Stripping (CY) | S.R. (CY/) |
|---|---|---|---|---|---|---|
| 1st Year | 50,000 | .071 - .086 | | 3550-4300 | 137,000 | 2.74 |
| 2nd Year | 86,000 | .050 - .059 | | 4350-5100 | 497,000 | 5.78 |
| Total Econ. Recov. Res. | 136,000 | .058 - .069 | | 7900-9400 | 634,000 | 4.66 |
| Sub-econ. Reserve Not Sched. | 24,000 | .058 - .083 | | 1400-2000 | 284,000 | 11.83 |
| Total Ore Reserve | 160,000 | .058 - .071 | | 9300-11400 | 918,000 | 5.74 |

# 6.0 PRODUCTION EQUIPMENT, FACILITIES, AND SCHEDULE

## 6.1 General Production Schedule

The 136,000 ton ore reserve used in this study has been scheduled for mining and processing in two years. It appears that, if a decision to proceed with the project were made this month, (April 1987) the necessary permits could be obtained in time to commence stripping and mining in early July, 1987.

It appears reasonable to assume that leaching can be done through November each year. A July mining startup should allow for mining and leaching 50,000 tons of ore in 1987, at rates commensurate with the ore body size. Using a mining rate of 1,000 tons per day will allow for mining and stockpiling an additional 16,000 tons of ore for leaching in 1988.

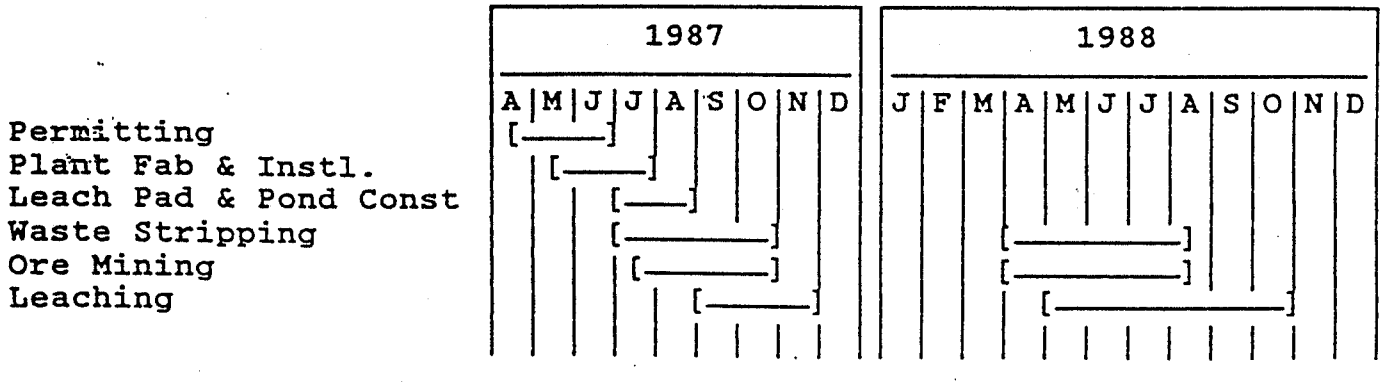
The above assumptions have been incorporated into an "Expected Case" production schedule for 1987: permitting and fabricating the recovery plant in May and June; installing leach pads, ponds, and recovery plant in July and August; waste stripping, ore mining and building leach piles in July through October; and leaching ore and recovering gold in September through November.

The production schedule for 1988 is: waste stripping, ore mining, and leach pile construction in April through August; and leaching ore and recovering gold in May through October.

This schedule is shown graphically below. The resultant scheduled ore and waste production is listed in the following table.

Figure 6.1

Mine Development & Production Schedule



## Mine Production Schedule

| Month | Ore Production | | Waste Production | |
|---|---|---|---|---|
| | Sched. Hrs. Per Day | Tons | Sched. Hrs. Per Day | Cubic Yards |
| 7/87 (1/2 mo) | 10 | 10,000 | 10 | 45,000 |
| 8/87 | 10 | 20,000 | 10 | 46,000 |
| 9/87 | 10 | 20,000 | 10 | 46,000 |
| 10/87 | 8 | 16,000 | 10 | 48,000 |
| | | ------ | | ------ |
| 1987 Subtotal | | 66,000 | | 185,000 |
| 4/88 | 8 | 15,000 | 20 | 96,000 |
| 5/88 | 8 | 15,000 | 20 | 96,000 |
| 6/88 | 8 | 15,000 | 20 | 96,000 |
| 7/88 | 8 | 15,000 | 20 | 96,000 |
| 8/88 (2/3 mo) | 8 | 10,000 | 20 | 65,000 |
| | | ------ | | ------ |
| 1988 Subtotal | | 70,000 | | 449,000 |
| | | ====== | | ======= |
| TOTALS | | 136,000 | | 634,000 |

### 6.2 Recovery Plant And Auxiliary Facilities

The planned recovery plant for Fire Creek was regarded as a key element of the project, to be built and operated on the following basis: the recovery plant will be owned and operated by AAMC; it will be built under contract, probably by Kappes Cassiday. Its design will incorporate gold recovery out of cyanide solution onto carbon in enclosed vessels; gold will be re-solubilized by hot organic cyanide solutions; recovered by electrowinning, and smelted to produce dore' for sale to a metal buyer.

The entire recovery plant would be mounted in a trailer for ready portability to another project; it would be capable of solution handling and metal recovery commensurate with mine production rates of about 1,000 tons per day.

Three additional trailers are required and would be finished, equipped, and provided by AAMC. They are: office trailer, laboratory trailer, and supply trailer.

Electric power for both the recovery and crushing/leaching operations would be provided by portable generators (100 and 150 KW). One is on hand; an additional generator would have to be purchased.

Water for leaching would be pumped from a small pond on Fire Creek to a water make-up storage pond at the plant site.

Mine haul roads would be constructed from mine waste. Access roads would be improved by blading only, without additional materials required.

A general layout map for the Fire Creek Project, as presently planned, is shown on the map in Appendix 6.2.

## 6.3 Leach Pad and Ponds

The leach pad will be placed to the west of the present pad location. This area has a relatively uniform grade of approximately 14% over a large enough area to accommodate the present reserves. Calculations of the agglomerate density indicate that the pad should be about 500 x 550 feet. Due to the slope, a flat (1-2%) toe will be constructed for an additional 50 feet. This will anchor the heap and eliminate stability problems.

Construction of the pad will be in four phases. The first phase will be the removal of all vegetation and stockpiling of the topsoil for reclamation. The second phase will be construction of the flat toe, and to some extent, depending on depth to bedrock, flattening of the slope by cut and fill techniques. All of the base will be compacted using the loaders. The third phase will be the placement of the PVC liner. These will come in strips and will be glued together during placement. The edges will be buried using material existing on site. The final phase will be the placement of perforated pipe, perpendicular to contour, for solution drainage. Possibly the liner will be covered with a gravel blanket; a decision would be made following further consultation with Kappes Cassiday.

The leach ponds are to be located in approximately the same area as they presently exist. For the the present plan, though, larger ponds will be required. Presently, the existing barren pond will be lengthened to the south and a new liner installed. This will be the new barren pond. Adjacent to the new pregnant pond, to the south (also in the drainage), a new pregnant pond will be constructed. The existing pregnant pond will be used for storage of make up water. If the present liner condition is unusable, the pond will be relined.

General dimensions of the two ponds will be 125 x 210 x 12 feet. Material for the construction of the dams and side slopes will be from the old leach pile if allowed by the regulatory agencies, otherwise a borrow pit will be utilized in the clay zone to the east of the present pad location. Hypalon will be the liner material for all ponds.

## 6.4 Ore Mining And Waste Stripping

Previous road construction, drilling, and test mining in the mineralized zone have indicated that breaking of ore and waste should not require drilling and blasting, and can be done with a dozer mounted ripper. We have assumed the use of a D-9 ripper dozer for this purpose; possibly a newer D-8 might prove adequate.

Ore mining is planned to be done with a Cat 235 hydraulic backhoe with a 1-1/2 CY (heaped) bucket. Use of a backhoe is to minimize dilution of ore occurring in mining the narrow steep dipping, irregular ore bodies. This unit will also provide adequate breakout force and loading reach.

Waste will be loaded with a single Cat 988 front end loader with 7 CY bucket; for short waste hauls, the loader will also tram the waste.

For the average, or usual, ore and waste hauls, we have assumed the use of Cat 769 35-ton trucks, although it may prove advantageous, both operationally and costwise, to use smaller trucks. It appears that a fleet of 4 769s would be required to handle the expected ore and waste hauls.

For the necessary close-spaced mine control sampling, we have assumed the use of a small tractor-mounted pipeline trencher to cut channel samples across probable ore zones.

A Cat 140G grader, water truck, mechanic's truck and mine foreman's pickup complete the mining equipment spread.

Ore mining is scheduled on one 8- or 10-hour shift per day, as required. Waste stripping is scheduled on a single 10-hr. shift per day for 1987, and on two 10-hr. shifts per day in 1988, to handle the higher stripping ratio in 1988. It was assumed for estimating purposes that the dozer, grader, and water truck would be used for both ore mining and waste stripping operations.

A temporary metal building about 75' x 50' with concrete floor is included in the plan for equipment maintenance and parts/supply storage.

## 6.5 Ore Crushing, Agglomerating, Handling, And Leach Pile Construction

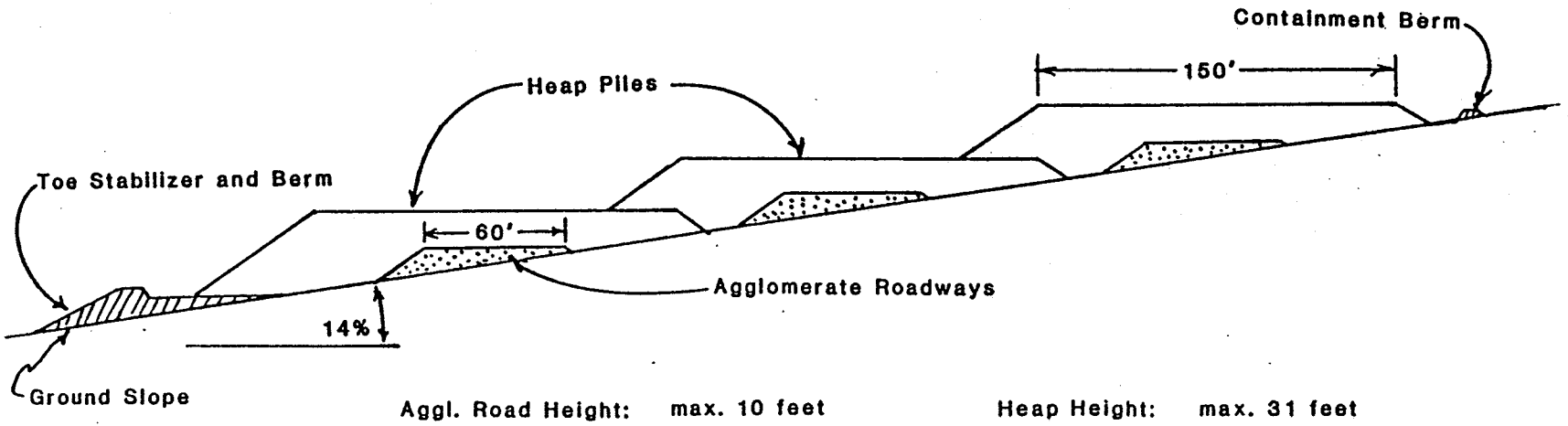
Ore will be moved from a truck dump stockpile to a portable crushing and screen plant by a second Cat 988 front end loader. Primary crushing of the ore anticipates use of a feeder breaker. Portland cement (at a rate of 30lb./ton) will be added to the crushed ore as an agglomerating agent. The ore will then pass through a screening plant(screening to 3/4" size). Plus 3/4" ore will be conveyed to a secondary impact crusher. Discharges will then be blended and a cyanide solution added to the system for wetting prior to entering an agglomerating drum, which would be selected to provide optimum agglomeration and maximizing leach recovery. Agglomerates discharged from the drum will be conveyed via 70-foot portable conveyors to the radial stacker on the pad where the heap is to be built.

Heap construction will be a two phase operation. Due to the slope of the pad, it will be necessary to build a level roadway across the pad for the smooth operation of the radial stacker. This will be considered the first phase. It will be accomplished by extending the portable conveyors incrementally while building the roadway out with the use of the dozer and/or loader. The roadway is planned to be 60 feet wide to allow the maximum swing for the radial stacker. The second phase will be the placement of the heap using the radial stacker from the roadway. The center of the heap pile will be over the center of the road and attain a maximum height of 20 to 25 feet. The top of the heap will be level and have a width of approximately 150 feet. The maximum height of any portion of the heap (basically the downslope crest) will be between 30 to 35 feet. The stacker will begin loading the heap from the farthest (western)end of the pad an continue loading in a retreating fashion. Figure 6.5 on the following page shows a schematic section through the leach piles.

It is anticipated that ore crushing, handling and pile building will be done only on day shift, either 8- or 10-hours, matching the mining production.

## 6.6 Leaching And Recovery

Leaching of the heap is planned to utilize a wobbler sprinkler system. Dimensions of the sprinkler head placement have not been determined at this time, but should be somewhere on the order of 20 x 30 feet. Solution will be added to the heap at the approximate rate of 0.005 gallons/sq. ft./minute which translates into a total of about 570 gpm for each heap under active leach or wash.




| | | | |
|---|---|---|---|
| Aggl. Road Height: | max. 10 feet | Heap Height: | max. 31 feet |
| | min. 2 feet | | min. 10 feet |
| | avg. 6 feet | | avg. 20 feet |

Figure 6.5 Leach Pile Section

Water balance studies are not complete at this time, but approximate calculations indicate that the water supply available from Fire Creek (a surface flow of about 30 gpm plus an unknown sub-surface flow) and the storage capacity of the planned ponds will require a staged initiation of leaching for each heap.

Recovery of the gold is presently planned to utilize a trailer mounted CIC (carbon in column) plant designed and built by Kappes Cassiday. Pregnant solution will be pumped through the carbon columns and barren solution then returned to the barren pond for recycling to the heap. Once the carbon is fully loaded, pumping will cease so the carbon can be stripped and electrowon. Electrowinning products will then be smelted in the furnace on site to produce dore' for sale to a precious metal buyer.

## 6.7 Equipment And Personnel Requirements

Equipment requirements are based on cycle time studies and equipment performance estimates. In order to reach and maintain the desired production of the mine, as well as the construction needed at the plant, the following table summarizes the major equipment planned for the mining operation.

Mine Equipment:

1 - Cat. 988B wheel loader
1 - Cat. D9L track ripper dozer
1 - Cat. 235 hydraulic backhoe
1 - Cat. 140G motor grader
2 - Cat. 769C 35T truck (4 in Yr. 2)
1 - Ford F600 water truck
1 - small tractor w/trencher

Plant Equipment

The list below summarizes the basic processing plant facilities and equipment requirements for the project.
1 - 988B wheel loader
1 - 9"(?) feeder breaker (primary crusher)
1 - screening plant
1 - secondary crusher (type not yet determined)
1 - agglomerating drum (capacity of 1000 TPD)
1 - Radial stacker (self propelled)
10 - 70 foot portable conveyers (possibly 2 additional in 2nd year)
1 - CIC trailer mounted recovery plant

1 - Laboratory trailer
1 - Atomic absorption unit
1 - Electric smelting furnace
1 - cement silo w/ auger feeder
1 - solution mixing facility
4 - pumps (misc. sizing but one minimum of 700 gpm @ 30 psi)
2 - diesel generators totaling 250 KW

Miscellaneous Equipment and Auxiliary Facilities:

3 - Pickups
1 - Equipment maintenance building
    Fencing
    Fuel tank
    Pipe, fittings, valves, sprinklers
1 - Office trailer

Personnel Requirements:

Personnel requirements to man and operate the project on a 5 day per week, 8-10 hr./shift schedule:

| Supervisory/Technical/Egr'g | No. |
|---|---|
| Project Manager | 1 |
| Geologist/Egr. | 1 |
| Egr./Asst. | 1 |
| Lab/Plant Mgr. | 1 |
| Lab Tech. | 2 |
| | 6 |

| Ore Processing | |
|---|---|
| Loader Operator | 1 |
| Crusher/Agglom. Oper. | 1 |
| Asst. Tech. | 2 |
| | 4 |

## Ore Mining & Waste Stripping

| | |
|---|---|
| Dozer Operator | 1 |
| Backhoe Operator | 1 |
| Loader Operator | 1 |
| Truck Drivers | 4 (6 in Yr. 2) |
| Patrol/$H_2O$ Tk Oper. | 1 |
| Mechanic/Operator | 1 (2 in Yr. 2) |
| | 9 |
| Total Manpower Requirements | 19 (22 in Yr. 2) |