Sulphurets

888179

NEWHAWK GOLD MINES LTD. (NPL)
GRANDUC MINES LIMITED

STAGE I

ENVIRONMENTAL & SOCIOECONOMIC IMPACT ASSESSMENT FOR THE

SULPHURETS PROPERTY

January, 1989

2.2 Geology, Mineralization and Ore Reserves

2.2.1. Regional Geology

The Sulphurets claims area is located within the Stewart Complex, predominantly comprised of Jurassic sedimentary and volcanic rocks intruded by late Jurassic plutons. Extreme alteration is associated with mineralization throughout the Stewart Complex. To the west is the main Coast Crystalline Complex, with Bowser Basin sedimentary rocks lying to the east.

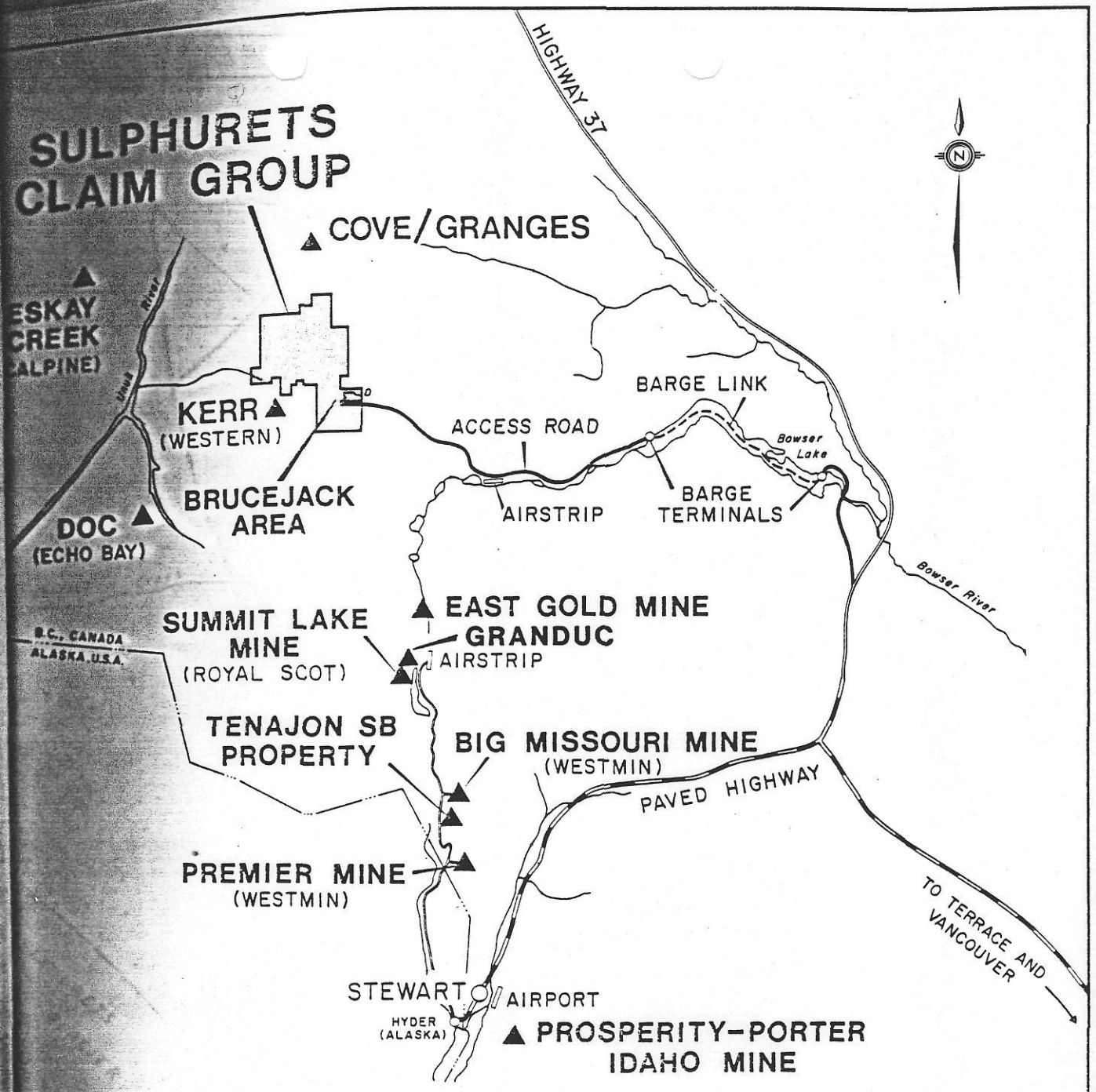
Numerous past producers, exploration projects and new mines are located within the Stewart Complex, stretching from Anyox in the south to the Unuk River in the north. Several excellent precious metal properties in the area are the Snip, the Doc, and the Kerr. To the south are the old Granduc copper mine, the Summit Lake gold mine of Royal Scot Resources, the S.B. Property of Tenajon Resources Corp., and the Premier and Big Missouri Mines slated for production by Westmin Resources Limited in early 1989. The relative location of these properties is illustrated in Figure 2-1.

2.2.2 Property Geology

The Sulphurets claims area is underlain by Lower to Middle Jurassic volcanic and sedimentary rocks. These rocks are cut by two, elongate sub-parallel, northerly trending zones of intrusive rocks ranging from diorite to granite in composition and which appear to be sub-alkaline. The intrusives enclose a northerly-trending zone of intense alteration. Sericite is the most commonly found alterations mineral, with K-feldspar, chlorite and propylictic-type minerals present to a lesser degree.

Structurally controlled, epithermal silver-gold-base metal veins occur mainly in massive intermediate volcanic or intrusive rocks within a 1 km wide area of intense, sericite-dominant alteration. The veins consist of quartz, minor calcite and trace to 20% sulphide minerals. They range from simple veins to complex vein zones and stockworks. Geology of the area is presented in Figure 2-2.

Porphyry and epithermal vein type mineralization is also present. Porphyry copper-molybdenum and copper mineralization occurs in the north and northwest portions of the property and is associated respectively with K-feldspar assemblages that are locally overprinted by sericite alteration, and with hornfels plus weakly altered granite and



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SULPHURETS PROPERTY

LOCATION OF ADJACENT PROPERTIES

0 15 30 Kilometres

0 5 10 20 Miles

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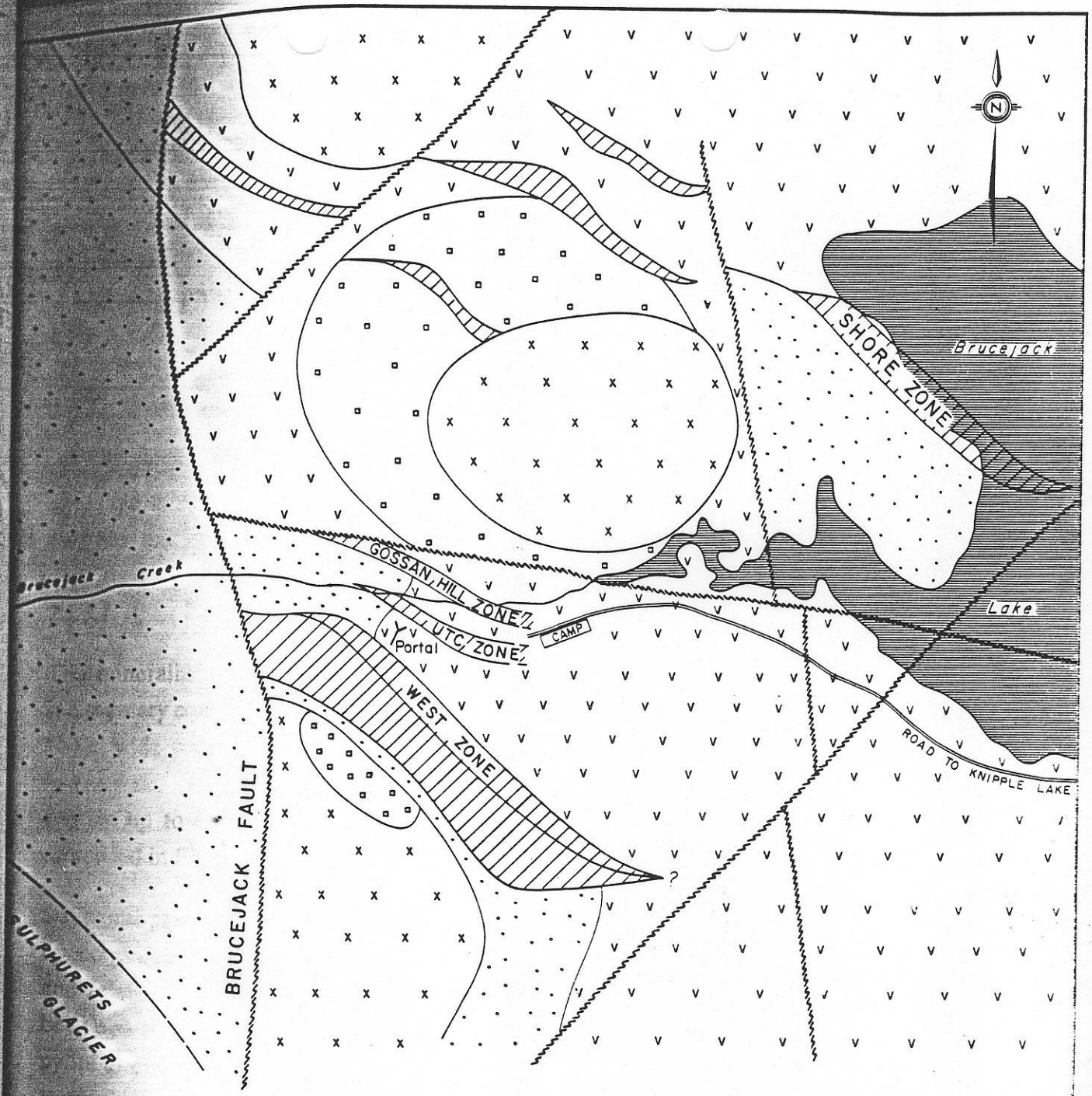
FIGURE 2-1



Legend

- Quartz Stockwork
- Syenite
- Plagioclase Porphyry
- Volcanics
- Sediments
- Geological contact
- Fault

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BRUCEJACK AREA

Geology

0 250 500 METRES

0 500 1000 1500 FEET

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FIGURE 2-2

syenite. Other porphyry copper, molybdenum, copper-molybdenum-silver, and gold mineralization is generally accompanied by sericite dominant alteration. Gold is found in a shell of 15 to 40% pyrite around a small core of copper-molybdenum-gold mineralization in the west-central area of the property. A disseminated gold zone in the eastern part of the prospect is entirely in intermediate tuff-breccia with 5 to 10% pyrite.

2.2.3 Mineralization

Over 20 mineralized zones have been identified on the Sulphurets property, indicating a very high mineral potential. The better know zones are shown in Figure 2-3 and the four best understood are described below.

2.2.3.1 West Zone

The mineralization of the West Zone is located in the volcanics near the volcanic-sedimentary contact. This contact makes a northwest-trending zone of alteration about 100 m wide paralleling the hornblende-feldspar-porphyry-syenite contact immediately to the west. The complex vein system within this zone may be up to 40 m thick and contain up to 60% vein material. A typical plan and section of the West Zone are presented in Figures 2-4 and 2-5.

Structural patterns suggest that quartz veins and veinlets were emplaced in extensional openings due to right lateral movement along steeply dipping subparallel fault zones and related conjugate shears. Boudinage quartz veins with sigmoid structures have been observed both in small scale and in a mine-wide scale. A pervasive sericite-silica-pyrite alteration marks the zone which abuts the syenite on the northwest and appears to continue to the southeast. This zone has now been drilled on approximately 10 m spaced sections over much of its length.

The West Zone is open to the south and is cut by the syenite to the north, but appears to plunge below existing drill holes to the north. The zone has been defined to a depth of 150 m, and has been intersected as deep as 500 m below surface. The West Zone is readily accessible by present underground workings.

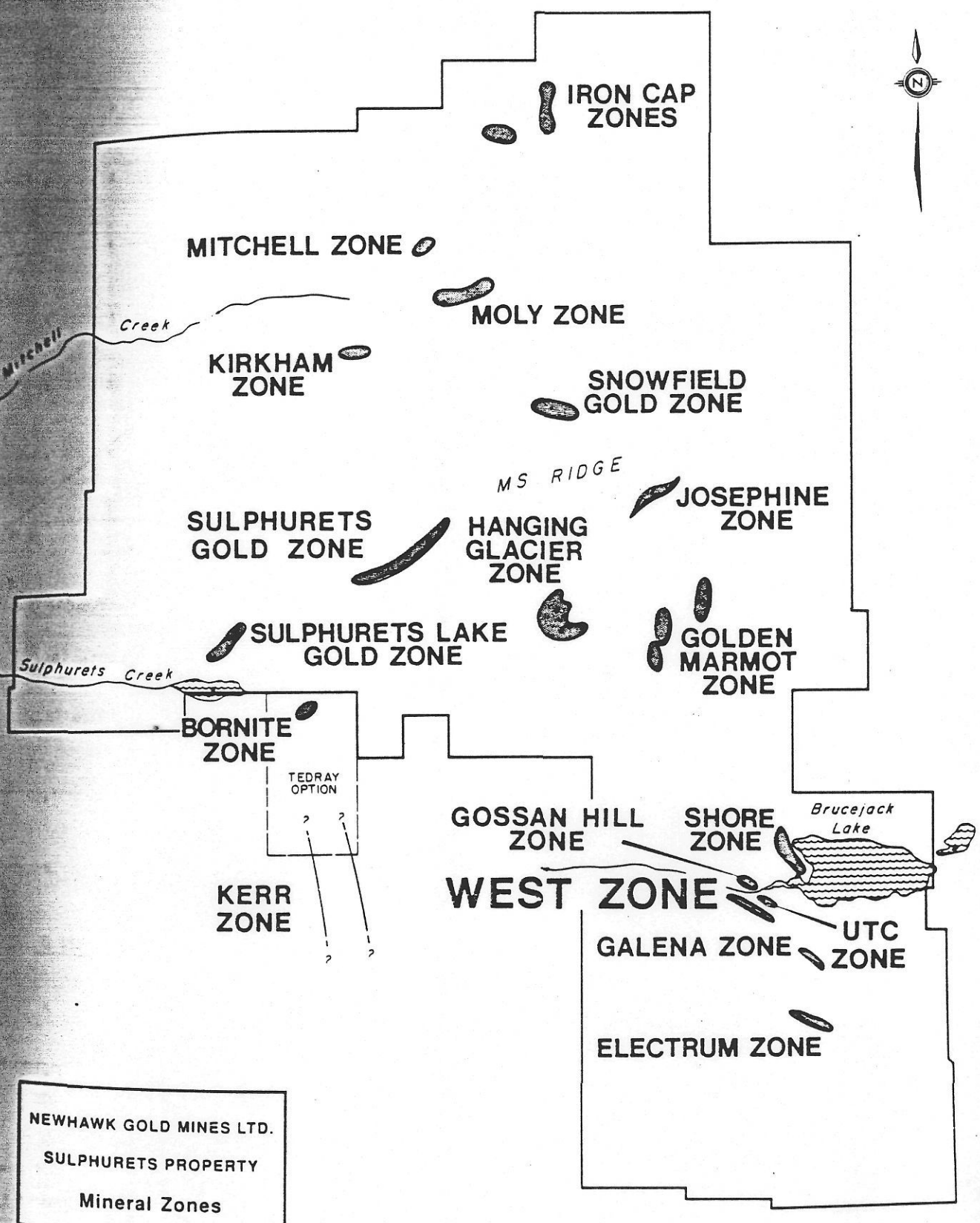
IRON CAP ZONES
MITCHELL ZONE
MOLY ZONE
Mitchell Creek
KIRKHAM ZONE
SNOWFIELD GOLD ZONE
MS RIDGE
JOSEPHINE ZONE
SULPHURETS GOLD ZONE
HANGING GLACIER ZONE
SULPHURETS LAKE GOLD ZONE
GOLDEN MARMOT ZONE
Sulphurets Creek
BORNITE ZONE
TEDRAY OPTION
GOSSAN HILL ZONE
SHORE ZONE
Brucejack Lake
KERR ZONE
WEST ZONE
UTC ZONE
GALENA ZONE
ELECTRUM ZONE
N
NEWHAWK GOLD MINES LTD.
SULPHURETS PROPERTY
Mineral Zones
0 1.5 3 Kilometres
0 1 2 Miles
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FIGURE 2-3

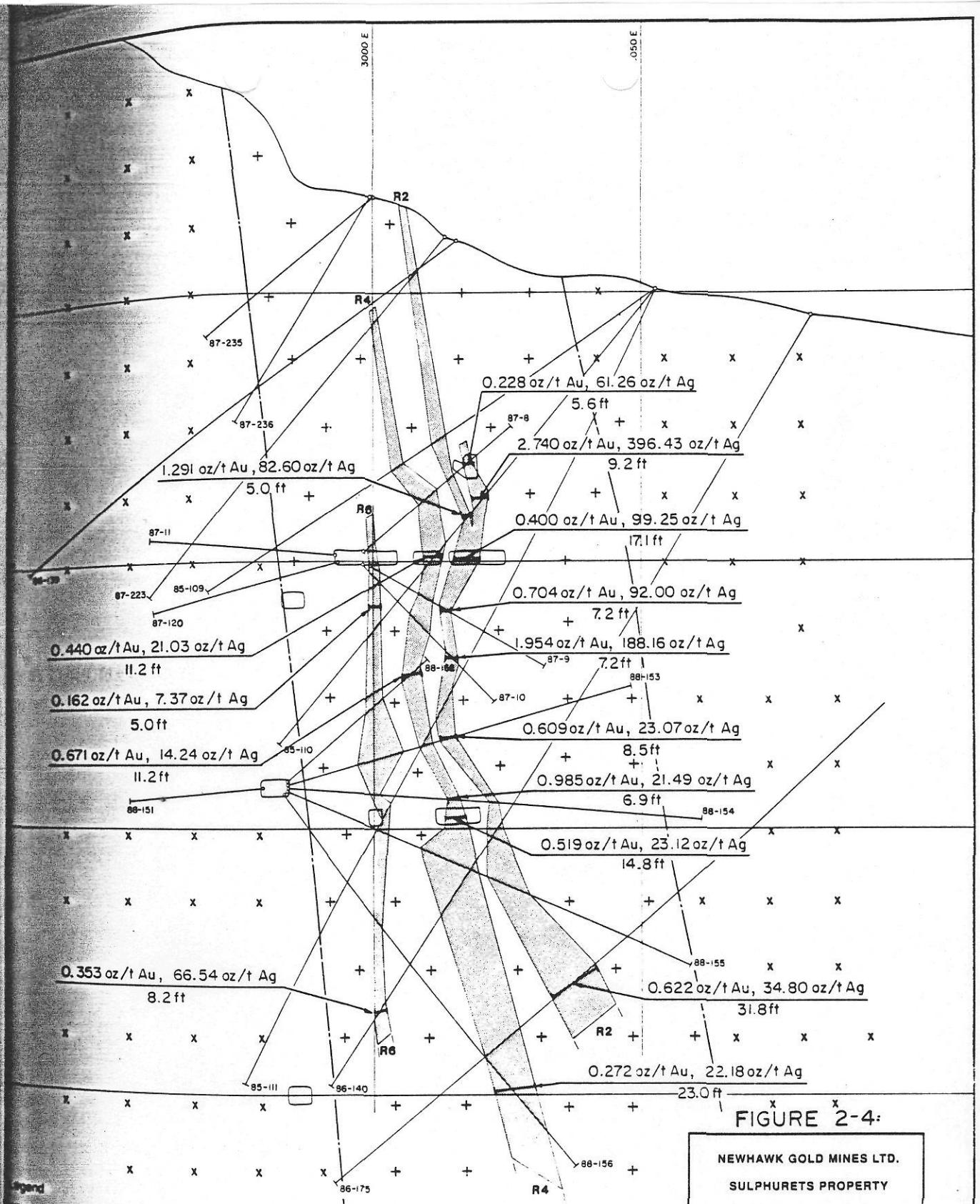

FIGURE 2-4:

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WEST ZONE

Cross Section
(Looking North)
51+00S

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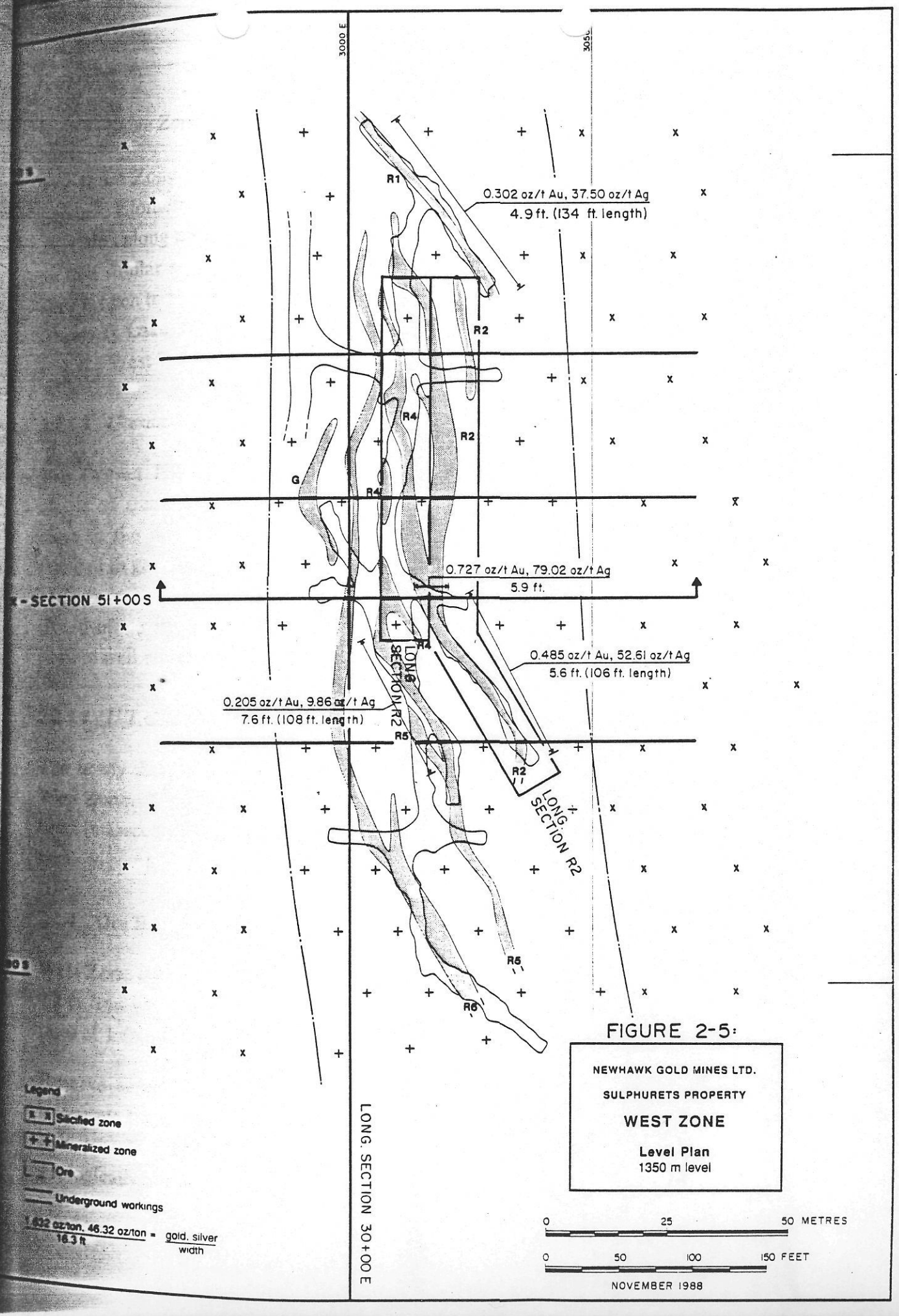

FIGURE 2-5:

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WEST ZONE

Level Plan
1350 m level

2.2.3.2 *Shore Zone*

The Shore Zone is located along the western shore of Brucejack Lake, approximately one-half kilometre east of the West Zone and forms a broad 150 m wide zone of alteration along a strong north-west trending fault zone. Stratigraphically, it appears to be in a similar setting to the West Zone near the volcanic-sedimentary contact. The zone is open to the northwest and appears to be continuing to the southeast underneath Brucejack Lake. Drilling on the Shore zone has indicated mineralization comparable with the West Zone in length, width, grade, structure and configuration.

2.2.3.3 *Gossan Hill Zone*

The Gossan Hill Zone consists of one strong quartz vein with sericite and silica alteration trending roughly east-west just north of Brucejack Creek and cutting very close to the north end of the West Zone. Trenching in 1983, and drilling in 1985 resulted in good grade silver-gold mineralization. This vein appears to be in the order of 30 m in length based on the three holes drilled to date. The Gossan Hill Zone is closed off to the east, but is still open to the west. The Gossan Hill zone is not at present well understood and is currently being re-examined.

2.2.3.4 *U.T.C. Zone*

The newly discovered U.T.C. zone is located in the order of 80 m to the east of the West Zone. The zone appears to top out at approximately 200 m below surface and has been intersected at more than 300 m below surface. The strike of the U.T.C. Zone is north to south and plunging to the south.

2.2.4 Ore Reserves

West Zone ore reserves have been calculated by M. Vulimiri, M.S. at a cut-off grade of 0.2 oz/ton gold equivalent. Gold equivalent was calculated based on a gold to silver ratio of 1:66.66. The ore reserves for the 0.2 oz/ton cutoff are presented in Table 2-1.

Reserve estimates were calculated from long sections which were drawn down the interpreted centre of each of the six ore shoots making up the West Zone. The drill hole, trench and cross cut pierce points used on the long sections were determined from geologically interpreted cross sections.

Table 2-1

Newhawk Gold Mines Ltd. (NPL), Sulphurets Property
Geological Reserves, West Zone

Category	Tonnage		Gold		Silver	
	Tons	Tonnes	oz/ton	g/t	oz/ton	g/t
Measured and Indicated	304,044	275,824	0.387	13.27	26.19	897.9
Inferred	550,028	498,977	0.335	11.49	21.15	725.1
Total	854,072	774,800	0.354	12.14	22.94	786.5

* Based on a cut-off grade of 0.2 oz/ton gold equivalent.

Triangular blocks were constructed on the long sections using the closest three pierce points. Tonnage for each block was calculated using the true distances between pierce points and a specific gravity of 2.75. The block grades were calculated using the linear weighted average grade for each pierce point.

Blocks with pierce point separation of less than 10 m were included in the measured category and blocks with 10 to 30 m pierce point separations were included in the indicated category.

Inferred reserves were calculated by averaging drill hole intersections within an inferred block, averaging blocks adjacent to an inferred block or a combination of both. The inferred zones are geologically traceable, and in no case were projected below 1,100 m elevation.

2.3 Mine Plan

2.3.1 General Description

The West Zone will be mined by underground mining methods. The orebody will be accessed by three portals. One will be at 1,400 m elevation and will be used for ore haulage to the mill. One will be at 1,378 m and be used for ventilation and waste haulage while the third will be at 1,385 m and be used for ventilation exhaust.

The orebody will be accessed by means of a 2.74 m by 4.13 m (9' x 13.5') ramp driven at 15% in the footwall. All mining will be by means of rubber tired L.H.D. machines and trackless jumbos. Utility vehicles will be used to move men and supplies. Ore and waste will be removed from the mine by rubber tired haulage trucks of 13 ton capacity hauling up the ramp. The truck haulage system will be used down to the 1,250 m level after which shaft hoisting may be considered.

A mechanized cut-and-fill stoping system is proposed for the West Zone. Two mining horizons will be established with one probably starting at 1,325 m and the other at 1,250 m. Shrinkage stoping may be adopted in isolated ore shoots of appropriate geometry and grade.

Ore present in all zones will be removed on each lift of mining. Trackless equipment will be used to access every lift, in all zones, from the footwall ramp. Figure 2-6 shows a generalized section of the orebody and access system.

Hydraulic backfill will be produced in the mill by creating a coarse fraction from cycloned tailing. Backfill will be pumped into the mine in pipelines and boreholes at 60 to 70% density by weight. The backfill will then be used as a platform for mining each subsequent lift.

The mine will produce 318 tonnes/day (11,130 tonnes/year) of ore, and 90 tonnes/day (31,751 tonnes/year) of waste. All ore will be deposited directly at the mill from trucks without surface stockpiling. Of the total waste approximately 50% will be left underground and used as backfill, and 45 tonnes/day (15,876 tonnes/year) of waste will be hauled to surface. Waste brought to surface will be deposited at either site 1 or 2 on the site plan and will be inundated to reduce the risk of acid generation.

2.3.2 Mining Method

Mechanized cut-and-fill has been selected as the main mining method for the West Zone. This method allows for very selective mining, the ability to sort ore and waste in the stopes and also disposing of waste material in the stope to minimize haulage to surface. The method also maximizes the extraction of economically recoverable reserves.

At least six fully trained and certified mine rescue employees will be available on surface during operations in the mine. Training for these employees will be scheduled on a monthly basis. Backup teams will be arranged from other mines in the province.

An emergency stench warning system will be installed in the compressed air system. All underground employees will be required to carry a filter type self rescuer and they will be instructed in its use and in procedures to follow in the event of an emergency.

The mine will have at least two means of egress from all active stoping areas, one being the ramp and the other a ladder-equipped raise. All emergency routes in the mine will be clearly marked.

A refuge station will be provided close to the ramp system on the 1,300 m level. This will also double as a lunch room and will be fire proof, supplied with compressed air and capable of being sealed.

2.3.10.3 Instruction of Workers

Employees will be trained, certified and authorized where required by specific legislation. All employees will be instructed and trained to avoid hazards related to their work and to ensure efficient exercising of their duties.

2.4 Metallurgy and Process Plant

2.4.1 Characteristics of Ore, Multi-Elemental Scan

The ore of the West Zone deposit consists of erratic veins and lenses containing native gold and silver together with a variety of sulphide minerals in a quartz rich environment within a zone of altered volcanics. Table 2-2 presents the results of an ICAP analysis of the expected mill feed material. Significant economic value is imparted to the material by both the gold and silver.

The gold occurs in a range from relatively coarse grains (40-100 microns) liberated by standard comminution methods to minutely fine grained material locked in either pyrite or quartz gangue. The silver occurs in small amounts as native metal but the bulk is intimately associated with or a component of the various sulphide minerals found in the ore. The following is a mineralogical assessment of the feed:

Table 2-2

Chemical Analysis of West Zone Ore

Element			Concentration
Aluminum	Al	(%)	0.17
Silver	Ag	(ppm)	>200
Arsenic	As	(ppm)	95
Barium	Ba	(ppm)	70
Beryllium	Be	(ppm)	<0.5
Bismuth	Bi	(ppm)	2
Calcium	Ca	(%)	0.32
Cadmium	Cd	(ppm)	19.0
Cobalt	Co	(ppm)	5
Chromium	Cr	(ppm)	101
Copper	Cu	(ppm)	447
Iron	Fe	(%)	3.28
Gallium	Ga	(ppm)	<10
Mercury	Hg	(ppm)	2
Potassium	K	(%)	0.14
Lanthanum	La	(ppm)	<10
Magnesium	Mg	(%)	0.07
Manganese	Mn	(ppm)	83
Molybdenum	Mo	(ppm)	2
Sodium	Na	(%)	0.01
Nickel	Ni	(ppm)	6
Phosphorus	P	(ppm)	750
Lead	Pb	(ppm)	1330
Antimony	Sb	(ppm)	70
Selenium	Se	(ppm)	10
Strontium	Sr	(ppm)	86
Titanium	Ti	(%)	<0.01
Thallium	Tl	(ppm)	<10
Uranium	U	(ppm)	<10
Vanadium	V	(ppm)	9
Tungsten	W	(ppm)	15
Zinc	Zn	(ppm)	2440

Pyrite	9.70%
Sphalerite	0.50%
Tetrahedrite	0.10%
Jalpaite	0.10%
Ruby Silver	0.05%
Galena	0.05%
Chalcopyrite	trace
Native Gold	trace
Native Silver	trace
Gangue	89.50%

The specific gravity of the ore is 2.75-2.80 with a relative work index of 15.2.

2.4.2 Metallurgy

Testwork was carried out by Lakefield Research and Mr. Gary W. Hawthorn to assess the metallurgical response of the ore to possible processing options. The work included gravity separation, flotation, roasting of both ore and concentrate and cyanidation of the whole ore or the various products.

2.4.2.1 Gravity Concentration

To assess the potential to exploit the differences in density between the free gold and silver sulphide minerals and the mainly silicious gangue, gravity separation tests were undertaken. Gravity methods produced recoveries of 25-54% of the gold but consistently less than 8% for the silver. This indicated an opportunity to capture a significant portion of the gold in the grinding circuit.

2.4.2.2 Cyanidation

Cyanidation tests were carried out to assess the amenability of the remaining precious metals to recovery by leaching. Cyanidation of the gravity tailings provided good gold recoveries but resulted in a poor (<40%) return on the silver values. This indicated that the gold not recovered by gravity was either fine free gold or fine gold that was loosely associated with either the sulphide or gangue minerals. The poor silver recoveries were likely due to its presence in the form of the relatively insoluble sulphides, tetrahedrite and proustite.