**Geological Mapping**

**Magnetometer and Electro Magnetic**

**Survey**

**New Imperial Mines Limited**

**War Eagle Area**

**Whitehorse Copperbelt**

**May 15 - September 15, 1967**

**BY**

**R. G. Hilker, P. Eng.**



This report has been examined by the Geological Evaluation Unit. Approved as to technical worth by:

D C Findlay
RESIDENT GEOLOGIST

Approved as to cost in the amount of: $ 30,000

R. G. Needham
RESIDENT MINING ENGINEER

Accepted as representation work under Section 53(4) Yukon Quartz Mining Act.

COMMISSIONER OF YUKON

TABLE OF CONTENTS



POCKET: -

1. War Eagle Area Geological Maps - 4 Sheets, 1" = 200 feet.
2. War Eagle Area Electro-Magnetic E. M. 16 Survey - 6 Sheets, 1" = 200 feet.
3. War Eagle Area Magnetic Survey - 6 Sheets, 1" = 200 feet.
4. Sketch Map of Claims for Assessment Work, Sheet 105-D-14 and 105-D-11, 1" = ½ mile.
5. War Eagle Area - Exploration 1967 - Linegrid.

## Introduction:

The following geological and geophysical report is submitted to the Whitehorse Mining Recorders Office for the purpose of assessment work on a group of claims on the Whitehorse Copperbelt.

Geological and geophysical work was conducted over the claim group between May 15th and September 15th, 1967. The survey work was done by New Imperial Mines Limited under the direction and supervision of R. G. Hilker, P. Eng.

It is requested that the information and contents of this report remain confidential.

## Claim Location:

The War Eagle group of claims are located west of Rabbits Foot Canyon, Porter Creek and the Fish Lake Road, north of Whitehorse. (See claims for assessment work sketch). The claim group is also located west of the Alaska Highway between mile 919 and mile 921.

The War Eagle claim group consists of the following 83 Quartz Mineral Claims and Fractions: Jean, Angela, Anne, Pit, Bornite, Rox, Zircon, Ace, Rapuzzi, Sanson and Jay. All of the claims are located on sheet 105-D-14 and 105-D-11, Whitehorse Mining District.

New Imperial Mines Limited of Postal Address Box 2380, Whitehorse, Yukon Territory, either owns or holds under option, the forementioned claim groups.

## Linecutting Grid:

A linecutting grid of 119.14 miles was slashed over the claim group to conduct the respective surveys upon (see Line Grid Sketch). The main baseline has a bearing due north and 400 foot spaced crosslines were slashed off the main control line. The crosslines were slashed at right angles to the baseline in a east and west direction. Tie lines were

...2

slashed on the west and east boundries and the ends of the crosslines were located. Line 24 + 00 was slashed using a transit for alignment 61 + 00 feet west and 55 + 00 feet east. Crosslines at 200 feet spacing were cut between line 10 + 00 and line 110 + 00 to the west. The 200 feet crossline spacing was also cut between line 64 + 00 and line 80 + 00 east. Crosslines at 100 feet spacing were cut between line 98 + 00 and line 110 + 00 east.

Pickets were placed along the lines each 100 feet chained distance to work the lengths of the lines.

The following lists show the length of the lines over the entire linecutting grid and includes secondary baselines and tie lines.

| West | | | East | | |
|---|---|---|---|---|---|
| Lines | Length | Distance | Lines | Length | Distance |
| 0 | 6130W | 48S | 0 | 5570E | 22N |
| 4N | 6130 | 358N | 4N | 5559 | 485 |
| 8 | 5755 | 819 | 8 | 5389 | 807 |
| 10 | 2800 | | 12 | 5279 | 1232 |
| 12 | 5725 | 1157 | 16 | 5424 | 1632 |
| 14 | 3200 | 1417 | 20 | 5512 | 2001 |
| 16 | 5459 | 1581 | 24 | 5500 | 2400 |
| 18 | 3200 | 1796 | 28 | 4205 | 2864 |
| 20 | 6107 | 2060 | 32 | 4210 | 3229 |
| 22 | 3200 | 2186 | 36 | 5447 | 3616 |
| 24 | 6100 | 2400 | 40 | 5128 | 3989 |
| 28 | 6100 | 2879 | 44 | 5410 | 4365 |
| 32 | 6100 | 3203 | 48 | 5410 | 4700 |
| 36 | 6130 | 3770 | 52 | 5410 | 5135 |
| 40 | 6145 | 4000 | 56 | 5410 | 5456 |
| 44 | 6158 | 4358 | 60 | 5410 | 5974 |
| 48 | 6167 | 4823 | 64 | 5200 | 6580 |
| 52 | 6180 | 5250 | 66 | 1300 | |
| 56 | 6200 | 5760 | 68 | 5380 | 6802 |
| 60 | 6210 | 6018 | 70 | 1200 | |
| 64 | 6220 | 6353 | 72 | 5355 | 7210 |
| 68 | 6235 | 6794 | 74 | 1300 | |
| 72 | 6248 | 7154 | 76 | 5345 | 7752 |
| 76 | 6259 | 7584 | 78 | 1300 | |
| 80 | 6270 | 8102 | 80 | 5338 | 8011 |
| 84 | 6270 | 8417 | 84 | 5320 | 8517 |
| 88 | 6270 | 8793 | 88 | 4060 | |
| 92 | 6262 | 9282 | 92 | 5313 | 9245 |
| 94 | 1730 | | 96 | 5310 | 9780 |
| 96 | 6275 | 9735 | 98 | 3635 | 9788 |
| 98 | 1770 | | 99 | 3645 | 9880 |
| 100 | 6310 | 10008 | 100 | 3600 | 9981 |
| 102 | 1810 | | 101 | 3540 | 10091 |
| 104 | 6325 | 10485 | 102 | 3655 | 10173 |
| 106 | 1860 | | 103 | 3500 | 10320 |
| 108 | 6340 | 10782 | 104 | 3600 | 10401 |
| 110 | 1900 | | 105 | 3585 | 10502 |
| 112 | 6370 | 11275 | 106 | 3575 | 10600 |

...3

**Lines Continued:**

West

| Lines | Length | Distance |
|---|---|---|
| 116 | 6390 | 11805 |
| 120 | 6405 | 12080 |
| 124 | 6440 | 12481 |
| 128 | 6000 | 12805 |
| 132 | 6000 | 13200 |
| 136 | 6000 | 13641 |
| 140 | 6007 | 14020 |
| 144 | 6030 | 14379 |
| 148 | 6030 | 14733 |
| 152 | 6030 | 15286 |
| 156 | 6038 | 15689 |
| | 267,280 | 50.62 Miles |

East

| Lines | Length | Distance |
|---|---|---|
| 107 | 3460 | 10710 |
| 108 | 3400 | 10790 |
| 109 | 3450 | 10917 |
| 110 | 3450 | 11016 |
| 112 | 3400 | 11214 |
| 114 | 3400 | 11397 |
| 116 | 3355 | 11591 |
| 118 | 3400 | 11794 |
| 120 | 3380 | 12019 |
| 124 | 3400 | 12400 |
| 128 | 3400 | 12789 |
| 132 | 3500 | 13220 |
| 136 | 3650 | 13625 |
| 140 | 3900 | 14030 |
| 144 | 3980 | 14421 |
| 148 | 4000 | 14832 |
| 152 | 3100 | 15248 |
| 156 | 2800 | 15629 |
| | 230,754 | 43.72 Miles |

| | |
|---|---|
| BL8W | 1400 |
| BL27W | 1600 |
| BL43E | 1200 |
| BL27E | 4400 |
| BL30E | 5300 |

13,900 - 2.63 Miles

| | |
|---|---|
| TL61W | 12481N |
| TL60W | 3281 |
| TL40W | 1200 |
| TL28E | 5829 |
| TL55E | 9780 |

31,571 - 5.97 Miles

| | |
|---|---|
| Crossline West | 50.62 |
| Crossline East | 43.72 |
| Baseline | 2.63 |
| Tie Line | 5.97 |
| Total: | 102.94 Miles |

**War Eagle Detail Line:**

West

| Lines | Length | Distance |
|---|---|---|
| 26N | 3700 | 2552N |
| 30 | 3700 | 2945 |
| 34 | 3700 | 3285 |
| 38 | 3700 | 3774 |
| 42 | 3700 | 4166 |
| 46 | 3700 | 4496 |
| 50 | 3700 | 4922 |
| 54 | 3700 | 5370 |
| 58 | 3700 | 5751 |
| 62 | 3700 | 6140 |
| 66 | 3700 | 6584 |

| Lines | Length | Distance |
|---|---|---|
| 70 | 3700 | 6978 |
| 74 | 3700 | 7352 |
| 78 | 3700 | 7801 |
| 82 | 3700 | 8177 |
| 86 | 3700 | 8600 |
| 90 | 3700 | 9020 |
| 94 | 3700 | |
| 98 | 3700 | |
| 102 | 3700 | |
| 106 | 3700 | 3 |
| 110 | 3700 | 5 |

814,000 = 15.42 Miles

Tie Line 37W 6400 = 1.21 Miles

...4

**Employees:**

**Geologists**

Mr. Ian Robinson,
Room 127, Co-ed Dormitory,
Michigan Tech. University,
Houghton, Michigan. U.S.A.

Mr. Micheal Brady,
1206 College Avenue,
Houghton, Michigan.
U.S.A.

Mr. Robert McCandless,
P. O. Box 315,
Whitehorse, Y. T.

Mr. R. G. Hilker,
P. O. Box 566,
Whitehorse, Y. T.

**Geological Assistants**

Mr. James Parker,
P. O. Box 1161,
Whitehorse, Y. T.

Mr. William Drury,
P. O. Box 998,
Whitehorse, Y. T.

Mr. Shawn McLennan,
P. O. Box 520,
Whitehorse, Y. T.

**Magnetometer**

Mr. Micheal Redfearn,
P. O. Box 206,
Hancock, Michigan. USA

Mr. Micheal Smith,
P. O. Box 244,
Whitehorse, Y. T.

E. M. 16

Mr. Fred Orschoff,
1335 Bowness Road, N. W.,
Calgary, Alberta.

Mr. Myrl Currie,
P. O. Box 548,
Whitehorse, Y. T.

**Surveyor**

Mr. Dave Chorney,
4693 West 12th Avenue,
Vancouver, B. C.

**Rodman**

Mr. Fred Metcalfe,
P. O. Box 153,
Whitehorse, Y. T.

**Drafting Assistant**

Miss Marion Metcalfe,
P. O. Box 153,
Whitehorse, Y. T.

**Cook**

Mr. Oliver St. Marie,
P. O. Box 548,
Whitehorse, Y. T.

Mr. Dan O'Connel,
P. O. Box 548,
Whitehorse, Y. T.

**Linecutters**

Mr. Roger Voisine,
1139 - 3rd Avenue,
Val Dor, Quebec.

Mr. Legar Roy,
P. O. Box 910,
Val Dor, Quebec.

Mr. Nick Kostilik,
P. O. Box 910,
Val Dor, Quebec.

The supervision of all geological and geophysical personnel was by Mr. R. G. Hilker, P. Eng., of P. O. Box 566, Whitehorse, Y. T., Agent and Employee of New Imperial Mines Limited.

...5

Geological Survey:

Geological mapping was conducted over the 120 miles of line grid at a scale of 1" = 200 feet. (See 4 Sheets of Geological Maps.) About 50% bedrock was exposed in the area mapped. Glacial overburden with spruce-pine-poplar and alder vegetation cover the area. Lines were spaced at 400-200-100 feet intervals to permit detail geology mapping.

Local Geology:

The original rocks on the Whitehorse Copperbelt, were the Lewes River Group - Upper Triassic in age. The formation consists of:

(a) quartzite, arkose, greywacke and argillite

(b) limestone and dolomite

On parts of the Copperbelt the Laberge Group, Lower Jurassic in age, overlays the Lewes River Group. The two groups of rocks were upheaved and intruded by the Cretaceous Coastal Intrusive batholith. The igneous intrusive sequence consists of granite, granodionite to dioritic rocks. In very recent times the Miles Canyon extrusive basalt has covered parts of the forementioned rock groups.

Metamorphism:

The Lewes River limestone and dolormite were the most predominate original rock types before being metamorphosed by the large igneous intrusive. The metamorphosed limestone and dolomite, with quartzite beds, were changed to a skarn type rock with various secondary siliceous minerals introduced. The skarns were developed due to an addition of silicate between the hot igneous intrusive and the sedimentary rock types. In places along the contacts between the Lewes River Group and the Coastal Intrusive copper ores were deposited in mineable sized deposits. The deposits are considered to be contact metasomatic in origin with two types of ore and mineral assemblages occuring. In parts the original rock types have only been affected by heat and pressure that recrystalized the limestone and dolomite. The present deposits can be considered as metamorphosed roof pennants and huge remnants of sedimentary rock trapped in the igneous intrusive.

TABLE FORMATIONS (Page 6)

WHITEHORSE COPPERBELT

TABLE OF FORMATIONS

CENOZOIC

Quaternary

Pleistocene & Recent

| | |
|---|---|
| Q | Alluvium, Glacial Drift |
| 10 | Miles Canyon Basalt |

Post Cretaceous

Intrusive Dykes or Sills

| | | | |
|---|---|---|---|
| 9 | 9 A | Acidic | Granitic, Aplite, Felsite, 9 A May Predate Skarn |
| | 9 B | Basic | Andesite, Diorite, Post-Ore |

MESOZOIC

Cretaceous

Coast Intrusives

| | | | |
|---|---|---|---|
| 8 | Diorite | 8a | Altered |
| | | 8b | Unaltered |
| 7 | Granite, Granodiorite, Quartz Monzonite | | |

Lower Jurassic & Later

| | |
|---|---|
| 6 | Laberge Group |

Upper Triassic

Lewes River Group (Metamorphosed)

| | |
|---|---|
| 5 | Limestone and or Dolomite 5 B Carb Limestone |
| 4 | Quartzite, Greywacke, Argillite, Arkose<br>4 q Quartzite, 4 g Greywacke |
| 3 | Skarn - 3a Actinolite, 3c Chlorite, 3d Diopside, 3e Epidote<br>3 g Garnet, 3s Serpentine, 3t Tremolite, 3f Feldspar |
| 2 | Skarn - Bornite, Chalcopyrite, Copper Oxides with; 2a Actionolite<br>2c Chlorite, 2d Diopside, 2e Epidote, 2g Garnet, 2s Serpentine |
| 1 | Magnetite Skarn - 10 - 80% Magnetite, Bornite, Cpy, Valeriite,<br>Cu Oxides is - Serpentine, 1D-Diopside, 1C-Chlorite |

...7

Lithology of Skarns:

The two skarn types that have developed are composed of one or more of the following minerals:

(a) Calcium - magnesium - silicate skarn made up of; actinolite tremolite, diopside, wollastonite, epidote, garnet, chlorite, feldspar and alteration minerals.

(b) Calcium - magnesium - iron skarn consisting of; sepentine, diopside magnetite and specular hematite.

The skarns are usually light in color and very fine grained, but occasionaly with good crystals of all the forementioned minerals. The contact between the skarn and unaltered but recrystallized limestone is sharp and abrupt. The diorite grades from a fresh black and white colored variety to an altered greyish diorite and then into a "dioritic" skarn. The contact between the skarn and the dioritic skarn, or diorite, is often marked by abundant pink epidote or zoisite.

Economic Geology:

The host rock for the mineral deposits consists of three types, (a) iron-copper serpentine or diopside skarn, (b) copper sulphide skarn, (c) barren skarn. In parts the mineralized skarns are dioritized and in places interbedded with mineralized quartzite. The wall rocks contacting the skarn and ore deposits, are recrystallized limestone or a fresh to altered diorite. The diorite appears to halo the ore deposits and grade into grandodiorite and granites.

The predominant copper mineralization consists of the sulphides bornite and chalcopyrite. On the north end of the Copperbelt in the War Eagle Area molybdenum occures with copper sulphides. In the Pueblo Area of the Copperbelt copper sulphides are associated with magnetite and lesser quantities of hematite. Gold and silver are associated with chalcopyrite mineralization in all ore deposits. From the mineralization observed on the central ore deposits it is possible that two stages of primary mineralization occured. The first copper mineralization deposited of chalcopyrite and quartz replacement.

...8

The copper minerals that occur in the ore deposits are: bornite, chalcopyrite, valeriite, chalcocite, tetrahedrite, covellite, cuprite, malachite, azurite, chrysocolla and minor native copper. The iron minerals are magnetite, specular and micaceous hematite, goethite, limonite, pyrite and pyrrhotite. Magnetite is the main iron mineral. The molybdenum minerals are molybdenite, powellite and scheelite? Other rare minerals are gallium, vanadium, cobalt, nickel, palladium, platinum and manganese. ? $WO_4$

The ore deposits are highly jointed, faulted and with very irregular shaped hanging and foot walls. Large and small folds are evident in surface outcrops with faulting due to folding of the rocks. Slickensides and shears are present in the diamond drill core and on surface outcrops. Both pre-ore and post-ore felsic and mafic dikes have cut the Lewes River group of metamorphic rocks.

The presently delineated ore deposit in the War Eagle Area is as follows:

-- War Eagle - The ore deposit contains copper mineralization in a garnet - diopside - tremolite - epidote skarn. There is 1,230,000 tons of 1.29% copper delineated at the War Eagle deposit.

Interpretation:

The geological mapping has outlined skarn zones in the following areas:

(1) Pueblo
(2) War Eagle and South towards Pueblo
(3) Copper King - Carlisle
(4) Anaconda - Rabbits Foot

The skarn zones contact with greywacke - quartzite, limestone or granite - granodiorite and are all associated with small surface copper mineralization showings. Old underground workings have been developed on several of the showings that consist of shallow shafts to lateral drifting.

...9

The mineralized skarn zones occur due to the igneous intrusive. Skarn rock types have been developed on the western and eastern side of the large igneous granite - granodiorite plug intrusive in the central and south-eastern part of the map area. The skarns have probably developed in the dolomitic facies of the Lewes River limestone. The dolomite has supplied the magnesium and the igneous intrusive the silicate for the skarn magnesium-silicate mineral assemblage. Copper mineralization consisting of bornite and chalcopyrite has been deposited during the contact metasomatic development of the skarn zones.

The significant feature of the geological mapping is the outlines of the several skarn zones, as these areas are potential copper ore deposits.

Conclusions and Recommendations:

The skarn zones are to be correlated with the electro-magnetic and magnetic surveys to find anomalous trends that may indicate ore deposition. The trends of mineralization, in the skarn rock types that are mapped, could be test diamond drilled to explore for mineralization in the sub-surface.

Geophysical Surveys:

A. E. M. 16 - Electro Magnetic Survey:

1) Description of Instrument

The Geonics Electro-Magnetic E. M. 16 Instruments is a receiver that measures the secondary vertical component from a conductive body. The power source is from a VLF transmitting station that operates for the detection of submarines on the North American Continent. The VLF transmitters have vertical antenna, the antenna current radiates a concentric horizontal magnetic field. When the magnetic field meets a buried conductive body a secondary field is created. The E. M. 16 receiver measures the horizontal and vertical axis, of the secondary field set up by a conductive body, with an in-phase and quadrature percentage of tilt angle reading.

The instrument is equipped with two crystals for the choice of selection of the VLF power source, parallel to the strike of bedrock in any area worked. The two crystals for the stations used in the War Eagle Survey were as follows:

Station NPG - Seattle, Washington - Frequency 18.6 KHZ
Station NSS - Annapolis, Maryland - Frequency 21.4 KHZ

The Seattle station has nearly parallel alignment for the Northwesterly bearing bedrock and Yukon River Valley of the Whitehorse Copperbelt. The Seattle station was used for the entire survey in the War Eagle Area and when required the Annapolis station was used for check work. No results were plotted from the Annapolis station, as few check readings were taken.

2) Reference to Published Geology

Publications on the Whitehorse Copperbelt Geology are as follows:

G.S.C. - Memoir 312 - J. O. Wheeler, 1961
Whitehorse Map - Area Y. T. - 105D

G.S.C. - Paper 63-41 - E. D. Kindle, 1964
Copper and Iron Resources,
Whitehorse Copperbelt, Y. T.

Canada Department of Mines - Geological Survey Branch
Report on the Whitehorse Copperbelt, Y. T., 1909
by R. G. McConnell.

...11

2) Reference to Published Geology - Continued

Western Miner - Volume 40 Number 7 - July 1967
The Whitehorse Copperbelt - R. G. Hilker

3) Field Notes

The E. M. 16 field notes are stored in the Engineering Department at New Imperial Mines Office. The field notes are available for inspection or reference upon request.

4) Interpretation

The E. M. 16 field readings were profiled on the linecutting grid plan at a horizontal scale of 1" =.200 feet, in-phase and quadrature readings at 1" = 20 percent. The in-phase readings are plotted with a solid line and quadrature readings with a broken line. The positive and negative signs for the readings are indicated on the sheet legend. There are six sheets of E. M. 16 Survey Results, plotted and profiled and the conductive zones are marked on the individual sheets where they are applicable. The following is a brief discussion of each of the six sheets:

Sheet 1 E. M. 16 Lines 0 + 00 to 48 + 00 West of War Eagle Baseline. This sheet covers the old Pueblo and Dry Gulch copper mineralized showings and geologicaly mapped skarn zones. The Yukon Electrical power lines and metal penstock has effected the E. M. 16 readings and indicated perfect conductors.

In the skarn zone at the old Pueblo workings, fine conductors have been indicated. The conductors are about four hundred feet long and are not continuous but offset from one another. The Dry Gulch showing is outlined with a weak conductor that may be due to conductivity at depth. A weak conductor that is probably horizontal is outlined over the skarn zone between line 38 + 00 and 48 + 00.

Sheet 3 E. M. 16 Lines 52 + 00 to 100 + 00 West of War Eagle Baseline. This sheet is a continuation of Sheet 1 to the North.

...12

Sheet 3 (cont'd) The War Eagle orebody is indicated on line 84 + 00 at 24 + 00 feet West by the in-phase reading. There is a difference of 67 percent between the positive and negative tilt angles over the highly conductive vertical sulphide body. The positive in-phase readings on lines 88 + 00, 90 + 00 and 96 + 00 at about 24 + 00 feet, suggest a magnetic conductor, and an extension of the War Eagle orebody. The skarn zone south of line 84 + 00 is outlined by broad negative in-phase and quadrature readings. The skarn zone is outlined across the profiles between lines 50 + 00 and line 80 + 00 and is confirmed by the geological mapping that is included in this report. Conductive overburden is indicated between lines 50 + 00 and line 92 + 00 by the negative in-phase and corresponding positive quadrature profile. An inclined conductor is indicated on line 96 + 00 and line 100 + 00 at 15 + 00 feet west in the granite. Further north of this area the granite is copper mineralized at line 124 + 00.

Sheet 5 E. M. 16 Lines 102 + 00 to 156 + 00 West of War Eagle Baseline. This sheet covers the extension of the War Eagle Deposit and a continuation north of Sheet 3.

A weak conductor is indicated in the granite between lines 120 + 00 and 128 + 00 about 15 + 00 feet west of the baseline. This general area was found to contain copper sulphide mineralization in the contact between granodiorite and quartzite. This zone is extended to the north and south. The northern conductor crosses lines 132 + 00 to 144 + 00 with a north-west strike and follows the granite-quartzite contact. The southern zone is located between lines 104 + 00 to 116 + 00 at about 15 + 50 west of the baseline. The southern conductor adjoins a zone of conductive overburden. The possible sulphide conductor is indicated at the intersection between the in-phase reading returning to a positive angle and the quadrature tilt angle becoming negative.

...13

Sheet 5 (cont'd) The small skarn zone contacts with quartzite or possible granodiorite is indicated between lines 102 + 00 and 120 + 00 at about 45 + 00 feet west of the Baseline. Conductive overburden is evident due to the positive quadrature intensity and negative in-phase readings. To the north of the skarn zone between line 140 + 00 and 152 + 00 another zone of conductive overburden is outlined. The west flank of this zone appears to contain a possible sulphide conductor. This conductor is located at the intersection of where the in-phase is returning to a positive tilt angle and the quadrature is becoming negative.

Sheet 2 E. M. 16 Lines 0 + 00 to 48 + 00 east of the War Eagle Baseline. The rock type in the area covered by sheet number 2 has been geologicaly mapped as granodiorite. Conductive overburden is suggested on the profiles between lines 0 + 00 and 20 + 00 at about 28 + 00 east. A weak conductor is indicated between line 24 + 00 and line 48 + 00. The conductor is aligned with Porter Creek on the northern sheet number 4, and offset about 800 feet west of the Copper King mineralized workings. This conductor is in granite but could be caused by a mineralized fault zone or wet shear and fault gouge.

The power line along the baseline has effected the E. M. 16 readings and obliterated the true conductivity of an area to the east and west of the baseline.

Sheet 4 E. M. 16 Lines 52 + 00 to 100 + 00 East. This sheet is the northern continuation of sheet number 2.

A weak conductor is indicated along Porter Creek between lines 52 + 00 and 68 + 00, 30 + 00 feet east of the baseline. The conductor could be caused by sulphides or a wet shear and fault. The old Copper King and Carlisle showings, in the skarn rock type, have seven short conductors indicated between lines 60 + 00 and 76 + 00. All of these conductors could be due to sulphides as there is abundant surface mineralization present in the skarn rock.

...14

Sheet 4 (cont'd) Between lines 84 + 00 and 88 + 00, 27 + 00 East of the baseline a conductor is indicated along Porter Creek. This zone may be continuous to the conductors further south and caused by a wet fault or sulphides.

A strong conductor in the granitic rock is indicated between lines 96 + 00 and 100 + 00, 22 + 00 feet east of the baseline. The zone is aligned with the Rabbit Foot showing further north. The conductor may be caused by sulphides that extend south from the shaft location at the Rabbit Foot.

The Porter Creek electric power line cuts across the east end of lines 84 + 00 through 100 + 00 and distorts the E. M. 16 readings.

Sheet 6 E. M. 16 Lines 104 + 00 to 156 + 00 East. This sheet is a continuation north of the E. M. 16 Survey from sheet number 4. A broad and weak conduction outlines the granite-skarn contact between lines 104 + 00 and 144 + 00 at about 19 +00 feet east of the baseline. The contact may be sulphide mineralized but the conductor is probably caused by the difference in the two rock types. A similar contact conductor is located between lines 128 + 00 and 132 + 00 at a distance of 25 + 00 feet east of the baseline.

Eight parallel conductors occur on the Rabbit Foot and Anaconda showings, between lines 104 + 00 and 120 + 00. These eight conductors are all contained within a large skarn zone. The conductors are probably caused by sulphide mineralization, as indicated by the abundant surface showings of bornite.

The Porter Creek power line runs along the east end of all the lines on this sheet.

...15

5) Conclusions and Recommendations

All of the E. M. 16 electro magnetic conductors, on the six sheets of profiles, are of sufficient interest to conduct additional check work upon.

The Conductors on the Pueblo, War Eagle, Copper King, Carlisle, Rabbit Foot and Anaconda are probably caused by copper sulphide mineralization. These conductors are all within skarn zones and associated with considerable surface mineralization. The six old showings have all been mined and various amounts of development work conducted upon them.

The conductors associated with geological contacts are of particular interest due to the possibility of mineralization between two rock types. Mineralization in the granite, with a porphry type of copper deposit, may be causing the conductors in the granite.

It is recommended to conduct another geophysical method check over all of the conductors outlined by the E. M. 16. Another electro magnetic method or induced polarization survey would adequately check the E. M. 16 results. The Mark 4 Ronka Horizontal Electro Magnetic instrument using a 200 foot coil separation would check the E. M. 16 conductors, if run in the cold dry winter months. If the horizontal Ronka was used for a check survey clinometers must be attached to the transmitter and receiver coils to guarantee that the two coils are in the same plane when operating in hilly terrain. It will be necessary to run an induced polarization survey when there is less than three inches of frozen ground. The I.P. would require 200 and 400 foot electrode spacing readings on a 400 foot spaced line grid. If results warranted, readings would be taken at 100 and 50 feet electrode spacing. The horizontal E. M. check survey would cost about $3,000 and the I.P. Check survey would cost approximately $10,000.

B. Magnetics - Fluxgate Magnetometer Survey

1) Available Airborne Magnetics

The War Eagle Map exploration grid is contained within the area covered by the Geological Survey of Canada Airborne Magnetic Map 3376G - Whitehorse, Yukon Territory, Scale 1" = 1 Mile.

2) Description of Magnetometer

Two Sharpe MF-1 Fluxgate Magnetometers were used to conduct the magnetic survey on the War Eagle Area. Specifications of the instrument by the manufacturer are as follows:

| | |
|---|---|
| Maximum Sensitivity | 20 gammas/scale division on 1000 gamma range. |
| Readability | 5 gammas or ¼ scale division on 1000 gamma range. |
| Ranges | 1000 - 3000 - 10000 - 30000 - 100000 gammas. |
| Maximum Range | ± 100,000 gammas. |
| Latitude Adjustment Ranges | 10,000 to 75,000 gammas, Northern Hemisphere. |
| Batteries | 12 "C" Cell Flashlight Batteries. |

The fluxgate magnetometer as defined by M. B. Dobrin in the text book "Introduction to Geophysical Prospecting", is as follows:

"The flux-gate magnetometer, also known as the saturable reactor, makes use of a ferrmagnetic element of such high permeability that the earth's field can induce a magnetization that is a substantial proportion of the saturation value. If this field is superimposed upon a cyclic field induced by a sufficiently large alternating current in a coil around the magnet, the resultant field will saturate the core. The phase of each energizing cycle at which saturation is reached gives a measure of the earth's ambient field".

The MF-1 Fluxgate Magnetometer measures the vertical component of total magnetic field. The instrument does not require a tripod and only needs to be oriented in the general north magnetic pole direction. The sensitivity of the instrument cannot be changed except by rough handling of the instrument.

...17

All instrument readings are directly in gammas and no conversion from scale divisions to gammas are necessary.

3) Field Procedure

Two MF-1 Fluxgate Magnetometers were used during the survey, one magnetometer was used to measure daily diurnal variation and the second instrument was used to read field intensities.

The diurnal magnetometer was set up in a stationary position in the exploration office and readings taken every five minutes during the time interval the field magnetometer was operating. Daily diurnal variation in the magnetic field was plotted on a graph that showed the time and the magnetic readings. The graph was used to find the magnetic variation from the normal and a positive or negative gamma correction made on each field intensity observation taken. The field magnetometer was read at pre-determined magnetic base control stations and then individual stations were read along the various grid lines.

The main magnetic control station (B.C.S. - 2), was established on the baseline at L24 + 00 with a value of 4190 gammas and determined from the main magnetic control station of an assumed 2000 gamma value, and located at Mile 910.3 Alaska Highway. This main control station on the highway, is used for all magnetometer surveys on the New Imperial Mines property. Several control stations were determined along the baseline at convenient line spacing using B.C.S. - 2, as a reference. Before any readings were taken on the grid lines, a base control station was read. In this manner all readings on the grid system were to a common magnetic intensity base.

4) Field Notes

The magnetometer field notes and daily diurnal magnetic readings are stored in the New Imperial Mines Limited Engineering Office and are available for reference. The daily diurnal graphs have been retained for future reference and are also available.

...18

5) Interpretations

The magnetic survey has been plotted and contoured on six plans at a scale of 1" = 200 feet. The magnetometer results are enclosed in the back pocket of this report.

The main value of a magnetic survey on the Whitehorse Copperbelt is to outline high magnetic intensities. The magnetic highs could be caused by iron-magnesium-silicate skarn deposits that contain commercial quantities of copper and similarto the Little Chief or Arctic Chief ore deposits.

The following general observations are noted for each of the six magnetic sheets.

Sheet 1 Magnetics Map, Lines 0 + 00 to 48 + 00 - West of baseline.

The average magnetic intensities vary between 3600 and 4000 gammas and occur over the sedimentary quartzite-greywacke and limestone rock types. The higher than average magnetic intensities that vary between 4000 and 5300 gammas are caused by the granite-granodiorite igneous intrusive. The magnetic highs also enclose lower intensities giving a minor dipolar effect in the intrusive rocks. The contact between the intrusive and sedimentary rocks is sharply defined between lines 0 + 00 and 48 + 00 at approximately 16 - 21 + 00 feet west of the baseline. The higher than average magnetic intensities in the igneous rocks, are due to a greater amount of magnetite. Most felsic rock types contain minor quantities of magnetite. The magnetic high trends in a northern direction along the igneous-sedimentary contact.

On line 14 + 00 at 22 + 00 feet west, ore reading of 5938 gammas was observed and occured within an inferred skarn zone in the Pueblo area. The high intensity could be caused by micaceous hematite and magnetite.

Line 34 + 00 at 28 + 00 feet west has a magnetic observation measured as 4664 gammas that is confined within an inferred skarn zone. This reading could also be caused by micaceous hematite and magnetite.

...19

Sheet 1 (Cont'd): The inferred skarn zones as indicated by the geological mapping within the area covered by the magnetic sheet 1, abuts or contacts the igneous intrusive. There appears to be no greater magnetic intensity over the skarn zones except for the two previous mentioned intensities on line 14 + 00 and line 34 + 00.

Sheet 3 Magnetics Map, Lines 52 + 00 to 100 + 00 - West of baseline. This sheet is a continuation north of sheet 1.

The igneous intrusive rock types are outlined by higher magnetic intensities, as on sheet 1. Correspondingly, the sedimentary rocks have lower magnetic intensities and are outlined on the western part of the sheet.

The War Eagle ore deposit skarn zone extends between line 50 + 00 and 100 + 00 at approximately 22 + 00 feet west of the baseline and is rimmed by magnetic highs along the contact with the igneous intrusive. Between line 72 + 00 and line 100 + 00 the granite loops across the skarn zone and a narrow band strikes south in a long finger shape. The magnetic highs roughly confirm the outline of the igneous intrusive to the east and west side of the War Eagle skarn. The skarn zone is truncated at line 100 + 00 at approximately 27 + 00 west of the baseline. The magnetic highs associated in the previously mentioned area suggests igneous intrusive rock and truncationof the skarn.

On line 84 + 00 at 25 + 00 feet west of the baseline a single magnetic high of 6206 gammas is caused by magnetite. The high intensity is located in an area diamond drilled and confirmed to containe bornite, chalcopyrite and in parts magnetite.

The magnetic high on line 75 + 00 at 17 + 00 feet west of the baseline is near the geological contact between the skarn and quartzite. The high intensity may be caused by magnetite associated with copper sulphides and requires further checking.

Sheet 5 Magnetics Map, Lines 104 + 00 to 156 + 00 - West of the baseline. This sheet is a continuation north of the line grid from sheet 3.

...20

Sheet 5 (Cont'd): The magnetic high intensities, between 3900 - 4900 gammas, correspond with the granite igneous intrusive in the central part of Sheet 6. The 4000 gamma contour outlines the granite, and confirms the termination of the granite between lines 148 + 00 and 152 + 00 at about 26 + 00 feet west of the baseline. The magnetic high over the granite checks the inferred intrusive - sedimentary contact as delineated by the geological mapping.

Two high magnetic readings of 4996 gammas on line 116 + 00 at 42 + 00 feet and 44 + 00 feet west of the baseline, occur close to a skarn-granite contact. The high intensities may occur in the skarn and be caused by magnetite. The inferred contact between the granite and skarn may not be separated by quartzite, as indicated on sheet 3 of the geological map, on line 116 + 00 and 44 + 00 feet west of the baseline.

The War Eagle ore deposit skarn zone may extend to line 112 + 00 at about 30 + 00 feet west of the baseline. A few low magnetic readings were observed on lines 102 + 00 to line 112 + 00 with a value of about 3800 gammas, that indicates sedimentary or skarn.rocks, rather than igneous intrusive. A high reading of 6134 gammas on line 110 + 00 feet west of the baseline would be on the approximate contact between the possible skarn zone and granite intrusive. The area previously described is covered with overburden and only a few scattered outcrops are available to correlate the geological contacts. The extension of The War Eagle skarn zone between lines 102 + 00 and 112 + 00 requires a number of overburden drill holes to confirm the rock type in this area.

Sheet 2 Magnetics Map, Lines 0 + 00 to 48 + 00 - East of baseline.

The granite intrusive plug that sheet 2 covers has higher than average background magnetic intensities. One area, that is covered by overburden, indicates normal background magnetic intensities, for sedimentary rock types. This area is located between lines 0 + 00 and 36 + 00 and about 27 + 00 feet east of the baseline.

Sheet 2 (Cont'd): An electromagnetic conductive zone was noted to have been indicated in this area on sheet 2 of the E. M. 16 profile map. Additional work should be done in the area using the overburden drill. The area may contain a skarn zone and possible mineralization.

The high trend that cuts across the northwest corner of sheet 2 may be caused by a structural break and can be considered a fault zone. The magnetic high is parallel to the base of a granite cliff.

Sheet 4 Magnetics Map, Line 52 + 00 to 100 + 00 - East of baseline. This sheet is the continuation north of the magnetic data from sheet 2. High magnetic intensities in the granites on sheet 4, occur close to the contacts with skarn.

The magnetic reading of 5183 to 4902 gammas in granite on line 72 + 00 at 28 + 00 feet east of the baseline, is within 200 feet of Copper King skarn zone contact. Also on line 72 + 00 at 12 + 00 feet east a reading of 5544 gammas was observed. The trend of the high magnetic intensities on line 72 + 00 are aligned with the skarn-quartzite contact to the east. It is possible there is a structural feature in this area with magnetite mineralization along the line of weakness. The greater than average, background magnetic intensities over the granite, outlines the intrusive contact with the sedimentary and skarn rock types.

Between lines 96 + 00 and 104 + 00 at 21 - 36 + 00 feet east of the baseline high magnetic readings were observed in the granite. This area the granite contacts with a large skarn zone that strikes to the west. The high magnetics are located within the granite on the south boundary of the skarn. The magnetic differences, in the forementioned area, may be caused by magnetite contact mineralization. The sedimentary and skarn rock types on sheet 4 have magnetic values less than the granite and are indicated between lines 64 + 00 and 98 + 00 at 33 + 00 feet east of the baseline.

Sheet 6 Magnetics Map, Line 106 + 00 to 156 + 00 East of baseline. This sheet is a continuation north of the magnetic data on sheet 4. Magnetic highs outline the igneous intrusive in the southwest corner

Sheet 6 (Cont'd): of the sheet, between lines 106 + 00 and 120 + 00.

There is no particular difference between the sedimentary quartzite and the skarn zone on lines 106 + 00 and 136 + 00 at about 17 + 00 feet east of the baseline.

The geological mapped copper sulphide mineralization on the Anaconda and Rabbit Foot showing is not associated with any magnetite, as indicated by the low magnetic readings in the two areas.

The magnetic data used in conjunction with the geological mapping and electro-magnetic survey has confirmed definite areas for further exploration.

6) Conclusions and Recommendations

The magnetic data on the six sheets confirms the outline of the igneous intrusive, as indicated on the geological maps. The northern extension of the War Eagle skarn zone, possible 1000 feet extension into the granite, should have more work conducted to confirm if skarn is present.

Additional work should be conducted on lines 0 + 00 to 36 + 00 at about 27 + 00 feet east of the baseline, to confirm the presence of skarn within the granite.

Magnetite in the War Eagle map area is nearly nonexistant, except for a small quantity in the Pueblo and War Eagle mineralized showings.

**Expenditures:**

The following list contains the various costs incurred in the War Eagle Area Geological and Geophysical Surveys.

| | | |
|---|---|---|
| Operation Supplies (Equipment) | $ | 1,195.81 |
| Vehicles | | 1,725.93 |
| Line Cutting (120 Miles @ $85.00/Mile) | | 10,200.00 |
| Geophysics - E.M. Survey | | 8,003.73 |
| Geophysics Magnetics | | 3,122.86 |
| Geological Mapping | | 5,456.02 |
| Bunkhouse Operating Supplies | | 2,134.04 |
| Bunkhouse Repair Supplies & Power | | 399.61 |
| Cookhouse Food | | 4,837.60 |
| Cookhouse Operating Supplies | | 285.44 |
| Cookhouse Repair Supplies | | 1,461.74 |
| Cookhouse Operating Labour | | 3,934.14 |
| Supervision Salaries | | 3,000.00 |
| TOTAL: | $ | 45,756.92 |

I, EUCLID BERUBE, Do hereby certify that the previous listed accounts are correct for the Exploration Expenditures incurred during the 1967 Field Season.

Certified Correct
E. Berube,
Accountant.

C A N A D A )
YUKON TERRITORY )
TO WIT: )

I, Robert G. Hilker, P. Eng.,

of P. O. Box 566, Whitehorse, Yukon Territory,

do solemnly declare, -

To the best of my knowledge $ 43,756.92 Expenditures were incurred by New Imperial Mines Limited, for the 1967 w r Eagle Area Geological and Geophysical Surveys. The expenses were made between May 15 and September 15, 1967.

And I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath and by virtue of The Canada Evidence Act.

Declared before me at Whitehorse,
in the Yukon Territory, this 13 day of
October A.D. 19 67

Robert G. Hilker

A Commissioner for Oaths for Yukon Territory

SHEET No 1

Association of Professional Engineers of the Yukon
R. G. HILKER
GEOLOGICAL ENGINEER

## GEOLOGICAL LEGEND

**CENOZOIC**
QUARTERNARY
PLEISTOCENE & RECENT

- Q — ALLUVIUM, GLACIAL DRIFT
- 10 — MILES CANYON BASALT

**POST CRETACEOUS**
INTRUSIVE DYKE OR SILLS

- 9 — 9A ACIDIC — GRANITIC, APLITE, FELSITE, 9a MAY PREDATE SKARN
  9B BASIC — ANDESITE, DIORITE, POST — ORE

**MESOZOIC**
CRETACEOUS
COAST INTRUSIONS

- 8 — DIORITE — 8a ALTERED, 8b UNALTERED
- 7 — 7G GRANITE, 7B GRANODIORITE, 7M QUARTZ MONZONITE

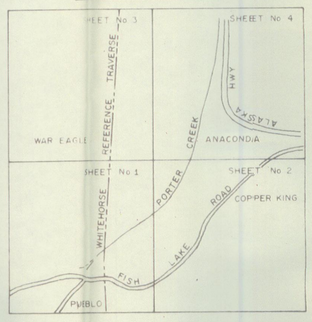
**LOWER JURASSIC & LATER**

- 6 — LABERGE GROUP

**UPPER TRIASSIC**
LEWES RIVER GROUP (METAMORPHOSED)

- 5 — 5 LIMESTONE AND/OR DOLOMITE
  5B CARBONACEOUS LIMESTONE
- 4 — QUARTZITE (q), GREYWACKE (g), ARGILLITE (a), ARKOSE (k),
- 3 — SKARN — 3a ACT, 3c CHL, 3d DIOP, 3e EPID, 3g GARNET, 3k SERP, 3t TREM, 3f FELD,
- 2 — SKARN — BORN, CHALCO, Cu OXIDES, WITH; 2a ACT, 2c CHL, 2d DIOP, 2e EPID, 2g GARNET, 2k SERP, 2t TREM, 2f FELD.
- 1 — MAGNETITE — SERPENTINE SKARN — 10–60% MAG, SERP, BORN, Cu OXIDES,

SHEET LOCATION PLAN




LEGEND

OUTCROP -
SMALL OUTCROP - x
GEOLOGICAL CONTACT -
CONTACT (INFERRED) - - - - - -
FAULT (INFERRED) -
ROCK TYPE - 5B - 3/5

SHEET No. 2

78+00N
72+00N
60+00N
48+00N
36+00N
24+00N
12+00N
0+00N

BASE LINE
POWER LINES
TIE LINE

PORTER CREEK
FISH LAKE ROAD
McINTYRE CREEK
PENSTOCK
PENSTOCK
POWER LINE
POWER LINE
POWER LINE
POWER HOUSE
POWDER MAGAZINE
POWDER MAGAZINE
Cu MINERALIZED GRANITE
COPPER KING
CARLISLE

7B

GEOLOGISTS: IAN ROBINSON — MICHAEL BRADY

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. | | |
| 1967 WAR EAGLE EXPLORATION AREA GEOLOGICAL MAPPING | | |
| DR BY M.M. & W.D.S. | APP'D BY R HILKER | REVISIONS |
| DATE SEPT. 1967 | SCALE 1" = 200' | |
| REF. No. | DWG. No. | |

Association of Professional Engineers of the Yukon
R. G. HILKER
GEOLOGICAL ENGINEER

SHEET No. 3



BL 2
BL 3
BL 5
BL 6
156+00N
144+00N
132+00N
120+00N
110+00N
108+00N
98+00N
84+00N
80+00N
27+00 E
TIE LINE
BASE LINE
REFERENCE TRAVERSE
WHITEHORSE
Cu MINERALIZED 78 B 1-4g
GRAVEL PIT
POND
DUMP
WELL
4g/q
7B
5
3
4g
4q
4q/g
4q/g/k
55°
68°
30°

SHEET No. 4



156+00N
144+00N
132+00N
120+00N
108+00N
96+00N
84+00N
80+00N

PORTER CREEK TOWNSITE

4q
4q/k
4q/g
3
7B
9B
5B
Cpy
ANACONDA
RABBITS FOOT
LAKE
BM 63668

POWER LINE
PIPE LINE
ALASKA HWY
PORTER CREEK
McINTYRE CREEK
WAR EAGLE ROAD
FISH LAKE ROAD

WHITEHORSE REFERENCE TOWER

BL9

BL10

SKARN ZONE

DRY GULCH CONDUCTOR

PUEBLO CONDUCTORS

POWER LINE

POWER LINE

POWER LINE

POWER LINE

PENSTOCK

6100 TIE LINE

BASE LINE

48+00
46+00
44+00
42+00
40+00
38+00
36+00
34+00
32+00
30+00
28+00
26+00
24+00
22+00
20+00
18+00
16+00
14+00
12+00
10+00
8+00
4+00
0+00

60+00 58+00 56+00 54+00 52+00 50+00 48+00 46+00 44+00 42+00 40+00 38+00 36+00 34+00 32+00 30+00 28+00 26+00 24+00 22+00 20+00 18+00 16+00 14+00 12+00 10+00 8+00 6+00 4+00 2+00 0+00

CONDUCTOR

LINE

+

-

IP

Q

#5 #6

#3 #4

#2

SHEET 1
1" = 200'
1" = 100'

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL
ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. Y. T. | | |
| EM 16, LINES 0+00 to 48+00, WEST OF B, WAR EAGLE GRID | | |
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JULY 3/67 | SCALE 1" = 20"/ 1" = 200' | |
| REF. No. | DWG. No. | SHEET 1 |

BL 5

BL 6

BL 8

BL 9

GRANITE CONDUCTOR

CONDUCTIVE OVERBURDEN

WAR EAGLE CONDUCTOR

CONDUCTIVE OVERBURDEN

SKARN ZONE

CONDUCTIVE OVERBURDEN

SKARN ZONE

QUARTZITE ± LIMESTONE CONTACT

100+00
96+00
94+00
92+00
90+00
88+00
86+00
84+00
82+00
80+00
78+00
76+00
74+00
72+00
70+00
68+00
66+00
64+00
62+00
60+00
58+00
56+00
54+00
52+00
50+00

BASE LINE

POWER LINE

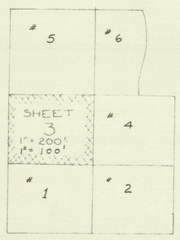
61+00 W TIE LINE

WHITEHORSE REFERENCE TRAVERSE

IP

CUT LINE

Q




Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. Y. T. | | |
| E.M.16, LINES 52+00 to 100+00, WEST | | |
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE AUG. 25/67 | SCALE 1" = 200' 1" = 20" | |
| REF. No. | DWG. No. | SHEET 3 |

RABBIT FOOT CONTACT LOW

PORTER CREEK LOW

COPPER KING

CARLISLE

PORTER CREEK LOW

POWER LINE

BASE LINE

TIE LINE 5500

100+00
98+00
96+00
92+00
88+00
84+00
80+00
76+00
72+00
68+00
64+00
60+00
56+00
52+00

78
74
70
66

SWAMP

POWER LINE

PIPE LINE

HIGHWAY

#5 #6

#3

SHEET
1" = 200'
1" = 100'

#1 #2

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. Y. T. | | |
| EM16 MAP, LINES 52+00 to 100+00, EAST | | |
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE AUG. 24/67 | SCALE 1" = 200' 1" = 20' | |
| REF. No. | DWG. No. | SHEET 4 |

N

156+00
152+00
148+00
144+00
140+00
136+00
132+00
128+00
124+00
120+00
116+00
112+00
110+00
108+00
106+00
104+00
102+00

61+00W TIE LINE

BASE LINE

POWER LINE

CONDUCTIVE OVERBURDEN

CONTACT

GRANITE

CONDUCTOR

GRANITE MINERALIZED CONDUCTOR

POSSIBLE CONDUCTOR

CONDUCTIVE OVERBURDEN

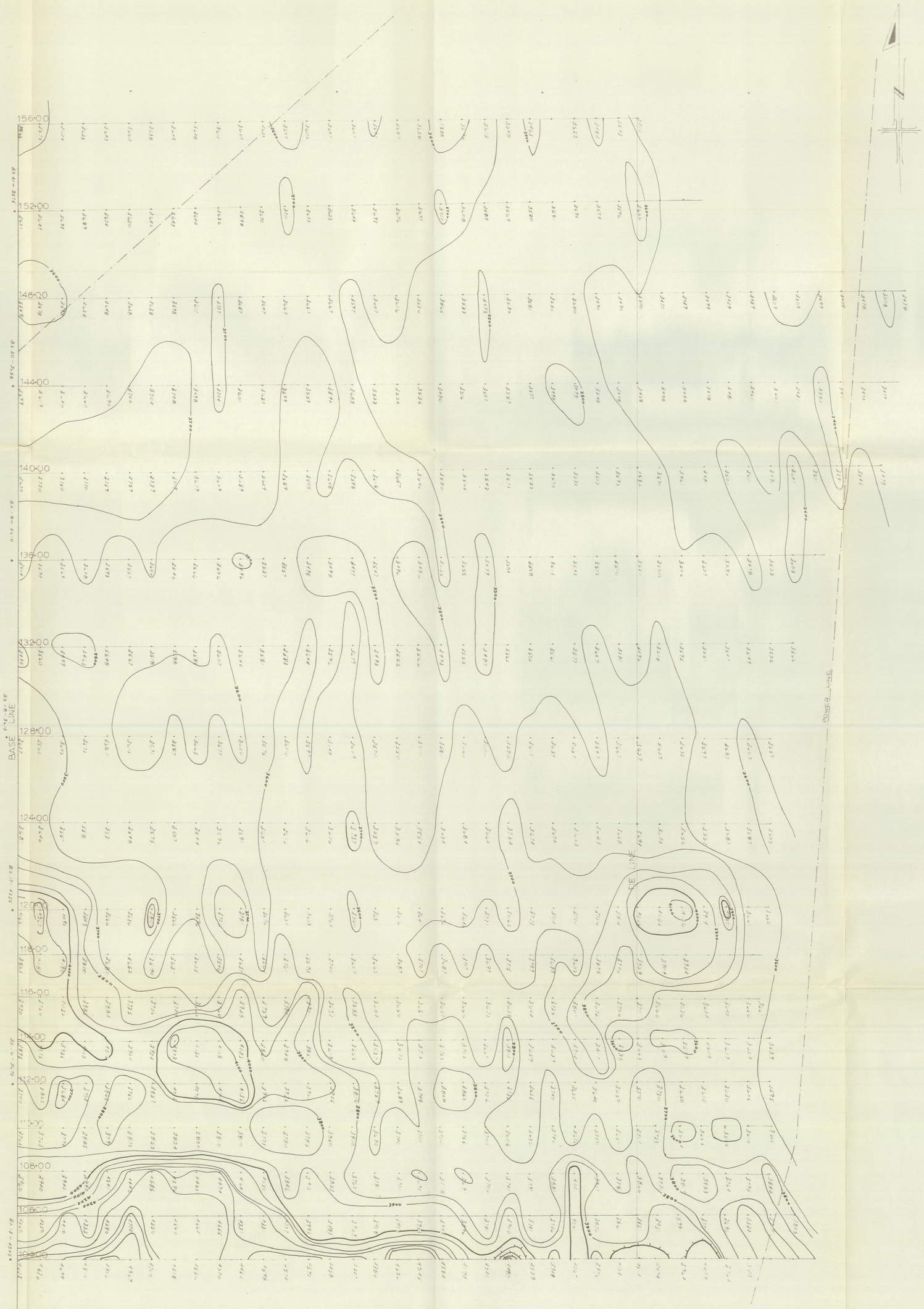
SKARN ZONE

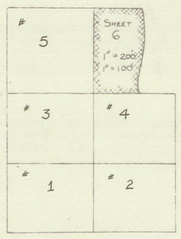
SHEET 5
1" = 200'
1" = 100'

# 6
# 3
# 4
# 1
# 2

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. Y. T. | | |
| EM 16 LINES 102·00 to 156·00 WEST | | |
| DR BY D. CHORNEY | APP'D BY | REVISIONS |
| DATE SEPT 13/67 | SCALE 1" = 200' 1" = 20% | |
| REF. No. | DWG. No. | SHEET 5 |




Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. | | |
| MAG MAP, LINES, 104+00 to 156+00, EAST | | |
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE AUG. 7, /67 | SCALE 1" = 200' | HIGH - J |
| REF. No. | DWG. No. | SHEET, 6 |

61+00W TIE LINE

PENSTOCK

52+00

48+00

44+00

40+00

36+00

32+00

30+00

28+00

BASE LINE

24+00

20+00

16+00

12+00

8+00

4+00

0+00

| | |
|---|---|
| # 5 | # 6 |
| # 3 | # 4 |
| SHEET 1 1" = 200' 1" = 100' | # 2 |

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

MAG MAP, LINES 0+00 to 48+00, WEST.

| | | |
|---|---|---|
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JULY 3/67 | SCALE 1" = 200' | |
| REF. No. | DWG. No. | SHEET 1 |

52+00

48+00

44+00

40+00

36+00

32+00

28+00

24+00

20+00

16+00

12+00

8+00

4+00

0+00

BASE LINE

2700 OFFSET BASE LINE

55+00E TIE LINE

LOW

HIGH

HIGH

HIGH

HIGH

LOW

LOW

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL
ENGINEER

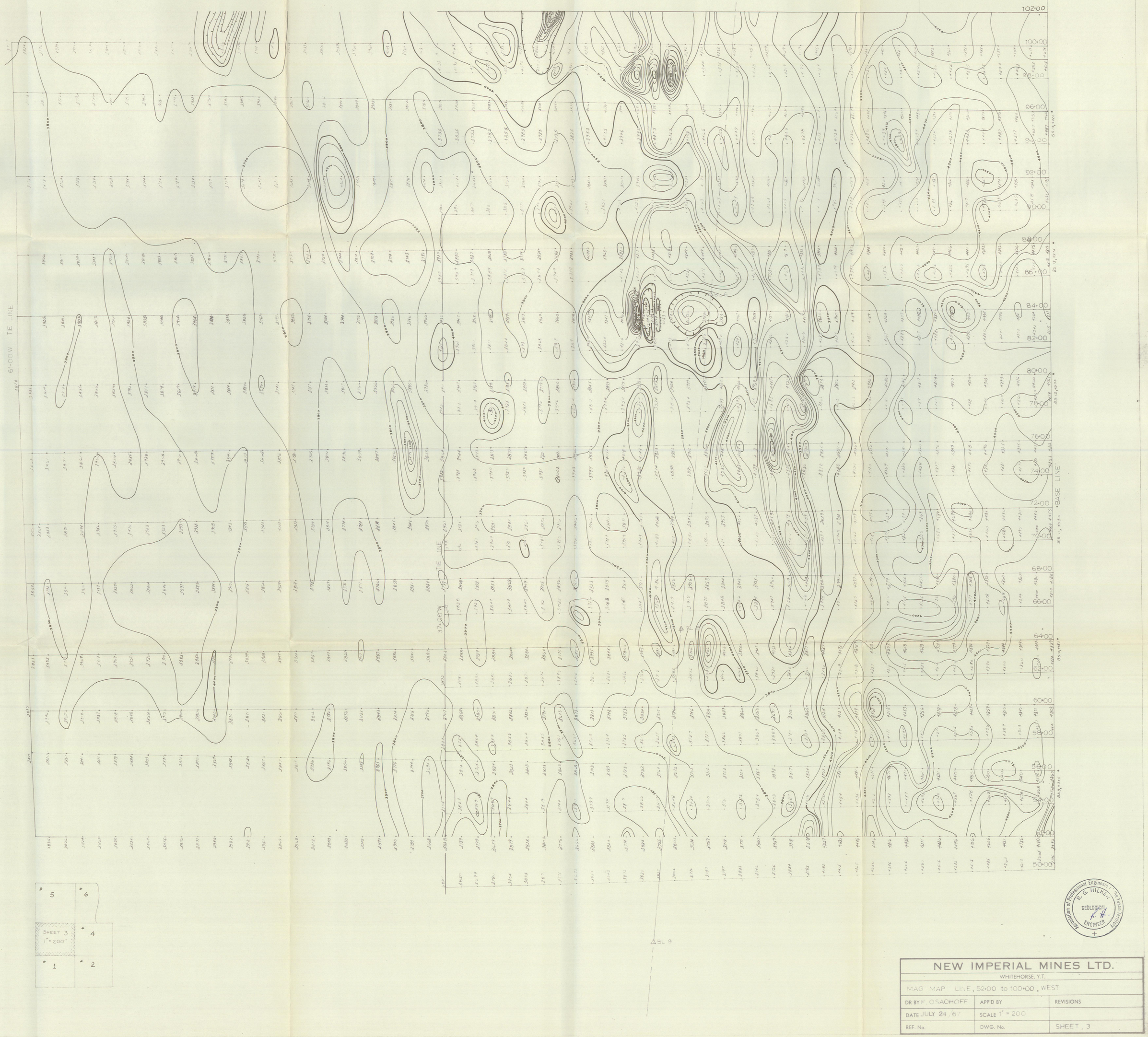
| | | |
|---|---|---|
| # 5 | # 6 | |
| # 3 | # 4 | |
| # 1 | SHEET 2 1" = 200' | |

# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

MAG MAP, LINE, 0+00 to 48+00, EAST

| | | |
|---|---|---|
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JUNE 23 / 67 | SCALE 1" = 200' | |
| REF. No. | DWG. No. | SHEET, 2 |







Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL
ENGINEER

# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

MAG MAP LINE, 52+00 to 100+00, WEST

| | | |
|---|---|---|
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JULY 24, 67 | SCALE 1" = 200 | |
| REF. No. | DWG. No. | SHEET, 3 |

104+00

100+00

98+00

96+00

92+00

88+00

84+00

80+00

76+00

72+00

68+00

64+00

60+00

56+00

BASE LINE

55+00 TIE LINE

HIGH

HIGH

HIGH

HIGH

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

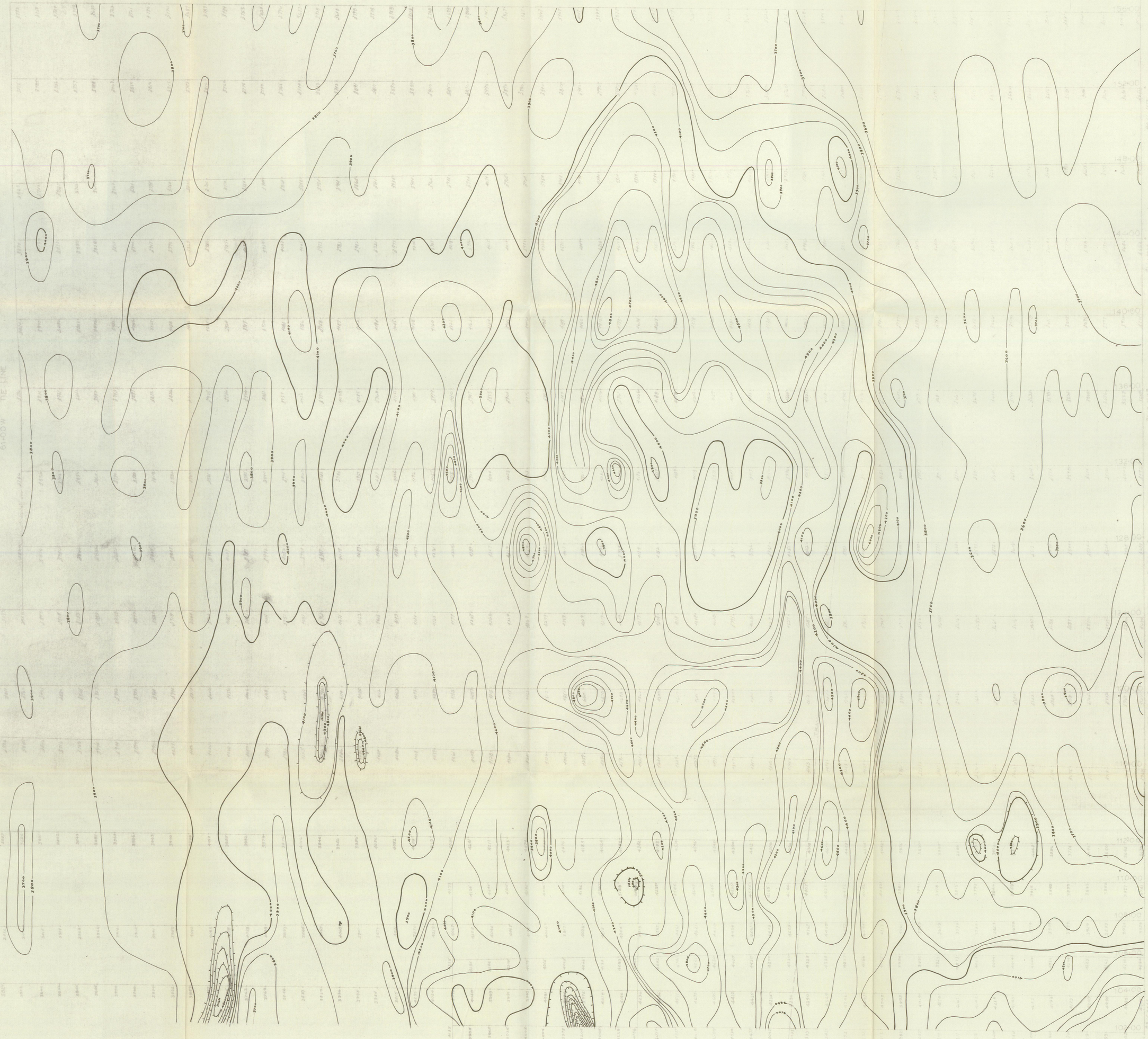
| | | |
|---|---|---|
| # 5 | # 6 | |
| # 3 | SHEET 1" = 200' 1" = 100' | |
| # 1 | # 2 | |

# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

MAG MAP LINES 52+00 to 100+00 EAST

| | | |
|---|---|---|
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JULY 21/67 | SCALE 1"=200' | |
| REF. No. | DWG. No. | SHEET 4 |



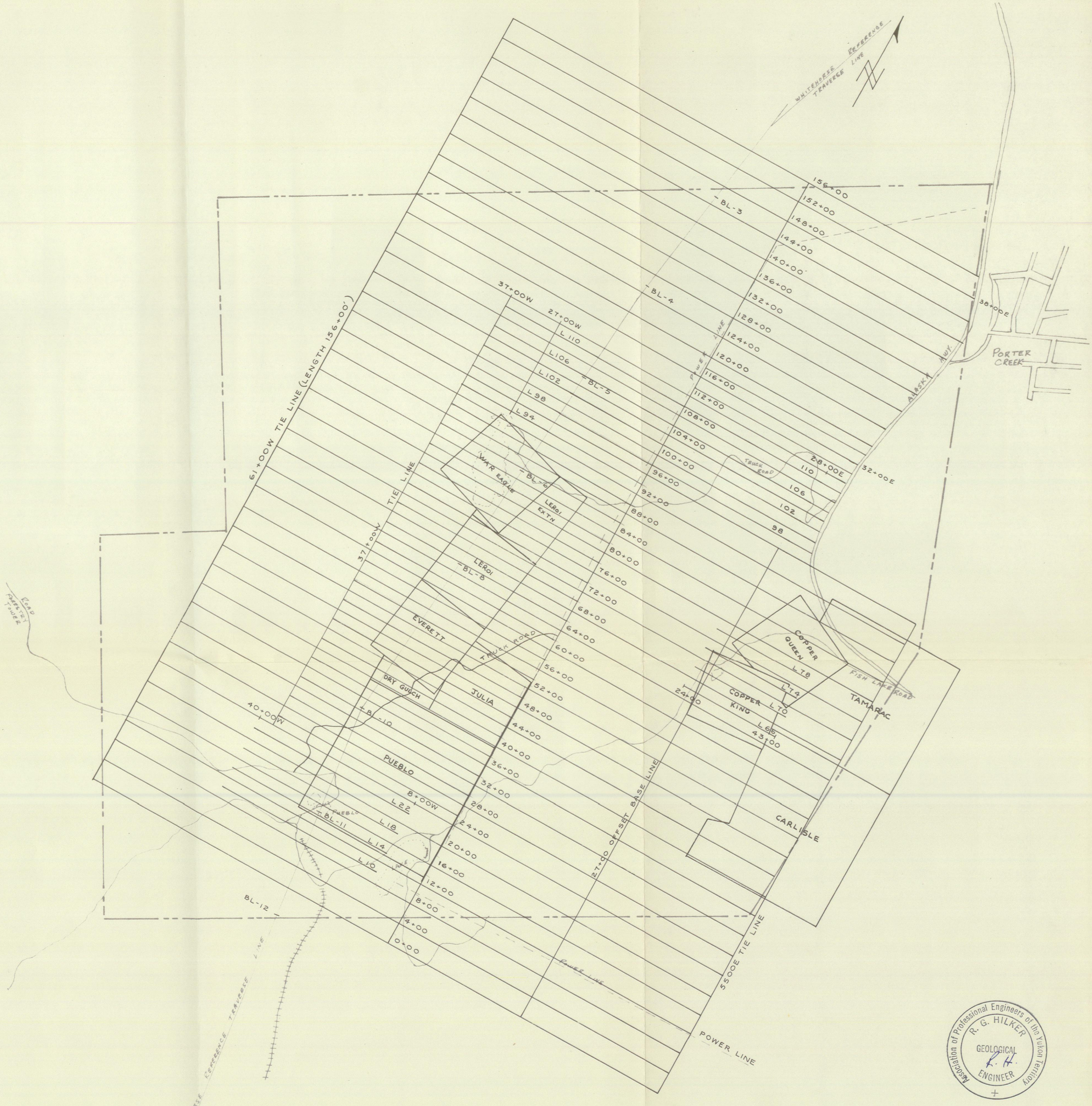

SHEET 5
1" = 200'

Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

NEW IMPERIAL MINES LTD.
WHITEHORSE, Y.T.

MAG MAP. LINE 104+00 to 156+00, WEST

| | | |
|---|---|---|
| DR. BY F. OSACHOFF | APP'D. BY | REVISIONS |
| DATE JULY 26/67 | SCALE 1" = 200' | |
| REF. No. | DWG. No. | |




Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL
ENGINEER

## LINE GRID

| | | | |
|---|---|---|---|
| TOTAL CROSSLINES | - | 579,434 FT. | - 109.14 MILES |
| WEST TIE LINE | - | 23,362 FT. | - 4.42 MILES |
| EAST TIE LINE | - | 15,609 FT. | - 2.96 MILES |
| OFFSET BASE LINE | - | 13,900 FT. | - 2.63 MILES |
| | | TOTAL | - 119.15 MILES |

# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

## WAR EAGLE AREA - EXPLORATION - 1967

| | | |
|---|---|---|
| DR BY R HILKER | APP'D BY | REVISIONS OCT. 11/67, R9H.C |
| DATE DEC-1-66 | SCALE 1" = 1000' | |
| REF. No. | DWG. No. | |

48+00
44+00
40+00
36+00
32+00
28+00
24+00
20+00
16+00
12+00
8+00
4+00
0+00

POWER LINE

BASE LINE

27+00 OFFSET BASE LINE

PORTER CREEK LOW E&T

5500 E TIE LINE

CONDUCTIVE OVERBURDEN

CANYON

CREEK

POND

| # 5 | # 6 |
|---|---|
| # 3 | # 4 |
| # 1 | SHEET 2 1"=200' |

CONDUCTOR

+ Q IP

− LINE

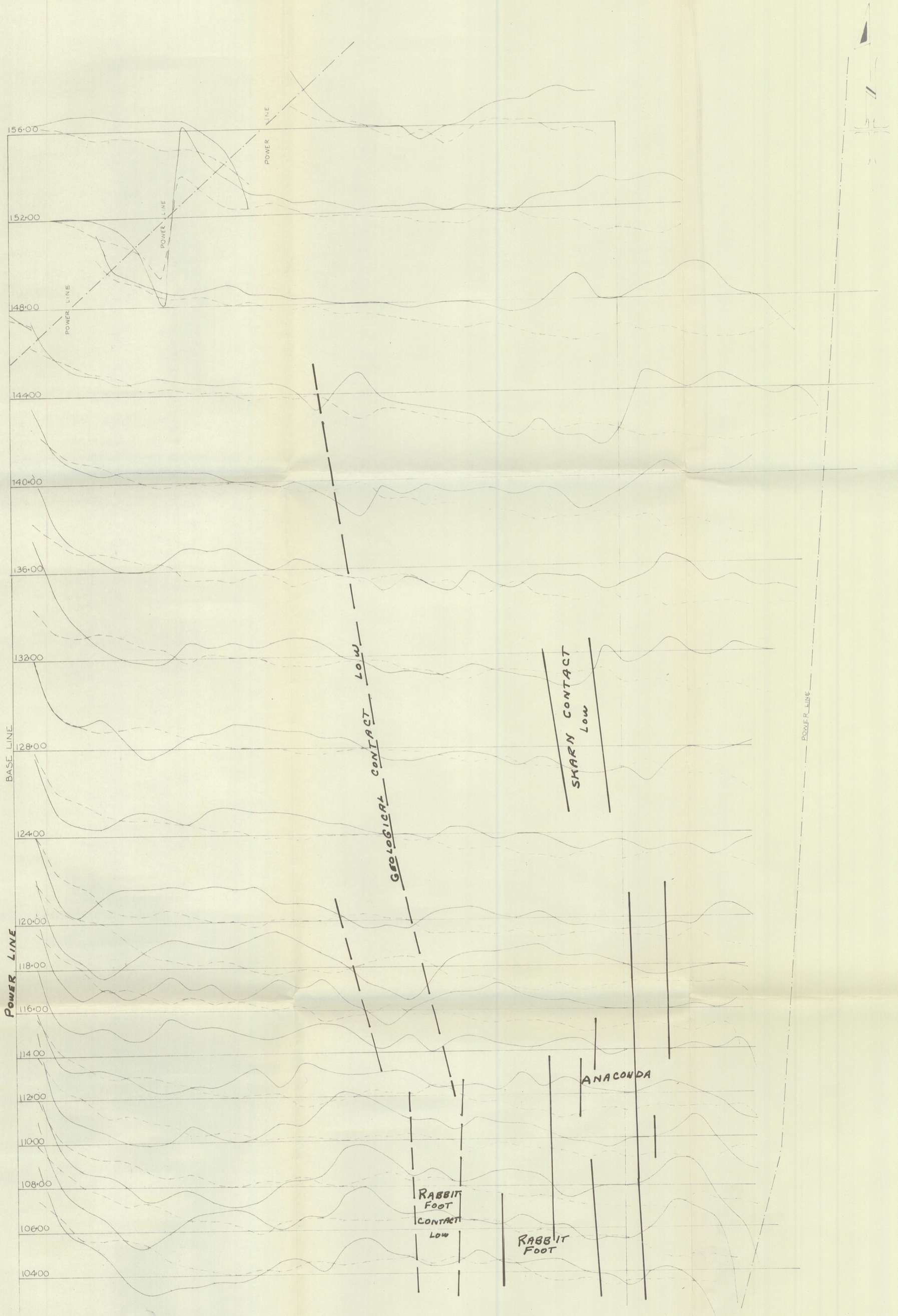
Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

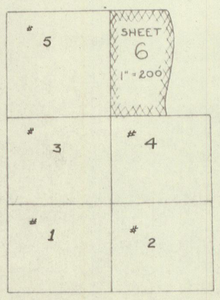
# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T. Y. T.

EM 16 , LINES 0+00 to 48+00, EAST OF B.L. WAR EAGLE AREA

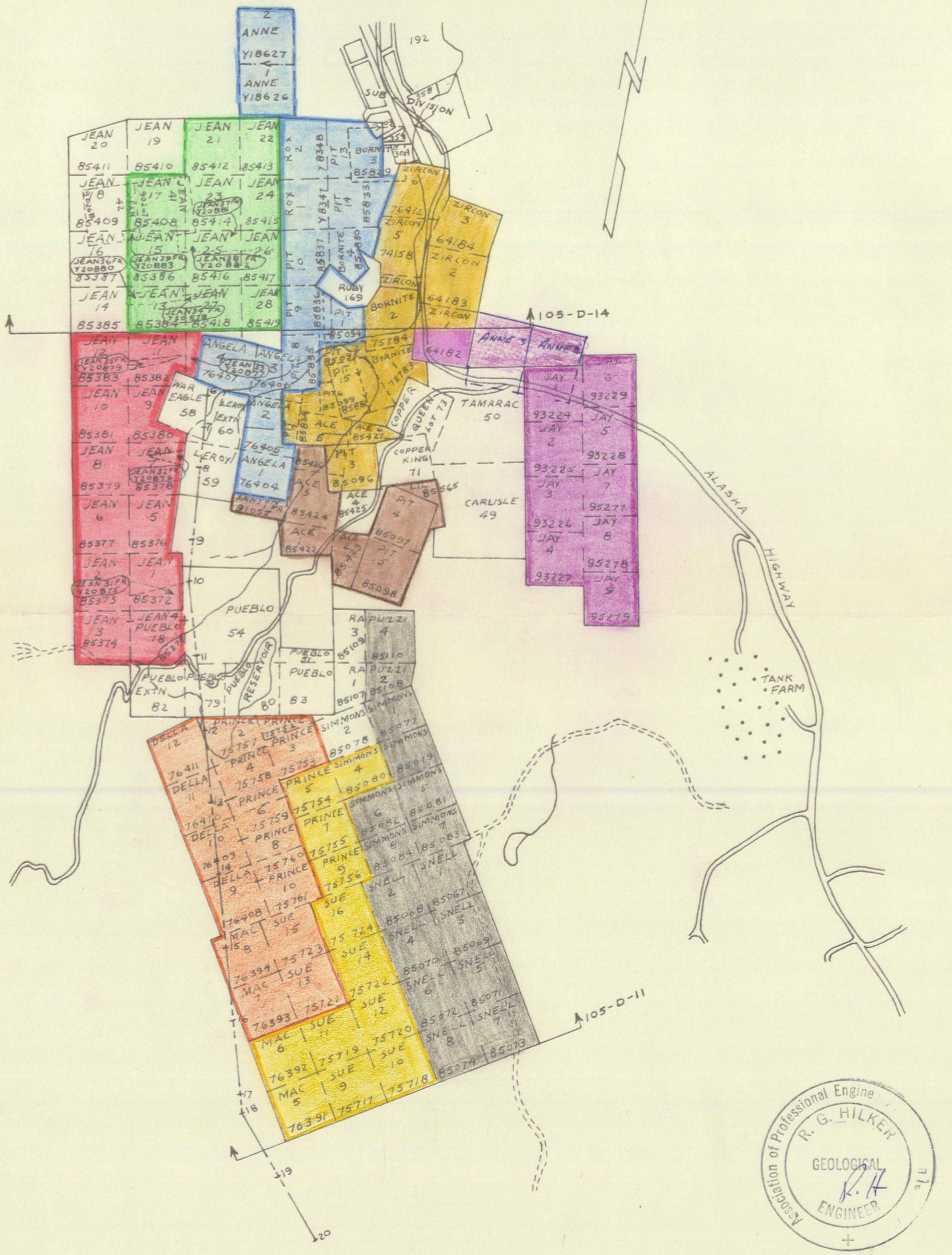
| | | |
|---|---|---|
| DR BY F. OSACHOFF | APP'D BY | REVISIONS |
| DATE JUNE 26/67 | SCALE 1"=20% 1"=200' | |
| REF. No. | DWG. No. | |




Association of Professional Engineers of the Yukon Territory
R. G. HILKER
GEOLOGICAL ENGINEER

| NEW IMPERIAL MINES LTD. | | |
|---|---|---|
| WHITEHORSE, Y.T. | | |
| EM 16 , LINES 104·00 to 156·00, EAST | | |
| DR BY F OSACHOFF | APP'D BY | REVISIONS |
| DATE SEPT 12/67 | SCALE 1" = 200' 1" = 20% | |
| REF. No. | DWG. No. | |




Association of Professional Engineers
R. G. HILKER
GEOLOGICAL
ENGINEER

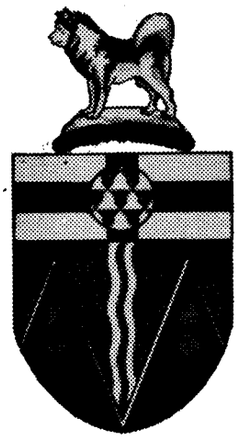
# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

CLAIMS FOR ASSESMENT WORK-SHEET: 105-D-14 / 105-D-11

| | | |
|---|---|---|
| DR. BY W.D.S. | APP'D. BY R.HILKER | REVISIONS. |
| DATE SEPT. 21/67 | SCALE 1" = ½ MILE | |
| REF. No. | DWG. No. | |

# "COPPER MINING ON THE WHITEHORSE COPPERBELT - YUKON TERRITORY"



by

R. G. Hilker, P. Eng.
Chief Geologist
New Imperial Mines Limited

Presented at the 1967 Alaska Purchase
Centennial Minerals Conference
University of Alaska Campus - College, Alaska
Sponsored by
Alaska Section AIME
S. W. Alaska Section AIME
British Columbia Section CIMM
University of Alaska

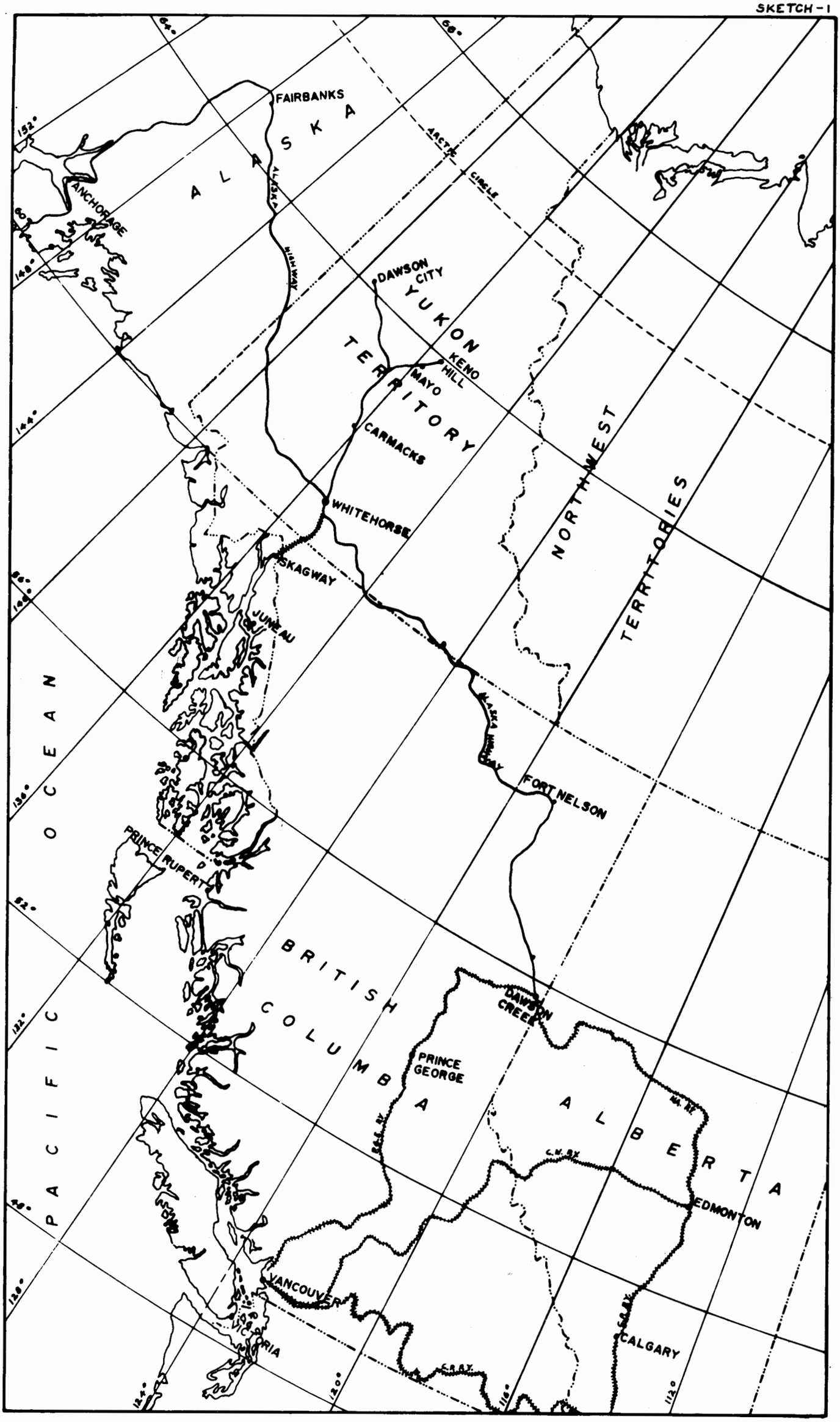
## 1. ABSTRACT

The Whitehorse Copperbelt lies on the West side of the Whitehorse trough in the southwest Yukon at about north 60½ degrees latitude and west 135 degrees longitude. Copper mineralization, consisting mainly of bornite and chalcopyrite, along an 18 mile belt was discovered in 1897 by miners travelling north to Dawson, during the start of the Klondike Gold Rush. The Lewes River Group - Upper Triassic in age, was intruded by a large igneous batholith of the Coastal Intrusive - Cretaceous in age. The sedimentary rocks were changed to calcium - magnesium - silicate skarn and calcium - magnesium - iron skarns with copper mineralization, near the intrusive contacts. The deposits are considered to be contact metasomatic in origin with siliceous minerals and copper - iron mineralization introduced. Proven ore reserves in five deposits consist of about 5½ million tons of copper grading 1.25 percent, in parts molybdenite and an average of $1.13 gold/silver values. In addition to these reserves 3½ million tons grading 2.14% have been outlined at depth on the Little Chief Deposit. Open pit mining is to be used to exploit the five deposits on a year round basis of mining, with a possibility of an underground operation at the Little Chief deposit. Under an agreement with a Japanese metal mining company and a Canadian Bank, 7.45 Million dollars were provided for mine and milling facilities. The agreement with the Japanese firm provides for a ten year contract for the sale of all concentrates produced from the property. The mill will produce about 29,000 tons of 35 percent copper concentrate each year. The concentrate will be shipped in containers by narrow gauge railway from Whitehorse, Y. T., to Skagway, Alaska, by boat to Vancouver, B. C. and then to Japan.

## 2. INTRODUCTION

The Yukon Territory is located in the northwestern section of North America and extends to the Arctic Ocean. It is bordered on the east by the Northwest Territories, on the south by British Columbia and on the

SKETCH - 1




C 22559

west by Alaska (location sketch - 1). The total area of the Yukon is 207,076 square miles and with a population of 16,000 in 1966. The capital city is Whitehorse, located in the southwestern corner of the Territory.

The principal settlements are Watson Lake, Teslin, Whitehorse, Carmacks, Haines Junction, Carcross, Mayo, Elsa, Calumet and Dawson City.

Access to the Yukon is by road, railroad and airlines. The Alaska Highway runs from the British Columbia border at mile 620 to mile 1247 on the Alaska Border. There are a total of 1479.9 miles of Territorial roads that connect with the Alaska Highway. The White Pass and Yukon Route, a narrow gauge railway, links the seaport of Skagway, Alaska, with Whitehorse, a total distance of 110 miles. Whitehorse, Dawson City and Mayo are serviced daily by Canadian Pacific Airlines flying DC-6s and a DC-3 from southern points. Wein Alaska flies daily service between Whitehorse and Juneau, Alaska with connecting flights to southern localities. Bus service on the highway is run daily during the summer and weekly in the winter, by Canadian Coachways between Dawson Creek, B. C. and settlements in the Yukon. Several trucking firms run scheduled hauls into the Territory from southern points and maintain distribution terminals in Whitehorse. The greatest percentage of petroleum products is transported into the Yukon by the White Pass and Yukon Route using a pipeline from Skagway, Alaska and tanker cars. The exception is the petroleum products trucked to Whitehorse from Haines, Alaska (254 miles) by the British American Company.

Hydro electrical power is supplied to the Whitehorse Area by the government owned Northern Canada Power Commission, that operates a 11,500 kilowatt plant. The power is distributed by the privately owned firm of Yukon Electrical Company, which also maintains a plant with a 1500 kilowatt capacity. Other Yukon communities are supplied with electrical power by the two forementioned companies, using diesel plants.

Climatic conditions in the Whitehorse area are relatively pleasant for the northerly latitude. The yearly mean temperature is 31 degrees F. with an average percipitation of 10 inches. The long and pleasant daylight hours in the summer offset the short cold days in the winter months.

The Whitehorse Copperbelt lies on the west side of the Whitehorse Trough (Wheeler, 1961, p. 109) at about north 60½ degrees latitude and west 135 degrees longitude. There are 28 copper showings distributed along the northwesterly bearing belt, that is 18 miles long and 3 miles wide.

Whitehorse is located two miles from the northern end of the Copperbelt (location sketch - 2).

Whitehorse is a city of 6000 population with a good assortment of business establishments and living facilities necessary for a mining community.

## 3. PHYSIOGRAPHY AND GLACIATION

The Whitehorse Trough, between the Teslin and Lewes plateau (Bostock, 1948, p. 65), is drained by the Yukon River. The broad Yukon River valley has an elevation of 2,000 to 2,500 feet above sea level. Mountains rise on either side to an approximate elevation of 5,000 feet and are within the northern extension of the Coast Mountains Range. The Copperbelt is located on the west side of the valley from the Yukon River.

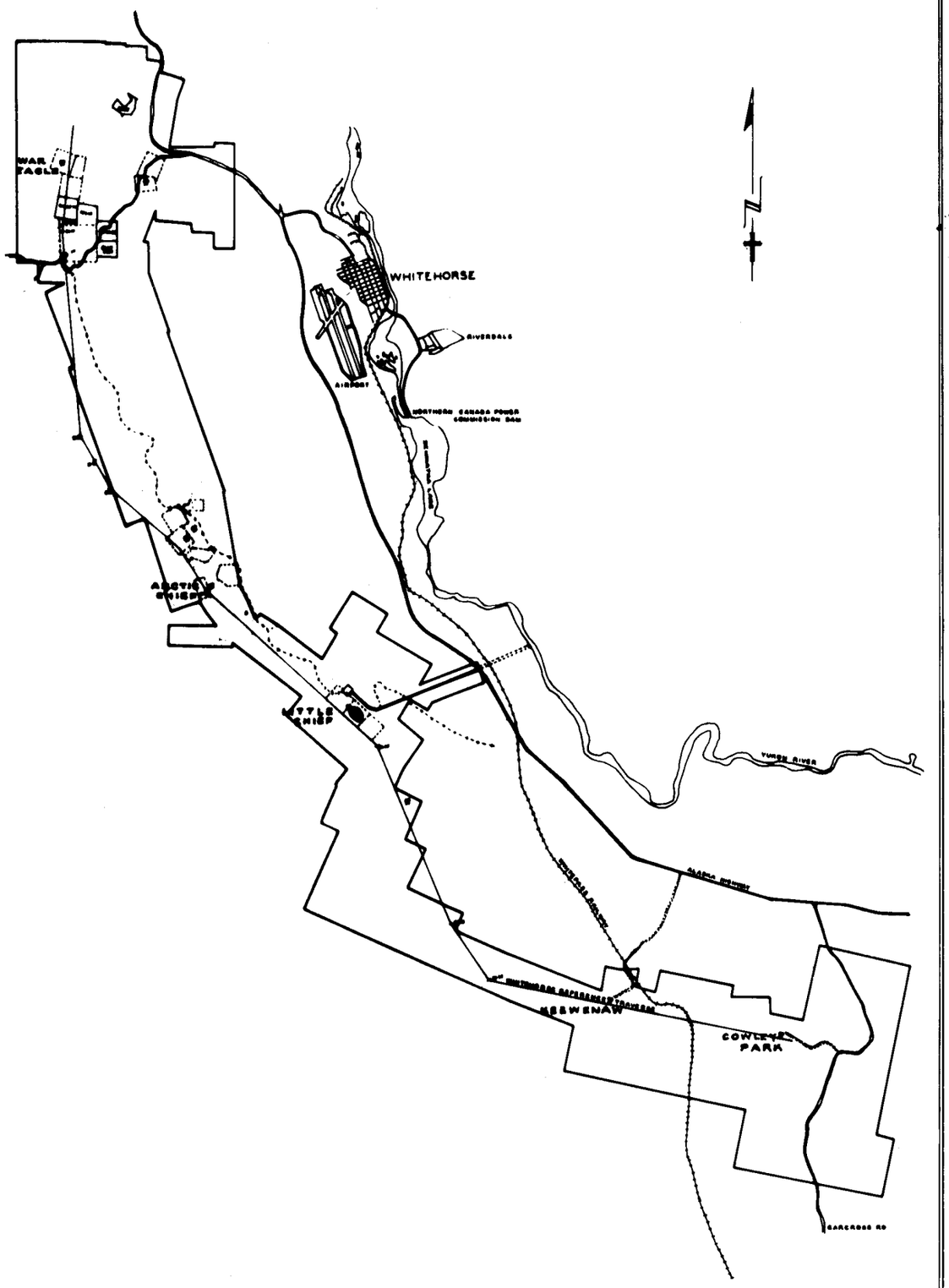
The area was once covered by the Cordilleran ice-sheet and the latest valley glaciation is Pleistocene in age. Thick glacial debris deposits are scattered along the east side of Yukon River valley opposite Whitehorse. The west side of the valley has about 75 percent glacial cover but with lesser thickness of glacial debris than on the eastern side of the Yukon River.

## 4. HISTORY

Discoveries of copper outcrops in the Whitehorse area were first reported by miners on their way to Dawson in 1897. The first claims were staked by Jack McIntyre who located the Copper King on July 6, 1898. The Big Chief and Little Chief claims were staked by Wm. McTaggart and Andrew Oleson in the later part of 1898. By 1899 most of the Copperbelt was prospected and staked, the more important discoveries were the Anaconda, Pueblo, Best Chance, Arctic Chief, Grafter, Valerie, War Eagle and others. During 1900 McIntyre and Granager, the owners of the Copper King, made a shipment of 9 tons of rich bornite ore stated to have yeilded 46.40% copper. Small shipments of selected hand picked ore were made from several of the previous mentioned properties up to 1909. The most interestingm mineral claims on the Copperbelt were given title to Crown Grant Mineral Claims up to the year 1909 on the Whitehorse Copperbelt.

In 1907, transportation of the ore between the properties and Whitehorse, on the 4 - 7 miles of Territorial wagon road, cost between $3.00

SKETCH -2




NEW IMPERIAL MINES LTD.
WHITEHORSE, Y.T.
N.M. CLAIMS LOCATION PLAN

| | | |
|---|---|---|
| DR BY | APP'D BY | REVISIONS |
| DATE MARCH 10-67 | SCALE | |
| REF No | DWG No | |

092559

- $4.00 per ton. By rail from Whitehorse and steamer to the various west coast smelters the cost was $6.00 per ton.

Between 1915 and 1920 development was done on the Copper King, Carlisle, Pueblo and War Eagle properties. In March of 1917 a disastrous mine cave at the Pueblo killed several miners and forced the closure of the largest producer on the Copperbelt. Mining ceased on the Copperbelt in 1920 due to the end of World War I and a drop in the price of copper.

In 1927 the Richmond Yukon Company Ltd. drilled at the Pueblo mine and other properties between 1926 and 1929. Once again a drop in the price of copper from 18¢ to 8¢ caused activity in the area to be abandoned during the 1930 depression years.

Noranda Mines Ltd. acquired claims and conducted geophysical surveys, geological mapping, trenching and diamond drilling in 1946 through to 1948 on the Copperbelt and in particular the Little Chief, Big Chief and Valerie areas. The company gave up the search due to the low grade of copper ore outlined by the drill program.

Under the direction of Mr. Aubrey Simmons, Imperial Mines and Metals Ltd. was formed in September of 1954 and acquired by staking, purchase or option numerous claims on the Copperbelt in 1955. In 1956 the company conducted magnetometer surveys and diamond drilling on the Arctic Chief and Best Chance claims. In March of 1957 the name of the Company was changed to New Imperial Mines Ltd.

New Imperial Mines Ltd. was reorganized by Mr. Arnold Pitt and exploration drilling for copper ore was begun in June of 1963 on the Whitehorse Copperbelt. By the end of 1964 the Company held 348 mineral and Crown Grant claims and had delineated 2.1 million tons of ore grading 1.20% copper. In June of 1964 the first feasibility report proved possible an open pit mining operation with a 1000 tons per day mill that could be increased to 2000 tons per day. In November of 1965 a second feasibility report was favourable for a 2000 ton per day mill, based on ore reserves of 5½ million tons of ore grading 1.20% copper to be open pit mined.

In December of 1965 an agreement for senior financing for the development of the property was signed with the Sumitomo Metal Mining Company of Japan. On July 1st, 1966, construction commenced on the mill site, near the Little Chief deposit, located in the central part of the Whitehorse Copperbelt. Mining started at the Little Chief Open Pit in the summer of

1966. The New Imperial Mines Ltd. mill began treating ore from the Little Chief deposit at the end of March 1967. (Claim and Property Sketch - 2).

Financing exploration of the property is as follows:

(a) Imperial Mines and Metals was incorporated in September 1954 with an authorized capital of 5 million shares.

(b) Sumitomo Metal Mining Company of Japan was given an exclusive option to purchase all future mill concentrates and to supply capital for mill financing in August 1964. A condition of the Agreement was their purchase of 200,000 shares of New Imperial Mines Ltd. stock for $150,000.

(c) Increased authorized capital to 5½ million shares on September 10, 1964.

(d) The Company optioned six separate agreements to purchase 90 mineral claims for $522,500 cash between 1963 and 1971.

(e) During 1964, 1.4 million shares were issued for $890,000 cash.

(f) In February, 1965, an agreement was made with Sumitomo Metal Mining Company of Japan, who advanced the Company $175,000 for exploration. New Imperial Mines Ltd. agreed not to enter into any agreements for sale or ore or concentrates, for financing further exploration or development costs, or sell any property without the approval of Sumitomo until December 31, 1965. The Company further granted Sumitomo an option to convert $90,750 of the $175,000 loan into 55,000 shares at $1.65 per share and the remaining $84,250 into 64,808 shares at $1.30 per share. These shares were issued in March of 1966.

(g) In September of 1965 Sumitomo agreed to advance $100,000 to the Company for option payments on claims and for a feasibility study. The advance was repaid on March 30, 1966.

(h) The authorized capital stock of New Imperial Mines Ltd. was increased to 7½ million shares on December 13, 1965.

## 5. GEOLOGY

### Local Geology

The original rocks on the Whitehorse Copperbelt, were the Lewes River Group - Upper Triassic in age. The formation consists of:

(a) quartzite, arkose, greywacke and argillite

(b) limestone and dolomite

On parts of the Copperbelt the Laberge Group, Lower Jurassic in age, overlays the Lewes River Group. The two groups of rocks were upheaved and intruded by the Cretaceous Coastal Intrusive batholith. The igneous intrusive sequence consists of granite, granodionite to dioritic rocks. In very recent times the Miles Canyon extrusive basalt has covered parts of the forementioned rock groups.

Metamorphism

The Lewes River limestone and dolormite were the most predominate original rock types before being metamorphosed by the large igneous intrusive. The metamorphosed limestone and dolomite, with quartzite beds, were changed to a skarn rock type with various secondary siliceous minerals introduced. The skarns were developed due to an addition of silicate between the hot igneous intrusive and the sedimentary rock types. In places along the contacts between the Lewes River Group and the Coastal Intrusive copper ores were deposited in mineable sized deposits. The deposits are considered to be contact metasomatic in origin with two types of ore and mineral assemblages occuring. In parts the original rock types have only been affected by heat and pressure that recrystalized the limestone and dolomite. The present deposits can be considered as metamorphosed roof pennants and huge remnants of sedimentary rock trapped in the igneous intrusive.

TABLE FORMATIONS (Table 1)

Lithology of Skarns

The two skarn types that have developed are composed of one or more of the following minerals:

(a) Calcium - magnesium - silicate skarn made up of; actinolite, tremolite, diopside, wollastonite, epidote, garnet, chlorite, feldspar and alteration minerals.

(b) Calcium - magnesium - iron skarn consisting of; sepentine, diopside magnetite and specular hematite.

The skarns are usually light in color and very fine grained, but occasionaly with good crystals of all the forementioned minerals. The contact between the skarn and unaltered but recrystallized limestone is sharp and abrupt.

# WHITEHORSE COPPERBELT

## TABLE OF FORMATIONS

CENOZOIC

Quaternary

Pleistocene & Recent

| | |
|---|---|
| Q | Alluvium, Glacial Drift |
| 10 | Miles Canyon Basalt |

Post Cretaceous

Intrusive Dykes or Sills

| | | | |
|---|---|---|---|
| 9 | 9 A | Acidic | Granitic, Aplite, Felsite, 9 A May Predate Skarn |
| | 9 B | Basic | Andesite, Diorite, Post-Ore |

MESOZOIC

Cretaceous

Coast Intrusives

| | | | |
|---|---|---|---|
| 8 | Diorite | 8a | Altered |
| | | 8b | Unaltered |
| 7 | Granite, Granodiorite, Quartz Monzonite | | |

Lower Jurassic & Later

| | |
|---|---|
| 6 | Laberge Group |

Upper Triassic

Lewes River Group (Metamorphosed)

| | |
|---|---|
| 5 | Limestone and or Dolomite 5 B Carb Limestone |
| 4 | Quartzite, Greywacke, Argillite, Arkose<br>4 q Quartzite, 4 g Greywacke |
| 3 | Skarn - 3a Actinolite, 3c Chlorite, 3d Diopside, 3e Epidote<br>3g Garnet, 3s Serpentine, 3t Tremolite, 3f Feldspar |
| 2 | Skarn - Bornite, Chalcopyrite, Coppe Oxides with; 2a Actionolite<br>2c Chlorite, 2d Diopside, 2e Epidote, 2g Garnet, 2s Serpentine |
| 1 | Magnetite Skarn - 10 - 80% Magnetite, Bornite, Cpy, Valeriite,<br>Cu Oxides is - Serpentine, 1D-Diopside, 1C-Chlorite |

The diorite grades from a fresh black and white colored variety to an altered greyish diorite and then into a "dioritic" skarn. The contact between the skarn and the dioritic skarn, or diorite, is often marked by abundant pink epidote or zoisite.

Economic Geology

The host rock for the mineral deposits consists of three types, (Table 1), (a) iron-copper serpentine or diopside skarn, (b) copper sulphide skarn, (c) barren skarn. In some parts of the Copperbelt the mineralized skarns are dioritized and in places interbedded with mineralized quartzite. The wall rocks contacting the skarn and ore deposits, are recrystallized limestone or a fresh to altered diorite. The diorite appears to halo the ore deposits and grade into granodiorite and granites.

The predominant copper mineralization consists of the sulphides bornite and chalcopyrite. On the north and south ends of the Copperbelt molybdenum occures with copper sulphides. In the central part of the Copperbelt copper sulphides are associated with magnetite and lesser quantities of hematite. Gold and silver are associated with chalcopyrite mineralization in all ore deposits. From the mineralization observed on the central ore deposits it is possible that two stages of primary mineralization occured. The first copper mineralization deposited was mainly bornite with the magnetite and the second stage consisted of chalcopyrite and quartz replacement. It is likely that chalcopyrite and quartz replacement has occured in the ore deposits on the north and south ends of the Copperbelt.

The copper minerals that occur in the ore deposits are: bornite, chalcopyrite, valeriite, chalcocite, tetrahedrite, covellite, cuprite, malachite, azurite, chrysocolla and minor native copper. The iron minerals are magnetite, specular and micaceous hematite, goethite, limonite, pyrite and pyrrhotite. Magnetite is the main iron mineral. The molybdenum minerals are molybdenite, powellite and scheelite. Other rare minerals are gallium, vanadium, cobalt, nickel, palladium, platinum and manganese.

The ore deposits are highly jointed, faulted and with very irregular shaped hanging and foot walls. Large and small folds are evident in surface outcrops with faulting due to folding of the rocks. Slickensides and shears are present in the diamond drill core and on surface outcrops.

Both pre-ore and post-ore felsic and mafic dikes have cut the Lewes River group of metamorphic rocks.

The presently delineated ore deposits on the Whitehorse Copperbelt (sketch - 2), are as follows:

(1) War Eagle - The ore deposit contains copper mineralization in a garnet - diopside - tremolite - epidote skarn. There is 1,230,000 tons of 1.29% copper delineated at the War Eagle deposit.

(2) Arctic Chief - The deposit contains 400,000 tons of 1.32% copper contained in a magnetite serpentine skarn.

(3) Little Chief - (Sketch - 3, L.C. Section). The Little Chief deposits contains 1,910,000 tons grading 1.41% copper ore in the area to be open pit mined. Recent drilling has indicated an additional 3½ million tons of ore grading 2.14% copper. The feasibility of an underground mining operation is presently being considered on the Little Chief Deposit. The host rock for mineralization, is a calcium - magnesium - iron skarn.

(4) Keewenaw - The Keewenaw deposit is a highly dioritized skarn with 380,000 tons grading 1.10% copper mineralization.

(5) Cowley Park - The host rock at the Cowley Park deposit is a calcium - magnesium skarn, and contains 1,370,000 tons of ore grading 0.87% copper and 0.091% $MoS_2$.

(6) Best Chance - The ore reserves are 200,000 tons grading 1.00% copper.

6. MINING

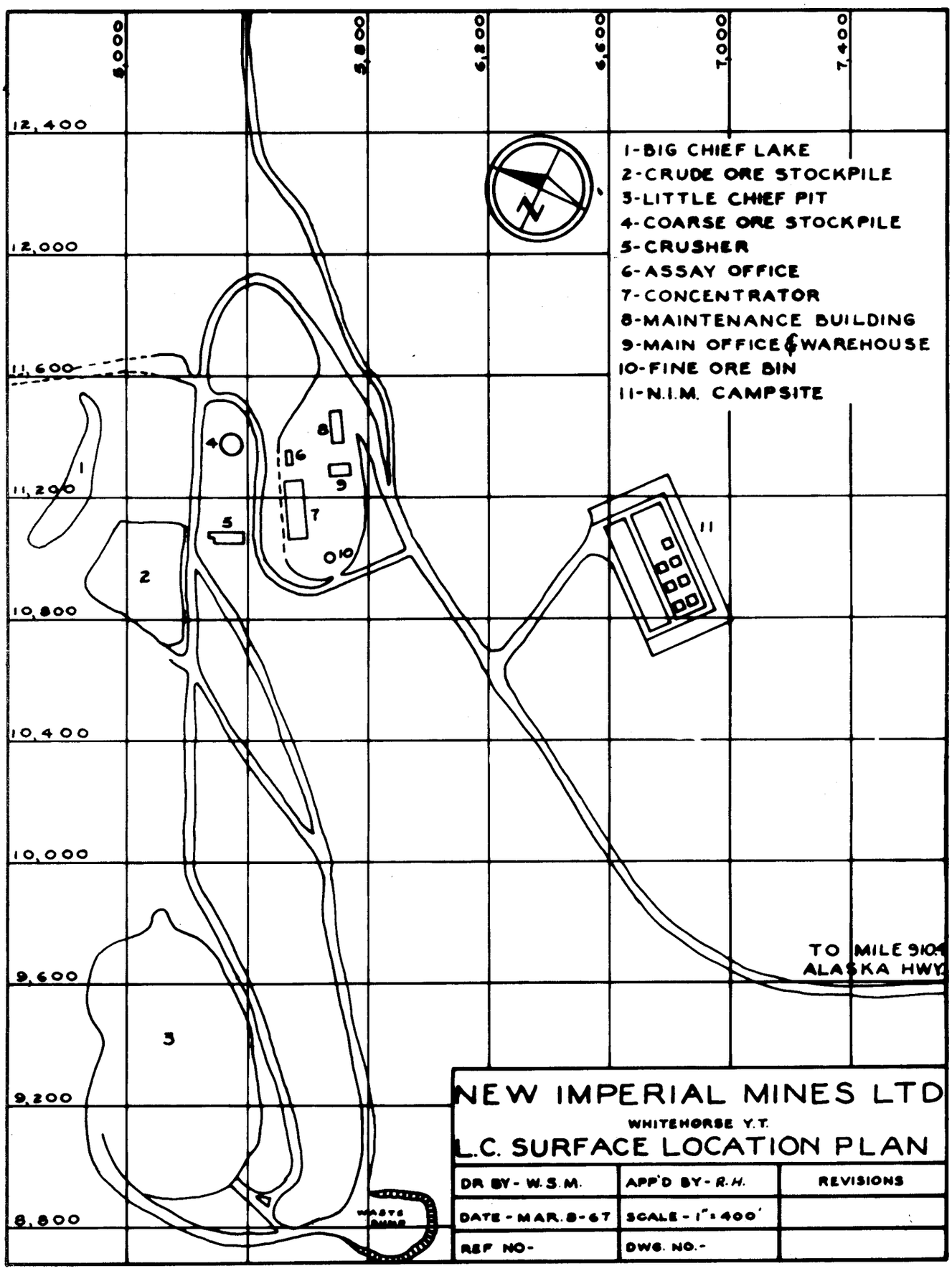
Method

Mining on the War Eagle, Arctic Chief, Little Chief, Keewenaw and Cowley Park (Sketch - 2), is to be done by open pit. The first pit to be developed is the Little Chief which is located in the central part of the Copperbelt near the mill site (Sketch - 4).

The Little Chief Pit (Sketch - 5, Little Chief Pit Plan), will reach a total depth of 350 feet from surface. The pit walls slope 62 degrees between the 20 foot safety berms. The safety berms are to be placed after each third 25 foot bench. The pit road has a constant 8% grade and is 40 feet wide.

Below the Little Chief open pit floor is 3½ million tons of ore

SKETCH - 4




# NEW IMPERIAL MINES LTD

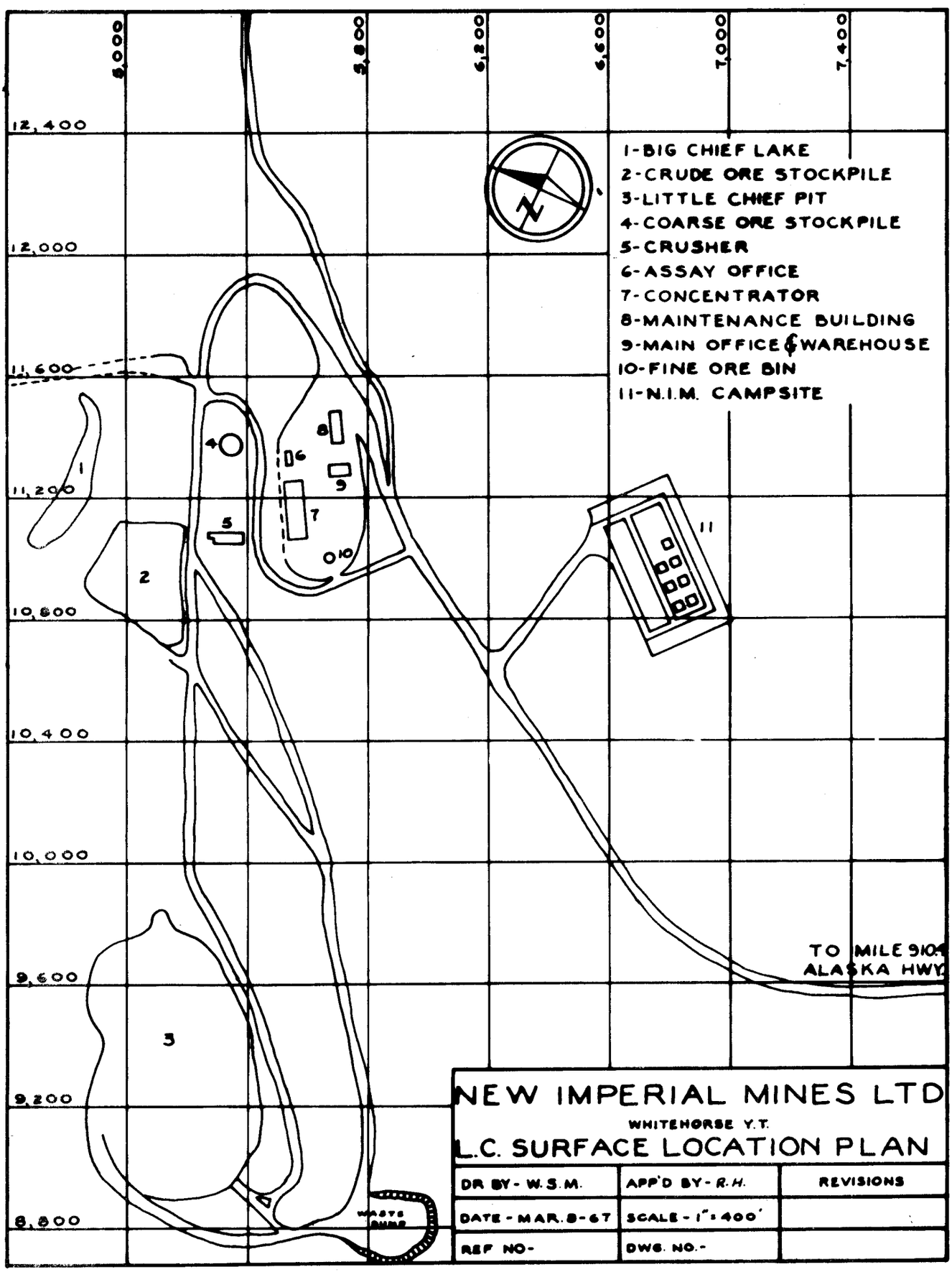
WHITEHORSE Y.T.

## L.C. SURFACE LOCATION PLAN

| | | |
|---|---|---|
| DR BY - W.S.M. | APP'D BY - R.H. | REVISIONS |
| DATE - MAR. 8-67 | SCALE - 1" = 400' | |
| REF NO- | DWG. NO.- | |

092559

SKETCH - 4




# NEW IMPERIAL MINES LTD

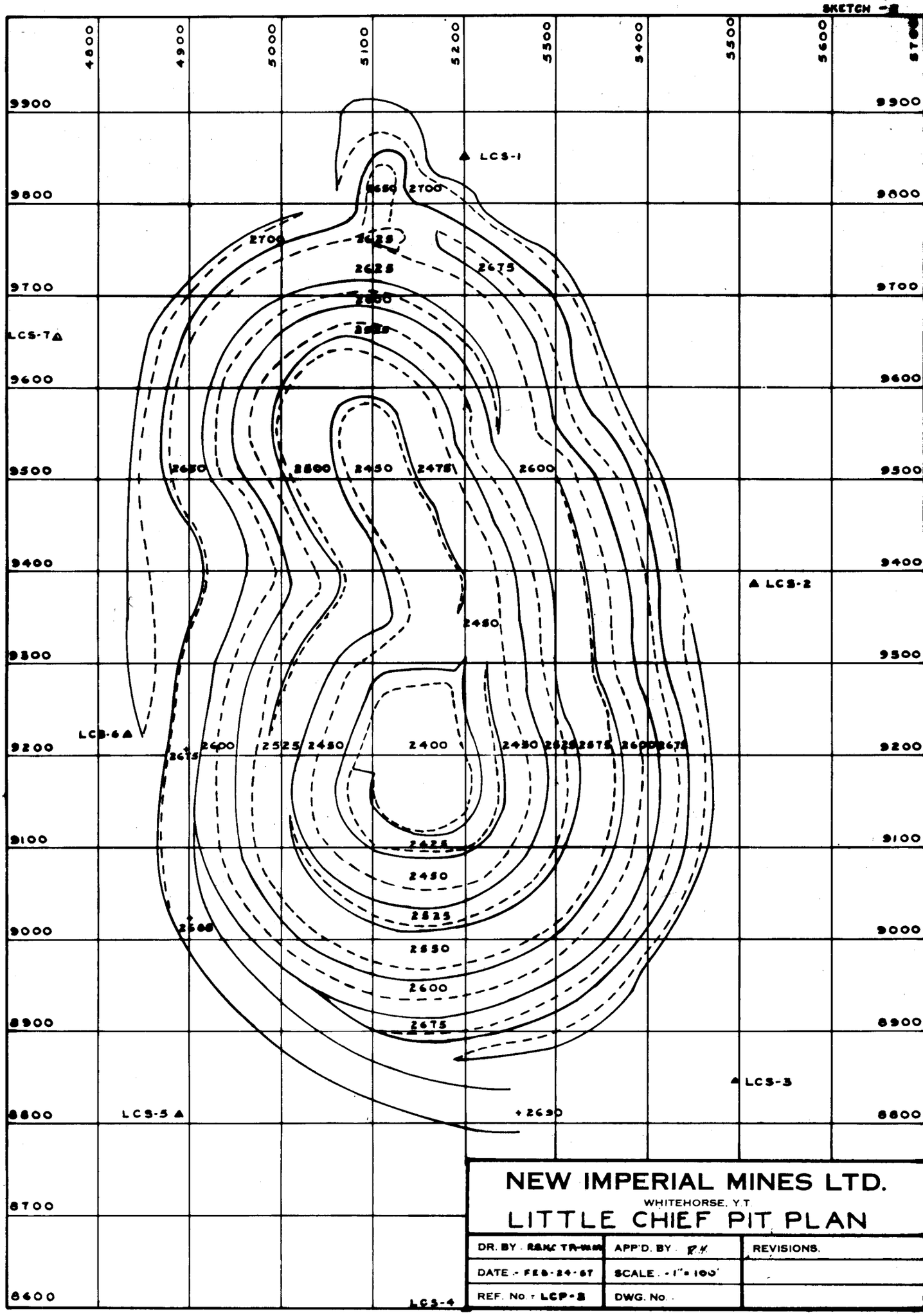
WHITEHORSE Y.T.

## L.C. SURFACE LOCATION PLAN

| | | |
|---|---|---|
| DR BY - W.S.M. | APP'D BY - R.H. | REVISIONS |
| DATE - MAR. 8-67 | SCALE - 1" = 400' | |
| REF NO- | DWG. NO.- | |

092559

SKETCH -B




# NEW IMPERIAL MINES LTD.

WHITEHORSE, Y.T.

## LITTLE CHIEF PIT PLAN

| | | |
|---|---|---|
| DR. BY - [illegible] | APP'D. BY - [illegible] | REVISIONS. |
| DATE - FEB-24-67 | SCALE - 1" = 100' | |
| REF. No. - LCP-B | DWG. No. - | |

grading 2.14% copper. An underground back fill mining operation is presently being considered for the deep ore.

Production

The daily production is based on 2,500 tons of ore per day. The Little Chief Pit stripping ration is 1.12:1 and the daily mine requirements are 11,675 tons per day with 327,000 tons per month ore and waste.

The equipment to remove the ore and waste consists of five 35 ton trucks, one 5½ yard front end loader, two 2½ yard diesel shovels, one D8 Crawler Tractor, one grader, one 600 cubic foot air compressor, two jackhammers and one crawler drill.

Blasting the ore and waste has been found satisfactory using a 16 foot triangular hole pattern and 6 inch diameter blast holes. The blasting agent used is ammonia nitrate, prima-cord and some hydromex, when necessary. Most of the blasts vary from 40 - 60,000 tons in size.

The ore sorting is done by the geology department using one sampler and one pit sorter. Ore is blocked off in a blast, from information on the ore grading level plans and by visual examination of the drill cuttings. The drill cuttings, in an ore zone, are sampled and assayed for copper content. The results of several drill hole assays determine where the final blocked off limits of the blasted ore will be located. Good ore recovery has been experienced to date between calculated ore in place and actual pit sorted and hauled ore. Until more mill heads are available, it is difficult to know what ore dilution is taking place in the present methods of blasting and ore sorting.

## 7 MILLING

The New Imperial Mines Limited Mill Site is located in the central part of the Whitehorse Copperbelt (Sketch - 2 and 4), near the Little Chief Pit. When the mill is running at capacity it is expected to treat 2,500 tons of ore per day. The ore is treated by flotation for the recovery of the copper content.

The crude ore enters the crusher from an outside hopper, into a reciprocating pan feeder, through a grizzly feeder and into the 48 x 42 inch jaw crusher. The ore, minus 6 inch particle size, passes to the course ore stockpile by conveyor. A draw off conveyor beneath the course ore stockpile returns the ore to the secondary Symons cone crusher and then to the similiar

tertiary Symons cone crusher. The ore is passed through a primary screen, at a particle size of minus 5/8 of an inch, onto a conveyor to the fine ore bin. The ore is then transported to the mill by four conveyors. In the mill grinding is started in a 9 x 13 foot size Rod Mill and one 10 x 16 foot size Ball Mill. Classification of the ore is through two 24 inch cyclones. The pulp, 65% minus 200 mesh, is then treated with xanthate, pine oil and Quartec reagents in a conditioner and passes into the rougher flotation cells. The rougher flotation cell concentrate goes to a cyclone and underflow to a regrind 6 x 7 foot size Ball Mill. Following rougher flotation a scavenger concentrate is returned to the conditioner. The final product is thickened, stored in an agitator, filtered and dried to 8% moisture content. The concentrate is stored in the Mill Building in 25 ton containers for shipment. The mill is expected to produce a 35% copper concentrate with an average 85% recovery, and ore mill feed to be greater than 0.45% copper content.

Containers are placed on low bed trailers and trucked to Whitehorse and off loaded onto flat cars. The White Pass and Yukon Route transport the bulk concentrate 110 miles to Skagway, Alaska, by narrow gauge railway. The 25 ton concentrate containers are off loaded from the rail cars onto the White Pass ship at Skagway for shipment to Vancouver, British Columbia. In Vancouver, the concentrate is stored in bulk until 3,000 tons have accumulated for shipment to Sumitomo Metal Mining Company of Japan.

## 8. MARKETING

### Financing

In December, 1965, a Letter of Intent was signed between Sumitomo Metal Mining Company of Japan and New Imperial Mines Limited. As a feasibility study completed the month previous has estimated a total cost of $7,253,900. to bring the property to production, Sumitomo agreed to supply two-thirds of this amount with New Imperial supplying the remaining one-third.

By June, 1966, this had been formalized in a firm agreement, duly ratified by the Japanese Government. New Imperial had arranged its participation amount through a loan from the Toronto-Dominion Bank.

## Sale of Concentrate

By the terms of their agreement, New Imperial is required to sell exclusively to Sumitomo all the copper concentrates produced in the Whitehorse Copperbelt property for a period of ten years. The price of copper concentrate is to be the sum of the payments for gold, silver and copper. Copper prices are based on the average export refinery price for electrolytic copper wire bar as published in the Engineering and Mining Journal. There are minimum values set for the content of gold and silver included in the copper concentrate.

ON ITS WAY: Boxed pliofilmed containers carry the first shipment of ore from New Imperial to White Pass and Yukon Route for the beginning of it voyage to Japan.