VLF-ELECTRO-MAGNETIC SURVEY

&

MAGNETOMETER SURVEY

ON THE

BURGOYNE GROUP MINERAL CLAIMS

N.T.S. 92I/6W & 92I/3W

KAMLOOPS MINING DIVISION

LATITUDE:	50°15' NORTH
LONGITUDE:	121°24' WEST
OWNER:	J.M. ASHTON
OPERATOR:	808 EXPLORATION SERVICES LTD.
CONSULTANT:	J.D. GRAHAM, P.ENG.
AUTHOR:	J.M. ASHTON, P.ENG.
SUBMITTED:	30 AUGUST, 1990

Prepared By:

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SECTION 1.0 INTRODUCTION

The first recorded work on this prospect was by Alfred A. Burgoyne, M.Sc., in October 1969. Burgoyne's geochemical survey conducted largely over the area presently occupied by the Rebecca Mineral Claims was successful in delineating a large area of copper enriched soils that extends for a strike length of close to 5,000 feet (1,500 m) with a maximum width of 2500 feet (750 m). Limited follow up trenching work by Burgoyne over a small section of the anomalous area showed significant oxidized copper mineralization within a shear zone in the volcanics. Including a central zone 35 feet (10.7 m) in width which assayed 0.73% copper, the average found across a 270 foot width, excluding a 25 foot barren zone, was about 0.20% copper. J. W. Antal, P.Geol. concluded in his November, 1969 report that the lithology and structure found within the claim area had the potential for hosting a large low-grade copper deposit.

As shown on the accompanying claim map, the Nicoamen River flows near the east and north boundary of the Burgoyne Group and empties itself into Thompson's River at the Group's northwest corner. Historical records of early British Columbia state that in the early 1850's, Indians found coarse placer gold near the mouth of the Nicoamen River where it empties into Thompson's River. This location is geologically close to the large copper bearing zone found on the Burgoyne prospect and could be indicative of a genetic relationship.

The Burgoyne report of October 1969 recommended further extensive work on the claims of which only a limited amount of trenching, and reconnaissance geology was carried out by J.W. Antal. The trenching work uncovered significant copper mineralization in place to support the thesis that a large low grade copper deposit may underlay the claim area, notwithstanding the local geology could play host to a limestone 'replacement' type deposit similar to that which was mined at the Craigmont Mine about 23 miles (37 km) easterly.

SECTION 2.0 LOCATION & ACCESS

The Burgoyne Group of mineral claims are located approximately 19 km (11.8 miles) south of Spences Bridge, British Columbia. Spences Bridge is located approximately 109 km (118 miles) by air northwest of Vancouver British Columbia on Trans Canada Highway 1.

Locally, the northwest corner of the Burgoyne Group is located close to the confluence of the Nicoamen River where it enters Thompson's River.

A good all-weather forest service road provides immediate and easy access to the central part of the claims southward from the paved Trans Canada Highway near the confluence of the Nicoamen and Thompson River. Several old logging roads with secondary tree growth cross the property and intersect with the main access road thereby providing the potential for road access to most every sector of the property through a minimum of rehabilitation.

SECTION 3.0 PROPERTY & OWNERSHIP

The Burgoyne Group is comprised of the following mineral claims with expiry dates shown subject to acceptance of this report:

Mineral Claim	Units	Record #	Expiry Date
Rebecca 1	16	8638	21 June 1993
Rebecca 2	1	8639	20 June 1993
Rebecca 3	1	8640	20 June 1993
Rebecca 4	1	8641	20 June 1993
Rebecca 5	1	8642	20 June 1993
Rebecca 6	1	8643	20 June 1993
Sheryl	20	9416	9 June 1994
TOTAL	41		

The mineral claims are held by record in the name of J.M. Ashton of Vancouver, British Columbia.

SECTION 4.0 PHYSIOGRAPHY & OUTCROP

The claims cover an area of moderate to steep topographical relief. The central and western part of the claims are traversed by a multiple switchback road that climbs the east side of the Thompson River canyon rising from the canyon bottom at 700 feet (213 m) elevation to a saddle between two peaks at 3,500 feet (1,070 m) elevation within a distance of 2 miles (3.2 km). This represents an average mountain slope of 26.5%. Locally the relief is moderate to steep in the area of interest yet easily accessible by foot from the switchback road.

The area of interest is part of the Cascade Mountains which are separated from the Coast Mountains to the west by Fraser's River. Thompson's River meets Fraser's River at Lytton about 8 miles (13 km) west from the property.

The Cascade Mountains are lower and less rugged than the Coast Mountains and generally consist of rolling and rounded summits which is the case at the higher elevations on this property.

Southern and western exposures on the property tend to be open areas and easily traversed whereas northern and eastern slopes are much more heavily wooded. The area of interest on the property is a north facing slope that has been logged of most of its coniferous growth with new growth represented by denser deciduous trees and in places associated with difficult to traverse underbrush.

Outcrop is generally lacking over the area of interest so trenching is required to provide access to the bedrock. Depth of overburden is expected to vary from a few feet where some of the early trench work was preformed to an indeterminate depth in the neighbouring north-south striking gulleys. Outcrop over the entire property is estimated at less than 20 percent and is generally found adjacent to the area of interest on the steep side slopes.

SECTION 5.0 REGIONAL AND LOCAL GEOLOGY

The regional geology is described in Geological Survey of Canada Memoir 262, Ashcroft Map-Area, British Columbia and is shown on G.S.C. Map 1010A, Ashcroft (N.T.S. Sheet 92I (West Half)).

According to A. Burgoyne the Burgoyne Group lies within a northwesterly to north-northwesterly trending sedimentary sequence of probable Jurassic age made up of a series of rocks containing conglomerate, sandstones, mudstone, argillite, dolomite, re-crystallized dolomite and fine to coarsely crystalline limestone. This sequence dips to the east at about 40 degrees.

The sedimentary sequence is overlain uncomfortably by the Lower Cretaceous Kingsvale Group of basalt, andesite agglomerate, tuff and breccia.

The sedimentary sequence appears to be underlain and probably intruded by Lower Cretaceous granodiorite, quartz diorite and diorite apophyses related to the Mount Lytton Batholith, although younger intrusives subcropping the area are not to be ruled out.

More detailed geological work carried out on the Burgoyne Group by J.W. Antal over the area of interest in 1969 is described in his report 'Geology of T Claims', Nicoamen River Area, Kamloops Mining Division, Department of Mines and Petroleum Resources Assessment Report 2532. The geological description therein is difficult to interpret compared to the Burgoyne evaluation so it will not be described or discussed here except for the mineral potential as reported.

SECTION 6.0 MINERAL POTENTIAL

One model of comparative geology to the Burgoyne prospect is the Craigmont Mines deposit located 23 miles (37 km) due east near Merritt, British Columbia which saw the milling of more than 34 million metric tons of copper ore which produced a total of 403 million kilograms (887 million pounds) of copper.

The Craigmont deposit was formed by the intrusion of border phase rocks of the Lower Cretaceous Guichon Creek Batholith quartz diorites to granodiorites into the thick Nicola Volcanic Sedimentary series of agglomerate, breccia, andesitic flows, limestones, argillite and greywacke.

Pyrometasomatic replacement ore bodies of copper and iron (hematite and magnetite) developed as a result of skarnification of the limestones and limey sediments. The bulk of the copper ore was found in the skarn.

At the Craigmont deposit two stages of mineralization occurred, a magnetite-chalcopyrite stage and a specularite-chalcopyrite stage (the bulk of the ore).

The magnetite-chalcopyrite zone was identified by a high intensity magnetic anomaly of 14,000 gammas above back ground.

A geochemical soil survey carried out in 1969 on the Burgoyne Prospect by Crest Laboratories (B.C.) Ltd. under the direction of Alfred A. Burgoyne, M.Sc. over part of the claim area, found a very large copper in soils anomaly with greater than 100 parts per million copper with dimensions of 5,000 feet by an average width of approximately 2,000 feet. See Map 3.

Within approximately one half of this area a series of higher order copper anomalies exceeding 400 parts per million copper are found with the largest having a dimension of about 2,000 feet long by 1,300 feet wide with a mean copper value of 760 parts per million. The dimension and strength and anomalous character of this geochemical expression appears commensurate with the largest of the Highland Valley deposits, located 12 miles (19 km) to 24 miles (38 km) to the northeast.

Four trenches placed over the central part of the large copper in soils anomaly on the Burgoyne Prospect were reported on by J.W. Antal as being found within a thick unit of well altered siliceous calcic rocks with interbedded altered volcanics.

A systematic sampling across 244 feet of Trench C returned an average value of 0.21% copper within which a core zone assayed 0.73% copper across 35 feet.

The skarnification products as identified by J.W. Antal, e.g. epidote, actinolite, magnetite and hematite, in association with copper minerals are what would be expected in the low temperature phase of a replacement type massive sulphide mineralizing event similar to the Craigmont Model.

The J.W. Antal report concluded that the Burgoyne Prospect is both litholigcally and structurally suited for the presence of a large low-grade copper deposit and that the presence of magnetite in association with the copper may be a strong clue as to the location of its bedrock source. His recommendations included a magnetometer survey followed by trenching and drilling of selected targets.

SECTION 7.0 VLF-EM SURVEY & MAGNETOMETER SURVEY

7.1 INTRODUCTION

Very Low Frequency Electromagnetic (VLF-EM) and Magnetometer surveys were carried out over the probable location of a large high order copper in soils anomaly on the Burgoyne Group Mineral Claims to prospect for potential massive sulphide replacement mineralization of the type that was mined at the Craigmont Mines Ltd. copper deposit found in a similar geological environment.

The VLF-EM survey was employed because it will identify near surface electrically conducting bodies such as massive or semi-massive sulphides and the magnetometer survey was employed because of the apparent association of the copper minerals with areas of enriched magnetite.

A well marked survey grid was placed over the claims simultaneously as the survey progressed.

The field work was carried out by Mr. B.G. Richards, P.Eng. (VLF-EM Equipment Operator) and Mr. A. von Kursell (Magnetometer Equipment Operator) during the period 9 June to 16 June 1990.

Prior to commencing the field work, the Sheryl Mineral Claim, Record Number 9416 (20 Units) was staked on 9 June, 1990.

7.2 GRID PREPARATION

The grid lines have an east-west azimuth and the base-line a north-south azimuth. The base-line follows the north-south claim lines as shown on the drawings.

Compass declination used was 24 degrees east as defined by N.T.S. Map Sheet 92I/6W.

Stations were flagged and marked every 25 meters along the grid lines using a Topo-chain measuring unit Slope corrections were made over the steeper grid sections. Tyvex tags with grid co-ordinates marked with indelible black ink were placed every 100 meters along the grid lines. Magnetometer and VLF-EM unit readings were taken at every 25 metre station location along the grid lines.

The base line was flagged and blazed along its entire length and Tyvex tags marked with the respective co-ordinate identifications were placed every 100 metres.

The Base Line Station 00, Line 50+00 North is found at the Legal Corner Post of Rebecca 1 Mineral Claim. The base line is co-incident with the west boundary of the Rebecca 1 Claim.

A total of 14.2 km of base line and grid lines were completed.

7.3 INSTRUMENTATION

VLF-EM Unit

A Geonics Limited Model EM16, very low frequency-electromagnetic (VLF-EM) receiver was used for the VLF-EM survey. The Instrument bore Serial Number 8410053 and was manufactured in 1983. Specifications and Principles of operation of the Instrument are included herein as Appendix I.

Magnetometer

A Barringer Research Limited Total Field, Proton Precession Type Magnetometer, Model GM-122 was used for the Magnetometer Survey. The Instrument bore Serial Number 7534. Specifications and Principles of Operation of the Magnetometer are included herein as Appendix II.

7.4 VLF-EM SURVEY PROCEDURE

The survey procedure as is generally recommended in the EM-16 Operating Manual was used.

The grid was well oriented to cross the local strike lithology. The grid direction, which was also the read direction was considered satisfactory to obtain good EM signal coupling with a conductor aligned close to the lithological strike.

Therefore the Fraser Filter technique could be applied with a high degree of confidence.

The two VLF stations selected for the survey as giving good audio output response with satisfactory orientation to provide good coupling were:

Transmitter Location	Station I.D.	Co-ordinates Long./Lat.	Frequency (k-Hertz)	Output (kW)
Lualualei, Hawaii	TX1 (NPM)	158 W 09 21 N 25	23.4	600
Seattle, Washington	TX2 (NLK)	121 W 55 48 N 12	24.8	125

The following table summarizes the salient survey parameters:

Station	*Apparent Azimuth	Grid Azimuth	Read Azimuth	Coupling Angle
Channel 1 (TX1) NPM -	230°	270°/90°	270°	40°
Channel 2 (TX2) NLK -	205°	270°/90°	270°	65°

* Nearest 5°

At each station location the following data was recorded for each transmitter channel:

1. Channel Identification

2. Co-ordinate Location

3. Dip Angle (%)

4. Quadrature

7.5 PRESENTATION OF VLF-EM DATA

The VLF data was plotted two ways. The percent dip angle versus percent quadrature as field recorded was plotted in cross section form. The dip angle data was processed utilizing the filtering method developed by D.C. Fraser. All dip angle data was treated using the Fraser Filter technique.

The Fraser Filter technique was developed to perform several functions which includes:

1. Shifts the phase of the dip angle by 90° so that cross-over and inflection points from positive to negative and vice-versa, are transformed into peaks to permit contouring of anomalies about their apparent axes.

2. Removes the d-c waveform component and attenuates long wave lengths to increase the resolution and positioning of local anomalies.

The technique is straight forward to apply by simple arithmetic and algebraic addition and subtraction operations.

7.6 MAGNETOMETER SURVEY PROCEDURE

Magnetometer readings were taken at 25 metre station intervals along the grid lines. At each station the following data was recorded:

1. Station co-ordinates.
2. Magnetometer reading in absolute gamma values.
3. Time of reading.

Magnetometer readings were taken in accordance with the procedure recommended by Barringer and described herewith in Appendix III.

Normally the survey readings are accurate to the nearest integer gamma value. In this case when the survey began, the instrument was found to have a non-functioning last digit display. Therefore the survey was carried out to the nearest 10 gamma's sensitivity rather than a single integer gamma value in sensitivity.

The survey included several closed loop readings with readings duplicated at different time at the same station to determine the diurnal variation effects at the time of the survey. The diurnal magnetic field variation observed from field readings was compared with data obtained from the Pacific Geoscience Centre at Victoria, British Columbia, and appropriate data corrections were made.

7.7 PRESENTATION OF MAGNETOMETER DATA

Magnetometer readings were corrected for diurnal variation and plotted in their absolute value form at their respective co-ordinate locations. These results were contoured to the nearest 1,000 gammas as magnetic relief was found to be well pronounced.

SECTION 8.0 SURVEY RESULTS

8.1 MAGNETOMETER SURVEY RESULTS

The contoured results excluded the magnetic data gathered from traversing Line 58. The Operator reported reading difficulties with the instrument on this line because of the ingress of moisture during a period of extreme precipitation. Further exploration of this area should include a re-survey of this line.

Recorded total field magnetic intensity following diurnal correction ranged from a low of 52,440 gammas (nanoteslas) and a high of 61,600 gammas.

Area average magnetic relief ranges between approximately 55,000 and 58,000 gammas.

One distinct magnetic anomaly of magnitude and volume was found over what is believed to be part of the anomalous copper mineralized area discovered by Burgoyne in 1969.

This anomaly has a vertical relief of greater than 3,000 gammas with a strike direction of about 350 degrees azimuth for approximately 460 meters (1,500 feet). The anomaly appears to fit the lithological strike and may represent a magnetic enriched zone within altered limey sediments and limestones thought to subcrop in that vicinity. The magnetite may have significant copper mineralization in association with it.

The lack of useable data from Line 58 precludes any attempt to interpret the spatial aspects of this magnetic anomaly with any confidence. However this anomaly does warrant both confirmation and better definition through a further detailed survey.

The detailed survey area should cover that area between Line 52+00 North and Line 60+00 North from Station 200 East to 350 West, an area 800 metres by 550 metres.

8.2 VLF-EM SURVEY RESULTS

Two independent Very Low Frequency (VLF) Electromagnetic (radio-wave) signals were used as magnetic induction sources in seeking anomalies of conductive material in this survey.

The two signal sources described under Section 7.4, VLF-EM Survey Procedure were:

Station 1; Lualualei, Hawaii; 23.4 kHz

Station 2; Seattle, Washington; 24.8 kHz

Both signals at the beginning of the survey were loud and clear and their apparent transmitter directions were quickly and easily determined. Dip angle and quadrature tuning for each transmitter was easily determined at each survey station.

Station 1 was in transmission mode for almost the entire survey period except on Line 60. Station 2 periodically failed to transmit. Those Lines of the survey that lacked EM data during the no reception period are noted.

In general there appears to be reasonably good correlation of EM data from each of the independent transmitters.

The largest and integrally strongest EM conductor is the H1 group, H1, H1A and H1B (prefix H= Hawaii Transmitter; anomalies 1, 1A and 1B), which correlates with the Seattle Transmitter Group S1, S1A and S1B.

This large conductive area ranging between Moderate and Fair in conductive response extends for 800 metres (2600 feet) in a northerly direction and occupies the southeast flank of the magnetic anomaly. Anomaly H4B (correlates with S5 Anomaly) occupies the northwest flank of the magnetic anomaly, and is considered a fair to low order conductor.

VLF-EM conductors surround the magnetic anomaly and do not appear to be co-incident with it.

Massive magnetite is considered to have a fair to moderate conductivity in association with a high magnetic response. Less than massive or disseminated magnetite will exhibit a moderate to low magnetic response with an associated low conductivity, or no conductive response at all.

The electromagnetic conductive zones which surround the magnetic anomaly could represent sulphides introduced into the host lithology from a heat and solution source represented by the magnetic anomaly.

Those conductive zones found by the VLF-EM Survey other than close to the magnetic anomaly described above, and east of Station 400 East appear to be associated with the Kingsvale Volcanic unit and remote from the known zone of hydrothermal alteration. Only a positive geochemical signature over these VLF-EM conductive zones would encourage their evaluation at a later date.

SECTION 9.0 SUMMARY & RECOMMENDATIONS

SUMMARY AND RECOMMENDATIONS

In October 1969, A. Burgoyne, M.Sc. discovered a large area of extremely anomalous copper in soils, which later trenching showed significant copper mineralization within the underlying hydrothermally altered bedrock.

This work was never followed up to this writer's knowledge.

The area of strong copper values found by Burgoyne is thought to occupy the area bisected by the baseline selected for the magnetometer and VLF-EM surveys that are described herein. See the accompanying Map 7, Geochemistry, Copper in Soil (ppm) which shows the results of the Burgoyne Survey.

Within the area of alteration and anomalous copper this geophysical survey has delineated a significant magnetic anomaly with bordering electrically conductive zones on its east, south and west flanks within favourable lithology.

The magnetic anomaly and flanking conductive zones may be genetically related, and could represent a complex sulphide enriched system of chalcopyrite-magnetite-hematite along with other unknown accessory minerals. The magnetic anomaly could represent either a subcropping intrusive with accessory magnetite; or an intrusive with a magnetically enriched border phase, as magnetite is commonly an early stage zoning feature of such a system. The conductive zones could represent distal sulphide bodies related to either intrusive case.

Recommended follow-up work should include:

1. Re-do the magnetometer survey over the area of the magnetic anomaly with lines at 50 metre spacings and station intervals of 10 metres, including the re-survey of Line 58. The re-survey should include that area bounded by Lines 52+00 North and Line 60+00 North from Station 200 East to Station 350 West, an area 800 metres by 550 metres. It is recommended that a vertical gradiometer type magnetometer be used for this survey to obtain a better spatial understanding of the magnetic body causing the anomaly.

2. Re-sample the soils over the present survey grid and have them analyzed for 30 elements utilizing the ICP method with digestion by aqua-regia. This work should confirm the location of the Burgoyne copper anomaly so that a positive geophysical-geochemical correlation can be made to assist in identifying priority drill and/or trenching targets.

3. Map the surface geology in some detail over the grid area following the geochemical re-survey and magnetometer re-survey. An amount of trenching will be required in conjunction with this work to access the bedrock for mapping purposes.

In all probability the results of additional work proposed will justify a drill program to test the magnetic anomaly and identified conductive zones.

SECTION 10.0 - COST STATEMENT

10.1 SUMMARY

1. Personnel	8,301.00
2. Field Expense	887.31
3. Room & Board	568.13
4. Travel Expense	71.65
5. Geophysical Equipment Rental	600.00
6. Report Reproduction & Drawings	145.00
TOTAL	**$10,573.09**

10.2 PERSONNEL

1. Trip Preparation

J.M. Ashton, P.Eng.	
½ day @ $400.00 per day	200.00

2. Mobilization, Demobilization & Travel 7 June - 16 June Vancouver-Kamloops-Lytton Return

B.G. Richards, P.Eng.	
A. von Kursell	
1½ days @ $280.00 per day	
1½ days @ $200.00 per day	720.00

3. VLF-EM Survey & Magnetometer Survey

B.G. Richards, P.Eng.	
7 days @ $280.00 per day	1,960.00
A. von Kursell	
7 days @ $200.00 per day	1,400.00

4.A) Data Preparation, Reports & Drawings

J.M. Ashton, P.Eng.	
4 days @ $400.00 per day	1,600.00

B) Plotting & Drafting

E.B. Catapia, C.Tech	
37 Hours @ $43.00 per hour	1,591.00

C) Report Typing & Collation, Drawing Reproduction

21 hours @ $30.00 per hour	630.00

D) Consultant, J.D. Graham, P.Eng. ½ day @ $400.00 per day		200.00
	TOTAL	**$ 8,301.00**

10.3 FIELD EXPENSE

1. Truck Rental, 4x4 7 days @ $65.00 per day		420.00
2. Mileage, Kamloops, Site & Return 805 km @ $0.25/km		201.25
3. Gasoline		60.00
5. Field Supplies		206.06
	TOTAL	**$ 887.31**

10.4 ROOM & BOARD

1. Motel		362.88
2. Meals		205.25
	TOTAL	**$ 568.13**

10.5 TRAVEL EXPENSE

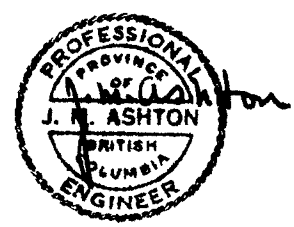
1. Gasoline		71.65
	TOTAL	**$ 71.65**

10.6 GEOPHYSICAL EQUIPMENT RENTAL

1. Magnetometer Rental		150.00
2. VLF-EM Unit Rental		450.00
TOTAL	**$**	**600.00**

10.7 REPORT REPRODUCTION & DRAWINGS

1. Estimated		145.00
TOTAL	**$**	**145.00**



SECTION 11.0 - CERTIFICATION OF J.M. ASHTON, P.ENG.

I, J.M. Ashton of Suite 1451 - 409 Granville Street, Vancouver British Columbia hereby certify that:

1. I am a Consulting Engineer and principal in the Company, 808 Exploration Services Limited.

2. I am a graduate of the University of British Columbia with a B.A.Sc. in Electrical Engineering (1966).

3. I am a member in good standing in the Association of Professional Engineers of the Province of British Columbia.

4. I am a member of the Canadian Institute of Mining and Metallurgy.

5. I have practiced as a mineral explorationist and consulting engineer since 1969.

6. This report was prepared by myself. I requested that J. Donald Graham, P.Eng. review the contents herein and certify the same if in concurrence.

J.M. Ashton, P.Eng.

Dated this 27th day of August 1990
VANCOUVER, BRITISH COLUMBIA

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. M. ASHTON

SECTION 12.0 - CERTIFICATION OF J. D. GRAHAM, P.ENG.

I, J. Donald Graham of 3962 West 37th Avenue, Vancouver, British Columbia, hereby certify that:

1. I am a graduate of the University of British Columbia with a B.A.Sc. in Geological Engineering (1962).

2. I am a graduate of the University of British Columbia with an M.A.Sc. in Mining Engineering (1964).

3. I am a Member of the Canadian Institute of Mining and Metallurgy.

4. I am a registered member, in good standing, of the Association of Professional Engineers of the Province of British Columbia.

5. I am a Geological and Mining Engineer

6. I have practiced my professions since graduation to date.

7. I agree with and endorse the contents of this report.

J. Donald Graham, P.Eng.

Dated this 27th day of August 1990
VANCOUVER, BRITISH COLUMBIA

SECTION 13.0 - REFERENCES

1. Antal, J.W., November 1969; Geology of T Claims, Nicoamen River Area, Kamloops Mining Division.

2. Bristow, J.F., April 1968; The Geology of the Craigmont Mine: Canadian Institute of Mining and Metallurgy Presentation, Vancouver British Columbia.

3. Burgoyne, A.A., October 1969; Report on Copper Geochemical Soil Survey, T Group of Claims T1-T28, Nicoamen River Area, Kamloops Mining Division, British Columbia.

4. Duffell, S., and McTaggart, K.C., 1952; Ashcroft Map-Area, British Columbia, Geological Survey of Canada, Memoir 262.

5. Fraser, D.C., December 1969; Contouring of VLF-EM Data, Geophysics, Volume XXXIV, No.6.

6. Geonics Limited, June 1983, Operating Manual for EM16, VLF-EM.

APPENDIX I

VLF-EM 16

SPECIFICATIONS

&

PRINCIPLES OF OPERATION

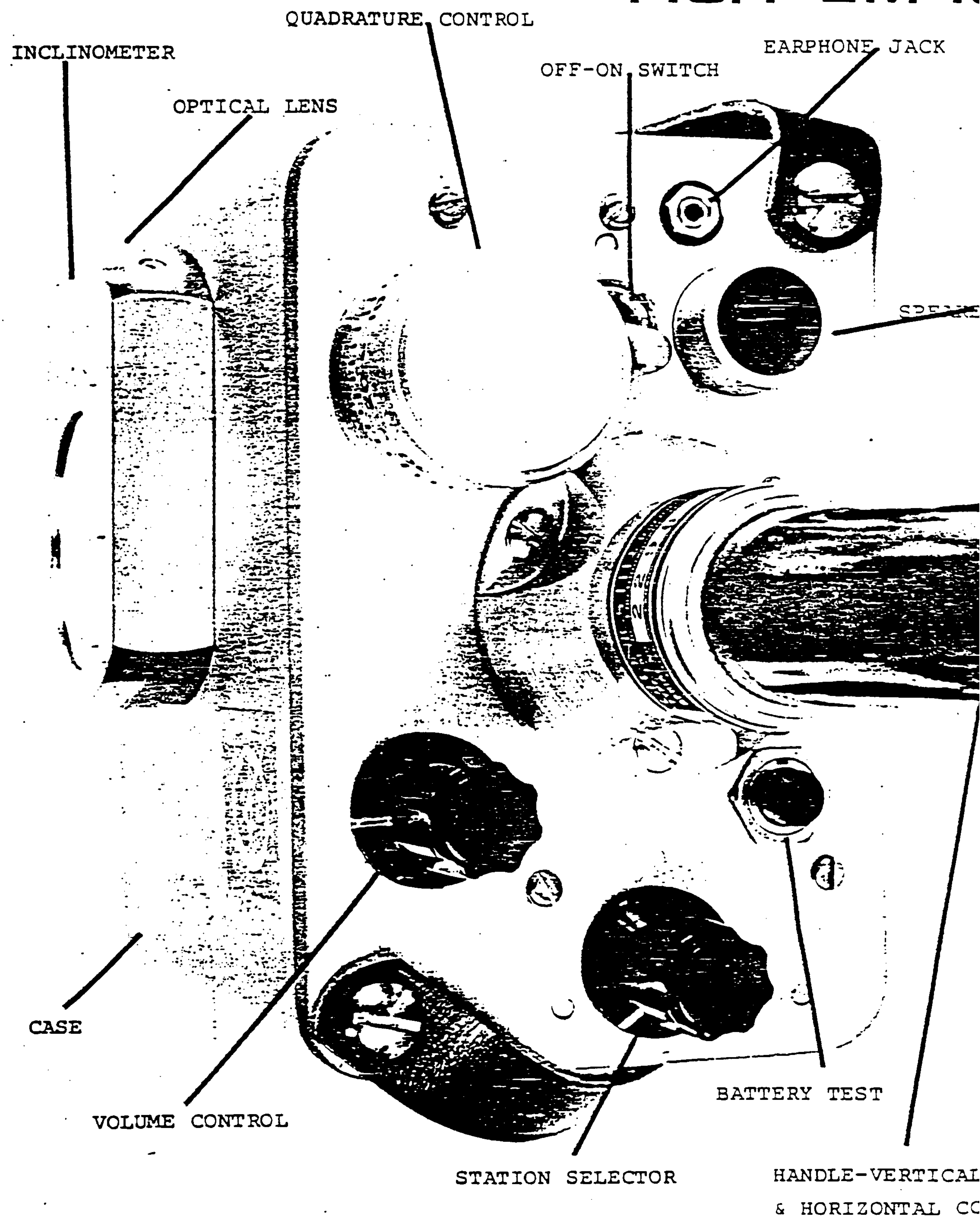
EM16 SPECIFICATIONS

MEASURED QUANTITY	Inphase and quad-phase components of vertical magnetic field as a percentage of horizontal primary field. (i.e. tangent of the tilt angle and ellipticity).
SENSITIVITY	Inphase: ±150% Quad-phase: ± 40%
RESOLUTION	±1%
OUTPUT	Nulling by audio tone. Inphase indication from mechanical inclinometer and quad-phase from a graduated dial.
OPERATING FREQUENCY	15-25 kHz VLF Radio Band. Station selection done by means of plug-in units.
OPERATOR CONTROLS	ON/OFF switch, battery test push button, station selector switch, audio volume control, quadrature dial, inclinometer.
POWER SUPPLY	6 disposable 'AA' cells.
DIMENSIONS	42 x 14 x 9cm
WEIGHT	Instrument: 1.6 kg Shipping: 5.5 kg

CAUTION

EM16 CLINOMETER MAY BE DAMAGED BY EXPOSURE TO TEMPERATURES BELOW -30° C.

FIG. I EM 18


QUADRATURE CONTROL
INCLINOMETER
EARPHONE JACK
OFF-ON SWITCH
OPTICAL LENS
CASE
VOLUME CONTROL
STATION SELECTOR
BATTERY TEST
HANDLE-VERTICAL
& HORIZONTAL CO

APPENDIX II

MAGNETOMETER

SPECIFICATIONS

PRINCIPLE OF OPERATION

&

OPERATING PROCEDURES

SUMMARY OF OPERATING PROCEDURE FOR GM-122

A — Connectors securely locked.

B — Arm fully extended, important to hold the sensor stable during read mode.

C — Staff fully extended with two sections deployed for an overall height of 5 feet.

D — Ensure that the operator does not carry metallic objects such as steel eyeglass frames, watches, large belt buckles, etc.

E — Select correct range using 'Manual' procedure and begin survey.

BARRINGER RESEARCH

BARRINGER RESEARCH LIMITED
GROUND MAGNETOMETER
MODEL GM-122

Ser# 7534

Prepared by:

Barringer Research Limited
304 Carlingview Drive
Rexdale, Ontario, Canada M9W 5G2

SPECIFICATIONS

Range:	20,000 to 99,999 in 12 ranges
Accuracy:	± 1 γ through operating temperature range
Sensitivity:	1 γ
Gradient Tolerance:	600 γ/ft.
Power:	12 "D" cells
Power Consumption:	< 50 Joules (Wsec) per reading
Polarizing Power:	0.8 A @ 13.5 V for 1.5 sec. (3 second cycle) 0.8 A @ 13.5 V for 3 sec. (6 second cycle)
Number of Readings with 1 Battery Set:	2,000 - 10,000 depending on type of batteries
Frequency of Readings:	1 every 3 seconds 1 every 6 seconds
Controls:	Pushbutton switch Range Selection switch - Slide switch for 3 and 6 sec. located on P/C Board
Output:	5 digit incandescent filament readout
Indicators:	LED point Lock Indicator - last three digits of the display blanked off when phaselock not achieved Segment Function Indicator - all segments light up to permit visual inspection of the display function

Mechanical:

Instrument:	Dimensions - 7" X 3.5" X 11" (18 cm X 9 cm X 28 cm) Weight - 8 lbs (3.6 kg) including batteries
Sensor:	Omnidirectional noise cancelling toroidal sensing head Dimensions - 4 7/8" (12 cm) diameter - 4 3/8" (11 cm) height Weight - 3 lbs (1.4 kg)
Ambient Conditions:	Operating Temperature Range - -40°F to 131°F (-40°C to 55°C) Relative Humidity - 0 to 100%
Environmental:	Instrument and sensor case made of high impact plastic

Section 2

SYSTEM

Each system comprises of:

(a) GM-122 Magnetometer Console

(b) Omnidirectional Toroidal Sensor

(c) Two Retractile Cords

(d) 5 ft. Telescopic Staff

(e) Carrying Harness

(f) Instruction Manual

(g) Set of Batteries

Section 3

OPTIONAL ACCESSORIES

The following are available for purchase from Barringer Research Limited:

(a) 2 ft. Staff Extender

(b) Battery Belt

(c) Backsack for Sensor

(d) Staff Adaptor - In case of breakage of the telescopic staff, the adaptor allows use of a piece of wood for a shaft

(e) Air freight shipping case with custom military specification foam insert to hold all accessories

Section 4

SPARE PARTS

Spare parts are available from Barringer Research Limited for purchase:

(a) Set of Battery Holders

(b) Display Board

(c) Sensor

(d) Retractile Cable for Sensor

(e) Staff

Section 5

GM-122 PROTON MAGNETOMETER

GENERAL DESCRIPTION, PRINCIPLE OF OPERATION

If a proton rich fluid such as kerosene, jet fuel, heptane, etc. is placed into a magnetic field the protons will align along the magnetic field vector. The magnetic field is induced in the sensor upon depressing the pushbutton. Then this field is suddenly removed. Protons which behave as elementary gyroscopes will start precessing around the remaining magnetic field - that of the earth. The precession frequency is directly proportional to the magnetic field of the earth. The magnetometer counts this frequency, divides it by the appropriate constant to obtain a reading in gammas ($1\ \gamma = 10^{-5}$ gauss) and displays the reading in the form of a 5 digit number.

OPERATING INSTRUCTIONS

1. To check the console

   (a) Insert batteries, place unit in its case and leave the sensor disconnected.

   (b) Depress the pushbutton momentarily. Within three seconds, two digits should light up. This checks the function of the lock indicator.

   (c) Press and hold the pushbutton depressed until the digital display indicates. All 5 digits should light up. This checks the function of the lock indicator override.

   (d) To check the readout, keep the button depressed at the end of the 3 or 6 second cycle. The display will then indicate 88888 for an additional 1.5 or 3 seconds, respectively. This tests the function of all the display segments and their drivers.

2. To take readings

   (a) Connect the sensor head by means of the retractile cord to the sensor connector (3-pin). Place the head on top of the telescopic staff and hold at arm's length.

   (b) Select the range roughly according to the the magnetic field intensity expected in the area.

   (c) Depress the pushbutton momentarily. If all 5 digits appear, the range selection was correct and reading is valid. If only the first two digits appear, the range selection is incorrect. Select the next higher or lower

2. (c) continued

   range, and press the pushbutton again. Proceed this way until all 5 digits light up. If no range is found such that the magnetometer displays full reading it may mean one of the following:

   - The gradient of the magnetic field is intolerable to the magnetometer. The effect of the gradient is a fast collapse of the precession signal.
   - No precession signal is available to the magnetometer due either to absence of initial polarizing command or to sensor failure.

NOTE 1: FUNCTION OF THE LOCK INDICATOR

The lock indicator blanks off the last three digits when the magnetometer begins to skip in counting the precession frequency due to low signal to noise ratio presented to the phaselock loop. The practical result is that the accuracy may in such case fall below $\pm 1\ \gamma$ and the lock indicator circuit will prevent the operator from taking erroneous readings. Some operators, due to their experience will feel that they can interpret data with inaccuracies of more than $\pm 1\ \gamma$.

For a single reading with lock indicator disabled, the start pushbutton must be depressed during the instrument count, i.e., a fraction of a second before the visual display time. A convenient way of doing this is to press the pushbutton for start and hold until the display comes up.

NOTE 1: continued

When lock indicator is disabled, it is necessary to determine what accuracy should be associated with the readings. This may be accomplished by taking several measurements at the same position, examining the statistical distribution of these and establishing the mean value of the reading and uncertainty associated with it. The gradient tolerance is increased in this mode due to higher uncertainties assumed.

CAUTION

When lock indicator is disabled and the magnetometer receives insufficient signal (e.g. heavy gradients or interference from overhead power lines or spherics, incorrect range selection, lack of connection between console and sensor) the readout will display a number unrelated to the magnetic field. This number may be sometimes quite stable and the count may be mistaken for a correct reading. The fact that the readings often differ substantially from the selected range or are widely scattered aids in recognition of this condition. Reliable failsafe readings are obtained through the use of the lock indicator.

NOTE 2: BATTERY SLEEVES

Employ the battery sleeves if there is any possibility that the batteries to be used are not reliably insulated from their jackets.

NOTE 3: BATTERY PACK LIFE

A fresh battery pack will provide 2,000 to 10,000 readings depending on the type of batteries used. When the batteries are getting low, a LED will light up left of the left-most digit of the display. This indicates that batteries should be replaced that same day. It does not mean the readings are incorrect. The magnetometer can be used for about 250 readings after the battery indicator went on.

NOTE 4: USE OF BATTERY BELT

The output of batteries falls off with decreasing temperature. It is suggested therefore that below 0°C (+32°F) the battery belt (optional) be used. This may be connected through the external battery connector. It is advisable to remove the internal batteries. Batteries in the battery belt are kept then at the operator's body temperature, protected from ambient temperature by the operator's clothing.

NOTE 5: USE OF BACKSACK

If backsack for the sensor is provided (optional), the sensor may be placed in this, leaving the operator's hands free.

If the backsack is used, the sensing head is in close proximity of the console which may cause degradation of the accuracy associated with such

NOTE 5: continued

readings to more than ± 1 γ. Operators should exercise even greater caution about the ferro-magnetic objects they may be wearing like pocket knives, keys, watches and belt buckles.

NOTE 6: STAFF EXTENDER

When the operator prefers to increase separation of the sensor from the console and ground for the least disturbed readings, an optional 2 ft. staff extender will provide a total staff length of 7 ft.

NOTE 7: COLD WEATHER OPERATION

The magnetometer case is not hermetically sealed. In operations in very cold weather, cycling of temperature and humidity may cause condensation inside the case. It is recommended to avoid unnecessary changes between indoors and outdoors, and is preferable to leave the magnetometer in the cold.

Section 7

MAINTENANCE

The following simple procedures may be used to correct minor malfunctions:

(a) Display Failure - Upon depressing the pushbutton and holding it continuously for 6 seconds, some of the segments may fail to light up. Open the instrument case, remove the display board and replace by spare board.

(b) Sensor Failure - This will demonstrate itself by loss of precession signal. Check for the continuity of the sensing coil and cable. Check for the presence of liquid within the sensing head by removing the plug. The liquid content should be 41.0 cu. in. or 670 cc. If these do not rectify the situation, use the spare sensor.

(c) Battery Care - If the magnetometer is used infrequently or stored with its internal batteries for long periods of time, the contacts may corrode appreciably. The magnetometer enclosure will trap moisture within, which will contribute to corrosion of the contacts. If the contacts are found to have corroded appreciably, replace battery holders. This may be accomplished by disconnecting all soldered joints to the battery holders, unscrewing holders from the chassis and installing the spare holders. Corrosion may be minimized by using a moisture absorbant in small paper sacks.

PRINCIPLES OF OPERATION

The VLF-transmitting stations operating for communications with submarines have a vertical antenna. The Antenna current is thus vertical, creating a concentric horizontal magnetic field around them. When these magnetic fields meet conductive bodies in the ground, there will be secondary fields radiating from these bodies. (See Figures 3 & 4). This equipment measures the vertical components of these secondary fields.

The EM16 is simply a sensitive receiver covering the frequency band of the VLF-transmitting stations with means of measuring the vertical field components.

The receiver has two inputs, with two receiving coils built into the instrument. One coil has normally vertical axis and the other is horizontal.

The signal from one of the coils (vertical axis) is first minimized by tilting the instrument. The tilt-angle is calibrated in percentage. The remaining signal in this coil is finally balanced out by a measured percentage of a signal from the other coil, after being shifted by 90°. This coil is normally parallel to the primary field,(See instrument Block Diagram - Figure 2).

Thus, if the secondary signals are small compared to the primary horizontal field, the mechanical tilt-angle is an accurate measure of the vertical real-component, and the compensation $\pi/2$-signal from the horizontal coil is a measure of the quadrature vertical signal.

Some of the properties of the VLF radio wave in the ground are outlined by Figures 4 thru 9.

ACCOMPANYING NOTES FOR FIGURES 2 - 9

FIGURE 2 is the block diagram of the EM16. The diagram is self-explanatory. Both the coils (reference and signal coil) are housed in the lower part of the handle. The directions of the axis of the coils are as follows: The reference coil axis is basically horizontal and is kept more or less parallel to the primary field during measurement. The signal coil is at right angles to the reference coil and its axis is, of course, vertical.

The signal amplifier has the two inputs, one connected to the signal coil and one to the reference channel. By tilting the coils, the operator minimizes the signal from the signal (vertical axis) coil. Any remaining signal is reduced to zero by the quadrature control in the reference channel. The signal amplifier has zero output

FIGURE 2 Continued...

when both input signals are equal in amplitude and phase. Thus, the setting of the quadrature control for minimum output from the receiver indicates the relative amount of the quadrature signal of the vertical coil. The measured value does not depend on the absolute value of the signal, only the relative values are measured.

FIGURE 3 shows the proper planning of survey in relation to the direction of strike and primary field, direction of survey lines etc.

FIGURE 4 explains the time delay (phase lag) ϕ of travelling electromagnetic wave above and in the conductive ground. The amplitude of the wave in the ground is also attenuated.

FIGURE 5 shows on the left the physical direction of the primary (H_x) and secondary (H_z) field vectors in relation to conductive ground and target. The location of secondary current distribution in the target is shown schematically. We see that most current concentration is in the upper edge of the good conductor. The return secondary current is more spread due to the diminishing primary field in the conductive rock. On the right, the time vectors show the retarded phase of H_x in the target and the phase advance of the secondary field H_z compared to H_x. We must remember that the H_z will have additional phase lag when it penetrates back towards the surface.

This figure shows a positive real component of the H_z while the quadrature remains negative.

FIGURE 6 This graph shows the primary field attenuation in nepers, relative amplitude and phase lag in radians of the primary field as function of depth and conductivity of the ground. This graph is for 20 kHz.

FIGURE 7 shows the maximum obtainable amplitude H_z from a sphere or horizontal cylinder as a function of the radius-to-depth ratio. The schematic on the left shows the depth determination for the spherical or cylindrical target.

FIGURE 7 Continued...

The equation for the phase shift and attenuation of the primary field in conductive material, where $\sigma/\varepsilon\omega >> 1$ is as follows:

$$\alpha = \beta = \sqrt{\frac{\omega\mu\sigma}{2}}$$

where α = attenuation, nepers/m
β = phase lag, radian/m
$\omega = 2\pi f$
μ = magn. permeability $= 4\pi x 10^{-7}$

σ = mhos/m

FIGURE 8 This graph gives the amplitude and phase shift of the field (in conductive media) as function of skin depth, $\delta = 1/\alpha$.

This equation gives the skin-depth in meters for certain conductivity and frequency. Normalize this to one, and the graph in Figure 8 gives the amplitude and phase shift of the wave at any relative depth.

FIGURE 9 The vertical field from a long wire source is plotted here. A vertical semi-infinite sheet target would be simulated this way. In practice it hardly works accurately due to the spread of the secondary current in the target because of the finite conductivity and the attenuation and phase shift of the primary field as function of depth.

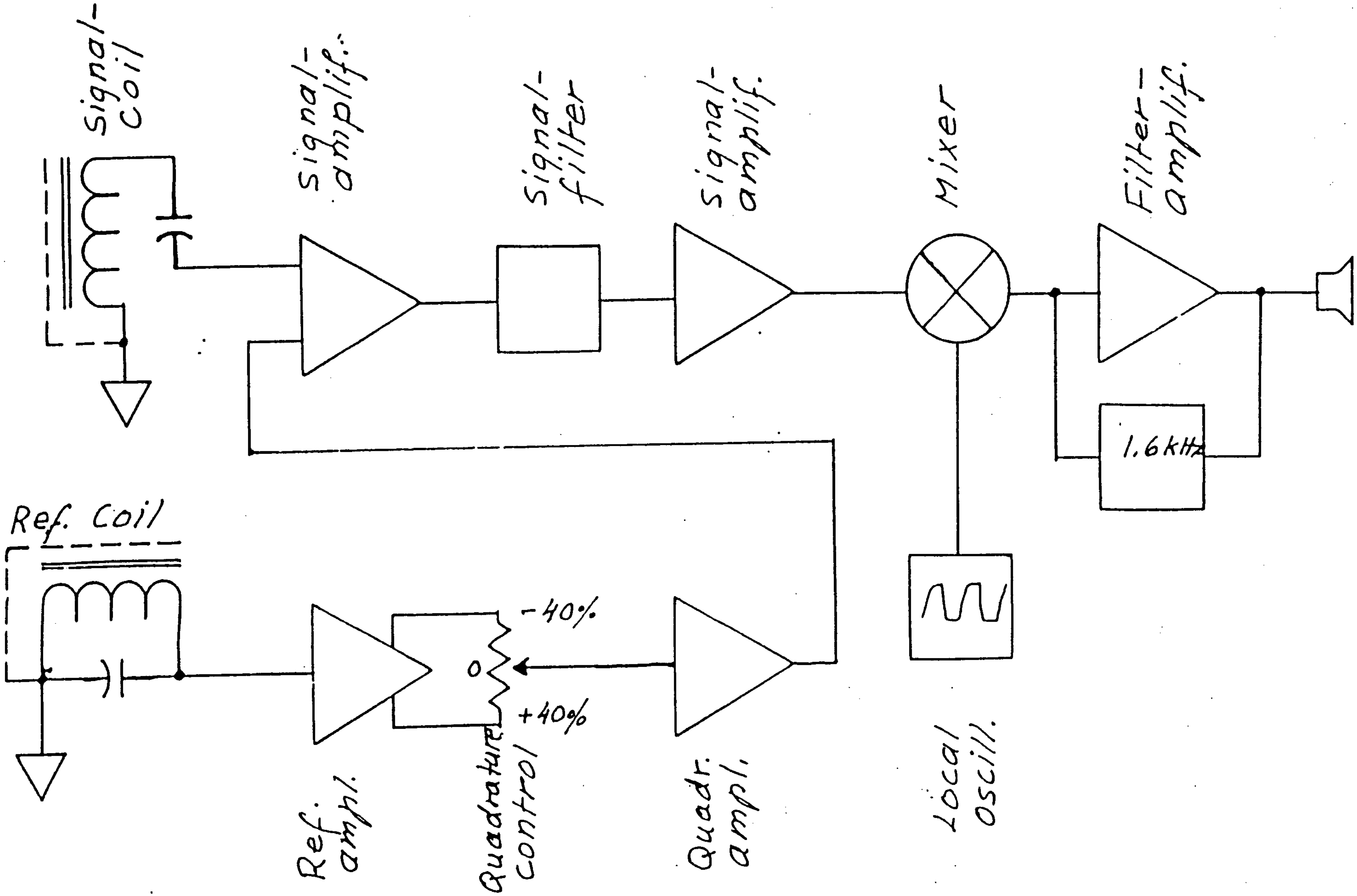
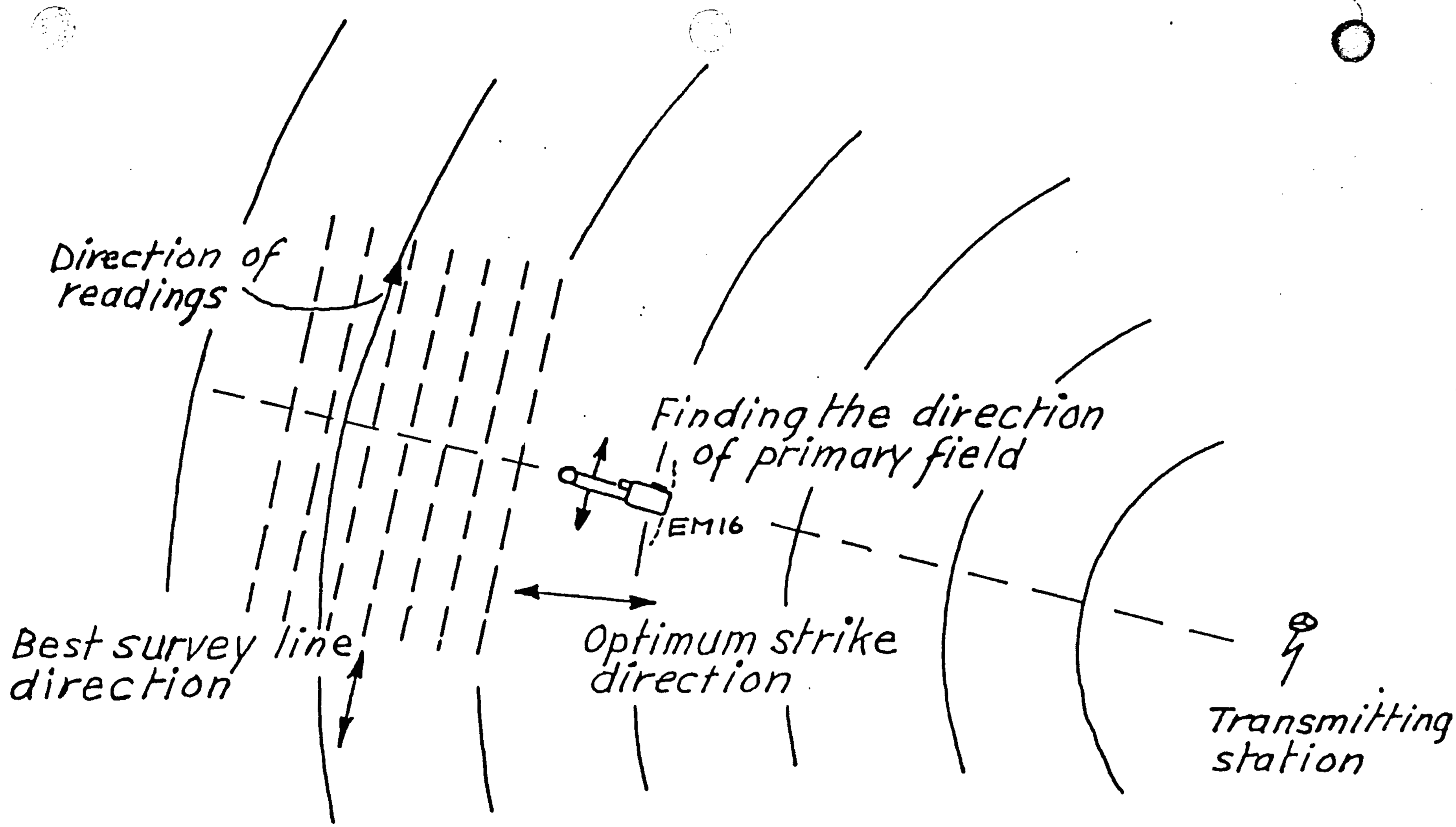


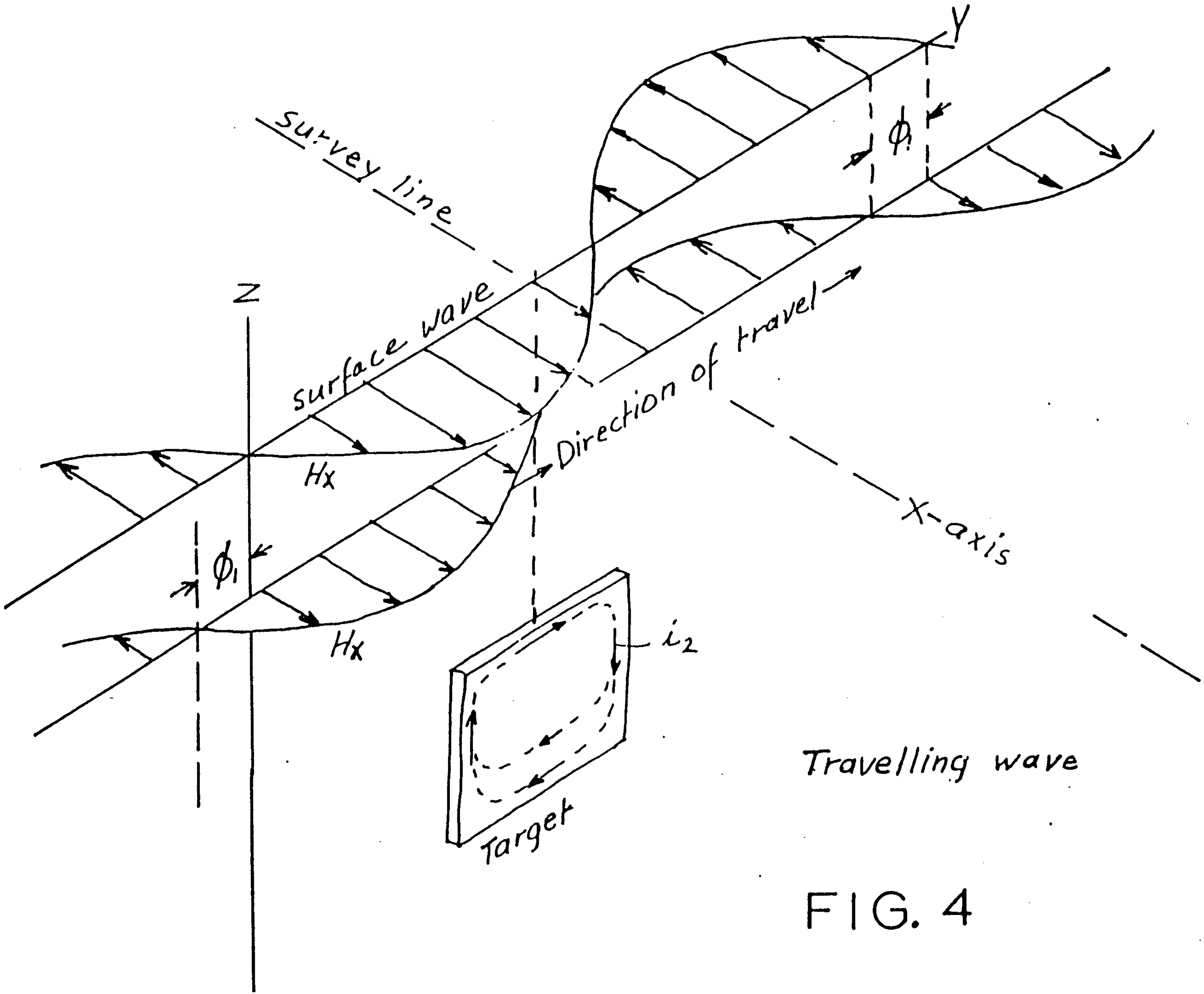
FIG. 2

EM16 VLF-EM
Block Diagram
GEONICS LTD.



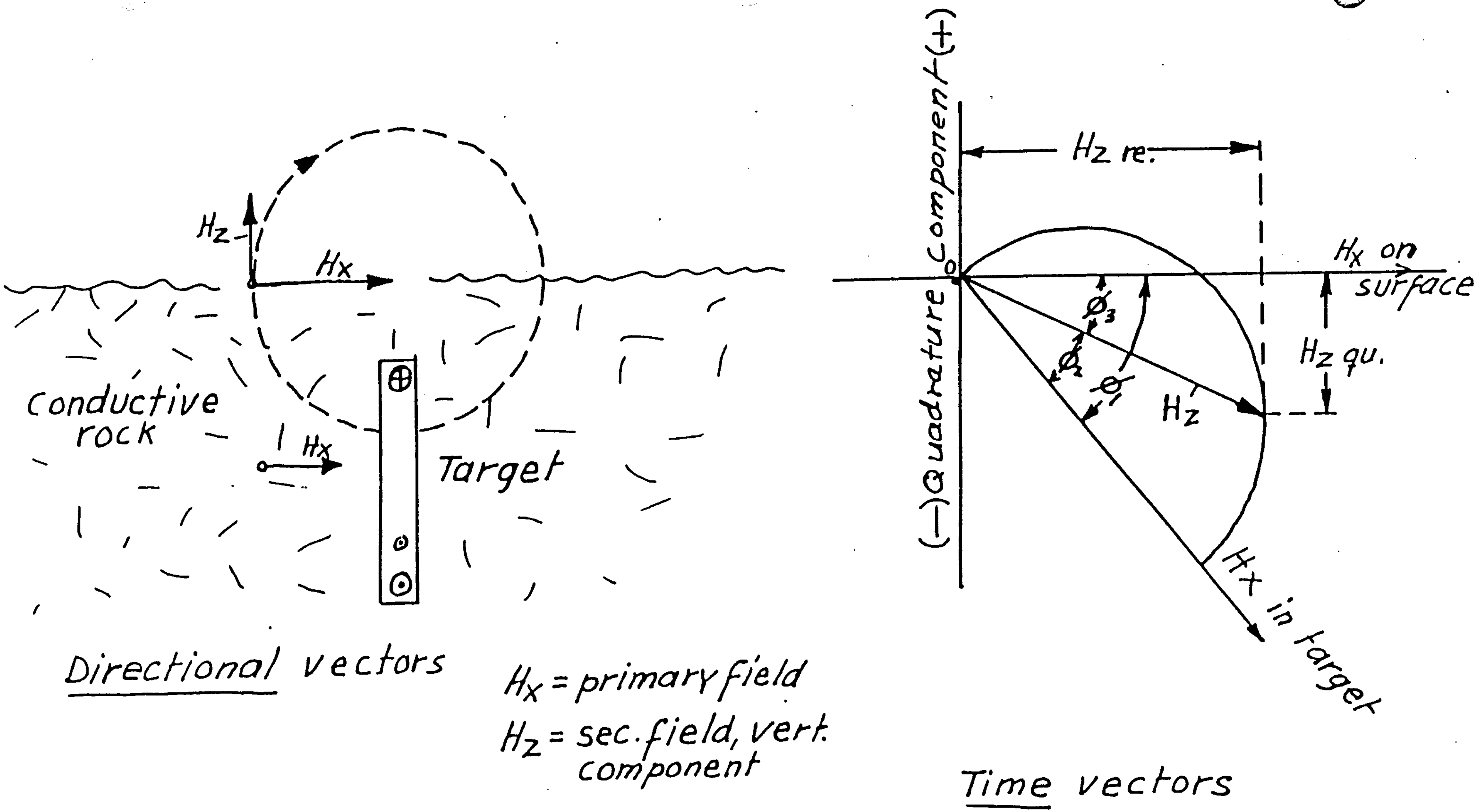
Planning of survey

FIG. 3



Travelling wave

FIG. 4



Conductive target in conductive medium

FIG. 5

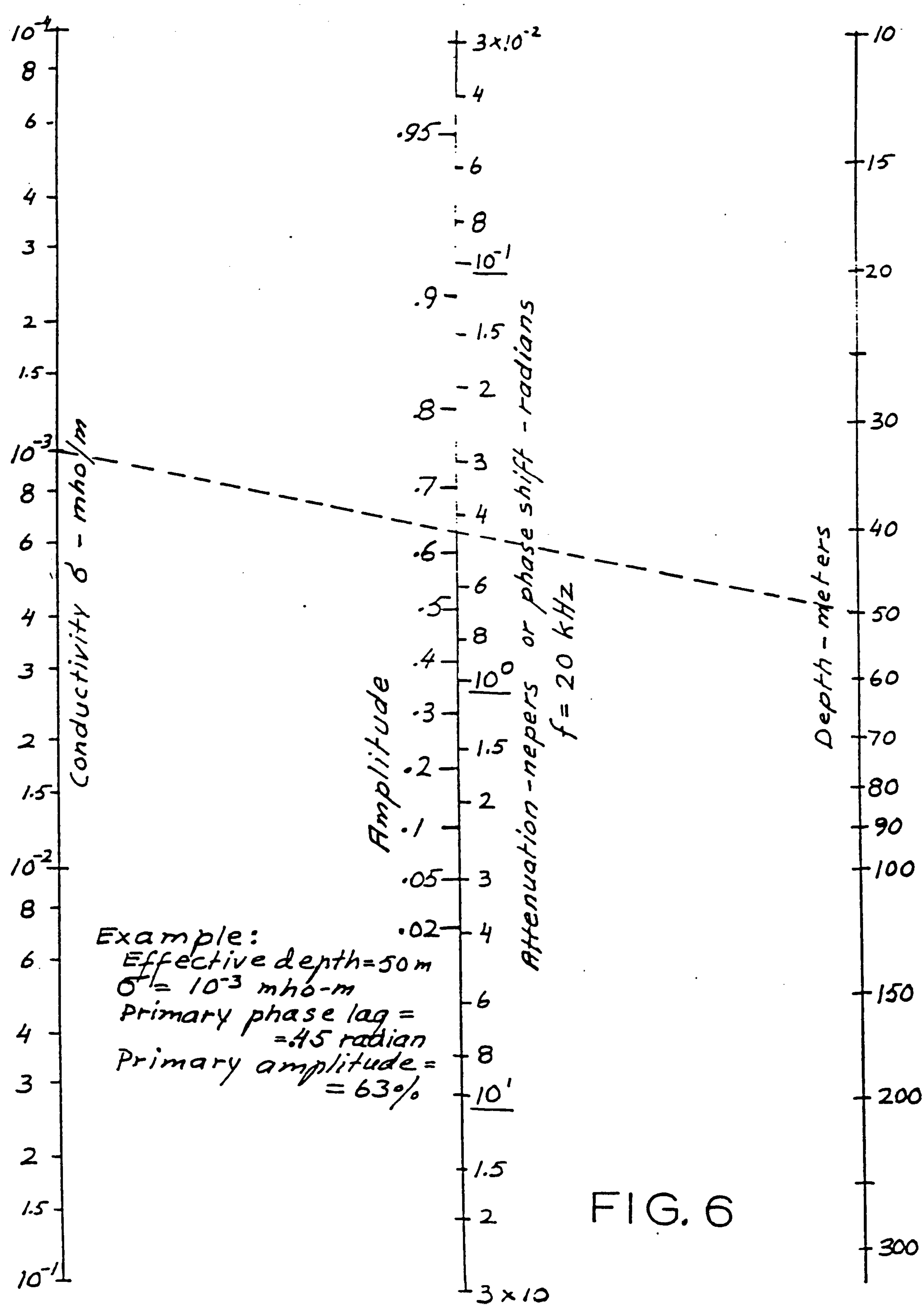
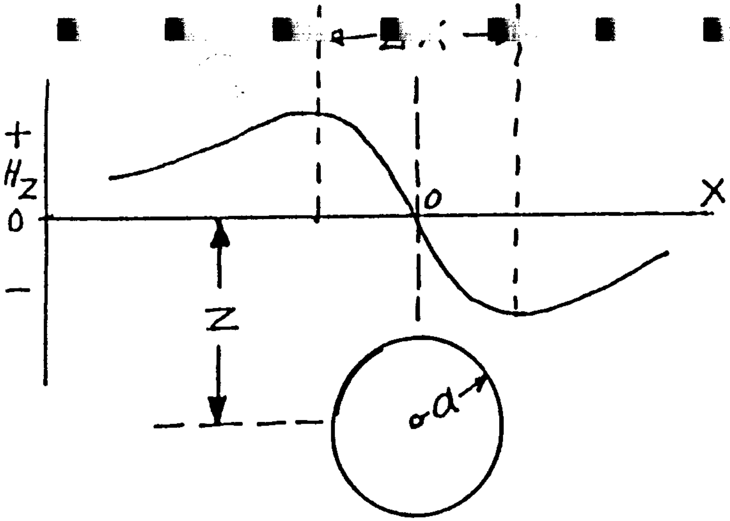

Conductivity σ - mho/m
Amplitude
Attenuation - nepers or phase shift - radians
f = 20 kHz
Depth - meters
Example:
Effective depth = 50 m
σ = 10⁻³ mho-m
Primary phase lag =
= .45 radian
Primary amplitude =
= 63%

FIG. 6



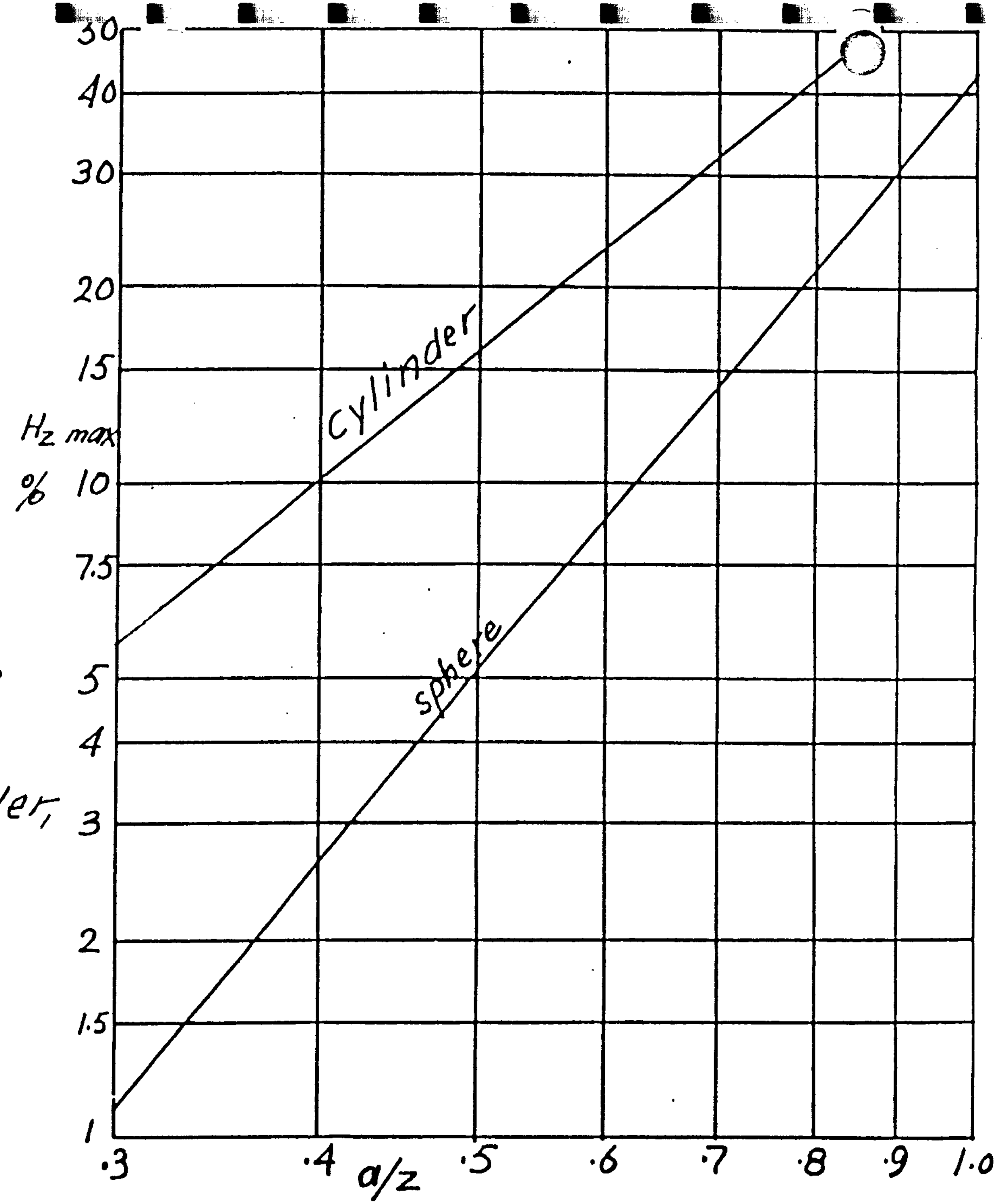
Long cylinder or sphere in horizontal field $H_x = 1$

Depth $Z = 1.16\,\Delta X$ for cylinder,

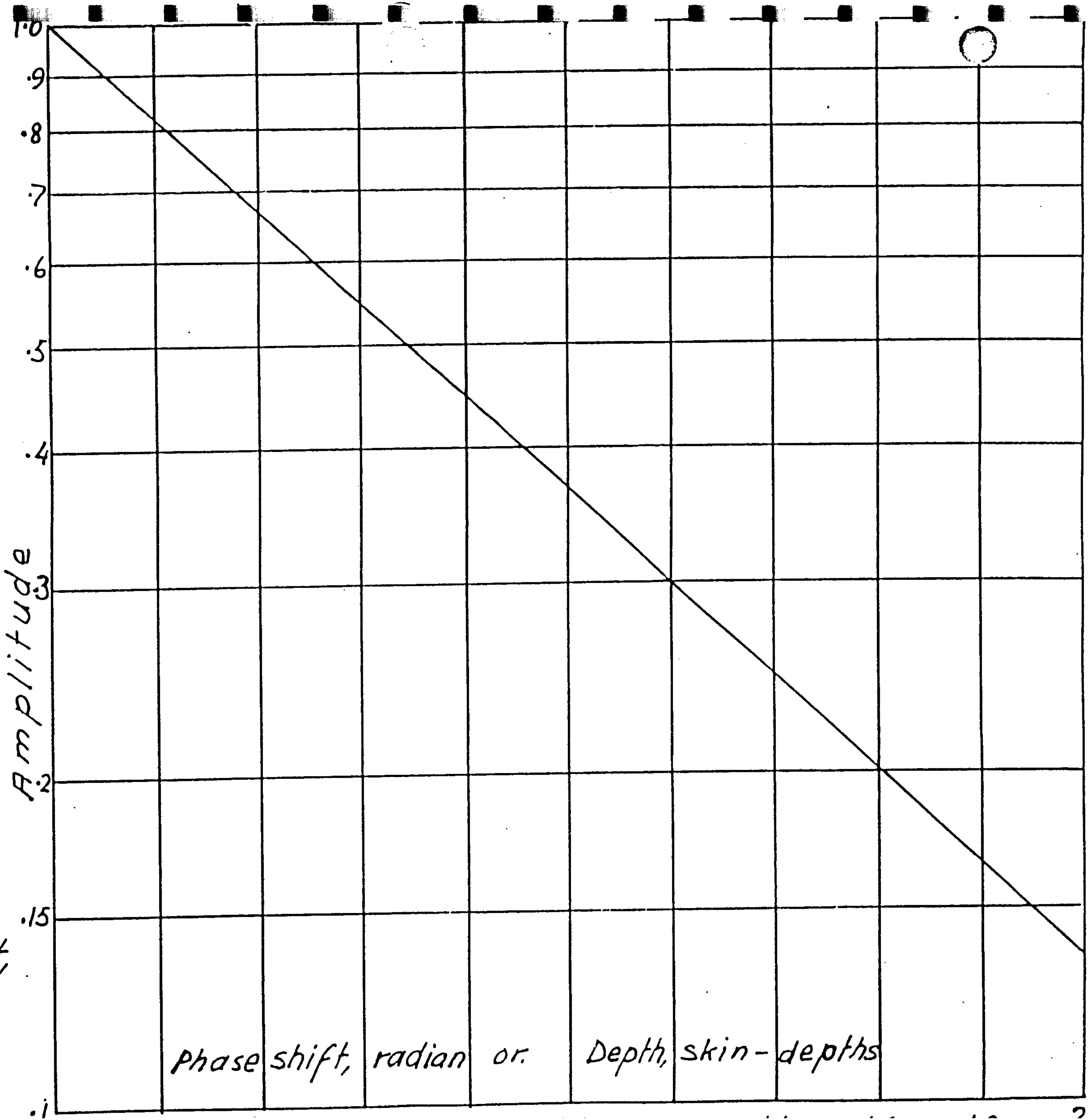
$Z = \Delta X$ for sphere

$\sigma = \infty$

FIG. 7



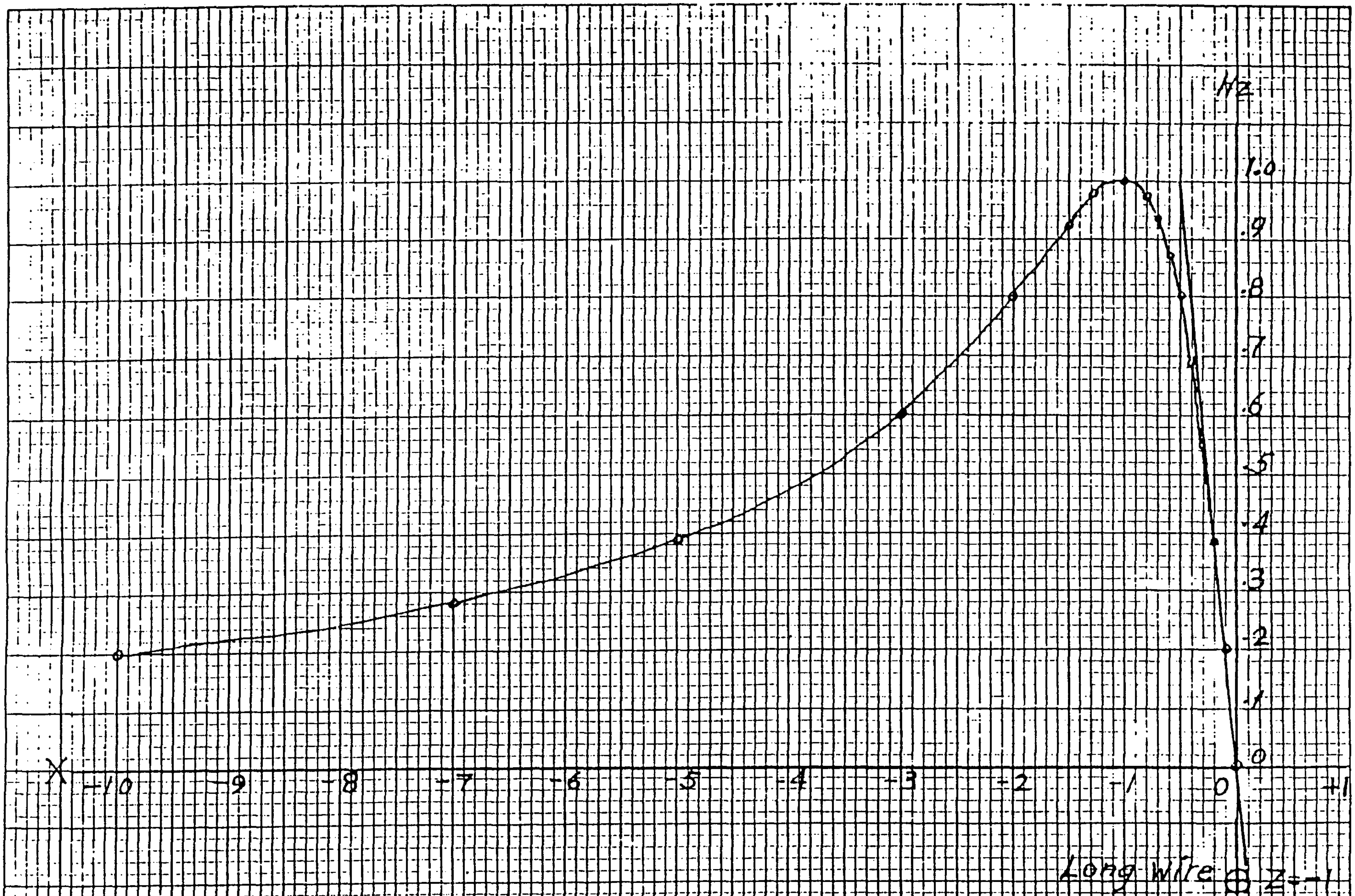
Maximum available anomaly from a sphere and cylinder



Primary field in conductive rock.

Depth, phase shift, amplitude

FIG. 8



Vertical Field
Long wire source

FIG. 9

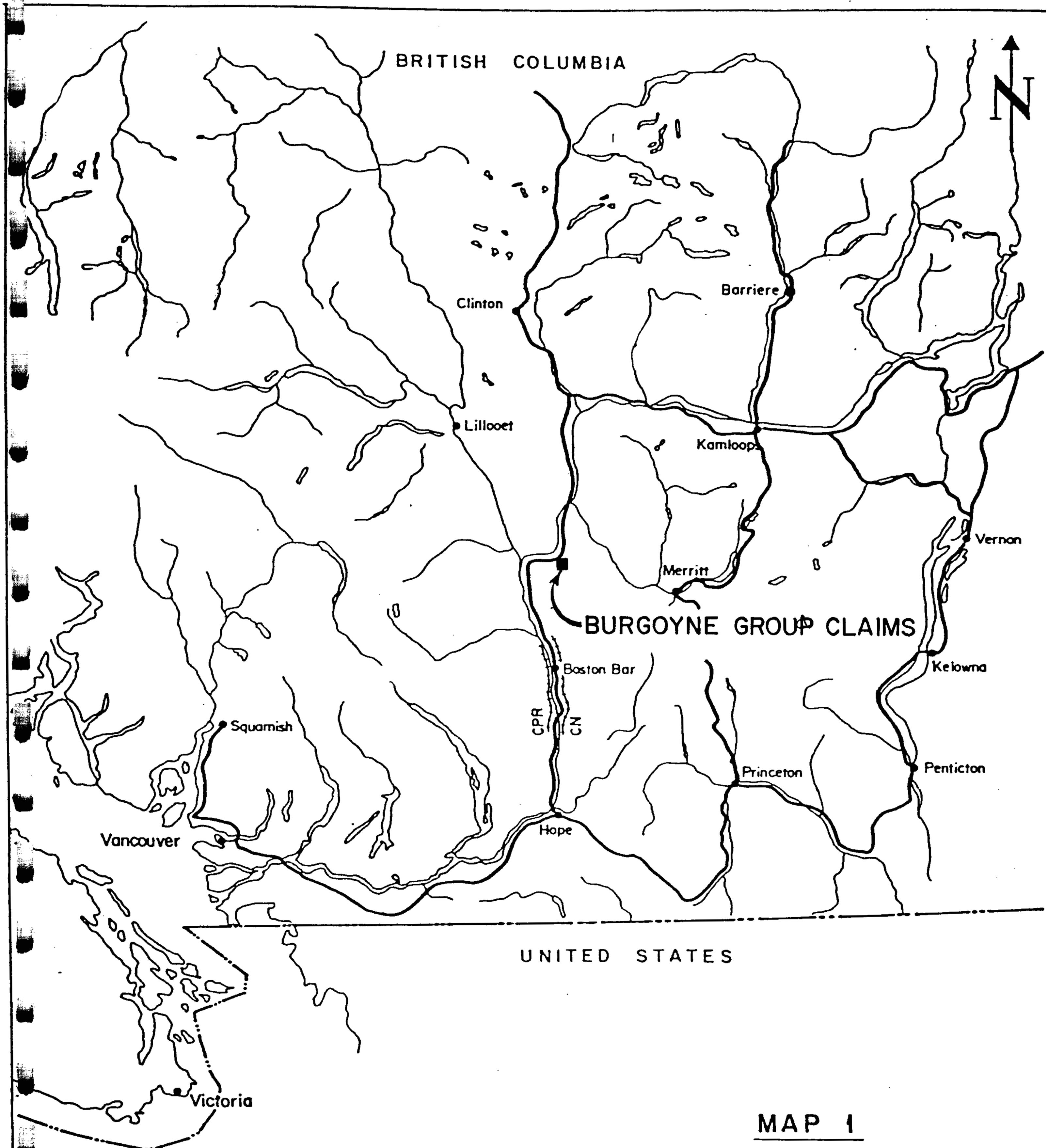
SELECTION OF THE STATION

The magnetic field lines from the station are at right angles to the direction of the station. Always select a station which gives the field approximately at right angles to the main strike of the ore bodies or geological structure of the area you are presently working on. In other words, the strike of geology should point to the transmitter. (See Figure 3). Of course, $\pm 45^{\circ}$ variations are tolerable in practice.

Tuning of the EM16 to the proper transmitting station is done by means of plug-in units inside the receiver. The instrument takes two selector-units simultaneously. A switch is provided for quick switching between these two stations.

To change a plug-in unit, open the cover on top of the instrument, and insert the proper plug. (Figure 10) Close the cover and set the selector switch to the desired plug-in.

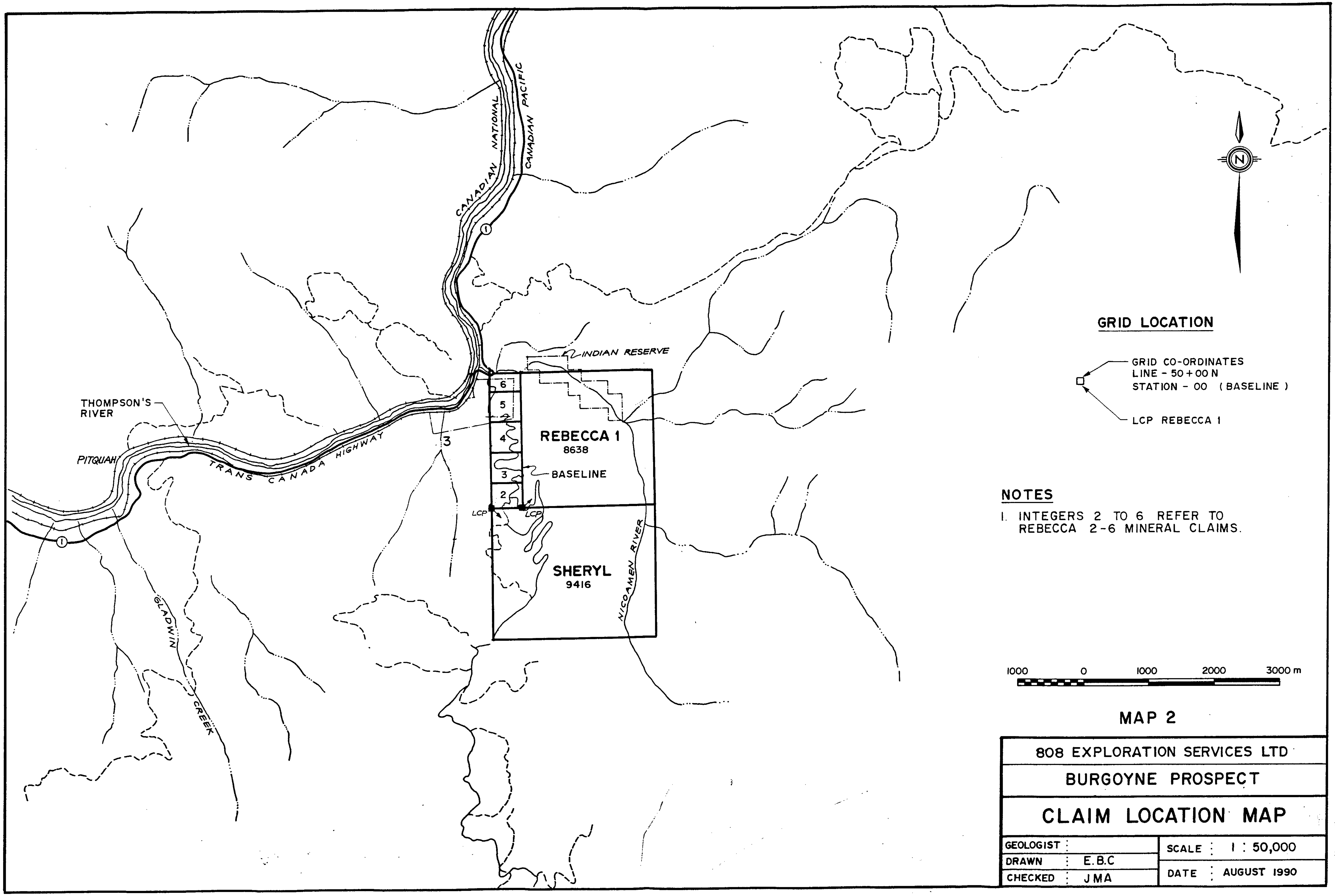
On the following pages is a variety of information on the most commonly used (i.e. reliable) VLF Transmitters including transmission frequency, geographical location and their scheduled maintenance periods.

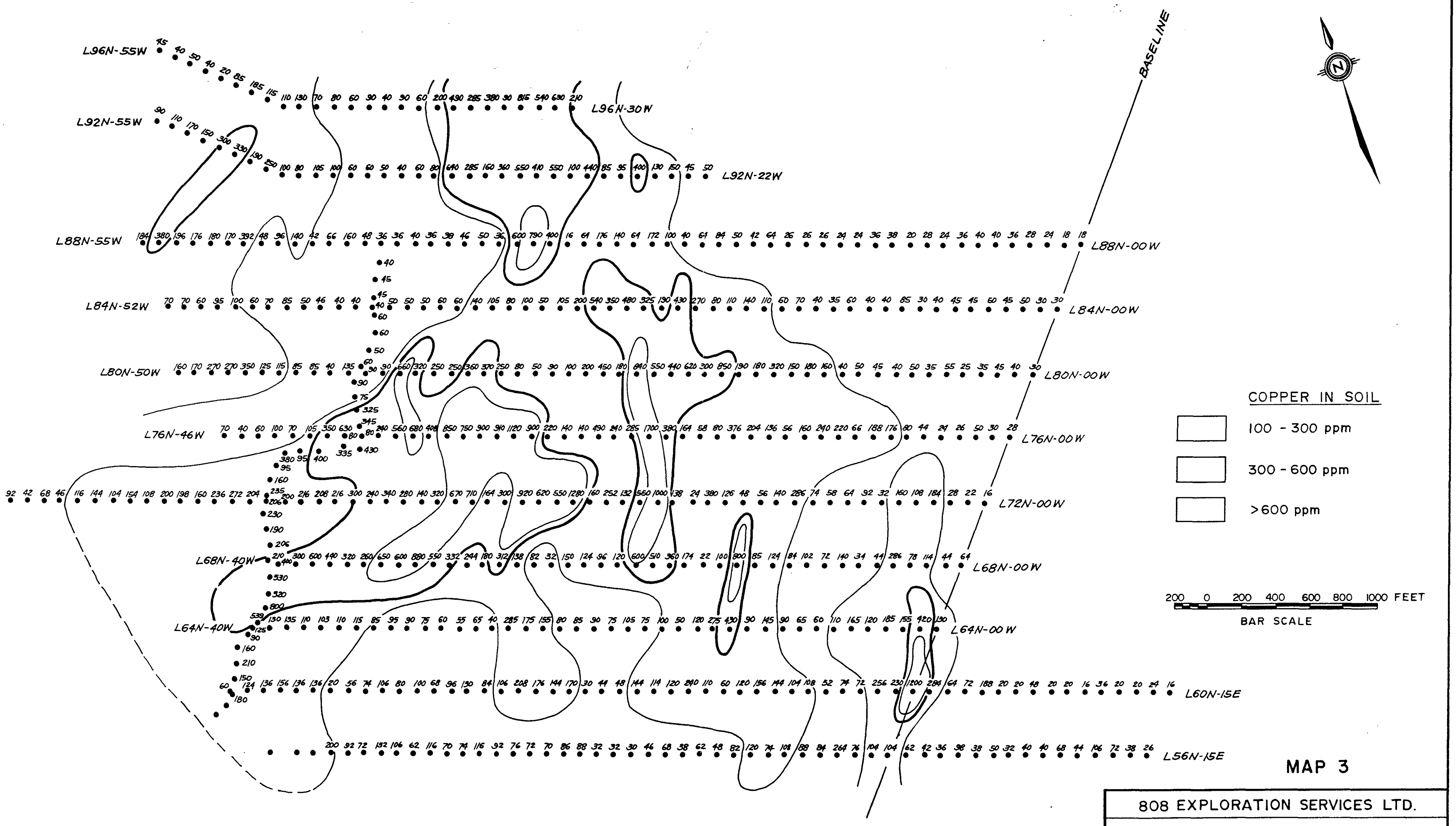


MAP 1

BURGOYNE GROUP MINERAL CLAIMS

GENERAL LOCATION MAP

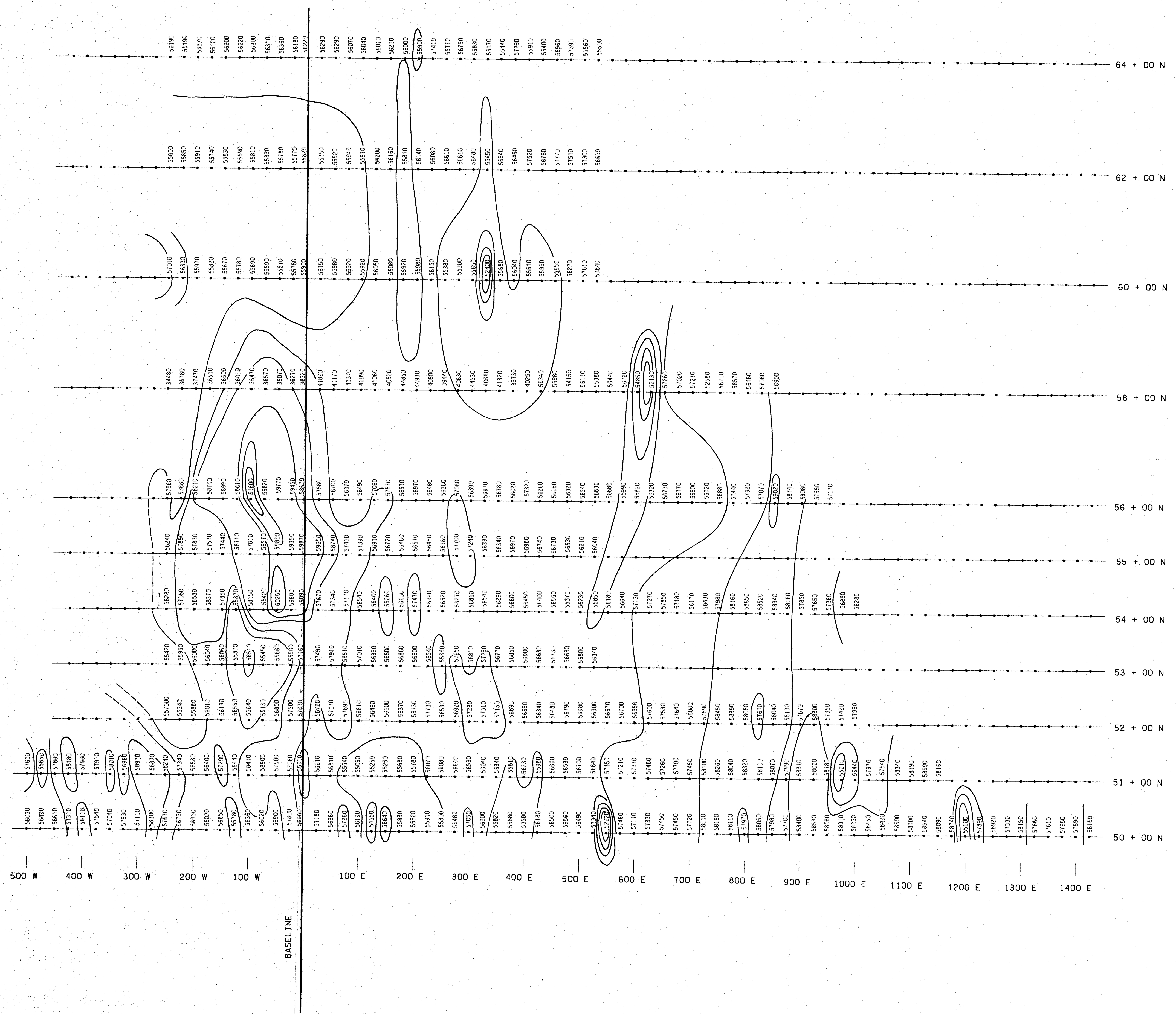

CANADIAN NATIONAL
CANADIAN PACIFIC
1
INDIAN RESERVE
THOMPSON'S RIVER
PITQUAH
TRANS CANADA HIGHWAY
3
6
5
4
3
2
REBECCA 1
8638
BASELINE
LCP
LCP
SHERYL
9416
NICOAMEN RIVER
GLADWIN CREEK
1
N
GRID LOCATION
GRID CO-ORDINATES
LINE - 50+00 N
STATION - 00 (BASELINE)
LCP REBECCA 1
NOTES
1. INTEGERS 2 TO 6 REFER TO REBECCA 2-6 MINERAL CLAIMS.
1000 0 1000 2000 3000 m
MAP 2
808 EXPLORATION SERVICES LTD
BURGOYNE PROSPECT
CLAIM LOCATION MAP
GEOLOGIST :
DRAWN : E.B.C
CHECKED : JMA
SCALE : 1 : 50,000
DATE : AUGUST 1990

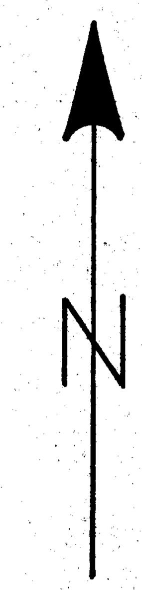


MAP 3

AFTER : ALFRED A. BURGOYNE M.Sc. OCTOBER 1969

808 EXPLORATION SERVICES LTD.		
BURGOYNE PROSPECT		
GEOCHEMISTRY COPPER IN SOIL (ppm)		
J.M. ASHTON	EBC	AUGUST 1990





NOTES:

1. VALUES PLOTTED TO NEAREST 1000 GAMMA'S ONLY.
2. CORRECTED FOR DIURNAL VARIATION.
3. DATA ON WEST HALF OF LINE 58 + OON REJECTED DUE TO PROBABLE INSTRUMENT MALFUCTION.

GEOLOGICAL BRANCH ASSESSMENT REPORT

20,252

100 75 50 25 0 100 200 300 400 meter

BAR SCALE

MAP 4

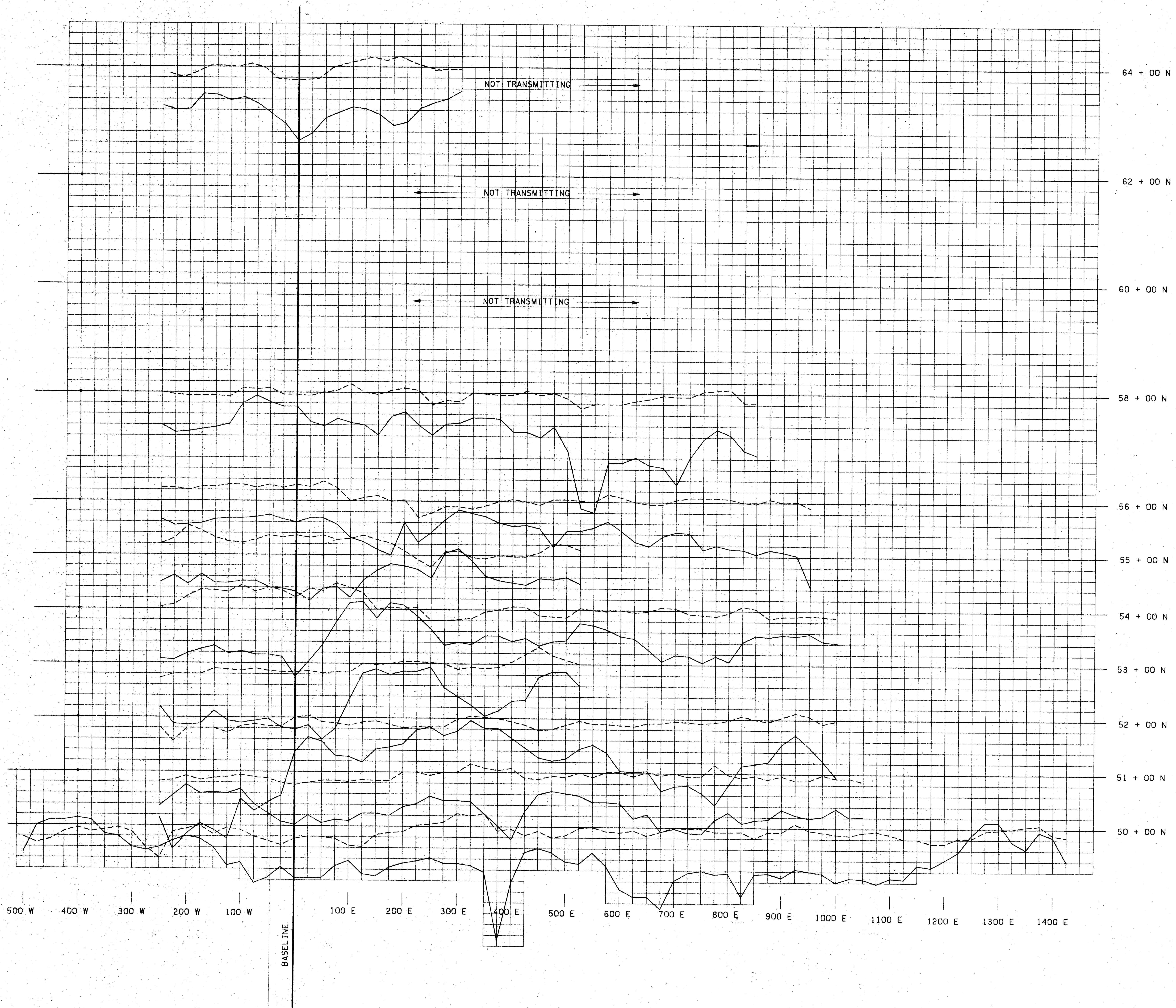
808 EXPLORATION SERVICES LTD.

BURGOYNE GROUP MINERAL CLAIMS

MAGNETOMETER SURVEY
TOTAL FIELD PLAN

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — J. M. ASHTON

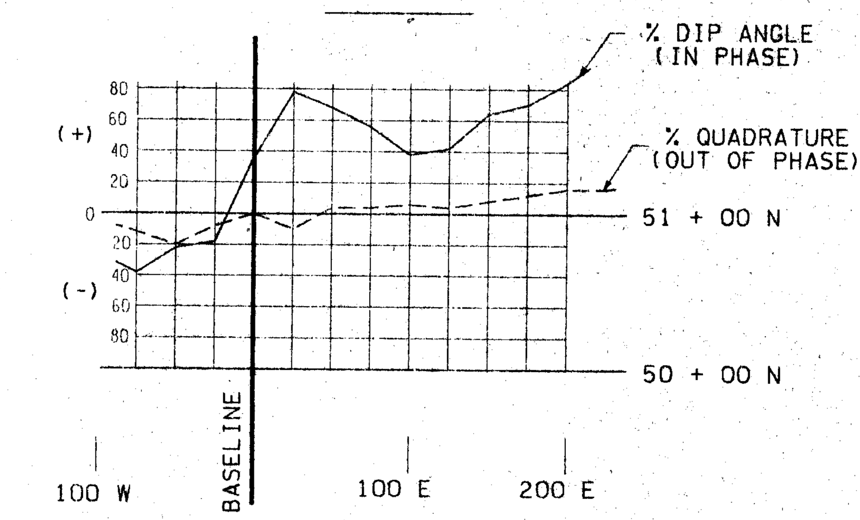
PLOTTED BY	JMA/BGR	SCALE	1 : 4000
DRAWN BY	EBC	DATE	AUGUST 15, 1990
CHECKED BY	BGR		

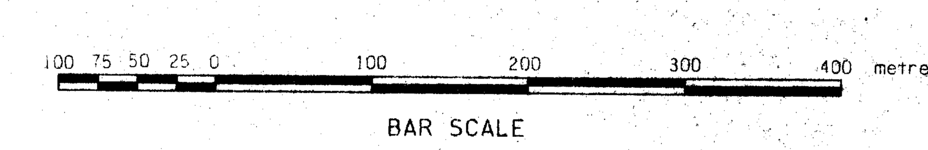


GEOLOGICAL BRANCH ASSESSMENT REPORT

20,252

LEGEND





MAP 5

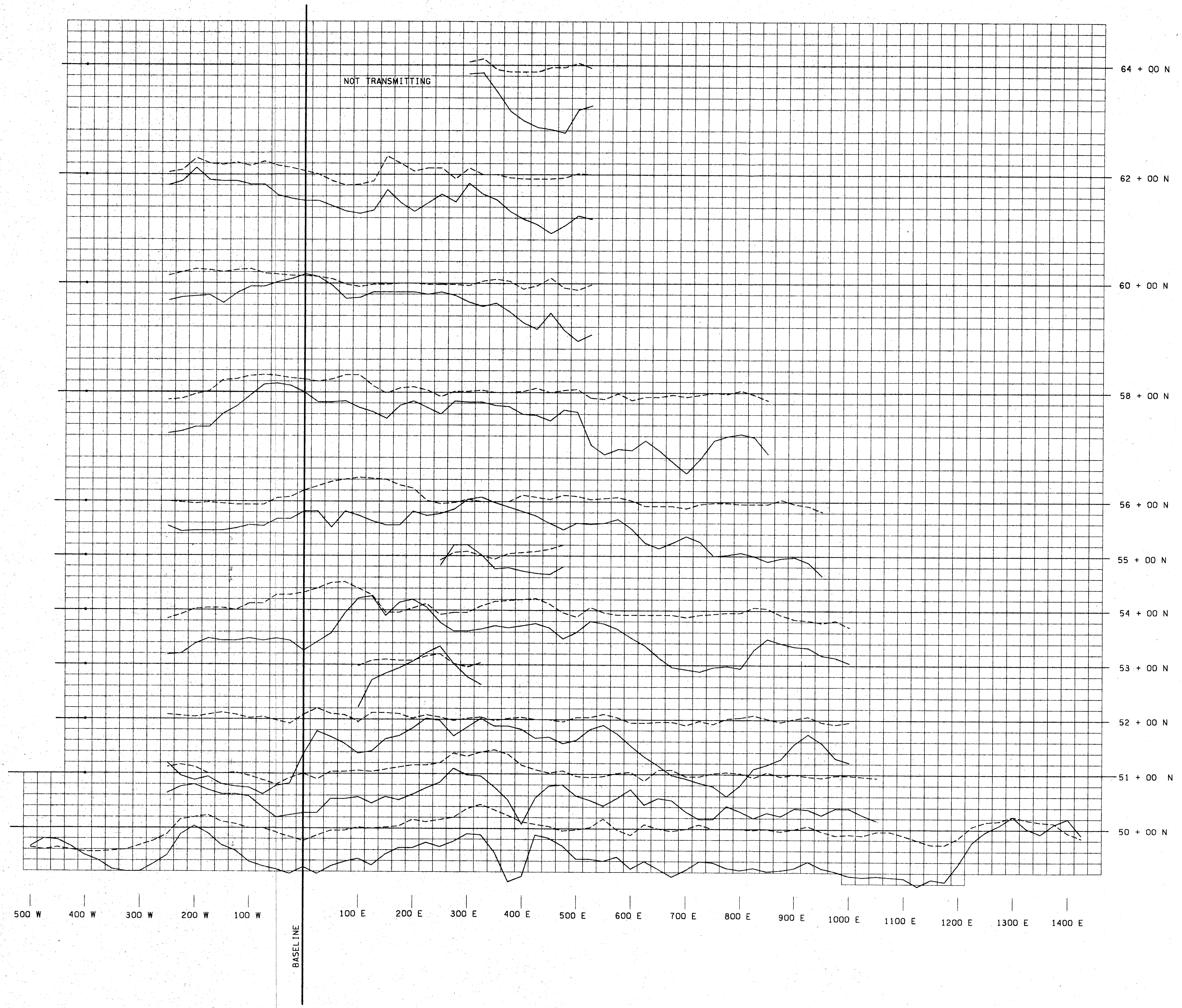
PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — ASHTON

808 EXPLORATION SERVICES LTD.

BURGOYNE GROUP MINERAL CLAIMS

STATION 1
VLF-EM
% DIP ANGLE / % QUADRATURE
LUALUALEI, HAWAII (STN NPM) ,23.4 kHz

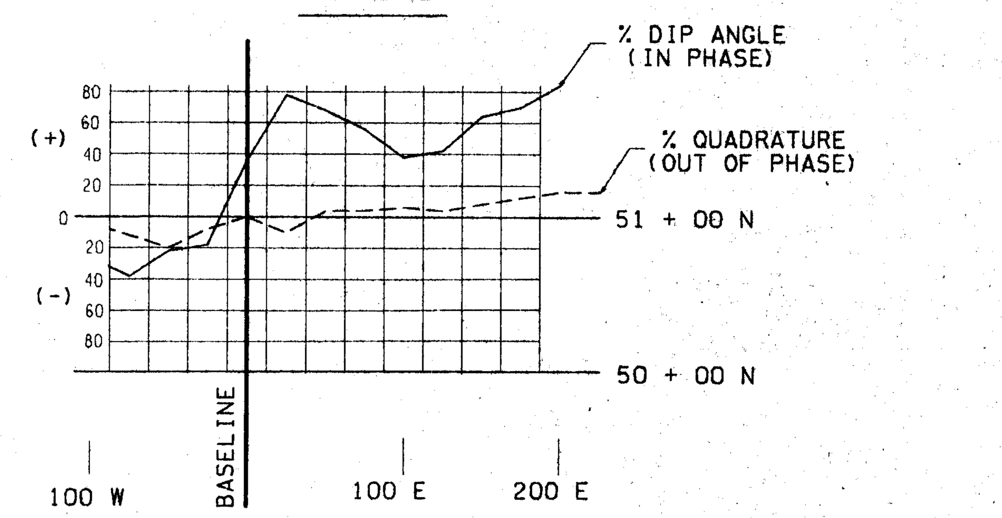
PLOTTED BY	JMA/BGR	SCALE	1 : 4000
DRAWN BY	EBC	DATE	AUGUST 15, 1990
CHECKED BY	BGR		



GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,252

LEGEND



100 75 50 25 0 100 200 300 400 meter

BAR SCALE

MAP 6

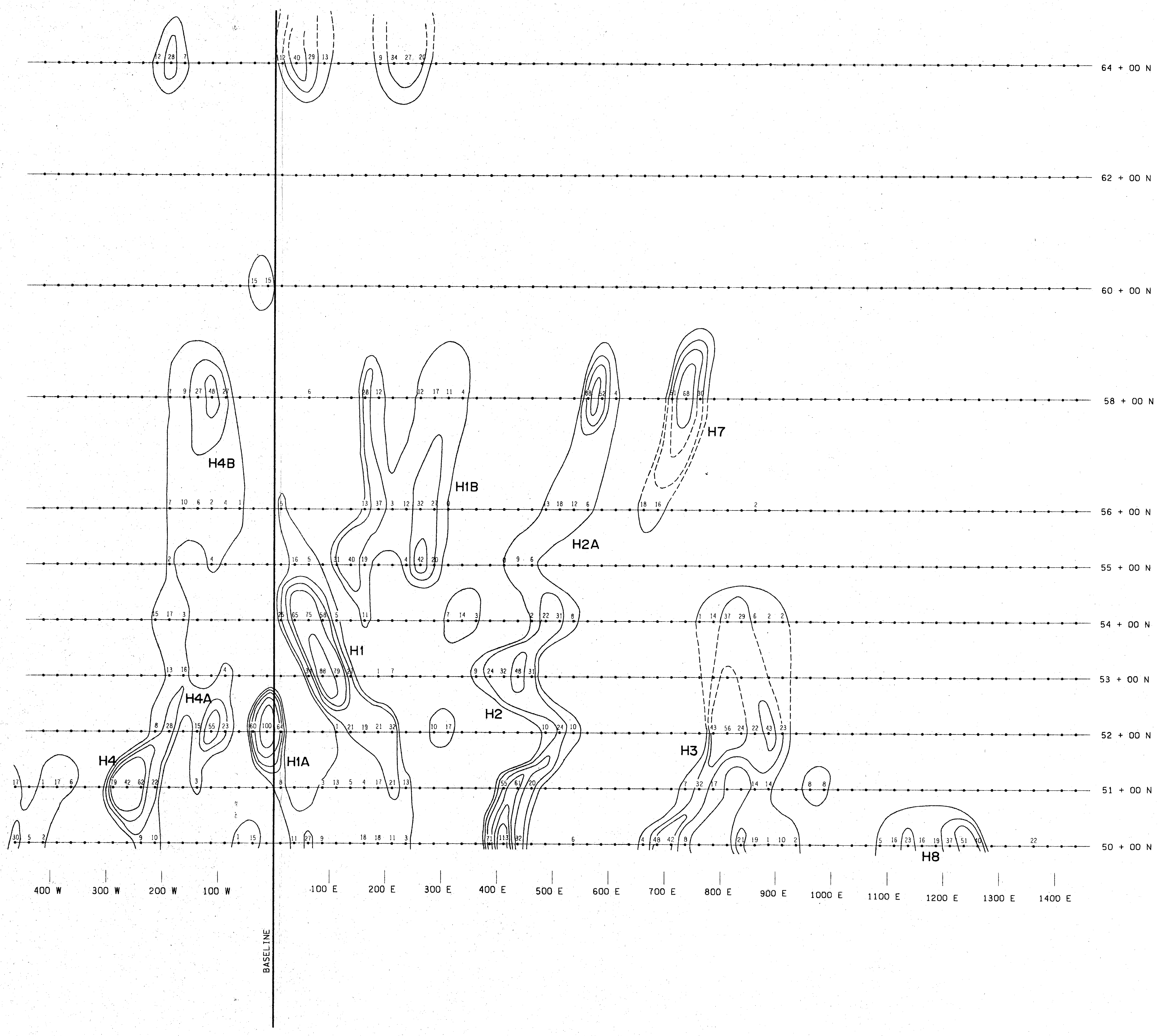
PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — J. M. ASHTON

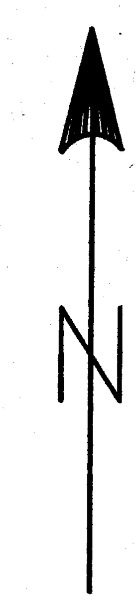
808 EXPLORATION SERVICES LTD.

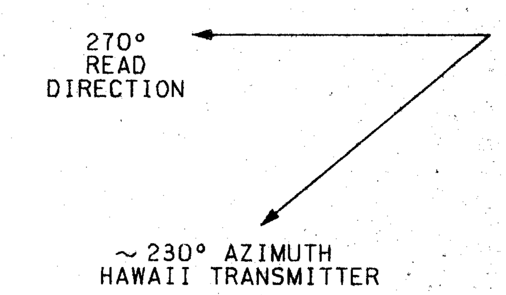
BURGOYNE GROUP MINERAL CLAIMS

VLF-EM
% DIP ANGLE / % QUADRATURE
STATION 2 (SEATTLE, WASHINGTON 24.8 kHz)

PLOTTED BY	JMA/BGR	SCALE	1 : 4000
DRAWN BY	EBC	DATE	AUGUST 15, 1990
CHECKED BY	BGR		







LEGEND:

88 • LOCATION & MAGNITUDE OF FILTERED DATA POINT.

H4A - ANOMALY IDENTIFICATION

NOTES:

1. COUNTOUR INTERVAL=20 INTERGER UNITS OF FRASER FILTERED DIP ANGLE VALUES.

GEOLOGICAL BRANCH ASSESSMENT REPORT

20,252

100 75 50 25 0 100 200 300 400 meter

BAR SCALE

MAP 7

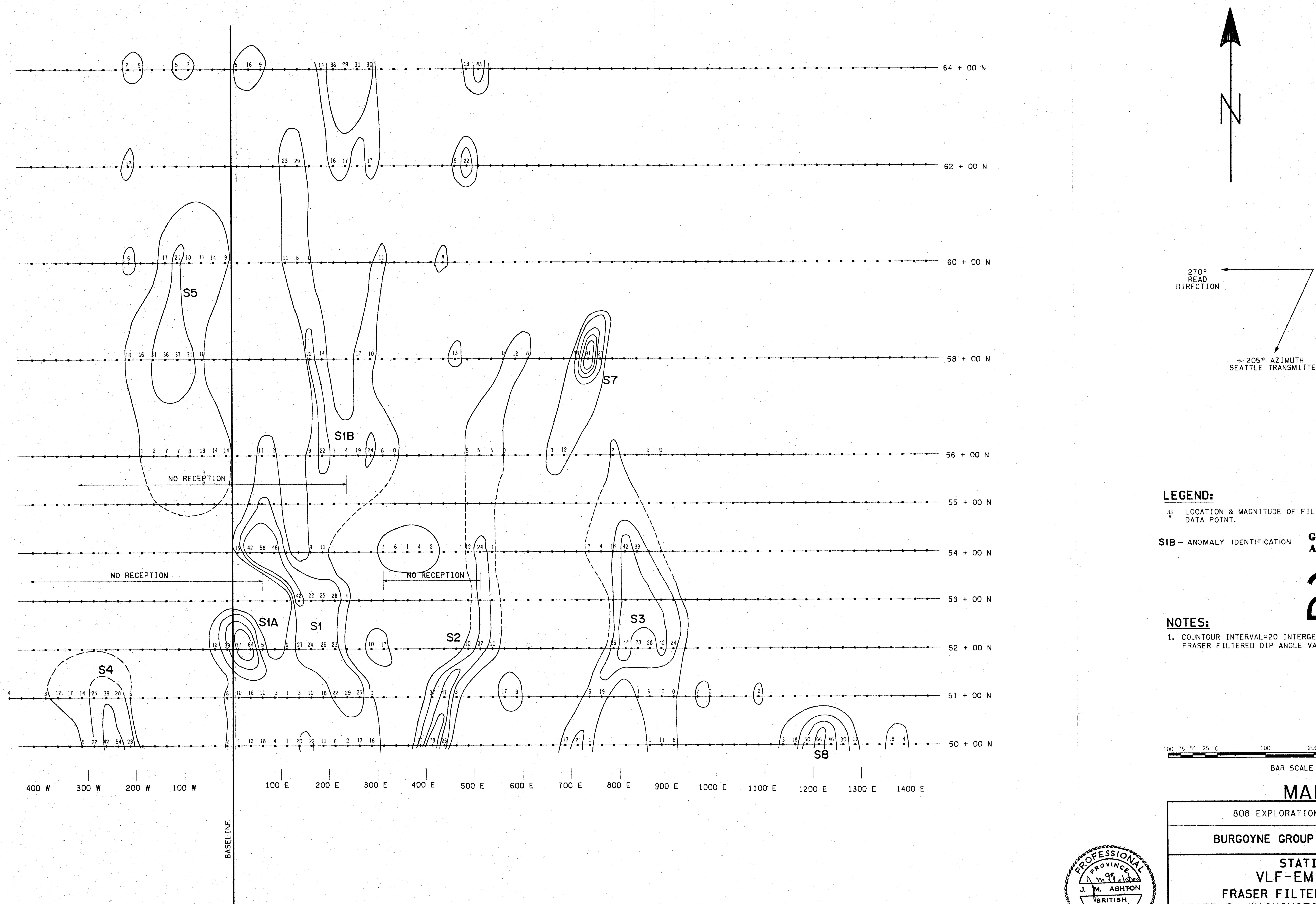
808 EXPLORATION SERVICES LTD.

BURGOYNE GROUP MINERAL CLAIMS

STATION 1
VLF-EM SURVEY
FRASER-FILTERED CONTOUR MAP
LUALUALEI, HAWAII (STN NPM), 23.4kHz

PLOTTED BY	JMA/BGR	SCALE	1 : 4000
DRAWN BY	EBC	DATE	AUGUST 25, 1990
CHECKED BY	BGR		

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — J. M. ASHTON



LEGEND:

88 • LOCATION & MAGNITUDE OF FILTERED DATA POINT.

S1B – ANOMALY IDENTIFICATION

GEOLOGICAL BRANCH ASSESSMENT REPORT

20,252

NOTES:

1. CONTOUR INTERVAL=20 INTERGER UNITS OF FRASER FILTERED DIP ANGLE VALUES.

100 75 50 25 0 100 200 300 400 meter

BAR SCALE

MAP 8

808 EXPLORATION SERVICES LTD.

BURGOYNE GROUP MINERAL CLAIMS

STATION 2
VLF-EM SURVEY
FRASER FILTERED CONTOUR MAP
SEATTLE, WASHINGTON (STN NLK) 24.8kHz

PLOTTED BY	JMA/BGR	SCALE	1 : 4000
DRAWN BY	EBC	DATE	AUGUST 25, 1990
CHECKED BY	BGR		

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. M. ASHTON