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REPORT ON A

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HIGH SENSITIVITY MAGNETIC & VLF-EM AIRBORNE SURVEY

SHARP LAKE PROJECT

HAILEYBURY ONTARIO

for

BETHLEHEM RESOURCES CORPORATION

by

TERRAQUEST LTD.
Toronto, Canada

June 25, 1993

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1.0 INTRODUCTION

This report describes the specifications and results of an airborne geophysical survey carried out for BETHLEHEM RESOURCES CORPORATION of 700-815 West Hastings Street, Vancouver, B.C. V6C 1B4 by Terraquest Ltd., 100-1373 Queen Victoria, Mississauga, Ontario L5H 3H2. The field work was carried out from May 12 to May 17, 1993 and the data processing, interpretation and reporting from May 18 to June 25, 1993.

The purpose of a survey of this type is two-fold. First to prospect directly for anomalously conductive and magnetic areas in the earth's crust which may be caused by, or at least related to, kimberlite pipes. A second is to use the magnetic and conductivity patterns derived from the survey results to assist in mapping geology, and to indicate the presence of faults, shear zones, folding, alteration zones and other structures which may control mineralization. To achieve this purpose the survey area was systematically traversed by an aircraft carrying geophysical instruments along parallel flight lines spaced at even intervals, 100 metres above the terrain surface, and aligned so as to intersect the regional geology and structure in a way to provide the optimum contour patterns of geophysical data.

2.0 SURVEY AREA

The survey area is located in the western part of Bucke Township, three kilometres west of the town of Haileybury, Ontario. The survey area is rectangular in shape, 8 kilometres north-south and 5.8 kilometres east-west. The Bucke township boundaries form the western and northern survey edges. Highway #11 passes through the centre of the survey area; numerous roads occur throughout the area.

The latitude and longitude are 47 degrees 27 minutes, and 79 degrees 43 minutes respectively, and the N.T.S. reference is 31M/5.

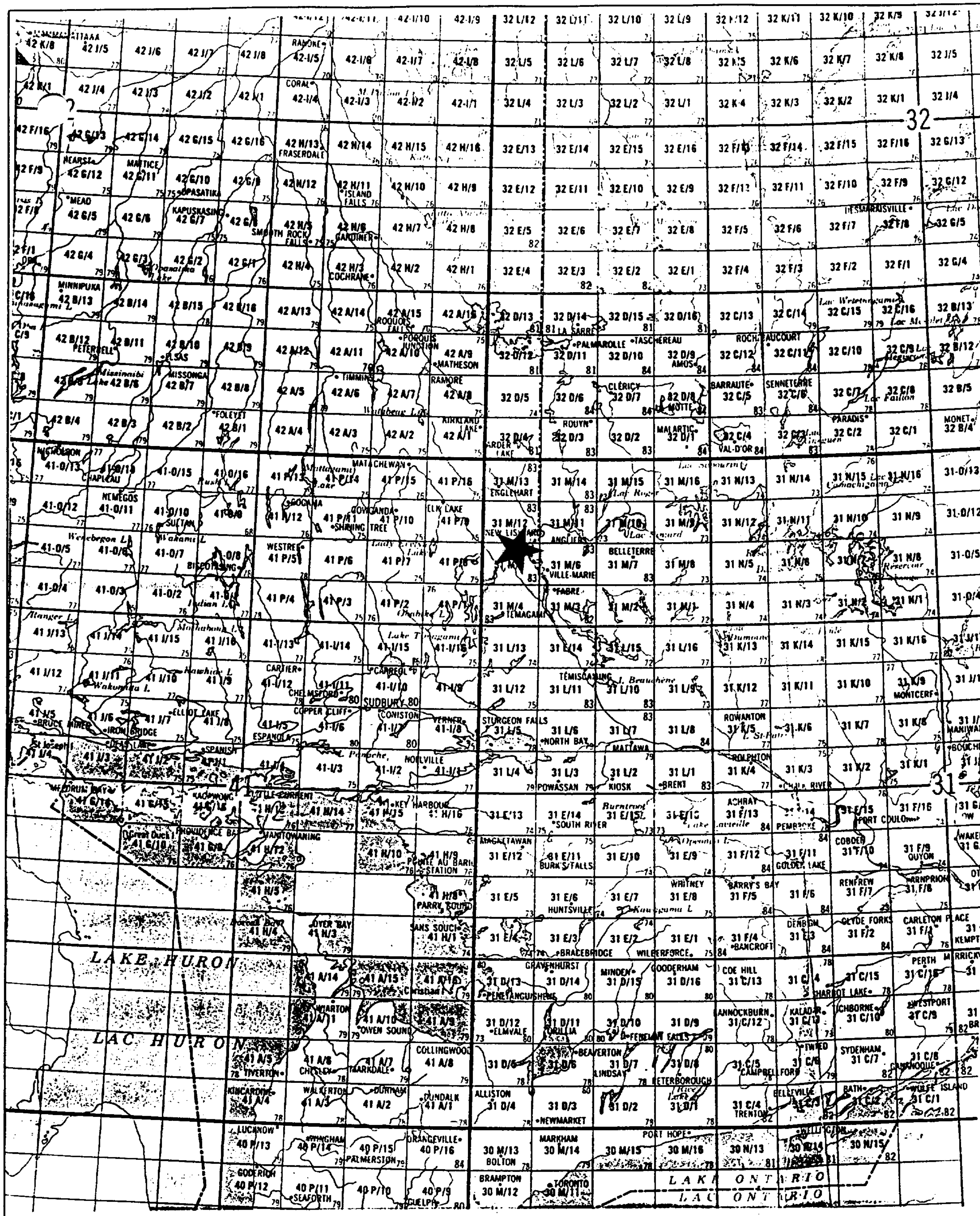

FIGURE 1. General Location

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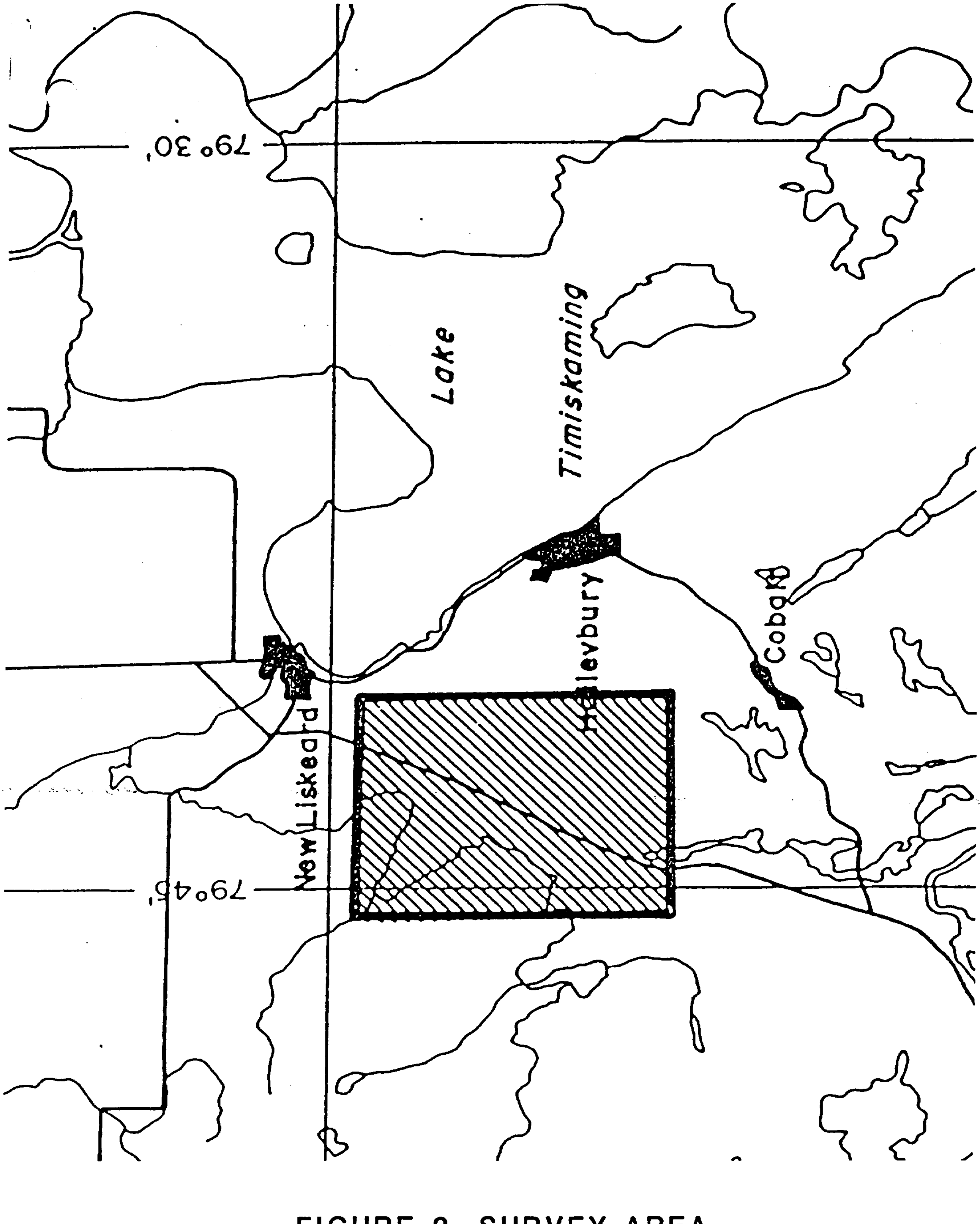


FIGURE 2. SURVEY AREA

3.0 GEOLOGY

Map References

1. Map 1956A: Township of Bucke, Ontario. scale 1:15,840, ODM 1956
2. Map 2474: Firstbrook and Parts of Surrounding Townships, Ontario. scale 1:31,680, OGS 1984
3. Map 2361: Sudbury-Cobalt, Geological Compilation Series. scale 1:253,440. OGS 1977
4. Map P.2296: Temagami-Englehart Area, Bouger Gravity and Generalized Geological Map. scale 1:100,000, OGS 1980
5. Map P.3101: Lake Timiskaming Paleozoic Outlier. scale 1:20,000, OGS 1987
6. Brummer J.J., MacFadyen, D.A., Pegg,C.C., 1992: Discovery of Kimberlites in the Kirkland Lake Area, Northern Ontario, Canada. Part II: Kimberlite Discoveries, Sampling, Diamond Content, Ages and Emplacement. Explora. Mining Geol., Vol.1 No.4, pp.351-370

The survey area is underlain predominantly by Precambrian clastic sediments which young to the west. The oldest are conglomerates, arkose and greywacke of Timiskaming age, followed by the Huronian suite, comprised of the Coleman Member, Firstbrook Member and Lorrain Formation in order of decreasing age. They vary in composition from conglomerate to greywacke to quartzite.

These sediments have been intruded by the Nipissing Diabase sill, also of Precambrian age. This sill occurs at several locations in the survey area with exposures of both the bottom and top edges of the sill. A few known diabase dykes trend to the northwest and north. Several lamprophyre dykes, which occur along the eastern half of the survey area within the Timiskaming sediments, trend to the northeast.

Ordovician limestone and associated clastic sediments occur along the east and northeast parts of the area.

It is presumed that older Precambrian metavolcanics and associated metasediments underlie the Huronian sediments. An inlier of Keewatin metavolcanics occurs to the south at Sasaginaga Lake.

The contacts between the Keewatin suite, Timiskaming clastics, Huronian clastics and Ordovician limestones are all unconformable.

Two major faults, the McKenzie and Cross Lake Faults strike to the northwest, possess significant topographic relief and are part of the Lake Timiskaming Structural Zone. Smaller faults are parallel and subparallel to these features. Other faults strike variably to the northeast and north.

At least two kimberlite diatremes have been identified within the survey area. BU1 was discovered by Monopros Ltd. in the early eighties, is located at UTM 596,700E and 5258,800N, and is Upper Jurassic in age (155 MA). A lobe or extension occurs on the western side. Diabase xenoliths found at depth within the diatreme indicate the presence of a deeper portion of the diabase sill. A second pipe occurs 800 metres to the southeast at UTM 597,500E and 5258,500N.

4.0 EQUIPMENT SPECIFICATIONS

4.1 AIRCRAFT

The survey was carried out using a Cessna 206 aircraft, registration C-GGLS, which carries a three high sensitivity magnetometers and a VLF electromagnetic detector. It is equipped with long range tanks, outboard tanks (total 11 hours range), balloon tires, cargo door and full avionics.

The aircraft has been extensively modified to support a tail stinger, two wing tip extensions and a VLF-EM assembly. Considerable effort has been made to remove all ferruginous materials near the sensors and to ensure that the aircraft electrical system does not create any noise. With these modifications this aircraft is probably the quietest magnetic platform in the industry with a figure of merit of 9 nT uncompensated and less than 2 nT compensated using G.S.C. standards.

The aircraft is owned and operated by Terraquest Ltd. under full M.O.T approval and certification for specialty flying including airborne geophysical surveys. The aircraft is maintained at base of operations by a regulatory AMO facility, Leggat Aviation Inc. and in the field by a Terraquest Ltd. AME in association with an approved AMO.

4.2 AIRBORNE GEOPHYSICAL EQUIPMENT

The airborne geophysical system has three high sensitivity, cesium vapour magnetometers and a VLF-EM system. Ancillary support equipment include tri-axial fluxgate magnetometer, video camera, video recorder, radar altimeter, barometric altimeter, GPS receiver and a navigation system which includes a left/right indicator and a screen showing survey area with real time flight path. All data is collected and stored by the data acquisition system.

Cesium Vapour Magnetometer in Tail Stinger:

Model	VIW 2321 H-8
Manufacturer	Scintrex
Serial Number	8801101
Resolution	0.001 nT counting @ 0.1 per second
Sensitivity	+/- 0.005 nT
Dynamic Range	20,000 to 100,000 nT
Fourth Difference	0.02 nT

Cesium Vapour Magnetometer in Wing Tips Extensions:

Model	CS-2
Manufacturer	Scintrex
Serial Numbers	921203, 921204
Resolution	0.001 nT counting @ 0.1 per second
Sensitivity	+/- 0.005 nT
Dynamic Range	15,000 to 100,000 nT
Fourth Difference	0.02 nT

VLF-EM System (mounted in tube forward of midsection of port wing):

Model	TOTEM 2A
Manufacturer	Herz Industries Ltd.
Serial Number	2805510
Primary Source	Magnetic field component radiated from VLF radio transmitters (1 or 2 simultaneously)
Parameters Measured	X, Y, Z components at two frequencies
Frequency Range	15.0 kHz to 24.3 kHz in 100 Hz steps
Sensitivity	130 uV to 100 uV at 20 kHz, 3dB down at 14kHz and 24 kHz
Output Span	+/- 100% = +/- 1.0 V
Internal Noise	1.3 uV rms
Output	Total Field, Quadrature; each frequency

The VLF-EM uses three orthogonal detector coils to measure (a) the total field strength of the time-varying EM field and (b) the phase between the vertical coil and both the "along line" coil (LINE) and the "cross-line" coil (ORTHO). The LINE frequency is tuned to a transmitter station that is ideally positioned at right angles to the flight lines, while the ORTHO frequency transmitter should be in line with the flight lines.

Tri-Axial Magnetic Field Sensor (for compensation, mounted in the forepart of tail stinger):

Model	MAG-03MC
Manufacturer	Bartington Instruments Ltd.
Internal Noise	at 1 Hz - 1 kHz; 0.6 nT rms
Bandwidth	0 to 1 kHz maximally flat, -12 dB/octave roll off beyond 1 kHz
Frequency Response	1 Hz - 100 Hz: +/- 0.5% 100 Hz - 500 Hz: +/- 1.5% 500 Hz - 1 kHz: +/- 5.0%
Calibration Accuracy:	+/- 0.5%
Orthogonality	+/- 0.5% worst case
Package Alignment	+/- 0.5% over full temperature range
Scaling Error	absolute: +/- 0.5% between axes: +/- 0.5%

Video Camera (camera mounted in belly of aircraft)

Model	TC2055NC (colour)
Manufacturer	RCA
Serial Number	19492
Lens	4.87 mm, auto iris - white balance

Video Recorder (mounted in rack)

Model	AG 2400 (commercial grade)
Manufacturer	Panasonic
Serial Number	C8TA00281 (plus 2 backups)

Radar Altimeter

Model	KA-131
Manufacturer	King
Serial Number	071-1114-00
Accuracy	5% up to 2,500 feet
Calibrate Accuracy	1%
Output	Analogue for pilot; Converted to digital for data acquisition

Barometric Altimeter

Model	LX18001AN
Manufacturer	Sensym
Source	Coupled to aircraft barometric system

Differential GPS Receiver (antenna mounted on top of tail)

Model	MX 4200D
Manufacturer	Magnavox
Serial Number	5057
Type	Continuous tracking, L1 frequency, C/A code (SPS), 6-channel (independent)
Receiver Sensitivity	-143 dBm Costas threshold
Position Update	once per second
Accuracy	position (SA implemented) 100 metres position (no SA) 30 metres velocity 0.1 knot time recovery 1pps, 100 nsec pulse width
Data Recording	all GPS data and positional data logged by PDAS1000 data acquisition system.

Navigation Interface (mounted in rack with pilot and operator readouts):

Model	PNAV 2001
Manufacturer	Picodas Group Inc.
Data Input	Real time processing of GPS output data
Pilot Readout	Left/Right indicator
Operator Readout	Screen Modes: map, survey and line
Data Recording	All data recorded in real time by PDAS 1000

Data Acquisition System (mounted in rack)

Model	PDAS 1000
Manufacturer	Picodas Group Inc.
Operating System	MS-DOS
Microprocessor	80386sx - 16 CPU
Coprocessor	Intel 80386sx
Memory	On board up to 8 MB, page interleaving, shadow RAM for BIOS, support EMS 4.0
Clock	real time, hardware implementation of MC14618 in the integrated peripherals controller
I/O slots	5 AT and 3 PC compatible slots
Display	Electro-luminescent 640x400 pixels
Graphic Display	Scrolling analog chart simulation with up to 5 windows operator selectable; freeze display capability to hold image for inspection
Recording Media	Standard 80 Mbyte hard disk with extra shock mounts; Standard 1.44 Mbyte floppy disk; Standard tape backup
Sampling	Selectable for each input type; 1, 0.5, 0.25, 0.2 or 0.1 seconds
Inputs	12 differential analog input with 16 bit resolution
Serial Ports	2 RS-232C (expandable)
Parallel Ports	Ten definable 8 bit I/O; Two definable 8 bit outputs

The PDAS 1000 also contains the magnetometer processor boards, one for each cesium vapour magnetometer:

Model	PCB
Manufacturer	Picodas Group Inc.
Input Range	20,000 - 100,000 nT
Resolution	0.001 nT
Bandwidth	0.7, 1 or 2 Hz
Microprocessor	TMS 9995
Firmware	8 KBit EPROM board resident
Internal Crystal	18,432 KHz
Absolute Crystal Accuracy	<0.01%
Host Interfacing	8 KByte dual port memory
Address Selection	Within 20 bit addressing in 8 KByte software selectable steps
Input Signal	TTL, CMOS, Open collector compatible or sine wave with decoupler
Input Impedance	TTL>1KOhm

Magnetic compensation for aircraft and heading effects is done in real time. Raw magnetic values are also stored and thus if desired, compensation with different variables can be run at a later time.

Other Boards

Analog Processor	PCB - provides separate A/D converter for each analog input with no multiplexing; each channel is sampled at a rate of 1,000 samples per second with digital processing applied
Navigation	ARINC Navigation Interface PCB enables communication with the Loran C and GPS navigation units

Power Supplies

1) PC6B converter to convert the 13.75 volt aircraft power to 27.5 volts DC.
2) Power Distribution Unit manufactured by Picodas Group Inc. located in the instrument rack interfaces with the aircraft power and provides filtered and continuous power at 13.75 and 27.5 vDC to all rack components.
3) The PDAS-1000A contains a 32 volt DC cesium sensor switching power supply used in conjunction with real time magnetometer compensation option; also enables interfacing the fluxgate magnetometer and the barometric altimeter; also provides clean power for radar altimeter and ancillary equipment (PC notebook, printer).

4.3 MAGNETIC BASE STATION

High sensitivity base station data is provided by an Overhauser magnetometer, data logging onto a PC 386sx notebook and time synchronization with ground GPS receiver.

Magnetic Sensor:

Model	GSM-11
Manufacturer	Gem Systems Inc.
Type	Overhauser proton precession
Sensitivity	0.01 nT at 10 readings per second
Accuracy	0.5 nT absolute

Magnetic Processor:

Model	MEP-810
Manufacturer	Urtec Inc.
Range (signal)	20,000 - 100,000 nT
Resolution (signal)	10 pT
Resolution (fdd)	1 pT
Clock Stability	2 ppm per year
Absolute accuracy correction	+/- 999x10e-6

Logging Software:

Logging software by Picodas Group Inc. version 5.02 to IBM compatible PC with RS-232 input; supports real time graphics, automatic startup, compressed data storage, selectable start/stop times, automatic disk swapping, plotting of data to screen or printer at user selected scales, and fourth digital difference and diurnal quality flags set by user.

A second, medium sense base station was available as backup with the following specifications:

Magnetometer

Model	GSM-9
Manufacturer	Gem Systems Inc.
Type	Overhauser proton precession
Range	20,000 - 100,000 nT in 23 overlapping steps
Resolution	1 nT
Accuracy	+/- 1 nT
Gradient Tolerance	up to 5,000 nT/metre
Operating Modes	manual pushbutton, cycling at 1.85 seconds, logging software controlled

Logging

Base station logging software version 5.02 by Picodas group Inc. onto NEC Multispeed laptop computer.

4.4 GPS BASE STATION

The ground GPS base station equipment was identical to the GPS receiver and antenna used in the aircraft (see above for specifications). The data was logged onto a 486dx notebook computer. Ground GPS data was collected to perform post flight differential correction to the flight path.

4.5 IN-FIELD COMPUTING FACILITIES

The following equipment were supplied for infield preliminary processing:

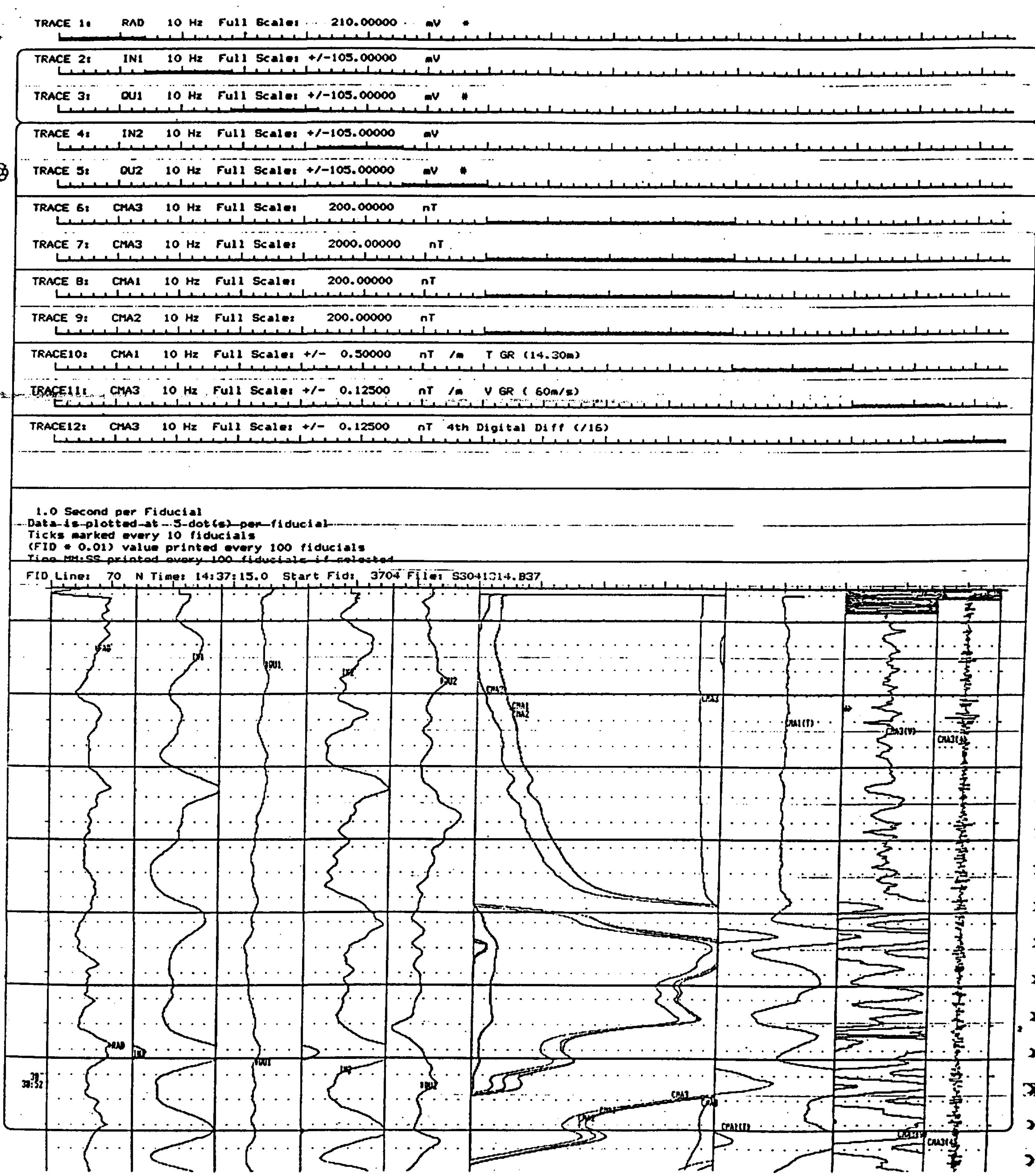
Computer

486/50 DX 8 MB; 1.44 FDD, 1.2 FDD, ATI VGA Wonder, 320 MB Fujitsu HD, Phantom 250 tape drive, colour Magnavox 17" VGA monitor, internal fax/modem, mouse

Printer

Fujitsu DL3600 colour

FIGURE 3. Sample of Analog Data



5.0 SURVEY SPECIFICATIONS

5.1 LINES AND DATA

Survey area coverage	321 kilometres
Line direction	090 degrees azimuth
Line interval	150 metres
Tie line interval	7 kilometres
Terrain clearance	100 metres
Average ground speed	60 metres/second
Data point interval:	
Magnetic	6 metres
VLF-EM	6 metres
Channel 1 (LINE)	NSS Annapolis, 21.4 kHz
Channel 2 (ORTHO)	NAA Cutler, 24.0 kHz

5.2 TOLERANCES

Line spacing:	Any gaps wider than twice the line spacing and longer than 10 times the line spacing were filled in by a new line.
Terrain clearance:	Portions of line which were flown above 125 metres for more than one kilometre were reflown if safety considerations were acceptable.
Diurnal magnetic:	Less than ten gammas deviation from a smooth background over a period of two minutes or less as seen on the base station analogue record.
Manoeuvre noise:	nil

5.3 NAVIGATION AND RECOVERY

The satellite navigation system was used to ferry to the survey site and to survey along each line using UTM coordinates. The accuracy is variable depending on the number and condition of the satellites, however it is generally less than twenty five metres and typically in the ten to fifteen metre range. Post flight differential correction improves the accuracy of the flight path recovery to a range of plus or minus three metres.

A video camera recorded the ground image along the flight path. A video recorder and screen in the cockpit enables the operator to monitor the accuracy of the flight path during the survey. This system also provides a backup system for flight path recovery.

6.0 DATA PROCESSING

The magnetic data from the tail stinger location was first corrected by base station subtraction then levelled in the standard manner by tying survey lines to the tie lines. The IGRF has not been removed. The total field was contoured by computer using a program provided by Geonex/Aerodat. To do this the final levelled data set was gridded at a grid cell spacing of 1/10th of an inch at map scale.

The vertical magnetic gradient was computed from the gridded and contoured total field data using a method of transforming the data set into the frequency domain, applying a transfer function to calculate the gradient, and then transforming back into the spatial domain. The method is described by a number of authors including Grant, 1972 and Spector, 1968.

The VLF-EM data from channel 1 were treated automatically so as to normalize the non conductive background areas to 100 (total field strength) and zero (quadrature).

All data processing, map contouring and plotting were carried out by Geonex/Aerodat of Mississauga.

The data from the wing tip magnetometers and the second VLF-EM channel have not been processed. This raw data is owned by the client and may be viewed in profile on the field generated analogs. They can be processed into map format upon request.

Grant, F.S. and Spector A., 1970: Statistical Models for Interpreting Aeromagnetic Data; Geophysics, Vol 35

Grant, F.S., 1972: Review of Data Processing and Interpretation Methods in Gravity and Magnetics; Geophysics Vol 37-4

Spector, A., 1968: Spectral Analysis of Aeromagnetic maps; unpublished thesis; University of Toronto.

7.0 INTERPRETATION

7.1 GENERAL APPROACH

To satisfy the purpose of the survey as stated in the introduction, the interpretation procedure was carried out on both the magnetic and VLF-EM data. On a local scale "geological" units were interpreted from the magnetic gradient contour patterns based on their characteristic patterns and intensities, or "signatures". The contacts are typically located along the steepest section of the gradient; therefore the vertical magnetic gradient format was used primarily to delineate stratigraphy. The total magnetic field format was used to determine the relative magnetic intensity of the interpreted unit. Where possible these units were related to existing geology (known outcrops) to provide a geological identity to the units.

Magnetic anomalies that are caused by iron deposits of ore quality are usually obvious owing to their high amplitude, often in tens of thousands of gammas. Mafic to felsic metavolcanics are usually characterized by respectively strong to weak magnetic intensities. Clastic metasediments generally possess very low magnetic susceptibilities and therefore correlate with very low magnetic responses, and in some cases, the observed responses are overwhelmed by the magnetic field from the surrounding lithologies.

Alteration zones can show up as anomalously quiet areas, often adjacent to strong, circular anomalies that represent intrusives, or along an otherwise magnetically active horizon. In some cases contact metamorphic aureoles are characterized by magnetic anomalies.

On a regional scale the total magnetic field contour patterns were used in the same way to delineate bodies of larger dimensions.

Faults and shear zones were interpreted primarily from lateral displacements of otherwise linear magnetic anomalies but also from long narrow "lows". The direction of regional faulting and the topographic lineaments in the general area were taken into account when selecting the dominant fault orientations. Folding is usually seen as curved regional patterns.

VLF-EM anomalies were evaluated according to a) the relative intensities of the total field strength, b) correlation of the total field strength with magnetic, geologic and topographic features, and c) the intensity and nature of the quadrature or phase response.

Areas showing a smooth VLF-EM response somewhat above background (ie. 110 or so) are likely caused by overburden which is thick enough and conductive enough to saturate at these frequencies. In this case no response from bedrock is seen.

FIGURE 4

TERRAQUEST CLASSIFICATION OF VLF-EM CONDUCTOR AXES

SYMBOL	CORRELATION	ASSOCIATION: Possible Origins
a , A	Coincident with magnetic stratigraphy	Bedrock magnetic horizons: stratabound mineralogic origin or shear zone
b , B	Parallel to magnetic stratigraphy	Bedrock non-magnetic horizons: stratabound mineralogic origin or shear zone
c , C	No correlation with magnetic stratigraphy	Association not known: possible small scale stratabound mineralogic origin, fault or shear zone, overburden
d , D	Coincident with magnetic dyke	Dyke or possible fault: mineralogic or electrolytic
f , F	Coincident with topographic lineament or parallel to fault system	Fault zone: mineralogic or electrolytic
ob , OB	Contours of total field response conform to topographic depression	Most likely overburden: clayey sediments, swampy mud
cul , CUL	Coincident with cultural sources	Electrical, pipe or railway lines

NOTES

1 - Upper case symbols denote a relatively strong total field strength

2 - Underlined symbols denote a relatively strong quadrature response

3 - Mineralogic origins include sulphides, graphite, and in fault zones, gouge

4 - Electrolytic origins imply conductivity related to porosity or high moisture content

e VLF-EM conductor axes have been identified and evaluated according to the Terraquest classification system (Figure 4). This system correlates the nature and orientation of the conductor axes with stratigraphic, structural and topographic features to obtain an association from which one or more possible origins may be selected. Alternate associations are indicated in parentheses.

The phase response has been categorized according to whether the slope/direction is normal, reverse, or no phase at all. The significance of the differing phase responses is not completely understood although in general reverse phase indicates either overburden as the source or a conductor with considerable depth extent, or both. Normal phase response is theoretically caused by surface conductors with limited depth extent. In some cases, a change in the orientation of the conductor appears to affect the sense of the phase response.

7.2 INTERPRETATION

The magnetic and VLF-EM data are shown in contoured format on maps at a scale of 1:15,000 in the back pocket. An interpretation map is also provided. The following notes are intended to supplement these maps.

The total magnetic field has a relief of approximately 1,200 nannoteslas from 57,640 nT to over 58,800 nT. The strongest responses occur to the southwest and just west of Constance Lake. Most of the responses fall within a range of 600 nT. The vertical magnetic gradient shows improved resolution and has been used to delineate the stratigraphy and structure.

Generally there is a very poor correlation between the magnetic responses and the geology mapped at the surface. This is due to the fact that most of the near surface rocks are clastic or chemical sediments which are traditionally very low in magnetic minerals. For the most part there is no correlation with the lamprophyre dykes; either they are not magnetic or they do not provide sufficient magnetic mass to evoke a discernible response at this scale. There is some correlation in the southeast corner of the area where they are more extensive, but the lamprophyres are probably not the sole source.

For the purposes of this interpretation, it is assumed that most of the magnetic responses are derived from underlying rocks, presumably from the metavolcanic suite. The sediments are relatively transparent to the magnetic field and therefore should not mask the responses significantly.

The objective of this simplification is not to map the geology but rather to identify magnetic responses that do not fit readily with a known stratigraphic trend, shape or intensity, and hence should be considered as potential for kimberlite.

It is recognized that the Nipissing Diabase Sill is not taken into account by this simplification. In the southwest quadrant the sill coincides with strong magnetic sponses. The sill appears to possess a complex magnetic character as it is not consistent in areas where it is exposed nor in areas where it is presumed to underlie clastics. Hence only the magnetic phases would be amenable to mapping. Also the presence of diabase xenoliths deep within the kimberlite pipe (BU1) indicates that the sill is not uniform and may occur at different levels. Furthermore, the fact that the strong magnetic responses in the southwest quadrant continue right up to the edge of the bottom of the sill where it is presumably quite thin, suggests that either the sill may be locally near vertical in attitude or that the magnetic responses are derived from rock units beneath the sill.

Therefore, for this interpretation, most of the magnetic responses are attributed to the underlying metavolcanic suite. The magnetic pattern is delineated as either relatively nonmagnetic (Unit 1) or magnetic (Unit 2). Unit 1 most likely includes the felsic metavolcanics and associated sediments whereas Unit 2 most likely represents mafic metavolcanics, intrusives and any possible lean iron formation. It must be borne in mind that the total intensity of these units will be augmented by the magnetic contribution from the sill, as variable as it may be.

An abundance of faults and/or shear zones have been interpreted from the magnetic data, particularly the vertical magnetic gradient. Most of these trend to the northwest and are probably related to the same events that caused the Cross Lake and McKenzie Faults. Other important structural directions are northeast, north-northeast, north, and west-northwest. It is cautioned that the identification of structures by magnetic techniques is biased in favour of those elements that cross the dominant magnetic fabric.

The Cross Lake and McKenzie Faults appear to be a broad zone of numerous subparallel structures across most of the survey area except in the northwest quadrant where they are more confined. The magnetic character of the lithologies proximal to the structures in the northwest appear to be diminished as they approach the structural zones. It is suggested that at this location, the major northwest trending structures may be tensional in nature providing a conduit for fluids which have altered the surrounding bedrock.

The VLF-EM survey has identified a surprisingly large number of strong conductor axes, partly due to the fact that the dominant structural fabric couples well with the Annapolis VLF-EM transmitter. Also, in the absence of conductive overburden, the VLF-EM signal is capable of considerable depth penetration through poorly conductive rocks such as clastic sediments.

Those conductor axes that are aligned with magnetically interpreted structures or crosscut stratigraphy are interpreted to be related to faults or shear zones. This type of conductivity may be caused by minerals such as sulphides, graphite or gouge along the structure, or to an ionic effect created by water or porosity either within the structure or along the upper weathered and leached edge. The VLF-EM responses have been used to augment the magnetic structural interpretation.

A few conductor axes coincide with or are parallel to magnetic stratigraphy and therefore possess increased potential for bedrock sources. These may include conductive minerals such as disseminated to massive sulphides or graphite, or conductive rock such as porous flow tops. It is suspected that these conductors may originate from the underlying Keewatin metavolcanic suite.

The known kimberlite diatremes serve as examples of anomalies, in this particular geologic and magnetic environment, with positive magnetic expressions. Note that the western extension of the BU1 diatreme coincides with an area mapped as exposed diabase; for this reason, the coincidence with mapped exposures of other rock types is not necessarily sufficient to write-off a target.

From these models seventeen targets have been interpreted. Three of these are negative anomalies. The targets are listed below with comments, not in any order of priority:

- T1 - similar to BU1, bounded by two structures
- T2 - augmented magnetic expression within sill
- T3 - same as T2, may be related to increased thickness of sill
- T4 - anomaly coincides with topographic depression and edge of major structure
- T5 - distinctive negative anomaly, bounded by NW and NE structures
- T6 - small distinctive anomaly; single line, - possibly cultural
- T7 - moderate total field anomaly without stratigraphic implication
- T8 - moderate vertical magnetic gradient anomaly with distinctive surrounding low, along major structural zone
- T9 - strong total field anomaly at and beyond bottom of sill, topographic depression, along major structure
- T10 - small negative anomaly, along major structure, break in VLF-EM conductivity
- T11 - small positive anomaly, single line, coincident topographic depression
- T12 - strong total field anomaly, along major structure
- T13 - moderate strength broad total field anomaly, NW and NE structures
- T14 - broad negative vertical magnetic gradient anomaly which interrupts magnetic trends, edge of Cross Lake Fault
- T15 - small total field anomaly, several lines but possibly cultural
- T16 - subtle anomaly, juncture of two structures
- T17 - strong total field anomaly, topographic depression, NE structures

If T2, T3 or T4 show any further encouragement, then all the remaining anomalies in that area should be considered as potential targets.

[illegible].0 SUMMARY

An airborne combined, high sensitivity magnetic and VLF-EM survey has been carried out at 150 metre line intervals with data reading stations at 6 metres along the flight lines. The data is produced on maps at a scale of 1:15,000.

The magnetic data has been used to outline the structure and trends of the geological units that occur at depth beneath chemical and clastic sedimentary. It has been assumed that the mapped sedimentary rocks are essentially devoid of magnetic minerals and that all magnetic responses are derived from underlying rock types. The Nipissing diabase has variable magnetic responses, but for the sake of consistency and due to the complicated nature of the sill, these responses have been grouped together with the underlying responses. The objective was not to map the surface rocks but rather to interpret the detailed, total magnetic stratigraphy and associated structures. Any magnetic features that did not fit these trends become potential targets for kimberlite diatremes.

Numerous faults and/or shear zones have been interpreted. The dominant tend is to the northwest; other trends include northeast, north-northeast, north and west-northwest. The style of deformation and displacement appears to change along the Cross Lake and McKenzie Lake Faults.

Many VLF-EM conductor axes were found most of which are associated with structural sources. The high number and strength of conductors is probably related to the lack of conductive overburden and the nonconductive nature of the clastic rocks, which together permit deep penetration of the VLF-EM signal. A few conductors coincide with magnetic stratigraphy and thus may be derived from the underlying metavolcanic suite.

The known kimberlite diatremes can be readily identified from their magnetic signatures. Seventeen new targets have been recommended for follow-up investigation, three of which are negative anomalies. These targets have been described briefly according to their magnetic response and their structural and topographic environments.

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GEOLOGICAL ASSOCIATION OF CANADA
CHARLES Q. BARRIE
FELLOW

APPENDIX I

PERSONNEL

Field:	Operator	Marc Caron
	Pilot	Ken Towers
	Completion Date	May 17, 1993
Office:	Manager/Interpretation	Charles Q. Barrie
	Processing	Geonex/Aerodat

APPENDIX II

CERTIFICATE OF QUALIFICATION

I, Charles Q. Barrie, certify that :

1. I am registered as a Fellow with the Geological Association of Canada and work as a Professional Geologist.

2. I hold an honours B.Sc. degree in Geology from McMaster University, obtained in 1977.

3. I hold an M.Sc. degree in Geology from Dalhousie University, obtained in 1980.

4. I am a member of the Prospectors and Developers Association of Canada.

5. I am a member of the Canadian Institute of Mining, Metallurgy and Petroleum.

6. I have worked seasonally as a geological student in the mining industry for five years, and continuously as a geologist for thirteen years.

7. I am employed by and am an owner of Terraquest Ltd., specializing in high sensitivity airborne geophysical surveys.

8. The accompanying report has been prepared from airborne data collected by Terraquest Ltd. exclusively for BETHLEHEM RESOURCES CORPORATION. Reference material included geological maps published by the provincial government and journal publications. I have not visited the property.

Toronto, Ontario
June 25, 1993

Signed

Qual.# 2.8305

Charles Q. Barrie, M.Sc.
Vice President, TERRAQUEST LTD.

and Mines
Ontario

After Recording Claim
Mining Act

W9400.00960
2.15579

Personal information collected on this form is obtained under the authority of the ... this collection should be directed to the Provincial Manager, Mining Lands, ... Sudbury, Ontario, P3E 6A5, telephone (705) 670-7264.

31M05NE0109 2.15579 BUCKE

900

Instructions:
- Please type or print and submit in duplicate.
- Refer to the Mining Act and Regulations for r... Recorder.
- A separate copy of this form must be completed for each Work Group.
- Technical reports and maps must accompany this form in duplicate.
- A sketch, showing the claims the work is assigned to, must accompany this form.

GAO

Recorded Holder(s): KEITH M. BARRON JOHN EWANCHUK ROBERT L. BARNETT		Client No.: 297989, 105259, 130349
Address: 14 OSTRANDER BLVD. RR10, BRAMPTON, ON L6V 3N2		Telephone No.: (905) 456-0926
Mining Division: LARDER LAKE	Township/Area: BUCKE TWP.	M or G Plan No.: G 3413
Dates Work Performed From: MAY 12/93		To: JUNE 25/93

Work Performed (Check One Work Group Only)

Work Group	Type
Geotechnical Survey	AIRBORNE GEOPHYSICAL MAGNETIC + VLF-EM SURVEYS
Physical Work, Including Drilling	
Rehabilitation	
Other Authorized Work	
Assays	
Assignment from Reserve	

RECEIVED
SEP 21 1994
MINING LANDS BRANCH

Total Assessment Work Claimed on the Attached Statement of Costs $ ~~2631.97~~ 2632.-

Note: The Minister may reject for assessment work credit all or part of the assessment work submitted if the recorded holder cannot verify expenditures claimed in the statement of costs within 30 days of a request for verification.

Persons and Survey Company Who Performed the Work (Give Name and Address of Author of Report)

Name	Address
TERRAQUEST LTD.	1373 QUEEN VICTORIA AVENUE
	MISSISSAUGA, ONT. L5H 3H2
CHARLES Q BARRIE	

(attach a schedule if necessary)

Certification of Beneficial Interest * See Note No. 1 on reverse side

I certify that at the time the work was performed, the claims covered in this work report were recorded in the current holder's name or held under a beneficial interest by the current recorded holder.	Date: 13 Sept/94	Recorded Holder or Agent (Signature): Keith M. Barron

Certification of Work Report

I certify that I have a personal knowledge of the facts set forth in this Work report, having performed the work or witnessed same during and/or after its completion and annexed report is true.

Name and Address of Person Certifying: KEITH M BARRON, 14 OSTRANDER BLVD. RR 10 BRAMPTON, ON L6V 3N2		
Telepone No.: 905) 456-0926	Date: Sept 13/94	Certified By (Signature): Keith M Barron

For Office Use Only

Total Value Cr. Recorded: $2632.	Date Recorded: Sept 14/94	Mining Recorder: [signature]	Received Stamp: ... DIVISION ... SEP 14 PM 3 15 ... RECEIVED
	Deemed Approval Date: Dec. 13/94	Date Approved:	
	Date Notice for Amendments Sent:		

0241 (03/91)

Ontario

Ministry of Northern Development and Mines

Ministère du Développement du Nord et des mines

Statement of Costs for Assessment Credit

État des coûts aux fins du crédit d'évaluation

Mining Act/Loi sur les mines

Transaction No./N° de transaction: W9480.00462

2.15579

Personal information collected on this form is obtained under the authority of the Mining Act. This information will be used to maintain a record and ongoing status of the mining claim(s). Questions about this collection should be directed to the Provincial Manager, Minings Lands, Ministry of Northern Development and Mines, 4th Floor, 159 Cedar Street, Sudbury, Ontario P3E 6A5, telephone (705) 670-7264.

Les renseignements personnels contenus dans la présente formule sont recueillis en vertu de la Loi sur les mines et serviront à tenir à jour un registre des concessions minières. Adresser toute question sur la collecte de ces renseignements au chef provincial des terrains miniers, ministère du Développement du Nord et des Mines, 159, rue Cedar, 4e étage, Sudbury (Ontario) P3E 6A5, téléphone (705) 670-7264.

1. Direct Costs/Coûts directs

Type	Description	Amount Montant	Totals Total global
Wages Salaires	Labour Main-d'oeuvre		
	Field Supervision Supervision sur le terrain		
Contractor's and Consultant's Fees Droits de l'entrepreneur et de l'expert-conseil	Type GEOPHYSICAL	2631 97	
	SURVEY	2632 00	
Supplies Used Fournitures utilisées	Type		2632 00
Equipment Rental Location de matériel	Type		

Total Direct Costs / Total des coûts directs: 2632.00

2. Indirect Costs/Coûts indirects

** Note: When claiming Rehabilitation work indirect costs are not allowable as assessment work.
Pour le remboursement des travaux de réhabilitation, les coûts indirects ne sont pas admissibles en tant que travaux d'évaluation.

Type	Description	Amount Montant	Totals Total global
Transportation Transport	Type		
Food and Lodging Nourriture et hébergement			
Mobilization and Demobilization Mobilisation et démobilisation			

RECEIVED SEP 2[illegible] 1994 MINING LANDS BRANCH

Sub Total of Indirect Costs / Total partiel des coûts indirects

Amount Allowable (not greater than 20% of Direct Costs) / Montant admissible (n'excédant pas 20 % des coûts directs)

Total Value of Assessment Credit (Total of Direct and Allowable Indirect costs) / Valeur totale du crédit d'évaluation (Total des coûts directs et indirects admissibles)

Note: The recorded holder will be required to verify expenditures claimed in this statement of costs within 30 days of a request for verification. If verification is not made, the Minister may reject for assessment work all or part of the assessment work submitted.

Note : Le titulaire enregistré sera tenu de vérifier les dépenses demandées dans le présent état des coûts dans les 30 jours suivant une demande à cet effet. Si la vérification n'est pas effectuée, le ministre peut rejeter tout ou une partie des travaux d'évaluation présentés.

Filing Discounts

1. Work filed within two years of completion is claimed at 100% of the above Total Value of Assessment Credit.
2. Work filed three, four or five years after completion is claimed at 50% of the above Total Value of Assessment Credit. See calculations below:

Total Value of Assessment Credit		Total Assessment Claimed
	× 0.50 =	

Remises pour dépôt

1. Les travaux déposés dans les deux ans suivant leur achèvement sont remboursés à 100 % de la valeur totale susmentionnée du crédit d'évaluation.
2. Les travaux déposés trois, quatre ou cinq ans après leur achèvement sont remboursés à 50 % de la valeur totale du crédit d'évaluation susmentionné. Voir les calculs ci-dessous.

Valeur totale du crédit d'évaluation		Évaluation totale demandée
	× 0,50 =	

Certification Verifying Statement of Costs

I hereby certify:
that the amounts shown are as accurate as possible and these costs were incurred while conducting assessment work on the lands shown on the accompanying Report of Work form.

that as Keith M. Brown [illegible] (Recorded Holder, Agent, Position in Company) I am authorized to make this certification

Attestation de l'état des coûts

J'atteste par la présente :
que les montants indiqués sont le plus exact possible et que ces dépenses ont été engagées pour effectuer les travaux d'évaluation sur les terrains indiqués dans la formule de rapport de travail ci-joint.

Et qu'à titre de ______ (titulaire enregistré, représentant, poste occupé dans la compagnie) je suis autorisé à faire cette attestation.

Signature: [signature] Date: [illegible] Sept [illegible]

0212 (04/91)

Nota : Dans cette formule, lorsqu'il désigne des personnes, le masculin est utilisé au sens neutre

Work Report Number for Applying Reserve

Claim Number (see Note 2)

See appended list

Total Number of Claims

Claim Number	Number of Claim units	Value of Assessment Work Done on this Claim	Value Applied to this Claim
L1186973	1	$ 51.00	$ 51.00
L1118549	4	$ 202.00	$ 202.00
L1186737	1	$ 51.00	$ 51.00
L1118550	4	$ 202.00	$ 202.00
L1118531	4	$ 202.00	$ 202.00
L1186966	4	$ 202.00	$ 202.00
L1186967	1	$ 51.00	$ 51.00
L1118540	1	$ 51.00	$ 51.00
L1186970	2	$ 101.00	$ 101.00
L1186972	1	$ 51.00	$ 51.00
L1118554	4	$ 202.00	$ 202.00
L1118555	4	$ 202.00	$ 202.00
L1118541	2	$ 101.00	$ 101.00
L1118524	1	$ 51.00	$ 51.00
L1191097	4	$ 202.00	$ 202.00
L1191098	2	$ 101.00	$ 101.00
L1186969	1	$ 51.00	$ 51.00
L1186968	6	$ 304.00	$ 304.00
L1197203	2	$ 101.00	$ 101.00
L1118522	1	$ 51.00	$ 51.00
L1118523	2	$ 101.00	$ 101.00

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SEP 21 1994
MINING LANDS BRANCH

Total Number of Claims 21

Total Value of Work Done = $ 2,632.00

Total Value Work Applied = $ 2,632.00

2.15579

Ontario

Ministry of
Northern Development
and Mines

Ministère du
Développement du Nord
et des Mines

Geoscience Approvals Office
933 Ramsey Lake Road
6th Floor
Sudbury, Ontario
P3E 6B5

Telephone: (705) 670-5853
Fax: (705) 670-5863

Our File: 2.15579
Transaction#:W9480.00462

November 18, 1994

Mining Recorder
Ministry of Northern Development
and Mines
4 Government Road East
Kirkland Lake, Ontario
P2N 1A2

Dear Mr. Spooner:

RE: APPROVAL OF ASSESSMENT WORK ON MINING CLAIMS L1186973 ET. AL. IN BUCKE TOWNSHIP.

The assessment credits for Airborne Geophysics, sections 15 of the Mining Act Regulations, as listed on the original Report of Work, have been approved as of **November 17, 1994.**

Please indicate this approval on the claim record sheets.

If you have any questions concerning this submission please contact Dale Messenger at (705) 670-5858.

ORIGINAL SIGNED BY:

Ron C. Gashinski
Senior Manager, Mining Lands Section
Mining and Land Management Branch
Mines and Minerals Division

DEM/jl
Enclosures:

cc: Assessment Files Office
Sudbury, Ontario

Resident Geologist
Cobalt, Ontario

Ministry of Natural Resources / Ministry of Northern Development and Mines — Ontario

2.155 79

INDEX TO LAND DISPOSITION

PLAN
G-3413

TOWNSHIP
BUCKE

M.N.R. ADMINISTRATIVE DISTRICT
TEMAGAMI

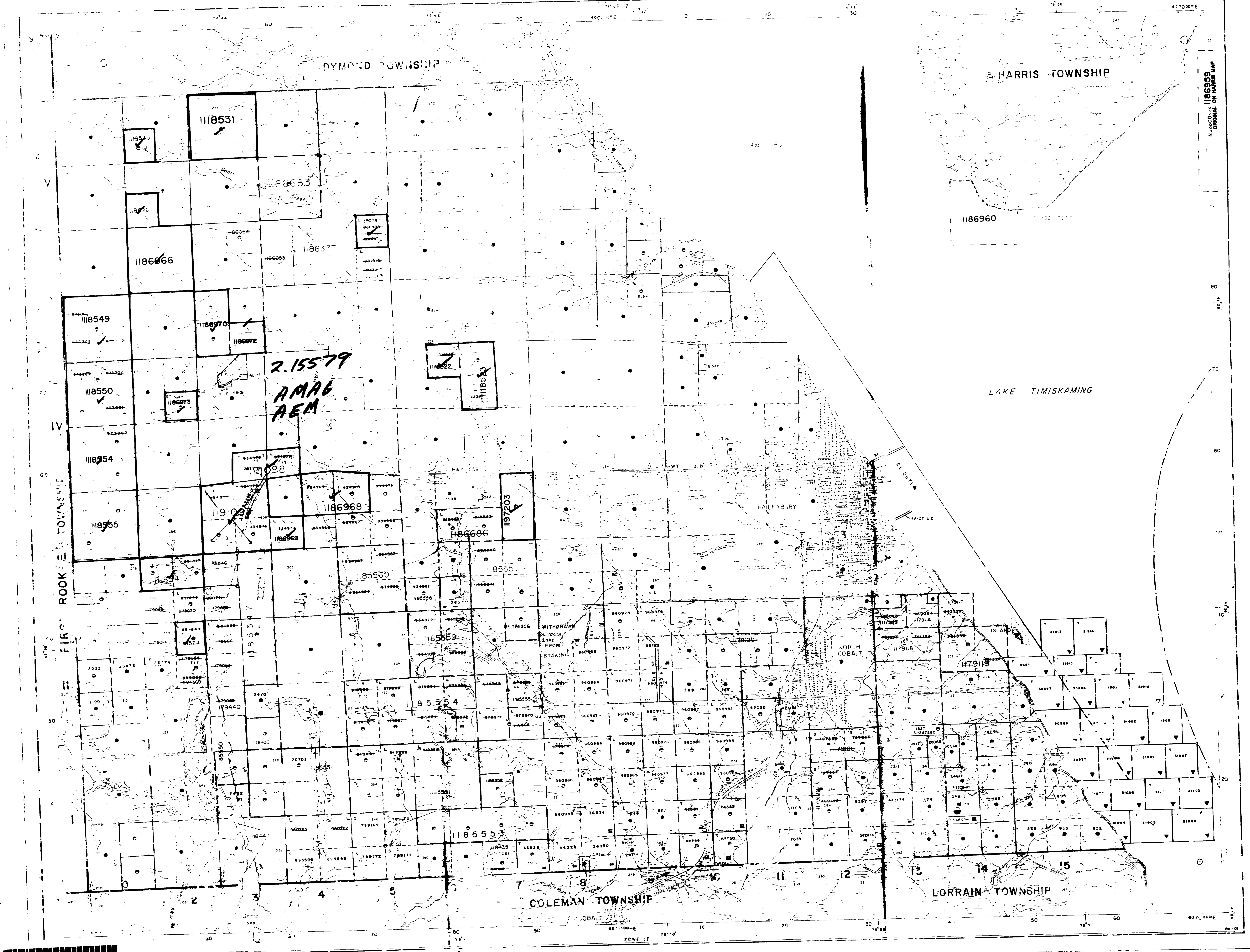
MINING DIVISION
LARDER LAKE

LAND TITLES/REGISTRY DIVISION
TIMISKAMING

GEOLOGY REFERENCE COBALT RESIDENT GEOLOGIST

Scale 1:20 000

Contour Interval 10 Metres



AREAS WITHDRAWN FROM DISPOSITION

MRO - Mining Rights Only
SRO - Surface Rights Only
M+S - Mining and Surface Rights

SYMBOLS

Reservation
Contour
Depression
Flooded land
Railway single track
double track
abandoned
Road, highway
access
Shoreline (original)
Transmission line
Wooded area

DISPOSITION OF CROWN LANDS

Patent
- Surface & Mining Rights
- Surface Rights Only
- Mining Rights Only

Lease
- Surface & Mining Rights
- Surface Rights Only
- Mining Rights Only

Licence of Occupation
Order-in-Council
Cancelled
Reservation
Sand & Gravel

NOTES

FLOODING ... ELEVATION 595' ABOVE ... LEVEL IN LAKE TIMISKAMING ... FILE 13534

NORTH HALF LOT 8 CON 2 SUBJECT TO SANITARY CONTROL OF CONSTANCE LAKE FOR TOWN OF HAILEYBURY.

STAKINGS OF MINING CLAIMS WITHIN TOWNSITES SHOWN THUS ONLY WITH CONSENT OF THE MINISTER

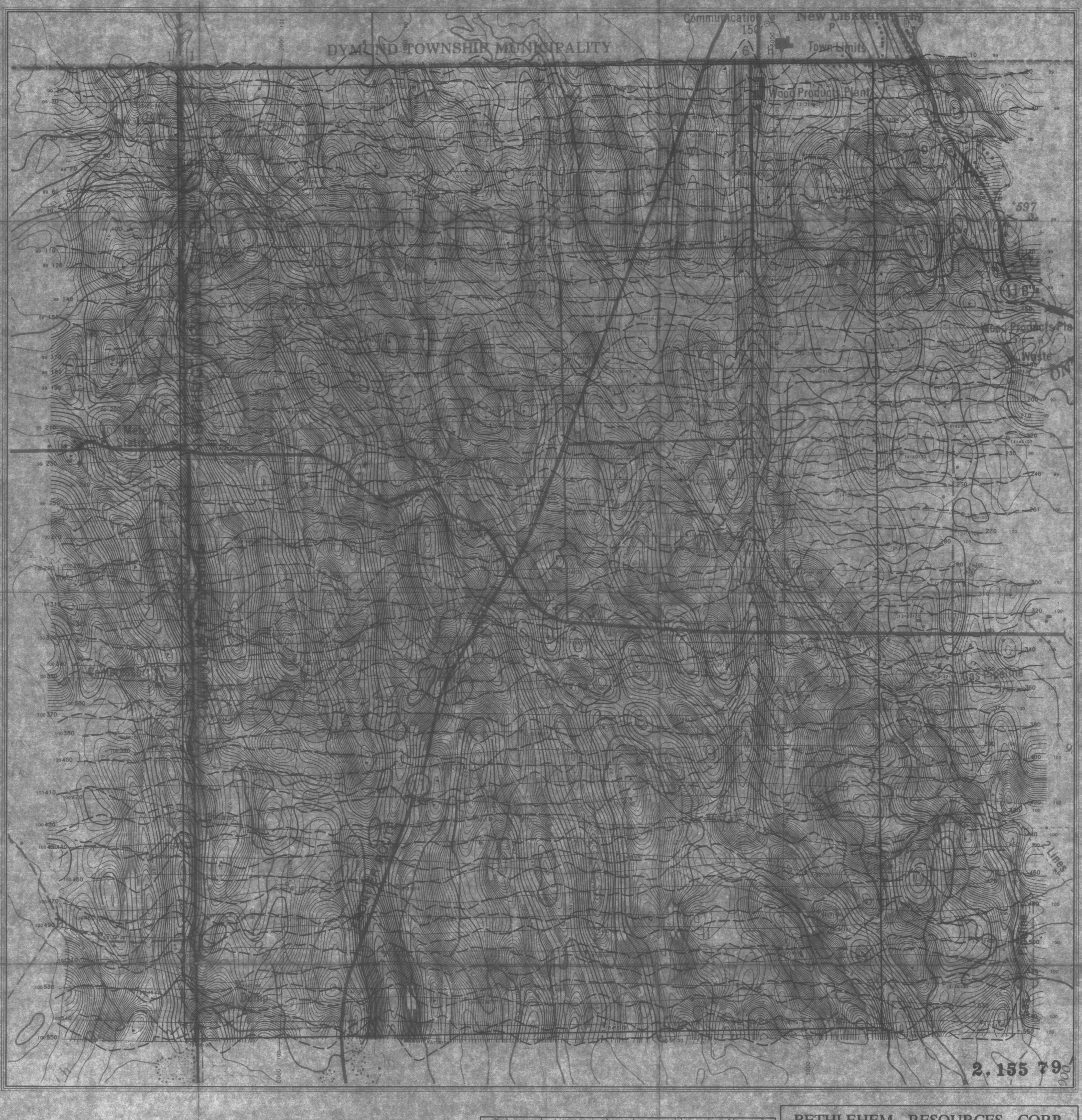
Surface Rights Withdrawn under Sec. 36
The Mining Act R.S.O. 1980 ORDER NO. W-...
Trans Canada Pipeline Right of Way and Buffer
Zone particularly 40.25 meters or 132 ft. on either side of centre line of right of way

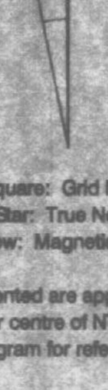
THE INFORMATION THAT APPEARS ON THIS MAP HAS BEEN COMPILED FROM VARIOUS SOURCES AND ACCURACY IS NOT GUARANTEED. THOSE WISHING TO STAKE MINING CLAIMS SHOULD CONSULT WITH THE MINING RECORDER, MINISTRY OF NORTHERN DEVELOPMENT AND MINES FOR ADDITIONAL INFORMATION ON THE STATUS OF THE LANDS SHOWN HEREON

CIRCULATED APRIL 27/88

Map base and land disposition drafting by Surveys and Mapping Branch, Ministry of Natural Resources

The ... of land, location of lot fabric and parcel boundaries on this index was compiled for administrative purposes only





Square: Grid North
Star: True North
Arrow: Magnetic North

Angles presented are approximate mean deviations for centre of NTS sheet 31M/5. Use diagram for reference only.

Grid North - True North: -0°55'
Grid North - Magnetic North: -11°47'
Annual change: 4.1' from 1982

FLIGHT PATH

Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system.

Lines were flown at an azimuth of 90-270°, with an average line spacing of 150 m.

Average terrain clearance of 100 m was monitored by radar, and barometric altimeters.

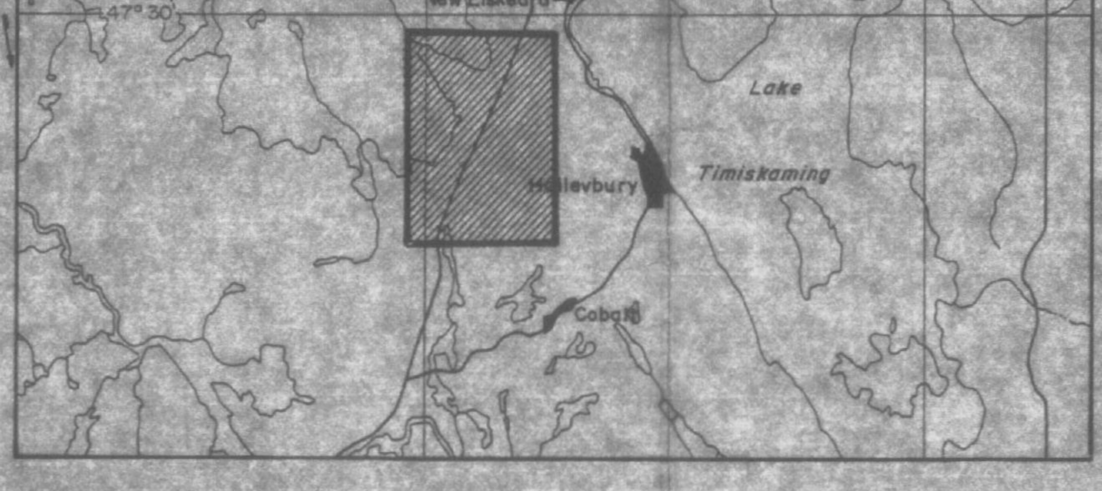
TOTAL FIELD VLF-EM

Total field VLF-EM data, measured by a Herz Totem 2A sensor at an average elevation of 100 m.

Station NSS, Annapolis, MD 21.4 kHz. (Arrow points to station location)

Contour data: Line
Profile data: Quadrature
Profile scale is 2%/mm, with the flight line equaling zero. Contours are multiples of those listed below:

- 2 %
- 10 %
- 50 %
- Quadrature



BETHLEHEM RESOURCES CORP.

TOTAL FIELD VLF-EM

SHARP LAKE AREA

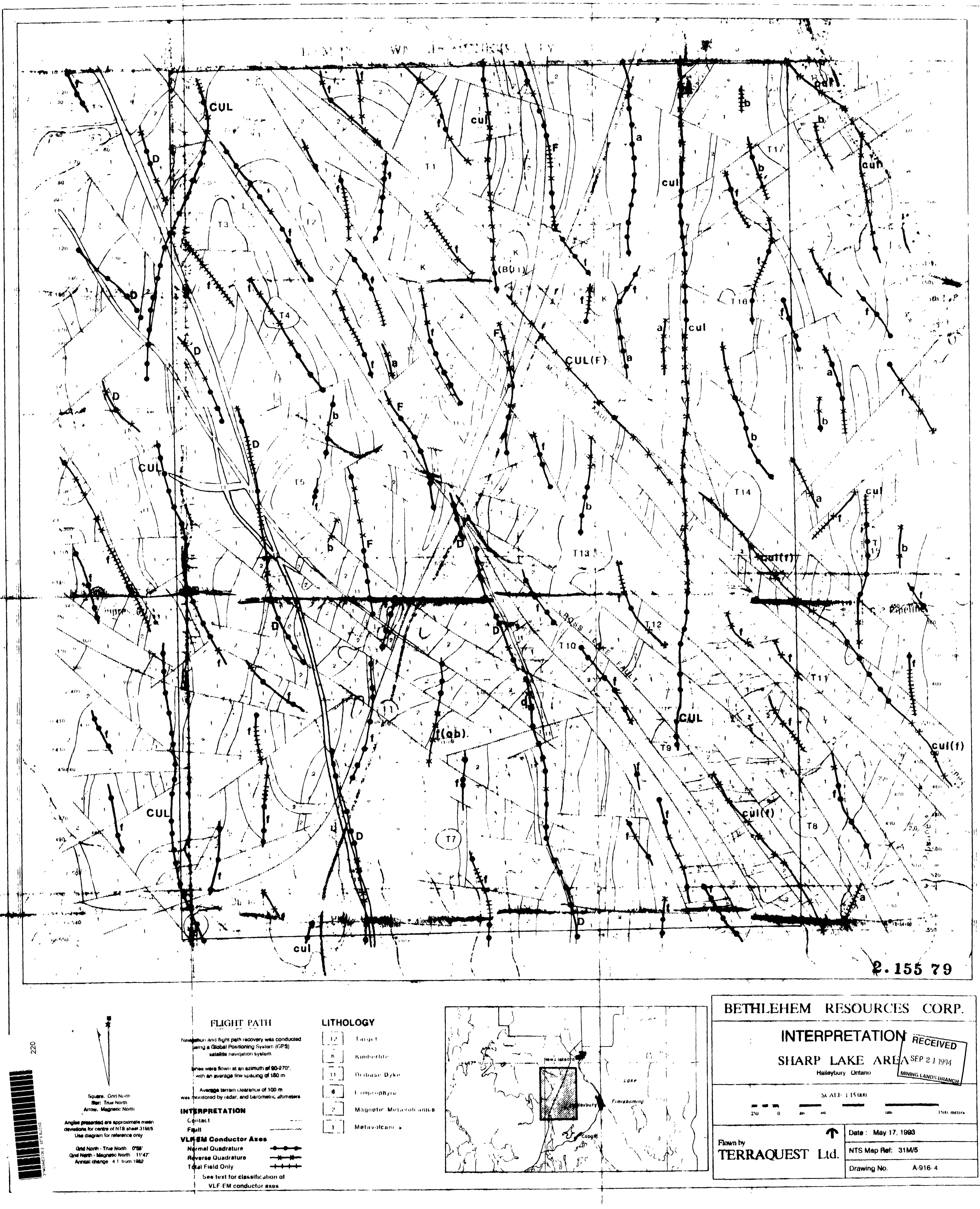
Haileybury, Ontario

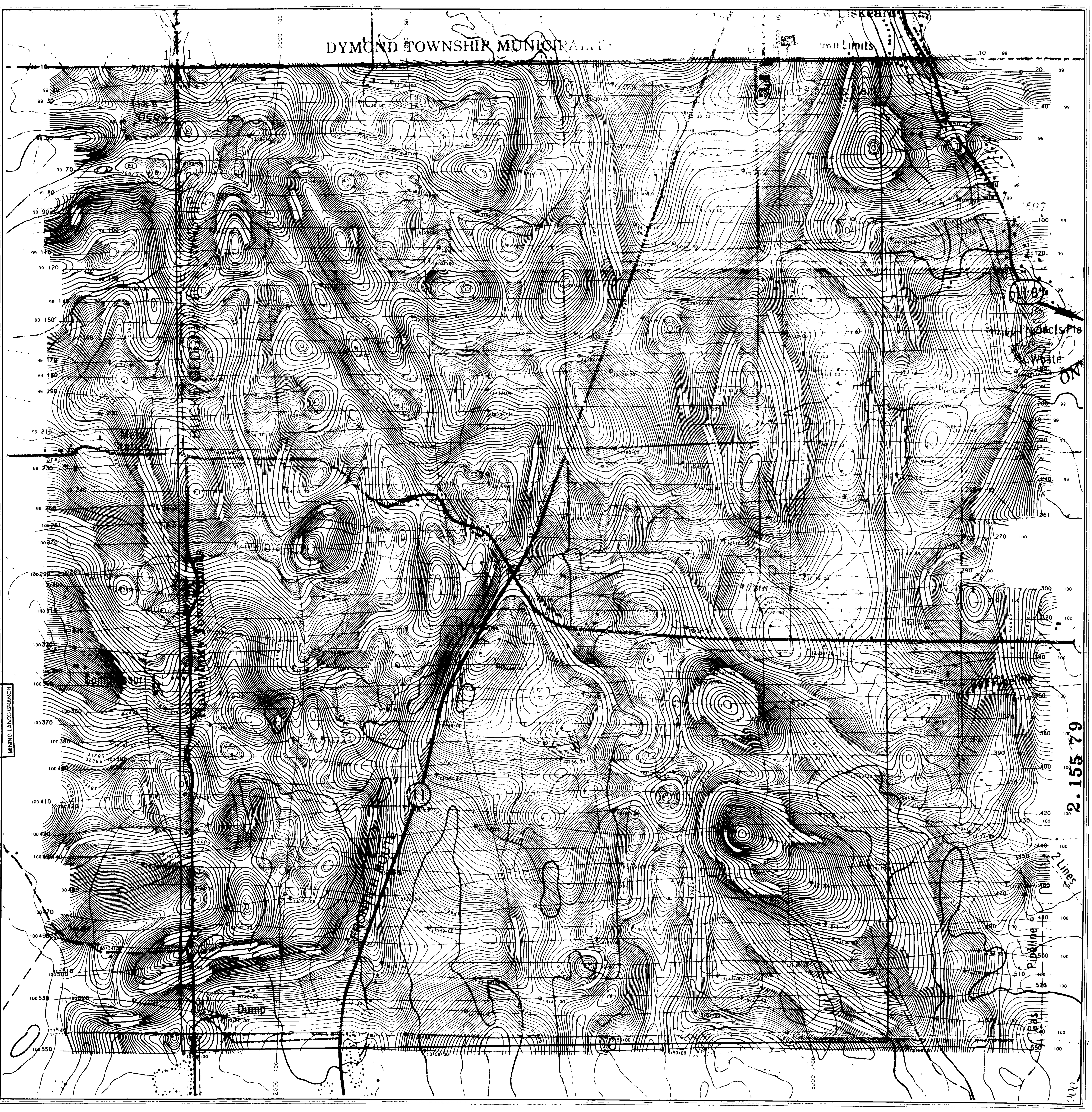
SCALE 1:15 000

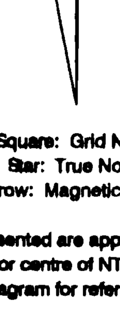
250 0 200 400 1000 1500 metres

Flown by
TERRAQUEST Ltd.

Date : May 17, 1993
NTS Map Ref: 31M/5
Drawing No. A-916-3


2.155 79
Square. Grid North
Star: True North
Arrow. Magnetic North
Angles presented are approximate mean deviations for centre of NTS sheet 31M/5
Use diagram for reference only
Grid North - True North 0°55'
Grid North - Magnetic North 11°47'
Annual change 4.1 from 1982
FLIGHT PATH
Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system
Lines were flown at an azimuth of 90-270°, with an average line spacing of 150 m
Average terrain clearance of 100 m was monitored by radar, and barometric altimeters
INTERPRETATION
Contact
Fault
VLF-EM Conductor Axes
Normal Quadrature
Reverse Quadrature
Total Field Only
See text for classification of VLF-EM conductor axes
LITHOLOGY
12 Target
K Kimberlite
11 Diabase Dyke
6 Lamprophyre
2 Magnetic Metavolcanics
1 Metavolcanics
New Liskeard
Haileybury
Cobalt
Lake Timiskaming
BETHLEHEM RESOURCES CORP.
INTERPRETATION
SHARP LAKE AREA
Haileybury Ontario
RECEIVED
SEP 21 1994
MINING LANDS BRANCH
SCALE 1:15 000
250 0 1500 metres
Flown by
TERRAQUEST Ltd.
Date: May 17, 1993
NTS Map Ref: 31M/5
Drawing No. A-916-4





Square: Grid North
Star: True North
Arrow: Magnetic North

Angles presented are approximate mean deviations for centre of NTS sheet 31M/5. Use diagram for reference only.

Grid North - True North: -0°55'
Grid North - Magnetic North: -11°47'
Annual change: 4.1' from 1982

FLIGHT PATH

Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system.

Lines were flown at an azimuth of 90-270°, with an average line spacing of 150 m

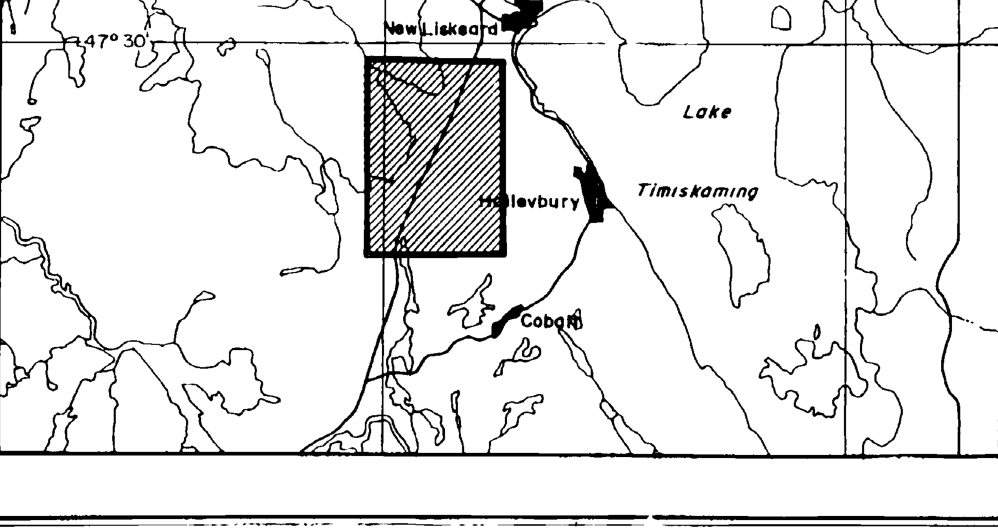
Average terrain clearance of 100 m was monitored by radar, and barometric altimeters.

TOTAL FIELD MAGNETICS

Total field magnetic intensity contour data, measured by a cesium high sensitivity magnetometer at an average sensor elevation of 100 m, and corrected for diurnal variation.

Map contours are in nanoTeslas, and are multiples of those listed below:

2 nT
10 nT
50 nT
200 nT
1000 nT



BETHLEHEM RESOURCES CORP.

TOTAL FIELD MAGNETICS

SHARP LAKE AREA

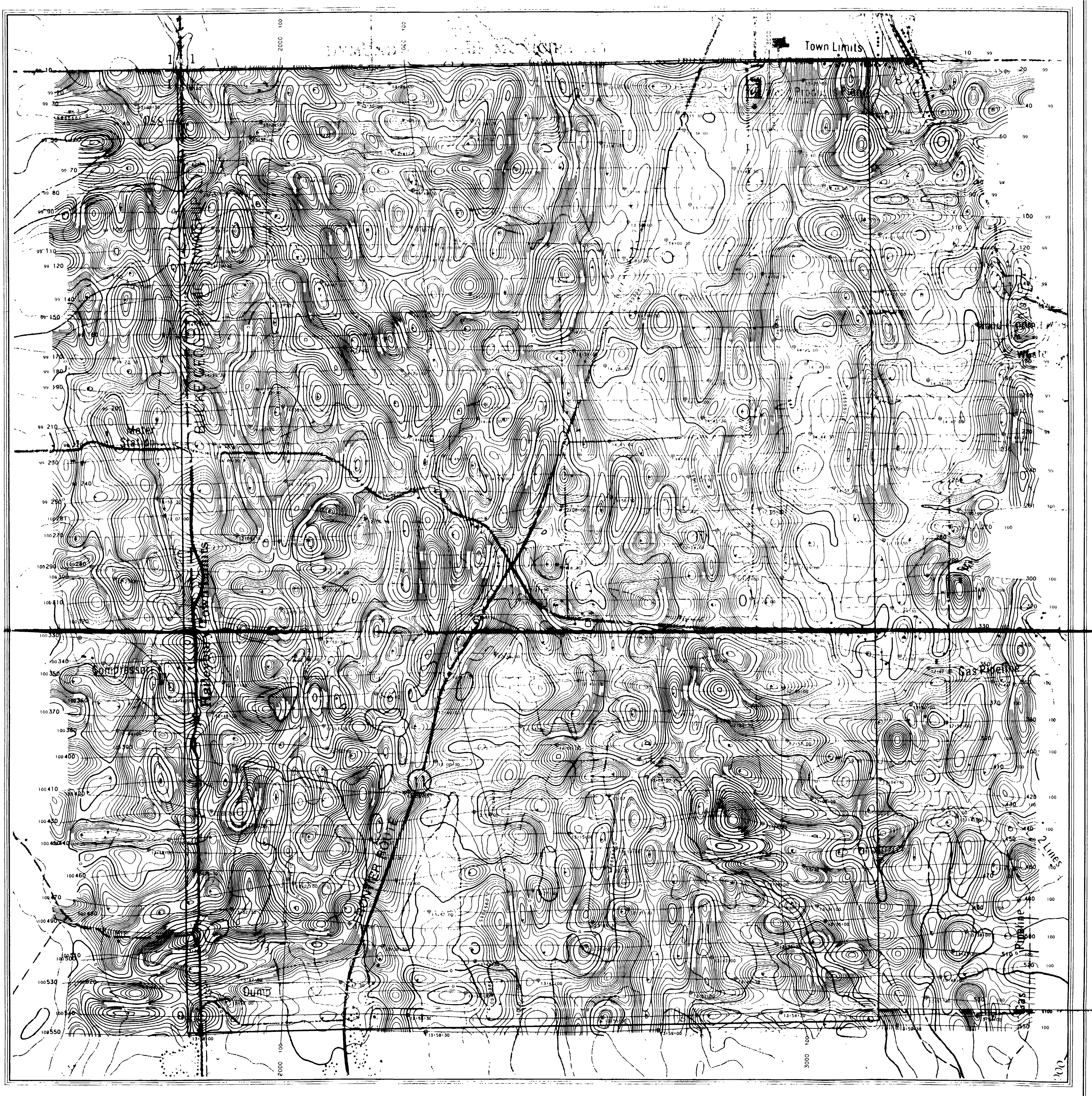
Haileybury, Ontario

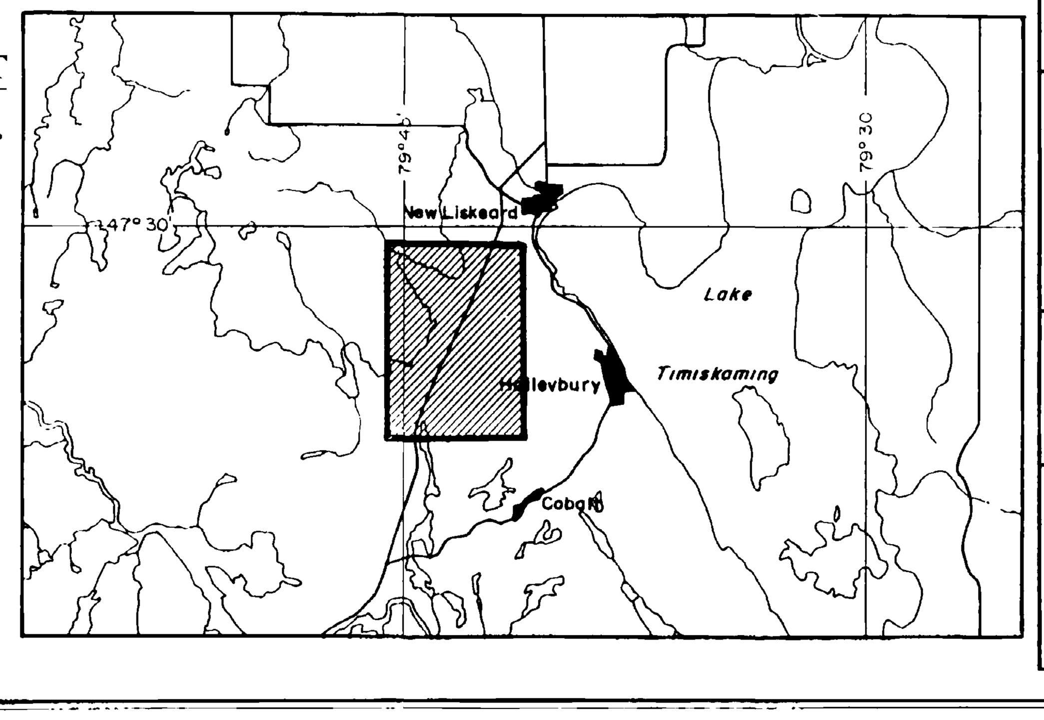
SCALE 1:15 000

250 0 200 400 1000 1500 metres

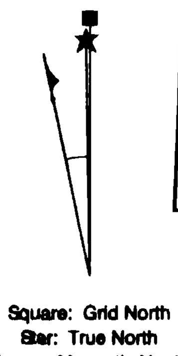
Flown by
TERRAQUEST Ltd.

Date : May 17, 1993
NTS Map Ref: 31M/5
Drawing No. A-916-1





2.155 79



Square: Grid North
Star: True North
Arrow: Magnetic North

Angles presented are approximate mean deviations for centre of NTS sheet 31M/5. Use diagram for reference only.

Grid North - True North: -0°55'
Grid North - Magnetic North: -11°47'
Annual change: 4.1' from 1982

RECEIVED
SEP 21 1994
MINING LANDS BRANCH

FLIGHT PATH

Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system.

Lines were flown at an azimuth of 90-270°, with an average line spacing of 150 m.

Average terrain clearance of 100 m was monitored by radar, and barometric altimeters.

VERTICAL GRADIENT

Vertical magnetic gradient contour data, calculated from the gridded total field magnetics data.

Map contours are in nanoTeslas/metre, and are multiples of those listed below:

- 0.2 nT/m
- 1 nT/m
- 5 nT/m
- 25 nT/m
- 100 nT/m

BETHLEHEM RESOURCES CORP.

VERTICAL MAGNETIC GRADIENT

SHARP LAKE AREA

Haileybury, Ontario

SCALE 1:15 000

250 0 200 400 1000 1500 metres

Flown by TERRAQUEST Ltd.

Date : May 17, 1993

NTS Map Ref: 31M/5

Drawing No. A-916-2

240