7/88

REPORT ON
COMBINED HELICOPTER BORNE
MAGNETIC, ELECTROMAGNETIC AND VLF
SURVEY
LIGHTNING CREEK PROPERTY
QUESNEL DISTRICT, BRITISH COLUMBIA

93H/4E
53°02'24" 121°41'
Cariboo M.D.

for

Owner/Operator: LIGHTNING CREEK RESOURCES LTD.

by

AERODAT LIMITED

August 17, 1987

J8703.LC

G. Podolsky
P. Eng.

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(Scale 1:10,000)

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1: INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Lightning Creek Resources Ltd. by Aerodat Limited. Equipment operated included a four frequency electromagnetic system, a high sensitivity cesium vapour magnetometer, a two frequency VLF-EM system, a video tracking camera, an altimeter and an electronic positioning system. Electromagnetic, magnetic and altimeter data were recorded both in digital and analog form. Positioning data were stored in digital form and recorded on tape as well as being marked on the flight path mosaic by the operator while in flight.

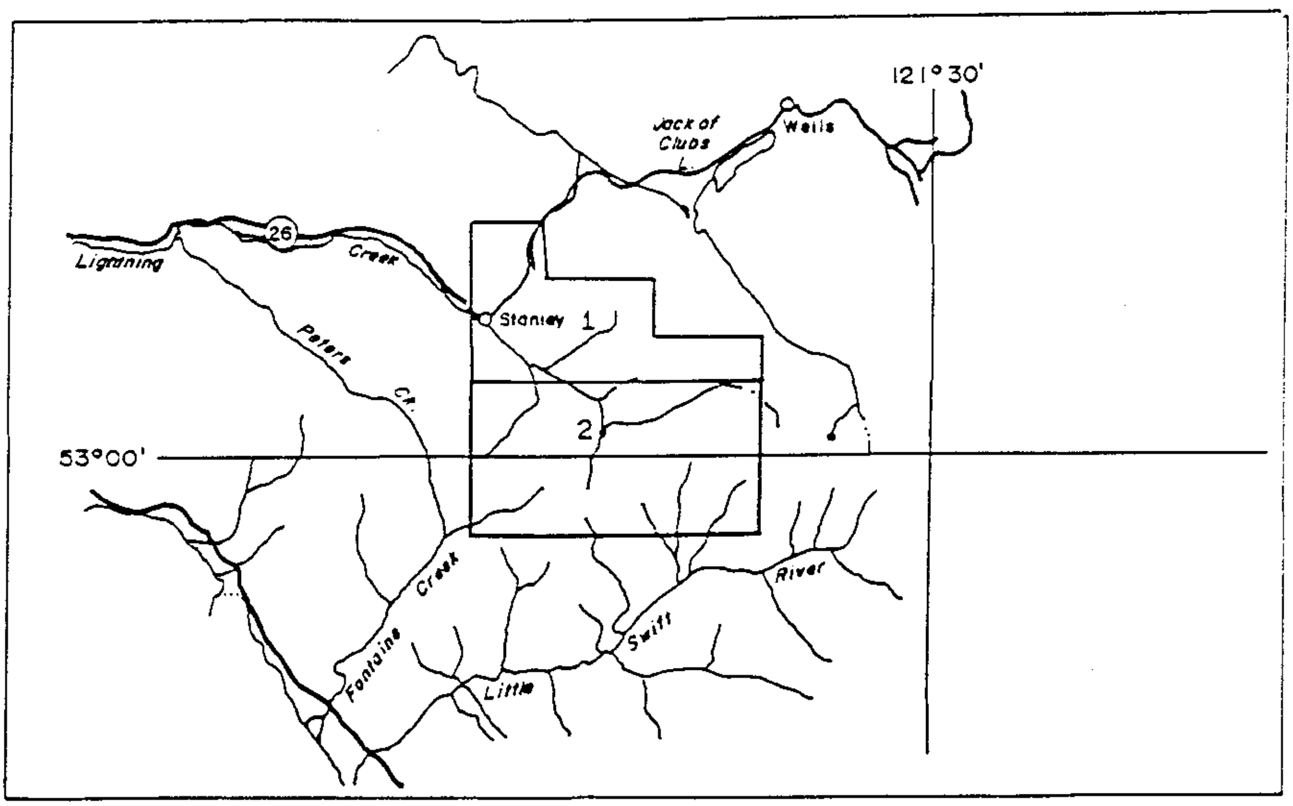
The survey area, comprising a block of ground in the Quesnel Mining District of northern British Columbia and situated about 12 kilometres west southwest of Barkerville, was flown during the period of February 21st to 24th, 1987. Five flights were required to complete the survey with flight lines oriented at Azimuths of 090-270 degrees and flown at a nominal spacing of 150 metres. Coverage and data quality were considered to be well within the specifications described in the contract.

The purpose of the survey was to record airborne geophysical data over and around ground that is of interest to Lightning Creek Resources Ltd.

A total of 535 kilometres of the recorded data were compiled in map form and are presented as part of this report according to specifications outlined by Lightning Creek Resources Ltd.

2: SURVEY AREA LOCATION

The survey area is depicted on the index map shown below. It is centred at Latitude 53 degrees 01 minutes north, Longitude 121 degrees 40 minutes west, approximately 12 kilometres west southwest of Barkerville and 55 kilometres almost due east of Quesnel in the Quesnel Highland area of northern British Columbia (NTS Reference Map Nos. 93 A/13, 93 H/4). The area is accessed from the Quesnel-Wells Highway (# 26) that cuts the north western corner of the area or by helicopter out of Quesnel.



3: AIRCRAFT AND EQUIPMENT

3.1 Aircraft

An Aerospatiale A-Star 350D helicopter, (C-GNSM), owned and operated by Lakeland Helicopters Limited, was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 75 metres.

3.2 Equipment

3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat four frequency system. Two vertical coaxial coil pairs were operated at 955 Hz and 4536 Hz and two horizontal coplanar coil pairs at 4268 Hz and 33.9 kHz. The transmitter-receiver separation was 7 metres. Inphase and quadrature signals were measured simultaneously for the four frequencies with a time constant of 0.1 seconds. The electromagnetic bird was towed 30 metres below the transmitter.

3.2.2 VLF-EM System

The VLF-EM System was a Herz Totem 2A. This instrument measures the total field and quadrature components of two selected transmitters, preferably oriented at right angles to one another. The sensor was towed in a bird 27 metres below the helicopter. The transmitting stations monitored were NLK, Jim Creek, Washington for the "Ortho" station and NAA, Cutler, Maine for the "Line" station broadcasting at 24.8 and 24.0 kHz respectively.

3.2.3 Magnetometer

The magnetometer employed a Scintrex Model VIW - 2321 H8 cesium, optically pumped magnetometer sensor. The sensitivity of this instrument was 0.1 nanoTeslas at a

0.2 second sampling rate. The sensor was towed in a bird 27 metres below the helicopter.

3.2.4 Magnetic Base Station

A Geometrics G803 proton precession magnetometer was operated at the base of operations to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to facilitate later correlation.

3.2.5 Radar Altimeter

A King KRA-10 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

3.2.6 Tracking Camera

A Panasonic video tracking camera was used to record flight path on standard VHS video tape. The camera was operated in continuous mode. Fiducial numbers and time reference marks, for cross-reference to the analog and digital data, were encoded on the tape.

3.2.7 Analog Recorder

An RMS dot-matrix recorder was used to display the data during the survey. In addition to manual and time fiducials, the following data were recorded:

Channel	Input	Scale
ALT	Altimeter (150 m at top of chart)	3 m/mm
CXI1	Low Frequency Inphase	2.5 ppm/mm
CXQ1	Low Frequency Quadrature	2.5 ppm/mm
CXI2	High Frequency Inphase	2.5 ppm/mm
CXQ2	High Frequency Quadrature	2.5 ppm/mm
CPI1	Mid Frequency Inphase	10 ppm/mm

CPQ1	Mid Frequency Quadrature	10	ppm/mm
CPI2	33 kiloHerz Inphase	20	ppm/mm
CPQ2	33 kiloHerz Quadrature	20	ppm/mm
VLT	VLF-EM Total Field, Line	2.5	%/mm
VLQ	VLF-EM Quadrature, Line	2.5	%/mm
VOT	VLF-EM Total Field, Ortho	2.5	%/mm
VOQ	VLF-EM Quadrature, Ortho	2.5	%/mm
MAGF	Magnetometer, fine	1.0	nT/mm
MAGC	Magnetometer, coarse	10	nT/mm
PWRL	Power Line Indicator		

3.2.8 Digital Recorder

A DGR33 data system recorded the survey on magnetic tape. Information recorded was as follows:

Equipment	Recording Interval
EM system	0.1 seconds
VLF-EM	0.5 seconds
Magnetometer	0.25 seconds
Altimeter	0.5 seconds
Power Line Monitor	0.5 seconds

4: DATA PRESENTATION

4.1 Base Map

A photomosaic base at a scale of 1:10,000 was prepared by enlargement of aerial photographs of the survey area.

4.2 Flight Path Map

The flight path was derived from the from an examination of the video tape from the flight path tracking camera system. Points along the flight path that could be identified on the video presentation, were marked on the photomosaic with reference to time. These points were then digitized to produce the 'picked' flight path. It is estimated that positioning is generally accurate to about 30 metres with respect to the topographic detail of the base map. The flight path is drawn with reference fiducials, time marks and navigator's manual fiducials for cross reference to both the analog and digital data and is presented on a Cronaflex overlay of the base map.

4.3 Airborne Electromagnetic Survey Interpretation Map

An interpretation map was prepared showing flight lines, fiducials, peak locations of anomalies and conductivity thickness range along with the Inphase amplitudes. These values were computed from the 4600 Hz coaxial response. Individual conductors, conductive zones and conductive areas have been delineated and numbered on the Interpretation Map. The data are presented on a Cronaflex overlay of the base map.

4.4 Total Field Magnetic Contours

The aeromagnetic data were corrected for diurnal variations by adjustment with the digitally recorded base station magnetic values. No correction for regional variation was applied. The corrected profile data were interpolated onto a regular grid at a 25 metre true scale interval using a cubic spline technique. The grid provided the basis for threading the presented contours at a 2 nanoTesla interval.

The aeromagnetic data have been presented with flight path and electromagnetic anomaly information on a Cronaflex overlay of the base map.

4.5 Vertical Magnetic Gradient Contours

The vertical magnetic gradient was calculated from the gridded total field magnetic data. Contoured at a 0.2 nT/m interval, the gradient data were presented on a Cronaflex overlay of the base map.

4.6 Apparent Resistivity Contours

The electromagnetic information was processed to yield a map of the apparent resistivity of the ground.

The approach taken in computing apparent resistivity was to assume a model of a 200 metre thick conductive layer (i.e., effectively a half space) over a resistive bedrock. The computer then generated, from nomograms for this model, the resistivity that would be consistent with the bird elevation and recorded amplitude for the coaxial frequency pair. The apparent resistivity profile data were interpolated onto a regular grid at a 25 metres true scale interval using a cubic spline technique.

The contoured apparent resistivity data were presented on a Cronaflex overlay of the base map with the flight path and electromagnetic anomaly information.

4.7 VLF - EM Total Field Contours

The VLF-EM signals from NAA, Cutler, Maine and NLK, Jim Creek, Washington, broadcasting at 24.0 kHz and 24.8 kHz respectively, were compiled in contour map form and presented on a Cronaflex overlay of the base map.

4.8 Relative Overburden Thickness Contours

The electromagnetic information was processed to yield a map of the relative overburden thickness. This was accomplished by first deriving the apparent resistivity of the ground for a thin sheet model and then, from an assumed constant value of overburden resistivity, computing appropriate overburden thicknesses over the area.

The approach taken in computing apparent resistivity was to assume a suitable model of a conductive layer (i.e., the overburden) over a resistive bedrock. The computer then generated, from nomograms for this model, the resistivity that would be consistent with the bird elevation and recorded amplitude for the coaxial frequency pair.

The overburden thickness data were interpolated onto a regular grid at a 25 metres true scale interval using a cubic spline technique.

The calculated overburden thickness data have been presented in contour form along with EM anomalies and flight lines on a Cronaflex overlay of the topographic base map.

5: INTERPRETATION

5.1 GEOLOGY

A small topographic map with drill hole locations and overburden depths along Lightning Creek as well as two churn drill sections, indicate the presence of "heavy" pyrite mineralization within certain of the limestone strata that underlie the survey area. No other geologic data were supplied to Aerodat by Lightning Creek Resources Ltd. and no published data were available to the writer. Also, types of targets sought have not been discussed or identified by Lightning Creek Resources Ltd. although it is generally assumed that the primary interest is in gold mineralization. Barkerville, a historic gold mining camp, lies approximately 14 kilometres east southeast of the survey.

5.2 MAGNETICS

The magnetic data from the high sensitivity cesium magnetometer provided virtually a continuous magnetic reading when recording at two-tenth second intervals. The system is also noise free for all practical purposes.

The sensitivity of 0.1 nT allows for the mapping of very small inflections in the magnetic field, resulting in a contour map that is comparable in quality to ground data. Both the fine and coarse magnetic traces were recorded on the magnetic charts.

The Total Field magnetic map shows a fairly persistent north easterly to north northeasterly magnetic grain throughout the area with one north westerly zone in the south central part of the south sheet. It is felt that the magnetic pattern is an overall reflection of the combined effects of topography and stratigraphy and, to a lesser extent, structure (i.e., faulting).

Maximum magnetic response is a fairly low 125 nanoTeslas above a 58,000 nT average background level. Overall magnetic relief is only about 210 nT but is quite sharp, suggesting only minor susceptibility contrast in the near surface stratigraphy. No intrusive activity is evident and the faulting indicated on the Interpretation Map (generally north-south to north northwesterly) is only a sampling of the possible cross structures that may be interpreted from the magnetic data. Faulting along the magnetic grain (i.e., "strike" faults) is probably more common but harder to isolate due to topographic effects. The drainage courses themselves are probably an indication of faulting.

5.3 VERTICAL GRADIENT MAGNETICS

The relatively low levels of magnetic relief and the mountainous terrain are not conducive to good quality Vertical Magnetic Gradient data. The present data tend to conform to the Total Field magnetic patterns and provide some support to the structural interpretation but the possible need for terrain corrections make the data of little interpretive value. Further processing of the data is not warranted.

5.4 ELECTROMAGNETICS

The electromagnetic data was first checked by a line-by-line examination of the analog records. Record quality was good with some noise noted on the 34 kHz coplanar quadrature trace and minor noise levels on the coaxial traces. This was readily removed by an appropriate smoothing filter. Sferic noise was essentially absent. Geologic noise, in the form of surficial conductors, is present on the higher frequency responses but does not seem to be a significant problem in the identification of bedrock conductors.

Anomalies were picked off the analog traces of the low and high frequency coaxial responses and then validated on the coplanar profile data. These selections were then checked with a proprietary computerized selection program which can be adjusted for ambient and instrumental noise. The data were then edited and re-plotted on a copy of the of the profile map. This procedure ensured that every anomalous response spotted on the analog data was plotted on the final map and allowed for the rejection - or inclusion if warranted - of obvious surficial conductors. The 33 kHz data was not used in the selection of bedrock conductors but was relied upon for the identification of surficial zones.

Each conductor or group of conductors was evaluated on the bases of magnetic (and lithologic, where applicable) correlations apparent on the analog data and man made or surficial features not obvious on the analog charts.

RESULTS: A number of conductive zones and areas were detected by the electromagnetic system within the boundaries of the survey area. Taken together, they are indicative of a generally flat dipping conductive sheet that conforms somewhat to the topography and is exposed (?) near or at the summit of the various mountain peaks and ridges and along several of the stream cuts. North east to NNW faulting as well as the possible NE faults along the more common drainage direction, may control the near surface orientation of this horizon. There does not appear to be any correlation between magnetic susceptibility and conductance.

CONDUCTORS I & II - (Lines 10 to 90): Conductors I and II, in the north west corner of the survey area, occur along south westerly trending ridges that extend off the peak of Nelson Mountain. They are characteristic of a multi-banded, nearly flat lying conductive horizon (or horizons) that outcrops along the flanks and near the crest of the ridge. Conductances are low for zone I and moderate to high for zone II. Previous staking indicates that these zones, particularly II, may have been the focus of prior exploration activity.

CONDUCTORS III & V - (Lines 120 to 170 and 250 to 291): Conductor III, along the west boundary of the north sheet, occurs near the base of Nelson Mountain along Davis Creek. It may be controlled by the north-south trending fault zone interpreted from the magnetics but is likely stratigraphically related to Conductor II. Conductance is also in the moderate to high range.

Conductor V is in a similar setting to III but occurs to the south of Lightning Creek, at the base of Grub Mountain along Last Chance Creek. Conductances are in the moderate range. Note that both zones III and V have been staked previously.

CONDUCTOR IV - (Lines 221 to 260): This is classed as a possible bedrock conductor but may actually be cultural in origin as it falls over the eastern outskirts of the village of Stanley. and is along the extension of the power line that follows Provincial Highway # 26 out of Stanley. Ground checks are recommended on this zone.

CONDUCTIVE AREAS VII, VIII, VIIIa, VIIIb - (Lines 141 to 170 and 271 to 400): These conductive areas occur near the summits of Mount Amador (VII) and Mount Pinkerton (VIII) with areas VIIIa and VIIIb along the south west and south east flanks of Mount Pinkerton. They indicate that the conductive horizons are not necessarily flat lying but undulate somewhat with topography. With the exception of VIIIa, each area appears to extend beyond the survey boundaries. Conductances fall into a moderate to high range.

CONDUCTIVE AREA IX - (Lines 350 to 420): Conductive area IX occurs along the base of Houseman Creek near the junction with Lightning and Milk Ranch Pass Creeks. It also falls just north of the intersection of interpreted NNW and NE faults with Houseman Creek probably an extension of the NE fault system. The two churn drill holes along Lightning Creek were sunk just to the south of this conductive area. Conductances are low to the west of the interpreted fault line but moderate to the east of the fault along the east edge (i.e., uphill edge) of the conductive area. Careful mapping along Houseman Creek should disclose the cause of the anomalous response.

CONDUCTIVE ZONES X, Xa - (Lines 560 to 630): This conductive area represents several short zones near the summit of Milk Ranch Mountain both to the west (X and Xa) and east (unmarked) of the interpreted NNE fault system that extends to the south central edges of the survey. Conductances tend to be low except to the east of the fault where they are slightly higher. The latter zone occurs at the upper reaches of a south easterly creek cut that leads into the Little Swift River.

CONDUCTIVE AREA XI - (Lines 460 to 610): Conductive area XI occurs at the intersection of interpreted NNE and N-S faults along the west flank of the eastern ridge off Elk Mountain. Conductances are low and the area is probably a 'leaner' portion of the stratigraphic horizon common (?) to Conductors VIII through X. Conductor XII appears to be an isolated segment of the same sheet. Its conductance may be enhanced by slight errors in determining inphase base levels.

5.5 APPARENT RESISTIVITY

The Apparent Resistivity map gives what the writer considers to be the best depiction of the distribution of conductive zones and areas throughout the survey, certainly better than the profile maps and far superior to the VLF map. In particular, it indicates that the horizon as represented by Conductive Area XI may continue beyond the east edge of the survey boundary and that zones IV and V may be part of the same zone not necessarily confined to the creek valley.

A compilation of the Apparent Resistivity data with available geology on a topographic base map might indicate additional possible exploration targets within the area.

5.6 VLF - EM TOTAL FIELD

The VLF map shows some correlation with the magnetic trends but topographic effects negate the usefulness of the data. This is generally true for all airborne VLF surveys flown in mountainous terrain.

5.7 CONCLUSIONS

The Apparent Resistivity map, when considered together with the topographic map, leads the writer to conclude that the conductive zones and areas detected in this survey represent an gently undulating conductive stratum (or strata) between roughly the 4600 to 5600 foot elevations. Erosion has exposed these beds around the mountain sides and along the base of several of the creeks. There is no correlation evident between the magnetic and electrical data.

5.8 **RECOMMENDATIONS**

On the bases of the results of this airborne survey, no further geophysical work can be recommended over the area. The resistivity data, together with any available geology, should be compiled on a topographic map of the area. Careful geologic mapping, particularly along the creek beds, should be sufficient to explain most of the conductive anomalies.

Without some knowledge of the client's mineralization criteria or exploration objectives in this area, recommendations on exploration targets or priorities cannot be made.

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
PROVINCE OF ONTARIO

George Podolsky
for
AERODAT LIMITED
August 17, 1987

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APPENDIX I

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat four frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies and the lower frequency horizontal coplanar coil pair is operated at a frequency approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for a non-magnetic vertical half-plane model on the accompanying phasor diagram. Other physical models will show the same trend but different quantitative relationships.

The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth at selected anomalies. The results of this calculation are presented in table form in Appendix II and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, may be strongly magnetic, its conductivity and thickness may vary with depth and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

Most overburden will have an indicated conductance of less than 2 mhos; however, more conductive clays may have an apparent conductance of say 2 to 4 mhos. Also in the low conductance range will be electrolytic conductors in faults and shears.

The higher ranges of conductance, greater than 4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to sulphide or graphite bearing rocks.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors; sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant consideration in association with minor conductive sulphides, and the electromagnetic response only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly, but minor accessory sulphide mineralization could provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization; however, a moderate to low conductance value does not rule out the possibility of significant economic mineralization.

Geometrical Considerations

Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes. As the dip of the conductor decreased from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.

As the thickness of the conductor increases, induced current flow across the thickness of the conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible. As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1*.

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair.

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor; a pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles. In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is elliptically polarized in the vicinity of electrical conductors. The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component of the polarization ellipse.

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measureable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground the depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field response is an indicator of the existence and position of a conductivity anomaly. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The amplitude of the quadrature response, as opposed to shape is function of target conductance and depth as well as the conductivity of the overburden and host rock. As the primary field travels down to the conductor through conductive material it is both attenuated and phase shifted in a negative sense. The secondary field produced by this altered field at the target also has an associated phase shift. This phase shift is positive and is larger for relatively poor conductors. This secondary field is attenuated and phase shifted in a negative sense during return travel to the surface. The net effect of these 3 phase shifts determine the phase of the secondary field sensed at the receiver.

A relatively poor conductor in resistive ground will yield a net positive phase shift. A relatively good conductor in more conductive ground will yield a net negative phase shift. A combination is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

A net positive phase shift combined with the geometrical cross-over shape will lead to a positive quadrature response on the side of approach and a negative on the side of departure. A net negative phase shift would produce the reverse. A further sign reversal occurs with a 180 degree change in instrument orientation as occurs on reciprocal line headings. During digital processing of the quadrature data for map presentation this is corrected for by normalizing the sign to one of the flight line headings.

APPENDIX II

ANOMALY LIST

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
8	10	A	2	12.8	6.3	2.9	0	781
8	10	B	0	10.7	20.5	0.4	0	539
8	20	A	2	11.7	5.1	3.3	0	708
8	20	B	0	6.7	15.4	0.2	0	553
8	20	C	0	8.3	11.9	0.5	0	608
8	20	D	0	12.8	16.6	0.7	0	658
8	20	E	2	16.6	9.5	2.5	0	680
8	30	A	1	14.7	11.9	1.5	0	633
8	30	B	2	18.3	11.6	2.3	0	605
8	30	C	0	8.9	13.3	0.5	0	582
8	30	D	2	11.2	6.0	2.4	0	667
8	40	A	2	17.1	7.4	3.8	0	646
8	40	B	1	12.0	8.4	1.7	0	643
8	40	C	1	9.0	5.5	1.9	0	610
8	50	A	1	9.7	5.9	1.9	0	621
8	50	B	1	10.8	9.0	1.3	0	617
8	50	C	0	8.1	8.1	0.9	0	661
8	50	D	2	12.7	8.0	2.0	0	681
8	50	E	3	12.8	3.9	5.5	0	680
8	60	A	2	7.4	2.8	3.4	0	715
8	60	B	2	7.7	3.2	3.0	0	904
8	60	C	3	20.3	7.1	5.3	0	627
8	60	D	2	18.2	9.1	3.2	0	671
8	60	E	0	8.4	15.4	0.4	0	521
8	60	F	0	8.2	12.7	0.5	0	594
8	60	G	0	7.4	7.4	0.8	0	583
8	70	A	2	17.4	10.6	2.4	0	652
8	70	B	4	36.5	10.7	8.0	0	613
8	70	C	3	29.2	8.3	7.8	0	705
8	70	D	5	24.4	3.9	16.1	0	639
8	70	E	1	5.3	2.8	1.9	0	857
8	70	F	2	10.8	5.8	2.4	0	646
8	80	A	4	25.8	5.2	12.0	0	617
8	80	B	2	17.1	7.3	3.8	0	684
8	90	A	2	10.2	4.2	3.4	0	618
8	90	B	1	10.9	9.2	1.3	0	654

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
8	90	C	3	14.9	4.6	5.7	0	668
8	90	D	2	12.0	5.5	3.1	0	667
8	100	A	2	7.7	3.3	2.9	0	853
8	100	B	2	8.1	3.1	3.5	0	634
8	110	A	0	4.7	4.2	0.8	0	612
8	110	B	0	4.2	5.5	0.4	0	570
8	110	C	2	12.5	5.6	3.2	0	758
8	120	A	3	9.4	3.0	4.7	0	783
8	130	A	1	7.2	5.3	1.3	0	664
8	130	B	0	3.4	5.6	0.3	0	584
8	141	A	4	47.0	11.7	10.8	0	594
8	141	B	3	35.7	13.4	5.8	0	593
8	141	C	3	26.6	10.0	5.2	0	617
8	141	D	1	7.5	6.9	1.0	0	768
8	141	E	0	11.2	14.9	0.7	0	647
8	141	F	3	10.9	3.8	4.4	0	871
8	141	G	2	7.7	4.1	2.1	0	632
8	150	A	3	15.4	4.7	5.8	0	674
8	150	B	0	8.6	14.9	0.4	0	581
8	150	C	0	6.0	10.8	0.3	0	670
8	150	D	0	6.7	12.3	0.3	0	602
8	150	E	2	11.8	5.3	3.2	0	686
8	150	F	3	30.2	8.9	7.5	0	617
8	160	A	3	36.9	12.8	6.5	0	567
8	160	B	3	33.4	13.0	5.4	0	577
8	160	C	0	4.7	8.2	0.3	0	662
8	160	D	0	10.2	12.5	0.7	0	633
8	160	E	0	11.7	12.6	0.9	0	647
8	160	F	0	6.0	8.6	0.4	0	713
8	160	G	3	14.5	3.8	7.1	0	638
8	160	H	5	28.6	4.6	16.7	0	599
8	170	A	2	10.8	5.8	2.4	0	614
8	170	B	0	5.2	9.7	0.3	0	705
8	170	C	0	6.1	9.1	0.4	0	715
8	170	D	1	14.0	12.9	1.2	0	625
8	170	E	0	14.5	17.3	0.9	0	585
8	170	F	0	7.6	11.9	0.4	0	575

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
8	180	A	0	9.7	11.1	0.8	0	575
8	180	B	0	11.3	15.6	0.6	0	611
8	180	C	0	8.4	14.8	0.4	0	610
8	180	D	0	7.7	13.3	0.4	0	628
9	190	A	0	10.2	15.8	0.5	0	595
9	190	B	1	11.7	11.4	1.1	0	648
9	200	A	0	6.8	8.1	0.6	0	683
9	200	B	0	12.6	17.2	0.7	0	570
9	200	C	0	15.8	20.7	0.8	0	575
9	200	D	1	4.8	2.6	1.7	0	823
9	200	E	0	3.5	8.2	0.1	0	532
9	210	A	1	6.2	4.4	1.3	0	605
10	221	A	2	7.6	4.2	2.0	0	715
10	230	A	2	14.4	7.7	2.7	0	620
10	240	A	1	7.9	4.7	1.8	0	754
10	240	B	1	7.9	4.7	1.8	0	754
10	240	C	0	5.2	5.7	0.6	0	687
10	240	D	0	5.2	5.7	0.6	0	687
10	240	E	2	10.2	5.7	2.2	0	595
10	240	F	2	10.2	5.6	2.3	0	595
10	250	A	1	9.9	6.3	1.8	0	673
10	250	B	1	9.9	6.5	1.7	0	671
10	250	C	1	11.2	8.3	1.5	0	624
10	250	D	1	11.2	8.3	1.5	0	624
10	250	E	0	9.4	11.8	0.7	0	588
10	250	F	0	9.4	11.8	0.7	0	588
10	250	G	1	9.4	6.8	1.5	0	684
10	250	H	1	9.4	6.8	1.5	0	684
10	250	J	2	9.5	4.5	2.7	0	723
10	250	K	2	9.5	4.5	2.7	0	723
10	260	A	3	20.2	6.6	5.8	0	621
10	260	B	2	10.3	4.0	3.7	0	662
11	271	A	3	18.7	5.4	6.7	0	842
11	271	B	3	19.5	5.4	7.2	0	622
11	271	C	0	7.1	11.2	0.4	0	614

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
11	271	D	0	5.2	11.2	0.2	0	645
11	271	E	1	15.3	12.9	1.4	0	643
11	271	F	0	7.4	11.6	0.4	0	572
11	281	A	2	27.7	13.6	3.7	0	626
11	281	B	0	10.2	10.9	0.9	0	662
11	281	C	0	11.0	11.6	0.9	0	636
11	281	D	3	12.6	3.4	6.5	0	789
11	281	E	2	7.6	3.1	3.1	0	674
11	291	A	2	8.9	3.6	3.3	0	667
11	291	B	0	5.2	7.7	0.4	0	661
11	291	C	0	9.9	12.9	0.7	0	623
11	291	D	2	20.9	11.4	2.9	0	624
11	291	E	3	23.0	8.3	5.3	0	632
11	291	F	3	37.0	11.5	7.5	0	680
11	291	G	3	31.1	12.6	5.0	0	660
11	291	H	3	28.0	11.2	4.9	0	665
11	291	J	3	36.1	13.5	5.8	0	667
11	300	A	3	28.6	12.7	4.3	0	658
11	300	B	4	28.8	5.2	14.3	0	592
11	300	C	3	19.5	5.8	6.5	0	642
11	300	D	0	10.9	11.4	0.9	0	626
11	300	E	1	13.3	13.3	1.1	0	624
11	300	F	0	6.7	7.3	0.7	0	643
11	300	G	2	8.6	3.9	2.8	0	760
11	310	A	0	2.8	7.9	0.1	0	608
11	310	B	0	6.2	7.3	0.6	0	673
11	310	C	3	23.3	9.2	4.7	0	511
11	310	D	3	23.3	7.7	6.0	0	550
11	310	E	4	41.2	11.9	8.5	0	593
11	310	F	4	70.9	14.8	15.3	0	596
11	310	G	5	71.4	13.2	18.0	0	604
11	310	H	4	39.9	10.9	9.1	0	626
11	321	A	0	6.1	9.2	0.4	0	589
11	321	B	0	6.0	8.7	0.4	0	600
11	321	C	0	6.8	12.0	0.3	0	566
11	321	D	0	6.6	12.1	0.3	0	607
11	321	E	0	6.8	9.9	0.5	0	672
11	321	F	2	16.6	11.1	2.1	0	617
11	321	G	2	16.4	8.0	3.1	0	598
11	321	H	2	16.2	6.7	3.9	0	583

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
11	321	J	2	17.7	10.2	2.6	0	644
11	321	K	2	28.5	13.6	3.9	0	626
11	321	M	3	39.6	17.0	5.0	0	615
11	321	N	3	42.3	16.7	5.7	0	644
11	321	O	3	27.2	12.2	4.2	0	703
11	321	P	2	22.4	14.8	2.3	0	647
11	321	Q	3	28.2	10.6	5.3	0	611
11	321	R	2	32.5	16.4	3.8	0	626
11	330	A	3	26.4	8.7	6.2	0	709
11	330	B	1	10.9	10.3	1.1	0	597
11	330	C	3	20.9	6.9	5.8	0	722
11	330	D	3	14.7	5.9	4.0	0	681
11	330	E	0	10.2	11.6	0.8	0	611
11	331	A	2	9.6	5.7	2.0	0	726
11	331	B	3	26.4	9.1	5.9	0	699
11	331	C	4	43.4	8.7	14.0	0	624
11	331	D	4	40.2	8.4	13.0	0	653
11	331	E	3	21.7	7.7	5.3	0	753
11	340	A	2	16.4	8.7	2.8	0	637
11	340	B	2	13.4	7.4	2.5	0	710
11	340	C	1	12.0	9.3	1.5	0	626
11	340	D	2	11.4	5.3	3.0	0	653
11	340	E	0	9.3	9.9	0.9	0	649
11	350	A	0	6.7	8.1	0.6	0	583
11	350	B	2	14.5	5.9	3.9	0	625
11	350	C	3	19.9	7.8	4.5	0	597
11	350	D	3	20.4	6.0	6.7	0	599
11	350	E	3	19.3	5.1	7.6	0	701
11	360	A	2	16.7	7.4	3.6	0	637
11	360	B	2	17.4	7.6	3.7	0	693
11	360	C	4	25.2	6.3	8.9	0	613
11	360	D	4	23.7	5.4	9.9	0	673
11	360	E	3	13.6	5.3	4.0	0	671
11	360	F	1	8.6	7.8	1.0	0	678
11	360	G	3	15.6	4.8	5.8	0	639
11	360	H	0	7.0	6.6	0.9	0	599
11	360	J	1	6.9	6.0	1.0	0	745
11	370	A	0	9.4	10.8	0.8	0	643
11	370	B	0	9.8	11.5	0.8	0	514

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
11	370	C	0	10.0	12.0	0.7	0	563
11	370	D	3	14.6	3.6	7.7	0	639
11	370	E	2	14.2	7.2	2.8	0	670
11	370	F	3	21.2	7.2	5.6	0	662
11	370	G	4	24.3	6.1	8.8	0	639
11	380	A	3	29.9	9.1	7.2	0	681
11	380	B	3	31.0	10.5	6.3	0	601
11	380	C	3	23.2	10.3	4.0	0	610
11	380	D	2	13.4	7.9	2.3	0	623
11	380	E	2	10.7	5.5	2.5	0	577
11	380	F	1	11.9	10.3	1.3	0	587
11	390	A	0	7.2	12.1	0.4	0	591
11	390	B	0	5.4	11.5	0.2	0	534
11	390	C	0	7.2	7.7	0.8	0	727
11	390	D	1	12.8	11.4	1.3	0	581
11	390	E	1	16.1	12.6	1.6	0	532
11	390	F	1	14.9	11.8	1.6	0	716
11	390	G	1	13.6	9.5	1.8	0	614
11	390	H	2	16.0	8.6	2.7	0	645
11	390	J	3	24.0	7.5	6.5	0	582
11	390	K	3	21.3	5.8	7.5	0	591
11	390	M	3	21.4	6.0	7.3	0	662
11	390	N	4	31.6	7.8	9.7	0	661
11	390	O	3	29.7	9.4	6.8	0	643
11	400	A	3	13.7	4.9	4.5	0	693
11	400	B	3	15.6	5.8	4.5	0	682
11	400	C	0	7.7	8.0	0.8	0	665
11	400	D	0	7.0	9.0	0.6	0	595
11	400	E	0	7.2	9.4	0.6	0	602
11	400	F	2	16.4	10.1	2.3	0	621
11	400	G	1	7.1	5.8	1.1	0	771
11	410	A	0	10.5	11.4	0.9	0	559
11	410	B	0	7.9	7.7	0.9	0	581
11	410	C	1	7.5	6.2	1.1	0	725
11	410	D	0	8.3	9.5	0.7	0	631
11	420	A	0	8.3	9.8	0.7	0	680
11	420	B	1	6.4	3.7	1.8	0	620
11	430	A	0	8.2	8.0	0.9	0	634
11	440	A	0	5.4	9.8	0.3	0	654

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
11	450	A	0	9.1	9.1	0.9	0	614
11	450	B	0	8.1	10.8	0.6	0	570
11	460	A	1	16.3	14.9	1.3	0	614
11	460	B	1	14.7	16.4	1.0	0	592
11	460	C	0	6.7	9.6	0.5	0	598
12	470	A	0	8.2	15.4	0.3	0	578
12	470	B	1	11.7	11.1	1.1	0	631
12	470	C	0	6.7	10.4	0.4	0	655
12	470	D	0	9.7	14.9	0.5	0	582
12	470	E	1	14.7	14.3	1.2	0	641
12	470	F	2	17.6	12.0	2.0	0	635
12	470	G	1	15.2	13.7	1.3	0	619
12	480	A	1	13.4	14.0	1.0	0	643
12	480	B	1	13.6	9.8	1.7	0	672
12	480	C	1	13.2	14.1	1.0	0	634
12	480	D	1	12.1	12.8	1.0	0	578
12	480	E	2	13.8	9.0	2.0	0	582
12	480	F	0	5.3	9.7	0.3	0	573
12	491	A	0	6.9	9.7	0.5	0	715
12	491	B	1	8.1	7.5	1.0	0	657
12	491	C	2	11.6	6.6	2.3	0	590
12	491	D	1	14.4	10.4	1.8	0	606
12	500	A	5	17.4	2.0	22.9	0	785
12	500	B	0	11.3	13.8	0.8	0	598
12	500	C	0	12.3	16.0	0.7	0	600
12	500	D	0	12.8	16.2	0.8	0	587
12	500	E	1	15.5	12.9	1.5	0	614
12	500	F	2	11.1	4.9	3.2	0	608
12	500	G	0	6.9	9.9	0.5	0	625
12	500	H	1	9.3	6.5	1.6	0	713
12	500	J	1	9.1	6.9	1.4	0	671
12	510	A	1	7.6	4.6	1.8	0	643
12	510	B	0	8.2	12.6	0.5	0	603
12	510	C	0	7.3	8.2	0.7	0	621
12	510	D	2	18.7	11.2	2.5	0	605
12	510	E	5	25.6	3.8	18.1	0	671
12	520	A	1	8.4	6.4	1.3	0	709

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
12	520	B	2	9.4	4.1	3.0	0	795
12	520	C	0	4.3	8.6	0.2	0	612
12	530	A	0	8.1	10.4	0.6	0	623
12	530	B	2	12.2	7.5	2.1	0	705
12	530	C	1	13.5	10.5	1.5	0	645
12	540	A	2	14.7	9.1	2.2	0	679
12	540	B	2	13.7	6.1	3.4	0	686
12	540	C	1	10.2	7.2	1.6	0	680
12	540	D	0	8.9	9.4	0.8	0	636
12	540	E	0	8.5	10.6	0.6	0	670
12	540	F	1	12.1	12.5	1.0	0	603
12	540	G	0	6.7	10.6	0.4	0	595
12	540	H	0	7.7	9.7	0.6	0	604
12	550	A	0	5.6	6.8	0.6	0	551
12	550	B	0	4.7	7.7	0.3	0	643
12	550	C	0	7.6	12.0	0.4	0	609
12	550	D	2	20.7	13.0	2.4	0	572
12	550	E	2	17.9	12.2	2.1	0	597
12	550	F	1	12.9	10.6	1.4	0	669
12	550	G	2	11.1	5.2	2.9	0	663
12	550	H	2	14.1	6.0	3.6	0	652
12	550	J	2	11.6	5.7	2.8	0	716
12	550	K	2	12.1	7.0	2.2	0	636
12	550	M	1	13.5	9.1	1.9	0	646
12	550	N	1	11.0	10.3	1.1	0	635
12	560	A	2	7.6	3.9	2.2	0	701
12	560	B	2	9.4	5.3	2.1	0	682
12	560	C	1	10.3	6.5	1.9	0	711
12	560	D	1	8.0	6.1	1.3	0	704
12	570	A	0	8.5	8.7	0.9	0	563
12	570	B	0	4.7	7.1	0.4	0	574
12	570	C	1	12.0	11.1	1.2	0	620
12	570	D	0	7.9	8.0	0.9	0	626
12	570	E	2	10.2	5.1	2.6	0	670
12	570	F	2	11.6	5.7	2.8	0	614
12	570	G	2	14.6	7.8	2.7	0	627
12	570	H	2	18.9	10.7	2.7	0	600
12	570	J	0	6.3	8.1	0.5	0	635
12	580	A	1	11.7	7.7	1.8	0	623

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
12	580	B	1	8.1	4.9	1.8	0	654
12	580	C	1	9.1	8.7	1.0	0	676
12	580	D	1	13.3	10.6	1.5	0	627
12	580	E	1	13.9	10.5	1.6	0	628
12	580	F	0	8.1	8.3	0.8	0	669
12	580	G	0	7.8	10.0	0.6	0	600
12	580	H	1	7.6	6.7	1.0	0	610
12	580	J	0	8.1	8.2	0.9	0	589
12	590	A	0	8.8	10.4	0.7	0	585
12	590	B	0	5.5	6.4	0.6	0	571
12	590	C	2	27.5	21.3	2.0	0	581
12	590	D	2	29.1	17.8	2.8	0	599
12	590	E	3	21.3	7.9	5.0	0	619
12	590	F	3	24.4	10.9	4.0	0	580
12	590	G	1	12.4	9.7	1.5	0	601
12	590	H	1	17.2	13.7	1.6	0	626
12	590	J	0	6.9	9.3	0.5	0	578
12	600	A	0	6.5	6.2	0.9	0	634
12	600	B	0	6.1	6.5	0.7	0	714
12	600	C	3	12.5	4.8	4.0	0	661
12	600	D	2	12.5	6.5	2.6	0	621
12	600	E	2	11.5	5.0	3.3	0	649
12	600	F	2	8.8	3.8	3.0	0	798
12	600	G	0	8.2	9.7	0.7	0	585
12	610	A	2	10.1	5.1	2.5	0	667
12	610	B	0	7.6	9.6	0.6	0	687
12	610	C	0	8.0	11.6	0.5	0	615
12	610	D	0	7.3	10.4	0.5	0	629
12	620	A	4	7.8	1.5	8.9	0	781
12	620	B	0	6.5	6.0	0.9	0	701
12	620	C	1	8.4	7.8	1.0	0	666
12	620	D	1	8.4	7.1	1.1	0	664
12	620	E	1	8.1	6.8	1.1	0	681
12	630	A	1	12.3	11.1	1.2	0	576
12	630	B	1	12.3	11.0	1.2	0	596
12	630	C	2	20.9	13.0	2.5	0	547
12	630	D	2	14.2	9.2	2.0	0	660
12	640	A	2	9.7	4.4	2.9	0	686
12	640	B	2	7.0	2.8	3.1	0	888

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

J8703

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS
12	640	C	0	5.0	7.3	0.4	0	598
12	640	D	0	5.2	6.8	0.5	0	615
12	650	A	0	8.2	12.9	0.4	0	534

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

APPENDIX III

CERTIFICATE OF QUALIFICATIONS

I, GEORGE PODOLSKY, certify that: -

1. I am registered as a Professional Engineer in the Province of Ontario and work as a Professional Geophysicist.

2. I reside at 172 Dunwoody Drive in the town of Oakville, Halton County, Ontario.

3. I hold a B. Sc. in Engineering Physics from Queen's University, having graduated in 1954.

4. I have been continuously engaged in both professional and managerial roles in the minerals industry in Canada and abroad for the past thirty two years.

5. I have been an active member of the Society of Exploration Geophysicists since 1960 and hold memberships on other professional societies involved in the minerals extraction and exploration industry.

6. The accompanying report was prepared from information published by government agencies, materials supplied by Lightning Creek Resources Ltd., and from a review of proprietary geophysical data compiled by Aerodat Ltd. in the course of producing this airborne survey. I have not visited the property.

7. I have no interest, direct or indirect, in the property described nor do I hold securities in Lightning Creek Resources Ltd.

8. I hereby consent to the use of this report in a Statement of Material Facts of the Company and for the preparation of a prospectus for submission to the British Columbia Securities Commission and/or other regulatory authorities.

Signed,

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
PROVINCE OF ONTARIO

Oakville, Ontario

August 17, 1987

George Podolsky, P. Eng.

GEOPOD ASSOCIATES INC.

any other causes which are beyond Aerodat's reasonable control.

(d) Notwithstanding anything to the contrary herein expressly contained or implied Aerodat shall indemnify and save harmless Lightning from and against all losses, cost, damages and demands of any nature whatsoever which may be suffered by or brought against Lightning arising out of and attributable in any manner to any or all operations conducted by Aerodat pursuant to this Agreement.

(e) It is agreed and understood that Aerodat is, while acting under this Agreement, an independent contractor and not acting as an agent or servant of Lightning, and any persons engaged by Aerodat to conduct operations pursuant to the Agreement shall be the employees of Aerodat and not of Lightning.

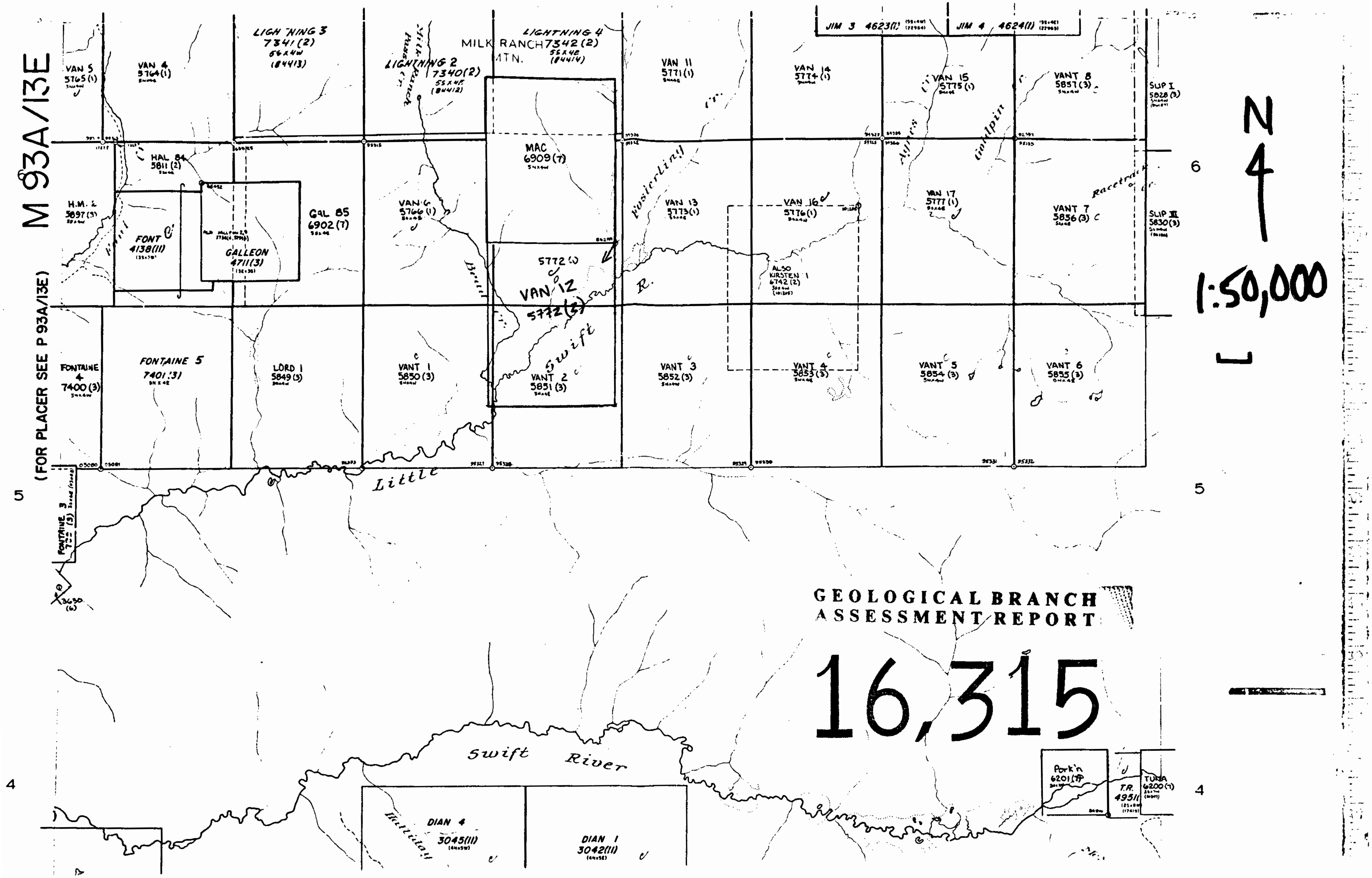
(f) Aerodat carries comprehensive general liability insurance including non-owned automobile liability insurance of $2,000,000 for bodily injury and property damage, and non-owned aircraft liability insurance with combined limit of liability of $2,000,000 bodily injury and property damage, any one occurrence.

(g) All information relating to the survey shall belong exclusively to Lightning and its assigns and Aerodat shall keep such information strictly confidential.

8. CHARGES:

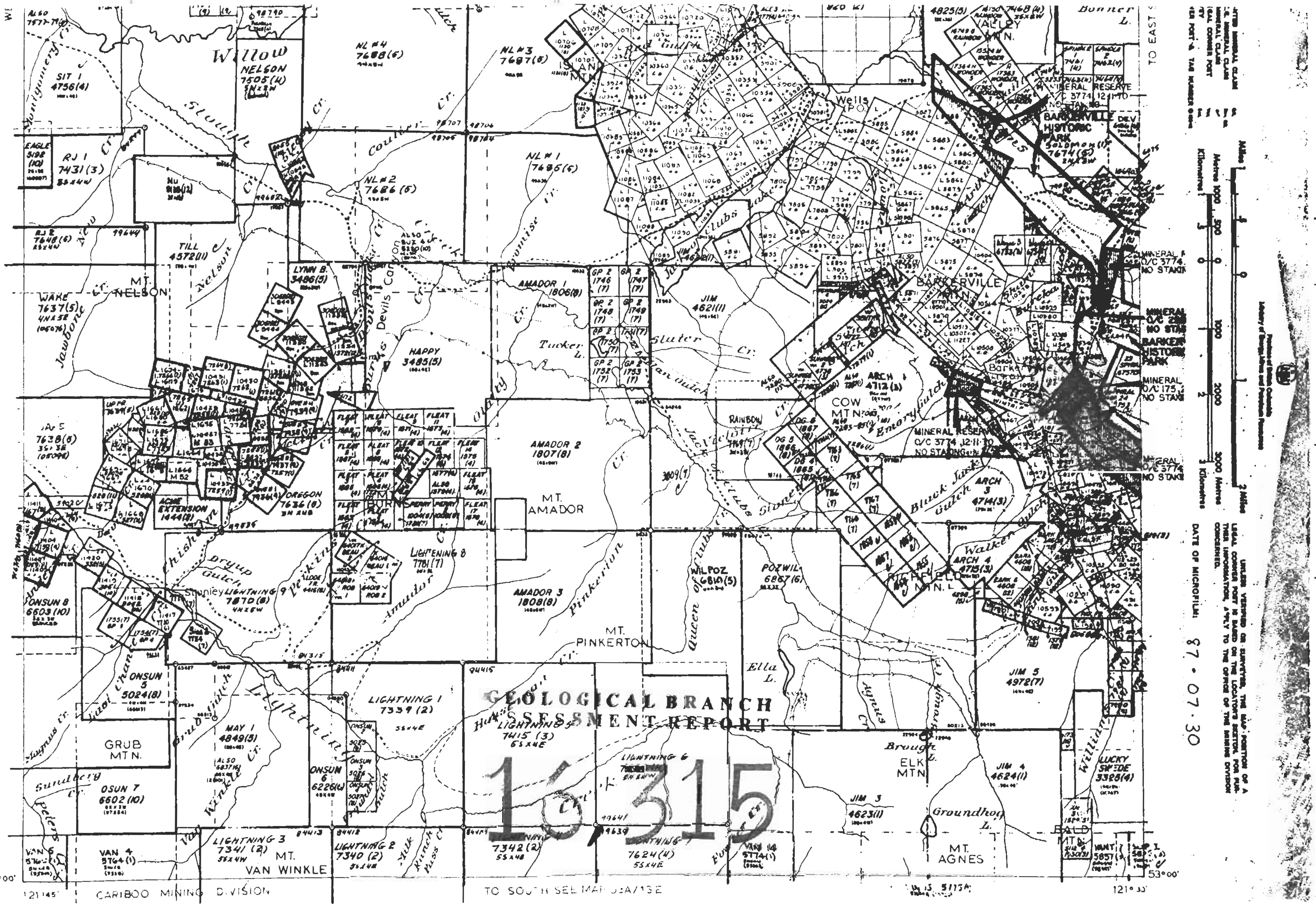
a)	Mobilization/Demobilization	$	3,000.00
b)	Survey charges described above including mobilization/- demobilization, all helicopter charges and data presentation for approximately		
	400 kilometres @ $75.00/line km.	$	30,000.00
	TOTAL	$	33,000.00

J.C. Teezi



M 93A/13E
(FOR PLACER SEE P 93A/13E)
N
1:50,000
LIGHTNING 3 7341 (2)
MILK RANCH MTN.
LIGHTNING 4 7342 (2)
LIGHTNING 2 7340 (2)
JIM 3 4623(1)
JIM 4 4624(1)
VAN 5 5765 (1)
VAN 4 5764 (1)
VAN 11 5771 (1)
VAN 14 5774 (1)
VAN 15 5775 (1)
VANT 8 5857 (3)
SLIP I 5828 (3)
HAL 84 5811 (2)
MAC 6909 (7)
H.M. 2 5897 (3)
FONT 4138(11)
GALLEON 4711(3)
GAL 85 6902 (7)
VAN 6 5766 (1)
VAN 13 5773(1)
VAN 16 5776(1)
VAN 17 5777 (1)
VANT 7 5856 (3)
SLIP II 5830(3)
5772 (1)
VAN 12 5772(1)
ALSO KIRSTEN 1 6742 (2)
FONTAINE 4 7400 (3)
FONTAINE 5 7401 (3)
LORD 1 5849 (3)
VANT 1 5850 (3)
VANT 2 5851 (3)
VANT 3 5852 (3)
VANT 4 5853 (3)
VANT 5 5854 (3)
VANT 6 5855 (3)
Swift
R.
Little
FONTAINE 3
Swift River
DIAN 4 3045(11)
DIAN 1 3042(11)
Pork'n 6201
T.R. 4951
TUNA 6200 (1)
GEOLOGICAL BRANCH
ASSESSMENT REPORT
16,315

93H/4E - 4N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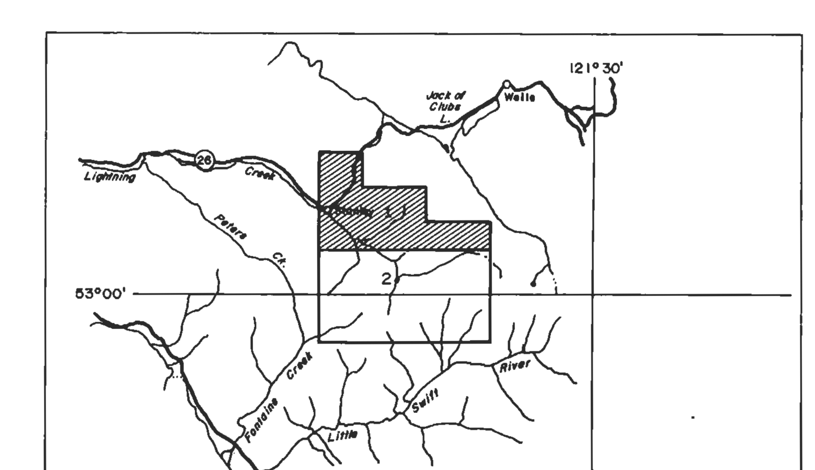
NL #4 7688(6)
NL #3 7687(6)
SIT 1 4756(4)
EAGLE 5192 (10)
RJ 1 7431(3)
NL #2 7686(6)
NL #1 7695(6)
Wells
BARKERVILLE HISTORIC PARK
MINERAL RESERVE
TILL 4572(II)
MT. NELSON
WAKE 7637(5)
LYNN B. 3486(5)
Devils Canyon Cr.
AMADOR 1 1806(8)
Tucker L.
Slater Cr.
JIM 4621(1)
HAPPY 3485(5)
BARKERVILLE MTN.
ARCH 4712(3)
COW MTN.
Emory Gulch
MINERAL RESERVE O/C 3774 12-11-70 NO STAKING
AMADOR 2 1807(8)
MT. AMADOR
Jack of Clubs Cr.
RAINBOW
Black Jack Gulch
ARCH 3 4714(3)
OREGON 7636(6)
ACME EXTENSION 1444(9)
ONSUN 8 6603(10)
Chisholm
Dry Gulch
LIGHTNING 8 7781(7)
AMADOR 3 1808(8)
Pinkerton
WILPOZ 6810(5)
POZWIL 6867(6)
ARCH 4 4715(3)
RICHFIELD MTN.
Walker Gulch
MT. PINKERTON
Amador Cr.
Queen of Cr.
Ella L.
JIM 5 4972(7)
ONSUN 5 5024(8)
GRUB MTN.
MAY 1 4849(5)
LIGHTNING 1 7339 (2)
LIGHTNING 5 7415 (3)
LIGHTNING 6
Lightning
Van Winkle Cr.
ONSUN 6 6226(4)
Brough L.
ELK MTN
JIM 4 4624(1)
LUCKY SWEDE 3325(4)
OSUN 7 6602(10)
JIM 3 4623(1)
Groundhog L.
BALD MTN.
LIGHTNING 3 7341 (2)
MT. VAN WINKLE
LIGHTNING 2 7340 (2)
7342(2)
7624(4)
MT. AGNES
VAN 4 5764(1)
53°00'
121°45'
CARIBOO MINING DIVISION
TO SOUTH SEE MAP 93A/13E
121°30'
TO EAST
Bonner L.
VALLEY MTN.
Solomon
GEOLOGICAL BRANCH ASSESSMENT REPORT
16,315
DATE OF MICROFILM: 87 · 07 · 30
Miles
Kilometres
UNLESS VERIFIED BY SURVEYOR, THE MAP POSITION OF A LEGAL CORNER POST IS BASED ON THE LOCATOR'S SKETCH. FOR FURTHER INFORMATION, APPLY TO THE OFFICE OF THE MINING DIVISION CONCERNED.
Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

N



LIGHTNING CREEK RESOURCES LTD.

BASE MAP

QUESNEL

BRITISH COLUMBIA

(1)

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 , 93H/4
MAP No:	1

J 8703

N

Positioning .... 35 mm TRACKING FILM
Mean flight line spacing .... 150 metres

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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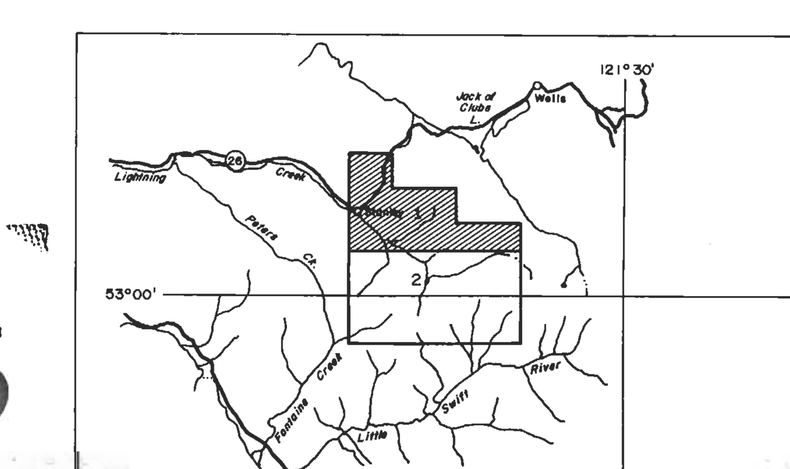


LIGHTNING CREEK RESOURCES LTD.

ELECTROMAGNETIC SURVEY
FLIGHT PATH

QUESNEL
BRITISH COLUMBIA

(2)

SCALE 1/10,000
0 330 660 1320 1/2 mile
0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	Februdry 1987
N.T.S. No.	93A/13 ,93H/4
MAP No.	2

J8703

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315

INTERPRETATION LEGEND

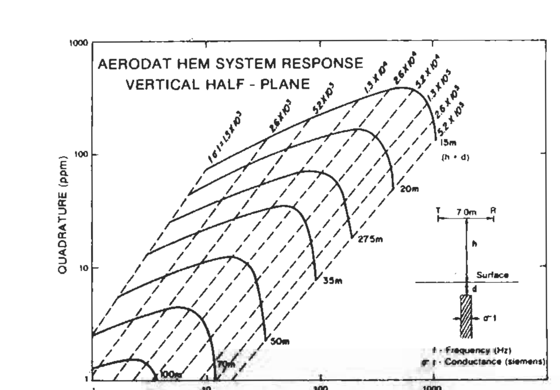
- EM. Anomaly A. in-phase amplitude 7 ppm. Conductivity thickness of 2 mhos. (see code)
- Interpreted bedrock conductor axis
- Conductive Zone
- Possible bedrock conductor axis
- Fault

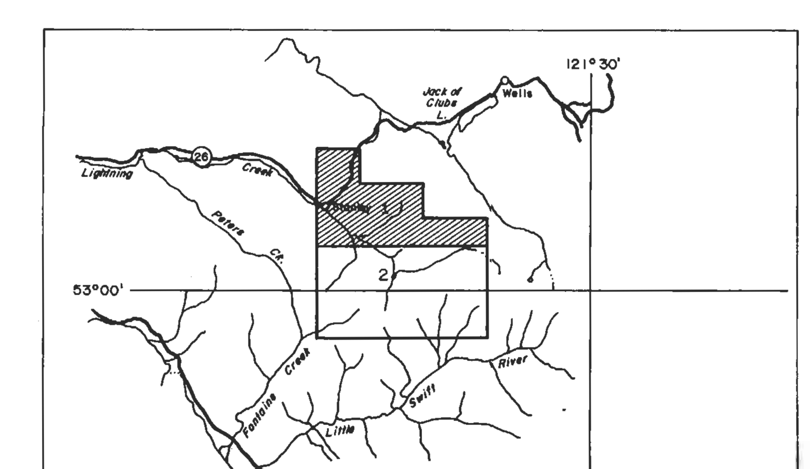
EM RESPONSE

Conductivity thickness in mhos

- 30 –
- 15 - 30
- 8 - 15
- 4 - 8
- 2 - 4
- 1 - 2
- 0 - 1

Positioning .... 35 mm TRACKING FILM
Mean EM sensor elevation .... 30 metres
Mean flight line spacing .... 150 metres





LIGHTNING CREEK RESOURCES LTD.

ELECTROMAGNETIC SURVEY INTERPRETATION

QUESNEL

BRITISH COLUMBIA

(3)

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 ,93H/4
MAP No:	3

J 8703

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315

TOTAL FIELD MAGNETIC CONTOURS

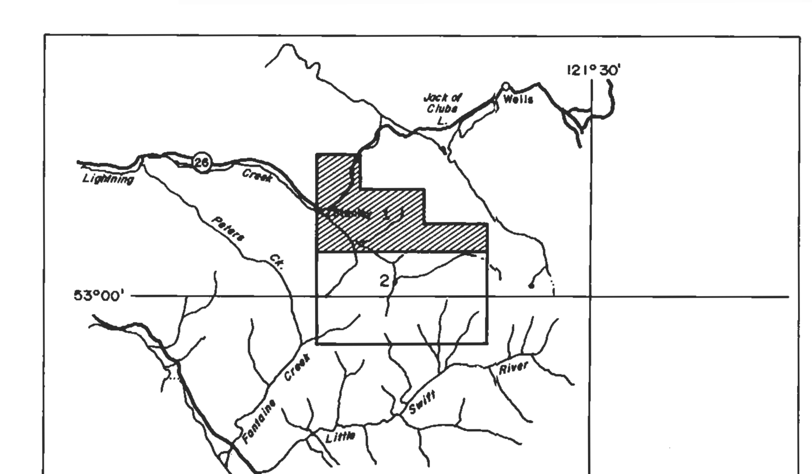
MEAN MAGNETOMETER SENSOR ELEVATION: 48 metres

CONTOUR INTERVAL: 2 gammas

100 gammas

10 gammas

2 gammas



LIGHTNING CREEK RESOURCES LTD.

TOTAL FIELD MAGNETIC CONTOURS

QUESNEL
BRITISH COLUMBIA

(4)

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13, 93H/4
MAP No:	4

J 8703

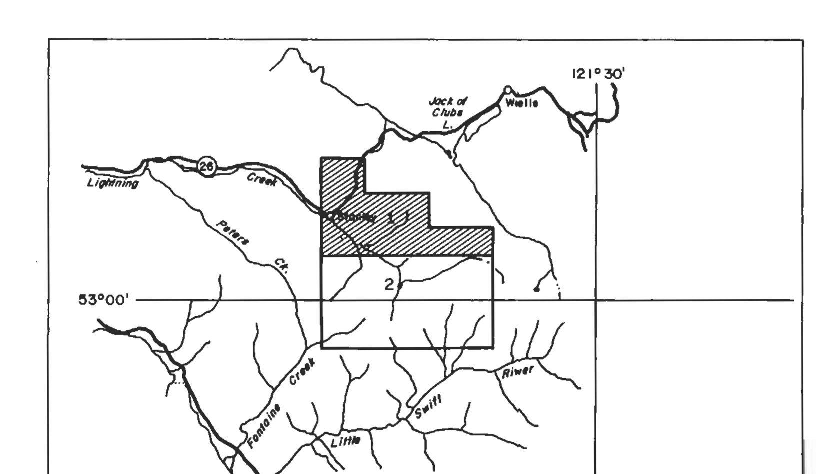
N

VERTICAL MAGNETIC GRADIENT
(CALCULATED FROM TOTAL MAGNETIC FIELD)
CONTOUR INTERVAL:

5 gammas / metre ....
1 gammas / metre ....
.2 gammas / metre ....

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315



LIGHTNING CREEK RESOURCES LTD.

COMPUTED VERTICAL MAGNETIC GRADIENT CONTOURS

QUESNEL (5)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 , 93H/4
MAP No:	5

J 8703

N

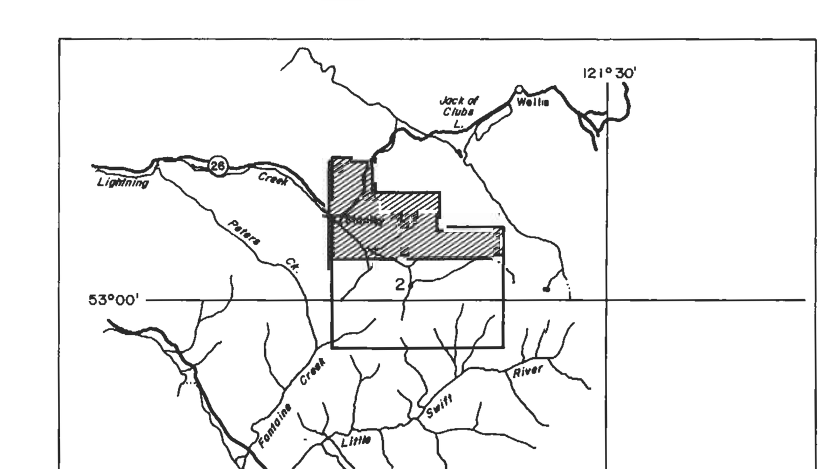
GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315

APPARENT RESISTIVITY CONTOURS

Calculated assuming 200 m conductive layer
(using 4600 Hz coaxial data).

(contour line)	$10^{N.0}$ OHM-M	N = 1,2,3 ... 9
(contour line)	$10^{N.M}$ OHM-M	M = 2,4,6,8
(contour line)	$10^{N.M}$ OHM-M	M = 1,2,3 ... 9



LIGHTNING CREEK RESOURCES LTD.

APPARENT RESISTIVITY CONTOURS

QUESNEL (6)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 ,93H/4
MAP No:	6

J 8703

N

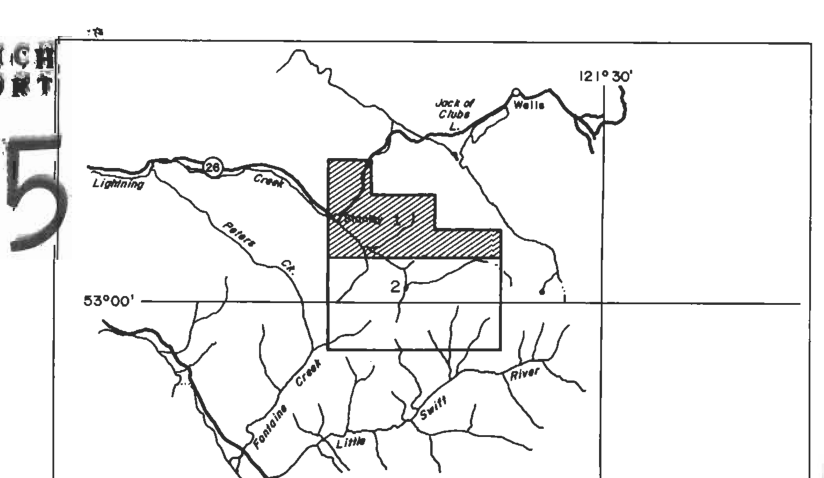
VLF-EM TOTAL FIELD CONTOURS

VLF STATION: NAA (Cutler, Maine) 24.0 kHz.
MEAN VLF-EM
SENSOR ELEVATION: 48 metres

CONTOUR INTERVAL:
50% ....
10% ....
2% ....

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315



LIGHTNING CREEK RESOURCES LTD.

VLF-EM TOTAL FIELD CONTOURS

QUESNEL
BRITISH COLUMBIA

SCALE 1/10,000
0 330 660 1320 1/2 mile
0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 , 93H/4
MAP No:	7

J8703

GEOLOGICAL BRANCH
ASSESSMENT REPORT

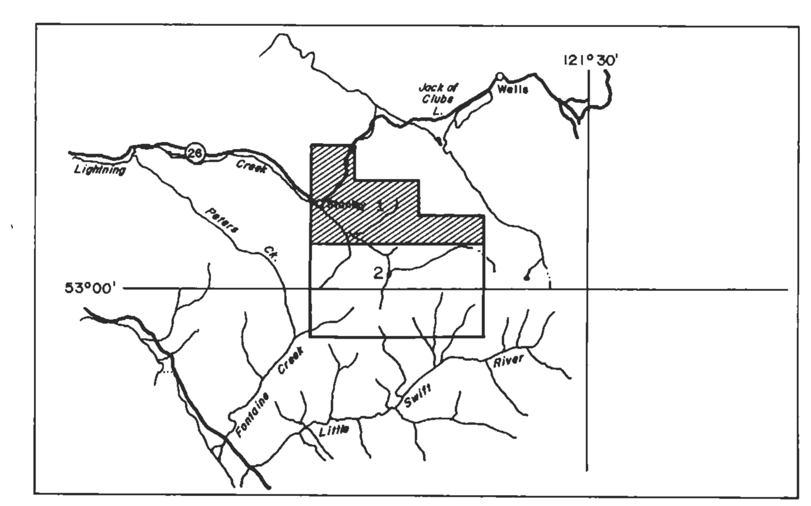
16,315

N

COMPUTED OVERBURDEN THICKNESS

Contour interval - 2 metres

50 metres.........
10 metres.........
2 metres.........



LIGHTNING CREEK RESOURCES LTD.

COMPUTED OVERBURDEN THICKNESS

QUESNEL

BRITISH COLUMBIA

(8)

SCALE 1/10,000

0 330 660 1320 1/2 mile

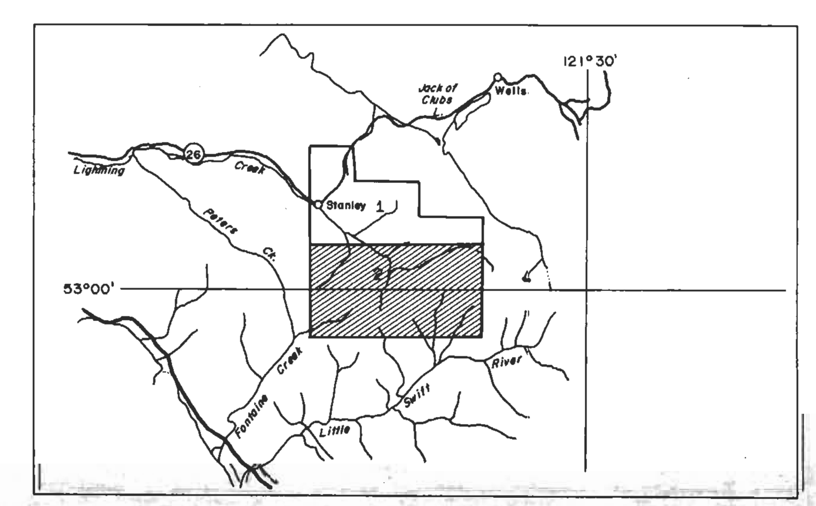
0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 ,93H/4
MAP No:	8

J8703

N



LIGHTNING CREEK RESOURCES LTD.

BASE MAP

QUESNEL (9)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

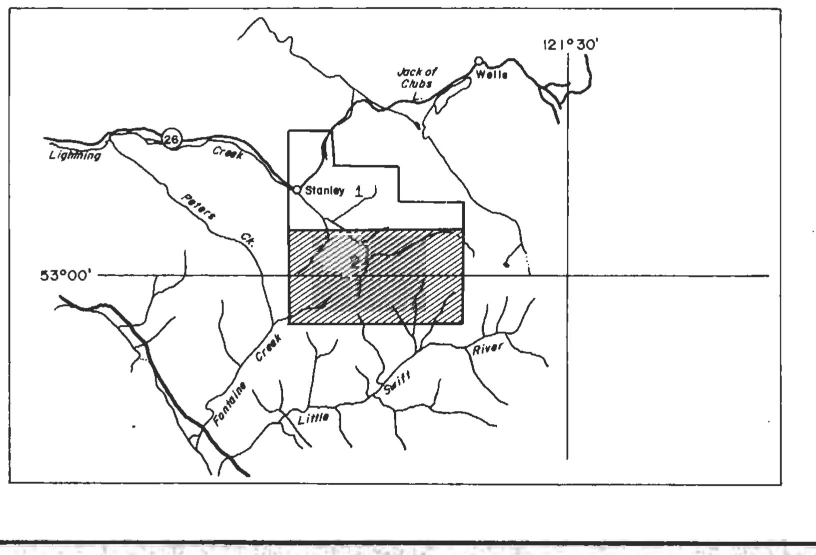
AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 ,93H/4
MAP No:	1"

J8703

N

Positioning .... 35 mm TRACKING FILM
Mean flight line spacing .... 150 metres



LIGHTNING CREEK RESOURCES LTD.

ELECTROMAGNETIC SURVEY
FLIGHT PATH

QUESNEL (10)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile
0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13, 93H/4
MAP No:	2

J 8703

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315

INTERPRETATION LEGEND

- EM. Anomaly A. in-phase amplitude 7 ppm. Conductivity thickness of 2 mhos. (see code)
- Interpreted bedrock conductor axis
- Conductive Zone
- Possible bedrock conductor axis
- Fault

EM RESPONSE

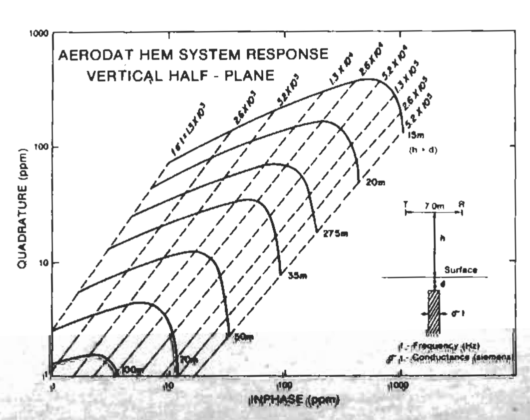
Comductivity thickness in mhos

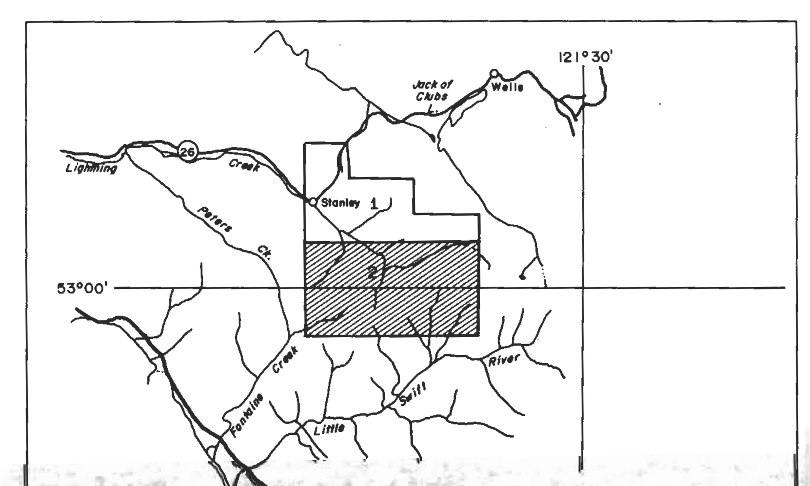
- 30 →
- 15 - 30
- 8 - 15
- 4 - 8
- 2 - 4
- 1 - 2
- 0 - 1

Positioning .... 35 mm TRACKING FILM

Mean EM sensor elevation .... 30 metres

Mean flight line spacing .... 150 metres





LIGHTNING CREEK RESOURCES LTD.

ELECTROMAGNETIC SURVEY INTERPRETATION

QUESNEL

BRITISH COLUMBIA

(11)

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 , 93H/4
MAP No:	3

J 8703

TOTAL FIELD MAGNETIC CONTOURS

MEAN MAGNETOMETER SENSOR ELEVATION: 48 metres

CONTOUR INTERVAL: 2 gammas

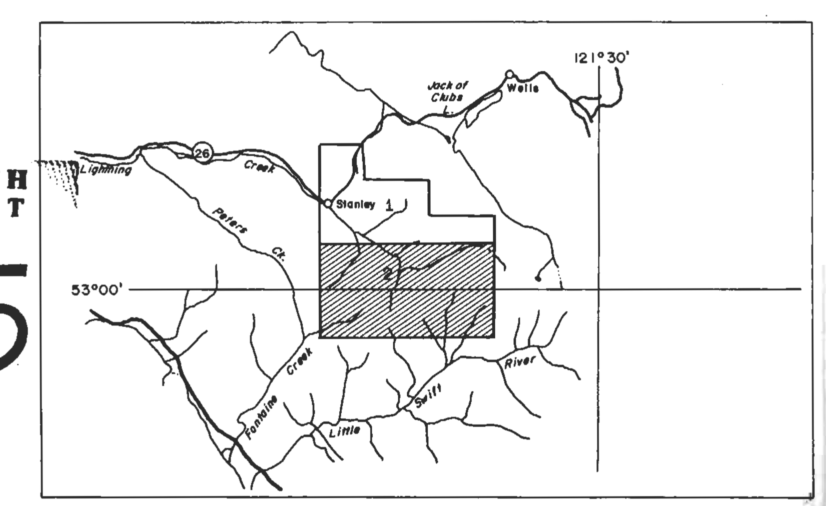
100 gammas

10 gammas

2 gammas

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,315



LIGHTNING CREEK RESOURCES LTD.

TOTAL FIELD MAGNETIC CONTOURS

QUESNEL (12)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

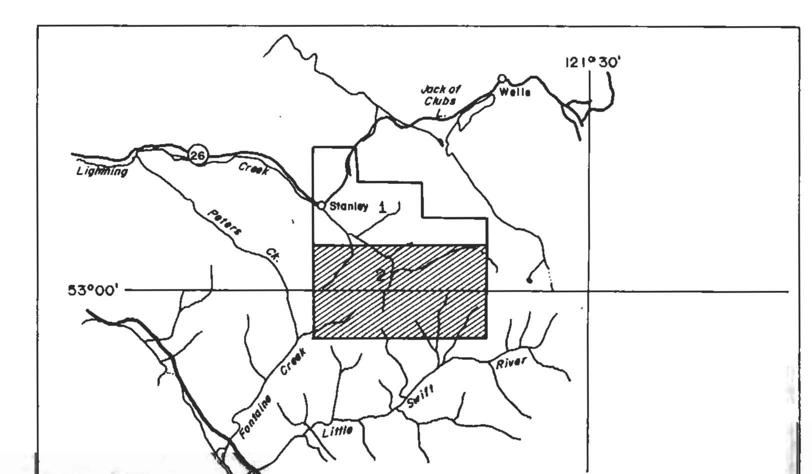
DATE:	February 1987
N.T.S. No:	93A/13, 93H/4
MAP No:	4

J8703

VERTICAL MAGNETIC GRADIENT

(CALCULATED FROM TOTAL MAGNETIC FIELD)
CONTOUR INTERVAL:

5 gammas / metre ....
1 gammas / metre ....



LIGHTNING CREEK RESOURCES LTD.

COMPUTED VERTICAL MAGNETIC GRADIENT CONTOURS

QUESNEL (13)

BRITISH COLUMBIA

SCALE 1/10,000

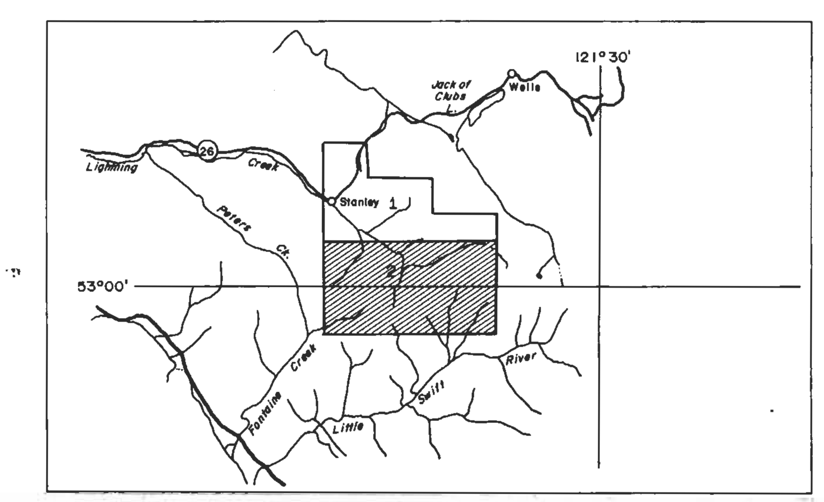
0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13, 93H/4
MAP No:	5

J8703



APPARENT RESISTIVITY CONTOURS

Calculated assuming 200 m conductive layer (using 4600 Hz coaxial data).

- 10^{N0} OHM-M — N 1,2,3, 9
- 10^{NM} OHM-M — M 2,4,6,8
- 10^{NM} OHM-M — M 1,2,8, 9

GEOLOGICAL BRANCH ASSESSMENT REPORT

16,315

LIGHTNING CREEK RESOURCES LTD.

APPARENT RESISTIVITY CONTOURS

QUESNEL (14)

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13 , 93H/4
MAP No:	6

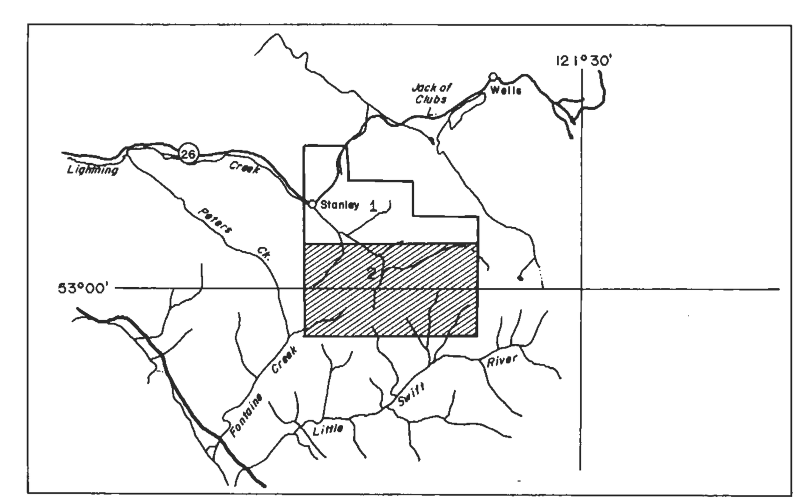
J 8703

N

VLF-EM TOTAL FIELD CONTOURS

VLF STATION: NAA (Cutler, Maine) 24.0 kHz.
MEAN VLF-EM
SENSOR ELEVATION: 48 metres

CONTOUR INTERVAL:
50% ....
10% ....
2% ....



LIGHTNING CREEK RESOURCES LTD.

VLF-EM TOTAL FIELD CONTOURS

QUESNEL
BRITISH COLUMBIA

(15)

SCALE 1/10,000

0 330 660 1320 1/2 mile
0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13, 93H/4
MAP No:	7

J 8703

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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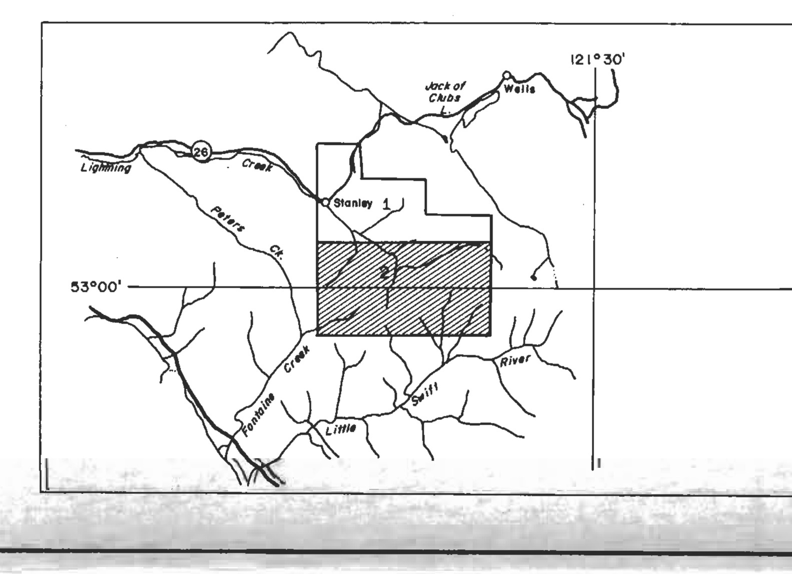
COMPUTED OVERBURDEN THICKNESS

Contour interval - 2 metres

50 metres.........
10 metres.........
2 metres.........



LIGHTNING CREEK RESOURCES LTD.

COMPUTED OVERBURDEN THICKNESS

QUESNEL

BRITISH COLUMBIA

SCALE 1/10,000

0 330 660 1320 1/2 mile

0 100 200 500 1 Kilometre

AERODAT LIMITED

DATE:	February 1987
N.T.S. No:	93A/13', 93H/4'
MAP No:	8

J8703