HELICOPTER ELECTROMAGNETIC
AND MAGNETIC SURVEYS

WINGDAM AREA, BRITISH COLUMBIA

TANACANA MINES LIMITED

APRIL, 1980

93 G 1E and 93H4W

June, 1980
MISSISSAUGA, ONTARIO.

AERODAT LIMITED.
W.P. Boyko, M.Sc.,P.Eng.

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LIST OF MAPS

(Scale 1:10,000)

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1. INTRODUCTION

This report describes a combined helicopter magnetic and electromagnetic survey carried out for Tanacana Mines Limited in the Wingdam area, east of Quesnel in British Columbia.

The survey was flown on April 27th, 1980, using an Alouette III helicopter C-FCFT operated by Kenting Helicopters of Calgary, Alberta. A total of 100 miles were flown along east-west lines spaced a nominal 660 feet.

The electromagnetic system used was an Aerodat dual frequency unit, consisting of vertical, coaxial coils mounted approximately 7.0 meters apart in a "bird" towed 100 feet below the helicopter. Separate transmitting and receiving coils were used for each frequency. Operating frequency of the system was 900 Hz and 4200 Hz. Specifications of the magnetometer and ancillary instruments are given in Appendix I.

2. SURVEY PROCEDURE

2.1 General

The survey was flown at a nominal line spacing of 660 feet. Survey airspeed averaged about 40 mph., and the aircraft maintained an average terrain clearance of 250 feet, with the EM bird 100 feet below, or approximately 150 feet above the ground. The magnetometer sensor was located on a tow cable 50 feet below the aircraft, and approximately 200 feet above the ground.

Survey equipment consisted of an Aerodat dual frequency electromagnetic system, a Barringer AM-104 proton magnetometer, an Aerodat-Perle data acquisition system, a Hoffman radar altimeter, a Geocam 35 mm flight path camera, and a Barringer 8-channel analogue recorder.

Personnel directly involved in the survey were as follows:

Robert Hage - Helicopter pilot
W.P. Boyko - Operations manager and equipment operator
Pierre Moisan - Equipment operator
Winston Chin Quee - Data processing
Alexander Mlcuch - Geophysicist

Data Plotting Services of Don Mills computer processed the EM data and gridded, contoured and plotted the magnetics on an automatic plot-bed plotter. Flight path was recovered by Jumal and Associates of Toronto.

2.2 Flight Path Positioning

Survey navigation was based on photomosaics at a scale of 1:10,000. Manual fiducial flight path control was used in flight, and subsequently flight path was verified using 35 mm film acquired by a Geocam flight path camera operated during the flights. Flight path was plotted on an uncontrolled photograph mosaic at a scale of 1:10,000, which also was used as a base map for presentation of survey results.

3. DATA PRESENTATION

3.1 Electromagnetics

Airborne Electromagnetic Survey Interpretation Map shows interpreted axes of conductive responses on the lower frequency. The responses are indicated as circles with a number outside the circle giving the inphase amplitude in parts per million (ppm) of the primary field strength, and a number within the circle giving the apparent conductance range on a ten division scale shown on the map legend. The apparent conductance is determined by applying the inphase and quadrature anomaly amplitudes to a phasor diagram for the vertical half-plane model. The relationship of apparent conductance to true conductance, which in the case of narrow, slab-like bodies is the product of the electrical conductivity and average thickness, depends upon how closely the body approximates the sheet-like form, and upon how nearly at right angles its strike direction is to the flight line of the aircraft.

Conductance in mhos is the reciprocal of resistance in ohms and is a geologic parameter because it is characteristic of the conductor alone. It is generally independent of frequency and flying height (or depth of burial) and relatively independent of conductor strike length and dip.

The inphase amplitude is a function of both flying height and dip, and is more strongly affected by conductor size than is conductance. Although the conductances presented are apparent only, they are most useful for comparative evaluation of conductors.

Most overburdens have apparent conductances which fall into the lowest range on the scale ($<$ 2 mhos), whereas conductive clays may have apparent conductances in the next range (2-4 mhos). The higher ranges in the scale ($>$ 4 mhos) indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials which conduct electronically are limited to the metallic sulphides and to graphite. Thus, the higher apparent conductance categories are generally limited to graphite and to sulphide-bearing rocks. A strong conductance ($>$ 15 mhos) indicates well-connected mineralization extending throughout a fairly large region, and this often suggests either graphite zones or massive sulphides. Poor to moderate conductances (4-15 mhos) may originate from massive sulphides, if they are not well interconnected or if they are of a poorly conducting variety such as galena.

Also determined from the phasor curves but not shown in the Airborne Electromagnetic Survey are the apparent depths to the conductors. Although the phasor curves are often able to distinguish between conditions of comparatively thick and thin overburden, the depth estimates are not generally reliable. Some of the more common reasons for this are:

(i) the conductivity of the body may change with depth

(ii) the conductor plunges

(iii) the dip is substantially less than vertical

(iv) interference from conductive overburden or host rock has distorted the anomalies

(v) the body has too short a strike length to give a good half-plane response.

Any of the conditions enumerated above may effect the anomaly amplitudes. Some will cause roughly proportionate changes in both phases, so that the depth estimates tend to be more seriously affected than the conductance estimates. Appendix III provides a listing of responses together with amplitude (in ppm), apparent conductances, apparent depths to the conductor and sensor height.

Airborne Electromagnetic Survey Profile Maps show continuous record of inphase and quadrature EM responses along the flight lines in addition to the information shown on the Electromagnetic Survey Map. These profiles are transcribed and plotted from magnetic tape recorded in flight, after assigning a suitable base-level value. Profiles are presented for both the 900 and 4200 frequencies separately.

In each case the heavier line represents inphase, and the thinner line is out-of-phase.

3.2 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 and 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 response may be suppressed or even reversed in sign.

4. RESULTS AND COMMENTS

4.1 General Observations

Most of the responses are of bedrock origin indicated by relatively high apparent conductance. Exceptions to this are along the highway following Lightning Creek where power line responses are difficult to distinguish from genuine bedrock responses.

In general, the bedrock responses are broad and multiple, suggesting graphitic sedimentary rocks as the probable cause. However, pyrite or other conductive sulphides may occur within or adjacent to the conductors caused by graphitic sedimentary rocks. The area with greatest potential for sulphide conductors appears to be in the northeast half of the area where conductors are of local extent and strike north to northeast.

4.2 Conductor Description

Interpreted axes of conductors fall into two general strike directions. A pronounced broad, northwest trending zone of conductors dominates the southwest half of the area, and scattered conductors of local extent prevail in the northeast part.

The northwest trending belt of conductors in the southwest part display good apparent conductance, although they are generally broad. Graphitic sedimentary rocks or volcanic rocks with conductive salts are the most probable cause. The northeast boundary of the belt terminates along a northwest trending magnetic zone, most likely representing basic intrusive material. Diverse strikes on either side of this demarcation line suggest that the basic intrusive follows a major fault structure or disconformity.

Conductors to the northeast are of local extent and offer a better possibility of being caused by sulphides.

(1) A zone of several parallel conductors runs along the upper reaches of Ramos Creek. The conductors are rather broad, but have good apparent conductance.

(2) Several zones of parallel conductors are located in this area. Apparent conductance and character are identical to area (1).

(3) A relatively long conductive zone runs along Lightning Creek, extending northeast of Wingdam. In places the conductor is difficult to distinguish from power-line disturbance, however, it should be investigated on the ground for possible sulphides.

(4) Broad, weak responses with good apparent conductance. The interpreted axes follow a magnetic lineament suggesting

a possible shear zone.

(5) Excellent profile character, good apparent conductance, and local occurrence,make this one of the better targets. The conductor also parallels a magnetic lineament.

(6) and (7) roughly follow a creek flowing into Everton Creek. The zone is broad, but conductance is fair. Should be investigated on the ground.

(8) (9) (10) and (11) appear to be associated with the northwest trending magnetic zone, although there is a possibility of these conductors being related to the broad conductive band to the southwest. Conductor (8) appears to follow Wingdam Creek, and might represent a shear zone.

5. CONCLUSIONS AND RECOMMENDATIONS

Two conductive environments are indicated by the survey. In the southwest half of the area, conductors strike uniformly northwest, and are broad, with good apparent conductivity. The conductors are most likely produced by conductive rock-types and no specific possible sulphide targets can be recognized.

Conductors in the northeast part of the survey area are of local extent and offer a better potential as sulphide targets. Ground geological examination is recommended on the eleven indicated conductive zones. Conductor (5) is considered to be of highest priority.

Respectfully submitted,

Mississauga, Ontario. W.P. Boyko, M.Sc., P.Eng.
June 24, 1980.

APPENDIX I

Instrumentation

Electromagnetic Instrument

Type: Dual frequency inphase-quadrature instrument manufactured by Aerodat Limited, Toronto.

Coils: The transmitting and receiving coils are located in a "bird" towed 100' below the helicopter. The coils are coaxial and are 25 feet apart. The coil axis is in the direction of travel.

Frequency: 900 Hz and 4200 Hz.

Noise Level: 1-2 ppm at 0.1 second time constant.

Magnetometer

Type: Proton precession model AM-104 manufactured by Barringer Research Limited, Toronto.

Cycling time: 1.13 seconds.

Polarizing time: 0.587 seconds.

Sensing head design: 5 inch diameter Toroid.

Horizontal Positioning

Geocam 35 mm flight path camera and intervalometer.

Vertical Positioning

Hoffman Radar Altimeter

Data Recorders

Eight channel Barringer analogue pen recorder.

Aerodat DAC-NAV magnetic tape digital acquisition system.

APPENDIX II

Analogue Tape

The flight tape consists of eight channels of information as follows:

Channel	Time Constant	Scale Units/mm	Noise
1. Radar Altitude	1 sec	10 feet	10 feet
2. EM 900 inphase	0.1 sec	2 ppm	1 ppm
3. EM 900 Quadrature	0.1 sec	2 ppm	1 ppm
4. EM 4200 inphase	0.1 sec	2 ppm	1 ppm
5. EM 4200 quadrature	0.1 sec	2 ppm	1 ppm
6. Magnetometer	1 sec	2.5 gamma	1 gamma
7. 60 Hz Monitor			
8. Magnetometer	1 sec	25 gamma	1 gamma

In addition, three fiducial markers are used between the channels, as follows:

Fiducial	Occurrence
60 hz marker	occurs only over power lines.
Camera fiducials	occurs regularly at 5 second intervals on every line.
Navigator fiducials	occurs discontinuously on every line.

The 60 hz. fiducial identifies anomalies generated by power lines, allowing them to be deleted from the EM map.

The navigator fiducial marks represent points on the ground which were recognized by the aircraft navigator. The beginning of the flight line is flagged by a pair of navigator fiducials. These are followed by a series of unevenly-spaced fiducials moving right-wards along the tape, which is the direction of flight. The end of the line is flagged by a string of three navigator fiducial marks.

The camera fiducial marks indicate points on the strip film.

The flight line numbers and anomaly letters as marked on the maps are taken directly from the flight tapes. The line numbers, followed by an N or S are displayed at the top of the tape above the radar altitude trace. The N or S corresponds to the flight direction of the particular line, which is survey north, or survey south. The anomaly letters, in alphabetic order by line, are found between the radar altitude trace and the upper inphase EM trace.

APPENDIX III

Anomaly Listing

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
1A	3.2	3.1	3	164	100
1B	2.4	5.7	1	97	81
1C	11.8	21.8	2	12	107
1D	18.9	29.5	3	11	101
1E	15.4	20.9	4	0	151
1F	17.6	15.8	7	0	154
1G	18.9	17.1	7	3	143
1H	10.7	6.4	10	44	159
1J	43.4	23.2	19	0	142
2A	31.2	12.2	26	30	122
2B	30.7	11.5	27	44	109
2C	13.8	7.1	14	55	137
2D	43.7	27.6	15	4	119
2E	23.1	20.2	8	33	105
2F	34.0	23.4	13	3	128
2G	56.7	50.6	11	0	122
2H	57.6	65.6	8	0	93
2J	25.5	18.4	11	21	122
2K	46.0	26.1	18	0	139
2M	48.3	29.4	17	0	143
2N	9.7	5.5	11	86	127
2O	10.0	5.3	12	44	170
3A	15.0	8.9	12	0	197
3B	6.7	7.5	4	73	117
3C	13.8	9.7	9	59	119
3D	19.6	20.9	6	17	118
3E	23.2	38.2	4	0	112
3F	27.9	42.3	4	0	124
3G	45.0	46.8	8	0	134
3H	43.7	30.1	14	0	161
3J	31.1	17.7	16	8	134
3K	20.3	12.8	12	0	191
3M	20.6	10.0	17	30	139
3N	19.4	9.8	16	48	123

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
4A	27.6	12.3	21	48	107
4B	30.0	12.6	23	34	118
4C	12.5	4.4	22	93	117
4D	12.4	9.3	8	21	160
4E	12.2	11.2	6	14	155
4F	5.6	11.9	1	11	131
4G	6.7	11.1	2	16	139
4H	20.9	30.4	4	0	117
4J	21.3	36.2	3	0	136
4K	13.2	10.1	8	17	159
4M	13.7	12.0	7	35	131
4N	14.5	11.6	8	25	143
5A	4.9	2.7	9	150	121
5B	3.5	5.7	2	64	133
5C	11.3	10.6	6	75	98
5D	10.8	14.6	3	0	147
5E	2.5	8.2	0	0	170
5F	2.8	6.2	1	0	191
5G	4.7	3.5	6	1	253
5H	30.8	15.4	19	42	105
5J	27.5	17.1	13	51	94
5K	11.8	6.8	11	107	91
6A	10.0	3.4	22	122	106
6B	10.5	6.6	9	71	131
6C	9.2	6.0	9	80	129
6D	5.0	7.7	2	73	105
6E	1.2	2.1	1	117	156
6F	0.1	3.2	0	0	190
6G	4.3	4.6	3	77	150
6H	6.3	4.4	7	54	181
6J	3.9	4.4	3	81	149
7A	5.6	4.2	6	77	162

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
7B	7.4	4.1	10	87	148
7C	9.0	3.0	22	58	179
7D	10.6	6.3	10	64	140
7E	3.6	3.4	4	104	152
7F	8.2	5.1	9	65	156
7G	9.3	1.6	54	64	180
8A	10.4	4.3	17	60	160
8B	18.6	2.9	75	30	164
8C	7.0	4.1	9	94	143
8D	9.1	4.4	13	80	145
8E	9.6	5.5	11	90	123
8F	9.5	4.1	16	51	174
8G	7.1	1.6	36	127	138
8H	9.3	3.5	18	81	150
8J	9.2	6.5	8	55	150
8K	12.1	9.5	7	30	150
8M	6.7	8.2	3	41	142
8N	8.5	7.9	5	33	158
9A	6.1	10.3	2	4	154
9B	6.6	8.7	3	26	150
9C	23.0	7.8	28	29	142
9D	6.3	2.9	12	42	215
9E	5.2	3.2	7	71	188
9F	3.9	3.3	4	134	124
9G	4.0	3.1	5	120	146
9H	6.0	5.6	4	83	132
9J	8.2	6.6	6	9	195
9K	8.6	4.8	10	43	180
9M	23.1	6.1	40	14	161
9N	11.3	7.2	10	72	124
9O	0.3	2.5	0	0	187
10A	0.0	2.2	?	?	127

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
10B	1.2	3.0	0	50	171
10C	3.3	2.4	5	105	183
10D	8.0	5.4	8	99	118
10E	7.3	4.1	10	64	171
10F	11.1	7.7	8	36	157
10G	11.8	10.2	6	60	115
10H	15.5	13.2	7	27	134
10J	14.3	13.3	6	34	125
10K	10.1	10.1	5	0	180
10M	10.1	10.6	5	17	153
10N	10.5	8.1	7	16	174
10O	11.5	8.6	8	10	176
11A	12.9	9.7	8	17	162
11B	27.2	18.2	12	1	142
11C	32.3	23.7	11	0	154
11D	10.5	12.1	4	20	141
11E	9.1	8.9	5	31	151
11F	3.9	3.0	5	94	175
12A	0.1	2.5	0	0	129
12B	0.0	2.3	?	?	145
12C	0.6	2.4	0	85	121
12D	3.3	1.1	15	151	183
12E	16.0	7.3	17	44	142
12F	20.5	7.1	26	43	135
12G	14.9	4.9	25	0	209
12H	17.2	5.6	27	44	146
12J	10.9	9.1	6	69	113
12K	18.4	13.4	10	40	120
12M	24.2	16.9	11	27	120
12N	23.6	20.5	8	4	134
12O	17.6	11.6	11	0	167
12P	17.1	5.8	26	31	159

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
13A	24.6	17.3	11	0	161
13B	20.4	19.2	7	4	136
13C	13.0	7.8	11	13	177
13D	12.1	6.5	12	27	172
13E	22.0	11.5	16	16	147
13F	24.4	9.2	25	8	158
13G	11.6	5.4	15	46	162
13H	10.9	4.7	16	56	159
13J	8.8	4.0	14	77	152
13K	0.5	3.4	0	0	238
13M	2.5	1.0	11	229	133
13N	2.2	0.4	29	263	138
14A	1.4	2.9	1	74	159
14B	1.8	2.2	2	151	138
14C	2.5	5.1	1	4	190
14D	2.2	2.0	3	193	113
14E	11.4	3.8	23	68	150
14F	17.1	6.2	24	1	187
14G	20.1	10.1	16	37	133
14H	15.0	8.5	12	14	169
14J	13.2	7.4	12	20	172
14K	12.0	5.2	16	0	212
14M	23.4	13.5	14	0	169
14N	19.7	10.4	15	0	187
15A	13.6	10.7	8	5	167
15B	12.9	8.4	10	3	183
15C	11.3	7.5	9	19	175
15D	16.7	10.4	11	44	129
15E	16.6	6.9	19	51	136
15F	1.0	4.2	0	0	250
15G	2.7	2.0	4	168	140
15H	3.3	2.2	5	126	169

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
16A	4.5	3.9	4	154	91
16B	5.5	2.2	14	142	132
16C	3.2	4.0	2	126	108
16D	3.4	3.6	3	102	145
16E	2.3	3.6	1	27	206
16F	2.3	4.3	1	13	197
16G	2.9	2.1	5	167	136
16H	4.9	3.2	7	87	174
16J	7.0	4.9	7	51	175
16K	8.1	7.8	5	49	142
16M	9.7	8.0	6	7	184
17A	16.7	11.6	10	8	159
17B	14.5	11.6	8	7	161
17C	12.4	9.1	8	46	137
17D	9.4	7.5	7	49	147
17E	0.4	2.9	0	29	128
17F	0.0	1.3	?	?	139
17G	2.5	5.7	1	62	118
17H	12.8	10.4	7	0	190
17J	6.0	9.1	2	10	159
17K	2.5	4.4	1	86	125
17M	12.5	9.0	8	83	100
17N	9.8	6.6	8	86	117
17O	2.5	2.2	3	198	98
18A	0.0	2.2	?	?	165
18B	2.8	4.4	1	71	146
18C	3.7	4.1	3	57	180
18D	7.6	7.4	5	0	205
18E	6.7	6.1	5	71	138
18F	8.0	5.5	8	88	129
18G	6.1	7.0	3	85	111
19A	0.0	3.7	?	?	127

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
19B	0.2	2.6	0	0	175
19C	0.0	0.3	?	?	120
19D	0.7	1.7	0	107	162
19E	4.4	4.9	3	69	151
19F	5.4	5.8	3	74	136
19G	4.4	4.5	3	99	132
19H	1.2	6.0	0	0	204
19J	0.0	5.7	?	?	144
19K	0.0	2.0	?	?	142
20A	2.5	4.7	1	68	133
20B	6.2	9.9	2	0	168
20C	3.3	6.5	1	31	149
20D	2.9	3.3	2	147	107
20E	7.2	6.1	6	96	114
20F	7.7	5.6	7	92	124
20G	4.2	2.8	6	134	139
20H	8.4	3.0	19	101	140
21A	0.0	3.1	?	?	174
21B	0.1	2.6	0	0	153
21C	3.6	3.6	3	63	185
21D	4.3	4.5	3	8	222
21E	3.8	4.5	3	42	183
21F	3.6	2.5	5	65	219
22A	0.0	2.4	?	?	183
22B	0.9	5.9	0	0	149
22C	2.3	7.7	0	22	125
22D	0.9	3.2	0	91	104
22E	8.3	4.6	10	95	130
22F	3.2	3.3	3	120	135
22G	3.9	2.7	6	139	137
22H	3.8	2.9	5	101	170
22J	2.3	2.6	2	136	140

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
22K	1.6	2.5	1	63	197
23A	0.8	7.6	0	0	122
23B	8.5	6.2	7	64	145
23C	6.8	5.7	5	50	165
23D	1.3	4.2	0	32	150
23E	3.5	5.9	1	3	189
23F	2.6	5.8	1	9	171
24A	5.6	15.5	1	0	160
24B	2.4	4.0	1	79	141
24C	6.0	5.6	4	58	157
24D	8.4	6.3	7	52	155
24E	8.5	5.7	8	67	147
24F	5.9	3.2	9	110	145
24G	6.0	2.4	14	130	136
24H	0.8	5.6	0	0	153
24J	0.4	4.1	0	0	161
25A	1.8	3.2	1	42	194
25B	1.4	2.9	1	38	197
25C	3.6	3.1	4	117	147
25D	5.3	2.3	13	133	143
25E	3.7	2.0	8	108	191
25F	3.8	8.7	1	1	154

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.

$EOJ

JOB EXECUTION TIME = 00 HOURS- 00 MINUTES- 28.02 SECONDS

TOTAL JOB TIME = 00 HOURS- 01 MINUTES- 19.37 SECONDS

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
1A	8.1	8.6	1	83	100
1B	11.0	16.8	1	56	81
1C	42.0	41.9	2	0	107
1D	58.2	52.8	2	0	101
1E	42.6	29.3	3	0	151
1F	37.1	22.0	4	0	154
1G	40.0	25.6	3	0	143
1H	17.6	4.1	10	34	159
1J	68.7	18.6	12	0	142
2A	44.2	9.4	14	20	122
2B	43.6	8.6	16	34	109
2C	20.6	5.8	8	44	137
2D	76.6	31.9	7	0	119
2E	42.7	41.9	2	2	105
2F	55.7	29.7	5	0	128
2G	100.9	53.7	6	0	122
2H	99.9	98.5	3	0	93
2J	46.0	35.1	3	0	122
2K	73.9	23.8	10	0	139
2M	82.2	27.0	10	0	143
2N	15.6	5.2	6	69	127
2O	15.6	4.0	8	31	170
3A	22.0	10.8	4	0	197
3B	13.5	9.7	2	61	117
3C	20.7	9.9	4	50	119
3D	44.1	46.9	2	0	118
3E	83.0	64.0	3	0	112
3F	89.2	60.4	4	0	124
3G	88.7	44.4	6	0	134
3H	71.3	24.1	9	0	161
3J	48.7	17.7	7	0	134
3K	33.2	13.2	6	0	191
3M	27.7	7.1	10	26	139
3N	27.0	6.1	11	44	123

'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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
4A	34.2	7.6	13	48	107
4B	37.1	6.7	17	34	118
4C	10.8	1.2	23	120	117
4D	18.8	14.4	2	0	160
4E	20.7	14.6	2	0	155
4F	19.1	28.3	1	0	131
4G	19.1	22.5	1	0	139
4H	61.8	50.1	3	0	117
4J	76.8	45.2	5	0	136
4K	21.8	18.1	2	0	159
4M	27.3	13.0	4	23	131
4N	26.6	11.7	5	15	143
5A	6.6	2.3	4	141	121
5B	10.1	6.7	2	69	133
5C	24.8	11.3	4	63	98
5D	33.4	24.1	3	0	147
5E	16.5	18.3	1	0	170
5F	13.5	11.3	2	0	191
5G	8.4	1.4	13	2	253
5H	49.0	10.6	15	32	105
5J	48.6	14.4	10	40	94
5K	20.7	7.6	6	85	91
6A	14.4	5.2	5	94	106
6B	21.9	7.2	7	44	131
6C	19.9	8.3	5	47	129
6D	21.4	15.2	2	48	105
6E	10.4	7.8	2	37	156
6F	8.7	8.4	1	0	190
6G	15.3	6.1	5	43	150
6H	15.5	2.4	16	25	181
6J	11.0	3.6	5	72	149
7A	10.3	5.2	3	52	162

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	DEPTH	BIRD HEIGHT
7B	9.2	2.6	6	91	148
7C	9.2	0.4	89	76	179
7D	16.2	4.5	7	57	140
7E	7.2	4.4	2	80	152
7F	15.2	6.3	4	37	156
7G	10.0	1.1	24	63	180
8A	15.9	5.9	5	32	160
8B	21.6	1.8	42	24	164
8C	10.8	5.4	3	67	143
8D	15.1	6.3	4	48	145
8E	17.1	7.4	4	61	123
8F	14.4	5.6	5	24	174
8G	10.1	3.4	5	89	138
8H	13.2	4.2	6	59	150
8J	16.6	8.6	3	30	150
8K	24.6	12.5	4	8	150
8M	18.6	14.1	2	15	142
8N	18.3	11.1	3	10	158
9A	21.2	13.2	3	5	154
9B	18.8	10.6	3	19	150
9C	33.3	3.3	37	19	142
9D	10.8	0.7	48	24	215
9E	9.7	1.2	19	56	188
9F	9.0	3.5	4	109	124
9G	8.5	2.9	5	95	146
9H	14.7	8.8	3	50	132
9J	17.2	7.0	5	0	195
9K	14.2	3.3	9	28	180
9M	28.2	1.3	100	12	161
9N	20.1	6.7	6	56	124
9O	5.5	8.7	0	0	187
10A	5.5	9.4	0	37	127

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
10B	8.8	6.8	2	31	171
10C	8.7	3.4	4	52	183
10D	15.4	5.4	5	78	118
10E	11.7	4.4	5	43	171
10F	21.4	9.3	4	13	157
10G	24.2	12.4	4	43	115
10H	33.5	17.7	4	7	134
10J	33.9	16.9	4	17	125
10K	25.0	14.0	3	0	180
10M	24.1	14.2	3	1	153
10N	19.1	8.3	4	3	174
10O	20.7	9.3	4	0	176
11A	25.1	9.3	6	2	162
11B	48.2	17.7	7	0	142
11C	60.9	20.4	9	0	154
11D	27.6	15.5	3	8	141
11E	20.0	9.9	4	20	151
11F	5.2	1.3	6	118	175
12A	3.6	5.6	0	70	129
12B	4.7	6.1	1	55	145
12C	5.3	5.6	1	92	121
12D	6.5	1.9	5	85	183
12E	25.7	6.9	9	26	142
12F	29.6	4.7	19	30	135
12G	21.7	4.1	14	0	209
12H	26.0	6.5	10	22	146
12J	27.7	16.6	3	33	113
12K	40.1	15.8	6	19	120
12M	50.5	22.2	6	6	120
12N	55.1	27.4	5	0	134
12O	36.0	17.6	5	0	167
12P	25.4	5.9	11	12	159

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
13A	52.4	21.9	6	0	161
13B	51.8	31.8	4	0	136
13C	24.4	10.7	5	0	177
13D	21.9	9.1	5	0	172
13E	37.3	10.1	10	1	147
13F	35.4	6.3	17	0	158
13G	19.4	4.7	10	24	162
13H	17.4	2.5	19	40	159
13J	14.4	3.3	9	56	152
13K	6.5	3.1	3	14	238
13M	6.5	4.5	2	100	133
13N	5.4	3.4	2	116	138
14A	5.5	3.1	2	101	159
14B	6.5	5.7	1	76	138
14C	12.1	15.5	1	0	190
14D	3.8	5.0	0	101	113
14E	13.9	3.3	9	59	150
14F	21.2	3.8	15	0	187
14G	32.5	9.9	8	21	133
14H	25.8	11.2	5	0	169
14J	22.2	9.4	5	0	172
14K	17.2	6.2	5	0	212
14M	40.5	13.9	7	0	169
14N	31.3	10.3	7	0	187
15A	26.3	17.7	3	0	167
15B	20.0	10.9	3	0	183
15C	17.9	11.3	3	0	175
15D	26.5	9.8	6	32	129
15E	20.5	4.2	12	49	136
15F	4.3	5.5	1	0	250
15G	3.7	4.9	0	76	140
15H	5.6	6.3	1	34	169

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
16A	12.4	6.6	3	107	91
16B	11.0	4.0	5	87	132
16C	10.1	10.0	1	67	108
16D	10.0	9.1	1	37	145
16E	8.3	10.8	1	0	206
16F	9.4	9.8	1	0	197
16G	5.7	5.0	1	88	136
16H	8.2	3.5	3	63	174
16J	14.0	8.0	3	12	175
16K	17.8	5.3	7	47	142
16M	17.9	6.7	5	1	184
17A	31.6	14.2	5	0	159
17B	30.0	15.7	4	0	161
17C	23.4	10.2	5	28	137
17D	18.8	10.2	3	24	147
17E	4.2	9.4	0	24	128
17F	0.0	2.0	?	?	139
17G	7.0	6.8	1	82	118
17H	25.0	10.4	5	0	190
17J	17.3	13.7	2	0	159
17K	8.9	4.4	3	100	125
17M	23.3	8.9	5	68	100
17N	17.4	5.2	7	74	117
17O	8.5	3.3	4	139	98
18A	3.9	4.6	1	59	165
18B	7.0	3.8	2	95	146
18C	7.9	5.2	2	41	180
18D	17.1	9.4	3	0	205
18E	14.2	8.2	3	48	138
18F	15.0	7.0	4	61	129
18G	15.4	11.7	2	56	111
19A	5.1	17.9	0	0	127

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
19B	2.8	7.1	0	0	175
19C	1.7	3.4	0	101	120
19D	6.0	4.4	1	73	162
19E	15.4	5.4	5	45	151
19F	17.5	7.4	4	47	136
19G	13.8	5.8	4	67	132
19H	17.7	10.6	3	0	204
19J	15.4	12.3	2	21	144
19K	8.1	6.2	2	67	142
20A	12.2	9.2	2	49	133
20B	24.3	17.8	2	0	168
20C	12.1	12.8	1	11	149
20D	8.4	6.4	1	99	107
20E	14.1	8.5	3	71	114
20F	14.0	7.9	3	63	124
20G	7.8	5.9	2	74	139
20H	12.4	3.4	7	76	140
21A	3.6	11.8	0	0	174
21B	2.2	9.5	0	0	153
21C	6.0	1.4	7	95	185
21D	8.9	3.3	4	13	222
21E	14.1	6.9	3	10	183
21F	9.1	4.0	3	9	219
22A	2.3	1.8	1	136	183
22B	13.7	10.7	2	24	149
22C	18.1	12.7	2	37	125
22D	4.9	5.2	1	115	104
22E	14.1	3.3	9	79	130
22F	5.6	4.7	1	95	135
22G	6.0	3.4	2	114	137
22H	7.4	5.9	1	42	170
22J	4.4	6.6	0	51	140

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.

LINE AND ANOMALY	INPHASE PPM	QUADRATURE PPM	CONDUCTOR MHOS	CONDUCTOR DEPTH	BIRD HEIGHT
22K	5.4	7.7	1	0	197
23A	8.3	25.9	0	0	122
23B	15.1	4.5	7	55	145
23C	12.9	4.2	6	45	165
23D	6.2	7.6	1	37	150
23E	14.5	7.7	3	0	189
23F	13.2	7.4	3	21	171
24A	29.8	28.8	2	0	160
24B	6.3	5.6	1	74	141
24C	10.8	4.1	4	62	157
24D	14.3	5.9	4	42	155
24E	13.9	5.7	4	52	147
24F	8.9	2.7	5	95	145
24G	7.5	1.9	7	122	136
24H	7.4	18.0	0	0	153
24J	4.6	10.4	0	0	161
25A	6.4	10.8	0	0	194
25B	5.1	9.7	0	0	197
25C	5.7	5.5	1	70	147
25D	8.6	2.0	8	105	143
25E	5.2	0.5	23	114	191
25F	18.8	12.8	2	8	154

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.

EOJ

JOB EXECUTION TIME = 00 HOURS- 00 MINUTES- 28.03 SECONDS

OTAL JOB TIME = 00 HOURS- 01 MINUTES- 53.00 SECONDS

D. GEOLOGICAL, GEOPHYSICAL, GEOCHEMICAL

(Details in report submitted as per section 5, 6, or 7 of regulations.)
(The itemized cost statement must be part of the report.)
(State type of work in space below.)

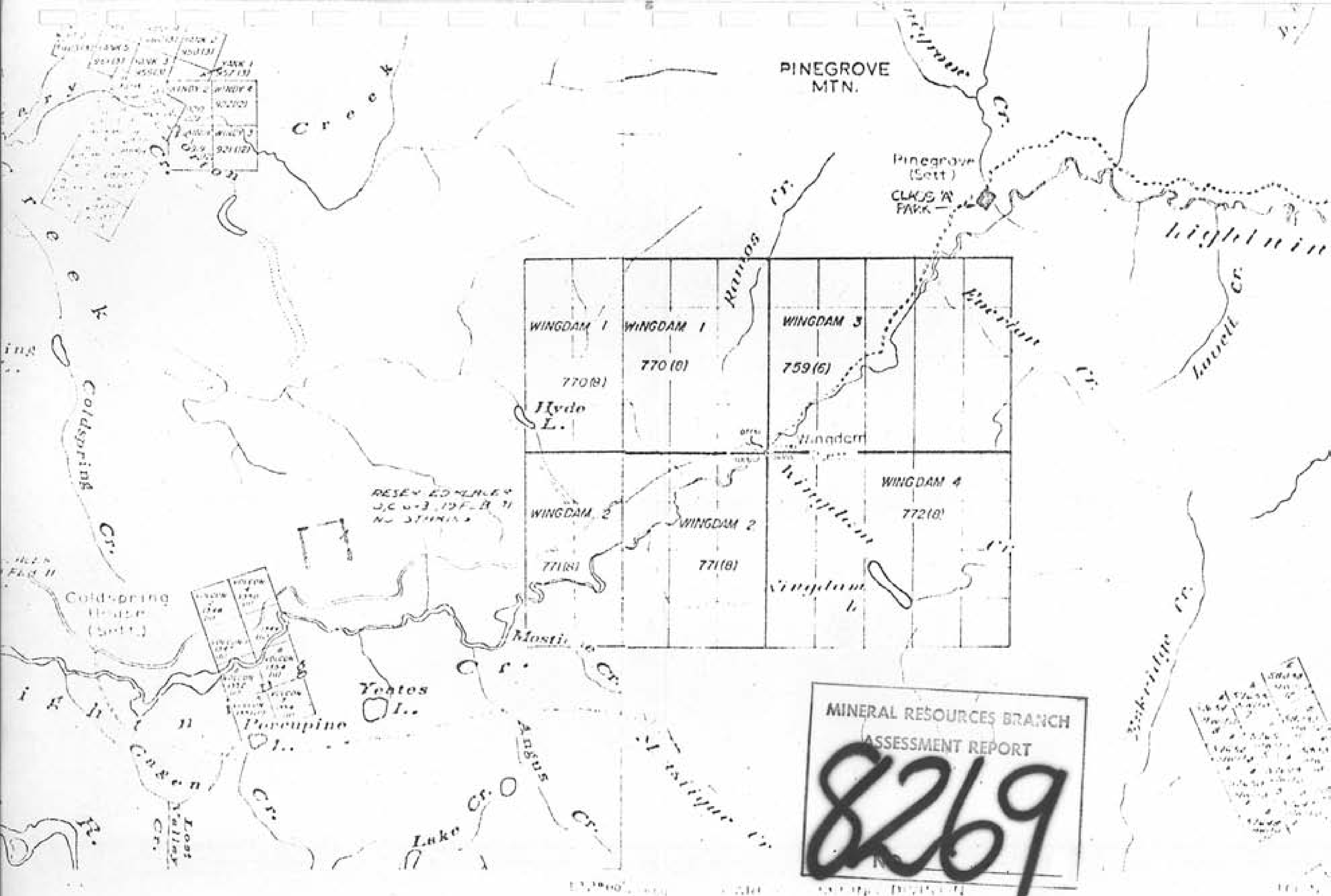
HEM survey on 1/8 mile spacing, Run by Aerodat Ltd Toronto on April 27, 1980. Report to Follow | 16,000.00

TOTAL OF C AND D | 16,000.00

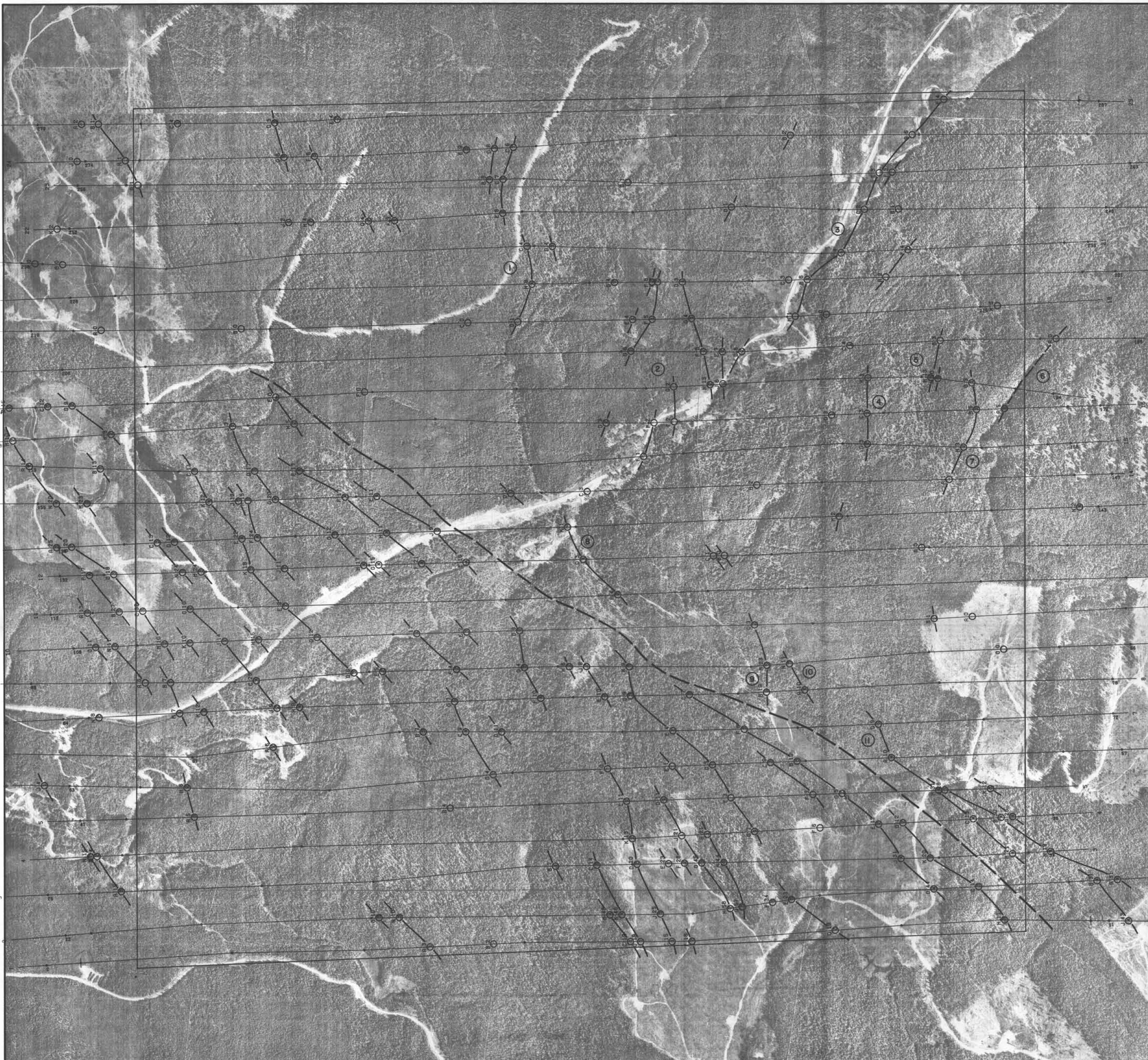
Who was the operator (provided the financing)?

Name TANAGANA MINES LTD

Address 200 GRANVILLE Square
VANCOUVER BC


PINEGROVE MTN.
Pinegrove (Sett.)
Creek
Hyde L.
WINGDAM 1 770(8)
WINGDAM 1 770(8)
WINGDAM 3 759(6)
WINGDAM 2 771(8)
WINGDAM 2 771(8)
WINGDAM 4 772(8)
Coldspring Cr.
Coldspring House (Sett.)
Yeates L.
Porcupine L.
Angus Cr.
Lake Cr.
Lowell Cr.
Mostique Cr.

93H/4W 93G/1E



EM RESPONSE

Conductivity thickness in mhos

- ⑨ > 500
- ⑧ 250 – 500
- ⑦ 125 – 250
- ⑥ 60 – 125
- ⑤ 30 – 60
- ④ 15 – 30
- ③ 8 – 15
- ② 4 – 8
- ① 2 – 4
- ○ < 2
- 25 Inphase response

EM ANOMALY SYMBOLS

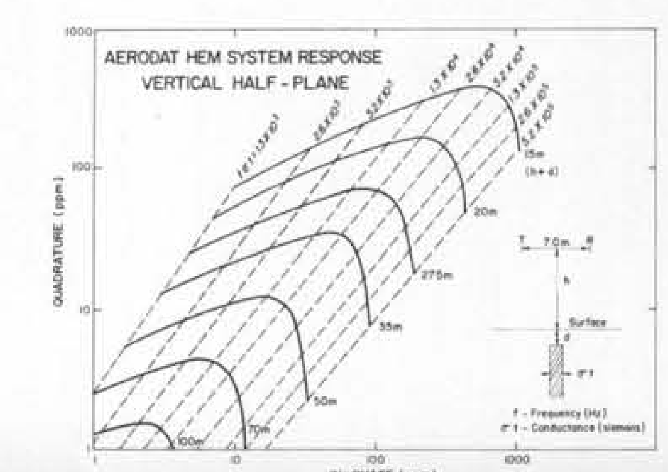
EM Anomaly A, in-phase amplitude 7 p.p.m. Conductivity thickness range 2 (see code)

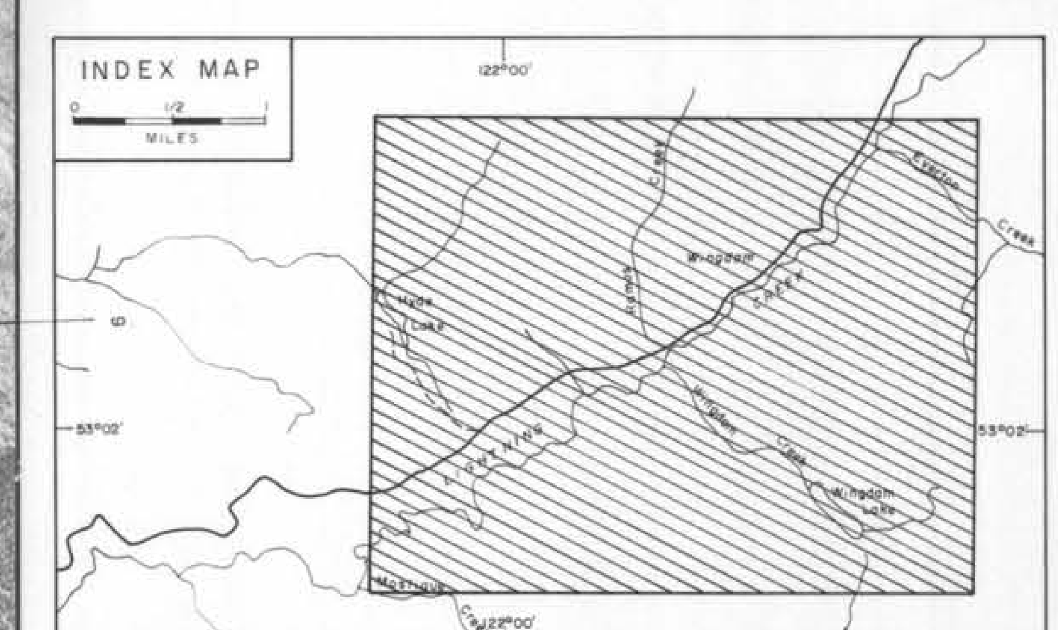
7 — Interpreted conductor axis "7"

Horizontal control .... based on photo laydown

Average bird height .... 150 Feet

Line spacing .... 660 Feet





TANACANA MINES LIMITED

WINGDAM AREA

BRITISH COLUMBIA

INTERPRETATION MAP

AIRBORNE ELECTROMAGNETIC SURVEY

SCALE 1/10,000

500 0 500 Metres

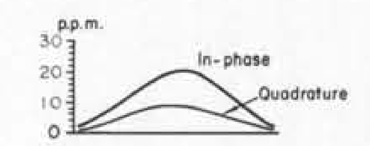
2000 0 2000 Feet

AERODAT

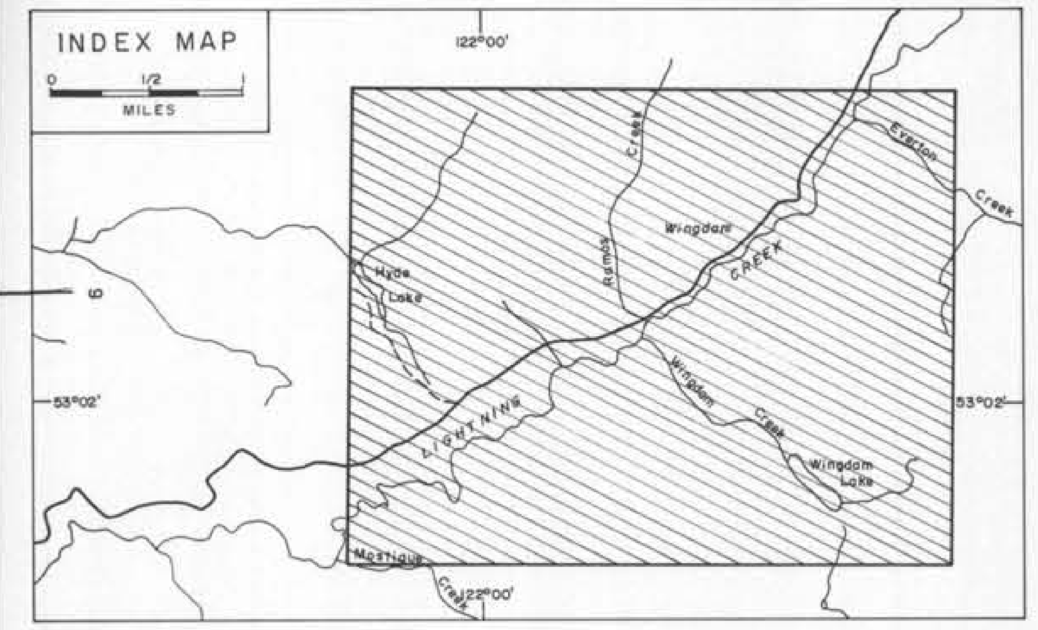
DATE: APRIL 1980

N.T.S. No: 93G, 93H

MAP No: 1



INDEX MAP



TANACANA MINES LIMITED

WINGDAM AREA

BRITISH COLUMBIA

900 Hz

ELECTROMAGNETIC SURVEY PROFILES

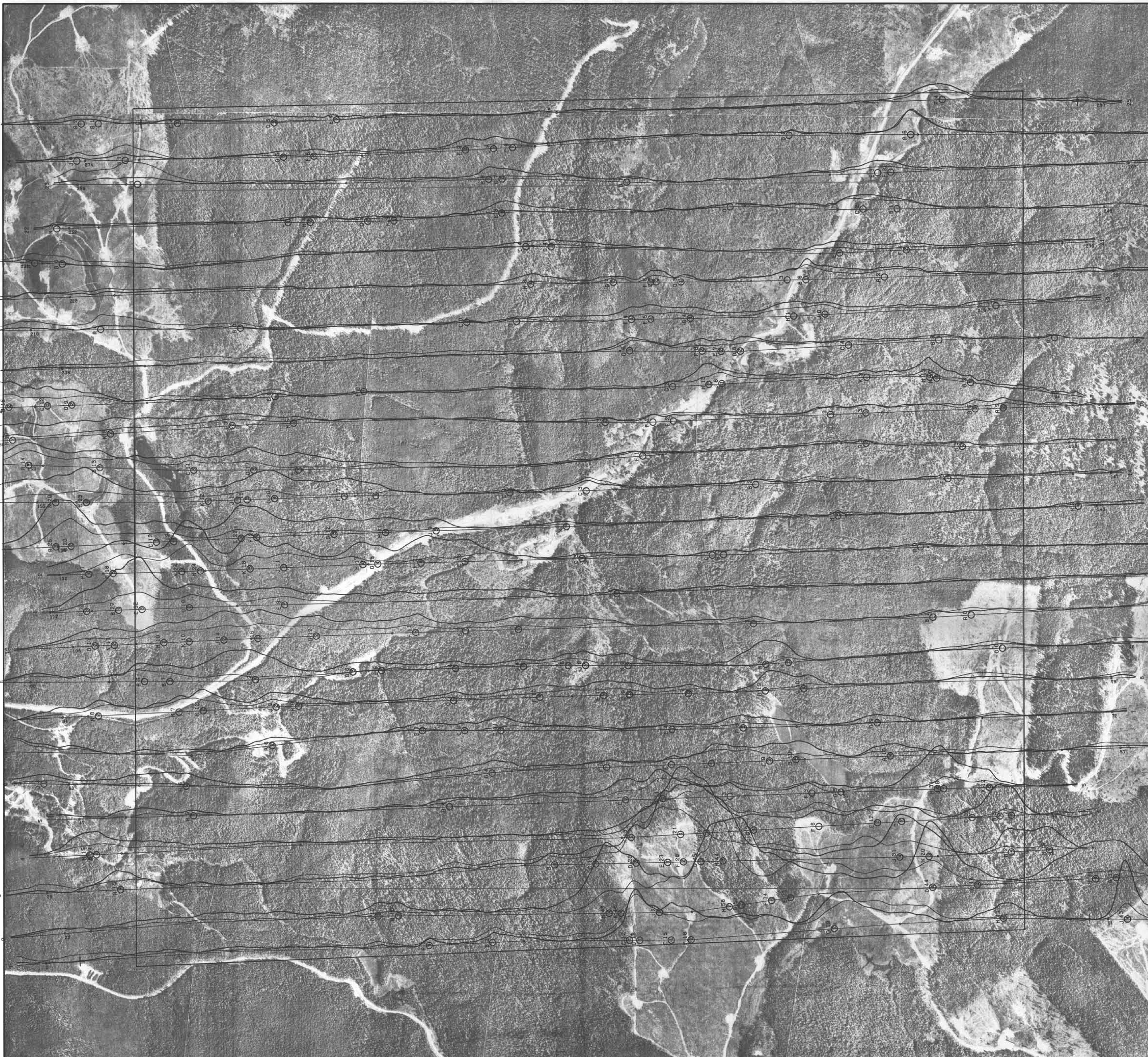
SCALE 1/10,000

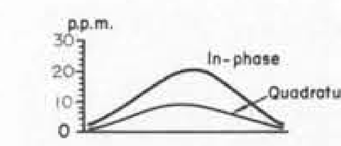
500 0 500 Metres

2000 0 2000 Feet

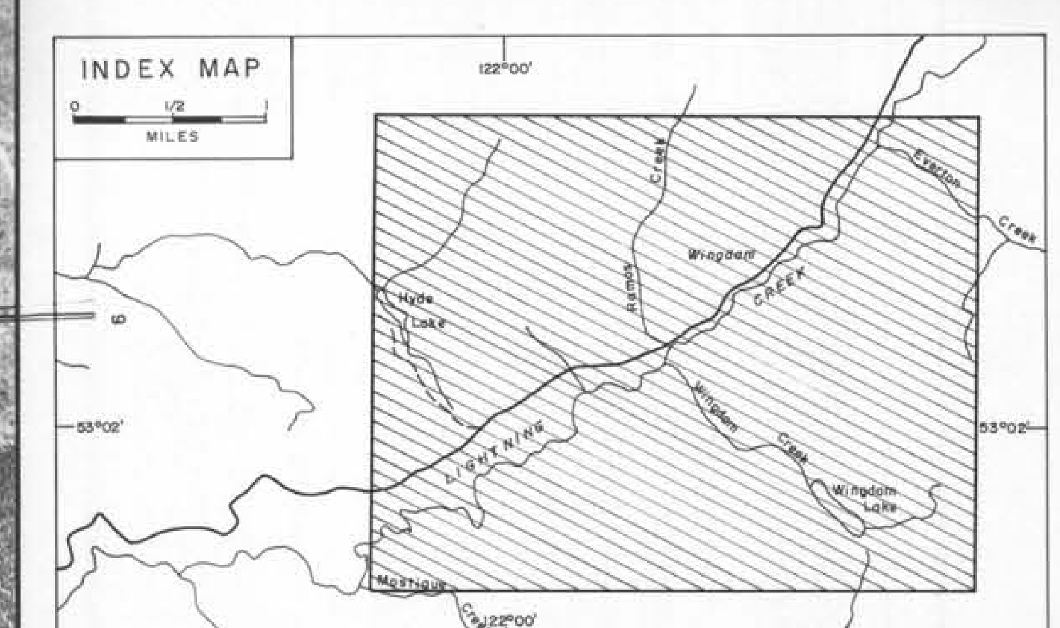
AERODAT

DATE :	APRIL 1980
N.T.S. No :	93G, 93H
MAP No :	2





INDEX MAP



TANACANA MINES LIMITED

WINGDAM AREA

BRITISH COLUMBIA

4200 Hz

ELECTROMAGNETIC SURVEY PROFILES

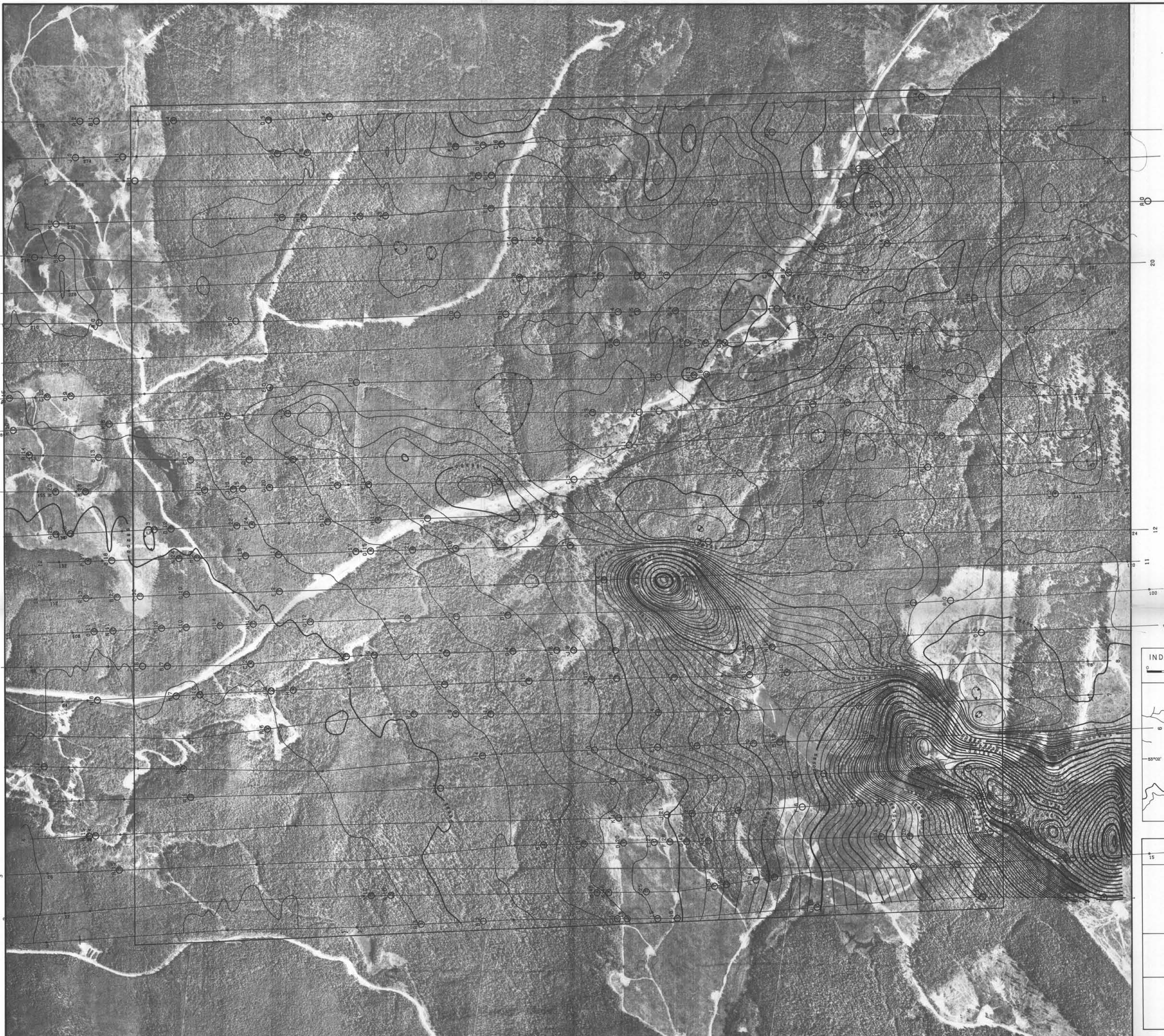
SCALE 1/10,000

500 0 500 Metres

2000 0 2000 Feet

AERODAT

DATE :	APRIL 1980
N.T.S. No :	93G, 93H
MAP No :	3

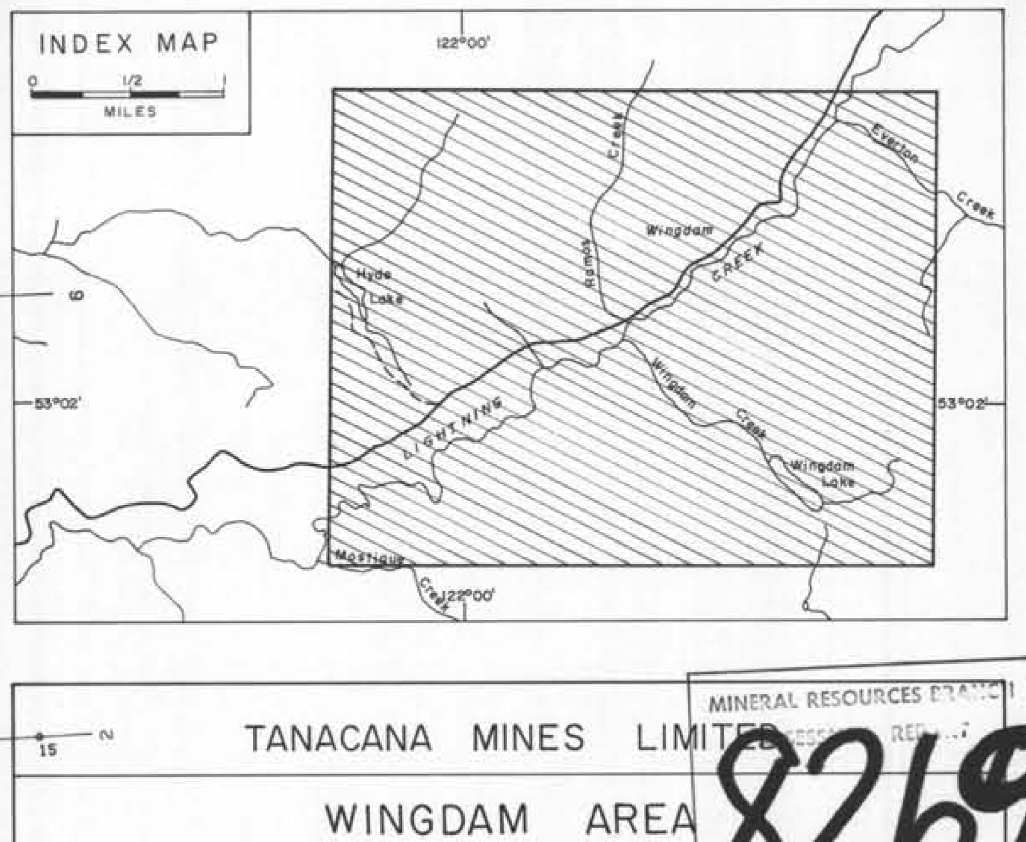


LEGEND

500 gammas ....

100 gammas ....

20 gammas ....



TANACANA MINES LIMITED

WINGDAM AREA

BRITISH COLUMBIA

TOTAL FIELD MAGNETIC MAP

SCALE 1/10,000

500 0 500 Metres

2000 0 2000 Feet

AERODAT

DATE :	APRIL 1980
N.T.S. No :	93G, 93H
MAP No :	4