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REPORT ON THE

HELICOPTER AFMAG SURVEY 7.35,43,44,51/19

NORHTWESTERN TASMANIA

FOR

MINES EXPLORATION PTY. LTD.

E.L. 5/63 COMSTAFF

Received 19th Sept. 1966
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AMG REFERENCE POINTS ADDED

McPHAR GEOPHYSICS LIMITED

GENERAL NOTES ON THE AIR-BORNE AFMAG METHOD

The air-borne Afmag system measures the distortion (dip) of natural electromagnetic fields at audio frequencies. In the absence of conductors, these fields have a random distribution in the horizontal plane, but no vertical component. The presence of a vertical component, as evidenced by a dip of the field from the horizontal, is an indication of the presence of a conductive or paramagnetic anomaly.

In general, the Afmag system may be thought of as a vertical loop electromagnetic system in which the transmitter is located at infinity. The low operating frequencies (140 & 510 cps) of the Afmag provide good discrimination against poor conductors, and a greater depth of penetration than is available with conventional electromagnetic methods.

The air-borne Afmag system consists of a receiver, an electronic console, and a recorder.

The receiving system is mounted in a towed bird and consists of two coils with their axes in the vertical plane at 45° to the horizontal and 90° to each other. The inclination of the field is measured by comparing the outputs of these two coils. When the field is horizontal, the outputs of these coils are equal. If the field is tilted (distorted), the degree of dip is obtained from the ratio of the outputs of the two coils. The axes of the coils lie in the plane of the flight path of the aircraft, and consequently have maximum response to a conductor crossed at right angles.

The console, which is carried in the aircraft, is used to amplify, detect and compare the signals picked up in the receiver. The resulting information is recorded on a 3 channel recorder.

The dip angle information is shown on the upper and lower channels or traces. The upper trace records the 140 cps information and the lower on the 590 cps information. Both of these traces are at a scale of approximately 1 cm equals 15 degrees of dip angle. An anomaly is characterized by an upward (positive) deflection of the pen from the center line followed by a downward or negative deflection. The crossover point indicates the electrical center of the conductor. Interpretation is based primarily on this dip angle information.

The center trace provides a monitoring of the signal level at 140 cps as well as the ground clearance of the aircraft. The single trace is multiplexed.

McPHAR GEOPHYSICS LIMITED

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HELICOPTER AFMAG SURVEY
NORTHWESTERN TASMANIA
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1. INTRODUCTION

At the request of Mines Exploration Proprietary Limited a Helicopter Afmag survey has been carried out over four areas in Northwestern Tasmania. These areas which have been designated Areas A, B, C and D are underlain by Proterozoic and Cambrian - Devonian sediments which consist chiefly of slates with some quartzites and tuffs. Pyrite and graphite are common in the areas while intrusive bodies of serpentine are rare.

The orebodies in the district are generally rich in sulphide and include tin bearing pyrite near Waratah as well as the complex sulphide containing silver, lead, zinc and copper at Rosebery. The purpose of the survey was to locate any conductors in the hope that they would be indicative of large sulphide structures.

A line spacing of approximately 1/8 mile was used throughout the program. The line direction was oriented roughly perpendicular to the geologic trend (i. e. NW-SE in Area A, E-W elsewhere.) The field surveying was carried out during January and February 1966, during the period of maximum Afmag field strength.

2. GEOLOGICAL SOURCES OF CONDUCTIVITY

Massive Sulphides

Massive sulphides are the prime target of an electrical survey. Sizeable bodies of this material give rise to strong Afmag anomalies.

Faults & Shears

Due to the great depth of penetration provided by the Afmag system, faults and shears often cause sizeable responses.

Graphite

Graphite is a common cause of conductors. ?!

Serpentinized Rock

This material has a relatively low conductivity and shear zones within are often responsible for anomalous responses.

3. PRESENTATION OF RESULTS

The results of the survey are shown on the accompanying maps. The base for the maps are several series of airphoto strips which are uncontrolled. Lines in Area C have been drawn across two sets of photos which are of quite different scale. Consequently, many of the topographic features may be badly distorted. All scales are approximate only.

		Dwg. No.
Area A	1" = 1900'	4230
Area B	1" = 1900'	4231
Area C north	1" = 1500' & 1" = 2100'	4232-1

Area C south	1" = 1500'	4232-2
Area D	1" = 1500'	4233 - not recieved with this report

The Afmag conductor axes have been indicated on the flight lines according to the legend shown on the maps. Three characteristics of the individual responses have been indicated by the numerals and letters shown to the right of the symbol.

The first number is a measure of the peak to peak amplitude of the high frequency dip angle. For convenience, this has been measured in millimetres and the scale used throughout the survey was 1 cm equals 15 degrees of dip angle.

Each anomaly has also been assigned a letter to indicate the shape and certainty factor of the response. The letter A has been used for a narrow sharp sinusoidal curve with a steep slope at the crossover. This would be indicative of a well-defined of sizeable but limited dimensions such as a large sulphide body. As the length of the build up increases and the slope decreases, the anomaly grade varies through B, C and D. In general, the C classification is typical of the response expected from a fault. That is, a broad response extending over several miles suggesting a source of appreciable depth extent.

The X classification has been used for events that could be due to spurious effects.

The above alphabetical classification has been made primarily from the appearance of the trace. Some consideration has been made for the ground clearance of the aircraft, but this is at best, inexact. Obviously an A class anomaly flown at 500 feet will decrease to a B or C if the ground clearance is 1,000 feet or more.

The third characteristic is the ratio of the low frequency response to the high. In general, large continuous conductors, such as faults, are found to have strong low frequency response and to be characterized by ratios in excess of 1.0. Smaller bodies of high conductivity are expected to have sizeable response at 590 cps and consequently, sharp responses with ratios of 1.0 or less are regarded as the most promising for sulphide bodies.

4. DISCUSSION OF RESULTS

The strength of the Afmag fields have both a diurnal and secular variation. The surveying was carried out during January and February when the strongest fields are known to exist and most of the flying was done during the afternoon. Nevertheless, the absolute value of the field levels was found to be quite low with respect to other areas of the world and to a recording station that was operated simultaneously on the mainland. Although there is much conjecture as to the cause of low Afmag field levels in Tasmania, this condition was first recognized in 1959 and has been confirmed on numerous occasions in the last few years.

Normally survey flying is restricted to fields strength that can be recorded at instrument settings of Gain 1, 2, 3 and 4. The Gain 4 setting is usually considered marginal and is only used during periods of low turbulence. However, the weak nature of the Afmag fields forced the acceptance of Gain 5 and occasionally Gain 6 operation, in order to complete the surveying in a reasonable length of time. Approximately 90 percent of the mileage was flown at Gain 5, although there were brief periods when Gains 3 and 2 could be used. The higher gain settings result in a lower signal-to-noise ratio and reduce the reliability and repeatability of the data. This is reflected in the relatively large number of X and D class anomalies which may largely be due to spurious effects such as noise, turbulence, etc.

The character of the Afmag flight traces from the 4 areas is quite different from those obtained in other geographical locations. Response at the high frequency is generally smooth and low in amplitude while low frequency trace is quite rough and irregular. The latter is due to the lower amplitude of the Afmag fields at 140 cps and the prevailing weak nature of the fields.

There are remarkably few anomalies in the areas flown and responses due to geologic conductors rarely exceed 6 millimetres. Furthermore, there are few anomalies that have long build-ups typical of extensive faults. In short, there appear to be an unusually low number of conductive structures in the areas flown despite the fact that pyrite and graphite are reported to be common. This may be due to a lack of continuity in the sulphide mineralization. The Chester Mine (Area C) is reported to contain 2 million tons of 40 percent sulphides but no recognizable Afmag response was obtained over this body in either the airborne work or detailed ground traverses.

The small number of responses and the general smooth character of the flight traces should not be mistaken for any reduction in the sensitivity of the equipment. Large responses, up to 40 millimetres peak to peak, occur over the power lines which border some of the areas. These have not been shown on the maps since they are obviously due to cultural features.

Because of the lack of strong geologic responses, very small events have been picked on the flight traces in the hope that these might be indicative of weak conductors. Where possible these have been grouped into zones which have been lettered numerically. Ground traversing on a sample of these zones should be adequate to establish the validity of the interpretation.

Area A

The numbering of the most important responses has been done from north to south rather than in order of relative importance.

Strong responses that occur along the southeast edge of Area A, coincident with the power line, have not been shown on the final map. Some effects from the power line can be seen up to a distance of 4,000 feet.

Zones 1 & 2

These two zones have been formed from the line to line correlation of 2 sets of weak responses but they appear worthy of ground checking and have been graded as secondary targets.

Zone 3

Zone 3 is based on a series of events that could all be spurious.

However, their correlation is good and they suggest an E-W feature. There are other anomalies on strike with this anomaly on Lines 6, 7 and 9. Together these may represent a conductive zone that is too weak to be recognized on every traverse line. Initial ground checks should be done near Line 13.

Zone 4

The strongest responses in this zone are the 4, C, 1, 5 on Line 26 and the 4, D, 1, 5 on Line 31. Zone 4 appears to be complex or perhaps due to several sub-parallel bands but some distortion could be due to errors in positioning. Several ground traverses should be run through this zone which has been graded as a second priority target.

Zone 5

Three reasonably well-formed responses are the basis for this E-W trending feature. It appears to lie to the west of Mount Bischaff in the vicinity of known lead-silver mineralization. Although there may be some interference from the power lines near Waratah, Zone 5 is considered to be a primary exploration target.

Zone 6

Zone 6 consists of a cluster of responses on Lines 31 to 35 and the 3 detail lines. It may represent one or more E-W trending conductors and is considered as a second priority target. The best responses occur on Lines 33 and 35.

Zone 7

This is a single and apparently isolated anomaly picked up on the east end of Line 33. It may be due to power line effects but its easy access warrants a second priority classification.

Zones 8 & 9

These interesting anomalies appeared worthy of special mention although they cannot be given a high priority in the follow-up program.

Zone 10, 11 & 12

These three individual responses are also worthy of note but do not warrant immediate ground work.

Zone 13 & 14

The 7, B2.0 on Line 60 and the 6, B, 1.0 on Line 62 are the best formed responses encountered in the entire Afmag program. They are typical of the results obtained over good conductors of limited strike length such as sulphide bodies. They occur in an area of known sulphides and definitely warrant a first priority grading.

where are these

13 = 1 mile W. Magnet mine approx.
14 = 1 mile S. magnet mine

Zone 15

The four responses that constitute this zone are not impressive and consequently it has been assigned to low priority.

Zone 16

Both of the responses in this zone occur near the end of the line and may be due to spurious effects. However, their amplitude and character warrant a second priority classification.

Area B

Field strengths were unusually high (i. e. Gain 3 & 2) during the flying of this small area. This resulted in a good signal-to-noise ratio.

Zone 17

This N-S trending zone has been interpreted from a series of responses near the west end of Area B. The anomalies occur on alternate lines but without regard to line direction. Zone 17 could be caused by changes in attitude of the bird over a topographic feature. Nevertheless, it is considered to be of secondary importance because of the variability of the response along its length.

Zones 18 & 19

These two isolated anomalies are not impressive but are considered a secondary targets because of their proximity to a road.

Area C

This area is characterized by remarkably smooth high frequency traces and very few geologic anomalies.

A strong high frequency response occurs on almost every line that is coincident with the Emu Bay Railway. There is no evidence of this feature on either of the low frequency dip angle or amplitude traces. On Line 86 the amplitude trace was changed to the high frequency and a strong increase in signal was obtained. This indicates that the anomalous effects are due to a signal that has a strong component near 590 cps., and could be a carrier used for communication on the railway. None of these anomalies have been shown since they are almost certainly due to cultural rather than geologic causes.

On the initial flying of the north part of Area C all of the east running lines were noisy due to turbulence caused by strong easterly winds. These lines were later reflown with a marked gain in trace quality.

Line 67 passes directly over the Chester Mine which is reported to contain 2 million tons of 40 percent sulphides. No recognizable response was obtained on either the reconnaissance line or the two short detail lines. The lack of response over this feature is not surprising since ground EM and Afmag surveys showed little or no response.

Only a few conductive "zones" have been interpreted from the data on Area C. There are a number of X class anomalies but many of these could be due to spurious effects.

Zone 20

Zone 20 consists of four D class anomalies that occur in an area where mineralized outcrop has been reported. Several ground Afmag traverses should be made to check this second priority target.

Zone 21

Two weak responses occur on the east end of Line 16 and 17 and appear to be correlated. Zone 21 warrants a second priority classification because of the similarity of these weak effects.

Zone 22

This zone is considered to be a low priority target but there is a suggestion of correlating low frequency response.

Zone 23, 24 & 25

These three individual responses appear to be of minor importance.

However, 24 and 25 have unusual low frequency amplitude and will warrant checking if any success is obtained over the higher priority zones.

Zone 26

Zone 26 consists of two responses that occur in the vicinity of electrical installations. However, they are reasonably far removed for any installations shown on the airphotos and consequently should be checked by ground Afmag traverses.

Zone 27

This is a low priority zone that lies to the south of the Emu Bay Railway and may be caused by a geologic structure.

The east end of Lines 110 111, 112 and 113 show a number of large responses that are thought to be due to the railway and the power installations for the mine and town of Rosebery. A careful study of recent plan of the area should be made to determine if any of these are due to geologic causes.

Area D

There is appreciable topographic relief in Area D and some difficulty was found with maintaining ground clearance. In addition, most clear days were found to be quite windy and thermal bumps have reduced the reliability of the results in many parts of the area. Nevertheless a few anomalies appear to warrant further consideration.

Zones 28 to 42 inclusive

Fifteen zones have been interpreted from the data that appear to be due to geologic features. Zones 33, 37, 38 and 42 have been given a secondary priority but any of these would warrant upgrading if their geological environment is particularly favourable. The remainder appear to be of minor importance and many could be due to spurious events.

5. SUMMARY AND RECOMMENDATIONS

Remarkably few anomalies have been encountered in the four areas flown and there are few indications of the large anomalies that are typical of extensive fault and shear zones. This lack of response is unusual for an area with pronounced linears and the reported abundance of both pyrite and graphite. It would appear that any large faults in the area are non-conductive and that many of the sulphide bodies do not have enough electrical continuity to respond to inductive methods. The latter has been proven by ground test surveys on the Chester Mine. (Area C).

In light of the above, it is evident that small responses may be of economic interest and consequently exceptionally small events have been picked from the flight traces. Many of these small events may be due to spurious effects and this likelihood has been increased by the low level of the Afmag fields during the period of the survey.

A total of 42 zones and individual responses have been selected as the most promising areas for ground follow-up work. These have been numbered from north to south through the 4 areas. A priority classification has been assigned according to their reliability, shape, character signal level, and ground clearance; with few exceptions there has been no consideration to the geologic setting. Ground follow-up should consist of

Afmag traversing followed by electromagnetic, magnetic and/or induced polarization surveys.

Zones 5, 13 and 14 are considered as primary targets. All of these occur in Area A and should constitute the initial ground investigations.

Second priority targets occur in all four areas. A total of 14 zones have been included in this group. All of these are considered worthy of ground Afmag traversing. They are as follows:-

Area A	Zones 4, 6, 7, 12
Area B	Zones 17, 18, 19
Area C	Zones 20, 21, 26
Area D	Zones 33, 37, 38, 42

The remaining zones are regarded as being of minor importance at present. However, if all of the first and second priority zones are recovered in the follow-up program, then all of the numbered zones would warrant some ground Afmag traversing. Interesting geology in the vicinity of these zones or the unnumbered responses would enhance their importance and warrant their upgrading.

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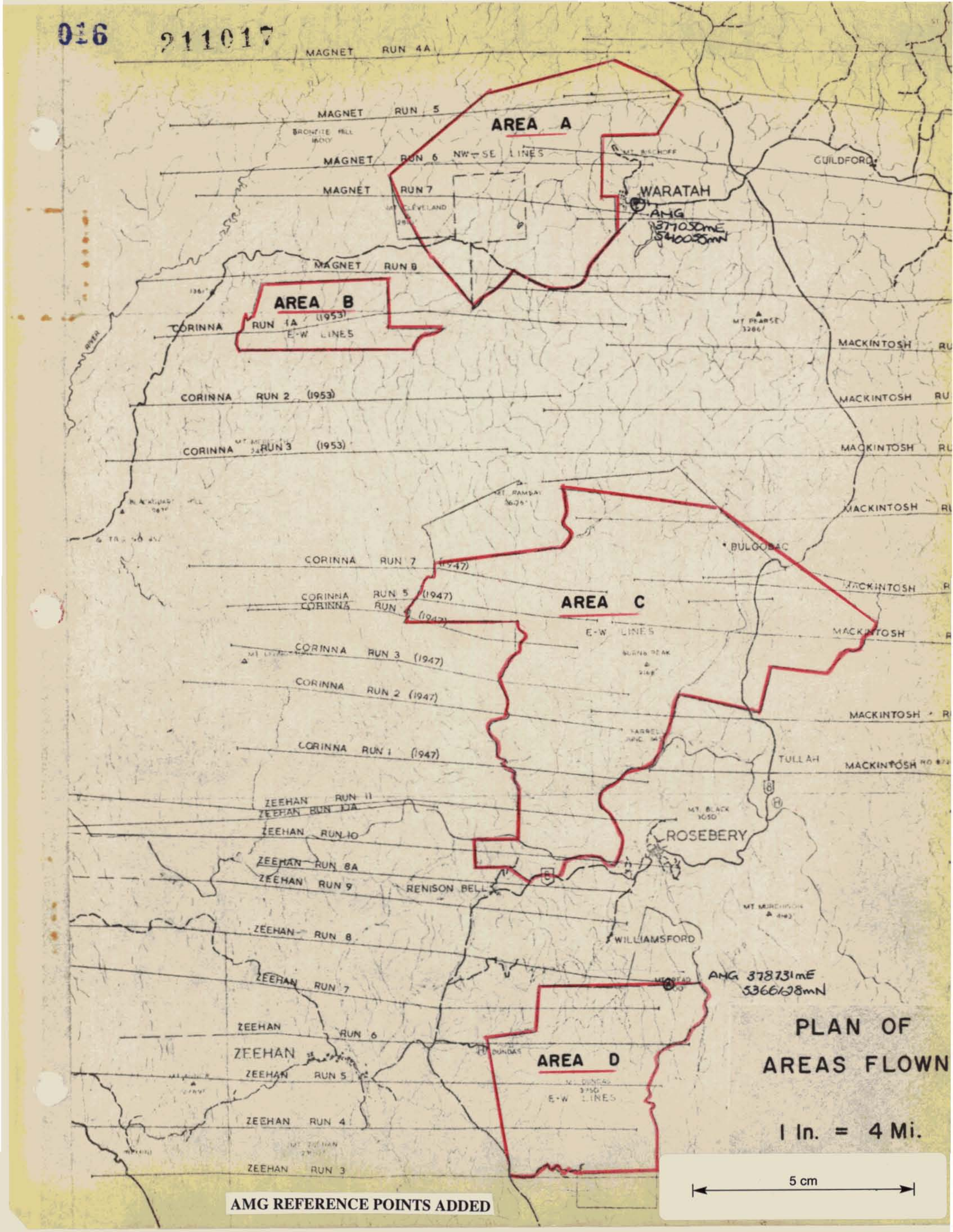
D. B. Sutherland,
Geophysicist.

Dated: September 2, 1966



016
211017
MAGNET RUN 4A
MAGNET RUN 5
AREA A
MAGNET RUN 6 NW—SE LINES
MAGNET RUN 7
MT. BISCHOFF
WARATAH
AMG
377050mE
5416035mN
GUILDFORD
MAGNET RUN 8
AREA B
CORINNA RUN 4A (1953)
E-W LINES
MT. PEARSE
MACKINTOSH
CORINNA RUN 2 (1953)
CORINNA RUN 3 (1953)
MT. RAMSAY
BULGOBAC
CORINNA RUN 7 (1947)
CORINNA RUN 5 (1947)
CORINNA RUN 4 (1947)
AREA C
E-W LINES
CORINNA RUN 3 (1947)
CORINNA RUN 2 (1947)
CORINNA RUN 1 (1947)
TULLAH
ZEEHAN RUN 11
ZEEHAN RUN 10A
ZEEHAN RUN 10
MT. BLACK
ROSEBERY
ZEEHAN RUN 8A
ZEEHAN RUN 9
RENISON BELL
MT. MURCHISON
ZEEHAN RUN 8
WILLIAMSFORD
ZEEHAN RUN 7
AMG 378731mE
5366128mN
ZEEHAN RUN 6
ZEEHAN
DUNDAS
AREA D
E-W LINES
ZEEHAN RUN 5
ZEEHAN RUN 4
ZEEHAN RUN 3
PLAN OF
AREAS FLOWN
1 In. = 4 Mi.
5 cm
AMG REFERENCE POINTS ADDED

PERSONNEL AND EQUIPMENT CONNECTED WITH THE HELICOPTER AFMAG SURVEY, E.L. 5/63, JANUARY 1966.

DWG.- AFM. 4230

7420

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HELICOPTER AFMAG. SURVEY

LOCATION MAP

211019

66-428

NOTE:
BASE MAP LIABLE TO VARIATION
DUE TO UNCONTROLLED MOSAIC.

MINES EXPLORATION PTY., LTD.

N.W. TASMANIA

AREA A

SCALE: 1" = 1900' (approx.)

5 cm

ANOMALOUS ZONE ---------- (12)

GRADED AFMAG. ANOMALY -------------- ●

AMPLITUDE OF 590 C.P.S. (IN M.M.)

SHAPE AND GRADE FACTOR 12, C, 0·9

RATIO – 140 C.P.S./ 590 C.P.S.

POSSIBLE AFMAG. RESPONSE ---------- X

FIDUCIALS ---------------------- 630 ○

4720

DRAWN: K.B.

DATE: APRIL, 1966

APPROVED:

DATE: 29/8/66

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DWG.- AFM. 4230 A

DWG. - AFM. 4231

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HELICOPTER AFMAG. SURVEY

LOCATION MAP

211020

MINES EXPLORATION PTY., LTD.

N.W. TASMANIA

AREA B

SCALE: 1" = 1900' (approx.)

5 cm

NOTE:
BASE MAP LIABLE TO VARIATION
DUE TO UNCONTROLLED MOSAIC.

ANOMALOUS ZONE 19

GRADED AFMAG ANOMALY ●

AMPLITUDE OF 590 C.P.S. (IN M.M.)

SHAPE AND GRADE FACTOR 12, C, 0·9

RATIO – 140 C.P.S./590 C.P.S.

POSSIBLE AFMAG. RESPONSE X

FIDUCIALS 630 o

66-428

DRAWN: K.B.

DATE: APRIL 1966

APPROVED:

DATE:

4721

DWG. - AFM. 4231 B

4723

McPHAR GEOPHYSICS LIMITED

HELICOPTER AFMAG SURVEY

LOCATION MAP

4723

211021

NOTE:
BASE MAP LIABLE TO VARIATION
DUE TO UNCONTROLLED MOSAIC.

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N.W. TASMANIA

AREA C

(NORTH PART)

ANOMALOUS ZONE ---------- (21)
GRADED AFMAG. ANOMALY ---------- ●
AMPLITUDE OF 590 C.P.S. (IN M.M.) — 12, C, 0·9
SHAPE AND GRADE FACTOR —
RATIO - 140 C.P.S. / 590 C.P.S. —
POSSIBLE AFMAG RESPONSE ---------- X
FIDUCIALS ---------- 630 ○

5 cm

211021

66-428

4723

AREA C

DRAWN: K.B.
DATE: APRIL, 1966
APPROVED:
DATE: 2/8/66

DWG. - AFM. 4232 - 1 C

4723

DWG. - AFM. 4232-2

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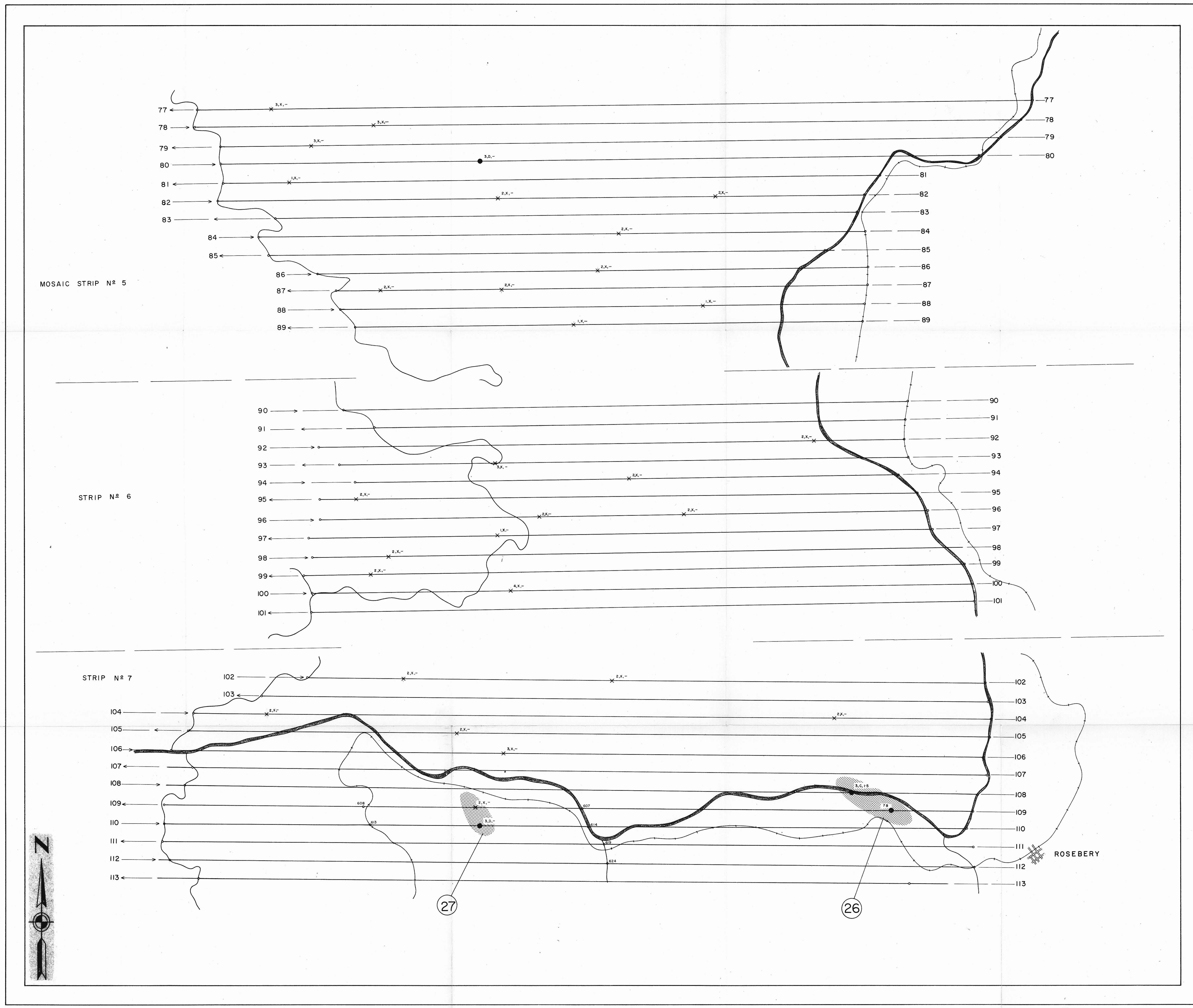
HELICOPTER AFMAG. SURVEY

LOCATION MAP



211022

NOTE:
BASE MAP LIABLE TO VARIATION
DUE TO UNCONTROLLED MOSAIC.

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AREA C

(SOUTH PART)

SCALE: 1" = 1500' (approx.)

5 cm

ANOMALOUS ZONE ---------- (26)
GRADED AFMAG. ANOMALY ---------- ●
AMPLITUDE OF 590 C.P.S. (IN M.M.)
SHAPE AND GRADE FACTOR — 12, C, 0·9
RATIO - 140 C.P.S./590 C.P.S.
POSSIBLE AFMAG. RESPONSE ---------- X
FIDUCIALS ---------- 6300

66-428

4722

DRAWN: K.B.
DATE: APRIL, 1966
APPROVED: [signature]
DATE: 29/8/66

McPHAR GEOPHYSICS LIMITED

DWG. - AFM. 4232-2