

ANIO



GEO INSTRUMENTS

A.C.N. 000 978 174 Pty. Limited

348 ROCKY POINT ROAD, RAMSGATE NSW 2219

PHONE 61 2 529 2355.

AUSTRALIA

FAX 61 2 529 9726

LOGISTICS REPORT

HELICOPTER GEOPHYSICAL SURVEY ANIO CREEK NORTH EAST TASMANIA

**DEPARTMENT OF STATE DEVELOPMENT AND RESOURCES
MINERAL RESOURCES TASMANIA DIVISION**

**30 Gordons Hill Road,
ROSNY PARK TASMANIA 7018**

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1. LOGISTICS

1.1 OPERATING BASE AND DATES OF SURVEY

1.1.1 Operating Base

The crew were based at Savage River situated in North Eastern Tasmania. The helicopter was operated from the Savage River airstrip.

1.1.2 Dates of Flying

Start of survey production	21st Nov 1993
Completion of production	21st Nov 1993

1.2 AIRCRAFT DETAILS AND NAMES OF FIELD CREW

1.2.1 Aircraft

Bell Helicopter B206 B3 "Jet Ranger" Registration VH-FHB

1.2.2 Field Crew

Pilot (Heli-Aust)	Peter Franks
Operator/Engineer	Shaun Adams
Operator	Thomas Atkinson
Survey Manager	Zoltan Beldi

2. SURVEY DETAILS

2.1 DESCRIPTION OF AREAS FLOWN

This survey area is marked on the area map in Appendix 1.

2.1.1 Flying Specifications

Flight line direction	330-150 deg true
Flight line spacing	100 metres
Tie line direction	060-240 deg true
Tie line spacing	500 metres
Magnetic sensor mean terrain clearance	60 metres
Spectrometer sensor mean terrain clearance	80 metres
Sampling interval (Magnetics)	0.10 seconds
(Radiometrics)	=< 7m / sample
	1.00 seconds
Total distance processed	101km

2.2 **MAPPING**

Flight Planning was conducted by reference to Australian Map Grid Coordinates and area diagrams both supplied by the Department of Mineral Resources, Tasmania.

A copy of the appropriate maps are included in Appendix 1 of this report.

2.3 **FLIGHT PATH RECOVERY**

Navigation was conducted primarily by reference to the positions provided by the Global Positioning System, hereafter referred to as (G.P.S.).

Flight path recovery was obtained by differentially correcting the flight data with static data that were obtained from a fixed base station GPS receiver.

The position of the reference base station antenna was derived from a differential solution of observations referenced to several bench marks.

The GPS base station was located

South Latitude	41° 30' 49" .008
East Longitude	145° 13' 05" .718

The above Co-ordinates are referenced to the AGD84 Spheroid.

Varying degrees of "Selective availability" were observed during the course of the survey.

In addition to GPS recording, the flight path was recorded visually by a continuous running VHS PAL Colour video camera/recorder fitted with a wide angle lens viewing the ground directly beneath the helicopter for verification purposes.

A synchronising fiducial number generated by the Data Acquisition System was recorded within the video frame and the analogue data monitor charts.

2.4 **MAGNETOMETER.**

The survey was flown using a Geometrics G-833 Ultra-high sensitivity Meta-Stable Helium Magnetometer sensor system. This sensor provides a Larmor signal within the range of 1.1 to 1.9Mhz that is processed by high precision counters embedded within the Geo Instruments G2000 Acquisition system.

The sensor and pre-amp were mounted in a "bird" and flown approximately 20 metres below the helicopter.

Survey Specifications were:

Sensitivity	0.01 nT
Signal/Noise Ratio	>100:1
Still Air RMS Noise	0.05 nT
Digital Recording Resolution	0.01 nT
Magnetic Gradient Tolerance	>20,000 nT / metre
Sample Time	0.10 sec. (Recorded at 0.20sec)
Sample Distance (Mean)	7 metres

2.5 SPECTROMETER

An Exploranium GR820 Differential Gamma Ray Spectrometer was used to measure the standard energy windows for the gamma radiation from TI-208, Bi-214, K-40, Total Count and Cosmic.

The gamma ray spectrometer was interfaced to a NaI (TI) crystal detector with a volume of 16.4 litres (1024 cubic inches). The detector pack was mounted inside the helicopter in the baggage compartment clear of the helicopter fuel tanks.

The GR820 measures the pulses generated by the crystal detector and controls the gain of each individual detector element by reference to the natural radiation emanating from the ground. The isotope selected for the gain control is determined during the survey and depends on the concentration observed during flights covering tie lines.

The Anio Creek Area had a prevalence of Thorium, therefore it was primarily used as the stabilising element.

The five differential channel windows were defined as follows:

Total Count	0.30 - 3.01 MeV
K - 40	1.37 - 1.57 MeV
Bi - 214	1.66 - 1.87 MeV
TI - 208	2.41 - 2.81 MeV
Cosmic	3.00 - 9.00 MeV

The digital recording contains uncorrected values for the channel windows.

2.6 ANALOG RECORDING.

A printer/plotter RMS Instruments Model GR-33 was used to record the following.

Channel	Parameter	Full Scale
00	Total Magnetic Field	200 nT
01	Total Magnetic Field	2000 nT
02	Total Count	1,500 cps
03	Potassium (K-40)	150 cps
04	Uranium (Bi-214)	150 cps
05	Thorium (TI-208)	150 cps
06	Radar Altitude	500 ft.
07	Barometric Altitude	500 m

Note that the radiometrics have been normalised to counts per second and Compton scatter (from Thorium) was removed from the Uranium and Potassium channels. Additionally, the fiducial mark correlates to those on the digital data.

2.7 *ALTIMETER.*

A Sperry AA-210 Radar Altimeter system was used. The pilot's analogue indicator provides an absolute altitude display from 0 to 750 metres (0 to 2,500 ft.). Though the altimeter is self calibrating, a check was carried out at 70ft referenced to the "bird" cable at the beginning and end of each flight.

The reference height above mean sea level was derived from the height value provided by the GPS receiver.

2.8 *BASE STATION MAGNETOMETER*

A Geometrics Model G-856 with digital recording was used as the base station magnetometer for recording the diurnal variations and was run continuously throughout the survey flying period. The base station was sampled at 5.0 second period.

Magnetic disturbance activity was classed as moderate throughout much of the survey. Those periods where the magnetic field excursions exceeded the specifications were reflight.

2.9 *DATA ACQUISITION SYSTEM*

The Geo Instruments G2000 is a Digital Acquisition System based on the IBM PC AT architecture.

The system is fitted with several modules tailored to condition the input data from the various sensing instruments.

A custom written software package facilitates the following;

- (a) Correct synchronisation of the data streams,
- (b) Formatting of all data received,
- (c) Extended error checking of all parameters,
- (d) Visual data presentation for monitoring purposes,
- (e) Generate and distribute synchronising Fiducial numbers,
- (f) Recording of data to magnetic media,
- (g) Calculation of position and provide steering display for pilot

2.10 GPS NAVIGATION SYSTEM.

This comprised two NovAtel 951R Receivers and associated antennas. The receiver is a ten channel CA code and carrier phase unit capable of tracking up to ten satellites simultaneously and deriving positions from all satellites in view.

Positions may be generated at 0.2 second intervals and internal recording capacities allow ten hours of positional data storage.

Two units were used in conjunction with each other to allow a real time differential solution to be obtained with the aid of a dedicated telemetry link operating in the UHF Band. Corrections were transmitted at three second intervals.

2.11 WEATHER DETAILS.

Weather information where relevant was recorded on the daily flight logs.

3. CALIBRATIONS

3.1 MAGNETICS

3.1.1 Magnetic Noise Envelope.

Post flight analysis indicated that the mean fourth difference noise level achieved was less than 0.025nTs over the whole of the survey. Only occasional bursts of noise exceeded these parameters. They were generally attributed to the effect of severe mechanical turbulence imposed on the bird whilst flying during strong winds in the proximity of sharp topographical relief.

3.1.2 Heading and Parallax Errors

A test flight prior to the survey confirmed no detectable heading error. This is normal and due to the 20m separation of the magnetometer sensor and pre-amp from the helicopter.

A flight was performed before the survey, to test for parallax errors in the system by flying over a metal shed in two opposing directions. It was determined that the digital readings lagged the camera recorded positions by 0.2 of a sample. This averages about two metres and is corrected in the field during merging of the positions with the acquired data.

3.2 **RADIOMETRICS**

3.2.1 **Stripping Coefficients.**

These coefficients were obtained at the beginning of the survey. They were derived using point source Thorium and Uranium samples placed to give a uniform irradiation of the detector pack while the spectrometer subtraction values were adjusted to give minimum observable contribution into the other channels.

The following stripping co-efficients were used for subsequent correction of the digital data:

KU	0.81
KT	0.40
UT	0.25
TU	0.06

The following corrections were used:-

	TC	K	U	Th
Altitude per metre	0.0037	0.0032	0.0042	0.0038
Aircraft background cps	60	3	2	0.75
Cosmic background cps	0.520	0.025	0.021	0.026

3.2.2 **Pre and Post Flight Checks**

All crystals were aligned prior to each day's flight using Cs137 sources and checked for drift at the conclusion of the day. Drift values were kept to a minimum by the correction mechanisms built into the GR820 spectrometer. An alarm is generated whenever the gain drift exceeds nominal tolerances and the GR820 is unable to correct the drift. An unresolved alarm will preclude further flying, however none were generated for this survey.

Pre and post flight checks were undertaken using the following samples:

Thorium sample
Uranium sample

Both pre and post flight sample checks were recorded in analogue and digital forms.

3.2.3 **Flight Calibrations**

A test line was flown before and following each days survey to assess the repeatability of the system pre and post data collection. A test line that exhibited some radiometric expression was selected.

4. DATA PROCESSING

4.1 RECOVERY INFORMATION

The post processed position information was merged with the geophysical data and then subjected to a number of checks. These include;

- (a) Speed correlation checks.
- (b) Spikes, dropouts and noise bursts in all data streams
- (c) Flight path coverage within specified parameters.

4.2 DIGITAL DATA

4.2.1 Magnetic Processing

All data were checked for abnormalities by an in-field data verification system that checks conformity of all parameters within a band of acceptable values.

Having verified all data in the field, the final processing sequence is reduced to the following steps;

- (a) Convert all variables to common base levels.
- (b) Normalise Base station Magnetometer levels.
- (c) Subtract normalised Base Station Magnetometer from Magnetometer values acquired along each line.
- (d) Subtract the IGRF Model from the magnetic datum.
- (e) Grid the data using a 50 metre square grid mesh.
Gridding method is as per Briggs 1974 utilising a four times line spacing search/scan radius.

No filters were applied to the data prior to gridding.

4.2.2 Radiometrics

The spectrometer data was composed of the spectrometer timer, radar and barometric altimeters and the windowed data (i.e. Total count, Potassium, Uranium, Thorium). The windowed data was normalised to counts per second and checked for steps, spikes and noise.

The dataset was then corrected for the following:

- 1 Aircraft Background
- 2 Compton Scatter due to Cosmic
- 3. Energy Stripping of K-40 and Bi-214

The altitude attenuation correction was performed as an exponential function to the nominal (80 metres) survey height.

4.3 DELIVERED ITEMS

- (a) 1:50,000 Scale Final Mylar base Maps of the following;

Flight Path Plots.

Total Magnetic Intensity contours.

Total Magnetic Intensity stacked profiles.

Total Radiometric Intensity contours.

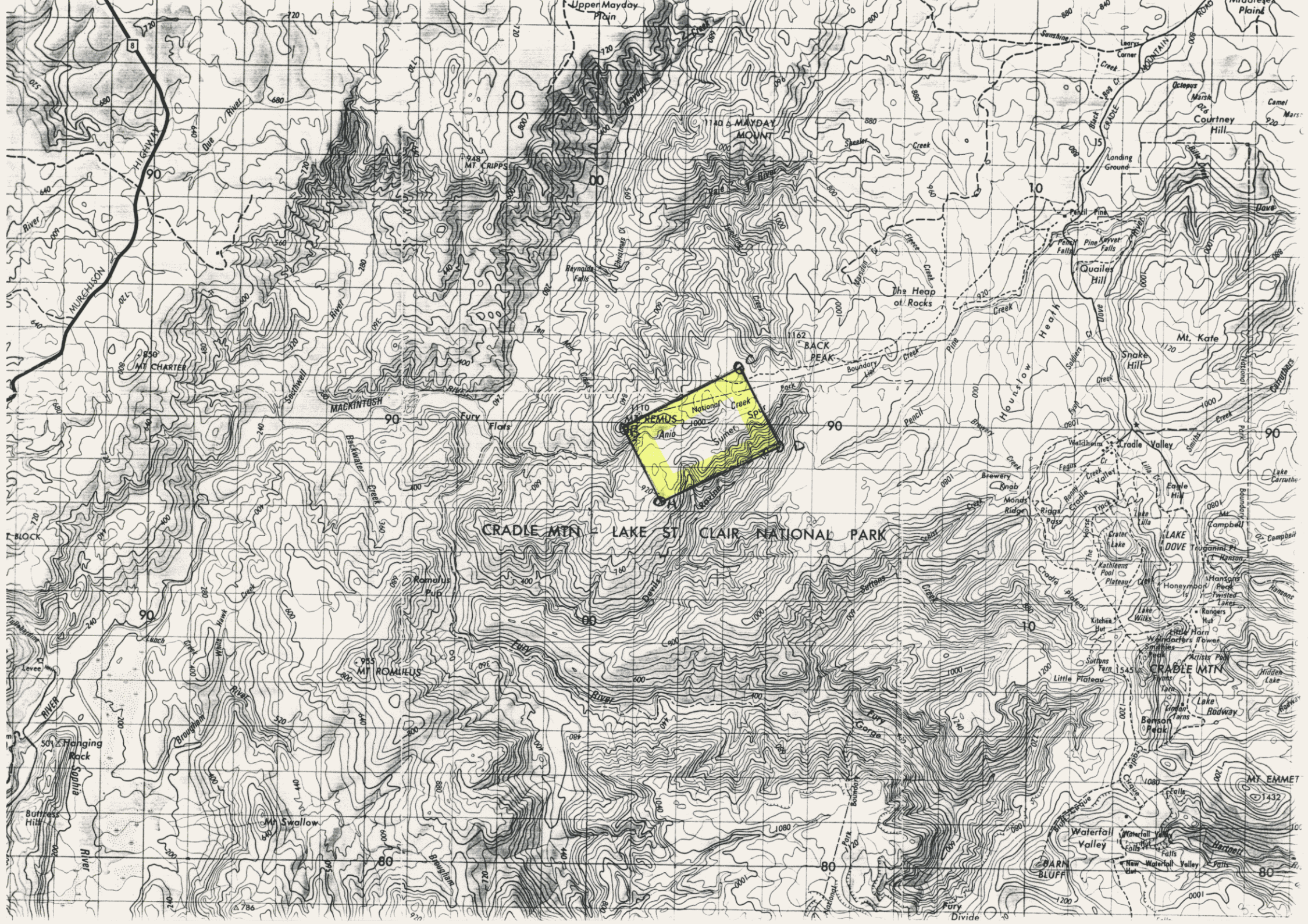
- (b) Gridded Data Tapes of Magnetic and Radiometric data
Located data tapes of all acquired parameters.

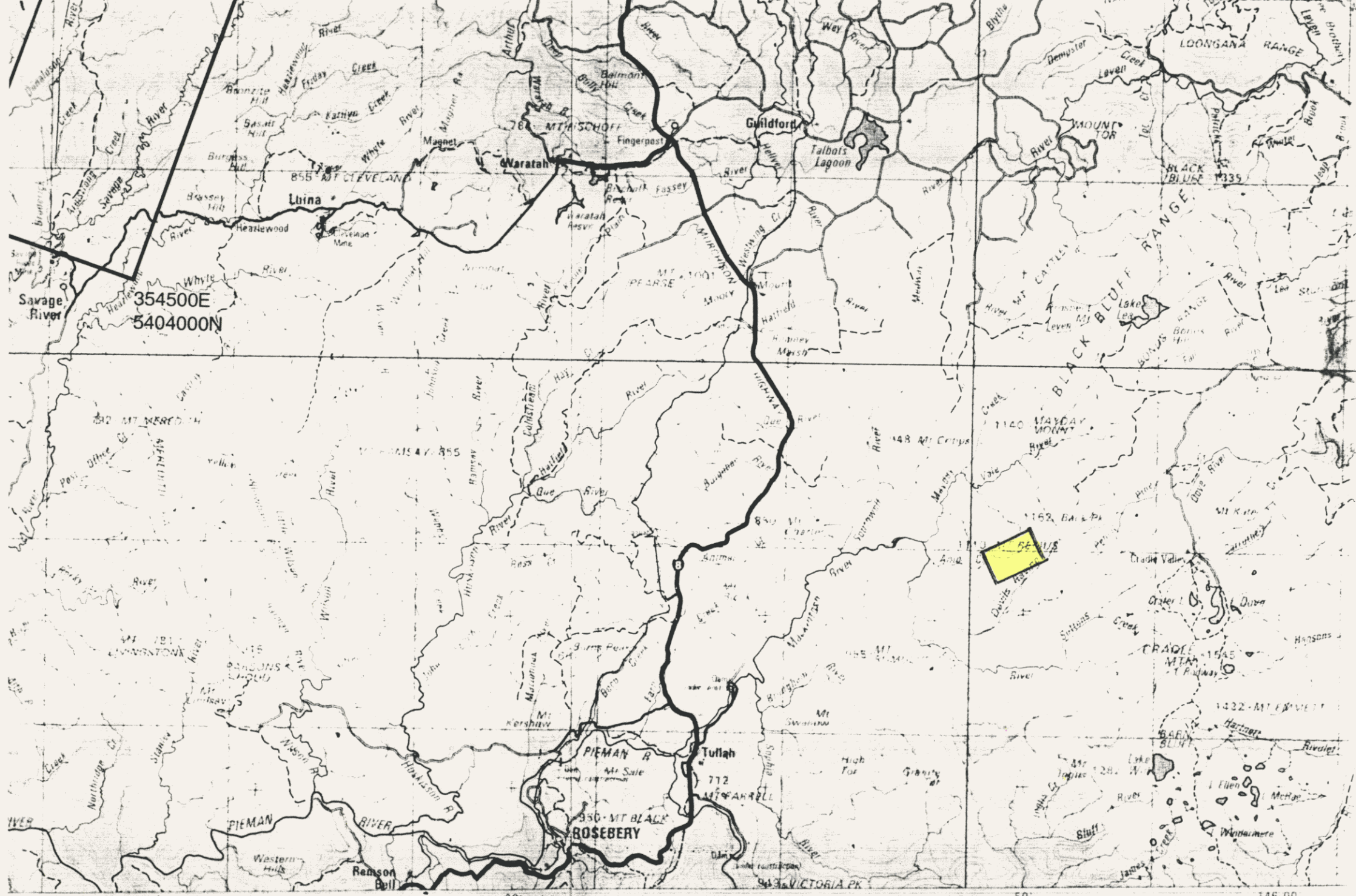
- (c) Raw data disks from helicopter system and Base station magnetometer.
Video flight path records

- (d) Analog chart records. (Annotated and folded)
Flight logs (original un-edited)

APPENDIX 1

MAP OF AREA FLOWN





354500E
540400N

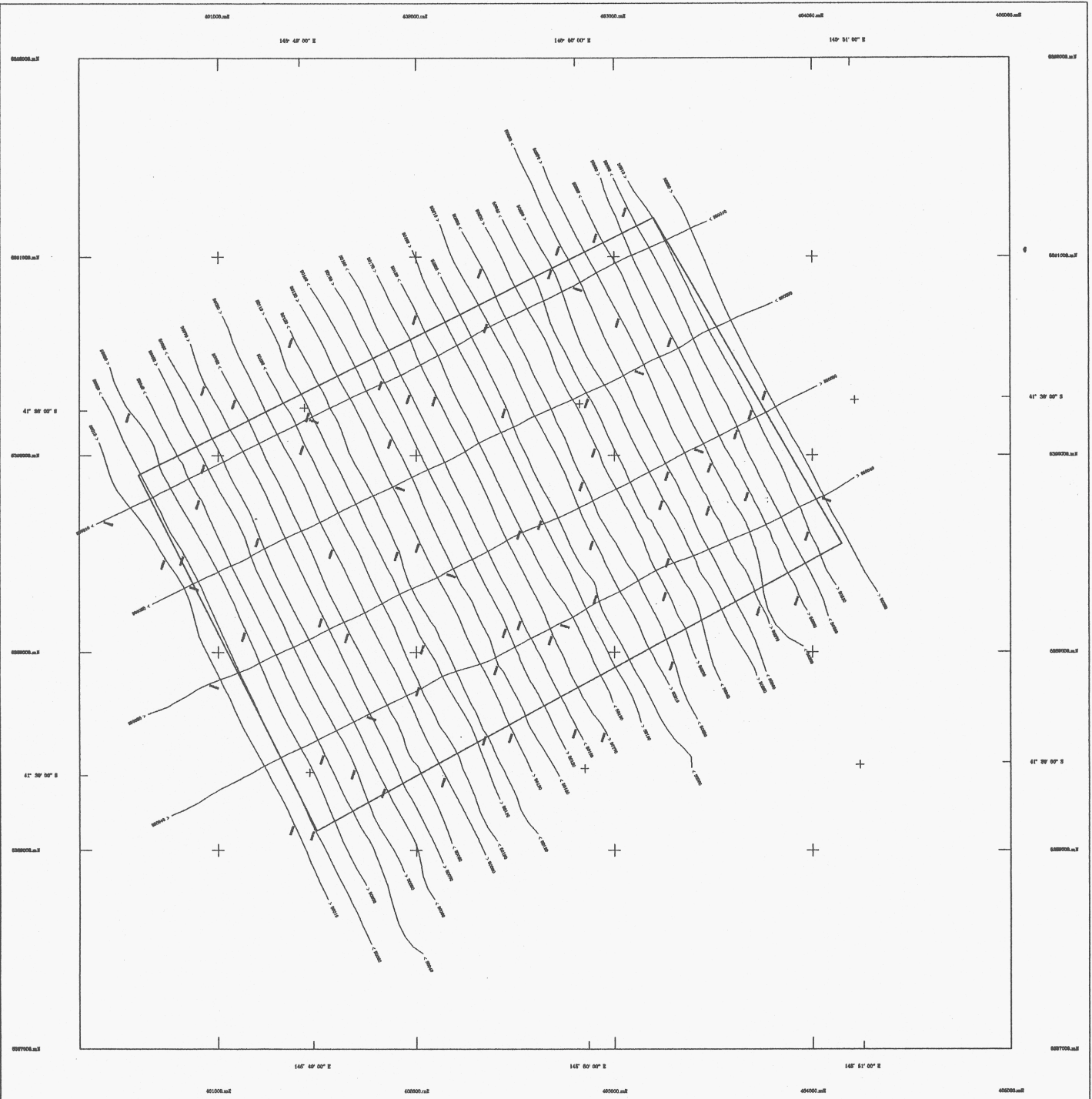
70 30 40 50 146 00

ZEEHAN HWY

APPENDIX 2

SET OF REDUCED SCALE MAPS

Qty.	Description
1	Final Flight Path map at 1:10,000 scale
1	Final TMI Profile maps at 1:10,000 scale
1	Final TMI Contour maps at 1:10,000 scale
1	Final Total Count Contour maps at 1:10,000 scale



AIRBORNE SURVEY EQUIPMENT

Aircraft: Bell 206 - 3 V8-PWR
 Magnetometer: Geometrics GDS Silex
 Magnetometer Orientation: 0.01 mT
 Magnetometer Sample Interval: 0.25 seconds
 Data Acquisition: 600 Instruments Model 2000
 Data Recorder: LA 24 Data Recorder
 Data Processor: 128K Data Recorder
 Control Unit: 14.5K Data Recorder
 Transmitter Sample Interval: 1.0 seconds
 Flight Path Recorder: TMS Colour Video System
 GPS Navigation System: Standard GPS Receiver

AIRBORNE SURVEY SPECIFICATIONS

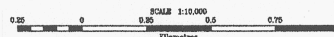
Flight line direction: 000 - 270 degrees
 Flight line separation: 100 metres
 Sw line separation: 000 - 100 metres
 Sw line separation: 000 metres
 Sw line separation: 00 metres (DTC)

FLIGHT PATH PROCESSING

Flight path calculated from differentially corrected GPS data using an Epsilon GPS Receiver
 GPS navigation data differentially corrected to real time
 GPS Base Station: East 41° 00' 00.00" S 149° 11' 41.40" E
 Survey 200 10 00000000
 Grid datum refers to Australian Map Grid Zone 55

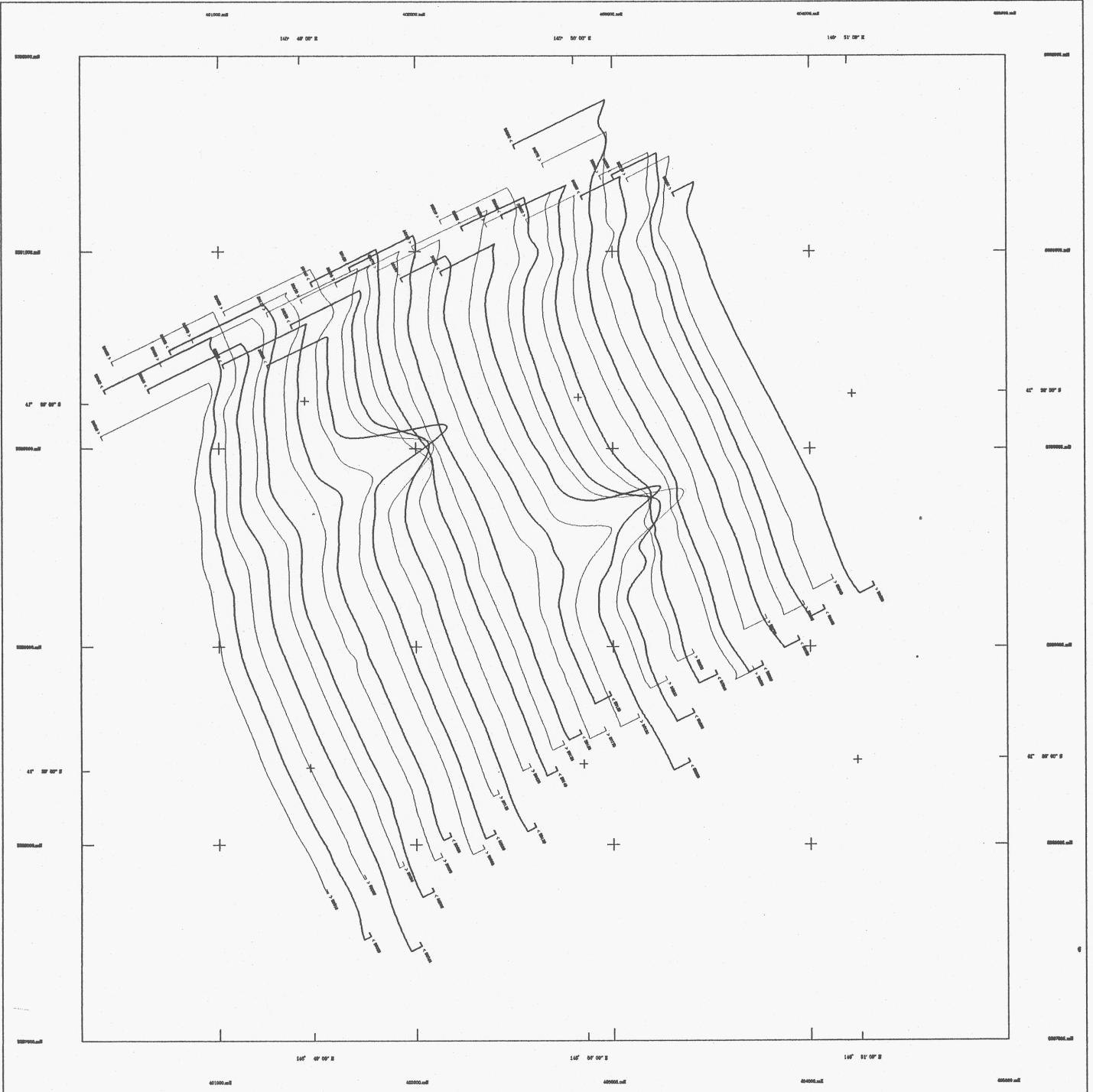
Anio Creek Airborne Geophysical Survey
 Tasmania Development and Resources
 Minerals Resources Tasmania
 Surveyed and compiled Geo Instruments Pty. Ltd
 Processed by Kovron Geophysics Pty. Ltd.
 October - November 1993

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Scale: 1:10,000
 Map Grid Zone: 55
 Spheroid: Australian National
 Projection: Universal Transverse Mercator





AIRBORNE SURVEY EQUIPMENT

Magnetometer
 Magnetometer Stabilisation
 Magnetometer Sample Interval
 Data Acquisition
 Data Processing
 Data Storage
 Data Transfer
 Data Output
 Data Archiving
 Data Security
 Data Backup
 Data Recovery
 Data Restoration
 Data Archiving
 Data Security
 Data Backup
 Data Recovery
 Data Restoration

AIRBORNE SURVEY SPECIFICATIONS

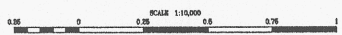
Flight Line Direction
 Flight Line Spacing
 Data Acquisition
 Data Processing
 Data Storage
 Data Transfer
 Data Output
 Data Archiving
 Data Security
 Data Backup
 Data Recovery
 Data Restoration

TOTAL MAGNETIC INTENSITY STACKED PROFILES

Stacked profiles presented
 100% (100%) applied to 100% covered
 Average survey line width value added to datum
 Datum Mean Value
 Vertical Scale

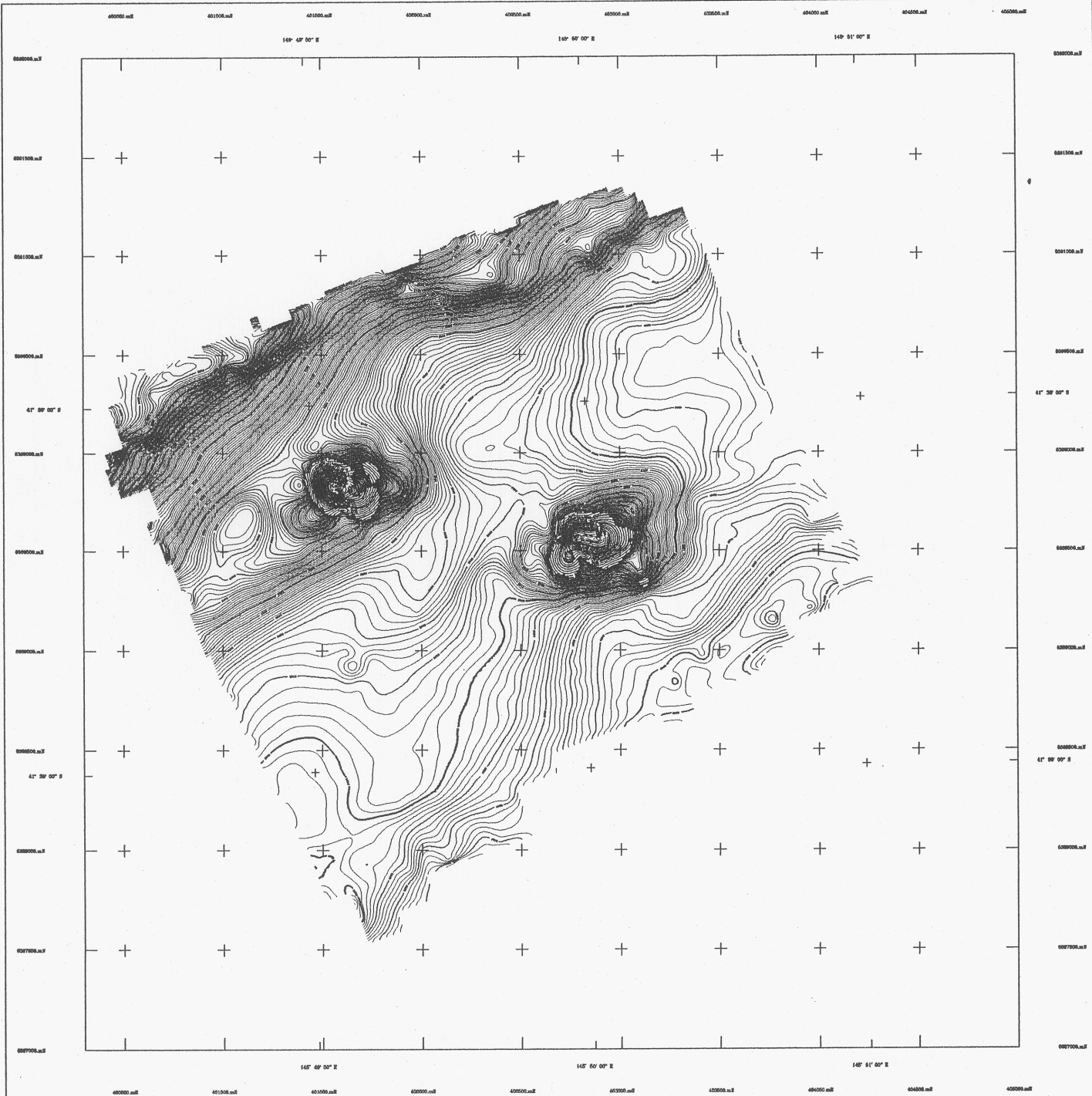
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MAP GRID ZONE 55
 SPHEROID : Australian National
 PROJECTION : Universal Transverse Mercator





AIRBORNE SURVEY EQUIPMENT

Aircraft: Bell 206 - 3 VIP-FSE
 Magnetometer: Geometrics GR85 Radius Type
 Magnetometer Foundation: 0.31 m
 Magnetometer Sample Interval: 0.25 sec
 Data Acquisition: Geo Instruments Model 8000
 Data Recording: 1.44 3 1/2 floppy disks
 Computer: International 486SX
 Crystal: 10 MHz Geometric Survey
 Magnetometer Sample Interval: 1.0 second (approx 50 metres)
 Flight Path Record: 800 metres (Video System)
 GPS Navigation System: Rovidal GPS Receiver

AIRBORNE SURVEY SPECIFICATIONS

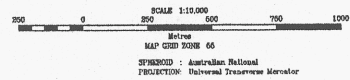
Flight Line Direction: 090 - 170 degrees
 Flight Line Separation: 200 metres
 Dr Line Direction: 000 - 180 degrees
 Dr Line Separation: 300 metres
 Terrain Clearance: 40 metres (MFL)

TOTAL MAGNETIC INTENSITY CONTOURS

General Specifications:
 Contour Interval: 2, 10, 50, 100, 1000 nT
 Contour Interval: 2, 10, 50, 100, 1000 nT

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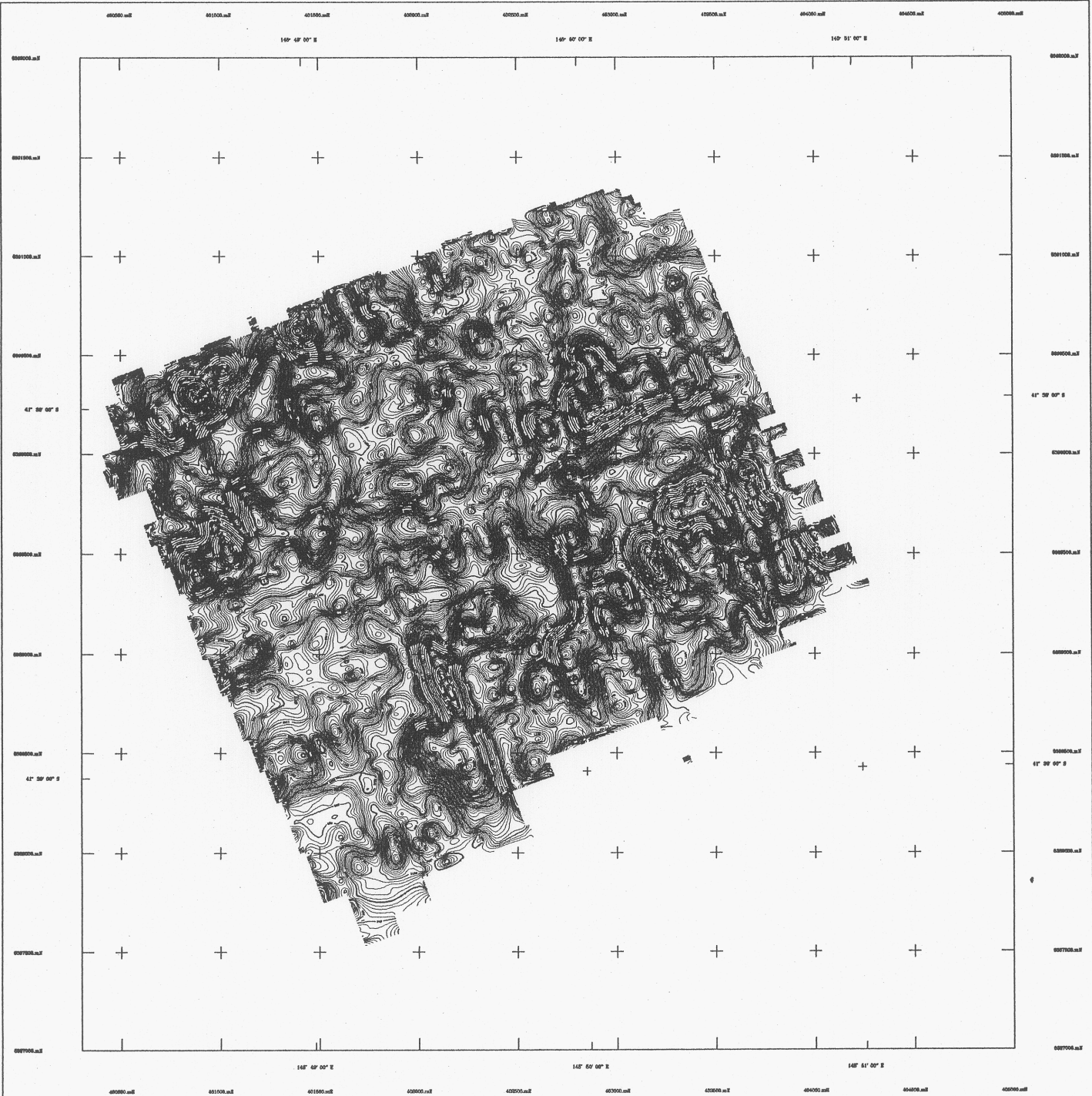
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1:10,000 AIRBORNE GEOPHYSICAL SERIES

ANIO CREEK SURVEY

TOTAL COUNT CONTOURS
MINERAL RESOURCES TASMANIA



AIRBORNE SURVEY EQUIPMENT

Aircraft: Dornier DO 28-2 V8-PRO
 Magnetometer: Geometrics CASM 3000m Topcon
 Magnetometer Bandwidth: 0.1 Hz
 Magnetometer Sample Interval: 0.25 seconds
 Data Acquisition: Geo Instruments Model 2020
 Data Storing: 1.44 MB floppy disks
 Spectrometer: Instruments OMS20
 Control Unit: Instruments OMS20
 Magnetometer Sample Interval: 1.2 Seconds (approx 20 metres)
 Flight Path Record: VRS Colour Video System
 GPS Navigation System: Realist GPS Receiver

AIRBORNE SURVEY SPECIFICATIONS

Flight line direction: 900 - 270 degrees
 Grid Line Separation: 500 metres
 Line Direction: 900 - 270 degrees
 Line Separation: 600 metres
 Survey Contour: 40 metres (MT)

TOTAL COUNT CONTOURS

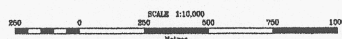
Data has been corrected for aircraft and cosmic backgrounds.
 Height corrected to a sea level datum of 50 metres.
 Minimum height of 50 metres + maximum of 200 metres.

Grid Mark: 50 x 50 metres

For the purpose of contouring a 500 metre
 contour interval. Data has been applied to the grid.
 Contour Interval: 50, 100, 200, 500 mgs

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MAP GRID: EDGSE 66
 SPHEROID: Australian National
 PROJECTION: Universal Transverse Mercator



APPENDIX 3

RAW FLIGHT REPORTS



GEO INSTRUMENTS

Pty. Limited (Inc. in N.S.W.)

OPERATORS FLIGHT REPORT

Page 1 of 2

Job No. 9304
 Area S Airport SAVAGE RIVER
 Flight 79 DY325 Take off 1222 Land 1537
 Date 21 11 93 Flight time 3:15
 Day Mo. Yr. Mag. Sens. F/S 1
 Airplane VH-FHB Fid. & Scan Interval
 Pilot P. FRANKS Svy. Alt.
 Co-Pilot Baro. Pres.
 Operator T. ATKINSON Baro. Alt. Correct
 Dataman S. ADAMS Rdr. Alt. Chart F/S

Spectrometer Multiplier Settings

Analog F/S cts.	Digital Mult. No.
K40.....	CTS.....Mlt.
Bi214.....	CTS.....Mlt.
TL208.....	CTS.....Mlt.
TC.....	CTS.....Mlt.
Sample Rate.....	Sec.

Rdr. Alt. F/S = Ft. at MV/Ft.

Line No. & Direct.	Fiducials and Scans		Local Time		Line Extent		Header	Remarks	Fids.
	Start	End	Start	End	From	To			
L32S	31067	31135	1310	1311					
L31N	31136	31270	1312	1314				SCRUB	
L15	31271	31365	1315	1317					
L2N	31366	31490	1318	1320					
L3S	31491	31600	1320	1322					
L4N	31601	31725	1323	1325					
L5S	31726	31820	1325	1327					
L6N	31821	31940	1327	1329					
L7S	31941	32050	1330	1332					
L8N	32051	32155	1332	1334					
L9S	32156	32260	1335	1336					
L10N	32261	32375	1337	1339					
L11S	32376	32475	1339	1341					
L12N	32476	32600	1342	1344					
L13S	32601	32710	1344	1346					
L14N	32711	32830	1346	1348					
L15S	32831	32945	1349	1351					
L16N	32946	33075	1351	1354					
L17S	33076	33200	1354	1356					
L18N	33201	33305	1357	1359					
L19S	33306	33400	1359	1401					
L20N	33401	33530	1401	1404					
L21S	33531	33640	1404	1406					
L22N	33641	33755	1406	1408					
L23S	33756	33870	1409	1411					
L24N	33871	33990	1411	1413					
L25S	33991	34100	1414	1416					
L26N	34101	34221	1416	1418					



GEO INSTRUMENTS
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OPERATORS FLIGHT REPORT

Page 2 of 2

Job No. 9304
 Area 5 Airport
 Flight 79 DY325 Take off Land
 Date 21/11/93 Flight time
 Day Mo. Yr. Mag. Sens. F/S /
 Airplane Fid. & Scan Interval
 Pilot Svy. Alt.
 Co-Pilot Baro. Pres.
 Operator Baro. Alt. Correct
 Dataman Rdr. Alt. Chart F/S

Spectrometer Multiplier Settings

Analog F/S cts.	Digital Mult. No.
K40	CTS Mlt.
Bi214	CTS Mlt.
TL208	CTS Mlt.
TC	CTS Mlt.
Sample Rate	Sec.

Rdr. Alt. F/S = Ft. at MV/Ft.

Line No. & Direct.	Fiducials and Scans		Local Time		Line Extent		Header	Remarks	Fids.
	Start	End	Start	End	From	To			
L275	34221	34355	1419	1421					
L28N	34356	34455	1422	1424					
L295	34456	34470	1424	1424				SCRUB	
L295	34471	34605	1425	1427					
L30N	34606	34705	1428	1430					
L315	34706	34820	1431	1433				2ND ATTEMPT	
TIW	34822	34950	1435	1437					
T2E	34951	34985	1438	1439				SCRUB	
T3E	34986	35120	1440	1442					
T2W	35121	35260	1443	1445					
T4E	35261	35405	1446	1449					
TESTLINE	35407	35525	1528	1530					
BKGND	35526	35580	1530	1531				LAKE	
GND	35581	35750	1536	1539					
TH	35751	35925	1544	1547					
U	35926	35990	1548	1549					
GND	35991	36095	1549	1551					

