Reynolds Range
Northern Territory
TEMPEST
Geophysical Survey

Acquisition and Processing Report

for

Toro Energy Limited

Prepared by :	K.T. Lee L. Stenning
Authorised for release by :	…………………………..
	…………………………..

Survey flown: August 2009

by

Fugro Airborne Surveys
435 Scarborough Beach Road, Osborne Park WA 6017, Australia
Tel: (61-8) 9273 6400   Fax: (61-8) 9273 6466

FAS JOB # 2066

CONTENTS

1. SURVEY OPERATIONS AND LOGISTICS

1.1 Introduction

Between the 23rd of August 2009 and the 30th of August 2009, Fugro Airborne Surveys Pty. Ltd. (FAS) undertook an airborne TEMPEST electromagnetic and magnetic survey for Toro Energy Limited, over the Reynolds Range Project areas in the Northern Territory. The survey consisted of two areas. Total coverage of the survey areas amounted to 1531.1 line kilometres flown in 7 flights. The survey was flown using a Shorts Skyvan SC-3-200 aircraft, registration VH-WGT owned and operated by FAS. This report summarises the procedures and equipment used by FAS in the acquisition, verification and processing of the airborne geophysical data.

1.2 Survey Base

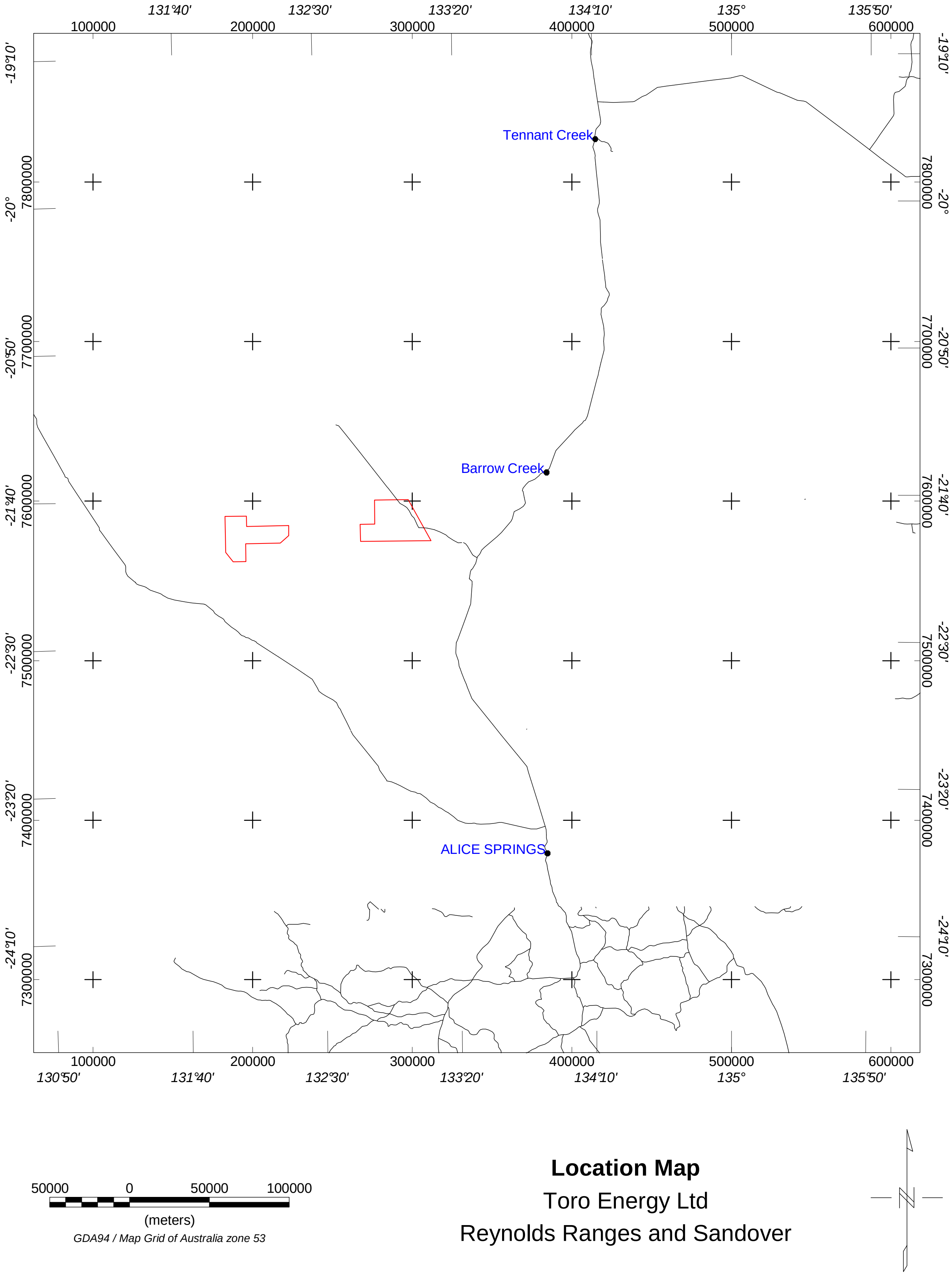
The survey was based out of Ti Tree, Northern Territory. The survey aircraft was operated from Ti Tree Airport with the aircraft fuel available on site. A temporary office was set up at the Ti Tree Roadhouse, where all survey operations were run and the post-flight data verification was performed.

1.3 Survey Personnel

The following personnel were involved in this project:

Project Supervision	- Acquisition	Bart Anderson
	- Processing	Adam Shales
On-site Crew Leader		Ben Riggs
Pilot/s		Mick Young
System Operator/s		Ben Riggs
Field Data Processing		Kah Tho Lee
Office Data Processing		Kah Tho Lee

1.4 Area Map



Location Map

Toro Energy Ltd

Reynolds Ranges and Sandover

1.5 General Disclaimer

It is Fugro Airborne Survey’s understanding that the data and report provided to the client is to be used for the purpose agreed between the parties. That purpose was a significant factor in determining the scope and level of the Services being offered to the Client. Should the purpose for which the data and report is used change, the data and report may no longer be valid or appropriate and any further use of, or reliance upon, the data and report in those circumstances by the Client without Fugro Airborne Survey's review and advice shall be at the Client's own or sole risk.

The Services were performed by Fugro Airborne Survey exclusively for the purposes of the Client. Should the data and report be made available in whole or part to any third party, and such party relies thereon, that party does so wholly at its own and sole risk and Fugro Airborne Survey disclaims any liability to such party.

Where the Services have involved Fugro Airborne Survey's use of any information provided by the Client or third parties, upon which Fugro Airborne Survey was reasonably entitled to rely, then the Services are limited by the accuracy of such information. Fugro Airborne Survey is not liable for any inaccuracies (including any incompleteness) in the said information, save as otherwise provided in the terms of the contract between the Client and Fugro Airborne Survey.

2. SURVEY SPECIFICATIONS AND PARAMETERS

2.1 Area Co-ordinates

The survey areas were located within WGS84 UTM Zone 53S, Central Meridian = 135
(Note - Co-ordinates in GDA94/MGA Zone 53S)

Area 1 – Reynolds Range

Easting	Northing
196077	7590573
196199	7584175
222590	7584657
222702	7578260
217396	7573681
195694	7573224
195910	7562013
187948	7561857
183217	7567672
182764	7590314

Area 2 – Reynolds Range East

Easting	Northing
196077	7590573
196199	7584175
222590	7584657
222702	7578260
217396	7573681
195694	7573224
195910	7562013
187948	7561857
183217	7567672
182764	7590314

2.2 Survey Area Parameters

Job Number	-	2066
Survey Company	-	Fugro Airborne Surveys Pty Ltd
Date Flown	-	23rd August – 30th August 2009
Client	-	Toro Energy Limited
EM System	-	25 Hz TEMPEST
Navigation	-	Real-time differential GPS
Datum	-	GDA94
Projection	-	MGA Zone 53S
Project Name	-	Reynolds Range, Northern Territory
Nominal Terrain Clearance	-	100 m
Area 1 – Reynolds Range		
Traverse Line Spacing	-	1000 m
Traverse Line Direction	-	089 – 269 degrees
Traverse Line Numbers	-	1000101 – 1002901
Line Kilometres	-	655.8 km
Area 2 – Reynolds Range East		
Traverse Line Spacing	-	1000 m
Traverse Line Direction	-	089 – 269 degrees
Traverse Line Numbers	-	200101 – 205301
Line Kilometres	-	875.3 km
Total Survey Line Kilometres	-	1531.1 km

2.3 Job Safety Plan

A Job Safety Plan was prepared and implemented in accordance with the Fugro Airborne Surveys Occupational Safety & Health Management System.

AIRCRAFT EQUIPMENT AND SPECIFICATIONS

2.4 Aircraft

Manufacturer	-	Shorts Skyvan
Model	-	SC-3-200
Registration	-	VH-WGT
Ownership	-	Fugro Airborne Surveys Pty Ltd

2.5 TEMPEST System Specifications

Specifications of the TEMPEST Airborne EM System (Lane et al., 2000) are:

- Base frequency - 25 Hz
- Transmitter area - 186 m^2
- Transmitter turns - 1
- Waveform - Square
- Duty cycle - 50%
- Transmitter pulse width - 10 ms
- Transmitter off-time - 10 ms
- Peak current - 300 A
- Peak moment - 55800 Am^2
- Average moment - 27900 Am^2
- Sample rate - 75 kHz on X and Z
- Sample interval - 13 microseconds
- Samples per half-cycle - 1500
- System bandwidth - 25 Hz to 37.5 kHz
- Flying height - 100 m (subject to safety considerations)
- EM sensor - Towed bird with 3 component dB/dt coils
- Tx-Rx horizontal separation - 117 m (nominal)
- Tx-Rx vertical separation - 37 m (nominal)
- Stacked data output interval - 200 ms (~12 m)
- Number of output windows - 15
- Window centre times - 13 μs to 16.2 ms
- Magnetometer - Stinger-mounted cesium vapour
- Magnetometer compensation - Fully digital
- Magnetometer output interval - 200 ms (~12 m)
- Magnetometer resolution - 0.001 nT
- Typical noise level - 1.0 nT
- GPS cycle rate - 1 second

2.5.1 EM Receiver and Logging Computer

The EM receiver computer was an EMFASDAS. The EM receiver computer execute a proprietary program for system control, timing, data acquisition and recording. Control, triggering and timing is provided to the TEMPEST transmitter and Digital Signal Processing (DSP) boards by the timing card, which ensures that all waveform generation and sampling is accomplished with high accuracy. The timing card is synchronised to the Global Positioning System (GPS) through the use of the Pulse Per Second (PPS) output from the system GPS card. Synchronisation is also provided to the magnetometer processor card for the purpose of accurate magnetic sampling with respect to the EM transmitter waveform.

The EM receiver computer displays information on the main screen during system calibrations and survey line acquisition to enable the airborne operator to assess the data quality and performance of the system.

2.5.2 TEMPEST Transmitter

The transmitted waveform is a square wave of alternating polarity, which is triggered directly from the EM receiver computer. The nominal transmitter base frequency was 25 Hz with a pulse width of 10ms (50 % duty cycle). Loop current waveform monitoring is provided by a current transformer located directly in the loop current path to allow for full logging of the waveform shape and amplitude, which is sampled by the EM receiver.

2.5.3 TEMPEST 3-Axis Towed Bird Assembly

The TEMPEST 3-axis towed bird assembly provides accurate low noise sampling of the X (horizontal in line), Y (horizontal transverse) and Z (vertical) components of the electromagnetic field. The receiver coils measure the time rate of change of the magnetic field (dB/dt). Signals from each axis are transferred to the aircraft through a tow cable specifically designed for its electrical and mechanical properties.

2.6 FASDAS Survey Computer

The Survey computer executes a proprietary program for acquisition and recording of location, magnetic and ancillary data. Data are presented both numerically and graphically in real time on the Video Graphics Array (VGA) Liquid Crystal Display (LCD) display, which provides an on-line display capability. The operator may alter the sensitivity of the displays on-line to assist in quality control. Selected EM data are transferred from the EM receiver computer to the SURVEY computer for quality control (QC) display.

2.6.1 Cesium Vapour Magnetometer Sensor

A cesium vapour magnetometer sensor is utilised on the aircraft and consists of the sensor head and cable, and the sensor electronics. The sensor head is housed at the end of a composite material tail stinger.

2.6.2 Magnetometer Processor Board

A FASDAS magnetometer processor board is used for de-coupling and processing the Larmor frequency output of the magnetometer sensor. The processor board interfaces with the survey computer, which initiates data sampling and transfer for precise sample intervals and also with the EM receiver computer to ensure that the magnetic samples remain synchronised with the EM system.

2.6.3 Fluxgate Magnetometer

A tail stinger mounted Bartington MAG-03MC three-axis fluxgate magnetometer is used to provide information on the attitude of the aircraft. This information is used for compensation of the measured magnetic total field.

2.6.4 GPS Receiver

A Novatel GPScard 951R is utilised for airborne positioning and navigation. Satellite range data are recorded for generating post processed differential solutions.

2.6.5 Differential GPS Demodulator

The OMNISTAR differential GPS service provides real time differential corrections.

2.7 Navigation System

A FASDAS Navigation Computer was used for real-time navigation. These computers load a pre-programmed flight plan from disk which contains boundary co-ordinates, line start and end co-ordinates, local co-ordinate system parameters, line spacing, and cross track definitions. The World Geodetic System 1984 (WGS84) latitude and longitude positional data received from the Novatel GPS card contained in the SURVEY computer is transformed to the local co-ordinate system for calculation of the cross track and distance to go values. This information, along with ground heading and ground speed, is displayed to the pilot numerically and graphically on a two line LCD display, and on an analogue Horizontal Strip Indicator (HSI). It is also presented on a LCD screen in conjunction with a pictorial representation of the survey area, survey lines, and ongoing flight path.

The Navigation computers are interlocked to the SURVEY computer for auto selection and verification of the line to be flown. The GPS information passed to the navigation computer is corrected using the received real time differential data from the OMNISTAR service, enabling the aircraft to fly as close to the intended track as possible.

2.8 Altimeter System

2.8.1 Radar Altimeter

Model:	Sperry Stars RT-220 radio altimeter system
Sample interval:	0.2 second
Accuracy:	+/- 1.5 % of indicated altitude.

The Sperry radio altimeter is a high quality instrument whose output is factory calibrated. It is fitted with a test function which checks the calibration of a terrain clearance of 100 feet, and altitudes which are multiples of 100 feet. The aircraft radio altitude is recorded onto digital tape as well as displayed on the aircraft chart recorder. The recorded value is the average of the altimeters output during the previous second.

2.8.2 Laser Altimeter

Model:	Optech 501SB (WGT)
Sample interval:	0.2 second
Accuracy:	± 0.05m at survey altitude

2.8.3 Barometric Altimeter

Output of a Digiquartz 215A-101pressure transducer is used for calculating the barometric altitude of the aircraft. The atmospheric pressure is taken from a gimbal-mounted probe projecting 0.5 metres from the wing tip of the aircraft and fed to the transducer mounted in the aircraft wingtip.

2.9 Video Tracking System

The video tape recorded by a PAL VHS colour video system is synchronised with the geophysical record by a digital fiducial display, which is recorded along with GPS latitude and longitude information and survey line number.

2.10 Data Recorded by the Airborne Acquisition Equipment

With the FASDAS acquisition system the raw EM data including fiducial, local time, X and Z axis sensor response, current monitor and bird auxiliary sensor output are recorded on the EM receiver computer as "*.raw" EM files. Logging to the files is continuous, however, a new *.raw EM file is created when the size of the previous one reaches 1Gb.

The FASDAS Survey computer records a continuous MSD file which contains all other ancillary data including magnetic, altimeter, GPS and analogue channels.

3. GROUND DATA ACQUISITION EQUIPMENT AND SPECIFICATIONS

3.1 Magnetic Base Station

A CF1 and a Scintrex ENVI magnetometer were used to measure the daily variations of the Earth's magnetic field. The base stations were established in an area of low gradient, away from cultural influences. The base stations were run continuously throughout the survey flying period with a sampling interval of 1 and 2 seconds respectively, at a sensitivity of 0.01 nT. The base station data were closely examined after each day's production flying to determine if any data had been acquired during periods of out-of-specification diurnal variation. The base stations were located approximately 80 m apart next to the apron at Ti Tree Airport.

3.2 GPS Base Station

A GPS base logging station was set up at the Ti Tree Airport. The sensor was contained in the CF1.

The GPS base system was comprised of a Novatel GPS PC card mounted in a portable IBM computer. The computer is connected to a mains UPS backup, with a reserve capacity of approximately 100 minutes, to ensure continuous data logging in the event of mains power interruptions.

The GPS base station position was calculated by logging data continuously at the base position over a period of approximately 23 hours. These data were then statistically averaged to obtain the position of the base station using GrafNav software.

The calculated GPS base position was (in WGS84):

Lat: 22° 07' 51.41845" S
Long: 133° 25' 17.39573" E
Height: 571.026 m. (WGS84 Ellipsoidal Height)

4. EM AND OTHER CALIBRATIONS AND MONITORING

At the beginning and end of each individual survey flight, the EM system is checked for background noise levels and performance. All of these checks are conducted at a nominal terrain clearance of 600 m (2000 ft) to eliminate ground response.

These checks include:-

4.1 GPS Repeat Point:

Where possible, the aircraft is parked in the same position after every flight and the GPS position recorded pre and post flight, to allow for checks on GPS quality and repeatability.

Pre-Flight GPS Repeat Point: Line 505FFFFPP
Post-Flight GPS Repeat Point: Line 605FFFFPP

Note: FFFF is the flight number and PP is the attempt number.

4.2 Pre-Flight Zero: Line C9001

This manoeuvre is performed once the aircraft is established en route to the survey area. Background EM levels are recorded and assessed by the airborne operator to determine if:-

a. the system noise level is acceptable,
b. the response had not varied significantly from previous flights, and
c. the sferic level is acceptable.

These data are recorded for approximately 90 seconds.

4.3 Pre-Flight Swoops: Line C9002

This manoeuvre is conducted immediately after the pre sortie zero. During this manoeuvre the relative position of the towed sensor is deliberately made to vary relative to the aircraft. The EM data are monitored by the airborne operator to confirm correct operation of the system during the manoeuvre.

4.4 Post-Flight Zero: Line C9003

This calibration is performed immediately following the completion of the survey sorties. Background EM levels are recorded to characterise any changes occurred in the system over the duration of the flight. These data are recorded for approximately 90 seconds.

4.5 Post-Flight Barometer Calibration: Line C1611

A recording of the barometer output is repeated following landing at the end of the flight to assist with calibration and determination of drift during the flight.

4.6 Additive EM Measurements: Lines C9004, C9005, and C9007

A recording of the background signal through the X, Y and Z receiver coil inputs is carried out before and/or after acquisition of data for survey lines on each flight. These measurements may be made with the transmitter on (C9004, C9005) or with the transmitter off (C9007). The signal from the receiver coils is removed from the signal pathway by disconnecting the power to the bird at the winch inside the aircraft.

4.7 Dynamic Magnetometer Compensation

To limit aircraft manoeuvre effects on the magnetic data that can be of the same spatial wavelength as the signals from geological sources, compensation calibration lines are flown in a low magnetic gradient area close to the survey. This involves flying a series of tests on the survey line heading and approximately 15 degrees either side to accommodate small heading variations whilst flying survey lines. The data for each heading consists of a series of aircraft manoeuvres, including pitches, rolls and yaws. This is done to artificially create the most extreme possible attitude the aircraft may encounter whilst on survey. Data from these lines are used to derive compensation coefficients for removing magnetic noise induced by the aircraft's attitude in the naturally occurring magnetic field.

Compensation data were acquired on the dates below.

25^{th} August 2009

4.8 Parallax Checks

Due to the relative positions of the EM towed bird and the magnetometer instruments on the aircraft and to processing / recording time lags, raw readings from each vary in position. To correct for this and to align selected anomaly features on lines flown in opposite directions, magnetics, EM data and the altimeters are 'parallaxed' with respect to the position information. System parallax is checked occasionally or following any major changes in the aircraft system which are likely to affect the parallax values.

Variable	Parallax Value
Magnetics	0 s
GPS	0 s
Radar Altimeter	0 s
EM - X	1.6 s
EM – Z	0.2 s

4.9 Radar Altimeter Calibration

The radar altimeter is checked for accuracy and linearity every 12 months or when any change in a key system component requires this procedure to be carried out. This calibration allows the radar altimeter data to be compared and assessed with other height data (GPS and barometric) to confirm the accuracy of the radar altimeter over it's operating range.

Absolute radar and barometric altimeter calibration was carried out over water at Mandurah, Western Australia and was successful in calibrating the radar altimeter to information provided by the GPS and barometer instrument. Calibration factors were as expected. The calibration procedure also provides parallax information required for positional correction of the radar and GPS altimeters.

4.10 Heading Error Checks

Historically, heading error checks have been part of the aeromagnetic data acquisition procedure but they are no longer used. Fugro Airborne Surveys now calculates these effects using the aircraft magnetic compensation system and specially developed software. The precision to which these effects are now calculated and corrected for is far in excess of the manual methods used in the past.

5. DATA PROCESSING

5.1 Field Data Processing

5.1.1 Quality Control Specifications

5.1.1.1 Navigation Tolerance

The re-flight specifications applied for the duration of the survey were:

Electronic Navigation - absence of electronic navigation data (e.g. GPS base station fails).

Flight Path - where the flightpath deviates from the flightplan by more than 50% of the nominal line spacing for more than 5 kilometres or where lines cross. The line spacing measurements to be used in determining such reflights will be made from the field flight path recovery

Altitude - terrain clearance continuously exceeds the nominal terrain clearance by plus or minus 30 m over a distance of 5 km or more unless to do so would, in the sole opinion of the pilot, jeopardise the safety of the aircraft or the crew or the equipment or would be in contravention of the Civil Aviation Safety Authority regulation such as those pertaining to built up areas.

5.1.1.2 Magnetics Noise And Diurnal Tolerance

The re-flight specifications applied for the duration of the survey were:

Magnetic Diurnal - where the magnetometer base station data exceeds a 10 nT change in 10 minutes.

5.1.1.3 Electromagnetic Data

The quality control checks on the electromagnetic data were:

Noise - where RMS noise in the last channel of the EM data exceeds 0.1 fT over 3 km for B-field (assessed in a resistive region) or where FAS believes an important anomaly is rendered un-interpretable.

Sferics – where sferic activity renders a potential anomaly un-interpretable.

5.1.2 In-Field Data Processing

Following acquisition, multiple copies of the EM data are made onto DVDs or CDs. The EM, location, magnetic and ancillary data are then processed at the field base to the point that the quality of the data from each flight can be fully assessed. Copies of the raw and processed data are then transferred to Perth for final data processing. A more comprehensive statement of EM data processing is given in section 6.2.3.

5.2 Final Data Processing

5.2.1 Magnetics

Magnetic data were compensated for aircraft manoeuvre noise using coefficients derived from the appropriate compensation flight. Base station data is edited so that all significant spikes, level shifts and null data are eliminated.

A diurnal base value was then added.

Area	Base Value
All Areas	52030 nT

A lag was applied to synchronise the magnetic data with the navigation data.

The International Geomagnetic Reference Field (IGRF) 2005 model (updated for secular variation) was removed from the levelled total field magnetics. An IGRF base value was then added to the data.

Area	Base Value	Updated Model
All Areas	52210 nT	2009.7

Where appropriate the magnetic data was tie line levelled. A FAS proprietary microlevelling process was then applied in order to more subtly level the data.

5.2.2 Derived Topography

Aircraft navigation whilst in survey mode is via real time differential GPS, obtained by combining broadcast differential corrections with on-board GPS measurements. Terrain clearance is measured with a radar altimeter.

The ground elevation, relative to the WGS84 spheroid used by GPS receiver units, is obtained by subtracting the terrain clearance from the aircraft altitude, noting the vertical separation between the GPS antenna and the radar altimeter, and applying suitable parallax corrections between the two measurements.

Where appropriate the digital terrain data was tie line levelled. A FAS proprietary microlevelling process was then applied in order to more subtly level the data.

An N-Value is subtracted to correct the final data to the Australian Height Datum (AHD).

The digital terrain model derived from this survey can be expected to have an absolute accuracy of +/- several metres in areas of low to moderate topographic relief. Sources of error include uncertainty in the location of the GPS base station, variations in the radar altimeter characteristics over ground of varying surface texture, and the finite footprint of the radar altimeter.

The accuracy of the elevation calculation is directly dependent on the accuracy of the two input parameters, radar altitude and GPS altitude. The radar altitude value may be erroneous in areas of heavy tree cover, where the altimeter reflects the distance to the tree canopy rather than the ground. The GPS altitude value is primarily dependent on the number of available satellites. Although post-processing of GPS data will yield X and Y accuracies in the order of 1-2 metres, the accuracy of the altitude value is usually much less, sometimes in the ±5 metre range. Further inaccuracies may be introduced during the interpolation and gridding process.

Because of the inherent inaccuracies of this method, no guarantee is made or implied that the information displayed is a true representation of the height above sea level. Although this product may be of some use as a general reference, THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.

5.2.3 Electromagnetic Data Processing

Details of the pre-processing applied to TEMPEST data can be found in Lane et al. (2000).

5.2.3.1 Standard EM Processing

Calibration
High altitude calibration data are used to characterise the system response in the absence of any ground response.

Cleaning and Stacking
Routines to suppress sferic noise, powerline noise, VLF noise, coil motion noise (collectively termed "cleaning") and to stack the data are applied to the survey line data. Output from the stacking filter is drawn at 0.2 second intervals. The stacked data are saved to file as an internal data management practice.

Deconvolution and Binning
The survey height stacked data are deconvolved using the high altitude reference waveform. The effect of currents in the transmitter loop and airframe ("primary") are then removed, leaving a "pure" ground response. The deconvolved ground response data are then transformed to B-field response for a perfect 100% duty cycle square wave. Finally, the evenly spaced samples are binned into a number of windows.

Table of TEMPEST window information for 25Hz base frequency

Window #	Start sample	End sample	No of samples	start time (s)	End time (s)	centre time (s)	centre time (ms)
1	1	2	2	0.000007	0.000020	0.000013	0.013
2	3	4	2	0.000033	0.000047	0.000040	0.040
3	5	6	2	0.000060	0.000073	0.000067	0.067
4	7	10	4	0.000087	0.000127	0.000107	0.107
5	11	16	6	0.000140	0.000207	0.000173	0.173
6	17	26	10	0.000220	0.000340	0.000280	0.280
7	27	42	16	0.000353	0.000553	0.000453	0.453
8	43	66	24	0.000567	0.000873	0.000720	0.720
9	67	102	36	0.000887	0.001353	0.001120	1.120
10	103	158	56	0.001367	0.002100	0.001733	1.733
11	159	246	88	0.002113	0.003273	0.002693	2.693
12	247	384	138	0.003287	0.005113	0.004200	4.200
13	385	600	216	0.005127	0.007993	0.006560	6.560
14	601	930	330	0.008007	0.012393	0.010200	10.200
15	931	1500	570	0.012407	0.019993	0.016200	16.200

The data are reviewed after windowing. Any decisions involving re-flights due to AEM factors are made at this point.

Raw and Final EM Data
The "raw" or "uncorrected" EM amplitudes reflect, not only the variations in ground conductivity, but the variations in geometry of the various parts of the EM measurements (i.e. transmitter loop pitch, transmitter loop roll, transmitter loop terrain clearance, transmitter loop to receiver coil horizontal longitudinal separation, transmitter loop to receiver coil horizontal transverse separation, and transmitter loop to receiver coil vertical separation) during the survey. For example, the largest influence on the early time EM amplitude is the terrain clearance of the transmitter loop. The larger the terrain clearance, the smaller the amplitude. Later window times (larger window number) show diminished variations due to terrain clearance.

"Final" or "geometry-corrected" located data are produced for optimum presentation of the EM amplitude data in image format (e.g. window amplitude images, principal component analysis images derived from the window amplitudes (Green,1998b)). Between "raw" and "final" states, the ground response data undergo an approximate correction to produce data from a nominated standard geometry. A dipole-image method (Green, 1998a) is used to adjust the data to the response that would be expected at a standard terrain clearance (100m), standard transmitter loop pitch and roll (zero degrees), and a standard transmitter loop to receiver coil geometry (117m behind and 37m below the aircraft). These variables have been set to their respective standard values in the "final" located data (whereas the "raw" located data file contains the variable field data). Zero parallax is applied to transmitter loop pitch, roll, terrain clearance, X component EM and Z component EM data prior to geometry correction. Over extremely conductive ground (e.g. > 100 S conductance), the estimates for transmitter loop to receiver coil separation determined from the primary field coupling factors may be in error at the metre scale due to uncertainty in the estimation of the primary field. This will influence the accuracy of very early time window amplitude information in the "geometry-corrected" located data. Receiver coil pitch has a significant effect on early time Z component response and late time X component response (Green and Lin, 1996). Receiver coil roll impacts early time Z component response.

Levelling

Limited range micro-levelling may be applied to the final window amplitudes for presentation purposes, principally for multi-flight surveys or when isolated re-flight lines are present.

5.2.3.2 Factors and Corrections

Geometric Factor

The geometric factor gives the ratio of the strength of the primary field coupling between the transmitter loop and the receiver coil at each observation relative to the coupling observed at high altitude during acquisition of reference waveform data. Variations in this factor indicate a change in the attitude and/or relative separation of the transmitter loop and the receiver coil.

Transmitter-Receiver Geometry

Transmitter to receiver geometry values for each observation are derived from the high altitude reference waveforms and knowledge of the system characteristics. These data are available in the located data (see section 6.2.6.1 for "standardised" values)

GPS Antenna, Laser Altimeter and Transmitter Loop Offset Corrections

The transmitter loop was mounted 0.1m above the GPS antenna on the aircraft. The GPS antenna is 3.3m above the belly of the aircraft. The laser altimeter sensor is mounted in the belly of the aircraft. Therefore a total of 3.05m (-0.25m + 3.3m) was added to the laser altimeter data to determine the transmitter loop height above the ground.

Transmitter Loop Pitch and Roll Correction

Measured vertical gyro aircraft pitch and roll attitude measurements are converted to transmitter loop pitch and roll by adding 0.45 degrees for pitch and 0.6 degrees for roll. Nose up is positive for pitch, and left wing up is positive for roll.

5.2.3.3 Primary Sources of EM Noise

A number of "monitor" values are calculated during processing to assist with interpretation. They generally represent quantities that have been removed as far as is practical from the data, but may still be present in trace amounts. These are more significant for interpretation of discrete conductors than for general mapping applications.

Sferic Monitor

Sferics are the electromagnetic signals associated with lightning activity. These signals travel large distances around the Earth. Background levels of sferics are recorded at all times from lightning activity in tropical areas of the world (eg tropical parts of Asia, South America and Africa). Additional higher amplitude signals are produced by "local" lightning activity (ie at distances of kilometres to hundreds of kilometres).

The sferic monitor is the sum of the absolute differences brought about by the sferic filter operations, summed over 0.2 second intervals, normalised by the receiver effective area. It is given in units of uV/sq.m/0.2s. Many sferics have a characteristic form that is well illustrated by figure 2 in Garner and Thiel (2000). The high frequency, initial part of a sferic event can be detected and filtered more easily than the later, low frequency portion. The sferic monitor indicates where at least the high frequency portion of a sferic has been successfully removed, but it is quite possible that lower frequency elements of the sferic event may have eluded detection, passing through to the window amplitude data. Thus, discrete anomalies coincident with sferic activity as indicated by the sferic monitor should be down-weighted relative to features clear of any sign of sferic activity.

Low Frequency Monitor

The Low Frequency Monitor (LFM) makes use of amplitudes at frequencies below the base frequency which are present in the streamed data to estimate the amplitude of coil motion (Earth magnetic field) noise at the base frequency in log10(pV/sqrt(Hz)/sq.m). The coil motion noise below the base frequency is rejected through the use of tapered stacking, but the coil motion noise at the base frequency itself is not easily removed. A sharp spike in the LFM can be an indicator of a coil motion event (eg the bird passing through extremely turbulent air). Note that the LFM will also respond to sferic events with an appreciable low frequency (sub-base frequency) component. This situation can be inferred when both the LFM and sferic monitors show a discrete kick.

Powerline Monitor

The powerline monitor gives the amplitude of the received signal at the powerline frequency (50 or 60 Hz) in log10(pV/sqrt(Hz)/sq.m). Careful selection of the base frequency (such that the powerline frequency is an even harmonic of the base frequency) and tapered stacking combine to strongly attenuate powerline signals. When passing directly over a powerline, the rapid lateral variations in the strength and direction of the magnetic fields associated with the powerline can result in imperfect cancellation of the powerline response during stacking. Some powerline-related interference can manifest itself in a form that is similar to the response of a discrete conductor. The exact form of the monitor profile over a powerline depends on the line direction, powerline direction, powerline current, and receiver component, but the monitor will show a general increase in amplitude approaching the powerline.

Grids (or images) of the powerline monitor reveal the location of the transmission lines. Note that the X component (horizontal receiver coil axis parallel with the flight line direction) does not register any response from powerlines parallel to the flight line direction since the magnetic fields associated with powerlines only vary in a direction perpendicular to the powerline. Note also that the Z component (vertical receiver coil axis) shows a narrow low directly over the powerline where the magnetic fields are purely horizontal.

Very Low Frequency Monitors

Wide area VLF communication signals in the 15 to 25 kHz frequency band are monitored by the TEMPEST system. In the Australian region, signals at 18.2 kHz, 19.8 kHz, 21.4 kHz and 22.2 kHz are monitored as the amplitude of the received signal at these frequencies in log10(pV/sqrt(Hz)/sq.m). The strongest signal comes from North West Cape (19.8 kHz). The signal at 18.2 kHz is often observed to pulse in a regular sequence. These strong narrow band signals have some impact on the high frequency response of the system, but they are strongly attenuated by selection of the base frequency and tapered stacking. The VLF transmissions are strongest in amplitude, in the horizontal direction at right angles to the direction to the VLF transmitter. This directional dependence enables the VLF monitors to be used to indicate the receiver coil attitude.

5.2.3.4 Other Sources of EM Noise

Man-made periodic discharges

If an image of the Z component sferic monitor shows the presence of spatially coherent events, then pulsed cultural interference would be strongly suspected. Since sferic signals are much stronger in the horizontal plane than in the vertical plane, few sferics of significant amplitude are recorded in Z component data. In contrast, evidence of cultural interference is generally swamped by true sferics in X component sferic monitor images.

Electric fences are the most common source of pulsed cultural interference. Periodic discharges (eg every second or so) into a large wire loop (fence) produce very large spikes in raw data. These are attenuated to a large degree by the sferic filter, but a residual artefact can still be present in the processed data.

Coil motion / Earth field noise
A change in coupling between the receiver coil and the ambient magnetic field will induce a voltage in the receiver coil. This noise is referred to as coil motion or Earth field noise. Receiver coils in the towed bird are suspended in a fashion that attempts to keep this noise below the noise floor at frequencies equal to and above the base frequency of the system. Severe turbulence, however, can result in 'coil knock events' that introduce noise into the processed data.

Grounded metal objects
Grounded extensive metal objects such as pipelines and rail lines can qualify as conductors and may produce a response that is visible in processed data. Grounded metal objects produce a response similar to shallow, highly conductive, steeply dipping conductors. These objects can sometimes be identified from good quality topographic maps, from aerial photographs, by viewing the tracking video, from their unusual spatial distribution (ie often a series of linear segments) and in some circumstances from their effect on the powerline monitor. A powerline running close to a long metal object will induce a 50 Hz response in the object.

5.2.4 Conductivity Depth Images (CDI)

CDI conductivity sections for TEMPEST data were calculated using EMFlow and then modified to reflect the finite depth of investigation using an in-house routine, *Sigtime*.

The *Sigtime* routine removes many of the spurious conductive features that appear at depth as a result of fitting long time constant exponential decays to very small amplitude features in the late times. For each observation, the time when the response falls below a signal threshold amplitude is determined. This time is transformed into a diffusion depth with reference to the conductivity values determined for that observation. Anomalous conductivity values below this depth are replaced by background values or set to undefined, reflecting the uncertainty in their origin. The settings and options applied are indicated in the appropriate header files for *Sigtime* output. This procedure is different to that which would be obtained by filtering conductivity values using either a constant time or constant depth across the entire line.

The "final" data for each area were input into version 5.10 of EMFlow to calculate Conductivity Depth Images (CDI). Conductivity values were calculated at each point then run through *Sigtime.* This processing was completed for the Z component data.

EMFlow was developed within the CRC-AMET through AMIRA research projects (Macnae et al, 1998, Macnae and Zonghou, 1998, Stolz and Macnae, 1998). The software has been commercialised by Encom Technology Pty Ltd. Examples of TEMPEST conductivity data can be seen in Lane et al. (2000), Lane et al. (1999), and Lane and Pracillio (2000).

Conductivity values were calculated to a depth of 300 m below surface at each point, using a depth increment of 3 m and a conductivity range of 5-200mS/m.

5.2.5 System Specifications for Modelling TEMPEST Data

Differences between the specifications for the acquisition system, and those of the virtual system for which processed results are given, must be kept in mind when forward modelling, transforming or inverting TEMPEST data.

Acquisition is carried out with a 50% duty cycle square transmitter current waveform and dB/dt sensors.

During processing, TEMPEST EM data are transformed to the response that would be obtained with a B-field sensor for a 100% duty cycle square waveform at the base frequency, involving a 1A change in current (from -0.5A to +0.5A to -0.5A) in a 1sq.m transmitter. Data are given in units of femtotesla (fT = 10^{-15} Tesla). It is this configuration, rather than the actual acquisition configuration, which must be specified when modelling TEMPEST data.

Window timing information is given above (see section 6.2.3).

5.2.5.1 Standard Height and Geometry

The “final” EM data have been standardised through an approximate transformation to a standard transmitter loop terrain clearance, transmitter loop pitch and roll of zero degrees, and a fixed transmitter loop to receiver coil geometry (roughly equal to the average “raw” geometry values). Transmitter loop pitch, transmitter loop roll and transmitter loop terrain clearance values for each observation have been modified to reflect the standard values. Hence, the “final” (fixed) geometry values should be used if modelling with the final X- and Z-component amplitude data - the following table summarises the values used to correct the transmitter height/pitch/roll/geometry to.

Table of values used to standardise transmitter loop height, pitch, roll and geometry

Variable	**Standardised value**
Transmitter loop pitch	0 degrees
Transmitter loop roll	0 degrees
Transmitter loop terrain clearance	100 metres
Transmitter loop – to – receiver coil geometry	117 m behind and 37 m below the aircraft

5.2.5.2 Parallax

The located data files utilise the following parallax values :-
- magnetics = 0 fiducials (0 observations from the zero parallax position),
- radar altimeter = 0 fiducials (0 observations from the zero parallax position),
- EM X-component = 1.6 fiducials (8 observation from the zero parallax position),
- EM Z-component = 0.2 fiducials (1 observations from the zero parallax position),

These EM parallax values are optimised for aligning the EM response amplitudes for horizontal or broad steeply dipping conductors, which account for the majority of responses in regolith-dominated terrains such as this.

For optimum gridded display of the response for discrete vertical or narrow conductors, the following EM parallax values are appropriate :-
- EM X-component = 0.4 fiducials (2 observations from the zero parallax position, or 8 observations from the “horizontal” parallax position),
- EM Z-component = 1.8 fiducials (9 observations from the zero parallax position, or -4 observations from the “horizontal” parallax position).

(NB Positive parallax values are defined in this case as shifting the indicated quantity back along line to smaller fiducial values. Location information remains in the zero parallax state.)

5.2.6 Delivered Products

Appendix IV contains a complete list of all data supplied digitally.

Digital ascii located data and a Geosoft GDB format was produced, containing the raw and final, X and Z EM data, conductivity data as well as magnetics and digital terrain.

Stacked CDI sections and CDI-multiplots (Z component) in “png” image format.

A flight path map was also delivered in Oasis “.map” fprmat and “png” image format.

Acquisition and processing report in hardcopy and digital format.

6. REFERENCES

Garner, S.J., Thiel, D.V., 2000, Broadband (ULF-VLF) surface impedance measurements using MIMDAS: Exploration Geophysics, 31, 173-178.

Green, A., 1998. Altitude correction of time domain AEM data for image display and geological mapping, using the Apparent Dipole Depth (ADD) method. Expl. Geoph. 29, 87-91.

Green, A., 1998. The use of multivariate statistical techniques for the analysis and display of AEM data. Expl. Geoph. 29, 77-82.

Green, A., Lin, Z., 1996. Effect of uncertain or changing system geometry on airborne transient electromagnetic data: CSIRO Expl. and Mining Research News No. 6, August 1996, 9-11, CSIRO Division of Exploration and Mining.

Lane, R., 2000, Conductive unit parameters : summarising complex conductivity distributions: Paper accepted for presentation at the SEG Annual Meeting, August 2000.

Lane, R., Green, A., Golding, C., Owers, M., Pik, P., Plunkett, C., Sattel, D., Thorn, B., 2000, An example of 3D conductivity mapping using the TEMPEST airborne electromagnetic system: Exploration Geophysics, 31, 162-172.

Lane, R., Leeming, P., Owers, M., Triggs, D., 1999, Undercover assignment for TEMPEST: Preview, Issue 82, 17-21.

Lane, R., Pracilio, G., 2000: Visualisation of sub-surface conductivity derived from airborne EM, SAGEEP 2000, 101-111.

APPENDIX I – Weekly Acquisition Reports

System: Tempest
Aircraft: VH-WGT

Total Job kms: 1722.000 Kms

Plan Kms Remain: 1318.000 Kms
% Complete: 23.461 %

9856.0 Hrs - Progressive M/R Hrs at the start of job, prior to mobilisation
9956.0 Hrs - The hours the Periodic Inspection is actally due at start of the job

Job Number: 2066
Contract Number: CT5943
Job Name: Reynolds Range and Sandover Prospects
Area Names: West Area, East Area
Client: Toro Energy

Date	Flt	Pilot initials	On board Oper initials	Production inc. Reflights Exc. Scrubs	FAS Scrub	Time Start	Time End	Engine Hours on M/R	Hours to Periodic Inspectio	Job Hrs to Date	Prod. to Date	FAS Scrubs to Date	Stdby Days	Activity Contribution	Activity	COMMENTS <u>Weather</u>, <u>Data delivery</u> <u>Aircraft movement</u>, etc
17-August-2009														1.00	MA	Inspection of WGT after major maintenance
Julian Day 229															Comment	MY & MD arrive adelaide
Monday																
									100.0							
Date 18-Aug		MY	MD, BR			9:35:00	11:05:00	1.5						1.00	MA	Check flight of Aircraft and survey gear
Julian Day 230															Comment	MD departs adelaide
Tuesday																
									98.5	1.5						
Date 19-Aug														0.50	MO	BR drive Adelaide for Coober Pedy with trailer
Julian Day 231		MY				14:40:00	18:45:00	4.1						0.25	MO	MY departs Adelaide for Cobber pedy with WGT
		MY				19:25:00	22:05:00	2.7						0.25	MO	MY Coober Pedy for Alice Springs with WGT
Wednesday																
									91.8	8.3						
Date 20-Aug														1.00	MO	BR departs Cobber Pedy for Alice springs
Julian Day 232															Comment	KTL Arrives Alice Springs
Thursday																
									91.8	8.3						
Date 21-Aug														0.30	MO	BR & KTL drive Alice Springs For Ti Tree with trailer
Julian Day 233		MY				10:35:00	11:35:00	1.0						0.30	MO	MY departs Alice Springs for Ti Tree with WGT
														0.40	SETUP	Survey base at Ti Tree setup
Friday																
									90.8	9.3						
Date 22-Aug														1.00	A	Failure to start left hand engine - no survey flying.
Julian Day 234																
Saturday																
									90.8	9.3						
Date 23-Aug	1	MY	BR	404.000		7:15:00	10:45:00	3.5						1.00	P	Production Flight.
Julian Day 235															Comment	Issue with left hand engine still exists.
Sunday																
									87.3	12.8	404.000					
			Totals This Week: ►	**404.000**			Week Hours:►	**12.8**	▲: A/C Hrs to Next Service					**7.00**		

System:	Tempest		
Aircraft:	VH-WGT	9856.0	Hrs - Progressive M/R Hrs at the start of job, prior to mobilisation
Total Job kms:	1722.000 Kms	9956.0	Hrs - The hours the Periodic Inspection is actally due at start of the job
Plan Kms Remain:	0.000 Kms		
% Complete:	100.000 %		

Job Number:	2066
Contract Number:	CT5943
Job Name:	Reynolds Range and Sandover Prospects
Area Names:	West Area, East Area
Client:	Toro Energy

Date	Flt	Pilot initials	On board Oper initials	Production inc. Reflights Exc. Scrubs	FAS Scrub	Time Start	Time End	Engine Hours on M/R	Hours to Periodic Inspectio	Job Hrs to Date	Prod. to Date	FAS Scrubs to Date	Stdby Days	Activity Contribution	Activity	COMMENTS Weather, Data delivery Aircraft movement, etc
24-August-2009	2	MY	BR	340.700		6:55:00	10:15:00	3.3						1.00	P	
Julian Day 236															Comment	BA & RL arrive
Monday																
									83.9	16.1	744.700					
Date 25-Aug	3	MY	BR	334.700		6:45:00	10:00:00	3.3						1.00	P	
Julian Day 237																
Tuesday																
									80.7	19.3	1079.400					
Date 26-Aug	4	MY	BR	400.600	50.400	7:00:00	10:30:00	3.5						1.00	P & S	Turblence
Julian Day 238																
Wednesday																
									77.2	22.8	1480.000	50.400				
Date 27-Aug	5	MY	BR	50.400		6:50:00	10:15:00	3.4						0.50	P & R	Production Flight
Julian Day 239														0.50	OJ	
															Comment	BA & RL depart.
Thursday																
									73.8	26.3	1530.400	50.400				
Date 28-Aug	6	MY	BR			7:00:00	10:00:00	3.0						1.00	OJ	
Julian Day 240																
Friday																
									70.8	29.3	1530.400	50.400				
Date 29-Aug	7	MY	BR			6:45:00	9:40:00	2.9						1.00	OJ	
Julian Day 241																
Saturday																
									67.8	32.2	1530.400	50.400				
Date 30-Aug	8	MY	BR	191.000		6:55:00	7:45:00	0.8						1.00	P	
Julian Day 242																
Sunday																
									67.0	33.0	1721.400	50.400				
			Totals This Week: ►	**1317.400**	**50.400**		Week Hours:►	**20.3**	▲: A/C Hrs to Next Service					**7.00**		

APPENDIX II – Flight Summary (Line Listing)

Area 1 – Reynolds Range

Line Number	X-minimum	X-maximum	Y-minimum	Y-maximum	# pts	Total distance
L1000101:0	182513.60	196354.70	7589592.52	7589857.96	1133	13845.21841878
L1000201:0	182529.11	196371.58	7588597.98	7588849.78	1026	13845.75528872
L1000301:0	182549.92	196389.76	7587599.95	7587850.48	1120	13842.90283858
L1000401:0	182577.67	196408.27	7586587.16	7586847.40	1024	13833.50540101
L1000501:0	182596.92	196432.31	7585602.58	7585849.71	1110	13838.45511955
L1000601:0	182615.81	196451.45	7584592.15	7584847.91	1041	13839.17342941
L1000701:0	182633.19	222854.46	7583596.23	7584330.48	3243	40231.012502
L1000801:0	182659.46	222871.12	7582564.18	7583332.99	3060	40222.21537618
L1000901:0	182667.72	222891.32	7581603.04	7582315.50	3262	40233.87719089
L1001001:0	182696.02	222910.80	7580596.13	7581330.68	3076	40224.34395481
L1001101:0	182709.07	222928.80	7579597.22	7580383.32	3289	40231.48899145
L1001201:0	182727.63	222940.20	7578600.32	7579333.28	2968	40222.19355534
L1001301:0	182752.73	222968.68	7577599.42	7578336.22	3347	40229.85292164
L1001401:0	182772.86	222025.97	7576586.42	7577325.13	2886	39264.24085283
L1001501:0	182798.70	220848.54	7575594.42	7576308.37	2987	38058.88194621
L1001601:0	182810.15	219646.89	7574595.08	7575268.20	2794	36845.12289377
L1001701:0	182837.17	218455.17	7573600.73	7574247.24	2793	35624.3494702
L1001801:0	182848.92	195967.59	7572587.08	7572851.07	1024	13122.08422045
L1001901:0	182873.12	195982.66	7571595.62	7571838.35	1007	13112.25520777
L1002001:0	182891.92	196008.50	7570601.44	7570841.04	1017	13119.3356213
L1002101:0	182914.98	196027.98	7569602.68	7569863.26	983	13116.56868114
L1002201:0	182932.76	196045.52	7568613.80	7568840.31	1017	13115.43908455
L1002301:0	182952.67	196062.87	7567600.67	7567834.98	978	13112.63755132
L1002401:0	183722.91	196083.65	7566621.25	7566837.51	960	12362.97634814
L1002501:0	184523.09	196103.09	7565628.70	7565840.21	875	11582.27319256
L1002601:0	185317.86	196116.45	7564654.09	7564840.47	863	10801.66060464
L1002701:0	186130.26	196141.38	7563657.90	7563791.29	762	10013.18230011
L1002801:0	186921.46	196163.28	7562673.46	7562841.11	732	9243.817705073
L1002901:0	187504.26	196173.77	7561686.20	7561853.35	658	8671.788048875
ALL	182513.60	222968.68	7561686.20	7589857.96	51035	655806.6087173

Area 2 – Reynolds Range East

Line Number	X-minimum	X-maximum	Y-minimum	Y-maximum	# pts	Total distance
L200101:0	276102.65	297672.47	7600770.09	7601205.89	1443	21585.13523193
L200301:0	276096.63	298311.63	7599773.68	7600068.98	2036	22218.55212425
L200501:0	276110.42	298880.59	7598770.65	7599052.52	1543	22773.44868881
L200701:0	276113.33	299428.33	7597770.61	7598103.94	2217	23324.94878007
L200901:0	276123.79	299956.74	7596773.64	7597090.17	1611	23836.71406999
L201101:0	276121.83	300509.35	7595763.35	7596103.10	2328	24394.77810624
L201302:0	276128.88	301071.34	7594770.24	7595107.52	1825	24945.71100097
L201502:0	276129.36	301617.40	7593774.04	7594112.96	2198	25491.84191982
L201701:0	276137.01	302164.04	7592775.71	7593120.82	1750	26031.72476122
L201901:0	276139.52	302726.97	7591776.18	7592128.80	2474	26596.17806736
L202101:0	276152.07	303277.74	7590767.55	7591134.98	1837	27130.7028361
L202301:0	276153.31	303830.15	7589774.99	7590142.72	2626	27683.11162201
L202501:0	276156.87	304391.05	7588776.22	7589151.22	1892	28240.24697369
L202701:0	276161.74	304926.30	7587770.89	7588160.59	2709	28772.29785881
L202901:0	276177.74	305483.43	7586769.41	7587161.73	1993	29309.81234675
L203101:0	276176.83	306037.14	7585778.34	7586171.74	2727	29865.26477981
L203301:0	267185.50	306584.22	7584652.83	7585178.10	2751	39405.18364275
L203501:0	267190.73	307143.79	7583649.08	7584187.70	3617	39963.88137242
L203701:0	267207.64	307690.28	7582656.08	7583193.54	2900	40490.9166478
L203901:0	267225.85	308238.31	7581652.26	7582197.05	3642	41018.47583285
L204101:0	267246.61	308784.92	7580655.25	7581206.45	2971	41544.32827113
L204301:0	267255.96	309350.61	7579650.49	7580212.51	3701	42100.89626789
L204501:0	267264.28	309887.47	7578654.23	7579223.50	3042	42629.98849068
L204701:0	267284.12	310446.12	7577652.94	7578230.45	3774	43167.84306867
L204901:0	267300.11	311003.05	7576651.18	7577233.51	3045	43710.29084102
L205101:0	267308.64	311548.95	7575653.53	7576241.14	3347	44247.47742738
L205301:0	267325.39	312099.64	7574654.97	7575256.70	3690	44783.59956004
ALL	267185.50	312099.64	7574654.97	7601205.89	69689	875263.3505905

APPENDIX III – Located Data Formats

Headers for final data files

FINAL EM – REYNOLDS RANGE

```
COMM FAS PROJECT NUMBER                                          2066
COMM AREA NUMBER:                                                   1
COMM SURVEY COMPANY:                          Fugro Airborne Surveys
COMM CLIENT:                                         Toro Energy Ltd
COMM SURVEY TYPE:                               25Hz TEMPEST Survey
COMM AREA NAME:                                      Reynolds Ranges
COMM STATE:                                                        NT
COMM COUNTRY:                                               Australia
COMM SURVEY FLOWN:                                        August 2009
COMM LOCATED DATA CREATED:                               October 2009
COMM
COMM DATUM:                                                     GDA94
COMM PROJECTION:                                                  MGA
COMM ZONE:                                                         53
COMM
COMM SURVEY SPECIFICATIONS
COMM
COMM TRAVERSE LINE SPACING:                                    1000 m
COMM TRAVERSE LINE DIRECTION:                             089-269 deg
COMM NOMINAL TERRAIN CLEARANCE:                                 100 m
COMM FINAL LINE KILOMETRES:                                  655.8 km
COMM
COMM LINE NUMBERING
COMM
COMM TRAVERSE LINE NUMBERS:                         1000101 - 1002901
COMM
COMM AREA BOUNDARY
COMM
COMM    196077    7590573
COMM    196199    7584175
COMM    222590    7584657
COMM    222702    7578260
COMM    217396    7573681
COMM    195694    7573224
COMM    195910    7562013
COMM    187948    7561857
COMM    183217    7567672
COMM    182764    7590314
COMM
COMM SURVEY EQUIPMENT
COMM
COMM AIRCRAFT:                                  SHORTS SKYVAN, VH-WGT
COMM
COMM MAGNETOMETER:                        Scintrex Cs-2 Cesium Vapour
COMM INSTALLATION:                                      stinger mount
COMM RESOLUTION:                                             0.001 nT
COMM RECORDING INTERVAL:                                        0.2 s
COMM
COMM ELECTROMAGNETIC SYSTEM:                              25Hz TEMPEST
COMM INSTALLATION:               Transmitter loop mounted on the aircraft
COMM                                       Receiver coils in a towed bird
COMM COIL ORIENTATION:                                            X,Z
COMM RECORDING INTERVAL:                                        0.2 s
COMM SYSTEM GEOMETRY:
COMM RECEIVER DISTANCE BEHIND THE TRANSMITTER:                 -117 m
```

```
COMM RECEIVER DISTANCE BELOW THE TRANSMITTER:                       -37 m
COMM
COMM RADAR ALTIMETER:                                         Sperry RT-220
COMM RECORDING INTERVAL:                                              0.2 s
COMM
COMM LASER ALTIMETER:                                      Optech 501SB (WGT)
COMM RECORDING INTERVAL:                                              0.2 s
COMM
COMM NAVIGATION:                                 real-time differential GPS
COMM RECORDING INTERVAL:                                              1.0 s
COMM
COMM ACQUISITION SYSTEM:                                             FASDAS
COMM
COMM DATA PROCESSING
COMM
COMM MAGNETIC DATA
COMM DIURNAL BASE VALUE APPLIED                                    52030 nT
COMM PARALLAX CORRECTION APPLIED (during final processing)          0.0 s
COMM IGRF BASE VALUE APPLIED                                       52210 nT
COMM IGRF MODEL 2005 EXTRAPOLATED TO                                 2009.7
COMM DATA HAVE BEEN MICROLEVELLED
COMM
COMM ELECTROMAGNETIC DATA
COMM SYSTEM PARALLAX REMOVED, AS FOLLOWS
COMM X-COMPONENT EM DATA                                             -1.6 s
COMM Z-COMPONENT EM DATA                                             -0.2 s
COMM DATA CORRECTED FOR TRANSMITTER HEIGHT, PITCH AND ROLL
COMM DATA CORRECTED FOR TRANSMITTER-RECEIVER GEOMETRY VARIATIONS
COMM DATA HAVE BEEN MICROLEVELLED
COMM CONDUCTIVITY DEPTH INVERSION CALCULATED                    EMFlow V5.10
COMM CONDUCTIVITY DEPTH RANGE                                   000 - 300 m
COMM CONDUCTIVITY DEPTH INTERVAL                                        3 m
COMM CONDUCTIVITIES CALCULATED USING HPRG CORRECTED EMZ DATA
COMM
COMM DIGITAL TERRAIN DATA
COMM PARALLAX CORRECTION APPLIED TO LIDAR ALIMETER DATA              0.0 s
COMM PARALLAX CORRECTION APPLIED TO GPS ALIMETER DATA                0.0 s
COMM DTM CALCULATED [DTM = GPS ALTITUDE - LIDAR ALTITUDE - GPS/LIDAR DIST]
COMM N-VALUE APPLIED TO CORRECT DTM TO AUSTRALIAN HEIGHT DATUM (AHD)
COMM DATA HAVE BEEN MICROLEVELLED
COMM
COMM ---------------------------------------------------------------------
COMM DISCLAIMER
COMM ---------------------------------------------------------------------
COMM It is Fugro Airborne Survey’s understanding that the data provided to
COMM the client is to be used for the purpose agreed between the parties.
COMM That purpose was a significant factor in determining the scope and
COMM level of the Services being offered to the Client. Should the purpose
COMM for which the data is used change, the data may no longer be valid or
COMM appropriate and any further use of, or reliance upon, the data in
COMM those circumstances by the Client without Fugro Airborne Survey's
COMM review and advice shall be at the Client's own or sole risk.
COMM
COMM The Services were performed by Fugro Airborne Survey exclusively for
COMM the purposes of the Client. Should the data be made available in whole
COMM or part to any third party, and such party relies thereon, that party
COMM does so wholly at its own and sole risk and Fugro Airborne Survey
COMM disclaims any liability to such party.
COMM
COMM Where the Services have involved Fugro Airborne Survey's use of any
COMM information provided by the Client or third parties, upon which
COMM Fugro Airborne Survey was reasonably entitled to rely, then the
COMM Services are limited by the accuracy of such information. Fugro
COMM Airborne Survey is not liable for any inaccuracies (including any
```

```
COMM incompleteness) in the said information, save as otherwise provided
COMM in the terms of the contract between the Client and Fugro Airborne
COMM Survey.
COMM
COMM With regard to DIGITAL TERRAIN DATA, the accuracy of the elevation
COMM calculation is directly dependent on the accuracy of the two input
COMM parameters lidar altitude and GPS altitude. The radar altitude value may
be
COMM erroneous in areas of heavy tree cover, where the altimeter reflects the
COMM distance to the tree canopy rather than the ground. The GPS altitude
value
COMM is primarily dependent on the number of available satellites. Although
COMM post-processing of GPS data will yield X and Y accuracies in the
COMM order of 1-2 metres, the accuracy of the altitude value is usually
COMM much less, sometimes in the ±5 metre range.  Further inaccuracies
COMM may be introduced during the interpolation and gridding process.
COMM Because of the inherent inaccuracies of this method, no guarantee is
COMM made or implied that the information displayed is a true
COMM representation of the height above sea level.  Although this product
COMM may be of some use as a general reference,
COMM THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.
COMM ---------------------------------------------------------------------
COMM
COMM ELECTROMAGNETIC SYSTEM
COMM
COMM TEMPEST IS A TIME-DOMAIN SQUARE-WAVE SYSTEM,
COMM TRANSMITTING AT A BASE FREQUENCY OF 25Hz,
COMM WITH 2 ORTHOGONAL-AXIS RECEIVER COILS IN A TOWED BIRD.
COMM FINAL EM OUTPUT IS RECORDED 5 TIMES PER SECOND.
COMM THE TIMES (IN MILLISECONDS) FOR THE 15 WINDOWS ARE:
COMM
COMM WINDOW      START       END      CENTRE
COMM    1        0.007      0.020      0.013
COMM    2        0.033      0.047      0.040
COMM    3        0.060      0.073      0.067
COMM    4        0.087      0.127      0.107
COMM    5        0.140      0.207      0.173
COMM    6        0.220      0.340      0.280
COMM    7        0.353      0.553      0.453
COMM    8        0.567      0.873      0.720
COMM    9        0.887      1.353      1.120
COMM   10        1.367      2.100      1.733
COMM   11        2.113      3.273      2.693
COMM   12        3.287      5.113      4.200
COMM   13        5.127      7.993      6.560
COMM   14        8.007     12.393     10.200
COMM   15       12.407     19.993     16.200
COMM
COMM PULSE WIDTH: 10 ms
COMM
COMM TEMPEST EM data are transformed to the response that would be
COMM obtained with a B-field sensor for a 100% duty cycle square
COMM waveform at the base frequency, involving a 1A change in
COMM current (from -0.5A to +0.5A to -0.5A) in a 1sq.m transmitter.
COMM It is this configuration, rather than the actual acquisition
COMM configuration, which must be specified when modelling TEMPEST data.
COMM
COMM
COMM LOCATED DATA FORMAT
COMM
COMM  Output field format : ASCII ASEG-GDF
COMM
COMM FIELD                        UNITS            NULL                FORMAT
COMM Line                                          -99999999           I10
```

COMM Flight		-99	I4
COMM Fiducial		-999999.9	F8.1
COMM Project_FAS		-9999	I6
COMM Aircraft		-9	I3
COMM Date		-9999999	I9
COMM Time	s	-9999.9	F8.1
COMM Bearing	deg	-99	I4
COMM Latitude	deg	-99.9999999	F12.7
COMM Longitude	deg	-999.9999999	F13.7
COMM Easting	m	-99999.99	F10.2
COMM Northing	m	-999999.99	F11.2
COMM Lidar	m	-999.99	F8.2
COMM Radalt	m	-999.99	F8.2
COMM Tx_Elevation	m	-999.99	F8.2
COMM DTM	m	-999.99	F8.2
COMM Diurnal	nT	-99999.99	F8.2
COMM Mag	nT	-99999.999	F11.3
COMM Mag_1VD	nT	-99.999	F8.3
COMM Tx_Pitch	deg	-999.99	F8.2
COMM Tx_Roll	deg	-999.99	F8.2
COMM Tx_Height	m	-999.99	F8.2
COMM HSep_Raw	m	-999.99	F8.2
COMM VSep_Raw	m	-999.99	F8.2
COMM Tx_Height_std	m	-999.99	F8.2
COMM HSep_std	m	-999.99	F8.2
COMM VSep_std	m	-999.99	F8.2
COMM EMX_nonhprg_01	fT	-999.999999	F12.6
COMM EMX_nonhprg_02	fT	-999.999999	F12.6
COMM EMX_nonhprg_03	fT	-999.999999	F12.6
COMM EMX_nonhprg_04	fT	-999.999999	F12.6
COMM EMX_nonhprg_05	fT	-999.999999	F12.6
COMM EMX_nonhprg_06	fT	-999.999999	F12.6
COMM EMX_nonhprg_07	fT	-999.999999	F12.6
COMM EMX_nonhprg_08	fT	-999.999999	F12.6
COMM EMX_nonhprg_09	fT	-999.999999	F12.6
COMM EMX_nonhprg_10	fT	-999.999999	F12.6
COMM EMX_nonhprg_11	fT	-999.999999	F12.6
COMM EMX_nonhprg_12	fT	-999.999999	F12.6
COMM EMX_nonhprg_13	fT	-999.999999	F12.6
COMM EMX_nonhprg_14	fT	-999.999999	F12.6
COMM EMX_nonhprg_15	fT	-999.999999	F12.6
COMM EMX_hprg_01	fT	-999.999999	F12.6
COMM EMX_hprg_02	fT	-999.999999	F12.6
COMM EMX_hprg_03	fT	-999.999999	F12.6
COMM EMX_hprg_04	fT	-999.999999	F12.6
COMM EMX_hprg_05	fT	-999.999999	F12.6
COMM EMX_hprg_06	fT	-999.999999	F12.6
COMM EMX_hprg_07	fT	-999.999999	F12.6
COMM EMX_hprg_08	fT	-999.999999	F12.6
COMM EMX_hprg_09	fT	-999.999999	F12.6
COMM EMX_hprg_10	fT	-999.999999	F12.6
COMM EMX_hprg_11	fT	-999.999999	F12.6
COMM EMX_hprg_12	fT	-999.999999	F12.6
COMM EMX_hprg_13	fT	-999.999999	F12.6
COMM EMX_hprg_14	fT	-999.999999	F12.6
COMM EMX_hprg_15	fT	-999.999999	F12.6
COMM X_Sferics		-9999.999	F10.3
COMM X_LowFreq		-9999.999	F10.3
COMM X_Powerline		-9999.999	F10.3
COMM X_VLF1		-9999.999	F10.3
COMM X_VLF2		-9999.999	F10.3
COMM X_VLF3		-9999.999	F10.3
COMM X_VLF4		-9999.999	F10.3
COMM X_Geofact		-9999.999	F10.3

```
COMM EMZ_nonhprg_01          fT          -999.999999      F12.6
COMM EMZ_nonhprg_02          fT          -999.999999      F12.6
COMM EMZ_nonhprg_03          fT          -999.999999      F12.6
COMM EMZ_nonhprg_04          fT          -999.999999      F12.6
COMM EMZ_nonhprg_05          fT          -999.999999      F12.6
COMM EMZ_nonhprg_06          fT          -999.999999      F12.6
COMM EMZ_nonhprg_07          fT          -999.999999      F12.6
COMM EMZ_nonhprg_08          fT          -999.999999      F12.6
COMM EMZ_nonhprg_09          fT          -999.999999      F12.6
COMM EMZ_nonhprg_10          fT          -999.999999      F12.6
COMM EMZ_nonhprg_11          fT          -999.999999      F12.6
COMM EMZ_nonhprg_12          fT          -999.999999      F12.6
COMM EMZ_nonhprg_13          fT          -999.999999      F12.6
COMM EMZ_nonhprg_14          fT          -999.999999      F12.6
COMM EMZ_nonhprg_15          fT          -999.999999      F12.6
COMM EMZ_hprg_01             fT          -999.999999      F12.6
COMM EMZ_hprg_02             fT          -999.999999      F12.6
COMM EMZ_hprg_03             fT          -999.999999      F12.6
COMM EMZ_hprg_04             fT          -999.999999      F12.6
COMM EMZ_hprg_05             fT          -999.999999      F12.6
COMM EMZ_hprg_06             fT          -999.999999      F12.6
COMM EMZ_hprg_07             fT          -999.999999      F12.6
COMM EMZ_hprg_08             fT          -999.999999      F12.6
COMM EMZ_hprg_09             fT          -999.999999      F12.6
COMM EMZ_hprg_10             fT          -999.999999      F12.6
COMM EMZ_hprg_11             fT          -999.999999      F12.6
COMM EMZ_hprg_12             fT          -999.999999      F12.6
COMM EMZ_hprg_13             fT          -999.999999      F12.6
COMM EMZ_hprg_14             fT          -999.999999      F12.6
COMM EMZ_hprg_15             fT          -999.999999      F12.6
COMM Z_Sferics                           -9999.999        F10.3
COMM Z_LowFreq                           -9999.999        F10.3
COMM Z_Powerline                         -9999.999        F10.3
COMM Z_VLF1                              -9999.999        F10.3
COMM Z_VLF2                              -9999.999        F10.3
COMM Z_VLF3                              -9999.999        F10.3
COMM Z_VLF4                              -9999.999        F10.3
COMM Z_Geofact                           -9999.999        F10.3
COMM CND[1:100]              mS/m        -9999.999        F10.3
COMM
```

FINAL EM – REYNOLDS RANGE EAST

```
COMM FAS PROJECT NUMBER                                        2066
COMM AREA NUMBER:                                                 2
COMM SURVEY COMPANY:                        Fugro Airborne Surveys
COMM CLIENT:                                      Toro Energy Ltd
COMM SURVEY TYPE:                              25Hz TEMPEST Survey
COMM AREA NAME:                          Reynolds Ranges East Area
COMM STATE:                                                      NT
COMM COUNTRY:                                             Australia
COMM SURVEY FLOWN:                                      August 2009
COMM LOCATED DATA CREATED:                             October 2009
COMM
COMM DATUM:                                                   GDA94
COMM PROJECTION:                                                MGA
COMM ZONE:                                                       53
COMM
COMM SURVEY SPECIFICATIONS
COMM
COMM TRAVERSE LINE SPACING:                                  1000 m
COMM TRAVERSE LINE DIRECTION:                           089-269 deg
```

```
COMM NOMINAL TERRAIN CLEARANCE:                                      100 m
COMM FINAL LINE KILOMETRES:                                       875.3 km
COMM
COMM LINE NUMBERING
COMM
COMM TRAVERSE LINE NUMBERS:                                200101 - 205301
COMM
COMM AREA BOUNDARY
COMM
COMM    196077    7590573
COMM    196199    7584175
COMM    222590    7584657
COMM    222702    7578260
COMM    217396    7573681
COMM    195694    7573224
COMM    195910    7562013
COMM    187948    7561857
COMM    183217    7567672
COMM    182764    7590314
COMM
COMM SURVEY EQUIPMENT
COMM
COMM AIRCRAFT:                                         SHORTS SKYVAN, VH-WGT
COMM
COMM MAGNETOMETER:                               Scintrex Cs-2 Cesium Vapour
COMM INSTALLATION:                                             stinger mount
COMM RESOLUTION:                                                   0.001 nT
COMM RECORDING INTERVAL:                                              0.2 s
COMM
COMM ELECTROMAGNETIC SYSTEM:                                    25Hz TEMPEST
COMM INSTALLATION:                  Transmitter loop mounted on the aircraft
COMM                                          Receiver coils in a towed bird
COMM COIL ORIENTATION:                                                   X,Z
COMM RECORDING INTERVAL:                                              0.2 s
COMM SYSTEM GEOMETRY:
COMM RECEIVER DISTANCE BEHIND THE TRANSMITTER:                       -117 m
COMM RECEIVER DISTANCE BELOW THE TRANSMITTER:                         -37 m
COMM
COMM RADAR ALTIMETER:                                          Sperry RT-220
COMM RECORDING INTERVAL:                                              0.2 s
COMM
COMM LASER ALTIMETER:                                      Optech 501SB (WGT)
COMM RECORDING INTERVAL:                                              0.2 s
COMM
COMM NAVIGATION:                                real-time differential GPS
COMM RECORDING INTERVAL:                                              1.0 s
COMM
COMM ACQUISITION SYSTEM:                                             FASDAS
COMM
COMM DATA PROCESSING
COMM
COMM MAGNETIC DATA
COMM DIURNAL BASE VALUE APPLIED                                    52030 nT
COMM PARALLAX CORRECTION APPLIED (during final processing)            0.0 s
COMM IGRF BASE VALUE APPLIED                                       52210 nT
COMM IGRF MODEL 2005 EXTRAPOLATED TO                                 2009.7
COMM DATA HAVE BEEN MICROLEVELLED
COMM
COMM ELECTROMAGNETIC DATA
COMM SYSTEM PARALLAX REMOVED, AS FOLLOWS
COMM X-COMPONENT EM DATA                                             -1.6 s
COMM Z-COMPONENT EM DATA                                             -0.2 s
COMM DATA CORRECTED FOR TRANSMITTER HEIGHT, PITCH AND ROLL
COMM DATA CORRECTED FOR TRANSMITTER-RECEIVER GEOMETRY VARIATIONS
```

```
COMM DATA HAVE BEEN MICROLEVELLED
COMM CONDUCTIVITY DEPTH INVERSION CALCULATED                   EMFlow V5.10
COMM CONDUCTIVITY DEPTH RANGE                                   000 - 300 m
COMM CONDUCTIVITY DEPTH INTERVAL                                        3 m
COMM CONDUCTIVITIES CALCULATED USING HPRG CORRECTED EMZ DATA
COMM
COMM DIGITAL TERRAIN DATA
COMM PARALLAX CORRECTION APPLIED TO LIDAR ALIMETER DATA               0.0 s
COMM PARALLAX CORRECTION APPLIED TO GPS ALIMETER DATA                 0.0 s
COMM DTM CALCULATED [DTM = GPS ALTITUDE - LIDAR ALTITUDE - GPS/LIDAR DIST]
COMM N-VALUE APPLIED TO CORRECT DTM TO AUSTRALIAN HEIGHT DATUM (AHD)
COMM DATA HAVE BEEN MICROLEVELLED
COMM
COMM ----------------------------------------------------------------------
COMM DISCLAIMER
COMM ----------------------------------------------------------------------
COMM It is Fugro Airborne Survey's understanding that the data provided to
COMM the client is to be used for the purpose agreed between the parties.
COMM That purpose was a significant factor in determining the scope and
COMM level of the Services being offered to the Client. Should the purpose
COMM for which the data is used change, the data may no longer be valid or
COMM appropriate and any further use of, or reliance upon, the data in
COMM those circumstances by the Client without Fugro Airborne Survey's
COMM review and advice shall be at the Client's own or sole risk.
COMM
COMM The Services were performed by Fugro Airborne Survey exclusively for
COMM the purposes of the Client. Should the data be made available in whole
COMM or part to any third party, and such party relies thereon, that party
COMM does so wholly at its own and sole risk and Fugro Airborne Survey
COMM disclaims any liability to such party.
COMM
COMM Where the Services have involved Fugro Airborne Survey's use of any
COMM information provided by the Client or third parties, upon which
COMM Fugro Airborne Survey was reasonably entitled to rely, then the
COMM Services are limited by the accuracy of such information. Fugro
COMM Airborne Survey is not liable for any inaccuracies (including any
COMM incompleteness) in the said information, save as otherwise provided
COMM in the terms of the contract between the Client and Fugro Airborne
COMM Survey.
COMM
COMM With regard to DIGITAL TERRAIN DATA, the accuracy of the elevation
COMM calculation is directly dependent on the accuracy of the two input
COMM parameters lidar altitude and GPS altitude. The radar altitude value may
be
COMM erroneous in areas of heavy tree cover, where the altimeter reflects the
COMM distance to the tree canopy rather than the ground. The GPS altitude
value
COMM is primarily dependent on the number of available satellites. Although
COMM post-processing of GPS data will yield X and Y accuracies in the
COMM order of 1-2 metres, the accuracy of the altitude value is usually
COMM much less, sometimes in the ±5 metre range.  Further inaccuracies
COMM may be introduced during the interpolation and gridding process.
COMM Because of the inherent inaccuracies of this method, no guarantee is
COMM made or implied that the information displayed is a true
COMM representation of the height above sea level.  Although this product
COMM may be of some use as a general reference,
COMM THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.
COMM ----------------------------------------------------------------------
COMM
COMM ELECTROMAGNETIC SYSTEM
COMM
COMM TEMPEST IS A TIME-DOMAIN SQUARE-WAVE SYSTEM,
COMM TRANSMITTING AT A BASE FREQUENCY OF 25Hz,
COMM WITH 2 ORTHOGONAL-AXIS RECEIVER COILS IN A TOWED BIRD.
```

```
COMM FINAL EM OUTPUT IS RECORDED 5 TIMES PER SECOND.
COMM THE TIMES (IN MILLISECONDS) FOR THE 15 WINDOWS ARE:
COMM
COMM WINDOW      START       END      CENTRE
COMM    1        0.007      0.020      0.013
COMM    2        0.033      0.047      0.040
COMM    3        0.060      0.073      0.067
COMM    4        0.087      0.127      0.107
COMM    5        0.140      0.207      0.173
COMM    6        0.220      0.340      0.280
COMM    7        0.353      0.553      0.453
COMM    8        0.567      0.873      0.720
COMM    9        0.887      1.353      1.120
COMM   10        1.367      2.100      1.733
COMM   11        2.113      3.273      2.693
COMM   12        3.287      5.113      4.200
COMM   13        5.127      7.993      6.560
COMM   14        8.007     12.393     10.200
COMM   15       12.407     19.993     16.200
COMM
COMM PULSE WIDTH: 10 ms
COMM
COMM TEMPEST EM data are transformed to the response that would be
COMM obtained with a B-field sensor for a 100% duty cycle square
COMM waveform at the base frequency, involving a 1A change in
COMM current (from -0.5A to +0.5A to -0.5A) in a 1sq.m transmitter.
COMM It is this configuration, rather than the actual acquisition
COMM configuration, which must be specified when modelling TEMPEST data.
COMM
COMM
COMM LOCATED DATA FORMAT
COMM
COMM  Output field format : ASCII ASEG-GDF
COMM
COMM FIELD                     UNITS           NULL                FORMAT
COMM Line                                      -99999999           I10
COMM Flight                                    -99                 I4
COMM Fiducial                                  -999999.9           F8.1
COMM Project_FAS                               -9999               I6
COMM Aircraft                                  -9                  I3
COMM Date                                      -9999999            I9
COMM Time                       s              -9999.9             F8.1
COMM Bearing                    deg            -99                 I4
COMM Latitude                   deg            -99.9999999         F12.7
COMM Longitude                  deg            -999.9999999        F13.7
COMM Easting                    m              -99999.99           F10.2
COMM Northing                   m              -999999.99          F11.2
COMM Lidar                      m              -999.99             F8.2
COMM Radalt                     m              -999.99             F8.2
COMM Tx_Elevation               m              -999.99             F8.2
COMM DTM                        m              -999.99             F8.2
COMM Diurnal                    nT             -99999.99           F8.2
COMM Mag                        nT             -99999.999          F11.3
COMM Mag_1VD                    nT             -99.999             F8.3
COMM Tx_Pitch                   deg            -999.99             F8.2
COMM Tx_Roll                    deg            -999.99             F8.2
COMM Tx_Height                  m              -999.99             F8.2
COMM HSep_Raw                   m              -999.99             F8.2
COMM VSep_Raw                   m              -999.99             F8.2
COMM Tx_Height_std              m              -999.99             F8.2
COMM HSep_std                   m              -999.99             F8.2
COMM VSep_std                   m              -999.99             F8.2
COMM EMX_nonhprg_01             fT             -999.999999         F12.6
COMM EMX_nonhprg_02             fT             -999.999999         F12.6
```

COMM	EMX_nonhprg_03	fT	-999.999999	F12.6
COMM	EMX_nonhprg_04	fT	-999.999999	F12.6
COMM	EMX_nonhprg_05	fT	-999.999999	F12.6
COMM	EMX_nonhprg_06	fT	-999.999999	F12.6
COMM	EMX_nonhprg_07	fT	-999.999999	F12.6
COMM	EMX_nonhprg_08	fT	-999.999999	F12.6
COMM	EMX_nonhprg_09	fT	-999.999999	F12.6
COMM	EMX_nonhprg_10	fT	-999.999999	F12.6
COMM	EMX_nonhprg_11	fT	-999.999999	F12.6
COMM	EMX_nonhprg_12	fT	-999.999999	F12.6
COMM	EMX_nonhprg_13	fT	-999.999999	F12.6
COMM	EMX_nonhprg_14	fT	-999.999999	F12.6
COMM	EMX_nonhprg_15	fT	-999.999999	F12.6
COMM	EMX_hprg_01	fT	-999.999999	F12.6
COMM	EMX_hprg_02	fT	-999.999999	F12.6
COMM	EMX_hprg_03	fT	-999.999999	F12.6
COMM	EMX_hprg_04	fT	-999.999999	F12.6
COMM	EMX_hprg_05	fT	-999.999999	F12.6
COMM	EMX_hprg_06	fT	-999.999999	F12.6
COMM	EMX_hprg_07	fT	-999.999999	F12.6
COMM	EMX_hprg_08	fT	-999.999999	F12.6
COMM	EMX_hprg_09	fT	-999.999999	F12.6
COMM	EMX_hprg_10	fT	-999.999999	F12.6
COMM	EMX_hprg_11	fT	-999.999999	F12.6
COMM	EMX_hprg_12	fT	-999.999999	F12.6
COMM	EMX_hprg_13	fT	-999.999999	F12.6
COMM	EMX_hprg_14	fT	-999.999999	F12.6
COMM	EMX_hprg_15	fT	-999.999999	F12.6
COMM	X_Sferics		-9999.999	F10.3
COMM	X_LowFreq		-9999.999	F10.3
COMM	X_Powerline		-9999.999	F10.3
COMM	X_VLF1		-9999.999	F10.3
COMM	X_VLF2		-9999.999	F10.3
COMM	X_VLF3		-9999.999	F10.3
COMM	X_VLF4		-9999.999	F10.3
COMM	X_Geofact		-9999.999	F10.3
COMM	EMZ_nonhprg_01	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_02	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_03	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_04	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_05	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_06	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_07	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_08	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_09	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_10	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_11	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_12	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_13	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_14	fT	-999.999999	F12.6
COMM	EMZ_nonhprg_15	fT	-999.999999	F12.6
COMM	EMZ_hprg_01	fT	-999.999999	F12.6
COMM	EMZ_hprg_02	fT	-999.999999	F12.6
COMM	EMZ_hprg_03	fT	-999.999999	F12.6
COMM	EMZ_hprg_04	fT	-999.999999	F12.6
COMM	EMZ_hprg_05	fT	-999.999999	F12.6
COMM	EMZ_hprg_06	fT	-999.999999	F12.6
COMM	EMZ_hprg_07	fT	-999.999999	F12.6
COMM	EMZ_hprg_08	fT	-999.999999	F12.6
COMM	EMZ_hprg_09	fT	-999.999999	F12.6
COMM	EMZ_hprg_10	fT	-999.999999	F12.6
COMM	EMZ_hprg_11	fT	-999.999999	F12.6
COMM	EMZ_hprg_12	fT	-999.999999	F12.6
COMM	EMZ_hprg_13	fT	-999.999999	F12.6

COMM EMZ_hprg_14	fT	-999.999999	F12.6
COMM EMZ_hprg_15	fT	-999.999999	F12.6
COMM Z_Sferics		-9999.999	F10.3
COMM Z_LowFreq		-9999.999	F10.3
COMM Z_Powerline		-9999.999	F10.3
COMM Z_VLF1		-9999.999	F10.3
COMM Z_VLF2		-9999.999	F10.3
COMM Z_VLF3		-9999.999	F10.3
COMM Z_VLF4		-9999.999	F10.3
COMM Z_Geofact		-9999.999	F10.3
COMM CND[1:100]	mS/m	-9999.999	F10.3

APPENDIX IV – List of all Supplied Data and Products

Initial Raw Products (Gridded data in Georeferenced TIFF format)

- Raw Total Magnetic Intensity
- Raw CDI's for 25% of survey lines
- Raw EM Channels (X and Z) for 3 selected windows

Preliminary Gridded Products (delivered in ERMapper format GDA94 MGA53S)

- Total Magnetic Intensity
- First Vertical Derivative TMI
- Digital Terrain Model
- 15 channels of X-component
- 15 channels of Z-component
- EM Time Constant for X-component
- EM Time Constant for Z-component

Final Located Data

2066_[1-2]_Final.hdr **-** header file describing the contents of…
2066_[1-2]_Final.asc - flat ascii file containing located magnetic, EM and digital terrain data
2066_[1-2]_Final.gdb - Geosoft database file containing located magnetic, EM and digital terrain data

Final Gridded Products (delivered in ERMapper format GDA94 MGA53S)

- Total Magnetic Intensity
- First Vertical Derivative TMI
- Digital Terrain Model
- 15 channels of X-component
- 15 channels of Z-component
- EM Time Constant for X-component
- EM Time Constant for Z-component

Final Digital Products

- Flight Path map
- Z-Component Conductivity Depth Image (CDI) Multiplots & Stacked sections

Final Acquisition and Processing Report

Delivered as hardcopy and digitally