RED RIVER RESOURCES LTD
BLYTHE GRAVITY SURVEY
August – September 2006

Report Number 06023

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1. INTRODUCTION

A precision GPS-gravity survey was carried out from 31st August to the 16th September 2006 for Red River Resources. The survey was located over an area known as "Blythe", north of the town of Natone in North Western district of Tasmania. A total of 714 new stations were surveyed by vehicle and foot.

For the gravity survey, data were acquired using a Scintrex CG5 digital gravity meter. Position and level data were obtained using Leica System 1200 GPS units to produce precise post processed GPS locations. All data were acquired using Daishsat vehicle methods.

Gravity data was reduced using standard reductions on the ISOGAL84 gravity network. GPS data were reduced to MGA coordinates with levels expressed as metres above the Australian Height Datum.

2. SURVEY OVERVIEW

The area surveyed was centred on the town of Natone, Tasmania (see Figure1).

The survey consisted of two sections. The first section was completed by vehicle with gravity data collected along existing roads and tracks. The second section was completed on foot along traverses that were oriented NW-SE.

The walking gravity survey consisted initially of 100m spaced stations situated on 200m spaced lines. This was later infilled to produce 100m spaced stations situated on 100m spaced lines

The regional survey consisted of a coverage consisting of 100m station spacing along roads and tracks that ran through the area. Due to the nature of the winding roads through the area, this station spacing was varied in order for the crews to safely acquire the gravity data.

Specifications for each survey are contained in Appendix C, at the back of this report.

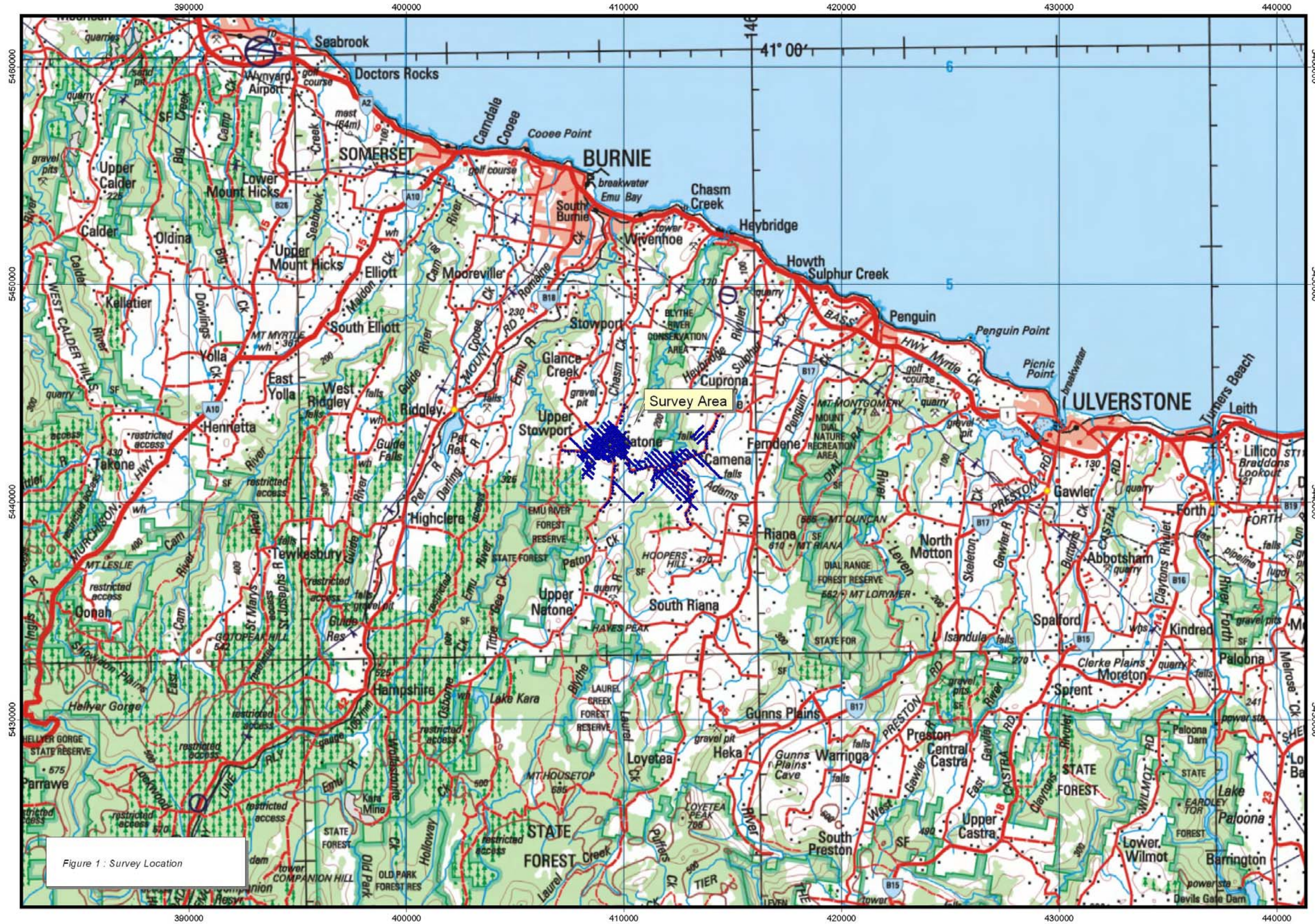


Figure 1 : Survey Location

3. PERSONNEL AND EQUIPMENT

3.1 Personnel

The supervisor in charge of the project was Mr. Frank Duffy. Frank was responsible for daily management of the job and for nightly data processing to ensure quality and integrity. Gravity and GPS measurements were carried out by:

Matt Ingall (Senior Observer)
Frank Duffy (Surveyor)
Kyle Jarvie (Operator)

Final data reduction and inspection were performed by the company geophysicist, Leon Mathews.

3.2 Survey equipment

- One Scintrex CG-5 digital gravity meter SN 24921 (A)
- Two Leica System 1200 dual frequency GPS receivers (Rover and Base)
- Two PDL Pacific Crest Data Modem/Radios
- Garmin Handheld GPS receivers for navigation
- Two Compaq notebooks for data processing and backup
- Various chargers, solar cells and batteries

Photo 1: Leica Real-Time GPS Base

3.3 Vehicles

4Due to the type of terrain to be encountered, 4WD vehicles were used for the duration of the job. To maintain the high Daishsat safety record, the vehicle was fitted with a range of safety equipment including:

- One 20l jerry can of water
- Two spare tyres
- Tyre pliers to effect tyre repairs in the field
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

3.4 Camp

The crew stayed at the Natone Fly Fishing Village for the duration of the survey.

3.5 Communications

The survey crews were equipped with a hand-held Globalstar satellite phone. Skeds were made to the Perth office at prescribed intervals.

4. GPS SURVEYING AND PROCESSING

4.1 Set out of the grid

This was done concurrently with the gravity data acquisition using Leica RTK GPS. Where possible, the readings were taken as close to the ideal coordinates as possible. Some stations were offset or omitted due to the nature of the terrain, e.g. hilly or thickly vegetated areas. As the Leica system was operating in precise RTK mode, set out accuracy was better than 2cm. At the repeat stations, a washer tied to pink flagging, marked with the station number, was used for identification. At each station, the station number, position and RL were recorded digitally by the GPS crew.

The crew consisted of two operators. The first operator is required to carry the GPS unit and to navigate to the station location. Once at the required location the operator will record the position information digitally and then either mark the station or wait at the location for the second operator to arrive. The second operator is required to carry the gravity meter and take gravity measurements at each location. The second operator is effectively one step behind the first operator while surveying in normal terrain.

Photo 2: A Typical Walking Crew Acquiring Gravity Data

For the section of the survey completed by vehicle, the GPS unit was set up inside the vehicle with the GPS/Radio antennae mounted on the roof of the vehicle. Gravity readings were taken directly underneath the GPS antenna whilst the vehicle engine was turned off and handbrake engaged. Readings were taken on level ground, usually just off to the side of the road.

Photo 3: Gravity Data Acquisition utilizing vehicle

4.2 Survey datum and control

The gravity surveying, and hence any gravity reductions, used the Australian Height Datum (AHD) as the reference datum. All new GPS/Gravity base stations were established using three days worth of static data, and connections to ITRF stations using AUSLIG's online GPS processing system, AUSPOS. For more information on this system, please visit http://www.ga.gov.au/geodesy/sgc/wwwgps/. Final deviations of better than 5mm were obtained for x,y and z, for all occupations.. Appendix D contains the GPS base station information.

4.3 Processing of the position and level data

The real-time kinematic GPS data were recorded on 32Mb CF Cards which were downloaded onto computers daily. All data is processed in real time, so no further processing was required.

Simple transformations to MGA and AHD were done using the GPS derived WGS84 positions output from the RTK system. MGA coordinates were obtained by simply projecting the GPS-derived WGS84 coordinates using a UTM projection with zone 55S. For all practicable purposes, the WGS84 geodetic coordinates are equivalent to GDA94 geodetic coordinates, so no transformation is necessary. For more information about GDA94 and MGA please visit http://www.ga.gov.au/geodesy/datums/.

AHD heights were calculated within Leica Geo-Office and the latest geoid model for Australia, AUSGEOID98. Information about the geoid, and the modeling process used to extract separations (N values) can be found at http://www.ga.gov.au/geodesy/ausgeoid/index.jsp. To obtain AHD heights, the modeled N value is subtracted from the GPS derived WGS84 ellipsoidal height (Figure 2).

$$H_{AHD}=h_{WGS84}-N$$

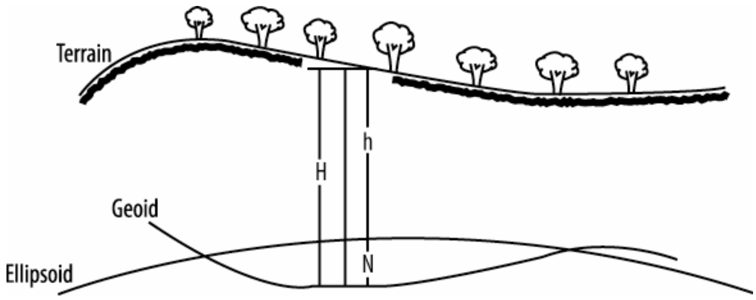


Figure 2: Geoid-Ellipsoid separation

4.4 GPS Performance

Performance from the Leica RTK system was excellent, with minimal downtime due to poor geometry and/or trees.

5. GRAVITY ACQUISITION AND PROCESSING

5.1 Gravity data acquisition

Gravity observations were made concurrently with the GPS measurements (Photo 4). Two observations were made for each station, with each observation consisting of a 20-second or greater stacking time. Multiple observations were made at each station so that any seismic or instrumental noise could be immediately detected. The tolerance between readings was set at 0.03 of a dial reading. Vertical and horizontal levels were restricted to 5 arc seconds at all times. At each station, the station number, time and two gravity readings (in dial units) were recorded in DAISHSAT carbon-copy gravity field books. The Scintrex CG5 also automatically records the station, time and readings digitally to allow for downloading to computer.

Photo 4 – Operator taking a gravity observation at Natone

5.2 Gravity base stations

A single gravity base station, 0003, was used for calculation of absolute gravity and drift determination. Details of the gravity base are contained in Appendix D. When in the field, a base station reading was taken in the morning before observing, and at evening after the last observation. When taking a base station reading, the observed gravity values were stacked over 60 seconds to ensure accuracy. Two observations of 60 seconds were taken at each base reading. Observations were repeated until the readings repeated to 0.010 of a dial reading or less. The base station was tied to two AFGN gravity bases 1964911141 and 1985911141 located at Devonport. The tie consisted of an A-B-A loop incorporating both AFGN stations, and was carried out with three meters on a single day.

5.3 Gravity data processing

Raw gravity data were processed on a daily basis to check for quality and integrity. This interim process produced a set of Bouguer Gravity values, which were contoured and imaged to provide a check for any anomalous readings that would need repeating. Geosoft GRAVRED software was used for the gravity reduction in the field. Upon conclusion of the job, the data were reprocessed using the standard AGSO formulae using Daishsat proprietary software. Other software used on this project includes Arcview, Geosoft, ChrisDBF, Waypoint and ERMAPPER. The formulae used are listed below:

Instrument scale factor: This correction was used to correct a gravity reading (in dial units) to a relative milliGal value based on the meter calibration.

Tidal correction: This correction was used to correct for background variations due to changes in the relative position of the moon and sun. The Scintrex calculated ETC was removed and a new ETC calculated using Geosoft Formulae and the surveyed GPS latitude. The formula is too complex to list here.

Instrument Drift: Since gravity meters are mechanical, they are prone to drift (extension of the spring with heat, obeying Hooke's law). If two base readings are taken one can assume that the drift between the two readings is linear and can therefore be calculated. The drift and tidal corrected value is referred to as the *observed gravity*.

Normal Gravity: The theoretical value of gravity was calculated using the 1967 variant of the International Gravity Formula and used to latitude correct the observed gravity.

$$Gn=9{,}780{,}318.456*(1+0.005\,278\,895*\sin^2\phi+0.000\,023\,462*\sin^4\phi)$$

where ϕ represents degrees of latitude;

Free-Air Correction: Since gravity varies inversely with the square of distance, it is necessary to correct for changes in elevation between stations to reduce field readings to a datum surface (in this case, AHD).

$$(3.08768 - 0.00440 \sin^2\phi)*h - 0.000001442*h^2 \ \ \mu ms^{-2} \text{ per metre}$$

Bouguer Correction: This correction accounts for the attraction of material between the station and datum plane that is ignored in the free-air calculation. Values of 2.67, 2.40 and 2.20 gm/cc(tm^{-3}) were used in the correction.

$$0.4191^* \rho \ \mu ms^{-2} \text{ per metre}$$

where ρ = density 2.67, 2.40 and 2.20 tm^{-3}

Free Air Gravity: This is obtained by applying the free air correction (FAC) to the observed gravity reading.

$$FAG=G_{OBSG84}\text{-}Gn+FAC$$

Bouguer Gravity: This is obtained when all the preceding reductions or corrections have been applied to the observed gravity reading.

$$BG267, 240, 220=G_{OBSG84}\text{-}Gn+FAC\text{-}BC$$

5.4 Gravity meter calibration and scale factors

The gravity meters used had previously been calibrated over a number of calibration ranges in WA and SA. Derived scale factors from these calibrations are shown below:

CG5 24921A SF = 1.000000

5.5 Gravity meter drift calibration

While the survey was in progress, the meter was cycled overnight as a check on instrument drift. Changes were made to the drift constant where appropriate.

6. RESULTS

Raw and processed GPS and gravity data are contained on CDROM as Appendix E. Hardcopy plots of station location/images are contained in Appendix A.

6.1 Stations Surveyed and Survey Progress

In total, 714 new stations were acquired during the survey. A brief production summary for the survey area is shown in Table 1 below. Production varied depending mainly on weather conditions, however access to paddocks through fences also slowed the progress of the crew. Typically the crew was able to obtain in excess of 50 stations per day when the fine weather prevailed.

Blythe 2006

Gravity stations acquired (including repeats)	747	stations
Gravity station repeats	33	4.6%
New gravity stations acquired	714	stations
Total accidents	0	accidents
Total hours lost from accidents	0	hours

Table 1 : Gravity Production Summary

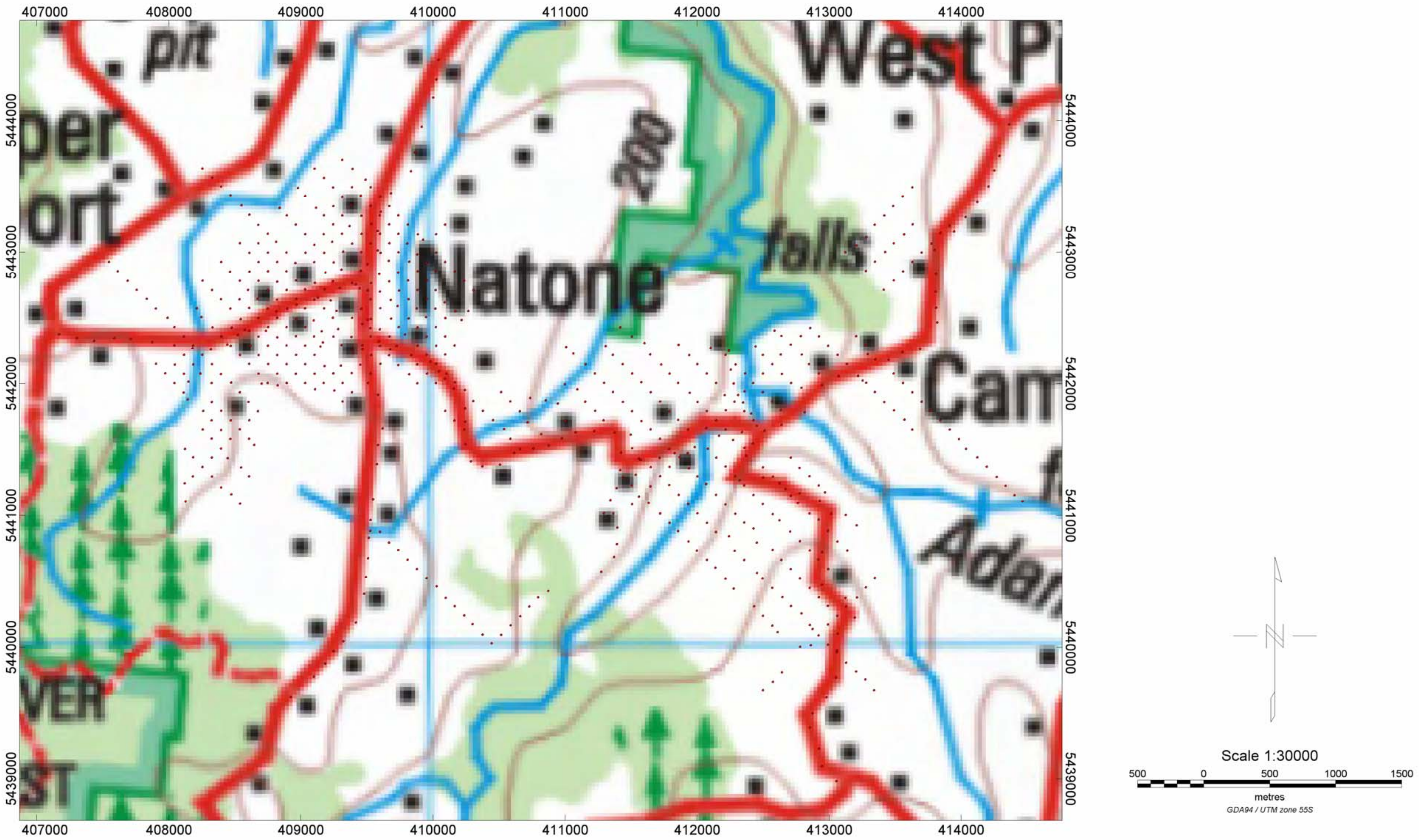
6.2 Data Repeatability

Analysis of the repeat data shows that measurement repeatability is excellent for both GPS and Gravity observations. An analysis for the survey is included in Appendix B. Based on the repeat data, one can assume the following typical accuracies for the observables:

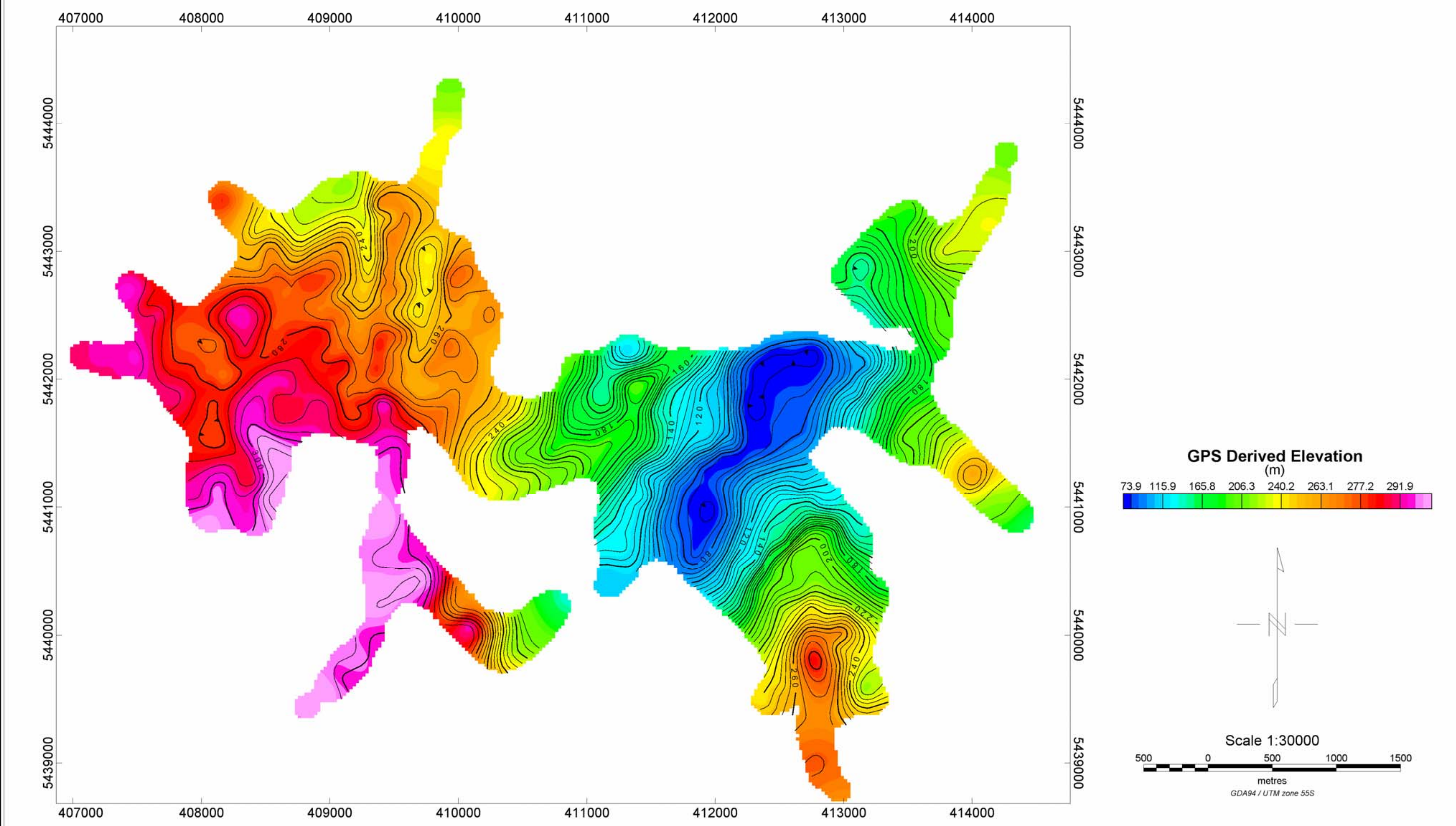
Z position observation : < 0.030 m
Gravity observation : < 0.020 mGals

APPENDIX A

Plots of station location / Images



06023 RVR
Blythe Gravity Survey **Plot of Station Locations**
survey by :Daishsat Geodetic Surveyors August - September 2006 www.daishsat.com
drawn by :MJJ

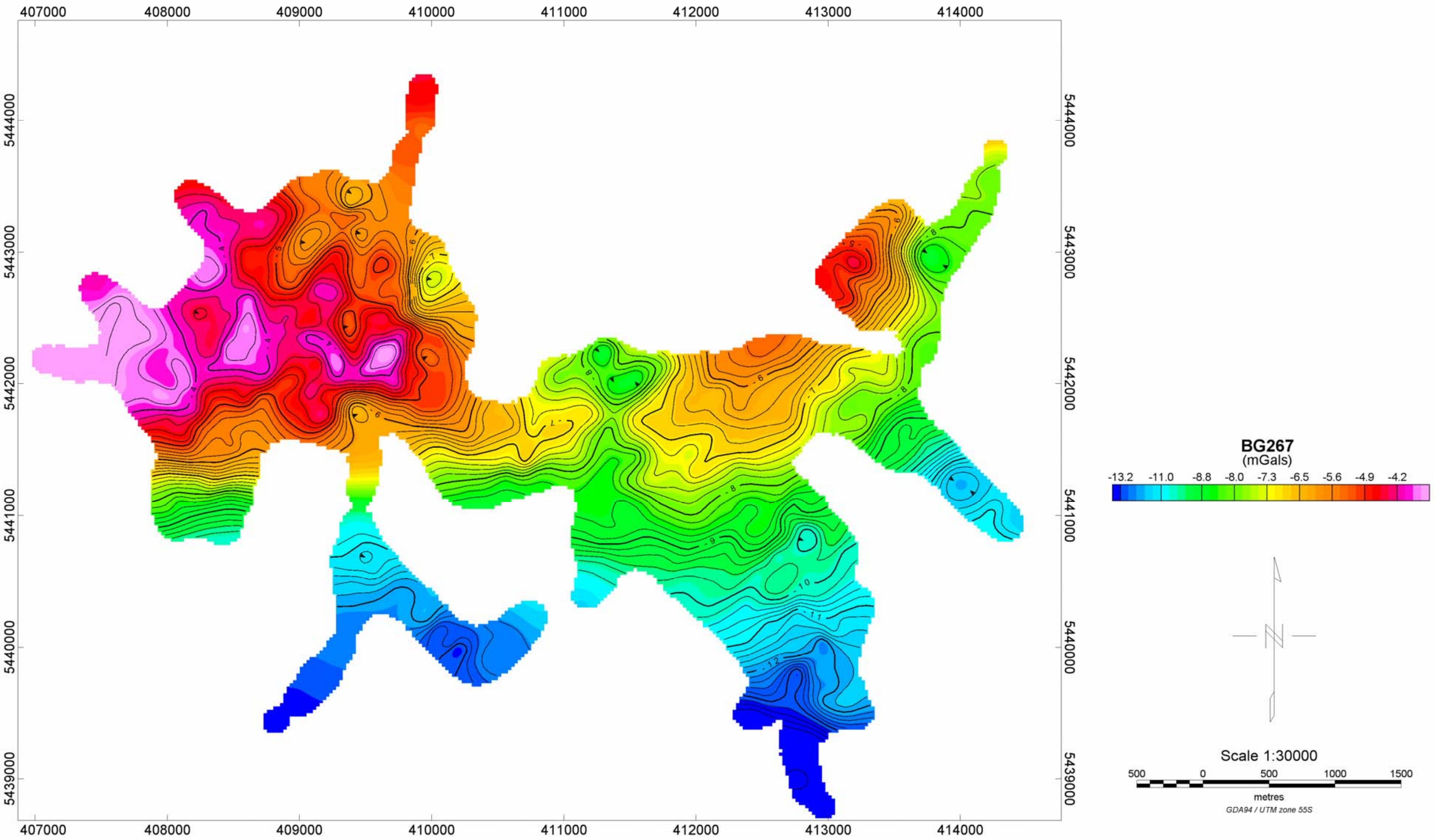


06023 RVR

Blythe Gravity Survey
Image of GPS Derived Elevation
Histogram Equalisation, Contour Interval 5 m

survey by :Daishsat Geodetic Surveyors
August - September 2006
www.daishsat.com

drawn by :MJJ

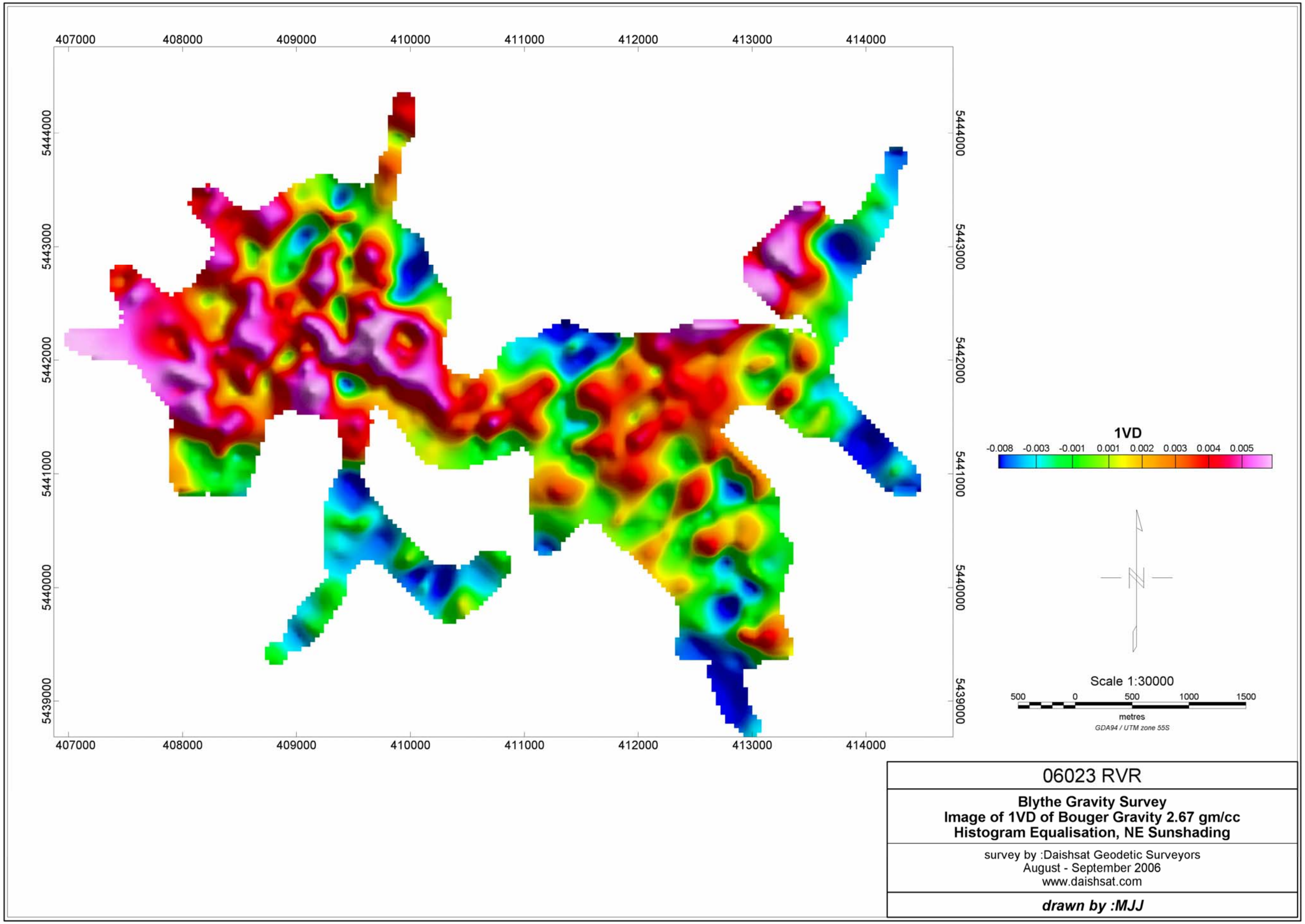


06023 RVR

Blythe Gravity Survey
Image of Bouger Gravity 2.67 gm/cc
Histogram Equalisation, Contour Interval 0.2 mGals

survey by :Daishsat Geodetic Surveyors
August - September 2006
www.daishsat.com

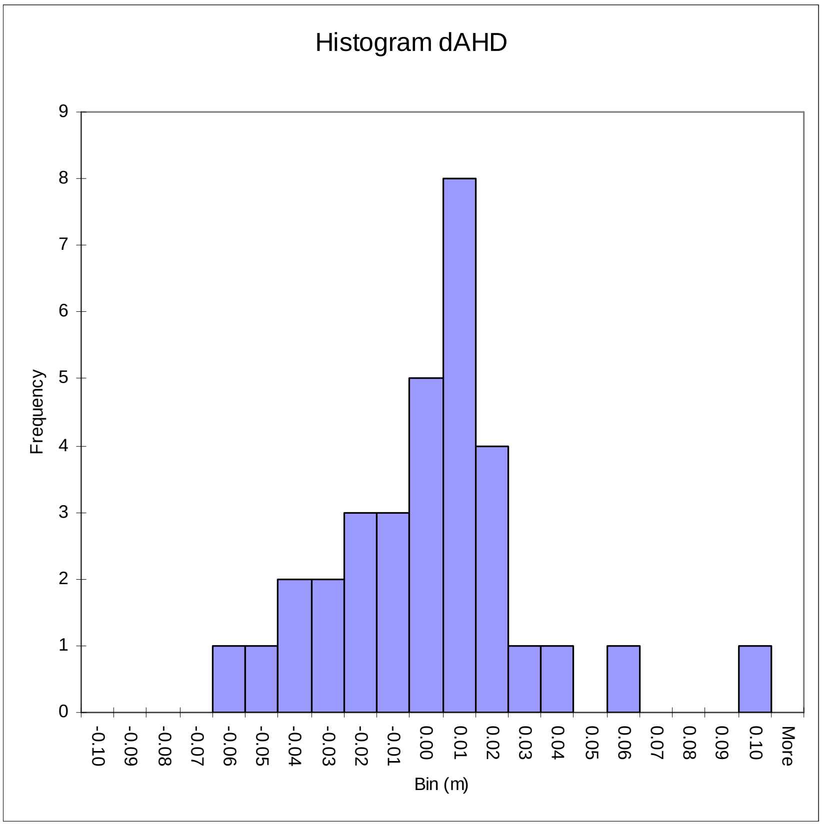
drawn by :MJJ


407000
408000
409000
410000
411000
412000
413000
414000
5444000
5443000
5442000
5441000
5440000
5439000
1VD
-0.008 -0.003 -0.001 0.001 0.002 0.003 0.004 0.005
Scale 1:30000
500 0 500 1000 1500
metres
GDA94 / UTM zone 55S
06023 RVR
Blythe Gravity Survey
Image of 1VD of Bouger Gravity 2.67 gm/cc
Histogram Equalisation, NE Sunshading
survey by :Daishsat Geodetic Surveyors
August - September 2006
www.daishsat.com
drawn by :MJJ

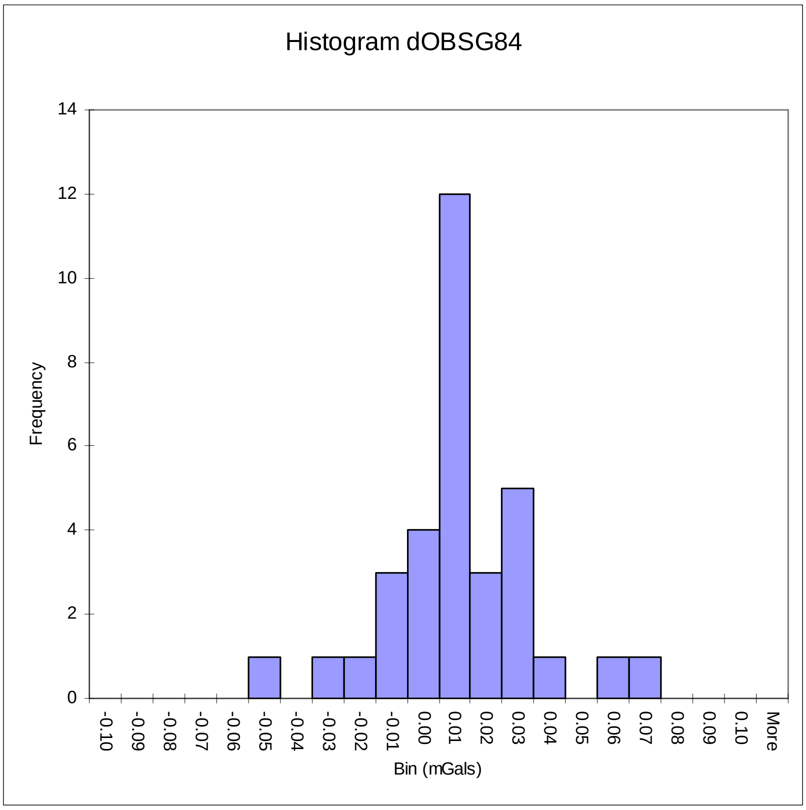
APPENDIX B

Repeat Tabulation and Analysis

Histogram dAHD



Histogram dOBSG84



Summary Statistics

	dAHD	*dOBSG*
Mean	-0.002	0.006
Standard Error	0.005	0.004
Median	0.000	0.006
Mode	0.018	0.007
Standard Deviation	0.031	0.022
Sample Variance	0.001	0.001
Kurtosis	2.610	1.364
Skewness	0.836	0.155
Range	0.164	0.115
Minimum	-0.064	-0.050
Maximum	0.100	0.065
Sum	-0.068	0.203
Count	33	33

APPENDIX C

Survey Specifications

06023 Blythe

Survey Name	Blythe
Operators	MI, FD, KJ
Techniques Employed	GPS, Gravity
Station Spacing	100m
Line Spacing	100m, 200m
Gravity Meter	Scintrex CG5
GPS	Leica 1200
Number of Points Surveyed	714
Gravity Base	0003

APPENDIX D

Base Station Information

Gravity Base 0003 – Natone Primary School

MGA94

EASTING	409593.614
NORTHING	5441791.253
ZONE	55
HEIGHT (AHD)	299.628

GDA94

LATITUDE	-41 10 12.649370 S
LONGITUDE	145 55 20.152542 E
HEIGHT	NA

OBSERVED GRAVITY

980207.737 mGals

SURVEYED BY

GPS- Daishsat, Position via single RTK shot from Daishsat GPS base 0004, expected accuracy better than 0.1m

Gravity - Base 0003 Tied to multiple AFGN bases, with an A-B-A loop using three meters.

MISCELLANEOUS DETAILS

The Base is located at front entrance of Natone Primary School, in front of commemorative plaque left of handrail.

Photo of Gravity Base 0003 with distinguishing features in background.

GPS Base 0004 – Natone Primary School

MGA94

EASTING	409505.020
NORTHING	5442003.966
ZONE	55
HEIGHT (AHD)	295.936

GDA94

LATITUDE	- 41 10 5.716997 S
LONGITUDE	145 55 16.464256 E
HEIGHT	294.790

OBSERVED GRAVITY

NA

SURVEYED BY

GPS- Daishsat, AUSPOS with multiple connections over two days. Expected accuracy better than 0.01m for x, y, z observations.

MISCELLANEOUS DETAILS

The GPS base was located within a paddock on a hill to the north of school. The GPS base was dismantled after the completion of the survey. No photo of this base is available