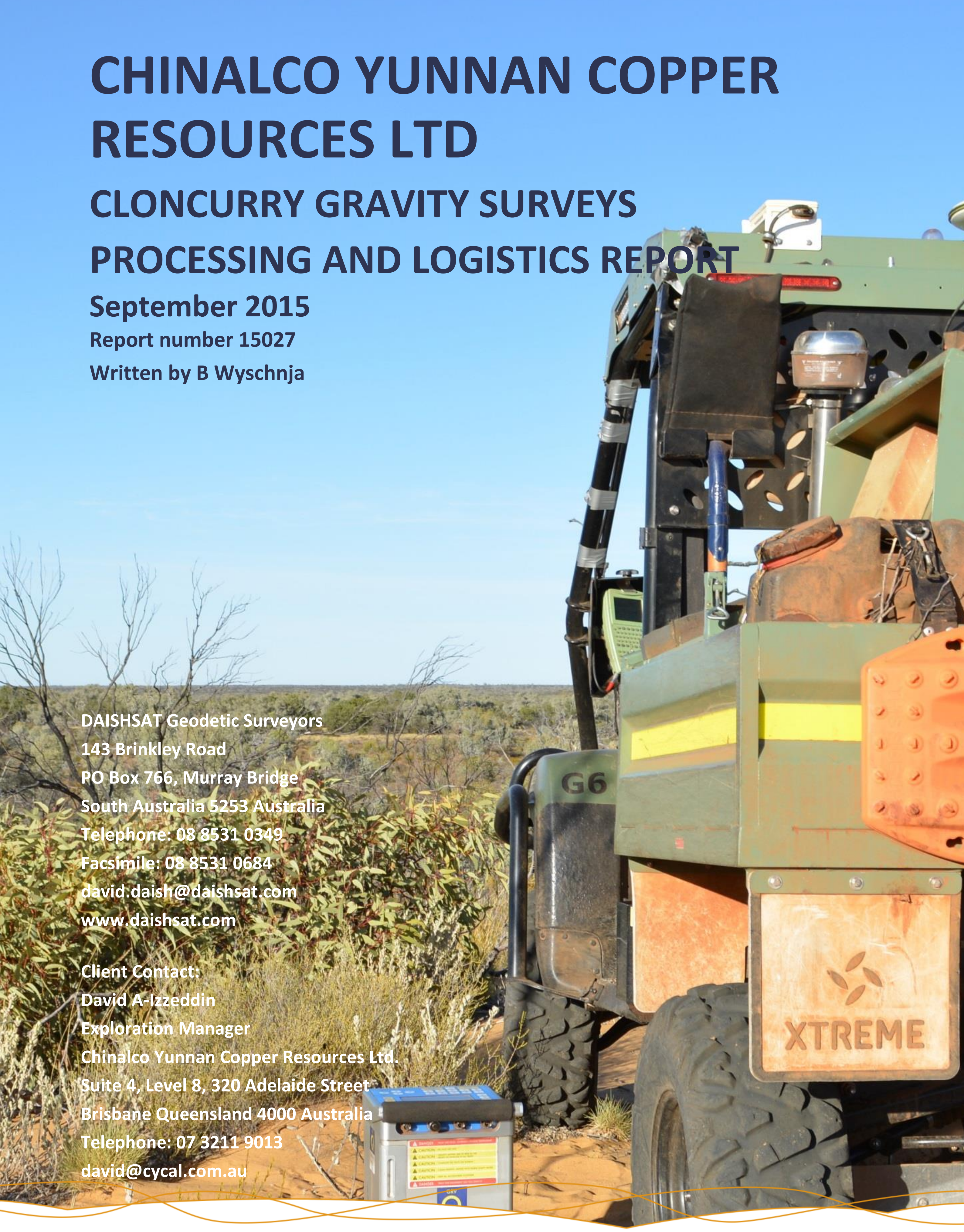
CHINALCO YUNNAN COPPER RESOURCES LTD

CLONCURRY GRAVITY SURVEYS PROCESSING AND LOGISTICS REPORT

September 2015

Report number 15027

Written by B Wyschnja



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DAISHSAT GEODETIC SURVEYORS

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1. INTRODUCTION

Daishsat Geodetic Surveyors carried out a precision GPS-Gravity survey during September 2015 for Chinalco Yunnan Copper Resources Ltd. with a total of 275 new gravity stations surveyed in the Cloncurry Region of Queensland.

Scintrex CG-5 Autograv gravimeters were used for gravity data acquisition and base station control; and Leica GX1230GG differential GPS receivers were used for gravity station positional acquisition. Gravity data were reduced using standard corrections and reductions applied to produce Geoidal Bouguer Anomalies on the ISOGAL84 gravity datum. Horizontal positions were provided in Map Grid of Australia 1994 (MGA94) Zone 54 south eastings and northings; whilst vertical positions were provided in Australian Height Datum (AHD) orthometric elevations. Gravity and GPS data were acquired using Daishsat ATV and foot borne methods.

2. SURVEY OVERVIEW

The Cloncurry survey consisted of two project areas located in the Cloncurry region of Queensland. The Elaine South grid was situated 56km west of Cloncurry along the Barkly Highway, and the Moonlight grid was situated 45km northwest of Cloncurry along the Burke Developmental Road.

The Elaine South grid consisted of 216 planned stations set out on a 250m x 250m square grid surrounding a Government Reserve exclusion area, extending out to a 500m x 500m diagonally offset grid. The terrain consisted of rocky hills and steep gullies covered in thick Spinifex. Due to poor access and the extremely rough terrain, only 162 stations were acquired on foot using an ATV to move around the grid. Many stations were offset from their planned locations while still maintaining adequate coverage.

The Moonlight grid consisted of 113 planned stations set out on a central 250m x 250m square grid surrounded by a 500m x 500m diagonally offset grid. The terrain was mostly flat, with thick turpentine scrub and numerous deep drainage channels. All 113 stations were acquired using two ATV’s.

FIGURE 1 shows the location of the survey grids, APPENDIX A contains station location plots, and specifications for the survey are contained in APPENDIX C.

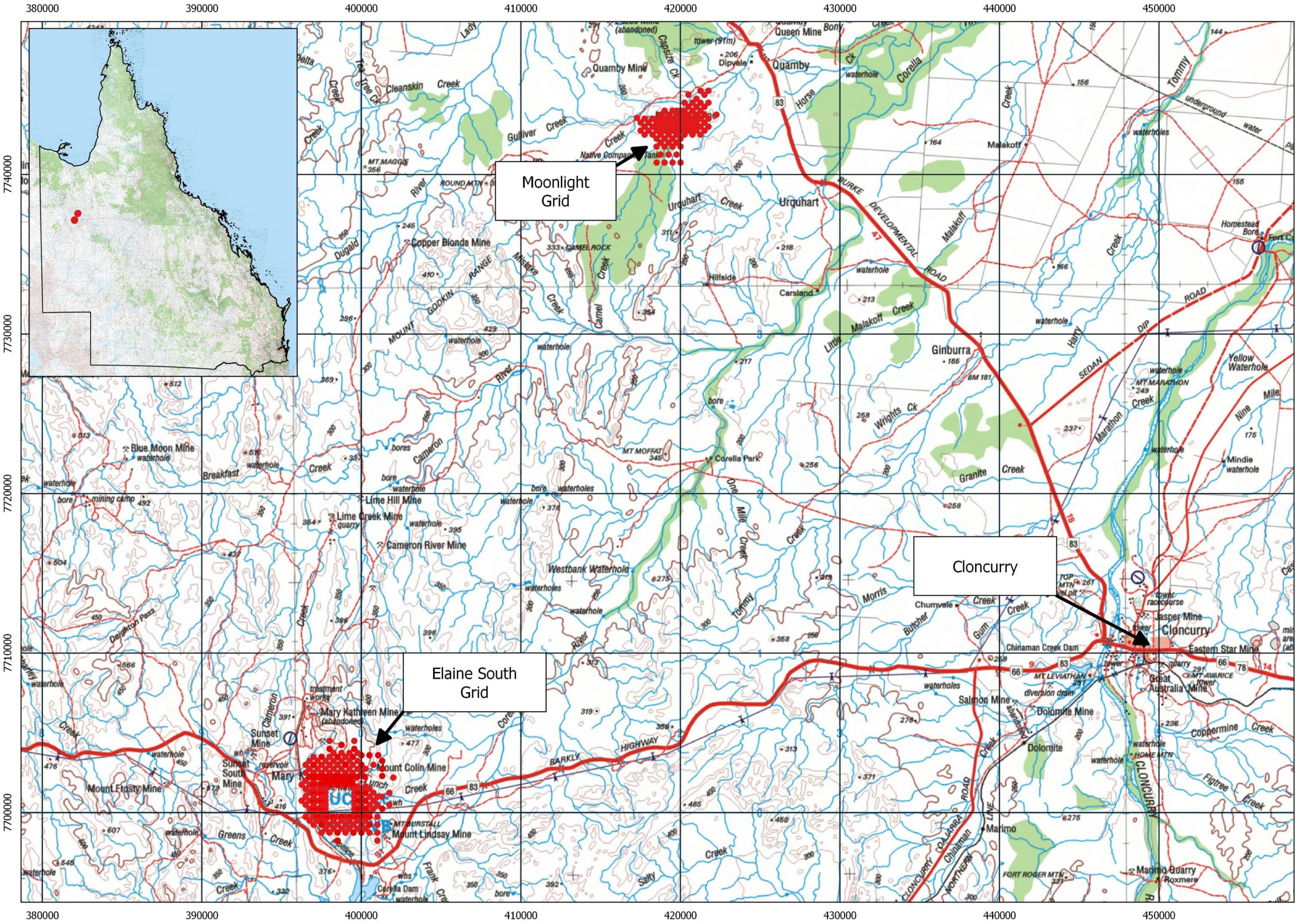


FIGURE 1 – SURVEY LOCATION

3. PERSONNEL AND EQUIPMENT

3.1 Personnel

Gravity surveying was supervised by two of Daishsat's most experienced field surveyors – Peter Rose and Ben Wyschnja – who were responsible for daily management of the job and for nightly data processing to ensure quality and integrity.

Final data reduction, image processing and inspection were performed by the company geophysicist, Grant Coopes.

3.2 Survey equipment

Surveying equipment utilised on this survey included:

- Scintrex CG-5 Gravity meters
- Leica System GX1230GG dual frequency DGPS receivers
- Garmin vehicle-mounted GPS receivers for navigation
- Notebooks for data processing and backup
- Various chargers, surveying equipment and batteries

3.3 Vehicles

Toyota Landcruiser 4WD vehicles were used for transport to and from site and heavily customised John-Deere Gator 4WD all-terrain vehicles (ATV's) were used to acquire gravity stations.

To maintain the high Daishsat safety record, the Landcruiser's were custom fitted with a range of safety equipment including:

- Omnitrack GPS tracking / communications system
- Dual fuel tanks
- Spare tyres, tubes and tyre repair kit
- Satellite phone and UHF Radio
- Self-recovery equipment including winch, snatch straps and a set of MAXTRAX
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

The Daishsat ATV's used were equipped with the following survey and safety equipment:

- Omnitrack GPS tracking / communications system
- 10L jerry can of spare fuel
- Spare tyres, tubes and tyre repair kit
- Satellite phone and UHF Radio
- Personal First Aid Kit
- Self-recovery equipment including winch, snatch straps and a set of MAXTRAX
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

3.4 Accommodation

The crew were accommodated at the Discovery Park in Cloncurry for the duration of the survey. Each grid was approximately 45 minutes by road from Cloncurry.

3.5 Communications

The survey crews were equipped with hand-held Iridium satellite phones, vehicle-mounted UHF radios and the "Omnitrack" satellite-based tracking and communication system were used on all vehicles to enable asset monitoring via a web interface. Scheduled communication and data exchanges with the Perth and Murray Bridge offices were ongoing for the duration of the job.

Photos 1-2 - Daishsat ATV and CG5 Gravity Meter

4. GPS SURVEYING AND PROCESSING

4.1 SET OUT OF THE GRID

This was done concurrently with the gravity data acquisition using Leica GX1230 dual-frequency GPS units operating in autonomous mode. Where possible, the readings were taken as close to the ideal coordinates as possible using a Garmin GPS to navigate the ATV; or the GX1230 when walking. Raw kinematic GPS data were logged by a Leica GX1230 receiver mounted inside the ATV cabins or carried in a backpack when walking, with the GPS antenna located on the vehicles roofs or fitted to a 2 metre surveying pole. Repeat stations were placed throughout the surveys to monitor any variations in positional accuracy. Repeats are placed with a washer tied with flagging and marked with the station number for future identification.

4.2 SURVEY DATUM AND CONTROL

All gravity surveying was carried out using the GPS' native horizontal and vertical datum – World Geodetic System 1984 (WGS84). Horizontal positions for each gravity station were provided in both Geocentric Datum of Australia (GDA94) latitude and longitude and Map Grid of Australia 1994 (MGA94) easting's and northing's; whilst vertical positions for each gravity reading were provided in Australian Height Datum (AHD) orthometric elevations.

Two new primary GPS reference base stations were used during the survey for survey positional control. Base 1532 was established on the southern side of the Government Reserve at the Elaine South grid; and Base 1464 was established to the north of the Moonlight grid.

AUSPOS Rapid Ephemeris Solution positions were initially adopted for Bases 1532 and 1464; calculated from the logged static GPS data from the first day of surveying. These initial positions were used for all GPS data processed from these bases as AUSPOS Final Ephemeris Solutions take up to two weeks to become available. Once the final solutions became available they were compared to the initial positions and the results showed differences of X = 0.002m, Y = 0.001m, and Z = -0.007m for Base 1532; and
X = 0.004m, Y = 0.004m, and Z = -0.002m for Base 1464. The preliminary data from each base were shifted by these differences and re-processed to produce final data.

Final co-ordinates for primary GPS reference bases are calculated using three days' worth of static GPS data connected to ITRF stations using Geoscience Australia's online GPS processing system, AUSPOS. These first-order bases show final deviations of better than 5mm obtained for x, y and z, for all occupations. For more information on this system, please visit http://www.ga.gov.au/earth-monitoring/geodesy/auspos-online-gps-processing-service.html. Details of Bases 1532 and 1464 can be found in Appendix D.

4.3 Processing of the Position and Level Data

Raw kinematic GPS data were logged at 5 second intervals on the Leica GX1230 GPS receiver mounted inside the ATV cabins or carried in the backpack, and static GPS data was logged at 5 second intervals on a Leica GX1230 GPS receiver set up at the GPS reference base station. At the end of each day all raw GPS data was downloaded onto a laptop, compressed and transferred to the Daishsat FTP site.

The data was then downloaded by Daishsat's Operations Manager and Surveyor, Harley Jones, who used Waypoint's GrafNav post-processing software to process the logged static data from the GPS reference base station and the logged kinematic data from the rover's to produce highly accurate horizontal and vertical positions for each gravity station location.

GrafNav is normally used for kinematic data which it is extremely well suited for. It can also process single static baselines. Receiver types can be mixed and matched via the use of a common format. This component of Waypoint was used for processing the kinematic data acquired each day.

GrafNav has been under continuous development since its original inception by Waypoint in 1992. The core of its robust processing engine is its carrier phase kinematic (CPK) Kalman filter. Some of the major advantages of Waypoint's kernel are:

- Fast processing - The GrafNav kernel is one of the fastest on the market.
- Robust Kalman filter - From experience with processing GPS data from fast jets and NASA sounding rockets, the processing kernel has become extremely robust. Efforts have been made to account for all of the various data error possibilities given the different types of GPS receivers that GrafNav/GrafNet can handle.
- Reliable OTF - Waypoint's on-the-fly (OTF) algorithm, called Kinematic Ambiguity Resolution (KAR), has had years of development and stresses reliability. Variations are implemented for both single and dual frequencies, and numerous options are available to control this powerful feature.
- Accurate Static Processing - Three modes of static processing are implemented in the processing kernel. Fixed static is the most accurate. A quick static solution is also available as an alternative, while the float and iono-free float solution is useful for long baselines.
- Dual Frequency - Full dual frequency support comes with GrafNav / GrafNet. For ambiguity resolution, this entails wide/narrow lane solutions for KAR, fixed static and quick static. Ionospheric processing is very important with the peak of the ionosphere's cycle occurring in 2000. The GrafNav kernel implements two ionospheric processing modes including the iono-free and relative models. The relative model is especially useful for airborne applications where initialization is near the base station, and this method is much less susceptible to L2 phase cycle slips.
- Forward and Reverse - Processing can be performed in both the forward and reverse directions. Both GrafNav and GrafNet also have the ability to combine these two solutions to obtain a globally optimum one.
- Velocity Determination - Since the GrafNav kernel includes the L1 Doppler measurement in its Kalman filter, velocity determination is very accurate. In addition to this, a considerable amount of code has been added specifically for the detection and removal of Doppler errors.
- Long Baseline - Because precise ephemeris and dual frequency processing is supported; long baselines accuracies can be as good as 0.1 PPM.

For more information about Waypoint processing software, and in particular, GrafNav, please visit http://www.novatel.com/products/software/.

GrafNav was used to output transformations from the GPS-derived WGS84 coordinates to MGA94 coordinates for each gravity station using a zone 54 South UTM projection. For all practicable purposes, the WGS84 geodetic coordinates are equivalent to the Geodetic Datum of Australia 1994 (GDA94) geodetic coordinates, so no transformation is necessary. GrafNav was also used to output Geodetic Reference System 1980 (GRS80) ellipsoidal elevations for each gravity station.

The processed GPS data was then matched to the time-stamp for each gravity station reading and checked for quality of the solutions. Once this was done the GPS data was emailed to Grant Coopes to be used for the gravity processing.

Geoscience Australia's online AUSGeoid09 batch processing tool (http://www.ga.gov.au/ausgeoid/) was used to calculate the geoid–ellipsoid separation, or N value (Figure 2). To obtain the Australian Height Datum (AHD) elevations, the calculated N value was subtracted from the GPS-derived WGS84 ellipsoidal elevation for each gravity station.

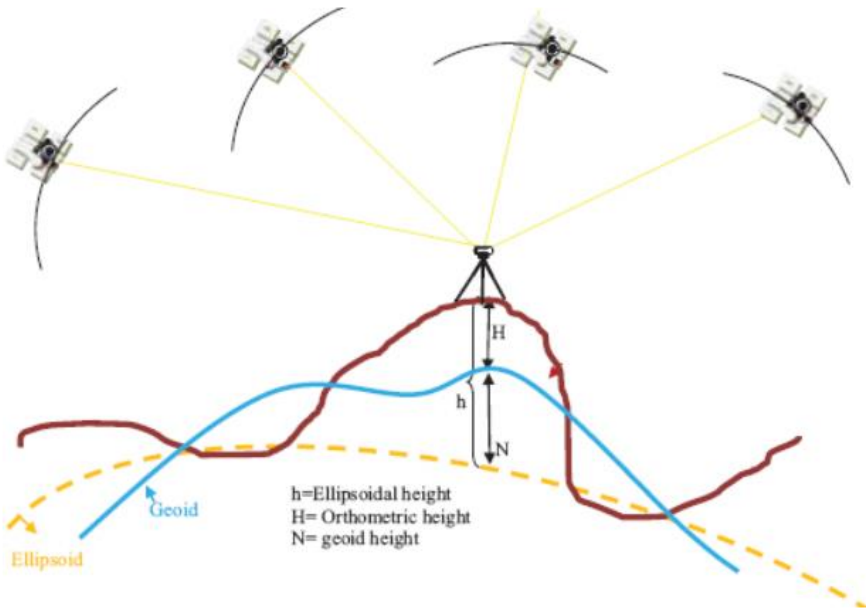


FIGURE 2 – GEOID-ELLIPSOID SEPARATION

5. GRAVITY ACQUISITION AND PROCESSING

5.1 GRAVITY DATA ACQUISITION

Two Scintrex CG-5 Autograv gravimeters were used for field acquisition. Gravity station point numbering was incremental along lines from east to west, starting from station 1001 to 1153 for the Elaine South grid; and station 2001 to 2113 for the Moonlight grid. These pre-determined station numbers were printed on the field maps and loaded onto the rover GPS units allowing the crews to navigate to them.

When taking a field reading the CG-5 meter was carefully placed on its tripod and levelled, restricting the vertical and horizontal levels to 5 arc seconds. Once the meter was level, two gravity observations of 20-second stacking time were read and recorded. The instrument was monitored for any seismic or instrumental noise and the X/Y tilts, temperature and tolerance between readings was monitored. The tolerance between readings was set at 0.030 of a dial reading; and any readings falling outside of this tolerance were re-read. The CG-5 automatically recorded the station number, reading time and raw gravity reading which were stored in the internal flash memory. Field readings were also manually recorded by the field crews in Daishsat carbon-copy gravity field books.

During the survey day the field crew's monitored internal repeat gravity stations as well as the drift closure at the end of the day. If the meter received a bump or knock the previous station was revisited in order to detect if a tare had occurred.

5.2 GRAVITY BASE STATIONS

Two new primary gravity base stations were established coincident with GPS Bases 1532 and 1464. Both of these bases were tied to AFGN Base 1994910155 located at the Cloncurry Airport. Base 1532 was tied using three A-B-B-A ties with two meters over three days (04/09/2015 – 06/09/2015); and Base 1464 was tied with two meters using one A-B-B-A tie (08/09/2015) and one A-B-A tie (09/09/2015).

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 120 seconds to ensure accuracy. Observations were repeated until the readings repeated to 0.010 of a dial reading or less.

5.3 GRAVITY DATA PROCESSING

At the end of each day the raw gravity data was downloaded from the CG-5 instruments onto a laptop where preliminary quality control was carried out. Any erroneous station numbers were corrected and readings that fell outside of the tolerances were removed. Once this was done Daishsat's in-house software was used to average the two 20-second readings for each gravity station, remove the Scintrex Earth Tide Correction and assign each gravity station reading a MGA94 easting and northing co-ordinate and a WGS84 ellipsoidal elevation. Geosoft GRAVRED software was then used to perform gravity reductions to produce a set of observed gravity values.

The following corrections were applied to the raw gravity data using Geosoft's GRAVRED software:

Instrument Scale Factor (SF): This correction is applied to correct each raw gravity reading (in dial units) to a relative gravity unit value based on the meter calibration.

$$r_{SF} = r_d \times SF$$

Where:

R_{SF} = scale factor corrected reading in milliGals

r_d = raw gravity meter reading in dial units

SF = instrument scale factor (dial units/milliGal)

Earth Tide Correction (ETC): This correction is applied to correct for background variations in the Earth's gravitational field due to changes in the relative position of the moon and sun. The Scintrex calculated ETC was removed and a new ETC was calculated using Geosoft Formulae (see Appendix E).

$$r_{ETC} = r_{SF} + ETC$$

Where:

r_{ETC} Earth Tide Corrected reading in milliGals

r_{SF} Scale Factor Corrected reading in milliGals

ETC Earth Tide Correction (ETC) in milliGals

Instrument Drift Correction (IDC): This correction is applied to compensate for the daily changes in the gravity meter due to mechanical stresses and strains encountered during surveying. The extension and contraction of the gravity meter spring with slight variations in temperature (obeying Hooke's Law) are the major cause of drift. The drift is assumed to be linear and is calculated by measuring the difference between the last and first base readings.

$$ID = \frac{r_{B2} - r_{B1}}{t_{B2} - t_{B1}}$$

Where:

ID Instrument Drift in milliGals/hour

r_{B2} 2nd Gravity Base reading in milliGals

r_{B1} 1st Gravity Base reading in milliGals

t_{B2} Time of 2nd Gravity Base reading

t_{B2} Time of 1st Gravity Base reading

Observed Gravity (G_{OBS}): The preceding corrections are applied to each of the raw gravity readings to calculate the earth's absolute gravitational attraction at each of the field gravity stations. Observed Gravity values were calculated for on the ISOGAL84 gravity datum.

$$G_{BOS} = G_{B1} + (r_{ETC} - r_{B1}) - (t - t_{B1}) \times ID$$

Where:

G_{B1} Gravity Base Observed Gravity in milliGals

r_{ETC} Earth Tide Corrected reading in milliGals

r_{B1} Gravity Base reading in milliGals

t Time of field reading

t_{B1} Time of Gravity Base reading

ID Instrument Drift in milliGals/hour

Once Observed Gravity values were produced, an Excel spreadsheet was used to calculate Infinite Slab Bouguer Anomaly values for each gravity station using the following corrections:

Theoretical Gravity (G_{T67}): As the Earth is not a perfect sphere, with the polar radius being smaller than the equatorial radius, gravity values vary with latitude. This is due to the differences in the distance from the centre of the Earth's mass and differences in centrifugal accelerations at varying latitudes. The theoretical value of gravity was calculated using the 1967 variant of the International Gravity Formula and used to latitude correct the observed gravity.

$$G_{T67} = 978031.8456 \times (1 + 0.005278895 \times \sin^2\phi + 0.000023462 \times \sin^4\phi)$$

Where:

ϕ GDA94 latitude in decimal degrees

Geoidal Free-Air Correction (GFAC): 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.

$$GFAC = (0.3087691 - 0.0004398 \times \sin^2\phi) \times h_{AHD} - 0.0000001442 \times h_{AHD}^2$$

Where:

h_{AHD} Height of the gravity meter above the Geoid (Ausgeoid09) in meters

Geoidal Bouguer Correction (GBC): This correction accounts for the attraction of material between the station and datum plane that is ignored in the free-air calculation. A value of 2.67 t/m^3 was used in the correction to represent solid earth.

$$GBC = 0.04191 \times \rho \times h_{AHD}$$

Where:

P Earth density in gm/cc

h_{AHD} Height of the gravity meter above the Geoid (Ausgeoid09) in meters

Geoidal Free Air Anomaly (GFAA): This is obtained by applying the Geoidal Free Air Correction (GFAC) to the Observed Gravity reading.

$$FAA = G_{OBSG} - G_{T67} + GFAC$$

Geoidal Bouguer Anomaly (GBA): This is obtained when all the preceding reductions or corrections have been applied to the observed gravity reading.

$$GBA = G_{OBSG} - G_{T67} + GFAC - GBC$$

5.4 Gravity Meter Calibrations and Scale Factors

The gravity meters used on the survey had previously been calibrated on the South Australian gravity calibration range. Derived scale factors from these calibrations are shown in Table 1 below:

Gravity Meters			
Meter	Model	Serial Number	Scale Factor
F	Scintrex CG-5	061240224	0.999675
Q	Scintrex CG-5	080640417	1.000026

Table 1: Gravity Meter Information

5.5 Quality Control of the Processed Gravity Data

Following the reduction of the gravity data to the Geoidal Bouguer Anomaly, quality control was carried out to check the repeatability of the positional and gravity observations.

The elevation and gravity data was gridded at 1/5th the line spacing using ChrisDBF to produce ERMapper compatible grid files of the AHD Elevation and Geoidal Bouguer Anomaly. A Remove Regional filter (using a First Order Polynomial) was applied to the Geoidal Bouguer Anomaly grid to produce a Residual Anomaly grid; and a First Vertical Derivative filter was also applied to the Geoidal Bouguer Anomaly grid. These grids were imaged using Oasis Montaj where they were checked for any anomalous points. A plot of the acquired gravity stations was regularly monitored to make sure no stations were missed. Station Location plots for each survey area are contained in Appendix A.

Photo 3 – Field Photo

6. RESULTS

Raw and processed GPS and gravity data are contained on CD-ROM as APPENDIX E.
A hardcopy plot of station locations and gridded data images are contained in APPENDIX A.

6.1 Stations Surveyed and Survey Progress

In total 275 new gravity stations were acquired during the project and of these, 19 were revisited for survey quality control and 8 of the existing survey stations were revisited to make sure the newly acquired data merged well with the existing data. The crews were able to average a reasonable production rate of 45 stations per day on the Elaine South grid (working as one walking crew), and 65 stations per crew on the Moonlight grid (using two ATV's), completing the surveys in 6 days. A brief production summary for the survey is shown in Table 2 below.

15027 Cloncurry Surveys	
New Gravity Stations Acquired	**275**
New Gravity Station Repeats	**19**
% New Gravity Station Repeats	**6.9%**
Exisitng Gravity Station Repeats	**8**
Total Gravity Stations Acquired (Including Repeats)	**302**

Table 2: Production Summary

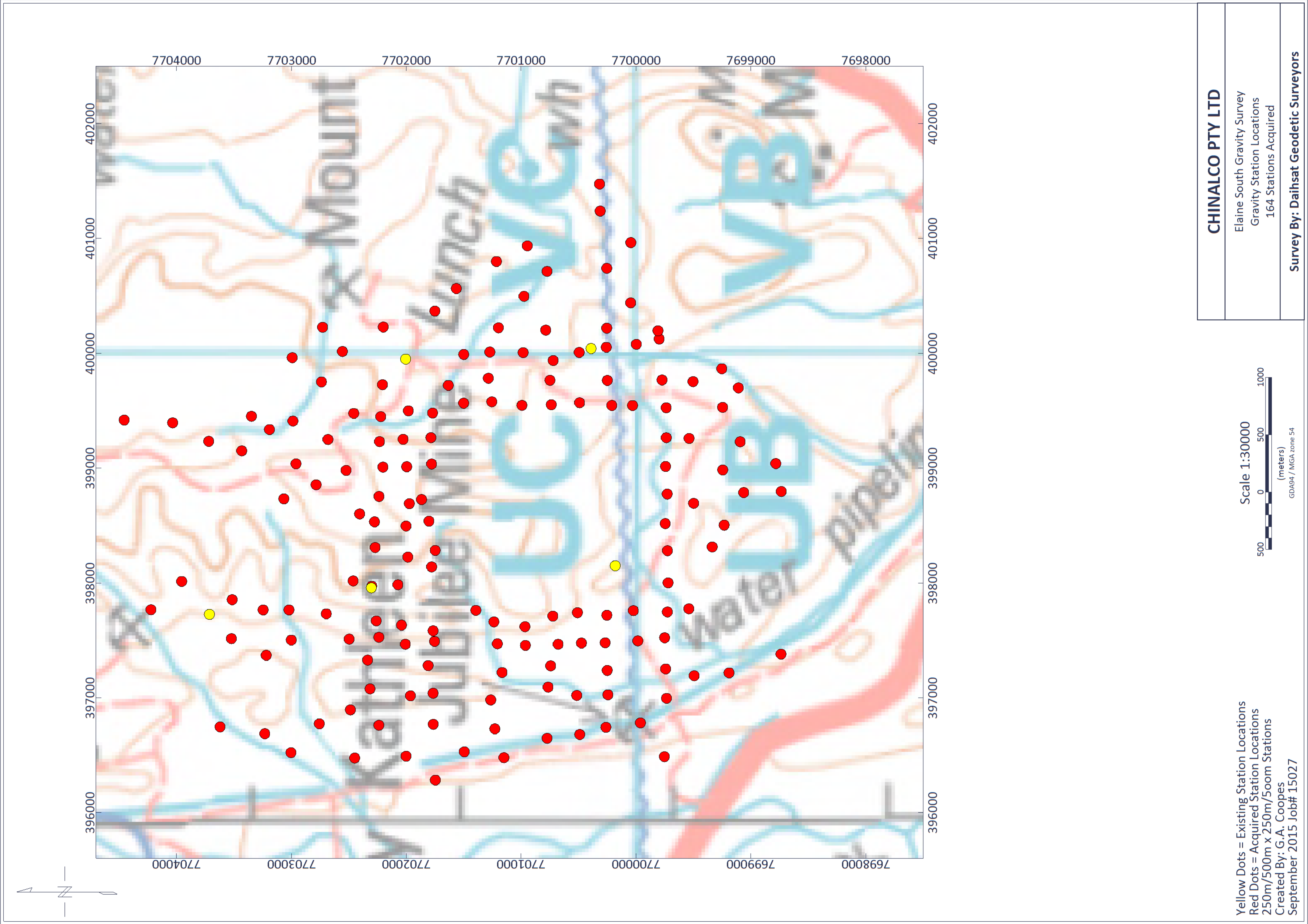
6.2 Data Repeatability

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

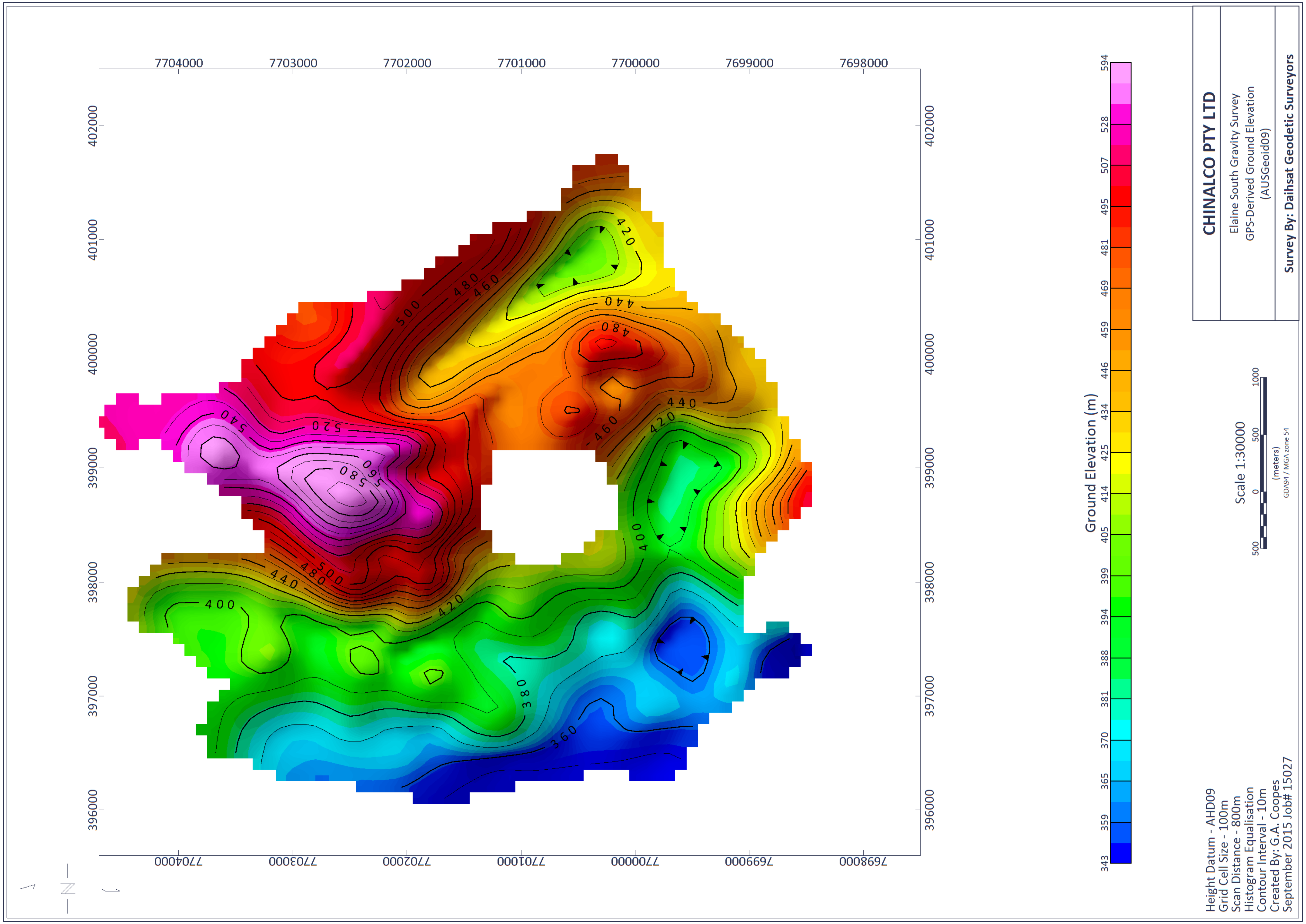
Z position observation: < 0.013 m
Gravity observation: < 0.012 mGal

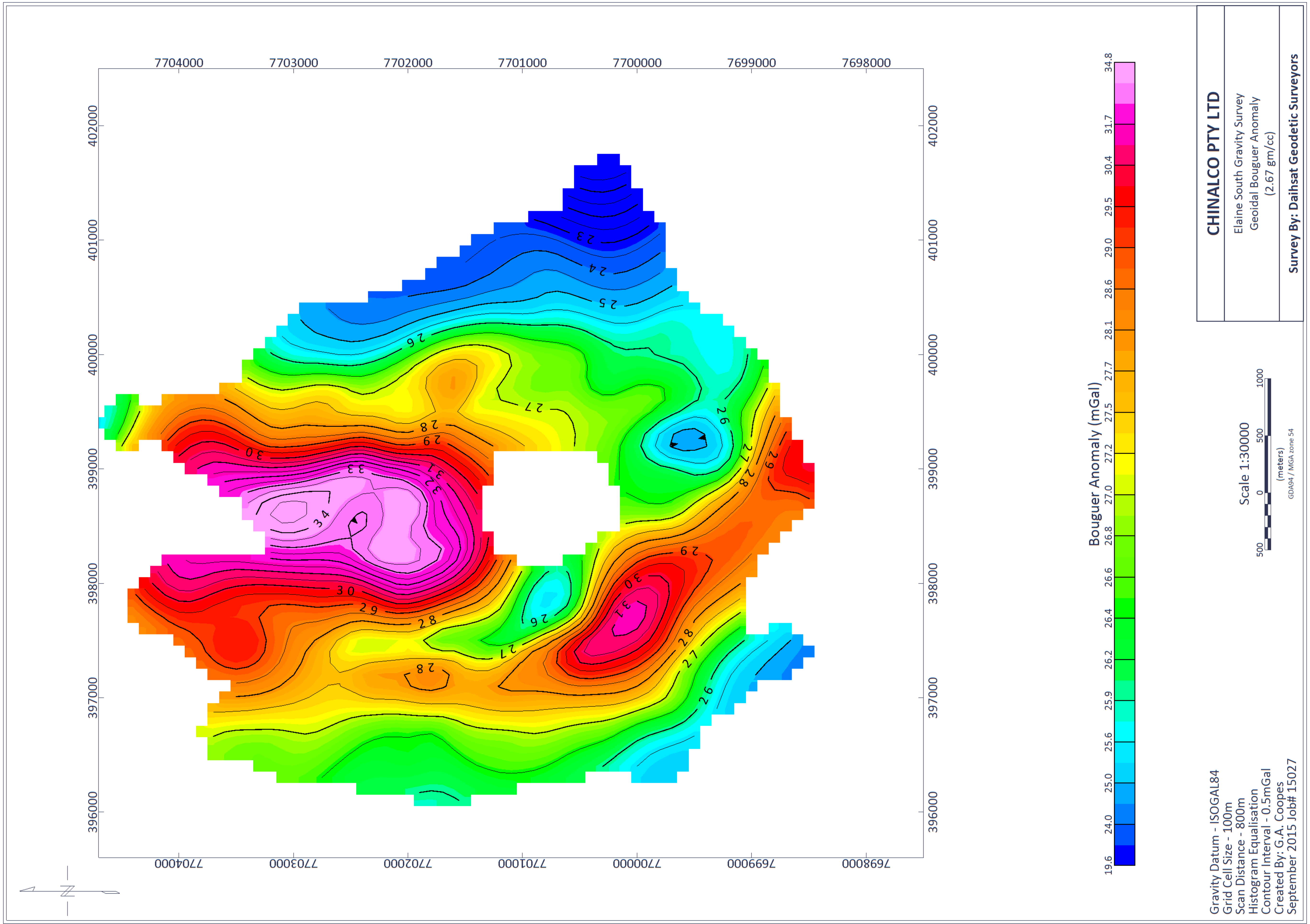
APPENDIX A

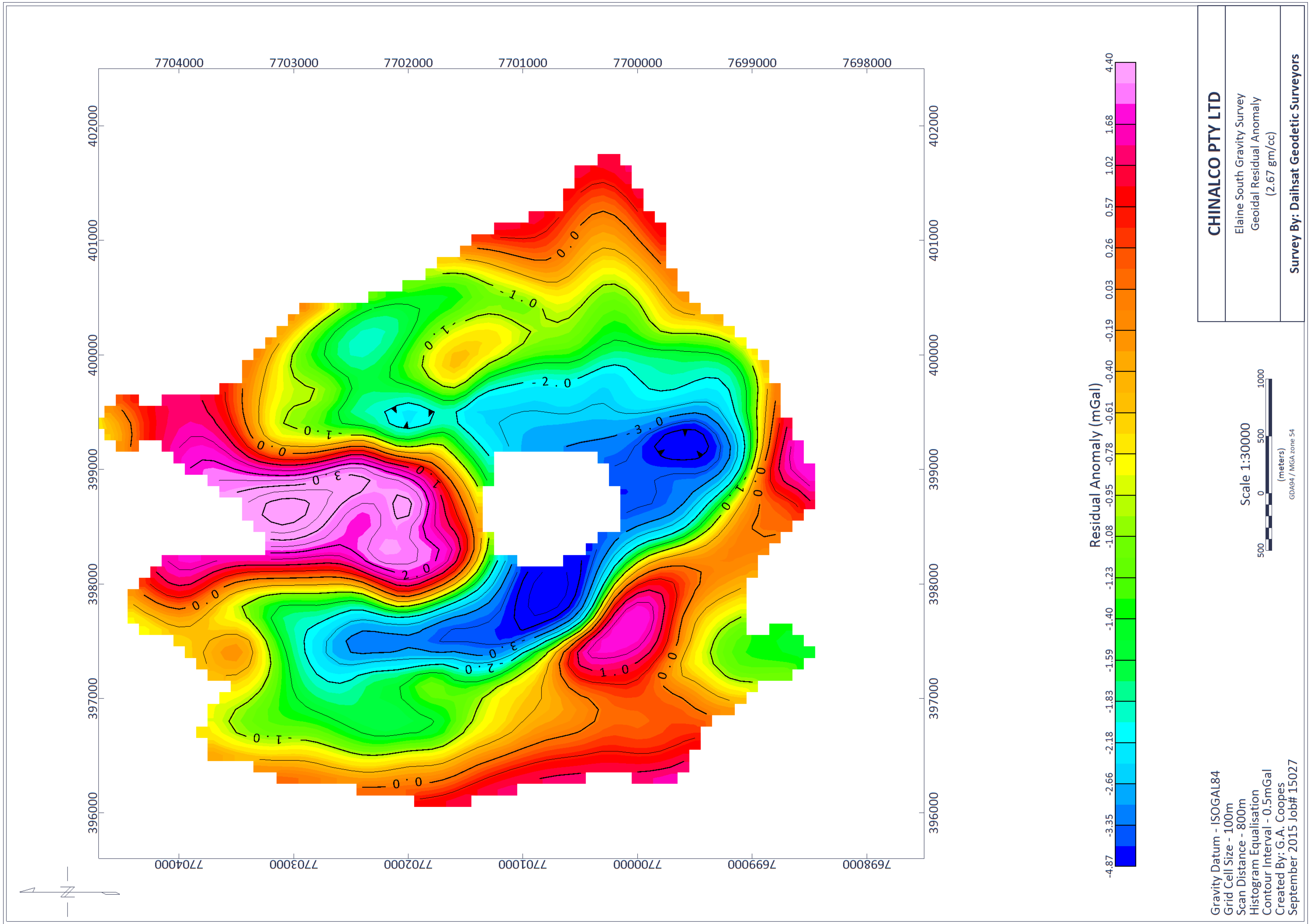
STATION LOCATION PLOTS AND GRIDDED DATA IMAGES



CHINALCO PTY LTD
Elaine South Gravity Survey
Gravity Station Locations
164 Stations Acquired
Survey By: Daihsat Geodetic Surveyors
Scale 1:30000
(meters)
GDA94 / MGA zone 54
Yellow Dots = Existing Station Locations
Red Dots = Acquired Station Locations
250m/500m x 250m/5oom Stations
Created By: G.A. Coopes
September 2015 Job# 15027
7704000
7703000
7702000
7701000
7700000
7699000
7698000
402000
401000
400000
399000
398000
397000
396000


CHINALCO PTY LTD
Elaine South Gravity Survey
GPS-Derived Ground Elevation
(AUSGeoid09)
Survey By: Daihsat Geodetic Surveyors
Ground Elevation (m)
Scale 1:30000
(meters)
GDA94 / MGA zone 54
Height Datum - AHD09
Grid Cell Size - 100m
Scan Distam - 800m
Histogram Equalisation
Contour Interval - 10m
Created By: G.A. Coopes
September 2015 Job# 15027


CHINALCO PTY LTD
Elaine South Gravity Survey
Geoidal Bouguer Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Bouguer Anomaly (mGal)
Scale 1:30000
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Contour Interval - 0.5mGal
Created By: G.A. Coopes
September 2015 Job# 15027


CHINALCO PTY LTD
Elaine South Gravity Survey
Geoidal Residual Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Residual Anomaly (mGal)
4.40
1.68
1.02
0.57
0.26
0.03
-0.19
-0.40
-0.61
-0.78
-0.95
-1.08
-1.23
-1.40
-1.59
-1.83
-2.18
-2.66
-3.35
-4.87
Scale 1:30000
500
0
500
1000
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Contour Interval - 0.5mGal
Created By: G.A. Coopes
September 2015 Job# 15027
7704000
7703000
7702000
7701000
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7699000
7698000
402000
401000
400000
399000
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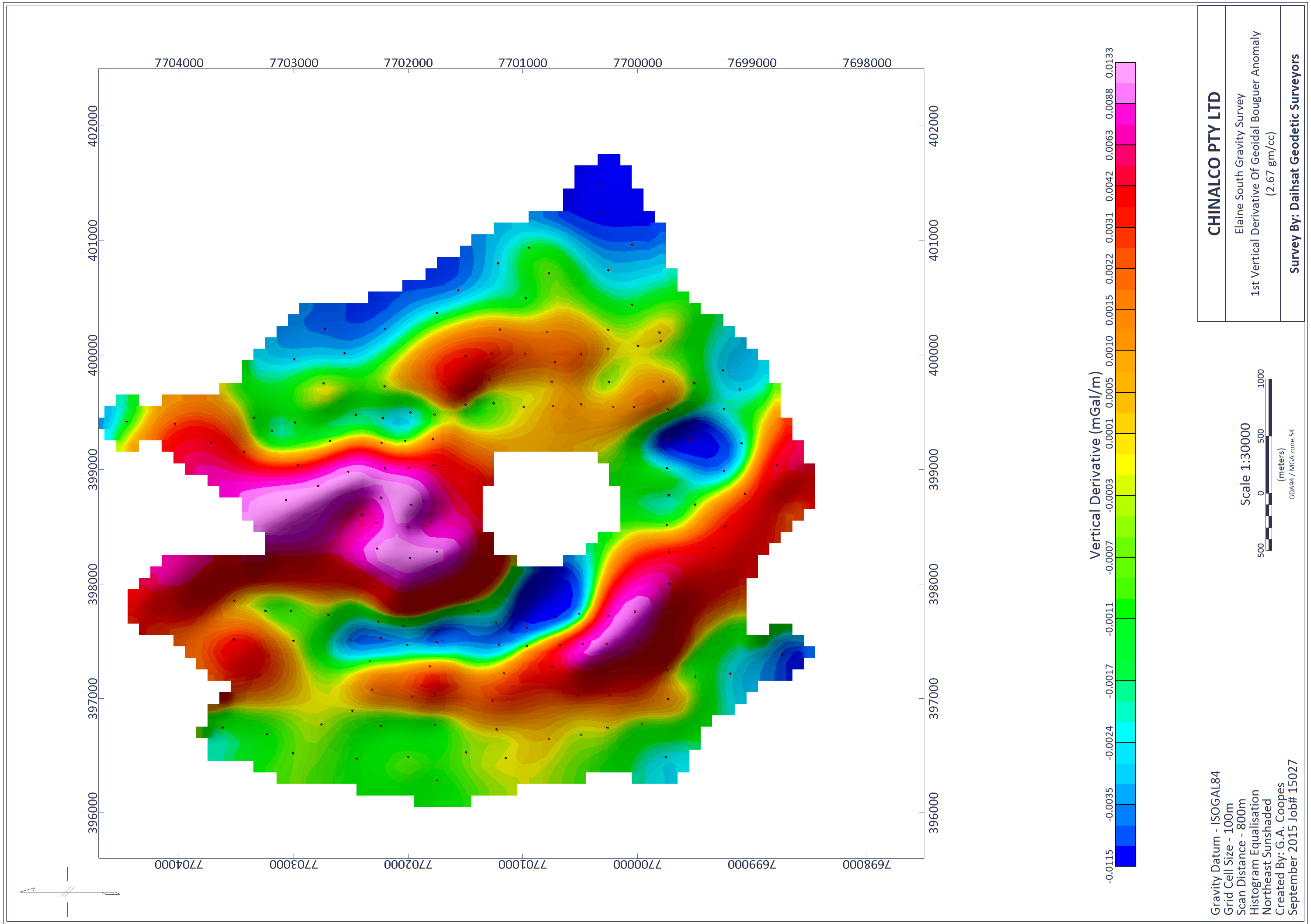

CHINALCO PTY LTD
Elaine South Gravity Survey
1st Vertical Derivative Of Geoidal Bouguer Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Vertical Derivative (mGal/m)
0.0133
0.0088
0.0063
0.0042
0.0031
0.0022
0.0015
0.0010
0.0005
0.0001
-0.0003
-0.0007
-0.0011
-0.0017
-0.0024
-0.0035
-0.0115
Scale 1:30000
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Northeast Sunshaded
Created By: G.A. Coopes
September 2015 Job# 15027
7704000
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402000
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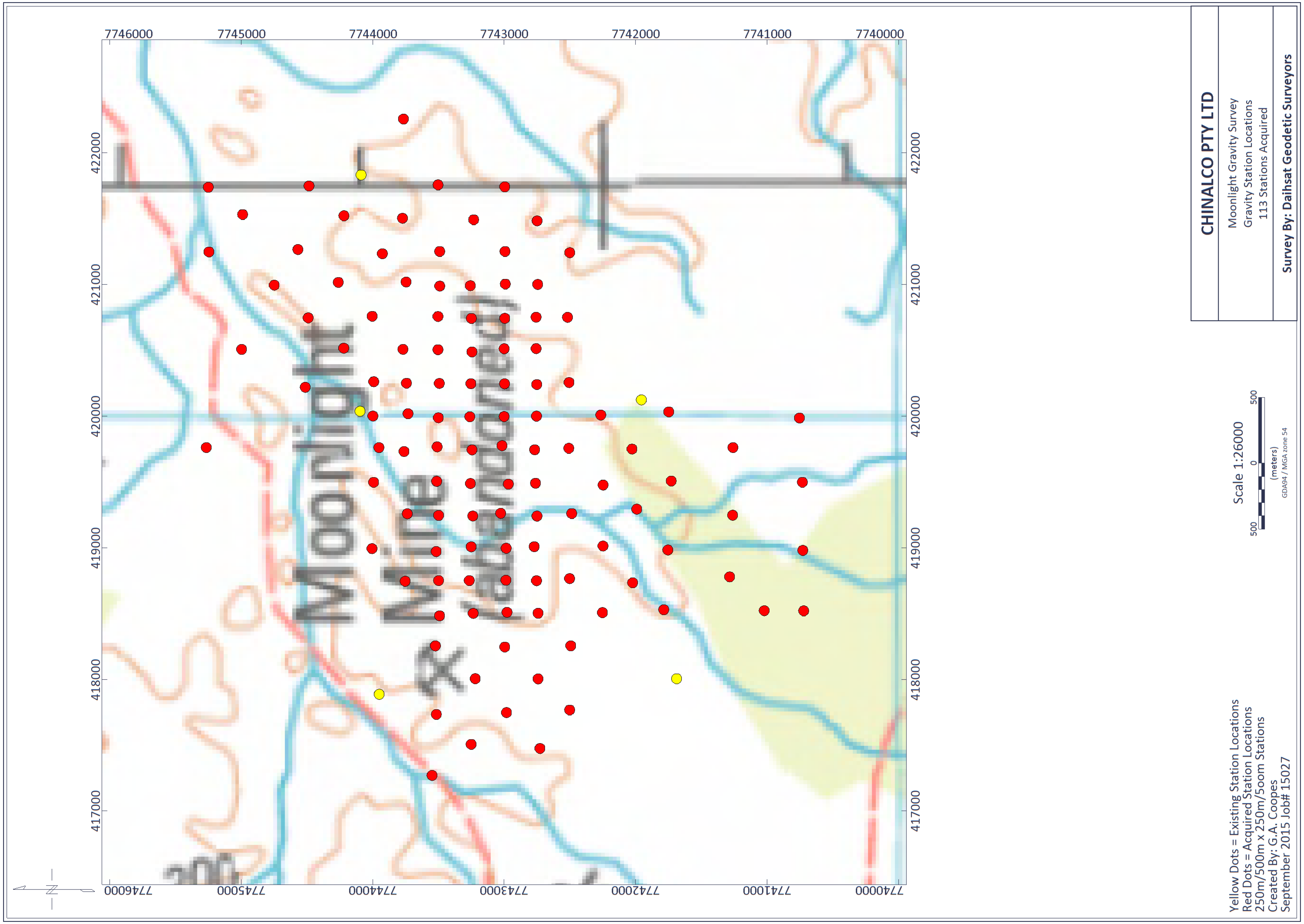
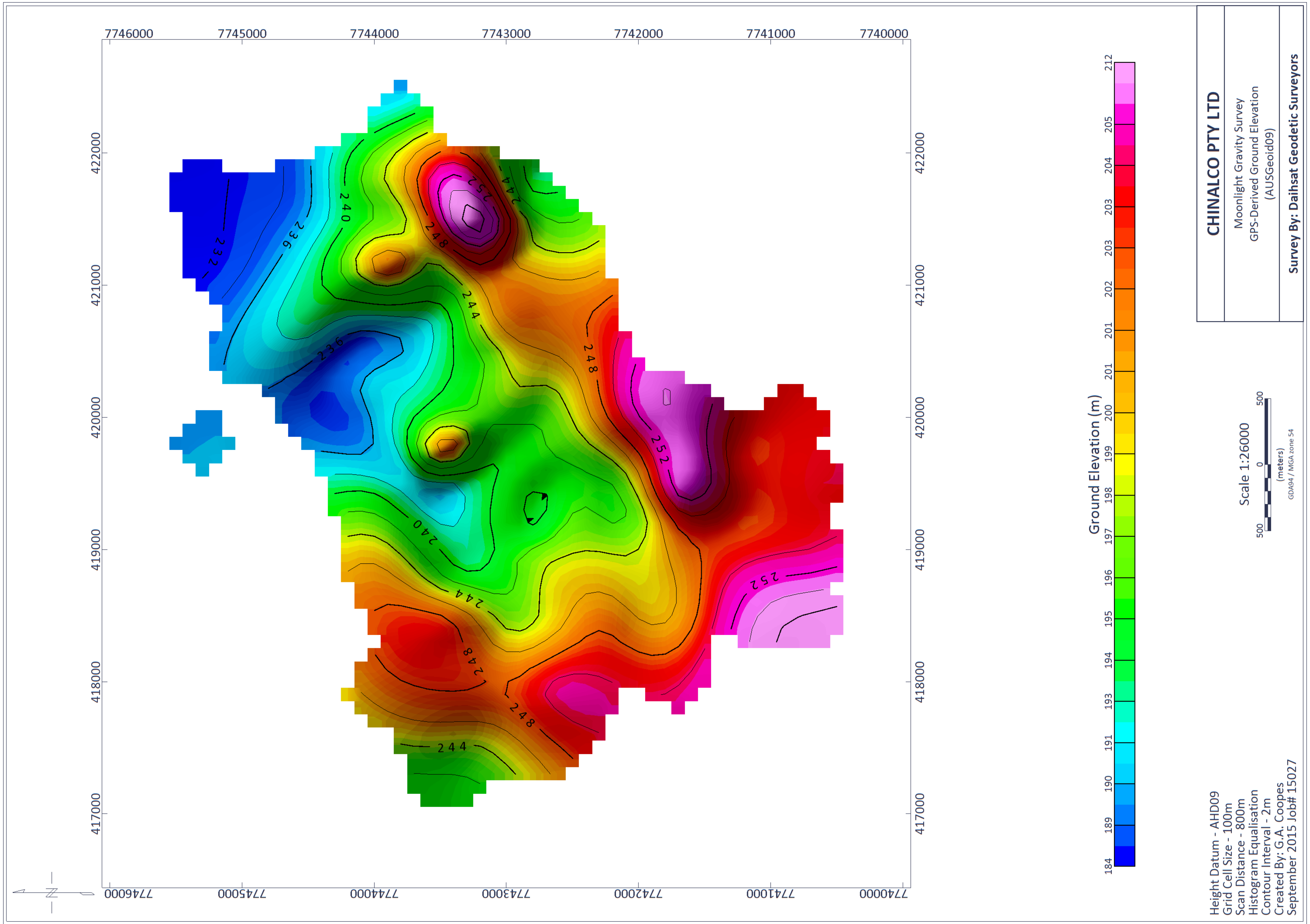
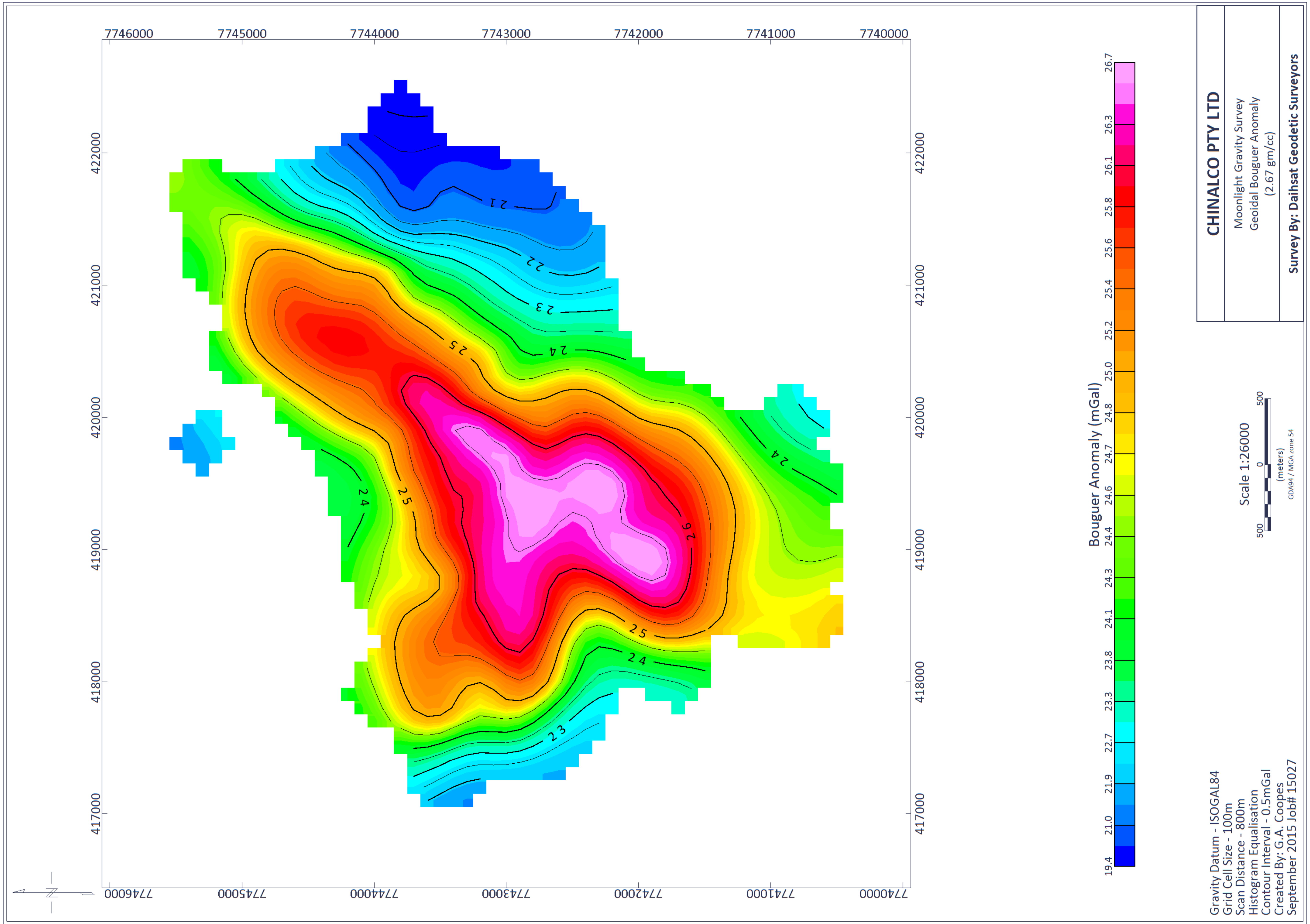
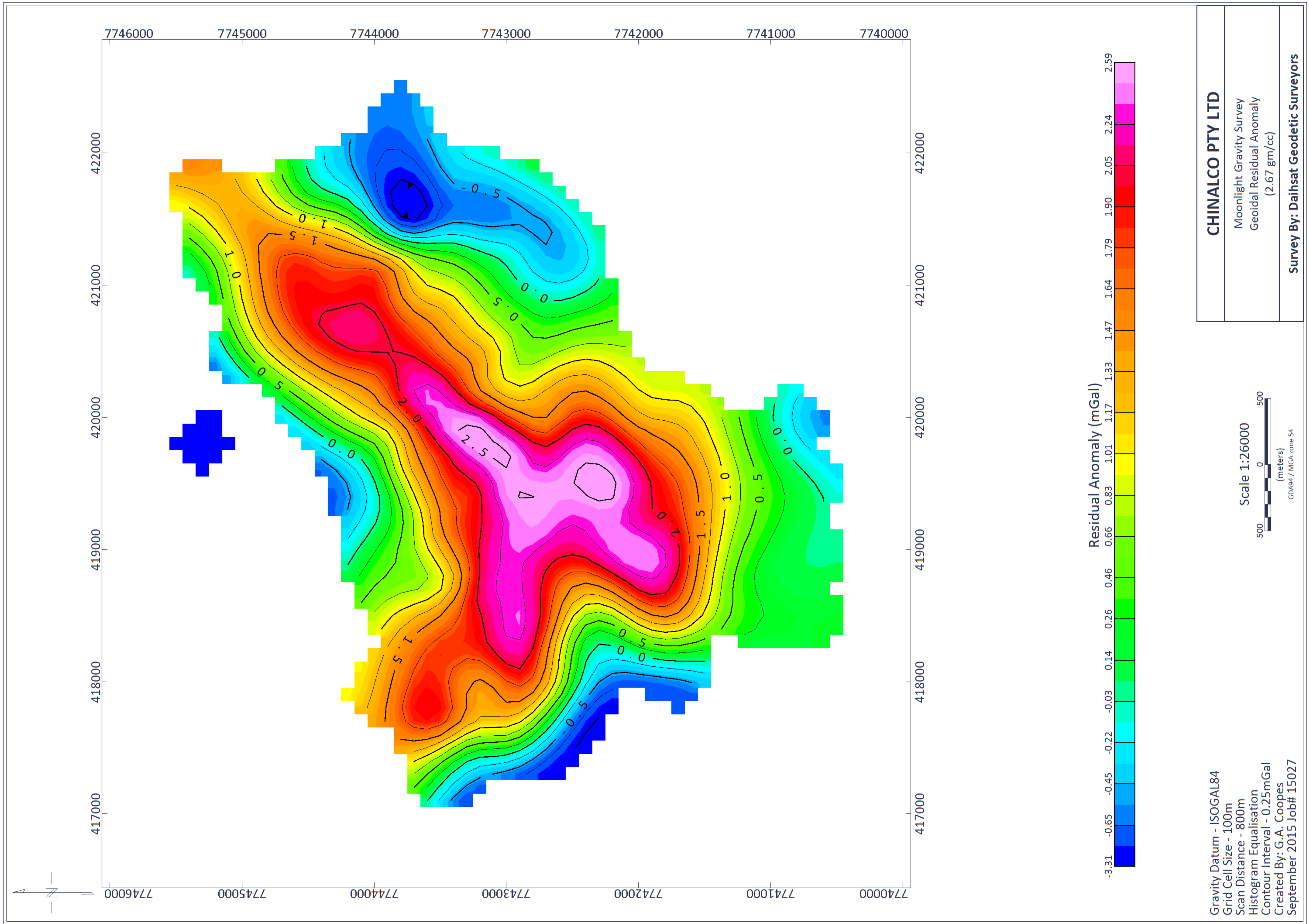

CHINALCO PTY LTD
Moonlight Gravity Survey
Gravity Station Locations
113 Stations Acquired
Survey By: Daihsat Geodetic Surveyors
Scale 1:26000
(meters)
GDA94 / MGA zone 54
Yellow Dots = Existing Station Locations
Red Dots = Acquired Station Locations
250m/500m x 250m/5oom Stations
Created By: G.A. Coopes
September 2015 Job# 15027
Moonlight
Mine
(abandoned)
7746000
7745000
7744000
7743000
7742000
7741000
7740000
422000
421000
420000
419000
418000
417000

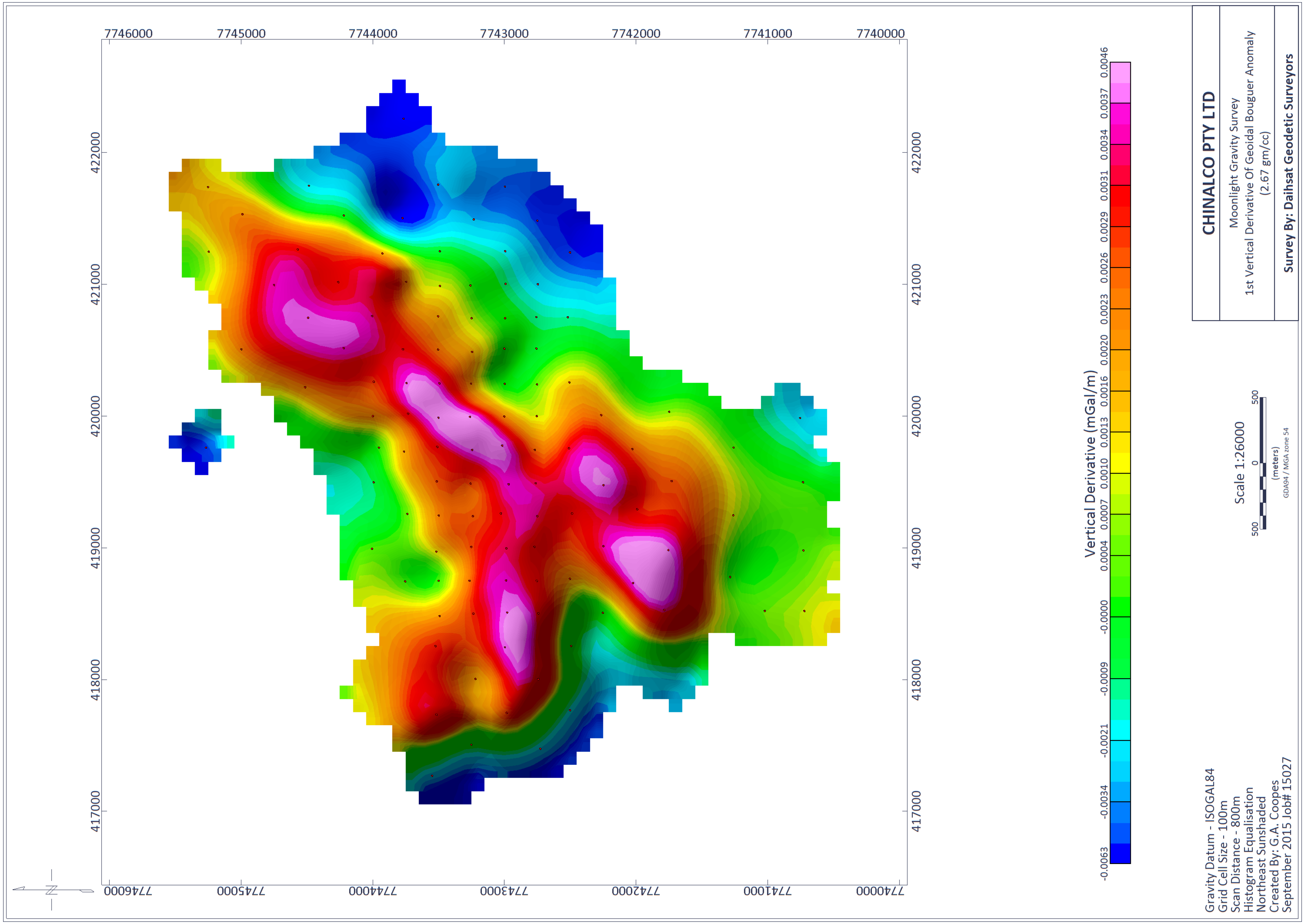

CHINALCO PTY LTD
Moonlight Gravity Survey
GPS-Derived Ground Elevation
(AUSGeoid09)
Survey By: Daihsat Geodetic Surveyors
Ground Elevation (m)
Scale 1:26000
(meters)
GDA94 / MGA zone 54
Height Datum - AHD09
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Contour Interval - 2m
Created By: G.A. Coopes
September 2015 Job# 15027



CHINALCO PTY LTD
Moonlight Gravity Survey
Geoidal Bouguer Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Bouguer Anomaly (mGal)
19.4
21.0
21.9
22.7
23.3
23.8
24.1
24.3
24.4
24.6
24.7
24.8
25.0
25.2
25.4
25.6
25.8
26.1
26.3
26.7
Scale 1:26000
500
0
500
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Contour Interval - 0.5mGal
Created By: G.A. Coopes
September 2015 Job# 15027
7746000
7745000
7744000
7743000
7742000
7741000
7740000
422000
421000
420000
419000
418000
417000
21
22
23
24
25
26



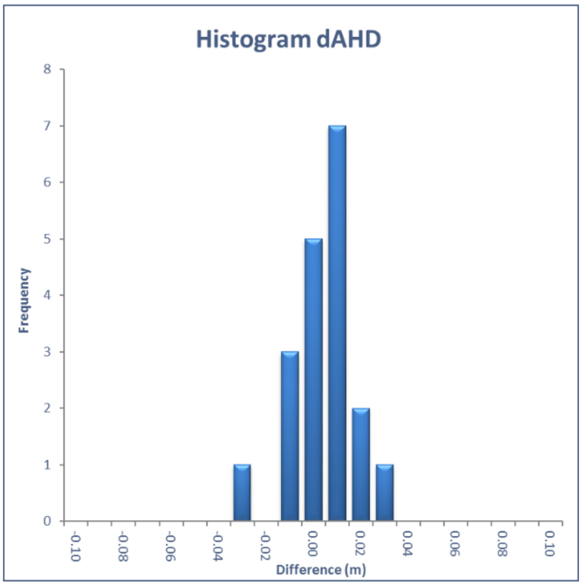
CHINALCO PTY LTD
Moonlight Gravity Survey
Geoidal Residual Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Residual Anomaly (mGal)
Scale 1:26000
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Contour Interval - 0.25mGal
Created By: G.A. Coopes
September 2015 Job# 15027


CHINALCO PTY LTD
Moonlight Gravity Survey
1st Vertical Derivative Of Geoidal Bouguer Anomaly
(2.67 gm/cc)
Survey By: Daihsat Geodetic Surveyors
Vertical Derivative (mGal/m)
Scale 1:26000
(meters)
GDA94 / MGA zone 54
Gravity Datum - ISOGAL84
Grid Cell Size - 100m
Scan Distance - 800m
Histogram Equalisation
Northeast Sunshaded
Created By: G.A. Coopes
September 2015 Job# 15027

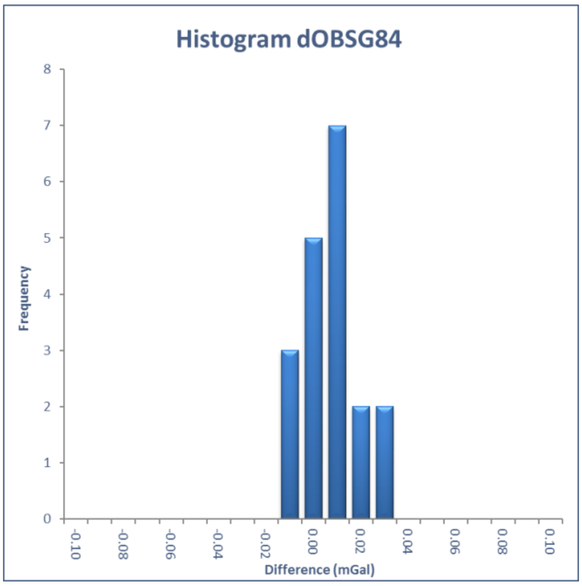
APPENDIX B

REPEAT TABULATION AND ANALYSIS

Repeatability of AHD



Repeatability of OBSG84



Summary Statistics

Summary Statistics		
Statistic	dAHD	dOBSG
Mean	0.001	0.002
Standard Error	0.003	0.003
Median	0.002	0.002
Mode	0.007	0.004
Standard Deviation	0.013	0.012
Sample Variance	0.000	0.000
Kurtosis	1.328	-0.059
Skewness	-0.315	0.674
Range	0.060	0.042
Minimum	-0.032	-0.013
Maximum	0.028	0.029
Sum	0.014	0.046
Count	19	19

APPENDIX C

Survey Information

15027 Cloncurry Surveys	
Client	CHINALCO RESOURCES LTD
Surveyors	PETER ROSE / BEN WYSCHNJA
Techniques Employed	Post Proccessed GPS / DATV Gravity / Walking Gravity
Station Spacing	500m / 250m
Line Spacing	500m / 250m
Gravity Meters	Scintrex CG5: SN: 080640417 & 061240224
GPS Units	Leica GX1230 (1 x Base & 2 x Rovers)
Number of Points Surveyed	302 Total (Includes 275 New, 19 Repeats & 8 Existing)
Gravity Base	Daishsat Bases: 1532 & 1464
GPS Base	Daishsat Bases: 1532 & 1464
Dates of Survey	3rd to the 8th of September, 2015

APPENDIX D

BASE STATION LOCATIONS AND INFORMATION

GPS/Gravity Base 1532 - Elaine South

FINAL AUSPOS CO-ORDINATES

MGA94 / AHD		GDA94 / WGS84	
EASTING (m)	398409.085	**LATITUDE (DMS)**	20° 47' 57.3887" S
NORTHING (m)	7699759.599	**LONGITUDE (DMS)**	140° 1' 25.7877" E
ZONE (UTM, South)	54	**ELL HT (m)**	431.678
ORTHO HT (AHD, m)	386.600		
N (AUSGEOID09, m)	45.078		

GRAVITY AND CONTROL DETAILS

OBSERVED GRAVITY	CONTROL DETAILS
978634.923 **ISOGAL84 (mGal)** 978634.845 **AAGD07 (mGal)**	**GPS** – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m. **Gravity** – Daishsat using multiple ABA ties to AFGN Station 1994910155 at Cloncurry Airport. Expected accuracy better than 0.010mGals.

MISCELLANEOUS DETAILS

Est. Date: 4/9/15	Established By: Peter Rose	Survey: 15027

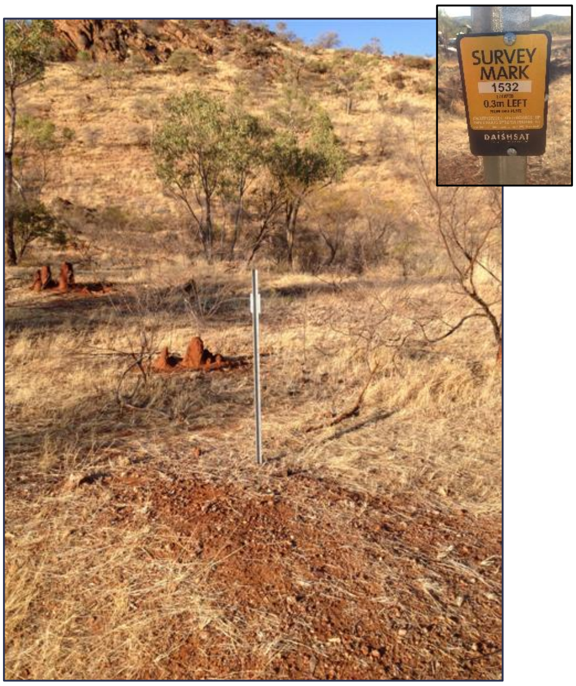
DESCRIPTION AND ACCESS

This base station consists of a small star picket protruding from the ground and is witnessed by a Daishsat survey plaque, placed on a large star picket ~ 0.3m to the right. The base is located approx 55 km west of Cloncurry and 3 kms north of the Barkly Highway

00.0km Start at the intersection of the Barkly Highway and The Burke Development Road (E446551 N 7710754) and travel west on the Barkley Highway

55.7km Leave the highway and follow road on your right and travel in a general northerly direction

58.7km The base station is approx 50m south of road on a side track



Field Photo Of Base

GPS/Gravity Base 1464 - Moonlight

FINAL AUSPOS CO-ORDINATES

MGA94 / AHD		GDA94 / WGS84	
EASTING (m)	419767.984	LATITUDE (DMS)	20° 23' 21.0119" S
NORTHING (m)	7745264.629	LONGITUDE (DMS)	140° 13' 52.0037" E
ZONE (UTM, South)	54	ELL HT (m)	236.080
ORTHO HT (AHD, m)	190.139		
N (AUSGEOID09, m)	45.941		

GRAVITY AND CONTROL DETAILS

OBSERVED GRAVITY	CONTROL DETAILS
978643.332 ISOGAL84 (mGal)	**GPS** – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.
978643.254 AAGD07 (mGal)	**Gravity** – Daishsat using multiple ABA ties to AFGN Station 1994910155 at Cloncurry Airport. Expected accuracy better than 0.010mGals.

MISCELLANEOUS DETAILS

Est. Date: 8/9/15	Established By: Peter Rose	Survey: 15027

DESCRIPTION AND ACCESS

This base station consists of a small star picket protruding from the ground and is witnessed by a Daishsat survey plaque, placed on a large star picket ~ 0.3m to the right. The base is located approx 8 kms west of Quamby in a clearing on the north side of a track.

0.0 km Start at the Quamby Hotel. Travel north on the Gregory Development Road
1.6 km Turn left and cross grid and travel west
2.5 km Cross grid and continue west
5.9 km Cross grid and continue west
7.5 km Base station is 40m North of the track in a clearing

Field Photo Of Base

APPENDIX E

DATA CD-ROM

(Attached to back cover)