

# TERRITORY IRON

## FRANCES CREEK GRAVITY SURVEY

### LOGISTICS & PROCESSING REPORT

July - October 2013

Report numbers 0013026

Written by GA Coopes

DAISHSAT Geodetic Surveyors  
143 Brinkley Road  
PO Box 766, Murray Bridge  
South Australia 5253 Australia

Telephone: 08 8531 0349  
Facsimile: 08 8531 0684  
david.daish@daishsat.com  
www.daishsat.com

Client Contact:  
Phil Hawke  
Hawke Geophysics  
Suite 5 / 102 Catalano Circuit  
Canningvale WA 6155  
Ph: (08) 9456 5655  
Mob: 0419 500 383  
Email: phil.hawke@optusnet.com.au



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## 1. INTRODUCTION

Daishsat Geodetic Surveyors carried out a precision GPS-Gravity survey between the months of April and November 2013 for Territory Iron with a total of 16,954 new gravity stations surveyed near the town of Pine Creek in the Northern Territory.

Gravity data was acquired using Scintrex CG-5 gravity meters whilst position and level data were obtained using Leica SR530 and GX1230 geodetic grade GPS systems to produce precise post-processed station locations. All data was acquired using Daishsat foot-borne methods.

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

## 2. SURVEY OVERVIEW

The Frances Creek gravity survey was situated at Territory Iron's Frances Creek iron ore mine located 20km north of Pine Creek in the Katherine region of the Northern Territory. The survey was designed to extend and infill upon existing gravity coverage around the mining corridor and was made up of four survey areas – France Creek (main), Frances Creek Extension, McCarthy and Millars.

The Frances Creek grid was located adjacent to the current mining operations and extended to the west and the north of the mine. This grid comprised of 5,473 new stations acquired at 25m and 50m spacing along east-west lines spaced 200m apart covering an area of 28.7km<sup>2</sup>.

The Millars grid was located ~3km to the north of the Frances Creek grid. This grid comprised of 1,054 new stations acquired at 25m and 50m spacing along lines orientated at 069°/249° spaced 200m apart covering an area of 3.6km<sup>2</sup>.

The Frances Creek Extension grid was located ~30km to the north of the Frances Creek grid. This grid comprised of 9,567 new stations acquired at 25m and 50m spacing along lines of various orientations spaced 200m apart covering an area of 30km<sup>2</sup>.

The McCarthy grid was located ~25km southeast of the Frances Creek grid. This grid comprised of 860 new stations acquired at 25m spacing along north-south lines spaced 100m apart covering an area of 2.1km<sup>2</sup>.

Terrain and vegetation encountered throughout the survey was extremely tough for surveying and included: large, rocky hills covered in thick vegetation; steep-sided ravines and gullies; rolling, rock-strewn hills; as well as mine infrastructure. Several gravity stations throughout the survey area were offset due to inaccessible terrain and vegetation and parts of the planned survey were omitted.

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





**Photos 1 - 3 – Field Survey Photos**



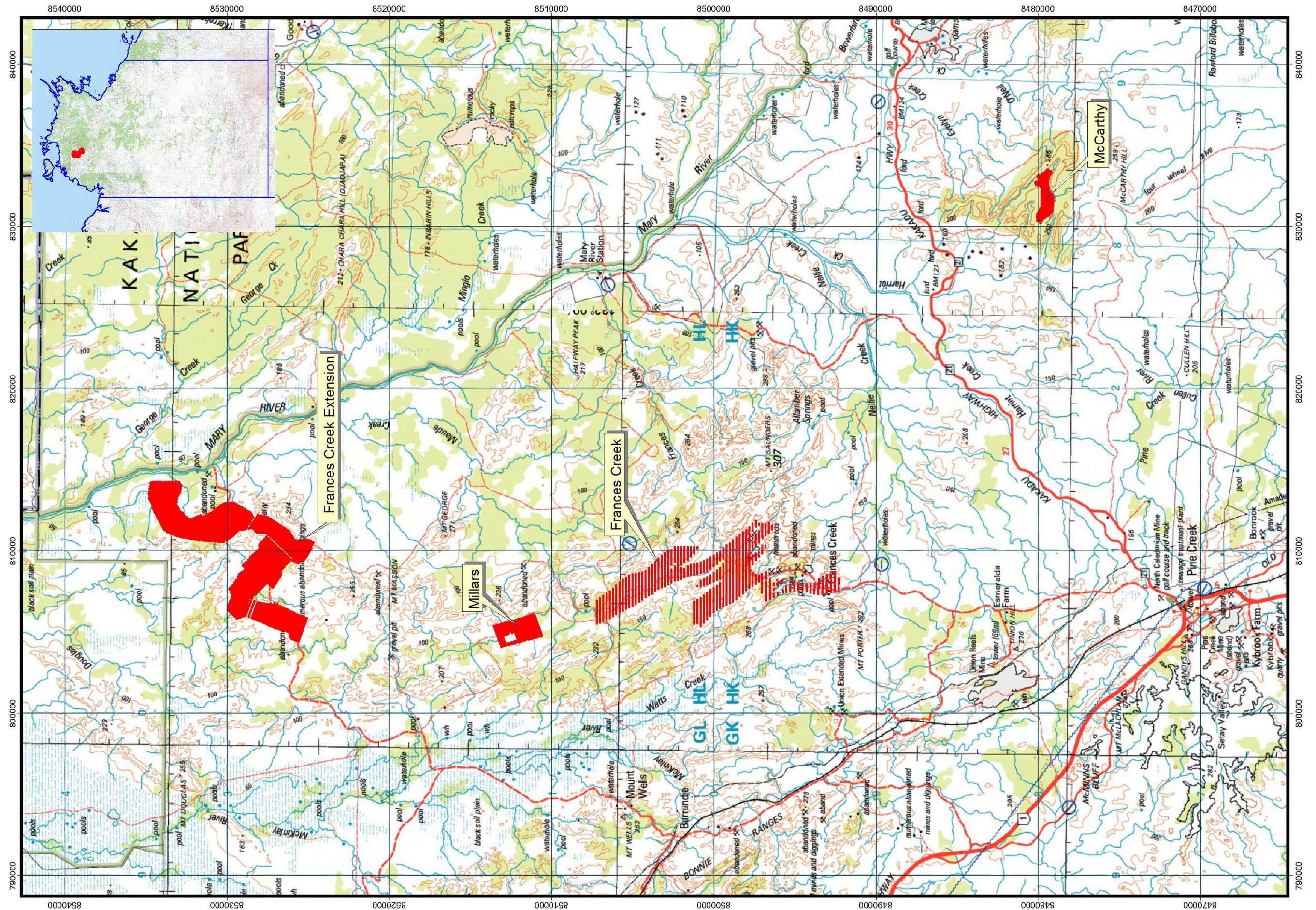


Figure 1 – Survey Location



### **3. PERSONNEL AND EQUIPMENT**

#### **3.1 Personnel**

The gravity survey was carried out by Ben Wyschnja, Hayden Harris, Kieran Brennan, Matthew Vassey, Peter Smith, Sam Wood, Shane Merchant, Will Lyon and Zac Shanahan. Ben and Peter – two of Daishsat’s most senior field surveyors – were responsible for supervising data acquisition, 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 GX1230 & SR530 dual frequency GPS receivers
- Notebooks for data processing and backup
- Various chargers, surveying equipment and batteries

#### **3.3 Vehicles**

Due to the location of the survey and the type of terrain to be encountered, Toyota Landcruiser 4WD vehicles were used for transport to and from site.

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 tires, tubes and tyre repair kit
- Satellite phone and UHF Radio
- Self-recovery equipment including, on board winch, snatch straps and rope
- Tools and spares to enable field repairs as necessary
- Survival kit with EPIRB emergency locator beacon

#### **3.4 Accommodation**

The crews were accommodated as close as possible to the survey areas with one crew staying at the Lazy Lizard Caravan Park and the other two crews camping near the Frances Creek Extension grid.

#### **3.5 Communications**

The survey crews were equipped with NextG digital phones, hand-held Iridium satellite phones, vehicle-mounted UHF radios and the “Omnitrack” satellite-based tracking and communication system was 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.

## 4. GPS SURVEYING AND PROCESSING

### 4.1 Set out of the grid

This was done concurrently with the gravity data acquisition using the Leica GX1230 GPS operating in post-processing mode. Where possible, the readings were taken as close to the ideal coordinates as possible using a Garmin GPS to navigate to the stations. At each station, the station number, position and RL were recorded digitally by the GPS crew. 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.

### 4.2 Survey datum and control

The gravity surveying, and hence any gravity reductions, used the Australian Height Datum (AHD) as the reference datum. Five new GPS base stations were established throughout the survey areas and were used for survey positional control. Base 1461 was used to survey the Frances Creek grid, Base 1438 was used to survey the Millars grid, Bases 1436 and 1439 were used to survey the Frances Creek Extension grid, and Base 1462 was used to survey the McCarthy grid. Co-ordinates for each new GPS base were calculated using three days' worth of static data, and connections to ITRF stations using Geoscience Australia's online GPS processing system, AUSPOS. For more information on this system, please visit <http://www.ga.gov.au/earth-monitoring/geodesy/auspos-online-gps-processing-service.html>. 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 logged GPS data was recorded on removable CF cards, which were downloaded onto the laptops daily. The data was then processed using Novatel's Waypoint post-processing suite.

Waypoint combines the processing components, GrafNav and GrafNet, in a complete package. GrafNav processes data for one baseline (e.g. one base and one remote). 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 and GrafNet share the same processing engine that has been under continuous development since its original inception by Waypoint in 1992. The core of this robust 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. It will process ~0.8 epochs per MHz per second on a Pentium II.

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.waypnt.com/grafnav\\_d.html](http://www.waypnt.com/grafnav_d.html).

Grid coordinates were obtained by projecting the GPS-derived WGS84 coordinates using a UTM projection with zone 52 & 53 south. For more information about WGS84 please visit <http://www.ga.gov.au/geodesy/datums/>.

AHD heights were also calculated by Waypoint which utilises the AUSGEOID98 geoid model for Australia. Information about the geoid, and the modelling process used to extract separations (N values) can be found at <http://www.ga.gov.au/geodesy/ausgeoid/>.





## 5. GRAVITY ACQUISITION AND PROCESSING

### 5.1 Gravity data acquisition

Gravity observations were made simultaneously with the GPS observation. Two observations were made for each station so that any seismic or instrumental noise could be immediately detected. Each observation consisted of a 20-second or greater stacking time. The accepted tolerance between readings was limited to 0.030 of a dial reading to ensure accuracy. Vertical and horizontal levels were restricted to 10 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 CG-5 also automatically records the station, time and readings digitally to allow for downloading to computer.

### 5.2 Gravity base stations

Gravity base stations were used for calculation of absolute gravity and drift determination. Five new gravity base stations were established during the survey coincident with the GPS bases. All five gravity bases were tied to AFGN Base 1980902318 located at Katherine's Tindal Airbase. Details of these bases 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 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

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. Other software used on this project includes ArcView, ChrisDBF, and Oasis Montaj.

The formulae used in the gravity reduction 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*.

**Theoretical 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.

$$GT = 978031.856 \times (1 + 0.005278895 \times \sin^2 \phi + 0.000023462 \times \sin^4 \phi)$$

where  $\phi$  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).

$$FAC = 0.308596 \times h_{AHD}$$

**Bouguer Correction:** 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 gm/cc was used in the correction.

$$BC = 0.0419088 \times \rho \times h_{AHD}$$

where  $\rho$  = density (2.67 gm/cc)

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

$$FAG = G_{OBSG} - GT + FAC$$

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

$$BG = G_{OBSG} - GT + FAC - BC$$

## 5.4 Gravity meter calibration and scale factor

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 below:

| Gravity Meters |               |               |              |
|----------------|---------------|---------------|--------------|
| Meter          | Model         | Serial Number | Scale Factor |
| H              | Scintrex CG-5 | 071040303     | 0.999540     |
| J              | Scintrex CG-5 | 080340364     | 0.999689     |
| N              | Scintrex CG-5 | 080440373     | 1.000124     |



## 6. RESULTS

Raw and processed GPS and gravity data are contained on CD-ROM as APPENDIX E.

Hardcopy plots of station locations and gridded data images are contained in APPENDIX A.

### 6.1 Stations Surveyed and Survey Progress

In total 17,642 new stations were acquired during the project and of these, 675 were revisited for survey quality control. In addition to this 13 existing stations were re-surveyed to ensure that the newly acquired data merged well with any existing data. The crews were typically able to achieve an average production rate of over 130 stations per day which was considered to be good given the terrain. A brief production summary for the area is shown in Table 1 below.

| Frances Creek Surveys                         |               |          |
|---|---------------|----------|
| Gravity Stations Acquired (Including Repeats) | <b>17,642</b> | Stations |
| New Gravity Station Repeats                   | <b>675</b>    | 4.0%     |
| New Gravity Stations Acquired                 | <b>16,954</b> | Stations |
| Existing Gravity Stations Repeats             | <b>13</b>     | Stations |

**Table 2: 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 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: < 0.017 m

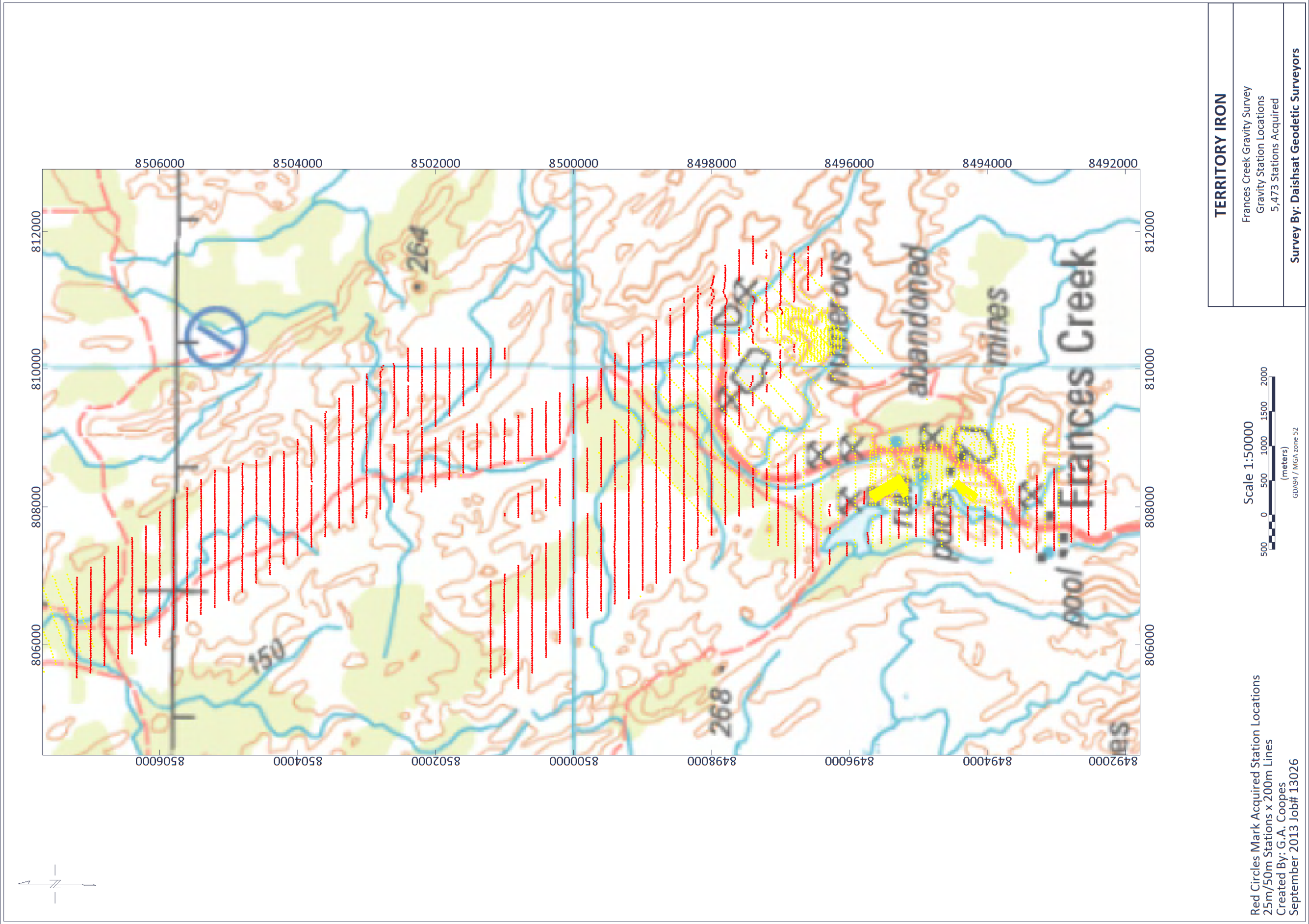
Gravity observation: < 0.014 mGals

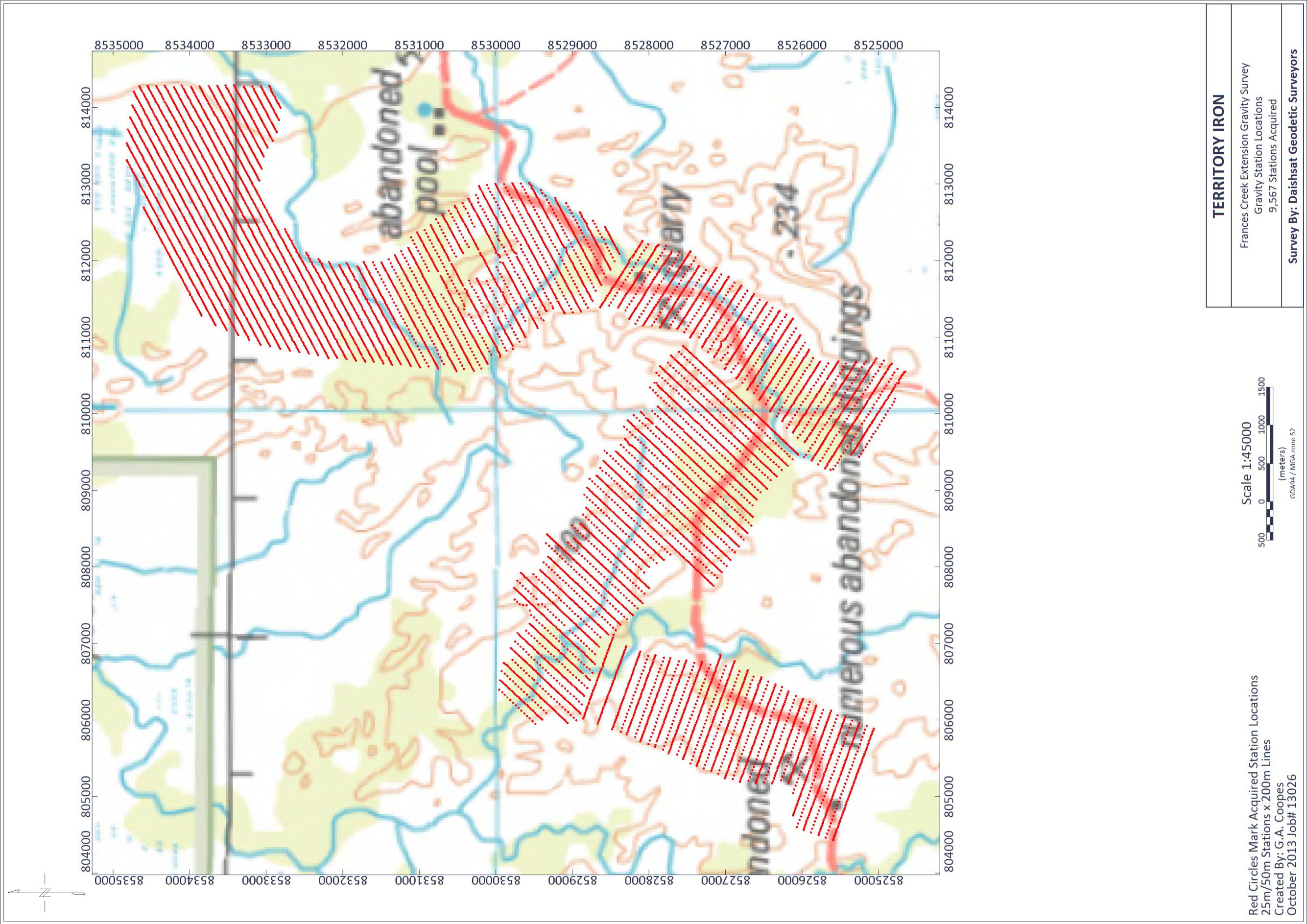
## APPENDIX A

### Station Location Plots

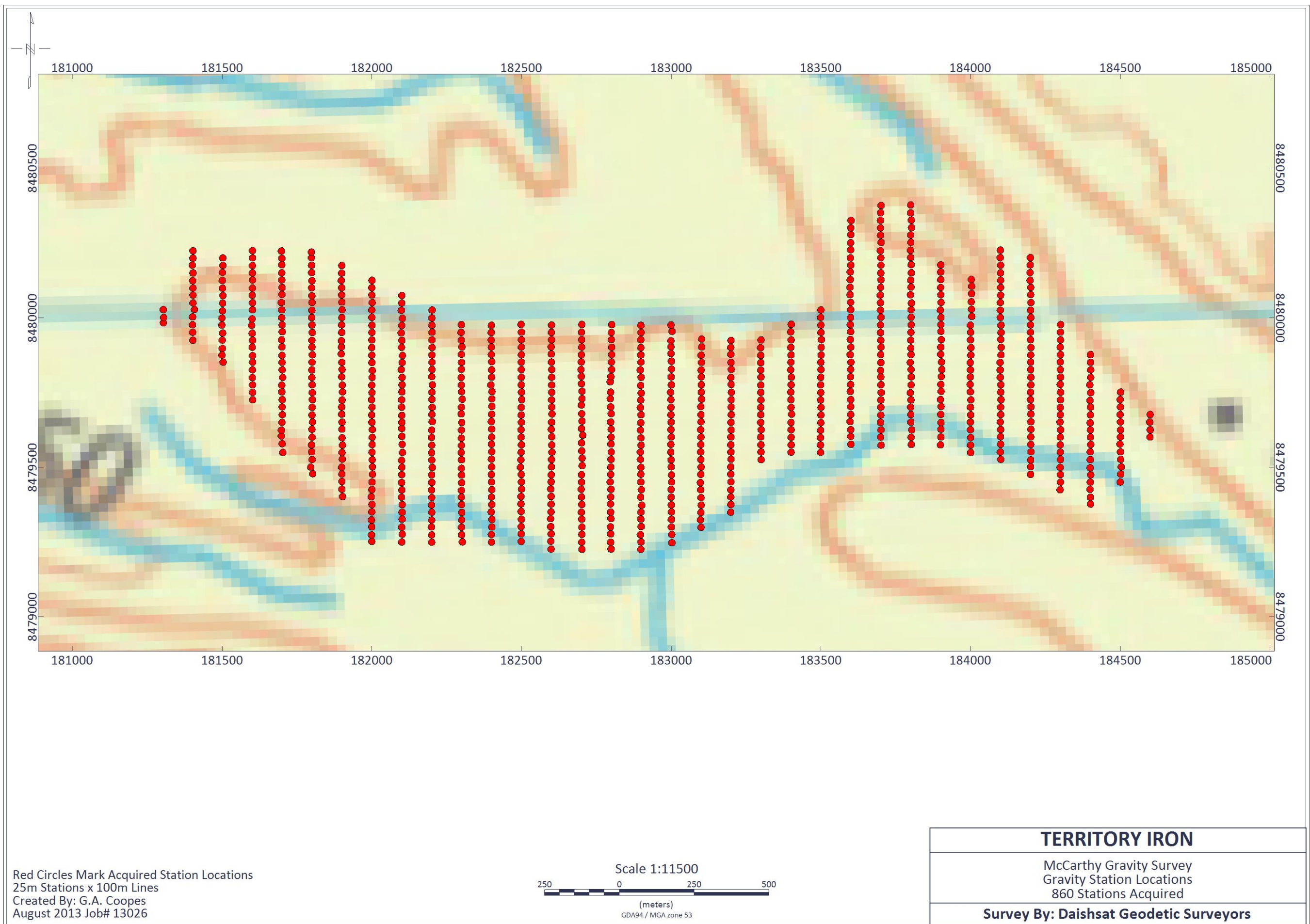


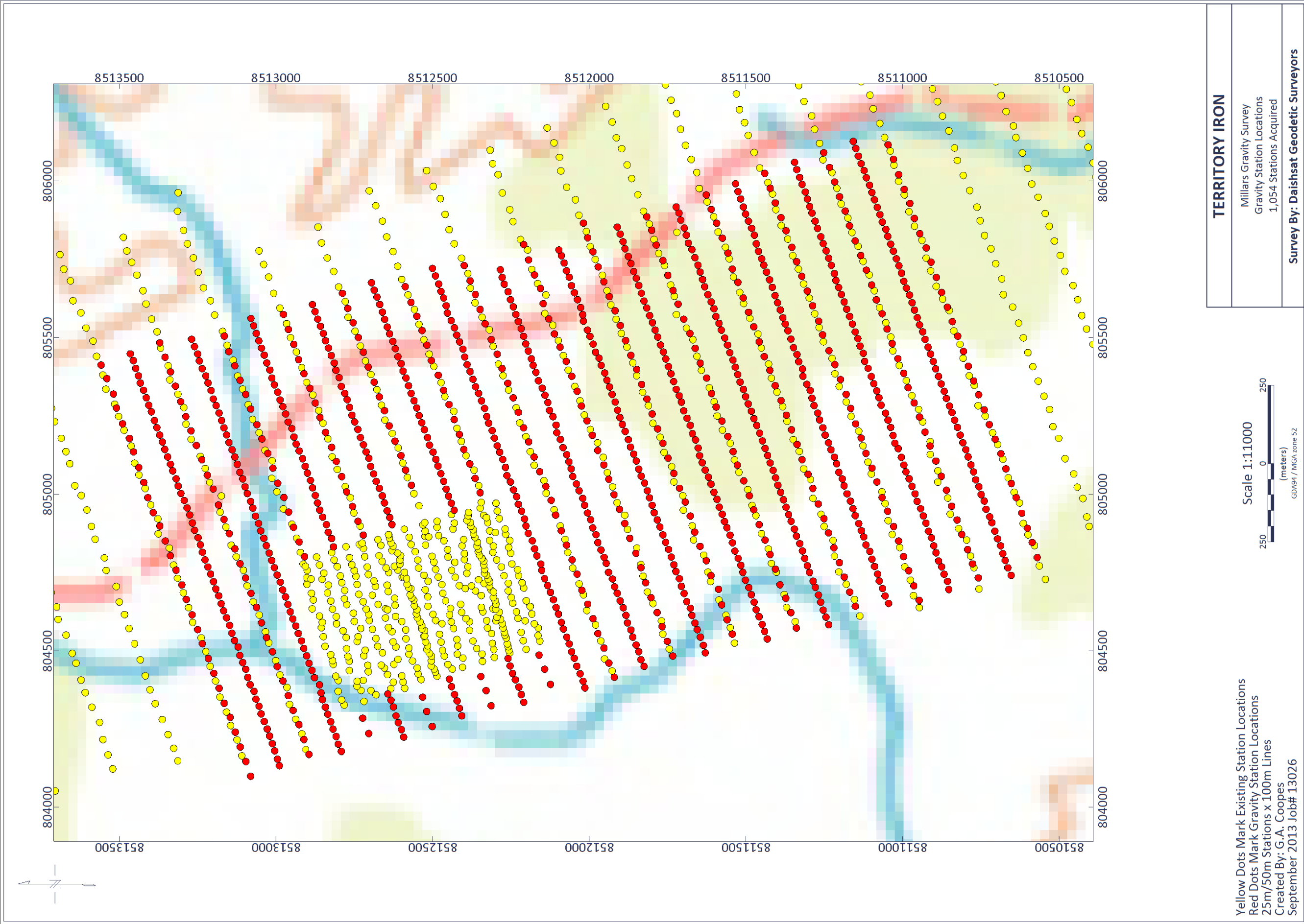








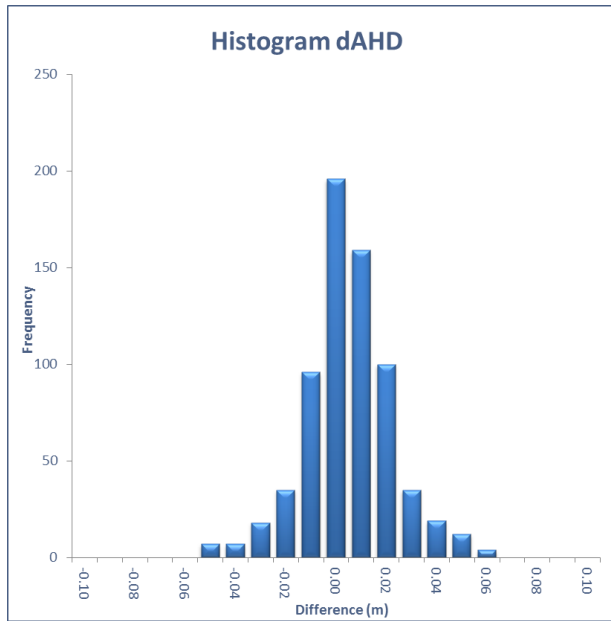




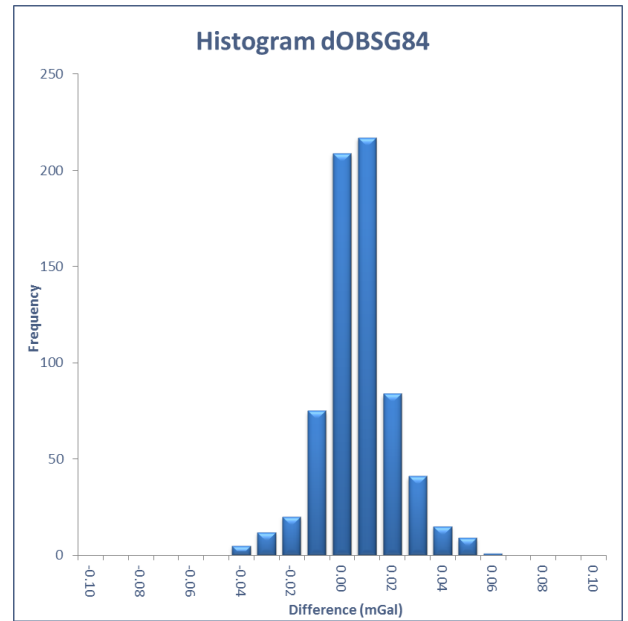
## APPENDIX B

### Repeat Tabulation and Analysis

#### Repeatability of AHD



#### Repeatability of OBSG84



#### Summary Statistics

| Summary Statistics |        |        |
|--------------------|--------|--------|
| Statistic          | dAHD   | dOBSG  |
| Mean               | 0.001  | 0.002  |
| Standard Error     | 0.001  | 0.001  |
| Median             | 0.000  | 0.001  |
| Mode               | 0.000  | 0.000  |
| Standard Deviation | 0.017  | 0.014  |
| Sample Variance    | 0.000  | 0.000  |
| Kurtosis           | 1.163  | 1.307  |
| Skewness           | -0.005 | 0.207  |
| Range              | 0.110  | 0.095  |
| Minimum            | -0.055 | -0.043 |
| Maximum            | 0.055  | 0.052  |
| Sum                | 0.391  | 1.526  |
| Count              | 688    | 688    |




**APPENDIX C**  
**Survey Information**

| Frances Creek Surveys            |   |
|----------------------------------|---|
| <b>Client</b>                    | TERRITORY IRON  |
| <b>Operators</b>                 | Ben Wyschnja / Hayden Harris / Kieran Brennan / Matthew Vassey / Peter Smith / Sam Wood / Shane Merchant / Will Lyon / Zac Shanahan |
| <b>Techniques Employed</b>       | Post-Processed GPS / Walking Ground Gravity   |
| <b>Station Spacing</b>           | 25m / 50m   |
| <b>Line Spacing</b>              | 100m / 200m   |
| <b>Gravity Meters</b>            | Scintrex CG5 SN: 071040303 / 080340364 / 080440373  |
| <b>GPS Units</b>                 | Leica SR530 (2 x Bases) & Leica GX1230 (3 x Rovers)   |
| <b>Number of Points Surveyed</b> | 17,642 Total (Includes 16,954 New and 688 Repeats)  |
| <b>Gravity Bases</b>             | Daishsat Bases: 1436 / 1438 / 1439 / 1461 / 1462  |
| <b>GPS Bases</b>                 | Daishsat Bases: 1436 / 1438 / 1439 / 1461 / 1462  |
| <b>Dates of Survey</b>           | 23 <sup>rd</sup> of July to the 21 <sup>st</sup> of October, 2013   |


**APPENDIX D**  
**Base Station Information**




| GPS/Gravity Base 1436 - Frances Creek Extension   |                             |  |                      |
|---|-----------------------------|--|----------------------|
| FINAL AUSPOS CO-ORDINATES   |                             |  |                      |
| MGA94 / AHD   |                             | GDA94 / WGS84  |                      |
| EASTING (m)   | 805231.206                  | LATITUDE (DMS)   | 13° 19' 10.34570" S  |
| NORTHING (m)  | 8525797.166                 | LONGITUDE (DMS)  | 131° 49' 02.42102" E |
| ZONE (UTM, South)   | 52                          | ELL HT (m)   | 163.631              |
| ORTHO HT (AHD, m)   | 112.179                     |  |                      |
| N (AUSGEOID09, m)   | 51.452                      |  |                      |
| GRAVITY AND CONTROL DETAILS   |                             |  |                      |
| OBSERVED GRAVITY  |                             | CONTROL DETAILS  |                      |
| 978318.526<br>ISO GAL84 (mGal)  |                             | GPS – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.  |                      |
| 978318.448<br>AAGD07 (mGal)   |                             | Gravity – Daishsat using multiple ABA ties to AFGN Base 1980902318 located at Katherine's Tindal Airport Carpark. Expected accuracy better than 0.010 mGal |                      |
| MISCELLANEOUS DETAILS   |                             |  |                      |
| Est. Date: 03/10/2013   | Established By: Peter Smith |  | Survey: 13026        |
| DESCRIPTION AND ACCESS  |                             |  |                      |
| <p>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 approximately 55km north of Pine Creek and 30km north of the Frances Creek mine on the Mount Wells road near an abandoned mine site. The base can be accessed by heading north from Pine Creek along the Stuart Highway, at 19.9km turn right onto Spring Hill Road and head northeast, at 32.2km turn left onto Mt Wells Road and head northwest, cross over the railway at 42.0km and at 42.6km turn right at the fork to continue northeast on Mt Wells Road. At 45.7km pass the Mt Wells Homestead on the left, at 59.3km pass sheds on the left, at 59.4 cross over a creek, at 61.7km veer take the left fork and head north crossing another creek at 62.2km. At 64.9km take the right fork and head northeast, cross another creek at 66.6km and at 75.7km Base 1436 can be found on the right ~10m off the shoulder of the track.</p> |                             |  |                      |
| <div></div>   |                             |  |                      |
| Field Photo Of Base   |                             |  |                      |




| GPS/Gravity Base 1438 - Millars   |                             |  |                      |
|---|-----------------------------|--|----------------------|
| FINAL AUSPOS CO-ORDINATES   |                             |  |                      |
| MGA94 / AHD   |                             | GDA94 / WGS84  |                      |
| EASTING (m)   | 805198.640                  | LATITUDE (DMS)   | 13° 26' 0.50040" S   |
| NORTHING (m)  | 8513182.527                 | LONGITUDE (DMS)  | 131° 49' 06.10979" E |
| ZONE (UTM, South)   | 52                          | ELL HT (m)   | 162.045              |
| ORTHO HT (AHD, m)   | 110.994                     |  |                      |
| N (AUSGEOID09, m)   | 51.051                      |  |                      |
| GRAVITY AND CONTROL DETAILS   |                             |  |                      |
| OBSERVED GRAVITY  |                             | CONTROL DETAILS  |                      |
| 978317.102<br>ISO GAL84 (mGal)  |                             | GPS – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.  |                      |
| 978317.024<br>AAGD07 (mGal)   |                             | Gravity – Daishsat using multiple ABA ties to AFGN Base 1980902318 located at Katherine's Tindal Airport Carpark. Expected accuracy better than 0.010 mGal |                      |
| MISCELLANEOUS DETAILS   |                             |  |                      |
| Est. Date: 30/08/2013   | Established By: Sam Wigmore |  | Survey: 13026        |
| DESCRIPTION AND ACCESS  |                             |  |                      |
| <p>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 approximately 30km north of Pine Creek and 5km north of the Frances Creek mine. The base can be accessed by travelling north from Pine Creek along the Kakadu Highway then turn left onto the Frances Creek Road and continue north to the Frances Creek mine offices. Pass the offices, turn left onto the main haul road and follow this past the mine pits on the right for 1.2km then turn left, after 400m turn right and head north for 20.9km (passing Base 1461 at 4.6km) then head cross-country for 200m where Base 1438 can be found in a clearing.</p> |                             |  |                      |
| <div><div></div><div></div></div>  |                             |  |                      |
| Field Photo Of Base   |                             |  |                      |

| GPS/Gravity Base 1439 - Frances Creek Extension II   |                             |  |                      |
|--|-----------------------------|--|----------------------|
| FINAL AUSPOS CO-ORDINATES  |                             |  |                      |
| MGA94 / AHD  |                             | GDA94 / WGS84  |                      |
| EASTING (m)  | 812125.292                  | LATITUDE (DMS)   | 13° 17' 35.79493" S  |
| NORTHING (m)   | 8528626.335                 | LONGITUDE (DMS)  | 131° 52' 50.21223" E |
| ZONE (UTM, South)  | 52                          | ELL HT (m)   | 117.366              |
| ORTHO HT (AHD, m)  | 65.736                      |  |                      |
| N (AUSGEOID09, m)  | 51.630                      |  |                      |
| GRAVITY AND CONTROL DETAILS  |                             |  |                      |
| OBSERVED GRAVITY   |                             | CONTROL DETAILS  |                      |
| 978325.520<br>ISO GAL84 (mGal)   |                             | GPS – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.  |                      |
| 978325.442<br>AAGD07 (mGal)  |                             | Gravity – Daishsat using multiple ABA ties to AFGN Base 1980902318 located at Katherine's Tindal Airport Carpark. Expected accuracy better than 0.010 mGal |                      |
| MISCELLANEOUS DETAILS  |                             |  |                      |
| Est. Date: 19/09/2013  | Established By: Peter Smith |  | Survey: 13026        |
| DESCRIPTION AND ACCESS   |                             |  |                      |
| <p>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 approximately 58km north of Pine Creek and 33km north of the Frances Creek mine. The base can be accessed by heading north from Pine Creek along the Stuart Highway, at 19.9km turn right onto Spring Hill Road and head northeast, at 32.2km turn left onto Mt Wells Road and head northwest, cross over the railway at 42.0km and at 42.6km turn right at the fork to continue northeast on Mt Wells Road. At 45.7km pass the Mt Wells Homestead on the left, at 59.3km pass sheds on the left, at 59.4 cross over a creek, at 61.7km veer take the left fork and head north crossing another creek at 62.2km. At 64.9km take the right fork and head northeast, cross another creek at 66.6km and at 85.1km Base 1439 can be found ~25m to the north of the track.</p> |                             |  |                      |
| <div></div>  |                             |  |                      |
| Field Photo Of Base  |                             |  |                      |

| GPS/Gravity Base 1461 - Frances Creek Bag Farm  |                              |  |                      |
|---|------------------------------|--|----------------------|
| FINAL AUSPOS CO-ORDINATES   |                              |  |                      |
| MGA94 / AHD   |                              | GDA94 / WGS84  |                      |
| EASTING (m)   | 809117.605                   | LATITUDE (DMS)   | 13° 33' 32.34476" S  |
| NORTHING (m)  | 8499239.586                  | LONGITUDE (DMS)  | 131° 51' 21.67142" E |
| ZONE (UTM, South)   | 52                           | ELL HT (m)   | 206.529              |
| ORTHO HT (AHD, m)   | 155.785                      |  |                      |
| N (AUSGEOID09, m)   | 50.744                       |  |                      |
| GRAVITY AND CONTROL DETAILS   |                              |  |                      |
| OBSERVED GRAVITY  |                              | CONTROL DETAILS  |                      |
| 978321.240<br>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.  |                      |
| 978321.162<br>AAGD07 (mGal)   |                              | Gravity – Daishsat using multiple ABA ties to AFGN Base 1980902318 located at Katherine's Tindal Airport Carpark. Expected accuracy better than 0.010 mGal |                      |
| MISCELLANEOUS DETAILS   |                              |  |                      |
| Est. Date: 23/07/2013   | Established By: Zac Shanahan |  | Survey: 13026        |
| DESCRIPTION AND ACCESS  |                              |  |                      |
| <p>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 approximately 30km north of Pine Creek and 5km north of the Frances Creek mine. The base can be accessed by travelling north from Pine Creek along the Kakadu Highway then turn left onto the Frances Creek Road and continue north to the Frances Creek mine offices. Pass the offices, turn left onto the main haul road and follow this past the mine pits on the right for 1.2km then turn left, after 400m turn right and head north for 4.6km to a Bag Farm (sample yard) on the left where the Base is located.</p> |                              |  |                      |
| <div></div>   |                              |  |                      |
| Field Photo Of Base   |                              |  |                      |



| GPS/Gravity Base 1462 - McCarthy   |                              |  |                      |
|--|------------------------------|--|----------------------|
| FINAL AUSPOS CO-ORDINATES  |                              |  |                      |
| MGA94 / AHD  |                              | GDA94 / WGS84  |                      |
| EASTING (m)  | 181867.348                   | LATITUDE (DMS)   | 13° 43' 58.65541" S  |
| NORTHING (m)   | 8479866.851                  | LONGITUDE (DMS)  | 132° 03' 30.94753" E |
| ZONE (UTM, South)  | 53                           | ELL HT (m)   | 292.655              |
| ORTHO HT (AHD, m)  | 242.354                      |  |                      |
| N (AUSGEOID09, m)  | 50.301                       |  |                      |
| GRAVITY AND CONTROL DETAILS  |                              |  |                      |
| OBSERVED GRAVITY   |                              | CONTROL DETAILS  |                      |
| 978295.880<br>ISO GAL84 (mGal)   |                              | GPS – Daishsat using a multiple static sessions and the AUSPOS online GPS Processing system. Expected accuracy of station coordinates better than 0.005m.  |                      |
| 978295.802<br>AAGD07 (mGal)  |                              | Gravity – Daishsat using multiple ABA ties to AFGN Base 1980902318 located at Katherine's Tindal Airport Carpark. Expected accuracy better than 0.010 mGal |                      |
| MISCELLANEOUS DETAILS  |                              |  |                      |
| Est. Date: 25/07/2013  | Established By: Zac Shanahan |  | Survey: 13026        |
| DESCRIPTION AND ACCESS   |                              |  |                      |
| <p>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 approximately 26km east-northeast of Pine Creek and can be accessed by travelling north along the Kakadu Highway for 8km and turn right onto a dirt track and head east. At 31.7km take the left fork, at 34.5km follow the track around to the left, at 35.4km go over a ridge and follow the track to the left, at 35.7km follow the track to the right where the Base 1462 can be found ~100m further along on a drill pad to the right.</p> |                              |  |                      |
| <div></div>  |                              |  |                      |
| Field Photo Of Base  |                              |  |                      |

## **APPENDIX E**

### **Data CD-ROM**

(Attached to back cover)