Open File Envelope No. 11,651

EL 3897, EL 3899, EL 3900 AND EL 3917

CODNA HILL, PUMPER DAM, WELCOME BORE AND BERESFORD HILL (PART OF CURDIMURKA PROJECT)

DATA RELEASE AT LICENCES' JOINT SURRENDER ON 1/12/2008 : COMBINED FIRST ANNUAL REPORT FOR THE PERIOD 20/8/2007 TO 26/8/2008

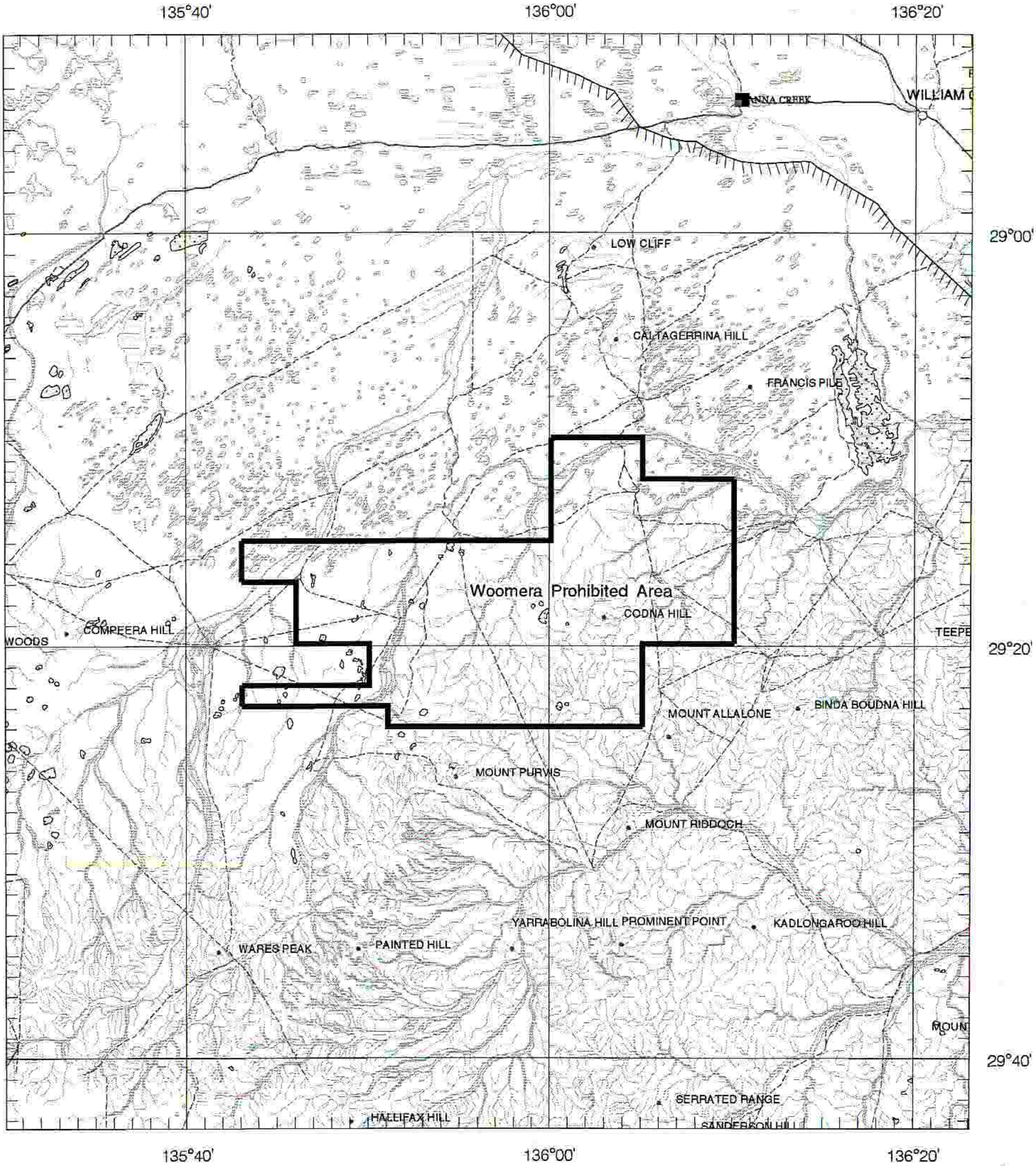
Submitted by
Barrick Gold of Australia Ltd
2009

Enquiries: Customer Services Branch
Minerals and Energy Resources
7th Floor
101 Grenfell Street, Adelaide 5000

Telephone: (08) 8463 3000
Facsimile: (08) 8204 1880

Government of South Australia
Primary Industries and Resources SA

SCHEDULE A



SCALE 1: 500 000

KILOMETRES 10 0 10 20 30 40 50 KILOMETRES

LICENCE GRANTED IN : DATUM AGD66

GDA
GEOCENTRIC DATUM OF AUSTRALIA

APPLICANT : **BARRICK GOLD OF AUSTRALIA LTD**

FILE REF : **33/07** TYPE : **MINERAL ONLY** AREA : **693** km² (approx.)

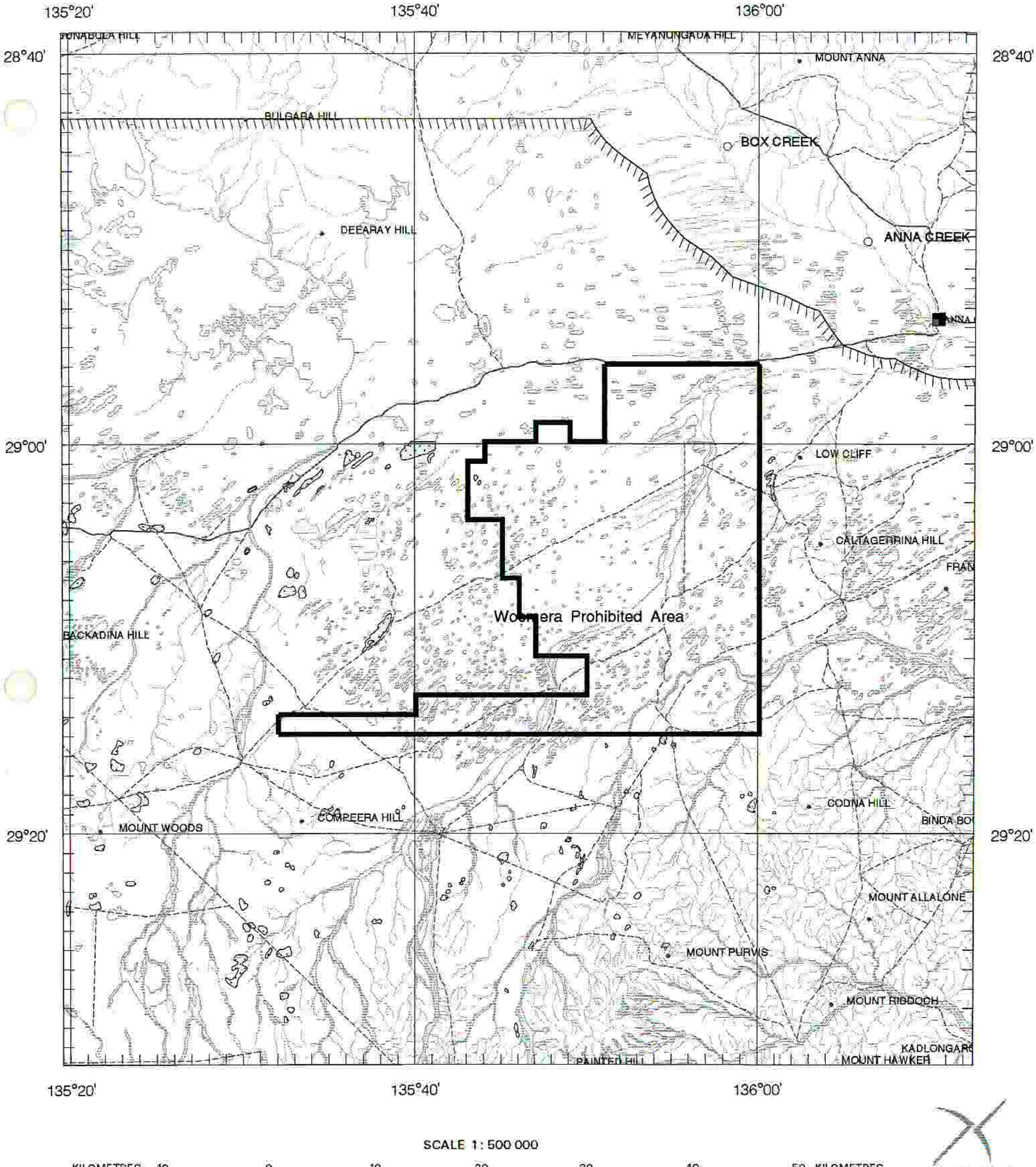
1:250000 MAPSHEETS : **BILLA KALINA**

LOCALITY : **CODNA HILL AREA - Approximately 100 km ESE of Coober Pedy**

DATE GRANTED : **20-Aug-2007** DATE EXPIRED : **19-Aug-2008** EL NO : ~~**3897**~~

Surrendered 19/11/08

SCHEDULE A



LICENCE GRANTED IN : DATUM AGD66

APPLICANT : **BARRICK GOLD OF AUSTRALIA LTD**

FILE REF : **36/07** TYPE : **MINERAL ONLY** AREA : **815** km^2 (approx.)

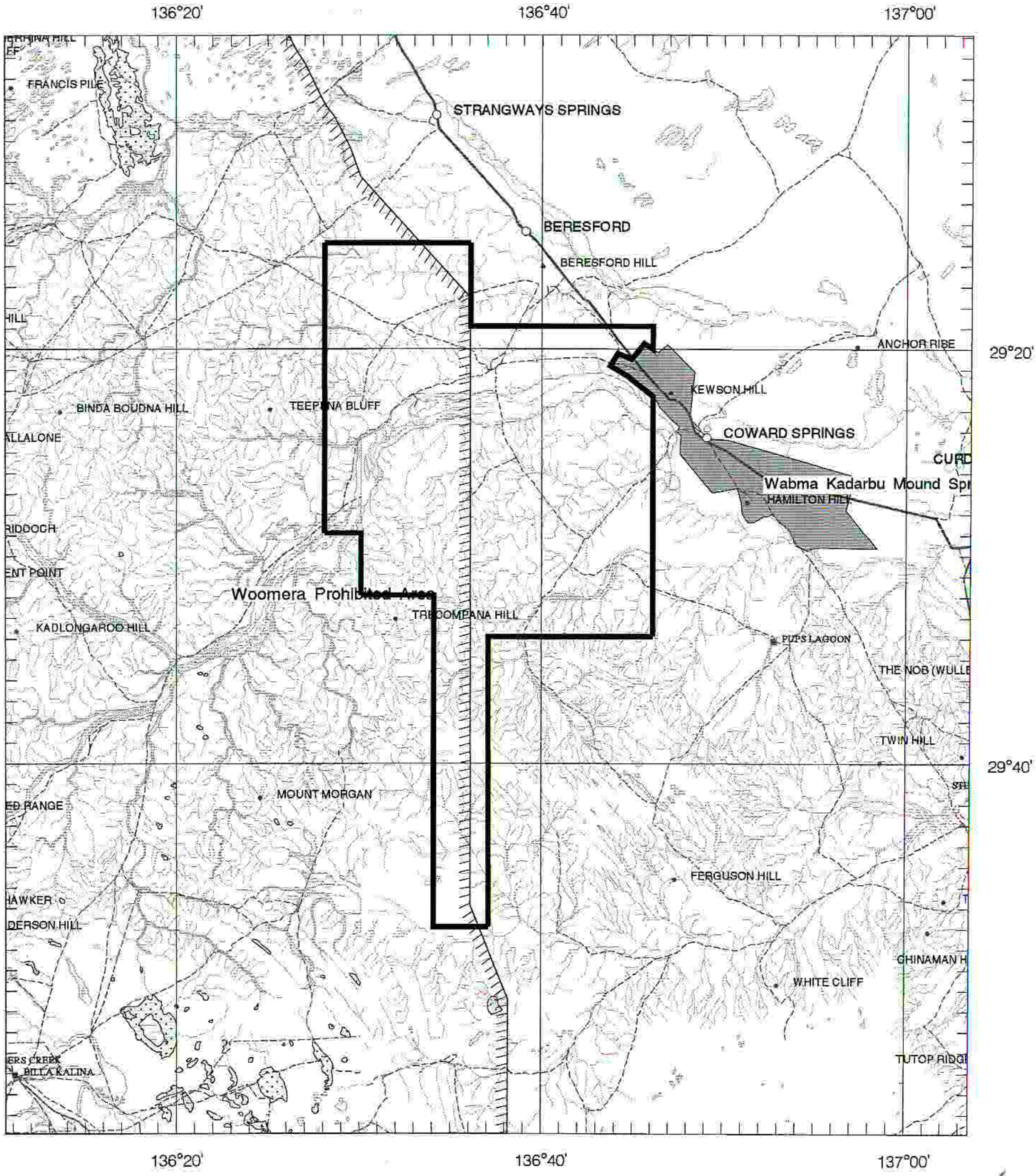
1:250000 MAPSHEETS : **WARRINA BILLA KALINA**

LOCALITY : **PUMPER DAM AREA - Approximately 105 km east of Coober Pedy**

DATE GRANTED : **20-Aug-2007** DATE EXPIRED : **19-Aug-2008** EL NO : **3899**

Surrendered 19/11/08

SCHEDULE A



SCALE 1: 500 000

KILOMETRES 10 0 10 20 30 40 50 KILOMETRES

LICENCE GRANTED IN : DATUM AGD66

GDA GEOCENTRIC DATUM OF AUSTRALIA

APPLICANT : **BARRICK GOLD OF AUSTRALIA LTD**

FILE REF : **38/07** TYPE : **MINERAL ONLY** AREA : **964** km² (approx.)

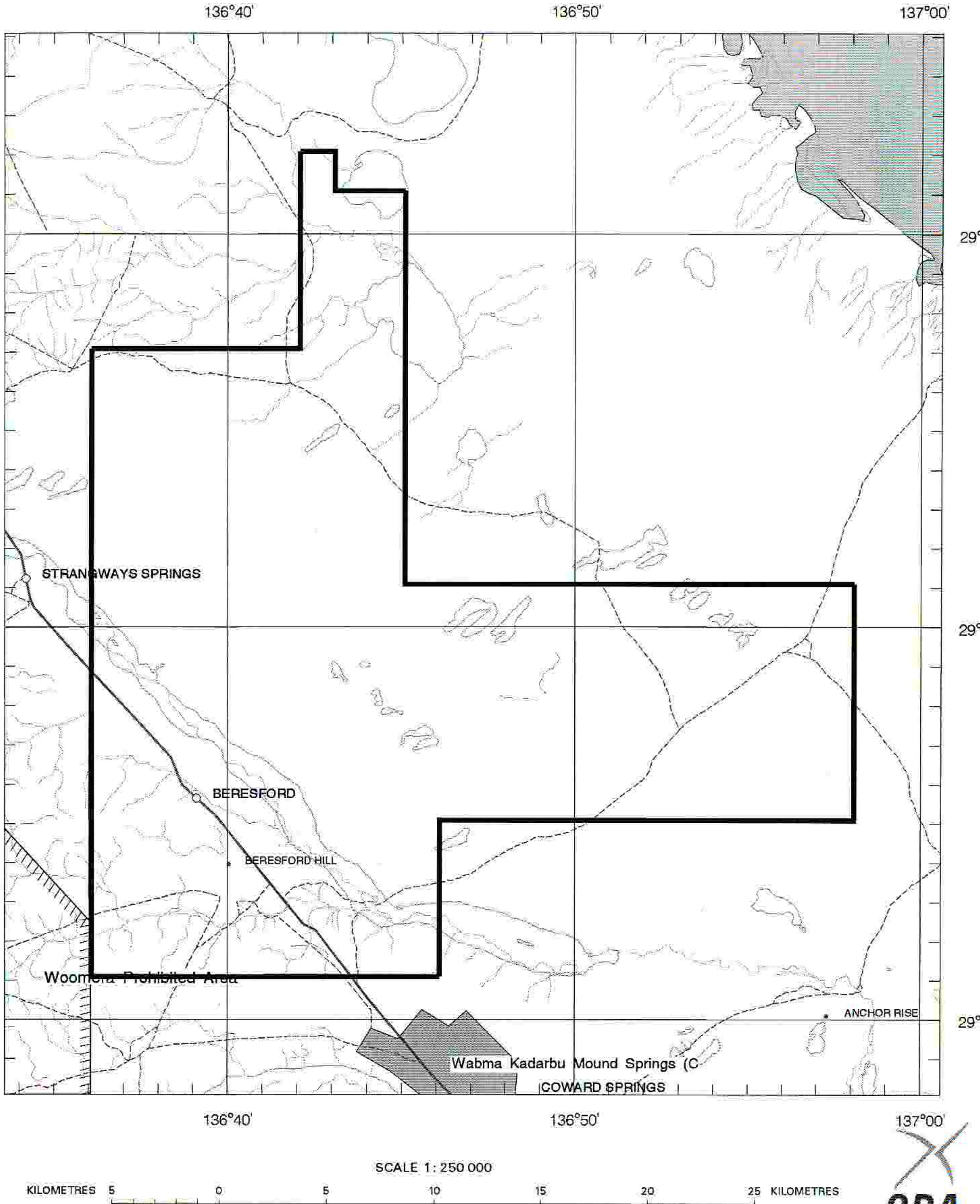
1:250000 MAPSHEETS : **BILLA KALINA CURDIMURKA**

LOCALITY : **WELCOME BORE AREA - Approximately 140 km northwest of Marree**

DATE GRANTED : **20-Aug-2007** DATE EXPIRED : **19-Aug-2008** EL NO : **~~3900~~**

Surrendered 19/11/08

SCHEDULE A



LICENCE GRANTED IN : DATUM AGD66

APPLICANT : **BARRICK GOLD OF AUSTRALIA LTD**

FILE REF : **32/07** TYPE : **MINERAL ONLY** AREA : **716** km² (approx.)

1:250000 MAPSHEETS : **LAKE EYRE CURDIMURKA**

LOCALITY : **BERESFORD AREA - Approximately 145 km northwest of Marree**

DATE GRANTED : **27-Aug-2007** DATE EXPIRED : **26-Aug-2008** EL NO : **3917**

SURRENDERED 19/11/08

BARRICK

AUSTRALIA PACIFIC

BARRICK GOLD OF AUSTRALIA LIMITED
ABN 19 008 143 137
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Perth Western Australia 6850

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Perth Western Australia 6850

Tel: +61-8-9212 5777
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File Code: Neales River (5028) & Curdimurka (S1071/02)

28 January 2009

The Director
Mineral Resources Group
Minerals and Energy Resources
GPO Box 1671
ADELAIDE SA 5001

Dear Sir/Madam

COMBINED REPORTING – NEALES RIVER & CURDIMURKA PROJECT

Barrick Gold of Australia Ltd (Barrick) is the registered holder and manager of Exploration Licences in the Neales River and Curdimurka regions. In lieu of lodging final combined mineral exploration reports for recently surrendered Exploration Licences 3776, 3855, 3856, 3857, 3897, 3899, 3900, 3912, 3913, 3914, 3915, 3916, 3917 & 4176, Barrick wishes to release the Neales River and Curdimurka combined reports lodged last year.

Should you require any further information, please do-not hesitate to contact me on 9212 5780 or via email at gsale@barrick.com.

Yours faithfully
BARRICK GOLD OF AUSTRALIA LIMITED

G Sale

Greg Sale
Senior Tenement Officer

BARRICK GOLD OF AUSTRALIA LIMITED

(ABN 19 008 143 137)

PROJECT 1071
SA PROJECT GENERATION – CURDIMURKA PROJECT

EL3897, EL3898, EL3899, EL3900, EL3917 & EL3918

ANNUAL TECHNICAL REPORT & EXPENDITURE

FOR THE PERIOD

27 August 2007 – 26 August 2008

TECHNICAL REPORT No. 1285

MAP SHEETS: SG5303 (Warrina), SG5307 (Billa Kalina), SG5308 (Curdimurka) & SG5304 (Lake Eyre)

DISTRIBUTION:

1. BGAL Perth 1071.311
2. BGAL Archive 1071.311
3. Primary Industry and Resources – South Australia PIRSA

Serena Goldsmith
Project Geologist
September, 2008

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FIGURES

APPENDICES

1.0 SUMMARY

This report details the exploration activities completed within the SA Project Generation – Curdimurka Project (Curdimurka Project), from 27 August 2007 to 26 August 2008.

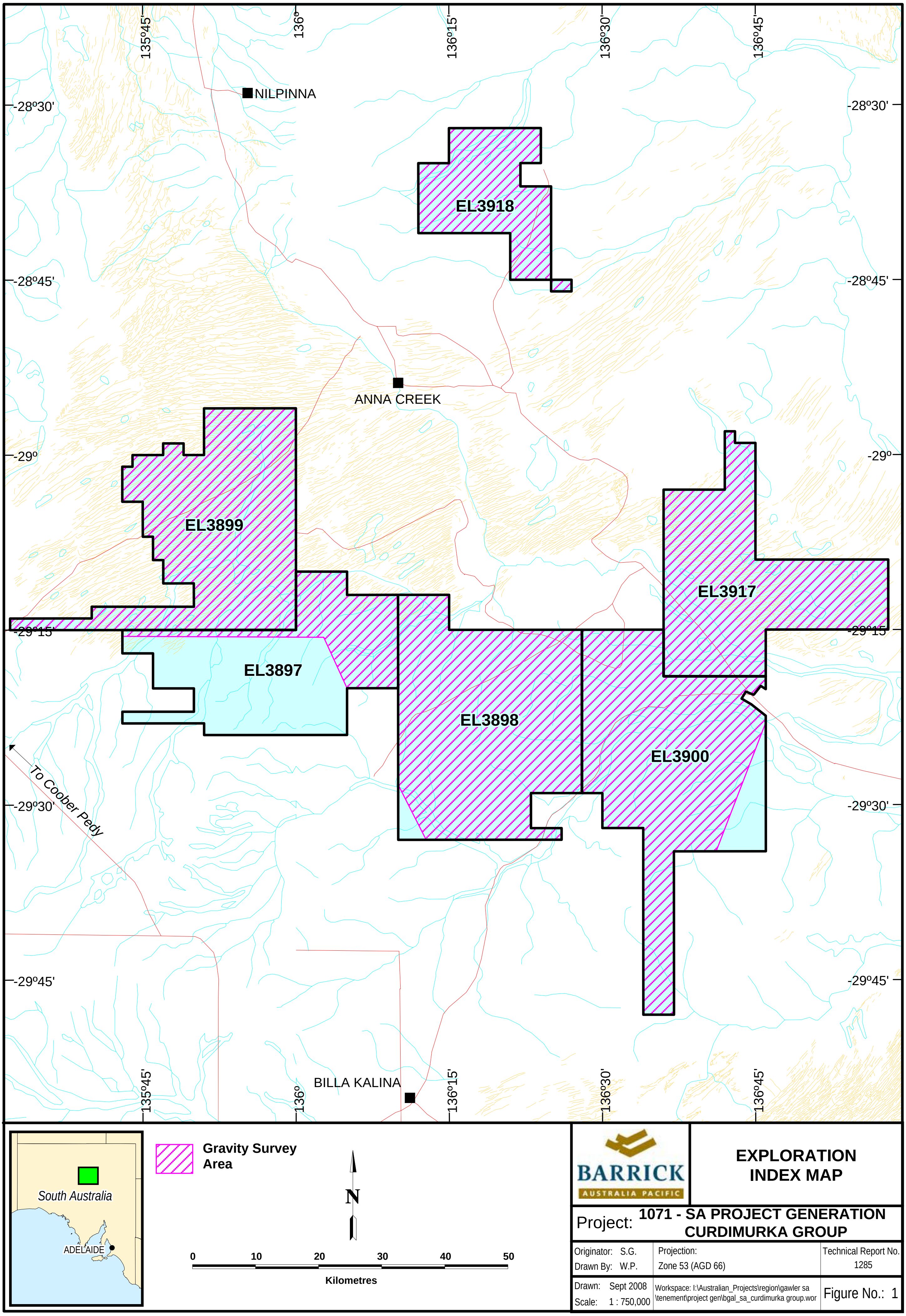
The exploration work during this period was conducted by Barrick Gold of Australia Limited and involved geological familiarisation of the region and project area as well as contributing to a regional ground gravity survey over the Eastern Gawler. The gravity survey collected over 2,000 stations at a station spacing of 1500m. These activities are summarised in Table 1 and illustrated in Figure 1.

Results from the ground gravity survey were encouraging. Anomalous areas have been identified within the Curdimurka Project area using a combination of structural setting, cover thickness, modelled depth, gravity and aeromagnetic response. These anomalous areas will be ranked and assessed against other anomalies identified in the region which will be the focus of further work.

Table 1
SA Project Generation – Curdimurka Project
Summary of Exploration Activities

Tenement	Gravity Stations	Station spacing (m)
EL3897	147	1500
EL3898	419	1500
EL3899	640	1500
EL3900	385	1500
EL3917	320	1500
EL3918	153	1500
TOTAL STATIONS	2064	

Keywords: IOCG, gold, copper, William Creek, Peake and Denison, gravity survey, Gawler Craton



BARRICK AUSTRALIA PACIFIC

EXPLORATION INDEX MAP

Project: **1071 - SA PROJECT GENERATION CURDIMURKA GROUP**

Originator: S.G. Drawn By: W.P.	Projection: Zone 53 (AGD 66)	Technical Report No. 1285
Drawn: Sept 2008 Scale: 1 : 750,000	Workspace: I:\Australian_Projects\region\gawler sa \tenement\project gen\bgal_sa_curdimurka group.wor	Figure No.: 1

2.0 LOCATION AND ACCESS

The Curdimurka Project consists of six tenements which are situated approximately 25-40km south, southeast and southwest of William Creek in South Australia. William Creek is a small town situated at the beginning of the Oodnadatta Track and approximately 700km north-northwest of Adelaide. Access from William Creek to the various tenements within the Curdimurka Project is along various un-sealed station tracks (Figure 2). Some parts of the project area are covered by sand ridges making access more difficult. The project area is situated mostly upon Anna Creek Station, with some overlap onto The Peake Station in the north and Billa Kalina and Stuarts Creek Stations in the south.

The exploration licences occur on the Warrina (5303), Billa Kalina (5307), Curdimurka (5308) and Lake Eyre (5304) 1:250,000 scale geological map sheets (Figure 2).

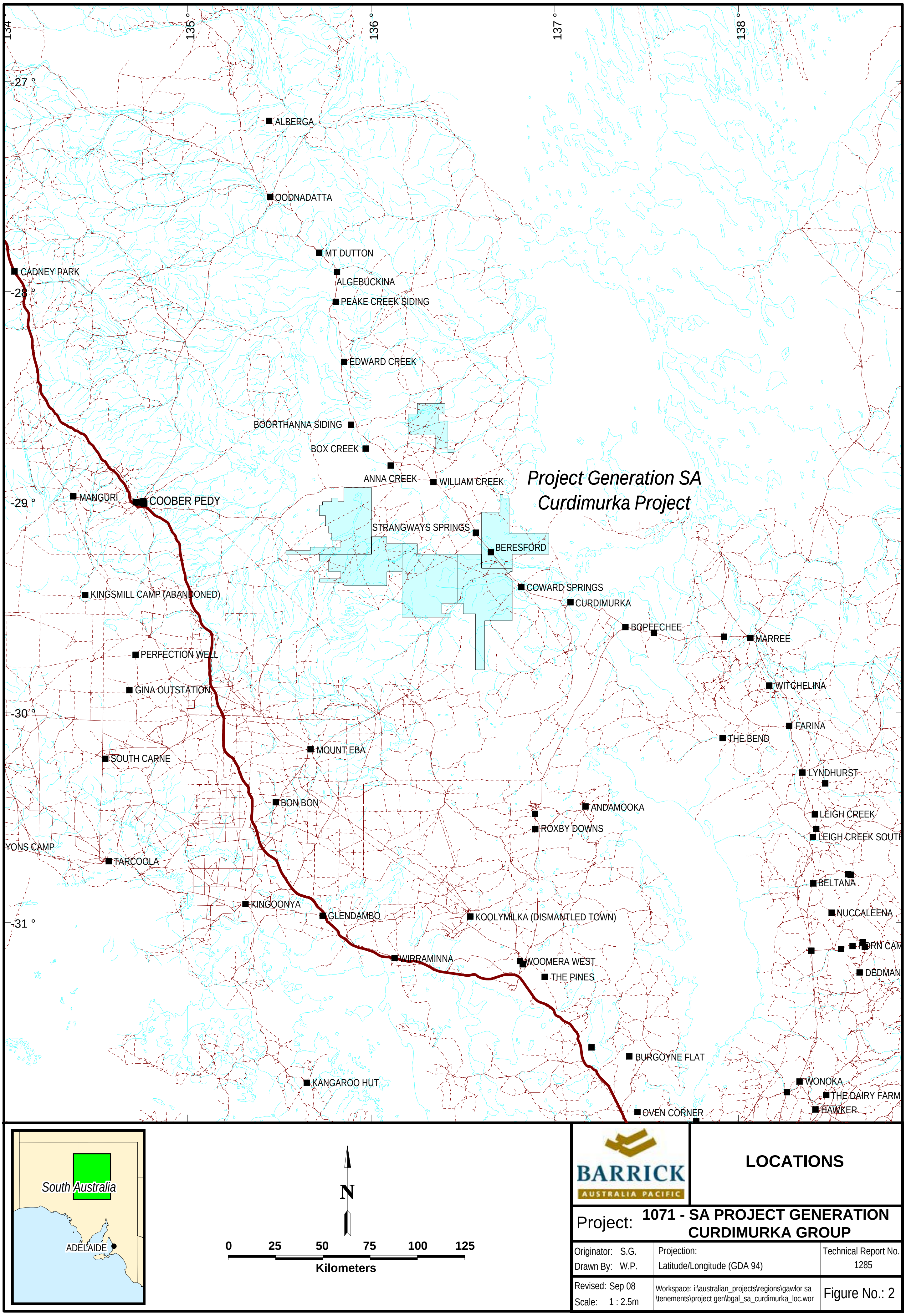
3.0 TENURE

The Curdimurka Project comprises six tenements over 4502km^2 as detailed in Table 2 and illustrated in Figure 3.

Barrick Gold of Australia Ltd (Barrick) is the registered title holder of all tenements and operators of exploration.

Table 2
SA Project Generation – Curdimurka Project
Tenement Register (at 1 September 2008)

Tenement	Area (sq km)	Commences	Expires	Req. Exp.	Comments
EL3897	693	20 Aug 2007	19 Aug 2008	$95,000	Renewal Pending
EL3898	962	20 Aug 2007	19 Aug 2008	$125,000	Renewal Pending
EL3899	815	20 Aug 2007	19 Aug 2008	$110,000	Renewal Pending
EL3900	964	20 Aug 2007	19 Aug 2008	$125,000	Renewal Pending
EL3917	716	20 Aug 2007	26 Aug 2008	$100,000	Renewal Pending
EL3918	352	20 Aug 2007	26 Aug 2008	$65,000	Renewal Pending
Total Expenditure - $620,000					

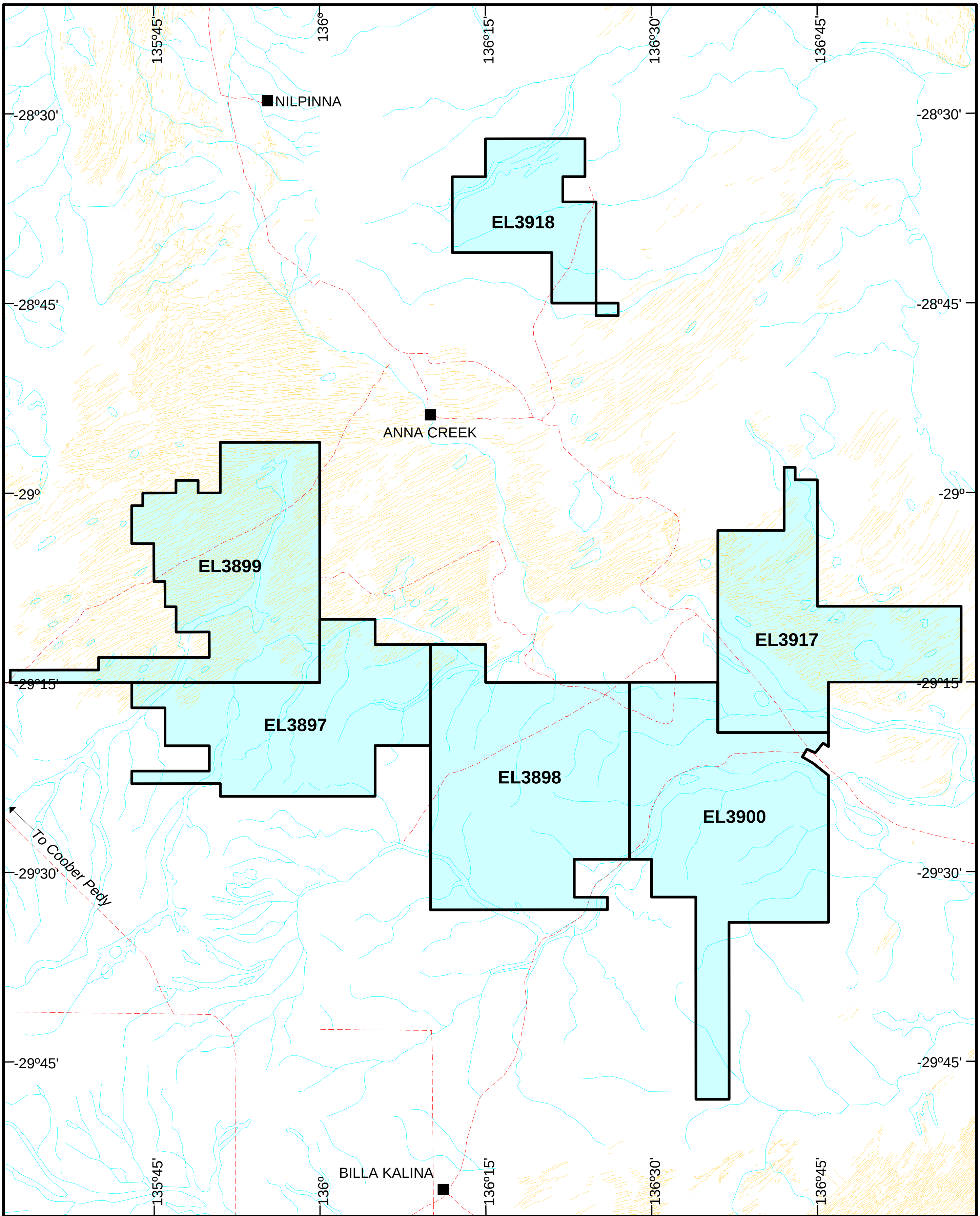


BARRICK
AUSTRALIA PACIFIC

LOCATIONS

Project: **1071 - SA PROJECT GENERATION CURDIMURKA GROUP**

Originator: S.G. Drawn By: W.P.	Projection: Latitude/Longitude (GDA 94)	Technical Report No. 1285
Revised: Sep 08 Scale: 1 : 2.5m	Workspace: i:\australian_projects\regions\gawlor sa \tenements\project gen\bgal_sa_curdimurka_loc.wor	Figure No.: 2



N

0 10 20 30 40 50

Kilometres

BARRICK
AUSTRALIA PACIFIC

TENEMENTS

Project: 1071 - SA PROJECT GENERATION CURDIMURKA GROUP

Originator: S.G. Drawn By: W.P.	Projection: Zone 53 (AGD 66)	Technical Report No. 1285
Drawn: Sept 2008 Scale: 1 : 750,000	Workspace: I:\Australian_Projects\region\gawler sa \tenement\project gen\bgal_sa_curdimurka group.wor	Figure No.: 3

4.0 GEOLOGY
(from Daly et al., 1998, Schwarz et al., 2006 and Drexel and Priess, 1993)

4.1 Regional Geology

The Curdimurka Project tenement package lies at the eastern end of the Mount Woods Complex and the southern end of the Peake and Denison Inlier along the eastern margin of the Gawler Craton, South Australia. The Mount Woods Domain contains fine grained, finely layered, banded iron formation and calcsilicates (Daly *et al.*, 1998). Aeromagnetic images show ductile metamorphic layering inferring reworking of the underlying Archaean. Within the Mount Woods Domain, metasediments underwent granulite facies metamorphism at 1736+-14Ma (Fanning *et al.*, 1997). Also within the Mount Woods Domain is the Engennia Adamellite which has SHRIMP U-Pb zircon age of 1691+-25Ma similar to the age of the Moody Suite granites from the southern Gawler Craton (Parker, 1993). Hiltaba Suite granites occur within the Mount Woods Domain, namely the undeformed Balta Granite (SHRIMP U-Pb age of 1584+-18Ma). The domain is bounded to the north by the Karari Fault and to the south by fault controlled basins. The eastern boundary is defined by a dramatically increasing thickness of overlying sediments and is interpreted to be coincident with the eastern margin of the Gawler Craton.

The Peake and Denison Inlier comprises quartzite (Baltucoodna Quartzite), amygdaloidal basalts and acid volcanics (Tidnamurkuna Volcanics), and quartz-chlorite-muscovite schists collectively termed the Peake Metamorphics. Ages within the Peake and Denison range from 1780+-12Ma (SHRIMP U-Pb zircon – rhyolite from the Tidnamurkuna Volcanics) to 1793+-8Ma (Wirriecurrie Granite) to 1533+-6Ma (SHRIMP U-Pb zircon – unnamed granites intruding the Peake Metamorphics on the eastern side of the Inlier). The boundaries of the Peake and Denison are defined by faulted and unconformable contacts with overlying Adelaidean sediments. Delamerian folding of Adelaidean sediments has mildly overprinted the basement units (Rogers and Freeman, 1996).

The Mount Woods Domain basement is overlain directly by the Boorthanna, Stuart Range and Mount Toondina Formations of the Early Permian to ?late Carboniferous Arckaringa Basin. The basal Boorthanna Formation represents a glacigene sequence with marine upper facies upon which the Stuart Range Formation (homogeneous marine shales and siltstones), and Mount Toondina Formation (terrestrial siltstones, coal and carbonaceous shale grading to sandstone and lacustrine shales) lie. Overlying this is the lower units if the Jurassic-Cretaceous aged Eromanga Basin, namely the basal Algebuckina Sandstone and Cadna-owie Formation (Great Artesian Basin aquifers) and the Bulldog Shale (intervening marine sequence). The Cadna-owie Formation and Bulldog Shale form the main outcropping units within the region.

Overlying the basement of the Peake and Denison Domain and making up the bulk of the outcropping ranges are a very thick sequence of Neoproterozoic sediments and basal volcanics which were deformed and intruded by intermediate and basic igneous and volcanic rocks and diapiric structures during the Palaeozoic Delamerian Orogeny. Unconformably overlying the Neoproterozoic sediments is various basin fill sediments of the Jurassic-Cretaceous aged Eromanga Basin including the Cadna-owie Formation and the Bulldog Shale which outcrop extensively through the region.

Large scale northwest and north northwest trending crustal-scale lineaments occur in the project area (O'Driscolls G2 and G9D lineament corridors) as well as major east-west trending structures which can be observed in the regional geophysics.

Associated with these crustal scale lineaments are smaller scale northeast trending structures.

4.2 Local Geology (from Schwarz *et al.*, 2006 and Drexel *et al.,* 1995)

Paleoproterozoic basement outcrops approximately 18km to the west of the main project area namely granulite, paragneiss, schist, BIF and quartzite of the Mount Woods Complex. The basement rocks are interpreted to be similar for the Curdimurka Project area in the south and west with the cover sequences thickening to the east. The basement rocks for the northern part of the project area (EL3918) are interpreted to be similar to the Peake Metamorphics of the Peake and Denison Domain.

The Paleoproterozoic rocks are overlain by differing basin fill sequences. The Mount Woods Domain area is unconformably overlain by the Early Permian to ?late Carboniferous Arckaringa Basin sediments. These include the Boorthanna, Stuart Range and Mount Toodina Formations which represent an Early Permian glacial depositional phase (Boorthanna Formation) followed by a marine transgression (Stuart Range Formation). Termination of marine sedimentation was brought about by crustal isostatic recovery or eustatic fall and a return to freshwater conditions with it the development of coal swamps (Mount Toodina Formation).

Overlying the Arckaringa Basin is the Jurassic-Cretaceous aged Eromanga Basin. It can be divided into three packages – a lower terrestrial unit (Algebuckina Sandstone and Cadna-owie Formation – Great Artesian Basin aquifers), intervening marine sequence (Bulldog Shale and Oodnadatta Formation) and upper terrestrial unit (Winton and Mackunda Formation. In the lower non-marine succession, large sand-dominated, braided fluvial systems drained centripetally into lowland lakes and swamps. The Early Cretaceous marine succession is dominated by thick highstand mudstones, with thin transgressive shoreface sandstone units. In the Late Cretaceous upper non-marine succession, meandering fluvial systems traversed a flood basin dominated by coal swamps and lakes. The Cadna-owie Formation and the Bulldog Shale are the main outcropping units within the Curdimurka Project area.

The Curdimurka Project area is covered by a thin veneer of recently deposited Cainozoic sediments including dunal sands and gibber plains. These units fringe the outcrops of the Eromanga Basin sediments.

5.0 PREVIOUS EXPLORATION

Previous exploration within the Curdimurka Project area has been conducted by Chevron Exploration Corporation, Shell Development Australia Pty Ltd, Newmont Pty Ltd, Dampier Mining Co Ltd, Cyprus Australia Coal Company, Stockdale Prospecting Ltd, Metana Minerals NL and Flinders Diamonds Ltd. Several commodities have been targeted in the area including IOCG (Iron oxide copper gold), diamonds and coal. These activities are summarised as follows;

- **Chevron Exploration Corporation (~1973)**

Chevron Exploration Corporation targeted the northern Curdimurka area for sedimentary uranium. The Algebuckina Sandstone was considered highly prospective for this type of deposit. Exploration work included seismic surveying, auger drilling,

scintillometer surveying of auger drilling samples, geobotanical surveys and water bore sampling. The
results from this work were not encouraging and the tenement was relinquished in 1974.

- **Shell Development Australia Pty Ltd (~1974)**

Shell Development Australia Pty Ltd targeted the edge of the Boorthanna Trough within the Permian units for shallow coal. The exploration work conducted included aerial photo interpretation and RC drilling. The drilling indicated that the target lithology, Mt Toondina Coal Measures, was not present in the area. The tenement was subsequently relinquished.

- **Newmont Pty Ltd (~1977)**

Newmont Pty Ltd conducted exploration for iron-oxide-copper-gold mineralisation in the Curdimurka area as part of their Mount Morgan project. Detailed gravity data was collected and anomalies identified. One drillhole was completed to 100.6m in the south of the project area which intersected sandy dolomites from 98m. The Mesozoic cover was interpreted to be excessively thick and the tenement was relinquished.

- **Dampier Mining Co Ltd (~1978-80)**

Following the discovery of Olympic Dam Dampier Mining and Newmont Pty Ltd initiated an exploration program in the Northern Gawler area targeting similar geophysical signatures. Exploration work included ground gravity and magnetic surveys and follow-up diamond drilling. Two gravity anomalies were tested. The first target was to be tested with one drillhole which failed to complete the pre-collar. The second target was tested with two drillholes both of which finished in Permian sediments (max depth 399m). Due to the difficult drilling conditions the area was considered to have significant untested potential. It is unclear if the tenement was relinquished or not renewed.

- **Cyprus Australia Coal Company (~1989)**

Cyprus Australia Coal Company was targeting Permian coal measures within the Mount Toodina Formation. Several drillholes into magnetic anomalies were drilled by Joint Venture partners Metana targeting diamonds. These holes happened to be situated on the edge of the Permian trough so Cyprus had the holes deepened to ensure full penetration of the Permian coal measures. The results were disappointing and no further work recommended.

- **Stockdale Prospecting Ltd and Metana Minerals NL (~1989-90)**

Cyprus signed a Joint Venture agreement with Stockdale Prospecting Ltd in 1984 allowing Cyprus to explore for all minerals but for Stockdale to retain the rights for diamonds only. Stockdale also signed a Joint Venture with Metana Minerals in 1988 allowing them to explore for diamonds over the area. Jurassic ages kimberlites were targeted from the diamond indicator minerals and diamonds were known to shed from the Algebuckina Sandstone. Exploration work included an aeromagnetic survey, ground magnetic surveys, drilling (including 5 holes for 288m) of a magnetic anomaly and heavy mineral sampling. No kimberlitic source was intersected and the magnetic anomaly was not explained from the drilling. Analysis of the heavy mineral concentrates from the drilling samples showed a sparse distribution of kimberlitic indicators indicating no presence of a kimberlitic source within the tenement. Metana withdrew from the Joint Venture in early 1990 and Stockdale relinquished the tenement shortly after.

- **Flinders Diamonds Ltd (2004)**

Flinders Diamonds Ltd also targeted the Curdimurka area for diamonds as part of their G2 project. A first pass sampling program was conducted to test for primary Permian aged kimberlitic source rocks. This involved drilling shallow holes on a 25km2 grid and sampling the material immediately above the Permian basement for diamonds and indicator minerals. No samples were collected from the drilling within the Curdimurka project area as the material overlying the Permian basement was deemed unsuitable (Bulldog Shale). No further work was recommended.

6.0 EXPLORATION ACTIVITIES AND RESULTS

Exploration activities conducted on the Curdimurka Project have all been carried out on the Australian Geodetic Datum 1984 (AGD84) in Zone 53.

Exploration activities carried out within the reporting period involved geological familiarisation of the region and project area as well a regional ground gravity survey which Barrick contributed to. The survey was conducted by PIRSA and was part of a large regional gravity survey designed to cover the eastern margin of the Gawler Craton.

6.1 Ground Gravity Survey

During 2007 Atlas Geophysics acquired ground gravity data over the Curdimurka Project area as part of a more extensive regional survey. Data were tied to the Australian Fundamental Gravity Network (AFGN) through the local William Creek Airstrip Gravity Station. Data was acquired at a station spacing of 1500m over the Curdimurka Project area.

Table 3
SA Project Generation – Curdimurka Project
Summary of Gravity Survey

Tenement	Gravity Stations	Station spacing (m)
EL3897	147	1500
EL3898	419	1500
EL3899	640	1500
EL3900	385	1500
EL3917	320	1500
EL3918	153	1500
TOTAL STATIONS	2064	

Full Survey details have been included in Appendix 2 including raw observation digital data listed in Appendix 1

7.0 CONCLUSIONS AND RECOMMENDATIONS

Results from the gravity survey were encouraging. The data generated from the survey has been integrated with other geophysical and geological data to identify anomalous areas. These anomalous areas will be ranked and assessed against other anomalous areas identified in the region. Further work will focus on the highest ranking anomalies and may take the form of;

- Infill gravity surveying – to gain further information over selected targets.
- Infill aeromagnetic surveying – to gain further information (structural) over selected targets.
- Other geophysical surveys e.g. Seismic – to gain a greater understanding of the cover sequence over selected targets /depth to basement.
- Drill testing

8.0 EXPENDITURE STATEMENT

The expenditure attributable to the ten tenements during the reporting period is summarised in Table 4, and details are included in Appendix 3 (exclusive of administration overheads).

Table 4
Curdimurka Project
Expenditure Summary

Tenement	Expenditure	*To period (last reporting date)*
EL3897	$14,201	20 Aug 2008
EL3898	$48,904	20 Aug 2008
EL3899	$43,128	20 Aug 2008
EL3900	$46,911	20 Aug 2008
EL3917	$38,109	26 Aug 2008
EL3918	$18,445	26 Aug 2008
TOTAL EXPENDITURE	$ 209,698	

9.0 REFERENCES

Drexel, JF, Preiss, WV and Parker, AJ (eds), 1993, *The Geology of South Australia, Vol 1: The Precambrian, South Australia*, Geological Survey, Bulletin 54.

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Fanning, CM, Reid, AJ, Teale, GS, 2007, *A geochronological framework for the Gawler Craton, South Australia*, Geological Survey, Bulletin 55.

Preiss, WV and Robertson, 2006, Adelaide Geosyncline and the Stuart Shelf, *In:* Cooper, BJ and McGeough, MA, 2006, South Australia Mineral Explorers Guide. Second edn. *South Australia. Department of Primary Industries and Resources. Mineral Exploration Data Package*, ch7.

Schwarz, M.P. *et al.,* 2006 *In:* Cooper, B.J. and McGeough, M.A. (Eds), 2006, South Australia mineral explorers guide. Second edn. South Australia. Department of Primary Industries and Resources. Mineral Exploration Data Package, 11 ch. 4.

APPENDIX 1

VERIFICATION LISTING FORM

Exploration Work Type	File Name	Format
Office Studies		
Literature search		
Database compilation		
Computer modelling		
Reprocessing of data		
Report	TR1285_A_2008	PDF
Airborne Exploration Surveys		
Aeromagnetics		
Radiometrics		
Electromagnetics		
Gravity		
Digital terrain modelling		
Other (specify)		
Remote Sensing		
Aerial photography		
LANDSAT		
SPOT		
MSS		
Radar		
Other (specify)		
Ground Exploration Surveys		
Geological Mapping		
Regional		
Reconnaissance		
Prospect		
Underground		
Costean		
Ground geophysics		
Radiometrics		
Magnetics		
Gravity	TR1285_Ground_Gravity_Data_Atlas	CSV
Digital terrain modelling		
Electromagnetics		
SP/AP/EP		
IP		
AMT		
Resistivity		
Complex resistivity		
Seismic reflection		
Seismic refraction		
Well logging		
Geophysical interpretation		
Other (specify)		
Geochemical Surveying		
Surface Geochemistry		
Stream sediment		
Soil		
Rock chip		
Laterite		
Water		
Biogeochemistry		
Isotope		
Whole rock		
Mineral analysis		
Other (specify)		
Drilling		
Data Dictionary		
Collar		
Assay		
Survey		
Lithology		
Events		
Recovery		
Magnetic Susceptibility		
Quartz		
Water		
Translation		
Alteration		
Vein		
Structure		
Drill		

APPENDIX 2

Atlas Geophysics Report Number R2007005

Northern G2 Helicopter Gravity Survey

Barrick Gold of Australia

Attention: Mr Brendan Howe

Report completed by:

Leon R Mathews
Geophysicist/Director

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PO BOX 1049
MORLEY WA 6943
AUSTRALIA

info@atlasgeo.com.au

ABN 68 123 110 243

20 October 2007

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APPENDICES

1.0 Company Overview

Atlas Geophysics Pty Ltd is an Australian company based in Bayswater, Western Australia, whose mission is to provide the highest quality geophysical resource data to the mining, petroleum and exploration industry in a safe and timely manner. Through experience, innovation and excellence, the company will exceed its client's expectations and will continually develop its technologies and methodologies to maintain its reputation for being the best in the business.

The company specialises in the acquisition, processing and interpretation of potential field datasets, with particular emphasis on gravity. The directors of the company, Leon Mathews B.Sc. Hons (Geophysics), and Mark Jecks B.Sc. (Geophysics) have a combined total of over 15 years experience in the field of gravity and bring to the company, a young, vibrant and motivated approach to project management. Strategically, through development and research, the company aims to expand into other geophysical acquisition markets that encompass methods such electrical, electromagnetic, induced polarisation and reflection seismic. The company also has interests in developing an airborne platform capable of acquiring high quality magnetic and radiometric data so it can offer its clients a complete airborne and ground geophysical solution.

Atlas Geophysics Pty Ltd is committed to the values and principles of Occupational Health and Safety and Environment. To this end, the company aims to prevent injuries and occupational illness to its employees and minimise any adverse environmental impact its activities may have.

2.2 Survey Configuration

Gravity acquisition over areas funded by Barrick Gold of Australia was conducted using a 1.5km by 1.5km square grid with 750m offset configuration. Areas not funded by Barrick Gold of Australia were surveyed at a 1.5km by 1.5km square grid configuration as part of the PIRSA PACE initiative. This spacing can be considered quite detailed for a helicopter survey, with most helicopter surveys being at 2km-4km spacing.

A small number of stations were offset from their planned station location where heavy tree cover, watercourses or infrastructure made helicopter landings risky. Pilots also took into consideration stock disturbance around bores, wells and dams. Some stations were also omitted where it was thought too dangerous to land the helicopter.

Appendix A contains a station location plot of the acquired gravity stations.

3.0 Personnel and Subcontractors

Atlas Geophysics Pty Ltd engages only fit, motivated and safe working professionals to conduct its gravity operations. Acquisition staff members are from a range of backgrounds, usually from the geoscience or geotechnical fields, and all are trained in senior first aid, bush survival, and advanced four wheel driving. Overseeing the acquisition and processing is the company's team of geophysicists – a team with a combined total of over 15 years experience in the acquisition, processing and quality analysis of gravity data.

3.1 Project Supervision

Supervising the project from the field and office were company directors, Leon Mathews and Mark Jecks. Leon and Mark have been involved in the acquisition, processing and interpretation of potential field data for over ten years and have directly overseen the acquisition and processing of over 400,000 gravity stations.

Both the supervisors were responsible for project supervision, as well as for conducting the acquisition, processing and quality analysis of the gravity data on a daily basis.

All final data processing, QA, reporting and delivery was performed by Leon Mathews.

3.2 Acquisition/Other Personnel

Other personnel participating in field acquisition of the gravity data on this project were:

Christopher Sloot	*Supervising Field Technician*
Michael Ledsome	*Supervising Field Technician*
Kyle Jarvie	*Supervising Field Technician*
Bryce Humphrey	*Field Technician*
Michael Van Senden	*Field Technician*
Michael Howard	*Field Technician*
Evan Jecks	*Field Technician*
Michael Ibbotson	*Field Technician*
Jonathon Kosanov	*Field Technician*

3.2 Subcontractors

Perth based helicopter operations company, Heliwest, were chosen to supply the helicopters, pilots and engineering support. More information about this company may be found at www.heliwest.com.au

4.0 Equipment and Instrumentation

4.1 Glonass/GPS Receiver Equipment

Leading-edge dual-frequency GPS technologies from Leica Geosystems such as the GPS1200 have been utilised on the project to allow for real-time centimetre level accuracy 3D positions. System specifications for the receivers utilised can be found in the attached brochures (Figures 2-4). Atlas Geophysics Pty Ltd is the first gravity acquisition company in Australia to utilise GNSS technology enabled receivers. The GPS1200 system is equipped with future proof GNSS technology which is capable of tracking all available GNSS signals including the currently available GLONASS. These new generation receivers, in conjunction with full GNSS tracking and processing, offer a new level of unmatched solution accuracy and reliability, especially when compared to existing conventional L1L2 GPS technologies.

The use of Glonass technology in addition to GPS provides very significant advantages:

Increased satellite signal observations

Markedly increased spatial distribution of visible satellites

Reduced Horizontal and Vertical Dilution of Precision (DOP) factors

Improved post-processed-kinematic (PPK) performance

Decreased occupation times means faster acquisition

Three Leica GPS1200 geodetic grade receivers were utilised to conduct the survey. Two receivers were used as post-processed-kinematic (PPK) rovers in the helicopters, with the third receiver used as a base station for logging static data on the control station.

On each helicopter, the GPS/Glonass antenna was mounted on the tail-boom of the aircraft, with the receiver mounted on a custom mount inside the rear cabin of the helicopter.

Navigation between gravity stations was facilitated by Garmin 296 GPS receivers operating in autonomous mode.

4.2 Gravity Instrumentation

Complementing the company's GNSS/GPS technologies is the latest in gravity instrumentation from Scintrex Ltd, the Scintrex CG-5 (Figure 5). The CG-5 digital automated gravity meter offers all of the features of the low noise industry standard CG-3M micro-gravity unit, but is smaller and lighter. It also offers improved noise rejection. By constantly monitoring tilt sensors electronically, the CG-5 automatically compensates for errors in gravity meter tilt. Due to a low mass and the excellent elastic properties of fused quartz, tares are virtually eliminated.

The CG-5 can be transported over very rough terrain, on quad bikes, foot, vehicle or helicopter without taring or drifting. In terms of repeatability, the CG-5 outperforms all existing gravity meter technologies, with a factory quoted repeatability of better than 0.005 mGals.

Table 1 below lists the gravity meters used on the project:

Gravity Meter Type	Gravity Meter Code*	Gravity Meter Serial Number
Scintrex CG5	H2	135
Scintrex CG5	A1	40240
Scintrex CG5	A2	40241
Scintrex CG5	A2	40269

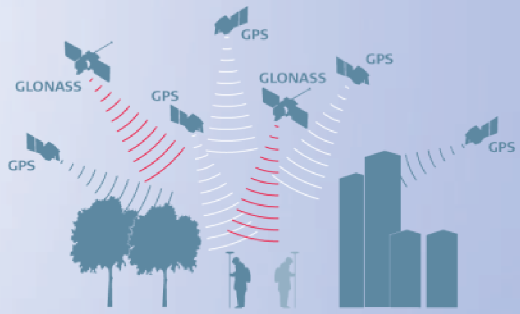
Table 1: Gravity meters used on the project.

4.3 Other Equipment

The company utilised the following additional equipment to fully support the operations:

- Two HP Laptop computers for data download and processing
- Six Iridium satellite phones for long distance communications and scheduled calls
- Two Omnitrack tracking units to track the position of the helicopters
- Personal Protective Equipment for all personnel
- Batteries, battery chargers, solar cells, UPS System
- Survey consumables
- Tools, engineering and maintenance equipment for vehicle and quadbike servicing
- First aid and survival kits
- Tyres and recovery equipment

Leica GPS1200
Fast, accurate, rugged and reliable



SMARTTRACK+

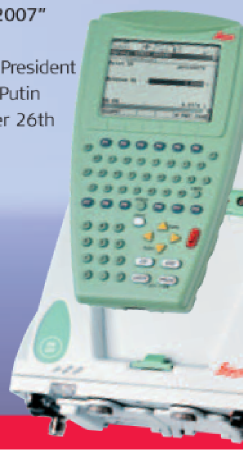
GNSS technology
GPS1200's SmartTrack+ measurement engine now utilizes two global navigation satellite systems increasing the number of tracked satellites. The new SmartTrack+ measurement engine tracks all available GNSS signals (L2C and GLONASS). More satellites means higher productivity, accuracy and reliability. SmartTrack+ acquires satellites within seconds, is ideal in urban canyons and obstructed areas where other receivers often fail. GPS1200 with SmartTrack+ is designed to support the future signals GPS L5 and Galileo.

SmartCheck+
Continuously checking provides the highest possible reliability. A unique, built-in integrity monitoring system checks all results immediately. SmartCheck+ now processes GPS and GLONASS measurements simultaneously for centimeter-accuracy, 20 Hz RTK at 30 km and more. Initialize within seconds and survey in obstructed areas with a GX1230/ATX1230 (GPS only) sensor or increase productivity with a GX1230 GG/ATX1230 GG (GPS and GLONASS).

GLONASS
For many years the GLONASS system was not reliable enough in terms of satellite availability and system performance. With recent launches and commitment from the Russian government, reliability and availability are significantly improved. Under normal conditions there are 2 to 5 additional satellites compared to a GPS only constellation – and even more satellites will be available over the next two years. Now is the time to invest in hybrid GNSS technology.

"The GLONASS system should be created before 2008, as it was originally planned ... We have the possibility. Let us see what can be done in 2006 – 2007"

(Russian President Vladimir Putin December 26th 2005).



Exceptionally rugged
Don't worry about how your crews handle GPS1200. It's built to Mil specs to withstand the roughest use. With its strong, precision-machined magnesium housing, GPS1200 stands up to drops and falls and the jolts and vibrations of machines.

Immune to bad weather
Designed for temperatures from –40° C to +65° C (storage +80° C). GPS1200 shrugs off arctic cold and blistering heat. Fully waterproof – withstands immersion to 1 m – sand and dustproof, it operates perfectly in any conditions from tropical rainfall to desert sandstorms. GPS1200 just keeps on working.

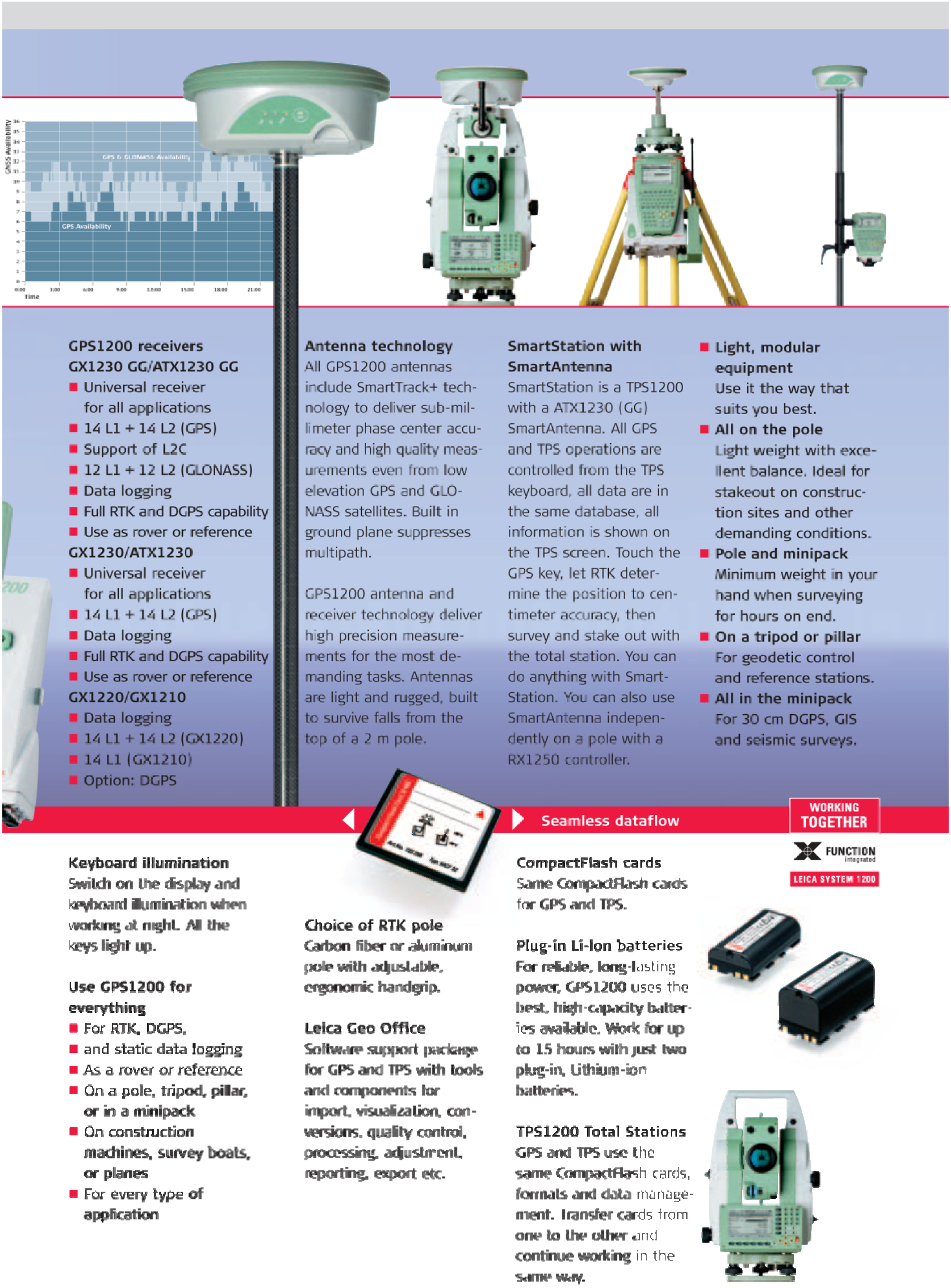
High contrast touch screen
The high quality 1/4 VGA (11 lines by 32 characters) with optional colour option (RX1250) touch screen guarantees perfect clarity and contrast. Whether in fading light or bright sunshine, you can always read the display perfectly. Operate using the touch screen or the QWERTY keyboard, which ever you prefer.

With or without controller
Connect the controller to the receiver when you need to input information and make full use of the on-board functions and programs.

RTK/DGPS communication
Radio modems, GSM, GPRS and CDMA modules fit in waterproof housings attached to the receiver. Attach either one or two devices for RTK/DGPS reference and rover applications.

With *Bluetooth* Wireless-Technology built in to the RX1250 controller complete cable free operation and connectivity to compatible wireless products is available.

Figure 2: Leica GPS1200 product brochure



GPS1200 receivers
GX1230 GG/ATX1230 GG
- Universal receiver for all applications
- 14 L1 + 14 L2 (GPS)
- Support of L2C
- 12 L1 + 12 L2 (GLONASS)
- Data logging
- Full RTK and DGPS capability
- Use as rover or reference

GX1230/ATX1230
- Universal receiver for all applications
- 14 L1 + 14 L2 (GPS)
- Data logging
- Full RTK and DGPS capability
- Use as rover or reference

GX1220/GX1210
- Data logging
- 14 L1 + 14 L2 (GX1220)
- 14 L1 (GX1210)
- Option: DGPS

Antenna technology
All GPS1200 antennas include SmartTrack+ technology to deliver sub-millimeter phase center accuracy and high quality measurements even from low elevation GPS and GLONASS satellites. Built in ground plane suppresses multipath.

GPS1200 antenna and receiver technology deliver high precision measurements for the most demanding tasks. Antennas are light and rugged, built to survive falls from the top of a 2 m pole.

SmartStation with SmartAntenna
SmartStation is a TPS1200 with a ATX1230 (GG) SmartAntenna. All GPS and TPS operations are controlled from the TPS keyboard, all data are in the same database, all information is shown on the TPS screen. Touch the GPS key, let RTK determine the position to centimeter accuracy, then survey and stake out with the total station. You can do anything with SmartStation. You can also use SmartAntenna independently on a pole with a RX1250 controller.

- **Light, modular equipment**
  Use it the way that suits you best.
- **All on the pole**
  Light weight with excellent balance. Ideal for stakeout on construction sites and other demanding conditions.
- **Pole and minipack**
  Minimum weight in your hand when surveying for hours on end.
- **On a tripod or pillar**
  For geodetic control and reference stations.
- **All in the minipack**
  For 30 cm DGPS, GIS and seismic surveys.

Seamless dataflow

WORKING TOGETHER

FUNCTION integrated

LEICA SYSTEM 1200

Keyboard illumination
Switch on the display and keyboard illumination when working at night. All the keys light up.

Use GPS1200 for everything
- For RTK, DGPS,
- and static data logging
- As a rover or reference
- On a pole, tripod, pillar, or in a minipack
- On construction machines, survey boats, or planes
- For every type of application

Choice of RTK pole
Carbon fiber or aluminum pole with adjustable, ergonomic handgrip.

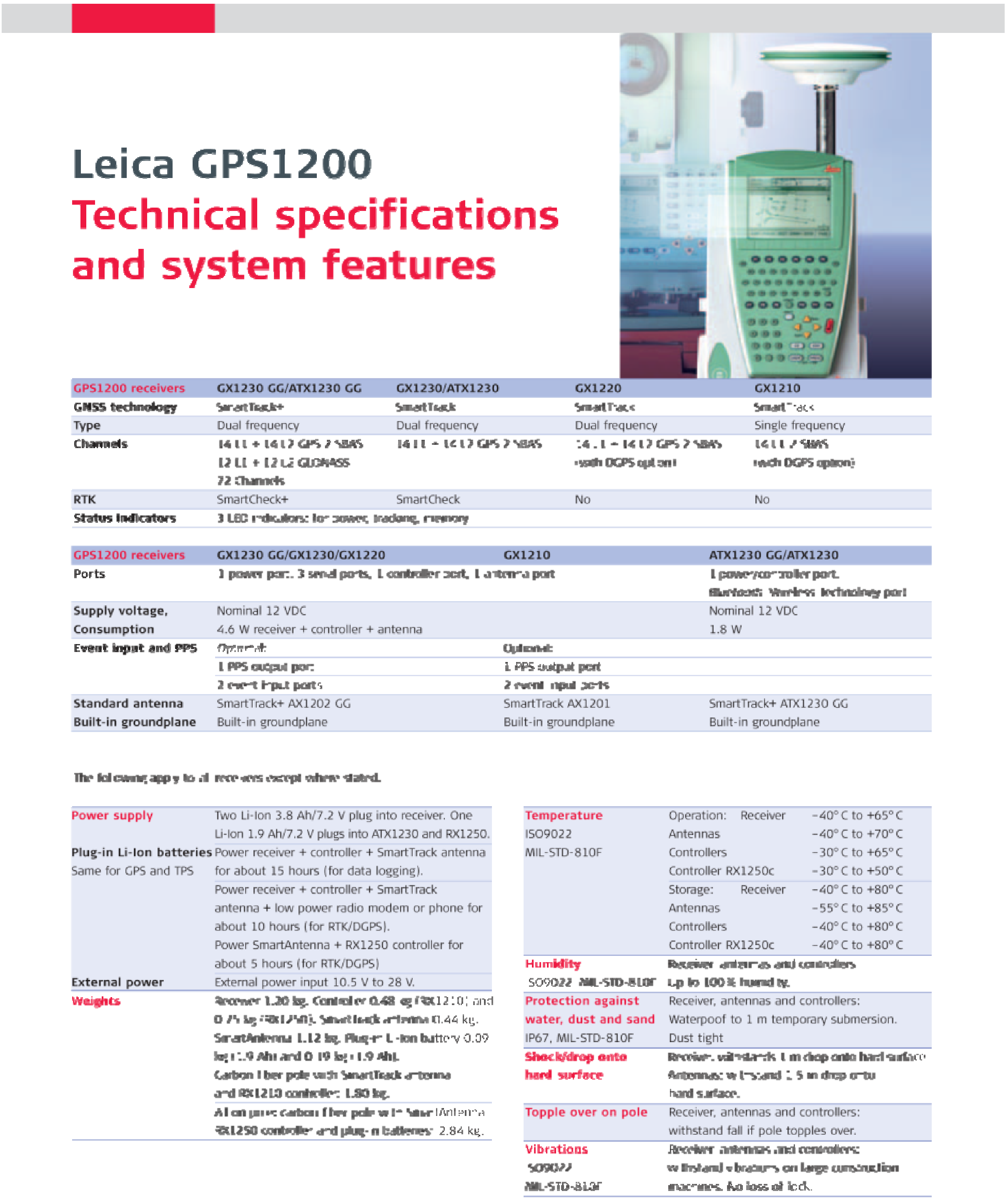
Leica Geo Office
Software support package for GPS and TPS with tools and components for import, visualization, conversions, quality control, processing, adjustment, reporting, export etc.

CompactFlash cards
Same CompactFlash cards for GPS and TPS.

Plug-in Li-Ion batteries
For reliable, long-lasting power, GPS1200 uses the best, high-capacity batteries available. Work for up to 15 hours with just two plug-in, Lithium-ion batteries.

TPS1200 Total Stations
GPS and TPS use the same CompactFlash cards, formats and data management. Transfer cards from one to the other and continue working in the same way.

Figure 3: Leica GPS1200 product brochure



Leica GPS1200
Technical specifications and system features

GPS1200 receivers	GX1230 GG/ATX1230 GG	GX1230/ATX1230	GX1220	GX1210
GNSS technology	SmartTrack+	SmartTrack	SmartTrack	SmartTrack
Type	Dual frequency	Dual frequency	Dual frequency	Single frequency
Channels	14 L1 + 14 L2 GPS 2 SBAS 12 L1 + 12 L2 GLONASS 72 Channels	14 L1 + 14 L2 GPS 2 SBAS	14 L1 + 14 L2 GPS 2 SBAS (with DGPS option)	14 L1 2 SBAS (with DGPS option)
RTK	SmartCheck+	SmartCheck	No	No
Status indicators	3 LED indicators: for power, tracking, memory			

GPS1200 receivers	GX1230 GG/GX1230/GX1220	GX1210	ATX1230 GG/ATX1230
Ports	1 power port, 3 serial ports, 1 controller port, 1 antenna port		1 power/controller port, Bluetooth® Wireless technology port
Supply voltage, **Consumption**	Nominal 12 VDC 4.6 W receiver + controller + antenna		Nominal 12 VDC 1.8 W
Event input and PPS	Optional: 1 PPS output port 2 event input ports	Optional: 1 PPS output port 2 event input ports	
Standard antenna **Built-in groundplane**	SmartTrack+ AX1202 GG Built-in groundplane	SmartTrack AX1201 Built-in groundplane	SmartTrack+ ATX1230 GG Built-in groundplane

The following apply to all receivers except where stated.

Power supply	Two Li-Ion 3.8 Ah/7.2 V plug into receiver. One Li-Ion 1.9 Ah/7.2 V plugs into ATX1230 and RX1250.
Plug-in Li-Ion batteries Same for GPS and TPS	Power receiver + controller + SmartTrack antenna for about 15 hours (for data logging). Power receiver + controller + SmartTrack antenna + low power radio modem or phone for about 10 hours (for RTK/DGPS). Power SmartAntenna + RX1250 controller for about 5 hours (for RTK/DGPS)
External power	External power input 10.5 V to 28 V.
Weights	Receiver 1.20 kg, Controller 0.48 kg (RX1210) and 0.75 kg (RX1250), SmartTrack antenna 0.44 kg, SmartAntenna 1.12 kg, Plug-in Li-Ion battery 0.09 kg (1.9 Ah) and 0.19 kg (3.8 Ah). Carbon fiber pole with SmartTrack antenna and RX1210 controller: 1.80 kg. All on pole: carbon fiber pole with SmartAntenna, RX1250 controller and plug-in batteries: 2.84 kg.

Temperature ISO9022 MIL-STD-810F	Operation: Receiver Antennas Controllers Controller RX1250c	−40° C to +65° C −40° C to +70° C −30° C to +65° C −30° C to +50° C
	Storage: Receiver Antennas Controllers Controller RX1250c	−40° C to +80° C −55° C to +85° C −40° C to +80° C −40° C to +80° C
Humidity ISO9022, MIL-STD-810F	Receiver, antennas and controllers: Up to 100% humidity.	
Protection against water, dust and sand IP67, MIL-STD-810F	Receiver, antennas and controllers: Waterpoof to 1 m temporary submersion. Dust tight	
Shock/drop onto hard surface	Receiver: withstands 1 m drop onto hard surface. Antennas: withstand 1.5 m drop onto hard surface.	
Topple over on pole	Receiver, antennas and controllers: withstand fall if pole topples over.	
Vibrations ISO9022 MIL-STD-810F	Receiver, antennas and controllers: withstand vibrations on large construction machines. No loss of lock.	

Figure 4: Leica GPS1200 technical specifications

SPECIFICATIONS

Sensor Type
Fused Quartz using electrostatic nulling

Reading Resolution
1 microGal

Standard Field Repeatability
< 5 microGal

Operating Range
8,000 mGal without resetting

Residual Long-Term Drift (static)
Less than 0.02 mGal/day

Range of Automatic Tilt Compensation
± 200 arc sec

Tares
Typically less than 5 microGals for shocks up to 20 G.

Automated Corrections
Tide, Instrument Tilt, Temperature, Noisy Sample, Seismic Noise Filter.

Dimensions
31 cm (H) x 22 cm x 21 cm
12 in (H) x 8.5 in x 8 in

Weight (including batteries)
8 kg, (17.5 lbs.)

Battery Capacity
2 x 6Ah (10.8V) rechargeable Litium-Ion Smart Batteries. Full day operation in normal survey conditions with two fully charged batteries.

Power Consumption
4.5 Watts at 25°C

Standard Operating Temperature Range
-40°C to +45°C

Ambient Temperature Coefficient
0.2 microGal/°C (typical)

Pressure Coefficient
0.15 microGal/kPa (typical)

Magnetic Field Coefficient
1 microGal/Gauss (typical)

Memory
Flash Technology (data security)
Standard 12 MBytes

Digital Data Output
RS-232 C and USB interface
Is optimized for Win XP™

Analog Data Output
Strip-Chart Recorder

Display Screen
¼ VGA 320 x 240 pixels

Keypad
27 key alpha/numeric

Standard System
- CG-5 Console
- Tripod base
- 2 rechargeable batteries
- Battery Charger, 110/240 V
- External Power 110/240 V
- RS-232 and USB Cables
- Carrying Bag
- Data dump and utilities software
- Operating Manual (CD)
- Transit Case

GPS
Enables GPS station referencing from an external 12 channel smart GPS antenna being connected via the RS-232 port. Standard GPS accuracy: <15m DGPS (WAAS) < 3m. Client has the option to use other higher accuracy GPS receivers outputting NMEA data string through the serial port.

OPTIONS

High Temperature Option
For use in climates that may exceed the normal operating temperate of 45°C. Allows operating temperatures of up to 55°C. This option is intended to be used in climates above freezing and needs to be ordered at the time of purchase.

Battery Belt
Suggested for cold weather operation.

COMPLETE GRAVITY SOLUTIONS

Special Applications
Please contact LRS Scintrex or your local representative.

Training Programs
LRS Scintrex can provide training programs at our office in Canada or at your location.

Application Software
LRS Scintrex can provide software packages to support your data processing, interpretation and mapping needs.

An ISO 9001:2000 registered company

* All specifications are subject to change without notice.

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Figure 5: Scintrex CG-5 specifications

Photo 1: Helicopters VH-FLR and VH-TVL

Photo 2: Helicopters, vehicles and crew outside the famous William Creek Hotel

5.0 Vehicle and Helicopter Transportation

5.1 Helicopters

Two Robinson R44 Raven II helicopters (call-signs TVL and FLR) were used to traverse between gravity stations during acquisition (Photos 1 and 2). The machines performed excellently considering the dusty conditions encountered, with the gravity crews experiencing little downtime due to helicopter maintenance or reliability issues. All helicopters were serviced in accordance with CASA specifications, with 100 hourly services carried out in nearby hangars.

All helicopters were equipped with EPIRB devices and comprehensive first aid and survival kits. Communications were via VHF radio and Iridium satellite phone.

Aviation fuel and oils were supplied by local operators in the area.

5.1 Support Vehicles

Supporting the helicopter operations were two 4WD Toyota Landcruiser utilities used for refuelling and pilot changeovers, and one Toyota 4WD wagon used for crew and pilot transport. The vehicles were fitted with the following equipment:

- Iridium satellite phone
- Magellan FX324 navigation grade GPS receiver
- Spare navigation grade GPS receiver with batteries
- First aid and survival kit
- Two spare tyres
- Recovery equipment for tyre repair
- Recovery equipment including winch for bogging, stranding.
- Comprehensive tool-kit to effect in field repairs
- 10L of drinking water
- Flashing rotating beacon

The vehicles used on the project were sourced from Ceduna Rent a Car and were covered under Ceduna Rent a Car's service and maintenance schedule.

6.0 Camping / Accommodation

No camping was required to conduct the survey. Accommodation and messing was supplied by local operators at each of the logistical bases: Oodnadatta, William Creek and Andamooka.

7.0 Communications, Internet and Scheduled Calls

The primary method of communication for the field crews was via Iridium satellite phones. The helicopter crews made scheduled calls to the field operations base at hourly intervals. In addition to scheduled calls, the position of the helicopter was reported to the operations base at 10 minute intervals using Omnitrack technology.

Internet connections for client contact and data server access were established using satellite broadband and Next G networks.

8.0 Survey Methodology

All gravity data were acquired using Atlas Geophysics Pty Ltd helicopter-borne techniques. These techniques, which involve concurrent GPS and gravity acquisition, allow for rapid acquisition of very high quality data.

8.1 Gravity and GPS Control Establishment

GPS and gravity control stations were established at each of the logistical bases: Oodnadatta, William Creek and Andamooka (Table 2). At each station, a permanent monument was erected to mark and witness the station. Each monument consisted of a uniquely numbered (in DTEI format) brass PSM set in concrete, alongside a small (30cm diameter) circular concrete slab also set in concrete. The PSM marked the position of the GPS control station and the concrete slab the position of the gravity control station. A steel star picket of 1.25m length was placed within 0.5m of each station and carried both a DTEI supplied and Atlas Geophysics Pty Ltd witness plaque numbered with a unique station number in accordance with the DTEI format (Figure 6).

Control Station ID	Lat / Long / Ht (GDA94)	Observed Gravity (mGals)
GRVGPS0003 *Oodnadatta*	-27 33 24.4075 135 26 26.8845 119.949	979212.257
GRVGPS0004 *William Creek*	-28 54 33.5007 136 20 15.8708 81.552	979320.434
GRVGPS0005 *Andamooka*	-30 26 14.2569 138 08 15.8749 128.564	979085.835

Table2: Gravity and GPS control stations used to control the survey

The details of all control stations have been recorded on Atlas Geophysics Pty Ltd control station summary sheets. The sheets include the geodetic coordinates, observed gravity value, station description, locality sketch, locality map and a digital photo of the station. The sheets are contained in Appendix B and will be submitted to DTEI for reference.

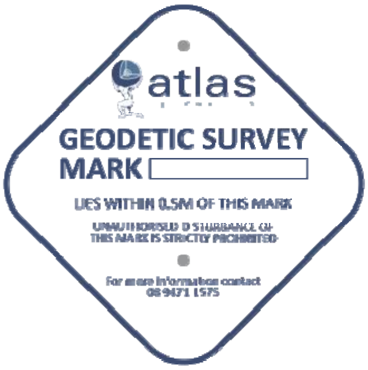


Figure 6: Atlas Geophysics Pty Ltd survey witness plaque

8.1.1 GPS Control

Primary GPS control was established at all control stations within the survey area and allowed all position and height information obtained from the gravity survey to be tied to the Geocentric Datum of Australia (GDA94) and Australian Height Datum (AHD).

Coordinates for the control stations were established using the 5 second static GPS data logged at the station whilst the gravity survey was underway. The static data has been submitted to Geoscience Australia's AUSPOS processing system to produce first-order geodetic control station coordinates accurate to better than 10mm for the x, y and z observables. Multiple days of static GPS data using different GPS antenna heights have been submitted to ensure accuracy and reliability of the solution.

Initial surveying was conducted using adopted control station coordinates since the AUSPOS system requires approximately two weeks before a Final Ephemeris Solution can be delivered. The adopted coordinates were derived from an autonomous GPS measurement at the control station giving an accuracy of better than 0.5m for x, y coordinates and better than 15m for the z coordinate. Once the final ephemeris solution for control station coordinates was delivered by AUSPOS, all control and field GPS measurements had the necessary DC shift applied to give accurate, absolute positions for east, north and elevation. The details of the control process have been summarised in a table included in Appendix C.

8.1.2 Gravity Control

Primary gravity control stations were established at the same location as the primary GPS control stations. Once tied to the Australian Fundamental Gravity Network (AFGN), the gravity control stations allowed all field gravity observations to be tied to the ISOGAL84/ISGN71 gravity datum employed by Geoscience Australia.

An accurate observed or absolute gravity value for the control stations was established via "ABABA" ties with multiple gravity meters to nearby AFGN stations. Table 3 summarises the control ties conducted. Expected accuracy of the individual tie surveys would be better than 0.01 mGals.

Control Station ID	AFGN station tied to	Date of tie
GRVGPS0003 *Oodnadatta*	Coober Pedy AS 1992932018 GRVGPS0004	07/06/07 and 12/06/07 19/07/07
GRVGPS0004 *William Creek*	William Creek Hotel 1967939308	12/07/07-14/07/07
GRVGPS0005 *Andamooka*	William Creek Hotel 1967939308 Woomera AS 1964910138	19/07/07 09/09/07

Table 3: Gravity and GPS control stations used to control the survey

8.2 GPS Data Acquisition, Processing and Quality Analysis

GPS-Glonass data were collected in static mode at each of the control stations and in kinematic mode on the helicopters using geodetic grade Leica GPS1200 receivers. Rigorous post-processing of the recorded kinematic data allowed for excellent GPS-Glonass ambiguity resolution and 3-D solution coordinate qualities better than 3cm for each of the gravity station locations. Atlas Geophysics quality analysis (QA) procedures ensured all data met and exceeded contract specifications. Atlas Geophysics QA procedures have ensured the final GPS-Glonass data have met and exceeded all contract specifications.

8.2.1 GPS-Glonass Acquisition

Each gravity station location (GSL) was positioned using navigation grade Garmin receivers fitted to the cockpit of the helicopters. Accuracy of the positioning system was better than 5m and where possible, the helicopter crew landed as close to the programmed station location as possible. Where it was too dangerous to land, stations were moved from the programmed coordinate. Some stations were omitted where it was not possible to find a safe landing spot. E.g. heavily vegetated, hilly and built up areas.

For the kinematic helicopter operations, the GPS-Glonass sensor was mounted on the tail boom of the aircraft and phase data logged by the receiver inside the cabin. Data were logged at five second epochs onto Compact Flashcard (CF) for later downloading and processing. Static data were also concurrently logged at the primary GPS control station to allow for later kinematic processing. Secondary control stations located within the survey area were also used to restrict GPS baseline length. Static post-processing of the primary and secondary station GPS data allowed for derivation of secondary base station coordinates.

8.2.2 GPS-Glonass Processing

The acquired raw GPS-Glonass data were processed nightly using Novatel Waypoint Grafnav v7.8 post-processing software (Figure 7). GrafNav is a fully-featured kinematic and static GPS/Glonass post-processing package that uses Waypoint's robust GPS/Glonass processing carrier phase kinematic (CPK) filter engine. The software is capable of processing raw kinematic GPS/Glonass data from most GPS/GNSS receivers and allows the user to process the roving data from as many as eight separate control stations to achieve accuracies at the centimetre level. The software can automatically switch from static to kinematic processing and has a fixed static solution for static initialisation of short or medium baselines that are below 30km. A float static solution is available for baselines longer than this. Kinematic Ambiguity Resolution (KAR) allows the session to start in kinematic mode and can help fix otherwise unrecoverable cycle slips. Ionopsheric processing and modelling is also included with the software and can help improve accuracy, especially over long baselines. Advantages of the Waypoint processing engine over other packages include:

Fast Processing – The Grafnav engine is one of the fastest on the market. For a single base station, a 2.40 Mhz PIII CPU can expect to process GPS data at 670 epochs/second. This means that a 4-hour 2 Hz data set will process one direction in 22 seconds. For two bases, processing takes 250 epochs/second or about 1 minute for the same 4-hour data set. For 4 bases, these times are 50 epochs/second or about 5 minutes.

Reliable OTF Processing – Waypoint's on-the-fly KAR algorithm has had years of development and testing. Various implementations and numerous options are available to control this powerful feature.

Multi-Base (MB) processing – With Version 7.80, GrafNav now supports true multiple control station processing where all of the baselines are incorporated into one sophisticated Kalman filter. This can spatially decorrelate some of the error sources while also allowing integer ambiguity determination using the closest base station. Satellite drop-outs at one base will also be compensated by the others. The two biggest advantages are improved overall accuracies and much less operator effort required to process and QC such data.

Accurate Static Processing – Three modes of static processing are implemented in the main processing kernel.

Dual Frequency Support – Full dual frequency GPS processing comes with the software. For ambiguity resolution, this entails wide/narrow lane solutions for KAR, fixed static and quick static. 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. GrafNav also has the ability to combine these two solutions to obtain a globally optimum one.

GPS + GLONASS – The GrafNav kernel has the ability to also process GPS+GLONASS data. This is especially advantageous for applications in forested areas, where the additional satellite coverage can improve accuracies.

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.

High Dynamics – The GrafNav kernel can handle extremely high dynamics from missiles, rockets, dropped ordinances, and fast flying aircraft.

Long Baseline - Because precise ephemeris and dual frequency processing is supported, long baselines accuracies can be as good as 0.1 PPM.

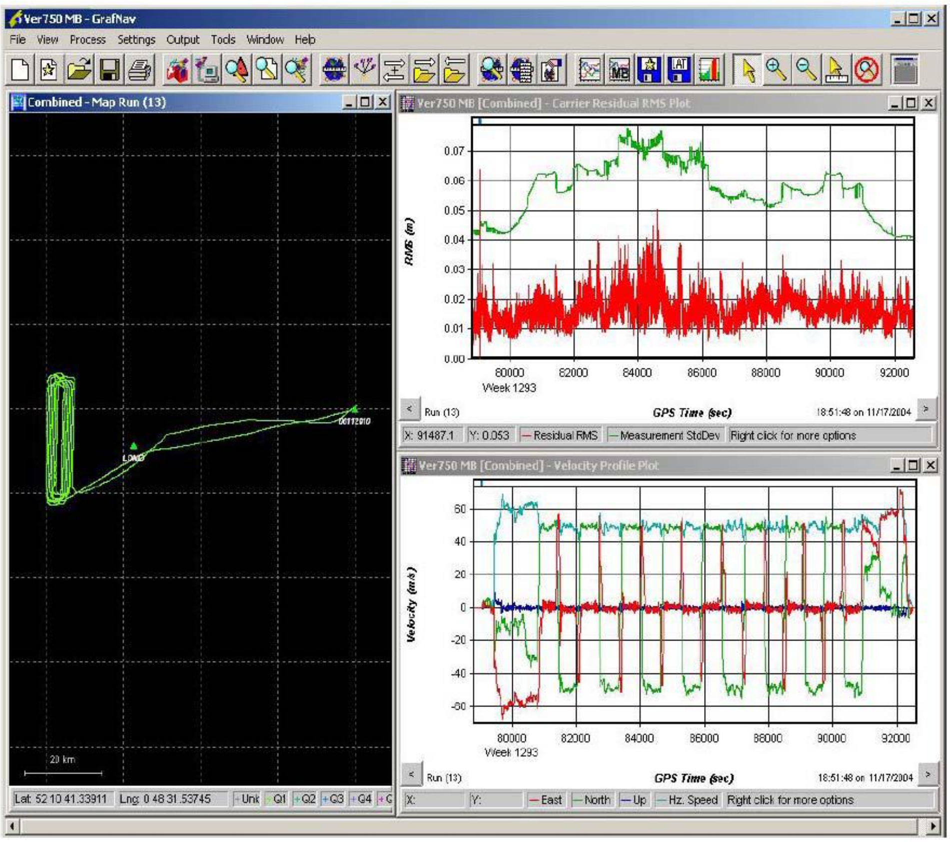


Figure 7: Waypoint Grafnav Processing Software

Once each epoch was processed to give a solution for the WGS84 position, transformations between GPS-Glonass derived WGS84/GDA94 coordinates to Map Grid of Australia (MGA) coordinates were conducted within Waypoint. For most practical applications, where a horizontal accuracy of only a metre or greater is required, GDA94 coordinates can be considered the same as WGS84. MGA94 coordinates were obtained by projecting the GPS-derived WGS84 coordinates using a Universal Transverse Mercator (UTM) projection with zone 53S. For more information about WGS84, GDA94 and MGA coordinates, the reader is asked to visit the Geoscience Australia website: http://www.ga.gov.au/geodesy/datums/gda.jsp.

Elevations above the Australian Height Datum (AHD) were modelled using Leica Geo Office software and the latest geoid model for Australia, AUSGEOID98. 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/. To obtain AHD elevation, the modeled N value is subtracted from the GPS derived WGS84 ellipsoidal height (Figure 8).

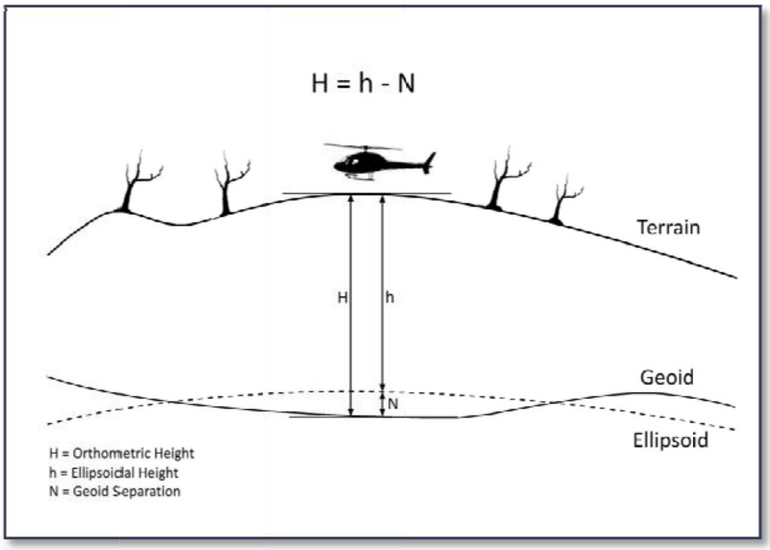


Figure 8: Geoid-Ellipsoid Separation

8.2.3 GPS/Glonass Quality Analysis

Rigorous quality analysis procedures were applied to the acquired GPS-Glonass data on a daily basis using Waypoint Grafnav's built in QA tools. Some of the tools used on this project include:

Combined Separation Plot: This plot shows the difference between the forward and reverse solutions (Figure 9). A perfect solution would have a separation of zero as this indicated the carrier phase ambiguities have been determined to be exactly the same value in both directions. A separation of better than 0.1m on a helicopter survey would indicate that the data is of high quality.

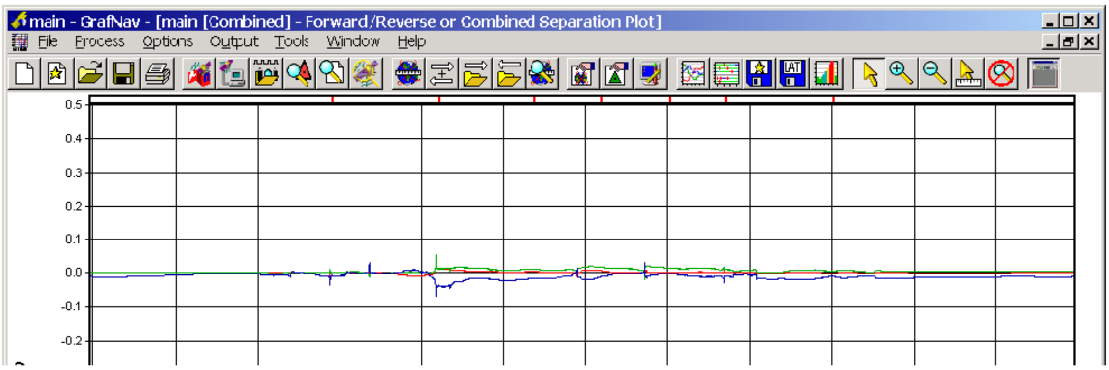


Figure 9: Combined Separation Plot

Float of Fixed Ambiguity Status Plot: This plot shows if the final solution is float or fixed (Figure 10). Fixed integer ambiguities generally have better accuracies (usually < 10cm accuracy). Ideally the plot should show fixed as this indicated an integer ambiguity fix on both forward and reverse directions.

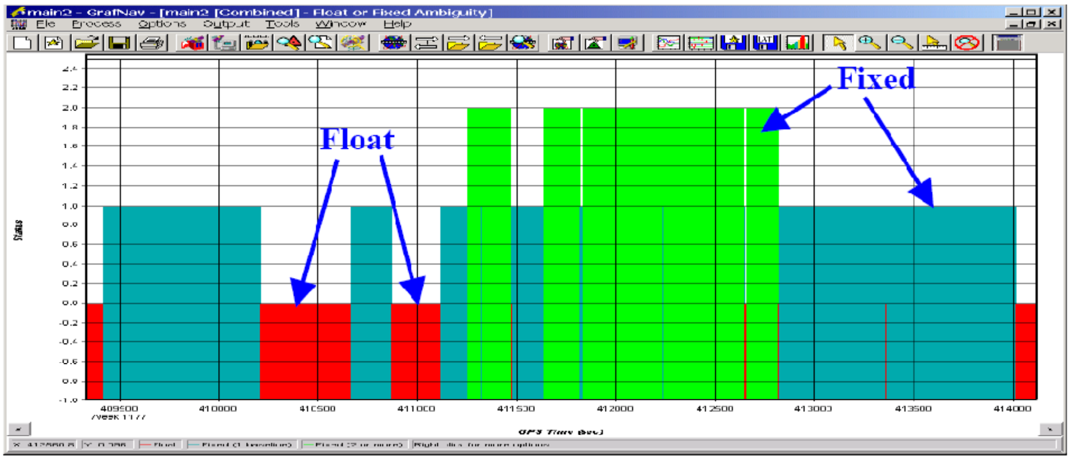


Figure 10: Float of Fixed Ambiguity Status Plot

Quality Factor Plot: This plot shows the quality of the final solution (Figure 11). There are five different quality factors plotted and these factors are also output in the Atlas Geophysics Pty Ltd GPS data file.

Quality 1 – Fixed Integer (Green)
Quality 2 – Stable Float (Aqua)
Quality 3 – Converging Float (Blue)
Quality 4 – DGPS or worse (Red)
Quality 5 – Single Point (Yellow)

Increasing quality factors indicate a worse solution. This is not a perfect indication, but it can be useful to isolate problems.

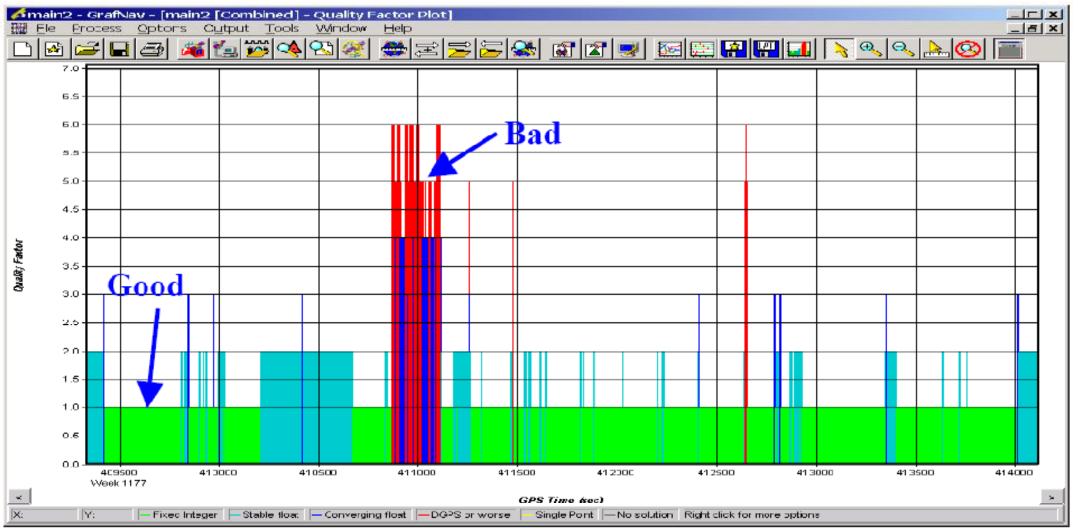


Figure 11: Quality factor plot

Complementing Waypoint GrafNav QA tools is the company's own in-house GPS quality analysis software. A module built into AGRIS (Atlas Geophysics Reduction and Information Software) allows the user to import the Waypoint output files and examine quality factors such as station repeatability, coordinate velocity, dilution of precision, coordinate quality factor and standard error for each gravity station location. The procedure is carried out before merging the positional data with gravity data for final reduction to Bouguer Gravity. Comprehensive statics, repeatability analysis and histogram plotting are also performed.

QA procedures were applied to the GPS-Glonass data on a daily basis and any gravity stations not conforming to contract specifications were repeated by the company at no cost to the client.

8.3 Gravity Data Acquisition, Processing and Quality Analysis

Gravity data was gained using the company's rapid acquisition, high accuracy helicopter-borne techniques. The company's own in-house reduction and QA software was used to reduce the data on a daily basis to ensure quality and integrity. Final delivered data met and exceeded contract specifications.

8.3.1 Calibration of the Gravity Meters

The gravity meters used on the project were calibrated pre and post survey on the Kensington Gardens – Norton Summit (2001.908-6091.208) calibration range in Adelaide, South Australia. The calibration process has validated the gravity meter's scale factor to ensure reduction of the survey data produces correct Observed Gravities from measured dial reading values. Table 4 summarises the results of the calibration tie and lists the resultant scale factors for each gravity meter. Appendix E contains the reduced data used to create the summary.

PRE SURVEY CALIBRATION RUN 11/05/07 and 04/07/07			
Gravity Meter	Gravity Meter SN	Calculated 6091.208 OBSG84 (mGals)	Diff (mGals)
A1	40240	979630.089	0.011
A2	40241	979630.120	0.020
A3	40269	979630.136	0.036
H2	135	Not available for calibration	

POST SURVEY CALIBRATION RUN 27/09/07			
Gravity Meter	Gravity Meter SN	Calculated 6091.208 OBSG84 (mGals)	Diff (mGals)
A1	40240	Not available for calibration	
A2	40241	979630.128	0.028
A3	40269	979630.122	0.022
	135	979630.066	-0.034

Table 4: Gravity meter scale factors

Weekly tilt-tests and cycles were conducted to ensure the meter's drift and tilt correction factors were valid. Gravity meter drift rates were monitored on a day to day basis using AGRIS software.

8.3.2 Acquisition of the Gravity Data

Gravity data were acquired concurrently with GPS-Glonass data using Scintrex CG5 gravity meters (Photo 3). Data were acquired in two separate shifts of five to six hours duration, with each shift consisting of a single loop controlled by observations at the gravity control stations. Each loop contained a minimum of two repeated readings so that an interlocking network of closed loops was formed. A total of 5% repeats were acquired for quality control purposes. Repeat readings were evenly distributed on a time-basis throughout each of the gravity loops.

Photo 3: Gravity observation

The gravity acquisition crew consisted of a single gravity operator and pilot. The pilot was responsible for navigating to each station, and once at the station, the operator disembarked from the helicopter and acquired the gravity data. The observation point was usually situated in front of the aircraft, in the pilot's view. Under no circumstances were readings taken outside of the pilot's view as this can jeopardise the safety of the operator. As the helicopter always landed on flat ground, the error due to the gravity observation not being coincident with the GPS-Glonass observation (which is at the tail-boom) is minimal. A small latitude based error of less than 0.005 mGals would apply, but this is not seen to be appreciable on a regional gravity survey, so is not corrected for.

At each station, the gravity operator took a minimum of two gravity readings of 20 second duration so that any seismic or wind noise could be detected. Control station readings were set to 60 second duration. Before taking the reading, the operator ensured that the instrument tilt-reading was restricted to less than 5 arc-seconds and after the reading, not higher than 20 arc-seconds. In some instances on salt lakes and salt pans, it was impossible to keep tilt-readings under 50 arc seconds due to the soft nature of the ground. This was not found to adversely affect the quality of the data since the gravity meter's tilt correction compensated well for it. Tilt-testing prior to project commencement showed that the gravity meters performed well even at extreme tilts (better than 0.005 mGals at +150/-150 arc-seconds).

If two separate readings did not agree to better than 0.02 mGals (0.01 mGals for control station readings), then the operator continued taking readings until the tolerance between consecutive readings was achieved. At the conclusion of the gravity reading, the final data display on the gravity meter was analysed to ensure the instrument was performing to specification and that the station observation provided data conforming to the project specifications. The operator also checked that the temperature, standard deviation and rejection values were within required tolerance before recording the reading. At each station, the operator recorded the gravity data digitally in the gravity meter as well as in an Atlas Geophysics Pty Ltd field book so that instrument drift and reading repeatability could be analysed easily whilst in the field. Data recorded at each GSL was assigned a unique station code and station number.

Repeat stations were marked with a biodegradable flagging tape for subsequent reoccupation. When reoccupying stations, the pilot positioned the helicopter as close to the original landing spot as possible (usually better than 10m). A small percentage of the repeat stations were positioned greater than 10m from the original location due to soft ground and/or windy conditions, but always on flat ground at the same level as the original observation. All repeat gravity readings were taken in exactly the same location, even if the helicopter landed slightly offset from the original position.

8.3.3 Processing of the Gravity Data

The acquired gravity data were processed using the company's in-house gravity pre-processing and reduction software, AGRIS. This software allows for full data pre-processing, reduction to Bouguer Anomaly, repeatability and statistical analysis, as well as full quality analysis of the output dataset.

The software is capable of downloading Scintrex CG3/CG5 and Lacoste Romberg gravity data. Once downloaded, the gravity data is analysed for consistency and preliminary QA is performed on the data to check that observations meet specification for standard deviation, reading rejection, temperate and tilt values. Once the data is verified, the software averages the multiple readings and performs a merge with the GPS data (which it has also previously verified) and performs a linear drift correction and earth tide correction. Calculation of Free Air and Bouguer Anomalies is then performed using the contract specified formulae.

The following corrections were applied to the dataset to produce Bouguer Anomaly values for each of the gravity stations. All formulae produce values in milliGals. To convert values to SI gravity units (gu) or μms^{-2}, simply multiply by a factor of 10.

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

$$r_c = r \cdot S(r)$$

where,

r_c corrected reading in milliGals
r gravity meter reading in dial units
$S(r)$ scale factor (dial units/milliGal)

Earth Tide Correction: As the earth is not a homogeneous sphere, it is subject to variations in gravity due to the gravitational attraction of the Sun and Moon. These background variations can be corrected for using a predictive formula which utilises the gravity observation position and time of observation. The Scintrex CG5 gravity meter automatically calculates ETC but uses only an approximate position for the gravity observation so is not entirely accurate. For this reason, the Scintrex ETC is subtracted from the reading and a new correction calculated within AGRIS software. The full formula is too complex to list here.

$$r_t = r_c + g_{tide}$$

where,
r_t tide corrected reading in milliGals
r_c scale factor corrected reading in milliGals
g_{tide} Earth Tide Correction (ETC) in milliGals

Instrument Drift Correction: Since all gravity meters are mechanical they are all prone to instrument drift. Drift can be caused by mechanical stresses and strains in the spring mechanism as the meter is moved, knocked, reset, subjected to temperature extremes, subjected to vibration, unclamped etc. The most common cause of instrument drift is due to extension of the sensor spring with changes in temperature (obeying Hooke's law). To calculate and correct for daily instrument drift, the difference between the gravity control station readings (closure error) is used to assume the drift and a linear correction is applied.

$$ID = \frac{r_{cs2} - r_{cs1}}{t_{cs2} - t_{cs1}}$$

where,
ID Instrument Drift in milliGals/hour
r_{cs2} control station 2nd reading in milliGals
r_{cs1} control station 1st reading in milliGals
t_{cs2} control station 2 time
t_{cs1} control station 1 time

Observed Gravity: The preceding corrections are applied to the raw gravity reading to calculate the earth's absolute gravitational attraction at each of the GSL's. The corrections produced Observed Gravities on the ISOGAL84 datum.

$$G_o = g_{cs1} + (r_t - r_{cs1}) - (t - t_{cs1}) \cdot ID$$

where,
G_o Observed Gravity in milliGals
g_{cs1} control station 1 known observed gravity in milliGals
r_t tide corrected reading in milliGals
r_{cs1} control station 1 reading in milliGals
t reading time
t_{cs1} control station 1 time
ID instrument drift in milliGals/hour

To convert ISOGAL84 Observed Gravities to POTSDAM65 Observed Gravities, the following formula was used:

$$G_{o\ 1965} = \left(\frac{G_{o\ 1980} - 979671.880}{1.00053}\right) + 979685.740$$

Normal Gravity: The normal (or theoretical) value at each GSL is calculated based on the assumption that the Earth is a homogeneous ellipsoid. Both the 1967 and 1930 variants of the International Gravity Formula are used to approximate the theoretical gravity at each station location and essentially produce a latitude correction. Gravity values vary with latitude as the earth is not a perfect sphere and the polar radius is much smaller than the equatorial radius. The effect of centrifugal acceleration is also different at the poles versus the equator. The formulae

$$G_{n\,1967} = (9780318(1 + 0.0053024 \cdot sin^2(l) - 0.0000059 \cdot sin^2(2l)))/10$$

$$G_{n\,1930} = 978049(1 + 0.0052884 \cdot sin^2(l) - 0.0000059 \cdot sin^2(2l))$$

where,

G_n Theoretical Gravity in milliGals

l GDA94 latitude at the GSL in decimal degrees

Free Air Correction: Since the gravity field varies inversely with the square of distance, it is necessary to correct for elevation changes from the reference geoid (AHD). Gravitational attraction decreases as the elevation above the reference geoid increases.

$$FAC = 0.3086 \cdot h$$

where,

FAC Free Air Correction in milliGals

l GDA94 latitude at the GSL in decimal degrees

h elevation above the reference geoid (AHD) in m

Bouguer Correction: If a gravity observation is made above the geoid, the effect of rock material between the observation and the geoid be taken into account. The slab of rock makes a positive contribution to the gravity value. A rock density of 2.67 gm/cc was used in the correction.

$$BC = 0.0419 \cdot \rho \cdot h$$

where,

BC Bouguer Correction in milliGals

ρ rock density (gm/cc)

h elevation above the reference geoid (AHD) in m

Free Air Anomaly: The free air anomaly is the difference between the observed gravity and theoretical gravity that has been computed for latitude and corrected for the elevation of the GSL above or below the geoid.

$$FAA_{1965} = G_{o\,1965} - G_{n\,1930} + FAC$$

$$FAA_{1984} = G_{o\,1984} - G_{n\,1967} + FAC$$

where,

FAA Free Air Anomaly in milliGals

G_o Observed Gravity milliGals
G_n Normal Gravity in milliGals
FAC Free Air Correction in milliGals

Bouguer Anomaly: The Bouguer anomaly is computed from the free air anomaly above by removing the attraction of the slab calculated by the Bouguer correction. The Bouguer anomaly is the most interpretable value derived from a gravity survey (in areas of low relief) as changes in the anomaly can be directly attributed to lateral density contrasts within the geology below the observation point.

$$BA_{\ 1965} = G_{o\ 1965} - G_{n\ 1930} + FAC - BC$$

$$BA_{\ 1984} = G_{o\ 1984} - G_{n\ 1967} + FAC - BC$$

where,
BA Bouguer Anomaly in milliGals
G_o Observed Gravity in milliGals
G_n Normal Gravity in milliGals
FAC Free Air Correction in milliGals
BC Bouguer Correction in milliGals

8.3.4 Quality Analysis of the Processed Gravity data

Following reduction of the data to Bouguer Anomaly, repeatability and QA procedures were applied to both the positional and gravity observations using AGRIS software. AGRIS checks the following as part of its QA processing:

Easting Observation Repeatability and Histogram

Northing Observation Repeatability and Histogram

Elevation Observation Repeatability and Histogram

Gravity Observation Repeatability and Histogram

Gravity SD, Tilt XY, Temperature, Rejection, Reading Variance

Gravity meter drift / closure

Gravity meter loop time, drift per hour

GPS Dilution of Precision, Coordinate Quality Factor, Standard Error

Variation of surveyed station location from programmed location

QA procedures were applied to the gravity data on a daily basis and any gravity stations not conforming to contract specifications were repeated by the company at no cost to the client. Some stations were revisited to verify single point anomalies - all were found to be genuine.

8.3.5 Additional Processing, Gridding and Plotting

Complementing the QA procedures is additional daily gridding, imaging and plotting of the elevation and gravity data. Once processed to Bouguer Anomaly and assessed for QA, data are imported into Geosoft Oasis Montaj or ChrisDBF software for gridding at 1/5th the station spacing to produce ERMapper compatible grid files. Resultant grids are contoured, filtered and interpreted using ERMapper and ArcMap software to check that data is smoothly varying and that no spurious anomalies are present. A first vertical, tilt angle and horizontal derivative filter are routinely applied to the data as these filters allow for excellent noise recognition. Once identified, any spurious stations can be field checked by the helicopter crew the following day and repeated if required.

Plotting of the acquired stations on a daily basis allowed for identification of any missed stations which were then gained the following day.

9.0 Results

The Northern G2 gravity survey was carried out with a minimum of fuss, with the only hindrances to production being a few shorter days due to adverse weather conditions and scheduled helicopter maintenance. The project ran very smoothly and was completed ahead of schedule. A total of **37,464** new gravity stations were gained during the survey.

Final data have been delivered to a technically excellent standard and are presented both digitally and hardcopy as Appendices to this report.

9.1 Survey Timing and Production Rates

Atlas Geophysics began gravity data acquisition on Wednesday 16th May 2007 and completed acquisition on Saturday 22nd September 2007.

An average of 180 new stations per helicopter per day was maintained for most of the survey, with some days yielding over 260 stations. Lower production days were mainly due to inclement weather or dust storms.

9.2 Data Formats

Final reduced ASCII data for the project has been delivered in standard PIRSA format in accordance with contract specifications. Table 6 overleaf details the format of the final gravity database supplied. All fields are comma delimited.

Raw GPS-GNSS and gravity data in their respective native formats have been included on the data DVD as Appendix X. The table (5) below summarises the deliverables.

Final Delivered Data	Format	Data DVD	Hardcopy
Gravity Database	Comma Space Delimited .csv	•	
Raw Positional Data	AGRIS format, comma delimited	•	
Raw Gravity Data	Scintrex CG5 format	•	
Raw GPS-GNSS Data	Waypoint GPB Binary	•	
Final Grids	ERMapper Grids .ers	•	
Final Tiff's	GeoTiff .tif	•	•
Logistics report	PDF .pdf	•	•

Table 5: Final Deliverables

Field Header	Field Description	Format	Units
PROJECT	Atlas Geophysics Project Number	9999	NA
STATION	Unique station ID	99999	NA
TYPE	Reading type : BASE or FIELD	STRING	NA
MGA94EAST	Coordinate Easting MGA94/GDA94	99999.999	m
MGA94NORTH	Coordinate Northing MGA94/GDA94	9999999.999	m
MGAZONE	MGA Zone Number	99	NA
GDA94LONG	Coordinate Longitude GDA94	999.99999999	Dec Deg
GDA94LAT	Coordinate Longitude GDA94	-99.99999999	Dec Deg
ELEVATION_MAHD	Coordinate Elevation AHD	999.999	m
REPEAT_ERROR_ELEVATION_M	Repeat Error for Elevation Observation	9.999	m
REPEAT_ERROR_GRV_MGALS	Repeat Error for Gravity Observation	9.999	mGals
REPEAT_ERROR_GRV_GU	Repeat Error for Gravity Observation	9.999	gu
DATE_DDMMYY	Observation Date	dd/mm/yy	NA
TIME_HHMMSS	Observation Time	hh:mm:ss	NA
DIAL_MGALS	Gravity Dial Reading	9999.999	dial units
ETC_MGALS	Earth Tide Correction (Longman)	9.999	mGals
OBSG84_GU	Observed Gravity ISOGAL84	9999999.999	gu
OBSG84_MGALS	Observed Gravity ISOGAL84	999999.999	mGals
OBSG65_GU	Observed Gravity POTSDAM65	9999999.999	gu
OBSG65_MGALS	Observed Gravity POTSDAM65	999999.999	mGals
GN_1967_GU	Normal Gravity 1967	9999999.999	gu
GN_1930_MGALS	Normal Gravity 1930	999999.999	mGals
FAA_1984_GU	Free Air Anomaly 1984	9999999.999	gu
FAA_1984_MGALS	Free Air Anomaly 1984	999999.999	mGals
FAA_1965_GU	Free Air Anomaly 1965	9999999.999	gu
FAA_1965_MGALS	Free Air Anomaly 1965	999999.999	mGals
BA267_1984_GU	Bouguer Anomaly 2.67 gm/cc 1984	9999999.999	gu
BA267_1984_MGALS	Bouguer Anomaly 2.67 gm/cc 1984	999999.999	mGals
BA267_1965_GU	Bouguer Anomaly 2.67 gm/cc 1965	9999999.999	gu
BA267_1965_MGALS	Bouguer Anomaly 2.67 gm/cc 1965	999999.999	mGals
METERSN	Serial Number of Gravity Instrument	99999	NA

Table 6: Final Gravity Database Format

9.4 Data Repeatability

The repeatability of both the gravity and GPS data was excellent. In total, **1,830** gravity and GPS repeat stations were collected and analysed. As a percentage, this equates to **4.9%** of the total number of new gravity stations acquired. Repeat stations were acquired so that an even distribution between gravity loops was established and that all loops were interlocked. Descriptive statistics pertaining to the repeatability are contained in Table 7 and Appendix F contains a tabulation of the actual repeat data.

The standard deviation of the gravity repeat deviations was **0.042 mGals** and the standard deviation of the GPS repeat deviations was **0.08 m**. These statistics confirm that the data has met and exceeded contract specifications.

	Gravity Repeat (mGals)	GPS Repeat (mAHD)
Mean	0.000	-0.003
Standard Error	0.001	0.002
Median	0.000	-0.003
Mode	0.005	0.007
Standard Deviation	0.043	0.078
Sample Variance	0.002	0.006
Kurtosis	0.319	1.200
Skewness	0.091	-0.023
Range	0.303	0.639
Minimum	-0.150	-0.330
Maximum	0.153	0.309
Sum	-0.881	-5.964
Count	1830	1830

Table 7: Repeat Statistics

9.4.1 Repeatability Histograms

Histograms showing the distribution of repeat differences for both the gravity and GPS observations are shown in Figures 12 and 13. Both the gravity and GPS repeat histograms exhibited normal distributions.

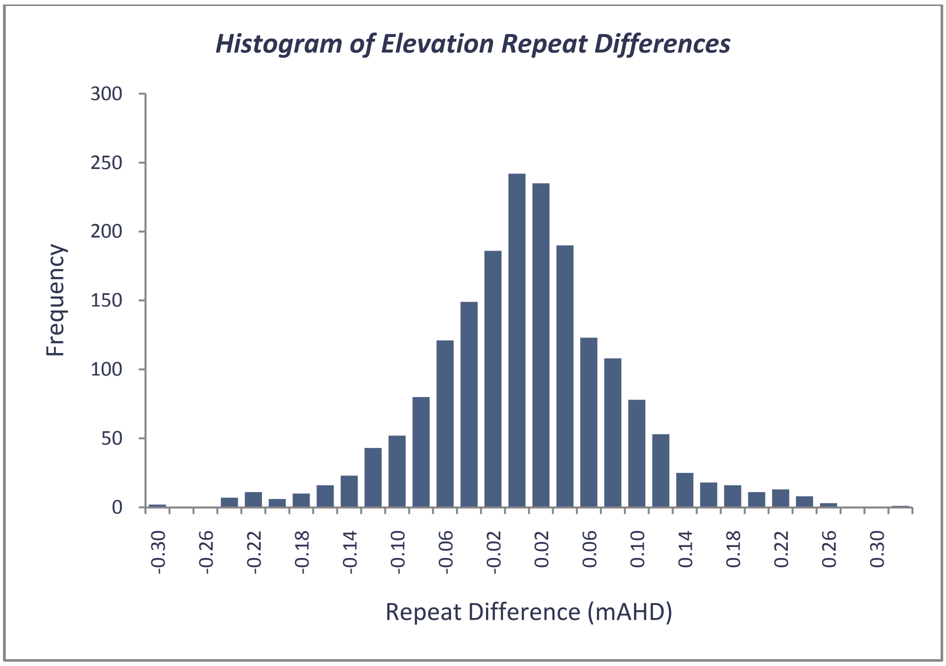


Figure 12: Histogram of GPS Repeat Differences

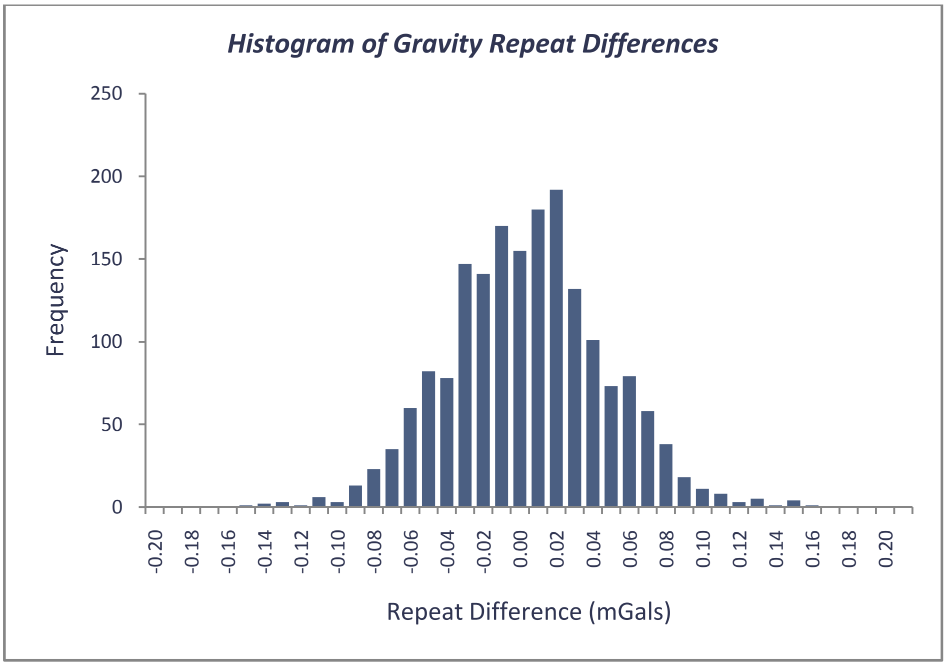


Figure 13: Histogram of Gravity Repeat Differences

9.5 Grids, Images and Plots

Final reduced data have been gridded using ChrisDBF software and a minimum curvature algorithm with multiple loops. All grids are provided in ERMapper compatible .ers format and are in units of mGals or m.

Grids for GPS Derived Elevation (AHD), Bouguer Anomaly (BA267) and 1st vertical derivative of Bouguer Anomaly (BA267VD) were produced for this particular project.

The grids produced have been imaged using Geosoft Oasis Montaj mapping and processing software. Five plots of these images have been included with this report to assist in data interpretation (Appendix A). The plots have been included digitally on the data CD in GIS compatible Geotiff format.

Station Location Plot: The first plot displays the acquired gravity station locations overlayed on a 1:250,000 topographic map of the area and surrounds. As evident on the plot, some stations have been moved off the original programmed co-ordinates due to terrain considerations.

GPS Derived Elevation: This plot displays a pseudocoloured grid of the digital elevation data obtained from the gravity survey (AHD grid). A histogram equalisation colour stretch has been applied when pseudocolouring. Overlying the image data are contours created at an interval of 10m.

Bouguer Anomaly 2.67 Contours: This plot displays a pseudocoloured grid of Bouguer Anomaly calculated with a rock density of 2.67 gm/cc. A histogram equalisation stretch has been applied when pseudocolouring. Overlying the image data are contours created at an interval of 2 mGal.

Bouguer Anomaly 2.67 Contours: This plot displays a pseudocoloured grid of Bouguer Anomaly calculated with a rock density of 2.67 gm/cc. A histogram equalisation stretch has been applied when pseudocolouring and a sunshade from the north-east has been applied.

Vertical Derivative Image: This plot displays pseudocoloured grid of the first vertical derivative of Bouguer Anomaly calculated with a rock density of 2.67 gm/cc. A histogram equalisation stretch has been applied when pseudocolouring and sunshading from the north-east has been applied. This image represents the rate of change of the Bouguer anomaly and is useful for detecting lineaments and body edges, especially where there are large regional gradients present.

10.0 Project Safety

There were no incidents or accidents to report on this project. Weekly toolbox meetings were held to discuss project safety and address any staff member concerns. A Hazard Identification and Risk Assessment (HIRA) was carried out for all new tasks not covered under Atlas Geophysics Standard Operating Procedures (SOP's) as documented in the company's Health Safety Environment and Community (HSEC) field manual.

11.0 Conclusion

Atlas Geophysics Pty Ltd is confident that it has delivered high quality data to its client to a high standard and in the safest way possible.

The company was pleased to be involved in the acquisition and processing of the gravity data collected on this project and look forward to working with PIRSA again in the future.

Leon Mathews
Director

Mark Jecks
Director

APPENDIX A
Plots and Imagery

APPENDIX B
Control Station Descriptions

GRVGPS0003 – OODNADATTA A/S

GDA 94		MGA Z53		AMG Z53	
Latitude	-27°33'24.4075"	*Easting*	543,515.878	*Easting*	543,387.164
Longitude	135°26'26.8445"	*Northing*	6,951,816.3393	*Northing*	6,951,644.773
Ellipsoidal Height	119.949	*Orthometric Height*	112.732	*Orthometric Height*	112.732

OBSERVED GRAVITY	
mGals	979085.835
GU	9790858.354

Occupation Method/Location Details

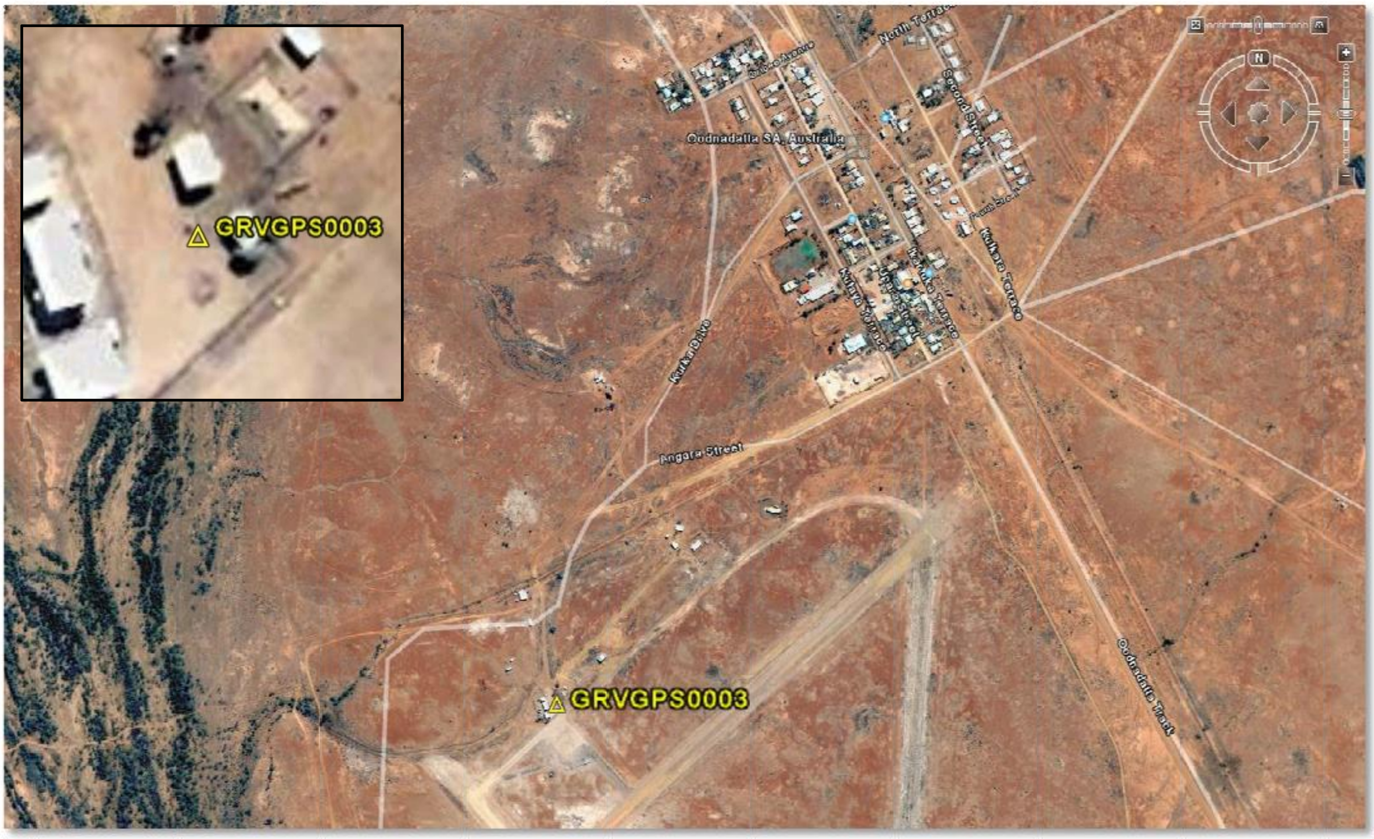
The GPS control point consists of a DTEI supplied brass plaque set in concrete and firmly secured in the ground. Marking the plaque is a DTEI station number: 5942-1203. The gravity control point consists of a small circular (30cm diameter) concrete slab set into the ground, opposite the GPS control point. The control station is witnessed by both an Atlas Geophysics survey plaque and a DTEI plaque attached to a 1.5 metre steel picket placed within 0.5m of the both control points.

Gravity Control was established via ABA loops to AFGN station 1992932018 at Coober Pedy A/S and one ABA loop to Atlas Geophysics base GRVGPS004 at William Creek. The gravity tie was completed with the gravity meters used for the main survey. Expected accuracy would be better than 0.01mGals.

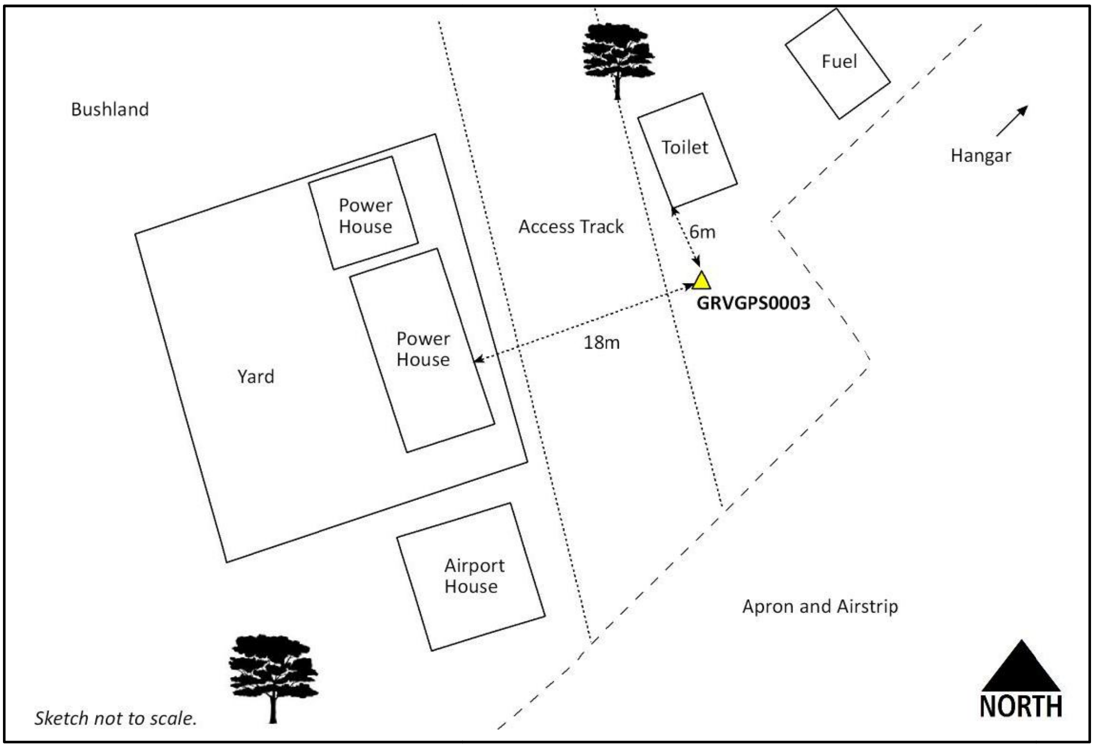
GPS Control was established using AUSPOS. Three separate +10 hour sessions were submitted to AUSPOS's online processing system where returned coordinates were accurate to better than 0.01m.

The station is located opposite the power generation building, at the Oodnadatta airstrip. It is positioned next to a large concrete slab, 6m south of the airstrip toilet block. Access to the airstrip is via Anagara Street, southwest from the main townsite. Users should notify Adam Plate at the Pink Roadhouse before accessing the station.

Photograph of Control Station GRVGPS0003 and surrounds



Location of Control Station GRVGPS0003



Locality Sketch of Control Station GRVGPS0003

APPENDIX C

GPS Control Processing and Information

GPS Control Station Information

atlas GEOPHYSICS

info@atlasgeo.com.au

Project P2007005
Client PIRSA
Area Northern G2
Zone 53

CONTROL STATION GRVGPS0003 OODNADATTA AERODROME

Receiver Type	Leica System 1200GG
Antenna Type	Leica AX1202GG
Antenna ARP Height	1.640

Adopted / Supplied Coordinates

Waypoint	GDA94 Lat Deg	Min	Sec	GDA94 Long Deg	Min	Sec	MGA East	MGA North	GDA94 Height	AHD Height	N
	-27	33	24.4045	135	26	26.8904	543517.148	6951816.47	123.777		

AUSPOS Rapid Coordinates

	GDA94 Lat Deg	Min	Sec	GDA94 Long Deg	Min	Sec	MGA East	MGA North	GDA94 Height	AHD Height	N

AUSPOS Final Coordinates

	GDA94 Lat Deg	Min	Sec	GDA94 Long Deg	Min	Sec	MGA East	MGA North	GDA94 Height	AHD Height	N
Solution 01	-27	33	24.4049	135	26	26.8445	543515.877	6951816.340	119.951	112.734	7.217
Solution 02	-27	33	24.4088	135	26	26.8444	543515.875	6951816.338	119.946	112.728	7.218
Solution 03	-27	33	24.4087	135	26	26.8447	543515.884	6951816.340	119.951	112.734	7.217
Solution AVG	**-27**	**33**	**24.4075**	**135**	**26**	**26.8445**	**543515.8787**	**6951816.3393**	**119.949**	**112.732**	**7.217**

Have you double checked your data entry?

☑ Yes ☐ No

SHIFTS REQUIRED (Add to GPS Field Files)	MGA East	MGA North	GDA94 Height
SHIFT ADOPTED TO FINAL	-1.269	-0.129	-3.828
SHIFT RAPID TO FINAL	0.000	0.000	0.000
SHIFT ADOPTED TO RAPID	0.000	0.000	0.000

APPENDIX G
Longman's Earth Tide Correction Formula

```
input dLat (latitude)
input dLon (longitude)
input dDate (date)
*Date broken down into year, month and date
input dTime (time)

array pClndr[12]={0,31,59,90,120,151,181,212,243,273,304,334}
lYr=year
lMo=month
lDa=day

ny=(lYr-1900)
days=(dTime/24.0+lDa-1+pClndr[lMo-1])
lLeap=(ny/4)
if(lLeap/2=ny and lMo<3)then lLeap=lLeap-1
lDay=(ny*365+lLeap+lDa+pClndr[lMo-1])
dcent = (ny*365.0+lLeap+days+0.5)/36525)
dhrs = (ny*365.0+lLeap+days+0.5)*24.0)
ds = (dcent*8399.7092 99+4.7200 2343 4+(dcent*dcent)*4.40696e-5)
dp=(dcent*71.01800936+5.835124713-(dcent*dcent)*1.80545e-4-dcent*2.1817e-
7*(dcent*dcent)
dh=(dcent*628.3319509+4.88162792+(dcent*dcent)*5.27962e-6)
doln=(4.523588564-dcent*33.757153303+(dcent*dcent)*3.6749e-5)
dps=(dcent*0.030005 26416+4.908229461+(dcent*dcent)*7.902463e-6)
des=(0.01675104-dcent*4.18e-5-(dcent*dcent)*1.26e-7)
dsoln=(sin(doln))
dci=(0.91369-cos(doln)*0.03569)
dsi=(sqrt(1.0-(dci*dci))
dsn=(dsoln*0.08968/dsi)
dcn=(sqrt(1.0-(dsn*dsn))
dtit=(dsoln*0.39798/(dsi*cos(doln)*dcn+1.0dsoln*0.91739*dsn))
det=(atan(dtit)*2.0)
if (det<0.0)then det=det+6.2831852)

dolm1=(ds-doln+det+sin(ds-dp)*0.1097 9944)
dolm=(dolm1+sin((ds-dp)*2.0)*0.003767474+sin(ds-
dh*2.0+dp)*0.0154002+sin((ds-dh)*2.0)*0.00769395)
dha=((dTime*15.0-180)*0.0174532 92519 9+dLon/57.2957795 13)
dchi=(dha+dh-atan(dsn/dcn))
dal=(dLat/57.295779513)
dct=(sin(dal)*dsi*sin(dolm)+cos(dal)*((dci+1.0)*cos(dolm-dchi)+(1.0-
dci)*cos(dolm+dchi))/2.0)
dda=(cos(ds-dp)*0.14325+2.60144+cos((ds-dp)*2.0)*0.0078644+cos(ds-
dh*2.0+dp)*0.0200918+cos((ds-dh)*2.0)*0.0146006)
dr=(6.378388/sqrt((1.0-((cos(dal)*cos(dal))*0.0067690 2+1.0)
r_1=(dda)
r_2=(dct)
r_3=(dr)
r_4=(dda)
r_5=(dda*dda)
r_6=(dct)
dgm=(dr80.49049*dda*(r_1*r_1)*((r_2*r_2)*3.0-1.0)+(r_3*r_3)*7.4e-
4*(r_5*r_5)*dct*((r_6*r_6)*5.0-3.0))
dols=(dh+des*2.0*sin(dh-dps))
dchis=(dha+dh)
dds=((des*cos(dh-dps)+1.0)*0.66881/(1.0-(des*des)))
dcf=(sin(dal)*0.39798*sin(dols)+cos(dal)*(cos(dols-
dchis)*0.95869+cos(dols+dchis)*0.0413))
dgs=(dr*13.2916*((dcf*dcf)*3.0-1.0)*dds*(dds*dds))

dTide = (dgm + dgs) * 0.00116
```

APPENDIX 3

Exploration Licences 3897 - 3900 and 3917 -3918
Curdimurka Project
Expenditure Statement for Year Ending 31 August 2008

Activity	***EL 3897***	***EL 3898***	***EL3899***	***EL 3900***	***EL 3917***	***EL3918***
	$	$	$	$	$	$
Geological Activities	1,662	6,441	6,028	6,083	4,817	2,540
Geochemical Activities	37	149	130	143	118	56
Geophysical Activities	8,831	35,324	30,908	33,852	27,965	13,246
Mineralogical Activities	83	331	289	317	262	124
Drafting Activities	2	9	8	8	7	3
Field Supplies	30	121	106	116	93	44
Travel Costs	94	370	322	352	288	138
Field Camp Activities	127	497	463	471	378	192
Technical Studies	292	1,117	964	1,047	847	416
Sub-Total	11,159	44,358	39,219	42,389	34,774	16,760
General Tenement Costs	72	174	165	167	77	80
Tenement Rents	2,867	3,979	3,371	3,987	2,962	1,456
Administration	103	393	373	368	296	148
TOTAL	**$14,201**	**$48,904**	**$43,128**	**$46,911**	**$38,109**	**$18,445**