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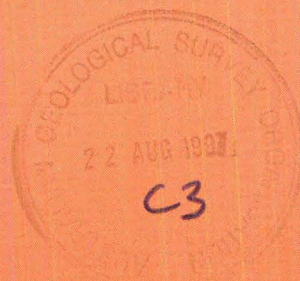
Australian Fundamental Gravity Network, 1993 Cobar - Mt Hope Gravity Tie, NSW Australia

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Operations Report

by

John W. Williams



AGSO Record 1997/33



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AUSTRALIAN
GEOLOGICAL SURVEY
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AUSTRALIAN FUNDAMENTAL GRAVITY NETWORK

1993

**COBAR - Mt HOPE GRAVITY TIE,
NSW AUSTRALIA**

OPERATIONS REPORT

by
John W Williams

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Record 1997/33

June 1997

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Primary Industries and Energy: Hon. J. Anderson, M.P.

Minister for Resources and Energy: Senator the Hon. W.R. Parer

Secretary: Paul Barratt

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Neil Williams

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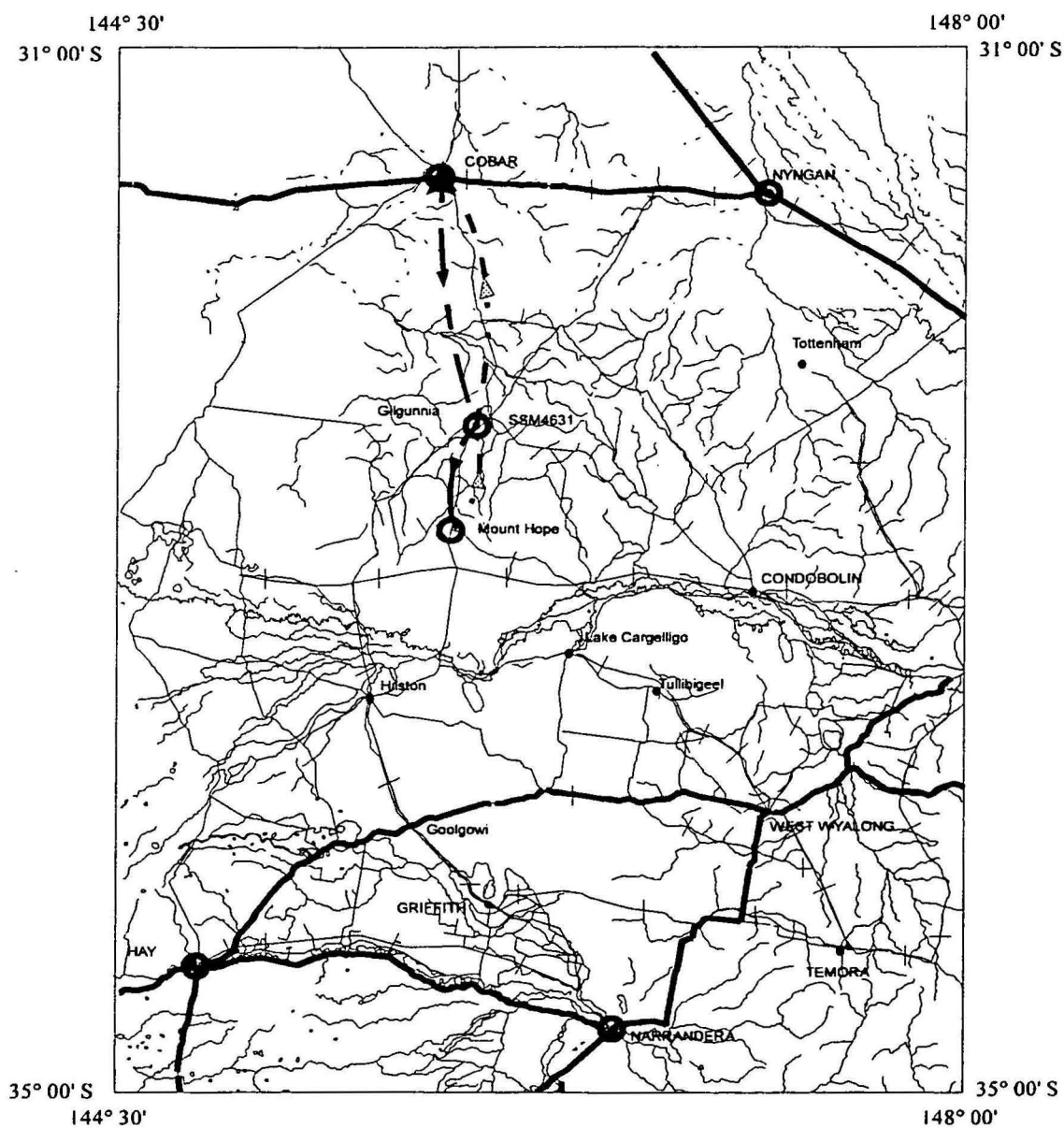
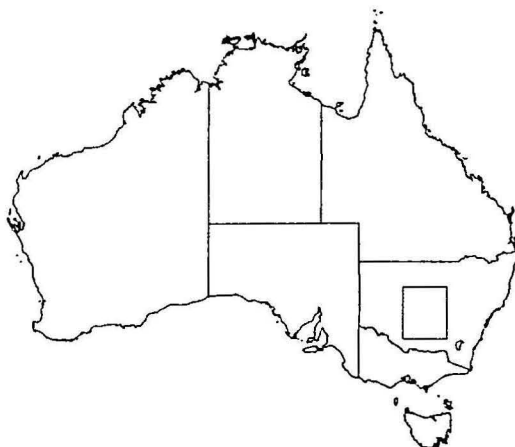


FIGURES

1. Location of Survey.

APPENDICES

1. Field Party and Equipment.
2. Gravity Base Station Location Diagrams and Control information.
3. Field Observations
4. Tidal Gravity Corrections
5. Initial Processing Summary and Statistics.



LOCATION OF SURVEY

Figure 1

SUMMARY

This report describes a gravity survey to establish two new gravity control stations in the Mt Hope area of NSW. As the new stations are located in an area poorly covered by existing control stations, they will be incorporated into the Fundamental Gravity Network of Australia (previously called the Isogal Network).

Two LaCoste and Romberg gravity meters, G20 and G101, were used to measure the gravity intervals during the survey which was conducted over three days in April 1993.

The new base stations were established using station 8090.0143 at the Cobar airport as the control point. The new base stations have been marked with inscribed blue identifier plugs set into concrete at the observation sites. The following table summarises the new station values.

NEW STATIONS ESTABLISHED DURING THIS SURVEY

Station ID	Latitude	Longitude	Location	Gravity (μms^{-2})	Ties
93911105	32° 49.47'	145° 52.27'	Windsock Mt Hope A/s.	9794943.68	4
93912105	32° 27.20'	145° 58.32'	SSM4631 (9001)	9794523.59	4

INTRODUCTION

The Australian Geological Survey Organisation (AGSO) has the responsibility of maintaining the Australian Fundamental Gravity Network (AFGN), previously known as the Isogal Network. This network provides a consistent gravity datum to control all gravity surveys carried out in and around Australia.

AGSO is currently putting additional effort into a project to refurbish the AFGN since the last systematic survey of the network in 1980. A large number of base stations have been destroyed by redevelopment of roads and buildings etc. During each annual survey program, as well as progressively restoring and augmenting the AFGN, new control stations are installed in areas nominated by the mineral exploration industry where there is only a sparse distribution of existing control stations.

The aim of this survey was to assist industry in their gravity exploration work by establishing two new control stations in the area of Mt Hope in central NSW as shown in figure 1.

Between the 4th and 8th of April 1993, the Gravimetry Section of AGSO performed a gravity survey from Cobar airport to a State Survey Marker #4631 (SSM4631) approximately 125 km south of Cobar and then to the Mt Hope airstrip windsock approximately 171 km south of Cobar. Two La Coste and Romberg gravity meters were read by one operator over a total period of three days.

SURVEY METHOD AND OPERATIONS

The field party consisted of one Senior Officer (Technical), John Williams, with a 4WD vehicle, and two La Coste & Romberg gravity meters G20, G101, and a Pronav GPS receiver.

Leaving Canberra on the 4th of April 1993 and travelling direct to Mt Hope airstrip a private company gravity base station, which had been read at the windsock, was located and read with the two meters. Another station at SSM4631 was then located some 46km north of Mt Hope where a new station was prepared and read. The last station read for the day was the Fundamental gravity control station 8090.0143 sited in the Cobar aerodrome terminal building.

On the 6th of April two complete gravity loops were read between these 3 points and concrete station markers and identifier plugs were installed.

These ties were repeated again on the 7th of April before returning to Canberra on the 8th of April 1993.

The Data were recorded on field sheets and were then entered into the gravity processing system on return to Canberra.

SURVEY DATA PROCESSING

The survey data processing was done in Canberra on a Sun workstation (via an IBM PC) by John W Williams. The field data from both meters was transferred to an input file format suitable for calculation of Earth tidal gravity correction, drift, and gravity interval, using AGSO programs ERTIDE and GRVHTS. The processing program GRVHTS was modified so that field gravity loop readings extending over more than 24 hours could be processed.

The readings were arranged to form loops which were then corrected for Earth tide, using program ERTIDE.

The corrected readings were then input to the network adjusting program GRVHTS, which used the two unknown stations as free nodes, the primary control station (fixed node) being at the Cobar airport Terminal building. The closed loops defined the drift of each meter. The drift, and tide corrected measured gravity intervals, between the nodes for each loop and for each meter, were least square adjusted to provide best fit values for all measured intervals. Final gravity values were then calculated for each station, using the control station value and the adjusted intervals.

RESULTS

Both meters performed well. Adjustments for and between meters were better than $0.2\mu\text{ms}^{-2}$. The standard deviation of adjustments was $0.08\mu\text{ms}^{-2}$.

No readings were discarded for the final processing as shown in Appendix 5.

The results are shown below.

Final Station Values

AUSTRALIAN GRAVITY DATA

9391 MTHOPE GRAVITY TIE

Station	Latitude(S)	Longitude(E)	Gravity	Location
80900143	31.00540°	145.00079°	9793892.60	Cobar Airport
93911105	32.82437°	145.87094°	9794943.67	Mt Hope A/S W/sock
93912105	32.45329°	145.97200°	9794523.58	SSM4631

APPENDIX 1
Field Party and Equipment

Personnel;	John Williams (Senior Officer (Technical) C),
Gravity Meters	LaCoste and Romberg numbers G20 and G101.
Vehicle	Toyota Landcruiser station wagon, registration number ZJE250
Other Equipment	Compac portable PC, Base plates camera, cement, station markers Pro Nav GPS receiver.

APPENDIX 2

Gravity Base Station Location Diagrams.

The following four pages are the Fundamental Gravity Network diagrams for the three base stations measured on this survey. Station 6491.0143 was not reoccupied on this survey. The descriptions and gravity values shown were accurate at the time of installation (April 1993) but these may change to some degree as the environment around each station is modified in the future.

Control Information.

The reference value used to control the gravity datum for this survey was $9793892.6 \mu\text{ms}^{-2}$ at gravity station numbered 8090.0143 which is located at the passenger terminal at the Cobar airport as shown on the diagram Cobar Sheet 1 of 2.

STATION NAME Mt Hope N.S.W.		STATION CODE 9391.1105	
LOCATION Mt Hope Airstrip	DESCRIBED / RECOVERED BY J W Williams <i>Drawn by J W Williams</i>	OBSERVED GRAVITY (ums-2) 9794943.68	DATE 1993
DESCRIPTION:		Station Class:	
STATION TYPE: Base POSITION: S 32 49' 28" E 145 52' 16" Position Source: ELEVATION: 209.5m Elevation Source:			

Station No. 9391.1105 Mt Hope NSW Sheet 1 of 1

GRAVITY STATIONS
AUSTRALIAN NATIONAL GRAVITY NETWORK



SSM4631 N.S.W.

9391.2105

Mt Hope - Cobar Rd.

J W Williams
Drawn by J W Williams

9794523.59

1993

DESCRIPTION:

Station Class:

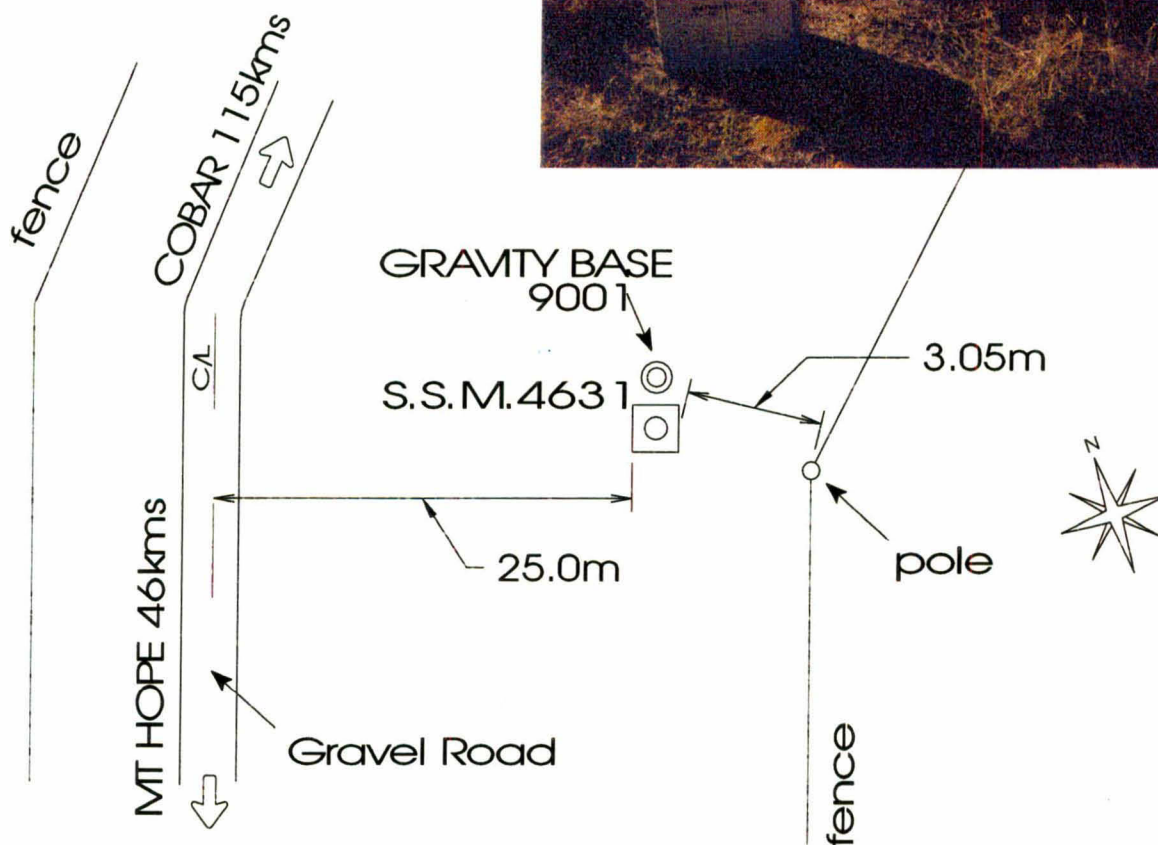
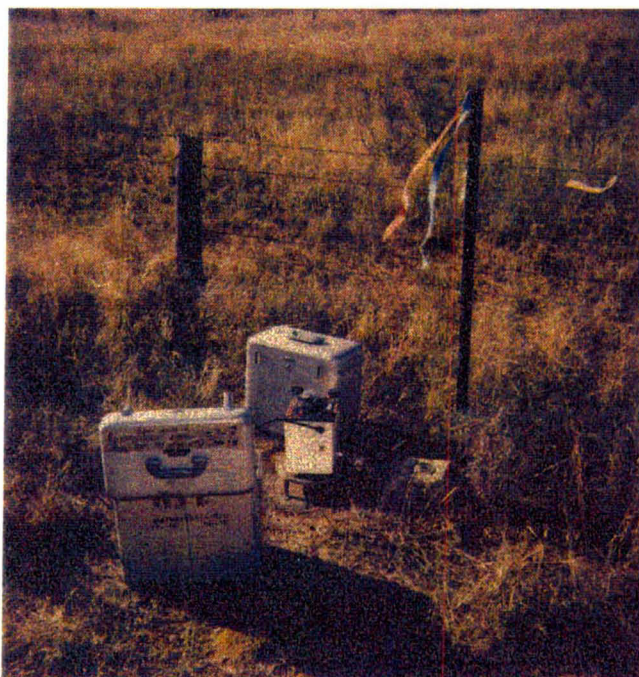
STATION TYPE: Base.

POSITION: S 32 27' 20" E 145 58' 32"

Position Source:

ELEVATION:

Elevation Source:



GRAVITY STATIONS
AUSTRALIAN NATIONAL GRAVITY NETWORK



Station No. 9391.2105 SSM4631 NSW

Sheet 1 of 1

STATION NAME

Cobar N.S.W.

STATION CODE

8090.0143

LOCATION

Airport Terminal

DESCRIBED / RECOVERED BY

HR & PW

*Drawn by P Wynne*OBSERVED GRAVITY (μms^{-2})

9793892.6

DATE

Nov 1996

DESCRIPTION:

Station Class:

STATION TYPE:

Base

POSITION:

S 31 32' 30" E 145 47' 54"

Position Source:

Report 261

ELEVATION:

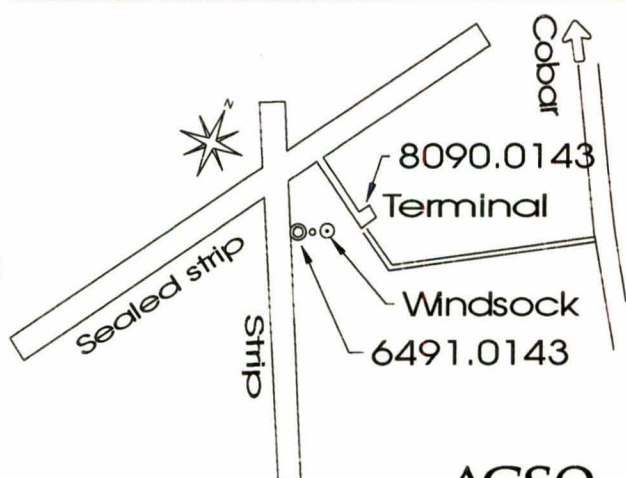
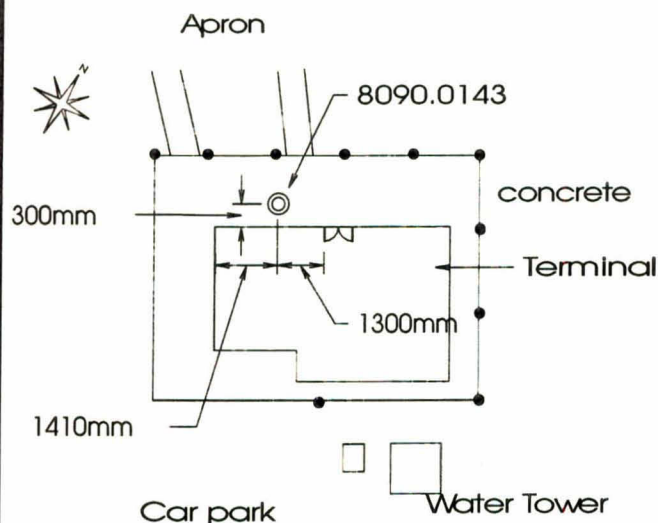
217.98m

Elevation Source:

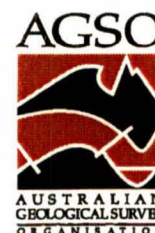
Report 261



8090.0143
(Facing Southeast from apron)



GRAVITY STATIONS
AUSTRALIAN NATIONAL GRAVITY NETWORK



STATION NAME

Cobar N.S.W.

STATION CODE

6491.0143

LOCATION

"Cobar" sign near windsock

DESCRIBED / RECOVERED BY
HR & PW*Drawn by P Wynn*OBSERVED GRAVITY (μms^{-2})

9793893.4

DATE

Nov 1996

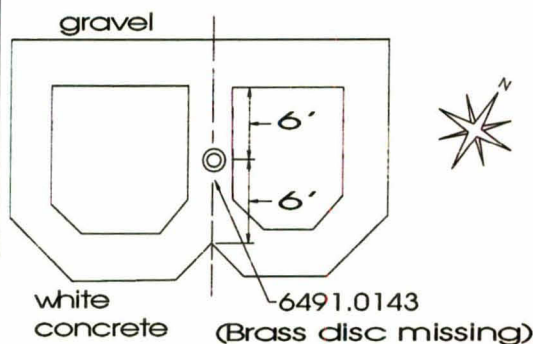
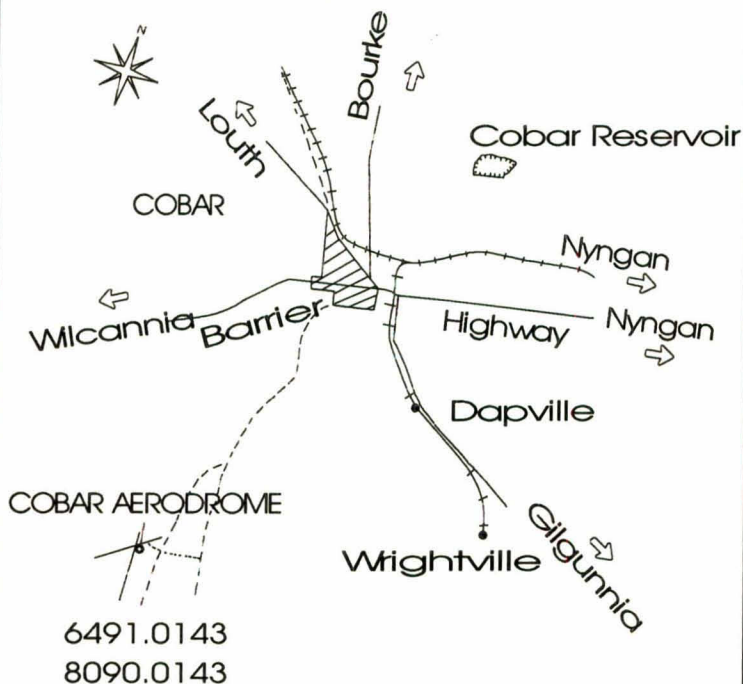
DESCRIPTION:

STATION TYPE: Base
 POSITION: S 31 32' 30" E 145 47' 54"
 Position Source: Report 261
 ELEVATION: 217.98m
 Elevation Source: Report 261

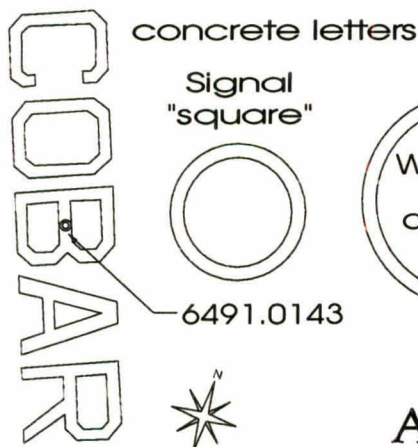
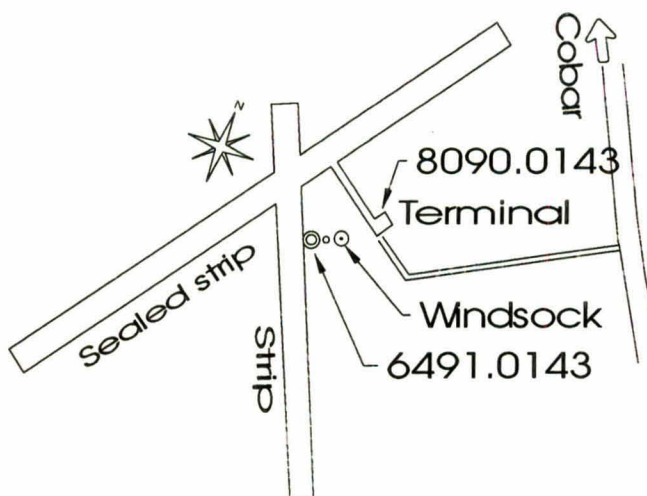
Station Class:



6491.0143

white
concrete

(Brass disc missing)



concrete letters

Signal
"square"Windsock
concrete
base

6491.0143

GRAVITY STATIONS
 AUSTRALIAN NATIONAL GRAVITY NETWORK



Station No. 6491.0143 Cobar

Sheet 2 of 2

APPENDIX 3

Field Observations

Loop#	Date	Meter#	Scale		
Station#	Time	Reading	Location	Comments	
9391	MTHOPE	GRAVITY	TIE		GRAVITY
TRAVERSE1	1060493	20L	1.050000	1	
93911105	1408	2952295	324946222145522564	Windsock Mt Hope A/S	
93912105	1503	2912378	322719777145583200	Survey Marker SSM4631	
80900143	1657	2852393	313240	145477	Cobar A/S Terminal
					ENDFLGHT
TRAVERSE1	2070493	20L	1.05	1	
80900143	0726	2852398			
93912105	0851	2912420			
93911105	0945	2952342			
93912105	1023	2912326			
80900143	1147	2852250			
93912105	1340	2912340			
93911105	1437	2952317			
93912105	1516	2912357			
80900143	1637	2852388			
					ENDFLGHT
TRAVERSE1	3080493	20L	1.05	1	
80900143	0736	2852405			
93912105	0903	2912445			
93911105	1008	2952365			
					ENDFLGHT
TRAVERSE2	1060493	101L	1.05	1	
93911105	1412	2985552			
93912105	1459	2945532			
80900143	1700	2885438			
					ENDFLGHT
TRAVERSE2	2070493	101L	1.05	1	
80900143	0729	2885451			
93912105	0855	2945565			
93911105	0948	2985585			
93912105	1027	2945490			
80900143	1152	2885301			
93912105	1344	2945485			
93911105	1440	2985584			
93912105	1518	2945540			
80900143	1641	2885428			
					ENDFLGHT
TRAVERSE2	3080493	101L	1.05	1	
80900143	0739	2885462			
93912105	0907	2945605			
93911105	1011	2985615			
					ENDFLGHT
					ENDGRAVS

APPENDIX 4

Tidal Gravity Corrections

Block name is - 9391 MTHOPE GRAVITY TIE
GRAVITY

Page No. 1

Computed on 1993/04/19

Station.	Hrs	Min	Corr.rdg.	Lat(deg.min)	Long(deg.min)	Correction(mGal)
TRAVERSE1 1	6/	4/93		20L 1.05000	GMT+ 10H 0M	
93911105	14	8	2952.313	32 49.4622 S	145 52.2564 E	.019
93912105	15	3	2912.353	32 27.1977 S	145 58.3200 E	-.026
80900143	16	57	2852.299	31 .3240 S	145 .0477 E	-.099
93911105	16	58	2952.199	32 49.4622 S	145 52.2564 E	-.101
93911105	33	45	2952.330	32 49.4622 S	145 52.2564 E	-.012 *
TRAVERSE1 2	7/	4/93		20L 1.05000	GMT+ 10H 0M	
80900143	7	26	2852.302	31 .3240 S	145 .0477 E	-.101
93912105	8	51	2912.370	32 27.1977 S	145 58.3200 E	-.052
93911105	9	45	2952.330	32 49.4622 S	145 52.2564 E	-.012
93912105	10	23	2912.342	32 27.1977 S	145 58.3200 E	.017
80900143	11	47	2852.312	31 .3240 S	145 .0477 E	.066
93912105	13	40	2912.383	32 27.1977 S	145 58.3200 E	.045
93911105	14	37	2952.325	32 49.4622 S	145 52.2564 E	.009
93912105	15	16	2912.339	32 27.1977 S	145 58.3200 E	-.019
80900143	16	37	2852.318	31 .3240 S	145 .0477 E	-.073
TRAVERSE1 3	8/	4/93		20L 1.05000	GMT+ 10H 0M	
93911105	14	37	2952.325	32 49.4622 S	145 52.2564 E	.009 *
80900143	31	36	2852.308	31 .3240 S	145 .0477 E	-.102
93912105	33	3	2912.375	32 27.1977 S	145 58.3200 E	-.074
93911105	34	8	2952.333	32 49.4622 S	145 52.2564 E	-.034
TRAVERSE2 1	6/	4/93		101L 1.05000	GMT+ 10H 0M	
93911105	14	12	2985.567	32 49.4622 S	145 52.2564 E	.016
93912105	14	59	2945.510	32 27.1977 S	145 58.3200 E	-.023
80900143	17	0	2885.343	31 .3240 S	145 .0477 E	-.100
93911105	33	48	2985.575	32 49.4622 S	145 52.2564 E	-.010 *
TRAVERSE2 2	7/	4/93		101L 1.05000	GMT+ 10H 0M	
80900143	7	29	2885.355	31 .3240 S	145 .0477 E	-.100
93912105	8	55	2945.518	32 27.1977 S	145 58.3200 E	-.049
93911105	9	48	2985.575	32 49.4622 S	145 52.2564 E	-.010
93912105	10	27	2945.509	32 27.1977 S	145 58.3200 E	.020
80900143	11	52	2885.365	31 .3240 S	145 .0477 E	.067
93912105	13	44	2945.526	32 27.1977 S	145 58.3200 E	.043
93911105	14	40	2985.590	32 49.4622 S	145 52.2564 E	.007
93912105	15	18	2945.520	32 27.1977 S	145 58.3200 E	-.021
80900143	16	41	2885.356	31 .3240 S	145 .0477 E	-.076
TRAVERSE2 3	8/	4/93		101L 1.05000	GMT+ 10H 0M	
93911105	14	40	2985.590	32 49.4622 S	145 52.2564 E	.007 *
80900143	31	36	2885.365	31 .3240 S	145 .0477 E	-.101
93912105	33	7	2945.537	32 27.1977 S	145 58.3200 E	-.071
93911105	34	11	2985.584	32 49.4622 S	145 52.2564 E	-.032

Coordinate averaging has been done

*** End Ertide. ***

Note: * These stations were taken from previous, or following days, to provide drift control.

APPENDIX 5

Initial Processing Summary And Statistics.

GRVHTS Version 6 of November 1992 - Phase one sub-program Computed on 1993/04/20 at 16:57:56

***** Input data for this pass being read from non-standard unit 40

Gravity meter data reduction

Latitude-Longitude data saved

Segment identification *9391 MTHPE GRAVITY TIE

GRAVITY *

TRAVERSE Flight 1 1 6/ 4/93 Meter 20L Scale factor 1.05000

Scale correction factor is 1.000406026840210

Station	Time	Gravity	Drift	Diff	Reading
9391.1105	1408	.000	.000	.000	2952.313
9391.2105	1503	-41.998	.001	.000	2912.353
8090.0143	1657	-105.105	.003	.000	2852.299
9391.1105	3345	.000	.018	.000	2952.330

TRAVERSE Flight 1 2 7/ 4/93 Meter 20L Scale factor 1.05000

Scale correction factor is 1.000406026840210

Station	Time	Gravity	Drift	Diff	Reading
8090.0143	726	.000	.000	-.013	2852.302
9391.2105	851	63.098	.003	.007	2912.370
9391.1105	945	105.105	-.004	.004	2952.330
9391.2105	1023	63.098	-.008	-.011	2912.342
8090.0143	1147	.000	-.001	-.001	2852.312
9391.2105	1340	63.098	.007	.017	2912.383
9391.1105	1437	105.105	-.002	-.004	2952.325
9391.2105	1516	63.098	-.011	-.012	2912.339
8090.0143	1637	.000	-.009	.013	2852.318

TRAVERSE Flight 1 3 8/ 4/93 Meter 20L Scale factor 1.05000

Scale correction factor is 1.000406026840210

Station	Time	Gravity	Drift	Diff	Reading
9391.1105	1437	.000	.000	.000	2952.325
8090.0143	3136	-105.113	.007	.000	2852.308
9391.2105	3303	-41.994	.008	.000	2912.375
9391.1105	3408	.000	.008	.000	2952.333

TRAVERSE Flight 2 1 6/ 4/93 Meter 101L Scale factor 1.05000

Scale correction factor is 1.002928018569946

Station	Time	Gravity	Drift	Diff	Reading
9391.1105	1412	.000	.000	.000	2985.567
9391.2105	1459	-42.011	.000	.000	2945.510
8090.0143	1700	-105.111	.001	.000	2885.343
9391.1105	3348	.000	.008	.000	2985.575

TRAVERSE Flight 2 2 7/ 4/93 Meter 101L Scale factor 1.05000

Scale correction factor is 1.002928018569946

Station	Time	Gravity	Drift	Diff	Reading
8090.0143	729	.000	.000	.000	2885.355
9391.2105	855	63.090	.003	.002	2945.518
9391.1105	948	105.108	.002	-.004	2985.575
9391.2105	1027	63.090	.002	-.005	2945.509
8090.0143	1152	.000	.007	.004	2885.365
9391.2105	1344	63.090	.011	.003	2945.526
9391.1105	1440	105.108	.010	.004	2985.590
9391.2105	1518	63.090	.008	.000	2945.520
8090.0143	1641	.000	.006	-.004	2885.356

TRAVERSE Flight 2 3 8/ 4/93 Meter 101L Scale factor 1.05000

Station	Time	Gravity	Drift	Diff	Reading
9391.1105	1440	.000	.000	.000	2985.590
8090.0143	3136	-105.105	-.005	.000	2885.365
9391.2105	3307	-42.000	-.006	.000	2945.537
9391.1105	3411	.000	-.006	.000	2985.584

MNSLOPE completed at 1.2 seconds.

Position data saved on scratch file

Position data transfer completed at 1.5 sec
16:57:57

***** Scratch file closed

GRVHTS Version 6 of November 1992 - Phase two sub-program
Computed on 1993/04/20 at 16:57:58

Least squares adjustment phase - commenced 2.2 sec

Number of segments to adjust together 1

*9391 MTHOPE GRAVITY TIE

GRAVITY *

Free nodes

9391.1105
9391.2105

Fixed nodes Values

8090.0143 9793892.600

Free and fixed node lists compared

Number of free nodes deleted is 0

Final number of free nodes is 2

Final number of fixed nodes is 1

Total number of nodes in list is 3

Maximum adjustment expected - Height 5.00 metres
Gravity 1.00 mums-
Magnetic 10.00 gammas

Data search commenced 2.3 sec

Segment identification *9391 MTHOPE GRAVITY TIE

GRAVITY *

TRAVERSE	1 1	6/ 4/93
TRAVERSE	1 2	7/ 4/93
TRAVERSE	1 3	8/ 4/93
TRAVERSE	2 1	6/ 4/93
TRAVERSE	2 2	7/ 4/93
TRAVERSE	2 3	8/ 4/93

Linkage search commenced 2.4 sec

Matrix inversion commenced 2.4 sec

Matrix inversion completed 2.4 sec

Least squares values for free nodes

node	VALUE
9391.1105	9794943.678
9391.2105	9794523.588

Connection table and adjustments

Node	Node	Difference	Adjustment	Flight
9391.1105	9391.2105	-419.979	-.112	TRAVERSE 1 1
9391.2105	8090.0143	-631.075	.087	TRAVERSE 1 1
8090.0143	FIXED 9391.1105	1051.054	.024	TRAVERSE 1 1
8090.0143	FIXED 9391.2105	630.979	.009	TRAVERSE 1 2
9391.2105	9391.1105	420.075	.016	TRAVERSE 1 2
9391.1105	9391.2105	-420.075	-.016	TRAVERSE 1 2
9391.2105	8090.0143	-630.979	-.009	TRAVERSE 1 2
8090.0143	FIXED 9391.2105	630.979	.009	TRAVERSE 1 2
9391.2105	9391.1105	420.075	.016	TRAVERSE 1 2
9391.1105	9391.2105	-420.075	-.016	TRAVERSE 1 2
9391.2105	8090.0143	-630.979	-.009	TRAVERSE 1 2
9391.1105	8090.0143	-1051.133	.055	TRAVERSE 1 3
8090.0143	FIXED 9391.2105	631.188	-.200	TRAVERSE 1 3
9391.2105	9391.1105	419.945	.146	TRAVERSE 1 3
9391.1105	9391.2105	-420.106	.016	TRAVERSE 2 1
9391.2105	8090.0143	-631.002	.014	TRAVERSE 2 1
8090.0143	FIXED 9391.1105	1051.108	-.030	TRAVERSE 2 1
8090.0143	FIXED 9391.2105	630.897	.091	TRAVERSE 2 2
9391.2105	9391.1105	420.180	-.090	TRAVERSE 2 2
9391.1105	9391.2105	-420.180	.090	TRAVERSE 2 2
9391.2105	8090.0143	-630.897	-.091	TRAVERSE 2 2
8090.0143	FIXED 9391.2105	630.897	.091	TRAVERSE 2 2
9391.2105	9391.1105	420.180	-.090	TRAVERSE 2 2
9391.1105	9391.2105	-420.180	.090	TRAVERSE 2 2
9391.2105	8090.0143	-630.897	-.091	TRAVERSE 2 2
9391.1105	8090.0143	-1051.052	-.026	TRAVERSE 2 3
8090.0143	FIXED 9391.2105	631.051	-.063	TRAVERSE 2 3
9391.2105	9391.1105	420.001	.089	TRAVERSE 2 3

Standard deviation of adjustments .08

Mean of adjustments .00

Maximum adjustment .20

Number of lines in network 28

Flight data adjusted - starting 2.6 sec.

Segment identification *9391 MTHOPE GRAVITY TIE
Gravity differences scaled by 10.0 for micrometres

GRAVITY *

Station list sort commenced 2.7 sec

Final sorted values

PAGE 1

*9391 MTHOPE GRAVITY TIE
 8090.0143 9793892.600 NODE
 9391.1105 9794943.678 NODE
 9391.2105 9794523.588 NODE

GRAVITY *

Number of stations in sorted list 3

Number of different stations 3

Station list sort completed 2.7 sec

1

GRVHTS Version 6 of November 1992 - Phase two sub-program Computed on 1993/04/20 at 16:57:59

Latitude-longitude insertion phase - Commenced 2.8 sec

Number of segments to merge 1

Segment identification *9391 MTHOPE GRAVITY TIE LATLONG *
 TRAVERSE 1 1 6/ 4/93
 TRAVERSE 1 2 7/ 4/93
 TRAVERSE 1 3 8/ 4/93
 ***** No latitude or longitude on field sheet for station 9391.110500
 TRAVERSE 2 1 6/ 4/93
 TRAVERSE 2 2 7/ 4/93
 TRAVERSE 2 3 8/ 4/93
 ***** No latitude or longitude on field sheet for station 9391.110500

Final position list checked

Merging of position data completed 3.0 sec

2 Non-fatal mistakes discovered

0 Missing positions in final list

0 Fatal errors occurred in merging

GRVHTS Version 6 of November 1992 - Phase two sub-program Computed on 1993/04/20 at 16:57:59

Creation of new segment file

New output file created on unit 2
 labelled *AUSTRALIAN GRAVITY DATA

93/04/20*

***** 3 Stations output in newly created segment on unit 2
 labelled *9391 MTHOPE GRAVITY TIE

93/04/20*

New output file on unit 2 terminated

labelled *AUSTRALIAN GRAVITY DATA

93/04/20*

CREATE completed at 3.1 sec.

Processing completed for job run

at 16:57:59 on 1993/04/20

Copy from file 2 to file 31
 Segment 1 named 9391 MTHOPE GRAVITY TIE

Number of stations = 3
 End of copy - final output file is unit 31
 Stop - Program terminated.