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A NOTE ON THE PROGRESS OF THE COMPILATION OF GEOPHYSICAL DATA ON THE BONAPARTE GULF BASIN

by

A.L. Bigg-Wither

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This note has been prepared as an interim measure to explain the scope of the compilation, the state of completion, and the degree of reliability of ties between the various surveys. Some suggestions are made for improving the ties. (Appendix A and B).

Certain data which have not yet been obtained by the B.M.R. are mentioned. We would be grateful if any of this information, if available, be supplied for inclusion in the compilation.

The collation and assessment of the data has taken longer than expected, but it is hoped to complete the work by August. Some parts are completed and could be distributed if necessary; we would prefer, however, to issue the compilation as a whole.

Although a lot of gravity data has been punched on to Hollerith cards with a view to determining Bouguer values by computer, this work has been postponed pending the availability of more staff. The work to be completed includes finalising the computer programme, plotting of the Bouguer values, and recontouring.

The "Contents" pages are included with this note, and also a list of the "Plates".

VOLUME I.

Volume I will contain the gravity compilation. Owing to the large amount of data involved, the volume will be prepared in four parts, as shown in the "Contents". The following discussion outlines each section in more detail:

Section 1 contains extracts from "Pendulum measurements of gravity in Australia, 1950-1951" by Dooley, McCarthy, Keating, Maddern & Williams (1961). This has been completed.

Section 2 covers the Keep River Survey, 1955, and includes data from Glover, Richardson & McGilvray (1955); it is accompanied by Appendices A, B, and D. (The details of the various appendices are given later). The section has been completed.

Section 3 - the B.M.R. Survey of July, 1956, by G.F. Clarke; data obtained from Clarke (pers. comm.) and from Thyer, Stott & Neuman (1959); Appendices A, C & D (Appendix B is included in "B" of section 4). Appendix D may be amended depending on the availability of calculation sheets from the B.M.R. Geophysical Branch; the section is otherwise completed.

Section 4 - the B.M.R. Survey of September to October, 1956, by P.M. Stott; data from Stott (pers. comm.) and Thyer et al (1959); Appendices A to E; Appendix D may be amended, as above; written but not edited.

Section 5 - Port Keats Survey, 1956, with details from Derrington, Warren & Burbury, (1957); Appendices B, D; data for Appendix A required, otherwise completed.

Section 6 - the B.M.R. Daly River Crossing - Port Keats Survey, 1957, from Stott & Langron (1959); Appendix B, D; data for Appendix A required.

Section 7 - Central Burt Range area, 1957, from the report by Burbury, (1957); Appendices A, B & D; completed.

Section 8 - Port Keats Survey (Coastal), 1957, also taken from a report by Burbury, (1958); Appendix B; data for Appendix A required, otherwise completed.

Section 9 - this section is from a compilation of gravity surveys, 1955-1957, by Burbury, (1958); completed.

Section 10 - Darwin-Wyndham (underwater survey), 1958, from Williams & Waterlander (1959); Appendix B only ; Appendix A required, otherwise completed.

Section 11 - this is from the compilation by Thyer et al, (op. cit.), of all surveys between 1955 and 1958 except for the Port Keats, and Daly River - Port Keats surveys; completed.

Section 12 - Moyle River, 1959, after Burbury (1959); Appendix B, and data for Appendix A is still required; in preparation.

Section 13 - the Bonaparte Gulf Survey, 1959, from the work done by Gulf Oil Syndicate and subsequently published in the P.S.S.A. Series, No.47 (1964); Appendix B; in preparation.

Section 14 - from the Wyndham - Victoria River Downs Survey in 1960; Appendices A, B, (D), and F, (Appendix D is included in Appendix F); in preparation.

Section 15 - Carlton Gravity Survey of 1961 for Oil Development N.L.; Appendices A & B; completed.

The survey details which are generally given in each section of the gravity compilation are as follows:

A. DATUMS FOR THE SURVEY
   1. Level:-
   2. Horizontal:-
   3. Gravity:-

B. METHODS OF SURVEY:-

I TOPOGRAPHIC
   1(a) Level:-
   (b) Horizontal:-

2. Loop Closure. If not looped the accuracy to be expected is discussed.

II GRAVITY:-

1. Instrument used, scale factor, method of drift control.
2. Elevation correction factor:-
3. Latitude correction.
4. Loop Closure:- If not looped, the accuracy to be expected is discussed.
5. Permanently marked stations (and how marked).

C. TOPOGRAPHIC TIES TO EARLIER SURVEYS

(a) Level.

(b) Horizontal.

D. TOPOGRAPHIC TIES FROM LATER SURVEYS.

(a) Level.

(b) Horizontal.

E. GRAVITY TIES TO EARLIER SURVEYS.

F. GRAVITY TIES FROM LATER SURVEYS.

G. SURVEY DATA AVAILABLE

I GRAVITY:-

1. Field Sheets (Appendix A)
2. Table of Principal facts or computation sheets. (Appendix B).

II TOPOGRAPHIC:

1. Field Sheets or field books. (Usually kept in filing system of Basins Study Group; some are presented in Appendix C).
2. Table of Principal facts. Giving Station No. distance plus bearings (when possible) and elevations. Appendix 'D'.

H. PRINCIPAL OBSERVATIONS:-

(Believed to be the most important observations made in the interpretation of the Bouguer Anomaly map).

I. OTHER IMPORTANT SURVEY DETAILS

VOLUME II The scope of Volume II - the seismic compilation - is shown in the "Contents". The discussions on the various sections have been completed.

VOLUME III . Volume III is also completed and includes correlations between gravity, geology and substructures determined by seismic methods, a brief discussion on aeromagnetic surveys, and finally - the Bibliography.

VOLUME IV.

Volume IV contains the plates. Because of their bulk, the plates have been separated into 4 parts, Parts 1 to 3 relevant to Volumes I to III respectively, and Part 4 with miscellaneous plans and maps which may be useful for future surveys.

COMPILATION AND REVIEW OF THE GEOPHYSICS OF THE BONAPARTE GULF BASIN, 1962

by

A.L. Bigg-Wither

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2. Aeromagnetic surveys.
3. Bibliography.

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APPENDIX A.

I THE REDUCTION OF LEVELS OF GRAVITY SURVEYS IN THE BONAPARTE GULF AREA TO A COMMON DATUM (See Plates 1+2).

The gravity survey in the Port Keats Area, 1956, used an assumed value of 10 feet at peg 54 as datum and obtained the following elevations for pegs 7, 79 and 128, (Derrington, et al, 1957).

Station	Elevation (above assumed atum)
7	43.9 ft.
79	9.6 ft.
128	90.88 ft.

The Daly River Crossing to Port Keats survey (B.M.R., 1957) tied the surveys in the Darwin - Katherine area (Stott & Langron, 1959) to the Port Keats Survey. The tie was between station D.12 at the Daly River Crossing and station 7 near the eastern end of the Port Keats Survey. (Sation D.12 is linked to Fountain Head Siding on the North Australian Railway, which, in turn, is tied to the Northern Territory Lands and Survey Bench Mark No.1). The levels obtained for peg 7 via Station D.12 with respect to three important datums are given below:

160.4 ft (Railway Datum)
57.65 ft (Darwin Town Datum)
48.40 ft (Mean Sea Level - Darwin)

The assumed height of 10 feet as peg 54 is therefore 4.5 feet too low. Thus the elevations of all stations given in Appendix 'B' of the Port Keats Survey should be adjusted by +4.5 feet.

The elevations of pegs 7, 79 and 128 adjusted to Mean Sea level are given below:

Station	Elevation (M.S.L)
7	48.40 ft.
79	14.10 ft.
128	95.38 ft.

In 1957 the Port Keats (Coastal) survey from the mouth of the Daly River to Pelican Island, (Burbury, 1957), tied in to the Port Keats Survey at two points:

i) Between station S.58 of the coastal survey and peg 128 at the northern end of the Port Keats Survey; the tie was made via an intermediate station S.A.1. An elevation of 110 feet relative to Darwin Tide Datum was obtained at station 128 of the Port Keats Survey.

ii) Between station B.51 of the coastal survey and B.52, which is peg 79 and at the eastern end of the Port Keats Survey; a height of 30 feet was obtained for peg 79 relative to Darwin Tide Datum.

Darwin tide datum is 28.42 feet below a bench mark on the N.E. face of the S.W. abutment of the jetty (Burbury, pers. comm.). Its relation to other Darwin datums is not known.

During the coastal survey, levels were obtained by taking readings at sea level and reducing them to Darwin Tide Datum using the Admiralty tide variation tables. I am not aware how the level tie was carried out between B.52 and peg 79. If it was optically levelled we can accept the figure of 30 feet. However in Appendix 'B' the elevation is given as (30)? which implies some doubt.

As the datum for the coastal survey is with respect to Darwin Tide Datum and its relation to other datums unknown, it is suggested that stations S.58 and B.51 be adjusted to mean sea level by accepting the values at stations 128 (95.38 feet) and 79 (14.10 feet) respectively, and all other stations altered accordingly. The differences are shown below:

Station	Elevation (M.S.L.)	Elevation Darwin Tide Datum	Difference
79	14.10 ft.	30	15.90 ft.
128	95.38 ft.	110	14.62 ft.

During the coastal survey a tie was made to the Keep River Survey (Glover et al, 1955). The tie was between station K10 of the coastal survey and station 214 of the Keep River Survey.
The elevation obtained for station 214 during the two surveys are compared below:

Station	Elevation from tie to Coastal Survey (Datum: Darwin Tide Datum)	Elevation Keep River Survey (Datum: 200' Assumed at Peg 60 M.N.)	Elevation Keep River Survey (Datums Approx. M.S.L.)*
214	24 ft	84.3 ft.	14.3 ft.

* From rod levels obtained in the northern parts of the area, along the banks of the Keep River, it became obvious that the assumed height of 200 feet for Peg 60 M.N. was about 70 feet too high.

A tie by B.M.R. in September 1956 (Thyer, et al, 1959) between the 60 M.N. station and a bench mark* near Kimberley Research Station showed that the height of 200 feet assumed at 60 M.N. was 78.6 feet too high with respect to Mean Low Water Mark, Wyndham.

The height taken for the bench mark near the Kimberley Research Station was subsequently found to be 25.1 feet too low - this bench mark was tied to S.P.1 on traverse 'A' Ninbing which in turn was tied to Public Works Department bench mark A.R. 38, and this later tie carried out during the Carlton Gravity Survey, 1961 for Oil Development N.L. showed the error. The assumed height of 200 feet at Peg 60 M.N. is therefore 53.5 feet too high with respect to Mean Low Water, Wyndham. Thus the elevation of station 214 is 30.8 feet with respect to mean Low Water Wyndham, and 18.3 feet with respect to Mean Sea Level, Wyndham (which is 12.5 feet above Mean Low Water Wyndham).

Thus the elevation of the coastal stations between station B.51 (which tied to peg 79 at the eastern end of the Port Keats Survey) and station K.10 (which tied to station 214 of the Keep River Survey) should be adjusted by accepting the values of 14.10 feet with respect to mean sea level at peg 79 and the value of 18.3 feet with respect to Mean Sea Level, Wyndham, at station 214.

The coastal survey also tied to the Moyle River Survey carried out in 1959. The tie was between station S.27 of the coastal survey and station 1 of the Moyle River Survey.

All coastal stations between S.58 (which was tied to peg 128 of the Port Keats Survey) and S.3 at the mouth of the Daly River should be adjusted by accepting the value of 95.38 feet above M.S.L. at peg 128 as correct and adjusting the stations accordingly. A correction of -14.62 feet should therefore theoretically be applied.

The elevation of station S.27 is given as 13 feet with respect to Darwin Tide Datum in Appendix B. When a correction of -14.62 feet is made its elevation becomes -1.62 feet, i.e. a mis-tie of -1.62 feet. As there is no closed loop around which errors can be distributed perhaps the best course to follow would be to apply a correction varying linearly from -14.62 feet at S.58 to -13.00 feet at S.27. From station S.27 to station S.3 at the mouth of the Daly River a constant amount of -13.00 feet could be subtracted from all the coastal stations.

The elevations of the rest of the surveys are with respect to Mean Low Water Wyndham or can be easily related to Mean Sea Level Wyndham by ties carried out between them.

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* This bench mark can no longer be located (see my comments, page).

The traverses which were levelled barometrically during the two B.M.R. surveys in 1956 are stations G.1 to G.17 surveyed in July 1956 and stations G.31 to G.35 along the highway to the 35 mile post. (2 mile intervals) and stations 35 M. to 55 M. along the Carlton Crossing - Ivanhoe highway were barometrically surveyed between September and October, 1956. The levels for the above stations are given in Appendix D. These levels have been adjusted by accepting the values obtained by optical levelling at points where both barometric and optical levelling was carried out. The method of adjustment of the Barometric levels is not very satisfactory for reasons mentioned in my report (in prep.).

The original barometric field data is presented in my report and recalculations can be made using additional points which were both barometrically and optically levelled.

II Vertical Control of gravity Surveys in the Bonaparte Gulf Area

In Volume IV, part 4 of my final report Plates taken from Survey groups of various Government departments giving bench marks and elevations will be presented to enable future surveys to tie to reliable stations. With this note a list of bench marks supplied by the Public Works Department, Wyndham is given on page 19. Bench Marks B.1 - B.127 were located at every mile along the wet weather track between Wyndham and Argyle Downs. The elevations are with respect to zero on the Tide Gauge at Wyndham Jetty which equals Low Water ordinary Spring Tides, Wyndham.

Many of these bench marks have probably been graded or bulldozed out. The following bench marks were recovered by Western Command Field Survey Section during their mapping operations in the Area.

BM1 - Outside Public Works Department Store at WYNDHAM.

BM24 - About 100 yards EAST of GOOSE HILL CREEK crossing.

BM27 - Beside main road, about 3 miles EAST of GOOSE HILL. Identified on photograph CAMBRIDGE GULF Run 9/5187 or 9/5197

BM33 - Beside main road about 6 miles EAST of BM27. Identified on photograph CAMBRIDGE GULF Run 9/5125.

BM95 - Beside road into THOMPSON SPRING SOUTH of and close to the foot of MT HENSMAN.

These and a few of those listed on page 19 may still be recoverable. The bench marks are concrete blocks 10" square and 10" above surface. The traverse was from Wyndham to Ivanhoe past House Roof Crossing. From Ivanhoe just east of H.J.13 and east of Nigger Hill and west of 8 Mile Well, east of Cockatoo Spring, east of Mt Hensman, then south to Argyle Downs.

BENCH MARKS FROM WYNDHAM TO ARGYLE DOWNS

B.M.No.	R.L.	B.M.No.	R.L.	B.M.No.	R.L.
B1	37.84	B44	72.01	B87	434.71
B2	26.25	B45	75.96	B88	408.13
B3	29.35	B46	88.85	B89	398.08
B4	44.89	B47	84.39	B90	428.09
B5	29.34	B48	107.83	B91	466.36
B6	30.86	B49	141.30	B92	385.02
B7	60.69	B50	158.49	B93	369.35
B8	41.60	B51	130.45	B94	411.36
B9	27.83	B52	103.63	B95	422.08
B10	30.09	B53	90.84	B96	433.78
B11	39.53	B54	133.53	B97	427.52
B12	26.49	B55	113.95	B98	408.93
B13	26.06	B56	106.97	B99	434.20
B14	25.12	B57	116.05	B100	466.02
B15	27.12	B58	117.72	B101	440.38
B16	29.88	B59	130.70	B102	397.81
B17	30.80	B60	129.65	B103	353.18
B18	35.13	B61	137.35	B104	335.81
B19	33.88	B62	138.85	B105	315.30
B20	31.31	B63	144.27	B106	289.57
B21	30.11	B64	127.06	B107	276.67
B22	46.25	B65	147.30	B108	266.08
B23	34.16	B66	154.24	B109	254.75
B24	33.81	B67	156.20	B110	254.68
B25	35.29	B68	156.15	B111	274.47
B26	37.47	B69	160.96	B112	262.98
B27	38.16	B70	180.08	B113	268.17
B28	38.90	B71	180.90	B114	275.01
B29	38.77	B72	174.69	B115	251.84
B30	38.39	B73	237.47	B116	246.04
B31	43.68	B74	247.82	B117	253.03
B32	47.02	B75	258.00	B118	254.77
B33	48.92	B76	294.34	B119	249.62
B34	51.77	B77	291.62	B120	241.97
B35	56.15	B78	319.24	B121	293.84
B36	57.83	B79	329.03	B122	256.44
B37	60.18	B80	330.36	B123	226.84
B38	62.49	B81	341.50	B124	286.77
B39	65.38	B82	324.57	B125	259.12
B40	66.50	B83	346.59	B126	243.83
B41	72.20	B84	402.49	B127	249.77
B42	74.25	B85	354.24		
B43	75.74	B86	420.28		

III Horizontal Control of gravity surveys in the Bonaparte Gulf Area (See Plate 3).

Most of the surveys in the Bonaparte Gulf area have one or more stations tied to mile posts of the Border Survey and hence the horizontal control for the gravity traverses is good.

In a few surveys, however, the stations were plotted from aerial photographs and the horizontal control is not as good.

Plate 78 of my report is presented with this note to enable the reader to locate the nearest astronomical or Laplace stations to the gravity surveys carried out in the Bonaparte Gulf Area. Horizontal ties could then be made from individual surveys to the control stations for better horizontal control. Details of the control stations and station summaries can be obtained from the Department of National Mapping, Canberra. ~~An~~ Examples of the type of information contained in the station summaries ~~is~~ are given on Plates 81 and 82 of my compilation — in prep.

APPENDIX B.

THE REDUCTION OF GRAVITY SURVEYS IN THE BONAPARTE GULF AREA TO A COMMON DATUM (See Plates 1 & 2).

The gravity readings in the Port Keats Area, (Minad, 1956) were reduced through gravity station No.1. Its latitude was calculated to be 14°20'46.8" with respect to astrofixes at Fossil Summit and Kulshil. A gravity value of 978388.98 milligals was assumed for station No.1.

With station No.1 as datum the following observed gravity values were obtained for stations 8, 79, 128 and 11.

STATION	OBSERVED GRAVITY Datum: 978388.98 milligals at Station No.1	
8	978392.20 milligals	
79	978381.64 milligals	(See Appendix B Port Keats Survey, in final report).
128	978341.69 milligals	
11	978393.51 milligals	

The Daly River Crossing to Port Keats Survey (B.M.R., 1957) tied the gravity surveys in the Darwin - Katherine Area (Stott and Langron, 1959) to the Port Keats Survey. The tie was between station D.12 at the Police Station near the Daly River Crossing and station 8 and 11 near the eastern end of the Port Keats Survey. Station D.12 is in turn tied to pendulum station No.32 at Darwin Airport which has an observed gravity value of 979315.5(0) milligals (Dooley et al, 1950).

An observed gravity value of 978373.30 milligals was obtained at station 8 and 978374.95 milligals for station 11 by the tie from station D.12. The difference between the values obtained at stations 8 and 11 by using station No.1 Port Keats as datum and by using station D.12 as datum per the Darwin Pendulum station during the 1957 B.M.R. Survey is 18.90 milligals at station 8 and 18.56 milligals at station 11, a mis-tie of .34 milligals over a distance of only 1.6 miles. The average drop in gravity value between the two sets of readings is 1.48 milligals. The mis-tie is too great to be ascribed to incorrect instrument calibration factors. Approximate reoccupations of stations and misreadings could be contributory factors. However, because the actual causes for the mis-tie are unknown, whatever adjustments are made are likely to be incorrect. Also, any adjustments made to stations 8 and 11 will have to be made to all stations of the Port Keats and the Daly River Crossing to Port Keats Survey . It has been found (see later) that by accepting the B.M.R. 1957 value at station 11 as correct, a closer tie occurs with the Keep River Survey to the south. It is suggested therefore that the B.M.R. values at station 11 and 8 be accepted as correct and that the observed gravity values of the Port Keats Survey, west of station 11 be reduced by 18.56 milligals to the absolute value. In this way

adjustments to the values of hundreds of stations can be avoided and the only adjustment necessary will be to the Port Keats stations between station 8 and 11. The adjustment could be made by applying a correction varying linearly from 18.90 milligals at station 8 to 18.56 milligals at station 11.

The Observed gravity values for station 8, 79, 128 and 11 with respect to Darwin Pendulum Station are therefore:-

STATION	OBSERVED GRAVITY Datum: 979315.5(0) milligals at Darwin Pendulum station.
8	978373.30 milligals
79	978363.08 milligals
128	978323.13 milligals
11	978374.95 milligals

In 1957, the Port Keats (Coastal) survey from the mouth of the Daly River to Pelican Island (Burbury, 1957), tied in to the Port Keats Survey at two points:

i) Between station S.58 of the Coastal survey and peg 128 at the northern end of the Port Keats survey. The observed gravity value of 978341.69 milligals at peg 128 (from the Port Keats Survey) was used as datum.

ii) Between station B.51 of the Coastal survey and B.52, which is peg 79 at the eastern end of the Port Keats Survey. An observed gravity value of 978380.50 milligals was obtained at peg 79 with respect to 978341.69 milligals at peg 128 by this tie.

In order to bring the observed gravity values for all stations of the Port Keats (Coastal) Survey to the absolute, they should be adjusted to the values of stations 128 and 79 derived from the B.M.R. 1957 survey.

The differences in the observed gravity values at stations 79 and 128 obtained during the Port Keats Survey and the Port Keats (Coastal) Survey are given below with respect to the Darwin Pendulum station as datum.

STATION	Port Keats Survey Observed Gravity Datum: 979315.5(0) milligals at Pendulum Station Darwin	Port Keats (Coastal) Survey Observed Gravity Datum: 978341.69 milligals at station 128.	Difference
79	978363.08 milligals	978380.50 milligals	17.42
128	978323.13 milligals	978341.69 milligals	18.56

A mis-tie of 1.14 milligals.

The Port Keats (Coastal) Survey traverse between stations 128 and 79 and the Port Keats Survey between these stations form a closed loop and normally any misclosure should be distributed around the loop. However, the coastal survey is likely to be the less accurate, as drift was controlled by returning to base stations only once during a day's survey. It would appear therefore that the best method of adjustment of the observed gravity values would be to accept the values of 978323.13 milligals for station 128 and 978363.08 milligals for station 79 and to apply a correction varying linearly from -17.42 milligals at station 79 to -18.56 milligals at station 128 around the Coastal Survey.

For stations along the coast to the north of station 128 a constant correction of -18.56 milligals should be made and a constant correction of -17.42 milligals for stations along the coast to the south of station 79.

The Port Keats (Coastal) Survey (Minad, 1957) obtained an observed gravity value of 978344.07 milligals for station S.27. To bring the observed gravity value at S.27 (which is to the north of and tied to station 128) to the absolute, a correction of -18.56 milligals must be applied. The absolute observed value of gravity at station S.27 is therefore 978325.51 milligals. Station S.27 provided the tie for the Moyle River Gravity Survey (Minad, 1959). The gravity data for the Moyle River Survey was reduced using the value of 978344.07 milligals at station S.27. Therefore, to bring the observed gravity values of the Moyle River survey to the absolute, a correction of -18.56 milligals must be applied to all stations.

The Port Keats (Coastal) Survey, (Burbury, 1957) also tied to the Keep River Survey (Minad, 1955), the tie being between station K.10 of the Coastal Survey and station 214 of the Keep River Survey. An observed gravity value of 978395.95 milligals was obtained at station 214 by this tie. This value is with respect to the observed gravity of 978344.07 milligals at station S.27. By accepting the value 978363.08 milligals for station 79 (B.M.R. 1957 Survey) as datum, as suggested above, values of the Keep River survey stations should be adjusted by -17.42 milligals. The value at station 214 therefore becomes 978378.53 milligals.

During the Keep River Survey (Minad, 1955), however, an observed gravity value of 978401.27 milligals was obtained at station 214 with respect to an assumed observed gravity value of 978409.20 milligals at Peg 60 M.N. (Minad Datum). Peg 60 was also tied to the 55 M.N. post which had an observed gravity value of 978419.25 milligals.

Subsequent ties between the Pendulum Station at Wyndham to stations G.1 and 55 M.N. post showed the correct absolute value for 55 M.N. post to be 978397.37 milligals. The gravity values at 55 M.N. based on an assumed gravity value at 60 M.N. post are therefore 21.88 milligals too high and thus the absolute gravity value of station 214

based on Wyndham Pendulum station should be 978379.39 milligals. A mis-tie of .86 milligals is therefore shown between the ties from Darwin Pendulum station and Wyndham Pendulum stations to station 214. Considering the length of the tie traverse, this degree of correspondence is good and the difference is probably due to slight inaccuracies in the calibration constants used. Theoretically, the mis-tie of .86 milligals should be distributed between the tie traverse from station 79 of the Port Keats Coastal Survey and station 214 of the Keep River Survey and between the tie traverse from Wyndham to station 214 via 55 M.N. post of the Border Survey and to all gravity stations which are tied to these traverses. However, as the tie at station 214 was only an approximate one and any adjustment of the gravity values on the tie traverse would require the readjustment of all gravity stations in the Bonaparte Gulf area, it is perhaps best at this stage to compromise by taking the average of the two observed gravity values obtained at station 214 and leave the remaining stations unadjusted.

Three gravity surveys in the Bonaparte Gulf Region tied in to S.P.1 of the B.M.R's Seismic and Gravity traverse A, Ninbing. (Robertson, 57 and Thyer et al, 59).

The first tie was by the B.M.R. in July 1956. The tie was between Wyndham Pendulum station and S.P.1 via stations G.1 and G.8. The observed gravity value at S.P.1 by this tie was 978385.58 milligals with respect to a value of 978389.41 milligals at G.8 (obtained by a tie to G.1). Recalculations of the tie between S.P.1 and G.8, accepting the value of 978389.41 milligals at G.8 as correct, gives an absolute observed gravity value of 978385.47 milligals for S.P.1. An error of .11 milligals.

In my record (in prep.) I have shown that the tie between Wyndham Pendulum station and G.1 had been miscalculated and should be .49 milligals higher. Therefore the absolute observed gravity value at S.P.1 should be 978385.96 milligals.

The next survey to tie to S.P.1 was the Bonaparte Gulf Gravity Survey (Western Australia), (Minad, 1959). The gravity data was reduced using a figure of 978404.91 milligals (assumed) for Peg 58 situated at old Ninbing Homestead. Bouguer values calculated at S.P.1 based on the above value were 11.82 milligals higher than that of the B.M.R. Therefore a correction of -11.82 milligals was applied to all stations. The observed gravity value for S.P.1 is given as 978399.16 milligals based on a value of 978404.91 milligals at station 58. The observed gravity value used as datum for this survey must therefore have been 978387.34 milligals at S.P.1. It will be noticed that the value given by the B.M.R. for S.P.1 is 978385.58 milligals. Thus, neither of the datums used is correct. It was shown above that the absolute observed gravity value at S.P.1 should be 978385.96 milligals.

The third survey to tie to S.P.1 was the Carlton Gravity Survey, 1961. The survey started at Pendulum Station B.M.R. No.30 which has an observed value of 978415.9(0) milligals. A series of gravity readings were established between the Pendulum Station and the Public Works Department bench mark A.R.38 near Kimberley Research Station. A.R.38 was then tied to S.P.1 of the B.M.R's Ninbing traverse and an absolute observed gravity value of 978386.09 milligals was obtained at S.P.1. This figure is within .13 of a milligals of the value obtained by the B.M.R. tie in 1956 after errors in the original calculation of the ties are corrected.

It is unfortunate that although three surveys in Western Australia came to within a few miles of the Border, no gravity ties were made to mile posts of the Border Survey.

Only the more important ties between the various surveys have been discussed above. In the final report, detailed analyses of all ties between the surveys will be given.

Plates 1 and 2 of this note will show which ties would be useful between the various surveys in order to bring a higher degree of accuracy to the Bouguer Anomaly map. The most important ties required are between the surveys in the Port Keats area to the north-east and the surveys in the Kimberley Research Station area to the south-west. At present only the Port Keats (Coastal) Survey and the B.M.R. Underwater Gravity survey link the two regions; these ties are not considered reliable because the gravity interval obtained during the Coastal Survey between stations B.37 and A.9, and the interval between corresponding stations 90 and 106 of the B.M.R. Underwater Survey differed by 11.6 milligals.

During the Port Keats (Coastal) Survey, (Burbury, 1957) a tie between station 79 of the Port Keats Survey (Minad, 1956) and station 214 of the Keep River Survey (Minad, 1955) obtained a value of gravity which was within .86 milligals of the value obtained at station 214 by a tie to Wyndham Pendulum station. It is more likely, therefore, that the gravity interval measured by Minad between stations B.37 and A.9 is correct, as it is difficult to suppose that an error of over 10 milligals could have occurred between station 214 of the Keep River Survey and station A.9 of the coastal survey a distance of approximately 21 miles. It is essential, if any confidence is to be placed in the Port Keats (Coastal) Survey and the B.M.R. Underwater Gravity Survey, to find out where the error lies. The best method to adopt is to run a traverse from station 214 of the Keep River Survey via stations K.10 to K.14 of the coastal survey and tie in to station 622 of the Keep River Survey. From station 622 the traverse should be extended via B.44 to A.9 of the Coastal Survey. This traverse will enable a check to be made on the interval between stations B.37 and A.9 of the Port Keats (Coastal) Survey. A further check would also result by the tie to the Keep River Survey.

As the only two surveys which tie the surveys in the north-east to those in the south-west are suspect, it is suggested that ties between the two areas be made in any of the following ways.

1. Along the coast between the two areas as was done during the Port Keats Coastal Survey. Due to the large range in height between high and low tides along the coast and estuaries it is difficult to locate existing coastal stations and exact reoccupations are seldom possible. Also, due to the large tidal range it is difficult to place permanent markers at stations. It is suggested therefore that the stations established by the Division of National Mapping be reoccupied whenever possible as these are of high accuracy, well monumented and detailed access information is available for them.

2. A shipborne gravity survey to be run with the Sonar Boomer Survey in the Bonaparte Gulf this year could help tie the surveys in the two areas if a sufficient number of ties to existing coastal stations can be made. However, as the coast is a treacherous one, with many reefs and subject to violent summer storms, this may not be possible. A solidly constructed wharf is maintained at the head of the Port Keats River and landing barges up to 40 tons capacity could be accommodated at this wharf.

If possible a tie should be made to the land at the Port Keats wharf by hauling out the La Coste-Romberg meter and bell and taking a reading on the wharf or preferably on land near the wharf. A tie could later be made between the nearest coastal station and this station, provided it is well monumented and can be exactly reoccupied. If it is not possible for the vessel to land at Port Keats wharf, luggers used by the Port Keats Mission to transport supplies could be used to bring the meter ashore, weather conditions permitting. If the hauling of the meter and bell is too difficult readings could be taken at the sea bottom below the wharf and the nearest point on the wharf directly above the observation point marked. The gravity interval between the observation point and an existing land station can be obtained later by taking readings between the stations making due allowance for the depth of water between the point of observation and the mark on the wharf. Australian Aquitaine Pty Ltd will soon be drilling Kulshil No.1 and are at present establishing loading and unloading facilities along a sandy beach on the coast to the west of Port Keats and suitable boats and help may be obtained from them if the luggers from Port Keats are not available.

The observed gravity interval between B.37 and A.9 of the Port Keats (Coastal) Survey (Burbury, 1957) and the corresponding stations 90 and 106 of the B.M.R. Underwater Gravity Survey, 1958 should be checked by taking readings with the La Coste-Romberg underwater gravity meter as near as possible to stations B.37 and A.9 of the Coastal Survey.

Also if the water is shallow enough the gravity interval should be taken between the station read by the La Coste-Romberg Meter and the coastal station by a Worden gravity meter.

3. A gravity survey by helicopter would be ideal to tie the surveys in the two areas together. The survey could be carried out in large looped traverses, selecting existing gravity stations of several surveys as turning points. The following traverses are recommended.

i) Station D.12 of the B.M.R. Daly River Crossing - Port Keats Survey, 1957 to station S.3 at the mouth of the Daly River. Station S.3 should then be tied to Astronomical station, Daly River (A), on the opposite bank. This would allow future surveys to start off from a reliable point and with a known absolute observed gravity value, as station D.12 is tied to Darwin Pendulum station.

ii) From station S.3 to Astro. station JH2(A) on the coast to S.24, S.27 and B.30 at the mouth of the Moyle River. Station S.27 should then be tied to station 1 of the Moyle River Survey (Minad, 1959) and to Astro. station JH3(A). This will enable future surveys to start off from a reliable point and with a known absolute observed gravity. A leap frog method should be adopted for this traverse for drift control.

iii) From station B.30 of the coastal survey to a station on the Moyle River to the south of station 65 of the Moyle River Survey. This station should then be tied in to station 65.

iv) From station 65 of the Moyle River Survey to station K.21 of the B.M.R. Daly River Crossing to Port Keats Survey, 1957 on the Moyle River.

v) From station K.21 to station D.68 on the Daly River Crossing to Port Keats Survey (B.M.R. 1957).

vi) From station D.58 to Astro. station JH2(A) and return.

vii) From station D.68 to station D.12 on the Daly River crossing.

viii) From Astro. station JH3(A) on the coast north of Port Keats to Astro. station JB7(A) near Port Keats station. Station JB7(A) should then be tied to S.58 of the coastal survey, and station 128 at the northern end of the Port Keats Survey and station B.37, the point at which the Underwater Survey tied to the coastal survey.

ix) From JB7(A) to Astro. station JH5(A) on the coast at Pearce Point. JH5(A) should then be tied to stations S.51, and B.53 of the coastal survey.

x) From station JH5(A) via station B.51 to station 79, 84, 97 and 94 of the Port Keats Survey.

xi) From station 94 to Astro. station on JH6(A) in Keyling Inlet at the mouth of the Fitzmaurice River.

xii) JH6(A) to station B50 on the coast at Swamp Point and back to station B.51 of the Coastal Survey.

xiii) From station B.51 via Astro. station LA21(A) in the Queens Channel to Astro. station JH6(A) and return to Astro. station LA21(A).

xiv) From Astro. station LA21(A) via stations 356, 15A, 513 of the Keep River Survey to stations 218, 214 (Keep River Survey) and K.10 (Coastal Survey). Station K.10 should then be tied to station 622 (Keep River Survey) via stations K.13 and K.14 (Coastal Survey).

xv) Station 622 to 78½ M.N. post of the Border (Minad station) via station A9 on the coast, the point at which the Underwater Survey tied to the coastal survey.

xvi) Station A9 west to station A1 and station 268 and return to A1 via station 217 and 283 of the Bonaparte Gulf Gravity Survey (Minad 1959).

The above traverses if carried out will result in several closed loops around which closure errors can be distributed and will provide a sound tie between the surveys in the two areas. The absolute gravity values at Astro. stations which are well monumented will provide a basic network of reliable stations to which future surveys can be tied.

Other valuable ties which could be made either by land or by helicopter are -

1. From S.P. 109 on B.M.R. traverse A, Ninbing, to station G.1. This traverse could be profitably extended to station 73/119 of the Wyndham to Victoria River Downs Survey B.M.R., 1960.

2. From N.B. 39 of the Carlton Gravity Survey (Oil Development N.L. 1961) to stations 73/112 and 73/109 on the Wynham - Victoria River Downs Survey. 73/109 back to N.B. 39 via B.M.R. stations P.4 and P.6.

3. From station 73/99 on the Wyndham - Victoria River Downs Survey to station R.32 of the Central Burt Range Survey (Minad, 1957).

4. Station 35 on the B.M.R. 1956 traverse, Spirit Hill to W.327 on the Keep River Survey (Minad, 1955).

5. Station W.125 to stations 23 and 200 within the Keep River Survey.

6. Station 622 of the Keep River Survey via station K.10 of the Coastal Survey to stations 214 and 210 of the Keep River Survey.

7. Ties from stations ET41, EJ27, EK22, EL16, EM10 and N.M.47 of the Carlton Gravity Survey (Oil Development N.L. 1961) to the nearest mile posts of the Border Survey (Minad stations).

8. Ties from station NG4 of the Carlton Gravity Survey to 262 of the Bonaparte Gulf Survey and G.12 of the B.M.R. Survey, July, 1956 .

9. Station 95 of the Bonaparte Gulf Survey to stations 39 and EC4 of the Bonaparte Gulf and Carlton Gravity Surveys.

10. A tie from EG40 of the Carlton Gravity Survey to station 247 of the Bonaparte Gulf Survey and thence to 78 and 78½ M.N. posts of the Border Survey (Minad Stations).

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(i) Unpublished reports.

(ii) Private Company Reports - indicated by an asterisk.

The unpublished reports include

(a) Bureau of Mineral Resources Records.

(b) Completion Reports on subsidized geophysical or drilling operations which may eventually be published.

(a) Reports in this category may be examined at the Bureau's Canberra and Melbourne offices. The Bureau of Mineral Resources Records are sometimes obtainable on loan from the Bureau - upon request.

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(ii) Private Company Reports are on unsubsidized geophysical operations of which the majority were carried out before the Petroleum Search Subsidy Act covering geophysical surveys came into operation in 1959. These reports are the property of the companies concerned and can be inspected at the Bureau's Canberra office only if a letter of authorisation from the company is first obtained.

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Bonaparte Gulf Basin

INTEGRATION OF GRAVITY SURVEYS

Scale 1 : 250,000

5 0 5 10 15 20

MILES

REFERENCE

5	Port Keats, Minad, 1956	•———•
6	Daly River Crossing - Port Keats, B.M.R. 1957.	▲———▲
8	Port Keats, (Coastal) Minad, 1957.	•S1
10	Darwin - Wyndham (Underwater), B.M.R., 1958	•———•
12	Moyle River, Minad, 1959.	○———○
	Astronomical Fixation	☼

Minad Mines Administration Pty. Ltd.
B.M.R. Bureau of Mineral Resources
(A) Established by Department of Army

ANSON BAY

DALY RIVER (A)

DALY RIVER

MOYLE RIVER

FITZMAURICE RIVER

"Nacoolya" H.S.

Gravity Tie (10,8).

Gravity and Level Tie (8,12)

Gravity Tie (6,5)

Level Tie (6,5)

Gravity and Level Tie (8,5)

Bureau of Mineral Resources, Geology and Geophysics. August 1964.

To accompany record No. 1965/

F.E, J.L.Mc

INTEGRATION OF GRAVITY SURVEYS

Bonaparte Gulf Basin

Scale 1 : 250,000

5 0 5 10 15 20

MILES

Gravity Tie (10, Pendulum Stn. Wyndham) WYNDHAM

Ninbing H.S. (Abd)

Gravity and Level Tie (4,3) Carlton Hill H.S

Gravity and Level Tie (13,4) BMR 109

Level Tie (4,3)

Gravity and Level Tie (3,3)

Gravity and Level Tie (4,3)

Level Tie (3,2) Barometric
Level Tie (4,2) Optical
Gravity Tie (3,2)

Gravity and Level Tie (4,2)

Gravity and Level Tie (7,4)

Gravity and Level Tie (7,4)

Gravity and Level Tie (8,2.)

Level Tie (4,2) (B.M.R. 177)

Gravity Tie (10,8)

EI, I S.P.I Gravity and Level Tie (4,13,15.)

LA 17(A)

LA 21(A)

REFERENCE

Astronomical Fixation

2. Keep River, Minad, 1955.
3,4. B.M.R. Survey, July to October, 1956.
7. Central Burt Range, Minad, 1957.
8. Port Keats (Coastal), Minad, 1957.
10 Darwin - Wyndham (Underwater) B.M.R. 1958.
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B.M.R. Bureau of Mineral Resources.
Minad. Mines Administration Pty. Ltd.
O.D.N.L. Oil Development N.L.
(A) Established by Department of Army

Bureau of Mineral Resources, Geology and Geophysics. August 1964.

To accompany record No 1965/

F.E. & J.L.M.

HORIZONTAL CONTROL

I.C.A.O. CHART 3109 DARWIN

Scale 1 : 1,000,000

0 10 20 30 40 50 100

STATUTE MILES

REFERENCE

First Order Triangulation

Second Order Triangulation

Third Order Triangulation

First Order Traverse

Traverse Station

Laplace Station (Fully Observed)

Laplace Station (Azimuth only)

Astronomical Fixation

NM Established by Division of National Mapping

(A) " " Department of Army

(S) " " " Lands (Respective State)

JOSEPH BONAPARTE GULF

AUSTRALIA WESTERN TERRITORY NORTHERN

VICTORIA RIVER

KING RIVER

KATHERINE R.

DALY RIVER

DRYSDALE

SUNN POINT (A) U240 (A)

THE NARROWS (A)

MM81(A)

LAKE FINNISS (A)

AS8(A) U241(A)

DARWIN

DARWIN NM/G21

DELISSAVILLE

NMS4

NMS7

AS9(A)

U34(A)

HUMPTY DOO (A)

EAST OF MARRAKAI (A)

NMG/22 TIDY HILL

QUARRY HILL NM 6/23

WEST OF MILNE (A)

MANTON DAM (A)

MARRAKAI (A)

ALARIC (A)

KN15(A)

U342 (A)

U340(A)

NMS5

NMG/24 GIANTS REEF

BATCHELOR

NMG/25 MT.MINZA

AS7 (A)

NMS6

KN1(A)

MT CARR NMG/26

AS4(A)

S/FOELSCHE(NM)

S/RINGWOOD(NM)

A23(A) A20(A)

S/N END BASE

S/DOUGLAS

DALY RIVER (A)

NEW MT PAQUALIN NM/627

AS3(A) S/DARWENT

S/ELLISON (NM)

AS6(A)

S/S END BASE BS1(A)

S/GEORGE

GROVE HILL(A) HAU7

MT OSBORNE NM/628

NM/G29 MT. WELLS (A)

NMT3

JM2 (A)

NM/FOUNTAIN HEAD AS1(A)

NM/PLATEAU

E41(A)

S/SAUNDERS (NM)

MM180(A)

DALY RIVER

TIPPERARY (A) HAU22

U343(A)

S/A/UNION HILL M/G30

DALY RIVER MISSION

NMT5

NMT4

AS5(A)

G48(A) NM/631

PINE CREEK

SANDS (NM)

NM/CULLEN

NM/GARIBALDI

U37(A)

JH3(A)

S/FOELSCHE HEADLAND(NM)

NM/632 MT GILES

JH4(A)

NMT6

NMT7

JW4 (A)

AS14(A)

JB6(A)

PORT KEATS MISSION JB7 (A)

JW2 (A)

S/FAR VIEW PK.

S/HELLING (NM)

JH5 (A)

NMS2

NMS3

S/HORNETT (NM)

NMT8

NMT2

JW3 (A)

S/BOWMAN

S/MULLEN'S RIDGE

S/PEARCE

NMT1

S/WOOD'S

L2(A)

U110(A)

JH6(A)

JW1(A)

S/FREDA(A)

U109(A)

NNS1

NNC 68

S/HOGARTH

S/TABLE HILL

L3(A)

S/BERTRUDE

U108(A) NMC54 L4(A) S/AUGUSTA CROWN

LA59 (A)

S/NEEDHAM

LA4(A)

LA4A(A)

U107(A)

COOLIBAH

NMC55

LA8(A)

S/ILLARA

LA11(A)

U106 COOLIBAH(A)

LA53(A)

S/BARNEY BLUFF

U105(A)

S/GREGORY

U105(A)

LA5 (A)

AUVERGNE

LA2(A)

TIMBER CREEK

LA 2 (A)

U104(A)

LA 60(A)

L5 (A)

LA24(A)

LA6(A)

S/PEAKE

L6(A)

S/ROMULA KNOB

VICTORIA PEAK

U102 (A)

LA26(A)

NMC 52

KN2 (A)

KN8(A)

JW 22(A)

JW 21(A)

KN3(A)

KN5 (A)

RO89 GEORGE(A)

RO91 TREES(A)

RO92 BERNIER (A)

RO86 CONE(A)

RO88 BARTON (A)

RO90 RED(A)

RO93 WHISKY (A)

RO94 ELSIE (A) ELSIE I.

RO87 PAGO (A)

KN4(A) KALUMBURU JMA9(S) MISSION

RO85 OSBORNE (A)

JW 24 (A)

RO84 CONNOR

JMA 10 (S)

JMA 16 (S)

JMA 11 (S)

TO 10(A)

JW 20(A)

RO95 THURBURN (A)

LA 49(A)

LA22 (A)

ASWYN III (A)

RO96 SLAB (A)

JMA 12(S)

JMA 15 (S)

T009 (A)

JMA 8 (S)

JMA 7(S)

JMA 13 (S)

JMA 14(S)

JMA 5(S)

JMA 6 (S)

JMA 4 (S)

FORREST RIVER MISSION JB 10 (A)

S/HBI4

S/ELEPHANT

S/HBI3

S/WILSHERE

LA23(A)

S/HBI1 NINBING

S/HBI2

LA 18 (A)

S/HJ5 ONSLOW

SQUOIN

S/HB6

S/HB7

LA48 (A)

S/W BASE

S/E BASE

RO97 WEST BASTION (A)

S/HBI0 NMC56

WYNDHAM

S/HJ1

S/HJ11

S/HB9

LA17 (A)

CARLTON

S/ERSKINE

RO28 PLOT(A)

LA 47(A)

RO30 BUTTONS GAP (A)

RO31 IVANHOE(A)

LA16(A)

S/HJ10

S/HJ12

S/CN1

S/HJ8

IVANHOE

S/COCKBURN

JB11(A)

RO27 GAP(A)

S/HJ13

S/HJ15

LA15 (A)

S/CN3

S/HJ14

LA46 (A)

RO26 OPTIC(A)

S/CN4

Bureau of Mineral Resources, Geology and Geophysics. May, 1965.

(BASED ON DS2/80-1)

To accompany record N° 1965/

F.E.

DEPARTMENT OF NATIONAL DEVELOPMENT

DIVISION OF NATIONAL MAPPING

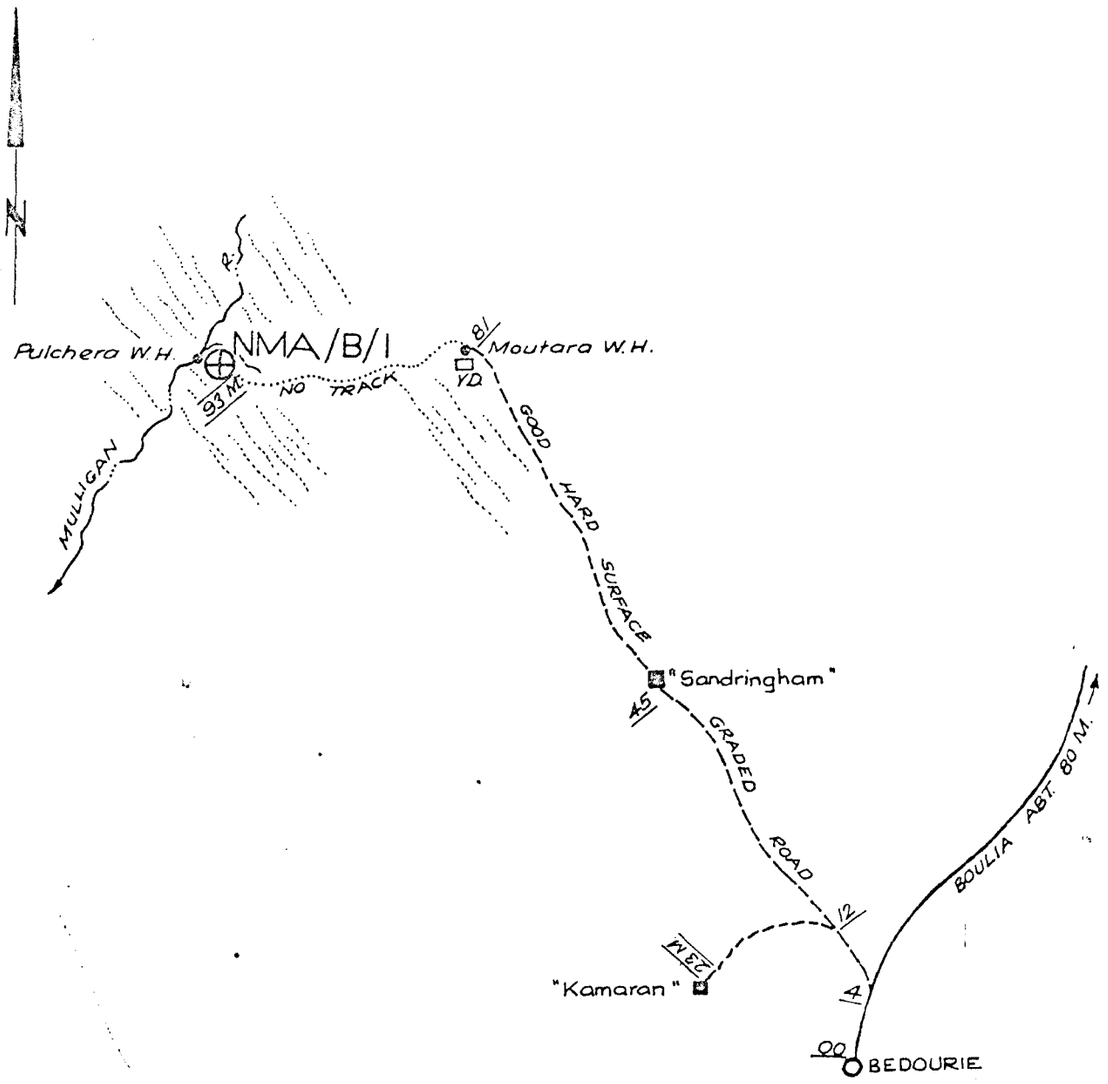
ASTRONOMICAL STATION SUMMARY

RECEIVED NO. 2
DATE 2 0 SEP 1954

F54-13

Station	Locality
NMA/B/1	

LOCALITY AND ACCESS DIAGRAM
Not to scale.



Map Name MT. WHELAN
State QUEENSLAND
Parish/Hundred
Map No. SE54/13 Scale 1 : 250 000
County/District
Allotment/Section/Portion

Latitude 23° 54' 44" Longitude 138° 38' 46" Height (in feet) 183
~~Probable Error~~/ Estimated Reliability of Result in Seconds of Arc. +/− 3 Lat 3 Long

ASTRONOMICAL AZIMUTHS

To Station	Azimuth	P.E. (in Secs. of Arc)

Method for Determining Heights **Aneroid Barometers**

TRANSVERSE MERCATOR CO-ORDINATES OF STATION

Zone 5 Easting	Zone 5 Northing	Zone 6 Easting	Zone 6 Northing	
694 734	2 019 972	137 828	2 020 548	In yards from F.O.
				In feet from T.O.

Convergence (Grid Minus True) + 01° 04' 24" | Convergence (Grid Minus True) − 00° 57' 16"

AIR PHOTOGRAPH IDENTIFICATION OF ~~STATION~~/PHOTO REFERENCE POINTS

Title MT. WHELAN Film No. SVY. 1268 Run No. 15 Photo No. 5066
Film held by R.A.A.F. Quadrant C X 3".70 Y 0".62 Diagonal 3".75
Quadrant X Y Diagonal

TRANSVERSE MERCATOR CO-ORDINATES OF PHOTO REFERENCE POINTS

Zone 5	E	694 730	N	2 019 972	Height
Zone 6	E	137 824	N	2 020 548	Height

Reference Books FIELD BOOKS NM 1053 , NM 1054 COMPS. BOOK 15/40 - 43 incl.

Observer I. McL. COLQUHOUN Date 13th. June, 1959

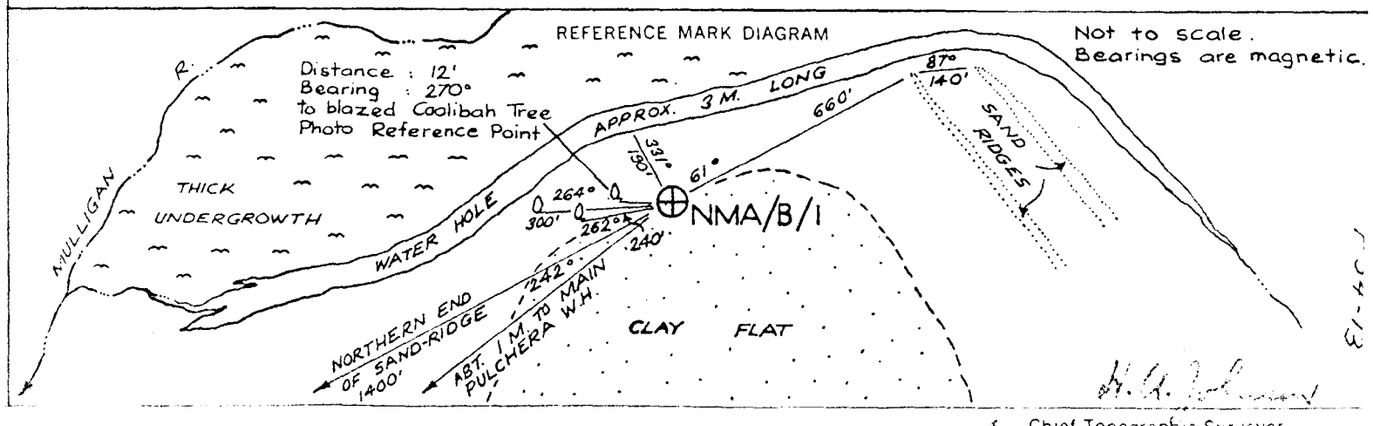
Instruments:
Theodolite WILD T2 No. 17847 Chronometer MERCER No. 17900
Chronograph

Time Signals
Station W.W.V.H. Reception Good.

Weather Conditions Fine; moonlight; south breeze.

Method of Marking Station Blazed Coolibah tree.

REFERENCE MARK DIAGRAM
Not to scale.
Bearings are magnetic.



Chief Topographic Surveyor.

Form 3

DIVISION OF NATIONAL MAPPING

TRIGONOMETRICAL STATION SUMMARY

ISSUE No. 1

DATE 22 MAY 1964

Station Name FOUR HILLS STATION (H55 3) Order FIRST

Station Established by Survey Department, South Australia — Date 1860
Station Re-established by Division of National Mapping — Date 1956

Particulars of Station Marking and Beacon, Reference Marks, Situation, Access Etc. } (see below)

Map Reference | Map Name | Scale | Edition | Date

Type of Survey : Triangulation.

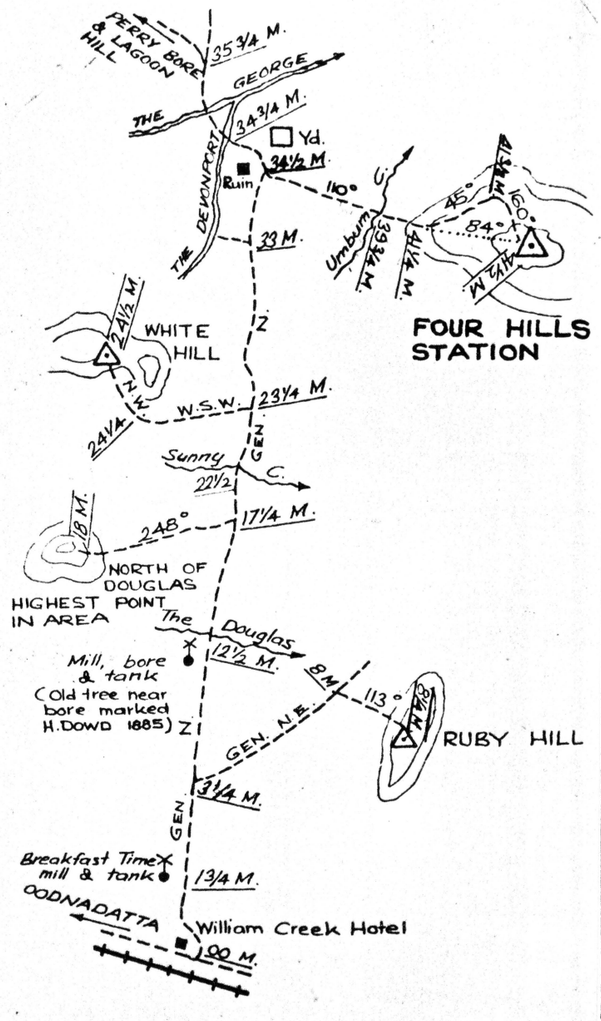
Station Mark : ½" copper tube set in concrete in centre of old cairn. Old mark not located.

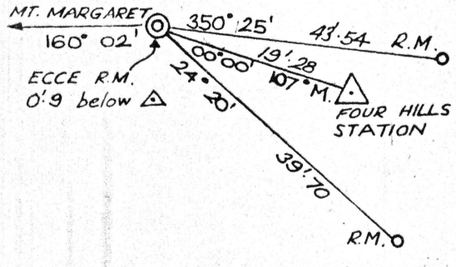
Beacon : A 10' x 4" x 4" oregon pole, with four 3' x 2' bondwood vanes attached 0'.3 below top, erected in centre of old cairn.

Reference Marks : Three ½" copper tubes set in concrete.

Access : The trig at Four Hills is on the most south-westerly hill. Approach is generally north from William Creek to the Old Umbum ruins about 34½ miles along an old station track. From Old Umbum bear 110° across open gibber country, which is good going, and the trig is visible all the way from the 34¾ mile point.
Umbum Creek is a rough crossing. From small stone pile at 41¼ miles, the cairn bears 84°. (Bearings magnetic). A number of small inter-visible stone piles marks the best approach. The vehicle should keep a few feet to the right of each pile, and may be driven to about 40 yards from trig. Nearest certain drinking water at Anna Creek homestead.

Not to scale.
Distances in miles.





References to previous work

Station Re-visited by

Map Name Warrina — Map Number SH 53/3 — Scale 1 : 250 000
State South Australia — County / District
Parish / Hundred — Allotment / Section / Portion

Latitude 28° 30' 29".263 — Longitude 136° 29' 24".694 — Height (in feet) 344

TRANSVERSE MERCATOR CO-ORDINATES OF STATION MARK

Zone 5 Easting	Zone 5 Northing	Zone Easting	Zone Northing
452 483.20	1 465 787.67		

In yards from T.O.
In feet from T.O.

Convergence (Grid Minus True) + 00° 14' 02".28 — Convergence (Grid Minus True)

Origin of Survey Sydney Observatory — Lat. 33° 51' 41".10 — Long. 151° 12' 17".85
Datum for Height Mean Sea Level - Port Augusta — Figure of Earth Clarke 1858

AIR PHOTOGRAPH IDENTIFICATION OF STATION MARK/~~PHOTO REFERENCE POINT~~

Title Lake Eyre — Film No. Svy 276 — Run No. 8 — Photo No. 302
Film held by Division of National Mapping — Quadrant D — X 1".69 — Y 2".03 — Diagonal 2".65

TRANSVERSE MERCATOR CO-ORDINATES OF PHOTO REFERENCE POINT

E — N — Height

Reference Books Field Books NM 377, 613

Station Observed	Observed Direction (a)	Adjusted Bearings True	Adjusted Bearings Grid	Log Distance (Feet)
	° ' "	° ' "	° ' "	
Mt. Margaret	00 00 00.00	273 18 13.33		
Mt. Denison	33 39 43.64			
Canegrass Ridge	69 36 06.99			
Ruby Hill	277 41 26.87			
Mt. Anna	333 49 33.81			

Directions Observed At Eccentric R.M.			
Mt. Margaret	00° 00' 00".00	273 18 03.14	
Mt. Denison	33 39 58.16		
Canegrass Ridge	69 36 36.18		
Ruby Hill	277 41 06.01		
Mt. Anna	333 49 25.66		

Eccentric Station Co-ordinates

Latitude 28° 30' 29".188
Longitude 136 29 24.495
Height 343'

Zone 5

Easting 452 477.31
Northing 1 465 790.23
Convergence + 00° 14' 02".19

(a) Observed directions are corrected by station adjustment and for eccentricity of instrument and object before entry in this column.

W. A. Johnson

Chief Topographic Surveyor.