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RECOMPUTATION OF THE 1963 AND 1967 RECONNAISSANCE HELICOPTER GRAVITY SURVEYS IN QLD, N.T., & W.A.

by

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ILLUSTRATIONS

SUMMARY

Data from the reconnaissance helicopter gravity surveys carried out in 1963 and 1967 were recomputed to remove errors and to create files of principal facts on magnetic tape.

The 1963 survey was made partly by the Division of National Mapping and partly by Velocity Surveys Ltd of Canada under contract to the Bureau of Mineral Resources, Geology and Geophysics (BMR). An area of 310 000 square kilometres of central Queensland was surveyed on an approximate 11-kilometre-square grid and about 4100 stations were read. Survey numbers 6303, 6304, 6305, and 6306 were assigned and all results were hand-computed. Contour maps were published showing Bouguer anomaly values.

Work in 1967 was carried out under contract to BMR by Rotowork Helicopters Pty Ltd, the geophysical work being sub-contracted to Kenneth McMahon and Partners. An area of 815 000 square kilometres of the Northern Territory and Western Australia was covered on an 11-kilometre-square grid and approximately 7200 stations were read. Surveys numbers 6704, 6705, 6706, 6707 and 6708 were assigned. Results were computer-processed; however some of the computational techniques used were unacceptable. Bouguer anomaly contour maps were published in preliminary form.

The data from these surveys were assembled in suitable form and processed on the CSIRO CDC CYBER 7600 computer using standard BMR programs. Datum control used was the Isogal survey for gravity and the Australian Height Datum for elevation. Principal facts for all stations have been listed on magnetic tap in standard format.

The files of principal facts for the 1963 and 1967 reconnaissance helicopter gravity surveys are now held by the Regional Gravity Group.

INTRODUCTION

The field operations of the 1963 reconnaissance helicopter gravity survey were carried out in two parts. Part one was carried out by the Division of National Mapping for BMR and covered 67 000 square kilometres of central Queensland. Part two was carried out by a private geophysical contractor Velocity Surveys Ltd of Canada, for BMR, and covered 234 000 square kilometres of central and eastern Queensland. Ground traverses to provide gravity control were made by BMR.

Approximately 4100 stations were read and survey numbers 6303, 6304, 6305, and 6306 were used. The 1963 results had been hand-computed and contour maps were published showing Bouguer anomaly values. Darby (1966) and Gibb (1966) discuss the 1963 survey operations and report on the preliminary interpretation of the gravity results in the 1963 survey area.

In 1967 the field operations were carried out under contract to BMR by Rotowork Helicopters Pty Ltd, the geophysical work being sub-contracted to Kenneth McMahon and Partners. The survey area covered 815 000 square kilometres of the Northern Territory and Western Australia (Plate 1) and approximately 7200 stations were read. Survey numbers used were 6704, 6705, 6706, 6707, and 6708.

The 1967 results had been computer processed by the contractor, but many errors and unjustified alterations had been left in the data. The processed Bouguer anomaly values had been contoured and provisional maps were published. Whitworth (1970) describes the survey operation and reports on the preliminary gravity interpretation of the 1967 survey area.

In both surveys the methods of operation were identical with the methods adopted by BMR on other helicopter gravity surveys (Vale, 1962). All traversing was done, on an approximate 11-kilometre-square grid, using the cell method described by Hastie & Walker (1962).

Recomputation was carried out to remove errors, and to create a file on magnetic tape of the principal facts in standard format using modern computer techniques.

OBJECTIVES

The main objectives were:

- To process the original field data and apply least-squares adjustment using programs written for the CSIRO CDC CYBER 7600 computer;
- To refer the data to new datum controls, for gravity the Isogal network (Barlow, 1970) and for elevation the Australian Height Datum (AHD) (Roelse, Grainger, & Graham, 1971);
- To list on mangetic tape, in a format compatible with current BMR requirements, the principal facts of the survey, i.e. station number, latitude, longitude, meter height, observed gravity, and ground height.

COMPUTATIONAL TECHNIQUES

With only slight modification, the computational method adopted was the same as that used for recomputation of the 1964 reconnaissance helicopter gravity survey (Allen & Woldron, 1974). Brief descriptions of the computer programs used for reprocessing the 1963 and 1967 gravity data are given in the Appendix.

1963 Survey

All data from the National Mapping survey (6303) and the Velocity Surveys survey (6304) were puched from the field sheets onto cards. Elevation data from survey 6304 were run through program INFL63 to convert altimeter readings in feet to millibars, and degrees Fahrenheit to degrees Celsius and where much of the base control was missing, linear drift was assumed for the field barometer.

The surveys were made before the establishment of the Isogal network and consequently reliance was placed upon the Isogal corrected values of the 6305 and 6306 ground control surveys. Some loops of survey 6304 were of an unacceptable standard and were reduced by hand at the final stage of processing.

Table 1 shows the standard deviation (S.D.) and the maximum adjustments (M.A.) at the internal and external standard deviation stages of processing. The E.S.D. values include fixed values from previous surveys.

TABLE 1: INTERNAL AND EXTERNAL STANDARD DEVIATIONS (1963)

SEGMENT	I.S.D.				E.S.D.			
	GRAVITY		HEIGHTS		GRAVITY		HEIGHTS	
	S.D.	M.A.	S.D.	M.A.	S.D.	M.A.	S.D.	M.A.
6303	0.07	0.33	1.66	8.35	0.09	0.43	2.20	10.32
6304A	0.04	0.14	1.23	4.82	0.09	0.42	2.31	7.02
6304B	0.02	0.06	1.07	3.36	0.07	0.29	2.22	8.35
6304C	0.03	0.08	1.70	8.46	0.06	0.27	2.38	9.17
6304D	0.02	0.06	1.95	6.80	0.05	0.13	3.07	10.47
6304E	0.01	0.03	0.87	3.40	0.07	0.19	2.17	4.93

(Gravity in milligals, heights in metres)

1967 Survey

The data for this survey were already on puched cards in the modern format. During processing many values were changed from those claimed by the contractor back to the original readings. This enabled errors and misreadings to be readily located and corrected.

Table 2 shows the standard deviations and maximum adjustments during processing. The E.S.D. values include fixed values from previous surveys.

TABLE 2: INTERNAL AND EXTERNAL STANDARD DEVIATION (1967)

SEGMENT	I.S.D.				E.S.D.			
	GRAVITY		HEIGHTS		GRAVITY		HEIGHTS	
	S.D.	M.A.	S.D.	M.A.	S.D.	M.A.	S.D.	M.A.
A	0.05	0.17	1.49	5.90	0.05	0.17	1.55	5.25
B	0.03	0.11	1.25	3.31	0.04	0.12	1.49	4.40
C + P	0.03	0.11	1.15	4.20	0.05	0.22	1.82	6.22
D	0.02	0.07	1.18	3.77	0.04	0.15	1.64	5.98
E + F	0.04	0.13	1.29	3.22	0.04	0.15	1.60	4.03
G	0.04	0.12	1.64	4.25	0.04	0.12	1.72	5.88
H	0.04	0.11	1.33	4.76	0.04	0.12	2.53	6.93
I + J	0.03	0.08	1.33	5.06	0.04	0.16	1.46	5.23
K + L	0.03	0.11	1.09	3.32	0.04	0.17	1.48	5.44
M + N	0.04	0.14	0.89	2.76	0.06	0.17	1.41	4.72
O + Q	0.02	0.09	0.93	2.90	0.03	0.15	1.39	4.41
R	0.04	0.14	1.13	3.42	0.05	0.24	1.79	7.06

(Gravity in milligals, heights in metres)

Elevation Control

In both surveys elevation control presented problems. From comparison with BMR barometric kmls, errors were detected in the AHD values of several open ended National Mapping traverses. Values for 'open ended' traverses are still considered provisional. Where these errors were detected they were shown to be punching errors and not due to the original surveying.

The High Water Mark (HWM) was said to have been read along the coast in both 1963 and 1967. However, some stations were shown to have been read other than at the HWM. Where a consistent level of values was apparent it was estimated to be at 2.0 metres above datum and this was used as fixed for computational purposes. In segment A of 1967 a value of 3.0 metres was estimated, in a region of extreme tides. Inconsistent values were left floating and consequently a few stations have negative values, all of which are shown above the value of Low Water Mark (LWM). The values of HWM and LWM were calculated at ports using Tide Tables and the AHD value of the tide stations.

Station Reoccupations

Many stations read in 1963 and 1967 were reoccuptations of previous survey stations. In cases where large differences occurred between the two occupations of the station, it was found that the stake had not been located and that the new stations had been located by the pin pricks on the photographs. In these cases new station numbers were assigned as positive reoccupations had not been made. Where the value obtained from a reoccupation differed only slightly from the original value, the original was retained.

Checking

To facilitate checking of principal facts, rough contours were produced using program LANDMAP. This program was also checked for possible positional errors.

Errors detected in this phase of processing were corrected using program SEGEDIT.

CONCLUSIONS

The results of the 1963 and 1967 reconnaissance helicopter gravity surveys have been recomputed and errors corrected. A few errors were detected in latitude and longitude values and also in published AHD values.

A principal facts file for each survey was created on magnetic tape in a format compatible with current BMR requirements. It includes station numbers, latitude, longitude, meter height, observed gravity, and ground height.

Final computed Bouguer anomaly values do not diverge greatly from those existing on published maps. The data are now suitable for inclusion on the Gravity Map of Australia.

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APPENDIX

DESCRIPTION OF COMPUTER PROGRAMS

The following is a brief description of programs used on the CYBER 7600 computer in the 1963 and 1967 recomputation work. The order indicates their position in the processing flow:

INFILE This program is used to create a data file on magnetic tape containing all the basic data in a format which enables the data to be edited at a later stage.

INFL63 This program converts altimeter feet to millibars and degrees Farenheit to degrees Celsius. The output is identical with the INFILE format.

FLTMAP Using the file created by INFILE this program creates a tape for plotting showing 'flights-as-flown'. There are two options:

FLTPLOT - for plotting helicopter flights,

TRAVPLOT - for plotting road traverses.

FINDER leads a magnetic tape in card image format and locates all multiply read stations which by definition should be nodes. The output is in the form of punched cards suitable for input to program GRAVHTS.

GRAVHTS This program is used to reduce gravity and height data, to apply least-squares adjustment, and to create a principal facts file (Whitworth, pers. comm.).

LANDMAP reads a standard GRAVHTS output tape and produced a rough contoured BA map for a specified density. There are two options:

(a) contours only,

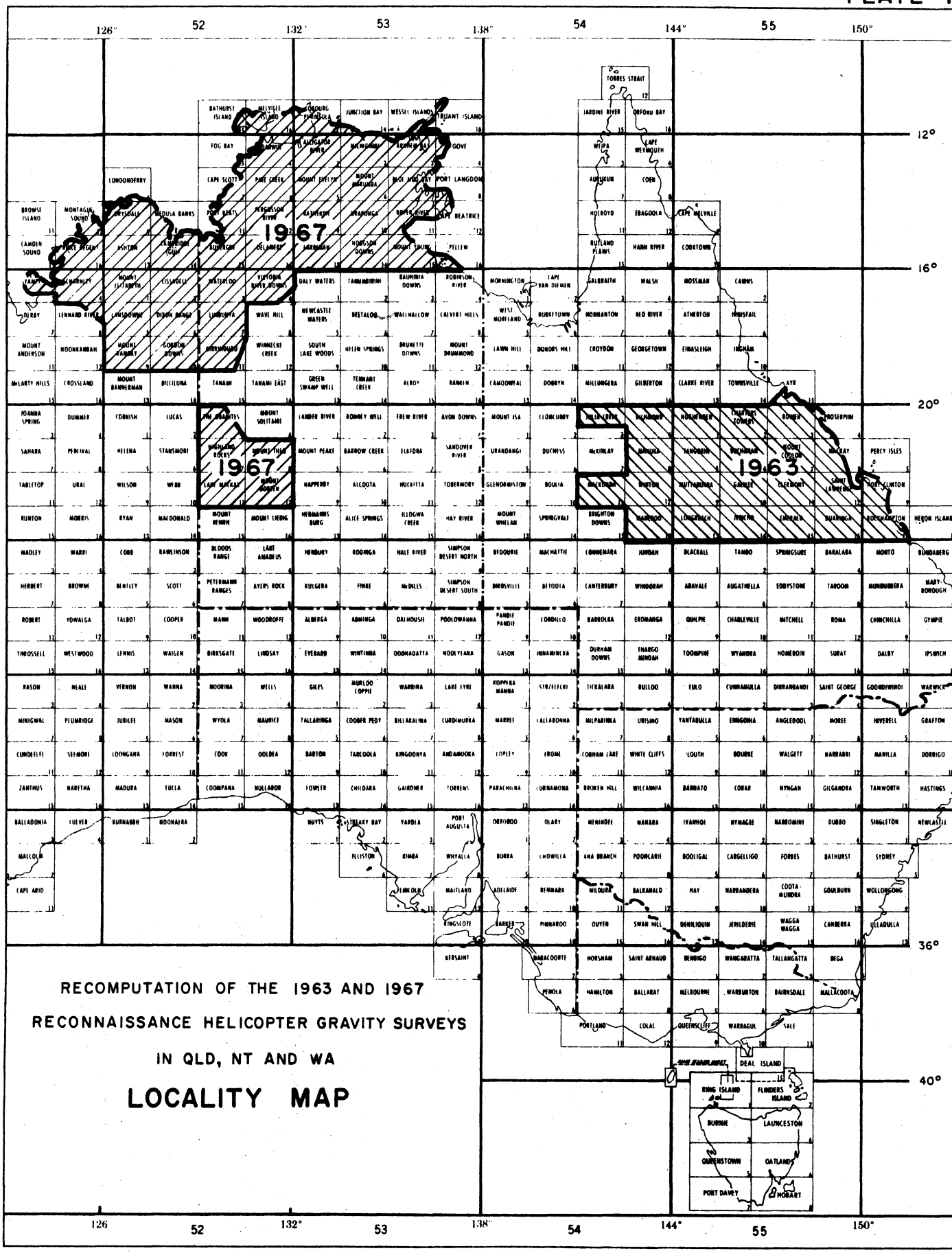
(b) contours, station numbers and positions.

The input file is checked for any stations falling within a specified radius. These are stations which are likely to have errors in latitude and longitude.

SEGEDIT This program is used to edit standard data files. It can be used to insert, amend, or delete stations, values, and informal station information.

SEGBA This program reads a standard principal facts file and produces a Bouguer anomaly print-out for specified densities.

PLATE 1



RECOMPUTATION OF THE 1963 AND 1967 RECONNAISSANCE HELICOPTER GRAVITY SURVEYS IN QLD, NT AND WA

LOCALITY MAP

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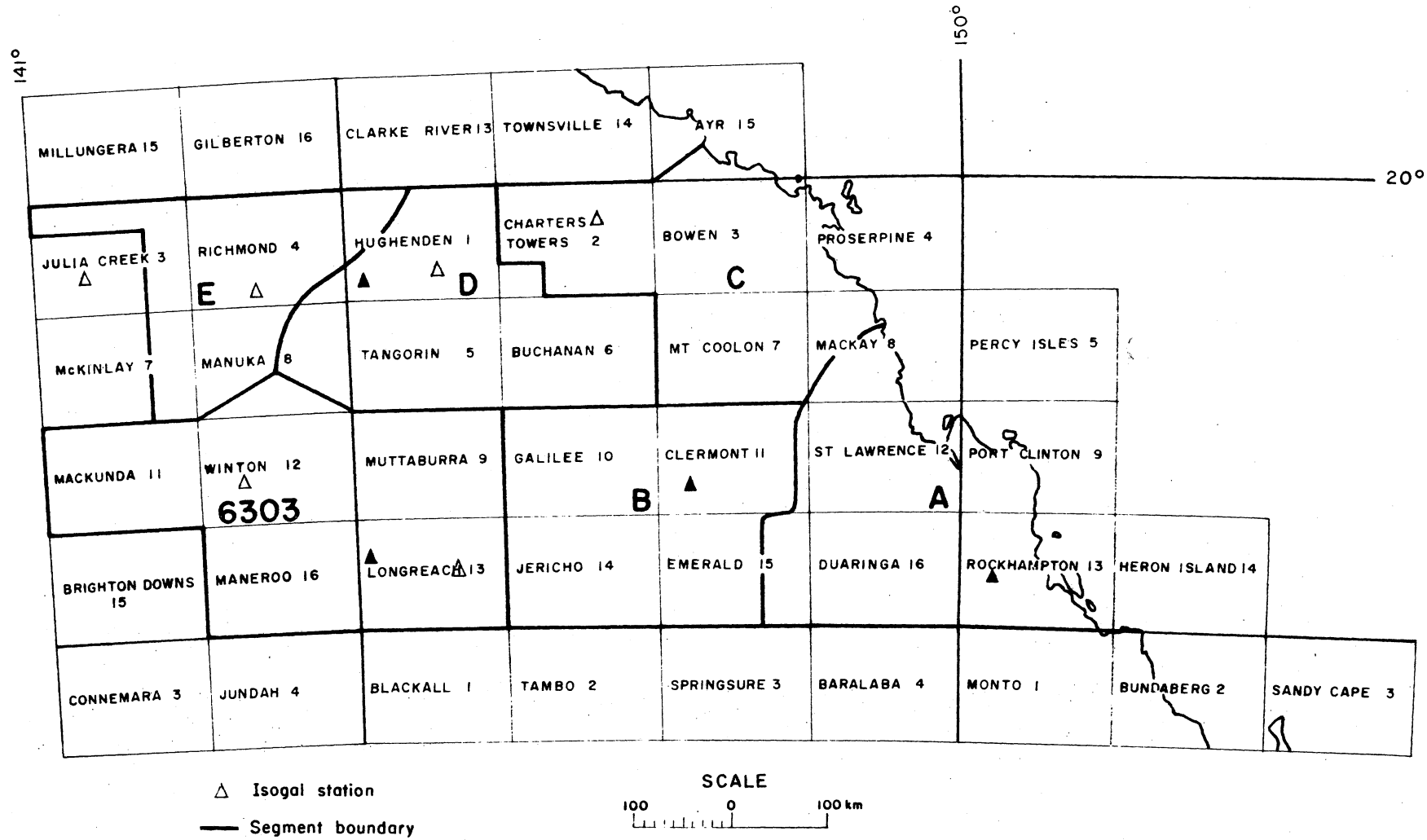
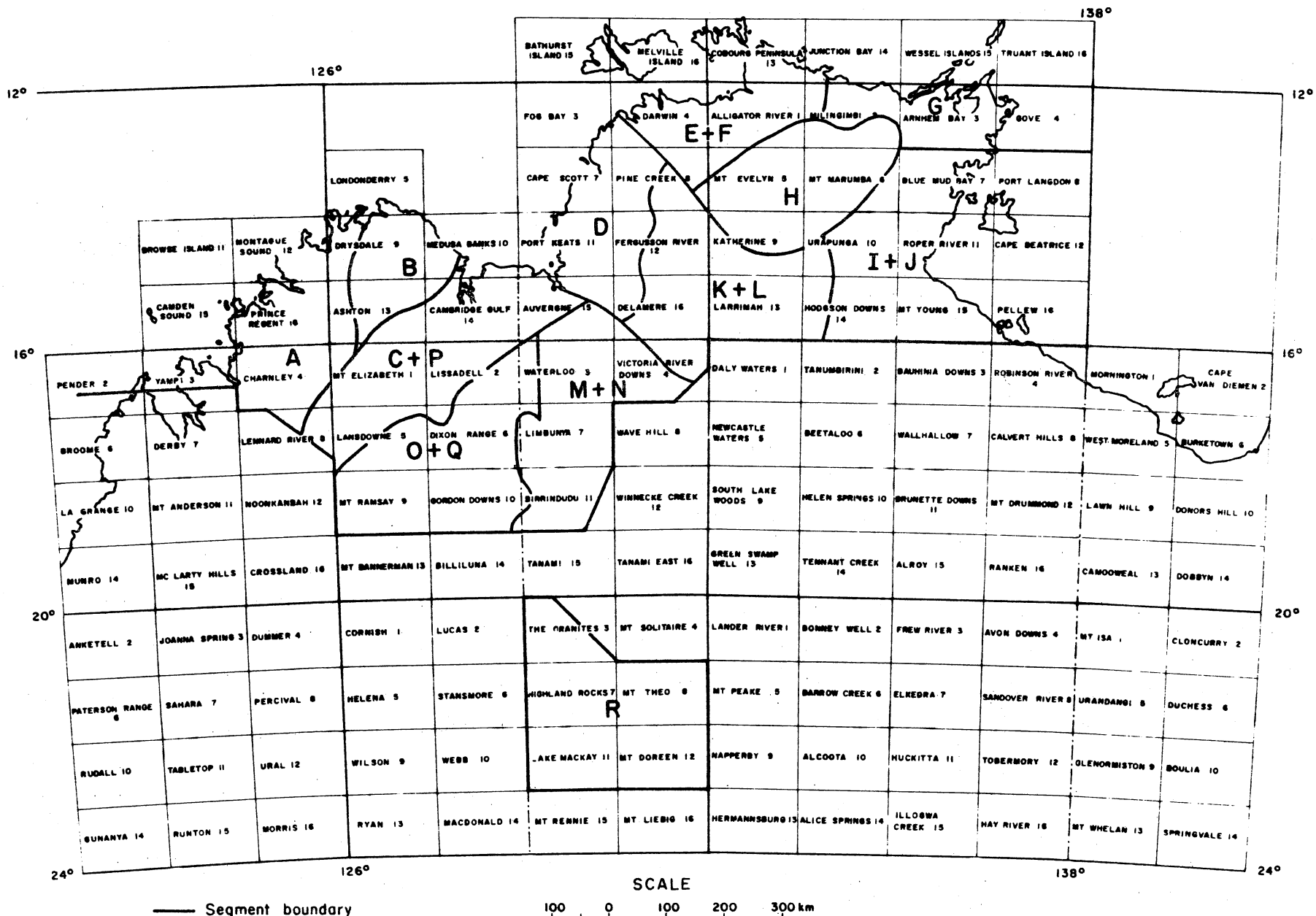


SEGMENTATION 1963



SEGMENTATION 1967