COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1967/125

BATHURST ISLAND WATER SUPPLY, NORTHERN TERRITORY.

by

A.T. Laws

5928/65

BATHURST ISLAND WATER SUPPLY, NORTHERN TERRITORY

by

A.T. Laws

Record 1967/125

CONTENTS

SUMMARY

The present water supply for Bathurst Island Mission has become insufficient to meet present demands; a new, or supplementary, supply is required. The existing wells are in laterite; further deepening of the wells and/or an increase in the number of wells is inadvisable. During an auger drilling project on Bathurst Island various thicknesses of Tertiary sands were intersected. An investigation is proposed for testing these sands for aquifer potential. Samples of the Tertiary sand have been examined and from available data it has been possible to delineate the extent of the sediments. Owing to the nature of the sands difficulties in well construction and development are liable to be met with. Six bore sites have been proposed to test drill the formation and to provide the required water supply.

INTRODUCTION

At the request of the Director of Water Resources, Water Resources Branch of the Northern Territory Administration, Tertiary sands on Bathurst Island were investigated in an effort to locate additional supplies of water for Bathurst Island Mission. The sands were revealed during augering in 1962.

Bathurst Island is a large island about 40 miles north of Darwin. Its area is 800 square miles and it is separated from Melville Island by the narrow Apsley Strait. The island has low relief; most of it is a dissected plateau but there are some low-lying areas.

Bores are required as near as possible to the Mission, but no farther distant than 20 miles. From the data available from the auger drilling it was only possible to deal with an area 14-20 miles from the Mission.

PRESENT SUPPLIES

The details of the present supplies of water on the Island are summarised by Barclay (1964). The existing water supply is obtained from several wells that have been sunk in the laterite that underlies topsoil in the Mission area. The laterite ranges in thickness from 11 to 18 feet and is permeable; it has a high coefficient of transmissibility, but has a low storage coefficient, i.e. it is very permeable but has a low specific yield. The lateritic layer overlies about 100 feet of Cretaceous mudstone, which is regarded as a poor aquifer (Dunn, 1962).

Suggestions from Barclay's report include the construction of an earth dam close to the Mission, near the airstrip, and the use of a perennial waterhole 5 miles west of the Mission on the north-west side of Mission Hill. Further construction of wells in the laterite would not yield sufficient supplies, while the danger of contaimination would be great.

Present supplies are now insufficient and an alternative supply is required.

TERTIARY SANDS

Dunn (1962) noted Tertiary sandstone overlying Cretaceous mudstone 20 miles north-west of the Mission, and suggested that it may be a good aquifer. At that time insufficient data were available to determine the areal extent of the sandstone and in the absence of test drilling its potential as a source of water was not considered.

In 1962, during an auger sampling project by R. Hare and Associate (Oil Permit No. 8, Northern Territory), auger holes were drilled to sample Cretaceous sediments beneath what was thought to be a thin cover of Tertiary sands. The original plans were modified when it was discovered that the sands were thicker than anticipated. The sands are particularly thick along the inland traverses of the project (Holes A1-A29, C1-C4 in Fig. 2), where only 4 holes passed through the sands into Cretaceous rocks. Many of the auger holes exceeded 100 feet in depth without passing through Tertiary sands.

A few of the auger samples were retained in store at the Resident Geological Section, Darwin, and were examined. Only one sample per auger hole was taken. There is no indication of the depth from which each sample was collected. The diamond drill core for Bathurst Island Well No. 2 was also examined.

From the auger and well samples (see Appendix) it is seen that generally the sands are very fine-grained quartz sands with good sorting. All samples have clay fines and laterite fragments in various proportions, most samples show iron staining. Insufficient material was present in each sample to allow a mechanical analysis to be done but from microscopic examination of each sample it appears that the Trask Coefficient would be very low, i.e. in the region of 1.5 to 2.5. These characteristics are important in a consideration of obtaining a water supply.

WATER PROSPECTS

In the report on the auger sampling project no mention was made of the occurrence of water, but it seems likely that some water would have been present.

The sands are very fine-grained; this will have considerable effect on the water prospects. Theoretically, actual size of a unit has no influence on the porosities of uniform spheres. But, as grain size decreases, friction, adhesion and bridging become of increasing importance and therefore the smaller the grain-size the greater the porosity (Fraser, 1935). Highest porosity is obtained when grains are all of one size. The addition of grains of differing size tends to lower porosity; hence the existence of small percentages of clay fines in some of the samples would tend to lower the overall porosity of the sands.

In these sands porosity is not to be equated with specific yield, for in such fine-grained sands specific retention is high. The specific retention of the sand is the ratio of the volume of water it will retain after saturation against the force of gravity to its own volume, expressed as a percentage. Conversely specific yield (or "effective" porosity) is the ratio of the volume of water which, after being saturated, can be drained by gravity to its own volume, expressed as a percentage. Specific yield is only a fraction of the porosity of an aquifer.

Retention becomes greater in finer-grained sands, particularly well-rounded grains, as the surface area of the grains is increased in proportion to the interstices and thus molecular attraction and adhesion causes a film of water to be retained against gravity. In a sand such as the Bathurst Island Tertiary sands one would expect a porosity of 40-45%, a specific retention of 30-35% and a specific yield of 10-15%. Possibly a supply will be obtained that will satisfy the needs of the Mission; but both Bathurst Island Well No. 1 (not in the area studied and Bathurst Island Well No. 2 were reported in the completion reports as dry and abandoned.

Owing to the very fine-grained nature of the sands, there will be a problem in well construction. Probably caving would occur in the well during construction, and after construction sand and clay fines would be

quite easily pumped into the hole. It would probably be necessary to introduce a gravel packing around the casing, particularly in the area of the screen, and to then develop the well by surging to remove fines.

PROPOSED BORE SITES

Figure 3 is a topographical sketch map obtained by using the elevations of the auger hole sites and aerial photograph interpretation.

Figure 4 is a structural contour map of the Tertiary-Cretaceous contact; it is from the report of the project (Hare, et al., 1962B).

Figure 5 is an attempt to combine the two previous figures and produce an isopach map of the post-Cretaceous sediments. The sediments are not entirely Tertiary sands; a capping of laterite probably exists in places.

In figure 5, area A forms a central ridge where the sand deposits are fairly shallow. Both B' and B'' mark areas where the deposits are thicker. As bore sites were requested within 20 miles of the Mission, it is intended to concentrate on the B' side of the ridge.

Between this area and the Mission there is no information about possible Tertiary sand deposits. However there may be sand deposits nearer that would warrant one or two test bores; if the bores are unsuccessful drilling should be attempted in area B'.

The selected sites are:-

1. SC.52-15/1001. Melville Island Adastraphoto 1963, Run 30, Photo 5188, Quadrant A, x = 0.87", y = 3.00", Diagonal = 3.13".

The proposed site is reached by the track from the Mission. Although no evidence is available from reports, it is expected that some Tertiary sands may be present above the Cretaceous mudstone and below the laterite. Drilling should cease on reaching the mudstone and should not exceed 125 feet.

2. SC.52-15/1002. Melville Island Adastraphoto 1963, Run 31 west, Photo 5105, Quadrant D, x = 0.79", y = 3.10", Diagonal = 3.10".

The proposed site is approximately 400 yards north-north-east of the Mission track.

3. SC.52-15/1003. Melville Island Adastraphoto 1963, Run 29, Photo 5070, Quadrant C, x = 2.93", y = 1.62", Diagonal = 3.30".

The proposed site is alongside an east-north-east trending track. This bore should pass through Tertiary sands and should not be drilled deeper than 150 feet. Sands more than 100 feet thick should be intersected.

4. SC.52-15/1004. Melville Island Adastraphoto 1963, Run 28A west, Photo 5214, Quadrant C, x = 1.02", y = 2.37", Diagonal = 2.55".

The proposed site is farther along the same track as 15/1003. The bore should pass through sands more than 100 feet thick, but should not be drilled deeper than 150 feet. The hole should be stopped on reaching Cretaceous mudstone.

5. SC. 52-15/1005. Melville Island Adastraphoto 1963, Run 28A west, Photo 5214, Quadrant A, x = 1.49", y = 3.02", Diagonal = 3.38".

The proposed site is approximately 1¼ miles east of 1004 and a bore at this site should pass through at least 150 feet of Tertiary sands.

6. SC.52-15/1006. Melvile Island Adastraphoto 1963, Run 27, Photo 5063, Quadrant B, x = 0.04", y = 1.57", Diagonal = 1.63".

The proposed site is approximately 1½ miles north-east of the track linking auger holes A3 and A20. A bore at this site should pass through about 100 feet of Tertiary sands and drilling should not exceed 150 feet in depth.

CONCLUSIONS AND RECOMMENDATIONS

1. A new or supplementary supply of water is required for Bathurst Island Mission.

2. Tertiary sands up to 200 feet thick occur in the south-centre of the island. Other deposits of Tertiary sand may occur nearer the mission.

3. The sands should provide satisfactory supplies of water; although permeability is believed to be good, specific yield is expected to be low.

4. Six bore sites have been selected in the area investigated but it is recommended that any Tertiary sand nearer the Mission be tested first.

5. It should not be necessary to drill for more than 150 feet before an adequate water supply is obtained.

6. Bores should be properly constructed, with properly designed screens and gravel packing, and should be developed by surging.

7. A continuous sample should be taken over every ten feet of hole.

REFERENCES

BARCLAY, J., 1964 - Geological notes on water supplies at Bathurst Island Mission, Garden Point and Paru Mission. Bur. Min. Resour. Aust. Rec. 1964/98 (Unpubl.)

DAILY, B., 1954 - Geological observations on Melville and Bathurst Islands. Unpub. Rep. Geol. Dept. Univ. of Adelaide.

DUNN, P.G., 1962 - Water supply - Bathurst Island Mission. Bur. Min. Resour. Aust. Rec. 1962/21 (Unpubl.)

FRASER, N.J., 1935 - A study of porosity and permeability of clastic sediments. J. Geol., 43 (8), 910-1010.

HARE, R., AND ASSOCIATES, 1961 - Well completion report, Bathurst Island Well No. 1. Completion Report Oil Permit No. 8. N.T.

HARE, R., AND ASSOCIATES, 1962a - Well completion report, Bathurst Island, Well No. 2. Completion Report Oil Permit No. 8 N.T.

HARE, R., AND ASSOCIATES, 1962b - Auger sampling project Bathurst Island. Completion Report Oil Permit No. 8. N.T.

MEINZER, O., 1923 - Outline of groundwater hydrology. U.S. Geol. Surv. Water Supply Pap. 494.

MEINZER, O. (Ed), 1942 - HYDROLOGY. Dover Publications, New York.

TODD, D.K., 1959 - GROUNDWATER HYDROLOGY. J. Wiley and Sons. New York.

APPENDIX

Auger A.1. Depth of hole 87 feet. All Tertiary sand? Fine-grained yellow sand; subrounded to rounded quartz grains, well sorted. About 15% clay fines.

Auger A.2. Depth of hole 93 feet. All Tertiary sand? Very fine-grained yellow/white sand; subrounded to rounded quartz grains, well sorted. About 25% clay fines. Some laterite fragments.

Auger A.3. Depth of hole 101 feet. All Tertiary sand? Very fine-grained yellow/brown/white sand; subrounded to rounded quartz grains, translucent to opaque; well sorted. About 5% clay fines.

Auger A.4. Depth of hole 101 feet. All Tertiary sand? Very fine-grained grey/green clayey sand; subrounded to rounded, ill-sorted quartz grains 65%. About 5% clay fines.

Auger A.5. Depth of hole 101 feet. 80 feet sand, 21 feet Cretaceous. Sample as in A.4.

Auger A.6. Depth of hole 101 feet. All Tertiary sand? Very fine-grained yellow/brown/white sand. Subrounded to rounded quartz grains, well sorted. About 5% clay fines.

Auger A.7. Depth of hole 51 feet. All Tertiary sand? Fine-grained red sand; rounded to subrounded quartz grains, well sorted; considerable iron-staining. About 5% clay fines.

Auger A.8. Depth of hole 54 feet. All Tertiary sand? Fine-grained red sand; subangular to subrounded quartz grains, fairly well sorted. About 15% white clay, also some small laterite fragments.

Auger A.9. Depth of hole 84 feet. All Tertiary sand? Fine-grained brown/black sand; subrounded to subangular quartz grains with considerable iron-staining including ferruginous material in the grains; fairly white to fawn clay. About 35% clay fines. Fairly well sorted.

Auger A.10. Depth of hole 84 feet. All Tertiary sand? Approximately white/fawn clay 80%, about 20% quartz grains, clear, subrounded to sub-angular.

Auger A.11. - A.20. Samples missing.

Auger A.21. Depth of hole 96 feet. All Tertiary sand? Very fine-grained red/brown sand; subrounded to subangular quartz grains, well sorted. Some iron-staining in places. About 15% clay fines.

Auger A.22. Sample missing.

Auger A.23. Depth of hole 48 feet. All Tertiary sand? Very fine-grained clayey sand, brown; subrounded to rounded quartz grains, fairly well sorted. About 35% clay fines.

Auger A.24. Depth of hole 96 feet. All Tertiary sand? Very fine-grained, light brown/yellow sand; rounded to subrounded quartz grains, some translucent, some opaque, some with iron-staining. Well sorted. About 50% clay fines; some laterite fragments.

Auger A.25. Depth of hole 96 feet. All Tertiary sand? Very fine-grained yellow/fawn/white sand; rounded quartz grains, well sorted, mostly translucent or opaque, but some with iron-staining. Some laterite fragments. About 5% clay fines.

Auger A.26. Depth of hole 96 feet. All Tertiary sand? Sample same as A.25.

Auger A.27. Depth of hole 96 feet. All Tertiary sand? Sample very similar to A.25. and A.26, but has higher percentage of clay fines, about 10-15%.

Auger A.28. Depth of hole 96 feet. All Tertiary sand? Fine-grained grey-brown clayey sand; subrounded to subangular quartz grains, translucent and opaque, well sorted. About 35% clay - brown, grey and white. Iron-staining on many of the quartz grains.

Auger A.29. Depth of hole 83 feet. 60 feet Tertiary sand, 23 feet Cretaceous. Sample is of a brown/grey mudstone that is probably Cretaceous in age.

Auger C.1. Depth of hole 113 feet; 80 feet Tertiary sand, 33 feet Cretaceous. Grey-green sandy clay. Clay about 55%, sand about 45% subrounded to subangular, fairly well sorted. Some laterite.

Auger C.2. Depth of hole 120 feet. All Tertiary sand? Very fine-grained yellow/fawn/white sand; subangular to subrounded quartz grains, well sorted, with some iron-staining. Clay fines about 15%.

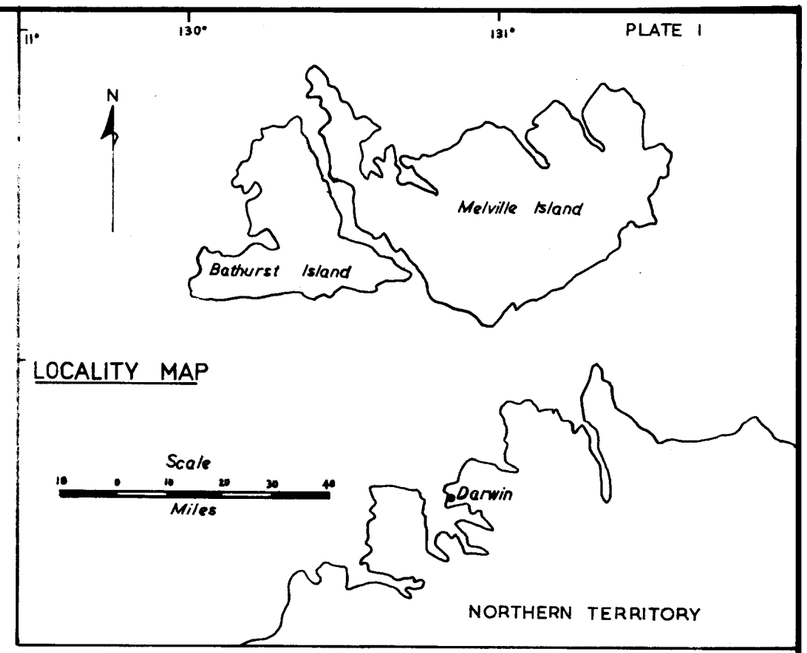
Auger C.3. Depth of hole 120 feet. All Tertiary sand? Very fine-grained red/brown sand; subangular to subrounded quartz grains, well sorted, translucent to opaque, with iron-staining of various degrees. Some laterite fragments.

Auger C.4. Depth of hole 120 feet. All Tertiary sand? Very fine-grained dark grey/brown sand; subangular to subrounded quartz grains mostly translucent but some opaque; well sorted. About 15% clay fines. Some laterite fragments.

Auger C.5. Depth of hole 120 feet. All Tertiary sand? Very fine-grained clayey sand; subangular to subrounded quartz grains, fairly well sorted. About 35% clay-white/fawn. Some laterite fragments.

Bathurst Island Well No. 2. Depth of well 1024 feet. Top 31 feet Tertiary sand, resting on Cretaceous. Sample from 11 feet to 21 feet. Very fine-grained brown yellow sand; subangular to subrounded quartz grains, translucent to opaque, some with ironstaining; well sorted. Some laterite fragments. About 20% clay fines, white/yellow.

PLATE I



Area (see text)

Track

Mangroves, showing seaward limit

Limit of 20 mile radius

LOCALITY MAP OF AREA
BATHURST ISLAND
NORTHERN TERRITORY

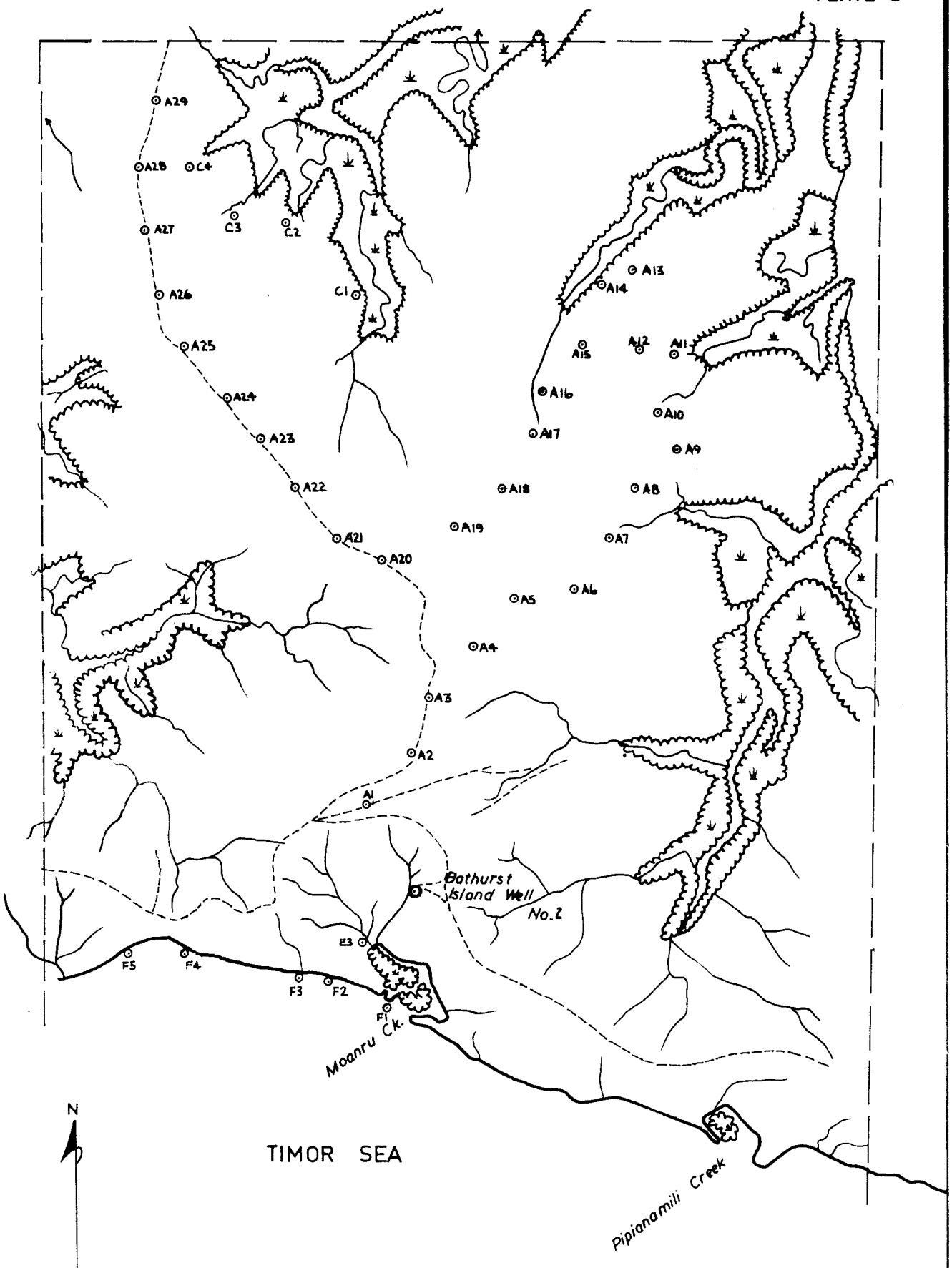
COMPILED BY RESIDENT GEOLOGICAL SECTION, DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

To accompany Record 1967/125

D52/A15/5

G67/49D

PLATE 2



LOCATION OF AUGER HOLES
BATHURST ISLAND
NORTHERN TERRITORY

⊙A,C,F,1,2,3. *Auger Holes*

Mangroves

------ *Track*

Scale

0 2 4

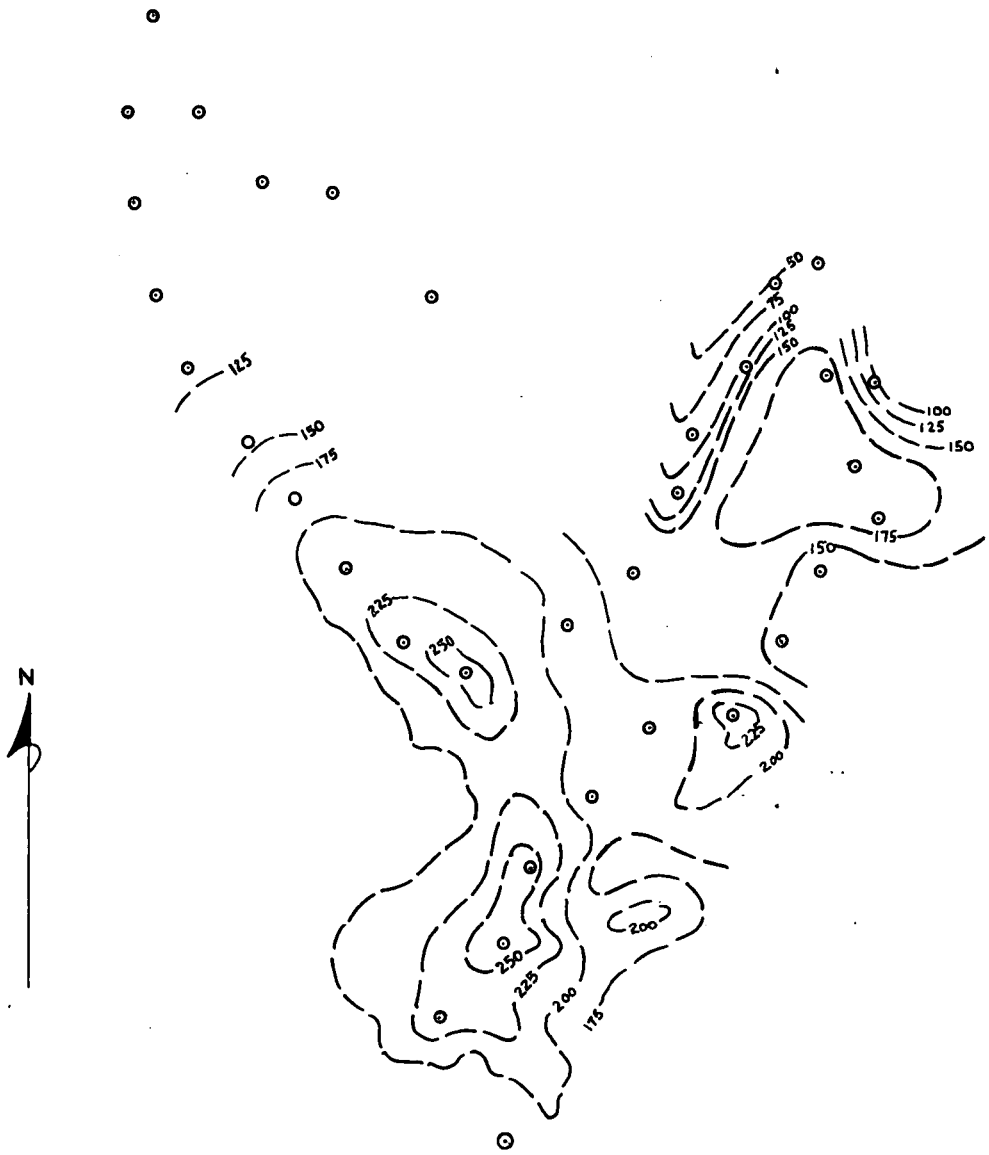
Miles

COMPILED BY RESIDENT GEOLOGICAL SECTION
DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

G67/50E

To accompany Record 1967/125

D52/A15/6



FORMLINES AROUND AUGER HOLES

BATHURST ISLAND

NORTHERN TERRITORY

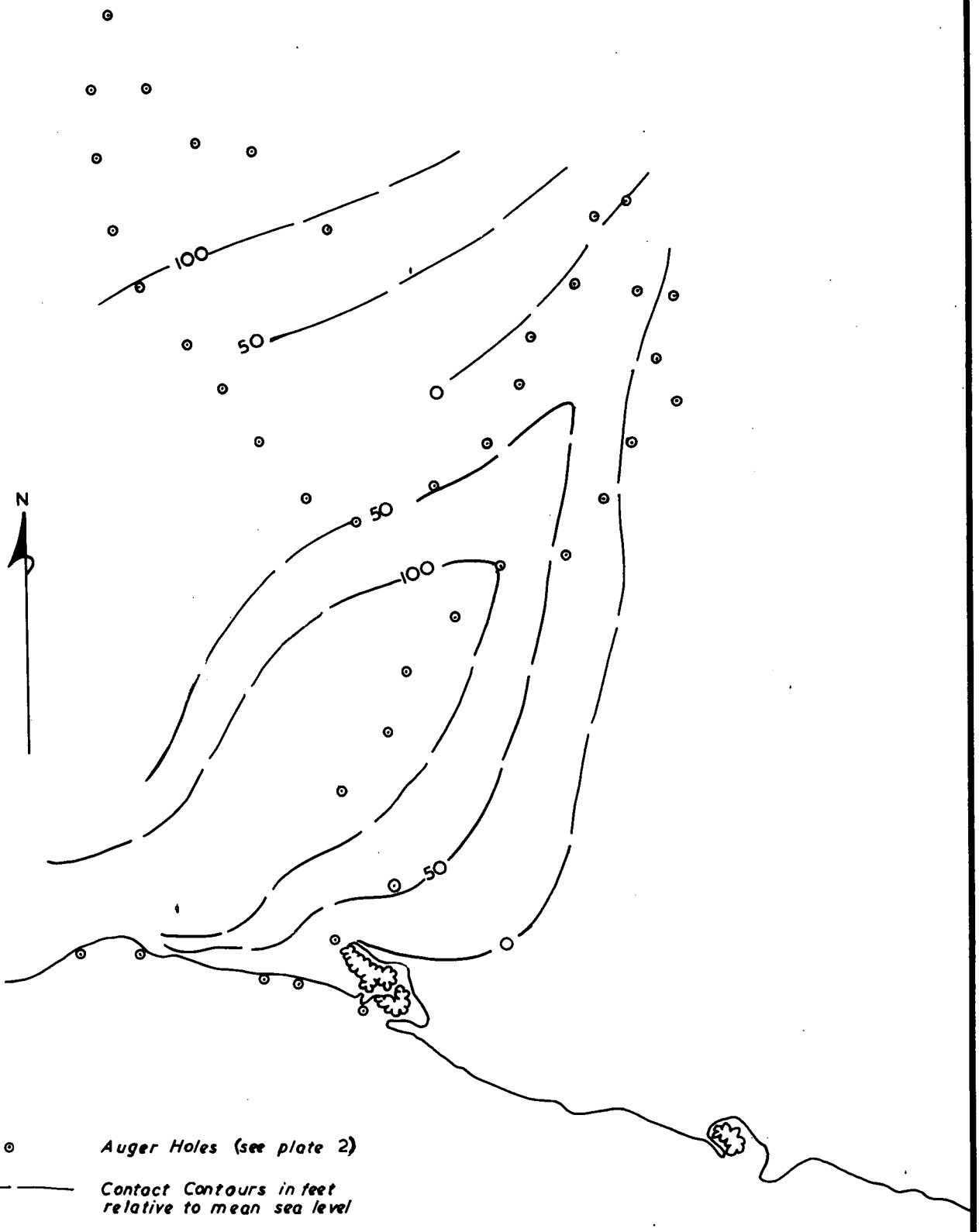
Scale
0 2 4
Miles

COMPILED BY RESIDENT GEOLOGICAL SECTION
DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

G67/51E

To accompany Record 1967/125

D52/A15/7



Auger Holes (see plate 2)

Contact Contours in feet relative to mean sea level

CONTOURS OF TERTIARY CRETACEOUS CONTACT

BATHURST ISLAND

NORTHERN TERRITORY

Scale

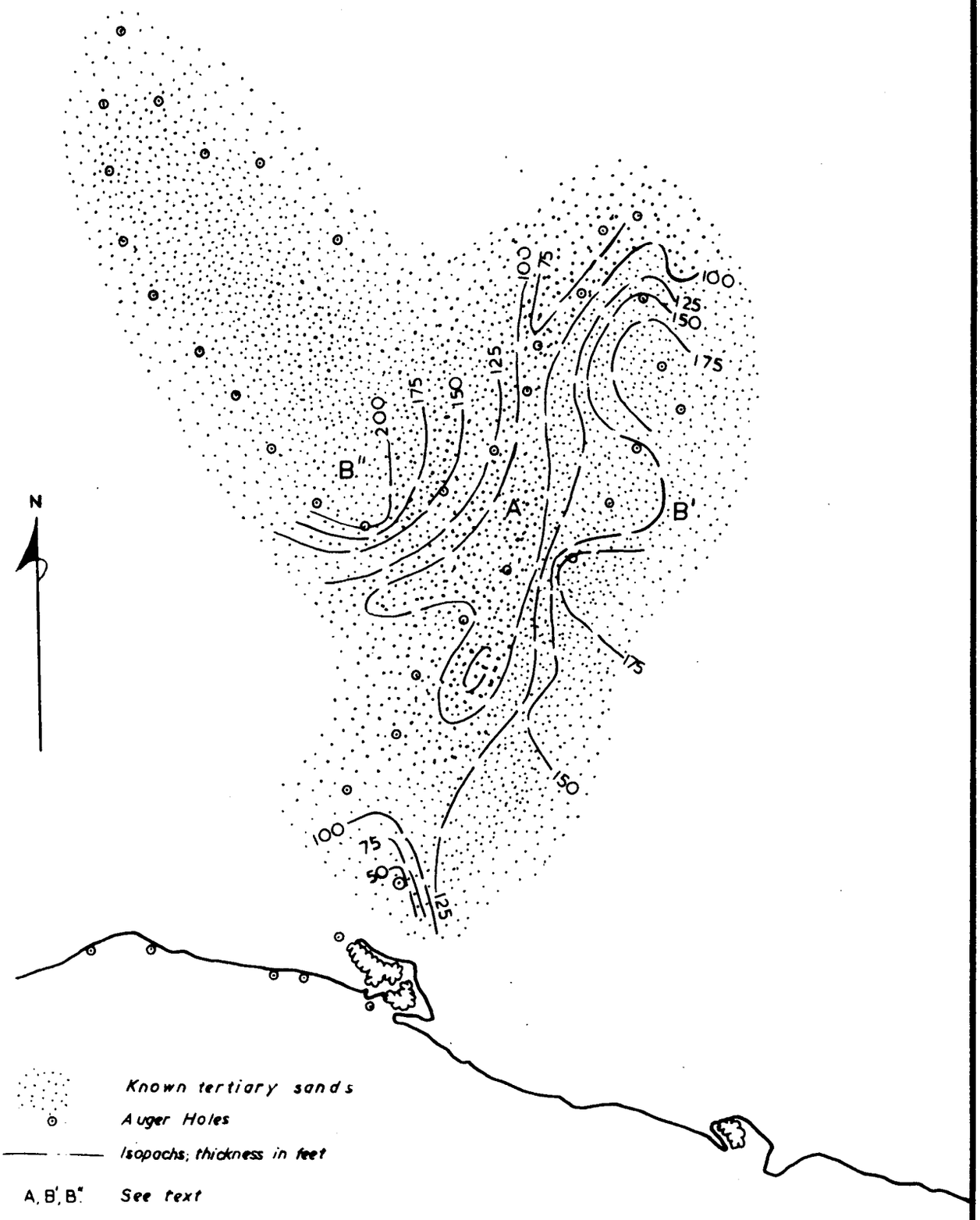
Miles

COMPILED BY RESIDENT GEOLOGICAL SECTION
DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

G67/52E

To accompany Record 1967/125

D52/A15/8



ISOPACHS OF POST-CRETACEOUS SEDIMENTS
BATHURST ISLAND
NORTHERN TERRITORY

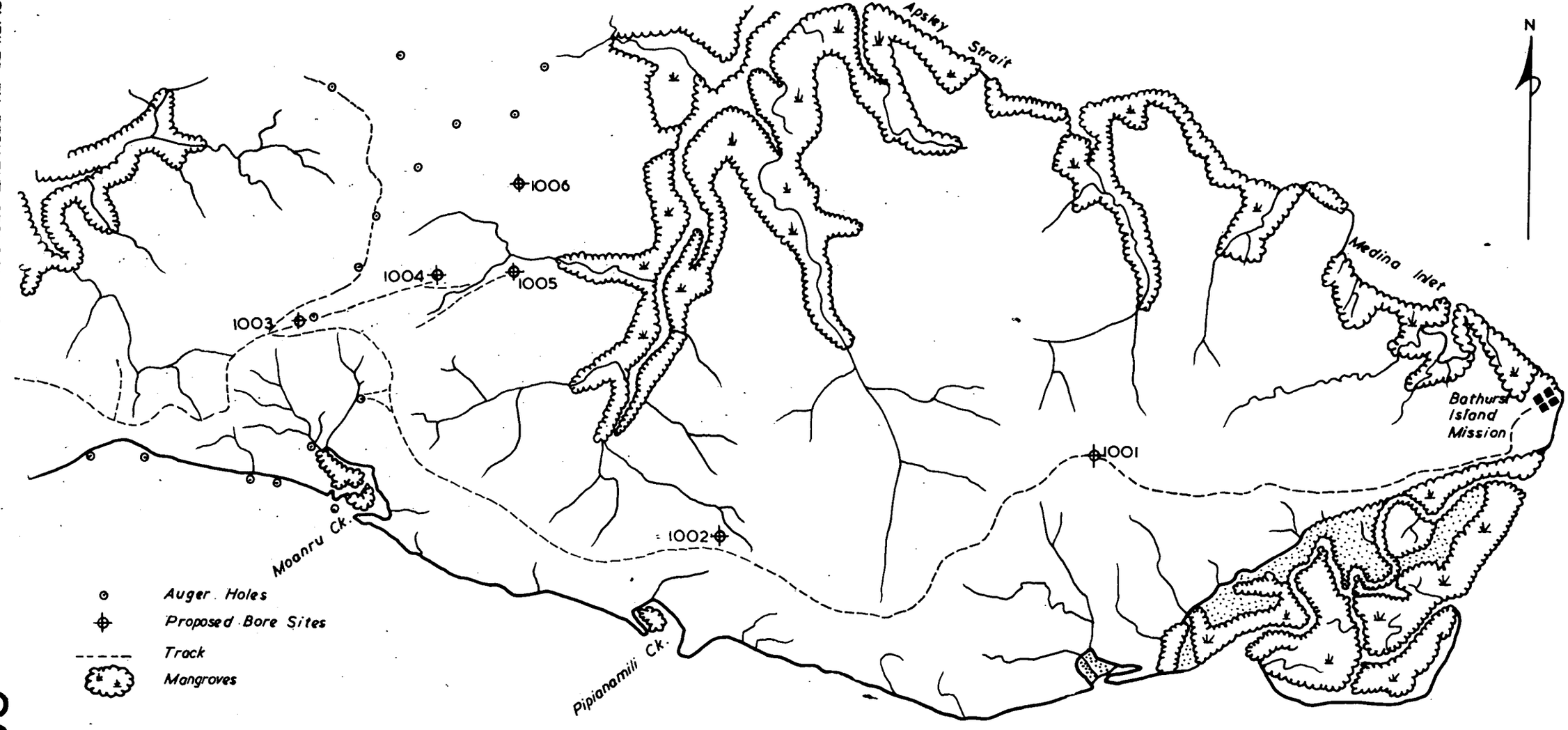
Scale
0 2
Miles

COMPILED BY RESIDENT GEOLOGICAL SECTION
DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

G67/53E

To accompany Record 1967/125

C52/A16/12



PROPOSED BORE SITES
BATHURST ISLAND
NORTHERN TERRITORY

COMPILED BY RESIDENT GEOLOGICAL SECTION
DRAWN BY MINES BRANCH DRAUGHTING OFFICE DARWIN JUNE 1967

To accompany Record 1967/125

D52/A15/10

G67/54E

PLATE 6