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MINOR WATER SUPPLY INVESTIGATIONS BY NORTHERN TERRITORY RESIDENT GEOLOGICAL SECTION: NORTH COAST AREA, 1963.

by

J. Barclay and P. Rix

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PLATES

GEOLOGICAL NOTES ON WATER SUPPLIES AT BATHURST ISLAND MISSION, GARDEN POINT AND PARU MISSIONS ON MELVILLE ISLAND.

by

J. Barclay

SUMMARY

Bathurst Island Mission, Garden Point and Paru Missions are situated on low lying lateritic plateaux.

Water supplies at Bathurst Island and Paru Missions are obtained from hand-dug wells in laterite and at Garden Point from a perennial spring.

A critical situation occurs at Bathurst Island and Paru Missions towards the end of each dry season when water rationing takes place. The Garden Point domestic supply is adequate but additional water is needed for expected extensions of farming.

Inspections were undertaken at the request of Water Resources Branch, Northern Territory Administration, as part of current investigations into providing adequate water supplies for domestic and farm use at the missions.

It is believed that water supplies could be improved at Bathurst Island Mission by drawing from a perennial water hole situated five miles west of the settlement, by completion of a partly constructed earth dam at the rear of the airstrip, and from additional wells sunk in the laterite; the risk of pollution of wells in the laterite is, however, high. At Paru Settlement, supplies could be increased by the construction of additional wells and by the use of a spring about one mile north of the settlement. At Garden Point the drilling of a number of test bores in the farm area is recommended.

INTRODUCTION

The main localities were first visited by sea, from 23rd - 26th April, 1963, and brief ground inspections were made on foot and by Mission Land Rover.

On 14th May, 1963, a helicopter flight was made over the areas with Mr. C. Forbes of Water Resources Branch, Darwin, and rapid ground inspections were made at selected localities.

Accompanying this report are locality maps and three sketch plans giving geological details (Plates 1 - 5).

GEOLOGY

BATHURST ISLAND MISSION - POPULATION 750

1. WELLS

The existing water supply is obtained from several wells sunk in a permeable layer of laterite which underlies the mission. The laterite is generally about 11 feet thick, but a thickness of 18 feet is recorded at the main well. Below the laterite are at least 1,000 feet of Cretaceous mudstone, which is regarded as a poor aquifer (Dunn, 1962).

The present survey was made at the end of the rainy season when it was impossible to examine the laterite in the wells because of a high water table. However, in a cliff section to the south of the mission a ferricrete layer, up to 10 feet thick, overlies a sequence of grey and green banded mudstone. The contact between ferricrete and mudstone is gently undulating, with a slight dip to the north.

The ferricrete is a layered deposit of ferruginous clayey sand with an unsorted, rounded and lateritized fraction varying from pebble to cobble size.

It is not known if the ferricrete extends inland as far as the wells and a future inspection would be necessary to clarify this point when the water table has dropped sufficiently to allow access to the wells.

2. EARTH DAM

A partly constructed earth dam close to the mission was inspected. The excavation was made by bulldozer and its dimensions are about 200 feet long, 150 feet wide and for the most part about 5 feet deep except at one end where a transverse cut was made to a depth of 15 feet.

The excavation penetrated the surface laterite layer and was terminated in the upper part of the Cretaceous mudstone.

It is believed that the mudstone could be utilized to form an effective seal to the sides and bottom of this excavation or for one of larger dimensions which could be constructed to carry a greater volume of water.

The site for the earth dam is apparently in a good position to catch a considerable part of the run-off of water from the airstrip area during the wet season.

3. PERENNIAL WATER-HOLE

A water-hole, situated five miles to the west of the mission, on the north-west side of Mission Hill, was inspected. It is reported to be the highest upstream hole of a string of water-holes connected in the wet season by a stream which flows to the north-east.

The water-hole inspected is about 50 feet long, 25 feet across and 6 feet deep. According to local reports, the water level is maintained throughout the dry season with a slight rise during the rainy period.

The cost of a water supply pumped from this locality to the mission may be prohibitive; any consideration of this scheme would have to be preceded by adequate testing of the available supply.

PARU SETTLEMENT - POPULATION 150

Paru Settlement lies on the west coast of Melville Island, directly opposite and a half mile distant from Bathurst Island Mission.

It is situated on a low lying plateau of lateritized clayey sand.

The existing water supply is drawn from three wells sunk in the laterite, which is at least 18 feet thick. There is no direct evidence of the nature of the underlying rocks. A low cliff section to the west of the settlement exposes about eight feet of lateritized clayey sands. At the foot of the cliff and extending out to sea for a distance of 300 feet is a sandy laterite platform which is most likely equivalent to the downward extension of the lateritized clayey sands in the cliff section.

Towards the end of the dry season, only one of the wells yields water; the supply is rationed.

The construction of additional wells would alleviate the water shortage, but examination of the potentiality of a spring about one mile north of the settlement and past Polari-Aara, may result in a more adequate and sanitary water supply. This spring was not examined during the present investigation.

GARDEN POINT MISSION - POPULATION 150

Garden Point Mission is situated on a low plateau of lateritized clayey sand.

The existing water requirements are supplied by a perennial spring which issues from an old coastline formed in the lateritic layer. The escape of water from the spring area is retarded by a raised beach and a water-hole has been naturally formed by this barrier. The water is pumped from the water-hole 300 yards eastwards to the mission.

At a short distance to the north of the spring, a low cliff of lateritized clayey sand occurs. The top 12 feet of the cliff consist of ferruginized clayey sand underlain by a 4-inch thick layer of laterite pebbles, up to 1-inch in size. Below this horizon, a mixed pallid and mottled zone is exposed for a depth of 3 feet to beach level. The nature of the underlying rocks is not known.

It is anticipated that additional water supplies will be needed as the development of agriculture and livestock is increased in the farm area which lies one half mile south-east of the mission. In this area, it is suggested that test bores be sunk to investigate the available underground water supply.

GENERAL

During the flights by helicopter to the mission stations, a visit was made to the Piper Head locality which lies ten miles north of Garden Point.

In this area, a 60-feet high cliff section consists of a ferruginized sandy layer, overlying poorly sorted and partly consolidated sand.

It is believed that these deposits are underlain by a ferruginous sandstone possibly of pre-Cretaceous age (P. Rix, 1963). This ferruginous sandstone also underlies the cliff sands at Luxmore Head, six miles south of Piper Head (P. Rix op.cit.), and it may possibly extend under the lateritic layer at Garden Point. The proposed test boring may prove this possibility and at the same time test the aquifer characteristics of the formation, if it occurs.

REFERENCES

DUNN, P.G., 1962 - Water Supply : Bathurst Island Mission. Bur. Miner. Resour. Aust. Rec. 1962/21.

RIX, P., 1963 - Notes on geological conditions at three Mission Sites on Bathurst and Melville Islands (unpublished report, Nor. Terr. Resident Geological Section, Darwin).

GEOLOGY AND WATER SUPPLIES AT ELCHO ISLAND, MILINGIMBI AND GOULBURN ISLAND MISSION SETTLEMENTS AND MANINGRIDA WELFARE SETTLEMENT ARNHEM LAND, N.T.

by

P. Rix

SUMMARY

Geological investigations relevant to the development of water resources were carried out at Elcho Island, Milingimbi and South Goulburn Island Missions and Maningrida Welfare Settlement, all situated along the north coast of Arnhem Land. Geological conditions are favourable for the development of adequate water supplies from a sandstone aquifer at Maningrida and a silt reservoir fed from a sandstone aquifer at Elcho Island. Conditions at Goulburn Island are less favourable, but adequate supplies can be developed from the laterite and Tertiary sediments there. Conditions at Milingimbi are unfavourable for the development of good water supplies and moderate supplies only are available from shallow wells in the laterite.

The main recommendations are that: the silt reservoir at Elcho Island be developed; that shallow wells, and possibly a deep, cased bore hole be sunk at Milingimbi; that shallow bore holes be drilled at Maningrida; and shallow wells be dug and a silt reservoir be developed at Goulburn Island.

INTRODUCTION

Elcho Island, Milingimbi and South Goulburn Island Missions, all situated along the north coast of Arnhem Land (Plate 1), were visited during May, 1963. The Maningrida area was visited by helicopter during the regional geological survey of Arnhem Land carried out in 1962 by the Bureau of Mineral Resources. The purpose of the visits was to assess the geological conditions relevant to the development of adequate water supplies both for existing and proposed settlements. Cattle watering points also were required on North and South Goulburn and Milingimbi Islands. Geological maps of the areas visited have been produced from ground observations and photo-geological interpretation.

The work was carried out at the request of the Water Resources Branch, Northern Territory Administration.

ELCHO ISLAND (Plate 7)

GEOLOGY

The pre-Cainozoic rock formations on Elcho Island comprise the two upper units of the Lower Cambrian Wessel Group* of sediments, the Marchinbar Sandstone* and the overlying Elcho Island Formation*. These were deposited in the Arafura Basin, the arcuate southern edge of which can be traced across northern Arnhem Land. The Marchinbar Sandstone consists of

* To be fully defined and described in a forthcoming Bulletin of the Bureau dealing with the geology of eastern Arnhem Land, N.T.

thinly-bedded to massive, white to pink, medium to coarse-grained sub-horizontal quartz sandstone; exposures are restricted to scattered outcrops protruding through the Cainozoic sand cover that has developed on the formation. Coastal outcrops at beach level occur on the west coast near the mission and on the east coast near the jetty, at the end of the vehicle track. North of the area mapped, the width of the sandstone belt diminishes considerably but the formation can be traced along the east coast as far as the north-east tip of the island (Plumb, 1964).

On the west side of the island, the Marchinbar Sandstone is overlain conformably by the Elcho Island Formation, which consists of a basal purple to brown, flaggy, fine-grained ferruginous sandstone overlain by more thinly-bedded grey micaceous siltstone, fine-grained ferruginous sandstone and green to grey glauconitic shale. This succession is well exposed in the cliffs just north of the mission. In 1923, bitumen was discovered on the shoreline near the mission, and was reported to occur, not very abundantly, as flat, hard, brittle cakes filling lenticular cavities in the flaggy beds (Wade, 1924). No bitumen was seen in the cliff sections examined during the present visit, but numerous small cakes of wave-borne bitumen were observed along the shoreline both on beach rubble and on bedrock. Farther north, along the west coast of the island, the rock types which crop out near the mission are overlain by flaggy chert, dolomitic siltstone and chert breccia (Plumb, op.cit.). The prevailing regional dip of the Cambrian rocks is about 1° west-north-west.

The beds of the Elcho Island Formation were lateritized during the Tertiary period and the cliffs near the mission expose a classic profile of aluminous laterite. The upper bauxitic zone and lower mottled and pallid zones are present; the pallid zone passes downwards into a zone of interbedded kaolinised shale and slightly weathered sandstone and siltstone beds that show differential weathering. The total thickness of beds exposed in the cliffs is about 80 feet, of which 60 feet form part of the Elcho Island Formation and 20 feet is aluminous laterite.

The laterite cover extends onto the outcrop of the Marchinbar Sandstone where, however, it is irregularly distributed. The Sandstone typically has a sand cover and has been unaffected by lateritization; the patches of laterite remaining on the Marchinbar Sandstone therefore probably represent a formerly more extensive thin cover of beds of the Elcho Island Formation.

Although some slight local folding occurs in the Marchinbar Sandstone, most of the outcrops in the southern part of the island are sub-horizontal. A number of lineaments on aerial photographs were proved by field observation, generally in coastal exposures, to be faults. The east-west trending faults intersect the coast near the mission and cause a considerable local variation in the dip and strike of the beds exposed on the wave-cut platform. The fault just north of the mission appears to have displaced lateritized beds of the Elcho Island Formation, the block between this fault and the southern fault having been downthrown. On the southern, or upthrow, side of the southern fault, a small outcrop of Marchinbar Sandstone occurs on the beach. Several springs occur in the areas where these faults intersect the coastline and fresh water streams extend from them across the beach. The springs and streams are seasonal; the southern spring persists well into the dry season.

The laterite profile on the west coast north of the mission is overlain by a bed of sandy hematite, up to two feet thick, which is capped by pebbles and cobbles of the same mineral composition. It is presumed to be Quaternary in age but its mode of origin is unknown. A separate note is being prepared on the occurrence of this unusual rock type.

Reefs of ferricrete (ferruginous gravel with a ferruginous cement) occur at shore level along the coasts; recent coastal silt, sand dunes, evaporite deposits and riverine alluvium complete the geological formations exposed on the island.

WATER SUPPLIES

MAIN SUPPLY

The main water supply for the Elcho Island Mission comes from the waterhole south-east of the mission. Surface water is seasonal but the waterhole is underlain by thick deposits of very fine white silt which occupy a small topographic basin on the surface of the Marchinbar Sandstone and contain water. Outcrops of the sandstone form a low ridge to the west of the waterhole and it is considered that the topographic basin is a reflection of a small tectonic basin in this area, and that the infilling material is Recent lagoonal silt. This silt is known to reach a depth of at least 48 feet in the centre of the waterhole, thereby providing a good reservoir for water storage.

In the wet season, the alluvium between the waterhole and the west coast is inundated, the water being ponded by the sand dune at the western end of the alluvial flat. This water escapes round the southern end of the dune and flows across the beach just north of an outcrop of Marchinbar Sandstone. A rubble dam has been built by the Mission authorities at the southern end of the dune on its eastern margin, in order to raise the water level in the sands and alluvium. During the present visit water was flowing over the rubble dam and escaping across the beach.

In the dry season the standing water level drops to about 13 feet below the surface in the silt reservoir. At the time of the visit, water was overflowing from the pipes embedded in the silt and it is likely that the silt basin is recharged by fresh water from the Marchinbar Sandstone aquifer.

Plentiful supplies of water exist in this silt reservoir but the pumping rate is low because of caving of the silt at high flow rates. C. Forbes, of Water Resources Branch, N.T. Administration, has suggested that this problem might be overcome by gravel packing, in which case supplies of water from this reservoir would be adequate for the mission for all purposes.

A sample of the silt was taken from near the pumphouse and a screen analysis of it was done by Water Resources Branch. This showed that over 99% of the material falls within the silt grade and almost 90% of it between grain sizes of 0.006 and 0.003 inches, that is, over a narrow range within the silt grade.

DEEP AQUIFERS

The island is underlain by Marchinbar Sandstone which has a regional dip of 1° west-north-west. It is believed to be about 500 feet thick and it overlies the Raiwalla Shale (see footnote p. 5), a succession of shales with thin interbeds of siltstone and sandstone. The sandstone aquifer that crops out on Elcho Island passes beneath Cadell Strait and forms Napier Peninsula; the body of fresh water which occurs within it on Elcho Island may therefore rest on a layer of salt water.

The borehole drilled for oil in 1926 reached a depth of 300 feet but no other details are available. The collar is at 110 feet above sea level on the high ground north of the mission and the exposures in the cliffs provide information on the first 100 feet of strata. It is likely that the hole entered Marchinbar Sandstone between 150 and 200 feet and therefore tapped the aquifer. The hole is blocked with a drilling tool about 30 feet below the surface and may have caved in below that; it is cased near the top but the length of casing in the hole is not known. If a bore is required to tap the aquifer it would probably be cheaper to drill another hole than attempt to clear and utilise the existing hole.

WELLS AND SPRINGS

Three wells are indicated on the map, between the mission and the airstrip; these supply the garden areas. The well nearest to the track passed through a thin layer of sandy hematite and encountered ferruginous micaceous siltstone to 34 feet. Similarly the southern well reached a depth of 30 feet in Elcho Island Formation, whereas the eastern well struck hard quartzitic sandstone at 20 feet. The water level in these wells falls considerably in the dry season but they provide sufficient water for the garden areas at the present time.

Two wells equipped with windmills have been sited close to the intersection of the west coast by the southern fault, where a strong spring issues from the fault. These wells provide an additional water supply but the water becomes brackish in the dry season, as might be expected from the position of the wells.

The spring at this site was flowing strongly during May, whereas the springs a little further north had only a small flow.

RECOMMENDATIONS

ELCHO ISLAND MISSION

The silt reservoir should be developed as the main supply for the mission, and if the technical problem of pumping from such fine material can be solved by gravel packing, it should supply all the needs of the mission. The removal of the trees growing on the silt in the waterhole area would cut losses by transpiration and thus raise the water level in the silt.

If deep boreholes are required, good supplies should be available from the Marchinbar Sandstone at depths of about 100 feet. A particularly favourable site would be on the small fold in the sandstone that forms the north-west side of the waterhole, in the vicinity of the sandstone outcrops near the vehicle track (Plate 7). Shallow wells for the garden areas and the projected Cypress Pine plantation, both of which are situated near the eastern end of the airstrip, should be sited on the northern fault shown in Plate 7. In this area a thin cover of laterite on Marchinbar Sandstone is expected and shallow wells would tap the water moving along the fault. A suitable site could be located from Plate 7 by taking a compass bearing and measuring the distance from the end of the airstrip. Any further shallow wells should be sited on these faults.

WARANGAIYU LAGOON

A second mission site is projected and will probably be located at Warangaiyu Lagoon, which is situated 11 miles north-east of Elcho Island Mission. The area was not visited because the track was obstructed by trees blown down during the recent cyclone.

The lagoon is just over one mile long and about one quarter of a mile wide. It is situated near the west coast of Elcho Island and is dammed at its north-western end by a sand dune. From air photos, the lagoon appears to lie in a depression in the laterite but its formation has been assisted by the development of the coastal sand dune at its north-western end. No photo-linear features were noted in the area.

There may be a thick layer of silt under this lagoon and, if so, the remarks concerning the silt reservoir near the Elcho Island Mission would apply. Shallow wells would yield only relatively small supplies from the laterite. The Marchinbar Sandstone aquifer is thought to be overlain by about 200 feet of Elcho Island Formation, and water supply conditions in the aquifer would be similar to those described above.

One difficulty concerning the development of supplies at this site is that the lagoon, from air photos, appears to be prone to invasion by salt water, by way of the drainage channel through the sand dune. If this is so, efficient damming would be required.

MILINGIMBI ISLAND (Plate 8)

GEOLOGY

Milingimbi Island, which is part of the Crocodile Islands, is a low island almost surrounded by evaporite deposits and coastal silts that support mangrove swamps. The island consists of Tertiary laterite overlying bedded siltstone of the Lower Cambrian Elcho Island Formation. A thin layer of ferruginous sandy soil covers the laterite over most of the island. The Milingimbi mission is sited behind the only section of shoreline that is free from mangrove swamps, and all the rock exposures occur along this section.

Exposures of the Cambrian rocks are restricted to the promontory to the north of the mission settlement. The settlement is largely situated on an area of stabilised dune sand and shelly raised beach deposits, but the promontory consists of thinly-bedded, light brown siltstone that has a white weathered surface and dips south-west at 10°. Some local folding is indicated as the regional dip of the beds is due north at about 1°. The island is close to the centre of the landward part of the Arafura Basin, consequently the rocks exposed are higher in the succession than any observed on Elcho Island, and the depth to the Marchinbar Sandstone aquifer correspondingly is greater. This aquifer crops out on the mainland 20 miles south of Milingimbi Island (Rix, 1964a) and has a prevailing dip of about 1° north. Using this figure, the depth to the Marchinbar Sandstone beneath Milingimbi Island would be approximately 1750 feet. The dip may flatten northwards from the edge of the basin, but this could only be ascertained by drilling.

The aluminous laterite crops out only on the coast near the mission, where it is slightly sheared and silicified along the fault that intersects the coast at this point. A similar rock type is exposed in the main supply well in the mission area and in the Macassar Well, both of which are situated on photo-linear features (Plate 8). The well in the north of the island also exposes aluminous laterite. The borehole near the mission is 120 feet deep, in soft rock, but no other details of the rock intersected are available.

The faults shown on Plate 8 were originally traced as photo-linear features and it was noted that one of the points of intersection was at the dense clump of trees at the Macassar Well. The presence of shearing and silicification in the laterite shows that there was post-laterite movement along the faults.

WATER SUPPLIES

MISSION BORE

The existing bore near the mission provides a moderate supply of water, but this is too saline for human consumption, although suitable for stock use.

WELLS

The main water supply for the mission is at present provided by shallow wells in the laterite. On geological grounds, the best position for a well is that of the old Macassar Well, which is a natural well situated at the intersection of three faults. This well is some 60 feet in diameter and is reputed to be 12 feet deep and to have an underground northward extension for about 50 feet. Its size and shape could be due to weathering and collapse of the laterite in the weak zone at the intersection of the faults. The water level was high during the visit and this well yields a moderate supply of good quality water.

The main mission supply well is situated south-south-east of the Macassar Well, is 15 feet deep and also yields a moderate supply of good quality water. The well in the north of the island is 20 feet deep, yields a moderate supply of good quality water, and is used for stock watering.

The water level in all the wells drops during the dry season and the water becomes brackish.

Saline water usually enters any well that is sunk to more than 18 feet, even if the standing water level is much higher than this. It seems, therefore, that a lens of fresh water extends to approximately 18 feet and is underlain by a layer of saline water. Wells that are less than 18 feet deep are fresh but turn slightly brackish at the end of the dry season owing to a small intake of saline water.

SURFACE SUPPLY

A surface source of fresh water on the island is the waterhole near the north-west edge of the timbered country. This hole is circular and has an asymmetrical cross section with a steep bank on the south-east side and a shallow sloping bank on the north-west side adjacent to the salt flats. The hole is reported to have a maximum water depth of 12 feet and to be underlain by 12 feet of silt. Only the very highest tides reach the edge of the hole and contaminate the fresh water. Native legend suggests that it is a meteorite crater but it is more likely to be a sink hole.

RECOMMENDATIONS

DEEP SUPPLIES

To obtain supplies of water at depth it would be necessary to drill a hole to the Marchinbar Sandstone aquifer. This might entail drilling a hole 1750 feet deep and casing it down to the aquifer; it would be a costly project but it would be the only way of ensuring a permanent, large supply of good water for an expanding settlement on the island.

SHALLOW WELLS

It is likely that shallow wells will continue to provide the water supply in the immediate future. Future wells should be sited on the faults shown on the map, but away from their seaward extremities to preclude the entry of salt water into the wells, particularly during the dry season. A very good site for a well is at the intersection of two faults at the southern corner of the cleared airstrip approach area closest to the mission (Plate 8).

The water supply from the "meteorite crater" waterhole could be improved by digging it out and lining it, and by building a wall on its seaward side to prevent contamination by salt water during periods of exceptionally high tides. The mission authorities intend to carry out some work on this waterhole during the dry season of 1963.

MANINGRIDA AREA (Plate 9)

GEOLOGY

Exposures in the vicinity of Maningrida Settlement were visited by helicopter during the 1962 Arnhem Land regional geological survey by the Bureau of Mineral Resources (Rix, 1964, a & b). Plate 9 shows the structure in the area. It can be seen that, from the point of view of water supplies, Maningrida is very favourably sited within the outcrop area of the Marchinbar Sandstone. The sandstone is covered with laterite, sand or ferricrete, but is exposed at a number of places on the coastline, including Gumeradji Point, West Point, Entrance Island and the west side of Hawkesbury Point. At all of these places white to buff, medium to coarse-grained quartz sandstone forms jointed pavements at or just above sea level.

Beds of the Raiwalla Shale succession crop out on the north-east side of the Tomkinson River where grey shales with thin interbeds of siltstone and quartz sandstone form a series of low, rounded hills. Beds of the Elcho Island Formation were not seen to crop out, but are believed to be present.

The prevailing regional dip of these three conformable stratigraphic units of the Lower Cambrian Wessel Group succession is about 1° north-east.

WATER SUPPLIES

Boreholes put down into the Marchinbar Sandstone aquifer anywhere in the area of Maningrida Settlement should get adequate supplies of good water at depths of not more than 150 feet. Some salt water will be present in the aquifer and boreholes should be sited as far away from the shoreline of the estuary as is convenient for the settlement.

GOULBURN ISLANDS (Plate 10)

GEOLOGY

The Goulburn Islands differ from the other localities described in this report in that they do not fall within the Arafura Basin in which sediments of Lower Cambrian age were deposited. Instead they consist predominantly of laterite, which, in places, is seen to rest on Tertiary sands and kaolinitic clays. The Upper Proterozoic Kombolgie Formation, which forms Tor Rock and Wellington Range on the mainland to the south, probably underlies the whole of the islands, but is exposed only on Sims Island and Bottle Rock, which consist entirely of this formation, and on the north-west corner of South Goulburn Island.

The Kombolgie Formation consists of coarse-grained quartz sandstone, commonly current-bedded and with grit and pebble-conglomerate horizons. One fragment of quartz-mica schist was obtained from a conglomerate horizon on Sims Island and was probably derived from Archaean rocks of the Myra Falls Metamorphics which are known from the mainland to the south. (Dunn, 1962). The sandstone is generally sub-horizontal but dips of 10^{o} were recorded on the north-west point of Sims Island; the inclination is probably due to faulting. A very shallow dip was also observed on Bottle Rock. The thickness of the Kombolgie Formation is unknown but is not likely to be greater than about 300 feet, of which 100 feet is exposed on Sims Island. The basement beneath the sandstone is probably formed by the Nimbuwah Granite which is exposed on the mainland south-east of the islands, near Junction Bay (Rix, 1964b).

The Tertiary beds consist of lagoonal, medium to coarse-grained sand with a matrix of kaolinitic clay and containing lenses of kaolinitic clay. They are exposed in cliffs on South Goulburn Island and on the south side of North Goulburn Island. At the latter locality, laterite 25 feet thick overlies 25 feet of Tertiary sand, with kaolinitic clay cropping out on the beach. This clay probably forms a lens in the sand but its extent is not known. The Tertiary sand probably is lenticular and has a patchy distribution on the islands.

Laterite is widespread and is to be seen in numerous cliff exposures on both islands. It is thought to be the result of complete lateritization of a thin cover of Cretaceous rocks; the Tertiary sands and clays have also been lateritized wherever they occur, presumably in shallow basins on the partially-lateritized (?) Cretaceous rocks. In the cliffs on the south side of North Goulburn Island, the laterite profile in the Tertiary beds consists of 3 feet of ferruginous zone overlying 18 feet of mottled and pallid zones. The pallid zone is difficult to differentiate from the white Tertiary beds beneath. Elsewhere on the islands the laterite profile is at least 20 feet thick. In the north-west of South Goulburn Island, the laterite overlies the quartz sandstone, the profile is much thinner and apparently consists of the ferruginous zone only. The Cretaceous rocks were probably very thin over the sandstone at this point and a full profile was not developed.

Ferricrete forms coastal reefs and surface deposits in various parts of the islands. The largest occurrence is in the south-west part of South Goulburn Island where ferricrete crops out over a considerable area and overlies Tertiary deposits in the cliffs.

Raised beach deposits, consisting of comminuted shells, ferruginous gravel, coral fragments and sand, with a calcareous cement, occur along parts of the coast. On the west side of South Goulburn Island they attain a thickness of 15 feet but elsewhere they are generally thinner, and most of the other occurrences are small benches, usually a few feet above high water mark.

Alluvium, and coastal silts, evaporite deposits and sand dunes occupy considerable areas on both islands.

A number of photo-linear features were observed on the islands and were identified as faults wherever they were found intersecting the coast. At these points, small, straight laterite cliffs commonly occur on the upthrow side, whereas the downthrow side is represented by low ground. From this it is evident that post-laterite movement has taken place along the faults.

WATER SUPPLIES

DEEP SUPPLIES

Prospects for deep supplies are not good as the Upper Proterozoic sandstone probably contains saline water. Consequently water supplies, both for the mission and for stock watering, must be obtained from the laterite and possibly from some of the Tertiary deposits.

SHALLOW SUPPLIES

On the Goulburn Islands, a large part of which is between 20 and 40 feet above sea level, good supplies of water exist in the laterite and the standing water level in the wells does not drop much below 8 feet even in the dry season. Three shallow wells in the laterite supply the mission with adequate supplies of good water at the present time.

The faults in the south-west part of South Goulburn Island were traced on compass bearings from the coast inland to the airstrips and trees were blazed to mark the lines of the faults. Clumps of pandanus were encountered at several localities close to these lines, indicating that water occurs close to the surface at these points. These lines could be used for siting additional shallow wells for stock watering if these were required in the future.

Similarly, the shorter faults on the western part of North Goulburn Island were traced out on the ground. No settlement exists on this island and no stock are grazed there at the present time, but plans are in hand to establish a herd of buffalo on the island in the future.

SURFACE WATER

Surface water is available for part of the year at a few places on the islands. On South Goulburn Island there are two notable sources of surface water - Undjuma Lagoon in the north and a large waterhole in the south-west corner of the island.

Undjuma is a large lagoon situated near the north coast of the island; it has a narrow extension south-west for one mile behind the large coastal dune by which it is dammed from the sea. During, and for some time after, the wet season surface water exists over the whole area of the lagoon. During the dry season, the water level drops to about 4 feet below the surface and drums embedded in the sand are used as small wells. It is likely that silt and fine sand deposits underlie this lagoon and that pumping from these may prove difficult. The lagoon retains water very well and it is suspected that Tertiary clays and sandy clays underlie the silt and sand deposits, providing an impervious base to the shallow reservoir. The south-east bank of the lagoon is formed by a low shelf of raised beach deposits in front of a 15-foot laterite cliff.

The waterhole in the south-west corner of the island occupies a depression in an area of thin ferricrete deposits that overlie Tertiary sands and clays. Probably the water occurs in some of these sands, where they overlie impermeable clay.

On North Goulburn Island, the laterite plateau across the northern part of the island has a rather rough photo-texture owing to a number of shallow depressions in the laterite surface. It is thought that patchy Tertiary beds underlie the laterite and some washing out of unconsolidated material has taken place, resulting in collapse of the laterite and the formation of depressions. The depressions form shallow seasonal waterholes, and any which overlie clay beds with overlying sand are likely to retain a considerable amount of water in the sand at shallow depths. The waterholes in the south-east of the island are also thought to be of this type.

RECOMMENDATIONS

For increased supplies near the mission, further shallow wells should be sunk in the laterite. All such wells should be carefully examined for pollution because water moving through cavities in the laterite lacks natural filtration. Cattle watering points on both islands should be sited as close as possible to the fault lines that were traced on the ground.

Undjuma Lagoon and the waterhole in the south-west of the South Island could be developed for stock watering by sinking a number of shallow wells and pumping moderate supplies of water from the sand. The waterholes on the North Island could be utilised in the dry season in a similar way, particularly those which are most persistent and which probably overlie impervious clay.

ACKNOWLEDGEMENTS

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REFERENCES

DUNN, P.R., 1962 - Alligator River, N.T., 1:250,000 Geological Series. Bur.Min.Resour. Aust. Explan. Notes SD53-1.

PLUMB, K.A. 1964 - Wessel Islands - Truart Island, N.T., 1:250,000 Geological Series. Bur.Min. Resour.Aust. Explan. Notes SC53-15 (in press).

RIX, P., 1964a - Milingimbi, N.T., 1:250,000 Geological Series. Bur.Min.Resour.Aust. Explan. Notes SD53-2 (in press).

RIX, P., 1964b - Junction Bay, N.T., 1:250,000 Geological Series. Bur.Min.Rseour.Aust. Explan. Notes SC53-14 (in press).

WADE, A., 1924 - Petroleum Prospects. Kimberley District of Western Australia and Northern Territory. Comm.Aust.Parl.Rep.

GEOLOGY AND WATER SUPPLIES AT POSSIBLE SITES FOR A FORESTRY AND TIMBER SETTLEMENT NORTH-WEST ARNHEM LAND, N.T.

by

P. Rix

SUMMARY

Geological investigations were carried out in the Wauk Lagoon area and on the coast at Mount Norris Bay, north-west Arnhem Land, to locate the best site for a forestry and timber settlement. Geological conditions at the coast are generally unfavourable, although limited water supplies may be available from a post-laterite fault and possibly from clayey sandstone of Tertiary age. At Wauk Lagoon, however, it is possible that the depth to impervious rock is small, and that the lagoon is fed by springs and by subsurface recharge from the water table in the thin cover of unconsolidated material overlying the impervious rock. It is concluded that the Wauk Lagoon site has the best water supply for a settlement, but coastal water bore sites have been chosen in case a subsidiary settlement is considered necessary at Mount Norris Bay.

INTRODUCTION

The Mount Norris Bay and Wauk Lagoon areas in north-west Arnhem Land, 150 miles east-north-east of Darwin (Plate 11, Figs. 1 and 2), were visited during October, 1963, in the company of Mr. J. Hauser and Mr. J. Mullen of the Forestry and Timber Bureau, Berrimah, and Mr. R. Ayre of the Department of Works, Darwin, to investigate possible sites for a projected forestry and timber settlement.

POSSIBLE SITES

WAUK LAGOON (Plate 12, Fig. 1)

GEOLOGY

Rock exposures in this area are very scarce. It is believed that a thin laterite cover overlies patchy clayey sandstone of possible Tertiary age, which rests at shallow depths on impervious rock, the nature of which is not known. A rounded boulder of diorite was found in the bank of the lagoon, but it is of doubtful origin as it could have been transported by aborigines.

WATER SUPPLIES

The lagoon is approximately half a mile long and has an average width of about 80 yards. The average depth is not known, but is thought to be at least 15 feet. The lagoon, therefore, contained at least 50,000,000 gallons of water at the time of the visit, which was at the end of the dry season. The lagoon is thought to owe its existence to the presence near the surface of impervious rocks that channel the water in the overlying superficial material into the lagoon by sub-surface movement. The lagoon is also fed by a number of springs on its eastern side.

MOUNT NORRIS BAY (Plate 12, Fig. 2)

GEOLOGY

A long, fairly narrow, laterite plateau flanks the coast on the east side of Mount Norris Bay and extends from Coombe Point in the south-west to Malay Bay in the north-east. The plateau is about 100 feet above sea level and is dissected on the seaward or north-west side; as a result a noticeable scarp has developed about one mile inland. On its south-east side the plateau slopes gently down to the creek that forms its south-east boundary, and no scarp has been developed.

Cliff exposures at Coombe Point show that the ferruginous laterite rests on clayey sandstone, probably of Tertiary age. The clayey sandstone probably extends under the low laterite plateau but it is likely to be lenticular and to have a patchy distribution. Flat-lying yellow claystone of Cretaceous (?) age crops out along the shoreline north-east of Coombe Point, and probably extends under the younger deposits for some distance inland.

WATER SUPPLIES

The low sand dunes along the coast are unlikely to contain sufficient water to supply a settlement. Small supplies of fresh water can be obtained from a small seep that occurs in a depression in the sands near Coombe Point, but it is considered that any pumping from such a source would draw in salt water. Seasonal swamps and water holes behind the coastal dune are fed only by surface run-off and are unsuitable as sources of permanent water.

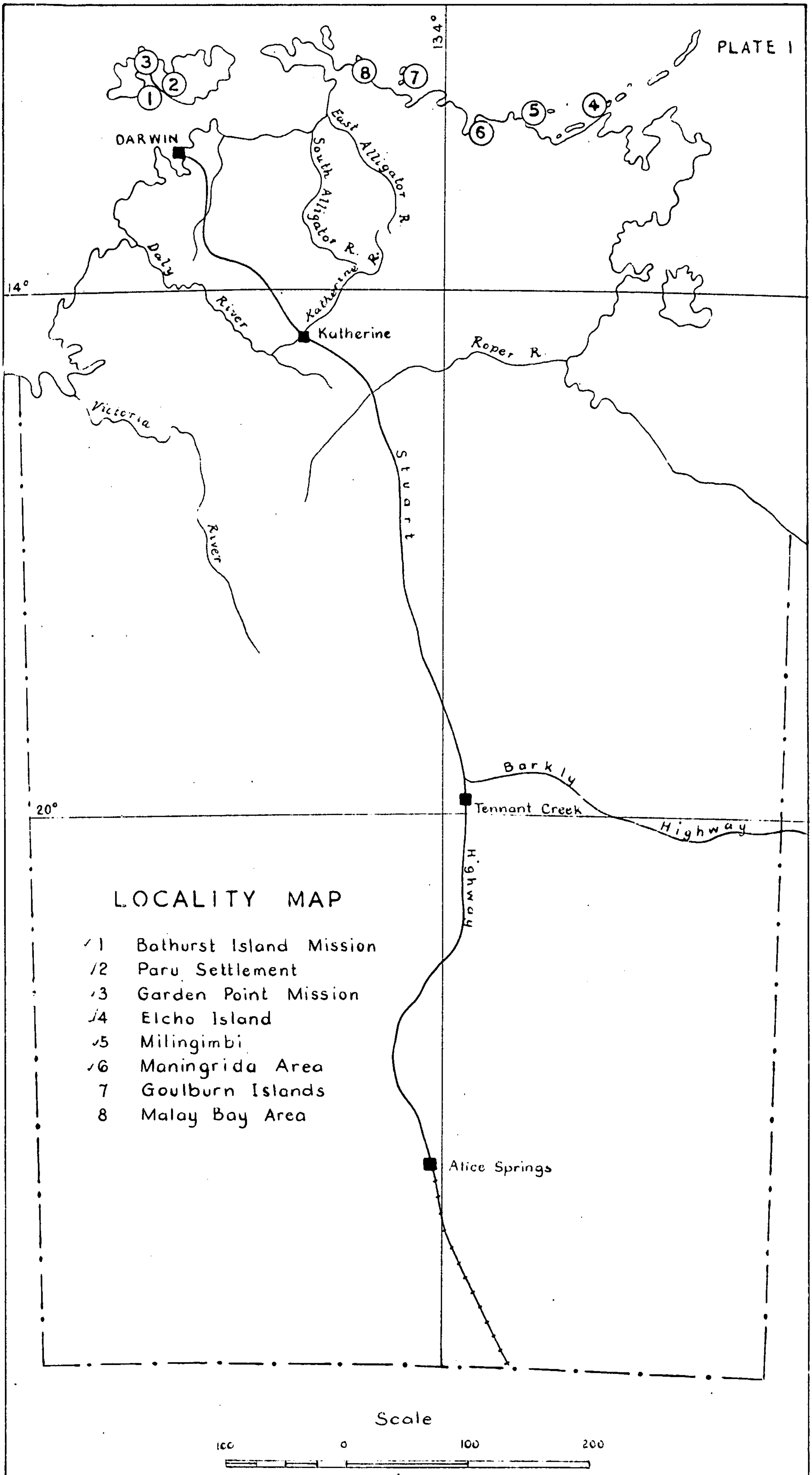
The only promising coastal sites would be close to the fault indicated in Plate 12, Fig.2. The northern part of the fault is marked by pandanus but no springs were seen during the visit. The surface trace of the fault is close to sea level and movement of salt water along the northern portion is likely. The southern part of the fault crosses the laterite plateau, thus providing more favourable conditions for the development of water supplies. The best bore sites are considered to be those marked A, B and C on Plate 12, Fig.2; such bores would tap water moving along the fault as well as any water in the clayey sandstone aquifer that probably underlies the laterite in this area. The patchy nature of the clayey sandstone and its possible low transmissibility means that supplies of water from even these sites could be rather small.

CONCLUSIONS

The best site for a settlement is Wauk Lagoon, where good supplies of permanent water exist. Coastal sites are less favourable, the optimum site being on the laterite plateau about 3¼ miles east-north-east of Coombe Point. Water supplies at this locality might be small unless a large number of bores or wells was sunk.

RECOMMENDATIONS

On geological considerations, Wauk Lagoon should be chosen as the site of the projected settlement. If other considerations make the choice of a coastal site necessary, water bores should be put down close to points A, B and C (Plate 12, Fig.2), and if necessary additional holes should be drilled between these points. Bores at points A and C should be drilled to a depth of at least 50 feet and not more than 100 feet; any hole at point B should be drilled to a depth of at least 100 feet and not more than 150 feet.



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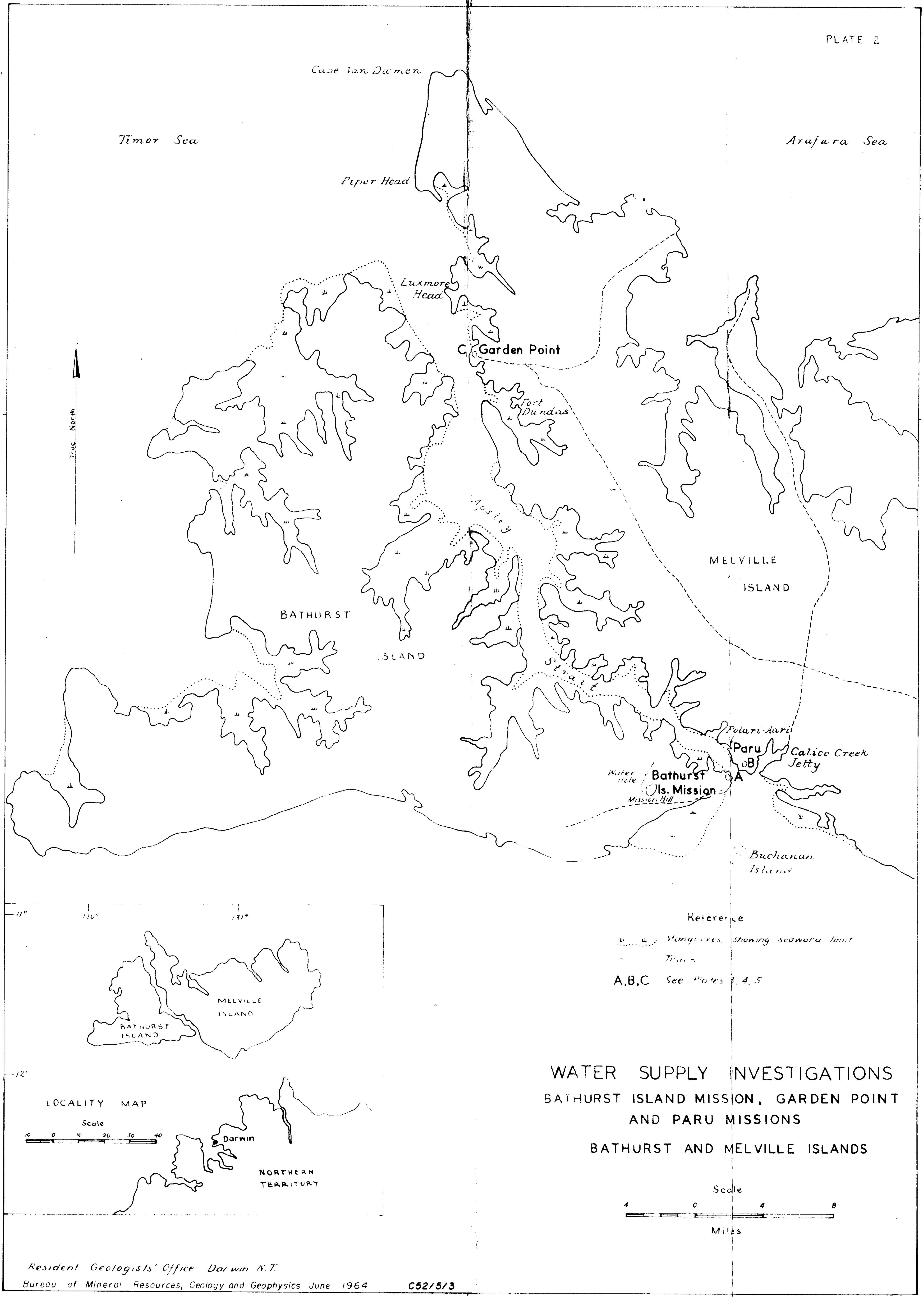

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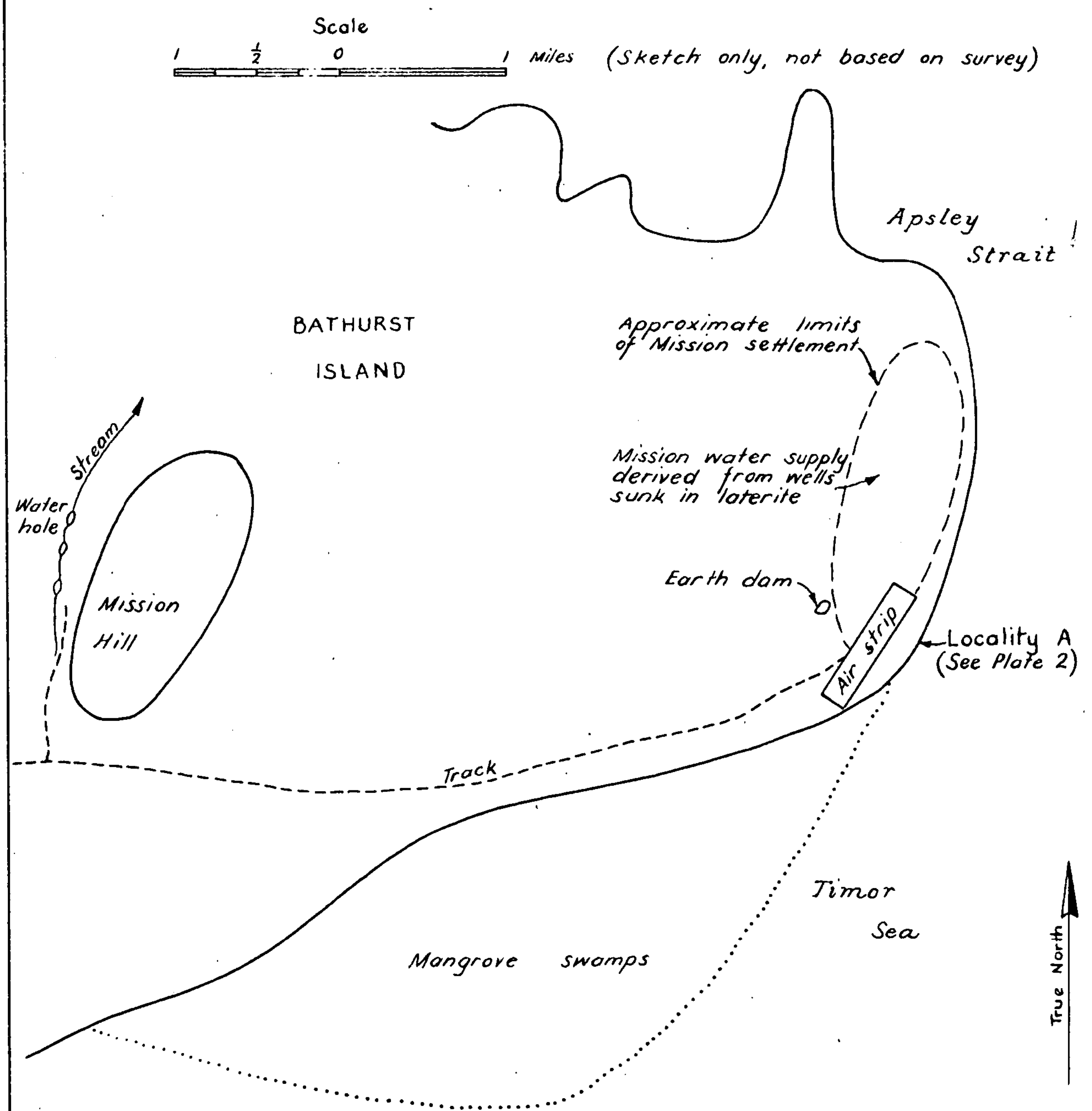
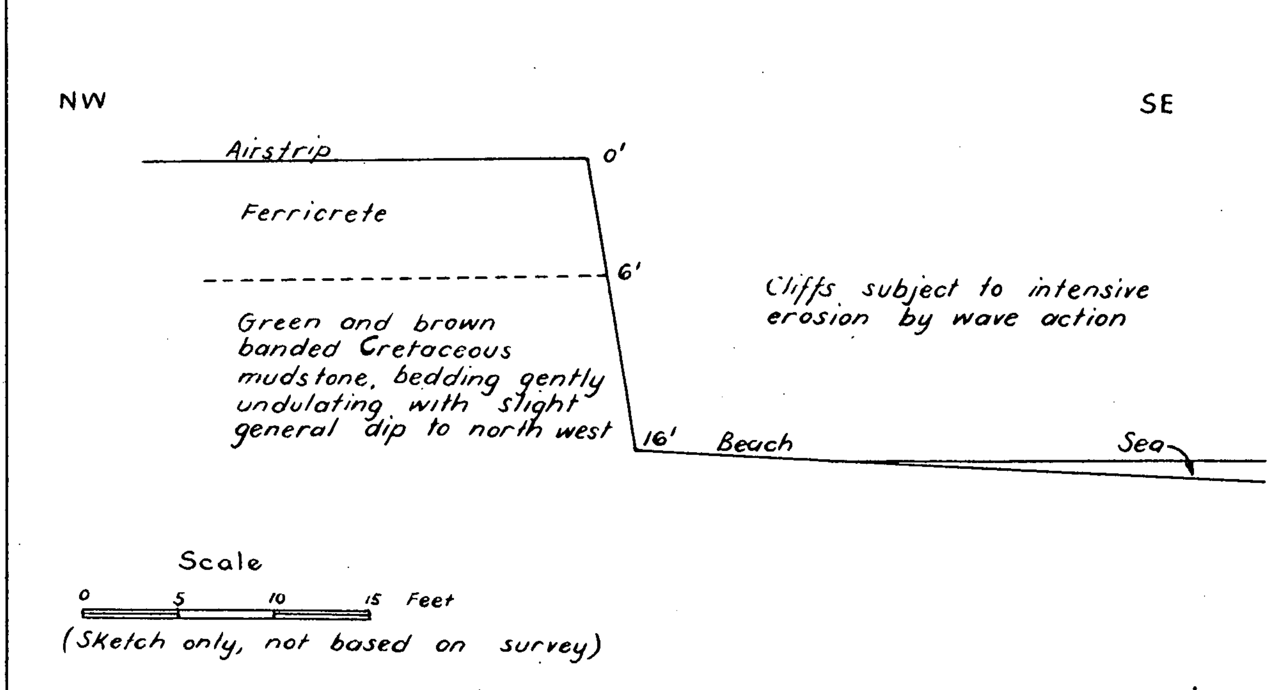
PLATE 3

Bathurst Island Mission



Locality A - Cliff Section



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BATHURST ISLAND MISSION
BATHURST ISLAND N.T.
WATER SUPPLY

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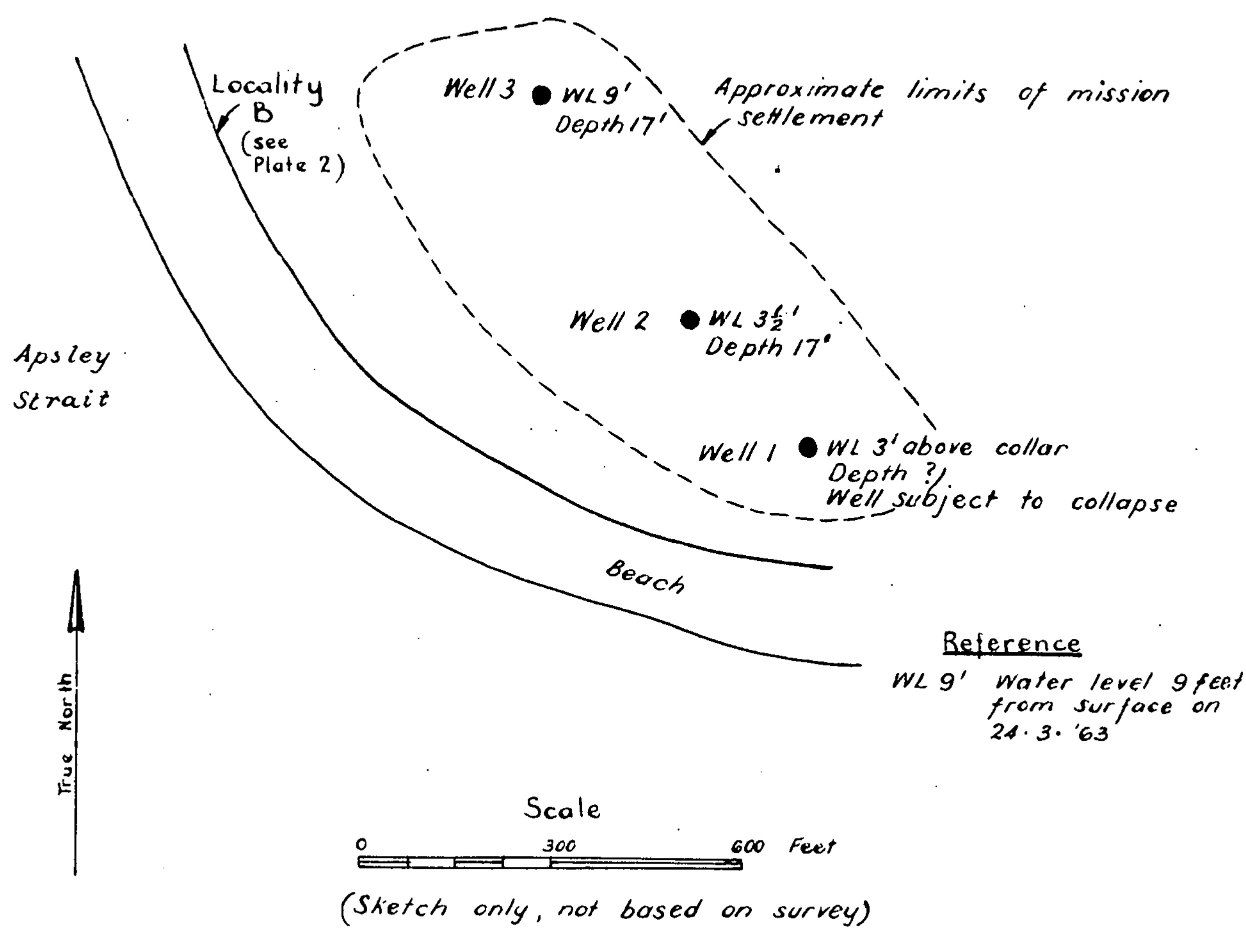
To accompany Record 1964/98

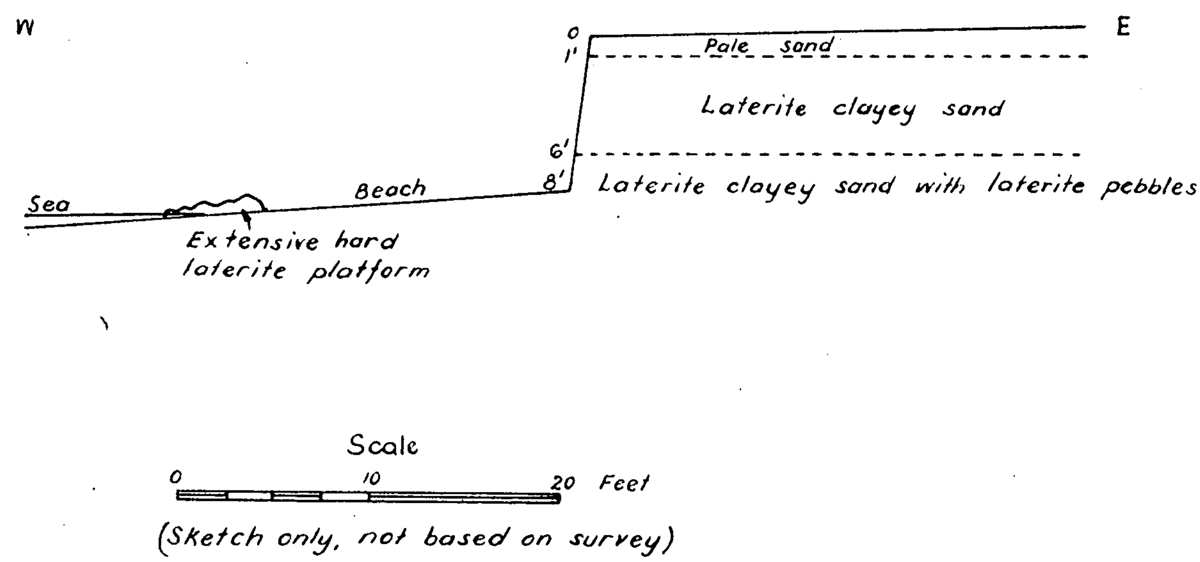
C52/5/DW4

PLATE 4

Paru Mission Settlement



Locality B - Cliff Section



PARU MISSION SETTLEMENT
MELVILLE ISLAND N.T.
WATER SUPPLY

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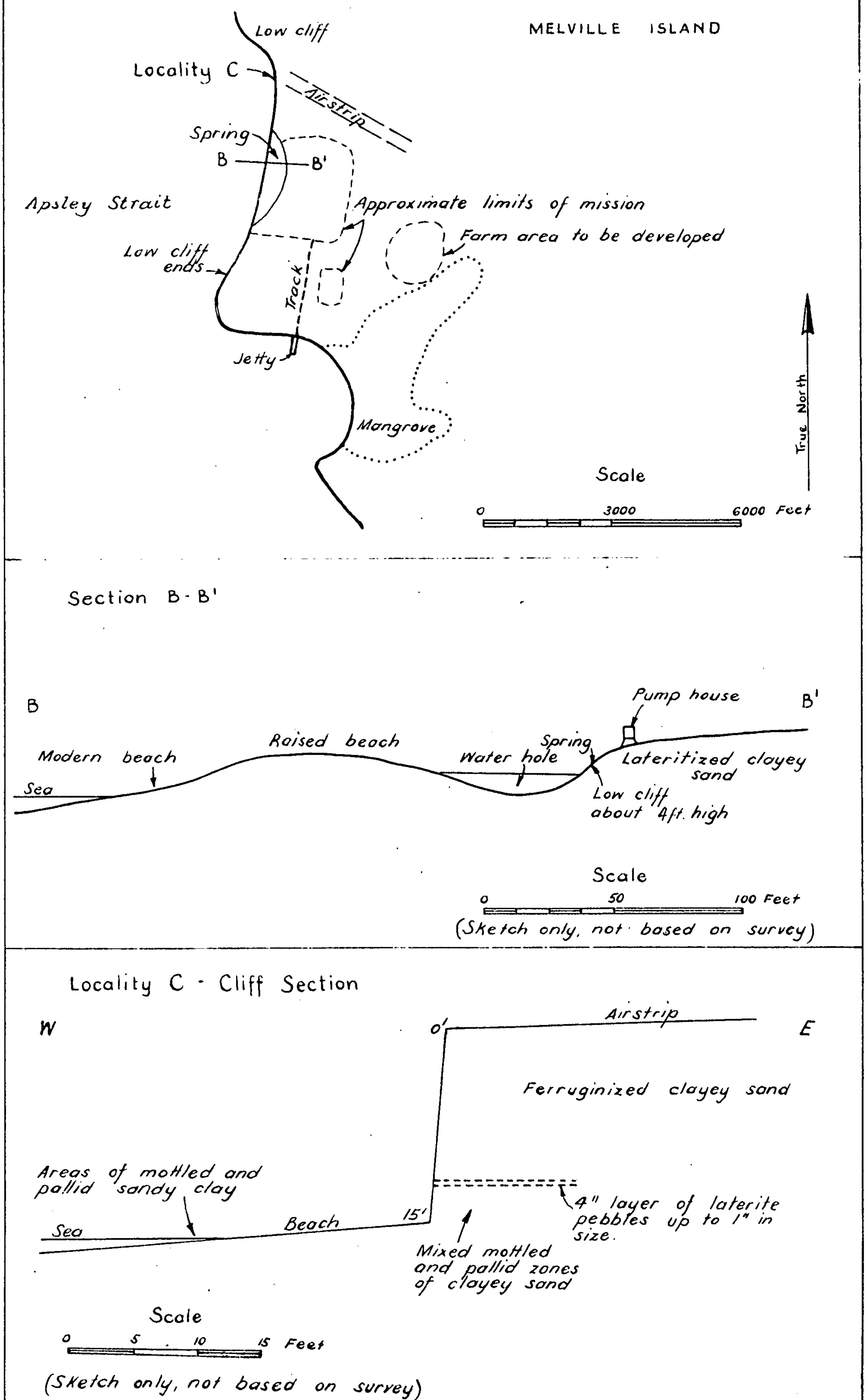
C52/5/DW 5

Garden Point Mission

PLATE 5



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GARDEN POINT MISSION
MELVILLE ISLAND N.T.
WATER SUPPLY

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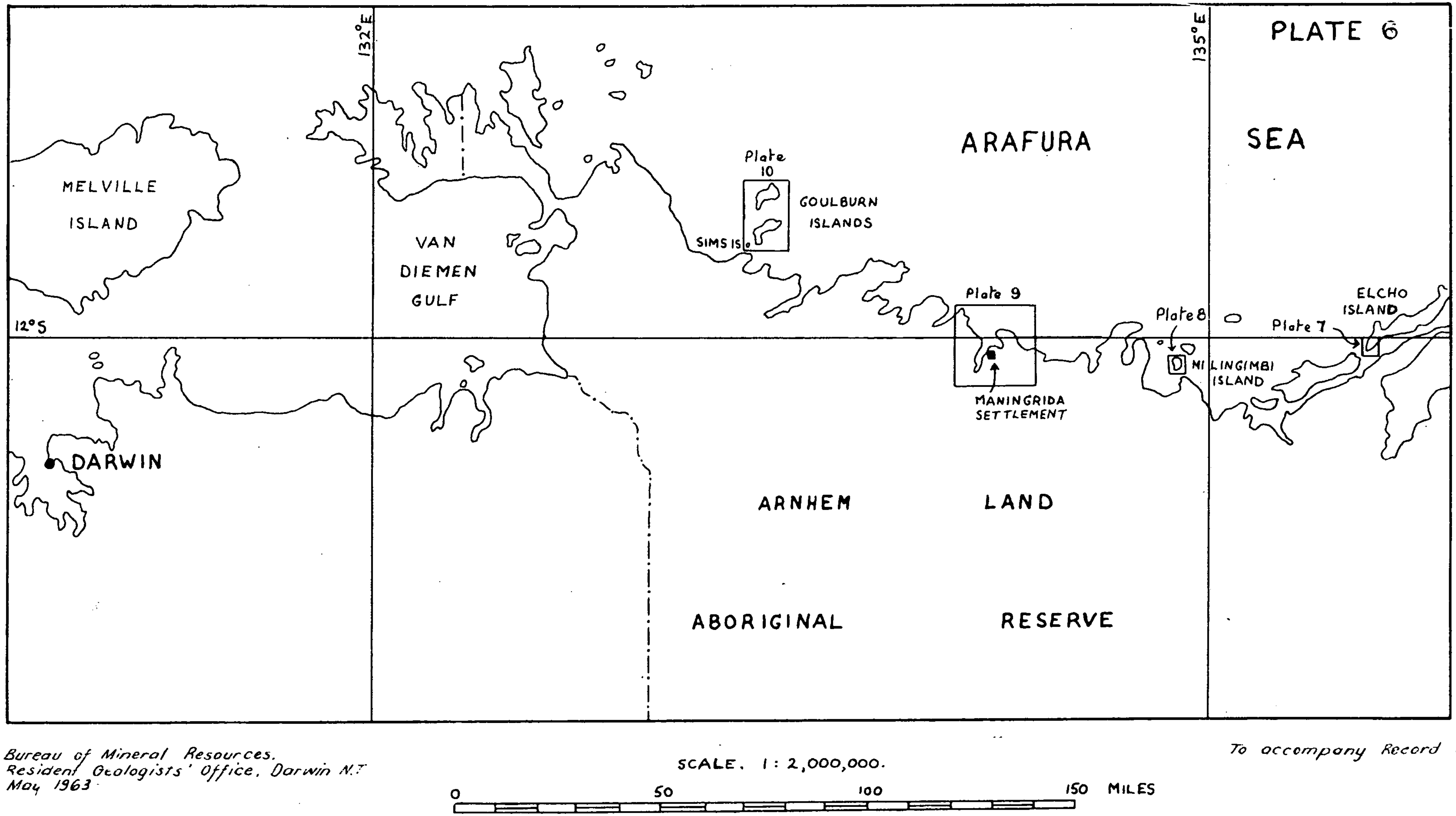
C52/5/DW 6



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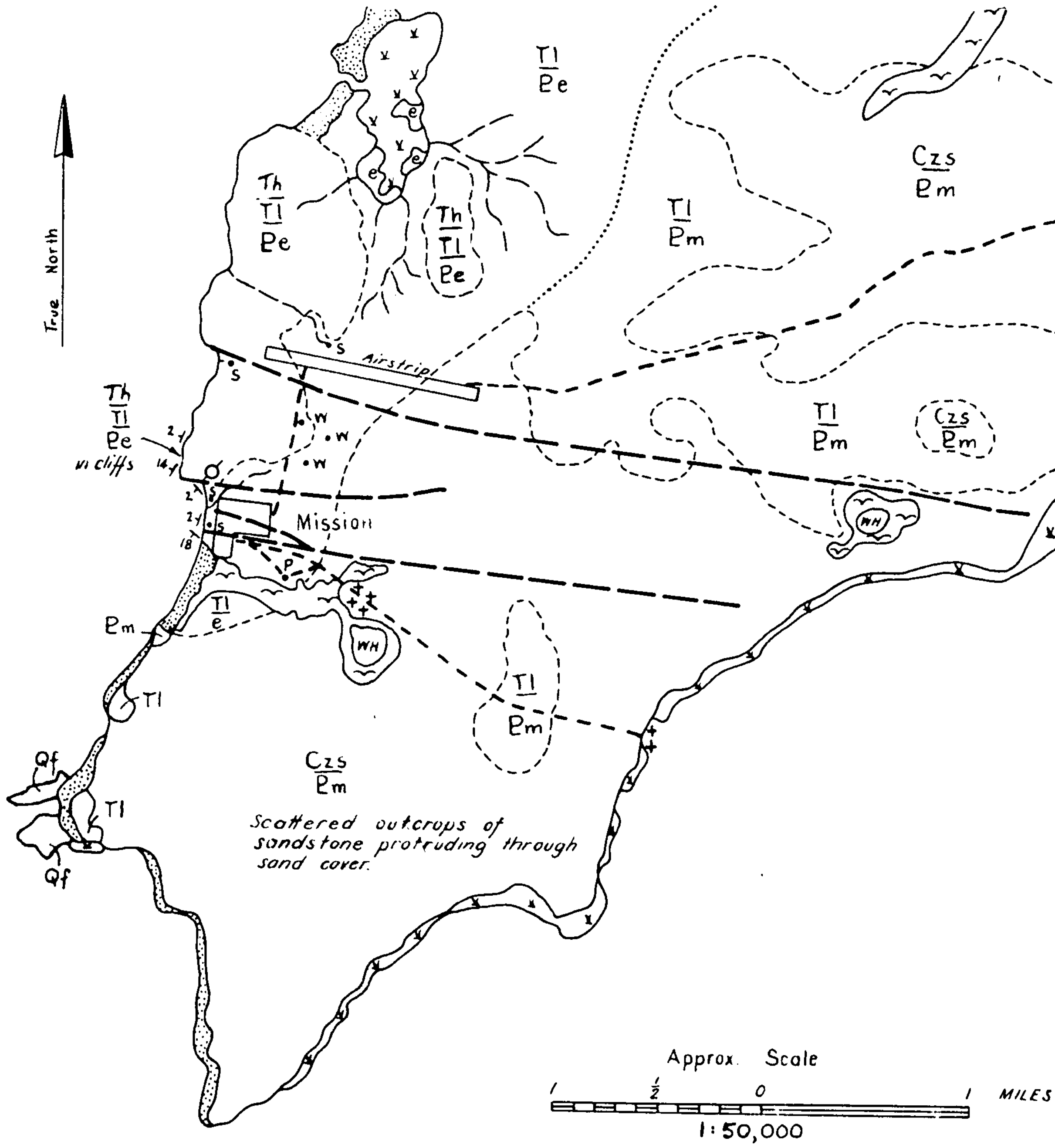
May 1963

To accompany Record 1964/98

LOCALITY MAP. NORTH COAST OF ARNHEM LAND, N.T.



Reference

Recent

Coastal dune sand and beach sand

Mangrove swamps on coastal silt

Evaporite deposits

Alluvium

Quaternary

Qf — Ferricrete

Tertiary

Th — Sandy hematite

Tl — Laterite

Cainozoic

Czs — Sand cover on Marchinbar Sandstone

Proterozoic

Pe — Elcho Island Formation * ferruginous sandstone, micaceous siltstone, glauconitic shale

Pm — Marchinbar Sandstone * thinly bedded to massive quartz sandstone.

Geological boundary definite

" " approximate

" " inferred

Fault

Dip of beds

\+ Outcrop of sub-horizontal Marchinbar sandstone

Seasonal creek

WH Seasonal waterhole

• S Seasonal spring

• W Well

• P Pumphouse

Dry hole (abandoned)

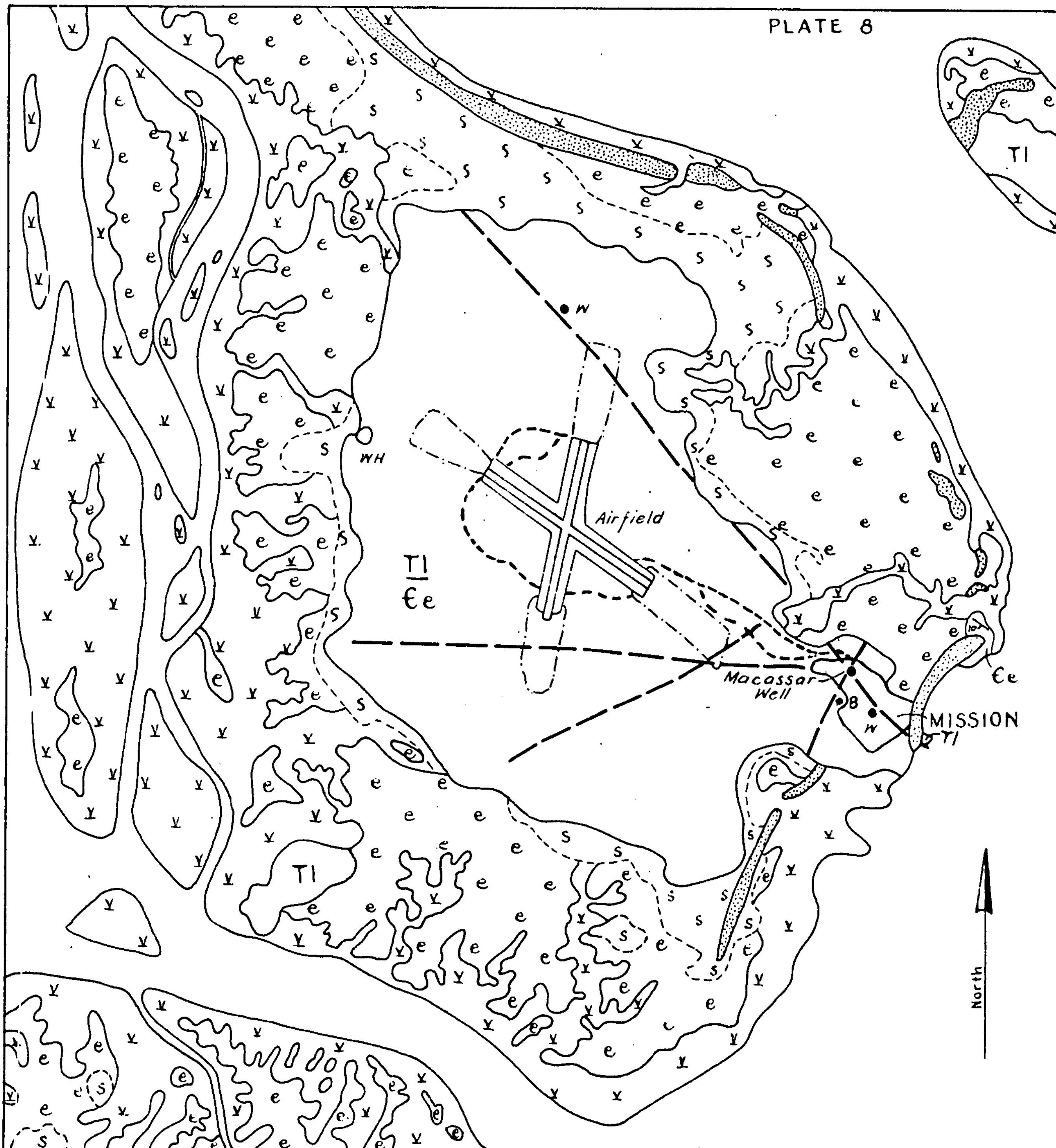
Vehicle track

* Names are defined in a forthcoming Bureau Bulletin

GEOLOGICAL MAP - SOUTHERN END OF ELCHO ISLAND, N.T.

To accompany Record No 1964/98

Bureau of Mineral Resources, Geology and Geophysics. June 1964 C53/A15/6



Reference

Recent

- Dune sand
- Thin layer of outwash soil on evaporite deposits
- Mangrove swamps on coastal silt
- Evaporite deposits

Tertiary

- Tl — Laterite

Lower Cambrian

- Ɛe — *Elcho Island Formation yellow-brown siltstone with white weathering surface.

* Name is defined in forthcoming Bureau Bulletin.

- Geological boundary definite
- " " approximate
- Fault, position approximate
- Dip of beds
- ● W — Well
- ● B — Bore hole
- O WH — Seasonal waterhole
- Boundary of cleared area
- Vehicle track

Approximate Scale

1 ½ 0 1 MILES

1 : 50, 000

GEOLOGICAL MAP - MILINGIMBI ISLAND, N.T.

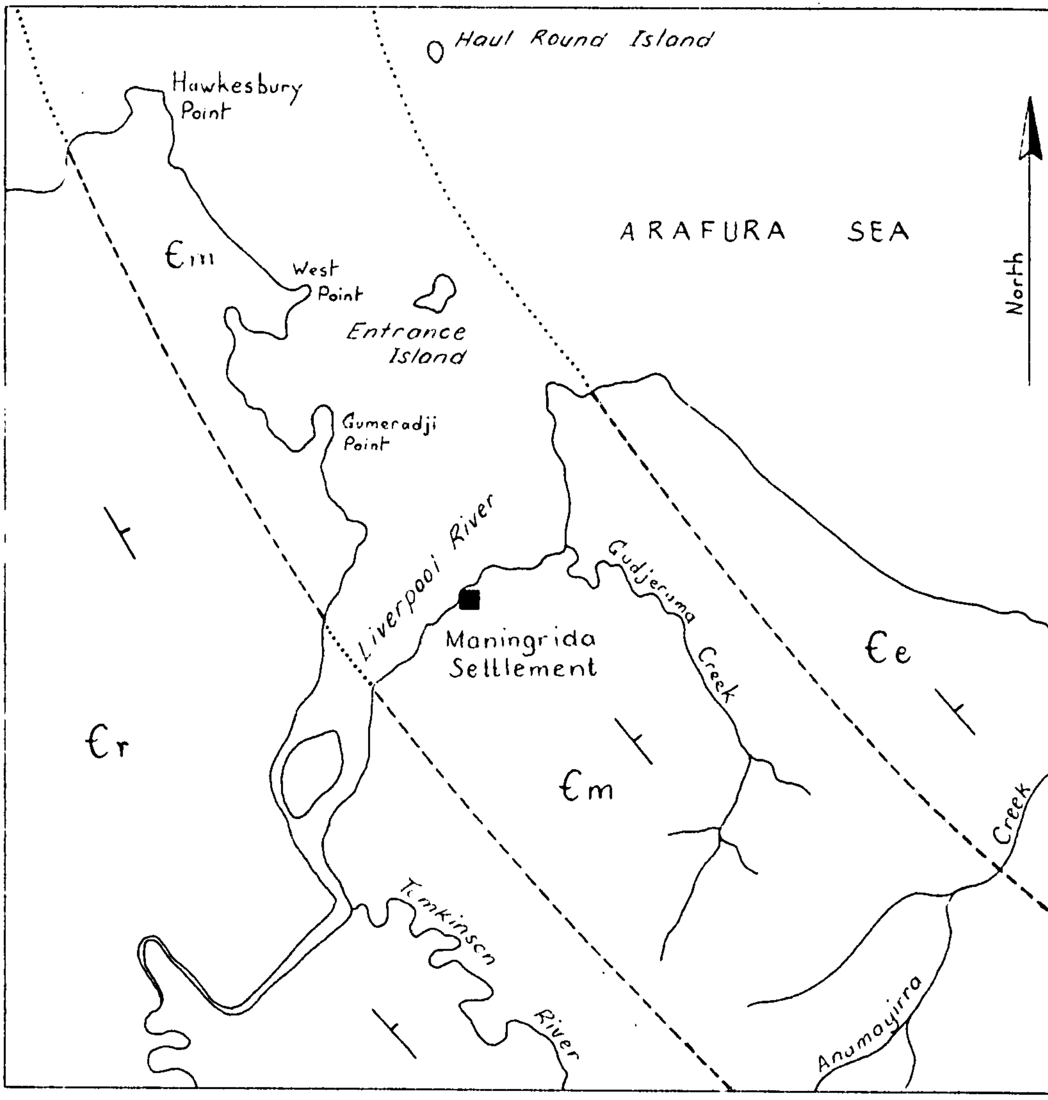
Bureau of Mineral Resources, Geology and Geophysics. D53-2-4.

Bureau of Mineral Resources, Resident Geologists Office Darwin N.T. June 1963

To accompany Record 1964/98

D53/2/DW.3.

PLATE 9



Reference

Єe	* Elcho Island Formation ferruginous sandstone overlain by interbedded ferruginous siltstone and glauconitic shale (Not exposed)
Єm	* Marchinbar Sandstone quartz sandstone
Єr	* Raiwalla Shale grey shale with thin interbeds of siltstone and sandstone.
------	Geological boundary - approximate
....	" " concealed
	Prevailing dip, mean value about 1°

* Names are defined in forthcoming Bureau bulletin

GEOLOGICAL MAP - MANINGRIDA AREA, N.T.

Scale 1:250,000

5 0 5 10 MILES

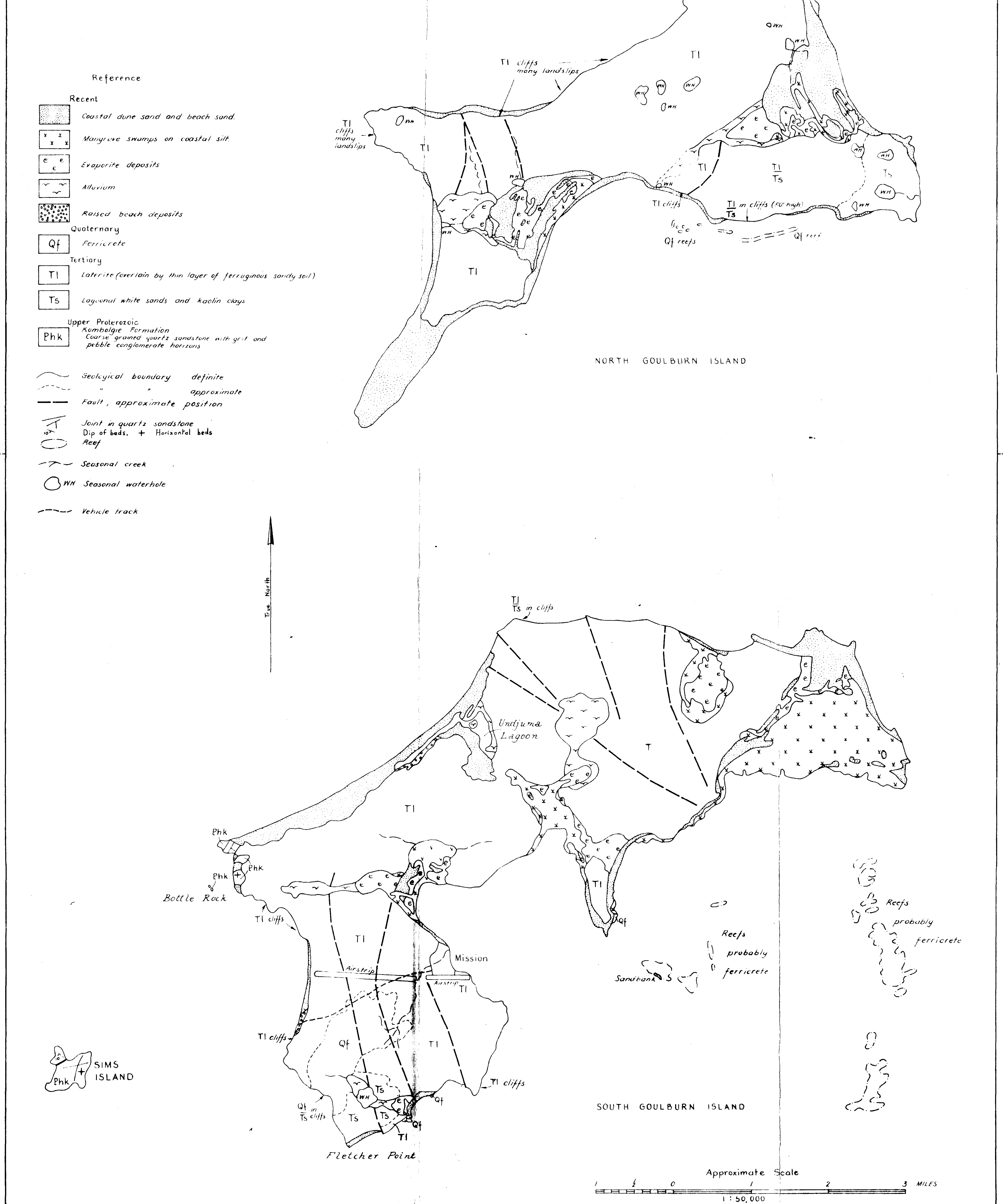
Bureau of Mineral Resources, Geology & Geophysics D53/2/3

Resident Geologists Office, Bureau of Mineral Resources, Darwin June 1963

To accompany Record 1964/98 D53/2/DW.2.

PLATE 10

GEOLOGICAL MAP - GOULBURN ISLANDS, N.T.



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Darwin N.T. June 1963

Bureau of Mineral Resources, Geology & Geophysics C53/13/3

To accompany Record 1964/98 C53/13/DW.1.

PLATE 11

MALAY BAY · MURGENELLA CREEK AREA N.T.

Fig. 1 Locality Map (See also Figure 2)

Fig. 2 Sketch Map showing access tracks and areas investigated in detail (PLATE 12)

Fig. 2

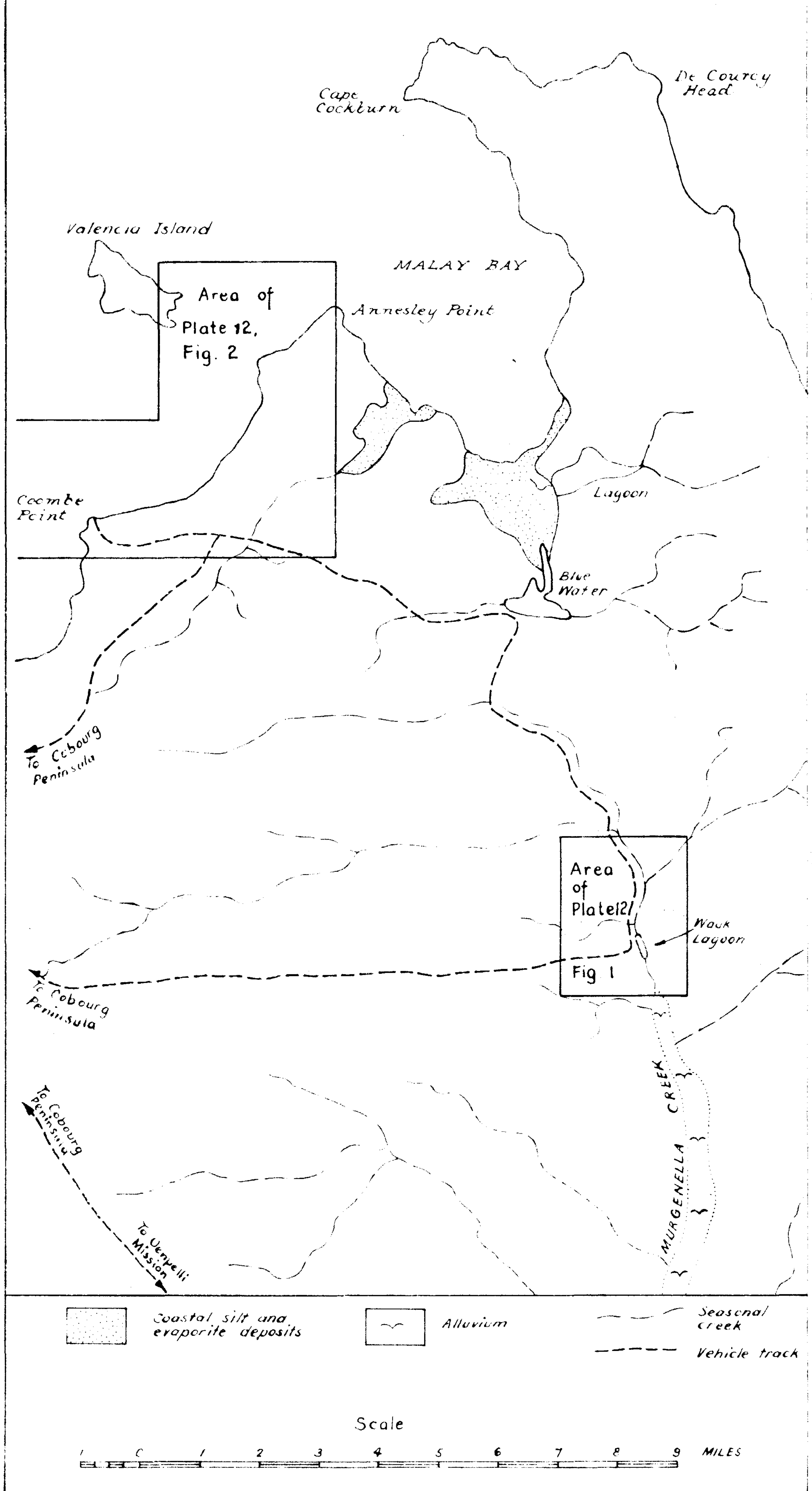
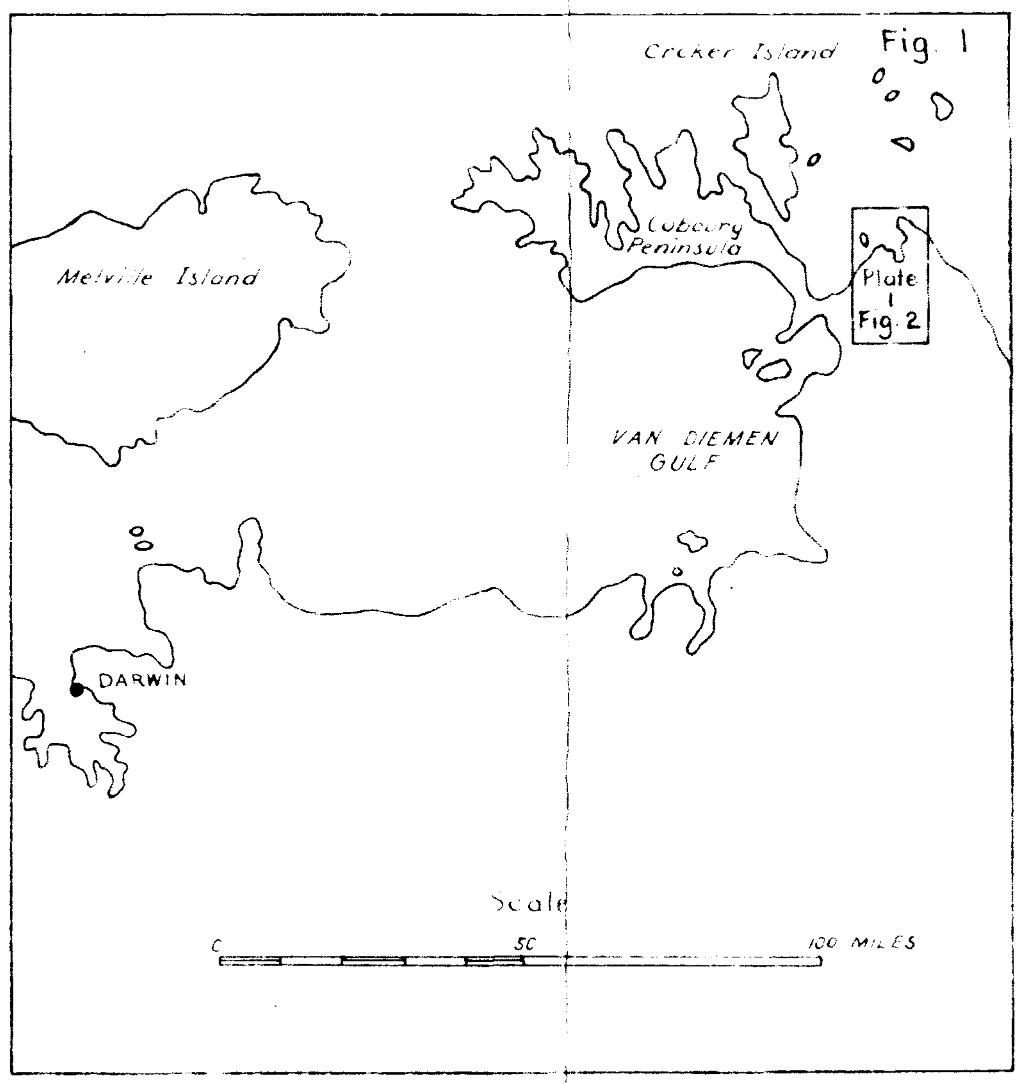


Fig. 1



Bureau of Mineral Resources Geology and Geophysics C53/13/1
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C53/13/DW.2.

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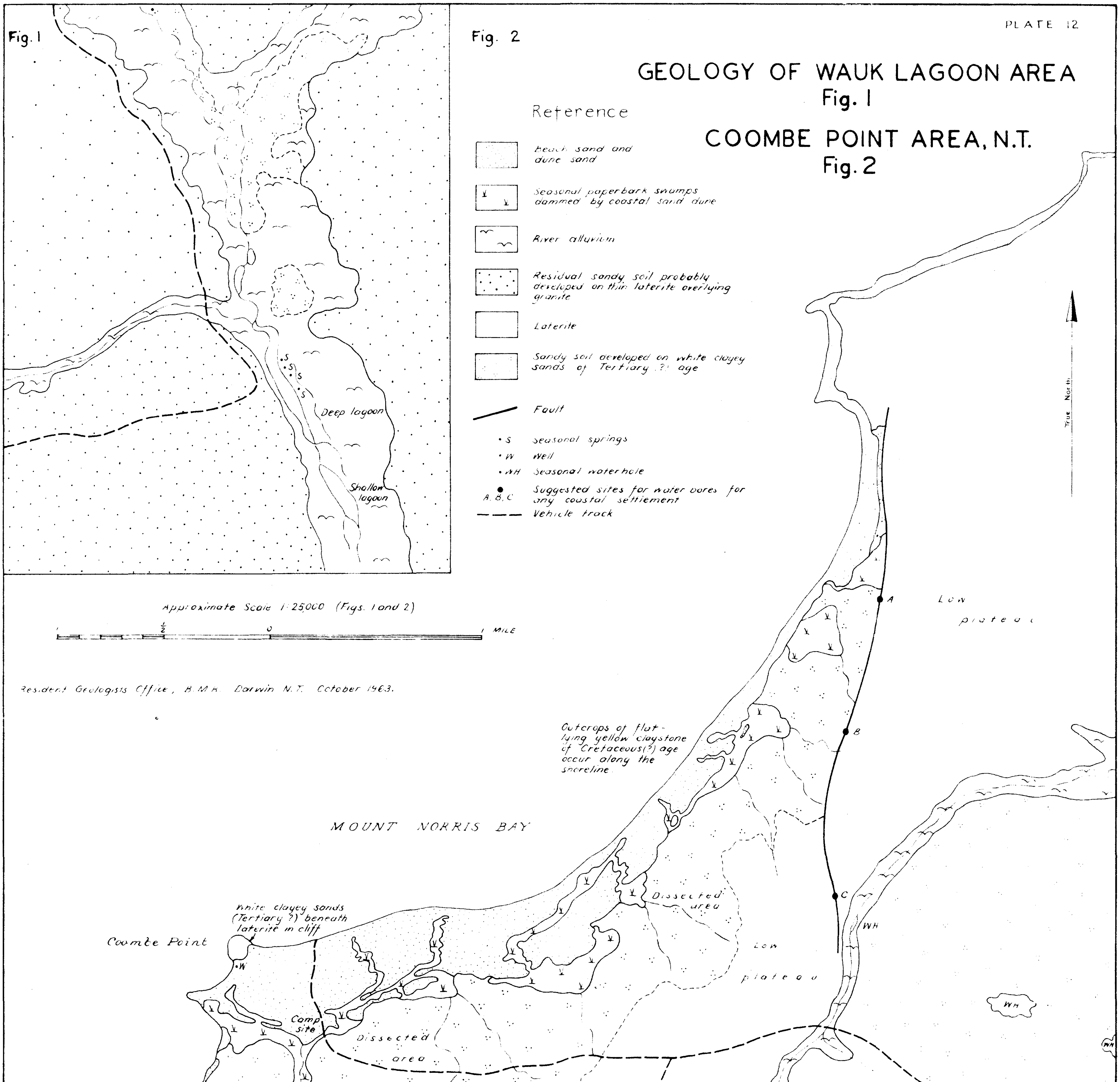

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