NORTH STRADBROKE ISLAND

by **J.W. Laycock**

(with 3 Text-figures)

ABSTRACT. The islands bordering Moreton Bay to its east are vegetated dunes formed during a past period of intense wind activity. Aeolian sand, as indicated by drilling, occurs to considerable depth below sea level. There is also evidence of sub-aerial weathering in bedrock samples and this implies subsequent drowning of the land surface. The occurrence of colouration (red, brown, grey) in much of the dune mass is thought to be due to decomposition of some of the disseminated heavy minerals – the older more leached dune sand being quite white in appearance. Of particular interest is the occurrence within the dunes of white argillaceous and black humate cemented sands, which have formed at the groundwater surface on interception of downward percolating products of leaching.

INTRODUCTION

North Stradbroke Island, about 40 km east of Brisbane, is one of a group of massive dune islands which occur off the southeast coast of Queensland. The island is the main centre in southeast Queensland for the production of the heavy minerals rutile, zircon, monazite, and ilmenite, and also for the production of silica sand. The island is also a groundwater reservoir for large quantities of fresh water and for many years it has been considered as a potential water supply for Brisbane. Numerous aspects of North Stradbroke Island including its flora, fauna, soils, mining, hydrogeology and land use have been discussed in Stevens & Monroe (1975). The hydrogeology is described in detail in Laycock (1975). The sedimentological history of these dunes is complex, however, it is likely that careful study will reveal past episodes of relative sea level changes and perhaps climatological changes.

PHYSIOGRAPHY

North Stradbroke Island forms the eastern boundary of the southern part of Moreton Bay. Its northern extremity is located about 29 km from the mainland, but the southern end is only 5 km from the mainland, and separated from it by a number of islands with intervening channels averaging 0.8 km in width. The island, comprising 285 km^2, is about 32 km long and 11 km in maximum width at the northern end. It is mainly formed by a series of massive transgressive dunes with northwesterly trending ridges, which rise to 219 m at Mount Hardgrave, about 5 km east of Dunwich. Rocky headlands mark the northeastern extremity of the island at Point Lookout, and occur also at Dunwich on the western side. The eastern and

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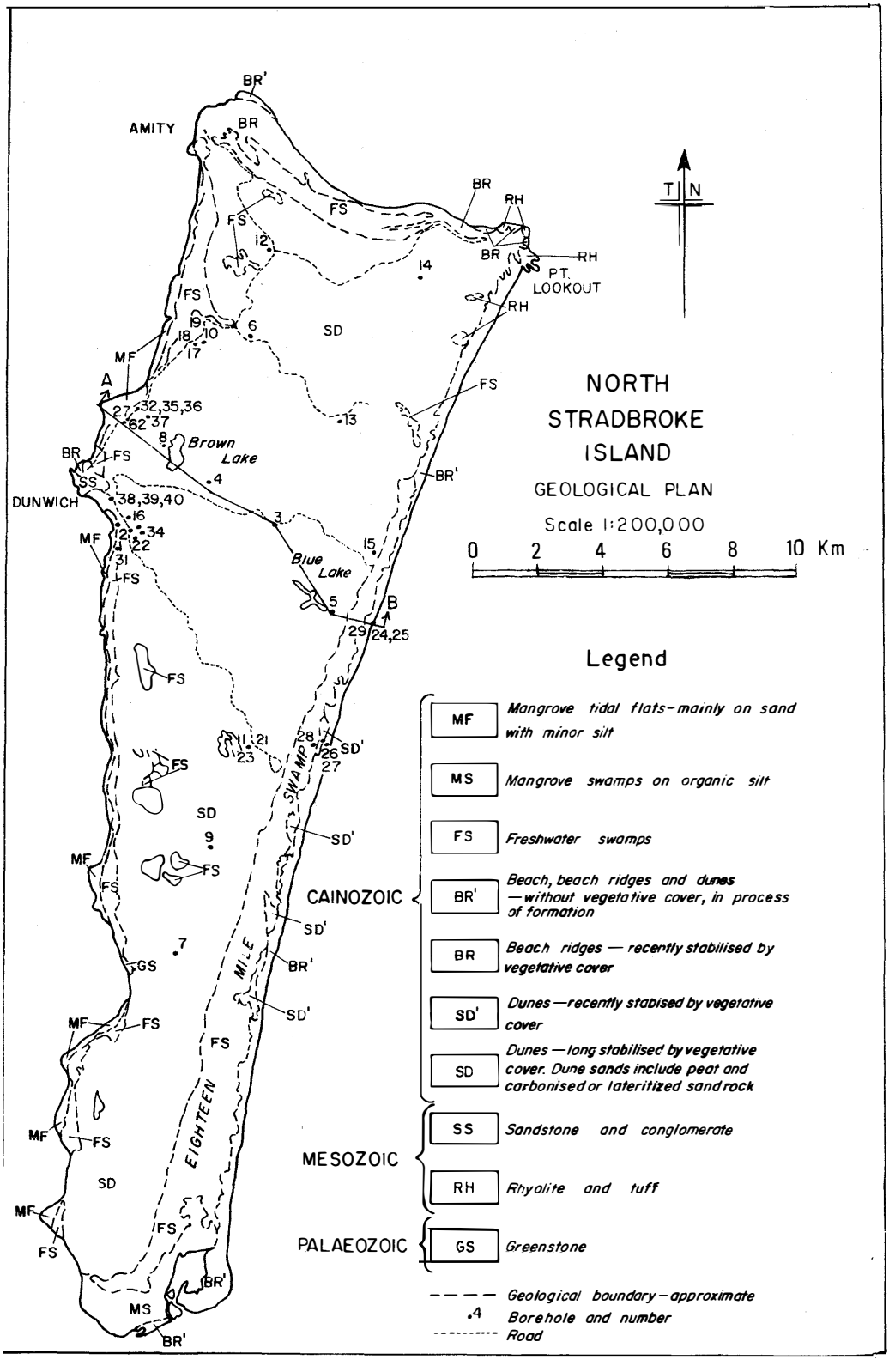


Text.-fig. 1 Geological plan of North Stradbroke Island.

northern coastlines are wave-washed; the western side is relatively wave-protected.

Peat swamps occur around the perimeter of the high dunes of the island, the largest being Eighteen Mile Swamp on the eastern side. Transgressive dunes occur along its eastern edge. A wave-cut escarpment separates the Eighteen Mile Swamp from the vegetated high sand dunes.

Several freshwater lakes occur on the island, the best-known being Brown Lake and Blue Lake. Freshwater drainage can be seen at numerous places on the island as surface flow. Freshwater Creek in the Eighteen Mile Swamp intercepts water from several easterly flowing streams and from spring lines on the eastern escarpment. The flow in Freshwater Creek is towards the south where it enters the sea at Swan Bay. There is no barrier to the swamps on the western side of the island; freshwater entering these swamps passes directly into Moreton Bay. Drainage on the western side of the island is via Yerrol Creek, Capembah Creek, Aranarawai Creek, Cooroon-Cooroonpah Creek, Myora Springs and also a number of other unnamed creeks south of Dunwich.

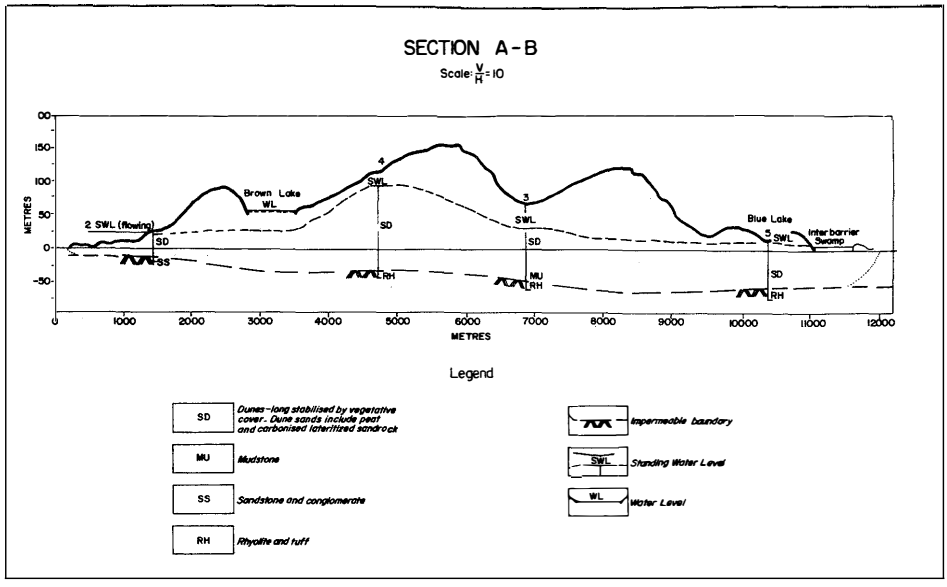
GEOLOGY

North Stradbroke Island is formed predominantly of unconsolidated Cainozoic sediments. However, rocks are exposed at Point Lookout, immediately to the south of Point Lookout at Dunwich, and at the southwest of the island near Canaipa Passage (Text-fig. 1). The stratigraphic and geomorphic succession is indicated in Text-fig. 1. The oldest exposed rock is a Palaeozoic greenstone which crops out in the southwest near Canaipa Passage. These phyllitic rocks are composed of epidote, actinolite, and albite; they may be equivalent to the Palaeozoic Rocksberg Greenstone of the Brisbane area (Cranfield *et al.* 1976). At Point Lookout and about 5 km to the south, rhyolite and rhyolitic tuff crop out. The rocks are white to greenish, fine-grained, and commonly fluidal. The steep cliffs at Point Lookout are composed of this hard and durable material.

Mesozoic cross-bedded sandstones crop out at Dunwich on the western side of the island. This occurrence has been referred to the Woogaroo Sub-Group by Cranfield *et al.* (1976). The outcrops are deeply weathered, and the lateritised clayey sandstone is used for road construction on the island.

The main body of the island is composed of stabilised dune sand of uniform composition. The sand is well sorted and subrounded; it consists of quartz grains (making up 90-99 per cent) together with minor concentrations of the heavy minerals rutile, zircon, ilmenite, monazite, magnetite, garnet, and rock particles. The uppermost organic layer of the sand supports a dense vegetation of eucalypts, banksias, acacias and tea-trees.

Grainsize distribution analysis of samples from bores to bedrock indicate marked similarity at all levels and suggests that all the sand mass above the prior bedrock surface is of aeolian origin. The sand core of the island has accumulated during periods of lower sea level, and of intense and persistent winds. The direction of the prevailing winds is evidenced by the



Text-fig. 2 Section across North Stradbroke Island showing water level.

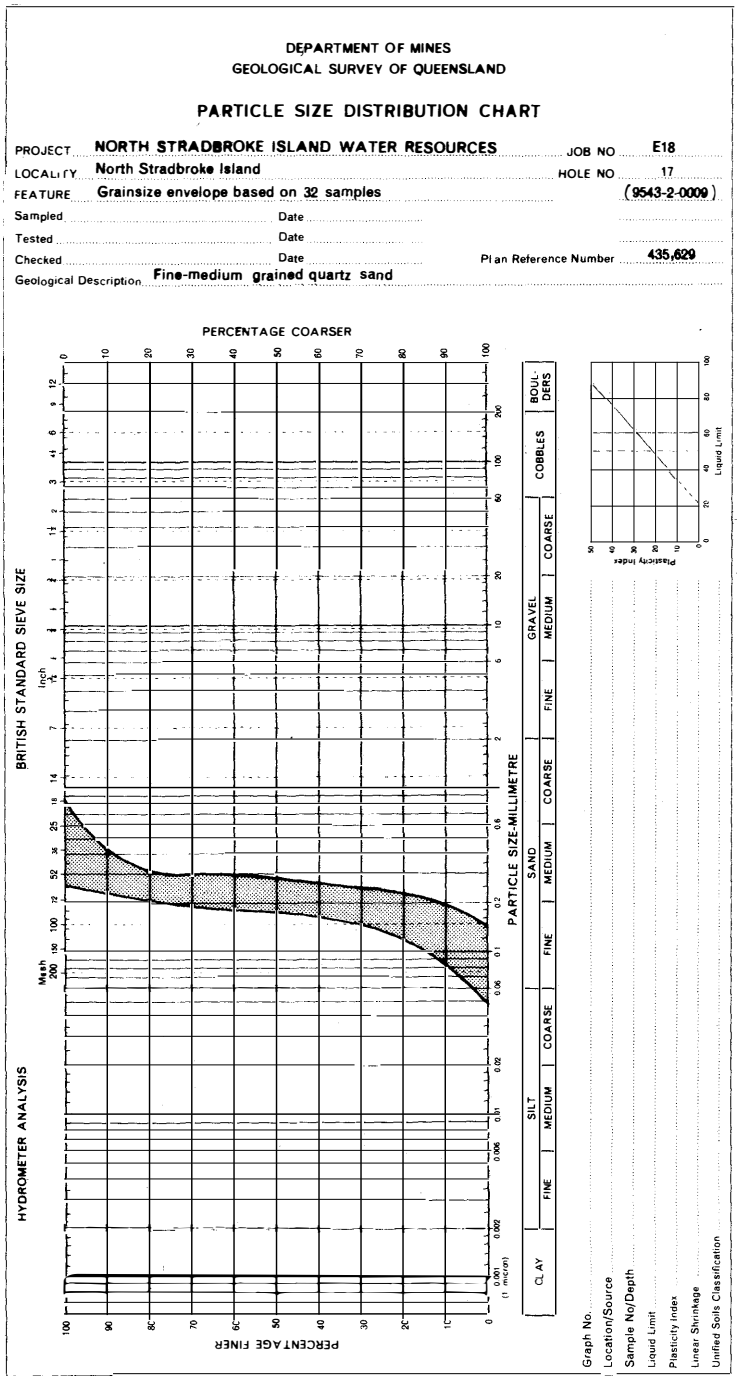
elongation of dune ridges in a north-northwesterly direction. The sand is continuous to 90 m below sea level. A typical grain size envelope is shown on Text-fig. 3.

The grainsize parameters range as follows for many samples:-

Graphic mean	1.6 Ø	to	5.64 Ø
Inclusive graphic standard deviation	0.21 Ø	to	1.89 Ø
Inclusive graphic skewness	−0.5	to	0.97
Graphic kurtosis	0.51	to	3.95

extreme values are generally anomalous.

Drilling has often revealed wide colour variations in the finer sized particles (red, yellow, brown, grey, black, and white). Sand mining has disclosed hard ferruginous (ironstone) layers and in places a nodular horizon forming part of an ancient soil profile. Highly carbonaceous sandrock (humate cemented sand) is associated with the dune sand and can be seen on the western side of the Eighteen Mile Swamp, particularly at the eastern end of the bitumen road which crosses the island to the east of Dunwich. Other occurrences of the carbonaceous sandrock are known; a sample described



Text-fig. 3 Particle size distribution chart

by Cookson & Pike (1954) from the north of the island indicated a Pliocene or younger age on the basis of its pollen flora.

The colouration of the dune sand is thought to be due to decomposition of disseminated heavy minerals. Continual leaching of such sand eventually results in a very white sand. Of particular interest is the occurrence within the sand mass of a layer of white argillaceous sand which was originally intersected in bore 16 between 40.5 and 50.3 m (from RL 34.97 at the top of the layer). This layer has subsequently been found to be extensive and is probably continuous between bore 16 and the vicinity of Brown Lake. The layer is thought to have formed by deposition of the leached products of weathering at the watertable. Subsequent to its formation the layer has acted as a barrier to downward percolating water and a perched aquifer has been formed. Drilling on the east coast has indicated the presence of a gravelly horizon on one bore.

The minimum age of burial of the Mesozoic bedrock surface has been determined by radiocarbon dating of a banksia cone as >37 000 years B.P. (Hekel, pers. comm.). The sample (SUA-477) was obtained from the top of a soil profile 12 m below low water datum near Myora Light.

Younger vegetated dunes occur on the eastern side of the island. These dunes are of parallel type and are also characterised by north northwest trending ridges; they were formed as blow-outs from earlier foredunes or beach ridges. The composition of the younger vegetated sand dunes is similar to the main island mass in that the dunes are composed wholly of quartz particles of similar grainsize with minor heavy-mineral concentrations. Ferruginous layers and carbonaceous sandrock have not been recognised in this unit. Associated with the vegetated longitudinal dunes, are some vegetated beach ridges. Both types of deposit have been extensively mined for their heavy minerals. The succession of vegetated beach ridges near-parellel to the present coastline in the north of the island indicates a prograded shore.

Beach sands, dunes, and beach ridges form the eastern coastline of the island and are subject to formation and erosion at the present time. The beach sand consists essentially of quartz grains of slightly larger mean diameter than those characteristic of the dunes. This beach sand, which contains the highest concentration of heavy minerals, has been extensively mined. Other features also in process of formation today are the mangrove muds in wave-protected areas on the west coast and in estuaries, and the freshwater swamps resulting from accumulation of fine-grained particles and organic material at numerous locations overlying the high dunes.

HYDROGEOLOGY

Groundwater occurs on North Stradbroke Island as a lenticular body, filling the pores between the sand grains which form the lower part of the island mass. The water mound has built up over a period of time by the combined effects of rainwater excess, the permeability of the sand mass, and the higher density sea water barrier. The groundwater surface conforms generally with the natural surface, and at places where spring-lines occur swamps have developed. Freshwater swamp has formed in this manner

following the formation of an off-shore bar, and seepage from the toe of the eastern escarpment. The maximum elevation of the potentiometric surface is about 60 m above sea level, and the gradient of the potentiometric surface towards the coast is about 1 in 65. Configuration of the groundwater and bedrock surfaces are shown in Text-fig. 2 (cross-section A-B of Text-fig. 1). The permeability of the main body of the island is sufficiently high for most rainfall to pass rapidly below the surface. During periods of intense precipitation, surface runoff occurs only at a few localities, where vertical permeability has been reduced significantly by overlying or admixed organic material as in the swamps. The location of the watertable and the permeability of the sand have been shown to have some effect on the morphology of the island. Complete absence of the fluvial activity is of particular interest.

Lakes on the island occur either as a result of perching of groundwater due to the retardation of downward percolation of precipitation excess by a layer of relatively low permeability, or as a watertable window. Blue Lake is the only lake known to be of the latter type.

Brown Lake has a surface area of 250 000 m^2 (25 ha) and a maximum depth of 6.4 m; its volume has been calculated as 770 000 m^3. It is completely surrounded by higher slopes and no surface stream outflow is associated with it. Blue Lake has a surface area of 73 000 m^2 (7.3 ha) and a maximum depth of 9.4 m; its volume is 436 000 m^3.

Measurements of the water levels on Blue Lake and Brown Lake over a number of years (Laycock 1975) indicate that while the level of Blue Lake remains constant (within 0.44 m), the level of Brown Lake over the same period has fluctuated over a range of 3.49 m due to the evaporation-rainfall relationships.

MINING

Three sand mining companies operate on the island; Associated Minerals Consolidated Ltd, Consolidated Rutile Ltd, and Australian Consolidated Industries Ltd. Associated Minerals Consolidated Ltd operates a dredge on the eastern side of the island. Primary gravity separation concentrates the heavy mineral as the dredge advances in the dredge pond. The heavy mineral concentrate is dumped adjacent to the working area, and it is transported later by truck for secondary concentration and heavy mineral separation at the Dunwich plant. The separation involves gravity, electromagnetic, and electrostatic processes. The separated ore is bagged or trucked in bulk on vehicular ferries to the export terminal in Brisbane. Consolidated Rutile Ltd. operates primarily on low grade heavy mineral occurrences in high dunes. This company mainly uses dry mining methods with buried loaders. The sand, fed to conveyor belts at a rate of 540 m^3/h, is slurried and pumped to the primary concentrators where gravity and electromagnetic separators produce a heavy mineral concentrate which is trucked to Dunwich for transport by barge to dry-mill operations at Meeandah, near the mouth of the Brisbane River.

The ilmenite concentrate in both company operations is generally

stockpiled. At present the relatively high chrome concentration in the ilmenite inhibits its use for the production of titanium dioxide for pigments. Some ilmenite is sold for refractory purposes, however. Australian Consolidated Industries Ltd. mine silica sand for use in glass production. The sand is extracted by scraper and shipped from Dunwich by barge to Brisbane.

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