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Coffs Harbour coastal planning study.

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WORKING PAPER 2

Geology

NSW Planning & Environment Commission
Grafton Office
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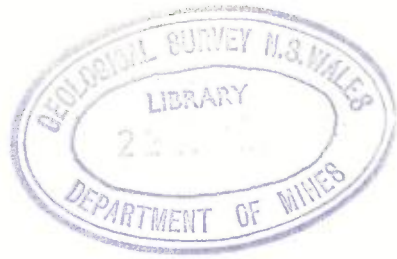
79/2

COFFS HARBOUR COASTAL PLANNING STUDY

Working Paper 2: GEOLOGY

Prepared by P.A. Mitchell



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79/2
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FOREWORD

This paper is the second in a projected series of fifteen arising from the Coffs Harbour Coastal Planning Study initiated by the State Government to assist in the formulation of the Coffs Harbour Sub-regional Environmental Plan.

It describes the geology of the Study Area, identifying economically significant resources and discussing foundation conditions.

The Government recommends a reading of all papers in the series to those interested in environmentally sound management of the coastline.

ERIC BEDFORD

Minister for Planning and Environment

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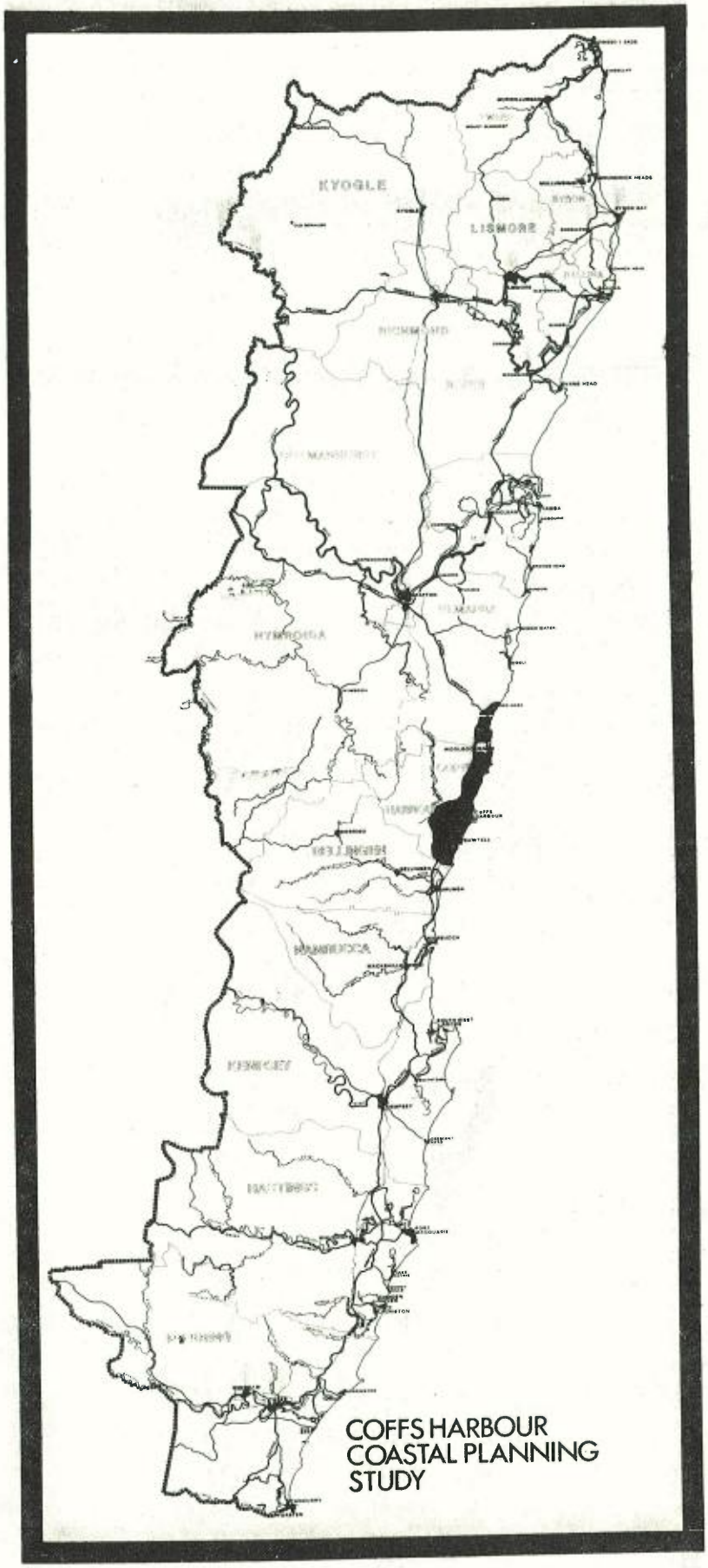


LOCATION MAP

MAP 1

A. THE GEOLOGY OF THE STUDY AREA

The regional geological setting comprises a sequence of metamorphic rocks with minor igneous intrusions which together form the basement. This basement is overlain in the valleys by unconsolidated alluvial sediments of silt, sand and gravel. Along the coastal zone embayments between basement rock headlands are infilled with a sequence of predominantly marine sand deposits. These unconsolidated deposits cover almost 30% of the study area.

The basement rock assemblage of metamorphic rocks originally consisted of thinly bedded shales and siltstones with some coarser grained sandstones. These rocks have, however, undergone possibly two phases of metamorphism with consequent changes in lithology and structure.

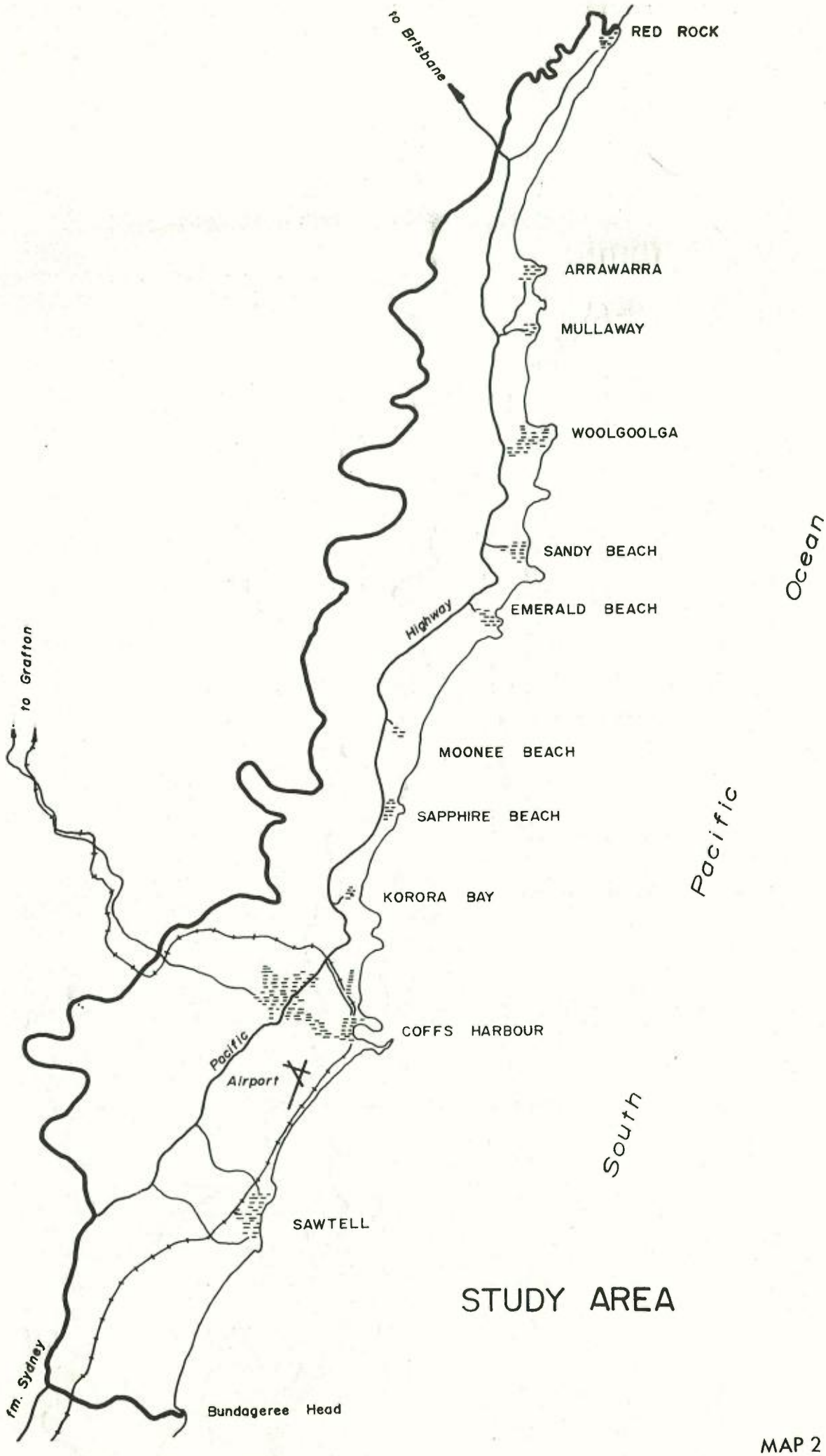
The rocks occurring to the south of a major east-west structural break, the Crossmaglen Fault running south of Sawtell, are known as the Nambucca Phyllites. Lithologically this unit consists of phyllite, slate and minor sandy argillites.

Immediately to the north of the fault, in the Sawtell - Coffs Harbour area, is the Brooklana Formation. This unit consists of siliceous argillite and slate with rarer greywacke. The argillites are dark coloured and highly cleaved, occurring in beds from a centimetre to several metres thick and are interbedded with lighter coloured, more siliceous rocks which may be finely laminated.

To the north of a line running from Lowanna to Coffs Harbour there is a zone of rocks known as the Coramba Beds. These rocks appear to have generally undergone a lower grade of metamorphism than those to the south, and the original lithology and bedding structures are readily identified.

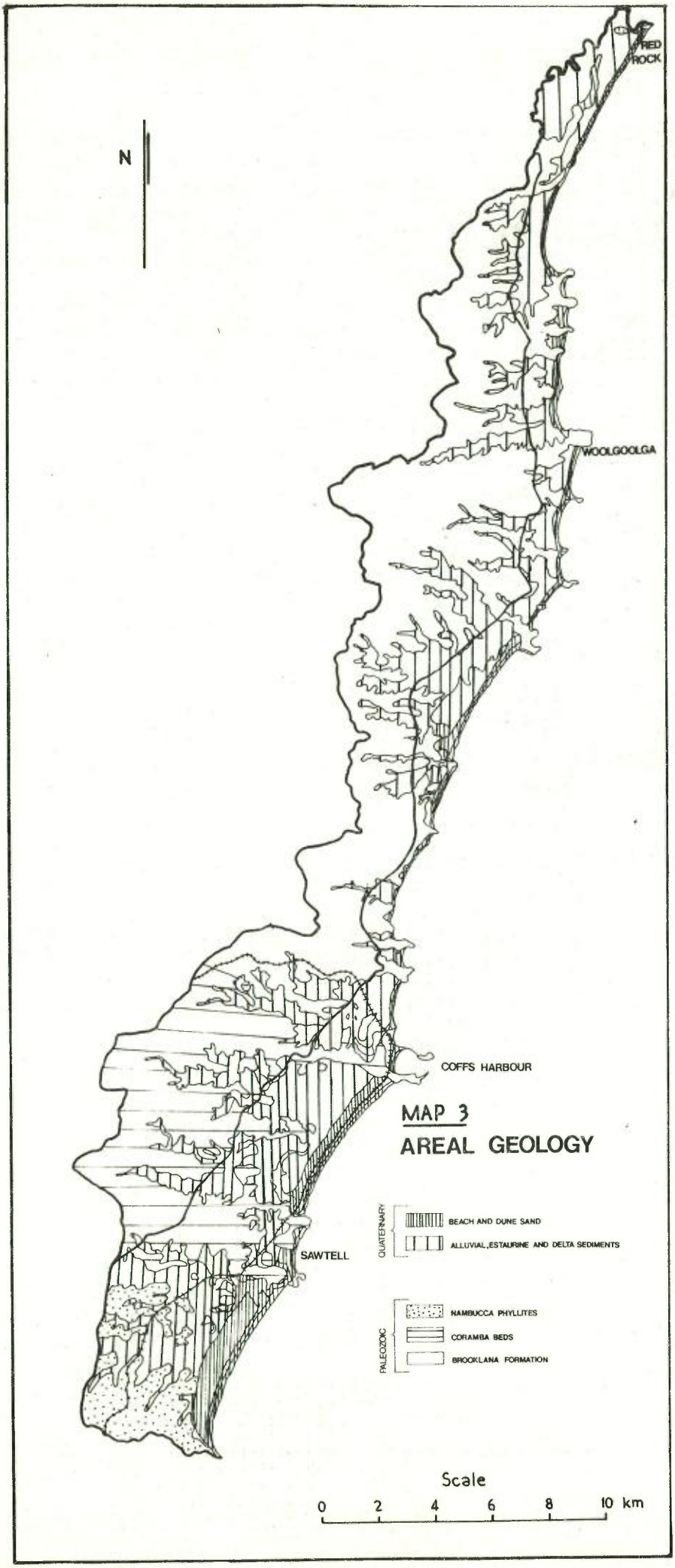
The Coramba Beds consist of greywacke, slate and siliceous argillite, with calcareous siltstone and acid and basic volcanics present in small quantities. Within this unit there are a number of distinctly different outcrops. In the vicinity of Woolgoolga massive hornsfelsic rocks similar to those in the Coffs Harbour district are present. At Red Rock, an outcrop of rock known as the Redbank River Beds occurs. This rock is of red to white colour and consists of well bedded jaspers and cherts, interbedded with an altered basaltic lava. In the Emerald Beach area there is a small outcrop of slightly porphyritic medium grained adamellite, known as Emerald Beach adamellite.

Quaternary sediments are of both Holocene and Pleistocene age. They consist of marine, estuarine and fluvial sediments, specifically including alluvium, barrier beach and dune sand, beach gravel and back barrier muddy sand.



STUDY AREA

MAP 2


N
RED ROCK
WOOLGOOLGA
COFFS HARBOUR
SAWTELL
MAP 3
AREAL GEOLOGY
QUATERNARY
BEACH AND DUNE SAND
ALLUVIAL, ESTAURINE AND DELTA SEDIMENTS
PALEOZOIC
NAMBUCCA PHYLLITES
CORAMBA BEDS
BROOKLANA FORMATION
Scale
0 2 4 6 8 10 km

The alluvium is varied but is mostly comprised of fluvial clay, silt sand and gravel. Back barrier deposits are found in areas that were originally estuarine lagoons but became gradually filled with sand blown in from the barrier dunes and alluvial material washed in by creeks.

Significant variation occurs in the Quaternary deposits from place to place. The alluvial deposits along Woolgoolga Creek consist of clay, up to nine metres thick, containing some irregular sand and gravel lenses. It is considered that similar conditions probably exist in alluvial flats along Pine, Boambee, Bonville and Moonee Creeks and most other alluvial areas along the coast.

The Pleistocene estuarine beach barrier deposits underlie the flat heath plains behind Boambee, Park and Moonee Beaches and probably also Corindi Beach. The eastern part of this unit generally consists of washover fan sand, one to three metres thick, overlying one metre of tidal channel estuarine sand, in turn overlying up to four metres of estuarine fine muddy sand and estuarine mud basin clay. In the western portion of this unit it is likely that the clay subunit would dominate.

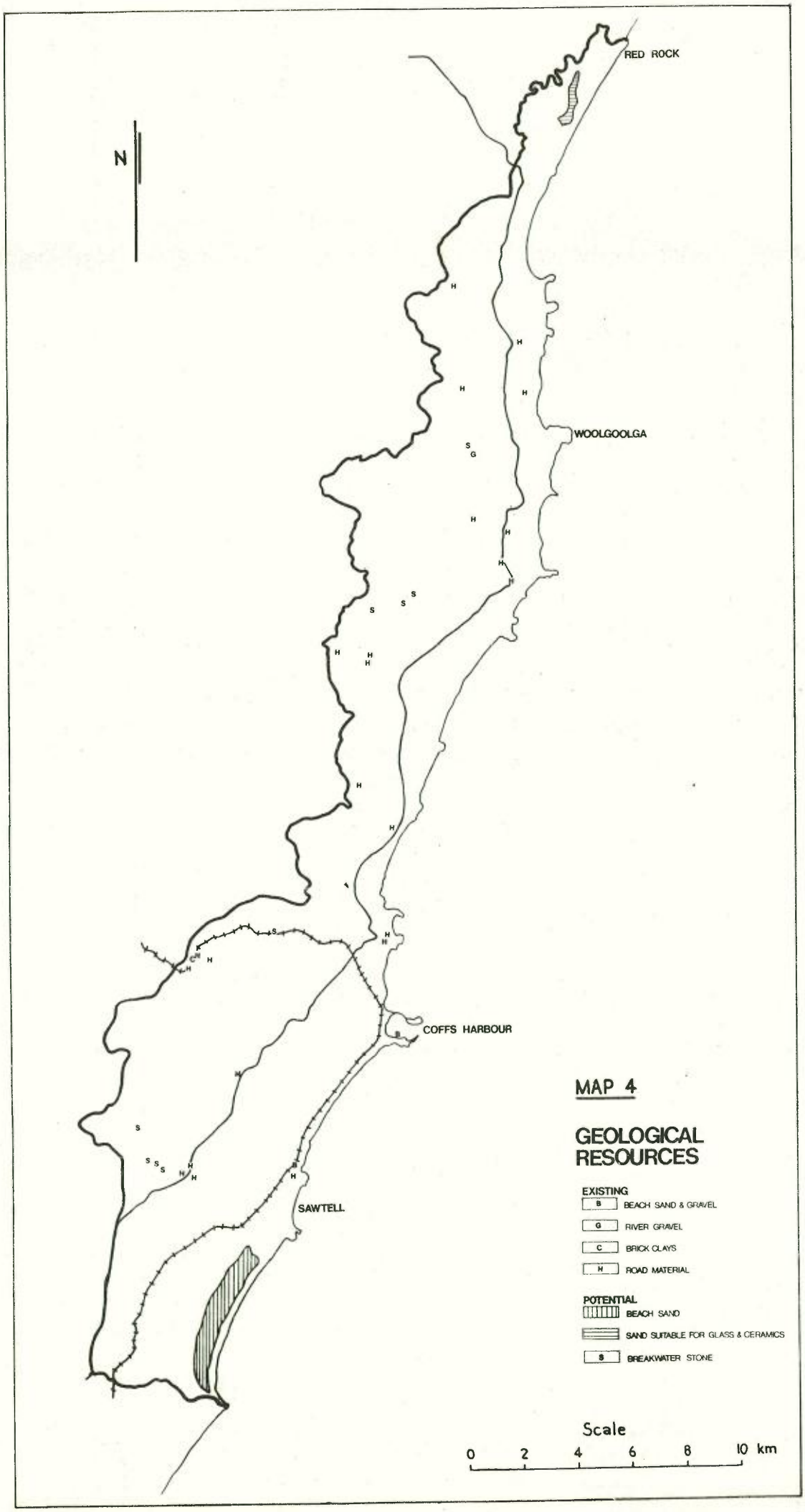
Beds of "sandrock" or indurated sand (weakly lithified relict sand deposits) occur almost universally in barrier sand areas of pleistocene age, at a depth of about a metre above sea level.

B. ECONOMIC GEOLOGY

In the past some deposits in the Study Area have been sources of limited mineral wealth. Copper deposits are found in the Brooklana Beds and were mined until recently at Karangi immediately to the west of the Study Area. While the extent and value of the copper deposits is not accurately known at this time, it is likely that if copper prices were to rise substantially these deposits could become commercially viable, albeit on a minor scale.

Deposits of mercury are found in the Coramba Beds and have been mined on a small scale in an area just to the west of Woolgoolga. As with copper, the extent of the mercury deposits is not accurately known, but they may prove to be of some value in the future.

The deposits of greatest economic significance in the Study Area are those that provide materials for construction and ceramics. Materials that are locally extracted include sand, gravel, aggregate, clay, road materials and breakwater stone.


RED ROCK
N
WOOLGOOLGA
COFFS HARBOUR
SAWTELL
MAP 4
GEOLOGICAL RESOURCES
EXISTING
B BEACH SAND & GRAVEL
G RIVER GRAVEL
C BRICK CLAYS
H ROAD MATERIAL
POTENTIAL
BEACH SAND
SAND SUITABLE FOR GLASS & CERAMICS
B BREAKWATER STONE
Scale
0 2 4 6 8 10 km

1. Sand

Sand is used in construction, manufacture of ready mixed concrete and for filling. Historically, in the Coffs Harbour area, most sand has been obtained from beaches and dunes and dredging of creek estuaries. At this time, Boambee and Hills Beaches and dunes at Bonville Beach are being quarried.

There are, however, a number of significant problems associated with this. Taking of sand from beaches, because it directly reduces the store of sediment, compounds the problem of coastal erosion. The extraction of sand from creek estuaries can have a similar effect. This is because material removed from estuarine sand banks is replaced through littoral drift and tidal inflow and causes accelerated erosion of the adjacent beaches.

It must be realised that the coastal zone is a dynamic geomorphic system and that the equilibrium state of the coastline, particularly beaches, depends on the balance of the coastal sediment budget. Any removal of sand from this active zone by extractive industry will cause sand for replacement to be eroded from another area. This process typically manifests itself as long term beach erosion.

As a consequence, the best places for sand extraction occur outside the active nearshore zone. This may be in relict marine sediment deposits at depths below the influence of waves and currents, or it may be in relict inland beach and dune systems.

Of the terrestrial sources there are two broad alternatives. These are the back barrier deposits or the relict dune systems further inland.

Back dune areas are generally low lying and in Coffs Harbour are underlain by an impermeable sandrock layer just above sea level. These locations are poorly drained and contain shallower depths of sand than dunal areas. Extraction of sand in these locations will result in the formation of large water filled holes. This adds to the costs of extraction and may also result in the creation of polluted surface water bodies. For these reasons it is suggested that low lying back dune areas are not suitable sites for sand extraction.

The remaining source of sand is relict dune systems. These occur in the coastal section of Boambee Basin and to the south of Sawtell. Here the sand bodies are relatively deep and well drained and they are therefore generally the most suitable sites for sand extraction. However, quarrying operations will have significant adverse impact in the form of vegetation destruction and disturbance to wildlife and

for this reason the above statement has to be qualified by an assessment of the conservation value of the flora and fauna on any proposed extraction site. Some areas have been previously mined for heavy mineral sands and these areas have poorly developed vegetation coverage. These locations may be those where extraction would have the least adverse impact.

2. Gravel

Gravel is used both for decorative facing panels and in concrete aggregate. There are a number of potential sources of gravel in the Coffs Harbour area; these include beaches, relict beaches, offshore sources, stream beds and alluvial plains.

Large pea-gravel deposits are present and have been extracted on several beaches in the Coffs Harbour area. This is considered to be undesirable. The presence of gravel in a beach is considered to indicate a high energy environment and removal of this material means that there is less material to dissipate the wave energy and the energy could therefore be spent on eroding the foredunes. For this reason, removal of gravel from the beach is likely to result in severe erosional problems.

Other potential sources of gravel do not have such severe environmental problems associated with their extraction. Exploitation of offshore resources outside the current and wave depth zone may be environmentally acceptable but this is a specific technical field outside the scope of this report. The commercial viability of exploitation of offshore resources is, however, largely unknown at this time.

Some gravel deposits occur in relict beach areas. Quarrying in these areas for gravel will have the same impact as sand extraction and therefore the same impacts can be expected and the same provisions will apply. Another possible source of gravel is extraction from alluvial flats. However, it is felt that the present level of demand makes it uneconomic to conduct the large scale washing and screening operations required to extract gravel from alluvium.

The remaining major source of gravel is from river beds. The Orara River and its tributaries to the west of the Study Area represent the major potential source of river gravels. However, a number of smaller creeks within the Study Area also contain considerable quantities of gravel, particularly Woolgoolga Creek and tributaries of Bonville Creek.

The extraction of gravel from creek beds can have

substantial adverse environmental effects in the form of disturbance to vegetation and wildlife, and erosion of stream beds and banks causing increased turbidity levels and siltation downstream. These effects will tend to be minimised if the rates of gravel removal and extraction sites are carefully controlled. Ideally gravel extraction should occur at the rate at which it is being replenished by geological processes.

Extraction sites are generally located at the break in slope, where the coastal ranges meet the flatter land below. Within this locality, the site chosen for extraction should be the most flat and stable location available that has proximity to existing roads. As well as this, extraction activities should not be located in areas containing vegetation stands of high conservation value. A final requirement is that access ways to the stream channel should be sealed.

3. Crushed aggregate

Most crushed aggregate is obtained from crushing of river gravels. However, as demands increase it may be necessary to resort to crushing of hard rocks. The Coramba and Brooklana metamorphics are a potentially suitable rock for this purpose. As outcrops of these rocks are widespread through the study area, the location of quarries could be considered to be reasonably flexible. Ideally, therefore, quarries should be located outside areas of high conservation recreation, agricultural or urban value and in locations of low visual prominence.

4. Clay and shale

Clay is used to supply the brickworks at Boambee. Two pits are located within the Study Area on deep weathered pelitic sediments, one pit in each of the Nambucca phyllites and the Brooklana Formation. Deposits of this type are widespread in the undulating parts of the region and there should be no shortage of brick clay and shale.

5. Road materials

Partially weathered metamorphic rocks are a most suitable source of road materials. The best locations to obtain this material are on steeper slopes where there is not a deep covering of soil. This operation usually requires extensive excavation and as such it creates a noticeable scar on the landscape. For this reason these quarries should be located in areas of low visual prominence and outside areas of high conservation, recreation, agricultural or urban value.

Rip rap / breakwater stone.

6. Heavy mineral sands

Heavy mineral sands containing rutile and zircon occur in the barrier beach and dune sands of the coastal strip. Economic deposits of heavy minerals occur on Boambee Beach and near Bundageree Creek, where grades range from 0.3 per cent to 5 per cent with isolated areas of greater than 5 per cent. Other economic deposits have been mined and the worked areas rehabilited. These include the ore bodies on Fiddamans, Moonee, and North Beaches, as well as south of Sawtell, and between Green and White Bluffs.

C. FCUNDATION CONDITIONS

1. Nambucca Phyllites

Phyllites and schists dominate the lithology of the unit. During metamorphism, the rocks of this unit have developed a network of quartz veins and undergone additional deformation as a result of major earth movements.

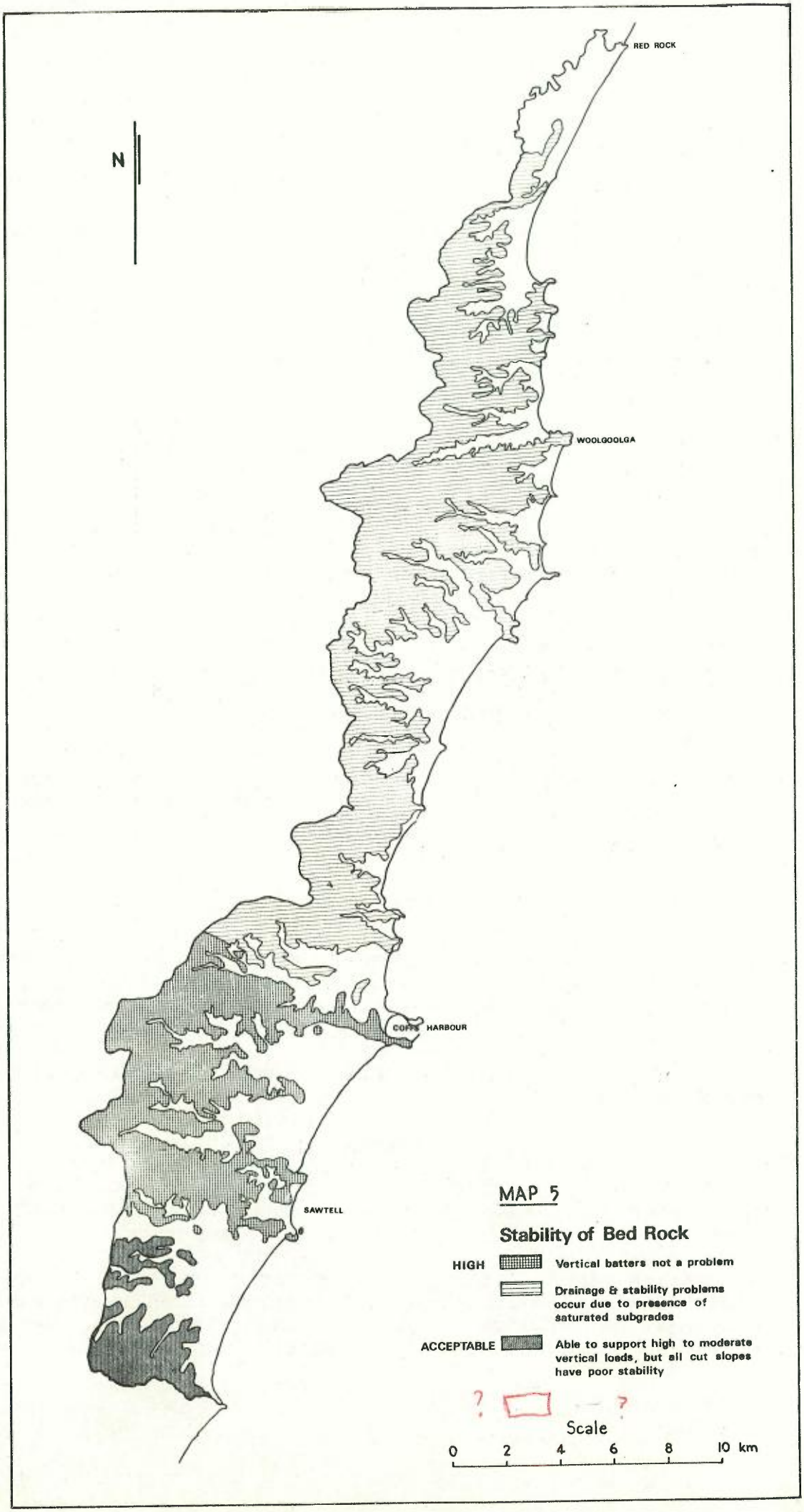
This sequence of geological events has given rise to variable rock conditions including old bedding boundaries, fracture lines and potential slip planes. These weaknesses also allow extensive and deep weathering which results in the opening up of fractures and formation of clay films. In general, while these rocks are capable of supporting moderate to high vertical loads, even when partly weathered they exhibit poor stability characteristics on all cut slopes.

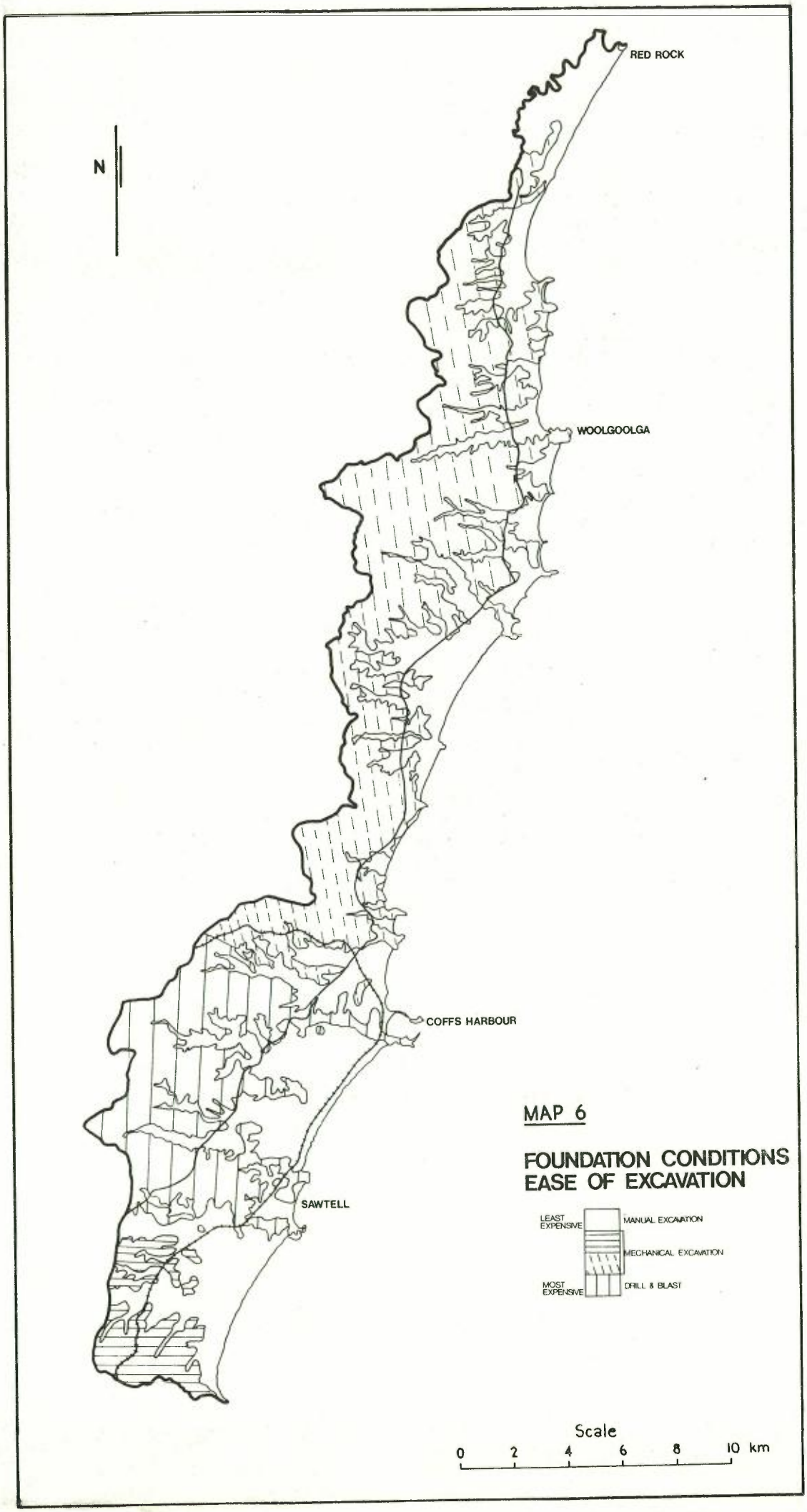
2. Coramba Beds

Steeply dipping and folded micaceous slates and argillites compose most of this rock unit. These rocks are commonly overlain by soils up to four metres deep, formed by deep weathering of bedrock due to the permeability of some rock strata.

A number of foundation hazards occur in this geological formation. On slopes over 20 per cent soil slip and creep is to be expected. As well as this, in cuttings whose side slopes are close or parallel to the angle of dip in the beds, fallout of large rock blocks is common. These difficulties are added to by the common occurrence of considerable drainage problems in the form of springs and saturated subgrades.

Despite these hazards reasonably stable foundation conditions can be achieved. However, caution is required in the location of large earthworks and structures. Detailed investigation in the form of drilling or seismic surveys


N
RED ROCK
WOOLGOOLGA
COFFS HARBOUR
SAWTELL
MAP 5
Stability of Bed Rock
HIGH
Vertical batters not a problem
Drainage & stability problems occur due to presence of saturated subgrades
ACCEPTABLE
Able to support high to moderate vertical loeds, but all cut slopes have poor stability
? ?
Scale
0 2 4 6 8 10 km


RED ROCK
N
WOOLGOOLGA
COFFS HARBOUR
SAWTELL
MAP 6
FOUNDATION CONDITIONS
EASE OF EXCAVATION
LEAST EXPENSIVE
MANUAL EXCAVATION
MECHANICAL EXCAVATION
MOST EXPENSIVE
DRILL & BLAST
Scale
0 2 4 6 8 10 km

should precede any such large developments.

Excavation of these rocks is not excessively expensive. In most cases they can be ripped with large bulldozers. The need for drill and blast is to be expected only in cuts deeper than six metres.

3. Brooklana Formation

Mostly massive argillites dominate this formation. The rock is quite competent and produces a stable foundation. As a result batters that are almost vertical are not found to be troublesome.

The stability of this rock type has allowed the formation of steep slopes. On this very steeply sloping country, under conditions of extended rainfall, soil slip is not uncommon. Fortunately, as most of the soils formed on this rock are shallow the problems of soil slip are minimal.

The major problem associated with this rock type as a foundation is the cost of excavation. The rock is generally unrippable and so earthworks deeper than 1 to 2 metres usually require expensive drill and blast operations.

4. The Quaternary sediments

These materials are highly varied and as such their properties as a foundation material are not uniform. Foundation conditions will primarily depend upon the texture and grading of the sediments, the types of clay present and drainage characteristics. These factors will be considered later in Coffs Harbour Working Paper 9: Soils.

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