

GEOLOGICAL INVESTIGATIONS OF FOUNDATIONS FOR TELEVISION MAST.

BLAKE STREET, DARWIN, N.T.

- By -

B. A. TAPP

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## SUMMARY

A geological survey was made of the Botanic Gardens area, Darwin, on behalf of the P.M.G. Department, Adelaide. The survey was part of the foundation investigations for the selection of a site suitable for the erection of a 250' television mast.

About 40' of flat lying Lower Cretaceous kaolinitic siltstones in part silicified, unconformably overlie blue-grey phyllites of the Moltenius Formation of Lower Proterozoic age.

Bore Hole No. 1, drilled vertically to 30'6", intersected silicified kaolinitic siltstones of Lower Cretaceous age. Core recovery was poor, averaging 67%.

It is concluded that the rocks intersected in this bore hole will form a suitable foundation, but detailed S.P.T. tests and mechanical analyses should be made of each 5' core interval.

## INTRODUCTION

At the request of the Divisional Engineer, Postmaster General's Department, Adelaide, a geological survey was made of the Botanic Gardens area in Darwin. The survey was made as part of an investigation of a suitable site for the erection of a 250' tower within the A.B.C. radio network area. The site selected is located on the southern side of a forty foot, flat topped plateau, overlooking Mindil Beach. The mast will have a 40' square base, the foundations will be sunk to a depth of 30'.

The area was mapped in detail, and four geological sections measured on the western scarp face.

## GEOLOGY

The geological succession of the Darwin area is shown on plate 1.

Mullaman Beds of Lower Cretaceous age consist of shale, siltstone and silicified siltstone. The beds are horizontal or sub-horizontal with dips varying from 0° to 10°. They unconformably overlie rock of Moltenius Formation of Lower Proterozoic age. The Moltenius consists of steeply dipping, compact, sericitic schists and phyllites, with layers of siltstone, sandstone and quartzite.

The exact thickness of these two formations at the site is not known; the Mullaman Beds attain a maximum thickness of about 80' in the Darwin area.

Laterite is only developed in small areas, where the A and B profiles are between 2 or 3 feet thick. Gravels of lateritic origin are widespread. The Lower Cretaceous "porcellanite" is a kaolin rich, iron stained, mottled, fine grained, silty rock, which probably represents the C zone of the laterite profile.

Within the area, exposures are rare although the soil cover is seldom more than 3 feet deep. Four exposures on the scarp edge bordering Goyder Avenue were measured in detail (plate 2).

The geology of the mast site is summarised as follows :

AGE	FORMATION	LITHOLOGY	THICKNESS
Lower Cretaceous	Mullaman Beds	Compact to friable, mottled, kaolinitic, iron stained, siltstones, in part silicified.	Up to 40'
		Unconformity	

AGE	FORMATION	LITHOLOGY	THICKNESS
Lower Proterozoic	Noltenius Formation	Outcrop poor. Ferruginous sandstone probably representing laterite A, profile developed on pre-existing land surface. Blue grey phyllite sediments.	Unknown

The log of bore hole No. 1 is shown on plate 4.

The geology of the four measured sections is tabulated below (refer plate 2 for locations) :-

SECTION NO.	LITHOLOGY
1	<p>Fine grained, weathered, mottled, white, partly silicified kaolinitic siltstone (30' exposed). The rocks vary from compact to friable texture, kaolin occurs as aggregates filling interstices between silt size quartz grains. A small amount of unaltered felspar is thought to be present. The rocks are patchily stained by iron oxide. The rocks dip approximately <math>4^{\circ}</math> to the east. The sequence is well jointed, the main direction of the vertical joints being <math>040^{\circ}</math>.</p> <p>Beneath these sediments a 2' thick layer of ferruginous sandy laterite rock is exposed. Within the upper <math>\frac{1}{2}</math>" of this layer, cavities are infilled by angular limonite and chert fragments.</p>
2	<p>About 20' of rock exposed. Well jointed, friable, weathered, yellow and white, partly silicified, kaolinised siltstones. Iron staining along fractures and joints produces a mottled appearance.</p>
3	<p>Flay lying, fine grained, mottled, iron stained silicified siltstone. Kaolin less abundant than at sections 1 or 2. Rare, small hematite aggregates.</p>
4	<p>A 30' exposure of compact, massive, weathered in part silicified, kaolinitic siltstone. The rock is well jointed; the main direction of the vertical joints being <math>310^{\circ}</math>. In parts the rocks consist almost entirely of kaolin, in other parts kaolin is nearly absent. Where present iron oxide is concentrated in the bedding planes.</p>

Apart from the lowest part of section 1, all the outcrops are Mullaman Beds.

### CONCLUSIONS

If the mast foundations are sunk to a depth of 30', the kaolinitic siltstones, as intersected in the bore hole, will be the holding rock. These sediments should be adequate for the foundation purposes required. Three factors should, however, be considered :-

1. The system of fractures, aligned at  $040^{\circ}$  and  $310^{\circ}$ , with minor horizontal, and other less well developed vertical joints, may cause movement within the foundations when under stress by tower movement.
2. After heavy rains, water seepage along joints may cause weaknesses within the fracture pattern. Water was struck in the bore hole at 25'.

3. Differential stress defects caused by variable hardness of the Lower Cretaceous rock unit and the patchiness of the silicified siltstones, may cause difficulty.










#### RECOMMENDATIONS

Although the rocks intersected in bore hole No. 1 should prove to be adequate as foundations, standard penetrometer tests, and mechanical analyses should be made of every 5' of core.

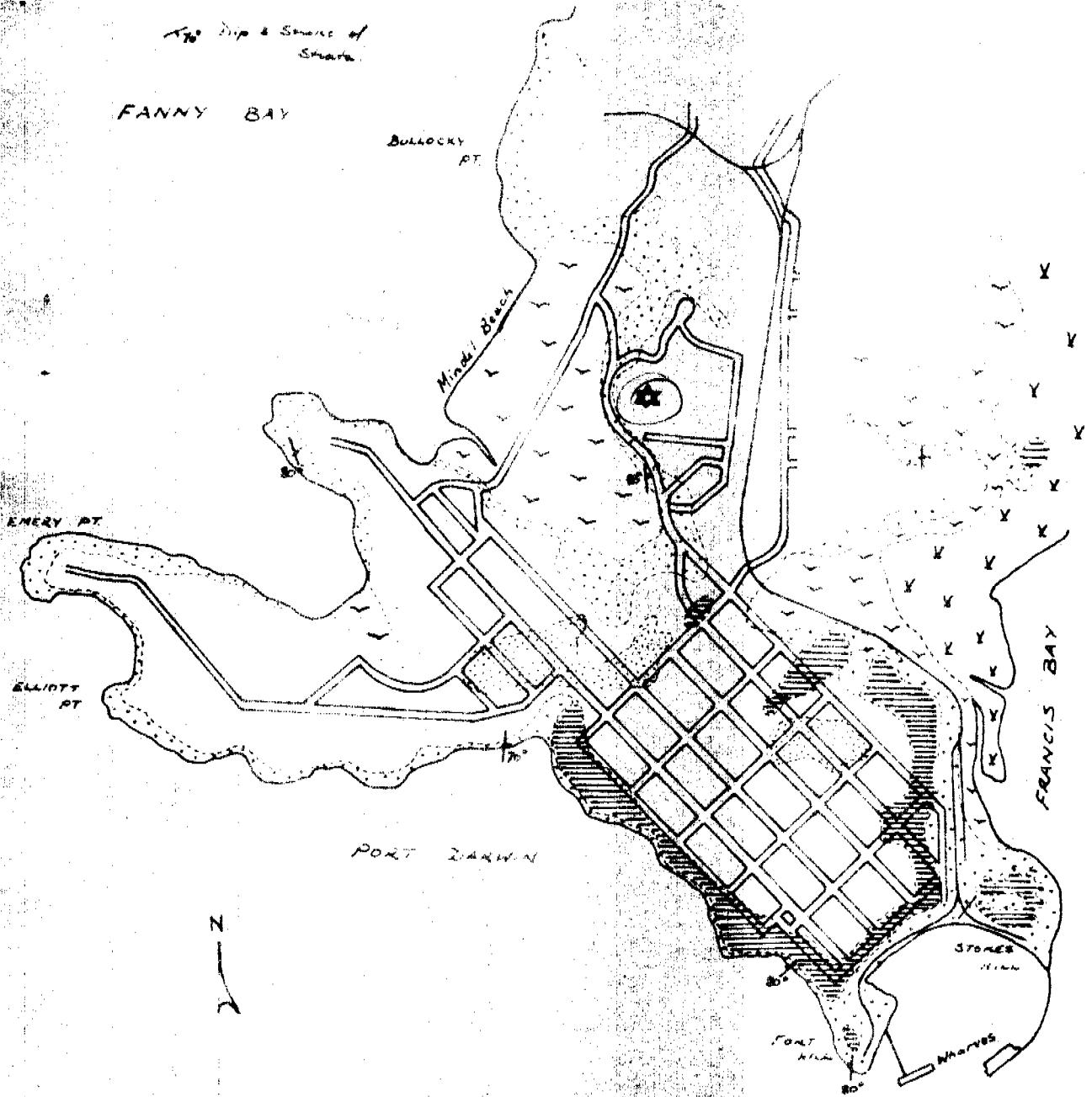
LOCATION of TELEVISION

MAST PROPOSED SITE

LEGEND:

- | GEOLOGICAL                  |   | TOPOGRAPHICAL                           |   |                            |
|-----------------------------|---|---|---|----------------------------|
| QUATERNARY                  |  | Residual soil & Late Pleistocene Gravel |  | RAILWAY AUSTRALIAN RAILWAY |
|                             |  | Tidal flats                             |  | MAJOR ROAD NETWORK         |
|                             |  | Sand, siltstone                         |  | PROPOSED SITE FOR MAST     |
| TERTIARY                    |  | Late Pleistocene                        |   |                            |
| CRETACEOUS (Wollaston Beds) |  | Shale, siltstone, Porcellanite          |   |                            |
|                             |  | SANDS, siltstone (Nothofagus formation) |   |                            |

$\frac{1}{10}$  Dip & Strike of Shale





GEOLOGICAL CROSS-SECTIONS

A & C and B D

LOCATIONS AS PER PLATE 2

SCALE HORIZONTAL 1:500

VERTICAL 1:100

0 50 100 FEET

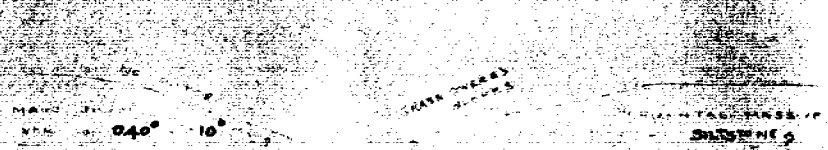
0 50 100 FEET

C

A & C  
B & D

0 50 100 FEET

A



10116



LEGEND

CRETACEOUS - Moutan Beds.

Unconformity - Erosion floor probably under variation possibly of the order of 5'

PROTEROZOIC - Neirenus Formation.

DEPTH (ft)	DEPTH (m)	DIAMETER (in)	DIAMETER (cm)	DESCRIPTION	REMARKS
				Grey sandy soil	
0-6	0-1.8	2"	5.1	6" Laterite Well weathered	Core very broken. Yellow soft limonitic sandy rock, with rounded (1-6m) gty & ironstone blebs, rare siltstone. Crumbly.
6-10	1.8-3.0	2"	5.1	Kaolinitic siltstone Partly silicified Well weathered	Core broken. Last 6" hard silicified. White, iron stained and mottled. Large (2") blebs of siltstone, mainly replaced by kaolin & ironstone.
10-16	3.0-4.9	2"	5.1	Kaolinitic siltstone Well weathered Partly silicified	6" white hard silicified kaolinitic siltstone. Kaolin & iron replacing quartz grains iron stains give mottled appearance. Kaolinitic white siltstone Soft Crumbly
16-24	4.9-7.3	2"	5.1	Silicified Siltstone Partly weathered	Yellow, brown, white, mottled siltstone. Hard, compact, massive. Iron oxides developed in cleavages normal to core axis. Rounded siltstone bands eroded by kaolin.
24-30	7.3-10.7	2"	5.1	Well weathered	.3" iron stained siltstone. Little kaolin, developed in bands
30-34	10.7-14.1	2"	5.1	Well weathered	4" soft clayey grey siltstone with iron staining
34-38	14.1-18.5	2"	5.1	Well weathered	Soft brown mottled siltstone. Iron oxides developed normal to core axis. Best seen in than above.
38-46	18.5-26.1	2"	5.1	Well weathered	1" hard iron on soft, mottled banded siltstone. Bands @ 45° to core axis.

GEMCO HYDRAULIC N.M.L.C. 2" CORE DIAMETER N. BENNETT 23-7-68 B.A. TAPP 1" & 2"

SILTSTONE  
LATERITE  
KAOLIN  
KAOLINIC CLAY CRUSA

M(P) 99

DEPTH (ft)	DEPTH (m)	DIAMETER (in)	DIAMETER (cm)	DESCRIPTION	REMARKS
				Weathered Kaolinitic silicified siltstone	Yellow white hard compact, massive.
18-20	5.5-6.1	2"	5.1	Weathered Kaolinitic siltstone	Soft, yellow, brittle massive, partly banded siltstone
20-26	6.1-10.7	2"	5.1	Weathered Kaolinitic siltstone	As above. Rare iron oxide staining.
26-28	10.7-12.1	2"	5.1	Weathered Kaolinitic siltstone	6" Soft white very kaolinitic siltstone. Rare patches of brown siltstone with little kaolin.
28-30	12.1-14.1	2"	5.1	Well weathered Laterite	Soft yellow, brittle massive siltstone.
30-32	14.1-16.1	2"	5.1	Well weathered Laterite	18" Ferruginous, vuggy iron rich sandy laterite.
32-34	16.1-18.5	2"	5.1	END OF HOLE	

GEMCO HYDRAULIC N.M.L.C. 2" CORE DIAMETER N. BENNETT 23-7-68 B.A. TAPP 1" & 2"

SILTSTONE  
LATERITE  
KAOLIN

M(P) 99