Department of Mines
South Australia

D.M. 421/57.

RB 45/33

REPORT ON SITE INVESTIGATION

PROPOSED H.& L.G. DEPARTMENT DEPOT

NORTHFIELD

PT. SEC. 2282, HD. YATALA

ASSOCIATED PLAN: 57-244

SUMMARY

Ten 30" diameter test bores revealed colluvial and alluvial deposits ranging from clay to coarse gravel, with silty and sandy material predominating. Profile development is mature, but shallow. There are superficial similarities in the profiles exposed, but they vary considerably in detail. The principal variables affecting the foundation conditions are the abundance of lime and the thickness and nature of the "B" horizon.

Material of adequate bearing capacity for the proposed structures occurs at various depths and recommended foundation depths in the vicinity of each test bore are given. However, practical difficulties arise due to differences in elevation of the recommended bearing material.

A redistribution of the buildings is suggested as a possible solution.

The importance of diverting water from the foundation areas is stressed.

INTRODUCTION

This investigation was initiated by Mr. F. A. Richmond, Commissioner of Highways, and carried out by the writer in co-operation with Mr. D. A. Cumming, Testing Officer, Highways and Local Government Department.

The proposed site is located in the suburb of Northfield at the corner of Brien's Road (or Bridge Road) and View Street. The site is in close proximity to the Northfield Railway Station, but separated from it by the deep gully known as Dry Creek. The appropriate map reference is Part Section 2282, Hundred of Yatala, County Adelaide.

GENERAL GEOLOGY AND TOPOGRAPHY

The site occupies an elevated and well-drained position on the Para Fault Block and is immediately south-east of the projected position of that fault. The deep gully of Dry Creek runs in an irregular north-westerly direction near the western boundary of the site and one of the old terraces of that creek occupies part of the site. This terrace is about 15 feet below the general level of that part of the area shown on the accompanying plan north-westerly of the proposed carpenters shop

Easterly of this shop the ground rises steadily to the asphalt plant and beyond.

The material occupying the site for a considerable depth consists of clayey silts and sands and discontinuous gravel beds, covered by colluvial sandy clays and a final veneer of calcareous aeolian material of fine grain size.

The silts, sands and gravels were deposited by Dry Creek during a past intensely pluvial period. Uplift during late Tertiary times caused the rejuvenation of the creek which cut through its own beds. These transected beds can be seen in the cliff-like banks of the creek.

The uplift also caused the migration of the soil mantle from the resulting higher slopes to the creek valley, covering the alluvial deposits in the process.

Finally, dust storms and sand storms during a late Pleistocene arid period deposited a thin veneer of calcareous material over the whole landscape.

Subsequent soil-forming processes have resulted in the concentration of clays in the "B" horizon and the leaching of calcium carbonate from the topsoil and its redeposition at lower horizons.

THE PARA FAULT

The close proximity of the Para Fault raises a question as to the possibility of earthquake damage. This is a question that cannot be answered satisfactorily. First of all, the exact location of the fault has not been determined in this area and an error of up to one mile is possible. Secondly, there is no means of predicting the probable behavior of a fault over any given period of time. When a fault exists there is a possibility of movement, but it is not possible to predict when such movement will take place, if at all, nor its magnitude. All recorded earthquakes and earth tremors in Adelaide have resulted from movements along the Eden Fault which runs along the foothills of the Mount Lofty Ranges. The Para Fault has apparently remained stable during the period of recorded history.

THE SOIL PROFILES

The soil profiles are described in detail in the appended logs of the test boreholes.

The soils of this area are classified as red-brown earths, one of the Great Soil Groups of the internationally accepted soil classification system.

The sequence of mature red-brown earths overlying alluvial clayey silts and sands is very similar to that found in the Marion district. Here the soil is classified under our local system (Bulletin 32) as Type RB.5.

In detail the profiles exposed are variable. The profiles in test bores No.s 1, 3 and 7 are closely similar, bores No.s 1 and 3 being at the same elevation and bore No. 7 being some 8 ft. higher. Bore No. 2 exhibits a variation on the same theme, but the clay of the "B" horizon is distinctive and there is much more lime present in the "B-C" horizon. Bore No.4 exhibits a more complex pattern suggestive of several incomplete profiles superimposed one upon another.

The profile exposed in bore No.5 is distinguished by the very shallow "B" horizon and the abundance of lime below it. Bores No.s 8 and 9 exhibit profiles which, though still recognisable as red-brown earths differ from those described above and from one another, the profile in bore No.8 being very sandy throughout and that in bore No.9 being distinguished by the abundance of travertine rubble. The profiles in bore No.s 6 and 10 display their alluvial origins much more strongly and are closely similar although separated in elevation by some 15 feet.

FOUNDATION CHARACTERISTICS OF THE SOILS

As stated above, these soils collectively resemble Type RB.5 and it is considered that the experience gained in this type of soil can be applied to this site, excepting in the vicinity of bores Nos 5, 6, 8 and 10. The soil profile exposed in bore No.5 most closely resembles Type B.3.2 while that of bore No.8 is similar in many respects to Type RB2. The material shown

in bores Nos 6 and 10 most resembles a blend of Types RB6 and RB7 although here occurring in a more elevated environment.

The principal foundation characteristics of the soil types mentioned are as follows:-

Type RB.5

Soil Description: Red-brown earth, with heavy-textured, fine - structured "B" horizon, variable accretion of lime below "B" horizon diminishing with depth.

Seasonal Movement: Small to moderate seasonal movement occurs, mainly in the "B" horizon. Actual magnitude of movement unknown.

Incidence of Foundation Failure: Infrequent. About 10% of houses suffer mild cracks.

Compressive Strength: Ranges from 46± 8 p.s.i. at depths of 42" to 53" to 21 ± 2 p.s.i. at 98" to 116" from depths of 56" to 82" the compressive strength is 30 ± 2 p.s.i. (Compressive strength = 2 x cohesion)

Maximum Safe Bearing Capacity: 2½ tons per square foot.

Type BS.2

Soil Description: Mallee soil. Dark brown clayey topsoil with travertine rubble and marl at shallow to moderate depths.

Seasonal Movement: Seasonal shrinkage and swelling movements of small to moderate magnitude occur in topsoil layer (0 - 12")

Incidence of Foundation Failure: Rare to infrequent. All known foundation failures on this soil have been due to inadequate surface drainage, or to over-watering of adjacent gardens.

Special Characteristics: The marl and the lower limey clays lose much of their strength if allowed to become saturated.

Compressive Strength: Of the order of 28 + 7 p.s.i. at about

10% moisture.

Maximum Safe Bearing Capacity: 1½ tons per square foot over the normal range of moisture conditions.

Type R.B.2

Soil Description: Sandy, compact, red-brown earth with variable amounts of gravel, "B" horizon sandy, light textured and fine structured.

Seasonal Movement: Negligible

Incidence of Foundation Failure: Rare to non - existent.

Compressive Strength: Not determined, but observations suggest a high figure of the order of 50 to 60 p.s.i.

Maximum Safe Bearing Capacity: Probably 3½ to 4 tons per square foot.

Type RB.6

Soil Description: Shallow, sandy red-brown earth with a thin mottled and ironstained clay "B" horizon. Under the restricted conditions of drainage on the lower Adelaide Plains this soil is saline.

Seasonal Movement: No seasonal shrinkage or swelling movements take place, but there is a tendency to settlement during very wet winters.

Incidence of Foundation Failure: Infrequent

Compressive Strength: Not determined, but is certainly low

Maximum Safe Bearing Capacity: Of the order of 1½ tons per square foot (± ¼)

Type RB.7

Soil Description: Deep sandy red-brown earth with an ill-defined sandy clay "B" horizon. In the type area this soil is saline because of restricted drainage.

Seasonal Movement: No seasonal movement

Incidence of Foundation Failure: Rare to infrequent

Compressive Strength: Only subsoil determined. At depths of 60" to 72" = 36 ± 5 p.s.i. From 84" to 96" = 31 ± 3 p.s.i.

Maximum Safe Bearing Capacity: Of the order of 1¾ tons per square foot (± ¼)

The gravel horizon exposed in bore No.6 is not typical of Types RB6 - RB7 and the effect of this would be to impart greater rigidity. However, the material encountered in this bore below a depth of 3' 2" is of low bearing capacity, comparable with that of Type RB6.

ATTERBURG TEST RESULTS

An abundance of lime was observed in some of the test bores and this gave rise to some doubt as to the strength of these soils when wet. Experience elsewhere has shown that very limey clays tend to lose much of their strength when wet. Further, it is well known that building operations upset the natural balance of soil-water distribution and might cause parts of the soil to become saturated.

However, there was some doubt as to whether there was sufficient lime present to cause an appreciable loss of strength under wet conditions. After consultation with Mr. Cumming it was decided to run Atterburg tests on selected samples. Normally Atterburg tests are used for foundation soil classification purposes only. However, if a limey clay of only moderate sand content yields a low liquid limit and a low plasticity index, it can be assumed that the cause is the high lime content and that such a clay will lose much of its strength when wet. Samples N.7 and N.19-21 (inclusive) are considered to be cases in point. (See bore logs and appendix), and some depression of the figures due to the lime content is noted in samples N.2, N.10, N.14 and N.17. All other low results are considered to be mainly due to the high proportions of sand and/or silt.

RECOMMENDED FOUNDATION DEPTHS

In general the recommended foundation depth is immediately below the clay "B" horizon, i.e. on the limey clay, since the "B" horizon clay can be expected to shrink and swell seasonally. In detail the recommended foundation depths are as follows:-

Bore No.	Recommended Depth	R.L.
1	1' 11"	240.2
2	2' 0"	236.0
3	2' 6"	240.1

Bore No.	Recommended Depth	R.L.
4	1' 8"	238.8
5	At surface	236.0
6	At surface	240.3
7	1' 8"	248.3
8	3' 0"	250.6
9	1' 6"	258.7
10	At surface	225.9

It will be seen that these recommended depths impose some practical problems. For instance, the recommended foundation depth at the 2 - storey end of the laboratory and office block is over 4 ft. higher than that for the single-storey end. This particular problem could be solved by re-orienting the building along the line of bores Nos 1, 3 and 6.

DRAINAGE

Although the limey clay is the most stable from the point of view of seasonal shrinkage and swelling, it is obvious from a preceding chapter that every effort should be made to prevent water penetrating to this zone, or at least to keep it well drained. The proposed paving should provide excellent protection, but the proposed lawns should be dispensed with, or moved to positions well clear of the buildings.

CONCLUSION

The soils provide material of adequate bearing capacity for the proposed structures at the recommended foundation depths. However, these foundation depths impose practical difficulties with the present proposed layout. Either the layout will have to be revised or parts of the foundations will have to be seated at greater depths than those recommended. In this latter case it is highly probable that the bearing capacity will be lower than that at the recommended depth.

Especial care should be taken to prevent the limey clay zone from becoming too wet and thus losing strength.

Alan Gibson

A. A. GIBSON

SENIOR GEOLOGIST

SOILS GEOLOGY SECTION

AAG:JAH.

GEOLOGICAL LOGS OF 30" DIAMETER TEST BORES

H.& L.G. DEPOT, NORTHFIELD

(Bore numbers as per H.& L.G. general layout plan)

BORE NO. 1

R.L. of Collar 242.1'

Depth	Description
0" - 0' 9"	Reddish-brown silty loam
0' 9" - 1' 11"	Dark red-brown, granular, silty clay. Slight dull sheen on structural units. Moderate cracking.
1'11" - 3' 2"	Red-brown and brown mottled, very silty clay with numerous pockets of lime
3' 2" - 5' 2"	Light red-brown and brown mottled limey and very silty clay with numerous pockets of lime
5' 2" - 9' 0"	Red-brown to dark reddish-brown silty clay with frequent small pockets of lime
	Very slight cracking from 1'11" to 9' 0"

BORE NO. 2

R.L. of Collar 238.0'

Depth	Description
0" - 0' 5"	Grey-brown sandy clay loam
0' 5" - 0'10"	Reddish-brown sandy clay loam
0'10" - 2' 0"	Dark red-brown granular clay with sheen on structural units and moderate cracking
2' 0" - 3' 0"	Light red-brown sandy and limey clay with abundant pockets of lime
3' 0" - 8' 3"	Light and dark red-brown mottled sandy clay with numerous pockets of lime and occasional small pebbles
8' 3" - 10' 0"	Dark reddish-brown very sandy clay with an occasional coarse pebble

BORE NO. 3

R.L. of Collar 242.6'

Depth	Description
0" - 0' 3"	Reddish-brown silty loam
0' 3" - 1' 1"	Dark red-brown, granular, silty clay. Dull sheen on structural units. Moderate cracking.
1' 1" - 2' 6"	Light red-brown and brown mottled, limey and very silty clay with numerous pockets of lime
2' 6" - 7' 6"	Light red-brown and brown mottled, limey and very silty clay with abundant pockets of lime and some hard kernels of lime
7' 6" - 10' 6"	Red-brown to dark reddish-brown silty clay with occasional large pockets of lime
10'6" - 17' 4" 6"	Borehole. Not examined

BORE NO. 4

R.L. of Collar 242.6'

Depth	Description
0" - 0' 5"	Grey-brown sandy clay loam
0'5" - 1' 8"	Dark red-brown, granular clay with moderate sheen on structural units. Moderate cracking
1' 8" - 2' 6"	Light red-brown sandy and limey clay with numerous pockets of lime

Bore No. 4 (cont'd)

2' 6" - 3' 3"	Dark red-brown sandy clay with numerous pockets of lime
3' 3" - 4' 0"	Light red-brown sandy and limey clay with numerous pockets of lime
4' 0" - 8' 7"	Dark red-brown sandy clay with numerous pockets of lime and occasional hard kernels of lime
8' 7" - 10' 0"	Dark reddish-brown very sandy clay
10'0" - 17' 0"	6" Borehole. Not examined.

BORE NO.5.

R.L. of Collar 236.0'

0" - 0' 3"	Grey-brown sandy clay loam
0' 3" - 0' 9"	Dark red-brown sandy clay, dull, granular
0' 9" - 1' 9"	Marl with abundant kernels of lime
1' 9" - 3' 0"	Light red-brown sandy and limey clay with numerous pockets of lime
3' 0" - 4' 6"	Dark red-brown sandy clay with numerous pockets of lime
4' 6" - 7' 0"	Light red-brown, very sandy clay with frequent pockets of lime
7' 0" - 10'0"	Reddish-brown very sandy clay
10'0" - 14'0"	6" Borehole. Not examined

BORE NO. 6.

R.L.of Collar 240.3'

0" - 0' 4"	Grey-brown, finely sandy clay loam
0' 4" - 1' 0"	Light red-brown, very sandy loam
1' 0" - 1' 8"	Ditto, but with abundant water-worn gravel
1' 8" - 2' 2"	Dark red-brown, very sandy clay with some gravel
2' 2" - 3' 2"	Light red-brown, very sandy clay with abundant, dark, iron oxide flecks. Sparse gravel.
3' 2" - 5'11"	Light red-brown, very sandy loam. Occasional pebbles.
5'11" - 10'0"	Silt to medium grained sand, slightly clayey, not well compacted. Occasional pebbles up to 3" diameter.

BORE NO. 7

R.L. of Collar 250.0'

0" - 0' 5"	Reddish-brown sandy clay loam
0' 5" - 1' 8"	Dark red-brown, granular, silty clay, Slight dull sheen on structural units. Moderate cracking
1' 8" - 3' 3"	Light red-brown and brown mottled, limey and very silty clay with numerous pockets of lime
3' 3" - 6' 0"	Ditto, but with abundant pockets of lime
6' 0" - 9' 6"	Red-brown to dark reddish-brown, silty clay, with occasional large pockets of lime
	Very slight cracking from 1'8" to 9'6"

BORE NO. 8

R.L. of Collar 253.6'

0" - 0' 9"	Reddish-brown sandy clay loam
0' 9" - 1' 7"	Light red-brown sandy clay loam
1' 7" - 2' 5"	Dark red-brown, clayey and sandy silt. Slight cracking.
2' 5" - 3' 0"	Light red-brown ditto. Slight cracking.
3' 0" - 5' 6"	Mainly slightly clayey silt and fine sand. Very variable in lime content laterally. Numerous small nodules of lime.
5' 6" - 7' 9"	Clayey and sandy silt with abundant pockets of lime and much travertine rubble
7' 9" - 9' 9"	Red-brown, very silty clay with occasional large pockets of lime containing hard lime kernels

BORE NO. 9

R.L. of Collar 260.2'

0" - 0' 5"	Finely sandy, light red-brown loam
0' 5" - 1' 6"	Red-brown sandy clay. Dull, granular, friable. Slight to moderate cracking
1' 6" - 2' 6"	Pale reddish-brown, limey and sandy clay. Faint cracking
2' 6" - 6' 0"	Pale red-brown, limey and sandy clay with abundant fine travertine rubble
6' 0" - 9' 6"	Red-brown silty clay, becoming darker with depth. Occasional large patches of lime with some hard kernels of lime

BORE NO.10

R.L. of Collar 225.9'

0" - 0' 6"	Light grey-brown, sandy clay loam
0' 6" - 1' 7"	Very light red-brown sandy loam
1' 7" - 1' 10"	Ditto, but with numerous laterite nodules
1'10" - 2' 6"	Red-brown, finely sandy clay with heavy, dark, iron oxide mottling and numerous laterite nodules
2' 6" - 2'10"	Very light red-brown sandy clay loam with numerous laterite nodules
2'10" - 3' 9"	Red-brown finely sandy clay with heavy, dark, iron oxide mottling, numerous laterite nodules and sparse pockets of lime
3' 9" - 4' 9"	Dark red-brown, coarsely granular clay with moderate sheen on structural units. Slight cracking.
4' 9" - 6'10"	Ditto, but with numerous pockets of lime
6'10" - 8' 4"	Red-brown, very sandy and silty clay with occasional pebbles.
8' 4" - 10' 0"	Dark red-brown, moderately clayey silt-sand with occasional pebbles.

Logged by A.A. Gibson.

APPENDIX

Results of Atterberg Tests

Samples marked as under, yielded on analysis:-

Sample No.	Hole No.	Horizon	Depth		Liquid limit	Plastic Limit	Plasticity Index
N 1	1	2	0' 9"	1'11"	70 %	30 %	40
N 2	1	3	1'11"	3' 2"	57	24	33
N 3	1	4	3' 2"	5' 2"	68	27	41
N 4	1	5	5' 2"	9' 0"	53	23	30
N5	2	2	0'10"	2' 0"	76	25	51
N 6	2	3	2' 0"	3' 0"	60	28	32
N 7	2	4	3' 0"	8' 3"	45	20	25
N 8	2	5	8' 3"	10' 0"	36	17	19
N 9	3	2	0' 3"	1' 1"	74	32	42
N 10	3	3	1' 1"	2' 6"	54	26	28
N 11	3	4	2' 6"	7' 6"	51	22	29
N 12	3	5	7' 6"	10' 6"	39	18	21
N 13	4	2	0' 5"	1' 8"	67	33	34
N 14	4	3	1' 8"	2' 6"	58	27	31
N 15	4	4	2' 6"	3' 3"	64	27	37
N 16	4	5	3' 3"	4' 0"	65	29	36
N 17	4	6	4' 0"	6' 7"	54	23	31
N 18	5	2	0' 3"	0' 9"	58	30	28
N 19	5	3	0' 9"	1' 9"	42	21	21
N 20	5	4	1' 9"	3' 0"	47	20	27
N 21	5	5	3' 0"	4' 6"	45	21	24
N 22	5	6	4' 6"	7' 0"	37	16	21
N 23	5	7	7' 0"	10' 0"	24	17	7

Type of Material : Foundation Test Hole samples.
Locality: Highways and local Gov. Depot, Northfield.
Source: A. A. Gibson. Senior Geologist, Exhibition Building.

Thomas R. Frost.

CHIEF ANALYST

VIEW ST.

Boundary

Tree Reserve

Light B.S.T.

Site for Canteen etc

Light B.S.T.

Crushing Plant ⊕2

Laboratory

Mechanical Offices

Lawn

Lawn

Asphaltic

Concrete

Asphaltic Concrete

Weighbridge

Watchman's Office

Boundary

Tree Reserve

Plant Store | Packing & Despatch | Open Shelter | Plant Shelter

Asphaltic Concrete

Suspense Store | Packing & Despatch | Open Shelter | Steel Store

Asphaltic Concrete

Employees' Car Park (Approx. 100 Cars)

Road Reserve

BRIDGE ROAD or BRIENS ROAD

Tree Reserve

4" Light Bitumen Surface Treatment

Engine Repair | Offices | Tool Store | Parts Store | Canteen Store

Machine Shop

⊕5 ⊕4 ⊕3

Assembly Bays

Wash Room & W.C.'s

Tractor & Grader Pens

⊕6

Cement Concrete

Cement Concrete

Steam Clean Karrigeel Shed

⊕10

Cement Concrete

Transport Office

Hut Building Shelter | Carpenters' Shop | Timber Store

Cement Concrete

Asphaltic Concrete

Spray Paint Shop

Engine Test Karrigeel

⊕7 Motor Shop ⊕8

Asphaltic Concrete

Boiler Shop ⊕9

Asphaltic Concrete

Asphaltic Concrete

TEST BORES.....⊕7

To accompany report by R.A. Gibson Geologist

S.A. DEPARTMENT OF MINES

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

PROPOSED HIGHWAYS AND LOCAL GOVERNMENT DEPT. DEPOT
NORTHFIELD
SEC. 2282 Hd. YATALA
FOUNDATION TEST BORES

Approved	Passed
Director of Mines	

Drn.
Tcd. ROW
Ckd. RA
Exd.

Scale: 40' TO 1"
57-244
Ha 5
Date 15-7-57