18

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

FOUNDATION INVESTIGATIONS

NEW GOVERNMENT BUILDING, VICTORIA SQUARE

by

J.B. Firman
Assistant Senior Geologist

10th August, 1964

RB 59/37

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INTRODUCTION

This report contains information used by the staff of the Geological Survey at various times as a basis for advice to authorities responsible for construction of the new Government Offices at Victoria Square. It is not therefore an integrated report. The basic information collected here is as follows:

1) Soil Classification Chart.

2) Percussion Log, Bore 2, with accompanying Bore Log Analysis.

3) Diamond Drill Log, Bore 2.

4) Percussion Log, Bore 4.

5) Diamond Drill Log, Bore 4.

6) Photographs of Diamond Drill Core, Bores 2 and 4.

7) Original Geological Logs. Including preliminary log of struck-off ends from 72 to 106 feet, and sludge log from 158 to 200 ft.

8) Water Analyses. Bore No. 4.

A report (No. 58/126) entitled "Foundation Stratigraphy" by J.M. Lindsay, with an appendix by W.K. Harris, has been issued under separate cover.

Because verbal information has already been supplied to the authorities concerned with the project, the report is restricted to explanatory notes on the Bore Log Analysis, the foundation characteristics of the Hallett's Cove Sandstone (Limestone) in Bores 2 and 4, and a note by the Senior Geologist, Engineering Geology Section, based on examination of the limestone as it occurs at this and other sites in the City of Adelaide.

Departmental reports by Messrs. Lindsay and Harris, reports for Kinnaird Hill and Associates by J. Cox, reports by Senior Palaeontologist, N.H. Ludbrook, and the Geology of South

Australia (Journal of the Geological Society of Australia Volume 5, Part 2) have been freely consulted during the preparation of this report.

BORE LOG ANALYSIS

A special table has been prepared for this project setting out those sedimentary and other features causing variations in soil mechanics values* and physical properties noted during geological logging. The samples logged were not those tested, in most cases, so there was no opportunity for a detailed explanation of anomalies in soil mechanics data.

The proven continuity of strata is responsible for similar trends in graphs of physical properties in Bores 2 and 4 (See moisture content, density and Atterburg Limits, for example.)

One of the features brought out by this investigation is the general control of texture variations on density and other physical properties.

The position of sandy aquifers should be noted. There is a good correlation between the graph showing piezometric head and the moisture content profile, the broad pattern being markedly influenced by sandy aquifers at about 35 and 60 feet.

Some of the more important features set out on the table are now discussed. The treatment is not exhaustive, rather, it is intended to show that a fairly complete picture of sub-surface conditions could be obtained by detailed synthesis of soil mechanics, palaeontological, tectonic and sedimentary data. The review begins with the earliest geological events recorded, so that a proper sequence is maintained and repetition avoided.

* For tables and graphs mentioned herein see reports by Kinnaird Hill and Associates.

Blanche Point Marls (Soft Member)

This unit was deposited during the Eocene, but sedimentation possibly extended into the Oligocene. On the table, a sandy member is shown separating a lower silt from an upper silt. The lower silt from 150 to 200 feet was laid down in deeper water and in a more open situation than the upper silt between 89 and 100 feet. The upper silt represents a shallow water, near-shore environment with restricted marine access.

Post depositional changes show that breaks in sedimentation with subaerial exposure occurred above and below the sandy member. The break at the base is probably the most important and may reflect the removal by shallow marine traction currents and/or by subaerial fluvial erosion of part of the sequence.

The sandy member is described in this report as the 4th aquifer.* Static level is high, at about 60 feet below ground surface, which indicates considerable pressure. This aquifer is responsible for relatively high values (up to 85%) on the graph of moisture content.

Sedimentation was probably brought to an end by uplift. How much of this sequence was removed by erosion after uplift, here and elsewhere within the basin area, is not known.

Port Willunga Beds

The Port Willunga Beds were deposited under shallow shelf conditions with slow terrigeneous sedimentation. Lindsay in his report provides a table comparing thicknesses of sequences which shows that a maximum of 100 feet of this unit could have been removed prior to deposition of the Hallett Cove Sandstone, all of the Sequence except the basal 8 or 9 feet being eroded.

Footnote
* The 5th if the near surface perched ground water table at 8 ft. is included

This need not imply continuous uninterrupted sedimentation followed by uplift and erosion. On the contrary, the tectonic and sedimentary history of the basin suggests numerous interruptions, even involving sedimentation during tectonism with resulting variations in thickness of rock units across structural breaks.

The time break shown by faunal changes marks regression of the sea. Ferruginous staining shows subaerial weathering of the basal part of the unit.

The Port Willunga Beds and the underlying soft member of the Blanche Point Marls together form a sequence of 60 to 70 feet of silt with thin interbeds of sand. The silt with its high organic content, and polymodal size composition is a most unsuitable founding material. Penetration data provides confirmation of this point.

Hallett Cove Sandstone (Limestone)

The Hallett Cove Sandstone is the youngest Tertiary unit and marks the end of conditions described variously as "warm and humid" and "Warm - temperate or sub-tropical" in the palaeontological report. There is a profound change in lithology and a sharp faunal break between this unit and the underlying Port Willunga Beds.

At this site the Hallett Cove Sandstone is a thin and irregularly bedded sequence of limestone and clay. A thin bed of sand is indicated within the sequence at about 60 feet below ground surface. The composition and irregular nature suggest the removal of material and/or non-deposition throughout the sequence. Uplift during sedimentation may be responsible for this.

A rare and depauperate fauna towards the top marks the onset of colder, increasingly unfavourable conditions towards the end of the Pliocene.

For detailed comments on foundation conditions the reader is referred to the following sections which deal exclusively with the problem of founding large structures on the limestone.

Pleistocene "Mottled Clays":

Major faulting came to an end in late Tertiary time, but there is evidence that minor faulting and regional uplift continued into the Recent. Profound changes in the position of the Strand and of the climatic zones were caused by glacio-eustatism. Sea level, for example, probably fell exposing most of the continental shelves, and glacial (at least peri-glacial) conditions were established in southern Australia. Extreme conditions of this sort were imposed on the area at least several times during the last million years (Quaternary time). This time of marked physical gradients is in sharp contrast to the Tertiary era which preceded it.

Preconsolidation figures from clays of the Port Willunga Beds have been taken to show erosion of about 125 feet of that unit. However, a similar amount of overburden can be reconstructed from the Port Willunga Beds, the Hallett Cove Sandstone, ? basal Pleistocene deposits and shallow water in which the deposits were laid down.

Iron staining and solution cavities at the top of the remaining Hallett Cove Sandstone mark weathering during subaerial exposure. The poorly developed solution cavities may show that the relief at this time was not great enough to significantly lower the groundwater table. This theory requires continuing uplift of the Para Block during Pleistocene time, for materials comparable to basal clays on the Para Block were graded to a sea level at least 270 feet below L.W.O.S.T. in the adjoining rift.

The Pleistocene "Mottled Clay" can be divided into three members; a lower clay, a middle sand bed, and an upper clay.

The wide spread of undrained shear strength values in the lower clay member probably correlate with variations in consistency and moisture content from place to place throughout the mass. Decrease in shear strength from 40 to 55 feet, increasing voids ratio over the same interval and decrease in activity probably mark a "dessication surface", according to Cox of Kinnaird Hill and Associates. This conclusion receives support

from the mottling and ferruginisation at about this depth.

Physical properties logged for the upper clay member are fairly uniform, in marked contrast to these in the lower clay member.

Texture variations appear to be responsible for the correlation of low sand-high silt and clay percentages with Liquid Limit, Plasticity Index and Shrinkage Ratio in tables attached to the mechanical analysis charts. This is particularly true of the upper clay member.

Late Pleistocene to recent events are represented in the section by the limey surface clays. The lime may be responsible for variations in certain soil mechanics values between this and the lower clay. Elsewhere, a high lime content correlates with low strength clays. The perched groundwater table at about 8 feet also influences near surface conditions.

FOUNDATION CHARACTERISTICS OF HALLETT COVE SANDSTONE (LIMESTONE) AT THE SITE

Diamond Drill logs of the Hallett Cove Sandstone intersected in Bores 2 and 4, Victoria Square, are given in Appendices 3 and 5, together with photos of the core (Appendix 6).

Some of the more important features related to foundation conditions are as follows:

1. The Hallett Cove Sandstone at this site is a thin and irregularly bedded sequence of limestone and clay. A thin bed of sand is indicated in Bore Hole No. 2 by water loss during diamond drilling. Limestone beds range from less than 2 feet to about 5 feet in thickness. The whole sequence is about 22 feet thick in Bore Hole No. 2 and 15 feet thick in Bore Hole No. 4.

2. The limestone in the interval 61.5 feet to 66 feet in Bore Hole No. 2 contains solution cavities and clay seams within the limestone. These same features are found in the interval 56 feet to 68 feet in Bore Hole No. 4.

3. The denser limestone below the zone of clay seams and

solution cavities in both bores is broken by near vertical fractures, and by horizontal fractures in Bore Hole No. 4.

4. The thin irregular beds of limestone and clay, the solution cavities and clay seams, and the numerous near vertical fractures suggest that the Hallett Cove Sandstone is a poor foundation material for high point loads and is unlikely to transmit stress for any distance. Despite these conclusions it provides the most suitable material at about this depth; the thick underlying sequence of silt and sand being generally unsuitable.

5. Placing foundations on the Hallett Cove Sandstone may be difficult: Clay beds and seams may make grouting ineffective, and the sand bed mentioned in (1) may cause pore water pressure problems or may provide an irregular drain for soil water in the mass when under load. Foundations should be kept as near the surface of the sequence as possible to retain a maximum thickness of Hallett Cove Sandstone between the foundations and the underlying silts.

NOTES ON HALLETT COVE SANDSTONE

by

D. H. Stapledon

(Compiled from diamond drill holes and from examination of Reserve Bank pile shafts H2 and K3).

There appear to be essentially 4 nearly horizontal layers forming the 20-foot thick horizon.

LAYER A

The top layer about 5 feet (+) thick consists of about 70% hard white "limestone" in beds 0.05 to 0.3 ft. thick, separated by (interbedded with, in a sense) firm sandy clay or clay in "layers" 0.01 to 0.25 ft. thick, which makes up the other 30% of the rock mass. There are numerous steeply-dipping fractures which persist for a distance of about 0.3 ft. maximum (vertically).

These fractures therefore extend through individual "beds" of the "limestone", but do not (in the exposures seen) persist through the whole rock mass.

Although consisting mainly of rock, this layer contains so many joints and clay as seams and cavity fillings that the rock mass is relatively weak. Pile H2 at the Reserve Bank was seated immediately below this layer. It appeared that this Layer A had been excavated largely by hand and jack-pick.

It is considered that this Layer A is represented well by the core of Drill Hole No. 2 between 61.5 and 66 feet, and of Drill Hole 4 between 60 and 65 feet.

LAYER B

The next layer 4 to 6 feet thick in Pile E2 foundation area, but apparently generally thicker than this, consists of a dense calcareous sandstone bed. From the results of drilling this appears to contain relatively few persistent fractures. However one or two steeply-dipping slightly open fractures occur at 68.5 feet in Drill Hole No. 2. The chances of intersecting steeply dipping fractures with only 2 vertical cores of less than 2 inches diameter are not very great, and it can be inferred that a number of such fractures are present. Whether or not they persist right through the calcareous sandstone layer is not known, but it is considered quite likely that they do. During grouting operations at Pile E2 at the Reserve Bank, grout made its way right through from below Layer B to the upper surface of the layer, which suggests <u>interconnected</u> fractures at least.

LAYER C

Immediately underlying Layer B no core was recovered in diamond drill holes, and drilling water was lost. The core immediately adjacent to the core loss is soft and friable - poorly cemented. It has been inferred that this core loss of about 2 feet between 69 and 71 feet in Drill Hole No. 2 is a layer of uncemented sand.

It is proposed to use this inferred sand horizon as a drain. It is considered that the following would be necessary to assess the capacity of this sand horizon as a drain:

1. Preservation of drill holes by means of casing, perforated at the sand level, with a strainer gauze of appropriate size.
2. Testing the horizon for permeability using an accepted type of well-permeameter test of the pump or run-in type.
3. Measurement of groundwater levels in the preserved holes throughout summer and winter, to get the seasonal variation.
4. A check should be made on the amounts of waste water being fed into the sand from other buildings in the vicinity, and upon its effectiveness as a drain in these cases.

LAYER D

This is essentially the same as Layer B but a little more dense in some cases. It may consist locally (e.g. Drill Hole 2 between 71 and 77.5 feet) of two layers of dense calcareous sandstone separated by clay or sand. It contains a number of steeply dipping fractures where met in Drill Hole 2.

APPENDIX 1

SOIL CLASSIFICATION CHART

DEPARTMENT OF MINES SOUTH AUSTRALIA
SOILS CLASSIFICATION CHART

FORM E.S.1

			FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions on estimated weights)	GROUP SYMBOL	GROUP NAME and typical materials
COARSE GRAINED SOILS More than 50% of material is larger than No. 200 B.S. Sieve size.	GRAVELS More than 50% of the coarse fraction is larger than ¼ inch.	CLEAN GRAVELS Little or no fines	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	GRAVEL, well graded; gravel sand mixtures, little or no fines
			Predominantly one size, or a range of sizes, with some intermediate sizes missing.	GP	GRAVEL, poorly graded; gravel sand mixtures, little or no fines.
		DIRTY GRAVELS Appreciable amount of fines	Non-plastic fines – for identification see ML below.	GM	GRAVEL, excess silty fines; poorly graded gravel-sand-silt mixtures
			Plastic fines – for identification see C L below	GC	GRAVEL, excess clayey fines; poorly graded gravel-sand-clay mixtures
	SANDS More than 50% of the coarse fraction is smaller than ¼" inch.	CLEAN SANDS Little or no fines.	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes	SW	SAND, well graded; well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes, with some intermediate sizes missing.	SP	SAND, poorly graded; poorly graded sands gravelly sands, little or no fines
		DIRTY SANDS Appreciable amount of fines	Non plastic fines – for identification see M L below	SM	SAND, excess silty fines; poorly graded sand-silt mixtures
			Plastic fines – for identification see CL below	SC	SAND excess clayey fines; poorly graded sand-clay mixtures.

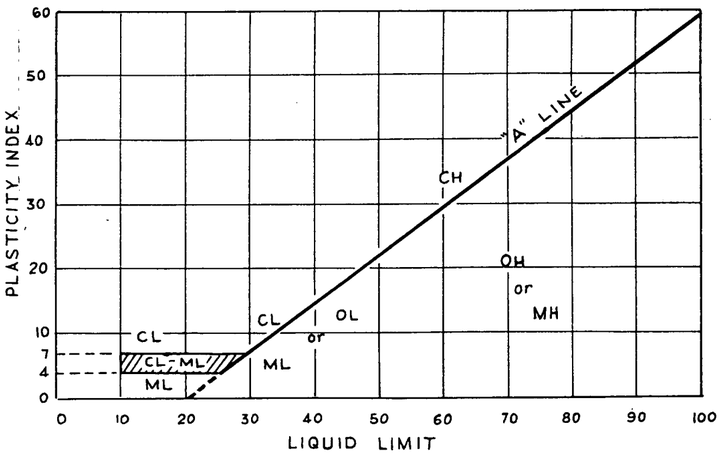
		FIELD INVESTIGATION PROCEDURES (on fraction smaller than B.S. No.7 sieve)						GROUP SYMBOL	GROUP NAME (and typical materials)
		SOIL CAST (wet soil)	SOIL THREAD	SHINE	DILATANCY	ODOUR	DRY STRENGTH		
FINE GRAINED SOILS More than 50% of material is smaller than No. 200 B.S. sieve size.	SILTS AND CLAYS Liquid limit less than 50	Forms fragile cast Cracks form when kneaded while moist	Thick crumbly thread; easily broken	None to very dull	Distinct	Not significant	None to slight	ML	SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour.
		Cast maybe handled freely without breaking. Can be kneaded moist without cracking. Material adheres to the hand.	Thread can be pointed as fine as a lead pencil, but is fragile.	Moderate	None to slight	Not significant	Moderate	CL	CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Cast fragile to cohesive material will adhere somewhat to the hand.	Soft, weak thread.	None to very dull	Slight to distinct	Decayed organic matter	Low	OL	ORGANIC SOIL low plasticity; organic silts and silt clays of low plasticity
	SILTS AND CLAYS Liquid limit more than 50	Moderately plastic and cohesive. Material adheres somewhat to the hand	Weak to medium thread. May be crumbly.	Dull	None to slight	Not significant	Moderate Powdered soil feels floury	MH	SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils elastic silts.
		Very plastic and cohesive. Material very sticky to the hand. Greasy to touch.	Very tough thread Can be rolled to a pin point.	Very glossy	None	Strong earthy.	High to very high. Cannot be powdered by finger pressure	CH	CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays
		Plastic and cohesive. Feels slightly spongy Greasy to touch.	Weak to medium thread. Often soft and fibrous	Moderate to very glossy	None	Decayed organic matter	Moderate to high. Powdered soil may be fibrous.	OH	ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by colour, odour, spongy feel and frequently by fibrous texture.						Pt	PEATY SOIL; Peat and other highly organic soils.

GRAIN SIZE CURVE to be used to identify soil fractions.

LABORATORY CLASSIFICATION CRITERIA

Coarse grained soils classified on basis of percentage of fines, as follows

PERCENT OF FINES	SANDS	Cu = $\frac{D60}{D10}$ Greater than 4 Cc = $\frac{(D30)^2}{D10 \times D60}$ Between one and 3	
		Not meeting all gradation requirements for GW	
Less than 5	SW, SP	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
		Atterberg limits above "A" line with PI greater than 7	
	GRAVELS	Cu = $\frac{D60}{D10}$ Greater than 6 Cc = $\frac{(D30)^2}{D10 \times D60}$ Between one and 3	
		Not meeting all gradation requirements for SW	
More than 12	GW, GP	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
		Atterberg limits above "A" line with PI greater than 7	
5 to 12	GM, GC	Borderline cases, use 2 symbols	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

NOTE : BOUNDARY CLASSIFICATIONS : Soils possessing characteristics of two groups are shown as a combination of two group symbols, e.g. GW-GC, well graded gravel with clay binder.

Based on "The Unified Soil Classification System" United States Department of the Interior, Bureau of Reclamation "Earth Manual" First Edition, Denver COLORADO 1960

64-246
M.G.

APPENDIX 2

ENGINEERING GEOLOGY LOG AND BORE LOG ANALYSIS

APPENDIX 3

Diamond Drill log

ENGINEERING GEOLOGY ~~PERCUSSION LOG~~, BORE 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA Hole No. 2

GEOLOGICAL LOG OF DRILL HOLE

PROJECT GOVERNMENT OFFICES CO-ORDINATES R.L. FT

FEATURE FOUNDATION TESTING HUNDRED DIRECTION °

LOCATION VICTORIA SQUARE SECTION ANGLE FROM HORIZONTAL °

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Depth and Size of Core	Log	Lift and Core recy %	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	Remarks
	0 to 61·5 feet Percussion Samples		60				
UPPER PLIOCENE HALLETT COVE SANDSTONE: Calcareous Sandstone	Very fine grained, pale grey, <10% insolubles. Core in 0·05 to 0·2 ft fragments					Numerous sub horizontal highly irregular solution cavities throughout. Thin clay seam at least 0·2 ft. wide. Greyish-yellow limey clay seam 65 to 66 ft cont. <25% lime.	Insoluble material in the Hallett Cove Sandstone is mainly quartz.
NO CORE			65		75		
Calcareous Sandstone	Dense, very fine grained, pale grey. Core in 0·1 to 1 ft. lengths.				60		Zones marked "No Core" probably represent clay seams. Sand recorded at other sites may occur in this bore at about 70 ft. where water loss is reported during diamond drilling.
NO CORE			70				
Calcareous Sandstone	Dense, fine-grained, pale yellowish-grey. Contains abundant fine-grained dark grey manganese. Core in 0·1 to 0·5 ft. lengths.				55	Thin steeply dropping fractures from 72 to 73 ft.	
NO CORE			75				
Calcareous sandstone	Shelly, fine grained pale yellowish brown <10% insolubles Rather porous. Core in 0·1 to 0·5 ft. lengths.				50	Numerous thin, steeply dipping irregular fractures from 77 to 77·5 ft.	
NO CORE			80				
silty clay	pale yellowish brown, limey <10% insolubles				5		
NO CORE							

83·5 ft. END of D.D. HOLE

1) Insoluble material in the Hallett Sandstone is mainly quartz

2) Zones marked "No Core" probably represent clay seams.

EXPLANATION

WATER LEVEL ▼ DATE

Drill No. Logged Vert. Scale

Type Sheet No. Sheet of

Driller Drawn S3757

Commenced Checked Drawing No. Ha6

Completed Submitted

250–7.60 8036

APPENDIX 4

ENGINEERING GEOLOGY PERCUSSION LOG, BORE 4

DEPARTMENT OF MINES - SOUTH AUSTRALIA

LOG OF PERCUSSION DRILL HOLE

HOLE NO. 4

SHEET 1 OF 2

PROJECT *GOVERNMENT OFFICES* Hirer

LOCATION *VICTORIA SQUARE* Sec. Hd

FEATURE *FOUNDATION TESTING* Depth R.L *253·25* Coords

SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	PENETRATION DATA BLOWS FOOT 20 40 60 80cm
		110			*Auger barrel, diamond drill and percussion drill to 112'3"*				
Top of bed									
Upper Eocene — Blanche Point Marls (soft member) — *Silt; dark grey, pyritic, with numerous casts of small shells and some pyritised tubular fossils. Large spherical aggregates of pyrite up to ¼" in diam. occur in some places.*		115		OL	*Organic soil, Low plasticity*	*Stiff*	*Damp*		
		120							
		125							
Becomes siltstone with horizontal layering below 129 ft. 9 ins. Last foot is silty sandstone.		130		OL	*Weakly cemented. Group symbol applies to powdered sample.*	*Stiff*	*Damp*		
				SM	*Sand, excess silty fines*	*Hard*	*Humid*		
Quartz sand; light brown coarse-grained to 136 ft. medium-grained to 137 ft. 3 ins. fine-grained to 141 ft.		135		SW	*Sand, well graded*	*Very loose*	*Wet*		
		140							
Silt; grey-brown, micaceous glauconitic with numerous scaphopods in the last foot.				OL	*Organic soil, low plasticity*	*VSt*	*M*		
		145		OL	*Sludge log*	*St.*	*M*		
						V.St.	*D*		
Sandstone; dark greenish-grey, fine grained, silty, glauconitic, fossiliferous, impure, limey. SiC G SiC G SiC G GG		150			*See Footnote sheet 2.*				
		155							

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp
Auger barrel	Supply	F-Firm	C-Compact	M-Moist
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet
Casing	← Water level. (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated
		H-Hard		

Plant No. Logged

Type Date

Driller Drilled

Started Traced B.L.S.

Finished Checked

PLAN No. S3805 Ha.6

Vertical Scale 5 Feet to 1 Inch

DEPARTMENT OF MINES - SOUTH AUSTRALIA

LOG OF PERCUSSION DRILL HOLE

HOLE NO. 4

SHEET 2 OF 2

PROJECT *GOVERNMENT OFFICES* Hirer

LOCATION *VICTORIA SQUARE* Sec. Hd

FEATURE *FOUNDATION TESTING* Depth R.L. *25·25* Coords

SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	PENETRATION DATA BLOWS FOOT 20 40 60 80/ca
		155							
?Sandy clay; dark greenish-grey, fine grained glauconitic limey. SiC									
Sandstone, dark greenish-grey, fine grained, silty glauconitic impure fossiliferous, limey. C SiCS / Si SC		160							
?Sandy clay Si SC									
Sandstone; dark greenish-grey fine grained, silty glauconitic, impure, fossiliferous, limey. Si CS / G / C G / GSC / G SiC		165			"Clay with hard seams" Logged by driller.				
		170							
		175							Sealed Tube
Clay, limey, silty 10% ± glauconite, some sand sized shell.				CL		St.	D		Blows N.A.
Sandstone, dark greenish-grey, fine grained, silty glauconitic, impure, fossiliferous, limey. G SiC		180							
As above with thin beds of ?sandy clay. SiC + some G		185							
		190			"Hard layers of rock with seams of clay" Logged by driller.				
Clay, silty, glauconite 20% ±, small shells 10%		195							Sealed Tube
				CL		St.	D		Blows N.A.
		200							

Upper Eocene Blanche Point Marls (Hard banded member)

Log of sludge size after drilling

G - Gravel
S - Sand
Si - Silt
C - Clay

N.B. Silty sandy gravel is written SiSG (amounts of various sizes increasing towards the right.)

End of hole

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp
Auger barrel	Supply	F-Firm	C-Compact	M-Moist
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet
Casing	← Water level. (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated
		H-Hard		

Plant No. ... Type ... Driller ... Started ... Finished ... Logged ... Date ... Traced B.L.S. Checked

PLAN No. S38050 H06

Vertical Scale 5 Feet to 1 Inch

APPENDIX 5

ENGINEERING GEOLOGY DIAMOND DRILL LOG, ,BORE 4

DEPARTMENT OF MINES — SOUTH AUSTRALIA Hole No. 4

GEOLOGICAL LOG OF DRILL HOLE

PROJECT GOVERNMENT OFFICES CO-ORDINATES ..... R.L. ..... FT

FEATURE FOUNDATION TESTING HUNDRED ..... DIRECTION ..... °

LOCATION VICTORIA SQUARE SECTION ..... ANGLE FROM HORIZONTAL °

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Depth and Size of Core	Log	Lift and Core rec'y %	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones
	0-56 feet Percussion Samples		50 55			
HALLET COVE SANDSTONE	Fine-grained pale grey with numerous sub-horizontal soln. cavities					Soln. tubes up to 0·1 ft. diameter are filled with light yellow limey silty clay. Clay seams of 66 to 66·5 ft, 57·1 to 57·6 ft, 60·5 to 60·7 ft, 67 to 67·2 ft, 67·5 to 68 ft.
	No Core					
	Calcareous Sandstone	Core in 0·1 to 0·6 ft. lengths	60			
	No Core					
	Calcareous Sandstone	Fine grained, pale grey, dense. Core in 0·1 to 1·5 ft. lengths	65			Free of soln. cavities.
	Calcareous Sandstone	Fine grained, pale yellowish-grey, porous.				Horizontal, near-vertical fractures 69 to 69·5 ft. are coated with fine grained spots of manganese.
	No Core	Core in 0·05 to 0·5 ft. lengths	70			
	71 ft. 6 ins.	End of D.D. Hole.				

EXPLANATION

WATER LEVEL ▼ DATE

Drill No. .....
Type .....
Driller .....
Commenced .....
Completed .....

Logged .....
Sheet No. .....
Drawn .....
Checked .....
Submitted .....

Vert. Scale .....

Sheet 1 of 1

S3758 Ha6
Drawing No.

250 7.60 0036

APPENDIX 6

PHOTOGRAPHS OF DIAMOND DRILL CORE, BORES 2 and 4

photo. 31285

photo. 31286

APPENDIX 7

ORIGINAL GEOLOGICAL LOGS

Department of Mines,
South Australia.

PERCUSSION DRILL LOG

Bore No.: 2

Project: Public Buildings Department - Government Offices

Purpose: Foundation Investigation

Location: Victoria Square

Depth: 130 ft. R.L. 253.25ft. Core Diameter: 4" Commenced: 21/1/64 Completed 29/1/64 Bore Serial No. 754/64

Bore Logged by: J.B. Firman Date: 18th May Driller: D.R. Phillips Docket No.: 1940/63 Plant: 24

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration Blows/Ft.	Water Condition	Consistency or Density	Remarks (Group Symbol)
0	32	Pale grey clay with pale red and dark yellow mottling in some places. Numerous small soft patches of earthy lime from 6 ft. to 8 ft. Scattered limey patches from 9 ft. to 10 ft. Granular structure from 5 ft. to 10 ft. Polyhedral structure and bright sheen from 15-16 ft., 24 ft. to 25 ft., slickensides at 2 to 3 ft., 20 to 21 ft., 24 to 25 ft. and 31 ft. to 32 ft. Vertical faces of large prismatic structures from 16 to 17 ft., 27 to 28 ft. and 30 to 31 ft.	0	1				No Sample
			1	2				" "
			2	3	12	Damp	Very stiff	CH
			3	4				No Sample
			4	5				" "
			5	6	9	Damp	Very Stiff	CL
			6	7				No Sample
			7	8	9	Damp	Very Stiff	CL
			8	9				No Sample
			9	10	8	Damp	Very Stiff	CL
			10	11	9	2"	" "	
			11	12	15	"	" "	
			12	13				No Sample CH
			13	14				" " "

GOVT. OFFICES - BORE 2 (contd.)

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration Blows/Ft.	Water Condition	Consistency or Density	Remarks (Group Symbol)
32	39	Pale grey sandy clay and clayey sand with dark yellow, dark red mottling. Thin cracks are ferruginised.	14	15				No sample
			15	16	12	Damp	Very Stiff	Empty tube CH
			16	17	12	"	" "	"
			17	18				No sample
			18	19				" "
			19	20	12	Damp	Very Stiff	CH
			20	21	12	"	" "	"
			21	22				No sample
			22	23				" "
			23	24	12	Damp	Very Stiff	CH
			24	25	12	"	" "	"
			25	26				No sample
			26	27				" "
			27	28	12	Damp	Very Stiff	CH
			28	29	12	"	" "	CH
			29	30	12	"	" "	CH
			30	31	12	"	" "	CH
			31	32	14	"	" "	CH
			32	33	35	"	Very Dense	SC-CH
			33	34	35	"	" "	"
			34	35	35	"	" "	"
			35	36	30	Damp	Very Dense	SC
			36	37	35	"	Dense	"
			37	38	35	"	"	"
			38	39	16	"	"	"

GOVT. OFFICES - BORE 2 (contd.)

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration Blows/Ft.	Water Condition	Consistency or Density	Remarks (Group Symbol)
39	61	Pale grey clay with dark yellow and red mottling to 44 ft. and with light yellow mottling lower. Clay breaks vertically on drying. Well developed slickenside with a bright sheen from 51 to 52 ft., 53 to 54. Abundant patches of off-white earthy lime from 57 to 59 ft. Becoming very clayey sand 59 to 60 ft. and clayey fine sand 60 to 61 feet.	39	40	25	Damp	Very stiff	CH
			40	41	25	"	" "	"
			41	42	25	"	" "	"
			42	43	26	"	" "	"
			43	44	25	"	" "	"
			44	45	25	"	" "	"
			45	46	25	"	" "	"
			46	47	25	"	" "	"
			47	48	25	"	" "	"
			48	49	25	"	" "	"
			49	50		(no sample)		
			50	51	22	Damp	Very stiff	"
			51	52	22	"	" "	"
			52	53	20	Humid	Stiff	"
			53	54	20	"	"	"
			54	55				Empty tube
			55	56				" "
			56	57	14	Humid	Stiff	CH
			57	58	23	"	Very stiff	CL
			58	59	23	"	" "	"
			59	60	23	Damp	Dense	SC
			60	61	25	"	"	SM
61	61'6"	Pale grey fine-grained sand containing fragments of dense sandy limestone. Limestone contains a minor amount of fine-grained mineral (manganese?) casts of ?shell fragments and is slightly iron stained with pale and dark brown patches.	61	61'6"	100	Wet		Cemented

GOVT. OFFICES - BORE 2 (contd.)

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration Blows/Ft.	Water Condition	Consistency or Density	Remarks (Group Symbo
			61'6"	63				
			63	64				
			64	65				
			65	66				
			66	67				
			67	68				
			68	69				
			69	70				
			70	71				
			71	72				
			72	73				
			73	74				
			74	75				
			75	76				
			76	77				
			77	78				
			78	79				
			79	80				
		Hallett Cove Sandstone to about 80 ft.						
80	83	Dark yellowish brown shelly quartz sand with numerous lumps of hard Hallett Cove Sandstone and large shell fragments, becomes fine-grained without visible shell fragments in the last foot. Fragments of pale grey and yellow finely mottled clayey silt also occur in the lower sand.	80	81	8	Sludge from diamond drilling and reaming		
			81	82	10			
			82	83	9			
			83	84				No sample
84	86	Pale greenish grey limey clayey silt with a small amount of ferruginous staining.	84	85		Damp	Very stiff	No blows
			85	86	10	"	"	
			86	87				Empty tube

GOVT. OFFICES - BORE 2 (contd.)

Depth		Description	Sample Depth		Penetration Blews/ft.	Water Condition	Consistency or Density		Remarks (Grp.Symbol)
From	To		From	To					
87	92	Pale greenish grey and light grey coarsely mottled limey slightly clayey silt with numerous small shell fragments including gastopods. Casts of pectenifrom shells and tubular fossils are also present.	87	88	10	Humid	Very stiff		
			88	89					Empty Tube
			89	90	9	Humid	Very stiff		
			90	91	10	"	Stiff		
			91	92	10	"	"		
			92	93					No sample
			93	94					" "
			94	95	11	Damp	Very stiff		OL
94	98	Dark grey and greyish brown organic clayey silt. Small amounts of ?mica. Sparse brown ferruginous staining also occurs.	95	96	11	"	"	"	"
			96	97	10	"	"	"	"
			97	98	8	"	"	"	"
98	104	Greyish yellow slightly grey mottled fine-grained silty sand with abundant mic. Upper foot is light grey yellow with light red-brown mottles (erosional break).	98	99	8	"	"	"	SM
			99	100	8	Wet	Stiff		"
			100	101	5	"	"		"
			101	102	5	"	"		"
			102	103	5	"	"		"
			103	104	5	"	Firm		"
104	113	Pale greenish grey fine-grained sand with pale green mica (chlorite?)	104	105	7	"	Very stiff		"
			105	106	6	"	"	"	"
			106	107	6	"	"	"	"
			107	108	6	"	"	"	"
			108	109	7	"	Firm		"
			109	110	8	"	Stiff		"
			110	111	10	"	Stiff		"
			111	112	10	Damp	Firm		"
			112	113	10	"	Very stiff		"

GOVT. OFFICES - BORE 2 (Contd.)

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration Blows/ft.	Water Condition	Consistency or Density	Remarks (Group Remarks)
113	130	Dark grey-brown micaceous silt with ?pyrite as staining and replacement of small tubular fossils (?pyrite has a distinctive irridescent purple and in some places pink colour). Casts of small shells with prominent ribs are also present. Upper foot coarsely mottled dark grey and light grey with brown ferruginous staining and some ring-shaped masses of ?pyrite.	113	114	10	Damp	Stiff	SM
			114	115	10	"	Very stiff	"
			115	116	10	"	" "	OL
			116	117	10	"	" "	"
			117	118	10	"	" "	"
			118	119	10	"	" "	"
			119	120	10	"	" "	"
			120	121	10	"	" "	"
			121	122	10	"	" "	"
			122	123				No sample
			123	124	10	Damp	" "	OL
			124	125	10	"	" "	"
			125	126	10	"	" "	"
			126	127	12	"	" "	"
			127	128	10	"	" "	"
			128	129	10	"	" "	"
			129	130	10	"	" "	"

END OF HOLE

DATA FROM DRILLERS LOGS - BORE 4

Footage	Drillers Log of Strata	Drillers Comments	Remarks
0 - 39'5"			Auger Barrel. No Log
39 - 55'	Mottle Clay		Percussion drilling begins Pleistocene "Mottled Clay"
55 - 56'	Clay traces limestone		Top Hallett Cove Sandstone (Limestone)
56 - 56'6"	Limestone	Water lost at 60 ft.	Hallett Cove Sandstone
61 - 69'	Limestone		Hallett Cove Sandstone to 83 ft.
69 - 70'	Sand	Diamond Drilled 56 - 70ft. 6 ins.	
70 - 72'6"	Limestone		
72'6"- 73'	Sand		Percussion with sealed tubes continues to 146 ft., then chisel bit for most of hole to end.
73 - 74'	Limestone		Geological Log begins here.
74 - 87'	Limestone	Not hard	
87 - 106'	Clay		Pt. Willunga Beds and Blanche Point Marls. Refer to Geological Log for details.

PERCUSSION DRILL LOG

Department of Mines,
South Australia

Preliminary Log of struck-off ends from sealed tube samples

Bore No.: 4

Project: Public Bldgs. Dept. Site Investigation **Purpose:** c Foundation Testing

Location: Victoria Square **Hundred:** **Section:**

Depth: 200' **R.L.** **Core Diameter:** 4" **Commenced:** 16/1/64 **Completed:** 25/2/64 **Bore Serial No.** 751/64 **Plant:** 2

Bore Logged by: J.B.F. **Date:** **Driller:** E. Jamieson **Docket No.** 1940/63

Depth	Description	Sample Depth From	Sample Depth To	Penetration (1) Blows	Water Condition	Consistency or Density	(2)	Remarks
72 - 73'	Light yellowish-grey medium-grained sand containing about 65% quartz and 35% lime cement with a few lumps of hard limey sandstone.	72	73	-				Diamond Drilling to 74 ft.
73 - 74'	Light yellowish grey gravelly sand with composition as for 72-73 ft.	73	74	-	Note Hallett Cove Sandstone (Limestone) begins at about 56 ft. and continues to about 83 ft.			Percussion below
								74 to 81 ft. Missing
81 - 83'	Light yellowish grey limey clayey silt with small light brown mottles. Brown staining occurs around shells.	81	82		Damp	Very Stiff	MH	
		82	83		"	" "	MH	
		83	84		"	" "	MH	
		84	85		"	" "	MH	
		85	86		"	" ""	MH	

(1) Blows/Ft. are probably available on Sealed Tubes held by E.W.S. Soils Section
(2) Group Symbol: Earth Manual, 1960.

Depth From	Depth To	Description	Sample Depth From	Sample Depth To	Penetration (1)	Water Condition	Consistency or Density	(2)	Remarks
					Blows				
83 -	88'	Light yellowish grey limey and silty clay. Numerous close-spaced slickensides produce a polyhedral structure. Dull sheen on slickensided surfaces.	86	87'		Damp	Very Stiff	MH	
			87	88'		"	Stiff	MH	
88 -	90'	Light grey and yellowish grey very sandy clay with grey staining	88	89'		"	"	MH	
			89	90'		"	"	MH-CH	
90 -	92'	Light grey-brown sandy clay becoming light grey silty clay with olive mottles	90	91'		"	Hard	"	
			91	92'		"	Stiff	"	
92 -	94'	Light grey silty clay with yellowish brown mottling.	92	93'		"	"	"	
			93	94'		"	Firm	"	
94 -	96'	Grey clayey silt	94	95'		"	Stiff	"	
			95	96'		"	Hard	"	
96 -	106'	Light grey and yellowish grey silty and fine sandy clay becoming clayey fine sand below 99 feet.	96	97'		"	Very Stiff	CH	
			97	98'		"	Stiff	MH	
			98	99'		"	Loose	ML	
			99	100'		Moist	"	ML	
			100	101'		"	"	"	
			101	102'		"	"	"	
			102	103'		"	"	"	
			103	104'		"	"	"	
			104	105'		"	"	"	
			105	106'		Damp	"	"	

This log extends the section given in Bore 2 below 130' (Base of Bore 2)

PERCUSSION DRILL LOG.

Department of Mines,
South Australia.

Bore No.: 4

Project: Public Buildings Department - Government Offices

Purpose: Foundation Investigations

Location: Victoria Square

Depth: 200 ft. R.L. 253.25ft. Core Diameter: 4" Commenced: 16/1/64 Completed: 25/2/64 Bore Serial No. 751/64

Bore Logged by: J. B. Firman Date: May, 1964. Driller: E. Jamieson Docket No. 1940/63 Plant: 24

Depth		Description	Sample Depth		Penetration Blows/Ft.	Water Condition	Consistency or Density	Remarks (Group Symbol)
From	To		From	To				
112'3"	133'6"	Dark grey pyritic silt with numerous pecten-like casts of small shells and pyritised tubular fossils. Becomes siltstone with some horizontal layering below 129'9". Last foot is a silty sandstone. Large spherical aggregates of pyrite up to ½" diam. occur in some places.	112'3"	113'6"	24	Damp	Stiff	OL
			113'6"	114'9"	21	"	"	"
			114'9"	116'	21	"	"	"
			116	117'3"	21	"	"	"
			117'3"	118'6"	72	"	"	"
			118'6"	119'9"		"	"	Sample supplied by M.Lindsay, Palaeontology Section
			119'9"	121'	27	"	"	OL
			121	122'3"	27	"	"	"
			122'3"	123'6"	29	"	"	"
			123'6"	124'9"	29	"	"	"
			124'9"	126	28	"	"	"
			126	127'3"		"	"	No sample
			127'3"	128'6"	30	"	"	OL
			128'6"	129'9"	30	"	"	"

GOVT. OFFICES - BORE 4

Depth From	Depth To	Description
133'6"	141'	Light brown quartz sand. Coarse grained to 136', medium-grained to 137'3", fine-grained to 141'.
141	147'3"	Dark greenish grey-brown silt, micaceous, glauconitic and containing scaphods in the last feet.

Sample Depth From	Sample Depth To	Penetration Blows/Ft.	Water Condition	Consistency or Density			Remarks (Group Symbols)
129'9"	131'	29	Humid	Hard	OL when powdered	Weakly cemented?	
131	132'3"	25	"	"		"	
132'3"	133'6"	29	"	"	SM when powdery	"	
133'6"	134'9"	25	Wet	x Very loose	"	SW	
134'9"	136	32	"	"	"	"	
136	137'3"	38	"	"	"	"	
137'3"	138'6"	50	"	"	"	"	
138'6"	139'9"	54	"	"	"	"	
139'9"	141	54	"	"	"	"	
141	142'3"	24	Moist	Very stiff		OL	
142'3	144'9"		"	"	"	"	*
144'9"	146'	38	"	Stiff			
146'	147'3"	52	Damp	Very stiff		"	

END OF BORE

x Condition of material in laboratory only

* Material supplied by M. Lindsay, Palaeontology Section.

PERCUSSION DRILLING - SLUDGE LOG

Department of Mines,
South Australia.

BORE NO. 4

Project: Public Buildings Department - Government Offices

Purpose: Foundation Investigations

Location: Victoria Square

Depth: 200' R.L. Core Diameter: 4" Commenced: 16/1/64 Completed: 25/2/64 Bore Serial No. 751/64

Bore Logged by: J. B. Firman Date: May, 1964 Driller: E. Jamieson Docket No. 1940/64 Plant No. 24

Depth		Description of sludge	Interpretation of Material	Remarks
From	To			
146	149	Dark greenish grey silty clay with a small amount of coarse angular sand and some angular granules of a hard impure limey sandstone (50% lime as cement or finely comminuted fossil material). When washed residue is all of the sandstone together with a small amount of fossil debris. Moist.	Fossiliferous, glauconitic impure limey, silty fine-grained sandstone.	Same colour down to 163 feet.
149	150	Fine-grained gravel. Moist	Ditto	Washing leaves glauconite free
150	151	As for 146 to 149. Moist	Ditto	
151	154	Silty and clayey fine gravel. Moist	Ditto	
154	156	Sandy and clayey to very clayey fine gravel. Moist.		
156	158	Sandy and silty clay. Moist	Ditto, but may be sandy clay	

GOVT. OFFICES - BORE 4

Depth From	Depth To	Description of Sludge	Interpretation of Material	Remarks
158	159	Clayey very sandy fine gravel. Moist	Fossiliferous, glauconitic, impure, limey, silty fine-grained sandstone.	
159	160	Clayey and silty coarse sand. Moist	Ditto	
160	161	Sandy clay	Ditto	Clay with hard seams logged by driller from 160 to 190 ft.
161	162	Silty and sandy clay with some angular fragments of sandstone and a few large fossil fragments. Moist.	Ditto, but may be a sandy clay	
162	164	Silty and clayey coarse sand. Moist to 163, humid below with colour change to light greyish brown.	Ditto	Colour change due to moisture change.
164	166'6"	Hard angular fragments of sandstone from fine gravel to pebble size. Moist.	Ditto	
166'6"	169	Light greyish brown gravel of hard angular sandstone fragments. Humid.	Ditto	
169	170	Ditto with clay lumps up to 30 mm. diam. Humid.	Ditto	
170	171	Fine gravel of clay lumps and angular sandstone in a humid matrix of coarse sand size aggregates of silty clay. Humid.	Ditto	

GOVT. OFFICES - BORE 4

Depth From	Depth To	Description of Sludge	Interpretation of Material	Remarks
171	173	Light greyish brown gravelly sand (actually a dried silty clay). On washing yields coarse sand with some fine gravel of hard sandstone.	Fossiliferous, glauconitic, impure, limey, silty fine-grained sandstone.	
173	177	Dark greenish grey gravelly, silty clay. Damp to moist. Yields sandy fine gravel of hard sandstone on washing.	Ditto	
177	179	Greenish brown limey and silty clay with about 10% glauconite and 10% sand-sized shell fragments. This may be a soft bed in the sandstone.	Lithology as described	Damp, stiff CL
179	184	Dark greenish grey gravelly silty clay. Wet to 182, moist from 182 to 184.	Fossiliferous, glauconitic, impure, limey, silty fine-grained sandstone.	
184	198	Light greenish brown silty clay with some sandstone gravel. Humid to 185, moist at 186, damp to moist to 188, damp 188 to 190, moist 190 to 192, damp to 193, wet below.	May contain thin beds of sandy clay	Partially dried out sludge. Colour change due to change in moisture.
198	199	Greenish brown silty clay containing about 20% glauconite and 10% small shells.	Lithology as described	Damp, stiff CL
199	200	Dark greyish or greenish grey silty clayey gravel (up to 50mms). Contains abundant gastropods and fragments of large pelecypods. Gravel is platy and structured.		Hard layers of rock with seams of clay logged by driller from 190 to 200 ft.

END OF HOLE

APPENDIX 8

WATER ANALYSES - BORE NO. 4

GEOLOGICAL SURVEY OF SOUTH AUSTRALIA D.M.—C7

WATER ANALYSIS

Sample No. W909/64

Name and Address PUBLIC BUILDINGS, VICTORIA SQUARE

Location of Sample : Hundred Section

Sample collected by E. JAMIESON Date

Analysis made by A. NELSON and dated 26/ 2 /19 64

	P.P.M.	ASSUMED COMPOSITION OF SALTS	P.P.M.
Chlorine, Cl		Calcium carbonate	
Sulphuric acid (radicle), SO_4		Calcium sulphate	
Carbonic acid (radicle), CO_3		Calcium chloride	
Nitric acid (radicle), NO_3		Magnesium carbonate	
Sodium, Na		Magnesium sulphate	
Potassium, K.		Magnesium chloride	
Calcium, Ca		Sodium carbonate	
Magnesium, Mg		Sodium sulphate	
Silica, SiO_2		Sodium chloride	
		Sodium nitrate	
		Potassium chloride	
Total saline matter, Parts per million	1014	HARDNESS	
			P.P.M.
Total saline matter, Grains per gallon ATS	71	Total	
Total saline matter, Ounces per gallon		Temporary	
		Permanent	
Suspended matter		Due to calcium	
Organic matter		Due to magnesium	

Bore No. 4

Depth 106

Water Level 56

Water Cut 106

Supply G.P.H.

REMARKS

GOVERNMENT OFFICES, VICTORIA SQUARE

T. A. BARNES
Government Geologist

10M—11.63 2329

GEOLOGICAL SURVEY OF SOUTH AUSTRALIA D.M.—C7

WATER ANALYSIS

Sample No. W910/64

Name and Address PUBLIC BUILDINGS, VICTORIA SQUARE

Location of Sample : Hundred ..... Section .....

Sample collected by B. JAMIESON Date 20.2.64

Analysis made by A. NELSON and dated 26 / 2 /19 64

	P.P.M.	ASSUMED COMPOSITION OF SALTS	P.P.M.
Chlorine, Cl		Calcium carbonate	
Sulphuric acid (radicle), SO_4		Calcium sulphate	
Carbonic acid (radicle), CO_3		Calcium chloride	
Nitric acid (radicle), NO_3		Magnesium carbonate	
Sodium, Na		Magnesium sulphate	
Potassium, K.		Magnesium chloride	
Calcium, Ca		Sodium carbonate	
Magnesium, Mg		Sodium sulphate	
Silica, SiO_2		Sodium chloride	
		Sodium nitrate	
		Potassium chloride	
Total saline matter, Parts per million	1357	HARDNESS	
Total saline matter, Grains per gallon	95		P.P.M.
Total saline matter, Ounces per gallon		Total	
Suspended matter		Temporary	
Organic matter		Permanent	
		Due to calcium	
		Due to magnesium	

Bore No. 4

Depth 193

Water Level 65

Water Cut 193

Supply G.P.H.

REMARKS

GOVERNMENT OFFICES, VICTORIA SQUARE

T. A. BARNES

Government Geologist

10M—11.63 2329