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GEOLOGICAL AND GEOPHYSICAL INVESTIGATION OF THE CITY EAST DEVELOPMENT AREA, CANBERRA, A.C.T.

by

B.H. Dolan, G.A.M. Henderson, G. Jacobson and P.H. Vanden Broek

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SUMMARY

Investigations by seismic survey and rotary core drilling have shown that much of the proposed City East development area in Canberra is underlain by deeply weathered sedimentary rocks. The deep weathering occurs along a fault zone, 100 - 200 m wide, which extends from Ainslie in the north through City East to Lake Burley Griffin in the south. The great depth of weathering, up to 70 m, and its irregularity within the fault zone, poses problems for the design of building foundations in the area. The site for one of the major proposed buildings, the D.C.T. office building, as shown in Figure 1, has many diverse foundation conditions which would require special treatment to reduce differential settlement of the building.

INTRODUCTION

In March 1974 site investigations were undertaken by Ground Test Pty Ltd for a proposed office building for the the Capital Territory (D.C.T.). Department of D.C.T. office building will form part of the proposed City East Ddvelopment project (for location see Figure 1). Drilling indicated completely weathered bedrock to previously unsuspected depths of up to 70 m, causing problems with foundation design for the building. BMR was asked by the Capital Development Commission to carry National geophysical surveys and further rotary core drilling in City East project area in order to ascertain the extent deeply weathered rock and provide information relating to the feasibility of other proposed building construction in the area.

The project geologist was P.H. Vanden Broek in March and April, and G. Jacobson in May and June. B.H. Dolan was the project geophysicist, and G.A.M. Henderson carried out the geological mapping of the Civic Centre area.

GEOLOGY OF THE CANBERRA CITY (CIVIC CENTRE) AREA

A geological map of the Canberra City (Civic Centre) area is shown in Plate 1. It was compiled by G.A.M. Henderson in 1972 from records of mapping of excavations carried out by BMR officers over several years. Information from the current investigation in the City East area has been added to it.

GENERAL GEOLOGY

Alluvium

Alluvium of Tertiary or Quaternary age has been deposited in two valleys, which were drained by creeks flowing south into the Molonglo River. The alluvium, which is up to 5 m thick, consists of gravel, sand, and clay, and overlies Ordovician and Silurian bedrock.

Faulting in alluvium of probable Tertiary age has been observed by E.G. Wilson (pers. comm.) in the Monaro Mall excavation (Fig. 2). The faults were reverse faults dipping moderately steeply to the northeast.

Bedrock

Most of the Canberra City (Civic Centre) area is underlain by middle to late Silurian sedimentary rocks of the Canberra Group (Strusz and Henderson, 1971) which consists mainly of shale and mudstone, in part calcareous, dipping generally to the east and northeast at between 20 and

50 degrees. These rocks are separated from older, Ordovician and early Silurian, shale and mudstone to the west by a fault which has been observed in a tunnel under Liversidge Street, Acton (Opik, 1958), and which probably extends north beneath the alluvium (Plate 1).

The middle to late Silurian rocks can be divided into two units, which because of their markedly different weathering characteristics, are of particular significance for engineering works. The first unit (C on Plate 1), known in part as the City Hill Shale (Opik, 1958), crops out on City Hill and has also been mapped at Sullivan's Creek. It consists of uniform grey mudstone, much of which is calcareous, and which is relatively resistant to weathering. The mudstone is generally fresh or slightly weathered and moderately hard and strong, at a depth of less than 2 metres.

The other middle to late Silurian unit which includes parts of the Riverside Formation and Turner Mudstone (Opik, 1958) comprises mainly mudstone and shale (B on Plate 1) with thin beds of siltstone and fine-grained sandstone, and some limestone (D) and tuff (F). All of these rocks, except the limestone, are weathered to considerable depths throughout the area. The weathering profile is not known accurately but the information available indicates that moderately or highly weathered rock probably extends to a depth of at least 15 m in most places. Boulders of hard, tough, fresh limestone, set in a clay matrix, occur at shallow depths in places.

The rocks are folded, and in places are closely faulted and jointed. Fold axes are parallel to a meridional cleavage. In the City Hill Shale the plunge of folds ranges from 0 to 40 degrees and is generally to the north. A major fault, the City East Fault, has been confirmed by the present investigation. It trends northerly along a topographic lineament and has a zone, 100 - 200 m wide, of sheared and deeply weathered rocks with much clay associated with it.

FOUNDATION CONDITIONS

The conditions to be expected for excavations and building foundations depend largely on whether the underlying rock is the little-weathered mudstone or the other more deeply weathered rocks. The presence of limestone is also an important factor in a few places.

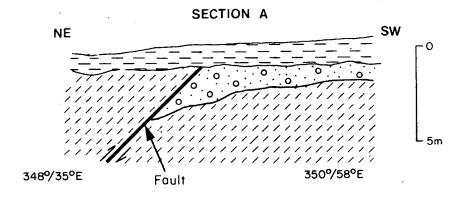
In the little-weathered mudstone (unit C) excavations for foundations of major buildings have generally encountered moderately strong rock within 2 m of the surface. For excavations deeper than 2 m a jack-pick would be needed, and extensive excavations would probably require blasting. No limestone has been recorded from the area of this partly

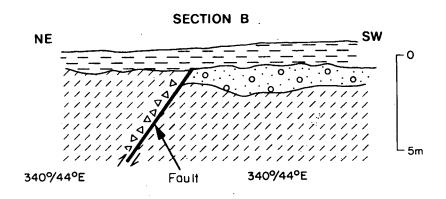


CITY EAST FIG. DRILLHOLES DIAMOND

To accompany Record 1974/123

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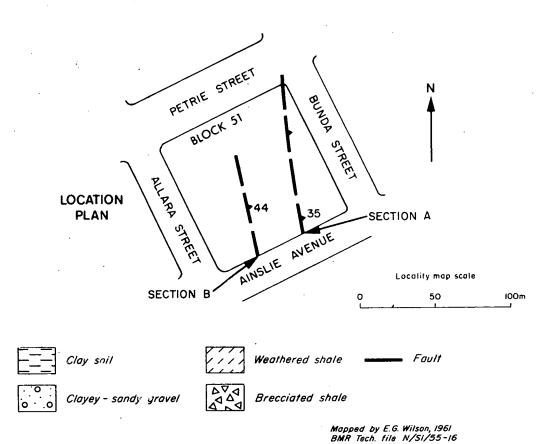


FIG. 2 REVERSE FAULTS IN THE MONARO MALL EXCAVATION, CANBERRA

calcareous rock unit C; however there is a possibility that small areas of cavernous limestone could occur.

In the other rock types (units B, D, E, F) the depth of foundations for large buildings depends on the local depth of weathering and the presence of any weaknesses such as fault zones or cavernous limestone; generally foundations need to be deeper than in the little-weathered mudstone. Owing to the deep weathering, excavation to a depth of about 15 m can probably be accomplished in most places by mechanical means (such as bulldozer and ripper, or power-shovel) without blasting. Where limestone occurs, the depth to sound rock is irregular.

GROUNDWATER

The rate of seepage of groundwater into deep excavations depends on the level of the zone of saturation and on the permeability of the rock and the superficial deposits. The information available indicates that the zone of saturation is fairly close to the surface in Canberra City and groundwater can be expected at a depth of 5 m or less in most places; on City Hill it is expected to be slightly deeper. Permeability is generally low in the bedrock, especially in the deeply weathered mudstone and shale where groundwater occurs only in fractures. Permeable lenses of alluvial sandy gravel are generally above the zone of saturation except during prolonged wet periods, but may carry perched aquifers. Highly permeable cavernous limestone has been encountered in some foundations in Canberra; however aquifers have not been intersected in excavations at any of the four known limestone localities in the Civic Centre area (Plate 1), although some seepage was encountered at the NRMA building site in Northbourne Avenue.

THE CITY EAST INVESTIGATION

The results of investigations carried out in the proposed City East development area are described below. Locations of seismic traverses and rotary drill holes in the project area are shown in Figure 1.

SEISMIC REFRACTION SURVEY

Seismic refraction surveys were carried out on 3 consecutive Sundays, 17 and 24 February, and 3 March, 1974. The field work was done by B.H. Dolan (geophysicist and party leader), M.I. McDowell, F.N. Michail (geophysicists) L. Hemphill, A. Martindale (technical officers) and three field hands. The main aim of this work was to obtain information about the structure of the area below depths of 30 m.

A previous seismic survey on the site by BMR in 1971 provided information at shallow depths only (Hill, 1972). The deepest refractor encountered had a seismic velocity of 1.6 to 2.2 km/s, and results indicated that a refractor with a higher seismic velocity (3.0 km/s) would occur at a depth greater than 28 m.

Methods and Equipment

The velocity with which a vibration is transmitted through rock varies with the nature of the rock; in general, the velocity increases with the strength of rock. In the seismic refraction method a number of ground vibration detectors (geophones) are placed a known distance apart along a line. An explosive charge is detonated along this line and the times of arrival of the longitudinal shock wave produced by this explosion are recorded from each geophone. From this information the depth to formations of different seismic velocity can be determined. The intercept method was used for interpretation (Heiland, 1946).

In order to obtain data on both shallow and deep refractors it is necessary to detonate charges close to the spread of geophones and at some distance from it. present investigation shots were fired up to 330 m from the end of the geophone spread. Shots were also fired directly below the end geophones to enable corrections to be made for the depth of the shot. Because the work was done in a built. up area several precautions had to be The charges taken. were placed in parks or car parking areas and in drill holes 5 to 10 m deep; a number of streets and parking areas were and traffic in the area was controlled by the closed; Because of the distance of the long shot points from police. the spread up to 2 kgs of charge had to be used.

The geophones used were type GSC-20D made by the Geospace Corporation. The two sets of recording equipment used were the PSU-19 and PT-700 made by Dresser - SIE.

Six geophone spreads were recorded separately. The spacing between the geophones was 4 m on the first spread and 15 m on the other five spreads.

Results

Figure 1 shows the location of the geophone spreads and Plate 2 shows the seismic cross-sections. The seismic velocities recorded and their interpretation are shown in Table 1.

The surface layer (A) consists of a thin layer (1 to 2 m) of dry soil, clay and gravel with a seismic velocity of about $0.3\ km/sec$ which is underlain by a layer, about 2 to

3 m thick, of partly saturated soil, clay and gravel with a velocity of about 1.0 km/sec. The average velocity of layer A is taken as 0.6 km/sec.

The second layer (B) consists mostly of saturated, completely or highly weathered mudstone with possibly some bands of moderately weathered mudstone.

TABLE 1

CORRELATION OF SEISMIC VELOCITY AND ROCK TYPE

LAYER	SEISMIC VELOCITY (km/s)	INTERPRETATION
A	0.6 (average)	Unsaturated soil, gravel and completely weathered rock.
В	1.6 - 2.1	Saturated, highly to completely weathered mudstone with possibly some interbedded layers of moderately weathered mudstone.
С	3.5 - 3.6	Moderately weathered to fresh mudstone (possibly fractured).
D	3.5 - 5.5	Moderately weathered to fresh rock of uncertain and possibly varied lithology.

The relatively high velocities (1.6 to 2.1 km/sec) for highly weathered mudstone are due to the formation being water saturated. In areas where this velocity is highest the formation probably has a greater proportion of moderately weathered fragments.

The third layer (C) is probably moderately weathered to fresh mudstone. The depth to this refractor varies over the site, from about 17 m at the northern end to about 70 m at the junction of spreads 5 and 6.

The deepest refractor encountered (D), has a variable velocity of 3.5 to 5.5 km/sec. This variability is considered to be due to different lithologies and zones of faulting. This refractor is deep (more than 50 m) over the site except at the western end of spread 2 where it is within 20 m of the surface. The velocities in excess of 5 km/sec indicate fresh or slightly weathered bedrock with tight joints.

Conclusions

The depth to bedrock, i.e. a refractor with seismic velocity of 3.5 km/sec or greater, ranges from about 20 m at the northern end of the site to about 70 m between Ainslie Avenue and Akuna Street in spread 6. The overlying material is mainly water-saturated, completely to highly weathered mudstone. Significant zones of different velocities were recorded in the deepest refractor and these could be due to lithological variations or to fault zones.

ROTARY CORE DRILLING

Although 14 rotary drillholes totalling 474 m in length were completed by BMR between February and June, 1974. The locations of the drillholes, which were numbered Canberra 60-73 inclusive, are shown in Figure 1. Drill cores are stored in the BMR Cores and Cuttings Laboratory, Fyshwick. The logs of the drill holes are given in Appendix 1 and definitions of weathering terms are given in Table 2.

TABLE 2

DEGREES OF WEATHERING OF ROCK

DEGREE OF WEATHERING		DESCRIPTION
FRESH	•	No discolouration or loss in strength.
FRESH STAINED	:	Limonitic staining along fractures; rock otherwise fresh and shows no loss of strength.
SLIGHTLY WEATHERED	:	Rock is slightly discoloured, but not noticeably lower in strength than the fresh rock.
MODERATELY WEATHERED	:	Rock is discoloured and noticeably weakened; N-size drill core generally cannot be broken by hand across the rock fabric.
HIGHLY WEATHERED	:	Rock is discoloured and weakened; N-size drill core can generally be broken by hand across the rock fabric.
COMPLETELY WEATHERED	;	Decomposed to a soil, but the original rock fabric is mostly preserved.

Results and discussion

Rotary core drilling confirmed and extended the results of the seismic refraction survey. The investigation has defined a trough of deeply weathered bedrock beneath a blanket of alluvial fill. The deeply weathered zone probably extends from Ainslie in the north through City East to the Central Basin of Lake Burley Griffin.

The deep weathering, and the shearing and brecciation observed in several drillhole cores indicates that faulting has affected a zone 100 - 200 m wide. In the excavation for a test pit at the DCT building site, several clay-filled fault zones several centimetres wide were observed (Fig. 5). These faults strike 005 -010 and most of them dip steeply east. Elsewhere in the Civic Centre area, east dipping reverse faults have been observed in the Monaro Mall excavation (Fig. 2) and at Electricity House in London Circuit (Gardner, 1974, p. 12). It is likely that the City East fault zone consists of numerous faulted segments bounded by reverse faults which dip steeply to the east.

Contours of the depth of weathering below ground surface are shown in Plate 1. These contours have been constructed on a generalised surface of slightly weathered or fresh bedrock, based on seismic and drilling results. The depth of weathering ranges up to about 70 m in the central part of the City East project area. Drillholes 64 and 69 in the northern part of the project area intersected hard, slightly weathered mudstone at depths of about 20 m.

In detail the weathering is irregular; in some drillholes relatively hard and strong, moderately weathered rock overlies softer and weaker, highly to completely weathered rock. In general, foundations on completely weathered mudstone (clay) are likely to have some settlement, whereas highly weathered mudstone is possibly satisfactory for pad footings. On the west side of the project area, multi-storey buildings have been founded on pad footings on highly weathered mudstone, e.g. the CAGA building (Fig. 3; Coffey & Hollingsworth, 1971).

Bedrock beneath the project area is generally calcareous mudstone, which is bluish-grey where fresh and yellowish-brown where weathered. The calcareous mudstone is fossiliferous, containing brachiopods and corals which indicate a middle or late Silurian age, and probably belongs to the Canberra Group as defined on the 1:50,000 geological map of Canberra by Strusz and Henderson (1971). Sandstone was intersected in drillhole 72 in Ainslie Avenue, and interbedded siltstone and sandstone was intersected in drillhole 71 in Glebe Park; both of these drillholes are on the east side of the fault zone. Brecciated mudstone was intersected in drillholes 62 and 64.

Groundwater was intersected in several drillholes at depths of 4-6 m, and in most cases rose to a potentiometric level of 1.5 - 2 m below ground surface. The groundwater was intersected at the base of the alluvium or at the top of the fractured mudstone. In drillhole 71 in Glebe Park, water under pressure was intersected in a fault zone at 27.7 m and flowed at the surface.

SOIL TEST RESULTS

Testing of some samples of weathered mudstone was undertaken in the laboratories of BMR and the Snowy Mountains Engineering Corporation in order to determine plasticity and strength parameters.

The completely weathered mudstone is a yellowish brown or reddish brown stiff silty clay generally classified as CL or CH on the Unified Soils Classification (Appendix 2).

Samples of completely weathered mudstone from a drillhole on the DCT building site proved to be ML on the Unified Soils Classification with plasticity indices of 8-9, and an unconfined compressive strength of 1.2 kg/cm (Appendix 2).

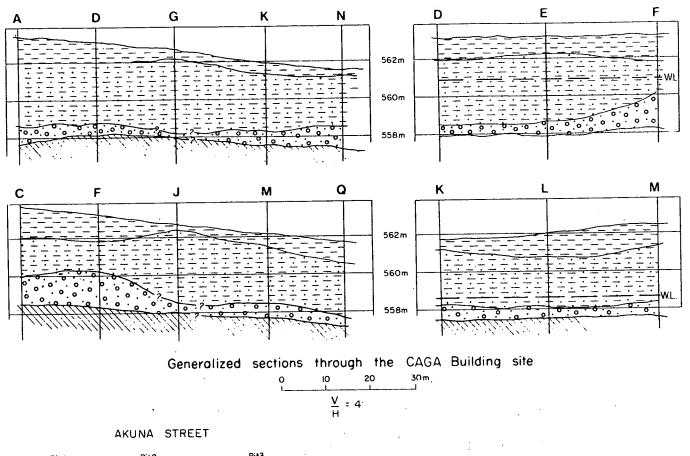
A summary of triaxial compression and consolidometer test results for samples of completely and highly weathered mudstone is given in Appendix 2.

THE D.C.T. BUILDING SITE

The D.C.T. office building is proposed to be a 13-storey structure, approximately 24 m by 73 m, with a basement excavation to a depth of approximately 5 m. Site investigations by Ground Test Pty. Ltd. (1974) have included 12 diamond drill holes, testing of soil samples, and load tests in a pit excavated to basement level.

About 4 m of gravelly alluvium overlies mudstone at the building site. The eastern half of the site is underlain by a wedge of relatively strong, moderately weathered mudstone overlying weaker, completely to highly weathered mudstone, which extends down to a depth of 70 m (Fig. 4). The western half of the site is underlain by completely to highly weathered mudstone to a depth of 70 m. The degree of weathering is irregular in detail with alternate layers of hard and soft material.

The geology of the test pit excavated at the site is shown in Figure 5. Several clay-filled fault zones up to 5 cm wide are exposed in highly weathered mudstone on the



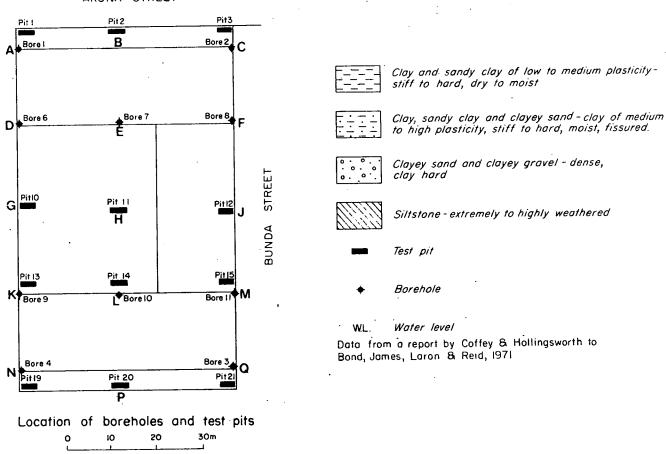


FIG. 3 FOUNDATION EXPLORATION FOR CAGA BUILDING, CANBERRA.

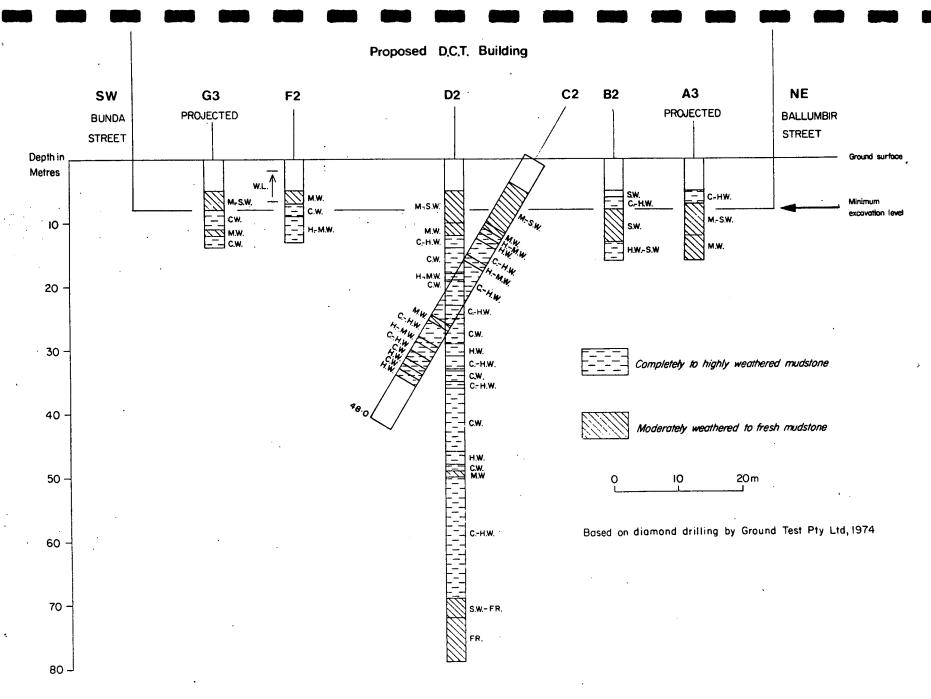


FIG. 4 CITY EAST PROJECT, GEOLOGICAL SECTION THROUGH FOUNDATION OF D.C.T. BUILDING
To accompany Record 1974/123

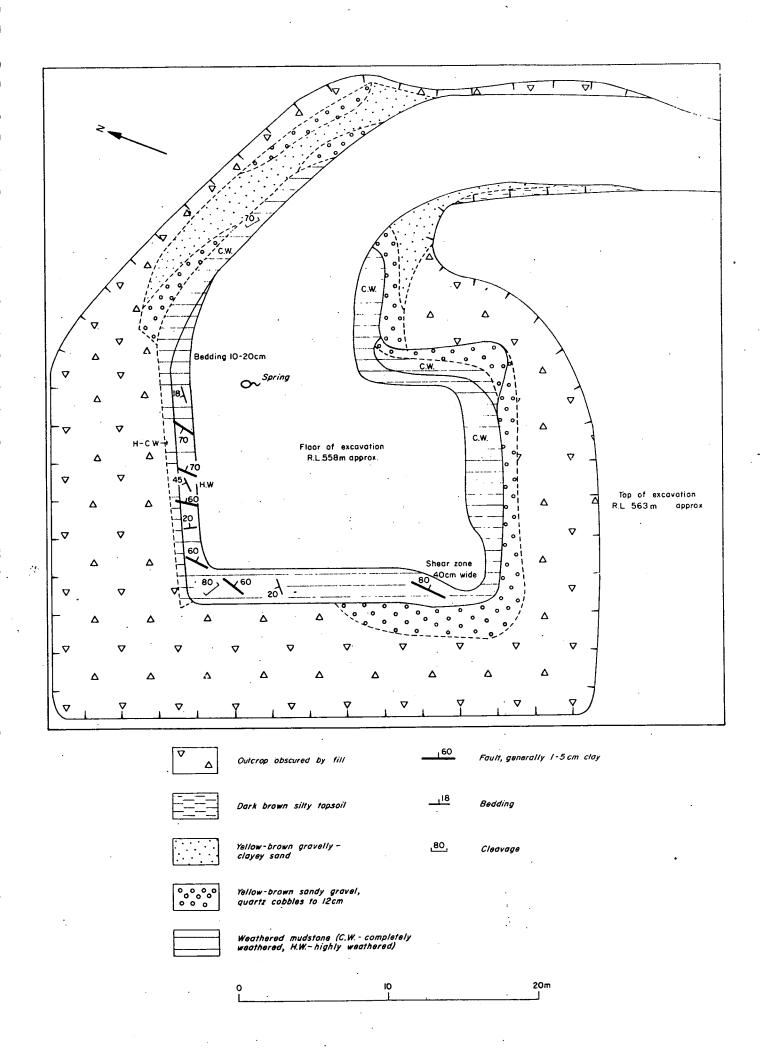


FIG. 5 GEOLOGICAL PLAN OF EXCAVATION D.C.T. BUILDING SITE, CANBERRA

western side. Measurements of bedding attitudes indicate a faulted syncline plunging 14 N, with shallow dips near the core. Dips of bedding measured in drill cores generally ranged from 20 to 40 degrees. Completely weathered mudstone is exposed on the southern side of the test pit. Problems of groundwater inflow from fractured mudstone were encountered in the excavation; a spring was exposed in the floor, and several of the test pile holes intersected groundwater.

Possible solutions to the foundation design problem have been discussed by the site investigation consultant (Ground Test Pty. Ltd., 1974). A combination of shallow footings on the northern side with friction piles over the remainder is favoured at the time of writing (June, 1974).

CONCLUSIONS

- 1. Seismic and drilling investigations have delineated a trough of highly to completely weathered rock, associated with a major fault zone 100-200 m wide, which trends north-south through the east side of Canberra City.
- 2. The hard, slightly weathered to fresh bedrock that forms the bed of the trough rises gently to the west and east of the project area and is deepest (70 m) on Section 53 which includes the proposed site for the D.C.T. building.
- 3. The varied degrees of weathering of the mudstone beneath D.C.T. building site provide difficult foundation conditions. The highly weathered mudstone may be satisfactory for pad footings, but the interlayered highly and completely weathered materials will settle differentially.
- 4. Foundation conditions for a large structure would be better in the northwest part of the City East development area where hard, slightly weathered rock has been encountered at depths of about 20 m.
- 5. The properties of the weathered rock are so varied within the City East development area that detailed site investigations will be required for every proposed structure.
- 6. Confined groundwater occurs in the fractured mudstone, and groundwater inflow in excavations is likely.

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APPENDIX 1

CITY EAST INVESTIGATION, CANBERRA

LOGS OF DIAMOND DRILL HOLES

BUREAU OF M	INERAL RESOURCES, EOPHYSICS	PROJECT CITY EAST INVESTIGATION, CANBERRA	HOLE NO 60
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM HORIZONTAL (0) 90° DIRECTION	SHEET OF 2
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NO	CORE	5m-	
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MUDSTONE M.WH.W. NO	CORE	50	
MUDETONE M.W H.W.		100	
M.W.		85	
H.W.		100 15m	
MUDSTONE C.W.			
NO	CORE		
MUDSTONE M.W H.W.		50	
S.W M.W.	CORE	20-	
NU	CORE	20m:	
Drill typeEOX Feed_HYDRAULIC Core barrel type TRIPLE TU Driller B.M.R. Commenced Completed MARC	Fracture Log — Nu Bedding and Joint P. BE Defect Frequency — Water Level Measur H -74.	mber of fractures per 25 cm of core. Zones of core loss blacked in. anes — Angles are measured relative to a plane normal to the core axis sheets. Test section to the core axis sheets. Test section of the core occurring at specified intercept angle range. Therefore occurring at specified intercept angle range. Level when hole in progress at specified depth. Level in completed hole on specified date. ALSO NUMBERED C.E.P. I	ons are indicated os.
Vertical scaleL'.V	20	C.W. COMPLETELY WEATHERED H.W. HIGHLY WEATHERED M.W. MODERATELY WEATHERED S.W. SLIGHTLY WEATHERED	I-55/AI6/II 76

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Drill type FOX	Fracture Log -	Nun	nber	of frac	tures p	er i	No 25 c	n of c	ore. Zo	ones	of co	ore los	es blacked in.	* Values i	tion with d	e Tests should be r computation s are indica
Core barrel type	1	, _	Numl	er of n	atural	def	ect	(shed	rs, joi	nts,f	racti	ures)	per 25cm of	by blacked		
Driller BM.R.			core	occurr	ing at s	pec	itia	d inter	cept a	ng/e /	range). .		Core Pho		egative No.
Commenced	Water Level Mea	sure	ment	ال – ء لاس	Lev	e/ #	nen n co	nore in mplete	progr d hole	00 SP	ecifi	ed da i		Depth (m)	Black &	White Co
Completed_MARS		w.	C	OMPL	ETE	٧,	•	YEV.	THEF	ED						

M.W. MODERATELY WEATHERED S.W. SLIGHTLY WEATHERED

Checked by

1.55/AIG/II76

BUREAU OF MIN GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PROJECT LOCATIO		CITY.	E	A5	T1	NYE	STI	GA	וסנד	N, CANBI	ERRA	но	LE NO. 6
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE F			ONT	A L		90				CTION		SHE	ετ Ι. ог.
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Cosing Graphic Log	% core	Depth and size of Core	Fract Lo		RQD		ct Fre	1 Ang	1		ctures seams,faults,etc	Water	Water Press Test Loss (Lugeons)
NO	CORE			•					-			·			
				-											
MUDSTONE H.W M.W.	Yellow brown		00	5m-								stained	d mangane joints: erous (brac		pods)
Mudstone M.W.	Yellow - brown moderately hard and strong.		00									Beddin	g 50°		
NO	CORE											Margane	se stained		
MUDSTONE M.W.	Yellow brown moderately hard and strong		30	10m-								joints, so Core in pieces	ome slickens 10-20 cm Brachiopods ing planes		out foss 3cm at
MUDSTONE M.W.	Yellowish - pinkish brown, moderately strong, but fragmented.		00									pieces.l	roken to 10 Manganese y filled joi t 14 m, stee	sta: nts	shear
MUDSTONE M.W. H.W.	Yellowish pinkish brown.		85	15m								2			
NO	CORE				 	Ш	ļ) Broken	and crushed		
MUDSTONE H.W C.W.	Pinkish - brown fragmented , weak	1///	90									1	and crushe recciated)	d	
NO	CORE			20n											1
Drill type FQ: FeedHYDRAU Core barrel type TRIPLET	Bedding and Joint in Defect Frequency	Piones — A	angles of no:	are mo	r 25 easu lefec	red te l	of col relat	ive to d s, join	plan ts,fr	na no actui	rmoli res) p	to the core.axis	Water Pri * Values in luga in conjunction w sheets. Test sec by blacked in str	ith co tions tips.	should be r omputation are indica
Commenced	Water Level Measu 1-1975 9-5-7	OLE ALS	- <u>▼</u> - 모 50	Leve. Leve. NUM	/who /inc 1BE	n h om RE	ole in i oleted D ELY	progre hole ol C.E.	es of spec P. T	, spec cifie 7. THE	cified d date). :	1	ck 8. V	

1-55/A16/II77

									•			
BUREAU OF MI GEOLOGY & GE	NERAL RESOURCE'S, OPHYSICS		ECT	CITY'	east	IMV	ESTIGAT	rio.N.,	CANBER	RA	но	LE NO. 61
GEOLOGICAL	LOG OF DRILL HOLE						.90°		CTION OF COLLAR		SHE	ET 2 OF 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic	Lift and % core	Depth and size of Core	1	RQD	Defect Fre		!	uctures , seams,faults,etc	Water	Water Pressure Test Losses (Lugeons) *
MUDSTONE C.W.	Soft, frogmented. pinkish -greyish brown weak		75	20 m	0 6 12 1	8+				and crushed precciated)		
NO	CORE											
MUDSTONE C.W H.W.	Yellowish -pinkish brown , weak		100	25m					Brecci	ated		
MUDSTONE	Pinkish - brown, some moderately strong pieces.		100	2311					are man	jointed -joints iganese stair Filled Son core	hed	
NO	CORE											
MUDSTONE	Pinkish brown,		80						stained	nanganese ,some slict broken and	en:	sided.
H.W MW.	some moderately strong fragments			•					! .	core.		
10	CODE			30m					•			
END O	CORE 30.5 m									,		
	T									T		
Drill typeFQX_	1	- 4			Notes				**************************************	Water Pres		
Core barrel type	Bodding and Joint B			-						* Values in lugeo in conjunction wit sheets. Test section	h con	putation
TRIPLE TUB		- Numb	er of nat	ural de	facts (shears,	joints,frac	tures) pe		by blacked in strip		
Driller_BM.R			-	-			of angle ran		death	Core Photograph	Neg	otive No.
Commenced		aments					ogress at s _i ple on specii			Depth (m) Black	a Wi	ite Colour
Completed . MARCI	HOLE	AL	50 N	JMBE	RED	c.E	P7				• • • • • • • • • • • • • • • • • • •	
Logged by .P.V.B.	1	c.w	. co	MPLE	ETELY	· ~	EATHER	LED				

H.W. HIGHLY WEATHERED
M.W. MODERATELY WEATHERED

Checked by

1.55/Δ16/1/7

BUREAU OF MI	NERAL RESOURCES,			SITY.	EAS	Œ	רמו־־	ÆSTI	LGAT	101	<u> </u>	ANBERRA		HO.	LE NO \$2
	LOG OF DRILL HOLE		FROM							 	DIRE	CTION		-	
		COORDI	- 0 x			•-			ct Fre			OF COLLAR.		Д.	r
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Cosing Graphic Log	1,44 g 1,800 g 1,800 g	of Siz	Frach Log	3	RQD		rcent	Ana			ctures seams,faults,etc	Water	Water Pressure Test Losses (Lugeons) *
,		1.		Ţ	ĬĬ				\exists						
	·			-											
NO	CORE			1											
•									=		-				
				-											
		=-		5m-								м		1	
MUDSTONE	Buff		100	1								joints.	ese stained 3-10 cm		
		<u> </u>										specing			
	Pinkish brown	<u></u>			$\parallel \parallel$						-				
C.W H.W.	weak rock - stiff clay		100	-								Broken	COLE		
		<u> </u>		-	$\parallel \parallel$										
MUDSTONE	Pinkish brown firm -sliff clay		100	10m											
c.w.							*					- - -			
.					\parallel										
HUDSTONE	Orange - brown														
c.w.	stiff clay		100												
												1 1			
NO	CORE Stiff clay		30												
c.v.; NO	CORE			15m	\coprod		ļ					<u> </u> 		-	
MUDSTONE	Yellow - pinkish		100									1			
C.W H.W.	Yellow - pinkish brown, mostly stiff clay.	 - -	100							:		·		-	
		 - -			#	\parallel	-							+	
MUDSTONE	Reddish - brown stiff day		100									1			
c.W.	ariii way		100									1			
		 - -		20m			<u> </u>	Ħ			E	1	·		
Drill typeFQX		· · · · · ·			No				:				Water Pre		
Feed _ HYDRAULIS	Bedding and Joint F	lanes —	Angles	are me	osúr	ød	relati	ve to a	plane	nor	mal :	to the core axis	* Values in luge in conjunction wi sheets. Test sect by blacked in str.	ith co tions o	mputation
TRIPLE TU		core oc	curring	g at spe	cifia	d	interce	pt ang	le rai	ge.			Core Photograp		gative No.
Commenced	Water Level Measu	rements =	<u>.</u>	. Leve! . Leve!	≢nen in co	m	oleted.	hole on	speci	ت او ر. الماري	dote	оврем. 1.	Depth (m) Blac	: k & W	hite Colour

HOLE ALSO NUMBERED C.E.P. II
C.W. COMPLETELY WEATHERED Logged by P.V.B., G.J. Vertical scale __U100_____ H.W. HIGHLY WEATHERED Checked by

Completed APRIL 1974

1-55/416/1178

	PHYSICS		ATION .	M HORIZ						DIREC	CANBERRA			LE NO.	
SEOLOGICAL	LOG OF DRILL HOLE	COO	LE FRO	M HORIZ		AL (6				R.L. (OF COLLAR				
Rock Type and agree of Weathering	Description Lithology, colour, strength, etc	Cosing	Lift and	Depth and size	Frácti Lo	- 10	0 0 0	fect Fr ntercer 30 6	t Angl	le	Structu Joints, veins, se		Water	Water Pro Test Lo (Lugeor	osse ns)
			-[20m	++++	ĬĬĬ							+-		
UDSTONE C.W.	Reddish brown stiff cby	-	- 80		1										
NO	CORE			_	111	11	-								
c.N.	Reddish brown		_ 75										_		
LUDSTONE H.W.	Reddish brown		90		4								-		
NO	CORE														
1ubstone c.w H.W.	Reddish brown weak, frable		45	25m	, 										
NO	CORE												-	-	
ludstone sreccia hw c.w.	Reddish brown, weak		81	0							Brecciat	red			
NO	CORE				#										
SUDSTONE	Reddish brown		<u>)</u> 50	30m							Breccio	red			
NO	CORE				4			_	+-	+				+	
•												Woto	r Prace	ure Tests	
Drill typeFQX. Feed _HYDRAUL Core barrel type _	Fracture Log — Bedding and Join	t Plat	185 - AI	igles are	per 2	urec	of core	e to o p	lane n	orma	i to the core axis	* Values in	lugeon. on with section	s should i comput ns are inc	be atio
IRIPLE T		C	ore occu	irring at	space	7180	intercup	ir ungre	, ong.	σ.		Core Phote	graph	Negative	No
Driller B.H.R.	Water Level Mea	suren	ents —	里 4	evel wi evel in	hen h com	oole in pr apleted h	ograss ola on s	of sp pecifi	ecifíd ied do	te.	Depth (m)	Block 8	B. White	C
Commenced															
Completed APRI		C.W.	COM	PLETE	LY	~	JEATH	EKE	•						
Completed_ACRI									J		-				
Completed APRI			MOS HIG				HERE		,						

GEOLOGY & GEO	LOG OF DRILL HOLE	ANGLE										CTION			6.15	
			NATE:	S			 r			quenc		OF COLLAR			L	T I OF.
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	78 COV	of Cor	Lo	ture og 12 i	ROD	1-1-		Anale	1	Struc Joints, veins, s	tures seams,faults	,etc	Wate	Voter Press Test Loss (Lugeons)
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						111			_]							
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NO	CORE] ' '											
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			40		1		-						· · ·	•		
MUDSTONE S.W.	,	1 2	40	ļ	1	-										
MUDSTONE C.W.			100	ļ												
					-							1				
												1				
MUDSTONE	Yellow - brown		100		4]				
s.w.			100									1				
				15 m												
			i]						=	1				
]											
						Щ									ļ	
M.W H.W. MUDSTONE		<u> </u>	60	<u> </u>	111	\parallel										
H.W C.W. C.W.				 			#								+	
MUDSTONE			100		4							-				
H.W.				20 1	\coprod											<u> </u>
						Note							Wo	ter Pre	ssure	Tests
Drill typeFQX_	AC Fracture Log - I	Vumber of	fract	ures p	er 25	5 cm	of co	ora. Zon	es o	f core	105	s blacked in.	in conjunc	tion wi	ith co	nould be re mputation
Core barrel type		— Numbe	r of no	turol (defe	cts	(shea	rs, joint	s,fr	actur	mai 85) f	to the core axis per 25cm of	sheets. Te by blacked			re indicat
Driller 8.M.R.		core o	currii	ng at s	peci	fied	inter	cept ang	le ro	ange.						gative No.
CommencedCompleted_MARS				Leve	e/ in	соп	plete	d hole on	spe	cified	date	9.	Depth (m)			hite Col
Logged by P.YAND	DEN . GROEK	LE AL		NUMI OMPL				.9.3.1 NBW							•	
Vertical scale1:	100	H.W.														
Checked by		M.W. S.W.	,	MO DE	RA	176	LY	WE	ATI	HER				-	1-5	5/A16/1179
	i															

EOLOGICAL I	_OG OF DRILL HOI	⊏ ANG	ATION	HORIZ	ONTAL	(0)	90.	DIRI	ECTION		- 046	ЕТ 2. ОГ 1
						T		requency	T	· · · · · · · · · · · · · · · · · · ·	<u> </u>	
Rock Type and gree of Weathering	Description Lithology, colour, strength,	Casing Graphic	Lift an % cor	Oapth of Cor	Fracture Log	RQD		- 4 4	Struc Joints, veins, s		Wate	Water Pressu Test Losse (Lugeons)
H.W.				20m		-						
	•											
HUDSTONE				-					1			
H.W.			70					- -	1			
				']			ļ
	1		<u> </u>								-	<u> </u>
UDSTONE			80						 			
MW.									· ·			
END OF	HOLE 24.4m (80 th e	1942)	25m	d , , , ,				1			
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orill type FQK_		a — Mumbi	er of from	turas n	No <i>er 25 c</i> .		re. Zones	of core lo	ess blacked in.	* Values in Id	igeons	should be re
eedHYDRAULL Core barrel type	Bedding and	Joint Plane	es — Angle	es are i	neasur	ed rela	tive to a p	lane normo	ol to the core axis	in conjunction sheets. Test s	ection:	s are indicat
TRIPLE TUB		ency — Nu	imbar of n	natural ing at s	defect: pecifie	s (shea d inter-	rs, joints, capt angla	fractures, range	per 25cm of	by blacked in		
Driller6_11.8 Commenced	Water Level		ents — 🔟	Lev	el when	hole in	progress	at specifi	ed depth.	Core Photog		legative No. White Col
C	l l		-2	Lev	el in co	mpietė	d hole on s	pacified do	,,,d.			
	77823#											
Completed MARCH Logged by R.VAND	en Rroek											
Completed MARCH	en Rroek									1	 	

BUREAU OF MI GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	LO	CAT	ION		. 	- · -		• • • • •	 	, <i>,</i>		, CANBE	RRA 	НО	LE NO 64
GEOLOGICAL	LOG OF DRILL HOLE		ORDI	INATE		ONT							CTION = OF COLLAR _		SHE	ET 1 OF 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing	Logue Logue	Lift and % core	Depth and size of Core	Fract			inte	rcept	Δn	110		ctures seams,faults,etc	Water	Water Pressul Test Losses (Lugeons) *
	and the second s			,												
										-						
									-			=				
	· .										-			-		
NO	CORE												, -	-		
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	·		: <u>.</u> .													
					10 m	;			_ :	_ [<u> </u>	-			
· ·						:				İ				_		-
MUDSTONE C.W.	Some breckia	-	- <u>-</u>	100		4	! !							w. fragmer matrix	₩ 5	
MUDSTONE		4	4									 				
BRECCIA		4	•	100		<u> </u>										
c.w.		4														
М		Δ				1										
MUDSTONE BRECCIA		4	•	100	15 m											
H.W C.W.			A		יייכין											
		+					$\left \cdot \right $						<u> </u>			
BRECCIA			۵										Angular	Mw. frag	mer	vis
H.WCW.		4	٨	100		1							1-3 cm	n in clay	'	
		۵	۸,		:					=						
		 	۵													
BRECCIA		A	۵	100	20 m											1
IFOV						No	otes				-			Water Pro	essure	Tests
Drill typeIFQX Feed _HYDRAULIC	Fracture Log N					r 25 c	m o	of cor						* Values in luga	ons s	hould be read
Core barrel type	1	- Nu	mbel	r of na	tural di	efect	s (s	hears	, join	s,fra	ctur			sheets. Test sec by blacked in str		re indicated
Driller . B. M. R.	Water Level Measu			- <u>-</u>		when	ho	le in p	rogre	ss of	spec			Core Photogra		gative No. Thite Colour
Commenced	119.7.4		محد		Level Umbī							date				
Vertical scale_1:10	ENT BROEK				MPLE.				IEV.			D		1		
		H.W	/ .	HIC	GHLY		W	EAT	HER	ED						
Checked by		M.V	J.	M	ODER	ATE	ELY	4	WE	HTA	ERI	ĒΟ				55/AI6/II80

BUREAU OF MII GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PROJECT		T. INVESTIGATIO	N, CANBERRA	HOLE NOSY
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM	M HORIZONTAL	,	CTION . =	SHEET 2 OF 2
Rock Type and Degree of Weathering	Description Lithology,colour,strength,etc	Cosing Graphic Log Lift and % core	0 6 18 18		Structures Joints,veins, seams,faults,etc	Water Pressure Test Losses (Lugeons) *
HUDSTONE S.W M.W.		100	20mj			
MUDSTONE S.W M.W.		100			2-12 cm pieces	
5.W.	· · ·	100	.+		Steeply dipping ino manganese stained	Joints
S.W. MUDSTONE		100	25m		vugs 1-2cm diox	meter
S.W. MUDSTONE S.W.					at 23.87 m.	
	END OF HOLE 26.8 m	(48 tsq)				
i						
					<u>.</u>	
Drill typeFQ.2 Feed _ H.Y.O.RAN Core barrel type _	SLIC Fracture Log — Bedding and Joi	nt Planes — Ang	jies are measure	n of core. Zones of core lo ad relative to a plane norma a (shears, joints, fractures,	ss blacked in. in conjunction of to the core axis sheets. Test s	Pressure Tests ugeons should be rea n with computation sections are indicated strips.
TRIPLE TO	JBE Defect Frequen Water Level Me	core occur - — asurements -	T Level when Level in co	d intercept angle rullye. hole in progress at specific mpleted hole on specified do	Core Photos	graph Negative No. Black & White Colou
Completed MASC Logged by C.VAN Vertical scale	DEN BROEK		DERATELY	WEATHERE D		

1-55/A16/1180

BUREAU OF MI GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	,	CITY_EA	ST	NYESTIGAT	1012	CANBERR	A	ног	_E NO. 6.5
GEOLOGICAL	LOG OF DRILL HOL	E ANGLE FF	ROM HORIZONTA	L (0)	. 90°	DIRE	CTION		SHE	ет. 1. оғ 2 .
Rock Type and Degree of Weathering	Description Lithology, colour, strength, e	Casing Graphic Log	A CO CO CO CO CO CO CO CO CO CO CO CO CO	100	Defect Freque Intercept An 0 30 60 8	616		itures seams,faults,etc	Water	Water Pressure Test Losses (Lugeons) #
NO	CORE									
MUDSTONE M.W.	Yellow - brown						Iron and stained	manganese joints		
M.W.	·									<i></i>
MUDSTONE H.W M.W.			10m							
H.W C.W.		==								
MUDSTONE HW C.W.		 	4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							
M.W.						-			1	
MUDSTONE M.W.			15m							
H.W C.W.		127							+	
MUDSTONE H.WC.W.				-					+	
H.W.					+++	+=		 	+	
MUDSTONE HWC.W.								· ·	$oldsymbol{igstyle igstyle igstyle igytyle igstyle igytyle igytyle igstyle igytyle$	
MUDSTONE M.W.									ļ	
M.W.			. 20m							
····	T T							Water Pro	Beaute	Taste
Drill typeFQX. Feed . HYDRAUL Core barrel type TRIPLETUI Driller .B.M.R.	BE Fracture Log Bedding and Jo Defect Freque Water Level Me	nint Planes — An ncy — Number o core occu easurements —	actures per 25 of gles are measured for actural defect from the grant of the grant	ed rela s (shea nd inter n hole in	ore. Zones of co tive to a plane no ers, joints,fractu cept angle range progress at spe d hole on specific	ormal f ires) p .cified	o the core axis er 25cm of depth.	w Values in luge in conjunction w sheets. Test sec by blacked in str Core Photogra	ions s ith co tions (ips.	hould be read mputation are indicated gative No.
Completed		OLE ALSO								
Logged by E.VAND. Vertical scale _ 130	EN	c.w.	COMPLET	ELY WI	WEATHERS EATHERED WEATHES					
Checked by		FIIW.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			• •		l	i	·55/A 6/ 8

BUREAU OF MI GEOLOGY & GE	NERAL RESOURCES, OPHYSICS		ECT(סעני	TAS	101	7,_¢A <i>⊾</i> ®	RRA		ноі	LE NO. 6.5
GEOLOGICAL	LOG OF DRILL HOLE	ANGL	E FROM	HORIZ	ON	TAL	(0)	90	•		DIRE	OF COLLAR			SHE	ET 2 OF 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core			cture og	ROD	tnt	ercep	equen of Ang o ec	ie .	1	uctures , seams,fault:	s,etc	Water	Water Pressure Test Losses (Lugeons) #
MUDSTONE			100	1 20 m j	Ш	\prod				\Box						
H.W-M.W.			100	-		$\!$										 <u>-</u>
MUDSTONE				-		$\dagger \dagger \dagger$										
Hw			100] :								į				
HW C.W.		1			Ш											
MUDSTONE HW	·				Ш	Ш	Ŀ									
MUDSTONE				•		Ш										
m . (100] :												
n.w				-	H	₩	1					<u> </u>			\dashv	
						Ш										
MUDSTONE				25m									•			
M.W.			90	-								1				
				-									_			
		1			Щ	Щ										
MUDSTONE			100													
MUDSTONE			100													
H.W.			100				<u> </u>									
	· · · · · · · · · · · · · · · · · · ·				$\parallel \parallel$! †	1						 			
MUDSTONE]			F									·
1				20-			F									
H.w.				30m								•				•
	· · · · · · · · · · · · · · · · · · ·			-	$\parallel \parallel$	$\parallel \parallel$								- 1		
MUOSTONE	•]												•
H.W C.W.				1												
END H	OLE 32 m (105 fee	\		-	#											
2.45	OLE 32 M (105 PEE	[1													ł	
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				}			-		$= \pm 1$						- 1	
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A STATE OF THE STA	the state was a special space to be a section of a second source	3 3 3 2	34187	(दुर-विक		· ·	2.4 * **		7	3 -	. ,		18,500			
Drill type . F.Q.X	[7] A. J. Seller, Phys. Rev. B 46 (1997) 115.		7, 7, 7, 7, 8 6, -	•		otes					lo -	Mantada	i	r Press		
Feed HYDRAULIC	0		•										in conjuncti	on with	com	
Core barrel type TRIPLETUBE													sheets. Test by blocked it			a Indicated
Oriller, B.M.R.		core oc	curring	at spe	cific	ad in	tercep	t-ang.	le ran	ge.			Core Phot	ograph	Nego	tive No.
Commenced For Carry	Water Level Measure		- <u>-</u>	Level :	rhei in ce	n hoi ompl	le in pro leted ho	ogres Ve on	s at s speci	specif fied o	ied d late:	depth. Selan Statistics	1		_	
Completed	···		COMP				WEAT			i						
Logged by P.VANOLN	BROEK		•						1	•		•	-,			
Vertical scaleJ:!O			HIGHL				HERT									
•	"	₩.	HOD	ERAT	EL	.γ	WE	. AT	HEF	KE D.		•				
Checked by				•					:						1-55	/AI6/IIB1
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BUREAU OF MIN GEOLOGY & GEO	NERAL RESOURCES, OPHYSICS	PROJECT CITY EAST INVESTIGATION, CANBERRA	HOLE NO.SS
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM HORIZONTAL (8) 90° DIRECTION COORDINATES R.L. OF COLLAR	SHEET . J. OF . 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Defect Frequency Structures Intercept Angle o 30 60 80 90 Joints, veins, seams, foults, etc	Water Pressur Test Losses (Lugeons) *
NO	CORE	5m	
MUDSTONE M.W S.W.	Yellow -brown	Manganese stained joints, some slickens	ded
MUDSTONE M.W S.W.	Yellow - brown	Core broken along 80° fault, 9.1 -10.0 m and 10.2 -11.6 m. manganese stained pieces.	
MUDSTONE M.W S.W.	Yellow - brown moderately strong	100 Manganese stains joints, 2-20 cm vugs to 1 cm where etched out.	spaking
MUDSTONE S.W.	Yellow-brown to pale yellow -green	100 Shears at 13.1 and 14.3 m	
MUDSTONE S.W.	Yellow - brown stron	15m Manganese stoines joints 3-20 cm s generally with rou or slickensided surfaces.	pacina
MUDSTONE M.W S.W.	Yellow - brown	90 Some broken core	
Drill type FOX Feed_HYDRAULO Core barrel type TRIPLE_TUB Driller B.M.R. Commenced Completed 23.73 Logged by P. VANDE Vertical scale . 1/10	Fracture Log — N Bedding and Joint Defect Frequency Water Level Measure N 660EK HOLE	Notes Water Pre Wate	rions are indicate

BUREAU OF M GEOLOGY & GE	INERAL RESOURCES,	PROJECT CITY FAST INVESTIGATION, CANBERRA	OLE NO. 6
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM HORIZONTAL (8) 90 DIRECTION COORDINATES R.L. OF COLLAR SI	-
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	0 6 12 18+	Water Pressu Test Losse (Lugeons)
MUDSTONE H.W.	Yellow - brown	closely jointed - mang stained & clay filled	
MUDSTONE H.W.	Yellowish - pinkish brown .	some broken core	
MUDSTONE M.W C.W.	Yellow - brown generally weak, some moderately strong pieces	erushed zone, 25cm, with plastic clay, at 250 m. manganese stained joints	
MUDSTONE C.W H.W.	Yellow - brown	sheared, much broken core	
MUDSTONE C.W.	Pinkish - brown stiff day	30m } Brecciated	
END	F HOLE 30 5 m (10	Feet)	
Ornil type FOX Feed MYDRAULIC Core barrel type TRIPLE TUBE Driller 8.M.R. Commenced Completed 28.73- Logged by P.VANDED Vertical scale L'IDQ	Fracture Log — Num Bedding and Joint Pla Defect Frequency — Water Level Measure HOLE AL	Notes Water Pressure The property of fractures per 25 cm of core. Zones of core loss blacked in. Number of natural defects (shears, joints, fractures) per 25 cm of core accurring at specified intercept angle range. The property of natural defects (shears) per 25 cm of core accurring at specified intercept angle range. The property of natural defects (shears) per 25 cm of core accurring at specified intercept angle range. The property of natural defects (shears) per 25 cm of core accurring at specified intercept angle range. Core Photograph Neglight (m) Black & W LSO NUMBERED C.E.P. 8 The property of core loss blacked in. The values in lugeons sin conjunction with considers. The sections of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The sections of the core axis in conjunction with considers. The sections of the core axis in conjunction with considers. The sections of the core axis in conjunction with considers. The sections of the core axis in conjunction with considers. The sections of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The section of the core axis in conjunction with considers. The conjunction with considers in conjunction with considers. The conjunction with considers in conjunction with considers. The conjunction with considers in conjunction with considers. The conjunction with considers in conjunction with considers. The conjunction with conjunction with conjunction with considers. The conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with conjunction with con	hould be read mputation are indicated gative No.
Checked by	·····	I.W. MODERATELY WEATHERED	55/Ai6/II82

BUREAU OF MII GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PROJECT CITY EAST INVESTIGATION, CANBERRA	HOLE NO. 97.
GEOLOGICAL	LOG OF DRILL HOLI	ANGLE FROM HORIZONTAL (0) 30° DIRECTION T. COORDINATES R.L. OF COLLAR	SHEET. 1 OF.2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Defect Frequency Structures Defect Frequency Structures	Water Pressure Test Losses (Lugeons) *
МО	CORE	5m	
MUDSTONE HW.	Yellow brown	Iron + manganese stained joints	
MUDSTONE H.W C.W.	Yellow . orange - bro	80 10 m	
MUDSTONE M.W H.W.	Yellow - brown some moderately strong pieces	100 Manganese stained joints . Huch broken core.	
MUDSTONE HW.	Yellow brown	100 20 cm sheared at 140 m.	
MUDSTONE MW.	Yellow brown	15m Closely jointed (2cm - 15cm)	
MUDSTONE M.W H.W.	Yellow brown	100 Broken core	
H.W C.W.		20 m	
Drill typeFOA _ Feed _ HYDRAU! Core borrel typeTRIPLETUE DrillerB.M.&. Commenced Completed _APA!! Logged by R.VAN!	Bedding and Jo. Defect Frequent Water Level Me	Number of fractures per 25 cm of care. Zones of core loss blacked in. Int Planes — Angles are measured relative to a plane normal to the core axis sheets. Test sectly — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range. Surements — I Level when hole in progress at specified depth. U Level in completed hale on specified date. E ALSO NUMBERED C.E.P. 9.	essure Tests sons should be read with computation tions are indicated rips ph Negative No. ck & White Colou
Vertical scale	900	HALL BELLY CAMPAGE	i - 55/Ai6/ii83

BUREAU OF MIN GEOLOGY & GEO GEOLOGICAL	OPHYSICS		LOCA	FION E FROM	HORIZ	CNT	ΑL (ə)	90.	 	 	DIRE	NBERBA		l i	LE NO. 67
GLOCOGICAL	20001 2	MILL HOLL	COOR	INATE	S							R.L.	OF COLLAR		SHE	ET 40F2
Rock Type and Degree of Weathering		scription lour, strength, etc	Graphic Loa	Lift and % core		Lo	۱ ۳			ercept 0 60			Struc Joints,veins,s	tures eams,faults,etc	Water	Water Pressure Test Losses (Lugeons) *
MUDSTONE H.W C.W.	Yellow -	brown, mostly		100	20m											
MUDSTONE C.W.	Yellow b	orown stiff	- - -	100			: ·									
MUDSTONE H.WCW.	Yellow stiff d	brown ·		100												
MUDSTONE CH.	Red bro	own plastic clay	- <u>-</u>		25m] ,				-			Breccia	ted	ļ	
MUDSTONE	Yellow	brown		100									·			
MUDSTONE Hwcw.	Yellow -	orange brown		100									Sheare	a		
MUDSTONE MWC.W.	Yellow	-orange brown		100									Iron and stained	manganese joints	:	
MUDSTONE MWCW.	weak,	- brown some moderate g pieces		100		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							Some b	oroken e crus	hed	
END OF	HOLE	32m (105	24)													
Drill typeFOX _ Feed _ HYD.RAUL Core borrel type TRIPLETVE	ıc	Fracture Log — N Bedding and Joint Defect Frequency	Pian es — Num	— Angl	es are n	er 2: neas defe	urec cts	of co I relai Isheai	tive to rs, jo	o a pla ints,fi	ne no ractu	ormal ires) ,	to the core axis	Water P ** Values in lug in conjunction sheets. Test se by blacked in si	eons with c	should be rea
Commenced APRUL Logged by P.VAN		Water Level Measu	core	occurr L st L	ing at s	peci el wh el in	fied en f com ELY	interd ole in pleted	progi progi d hole	ress o on spe THER	onge t spe ecific	icifiei ed dat	d depth.	Core Photogr		egative No. White Colou

H.W. HIGHLY WEATHERED

H.W. HODERATELY WEATHERED

1-55/A16/II83

Vertical scale__1:100____

Checked by

BUREAU OF MI GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	LOCATION _					ON, CANBE	RRA	HOLE N	0. .5 8
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM					DIRECTION . R.L OF COLLAR .		SHEET 1	
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Graphic Log Log '% core	Dapth and size of Core	Fracture Log	RQD	Intercept Anglo 30 60 80	le Str	uctures , seams,faults,etc	Water to o Test X - (Lug	Pressur Losses eons) *
NO	CORE							:		
SANDSTONE C.W.	Yellow brown, weak	100	5m	1			Brok	en`core		
NO	CORE									
FINE SANDSTONE C.W.	Yellow brown, weak	 15								
NO	CORE		10m					·		
MUDSTONE HW C.W.	Yellow, weak	 85					8 ro	ken core		
MUDSTONE C.W.	CORE	== 50	15m		·			·		
NO MUDSTONE CW	CORE	<u> </u>					Вго	ken core		
МО	CORE									
HUDSTONE H.W - C.W.	Week, yellow Porown	20								
NO	CORE		20m							
Drill typeFQX_Feed _ HYDRAU! Core barrel type TRIPLE _ TR	Fracture Log — No Bedding and Joint F Object Frequency — Water Level Measur 1974— DEN BROEK	Pianes — Angles - Number of no core occurring rements — Y I S ALSO C.W.,	i are mo	eosured lefects (lecified i when hi in comp NUMBI PLETE	of correlations of correlations of correlations of the correlation	ve to a plane nori i, joints,fracture ppt angle range.	mai to the core axi is) per 25cm of fied depth. date.	w Values in luged in conjunction wi sheets. Test secti by blacked in strij Core Photograp Depth (m) Black	th computations are ind ps.	tion licated
Checked by	,	. n.w.	אטיח	ier \					!-55/AI6	/1104

	INERAL RESOURCES, EOPHYSICS	LOCA	TION _						CANBER		но	LE NO. 6 9
GEOLOGICAL	LOG OF DRILL HOLE						.90*		OF COLLAR	•	SHE	ET 2 OF 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core	Depth and size of Core	ractur Log	ROD	Defect Fr Intercet 0 30 6		Stro Joints, veins	ctures seams,faults,etc		Water Pressu Test Losses (Lugeons)
			<u>-</u>	20 mj	6 (2	1						
NO	CORE											
SILTSTONE H.W.	Micaceous, sandy		60	4					Closely Broken	fractured,		
NO	CORE											
SILTSTONE HW - C.W.	Hicaceous, sandy			25m					·			
MUDSTONE HW C.W.	Yellow - brown weak		80									
										·		:
NO	CORE											·.
MUDSTONE	Yellow brown								Much b	oken core		
H.W C.W.				20								
NO-	-CORE		. 13	30m				and a				
END	OF HOLE 30.5 m(10	o fee)									
;										. :		•
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-	-			,								
	-											
			·									
Drill type FQ & Feed KYDRAULIE Core borrel type TRICLE TUE	Fracture Log — Nui Bedding and Joint Pl	ones ,	Angles	ore meas	ured i	of core	to a plane	normal to	the core axis	Water Press * Values in lugeoi in conjunction will sheets. Test sectio by blacked in strip	ns sho h com nns ar	ould be read putation

Level in completed hole on specified date.

COMPLETELY WEATHERED

HIGHLY WEATHERED

C.W.

H.W.

Completed APRIL 1934 Logged by R.VANDEN STORY

Vertical scale___1:10.0

Checked by

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1-55/416/1184

GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PROJE LOCAT		ITY.	EAS	T	NESTIGA	MUQN.	, CANBER!	RA	hO	LE NO 6
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE	FROM	HORIZ	ONTAL	(ė)_	90.		CTION OF COLLAR		SHE	E. 1 OF
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Cosing Graphic Log	Lift and % core	Depth and size of Core	Fractur Log	RQD				actures , seams,faults ,etc	Water Level	Water Press Test Loss (Lugeons)
NO	CORE			-	0 6 12	(8+						
MUDSTONE C.W. M.W. MUDSTONE C.WH.W. M.W.	Pink, stiff clay to weak rock		100	5m						nese stoined some crush	1 !	
NO	CORE								-			
Mudstone CW-NW	Pink, stiff clay		50	1677					sections	d manganes	e	
Nô	CORE											
indication in the second in th	Pink, stiff eley to weak 188k		4 5	เร็าก๊					Section ?	୧୧ ଅପ୍ରଥନ୍ତ ୧୬୪୩ ଅନ୍ୟନ୍ତେ		
N8	66RE	CHI		1					Joins			
Mudsīdinē Š:₩.	GREY - BIBWIT ; Hard Strong Hock		100						iron st jaints	ouned & cla Fossilifero	,	Filled
MUDSTONE S.W				20m								
Drill type FOX Feed HYDRAUL Core barrel type TRIPLE TUI Driller B.M.B. Commenced Completed 22-4 Logged by G. JAC Vertical scale 1:16	Recture Log — Nu Bedding and Joint F Defect Frequency — Water Level Measur	Vanes — - Numbe core oc rements	Angles r of natecurring	are me	osured fects in acified when h in com	of core relative shears interce ole in poleted i C.E.:	ie to a plane , joints, trace pt angle ran rogress at a role on speci	normal to normal to tures) po ga. ipecified ified date.	o the core care of the core of	Core Photograp	ns sh h con ons a	ould be rec putation e indicate
Checked by			M.Y	ű. M	ODE	VATE	EATHER! LY WE WEAT!	ATHER				

BUREAU OF MII GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PRÓJECT CIT	Y EAST	INYEST IGATION , CANBI	ERRA	HOLE NO 69.
	LOG OF DRILL HOLE	ANGLE FROM HUR COORDINATES	ZONTAL (8) 90° DIRECTION		SHEET 2:0F2
Rock Type and Degree of Weathering	Description Lithology, colour, strangth, etc	Graphic Log Lift and % core recovery Depth	Fracture Log R	Defect Fraquency Str. D Intercept Angle 0 30 60 80 90 Joints, veins	uctures , seams,faults,etc	Water Pressure Test Losses (Lugeons) *
MUDSTONE S.W.	Grey, hard, strong	100 Z0r	n	iron sta	m pieces, ined and illed joint	
MUDSTONE S.W.	Grey, hard, strong	100		foult p	sided vertice lone from 23-8 m crushed at	
S.W. MUDSTONE C.WH.W.	Weak, some strong pieces.	100	76		hed and in, probably by dipping	
MUDSTONE S.W. HUDSTONE FRESH STAINE	Grey, hard, strong Bluish grey, hard strong	100	T	2-40 steeply iron:	plane cm pièces dipping, stained joint ng dip 60°	
END	OF HOLE 30.5 m	(100 feet)				
Drill type FOZ Feed _ HYDRAU Core barrel type TRIPLETA Driller _ G.M.8	Bedding and Joint Defect Frequency	Planes — Angles are — Number of natura core occurring at	measured ro I defects (sh specified in	core. Zones of core loss blacked in. elative to a plane normal to the core a bears, joints,fractures) per 25cm of tercept angle range. e in progress at specified depth.	* Values in lugi in conjunction w sheets. Test sec by blacked in sti	pph Negative No.
Commenced	Water Level Medal	<u> </u>	LETELY	we ATHERED	Depth (m) 81a	ck & White Colou

Checked by___

- I-55/AI6/II85

BUREAU OF MIT GEOLOGY & GEO	NERAL RESOURCES, OPHYSICS	PROJECT CITY EAST INVESTIGATIONS CANBERRA	HOLE NO.70
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM HORIZONTAL (0) 90 DIRECTION	SHEET 1. OF 2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, atc	Defect Frequency Structures Log RQD Intercept Angle 0 30 60 80 90 Joints, veins, seams, faults, etc.	₩ater Pressure Test Losses Lugeons) *
NO .	CORE		
MUDSTONE C.W. (CLAY)	Red-brown Firm -stiff CLAY	5m - 100 - 1	
MUPSTONE C.W. (CLAY)	CORE Red - brown stiff CLAY	70 10m-	
NO	CORE		+ +
MUDSTONE C.W. (CLAY)	Red-brown, firm to stiff clay		
NO			
MUDSTONE C.W H.W.	Red -brown stiff clay to weak rack	80 Some broken and crushed.	
Drill typeFOX Feed _ HYDRAUL Core barrel type TRIPLE _TU!	Fracture Log — I Bedding and Joint	umber of fractures per 25 cm of core. Zones of core loss blacked in in conjunction in conjunction. Planes — Angles are measured relative to a plane normal to the core axis sheets. Test so by blacked in some conjunction.	
Driller 6.M.1 Commenced	Woter Level Meas		raph Negative No.

BUREAU OF MIN	NERAL RESOURCES, OPHYSICS		CT			AS	NL To	VES	T.G.	ATU	20A2_, NO	BERRA	ноі	_E NO.70_
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE	FROM PINATES	HORIZ	ONTA	L (8	OP (6				CTION		SHE	ет.2 ог2
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core	Depth and size	Fractu Log	R	a D In	tect Fr	t Angl	le	Struc Joints,veins, s	tures eams,foults,etc	1 6 3	Water Pressure Test Losses (Lugeons) #
MUDSTONE C.W H.W.	Red - brown	<u></u>		20m										-
NO	CORE					1								
MUDSTONE H.W.	Red-brown weak rock		100								Bedding	g dibs 70°		
NO	CORE					-		-					ļ	<u></u>
MUDSTONE CWH.W.	Red-brown stiff clay with some rock bonds		75	25m								d zones clay filled I mangan	, s sc	
NO	CORE													
MUDSTONE CwH.w.	Red - brown stiff clay with some rock bands		90	30m							Sheor	red		·
END	OF HOLE 305 m ((100	leet)	-										
				-										
.					1] .			
Drill typeEOJ Feed _ HYDRAUI Core barrel typeTRIPLE _ TUI Driller 8.M.R	BE Practure Log — N Bedding and Joint Defect Frequency	Plones - — Numb Core	- Angle ber of no occurring s	ns are m atural d ing at sp Leve	er 25 c neosur defect necifie	ed ri s (sl nd in: n hole	alative t hears, jo tercept d le in prog	o a pla ints,f ingle r ress à	ne no roctur ange. it spec	rmal res) p cified	to the core axis per 25cm of I depth.	Core Photogra	eons s vith co tions rips.	should be read omputation are indicated gative No.
Commenced	ACO.BSQN	C.W. H.W.	co	Leve Omple IIGHL	ETE	LY	eted hole W BATHE	M	HERI		• •			

1-55/A16/1186

GEOLOGY & GEO	DERAL RESOURCES, DEPHYSICS LOG OF DRILL HOLE	PROJECT CITY EAST INVESTIGATION, CANBERRA LOCATION CORNER BALLUMBIR / CORRANDERRK STS. CANBERRA CITY ANGLE FROM HORIZONTAL (0) 30° DIRECTION COORDINATES R.L. OF COLLAR	HOLE NO 71
Rock Type and legree of Weathering	Description Lithology, colour, strength, etc	Defect Fraguency Structures Defect Fraguency Structures Structu	Water Pressur Test Losses (Lugeons)
NO	CORE		
SANDSTONE C.W.	yellowish brown stiff sandy clay	5m-	
SANDSTONE H.W.	yellowish brown weak rock	bedding 25°-40° widely spaced join with chlorite and liminite infillings	
SANDSTONE C.W.	yellowish brown soft - etiff sandy clay		
SANDSTONE H.W.	yellowish brown weak rock - interbedded sand stone / siltstone O.5 cm - 2 cm.	bedding 30° ironstoined joints	
MUDSTONE C.W.	brown firm-stiff		
SANDSTONE - SILTSTONE H.W.	yellowish brown weak rock.	100 20m	
Drill typeEOX _ Feed _BYDRAU. Core barrel typeTRIPLETUI Driller _B.H.R.	Bedding and Joint Bedding and Joint Defect Frequency	w Values in lug in conjunction is sheets. Test set Walnes in set to a plane normal to the core axis sheets. Test set Walnes in lug in conjunction is sheets. Test set by blacked in st core occurring at specified intercept angle range. Core Photographeres in the core of the core occurring at specified intercept angle range.	ressure Tests reans should be rewith computation citions are indicatorips. aph Negative No. ack & White Col
Commenced LT = Completed _ 23 = Logged by G _ JA	5:74 5:74 COBSON	Level in completed hole on specified date: CW. COMPLETELY WEATHERED H.W. HIGHLY WEATHERED	

Checked by

I-55/AI6/II87

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BUREAU OF MINE SEOLOGY & GEOP	RAL RESOURCES, PHYSICS	PROJECT LOCATIO			EAS.	T	IVESTIGATION.,	CANBERRA		HOL	E NO71
SEOLOGICAL LO	OG OF DRILL HOLE	ANGLE F	FROM I	HORIZO	NTA	(e).	90° DIRE R.L.	OF COLLAR		1	ET 2 OF 2
Rock Type and egree of Weathering	Description _ithology,colour,strength,stc	Casing Graphic Log	% core	. 0	roctui Log	RQ	Defect Frequency Intercept Angle 0 30 60 80 90	Structu Joints,veins, sec	ires gms,fauits,etc	Water	Water Pressure Test Losses (Lugeons) *
1w c.w. 10	nostly dry, some was ck, yellowish - brown	*		20 m				·			
ANDSTONE /	interbedded laminated, yellowish brown		80	1				iron staine planes 20	d bedding		
	CORE		80	25m				broken a	core		
44 - 64	dark grey, moderatel strong rock, some sandstone bads		55					bedding dib 40°	2-4cm.		
NO	CORE		20					sand on -probable with arti	ly recovere 2 fault zon esian wat	e e er	
	ellow brown & dark			30 m							
1	F HOLE 30.5 m (100 fee	4)								
Drill type Feed Core barrel type	Bedding and Joint Defect Frequency	1 Planes y Ņumb core d	- Angle er of n occurr 	as are n atural ing at s	er 25 neasc defec pecif el wh	ired re cts (sh lied int en hole	core. Zones of core la lative to a plane norm ears, joints,fractures ercept angle range. In progress at specifi	ol to the core axis } per 25cm of ed depth.	w Values in lu in conjunction sheets. Test so by blacked in s	geons with ection etrips raph l	s are indicated
Commenced	Wate		ع. محالا	_ Lov	el in	comple	ted hale on specified d	a70.	Depth (m) B	TOCK 8	

1-55/A16/1187

GEOLOGY & GE	· ·	LOCATION _						CTION		- ^{HO}	LE NO. 12.
GEOLOGICAL	LOG OF DRILL HOLE	COORDINATE						OF COLLAR.		SHE	ET.!. OF 2.
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Graphic Log Lift and % core	Depth and size of Care	Fractur Log	RQD	Defect Free			ctures seams,faults,etc	Water	Water Pressur Test Losses (Lugeons) *
, NO	CORE										
MUDSTONE C.W.	Stiff clay, brown	95	5m -								
NO	CORE	0									
MUDSTONE C.W.		<u>-</u> 20	•								
NO	CORE	 100	•								
NO	CORE	10	10m						•		
MUDSTONE C.W.	Yellow-brown, stiff clay.	100						laminata dips 20	d , bedding		f
NO	CORE							<u> </u> .		-	
MUDSTONE C.W.	Yellow - brown, stiff clay	- 40									
NO	CORE							1			
SANDSTONE C.W.	Yellow- brown, sandy day	75 									
NO	CORE		7].			
SANDSTONE C.W.	Yellow - brown, sandy clay.	60	20 n								
Drill type _EOX Feed HYD AULIS Core borrel type TRICLE TUI Driller B.M.A.	Fracture Log No Bedding and Joint F Defect Frequency	Planes — Angle — Number of m core occurri rements —	s are me atural d ing at sp Level	asure efects ecified when i	of co d relat (sheat interd hole in	ive to a plan rs, joints,fra ept angle ra progress at	e normal nctures) p nge specified	to the core axis er 25cm of depth.	by blacked in str	ons s ith co tions ips. ph Ne	hould be read imputation are indicated gative No.
Commenced 25:5 Completed 30:5 Logged by G. TAC Vertical scale 1:55	5-74 5-74 0850M		_ Level	in con	apleted	i hole on spec WEATHE	ified date	·	Depth (m) Blad	ck 8 V	Vhite Colour

I-55/A |6/||**88**

Checked by___

BUREAU OF MI GEOLOGY & GE	NERAL RESOURCES, OPHYSICS	PROJECT _CJTY	east. In		CANBERRA		HOLE NO. 72
GEOLOGICAL	LOG OF DRILL HOLE	ANGLE FROM HORIZO	ONTAL (8)		CTION		SHEET . 2. OF 2.
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Grap Grap Log Log No Grap Ond &	0 6 12 18+	Defect Frequency Intercept Angle 0 30 60 80 90	Struc Joints,veins,s	tures eams,faults,etc	Water Pressure Test Losses (Lugeons) *
MUDSTONE C.W.	Stiff clay	60 20 m					
NO	CORE	60					-
HUDSTONE C.W.	Yallow-brown stiff clay	 100 25m					
MUDSTONE C.W.	Yellow-brown stiff clay	 					
EANDSTONE H.W.	Brown weak rock	10Q 30m					
SANDSTONE M.W.	light greyish brown moderately strong	100			dips 20°	d - bedding ,ironstouried ne broken	N 1
SANDSTONE M.W.	light greyish brown	100			broken	care	
SANDSTONE S.W.	light greyish brown	100 35m					
Drill typeEOX _ Feed _HYDRAULY Core barrel type	Fracture Log — N Bedding and Joint	umber of fractures per Planes — Angles are me — Number of natural di core occurring at spi	easured relati defects (shear	ive to a plane normal : s, joints,fractures) p	to the core axis	* Values in luged in conjunction will sheets. Test secti by blacked in strip	ons are indicated os.
Driller _G.M.R Commenced Completed Logged by S.JAC Vertical scale _J20	OBSON	rements — I. Level	l when hole in p		depth.'	Core Photograpi	h Negative No.
Checked by				• .			I-55/A16/II88

GEOLOGY & GE		LOCATIO	N		CANGERSA.	HOLE NO
GEOLOGICAL	LOG OF DRILL HOLE	COORDINA		R.L	OF COLLAR	SHEET 1. OF
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	O 6 12	RQD Intercept Angle 0 30 60 80 9	Structures O Joints, veins, seams, faults, etc	₩oter Press Test Loss (Lugeons)
NO .	CORE					
					<u> </u>	
MUDSTONE H.WC.W.	Yellow-brown weak rock		5m			
IUDSTONE M.W.	reddish brown - purple moderately strong rock				Clay filled joints core pieces 4-20 cm	
+ > 100 .	strong rock					
c.W.	etiff clay	==				
H.W.	purple		10m-			
NO NOSTONE MW.	reddish brown					
H.W.	CORE					
AUDSTONE C.W H.W.	realdish brown		15m		-	
HUDSTONE	purple				3 sheared	
M.W.	purple-grey moderately strong rack				bedding 40°, some broken core vugs are weathered out	
MUDSTONE S.W.	bluish grey, strong rock		20-6			
Orill typeEQX Feed HYDRAUL Core barrel type TRIPLE _TU	Fracture Log — No. Bedding and Joint H	Planes — An — Number o	ngles are measuréd of natural defects (of core. Zones of core ion trelative to a plane normal (shears, joints,fractures)	to the core oxis	essure Tests sons should be re with computation tions are indicat rips.
Oriller B.M.B Commenced 31-5	Water Level Measu	core occu rements —	rring at specified Level when h Level in com	intercept angle range ole in progress at specifie pleted hole on specified dat	Core Photogra	ph Negative No.
completed	01	H.W Y		WEATHERE D		
			MODERATEL' SLIGHTLY \	Y WE ATHERED		

BUREAU OF MIL GEOLOGY & GEO	NERAL RESOURCES, OPHYSICS		CCTCLTY_			YESTIGA:	, אסיד	canberr	A	НО	DLE NO.73
GEOLOGICAL	LOG OF DRILL HOLE		FROM HORIZ			90°		CTION		- sн	EET_2 OF_2.
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log		Fracture Log	RQD	Defect Freq Intercept 30 60	Angle		ctures seams,faults,etc	Water	Water Pressure Test Losses (Lugeons) *
MUDSTONE S.W - FRST	bluish grey		20m					some iro goints. F	nstained Ossiliferous		
HUDSTONE FRESH	bluish grey		25 m					bedding	35°-40°		
	e new of t)
								in the second of			
	•										
Drill type _FQX Feed_HYDRAULU Core barrel typeTRIPLETUB Driller_GM.R	Fracture Log — N Bedding and Joint Defect Frequency	Planes 	- Angles are m er of natural o ccurring at sp	egsured efects ecified	of.core drelativ (shears interce	re to a plane , joints,frac pt angle ran	normal f tures) p ga.	o the core axis er 25cm of	Water F * Values in lugin conjunction sheets. Test se by blacked in s Core Photogr	eons s with co ctions trips.	should be read omputation are indicated
Commenced	Water Level Measu	S.W.	SLIGHT	in com	pleted !	hole on special	peçified fied datë	depth.	1	ack & V	-

1-55/AI6/II**89**

APPENDIX 2

SOIL TEST RESULTS

CUMMUNWEALTH OF AUSTRALIA

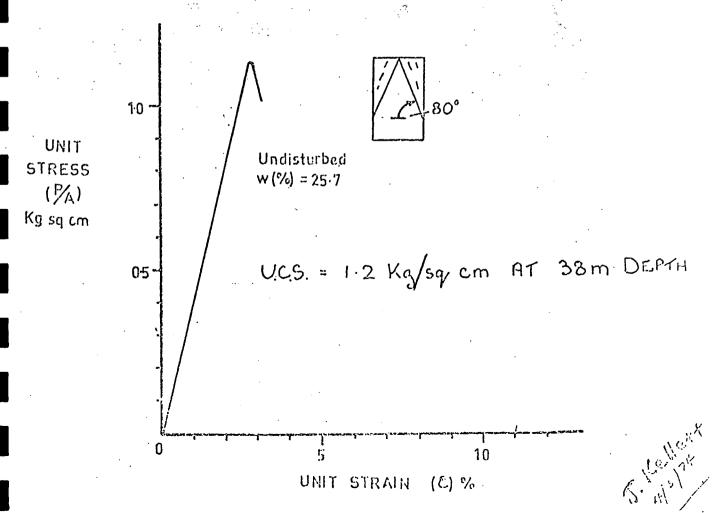
DEPARTMENT OF MINERALS AND EMERGY - BUREAU OF MINERAL RESOURCES ACY ENGINEERING GEOLOGY

TEST RESULT SHEET

Investigation:	CITY	EAST 1	PROJECT	
Location:				STREET
Sample Description(s):_				

Pare No.	D2	D2	D2			
Realh	50 m	49.9m	22 m			
Sample No	1	2	3			_

١.	·				 		
	Lower Liquid Litait	40	34.	38			
Ş	Lower Plastic Limit	31	26_	29			
1	Plasticity Index	9	8	9			
	Linear Shunkage	4.5	4.3	5.1		·	
\prod	Unified Classification	M.L.	M.L.	M.L.			
	U.S.PR.A. Classification	A-4(8)	A-4(8)	A-4(8)			



TRIAXIAL COMPRESSION TEST RESULTS

Saturated, consolidated, undrained, three stage tests on undisturbed samples, 5 cm diameter.

Drillhole		Depth (m)	Description	Cohesion (kPa)	Friction angle (degrees)
Groundtest	В2	18	Completely weathered mud-stone	46	29.4
Groundtest	Cl	30	Completely weathered mud-	55	25.7
BMR	64	16	Highly weathered mudstone	143	23.8
BMR	64	25	Highly weathered brecciated mud-stone	95	28.2
BMR	65	18	Highly-completely weathered mudstor	y 86 ne	25.1

Tests by Snowy Mountains Engineering Corporation (1974)

SUMMARY OF CONSOLIDOMETER RESULTS

Consolidometer tests were done on three samples of highly to completely weathered mudstone from BMR drill hole 65, depth 20-30 m.

COEFFICIENT OF CONSOLIDATION, Cv (m²/year)

Pressure increments (k Pa)

Sample	0-55	55-109	109-219	219-438	438-875	875-1313
λ .			_	-	•	14
A B	47	42	31	21	16	15
С	· <u>-</u>	_	-	34	54	13

COEFFICIENT OF COMPRESSIBILITY, My (m²/kN x 10⁻⁶)

Pressure increments (k Pa)

Sample	0-55	55-109	109-219	219-438	438-875	875-1313	
A	7	4	4	3	7	7	
В	82	57	120	49	34	23	
C	8	6	4	7	. 14	10	

Tests by Snowy Mountains Engineering Corporation (1974)

UNIFIED SOIL CLASSIFICATION SYSTEM

CLASSIFICATION CHART

				ATTON CHART
MAJOR DIVISIONS SYMBOLS		OLS	TYPICAL NAMES	
		GW	p 6	Well graded gravels or gravel-sand mixtures, little or no fines [®]
size	GRAVELS	GP		Poorly graded gravels or gravel-sand mixtures, little or no fines
SOILS	no. 4 U.S. sieve size)	GM .		Silty gravels, gravel-sand-silt mixture
NED No 20		GC		Clayey gravels, gravel-sand-clay mixture
I +-		sw		Well graded sands or gravelly sands, little or no fines
COARSE re than 1/2 of	SANDS (More than 1/2 of	ŚP		Poorly graded sands or gravelly sands, little or no fines
	coarse fraction> no.4 U.S. sieve size)	SM		Silty sands, sand silt-mixtures
Mor		sc		Clayey sands, sand-clay mixtures
e size		ML		Inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with low plasticity
GRAINED SOILS of soil < No. 200 sieve	SILTS AND CLAYS Liquid limit > 50	CL		tnorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
NED I No.		OL -		Organic silts and organic silty clays of low plasticty
GRAIN 2 of soil	į	мн		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
FINE than 1/2	SILTS AND CLAYS Liquid limit > 50	СН		Inorganic clays of high plasticity, fat clays
More t		он .		Organic clays of medium to high plasticity, organic silty clays, organic silts
HIC	GHLY ORGANIC SOILS	Pt		Peat and other highly organic soils

fines - portion of a soil finer than a no. 200 sieve

GRAIN SIZE CHART

GRAIN SIZE CHARI						
	Range of grain size					
Classification	U.S. Standard Sieve Size	Grain Size in Millimetres				
BOULDERS	Above 12	Above 305				
COBBLES	12"to 3"	305 to 76·2				
GRAVEL coarse fine	3 to No. 4 3 to 3/4" 3/4" to No. 4	76·2 to 4·76 76·2 to 19·1 19·1 to 4·76				
SAND coarse medium fine	No.4 to No. 200 No.4 to No. 10 No.10 to No.40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074				
SILT & CLAY	Below No. 200	Below 0:074				

PLASTICITY CHART (adopted from various sources) SHOW AND THE CLAMBER OF THE COLUMN AND THE CLAMBER OF THE CLAM

GEOLOGICAL MAP OF THE CIVIC CENTRE AREA, **CANBERRA**

SCALE

300 600 m.

REFERENCE

Note: Pattern shown where data available from excavations.

Mudstone, shale, siltstone – deeply weathered

Mudstone, shale - shallow weathered

Limestone – irregularly weathered



Siliceous shale - shallow weathered



Coarse tuff - deeply weathered



Underlying rock type unknown



Geological boundary, position accurate



Geological boundary, position approximate

Geological boundary, position inferred



Fault, position accurate



Fault, position approximate



—?— Fault, position inferred



Dip and strike of bedding



Auger or diamond drill hole showing rock type met and depth to moderately weathered rock



Depth to moderately weathered rock in excavation

Gravel locality; gravel generally as lenses immediately overlying bedrock and covered by younger alluvium or soil



Area covered by unconsolidated alluvial deposits, generally 3-5m thick, boundaries approximate

Contours of depth to stightly weathered or fresh rock, IOm interval, based on seismic surveys and diamond drilling



Area where depth of weathering greater than 70m

GN MN

A over B ⊕2m A over C? A over B WEST BASIN To accompany Record 1974/123

A over G

