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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

FLINDERS MEDICAL CENTRE - BEDFORD PARK
GEOLOGICAL INVESTIGATIONS REPORT NO. 2
DESIGN STAGE

Section 601, Hd. Adelaide

Client: Public Buildings Department

by

B.J. MORRIS
GEOLOGIST
ENGINEERING GEOLOGY SECTION.

Rept.Bk.No. 72/27

28th February, 1972.

72/27

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No.72/27
G.S. No. 4799
DM. No.1196/71

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SUMMARY AND CONCLUSIONS

Further to investigations carried out in 1967, a programme of geological mapping, trenching, diamond drilling and a seismic refraction survey has been completed.

Results of these investigations indicate that:

a. colluvial deposits ranging from 9ft. (2.7 m) to at least 57ft. (17.4 m) in thickness occur over the site.

b. the larger thickness of colluvium to the north of the creek which crosses the site may be due to an ancient buried north-west trending creek channel.

c. the colluvium is mainly underlain by tillite which is weathered to varying degrees and depths from one part of the site to another.

d. the variable degree and depth of weathering of bedrock is controlled by the degree of access of percolating groundwaters through joint and cleavage planes and crush seams.

e. where colluvium overlies highly weathered bedrock, the interface cannot be determined accurately by seismic refraction methods.

f. materials with seismic velocities of less than about 6 000ft./sec. would probably be readily rippable while that from 6 000ft./sec. to 7 000/ft.sec. would probably be difficult to rip and those greater than 7 000ft./sec. would probably require blasting.

g. the ground water table is not likely to be cut in any excavation, however some minor amounts of "perched" water could be encountered.

h. the less weathered tillite could provide an adequate foundation for the multi-storey buildings proposed. Depths to rock suitable for foundations based on results of drilling, are listed.

i. it is considered that friction piles would readily find refusal in the colluvium and/or the more weathered tillite. The actual depth of refusal could probably best be determined by test piles. Because of the variability of the colluvial deposits it is not possible to choose samples for laboratory testing which would be representative of the soil mass as a whole.

j. it is not possible to predict if and when any future movements may occur along the Eden Fault, the trace of which is about ¼ mile (4.02 m) from the site, but during seismic activity, buildings founded on rock generally suffer less damage than those on soil.

INTRODUCTION

As a result of a request from Mr. A. Dancauskis, Structural Section, Public Buildings Department, (Order No.C.149316) geological

investigations of the site of a proposed multi-storey hospital at Bedford Park (Fig. 1) were commenced on the 3rd November, 1971.

Geological investigations were made previously in 1967 and a report issued (Boucaut 1967), but due to a re-siting of the proposed buildings further work was deemed necessary.

Several multi-storey buildings, up to six storeys high, will be constructed on the site and their proposed locations are shown on Figure 3.

Geological investigations carried out during the present programme have included the following:-

.....geological surface mapping (Fig. 2).

.....five back-hoe trenches (Fig. 4).

.....five diamond drill holes (Appendix B and Fig. 2).

.....six seismic refraction traverses (Fig. 3).

REGIONAL GEOLOGY

The site is situated on the escarpment of the Eden Fault. The inferred trace of the fault, determined by geophysical methods (Bagot and Risely 1966), is about ¼ mile (402 m) to the west (Fig.1) of the site. The Eden Fault is part of the Eden-Burnside Fault Zone (up to ½ mile (804 m) wide) which is one of a number of north-south trending fault or fault zones which extend several hundreds of miles north of Adelaide. Movements along these faults during and since Tertiary time have resulted in the formation of the Mount Lofty Ranges (uplifted block) and the St. Vincent Gulf (sunken trough).

The Mount Lofty Ranges consist mainly of gently folded metamorphic rocks from the Adelaide System which were laid down as sediments in the Adelaide Geosyncline during Proterozoic time. To

the west, Quaternary and Tertiary sediments up to several hundred feet thick have been deposited in the trough and form the Adelaide Plains.

SITE GEOLOGY

Topography

The proposed site is situated on the western side of a broad gently sloping (4^{o} to 13^{o}) ridge and is bounded by the Flinders University access road to the east, residential houses to the west, and ovals to the north. Passing through the southern portion of the site is a westward flowing creek. The creek channel is 5ft. (1.5 m) to 15ft. (4.5 m) wide and is entrenched from 4ft. (1.2 m) to 5ft. (1.5 m) below a fairly flat level river terrace about 100ft. (300 m) wide. The banks of the river terrace slope at up to 20^{o} with the southern bank being the steepest.

The part of the site to the north of the creek was formerly used as a sanitorium and the surface is covered by fruit and ornamental trees, assorted shrubs, concrete and bituminous paving, fill up to 5ft. (1.5 m) deep and the remains of demolished buildings. There is a number of existing buildings and sheds near the western margin.

On the southern side of the creek the site is grass covered with some areas of fill up to 7ft. (2.1 m) deep near the eastern margin. There are two quarries on the site, up to 10ft. (3 m) deep, excavated into the southern bank of the creek.

Soil Types

The top soil over the site is variable and can be broadly divided into three main types, each type being confined to a specific area. The soil type is largely dependent upon the depth to bedrock,

degree of weathering and composition of the bedrock.

The area to the north of the creek terrace is covered by topsoil consisting largely of dark grey to black silty clay to a depth of about 1ft. (30 cms) overlying an extensive deposit of colluvium. The colluvium ranges in thickness from 9ft. (17.4 m) at the eastern (up hill) side of the site to 57ft. (17.4 m) at the western (down hill) side of the site and overlies weathered bedrock. This large thickness of colluvium is thought to be due to an ancient buried river channel (Fig. 3).

The river terrace is covered by a thin layer (0.5 ft. (15 cms)), of grey brown silt soil with 30% gravel fragments which overlies up to 24ft. (7.3 m) of river alluvium, which in turn lies on highly weathered bedrock, as shown in diamond drill holes DH7, 8 and 9 (Appendix B). The alluvium consists of 50% to 80% of sub-angular rock fragments of quartzite, slate, tillite and sandstone (average size 1-2 cms) in a dark red-brown sandy clay matrix. The material is bedded with a shallow dip downstream.

The ground surface to the south of the river terrace is covered largely by a dark brown silt soil up to 1.5ft. (45 cms) thick, with about 10% of sub-angular rock fragments (average size 8 mm) overlying creamy white calcrete (calcareous concretion) and limy silt soil up to 2ft. (60 cms) thick. Near the western margin of this area and exposed in trench TR13 (Fig. 4) the soil changes to a red-brown granular clay and silt soil 1ft. (30 cms) thick, overlying 2ft. (60 cms) of creamy white calcrete and limy silt soil. Below this is about 5ft. (1.5 m) of reddish yellow and creamy brown clay and silt soil with 10% sub-angular rock fragments (average size 1 cm) overlying highly weathered bedrock.

Rock Types

The rock types to the north of the creek have been discussed in an earlier report (Boucaut 1967). These are rocks of the Sturtian Tillite (Sturtian Age) and Tindelpina shale (Marinoan Age) of the Adelaide System. Similar rocks were found during the present investigations.

Rocks of Sturtian Tillite consist of interbeds of tillite containing sandstone and conglomerate.

.....The tillite is well exposed in outcrops in the creek bed, excavations at the eastern margin of the site, and trenches 10, 11 and 13 (Fig. 4) and was intersected in diamond drill holes DH6, 7, 8, 9 and 10 (Appendix B). In the fresh state it is a blue-grey to light brown coloured phyllitic, medium strong to strong (Table 1) fine-grained rock with up to 50% of sub-angular rock fragments of sandstone, quartzite, slate, quartz, gneiss and limestone up to 2ft. (61 cms) in size with an average size of about 5 mm. The weathered rock is typically brown and weak to medium strong.

.....The sandstone is an off-white, strong, medium to coarse-grained (2 mm) feldspathic rock which grades in part to a brown, fine to medium grained (0.3 mm) strong quartzite. This rock is well exposed in trenches TR11 and 12 (Fig. 4) and was intersected in diamond drill hole DH10 (Appendix B). It appears to occur as a layer about 6ft. (1.8 m) wide and is not nearly as extensive as the tillite.

.....The conglomerate is a coarse-grained (up to 4 mm), sub-angular, medium strong to very strong rock with 20% medium-grained sand matrix. The pebbles in the conglomerate consist of quartz,

TABLE 1.

CLASSIFICATION OF ROCK CONDITIONS AND STRENGTH OF ROCK SUBSTANCE

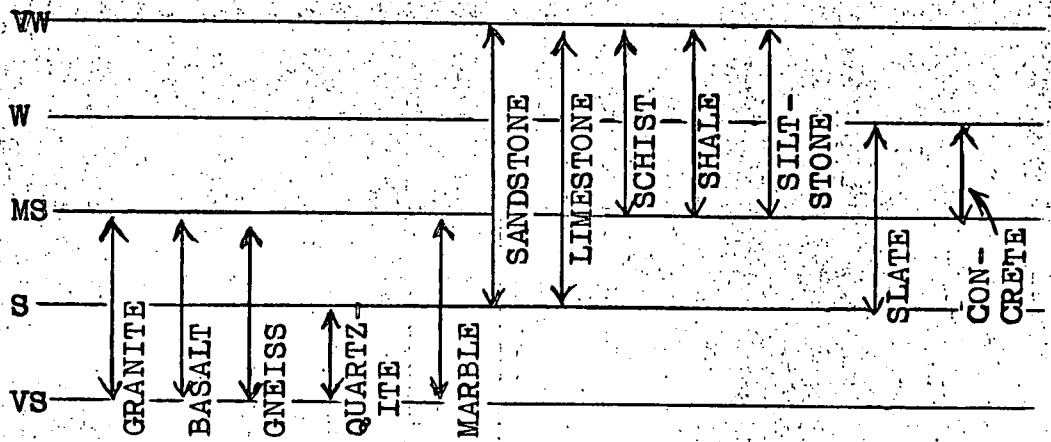
1. ROCK CONDITION TERMS

TERM	ABBRN	DEFINITION
Fresh	(F)	Substance shows no effects of chemical decomposition.
Chemically Decomposed	(D)	Substance is affected by chemical decomposition, but the exact process is not obvious.
Chemically Weathered	(W)	Substance shows effects of chemical decomposition processes which have occurred due to surface and near-surface agencies such as air and groundwater.
Chemically Altered	(A)	Substance shows effects of chemical decomposition processes which have occurred due to plutonic or volcanic fluids.
Extremely Decomposed	(XD)	Substance has been reduced to material which shows fabric of original rock, but which can be remoulded, i.e. soil substance. (Classified by Unified System).
Extremely Weathered	(XW)	
Extremely Altered	(XA)	

2. CLASSIFICATION OF ROCK SUBSTANCES BY UNCONFINED COMPRESSIVE STRENGTH

TERM	ABBRN	UNCONFINED COMPRESSIVE STRENGTH (Kg/sq.cm)	(lb/sq.in)
Very weak	VW	<70	≤ 1000
Weak	W	70 - 200	1000 - 3000
Medium strong	MS	200 - 700	3000 - 10,000
Strong	S	700 - 1800	10,000 - 25,000
Very strong	VS	>1800	$>25,000$

RANGE OF STRENGTHS OF SOME COMMON ROCK SUBSTANCES IN THE FRESH STATE*



*Samples of fresh rock tested to Australian Standard. For rocks showing planar anisotropy the long axis of the sample is normal to fabric planes.

3. EXAMPLES OF USE OF CLASSIFICATION

Geological Name	Rock Condition Term	Strength Term
Granite	Fresh	Strong
Granite	Weathered	Medium Strong
Schist	Fresh	Weak
Schist	Altered	Very Weak

tillite, slate and sandstone. The rock weathers to a yellow-brown, limonite rich, weak to medium strong rock. This rock is exposed in the quarry in the south bank of the creek terrace, in a road cutting about 1 000ft. (305 m) southeast of the site and was intersected in diamond drill hole DH10.

The Tindelpina Shale member lies unconformably over the Sturtian Tillite. The unconformity is exposed in a road cutting about 1 000ft. (305 m) southeast of the site. The shale is also exposed in trenches TR13 and 14 (Fig. 4). It is a brown thinly laminated calcareous medium strong rock.

Using results obtained from drilling, back-hoe trenching and seismic profiles, a contour plan of the colluvium-bedrock interface has been prepared (Fig. 3). These contours are based on fairly widely spaced points, and thus should be used only as an indication of the general shape and position of the interface.

Structure

Bedding in the Sturtian Tillite is not well developed but from drill core evidence and field exposures it dips at about 60° to the east with a general strike ranging from 017° to 030°. The Tindelpina Shale which lies with apparent angular unconformity on the Sturtian Tillite strikes generally at 024° with a variable dip ranging from 30° to 70° to the west. However, variations in strike and dip with folding probably occur across the site. Several gentle large scale folds, are exposed in a road cutting to the southeast of the site, and more intense small scale folding is exposed in trench TR14 and some of the nearby road cuttings.

The most well developed structure at the site is the cleavage which strikes consistently in a north-south direction and dips generally at 50° to the east. It is best developed in the less competent slaty layers and the cleavage planes are generally smooth with mica developed along them. This cleavage is known to occur throughout most rocks in the area with a fairly constant strike and dip.

Joints are common in the area, the main ones being steeply dipping and spaced from 2-15 cms. Joint planes are often smooth, coated with limonite, clay, calcite and manganese, and often open from 1 mm to 2 mm.

It appears that several minor crush or shear zones occur in the area. In the road cuttings to the southeast of the site are exposed several near vertical crush zones up to 1ft. (30 cms) wide but with no apparent displacement. The diamond drill cores showed several crush zones up to 4ft. (1.2 m) wide to a depth of about 40ft. (12 m) below the rock surface. The relatively large number of crush seams in the area is probably associated with the Eden-Burnside Fault Zone. This is thought to be a near vertical thrust fault (Bagot and Risely 1966).

Seismic Activity

The most recent movement along the Eden-Burnside Fault was on the 1st March 1954 with a maximum recorded magnitude of intensity 8 on the Modified Mercalli scale (Kerr-Grant 1956). The duration of the earthquake was short, probably about 2 or 3 seconds near the epicentre but material damage to many buildings was caused. The epicentral region was found to be an elongated strip over the Eden-Burnside Fault scarp near Darlington. It was concluded that small movements (2-5 cms) at shallow depth along this fault caused the earth-

quake. This was the first recorded earthquake near the city of Adelaide for about 100 years and it is impossible to predict when or if another movement will occur along this fault. Experience has shown that buildings founded on rock suffer less damage than those located on soil.

Weathering

Investigations have indicated that the bedrock has been considerably affected by chemical weathering to a depth of from 1ft. (30 cms) to 40ft. (12 m).

Chemical weathering is the decomposition of rock minerals, mainly by the circulation through open joints and cleavage planes and along permeable crushed zones, of groundwater containing atmospheric gases and organic acids. Hence the large variation in depth of weathering across the site is considered to be due to variations in the degree of openness of the joints and cleavage planes.

There is no apparent pattern in the depths of weathering and it is inferred that a complex arrangement of weathering products with a wide range of physical properties can be expected, particularly on the north side of the creek crossing the site. The Bedford Park Teachers' College some 1 200ft. (366 m) northeast of the site is founded on similar rock types, and this large variation in degree of weathering also occurred in this area (Stapledon and Steel 1965).

Table 1 shows the effect of weathering on the strength of the rock.

Groundwater

No springs or swampy ground occur at the site and the creek running through the site only flows during the winter months. The water table during the winter months lies at about RL.295ft. (90 m) at the eastern side of the site and falls to about RL.250 (76 m) at the west of the site. From water levels measured over the past three

years it appears that the water table can fall by up to 7ft. (2 m) during the summer months.

Thus it is not anticipated that the water table will be cut in any excavation above at least RL.295ft. (90 m). However, small quantities of "perched" water could be encountered in excavations in the large thickness of colluvium to north of the creek.

RESULTS OF SEISMIC REFRACTION SURVEY

Six seismic refraction traverses were carried out over the site during this investigation. Six seismic refraction traverses were also carried out during previous investigations (Kendell 1967). Details of the seismic investigations are given in Appendix A.

Reasonably good correlation was obtained between the types of material encountered in drill holes and the seismic velocities.

The following generalisations have been made:

Seismic Velocity (ft./sec.)	Material shown in Drillholes
up to 3 100	Colluvium
2 500 - 7 500	Tillite completely to moderately weathered.
greater than 7 500	Tillite slightly weathered to fresh.

Seismic velocities in the range 2 500ft./sec. to 3 100ft./sec. were obtained in both colluvium and highly weathered to completely weathered tillite. Thus where colluvium overlies slightly weathered to fresh tillite, the boundary can be indicated by seismic refraction methods, but where colluvium overlies highly weathered tillite, seismic refraction methods do not give a clear indication of the colluvium bedrock interface. It should be noted that below the water table a minimum velocity of about 5 000ft./sec. (the velocity

of water) is obtained. Thus where low velocity material (such as highly weathered tillite) occurs below the water table it will have an apparent velocity of about 5 000 ft./sec.

The seismic refraction results have been summarised on Sections A-A', B-B', C-C', D-D', E-E', G-G' (Figs. 5,6,7,8 and 9) and are used as the basis for interpretation between drillholes and surface exposures.

The seismic velocities obtained are largely related to the strength of the rock, and this can be used as a guide to the ease of excavation, that is, whether the material can be ripped by heavy duty tractors, e.g. a Caterpillar D9, or will require blasting.

It is considered that material with a seismic velocity of less than about 6 000ft./sec. would be readily rippable while from 6 000ft./sec. to 7 000ft/sec. would be difficult to rip and greater than 7 000ft./sec. would probably require blasting.

FOUNDATION AND EXCAVATION CONDITIONS

Inferred contour lines of the upper surface of the bedrock are shown on Figure 3 and depth to bedrock is shown in the geological cross sections (Figs. 5,6,7,8 & 9). It can be seen that bedrock lies close to the surface on the area to the south of the creek and along the eastern margin of the site, which is in direct contrast to the rest of the site where bedrock is covered by up to 57ft. (17.4 m) of colluviul and alluvial deposits.

The excavation and foundation conditions as observed in the cores from the ten diamond drillholes drilled over the site are summarised in Table 2. The suggested type of foundations is intended only as a guide to the foundation characteristics at this site and does not necessarily exclude alternative foundation designs.

It is thought that near vertical batters in any excavation on the site would be relatively stable during construction. But where the batters are to be permanent they should be at slopes of 1 on 1 (45°) in soil and 1 on 0.5 (63°) for rock.

B Morris
2 Mar. 1972.

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28.2.72

TABLE 2

SUMMARY OF EXCAVATION AND FOUNDATION CONDITIONS

Diamond Drill Hole	R.L. at Surface in feet	Vertical Depth in feet From	To	Condition of Rock	Excavation Conditions	Suggested Foundations
DH. 1	302.28	0	57	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 65ft. and grouting from 65ft. to 85ft.
		57	65	Moderately weathered highly weathered, fractured weak shales.		Friction piles should find refusal in the colluvium.
		65	85	Moderately weathered, fractured weak shales.	Probably rippable with blasting near bottom.	
		85	96.75	Fresh, strong shale.	Blasting required.	
DH. 2	324.28	0	35	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 36ft.
		35	36	Slightly weathered and fractured medium strong tillite.	Probably rippable.	Friction piles should find refusal in the colluvium.
		36	65	Slightly weathered and fractured strong to medium strong tillite.	Blasting probably required.	

DH. 3	336.8	0	10	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 35ft. with grouting from 35ft. to 50ft. or cast "in situ" piles to 50ft.
		10	35	Highly weathered, micro-fractured weak slate and tillite.		
		35	50	Slightly weathered to highly weathered, fractured strong to weak tillite.	Probably rippable.	Friction piles should find refusal at a depth of between 10 and 35ft.
		50	69	Fresh to slightly weathered strong tillite and conglomerate.	Blasting required.	
DH. 4	308.46	0	28	Colluvial deposit.	Readily excavated with earth moving equipment	Cast "in situ" piles to 45ft. with grouting from 45ft. to 60ft. or cast "in situ" piles to 60ft.
		28	45	Highly weathered weak fractured tillite.		
		45	60	Moderately weathered fractured medium strong slate and sandstone.	Probably rippable with blasting near bottom.	Friction piles shoul find refusal in the colluvium.
		60	72.8	Fresh to slightly weathered strong sandstone.	Blasting probably required.	

DH. 5	324.69	0	9	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 22ft.
		9	22	Moderately to highly weathered fractured medium strong to weak tillite.		Friction piles should find refusal at a depth of between 9 and 22ft.
		22	46	Fresh to slightly weathered medium strong tillite.	Blasting probably required.	
DH.6	334.75	0	5	Colluvial deposit.	Readily excavated with earth moving equipment.	Adequate foundations occur at a depth of 14ft.
		5	14	Highly to moderately weathered fractured weak tillite.		
		14	48.3	Slightly weathered to fresh strong tillite.	Blasting probably required.	
DH. 7	310.64	0	19	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 22ft. with grouting below 22ft.
		19	22	Highly weathered weak fractured siltstone.		
		22	41 51(?)	Slightly to highly weathered strong to weak siltstone and tillite.	Probably rippable with some blasting.	Friction piles may penetrate the colluvium but should find refusal close to the upper surface of the siltstone.
		41 (51?)	56.3	Slightly weathered medium strong to strong tillite.	Blasting probably required.	

H. 8	302.48	0	12	Colluvial deposit.	Readily excavated with earth moving equipment.	Case "in situ" piles to 16ft. with grouting below 16ft. or cast "in situ" piles to 35ft.
		12	16	Highly weathered weak fractured tillite.		
		16	25 35(?)	Moderately to slightly weathered, medium strong to weak tillite.	Probably rippable.	
		25 35(?)	48.8	Fresh to slightly weathered strong to medium strong tillite.	Blasting probably required.	Friction piles should find refusal close to the upper surface of the tillite.
DH. 9	299.24	0	17	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 37ft. with possibility of grouting to 49ft.
		17	37	Highly weathered weak to very weak fractured tillite.		
		37	54	Slightly weathered medium strong tillite with weak seams up to 1ft. wide.	Blasting probably required with some ripping near the top.	Friction piles should find refusal within the highly weathered tillite at a dept of from 17 to 37ft.
DH. 10	319.53	0	35	Colluvial deposit.	Readily excavated with earth moving equipment.	Cast "in situ" piles to 11ft. with grouting from 11ft. to 26ft. or cast "in situ" piles to 26ft.
		3.5	11	Highly weathered fractured weak to very weak tillite.		
		11	26	Slightly weathered to highly weathered, medium strong to weak tillite.	Probably rippable.	Friction piles should find refusal within the weathered tillite at a depth of from 11 to 26ft.
		26	51	Fresh to slightly weathered strong to medium-strong tillite and conglome ate.	Probably required blasting may be rippable with difficulty.	

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APPENDIX A

SEISMIC REFRACTION SURVEY REPORT

(All figures from this report are summarised in the geological report Figs. 5,6,7,8 & 9).

DEPARTMENT OF MINES
SOUTH AUSTRALIA

REPORT ON A SEISMIC REFRACTION SURVEY AT FLINDERS MEDICAL CENTRE SITE, BEDFORD PARK, S.A.

Client: Public Buildings Department, S.A.

by

R.A. GERDES
ASSISTANT SENIOR GEOPHYSICIST
EXPLORATION GEOPHYSICS SECTION

CONTENTS

PLANS

Plan No.	Title	Scale
S9598	Flinders Medical Centre Locality Plan Section 601, Hd. Adelaide	as shown
72-9	Flinders Medical Centre - Bedford Park. Interpretation of Seismic Refraction Survey Lines 1N 2N & 3N	1 inch = 40 feet 1:480
72-10	Line 1E 2E & 3E	1 inch = 40 feet 1:480
72-36	Flinders Medical Centre - Bedford Park. Section 601, Hd. Adelaide Seismic Lines and Drill Holes	as shown

Rept.Bk.No. 72/11
G.S. No. 4783
D.M. No. 1196/71

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 72/11
G.S. No. 4783
D.M. No. 1196/71

REPORT ON A SEISMIC REFRACTION SURVEY AT FLINDERS MEDICAL CENTRE SITE, BEDFORD PARK, S.A.

Client: Public Buildings Department, S.A.

ABSTRACT

Three layers with seismic velocity ranges 335 to 900 metres per second; 760 to 2270 metres per second and greater than 2500 metres per second corresponding to colluvium, weathered tillite and unweathered tillite respectively are shown to persist beneath the site of the proposed Flinders Medical Centre, Bedford Park, S.A.

Seismic profile interpretations show reasonable agreement with investigational drilling, allowing for the fact that there is no distinct change in velocity between the weathered tillite and the colluvium.

INTRODUCTION

As part of the geological investigation of the proposed excavation for the foundations of the Flinders Medical Centre at Bedford Park, a seismic refraction survey was requested by the South Australian Public Buildings Department in conjunction with a geological investigation by the Engineering Geology Section of the South Australian Geological Survey. The survey was carried out between the 22nd and the 30th November, 1971.

The purpose of the investigation was to determine the depth and degree of weathering and delineate the unweathered bedrock profile. The velocities of the overlying weathered

material give an idea of their rippability.

The site of the survey area was occupied by abandoned gardens, old concrete foundations and small quarries. The area was bounded on the east side by the Flinders University Road and on the west side by residential houses. The location of the site is shown in drawing No. S9598

GEOLOGY

The geology of the area is being determined from 5 diamond drill holes, trenches and surface mapping by B. Morris (Geologist, Engineering Geology Section).

The area consists essentially of Sturtian Tillite of the Adelaidian underlying recent colluvium deposits. The tillite consists mainly of shale, siltstones and sandstones, quartzite, and conglomerates. The recent colluvium deposits consist of claysoil, gravel, sand and rock fragments.

The Eden - Burnside fault is located northwest of the site under investigation.

PREVIOUS GEOPHYSICAL WORK

In 1967, six refraction traverses were surveyed just north of the present survey site and the interpreted results were compared with drill hole data.(Kendall, 1967). The comparison showed three distinct velocity ranges, which are given below:

VELOCITY RANGE (feet/sec) (305 to 457m/s)	LITHOLOGIES - Interpreted from Drill hole Data
1 000 to 1 500 feet/sec (305 to 457m/s)	Completely weathered material
2 200 to 5 300 feet/sec (671 to 1 615m/s)	Recent Colluvium Deposits and weathered Tillite
9 500 to 14 500 feet/sec (2 896 to 4 420m/s)	Slightly weathered to fresh Tillite

The colluvium had velocities ranging between 2 200 to 3 000 feet per second (671 to 914m/sec) and the weathered tillite had velocities ranging between 3 000 to 4 500 feet per second (914 to 1 372m/s).

Four gravity traverses surveyed in 1963 to delineate the Eden-Burnside Fault Zone, Bagot and Risely (1966), resolved the fault within 100 feet and located it to the northwest of this foundation site. Possible seismic activity along this fault must be considered as shearwaves could affect the hospital's foundations, if design precautions are not taken in the planning of the building.

SURVEY PROCEDURES

The seismic refraction spreads were laid out to include both building foundations sites and the locations of diamond drill holes.

The spread lengths and corresponding geophone spacings were varied to accommodate the foundation site length, the probable depth to basement (fresh rock) and the restrictions due to the Flinders University Road and residential houses.

A Texas Instrument 7000B, 24 channel recording seismograph mounted in a landrover, was used to record the first arrivals for the full length spread in all cases and for weathering spreads (geophone spacing 5 feet, (1.52m) overall spread length 115 feet (35.052m)) at intervals along the main spread.

The geophone spacings for each separate spread are given below:-

Line Number	Geophone Spacing	Length of Spread
1E	10 feet (3.048m)	230 feet (70.104m)
2E	20 feet (6.096m)	460 feet (140.208m)
3E	10 feet (3.048m)	230 feet (70.104m)
1N	20 feet (6.096m)	460 feet (140.208m)
2N (Southern Spread)	15 feet (4.572m)	345 feet (105.156m)
2N (Northern Spread)	20 feet (6.096m)	460 feet (140.208m)
3N	30 feet (9.144m)	690 feet (210.312m)

The shot points were located in the following positions:-

(i) At the centre of each spread, the nearest geophone distance being half the geophone spacing.

(ii) At the end of each spread, located at the end geophone position. The geophone was moved half the geophone spacing, from the shot point, and returned to its original position after shot was fired.

(iii) At a distance of 50 or 100 feet beyond the ends of each spread, dependent on the spread length and location.

(iv) On Lines 2N (Northern Spread) and 3N, shots were fired midway between geophones 6 and 7 and 18 and 19 respectively.

Weathering spreads were fired, where necessary, at shot points, for near surface velocity and additional data.

1 lb to 3 lbs of AN60 gelignite was used at the respective shot points, to provide the necessary seismic energy. Shot point drilling was requested at extra expense by the Public Buildings Department

to reduce the noise level on spreads 3E and 3N due to the close proximity of residential houses.

RESULTS AND INTERPRETATION

The time-distance curve for each profile was plotted. The intercept times and the velocities of the upper layers were obtained directly from the time-distance curves of the main spreads and weathering spreads.

The Reciprocal method of Hawkins (1961) was used to determine a corrected velocity for the high velocity layer and any lateral variations. The profile of the high velocity interface was determined from the time depth for each geophone position, after stripping off the upper layers using half intercept times. The depth for each geophone position was obtained using Hawkin's nomograph of depth conversion applied to the appropriate velocities.

The localities of the spreads are shown on drawing No. 72-36 with individual profiles being shown on separate drawings together with any drill hole data. Drawing numbers 72-9 and 72-10.

All spreads show a very thin soil profile with velocities less than 1 000 feet per second (304.8m/s).

The 1 000 ft/sec (304.8m/s) lens on the northern side of the Line 1N drawing No. 72-9 correlates with a cinder dump. The soil profile generally overlies a relatively thin undulating composite layer having velocities ranging from 1 100 to 2 960 feet per second (335 to 900m/s), with a mean and standard deviation of 37 determinations of 1 879 and 480 feet per second (573 and 146m/s) respectively. This layer probably correlates with colluvial deposits. On line 2E, drawing No. 72-10, a small layer of material having

velocity of 4 000 feet per second (1 219m/s) was detected on the weathering spread at the eastern end of the spread. This correlates with weathered siltstone with rock fragments, as logged by B. Morris in diamond drill hole DDH6.

An intermediate layer of variable thickness is present on all the spreads. The velocity of this layer ranges between 2 800 to 7 460 feet per second (760 to 2 270m/s); the mean and standard deviation of 27 determinations was 4 793 and 1 168 feet per second (1 461 and 356m/s) respectively. These probably correlate with weathered tillite. A lens of material having a velocity of 2 940 feet per second (896m/s) situated beneath the creek on line 2N correlates with an Alluvial Deposit.

The lower layer, or high velocity 'basement' which is assumed to correlate with fresh and /or slightly weathered tillite shows lateral velocity variations and an uneven refraction interface. The marked highs on the profile probably correlate with harder bands, which have not been completely resolved.

The lateral variations of the basement are considered to represent lithological changes, correlating with dipping beds. The variations tentatively show three possible ranges of velocity, which may correlate with the following lithologies:

RANGE feet per sec.	MEAN feet per sec.	STANDARD DEVIATION feet per sec.	LITHOLOGY	
5 330 to 7 300 (1 625 to 2 225m/s)	6 440 (1 963m/s)	607 (185m/s)	Siltstone & weathered tillite shales	
8 420 to 9 900 (2 566 to 3 017m/s)	8 740 (2 664m/s)	615 (187m/s)	Sandstone	Tillite
10 350 to 14 300	12 130 (3 697m/s)	1 324 (403.55m/s)	Quartzite	Tillite

CONCLUSIONS AND RECOMMENDATIONS

The velocities of the layers resolved in the area correspond to similar velocity ranges as delineated by Kendall (1967).

The velocity and depth results at the intersections of each line show small discrepancies, which probably indicate that the rock formations have anisotropic properties.

The correlation of the interpreted profiles with the drill hole data is satisfactory, but discrepancies do occur.

The refraction boundary between the weathered tillite and the colluvial deposits is not distinctive, as there is a velocity overlap between the two lithologies.

It is recommended that for future surveys of this type inside the metropolitan area, that all shot holes be drilled to a depth of 10 to 12 feet (3.048 to 3.6576 metres) before firing. This cuts down noise and earth displacement which can be a nuisance to the public.

RAG:AM
25.1.1971

R.A. GERDES
ASSISTANT SENIOR GEOPHYSICIST
EXPLORATION GEOPHYSICS SECTION

REFERENCES

Bagot, C.H., and B.G. Risely 1966 A Note and Geophysical Survey on the Eden-Burnside Fault Zone in the Bedford Park Area. Hd. Adelaide, S.A. Mines Dept., Rept. 62/106 (unpublished) D.M. 2156/62.

Hawkins, L.V. 1961 The Reciprocal Method of Routine Shallow Seismic Investigations. Geophysics V.26 Note pp. 806-819

Kendall, G.W. 1967 Report on Seismic Refraction Survey at Southern Districts Hospital Site, Bedford Park. S.Aust. Mines Dept. Rep 65/6 (unpublished) D.M. 885/66.

APPENDIX B

Logs of Diamond Drill Holes, photographs of cores and explanatory notes.

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. D.H. 1.
SERIAL No.

PROJECT FLINDERS MEDICAL CENTRE
FEATURE. FOUNDATIONS
LOCATION BEDFORD PARK.
SECTION 601. HUNDRED ADELAIDE.
CO-ORDINATES
ANGLE FROM HORIZ. 90° DIRECTION -
R. L. Surface 302.28 FT.
R.L. Collar 303.64 FT.
Datum 105.7 BELOW M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE DEPTH R.L. FT.	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0 100	④ WATER PRESSURE TESTS LUGEONS 0.5 1 5 10 50 100
RECENT COLLUVIAL DEPOSITS Interbedded CLAYSOIL, medium to high plasticity, grey and red-brown, Sandy and with gravels GRAVEL, poorly graded, excess clayey and silty fines. SAND, excess clay fines, grey and brown. SILT, high to medium plasticity.			NX C 300' NM LC 10 290' 280' 20 30 270' 40 260' 50 250'		NOT APPLICABLE	For detailed log see Dwgs. No S 5938 A&B		23 Feb to 3 Mar '67		FULL RETURN	NOT TESTED
No Core											
No Core											
No Core											
No Core											
No Core											

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3-5) Maximum effective pressure (bars) reached during test.
. Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No.	DD.24.	LOGGED	G.T. Roberts
TYPE	Mindrill	DATE	28 FEB 67
DRILLER	K. Kruse.	TRACED	M.A.S.
START.	13 Feb '67.	CHECKED	
FINISH	20 Feb '67.		

SHEET 1. OF 2. DRG. No. S5938 Ha6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH. 1

SERIAL No.

PROJECT FLINDERS MEDICAL CENTRE

FEATURE. FOUNDATIONS

LOCATION BEDFORD PARK

SECTION 601 . HUNDRED ADELAIDE.

CO-ORDINATES

ANGLE FROM HORIZ. 90°. DIRECTION —

R. L. Surface 302·28 . FT.

R.L. Collar 303·64 . FT.

Datum 105·7 BELOW M.S.L

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS S MS W VW SO)	CORE SIZE	DEPTH R L FT.	LOG	③ FRACTURE LOG (1 4 16 64)	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% (10 5 50)	WATER LEVEL DATE	CASING	DRILL WATER LOSS % (0 100)	④ WATER PRESSURE TESTS LUGEONS (0.5 1 5 10 50 100)
No Core				50 / 250								
Blue-grey to light grey beds from 0·01 to 0·5 ft. thick Core recovered as smooth surfaced sticks from 0·1 to 0·5 ft. long, with breakage to angular fragments in areas of seams and close jointing. PROTEROZOIC ADELAIDE SYSTEM TINDELPENA SHALES				60 / 240			Clayey weathered crushed seams. Bedding dips 50°-60° Joints dip 60° (2sets) 70° and 90° mainly planar smooth, many with thin limonite coatings Joints spaced from 0·05 to 0·5 ft. mainly 0·1 to 0·2 ft.					NOT TESTED
				70 / 230								
				80 / 220			Joint at 70° thickly coated with limonite					
				BM LC			Many joints strongly cemented with calcite up to 0·01 ft. thick					
				90 / 210								
							END OF HOLE 95·75 ft.					

FULL RETURN

① ROCK SUBSTANCE

STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
. Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. DD24
TYPE Mindrill
DRILLER K. Kruse.
START. 13TH FEB '67.
FINISH 20TH FEB '67.

LOGGED G.T. Roberts.
DATE 28TH FEB. '67.
TRACED M.A.S.
CHECKED

SHEET 2. OF 2.. DRG. No. S5938 No6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH2.
SERIAL No.

PROJECT FLINDERS MEDICAL CENTRE
FEATURE. FOUNDATIONS
LOCATION BEDFORD PARK
SECTION 601. HUNDRED ADELAIDE
CO-ORDINATES
ANGLE FROM HORIZ 90° DIRECTION —
R. L. Surface 324·28 FT.
R.L. Collar 324·42 FT.
Datum 105·7 BELOW MSL

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS S MS W VW SO)	CORE SIZE	DEPTH R.L. FT.	LOG	③ FRACTURE LOG (1 4 16 64)	STRUCTURES (JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES)	LIFT CORE LOSS% (10 5 50)	WATER LEVEL DATE	CASING	DRILL WATER LOSS % (0 100)	WATER PRESSURE TESTS ④ LUGEONS (0.5 1 5 10 50 100)
RECENT COLLUVIAL DEPOSITS Interbedded - GRAVEL, poorly graded with excess clayey and sandy fines CLAYSOIL, medium to high plasticity with gravel up to 50% grey and red-brown GRAVEL is mainly moderately to highly weathered shale, siltstone, and fine-grained sandstone between 0 and 28 ft; greenish-grey and brown fine grained sandstone with numerous small erratics between 28 and 35·5 ft. Gravel max. size >50mm. mainly <25 mm. Sub-rounded. CLAYSOIL often contains up to 50% highly to completely weathered shale fragments to 0·1 ft. thick. Tillite boulder			NX C; NM LC	1320; 1310; 1300; 1290			cemented gravel ←1·75; Washed during drilling; Cemented gravel; Washed during drilling; Cemented gravel ←3·5; cemented gravel ←4·5; Cement is red ferruginous.				NOT TESTED	
PROTEROZOIC ADELAIDE SYSTEM STURTIAN TILLITE. Tillite consists of fine grained sandstone and phyllite with scattered small erratics throughout, but fewer and smaller in phyllite. Foliation absent to 45ft., poorly developed 45-47ft., moderately developed 47-65 ft., dips 50-70°. Mainly smooth surfaced sticks from 0·05 to 1·2ft. long - surface pitted between 36 and 44ft. Some breakage to angular fragments in areas of seams and close spaced joints.				1280; 1270; 1260			Joints mainly subhorizontal, some at 60°-70°-85°, mainly open, some with up to 0·02 ft. ferruginous quartz. 0·04 ft. clayey seam at 73° 0·08 ft. clayey seam at 50° 0·02 ft. vertical clay seam. with vegetation roots. Clayey weathered crushed seam. Vertical joint with ferruginous clay coating to 0·01ft. Rough surfaced. Joints at 40-60°, mainly open, limonite stained, some quartz calcite veneers spaced 0·05 to 1·25 ft mainly 0·3 to 1·0 ft. Joint at 30° open 0·04 ft. Clayey, weathered crushed seam to 0·2 ft. thick. END OF HOLE 65 ft.		NO WATER March '67			

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System.

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
. Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. DD24
TYPE. MINDRILL
DRILLER K. Kruse
START. 21st Feb '67.
FINISH 24th Feb '67.
LOGGED G.T. Roberts.
DATE 10th Mar. '67.
TRACED M.A.S.
CHECKED

SHEET 1. OF 1.
DRG. No. S5939 Ha6.

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH3.

SERIAL No.

PROJECT FLINDERS MEDICAL CENTRE.

FEATURE FOUNDATIONS.

LOCATION BEDFORD PARK.

SECTION 601. HUNDRED ADELAIDE.

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION —

R.L. Surface 336·80 FT.

R.L. Collar 336·89 FT.

Datum 105·7 BELOW M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS, S, MS, W, VW, SO)	CORE SIZE DEPTH R.L. FT.	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS% 0 100	WATER PRESSURE TESTS ④ LUGEONS 0.5 1 5 10 50 100
No Core.			N.X. C								
RECENT COLUVIAL DEPOSITS: Clay soil medium to high plasticity, brown 5% gravel. Slightly calcareous			1330		Not Applicable						
PROTEROZOIC ADELAIDE SYSTEM – STURTIAN TILLITE: Mainly slates with fine grained sandstone bands between 12 and 16ft. Grey and light brown; becoming light purple below 21ft. Cleavage well developed – dips 35°.			1320			Bedding and joints dip 35 to 45°. Joints spaced mainly 0·1 to 0·3 ft. in slate 0·5 ft. in sandstone planar, smooth, grey and red clay coatings, rootlets to 11ft.					
						← 0·25 ft. thick, clayey, crushed seam.					
			1310			Crushed seam 0·2ft. thick at 35°.					
						Joint at 50° Clay coated clayey, weathered, crushed seam.					
Tillite consists of slate and fine grained sandstone with many small erratics < 10cm. Red-brown to 35·5 ft. then grey. Calcareous between 37·5 and 46 ft. 50% smooth surfaced fitting sticks from 0·1 to 0·5 ft. long. 50% broken to angular fragments with clay.			1300			Red and grey clayey crushed and weathered zone.					
						Clayed, crushed seam with vegetation rootlets.					
						Joints spaced 0·25 to 0·5 ft. mainly planar. – thin clay coatings, rare calcite. Dip 45°.					
						Joints spaced 0·05 to 0·5 ft. Sub-planar, sub-horizontal to dip 25°.					
Mainly 0·13 to 1·25 ft smooth surfaced, fitting sticks pitted surface between 50 and 59 ft.			1290								
Sandstone, coarse grained, brown to 50 ft, then grey brown.						Clayey, crushed seam. Bedding at 25° to 35°. Joints at mainly 25 to 45°, few 75° to 90° spaced mainly 0·25 to 0·5 ft. planar, open extensive limonite coatings 0·02 ft. thick near 52 ft.					
			1280								
Conglomerate, fine grained, blue grey.											
Slate with numerous erratics from 0·1 to 0·3 ft. diameter.			1270			Joints dip subhorizontal to 35° few to 75°–90° spaced 0·5 to 1·5 ft. Extensive multiple calcite veins up to 0·02 ft. thick.					
						END OF HOLE 69ft.					

21ST Mar '67

NOT TESTED

① ROCK SUBSTANCE

STRENGTH TERM: VS–Very Strong; S–Strong; MS–Medium Strong; W–Weak; VW–Very Weak; SO–Soil properties

CONDITION TERM: Fresh; Decomposed; Weathered; Altered; Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG

1 4 16 64 — Natural fractures per foot of core

12 3 3/4 3/16 — Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.

Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. DD24.
TYPE Mindrill.
DRILLER K. Kruse
START 27TH FEB '67
FINISH 1ST MAR '67

LOGGED G.T. Roberts.
DATE 14TH APRIL '67
TRACED M.A.S.
CHECKED

SHEET 1 OF 1.

DRG. No. S5940 Hab

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

PROJECT. FLINDERS MEDICAL CENTRE

LOG OF DIAMOND DRILL HOLE

HOLE NO. D.H.5.

SERIAL No.

FEATURE. FOUNDATIONS.

SECTION 601. HUNDRED ADELAIDE.

CO-ORDINATES

LOCATION BEDFORD PARK.

ANGLE FROM HORIZ. 90°. DIRECTION —.

R. L. Surface 324·69 FT.

R.L. Collar 325·49 FT.

Datum 105·7. BELOW M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS S MS W VW SO)	CORE SIZE	DEPTH R.L. FT.	LOG	③ FRACTURE LOG (1 4 16 64)	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% (10 5 50)	WATER LEVEL DATE	CASING	DRILL WATER LOSS% (0 100)	④ WATER PRESSURE TESTS LUGEONS (0.5 1 5 10 50 100)
RECENT COLLUVIUM. No Core. Fill, clayey. No Core. Fill, gravelly. Gravel, excess clayey fines. Max^m. gravel >50mm. Gravel is mainly moderately to highly weathered slates sub-rounded.			NXC	320		Not applic-able.						
PROTEROZOIC ADELAIDE SYSTEM - STURTIAN TILLITE. 0·1 to 1·0 ft smooth surfaced sticks 25% Broken to clayey fragments. 75% 0·1 to 0·3 ft fitting sticks. Tillite, consists of phyllite and slate, grey to purple-grey with scattered erratics mainly <10mm. but max. >75mm. Thin (>0·1ft.) calcareous bands and slightly calcareous throughout. Cleavage poorly to moderately developed, dips 35-40°.			NM LC	310			Joints dip 40° to 60°, few 90°, spaced mainly 0·05 to 0·25ft. Rough to smooth with some slichen sides. Open to weakly cemented mainly completely coated with calcite and clay. Crushed zone with soft calcite, (0·5ft) Sheared zone with soft calcite (0·5ft) 0·08ft crushed, weathered seam.		29TH Mar '67	FULL RETURN		Not TESTED.
				300			Joints dip 30° 60-70° spaced mainly 0·2 to 0·5ft. Max. 1·25ft. planar, smooth limonite and manganese coatings. Joints dip subvertical at 33, 34·5, 36, 37 and 44ft. Rough or hackly limonite coated. Grey clay infill 0·02ft. thick in join at 75-80°. Rootlets. Joint at 70° with calcreted and high plasticity clay. 0·05ft. thick.					
				290								
				280								
END OF HOLE 46 Ft.				270								
				260								

① ROCK SUBSTANCE STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. DD24. LOGGED G.T. Roberts.
TYPE. Mindrill. DATE 13 April '67
DRILLER K. Kruse TRACED M.A.S.
START. 7 Mar '67. CHECKED
FINISH 9 Mar '67.

SHEET 1 OF 1. DRG. No. S5942 Hab

P.F. Nº. S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 6

SERIAL No. 622/72

PROJECT FLINDERS MEDICAL CENTRE

FEATURE FOUNDATIONS

LOCATION BEDFORD PARK

SECTION 601 HUNDRED ADELAIDE

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION

R. L. Surface 334·75 FT.

R.L. Collar . . FT.

Datum 105·7 ft below M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE DEPTH R L FT.	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0 100	WATER PRESSURE TESTS ④ LUGEONS 0.5 1 5 10 50 100
RECENT: Calcrete and creamy brown silt soil with weathered rock fragments.	NO CORE		NMLC 0								
PROTEROZOIC SYSTEM ADELAIDE SYSTEM STURTIAN TILLITE: Limy silt soil and siltstone. Fine grained siltstone with up to 10% rock fragments up to 5 cm (average 0·5 cm) in size of quartzite, siltstone, gneiss, limestone, slate, granite, quartz and pyrite. Tillite is calcareous pinkish brown near top of hole grading to bluish grey near bottom. Complex sedimentary structures are common. Rock fragments often more weathered than the rock.			330 10 320 20 310 30 300 40 280			Cleavage dips 45° with planes infilled with lime and clay at top, below planes are coated with black manganese. Rock is discoloured either side of joint and cleavage planes. Bedding not obvious, but appears to dip at 60°. Joints dip at 75°. Fracture zone. Red silt and manganese coats cleavage and joint planes dipping from 20° to 90°. Numerous joint and cleavage planes filled with calcite.		9 10 NOV. 1971			NOT TESTED
END OF HOLE 48·3 ft.											

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER H. ASCHMONEIT
START 9 NOV. 1971
FINISH 10 NOV. 1971

LOGGED B.J. MORRIS
DATE 10 NOV. 1971
TRACED J.M.B.
CHECKED SLT.

SHEET 1. OF 1.

DRG. No. S 9563 No 6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

PROJECT FLINDERS MEDICAL CENTRE

FEATURE FOUNDATIONS

LOCATION BEDFORD PARK

SECTION 601 HUNDRED ADELAIDE

CO-ORDINATES -

ANGLE FROM HORIZ. 90° DIRECTION -

HOLE NO. D.H.7.

SERIAL No.

R.L. Surface 310.64 FT.

R.L. Collar . FT.

Datum 105.7 ft. below MSL

DESCRIPTION OF CORE	GROUP SYMBOL	① STRENGTH TERM	CORE SIZE DEPTH FT	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS% 0 100	④ WATER PRESSURE TESTS LUGEONS 0.5 1 5 10 50 100
RECENT COLLUVIAL DEPOSITS											
No Core			310 0 NMLC								
Gravel with up to 50% clay and sand, angular rock frags of slate and quartz about 1cm in size.											
No Core			300 10								
No Core											
Gravel up to 20% clay and sand.											
No Core											
PROTEROZOIC ADELAIDE SYSTEM STURTIAN TILLITE											
Fine grained brownish siltstone, grading to blue grey with depth. Thinly laminated with some pink layers. Slightly calcareous in patches.			290 20			Bedding and cleavage both dip about 40° but in opposite directions, bedding is variable. Jointing extensive ranging from 20° to 85°, with Shear zone planes coated with manganese and silt soil, many open to 1mm. Rock discoloured next to joints. Bedding dips 30°, joints dip 70°		15 Nov '71			NOT TESTED
Medium to coarse grained (up to 4mm. av. 1mm) cross-bedded sandstone, glacio-fluvial?			280 30			Joints dip consistently 65°, smooth and irregular surfaces coated with silt and manganese, cleavage 65°				NO LOSSES	
Tillite brown grey grading to blue grey with 10% rock frag at top grading to 40% with depth. Erratics of granite, gneiss, quartz sandstone. up to 6cms in size, av. 0.5cm.			270 40								
Crush zone, weathered to limonite, rich soil in parts.			260 50			Shearing approx 40° some jointing 70° and slickensides in 1 joint at 85°. Shear zone dip 25° cleavage dip 70°					
Tillite brown grey colour.											
Highly weathered tillite											
			60			END OF HOLE 56.3 ft.					

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3-5) Maximum effective pressure (bars) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15.
TYPE Mindrill.
DRILLER H. Aschmoneit
START. 12 Nov '71.
FINISH 15 Nov '71.

LOGGED B.T. MORRIS
DATE 18 Nov '71
TRACED D.W.W.
CHECKED R.N.

SHEET 1 OF 1. DRG. No. S9600 Ha6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 8

SERIAL No. 625/72

PROJECT. FLINDERS MEDICAL CENTRE

FEATURE. FOUNDATIONS

LOCATION BEDFORD PARK

SECTION 601. HUNDRED ADELAIDE.

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION —

R. L. Surface 302·48 FT.

R.L. Collar . . FT.

Datum 105·7 ft. below M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE DEPTH FT	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES; CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0 100	④ WATER PRESSURE TESTS LUGEONS 0.5 1 5 10 50 100
RECENT COLLUVIAL DEPOSITS											
No core			NMLC								
Coarse gravel, 2-3 cm, of quartz and slate, plus 20% red clay.			300								
No core											
No core			10								
Gravel, 1 cm, plus 5% clay.											
PROTEROZOIC SYSTEM ADELAIDE GLACIAL TILLITE STURTIAN			290			Cleavage well developed at top, and dip 45°. Joints dip 70°.					
Fine grained tillite, grey brown at top grading to blue grey at bottom. Erratics of quartzite, granite, gneiss, slate, about 15%, and up to 1·5 ft in size, average 0·5 cm.						Irregular open vertical joint with with white clay and weathered rock. Rock discoloured either side of joint planes. Joints often open 1mm or filled with quartz.					
			20								
Weathered granite erratic.			280								
Crush zone with limonite, silt soil and rock fragments.						Vertical joint with limonite coating.					
			30								
			270			Irregular vertical joint with manganese coating.					
Gneiss erratic.											
			40								
			260								
			50			END OF HOLE 48·8 ft.					

17 NOV. 1971

NO WATER LOSS

FAULTY PRESSURE GAUGE

① ROCK SUBSTANCE

STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
. Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER H. ASCHMONEIT
START 15. NOV. 1971.
FINISH 17 NOV. 1971.

LOGGED B. J. MORRIS
DATE 18 NOV. 1971
TRACED J.M.B.
CHECKED R.M.

SHEET 1. OF 1.

DRG. No. $9588 No 6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 9

SERIAL No. 626/72

PROJECT. FLINDERS MEDICAL CENTRE

FEATURE. FOUNDATIONS

LOCATION BEDFORD PARK

SECTION 601 HUNDRED ADELAIDE

CO-ORDINATES

ANGLE FROM HORIZ. 45° DIRECTION 090

R. L. Surface 299·24 FT.

R.L. Collar . . FT.

Datum 105·7 ft. below M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE R L	DEPTH FT.	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS% 0 100	WATER PRESSURE TESTS ④ LUGEONS 0.5 1 5 10 50 100
RECENT DEPOSITS COLLUVIAL												
No core												
Red clay soil plus up to 20% gravel (0·5cm).			NMLC									
No core												
Clay and sandy soil plus gravel.				10								
No core												
No core				290								
Coarse gravel, 2cm, of slate, tillite and quartz plus some clay soil.				20								
No core												
No core												
PROTEROZOIC ADELAIDE SYSTEM STURTIAN TILLITE												
Highly weathered tillite.							Joints at 60° and 30° with clay on surfaces.					
No core												
Conglomerate, sub-angular grains average size 0·5 cm. Crush seam with limonite rich soil. Quartzite →				280			← Bedding dips 60°.					
							Crush zone.					
				30			← Bedding dips 60°, also joints 60°					
Tillite, highly weathered, brownish-yellow colour with rock fragments up to 3cm in size.							Cleavage developed, dip 60°. Weathering extensive along joint plane with clay and manganese on surfaces. Dip vertical to 20°. Some slickensides on joint surface, 80°.					
No core												
No core				40								
Rock fragments are granite, quartzite, siltstone, quartz and limestone.				270			Manganese, calcite and clay commonly infills joint planes.					
No core												
Highly weathered to limonite rich rock and soil. →				50			← Completely broken zone with numerous joints.					
Grey-brown tillite, slightly weathered with numerous rock fragments, average 0·5 cm (10 cm).				260			← Crush seam at about 65°.					
				60			← Joint dips 70°.					
Higly weathered zone. Zone with 50% rock fragments							← Steep joints have red clay on surfaces and slickensides.					
							← Small crush seam.					
Zone with 50% rock fragments				250								
Sandstone layer, weathered and medium grained. →							Bedding dips 45°					
							END OF HOLE 76·8 ft.					

NOT TESTED

1 DEC. 1971

① ROCK SUBSTANCE

STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER H. ASCHMONEIT
START 18 NOV. 1971
FINISH 22 NOV. 1971

LOGGED B.J. MORRIS.
DATE 22 NOV. 1971
TRACED J.M.B.
CHECKED R.H.

SHEET 1. OF 1.

DRG. No. S9589 Ha6

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 10
SERIAL No. 628/72

PROJECT. FLINDERS MEDICAL CENTRE.
FEATURE. FOUNDATIONS
LOCATION BEDFORD PARK.
SECTION 601 . HUNDRED ADELAIDE
CO-ORDINATES
ANGLE FROM HORIZ. 45° DIRECTION 090°
R. L. Surface 319:53 FT.
R.L. Collar . FT.
Datum 105·7 ft. below M.S.L.

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE	DEPTH R L FT.	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0 100	④ WATER PRESSURE TESTS LUGEONS 0.5 1 5 10 50
RECENT Top soil Limy clay soil No core No core												
Brown weathered silty tillite with 5% rock fragments to 1cm size.				10			Numerous joints with clay and limonite coatings, dips 60° and vertical.					
Grey-brown silty tillite with 40% rock fragments, sub-angular and up to 2cm in size.				310 20								
Brown silty tillite with 15% rock fragments, average 0·3cm.												
Gneiss boulder.				300 30			Joints at 10° with limonite on Cleavage at 60°, surfaces with smooth planes, joints at 55° in opposite direction.					
							Crush seam.					
PROTEROZOIC ADELAIDE SYSTEM STURTIAN TILLITE Brown medium grained feldspathic quartzite, grain size 0·3mm, grades to a blue-grey coarse quartzite.				40 290			Joints open, dip 60° and coated with limonite, calcite and manganese. Bedding horizontal.					
Change to coarse sub-angular conglomerate; average grain size 4mm. 80% pebbles of quartzite and slate, and 20% sand matrix. Tillite and feldspar pebbles have weathered to limonite.				50 280			Joints at 55° and 75°, coated with limonite and open.					
Blue-grey sandy tillite with 40% rock fragments, average size 2mm. Patches of calcareous slaty tillite.				60			Joints dip 55° and coated with quartz.					
Conglomerate layer.							Quartz vein 1cm wide, dips 55°. Rock discoloured either side of joint.					
				70 270			Crush zone. Numerous joints filled with limonite and quartz, open to 1mm.					
END OF HOLE 72·6 ft.				80								

1 DEC. 1971

0·7
4·3
0·4

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

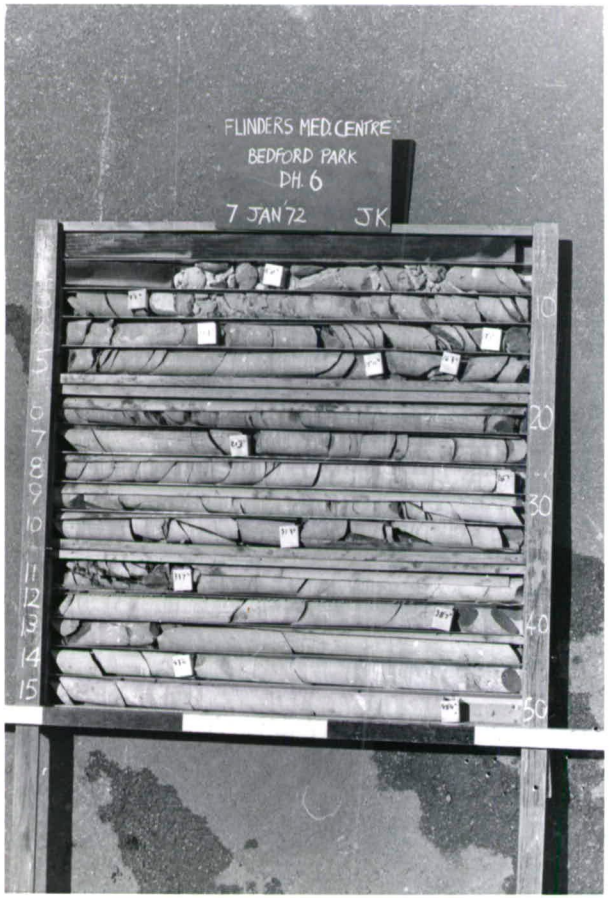
③ FRACTURE LOG
1 4 16 64 Natural fractures per foot of core
12 3 3/4 3/16 Equivalent length of core in inches

④ (3·5) Maximum effective pressure (bars) reached during test.
Min. = Minimum value.

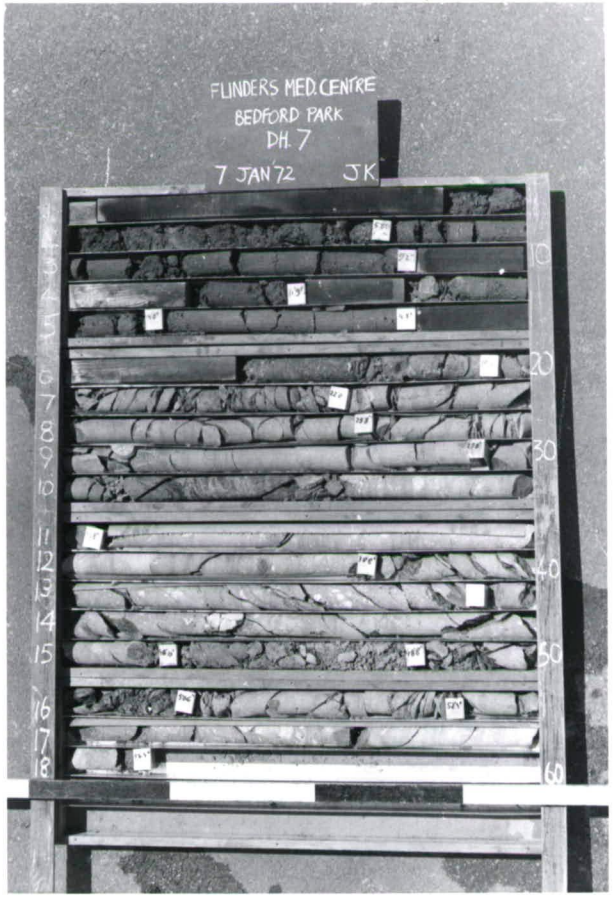
ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED B.J.MORRIS
TYPE MINDRILL	DATE 29.NOV.1971
DRILLER H.ASCHMONEIT	TRACED J.M.B.
START. 24 NOV. 1971.	CHECKED R.M.
FINISH 29.NOV.1971	
SHEET 1 OF 1	DRG. No. S9590 Ho6

P.F. Nº S5027D MB



ADELAIDE 21978



21979

21980

Adelaide 21981

21982

APPENDIX

LOGS OF DIAMOND DRILL HOLES AND EXPLANATORY NOTES

NOTES ON DRILLING PROCEDURES

Equipment

The core sizes are as follows:-

Symbol	Nominal Diameter of Cores (inches)
NXC (NX casing)	2.8
NMLC	2.0
BMLC	1.4

The NMLC and BMLC cores were obtained with "M" type stationery inner tube core barrels fitted with bottom discharge bits. The inner tubes were of the split type, ensuring minimum disturbance of the core during removal from the barrel.

Storing and marking of core

Cores are stored in wooden boxes, each compartment of which is designed to contain five feet of core. The internal length for each compartment is actually five feet one inch, to allow for 100 per cent core recovery. Roughness of the ends of the core, and small inaccuracies in measurement when breaking it to fit the box, make it difficult to fit five feet of core in a compartment of exactly that length. The boxes are marked with consecutive compartment numbers at one end, and the drilled depths from the surface in feet at the other.

The core was boxed in this manner at the drill site, the core being placed in its appropriate place in the box as soon as it was extracted from the core barrel. The bottom of each lift was marked with paint or indelible ink immediately it was placed in the box, and a corresponding mark made on the side of the core box. The measured depth of the hole in feet from the surface was painted on the side of the core box and on the core. Timber blocks cut to the correct length indicate core not recovered (red blocks), and core removed for testing (white blocks).

The core has been stored at the Department of Mines, Drilling and Mechanical Branch, Dalgleish Street, Thebarton, South Australia.

NOTES ON DIAMOND DRILL LOG SHEETS

The logs are plotted on a vertical scale of one inch = 10 feet (1:120) or one inch = five feet (1:60). In the column headed "Log", places where core was obtained are shown by stippling. Places where core was lost are shown by blank spaces.

The descriptions given on the log sheet refer only to materials recovered as core. Core is lost by the material being

ground or washed away during the drilling process; it may usually be inferred that such material is relatively weak. The weakness may arise from weathering or else from sheared, crushed, or closely jointed rock. It cannot always be assumed that the material not recovered is weak, since even solid rock core may be ground away and lost during drilling operations.

To the left of the graphic log is a geological description of the materials sampled. This includes:-

... Geological age)
... Rock unit name) Printed vertically
... Type of material)
... Mineral composition
... Cementation
... Physical description of core

Classification of the rock substance in terms of its strength and its condition (eg. weathering, alteration) is shown graphically in the column "Strength Term". The terms used in the classification are defined in Table 1. Where the substance has soil properties this is shown graphically in the column, and immediately to the left of the column under "Group Symbol", the symbol representing the remoulded sample as classified under the Unified Soils Classification (USBR 1966) is given.

The "Fracture Log" to the right of the graphic log column shows the degree of fracturing of the core by means of a histogram-type plot. Degree of fracturing means the degree to which the rock has mechanically broken up along geological defects such as joints, cleavage planes, foliation planes, bedding planes or seams. Fresh fractures across the fabric of the rock, not along the existing planar geological defects, are not included. In sections in which no core was recovered, the fracture log column is left blank.

In the column marked "Structures" the angles shown on joints, bedding, or other geological structures are the angles which they make with the plane at 90^{o} to the axis of the core, unless otherwise stated.

Percentage loss of drilling water as recorded by the driller is shown graphically in the column "Drill Water Loss %".

REFERENCE

1. UNITED STATES BUREAU OF RECLAMATION 1966, Earth Manual 2nd Edition.

NOTES ON WATER PRESSURE TESTING

Water pressure testing was carried out during drilling by sealing the hole with an expandable packer and pumping in water at measured pressures.

The following procedure was used.

a. Immediately after drilling of the test section, the hole was cleaned out by flushing with water pumped down through the drill rods, until the returning water was clear.

b. An expandable rubber packer in series with NX drill rods, was placed down the hole at the top of the test section and expanded to form a seal against the walls of the hole.

c. Water was pumped into the test section between the packer and the bottom of the hole, and the pressure measured by a pressure guage. The quantity of water pumped into the hole, for a given period, usually 5 minutes, was measured by a water meter.

The results have been used to calculate permeability figures for the rock mass, as described below.

Calculation of permeability figures

The results of the water pressure testing have been plotted as Lugeon units on the log.

One Lugeon unit is defined in Talobre (1957) as a water loss of 1 litre per minute per metre of drill hole of diameter 46 to 76 mm at a pressure of 10 bars (10.2 kg/cm^2) maintained for 10 minutes.

The testing procedure used has been described above. The conditions of test differed in some respects from those required by the above definition, but were sufficiently close to warrant the use of Lugeon units. It is generally not possible to reach test pressures as high as 10 bars, and Lugeon values are calculated by extrapolation from leakage values obtained at actual effective pressures used during the test. The maximum effective pressure obtained is shown on the log.

In some cases during testing water can be pumped into the test section at full pump capacity without registering any pressure in the gauge at the surface. The Lugeon value is then calculated assuming that the drill rods were filled with water, although it is most likely that the rods were only partly filled because no pressure was registered. In cases such as these the actual Lugeon value would be more than that calculated and is therefore shown on the log as a "minimum value".

REFERENCE

TALOBRE, J., (1957) La Mechanique des Roches (Dunod : Paris), pp. 151-5.

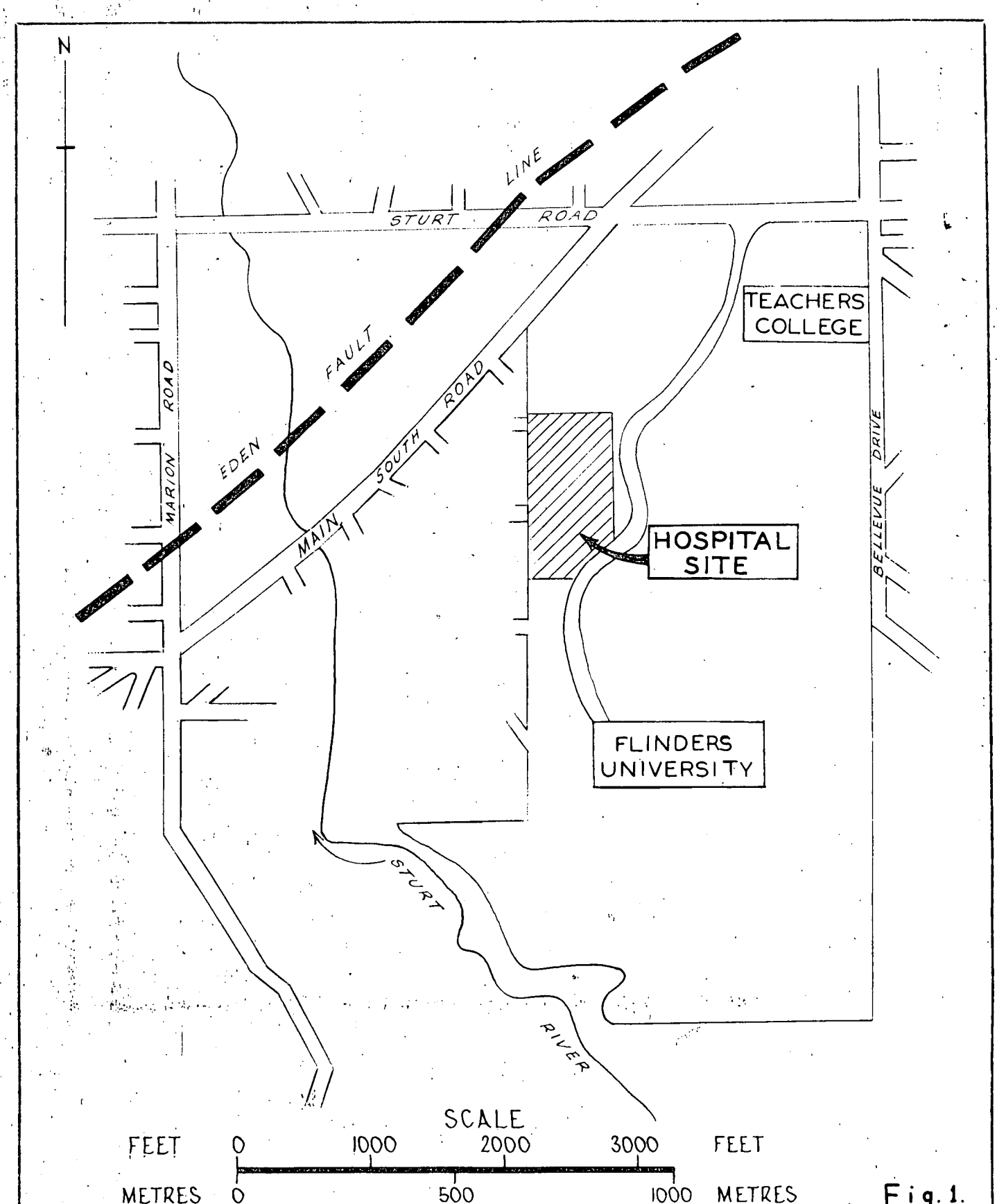


Fig. 1.

ENGINEERING GEOLOGY SECTION Compiled: B.J. MORRIS Drn: R.H. Ckd: B.J.M.	**DEPARTMENT OF MINES – SOUTH AUSTRALIA** FLINDERS MEDICAL CENTRE BEDFORD PARK SEC. 601: HD. ADELAIDE LOCALITY PLAN	Scale: As shown. Date: 16-12-71 Drn. No. S9598 Ha6

Fig. 2.

ACCESS ROAD TO FLINDERS UNIVERSITY

45° w-xw(MS-W) 1 ft. wide clayey weathered seam

Erratics upto 2ft. in diameter

Tillite W(MS-S)

Sandstone Fr-W(S-MS)

Fr-W(VS-S)

Quarry

quartzite Fr(S)

slate W(W-MS)

Sandstone W(S-MS)

Shot hole exposed thinly laminated slate W(W-MS)

Tillite W-XW(W-MS)

Thinly laminated slate W(MS)

Thinly laminated slate XW(W-MS)

Thinly laminated slate XW(VW)

Quarry

LINE 000 · LINE 2000 · LINE 1000 · LINE B · LINE A · LINE 2N · LINE 3E · LINE C · LINE 3N · LINE 2E · LINE IN · LINE IE

DH1 DH2 DH3 DH4 DH5 DH6 DH7 DH8 DH9 DH10

CH1 CH2 CH3 CH4

TR1 TR2 TR3 TR4 TR5 TR6 TR7 TR8 TR9 TR10 TR11 TR12 TR13 TR14

A A′ B B′ C C′ D D′ E E′ F F′ G G′

N

6000 5800 5600 5400

11400 11600 11800 12000 12200 12400 12600

TOP SOIL
silty clay soil

ALLUVIUM
gravel sand and clay

TILLITE
fine grained phyllitic siltstone typically brown when weathered with erratics of quartzite, slate, gneiss and limestone up to 2ft. diameter

CONGLOMERATE
coarse grained with up to 65% sub-rounded siliceous pebbles

SANDSTONE
medium to coarse grained, feldspathic and ferruginous in part, grading to a fine to medium grained brown quartzite in parts

SLATE
thinly laminated, fine grained brownish coloured rock

65° Strike and dip of bedding

35° Strike and dip of jointing

Vertical joint

40° Strike and dip of cleavage

8° Angle and direction of slope of ground surface

325 Natural surface contour in feet

Escarpment in feet

Crush seam

DH2 Diamond drill hole No. 2

45° Inclined diamond drill hole

CH2 Cable Tool hole No. 2

TR5 Back-hoe trench No. 5

Seismic Traverse

A A′ Geological Section

STRENGTH OF ROCK SUBSTANCE
(VS) very strong
(S) strong
(MS) medium strong
(W) weak
(VW) very weak

CONDITION OF ROCK SUBSTANCE
F Fresh
W Weathered
XW Extremely weathered

SCALE IN METRES
10 0 10 20 30 40 50 60

SCALE IN FEET
40 0 40 80 120 160 200

Datum: 105·7 ft. below M.S.L.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE — BEDFORD PARK
SEC. 601. HD. ADELAIDE
GEOLOGICAL PLAN

ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. B.J.M.	SCALE: AS SHOWN
		Tcd. D.J.M.	72-35 Ha6
Director of Mines	SUP. GEOLOGIST	Ckd.	
		Exd. B.J.M.	DATE: 1. Feb. 1972

ACCESS ROAD TO FLINDERS UNIVERSITY

LINE 000
LINE 1000
LINE 2000
LINE A
LINE B
LINE C
LINE 1E
LINE 2E
LINE 3E
LINE 1N
LINE 2N
LINE 3N

DH 1 57' R.L. 245
DH 2 35' R.L. 288
DH 3 10' R.L. 327
DH 4 28' R.L. 282
DH 5 9' R.L. 316
DH 6 5' R.L. 330
DH 7 19' R.L. 292
DH 8 12' R.L. 290
DH 9 17' R.L. 284
DH 10 4' R.L. 317

CH 1 30' R.L. 269
CH 2 56' R.L. 263
CH 3 23' R.L. 294
CH 4 55' R.L. 244

TR 1
TR 2
TR 3
TR 4
TR 5
TR 6
TR 7
TR 8
TR 9
TR 10 0·5' R.L. 333
TR 11 2' 357
5' R.L. 349
TR 12 4' R.L. 324
5' R.L. 322
TR 13
10' R.L. 305
TR 14
1·5' R.L. 313
18' R.L. 307
6' R.L. 306

6000
5800
5600
5400
11400
11600
11800
12000
12200
12400
12600

LEGEND

DH 7 ● — Diamond drill hole No. 7
19' — Thickness of colluvium in feet
R.L. 292 — Level of upper surface of bedrock

CH 1 ◉ — Cable tool hole No. 1
30' — Thickness of colluvium in feet
R.L. 269 — Level of upper surface of bedrock

TR 12 / 4' / R.L. 324 — Back-hoe trench No. 12, Thickness of colluvium in feet, Level of upper surface of bedrock

310 — Natural surface contour
290 — Inferred form lines of upper surface of bedrock

Seismic Traverse (1967)

Seismic Traverse (1971)

SCALE IN METRES
10 0 10 20 30 40 50 60
40 0 40 80 120 160 200
SCALE IN FEET

Datum: 105·7 ft. below M.S.L.

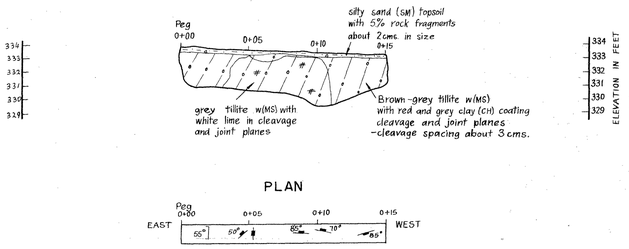
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE — BEDFORD PARK
SEC. 601. HD. ADELAIDE
UPPER SURFACE OF BEDROCK — FORM LINES

ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. B.J.M.	SCALE: AS SHOWN
		Tcd. D.J.M.	72-34 Ha6
Director of Mines	SUP. GEOLOGIST	Ckd.	
		Exd.	DATE: 1. Feb. 1972

TR 10

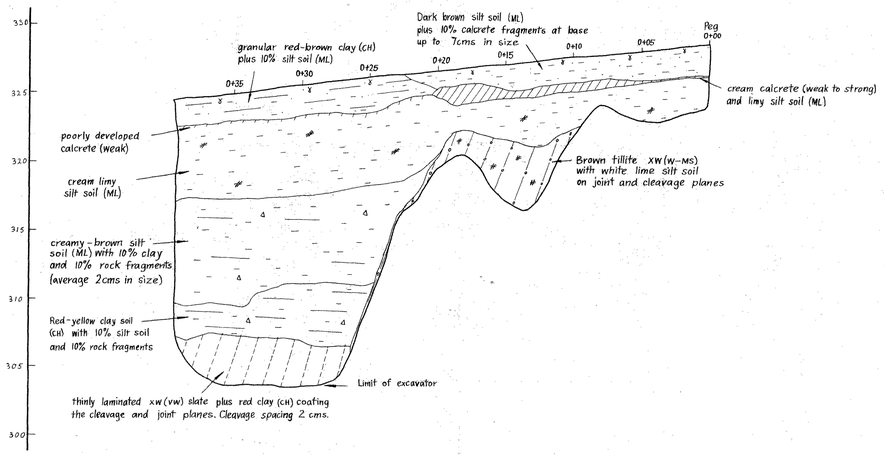
South Wall



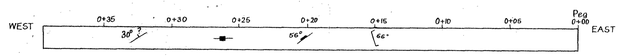
PLAN

TR 13

North Wall

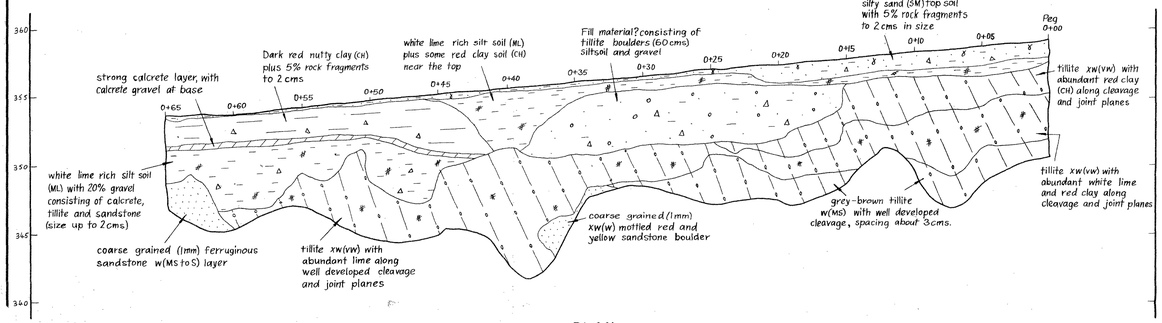


PLAN

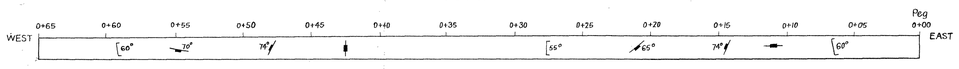


TR 11

North Wall

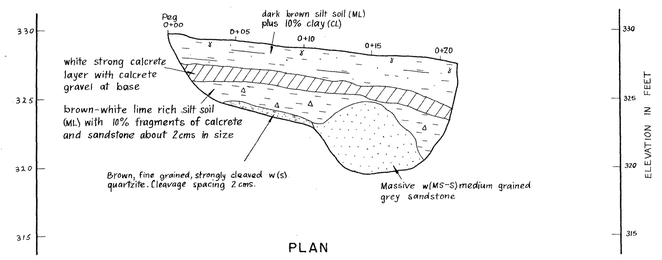


PLAN

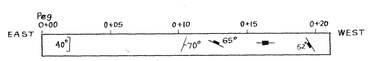


TR 12

South Wall

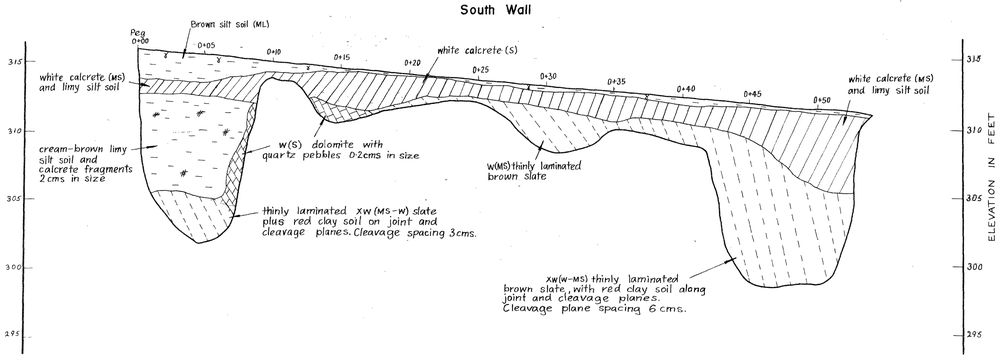


PLAN

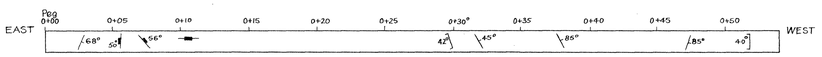


TR 14

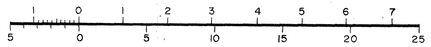
South Wall

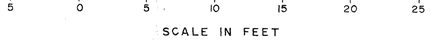


PLAN



SCALE IN METRES





SCALE IN FEET

LEGEND

SOIL TYPES ("Unified" Soils Classification)

ML	SILT SOIL	medium plasticity with minor clay soil, limy soil (#), rock fragments (Δ) and plant roots (χ)
SM	SAND	with excess silty fines and rock fragments.
CH	CLAY SOIL	high plasticity with some silt soil

ROCK TYPES

CALCRETE	white with associated limy silt soil.
TILLITE	brown-grey siltstone matrix with erratics of sandstone, quartz, slate, gneiss and limestone, average size 1 cm.
SANDSTONE	medium to coarse grained, ferruginous in part, and quartz rich.
SLATE	thinly laminated, fine grained and brownish coloured.
DOLOMITE	massive, grey-brown coloured with rounded pebbles (0-2cms) of quartz.

50°	Strike and dip of bedding.
30°	Strike and dip of jointing.
	Vertical joint.
40°	Strike and dip of cleavage.

STRENGTH OF ROCK SUBSTANCE

(VS)	Very strong
(S)	Strong
(MS)	Medium strong
(W)	Weak
(VW)	Very weak

CONDITION OF ROCK SUBSTANCE

F	Fresh
W	Weathered
XW	Extremely weathered

Note: For location of trenches see Drg. No. 72-35

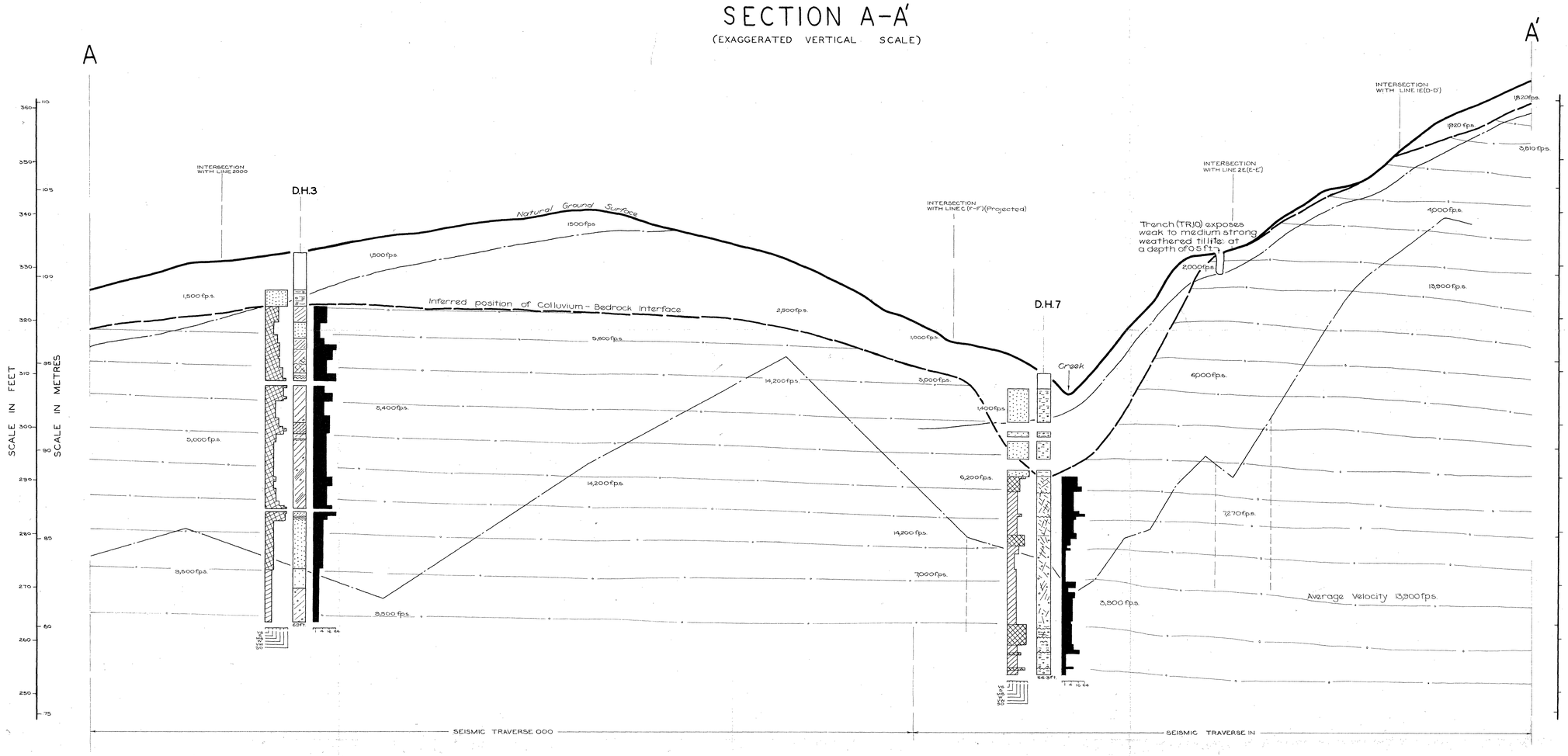
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK — SEC. 601 HD. ADELAIDE
GEOLOGICAL LOGS OF TRENCHES - TR 10,11,12,13,14.

ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. BM	SCALE: as shown
		Tcd. DJM	71-916 Ha6
	Approved and signed	Ckd. R.H.	
Director of Mines	SUP. GEOLOGIST	Exd. B.J.M.	DATE: 16th. DEC. 1971

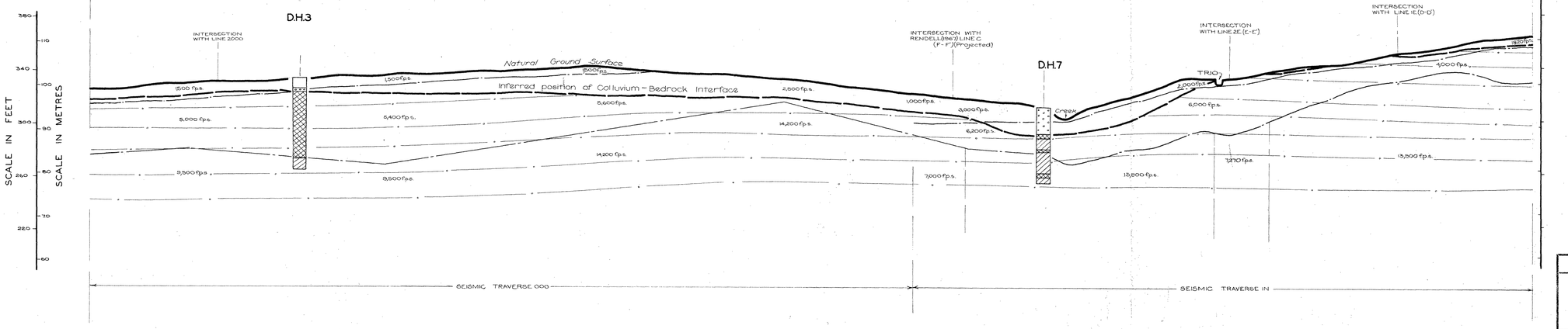
SECTION A-A'

(EXAGGERATED VERTICAL SCALE)



SECTION A-A'

(NATURAL VERTICAL SCALE)



DATUM : 105·7 FT. BELOW M.S.L.

NOTE : FOR LEGEND SEE DRG. NO. 72-69.
FOR LOCATION OF SECTION A-A' SEE PLAN 72-35.

SCALE IN METRES

10 0 10 20 30 40 50

40 0 40 80 120 160

SCALE IN FEET

FIG.5

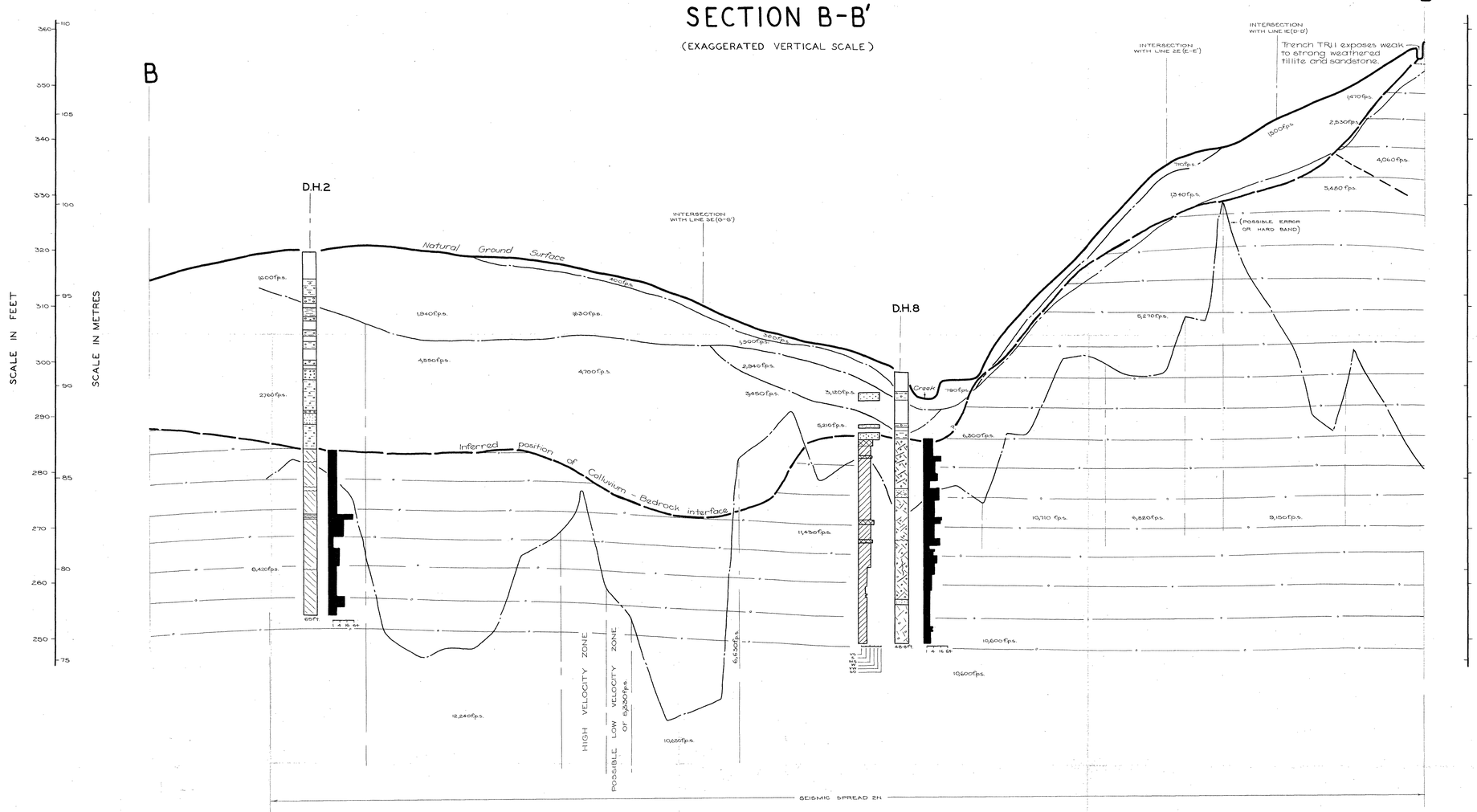
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK
SECTION 601 HUNDRED ADELAIDE
GEOLOGICAL SECTION A-A'

ENGINEERING GEOLOGY SECTION	GEOLOGIST 22 Mar 72	Drn. B.M.	SCALE : 1 IN. = 40 FT. HORZ.
		Tcd. A.G.R.	72-66 Has
	SUP. GEOLOGIST 23 Mar 72	Ckd. L.V.W.	
Director of Mines		Exd. B.J.M.	DATE : 10 MARCH 1972

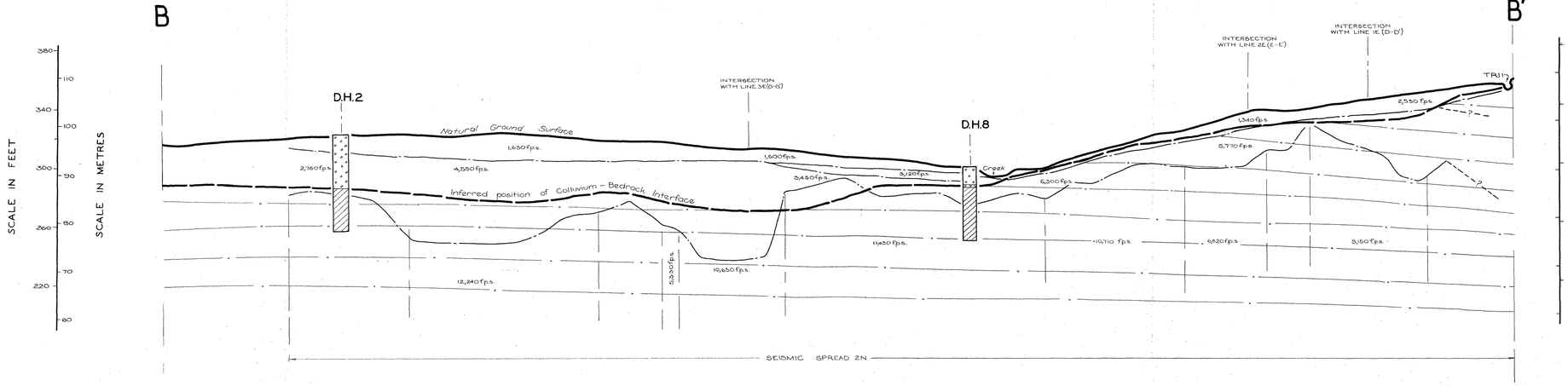
SECTION B-B'

(EXAGGERATED VERTICAL SCALE)



SECTION B-B'

(NATURAL VERTICAL SCALE)



DATUM : 105·7FT. BELOW M.S.L.

NOTE : FOR LEGEND SEE DRG.NO.72-69.
FOR LOCATION OF SECTION B-B' SEE PLAN 72-35.

SCALE IN METRES

10 0 10 20 30 40 50 60

40 0 40 80 120 160 200

SCALE IN FEET

FIG.6

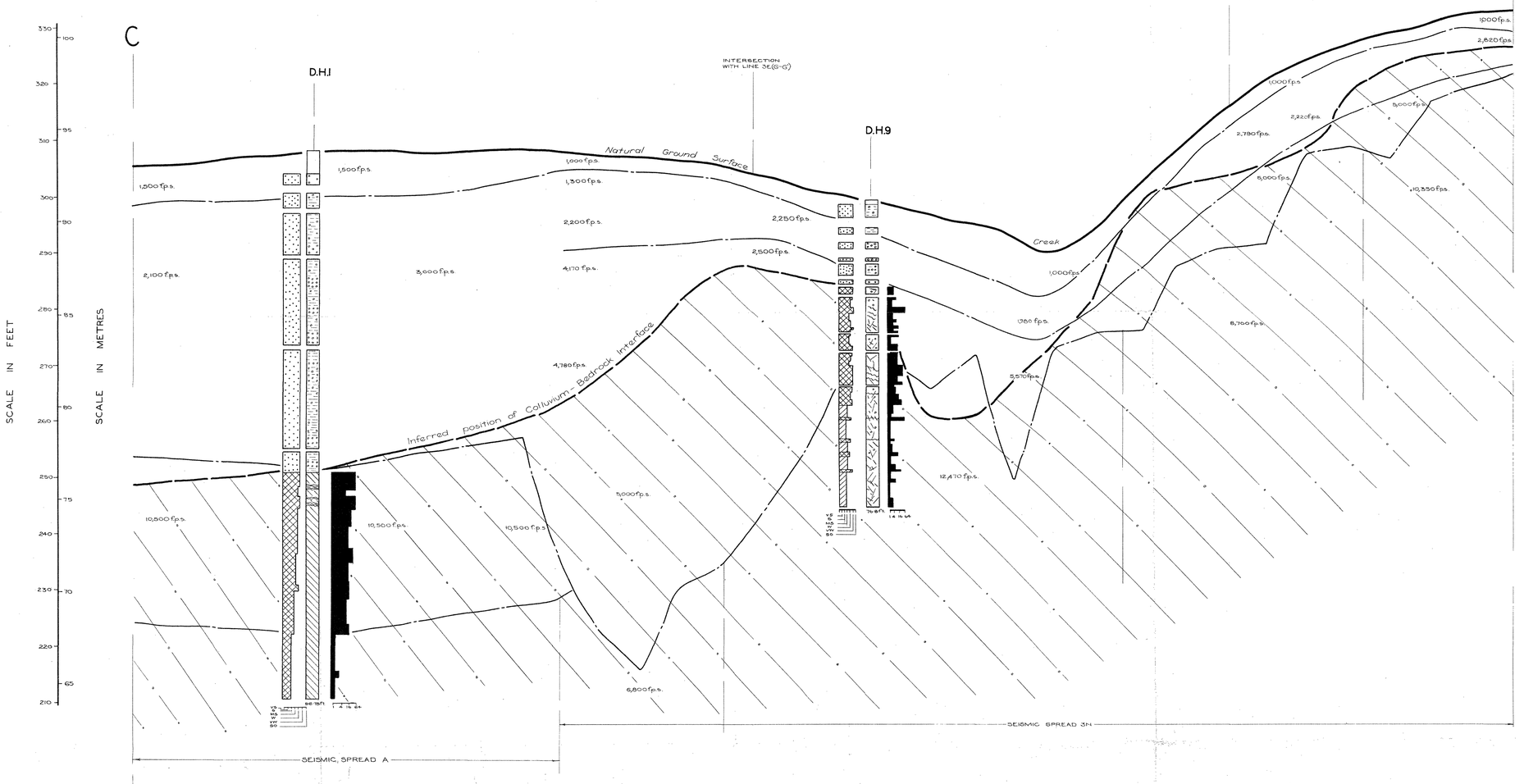
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK
SECTION 601 HUNDRED ADELAIDE
GEOLOGICAL SECTION B-B'

ENGINEERING GEOLOGY SECTION	21 Mar 72 GEOLOGIST	Drn. B.M.	SCALE: 1IN. = 40FT. HORZ.
		Tcd. A.G.R.	72-67 Ha6
Director of Mines	23 Mar 72 SUP. GEOLOGIST	Chd. L.V.W.	
		Exd. B.J.M.	DATE: 10 MARCH 1972

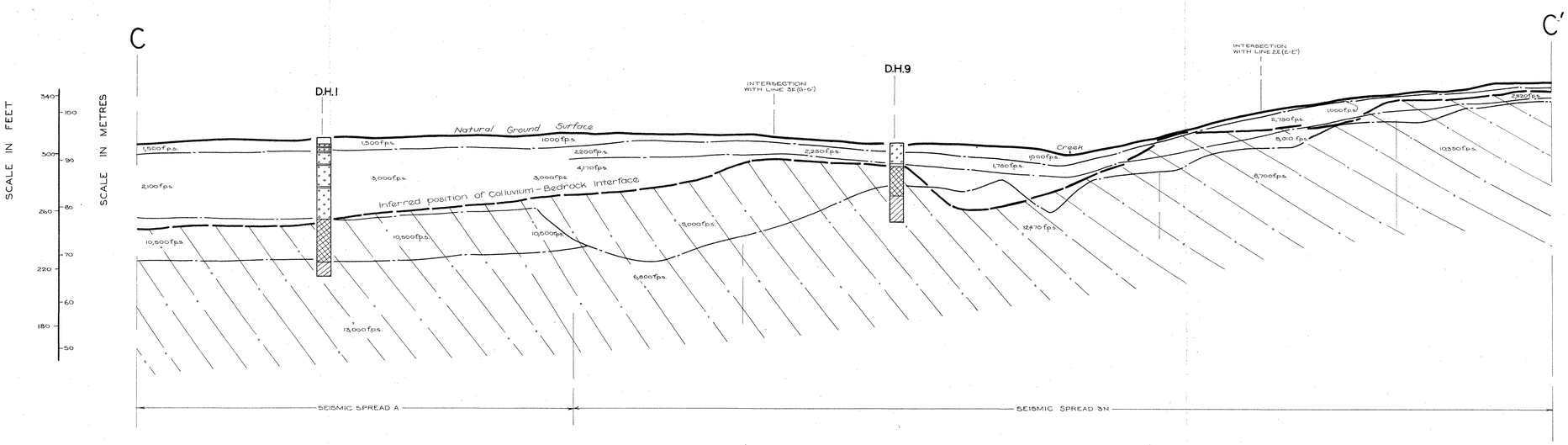
SECTION C-C'

(EXAGGERATED VERTICAL SCALE)



SECTION C-C'

(NATURAL VERTICAL SCALE)



DATUM : 105.7 FT. BELOW M.S.L.

NOTE : FOR LEGEND SEE DRG. NO. 72-69.
FOR LOCATION OF SECTION C-C' SEE PLAN 72-35.

SCALE IN METRES

10 0 10 20 30 40 50 60

40 0 40 80 120 160 200

SCALE IN FEET

FIG.7

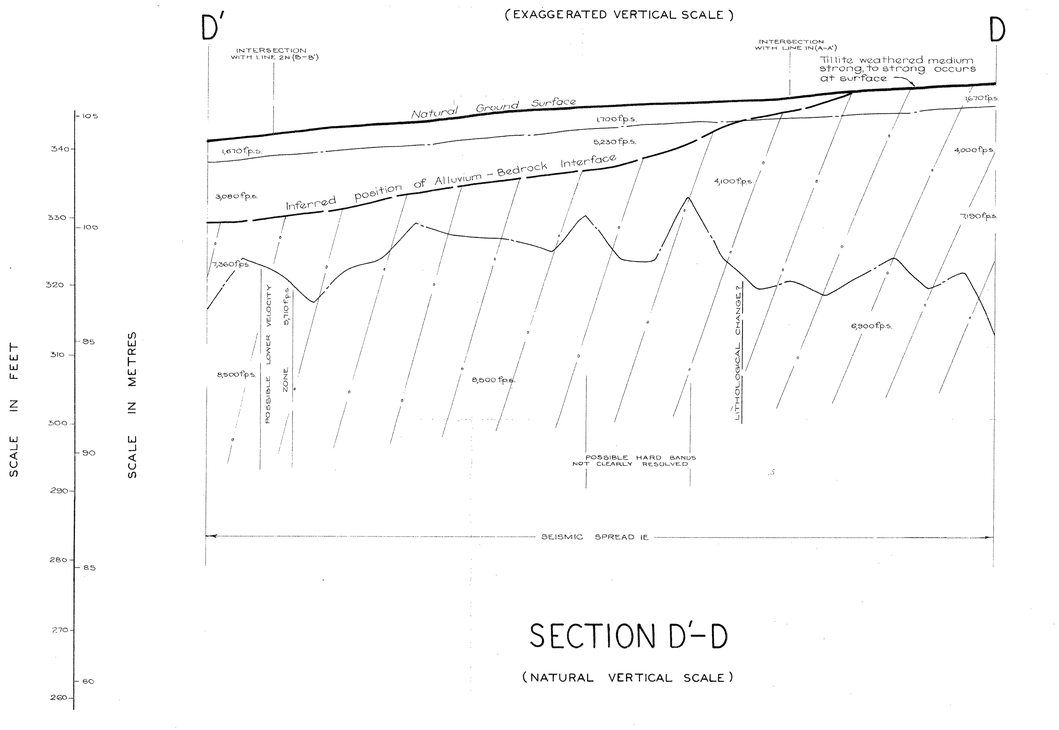
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK
SECTION 601 HUNDRED ADELAIDE
GEOLOGICAL SECTION C-C'

ENGINEERING GEOLOGY SECTION	21 Mar 72 GEOLOGIST	Drn. B.M.	SCALE: 1 IN. = 40 FT. HORZ.
		Tcd. A.G.R.	72-68 Ha 6
Director of Mines	SUP. GEOLOGIST	Ckd. L.V.W. Exd. S.J.M.	DATE: 10 MARCH 1972

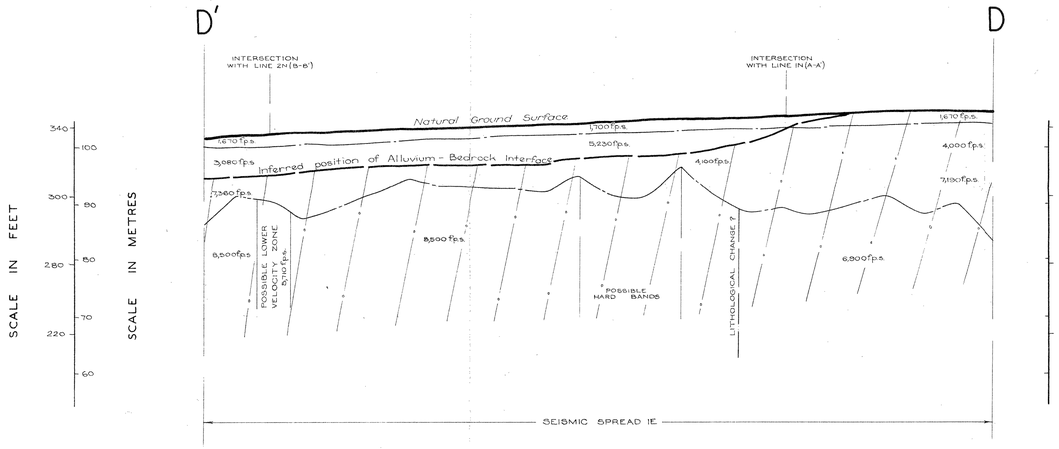
SECTION D'-D

(EXAGGERATED VERTICAL SCALE)



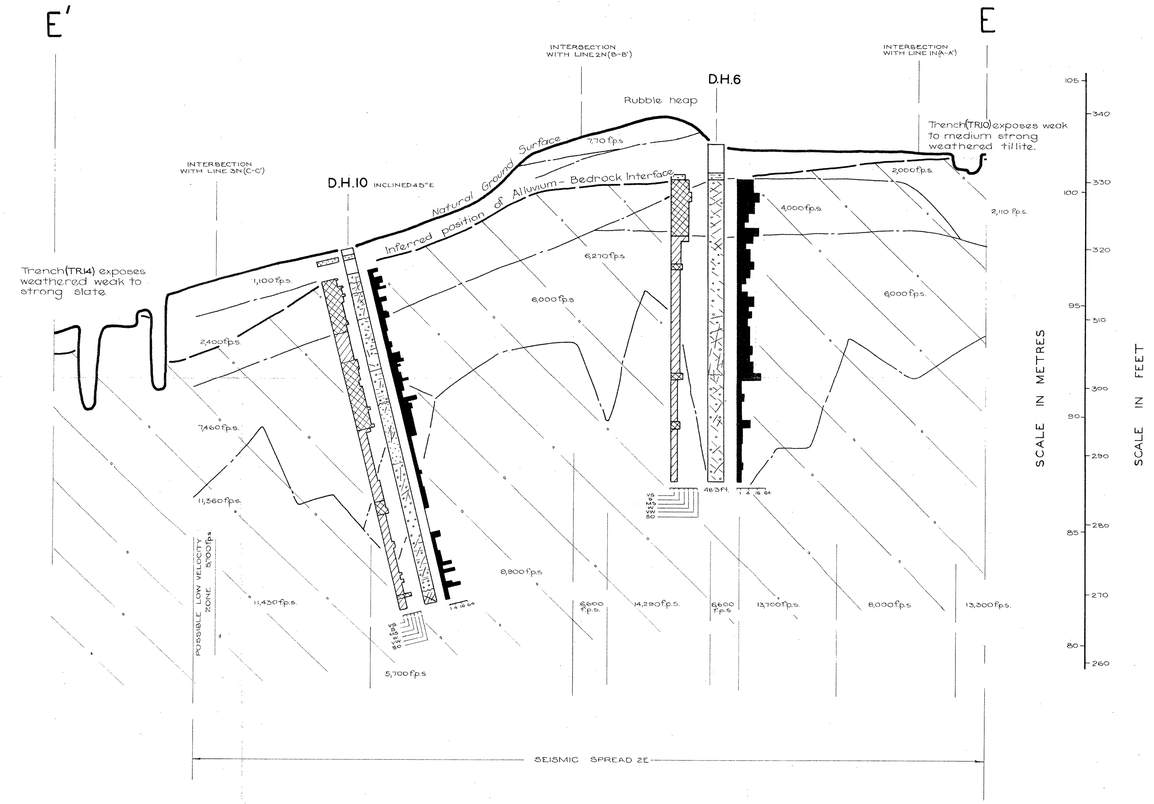
SECTION D'-D

(NATURAL VERTICAL SCALE)



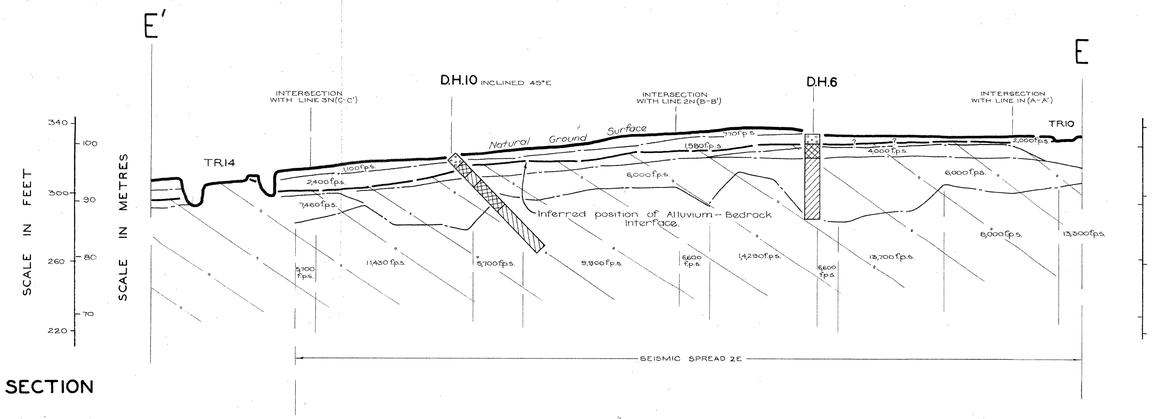
SECTION E'-E

(EXAGGERATED VERTICAL SCALE)



SECTION E'-E

(NATURAL VERTICAL SCALE)

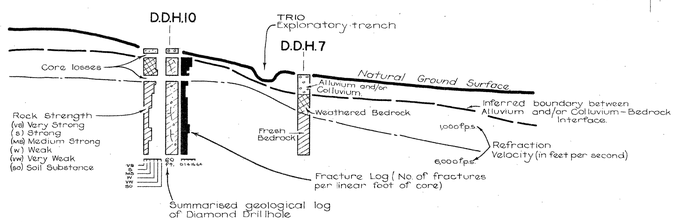


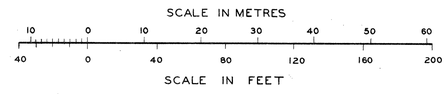
LEGEND

Topsoil, Alluvium and Colluvium, silty sand, clay and gravel.

Bedrock, consisting of tillite, conglomerate, slate and sandstone.

EXPLANATORY SECTION





DATUM : 105.7FT. BELOW M.S.L.

NOTE : FOR LOCATION OF SECTIONS D'-D & E'-E SEE PLAN 72-35

FIG.8

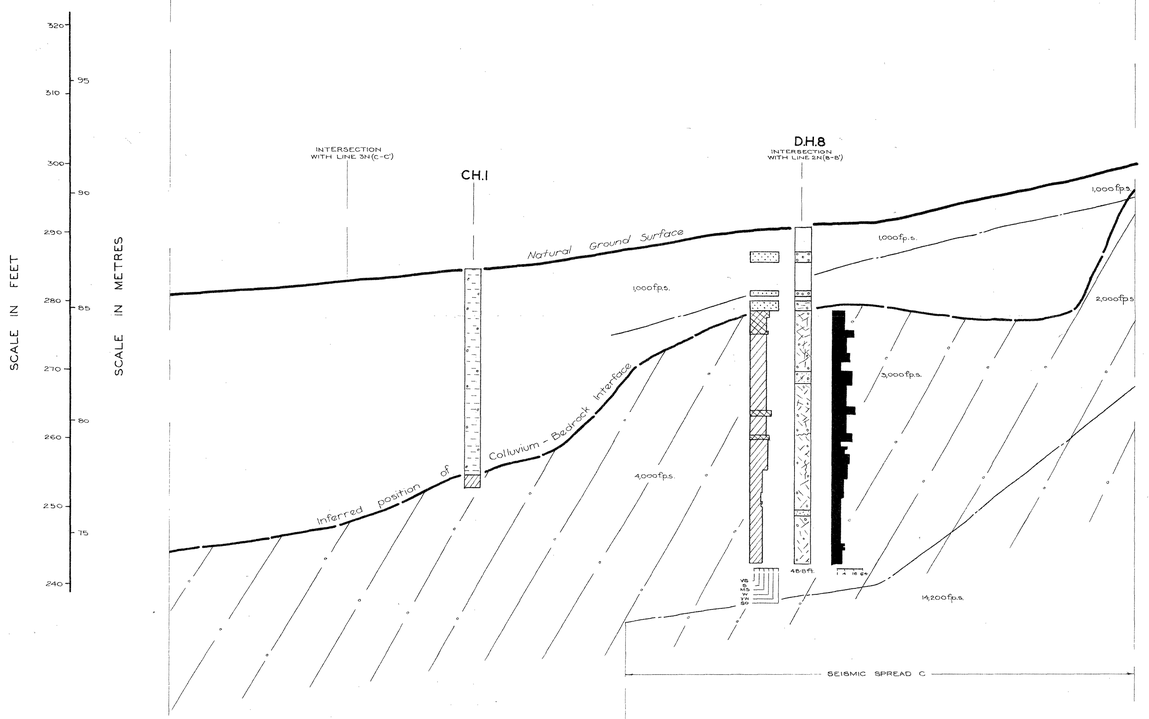
DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK
SECTION 601 HUNDRED ADELAIDE
GEOLOGICAL SECTIONS D'-D & E'-E

ENGINEERING GEOLOGY SECTION	GEOLOGIST 21 Mar 72	Drn. B.M.	SCALE: 1 IN. = 40 FT. HORZ.
		Tcd. A.G.R.	
		Ckd. L.V.W.	72-69 Ha 6
Director of Mines	SUP. GEOLOGIST	Exd. B.J.M.	DATE: 21 MARCH 1972

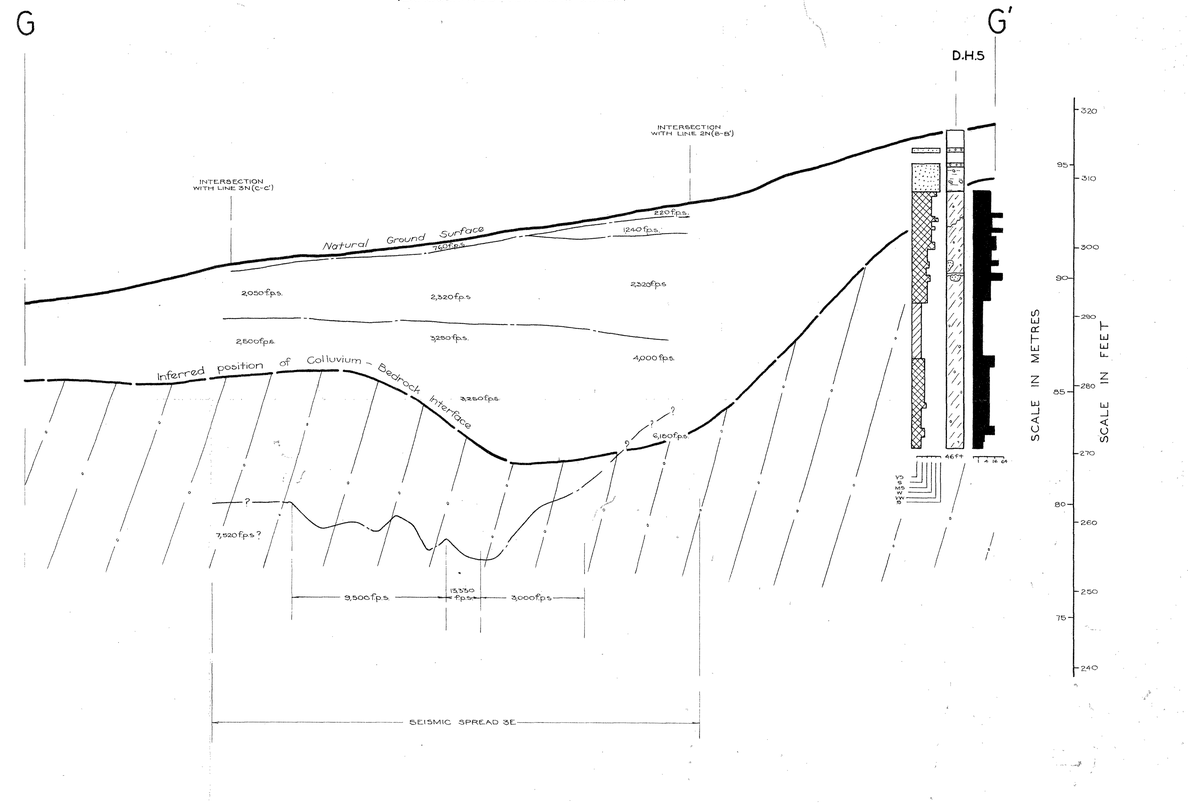
SECTION F'-F

(EXAGGERATED VERTICAL SCALE)



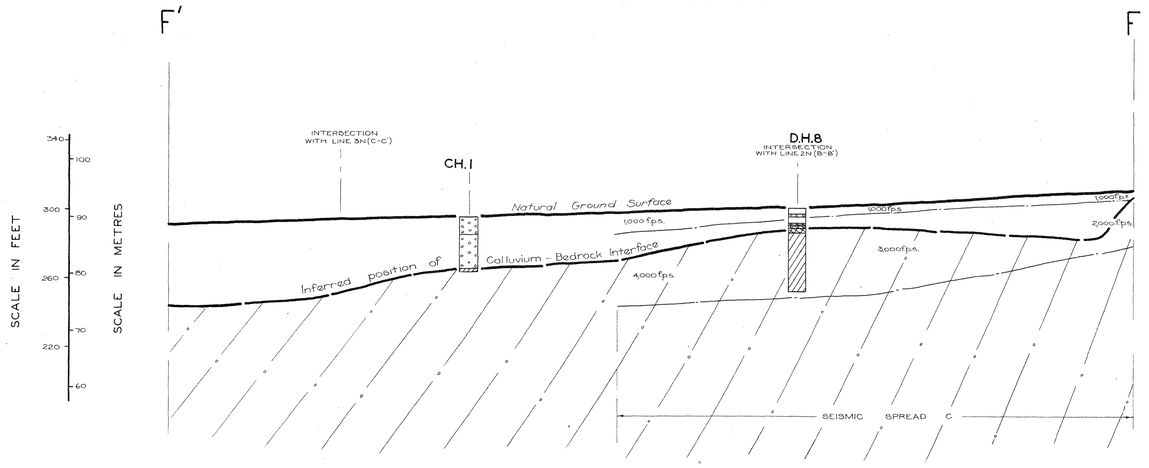
SECTION G-G'

(EXAGGERATED VERTICAL SCALE)



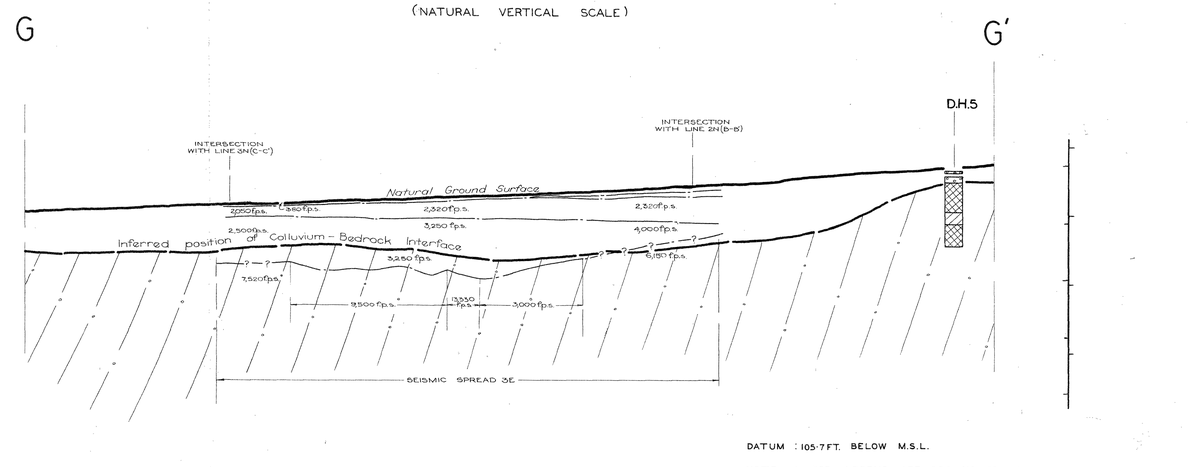
SECTION F'-F

(NATURAL VERTICAL SCALE)



SECTION G-G'

(NATURAL VERTICAL SCALE)



SCALE IN METRES

10 0 10 20 30 40 50 60

40 0 40 80 120 160 200

SCALE IN FEET

DATUM : 105·7FT. BELOW M.S.L.

NOTE : FOR LEGEND SEE DRG. NO. 72 - 69.
FOR LOCATION OF SECTIONS F'-F & G-G' SEE PLAN 72-35.

FIG.9

DEPARTMENT OF MINES — SOUTH AUSTRALIA

FLINDERS MEDICAL CENTRE
BEDFORD PARK
SECTION 601 HUNDRED ADELAIDE
GEOLOGICAL SECTIONS F'-F & G-G'

ENGINEERING GEOLOGY SECTION	GEOLOGIST 21 Mar 72	Drn. B.M.	SCALE: 1 IN. = 40 FT. HORZ.
		Tcd. A.G.R.	72 - 70 Ha 6
		Ckd. L.V.W.	
Director of Mines	SUP. GEOLOGIST 23 March 72	Exd. B.J.M.	DATE: 21 MARCH 1972