Section

Rept. Bk. No. 59/130
G.S. No. 3026
D.M. 2305/63
E.C. 64/17.

DEPARTMENT OF MINES
SOUTH AUSTRALIA

HAPPY VALLEY OUTLET TUNNEL, INLET PORTAL AREA
EXPLORATION OF SHAFT SITES
GEOLOGICAL REPORT

by

D.H. Stapledon
Senior Geologist

D.M. 2305/63

26th November, 1964.

RB 59/130

DEPARTMENT OF MINES
SOUTH AUSTRALIA

HAPPY VALLEY OUTLET TUNNEL, INLET PORTAL AREA

EXPLORATION OF SHAFT SITES

GEOLOGICAL REPORT

by
D.H. Stapledon
Senior Geologist

CONTENTS

Abstract

Introduction

Surface Geology

Results of Exploration

Conclusions

FIGURES

Figure No.	Title	Drawing No.
1	Happy Valley Outlet Tunnel Inlet Portal Area, Geological Sketch-Plan.	64-1069 Ha9
2	Drill Hole HVOS 1 Geological Log.	S3940 Ha9
3	Drill Hole HVOS 2 Geological Log.	S3941 Ha9

Rept. Bk. No. 59/130
G.S. No. 3026
D.M. 2305/63

26th November, 1964

Rept. Bk. No. 59/130
G.S. No. 3026
D.M. 2305/63

DEPARTMENT OF MINES
SOUTH AUSTRALIA

HAPPY VALLEY OUTLET TUNNEL, INLET PORTAL AREA

EXPLORATION OF SHAFT SITES

GEOLOGICAL REPORT

ABSTRACT

Diamond drilling near the Intake Portal of the Happy Valley Outlet Tunnel. has shown the Tunnel Portal and Access and Chlorination shafts to lie in highly to completely weathered slate. This weathered material is marginal in properties between weak rock and very strong soil. Support requirements for the shafts, foundations for the trashrack structure, and batter slopes for the portal open cutting are discussed.

INTRODUCTION

In a letter dated 1st October, 1964 the Engineer for Construction, Engineering and Water Supply Department requested that diamond drilling be carried out at the sites of two shafts at the portal of Happy Valley Outlet Tunnel.

The proposed chlorination shaft is to be 55 ft. deep, about 10 ft. square section, and the Access Shaft is to be 45 feet deep, about 20 feet across, roughly square section.

The shafts are to be 110 feet apart, and 260 feet and 150 feet respectively from the Inlet Portal of the tunnel (Figure 1). The primary purpose of the exploration was to determine the rock condition at each shaft site, and hence to enable selection of the most suitable type of construction stage support. In addition a reassessment was made of rock conditions in the Inlet Portal area, to determine cutting angles suitable for permanent stability, and foundation conditions for the Trashrack structure.

Two holes, HVOS 1 and HVOS 2 were drilled vertically to 57 feet and 45 feet respectively. The results are given on the attached detailed logs, (Figures 2 and 3). Weathering products referred to in the logs and in the text are defined on Table 1.

SURFACE GEOLOGY

The Portal and shaft sites are located on a gentle (7° to 10°) soil covered slope, adjacent to an arm of Happy Valley Reservoir. (Figure 1). Cuttings up to 3 feet deep in the area show fragments of completely to highly weathered slate beneath organic topsoil and red-brown clayey soil.

TABLE 1

WEATHERING PRODUCTS CLASSIFICATION

Term	Abbreviation	Definition
Fresh	Fr	The rock shows no discoloration, loss of strength, or any other effect, due to weathering.
Slightly weathered	SW	The rock is slightly discoloured, but not noticeably lower in strength than the fresh rock.
Moderately weathered	MW	The rock is usually discoloured and noticeable weakened, but two inch diameter cores cannot usually be broken up in unaided hands.
Highly weathered	HW	The rock is usually discoloured and weakened to such an extent that two-inch diameter cores when dry can be broken up readily by hand, across the bedding or rock fabric. Wet strength usually much lower than dry strength.
Completely weathered	CW	The rock is discoloured and reduced to a soil, but the original fabric of the rock is largely preserved. It is difficult to recover as diamond drill core.

RESULTS OF EXPLORATION

Hole HVOS 1 was drilled 56.7 ft. vertically down the centre line of the proposed chlorination shaft. From the surface to 8.5ft. core recovery was about 40%, the material recovered being organic topsoil, clay soil, and slate which is completely weathered into silty clay. From 8.5 to 17.5 ft. the recovery was almost 100%, in completely to highly weathered slate. From 17.5 ft. to the end of the hole 100% core was recovered in highly weathered slate. Bedding in this slate generally dips between 40° and 60°. The rock tends to part along bedding, and in addition is intersected

by two sets of clay-coated joints. Examination of surface exposures and orientation of the cores suggests the following to be the true attitudes of these structures.

(i) Bedding strike N.5°E, i.e. at 15° to tunnel direction, dip 40° to 60° W.

(ii) Joints, strike N 15° E, i.e. at 20° to tunnel direction, dip 60° E to vertical.

(iii) Joints, strike N. 170° E, is roughly parallel to tunnel direction, dip 0° to 20° E, i.e. into the hill slope.

Adjacent to the majority of the drilling "lifts" the rock is locally crushed into plastic silty clay containing small weathered slate fragments. It is considered that this is a result of "plugging" in the core barrel immediately before removal from the hole. The drilling was carried out with extreme care, but the highly weathered rock when wet apparently has little more strength than a hard clay, and when plugging occurred was readily broken up and moulded into plastic clay. Fragments of the intact highly weathered rock can be broken up in the fingers and moulded to produce similar material.

Hole HVOS 2, drilled 45 feet vertically at the Access Shaft site, passed through slate which was noticeably more weathered than that in Hole HVOS 1. The material is verging on the "completely weathered" state, in which the rock is reduced to a soil, but retains much of its initial fabric. It was much disturbed by the drilling, which was carried out very carefully.

The groundwater levels in the two holes are shown on the detailed logs. In Hole HVOS 2, only 80 feet from the reservoir edge, groundwater level was the same as reservoir level. In Hole HVOS 1, 140 feet upslope from the reservoir edge, the water level was 5 feet higher. These results suggest that the water table rises gently away from the reservoir edge. Below the water table the rock mass including joints and seams will be saturated.

Hole HVT 7 was drilled during the design stage, close to the site of the Trashrock structure. The core of this hole is similar to that of Hole No. 2 described above.

CONCLUSIONS

(a) General

Three diamond drill holes in the portal and shafts area show slate which is highly or completely weathered, that is, grading from rock into very strong soil, down to invert level of the proposed tunnel.

The weathered rock is intersected by steeply dipping and flat lying joints, many of which are smooth and slickensided, and have veneers of coatings of clay. Below R.L.'s 585 to 590 the weathered rock mass is probably saturated.

The core may easily be broken up and moulded into plastic clayey material during careful diamond drilling, and small pieces of core can be broken in the fingers and moulded into the plastic state. This type of behaviour suggests that the in-situ weathered rock will tend to break down rapidly to soil when subjected to similar treatment. This could be heavy blasting, or traffic over the tunnel invert, if saturated with water.

(b) Chlorination Shaft

It is considered that because of its relatively small size and simple shape, this shaft could be adequately supported by timber sets and lagging, during the construction period. The core of Hole HVOS 1 suggests that close lagging will prove necessary in at least the uppermost 20 feet, and could be necessary throughout the shaft, depending upon the amount of disturbance of the weathered rock during excavation.

(c) Access Shaft

This shaft is to be about 20 feet square, and core from the site is noticeably weaker than that from the Chlorination Shaft site. It is therefore considered best to allow for steel support with close lagging during the construction period.

(d) Trashrack Structure

The results of drilling (Holes HVT 7 and HVOS 1) suggest that this structure will be located on compact, highly to completely weathered slate. It is considered that this material is comparable to a very strong soil, and a safe bearing capacity of at least four

tons per square feet can be assumed.

(e) Portal Open Cutting

The proposed cutting will be up to 40 feet deep and will be mostly beneath reservoir level during operation of the tunnel. Near the surface the cutting will be in organic topsoil, red-brown clayey soil, and completely weathered slate.

The weathered slate should in general become more firm with depth below the ground surface, grading to highly weathered in the lower parts of the excavation.

Suggested cutting angles are as follow:

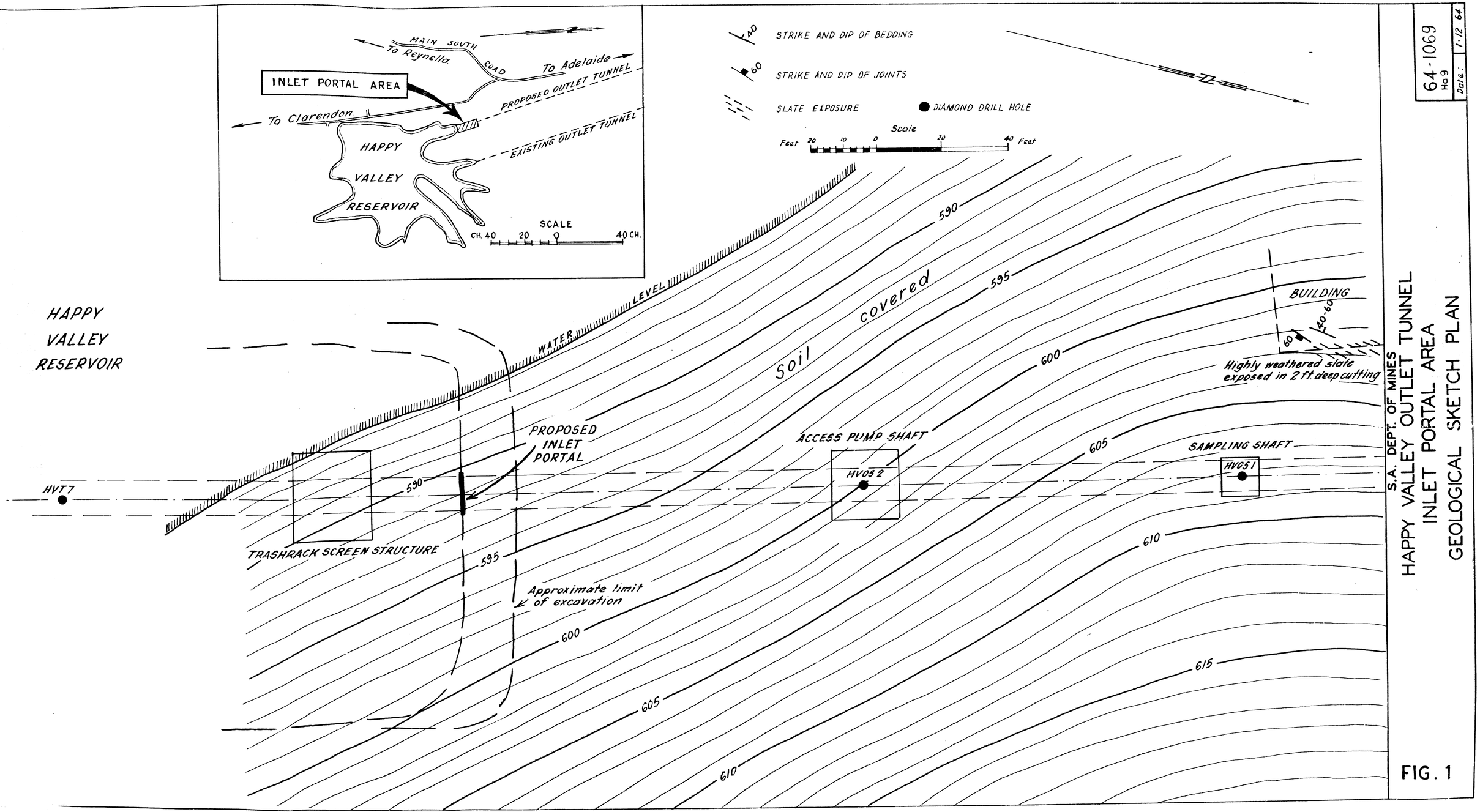
0 to 5 feet, 19°, (1 in 3) or flatter.

5 to invert, 30°, (approx. 1 in 2).

The materials do not appear suitable for protection by means of a membrane of pneumatically applied mortar, and it is suggested that rockfill may prove the most satisfactory means of ensuring permanent stability of the cuttings.

DHS:AWK
26/11/64

D.H. STAPLEDON
SENIOR GEOLOGIST
ENGINEERING AND SOILS GEOLOGY SECTION


INLET PORTAL AREA
MAIN SOUTH ROAD
To Reynella
To Adelaide
To Clarendon
PROPOSED OUTLET TUNNEL
EXISTING OUTLET TUNNEL
HAPPY VALLEY RESERVOIR
SCALE
CH. 40 20 0 40 CH.
STRIKE AND DIP OF BEDDING
STRIKE AND DIP OF JOINTS
SLATE EXPOSURE
DIAMOND DRILL HOLE
Scale
Feet 20 10 0 20 40 Feet
HAPPY VALLEY RESERVOIR
WATER LEVEL
Soil covered
590
595
600
605
610
615
BUILDING
40-60
60
Highly weathered slate exposed in 2 ft. deep cutting
PROPOSED INLET PORTAL
ACCESS PUMP SHAFT
HV052
SAMPLING SHAFT
HV051
HVT7
TRASHRACK SCREEN STRUCTURE
Approximate limit of excavation
S.A. DEPT. OF MINES
HAPPY VALLEY OUTLET TUNNEL
INLET PORTAL AREA
GEOLOGICAL SKETCH PLAN
64-1069
No. 9
Date: 1-12-64
FIG. 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. 1

GEOLOGICAL LOG OF DRILL HOLE

PROJECT HAPPY VALLEY OUTLET TUNNEL CO-ORDINATES —— R.L. 608 FT

FEATURE CHLORINATION SHAFT HUNDRED NOARLUNGA DIRECTION —— °

LOCATION ALONG CENTRE-LINE OF SHAFT SECTION 457 ANGLE FROM HORIZONTAL 90 °

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L. Casing	Depth and Size of Core	Log	Lift and Core recy %	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
TOPSOIL →	Dark brown, fibrous.							
NO CORE →								
CLAY SOIL →	Contains some rock fragment							
NO CORE →								
COMPLETE →								
NO CORE →								
High to Complete								
mainly high, Complete in seams.	Thinly bedded, pale yellow-brown to pinkish brown. In all places the core can be broken easily by hand, across the rock fabric.	Core in maximum 0·25 ft lengths	NXC		20	Structures obscured by weathering.		Full drilling water return throughout; hole not water pressure tested.
			NX		80			
			NMLC		40			
		600			30			
			10		100	Bedding dips 70° to 80°. Joints along bedding, & dip 60° to 70°, cutting across the bedding, are spaced 0·05 to 0·1 feet. Several seams up to 0·05 ft. thick of completely weathered rock and fine roots occur as shown.	14 Oct '64	
					100			
		590	20		100			
					100			
					100			LAKE LEVEL 14 Oct. '64
					100			
		580			100	Bedding dips from 45° to 80°, locally contorted as shown. Joints along bedding, and dip 60° to 80°, cutting across the bedding, are spaced 0·05 up to 1 foot, predominantly 0·25 feet. Most joints have veneers of clay or crushed rock, and many are polished or slickensided. Joints dip 10° to 20°, rough, irregular are spaced at 1 to 5 ft. intervals.		
			30		100			
					100			
		570			100			
			40		100			
					100			
		560			100			
			50		100			
					100			
Mainly highly weathered, completely weathered where shown	Core generally in 0·1 to 1 foot lengths, but broken into small fragments and clay adjacent to the end of each lift.							
Complete to high		551·3						

TAPLEYS HILL SLATE

56·7 feet END OF HOLE

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

FIG. 2.

Drill No. 5

Type E.1000

Driller Jensen

Commenced 8 Oct '64

Completed 13 Oct '64

EXPLANATION

WATER LEVEL ◀ DATE

Logged D.H.S.

Date 14 Oct 64

Drawn T.P.S.

Checked [illegible]

Submitted

Vert. Scale 1" = 10ft

Sheet 1 of 1

S3940

250—7.60 8036

Ha 9

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. 2

GEOLOGICAL LOG OF DRILL HOLE

PROJECT HAPPY VALLEY OUTLET TUNNEL CO-ORDINATES —— R.L. 600 FT

FEATURE ACCESS SHAFT HUNDRED NOARLUNGA DIRECTION °

LOCATION ALONG CENTRE-LINE OF SHAFT SECTION 457 ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Depth and Size of Core	Log	Lift and Core-rec'y %	STRUCTURES Joints, Veins, Seams Faults Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
Organic Topsoil clayey Slate HW-CW NO CORE HW-CW NO CORE HIGH TO COMPLETE NO CORE HW-CW NO CORE	Thinly bedded, pale yellow-brown to pinkish-brown. In all places the core can be easily broken by hand, across the rock fabric. In many places the core is broken into small fragments and clay.	590 580 570 560 555	NX NXC NMLC	70 10 40 60 80 95 100	Bedding dips 80°, several completely weathered clayey seams occur, mostly dipping 45° to 60°. Bedding dips 60° to 80°. Joints along bedding, and dip 60° to 80°, across bedding, and dip 10° to 20°, are spaced generally from 0·1 to 0·5 ft. Many joints are polished or slickensided and have veneers or seams of crushed rock. Some have black manganese oxide staining. Quartz veins up to 0·05 ft thick. Completely weathered seam 0·05 to 0·1 ft thick.	14 Oct '64	Full drilling water return throughout; hole not water pressure tested. LAKE LEVEL

TAPLEY'S HILL SLATE

Highly to completely weathered.

Core partly in 0·1 to 0·5 ft. lengths, and partly as clay and small fragments.

45 feet END OF HOLE

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

FIG. 3.

Drill No. 5
Type E.1000
Driller Jensen.
Commenced 6 Oct '64.
Completed 8 Oct '64.

EXPLANATION

WATER LEVEL ◀ DATE

HW Highly weathered
CW Completely weathered

Logged D.H.S.
Date 14 Oct '64
Drawn T.P.S.
Checked D.W.S.
Submitted

Vert. Scale 1" = 10ft

Sheet 1 of 1

S3941

250—7.60 8036

No 9