ENG. GEOLOGY SECTION

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

FERRY BERTH - CAPE JERVIS

Marine Res. Hd. Waitpinga

- Department of Marine and Harbors -

by

W.R.P. BOUCAUT
SUPERVISING GEOLOGIST
ENGINEERING DIVISION

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

FERRY BERTH - CAPE JERVIS

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REPORT ON GEOLOGICAL INVESTIGATIONS

Client: Department of Marine and Harbors

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D.M. No. 999/70

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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REPORT ON GEOLOGICAL INVESTIGATIONS

Client: Department of Marine and Harbors

SUMMARY AND CONCLUSIONS

Foundation conditions for a proposed ferry berth in a small inlet of the sea at Cape Jervis were investigated by 3 diamond drill holes to 50 ft., deep, put down into the sea bed from an existing jetty. These holes showed the floor of the inlet to be composed of sediments of Permian age and it is likely that the inlet was formed by glacial action in Permian times. Rocky outcrops of fresh,* very strong greywacke of the Kanmantoo Group of Cambrian Age forms the sides of the inlet.

The Permian sediments typically consist of beds, often lenticular, of gravels, sands, and silts of varying strength, and it would be difficult to locate a strong horizon thick enough, and continuous enough to form a foundation for driven piles.

* Terms underlined are defined in Table 1.

An exploration programme to prove the thickness and nature of the Permian sediments and the strength of the underlying greywacke is proposed, as it is considered that the greywacke would provide the best foundation material.

INTRODUCTION

It is proposed to construct a berth for a ferry in the small inlet of the sea at Cape Jervis. The berth would replace the existing jetty. A request to drill 3 drill holes to investigate foundation conditions was received in a letter from the Acting Chief Engineer, dated 17th August, 1970. Initially cable tool holes put down from a floating barge were proposed, but this was later charged to three cored diamond drill holes (D.H. 1, D.H. 2 and D.H. 3) put down to a depth of about 50 ft., from the existing jetty (Fig.1.). Logs of these diamond drill holes are included in Appendix A.

SITE GEOLOGY

Much of the shore line near Cape Jervis is composed of steep rocky cliffs. In a few places small inlets lead to sandy beaches. The existing jetty at Cape Jervis is located in an inlet approximately 300 ft., wide. Both sides of the inlet are composed of rock outcrops, but the floor of the inlet appears to be mainly beach sand and loose rock of Recent age (Fig.1.).

The rocky outcrops in the area are mainly of fresh very strong greywacke of the Kanmantoo Group of Cambrian age. However outcrops of sediments of the Cape Jervis Beds of Permian Age occur near the shore about ½ mile north of Cape Jervis. These sediments are, at this location,

about 100 ft., thick and consist of beds of clay, clayey shale, sandstone and gravel up to 30 ft., thick. These deposits were formed following the glaciation of Permian times, and generally fill old glacial valleys (L.W. Parkin (Ed.) 1969). Similar sediments were recovered during the drilling from the jetty, and is also exposed in batters of recent earthworks for parking areas at the back of the inlet. Details of the materials recovered during drilling are shown in the drill logs. (Appendix A).

DISCUSSION

The drilling results and surface exposures indicate that the inlet was formed during Permian times as a glacial valley and was then infilled with sediments. However, there is no indication as to the depth of the sediments or the condition of the underlying greywacke.

Experience in similar sediments elsewhere suggests that they are often lenticular and variable in nature from coarse gravel horizons, through dense sands to weak silts and clays, and it is common for the weaker horizons to be intermingled with the stronger layers. The various horizons would be expected to be generally flat lying although local dips of up to 35° have been recorded.

Due to the lenticular nature and the marked variation in strength of the various horizons it would be difficult to locate a particular horizons on which driven piles could be founded, and results so far suggest that piles could be safely founded only on the underlying greywacke.

It is recommended that an investigation programme be undertaken to determine the thickness of the Permian sediments beneath the proposed berth, and also the strength of the underlying greywacke.

This could be carried out in 2 stages.

(1) Seismic refraction traverses across the inlet to indicate depth to high velocity material. A suggested location of the traverses is shown on Fig. 1.

(2) One and possibly two push-tube/diamond drill holes to prove the nature and thickness of the Permian sediments as indicated by the seismic traverses, and to prove the nature of the underlying material,

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WRPB:JTS
28.1.71

REFERENCES

PARKIN, L.W. (Ed.) 1969. Handbook of South Australian Geology. Government Printer. Adelaide.

TABLE 1

CLASSIFICATION OF ROCK CONDITIONS AND STRENGTH OF ROCK SUBSTANCE

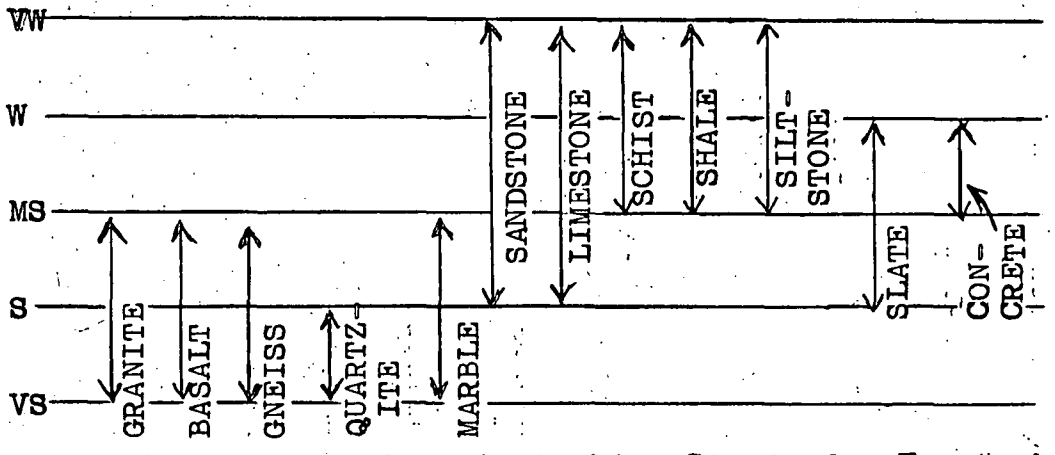
1. ROCK CONDITION TERMS

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

APPENDIX A

Logs of diamond drill holes and explanation notes

APPENDIX A

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.

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. 1

SERIAL No. 659/71

PROJECT. FERRY BERTH.

FEATURE. FOUNDATIONS.

LOCATION From existing jetty

SECTION MARINE RES. HUNDRED WAITPINGA

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION →

R. L. Surface . . FT.

R.L. Collar . . FT.

Datum .

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
DRILLED THROUGH SEAWATER.			10								
SEA FLOOR			20								
PERMIAN – CAPE JERVIS BEDS – Sandstone, pale, brown to white. Quartz grains in white clayey matrix. Grains mainly 0·3 to 0·7mm diameter – few grains and angular fragments of greywacke to 1cm size. Sticks have moderate dry strength, but weak to very weak when saturated.	NO CORE SP					Core mainly broken across horizontal planes. Few joints at 25°-35° – spaced few inches to greater than 1ft.	NOT RECORDED			NOT RECORDED	NOT TESTED
	NO CORE		30								
	NO CORE		40								
	SP		50			weathered zone?					
						END OF HOLE 50 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. 24
TYPE E 1000
DRILLER Ashmoneit.
START. 16 Dec. 70.
FINISH 17 Dec. 70.

LOGGED W.R.P. Boucaut.
DATE 14 Jan. 71.
TRACED E.B.T.
CHECKED W.P.B.

SHEET 1 OF 1. DRG. No. S9147 HC11

P.F. Nº S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. 2

SERIAL No. 660/71

PROJECT. FERRY BERTH

FEATURE. FOUNDATIONS

LOCATION From existing jetty

SECTION MARINE RES: HUNDRED WAITPINGA

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION —

R.L. Surface . . FT.

R.L. Collar . . FT.

Datum . . .

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
						DRILLED THROUGH SEAWATER.					
			10			SEA FLOOR.					
PERMIAN - CAPE JERVIS BEDS SANDSTONE Mainly quartz grains to 0·7mm in clay matrix - grey brown SHALE, Clayey, grey, angular quartz grains to 0·5 mm scattered throughout Fragments of greywacke from few mm to 3cm in size. sticks have some dry strength as noted but become weaker when saturated.	NO CORE NO CORE SC NO CORE SC/CL SC/CL		20 30 40			Core mainly broken across near horizontal planes. Few joints at 35° to 65° Wheathered seam? Wheathered seams!			NOT RECORDED		NOT TESTED
						END OF HOLE 46·9 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. 24
TYPE E 1000
DRILLER Aschoniet
START. 18 Dec. '70.
FINISH 19 Dec. '70.

LOGGED W.R.P. Boucaut
DATE 14 Jan. 71
TRACED E. B. T.
CHECKED W.P.B.

SHEET 1 OF 1. DRG. No. S9149 HC11

P.F. N° S5027D MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. 3

SERIAL No. 662/71

PROJECT. FERRY BERTH

FEATURE. FOUNDATION

LOCATION From existing jetty

SECTION MARINE Res. HUNDRED WAITPINGA

CO-ORDINATES

ANGLE FROM HORIZ. 90° DIRECTION —

R.L. Surface . . FT.

R.L. Collar . . FT.

Datum . .

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
						DRILLED THROUGH SEAWATER.					
			10			Sea Floor					
PERMIAN - CAPE JERVIS BEDS SHALE, clayey, grey grading to SANDSTONE in parts. Sand is mainly quartz up to 0·7mm size, in clay matrix. sticks have some dry strength as noted. Sandy portions are weaker than shales. All sticks loose strength when saturated.	grades to SC/CL in places		20			No structures apparent.					
	NO CORE										
			30			Mainly broken across near horizotal planes - no joints.					
	NO CORE					← Weathered seam?					
	SC		40								
	NO CORE					Structures mainly indeterminate - few joints apparent. dip 35°					
	NO CORE SC/CL					← Weathered seam?					
	SC/CL		50								
						END OF HOLE 60·5 ft.					

NOT RECORDED

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.

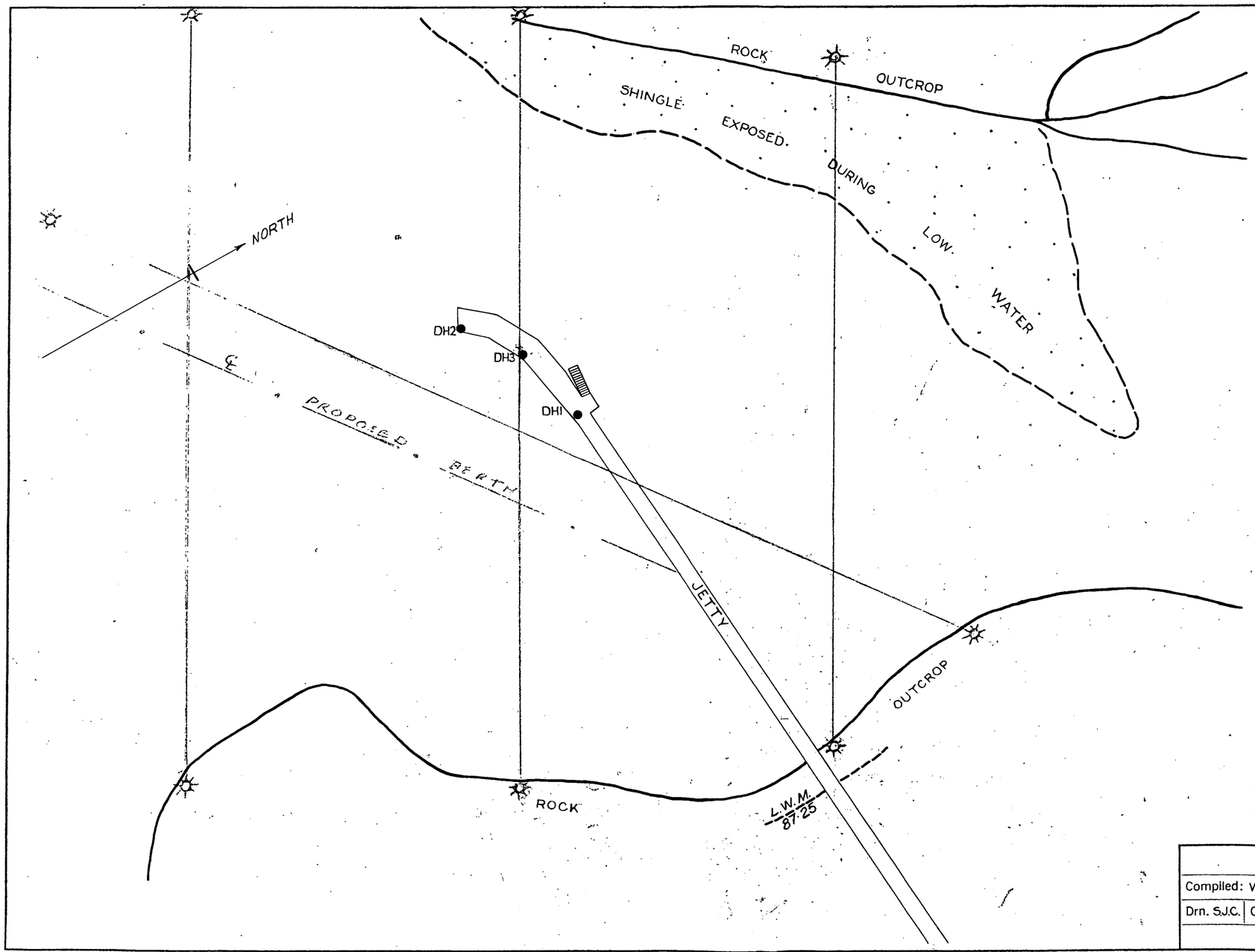
ENGINEERING GEOLOGY SECTION

DRILL No. 24
TYPE E 1000
DRILLER Aschmoneit
START. 21. Dec. 70
FINISH 23. Dec. 70

LOGGED W.P.R. Baucaut
DATE 14 Jan. 70
TRACED E.B.T.
CHECKED W.P.B.

SHEET 1 OF 1. DRG. No. S9148 HC 11

P.F Nº S5027D MB



LEGEND

● DH3 Diamond drill hole No. 3 (Approximate location)

Rock in outcrop is greywacke. (Kanmantoo Group)

Proposed seismic refraction traverse

FIG. 1

	DEPARTMENT OF MINES – SOUTH AUSTRALIA	Scale: 1" = 40 feet
Compiled: W.R.P.B.	FERRY BERTH – CAPE JERVIS	Date: 21st. JAN. '71
Drn. S.J.C. Ckd. E.B.T.	MARINE RES. HD. WAITPINGA	Drg. No. 71-57 Hc 11
	LOCATION OF DRILL HOLES	

1M–2.70 A1811