DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
GEOPHYSICS DIVISION

SHALLOW REFRACTION SURVEY IN THE VICINITY OF NARACOORTE SALEYARDS DISPOSAL LAGOONS

BY

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Rept.Bk.No. 79/9
G.S. No. 6128
D.M. No. 317/77

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ABSTRACT

A shallow seismic refraction survey was carried out around the disposal lagoons at the Naracoorte Saleyard to determine the depth to the Gambier Limestone. If the lagoon excavations are near or extend into the limestone the effluent could pollute the aquifer.

The Gambier Limestone was found to occur at a depth of 4-18 m and contains cavities filled with silts and clays. It is overlain by the Parilla Sands, the porosity and permeability of which are important in determining whether the aquifer is being polluted.

INTRODUCTION

At the request of the Engineering Division, a shallow seismic refraction survey was carried out around the disposal lagoons at the Naracoorte Saleyard located about 3 km east of Naracoorte (Figure 1). The purpose of the survey was to locate the top of the buried limestone in the vicinity of the lagoons. It is believed that if the bottom of the excavations for the disposal lagoons is situated in or near the limestone the effluent could permeate into the aquifer within the Gambier Limestone thereby polluting it.

This work was carried out by personnel from the Geophysics Division of the S.A. Department of Mines and Energy in October, 1978.

METHOD USED

The seismic refraction method involves recording the times taken for energy to travel from an impulse source to an array of geophones. The times are then plotted against

the geophone positions and the resultant time-distance curves analysed to obtain the velocities and thicknesses of layers beneath the geophone spread (Hawkins, 1961).

The recording apparatus used on this survey consisted of an SIE PT 100 twenty-four channel amplifier feeding an SIE ERC 6 electrostatic oscillograph. Standard seismic refraction geophones were used 5 m apart in an inline spread. In adjacent spreads (ie. 1&2, 5&6) geophone 1 was coincident with geophone 24 of the previous spread to ensure continuity of data.

Shotpoints were located at each end of the spread, at its centre, at the midpoint between the centre and each end and at approximately 50 m from each end. Shots consisted of gelignite charges located in drill holes 3 m deep. Uphole times were recorded from a geophone located at the top of each hole and this time was added to all arrival times to correct to the surface datum.

To obtain information on the surface layer it was necessary to carry out a series of weathering spreads at the centre and each end of each spread. A Bison Signal Enhancement hammer seismograph was used for this purpose, readings being obtained at 2 m intervals to a distance of 20 m.

Figure 2 shows the location of the seismic spreads around the lagoons.

RESULTS

The results, outlined below, are presented as seismic cross-sections in Figures 3&4.

Previously drilled observation bore-hole and refraction seismic results show a surface layer of weakly cemented sands 1-4 m deep with a mean velocity of 370 m/s (standard deviation 65 m/s) over the entire area. This layer is underalin

by a clay/silt layer with a mean seismic velocity of 855 m/s (standard deviation 90 m/s) extending to a depth of 4-6 m.

Geological interpretation of the drill hole logs has identified these near surface sediments as the Parilla Sands which are made up of medium grained clayey quartz sands and sandy clays.

Beneath the Parilla Sands is a discontinuous layer with a mean velocity of 1135 m/s (standard deviation 55 m/s) that is believed to be clayey sand and silt which has filled large holes in the surface of the Gambier Limestone.

The upper zone of the underlying limestone (Figure 5) is weathered and contains cavities filled with younger sands and silts. As a result, a layer with a mean velocity of 1510 m/s and standard deviation of 130 m/s is observed. This velocity is an average of the true limestone velocity and that of the younger material. Lateral changes in the degree of weathering, size and number of cavities all contribute to give rise to the large standard deviation obtained.

The surface of the highest velocity material detected, believed to be continuous unweathered Gambier Limestone, varies between 8 and 18 m in depth. The velocity of this layer is 2000 + m/s.

CONCLUSIONS & RECOMMENDATIONS

The lagoons are supposedly 2 m deep, but an accurate estimate is difficult to obtain due to the nature of the contents. It has been found that the limestone beneath the main lagoon is at depths varying from 4-18 m below ground level. The base of the excavations is therefore at least 2 m above the limestone so direct entry of the effluent into the limestone aquifer is unlikely.

Nevertheless, due to the porous nature of the surface sediments (as shown by water entry into drill-holes) it is possible that the lagoons are losing some of their contents into the aquifer through the intervening sediments. Hence, the porosity and permeability of the Parilla Sands is of prime importance in determining whether the effluent is polluting the aquifer. It is recommended that pump tests on existing observation bores be carried out to determine the permeability of the Parilla Sand.

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REFERENCES

Hawkins, L.V., 1961. The reciprocal method of routine shallow refraction investigations . Geophysics, 26, 806-819.

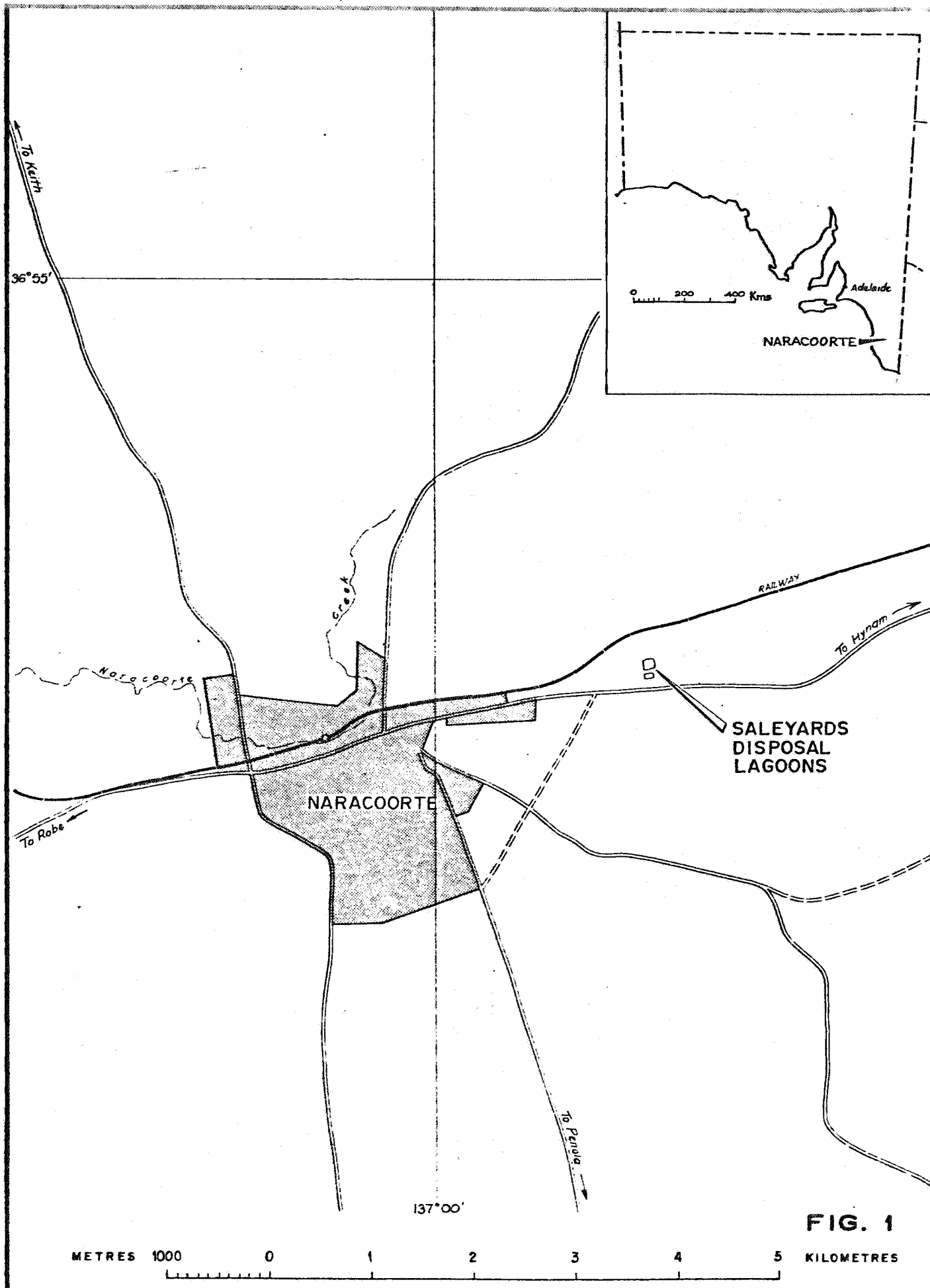


FIG. 1

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50 000
COMPILED B Taylor	NARACOORTE SALEYARDS SEISMIC SURVEY	DATE 29-11-78
DRN N.S. CKD	LOCALITY PLAN	PLAN NUMBER S 13800

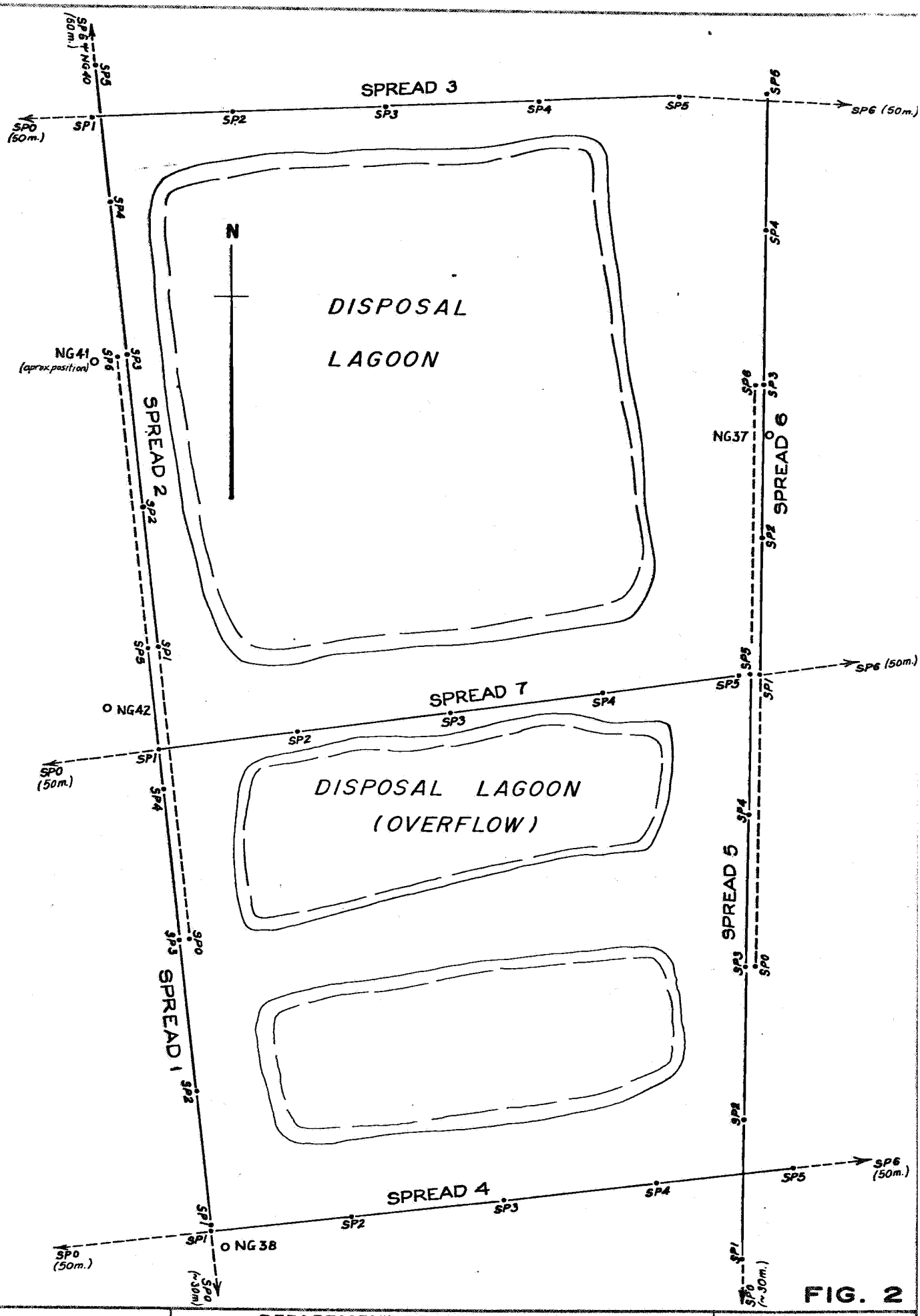


FIG. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1:1000
COMPILED M. Micenko	NARACOORTE SALEYARDS SEISMIC SURVEY	DATE 29-11-78
DRN N.S. CKD	PLAN OF SEISMIC TRAVERSES AROUND DISPOSAL LAGOONS	PLAN NUMBER S13801

JOB 1069

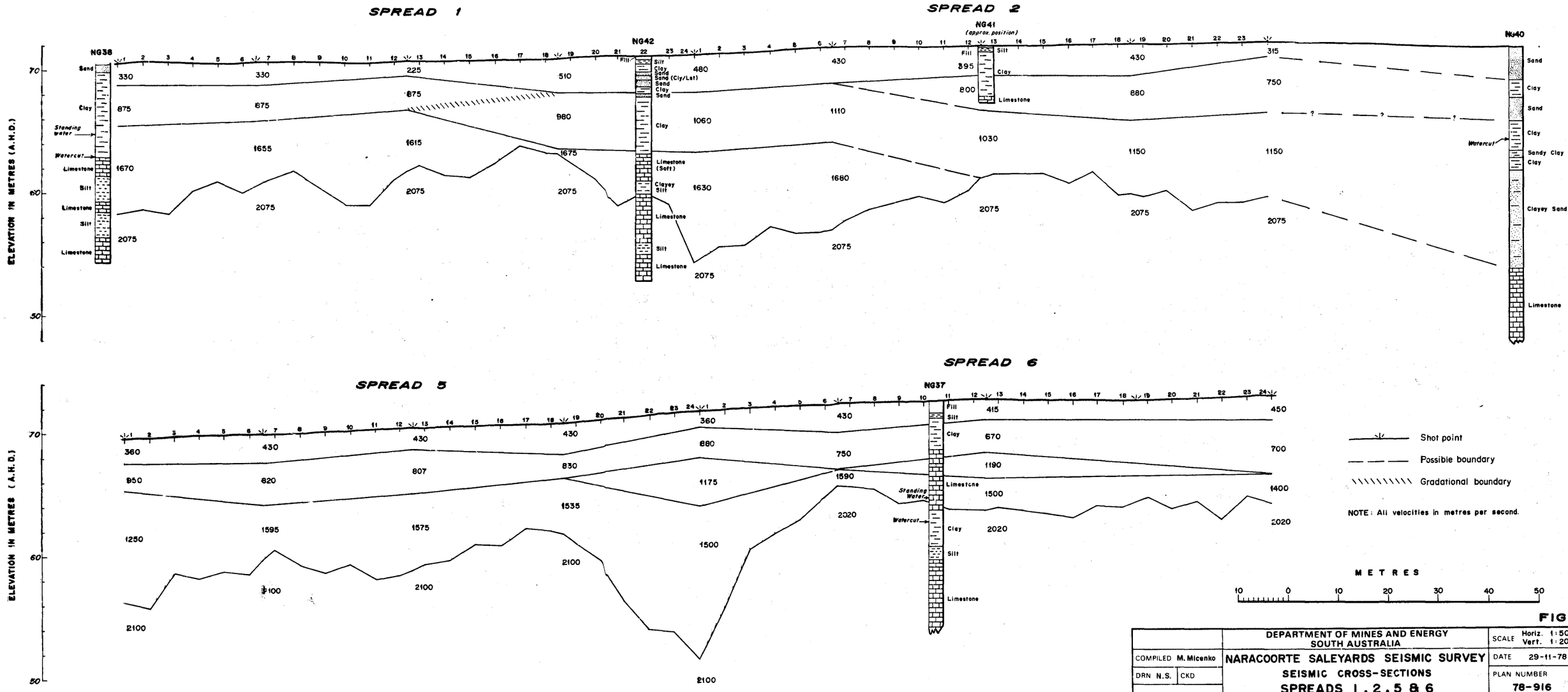
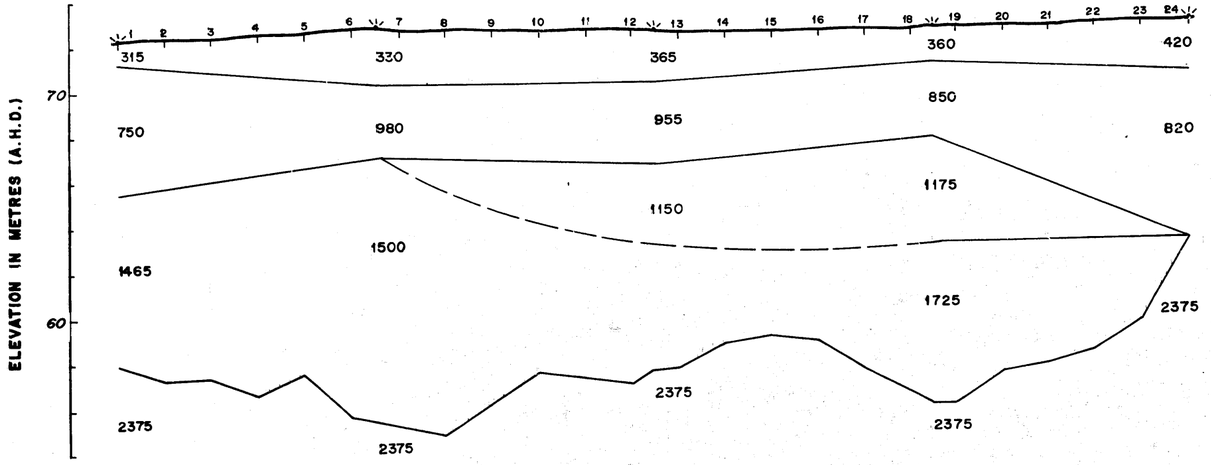


FIG. 3

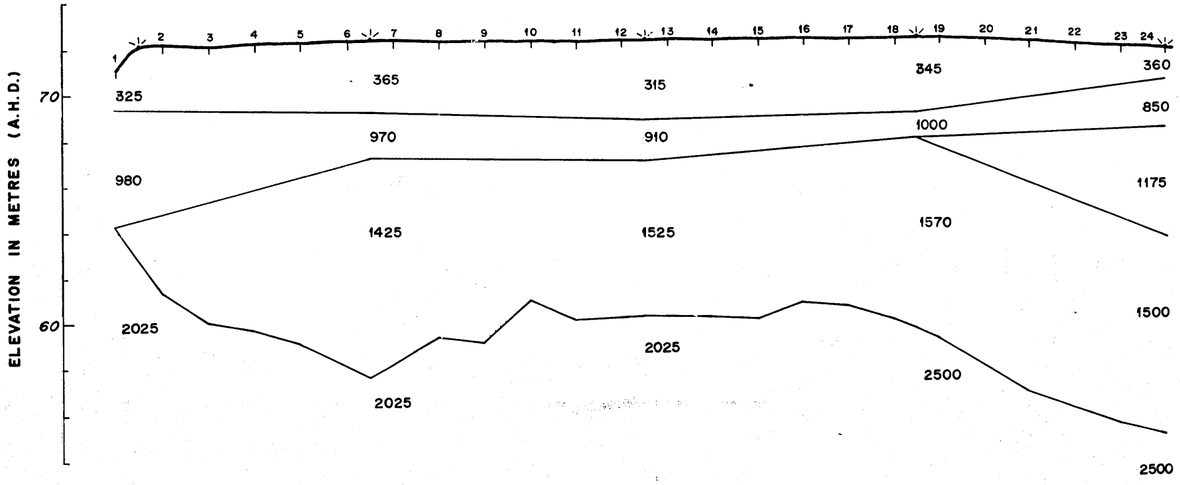
	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE Horiz. 1:500 Vert. 1:200
COMPILED M. Micenko	NARACOORTE SALEYARDS SEISMIC SURVEY	DATE 29-11-78
DRN N.S. CKD	SEISMIC CROSS-SECTIONS	PLAN NUMBER
	SPREADS 1, 2, 5 & 6	78-916

J05 1053

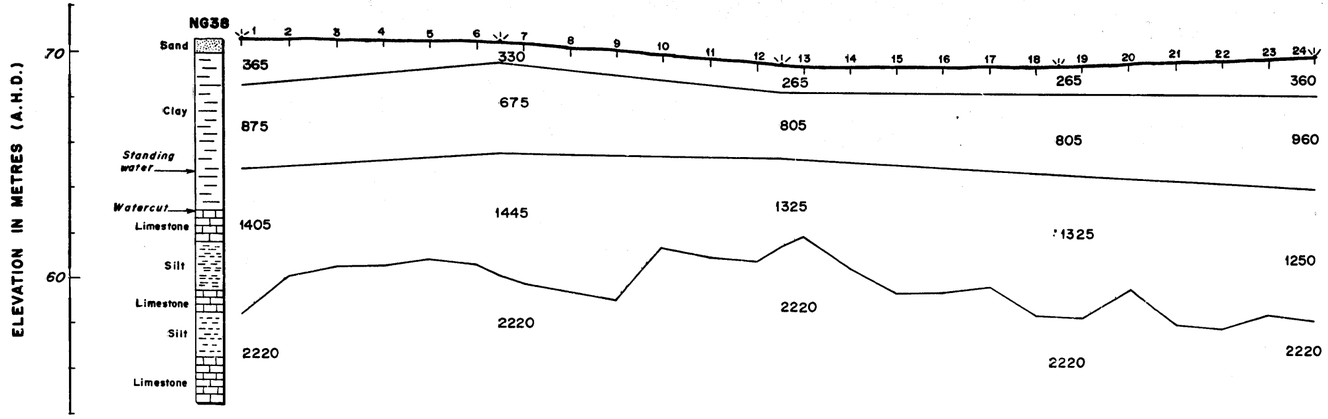
SPREAD 3



SPREAD 7



SPREAD 4



Shot point

Possible boundary

NOTE : All velocities in metres per second.

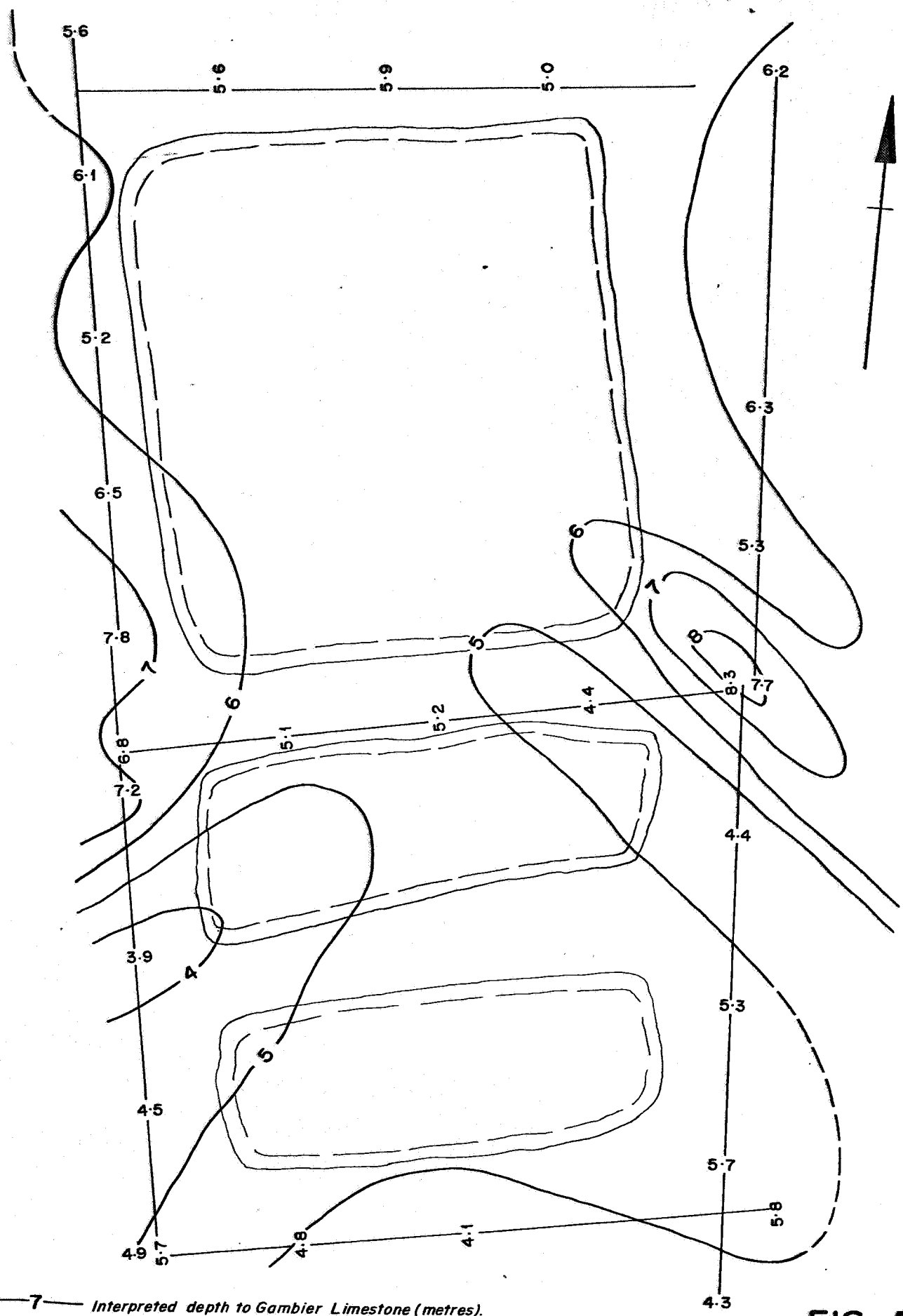
METRES

10 0 10 20 30 40 50

FIG. 4

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE Horiz. 1:500 Vert. 1:200
COMPILED M. Micenko	NARACOORTE SALEYARDS SEISMIC SURVEY	DATE 29-11-78
DRN N.S. CKD	SEISMIC CROSS-SECTIONS SPREADS 3, 4 & 7	PLAN NUMBER 78-917

Job 1069



—7— *Interpreted depth to Gambier Limestone (metres).*

FIG. 5

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1:1000
COMPILED M. Micenko	NARACOORTE SALEYARDS SEISMIC SURVEY	DATE 29-11-78
DRN N.S. CKD	INTERPRETED DEPTH TO GAMBIER LIMESTONE	PLAN NUMBER S 13802

JOB 1969