REPT.BK.NO. 73/193

SEISMIC REFRACTION SURVEY AT ANSTEY'S HILL

- E. & W.S. DEPARTMENT -

R.G. NELSON

Department of Mines
South Australia —

73/193

R/B 73/193

SEISMIC REFRACTION SURVEY AT ANSTEY'S HILL
CLIENT: E.W.S. DEPT.

20-8-73

by
R.G.NELSON

73-484 Seismic Refraction Survey -Anstey's Hill
Location Of Seismic Traverses

73-480 Seismic Refraction Survey -Anstey's Hill
Seismic cross-sections

Spread 3 - Hawkins Analysis

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

SEISMIC REFRACTION SURVEY AT ANSTEY'S HILL

Client : E. & W.S. DEPARTMENT

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R.G. NELSON
GEOPHYSICIST
EXPLORATION GEOPHYSICS SECTION

Rept.Bk.No. 73/193
G.S. No. 5198
D.M. No. 663/70

20th August, 1973.

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PLANS

Plan No.	Title	Scale
73-484	Seismic refraction survey - Anstey's Hill Location of seismic traverses.	As above
73-480	Seismic refraction survey - Anstey's Hill Seismic cross-sections.	1:500

DEPARTMENT OF MINES
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SEISMIC REFRACTION SURVEY AT ANSTEY'S HILL

ABSTRACT

It is proposed that a water filtration plant be constructed near the Anstey's Hill Tanks. Six seismic refraction traverses were made over the area concerned to test bedrock conditions. These show that the rocks comprising bedrock are phyllites and slates with velocities in the range 1 250 m/s to 2 000 m/s, dolomite with a velocity range of 3 000 m/s to 6 000 m/s and quartzite of about 5 300 m/s.

GEOLOGY

The geology of the area is discussed more fully by Dixon and Boucaut (1968). It will suffice to quote from their section headed: "General Geology".

"The site is on the western escarpment of the Adelaide Hills, that is on the escarpment of the Eden Fault. The inferred northeast-southwest trending trace of the fault is about ½ mile to the west of the tank sites. The area has a fairly youthful topography and is dissected by several westward flowing creeks, entrenched in steep sided valleys up to several hundred feet.

Rock outcrops occur over much of the area, and elsewhere exposures in road cuttings indicate that soil cover is usually only a few feet thick.

The area is underlain by a northeast-southwest trending zone of quartzites, phyllites, slates, shales and dolomites of the Torrensian Series of the Adelaide System of Proterozoic Age. These rocks are completely folded and faulted about northeast-southwest trending axes. In the area of the tanks the main structure appears to be a broad anticline with its axis in the dolomite bed".

FIELD TECHNIQUES

Six seismic refraction traverses were made (see Plan No. 73-484). These were laid down as in-line spreads with the following distances between geophones:

6 m for traverse 1
9 m " " 2
7 m " " 3
5 m " " 4
6 m " " 5
9.15 m " " 6

Traverses 1 to 4 were located on a ridge where the water treatment plant is to be established. Traverses 5 and 6 were made in the adjoining valley where a dam is to be constructed.

Twenty-four geophones were used in each spread. Their responses to impulses provided by detonating AN60 blasting gelignite in tamped shotholes were recorded using a Texas Instrument Co. 7000B recording seismograph.

Shots were fired on each spread:-

(a) at the spread centre;

(b) midway between geophones 6 and 7;

(c) " " " 18 and 19;

(d) at both ends of the spread (the end geophone in each case being moved halfway towards the adjacent geophone);

(e) as bracketing shots 100 m from each end of the spread.

Only the centre shot and the two end shots were fired for traverse 6.

INTERPRETATION

The rough topography and the fact that beds dip quite steeply makes interpretation very difficult. Shooting up-dip and down-dip on an inclined bed will produce two different apparent velocities, one higher than the true bed velocity, and one lower. Moreover, if the bed dips at an angle greater than the critical angle of refraction for the bed and the upper layer (i.e. = arcsin $\frac{V_0}{V_1}$), then no impulses can be refracted from it when shooting downdip. A case like this renders invalid such reciprocal methods of shooting as that outlined by Hawkins (1961).

It is important, therefore, to study the time-distance graphs very carefully so that such situations can be recognized: blind application of standard techniques may give false results. Good control may be gained from spreads oriented at right angles to one another.

Of the six traverses made, only traverse nos. 2 and 3 could be treated using Hawkins method. Formulae derived for the case of two dipping beds were used for the others.

RESULTS

Seismic cross-sections are shown in Plan No. 73-480.

Soil cover (200 to 500 m/s) nowhere exceeds 3 m in thickness. Beneath this lies a refractor of variable velocity (from 700 to 2 000 m/s). It is suggested that this is phyllite or slate in varying degrees of weathering. On the eastern side of the ridge in particular it seems that there is a highly weathered zone (consider, for example, the low velocity (730 m/s) zone shown on traverse 4). Detailed mapping of this zone may be necessary.

A refractor which appears to correspond to the dolomite bed appears next in the seismic sections. This has a velocity range of 3 000 m/s to 6 000 m/s and seems to be anisotropic (e.g. traverse 1 - 5 000 to 6 000 m/s, traverse 4 - 3 600 to 4 600 m/s).

The axis of the anticline seems to run along or parallel to alline through the following points:

Traverse	Geophone position
1	22
4	18-19
3	6-7

Table I gives an example of interpretational techniques as applied to traverse 3. It is along this traverse that the near-surface rocks are strongest.

CONCLUSIONS

The seismic survey confirms that soil cover in the area is at the most only a few metres thick. Underlying most of the ridge and the adjoining valley is a thick sequence (generally greater than 20 m) of phyllites, slates and shales whose velocity is low (1 250 m/s to 2 000 m/s). In places these are highly weathered (600 m/s to 900 m/s) and hence will have a low mechanical strength.

The dolomite and the quartzite have high seismic velocities (c. 5 000 m/s) and should be mechanically quite strong. The quartzite lies on the eastern end of traverse 5 which is otherwise underlain by some tens of metres of weathered and unweathered phyllites and slates. The dolomite lies at depths of 20 m or so along most of the ridge with the possible exception of the northern end (traverse 3) where strong rocks (c. 3 500 m/s) lie within a few metres of the surface.

RGN:JS
20.8.73.

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EXPLORATION GEOPHYSICS SECTION

REFERENCES

Dixon, H.W. and Boucaut, W.R.P., 1968. Mannum - Adelaide pipeline. Materials for Quarrying near inlet and outlet pipelines of Anstey's Hill tanks. Geological investigations, Progress Report No. 1. South Aust. Dept. Mines unpublished report, RB.67/69.

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

ANSTEY'S HILL SEISMIC REFRACTION SURVEY - JUNE ,1973

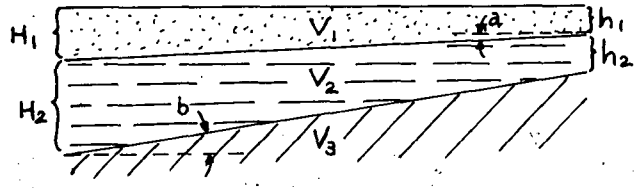
SPREAD 3 - HAWKINS ANALYSIS (using paper tapes 3-1 & 3-7)

	t1	t2	t#d	T1'	D	
1	92.96	63.92	29.44	63.52	7.28	South-east
2	89.64	67.25	29.45	60.19	7.25	
3	86.71	68.62	28.67	58.04	7.03	
4	84.17	68.43	27.30	56.87	6.66	
5	88.86	72.54	31.70	57.15	7.70	
6	83.20	79.41	32.30	50.89	7.81	
7	80.07	79.99	31.03	49.03	7.47	
8	75.00	74.70	25.85	49.14	6.08	
9	70.31	70.39	21.35	48.96	4.90	
10	69.33	71.37	21.35	47.98	4.78	
11	75.19	80.39	28.79	46.40	6.30	
12	70.50	82.54	27.52	42.97	5.87	
13	67.57	85.29	27.43	40.14	5.20	
14	66.79	85.49	27.14	39.65	4.51	
15	64.84	84.90	25.87	38.97	3.69	
16	61.32	85.68	24.50	36.82	2.91	
17	57.61	86.27	22.94	34.67	2.19	
18	55.27	88.03	22.65	32.61	1.63	
19	53.71	90.39	23.05	30.65	1.71	
20	51.17	90.78	21.97	29.19	1.69	
21	43.94	92.15	19.05	24.89	1.51	
22	41.60	92.54	18.07	23.52	1.48	
23	37.69	93.52	16.61	21.08	1.40	
24	35.93	92.54	15.24	20.69	1.32	North-west

t1 - travel time for north shot
t2 - travel time for south shot
t#d - time-depth from reciprocal analysis
T1' - corrected travel time for north shot
D - depth (in metres)

Geophone spacing = 7m

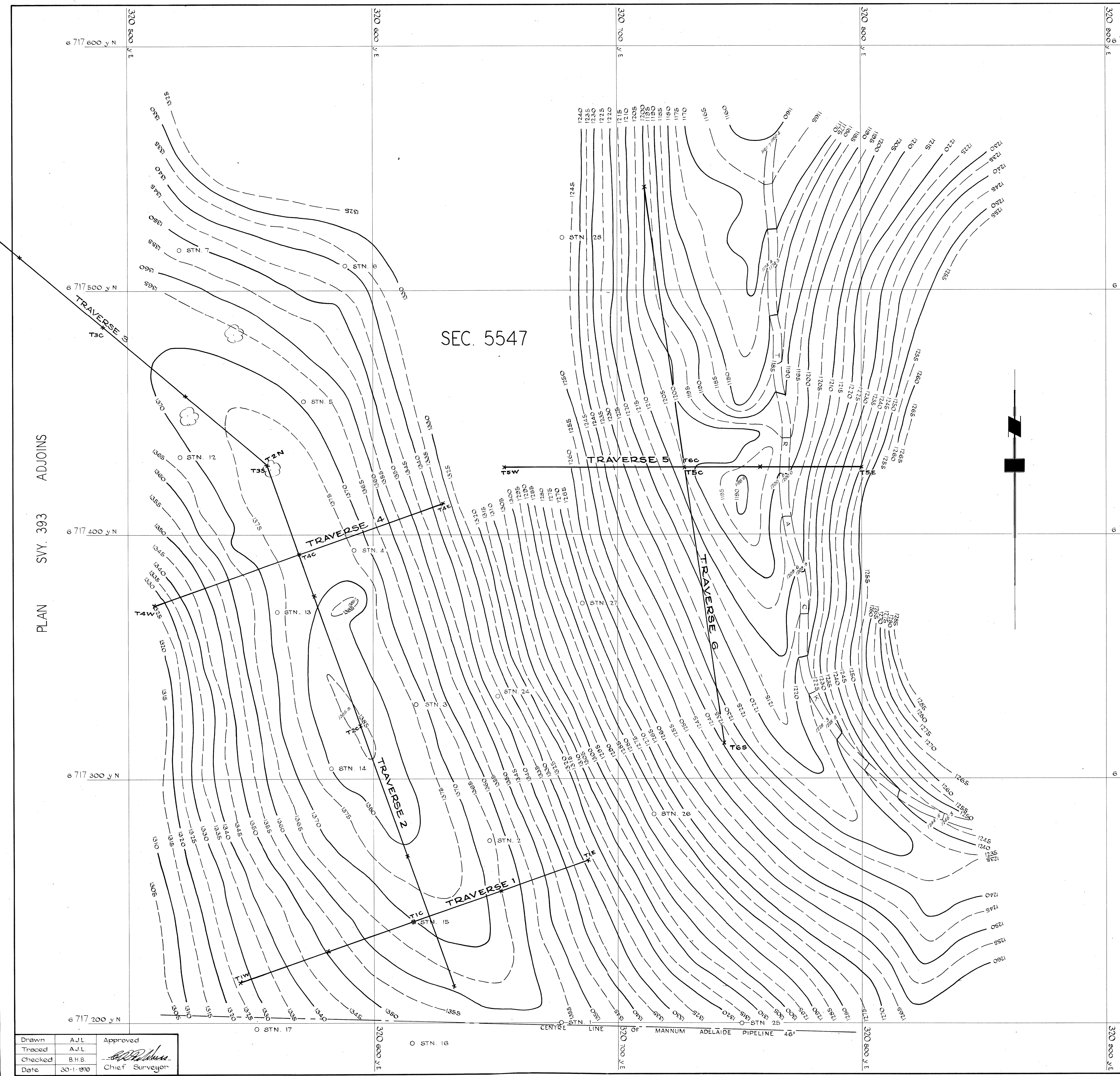
ANALYSIS USING DIPPING BED FORMULAE

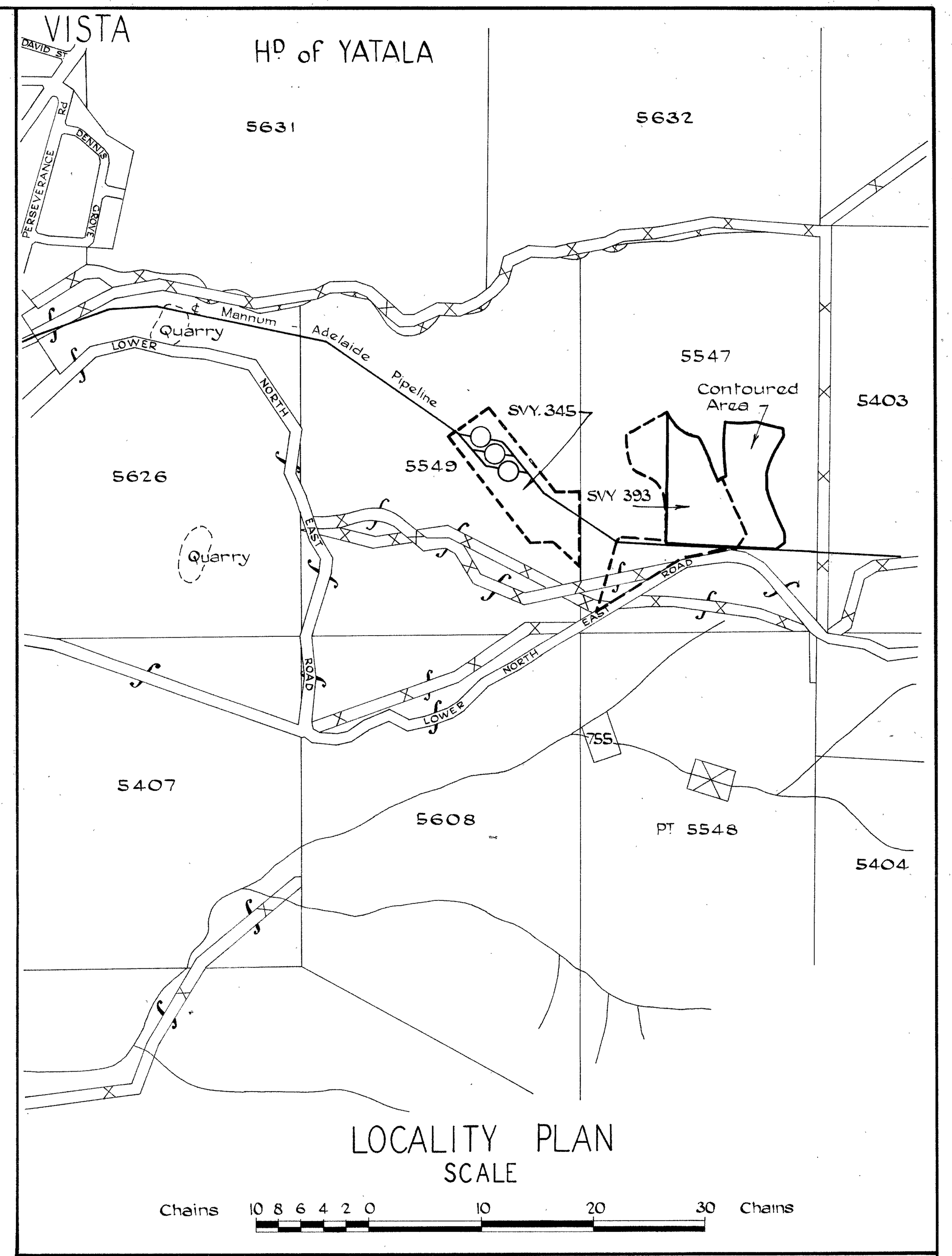


V1 = 410m/s
H1 = 1.75m
H2 = 6.26m
a = 0°
b = 3.0°

V2 = 910m/s
h1 = 1.25m
h2 = 0.18m

V3 = 2864m/s





T.M. COORDINATES		
STATION	COORDS. NORTH	COORDS. EAST
1	6717200·38 y	320676·55y
2	6717274·5	320648·0
3	6717330·5	320617·5
4	6717394·0	320592·5
5	6717455·0	320571·5
6	6717510·0	320589·0
7	6717516·5	320521·0
12	6717431·5	320520·5
13	6717368·0	320561·0
14	6717304·5	320583·0
15	6717241·0	320616·0
16	6717192·0	320615·5
17	6717197·5	320552·0
24	6717363·9	320626·8
25	6717199·5	320750·7
26	6717285·3	320714·8
27	6717371·7	320685·7
28	6717521·5	320677·6

Note: Grid established from station 1 and P.M. 43-810 vide Plan SVY. 345.

CONTOUR PLAN
SCALE
Feet 50 0 50 100 150 Feet

S.A.G.
ENGINEERING AND WATER SUPPLY DEPARTMENT
MANNUM - ADELAIDE PIPELINE
PROPOSED ANSTEY HILL WATER TREATMENT WORKS
CONTOURS OVER SITE FOR SLUDGE LAGOON
SECTION 5547 HUNDRED OF YATALA

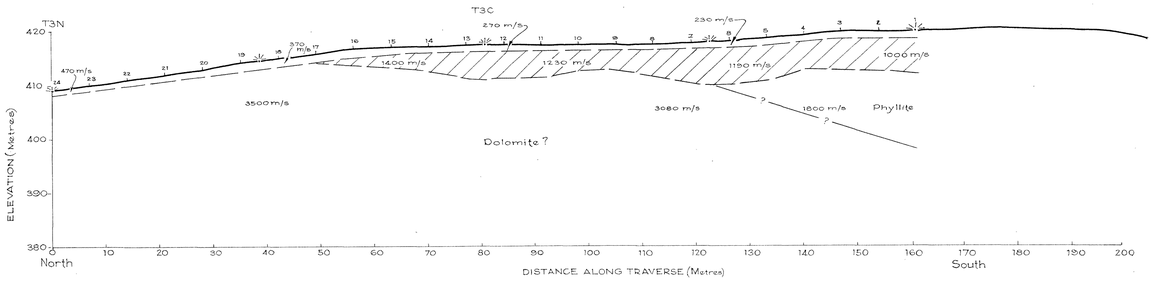
E.W.S. 6581/69
LB 37/69 SB 1/70

SEISMIC REFRACTION SURVEY
ANSTEY'S HILL
LOCATION OF SEISMIC TRAVERSES
S.A. DEPT. OF MINES

SVY. 428
73-484
Ha5

Drawn	A.J.L.	Approved
Traced	A.J.L.	
Checked	B.H.S.	
Date	30-1-1970	Chief Surveyor

TRAVERSE 3



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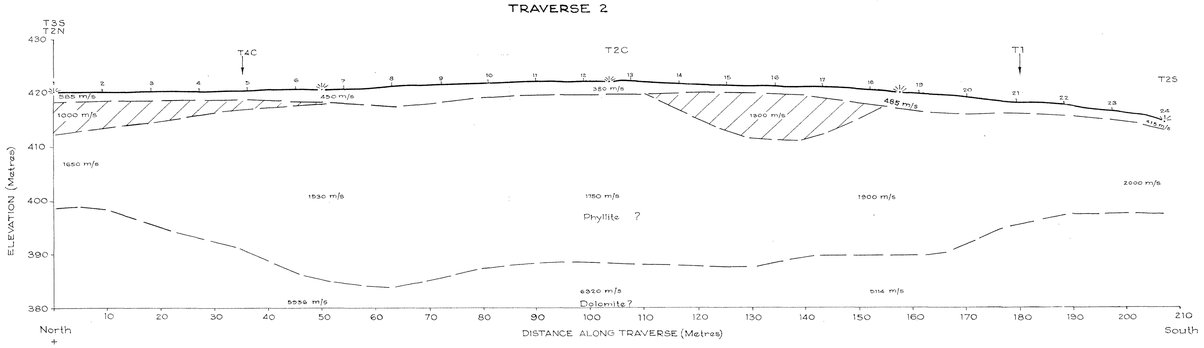
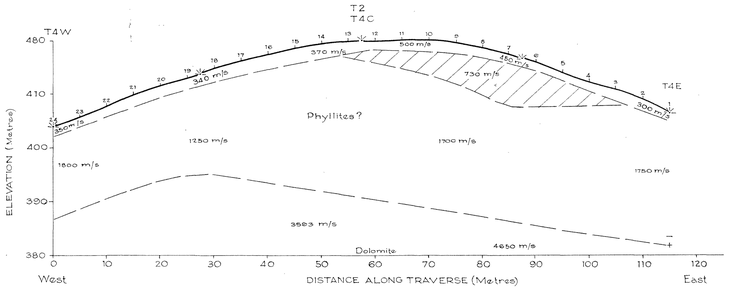
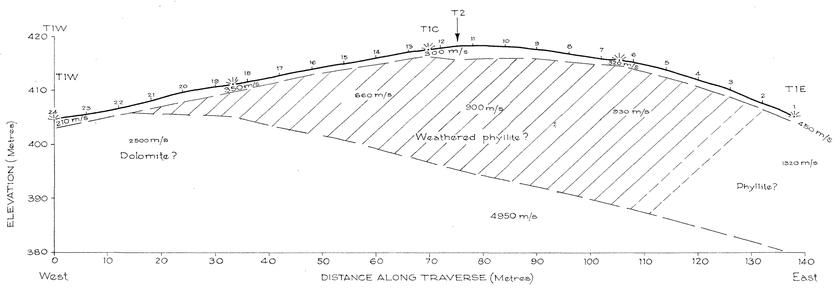


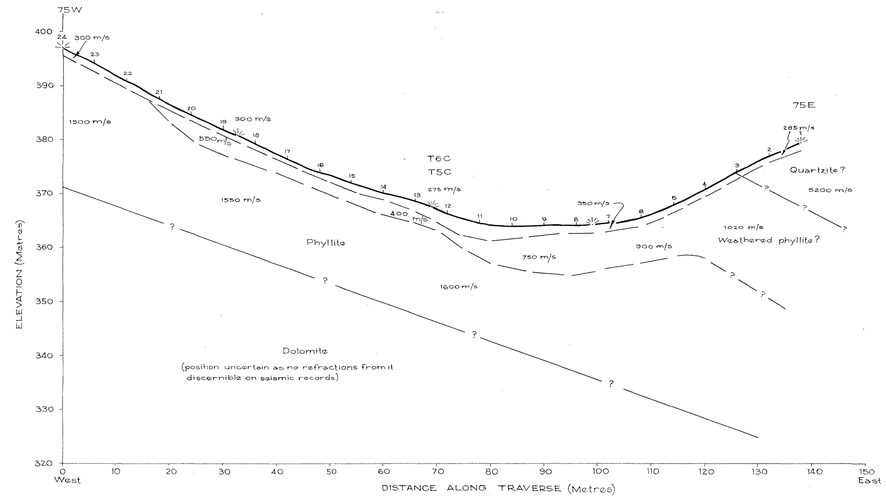
TRAVERSE 4



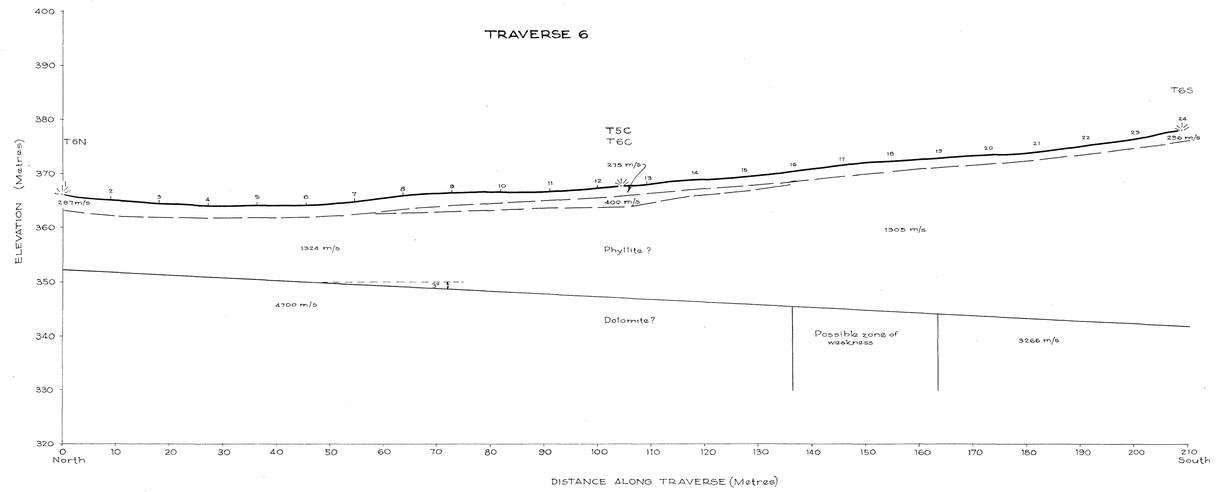
TRAVERSE 1



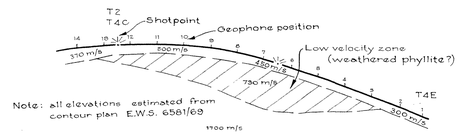
TRAVERSE 5



TRAVERSE 6



LEGEND



Note: all elevations estimated from contour plan E.W.S. 6581/69

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC REFRACTION SURVEY-ANSTEY'S HILL

SEISMIC CROSS-SECTIONS

EXPLORATION GEOPHYSICS SECTION	R. Nelson GEOPHYSICIST	Drn. R. N.	SCALE: 1:500
		Tcd. G.M.	73-480
		Ckd. A.F.	H&S
Director of Mines		Exd.	DATE: 2nd July 1973

ANSTEY'S HILL SEISMIC REFRACTION SURVEY - JUNE ,1973

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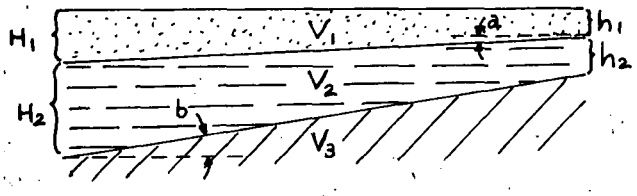

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