ARTIFICIAL LAKE SITE AT MONARTO SEISMIC REFRACTION SURVEY.

(Previous to seismic along full length of Sites 1 and Sites 2.)

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South Australia —

DEPARTMENT OF MINES

SOUTH AUSTRALIA

ARTIFICIAL LAKE SITE AT MONARTO - SEISMIC REFRACTION SURVEY

by

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27th February, 1973

Rept.Bk.No. 73/58
G.S. No. 5065
D.M. No. 740/72

CONTENTS

PLANS

Plan No.	Title	Scale
73-122	Artificial lake site at Monarto. Location of seismic refraction traverses.	1:100 000
73-123	Artificial lake site at Monarto. Section AA'.	As shown
73-124	Artificial lake site at Monarto. Section BB'.	"
73-125	Artificial lake site at Monarto. Section CC'.	"
73-126	Artificial lake site at Monarto. Section DD'.	"

DEPARTMENT OF MINES
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ABSTRACT

Over the site proposed for an artificial lake in the area for which the new city of Monarto is planned seismic refraction traverses were used in an attempt to check bedrock conditions. Shooting conditions were very difficult over most of the area as overburden is very thin. Nevertheless, the results indicate that in some places bedrock may be lower than full storage level, causing leakage problems.

INTRODUCTION

The site proposed for the city of Monarto lies about 3 km north-west of Monarto South. The area investigated is on the western margin of the Murray Basin and is underlain by Cambrian rocks of the Kanmantoo Group.

Covering this bedrock formation is a thin veneer of sediments, notably transgressive Tertiary limestones of the Mannum Formation, some calcrete, and alluvial silts and sands in the valley occupied by Dry Creek and Rocky Gully (see Plan No. 73-122).

The Cambrian rocks are mica schists and fine-grained schistose greywacke and as such could be expected to show some anisotropy as regards seismic velocities. The Tertiary limestones are quite hard, while the calcrete observed was found to be reasonably soft and rubbly.

It is proposed to dam part of the Dry Creek-Rocky Gully valley to produce an artificial lake which will be incorporated into the city centre. The position planned for the dam is shown in Plan No. 73-122.

The aims of the seismic investigation were

(a) to investigate bedrock conditions and thickness of overburden along the dam axis and

(b) to see how viable the seismic refraction method is for determining depths to bedrock along the abutments of the lake.

METHODS USED

The seismic refraction method involves recording the responses of an array of geophones to an impulse transmitted into the ground, generally by means of explosives. The geophones are usually placed in line with measured distances between each geophone and the shotpoint. The recordings are then examined for the first onset of energy and these "first breaks" are plotted against geophone distance from the shotpoint as time-distance curves. These curves can be analysed to give the velocities and thicknesses of various rock layers in the ground beneath the geophone line.

The locations of the seismic traverses are shown in Plan No. 73-122. The instrument used was a Texas Instrument Co. 7000B recording seismograph, which records information from up to twenty-four geophones. Standard seismic refraction geophones were used in in-line spreads with a spacing of 9.14 m (30 ft) between geophones. Shotpoints are shown in the plan. AN60 blasting

gelignite was the explosive used.

RESULTS

Velocities and thicknesses were determined from analysis of the time-distance curves. The reciprocal method reviewed by Hawkins (1961) was used to obtain further information of bedrock relief and velocity.

Section AA' (see Plan No. 73-123)

Traverse AA' was made along the axis of the proposed dam.

The section shows an alluvium filled valley underlain by high velocity bedrock. The alluvial sediments have velocities of the order of 400 m/s and achieve thicknesses of around 4 m near the centre of the traverse. The bedrock refractor has a distinct velocity change about 30 m west of the traverse centre, going from a velocity of 3000 m/s in the west to a velocity of 4900 m/s in the east.

Schist which is exposed on the eastern wall of the valley appears to be weathered to a depth of 3-4 m, the weathered schist having a velocity of 600 m/s. Weathered schist also underlies a thin cover of alluvium in the western end of the traverse: this has a velocity of 1150 m/s and extends to a depth of about 4 m.

Section BB' (see Plan No. 73-124)

The western end of this traverse started at the creek which flows through the valley. Alluvium (and possibly weathered schist) (velocity, 700 m/s) to a depth of 4 m overlies fresh schist

having a velocity of 3700 m/s at this point.

110 m to the east the alluvium thickness increases to 10 m. A band of harder, more resistant bedrock is encountered east of this point. This has a velocity of 6700 m/s and it terminates quite abruptly the gradual thickening of alluvium eastwards from the creek.

Eastwards from here the overburden decreases steadily in thickness from 6 m to where limestones of the Man num Formation crop out.

Shooting from the eastern end of the traverse proved very difficult as the lack of soil cover over the hard limestones made tamping of the shots almost impossible. The resulting records were very poor, with many traces untimeable. It was only after reshooting a number of times that an acceptable record was obtained.

The time-distance curve for this is shown in Plan No. 73-124

An initial velocity of 1800 m/s is associated with the limestone. This is appeared to be followed at 9.4 m by a 2200 m/s layer which could be either harder limestone or else weathered schist. At a depth of 38 m, having a velocity of 4100 m/s, lies what is probably unweathered schist.

Because of the poor quality of the records obtained, this interpretation should be checked by drilling.

Section CC' (see Plan No. 73-125)

This traverse was made at right angles to traverse BB' at its eastern end in order to check the depths and velocities

obtained in that traverse. The distance between geophones was reduced from 9.14 m (30 ft) to 1.53 m (5 ft) so that any subtle changes in velocity might be more easily detected. Three geophone spreads were required to complete the traverse, which was shot from both ends.

The limestone appears again as a layer with a velocity of 1300 m/s and a thickness of 9.4 m. It is underlain by a layer with a velocity of 2550 m/s, which is probably slightly weathered schist. The traverse does not extend far enough for the 4100 m/s layer detected in traverse BB' to manifest itself on the time-distance curve.

At the northern end of this traverse the 1300 m/s limestone layer grades into a 900 m/s layer, which is probably calcrete. The transition boundary is probably near the position shown.

Section DD' (see Plan No. 73-126)

As in section AA' the western end of this traverse is underlain by a thin cover of alluvial overburden, followed by weathered schist (1550 m/s). Unweathered schist with a velocity of 4250 m/s lies at a depth of 10-11 m.

Alluvial overburden (730-750 m/s) occupies the valley at the traverse centre to a maximum depth of 10 m.

At the eastern end, a layer of calcrete (1000 m/s) appears. It is probable that this is underlain by weathered schist or limestone, but the velocity contrast may be so small that the boundaries may be undetectable. All that can be safely said is that this 1000 m/s zone extends to a depth of 6.7 m at

this point, where it is followed by fresh schist (4250 m/s).

CONCLUSIONS

Cambrian bedrock consisting of schists and greywackes of the Kanmantoo Group, which underlies more recent sediments in this area, has seismic velocities which vary in the range 3000 m/s - 4900 m/s, with occasional hard bands at 6700 m/s. In many places it has undergone physical and chemical weathering to depths of 4 m or more.

Tertiary limestone of the Mannum Formation, which overlies the bedrock in places, has a velocity range of 1300 - 1800 m/s. Where exposed, it is hard and undiggable. At the western end of traverse BB' its thickness appears to be 9.4 m, which would place its base below full storage level.

Near the centre of the valley, the maximum thickness of alluvial overburden increases from about 4 m on the dam axis to 10 m on traverses BB' and DD' (upstream).

RECOMMENDATION

A drill hole is recommended at the intersection of traverses BB' and CC' to see if, as the results of these two traverses suggest, the limestone does have a thickness in excess of 9 m here.

27th February, 1973

R.G. NELSON
GEOPHYSICIST

REFERENCE

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

N

MURRAY BRIDGE – ONKAPARINGA PIPELINE

FULL STORAGE LEVEL OF LAKE (90m CONTOUR)

D' C' B' C D B A A'

Dry Creek

AXIS OF PROPOSED DAM

95 90 85

Rocky Gully

PRINCES HIGHWAY

To Murray Bridge

SCALE

METRES 500 0 500 1000 METRES

LEGEND

D D' — Seismic traverse : direction of Section DD'

90 — Surface contour in metres (Datum – Sea level)

Railway

Minor roads and tracks

Buildings

Fence

NOTE: This plan compiled from State Planning Office air photo maps no 6727-9 & 6727-12

FIG.

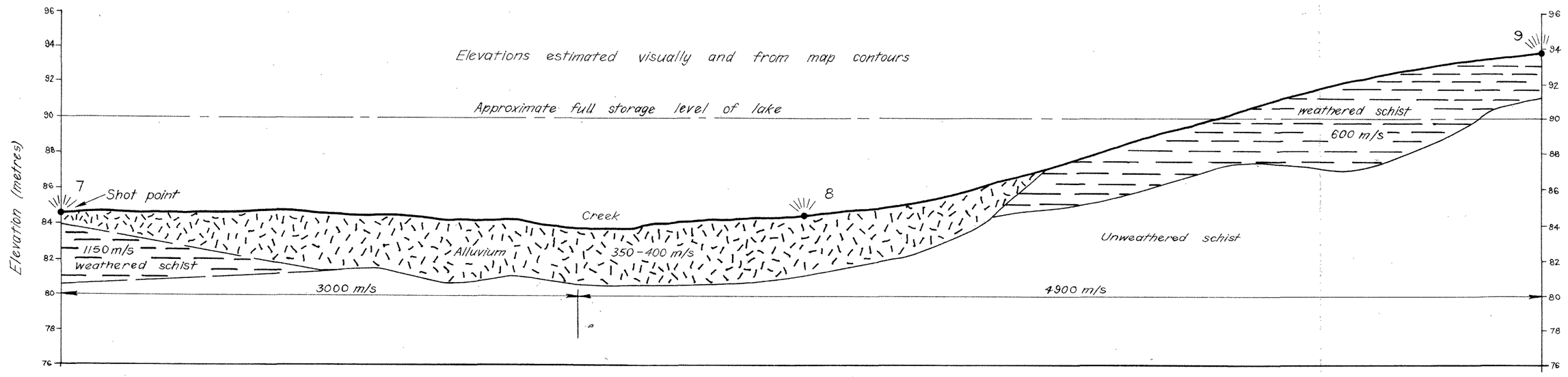
DEPARTMENT OF MINES — SOUTH AUSTRALIA

ARTIFICIAL LAKE SITE AT MONARTO

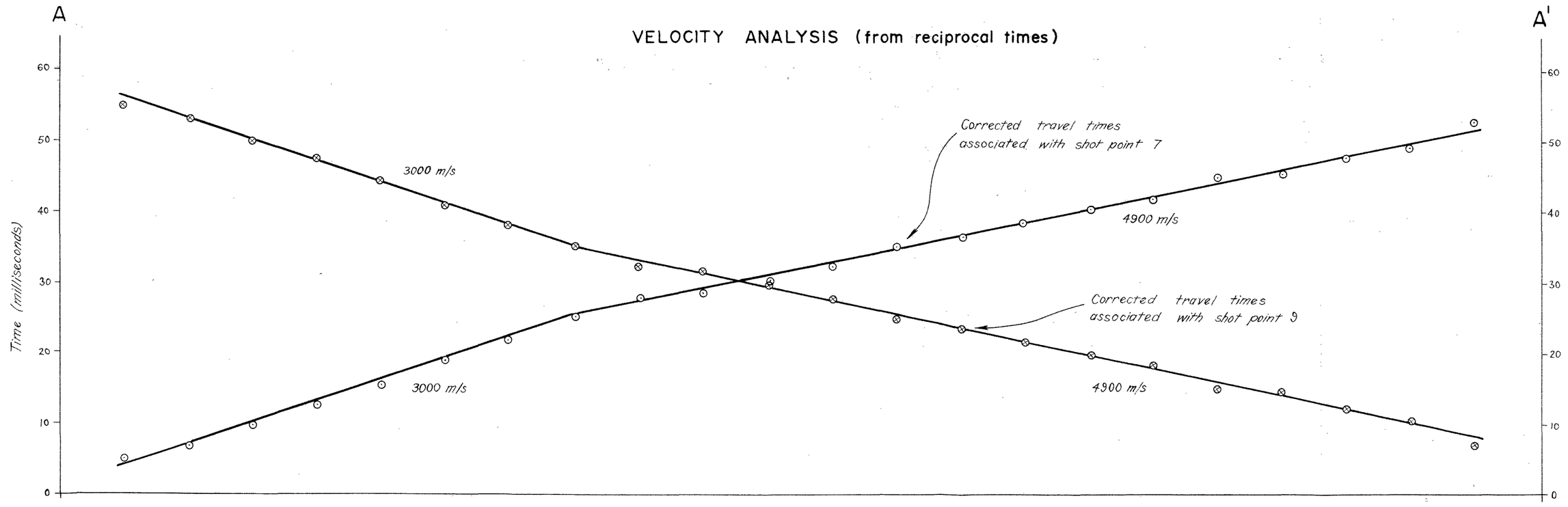
LOCATION OF SEISMIC REFRACTION TRAVERSES

EXPLORATION GEOPHYSICS SECTION	GEOPHYSICIST	Drn. R.N.	SCALE: 1:10000 Orig.
		Tcd. D.J.M.	73-122 Hb7
Director of Mines		Ckd. L.V.W.	
		Exd.	DATE: 20 Feb. 1973

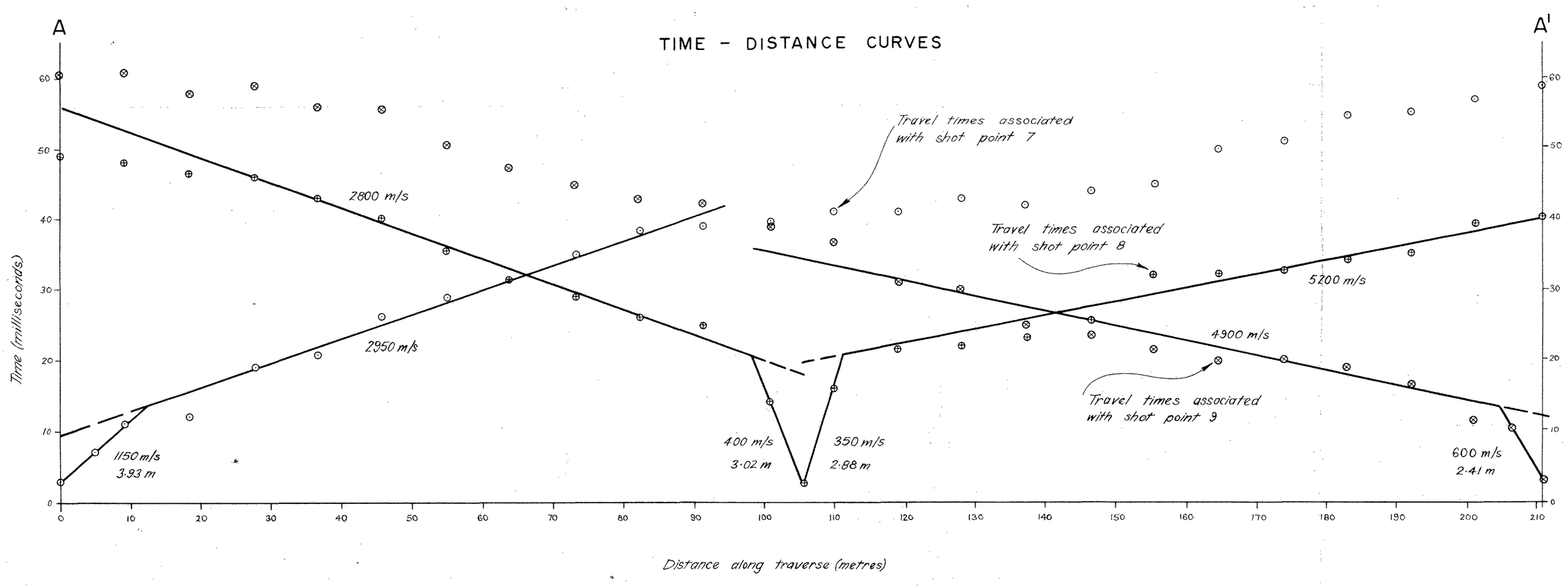
INTERPRETED CROSS-SECTION AA', looking north



VELOCITY ANALYSIS (from reciprocal times)



TIME - DISTANCE CURVES



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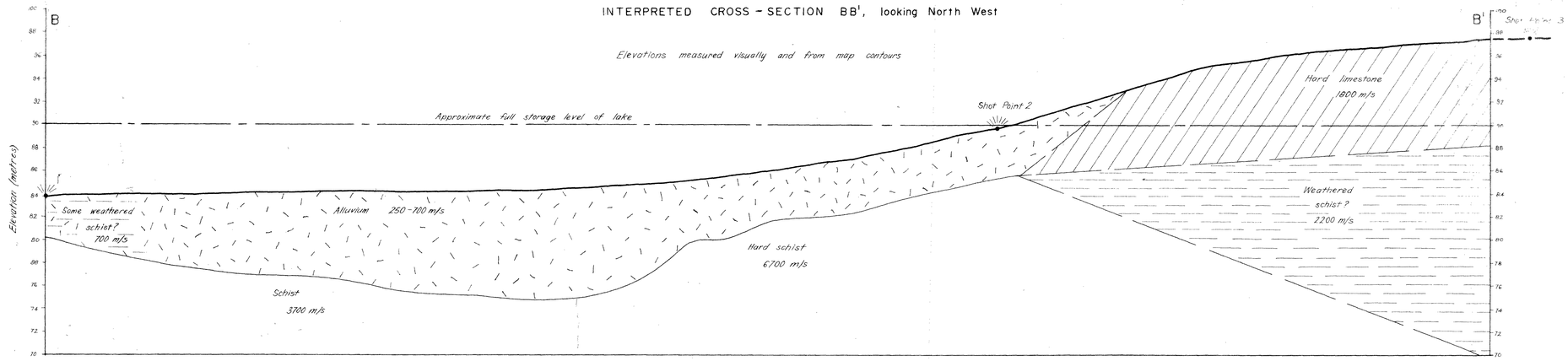
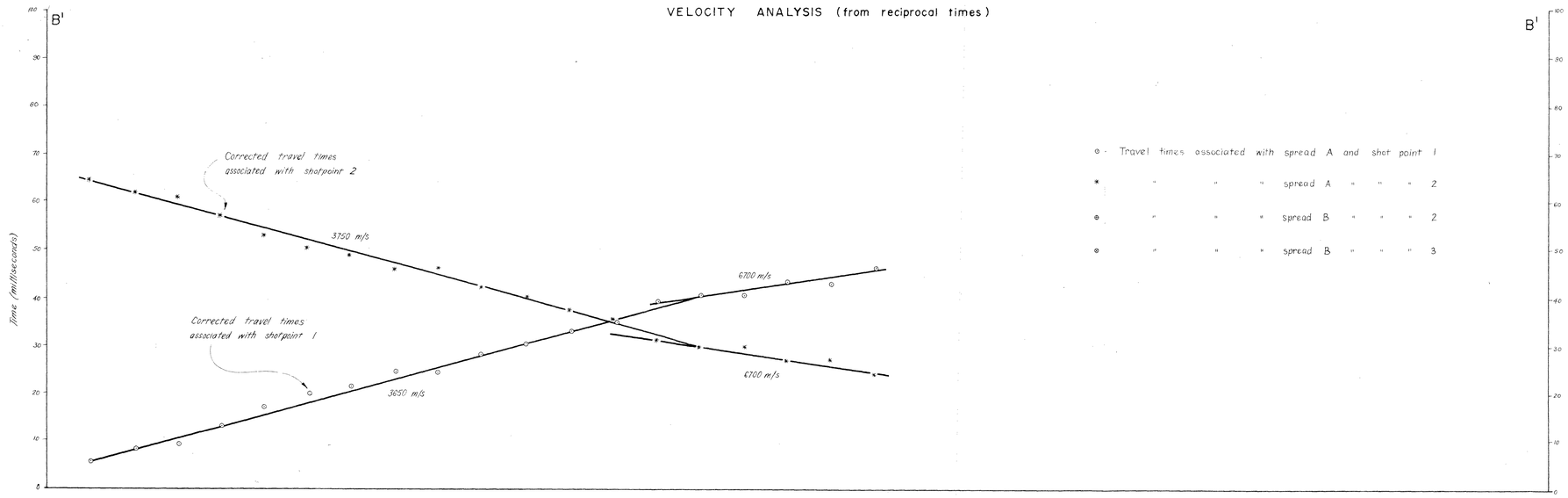
ARTIFICIAL LAKE SITE AT MONARTO
SECTION AA'

EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: 1:500 Horizontal
		Tcd. D.J.M.	73-123
		Ckd. L.W.W.	Hb7
Director of Mines		Exd.	DATE: 22 Feb. 1972

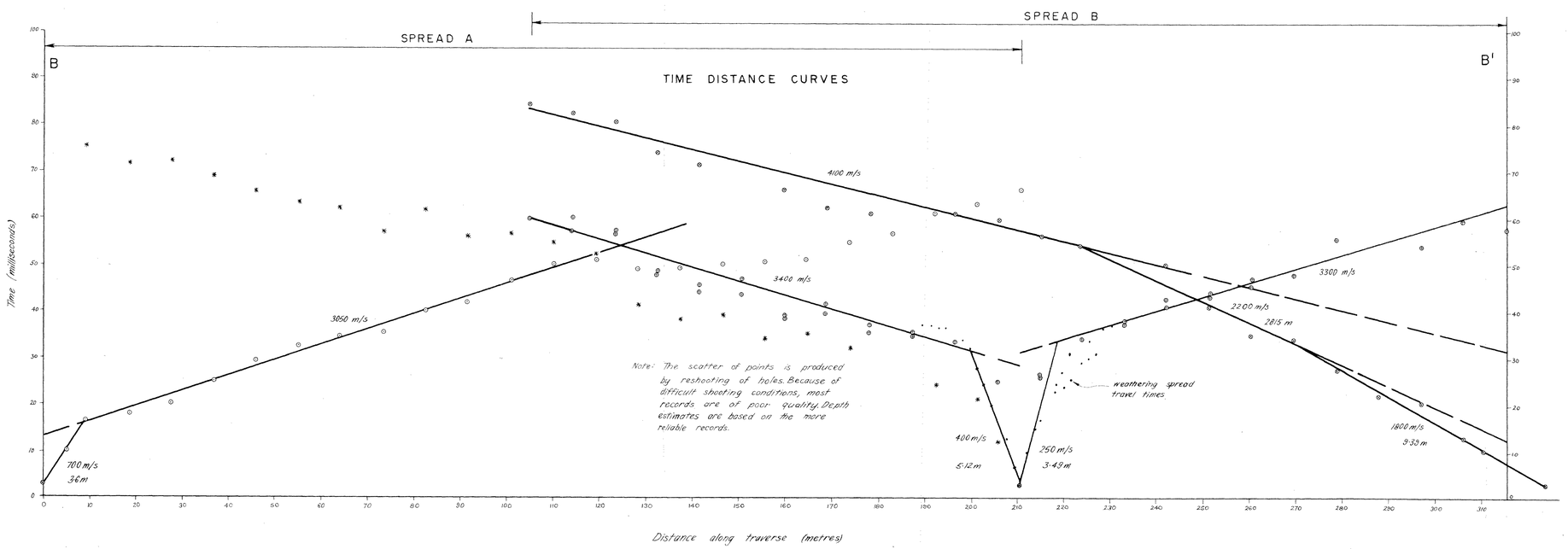
INTERPRETED CROSS - SECTION BB', looking North West



VELOCITY ANALYSIS (from reciprocal times)

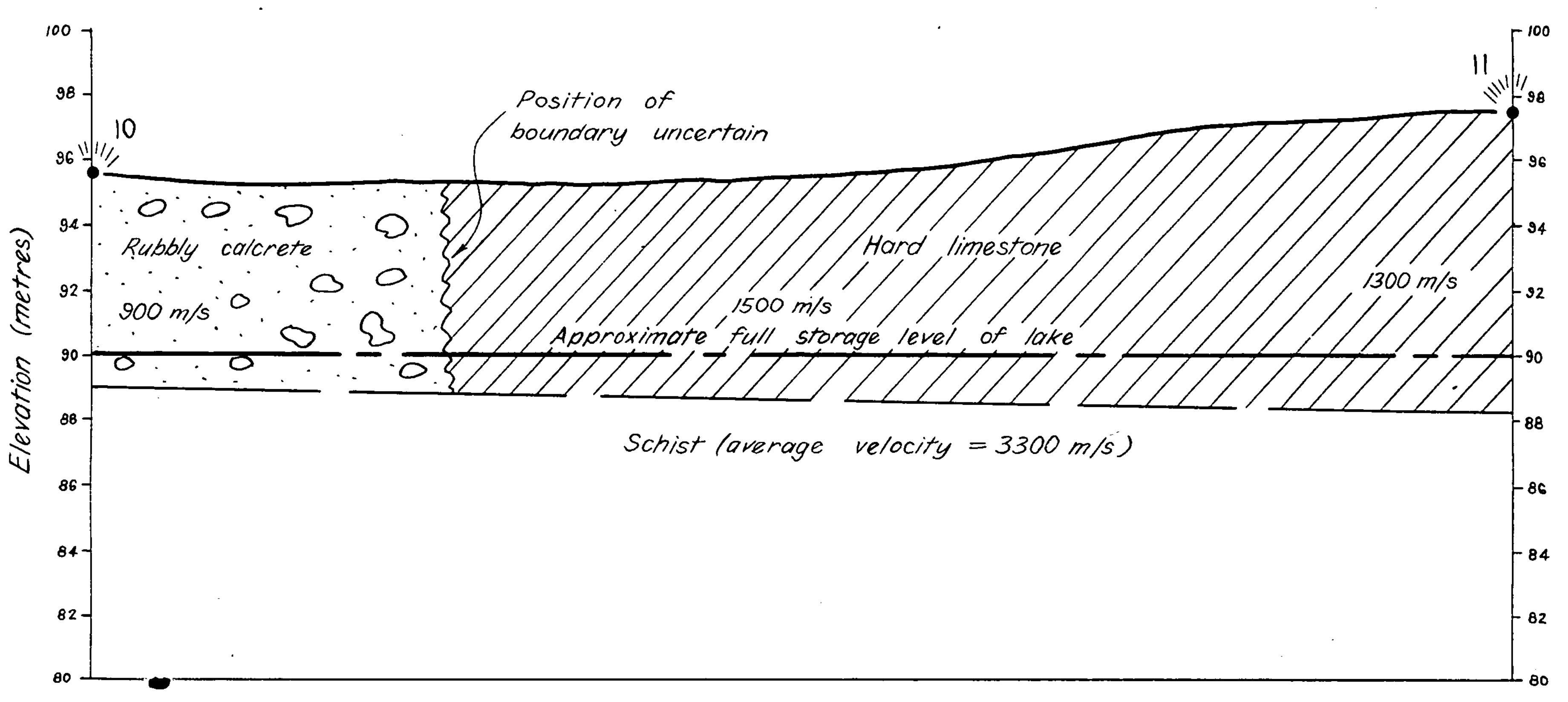


TIME DISTANCE CURVES

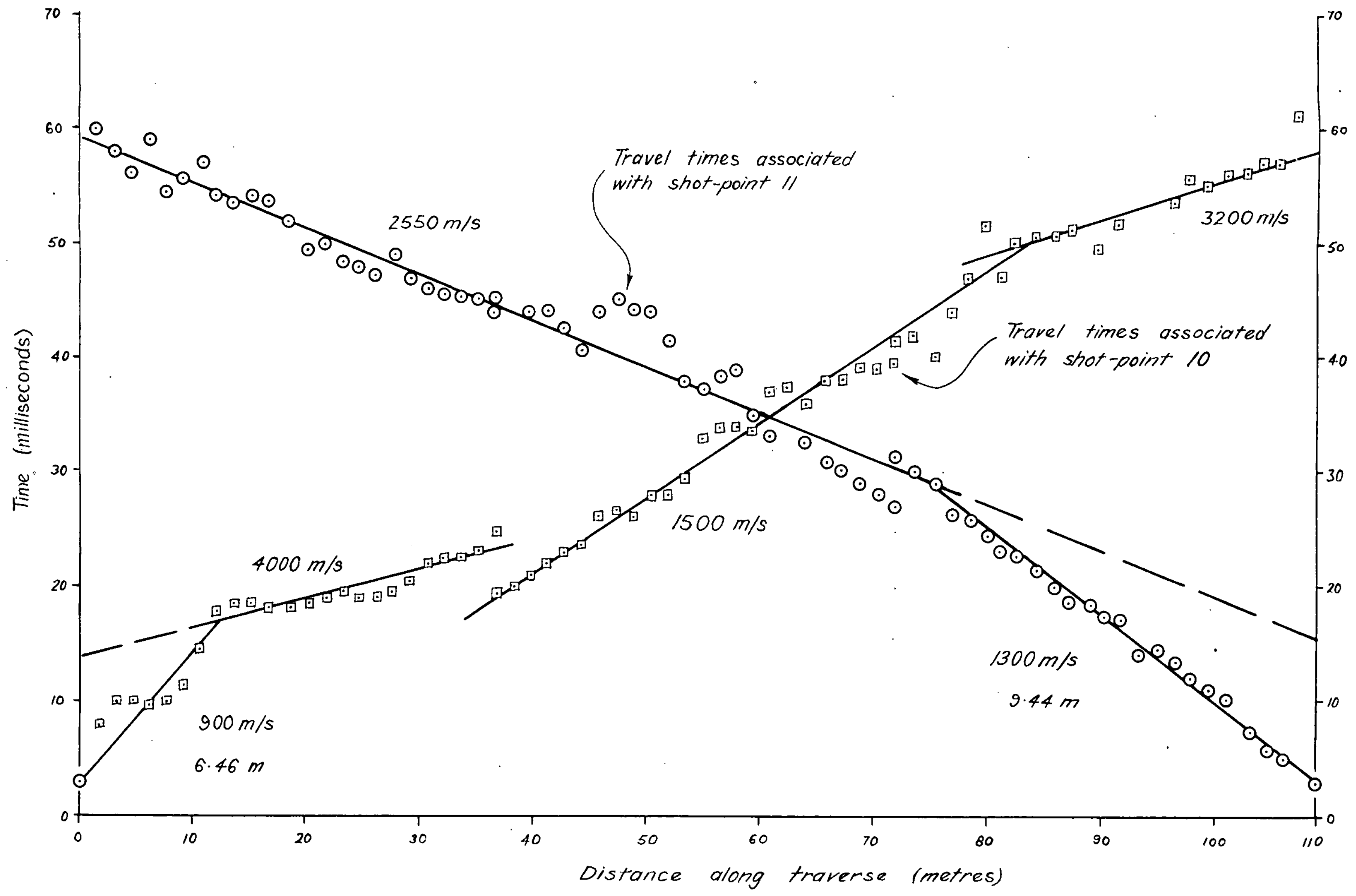


DEPARTMENT OF MINES — SOUTH AUSTRALIA			
ARTIFICIAL LAKE SITE AT MONARTO SECTION BB'			
EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: 1:500 Horizontal
		Tcd. D.M.	73-124
		Ckd. L.V.W.	Hb7
Director of Mines		Exd.	DATE: 26 Feb. 1973

C INTERPRETED CROSS-SECTION CC', looking north east C'



C TIME – DISTANCE CURVES C'



EXPLORATION GEOPHYSICS SECTION

Compiled: R. Nelson

Drn. D.J.M. Ckd. L.V.W.

DEPARTMENT OF MINES – SOUTH AUSTRALIA

ARTIFICIAL LAKE SITE AT MONARTO

SECTION CC'

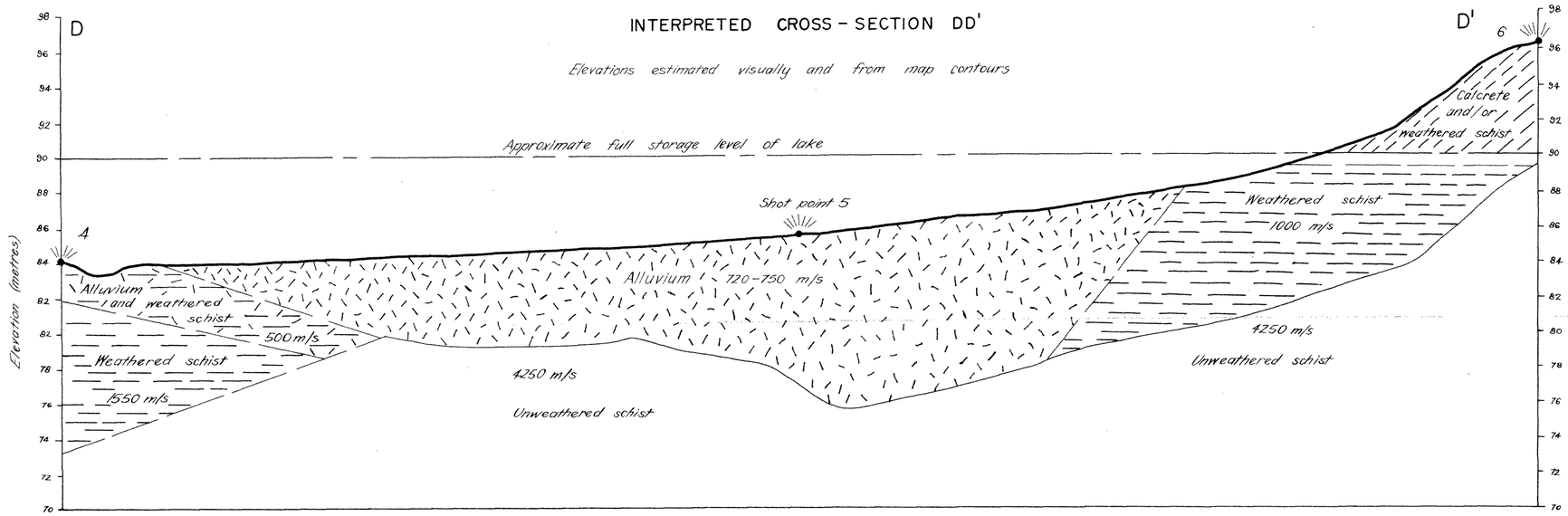
Scale: 1:500 Horiz.

Date: 21 Feb. 1973

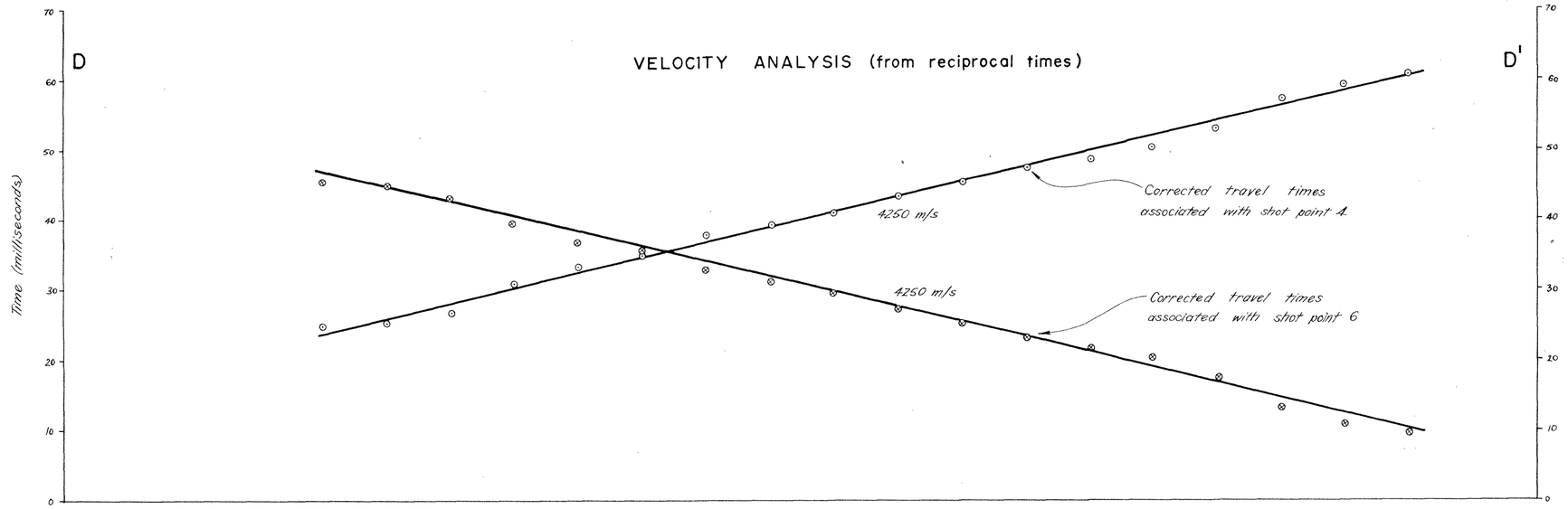
Drg. No. 73-125 Hb7

INTERPRETED CROSS – SECTION DD'

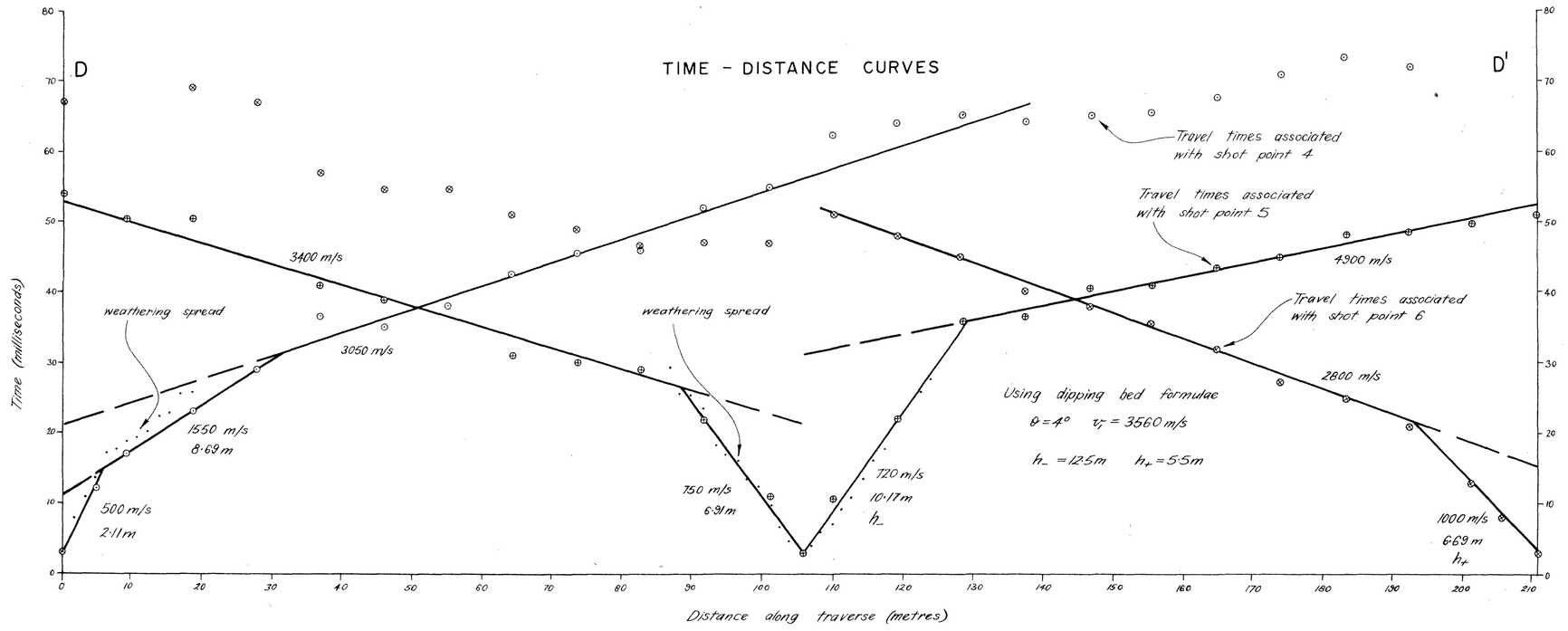
Elevations estimated visually and from map contours



VELOCITY ANALYSIS (from reciprocal times)



TIME – DISTANCE CURVES



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ARTIFICIAL LAKE SITE AT MONARTO
SECTION DD'

EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: 1:500 Horizontal
		Tcd. D.J.M.	73-126
		Ckd. L.V.W.	Hb7
Director of Mines		Exd.	DATE: 23 Feb 1973