

ENG. GEOLOGY SECTION



LITTLE PARA DAM - OUTLET TOWER
AND CONTROL HOUSE

Hds. Yatala and Munno Para

REPORT ON FOUNDATION EXCAVATIONS

CLIENTS: ENGINEERING AND WATER SUPPLY DEPARTMENT

J.C. BEAL

Department of Mines
South Australia —

64-38 74/24

DEPARTMENT OF MINES
SOUTH AUSTRALIA

LITTLE PARA DAM - OUTLET TOWER AND CONTROL HOUSE

Hds. of Yatala and Munno Para

REPORT ON FOUNDATION INVESTIGATIONS

Client: Engineering & Water Supply Department

by

J.C. BEAL
GEOLOGIST

ENGINEERING GEOLOGY

Rept.Bk.No. 74/24
G.S. No. 5340
D.H. No. 624/72
Eng. Geol. No. 1964/38

24th January, 1974

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REPORT ON FOUNDATION INVESTIGATION

- Engineering & Water Supply Department

SUMMARY AND CONCLUSIONS

Field Investigations for the Outlet Tower and Control House foundations show sound bedrock underlying hillside material and alluvium up to 5 m thick. The bedrock should provide acceptable foundation conditions.

However, the following points are suggested:

- Removal of all alluvium including a possible old river channel located during a seismic survey.
- Removal or bolting of unstable blocks along the quartzite cliff face.
- Assessment of rock quality at depths beneath outlet tower prior to grouting and anchoring tie wires.

INTRODUCTION

Following a request from the Engineering and Water Supply Department, field work was carried out at the Outlet Tower and Control House sites to ascertain foundations conditions.

As these two structures are part of the same water outlet system it has been decided to combine results of the investigation into one report.

SITE GEOLOGY

Outlet Tower

The geology of the area adjacent to the proposed outlet tower has previously been mapped in detail (Report Book No. 73/310).

Upon the removal of 1 m - 3 m of overlying alluvial and hillside material the tower will site upon MS-S, (MW) - (SW)*; dolomite, Unit 13. The overall rock quality to be expected beneath the outlet Tower should provide adequate foundation for proposed construction work†.

Quartzite (Unit 12) is approx. 15 m thick, VS - S; (SW) - (MW) and is found beneath the dolomite at depths below the base of the alluvials ranging from 0.5 m - 3.0 m. Both the dolomite and quartzite dip approximately 30° eastwards (see Figs. 1, 2 and 5).

The contact between Unit 13 and 12 appears basically sound although some slip may have occurred along this contact during tectonic activity in the past. Where the contact approaches river level some increased weathering along the contact may be expected. Also here the dolomite is at its minimum thickness and the rock quality should be carefully examined following the removal of alluvium and prior to establishing the outlet tower foundations.

The contact between the base of quartzite Unit 12 and the shaly dolomite, Unit 11, has been shown to be the site of cavity formation and intensive weathering of the shaly dolomite.

Drillhole No.5 is currently showing Artesian pressure, the later probably derived from a head of water formed by waters collecting at a higher level and running down the contact of Units 12 and 11.

Cohesion across this contact may be assumed to be nil. This should be noted when designing anchorage for the outlet tower.

* See Appendix A: Soil and Rock Classifications.

† For rock strength and specific gravity values see table I and Table II.

Grouting in the vicinity of this contact may be in order prior to the establishment of the tower anchors.

An attempt has been made to show diagrammatically (Fig.3) the dimensions and form of expected fracture-joint blocks occurring within Quartzite Unit 12.

The joints exposed in the quartzite at river level on the right hand side of the creek are discontinuous, tightly closed and spaced 50 cm - 1.0 m apart. In the lower flaggy half of the unit the joints occur with increased frequency and the bedding planes are more strongly defined. This results in less massive unit blocks.

The photograph of DH5 (Report Book No. 73/310. Appendix II photograph 15) suggests that between depths 7.50 m and 16.20 m fractures are 30 cm to 70 cm apart but because this is an angled borehole they may represent fracturing along bedding planes resulting from drilling and therefore only one true joint may have been intersected, this at 10.00 m dipping at approx. 75°.

Short anchorage ties may be grouted in the sound quartzite between EL95 and EL86 (along the centre line of the outlet tower) and longer ones taken preferably 3 - 4 m beneath the Unit 12 - Unit 11 contact.

Control House

The proposed alignment for the downstream outlet structure including the wall, the control house, stilling basin and selective water outlet pipe traverses in the main alluvials of the Little Para River (See Figures 1 and 2).

Four metres at the eastern end of the alignment at EL101.7 traverses shaly dolomite which outcrops immediately beneath the base of the quartzite cliff; the western end traverses hillside debris and alluvials.

Excavation in the order of 5 m will be required at the eastern end down to EL99 (proposed EL base of outlet duct). The dolomite is S - W; (HW) - (MW) and should be sufficiently fissile

to facilitate easy ripping. However, the more weathered massive dolomite does not show open fractures and difficulty in ripping may be encountered.

The upper part of the quartzite cliff face (Unit 12) is fractured by jointing into large slabs of the order 3 m x 2 m x 0.7 m. These slabs are supported by the underlying flaggy quartzite (See cross section B - B. Fig.2). Removal of the looser boulders and/or pinning with rock bolts is strongly recommended, in particular to protect the control house (See Report Book No. 73/274; Geological Investigations - Outlet Duct Alignment).

A seismic refraction survey (See Appendix B) suggests the possible presence of a water filled pebble bed (old river channel?) lying beneath 4 m of alluvium. Examination of this pebble bed, (Approx. 5m x 7m cross section, of unknown depth) and lateral extent as a possible leakage path should be undertaken. It is also possible that saturation of the downstream toe of the dam may result if the channel is only partially excavated and the foundations for the downstream wall placed adjacent to the channel.

The seismic survey indicates the presence of lower velocity material occurring towards the northern end of the spreads. This may suggest the presence of a fault zone or deterioration of rock quality between the dolomite/quartzite contact.

This contact has not been delineated and the occurrence of cavities and highly weathered dolomite along this contact should be kept in mind.

The right hand side of the valley is basically the dip slope of the strata and any excavation into the hillslope will consequently reduce the stability of uphill rock units and hillside debris.

This will be true for excavation along the western extremities of the Control House alignment and during cutting of the access road.

Approximately six metres of fill upstream of the concrete facing of the wall will be required to build up the platform from bedrock to reach EL. 104.3, the proposed height of the wall.

Overall, the rock quality to be expected beneath the Control House and wall should prove adequate for foundation for the proposed construction work.

J.C. Beal.

J.C. BEAL
GEOLOGIST

24th January, 1974
JCB:TG

REFERENCES

- Beal, J.C., 1973. Little Para Dam - Outlet Duct Alignment. Report on Geological Investigations. S.A. Dept. Mines Rept. Bk. No. 73/274.
- Beal, J.C., 1974. Little Para Dam - Detailed Geological Mapping of the Grout Cap Alignment Hd. Yatala - Munno Para. S.A. Dept. Mines Rept. Bk. No. 73/310.

APPENDIX A

Soil and Rock Classification

ENGINEERING CLASSIFICATION OF ROCK MATERIAL

1. ROCK CONDITION

| TERM | ABBRN | DEFINITION |
|----------------------|-------|---|
| Fresh | (F) | No weathering effects visible to naked eye. |
| Weathered | (W) | Shows visible effects of chemical decomposition caused by air and groundwater. Can be subdivided: |
| Slightly weathered | (SW) | - change in appearance but no loss in strength |
| Moderately weathered | (MW) | - change in appearance but with significant loss in strength. |
| Completely weathered | (CW) | - has soil properties and often shows complete change in appearance. |
| Altered | (A) | Shows chemical and physical alteration to rock fabric caused by temperature, pressure or injection of other material. |

2. ROCK STRENGTH

Can be correlated with unconfined compressive strength tested in the laboratory.

| TERM | ABBRN | Kg cm ² (p.s.i.) | FIELD TEST |
|---------------|-------|--------------------------------|--|
| Very weak | VW | 70 (1 000) | Breaks and crumbles easily in the hands. |
| Weak | W | 70-200 (1 000-3 000) | Breaks easily with hammer (Normal tap. |
| Medium strong | MS | 200-700 (3 000-10 000) | Rings and breaks to firm hammer blow (range of concrete) |
| Strong | S | 700-1 800 (10 000-25 000) | (Very difficult to break with hammer |
| Very strong | VS | >1 800 (>25 000) | (and requires sledge |

3. USE OF CLASSIFICATION

Note that Condition and Strength terms do not necessarily correspond.

Strength depends on the type of rock while condition depends on external effects, e.g.

| <u>Rock Material</u> | <u>Condition</u> | <u>Strength</u> |
|----------------------|------------------|-----------------|
| Granite | Fresh | Strong |
| Schist | Fresh | Weak |

ENGINEERING CLASSIFICATION OF SOILS

The Unified Soil Classification System

| COARSE-GRAINED SOILS <small>More than 50% of materials larger than No. 200 U.S. sieve size</small> | FIELD INVESTIGATION PROCEDURES <small>Excluding particles larger than 7.5cm and basing fractions on estimated weights</small> | | | | | | GROUP SYMBOL | GROUP NAME <small>and typical materials</small> | | LABORATORY CLASSIFICATION CRITERIA | | | | |
|---|--|---|--|---|----|--|--|--|---|--|--|--|--|--|
| | | | | | | | | | | | | | | |
| GRAVELS <small>More than 50% of the coarse fraction is larger than 2mm. (retained on B.S.7 sieve)</small> | CLEAN GRAVELS <small>Little or no fines</small> | Wide range in grain sizes, and substantial amounts of all intermediate particle sizes | | | | GW | GRAVEL, well graded; gravel sand mixtures, little or no fines | <small>Coarse-grained soil classified on basis of percentage of fines, as follows</small> PERCENT OF FINES GW SP Less than 5 GM GP More than 12 SM SC 5 to 12 Borderline cases use 2 symbols | <small>Grain size curves to be used to identify soil fractions</small> | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ Between 1 and 3 | | | | |
| | | DIRTY GRAVELS <small>Appreciable amount of fines</small> | Predominantly one size or a range of sizes, with some intermediate sizes missing | | | | GP | | | GRAVEL, poorly graded; gravel sand mixtures, little or no fines | <small>Not meeting all gradation requirements for GW</small> | | | |
| | DIRTY GRAVELS <small>Appreciable amount of fines</small> | | Non-plastic fines—for identification see ML below | | | | GM | | | GRAVEL, excess silty fines; poorly graded gravel-sand-silt mixtures | <small>Atterberg limits below "A" line or PI less than 4</small> | <small>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</small> | | |
| | | DIRTY GRAVELS <small>Appreciable amount of fines</small> | Plastic fines—for identification see CL below | | | | GC | | | GRAVEL, excess clayey fines; poorly graded gravel-sand-clay mixtures | <small>Atterberg limits below "A" line or PI greater than 7</small> | <small>4 and 7 are borderline cases requiring use of dual symbols</small> | | |
| | SANDS <small>More than 50% of the coarse fraction is smaller than 2mm. (passing B.S.7 sieve)</small> | | CLEAN SANDS <small>Little or no fines</small> | Wide range in grain sizes, and substantial amounts of all intermediate particle sizes | | | | | | SW | SAND, well graded; well graded sands, gravelly sands, little or no fines | <small>Coarse-grained soil classified on basis of percentage of fines, as follows</small> PERCENT OF FINES GW SP Less than 5 GM GP More than 12 SM SC 5 to 12 Borderline cases use 2 symbols | <small>Grain size curves to be used to identify soil fractions</small> | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ Between 1 and 3 |
| | | DIRTY SANDS <small>Appreciable amount of fines</small> | | Predominantly one size or a range of sizes, with some intermediate sizes missing | | | | | | SP | SAND, poorly graded; poorly graded sands, gravelly sands, little or no fines | | | <small>Not meeting all gradation requirements for SW</small> |
| DIRTY SANDS <small>Appreciable amount of fines</small> | Non-plastic fines—for identification see ML below | | | | SM | SAND, excess silty fines; poorly graded sand-silt mixtures | <small>Atterberg limits below "A" line or PI less than 4</small> | <small>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</small> | | | | | | |
| | DIRTY SANDS <small>Appreciable amount of fines</small> | Plastic fines—for identification see CL below | | | | SC | SAND, excess clayey fines; poorly graded sand-clay mixtures | <small>Atterberg limits below "A" line or PI greater than 7</small> | <small>4 and 7 are borderline cases requiring use of dual symbols</small> | | | | | |

| FINE-GRAINED SOILS <small>More than 50% of material is smaller than No. 200 U.S. sieve size</small> | FIELD INVESTIGATION PROCEDURES <small>on fraction smaller than 0.4mm. (passing B.S. 36 sieve)</small> | | | | | | | GROUP SYMBOL | GROUP NAME <small>and typical materials</small> |
|---|--|--|-------------------|--------------------|------------------------|---|----|---|--|
| | | | | | | | | | |
| SILTS AND CLAYS <small>Liquid limit less than 50</small> | SOIL CAST (soil wet) | SOIL THREAD | SHINE | DILATANCY | ODOUR | DRY STRENGTH | ML | SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour | |
| | Forms fragile cast Cracks form when kneaded while moist | Thread crumbly, breaks easily, breaks | None to very dull | Distinct | Not significant | None to slight | CL | CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clay, sand, clays, silty clays, lean clays | |
| | Cast may be handled freely without breaking Can be kneaded moist without cracking Material adheres to the hand | Thread can be powdered as fine as a "lead pencil" but is fragile | Moderate | None to slight | Not significant | Moderate | OL | ORGANIC SOIL, low plasticity; organic silts and silt clays of low plasticity | |
| SILTS AND CLAYS <small>Liquid limit more than 50</small> | Cast fragile to cohesive; material will adhere somewhat to the hand | Soft, weak thread | None to very dull | Slight to distinct | Decayed organic matter | Low | MH | SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | |
| | Moderately plastic and cohesive Material adheres somewhat to the hand | Weak to medium thread; may be crumbly | Dull | None to slight | Not significant | Moderate Powdered soil feels fibrous | CH | CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays | |
| | Very plastic and cohesive Material very sticky to the hand Greasy to touch | Very tough thread, can be rolled to a pin point | Very glossy | None | Strong earthy | High to very high Cannot be powdered to finer pressure | OH | ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity | |
| Plastic and cohesive Feels slightly spongy Greasy to touch | | | | | | | PI | PEATY SOIL; Peat and other highly organic soils | |
| <small>Readily identified by colour, odour, spongy feel and frequently by fibrous texture</small> | | | | | | | | | |

NOTE: BOUNDARY CLASSIFICATIONS: Soil possessing characteristics of two groups are shown as a combination of two group symbols, eg. GW-GC, well graded gravel with clay binder.

Based on "The Unified Soil Classification System" United States Department of the Interior, Bureau of Reclamation "Earth Manual" First Edition, Denver COLORADO 1950.

PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

APPENDIX B

**Report on Seismic Refraction
Survey at Little Para Dam.**

DEPARTMENT OF MINES
SOUTH AUSTRALIA

REPORT ON SEISMIC REFRACTION SURVEY

AT LITTLE PARA DAM SITE

Client: Engineering and Water Supply Department

by

R.A. GERDES

ASSISTANT SENIOR GEOPHYSICIST

EXPLORATION GEOPHYSICS SECTION

17th July, 1973

Rept. Bk. No. 73/174
G.S. No. 5179
D.M. No. 627/72

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| INTRODUCTION | 1 |
| SURVEY PROCEDURES AND RESULTS | 2 |
| INTERPRETATION | 2 |
| CONCLUSIONS | 2 |
| REFERENCES | 3 |

PLATES

| <u>Drawing No.</u> | <u>Title</u> | <u>Scale</u> |
|--------------------|---|--------------|
| 73-502 | Little Para Dam Seismic Survey Locality Plan | 1:2000 |
| 73-503 | Little Para Dam Interpretated cross sections of seismic spreads 1 and 2 | 1:300 |

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept. Bk. No. 73/174

G.S. No. 5179

D.M. No. 627/72

REPORT ON SEISMIC REFRACTION SURVEY
AT LITTLE PARA DAM SITE

Client: Engineering and Water Supply Department

ABSTRACT

A refraction seismic survey was conducted on the west bank of the Little Para Creek at the proposed Dam site.

The interpreted bedrock profile indicates a very shallow basement with little relief variations. Possible old channels have been resolved.

INTRODUCTION

This seismic refraction survey was requested by the Engineering Geological Section of the South Australian Geological Survey for the South Australian, Engineering and Water Supply Department.

The purposes of this survey was to locate the depth to, and velocity of the bedrock; and the thickness and velocity variations of the overburden. The location of this site is shown in drawing No. 73-502.

The survey was carried out by R. Turner (Senior Technical Officer) and R. Beech (Technical Officer) of the Exploration Geophysics Section on the 10th July, 1973.

SURVEY PROCEDURES AND RESULTS

A S.I.E. P19, 12 channel recording seismograph, mounted in a landrover was used to record the first arrivals at the geophones for a conventional spread arrangement. The geophone spacing was 10 feet (3.048 metres). Shots were fired at the centre, at approximately 1.52 m off the extremities, and at equidistant positions, 18 metres from the ends of each spread. The data from the latter shot points were used for the interpretation of the bedrock profile, as specified by Hawkins (1961).

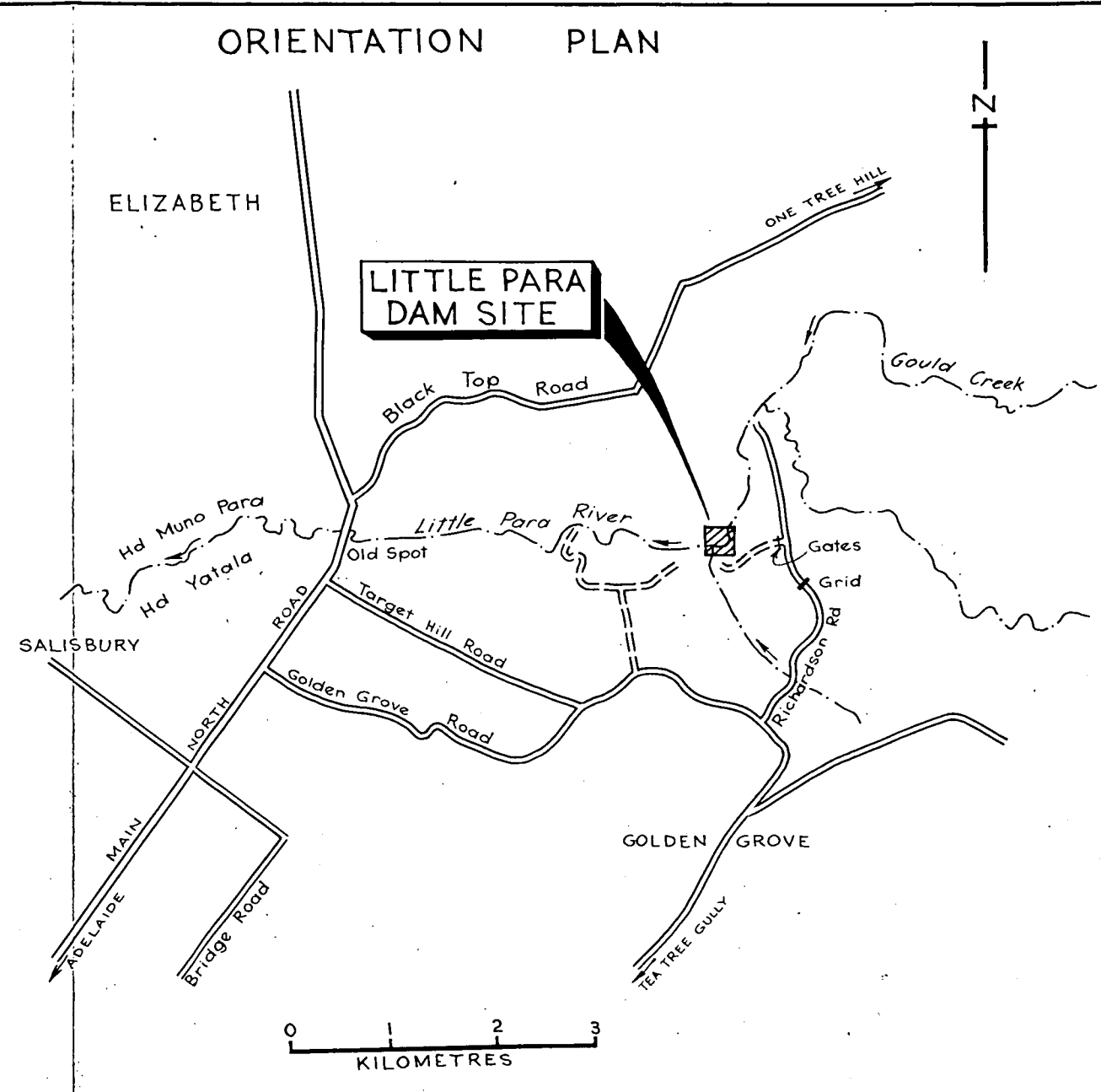
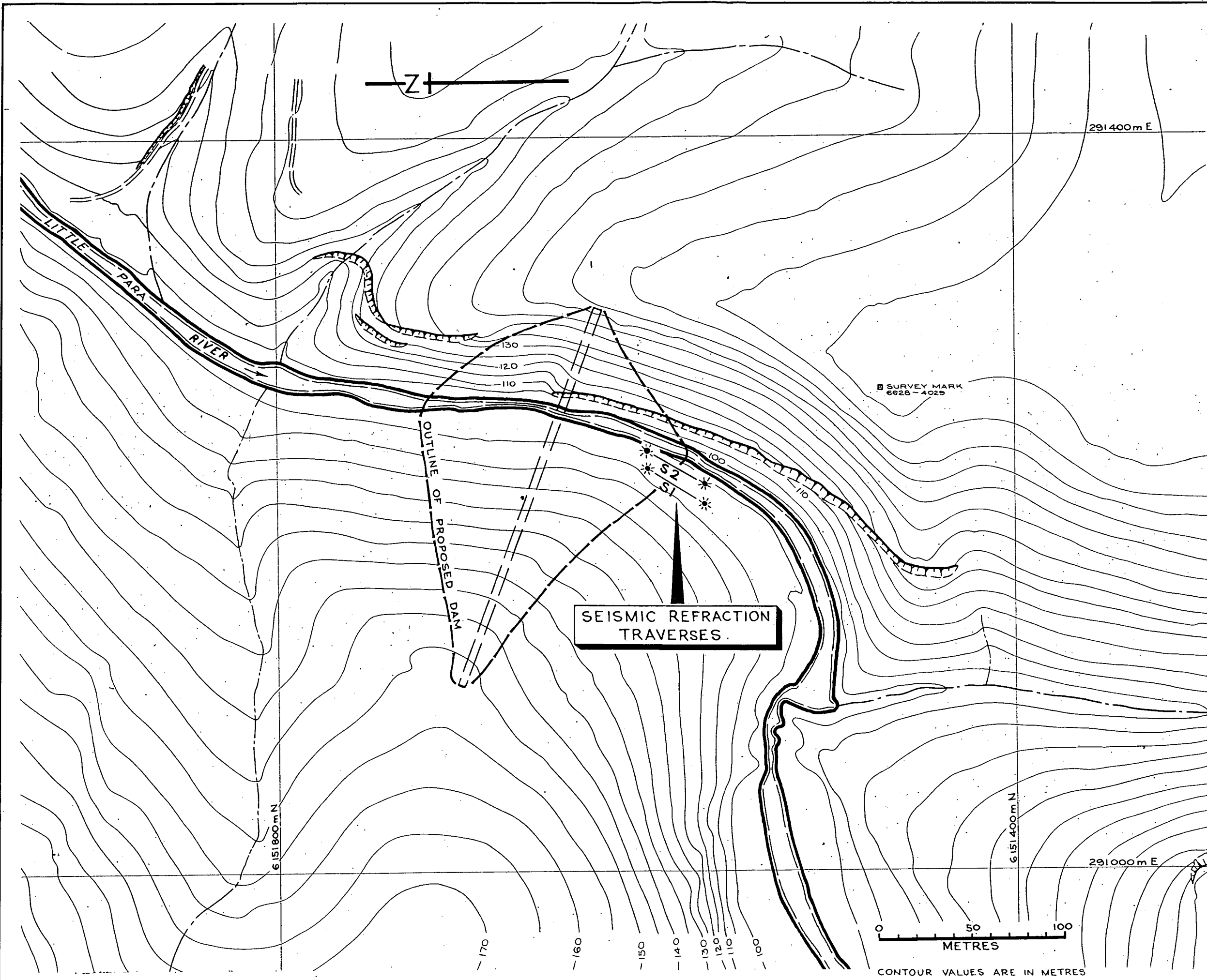
INTERPRETATION

The interpreted cross sections of spreads 1 and 2 are shown as Fig. 1 and 2 in drawing No. 73-503. The profiles show a very thin layer of overburden with velocities ranging between 335 to 510 metres per second, approximately 4 metres thick. There are local areas having velocities between 610 to 1524 metres per second, which probably represent alluvial material in old channels, perhaps with quartz boulder beds.

The basement layer has velocities of 3917 and 4624 metres per second in spreads 1 and 2 respectively. This velocity variation may indicate a different degree of weathering of the quartzite beneath each spread. Local lateral velocity variations are probably present at the northern end of each spread. The 1016 metres per second basement variation in spread 1 may indicate the presence of a shear zone.

CONCLUSIONS

The bedrock profile is relatively smooth and shows small local depression, probably representing old stream cuttings. The velocity of the bedrock shows uniformity in composition, with probably local lower velocity zones at the northern end of spreads.



For interpreted cross-sections see plan no 73-503

| | | |
|---------------------------------------|--|----------------------------|
| DEPARTMENT OF MINES - SOUTH AUSTRALIA | | Scale: 1:2000 |
| Compiled: R. Gerdes | LITTLE PARA DAM SEISMIC SURVEY LOCALITY PLAN | Date: 17 July 1973 |
| Drn. A.F. Ckd: | | Drg. No. 73-502 H2.5 |

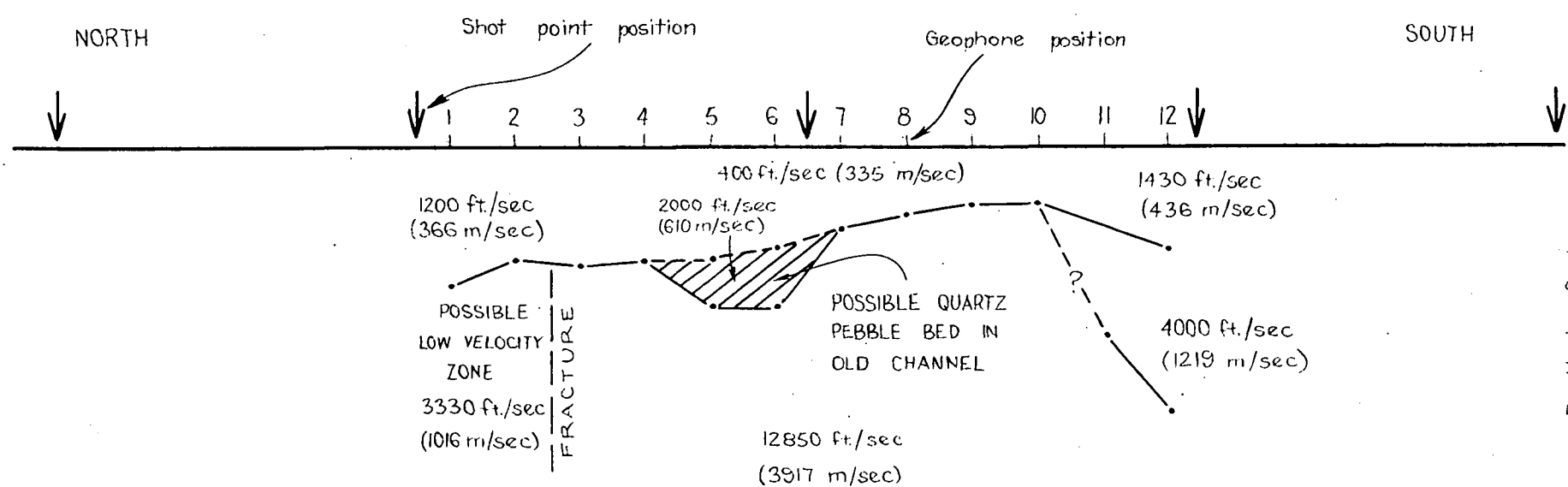


FIG. 1 INTERPRETED CROSS SPREAD OF SPREAD 1

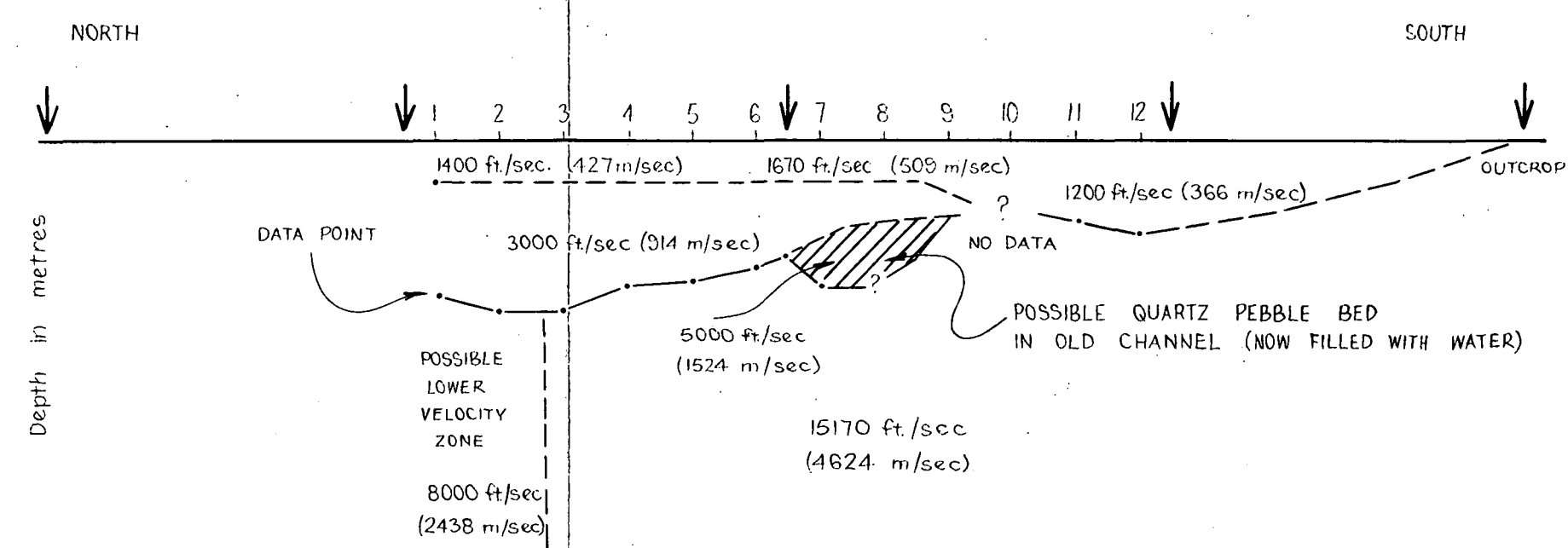
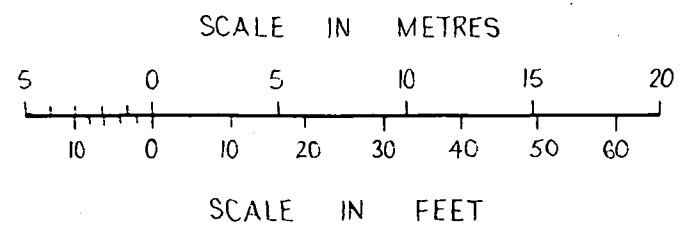


FIG. 2 INTERPRETED CROSS SPREAD OF SPREAD 2

SCALE: 1cm ≡ 3 metres (Horiz.) 1cm ≡ 2 metres (Vert.)

For location of sections 1 and 2 see plan number 73-502

| | | |
|--------------------------------------|---|-------------------------------|
| EXPLORATION GEOPHYSICS SECTION | DEPARTMENT OF MINES - SOUTH AUSTRALIA | Scale: as above (1:300) |
| Compiled: R.A. Gerdes | LITTLE PARA DAM INTERPRETED CROSS SECTIONS OF SEISMIC SPREADS 1 AND 2 | Date: 23 July 1973 |
| Drn. D.J.M. Ed. | | Drsg. No. 73-503 Ha 2+5 |

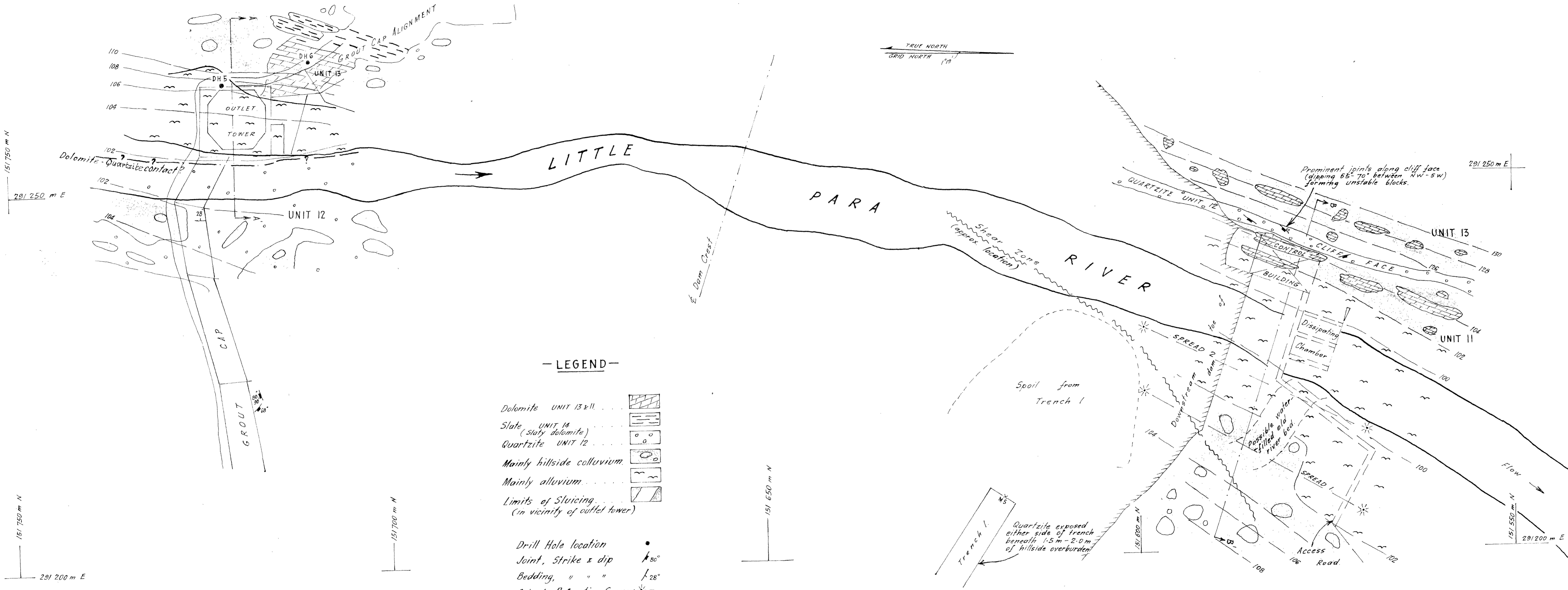
P H O T O G R A P H S



Plate 1. View along Outlet Duct Alignment
taken from proposed Outlet Tower Site.



Plate 2. Quartzite Cliff face (Unit 12) near to
Control House.



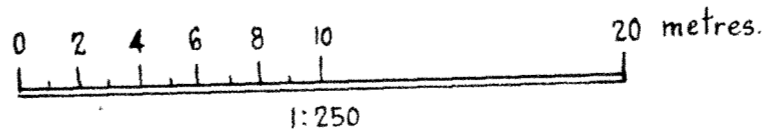
- LEGEND -

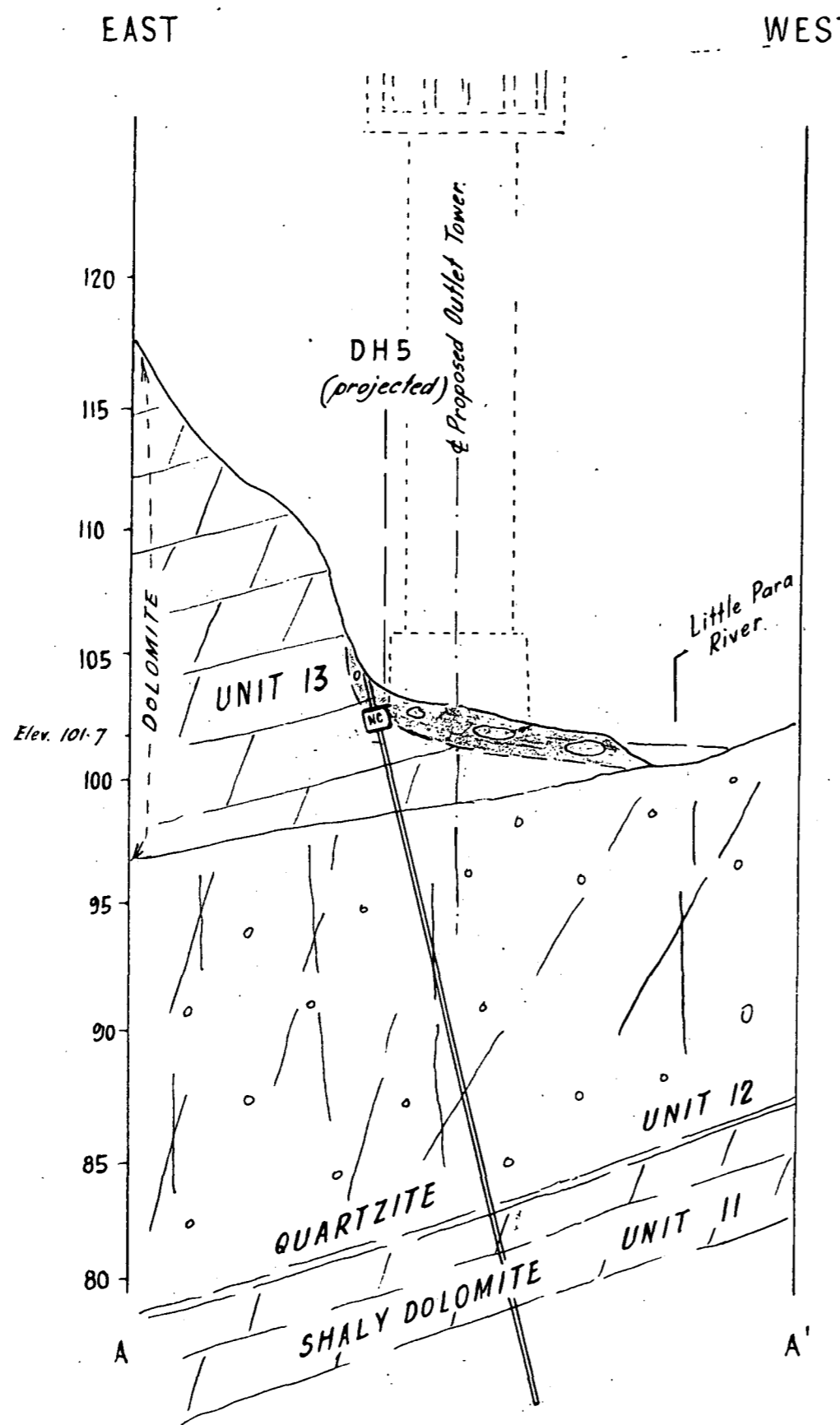
- Dolomite UNIT 13 & 11
- Slate UNIT 14 (slaty dolomite)
- Quartzite UNIT 12
- Mainly hillside colluvium
- Mainly alluvium
- Limits of Sluicing (in vicinity of outlet tower)
- Drill Hole location
- Joint, Strike & dip 30°
- Bedding, " " " 28°
- Seismic Refraction Survey
- No core recovery during drilling
- Contours in metres 104

FIG. 1

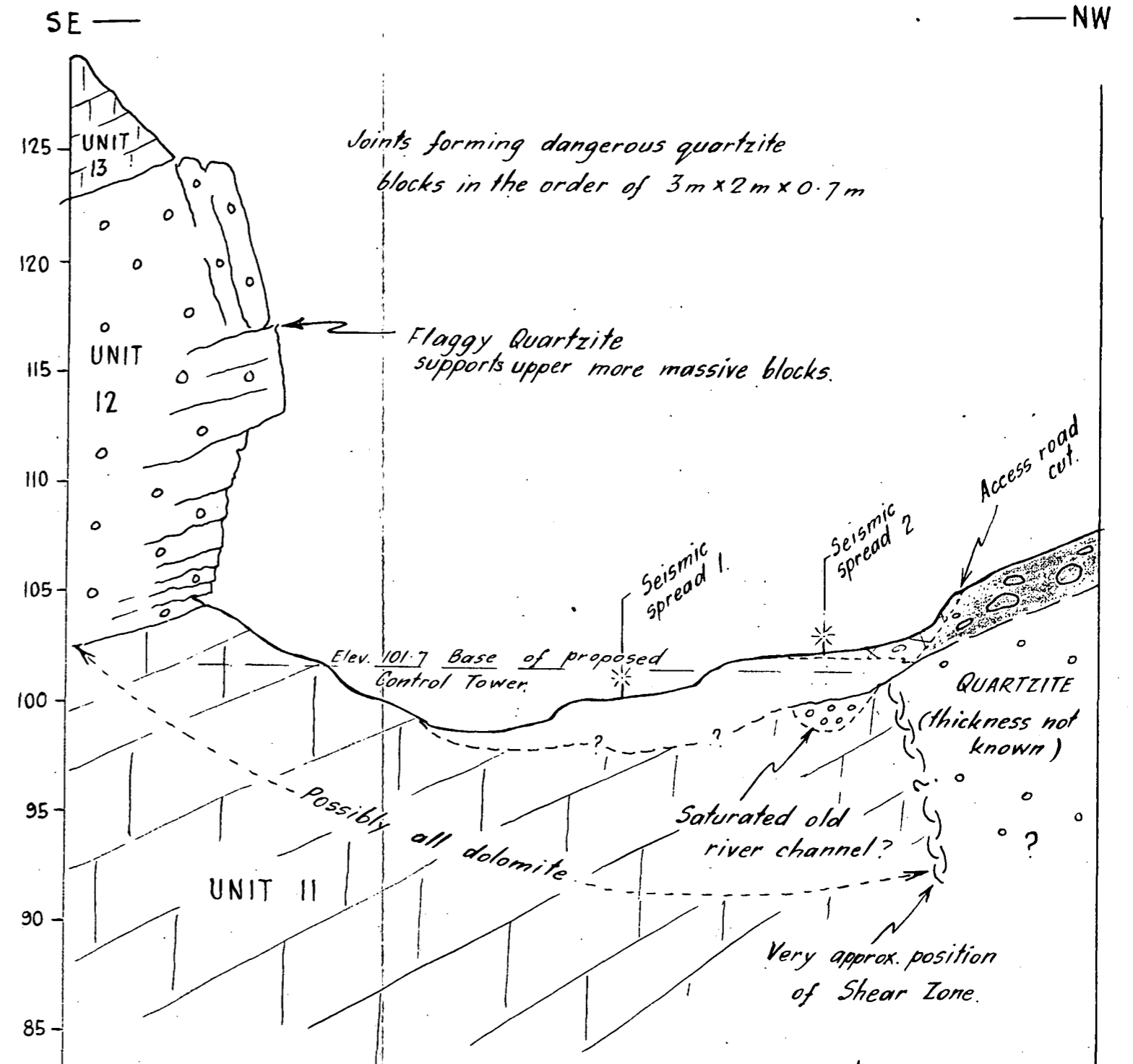
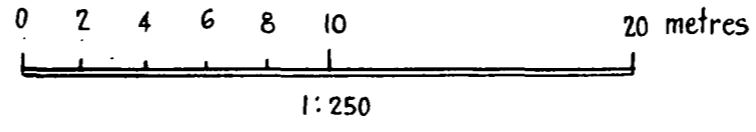
| | | | |
|--|--------------------------|--|--|
| DEPARTMENT OF MINES — SOUTH AUSTRALIA | | | |
| LITTLE PARA DAM OUTLET TOWER & CONTROL HOUSE FOUNDATION INVESTIGATION GEOLOGICAL PLAN | | | |
| ENGINEERING GEOLOGY SECTION | J. C. Beal, Geologist | Drn. J. C. B. Tcd. B. S. G. Ckd. Exd. | SCALE: 1:250 74-63 DATE: 1-2-74 |
| Director of Mines | | | |

NOTE: Results of Seismic Spreads given in Report Book No 73/174 by R.A. Gerdes.





OUTLET TOWER SECTION A-A'



CONTROL HOUSE - SECTION B-B'

FIG. 2

| | | | |
|---|--------------------------------|---------------|------------------|
| DEPARTMENT OF MINES — SOUTH AUSTRALIA | | | |
| LITTLE PARA DAM OUTLET TOWER & CONTROL HOUSE FOUNDATION INVESTIGATION CROSS - SECTIONS | | | |
| ENGINEERING GEOLOGY SECTION | J. C. Beal <i>Geologist</i> | Drn. J. C. B. | SCALE: 1:250 |
| | | Tcd. B. S. G. | 74-64 |
| | | Ckd. | |
| Director of Mines | | Exd. | DATE: 1 - 2 - 74 |

POSSIBLE BLOCK PATTERN
 based on field observations.
 Section taken parallel to section
 A-A' (See cross section Fig. 2)

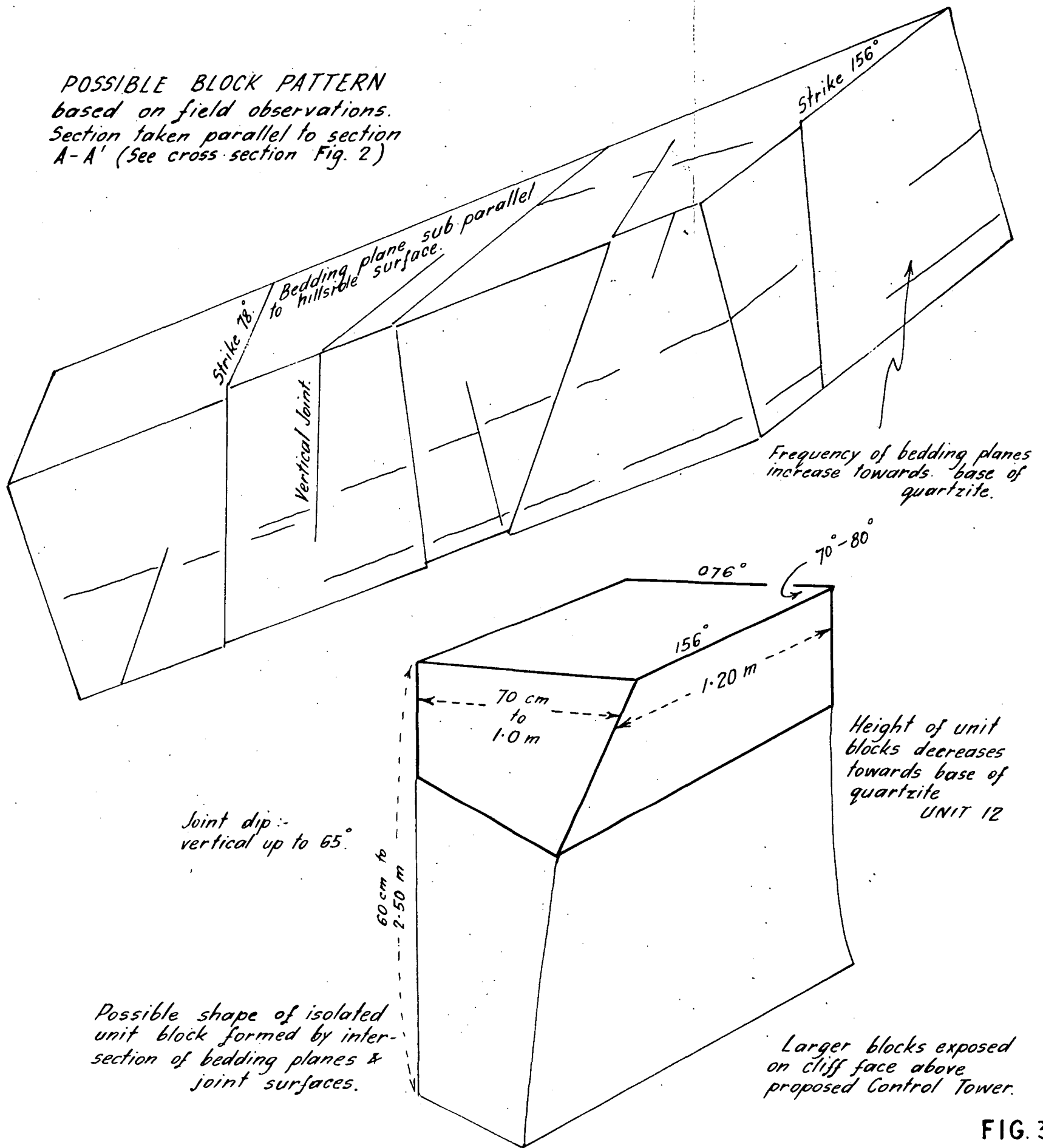


FIG. 3

| | | | |
|---|---------------------------|---------------|--------------------|
| DEPARTMENT OF MINES — SOUTH AUSTRALIA | | | |
| LITTLE PARA DAM OUTLET TOWER & CONTROL HOUSE FOUNDATION INVESTIGATION QUARTZITE FRACTURE BLOCK UNITS | | | |
| ENGINEERING GEOLOGY SECTION | J. C. Beal, Geologist. | Drn. J. C. B. | SCALE: Sketch only |
| | | Tcd. B. S. G. | 74-65 |
| | | Ckd. | |
| | | Exd. | DATE: 1 - 2 - 74 |
| Director of Mines | | | |

PROJECT: LITTLE PARA DAM

LOG OF DIAMOND DRILL HOLE

SERIAL No.

FEATURE: GROUT GAP

SECTION 1500 HUNDRED YATALA

E. L. Surface 103.90 m

LOCATION: LOWER LEFT ABUTMENT

COORDINATES 6 151 721.6

291.264.1

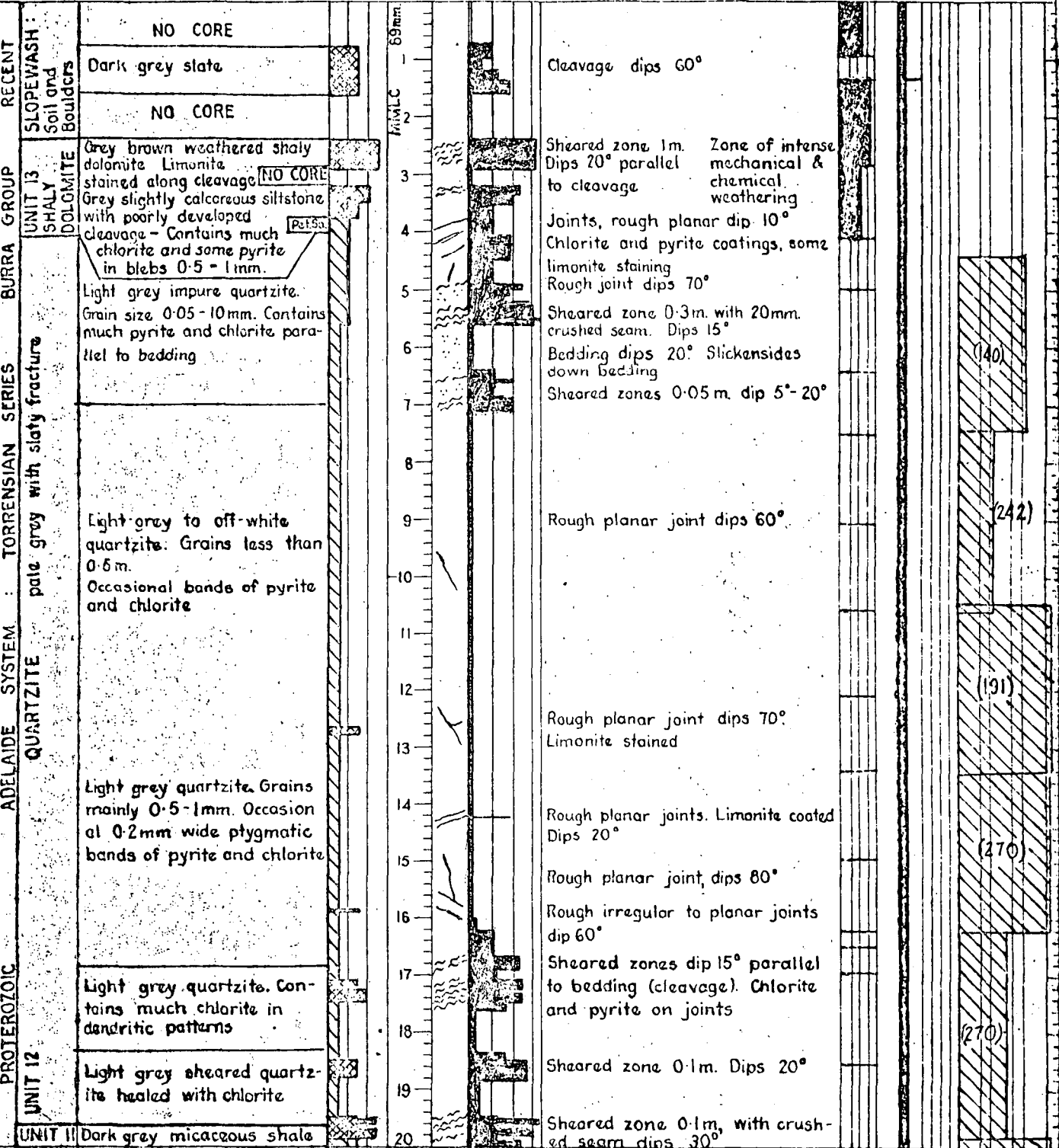
E. L. Collar 103.90 m





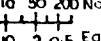
ANGLE FROM HORIZ. 55°

DIRECTION 270°

Datum AHD

| DESCRIPTION OF CORE | GROUP SYMBOL | STRENGTH TERM | CORE SIZE DEPTH LOG | FRACTURE LOG | STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES | LIFT CORE LOSS % | WATER LEVEL | CASING DRILL WATER LOSS % | WATER PRESSURE TESTS LOGGERS |
|---------------------|--------------|---------------|---------------------|--------------|---|------------------|-------------|---------------------------|------------------------------|
| | | | | | | | | | |



| | | | | | | | | | | | |
|--|--|---|--|---|--|---|--|----------------------|--|---|--|
| ROCK SUBSTANCE STRENGTH TERM VS-Very Strong S-Strong MS-Medium Strong W-Weak VW-Very Weak SO-Soil properties | | CONDITION TERM  Fresh  Weathered  Altered  Not Applicable | | FRACTURE LOG 2 10 50 200 Natural fractures per metre of core  50 10 2 0.5 Equivalent length of core in cm (350) Maximum effective pressure (Kilopascals) reached during test. Min. = Minimum value. | | ENGINEERING GEOLOGY SECTION DRILL No. 15 TYPE MINDRILL DRILLER J. JENSEN START. FEB 1973 FINISH 15 FEB 1973 | | | | LOGGED M. DIXON DATE 28 FEB 1973 TRACED TJE CHECKED | |
| Substances with soil properties remoulded and classified by Unified System | | | | | | SHEET 1. OF 2. | | DRG. No. S10473 Ho+2 | | | |

PROJECT: LITTLE PARA DAM

LOG OF DIAMOND DRILL HOLE

SERIAL No.

FEATURE: GROUT CAP

SECTION 1860 HUNDRED YATALA

E. L. Surface 103.90 m

LOCATION: LOWER LEFT ABUTMENT

CO-ORDINATES 6 151 721.6 291 260.1
ANGLE FROM HORIZ. 55° DIRECTION 270°

E. L. Collar 103.90 m

Datum A.H.D.

| DESCRIPTION OF CORE | GROUP SYMBOL | STRENGTH TERM | CORE SIZE DEPTH (m) | FRACTURE LOG | STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES | WATER LOSS % | WATER LEVEL | CASING | DRILL WATER LOSS % | WATER PRESSURE TESTS |
|---|--------------|---------------|---------------------|--------------|--|--------------|-------------|--------|--------------------|----------------------|
| | | | | | | | | | | |
| BURRA GROUP SHALY DOLOMITE UNIT II Quartz-chlorite veins contain fine grained pyrite in aggregate up to 5 mm. Dark grey shaly impure dolomite Contains pyrite and chlorite along cleavage. Shows small scale slump structures Dark grey shaly dolomite Numerous broad-sheared zones 0.2-0.5 m wide Quartz chlorite veins Sheared zones, parallel to cleavage Light grey dolomite Gray clay and silt (some calcareous) with gravel fragments up to 10 mm. Crushed seams 5mm. Dips 5-10° parallel sheared zones Petrological Sample Contains pyrite and chlorite along cleavage. Markedly anisotropic. Parts readily along cleavage. Possibly loses strength when wet. Sheared zones 0.5 m. Dips 5-10° Crushed seam 10 mm Numerous narrow sheared zones 5-20 mm wide | | | 21 | | Quartz chlorite veins 0.5 m. with 50 mm sheared zone | | | | | (81) |
| | | | 22 | | Cleavage developed, smooth with chlorite and pyrite Few rough joints dip 50° Sheared zone 0.7 m parallel to cleavage | | | | | |
| | | | 23 | | Small sheared zones 0.1-0.15 m parallel to cleavage. | | | | | |
| | | | 24 | | Bedding parallel to or sub-parallel to cleavage. | | | | | |
| | | | 25 | | | | | | | |
| | | | 26 | | | | | | | |
| | | | 27 | | | | | | | |
| | | | 28 | | | | | | | |
| | | | 29 | | | | | | | |
| | | | 30 | | | | | | | |
| | | 31 | | | | | | | | |
| | | 32 | | | | | | | | |
| END OF HOLE 32.40m. | | | | | | | | | | |

① ROCK SUBSTANCE--

STRENGTH TERM
 VS-Very Strong
 S-Strong
 MS-Medium Strong
 W-Weak
 VW-Very Weak
 SO-Soil properties

CONDITION TERM

②

Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
 50 10 2 05 length of core in cms
 2 10 50 200 Natural fractures per metre of core
 50 10 2 05 Equivalent length of core in cm
 (350) Maximum effective pressure (Kilopascals) reached during test.
 Min. - Minimum value.

④

ENGINEERING, GEOLOGY SECTION

DRILL No. 15
 TYPE MINDRILL
 DRILLER J. JENSEN
 START 7 FEB 1973
 FINISH 15 FEB 1973

LOGGED H. DIXON
 DATE 28 FEB 1973
 TRACED TJE
 CHECKED

SHEET 2 OF 2 DRG No. S104730

TABLE I

LITTLE PARA DAM

QUARTZITE DRILL CORE TESTS

| Specimen No. | Bore Hole No. | Depth m | Compressive Strength Mpa | | Young's Modulus MPa | | Comments |
|--------------|---------------|----------------------|--------------------------|-----|---------------------|-------------------|---|
| | | | Dry | Wet | Dry | Wet | |
| 1 | DH14 LP3 | 8.0 to 8.1 | 86.5 | | 5.3×10^4 | | failure occurred on 2 cleavage planes |
| 2 | DH14 LP3 | 8.1 to 8.22 | | 114 | | 5.0×10^4 | |
| 3 | DH13 LP1 | 13.0 to 13.1 | 166 | | 8.7×10^4 | | failure occurred on several cleavage planes |
| 4 | DH13 LP1 | 13.1 to 13.22 | | 230 | | 7.8×10^4 | |
| 5 | DH14 LP4 | 12.4 to 12.5 | 232 | | 8.2×10^4 | | |
| 6 | DH13 LP2 | 16.26 to 16.36 | 296 | | 7.7×10^4 | | |

TABLE II

LITTLE PARA DAM - QUARTZITE UNIT 12
SPECIFIC GRAVITY

| *Sample | 1 | 2 | 3 |
|-----------------------------------|-------------|--------------|---------------|
| Depth | 6.55-6.65 m | 12.0-12.10 m | 16.40-16.50 m |
| Gross App SG SSD Basis | 2.645 | 2.597 | 2.615 |
| Gross App SG Oven Dry Basis | 2.640 | 2.593 | 2.610 |
| Apparent SG | 2.65 | 2.60 | 2.62 |
| Water Adsorption. | 0.21% | 0.14% | 0.20% |

*All samples taken from Drill Hole No. 5.