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Geological investigation of a proposed 4.5 ML reservoir at Clarendon Vale

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INTRODUCTION

A reconnaissance geological investigation for a proposed 4.5 ML water storage reservoir at Clarendon Vale sought to provide the Clarence Council with a geological appraisal of the site, with particular emphasis on the likely excavation conditions that could be encountered.

The reservoir is to be built on Cuthbertson's property on the western slopes of Stanfields Hill (537420 mE, 5250400 mN) (fig. 1). The site has a moderate slope and the construction of the reservoir at about the 94 m contour level will entail a substantial cut of up to eight metres below the natural surface.

GEOLOGY

The Hobart 1:50 000 scale geological map sheet (Leaman, 1972) indicates that the reservoir will be located close to the western margin of a narrow north-trending dolerite body which has intruded Triassic–Permian age sedimentary rocks.

The site visit confirmed this to be the case. The reservoir is underlain by dolerite with sandstone-siltstone sedimentary rocks occurring further downslope.

The surface geology at the site consists of a high plasticity clay with scattered dolerite float (boulders) across the slope. There was no outcrop noted on site.

SEISMIC REFRACTION SURVEY

A four-spread seismic refraction survey was carried out to ascertain the nature of the subsurface materials with respect to the type of excavation conditions that could be expected. A twelve-channel seismograph, with 2.0 and 3.0 m geophone spacings, was used. All spreads were fired from both ends using gelignite and electric detonators. The spread locations are shown on Figure 2 and the results of the survey are summarised in Table 1.

The velocity plots are typically asymmetrical with some stepped segments indicating that variable conditions can be anticipated across the site. The V_2 velocity layer, whilst observed in all spreads, was recorded from one end only in three of the four spreads. This suggests that the material representing this velocity segment lenses in and out over the site.

Materials represented by the V_3 velocity layer are likely to vary considerably from a highly weathered low strength rock (1350 m/s) through to hard, high strength slightly weathered dolerite (2100 m/s).

The layer depth figures expressed in Table 1 should not be regarded as absolute values but rather represent average depths of the various interpretation methods used.

EXCAVATION CONDITIONS

The rippability guide chart (fig. 3) relates the excavation capability of heavy machinery (D9 or similar) to seismic velocities over a range of rock types. The chart indicates that dolerite is rippable for velocities up to 1800 m/s. Between 1800 and 2500 m/s, ripping is considered marginal and ultimately depends largely on the orientation and intensity of fracturing of the rock mass.

The results of the survey indicate that whilst conditions are likely to vary across the site, the majority of the material to be excavated should be rippable. The use of a rock breaker would be anticipated for the materials represented by the upper end of the V_3 velocity layer (spread 1) where ripping may be marginal. This will depend on the nature of the jointing. It is possible that minor isolated blasting may be necessary.

The high velocity V_4 layer only becomes applicable in spread 1 where excavation depths of around 8.0 m are anticipated. These materials would certainly require extensive blasting but are only anticipated to occur at about the base excavation level and below.

SUMMARY

The site is covered with 1.0–2.0 m of clay soil and underlain by an irregularly weathered dolerite body.

The seismic refraction survey results indicate that the majority of the materials are rippable to the required depth of excavation, although some zones are considered marginal and workability will ultimately be a product of the joint geometry and weathering characteristics of the rock mass. It is envisaged there will be little need for explosives.

Major stability problems associated with the excavated face are not anticipated, although minor isolated rock falls and/or the dislodgement of individual blocks can be expected from time to time as a result of natural degradation processes.

REFERENCE

LEAMAN, D. E. 1972. *Geological Atlas 1:50 000 scale series. Sheet 82 (8312S). Hobart*. Department of Mines, Tasmania.

[7 July 1989]

Figure 1

Location of proposed reservoir

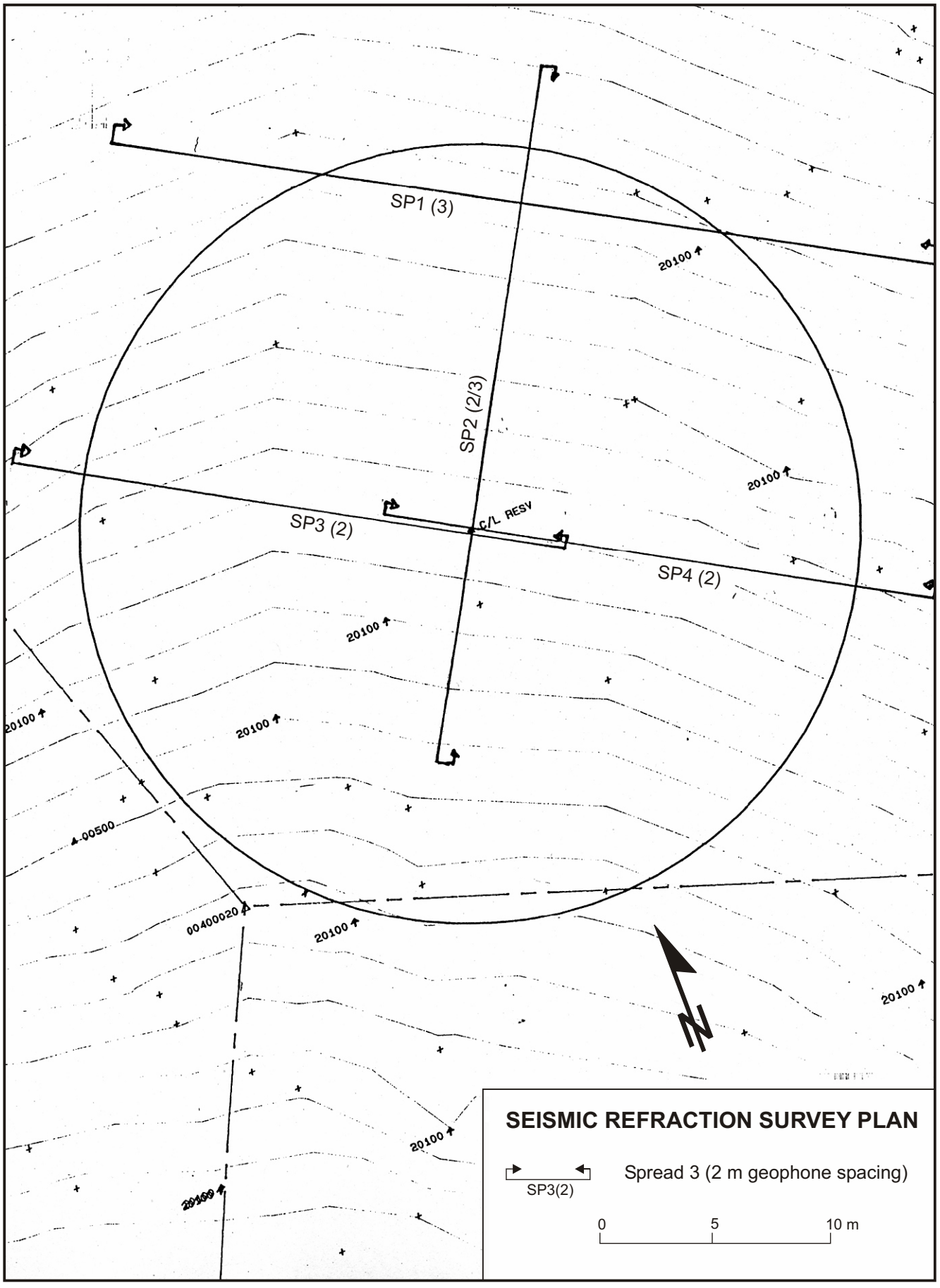
SP1 (3)
SP2 (2/3)
SP3 (2)
C/L RESV
SP4 (2)
20100
00500
00400020
SEISMIC REFRACTION SURVEY PLAN
Spread 3 (2 m geophone spacing)
SP3(2)
0
5
10 m

Figure 2

TABLE 1

Seismic refraction survey, Clarendon Vale reservoir site

Spread No.	Rock type	Velocity (m/s)	Layer depth (m)	Thickness (m)	Geological interpretation
1	Dolerite	V_1: 375–430	1.0–1.4	1.0–1.4	Topsoil — surface clay layer
		V_2: 1090*	3.2	2.2	Residual clay and boulders and/or EW–HW
		V_3: 1850–2100	8.0–11.0	6.6–7.8	MW–SW rock; joints open–tight
		V_4: 4500			FR rock; massive–tightly jointed
2	Dolerite	V_1: 350–500	1.1–2.2	1.1–2.3	Topsoil — surface clay layer
		V_2: 800*	3.2	2.1	Residual clay and boulders
		V_3: 1650–1700	10–12†	7–10†	MW–SW rock; joints generally open
3	Dolerite	V_1: 350–545	1.2–1.8	1.2–1.8	Topsoil — surface clay layer
		V_2: 890*	3.2	2.0	Residual clay and boulders
		V_3: 1350–1600	5.2(+)	2.0(+)	HW–MW rock; joints open some clay fill
		V_4: 2650*			SW–FR rock; joints tight
4	Dolerite	V_1: 350–375	1.0–1.1	1.0–1.1	Topsoil — surface clay layer
		V_2: 670–890	2.9–4.3	1.9–3.2	Residual clay and boulders
		V_3: 1850–2000	7.3(+)	4.4(+)	SW rock; joints open–tight
		V_4: 4000			FR rock; massive to tightly jointed

† : minimum layer depth assuming V_4 = 3000 m/s
* : Velocity recorded from one end only
FR = fresh, SW = slightly weathered, MW = moderately weathered, HW = highly weathered, EW = extremely weathered

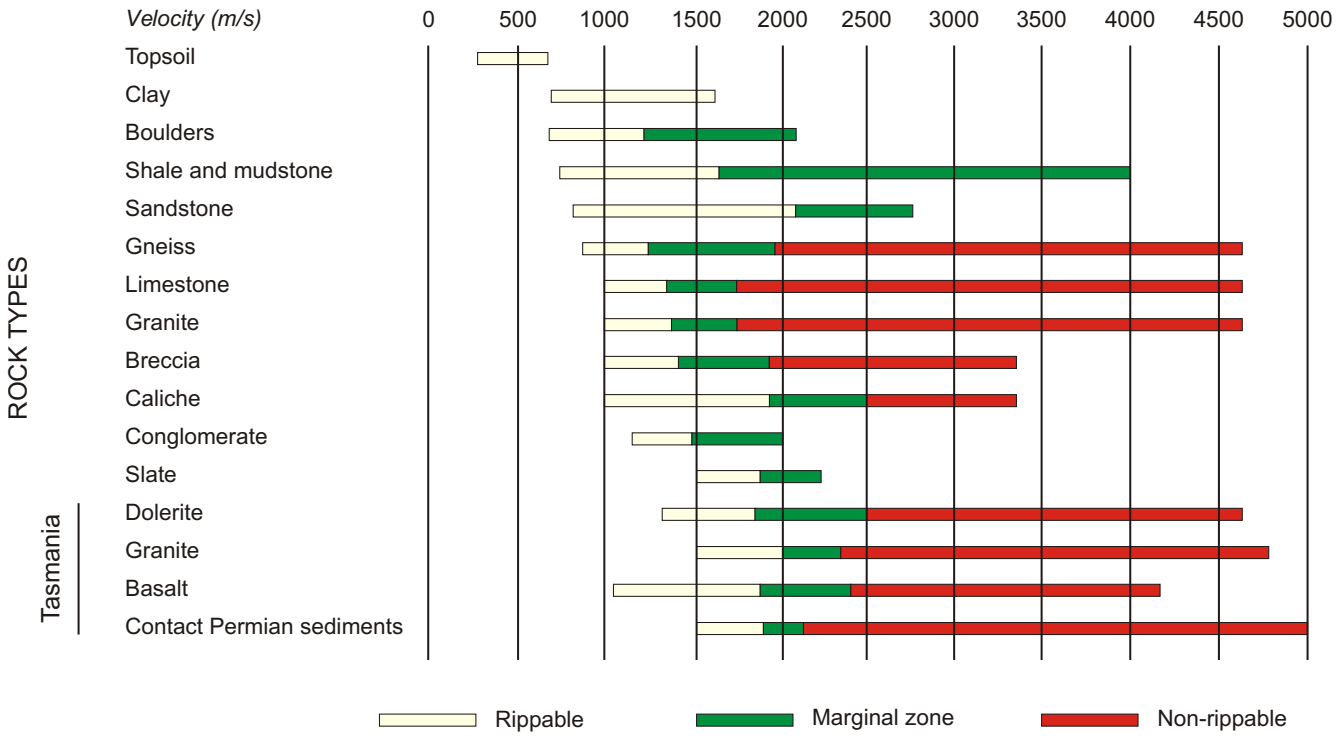

Figure 3

Guide to rippability (adapted from Soil Test Inc.)