



Geological investigation of proposed Clarendon Vale reservoir inlet pipeline, Clarendon Vale

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INTRODUCTION

The geological investigation for the proposed 1.2 km inlet pipeline to the 4.5 ML Clarendon Vale water storage reservoir, currently under construction, was undertaken at the request of the Hobart Regional Water Board.

The locality plan of the reservoir site and the proposed route of the inlet pipeline is shown in Figure 1.

The investigation sought to provide basic information on the following:

- (i) the nature and range of subsurface materials likely to be encountered along the inlet pipeline to a depth of 2–3 m (average excavation depth);
- (ii) the rippability or ease of excavation of materials; and
- (iii) the soil corrosivity along the entire route.

The reservoir site was the subject of a previous investigation carried out by the Department of Mines in July 1989 (Donaldson, 1989).

The current investigation of the inlet pipeline involved geological route mapping, continuous resistivity traversing, with seismic refraction surveys at selected locations along route.

SURVEY DETAILS

Resistivity

Continuous resistivity traversing was carried out along the entire route so that a guide to the soil corrosivity could be determined. The traversing was done using the constant electrode spacing Wenner configuration; electrode spacings of 4.0 m were employed.

Seismic refraction

Three spreads were fired at locations selected using the results of the geological mapping and resistivity survey (fig. 1). These were designed to determine a

typical range of excavation conditions likely to be expected. Traverses were carried out in both areas of substantial dolerite float and soil cover only.

A Nimbus 12-channel seismograph was used; spread lengths of 24.0 m were employed with 2.0 m geophone spacings. Shots were fired from both ends. Calculations were by the critical distance, intercept time, and where appropriate, the reciprocal time methods.

Data interpretation

In any investigation employing geophysical methods, the results are an interpretation (based largely on experience) of the physical properties measured. Investigative work at this preliminary survey level cannot hope to accurately predict the extremes or rapid variability of materials (both laterally and vertically) that may exist over short distances.

Whilst every effort has been made to predict the likely nature and range of materials to be encountered, contractors should view the results only as a guide to conditions anticipated along the route. Additional investigations, such as a series of trial excavations, should preferably be undertaken to test the validity of the information inferred from the geophysical results. This would also enable contractors to assess the capability and suitability of their machinery for varying rock conditions.

GEOLOGY

The provisional 1:25 000 scale Engineering Geology of the Greater Hobart area map (Hofto, 1990) indicates that the proposed pipeline route is entirely underlain by Jurassic age dolerite. The site investigation has confirmed this to be the case.

Bedrock was not observed to outcrop along the proposed route and the geology was based on surface soil information. This soil, which consisted of brown to black high plasticity clay with associated dolerite float (boulders), is evident along most of the route.

GEOPHYSICS

The seismic refraction survey results (Table 1) clearly indicate the variability in subsurface conditions that exist along the inlet pipeline route. The velocity plots are typically symmetrical in the broad sense but have 'stepped' segments throughout. This 'stepping' effect is most apparent on the V₃ velocity layer and is considered to represent variations in the weathering characteristics of the rock mass.

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

The resistivity survey results (fig. 2) can often be interpreted (with caution) in a qualitative manner to indicate areas of substantial soil development as distinct from areas of probable bedrock close to the surface. Although the correlation is crude, deep 'soil' profiles tend to have resistivity values less than 5000 m, whilst shallow 'hard rock' conditions are probably present above 10 000 m. However it does not follow that the high resistivity areas necessarily indicate hard rock conditions close to the surface. It is stressed therefore that these results should be used with caution. Nevertheless, it does give an indication and guide to those areas where either 'soil' or 'rock' conditions are likely to be prevalent.

Based on previous experience the resistivity profile observed over this inlet pipeline route suggests that few 'hard' rock conditions are likely to be encountered within the limits of excavation.

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. Velocities in excess of these figures are considered to represent material that is non-rippable.

Typically, dolerite has highly variable weathering characteristics which result in rapid changes in the nature and strength of the rock mass over short distances.

Bedrock materials (representing the V₃ velocity layer) are likely to vary considerably from a more moderately weathered low strength rock (1750 m/s) through to hard high strength slightly weathered dolerite (2500 m/s).

It is the weathering, strength and joint (defect) characteristics of the rock mass that will ultimately

determine the ease of excavation of those areas of 'bedrock' encountered along route.

The results of the survey indicate that whilst 'bedrock' conditions, where encountered, are likely to vary along the route, the majority of the material to be excavated should be able to be worked with a large traxcavator employing a hydraulic impact rock breaker to loosen the material.

From the results of the survey, it is considered that the use of explosives is unlikely to be necessary.

SOIL CORROSIVENESS

The resistivity plot (fig. 2) indicates the relationship between resistivity and the degree of soil corrosivity. The classes used are based on information obtained from the Board.

Overall, the materials along the proposed inlet pipeline appear to be in the mildly corrosive range. No comment is made on the degree of protection required to ensure the longevity of the pipes.

SUMMARY

The 1.2 km inlet pipeline route is underlain by an irregularly weathered dolerite body.

The geophysical survey results, together with the geology, indicate conditions comprising a variable soil/rock profile with possible rapid variations in the strength and the degree of weathering of the material over relatively short distances. Some zones may be marginal for ripping, and workability will ultimately be a product of the joint geometry and weathering characteristics of the rock mass. It is envisaged that the need to use explosives is unlikely, and that the material to be excavated should be able to be successfully worked with a large traxcavator employing a hydraulic impact rock breaker.

The soil corrosivity results indicate that the pipeline will be laid in mildly corrosive soils.

Finally, it is recommended that contractors take time to view the profile exposed at the recently excavated reservoir site followed by a series of trial excavations along the inlet pipeline route to confirm, and if necessary, modify the above findings and predictions.

REFERENCES

- DONALDSON, R. C. 1989. Geological investigation of a proposed 4.5 ML reservoir at Clarendon Vale. *Report Department of Mines Tasmania* 1989/47.
- HOFTO, P. 1990. *Urban Engineering Geological Mapping Project. Map 1. Engineering Geology Greater Hobart Area.* Division of Mines and Mineral Resources Tasmania.

[21 September 1992]

TABLE 1
Seismic refraction survey

Rock Type	Velocity Layer	Velocity (m/s)	Depth (m)	Thickness (m)	Geological interpretation
<i>Spread 1 [CH516-540 m]</i>					
Dolerite	V ₁	365-400	0.6-0.7	0.6-0.7	Surface soil profile – unconsolidated clay (CH)
	V ₂	800	1.6-1.7	1.0	Residual clay and boulders, possibly some EW bedrock
	V ₃	1715-1875	7.0*	5.4*	MW-SW bedrock
	V ₄	4000+	-	-	FR bedrock; massive, tightly jointed
<i>Spread 2 [CH516-540 m]</i>					
Dolerite	V ₁	310-330	0.6-0.8	0.6-0.8	Surface soil profile – unconsolidated clay (CH)
	V ₂	670-705	2.9-3.6	2.3-2.8	Residual clay and boulders
	V ₃	1850-2400	-	-	SW bedrock; joints open to tight
<i>Spread 3 [CH895-919 m]</i>					
Dolerite	V ₁	360-480	0.6-0.7	0.6-0.7	Surface soil profile – unconsolidated clay (CH)
	V ₂	1000	3.0-3.2	2.4-2.5	Residual clay and boulders grading into EW-HW rock
	V ₃	2650-3200	-	-	SW-FR bedrock; joints tight

* Minimum layer depth

+ Velocity observed from one end only

EW = extremely weathered HW = highly weathered MW = moderately weathered SW = slightly weathered FR = fresh

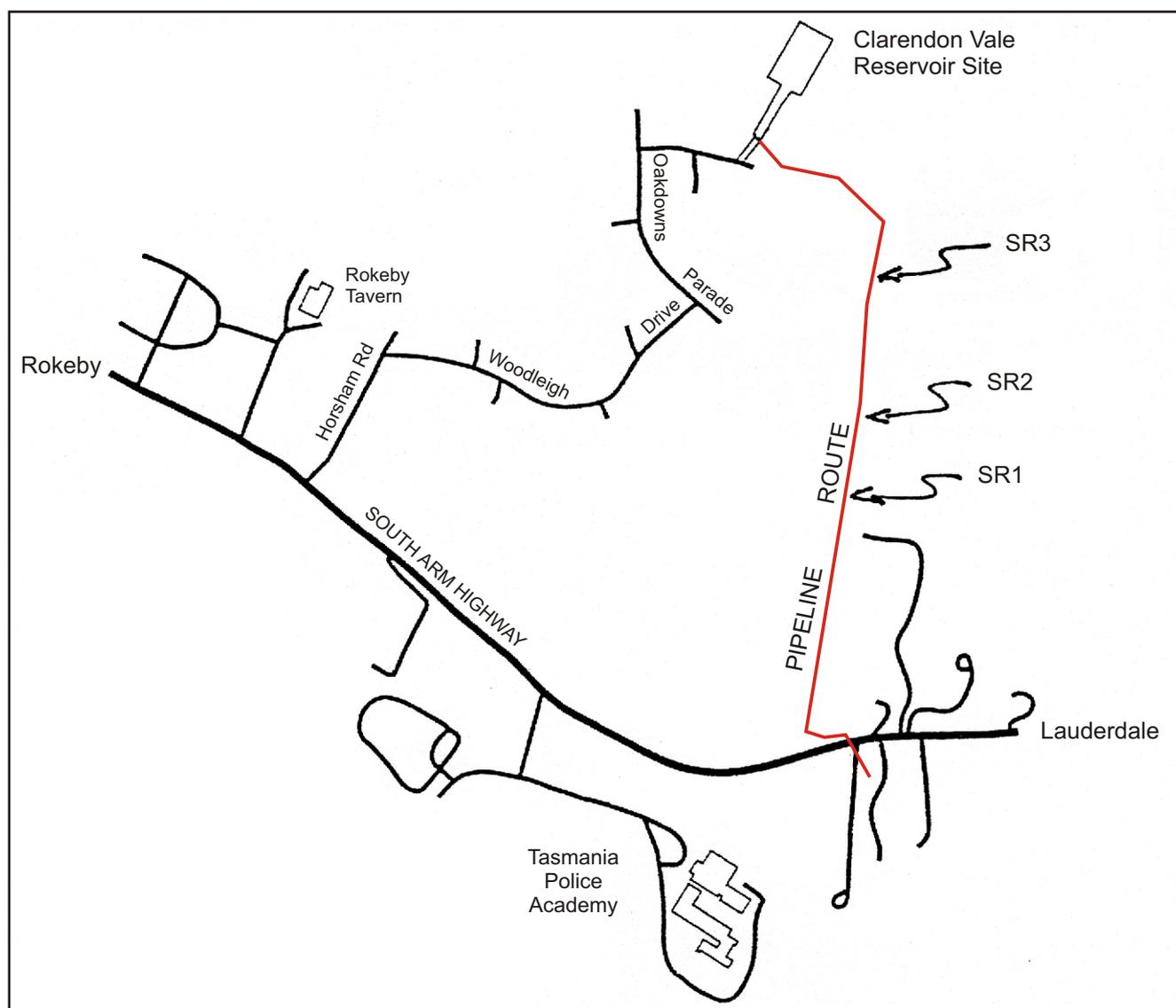


Figure 1

Location of inlet pipeline route and seismic refraction spreads

CLARENDON VALE RESERVOIR INLET PIPELINE
RESISTIVITY SURVEY

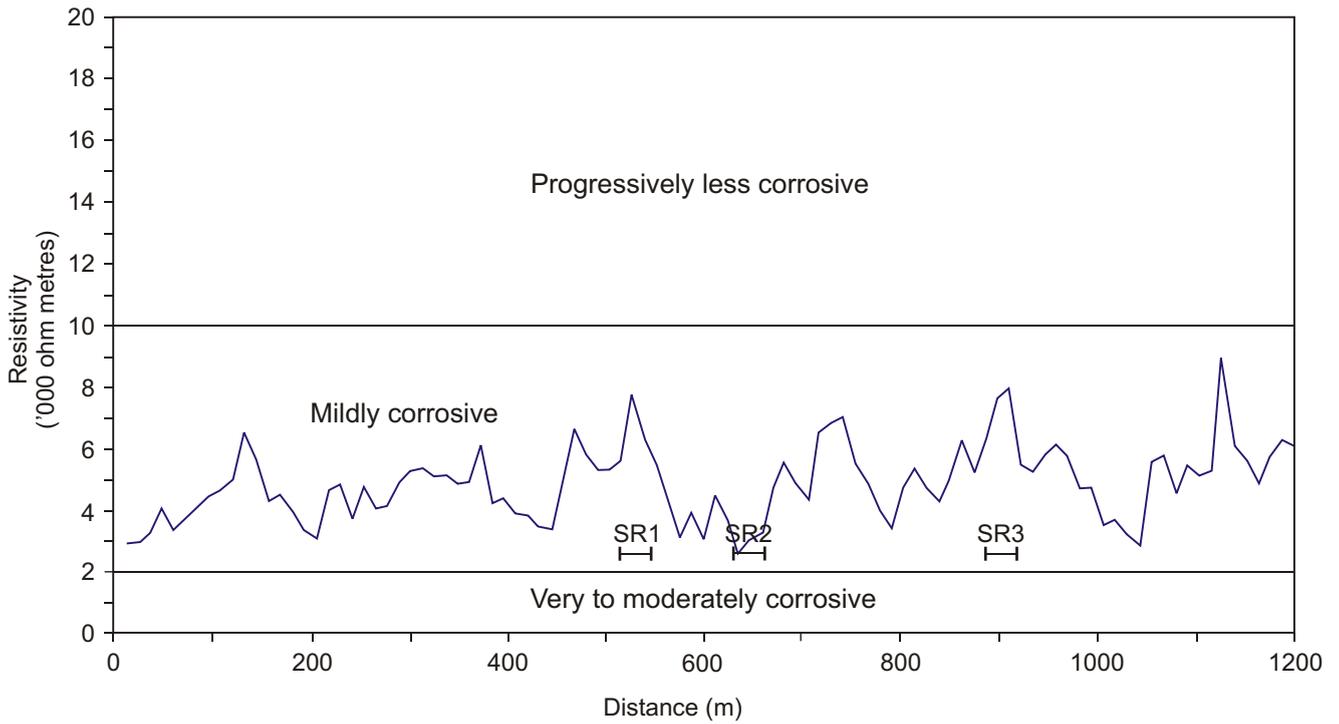


Figure 2
Resistivity survey

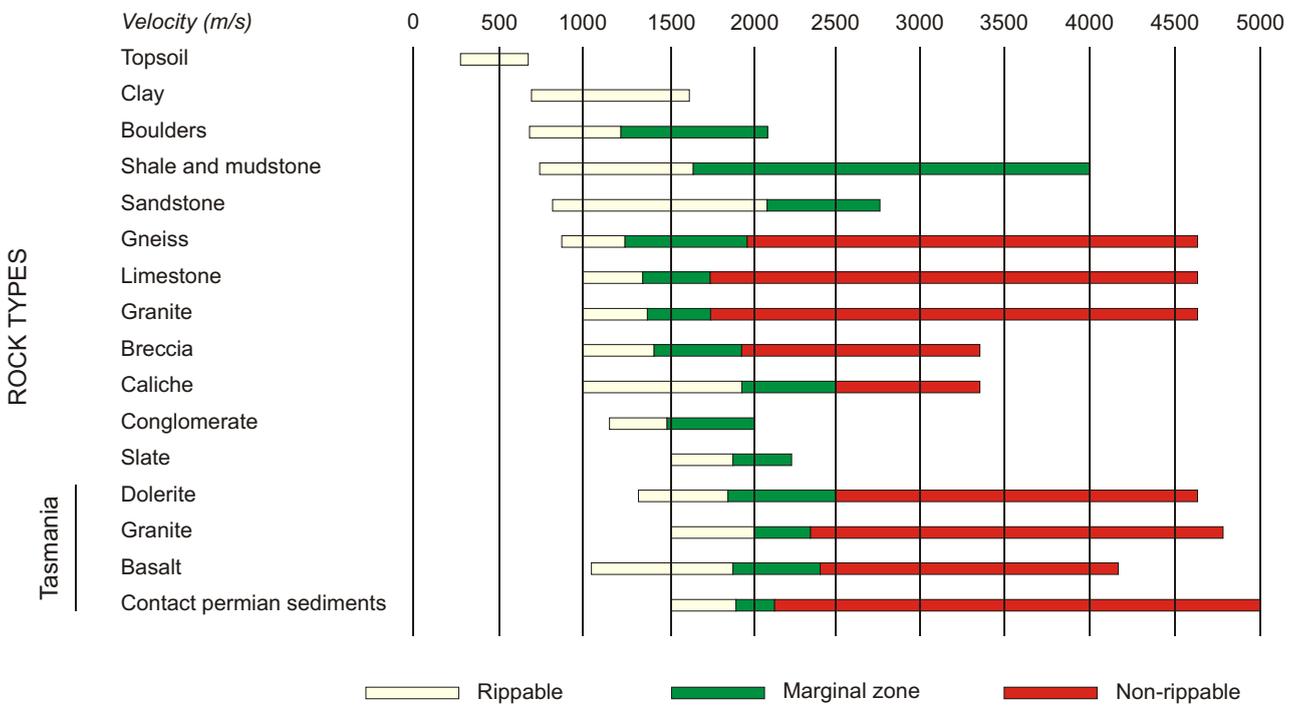


Figure 3
Guide to rippability (adapted from Soil Test Inc.)