1979/55. Preliminary investigation of proposed Latrobe bypass, Australian National Railways Western Line.

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INTRODUCTION

In October 1979, the Australian National Railways Commission (Tasmanian Region) requested the Department of Mines to undertake a geological investigation for the proposed deviation of the Western Line at Latrobe. The proposal involves the construction of a 2.5 km section of line [DQ502328 to DQ485344] which will by-pass the town of Latrobe and eliminate two bridges that cross the Mersey River. The alternative routes being considered pass through the old Mersey and Alfred Coalfield mine workings around the bank above Ballahoo Creek (fig. 1).

The investigation has involved geological mapping and a seismic refraction survey. This report describes the results of the investigations carried out during November and December, 1979.

REGIONAL SETTING AND GEOLOGY OF PROJECT AREA

The major rock units in the project area are Permian and Quaternary sediments. The Permian succession in the Latrobe area is represented by the Spreyton Beds, which underlie the Mersey Coal Measures. A north-east trending fault marks the western extent of the Mersey Coalfield where the Mersey Coal Measures have been downthrown to the south-east against the Spreyton Beds.

The Spreyton Beds, predominantly mudstone with beds of calcareous pebbly sandstone, underlie the northern section of the proposed routes.

The Mersey Coal Measures may be divided into three members, a 'top sandstone' overlying a 'coal horizon' overlying a 'bottom sandstone'. These rocks are seen in a natural exposure in the cliffs on the left bank of Ballahoo Creek near the old Mersey Colliery, but only part of the 'top sandstone' and the 'coal horizon' is exposed. The 'bottom sandstone' does not crop out in this area, but bores have indicated it is predominantly sandstone with beds of conglomerate and bands of mudstone. The 'top sandstone' is typically a thick and flaggy bedded sandstone varying from fine to very coarse grained and containing lenticular beds of mudstone. Borehole records indicate the thickness varies from 7 to 20 m; the Ballahoo Creek section is of the order of 10 m thick.

The 'coal horizon' is predominantly mudstone and varies from 1.5 to 6 m in thickness. The coal seam has an average thickness of 0.6 m.

Quaternary alluvial deposits forming the floodplain of the Mersey River consist of silty sand (SM) with associated gravel and boulder beds. Both of the proposed routes cross the alluvial deposits.

MINE WORKINGS

Two collieries, the Alfred and the Mersey, which worked during the latter half of the nineteenth century, are close to the proposed routes.

Records show that the Alfred Colliery commenced production in about 1858 and was closed in about 1880. Coal was extracted from two adits which were driven into the hillside south-east of Coal Hill Road just above the

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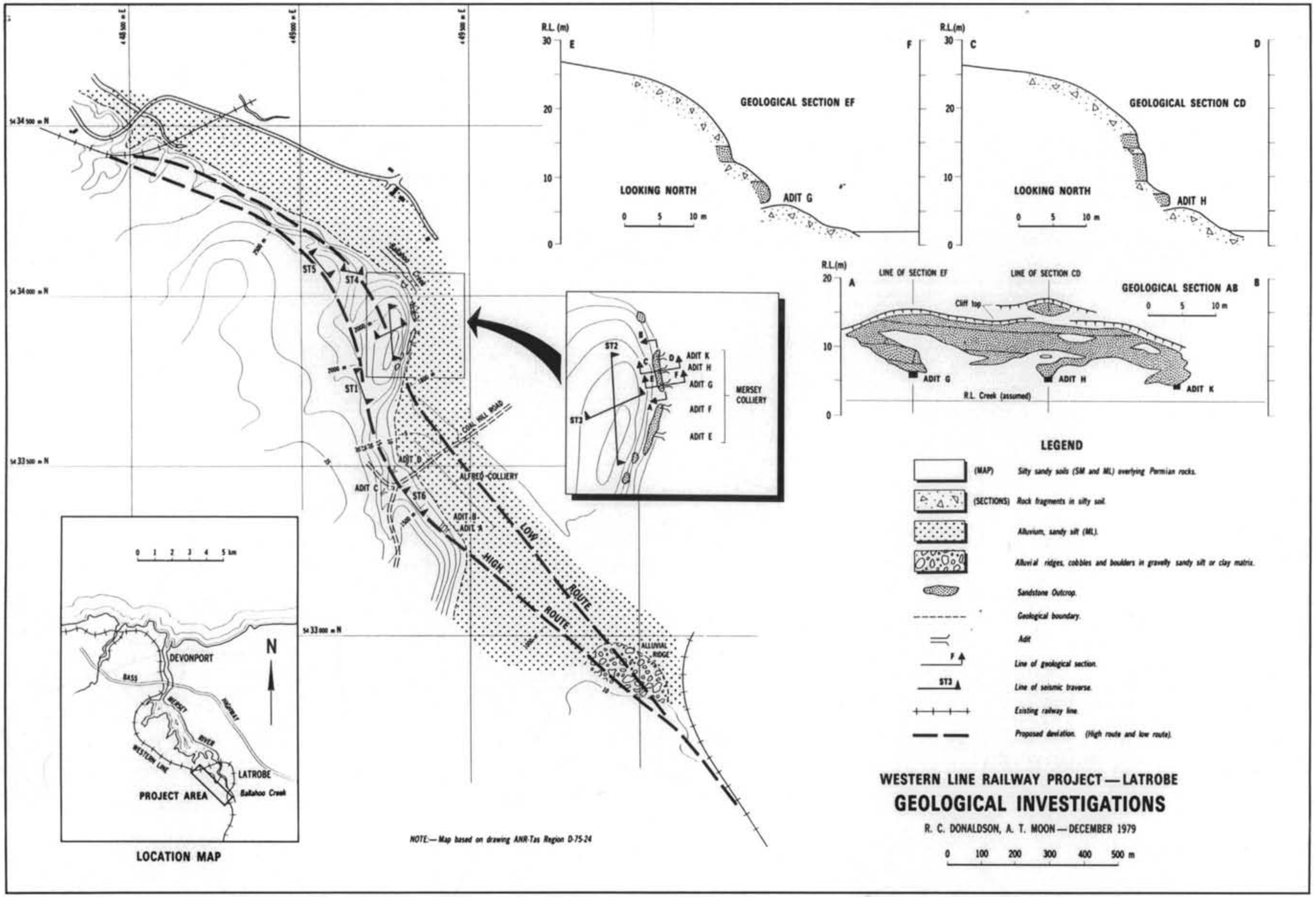

Figure 1.

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level of the alluvium (adits A and B on fig. 1). These adits extend underneath the proposed high route. Coal was intersected about 120 m from the entrance to the adits. The main tunnel (adit C) was driven in the creek re-entrant, about 50 m to the south-west of the high route where it crosses Coal Hill Road. It is reported to have cut the seam about 120 m from the entrance. A fourth adit (adit D) was noted on the proposed high route about 50 m north-west of Coal Hill Road. No details are available on extent of workings from this adit. Estimated coal production from the Alfred Colliery is in the vicinity of 100 000 tonnes.

The Mersey Colliery was worked between 1861 and about 1890. Coal was extracted from five adits driven into the cliff from the bank of Ballahoo Creek (adits E-H, K, fig. 1). The coal seam ranged in thickness from 150 mm to 300 mm and was overlain by a coarse sandstone with an intervening bed of bluish shale which was reported to have thinned from one metre in the face of the cliff to less than 0.3 m. The colliery was a regular producer for a number of years. No production figures are available but the mine area contained approximately 40 000 tonnes, and probably most of this was extracted.

There are no records available on the extent of the mine workings. Nevertheless, taking into consideration the volume of the material extracted, it is likely that the workings extend under the proposed low route in the vicinity of the 21 m deep cut. It is estimated that the adits could be less than 5 m below the base of the cut.

SURFACE CONDITIONS

The proposed routes cross two contrasting terrains. The south-eastern parts of the routes cross the floodplain of the Mersey River and the northern parts cross the gentle hill country underlain by the Permian rocks.

Most of the floodplain is flat and is cut by drainage ditches. Some areas are subject to flooding. The surface soils are mainly sandy silt (ML - Unified Soil Classification System). Not all the floodplain is flat and there is a prominent alluvial ridge at the south-eastern end of the two routes (fig. 1). This ridge rises 3 to 4 m above the general level of the floodplain. The surface soils consist of rounded cobbles and boulders up to 300 mm diameter in a matrix of dense gravelly silty sand (SM). Most of the pebbles consist of quartzite.

The hill country consists of flat topped ridges cut by broad open gullies. Most slopes are less than 10°, except along the edge of the floodplain where steep slopes and cliffs occur (fig. 1). The surface soils consist of silty sand (SM) or sandy silt (ML). In some places on the ridge tops are rounded cobbles of quartzite scattered on the surface. Most of the slopes appear to be well drained, but flat ridge tops and valley floors may become waterlogged at times.

SUBSURFACE CONDITIONS

Direct observation

No investigation of the subsurface conditions on the floodplain has been carried out. A road cut through the alluvial ridge indicates that the cobbles and boulders are at least 1.5 m thick, although the matrix contained more clay (CL) than at the surface.

The soils in the hill country were exposed in several track cuttings and also in the seismic refraction shot holes. In all cases the topsoil consisted of grey sandy silt (ML) with some gravel and many fine roots. Along seismic traverse ST6 the topsoil, typically about 0.3 m thick, is underlain by yellow-brown high plasticity clay (CH). In all other exposures the topsoil is underlain by residual soil consisting of sandy silt (ML) or silty clay. Exposures in a track overlooking Ballahoo Creek show extremely weathered rock at depths of 0.5 to 1 m. The rock consists of laminated (1 to 5 mm) micaceous, carbonaceous fine sandstone overlying massive fine to medium grained sandstone. Both materials are of extremely low strength and remould easily to silty sand or sandy silt. The exposure is about 1.2 m deep and occurs about 8 to 14 m above Ballahoo Creek (RL 10 to 16 m).

Rock is exposed in the cliffs overlooking Ballahoo Creek (Sections CD and EF, fig. 1). The rock consists of slightly weathered, low to medium strength, current bedded, slightly friable fine to medium grained sandstone. It is feldspathic and micaceous and is pale grey with yellow-brown zones. It contains thin coal lenses less than 2 mm thick and some thin bands of sub-rounded quartz pebbles. The sandstone is about 10 m thick and is roughly horizontal (there appears to be dip of about 5° towards the north). Bedding planes are 1 to 2 m apart. There are several near vertical rough irregular joints extending several metres. Joint spacing is generally 1 to 3 m but locally 0.3 to 1 m. The sandstone is underlain by slightly weathered, pale grey, very low strength carbonaceous shale. There are continuous partings of coal several millimetres thick. The shale bed is at least one metre thick. This is the horizon from which coal has been worked and several adits have been excavated into the shale.

Seismic refraction results

Six seismic refraction traverses were carried out with a Texas Geospace Instruments GT2 refraction seismograph. The location of the traverses are shown on Figure 1 and interpreted profiles are given in Figures 2 and 3. Depth interpretations were carried out by the critical distance and reciprocal methods.

Most traverses show three layers. Traverses ST2 and ST3 crossed a discontinuity (possibly a fault) and were more difficult to interpret. The seismic velocities and interpreted material are given below in Table 1. The interpretations are based on local geology and experience elsewhere and can only be confirmed by direct investigation (trenching or drilling).

EXCAVATION CONDITIONS

The low route will involve excavation of about 120 000 m^3 of material (*in situ*) and the high route will involve excavation of about 70 000 m^3 of material.

The top layer interpreted from the seismic refraction results (V = 350 to 700 m/s) is likely to be readily excavated by scrapers, although an elevating scraper may be required where clay soils occur. The depth of this layer varies from 2 to 12 m (fig. 2). The intermediate layer (V = 900 to 1800 m/s) will generally require light ripping before removal by bulldozers and scrapers. There may be some harder zones requiring heavier ripping, but it is unlikely that blasting will be required if a Caterpillar D8 or equivalent is used. From the seismic refraction results available, it appears that about 80% of the material to be excavated for the high route consists of the top layer low velocity material and the remaining 20% consists of the intermediate material. These figures are preliminary estimates only

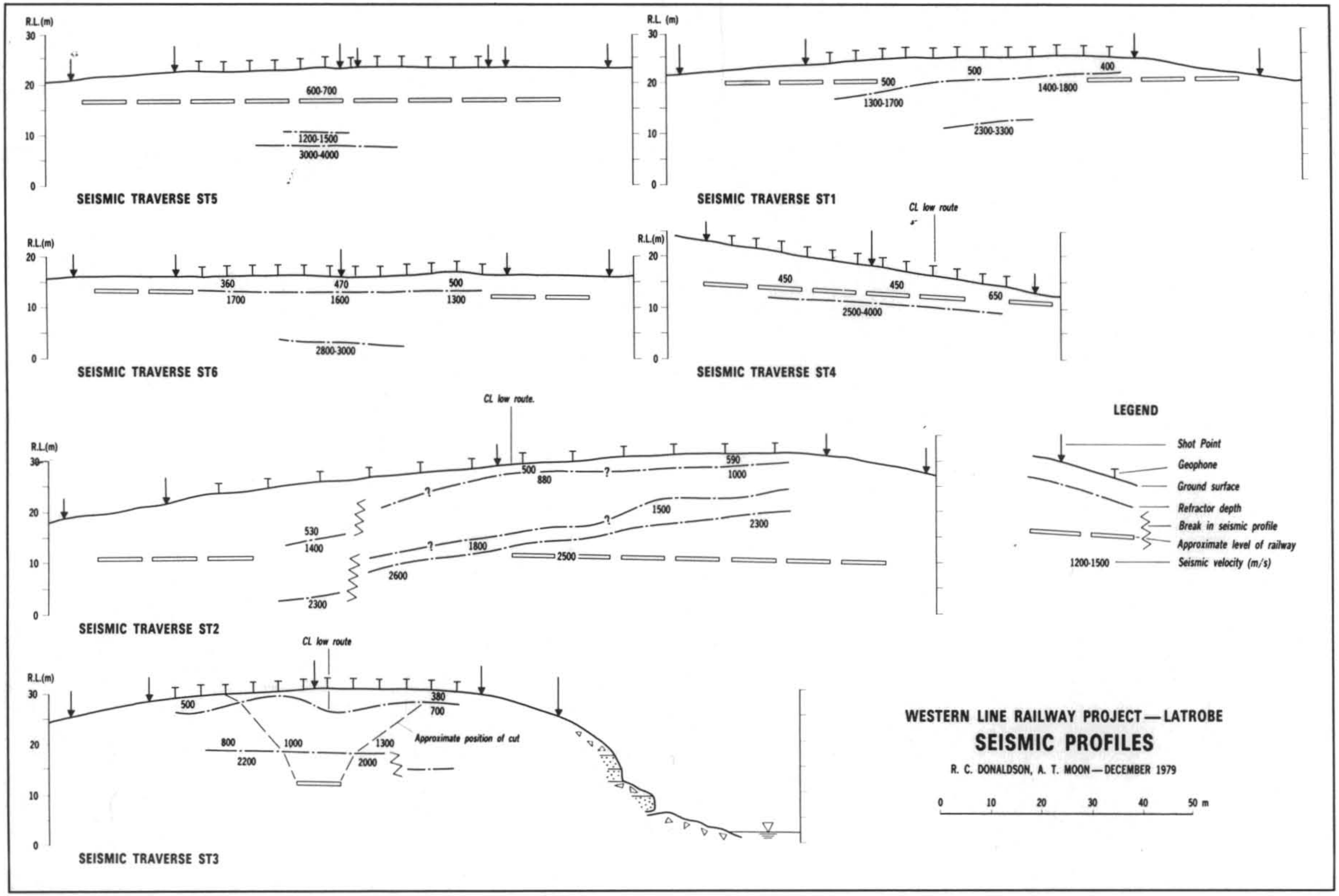

Figure 2.

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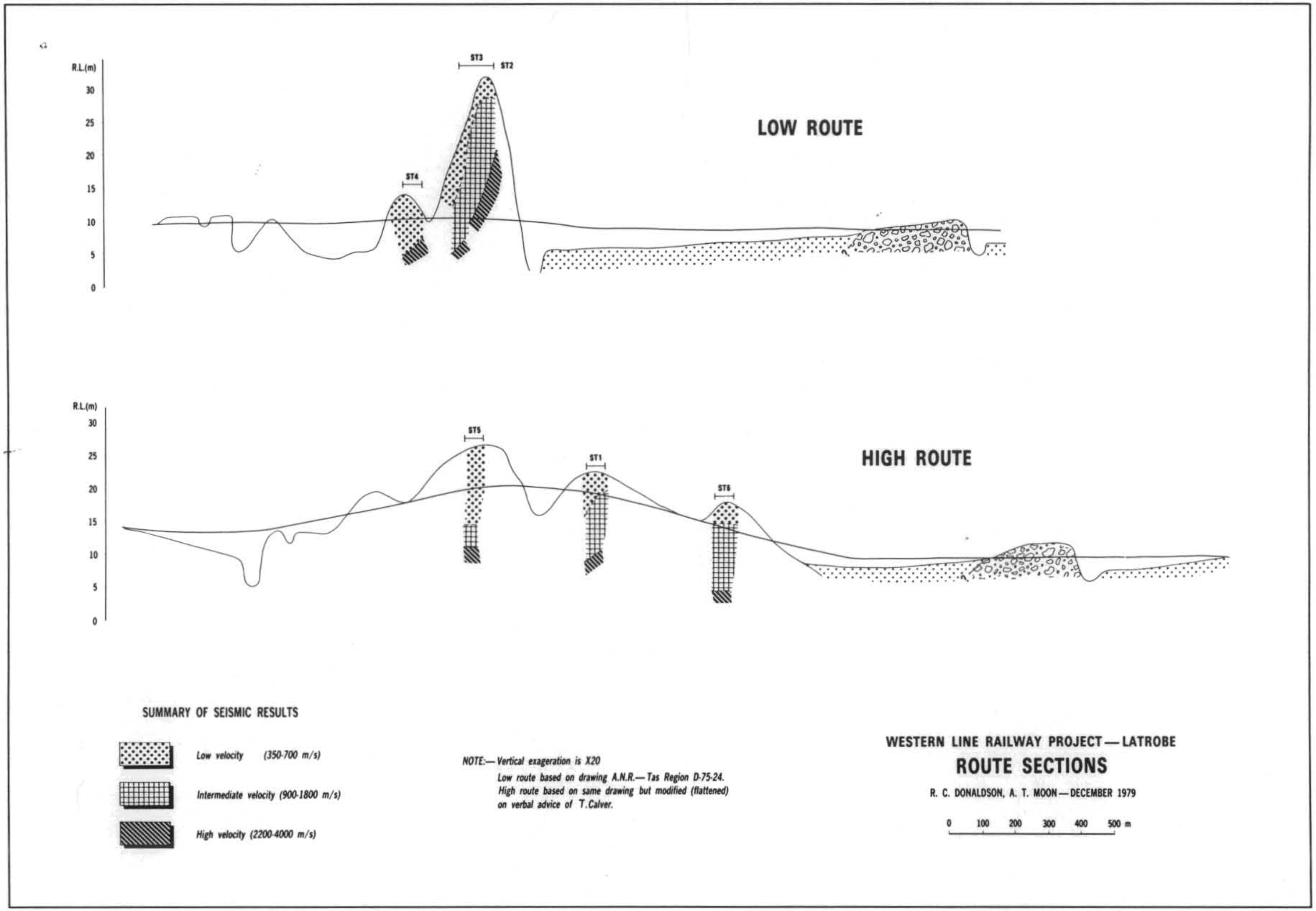

Figure 3.

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Table 1. SEISMIC VELOCITY AND INTERPRETED MATERIAL

Velocity (m/s)	*Interpreted material*
350 to 700	Topsoil and residual soil and some extremely weathered rock. Sandy silt and silty sand (ML and SM). Some clay and clayey silt in places (CH and MH).
900 to 1800	Highly weathered rock (sandstone or mudstone) contain joints and soil seams or rock fragments in very stiff or dense soil.
2200 to 4000	Compact fresh or slightly weathered rock (sandstone or mudstone).

and based on very little information.

The bottom layer (V = 2200 to 4000 m/s) will probably require blasting. Although the rock seen in outcrop is not very strong, the widely spaced bedding planes and joints (greater than one metre) will make ripping very difficult. However, the more resistant beds tend to be those seen in outcrop and thinly bedded sandstone and beds of mudstone which are rippable may occur. Ripping may be easier from south to north because of the gentle northerly dip of the beds. In view of the velocities measured and the rocks seen it should be assumed at this stage that the entire bottom layer will require blasting.

The results to date indicate that the bottom layer will not be encountered in the cuttings on the high route. The bottom layer will be located in the base of the 21 m deep cut on the low route. The depths shown on seismic traverses ST2 and ST3 are the best interpretations with the data available and they may be in error by several metres. However it appears that the top of the bottom layer occurs between RL15 and RL20 m, although it is deeper towards the north. This corresponds to the top of the sandstone outcrops in the cliff exposures (sections AB, CD and EF, fig. 1) at RL15 to 17 m. Thus it appears that up to 10 m of rock may require blasting at the southern end of the deep cut, while the northern end of the cut may require no blasting at all. The step in the seismic profiles may represent a fault trending NNW with a downthrow of 3 to 4 m to the east.

The high route will cross over the Adits A and B about 200 m south-east of Coal Hill Road. The adits are likely to occur about five metres below the railway line. The position of the adits is known and it appears that no coal was worked from immediately under the railway in this area. If subsidence occurred over the position of the adit the area could be backfilled and/or bridged.

The low route under the deep cutting may also be undercut by adits and also old coal workings. It is not possible to say where and how extensive the old workings are but they could occur within five metres of the base of the deep cut.

No detailed cost estimates for the excavations have been prepared. Recent experience of the Department of Main Roads on the Arthur Highway, near Sorell in south-east Tasmania has been that excavation by scrapers has cost about $4 per m^3 and where ripping has been involved costs have been in the range of \$6 to \$8 per m^3. These figures are verbal quotes only and based on experience with different materials. It is recommended that the Australian National Railways approach the Department of Main Roads to discuss their specific problem in order to obtain more reliable figures.

STABILITY OF CUTS

No testing of the materials has been carried out and these comments, based on verbal advice from Department of Main Roads engineers, are included for preliminary design purposes only.

The low velocity top layer will probably consist of predominantly sandy and silty material. These should be stable to the heights required at slopes of 1½ to 1 (horizontal to vertical). Some of these materials may be erodible and should be grassed as soon as possible after excavation.

There has been no direct observation of the intermediate layer, but for preliminary design purposes slopes of 1 to 1 are suggested.

Slopes of ½ to 1 are suggested for the bottom layer. Some of the cliffs overlooking the floodplain are stable at this angle (section EF, fig. 1).

CONSTRUCTION MATERIALS

The quantity of fill required for either of the two routes is not known. It is assumed that the routes have been designed so that the material excavated from the cuttings will be used to provide fill for the embankments so alternative sources of fill are not discussed here. It should be noted that poor subgrade conditions consisting of waterlogged silty or clay soils may exist across part of the floodplain. These have not been investigated yet but consideration may have to be given to their drainage and/or their partial removal.

About 2000 to 4000 m^3 of topping material will be required. This can either be obtained from an existing local quarry or a borrow area developed especially for the job. The only material observed which may be suitable for topping is the cobbles and boulders in a gravelly silty sand matrix which makes up the alluvial ridge (fig. 1). In some places the matrix contains clay and the material may need to be washed. Sampling and testing would be required to determine whether the material is suitable. It is estimated that several tens of thousands of cubic metres occur in the ridge, so there should be adequate reserves.

Readymix operate a crushed basalt quarry at Nook, about 15 km from the site and Brambles produce road metal at their Mooreville Road quarry in Burnie. A price for delivery on site could be negotiated with either of these operators.

CONCLUSIONS

The detailed conclusions are presented in previous sections of this report and only a summary of the conclusions is given here.

The alternative routes are underlain by sandstone, mudstone and shale of Permian age and by alluvial deposits of Quaternary age. The Permian rocks contain old coal workings.

On the present information it appears that the whole of the high route can be excavated without blasting, whereas up to 10 m of rock may have to be removed by blasting from the northern end of the deep cut. Two adits cross under the high route south-east of Coal Hill Road. Adits and old coal workings probably occur under the deep cut on the low route.

Preliminary design slopes of 1½ to 1 for soils, 1 to 1 for intermediate material and ½ to 1 for rock are suggested.

Suitable topping material may be obtainable from an alluvial ridge at the south-eastern end of the route or existing quarry operators could deliver to the site.

RECOMMENDATIONS

This is a preliminary report only and further investigations are required. Subsurface investigations of the high route could be carried out with a large backhoe. If the low route is still being considered it should be drilled. A backhoe investigation of the alluvial ridge should also be carried out and pits across the floodplain could be used to investigate the subgrade. Testing of the samples obtained from the subsurface investigation will allow a better assessment of excavation conditions, cut slope stability and construction materials.

[19 December 1979]