

Slope stability in the Mt Punter area, eastern Tasmania.

D.J. Sloane

Abstract

Slopes steeper than about 15° underlain by dolerite talus overlying Triassic bedrock are potentially unstable. Dolerite talus deposits are composed of silty clay derived from weathered dolerite and vary in the amount of angular dolerite boulders they contain. The surface occurrence of angular and tabular dolerite boulders bears no relationship to the boulder content of the underlying talus. Water moves freely along the talus-Triassic bedrock interface but areas in which water is concentrated in flow along this interface cannot be readily located from the ground surface as their location is controlled by the bedrock sub-surface topography. Road construction has cut through the talus material and exposed the underlying bedrock along the MG22 access road. This removal of support combined with the natural lubrication and saturation of the talus material by the underground water has resulted in failure.

INTRODUCTION

In response to a request by the Forestry Commission an inspection of an area to the west of Mt Punter [EP913775] was made. Recent road construction in the BI30 Forestry coop has caused several small embankment failures and one large landslip failure that has blocked an access road. The Forestry Commission was concerned that logging operations resulting in the complete removal of vegetation may cause severe landslip and erosion problems in the region.

TOPOGRAPHY

The area has a rugged topography with the dolerite capped Mt Punter and Mt Puzzler contrasting with the broad St Pauls River valley at Nowhere Else, incised in Triassic sediments (Figure 1). The area is drained by the Coal Rivulet and its tributaries which flow into the St Pauls river as it emerges from a steep dolerite gorge containing the spectacular Meadstone Falls between Mt Puzzler and Mt Misery. The slope section at the head of the Nowhere Else valley is traversed by the MG22 access road, a side road from the main road linking the Valley Road and the Old Coach Road. It is this region where instability problems have been encountered.

GEOLOGY

The cross-section of the area (fig. 2) indicates the geological relationships. The main features consist of the Jurassic dolerite capped Mt Puzzler, considered to be a remnant of a dolerite sheet, overlying a shallowly dipping sequence of Triassic sandstone, shale and coal measures (R.H. Castleden, pers. comm.). The Triassic rocks are exposed in creek beds and in the culverts along the MG22 road. These sediments range from weathered conglomerate with well rounded quartzite and occasional granite pebbles to coarse to medium-grained feldspathic sandstone and mudstone sequences containing small coal seams.

Overlying the Triassic sediments is a veneer of Quaternary talus of variable thickness. The talus is composed of angular dolerite boulders in a matrix of dolerite-derived silty-clay. The talus varies in the proportion of dolerite boulders it contains from almost entirely (>95%) silty-clay to approximately 50% dolerite boulders. The clayey matrix has a moderate

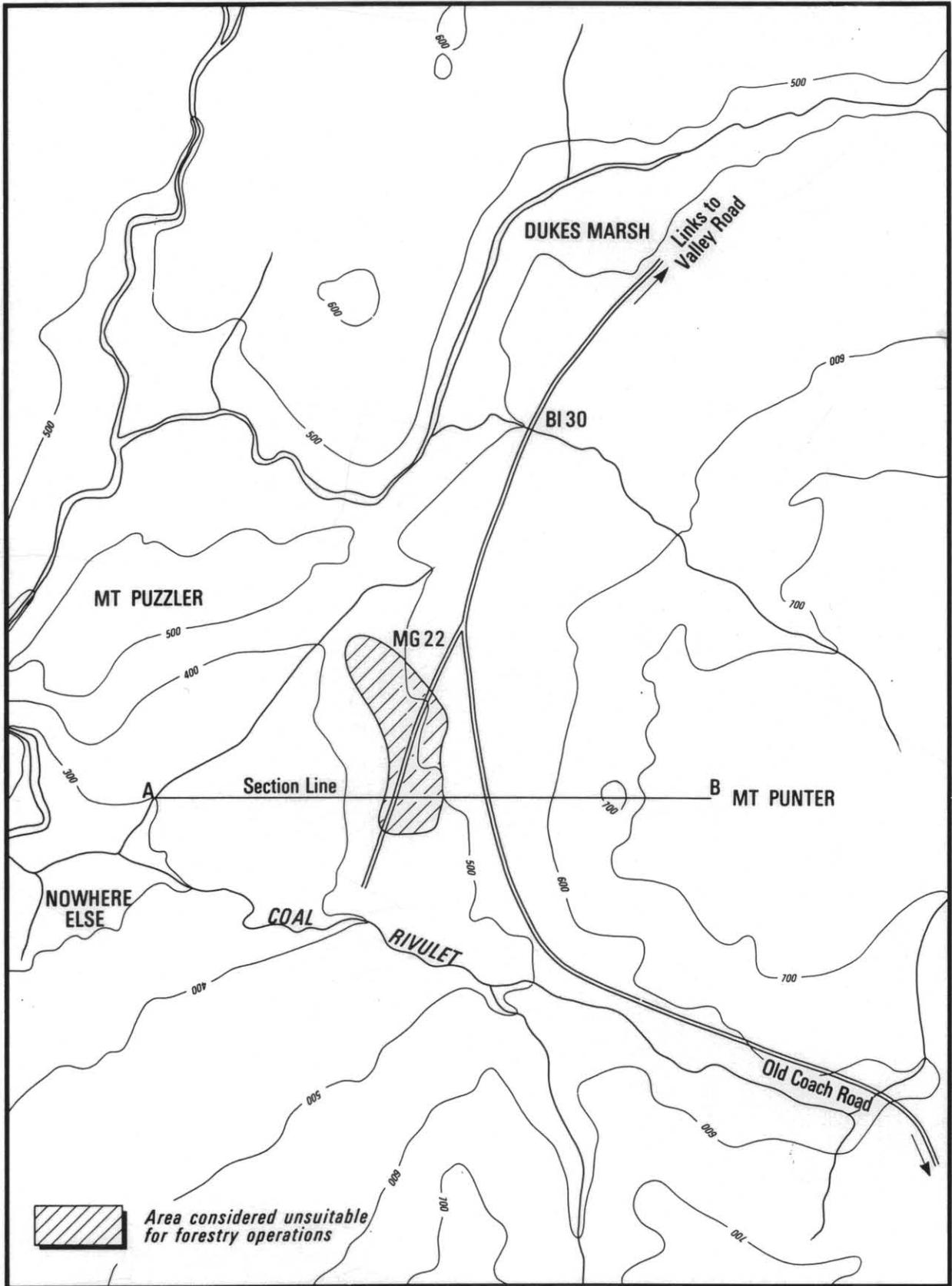


Figure 1. Sketch map of Mt Puzzler - Mt Punter area

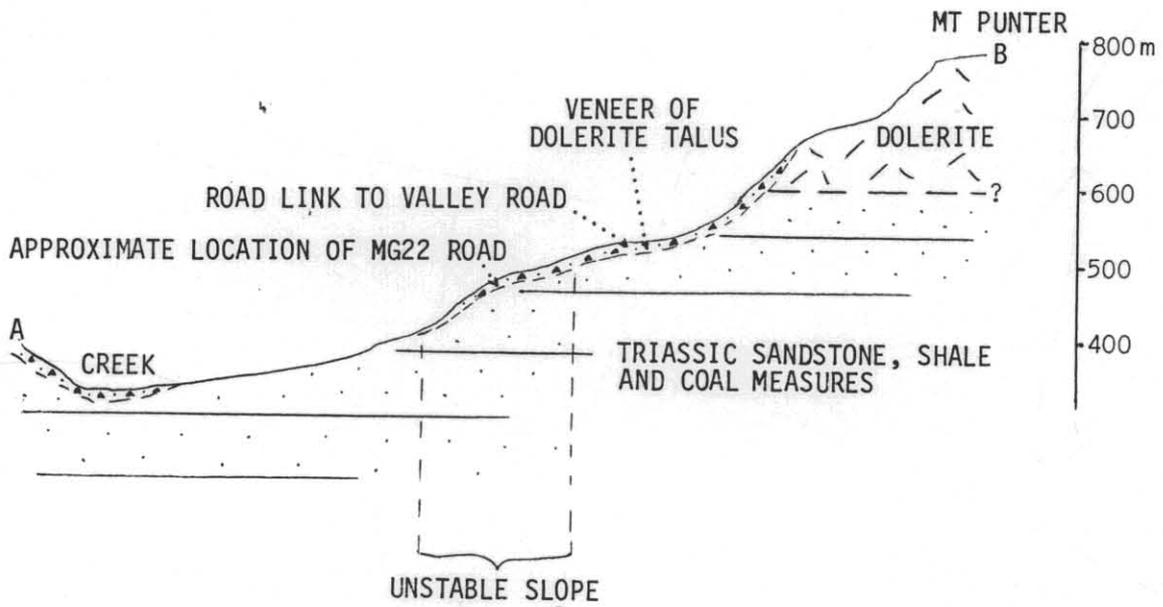


Figure 2. *Diagrammatic cross-section A-B*
(D.J. Sloane and R. Castleden)



Plate 1. *Toe area of main landslide blocking the MG22 access road. Note large tree still upright after being transported some 15m from its original position.*

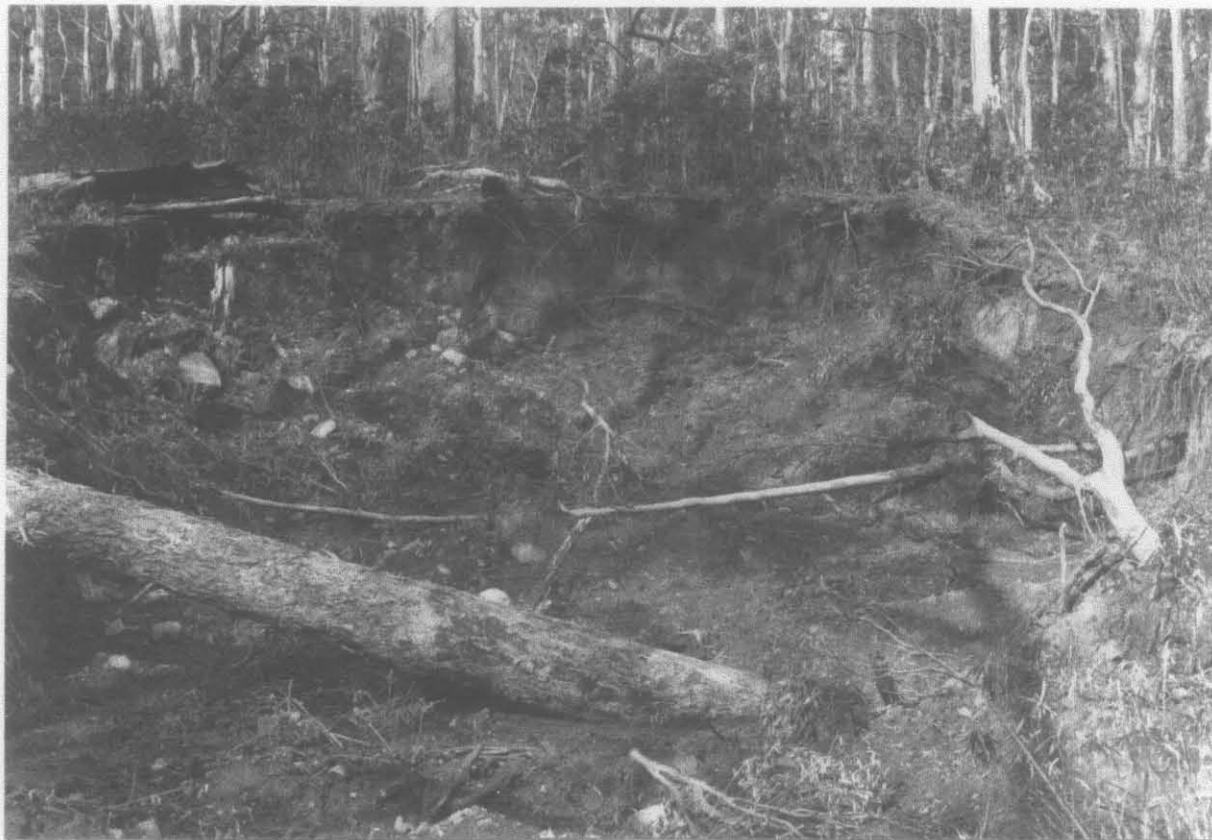


Plate 2. *Head scarp of main landslide. Note shallow tabular nature of slip with near vertical head scarp and side scarps.*

linear shrinkage as numerous dessication cracks can be seen where the material is exposed in road embankments. The surface occurrence of angular dolerite boulders cannot be taken as an indication of the amount of boulders in the underlying talus. Sections exposed in road embankments show less than 5% dolerite boulders while the ground surface is completely covered with angular dolerite slabs. This contrast may be indicative of climatic change between the deposition of the boulder strewn surface deposit, caused by a greater freeze-thaw and creep component and the deposition of the underlying silty-clay talus. The underlying deposit could indicate that previously weathered dolerite material has been subject to mass movement in a nearly water saturated condition resulting in a solifluction deposit. Climatic conditions were probably much colder than at present and a past glacial environment is considered suitable for the deposition of this material. Some of the boulders seen on the ground surface are very large. These boulders are sometimes 15 m in length and have been rafted on the solifluction(?) deposits over distances of 2 km or more from the nearest dolerite outcrops. The boulders appear to be derived from dolerite columns and generally have their long axes approximately aligned in the direction of the local slope.

SLOPE INSTABILITY

One large landslide has occurred which has blocked the MG22 access road (plate 1). The landslide is approximately 25 m wide by 75 m in length and between 4m and 5 m in depth. The head and side scarps are almost vertical and show good exposures of the talus material which has failed. In the head regions of the landslide small patches of the underlying Triassic rocks are exposed and evidence can be seen of patches of weathered Triassic rocks that have been included in the landslide material as it moved over the bedrock. From the talus exposures along the MG22 road the landslide occurs where the talus is thickest. Elsewhere along the MG22 road talus thicknesses range between 1 and 2 m. In the region of the main landslide the road is benched into a small hillside spur. This spur may in fact be the toe area of an old landslide. A short distance upslope from the active landslide morphological features belonging to an old landslide can be recognised. A small arcuate steeper slope segment can be seen while downslope from this is a flat section which is sloping back towards the regional hill slope. This 'back-slope' area also has trees which lean back towards the hill slope. Since this feature appears to be an old landslide and its presence explains the existence of a greater thickness of talus in the region of the active landslide as this area is probably the toe of the old slip. A previous history of failure may also be indicated by an exposure of talus material just to the north of the landslide. Here a small stream has eroded to the bedrock adjacent to the road and the talus has also been cut during road construction. The talus overlying the bedrock can be separated into a lower and upper deposit (plate 3). The lower deposit is composed largely of weathered dolerite derived silty clay containing about 5% to 10% of angular dolerite fragments. At the base of this unit there is a predominance of large dolerite boulders up to 0.5 m in diameter. The upper deposit is largely silty clay with less than 10% of dolerite fragments. At the interface of the two deposits discolouration has occurred indicating a possible hiatus between the deposits with weathering and incipient soil profile development occurring on the lower talus deposit before the upper solifluction, or possibly landslide material, was deposited.

The predominance of large boulders at the base of the lower talus material could explain the large amount of water which appears to flow underground through the talus. In several places where road construction has excavated to bedrock springs have been intercepted. This feature explains the lack of surface streams along this talus slope as most surface



Plate 3. Talus exposure adjacent to main landslip MG22 road.



Plate 4. *View of main landslide looking from the headscarp towards the toe area; note prone tree in centre.*



Plate 5. *Prone tree carried by landslide has shattered against an upright tree on the stable area adjacent to the main landslide.*

water infiltrates quickly through the porous talus and then passes along the talus-Triassic bedrock interface.

Most failures along the MG22 road are small embankment failures, a result of oversteepening of the talus material during road construction. The talus material contains few dolerite boulders in these areas and the clayey talus has a moderate coefficient of linear shrinkage as indicated by dessication cracking. These properties combined with some saturation from both surface waters and a rising watertable has resulted in failure where the angle of internal friction of the material has been exceeded by the embankment slopes combined with a removal of support due to the embankment excavation. There seems to be no correlation between embankment failure and the embankment heights along the road.

The large landslide which has blocked the road could be classified as a tabular debris slide. Its main features have been described previously. The debris material appears to have been water saturated during failure. This is indicated by the completely disaggregated appearance of the failed material (plate 4) compared to landslips in other areas where progressive failure has resulted in a series of 'slices' in the head region of the slip. A large tree has remained upright during failure and is now sitting on the debris toe at the edge of the original road indicating a displacement of at least 15 m.

Some idea of the speed of the landslide can be obtained from inspection of a large tree carried down with the debris. The tree is lying perpendicular to the direction of movement the butt becoming buried in the water saturated landslide debris (plate 4). Movement of the landslide has resulted in the tree striking another tree on the stable area adjacent to the landslide. The force of impact has shattered the tree carried by the landslide (plate 5). This is indication of rapid failure of material which was probably fairly liquid.

The main landslide is tabular in nature, the base of the landslide approximately parallelling the ground surface slope of 12°. Water flowing at the base of the talus material has provided lubrication at the base of the landslide which is located at the bedrock-talus interface. The water has also caused saturation of the talus in this region. Once disturbance has occurred it is likely that water moves up into the material due to increased pore pressures and the talus may even become thixotropic.

RECOMMENDATIONS

The areas of steep slope adjacent to the road in the BI30 crop have been outlined to R. Van Schie and P. Duckworth of the Forestry Commission. The area will subsequently be marked out and no logging operations will be conducted in this area. The region has been approximately outlined on the accompanying map (fig. 1). Forestry operations will be conducted during the dry summer months to further safeguard any potential instability. The toe area of the main landslide will be removed and the embankment so formed will be reduced to at least 1:1 batter. Further movement of the slip material may occur due to the removal of this toe area and the road may have to be cleared if further movements occur. Elsewhere where embankment failures have occurred and where large steep embankments have been made these should be reduced to a 1:1 batter or less. If renewed movement of the landslide becomes excessive and it becomes uneconomic to maintain the road then logging operations may have to cease below this point. Road drainage should be constructed and maintained to enable rapid dispersal of water from the upper side of the road.

ACKNOWLEDGEMENTS

The assistance and cooperation of Forestry Commission staff in useful discussions is appreciated and acknowledged. Their policy in restricting logging operations will do much to minimise the potential instability and consequent damage to the landscape.

[14 December 1978]