

1979/47. A landslide at Deviot

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Abstract

A landslide about 500 m north of the Deviot Post Office is endangering the road which runs along the shoreline of the Tamar River. The slip occurred during the week ending 26 October and was probably caused by a combination of heavy rain and high tides. Drainage from a swamp discharges on the embankment where the slip occurred and this would ensure that the clay in the slip area is kept in a moist and softened state. A drainage system that will maintain a low water table around the embankment is suggested. Because of the past history of movement along this section of road, other measures should be examined. These should include diversion of the road and piling or the placement of fill (protected from tidal action) along the toe of the slope.

INTRODUCTION

The Beaconsfield Municipal Council requested an inspection of a landslide that is affecting the road 500 m north of the Deviot Post Office [DQ936358]. An examination of the area was made on 29 October and again on 31 October. The request for inspection was made on 26 October, the movement apparently beginning in the preceding week.

RELIEF

The land surface is gently sloping in the vicinity and because of this, most was placed in Class II on the Landslip Zone map of the Tamar Valley. However, along the foreshore are parts of the river bank which slope steeply and attain heights of over 10 m. This is the situation where the landslide has occurred.

GEOLOGY

The area is underlain by Tertiary sediments and basalt. The basalt is coarse-grained and the outcrop patterns suggest that it intrudes the Tertiary sediments. Where exposed along the foreshore, the sediments consist of brown and light grey plastic clay with some seams of iron oxide. Near the slip is a large nodule or lens of siderite about two metres across.

X-ray diffraction analysis of the clay sediments in the slip shows that kaolinite is the dominant clay mineral present, with a moderate amount of montmorillonite and small amounts of illite. The last two minerals show considerable expansion when wet, whereas kaolinite is much less expansive.

SLIP FEATURES

The landslide has taken place on the bank of the River Tamar where it rises some 10 + metres above the river at a steep angle. The toe zone extends over a distance of about 45 m along the foreshore, while the slip heel extends along the eastern side of the road for a distance of about 30 m. As a result of the first movements, the council filled the heel area with gravel to road level, but continued movement from 26 to 29 October produced a further vertical displacement of about 400 mm. Movement between 29 and 31 October produced a further drop in the heel zone of the slip of about 300 mm.

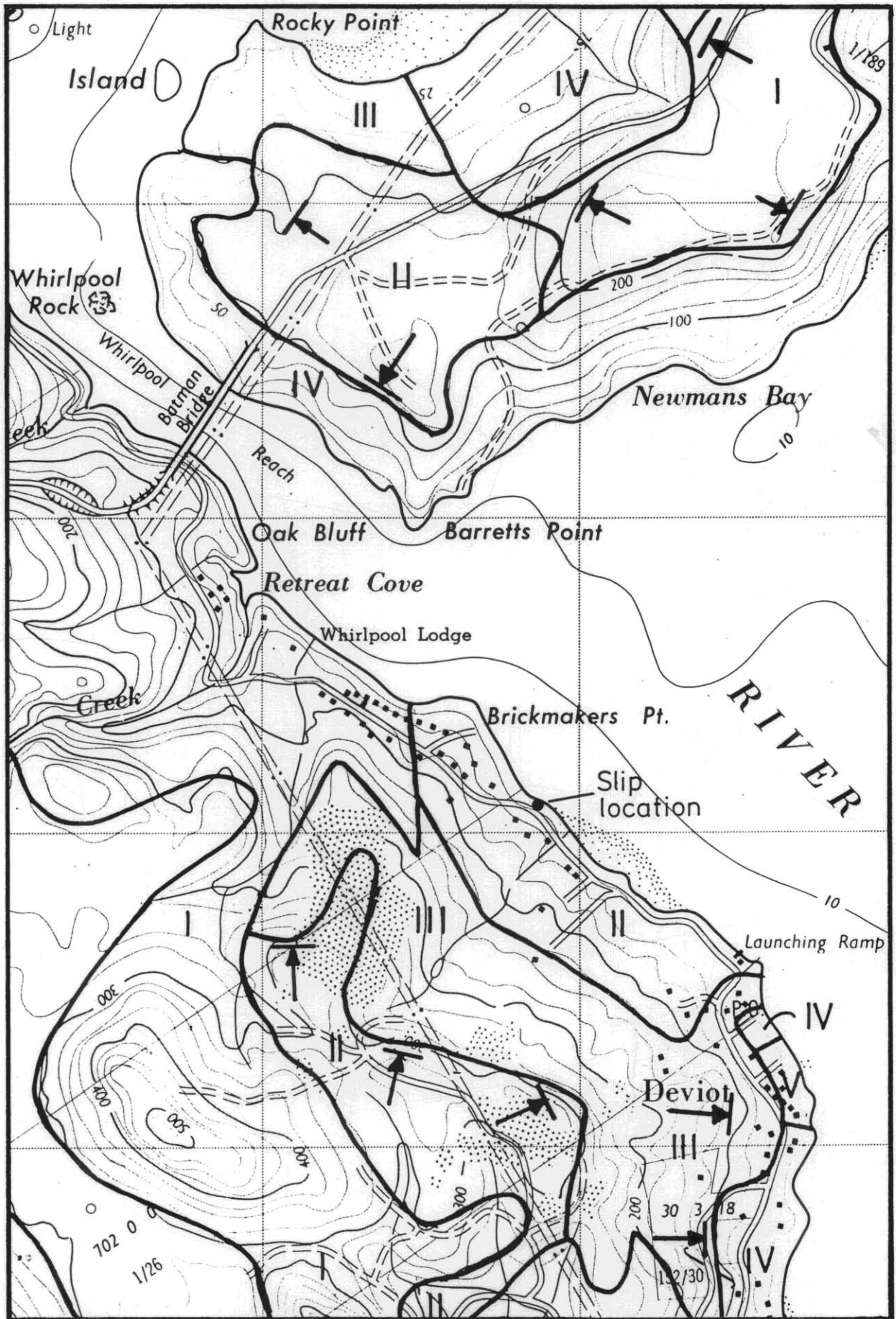


Figure 1. Location of landslide, Deviot

The angle of the slope from the road to the foreshore on either side of the slip is about 30 - 40°. The movement in the slip area has lowered the overall slope to the shoreline. About 10 m north of the slip a small crack extends for about 10 m along the eastern edge of the road. This may be a slight movement isolated from the larger one or may be caused by loss of lateral support as a result of the larger slip. About 60 m further north, a small crack extends across the road. If a large movement took place here, the whole road would be disrupted. This area was extensively repaired some four years ago after a failure and deep drainage was installed. Apparently the road was also repaired three times after movement about 20 years ago.

A culvert extends under the road at the site of the present slip and discharges water onto the embankment. This water is derived from a swamp area some 200 m west of the road. The site where previous repairs have been undertaken is also a drainage area. Since the movement has taken place, a pipe has been installed to carry the water to the lower part of the toe of the slip.

Inspection of the shoreline in the area shows that widespread movements have taken place in recent times and that it is almost certain that they occurred at the same time as those described above. From the area of the main movement to Brickmakers Point some 200 - 300 m to the north, about half of the length of the bank along the river has been subject to small slumps. Less material is involved because of the lower bank height, and the road is unaffected as it diverges west from the river about 70 m north of the slip. The river embankment is less affected south of the main slip.

CAUSES OF SLIP

Because of the extent of the movement in areas other than where the road is affected, it is apparent that there is some common cause. It is probable that the current movements are associated with widespread rain that has fallen in the area during 23 and 24 October, with recordings of 19 and 14 mm at Beaconsfield, 8 and 37 mm at Launceston and a total of 40.5 mm at Deviot. The rain was apparently extremely heavy during two short periods. It is probable that such deluges saturate the riverside embankment as both groundwater and surface runoff would concentrate here. If this saturation coincided with high tides, this would aid in producing unstable conditions. High tides on 25 October had a long high level period. On 28 October, the high tides measured at George Town were up to 0.2 m higher than those recorded on the six previous days.

An additional factor which probably contributes to the unstable conditions is the drainage from culverts discharging on the steep embankments to the river. This tends to keep the clay in the embankment in a weak and softened state.

REMEDIAL MEASURES

Landslips are likely to be a continuing problem in the area. There is a risk of landslide where the road is built on the edge of high steep embankments underlain by Tertiary sediments. When movement occurs, the high tides will eventually remove some of the material at the toe of the slip, maintaining a steep slope. Once a movement has taken place, the material in the slip remains in a weakened state for some years after the initial movement.

As is usual for most slip areas, drainage is an aid to stabilisation that could be undertaken. If the water table can be kept low on the embankment, movement is less likely. Now that a slip has occurred, it would be advantageous to design a drainage system for the swamp area that did not pass through the slip. Even small movements would be likely to disrupt the drainage and keep the slip material wet. Water from any drainage system installed for the slip area, or for the swamp west of it, should be piped to river level and not allowed to discharge on the embankment.

Apart from drainage, three other possible solutions could be examined.

- (1) Diversion of the road inland. It is apparent that for a short section, where the road runs along the edge of the high river embankment, movement will be a continuing problem. A route without landslip problems could almost certainly be found further west.
- (2) Piling. The volume of material involved in the slip is not large despite the slip's dimensions. Piling has been a solution used occasionally to stabilise landslips along the Tamar. However, the action of driving the piles could cause further serious movement on the present slip and in adjacent areas. The pile driver itself would endanger the area behind the present slip (i.e. the road). Because of the soft nature of the material in the slip, piling would need to be closely spaced and quite deep. Some subsurface investigations would probably be required before a programme of piling could be initiated.
- (3) Loading the toe. The difficulty with placing fill against the toe area is access. Tipping material over the face from the road would only tend to push the slip further and increase the danger of extending the movement to include the road. The placement of a loading material against the toe and extending it upslope towards the road at a shallow angle would be one method of stabilising the area. Protection of the material would be needed to prevent its removal by tides.

The three measures above are likely to involve considerable expense. The last two do not solve the problem of future landslips that may form adjacent to the present one although they may be less expensive than road diversion.

[9 November 1979]