



Division of Mines and Mineral Resources — Report 1990/39

Inspection and drilling at a house lot at Windermere

by W. L. Matthews

Inspections and investigation work have been undertaken on a block of land in Windermere Road, Windermere, on several occasions, with the block initially inspected for the owner in 1987.

The block has an average slope angle of about 15° and is underlain by sediments of Tertiary age. The slope is uneven and this may be due to old landslip movements or to differential erosion. A shallow valley extends down the eastern margin of the lot.

Tertiary-age sediments often consist of plastic clay where exposed at nearby locations. If similar material was to underlie this lot there would obviously be some risk of unstable conditions developing considering the slope of the land and its position at the foot of the slope. Fronting on to the Tamar estuary would also ensure that the toe of the slope would often be in a very moist and low strength condition.

Although there were houses on each side of the lot, with the house on the eastern side in a comparable position to the pegs on this lot, each piece of land in this area should be considered separately. One house in the vicinity has been affected by landslips and cracks in others may be due to landslip. For these reasons subsurface investigations were recommended because of the doubt about the future stability of the lot. This would allow the material at depth to be examined as well as investigating the groundwater conditions. It

was recommended that the work be undertaken by an auger drill with a capability of taking undisturbed samples, although access may have prevented this and a backhoe may have to be used.

Drill holes

Four holes were drilled to various levels during 1988 (Appendix 1). Hole 1 was drilled by a trailer-mounted drill while the lower holes had to be drilled with hand motorised equipment because of the steepness and the wet nature of the lot when the work was undertaken. The slope angle over the lot averages 15°.

Clay, silty clay, sandy clay and some gravelly material were encountered in the holes. The lower holes contained gravel that was too coarse to penetrate with the hand drill.

Various tests were undertaken on samples from the drill holes (Table 1). Atterberg limits (LL and PL) show moderate to fairly high plasticity and linear shrinkages are also moderate to high. The clay fraction has been analysed and the expansive clay mineral montmorillonite is in moderate to high proportions while kaolinite makes up most of the remainder. Gibbsite is in small proportions. One shear strength measurement has been made with a value of $\tau = 15$ and $c'_r = 4$.

Table 1
Soil testing results

Hole No	Depth (m)	LL	PL	LS	τ (°)	c'_r (kPa)	Clay fraction		
							Montmorillonite	Kaolinite	Gibbsite
1	1.5	65	21	18					
1	3.4	84	22	21	15	4	40	60	
1	6.7	57	23	15			15	80	5
2	2.4	63	21	17					
4	1.2	105	26	23			40	60	

Analyses and measurements by R. N. Woolley

Preliminary stability analyses were performed using this shear strength value. These indicate that the land may be stable under dry conditions or when the water level underground is relatively deep, but potentially unstable when water levels are shallower. Factors of safety (FS) of 1.3 or less are regarded as indicating unsafe conditions. From these results, development of the lot appears risky.

Before a final conclusion on the stability was made, it was proposed to undertake another shear strength test when the equipment became available and to dig a hole with a backhoe towards the bottom of the slope to examine how thick the gravel layer is and what underlies it.

Test pits

Subsequent to the 1988 investigations two test pits were dug on the lower part of the property.

The first pit, on the southeast side, encountered gravelly material and sediments with a relatively low clay content. The pit on the southwest corner encountered more clayey material and a strength test on this produced residual values of $\phi'_r = 13^\circ$ and $c'_r = 2$ kPa. These are lower than the results previously obtained from a drill hole ($\phi'_r = 15^\circ$, $c'_r = 4$ kPa). Stability analyses using the previous values indicated that stability was doubtful under a range of circumstances. As the subsequent values are lower, the use of these in stability analyses would result in more doubtful future stability being indicated.

From these results it cannot be recommended that the lot be developed for housing unless significant support is added to the slope and deep drainage is installed to ensure that groundwater is kept to low levels below the surface.

[30 October 1990]

APPENDIX 1

Logs of drill holes

Hole 1

0 - 0.3 m	Dark brown sandy clay, moist.
0.3 - 1.5 m	Lighter brown plastic clay, moist.
1.5 - 2.4 m	As above with a little silt, slightly moist.
2.4 - 4.3 m	Light brown silty clay, fragmental, slightly moist.
4.3 - 4.9 m	Light brown sandy silty clay, fragmental, moist.
4.9 - 5.2 m	Silty clay, a little sand, fragmental.
5.2 - 6.7 m	Light brown silty clay, fragmental, moist.

Hole 2

0 - 1.2 m	Brownish grey plastic clay, basalt boulder.
1.2 - 2.4 m	Light brown silty clay.
2.4 m+	Blue-grey plastic clay, fairly stiff.

Hole 3

0 - 0.3 m	Dark brown plastic clay.
0.3 - 0.9 m	Brown plastic clay.
0.9 - 1.4 m	Gravelly material.
Difficult to drill further.	

Hole 4

0 - 0.3 m	Dark plastic clay.
0.3 - 1.5 m	Light brown plastic clay.
1.5 m+	Gravelly material, very hard to drill.