UR1990_29

Tasmania Department Of Resources and Energy

Division of Mines and Mineral Resources — Report 1990/29

Interim report on a landslide at Hone Road, Rosetta

by B. D. Weldon

INTRODUCTION

The Division of Mines and Mineral Resources was requested to conduct an investigation into the cause of the structural damage to houses in the Hone Road area of Rosetta. The request was from Dobson Mitchell and Allport, Barristers and Solicitors for the Glenorchy Council. The investigation consisted of a subsurface sampling programme, which included back-hoe test pits and auger holes. This is an interim report by Engineering Geologist B. Weldon to initiate discussion and to enable decisions to be made about the future course of investigations.

GEOLOGY

The geology of the area has been mapped by Leaman (1972). The mapping does not accurately depict the complex nature of the materials in the area. The oldest rock type in the area is Permian age mudstone, siltstone and minor sandstone. This rock occurs in test pits behind the homes on the upper side of Hone Road. Permian age sediments also occur at the corner of Crosby Road and Officer Street. Triassic age quartz sandstone, the next youngest rock type, crops out at the corner of Officer Street and Hone Road. Here a small dyke of the next youngest rock type, Jurassic age dolerite, intrudes the sandstone. Dolerite crops out beneath the transmission lines near Gunn Court and in the road cuttings on the extension to Nathan Street.

Figure 1 is presented as a fact map showing the locations of rock exposures and the positions of test pits and auger holes. Table 1 summarises the materials encountered in the test pits and auger holes.

The auger holes (except those marked with an asterisk) were drilled with a petrol-driven hand-operated auger drill which has limited capacity. This was used to provide near-surface details on the materials from sites inaccessible by back-hoe or trailer-mounted drill rigs. Those holes marked with an asterisk were drilled using a trailer mounted hydraulically-driven drill rig.

The word 'affinities' has been used here as the materials are considered to be slope deposits produced from mass wasting processes rather than being *in situ*. The materials encountered were usually sandy or silty clays containing gravel to boulder size particles of variably weathered rock of the age(s) denoted. The materials in the test pits appeared to have a permeability which varied rapidly within the pit from moderate to low. Samples from the test pits are presently being examined to determine whether spores, which can be dated, are present.

Table 1. *SUMMARY OF HOLES DRILLED*

Drill Hole	*Method*	*Depth (m)*	*Material*
1	test pit	1.4	Permian rock, considered *in situ*
2	test pit	1.1	Permian rock, considered *in situ*
3	test pit	2.9	Triassic affinities on west side, Permian affinities on east side
4	test pit	3.0	Triassic and Permian affinities
5	test pit	3.0	Permian affinities
6	test pit	2.9	Triassic affinities
7	test pit	3.3	Permian affinities
8	test pit	4.0	Triassic affinities but with dolerite and Permian gravel/boulders
9	test pit	2.4	Triassic affinities but with dolerite boulders
A	auger hole	3.9	Permian affinities
B*	auger hole	5.4	Permian affinities
C*	auger hole	6.9	Permian affinities
D	auger hole	1.4	Triassic affinities
E	auger hole	5.4	Triassic and Permian affinities
F	auger hole	2.8	Triassic affinities
G	auger hole	1.5	Triassic affinities

The relative topographical positions and the observed distribution of the various materials indicates that the area has either been faulted or has been subjected to gross slope mass movements in the past, or both.

GEOMORPHOLOGY

A NW-SE trending ridge is located between Marys Hope Road and Radcliffe Crescent. The SW face of the ridge has a slope in excess of 20 degrees. Localised, surficial slope movements appear to have occurred on this slope in the past. The NE face of the ridge has a slope of about 15°, but the slope is locally steeper. Hone Road is built on this slope. The ridge terminates in an E–SE facing slope of up to 25 degrees.

Marys Hope Road is located in the valley of Jacques Creek. The valley is constricted by the termination of the ridge at its SE end. Examination of aerial photographs indicate that

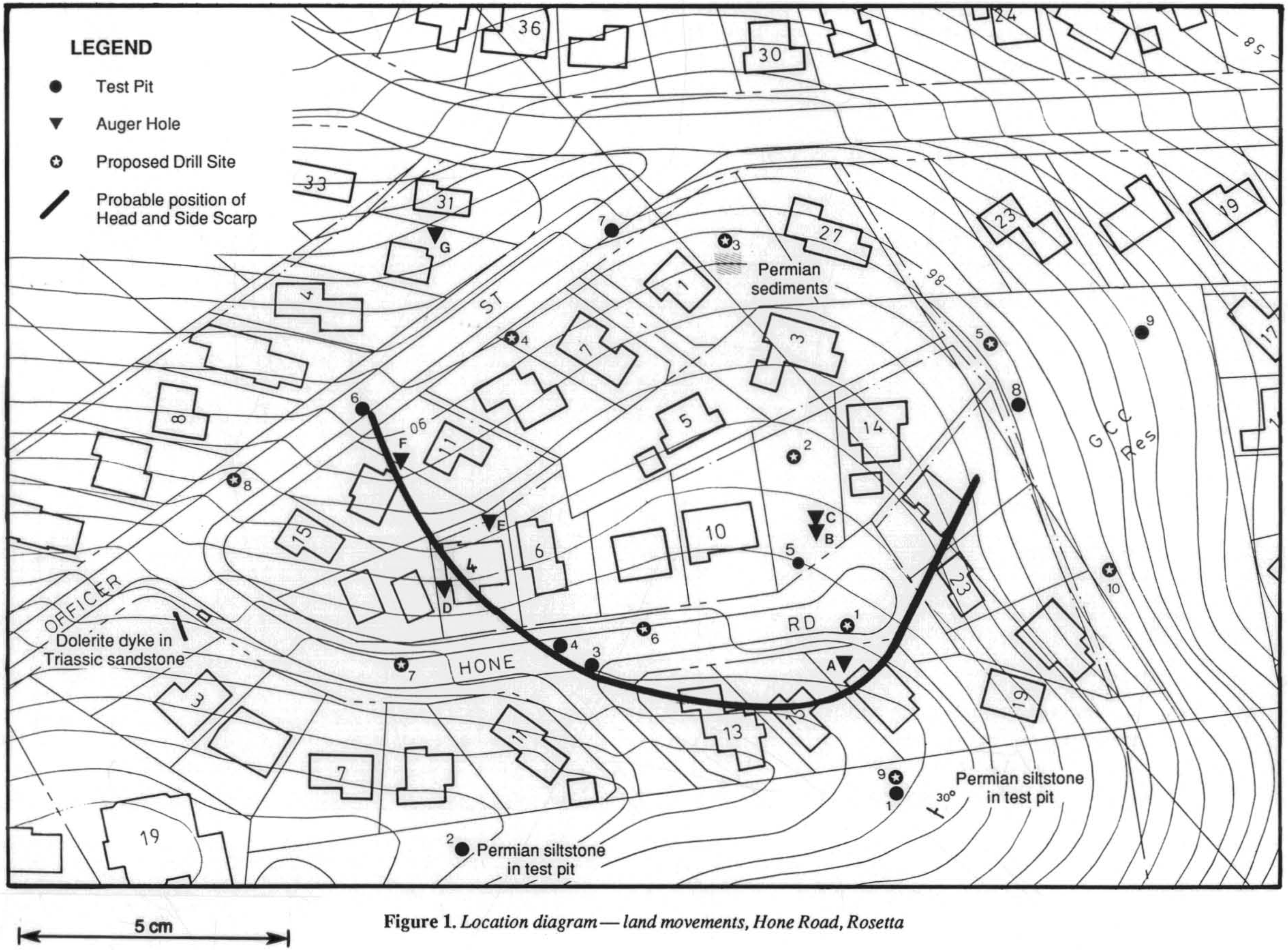

Figure 1. *Location diagram — land movements, Hone Road, Rosetta*

2/19

in recent geological time a landslide has probably occurred on the E–SE face where the ridge terminates. Homes on the upper side of Taylor Court are probably built on the ancient (i.e. probably pre-European settlement) landslide debris. The aerial photographs also indicate that an ancient landslide may have occurred from the un-named cul-de-sac in Hone Road towards Officer Street in a northerly direction. The toe of this landslide appears to be on the downslope side of Officer Street. The area involved in this movement is covered by trees in the March 1946 aerial photographs but in the March 1973 photographs, the area had been cleared and a scrubby vegetation appears to have developed.

Test pits on the ridge line (test pits 1 and 2) exposed Permian rock dipping at between 28 and 38° in the direction of 070° (i.e. in a ENE direction). This may account for the relative stability of the slope on the SW face of the ridge where the dip direction is into the slope. On the NE face of the ridge, the dip of the rock appears to be generally steeper than the slope. If the dip flattens to a dip which is less than the slope angle then this may result in potential instability. Lower on the slope the exposures in test pit 7 indicate that the dip on the rock may be different to that on the ridge, with the bedding flatter than the slope angle. This may therefore be a factor in the current instability problem.

HYDROLOGY

During excavation of the water main in the un-named cul-de-sac off Hone Road, water was observed issuing from rock at 0.6 m below ground level. A sample of this water was analysed for fluoride content by the Government Analyst. The fluoride content was 0.2 milligrams per litre (i.e. 0.2 ppm). The fluoridated water supply in the area is expected to have a fluoride content between 0.9 and 1.1 ppm. If the clays are under-saturated with respect to fluoride, the fluoride may be absorbed into the crystallographic structure of the clay, and therefore may not be detected in the seepage water until the clays become fully saturated. A sampling programme is required to determine if this water source is natural seepage or results from infiltration from garden watering.

A council water main in the cul-de-sac off Hone Road was exposed by test pitting. The water main was considered to be watertight. However the trench backfill materials and the road sub-base and base courses were saturated. The source of the water appears to be similar to that mentioned in the previous paragraph. Samples of water taken from the bottom of the trench below the water main were analysed as containing 0.2 ppm fluoride. It is obvious that the trench backfill is acting as a french drain.

A stormwater pipe was revealed in test pit 3 (between 11 and 13 Hone Road). The pipe showed a crack with a 5–10 mm separation at the crown, but only a hairline crack near the base on one side and a horizontal crack about 25–30mm above the invert on the opposite side of the pipe. This pipe fracture would allow water to enter the trench backfill during times of high flow, but is unlikely to have contributed water under normal flow conditions. The trench backfill was moist.

A stormwater pipe was also exposed in test pit 7 (outside 1 Officer Street). Here again, water present in the trench backfill flowed into the bottom of the pit. The water has not been analysed for fluoride content. Test pit 6 (outside 11 Officer Street) had a small trickle of water from 2.4 m depth below street level. A service trench was not intersected by this pit. Council plans indicate that sewer, stormwater and water main pipe lines are nearby. The water has not been analysed.

A water table was not exposed in the test pitting, nor observed in the auger holes. The materials in the test pits, as noted earlier, appear to have a variable permeability from moderate to low. Several layers of 'puggy' clay were intersected at shallow depth in the holes. It is considered that the 'puggy' clays are probably receiving moisture from the french drain action of the service trenches and from individual house connections which are broken.

LANDSLIDE

The distress to the houses in Hone Road and Officer Street is considered to be associated with landslide movement. It is the author's opinion that the landslide is relatively deep seated. In support of this, the most severely distressed houses are located around the perimeter of the active zone in the head and side scarp regions, whilst houses within the body of the moving mass have cracking which is consistent with their age, type of construction, and the soils on which they are built. If the landslide was relatively shallow, more distortion is likely in the houses on the body of the moving mass. In time, these houses may show distortion if further movement occurs which results in tension cracking of the main landslide body.

Information supplied by householders suggests that some initial movement had occurred prior to December 1989. Several houses showed signs of stress prior to this time. However in December 1989/January 1990 many residents noticed cracks in their homes. The current movement which resulted in this cracking occurred in one of the driest years in the past decade. This is unexpected, as one of the main causes of a landslide is the presence of water (pore pressure). Therefore it is highly unlikely that rainfall is the trigger mechanism for the current period of movement. Upon returning from an interstate trip (in mid- December 1989), a resident observed water bubbling out of the bank in front of 13 Hone Rd. He reported this to council which apparently effected repairs the following day. The break has been reported by various sources as a shear failure in the cast iron water main to a failure of an elbow water seal caused by due wear and tear. It appears that there was a period of 8–12 hours between the resident reporting the water leak and the council effecting repairs. During this time the break was able to supply water to the subsurface materials. It is possible that this water added mass and increased pore pressure to aggravate a pre-existing failure plane which subsequently moved. This therefore may be the cause of the house cracking which was reported by numerous residents in December 1989/January 1990.

If the addition of water from the burst water main did aggravate movement on a pre-existing failure plane, then the area may be at high risk of further movement during the next period of high rainfall. Given our present understanding of the mode of failure and the granular nature of the materials involved, it is not likely that further movement will be catastrophic. Progressive failure is likely to occur in a manner similar to that already experienced. It is considered that with further movement, tension cracking may develop within the body of the landslide. This may affect those houses on the body of the landslide which presently show little sign of stress.

All materials exposed in test pits and auger holes appear to have been transported to their present locations by some process, possibly slope mass wasting in recent geological time. Only the Permian siltstone in the paddock behind the houses on the high side of Hone Road, and the Triassic sandstone and dolerite dyke on the corner of Hone Rd and Officer Street, appear to be *in situ*. The Permian siltstone on the corner of Crosby Road and Officer Street may be *in situ*. The test pit outside No 1 Officer Street encountered rock between 1.0 and 2.7 m depth but this was underlain by clay to at least 3.3 m depth. The clay may be extremely weathered Permian rock which is *in situ* but this could not be proved conclusively by the test pit exposure.

All materials encountered in the test pits and auger holes could be subject to landslide movement as they are essentially clays with varying quantities of silt, sand, gravel and boulders. Where the clay content of materials exceeds about 12%, the materials may behave principally as clay. The apparent permeability of the materials varies from moderate to low. 'Puggy' clay layers commonly occur between 0.9 and 1.8 m depth in the area examined. These clays may be receiving water from broken house sewer connections as well as from some council service trenches which appear to be acting as french drains. Whatever the source, the addition of this water causes the material to lose strength. It cannot be equivocally demonstrated that these clays comprise the zone within which movement is occurring.

Test pits 8 and 9 (in the Glenorchy City Council reserve) suggest that the materials continue to considerable depth. The failure plane or zone may occur anywhere within this depth (still to be determined), or on the interface between these materials and the underlying bedrock, or within a bedding plane or fracture zone within the bedrock itself. Stability back-analysis (Appendix 1) indicates a ball-park figure of about 12 m depth for the maximum depth to the failure plane or zone.

DISCUSSION

It would appear that the Hone Road–Officer Street–Crosby Road–Taylor Court area of Rosetta is underlain by sandy or silty clay with gravel and boulder-size rock. This material is derived from slope mass wasting processes. Prior to development the area was covered by trees. These trees would have contributed to the stability of the area. Tree roots act by increasing shear strength by binding the soil, and the trees themselves extract moisture from the ground by evapotranspiration. The tree cover of the area was largely removed during residential development of the area, and associated significant earthworks may have redistributed loads on the slope. Services have also been installed along the slope in trenches backfilled with granular materials, which now act as french drains. There is therefore a potentially long wetting front if leakage occurs from service pipes or individual house connections.

Human occupation of the area has also effectively added mass to the slope from the weight of buildings, importation of garden soil, backfill behind retaining walls etc. The overall effect of this may be a mass or weight equivalent to an additional 0.5 m of cover to the entire slope. The distribution of this mass is not uniform, and the majority of the mass would appear to have been added in the head scarp area of the landslide where it contributes to driving forces. The area was first developed in 1978 and there has been progressive building activity to 1987. The development pattern has essentially been from the lower slope upwards. Residents have established or still are establishing new gardens which require watering, often in greater frequency (and commonly quantity) than for established gardens. Some of this water may have contributed to wetting on or in the failure zone, given the apparent permeability of the materials.

Dr O. Ingles, consultant in soil engineering and risk management, has examined the volume stability of the soils in the area. Soils containing significant components of dolerite-derived material are rated by Dr Ingles as class M (see Appendix 2) for the purposes of AS2870 (residential slabs and footings). Such soils are poorly represented in the area suffering greatest distress. In this area the soils are derived mostly from the Permian or Triassic sediments. Dr Ingles rates the Permian soils as class S for the purposes of AS2870. The soils derived mostly from Triassic materials have not been tested. They are likely, depending on the clay content, to rate as class M. Therefore the soils in the area have some potential for moderate to deep cracking during dry seasons. This mechanism may provide easy access for excess surface runoff to penetrate to deeper layers within the subsurface profile.

It would appear that prior to subdivisional development, the area under investigation was in a delicate state of equilibrium with respect to slope stability. This was not recognised at the time and is easier to identify in retrospect. The cumulative effect of development as a residential area has been to progressively alter the stability balance, resulting in the landslide movements which are now occurring.

MATTERS REQUIRING FURTHER CONSIDERATION

This investigation has been confined to a relatively shallow depth, and a distinct landslide plane or zone of movement has not been clearly indicated. It is acknowledged that it may be difficult to recognise such planes or zones but there is a distinct possibility that the failure zone may be much deeper than the depths examined. Test pits 8 and 9 (on the council reserve) suggest that the slope deposits are at least 12 m thick at that site. A further investigation programme is needed should such conditions prevail over the balance of the area under consideration.

The failure plane or zone may in fact be a bedding plane or other defect within the basement rocks of the area. From observations at test pits 1 and 2 the bedding plane is inclined in the direction in which movement has occurred. The basement bedrock may have been encountered by the deeper auger holes where drilling refusal occurred. In this event the interface between the bedrock and the overlying soil-like materials is only moist and is unlikely to be the failure zone. However it is more probable that the auger holes terminated on gravel or boulders which are greater in size than the diameter of the drill augers, and which could not be broken up by the augers.

The occurrence of water in the excavations in the un-named cul-de-sac in Hone Road at 0.6 m below ground level is enigmatic if the water is from a natural source. The source of the water should be explored further by trenching from the point where the water was observed in whichever direction is required.

The council records of maintenance in the area suffering movement should be examined and compared to records from the surrounding areas, up to say 500 m outside the affected area. Records from 1978 onwards should be examined and comparisons of incident type, rate and distribution made. Such examination may provide a clue as to when the earliest movements occurred.

PROGRAMME FOR FURTHER INVESTIGATIONS

A series of resistivity traverses are proposed on the Permian sediments behind the houses on the upper side of Hone Road. The purpose of this is to determine whether there is a sharp (?near-vertical) boundary between the Permian sediments and the slope materials, or whether the boundary is gradational and more gently inclined. This will be important in determining possible remedial methods for 13, 15 and 17 Hone Road, as investigations may indicate basement rocks at shallow depth on which underpinning piles can be founded. If the boundary is near-vertical but under the houses, it may be possible to anchor a support system for the houses into the rock mass. It would be necessary to first ensure that the rock mass is sufficiently intact to achieve this, or that its intactness be ensured by grouting under pressure. As the area is developed the length of the resistivity traverses will be restricted. This will also restrict the depth of interpretation, but will provide useful information on the subsurface profile. Borings are proposed using a specialised investigative drill rig. The purpose of this is to examine the subsurface profile to a much greater depth than has been possible to date. The drill rig should be capable of auger drilling, tube sampling, standard penetration testing, and down-the-hole percussive drilling or tricone roller drilling with compressed air. Using these techniques it should be possible to obtain representative samples at regular intervals down the bore hole without having to introduce lubricating fluids. The drill rig should also be capable of diamond drilling using NMLC techniques in the event that diamond drilling was considered imperative.

The locations where it is considered desirable to drill are shown on the attached plan. The holes need to be monitored and logged by an engineering geologist to obtain maximum information. Approximate costing of this work, if undertaken by the Division of Mines and Resources, is presented in Appendix 3.

It is considered desirable that critical cracks in the more severely distressed houses be regularly monitored. An acceleration in the rate of movement of the cracks may be the precursor of a major landslide movement. An early warning of such a movement is vitally important considering the human occupancy of the area. Appendix 4 presents details of an automatic recording device which could be installed. Such a system may also include a rain gauge which would provide site-specific details about rainfall. A relationship between accumulated rainfall and movement on cracks may therefore be established.

[21 May 1990]

APPENDIX 1

Stability Analysis

Slope stability analysis is calculated using the Factor of Safety concept. A commonly used definition is:

$$\textit{Factor of Safety} = \frac{\textit{Sum of restoring forces on the slope}}{\textit{Sum of driving forces on the slope}}$$

The restoring forces include the strength parameters (cohesion and friction) and the mass of that part of the soil resisting movement. The driving forces include pore pressure, load on the soil, and the mass of that part of the soil provoking movement.

From the above equation it can be seen that the driving and restoring forces are equal when the Factor of Safety (FS) equals one. The FS becomes less than one when the driving forces predominate and failure occurs.

Stability analysis is usually simplistic and does not take into account the variability of natural materials.

Back analysis can be used to reconstruct the conditions extant at the time of failure. Since the FS equals one at failure, the equation can be used to determine the value of one parameter if the others are known.

Zero cohesion analysis is used to determine the long term stability of a slope. The assumption is that small movements of parts of the potential landslide mass over long periods of time tend to reduce the internal cohesion to zero.

The most simple form of stability analysis is for a planar failure (i.e. a block sliding on a plane) using zero cohesion conditions. The equation evaluated is given below. Input for the zero cohesion case is the slope angle, the friction angle and the pore pressure ratio. At Hone Road, the slope angle is about 15 degrees.

$$FS = \left(\frac{c'}{\gamma d}\right) sec\, \alpha\; cosec\, \alpha + \left(\frac{\tan \beta'}{\tan \alpha}\right)(1 - r_u\, sec^2\, \alpha)$$

where:

- c' = effective cohesion
- γ = density of material above the failure plane
- d = depth of the failure plane
- α = angle of slope
- β' = effective angle of internal friction
- r_u = pore pressure ratio.

The analysis indicates that if the angle of internal friction is less than or equal to 15°, failure can occur over the entire range of pore pressure ratios from a completely dry slope ($r_u = 0.0$) to a fully saturated slope ($r_u = 0.5$). Failure can occur where the effective angle of internal friction is 30° but only when the slope is fully saturated (i.e. when $r_u = 0.5$).

In the short term, some cohesion may be mobilised in resisting movement. Back analysis utilising low effective cohesion suggests that once the failure plane exceeds about 12 m depth, only small changes occur to the factor of safety. This does not preclude the failure plane occurring at a greater depth.

Circular stability analysis was examined. The equation evaluated is given below.

$$FS = \frac{\Sigma\,((c'b + (W - r_u\, b)\tan \beta')\,(\frac{1}{m\,\alpha}))}{\Sigma\, W \sin \alpha}$$

where:

- $m\alpha$ = $\cos \alpha\ (1+(\tan \alpha \tan \beta')\,/\,FS)$
- c' = effective cohesion
- b = width of slice
- W = weight of slice
- r_u = pore pressure ratio
- β' = effective angle of internal friction
- α = slope of failure plane

The heel of the landslide is defined by the cracked houses in Hone Road (No. 13–17) and the toe is probably at the intersection of Officer Street and Crosby Road. A circular failure which is about 12 m below ground level at its deepest point is indicated. Failure can occur at low effective cohesion, low effective angle of internal friction, and pore pressure ratios which suggest that the mass above the failure plane is saturated to at least half the depth to the failure plane.

The stability analyses have been performed in the absence of site specific information on effective cohesion, effective angle of internal friction and measured pore pressure ratios. The importance of the analyses is to provide indicators to the likely soil strengths and the position of the failure plane. A failure plane much deeper than the depths investigated to date is suggested. It is therefore vitally important that additional, deeper investigations be conducted. From those investigations it should be possible to obtain samples which will provide site specific strength information, to measure any pore pressure ratios, and possibly to identify the failure plane or zone.

APPENDIX 2

Site class designation according to Australian Standard 2870

FOUNDATION	CHARACTER	CLASS
Sand and rock	Stable	A
Silt and some clay		S
Moderately reactive clay	Reactive	M
Highly reactive clay		H
Extremely reactive clay		E
Sand	Controlled fill	A
Material other than sand		A to P
Mine subsidence	Problem	P
Uncontrolled fill		
Landslip		
Soft		
Collapsing soils		

APPENDIX 3

Drilling Proposal: Hone Road Area, Rosetta

Up to ten boreholes to unspecified depth are required at the locations indicated on the attached plan. The necessity for each hole must be assessed in view of the information obtained as the drilling programme progresses.

Wherever possible the holes are to be advanced by auger drilling.

Undisturbed drive tubes are to be taken at one metre intervals from the surface in materials which are soil-like. In the event that tubes cannot be driven or samples are not retained, a Standard Penetration Test (SPT) is to be performed at one metre intervals. Where SPT penetration is not being achieved over 20 successive blows, a solid cone may be substituted for the spilt tube sampler and the test recommenced.

Where advance by augers is not possible, down-the-hole hammer percussive drilling or tricone roller drilling using compressed air as the flushing medium is to be used to advance the hole. If boulders are encountered and drilled through into soil-like materials, the hole may continue to be advanced by down-the-hole percussive or tricone roller methods, or alternatively by reverting to auger drilling.

Water intersections are to be carefully recorded.

A hole cannot be terminated without the consent of the supervising geologist who will maintain a log of the hole and assess the desirability of continuing the hole by using NMLC diamond-drilling techniques with a high consistency mud which is re-circulated.

In the event that diamond drilling is required, the volume of mud prepared shall be recorded before diamond drilling commences and again after drilling is completed. Due allowances are to be made for the cutting returns and the volume of mud remaining in the hole. If additional mud is required above that originally prepared, the volume of the additional mud is to be recorded.

The depth drilled by diamond drilling shall be kept to a minimum.

The best estimate of the cost involved by the Division in undertaking this work is to allow one working day for establishment on site and one working day per hole (including moving from previous site), giving a total of 11 working days should all holes be necessary. The drill rig hire (with operators and all necessary plant) is $1000 per day giving a cost of $11 000.

The drill rig capable of performing this work is currently operating at Devonport and is unlikely to be available prior to 4 June.

It is stressed that the drilling programme is designed to obtain an understanding of the geology in the area. The results may indicate that certain types of remedial measures (such as under-pinning with piles) will be possible, but additional site-specific work is likely to be required at each damaged house site.

APPENDIX 4

Automatic Data Logging

UniData data loggers could be used at Hone Road to automatically gather information on crack movement and local rainfall. The Division of Mines and Mineral Resources has several installations throughout the State which monitor landslide movements.

The basic unit consists of a portable data logger which is mounted in a weatherproof enclosure in which a termination strip and frame are located. Various sensors are connected to the termination strip for signal conditioning prior to data being recorded by the logger. The input signal accepted is 0–2.55 volts. Each logged event is referenced to real time.

The data loggers are programmed using software running on a (laptop) IBM-compatible micro-computer. Data may be recorded at intervals in excess of 5 seconds. Up to 8 analog and 2 digital signals can be attached to the one unit. At Hone Road, linear position (analog) sensors can be positioned across cracks to monitor their movement. A relative, not an absolute movement is measured. A tipping bucket rainfall gauge (a digital sensor) would provide data on local rainfall. This is regarded as important, as a local relationship between rainfall and movement could be established to serve as a warning to the residents. If a water table is intersected in a bore hole, a water depth probe (an analog device) could also be connected to a logger to provide data for pore pressure ratio determinations.

Three installations are envisaged as follows.

1. 17 Hone Road, with a total of 8 linear position sensors connected to 15 and 17 Hone Road and one tipping bucket rain gauge.

2. 4 Hone Road, with a total of 8 linear position sensors connected to 2 and 4 Hone Road and 13 Officer Street.

3. 2 Officer Street, with up to 8 linear position sensors.

A water depth probe could be connected to any of the above installations if needed.

At the present time the Division has three loggers available for short term hire. These logers are committed to a water bore monitoring programme and will be available for several months only. The short term hire of a weatherproof enclosure, termination strip and frame and logger from the Division is $6 per day per unit. It will be necessary to purchase the required sensors. The Division has the necessary software to programme the loggers and to download data from them.

The following table lists the most current prices (excluding tax) available to us at the time of writing. The local UniData distributor is Mr M. Hills of Imbros Pty Ltd. Other suppliers produce similar devices.

Additional requirements are an IBM compatible micro-computer, data transfer cable and software.

ITEM	COST ($)	QUANTITY	TOTAL ($)	
Weatherproof enclosure	113.41	3	340.23	
Termination strip and frame	155.84	3	467.52	
32K logger	733.67	3	2201.01	
Tipping bucket rainfall gauge	756.04	1	756.04	
Linear position sensors in lots of 10	19.50 ea	24		468.00
in lots of 25+	17.34 ea	25	433.50	
2 m capacative water probe	321.40	1	321.40	
or 5 m water depth probe	651.29	1		+329.89
		TOTAL	$4519.70	

APPENDIX 5

Engineering logs of test pits

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ENGINEERING LOG – EXCAVATION

excavation no. 1

sheet of

project HONE RD ROSETTA

location rear of No 15 HONE RD

co-ordinates

R.L.

excavation dimensions

exposure type test pit

equipment JCB 3CX

operator

pit commenced 30-4-90

pit completed 30-4-90

logged by BDW

checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
	NIL			0.10		CL	SILTY CLAY black mod-low plasticity TOPSOIL	M	Fb		
				0.50		GC	GRAVELLY SILTY CLAY medium grey moderate plasticity silty clay with sub angular to angular medium size Permian siltstone	D	Fb		
				1 1.40			SILTSTONE: brown-grey variably weathered in-situ Permian siltstone Major beds about 300mm thick	D-M			beds dip in direction 070° at 30-38° Iron staining on joints Clay to 10mm thick between bedding
							END OF EXCAVATION				

sketch

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

REPORT 1990/29

PAGE 11

excavation no.

sheet 2 of

11/19

project HONE RD - ROSETTA   location rear of Nº 9 HONE RD

co-ordinates

R.L.

excavation dimensions

exposure type test pit

equipment JCB 3CX

operator

pit commenced 30-4-90

pit completed 30-4-90

logged by B DW

checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
	NIL			0.05			SILTY CLAY, black, mod-low plasticity TOPSOIL	M	Fb		
				0.35			SILTY GRAVELLY CLAY light grey-brown moderate plasticity, angular med-fine gravel	D	Fb		
				1.10			SILTSTONE: brown-grey siltstone (Permian age) variably weathered iron staining on joints, clay (dark grey, high plasticity) on joints and between bedding	D - M			
							END OF EXCAVATION				

5 cm

sketch

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no. 3
sheet of

project HONE RD - ROSETTA   location Outside No 13 HONE RD

co-ordinates
R.L.
excavation dimensions

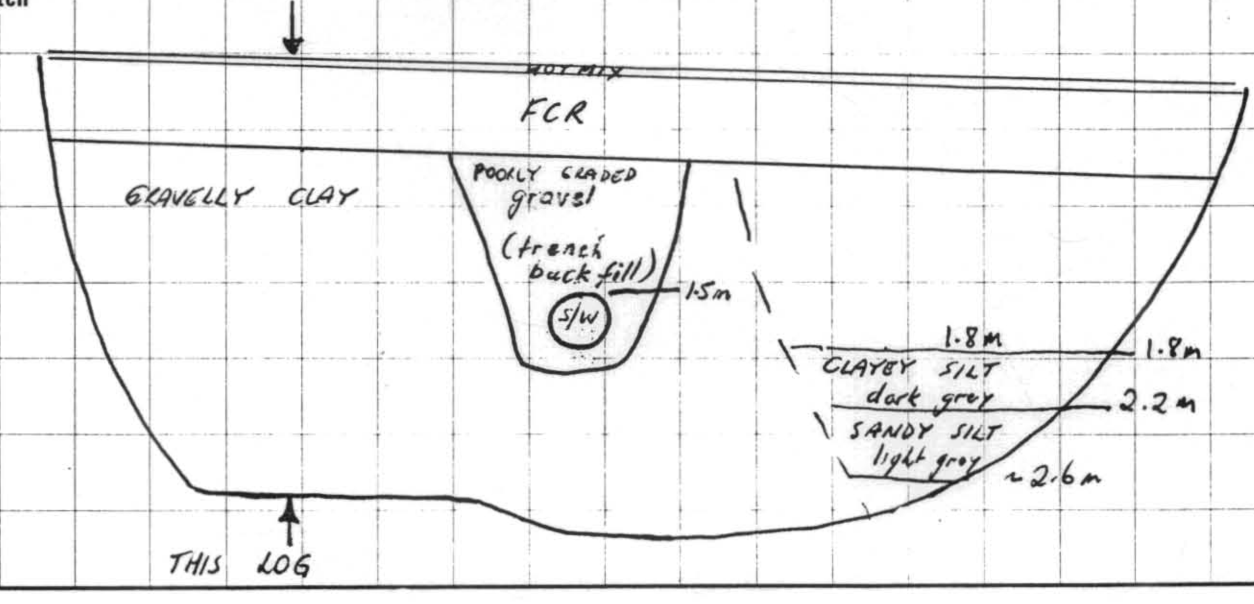
exposure type test pit
equipment JCB 3CX
operator

pit commenced
pit completed
logged by
checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
				0.05			HOTMIX				
				0.60		GW	GRAVEL: FCR road making materials				
				1 2 2.9m		GC	GRAVELLY CLAY: high plasticity clay, mottled yellow-brown with some reddish mottles, fine sand, organic material. Medium-coarse size gravel fragments, of extremely weathered fine-medium size sandstone with occassional mudstone/siltstone fragments. Colour variations occur both laterally and vertically in test pit with no discernable layering. Patches of uniform grey clay, uniform light brown clay and mottled orange-yellow or mottled grey-brown-orange clay usually with fine sand grains				Appears to have a reasonably high permeability.
				3			END OF EXCAVATION				

5 cm

sketch



TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no.
sheet 4 of

project HONE RD - ROSETTA   location Outside Nº 6 HONE RD

co-ordinates
R.L.
excavation dimensions

exposure type test pit
equipment JCB 3CX
operator

pit commenced 18-4-90
pit completed 18-4-90
logged by ADW
checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
	NIL			0.05			HOTMIX				
				0.40		GW	GRAVEL: FCR road making material	M	D		MAN MADE GROUND
				0.90		GC	GRAVELLY SILTY CLAY [FILL]	M	MD		
				1 – 1.30		CL	CLAYEY SILT: dark grey, low plasticity, some sand, organic material (roots, rootlets), wet in patches	M - W	MD		'A' soil horizon
				1.50		ML	SANDY SILT: light grey, low plasticity fine sand	M	MD		'E' soil horizon
				2 – 2.20		CH	CLAY: mottled brown - yellow - grey high plasticity clay, moisture content near plastic limit or slightly lower, occassional red mottles, organic material (roots, rootlets)	M	St		'B' soil horizon
				3.00		SC	SANDY CLAY: mottled yellow-grey, some organic material, high plasticity moisture content near plastic limit some relic coarse - medium gravel size fragments, usually siltstone or sandstone.	M	St		'CB' soil horizon

END OF EXCAVATION AT 3.00 m

sketch

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no. 5
sheet of

14/19

project HONE RD – ROSETTA | location Nº 12 Hone Rd

co-ordinates | exposure type test pit | pit commenced 9-5-90
equipment JCB 3CX | pit completed 9-5-90
R.L. | logged by ADW
excavation dimensions | operator | checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
				0.10		CL	SILTY CLAY: dark grey TOPSOIL, low plasticity				
				0.60		CL	SILTY CLAY: light grey, low to medium plasticity				
				1, 2, 3.0		CH	CLAY: dark grey, high plasticity with sub angular ?Permian gravel				
							End of Excavation at -3.0m				

sketch

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no. 6
sheet of

project HONE RD - ROSETTA
location outside No's 11-13 OFFICER ST

co-ordinates
R.L.
excavation dimensions

exposure type test pit
equipment JCB 3CX
operator

pit commenced 30-4-90
pit completed 30-4-90
logged by BDW
checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
	NIL			0.50			HOTMIX	D	D		Microscopic examination reveals an apparently high primary porosity
				0.30			GRAVEL : FCR road making materials	M	D		
				0.90			SILTY CLAY: dark grey with green tinge becoming lighter with depth, high plasticity clay, roots, organic material, trace sand.	M ≃ P.L.	F-St		
				1 2 2.90			GRAVELLY CLAY: yellow brown moderate to high plasticity clay with fine to coarse gravel size sub-angular to angular TRIASSIC age sandstone to siltstone gravel. Patches of greenish-grey silty sand matrix and patches of brecciated material. SAND content of matrix varies from a trace to in excess of 50% both laterally and vertically.				

sketch

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no. 7

sheet of

16/19

project HONE RD ROSETTA | location outside Nº 1 OFFICER ST

co-ordinates

R.L.

excavation dimensions

exposure type test pit

equipment JCB 3CX

operator

pit commenced 30-4-90

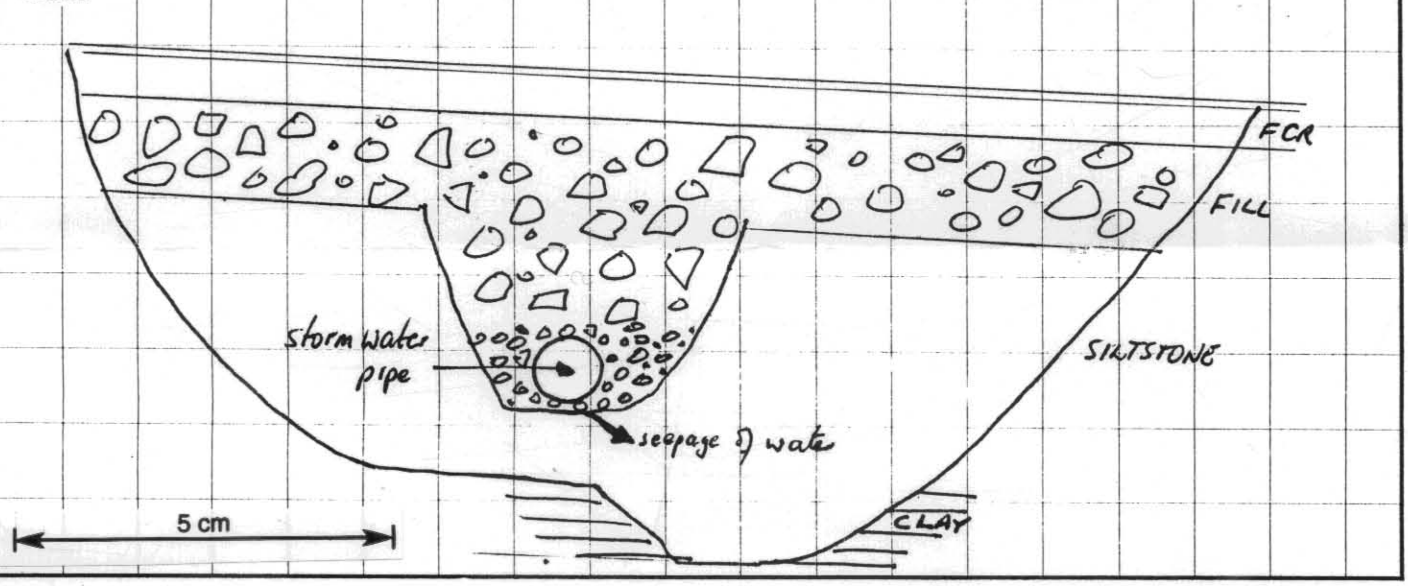
pit completed 30-4-90

logged by BDW

checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
					0.05			HOTMIX	D	D		
					0.30			GRAVEL: FCR road making materials	M	D		
					1.00			CLAYEY GRAVEL [FILL]: moderate to high plasticity yellow-orange clay, light grey and cream coloured in places with sub angular to angular medium size gravel of mudstone and sandstone	M	MD		
	NIL		from bottom of storm water trench		2 2.70			SILTSTONE: grey-cream to brown mudstone/siltstone, variably weathered (MW-EW) often with red-brown staining				
					3 3.30			CLAY: high plasticity, mottled yellow-orange + light grey, occassional red-orange mottles. Some sand + fine gravel (sandstone). ?? EW MUDSTONE/SILTSTONE	M ≃ P.L.			
								END OF EXCAVATION				

sketch



TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

excavation no. 8
sheet of
17/19

project: Hone Rd – Rosetta
location: G.C.C. Reserve, rear of 14/16 Hone Rd.

co-ordinates:
R.L.:
excavation dimensions:
exposure type: test pit
equipment: CAT E70
operator:
pit commenced: 9-5-90
pit completed: 9-5-90
logged by: BDW
checked by:

penetration 1 2 3	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
				0.20			SILTY CLAY: brown FILL / TOPSOIL	M	Fb		
				0.90			CLAY: brown, medium-high plasticity roots, rootlets, with fine-medium size subangular Permian + Triassic age gravel particles	M< P.L.	VSt-H		columnar pedal structure ~150-200 mm wide
				1.00 – 1.20			CLAY: orange-brown, medium-high plasticity	M< P.L.	VSt		
				2, 3, 4			GRAVELLY CLAY: generally light brown medium-high plasticity clay containing sub rounded boulders and gravel size particles of dolerite, sandstone, siltstone and mudstone derived from Triassic age rocks and possibly some Permian age mudstone/siltstone. Boulders often have a shiny rim of clay plastered about their perimeter. Some carbonaceous lenses, nodules. Dolerite boulders are variably weathered (slightly – extremely) with some shearing joint surfaces				some pockets of material appear to exhibit 'bedding' with a dip direction toward NNE.
				4			End of Excavation at ~4.0m				

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – EXCAVATION

REPORT 1990/29

PAGE 18

excavation no.

sheet 9 of

18/19

project: Hone Rd - Rosetta | location: Rear of 23 + 21 CROSBY RD

co-ordinates:
R.L.:
excavation dimensions:

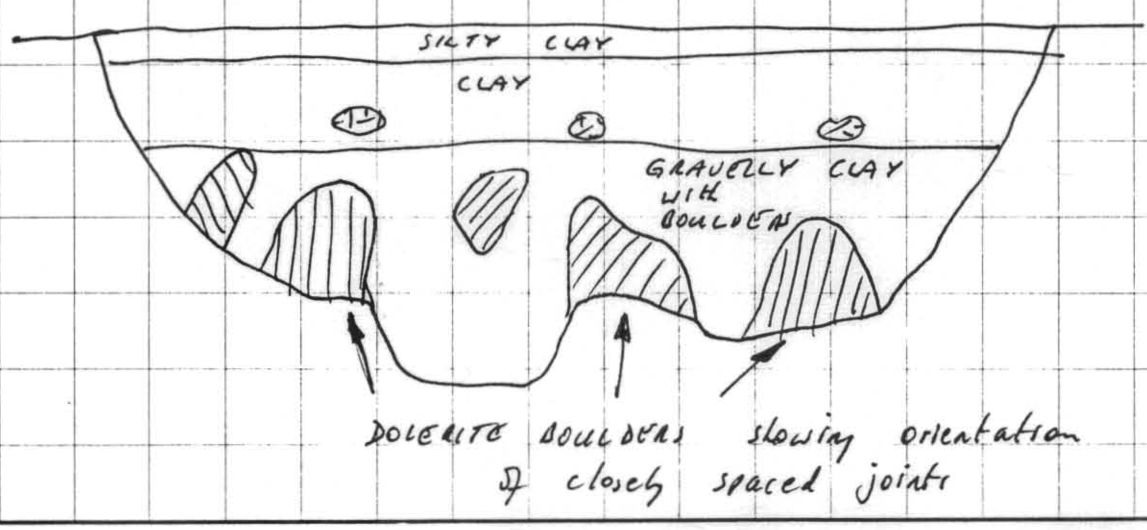
exposure type: test pit
equipment: CAT excavator E70
operator:

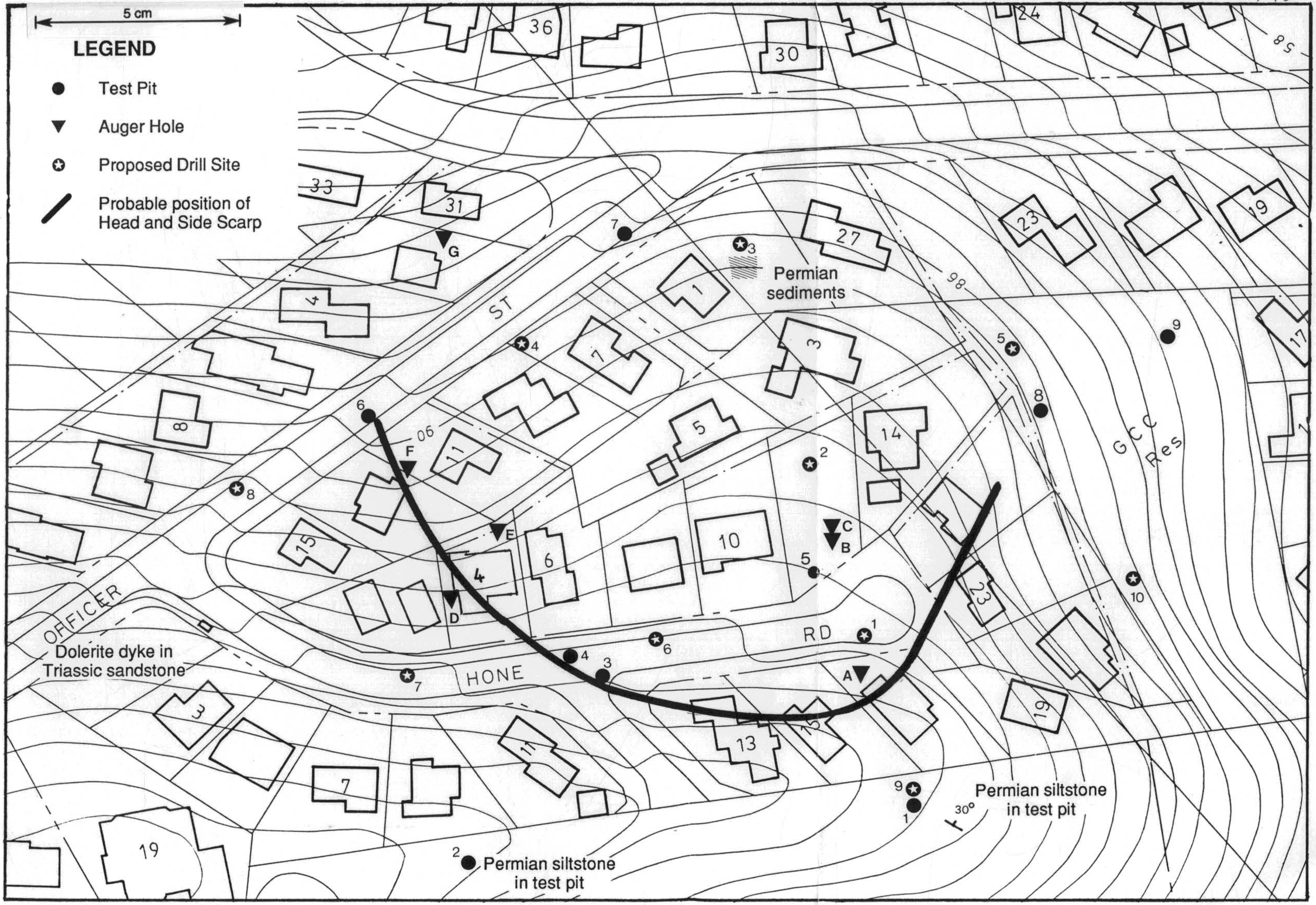
pit commenced: 9-5-90
pit completed: 9-5-90
logged by: BDW
checked by:

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
				0.20		CL-CH	SILTY CLAY: dark brown, medium plasticity	M	Fb		
				0.80		CH	CLAY: dark brown, high plasticity clay with sub rounded dolerite gravel to 80-90 mm Ø, roots, rootlets	MC ≈ PL			prismatic pedal structure
				1 2 2.40		GC	GRAVELLY CLAY WITH BOULDERS: mottled yellow-brown and occasional red mottles, high plasticity clay. Boulders of dolerite up to 800 mm across and in excess of 1000 mm long. Clay between dolerite boulders contains fine-medium size gravel derived from Triassic and possibly some Permian age rocks. Some organic material + red clay between boulders. Some calcareous material				Closely spaced (10-15 mm) joints in most dolerite boulders. Orientation of joints varies between boulders from subvertical to 70° from vertical

5 cm

sketch




5 cm
LEGEND
Test Pit
Auger Hole
Proposed Drill Site
Probable position of
Head and Side Scarp
Permian sediments
Permian siltstone
in test pit
Permian siltstone
in test pit
Dolerite dyke in
Triassic sandstone
OFFICER
ST
HONE
RD
G C C
Res
30°