Butler Partners
geotechnical • geo-environmental • groundwater

PLANS AND DOCUMENTS referred to in the PDA DEVELOPMENT APPROVAL

Approval no: DEV2020/1099

Date: 9 December 2020

Queensland Government

Slope Stability Assessment
Oxley PDA - Stage 1A

Seventeen Mile Rocks Road, Oxley

Prepared for

Economic Development Queensland

Project No. 018-118D

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SECTION 1 - INTRODUCTION

1.1 Project

It is understood that Economic Development Queensland (EDQ) is proposing to develop Stage 1A of the Oxley PDA site (part of the former Oxley Secondary College), by the construction of a residential subdivision comprising thirty-nine new residential allotments and open space areas. The location and extent of the Stage 1A site are indicated in Figure 1 and attached Drawing No. 1.

Figure 1: Stage 1A location and extent

As input to the design and DA/EDQ approval processes for the Stage 1A development, slope stability assessment of the Stage 1A portion of the overall Oxley PDA site was required, including consideration of relevant slope stability comments from the following two EDQ provided documents:

- Department of State Development, Manufacturing, Infrastructure and Planning's letter to EDQ of 23 April 2020 (Ref DEV2020/1099); and
- Appendix A of EDQ's submitted reports review.

1.2 Proposed Scope of Work

It was proposed to undertake geotechnical assessment of the stability of sloping ground on the Stage 1A site by the drilling and sampling of six bores to 12m to 15m depth (or prior refusal), at accessible locations along the sloping ground below the Seventeen Mile Rocks Road site boundary, with groundwater monitoring wells proposed installed in four of the bores, to enable groundwater level monitoring over time.

The use of a backhoe/mini excavator was also proposed to assist with access to bore locations and to undertake some test pits in the vicinity of Bore 18 (refer Section 2.1.1), to help determine the extent of any fill near the bore.

In order to estimate future groundwater level rises at the site, a detailed groundwater model would be required to be constructed and run under a number of rainfall scenarios; construction of a groundwater model did not form part of the current investigation scope.

Using the results of the proposed fieldwork, laboratory testing outcomes and the results of relevant previous investigations conducted in the Stage 1A site, a geotechnical report was proposed for Stage 1A of the development that would provide geotechnical design information on each of the topics listed below, as appropriate:

- details and descriptions of the existing strata;
- laboratory test results, including erosion and sediment control parameters;
- groundwater observations;
- slope stability calculation results;
- options for remedial slope stabilisation works, if required;
- development proposal impacts;
- building loads/slope modifications;
- deep foundations;
- potential for slow creep failure;
- subsoil drainage and concrete lining;
- vegetation planting and maintenance;
- southern slope stability;
- prevention of water ingress into the site slopes;
- further investigation – prior to and post construction; and
- sensitivity of slope stability analysis to groundwater levels.

1.3 Commission

Based on the proposed development and anticipated subsurface conditions, a fee to undertake the geotechnical investigation and slope stability assessment of the Stage 1A site was presented in a proposal of 22 May 2020. Butler Partners Pty Ltd (Butler Partners) was subsequently commissioned by EDQ to conduct the investigation as proposed, which has been conducted in consultation with EDQ. This report has been issued in three draft forms for comment, with the last draft being issued on 3 September 2020, after completion of a site groundwater assessment and following feedback from EDQ.

SECTION 2 - THE SITE

2.1 Background

2.1.1 Past Investigations

Butler Partners has previously undertaken preliminary geotechnical investigation (in conjunction with a preliminary contamination assessment), of the overall Oxley PDA site, and the results of the preliminary geotechnical investigation are given in the following report:

Preliminary Geotechnical Investigation
Former Oxley Secondary College
Blackheath Road, Oxley
Project No.: 018-118A
Dated: 16 May 2018

Butler Partners has also previously undertaken a broadscale slope stability assessment and a subsequent detailed slope stability assessment of the eastern site slopes (below Blackheath Road), and the results are contained in the following reports:

Broadscale Slope Stability Assessment
Former Oxley Secondary College
Blackheath Road, Oxley
Project No.: 018-118B
Dated: 31 October 2018

Additional Slope Stability Assessment
Former Oxley Secondary College
Blackheath Road, Oxley
Project No.: 018-118B
Dated: 26 August 2019

Relevant Bore Report sheets for Bore 18 (from the 26 August 2019 investigation report), are included in Appendix B and relevant factual laboratory test data from Bore 18 are included herein.

2.1.2 Groundwater Assessment

A groundwater assessment of the site has been undertaken by Butler Partners and the results are given in the following report:

Groundwater Assessment
Oxley Parkside Development – Stage 1A
Blackheath Road, Oxley
Project No.: 018-118D
Dated: 24 August 2020

In broad summary, the results of the assessment indicate that the shallowest groundwater depth calculated by the groundwater model was approximately 5m, with the soils beneath the calculated 5m deep water table level being unsaturated.

2.1.3 Existing Slope Analysis Results

KN Group Pty Ltd (KN) has undertaken an analysis of the site slopes to categorise them into the slope ranges indicated below and the results of the KN slope analysis are indicated by coloured shading on Drawing No. 1, attached:

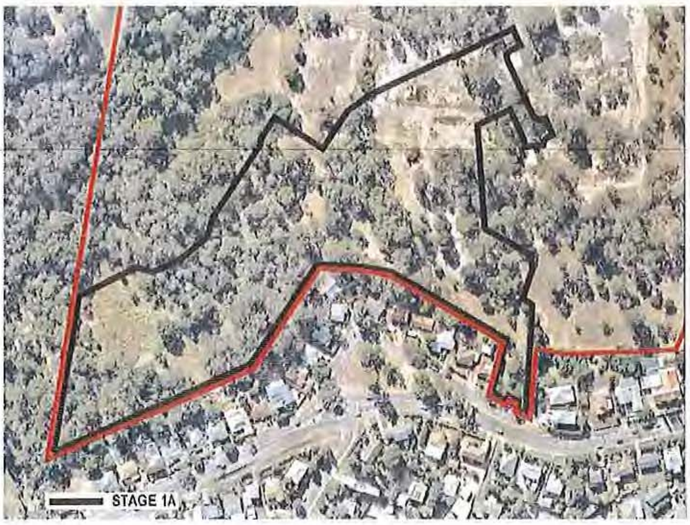
15° to 18°; 18° to 21°; 21° to 25°; and >25°.

2.2 Site Description

The site is located adjacent to Seventeen Mile Rocks Road, close to its intersection with Blackheath Road. At the time of the assessment, the site had been cleared of past development and contained a moderate cover of medium to tall trees, with long and mown grass undergrowth. The southern portion of the site comprised (apparently) natural slopes (but with a fill zone), with overall slope angles generally downwards to the north, varying between 5° and 10° and up to 20° in localised areas. The ground surface level across the site is highly variable and non-uniform and varied at the bore locations between RL32.0m (Bore 105) and RL48.5m (Bore 100).

An aerial view of the overall Oxley PDA site taken on 4 November 2018 is given in Photograph 1, and an aerial view of the Stage 1A site taken on 25 May 2020 is given in Photograph 2. Four views of sections of the Stage 1A site, taken at the time of the assessment, are given in Photograph 3 to Photograph 6.

Photograph 1: An aerial view of the overall Oxley PDA site on 4 November 2018. Source: NearMap



Photograph 2: Stage 1A portion of the Oxley PDA site on 25 May 2020. Source: NearMap

Several of the existing (off-site) properties located along the southern boundary of the site (along Seventeen Mile Rocks Road), appear to have had fill placed along some sections of their rear (northern) boundaries to 'level' the sites. Concentrated surface water flow zones also emanate from several of the properties.

A detailed walk-over inspection of the Stage 1A site slopes by senior experienced geotechnical engineers and a (non-stereo) inspection of aerial photographs of the site did not reveal any indications of any significant instability over the area.

Photograph 3: View of the site looking north-east from Bore 100

Photograph 4: View of the site looking south-west from Bore 102

Photograph 5: View of the site looking north-east from Bore 102

Photograph 6: View of the site looking east from Bore 105

2.3 Geology

An extract of the Geological Survey of Queensland's 1:31,680 geological series City of Brisbane sheets is given in Figure 2 (with the approximate Oxley PDA Stage 1A site boundary indicated). The geology map indicates that the majority of the Stage 1A site is mapped in an area of Tertiary deposits of the Corinda Formation (comprising mudstone, shale with minor sandstone and limestone); a very small area at the very western end of the site is mapped in an area of Triassic deposits of Moorooka Formation (comprising massive siliceous conglomerate, sandstone and minor shale); and an intrusion is mapped of Quaternary deposits (comprising alluvial sand, silt, mud, clay and gravel) onto a small section of the north-western section of the overall site.

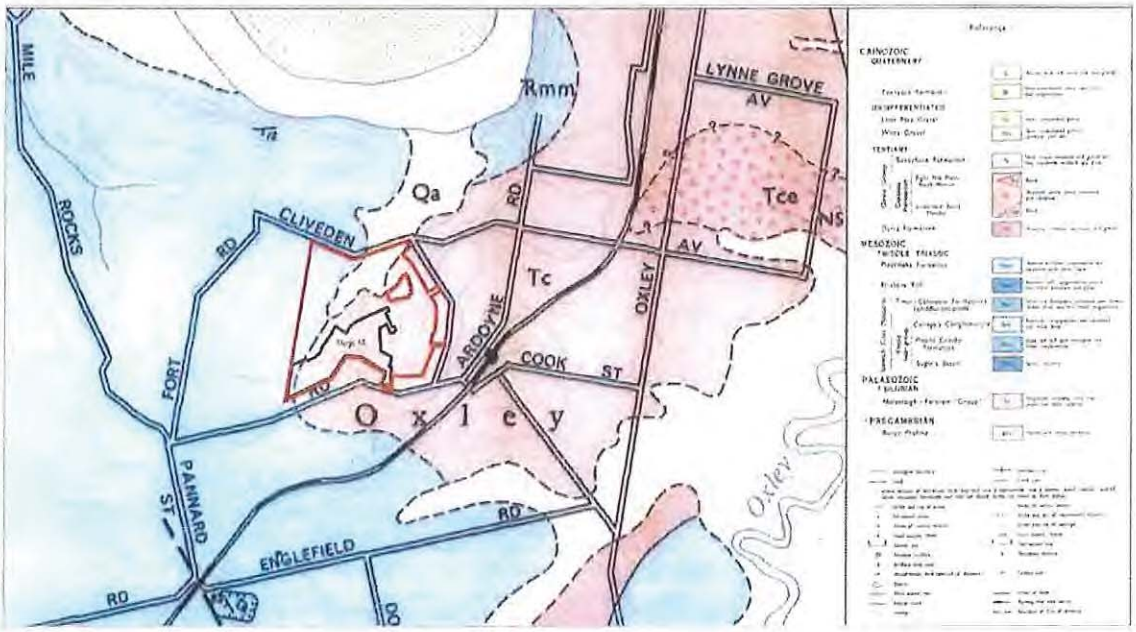


Figure 2: Extract from the 1:31,680 Geological Survey of Queensland – City of Brisbane map

2.4 Landslide History of General Area

2.4.1 Brisbane City Council – Landslide Overlay

The relevant section of Brisbane City Council's (BCC) Landslide overlay map 1:22,000 sheets is reproduced in Figure 3, which indicates that two very small sections of (cut) sloping ground located around the access road to the Stage 1A site (along Seventeen Mile Rocks Road), are landslide susceptible, in accordance with the requirements of the State Planning Policy (SPP). The indicated landslide risk areas for the overall Oxley PDA site are located in areas mapped as Corinda Formation in the 1:31,680 City of Brisbane geology map (Figure 2).

Figure 3: Extract from the BCC Landslide Overlay Map, with approximate site boundary indicated in red and landslide susceptibility areas indicated in brown

2.4.2 Past Landslides

It is understood that past significant landslides have occurred within the Corinda Formation (and overlying soils), along Seventeen Mile Rocks and Blackheath Roads, in the general vicinity (and to the east), of the Stage 1A site.

Hoffman and Willmott (1984)[1] note that "*the prime cause of slope failure is excessive pore pressure in interbedded, inclined claystone and sandstone beds in the Tertiary units….* (due to) *….. infiltration of extra water (for example by earthworks, pipe trenches, garden watering, etc.) into permeable layers within the slope, or from compacting of soil at the toe of the slope thus prohibiting natural seepage into drainage channels. Most significant, however, is the rise of the water table, and pore pressure, when the natural forest cover of an area is cleared. Loss of root support also directly reduces the effective strength of the soil.*"

2.5 Site Slope Creep Movement

A walk over inspection of the sloping sections of the Stage 1A site did not reveal any indications of site slope creep (or any indications of general instability). No indication of slope creep could be observed in mature trees located on the sloping sections of the site; as indicate in selected Photograph 7 and Photograph 8, no indication of bent tree trunks (which is indicative of slope creep/failure), was observed.

Photograph 7: General view of mature trees

Photograph 8: General view of mature trees

[1] Hoffman, G.W. & Willmott, W.F., 1984: "Landslide Susceptibility of Natural Slopes in the City of Brisbane" Department of Natural Resources, Mines and Water 1984/10

SECTION 3 - FIELDWORK

3.1 Drilling and Sampling Methods

The investigation comprised the drilling and sampling of six bores (Bores 100 to 105) to between 15.25m and 21.95m depth, with truck and track mounted Hydrapower Scout drilling rigs. All bores were initially drilled using solid flight augers to between 2.5m and 3.0m depth, then extended using washboring methods, with drill fluid circulation for cuttings removal. Strata identification was based on inspection of cuttings recovered on the augers, supplemented with inspection of disturbed Standard Penetration test (SPT) and 'undisturbed' 50mm diameter tube samples, recovered at selected depths. Hand 'pocket' penetrometer readings were taken in the ends of the tube samples to assist with the strength classification of cohesive soils.

3.2 Test Pit Excavation

Three test pits (Test Pit 1 to 3) were excavated to between 1.9m and 2.4m depth by a Takeuchi TB153 6 tonne mini excavator using a 0.6m wide toothed bucket. Strata identification was from the inspection of the spoil recovered in the bucket, together with the inspection (at shallow depth) of the test pit walls. On completion, the test pits were backfilled with excavated spoil and surface 'tracked'.

3.3 Groundwater Monitoring Wells

A standpipe groundwater monitoring well was installed in Bores 100, 101, 102 and 105 at the completion of drilling; construction details for each well are indicated on the relevant Bore Report sheets.

3.4 Bore and Test Pit Locations and Supervision

The bores and test pits were set out in the field by direct measurement from existing site features and their approximate locations are indicated on Drawing No. 1. The approximate ground surface level at each bore and test pit location was estimated by interpolation between contours given on a plan supplied by EDQ.

Experienced geotechnical engineers set out the bore and test pit locations, logged the subsurface profiles encountered, determined the insitu sampling and testing program and supervised the fieldwork and the installation of the groundwater monitoring wells.

SECTION 4 - INVESTIGATION RESULTS

4.1 Subsurface Conditions

The subsurface conditions encountered in the bores and test pits are given on the Bore and Test Pit Report sheets included in Appendix A, using classification and descriptive terms defined in accompanying notes (which are based on Australian Standard AS1726 – 1993). It should be noted that the rock types indicated on the Bore Report sheets are based on visual assessment only; no petrographic analysis has been undertaken for confirmation.

For a description of the subsurface conditions encountered at the locations of Bores 18 and 100 to 105, the Bore Report sheets should be consulted. However, in broad summary the subsurface conditions encountered in the bores generally comprised a surface layer of either topsoil to between 0.1m and 0.5m depth in Bores 103 and 104, or fill which was encountered to between 0.2m and (possibly) up to 7.0m depth in Bores 18, 101 and 102. The fill is probably uncontrolled and in Bores 18 and 102, comprised silty/sandy clays that essentially had the same appearance as the natural soils, and it was therefore very difficult to distinguish the fill from the natural soils. As a result, the depth of fill indicated in the Bore Report sheets for Bores 18 and 102 should be considered as approximate only and subject to confirmation.

The three test pits excavated in the immediate vicinity of Bore 18, encountered fill to between 0.7m and 2.0m approximately, which indicated that the possible depth of fill of 7.0m, indicated on the Bore Report sheet for Bore 18, may be an overestimate of the actual fill depth at that location by approximately 3m to 4m.

The topsoils and fill were underlain (or exposed from ground surface in Bore 105), by interbedded layers of stiff to hard silty/sandy clay and medium dense to very dense clayey sand, which are considered to predominantly be residual soils, derived from the in place weathering of predominantly mudstone and sandstone (rock). The soils were underlain in turn in all bores, except Bore 101, by extremely low to very low strength sandstone/mudstone/siltstone below 4.5m and 13.5m depth approximately. In Bore 102 a thin low strength band of mudstone was encountered within the clays and in Bores 103 and 104 bands of silty clay between 1.0m and 2.0m thick were encountered with the rock. It should be noted that 'harder' rock may exist close below bore termination depths and at shallower depth elsewhere on the site.

'Strength inversions' (i.e. 'weaker' material underlying 'stronger' material), were encountered in some bores. For example, very stiff silty clay underlying hard silty clay at 4.5m depth (RL44.0m) in Bore 100; very stiff silty clay underlying hard silty clay at 3.0m depth in Bore 101 (RL42.8m) and also at 17.0m depth (RL16.2m) in Bore 103.

4.2 Soil Structure

Slickensides were encountered in a thin layer of mudstone in Bore 18 and in relatively thin layers of silty and sandy clays encountered in Bores 100 and 105. Small fissures were noted in some clays, but the fissures had not developed into slickensides. Some relict rock joints were encountered in sandy clays in Bore 101.

4.3 Groundwater

Free groundwater was only encountered during the auger drilling of Bore 18, during previous investigations, at the depth/reduced level given in Table 1. The use of water/mud circulation for cuttings removal during the drilling of Bores 100 to 105 precluded groundwater observations during drilling at these locations. Groundwater observations made in the groundwater monitoring wells (after well development), installed in Bores 100, 101, 102 and 105, are also given in Table 1.

It should be noted that groundwater levels can vary seasonally and with prevailing weather (and vegetation) conditions. If a significant time elapses following this investigation and/or following significant 'wet' weather, it would be prudent to confirm groundwater levels.

Table 1: Groundwater Observations During Auger Drilling and in the Monitoring Wells

Bore	Groundwater Observations			
	September 2018		6 July 2020	
	Depth (m)	Reduced Level	Depth (m)	Reduced Level
18	7.0	RL31.1m	Lost	
100	–	–	8.8	RL39.7m
101	–	–	7.2	RL38.6m
102	–	–	14.6	RL23.4m
105	–	–	11.3	RL20.7m

The depths to groundwater given in Table 1 are in the same range as the depths to groundwater measured in the monitoring wells (Wells 21 and 25 to 29), located on the eastern slopes of the overall Oxley PDA site (refer to Butler Partners's reports dated 31 October 2018 and 26 August 2019, which are referenced in Section 2.1.1).

4.4 Laboratory Testing

Selected soil and fill samples were tested in Ground Testing Services Pty Ltd's (GTS) NATA endorsed geotechnical testing laboratories (using Australian Standard AS2870 testing methods), to determine erosion and sediment control parameters, particle size distribution, plasticity, and peak shear strength in triaxial compression and direct shear and residual shear strength in direct shear. The test results are summarised in the following sections and laboratory test report sheets are included in Appendix C; the results of relevant previous laboratory test results from Bore 18 (from the earlier investigation/assessment report of 26 August 2019), are also included for completeness.

It should be noted that sample descriptions provided in the laboratory results summary tables (and the laboratory test result sheets) are based on the inspection of each individual laboratory test sample only. No allowance has been made in sample descriptions for sampling, sub-sampling or test methodology in determination of the mass material properties. Estimates of mass material properties are provided on each individual Bore Report sheet and as such, the laboratory test results should be read in conjunction with the relevant report sheets.

4.4.1 Dispersion Potential

Seven selected samples recovered from the bores were tested to determine Emerson Class Number (ECN), pH and electrical conductivity and a summary of the reported test results is presented in Table 2. The results of the Emerson Class Number testing indicate that six of the samples tested had a low to very low potential for dispersion (i.e. ECN = 5 and 6) and one sample from Bore 18, had a moderate to high potential for dispersion (i.e. ECN = 3).

Table 2: Summary of Erosion and Sediment Control Parameters Test Results

Bore	Sample Depth (m)	Sample Description	Emerson Class No.	pH	Electrical Conductivity (mS/cm)
18	0.5 – 0.95	Silty Clay	3	4.1	–
100	1.5 – 1.95	Silty Clay	5	4.5	0.61
101	1.5 – 1.9	Sandy Clay	6	4.1	0.43
102	0.5 – 0.95	Fill – Silty Clay	5	4.2	0.47
103	0.5 – 0.95	Silty Clay	5	4.3	0.35
104	0.5 – 0.95	Silty Clay	5	4.4	0.34
105	0.5 – 0.75	Silty Clay	6	4.0	0.62

4.4.2 Particle Size Distribution

Twenty-four samples of soil recovered from the bores were tested for measurement of particle size distribution using wash sieve grading techniques, and the reported results are summarised in Table 3.

Table 3: Summary of Particle Size Distribution Test Results

Bore	Sample Depth (m)	Sample Description	Sample Moisture Content (%)	Gravel Fraction(1) (%)	Sand Fraction(2) (%)	Silt and Clay Fraction(3) (%)
100	4.5 – 4.95	Silty Clay	28.1	4	10	86
	7.5 – 7.9	Clayey Silt	30.0	0	1	99
	10.5 – 10.63	Sandstone (XW)	23.4	3	41	56
	13.5 – 13.94	Sandstone (XW)	19.1	0	19	81
	18.0 – 18.44	Silty Clay	23.1	0	1	99
101	1.5 – 1.9	Silty Clay with Sand	22.4	1	10	89
	6.0 – 6.45	Sandy Clay	17.6	9	31	60
	9.0 – 9.43	Silty Clay	20.1	0	4	96
	12.0 – 12.45	Silty Clay	19.1	0	3	97
102	6.0 – 6.45	Silty Clay	20.0	0	8	92
	13.5 – 13.95	Sandstone (XW)	18.9	0	83	17
	15.0 – 15.45	Sandstone (XW)	21.3	0	78	22
103	1.5 – 1.85	Silty Clay	14.8	1	9	90
	4.6 – 4.72	Sandstone (XW)	16.5	0	85	15
	6.0 – 6.13	Sandstone (XW)	13.8	0	83	17
	10.5 – 10.77	Sandstone (XW)	20.8	2	84	14
104	3.0 – 3.45	Silty Clay	12.4	1	7	92
	6.0 – 6.14	Sandstone (XW)	22.4	0	84	16
	10.5 – 10.95	Silty Clay	7.6	0	0	100
	15.0 – 15.43	Mudstone (XW)	20.2	0	6	94
105	7.5 – 7.8	Silty Clay	20.8	0	4	96
	9.0 – 9.23	Clayey Sand	24.9	2	69	29
	10.0 – 10.45	Silty Clay	21.8	0	1	99
	10.5 – 10.75	Clayey Silt	22.6	0	4	96

4.4.3 Plasticity

Thirty samples of silty/sandy clay and weathered rock recovered from the bores were tested for measurement of plasticity using Atterberg limits and linear shrinkage test methods. The test results are summarised in Table 4, together with the sample classifications and an estimate of the drained internal friction angle (ϕ') for each sample, inferred from a published correlation with plasticity[2]. The plasticity test results indicate that the samples tested varied between relatively low and high plasticity.

[2] Gibson, R.E. (1953), *Experimental determination of the true cohesion and true angle of internal friction in clays*, Proc 3rd I.C.S.M.F.E., Zurich, pp126 - 130

Table 4: Summary of Plasticity Test Results and Correlations

Bore	Sample Depth (m)	Sample Depth	Sample Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Classification*	Inferred Drained Friction Angle	
									Peak (ø') (degrees)+	Residual (ø'r) (degrees)+
18	4.5 – 4.95	Silty Clay	28.5	52	23	29	12.0	CH	25	20
	7.5 – 7.95	Silty Clay	29.3	32	15	17	6.0	CL	30	23
100	1.5 – 1.95	Silty Clay	13.5	57	25	32	11.5	CH	25	19
	4.5 – 4.95	Silty Clay	24.0	64	27	37	13.5	CH	23	17
	7.5 – 7.9	Clayey Silt	30.0	62	36	26	13.0	MH	25	19
	13.5 – 13.94	Silty Clay with Sand	16.3	49	24	25	0.5	CI	25	19
101	1.5 – 1.9	Silty Clay with Sand	15.6	66	29	37	13.5	CH	23	17
	6.0 – 6.45	Sandy Clay	15.3	36	20	16	1.0	CI	30	25
	12.0 – 12.45	Silty Clay	14.2	48	19	29	7.5	CI	26	20
102	3.0 – 3.45	Silty Clay	13.1	57	23	34	12.5	CH	24	18
	4.5 – 4.95	Silty Clay	24.6	64	20	44	17.5	CH	23	17
	6.0 – 6.45	Silty Clay	16.4	74	28	46	14.0	CH	23	17
	7.5 – 7.95	Silty Clay	13.1	60	20	40	12.5	CH	23	17
	9.0 – 9.45	Silty Clay	17.1	102	49	53	16.5	CH	22	13
103	1.5 – 1.85	Silty Clay	11.3	58	28	30	10.5	CH	25	19
	15.0 – 15.41	Mudstone (XW)	17.9	47	28	19	7.5	XW	28	23
	17.0 – 17.4	Silty Clay	31.3	69	21	48	17.0	CH	22	17
	18.0 – 18.43	Mudstone (XW)	13.6	52	22	30	10.5	XW	25	19
104	1.5 – 1.95	Silty Clay	6.7	51	21	30	10.0	CH	25	19
	3.0 – 3.45	Silty Clay	10.7	53	20	33	10.5	CH	24	18
	10.5 – 10.95	Silty Clay	12.1	50	21	29	10.5	CH	25	19
	13.5 – 13.95	Silty Clay	19.4	70	31	39	13.5	CH	23	17
	15.0 – 15.43	Mudstone (XW)	16.8	44	21	23	7.5	XW	26	23
105	0.5 – 0.95	Silty Clay	11.9	79	30	49	15.5	CH	22	17
	6.0 – 6.3	Silty Clay	14.9	47	20	27	13.0	CI	25	19
	7.5 – 7.8	Silty Clay	17.5	70	31	39	15.5	CH	23	17
	10.0 – 10.45	Silty Clay	21.8	49	17	32	14.5	CI	24	18
	10.5 – 10.75	Clayey Silt	16.2	53	34	19	6.5	MH	28	23
	12.0 – 12.35	Silty Clay	23.1	58	20	38	15.0	CH	23	17
	13.5 – 13.92	Mudstone (XW)	14.6	55	20	35	11.0	CH	24	18

* Australian Standard AS1726 – 1993 *Geotechnical site investigation*; + Estimated from a published correlation with plasticity index

The approximate values of inferred drained peak and residual shear strength values (based on sample plasticity) are given in Table 4, and their approximate average values are summarised as follows:

Average Inferred Peak Strength (ø') : 25 degrees

Average Inferred Residual Strength ($ø'_r$) : 19 degrees

4.4.4 Drained Shear Strength

4.4.4.1 Peak Strength

4.4.4.1.1 Triaxial Shear

Two 'undisturbed' samples of silty clay recovered from Bores 18 and 105 were tested for measurement of peak 'effective' shear strength using a staged, consolidated, undrained triaxial test method with pore pressure measurement and a summary of the reported results is presented in Table 5.

Table 5: Reported Triaxial Peak Strength Test Results

Bore	Sample Depth (m)	Sample Description	Sample Moisture Content (%)	Effective Peak Shear Strength Parameters	
				c' (kPa)	ϕ' (degrees)
18	7.5 – 7.95	Silty Clay	31.3	23	23
105	12.0 – 12.35	Silty Clay	23.1	39	21

4.4.4.1.2 Direct Shear

Three 'undisturbed' samples of silty clay recovered from Bores 102, 103 and 105 were tested in direct shear to assess peak 'effective' shear strength using staged, consolidated, direct shear test methods and a summary of the test results is presented in Table 6.

Table 6: Reported Direct Shear Peak Strength Test Results

Bore	Sample Depth (m)	Sample Description	Sample Moisture Content (%)	Effective Peak Shear Strength Parameters	
				c' (kPa)	ϕ' (degrees)
102	4.5 – 4.95	Silty Clay	24.4	23	21
103	17.0 – 17.4	Silty Clay	31.3	17	20
105	6.0 – 6.3	Silty Clay	15.0	44	24

4.4.4.2 Residual Strength

One 'undisturbed' sample of silty clay/clayey silt was recovered from each of Bores 100 and 105. Each sample was tested in direct shear to assess 'residual' shear strength, using staged, consolidated, direct shear test methods on a 'hand-wound' failure surface and a summary of the test results is presented in Table 6.

Table 7: Reported Direct Shear Residual Strength Test Results

Bore	Sample Depth (m)	Sample Description	Sample Moisture Content (%)	Effective Residual Shear Strength Parameters	
				c'_r (kPa)	ϕ'_r (degrees)
100	7.5 – 7.9	Silty Clay	30.6	0	13
105	10.0 – 10.45	Silty Clay	21.8	0	16

SECTION 5 - GEOTECHNICAL COMMENTS

5.1 Ground Model

The results of geotechnical investigation indicate that the bores and test pits located on the sloping sections of the site generally indicated a surface layer of either topsoil to between 0.1m and 0.5m depth in two bores, or fill which was encountered to between 0.2m and (possibly) up to 7.0m depth in three bores. The fill is probably uncontrolled and comprised silty/sandy clays that essentially had the same appearance as the natural soils, and it was therefore very difficult to distinguish the fill from the natural soils.

The topsoils and fill were underlain (or exposed from ground surface in one bore), by interbedded layers of stiff to hard silty/sandy clay and medium dense to very dense clayey sand, which contained strength inversions and are considered to predominantly be residual soils, derived from the in place weathering of predominantly mudstone and sandstone (rock). The soils were underlain in turn in all bores (except one), by extremely low to very low strength sandstone/mudstone/siltstone below 4.5m and 13.5m depth approximately. Thin low strength bands of mudstone were encountered within the clays and bands of silty clay between 1.0m and 2.0m thick were encountered with the rock.

Free groundwater was observed between 7.0m and 14.6m depth in monitoring wells installed during the investigation.

5.2 Existing Fill

It is not known whether the existing fill material encountered in Bore 18 and Test Pits 1 to 3 is 'controlled' (i.e. has been placed and uniformly compacted to an appropriate engineering specification under supervision). Supporting documentation should be obtained and checked to confirm that the fill has been placed in a controlled manner to a specification that is appropriate for the proposed development. If documentation does not exist (or the specification used for filling is not appropriate), then it is suggested that the existing fill be assumed to be uncontrolled, which would be consistent with the general appearance of the fill encountered in the bore and test pits.

If the fill cannot be shown to be controlled, then consideration should be given to the potential for adverse variation to exist in both the composition and degree of compaction of the fill. The presence of voids within uncontrolled fill as well as potential soft/loose zones or inclusions of deleterious materials may lead to potentially significant future total and differential settlements, occurring possibly over relatively short distances, or adverse effects on slope stability.

To minimise the risk of potentially adverse future settlement occurring (or adverse effects on slope stability), it is recommended that all uncontrolled fill present be removed and replaced/recompacted with Level 1 controlled fill during the bulk earthworks program that will occur during the construction of the Stage 1A development. It is recommended that geotechnical inspection (and fill control), should be undertaken by Butler Partners during bulk earthworks to confirm the extent of existing fill to be removed and to control the replacement fill.

5.3 Landslide Susceptibility

Reports by others (refer to Section 2.4), indicate that a number of known landslides have previously been reported to the east of the Stage 1A site (and predominantly located within the Corinda Formation). The landslides are reported to generally be linked to an increase of pore water pressure within soil and weathered rock generally occurring after significant heavy rain events, poor drainage channels and surface water infiltration into slopes (i.e. service trenches, garden watering, roof drainage pipes discharging to the ground behind the crest of slopes, etc.). Other factors contributing to the development of landslides may be associated with localized zones of reduced soil shear strength (i.e. fissures/slickensides within the near surface clays), erosion, and clearing of vegetation and loss of root support over existing slopes.

It would be important to adopt proper design and construction techniques for the proposed site redevelopment, to prevent similar issues occurring.

5.4 Sinkholes

Unlike the eastern site slopes (refer to 26 August 2019 report), no 'sinkholes' were observed on the site.

5.5 Slickensides

Slickensides were encountered in relatively thin bands of silty/sandy clays in Bores 100 and 105 and in a thin band of weathered mudstone in Bore 18. However, from inspection of the samples taken, there did not appear to be extensive zones of slickensides and no indications of past slope failures have been observed on site. However, if extensive zones of fissures/slickensides are present within the soils in an area(s) of the site, their presence could have an adverse effect on slope stability.

The potential effects for long term strength reduction effects from slickensides have been considered in the stability analysis (Section 5.10), by reducing the effective stress soil strength parameters for the clay soils; no extensive zones of fissures/slickensides have been detected in the investigation work conducted to date, so the strength reduction adopted for the stability analysis is considered to provide conservative results (i.e. a lower factor of safety than is actually the case).

5.6 Existing Fill

It is not known whether the existing fill material encountered in Bores 18, 101, 102 and Test Pits 1, 2 and 3 is 'controlled' (i.e. it is not known whether the fill has been placed and uniformly compacted to an appropriate engineering specification). If the existing fill is required to support settlement sensitive elements of future development (e.g. services etc.) supporting documentation should be obtained and checked to confirm that the fill has been placed in a controlled manner to a specification that is appropriate for the proposed development. If documentation does not exist (or the specification used for filling is not appropriate) then it is suggested that the existing fill be assumed to be uncontrolled.

If the fill cannot be shown to be controlled, then consideration should be given to the potential for adverse variation to exist in both the composition and degree of compaction of the fill. The presence of voids within uncontrolled fill as well as potential soft/loose zones or inclusions of deleterious materials may lead to potentially significant future total and differential settlements, occurring possibly over relatively short distances.

5.7 Clay Shear Strength

5.7.1 Peak Strength

The approximate average value of the measured drained effective peak strength friction angle values given in both Table 5 and Table 6 is approximately 22 degrees, which is approximately 3 degrees lower than the average inferred peak drained friction angle of 25°, based on correlations with sample plasticity (refer Section 4.4.3).

5.7.2 Residual Strengths

The approximate value of the measured drained effective residual strength friction angle value given in Table 7 is 16 degrees, which is approximately 3 degrees lower than the average inferred residual drained friction angle of 19°, based on correlations with sample plasticity (refer Section 4.4.3).

5.8 Slope Stability Assessments

5.8.1 Acceptable Factor of Safety

5.8.1.1 Peak Strength

It is typical to adopt minimum calculated Factor of Safety (FOS) values in the range of 1.4 to 1.5 under 'long term' conditions and in the range of 1.2 to 1.3 under 'short term' (construction type or varying groundwater level etc.) conditions, depending on the level of uncertainty in input parameters. Where detailed investigation has been carried out and applied loads are well defined, a FOS at the low end of the range could be considered, however, as the degree of uncertainty in parameters, geometry, applied loads, groundwater conditions and variability increases, the acceptable FOS limit from slope stability analysis should increase.

5.8.1.2 Residual Strength

It is considered acceptable to adopt minimum calculated Factor of Safety (FOS) values in the range of 1.15 to 1.25 under 'long term' residual soil strength conditions; as the slickensides encountered in the bores, were not considered to be indicative of extensively slickensided soils; higher FOS values would be required for extensive areas of slickensiding.

5.8.2 Geometry

Stability analysis of the sloping ground down from the southern perimeter of the site has been carried out using six approximate cross-sections taken through selected locations near Bores 100 to 105, based on existing ground surface contours and finish design profiles given on survey information provided by EDQ/KN and the investigation results undertaken by Butler Partners.

The existing ground surface profiles selected for the analyses generally represent reasonably 'typical' slope profiles encountered below the southern boundary of the site (ranging from 5 to 21 degrees). Very localised areas of sloping ground with steeper slope angles (greater than 25 degrees) have been identified by KN at the southern boundary of the site, near Bores 100 and 101 (refer Drawing No. 1).

Table 8: Approximate Range of Slope Angles Assessed

Bore	KN Group's Slope Analysis Range
100	15° to 21°
101	15° to 18°
102	Less than 15°
103	15° to 18°
104	Less than 15°
105	Less than 15°

5.8.3 Stability Assessment Model

The slope stability analyses were undertaken using the commercially available geotechnical analysis software Slope/W, which uses limit equilibrium methods to calculate a minimum FOS on slope stability. The analyses were carried out were based on the following assumptions:

- adoption of six slope geometries based on survey information and design contours provided by EDQ;
- subsurface profiles based on the results of current and previous bores;
- Mohr-Coulomb strength model for soils;
- strength parameters based on the results of the strata strengths encountered at the current and previous bore locations and the results of laboratory testing;
- three groundwater levels (2m, 4m and 6m below ground surface level from crest to toe);
- 'long term' analysis carried out using effective stress soil strength parameters in cohesive strata; and
- a separate 'long term' analysis carried out using the final design profile and a long term surcharge allowance of 5kPa a the location of each proposed building envelope, based on KN design drawings; Butler Partners recommends no additional load should be applied to the slopes, if possible.

If building loads, slope modification works etc. are proposed, additional stability analysis will be required to confirm that the proposed works do not adversely affect slope stability.

5.8.4 Adopted Material Properties and Subsurface Profiles

The 'long term', effective soil and weathered rock strength parameters used in the stability analyses are summarised in Table 9. The peak strength friction angle value of 23 degrees for soils adopted for the stability analyses has been based on the average measured peak strength values obtained from the triaxial and direct shear tests, which is less than the average inferred peak strength value from Table 4.

As some of the clays and weathered mudstone encountered at the site (and during previous investigations of the eastern slopes of the Oxley PDA development), have been found to contain what appear to be 'small' zones of slickensides, separate 'long term' analysis cases have been undertaken to assess the potential effects if any zones of significant slickensides exist. The analysis was based on the assumption that the very stiff to hard clays are slickensided and has been carried out adopting a drained residual friction angle of 16 degrees for the clays, which is approximately 3 degrees less than the average of the inferred residual friction angle values given in Table 4 (but equal to the residual strength test results given in Table 7).

Table 9: Material Properties Adopted for Analysis

Bore	Stability Analysis Model Layer	Material	Unit Weight (kN/m^2)	Long Term Drained Parameters		
				Peak Strength		Residual Strength
				Cohesion – c' (kPa)	Friction Angle (ø') (degrees)	Friction Angle (ø'$_r$) (degrees)
100	1	Stiff Clay	19	1	23	-
	2	Very Stiff Clay	19	1	23	16
	3	Hard Clay	19	1	23	16
	4	Very Stiff Clay	19	1	23	16
	5	Hard Clay	19	1	23	16
	6	Extremely Low Strength Sandstone	20	5	24	-
101	1	Stiff Clay	19	1	23	-
	2	Hard Clay	19	1	23	16
	3	Very Stiff Clay	19	1	23	16
	4	Medium Dense Clayey Sand	21	0	30	-
	5	Dense Clayey Sand	21	0	33	-
	6	Very Stiff Clay	19	1	23	16
	7	Hard Clay	19	1	23	16
	8	Very Stiff Clay	19	1	23	16
102	1	Existing Fill*	21	3	25	-
	2	Very Stiff Clay	19	1	23	16
	3	Hard Clay	19	1	23	16
	4	Extremely Low Strength Sandstone	20	5	24	-
103	1	Stiff Clay	19	1	23	-
	2	Hard Clay	19	1	23	16
	3	Very Dense Clayey Sand	21	0	35	-
	4	Extremely Low Strength Sandstone	20	5	24	-
	5	Extremely Low Strength Mudstone	20	1	23	16
	6	Very Stiff Clay	19	1	23	16
	7	Extremely Low Strength Mudstone	20	1	23	16
104	1	Stiff Clay	19	1	23	-
	2	Very Stiff Clay	19	1	23	16
	3	Hard Clay	19	1	23	16
	4	Extremely Low Strength Sandstone	20	5	24	-
	5	Hard Clay	19	1	23	16
	6	Extremely Low Strength Sandstone	20	5	24	-
	7	Hard Clay	19	1	23	16
	8	Extremely Low Strength Mudstone	20	1	23	16
105	1	Hard Clay	19	1	23	16
	2	Medium Dense Clayey Sand	21	0	30	-
	3	Stiff Clay	19	1	23	-
	4	Hard Clay	19	1	23	16
	5	Very Dense Clayey Sand	21	0	35	-
	6	Hard Clay	19	1	23	16
	7	Extremely Low Strength Mudstone	20	1	23	16

* Assumed to be controlled; to be confirmed

5.8.5 Slope Profile Adopted using Existing Ground Surface Contours

The slope profile and stratigraphy adopted for each of the six sections anlaysed are given in Figure 4 to Figure 9 and the location of each section analysed is indicated in Drawing No. 1. It should be carefully noted that at the location of Bore 102, the fill was assumed to be controlled for the purpose of the stability analysis; if the existing fill is uncontrolled, a lower FOS value would apply to this location.

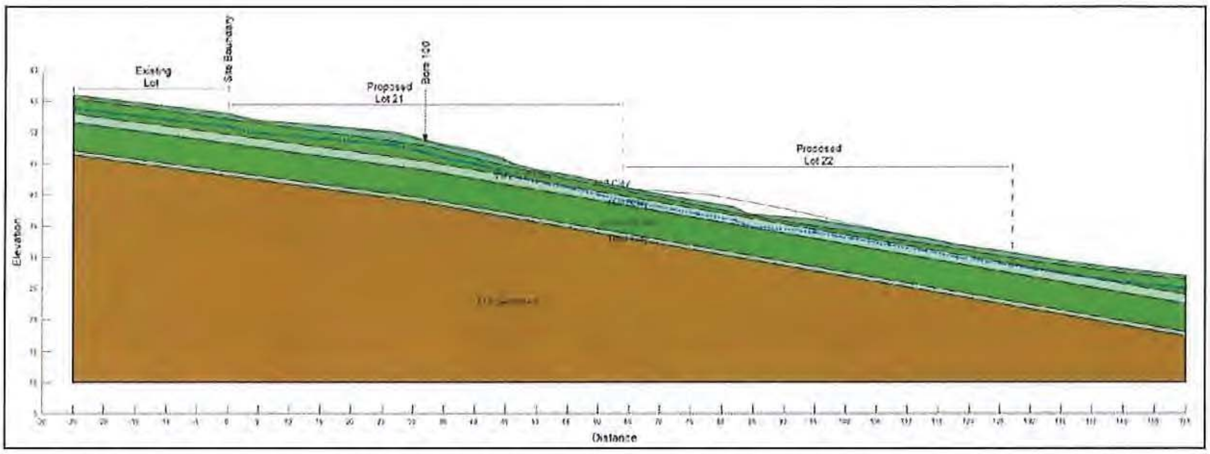


Figure 4: Adopted slope profile and stratigraphy of section near Bore 100

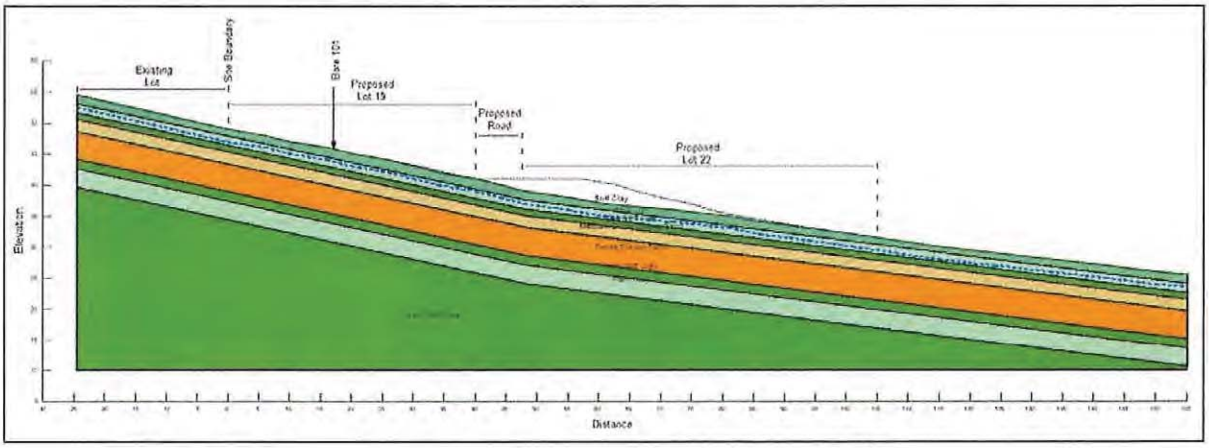


Figure 5: Adopted slope profile and stratigraphy of section near Bore 101

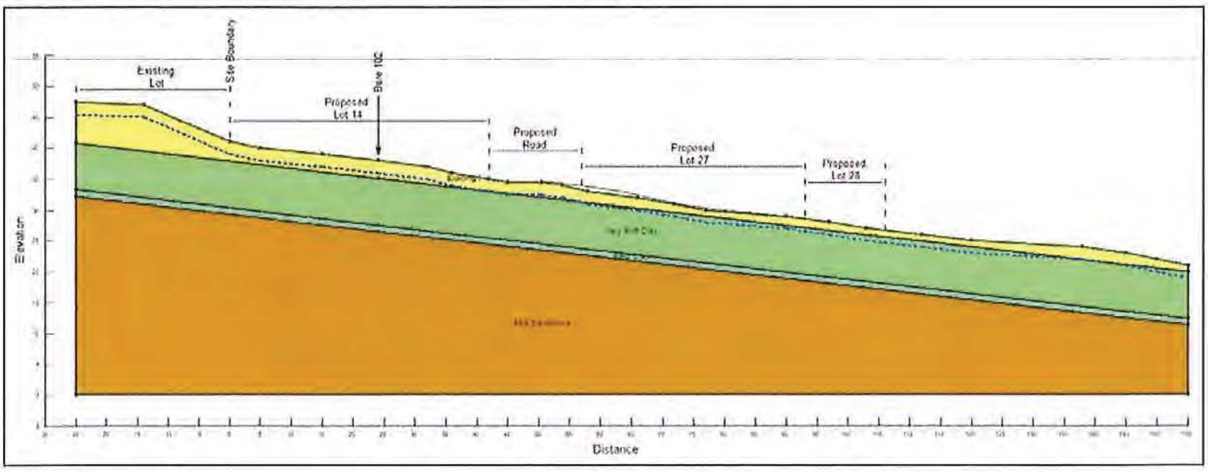


Figure 6: Adopted slope profile and stratigraphy of section near Bore 102

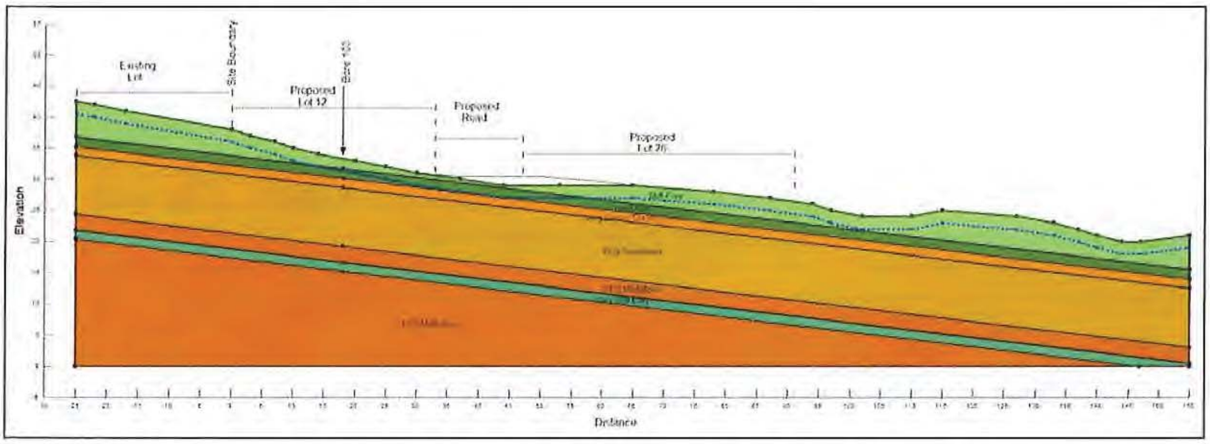


Figure 7: Adopted slope profile and stratigraphy of section near Bore 103

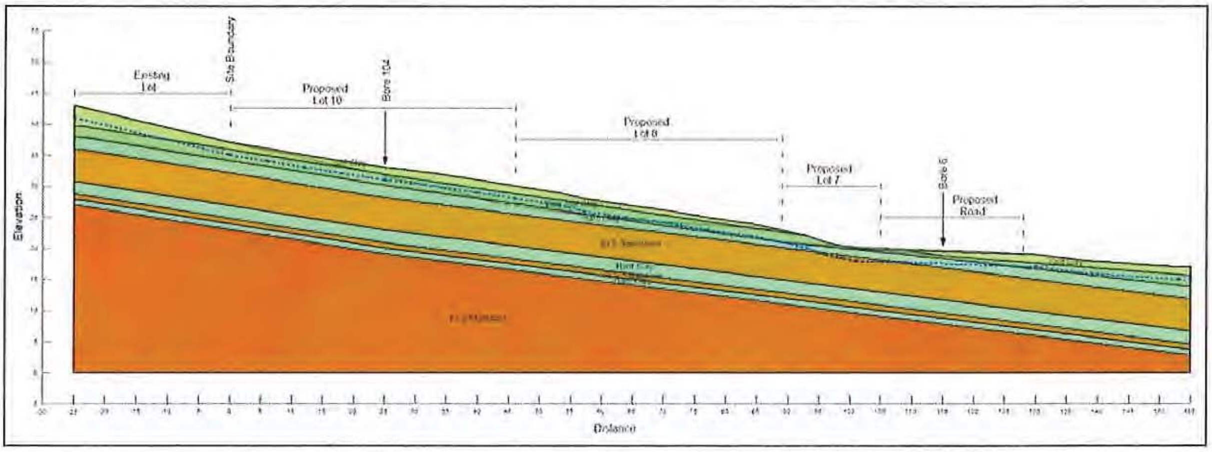


Figure 8: Adopted slope profile and stratigraphy of section near Bore 104

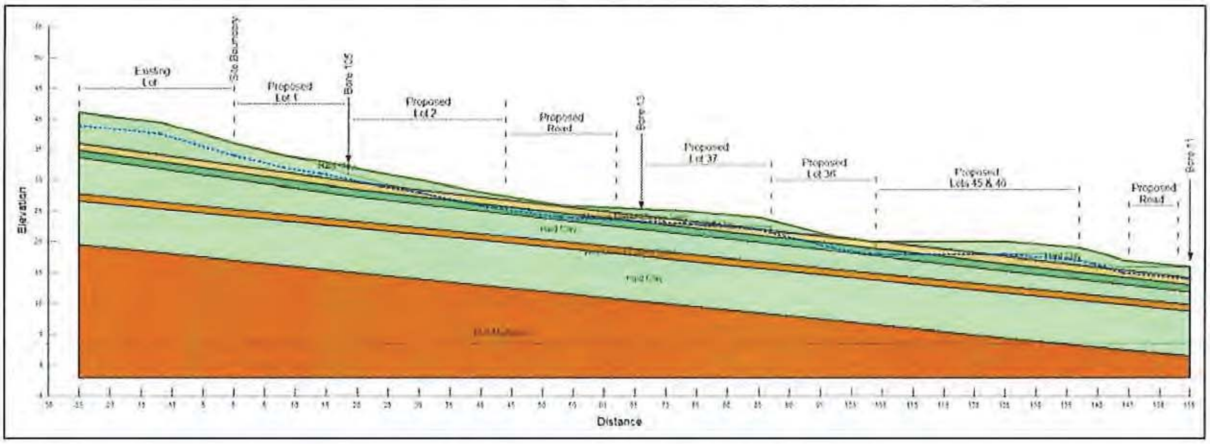


Figure 9: Adopted slope profile and stratigraphy of section near Bore 105

5.8.6 Groundwater Levels

The results of Butler Partners's groundwater assessment of the site (refer Section 2.1.2), indicate that the shallowest groundwater model calculated depth of groundwater is 5m below existing ground surface levels. As a result, groundwater depths of 4m and 6m below existing ground surface level, have been used in the slope stability assessment.

5.8.7 Analysis Results for Existing Profile – Peak Strength

Automated searches of the calculated potential circular failure surfaces were carried out to assess the failure surface with the lowest calculated FOS at each bore location for groundwater depths of 4m and 6m, adopting the existing ground profile and peak strengths and the results are summarised below.

5.8.7.1 Groundwater Depth – 4m

The results of the analysis of the slope profile at each bore, with the groundwater level at 4m below the ground surface, are presented graphically in Figure 10 to Figure 15, which also indicate the failure surface with the lowest calculated FOS, for each analysis conducted.

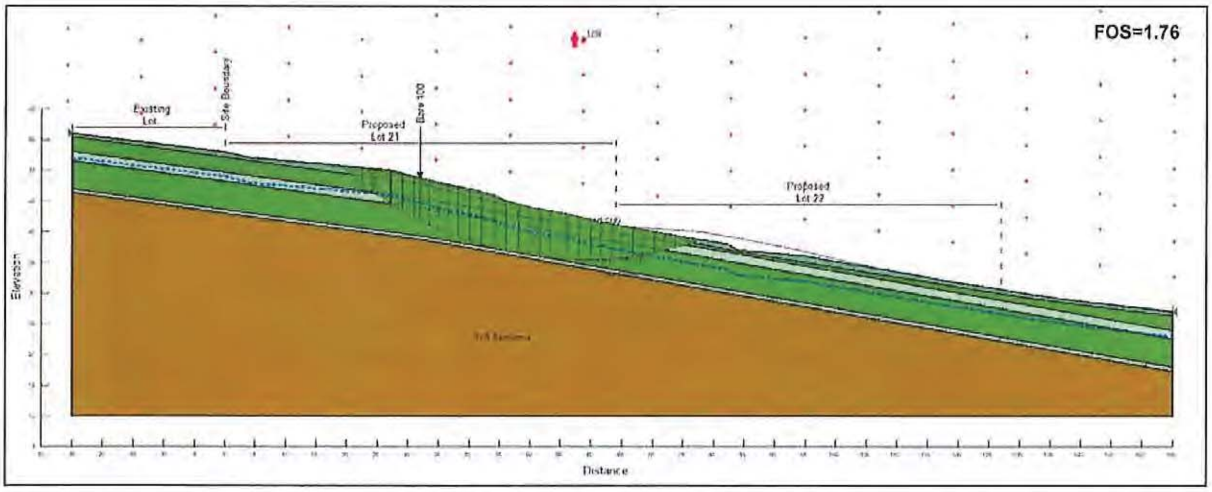


Figure 10: 'Long term' analysis of natural slope profile near Bore 100 (with 4m deep groundwater)

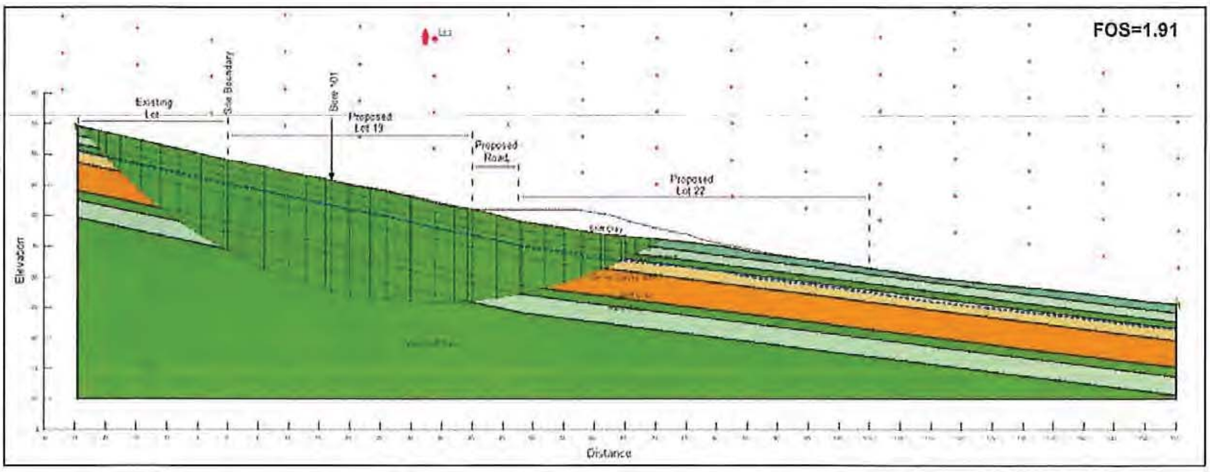


Figure 11: 'Long term' analysis of natural slope profile near Bore 101 (with 4m deep groundwater)

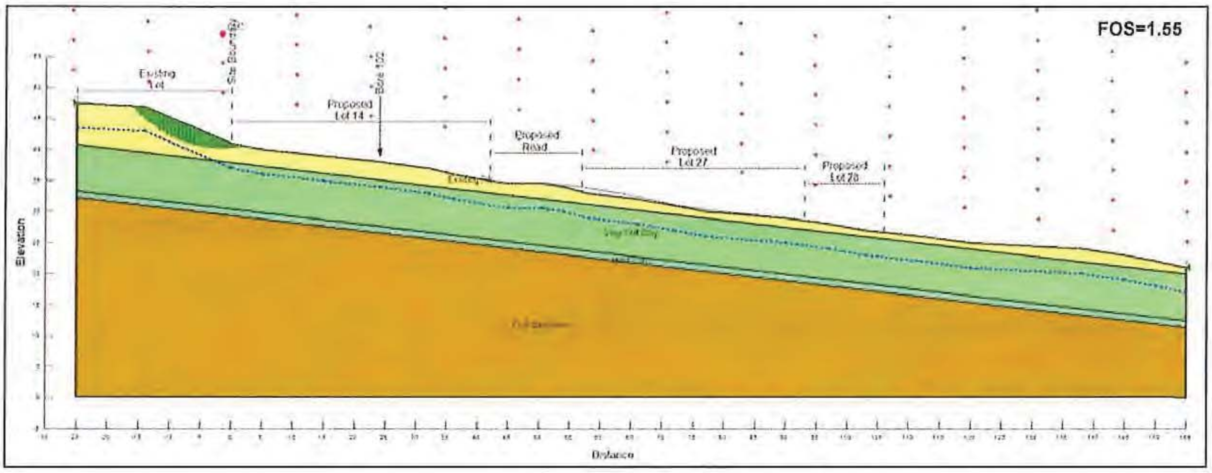


Figure 12: 'Long term' analysis of natural slope profile near Bore 102 (with 4m deep groundwater)

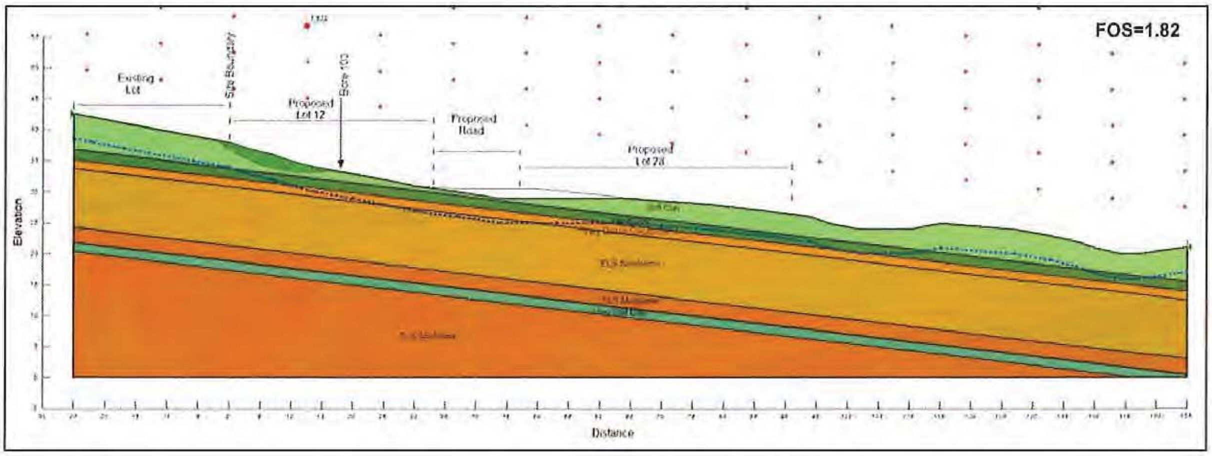


Figure 13: 'Long term' analysis of natural slope profile near Bore 103 (with 4m deep groundwater)

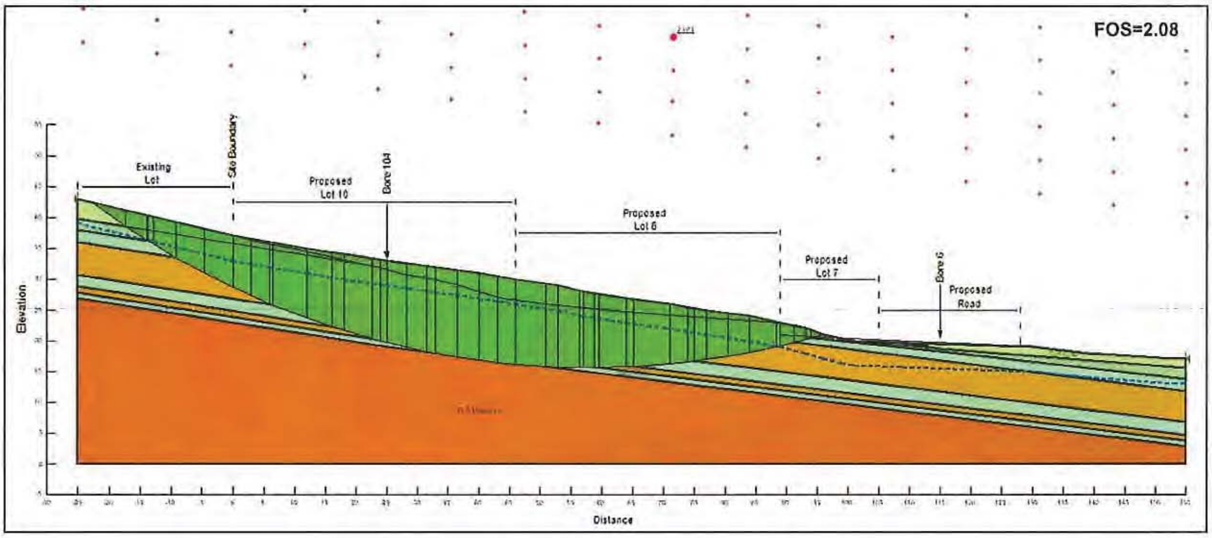


Figure 14: 'Long term' analysis of natural slope profile near Bore 104 (with 4m deep groundwater)

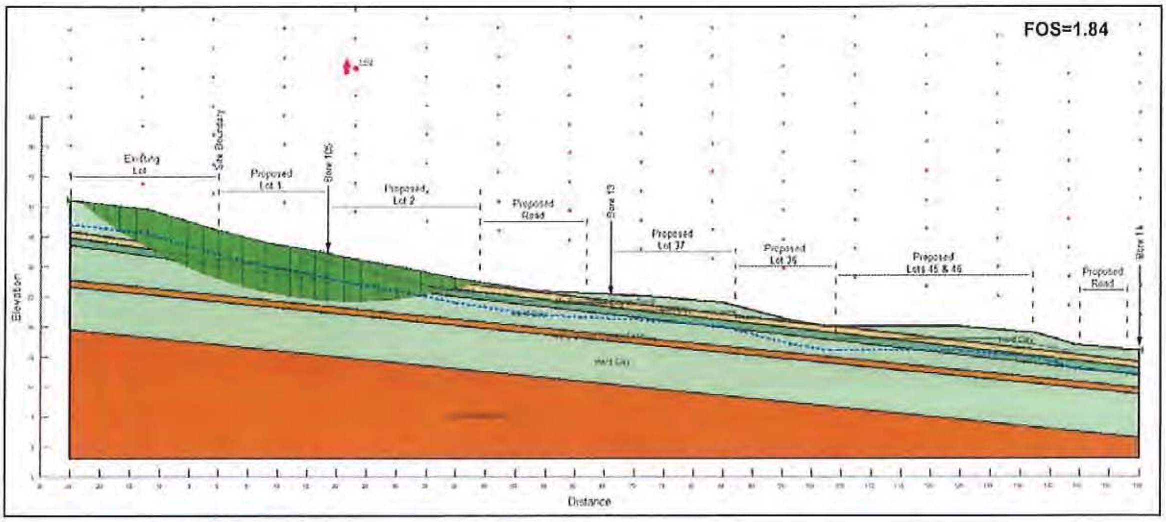


Figure 15: 'Long term' analysis of natural slope profile near Bore 105 (with 4m deep groundwater)

5.8.7.2 Groundwater Depth – 6m

The results of the analysis of the slope profile at each bore, with the groundwater level at 6m below the ground surface, are presented graphically in Figure 16 to Figure 21, which also indicate the failure surface with the lowest calculated FOS, for each analysis conducted.

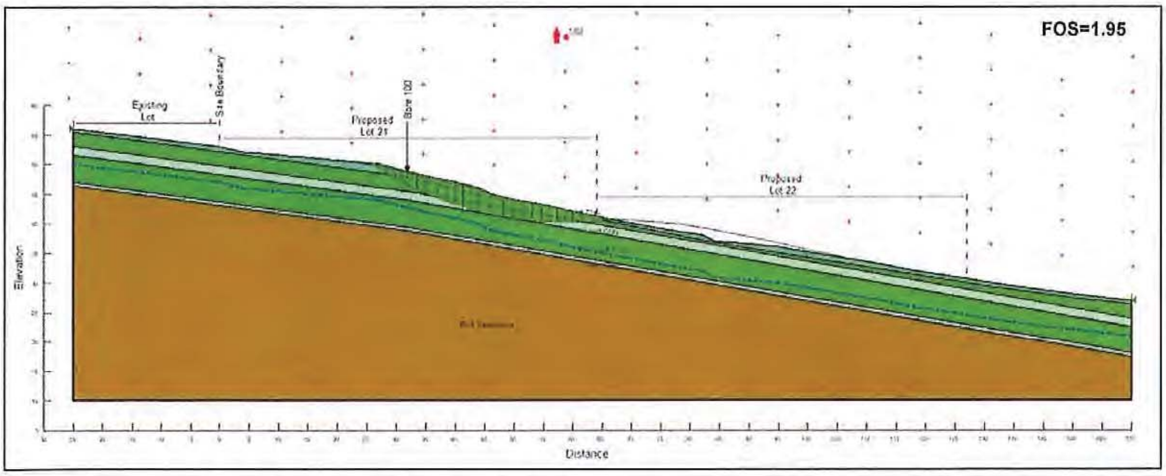


Figure 16: 'Long term' analysis of natural slope profile near Bore 100 (with 6m deep groundwater)

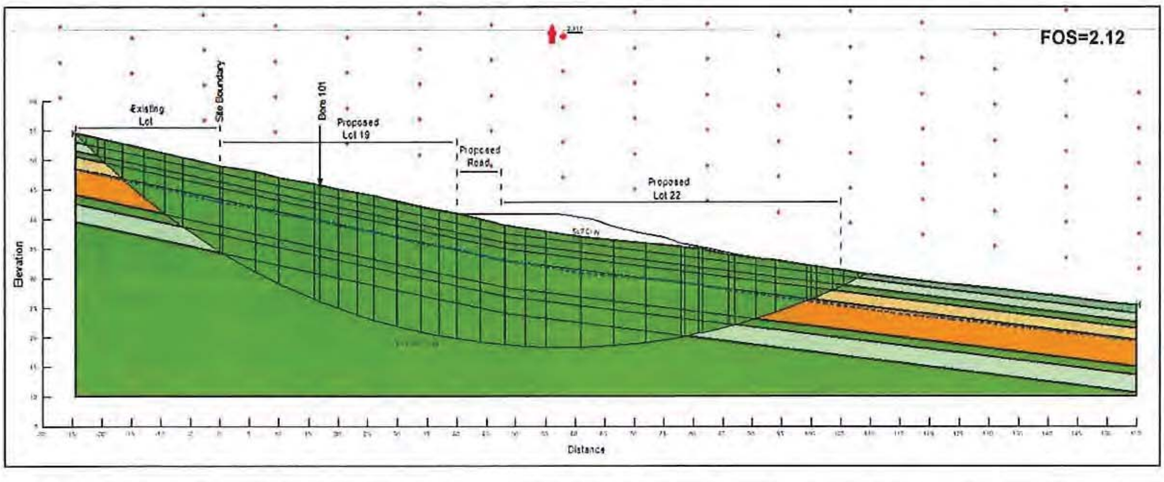


Figure 17: 'Long term' analysis of natural slope profile near Bore 101 (with 6m deep groundwater)

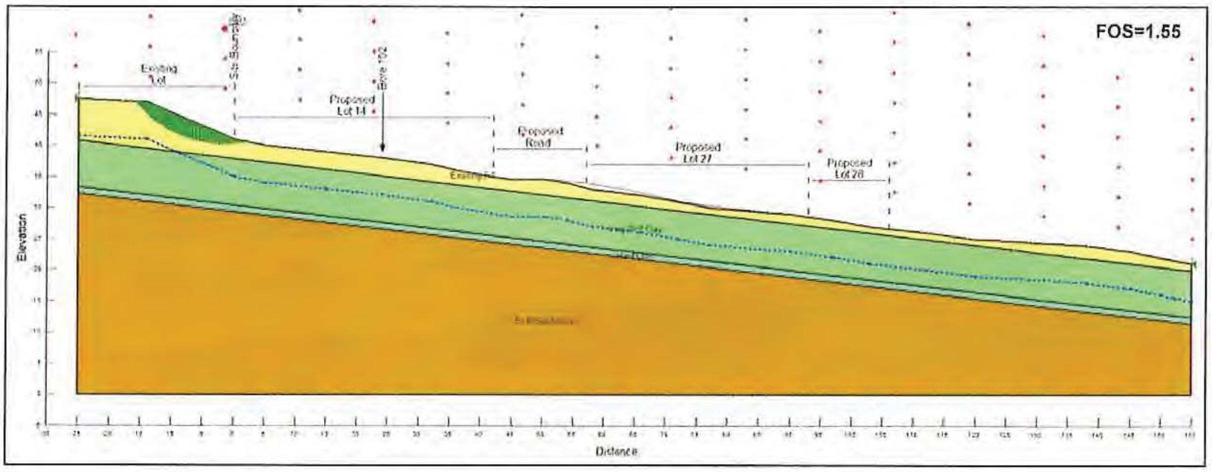


Figure 18: 'Long term' analysis of natural slope profile near Bore 102 (with 6m deep groundwater)

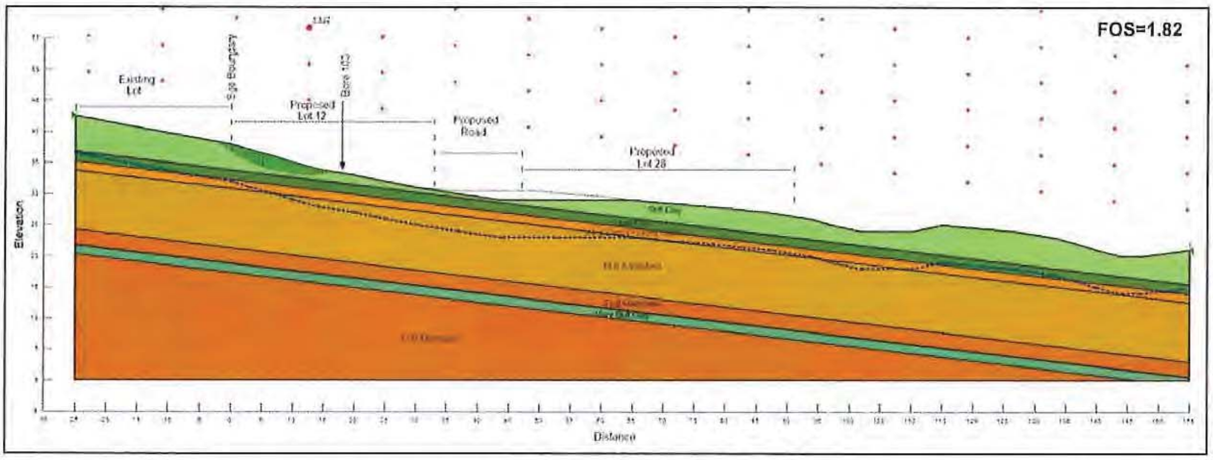


Figure 19: 'Long term' analysis of natural slope profile near Bore 103 (with 6m deep groundwater)

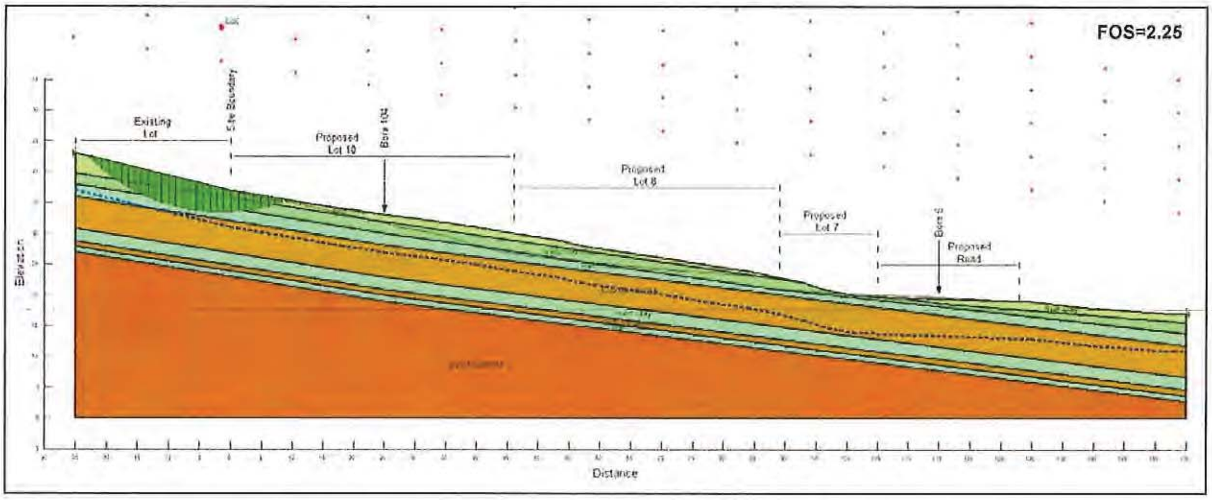


Figure 20: 'Long term' analysis of natural slope profile near Bore 104 (with 6m deep groundwater)

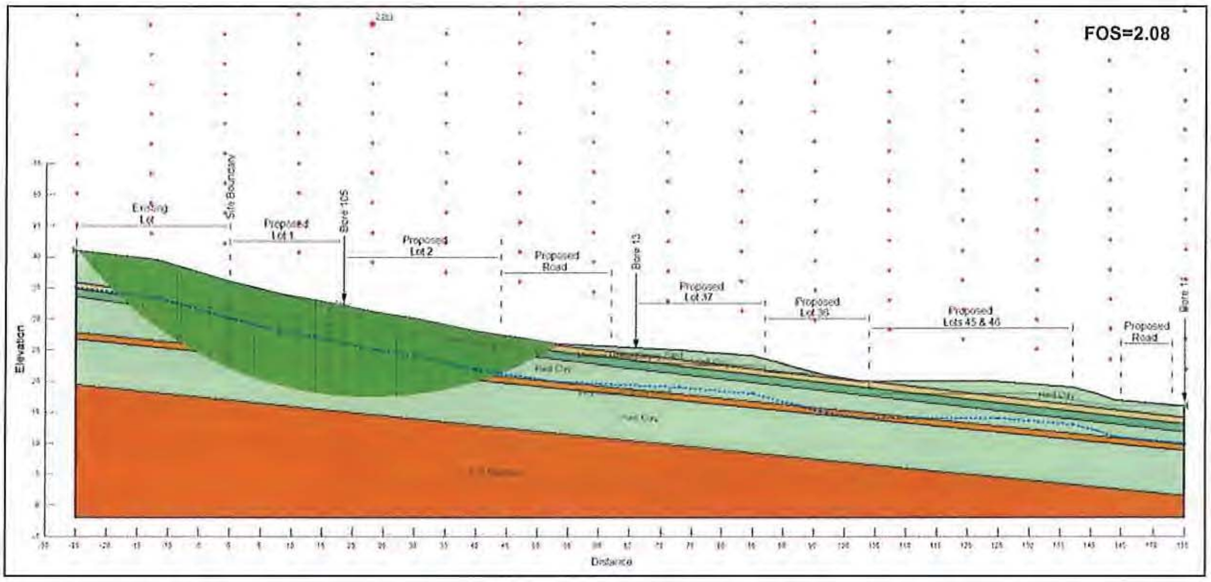


Figure 21: 'Long term' analysis of natural slope profile near Bore 105 (with 6m deep groundwater)

5.8.7.3 Results Summary

The results of all peak strength stability analyses conducted for the existing ground conditions at each bore, for each of the two groundwater depths adopted, are summarised in Table 10.

Table 10: Calculated Minimum FOS Values for Long Term Conditions

Description	Lowest Calculated FOS (Long Term)	
	Groundwater at 4m Below Ground Surface	Groundwater at 6m Below Ground Surface
Analysis of natural slope profile near Bore 100	1.76	1.95
Analysis of natural slope profile near Bore 101	1.91	2.12
Analysis of natural slope profile near Bore 102	1.55	1.55
Analysis of natural slope profile near Bore 103	1.82	1.82
Analysis of natural slope profile near Bore 104	2.08	2.25
Analysis of natural slope profile near Bore 105	1.84	2.08

5.8.8 Slope Analysis Based on KN's Design Earthworks Profiles

The design earthworks slope profile and stratigraphy adopted for each of the six sections analysed are given in Figure 22 to Figure 27. The stability analysis included a 5kPa surcharge allowance for future development load, together with the slope modification works nominated on KN's earthworks design drawings; it is recommended that no development surcharge greater than 5kPa be added to slopes; if the locations of surcharges differ from KN's earthworks design drawings, the potential effects on slope stability should be considered.

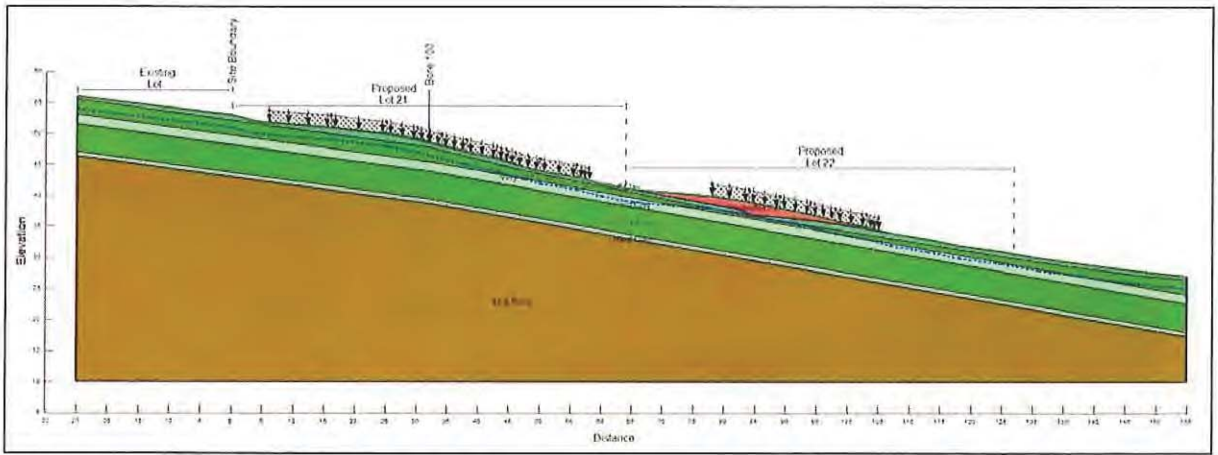


Figure 22: Adopted slope profile and stratigraphy of section near Bore 100

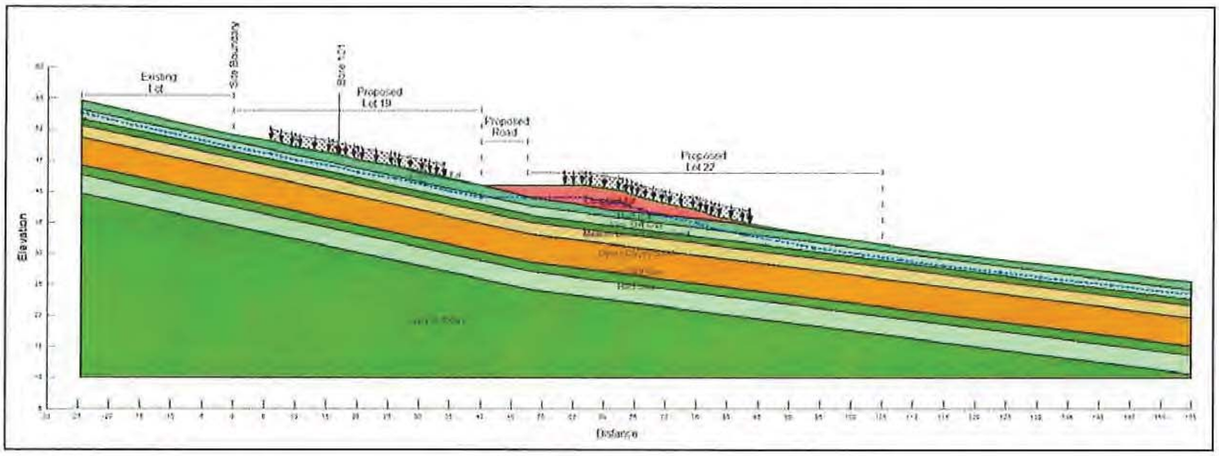


Figure 23: Adopted slope profile and stratigraphy of section near Bore 101

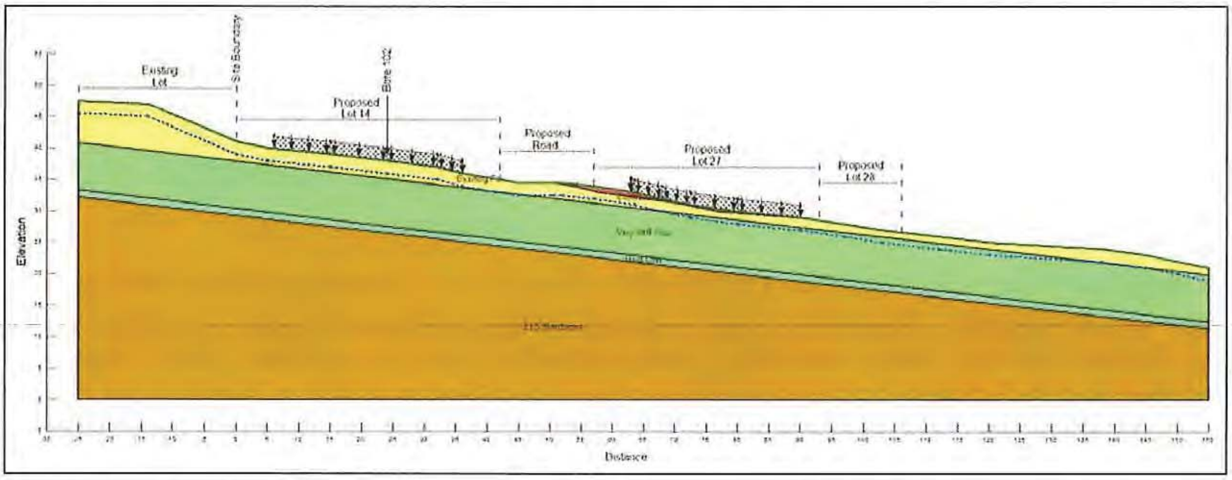


Figure 24: Adopted slope profile and stratigraphy of section near Bore 102

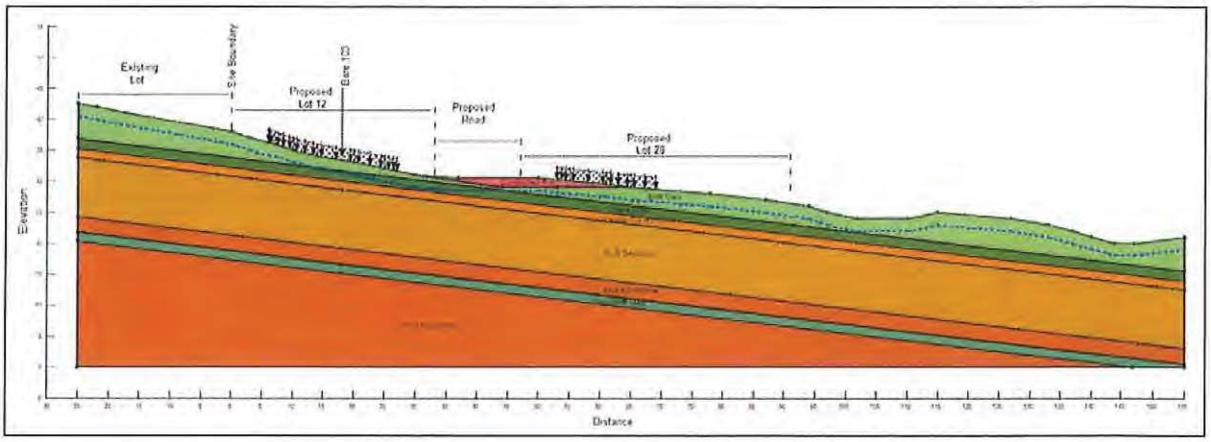


Figure 25: Adopted slope profile and stratigraphy of section near Bore 103

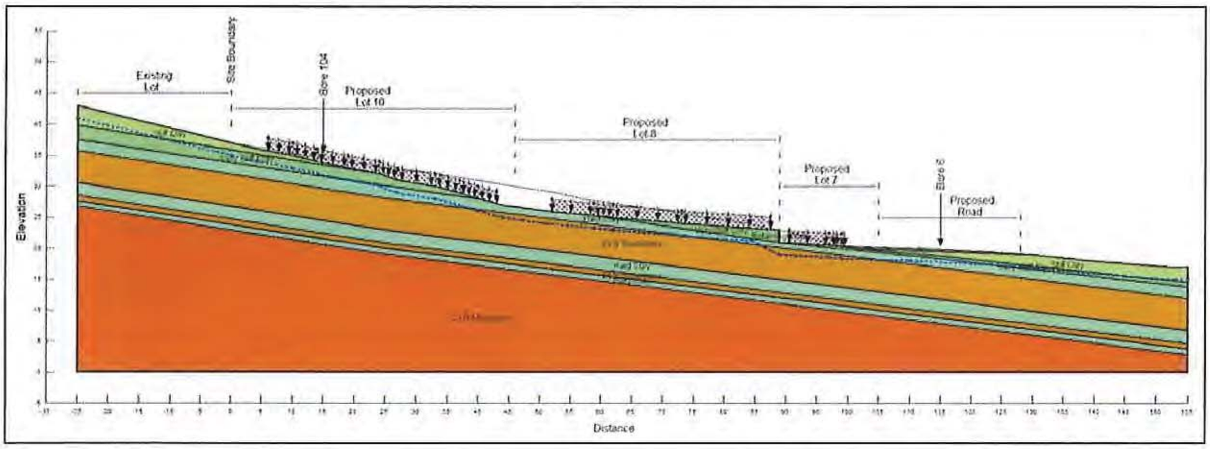


Figure 26: Adopted slope profile and stratigraphy of section near Bore 104

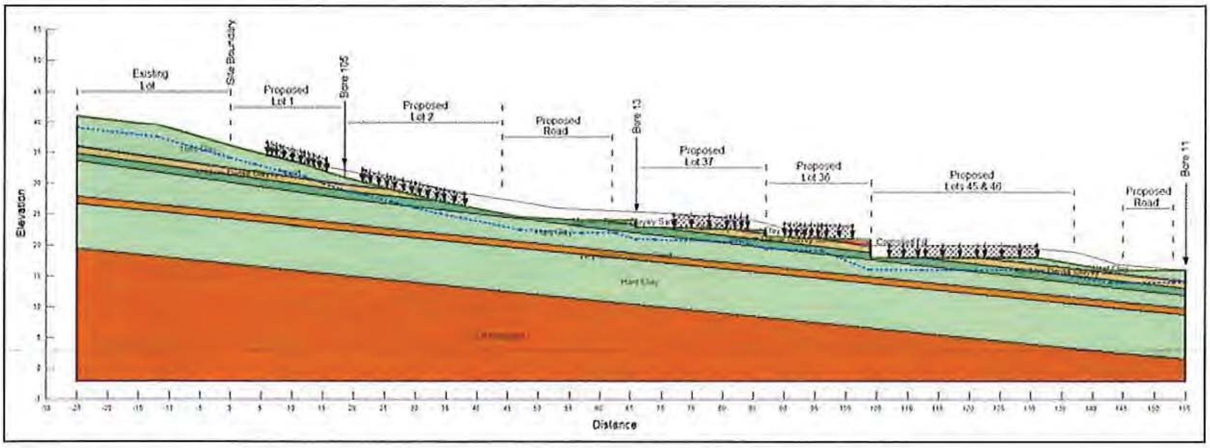


Figure 27: Adopted slope profile and stratigraphy of section near Bore 105

5.8.9 Analysis Results for Design Earthworks Profile – Peak Strength

Automated searches of the calculated potential circular failure surfaces were carried out to assess the failure surface with the lowest calculated FOS at each bore location adopting the design earthworks profile and peak strengths and the results are given below.

5.8.9.1 Groundwater Depth – 4m

The results of the analysis of each design slope profile, with the groundwater level at 4m below the ground surface, are presented graphically in Figure 28 to Figure 33, which also show the failure surface with the lowest calculated FOS, for each analysis conducted.

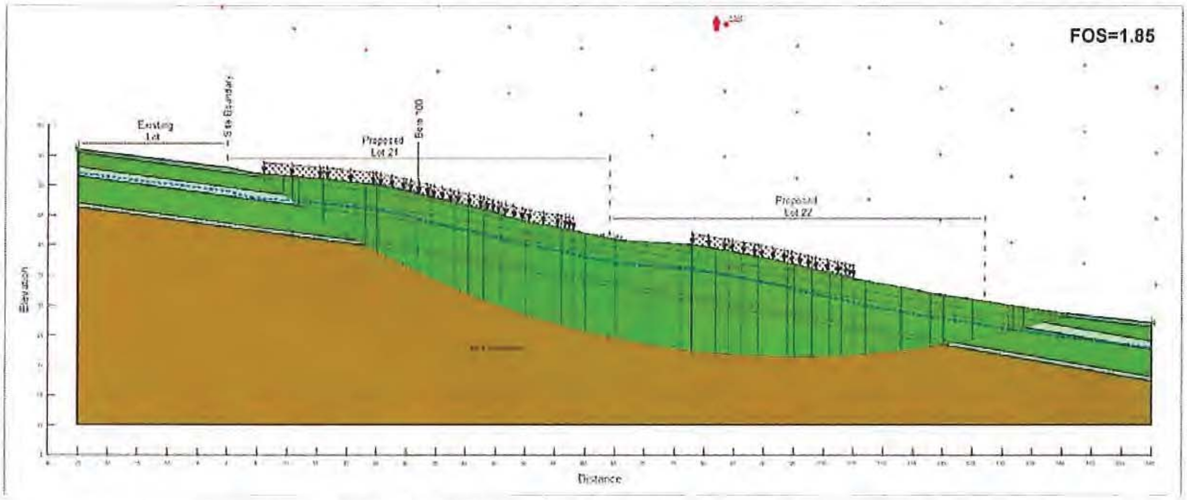


Figure 28: 'Long term' analysis of final design profile near Bore 100 (with 4m deep groundwater)

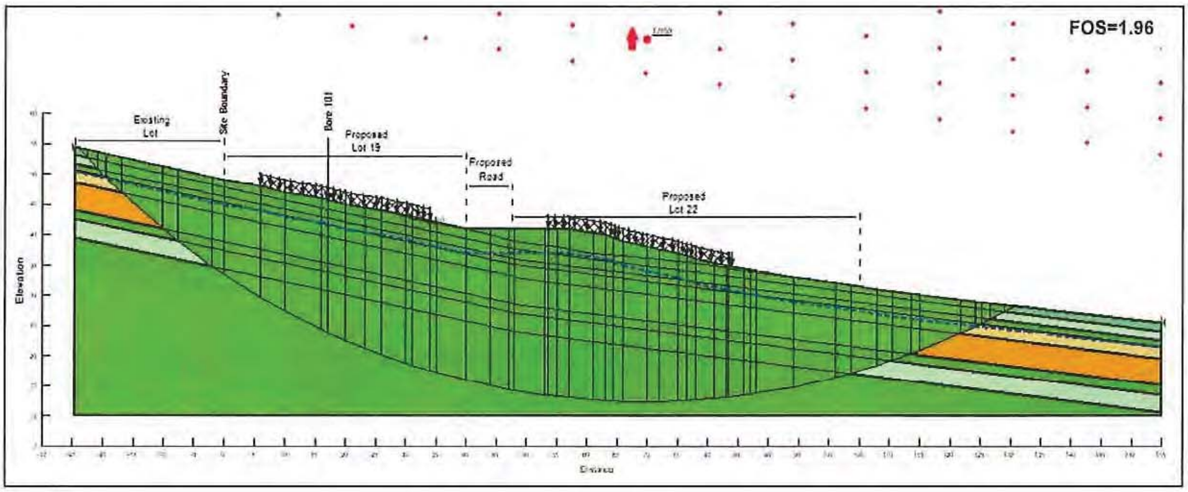


Figure 29: 'Long term' analysis of final design profile near Bore 101 (with 4m deep groundwater)

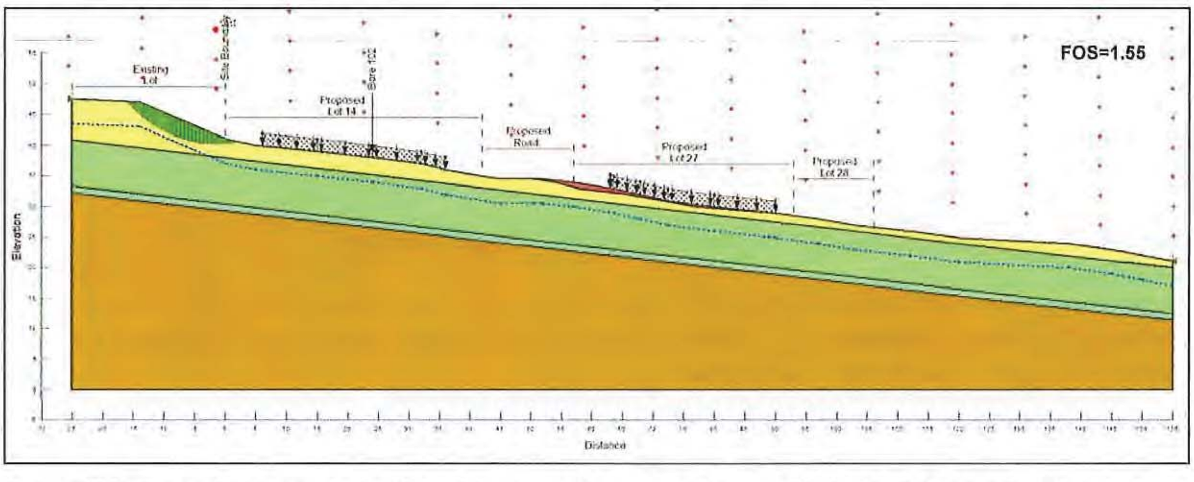


Figure 30: 'Long term' analysis of final design profile near Bore 102 (with 4m deep groundwater)

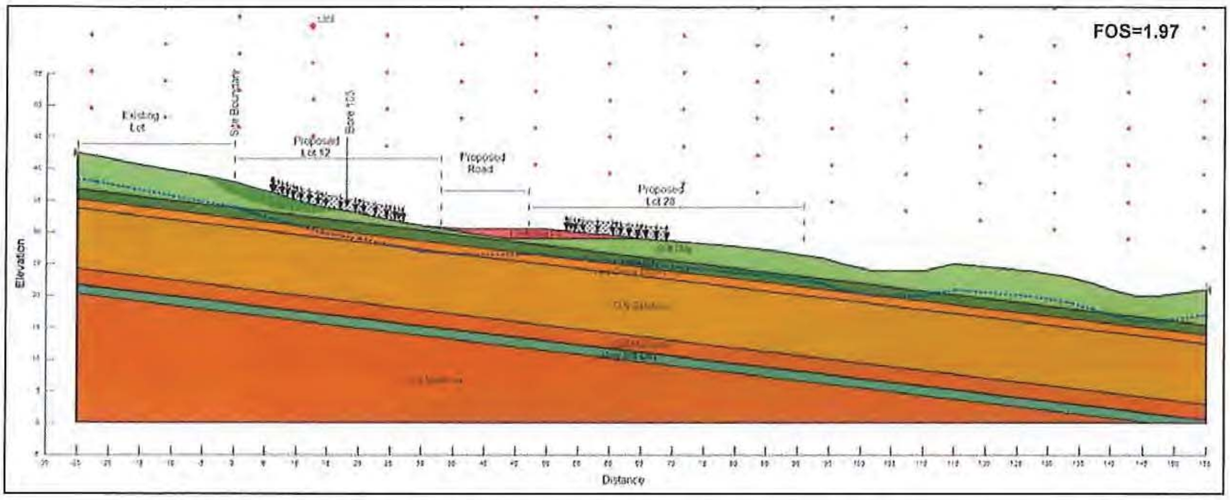


Figure 31: 'Long term' analysis of final design profile near Bore 103 (with 4m deep groundwater)

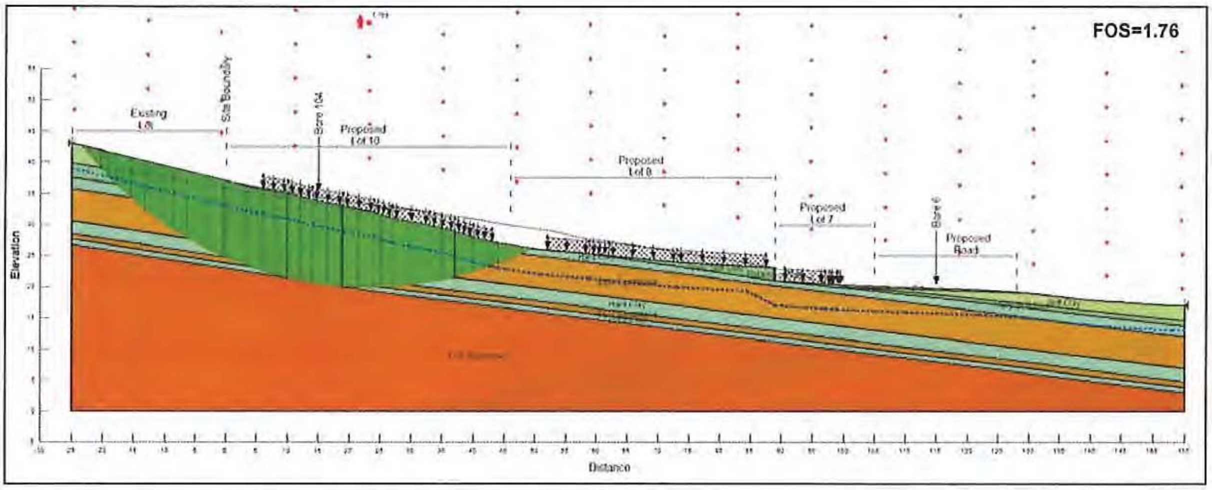


Figure 32: 'Long term' analysis of final design profile near Bore 104 (with 4m deep groundwater)

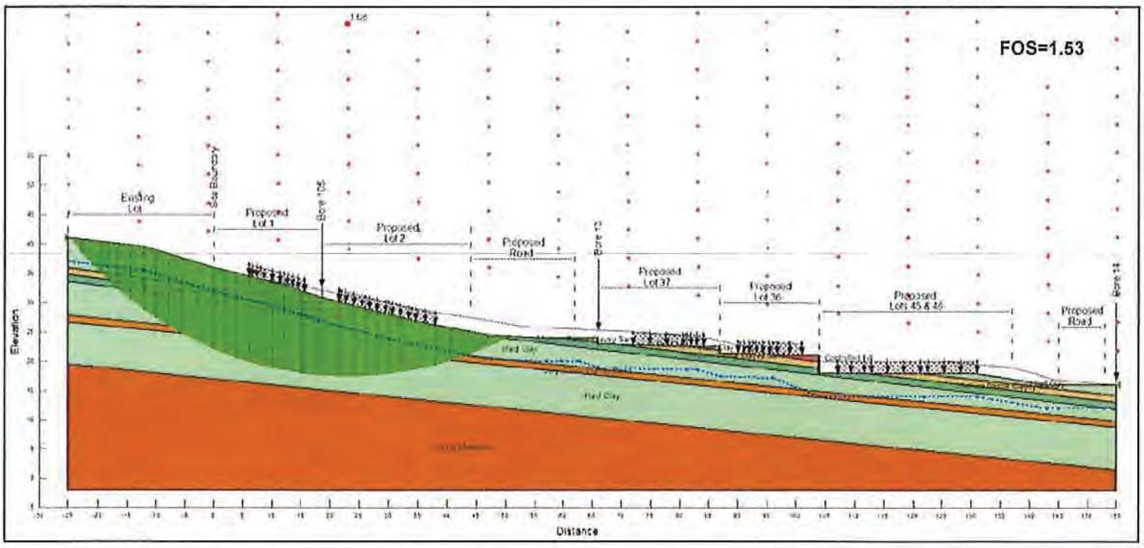


Figure 33: 'Long term' analysis of final design profile near Bore 105 (with 4m deep groundwater)

5.8.9.2 Groundwater Depth – 6m

The results of the analysis of each design slope profile, with the groundwater level at 6m below the ground surface, are presented graphically in Figure 34 to Figure 39, which also show the failure surface with the lowest calculated FOS, for each analysis conducted.

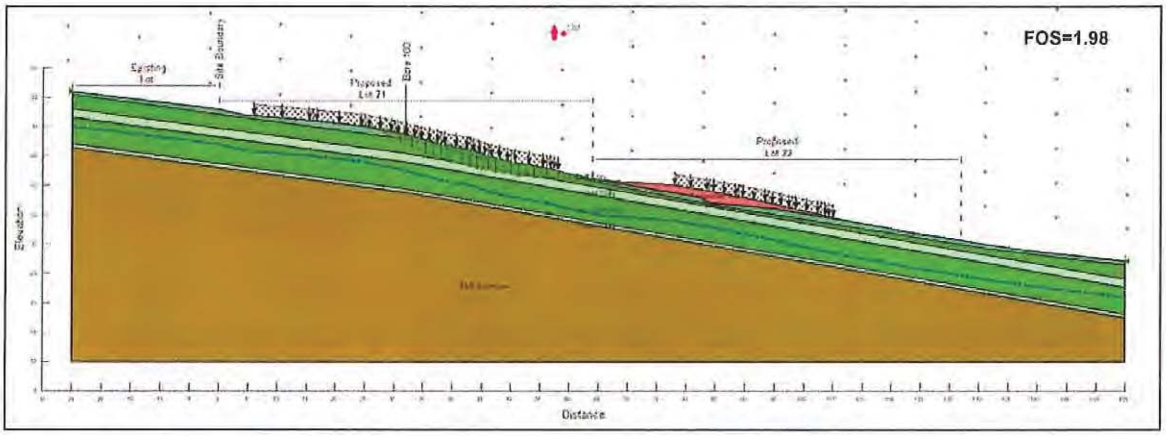


Figure 34: 'Long term' analysis of final design profile near Bore 100 (with 6m deep groundwater)

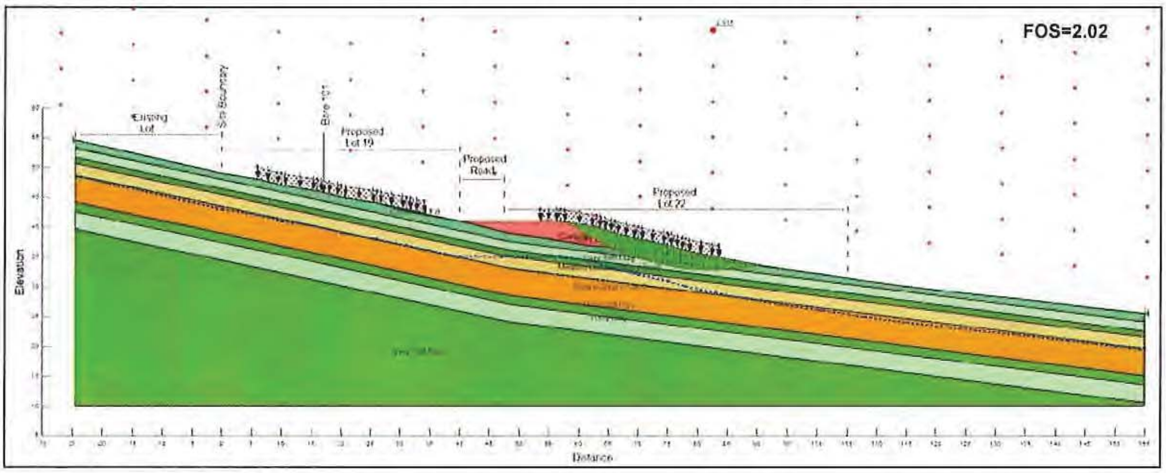


Figure 35: 'Long term' analysis of final design profile near Bore 101 (with 6m deep groundwater)

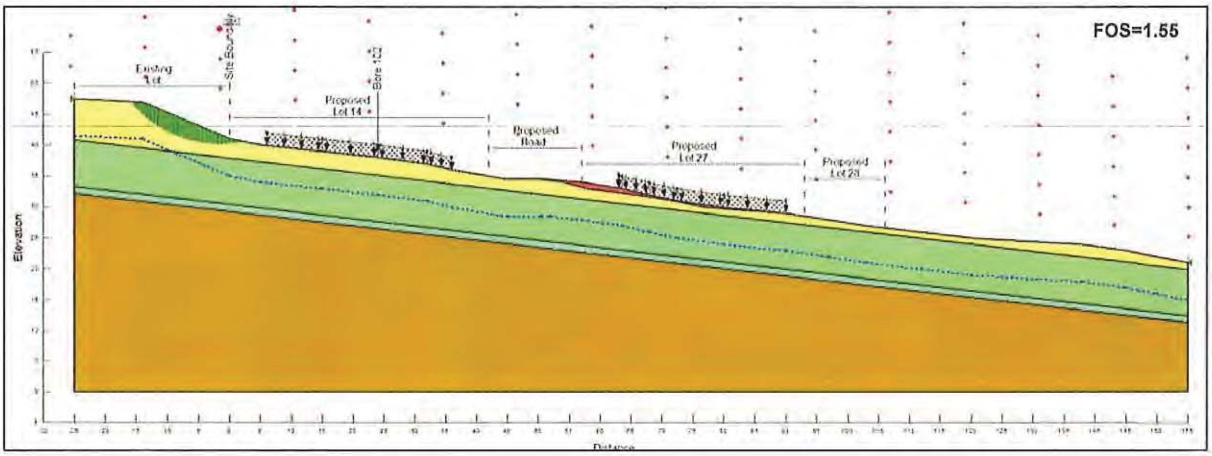


Figure 36: 'Long term' analysis of final design profile near Bore 102 (with 6m deep groundwater)

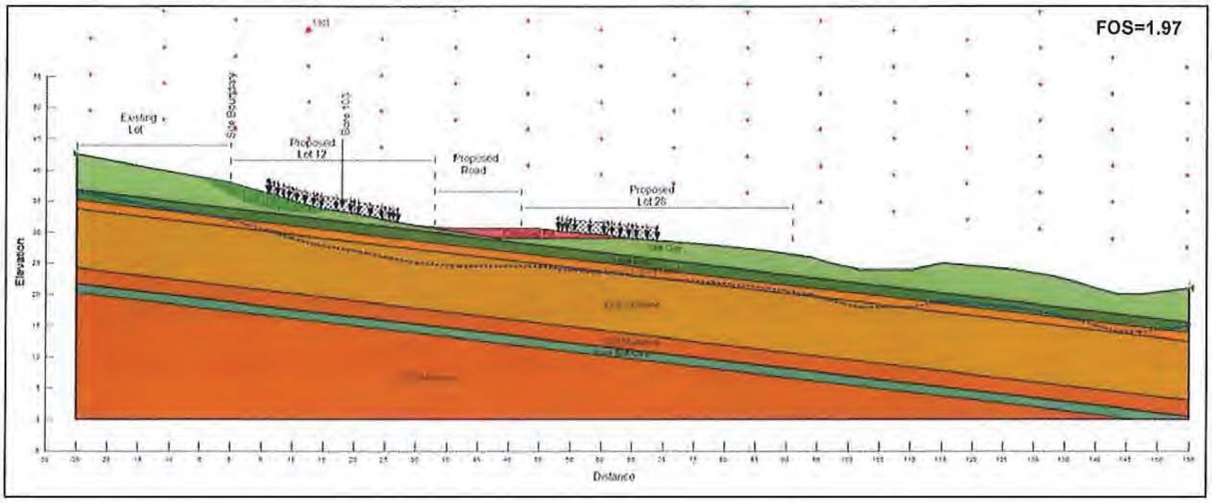


Figure 37: 'Long term' analysis of final design profile near Bore 103 (with 6m deep groundwater)

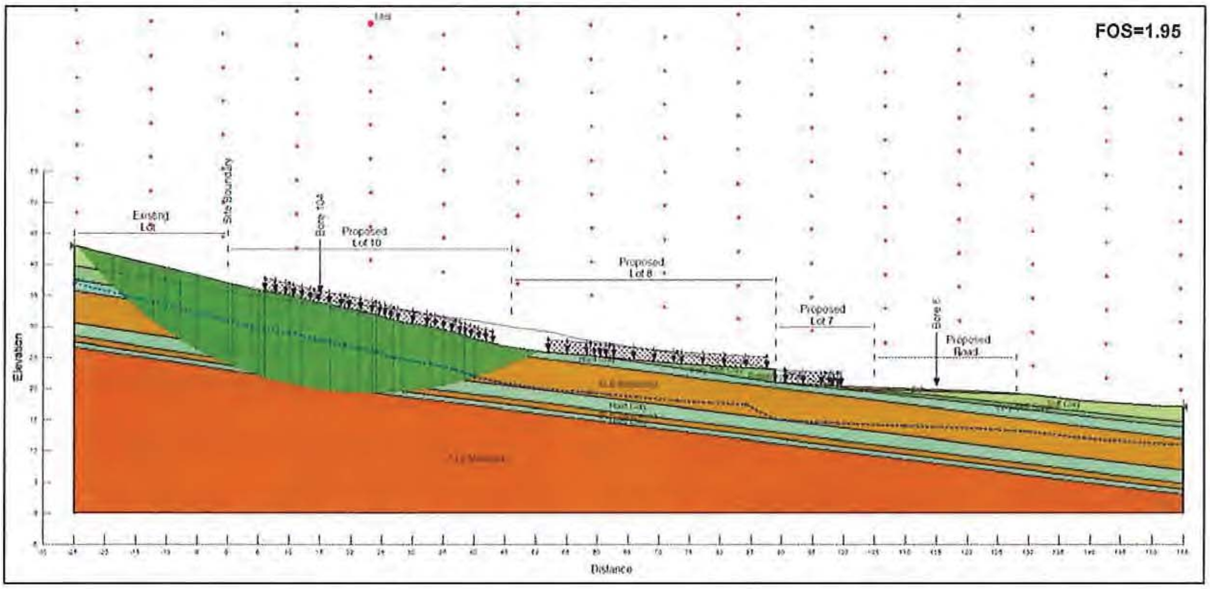


Figure 38: 'Long term' analysis of final design profile near Bore 104 (with 6m deep groundwater)

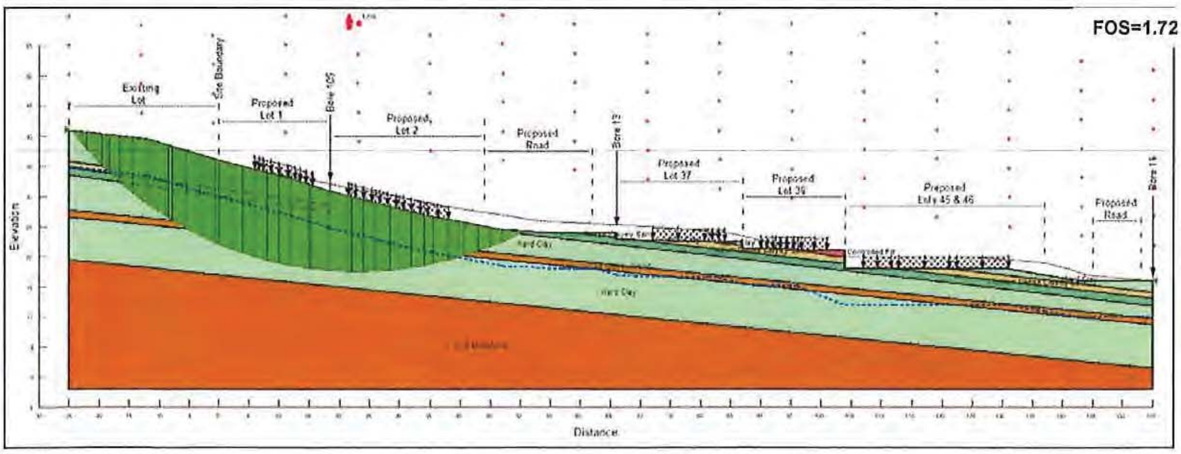


Figure 39: 'Long term' analysis of final design profile near Bore 105 (with 6m deep groundwater)

5.8.9.3 Results Summary

The results of all peak strength stability analyses conducted for the design earthworks profile at each bore, for each of the three groundwater depths adopted, are summarised in Table 11.

Table 11: Calculated Minimum FOS Values for Long Term Peak Strength Conditions

Description	Lowest Calculated FOS (Long Term)	
	Groundwater at 4m Below Ground Surface	Groundwater at 6m Below Ground Surface
Analysis of final design profile near Bore 100	1.85	1.98
Analysis of final design profile near Bore 101	1.96	2.02
Analysis of final design profile near Bore 102	1.55	1.55
Analysis of final design profile near Bore 103	1.97	1.97
Analysis of final design profile near Bore 104	1.76	1.95
Analysis of final design profile near Bore 105	1.53	1.72

It should be noted that the stability analysis results summarised in Table 11 include a 5kPa surcharge allowance for future development load, together with the slope modification works nominated on KN's earthworks design drawings. It is recommended that (if possible), no development surcharge be added to slopes.

5.9 Stability of Near Surface Soils – If Saturated

Stability analysis to assess the potential effects of saturated near surface soils has been undertaken for each of the six design earthworks sections detailed in Section 5.8.8 (to identify potential instability within the near surface materials during intense rainfall), and the results of the analysis for each slope profile, are presented graphically in Figure 40 to Figure 45, which also show the failure surface with the lowest calculated FOS.

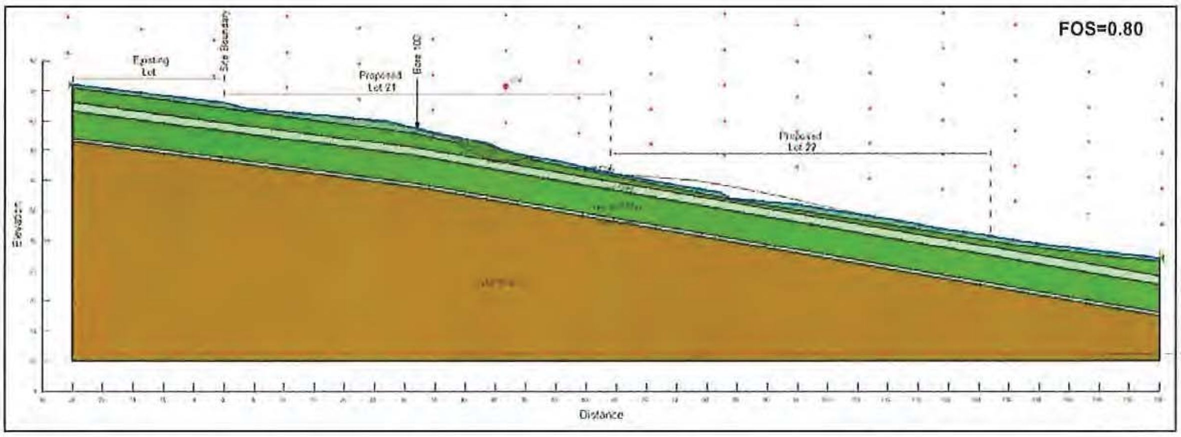


Figure 40: Analysis of near surface soils for the slope profile near Bore 100

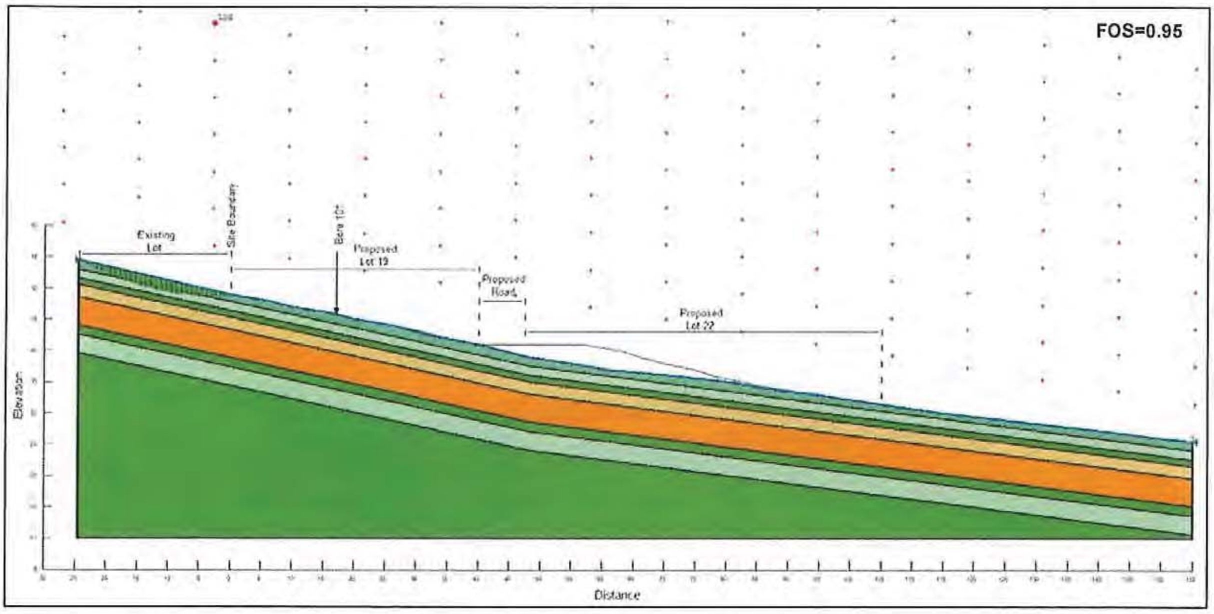


Figure 41: Analysis of near surface soils for the slope profile near Bore 101

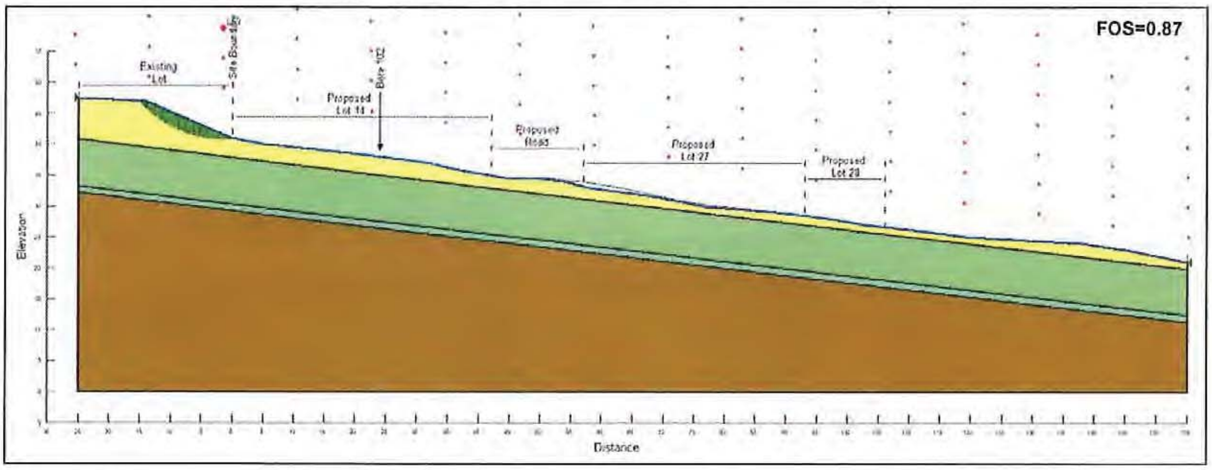


Figure 42: Analysis of near surface soils for the slope profile near Bore 102

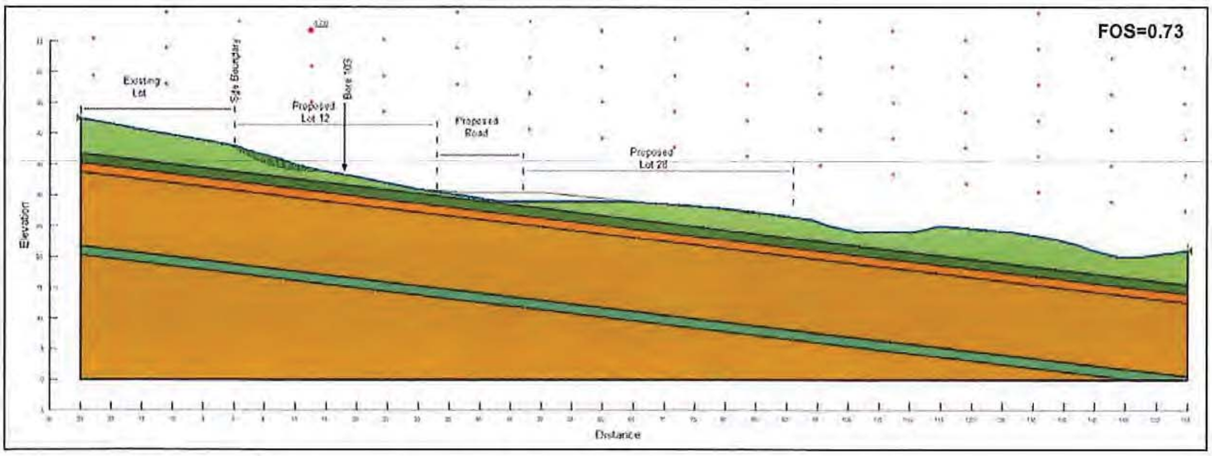


Figure 43: Analysis of near surface soils for the slope profile near Bore 103

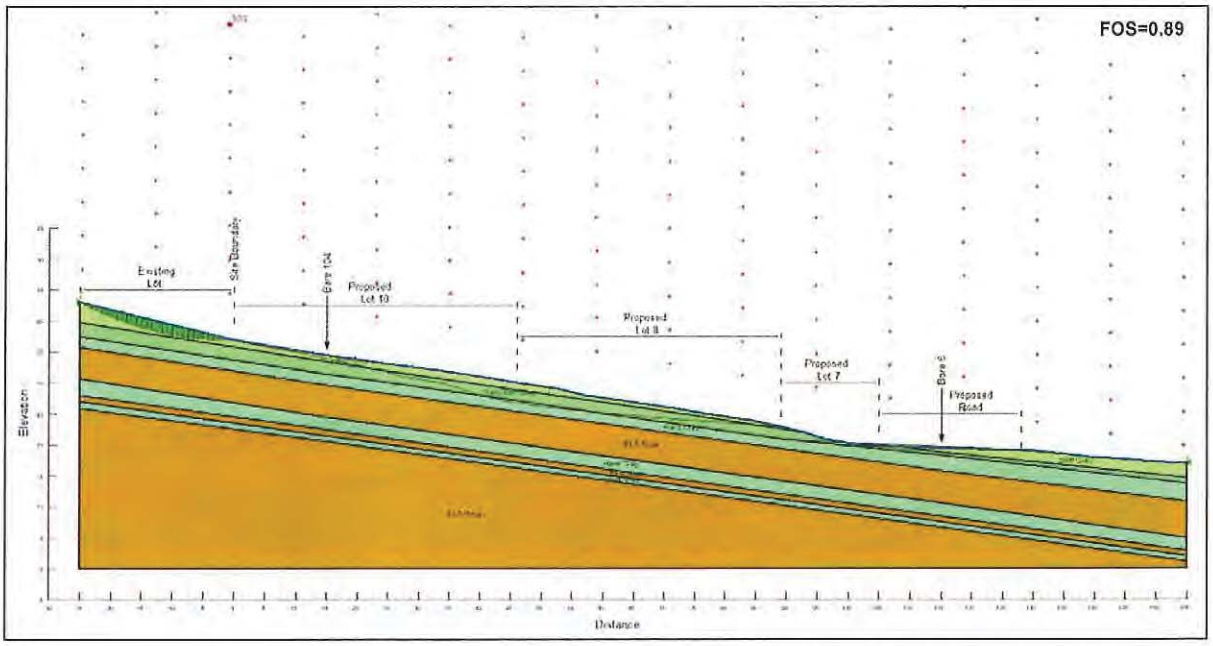


Figure 44: Analysis of near surface soils for the slope profile near Bore 104

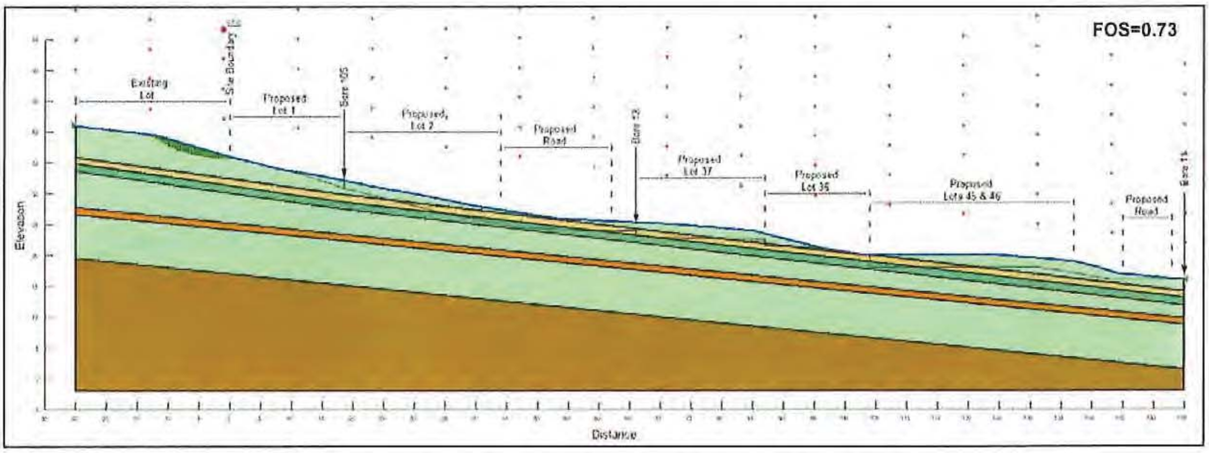


Figure 45: Analysis of near surface soils for the slope profile near Bore 105

5.9.1 Results Summary

The results of all stability analyses conducted for saturated near surface soils and the design earthworks profiles at each bore location are summarised in Table 12.

Table 12: Calculated Minimum FOS Values for Long Term Conditions – Near Surface Soils

Description	Lowest Calculated FOS (Long Term)					
	Slope Profile near Bore 100	Slope Profile near Bore 101	Slope Profile near Bore 102	Slope Profile near Bore 103	Slope Profile near Bore 104	Slope Profile near Bore 105
Analysis of Near Surface Saturated Soils	0.80	0.95	0.87	0.73	0.89	0.73

The analysis results confirm that, in zones of saturated surface soils, zones of relatively shallow soil failure could be expected. However, visual observations over the sloping sections of Stage 1A, did not reveal any zones of shallow (or deep) failures, presumably because broad scale saturation of near surface soils does not readily occur at the site.

5.10 Residual Strength Analysis

Based on the results of the inspection of soil and weathered rock samples recovered during the investigation, slickensides were encountered in some of the samples, however, there did not appear to be extensive zones of slickensides and no indications of past slope failures have been observed on site. However, if extensive zones of slickensides are present within the soils in an area(s) of the site, their presence could have an adverse effect on slope stability; additional stability analysis was conducted assuming that extensive zones of slickensides exist, to estimate their potential effect on slope stability.

Each of the analyses carried out using peak strengths for the existing and final design ground profiles have been reanalysed, using residual strength values (as indicated in Table 9) and groundwater depths of 4m and 6m and the results are summarised in Table 13 and Table 14.

5.10.1 Existing Slope Profiles

The existing ground surface profiles at Bores 100 to 105 were analysed using residual strengths for groundwater depths of 4m and 6m and results are summarised in Table 13.

Table 13: Calculated Minimum FOS Values for Residual Strength and Long Term Conditions

Description	Lowest Calculated FOS (Long Term)*	
	Groundwater at 4m Below Ground Surface	Groundwater at 6m Below Ground Surface
Analysis of natural slope profile near Bore 100	1.20	1.35
Analysis of natural slope profile near Bore 101	1.40	1.40
Analysis of natural slope profile near Bore 102	1.26	1.41
Analysis of natural slope profile near Bore 103	1.28	1.28
Analysis of natural slope profile near Bore 104	1.54	1.54
Analysis of natural slope profile near Bore 105	1.30	1.47

* Minimum FOS values using residual strength parameters

5.10.2 Final Design Profiles

The final design profiles at Bores 100 to 105 were analysed using residual strengths for groundwater depths of 4m and 6m and results are summarised in Table 14.

Table 14: Calculated Minimum FOS Values for Residual Strength and Long Term Conditions

Description	Lowest Calculated FOS (Long Term)*	
	Groundwater at 4m Below Ground Surface	Groundwater at 6m Below Ground Surface
Analysis of final design profile near Bore 100	1.42	1.44
Analysis of final design profile near Bore 101	1.55	1.68
Analysis of final design profile near Bore 102	1.39	1.55
Analysis of final design profile near Bore 103	1.74	1.74
Analysis of final design profile near Bore 104	1.34	1.34
Analysis of final design profile near Bore 105	1.19	1.34

* Minimum FOS values using residual strength parameters

5.11 Conclusions

5.11.1 Peak Strength Analysis

5.11.1.1 Existing Ground Profiles

The stability analysis results for the existing ground profiles using peak strength are summarised in Table 10 and indicate that at five sections analysed (i.e. Bores 100, 101, 103, 104 and 105), the minimum calculated FOS values are considered to be acceptable for the long term stability for non-slickensided clays and a groundwater level up to approximately 4m below the ground surface. The stability analysis results for Bore 102 are lower (but acceptable), than for the other five locations, because the critical failure circle passes through the adjacent property on Seventeen Mile Rocks Road and is reflective of a marginal stability situation on the adjacent property lot, not on Stage 1A.

5.11.1.2 Design Ground Profile

The stability analysis results for the proposed design earthworks ground profiles using peak strength are summarised in Table 11 and indicate that at four sections analysed (i.e. Bores 100, 101, 103 and 104), the minimum calculated FOS values are considered to be acceptable for the long term stability for non-slickensided clays and a groundwater level up to approximately 4m below the ground surface. The stability analysis results for Bores 102 and 105 are lower (but acceptable), than for the other four, locations because the critical failure circles pass through the adjacent properties on Seventeen Mile Rocks Road and are reflective of a marginal stability situation on the adjacent property lots, not on Stage 1A.

5.11.2 Near Surface Soils

The stability analysis results for saturated near surface soils summarised Table 12 indicate that localized instability of these materials is likely to occur under saturated conditions. Is it suggested that revegetation of the slopes would provide root support and help prevent surface erosion; installation of some shallow subsurface drainage and concrete lining of any existing (or proposed) zones of concentrated surface water flow would assist in preventing near surface soil failure.

5.11.3 Residual Strength Analysis

The stability analysis results for assumed heavily slickensided clays (no heavily slickensided zones were encountered), included in the slope profile are summarised in Table 13 for the existing ground slopes and in Table 14 for the design earthworks profiles. The results indicate that the minimum calculated FOS values are considered to be acceptable for the long term stability for heavily slickensided clays and a groundwater level not higher than approximately 4m below the ground surface. However at the time of writing, there has not been any indication of groundwater levels above approximately 7m depth, based on ongoing groundwater monitoring at the site.

Provided the groundwater table remains below 4m depth, the risk of 'rapid' slope failure in any zones of extensive fissures/slickensides (if such zones do exist) is considered to be relatively low; extensive zones of fissures/slickensides are not indicated by the results of the investigation work completed to date. The calculated minimum FOS values for the slopes at Bores 100 and 105 are within, or in excess of, the range of FOS values given in Section 5.8.1.2, for acceptance of long term slope stability.

It should be noted that, because zones of heavily slickensided soils were not encountered during the investigation, the calculated FOS values for heavily slickensided soils are considered to be conservative (i.e. the actual FOS values are considered to be higher than those indicated in Table 13 and Table 14).

5.12 Prevention of Water Ingress into the Site Slopes

All areas where surface water can readily penetrate into the site slopes (e.g. depressions etc.), should be backfilled with impervious, compacted materials to prevent inflow.

It is also suggested that the ground surface at the crest of slopes be grade away from the crest, if possible, and a concrete lined collector drain should be installed along the slope crest, to minimise surface water flow down slopes.

If any existing houses located adjacent to the site boundary (along Seventeen Mile Rocks Road) have roof drainage pipes that discharge to the ground, it is strongly recommended that all water discharged to the ground be collected into a piped disposal system to prevent the water discharge from infiltrating into the groundwater system and potentially reducing the stability of the adjacent site slopes.

Decommissioned services should be located, removed and remediated to prevent future sinkholes development along their alignments.

Use of soakage pits as a method of stormwater discharge, must be avoided anywhere over, close to or behind sloping ground.

5.13 Groundwater Level Monitoring

It is suggested that the groundwater level in at least one of the existing monitoring wells (located away from proposed earthworks activities), should be monitored for as long as possible, at a frequency not greater than monthly (and after all significant rain events), to at least the end of the next 'wet' season.

5.14 Guidelines for Site Development Layout to Minimise Slope Instability Risk

In order to minimise the potential for any future site development layout to adversely affect the stability of the existing southern site slopes, the following are recommended for incorporation into site development layout design:

- do not develop within a 6m exclusion zone from the southern site boundary, except at Lots 19 and 20 (located behind Nos. 93 and 95 Seventeen Mile Rocks Road), where the exclusion zone should be increased to 8m;
- limit cut depth on or below slopes to not more than 1m and retain the cut with fully engineered structural retaining walls (boulder walls or similar are not suitable for use);
- if the toe of slopes are to be filled over, the fill should consist of free draining materials only (or a purpose designed drain installed for the full depth of the fill), to prevent elevation of the groundwater level at the slope toe;
- do not place any significant depth of fill on slopes; and
- if feasible, do not locate development on slopes steeper than 18°.

5.15 Suggested Engineering Requirements to Supplement Site Layout Development

In addition to the site layout development recommendations given in Section 5.14, the following are strongly recommended to limit adverse effects on the stability of the eastern site slopes, based on the results of this slope stability assessment and on past experience:

- install a concrete lined 'spoon' drain across the rear of lots located along the southern site boundary, to prevent stormwater flow down the slopes;
- install shallow sub soil drainage to prevent the saturation of topsoil (and near surface) layers;

- minimise tree removal and, if possible, plant (and maintain), the slopes with deep rooted vegetation/trees;
- keep excavation of slopes to a minimum and ensure that they are retained with engineer designed retaining walls;
- found any 'heavy' structures to be situated on slopes on deep foundations so that they do not add any significant load to slopes; and
- subject all site development proposals to location specific slope stability assessment.

The Australian Geomechanics Guidelines (the Guidelines) for Slope Management and Maintenance (Australian Geomechanics Vol 42, No. 1, March 2007) should be referred to, to provide additional guidance on minimising the risks associated with development on sloping site. Geoguide LR8 (Construction Practice) is attached in Appendix D from the Guideline for general information.

5.16 Deep Foundations

The need for deep foundations will depend on the building type/load proposed for each lot (which is currently unknown), and must be determined by lot specific geotechnical investigation and slope stability assessment, which is the responsibility of each individual lot owner.

5.17 Vegetation Planting and Maintenance

The removal of some isolated trees (with engineering input), in the Stage 1A area, if required as part of site development, would not be expected to destabilise the overall Stage 1A slopes, as the slip circles with the lowest FOS values are generally deep seated, and extend significantly below the root zone of existing trees. However, it is recommended that any trees removed be replaced and (if possible), supplemented with additional new plantings, as a means of assisting with the stabilisation of near surface soils (refer Section 0).

5.18 Existing Fill Depth and Extent

The extent and depth of the existing uncontrolled fill encountered in and around Bore 18 should be determined by engineering inspection during site bulk earthworks. All uncontrolled fill should be replaced under Level 1 control using site won clay soils, to prevent stormwater seepage into the slope.

5.19 Long Term Monitoring

Based on the results of the investigation and on the stability analysis results, installation of ground movement monitoring measures (e.g. permanent survey markers, inclinometers, additional groundwater level monitoring wells etc.) are not considered to be required.

BUTLER PARTNERS PTY LTD

RICARDO ZANNIN-PESCE
Senior Geotechnical Engineer

Reviewed by:
MIKE NEIGHBOUR
Principal

BRUCE BUTLER
Senior Principal

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

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e-mail: info@asfe.org www.asfe.org

LEGEND

100	Bore and Monitoring Well (current investigation)
1, 16	Bore (previous investigations)
21	Bore/Monitoring Well (existing)
22	Bore (environmental)
TP1	Test Pit
	Section for Slope Stability Assessment
	Stage 1A Boundary

KN Group's Slope Analysis Range:

- from 15 to 18
- from 18 to 21
- from 21 to 25
- from 25>

Slope Analysis Overlay 12.12.18

KN Group's 'Slope Analysis Layout', Drawing No.19-173-101-EW_Bound 200601.dwg received 01.June2020; and DSDMIP's current site layout plan, Drawing 1018015_34-35D_ROL FIR_EXT20200826.dwg received 26 August 2020

File Location: z:\projects\2018series\018-118D\Drawings\Geotechnical\ Rpt Dwgs June-July\018-118D Dwg\RevE_FINAL_Slope Analysis.dwg 30 SEPT.2020

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Stage 1A

UBD Reference: Map 198 Grids G8-J6 (ACS,v8) not to scale

Slope Stability Assessment Oxley PDA - Stage 1A

Seventeen Mile Rocks Road, Oxley

Locality Plan, Bore Locations and Slope Analysis

CLIENT: Economic Development Queensland

SCALE AT A3: 0 25 50 75 100m — 1:2500

DATE:	SEPTEMBER 2020
DRAWN:	FD
APPROVED:	
PROJECT No:	018-118D — RPT: Geo
DRAWING No:	1 — REV: E

APPENDIX A

BORE AND TEST PIT REPORT SHEETS WITH EXPLANATORY NOTES

BORE REPORT

Butler Partners — geotechnical • geo-environmental • groundwater

Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 100

Date: 29 June 2020
Ground Surface Level: RL48.5m*

Depth (m)	Description	RL (m)	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
0	***SANDY CLAY (CH)*** - stiff, brown, fine grained sand	48.5				
0.5–0.95			S	0.5 / 0.95	5,7,9 N=16	Bentonite
0.6	***SILTY CLAY (CL)*** - very stiff, brown mottled red-brown and grey	47.0				
1.5–1.95			S	1.5 / 1.95	5,11,13 N=24	
3.0	- hard, red-brown mottled brown, with fine grained sand, with slickensides	46.0 / 45.0	U	3.0 / 3.4	pp>600	Casing
4.5	- very stiff, brown mottled grey, with bands of weathered sandstone and some small fissures	44.0 / 43.0	S	4.5 / 4.95	6,10,17 N=27	Sand
6.0–6.45		42.0	S	6.0 / 6.45	7,9,17 N=26	
7.5	***CLAYEY SILT (MH)*** - very stiff, grey	41.0 / 40.0	U	7.5 / 7.9	pp=500	Screen
9.0	- hard, grey, with small fissures	39.0	S	9.0 / 9.43	6,14,30 /130mm	
9.7	***SANDSTONE (XW)*** - extremely low strength, red-brown mottled brown and grey, fine to medium grained	38.0				
10.5–10.63			S	10.5 / 10.63	30/130mm	
11.3	- medium to high strength bands	37.0				

U Undisturbed Tube Sample (50mm dia) | S Standard Penetration Test (SPT) | E Environmental Sample | Is(50) Point Load Test Result (MPa)
D Disturbed Sample | HB SPT Hammer Bouncing | Up Pushtube Sample | (d) Diametral Test
B Bulk Sample | ( ) No Sample Recovery | C NMLC Coring | (a) Axial Test
pp Pocket Penetrometer Test (kPa) | V Vane Shear Strength, Uncorrected (kPa) | (i) Lump Test

Rig: Hydrapower Scout
Logged by: PZ
Drilling Method: Auger to 3.0m, casing to 2.5m,then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

Butler Partners
geotechnical • geo-environmental • groundwater

Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 100

Date: 29 June 2020
Ground Surface Level: RL48.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
12	***SANDSTONE (XW)*** - extremely low strength, with medium to high strength bands, grey mottled orange-brown, fine grained	36.0		S	12.0 – 12.4	13,29,30 /100mm	
13	- grey, fine grained	35.0		S	13.5 – 13.94	14,24,30 /140mm	
14		34.0					
15		33.0		S	15.0 – 15.44	28,29,30 /140mm	
16		32.0		S	16.5 – 16.94	18,29,30 /140mm	
17		31.0					
18	- with silty clay bands	30.0		S	18.0 – 18.44	15,23,30 /140mm	
19		29.0		S	19.5 – 19.94	15,24,30 /140mm	
20	End of Bore at 19.94 m	28.0					
21		27.0					
22		26.0					
23							

U Undisturbed Tube Sample (50mm dia)	**S** Standard Penetration Test (SPT)	**E** Environmental Sample	**Is(50)** Point Load Test Result (MPa)
D Disturbed Sample	**HB** SPT Hammer Bouncing	**Up** Pushtube Sample	**(d)** Diametral Test
B Bulk Sample	**( )** No Sample Recovery	**C** NMLC Coring	**(a)** Axial Test
pp Pocket Penetrometer Test (kPa)	**V** Vane Shear Strength, Uncorrected (kPa)		**(i)** Lump Test

Rig: Hydrapower Scout
Logged by: PZ
Drilling Method: Auger to 3.0m, casing to 2.5m,then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

Butler Partners
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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 101

Page No: 1 of 2
Date: 30 June 2020
Ground Surface Level: RL45.8m*

Depth (m)	Description	RL (m)	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
0	***FILL*** - mixture of clay, sand and gravel	45.8				
	SANDY CLAY (CH) - stiff, red-brown mottled brown, fine to coarse grained sand	45.0	S	0.5 0.95	3,4,6 N=10	Bentonite
1.5	- hard, grey mottled brown	44.0	U	1.5 1.9	pp>600	
3	- very stiff, grey mottled brown, with small fissures	43.0 42.0	S	3.0 3.45	3,5,11 N=16	
4	***CLAYEY SAND (SC)*** - medium dense, brown mottled orange-brown, fine grained	41.0	S	4.5 4.95	11,12,11 N=23	Casing Sand
6	- dense	40.0 39.0	S	6.0 6.45	14,14,21 N=35	
		38.0	S	7.5 7.95	15,23,22 N=45	
8	- grey	37.0 36.0	S	9.0 9.43	13,14,23 N=37	Screen
10.5	***SANDY CLAY (CL)*** - very stiff, grey, fine grained sand	35.0	S	10.5 10.95	7,9,19 N=28	

U	**Undisturbed Tube Sample (50mm dia)**	**S**	**Standard Penetration Test (SPT)**	**E**	**Environmental Sample**	**Is(50)**	**Point Load Test Result (MPa)**
D	**Disturbed Sample**	**HB**	**SPT Hammer Bouncing**	**Up**	**Pushtube Sample**	**(d)**	**Diametral Test**
B	**Bulk Sample**	**( )**	**No Sample Recovery**	**C**	**NMLC Coring**	**(a)**	**Axial Test**
pp	**Pocket Penetrometer Test (kPa)**	**V**	**Vane Shear Strength, Uncorrected (kPa)**			**(i)**	**Lump Test**

Rig: Hydrapower Scout

Logged by: PZ

Drilling Method: Auger to 3.0m, casing to 2.5m,then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 101

Date: 30 June 2020
Ground Surface Level: RL45.8m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
11.7–12.1	***SANDY CLAY (CL)*** - very stiff, grey, fine grained sand	34.0					
12.1–13.4	- hard			S	12.0–12.45	9,13,21 N=34	
13.4–15.0	- with relict rock joints	32.0		S	13.5–13.95	8,15,23 N=38	
15.0–15.4	- very stiff	31.0		S	15.0–15.4	pp=540	
15.4	End of Bore at 15.4 m						

U Undisturbed Tube Sample (50mm dia)
D Disturbed Sample
B Bulk Sample
pp Pocket Penetrometer Test (kPa)
S Standard Penetration Test (SPT)
HB SPT Hammer Bouncing
( ) No Sample Recovery
V Vane Shear Strength, Uncorrected (kPa)
E Environmental Sample
Up Pushtube Sample
C NMLC Coring
Is(50) Point Load Test Result (MPa)
(d) Diametral Test
(a) Axial Test
(i) Lump Test

Rig: Hydrapower Scout

Logged by: PZ

Drilling Method: Auger to 3.0m, casing to 2.5m,then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 102

Date: 1 June 2020
Ground Surface Level: RL38.0m*

Depth (m)	Description	RL (m)	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
0	***FILL***	38.0				Casing
	- brown, sandy clay, fine to coarse grained, with some fine to coarse subangular gravel					Concrete
			S	0.5 – 0.95	5,8,7 N=15	
1	- dark brown, silty clay, with trace of charcoal	37.0				Spoil
			S	1.5 – 1.95	4,9,15 N=24	
2		36.0				
	- grey gravel, fine to medium subangular to angular					
3	***SILTY CLAY (CH)***	35.0				
	- very stiff, grey-brown mottled orange		S	3.0 – 3.45	6,8,10 N=18	
	- brown					
4	- pale grey	34.0				Bentonite
			U	4.5 – 4.95	pp=390	
5		33.0				
	- pale grey mottled brown					Sand
6		32.0	U	6.0 – 6.45	pp=400	
7		31.0				Screen
			S	7.5 – 7.95	8,12,12 N=24	
8	- grey	30.0				
9		29.0	U	9.0 – 9.45	pp=470	
10		28.0				
	MUDSTONE (HW)		(S)	10.5 – 10.54	30/40mm HB	
	- low strength, pale brown					
11	***SILTY CLAY (CH)***	27.0				
	- hard, pale brown					

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Pushtube Sample	(d)	Diametral Test
B	Bulk Sample	( )	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(i)	Lump Test

Rig: Hydrapower Scout

Logged by: NA

Drilling Method: Auger to 4.5m, casing to 4.5m, then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 102

Date: 1 June 2020
Ground Surface Level: RL38.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
12–16.7	***SANDSTONE (XW)*** - extremely low strength, brown, fine to coarse grained	26.0–21.3		S	12.0–12.1	30/100mm	
				S	13.5–13.59	30/90mm	
				S	15.0–15.45	30/145mm	
				S	16.5–16.61	30/110mm	
16.7	End of Bore at 16.7 m	21.3					

Depth scale: 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
RL scale: 26.0, 25.0, 24.0, 23.0, 22.0, 21.0, 20.0, 19.0, 18.0, 17.0, 16.0, 15.0

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Pushtube Sample	(d)	Diametral Test
B	Bulk Sample	( )	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(i)	Lump Test

Rig: Hydrapower Scout

Logged by: NA

Drilling Method: Auger to 4.5m, casing to 4.5m, then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 103

Page No: 1 of 2
Date: 5 and 8 June 2020
Ground Surface Level: RL33.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Sample ID	Test Results
0	***SILTY SAND (SM)*** - loose, brown-dark brown, fine to coarse grained sand (topsoil)	33.2					
	SILTY CLAY (CH) - stiff, brown mottled grey and white			S	0.5 – 0.95		6,6,8 N=14
1		32.0					
	- hard			U	1.5 – 1.85		pp>600
2		31.0					
	- orange-brown						
3	***CLAYEY SAND (SC)*** - very dense, brown and orange-brown, fine grained sand, 4.0m to 4.5m, clay bands	30.0		S	3.0 – 3.24		4,30/90mm
4		29.0					
	SANDSTONE (SW) - extremely low strength, orange-brown, fine to medium grained			S	4.6 – 4.72		30/120mm
5		28.0					
6	- brown mottled grey-white	27.0		S	6.0 – 6.13		30/130mm
7		26.0					
				S	7.5 – 7.63		30/120mm
8		25.0					
9				S	9.0 – 9.09		30/90mm
		24.0					
10		23.0					
				S	10.5 – 10.77		5,30/120mm
11		22.0					

D	Disturbed Sample	V	Vane Shear Strength, Uncorrected (kPa)	C	NMLC Coring
B	Bulk Sample	S	Standard Penetrometer Test (SPT)	Is(50)	Point Load Test Result (MPa)
U	Undisturbed Tube (50mm diameter)	SPT	Hammer Bouncing	(d)	Diametral Point Load Strength Test
pp	Pocket Penetrometer Test (kPa)	( )	No Sample Recovery	(a)	Axial Point Load Strength Test
E	Environmental Sample	A	Asbestos Sample		

Rig: Hydrapower Scout
Logged By: PZ
Drilling Method: Auger to 3.0m, casing to 3.0m, then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 103

Date: 5 and 8 June 2020
Ground Surface Level: RL33.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Sample ID	Test Results
12	**SANDSTONE (SW)** - extremely low strength, brown mottled grey-white, fine to medium grained	21.0		S	12.0 – 12.1		30/100mm
	- 12.5m to 13.0m, clayey sand bands						
13		20.0		S	13.5 – 13.59		30/90mm
14	**MUDSTONE (XW)** - extremely low strength, dark grey	19.0					
15		18.0		S	15.0 – 15.41		12,27,30/110mm
16		17.0					
	SILTY CLAY (CH) - hard, dark grey			S	16.5 – 16.95		8,17,24 N=41
17	- very stiff, dark grey	16.0		U	17.0 – 17.4		pp=350
18	**MUDSTONE (XW)** - extremely low strength, dark grey	15.0		S	18.0 – 18.43		17,23,30/130mm
19		14.0					
20		13.0		S	20.0 – 20.2		15,30/50mm
	SILTSTONE (DW) - very low to low strength, grey						
21	**MUDSTONE (XW)** - extremely low strength, grey	12.0		S	21.5 – 21.95		15,21,26 N=47
22	End of Bore at 21.95 m	11.0					
23							

D	Disturbed Sample	V	Vane Shear Strength, Uncorrected (kPa)	C	NMLC Coring
B	Bulk Sample	S	Standard Penetrometer Test (SPT)	Is(50)	Point Load Test Result (MPa)
U	Undisturbed Tube (50mm diameter)	SPT	Hammer Bouncing	(d)	Diametral Point Load Strength Test
pp	Pocket Penetrometer Test (kPa)	( )	No Sample Recovery	(a)	Axial Point Load Strength Test
E	Environmental Sample	A	Asbestos Sample		

Rig: Hydrapower Scout
Logged By: PZ
Drilling Method: Auger to 3.0m, casing to 3.0m, then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

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BORE 104

Date: 2 June 2020
Ground Surface Level: RL33.0m*

Depth (m)	Description	RL (m)
0.0	***SILTY CLAY (CH)*** - stiff, brown, trace of fine to coarse grained sand (topsoil)	33.0
	- stiff	
1.0	- very stiff, pale grey-brown	32.0
3.0	***SILTY CLAY (CH)*** - hard, pale grey-brown	30.0
4.0	- red	29.0
5.0	***SANDSTONE (XW)*** - extremely low strength, brown, fine to coarse grained	28.0
10.0	***SILTY CLAY (CH)*** - hard, grey mottled brown	23.0

Sample Type	Sample Depth (m)	Test Results
S	0.5 – 0.95	5,6,9 N=15
S	1.5 – 1.95	9,11,15 N=26
U	3.0 – 3.45	pp>600
U	4.5 – 4.95	pp>600
S	6.0 – 6.14	30/140mm
S	7.5 – 7.63	30/130mm
S	9.0 – 9.13	30/130mm
U	10.5 – 10.95	pp>600

U Undisturbed Tube Sample (50mm dia)	S Standard Penetration Test (SPT)	E Environmental Sample	Is(50) Point Load Test Result (MPa)
D Disturbed Sample	HB SPT Hammer Bouncing	Up Pushtube Sample	(d) Diametral Test
B Bulk Sample	( ) No Sample Recovery	C NMLC Coring	(a) Axial Test
pp Pocket Penetrometer Test (kPa)	V Vane Shear Strength, Uncorrected (kPa)		(i) Lump Test

Rig: Hydrapower Scout

Logged by: NA

Drilling Method: Auger to 2.5m, casing to 3.0m, then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 104

Page No: 2 of 2
Date: 2 June 2020
Ground Surface Level: RL33.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Test Results
11.65–12.1	***SILTY CLAY (CH)*** - hard, grey mottled brown					
12.1–13.0	***SANDSTONE (XW)*** - extremely low strength, brown, fine to coarse grained	21.0		U	12.0 – 12.45	pp>600
13.0–13.9	***SILTY CLAY (CH)*** - hard, grey, trace of fine grained sand	20.0		S	13.5 – 13.95	10,17,30 N=47
13.9–18.45	***MUDSTONE (XW)*** - extremely low strength, grey	19.0		S	15.0 – 15.43	15,22,30/130mm
				S	16.5 – 16.95	16,22,30 N=52
				S	18.0 – 18.45	13,21,30 N=51
18.45	End of Bore at 18.45 m					

Depth scale: 12–23 m; RL scale: 21.0–10.0 m.

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Pushtube Sample	(d)	Diametral Test
B	Bulk Sample	( )	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(i)	Lump Test

Rig: Hydrapower Scout
Logged by: NA
Drilling Method: Auger to 2.5m, casing to 3.0m, then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 105

Page No: 1 of 2
Date: 9 June 2020
Ground Surface Level: RL32.0m*

Depth (m)	Description	RL (m)	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
0		32.0				
0.0–0.7	***SILTY CLAY (CH)*** - hard, brown, trace of fine grained sand		S	0.5–0.75	pp>600	
0.7–2.2	- grey	31.0				Cement
			S	1.5–1.8	pp>600	
2.2–3.3	***CLAYEY SAND (SC)*** - medium dense, orange-brown mottled grey and white, fine to coarse grained sand	30.0				
		29.0	S	3.0–3.45	9,7,8 N=15	
3.3–4.5	***SILTY CLAY (CH)*** - stiff to very stiff, grey	28.0				Casing
4.5–7.5	***SILTY CLAY (CI)*** - hard, dark grey, with minor slickensides	27.0	U	4.5–4.75	pp>600	Backfill
		26.0	U	6.0–6.3	pp>600	
		25.0				Bentonite
7.5–8.6	***SILTY CLAY (CH)*** - hard, dark grey	24.0	U	7.5–7.8	pp>600	
8.6–9.6	***CLAYEY SAND (SC)*** - very dense, brown mottled orange-brown and grey	23.0	S	9.0–9.23	28,30/80mm	Sand
9.6–10.5	***SILTY CLAY (CI)*** - hard, brown	22.0	U	10.0–10.45	pp>600	Screen
10.5–	***CLAYEY SILT (MH)*** - hard, grey and brown	21.0	U	10.5–10.75	pp>600	

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Pushtube Sample	(d)	Diametral Test
B	Bulk Sample	( )	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(i)	Lump Test

Rig: Hydrapower Scout

Logged by: PZ

Drilling Method: Auger to 3.0m, casing to 3.0m, then washbore

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

BORE REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

BORE 105

Date: 9 June 2020
Ground Surface Level: RL32.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Test Results	Groundwater Monitoring Bore
12	***SILTY CLAY (CH)*** - hard, grey	20.0		U	12.0 – 12.35	pp>600	
13		19.0					
14	***MUDSTONE (XW)*** - extremely low strength, grey	18.0		S	13.5 – 13.92	13,25,30 /120mm	
15		17.0		S	15.0 – 15.25	17,30/100mm	
16	End of Bore at 15.25 m	16.0					
17		15.0					
18		14.0					
19		13.0					
20		12.0					
21		11.0					
22		10.0					
23		9.0					

U Undisturbed Tube Sample (50mm dia)
D Disturbed Sample
B Bulk Sample
pp Pocket Penetrometer Test (kPa)
S Standard Penetration Test (SPT)
HB SPT Hammer Bouncing
( ) No Sample Recovery
V Vane Shear Strength, Uncorrected (kPa)
E Environmental Sample
Up Pushtube Sample
C NMLC Coring
Is(50) Point Load Test Result (MPa)
(d) Diametral Test
(a) Axial Test
(i) Lump Test

Rig: Hydrapower Scout
Logged by: PZ
Drilling Method: Auger to 3.0m, casing to 3.0m, then washbore
Groundwater: No free groundwater encountered during auger drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

TEST PIT REPORT

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Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

TEST PIT 1

Page No: 1 of 1
Date: 9 June 2020
Ground Surface Level: RL41.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Sample ID
0	***FILL*** - dark brown, sandy silty clay, fine to coarse grained sand, with roots	41.0				
	- dark brown, clayey silty sand, fine to coarse grained, with fine to coarse grained subangular to subrounded gravel, with subangular cobbles up to 100mm width, trace of roots and organics thoughout			D	0.3–0.8	
1		40.0				
	- interbedded with bands of sandy silty clay			D	1.4–2.0	
2	- brown, sandy silty clay, fine to coarse grained sand, with fine to coarse subangular gravel (possibly natural)	39.0				
	SILTY CLAY (CL) - pale grey-brown, with fine grained sand					
3	End of Test Pit at 2.4 m	38.0				
4		37.0				
5		36.0				
6		35.0				
7		34.0				
8		33.0				
9		32.0				
10		31.0				
11		30.0				

D Disturbed Sample | **B** Bulk Sample | **E** Environmental Sample
U Undisturbed Tube (50mm diameter) | **A** Asbestos | **Is(50)** Point Load Test Result (MPa)

Rig: Takeuchi TB153 6t Excavator
Logged By: CM
Bucket Size: 600mm Tooth
Groundwater: No free groundwater encountered during excavation
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

TEST PIT REPORT

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TEST PIT 2

Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

Page No: 1 of 1
Date: 9 June 2020
Ground Surface Level: RL38.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Sample ID
0	*FILL* - brown, sandy silty clay, fine to coarse grained sand, with roots	38.5				
	- grey-brown, sandy clayey silt, fine to coarse grained sand, with bands of sandy clay					
1	*SANDY SILTY CLAY (CI)* - dark brown, fine to medium grained sand	37.0				
	SILTY CLAY (CI) - grey-brown mottled orange, with fine to medium grained sand					
2	End of Test Pit at 1.7 m	36.0				
3		35.0				
4		34.0				
5		33.0				
6		32.0				
7		31.0				
8		30.0				
9		29.0				
10		28.0				
11		27.0				

D **Disturbed Sample** **B** **Bulk Sample** **E** **Environmental Sample**
U **Undisturbed Tube (50mm diameter)** **A** **Asbestos** **Is(50)** **Point Load Test Result (MPa)**

Rig: Takeuchi TB153 6t Excavator **Logged By:** CM
Bucket Size: 600mm Tooth
Groundwater: No free groundwater encountered during excavation
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

TEST PIT REPORT

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TEST PIT 3

Client: Economic Development Queensland
Project: Slope Stability Assessment
Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Project No: 018-118D

Page No: 1 of 1
Date: 9 June 2020
Ground Surface Level: RL39.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Sample Depth (m)	Sample ID
0		39.0				
0.0–1.2	***FILL*** - dark brown, sandy silty clay, fine to coarse grained sand, with roots; - with fine to coarse subangular to subrounded gravel, trace of roots and orangics	38.0				
1.2–1.9	***SILTY CLAY (CL)*** - brown, fine to medium grained sand	37.0				
1.9	End of Test Pit at 1.9 m					

D Disturbed Sample
U Undisturbed Tube (50mm diameter)
B Bulk Sample
A Asbestos
E Environmental Sample
Is(50) Point Load Test Result (MPa)

Rig: Takeuchi TB153 6t Excavator
Logged By: CM
Bucket Size: 600mm Tooth
Groundwater: No free groundwater encountered during excavation
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

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Notes on Description and Classification of Soil

The methods of description and classification of soils used in this report are generally based on Australian Standard AS1726-1993 Geotechnical Site Investigations.

Soil description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures or in undisturbed samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

In the case of cone or piezocone penetrometer tests, actual soil samples are not recovered and soil description is inferred based on published correlations, past experience and comparison with bore and/or test pit data (if available).

Soil classification is based on the particle size distribution of the soil and the plasticity of the portion of the material finer than 0.425mm. The description of particle size distribution and plasticity is based on the results of visual field estimation, laboratory testing or both. When assessed in the field, the properties of the soil are estimated; precise description will always require laboratory testing to define soil properties.

Where soil can be clearly identified as FILL this will be noted as the main soil type followed by a description of the composition of the fill (e.g. FILL – yellow-brown, fine to coarse grained gravelly clay fill with concrete rubble). If the soil is assessed as possibly being fill this will be noted as an additional observation.

Soils are generally described using the following sequence of terms. In certain instances, not all of the terms will be included in the soil description.

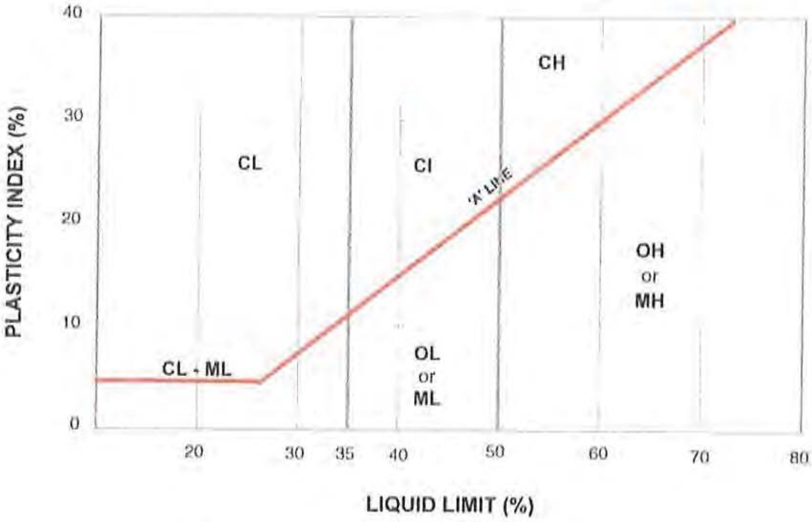
MAIN SOIL TYPE (CLASSIFICATION GROUP SYMBOL)
- strength/density, colour, structure/grain size, secondary and minor components, additional observations

Information on the definition of descriptive and classification terms follows.

<u>SOIL TYPE and CLASSIFICATION GROUP SYMBOLS</u>

	Major Divisions	Particle Size	Classification Group Symbol	Typical Names
	BOULDERS	>200mm		
	COBBLES	63 – 200mm		
COARSE GRAINED SOILS (more than half of material is larger than 0.075mm)	GRAVELS (more than half of coarse fraction is larger than 2.36mm)	Coarse: 20 – 63mm Medium: 6 – 20mm Fine: 2.36 – 6mm	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
			GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than 2.36mm)	Coarse: 0.6 – 2.36mm Medium: 0.2 – 0.6mm Fine: 0.075 – 0.2mm	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
			SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (more than half of material is smaller than 0.075mm)	SILTS & CLAYS (liquid limit <50%)		ML	Inorganic silts and very fine sands, silty/clayey fine sands or clayey silts with low plasticity.
			CL and CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS (liquid limit >50%)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils.
			CH	Inorganic clays of high plasticity.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

PLASTICITY CHART FOR CLASSIFICATION OF FINE GRAINED SOILS



(Reference: Australian Standard AS1726-1993 Geotechnical site investigations)

DESCRIPTIVE TERMS FOR MATERIAL PROPORTIONS

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
<5	Omit, or use 'trace'	<15	Omit, or use trace.
5 – 12	Describe as 'with clay/silt' as applicable.	15 – 30	Describe as 'with sand/gravel' as applicable.
>12	Prefix soil as 'silty/clayey' as applicable	>30	Prefix soil as 'sandy/gravelly' as applicable.

STRENGTH TERMS – COHESIVE SOILS

Strength Term	Undrained Shear Strength	Field Guide to Strength
Very soft	<12kPa	Exudes between the fingers when squeezed in hand.
Soft	12 – 25kPa	Can be moulded by light finger pressure.
Firm	25 – 50kPa	Can be moulded by strong finger pressure.
Stiff	50 – 100kPa	Cannot be moulded by fingers, can be indented by thumb.
Very stiff	100 – 200kPa	Can be indented by thumb nail.
Hard	>200kPa	Can be indented with difficulty by thumb nail.

DENSITY TERMS – NON COHESIVE SOILS

Density Term	Density Index	SPT "N"	CPT Cone Resistance
Very loose	<15%	0 – 5	0 – 2MPa
Loose	15 – 35%	5 – 10	2 – 5MPa
Medium dense	35 – 65%	10 – 30	5 – 15MPa
Dense	65 – 85%	30 – 50	15 – 25MPa
Very dense	>85%	>50	>25MPa

COLOUR

The colour of a soil will generally be described in a 'moist' condition using simple colour terms (e.g. black, grey, red, brown etc.) modified as necessary by "pale", "dark", "light" or "mottled". Borderline colours will be described as a combination of colours (e.g. grey-brown).

EXAMPLE

e.g. CLAYEY SAND (SC) – medium dense, grey-brown, fine to medium grained with silt.

Indicates a medium dense, grey-brown, fine to medium grained clayey sand with silt.

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Notes on Description and Classification of Rock

The methods of description and classification of rock used in this report are generally based on Australian Standard AS1726-1993 *Geotechnical site investigations.*

Rock description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures, or in core samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

Notes outlining the method and terminology adopted for the description of rock defects are given below, however, detailed information on defects can generally only be determined where rock core is taken, or excavations or exposures allow detailed observation and measurement.

Rocks are generally described using the following sequence of terms. In certain instances not all of the terms will be included in the rock description.

ROCK TYPE (WEATHERING SYMBOL), strength, colour, grain size, defect frequency

Information on the definition of descriptive and classification terms follows.

ROCK TYPE

In general, simple rock names are used rather than precise geological classifications.

ROCK MATERIALS WEATHERING CLASSIFICATION

Term	Weathering Symbol	Definition
Residual soil	RS	Soil developed from extremely weathered rock; the mass structure and substance fabrics are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water.
Distinctly weathered *	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
- Highly weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock, usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
- Moderately weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock may be no longer recognisable.
Slightly weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

** Subdivision of this weathering grade into highly and moderately may be used where applicable.*

STRENGTH OF ROCK MATERIAL

Term	Symbol	Point Load Index I_s (50)	Field Guide To Strength
Extremely low	EL	<0.03MPa	Easily remoulded by hand to a material with soil properties.
Very low	VL	0.03 – 0.1MPa	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1 – 0.3MPa	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 – 1.0MPa	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	1.0 – 3.0MPa	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very high	VH	3.0 – 10.0MPa	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely high	EH	>10MPa	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:
1. *These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.*
2. *The field guide visual assessment for rock strength may be used for preliminary assessment or when point load testing is not available.*
3. *Anisotropy of rock may affect the field assessment of strength.*

COLOUR

The colour of a rock will generally be described in a 'moist' condition using simple colour terms (e.g. black, grey, red, brown, etc) modified as necessary by 'pale', 'dark', 'light' or 'mottled'. Borderline colours will be described as a combination of colours (e.g. grey-brown).

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GRAIN SIZE

Descriptive Term	Particle Size Range
Coarse grained	0.6 – 2.0mm
Medium grained	0.2 – 0.6mm
Fine grained	0.06 – 0.2mm

DEFECT FREQUENCY

Where appropriate, a defect frequency may be recorded as part of the rock description and will be expressed as the number of natural (or interpreted natural) defects present in an equivalent one metre length of core; by use of the following defect frequency descriptive terms; or both. The descriptive terms refer to the spacing of all types of natural defects along which the rock is discontinuous and include, bedding plane partings, joints and other rock defects, but excludes known artificial fractures such as drilling breaks.

Defect Frequency	Description
Fragmented	Rock core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter.
Highly Fractured	Core lengths are generally less than 20mm to 40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm to 100mm with occasional shorter and longer sections.
Fractured to Slightly Fractured	Core lengths are mainly 100mm to 300mm with occasional shorter to longer sections.
Slightly Fractured	Core lengths are generally 300mm to 1,000mm with occasional longer sections and occasional sections of 100mm to 300mm.
Unbroken	The core does not contain any fractures.

EXAMPLE

e.g. SANDSTONE (XW) – low strength, pale brown, fine to coarse grained, slightly fractured.

ROCK DEFECT LOGGING

Defects are discontinuities in the rock mass and include joints, sheared zones, cleavages and bedding partings. The ability to observe and log defects will depend on the investigation methodology. Defects logged in core are described using the abbreviations noted in the following tables.

The *depth* noted in the description is measured in metres from the ground surface, the *defect angle* is measured in degrees from horizontal, and the defect *thickness* is measured normal to the plane of the defect and is in millimetres (unless otherwise noted).

Defects are generally described using the following sequence of terms:

Depth, Defect Type, Defect Angle (dip), Surface Roughness, Infill, Thickness

DEFECT TYPE

B	– Bedding
J	– Joint
S	– Shear Zone
C	– Crushed Zone

SURFACE ROUGHNESS

i	- rough or irregular, stepped
ii	- smooth, stepped
iii	- slickensided, stepped
iv	- rough or irregular, undulating
v	- smooth, undulating
vi	- slickensided, undulating
vii	- rough or irregular, planar
viii	- smooth planar
ix	- slickensided, planar

INFILL

Infill refers to secondary minerals or other materials formed on the surface of the defect and some common descriptions are given in the following table together with their abbreviations.

Ls	- limonite staining
Fe	- iron staining
Cl	- clay
Mn	- manganese staining
Qtz	- quartz
Ca	- calcite
Clean	- no visible infill

EXAMPLE

3.59m, J, 90, vii, Ls, 1mm

indicates a joint at 3.59m depth that is at 90° to horizontal (i.e. vertical), is rough or irregular and planar, limonite stained and 1mm thick.

APPENDIX B

BORE REPORT SHEET FROM PREVIOUS INVESTIGATION

BORE REPORT

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Client: Economic Development Queensland
Project: Proposed Retirement Village and Child Care Developments
Location: Former Oxley Secondary College, Blackheath Road, Oxley
Project No: 018-118D

BORE 18

Page No: 1 of 1
Date: 25 September 2018
Ground Surface Level: RL38.1m*

Depth (m)	Description	RL (m)	Sample Type	Sample Depth (m)	Test Results
0		38.1			
0 – 1.2	***FILL*** - brown, silty clay, trace of fine subrounded gravel (reworked natural)		S	0.5 – 0.95	5,7,8 N=15
1.2 – 2.5	- brown with yellow and orange mottle	37.0	U	1.5 – 1.95	pp>600
2.5 – 7.0	***SILTY CLAY (CH)*** - very stiff, brown with orange and red mottle (possible fill)	36.0	S	3.0 – 3.45	9,13,14 N=27
		35.0 / 34.0	U	4.5 – 4.95	pp=320
		33.0 / 32.0	S	6.0 – 6.45	7,9,10 N=19
7.0 – 8.5	***SILTY CLAY (CL)*** - stiff, grey with red mottle	31.0 / 30.0	U	7.5 – 7.95	pp=220
8.5 – 10.4	- very stiff, with bands of fine subangular gravel	29.0	S	9.0 – 9.45	7,9,11 N=20
		28.0	U	10.5 – 10.55	pp>600
10.4 – 11.3	***MUDSTONE (XW)*** - extremely low strength, pale brown, with slickensides		S	10.55 – 10.82	21,30/120mm
11.3 – 12.06	- very low strength	27.0	S	12.0 – 12.06	30/60mm HB
12.06	End of Bore at 12.06 m	26.0			
13		25.0			

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Pushtube Sample	(d)	Diametral Test
B	Bulk Sample	( )	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(l)	Lump Test

Rig: Jacro 350
Logged by: NA
Drilling Method: Auger
Groundwater: Free groundwater encountered at 7m during drilling
Remarks: *Approximate ground surface level estimated from a contour plan supplied by Economic Development Queensland

APPENDIX C

LABORATORY TEST REPORT SHEETS

GROUND TESTING SERVICES

NATA
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Brisbane Laboratory
11 Moore Street
Albion Queensland 4010
Telephone: 61 (07) 3256 2900
Accreditation No. 19529

TQCSI Quality Certified ISO 9001:2015

Accredited for compliance with ISO/IEC 17025 - Testing

EMERSON CLASS NUMBER TEST REPORT

Test Procedure: AS1289.3.8.1

pH TEST REPORT

Test Procedure: AS1289.4.3.1

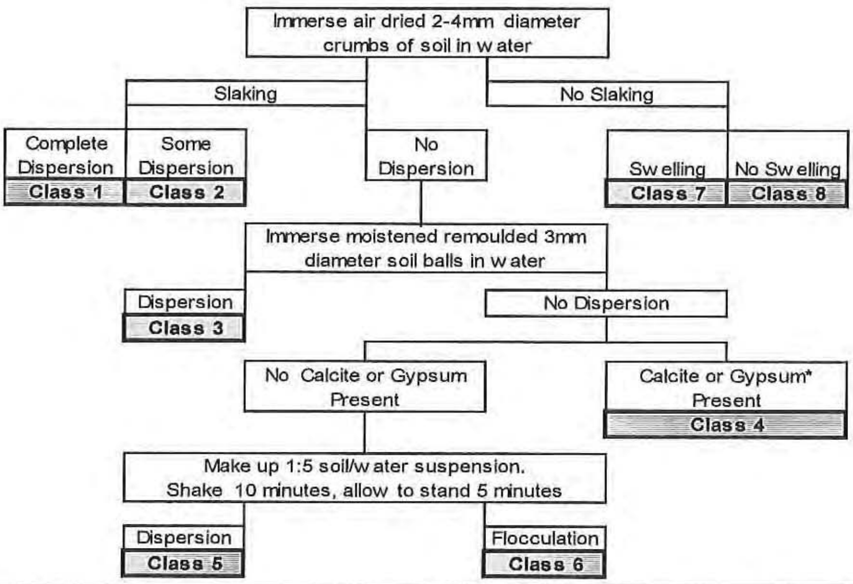
CONDUCTIVITY REPORT

Soil Chemical Methods, Rayment & Lyons

Client:	Economic Development Queensland	**Report No.:**	018-118D_ECN_T2006-01
Project:	Slope Stability Assessment	Tested by:	CT/FC
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Date:	16/06/2020
		Checked by:	CT
Project No:	018-118D	Date:	17/06/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Determination of Emerson Class Number



Sample Number:	T2006-01	T2006-05	T2006-09	T2006-13	
Sampling Method:					
AS1289.1.2.1	Clause 6.5.3	Clause 6.5.3	Clause 6.5.3	Clause 6.5.3	
Bore:	102	103	104	105	
Depth (m):	0.5-0.95	0.5-0.95	0.5-0.95	0.5-0.75	
Date Sampled:	1/06/2020	5/06/2020	2/06/2020	9/06/2020	
Sample Description:	Fill - Silty Clay	Silty Clay	Silty Clay	Silty Clay	
Water Type:	Distilled	Distilled	Distilled	Distilled	
Water Temperature (°C):	24.0	24.0	24.0	24.0	
Emerson Class Number	**5**	**5**	**5**	**6**	
pH	**4.2**	**4.3**	**4.4**	**4.0**	
Conductivity (mS/cm)	**0.47**	**0.35**	**0.34**	**0.62**	

Comments:

Disclaimer:- Conductivity method is not NATA accredited

Authorised Signatory

[signature]

Craig Tucker

17 June 2020

Date

GROUND TESTING SERVICES

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11 Moore Street
Albion Queensland 4010
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Accreditation No. 19529

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TQCSI Quality Certified ISO 9001:2015

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EMERSON CLASS NUMBER TEST REPORT

Test Procedure: AS1289.3.8.1

pH TEST REPORT

Test Procedure: AS1289.4.3.1

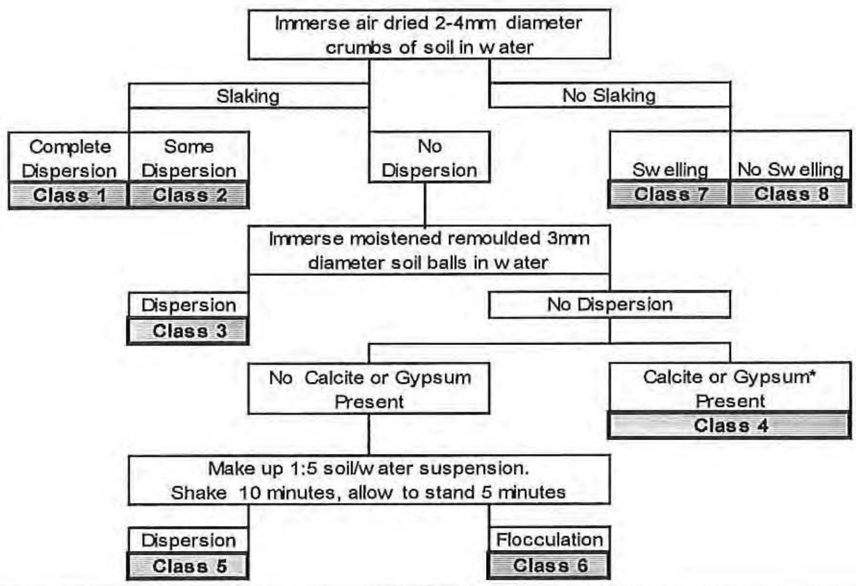
CONDUCTIVITY REPORT

Soil Chemical Methods, Rayment & Lyons

Client:	Economic Development Queensland	**Report No.:**	018-118D_ECN_T2007-01
Project:	Slope Stability Assessment	Tested by:	CT
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Date:	4/07/2020
		Checked by:	CT
Project No:	018-118D	Date:	6/07/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Determination of Emerson Class Number



Sample Number:	T2007-01	T2007-06			
Sampling Method:					
AS1289.1.2.1	Clause 6.5.3	Clause 6.5.3			
Bore:	100	101			
Depth (m):	1.5-1.95	1.5-1.9			
Date Sampled:	29/06/2020	30/06/2020			
Sample Description:	Silty Clay	Sandy Clay			
Water Type:	Distilled	Distilled			
Water Temperature (°C):	22.0	22.0			
Emerson Class Number	**5**	**6**			
pH	**4.5**	**4.1**			
Conductivity (mS/cm)	**0.61**	**0.43**			

Comments:

Disclaimer:- Conductivity method is not NATA accredited

Authorised Signatory

6 July 2020

Craig Tucker ***Date***

GROUND TESTING SERVICES

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2007-01**		
Project:	Slope Stability Assessment	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	6/07/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2007-01	T2007-02	T2007-04	T1007-06	T2007-07
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3
Bore:	100	100	100	101	101
Depth (m):	1.5-1.95	4.5-4.95	13.5-13.94	1.5-1.9	6.0-6.45
Liquid Limit (%)	57	64	49	66	36
Plastic Limit (%)	25	27	36	29	25
Plasticity Index (%)	32	37	13	37	11
Linear Shrinkage (%)	11.5	13.5	2.0	13.5	2.0
Sample Moisture Content (%)	13.5	24.0	16.3	15.6	15.3
Shrinkage Mould Length (mm)	*124.56*	*124.88*	*250.42*	*124.82*	*126.91*
Sample History	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*
Cracking of Linear Shrinkage Sample	*None*	*None*	*Moderate*	*None*	*Slight*
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*	*Slight*	*Slight*
Curling of Linear Shrinkage Sample	*Moderate*	*Moderate*	*None*	*Moderate*	*None*

Comments

Authorised Signatory

[signature]

Craig Tucker

6 July 2020
Date

GROUND TESTING SERVICES

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ALBION QLD 4010
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Accreditation No. 19529

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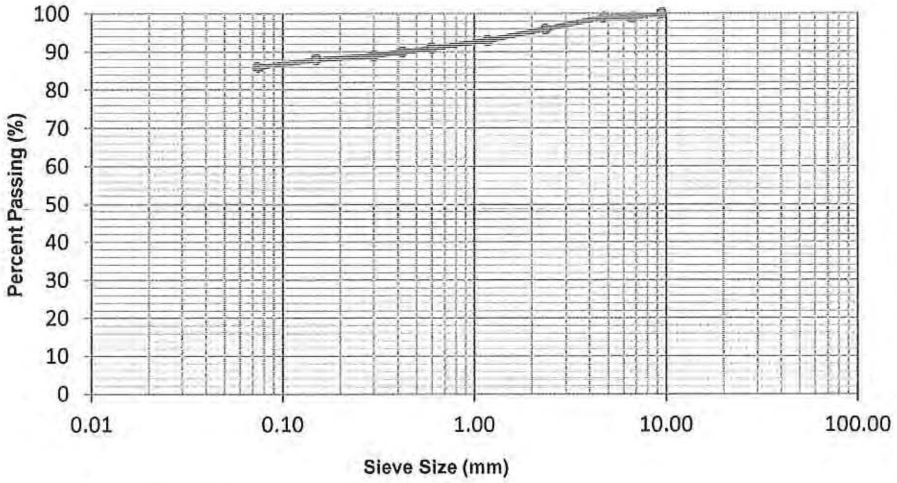
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-02**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-02
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	28.1
Bore:	100
Depth (m):	4.5-4.95

AS SIEVE SIZE (mm)	PERCENT PASSING
9.5	100
6.7	99
4.75	99
2.36	96
1.18	93
0.600	91
0.425	90
0.300	89
0.150	88
0.075	86



Comments:	***Authorised Signatory***
	Craig Tucker ***6 July 2020*** ***Date***

Material Test Report

Report Number: **018-118D-2A**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Change of project details*
Date Issued: 29/09/2020
Client: Economic Development Queensland
Level 14, 1 William Street, Brisbane QLD 4000
Project Number: 018-118D
Project Name: Slope Stability Assessment
Project Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request: 1175
Sample Number: G20-1175A
Date Sampled: 29/06/2020
Dates Tested: 02/07/2020 - 06/07/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: **Bore 100, Depth: 7.5 - 7.9m**

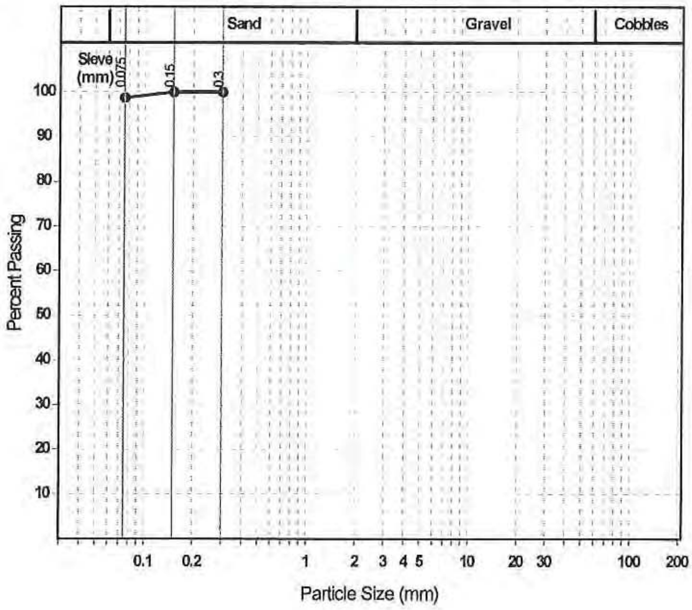
GROUND TESTING SERVICES
Ground Testing Services Pty Ltd
Gold Coast Laboratory
2/23 Traders Way Currumbin QLD 4223
Phone: (07) 5535 2539
Email: enquiries@groundtestingservices.com.au

NATA WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing
Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
0.3 mm	**100**			0		
0.15 mm	**100**			0		
0.075 mm	**99**			1		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	30.0

Particle Size Distribution



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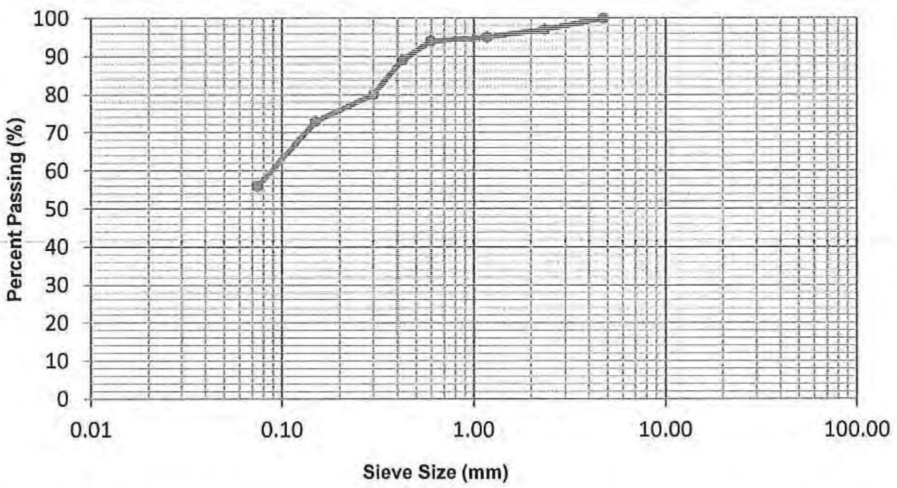
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-03**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-03
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	23.4
Bore:	100
Depth (m):	10.5-10.63

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	97
1.18	95
0.600	94
0.425	89
0.300	80
0.150	73
0.075	56



Comments:

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Craig Tucker

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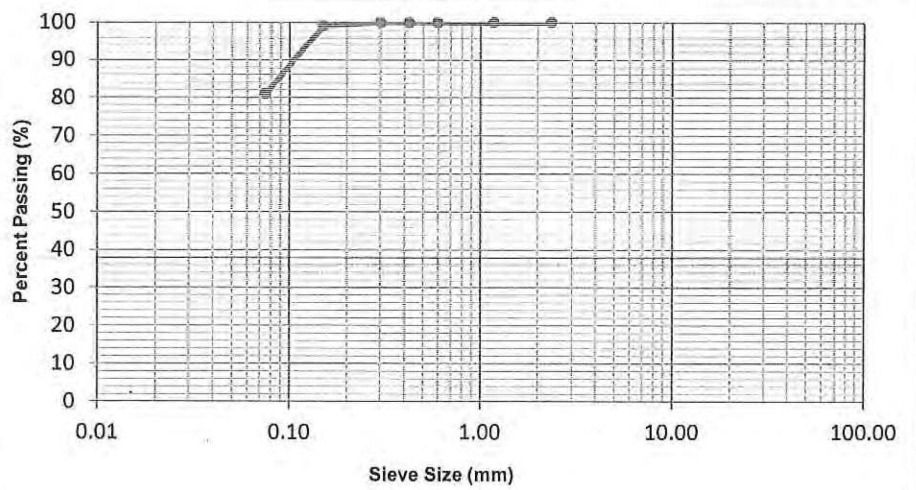
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-04**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-04
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	19.1
Bore:	100
Depth (m):	13.5-13.94

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	100
0.425	100
0.300	100
0.150	99
0.075	81



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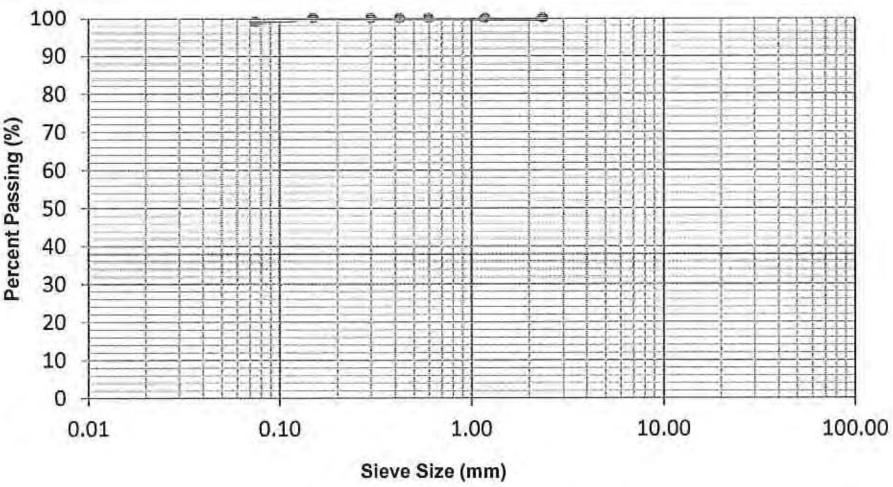
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-05**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-05
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	23.1
Bore:	100
Depth (m):	18.0-18.44

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	100
0.425	100
0.300	100
0.150	100
0.075	99



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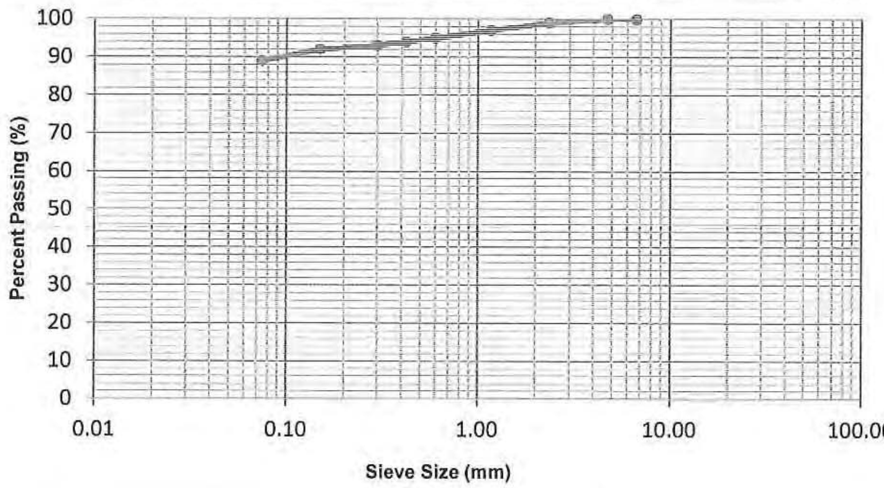
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	30/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-06**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-06
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	22.4
Bore:	101
Depth (m):	1.5-1.95

AS SIEVE SIZE (mm)	PERCENT PASSING
6.7	100
4.75	100
2.36	99
1.18	97
0.600	95
0.425	94
0.300	93
0.150	92
0.075	89



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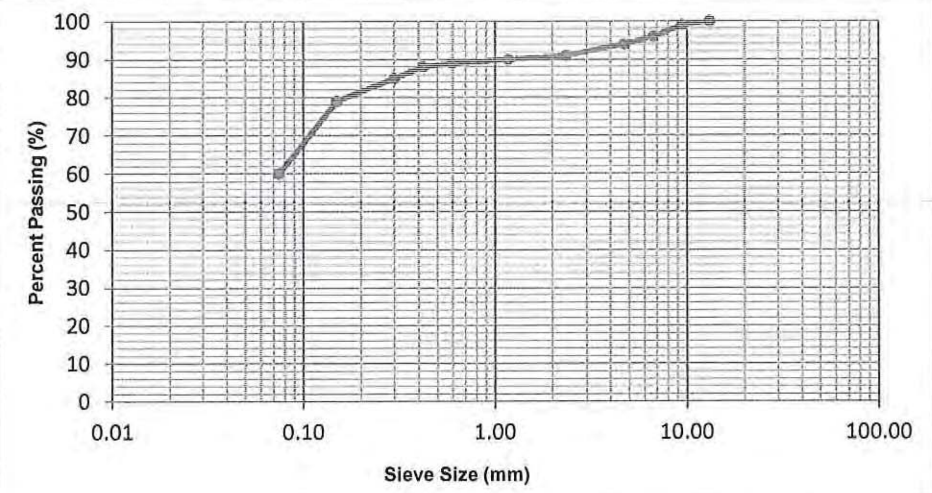
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	30/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-07**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-07
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	17.6
Bore:	101
Depth (m):	6.0-6.45

AS SIEVE SIZE (mm)	PERCENT PASSING
13.2	100
9.5	99
6.7	96
4.75	94
2.36	91
1.18	90
0.600	89
0.425	88
0.300	85
0.150	79
0.075	60



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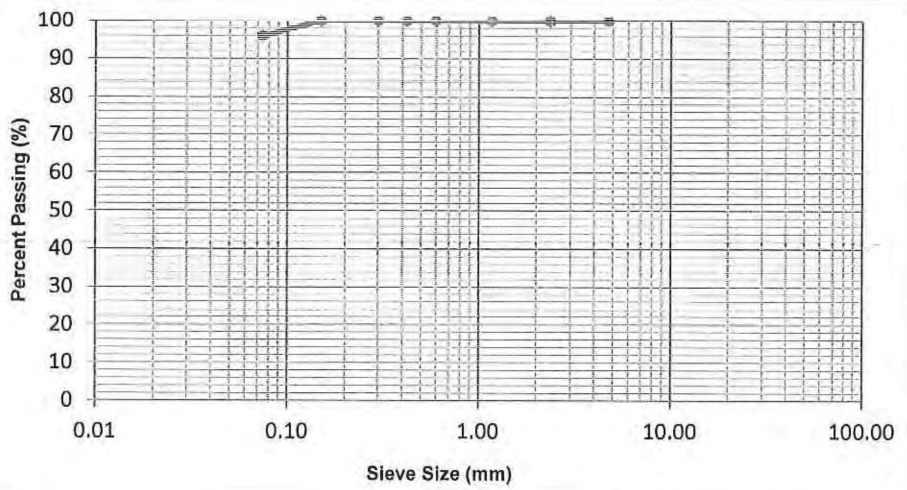
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	30/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-08**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-08
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	20.1
Bore:	101
Depth (m):	9.0-9.43

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	100
1.18	100
0.600	100
0.425	100
0.300	100
0.150	100
0.075	96



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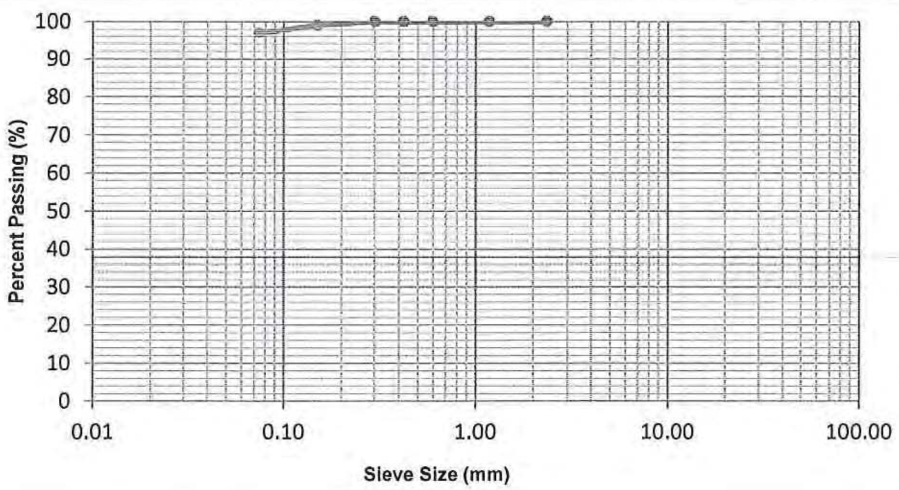
Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	30/06/2020	Tested by and Date:	CT 4/07/2020
Project:	Slope Stability Assessment	Checked by:	CT 4/07/2020	Date:	6/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2007-09**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2007-09
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	19.1
Bore:	101
Depth (m):	12.0-12.45

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	100
0.425	100
0.300	100
0.150	99
0.075	97



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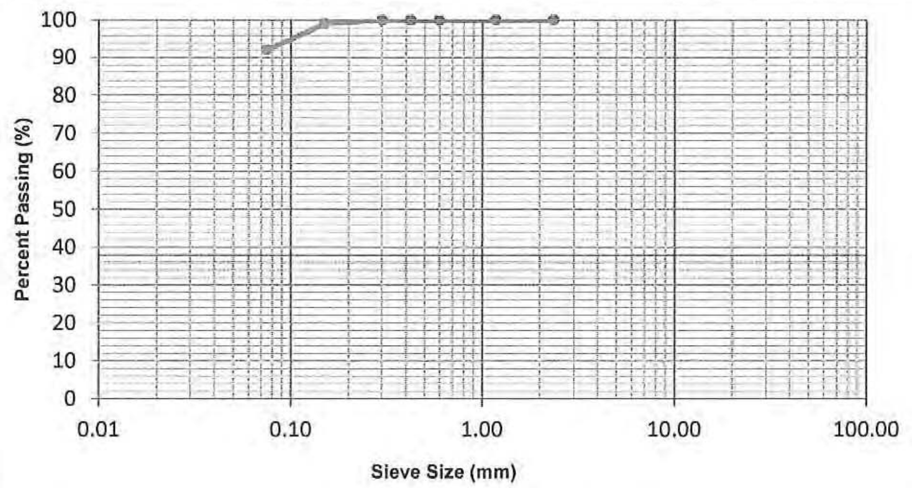
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	1/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-17**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-17
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	20.0
Bore:	102
Depth (m):	6.0-6.45

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	100
0.425	100
0.300	100
0.150	99
0.075	92



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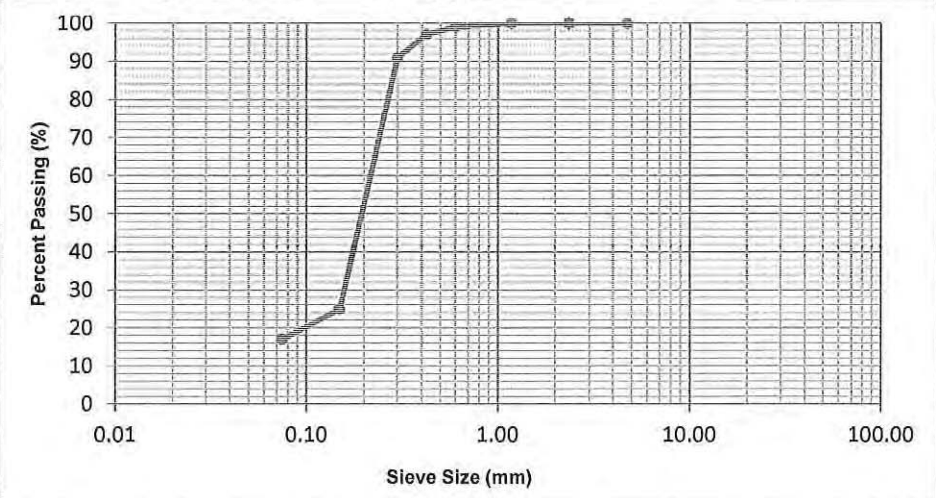
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	1/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-19**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-19
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	18.9
Bore:	102
Depth (m):	13.5-13.95

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	100
1.18	100
0.600	99
0.425	97
0.300	91
0.150	25
0.075	17



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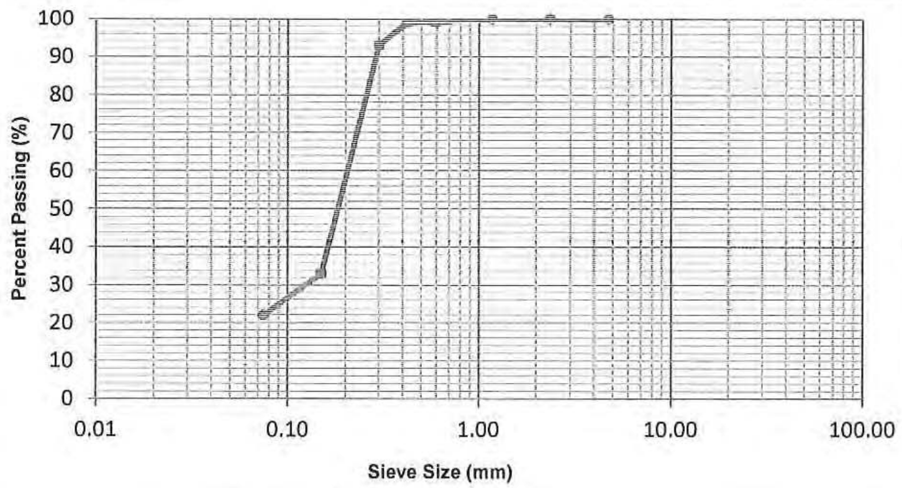
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	1/06/2020	Tested by and Date:	FC/CT 16/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	17/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-04**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-04
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	21.3
Bore:	102
Depth (m):	15.0-15.45

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	100
1.18	100
0.600	99
0.425	99
0.300	93
0.150	33
0.075	22



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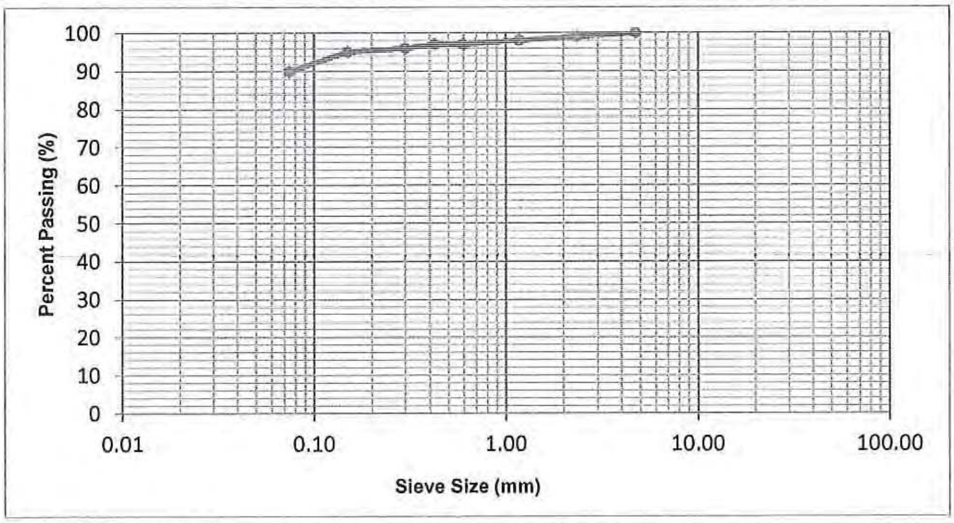
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	√	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	√	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	5/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-20**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-20
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	14.8
Bore:	103
Depth (m):	1.5-1.85

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	99
1.18	98
0.600	97
0.425	97
0.300	96
0.150	95
0.075	90



Comments:	***Authorised Signatory***
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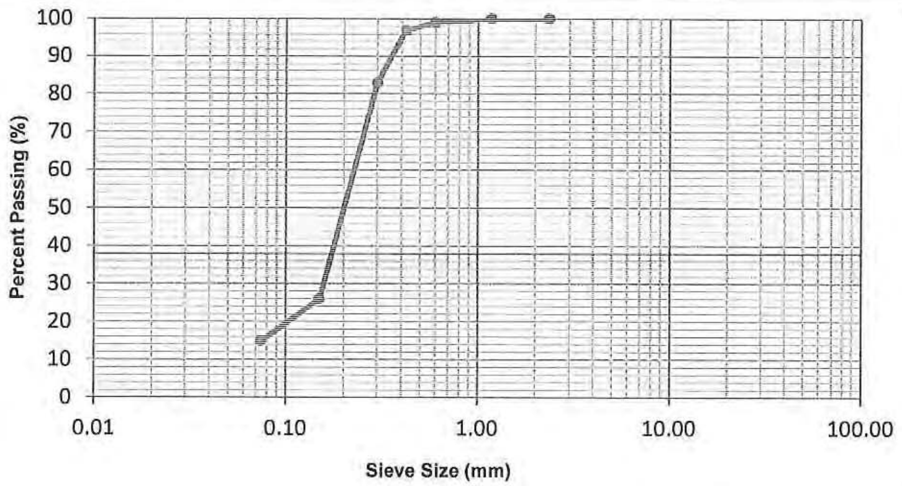
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	5/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-21**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-21
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	16.5
Bore:	103
Depth (m):	4.6-4.72

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	99
0.425	97
0.300	83
0.150	26
0.075	15



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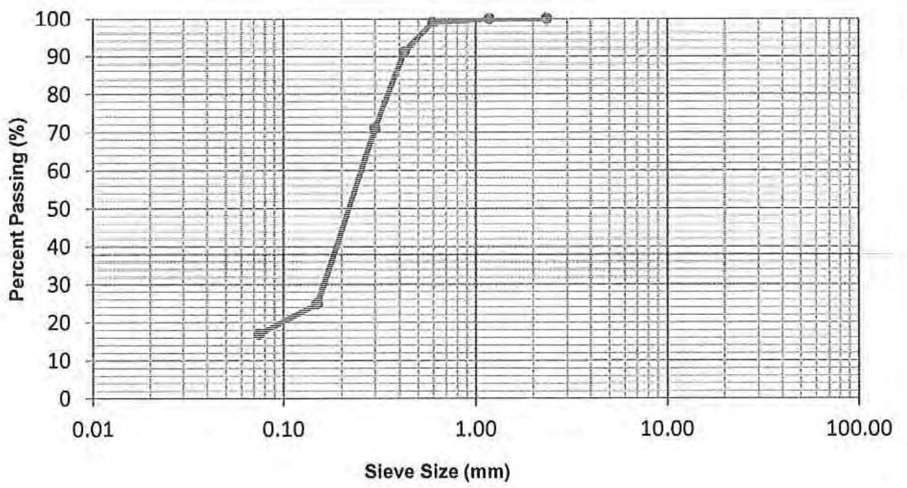
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	5/06/2020	Tested by and Date:	FC/CT 16/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	17/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-06**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-06
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	13.8
Bore:	103
Depth (m):	6.0-6.13

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	99
0.425	91
0.300	71
0.150	25
0.075	17



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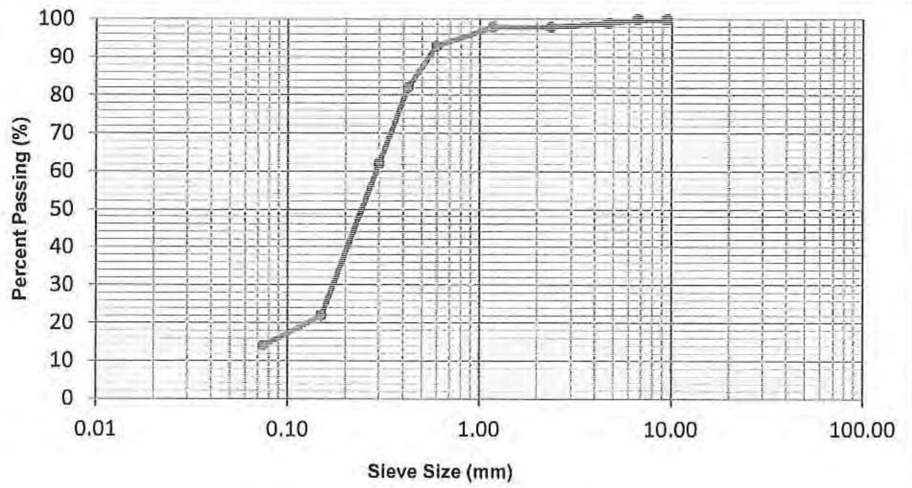
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	5/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-22**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-22
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	20.8
Bore:	103
Depth (m):	10.5-10.77

AS SIEVE SIZE (mm)	PERCENT PASSING
9.5	100
6.7	100
4.75	99
2.36	98
1.18	98
0.600	93
0.425	82
0.300	62
0.150	22
0.075	14



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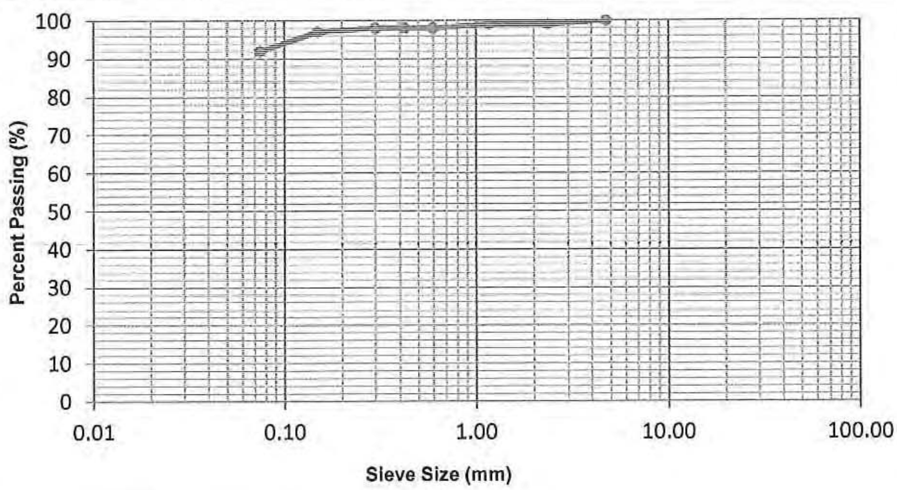
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	2/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-23**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-23
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	12.4
Bore:	104
Depth (m):	3.0-3.45

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	99
1.18	99
0.600	98
0.425	98
0.300	98
0.150	97
0.075	92



Comments:	***Authorised Signatory***
	Craig Tucker — ***23 June 2020*** ***Date***

GROUND TESTING SERVICES

Albion Laboratory
11 Moore Street
ALBION QLD 4010
Telephone 61 (07) 3256 2900
Accreditation No. 19529

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TQCSI Quality Certified ISO 9001:2015

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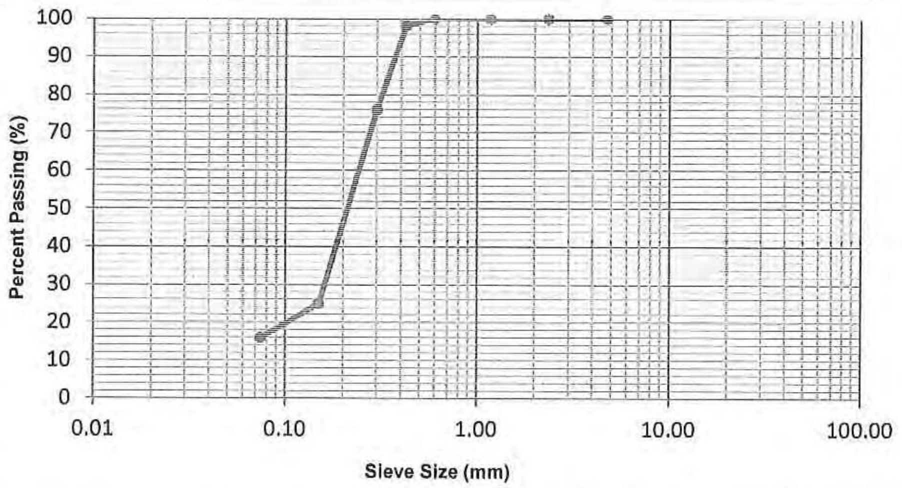
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	2/06/2020	Tested by and Date:	FC/CT 16/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	17/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-11**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-11
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	22.4
Bore:	104
Depth (m):	6.0-6.14

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	100
1.18	100
0.600	100
0.425	98
0.300	76
0.150	25
0.075	16



Comments:

Authorised Signatory

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17 June 2020

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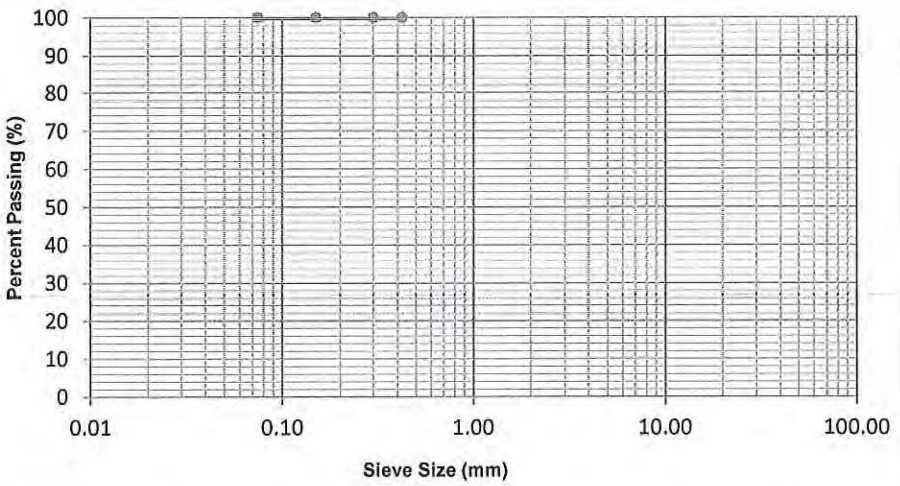
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	2/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-24**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-24
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	7.6
Bore:	104
Depth (m):	10.5-10.95

AS SIEVE SIZE (mm)	PERCENT PASSING
0.425	100
0.300	100
0.150	100
0.075	100



Comments:

Authorised Signatory

Craig Tucker

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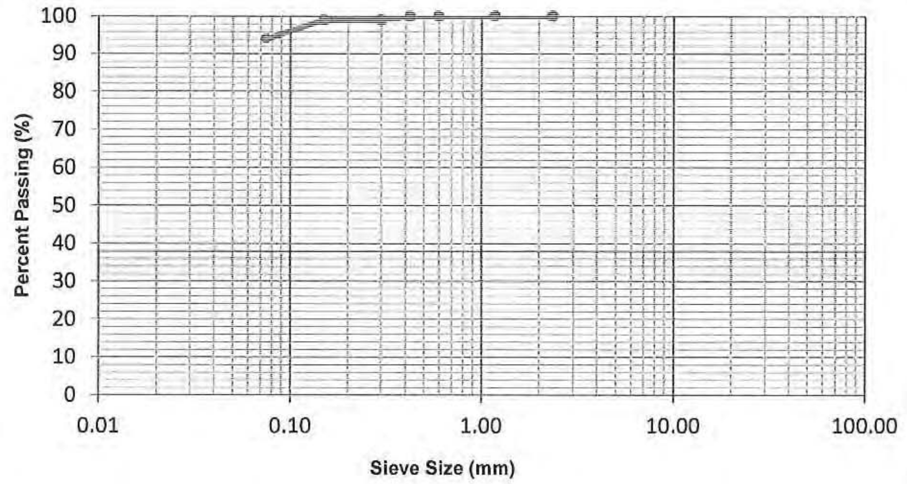
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	2/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-25**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-25
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	20.2
Bore:	104
Depth (m):	15.0-15.43

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	100
0.425	100
0.300	99
0.150	99
0.075	94



Comments:

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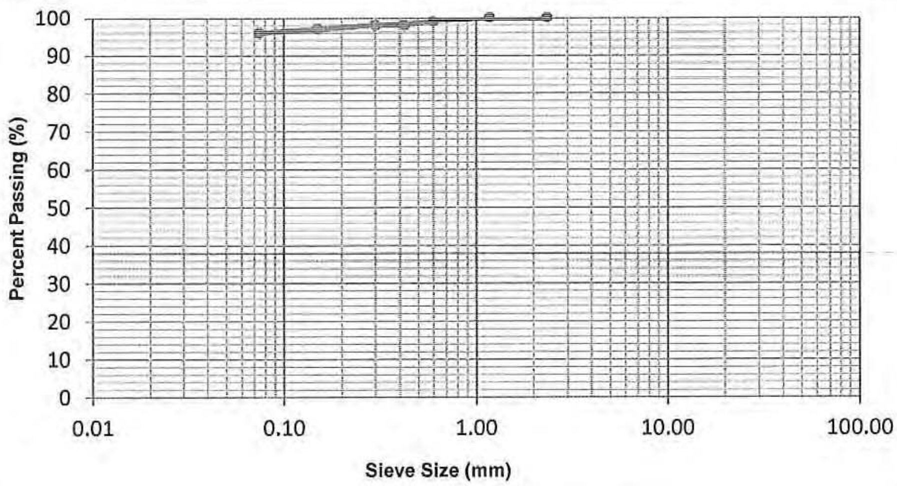
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	9/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-26**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-26
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	20.8
Bore:	105
Depth (m):	7.5-7.8

AS SIEVE SIZE (mm)	PERCENT PASSING
2.36	100
1.18	100
0.600	99
0.425	98
0.300	98
0.150	97
0.075	96



Comments:

Authorised Signatory

Craig Tucker

23 June 2020

Date

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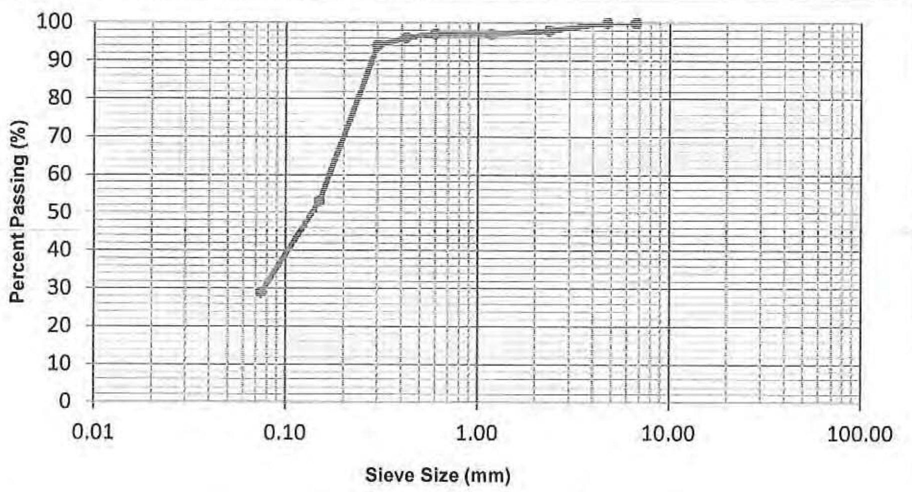
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	9/06/2020	Tested by and Date:	FC/CT 16/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	17/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-15**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-15
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	24.9
Bore:	105
Depth (m):	9.0-9.23

AS SIEVE SIZE (mm)	PERCENT PASSING
6.7	100
4.75	100
2.36	98
1.18	97
0.600	97
0.425	96
0.300	94
0.150	53
0.075	29



Comments:

Authorised Signatory

Craig Tucker

17 June 2020

Date

Material Test Report

Report Number:	**018-118D-3A**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*Change of project details*
Date Issued:	29/09/2020
Client:	Economic Development Queensland Level 14, 1 William Street, Brisbane QLD 4000
Project Number:	018-118D
Project Name:	Slope Stability Assessment
Project Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request:	1188
Sample Number:	G20-1188A
Date Sampled:	04/07/2020
Dates Tested:	08/07/2020 - 10/07/2020
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Bore 105, Depth: 10.0 - 10.45m**

GROUND TESTING SERVICES
Ground Testing Services Pty Ltd
Gold Coast Laboratory
2/23 Traders Way Currumbin QLD 4223
Phone: (07) 5535 2539
Email: enquiries@groundtestingservices.com.au

NATA WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

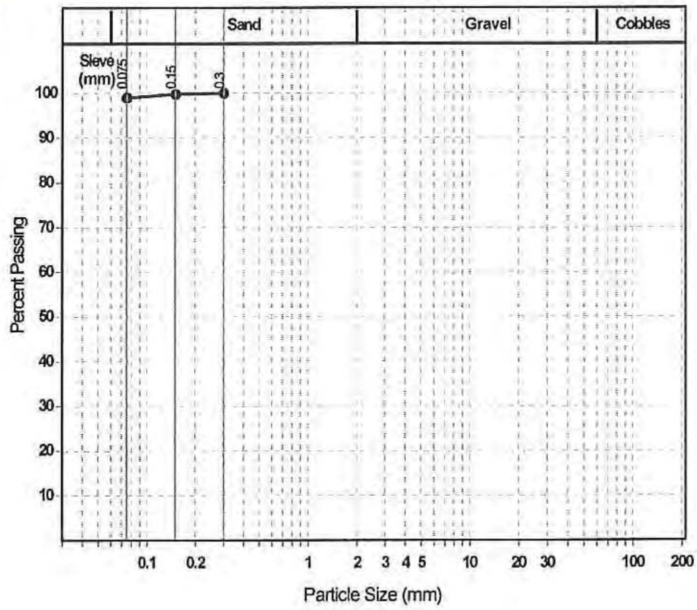
Particle Size Distribution (AS1289 3.6.1)

Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
0.3 mm	**100**			0		
0.15 mm	**100**			0		
0.075 mm	**99**			1		

Moisture Content (AS 1289 2.1.1)

Moisture Content (%)	21.8

Particle Size Distribution



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Telephone 61 (07) 3256 2900
Accreditation No. 19529

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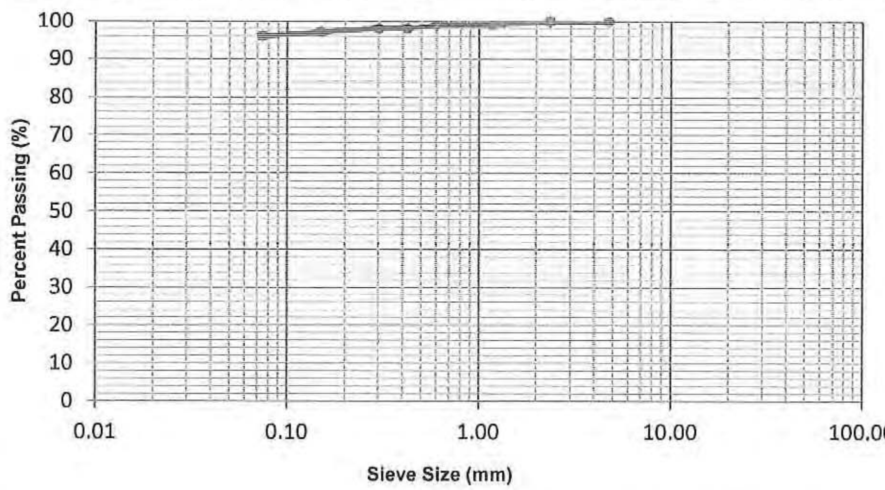
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Procedure: AS1289.3.6.1	✓	*Test Procedure: Q103A*	
Test Procedure: AS1289.2.1.1	✓	*Test Procedure: Q103B*	

Client:	Economic Development Queensland	Sample Date:	9/06/2020	Tested by and Date:	FC/CT 23/06/2020
Project:	Slope Stability Assessment	Checked by:	CT	Date:	23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	**Report No.:**	**018-118D_PSD_T2006-27**		
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample No.:	T2006-27
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Sample Moisture Content (%):	22.6
Bore:	105
Depth (m):	10.5-10.75

AS SIEVE SIZE (mm)	PERCENT PASSING
4.75	100
2.36	100
1.18	99
0.600	99
0.425	98
0.300	98
0.150	97
0.075	96



Comments:

Authorised Signatory

Craig Tucker

23 June 2020

Date

GROUND TESTING SERVICES

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Accreditation No. 19529

NATA ACCREDITED FOR TECHNICAL COMPETENCE

TQCSI ISO 9001:2015 Quality Certified AU1521-QC-IEC-SC

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2007-01**		
Project:	Slope Stability Assessment	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	6/07/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2007-01	T2007-02	T2007-04	T1007-06	T2007-07
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3
Bore:	100	100	100	101	101
Depth (m):	1.5-1.95	4.5-4.95	13.5-13.94	1.5-1.9	6.0-6.45
Liquid Limit (%)	57	64	49	66	36
Plastic Limit (%)	25	27	36	29	25
Plasticity Index (%)	32	37	13	37	11
Linear Shrinkage (%)	11.5	13.5	2.0	13.5	2.0
Sample Moisture Content (%)	13.5	24.0	16.3	15.6	15.3
Shrinkage Mould Length (mm)	*124.56*	*124.88*	*250.42*	*124.82*	*126.91*
Sample History	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*
Cracking of Linear Shrinkage Sample	*None*	*None*	*Moderate*	*None*	*Slight*
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*	*Slight*	*Slight*
Curling of Linear Shrinkage Sample	*Moderate*	*Moderate*	*None*	*Moderate*	*None*

Comments	***Authorised Signatory***	
	Craig Tucker	6 July 2020 ***Date***

Material Test Report

Report Number:	018-118D-2B
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*Change of project details*
Date Issued:	29/09/2020
Client:	Economic Development Queensland Level 14, 1 William Street, Brisbane QLD 4000
Project Number:	018-118D
Project Name:	Slope Stability Assessment
Project Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request:	1175
Sample Number:	G20-1175A
Date Sampled:	29/06/2020
Dates Tested:	02/07/2020 - 06/07/2020
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Bore 100, Depth: 7.5 - 7.9m**

GROUND TESTING SERVICES

Ground Testing Services Pty Ltd
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NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	62		
Plastic Limit (%)	36		
Plasticity Index (%)	**26**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	30.0

GROUND TESTING SERVICES

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.1
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2007-09**		
Project:	Slope Stability Assessment	Sample Date:	29/06/2020	Tested by and Date:	CT 4/07/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	6/07/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2007-09
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Bore:	101
Depth (m):	12.0-12.45

Liquid Limit (%)	48
Plastic Limit (%)	23
Plasticity Index (%)	25
Linear Shrinkage (%)	7.5
Sample Moisture Content (%)	14.2

Shrinkage Mould Length (mm)	*124.93*
Sample History	*Air Dried*
Sample Preparation	*Dry Sieved*
Cracking of Linear Shrinkage Sample	*Slight*
Crumbling of Linear Shrinkage Sample	*None*
Curling of Linear Shrinkage Sample	*Slight*

Comments	***Authorised Signatory***	
	Craig Tucker	6 July 2020 ***Date***

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2006-02**		
Project:	Slope Stability Assessment	Sample Date:	1/06/2020	Tested by and Date:	CT/FC 16/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	17/06/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2006-02	T2006-03	T2006-07	T2006-08	T2006-10
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3
Bore:	102	102	103	103	104
Depth (m):	3.0-3.45	7.5-7.95	15.0-15.41	18.0-18.43	1.5-1.95
Liquid Limit (%)	57	60	47	52	51
Plastic Limit (%)	23	20	28	22	21
Plasticity Index (%)	34	40	19	30	30
Linear Shrinkage (%)	12.5	12.5	7.5	10.5	10.0
Sample Moisture Content (%)	13.1	13.1	17.9	13.6	6.7
Shrinkage Mould Length (mm)	*124.91*	*251.11*	*124.87*	*127.01*	*124.75*
Sample History	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*
Cracking of Linear Shrinkage Sample	*None*	*None*	*None*	*None*	*None*
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*	*None*	*None*
Curling of Linear Shrinkage Sample	*Slight*	*Extensive*	*Slight*	*Slight*	*Slight*

Comments	***Authorised Signatory***
	Craig Tucker — 17 June 2020 ***Date***

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2006-17**		
Project:	Slope Stability Assessment	Sample Date:	2/06/2020	Tested by and Date:	CT/FC 23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	24/06/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2006-17	T2006-18	T2006-20	T2006-23	T2006-24
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3
Bore:	102	102	103	104	104
Depth (m):	6.0-6.45	9.0-9.45	1.5-1.85	3.0-3.45	10.5-10.95
Liquid Limit (%)	74	102	58	53	50
Plastic Limit (%)	28	49	28	20	21
Plasticity Index (%)	46	53	30	33	29
Linear Shrinkage (%)	14.0	16.5	10.5	10.5	10.5
Sample Moisture Content (%)	16.4	17.1	11.3	10.7	12.1
Shrinkage Mould Length (mm)	*124.93*	*124.50*	*250.34*	*124.80*	*251.22*
Sample History	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*	*Air Dried*
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*
Cracking of Linear Shrinkage Sample	*None*	*None*	*Slight*	*None*	*None*
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*	*None*	*None*
Curling of Linear Shrinkage Sample	*Slight*	*Extensive*	*None*	*Slight*	*Slight*

Comments

Authorised Signatory

[signature]

24 June 2020

Craig Tucker ***Date***

GROUND TESTING SERVICES

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2006-12**		
Project:	Slope Stability Assessment	Sample Date:	2/06/2020	Tested by and Date:	CT/FC 16/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	17/06/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2006-12	T2006-14	T2006-16		
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3		
Bore:	104	105	105		
Depth (m):	13.5-13.95	0.5-0.95	13.5-13.92		
Liquid Limit (%)	70	79	55		
Plastic Limit (%)	31	30	22		
Plasticity Index (%)	39	49	33		
Linear Shrinkage (%)	13.5	15.5	11.0		
Sample Moisture Content (%)	19.4	11.9	14.6		
Shrinkage Mould Length (mm)	*250.36*	*249.12*	*250.37*		
Sample History	*Air Dried*	*Air Dried*	*Air Dried*		
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*		
Cracking of Linear Shrinkage Sample	*Slight*	*None*	*Slight*		
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*		
Curling of Linear Shrinkage Sample	*Slight*	*Extensive*	*Moderate*		

Comments

Authorised Signatory

Craig Tucker

17 June 2020
Date

Material Test Report

Report Number: **018-118D-1**
Issue Number: 3 - *This version supersedes all previous issues*
Reissue Reason: *Change of project details*
Date Issued: 29/09/2020
Client: Economic Development Queensland
Level 14, 1 William Street, Brisbane QLD 4000
Project Number: 018-118D
Project Name: Slope Stability Assessment
Project Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request: 1101
Sample Number: G20-1101A
Date Sampled: 01/06/2020
Dates Tested: 15/06/2020 - 19/06/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: **Bore 102, Depth: 4.5 - 4.95m**

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Gold Coast Laboratory
2/23 Traders Way Currumbin QLD 4223
Phone: (07) 5535 2539
Email: enquiries@groundtestingservices.com.au

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Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	64		
Plastic Limit (%)	20		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	17.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	24.6

Material Test Report

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Report Number:	**018-118D-1**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Change of project details*
Date Issued:	29/09/2020
Client:	Economic Development Queensland Level 14, 1 William Street, Brisbane QLD 4000
Project Number:	018-118D
Project Name:	Slope Stability Assessment
Project Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request:	1101
Sample Number:	G20-1101B
Date Sampled:	05/06/2020
Dates Tested:	15/06/2020 - 19/06/2020
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Bore 103, Depth: 17.0 - 17.4m**

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Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	69		
Plastic Limit (%)	21		
Plasticity Index (%)	**48**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	17.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	31.3

Material Test Report

Report Number: **018-118D-1**
Issue Number: 3 - *This version supersedes all previous issues*
Reissue Reason: *Change of project details*
Date Issued: 29/09/2020
Client: Economic Development Queensland
Level 14, 1 William Street, Brisbane QLD 4000
Project Number: 018-118D
Project Name: Slope Stability Assessment
Project Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request: 1101
Sample Number: G20-1101C
Date Sampled: 09/06/2020
Dates Tested: 15/06/2020 - 25/06/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: **Bore 105, Depth: 6.0 - 6.3m**

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Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	47		
Plastic Limit (%)	20		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	14.9

Material Test Report

Report Number: **018-118D-3B**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Change of project details*
Date Issued: 29/09/2020
Client: Economic Development Queensland
Level 14, 1 William Street, Brisbane QLD 4000
Project Number: 018-118D
Project Name: Slope Stability Assessment
Project Location: Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request: 1188
Sample Number: G20-1188A
Date Sampled: 04/07/2020
Dates Tested: 08/07/2020 - 10/07/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: **Bore 105, Depth: 10.0 - 10.45m**

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Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	49		
Plastic Limit (%)	17		
Plasticity Index (%)	**32**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	14.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	21.8

Material Test Report

Report Number:	**018-118D-1**
Issue Number:	3 - *This version supersedes all previous issues*
Reissue Reason:	*Change of project details*
Date Issued:	29/09/2020
Client:	Economic Development Queensland Level 14, 1 William Street, Brisbane QLD 4000
Project Number:	018-118D
Project Name:	Slope Stability Assessment
Project Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley
Work Request:	1101
Sample Number:	G20-1101D
Date Sampled:	09/06/2020
Dates Tested:	15/06/2020 - 19/06/2020
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Bore 105, Depth: 12.0 - 12.35m**

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Approved Signatory: Rede Irwin
Laboratory Manager
NATA Accredited Laboratory Number: 18820

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	58		
Plastic Limit (%)	20		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	15.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	23.1

GROUND TESTING SERVICES

Brisbane Laboratory
11 Moore Street
Albion Qld 4010
Telephone 61 (07) 3259 2600
Accreditation No. 19529

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Atterberg Limits Test Report

Test Procedure: AS1289.2.1.1
Test Procedure: AS1289.3.1.2
Test Procedure: AS1289.3.2.1
Test Procedure: AS1289.3.3.1
Test Procedure: AS1289.3.4.1

Client:	Economic Development Queensland	**Report No.:**	**018-118D_ATL_T2006-25**		
Project:	Slope Stability Assessment	Sample Date:	2/06/2020	Tested by and Date:	CT/FC 23/06/2020
Location:	Oxley PDA - Stage 1A, Seventeen Mile Rocks Road, Oxley	Checked by:	CT	Date:	24/06/2020
Project No:	018-118D	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL			

Sample Number:	T2006-25	T2006-26	T2006-27		
Sampling Method: AS1289.1.2.1	Cl.6.5.3	Cl.6.5.3	Cl.6.5.3		
Bore:	104	105	105		
Depth (m):	15.0-15.43	7.5-7.8	10.5-10.75		
Liquid Limit (%)	44	70	53		
Plastic Limit (%)	21	31	34		
Plasticity Index (%)	23	39	19		
Linear Shrinkage (%)	7.5	15.5	6.5		
Sample Moisture Content (%)	16.8	17.5	16.2		
Shrinkage Mould Length (mm)	*250.35*	*249.23*	*126.99*		
Sample History	*Air Dried*	*Air Dried*	*Air Dried*		
Sample Preparation	*Dry Sieved*	*Dry Sieved*	*Dry Sieved*		
Cracking of Linear Shrinkage Sample	*None*	*None*	*None*		
Crumbling of Linear Shrinkage Sample	*None*	*None*	*None*		
Curling of Linear Shrinkage Sample	*Slight*	*Slight*	*Slight*		

Comments	***Authorised Signatory***	
	Craig Tucker	24 June 2020 ***Date***

GROUND TESTING SERVICES

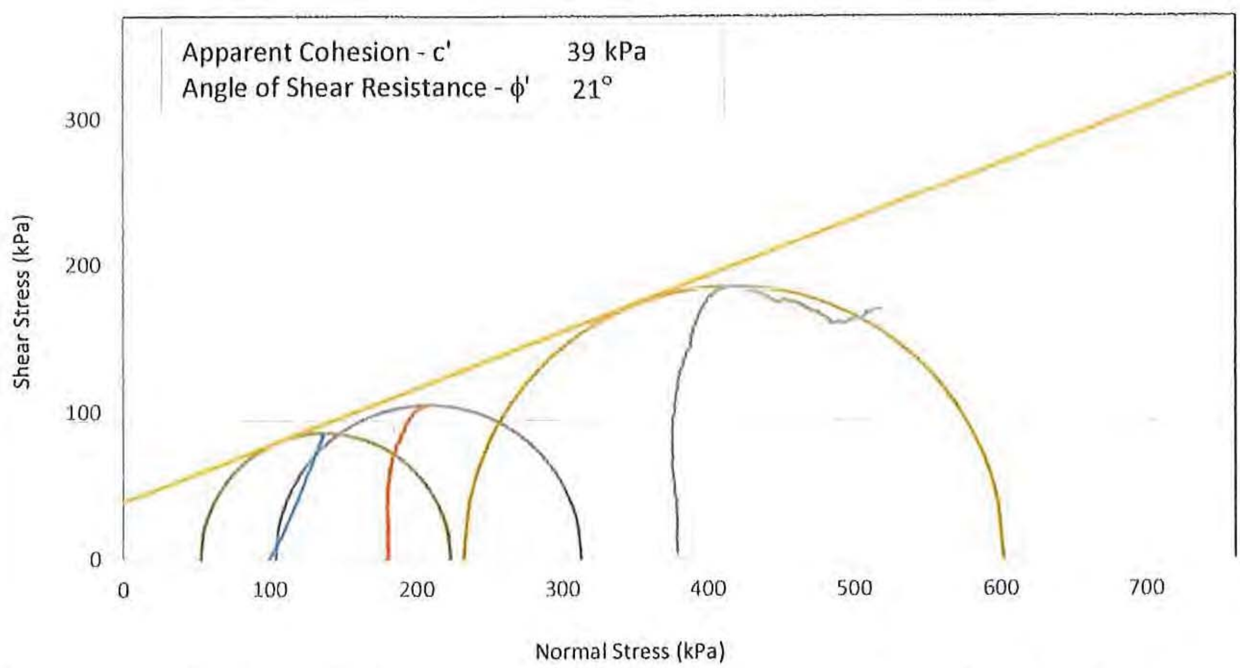
Gold Coast Laboratory
2/23 Traders Way
Currumbin, Queensland 4223
Telephone 61 (07) 5535 2539

Consolidated Undrained Triaxial Test Summary

Client:	Economic Development Queensland		
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020
Initial Height (mm):	100.1	**Initial Diameter (mm):**	47.3
Initial Moisture Content (%):	23.1	**Wet Density (t/m^3):**	2.03
Final Moisture Content (%):	27.0	**Dry Density (t/m^3):**	1.65
Length to Diameter Ratio:	2.0	**Failure Type:**	Shear

Mohr Circle Diagram (with stress paths)



Stage	Initial Effective Stress (kPa)	$\sigma'_{1f} - \sigma'_{3f}$ (kPa)	σ'_{1f} (kPa)	σ'_{3f} (kPa)	u_f (kPa)
1	100	171.1	223.1	52.0	48.0
2	200	209.3	313.3	104.0	96.0
3	400	369.8	601.8	232.0	168.0
		at 20% strain	686.1	347.0	53.0

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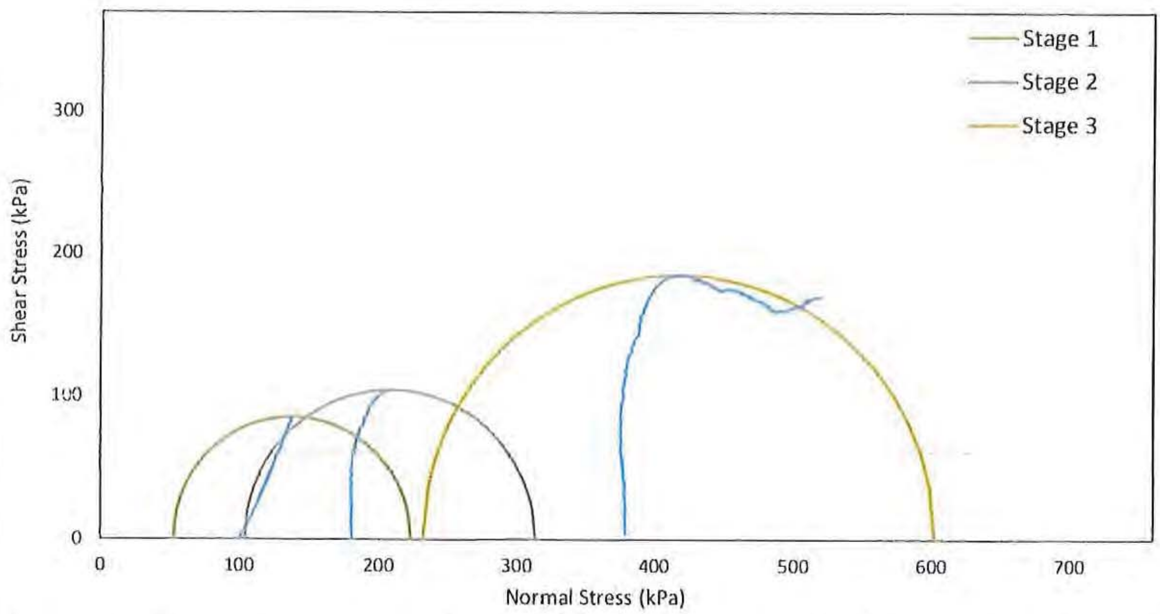
Consolidated Undrained Triaxial Test Report

Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020
Initial Height (mm):	100.1	**Initial Diameter (mm):**	47.3
Initial Moisture Content (%):	23.1	**Wet Density (t/m^3):**	2.03
Final Moisture Content (%):	27.0	**Dry Density (t/m^3):**	1.65
Length to Diameter Ratio:	2.0	**Failure Type:**	Shear

Mohr Circle Diagram



Stage	Initial Effective Stress (kPa)	$\sigma'_{1f} - \sigma'_{3f}$ (kPa)	σ'_{1f} (kPa)	σ'_{3f} (kPa)	u_f (kPa)
1	100	171.1	223.1	52.0	48.0
2	200	209.3	313.3	104.0	96.0
3	400	369.8	601.8	232.0	168.0
		at 20% strain	686.1	347.0	53.0

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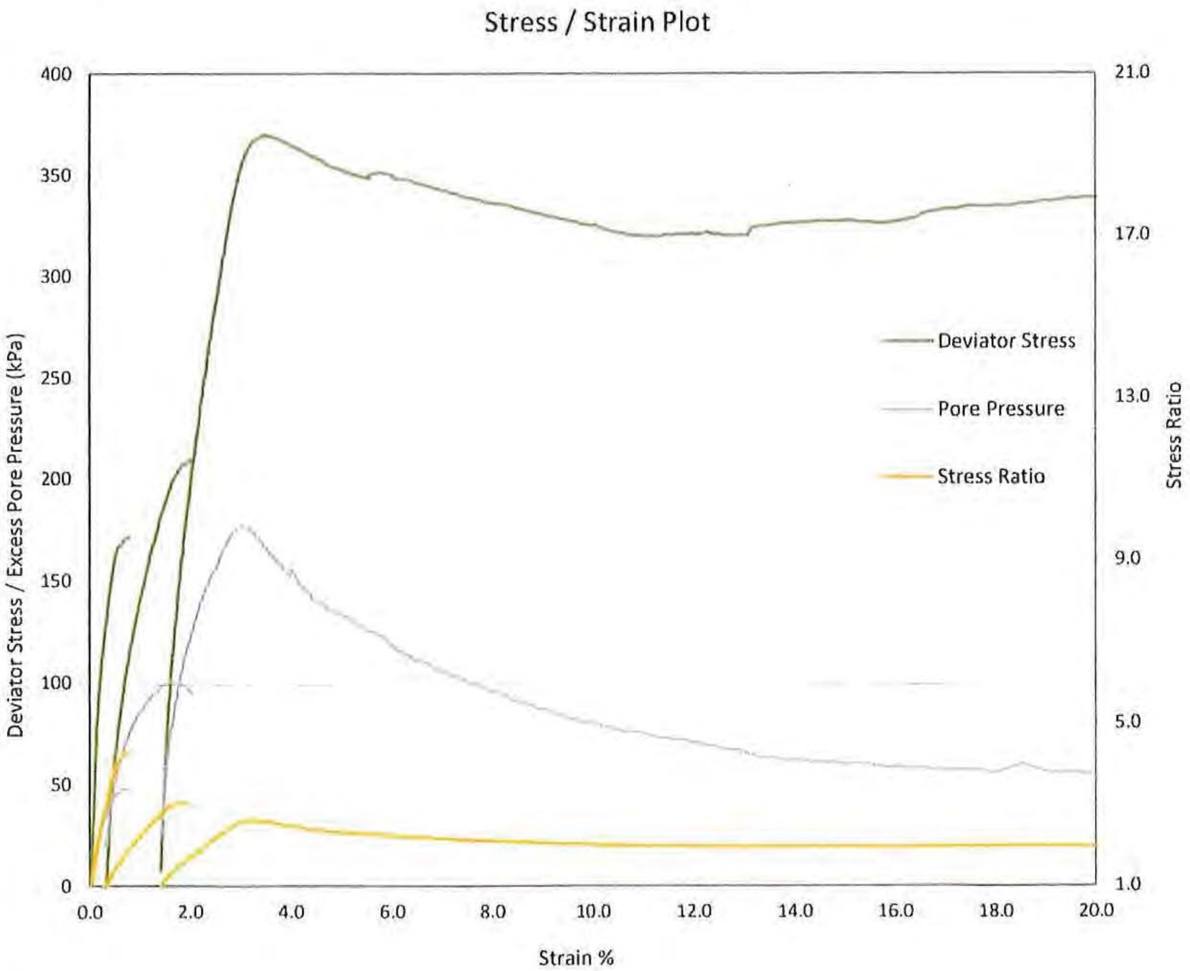
Consolidated Undrained Triaxial Test Report

Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020



Stage	Strain Rate (mm/min)	Maximum Deviator Stress (kPa)	Strain at Maximum Deviator Stress (%)
1	0.005	171.1	0.74
2	0.001	209.3	2.00
3	0.003	369.8	3.45

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Consolidated Undrained Triaxial Test Report

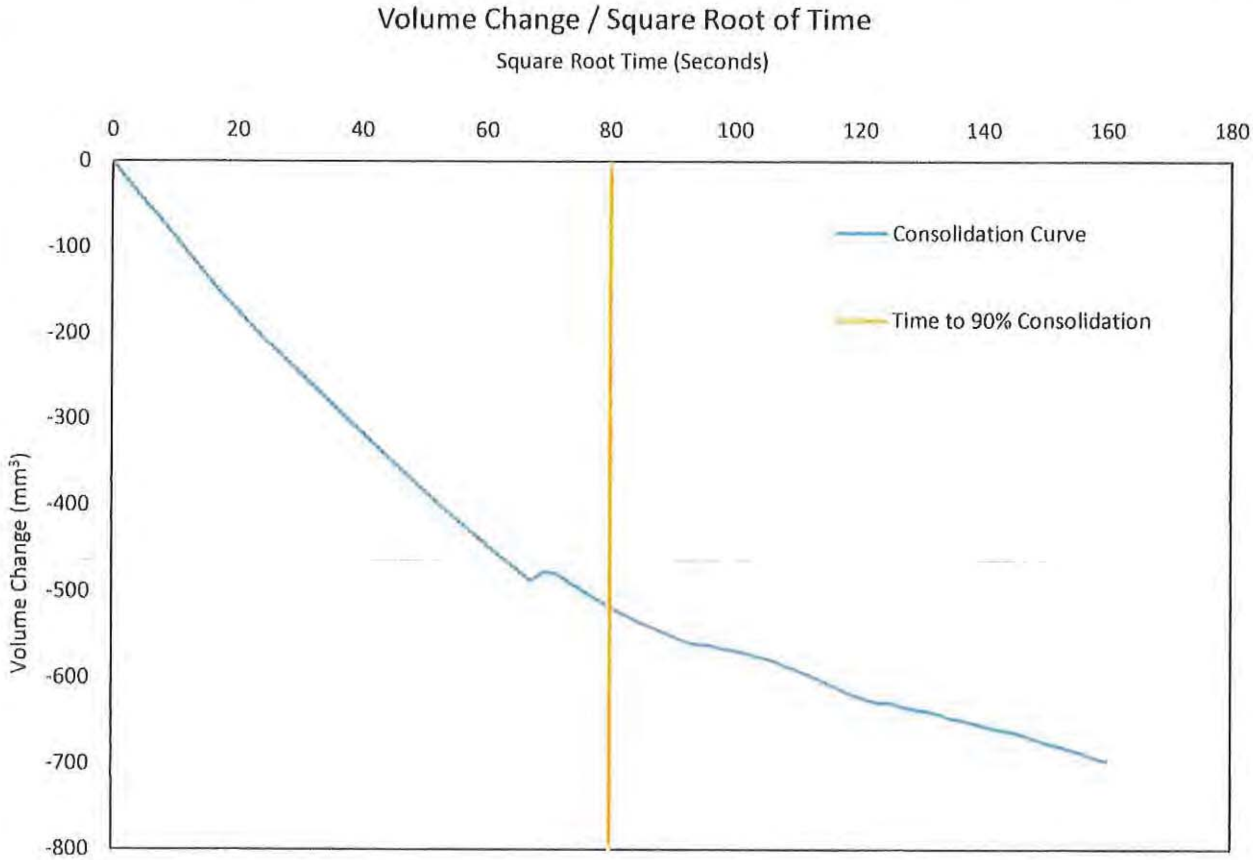
Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020

Consolidation Stage 1

Cell Pressure (kPa):	600	**Back Pressure (kPa):**	500	**Effective Stress σ' (kPa):**	100



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Consolidated Undrained Triaxial Test Report

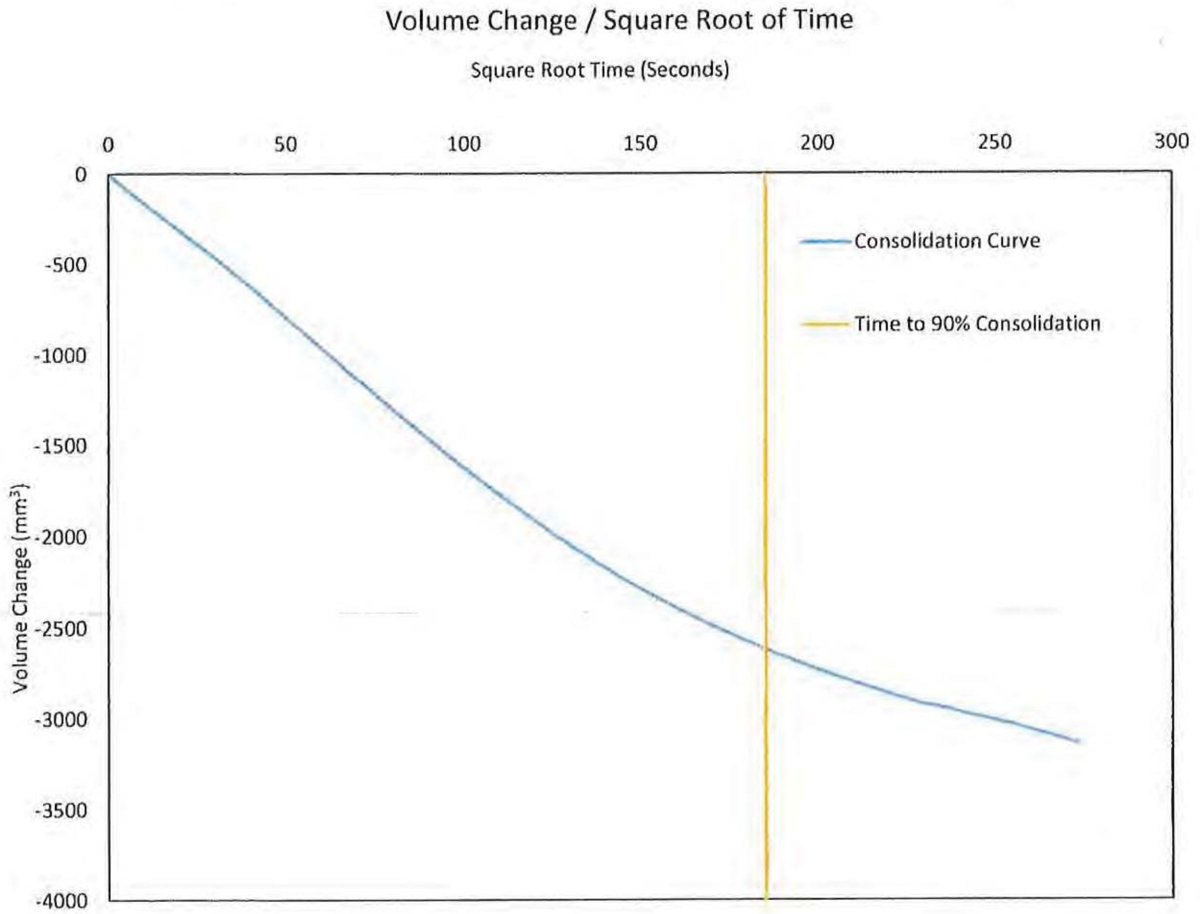
Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020

Consolidation Stage 2

Cell Pressure (kPa):	700	**Back Pressure (kPa):**	500	**Effective Stress σ' (kPa):**	200



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Consolidated Undrained Triaxial Test Report

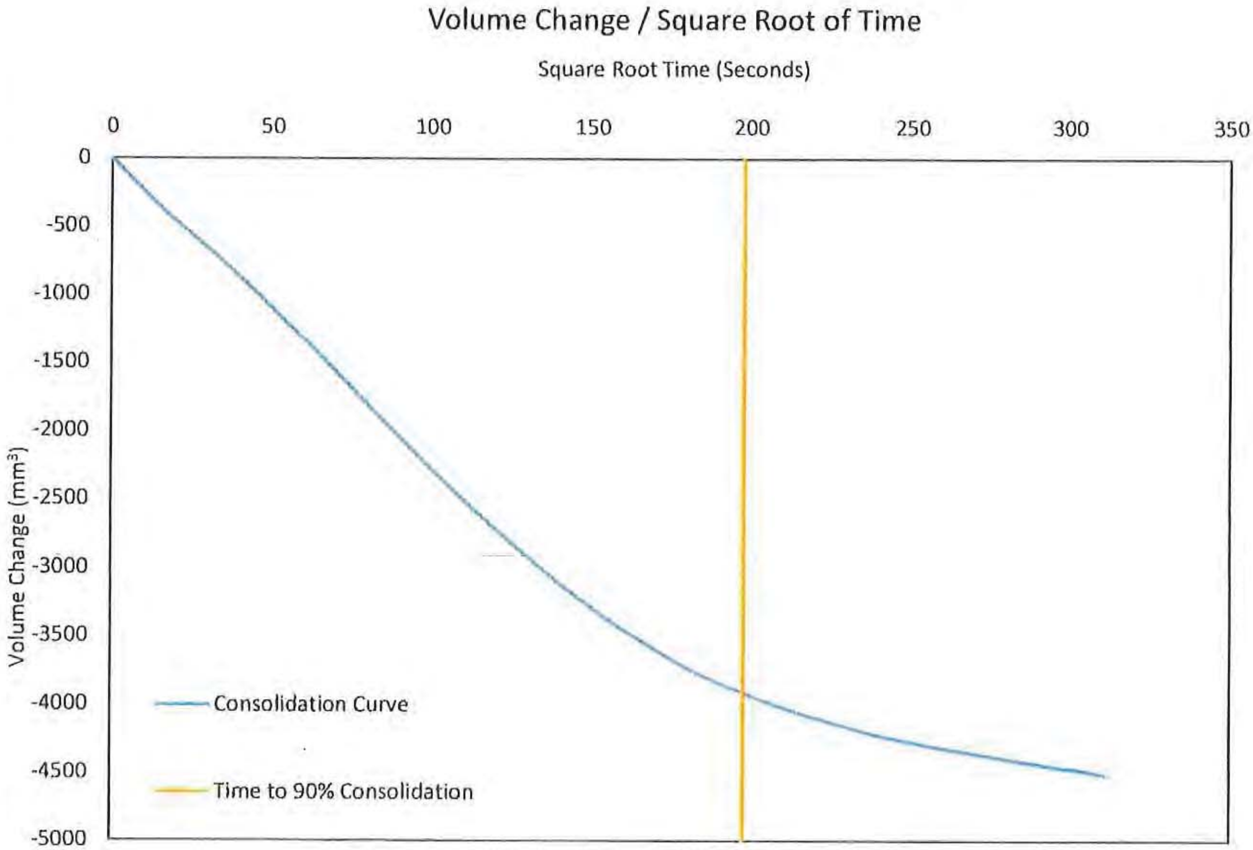
Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020

Consolidation Stage 3

Cell Pressure (kPa):	900	**Back Pressure (kPa):**	500	**Effective Stress σ' (kPa):**	400



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Consolidated Undrained Triaxial Test Report

Test Procedure: AS1289.6.4.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_CU_G20-1101D
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A,	**Date:**	18/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

Sample Description:	Silty Clay	**Sample Number:**	G20-1101D
Bore:	105	**Depth (m):**	12.0 - 12.35
Sample Type:	Undisturbed	**Date Sampled:**	9/06/2020
Saturation Phase - ΔH (mm):	0.0	**Initial Cell Pressure (kPa):**	0

Sample Before Test

Sample After Test

Sample Description (Clause 10(e))

No evidence of natural layers, stones or calcerous matter.

Comments:

Authorised Signatory: [signature]
Mike Neighbour

Date: 26.6.2020

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DIRECT SHEAR STRENGTH OF A SOIL (SHEAR BOX) TEST REPORT

Test Procedure: AS1289.6.6.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_SBT_G20-1101A
Project:	Slope Stability Assessment	**Tested by:**	CL
Location:	Oxley PDA - Stage 1A	**Date:**	15/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	22/06/2020

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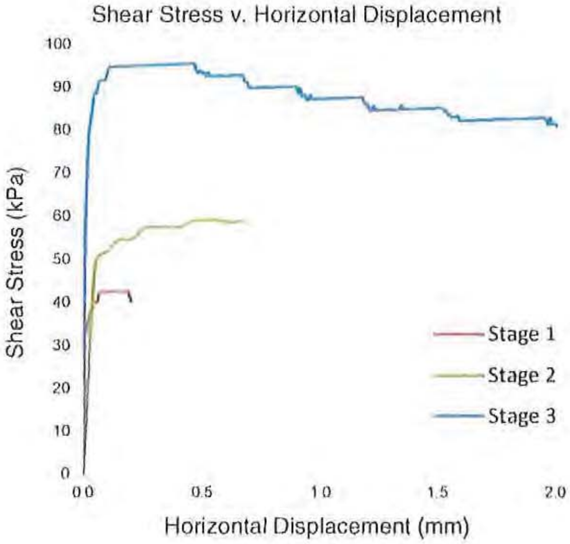
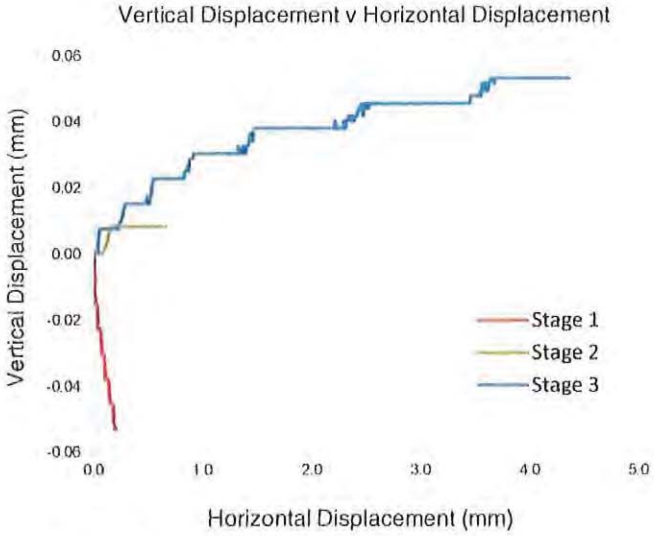
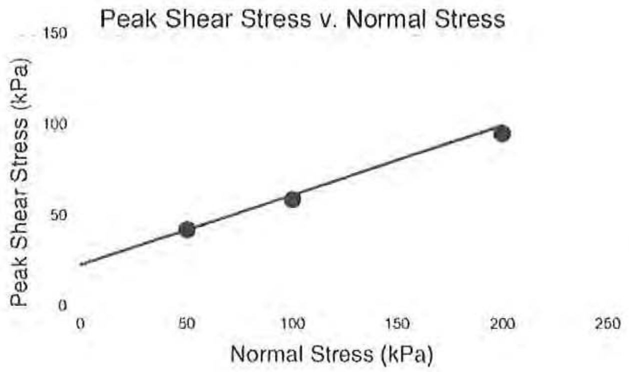
Stage	Moisture Content (%)		Initial Dry Density (t/m^3)	Shearing Rate (mm/min)	Normal Stress (kPa)	Peak Shear Stress (kPa)
	Initial	Final				
1	24.4	-	1.56	0.005	50.0	42.5
2	-	-	-	0.005	100.0	59.1
3	-	31.2	-	0.005	200.0	95.4
Type of Specimen	Undisturbed		**Size of Shear Box (mm)**	45		
Conditions	Dry		**Sample Shape**	Circle		







Sample No.:	G20-1101A
Sampling Method:	AS1289.1.2.1 Clause 6.5.3
Bore:	102
Depth (m):	4.5 - 4.95
Sample Description:	Silty Clay
Apparent Cohesion (kPa)	**Friction Angle (degrees)**
23	**21**

Values for cohesion and friction angle are interpetations only

Comments

Authorised Signatory

Mike Neighbour

Date: 22.6.2020

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DIRECT SHEAR STRENGTH OF A SOIL (SHEAR BOX) TEST REPORT

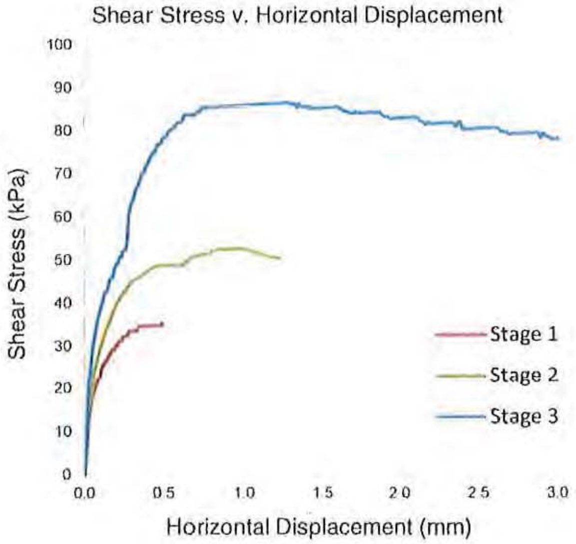
Test Procedure: AS1289.6.6.2 AS1289.2.1.1

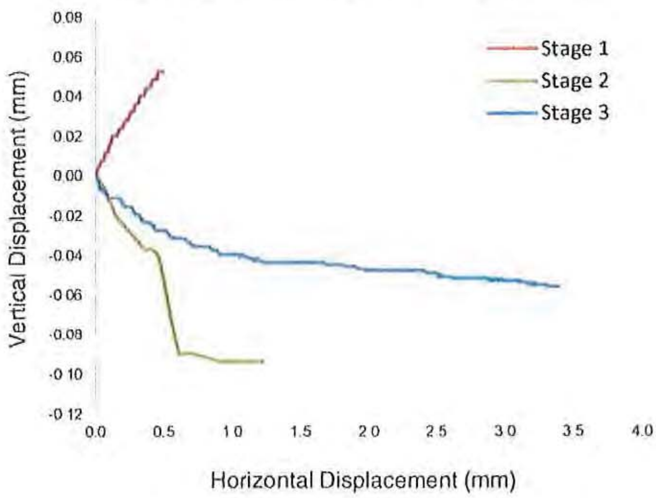
Client:	Economic Development Queensland	**Report No.:**	018-118D_SBT_G20-1101B
Project:	Slope Stability Assessment	**Tested by:**	CL
Location:	Oxley PDA - Stage 1A	**Date:**	15/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	22/06/2020

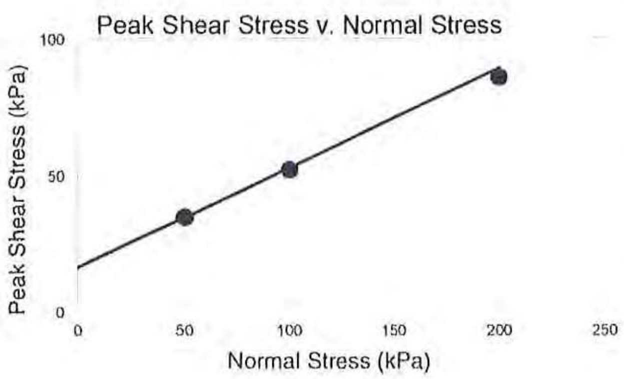
THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Stage	**Moisture Content (%)**		**Initial Dry Density (t/m^3)**	**Shearing Rate (mm/min)**	**Normal Stress (kPa)**	**Peak Shear Stress (kPa)**
	Initial	**Final**				
1	31.3	-	1.48	0.005	50.0	35.3
2	-	-	-	0.005	100.0	52.7
3	-	33.2	-	0.005	200.0	86.5

Type of Specimen	Undisturbed	**Size of Shear Box (mm)**	45
Conditions	Dry	**Sample Shape**	Circle







Sample No.:	G20-1101B
Sampling Method:	AS1289.1.2.1
	Clause 6.5.3
Bore:	103
Depth (m):	17.0 - 17.4
Sample Description:	Silty Clay
Apparent Cohesion (kPa)	**Friction Angle (degrees)**
17	**20**

Values for cohesion and friction angle are interpetations only

Comments

Authorised Signatory
Mike Neighbour
Date: 22.6.2020

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GROUND TESTING SERVICES
Gold Coast Laboratory
2/23 Traders Way
Currumbin, Queensland 4223
Telephone 61 (07) 5535 2539
Accreditation No. 18820

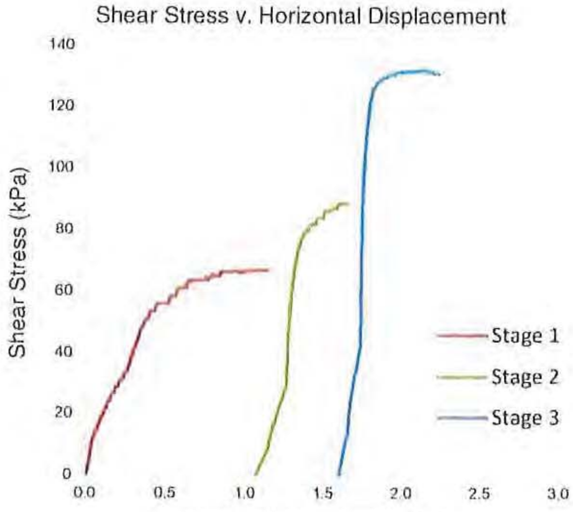
DIRECT SHEAR STRENGTH OF A SOIL (SHEAR BOX) TEST REPORT

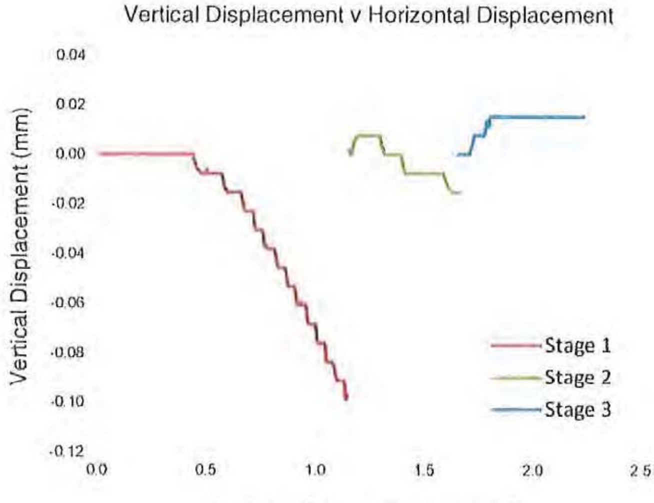
Test Procedure: AS1289.6.6.2 AS1289.2.1.1

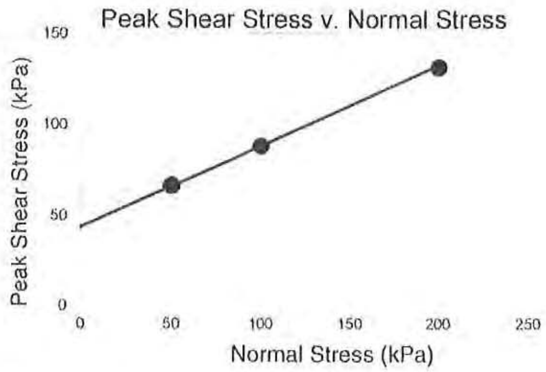
Client:	Economic Development Queensland	**Report No.:**	018-118D_SBT_G20-1101C
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A	**Date:**	22/06/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	26/06/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Stage	**Moisture Content (%)**		**Initial Dry Density (t/m^3)**	**Shearing Rate (mm/min)**	**Normal Stress (kPa)**	**Peak Shear Stress (kPa)**
	Initial	**Final**				
1	15.0	-	1.82	0.001	50.0	66.8
2	-	-	-	0.001	100.0	88.5
3	-	21.5	-	0.001	200.0	131.8
Type of Specimen	Undisturbed		**Size of Shear Box (mm)**	45		
Conditions	Submerged		**Sample Shape**	Circle		







Sample No.:	G20-1101C
Sampling Method:	AS1289.1.2.1
	Clause 6.5.3
Bore:	105
Depth (m):	6.0 - 6.3
Sample Description:	Silty Clay
Apparent Cohesion (kPa)	**Friction Angle (degrees)**
44	**24**

Values for cohesion and friction angle are interpetations only

Comments

Authorised Signatory

Mike Neighbour

Date: 26.6.2020

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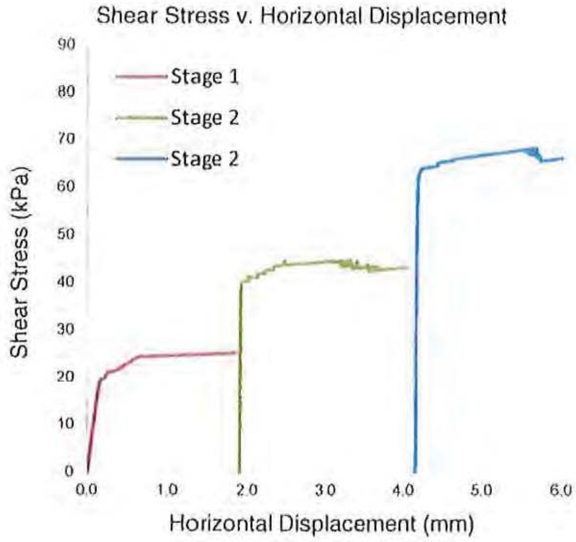
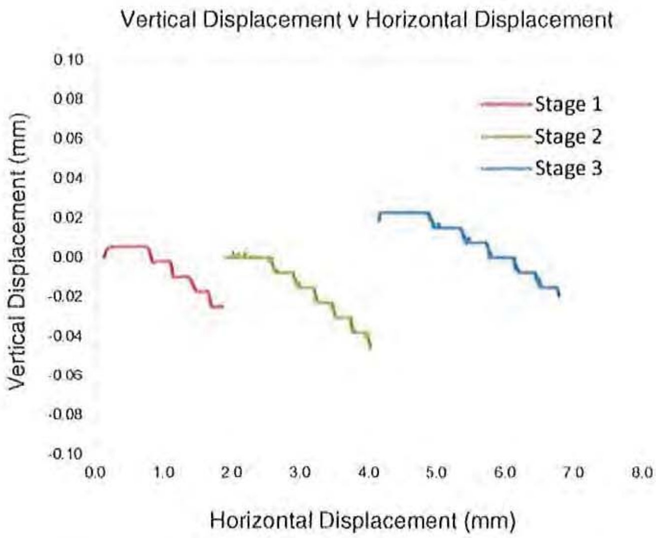
DIRECT SHEAR STRENGTH OF A SOIL (SHEAR BOX) TEST REPORT

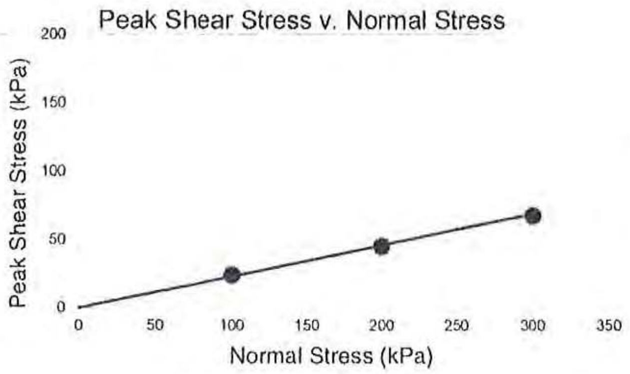
Test Procedure: AS1289.6.6.2 AS1289.2.1.1

Client:	Economic Development Queensland	**Report No.:**	018-118D_SBT_G20-1175A
Project:	Slope Stability Assessment	**Tested by:**	WR
Location:	Oxley PDA - Stage 1A	**Date:**	2/07/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	7/07/2020

Stage	Moisture Content (%)		Initial Dry Density (t/m^3)	Shearing Rate (mm/min)	Normal Stress (kPa)	Residual Shear Stress (kPa)
	Initial	Final				
1	30.6	-	1.41	0.003	100.0	24.5
2	-	-	-	0.003	200.0	45.7
3	-	36.9	-	0.003	300.0	68.2
Type of Specimen	Undisturbed		**Size of Shear Box (mm)**	45		
Conditions	Submerged		**Sample Shape**	Circle		







Sample No.:	G20-1175A
Sampling Method:	AS1289.1.2.1
	Clause 6.5.3
Bore:	100
Depth (m):	7.5 - 7.9
Sample Description:	Silty Clay
Apparent Residual Cohesion (kPa)	**Residual Friction Angle (degrees)**
0	**13**

Values for cohesion and friction angle are interpetations only

Comments

Authorised Signatory

Mike Neighbour

Date: 7.7.2020

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NATA ACCREDITED FOR TECHNICAL COMPETENCE

TQCSI Quality Certified AU1531-OC-EC-SC ISO 9001:2015

Accredited for compliance with ISO/IEC 17025 - Testing

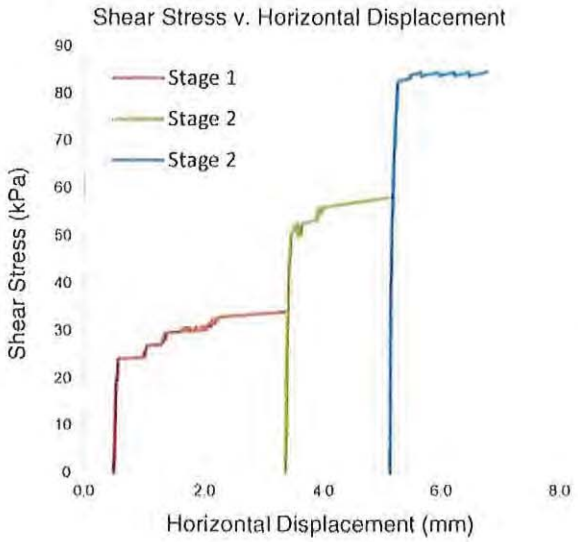
DIRECT SHEAR STRENGTH OF A SOIL (SHEAR BOX) TEST REPORT

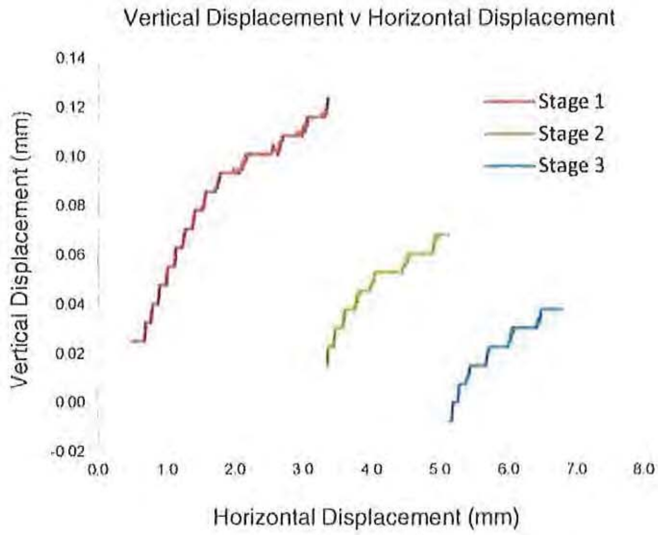
Test Procedure: AS1289.6.6.2 AS1289.2.1.1

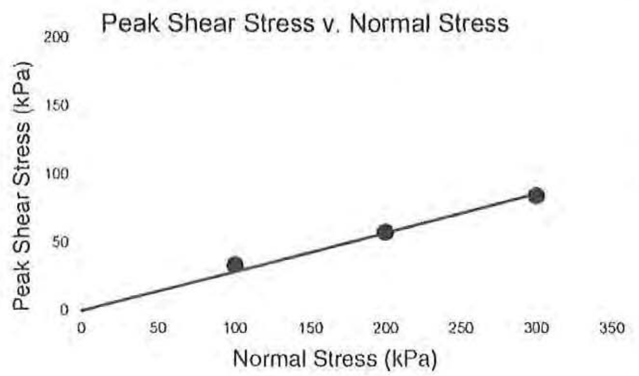
Client:	Economic Development Queensland	**Report No.:**	018-118D_SBT_G20-1188A
Project:	Oxley PDA - Stage 1A	**Tested by:**	WR
Location:	#REF!	**Date:**	8/07/2020
	Seventeen Mile Rocks Road, Oxley	**Checked by:**	WR
Project No:	018-118D	**Date:**	13/07/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Stage	Moisture Content (%)		Initial Dry Density (t/m^3)	Shearing Rate (mm/min)	Normal Stress (kPa)	Residual Shear Stress (kPa)
	Initial	Final				
1	22.6	-	1.60	0.003	100.0	34.0
2	-	-	-	0.003	200.0	58.2
3	-	27.1	-	0.003	300.0	84.6
Type of Specimen		Undisturbed	**Size of Shear Box (mm)**		45	
Conditions		Submerged	**Sample Shape**		Circle	







Sample No.:	G20-1188A
Sampling Method:	AS1289.1.2.1
	Clause 6.5.3
Bore:	105
Depth (m):	10.0 - 10.45
Sample Description:	Silty Clay
Apparent Residual Cohesion (kPa)	**Residual Friction Angle (degrees)**
0	**16**

Values for cohesion and friction angle are interpetations only

Comments

Authorised Signatory

Mike Neighbour

Date: 13.7.2020

APPENDIX D

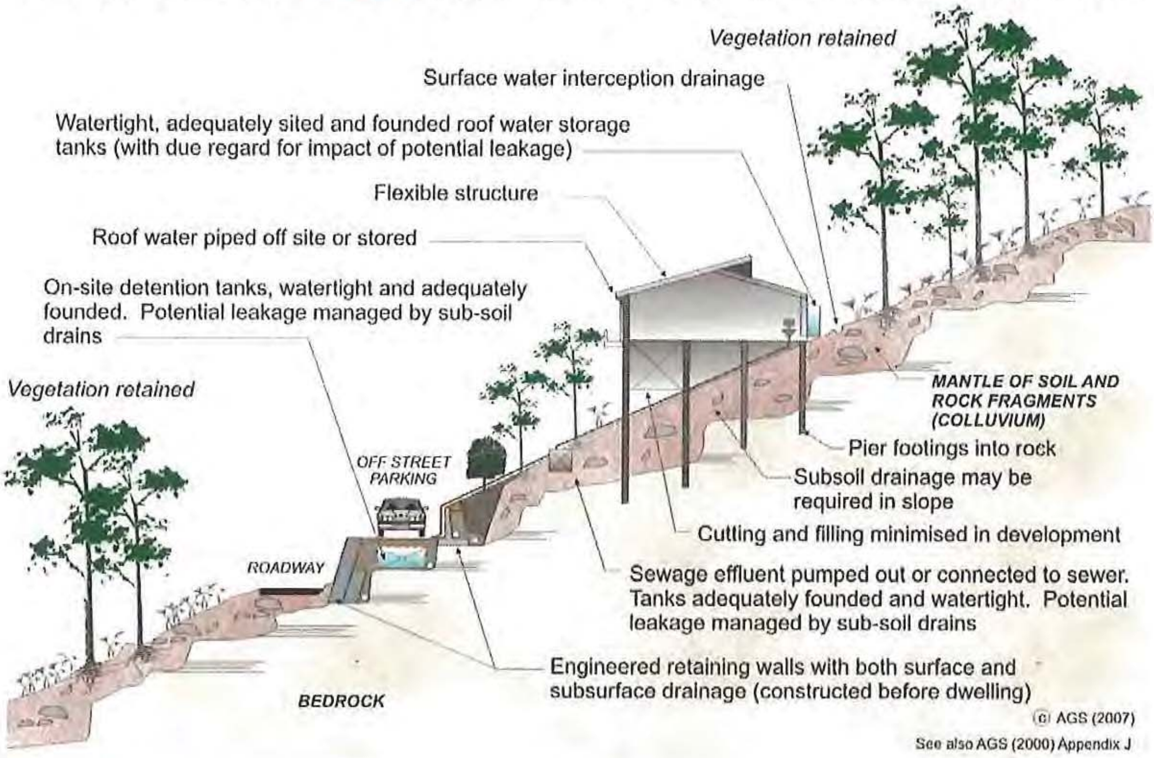
AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.

EXAMPLES OF **GOOD** HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

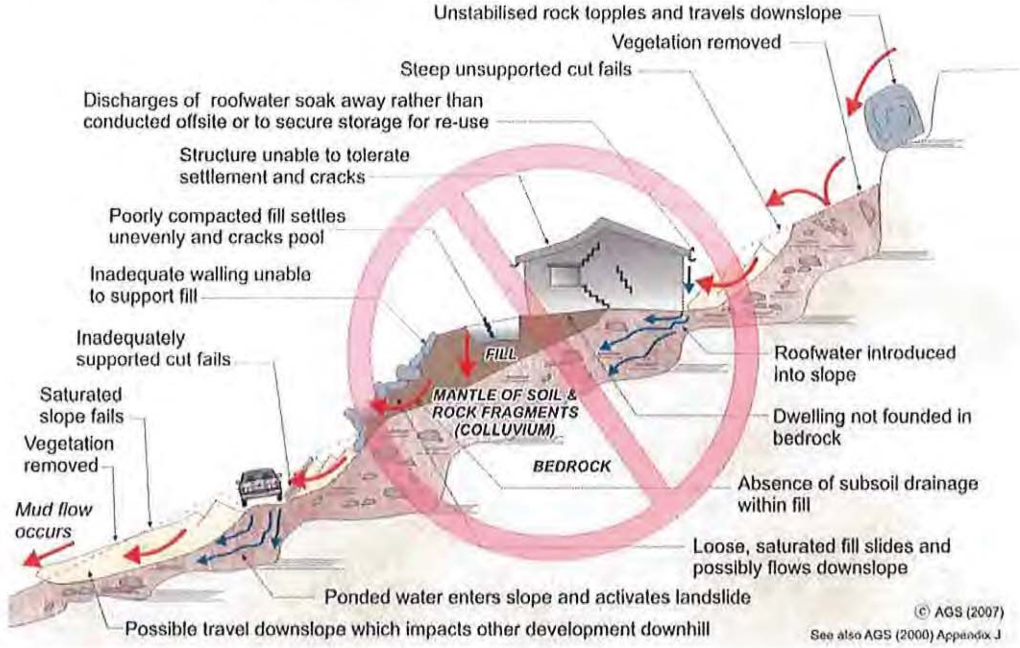
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

EXAMPLES OF POOR HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.