21 November 2016

RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE

GEOTECHNICAL INVESTIGATION REPORT

Bay of Plenty Regional Council
Ref. TGA2016_0216AB Rev0

116 Cameron Road, Tauranga, 3110
www.cmwgeosciences.co.nz

Table of Contents

1 INTRODUCTION 1

2 SITE DESCRIPTION 1

2.1 General 1
2.2 Floodway Stopbank F1 (5700 – 8800) 2
2.3 Floodway Stopbank F2 (0 – 1450) 3
2.4 Floodway Stopbank F3 (0 – 1700) 3
2.5 River Stopbank R1 (4200 – 4600) 3
2.6 River Stopbank R2 (8950 – 10600) 3
2.7 River Stopbank R3 (12300 – 12640) 3

3 PREVIOUS REPORTS 4

4 FIELD INVESTIGATIONS 4

4.1 Methodology 4
4.2 Boreholes 5
4.2.1 Hand Auger Boreholes 5
4.2.2 Machine Boreholes 5
4.3 Laboratory Particle Size Analysis 5
4.4 Investigation Summary 5

5 GROUND MODEL 6

5.1 Geological Setting 6
5.2 Soil Stratigraphy 6
5.3 Design Flood Events 8

6 GEOTECHNICAL ANALYSIS 8

6.1 Geohazards 8
6.2 Geotechnical Design Parameters 9
6.3 Overtopping 11
6.4 Seepage Analysis 12
6.4.1 General 12
6.4.2 Methodology 12
6.4.3 Analyses Results 13
6.4.4 Sensitivity Analysis 15
6.5 Stability Analyses 15

7 REMEDIAL OPTIONS 18

7.1 General 18
7.2 Soil Overlay 18
7.3 Fill Buttress 18
7.4 Seepage Cut-off 18
7.5 Filter trench 19
7.6 Wick Drains 20

8 CONCLUSIONS 20

9 RECOMMENDATIONS FOR FURTHER WORK 21

10 LIMITATIONS 22

Figures

Figure 01 - Geotechnical Investigation Plan
Figure 02 - Geotechnical Investigation Plan – F1
Figure 03 - Geotechnical Investigation Plan – F2/F3
Figure 04 - Geotechnical Investigation Plan – R1
Figure 05 - Geotechnical Investigation Plan – R2
Figure 06 - Geotechnical Investigation Plan – R3
Figure 07 - Cross Section F1A
Figure 08 - Cross Section F1B
Figure 09 - Cross Section F1C
Figure 10 - Cross Section F1D
Figure 11 - Cross Section F1E
Figure 12 - Cross Section F2A
Figure 13 - Cross Section F2B
Figure 14 - Cross Section F2C
Figure 15 - Cross Section F2D
Figure 16 - Cross Section F3A
Figure 17 - Cross Section F3B
Figure 18 - Cross Section F3C
Figure 19 - Cross Section F3D
Figure 20 - Cross Section R1A
Figure 21 - Cross Section R1B
Figure 22 - Cross Section R1C
Figure 23 - Cross Section R2A
Figure 24 - Cross Section R2B
Figure 25 - Cross Section R2C
Figure 26 - Cross Section R2D
Figure 27 - Cross Section R2E
Figure 28 - Cross Section R3A
Figure 29 - Cross Section R3B
Figure 30 - Cross Section R3C
Figure 31 - Cross Section R3D

Appendices

Appendix A: Geotechnical Investigation Data

Appendix B: Laboratory Test Results

Appendix C: Soil Stratigraphy

Appendix D: Flood Hydrographs

Appendix E: Selected Seepage and Slope Stability Outputs

1 INTRODUCTION

CMW Geosciences (NZ) Ltd (CMW) was engaged by Bay of Plenty Regional Council (BOPRC) to carry out a geotechnical investigation, assessment and interpretive reporting for six stopbank sites along the Rangitaiki River and Floodway in Edgecumbe.

These sites were identified by BOPRC as requiring further geotechnical investigation and assessment as part of an ongoing project to increase the overflow capacity of the Rangitaiki Floodway and to reduce the risk of failure of the Rangitaiki River stopbanks. This report will be used to establish details of a forward works programme of stopbank improvements and construction details of capital works.

This report presents the results of our investigation and an assessment of the geotechnical suitability of the stopbanks to withstand the design flood events. Where required, conceptual geotechnical remediation options have been provided.

The investigation and associated report have been undertaken in accordance with the CMW Tender dated 06 May 2016 (ref. TGA2016_0216AA Rev0).

2 SITE DESCRIPTION

2.1 General

The general site is located within the township of Edgecumbe, situated along the Rangitaiki River in the Bay of Plenty, as shown on Figure 01. The Rangitaiki River has its headwaters in the Ahimanawa Range, south of State Highway 5 between Taupo and Napier with a total catchment area of approximately 3,000 km².

Six stopbanks have been identified by BOPRC for further geotechnical investigation as part of an ongoing project to increase the overflow capacity of the Rangitaiki Floodway and reduce the risk of failure of the Rangitaiki River stopbanks. These stopbank locations are presented in Figures 01 to 06 respectively, and are referenced as follows:

Table 1: Stopbank Locations

Name	Description	Bank	Chainage (m)
F1	McLean Road upstream to SH2	Right	5700 – 8800
F2	SH2 upstream to start of stopbank	Right	0 – 1450
F3	Upstream of milking shed to start of stopbank	Left	0 – 1700
R1	Reynolds Bend	Right	4200 – 4600
R2	Opposite Soldiers Road to Fonterra	Right	8950 – 10600
R3	Transpower Substation	Right	12300 – 12640

The stopbanks were constructed in the early 1970s using locally available soils with embankment gradients of approximately 1:3 (V:H).[1] CMW do not have specific details as to how the original stopbanks were constructed or the material used. Following slumping and movements of the stopbanks during the 1987 Edgecumbe earthquake, extensive lengths of the stopbank were repaired where some of the slopes were steeper than the original 1:3 (V:H) gradient. Recently, the stopbanks have been subject to minor earthworks due to a change in design flood levels as well as remedial works following flood events.

[1] Ice Geo & Civil (2005) *Rangitaiki River Stopbanks – Review of Stability*, prepared for Environment Bay of Plenty.

All the stopbanks analysed within this report have grassed slopes. Further details of each specific stopbank section considered in this report, including stopbank configurations, are summarised below.

Table 2: Stopbank Configurations

Name	Stopbank height (m)	Upstream (river) slope gradient (V:H)	Stopbank crest width (m)
F1A	2.0	1 : 3.5	8.0
F1B	2.1	1 : 2.9	6.0
F1C	1.8	1 : 3.1	4.0
F1D	1.9	1 : 2.9	5.2
F1E	2.0	1 : 3.2	4.0
F2A	2.1	1 : 4.8	4.8
F2B	1.6	1 : 4.3	3.8
F2C	1.2	1 : 4.6	3.8
F2D	1.6	1 : 2.8	3.4
F3A	1.7	1 : 4.2	4.8
F3B	1.0	1 : 5.4	2.6
F3C	1.6	1 : 3.9	3.6
F3D	1.4	-	-
R1A	1.2	1 : 3.7	4.5
R1B	1.8	1 : 2.5	4.8
R1C	1.8	1 : 2.2	3.6
R2A	3.6	1 : 4.0	4.6
R2B	1.5	1 : 3.2	3.6
R2C	2.9	1 : 4.3	3.8
R2D	1.5	1 : 3.7	3.7
R2E	1.5	1 : 3.9	3.6
R3A	4.6	1 : 3.1	4.8
R3B	4.4	1 : 3.1	4.0
R3C	3.0	1 : 2.3	4.5
R3D	3.0	1 : 2.3	4.5

2.2 Floodway Stopbank F1 (5700 – 8800)

Floodway stopbank F1 is located from the edge of Awakeri Road (State Highway 2) on the northern end to McLean Road at its southern end covering a total length of 3100m, as shown on Figure 02. Reid's Floodway canal is located to the east of Rangitaiki River and is designed to carry some of the river flows in peak flood events. The canal is contained by stopbanks, with the F1 stopbank being the right bank from 5700m chainage to 8800m as specified by the Bay of Plenty Regional Council.

Within this area the stopbank crest width ranged from 8m at the upstream end near Awakeri Road, narrowing to 4m near McLean Road with an approximate stopbank height of 2m.

Visual inspection by CMW of the incised channel running alongside the F1 stopbank showed that there were several slumps that had occurred along the upstream (river) banks exposing the soil stratigraphy.

2.3 Floodway Stopbank F2 (0 – 1450)

Floodway stopbank F2 is located upstream of Awakeri Road (SH2) and runs for 1450m, as shown on Figure 03. The chainage along the bank is from 0m to 1450m, with a fault line located at the end of the stopbank that occurred during the 1987 Edgecumbe earthquake, where approximately 1.5m of ground subsidence was observed.[2]

The F2 stopbank is the right bank (looking downstream) of the Reid's Floodway channel and has an approximate height of 1.6m. It ranges from a width of 4.8m near Awakeri Road, to 3.4m at the southern end of the stopbank where the embankment height reduces due to more elevated ground adjacent to the stopbank.

2.4 Floodway Stopbank F3 (0 – 1700)

The F3 floodway stopbank is located opposite the Transpower substation upstream of Edgecumbe, near McCracken Road as shown on Figure 03. It runs for 1700m from chainage 0m to 1700m.

The stopbank is located along the left bank of the Reid's Floodway channel. It varies in width from 2.6m to 4.8m and has an approximate height of 1.4m. The stopbank is terminated at its southern end by joining up with Hydro Road fill embankment to the west.

2.5 River Stopbank R1 (4200 – 4600)

The R1 river stopbank is located at Reynold's Bend downstream of Edgecumbe, to the west of East Bank Road as shown on Figure 04. It runs for 400m from chainage 4200m to 4600m along the right bank of the Rangitaiki River.

During the 2004 flood event in Edgecumbe, heavy rain and the upstream Matahina dam release caused the stopbank at Reynold's Bend to breach which resulted in extensive flooding and ponding to the adjacent farmlands. Extensive rebuilding of the stopbank was completed in this area immediately after the flood.

The R1 stopbank being investigated is approximately 1.6m high and varies in width from 3.6m to 4.8m.

2.6 River Stopbank R2 (8950 – 10600)

The R2 river stopbank is located from 500 East Bank Road to the Fonterra Dairy Factory, as shown on Figure 05. It runs for 1650m along the right bank of the Rangitaiki River from chainage 8950m to 10600m.

The stopbank ranges in width from 4.6m near the Fonterra Dairy Factory to 3.6m further downstream. It varies in height from 3.6m to 1.5m, with the average height being approximately 2.2m.

2.7 River Stopbank R3 (12300 – 12640)

The river stopbank R3 is located upstream of Edgecumbe at the Transpower substation along Hydro Road as shown on Figure 06. It runs for 340m from chainage 12300m to 12640m along the right bank.

The Transpower substation is a high importance level structure (AS/NZS 1170.0:2002), and supplies power to the eastern Bay of Plenty.

[2] Pender, M.J. and Robertson, T.W. (Ed) (1987) *Edgecumbe Earthquake: Reconnaissance Report.* Bulletin of the New Zealand National Society for Earthquake Engineering Vol. 20, No. 3, September 1987.

The R3 stopbank is approximately 4.5m wide with an average height of 3.75m. Additional buttresses have been placed along the downstream (landward) stopbank toe in recent years to reduce the risk of heaving and piping within the upper soil layers during flood events. This buttress ranges in width from 3m to 6m and has an average height of 1.65m, only built to a partial height of the original 3.75m embankment.

It is known from reviewing various reports completed at the Transpower site that other remedial options such as toe drains and relief trenches have been implemented but CMW have not been supplied with any further details pertaining to their design and location. They have therefore not been included in any analyses completed by CMW.

3 PREVIOUS REPORTS

A number of geotechnical investigation and assessment reports have been completed for the Rangitaiki River stopbanks and associated Reid Canal Floodway stopbanks over the last 15 years by various consultancies, with the most relevant to the subject site listed below:

- Stopbank Assessment Rangitaiki River Edgecumbe prepared by Opus International Consultants Limited, Ref No. 2069, dated June 2000;
- Reid's Canal: Left bank upgrading Geotechnical Assessment prepared by Ice Geo & Civil Limited, dated October 2009;
- Reid Canal Stopbanks Geotechnical Study prepared by Riley Consultants Limited, dated May 2010;
- Rangitāiki River Stopbank assessment: upstream Langdons (section 15) RB 6700-7100m prepared by Ice Geo & Civil Limited, dated April 2011;
- Reid's Canal Floodway upgrading Stage 4 (3650-7000m) Geotechnical Assessment prepared by Ice Geo & Civil Limited, dated May 2013;
- Rangitaiki River Stopbank Assessment: Reynold's Bend Right Bank 3040-4700m prepared by Ice Geo & Civil Limited, dated June 2014;
- Transpower Edgecumbe Substation 33kV Indoor conversion: Assessment of effects on security of the Rangitāiki River Stopbank prepared by Ice Geo & Civil Limited, dated August 2014.

Previous site investigation data and laboratory results where relevant have been used to develop the geological models and material parameters for the subject sites. The conclusions and recommendations from the previous reports that were applicable to the subject sites were reviewed during the preparation of this document.

4 FIELD INVESTIGATIONS

4.1 Methodology

Site investigations were completed from 20 June 2016 to 19 July 2016 along the six areas of stopbank as specified by the BOPRC. In order to assess the subsurface soil profile in each region, a combination of shallow hand auger boreholes and deep machine boreholes were completed based upon suggestions by BOPRC. To determine the soil properties of each stratigraphic soil layer, laboratory testing was undertaken on a selection of soil samples obtained from the machine boreholes.

The latest site investigation data is corroborated with historic geotechnical investigations completed within nearby areas.

4.2 Boreholes

4.2.1 Hand Auger Boreholes

Hand auger boreholes were completed at all of the stopbank locations, excluding area R1. A total of 24 boreholes were completed to depths of up to 5m below the existing ground surface, with in-situ shear vane measurements recorded using a hand held shear vane apparatus at regular intervals. Dynamic Cone Penetrometer (DCP) tests were completed adjacent to all hand auger boreholes to a depth of 5m or refusal, to provide a strength profile of the soils, typically at and beyond the toe of the stopbanks.

4.2.2 Machine Boreholes

18 machine boreholes were drilled across the stopbank locations, excluding area R2. Hollow Tube Coring (HQ) was completed by Drillcore Limited, to depths of up to 16.95 metres below ground level with Standard Penetration Tests (SPTs) completed at 1.5m increments. Machine boreholes were typically drilled through the crest of the stopbanks.

The surveyed locations of the hand auger and machine boreholes referred to above are shown on the geotechnical investigation plans and cross sections. A copy of the field test data together with a detailed description and depths of the strata encountered is presented in Appendix A.

4.3 Laboratory Particle Size Analysis

Eighteen soil samples were obtained from the machine boreholes in order to complete particle size analysis on the different soil layers identified. Samples were sent to Opus International Consultants Limited (Opus) in Hamilton to complete the testing. Fifteen particle size distribution tests were completed using the wet sieve method for sands and gravels, and three tests were completed using the hydrometer method for silts and clays.

A copy of the laboratory test results is presented in Appendix B.

4.4 Investigation Summary

A summary of the investigations completed at each stopbank area are presented below.

Table 3: Investigation Summary

Name	CMW Investigations			Relevant Previous Investigations		
	No. of hand augers	No. machine boreholes	No. of lab tests	No. of hand augers	No. machine boreholes	No. of lab tests
F1	5	5	5	2	2	-
F2	4	4	4	1	-	-
F3	4	4	5	8	-	-
R1	-	4	3	15	-	5
R2	5	-	-	-	1	-
R3	6	1	1	11	5	6

5 GROUND MODEL

5.1 Geological Setting

The Rangitaiki Plains lie within the Whakatane Graben at the northern land extent of the Taupo Volcanic Zone. Prominent north-south fault scarps border the Rangitaiki Plains in the east, west and south-west[3]. Soils within this region consist of Holocene alluvial deposits described as "sands silts and gravels of modern streams" by Healy et al. (1964)[4]. Sediments from the Rangitaiki River and Tarawera River have built up the plains, with surface deposits consisting of sands dunes, drained peat swamps, and floodplains composed of pumiceous and minor greywacke alluvium[5]. Airfall ash from the Kaharoa and Tarawera eruptions in 1886 are interbedded with peats and silts in the plains lowlands.

Subsidence within the Whakatane Graben is occurring at long-term rates of approximately 2 ± 1 mm/year[6] with an associated extension of the graben. The alluvial lowlands surrounding Edgecumbe were formed in the last 8,000 years and are thus geologically very young and unconsolidated.

5.2 Soil Stratigraphy

The soil stratigraphy in all boreholes consisted of stopbank fill underlain by alluvial deposits. These alluvial deposits extended to beyond the depth of the 15.5m machine boreholes and comprised silts, clayey silts, sands, silty sands, gravels and peat.

A summary of the soil stratigraphy is presented in Table 4, with a more detailed description of each stopbank area presented in Appendix C.

[3] Pullar, W.A. (1985) *Soils and land use of Rangitaiki Plains, North Island, New Zealand*. N.Z. Soil Survey Report 86

[4] Healy, J.; Thompson, B.N; Schofield, J.C. (1964) *Sheet 5 – Rotorua. Geological Map of New Zealand.* 1:250000. Wellington, New Zealand. Department of Scientific and Industrial Research

[5] Pullar, W.A. (1985) *Soils and land use of Rangitaiki Plains, North Island, New Zealand*. N.Z. Soil Survey Report 86

[6] Nairn, I.A. and Beanland, S. (1989) *Geological setting of the 1987 Edgecumbe earthquake, New Zealand.* New Zealand Journal of Geology and Geophysics, 32:1, 1-13.

Table 4 – Soil Stratigraphy Summary

Area	Stopbank Fill				Natural Soil Profile			
	Thickness (m)	Description	Su (kPa)	DCP (blows per 100mm)	Thickness (m)	Description	Su (kPa)	SPT N-value
F1	2.6	Silts	30 - 164	2 - 4	0.2	Buried Topsoil		
					4.4	Silts	51 - 104	13 - 24
					2.3	Clayey silt and Peat lenses		0 - 5
					>6.0	Sand, silty and gravelly Sand		9 - 50
F2	2.4	Silts and sands	50 - 175	1 - 6	0.5	Buried Topsoil		
					5.8	Silts	93 - UTP	6 - 27
					4.8	Clayey silt and Peat lenses		0 - 7
					>5.9	Sands and gravelly sand		5 - 33
F3	2.2	Silts and sands	24 - UTP	0 - 15	0.4	Buried Topsoil		
					9.6	Sands and gravels		8 – 12
					6.5	Silts, clayey silts and peat lenses		0 - 21
					>4.45	Sands and gravels		7 - 22
R1	2.1	Clayey silts			8.4	Clayey silts and silts with peat lenses		0 - 26
					>8.35	Sands and gravels		16 - 51
R2	2.6	Silts and sands	140 - UTP	1 - 20	1.4	Silts	65 - 189	
					>1.0	Sands		
R3	3.75	Silts	66 - 100	1 - 5	14.5	Interbedded sands, silts and clayey silts		3 - 29
					>5.5	Gravelly sands and silty sands		11 – 50+

5.3 Design Flood Events

Flood hydrographs for each of the subject sites were provided by BOPRC. These hydrographs were simplified in order to obtain a representative flood event that could be entered for slope stability and seepage analysis. Flood levels were taken at 24 hour intervals throughout the duration of the flood event for all stopbanks, excluding F2. A peak flood measurement for the stopbanks (excluding F2) was taken at a 12 hour interval on day 7 of the flood event (e.g. Day 7.5). Given that Reid's Canal is dry prior to and following a flood event for F2, a six hour time step was used in the analyses during the peak flows over a four day period. It should be noted that before and after the flood event, the F2 canal is dry. These representative flood hydrographs can be found in Appendix D.

Design flood events are summarised in Table 5 below.

Table 5: Design Flood Events

Stopbank	Design Event (as specified by client)	Comments
F1	100 year with allowance for climate change	Flood event lasts for a 14 day period.
F2	100 year with allowance for climate change	Flood event lasts for a 14 day period.
F3	100 year with allowance for climate change	Flood event lasts for a 14 day period.
R1	100 year with allowance for climate change	Flood event lasts for a 14 day period. Based on 1998 flood event – two peak flows included.
R2	100 year with allowance for climate change	Flood event lasts for a 14 day period. Based on 1998 flood event – two peak flows included.
R3	300 year with allowance for climate change	Flood event lasts for a 14 day period. Based on 1998 flood event – two peak flows included. Adjacent to Transpower Substation, high importance level structure (AS/NZS 1170.0:2002).

6 GEOTECHNICAL ANALYSIS

6.1 Geohazards

The following specific Geohazards at the stopbanks, due to a flood event, are considered relevant and have been considered in the following section of this report:

- Overtopping: which may occur when the stopbank height is lower than the peak design flood level;
- Slope stability failure: this may occur under low river levels, high river levels and rapid drawdown conditions;
- Piping failure: initiation and continuation of seepage and uncontrolled discharge within or beneath the stopbank due to high hydraulic gradients, in turn leading to piping failure and progressive instability;
- Uplift and heave: may occur as a result of high water pressures developing in underlying soils.

6.2 Geotechnical Design Parameters

Estimates of hydraulic conductivity were calculated based on field descriptions of soils and laboratory particle size distributions completed as part of this scope of work along with reviewing previous soil testing undertaken by other companies.

In order to determine the hydraulic conductivity of each soil sample, six different equations were used based on particle size distribution of the soils. A geostatistical mean value was taken for each soil sample across the six different equations, in order to determine a representative value. These representative values were compared to typical accepted values for the same soil type in order to determine the hydraulic conductivity to be used in analyses.

The range of methods used to complete the calculations is presented in Table 6.

Table 6: Laboratory Testing Summary

Sample	Depth (m)	Description	Hydraulic conductivity, k (m/s)						
			Hazen[1]	Bilas[2]	Seelheim[3]	Shepherd[4]	Alyamani & Sen[5]	Beyer[6]	Mean Value
F1-002	10.1-10.2	SAND with some gravel and minor clay/sit	$1.45x10^{-3}$	$1.57x10^{-3}$	$1.95x10^{-3}$	$1.06x10^{-3}$	$3.07x10^{-4}$	$7.5x10^{-4}$	$6.9x10^{-4}$
F2-001	11.5-11.8	SILT with some clay	-	$3.73x10^{-9}$	$4.32x10^{-7}$	$1.02x10^{-6}$	$9.83x10^{-8}$	-	$1.13x10^{-7}$
F2-004	7.3-7.5	Clayey/Silty SAND	-	-	$2.01x10^{-5}$	$2.42x10^{-5}$	$4.57x10^{-6}$	-	$1.3x10^{-5}$
F3-001	1.3-1.4	Gravelly SAND with minor clay/silt	$1.42x10^{-3}$	$2.43x10^{-4}$	$2.01x10^{-3}$	$1.08x10^{-3}$	$3.2x10^{-4}$	$1.1x10^{-3}$	$8.0x10^{-4}$
F3-002	12.45-12.65	SAND with some gravel and minor clay/silt	$1.97x10^{-3}$	$1.93x10^{-4}$	$1.08x10^{-3}$	$6.47x10^{-4}$	$1.17x10^{-4}$	$1.02x10^{-3}$	$5.6x10^{-4}$
F3-004	5.8-6.0	Sandy clayey/silty GRAVEL	-	-	$4.97x10^{-3}$	$2.28x10^{-3}$	$1.13x10^{-3}$	-	$2.3x10^{-3}$
F3-005	2.8-3.0	SAND with minor gravel	$2.67x10^{-3}$	$2.62x10^{-4}$	$1.04x10^{-3}$	$6.28x10^{-4}$	$7.81x10^{-5}$	$1.38x10^{-3}$	$6.05x10^{-4}$
R1-001	4.95-5.1	SILT with minor clay and sand	$2.32x10^{-5}$	$1.84x10^{-8}$	$5.14x10^{-7}$	$1.18x10^{-6}$	$8.13x10^{-8}$	$1.20x10^{-5}$	$7.94x10^{-7}$
R1-003	2.9-3.0	SILT with some sand and clay	$1.16x10^{-5}$	$1.10x10^{-8}$	$1.03x10^{-6}$	$2.09x10^{-6}$	$2.08x10^{-7}$	$6.0x10^{-6}$	$7.65x10^{-7}$
R3-001	7.4-7.5	SAND with some gravel and minor clay/silt	$5.8x10^{-4}$	$4.66x10^{-5}$	$1.16x10^{-3}$	$6.87x10^{-4}$	$2.2x10^{-4}$	$3.0x10^{-4}$	$3.35x10^{-4}$

NOTE:

1. Hazen, A. (1893): Some physical properties of sand and gravels with special reference to their use in filtration.- Ann. Rep. Mass. State Bd. Health, 24, 541-556, Boston.
2. Bilas, Z. & Kleczkowski, A.S. (1970): Über den praktischen Gebrauch von einigen empirischen Formeln zur Bestimmung des Durchlässigkeitskoeffizienten k.- Archiwum Hydrotechniki, 405-417, Warschau. [Polnish], English Summary p. 417.
3. Seelheim, F. (1880): Methode zur Bestimmung der Durchlässigkeit des Bodens.- Zt. anal. Chemie, 19, 387-418. [German]
4. Shepherd, R.G. (1989): Correlations of permeability and grain size.- Ground Water, 27, 633-638.
5. Alyamani & Sen (1993)
6. Beyer, W. (1964): Zur Bestimmung der Wasserdurchlässigkeit von Kiesen und Sanden aus der Kornverteilung.- Wasserwirtschaft – Wassertechnik (WWT), 165-169. [German]

Materials found beneath the stopbanks were classified by soil type. Representative effective stress and total stress parameters were developed for each of the identified geological units based on the results of the investigation, previous experience with similar materials and a review of previous investigations and material properties used in analysis.

Hydraulic conductivity values were obtained by reviewing the laboratory results and calculations and comparing them to typical accepted values.

Design parameters assumed in our geological models are presented in Table 7 below.

Table 7: Geotechnical Design Parameters for Stability and Seepage Assessment[7]

Soil Type	Consistency	Unit weight γ (kN/m^3)	Cohesion c (kPa)	Friction angle, ϕ (deg)	Undrained shear strength, s_u (kPa)	Hydraulic conductivity k (m/s)
Silt	VS/S	16	0	24	10 to 25	1×10^{-7}
	F/St	17	2	26	50 to 75	
	VSt/H	18	5	28	150	
Silty Sand	VL/L	16	0	28	-	
	MD	17	0	32	-	2.5×10^{-6}
	D/VD	18	0	36	-	0.5×10^{-6}
Fine Sand	VL/L	16	0	28	-	
	MD	17	0	32	-	5×10^{-5}
	D/VD	18	0	36	-	1×10^{-5}
Medium to coarse Sand	VL/L	16	0	28	-	5×10^{-4}
	MD	17	0	32	-	
	D/VD	18	0	36	-	1×10^{-4}
Gravelly Sand	VL/L	16	0	28	-	
	MD	17	0	32	-	2.5×10^{-4}
	D/VD	18	0	36	-	0.5×10^{-4}
Gravel	VL/L	16	0	28	-	
	MD	17	0	32	-	5×10^{-3}
	D/VD	18	0	36	-	1×10^{-3}
Clayey Silt	VS/S	16	0	26	10 to 25	1×10^{-8}
	F/St	17	2	27	50 to 75	
	VSt/H	18	5	30	150	
Peat	S	14	2	18	10	5×10^{-8}
Stopbank Fill		18	0	30	75	2×10^{-6}

NOTE:
- Assumed k_h/k_v for clay/silt = 2
- Assumed k_h/k_v for sand/gravel = 1
- k for VL/L and MD materials in sands/gravels is 5 times that of D/VD

6.3 Overtopping

Overtopping may occur when the stopbank height is lower than the peak design flood level. Stopbank heights within the river stopbank areas, R1 to R3 were sufficiently high enough to contain the design flood event. Within the floodway stopbank areas, F1 to F3, overtopping occurs in several places and design and peak flood RL levels are summarised in Table 8 below.

[7] Terzaghi, K and Peck, R.B. (1964) *Soil Mechanics in Engineering Practice*

Table 8: Overtopping and Stopbank Design Summary				
Stopbank Cross Section	**Existing crest level RL (m)**	**Peak flood level RL (m)**	**Additional overlay required (mm)**	**New crest level used in analysis RL (m)**
F1A	3.83	3.93	100	4.1
F1B	3.78	3.85	70	4.1
F1C	3.76	3.79	30	4.1
F1D	3.49	3.73	240	4.1
F1E	3.41	3.66	250	4.1
F2A	4.33	4.24	-	4.4
F2B	4.29	4.33	40	4.4
F2C	4.02	4.38	360	4.4
F2D	4.43	4.38	-	-
F3A	3.97	4.32	350	4.5
F3B	3.89	4.37	480	4.5
F3C	4.23	4.41	180	4.5
F3D	-	4.41	-	-

From the table above it can be seen that the additional overlay required along the stopbank varies for each cross section. For simplicity in modelling, the minimum RL required for the maximum peak flood level was assumed along the entire length of each stopbank area, which also provides for some freeboard to the peak flood event.

The analyses were undertaken on the assumption that stiff to very stiff silts would be used as the overlay fill material with slope gradients maintained at 1:3 (V:H) for consistency and in order to match the original fill batter gradients.

6.4 Seepage Analysis

6.4.1 General

Seepage analyses were undertaken in order to identify potential failure mechanisms and, where required, remedial options. It was completed using the numerical analysis software SLIDE Version 6.0 under transient and steady-state groundwater conditions. The SLIDE program is two-dimensional only so cannot accurately show three-dimensional effects.

6.4.2 Methodology

During seepage analysis, transient groundwater conditions were obtained from the flood hydrographs provided by BOPRC for each area of the stopbanks (Appendix D). Representative peak values were chosen for each stopbank cross section in order to model the 14 day flood event within SLIDE. Steady state conditions were entered based on observed groundwater levels and river levels during the field investigations.

It should be noted that seepage results should be considered representative only as the variable nature of material properties often results in hydraulic conductivity differences of several orders of magnitude.

Due to the alluvial deposition and significant horizontal stratification of the soil layers, internal erosion is most likely to occur within the foundation soils. Continuity of the layers and particle size distribution

determines whether piping can occur, which will affect the stopbanks stability. Piping is most likely to occur in soils with high fines content, typically silts and sandy silts or fine sands. In order for a pipe to form the following four conditions must exist[8]:

- There must be a seepage flow path and source of water;
- Erodible material must be within the seepage path and able to be carried by the flow of water;
- There must be an open and unfiltered exit from which the material may escape;
- The material being piped, or above the pipe, must have some cohesion in order support an open channel.

Internal erosion not only increases the risk of settlement of the stopbank and stopbank failure, but also introduces the risk of heave or uplift as higher pore pressures develop within the subsoils.

6.4.3 Analyses Results

General

Seepage analysis results indicate that the flood event duration is not long enough to generate significant pore pressures or steady state groundwater conditions within the embankment, however seepage through the foundation is indicative of potential piping and heave issues.

A summary of seepage issues, where applicable, is presented in Table 9. Outputs where hydraulic gradients do not progress significantly beneath the stopbank and dissipate by the end of the flood event are not presented. The minimum factor of safety required against heave is at least 3.0 but preferably 5.0[9]. For heave to occur the gradient of the flownet must approach unity, therefore this corresponds to a maximum hydraulic gradient of 0.3 within the soil layers. This hydraulic gradient of 0.3 was also used as the critical hydraulic gradient for piping to initiate and progress as heave is directly linked to piping.

Other methods of determining the likelihood of piping developing are probability based only, and have been used as an additional analyses method. Results for each stopbank are discussed below and take into consideration the hydraulic gradients of the soils, along with the susceptibility to piping of the soil materials present.

Table 9: Seepage Analyses Results Summary

Stopbank Cross Section	Seepage issue	Maximum Hydraulic Gradient	Factor of Safety
F3A	Piping and heave	5.10	0.20
F3B	Piping and heave	4.80	0.21
F3D	Piping	4.40	0.23
R1A	Surface water and heave	-	-
R1B	Heave (inland)	-	-
R1C	Heave (inland)	-	-
R2B	Piping	1.33	0.75
R2C	Piping	6.00	0.17
R2D	Piping	3.20	0.31
R2E	Piping	5.50	0.18
R3B	Piping	16.15	0.06

[8] Fell, R.; McGregor, P.; Stapledon, D.; Bell, G. (2015) *Geotechnical Engineering of Dams.* CRC Press.
[9] Fell, R.; McGregor, P.; Stapledon, D.; Bell, G. (2015) *Geotechnical Engineering of Dams.* CRC Press.

F1 Stopbank

Beneath the F1 stopbank fill embankments, transient groundwater analyses show high hydraulic gradients within the organic silt lens, however the high hydraulic gradients were predominantly found at the upstream toe of the stopbank and dissipated rapidly. As the high hydraulic gradients did not progress and the flood event duration is sufficiently short, no significant pore pressures developed. The type of material (organic silt) is not considered to be at risk of piping, and seepage was therefore not considered to be an issue within the F1 region.

F2 Stopbank

The foundation soils beneath the F2 stopbank are not considered to be at risk of piping. Within the first few metres below ground level, organic silts, peat and very stiff to hard silts are present. None of these soils are considered to be susceptible to piping and hydraulic gradients within the soils are low due to their low permeability. The organic silt and peat layers do however pose a risk of minor settlement to the stopbank due to their compressible nature.

F3 Stopbank

Underlying the stopbank fill and buried topsoil along the F3 stopbank is a thin layer of fine to medium grained sands, with stiff silts or coarse gravels below. This material is susceptible to piping and erosion as seepage occurs. SLIDE outputs (Appendix E) show that high hydraulic gradients occur within this sand layer and the water table rises to the surface on the landward side of the stopbank resulting in heave and surface water ponding. Hydraulic exit gradients of up to 5.1 were observed. It should be noted that the stability of the stopbank is directly affected by this potential seepage and uncontrolled discharge. Therefore, by controlling the seepage and its discharge, the stability will be greatly improved.

R1 Stopbank

Seepage analysis showed that the soils within the stopbank fill within R1 are predominantly stiff silts and clayey silts, which have low hydraulic conductivities. The foundation soils directly beneath the ground surface and stopbank consist of soft to stiff silts and clayey silts, underlain by peat and very stiff to hard silts to depths of up to 7.0m below ground level. These soils have low permeability's and are not considered to be at risk of piping. SLIDE outputs did not show any significant hydraulic gradients developing within the layers, and therefore the risk of piping is considered to be low.

At cross section R1A, the ground level falls into the neighbouring paddock where it could be seen that during the flood event, the groundwater level reached the ground surface at approximately 120m from the stopbank. There is an open drain located approximately 180m from the stopbank which is assumed to carry any run-off and seepage flows that occur during the flood event. There is also the potential for heave to develop inland on cross sections R1B and R1C. The water table begins to reach the surface approximately 130m from the stopbanks with positive pore pressures occurring near the ground surface.

R2 Stopbank

Seepage outputs within R2 showed that there is a risk of piping due to the sand layers found directly underneath the stopbank (as shown in Appendix E). High hydraulic gradients are observed in the sand layers although none progress far enough beneath the stopbank to reach a free exit point. Piping is therefore initiated during the flood event and it has the potential to progress over time. Cross section R2E in particular is of concern as there is a thin layer of fine to medium sand bound by stiff silts which is particularly susceptible to seepage and piping.

R3 Stopbank

Seepage beneath the stopbanks in R3 was found to be critical at cross section R3B. This was due to a thin layer of fine to medium sand being present directly beneath the stopbank fill, which is bound

by stiff silts above and below. High hydraulic gradients (up to 16.15) can be found within this high permeability layer and progress underneath the stopbank during the 14 day flood event. Overlays have previously been placed along the R3 stopbank to control heave, but a solution to the piping erosion issue has not been implemented to CMWs knowledge.

Seepage was not considered to be critical at the other cross section locations within R3, however this was based on the ground models developed which showed sands and gravelly sands at the surface.

6.4.4 Sensitivity Analysis

A sensitivity analysis was undertaken on the stopbank materials in order to determine the critical hydraulic conductivity that resulted in seepage through the stopbank. The sensitivity analysis was undertaken on certain cross sections only that involved either high water levels or narrow stopbanks. The results are summarised in Table 10 below.

Table 10: Sensitivity Analysis on Stopbank Materials

Stopbank cross section	Stopbank Material	Assumed hydraulic conductivity (m/s)	Hydraulic conductivity resulting in seepage (m/s)
R2A	Silty SAND	2×10^{-6}	1×10^{-3}
R2B	SANDS/SILTS	2×10^{-6}	1×10^{-4}
F2A	SILTS/SANDS	2×10^{-6}	1×10^{-4}
F2B	SILTS	2×10^{-6}	5×10^{-4}
F3C	Sandy SILTS	5×10^{-6}	$> 1 \times 10^{-3}$

A conductivity of 5×10^{-4} relates to very loose to medium dense medium to coarse sand (based on the assumed geotechnical parameters) and a conductivity of 5×10^{-3} relates to very loose to medium dense gravel. Throughout the analysis a homogenous stopbank material has been assumed based on what soils were predominantly encountered in order to simplify the model. In reality it was made up of numerous layers of sands, silts and clayey silts, so there could possibly be materials with higher conductivities which would create a flow path for the water through the stopbank.

From the sensitivity analysis it can be determined that the stopbank materials would need to be made up of medium to coarse sands or gravels in order for seepage through the stopbank to be an issue. Although these materials are found at numerous stopbank locations, they are all interbedded with silts, sandy silts or clayey silts. The overall risk of seepage becoming an issue during the design flood events through the stopbanks is therefore considered to be low.

6.5 Stability Analyses

Slope stability analyses were undertaken in conjunction with the seepage analyses using the GLE Morgenstern-Price method of slices in SLIDE version 6.0. Sections through the stopbanks at each site were analysed under a range of conditions as presented in Table 11. Selected stability printouts are attached alongside seepage outputs in Appendix E.

Table 11: Slope Stability Analysis Cases	
Slope Stability Case	**Required FoS[10]**
Prevailing Case (Low water level)	1.5
Elevated pore water pressure (r_u) conditions (peak flood and groundwater levels)	1.2
Rapid drawdown	1.2

Where the design flood event exceeded the stopbank level, a soil overlay was placed to the required height for modelling purposes. Table 12 below shows a summary of stopbank stability results for each cross section. The lowest factor of safety encountered during the steady-state and transient analysis is presented for both stopbank faces. It should be noted that shallow failures across the stopbank face have been ignored for analysis purposes and only global failure surfaces affecting the stability of the entire stopbanks have been presented. All of the stopbank areas have the river or floodway canal located on the left bank, except for stopbank F3 which has the floodway canal on the right bank.

Table 12: Stopbank Stability Results				
Stopbank Cross Section	**Slope Stability (lowest FoS)**			
	Left side	**Critical Failure Mechanism**	**Right side**	**Critical Failure Mechanism**
F1A	1.58	Rapid drawdown	2.09	All conditions
F1B	1.72	Rapid drawdown	2.11	All conditions
F1C	1.74	Rapid drawdown	2.68	All conditions
F1D	1.59	Rapid drawdown	2.48	All conditions
F1E	1.26	Rapid drawdown	1.96	All conditions
F2A	1.91	Rapid drawdown	1.97	All conditions
F2B	2.20	Rapid drawdown	2.41	All conditions
F2C	2.39	Rapid drawdown	2.63	All conditions
F2D	1.97	Rapid drawdown	-	N/A
F3A	1.61	Elevated water level	1.47	Low water level
F3B	1.15	Elevated water level and rapid drawdown	1.77	Rapid drawdown
F3C	2.83	All conditions	2.15	Low water level
F3D	-	N/A	2.74	All conditions
R1A	3.45	Low water level	2.27	All conditions
R1B	2.02	Low water level	2.07	All conditions
R1C	2.25	Low water level	2.53	All conditions
R2A	1.98	Low water level	1.63	All conditions
R2B	1.85	Low water level	1.93	All conditions
R2C	2.11	Low water level	1.80	All conditions
R2D	2.12	Low water level	1.65	All conditions
R2E	1.61	Low water level	1.56	All conditions
R3A	1.57	Low water level	1.28	All conditions

[10] New Zealand Dam Safety Guidelines, 2015 – NZSOLD

R3B	1.33	Low water level and rapid drawdown	1.22	All conditions
R3C	1.26	Low water level and rapid drawdown	1.39	All conditions
R3D	1.30	Low water level	1.28	All conditions

F1 Stopbank

Slope stability within the F1 stopbank showed that at all the cross sections sufficient factors of safety were obtained for both stopbank faces. The lowest factor of safety (FoS = 1.26) occurred on day 10 of the flood event on the left stopbank face during rapid drawdown at stopbank cross section F1E. As the lowest factor of safety for the rapid drawdown scenario is 1.2, the observed 1.26 factor is sufficient. Shallow surface slips were observed along the left stopbank face near Reid's Canal, however these did not affect the stopbanks stability. Over a significant amount of time however, these shallow slips may progress to a point where the stopbank is eroded and stability could become an issue.

F2 Stopbank

Sufficient factors of safety for stability were achieved at all cross sections along the F2 stopbank for the three scenarios shown in Table 11. The factors of safety across the stopbanks for slope stability were all greater than 1.9, well above the required factors of safety.

F3 Stopbank

Slope stability was an issue at cross sections F3A and F3B. At cross section F3A, a factor of safety of 1.47 was achieved on the canal side of the bank (right side) during the first three days of the flood event when low river levels were present. A minimum factor of safety of 1.5 is required for the low river level scenario, and therefore this case is only just unacceptable.

For cross section F3B on the landward side, a factor of safety of 1.15 is achieved through the stopbank crest with numerous shallower failures occurring near the toe of the slope on days 8 and 9 of the flood event. Some of these shallow failures impede into the embankment fill and will cause stability issues. The requisite factor of safety for peak flood levels and rapid drawdown is 1.2, and therefore cross section F3B does not meet these requirements.

R1 Stopbank

Minimum factors of safety for slope stability on both faces of the stopbank along R1 were above 2.0, significantly higher than the requisite factors of safety presented in Table 11. Shallow failures were observed on the berm located on the river side of cross section R1A, however they were do not affect the overall stability of the stopbank and are therefore not presented.

R2 Stopbank

Sufficient factors of safety for stability were achieved at all cross sections along the R2 stopbank for the three scenarios shown in Table 11. The lowest factor of safety across length of the stopbank was 1.56 which occurred during drawdown, therefore significantly greater than the required factor of safety.

R3 Stopbank

Shallow surface failures are observed in cross sections R3B, R3C and R3D on the river face of the stopbank with a minimum factor of safety of 1.26 observed. As these surface failures are present in the initial stages of the flood event where there are low river levels, they do not meet the requisite 1.5 factor of safety. As all of the slip circles are shallow, they do not affect the overall stability of the stopbank. However, over time these slips could erode the stopbank face which could later result in stability issues.

The landward side of the stopbank also showed shallow failures above the stopbank overlay, with the lowest factor of safety of 1.22 shown on cross section R3B. These failures were very shallow along the surface and are not considered to be significant to the overall stability of the stopbank.

7 REMEDIAL OPTIONS

7.1 General

A number of different remedial options were considered for the stopbanks with the most applicable and viable options summarised below. Please note that further engineering design is required for the suggested options.

7.2 Soil Overlay

A number of the stopbanks will be overtopped during the design flood event (refer Table 8), which has a very high potential to cause accelerated erosion and ultimate collapse of the stopbanks.

Soil overlays will therefore be required in those areas and must incorporate adequate freeboard, which have been applied in the above analyses.

Soil overlays must be keyed into the existing stopbanks by stripping all vegetation and topsoil, benching and proof compacting the exposed surface prior to placing the overlay fill. As previously stated, stiff to very stiff silts were assumed to be used as the overlay fill material with 1:3 (V:H) gradients, however this would need to be considered by Council and the consultant during the design of the overlays. If BOPRC adopt a soil overlay, it will be up to the Council or the design consultant to determine freeboard allowances.

7.3 Fill Buttress

An option to improve the stopbank stability is to increase the cross sectional area of the embankment. By applying a buttress to the landward side of the stopbank, a flatter slope gradient is achieved which improves the overall stability of the structure. Applying a buttress also results in longer flow path distances being generated which helps to prevent seepage. The additional pressure that will be applied to the soil due to the increased weight of the slope once fill is placed will also help to control issues relating to heave or uplift.

This option requires additional land on the landward side in order to extend the cross sectional area, which is up to the BOPRC to consider if applying this option.

This option would be considered applicable to the F3 stopbank on the downstream face of the stopbank. In particular, cross section F3B showed significant instability issues associated with heave and uplift resulting from high flow rates through the soils. A fill buttress was applied to F3B, with a crest width of 2.5m and gradient of 1:3 (V:H), and stability analysis was undertaken using SLIDE. The minimum factor of safety achieved was 1.21 during day 9 (rapid drawdown), therefore meeting the requisite factor of safety outlined in Table 10. It should be noted that this fill buttress will not address piping and seepage issues occurring in the foundation soils in F3B, as the groundwater still reaches the surface at the downstream buttress toe.

7.4 Seepage Cut-off

In order to prevent seepage through or under the stopbank, a potential option is to excavate and replace the core of the embankment with a low permeability soil such as a clay. When the core is excavated and replaced, the soils must be properly placed and compacted with the low permeability soil. Safe self-supporting cut or fill batters should be formed to no steeper than 1(V):2.5(H) unless

supported to full height by engineer designed retaining walls. All formed batters should be topsoiled and grassed immediately following construction to reduce the effects of surficial scour.

The source and/or type of material used for Engineer Certified Fill will dictate the type of quality control testing undertaken. The source of any imported fill should be discussed with and approved by the project geotechnical engineer to verify its appropriateness and quality control testing requirements.

Any spoil associated with earthworks should be removed from site. Under no circumstances should it be tipped directly over or beyond any crest of slopes due to slope stability considerations.

The cut-off needs to extend below the seepage flow path and end within a lower permeability layer. The cut-off key is required to have a minimum width of 5m.[11] The areas of stopbank where this option is applicable and typical depths required are detailed below in Table 13.

The cut-off also prevents the progression of piping as there is no longer a free exit available or a continuous flow path. By preventing seepage flows and the initiation and progression of piping, heave is also no longer an issue.

Table 13: Seepage Cut-off Locations and Details

Stopbank	Maximum depth required (m)	Comments
F3	>4.0	Must extend beyond the layer of fine sands found beneath the stopbank. Ranges in depth (from stopbank crest) from 2.8m to 4.0m.
R2	>5.0	Further deep investigations required in order to confirm soil stratigraphy beneath stopbank. Results indicative only. Ranges in depth from 2.6m to possibly greater than 5.0m.
R3	>3.0	Further deep investigation required across crest of stopbank in order to confirm soil stratigraphy beneath stopbank.

As the cut-off key is required to be at least 5m wide, and the core must be excavated in a series of benches, it will most likely require the total removal and reconstruction of the stopbank in the three locations mentioned above. This will need to be confirmed during design if Council decide to implement this option.

7.5 Filter trench

Another option to control piping erosion and heave is to excavate a downstream toe partially into the base of the embankment on the landward side. This drainage trench would need to be designed as a filter to allow water to flow in and through but with fine sands and silts being filtered out. The trench would be excavated into and parallel to the downstream (landward) toe of the stopbank to intercept groundwater seepage and provide a controlled outlet thereby mitigating the piping erosion issue.

Heave occurs when a thin impervious material overlays a high permeability layer resulting in uplift of the surface soils. The drainage trench would need to penetrate through the impervious surface material in order to provide a place for the water to drain to. The water collection and discharge method would need to be further analysed during the design stages in order to determine the most appropriate method.

[11] Fell, R.; McGregor, P.; Stapledon, D.; Bell, G. (2015) *Geotechnical Engineering of Dams.* CRC Press.

Appropriate filter material would need to consist of well graded granular soils with no less than 5% fines[12]. The basic concept of filter design is to ensure the particle size distribution of the filter obtains voids sufficiently small enough so as to prevent erosion of the base soil. Filter design will also need to be considered if Council choose to progress with this option.

It is important to note that a filter trench does not prevent seepage but rather intercepts the seepage flow in order to provide a controlled outlet. This thereby prevents the discharge of soil and the potential for piping erosion.

7.6 Wick Drains

Another option for piping erosion control is to install wick drains at the landward toe of the stopbank in order to drain water away from the toe. This will effectively filter the material as well as prevent issues associated with piping and heave. Wick drains have previously been suggested and designed by Ice Geo & Civil for different sections of the stopbank along the Rangitaiki River.

Wick drains are mainly used in soft, compressible soils in order to shorten the drainage path for water and provide a free draining flow path. They are typically used in order to accelerate consolidation of soft layers in soils and are installed in series.

Wick drains are considered a higher risk solution as they get blockages and may be difficult to design in order to achieve the correct flow. Further design would be required to determine whether this would be a viable option for Council.

It is important to note that wick drains, like the filter trench discussed above, do not prevent seepage but rather intercept the seepage flow in order to provide a controlled outlet. This thereby prevents the discharge of soil and the potential for piping erosion.

8 CONCLUSIONS

Presented in Table 14 below is a summary of the issues identified within each stopbank cross section along with remedial options required.

Table 14: Summary of stopbank issues and remedial options

Stopbank Cross Section	Failure Mechanism	Remedial Option
F1A	Overtopping	Soil overlay
F1B	Overtopping	Soil overlay
F1C	Overtopping	Soil overlay
F1D	Overtopping	Soil overlay
F1E	Overtopping	Soil overlay
F2A	N/A	
F2B	Overtopping	Soil overlay
F2C	Overtopping	Soil overlay
F2D	N/A	N/A
F3A	Overtopping, piping, heave, slope stability (RS)	Soil overlay, buttress, and cut-off, filter trench or wick drains
F3B	Overtopping, piping, heave. Slope stability (LS)	Soil overlay, buttress, and cut-off, filter trench or wick drains
F3C	Overtopping	Soil overlay

[12] Fell, R.; McGregor, P.; Stapledon, D.; Bell, G. (2015) *Geotechnical Engineering of Dams.* CRC Press.

F3D	Piping	Cut-off, filter trench or wick drains
R1A	Heave	Overlay, cut-off, filter trench or wick drains
R1B	Heave	Overlay, cut-off, filter trench or wick drains
R1C	Heave	Overlay, cut-off, filter trench or wick drains
R2A	N/A	N/A
R2B	Piping	Cut-off, filter trench or wick drains
R2C	Piping	Cut-off, filter trench or wick drains
R2D	Piping	Cut-off, filter trench or wick drains
R2E	Piping	Cut-off, filter trench or wick drains
R3A	N/A	N/A
R3B	Piping, slope stability (LS)	Cut-off, filter trench or wick drains, buttress
R3C	Slope stability (LS)	Buttress
R3D	Slope stability (LS)	Buttress

9 RECOMMENDATIONS FOR FURTHER WORK

Based on the analyses completed by CMW, and a review of previous investigations, the following suggestions are made for further work:

- It is recommended that within the F3 area, one of the three options mentioned above (cut-off, filter trench or wick drains) are implemented in order to control the seepage that is occurring during the flood event. Applying a buttress to the landward side of the stopbank is also an option, however this would be a short term fix for heave and would not provide a solution to the piping and seepage that is occurring in the foundation soils.
- It is also recommended for the F3 area that the Reid's Canal channel be re-contoured as it can be seen visually on the cross sections (Figures 16 to 19) that the sides of the channel are deeply incised and shallow failures were present in the SLIDE models. As this didn't affect the overall stability of the stopbanks at this stage they have not been presented. Over time however these shallow failures will erode the stopbank and will be of greater concern.
- It is recommended that deeper subsurface investigations are completed along stopbank R2 along the stopbank crest and on the landward side in order to determine the deeper subsoil materials and whether they are continuous. This will assist in developing a more accurate ground model in order to further analysis seepage effects.
- It should be noted that CMW only conducted one machine borehole within the R3 area (with the remaining tests being 5m hand auger boreholes), and it was located at the toe of the stopbank across cross section R3B. It is therefore assumed that the critical sand layer discussed above continues underneath the stopbank. Previous site investigation logs were used when determining the ground models for the site, however only two boreholes have been completed across the crest of the stopbank and are located downstream of the R3B cross section. It is recommended that further deep subsoil investigations are completed across the crest of the stopbank in order to gain a better understanding of the materials located beneath the stopbank fill to assist in seepage analysis.
- If further analysis is completed and confirms the presence of a sand layer beneath the embankment fill along the R3 stopbank, remedial options will be necessary to control the seepage within the foundation soils. One of the three options discussed above (cut-off, filter drain or drain wicks) should be considered as a solution to the seepage and piping issues.
- In the majority of the stopbank locations, a combination of remedial design options are recommended and should be considered.

10 LIMITATIONS

This report has been prepared for use by our client Bay of Plenty Regional Council, and their consultants. Liability for its use is limited to these parties and to the scope of work for which it was prepared as it may not contain sufficient information for other parties or for other purposes.

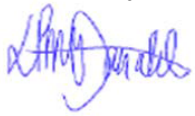
It should be noted that factual data for this report has been obtained from discrete locations using normal geotechnical investigation techniques. As such investigation methods by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist then the matter should be referred back to CMW immediately.

For and on behalf of
CMW Geosciences (NZ) Ltd

Prepared by:

Olivia Gill
Geotechnical Engineer

Reviewed by



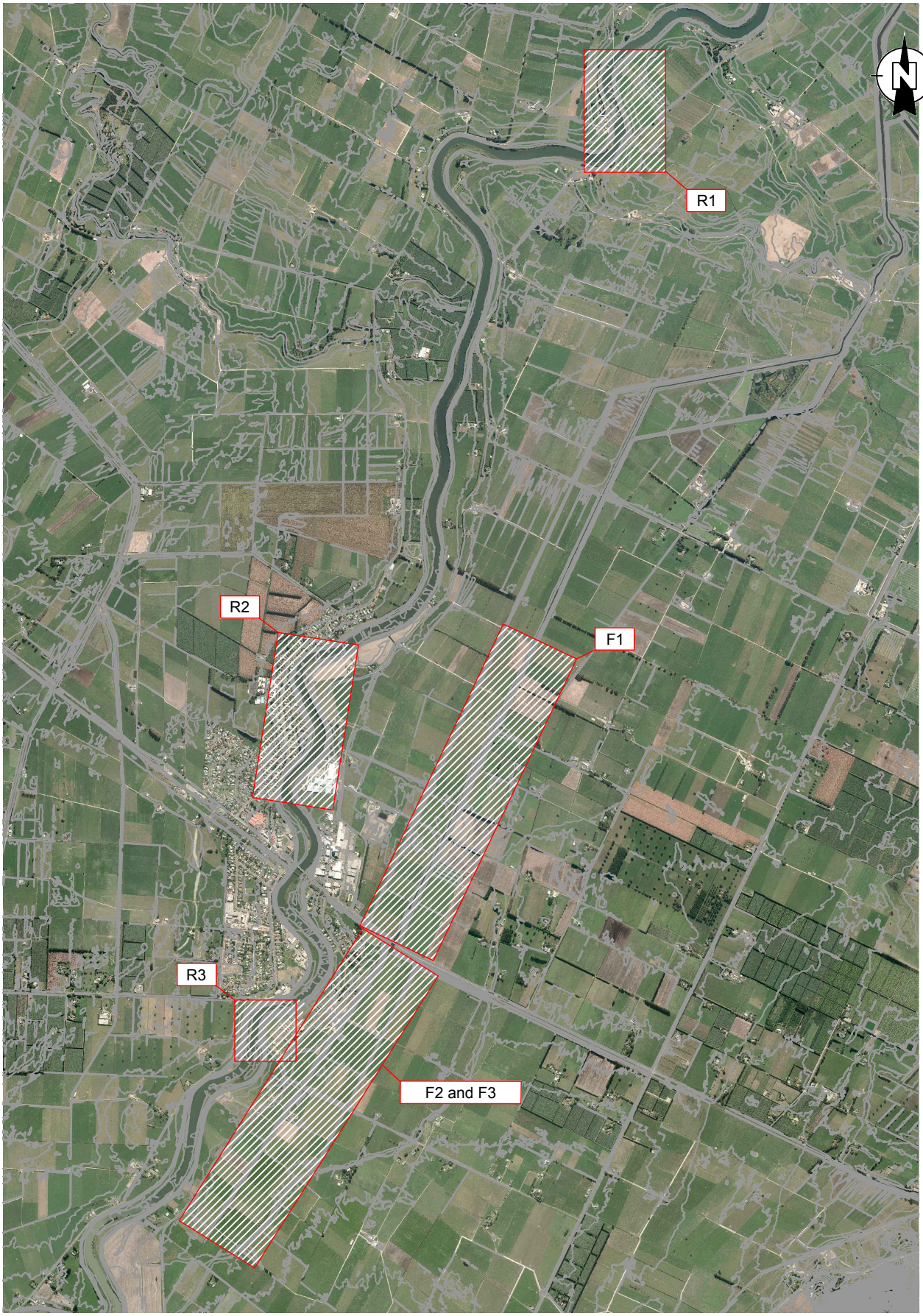
Louise McDonald
Geotechnical Engineer

Authorised by:

Dave Morton
Director/Principal Geotechnical Engineer
TCC Category 1 Geo-professional, CPEng

Distribution: 1 copy to Bay of Plenty Regional Council (electronic)
Original held by CMW Geosciences (NZ) Limited

Figures



1. NOTE: BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.

CMW Geosciences Pty Ltd, Chapman Morton Woodward	CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**	DRAWN: OMG	PROJECT: TGA2016_0216
	PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**	CHECKED: KB	FIGURE: 01
		REVISION: 0	SCALE: 1:35000
	TITLE: **GEOTECHNICAL INVESTIGATION PLAN**	DATE: 18/11/16	SHEET: A4 P

LEGEND:

- HA01 — HAND AUGER (HA) LOCATION
- MB01 — MACHINE BOREHOLE (MB) LOCATION
- CROSS SECTION TRACE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.
2. BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 02
		REVISION: 0	SCALE: 1:8000
TITLE: GEOTECHNICAL INVESTIGATION PLAN - F1		DATE: 04/10/2016	SHEET: A3 L

LEGEND:

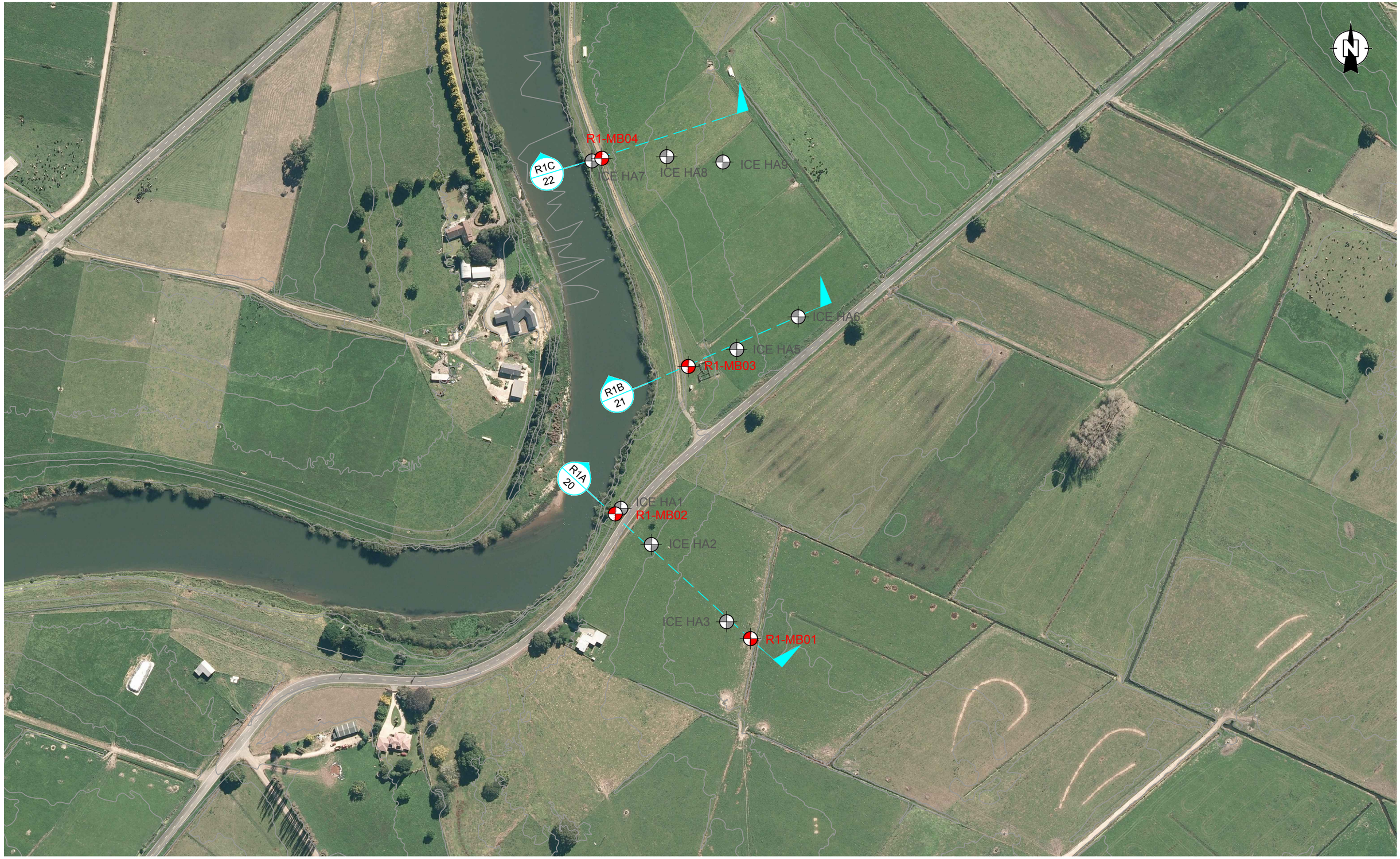
- HA01 — HAND AUGER (HA) LOCATION
- MB01 — MACHINE BOREHOLE (MB) LOCATION
- CROSS SECTION TRACE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.
2. BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY..

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 03
		REVISION: 0	SCALE: 1:7500
TITLE: GEOTECHNICAL INVESTIGATION PLAN - F2/F3		DATE: 04/10/2016	SHEET: A3 L



LEGEND:

- HA01 — HAND AUGER (HA) LOCATION
- MB01 — MACHINE BOREHOLE (MB) LOCATION
- ICE HA1 — ICE AND GEO 2014 HAND AUGER (HA) LOCATION
- CROSS SECTION TRACE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**	DRAWN: OMG	PROJECT: TGA2016_0216	
PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**	CHECKED: KB	FIGURE: 04	
	REVISION: 0	SCALE: 1:3000	
TITLE: **GEOTECHNICAL INVESTIGATION PLAN - R1**	DATE: 04/10/2016	SHEET: A3 L	

LEGEND:

- HA01 — HAND AUGER (HA) LOCATION
- OPUS BH1 — OPUS 1998 BOREHOLE (BH) LOCATION
- CROSS SECTION TRACE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.
2. BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**	DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**	CHECKED: KB	FIGURE: 05
	REVISION: 0	SCALE: 1:5000
TITLE: **GEOTECHNICAL INVESTIGATION PLAN - R2**	DATE: 04/10/2016	SHEET: A3 L

LEGEND:

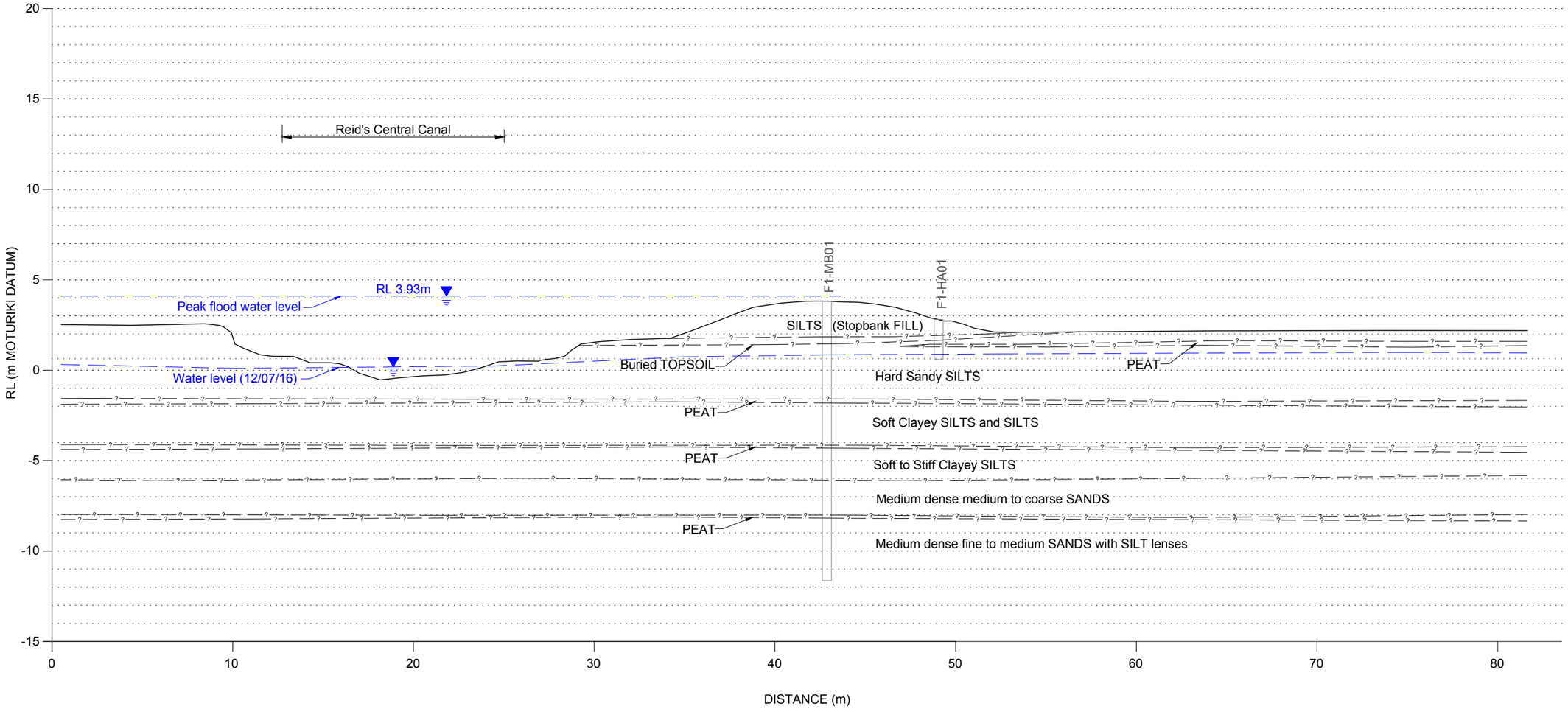
HA01	CMW HAND AUGER (HA) LOCATION
MB01	CMW MACHINE BOREHOLE (MB) LOCATION
ICE HA1	ICE AND GEO 2014 HAND AUGER (HA) LOCATION
OPUS BH6	OPUS 1998 BOREHOLE (BH) LOCATION
BECA BH1	BECA 2011 BOREHOLE (BH) LOCATION
AECOM BH1	AECOM 2009 BOREHOLE (BH) LOCATION
	CROSS SECTION TRACE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 AERIAL PHOTOGRAPHS AND DATA.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL	DRAWN: OMG	PROJECT: TGA2016_0216	
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE	CHECKED: KB	FIGURE: 06	
	REVISION: 0	SCALE: 1:3000	
TITLE: GEOTECHNICAL INVESTIGATION PLAN - R3	DATE: 04/10/2016	SHEET: A3 L	



CROSS SECTION F1A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

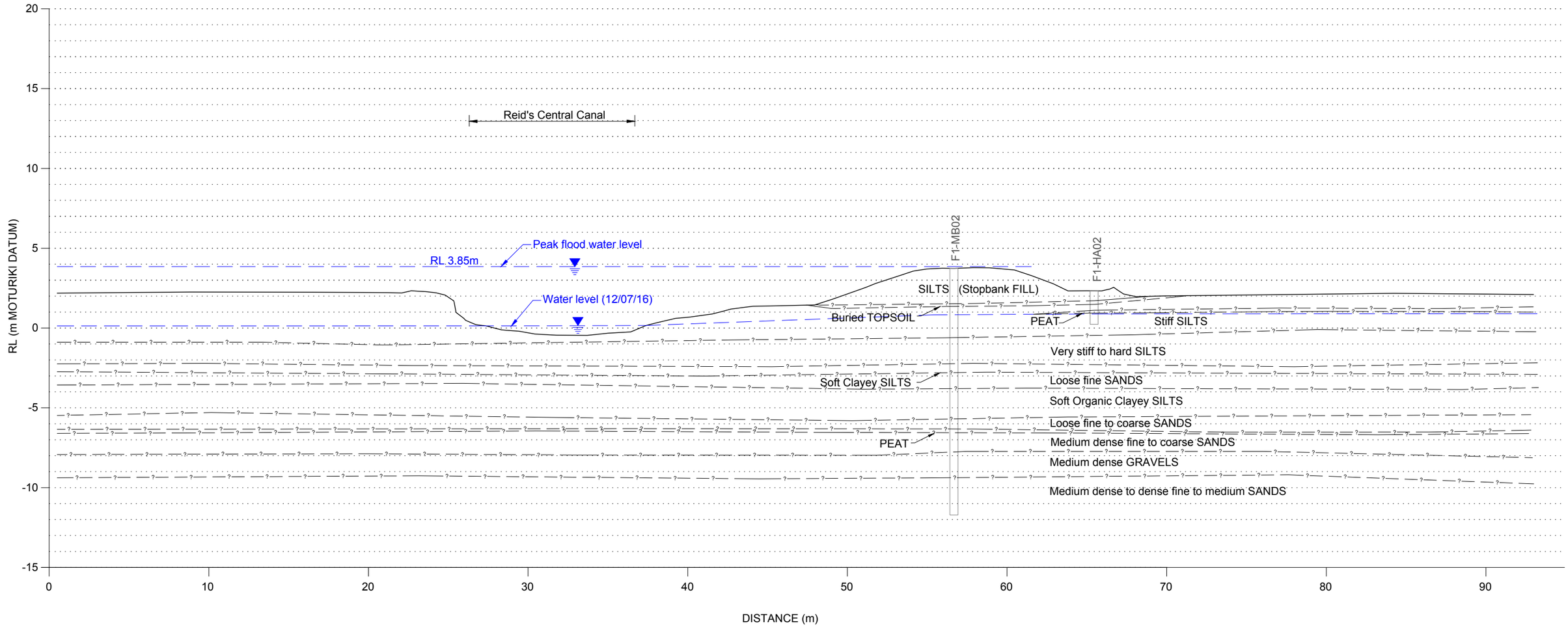
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 07
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F1A		DATE: 29/09/2016	SHEET: A3 L



CROSS SECTION F1B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

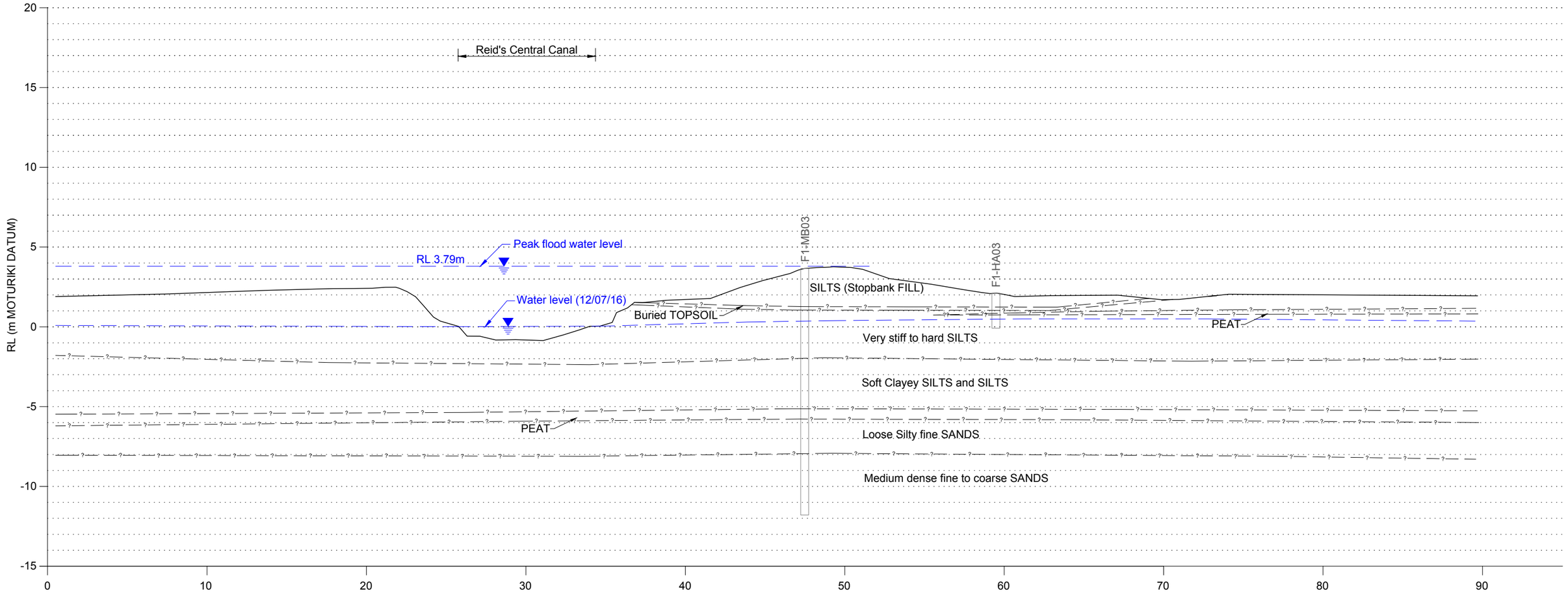
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 08
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F1B		DATE: 29/09/2016	SHEET: A3 L



CROSS SECTION F1C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

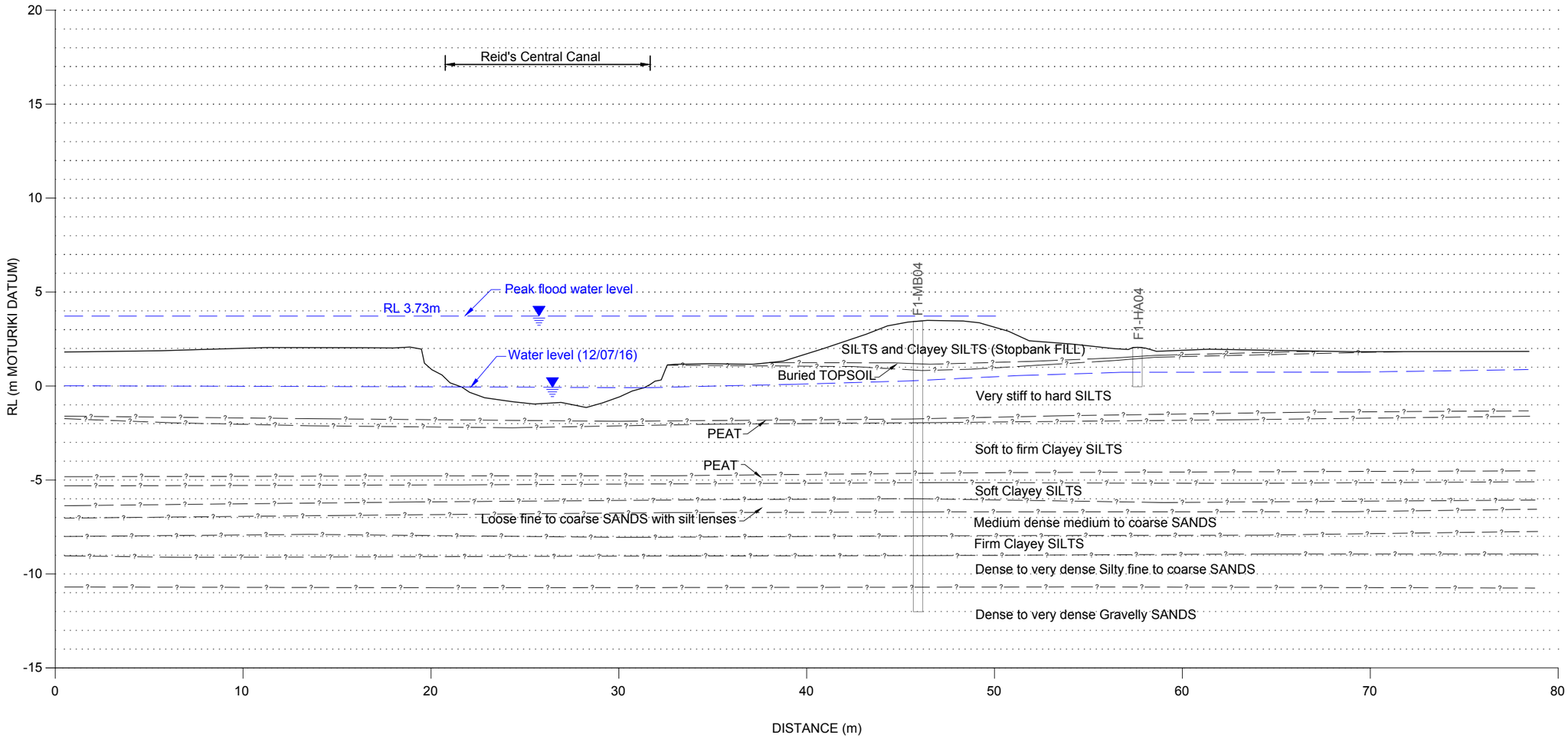
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 09
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F1C		DATE: 29/09/2016	SHEET: A3 L



CROSS SECTION F1D

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

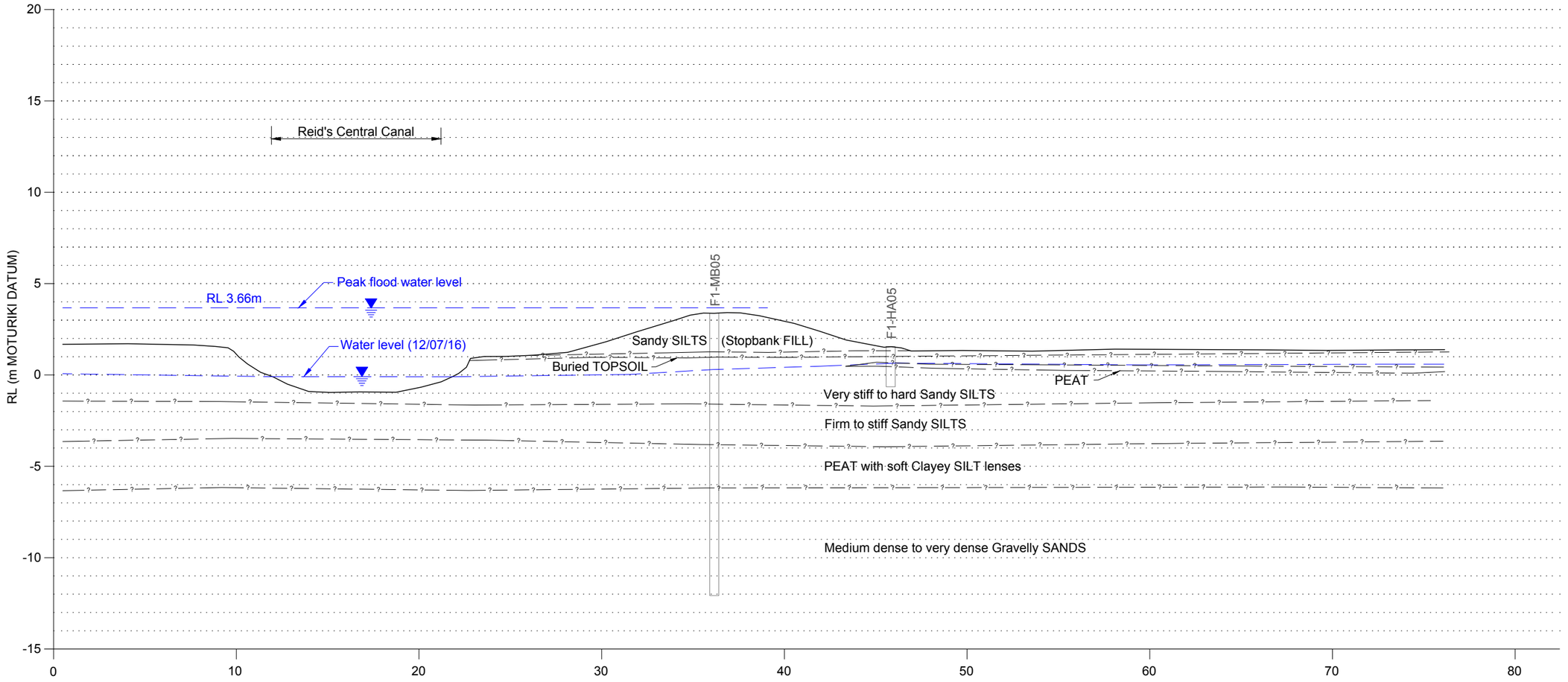
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 10
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F1D		DATE: 29/09/2016	SHEET: A3 L



CROSS SECTION F1E

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

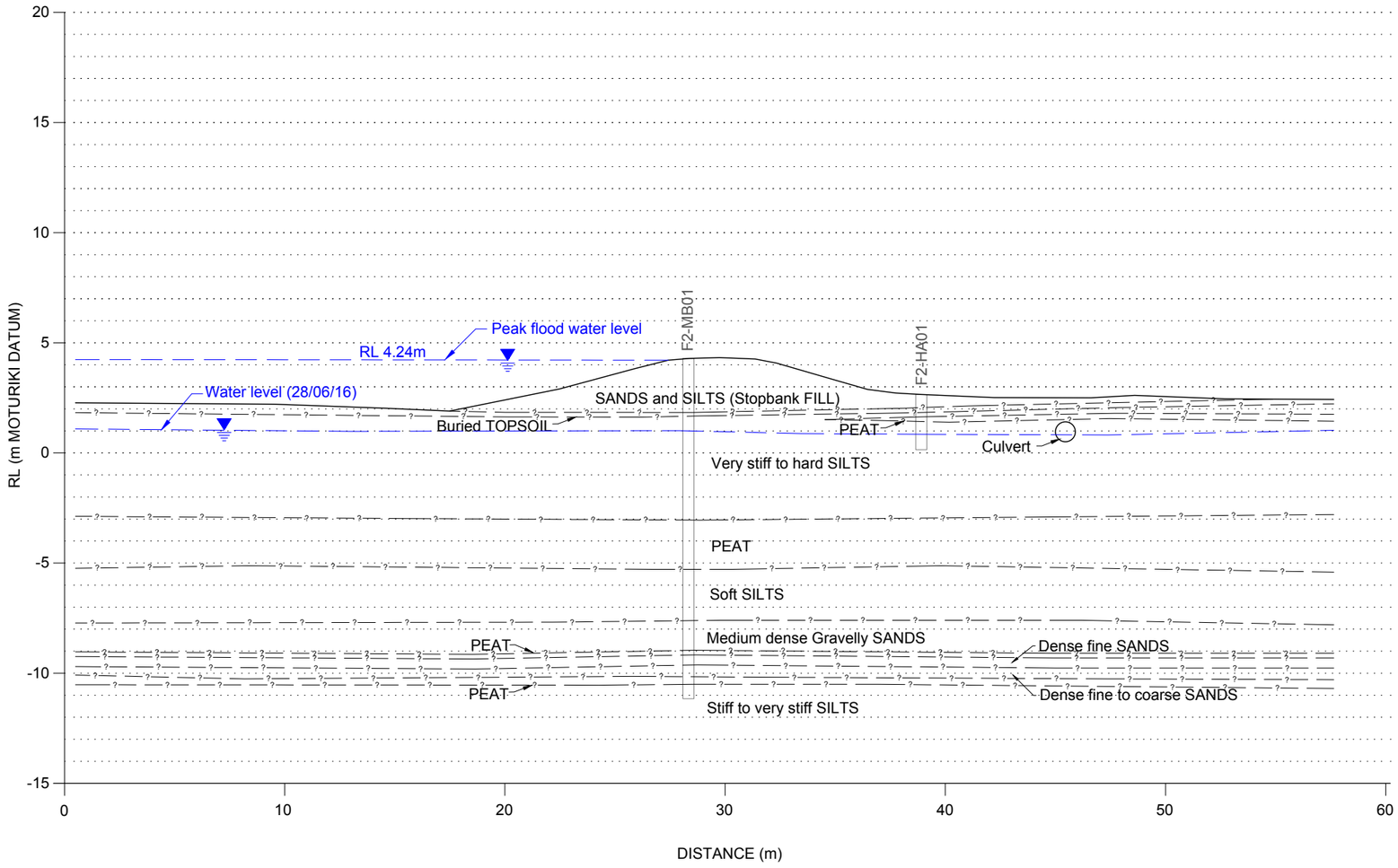
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 11
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F1E		DATE: 29/09/2016	SHEET: A3 L



CROSS SECTION F2A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

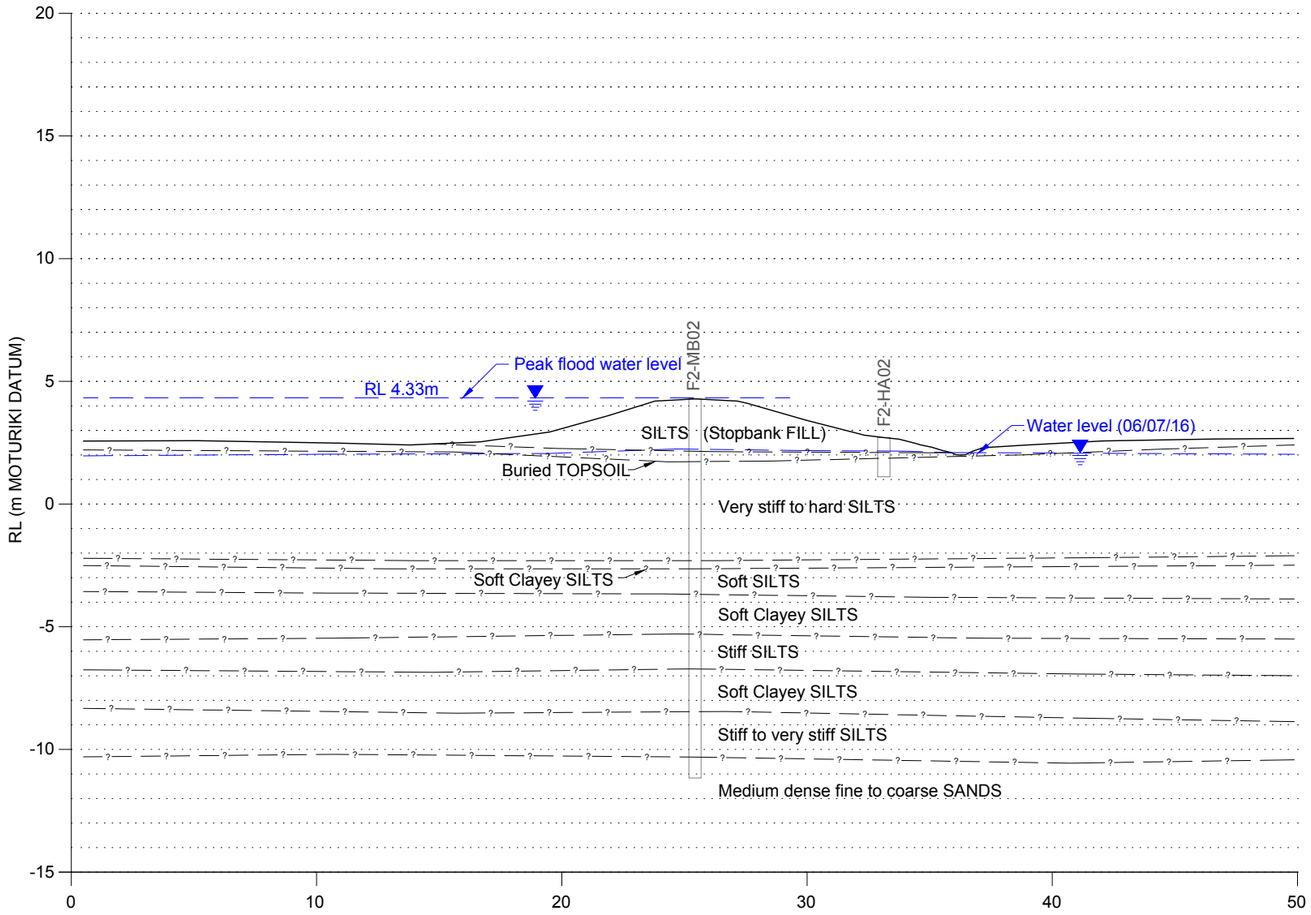
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 12
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F2A		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F2B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

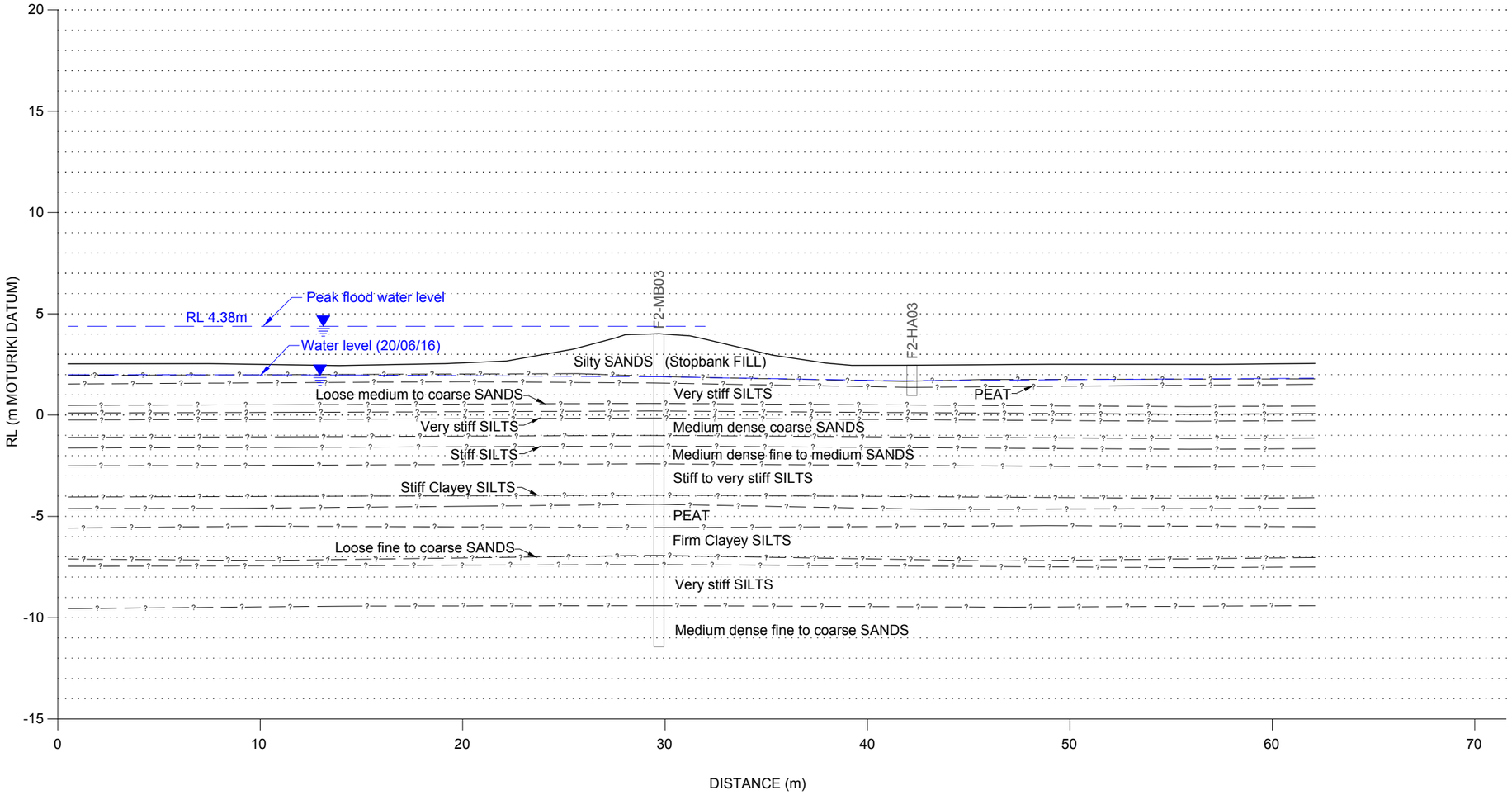
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION PROVIDED JULY 2016.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 13
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F2B		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F2C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

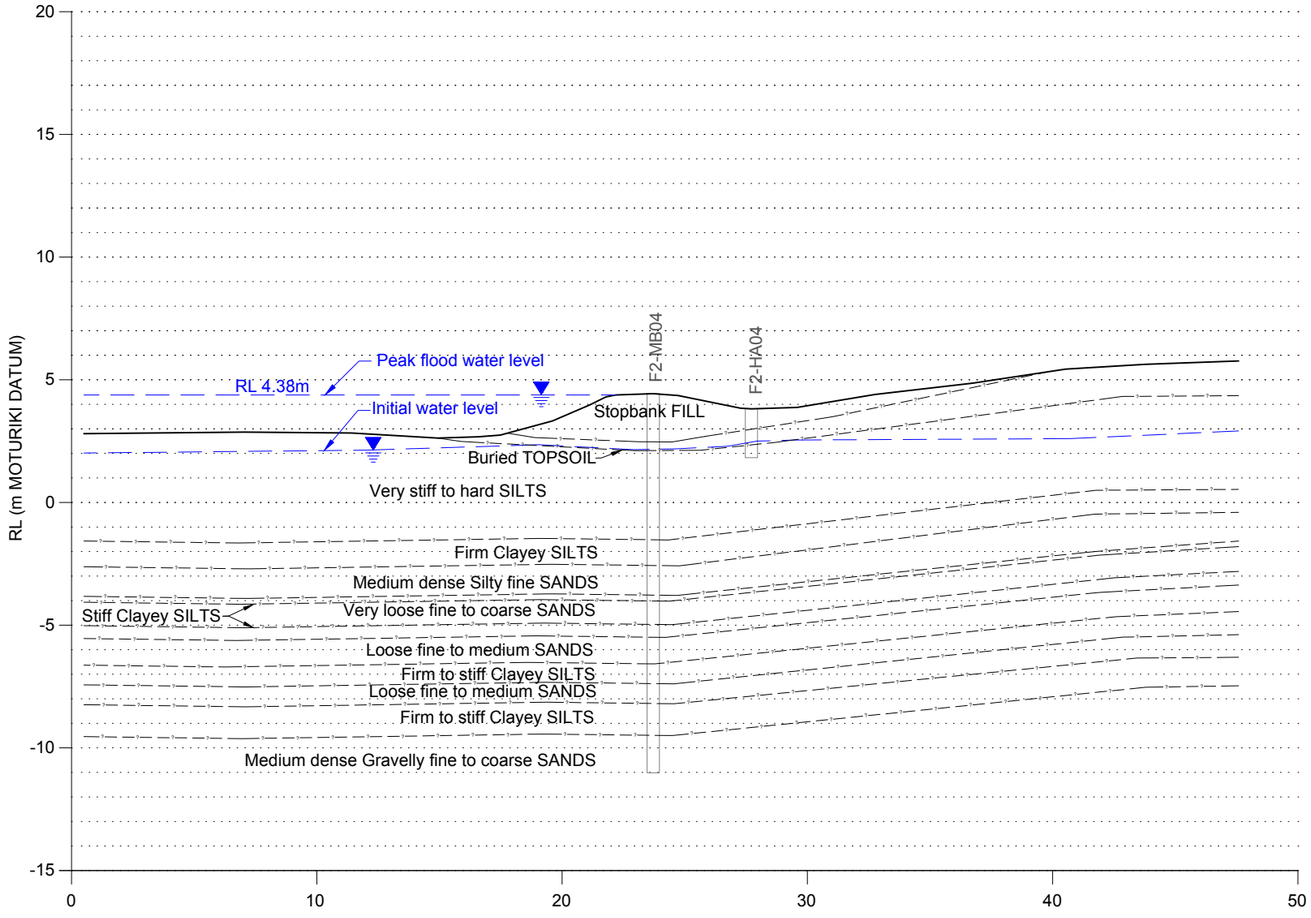
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 14
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F2C		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F2D

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

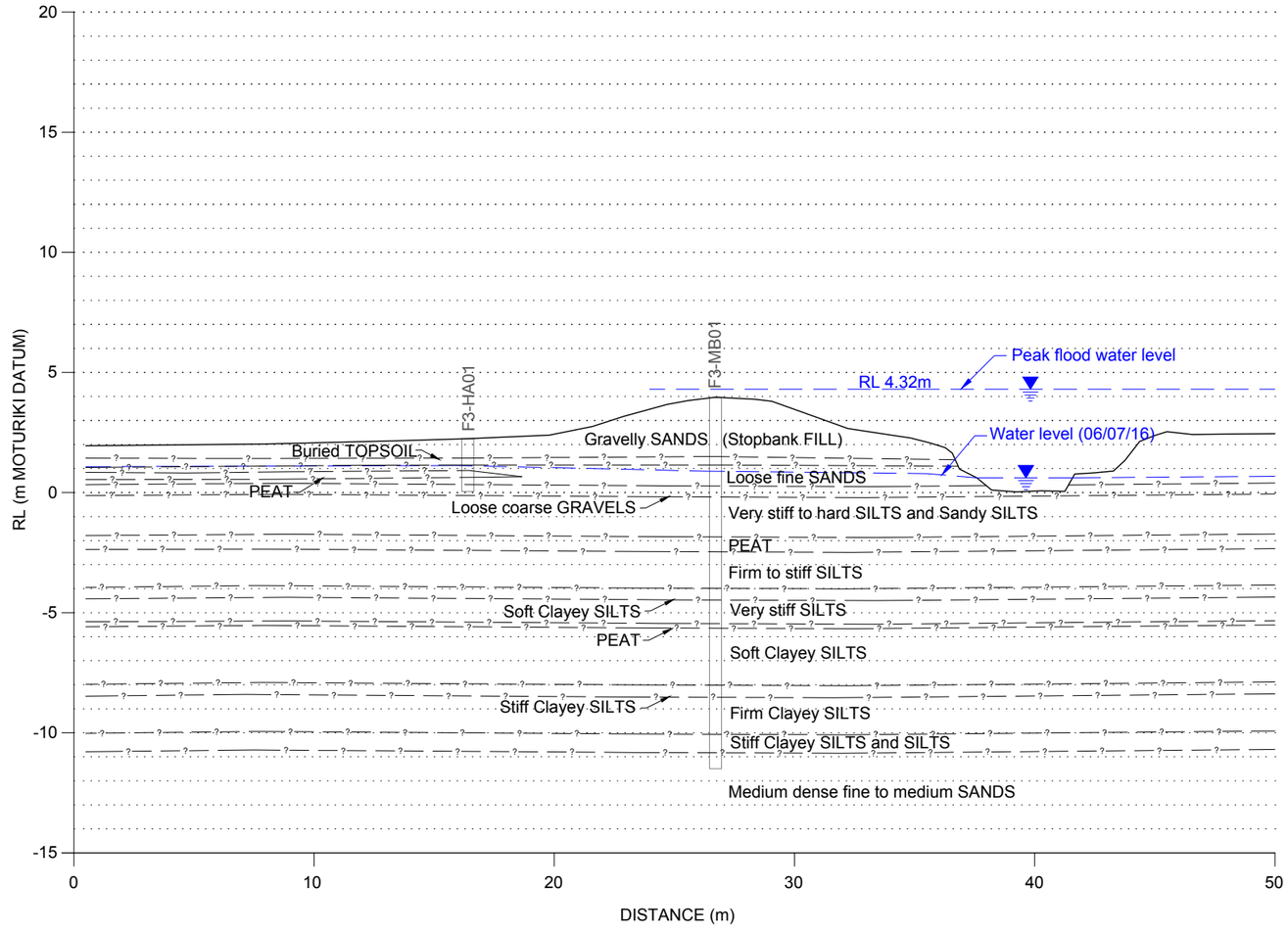
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 15
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F2D		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F3A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

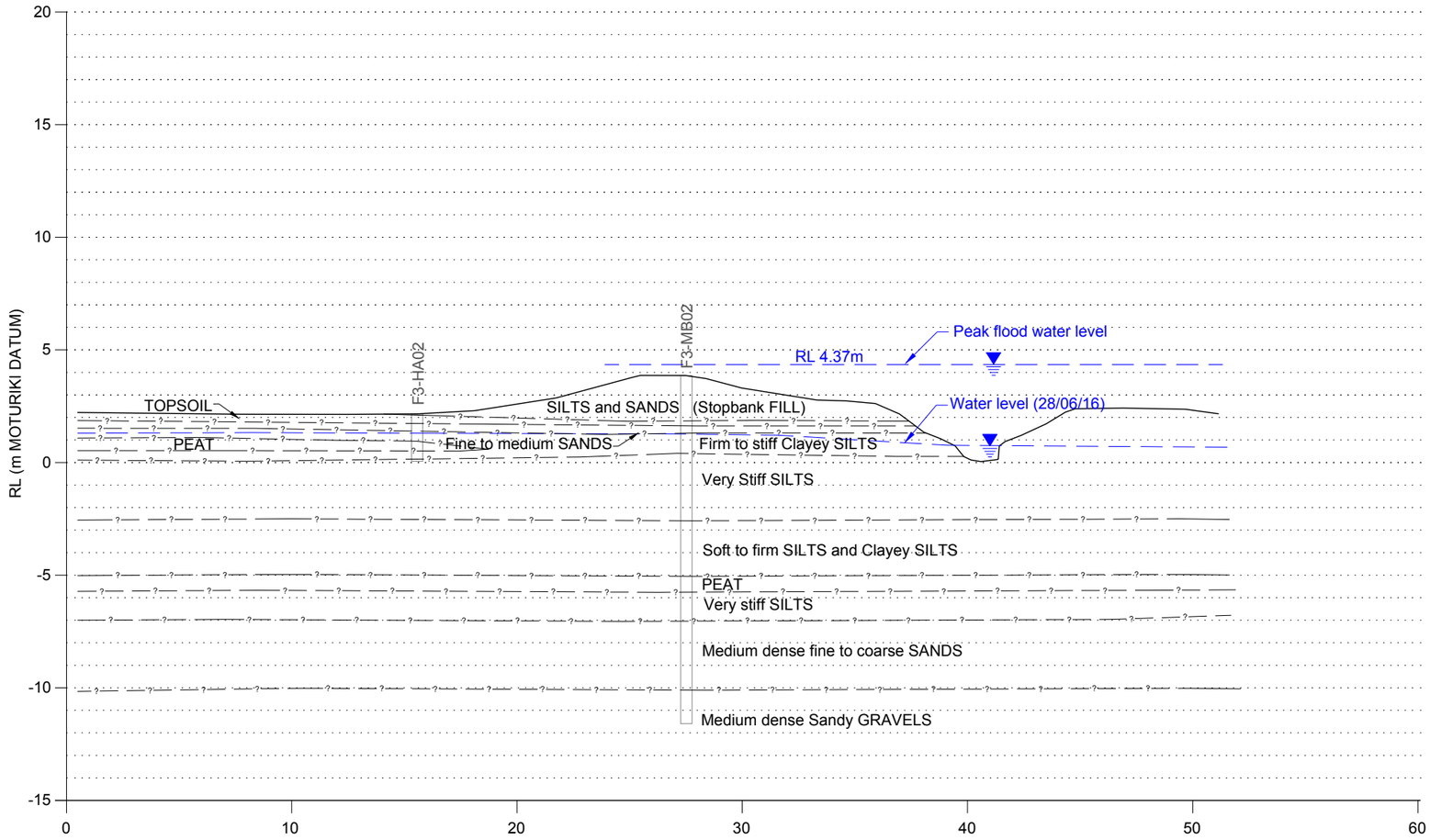
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 16
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F3A		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F3B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

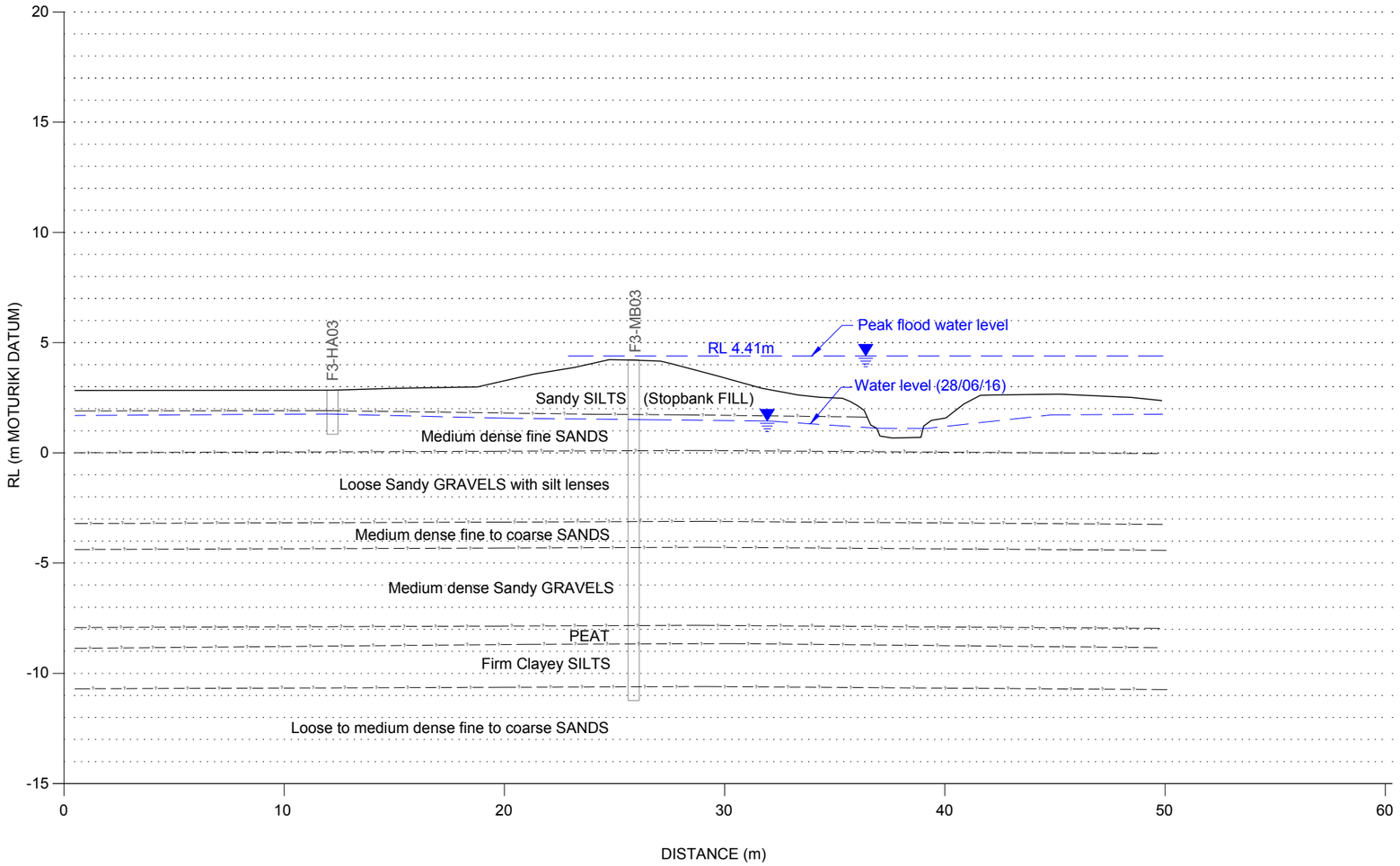
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 17
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F3B		DATE: 11/08/2016	SHEET: A3 L



CROSS SECTION F3C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

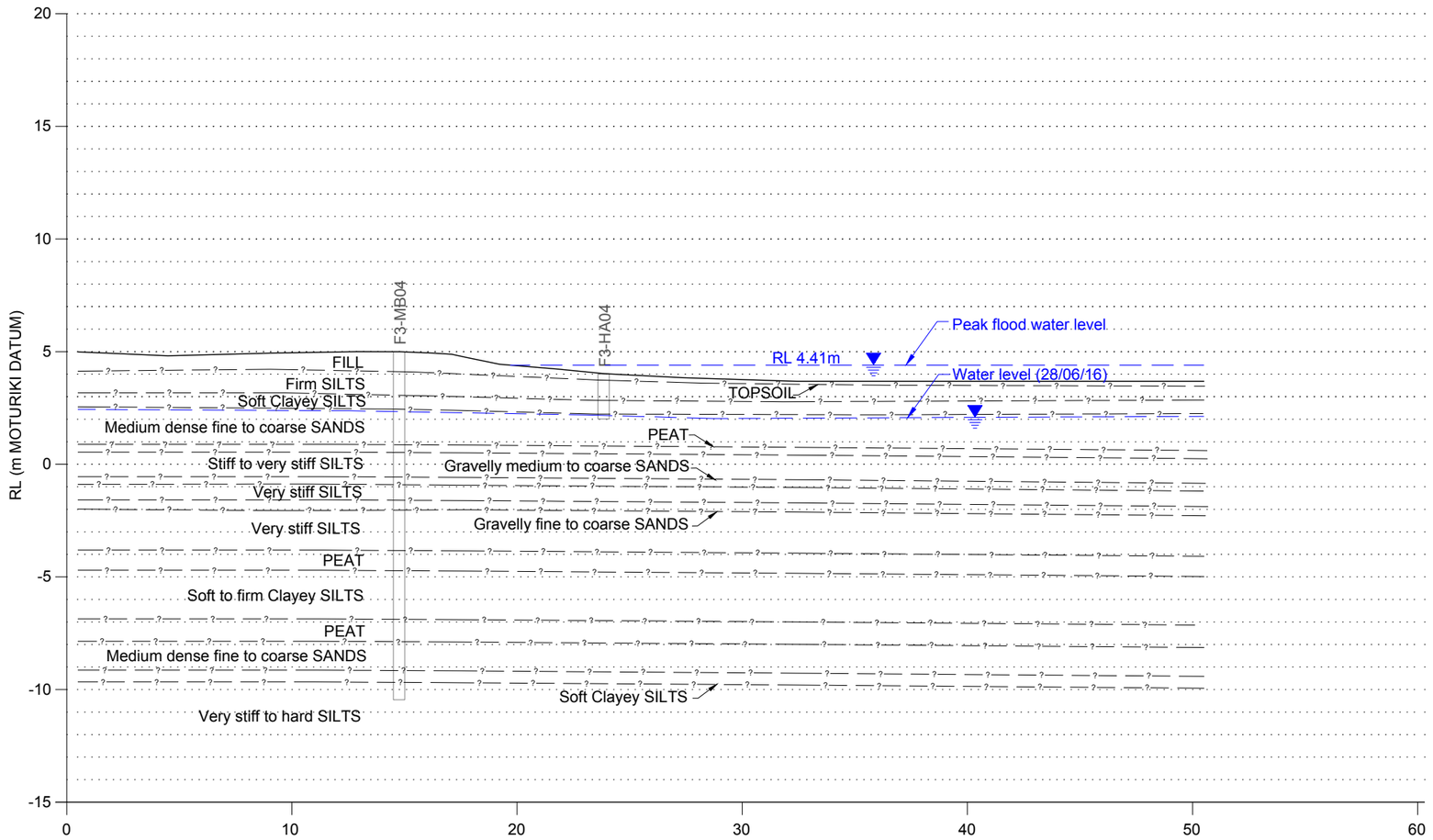
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 18
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F3C		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION F3D

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

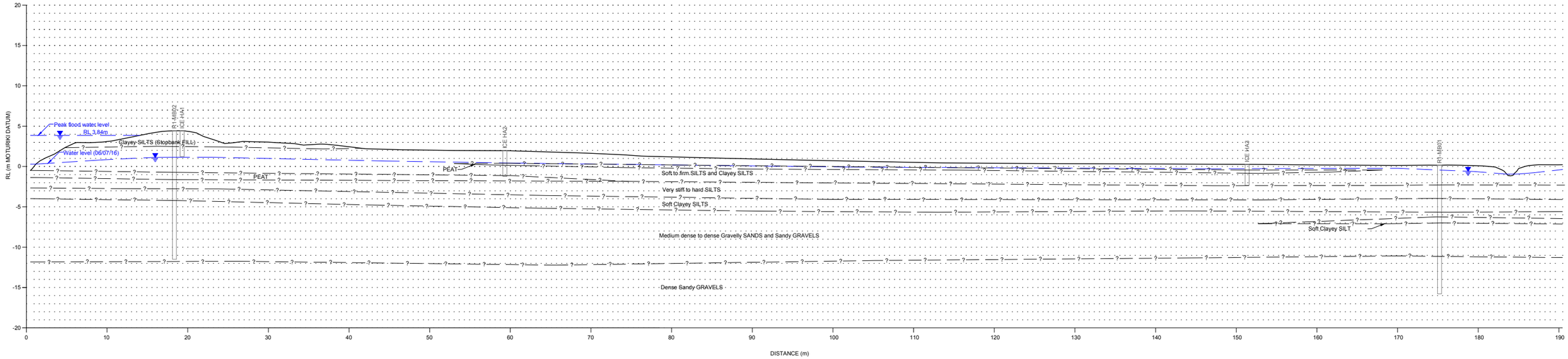
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 19
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION F3D		DATE: 04/10/2016	SHEET: A3 L



CROSS SECTION R1A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

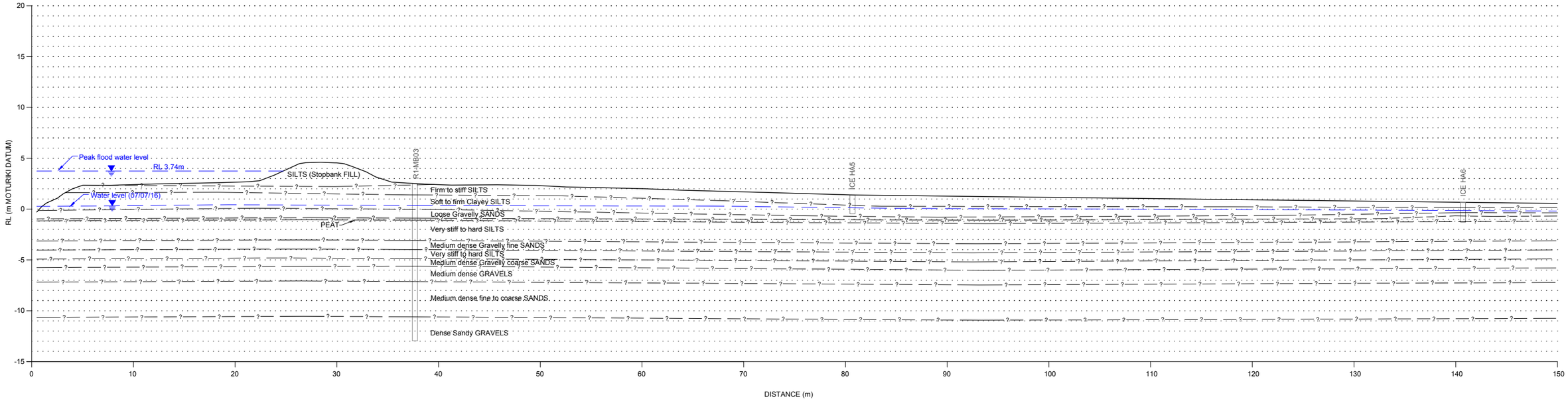
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:500 0 5 10 15 20 25 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**		CHECKED: KB	FIGURE: 20
		REVISION: 0	SCALE: 1:500
TITLE: **CROSS SECTION R1A**		DATE: 14/10/2016	SHEET: A3 L



CROSS SECTION R1B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

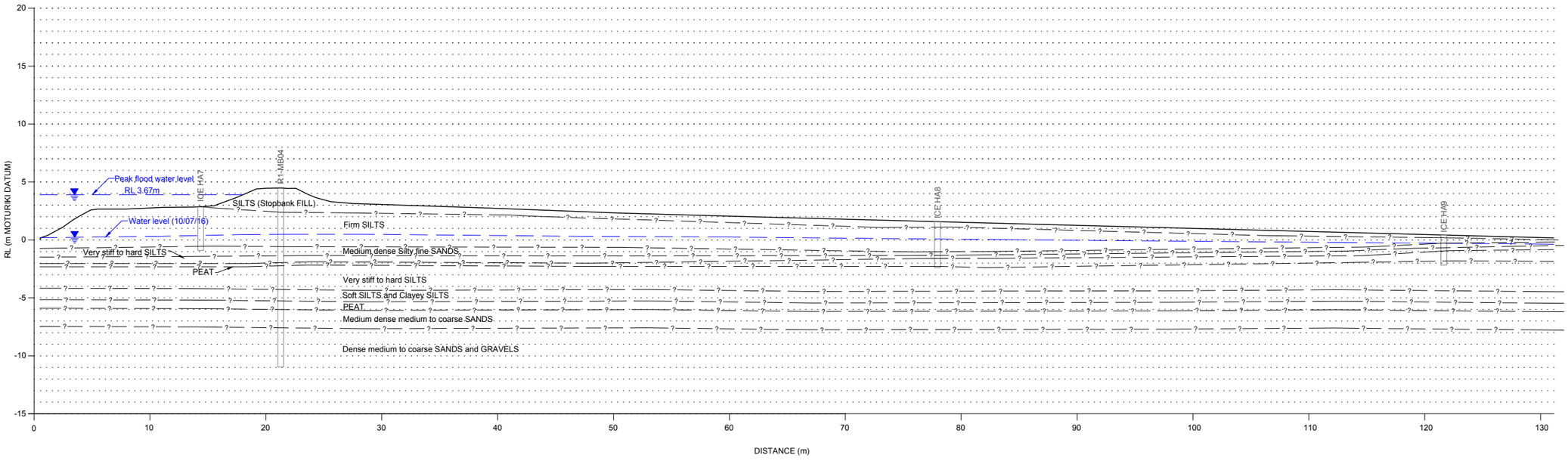
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:400 0 4 8 12 16 20 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 21
		REVISION: 0	SCALE: 1:400
TITLE: CROSS SECTION R1B		DATE: 14/10/2016	SHEET: A3 L



CROSS SECTION R1C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

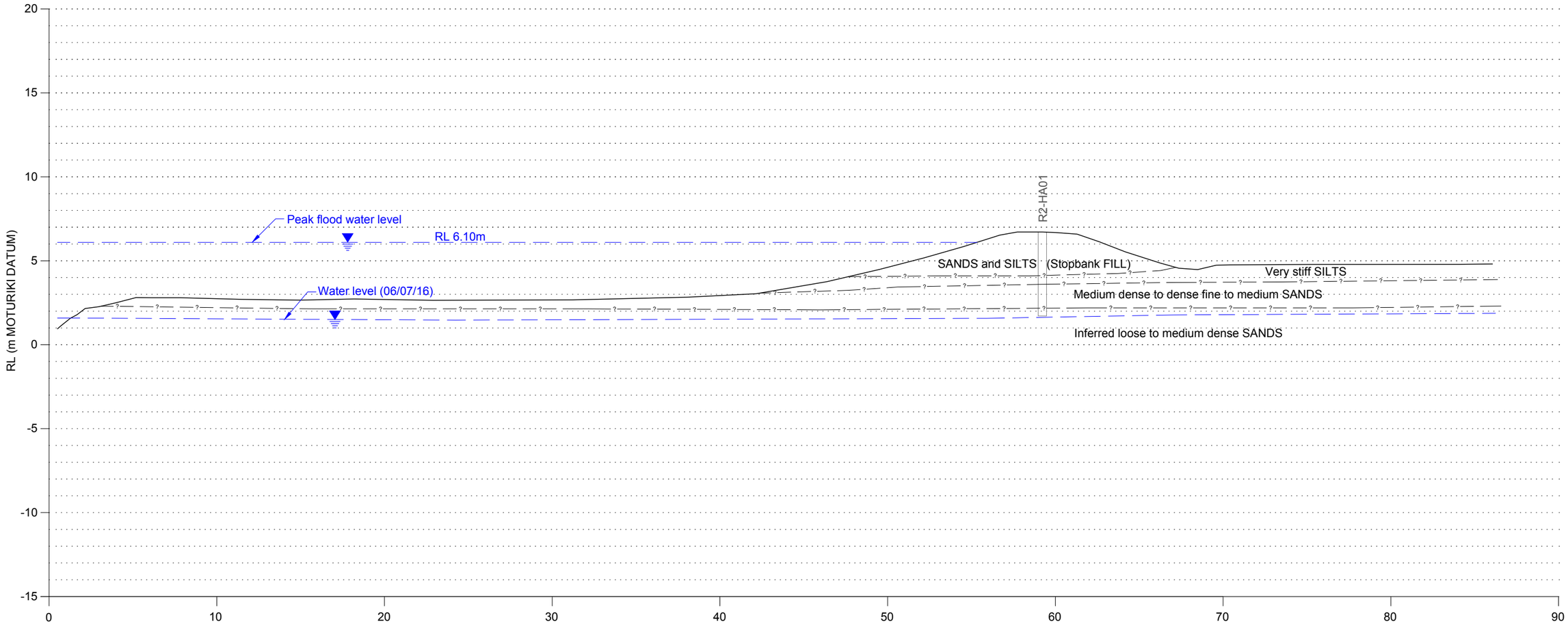
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:400 0 4 8 12 16 20 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 22
		REVISION: 0	SCALE: 1:400
TITLE: CROSS SECTION R1C		DATE: 14/10/2016	SHEET: A3 L



CROSS SECTION R2A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

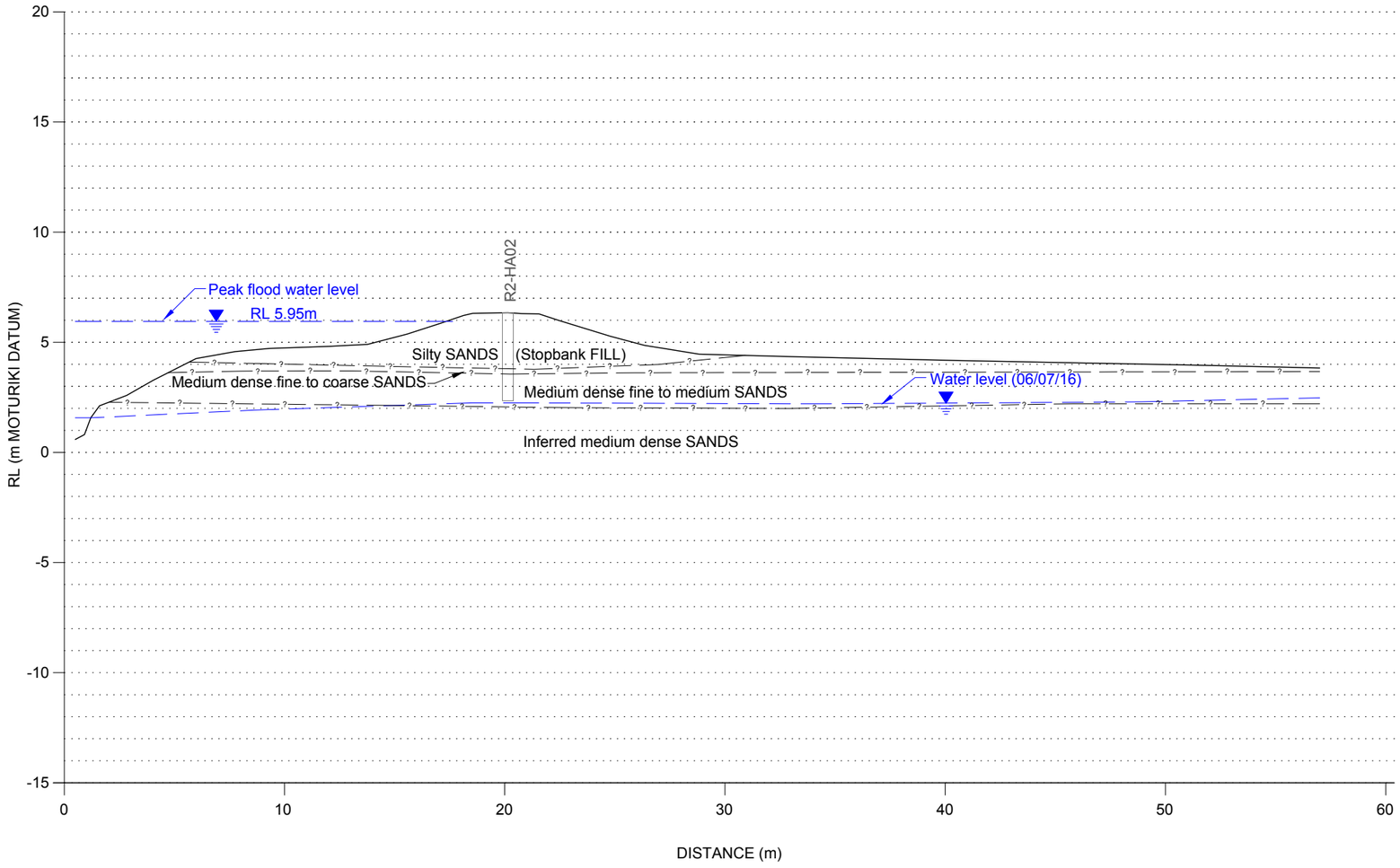
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 23
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION R2A		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R2B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

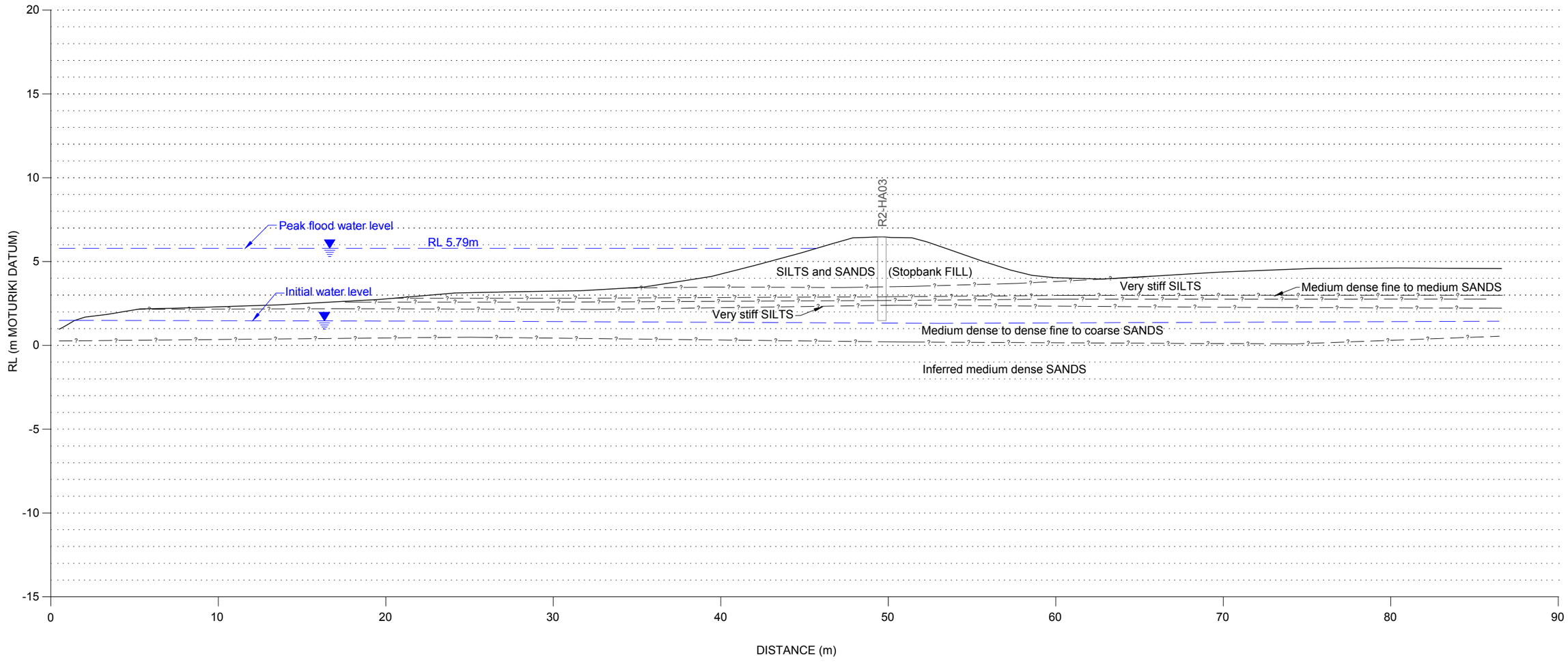
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 24
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION R2B		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R2C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

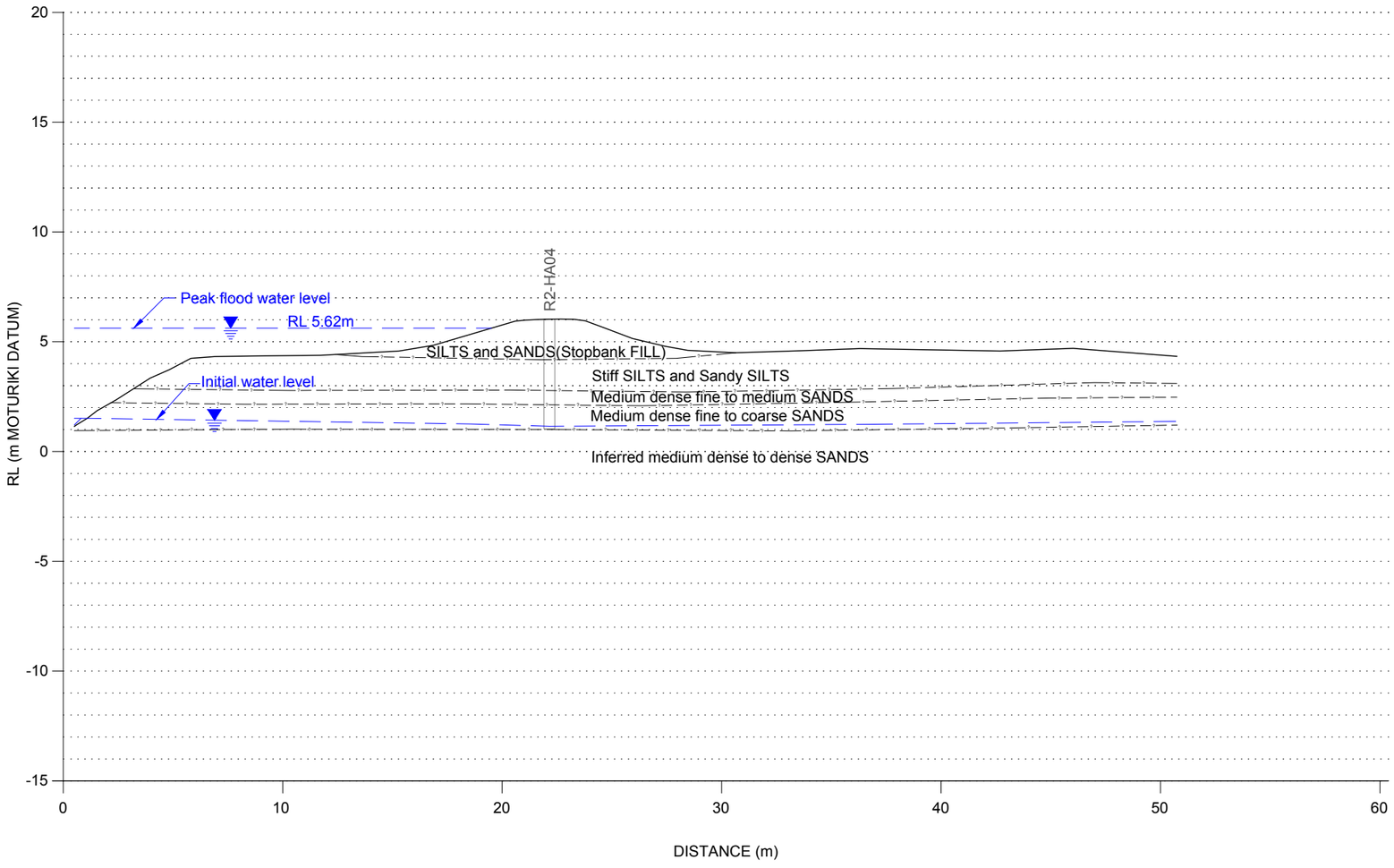
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 25
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION R2C		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R2D

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

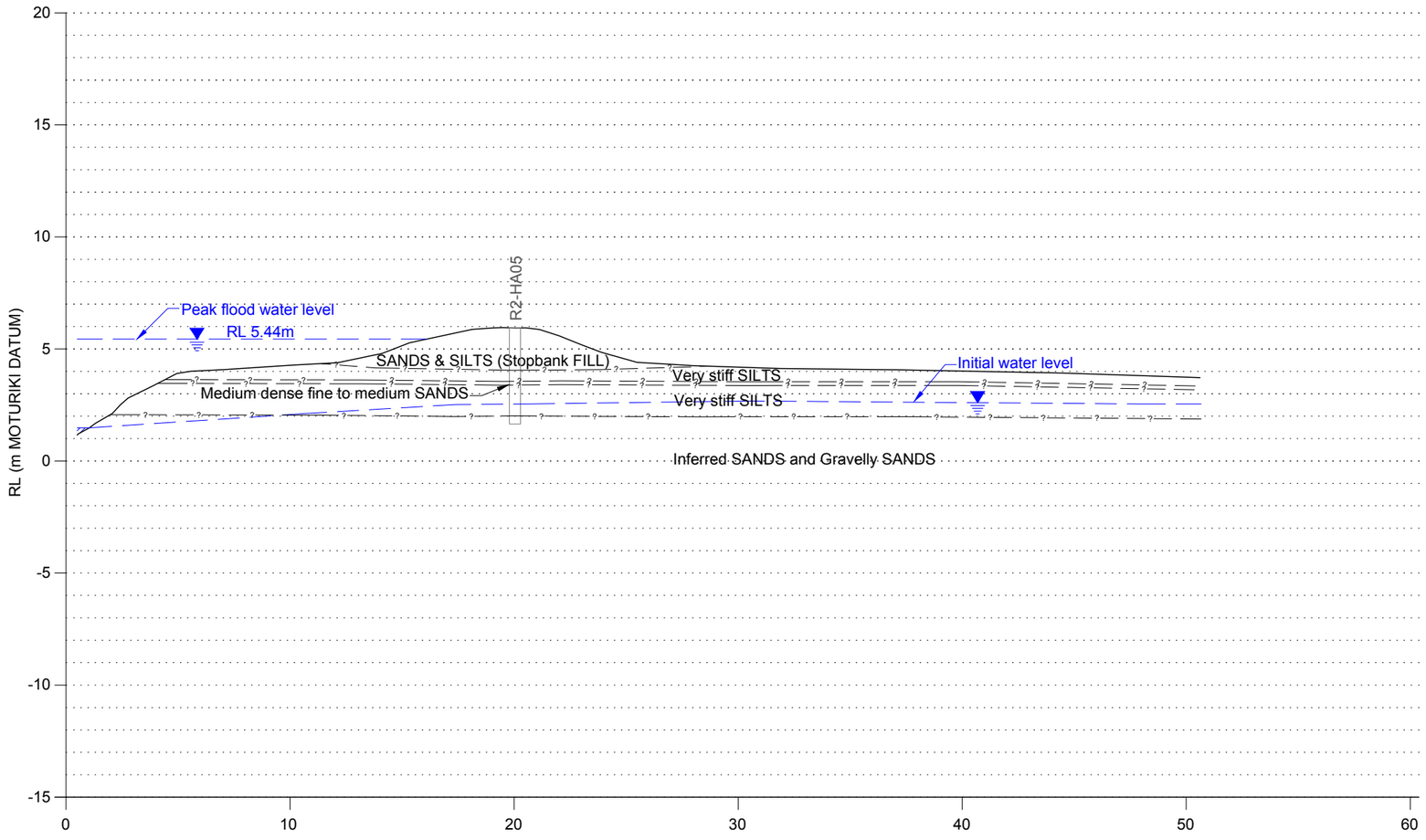
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 26
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION R2D		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R2E

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

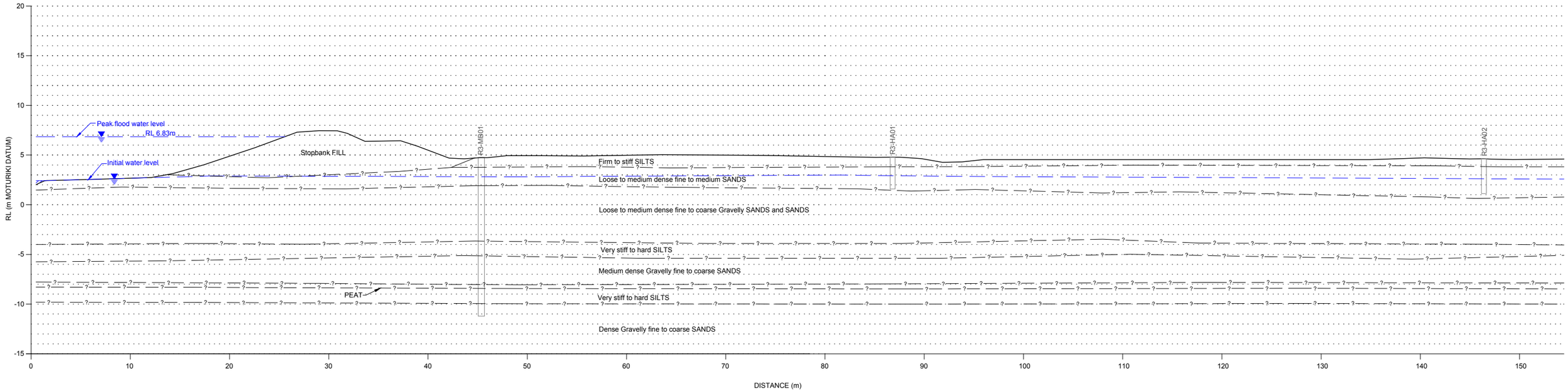
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:250 0 2.5 5 7.5 10 12.5 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 27
		REVISION: 0	SCALE: 1:250
TITLE: CROSS SECTION R2E		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R3A

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED WATER TABLE

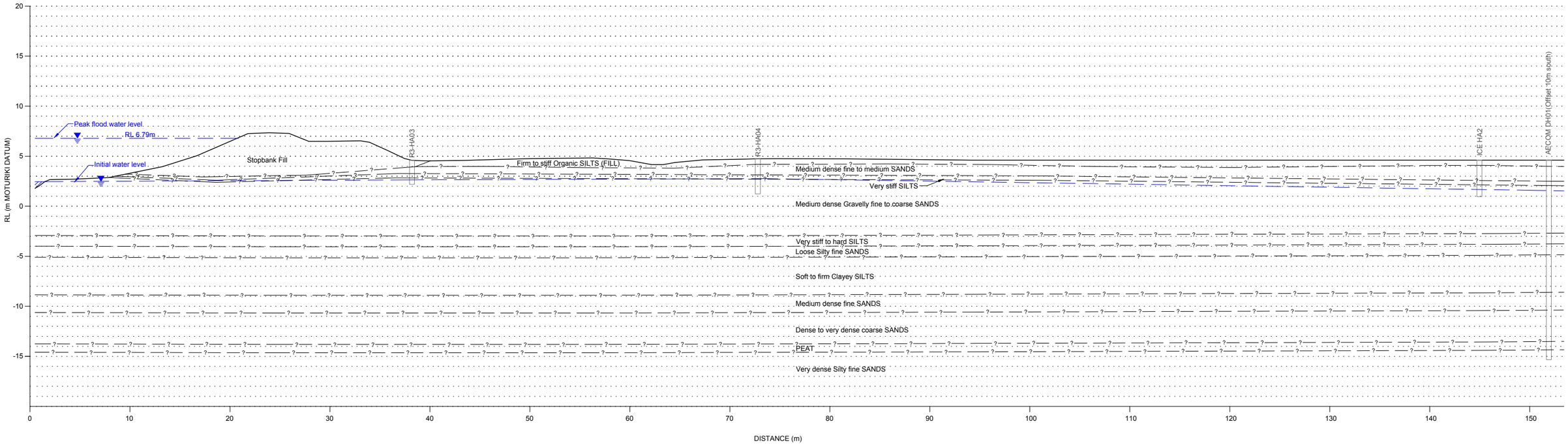
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:400 0 4 8 12 16 20 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**		CHECKED: KB	FIGURE: 28
		REVISION: 0	SCALE: 1:400
TITLE: **CROSS SECTION R3A**		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R3B

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED WATER TABLE

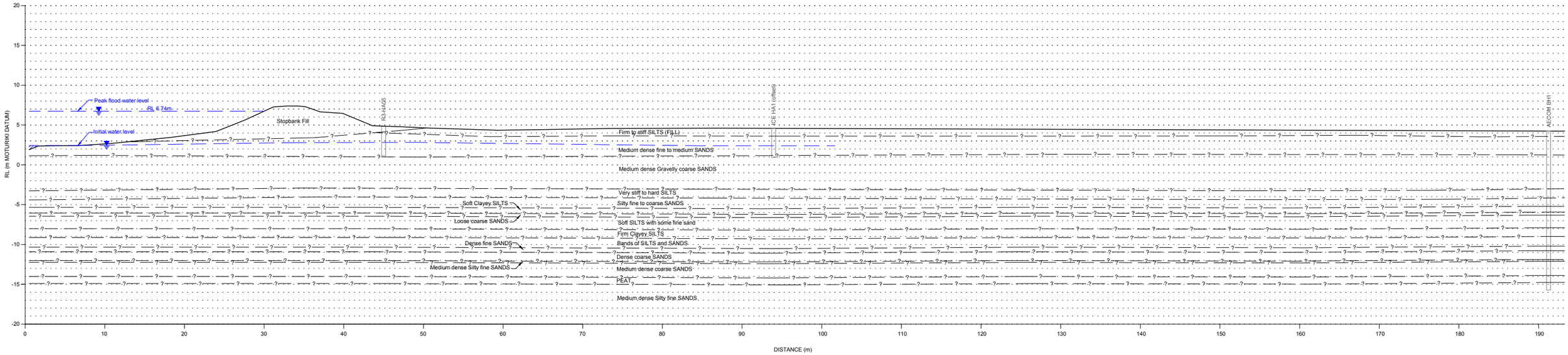
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:400 0 4 8 12 16 20 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: **BAY OF PLENTY REGIONAL COUNCIL**	DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: **RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE**	CHECKED: KB	FIGURE: 29
	REVISION: 0	SCALE: 1:400
TITLE: **CROSS SECTION R3B**	DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R3C

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

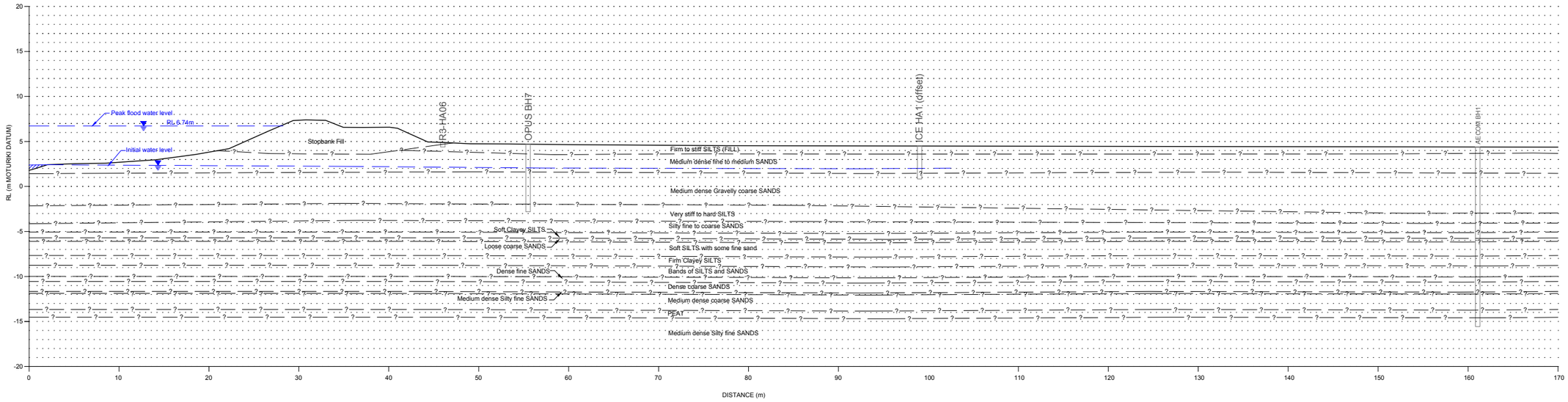
NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:500 0 5 10 15 20 25 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 30
		REVISION: 0	SCALE: 1:500
TITLE: CROSS SECTION R3C		DATE: 05/08/2016	SHEET: A3 L



CROSS SECTION R3D

LEGEND:

- SLOPE PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- WATER TABLE

NOTES:

1. BASE PLAN ADAPTED FROM: BAY OF PLENTY REGIONAL COUNCIL LIDAR 2011 DATA AND GPS SURVEY INFORMATION.
2. CMW BOREHOLE LOCATIONS ARE OBTAINED FROM GPS SURVEY.
3. OTHER BOREHOLE LOCATIONS ARE APPROXIMATE ONLY.

1:500 0 5 10 15 20 25 m

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

CLIENT: BAY OF PLENTY REGIONAL COUNCIL		DRAWN: OMG	PROJECT: TGA2016_0216
PROJECT: RANGITAIKI RIVER AND FLOODWAY, EDGECUMBE		CHECKED: KB	FIGURE: 31
		REVISION: 0	SCALE: 1:500
TITLE: CROSS SECTION R3D		DATE: 05/08/2016	SHEET: A3 L

Appendix A
Geotechnical Investigation Data

NZ GEOTECHNICAL SOCIETY INC

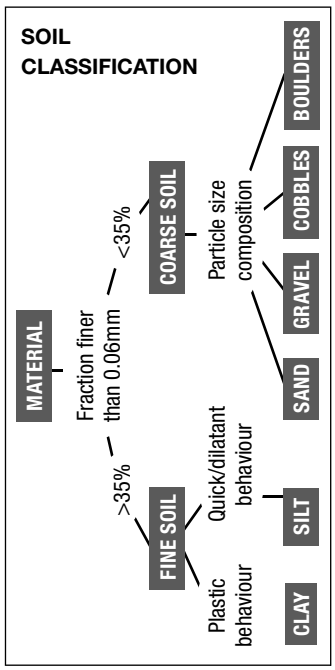
SOIL > field guide sheet

FIELD DESCRIPTION OF SOIL

SEQUENCE OF TERMS – fraction – colour – structure – strength – moisture – bedding – plasticity – sensitivity – additional

GRAIN SIZE CRITERIA

TYPE	COARSE								FINE		ORGANIC
	Boulders	Cobbles	Gravel			Sand			Silt	Clay	Organic Soil
			coarse	medium	fine	coarse	medium	fine			
Size Range (mm)	200		60	20	6	2	0.6	0.2	0.06	0.002	
Graphic Symbol											



PROPORTIONAL TERMS DEFINITION (COARSE SOILS)

Fraction	Term	% of Soil Mass	Example
Major	(….) [UPPER CASE]	≥ 50 [major constituent]	GRAVEL
Subordinate	(….) y [lower case]	20 – 50	Sandy
Minor	with some … with minor …	12 – 20 5 – 12	with some sand with minor sand
	with trace of (or slightly)…	< 5	with trace of sand (slightly sandy)

DENSITY INDEX (RELATIVE DENSITY) TERMS

Descriptive Term	Density Index (R_D)	SPT "N" value (blows / 300 mm)	Dynamic Cone (blows / 100 mm)
Very dense	> 85	> 50	> 17
Dense	65 – 85	30 – 50	7 – 17
Medium dense	35 – 65	10 – 30	3 – 7
Loose	15 – 35	4 – 10	1 – 3
Very loose	< 15	< 4	0 – 2

Note: • No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Test values.
• SPT "N" values are uncorrected. • Dynamic Cone Penetrometer (Scala)

CONSISTENCY TERMS FOR COHESIVE SOILS

Descriptive Term	Undrained Shear Strength (kPa)	Diagnostic Features
Very soft	< 12	Easily exudes between fingers when squeezed
Soft	12 – 25	Easily indented by fingers
Firm	25 – 50	Indented by strong finger pressure and can be indented by thumb pressure
Stiff	50 – 100	Cannot be indented by thumb pressure
Very stiff	100 – 200	Can be indented by thumb nail
Hard	200 – 500	Difficult to indent by thumb nail

ORGANIC SOILS/ DESCRIPTORS

Term	Description
Topsoil	Surficial organic soil layer that may contain living matter. However topsoil may occur at greater depth, having been buried by geological processes or man-made fill, and should then be termed a buried topsoil.
Organic clay, silt or sand	Contains finely divided organic matter; may have distinctive smell; may stain; may oxidise rapidly. Describe as for inorganic soils.
Peat	Consists predominantly of plant remains. ***Firm***: Fibres already compressed together ***Spongy***: Very compressible and open stucture ***Plastic***: Can be moulded in hand and smears in fingers ***Fibrous***: Plant remains recognisable and retain some strength ***Amorphous***: No recognisable plant remains
Roolets	Fine, partly decomposed roots, normally found in the upper part of a soil profile or in a redeposited soil (e.g. colluvium or fill)
Carbonaceous	Discrete particles of hardened (carbonised) plant material.

MOISTURE CONDITION

Condition	Description	Granular Soils	Cohesive Soils
Dry	Looks and feels dry	Run freely through hands	Hard, powdery or friable
Moist	Feels cool, darkened in colour	Tend to cohere	Weakened by moisture, but no free water on hands when remoulding
Wet			Weakened by moisture, free water forms on hands when handling
Saturated	Feels cool, darkened in colour and free water is present on the sample		

PLASTICITY (CLAYS & SILTS)

Term	Description
High plasticity	Can be moulded or deformed over a wide range of moisture contents without cracking or showing any tendency to volume change
Low plasticity	When moulded can be crumbled in the fingers; may show quick or dilatant behaviour

GRADING (GRAVELS & SANDS)

Term	Description	
Well graded	Good representation of all particle sizes from largest to smallest	
Poorly graded	Limited representation of grain sizes - further divided into:	
	Uniformly graded	Most particles about the same size
	Gap graded	Absence of one or more intermediate sizes

compiled by KATE WILLIAMS **design** KARRYN MUSCHAMP

NZ GEOTECHNICAL SOCIETY INC

This field sheet has been taken from and should be used and read with reference to the document FIELD DESCRIPTION OF SOIL AND ROCK. Guideline For the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005. **www.nzgeotechsoc.org.nz**

HAND AUGER BOREHOLE - F1-HA01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937233.5m N.5789659.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.79m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		2.8			OL: TOPSOIL - Organic SILT: brown, low plasticity. Occasional fine to coarse pumice gravel.	D to M	F to St	V-115(28) V-67(42)		
TS		2.1			OL: Sandy organic SILT: brown, non plastic. Sand is fine to coarse grained, well graded.	M		V-38(26)		
		1.9			*...becoming black, no sand.*					
Alluv.			1		ML: SILT: light brown mottled brown, low plasticity.					
		1.7			SW: Fine to coarse SAND: grey-brown, well graded.	D to M	L			
Pt		1.4			OL: Organic SILT: black, non plastic. Fibrous, slight organic odour.	M…				
		1.3			GM: Silty fine to coarse GRAVEL: grey, well graded, pumiceous.					
Alluvial Deposits	▼	1.2			SP: Fine to medium SAND: grey, poorly graded, pumiceous. Poor recovery.	W				
			2		*...trace to minor fine pumice gravel.*					
					Borehole terminated at 2.2 m					
			3				MD to D			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.6m. Alluv. stratigraphic code denotes Alluvial Deposits. Pt stratigraphic code denotes Peat. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F1-HA02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937404.7m N.5790016.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.44m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm)	Comments
					Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments				5 10 15 20	
Fill		2.4			OL: TOPSOIL - Organic SILT with trace gravel: brown, non plastic to low plasticity. Gravel is fine to medium, pumice.	D to M	St to VSt	V-112(31) V-155(65)		
					...becoming sandy silt.					
Alluv.		1.5	1		ML: SILT: light brown, low plasticity.	M		V-67(26)		
		1.4			SW: Fine to coarse SAND: grey-brown, well graded, pumiceous.					
Peat		1.2			OL: Organic SILT: black, low plasticity, fibrous. Slight organic odour.	M to W				
		1.0			*...20mm coarse pumice gravel lens.*					
Alluvial Deposits					SM: SILT with trace sand: grey, low plasticity. Sand is fine grained, pumiceous. Poor recovery.	W				
		0.5	2		GM: Gravelly SILT: grey, low plasticity. Gravel is fine to medium, pumiceous. Poor recovery.		MD to D			
					Borehole terminated at 2.1 m					
			3				D to VD			
			4							4.3-4.3m: DCP refusal.
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.9m. Groundwater measured after drilling. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F1-HA03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937556.5m N.5790349.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.11m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		2.1			OL: TOPSOIL - Organic SILT: brown, non plastic. Some silt lenses, light brown. Occasional medium to coarse pumice gravel.	M	F to St	V-164(43)		
								V-159(54)		
		1.4			ML: SILT: light brown, non plastic.	D to M				
		1.3			OL: TOPSOIL/SILT: brown, low plasticity. Soft.	M		V-46(13)		
			1		*...becoming sandy; grey, pumiceous.*	D…				
Pt		1.0			OL: PEAT: black, non plastic, completely decomposed. Soft, fibrous.	M				
		0.9			ML: SILT: light brown, low plasticity.	M…	MD to D			
Alluvial Deposits		0.8			SP: Fine to medium SAND : grey, poorly graded. Occasional fine to medium pumice gravel. Poor recovery.	W				
					Borehole terminated at 1.9 m					
			2							
			3				D to VD			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.3m. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F1-HA04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937738.2m N.5790740.0m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.06m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		2.1			OL: TOPSOIL - Organic SILT: brown, non plastic. Occasional medium pumice gravel.	D to M				
		1.8			SM: SILT: light brown, non plastic. Interbedded topsoil/organic silt layers.			V-51(16)		
TS		1.6			OL: Organic SILT: black to brown, low plasticity.		F			
Alluvial Deposits		1.5			ML: SILT with trace clay: light brown, low plasticity. Slightly greasy when reworked.	M		V-51(35)		
	▼	1.2	1		SW: Fine to coarse SAND: grey, well graded, pumiceous. Occasional fine to medium pumice gravel.		MD			0.9-1.2m: Auger pushed through easily.
		0.8			SM: Silty fine SAND: grey, poorly graded. Poor recovery.	W to S				
					Borehole terminated at 1.9 m					
			2							
			3				D to VD			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.5m. Running sands at 1.9m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F1-HA05

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937911.2m N.5791114.8m (NZTM)
Survey Source: GPS Survey
Elevation: RL 1.55m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		1.5			OL: TOPSOIL - Organic SILT: brown, low plasticity. Occasional medium pumice gravel.	M		V-97(35)		
Alluv.		1.0			ML: SILT: light brown, non plastic to low plasticity. Slightly powdery when dry.		F to St	V-30(20)		
		0.8			SW: Fine to coarse SAND: grey, well graded, pumiceous.	W				
Peat		0.6	1		OL: PEAT: black, non plastic, completely decomposed. Fibrous, slight organic odour.					0.9-1.0m: Auger pushed through easily.
		0.4			ML: SILT: light brown, low plasticity.			V-104(54)		
Alluvial Deposits					*...20mm thick fine to coarse pumice gravel lens.*					
					...20mm thick fine to coarse pumice gravel lens.	W to S	MD			
			2		Borehole terminated at 2.0 m		D			
			3							
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.6m and hard to auger. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 18/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1937227.9m N.5789662.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.82m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	SPT N-Value	Drilling Method/ Support	Comments/Defect Description
Fill		3.8	1		SM: SILT with some sand: brown, non plastic. Sand is medium to coarse, pumiceous. Occasional coarse pumice gravel and organic fibres.	M	S to F	100 40		(1,0,0) N* = 0, Recovery = 180mm		
TS		1.9	2		OL: PEAT: black, non plastic, highly decomposed. Common hard organic fibrous inclusions (50% of matrix).	M to W						
Alluvial Deposits		1.5	3		SM: Sandy SILT: grey, non plastic. Occasional interbedded bands of coarse pumice sand; horizontal, thick.	M	H	100 80		(5,6,8) N* = 14, Recovery = 360mm		2.8-3.0m: SAMPLE F1-001
			4		*...more gravels present.*			100 80		(5,7,7) N* = 14, Recovery = 360mm		
			5		*...medium pumice gravel lens.*						HQ	
Pt		-1.6			Pt: ORGANIC FIBRES: Black, hard, partially decomposed. Fibrous.	W		71				
Alluvial Deposits		-1.8	6		SM: SILT with trace sand: grey, non plastic. Sand is fine grained.	M to W	S					
		-2.2			ML: Clayey SILT: grey-brown to grey-green, low to medium plasticity. Soft, greasy. Some organic fibres.		S	44 62 100		(0,1,0) N* = 1, Recovery = 200mm (2,0,1) N* = 1, Recovery = 450mm		
Pt		-4.1	8		SM: Fine to medium SAND and organic SILT mixture: grey-brown, poorly graded, low plasticity. Some organic fibres.	W						
Alluvial Deposits		-4.3	9		ML: Clayey SILT: grey-brown to grey-green, low to medium plasticity. Soft to stiff, greasy. Some organic fibres.	W	F to St	100 89		(3,3,2) N* = 5, Recovery = 400mm		
		-6.0	10		SP: Fine to medium SAND: grey-brown with slight			100				
					Continued on next sheet							

Weathering: RS, CW, HW, MW, SW, DW
Estimated Strength: EW, VW, W, MS, S, VS, ES
Vane Shear Strength (kPa) Peak (Residual)
Defect Spacing (mm): <20, 20-60, 60-200, 200-600, 600-2000, >2000

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 18/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1937227.9m N.5789662.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.82m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits (Pt)		-6.2	11		orange staining, poorly graded. SW: Fine to coarse SAND with some gravel and minor silt: grey-brown, well graded. Gravel is a mixture of subrounded fine to medium pumice and subangular to subrounded fine black lithics. *...becoming less gravelly.*		MD		84				(5,8,9) N* = 17, Recovery = 380mm			10.1-10.2m: SAMPLE F1-002
		-7.5			ML: Clayey SILT: brown to grey-green, low to medium plasticity. Soft. Some thin organic fibres; black-brown, fibrous.		S		100							
		-8.0 -8.1	12		OL: Organic SILT: black, non plastic. Highly decomposed wood fragment, slightly fibrous, amorphous.											
					SP: Fine to medium SAND: grey mottled brown, poorly graded. *...becoming pale grey.*				91				(8,10,13) N* = 23, Recovery = 410mm			
		-9.1	13		SM: SILT with trace sand: pale grey streaked pale orange, poorly graded, non plastic. Powdery when reworked.				100							
		-9.6			SP: Fine to medium SAND: pale grey, poorly graded. *...some fine to medium pumice gravel.*	M to W	MD		100				(7,10,15) N* = 25, Recovery = 450mm			
		-10.1	14		SP: Fine to medium SAND: dark grey-green, poorly graded. *...hard organic fibres up to 10mm; black, fibrous. stiff.*				100							
			15						100				(8,14,15) N* = 29, Recovery = 450mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 16/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1937396.1m N.5790021.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.73m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		3.7			OL: TOPSOIL - Organic SILT: black, non plastic.											
		3.7			SM: Sandy SILT: brown, non plastic to low plasticity. Sand is coarse, pumiceous. Occasional medium to coarse pumice gravel. Occasional soft silt inclusions.				100							
			1				St									
									58				(2,1,1) N* = 2, Recovery = 260mm			
Alluv.		1.8	2		ML: SILT with trace clay: brown with orange staining, non plastic to low plasticity. Soft, powdery when reworked.	M	S									
TS		1.6			SP: Coarse SAND: grey, poorly graded.											
		1.5			OL: PEAT: black, non plastic, partially decomposed wood fragment. Very stiff, fibrous.				86							
		1.3			SP: Fine SAND: grey with slight orange staining, poorly graded.											
		1.1	3		SW: Fine to coarse SAND with some gravel: grey with slight orange staining, well graded. Gravel is medium to coarse, pumice.		L		67				(5,4,3) N* = 7, Recovery = 300mm			
Alluvial Deposits		0.0			SM: SILT with trace sand: grey, non plastic. Sand is fine grained.				100							
			4													
		-0.4			SW: Gravelly fine to coarse SAND with trace silt: grey, well graded. Gravel is coarse, pumice.											
		-0.6			SM: SILT with trace gravel: grey, non plastic. Gravel is fine, pumice.								(8,8,8) N* = 16, Recovery = 360mm			
			5				Vst to H		80						HQ	
						M to W			100							
		-2.3	6		ML: Clayey SILT: grey-green, low to medium plasticity. Soft, greasy when reworked.		S		100				(0,1,0) N* = 1, Recovery = 450mm			
		-2.8			SP: Fine SAND: greenish grey, poorly graded.											
			7				L		57							
		-3.5			SM: SILT with trace sand: grey with pale brown subhorizontal bedding, non plastic. Sand is fine grained.											
		-3.8			OL: Organic Clayey SILT: grey-brown, low plasticity. Soft, greasy, spongy. Trace highly decomposed wood fragments. Occasional organic fibres.				100				(0,0,0) N* = 0, Recovery = 450mm			
Peat			8		*...becoming black.*	W										
							S		62							
			9										(0,1,1) N* = 2, Recovery = 150mm			
									33							
Alluv.		-5.8			SW: Fine to coarse SAND: grey, well graded. *...with a stiff organic fibre (10mm dia), orange-brown, very stiff.*		L		100							
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 16/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1937396.1m N.5790021.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.73m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Peat		-6.4			OL: Organic SILT: brown-grey, low plasticity. Soft, greasy, spongy. Trace highly decomposed organic wood fragment.		S									
Alluvial Deposits		-6.7			SW: Fine to coarse SAND with minor silt: grey with some orange staining, well graded.				89				(4,8,10) N* = 18, Recovery = 400mm			
			11													
		-7.8			GW: Sandy fine to coarse GRAVEL: mixture of pale orange and pale grey, subrounded, pumice. Some fine black subangular lithics. Sand is coarse grained, pumiceous.				100							
			12						44				(4,6,4) N* = 10, Recovery = 200mm			
					...gravel becoming fine.	M to W										
		-9.2	13		GP: Medium to coarse SAND with some gravel: grey, poorly graded. Gravel is fine, subangular to subrounded, pumice.		MD		100							
		-9.7			SP: Fine to medium SAND: grey, poorly graded.				89				(1,3,6) N* = 9, Recovery = 400mm			
			14													
					...30mm fine to coarse gravel and black organic silt lens.				100							
			15						93				(5,10,20) N* = 30, Recovery = 420mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 15/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1937545.5m N.5790354.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.65m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	SPT N-Value	Comments/Defect Description
Fill		3.7	1		ML: SILT with some sand: brown, non plastic, trace rootlets. Sand is coarse.	D to M	St	100			
					...some coarse pumice gravel.			60		(1,1,1) N* = 2, Recovery = 270mm	
TS		1.7	2		OL: Organic sandy SILT: pale brown-black, non plastic. Highly decomposed, soft, greasy. Sand is medium to coarse.	W	S	100			
		1.5			Pt: PEAT: black, partially decomposed wood fragement. Stiff, fibrous.						
		1.3	3		SM: SILT with some sand: grey-brown, non plastic. Sand is fine grained. Occasional gravel lenses; gravel is medium to coarse, pumiceous.	M to W		80		(4,9,10) N* = 19, Recovery = 360mm	
					...fine to coarse gravel lens, grey.						
Alluvial Deposits			4				Vst to H	100			
					...mixture of black organic fibres and fine pumice gravel.	W		87		(7,11,13) N* = 24, Recovery = 390mm	
			5		*...coarse pumice gravel lens, poorly graded*			100			HQ 5.5-5.6m: SAMPLE F1-003
		-2.1	6		ML: Clayey SILT: grey-green, low to medium plasticity. Soft.	M to W	S	100		(6,1,1) N* = 2, Recovery = 450mm	
		-2.8			SM: SILT : grey mottled brown with some green streaks, non plastic. Large hard organic fibre (130mm in length).		St				
		-3.4	7		ML: Clayey SILT: dark brown-grey, low to medium plasticity. Soft. Some layers of organic wood fragments, fibrous, stiff.	W	S	100			
					...becoming grey-green.			80		(0,1,0) N* = 1, Recovery = 360mm	
			8		*...becoming grey-green mixed brown, very soft.*			48			
Peat		-5.1	9		Pt: PEAT: brown, slightly decomposed wood fragment. Very stiff, fibrous.			89		(2,1,2) N* = 3, Recovery = 400mm	
		-5.8			SM: Silty fine SAND: grey-green, poorly graded. Minor organic fibres.			90			
			10		*...becoming grey-green with brown bedding.*						
					Continued on next sheet						

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 15/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1937545.5m N.5790354.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.65m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		...some coarse pumice sand	M to W	L		100				(2,2,2) N* = 4, Recovery = 450mm			
		-7.8			...some organic silt, black, soft.				76							
			12		SW: Fine to coarse SAND with some gravel: grey, well graded. Gravel is fine to medium, pumice.		MD		78				(4,8,11) N* = 19, Recovery = 350mm			
					...no gravels.				100							
		-9.4	13		...black subhorizontal bedding.											
		-9.5			SM: Sandy SILT: brown, low plasticity. Sand is medium grained.											
					SW: Silty fine to coarse SAND with some gravel: grey, well graded. Gravel is fine to medium, pumiceous.				80				(2,6,8) N* = 14, Recovery = 360mm			
			14						100							
			15						84				(5,7,10) N* = 17, Recovery = 380mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 19 July 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 13/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1937727.2m N.5790744.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.46m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		3.5			ML: SILT with trace sand: brown, non plastic. Sand is medium grained.	D										
					...trace medium pumice gravel.	D to M										
		2.9	1		ML: Clayey SILT with minor sand: pale brown to brown mottled black, low plasticity. Soft. Occasional fine to medium pumice gravel.	M to W	S		100							
									24				(1,0,1) N* = 1, Recovery = 110mm			
Alluv.		1.5	2		ML: SILT with trace clay: pale brown with orange staining, low plasticity.											
		1.3			*...becoming mottled brown.*											
TS		1.2			SP: Medium to coarse SAND: grey, poorly graded, pumiceous.				100							
		0.9			OL: Organic SILT : black, non plastic. Highly decomposed, trace organic wood material.											
Alluvial Deposits			3		SM: SILT with some sand: grey, non plastic, powdery when reworked. Sand is fine grained. Occasional gravel lenses; gravel is fine to coarse, up to 35mm dia, pumiceous.	M	Vst to H		36				(8,8,10) N* = 18, Recovery = 160mm			2.8-3.0m: SAMPLE F1-004
			4						90							
									67				(10,13,9) N* = 22, Recovery = 300mm			
			5												HQ	
Pt		-1.7			OL: Organic SILT: brown, low plasticity, greasy, highly decomposed. Soft, spongy. Slight organic odour.				100							
		-1.9			ML: Clayey SILT: grey-green, low to medium plasticity, greasy when reworked. Soft.											
Alluvial Deposits			6						56				(9,10,3) N* = 13, Recovery = 250mm			
					...trace organic fibres, yellow-brown.											
					...becoming grey-brown.				95							
			7				S to F									
					...some hard organic fragments and organic fibrousinclusions.				100				(0,0,0) N* = 0, Recovery = 450mm			
			8		*...becoming grey-green.*											
					...becoming grey-brown.				95							
Peat		-4.7			OL: Organic SILT with some hard organic fragments: brown-black, low plasticity. Soft, greasy. Organic fragments are partially decomposed, tinged yellow.											
		-5.1			ML: Clayey SILT: grey-green with some orange staining, low to medium plasticity.											
Alluvial Deposits			9						100				(1,0,1) N* = 1, Recovery = 450mm			
		-6.0			SM: Silty fine to coarse SAND: grey, well graded. Occasional thin silt lenses (up to 30mm thick).		L		100							
			10		Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 15 July 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 13/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1937727.2m N.5790744.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.46m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits		-6.6	11		SP: Medium to coarse SAND with some gravel: grey, poorly graded, pumiceous. Gravel is fine black lithics with some quartz.	M to W	MD		56				(6,6,4) N* = 10, Recovery = 250mm			
		-7.9			ML: Clayey SILT: dark grey-brown, low to medium plasticity. Greasy when reworked.		F		57							
		-8.5	12		SW: Fine to coarse SAND: grey, well graded, pumiceous.		D to VD		89				(1,17,18) N* = 35, Recovery = 400mm			
		-9.7	13		SW: Silty fine to coarse SAND : brown-black, well graded.				71							
		-10.5	14		SP: Gravelly fine to medium SAND: grey, poorly graded. Gravel is fine black lithics and quartz. Occasional coarse gravel lenses; dark grey, smooth, flat, subangular.				78				(9,20,30) N* = 50, Recovery = 350mm			13.5-13.5m: SPT - Over 50+ blows
			15						100				(5,12,19) N* = 31, Recovery = 450mm			
					Borehole terminated at 15.5 m				100							
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 15 July 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB05

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1937902.3m N.5791118.8m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.38m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		3.4			ML: SILT : brown, non plastic, minor rootlets.	D										
		3.2			Occasional coarse sand.											
					GM: Gravelly SILT with minor sand: brown, low plasticity. Gravel is coarse, subangular, pumiceous. Sand is fine grained.	D to M			100							
			1				St									
		2.2			SM: Sandy SILT: black, non plastic to low plasticity. Sand is coarse.	M			67				(1,1,1) N* = 2, Recovery = 300mm			
			2		...becoming soft, greasy.											
		1.3			...no sand.											
Alluvial Deposits					SM: Sandy SILT: pale brown with orange staining, non plastic. Sand is fine grained. Occasional coarse pumice gravel lenses.				76							
					...becoming grey and very stiff.											
			3			W	Vst to H		89				(5,7,6) N* = 13, Recovery = 400mm			
									81							
			4													
									100				(10,13,9) N* = 22, Recovery = 450mm			
		-1.6	5		SM: Sandy SILT: grey-green with occasional orange staining, non to low plasticity. Sand is fine grained.										HQ	
						M			86							5.8-5.9m: SAMPLE F1-005
			6				F to St		71				(1,2,2) N* = 4, Recovery = 320mm			
									76							
			7													
		-3.8			ML: Clayey SILT: grey-green, low plasticity. Soft, greasy when reworked.											
Peat		-4.0			Pt: PEAT: yellow-brown, stiff, fibrous, slightly decomposed.				73				(0,1,0) N* = 1, Recovery = 330mm			
		-4.6	8		OL: Organic SILT with trace organic inclusions: brown-black, greasy. Organic inclusions are partially decomposed, fibrous.	M to W	S									
		-5.0			ML: Clayey SILT: grey-green, low to medium plasticity. Soft, sticky, greasy when reworked.				67							
		-5.3			OL: Organic SILT with trace organic inclusions: black, non plastic. Highly decomposed.											
Alluvial Deposits			9			M			100				(0,0,3) N* = 3, Recovery = 450mm			
		-6.1			...becoming black.											
		-6.4			SM: Silty fine to medium SAND: pale grey-brown to orange-brown, poorly graded.				71							
			10		SW: Gravelly fine to coarse SAND: grey, well											
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 15 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F1-MB05

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 12/07/2016
Borehole Location: Refer to Figure 02

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1937902.3m N.5791118.8m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.38m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		graded. Gravel is fine black lithics and quartz.				100				(4,12,18) N* = 30, Recovery = 450mm			
									86							
			12						61				(7,13,20) N* = 33, Recovery = 300mm			
					...occasional coarse subangular gravel, dark grey.	M to W	MD to D									
			13						57							
									78				(7,9,9) N* = 18, Recovery = 350mm			
		-10.6	14		NO RECOVERY:				0							
		-11.6	15		SW: Gravelly fine to coarse SAND: grey, well graded. Gravel is fine black lithics and quartz.		VD		33				(15,19,27) N* = 46, Recovery = 150mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 15 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F2-HA01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: OMG
Checked by: KB
Position: E.1937159.5m N.5789103.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.65m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		2.7			OL: TOPSOIL - Organic SILT: brown, non plastic.					
Fill		2.6			ML: SILT with trace sand: brown mottled grey, low plasticity. Sand is fine grained. Occasional fine pumice gravel.	M	VSt	V-175(41)		
								V-116(52)		
TS		2.1			OL: Organic SILT: black mottled brown, low plasticity.	M to W				
Alluv.		1.9			ML: Clayey SILT: light brown, low to medium plasticity. Greasy when reworked.			V-112(64)		
Peat		1.8			SW: Fine to coarse SAND: grey, well graded, pumiceous. Occasional fine pumice gravel.					
		1.7	1		OL: Organic SILT: black, non plastic. Slight sulphurous odour. Trace organic fibres.	M	MD to D			
		1.5			SM: SILT with trace gravel: grey-brown, non plastic. Gravel is fine, pumiceous.					
		1.4			SP: Fine to medium SAND with some gravel: grey, well graded. Gravel is fine, pumiceous.					
		1.3			SM: SILT with trace sand: grey-brown, non plastic. Sand is fine grained. Occasional coarse pumiceous gravel.			V-UTP		
Alluvial Deposits					*...Poor recovery.*	M to W		V-UTP		
			2							
					Borehole terminated at 2.5 m		D to VD			3.9m: DCP - Refusal
			3							
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 1.8m. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F2-HA02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936775.1m N.5788312.5m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.71m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Topsoil		2.7			OL: TOPSOIL/Organic SILT: dark brown-black, non plastic to low plasticity. Occasional fibrous inclusions.	M to W	F to St	V-50(30)		
					...becoming sandy organic silt; sand is fine to coarse grained.					
Alluvial Deposits		1.8	1		GP: Fine to medium GRAVEL: grey, subangular, pumiceous.					
		1.6			SM: SILT with minor gravel: grey, non plastic. Powdery when reworked. Gravel is medium, pumiceous.	W	MD to D			
					...no gravels present.					
					Borehole terminated at 1.6 m					
			2							
			3				D to VD			
			4							4.4m: DCP - Refusal
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.0m.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F2-HA03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 20/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: OMG
Checked by: KB

Position: E.1936605.7m N.5787977.4m (NZTM)
Survey Source: GPS Survey

Elevation: RL 2.46m
Datum: Moturiki

Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm)	Comments
TS		2.5			OL: TOPSOIL - Organic SILT: black, non plastic, minor rootlets.	D to M	VSt			
		2.3			ML: Clayey SILT: pale brown mottled orange, low plasticity.			V-162(51)		
Alluvial Deposits		2.2			SP: Fine to medium SAND: pale grey, poorly graded. *...auger was able to be pushed from 0.4m to 0.8m.*	M	L			
	▼	1.7	1		ML: SILT with some sand: black-brown, low plasticity; trace black organic fibres. Greasy when reworked. Sand is fine to medium grained.	M to W	St	V-120(54)		
		1.4			SP: SILT with trace sand: pale grey, non plastic. Sand is fine grained.	W	D	V-93(38)		
					Borehole terminated at 1.5 m					
			2				L to MD			
			3				D to VD			
			4							
			5							

Dynamic Cone Penetrometer (Blow/100 mm): 5 10 15 20

Termination reason: Hole Squeeze

Remarks: Shear vane - 1912. Little to no recovery from 1.2m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F2-HA04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 20/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: OMG
Checked by: KB

Position: E.1936506.4m N.5787826.1m (NZTM)
Survey Source: GPS Survey

Elevation: RL 3.81m
Datum: Moturiki

Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Topsoil		3.8			OL: TOPSOIL - Organic SILT: black, non plastic, minor rootlets.	M		V-109(32)		
					...some medium to coarse sand.					
Fill		3.4			SP: Fine to medium SAND: pale grey, poorly graded.	D to M				
TS		3.2			OL: SILT: black, low plasticity. Greasy when reworked. Trace hard organic inclusions and soft fibrous inclusions (10% of matrix).	M to W	VSt	V-139(34)		
					...becoming dark brown.					
Alluvial Deposits		3.0	1		SM: SILT with trace sand: pale grey-brown streaked orange orange-brown, low plasticity, poorly graded. Sand is coarse, pumiceous.					
		2.4			SW: Fine to coarse SAND: grey-brown, well graded.	W				
			2		Borehole terminated at 2.0 m					
			3				D to VD			
			4							
			5							

Termination reason: Hole Squeeze

Remarks: Shear vane - 1912. Little to no recovery from 1.8m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG Position: (NZTM) Elevation: RL 4.30m
Checked by: KB Survey Source: GPS Survey Datum: Moturiki Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		4.3	1		SW: Fine to coarse SAND with minor gravel: brown with some orange staining, well graded. Gravel is fine, black, subangular. Occasional medium pumice gravel.	M	MD		100							
		3.0			OL: Organic SILT : dark grey, non plastic. Occasional fine pumice gravel.	D to M			100				(2,8,8) N* = 16, Recovery = 450mm			
			2		*...becoming greasy when reworked, spongy and soft.*	M...										
		2.2			SM: Sandy SILT with some gravel: grey, poorly graded, non plastic. Sand is medium to coarse grained. Gravel is fine, pumiceous.				76							
TS		1.8			OL: Organic SILT with trace gravel: black to grey-green, non plastic. Stiff. gravel is fine, pumiceous.											
		1.7			SM: Sandy SILT: grey, non plastic, pumiceous. *...becoming powdery when reworked.*	M										
			3						84				(6,9,11) N* = 20, Recovery = 380mm			
		0.8			SM: SILT with trace sand: grey, non plastic to low plasticity, powdery when reworked. Sand is fine grained. Occasional coarse pumice gravel.				100							
			4										(10,13,14) N* = 27, Recovery = 450mm			
Alluvial Deposits							Vst to H		100							
			5		*...dark grey bedding; thin, sub-horizontal.*										HQ	
						D to M			100							
			6										(8,8,7) N* = 15, Recovery = 400mm			
									89							
			7						71							
		-3.0			Pt: PEAT: slightly decomposed organic wood fragment. Black, fibrous, greasy.											
									84				(0,1,0) N* = 1, Recovery = 380mm			
		-3.6	8		OL: Organic Clayey SILT: dark grey, low to medium plasticity. Greasy, spongy. Some hard organic inclusions. Occasional coarse pumice gravel.											
Peat		-4.0			Pt: PEAT: slightly decomposed organic wood fragment, brown, fibrous, greasy.	W	S		71							
			9										(1,0,0) N* = 0, Recovery = 110mm			
									24							
		-5.3			ML: SILT with some clay: grey-green, low to medium plasticity, soft, greasy. Trace stiff organic inclusions; brown-yellow.											
			10						100							
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG | Position: (NZTM) | Elevation: RL 4.30m
Checked by: KB | Survey Source: GPS Survey | Datum: Moturiki | Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	SPT N-Value	Comments/Defect Description
Alluvial Deposits					...becoming brown.	M to W					
			11		...some gravelly medium to coarse sand, pumiceous.			100		(0,0,0) N* = 0, Recovery = 450mm	
		-7.0 -7.1			SM: Sandy SILT: grey-green, low plasticity, greasy. Sand is fine grained.	M	St	95			11.5-11.8m: SAMPLE F2-001
		-7.6			ML: SILT with some clay: grey-green, low to medium plasticity, greasy. ...becoming sandy; medium to coarse, pumiceous.						
			12		SW: Gravelly fine to coarse SAND: grey, well graded. Gravel is fine black lithics with some coarse, subangular pumice.			67		(4,6,6) N* = 12, Recovery = 300mm	
			13			M to W		100			
Pt		-9.0 -9.1			OL: Organic SILT: brown-black, low plasticity, greasy.	M	MD to D				
Alluv.					SP: Fine SAND: pale grey, poorly graded, pumiceous.			100		(13,17,16) N* = 33, Recovery = 450mm	
		-9.6	14		SW: Fine to coarse SAND: pale grey, well graded, pumiceous. Occasional medium pumice gravel.						
Peat		-10.1			OL: Organic SILT: brown-black, low to medium plasticity. Soft, spongy, greasy. Trace organic fibres.	M to W		86			
Alluv.		-10.5	15		SM: Sandy SILT: grey-brown, non plastic. Sand is fine grained. ...becoming powdery when reworked		St	100		(2,3,7) N* = 10, Recovery = 450mm	
					Borehole terminated at 15.5 m						
			16								
			17								
			18								
			19								
			20								

Weathering: RS, CW, HW, MW, SW, DW
Estimated Strength: EW, VW, W, MS, S, VS, ES
Vane Shear Strength (kPa) Peak (Residual)
Defect Spacing (mm): <20, 20-60, 60-200, 200-600, 600-2000, >2000
Drilling Method/ Support

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 27/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936768.2m N.5788315.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.29m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
TS		4.3			OL: TOPSOIL - Organic SILT with minor fine sand: brown, non plastic, minor rootlets.											
		4.2			SM: Silty fine SAND: brown, some coarse grains, poorly graded. Occasional coarse pumice gravel.		L to MD									
					...some orange staining and medium black gravel inclusions.				100							
Fill			1			D to M										
		3.1			SM: SILT: grey-green, non plastic. Very stiff, powdery when reworked. Occasional coarse pumice gravel.								(7,7,5) N* = 12, Recovery = 450mm			
					...becoming sandy; grey, fine to medium grained.		VSt		100							
			2		*...becoming brown.*											
		2.1			OL: Organic SILT with some sand: black, low to medium plasticity. Spongy, greasy. Sand is fine grained. Trace hard organic inclusions (20% of matrix).	M										
TS		1.7			SM: SILT with some gravel: grey, non plastic, powdery when reworked. Gravel is coarse, pumiceous.	M to W			100							
			3						80				(6,6,10) N* = 16, Recovery = 360mm			
		0.8			SM: SILT with trace sand: grey, non plastic. Powdery when reworked. Intermittent bands of fine to coarse pumice sand with occasional coarse pumice gravel.											
			4		*...black organic inclusions; brittle, stiff.*				100							
							Vst to H						(7,5,7) N* = 12, Recovery = 350mm			
			5			M			78						HQ	5.2-5.3m: SAMPLE F2-002
					...dark grey bedding; thin, sub-horizontal.				100							
			6		*...becoming sandy.*								(6,3,1) N* = 4, Recovery = 110mm			
Alluvial Deposits									24							
		-2.2			SW: Gravelly fine to coarse SAND: grey, well graded, pumiceous. Gravel is fine, black.											
		-2.3			ML: Clayey SILT: grey-green, low to medium plasticity. Soft, greasy.	M to W										
		-2.6	7		SM: SILT: grey-green, non plastic to low plasticity.				100							
						M										
									100				(0,0,0) N* = 0, Recovery = 450mm			
		-3.7	8		ML: Clayey SILT: grey-green streaked brown, low to medium plasticity. Soft, spongy. Occasional hard organic inclusions.		S									
					...50mm layer of hard organic fibres; dark brown. Occasional bright blue streaks.				86							
					...occasional hard organic inclusions.											
			9						100				(0,2,2) N* = 4, Recovery = 450mm			
		-5.4			SM: SILT with trace sand: grey-green, non plastic. Powdery when reworked. Sand is fine grained.				95							
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 27/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936768.2m N.5788315.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.29m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits		-6.2	11		ML: Clayey SILT with organic silt lenses: brown to grey-green, low to medium plasticity, greasy, spongy. Occasional hard organic inclusions; black.	M to W	St		100				(1,0,0) N* = 0, Recovery = 450mm			
		-7.1	12		ML: Clayey SILT: grey-green streaked brown, low to medium plasticity. Soft, greasy, spongy.		S		57							
					...becoming sandy.				100				(1,0,1) N* = 1, Recovery = 450mm			
		-8.5	13		SM: SILT with trace sand: brown to grey-green, non plastic. Powdery when reworked. Sand is fine grained.		St to VSt		76							
									89				(3,5,8) N* = 13, Recovery = 400mm			
			14						95							
		-10.3	15		SW: Fine to coarse SAND with some gravel: grey, well graded, pumiceous. Gravel is black, fine. Occasional coarse pumice gravel.		MD		60				(4,6,10) N* = 16, Recovery = 270mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 21/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936594.3m N.5787982.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.01m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
TS		4.0			OL: TOPSOIL - Organic SILT: dark brown, non plastic, minor rootlets.	M										
		3.8			SM: Silty fine SAND: orange-brown, poorly graded. Soft.	D to M			100							
Fill			1		*...becoming fine to coarse grained.*	M	L to MD									
					...becoming pale brown streaked orange.	D to M			53				(3,3,2) N* = 5, Recovery = 240mm			
		2.1	2		ML: Clayey SILT: brown, low plasticity. Greasy when reworked.	M	St		71							
Pt		1.9			OL: Organic SILT with some hard organic inclusions: black, low plasticity. Organic inclusions are fibrous, stiff.	D to M										
		1.6			SM: SILT with some sand: pale brown-grey, non plastic. Sand is fine grained.	M	VSt									
			3						100				(3,4,4) N* = 8, Recovery = 450mm			
		0.6			SP: Medium to coarse SAND with trace gravel: grey-brown, poorly graded. Gravel is coarse, subangular, pumice (up to 50mm dia).											
		0.2			SM: SILT with trace sand: pale brown-grey, non plastic. Sand is fine grained. Occasional coarse subangular to subrounded pumice (up to 35mm dia).	D to M			100							
			4													
		-0.2			*...hard organic inclusions.*	M	MD									
					SP: Coarse SAND with some gravel and organic inclusions: pale grey-brown, poorly graded, pumiceous. Gravel is coarse, subrounded, pumice (up to 25mm dia). Organic inclusions are stiff, fibrous.				80				(4,5,5) N* = 10, Recovery = 360mm			
		-0.9	5		SM: SILT with some sand: pale brown-grey, non plastic. Occasional medium to coarse pumiceous sand lenses.	W	St								HQ	
Alluvial Deposits		-1.5			SP: Fine to medium SAND: grey, poorly graded.	M	MD		100							
			6						100				(6,6,9) N* = 15, Recovery = 450mm			
		-2.4			ML: SILT with trace sand: pale brown, low plasticity. Sand is medium grained, pumiceous.	M to W	St to VSt		48							
			7		*...becoming grey-green.*											
					...becoming pale brown.				100				(1,3,3) N* = 6, Recovery = 450mm			
		-3.9	8		ML: Clayey SILT: grey-green to brown, low plasticity. Powdery and greasy when reworked.	M			71							
		-4.3			*...becoming brown.*											
		-4.4			SP: Medium SAND: grey-brown, poorly graded.											
Peat					Pt: PEAT: black, slightly decomposed wood fragment, fibrous, hard. Up to 50mm dia and 1.15m long.											
			9						76				(3,3,4) N* = 7, Recovery = 340mm			
		-5.5			SP: Medium to coarse SAND: grey-brown, poorly graded.											
		-5.6			ML: Clayey SILT: green-grey, low plasticity. Powdery				100							
			10													

Continued on next sheet

Termination reason: Target Depth

Remarks: Logged 24 June 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 21/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936594.3m N.5787982.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.01m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits					and greasy when reworked. Trace fibrous organic inclusions.	M to W										
		-6.9	11		SW: Fine to coarse SAND: grey-green, well graded.		L		69				(1,2,6) N* = 8, Recovery = 310mm			
		-7.4			SM: SILT: brown-grey, low plasticity. Greasy.	M	VSt		100							
		-8.1	12		SM: SILT with some sand: brown-grey, non plastic. Sand is fine grained.				53				(3,2,3) N* = 5, Recovery = 240mm			
						M to W										
			13		*...becoming grey-green. Sand is fine to medium grained.*	M			100							
					...becoming brown-grey.											
		-9.4			SW: Fine to coarse SAND: grey, well graded.		L		40				(0,2,4) N* = 6, Recovery = 180mm			
		-9.9	14		SW: Fine to coarse SAND with some gravel: grey, well graded. Gravel is coarse, subrounded, pumice (up to 15mm dia).	M to W	MD		100							
			15						62				(5,7,11) N* = 18, Recovery = 280mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 24 June 2016. TS stratigraphic code denotes Topsoil. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 20/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936503.2m N.5787828.5m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.43m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
TS		4.4			OL: TOPSOIL - Organic SILT: black, non plastic, minor rootlets.	D to…										
		4.2			SM: Silty fine SAND with some gravel: pale grey-brown, poorly graded. Gravel is fine, pumice.	M										
					...becoming coarse grained.											
Fill		3.6			ML: SILT with some sand: pale grey-brown streaked orange, non plastic. Sand is fine to medium grained.				91							
			1				St									
		3.2			OL: Organic SILT with trace sand: black, non plastic. Sand is medium grained. Trace hard organic inclusions and trace coarse subangular gravel.	D to M							(8,3,1) N* = 4, Recovery = 340mm			
									76							
TS		2.5	2		OL: Organic SILT: black, low plasticity. Greasy when reworked. Occasional bands of fine sand	M										
		2.1														
		2.0			SP: Coarse SAND: pale grey-white, poorly graded, pumiceous.	D to…										
					SM: SILT with some sand: pale grey-brown, low plasticity. Sand is fine grained. Occasional bands of coarse pumice gravel.	M			90							
			3			M to W							(4,7,12) N* = 19, Recovery = 450mm			
									100							
						D to M			100							3.4-3.7m: SAMPLE F2-003
			4				Vst to H						(8,8,7) N* = 15, Recovery = 200mm			
									44							
			5												HQ	
						M			70							
Alluvial Deposits		-1.6	6		ML: Clayey SILT: grey, low plasticity. Greasy when reworked.				44				(3,1,1) N* = 2, Recovery = 380mm			
						M to W	F									
		-2.6	7		SP: Silty fine SAND: grey, poorly graded.	M			100							
							MD									7.3-7.5m: SAMPLE F2-004
			8		*...becoming brown*								(3,6,5) N* = 11, Recovery = 450mm			
		-3.8				M			100							
		-4.0			ML: Clayey SILT: brown, low plasticity. Greasy when reworked.		St									
					SP: Silty fine SAND: green-grey, poorly graded.		L		95							
		-4.3														
		-4.4			SW: Fine to coarse SAND with some gravel: dark grey, well graded. Gravel is medium, pumice.											
			9		SM: SILT: green-grey, non plastic. Occasional subangular pumice gravel.	D to M							(1,0,1) N* = 1, Recovery = 200mm			
									44							
		-5.0			ML: Clayey SILT: brown to grey-green, low plasticity. Greasy when reworked.	M										
									90							
		-5.5														
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 20 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F2-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 20/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936503.2m N.5787828.5m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.43m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits		-5.8			SP: Fine to medium SAND with some gravel: grey, poorly graded. Gravel is coarse, subrounded to subangular, pumice.	M to W										
					SM: SILT with some sand: grey-green, non plastic. Powdery when reworked. Sand is fine grained.	M	F to St		100				(0,1,3) N* = 4, Recovery = 450mm			
		-6.5	11		ML: Clayey SILT: grey-green, low plasticity. Greasy when reworked.	W										
		-6.8			ML: SILT: grey-green, non to low plasticity. Powdery when reworked.				84							
					...brown-grey and grey-green bedding with minor fine sand.											
		-7.4	12		SP: Fine to medium SAND with some gravel: grey, well graded. Gravel is medium to coarse, pumiceous.		L		100				(2,4,5) N* = 9, Recovery = 450mm			
		-8.1			ML: Clayey SILT with some sand: brown-black, low plasticity. Greasy and powdery when reworked. Sand is fine grained.		F to St		100							
			13		*...becoming sandy.*	M							(2,3,4) N* = 7, Recovery = 200mm			
									44							
		-9.5	14		SW: Gravelly fine to coarse SAND: grey-white, well graded. Gravel is coarse, subangular to subrounded, pumiceous (up to 25mm dia).		MD		76							
			15										(4,9,11) N* = 20, Recovery = 220mm			
									49							
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 20 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F3-HA01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936493.2m N.5788473.0m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.24m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		2.2			OL: TOPSOIL/Organic SILT: brown, non plastic.					
Fill		2.2			SM: Silty fine SAND: grey brown, poorly graded. *...brown silt lense at 0.2m - 50mm thick.*	D				
TS		1.7			OL: Organic SILT: brown, low plasticity.		VSt	V-147(43)		
Alluv.		1.4	1		ML: SILT with minor clay: grey, low plasticity. Slightly greasy when reworked.	M		V-189+		
		1.1			SW: Fine to coarse SAND : grey, well graded, pumiceous.		MD to D			
Peat		0.9			Pt: PEAT/Organic SILT: black. Fibrous, slight organic odour.					
Alluv.		0.6			SP: Fine to medium SAND with trace gravel: grey-brown, poorly graded. Gravel is fine, pumiceous. *....poor recovery. Some powdery sand/silt layers.* *...no recovery.*	W				
			2		Borehole terminated at 2.2 m					
			3				D to VD			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. Little to no recovery from 1.8m. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F3-HA02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936274.5m N.5788134.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.15m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		2.2			SM: Silty fine to medium SAND: brown, poorly graded.					
		2.1			SM: SILT with trace sand: brown, low plasticity. Sand is fine to medium grained.			V-86(27)		
					...trace organic silt					
Alluv.		1.8			ML: Clayey SILT: light brown, low to medium plasticity. Greasy when reworked.		St	V-66(33)		
		1.2	1		SW: Fine to coarse SAND with minor gravel: grey, well graded, pumiceous. Gravel is fine, pumiceous.	S				
Peat		1.1			OL: Organic SILT: black to dark brown, fibrous.		VSt			
					...no recovery from 1.2m to 1.5m.					
Alluv.		0.6			SM: SILT: grey, poorly graded, non plastic.					
			2		*...no recovery from 1.7m to 2.1m.*					
					Borehole terminated at 2.1 m					
			3				D to VD			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 1.7m. Groundwater at 0.05m. Alluv. stratigraphic code denotes Alluvial Deposits.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F3-HA03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936014.5m N.5787729.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.84m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		2.8			ML: SILT with trace gravel and sand: brown, moist, slightly organic. Gravel is fine, black. Sand is medium to coarse. *...hand auger pushed easily from 0.3m to 0.9m.*	M	VS to S	V-24(15)		
TS		1.9			OL: Organic SILT: black, low plasticity. Fibrous.			V-UTP		
Alluvial Deposits		1.9	1		SW: Fine to coarse SAND with trace gravel.: brown, well graded, pumiceous. Gravel is fine, black.	M to W	L to MD			
		1.6			SW: Gravelly fine to coarse SAND: light brown, well graded, pumiceous. Gravel is fine, pumiceous.					
		1.4			SM: SILT with trace gravel: grey, non plastic, dilatant. Gravel is fine, pumiceous. *...little to no recovery from 1.5m.* *...becoming gravelly.*	W				
			2		Borehole terminated at 2.0 m					
			3				MD to D			
			4							
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 1.5m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - F3-HA04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 28/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1935710.4m N.5787570.3m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.02m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm)	Comments
TS		4.0			OL: TOPSOIL - Organic SILT: brown, low plasticity.	M				
		3.8			ML: SILT: grey-brown, non plastic.			V-127(46)		
		3.6			SM: SILT with trace sand: grey, non plastic. Sand is fine grained.			V-67(45)		
Alluvial Deposits			1			M to W	St to VSt	V-112(48)		
		2.8			ML: Clayey SILT: grey-brown, low to medium plasticity.			V-148(67)		
		2.2			SW: Fine to coarse SAND with some gravel: grey, well graded. Gravel is fine, pumiceous	W				
			2		Borehole terminated at 2.0 m					
			3				MD to D			
			4				D to VD			
			5							

Dynamic Cone Penetrometer (Blow/100 mm): 5 10 15 20

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 1.8m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 05/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936501.3m N.5788466.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.97m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW UW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		4.0			SM: Sandy SILT: orange-brown, non plastic, minor rootlets. Sand is medium to coarse grained.	D to M										
		3.4			SW: Gravelly fine to coarse SAND: orange-brown, well graded, occasional pumiceous grains. Gravel is dark red-brown, coarse, subrounded.	M			100							
		3.1	1		SM: Sandy SILT: orange-brown, non plastic. Sand is medium to coarse grained.		MD									
		2.9			SW: Gravelly fine to coarse SAND: orange-brown, well graded, occasional pumiceous grains. Gravel is dark red-brown, coarse, subrounded.				80				(7,10,7) N* = 17, Recovery = 360mm			1.3-1.4m: SAMPLE F3-001
		2.0	2		SM: Sandy SILT: grey, non plastic to low plasticity. Sand is coarse grained, pumiceous.											
TS		1.8			ML: Clayey SILT: dark brown-grey, low plasticity. Very stiff. Occasional fibrous organic inclusions.		VSt		90							
Alluvial Deposits		1.2														
		1.1	3		ML: Clayey SILT: pale brown, low plasticity. Very stiff.											
					SP: Fine SAND with organic silt: grey, poorly graded. Organic silt is black, greasy when reworked. Some hard organic inclusions (up to 5mm).				73				(2,3,5) N* = 8, Recovery = 330mm			
		0.5			SW: Silty fine to coarse SAND: brown-grey, well graded, pumiceous.	M...	L									
		0.3			GP: Sandy coarse GRAVEL: grey, poorly graded, subangular to subrounded, pumiceous. Sand is fine to medium grained.				100							
		0.1			SW: Gravelly fine to coarse SAND: grey, well graded. Gravel is coarse, pumiceous.											
		-0.1	4		SM: Sandy SILT: grey, non plastic, powdery when reworked. Sand is fine grained. Occasional coarse pumice gravel.											
					...becoming gravelly.				100				(9,9,12) N* = 21, Recovery = 450mm			
		-1.0	5		SM: SILT with trace sand: grey, non plastic. Sand is fine grained. Occasional coarse pumice gravel.		Vst to H		100						HQ	
Peat		-1.8														
			6		OL: Organic SILT: grey, low plasticity, highly decomposed. Some soft organic fibrous inlcusions (40% of matrix).		F		80				(0,1,4) N* = 5, Recovery = 360mm			
Alluvial Deposits		-2.5			SM: SILT with some sand: grey-green, non plastic. Sand is fine grained	M										
			7				F to St		43							
									100				(1,1,2) N* = 3, Recovery = 450mm			
		-4.0	8		ML: Clayey SILT: grey-green, low to medium plasticity. Soft, greasy.		S									
		-4.4			*...becoming brown-grey and sandy; fine grained.*				86							
					SM: SILT with some sand: brown-grey, non plastic. Occasional lenses of fine to medium sand; pumiceous. Occasional organic lenses; stiff, fibrous.		VSt									
			9						76				(6,9,9) N* = 18, Recovery = 340mm			
Pt		-5.5														
		-5.6			Pt: PEAT: brown-yellow. Hard organic wood fragment, slightly decomposed, fibrous. Up to 50mm diameter and 0.15m long.				86							
			10		ML: Clayey SILT: grey-green, low to medium											
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 05/07/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936501.3m N.5788466.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.97m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits					plasticity. Soft, greasy.											
			11		...becoming powdery when reworked. Occasional hard organic layers; brown, fibrous.		S		100 62				(0,0,2) N* = 2, Recovery = 450mm			
		-7.9	12		ML: Clayey SILT: brown, low to medium plasticity. Stiff, greasy.		St		100				(0,2,2) N* = 4, Recovery = 450mm			
		-8.5			ML: Clayey SILT: grey-green, low to medium plasticity, greasy.		F		76							
			13		...becoming brown. Trace organic fibrous inclusions.				100				(2,3,9) N* = 12, Recovery = 450mm			
		-10.0 -10.0	14		SP: Fine SAND: grey-brown, poorly graded. ML: Clayey SILT: brown, low to medium plasticity. Stiff, greasy.	M to W	St		81							
		-10.5			SM: SILT: brown, low plasticity. Greasy and powdery when reworked.	M										
		-10.8	15		SP: Fine to medium SAND: grey, poorly graded.	W	MD									15.0-15.4m: Missing SPT information.
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 05 July 2016. TS stratigraphic code denotes Topsoil. Alluv. stratigraphic code denotes Alluvial Deposits. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 24/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936284.7m N.5788128.1m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.86m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		3.9			SM: Sandy SILT with some gravel: pale brown, low plasticity. Sand is medium grained.	D										
		3.7			SM: SILT with trace gravel: brown with orange-brown staining, non plastic. Gravel is coarse, pumiceous.	D to…	St		100							
			1			M										
		2.5			SW: Fine to coarse SAND with some gravel: grey-brown, well graded. Gravel is coarse, pumiceous.				78				(4,3,3) N* = 6, Recovery = 350mm			
TS		1.8	2			M to W										
		1.6			OL: Organic SILT with trace organic fragments: black, low plasticity. Organic fragments are moderately decomposed, fibrous, spongy.		F to St		100							
		1.3			SP: Fine to medium SAND with some gravel: grey-black, poorly graded. Gravel is fine, pumiceous.											
			3		ML: Clayey SILT with trace organic fragments: black and grey bedding, low plasticity. Organic fragments are moderately decomposed, fibrous, spongy.	W			89				(4,4,9) N* = 13, Recovery = 400mm			
Alluvial Deposits		0.4			SM: SILT with trace gravel: grey, non to low plasticity. Gravel is coarse, subrounded, pumiceous.											
			4			M			100							
									91				(4,9,6) N* = 15, Recovery = 410mm			
			5		*...some hard organic inclusions; black, fibrous.*		VSt								HQ	
					...grey-brown bedding.				100							
			6			M to W										
									42				(6,3,3) N* = 6, Recovery = 190mm			
		-2.6			ML: Clayey SILT: grey-green, low plasticity. Greasy. Streak of broken down pumiceous material.											
		-3.0	7		SM: SILT with trace sand: pale grey and pale brown bedding, non plastic. Powdery when reworked. Sand is fine grained.				76							
					...becoming grey-green; trace thin organic fibres	M	S to F									
									100				(2,1,2) N* = 3, Recovery = 450mm			
			8													
		-4.5			ML: Clayey SILT: grey and brown bedding, low plasticity.	M to W			71							
Peat		-5.0	9		Pt: PEAT: slightly weathered organic wood fragment, black, fibrous, very stiff. Up to 50mm dia and 0.5m length.	M	VSt		82				(5,2,6) N* = 8, Recovery = 370mm			
		-5.7			SM: SILT with trace sand: grey-green, non plastic to low plasticity. Sand is fine grained. Occasional organic fibres.				57							
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 28 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 24/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936284.7m N.5788128.1m (NZTM)
Survey Source: GPS Survey
Elevation: RL 3.86m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW UW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits		-7.1	11		SW: Fine to coarse SAND with some gravel: grey-white, well graded, pumiceous. Gravel is fine black lithics.	M to W	VSt		69				(3,6,8) N* = 14, Recovery = 310mm			
			12						100							
			13				MD		89				(6,9,11) N* = 20, Recovery = 400mm			12.4-12.6m: SAMPLE F3-002
		-10.1	14		SW: Sandy GRAVEL: grey-white, pumice, coarse (up to 25mm dia). Some fine black lithics. Sand is coarse grained, pumiceous.				81							
			15						100				(3,4,8) N* = 12, Recovery = 450mm			
					Borehole terminated at 15.5 m				48							
			16						0				(10,8,10) N* = 18, Recovery = 0mm			
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 28 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 25/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936025.1m N.5787720.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.21m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
TS		4.2			OL: TOPSOIL - Organic SILT with trace sand: dark brown, non plastic, some rootlets.	D to…										
		4.1			SM: Sandy SILT: brown, non plastic. Sand is fine grained.											
Fill			1				S to F		90							1.3-1.5m: SAMPLE F3-003
									100				(1,2,1) N* = 3, Recovery = 450mm			
		2.3	2		OL: Organic SILT: dark grey streaked black, low plasticity. Soft, spongy.											
TS		1.8			SP: Fine SAND : grey, poorly graded, pumiceous.				100							
		1.6			*...becoming coarse.*											
			3		SP: Fine SAND with some gravel: grey-brown, poorly graded. Gravel is coarse, pumiceous. Occasional hard black organic inclusions.		MD		93				(3,6,6) N* = 12, Recovery = 420mm			
									100							
			4													
		0.1			SW: Sandy GRAVEL with minor silt: grey, fine to coarse, well graded, pumiceous. Sand is fine to coarse, pumiceous. Occasional sandy silt lenses.	M			100				(3,5,4) N* = 9, Recovery = 450mm			
			5												HQ	
									95							
Alluvial Deposits							L									5.8-6.0m: SAMPLE F3-004
			6						100				(4,4,5) N* = 9, Recovery = 450mm			
			7						100							
		-3.2			SP: Fine to medium SAND: grey, poorly graded.											
									100				(5,5,6) N* = 11, Recovery = 450mm			
		-3.7	8		SW: Fine to coarse SAND: black-grey, well graded, pumiceous. Occasional sandy silt lenses.											
									100							
		-4.3			SW: Sandy GRAVEL with minor silt: black-grey, fine to medium, subangular, pumiceous. Sand is fine to coarse, pumiceous. Occasional sandy silt lenses.		MD									
			9						71				(3,5,7) N* = 12, Recovery = 320mm			
									100							
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 28 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 25/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936025.1m N.5787720.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.21m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11						64				(3,6,6) N* = 12, Recovery = 290mm			
		-7.3			CORE LOSS:											11.5-12.0m: Core loss.
Peat		-7.8	12		OL: Organic SILT with fibrous inclusions: black, low plasticity. Soft.	M to W	S		100				(0,1,0) N* = 1, Recovery = 450mm			
Alluvial Deposits		-8.6	13		ML: Clayey SILT: grey-green, low plasticity. Greasy when reworked. *...becoming powdery when reworked.*		F		100							
									100				(1,2,4) N* = 6, Recovery = 450mm			
		-9.7	14		ML: Clayey SILT: grey-green with brown bedding, low plasticity. Greasy when reworked. Some fibrous black organic inclusions *...clayey silt, homogenous.*				100							
		-10.6	15		SW: Fine to coarse SAND: grey, well graded, pumiceous. Occasional gravel inclusions.		L						(10,3,4) N* = 7, Recovery = 450mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 28 June 2016. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 23/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1935709.0m N.5787579.3m (NZTM)
Survey Source: GPS Survey
Elevation: RL 5.00m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, UW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		5.0			GW: Fine to coarse GRAVEL: brown, subangular, loosely packed.											
		4.9			ML: Clayey SILT with trace sand and rootlets: brown-black, non plastic to low plasticity. Firm. Sand is medium grained, pumiceous.											
Alluvial Deposits		4.3	1		SM: SILT with trace sand: brown, non plastic. Firm. Sand is fine grained. *...becoming pale brown.* *...becoming soft.*	M	F						(0,0,0) N* = 0, Recovery = 120mm			
		3.0	2		ML: Clayey SILT: pale brown stained orange, low plasticity. Soft, greasy when reworked.	W	S									
		2.5	3		SW: Fine to coarse SAND: grey, well graded, pumiceous. *...becoming medium to coarse grained.*	M to W	MD						(3,6,5) N* = 11, Recovery = 300mm			2.8-3.0m: SAMPLE F3-005
Peat		0.9	4		OL: Organic SILT with some fibrous inclusions: black, non plastic. Fibrous inclusions are partially decomposed, stiff.	M	St to VSt						(3,6,10) N* = 16, Recovery = 410mm		HQ	
Alluvial Deposits		0.5	5		SM: SILT: grey-brown, non plastic. Greasy and powdery when reworked. *...becoming sandy.*											
		-0.6			SP: Gravelly medium to coarse SAND: grey-brown, poorly graded, pumiceous. Gravel is fine to medium, subrounded.	M to W	MD									
		-0.9	6		SM: SILT with trace sand: grey-brown, non plastic. Sand is fine grained.	M	VSt						(7,9,7) N* = 16, Recovery = 360mm			
		-1.5			SW: Gravelly fine to coarse SAND with some silt: grey-brown, well graded, pumiceous. Gravel is fine to medium, subrounded, pumice.		MD									
		-2.0	7		SM: SILT with some gravel: grey, non plastic. Gravel is coarse, pumiceous.		VSt						(8,9,10) N* = 19, Recovery = 310mm			
			8		*...becoming grey-brown.* *...no gravel present.*	D to M										
Peat		-3.8	9		Pt: PEAT: grey-brown streaked yellow, highly decomposed. Soft, fibrous, spongy.	M to W							(0,0,0) N* = 0, Recovery = 450mm			
		-4.7			ML: Clayey SILT: grey-green, low plasticity. Soft, greasy and slightly powdery when reworked.											
			10		Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 24 June 2016. Heavy rainfall event occurred 22 June 2016 and caused flooding and ponding on site.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - F3-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 23/06/2016
Borehole Location: Refer to Figure 03

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1935709.0m N.5787579.3m (NZTM)
Survey Source: GPS Survey
Elevation: RL 5.00m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		...50mm fine to medium sand lens.	M	S to F						(2,2,2) N* = 4, Recovery = 450mm			
					...occasional layers of black bark; becoming spongy											
Peat		-6.9	12		Pt: Organic SILT with some organic inclusions: black-brown, low plasticity, soft, spongy. Trace organic fibres and sand.	M to W							(3,2,2) N* = 4, Recovery = 320mm			
		-7.6			ML: Clayey SILT with trace organic inclusions: grey-brown, low plasticity. Soft, greasy, spongy.											
Alluvial Deposits		-7.9	13		SW: Fine to coarse SAND: grey, well graded, pumiceous.											
					...minor coarse subangular pumice gravel (up to 25mm)	M	MD						(7,10,9) N* = 19, Recovery = 320mm			
		-9.2	14		ML: Clayey SILT with minor sand: grey-brown, low plasticity. Soft, greasy, spongy. Sand is medium grained, pumiceous.	M to W	S									
		-9.7			SM: SILT: grey-green, non plastic.	M	Vst to H						(8,10,11) N* = 21, Recovery = 450mm			
			15		Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 24 June 2016. Heavy rainfall event occurred 22 June 2016 and caused flooding and ponding on site.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1938561.6m N.5794154.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 0.16m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
TS		0.2			OL: Organic SILT with trace fine sand: brown, low plasticity, trace rootlets.											
		0.1			ML: Clayey SILT: pale brown with orange staining, low to medium plasticity. Greasy when reworked. Soft. Occasional fine organic fibres.	M	S		100							
			1		*...becoming dark grey, very soft.*											
		-1.3			NO RECOVERY : Possible Peat layer				0				(0,0,0) N* = 0, Recovery = 0mm			
		-1.8	2		SP: Fine to medium SAND with organic silt: pale grey, poorly graded. Interbedded organic silt and wood fragments; fibrous, partially decomposed with slight organic odour. Stiff.	M to W										
		-2.1			SM: SILT: grey, low plasticity. Very stiff. Occasional fine organic fibres and fine pumice gravel.	M	VSt		86							
			3						89				(5,11,12) N* = 23, Recovery = 400mm			
									90							
		-3.9	4		*...interbedded medium to coarse pumice gravel and organic plant fibres.*											
					ML: Clayey SILT: dark grey, low to medium plasticity. Soft, greasy. Occasional yellow-black fibrous inclusions.	M to W	S		100				(0,0,0) N* = 0, Recovery = 450mm			
			5						76						HQ	
		-5.6			SM: SILT with trace sand: pale grey with dark grey bedding, low plasticity. Sand is fine grained.											
			6						47				(0,2,1) N* = 3, Recovery = 210mm			
		-6.3			ML: Clayey SILT with organic inclusions: dark grey, low to medium plasticity. Soft, greasy. Organic inclusions are yellow-brown, fibrous.	M	S to F									
		-6.9	7		*...interbedded organic silt and medium to coarse sand.*				95							
					SM: Silty fine to medium SAND: dark grey, poorly graded. Occasional fine to medium pumice gravel. *...large coarse pumice gravel (35mm dia).*											
									100				(3,6,7) N* = 13, Recovery = 450mm			
		-7.8	8		GP: Sandy fine to medium GRAVEL: grey to dark grey, pumiceous, subrounded. Sand is medium to coarse grained. *...clayey silt lens; black soft, low plasticity.*				81							
			9		*...highly decomposed organic black wood fragment; fibrous, soft.*		MD						(5,5,8) N* = 13, Recovery = 420mm			
									93							
									95							
Alluvial Deposits			10		Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 11 July 2016.

MACHINE BOREHOLE - R1-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1938561.6m N.5794154.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 0.16m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits		-10.0	11		SW: Gravelly fine to coarse SAND: dark grey, well graded. Occasional medium pumice gravel.	M to W	D		100				(8,9,11) N* = 20, Recovery = 450mm			
		-11.0			GP: Sandy fine to medium GRAVEL: grey to dark grey, poorly graded, subangular to subrounded, pumiceous. Some quartz and black lithics. Sand is medium to coarse.				90							
		-11.2			SW: Gravelly fine to coarse SAND: dark grey, well graded. Occasional medium pumice gravel.											
		-11.6	12		GP: Sandy fine to medium GRAVEL: grey to dark grey, poorly graded, subangular to subrounded, pumiceous. Some quartz and black lithics. Sand is medium to coarse.				100				(9,14,16) N* = 30, Recovery = 450mm			
					...becoming black, dark green, grey. No medium pumice gravel present.				38							
			13										(6,13,19) N* = 32, Recovery = 360mm			
									80							
			14		*...some pumice gravel.*				67							
		-14.7	15		GW: Fine to coarse GRAVEL: dark grey, well graded, subrounded to subangular, smooth, flat.				89				(5,13,19) N* = 32, Recovery = 400mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 11 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 09/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1938446.2m N.5794260.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.44m
Datum: Moturiki
Angle from horizontal: 90°

Unit	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	RQD	SPT N-Value	Comments/Defect Description
Fill	4.4		SM: Silty fine to coarse SAND: pale brown, well graded. Occasional coarse pumice gravel.	M					
	4.3		ML: Clayey SILT with some sand: orange-brown with orange staining, medium plasticity, trace rootlets. Firm. Sand is coarse, pumiceous.	D to M					
	4.0		ML: SILT with trace clay: brown, low plasticity, minor rootlets. Firm. Occasional coarse sand.			100			
		1	*...becoming greasy when reworked and pale brown.*						
			...becoming brown.	M to W					
						17		(2,1,1) N* = 2, Recovery = 80mm	
	2.5	2	ML: Clayey SILT: brown with orange staining, low plasticity, trace fine organic fibres. Soft, greasy.	W					
Alluvial Deposits	2.0		SM: SILT with trace sand: brown with orange staining, non plastic. Powdery when reworked. Sand is fine grained.		S to F	62			
		3				82		(1,2,0) N* = 2, Recovery = 370mm	
	1.0		ML: SILT with minor sand and clay: dark grey, low plasticity, soft, greasy. Sand is coarse grained. Occasional thin organic layers; highly decomposed wood fragments, black.	M to W		95			
		4	*...some black organic plant fibres, stiff.*						
			...becoming powdery when reworked.					(1,1,0) N* = 1, Recovery = 230mm	
		5				51			HQ 5.0-5.1m: SAMPLE R1-001
	-0.8								
Peat	-0.9		OL: Organic SILT: black-grey, low plasticity, greasy. Soft, slight organic odour. Some fine organic fibres, brown.	M		100			
			SM: Organic SILT with some sand: black, highly decomposed, fibrous. Sand is dark grey, medium to coarse.	M...	F to St				
	-1.4								
	-1.6	6	ML: Clayey SILT: dark brown-black, medium plasticity. Firm to stiff, sticky, greasy. Occasional organic fibres.			78		(7,11,14) N* = 25, Recovery = 350mm	
Alluvial Deposits			SM: Sandy SILT with trace gravel: grey, low plasticity. Sand is fine grained. Very stiff to hard. Gravel is coarse, pumiceous. Some fine black lithics.	M	Vst to H				
		7				100			
	-2.8		ML: Clayey SILT with trace sand: grey-green with black bedding, low to medium plasticity. Soft, greasy. Sand is coarse, pumiceous. Two large organic root fragments up to 100mm length and 20mm dia, yellow-brown.	M to W		100		(1,0,0) N* = 0, Recovery = 450mm	
		8		W	S				
						90			
	-4.2		SP: Fine to medium SAND with some organic fragments: grey-black, poorly graded. Organic fragments are black, fibrous, moderately decomposed.	M					
	-4.6	9	SW: Gravelly fine to coarse SAND: pale grey-brown, well graded. Gravel is black, fine grained, subangular. Some medium to coarse, subrounded pumice. Occasional silty sand lenses.			100		(2,6,10) N* = 16, Recovery = 450mm	
						88			
		10							

Continued on next sheet

Termination reason: Target Depth

Remarks: Logged 11 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 09/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1938446.2m N.5794260.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.44m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		...no gravels.											
		-6.9			SP: Medium to coarse SAND with minor gravel: pale brown-grey, poorly graded. Gravel is fine grained, pumiceous.				71				(10,14,11) N* = 25, Recovery = 320mm			
					...10mm stained orange band.				100							
		-7.5	12		SP: Gravelly medium to coarse SAND : pale grey-brown, poorly graded. Gravel is medium grained, pumiceous.				78				(7,9,13) N* = 22, Recovery = 350mm			
					...becoming fine to coarse grained, well graded.	M to W	MD to D		90							
			13						91				(7,9,12) N* = 21, Recovery = 410mm			
			14		...becoming orange-grey.				81							
			15						100				(8,15,20) N* = 35, Recovery = 450mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 11 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 07/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1938508.8m N.5794386.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.51m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
TS		2.5			OL: TOPSOIL - Organic SILT: brown, low plasticity, trace rootlets.											
Alluvial Deposits		2.4			SM: SILT with some sand: grey-brown with orange staining, non plastic. Sand is fine grained. Occasional coarse pumice gravel.				100							
		1.4	1		ML: Clayey SILT: grey-green, low plasticity. Firm to stiff, slightly powdery when reworked.	M	F to St									
					...becoming sandy.				100				(1,0,1) N* = 1, Recovery = 450mm			
		0.4	2		ML: Clayey SILT: grey-brown, medium plasticity, greasy when reworked. Soft.		S		90							
		0.0			*...50mm organic layer; black, fibrous, stiff.*											
			3		SW: Gravelly fine to coarse SAND: grey to brown, well graded. Gravel is black, fine grained, subangular, flat.	M to W	L		40				(1,0,1) N* = 1, Recovery = 180mm			
Pt		-0.9				W										
		-1.0			OL: Organic SILT : dark brown, low plasticity, greasy. Very soft.											
			4		SM: Sandy SILT: grey, low plasticity. Sand is fine to medium grained. Occasional coarse pumice gravel (up to 20mm dia).		Vst to H		100							4.4-4.5m: SAMPLE R1-002
									100				(6,11,13) N* = 24, Recovery = 450mm			
			5		*...coarse interbedded pumice gravels and trace hard black organic inclusions*	M to W									HQ	
					...fine to coarse interbedded pumice gravel.				95							
		-3.2			SP: Gravelly fine SAND: grey, poorly graded. Gravel is fine to coarse, pumice, subrounded.		MD									
			6						96				(5,10,16) N* = 26, Recovery = 430mm			
		-3.9			SM: SILT with trace sand: grey, non plastic. Sand is fine grained.											
			7			M	Vst to H		62							
		-4.8			SP: Gravelly coarse SAND: grey, poorly graded, pumiceous. Gravel is black, subangular.											
									62				(5,9,11) N* = 20, Recovery = 280mm			
			8													
		-5.6			GP: Sandy medium to coarse GRAVEL: grey, black, dark green, poorly graded, subangular to subrounded. Some coarse pumice gravel. Sand is coarse grained, pumiceous.				95							
					...some orange staining.		MD									
			9										(6,13,16) N* = 29, Recovery = 420mm			
									93							
		-7.1			SW: Fine to coarse SAND: grey with occasional black and orange grains, well graded.				76							
			10													
					Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 11 July 2016. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 07/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1938508.8m N.5794386.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 2.51m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		...some fine gravel; black, subangular.	M to W	MD		100				(6,11,13) N* = 24, Recovery = 450mm			
			12						95							
									53				(4,9,16) N* = 25, Recovery = 240mm			
		-10.6	13		GW: Sandy fine to coarse GRAVEL: brown, orange and black, well graded, subangular to subrounded. Sand is coarse grained; grey. ...with orange staining.				100							
									100				(13,21,25) N* = 46, Recovery = 450mm			
		-11.6	14		...becoming grey, some pumiceous gravel. GP: Medium GRAVEL: grey, black, orange and dark green, poorly graded, subangular to subrounded. Some coarse pumice gravel.	W	D		95							
			15		...some fine to medium sand; pale brown.				56				(13,23,26) N* = 49, Recovery = 250mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 11 July 2016. Pt stratigraphic code denotes Peat.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R1-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 10/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1938435.2m N.5794563.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.49m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		4.5			ML: SILT with some coarse gravel: orange-brown, non plastic, minor rootlets. Gravel is dark red to grey, up to 50mm dia.											
		4.2			ML: SILT with trace fine sand: brown, non to low plasticity.	D to M										
			1		*...becoming pale brown with orange staining, occasional coarse subangular gravel. Very stiff.*		VSt		100							
					...becoming grey mottled brown and blue, friable. Hard.	D			91				(6,8,6) N* = 14, Recovery = 410mm			
		2.5	2		ML: Clayey SILT: dark grey mottled orange-brown, low to medium plasticity.											
		2.4			ML: SILT with some sand and trace clay: pale brown with orange staining, low plasticity, firm. Sand is fine grained.				100							
Alluvial Deposits			3													2.9-3.0m: SAMPLE R1-003
									84				(1,2,1) N* = 3, Recovery = 380mm			
					...some gravel; fine black lithics.		F									
					...becoming grey with orange staining.				86							
			4			M										
									69				(2,3,3) N* = 6, Recovery = 310mm			
		-0.5	5		SM: Silty fine SAND: grey with dark grey subhorizontal bedding, poorly graded.		MD		81						HQ	
		-1.4	6		SM: SILT with trace sand: pale brown-grey, non plastic. Powdery when reworked. Sand is fine grained.		Vst to H		84				(5,8,9) N* = 17, Recovery = 380mm			
Peat		-2.0			OL: Organic SILT with trace organic inclusions: black, non plastic. Organic inclusions are highly decomposed wood fragments, slight organic odour.		S									
		-2.1			SP: Gravelly coarse SAND with organic inclusions: grey, poorly graded, pumiceous. Gravel is fine black lithics. Organic inclusions are hard, black, fibrous.											
		-2.3	7		SM: SILT with trace sand: grey, low plasticity. Powdery when reworked. Sand is fine grained. Occasional thin gravel lenses; fine to medium, pumiceous.				100							
Alluvial Deposits							Vst to H									
									89				(9,12,11) N* = 23, Recovery = 400mm			
			8						100							
			9		*...organic silt lens; black, low plasticity. Soft.*											
									100				(1,0,1) N* = 1, Recovery = 450mm			
		-5.0			ML: Clayey SILT: grey to dark grey, low plasticity. Soft. Silt seam running diagonally from 9.45m to 9.6m, stiff.		S									
		-5.3			OL: Organic SILT: black, low plasticity. Soft to firm.				71							
			10		Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 15 July 2016.

MACHINE BOREHOLE - R1-MB04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 10/07/2016
Borehole Location: Refer to Figure 04

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1938435.2m N.5794563.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.49m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Peat					Minor fibrous inclusions.											
					...becoming sandy.											
Alluvial Deposits		-6.0	11		SP: Medium to coarse SAND with trace quartz: grey, poorly graded, pumiceous.	M to W	MD		89				(4,11,15) N* = 26, Recovery = 400mm			
									95							
			12						100				(11,23,28) N* = 51, Recovery = 450mm			
			13						100							
									93				(12,16,21) N* = 37, Recovery = 420mm			
			14				D		100							
					...becoming black, fine to medium, no quartz. *...becoming grey with trace quartz.*											
			15						44				(11,18,23) N* = 41, Recovery = 420mm			
									95							
		-11.8 -11.9	16		GW: Fine to coarse GRAVEL: dark grey, well graded. Subangular, smooth, flat. SP: Gravelly coarse SAND with trace quartz: grey, poorly graded, pumiceous. Gravel is fine black lithics.				89				(14,21,22) N* = 43, Recovery = 400mm			
			17		Borehole terminated at 17.0 m											
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 15 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R2-HA01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 05

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936406.3m N.5790237.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 6.72m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		6.7			OL: TOPSOIL - Organic SILT: brown, non plastic. Minor rootlets.					
Fill		6.7			SW: Fine to coarse SAND with some gravel: light brown, well graded. Gravel is fine, pumice.					
		6.4			SP: Fine to medium SAND with trace silt: light brown, poorly graded.					
		6.2			SP: Medium to coarse SAND with trace gravel: grey-brown, poorly graded. Gravel is fine, pumiceous. Some fine black grains.					
		5.8			SM: Silty fine SAND: brown, poorly graded.	D	MD to D			
		5.7	1		SP: Medium to coarse SAND with trace gravel: grey-brown, poorly graded. Gravel is fine, pumiceous. Some fine black grains.					
		4.9			SM: SILT with trace sand: brown, non plastic. Powdery when reworked. Sand is fine grained.			V-140(43)		
			2			D to M		V-141(65)		
		4.1			ML: SILT with trace clay: brown, low plasticity. Slightly greasy when reworked.		VSt	V-189+		
					...becoming grey-brown.					
			3		*...minor coarse sand.*					
		3.6			SM: SILT with trace sand: grey with orange staining, non plastic. Powdery when reworked. Sand is fine grained.					
Alluvial Deposits		3.4			SP: Fine to medium SAND: grey-brown, poorly graded.	M				
					...becoming fine to coarse grained.		MD to D			
		2.8			SM: Silty fine SAND: grey with orange staining, poorly graded.					
		2.7	4		SP: Fine to medium SAND: grey-brown, poorly graded.					
					...becoming fine to coarse sand with trace fine gravel.	M to W	L to MD			
			5		Borehole terminated at 5.0 m					

Termination reason: Target Depth

Remarks: Shear vane - 1912. Possible groundwater at 5m depth. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R2-HA02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 06/07/2016
Borehole Location: Refer to Figure 05

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936591.6m N.5790659.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 6.35m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		6.3			OL: TOPSOIL - Organic SILT: brown, non plastic, minor rootlets.					
Fill		6.3			SM: Silty fine to medium SAND: grey-brown, poorly graded.					
		6.0			SP: Fine to medium SAND : grey, poorly graded.		MD			
		5.7			SM: Silty fine to medium SAND: grey-brown, poorly graded.					
			1							
							MD to D			
			2			M				
		4.1			ML: SILT with trace gravel: brown, non plastic to low plasticity. Gravel is fine, pumiceous. *...no gravels present.* *...some black charcoal inclusions.*					
		3.7			SW: Fine to coarse SAND: light brown, well graded.					
Alluvial Deposits		3.6			SP: Fine to medium SAND: grey, poorly graded.		MD			
			3							
			4		Borehole terminated at 4.0 m					
			5							

Termination reason: Hole Collapse

Remarks: TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R2-HA03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 15/07/2016
Borehole Location: Refer to Figure 05

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936547.5m N.5791006.1m (NZTM)
Survey Source: GPS Survey
Elevation: RL 6.48m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		6.5			OL: TOPSOIL - Organic SILT: brown, low plasticity.					
Fill		6.4			SM: Silty fine SAND: grey-brown, poorly graded.					
		5.8			SM: Sandy SILT: grey-brown, non plastic. Sand is fine grained.	D to M	MD	V-UTP		
		5.6			SM: Silty fine SAND: grey-brown, poorly graded.					
		5.5	1		SP: Gravelly fine to medium SAND with trace silt: grey-brown to light brown, poorly graded. Gravels are fine grained, pumiceous.					
		5.3			ML: SILT: light brown, non plastic.					
		5.2			SP: Fine to medium SAND: grey-brown, poorly graded.					
Alluvial Deposits		4.8			ML: SILT: light brown to brown, non plastic.	M		V-160(82)		
			2							
		4.3			SP: Fine to medium SAND: light brown, poorly graded.	D to M				
		4.1			ML: SILT: grey-brown mottled brown, low plasticity.			V-128(49)		
					...becoming brown with minor fine sand.					
					...becoming grey-brown with occasional fine pumice gravel. No sand.		VSt			
		3.5	3		ML: SILT with minor clay: grey-brown, low plasticity. Slightly greasy when reworked.			V-124(47)		
					...20mm lens of fine pumice gravel.			V-106(57)		
					...becoming grey-brown with orange staining.					
		2.9			SP: Fine to medium SAND: grey with orange staining, poorly graded.	M				
		2.7			ML: SILT with minor sand: grey with orange staining, low plasticity. Sand is fine grained.			V-109(57)		
			4							
		2.4			SP: Fine to medium SAND: grey with orange staining, poorly graded.					
		2.3			SW: Fine to coarse SAND: grey with orange staining, well graded.					
		2.1			SP: Fine to medium SAND: grey with orange staining, poorly graded.		MD to D			
		1.8			SW: Fine to coarse SAND: grey with orange staining, well graded.					
			5		Borehole terminated at 5.0 m					

Termination reason: Target Depth

Remarks: Shear vane - 1912. Groundwater not encountered. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R2-HA04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 15/07/2016
Borehole Location: Refer to Figure 05

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936777.1m N.5791112.0m (NZTM)
Survey Source: GPS Survey
Elevation: RL 6.03m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		6.0			OL: TOPSOIL - Organic SILT: brown, non plastic.					
Fill		6.0			SM: SILT with trace sand: light brown, non plastic. Sand is fine grained.	M	MD to D	V-UTP		
		5.8			SM: Silty fine SAND: light brown, poorly graded.					
		5.6			SW: Fine to coarse SAND with trace gravel: light brown, poorly graded. Gravel is fine, pumice.	D				
		5.4			SM: Sandy SILT: brown, non plastic. Sand is fine grained.	D to M				
					...20mm gravel lens					
		5.1			SP: Fine to medium SAND: grey, poorly graded.	D				
		5.0	1		ML: SILT: brown, non plastic.			V-189+		
		4.9			SM: SILT with trace sand: grey-brown, non plastic. Sand is fine grained.	D to M				
		4.8			SP: Fine to medium SAND with trace silt: grey-brown, poorly graded.					
		4.6			SM: Silty fine SAND: light brown, poorly graded.	M				
Alluvial Deposits		4.2			ML: SILT: brown, non plastic.		St			
			2		*...becoming grey with orange staining.*			V-65(50)		
					...becoming grey-brown.					
		3.7			SM: Sandy SILT: light brown, non plastic. Sand is very fine grained.	D to M		V-66(47)		
		3.1	3		SM: SILT with trace sand: grey-brown with orange staining, low plasticity. Sand is very fine.	M		V-65(34)		
		2.8			SP: Fine to medium SAND: grey, poorly graded.	D to M	MD			
		2.1	4		SW: Fine to coarse SAND : grey with orange staining, well graded.					
		1.6			SP: Medium to coarse SAND with minor gravel: dark grey to light brown, poorly graded. Gravel is fine, pumiceous.	M…				
		1.5			SW: Fine to coarse SAND with minor gravel: grey, well graded. Gravel is fine, pumiceous.	W	MD to D			
			5		Borehole terminated at 5.0 m					

Termination reason: Target Depth

Remarks: Shear vane - 1912. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R2-HA05

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 15/07/2016
Borehole Location: Refer to Figure 05

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1937154.8m N.5791307.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 5.94m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
TS		5.9			OL: TOPSOIL - Organic SILT: brown, low plasticity.	D				
Fill		5.8			SM: Silty fine to medium SAND: grey-brown to light brown, poorly graded.		MD			
		5.1			SM: Sandy SILT: brown, non plastic. Sand is fine to coarse grained.	D to M		V-UTP		
		4.9	1		SP: Medium to coarse SAND with minor gravels: light brown, poorly graded. Gravel is rounded, black lithics.					
		4.7			SM: Sandy SILT: brown, non plastic. Sand is fine to coarse grained.		D to VD			
		4.5			SP: Medium to coarse SAND with minor gravel: brown, poorly graded. Gravel is red-brown, medium, rounded. Hard to auger.					
Alluvial Deposits		4.0	2		ML: SILT : grey-brown with some orange staining, non plastic.	M		V-120(46)		
		3.7			SM: SILT with minor sand: grey-brown, low plasticity. Sand is fine grained.					
		3.5			SP: Fine to medium SAND: grey, poorly graded.					
		3.4			ML: SILT: grey-brown, low plasticity.	W	VSt	V-112(44)		
			3		...Poor recovery					
		2.6			SM: SILT with trace sand: grey, poorly graded, low plasticity. Sand is fine grained. Poor recovery.					
		2.4			ML: SILT with minor clay: grey with orange staining, low plasticity.			V-175(92)		
		1.9	4		SP: Fine to medium SAND: grey, poorly graded.		MD			
					Borehole terminated at 4.3 m					
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1912. No recovery from 4.1m. TS stratigraphic code denotes Topsoil.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA01

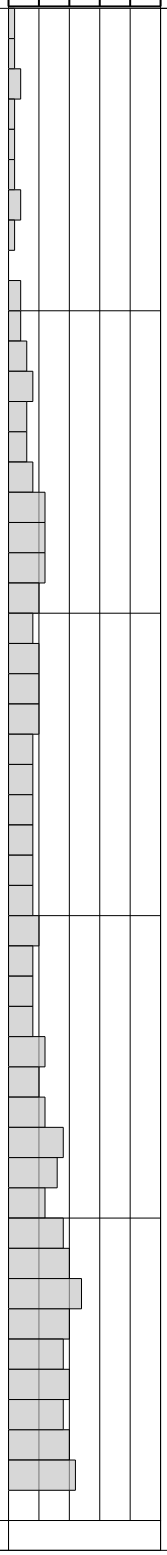
Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936250.8m N.5788642.9m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.79m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm)	Comments
Topsoil		4.8			OL: TOPSOIL - Organic SILT: brown, low plasticity.					
Fill		4.4			ML: SILT: brown, low plasticity. *...becoming light brown.*	M	F to St	V-100(46) V-80(40)		
Alluvial Deposits		3.8	1		SM: SILT with trace sand: light brown, non plastic. Powdery when reworked. Sand is fine grained. *...50mm thick silt lens; low plasticity.*	M to W		V-67(40)		
		3.3			SM: Sandy SILT: grey, low plasticity.			V-107(46)		
		3.1			SP: Fine to medium SAND: grey, poorly graded, pumiceous.					
		2.7	2		SM: Silty fine to medium SAND: grey, poorly graded.	W	MD			
			3		Borehole terminated at 3.2 m					
			4				D			
			5							



Termination reason: Hole Collapse

Remarks: Shear vane - 1861. No recovery from 2.8 to 3.2m.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA02

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936305.9m N.5788620.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.63m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Topsoil		4.6			OL: TOPSOIL - Organic SILT: brown, low plasticity.	M		V-66(20)		
					...becoming light brown.					
		3.8	1		ML: Clayey SILT: brown, low to medium plasticity.	M to W	St to VSt	V-80(40) V-104(51)		
					...becoming light brown-grey with orange staining.			V-103(57)		
Alluvial Deposits		2.8	2		SM: SILT with trace sand: grey, non plastic. Powdery when reworked. Sand is fine grained.	W		V-112(58)		
		2.4			SP: Fine to medium SAND : grey, poorly graded.		MD			
			3							
					Borehole terminated at 3.5 m					
			4				D			
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 3.0m.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA03

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936208.4m N.5788705.4m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.60m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		4.6			OL: TOPSOIL - Organic SILT: brown, non plastic to low plasticity. Occasional fine to medium gravel, rounded.					
Alluvial Deposits		4.1	1		ML: SILT: grey-brown, low plasticity.	M	F to St	V-97(35) V-77(20)		
		3.5			SM: SILT with trace sand: grey-brown, non plastic. Powdery when reworked. Sand is fine grained.			V-49(35)		
		3.3			SP: Fine to medium SAND with trace silt: light brown, poorly graded.	M to W	L to MD			
		2.8			SM: SILT with trace sand: grey, non plastic. Powdery when reworked. Sand is fine grained.	W				
		2.6	2		SW: Fine to coarse SAND with trace gravel: grey, well graded. Gravel is fine, pumiceous.	S	MD			
					Borehole terminated at 2.4 m					
			3							
			4				D			
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA04

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936243.1m N.5788708.7m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.74m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Topsoil		4.7			OL: Organic SILT with trace sand: brown, non plastic. Sand is black, coarse grained.	M				
					...slight organic odour, becoming dark grey-brown.			V-71(33)		
		4.1			SM: SILT with trace sand: light brown, non plastic. Powdery when reworked.		St	V-67(32)		
			1			M to W		V-66(49)		
Alluvial Deposits		3.1			SP: Silty fine to medium SAND: light brown-grey, poorly graded.					
		2.8			SM: SILT with trace sand: grey, non plastic. Powdery when reworked. Sand is fine grained.					
	▼	2.7	2		No recovery: Hand auger pushed through from 2.0m to 3.0m with little effort. Trace organic silt on auger blade. Resistance at 3.0m with little to no recovery.	S	L to MD			
			3		Borehole terminated at 3.5 m					
			4				MD to D			
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861. Little to no recovery from 3.0m.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA05

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936253.9m N.5788790.8m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.85m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		4.8			OL: TOPSOIL - Organic SILT with trace gravel: brown, non plastic. Gravel is black, medium to coarse.	M to W				
		4.6			SW: Fine to coarse SAND with trace gravel: brown-grey, well graded. Gravel is fine to coarse, pumiceous.		L to MD			
Alluvial Deposits		4.0			SM: Silty fine SAND: dark grey, poorly graded.					
		3.8	1		ML: SILT with trace clay: grey-brown, low plasticity.	M				
		3.6			SP: Coarse SAND with trace silt: dark brown, uniformly graded. Slight organic smell.					
		3.4			ML: SILT: light grey-brown with orange staining, non plastic to low plasticity.		St	V-63(49)		
		3.2			SM: SILT with trace sand: grey, non plastic. Powdery when reworked. Sand is fine grained.					
	▼		2					V-71(37)		
		2.6			SM: Silty fine SAND: grey, poorly graded.	W	L to MD			
			3							
					Borehole terminated at 3.7 m					
			4				MD			
			5							

Termination reason: Hole Collapse

Remarks: Shear vane - 1861.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

HAND AUGER BOREHOLE - R3-HA06

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:25 Sheet 1 of 1

Logged by: KB
Checked by: KB
Position: E.1936289.7m N.5788801.2m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.89m
Datum: Moturiki
Hole Diameter: 50mm
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Shear Strengths (kPa) Peak (Residual)	Dynamic Cone Penetrometer (Blow/100 mm) 5 10 15 20	Comments
Fill		4.9	0		OL: TOPSOIL - Organic gravelly SILT: brown, no plasticity. Gravel is medium to coarse, subrounded with occasional very coarse subangular gravel.		MD to D			
					...unable to dig through with shovel.					
					Borehole terminated at 0.5 m					
			1							
			2				MD			
			3							
			4				MD to D			
			5							

Termination reason: Refusal

Remarks: Shear vane - 1861.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

MACHINE BOREHOLE - R3-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 1 of 2

Logged by: OMG
Checked by: KB
Position: E.1936211.7m N.5788656.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.74m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments. Rock: Weathering; colour; fabric; rock name; strength; additional comments)	Moisture Condition	Consistency/ Relative Density	Weathering (RS, CW, HW, MW, SW, DW)	Recovery	RQD	Estimated Strength (EW, VW, W, MS, S, VS, ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20, 20-60, 60-200, 200-600, 600-2000, >2000)	Drilling Method/ Support	Comments/Defect Description
Fill		4.7			OL: TOPSOIL - Organic sandy SILT: brown, low plasticity, minor rootlets. Sand is fine to medium grained. Occasional medium gravel, black. *...becoming fine to medium grained.*	M			100							
		3.8	1		ML: Clayey SILT: brown with orange staining, low to medium plasticity. Soft, greasy. Trace rootlets. *...becoming sandy; fine to coarse grained, grey-brown.* *...no sand present, brown.*		S to F		67				(1,2,2) N* = 4, Recovery = 300mm			
		2.8	2		SM: Silty fine SAND: grey-brown with orange staining, poorly graded.				48							
		1.9	3		SW: Gravelly fine to coarse SAND: grey-brown, well graded. Gravel is black, medium grained. Some coarse pumice gravel.				33				(4,5,4) N* = 9, Recovery = 150mm			
		1.2			SP: Fine SAND: grey, poorly graded.											
		1.1	4		SW: Gravelly fine to coarse SAND: orange to grey, well graded. Gravel is black, fine to medium, subangular. Some coarse pumice gravel.	M to W	L		95							
			5						56				(2,4,6) N* = 10, Recovery = 250mm		HQ	
Alluvial Deposits		-0.7			SP: Fine to coarse SAND with some gravel: pale grey, poorly graded, pumiceous. Gravel is coarse, pumice. *...becoming fine to coarse grained, well graded.*				100							
			6						64				(6,7,9) N* = 16, Recovery = 290mm			
		-1.7			SW: Fine to coarse SAND with some gravel: grey, well graded, pumiceous. Gravel is fine black lithics.											
			7		*...becoming fine grained.*		MD		85							
		-2.5			SW: Fine to coarse SAND with some gravel: pale grey, well graded, pumiceous. Gravel is coarse pumice.											7.4-7.5m: SAMPLE R3-001
									89				(4,4,10) N* = 14, Recovery = 400mm			
		-3.2	8		GW: Fine to coarse GRAVEL: pale grey, well graded, pumice.											
		-3.4				M										
		-3.6			SM: SILT with some sand: grey, non plastic. Sand is fine grained. Occasional fine pumice gravel.	D to...										
		-3.7			SP: Medium to coarse SAND: pale grey, poorly graded, pumiceous.				76							
			9		SM: SILT with trace sand: grey-green, non plastic. Sand is fine grained. *...becoming sandy, fine grained.*		Vst to H						(3,8,11) N* = 19, Recovery = 380mm			
									84							
		-5.2							95							
			10		Continued on next sheet											

Termination reason: Target Depth

Remarks: Logged 05 July 2016.

MACHINE BOREHOLE - R3-MB01

Client: Bay of Plenty Regional Council
Project: Rangitaiki River and Floodway
Site Address: Edgecumbe
Project: TGA2016_0216
Date: 01/07/2016
Borehole Location: Refer to Figure 06

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

1:50 Sheet 2 of 2

Logged by: OMG
Checked by: KB
Position: E.1936211.7m N.5788656.6m (NZTM)
Survey Source: GPS Survey
Elevation: RL 4.74m
Datum: Moturiki
Angle from horizontal: 90°

Unit	Groundwater	RL (m)	Depth (m)	Graphic Log	Material Description Soil: USC; Soil Type; colour; structure; strength; moisture; bedding; plasticity; sensitivity; additional comments Rock: Weathering; colour; fabric; rock name; strength; additional comments	Moisture Condition	Consistency/ Relative Density	Weathering (RS CW HW MW SW DW)	Recovery	RQD	Estimated Strength (EW VW W MS S VS ES)	Vane Shear Strength (kPa) Peak (Residual)	SPT N-Value	Defect Spacing (mm) (<20 20-60 60-200 200-600 600-2000 >2000)	Drilling Method/ Support	Comments/Defect Description
Alluvial Deposits			11		SW: Gravelly fine to coarse SAND: grey, well graded. Gravel is mixture of coarse pumice; subrounded, and fine black lithics; subangular.				89				(7,12,13) N* = 25, Recovery = 400mm			
					...30mm organic layer, dark grey-brown, fibrous.	M to W	MD		95							
		-6.9			SP: Fine to medium SAND: grey, poorly graded. Occasional coarse pumice gravel.											
		-7.3	12		SW: Gravelly fine to coarse SAND: grey, well graded, pumiceous. Gravel is fine to medium, black, subangular to subrounded.				100				(5,6,9) N* = 15, Recovery = 450mm			
					...some fine sand/silt, greasy.											
Peat		-8.1	13		Pt: PEAT: partially decomposed organic wood fragment; brown, fibrous, very stiff.		VSt		95							
		-8.4			*...becoming grey, some silty fine SAND, grey, poorly graded, greasy.*											
Alluvial Deposits					SM: SILT with trace sand: grey-green, non plastic. Stiff. Sand is fine grained											
					...50mm clayey SILT lens, grey-green, low to medium plasticity, greasy.	M	Vst to H		67				(3,9,10) N* = 19, Recovery = 300mm			
			14													
		-9.7			*...becoming brown, sand*				76							
					SM: Silty fine SAND: brown, poorly graded, non plastic.											
		-10.1														
			15		SW: Gravelly fine to coarse SAND: grey, well graded, pumiceous. Gravel is mixture of fine black lithics and coarse subrounded pumice.	M to W	D		98				(10,17,18) N* = 35, Recovery = 440mm			
					Borehole terminated at 15.5 m											
			16													
			17													
			18													
			19													
			20													

Termination reason: Target Depth

Remarks: Logged 05 July 2016.

This report is based on the attached field description for soil and rock, New Zealand, Geotechnical Society Inc 2005.

Appendix B
Laboratory Test Results

CMW Geosciences (NZ) Ltd
Phone: 07 975 0916 Postal: PO Box 1344, Tauranga 3141
Address: 116 Cameron Road, Tauranga 3110
Email: kirstinb@cmwgeosciences.com

(7/16)

SOIL SAMPLE RECORD

CLIENT : Bay of Plenty Regional Council
CLIENT CONTACT : Ingrid Pak
SAMPLED BY : CMW Geosciences
PROJECT : Rangitaiki River and Floodway
PROJECT MANAGER : Kirstin Brown
DATE SAMPLED : 19/07/2016
PROJECT LOCATION : Edgecumbe
RESULTS REQ. BY : 4/08/2016
JOB REF NO : TGA2016_0216

Location	Sample Depth (m)	Material Description	Sample Type & No.	PSD (wet sieve)	PSD (Hydrometer)	Linear Shrinkage	CBR SMDD / MMDD	CBR % Comp. : 95%	Moisture Content	SMDD / MMDD / OMC	Shrink-Swell	Corrisivity (pH, Sulfide % Chloride)	UCS	Point Load	Atterberg Limit	Lab Ref No.
F1-MB01	2.8 - 3.0	Soil: Silty Sand	Disturbed	✓												F1-001
F1-MB01	10.05 - 10.2	Soil: Gravelly Sand	Disturbed	✓												F1-002
F1-MB03	5.5 - 5.6	Soil: Sand/Silt	Disturbed	✓												F1-003
F1-MB04	2.8 - 3.0	Soil: Sand/Silt	Disturbed	✓												F1-004
F1-MB05	5.8 - 5.9	Soil: Sand/Silt	Disturbed	✓												F1-005
F2-MB01	11.5 - 11.8	Soil: Clayey Silt	Disturbed		✓											F2-001
F2-MB02	5.15 - 5.3	Soil: Sand/Silt	Disturbed	✓												F2-002
F2-MB04	3.45 - 3.7	Soil: Sand/Silt	Disturbed	✓												F2-003
F2-MB04	7.3 - 7.5	Soil: Sand	Disturbed	✓												F2-004
F3-MB01	1.3 - 1.4	Soil: Gravelly Sand	Disturbed	✓												F3-001
F3-MB02	12.45 - 12.65	Soil: Sand	Disturbed	✓												F3-002
F3-MB03	1.3 - 1.5	Soil: Sand/Silt	Disturbed	✓												F3-003
F3-MB03	5.8 - 6.0	Soil: Gravelly Sand	Disturbed	✓												F3-004
F3-MB04	2.8 - 3.0	Soil: Sand	Disturbed	✓												F3-005
R1-MB02	4.95 - 5.1	Soil: Clayey Silt	Disturbed		✓											R1-001
R1-MB03	4.4 - 4.5	Soil: Sand	Disturbed	✓												R1-002
R1-MB04	2.9 - 3.0	Soil: Silt	Disturbed		✓											R1-003
R3-MB01	7.4 - 7.5	Soil: Sand	Disturbed	✓												R3-001

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

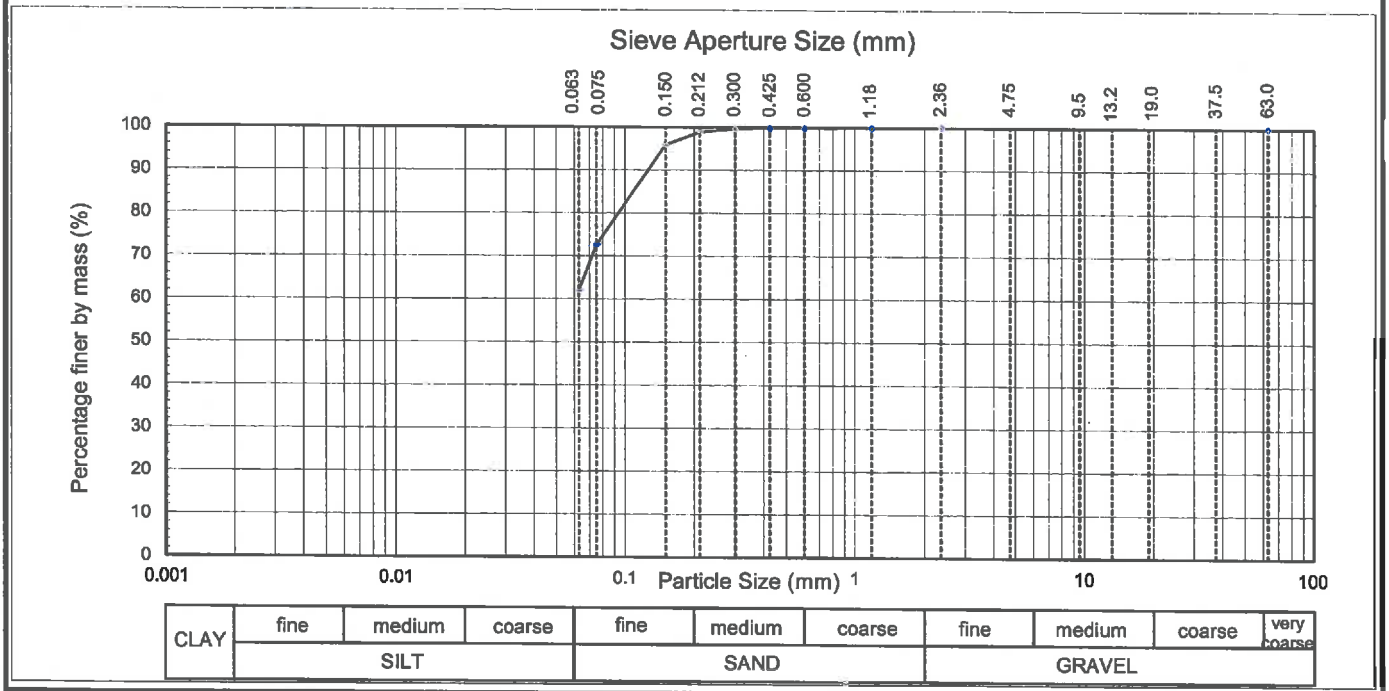
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F1-MB01** Depth: 2.8-3.0 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Sandy CLAY/SILT**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **68 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	99	--	--	--	--
19.0	--	1.18	100	0.150	96	--	--	--	--
13.2	--	0.600	100	0.075	73	--	--	--	--
9.5	--	0.425	100	0.063	62	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 29/07/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

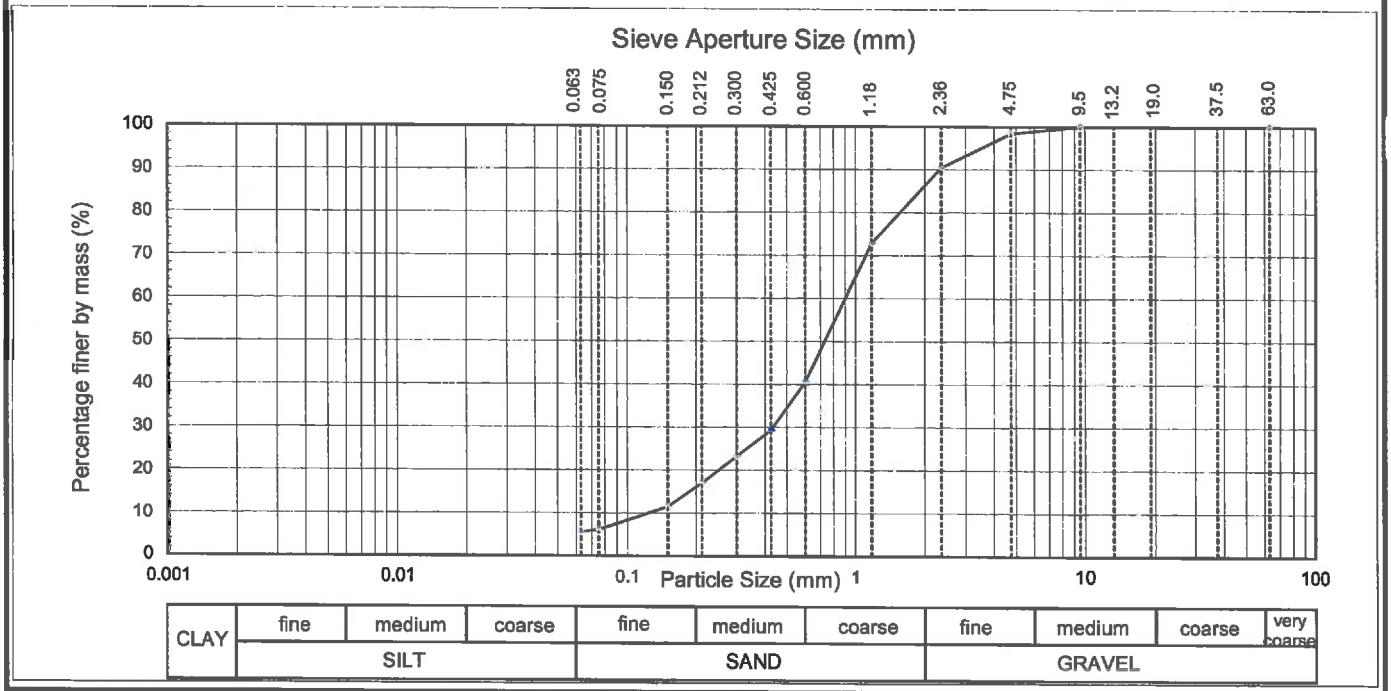
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F1-MB01** Depth: 10.05-10.2 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SAND with some Gravel and minor Clay/Silt**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **32 %**

Project No: 2-68382.16
Lab Ref No: HA330
Client Ref: TGA2016 0216

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	98	0.300	23	--	--	--	--
37.5	--	2.36	90	0.212	17	--	--	--	--
19.0	--	1.18	73	0.150	12	--	--	--	--
13.2	--	0.600	41	0.075	6	--	--	--	--
9.5	100	0.425	29	0.063	6	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method) Water Content: NZS 4402: 1986 Test 2.1	Fraction Passing finest sieve is by difference

Date Tested: 29/07/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

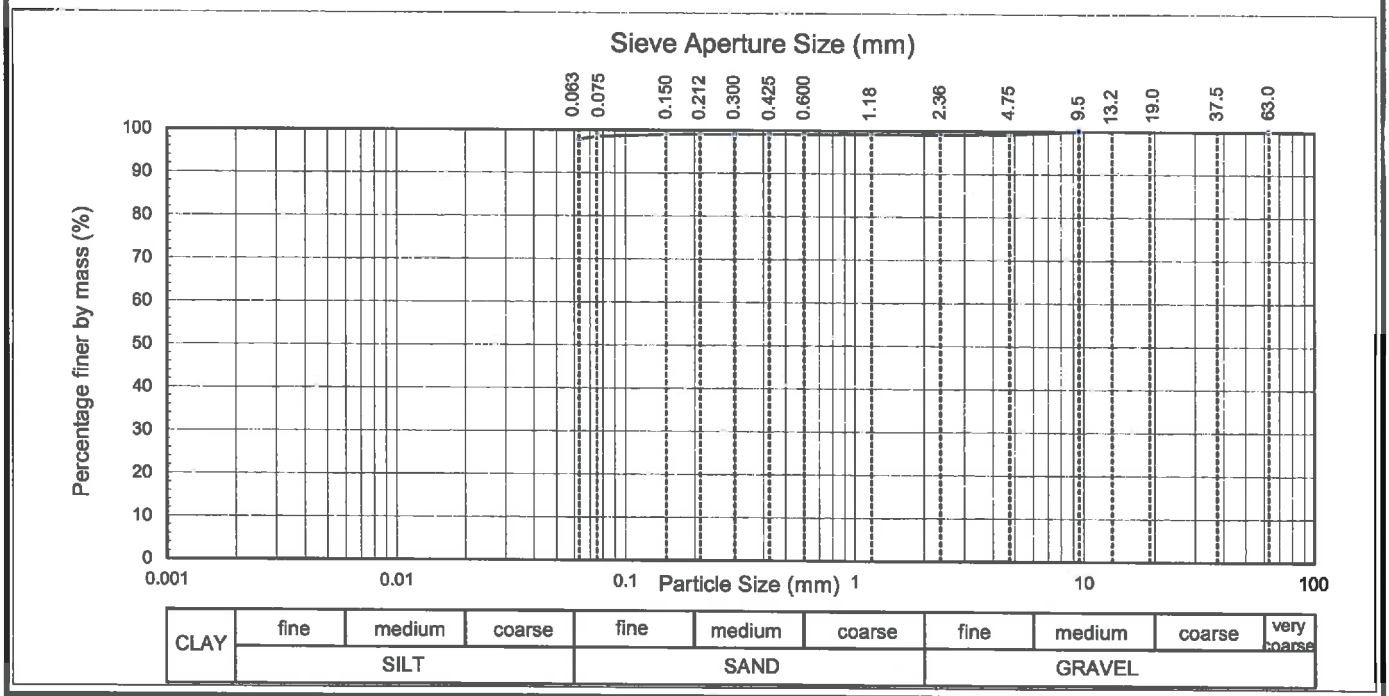
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F1-MB03** Depth: 5.5-5.6 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **CLAY/SILT**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **45 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016_0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	99	0.300	99	--	--	--	--
37.5	--	2.36	99	0.212	99	--	--	--	--
19.0	--	1.18	99	0.150	99	--	--	--	--
13.2	--	0.600	99	0.075	99	--	--	--	--
9.5	100	0.425	99	0.063	98	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

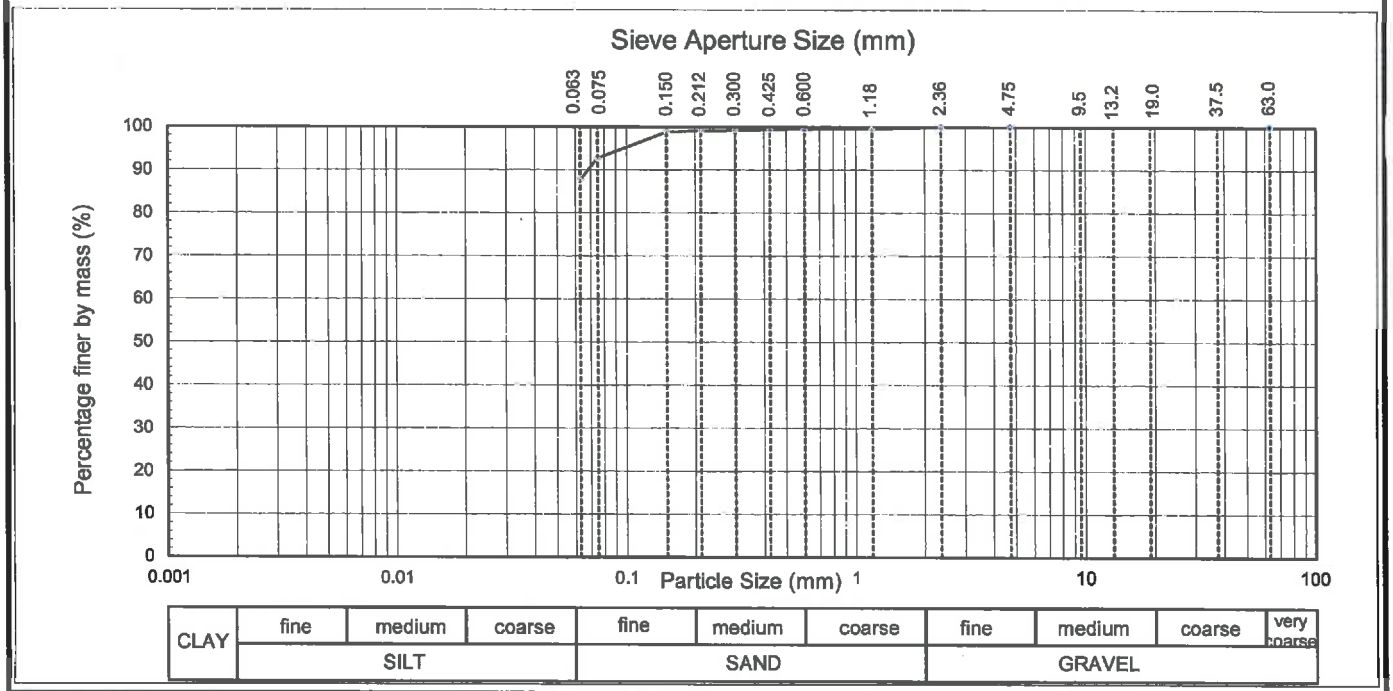
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F1-MB04** Depth: 2.8-3.0 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **CLAY/SILT with some Sand**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **60 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016_0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	--	--	--	--
37.5	--	2.36	100	0.212	99	--	--	--	--
19.0	--	1.18	100	0.150	99	--	--	--	--
13.2	--	0.600	99	0.075	93	--	--	--	--
9.5	--	0.425	99	0.063	88	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 1/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

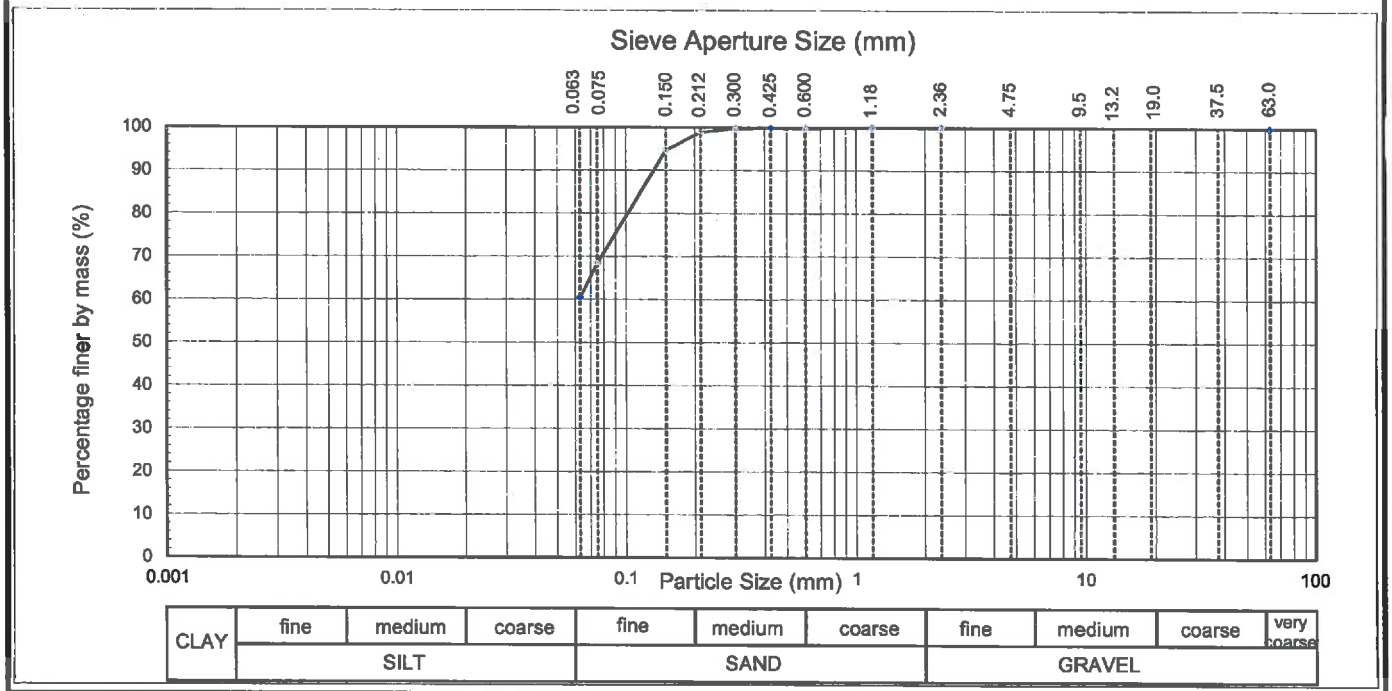
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F1-MB05** Depth: 5.8-5.9 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Sandy CLAY/SILT**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **36 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	99	--	--	--	--
19.0	--	1.18	100	0.150	95	--	--	--	--
13.2	--	0.600	100	0.075	68	--	--	--	--
9.5	--	0.425	100	0.063	60	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

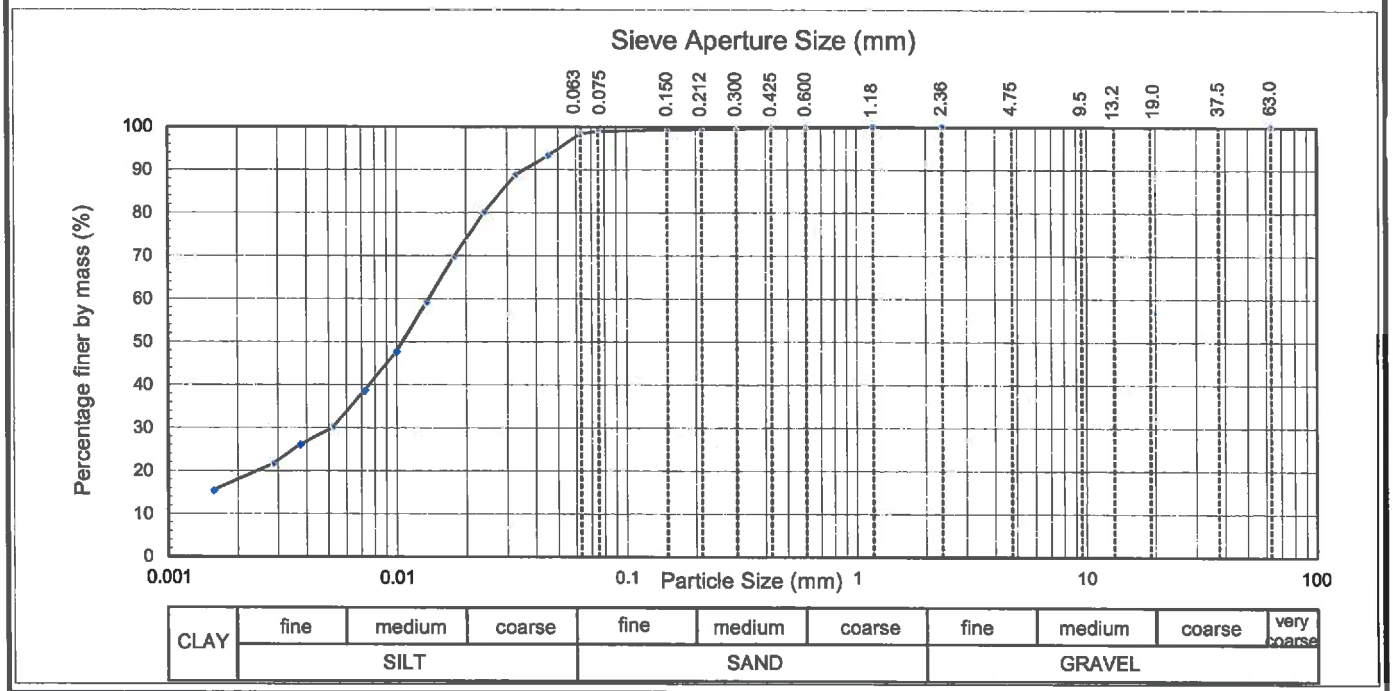
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F2-MB01** Depth: 11.5-11.8 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SILT with some Clay**
Solid Particle Density (t/m^3): **2.60 Assumed**
Water Content (as received): **40 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	0.0453	93	0.0072	39
37.5	--	2.36	100	0.212	99	0.0326	89	0.0052	30
19.0	--	1.18	100	0.150	99	0.0239	80	0.0037	26
13.2	--	0.600	100	0.075	99	0.0176	70	0.0028	22
9.5	--	0.425	100	0.063	98	0.0134	59	0.0016	15
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0099	48		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	Fraction Passing finest sieve is included in Hydrometer test
Water Content: NZS 4402: 1986 Test 2.1	pH of suspension : 8.0 (Whatmans Full Range pH Indicator paper)

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

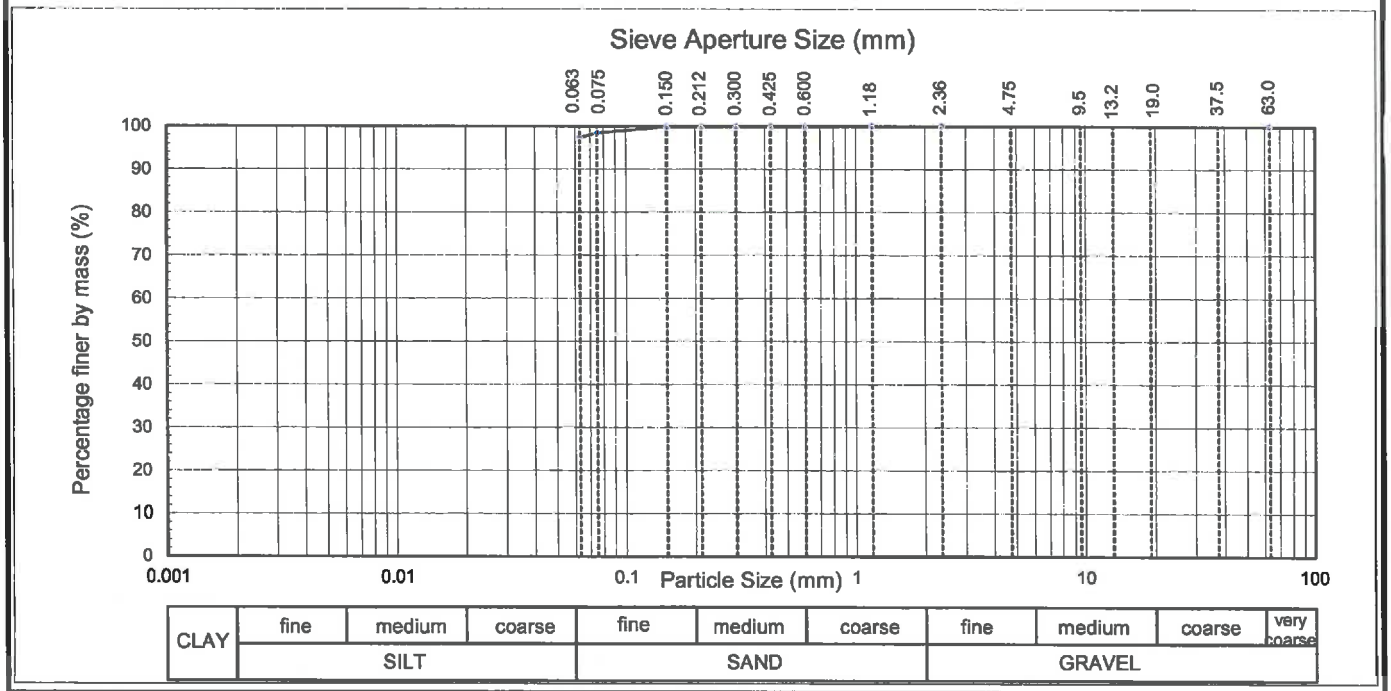
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F2-MB02** Depth: 5.15-5.3 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **CLAY/SILT with trace Sand**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **50 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	100	--	--	--	--
19.0	--	1.18	100	0.150	100	--	--	--	--
13.2	--	0.600	100	0.075	98	--	--	--	--
9.5	--	0.425	100	0.063	97	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

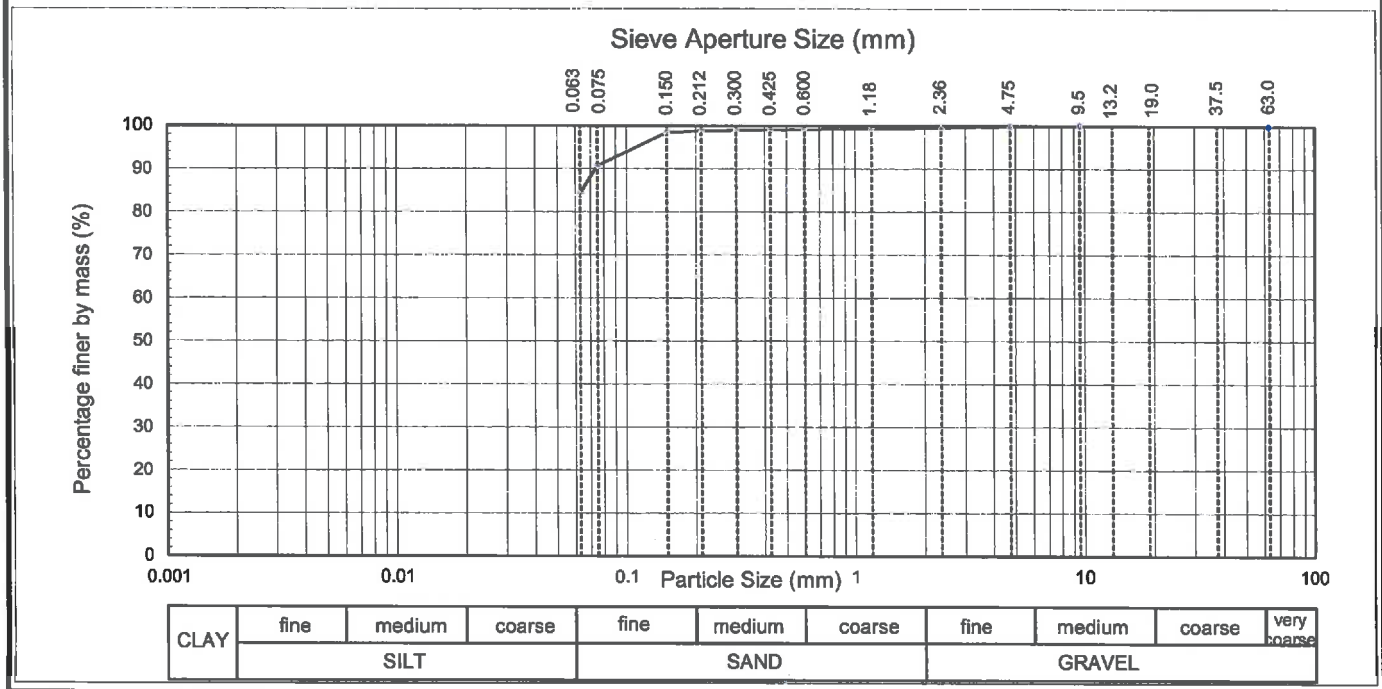
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F2-MB04** Depth: 3.45-3.7 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **CLAY/SILT with some Sand**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **64 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	--	--	--	--
37.5	--	2.36	100	0.212	99	--	--	--	--
19.0	--	1.18	99	0.150	98	--	--	--	--
13.2	--	0.600	99	0.075	91	--	--	--	--
9.5	100	0.425	99	0.063	84	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

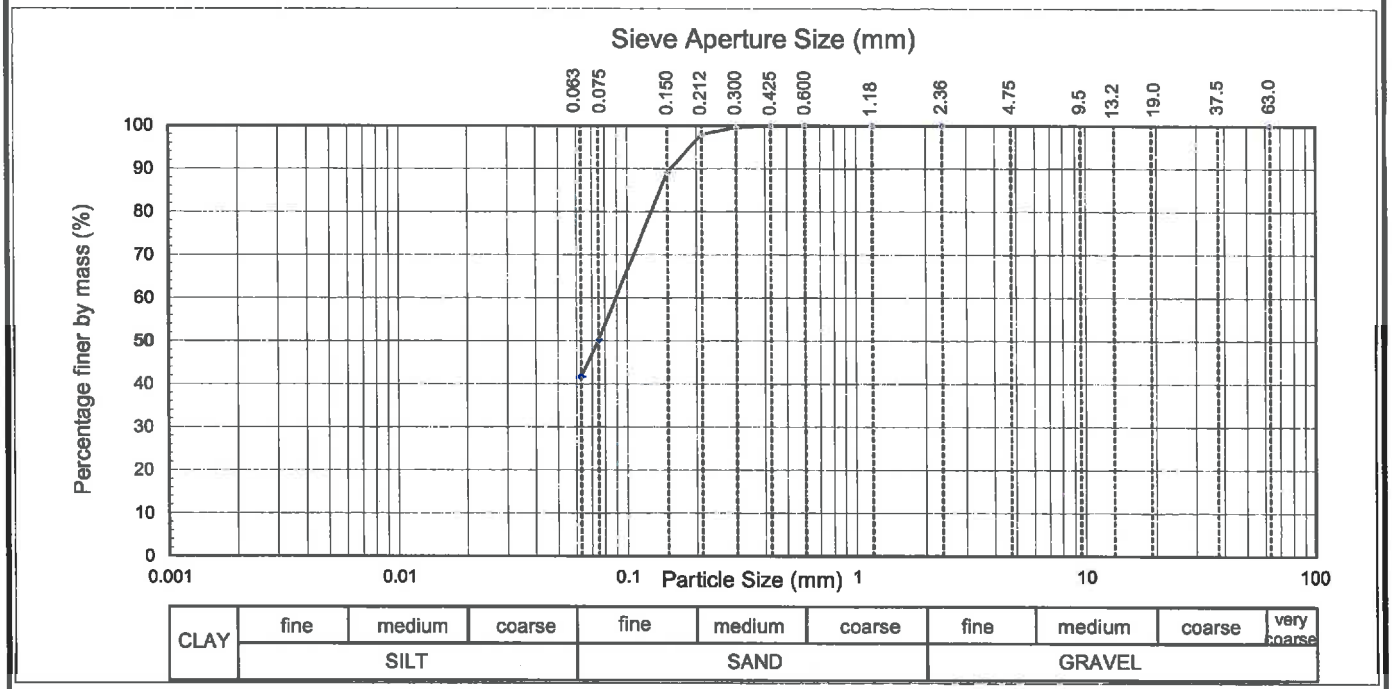
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences**

BH/TP/Sample ID: **F2-MB04** Depth: 7.3-7.5 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Clayey/Silty SAND**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **36 %**

Project No: 2-68382.16
Lab Ref No: HA330
Client Ref: TGA2016 0216

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	98	--	--	--	--
19.0	--	1.18	100	0.150	89	--	--	--	--
13.2	--	0.600	100	0.075	50	--	--	--	--
9.5	--	0.425	100	0.063	42	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

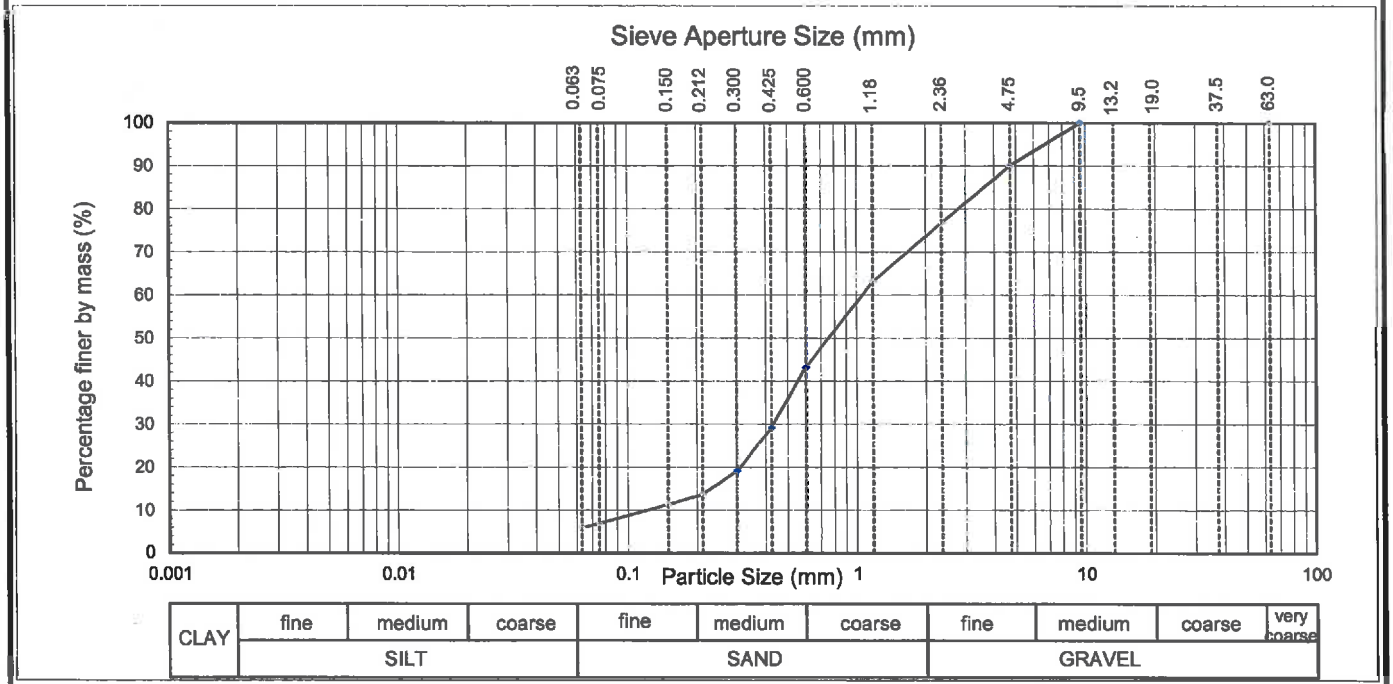
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F3-MB01** Depth: 1.3-1.5 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Gravelly SAND with minor Clay/Silt**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **25.7 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	90	0.300	19	--	--	--	--
37.5	--	2.36	77	0.212	14	--	--	--	--
19.0	--	1.18	63	0.150	11	--	--	--	--
13.2	--	0.600	43	0.075	7	--	--	--	--
9.5	100	0.425	29	0.063	6	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

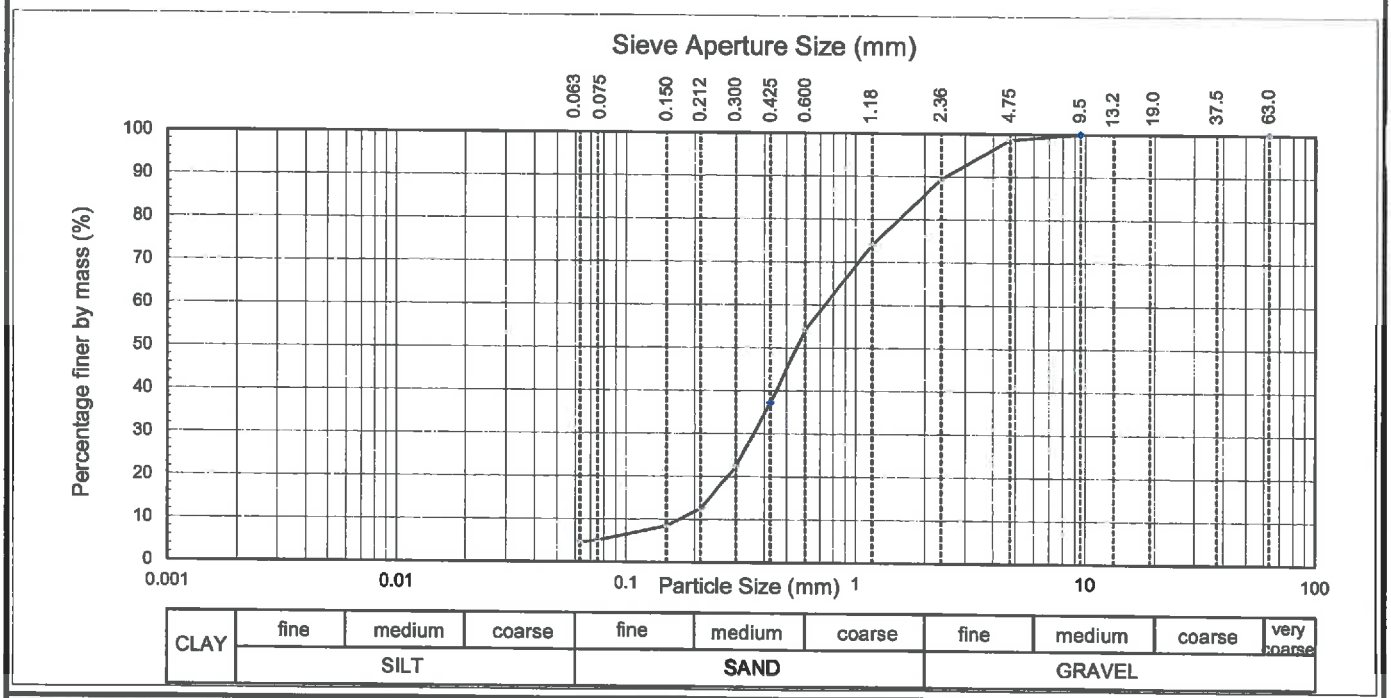
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F3-MB02** Depth: 12.45-12.65 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SAND with some Gravel and minor Clay/Silt**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **25.4 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	99	0.300	22	--	--	--	--
37.5	--	2.36	89	0.212	13	--	--	--	--
19.0	--	1.18	74	0.150	8	--	--	--	--
13.2	--	0.600	54	0.075	5	--	--	--	--
9.5	100	0.425	37	0.063	5	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

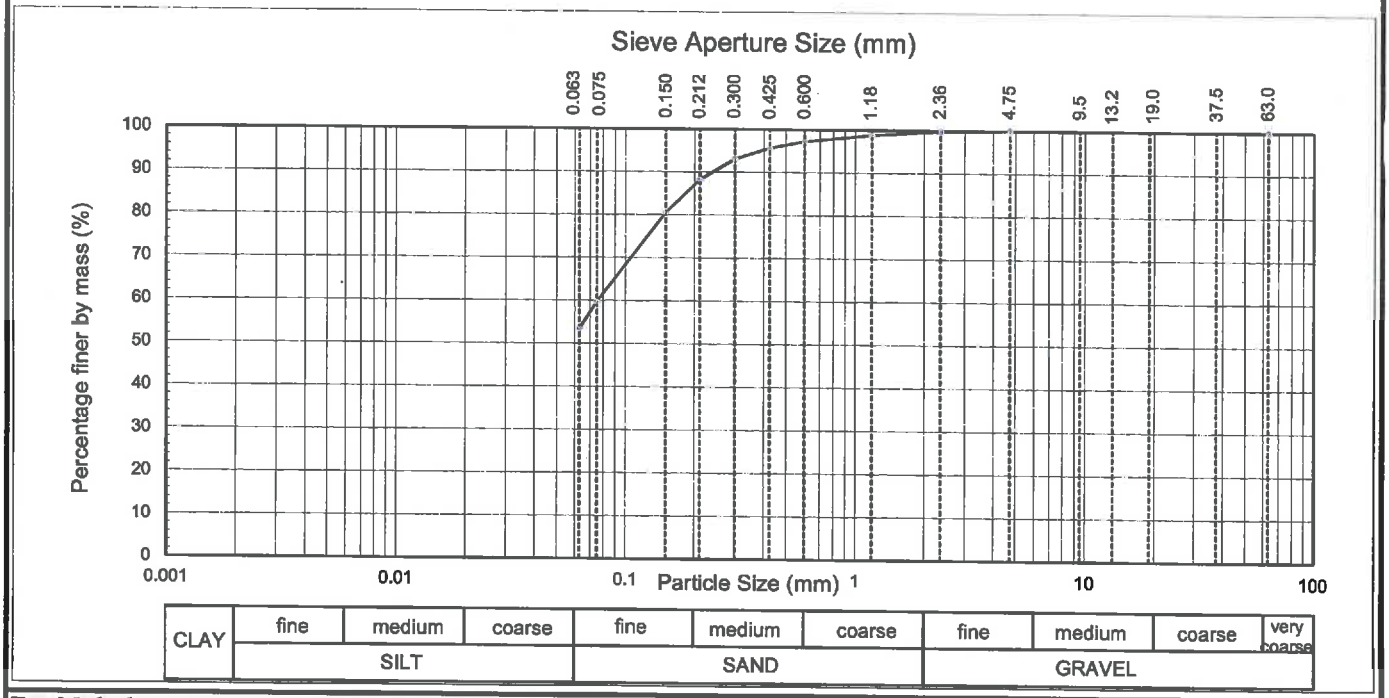
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F3-MB03** Depth: 1.3-1.5 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Sandy CLAY/SILT**
Solid Particle Density (t/m^3): **NA** **Assumed**
Water Content (as received): **40.7** **%**

Project No: 2-68382.16
Lab Ref No: HA330
Client Ref: TGA2016 0216

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	93	--	--	--	--
37.5	--	2.36	100	0.212	88	--	--	--	--
19.0	--	1.18	99	0.150	81	--	--	--	--
13.2	--	0.600	97	0.075	60	--	--	--	--
9.5	--	0.425	96	0.063	54	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

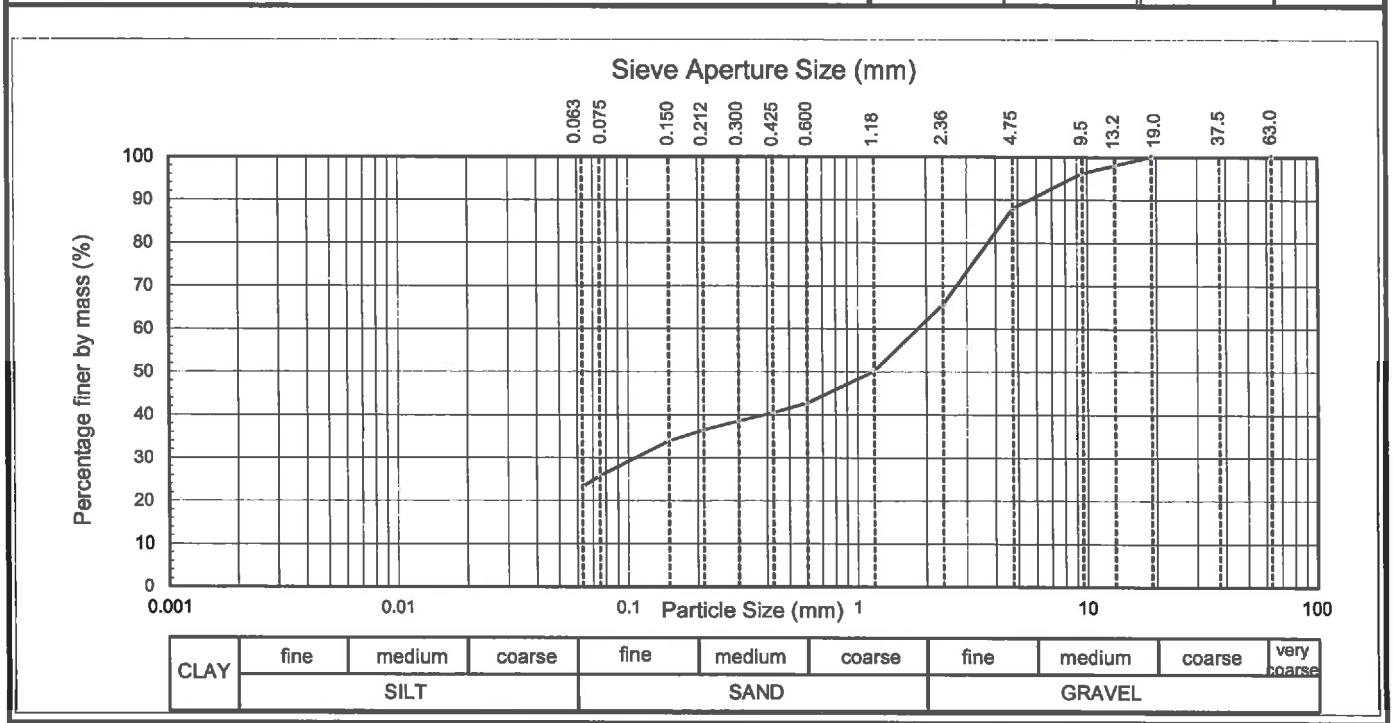
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F3-MB03** Depth: 5.8-6.0 metres
Sampled by : **Client** Date: 19/07/2016
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Sandy clayey/silty GRAVEL.**
Solid Particle Density (t/m^3): **NA** **Assumed**
Water Content (as received): **99** **%**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016_0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	88	0.300	39	--	--	--	--
37.5	--	2.36	66	0.212	37	--	--	--	--
19.0	100	1.18	50	0.150	34	--	--	--	--
13.2	98	0.600	43	0.075	26	--	--	--	--
9.5	96	0.425	40	0.063	23	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 4/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 4/08/2016

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

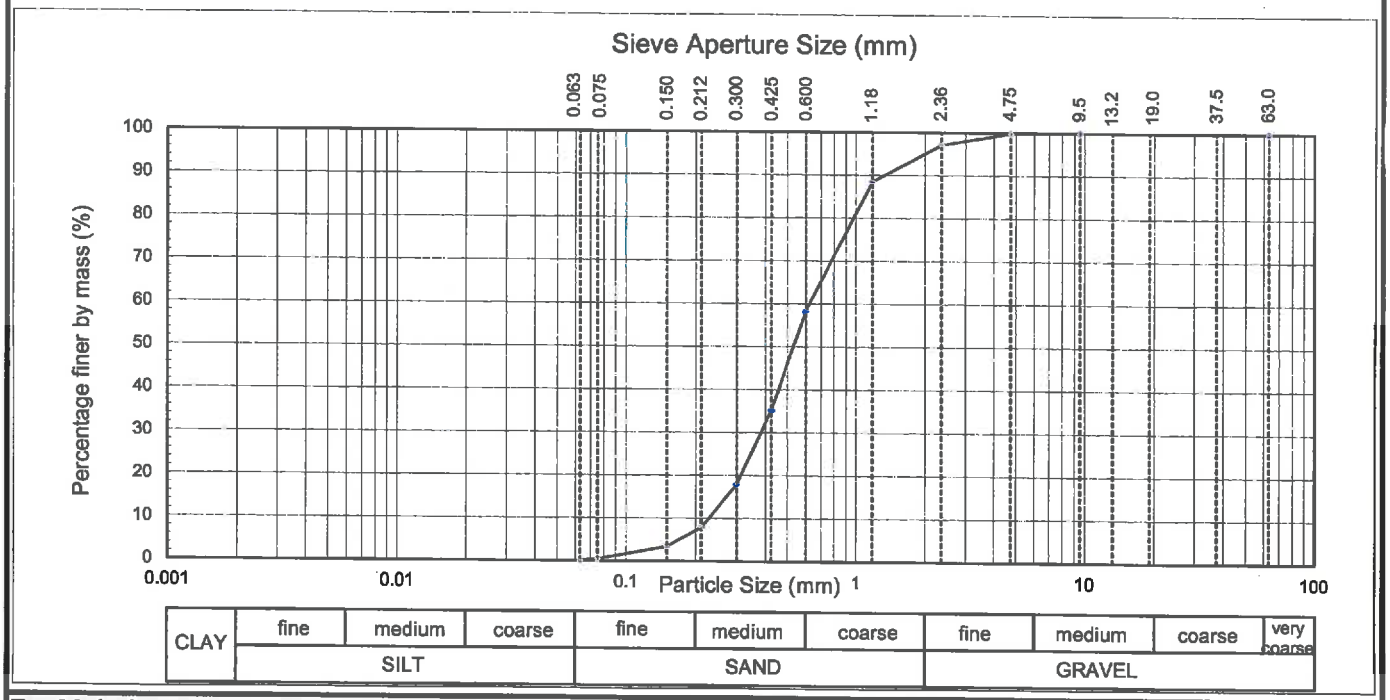
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **F3-MB04** Depth: 2.8-3.0 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SAND with minor Gravel**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **29 %**

Project No: 2-68382.16
Lab Ref No: HA330
Client Ref: TGA2016 0216

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	18	--	--	--	--
37.5	--	2.36	97	0.212	8	--	--	--	--
19.0	--	1.18	89	0.150	3	--	--	--	--
13.2	--	0.600	58	0.075	0	--	--	--	--
9.5	100	0.425	35	0.063	0	--	--	--	--
Note:	"–" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method) Water Content: NZS 4402: 1986 Test 2.1	Fraction Passing finest sieve is by difference

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

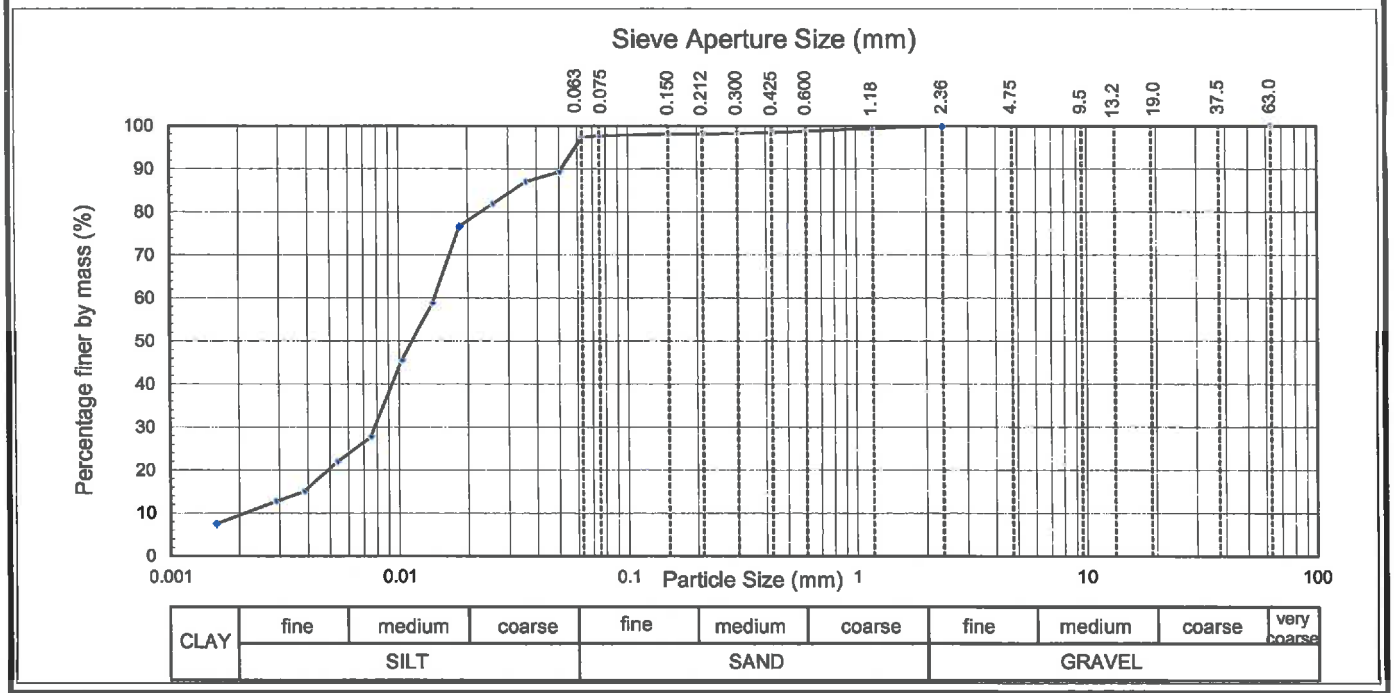
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **R1-MB02** Depth: 4.95-5.1 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SILT with minor Clay and minor Sand**
Solid Particle Density (t/m^3): **2.65 Assumed**
Water Content (as received): **74 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	98	0.0503	89	0.0075	28
37.5	--	2.36	100	0.212	98	0.0358	87	0.0054	22
19.0	--	1.18	99	0.150	98	0.0256	82	0.0038	15
13.2	--	0.600	99	0.075	98	0.0184	77	0.0029	13
9.5	--	0.425	98	0.063	97	0.0140	59	0.0016	7
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0102	46		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	Fraction Passing finest sieve is included in Hydrometer test
Water Content: NZS 4402: 1986 Test 2.1	pH of suspension : 8.0 (Whatmans Full Range pH Indicator paper)

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

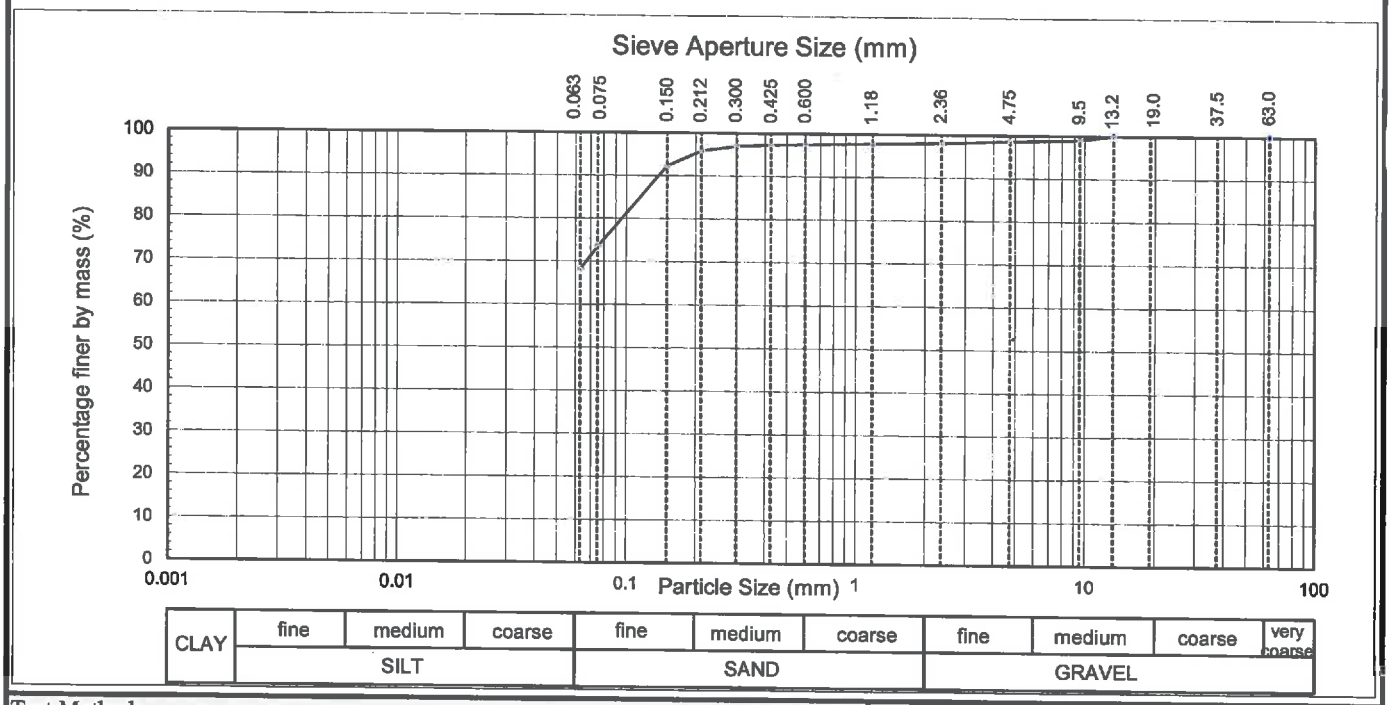
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **R1-MB03** Depth: 4.4-4.5 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **Sandy CLAY/SILT**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **71 %**

Project No: 2-68382.16
Lab Ref No: HA330
Client Ref: TGA2016 0216

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	99	0.300	97	--	--	--	--
37.5	--	2.36	98	0.212	96	--	--	--	--
19.0	--	1.18	98	0.150	92	--	--	--	--
13.2	100	0.600	97	0.075	73	--	--	--	--
9.5	99	0.425	97	0.063	68	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method) Water Content: NZS 4402: 1986 Test 2.1	Fraction Passing finest sieve is by difference

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

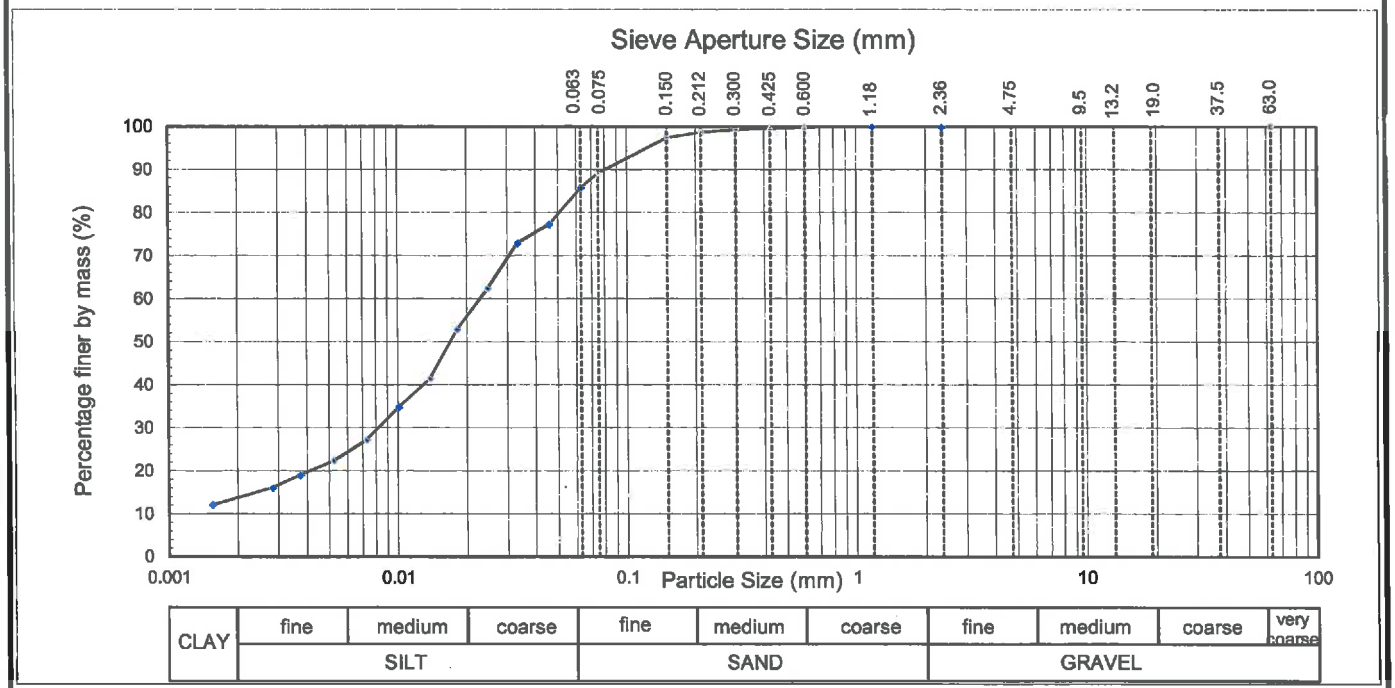
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **R1-MB04** Depth: 2.9-3.0 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SILT with some Sand and some Clay**
Solid Particle Density (t/m^3): **2.65 Assumed**
Water Content (as received): **41 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	0.0460	77	0.0073	27
37.5	--	2.36	100	0.212	99	0.0332	73	0.0052	22
19.0	--	1.18	100	0.150	97	0.0246	62	0.0037	19
13.2	--	0.600	100	0.075	89	0.0181	53	0.0028	16
9.5	--	0.425	100	0.063	86	0.0138	41	0.0016	12
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0100	35		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	Fraction Passing finest sieve is included in Hydrometer test
Water Content: NZS 4402: 1986 Test 2.1	pH of suspension : 8.0 (Whatmans Full Range pH Indicator paper)

Date Tested: 2/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD)
TEST REPORT

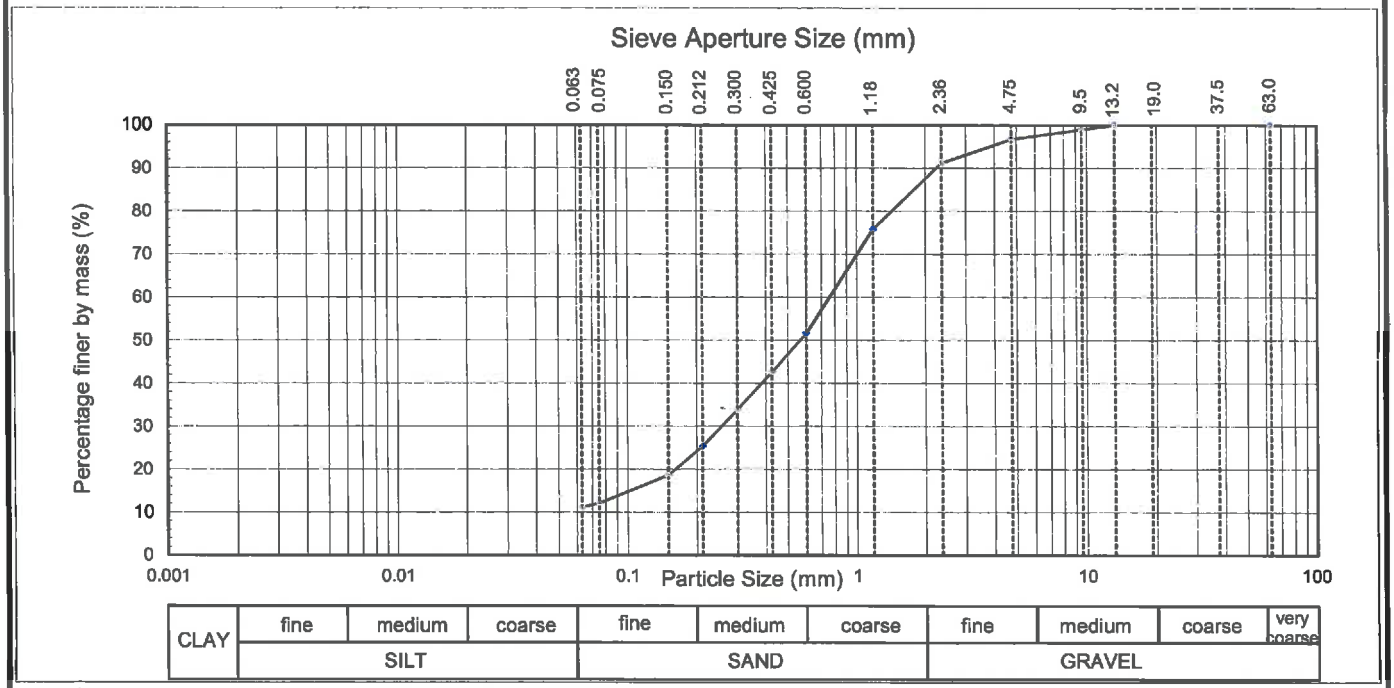
OPUS

Project : **Rangitaiki River and Floodway**
Location : **Edgecumbe**
Client : **CMW Geosciences (NZ) Ltd**

BH/TP/Sample ID: **R3-MB01** Depth: 7.4-7.5 metres
Sampled by : **Client** Date: 19/07/16
Date received : **25/07/16**
Sampling method : **Disturbed**
Sample condition : **As received**
Sample description : **SAND with some Gravel and minor Clay/Silt**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **63 %**

Project No:	**2-68382.16**
Lab Ref No:	**HA330**
Client Ref:	**TGA2016 0216**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	97	0.300	34	--	--	--	--
37.5	--	2.36	91	0.212	25	--	--	--	--
19.0	--	1.18	76	0.150	19	--	--	--	--
13.2	100	0.600	52	0.075	12	--	--	--	--
9.5	99	0.425	43	0.063	11	--	--	--	--
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 3/08/16
Date Reported: 4/08/16

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

IANZ ACCREDITED LABORATORY — All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 04/08/16

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

Appendix C
Soil Stratigraphy

Floodway Stopbank F1 (5700 – 8800)

The stopbank fill material along the F1 bank predominantly consisted of soft to very stiff silts to up to 2.6m below existing ground level measured from the centre of the stopbank crest. Undrained shear strengths ranged from 30kPa (within F1-HA05) to 164kPa (within F1-HA03) with the average being approximately 83kPa. Underlying the stopbank fill material in all borehole locations was a buried organic silt layer, interpreted as a historic surface topsoil layer.

Beneath the stopbank material and buried topsoil lens, alluvial deposits with thin interbedded peat layers were encountered. Directly beneath the buried topsoil was a stiff to hard silt layer, up to 7.2m below the existing ground level. SPT N-values measured during the advancement of the borehole ranged from 13 to 24, with the average being approximately 18. Underlying this was interbedded layers of soft clayey silts and decomposed peat, up to 9.5m below ground level with SPT N-values ranging from 0 to 5, with the average being approximately 2. Underlying the peat layers were medium dense to very dense sands, silty sands and gravelly sands, extending to beyond the depth of the 15.5m machine boreholes. SPT N-values in these sands ranged from 9 to over 50, with the average being approximately 24.

Within each of the hand auger boreholes a peat layer was encountered that was not found within the machine boreholes, and is therefore inferred to be a peat lens which extends away from the stopbank.

Groundwater levels were approximately 2.4m below ground level within the machine boreholes, and approximately 1.3m below ground level within the hand auger boreholes. This corresponds to an approximate RL of 1.2m.

Floodway Stopbank F2 (0 – 1450)

The stopbank fill material within the F2 stopbank predominantly consisted of stiff to very stiff silts and loose to medium dense sands, up to 2.4m below the existing ground level at the peak of the stopbank. Underlying the stopbank fill is a buried organic silt layer, interpreted as a historic surface topsoil layer.

Underlying the stopbank fill and topsoil, interbedded alluvial and peat deposits were encountered to beyond the depth of the 15.5m machine boreholes. Directly beneath the fill material and topsoil layer in all four machine boreholes was a layer of stiff to hard silts to depths of up to 8.4m below the existing ground surface. Within F2-MB02 this hard silt layer is interbedded with medium dense sand lenses. SPT N-values within this layer ranged from 6 to 27, with the average being approximately 15. Underlying these silts is a layer of soft to firm clayey silts and peat comprising partial to fully decomposed organic wood fragments. SPT N-values ranged from 0 to 7, with the average being approximately 2. Underlying the peat were interbedded silts and sands with occasional thin peat lenses, with all machine boreholes (excluding F2-MB01) at depth encountering medium dense sands and gravelly sands to beyond the extent of the 15.5m boreholes. F2-MB01 encountered stiff to very stiff silts at depth. N-values within these interbedded layers ranged from 5 to 33, with the average being approximately 13.

Groundwater levels were approximately 1.6m below ground level within the machine boreholes, and approximately 1.15m below ground level within the hand auger boreholes. This corresponds to an approximate RL of 2.2m.

Floodway Stopbank F3 (0 – 1700)

The stopbank fill material predominantly comprised a mixture of sands and silts, up to 2.2m below the existing ground surface. Underlying this fill material in all machine boreholes (excluding F3-MB04) was a thin organic silt layer, interpreted as a historic surface topsoil layer.

Underlying the stopbank fill and topsoil, interbedded alluvial and peat deposits were encountered to beyond the depth of the 15.5m machine boreholes. Directly beneath the topsoil were layers of loose to medium dense sands and gravels extending typically to 4m below the ground surface, but within

F3-MB03 to 12m below the existing ground level. SPT N-values within this layer ranged from 8 to 12, with the average being approximately 10.5. Underlying the sands were interbedded soft to stiff silts, clayey silts and peat to depths of up to 14.8m. SPT N-values within these soils ranged from 0 to 21, with the average being approximately 10. Underlying these silt and peat layers and extending to beyond the depths of all the 15.5m boreholes, excluding F3D, were medium dense sands and gravels. SPT N-values within these soils ranged from 7 to 20 with the average being approximately 15. Within F3D, very stiff to hard silts were underlying the medium dense sands and extended to beyond the depth of the machine borehole, with an N-value of 21 measured in the final 1.5m.

Groundwater levels were approximately 2.0m below ground level within the machine boreholes, and approximately 1.3m below ground level within the hand auger boreholes. This corresponds to an approximate RL of 1.8 m.

River Stopbank R1 (4200 – 4600)

The stopbank fill material predominantly comprised silts and clayey silts (as found within R1-MB02 and R1-MB04) up to 2.1m below the existing ground surface.

Within all four machine boreholes interbedded alluvial and peat deposits were encountered to beyond the depth of the 15.5m boreholes. Underlying the stopbank fill material found in R1-MB02 and R1-MB04, and from the ground surface for R1-MB01 and R1-MB03 was a layer of soft to stiff clayey silts and silts. Underlying this is in all machine boreholes excluding R1-MB01 was a thin layer of peat. Very stiff to hard silts interbedded with soft clayey silts was underlying the above layers and continued to depths of up to 7m below the existing ground surface. Within these upper silty layers, SPT N-values ranged from 0 to 26, with an average of approximately 9. Underlying the upper silty layers, were medium dense to dense sands and gravels extending to beyond the final 15.5m depth of the machine boreholes. SPT N-values ranged from 16 to 51, with the average being approximately 30.

Groundwater levels were approximately 2.5m below ground level within the machine boreholes. This relates to an approximate RL of 1.7m.

River Stopbank R2 (8950 – 10600)

The stopbank fill comprised interbedded sands and silts up to 2.6m below existing ground level. DCP blows per 100mm measured during the advancement of the test ranged from 1 to 20 within the stopbank fill, with the average being approximately 7.

Underlying the stopbank fill in all hand auger boreholes were alluvial deposits, extending to beneath the final 5m depth of the boreholes. Underlying the stopbank fill in all the boreholes (excluding R2_HA02) was a layer of stiff to hard silts to depths of up to 4m below existing ground level. Undrained shear strengths measured within the silt layers ranged from 65kPa to greater than 189kPa (the upper corrected limit on the shear vane apparatus), with the average being approximately 121kPa. Underlying the silts and extending to beneath the final 5m depth of the boreholes, were medium dense sands. DCP blows per 100mm within the sands ranged from 2 to 11m, with the average being approximately 5.5.

As the hand auger boreholes only extend to 5m below the crest of the stopbank, medium dense sands and gravels were inferred to underlie the soils encountered within the boreholes.

Groundwater levels were not encountered within two of the hand auger boreholes (R2-HA01 and R2-HA03). Within the remaining three boreholes, groundwater levels were approximately 4.0m below ground level. This relates to an approximate RL of 2.1m.

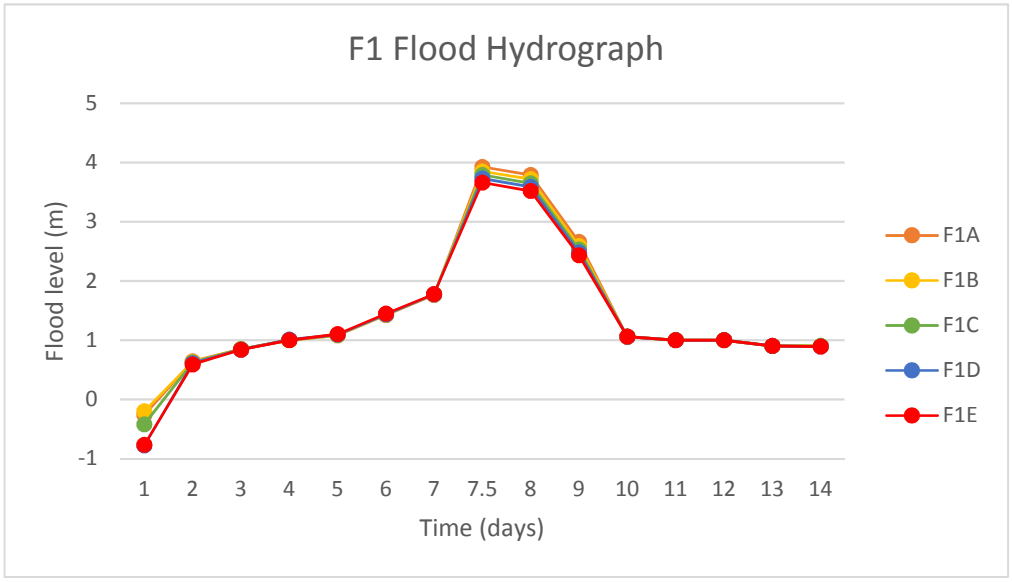
River Stopbank R3 (12300 – 12640)

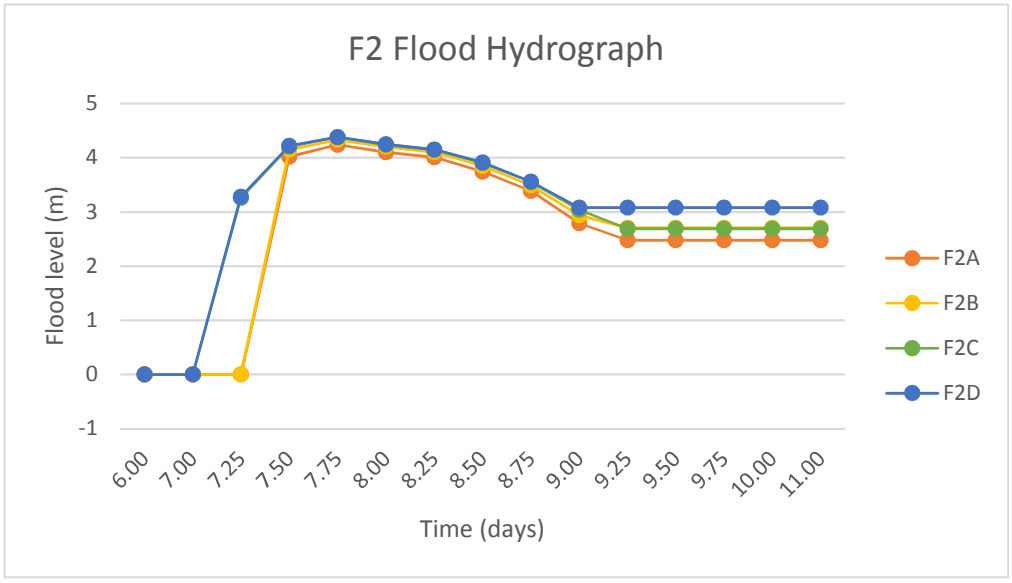
Within all the investigations, alluvial deposits with interbedded peat layers were found beneath the ground surface and extend to beyond the depth of the machine boreholes (maximum depth of 20m).

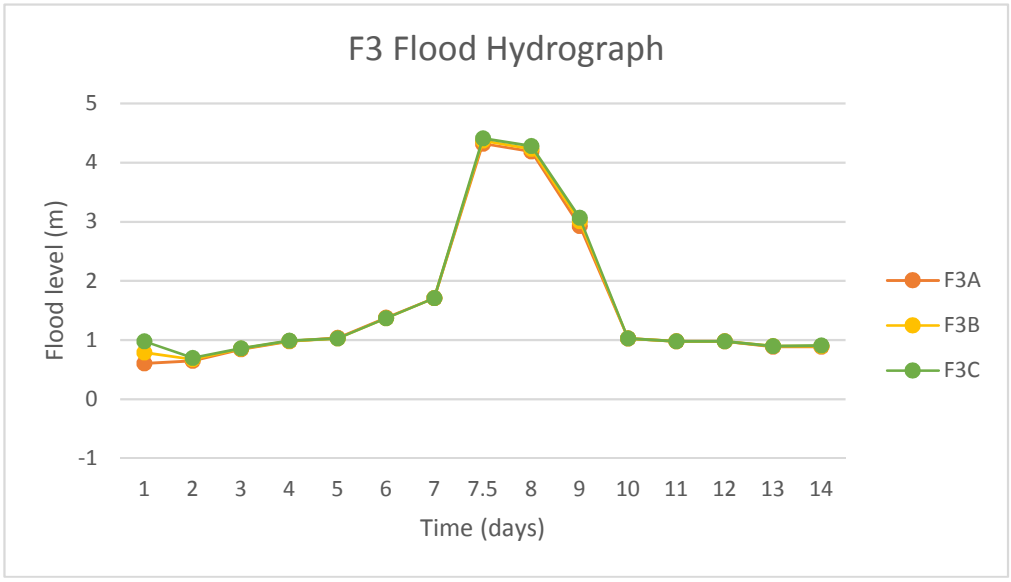
An approximately 1m thick layer of fill was found along the ground surface and consisted of firm to stiff silts and organic silts. Undrained shear strengths measured during the advancement of the hand auger boreholes ranged from 66kPa to 100kPa, with the average being approximately 79kPa. Directly beneath the fill were interbedded layers of medium dense sands, very stiff to hard silts and soft clayey silts which extend to up to 14.5m below the existing ground level. SPT N-values within these layers ranged from 3 to 29, with the average being approximately 13. Directly underlying these interbedded layers were medium dense to very dense gravelly sands and silty sands with a thin peat layer at approximately 18m below the existing ground level. SPT N-values within these sands ranged from 11 to over 50, with the average being approximately 29.

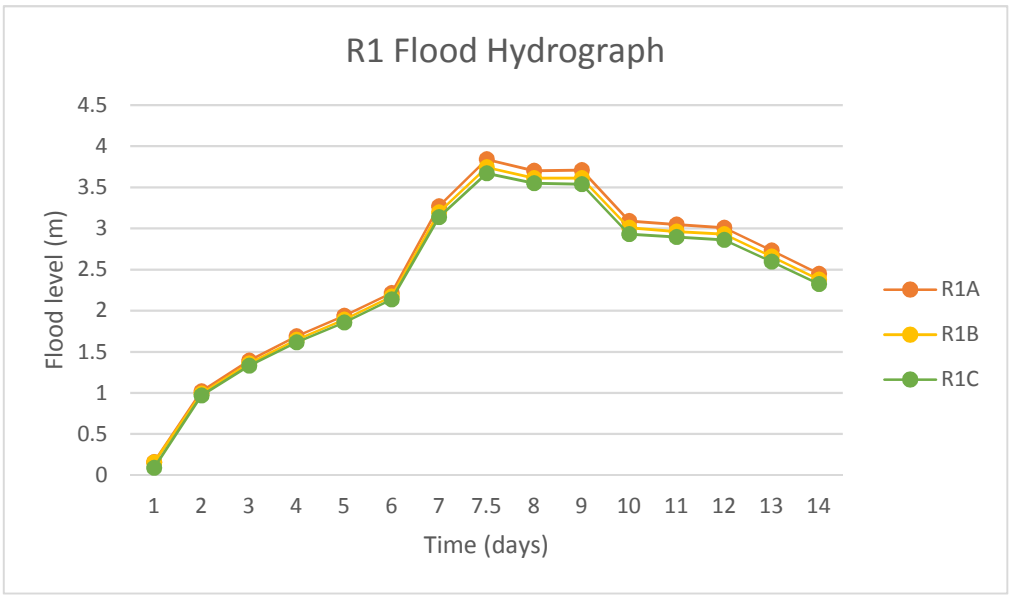
Groundwater levels were approximately 2.0m below ground level within the boreholes which corresponds to an approximate RL of 2.7m.

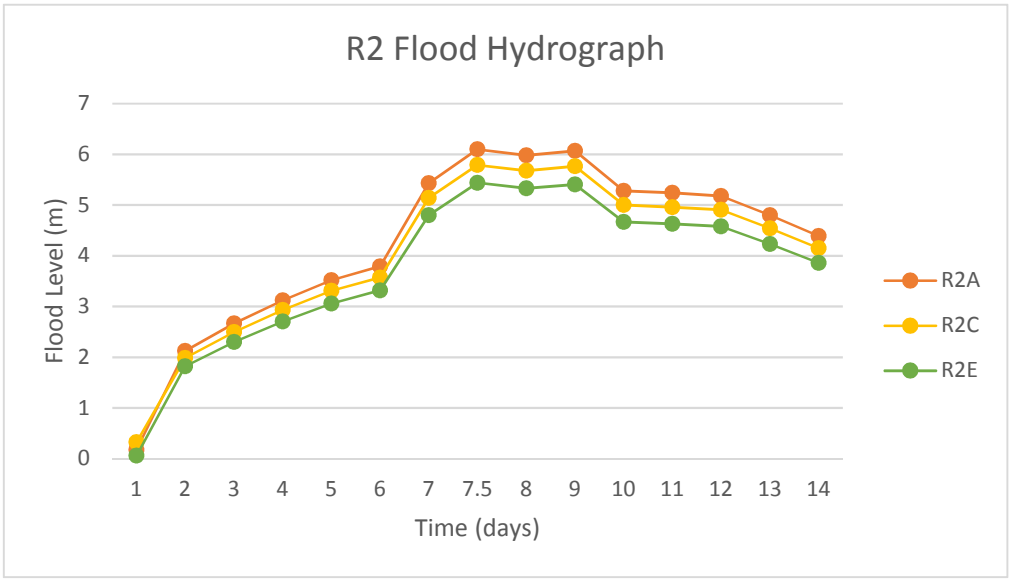
Appendix D
Flood Hydrographs

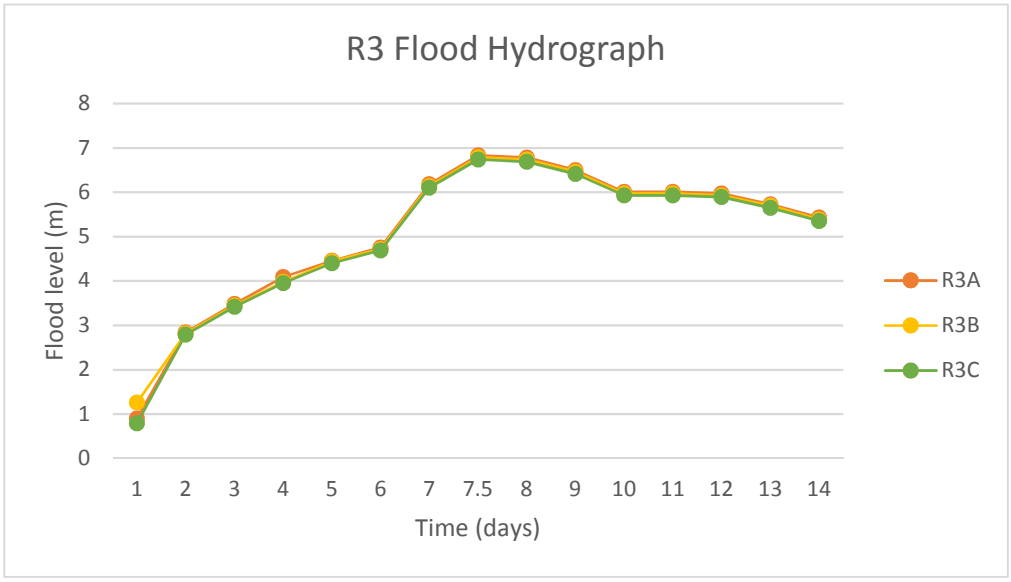

F1 Flood Hydrograph
Flood level (m)
5
4
3
2
1
0
-1
1 2 3 4 5 6 7 7.5 8 9 10 11 12 13 14
Time (days)
F1A
F1B
F1C
F1D
F1E


F2 Flood Hydrograph
Flood level (m)
5
4
3
2
1
0
-1
6.00 7.00 7.25 7.50 7.75 8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 11.00
Time (days)
F2A
F2B
F2C
F2D

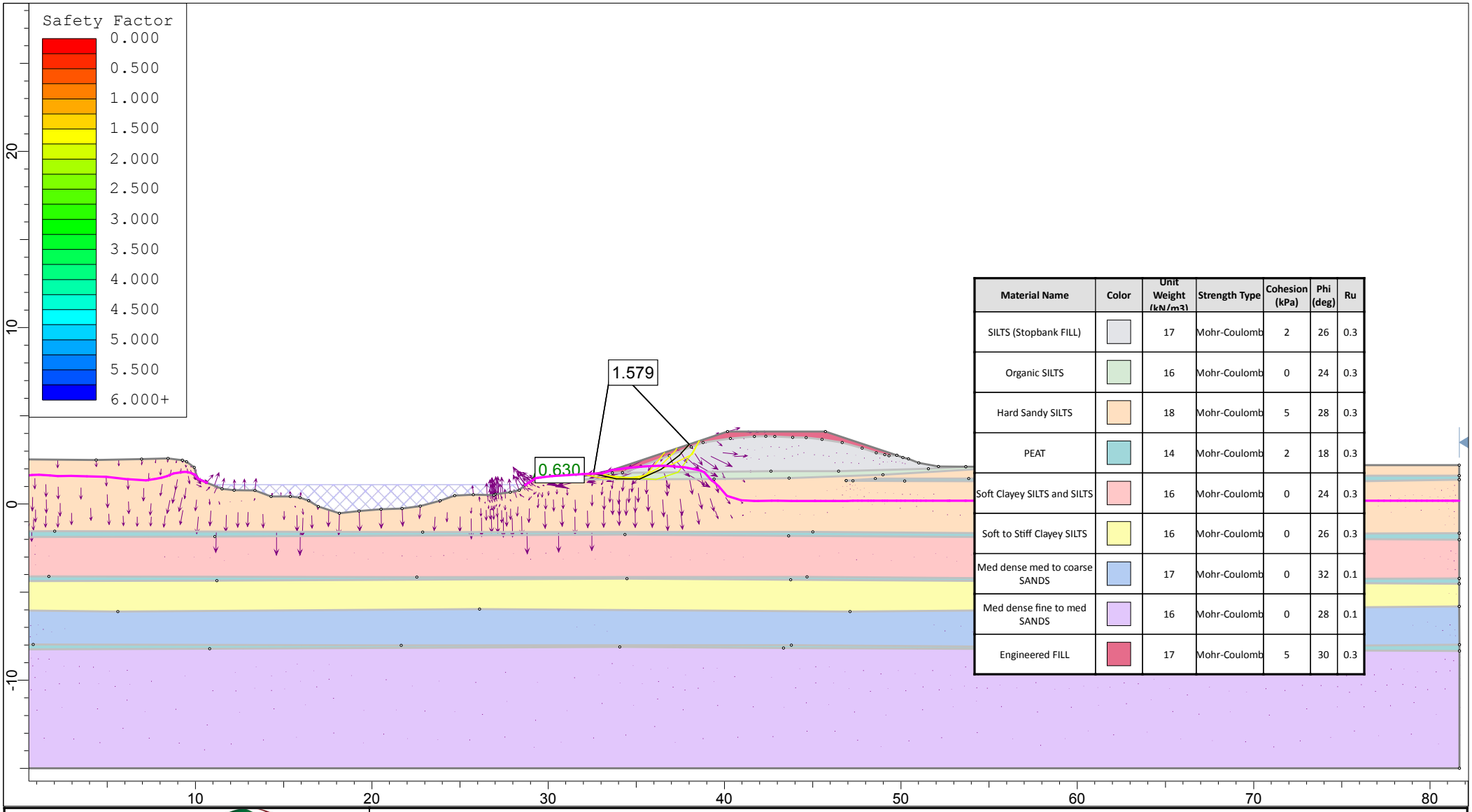

F3 Flood Hydrograph
Flood level (m)
5
4
3
2
1
0
-1
1 2 3 4 5 6 7 7.5 8 9 10 11 12 13 14
Time (days)
F3A
F3B
F3C


R1 Flood Hydrograph
Flood level (m)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 7.5 8 9 10 11 12 13 14
Time (days)
R1A
R1B
R1C


R2 Flood Hydrograph
Flood Level (m)
7
6
5
4
3
2
1
0
1 2 3 4 5 6 7 7.5 8 9 10 11 12 13 14
Time (days)
R2A
R2C
R2E


R3 Flood Hydrograph
Flood level (m)
8
7
6
5
4
3
2
1
0
1 2 3 4 5 6 7 7.5 8 9 10 11 12 13 14
Time (days)
R3A
R3B
R3C

Appendix E
Selected Slope Stability and Seepage Outputs



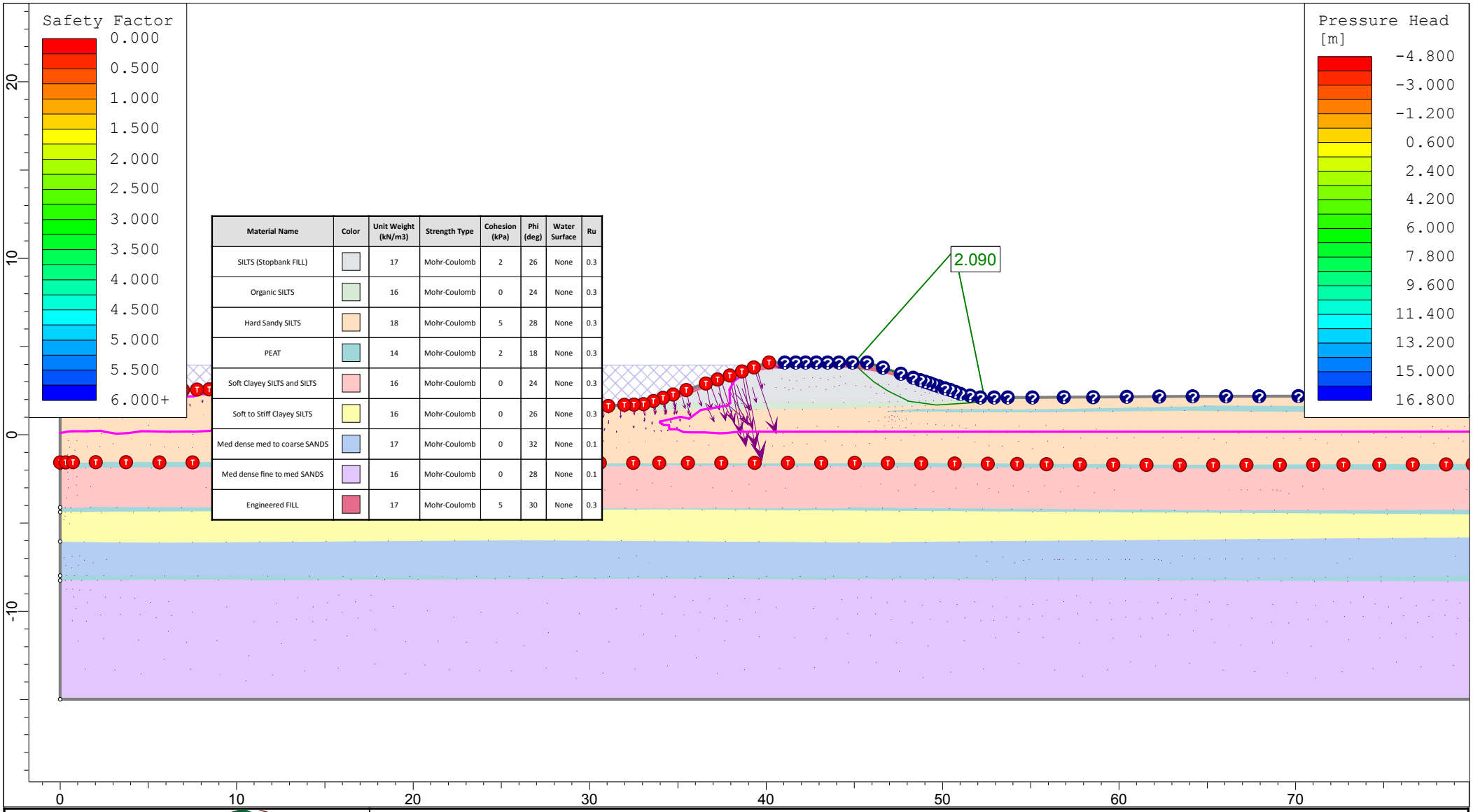
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	0.3
Organic SILTS		16	Mohr-Coulomb	0	24	0.3
Hard Sandy SILTS		18	Mohr-Coulomb	5	28	0.3
PEAT		14	Mohr-Coulomb	2	18	0.3
Soft Clayey SILTS and SILTS		16	Mohr-Coulomb	0	24	0.3
Soft to Stiff Clayey SILTS		16	Mohr-Coulomb	0	26	0.3
Med dense med to coarse SANDS		17	Mohr-Coulomb	0	32	0.1
Med dense fine to med SANDS		16	Mohr-Coulomb	0	28	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	0.3

CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1A: Lowest FoS shown - Flood event day 10		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	12/10/2016, 3:19:47 p.m.	*File Name*	F1A_filloverlay 121016.slim



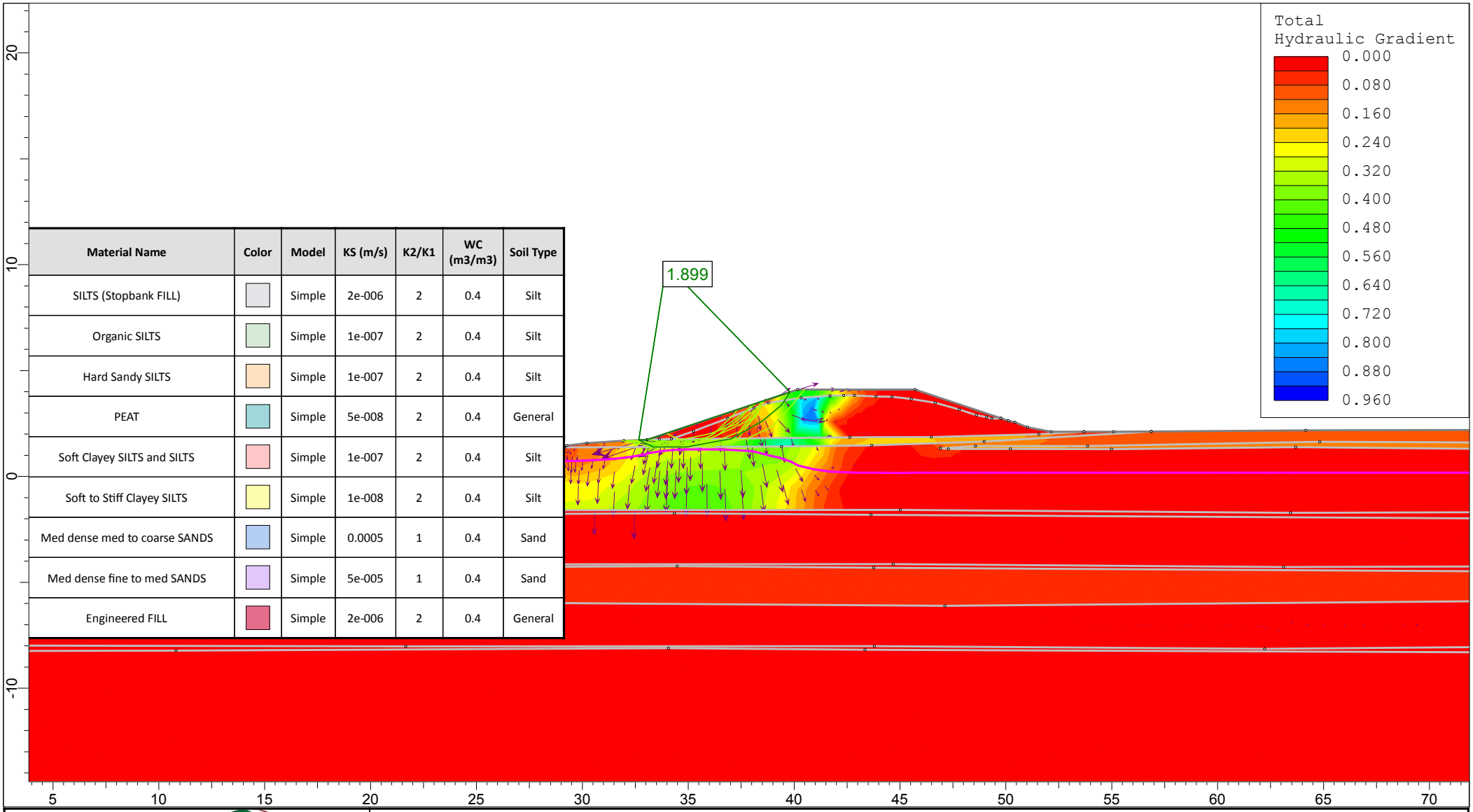
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILTS		16	Mohr-Coulomb	0	24	None	0.3
Hard Sandy SILTS		18	Mohr-Coulomb	5	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Soft Clayey SILTS and SILTS		16	Mohr-Coulomb	0	24	None	0.3
Soft to Stiff Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Med dense med to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to med SANDS		16	Mohr-Coulomb	0	28	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1A: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale* 1:300	*Company* CMW Geosciences Ltd
Date	12/10/2016, 3:19:47 p.m.		*File Name* F1A_filloverlay - RS 121016.slim



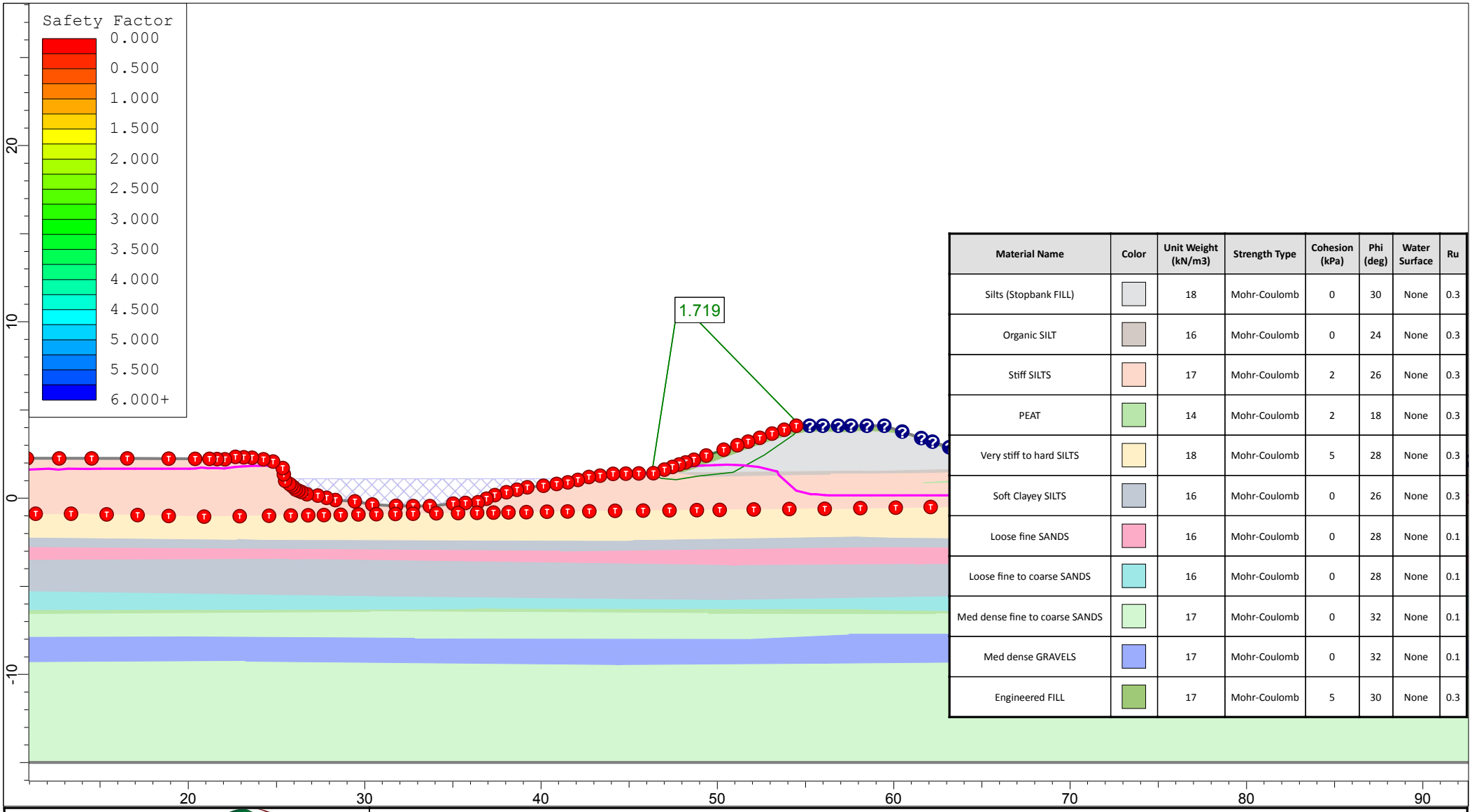
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS (Stopbank FILL)		Simple	2e-006	2	0.4	Silt
Organic SILTS		Simple	1e-007	2	0.4	Silt
Hard Sandy SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Soft Clayey SILTS and SILTS		Simple	1e-007	2	0.4	Silt
Soft to Stiff Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense med to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense fine to med SANDS		Simple	5e-005	1	0.4	Sand
Engineered FILL		Simple	2e-006	2	0.4	General

CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1A: Seepage - Flood event day 14		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	12/10/2016, 3:19:47 p.m.	*File Name*	F1A_filloverlay 121016.slim



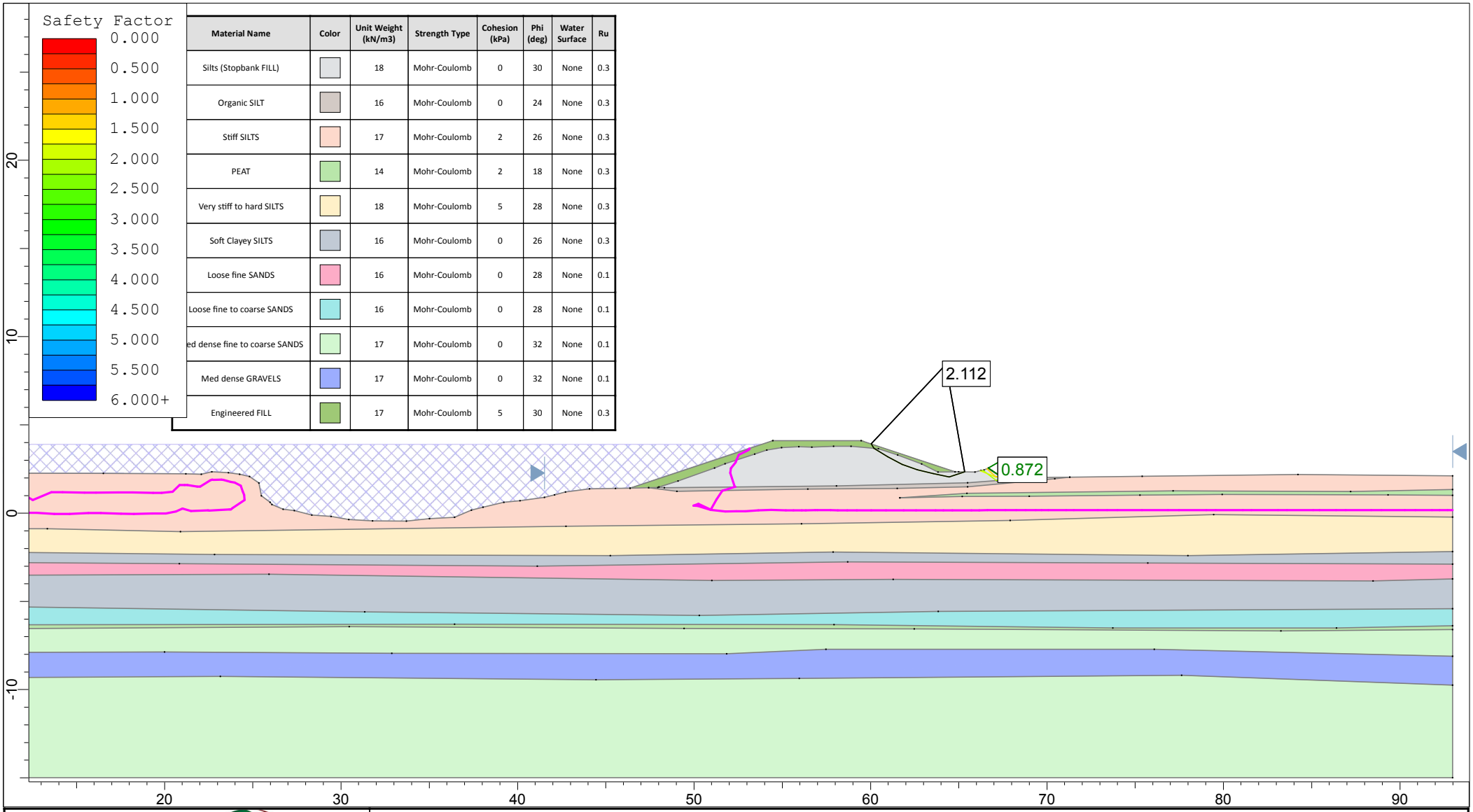
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silts (Stopbank FILL)		18	Mohr-Coulomb	0	30	None	0.3
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose fine SANDS		16	Mohr-Coulomb	0	28	None	0.1
Loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd

Checked Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1B: Slope stability - left side - lowest factor of safety shown (Day 10)		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	12/10/2016, 4:02:23 p.m.	*File Name*	F1B_filloverlay 311016.slim

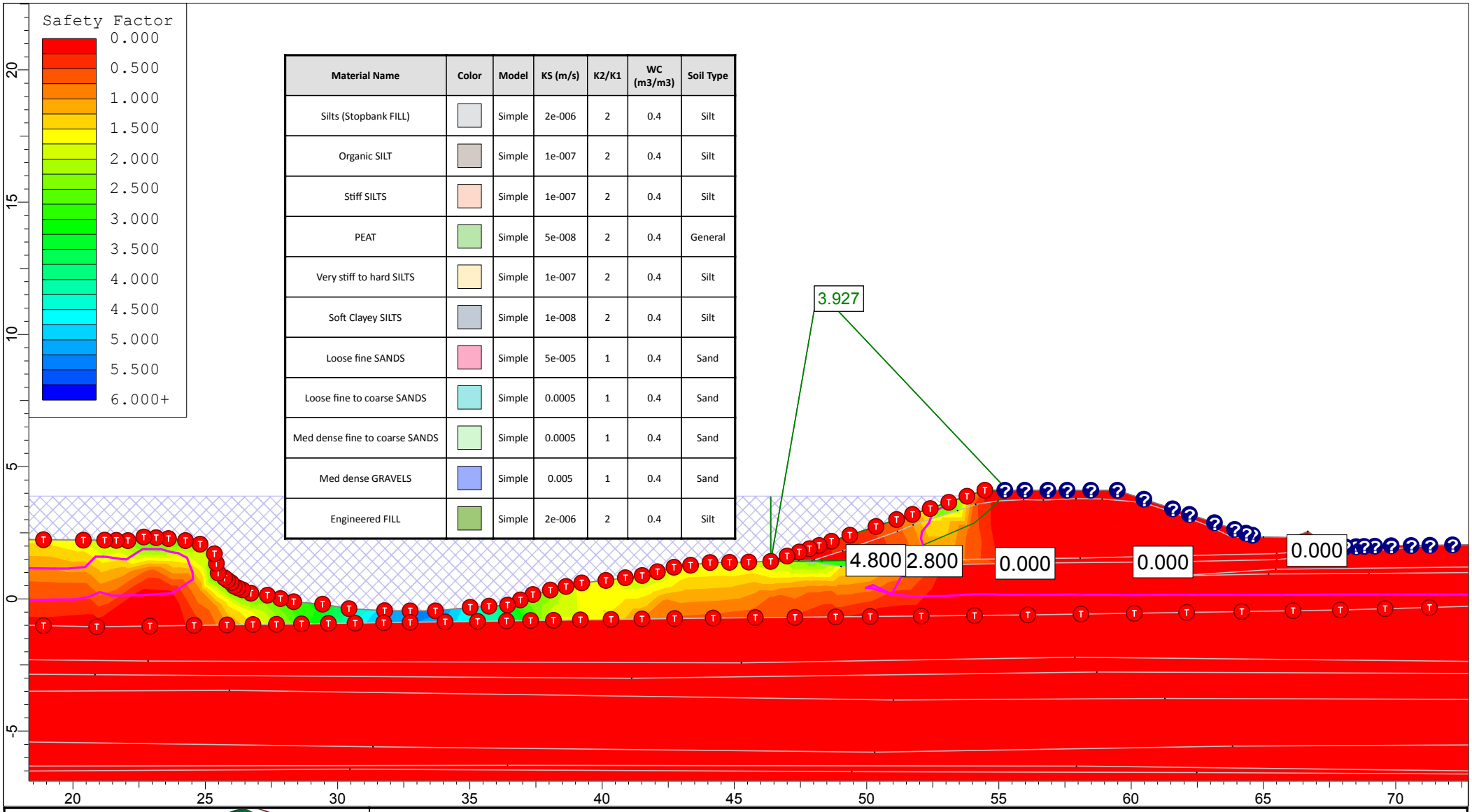


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silts (Stopbank FILL)		18	Mohr-Coulomb	0	30	None	0.3
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose fine SANDS		16	Mohr-Coulomb	0	28	None	0.1
Loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
ed dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1B: Slope stability - right side - lowest factor of safety shown (Day 7.5)		
Drawn By OMG	*Scale* 1:300	*Company*	CMW Geosciences Ltd
Date 12/10/2016, 4:02:23 p.m.		*File Name*	F1B_filloverlay RS 311016.slim



Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Silts (Stopbank FILL)		Simple	2e-006	2	0.4	Silt
Organic SILT		Simple	1e-007	2	0.4	Silt
Stiff SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose fine SANDS		Simple	5e-005	1	0.4	Sand
Loose fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense GRAVELS		Simple	0.005	1	0.4	Sand
Engineered FILL		Simple	2e-006	2	0.4	Silt

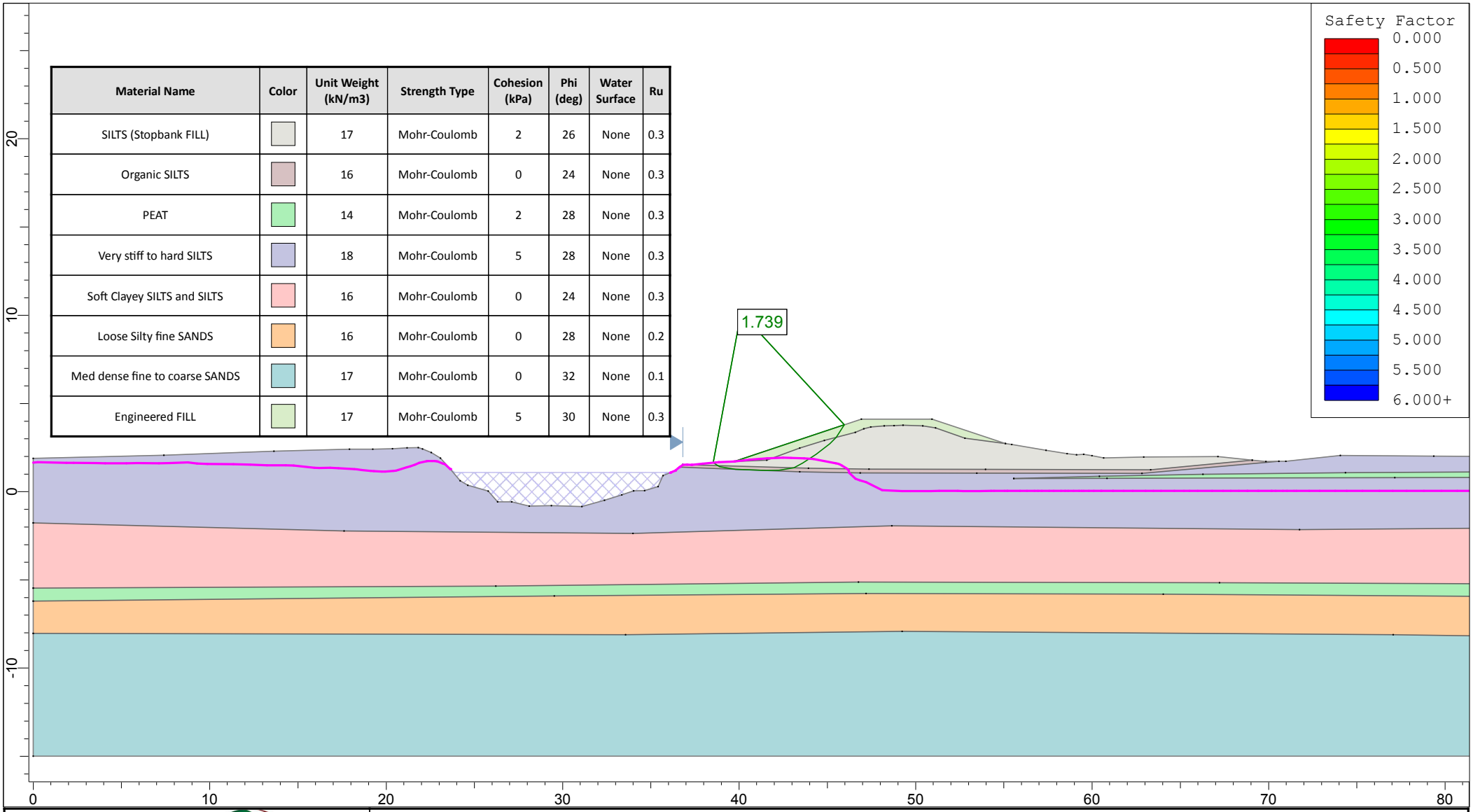
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1B: Seepage - Day 7.5 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	12/10/2016, 4:02:23 p.m.	*File Name*	F1B_filloverlay 311016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS and SILTS		16	Mohr-Coulomb	0	24	None	0.3
Loose Silty fine SANDS		16	Mohr-Coulomb	0	28	None	0.2
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

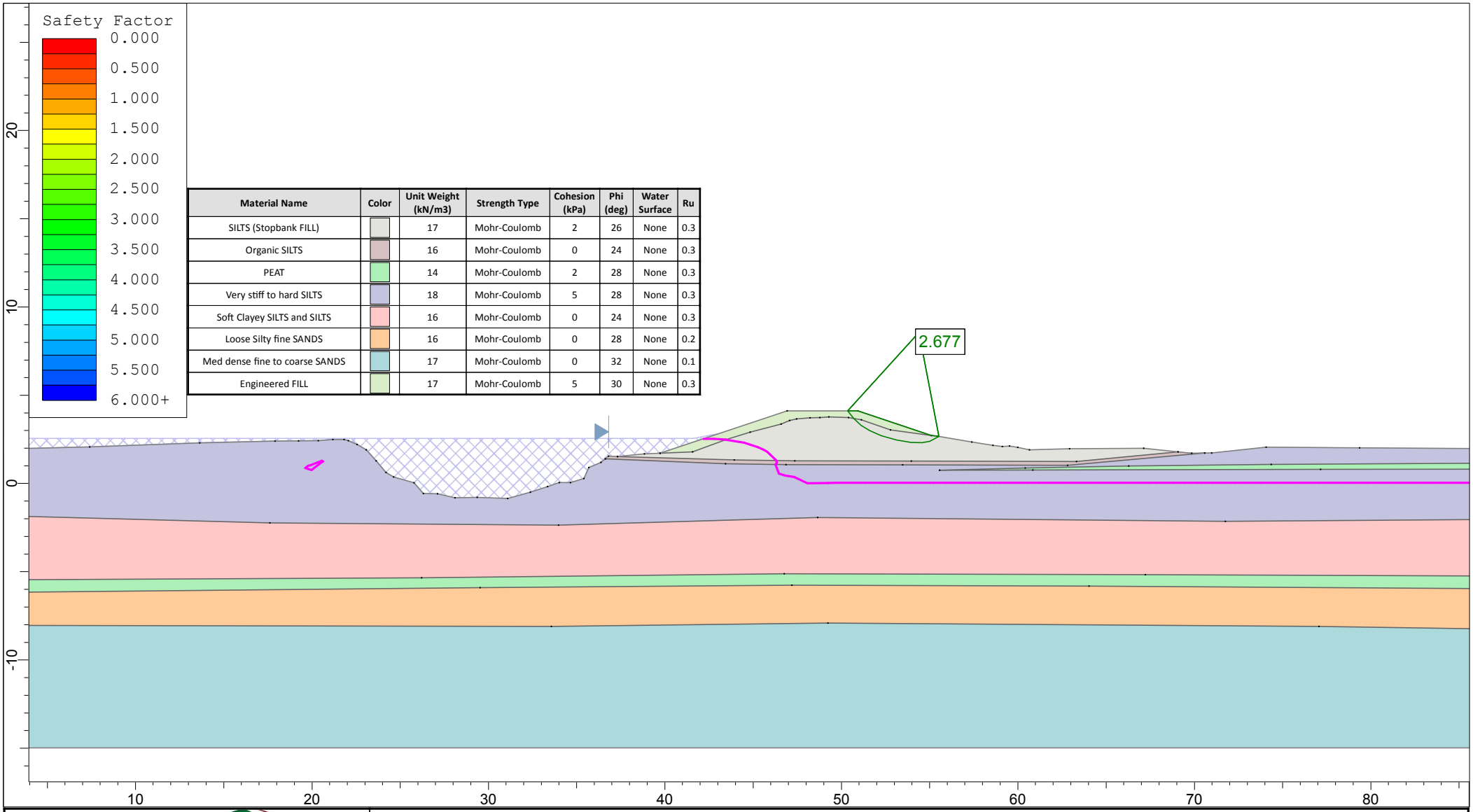


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1C: Slope Stability - left side - lowest factor of safety shown (Day 10)		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	12/10/2016, 4:40:52 p.m.	*File Name*	F1C_filloverlay- 311016.slim



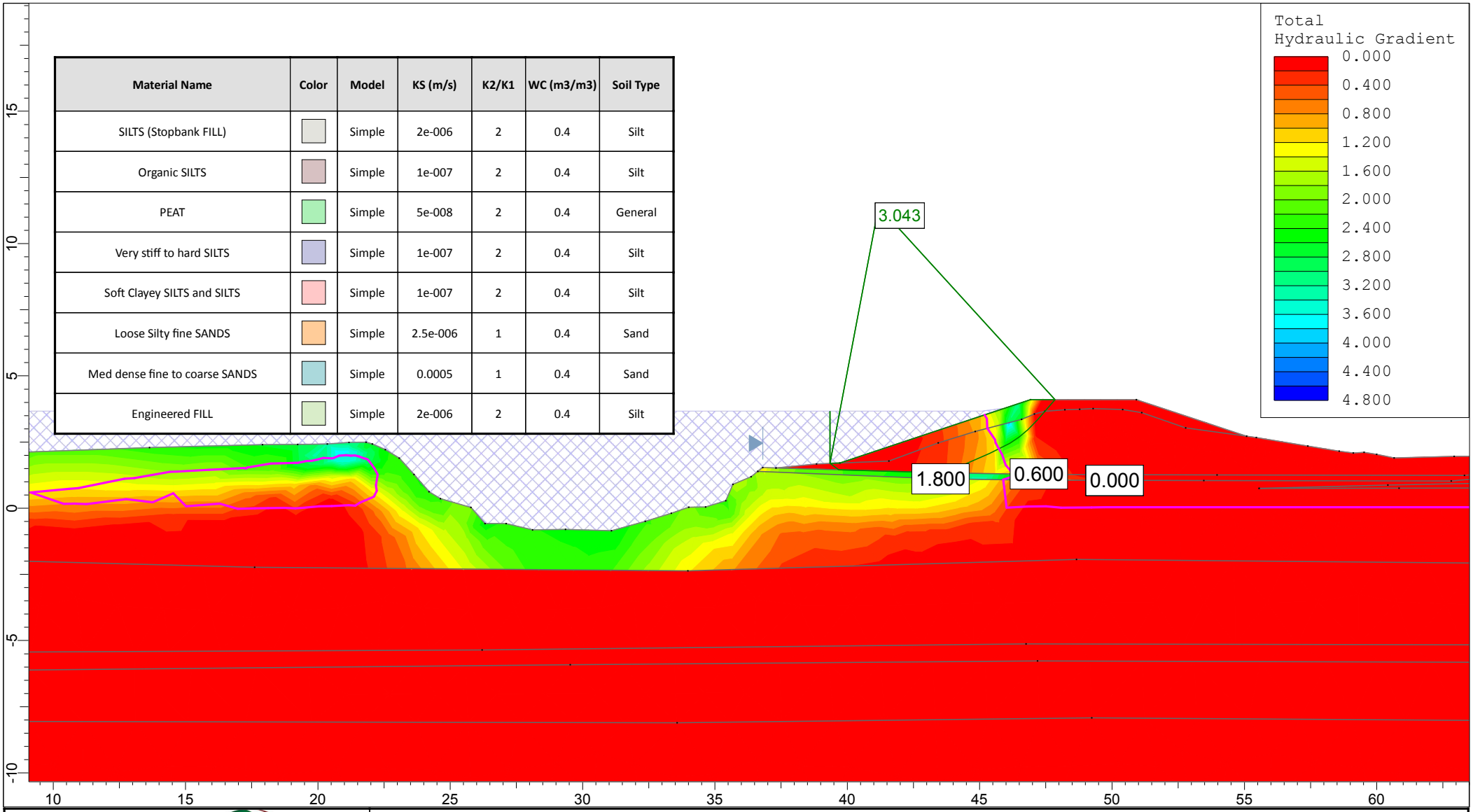
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS and SILTS		16	Mohr-Coulomb	0	24	None	0.3
Loose Silty fine SANDS		16	Mohr-Coulomb	0	28	None	0.2
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd
Cheyenne Morton Woodward

Project	Rangitaiki River and Floodway, Edgecumbe			
Analysis Description	Cross Section F1C: Slope Stability - right side - lowest factor of safety shown			
Drawn By	OMG	*Scale*	1:300	*Company* CMW Geosciences Ltd
Date	12/10/2016, 4:40:52 p.m.			*File Name* F1C_filloverlay- RS 311016.slim

SLIDEINTERPRET 6.035

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS (Stopbank FILL)		Simple	2e-006	2	0.4	Silt
Organic SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS and SILTS		Simple	1e-007	2	0.4	Silt
Loose Silty fine SANDS		Simple	2.5e-006	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Engineered FILL		Simple	2e-006	2	0.4	Silt



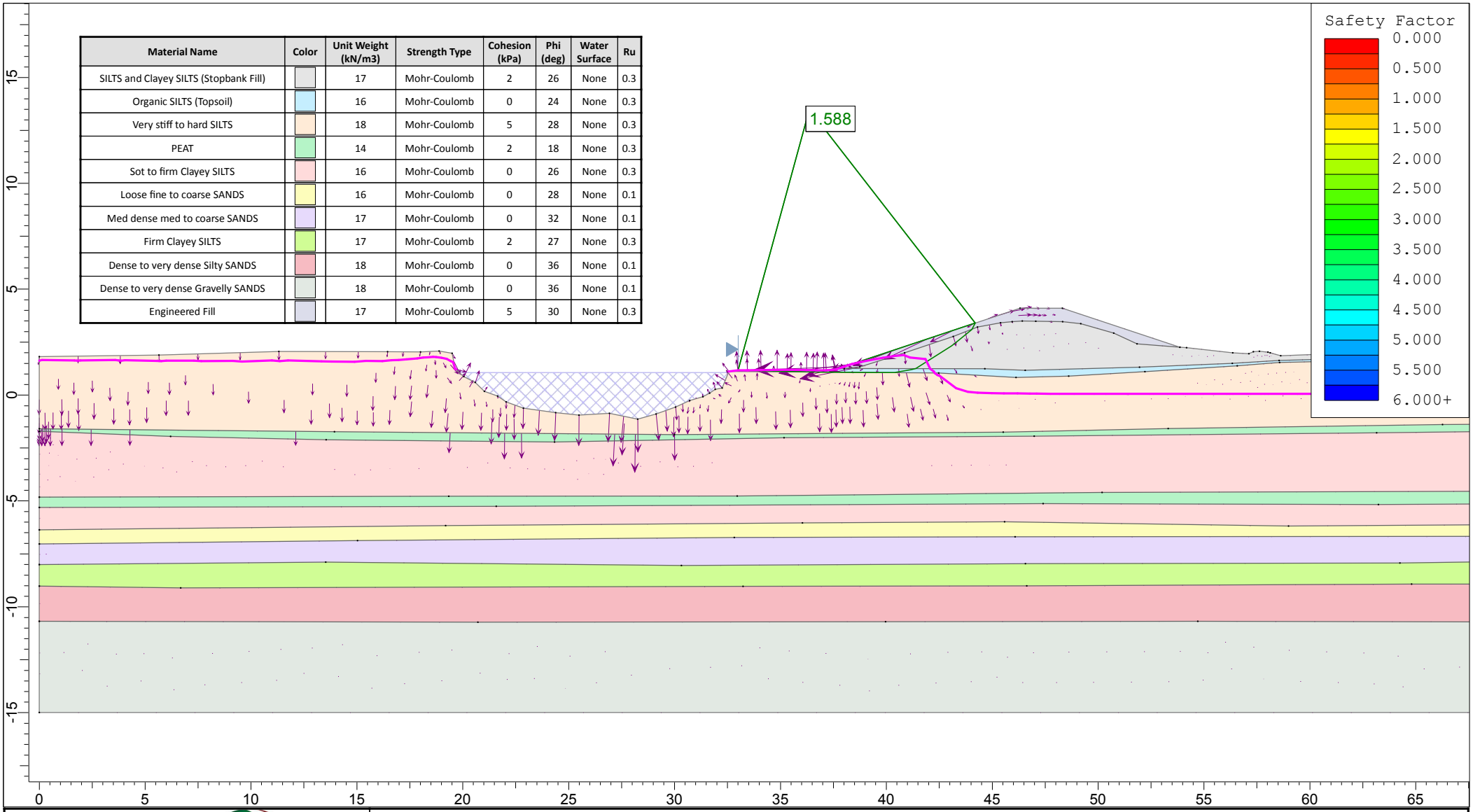
CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1C: Seepage - Day 8 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	12/10/2016, 4:40:52 p.m.	*File Name*	F1C_filloverlay- 311016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS and Clayey SILTS (Stopbank Fill)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILTS (Topsoil)		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Sot to firm Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense med to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Dense to very dense Silty SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense to very dense Gravelly SANDS		18	Mohr-Coulomb	0	36	None	0.1
Engineered Fill		17	Mohr-Coulomb	5	30	None	0.3

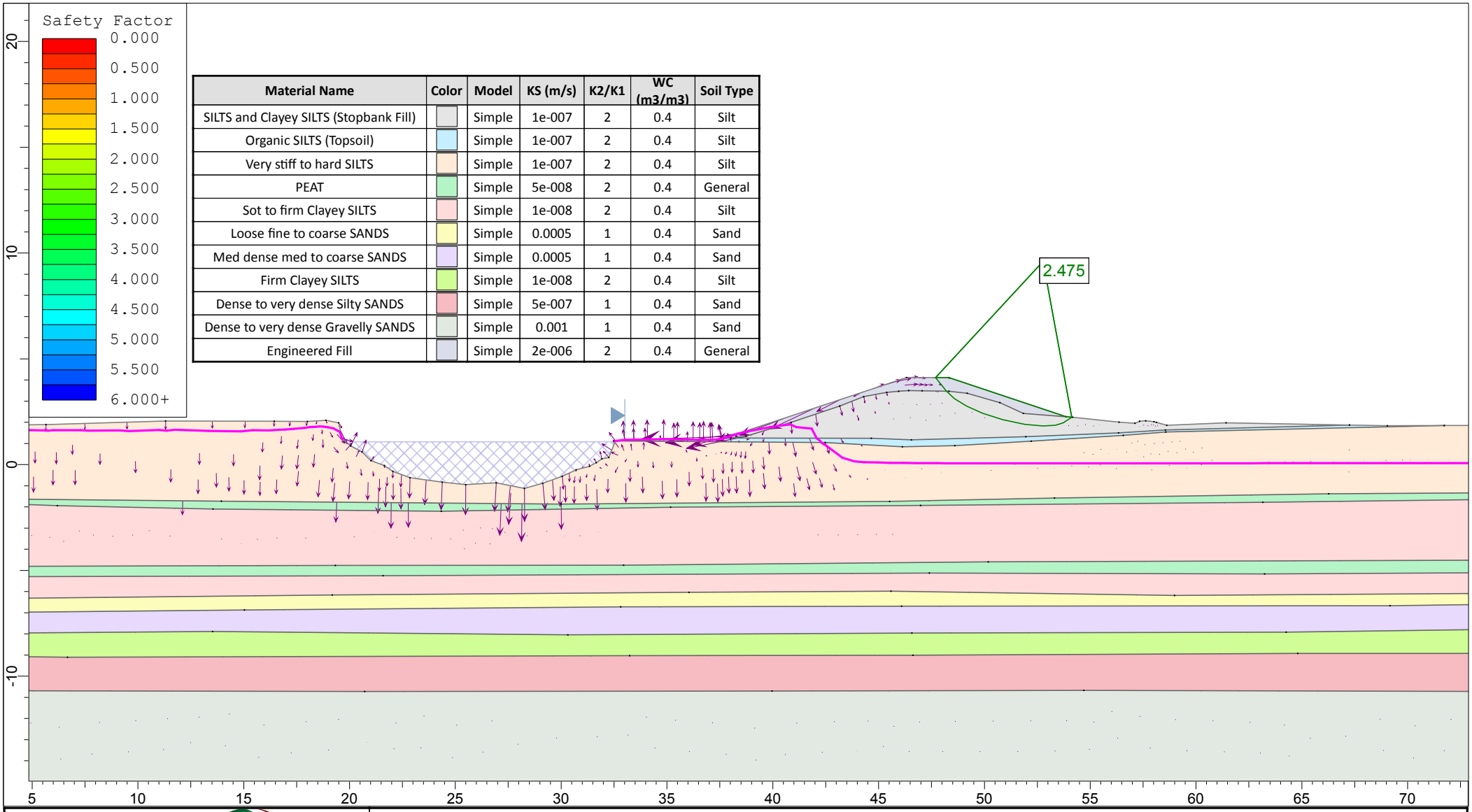


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1D: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:17:05 a.m.	*File Name*	F1D_filloverlay 131016.slim



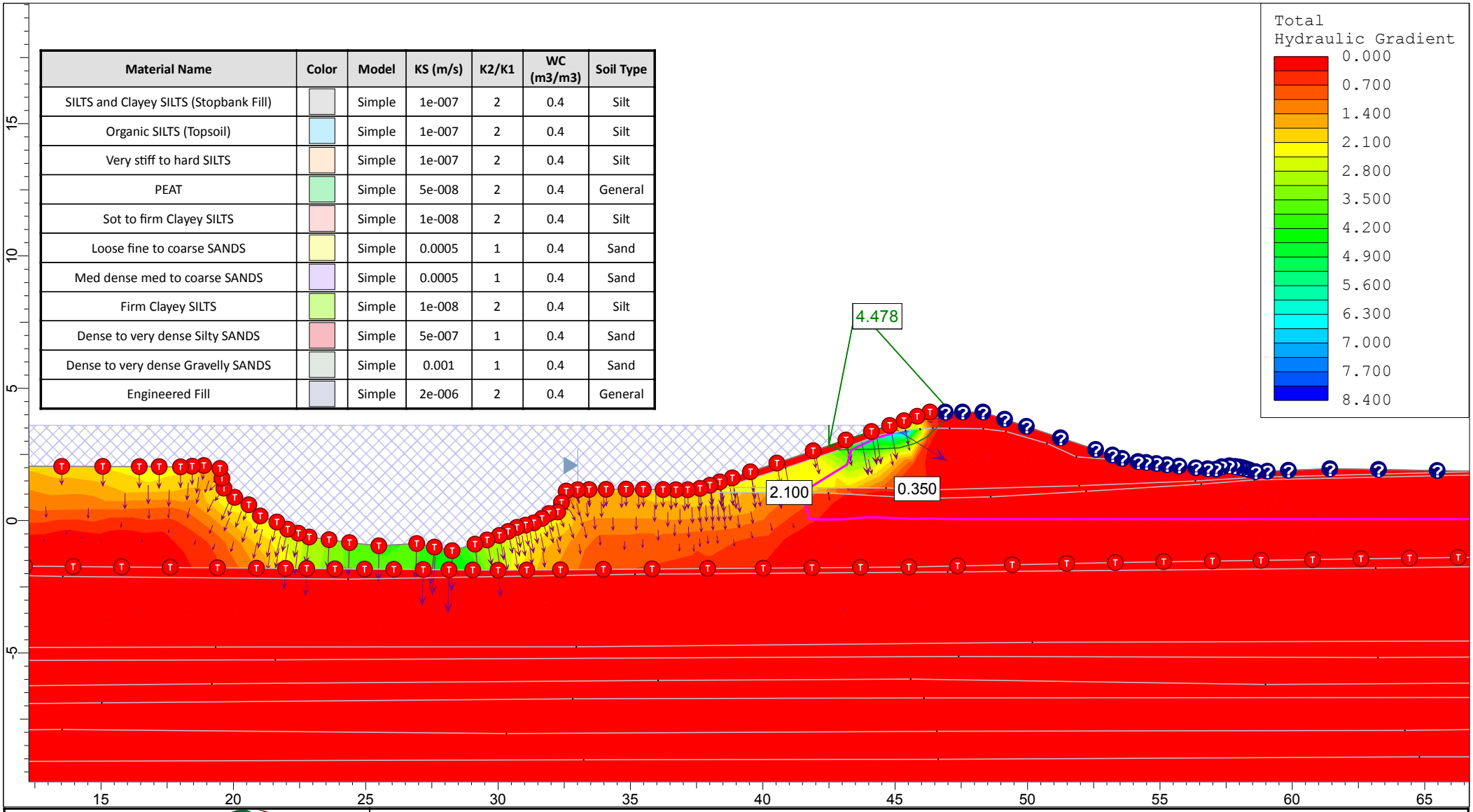
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS and Clayey SILTS (Stopbank Fill)		Simple	1e-007	2	0.4	Silt
Organic SILTS (Topsoil)		Simple	1e-007	2	0.4	Silt
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Sot to firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense med to coarse SANDS		Simple	0.0005	1	0.4	Sand
Firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Dense to very dense Silty SANDS		Simple	5e-007	1	0.4	Sand
Dense to very dense Gravelly SANDS		Simple	0.001	1	0.4	Sand
Engineered Fill		Simple	2e-006	2	0.4	General

CMW Geosciences (NZ) Ltd
Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1D: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:17:05 a.m.	*File Name*	F1D_filloverlay RS 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS and Clayey SILTS (Stopbank Fill)		Simple	1e-007	2	0.4	Silt
Organic SILTS (Topsoil)		Simple	1e-007	2	0.4	Silt
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Sot to firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense med to coarse SANDS		Simple	0.0005	1	0.4	Sand
Firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Dense to very dense Silty SANDS		Simple	5e-007	1	0.4	Sand
Dense to very dense Gravelly SANDS		Simple	0.001	1	0.4	Sand
Engineered Fill		Simple	2e-006	2	0.4	General

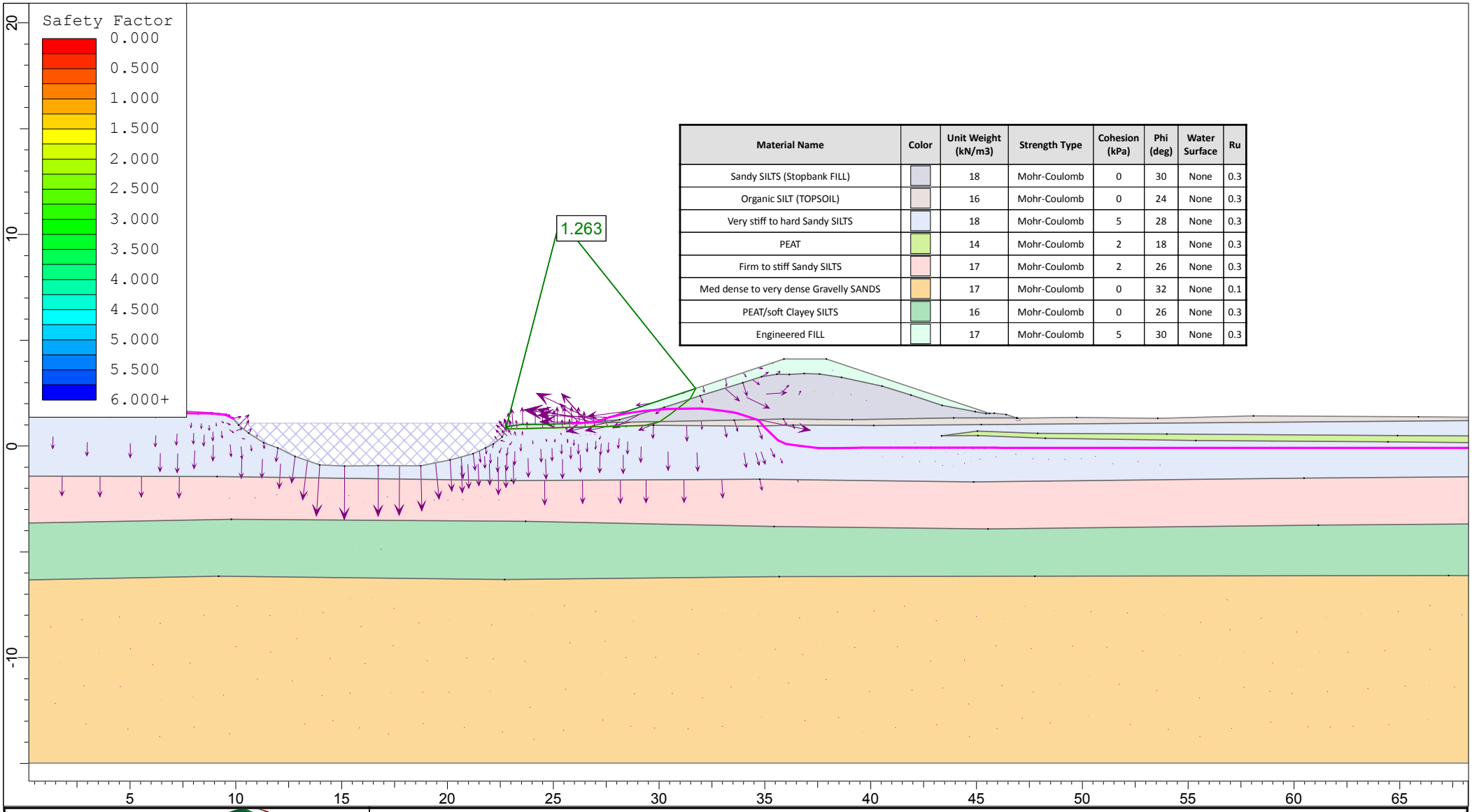


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1D: Seepage - Day 8 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:17:05 a.m.	*File Name*	F1D_filloverlay 131016.slim



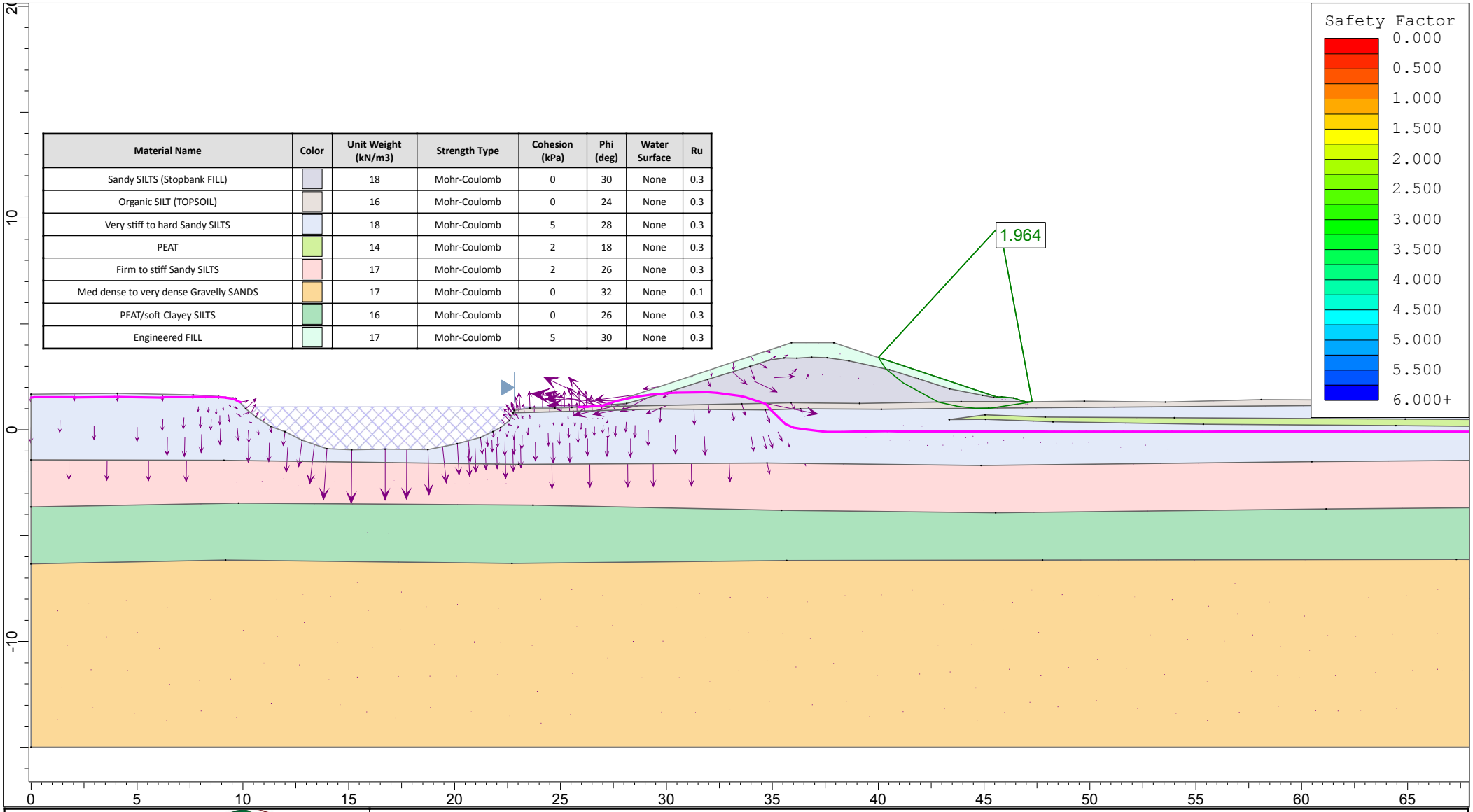
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Sandy SILTS (Stopbank FILL)		18	Mohr-Coulomb	0	30	None	0.3
Organic SILT (TOPSOIL)		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard Sandy SILTS		18	Mohr-Coulomb	5	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Firm to stiff Sandy SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense to very dense Gravelly SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT/soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1E: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:53:04 a.m.	*File Name*	F1E_filloverlay 131016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Sandy SILTS (Stopbank FILL)		18	Mohr-Coulomb	0	30	None	0.3
Organic SILT (TOPSOIL)		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard Sandy SILTS		18	Mohr-Coulomb	5	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Firm to stiff Sandy SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense to very dense Gravelly SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT/soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3



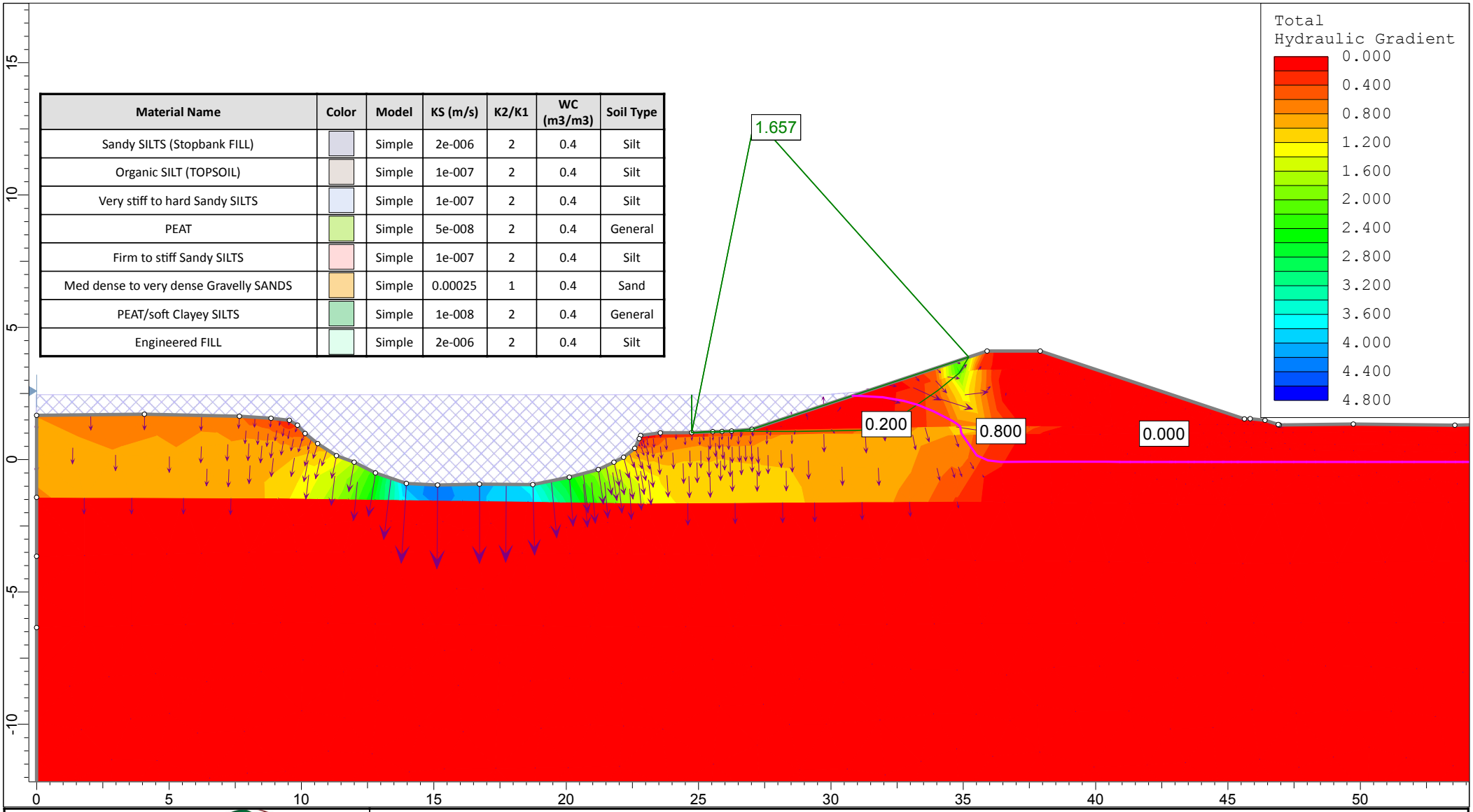
CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1E: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:53:04 a.m.	*File Name*	F1E_filloverlay RS 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Sandy SILTS (Stopbank FILL)		Simple	2e-006	2	0.4	Silt
Organic SILT (TOPSOIL)		Simple	1e-007	2	0.4	Silt
Very stiff to hard Sandy SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Firm to stiff Sandy SILTS		Simple	1e-007	2	0.4	Silt
Med dense to very dense Gravelly SANDS		Simple	0.00025	1	0.4	Sand
PEAT/soft Clayey SILTS		Simple	1e-008	2	0.4	General
Engineered FILL		Simple	2e-006	2	0.4	Silt



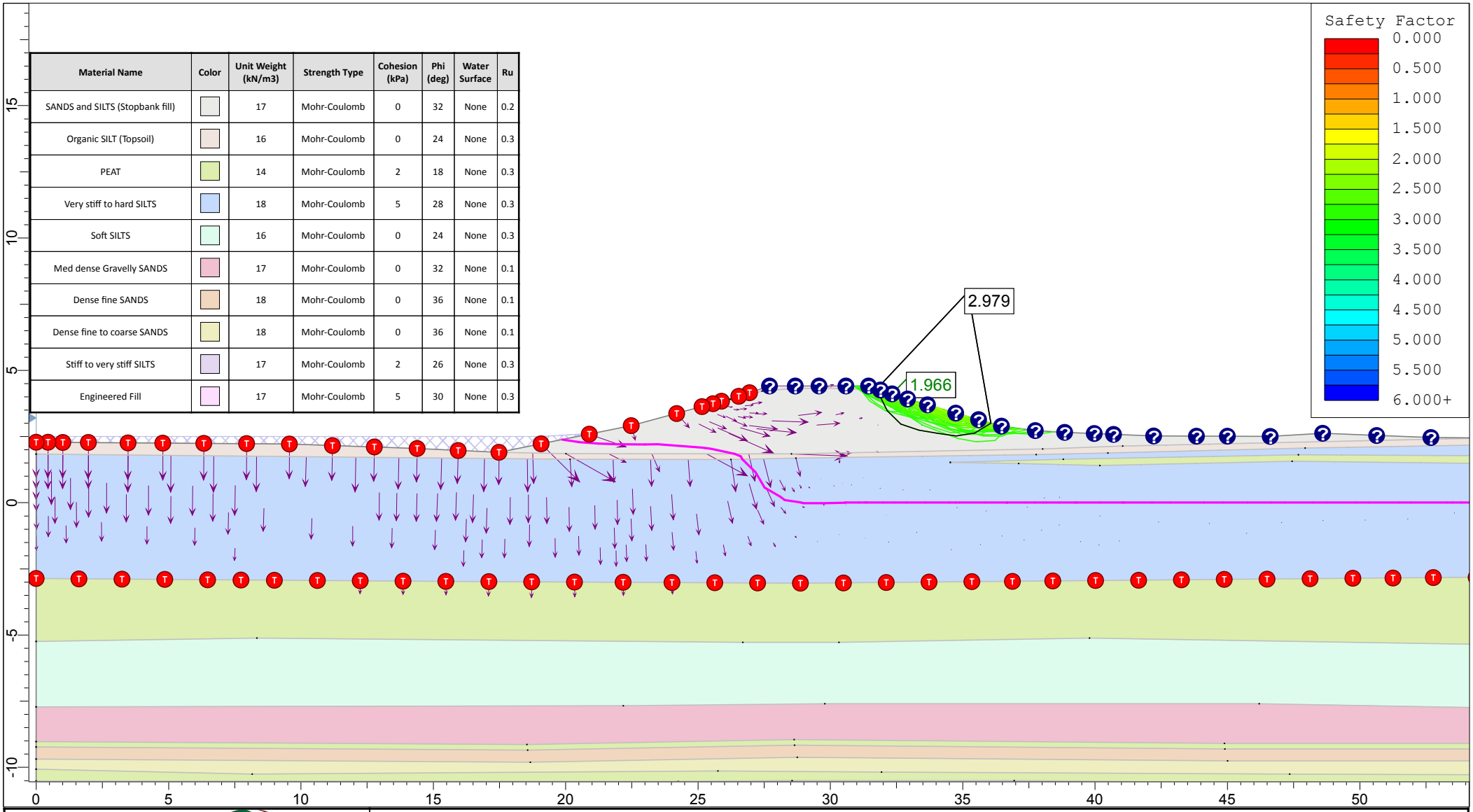
CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F1E: Seepage - Day 9 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	13/10/2016, 9:53:04 a.m.	*File Name*	F1E_filloverlay 131016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SANDS and SILTS (Stopbank fill)		17	Mohr-Coulomb	0	32	None	0.2
Organic SILT (Topsoil)		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Med dense Gravelly SANDS		17	Mohr-Coulomb	0	32	None	0.1
Dense fine SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense fine to coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
Stiff to very stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Engineered Fill		17	Mohr-Coulomb	5	30	None	0.3

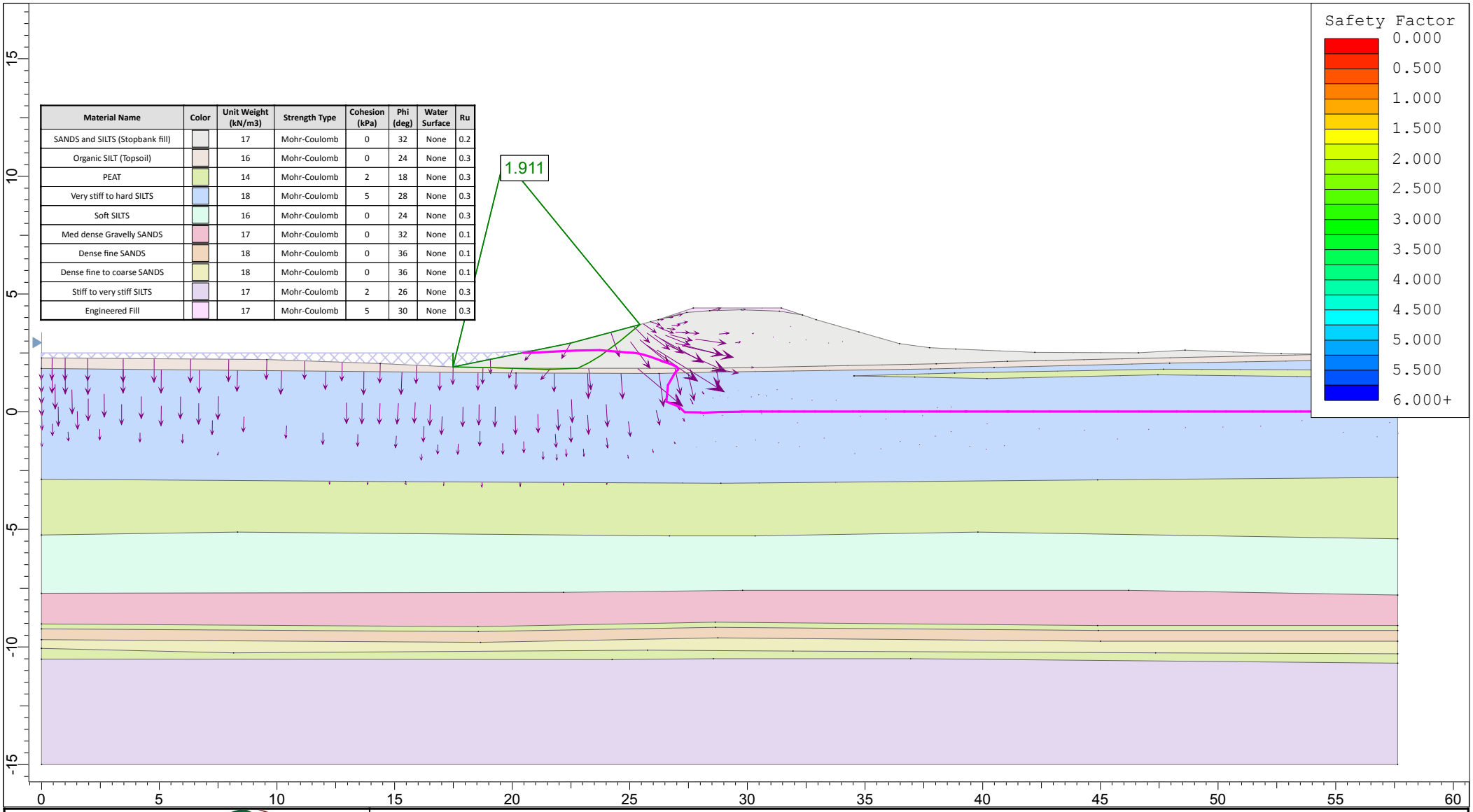


CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section F2A: Slope stability - right side - lowest factor of safety through stopbank				
Drawn By	OMG	*Scale*	1:200	*Company*	CMW Geosciences Ltd
Date	13/10/2016, 10:45:12 a.m.			*File Name*	F2A - fill overlay RS 131016.slim



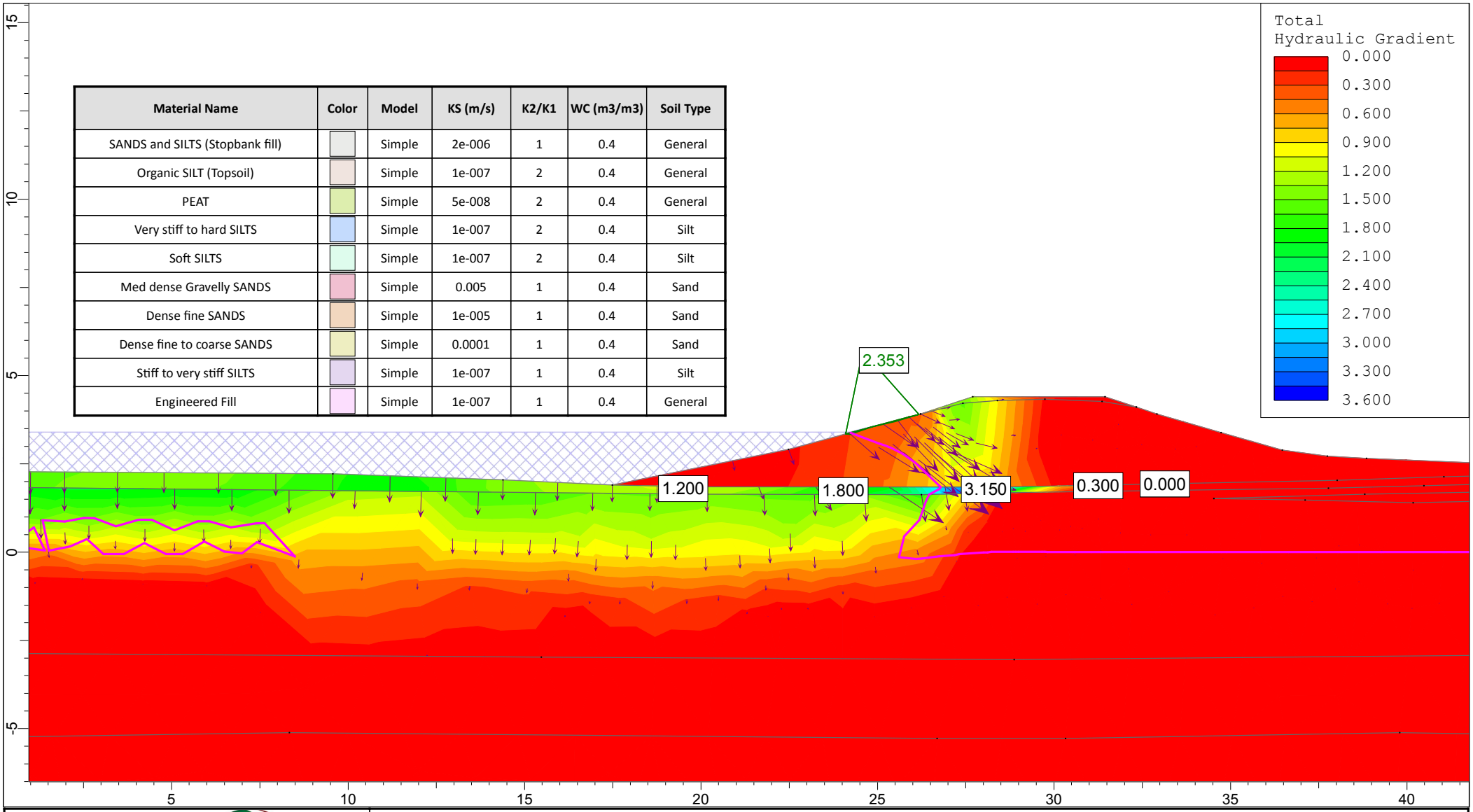
CMW Geosciences (NZ) Ltd

Chapman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F2A: Slope stability - LS - lowest factor of safety shown (Day 9.5)		
Drawn By	OMG	*Scale*	1:225
Company	CMW Geosciences Ltd		
Date	13/10/2016, 10:45:12 a.m.	*File Name*	F2A - fill overlay 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SANDS and SILTS (Stopbank fill)		Simple	2e-006	1	0.4	General
Organic SILT (Topsoil)		Simple	1e-007	2	0.4	General
PEAT		Simple	5e-008	2	0.4	General
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Soft SILTS		Simple	1e-007	2	0.4	Silt
Med dense Gravelly SANDS		Simple	0.005	1	0.4	Sand
Dense fine SANDS		Simple	1e-005	1	0.4	Sand
Dense fine to coarse SANDS		Simple	0.0001	1	0.4	Sand
Stiff to very stiff SILTS		Simple	1e-007	1	0.4	Silt
Engineered Fill		Simple	1e-007	1	0.4	General



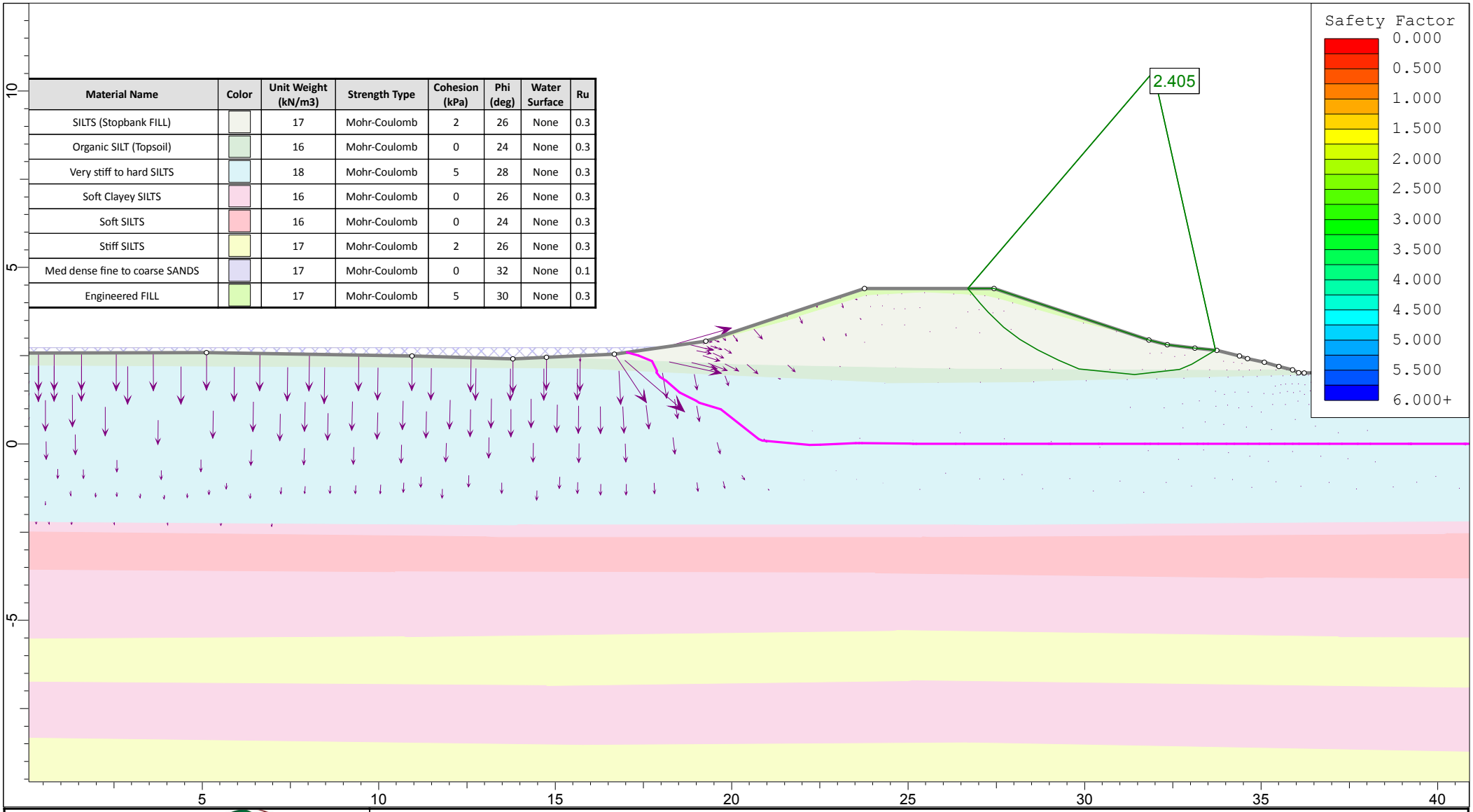
Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section F2A: Seepage - Day 8.75 - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	13/10/2016, 10:45:12 a.m.	*File Name*	F2A - fill overlay 131016.slim

CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILT (Topsoil)		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

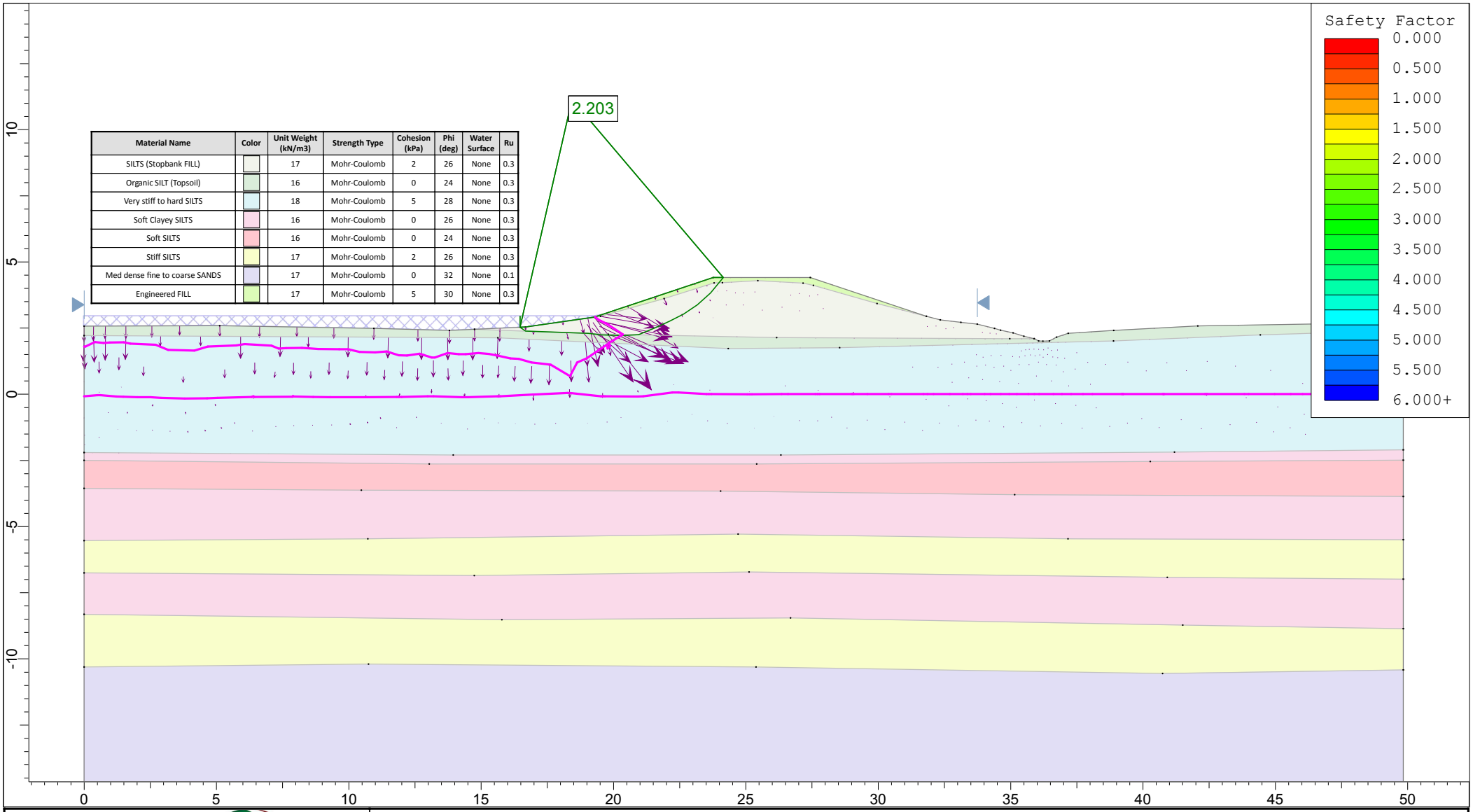


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2B: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	13/10/2016, 11:35:08 a.m.	*File Name*	F2B - fill overlay RS 131016.slim



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILT (Topsoil)		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

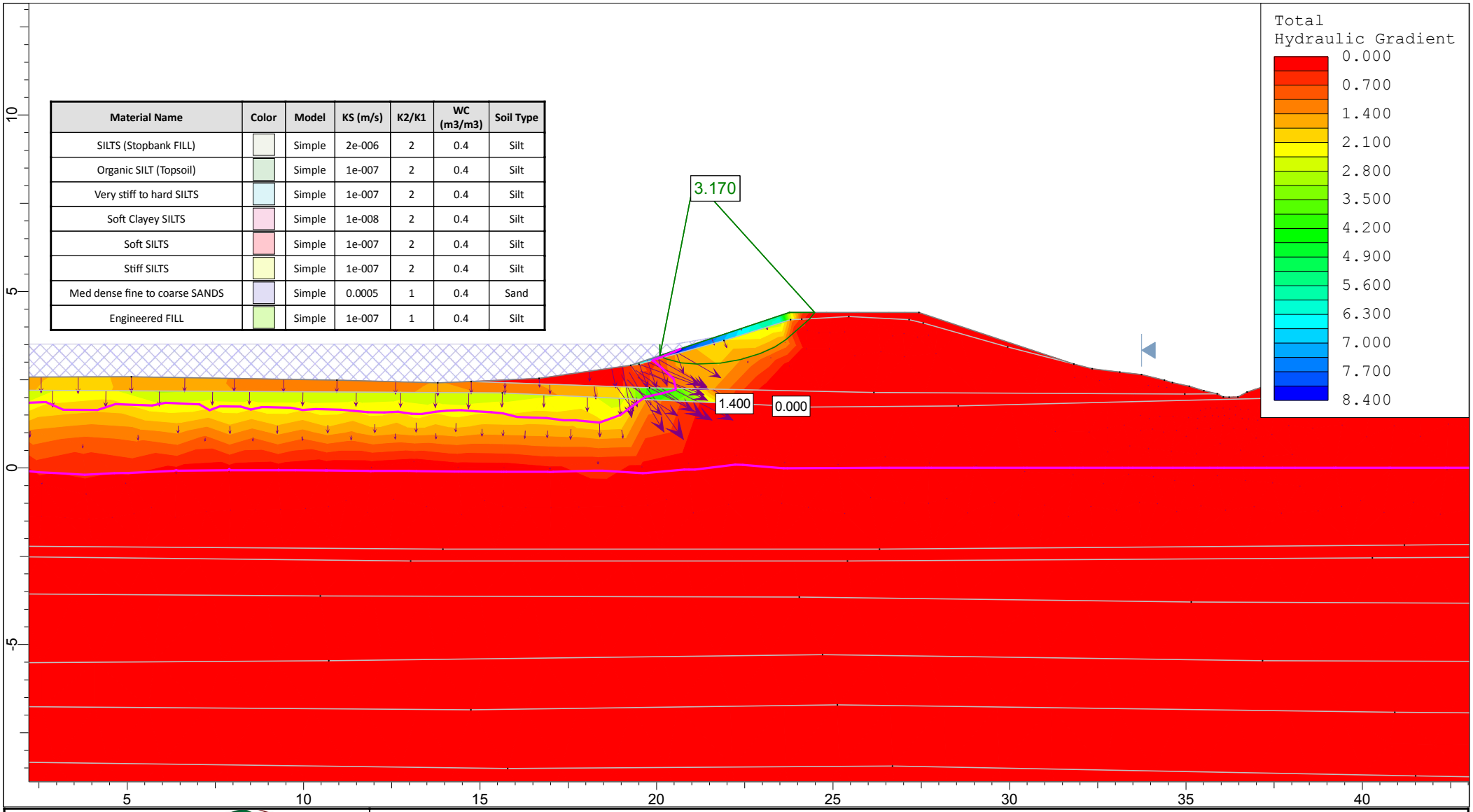
CMW Geosciences (NZ) Ltd

Cheeseman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2B: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	13/10/2016, 11:35:08 a.m.	*File Name*	F2B - fill overlay 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS (Stopbank FILL)		Simple	2e-006	2	0.4	Silt
Organic SILT (Topsoil)		Simple	1e-007	2	0.4	Silt
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
Soft SILTS		Simple	1e-007	2	0.4	Silt
Stiff SILTS		Simple	1e-007	2	0.4	Silt
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Engineered FILL		Simple	1e-007	1	0.4	Silt



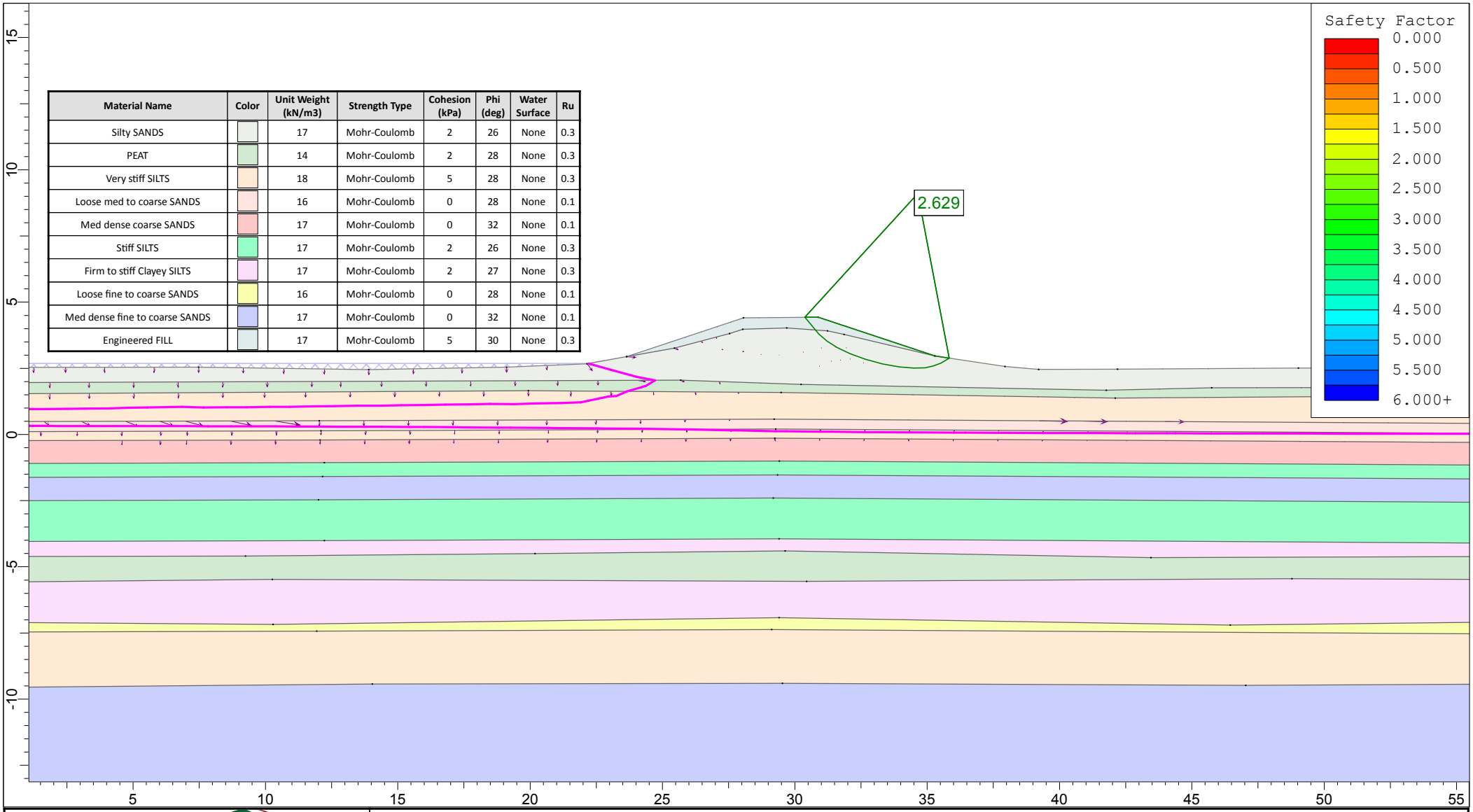
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2B: Seepage - Day 8.75 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	13/10/2016, 11:35:08 a.m.	*File Name*	F2B - fill overlay 131016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silty SANDS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Loose med to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3



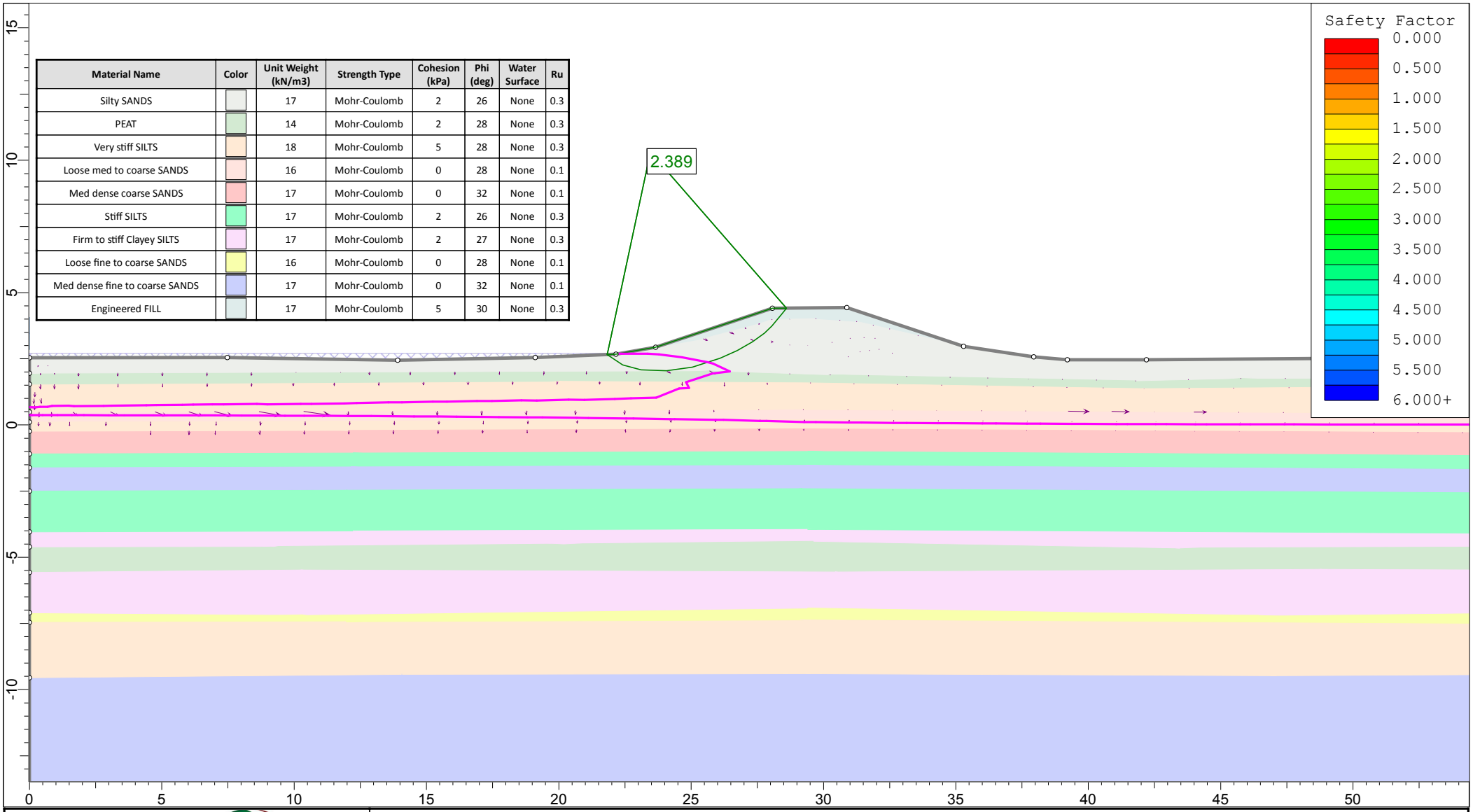
CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2C: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	13/10/2016, 1:43:11 p.m.	*File Name*	F2C - fill overlay RS 131016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silty SANDS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Loose med to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3



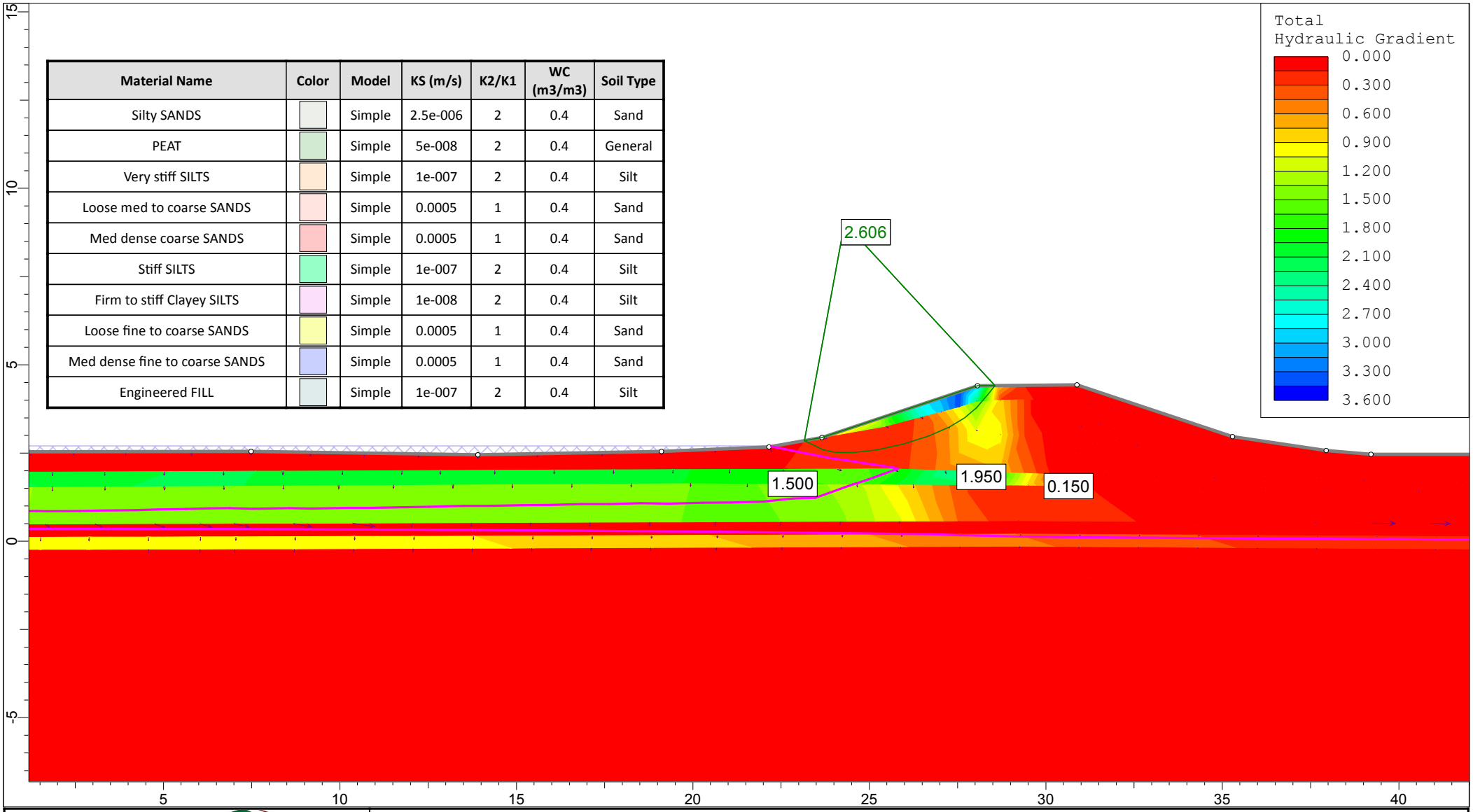
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2C: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	13/10/2016, 1:43:11 p.m.	*File Name*	F2C - fill overlay 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Silty SANDS		Simple	2.5e-006	2	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Very stiff SILTS		Simple	1e-007	2	0.4	Silt
Loose med to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense coarse SANDS		Simple	0.0005	1	0.4	Sand
Stiff SILTS		Simple	1e-007	2	0.4	Silt
Firm to stiff Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Engineered FILL		Simple	1e-007	2	0.4	Silt

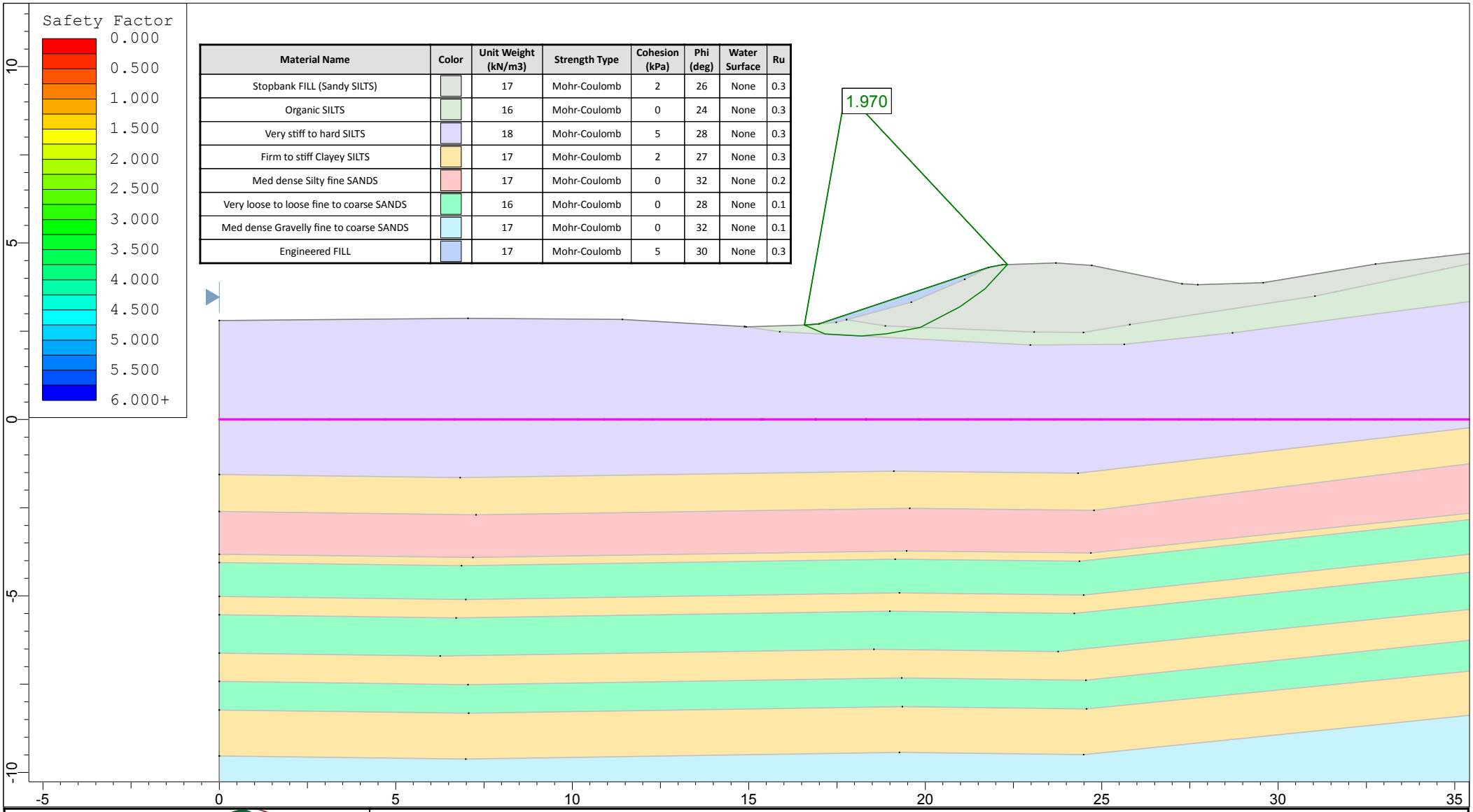


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2C: Seepage - Day 9.75 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	13/10/2016, 1:43:11 p.m.	*File Name*	F2C - fill overlay 131016.slim



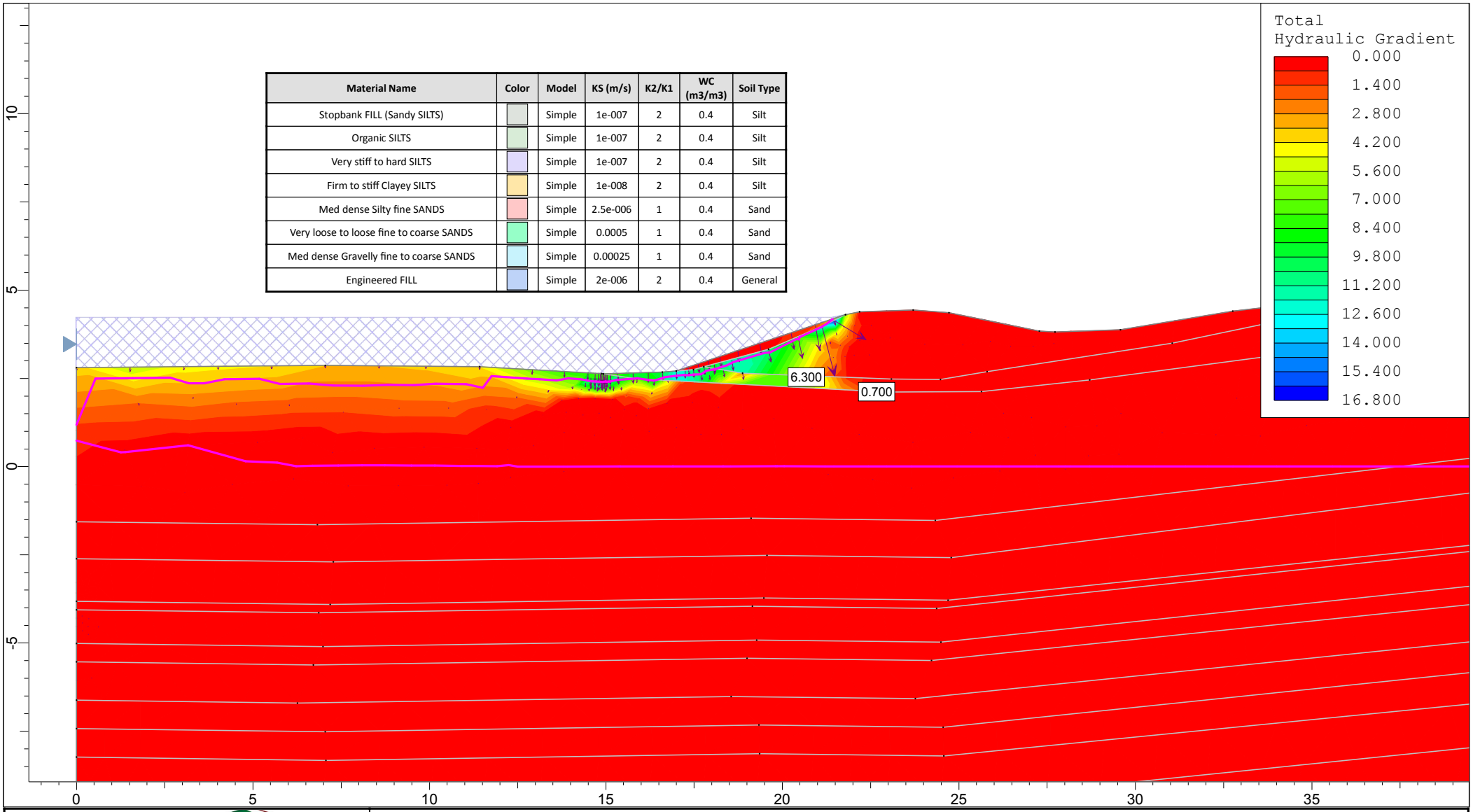
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank FILL (Sandy SILTS)		17	Mohr-Coulomb	2	26	None	0.3
Organic SILTS		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Med dense Silty fine SANDS		17	Mohr-Coulomb	0	32	None	0.2
Very loose to loose fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Med dense Gravelly fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Engineered FILL		17	Mohr-Coulomb	5	30	None	0.3

CMW Geosciences (NZ) Ltd
Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2D: Slope stability - left side (Day 7) - lowest factor of safety shown		
Drawn By	OMG	*Scale* 1:150	*Company* CMW Geosciences Ltd
Date	13/10/2016, 2:27:38 p.m.		*File Name* F2D - fill overlay 131016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Stopbank FILL (Sandy SILTS)		Simple	1e-007	2	0.4	Silt
Organic SILTS		Simple	1e-007	2	0.4	Silt
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Firm to stiff Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense Silty fine SANDS		Simple	2.5e-006	1	0.4	Sand
Very loose to loose fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense Gravelly fine to coarse SANDS		Simple	0.00025	1	0.4	Sand
Engineered FILL		Simple	2e-006	2	0.4	General



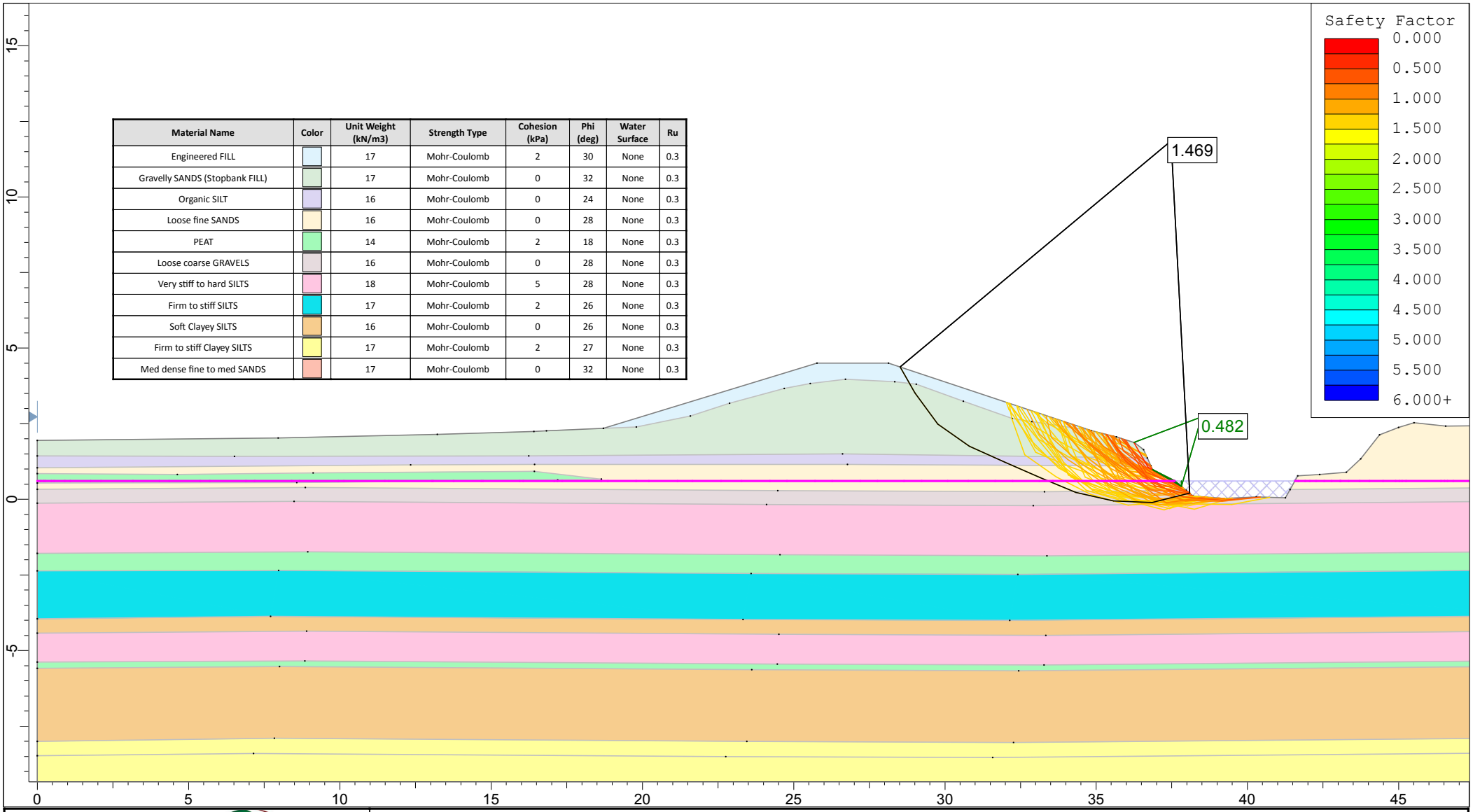
CMW Geosciences (NZ) Ltd

Geotechnical Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F2D: Seepage - Day 7.5 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	13/10/2016, 2:27:38 p.m.	*File Name*	F2D - fill overlay 131016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
Gravelly SANDS (Stopbank FILL)		17	Mohr-Coulomb	0	32	None	0.3
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Loose fine SANDS		16	Mohr-Coulomb	0	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Loose coarse GRAVELS		16	Mohr-Coulomb	0	28	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Firm to stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.3

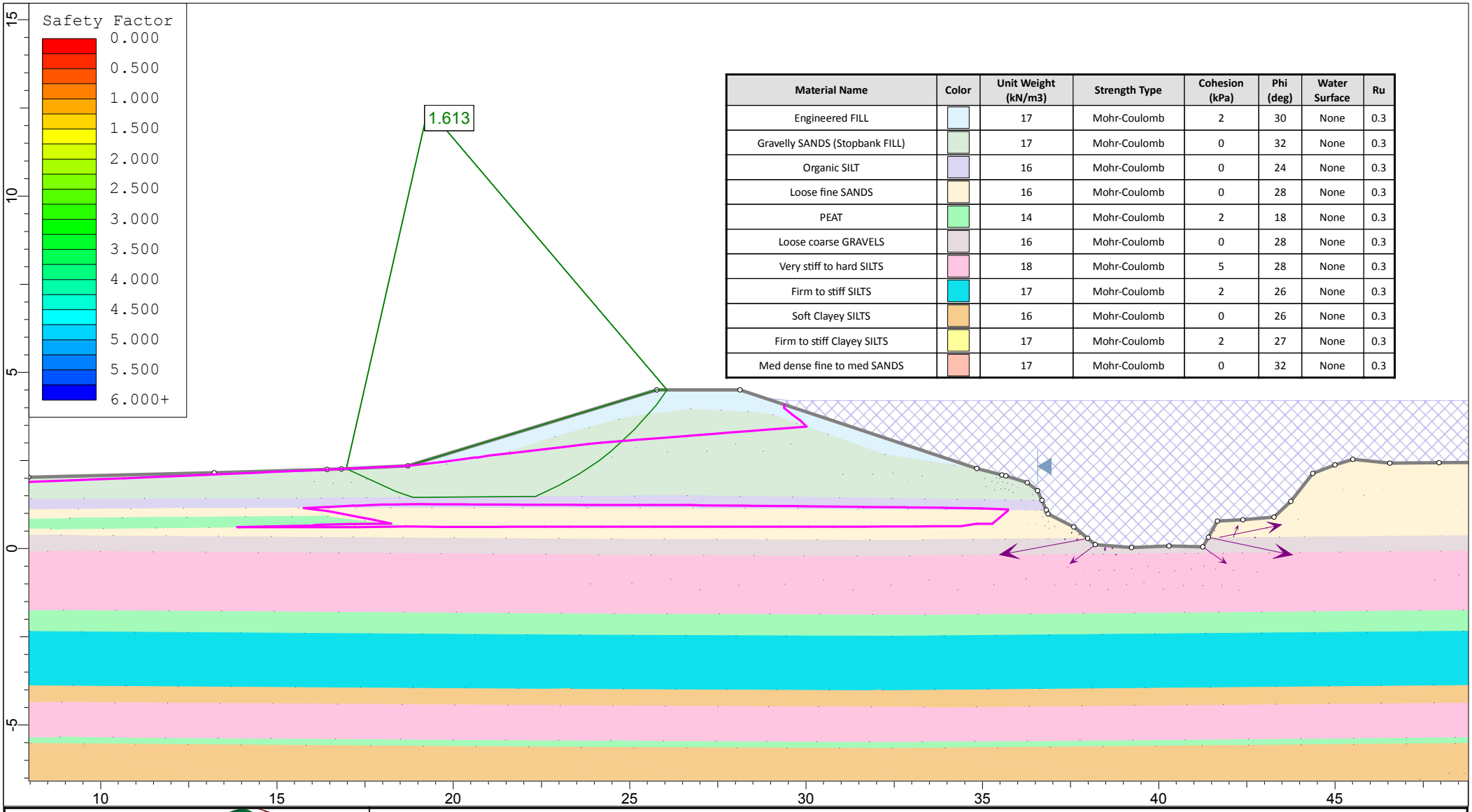


CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3A: Slope stability - right side (day 1) - factor of safety less than 1.5 shown		
Drawn By	OMG	*Scale*	1:175
Company	CMW Geosciences Ltd		
Date	31/10/2016, 9:30:23 a.m.	*File Name*	F3A-fill overlay 311016.slim



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
Gravelly SANDS (Stopbank FILL)		17	Mohr-Coulomb	0	32	None	0.3
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Loose fine SANDS		16	Mohr-Coulomb	0	28	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Loose coarse GRAVELS		16	Mohr-Coulomb	0	28	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Firm to stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.3

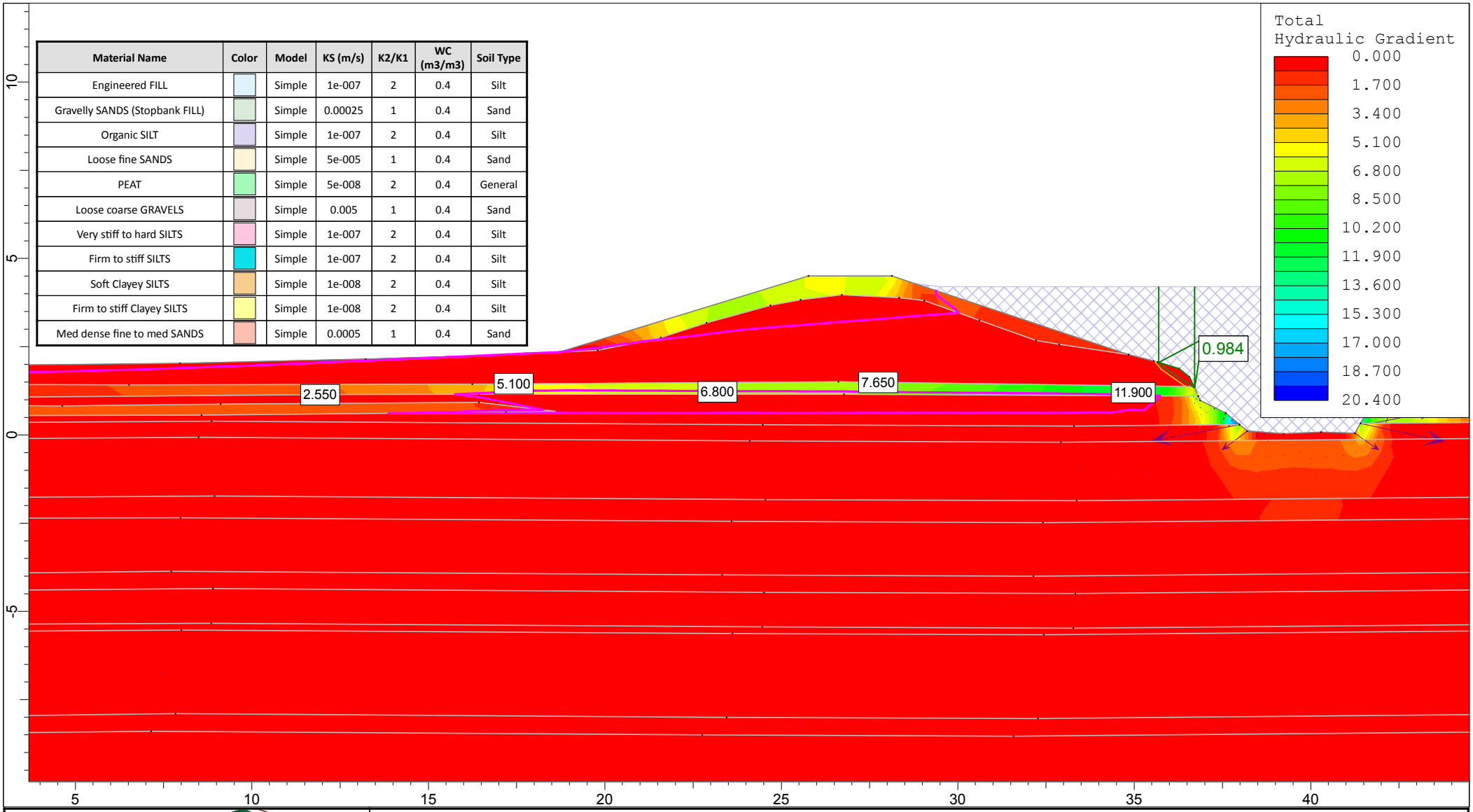
CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section F3A: Slope stability - left side (day 8) - lowest factor of safety shown				
Drawn By	OMG	*Scale*	1:150	*Company*	CMW Geosciences Ltd
Date	31/10/2016, 9:30:23 a.m.			*File Name*	F3A-fill overlay LS 311016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Engineered FILL		Simple	1e-007	2	0.4	Silt
Gravelly SANDS (Stopbank FILL)		Simple	0.00025	1	0.4	Sand
Organic SILT		Simple	1e-007	2	0.4	Silt
Loose fine SANDS		Simple	5e-005	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Loose coarse GRAVELS		Simple	0.005	1	0.4	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Firm to stiff SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
Firm to stiff Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense fine to med SANDS		Simple	0.0005	1	0.4	Sand



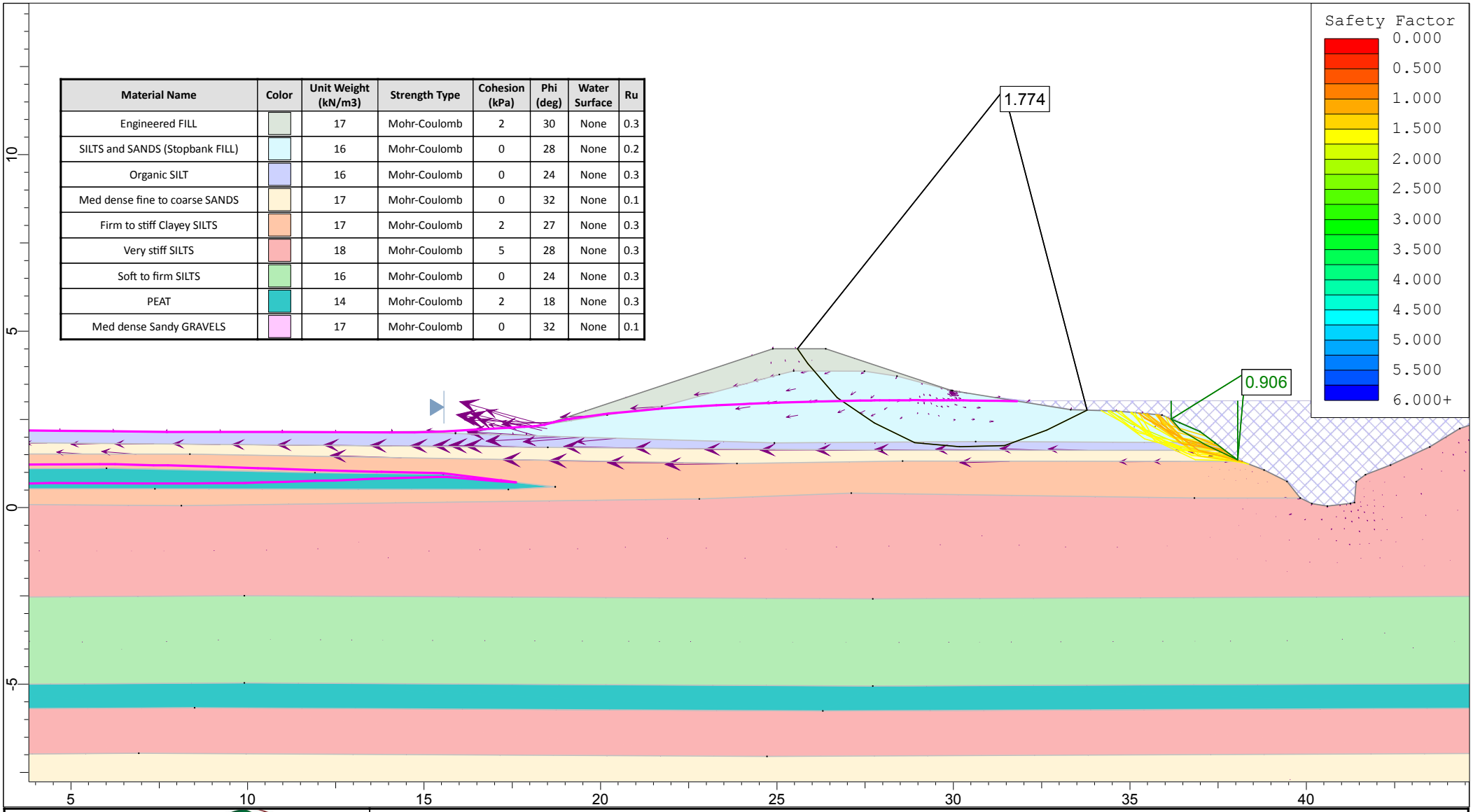
CMW Geosciences (NZ) Ltd

Golder Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3A: Seepage - day 8 of flood event - maximum hydraulic gradients		
Drawn By	OMG	*Scale* 1:150	*Company* CMW Geosciences Ltd
Date	31/10/2016, 9:30:23 a.m.		*File Name* F3A-fill overlay 311016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
SILTS and SANDS (Stopbank FILL)		16	Mohr-Coulomb	0	28	None	0.2
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft to firm SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Med dense Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1

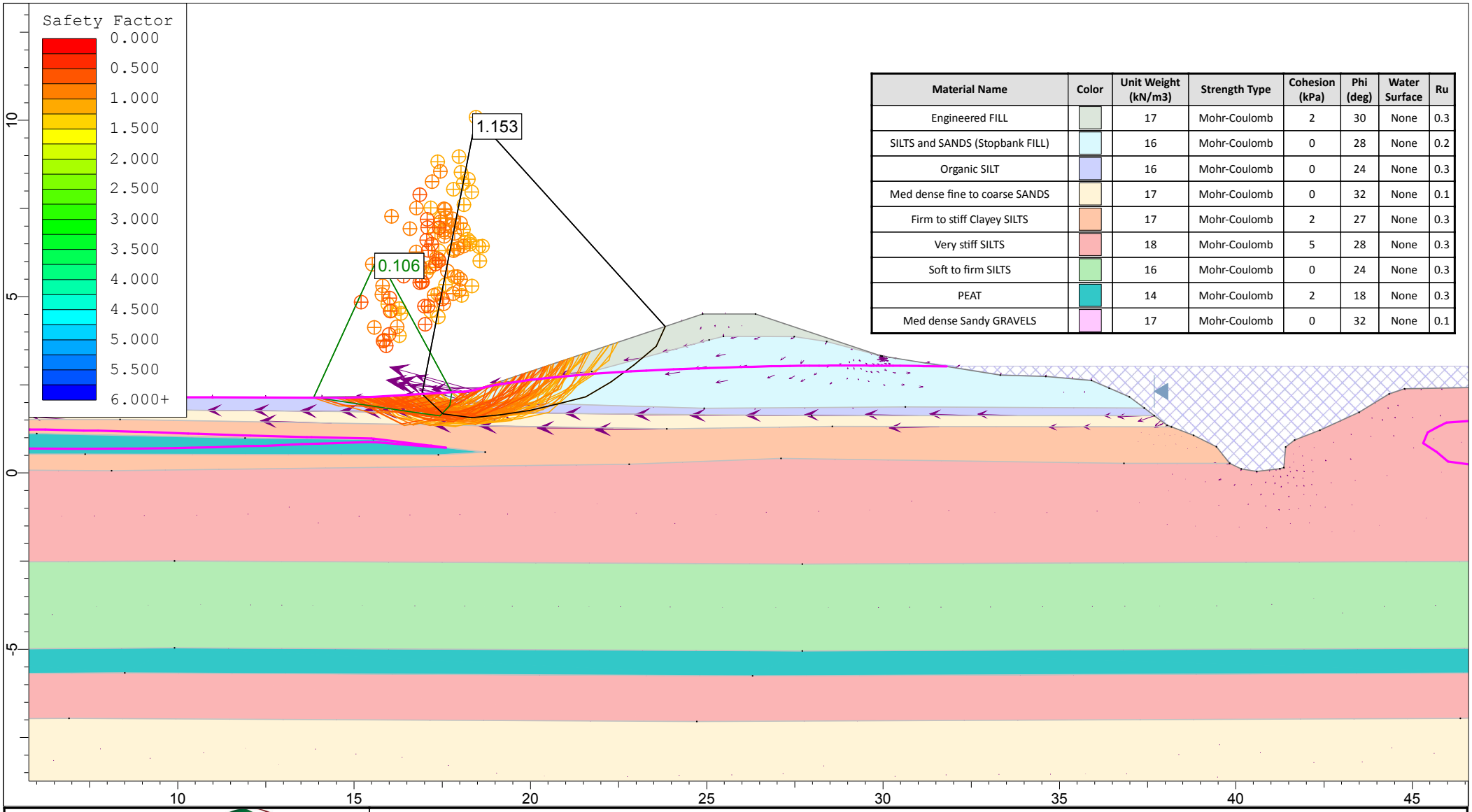


CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3B: Slope stability - right side (Day 9) - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	31/10/2016, 2:51:46 p.m.	*File Name*	F3B-fill overlay 311016.slim



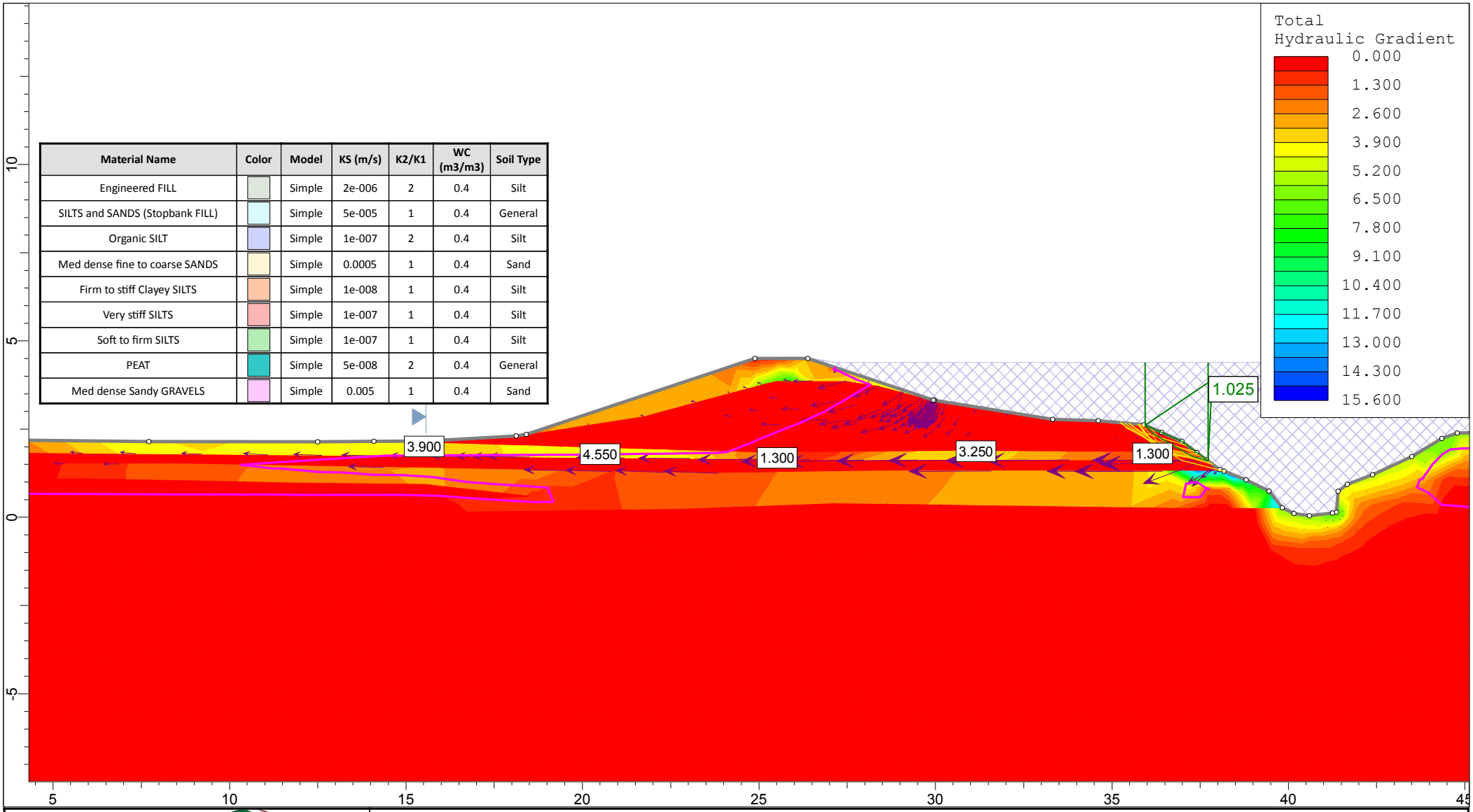
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
SILTS and SANDS (Stopbank FILL)		16	Mohr-Coulomb	0	28	None	0.2
Organic SILT		16	Mohr-Coulomb	0	24	None	0.3
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Firm to stiff Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft to firm SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Med dense Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3B: Slope stability - left side (Day 9) - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	31/10/2016, 2:51:46 p.m.	*File Name*	F3B-fill overlay LS 311016.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Engineered FILL		Simple	2e-006	2	0.4	Silt
SILTS and SANDS (Stopbank FILL)		Simple	5e-005	1	0.4	General
Organic SILT		Simple	1e-007	2	0.4	Silt
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Firm to stiff Clayey SILTS		Simple	1e-008	1	0.4	Silt
Very stiff SILTS		Simple	1e-007	1	0.4	Silt
Soft to firm SILTS		Simple	1e-007	1	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Med dense Sandy GRAVELS		Simple	0.005	1	0.4	Sand

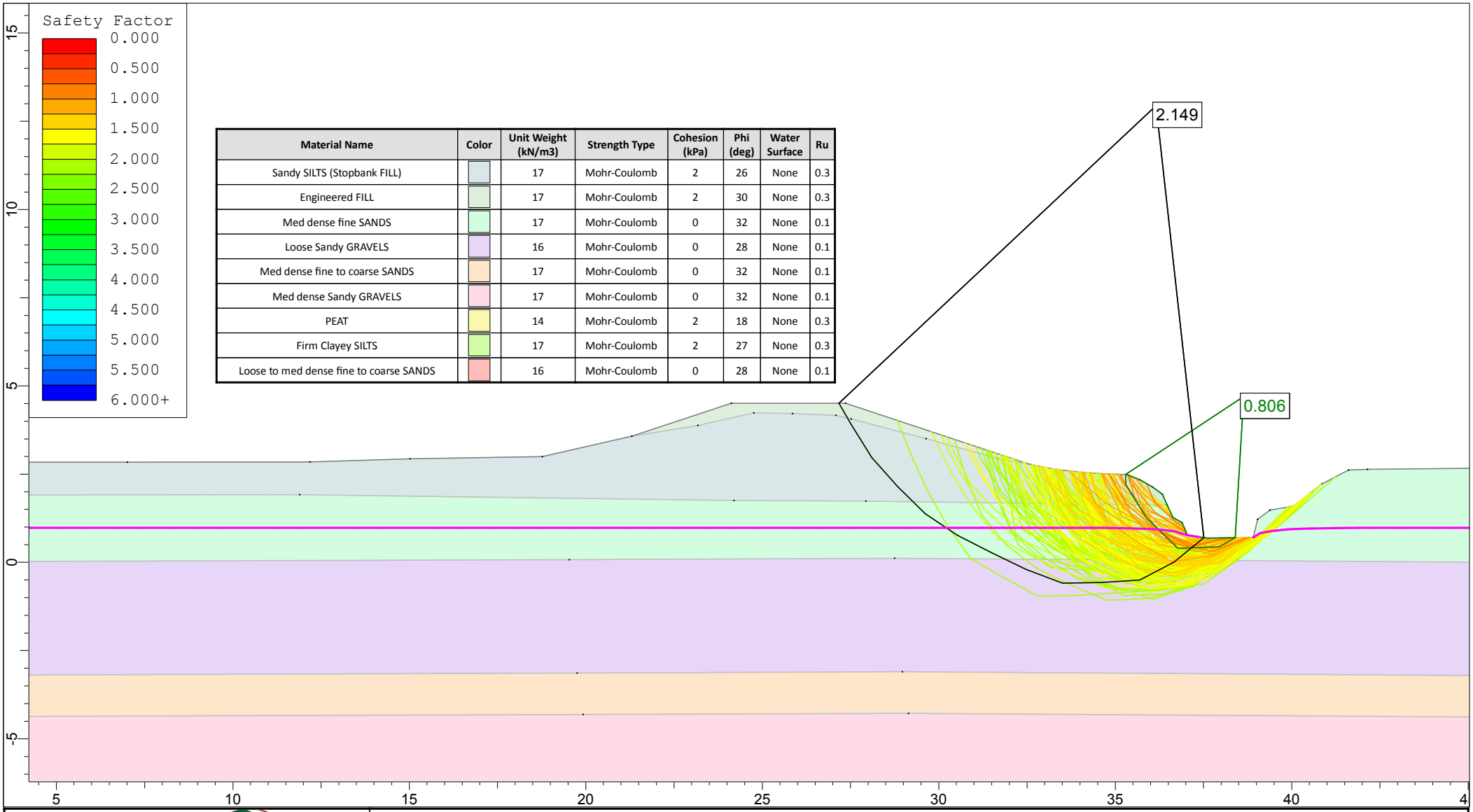


CMW Geosciences (NZ) Ltd

Golder Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3B: Seepage - Day 7.5 of flood event - maximum hydraulic gradients		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	31/10/2016, 2:51:46 p.m.	*File Name*	F3B-fill overlay 311016.slim



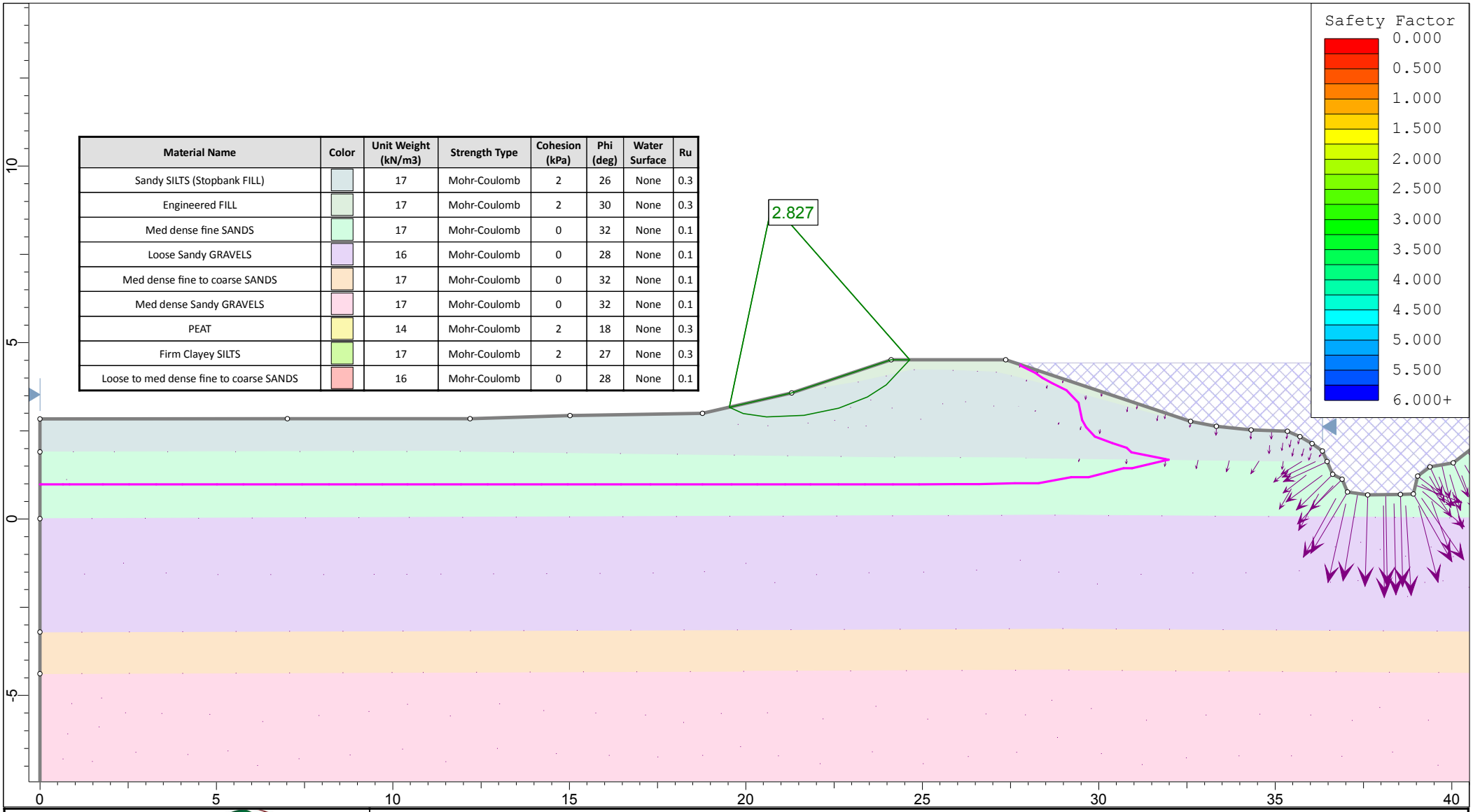
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Sandy SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
Med dense fine SANDS		17	Mohr-Coulomb	0	32	None	0.1
Loose Sandy GRAVELS		16	Mohr-Coulomb	0	28	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Loose to med dense fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3C: Slope stability - right side (Day 2) - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	14/10/2016, 1:33:50 p.m.	*File Name*	F3C-fill overlay 141016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Sandy SILTS (Stopbank FILL)		17	Mohr-Coulomb	2	26	None	0.3
Engineered FILL		17	Mohr-Coulomb	2	30	None	0.3
Med dense fine SANDS		17	Mohr-Coulomb	0	32	None	0.1
Loose Sandy GRAVELS		16	Mohr-Coulomb	0	28	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Loose to med dense fine to coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1

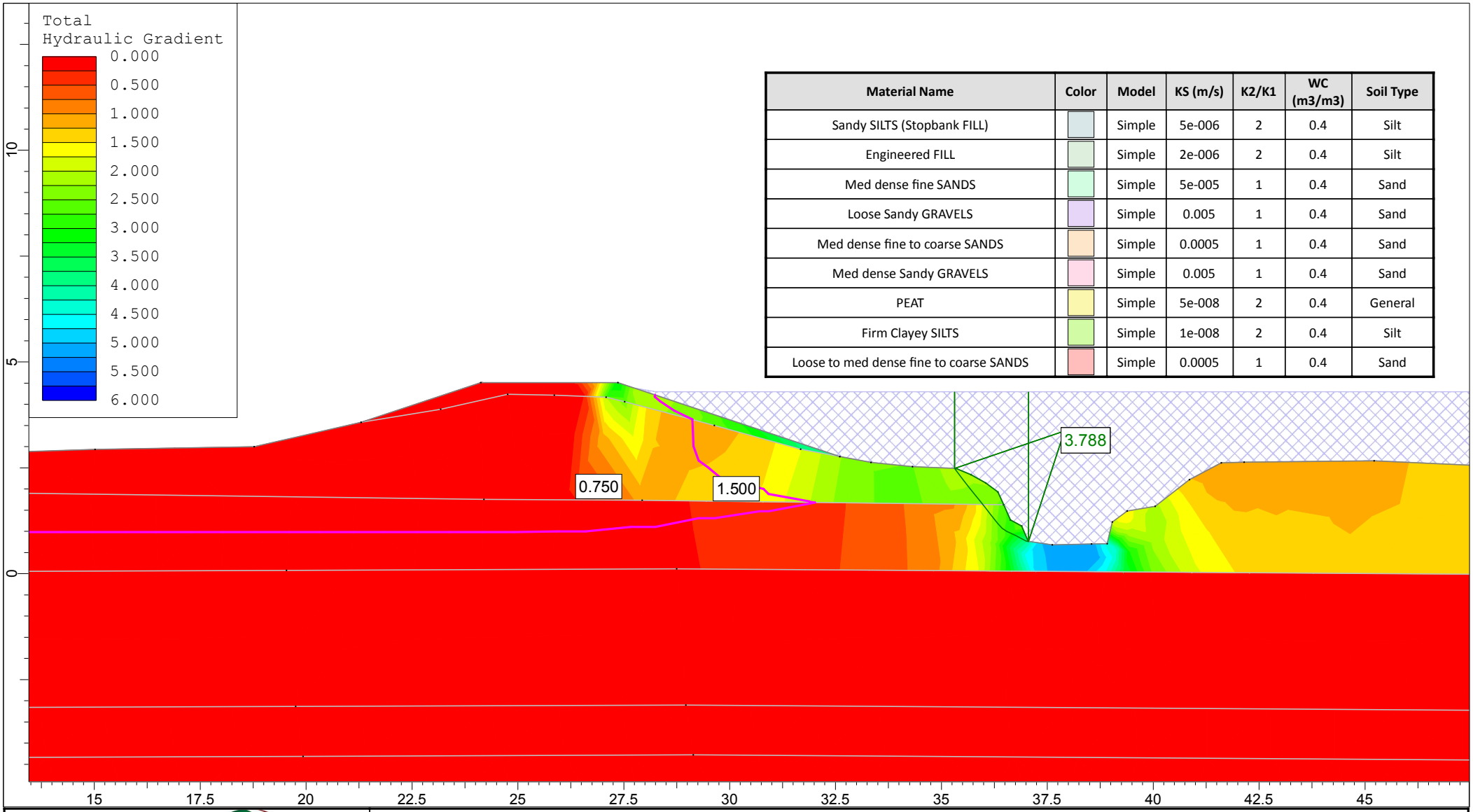


CMW Geosciences (NZ) Ltd

Checked Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3C: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	14/10/2016, 1:33:50 p.m.	*File Name*	F3C-fill overlay LS 141016.slim

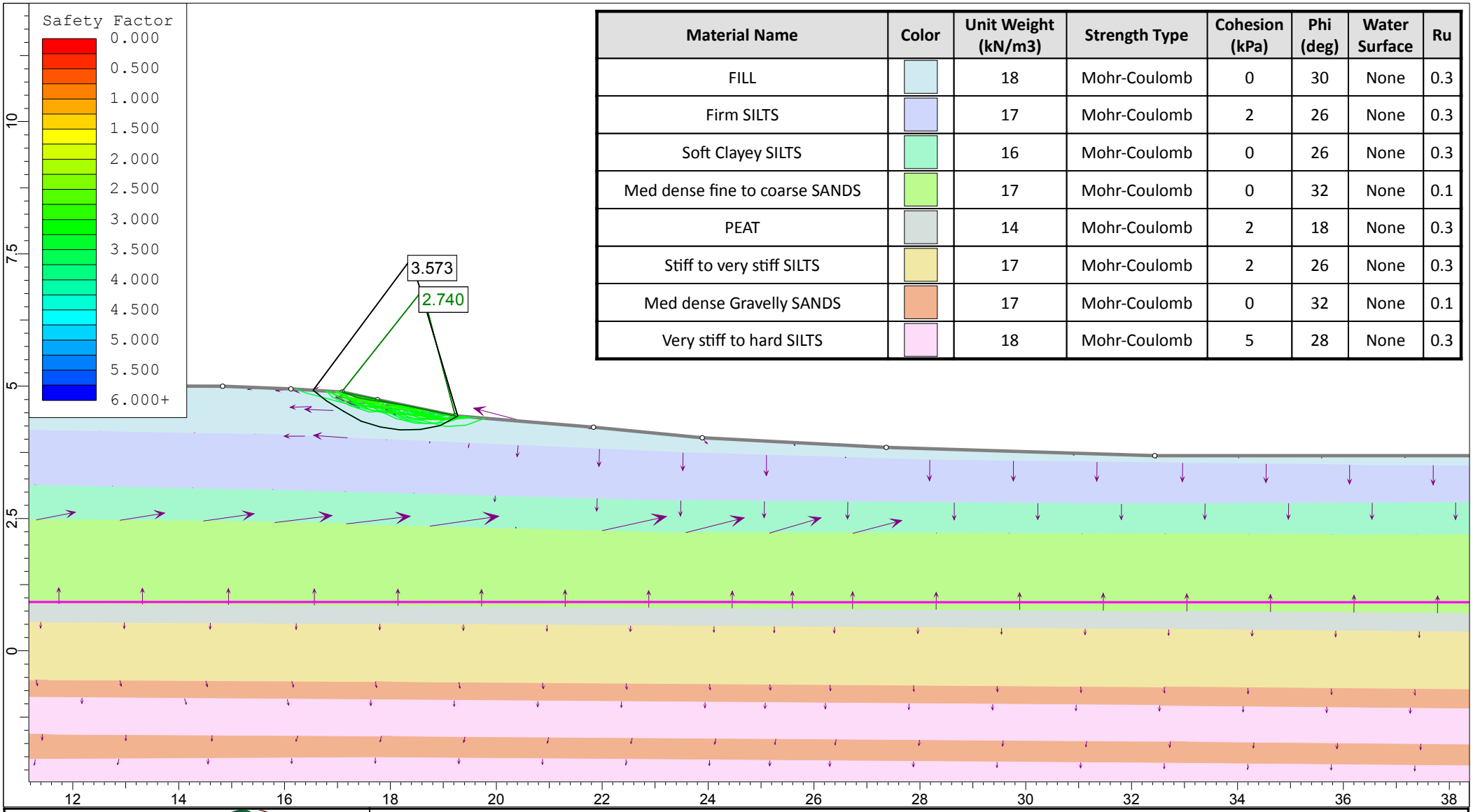


Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Sandy SILTS (Stopbank FILL)		Simple	5e-006	2	0.4	Silt
Engineered FILL		Simple	2e-006	2	0.4	Silt
Med dense fine SANDS		Simple	5e-005	1	0.4	Sand
Loose Sandy GRAVELS		Simple	0.005	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense Sandy GRAVELS		Simple	0.005	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose to med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3C: Seepage - Day 8 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:125
Company	CMW Geosciences Ltd		
Date	14/10/2016, 1:33:50 p.m.	*File Name*	F3C-fill overlay 141016.slim

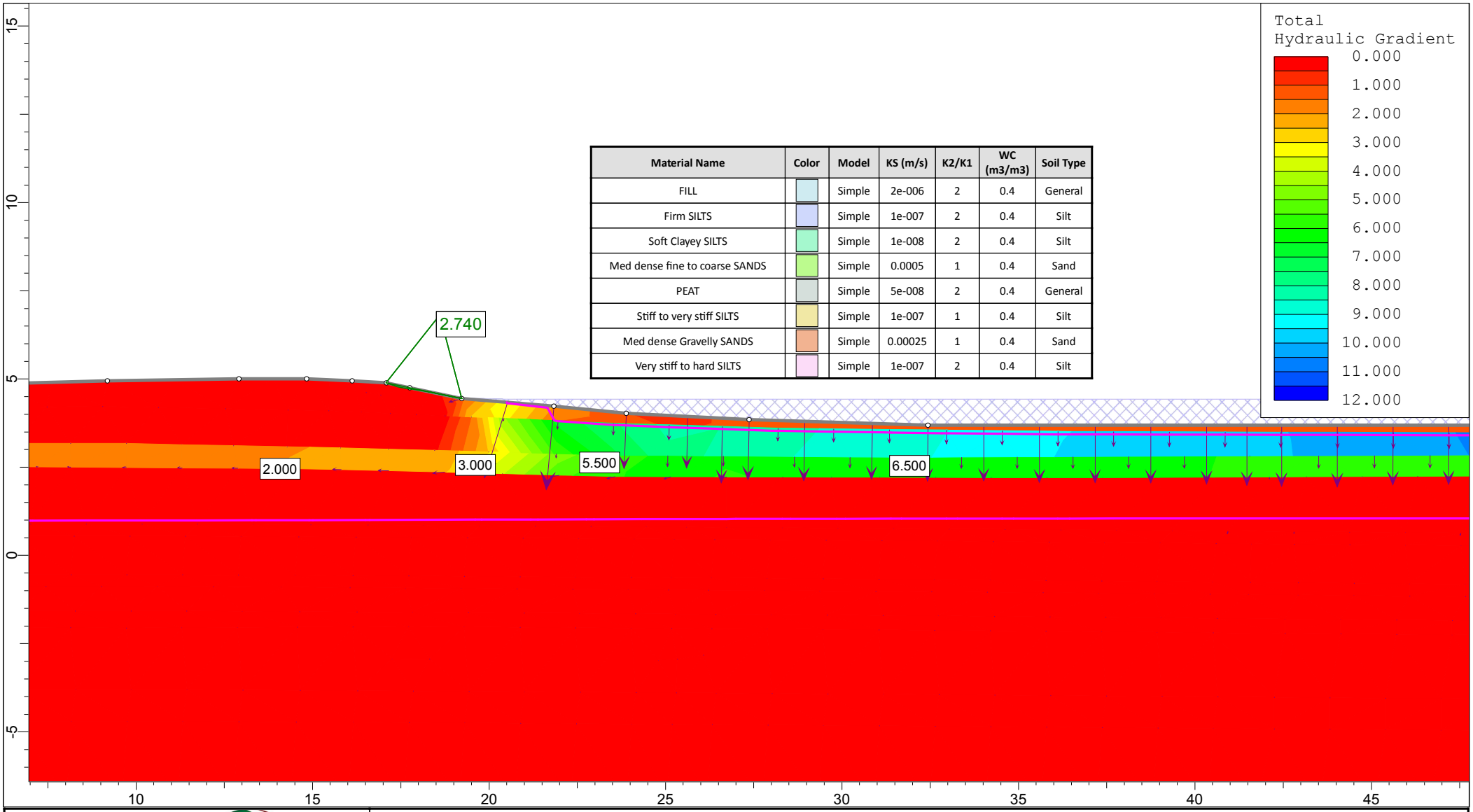


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
FILL		18	Mohr-Coulomb	0	30	None	0.3
Firm SILTS		17	Mohr-Coulomb	2	26	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Stiff to very stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense Gravelly SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3

CMW Geosciences (NZ) Ltd
Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3D: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:100
Company	CMW Geosciences Ltd		
Date	14/10/2016, 2:53:14 p.m.	*File Name*	F3D-fill overlay 141016.slim



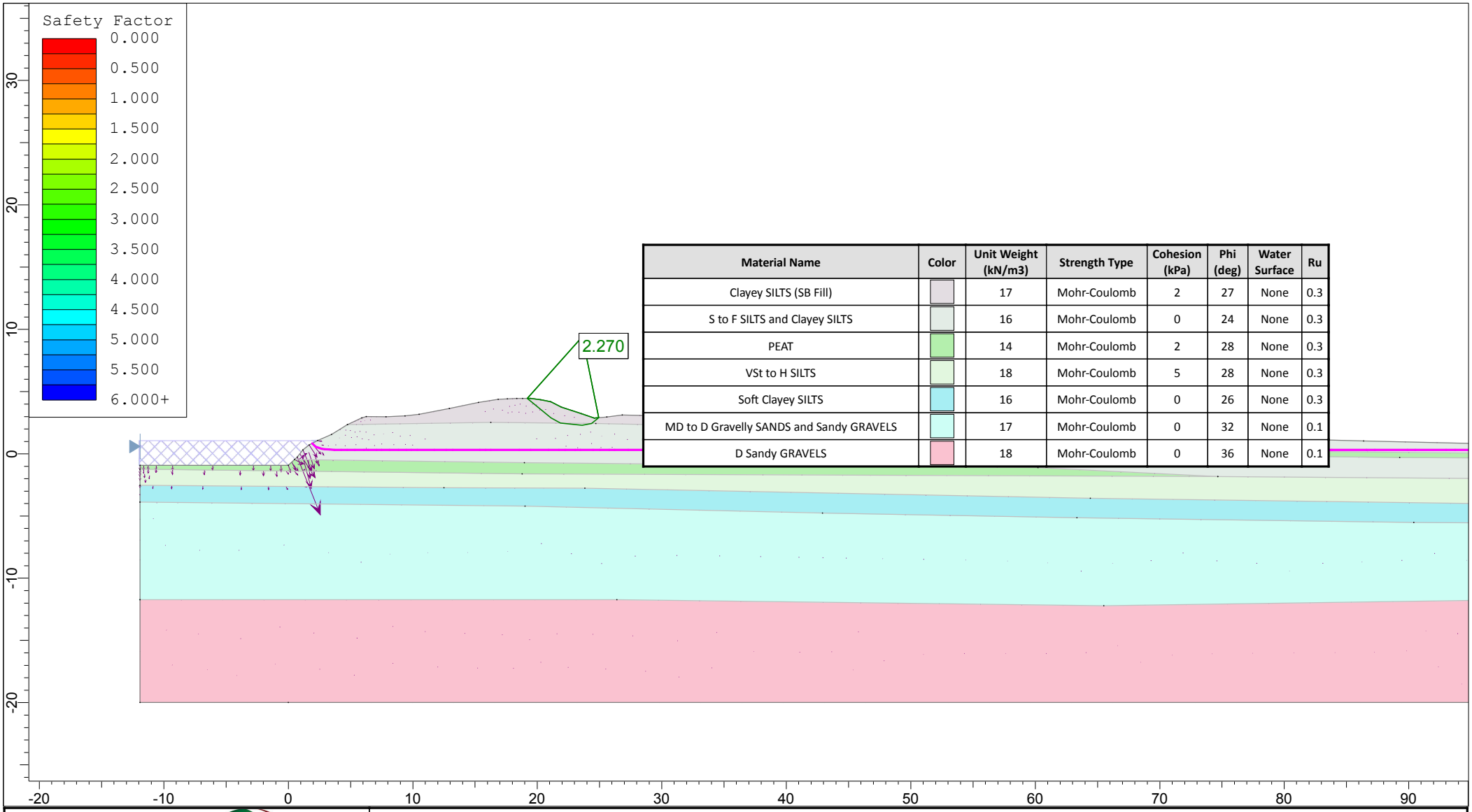
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
FILL		Simple	2e-006	2	0.4	General
Firm SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Stiff to very stiff SILTS		Simple	1e-007	1	0.4	Silt
Med dense Gravelly SANDS		Simple	0.00025	1	0.4	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt

CMW Geosciences (NZ) Ltd

Checked Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section F3C: Seepage - Day 7.5 of flood event - maximum hydraulic gradients		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	14/10/2016, 2:53:14 p.m.	*File Name*	F3D-fill overlay 141016.slim

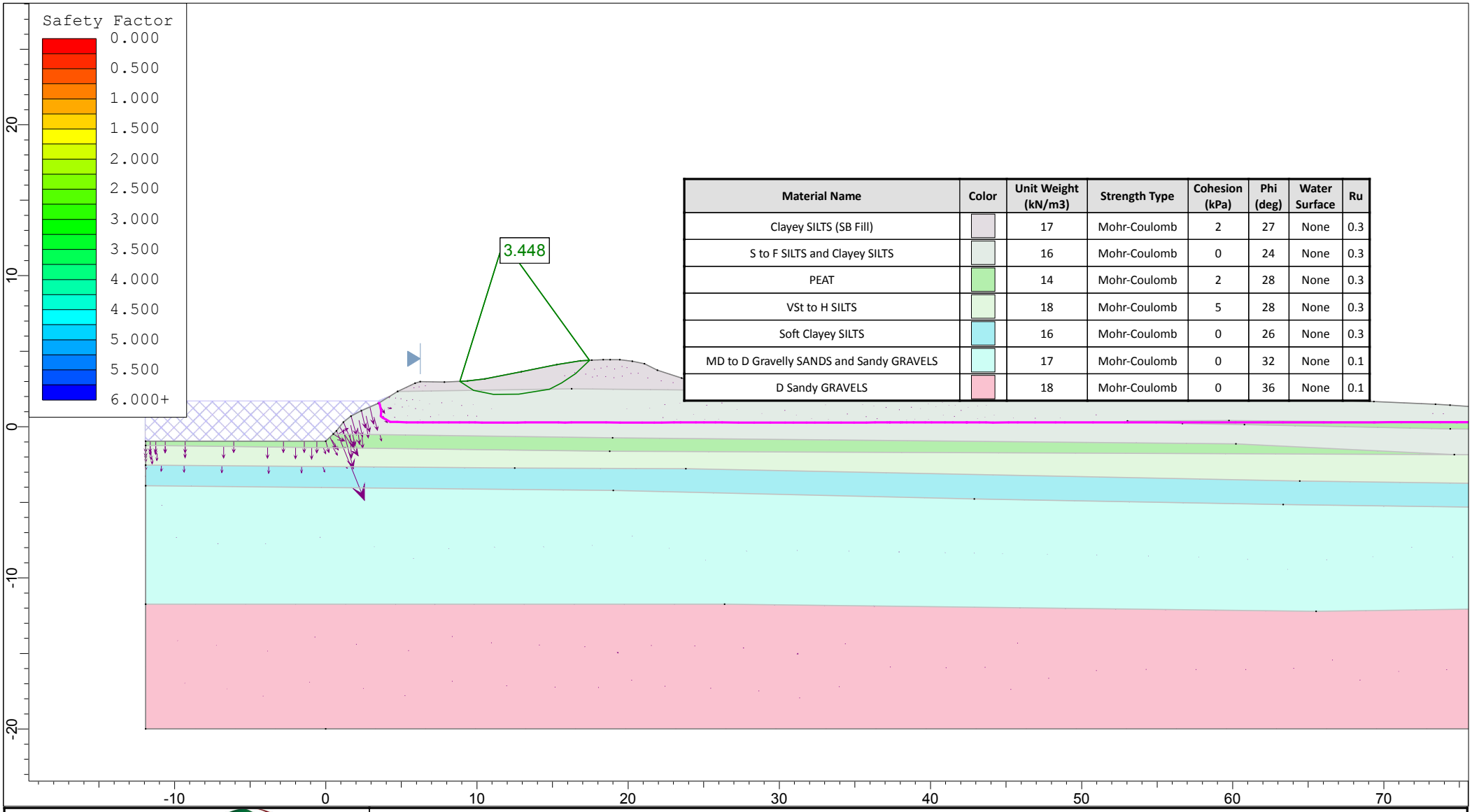


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Clayey SILTS (SB Fill)		17	Mohr-Coulomb	2	27	None	0.3
S to F SILTS and Clayey SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
VSt to H SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
MD to D Gravelly SANDS and Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
D Sandy GRAVELS		18	Mohr-Coulomb	0	36	None	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1A: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale* 1:425	*Company* CMW Geosciences Ltd
Date	12/09/2016, 1:58:50 p.m.		*File Name* R1A_RS.slim

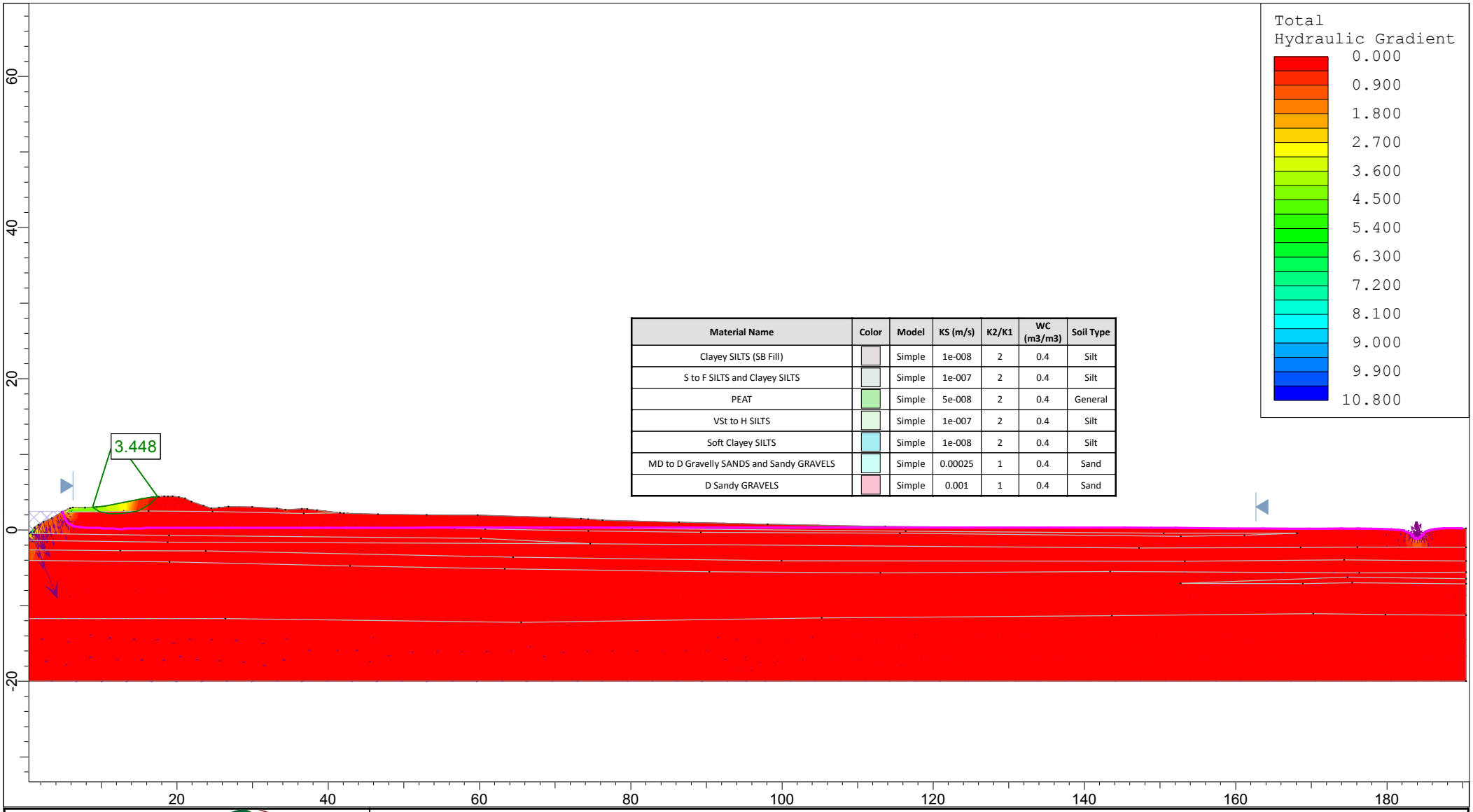


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Clayey SILTS (SB Fill)		17	Mohr-Coulomb	2	27	None	0.3
S to F SILTS and Clayey SILTS		16	Mohr-Coulomb	0	24	None	0.3
PEAT		14	Mohr-Coulomb	2	28	None	0.3
VSt to H SILTS		18	Mohr-Coulomb	5	28	None	0.3
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
MD to D Gravelly SANDS and Sandy GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
D Sandy GRAVELS		18	Mohr-Coulomb	0	36	None	0.1

CMW Geosciences (NZ) Ltd
Cheesman Morton Woodward

Project	Rangitaiki River and Floodway, Edgecumbe			
Analysis Description	Cross section R1A: Slope stability - left side - lowest factor of safety shown			
Drawn By	OMG	*Scale*	1:350	*Company* CMW Geosciences Ltd
Date	12/09/2016, 1:58:50 p.m.			*File Name* R1A_LS.slim

SLIDEINTERPRET 6.035

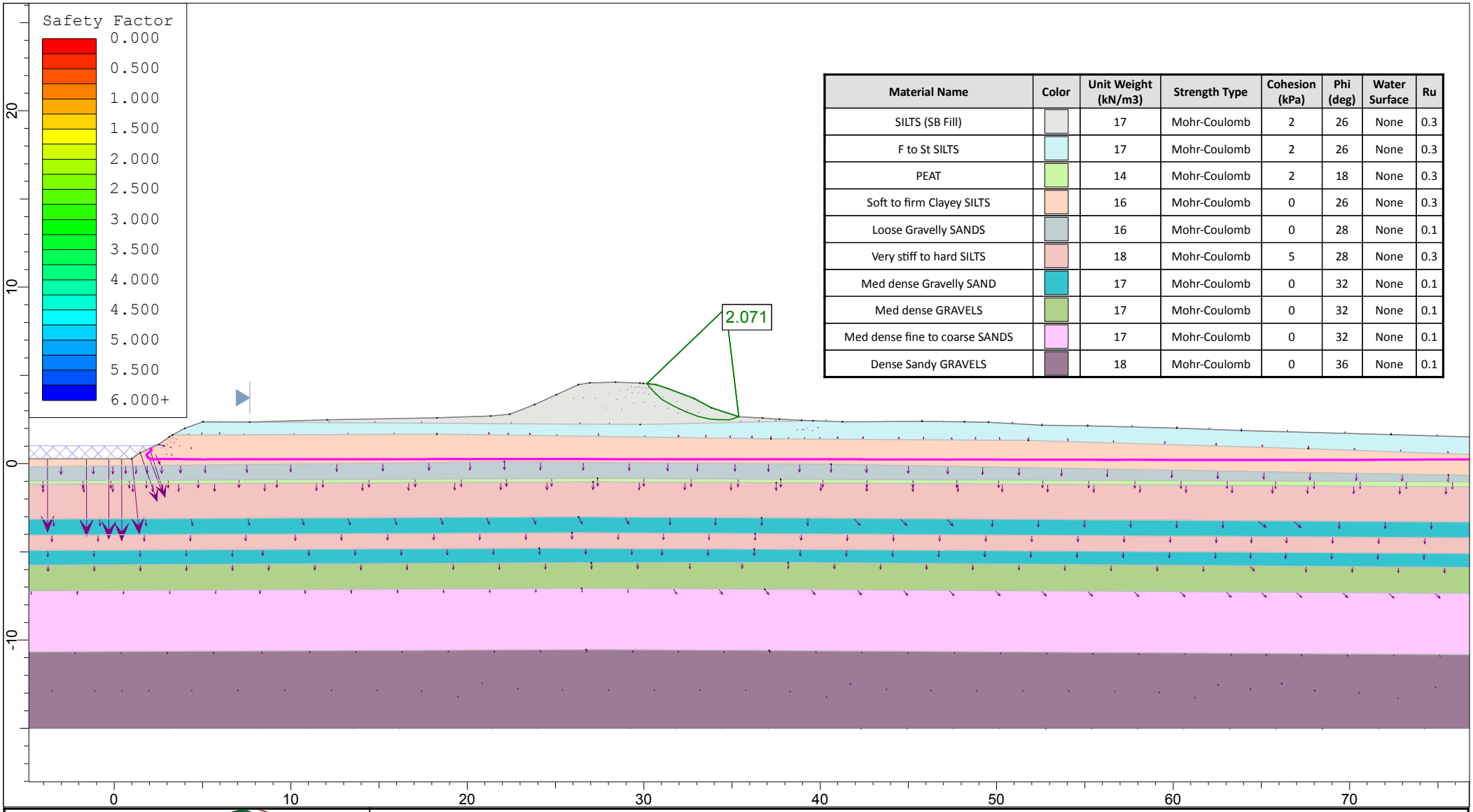


Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Clayey SILTS (SB Fill)		Simple	1e-008	2	0.4	Silt
S to F SILTS and Clayey SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
VSt to H SILTS		Simple	1e-007	2	0.4	Silt
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
MD to D Gravelly SANDS and Sandy GRAVELS		Simple	0.00025	1	0.4	Sand
D Sandy GRAVELS		Simple	0.001	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section R1A: Seepage - day 14 of flood event				
Drawn By	OMG	*Scale*	1:700	*Company*	CMW Geosciences Ltd
Date	12/09/2016, 1:58:50 p.m.			*File Name*	R1A_LS.slim

SLIDEINTERPRET 6.035



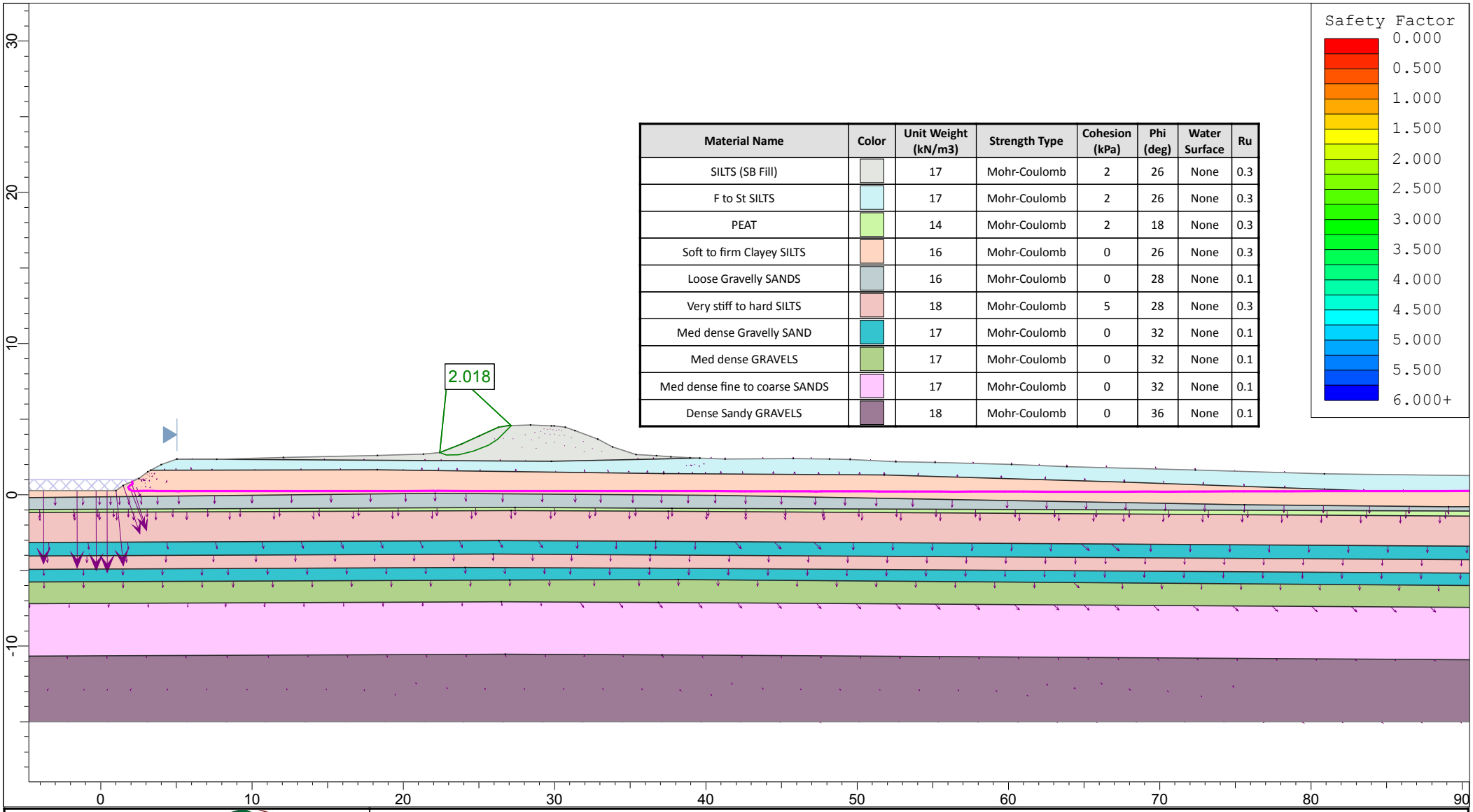
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (SB Fill)		17	Mohr-Coulomb	2	26	None	0.3
F to St SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Soft to firm Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose Gravelly SANDS		16	Mohr-Coulomb	0	28	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Gravelly SAND		17	Mohr-Coulomb	0	32	None	0.1
Med dense GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Dense Sandy GRAVELS		18	Mohr-Coulomb	0	36	None	0.1

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1B: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale* 1:300	*Company* CMW Geosciences Ltd
Date	19/09/2016, 2:45:51 p.m.		*File Name* R1B_RS.slim



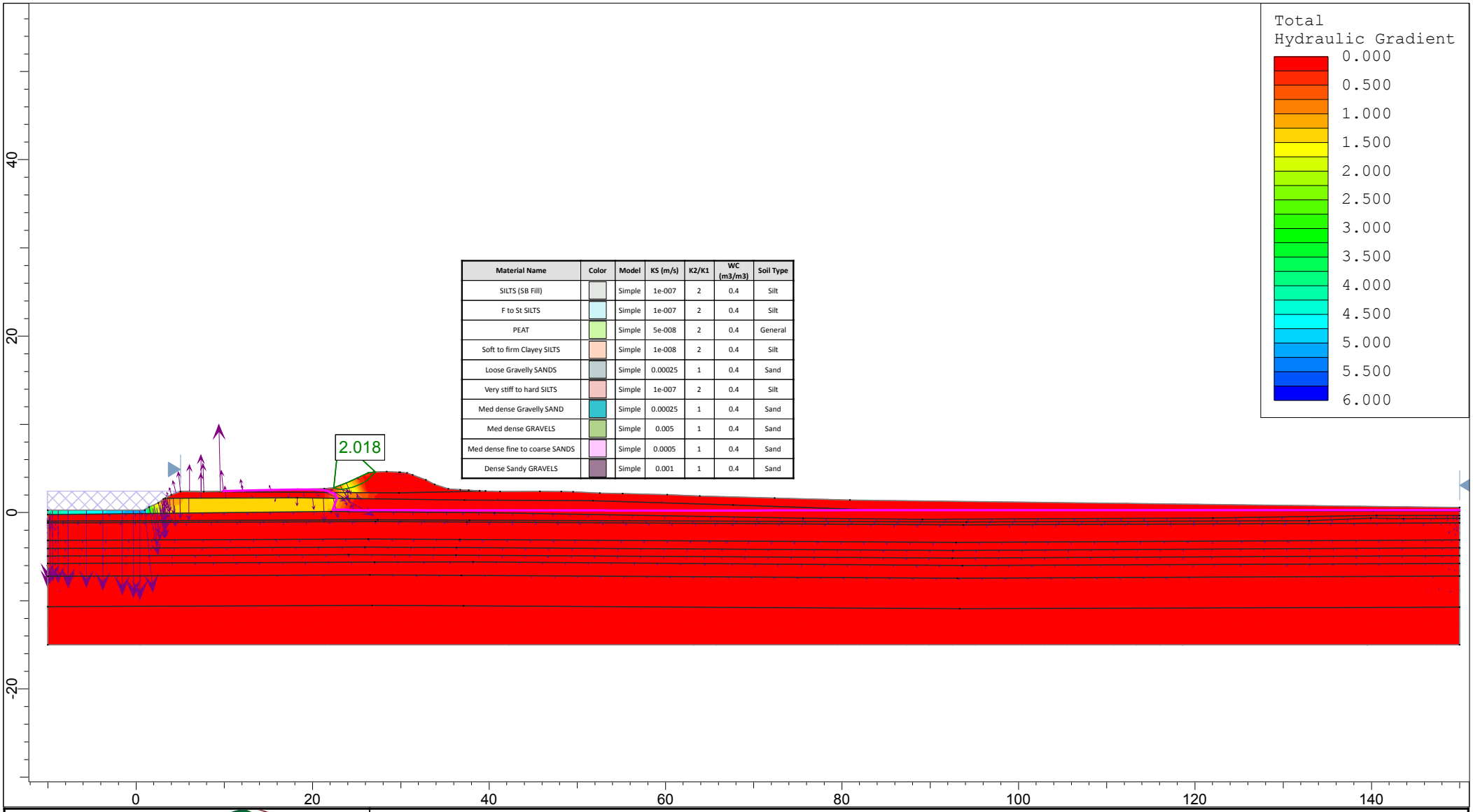
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (SB Fill)		17	Mohr-Coulomb	2	26	None	0.3
F to St SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Soft to firm Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose Gravelly SANDS		16	Mohr-Coulomb	0	28	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Gravelly SAND		17	Mohr-Coulomb	0	32	None	0.1
Med dense GRAVELS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Dense Sandy GRAVELS		18	Mohr-Coulomb	0	36	None	0.1

CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section R1B: Slope stability - left side - lowest factor of safety shown				
Drawn By	OMG	*Scale*	1:350	*Company*	CMW Geosciences Ltd
Date	19/09/2016, 2:45:51 p.m.			*File Name*	R1B.slim

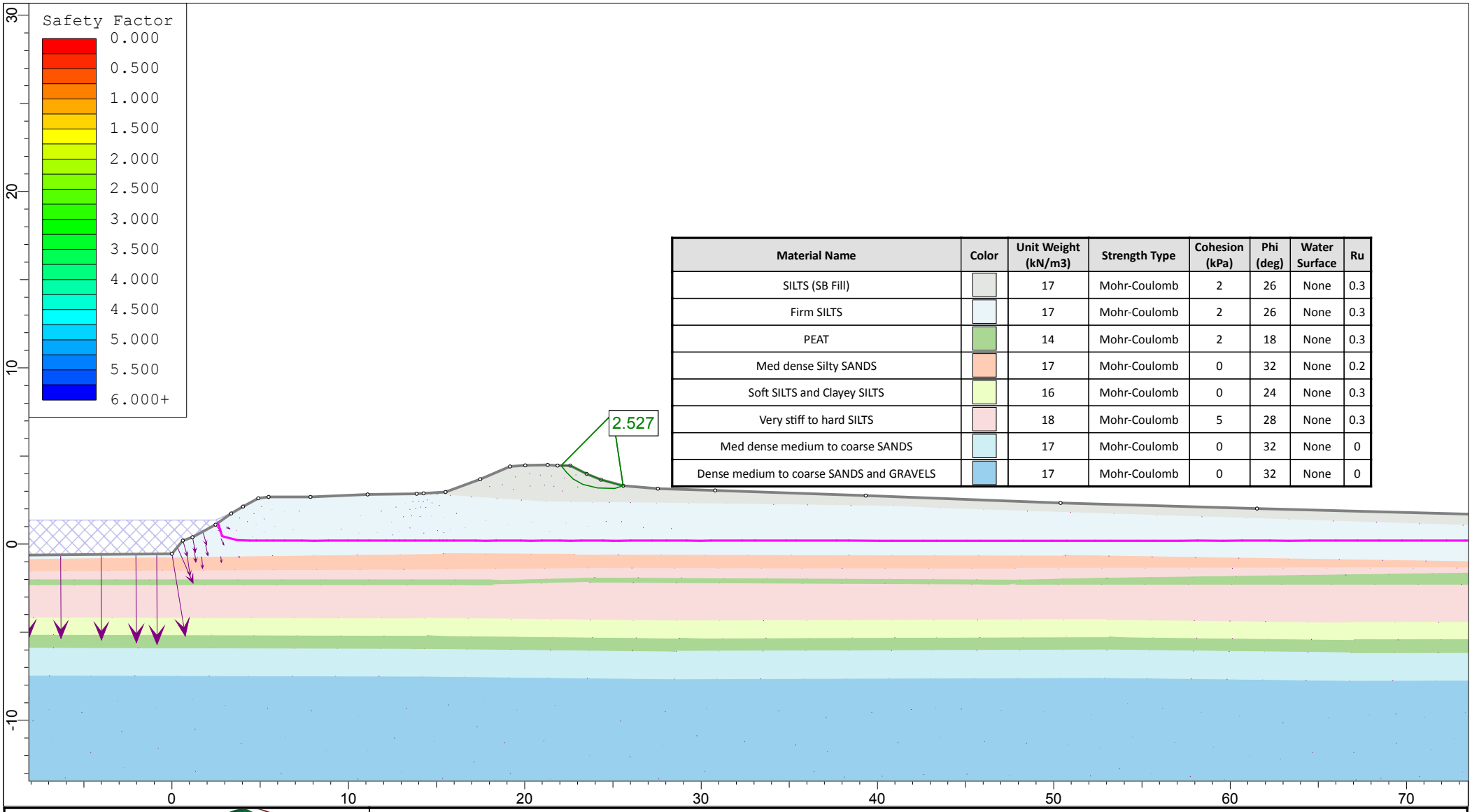


Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS (SB Fill)		Simple	1e-007	2	0.4	Silt
F to St SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Soft to firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose Gravelly SANDS		Simple	0.00025	1	0.4	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Med dense Gravelly SAND		Simple	0.00025	1	0.4	Sand
Med dense GRAVELS		Simple	0.005	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Dense Sandy GRAVELS		Simple	0.001	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1B: Seepage - day 14 of flood event		
Drawn By OMG	*Scale* 1:600	*Company* CMW Geosciences Ltd	
Date 19/09/2016, 2:45:51 p.m.		*File Name* R1B.slim	

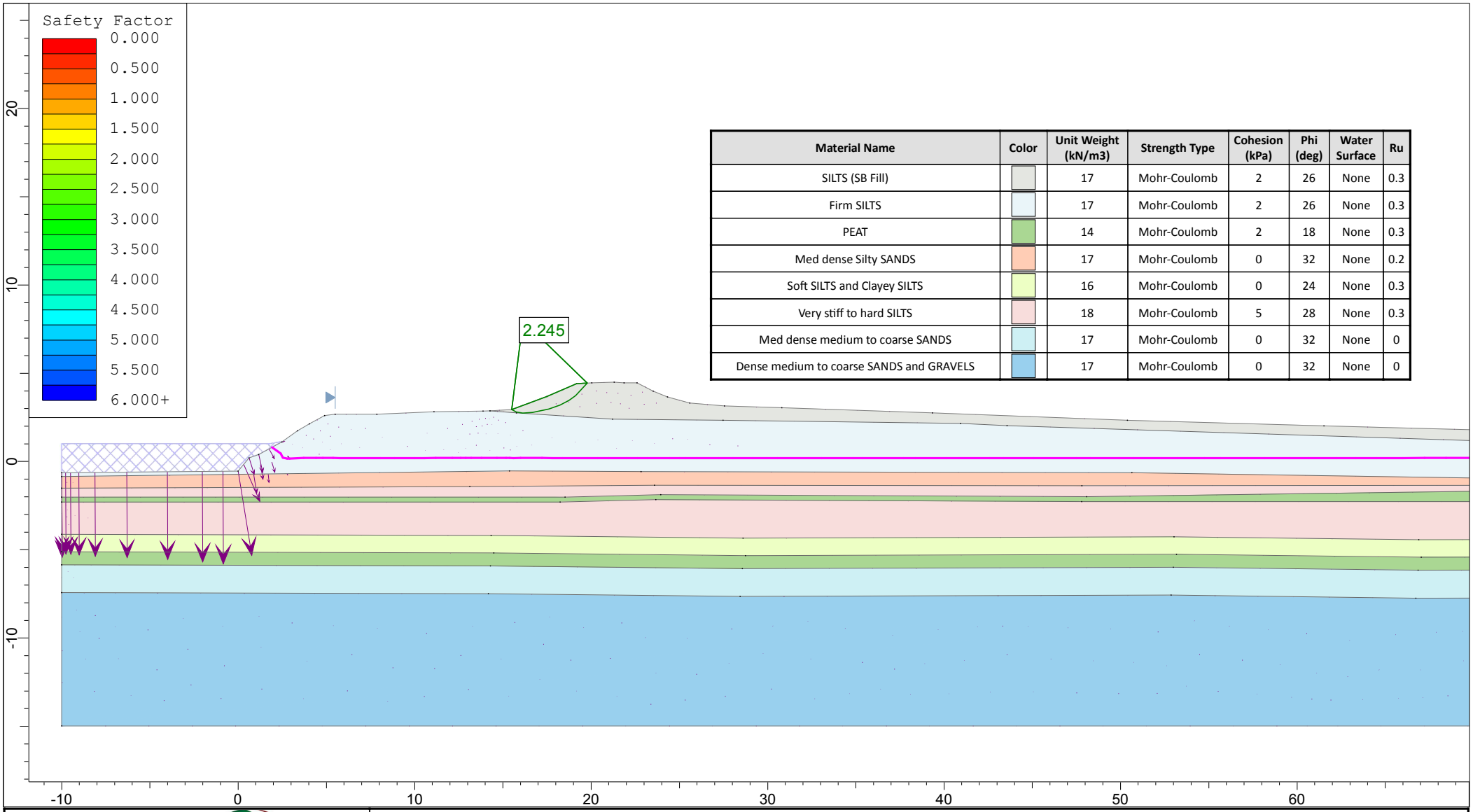


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (SB Fill)		17	Mohr-Coulomb	2	26	None	0.3
Firm SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft SILTS and Clayey SILTS		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense medium to coarse SANDS		17	Mohr-Coulomb	0	32	None	0
Dense medium to coarse SANDS and GRAVELS		17	Mohr-Coulomb	0	32	None	0

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1C: Slope stability - right side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	19/09/2016, 3:50:12 p.m.	*File Name*	R1C_RS.slim

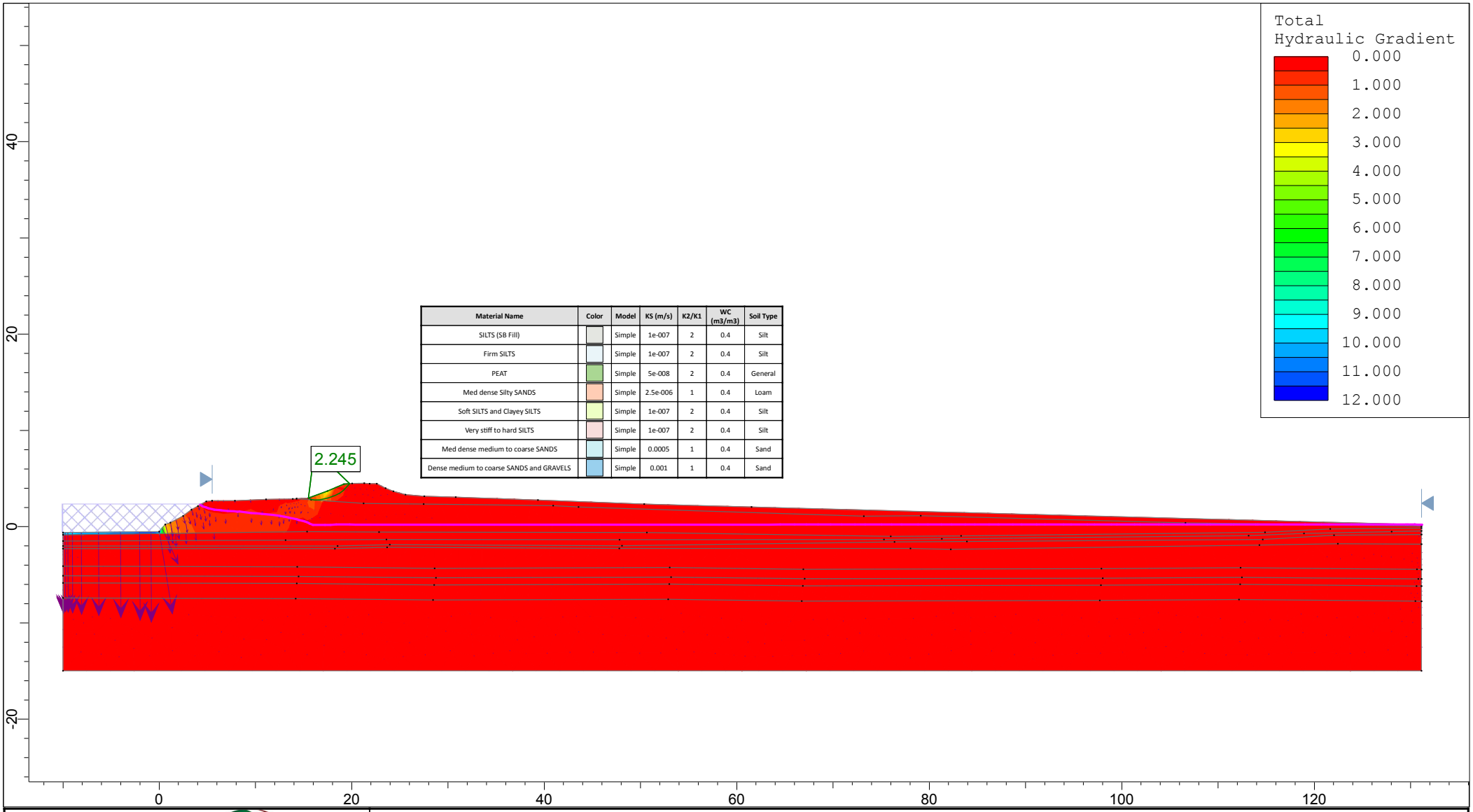


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS (SB Fill)		17	Mohr-Coulomb	2	26	None	0.3
Firm SILTS		17	Mohr-Coulomb	2	26	None	0.3
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft SILTS and Clayey SILTS		16	Mohr-Coulomb	0	24	None	0.3
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense medium to coarse SANDS		17	Mohr-Coulomb	0	32	None	0
Dense medium to coarse SANDS and GRAVELS		17	Mohr-Coulomb	0	32	None	0

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1C: Slope stability - left side - lowest factor of safety shown		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	19/09/2016, 3:50:12 p.m.	*File Name*	R1C.slim



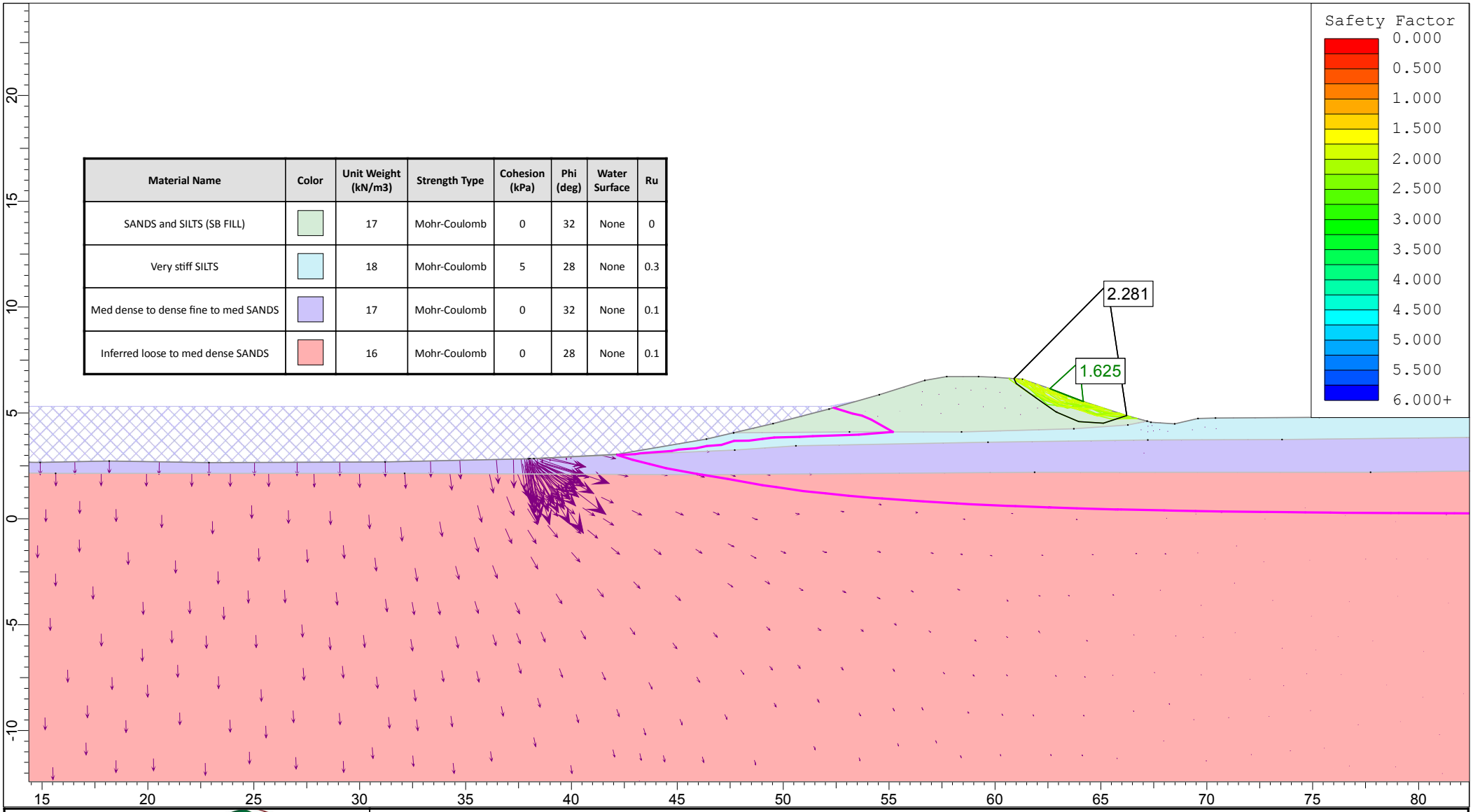
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS (SB Fill)		Simple	1e-007	2	0.4	Silt
Firm SILTS		Simple	1e-007	2	0.4	Silt
PEAT		Simple	5e-008	2	0.4	General
Med dense Silty SANDS		Simple	2.5e-006	1	0.4	Loam
Soft SILTS and Clayey SILTS		Simple	1e-007	2	0.4	Silt
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Med dense medium to coarse SANDS		Simple	0.0005	1	0.4	Sand
Dense medium to coarse SANDS and GRAVELS		Simple	0.001	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R1C: Seepage - day 14 of flood event		
Drawn By	OMG	*Scale*	1:550
Company	CMW Geosciences Ltd		
Date	19/09/2016, 3:50:12 p.m.	*File Name*	R1C.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SANDS and SILTS (SB FILL)		17	Mohr-Coulomb	0	32	None	0
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense to dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred loose to med dense SANDS		16	Mohr-Coulomb	0	28	None	0.1



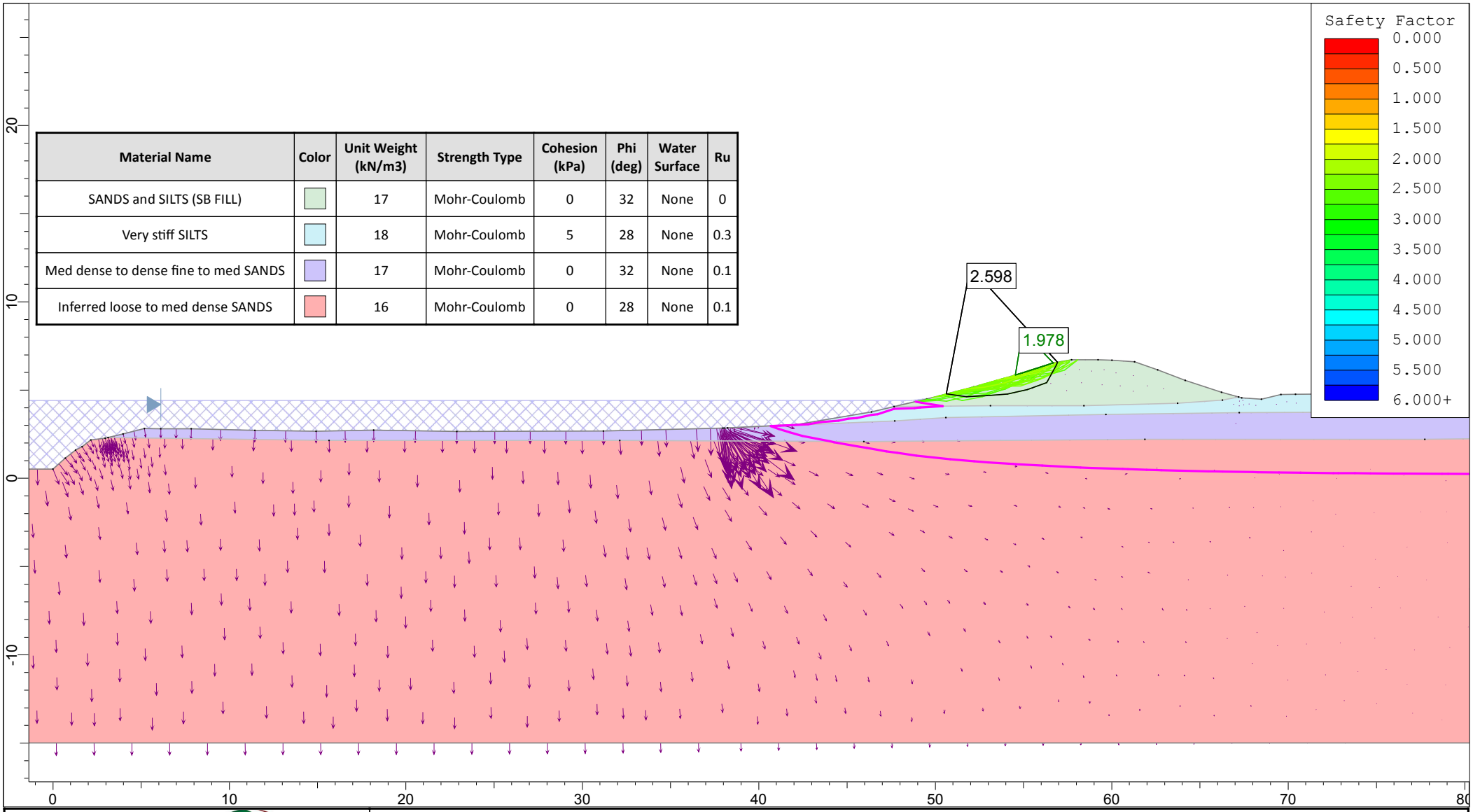
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2A: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	14/10/2016, 3:14:45 p.m.	*File Name*	R2A RS 141016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SANDS and SILTS (SB FILL)		17	Mohr-Coulomb	0	32	None	0
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense to dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred loose to med dense SANDS		16	Mohr-Coulomb	0	28	None	0.1

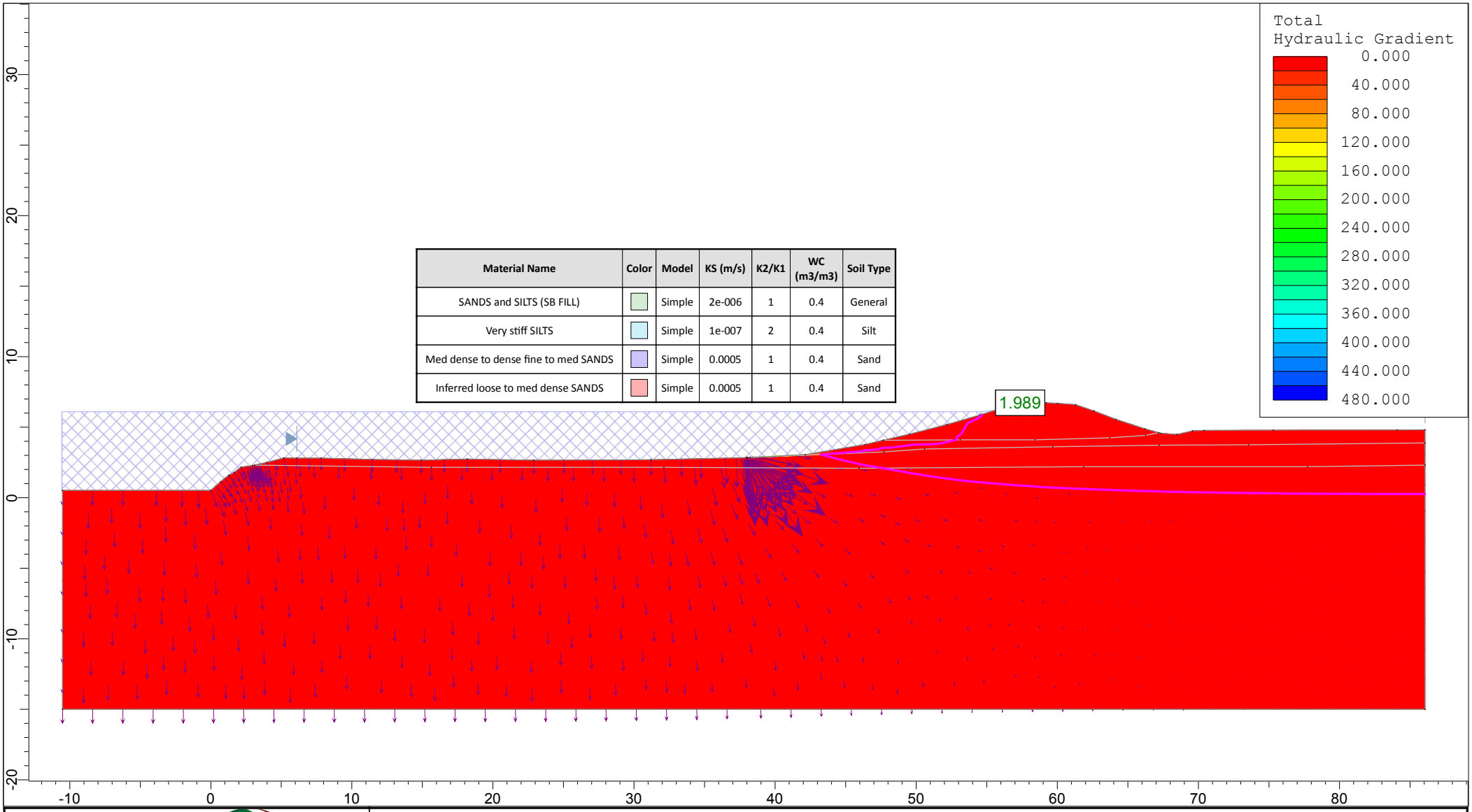


CMW Geosciences (NZ) Ltd

Geotechnical Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section R2A: Slope stability - left side - lowest factor of safety through stopbank				
Drawn By	OMG	*Scale*	1:300	*Company*	CMW Geosciences Ltd
Date	14/10/2016, 3:14:45 p.m.			*File Name*	R2A 141016.slim

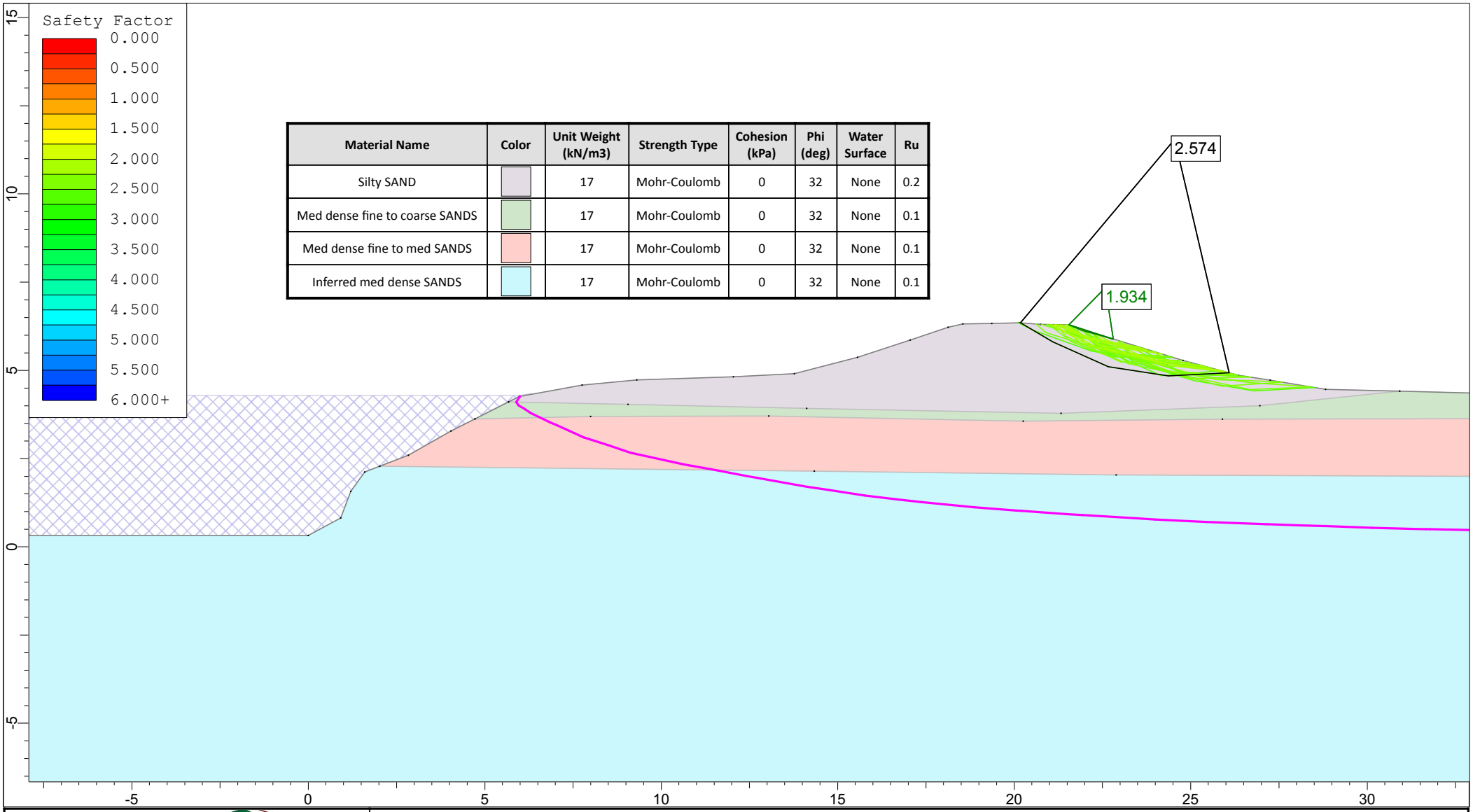


Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SANDS and SILTS (SB FILL)		Simple	2e-006	1	0.4	General
Very stiff SILTS		Simple	1e-007	2	0.4	Silt
Med dense to dense fine to med SANDS		Simple	0.0005	1	0.4	Sand
Inferred loose to med dense SANDS		Simple	0.0005	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross section R2A: Seepage - day 7.5 (peak) of flood event				
Drawn By	OMG	*Scale*	1:375	*Company*	CMW Geosciences Ltd
Date	14/10/2016, 3:14:45 p.m.			*File Name*	R2A 141016.slim

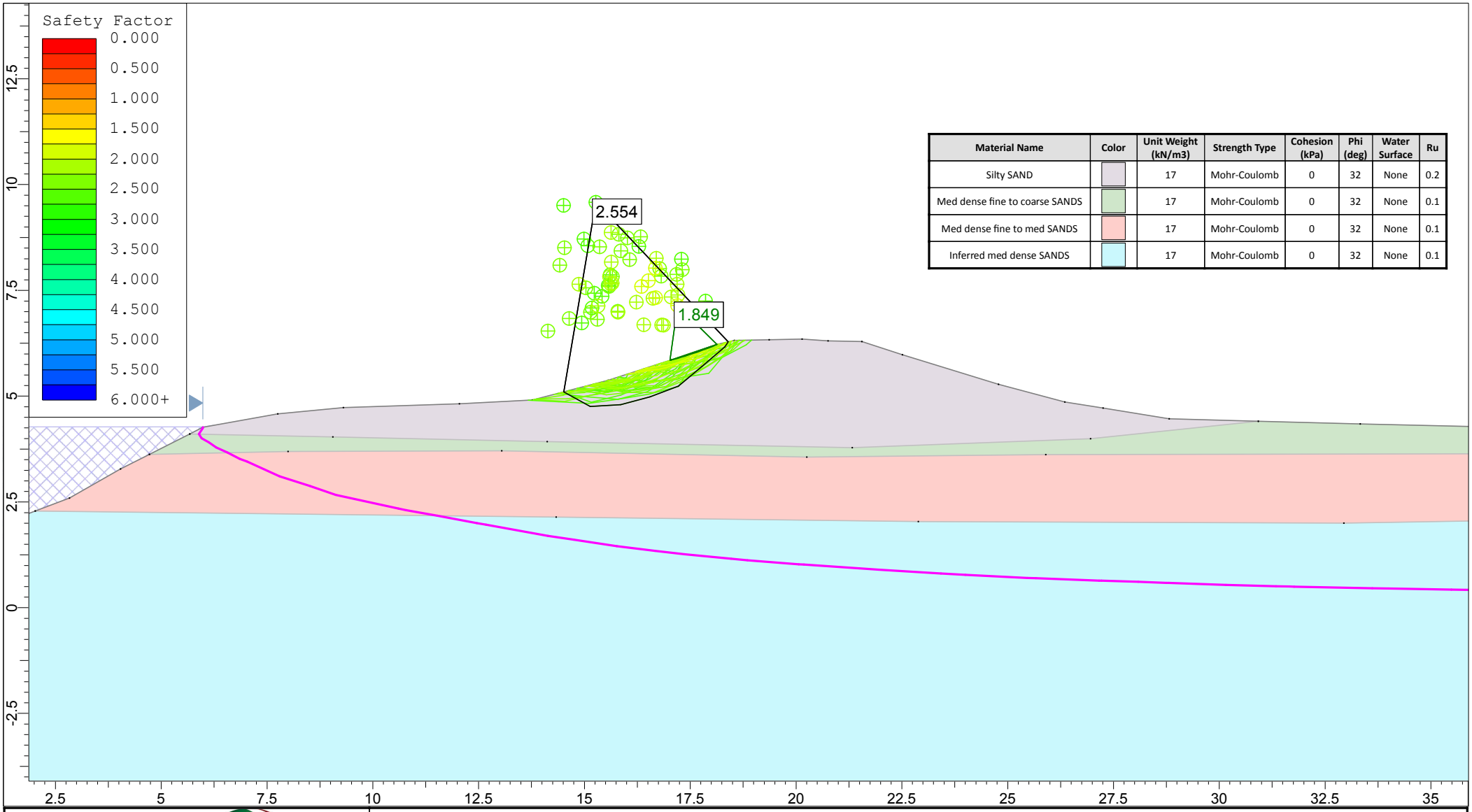


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silty SAND		17	Mohr-Coulomb	0	32	None	0.2
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd
Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2B: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale* 1:150	*Company* CMW Geosciences Ltd
Date	18/10/2016, 1:24:06 p.m.		*File Name* R2B RS 181016.slim

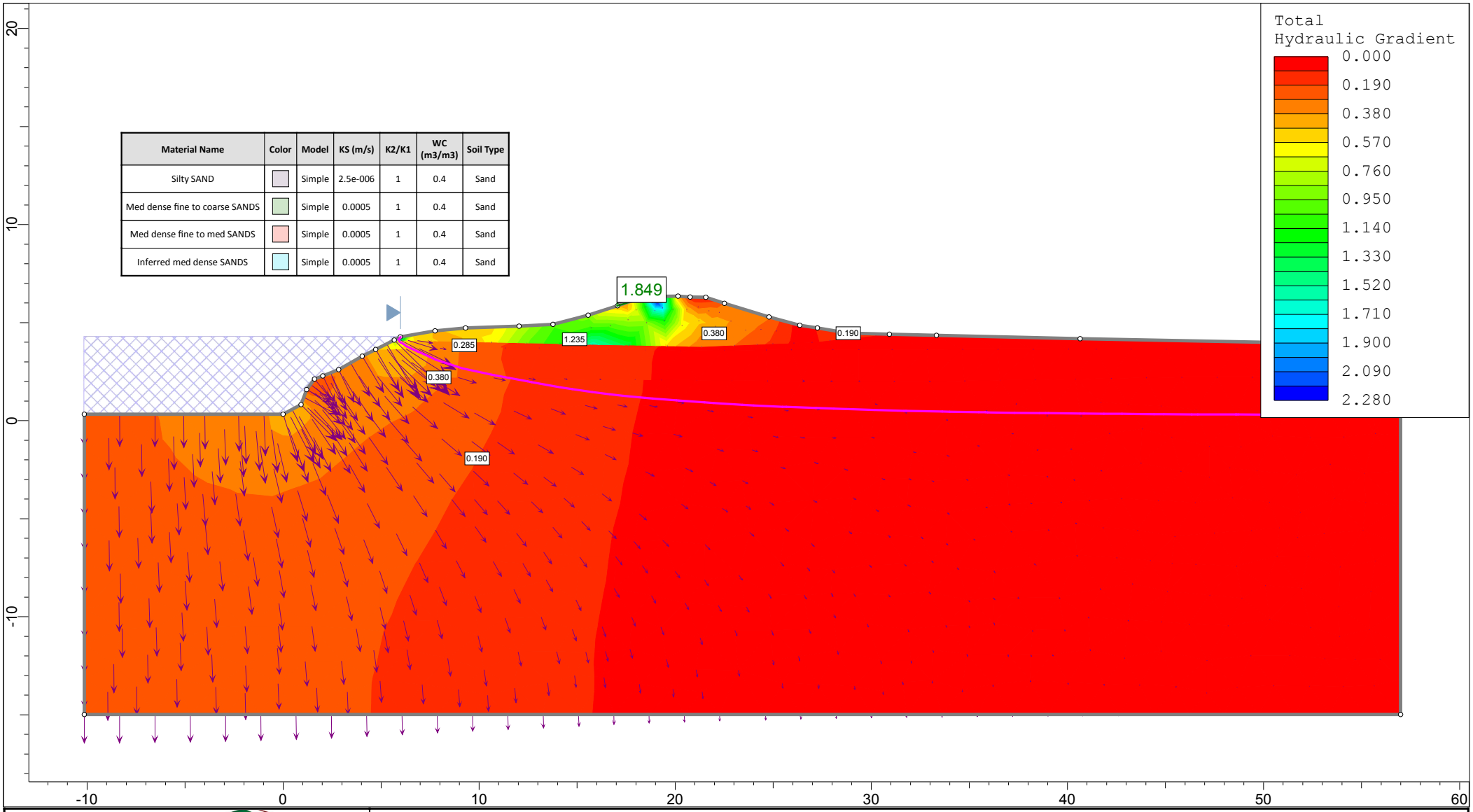


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Silty SAND		17	Mohr-Coulomb	0	32	None	0.2
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2B: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:125
Company	CMW Geosciences Ltd		
Date	18/10/2016, 1:24:06 p.m.	*File Name*	R2B 181016.slim



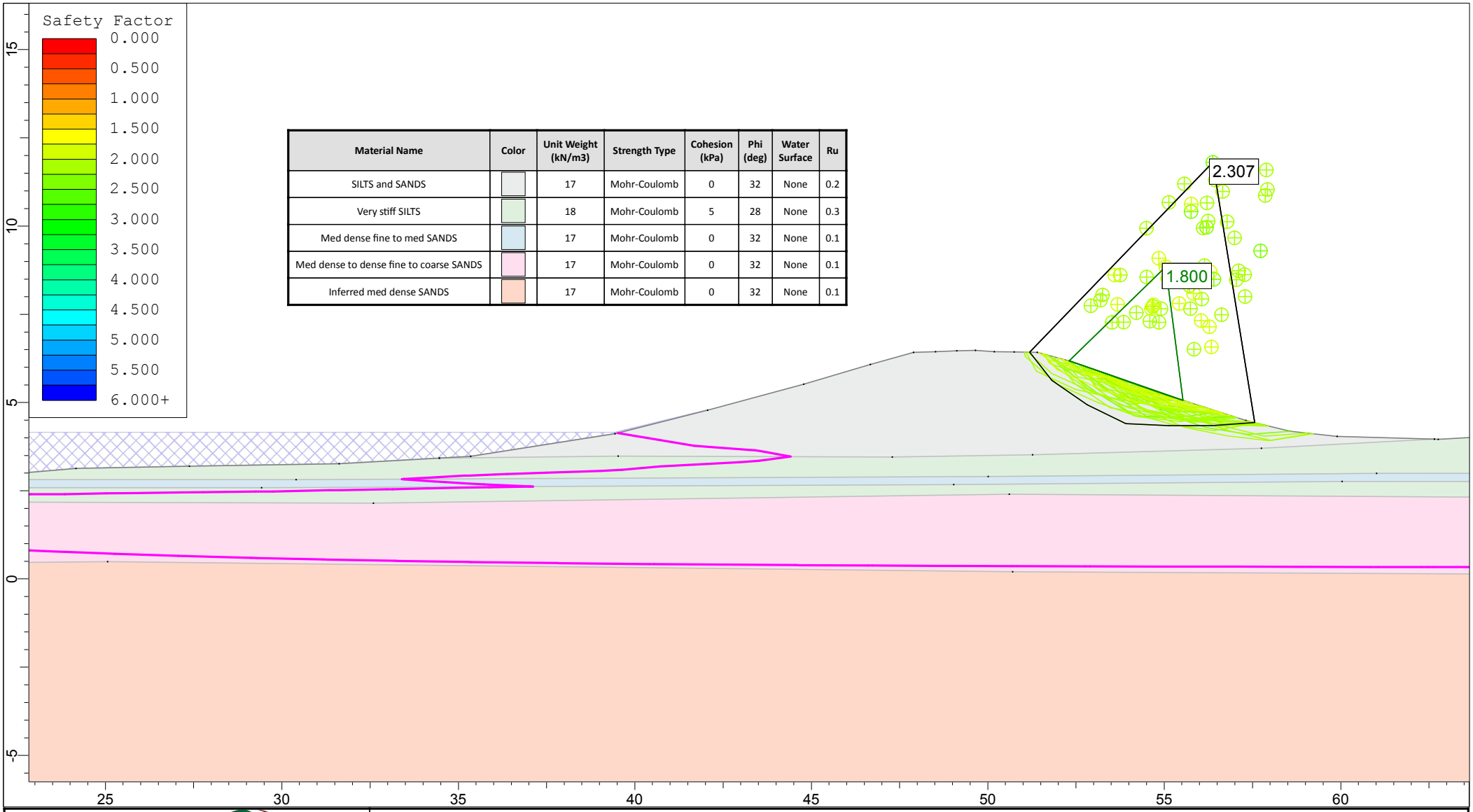
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Silty SAND		Simple	2.5e-006	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Med dense fine to med SANDS		Simple	0.0005	1	0.4	Sand
Inferred med dense SANDS		Simple	0.0005	1	0.4	Sand

CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2B: Seepage - day 14 of flood event		
Drawn By OMG	*Scale* 1:270	*Company*	CMW Geosciences Ltd
Date 18/10/2016, 1:24:06 p.m.		*File Name*	R2B 181016.slim



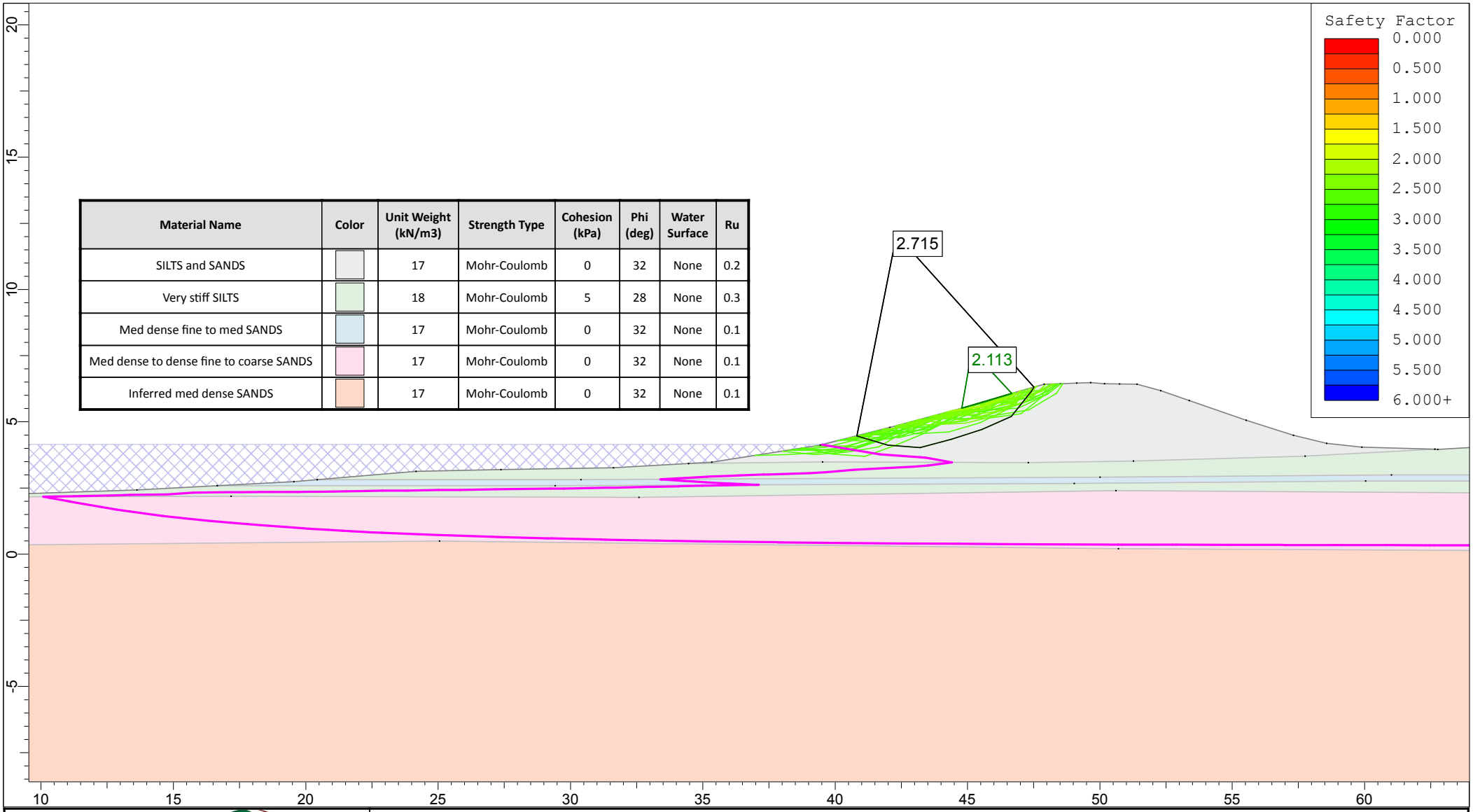
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS and SANDS		17	Mohr-Coulomb	0	32	None	0.2
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense to dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2C: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:02:46 p.m.	*File Name*	R2C RS 181016.slim



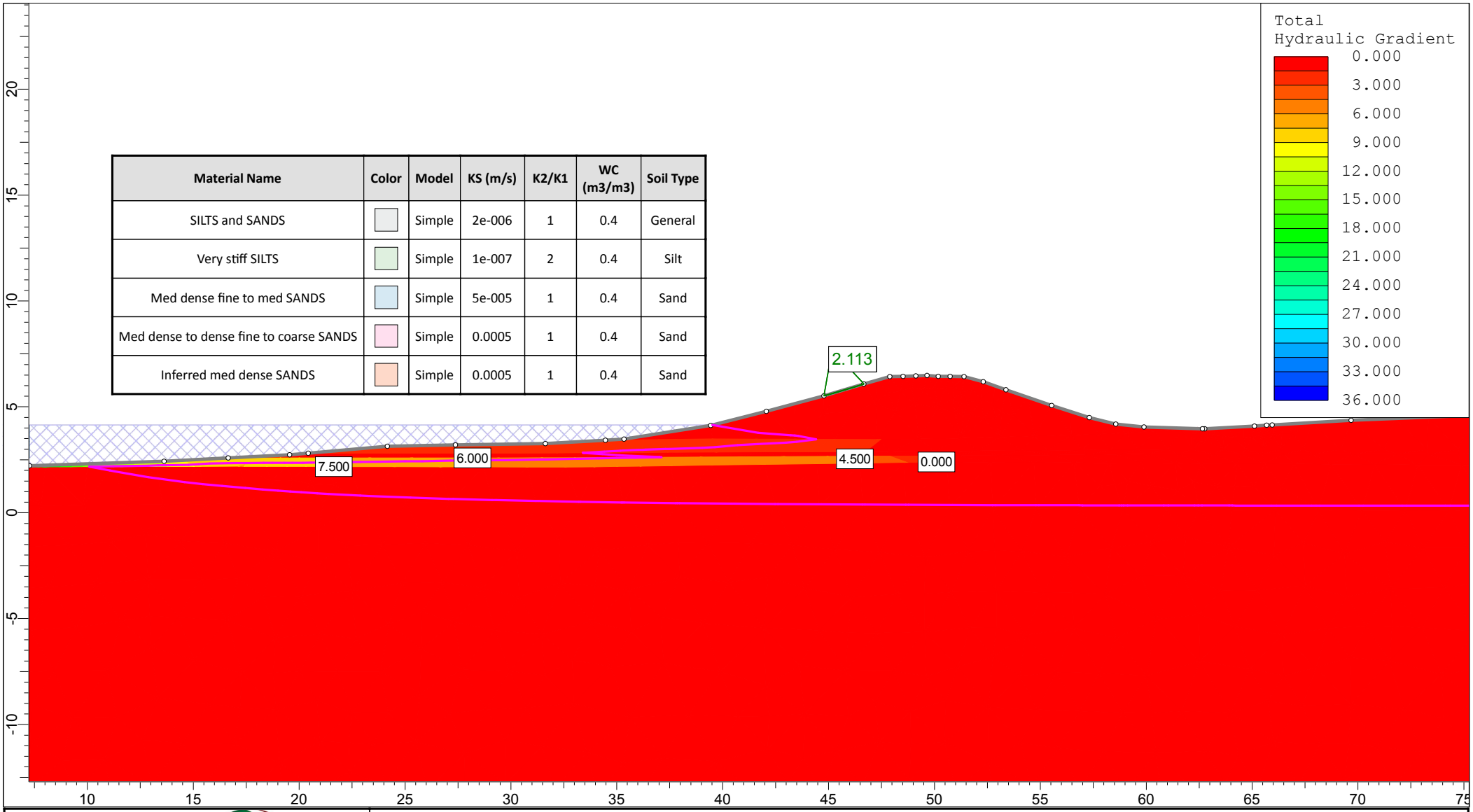
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS and SANDS		17	Mohr-Coulomb	0	32	None	0.2
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense to dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2C: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:02:46 p.m.	*File Name*	R2C 181016.slim



Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS and SANDS		Simple	2e-006	1	0.4	General
Very stiff SILTS		Simple	1e-007	2	0.4	Silt
Med dense fine to med SANDS		Simple	5e-005	1	0.4	Sand
Med dense to dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Inferred med dense SANDS		Simple	0.0005	1	0.4	Sand

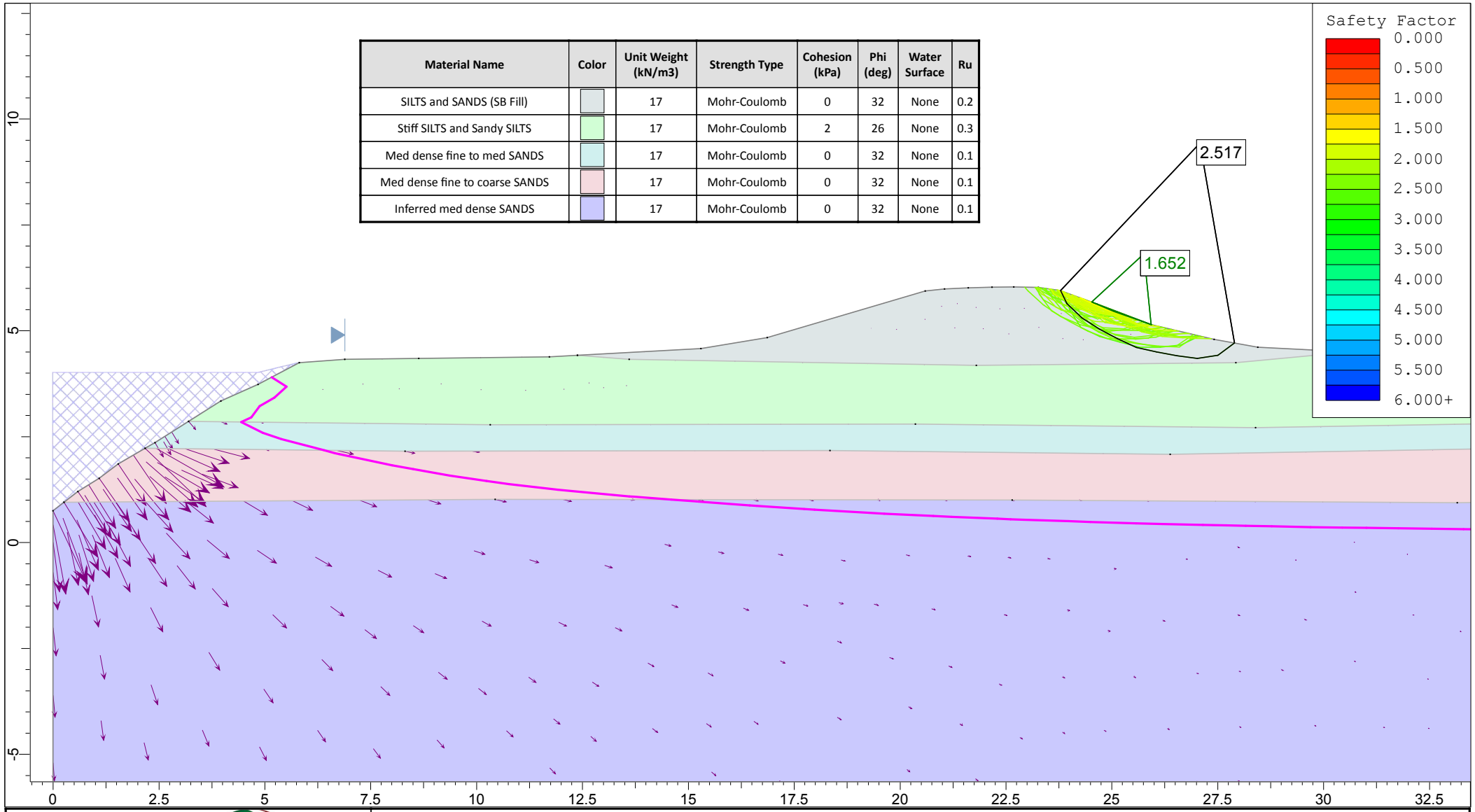
CMW Geosciences (NZ) Ltd

Checked: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2C: Seepage - day 14 of flood event		
Drawn By OMG	*Scale* 1:250	*Company*	CMW Geosciences Ltd
Date 18/10/2016, 2:02:46 p.m.		*File Name*	R2C 181016.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS and SANDS (SB Fill)		17	Mohr-Coulomb	0	32	None	0.2
Stiff SILTS and Sandy SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

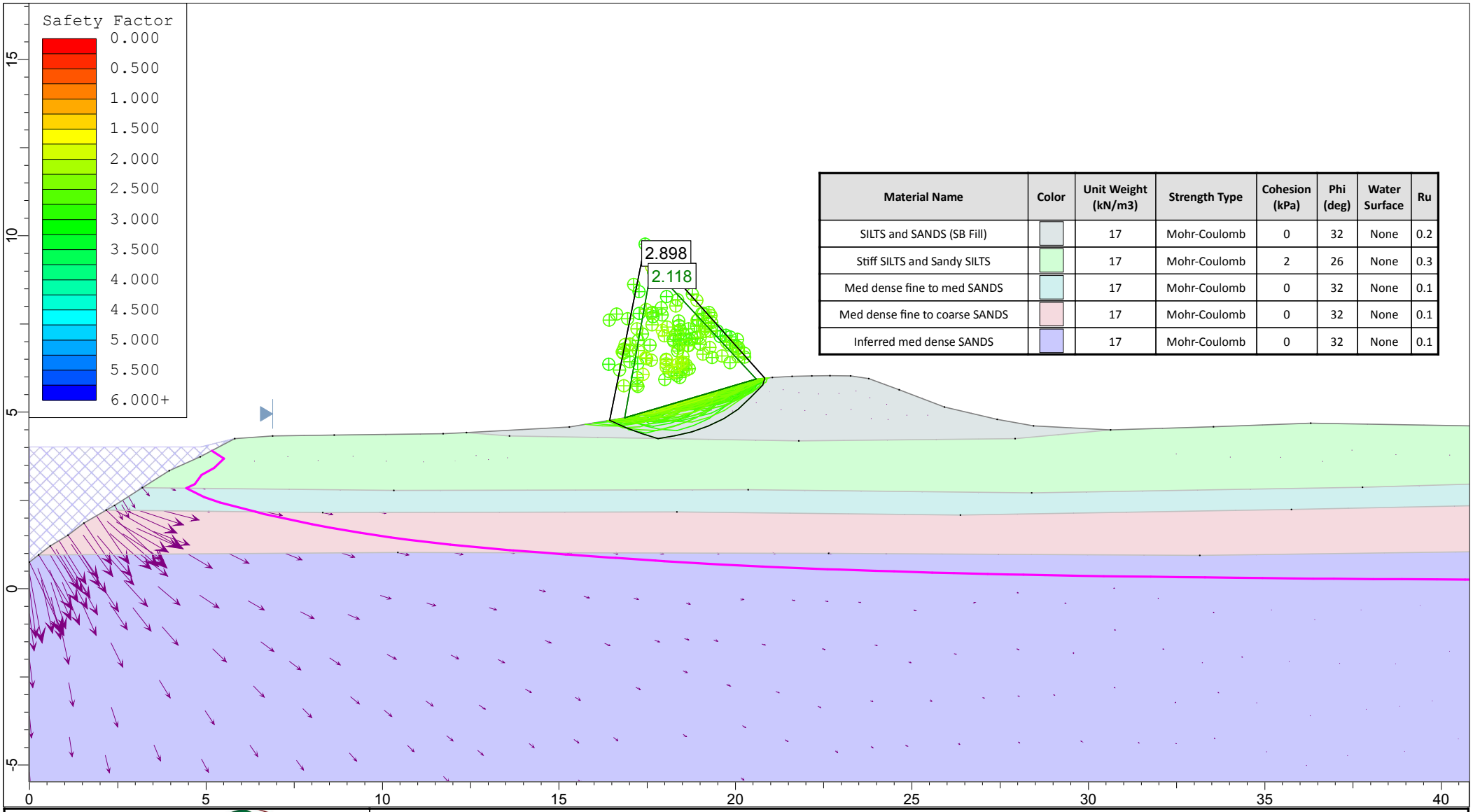


CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2D: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:125
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:33:58 p.m.	*File Name*	R2D RS 181016.slim



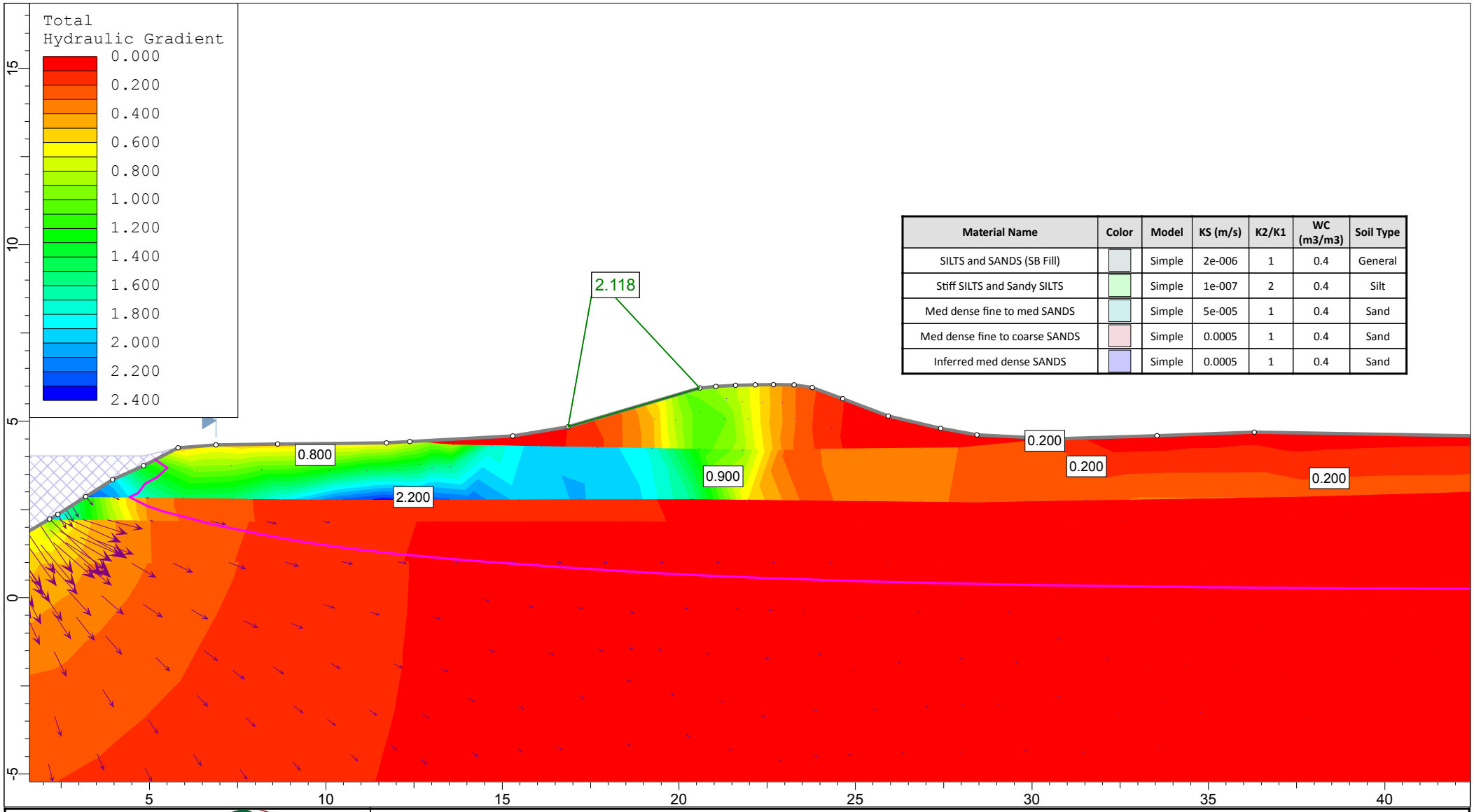
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SILTS and SANDS (SB Fill)		17	Mohr-Coulomb	0	32	None	0.2
Stiff SILTS and Sandy SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2D: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:33:58 p.m.	*File Name*	R2D 181016.slim

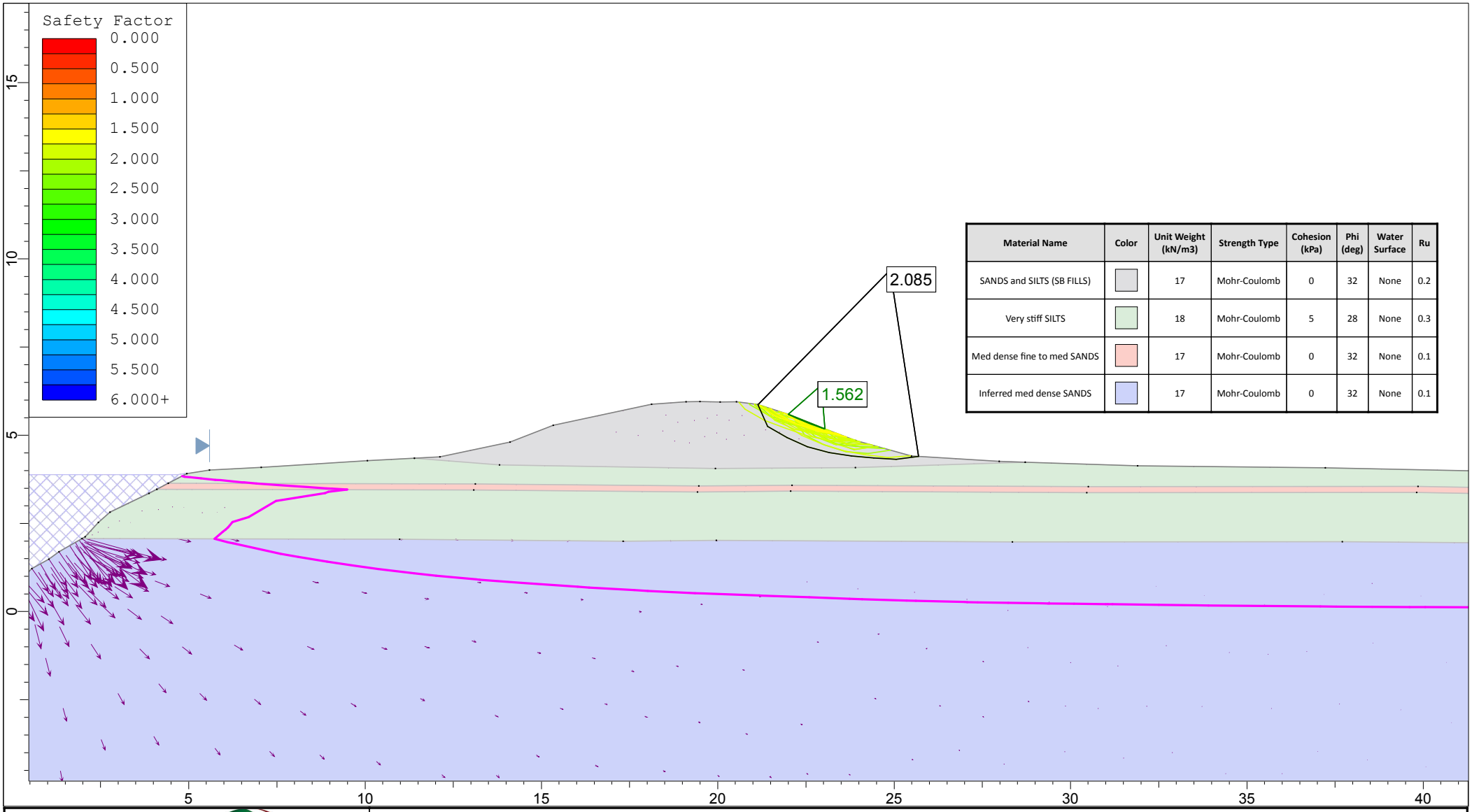


Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SILTS and SANDS (SB Fill)		Simple	2e-006	1	0.4	General
Stiff SILTS and Sandy SILTS		Simple	1e-007	2	0.4	Silt
Med dense fine to med SANDS		Simple	5e-005	1	0.4	Sand
Med dense fine to coarse SANDS		Simple	0.0005	1	0.4	Sand
Inferred med dense SANDS		Simple	0.0005	1	0.4	Sand

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2D: Seepage - day 14 of flood event		
Drawn By OMG	*Scale* 1:150	*Company*	CMW Geosciences Ltd
Date 18/10/2016, 2:33:58 p.m.		*File Name*	R2D 181016.slim

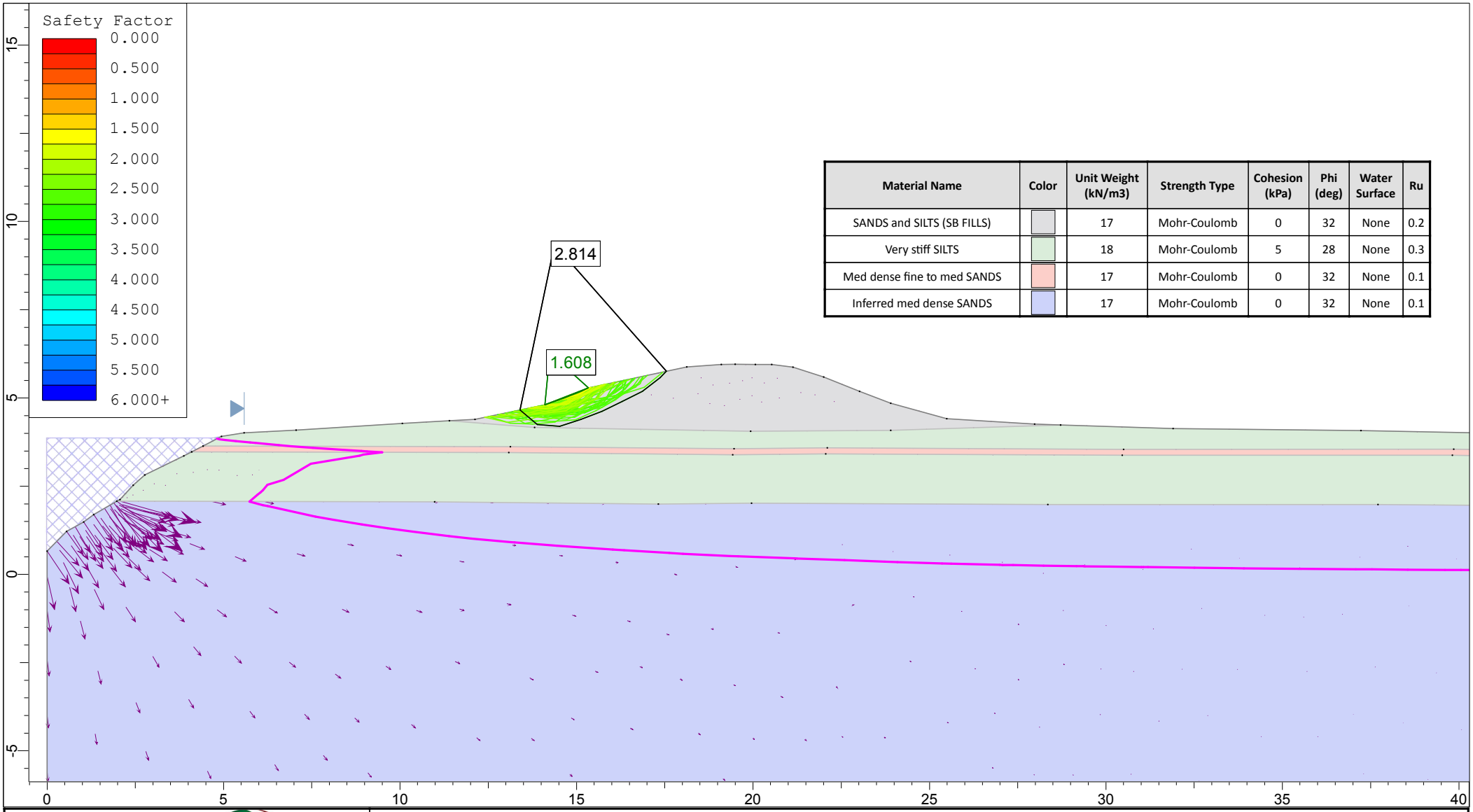


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SANDS and SILTS (SB FILLS)		17	Mohr-Coulomb	0	32	None	0.2
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2E: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:53:07 p.m.	*File Name*	R2E RS 181016.slim



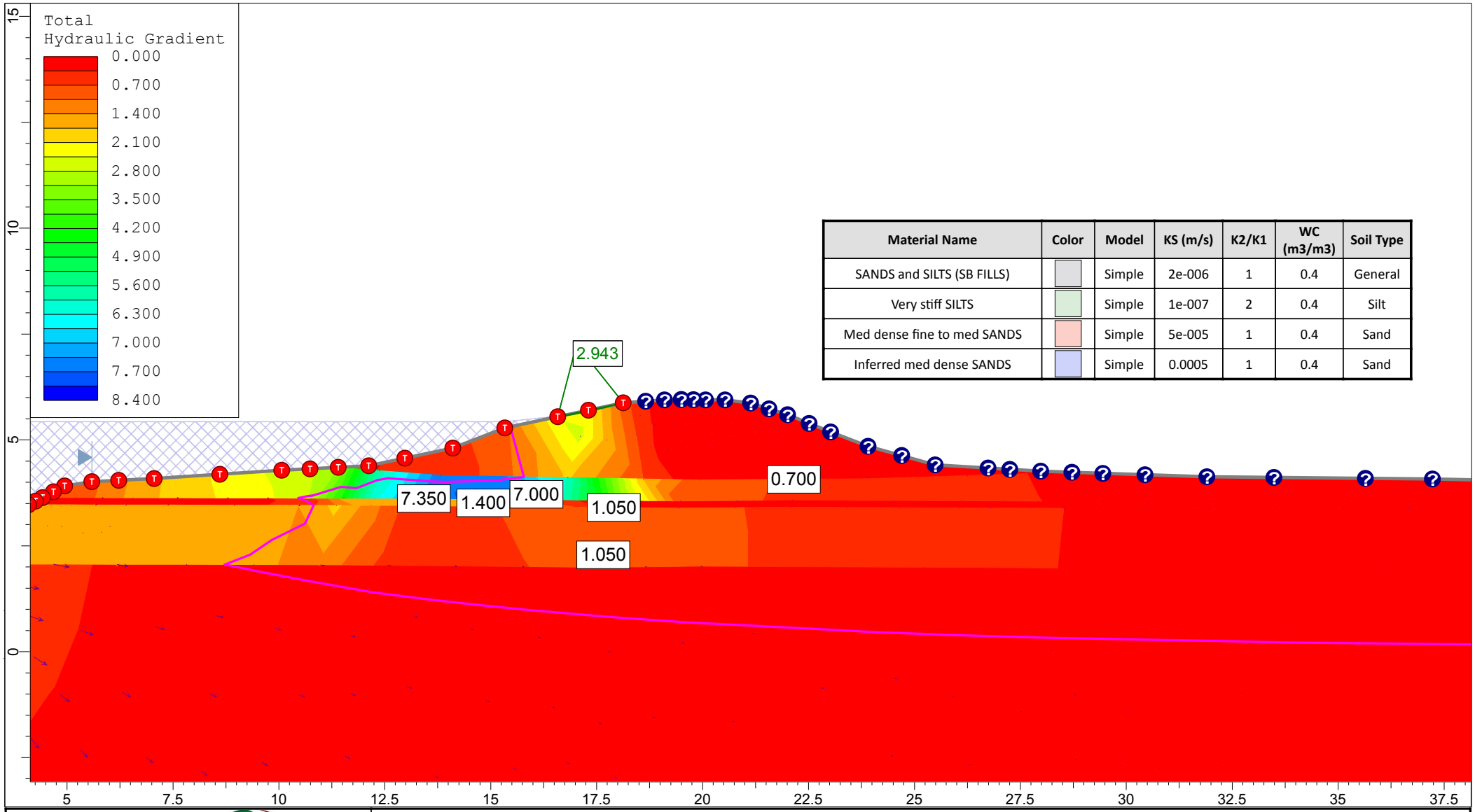
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
SANDS and SILTS (SB FILLS)		17	Mohr-Coulomb	0	32	None	0.2
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Inferred med dense SANDS		17	Mohr-Coulomb	0	32	None	0.1

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2E: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:150
Company	CMW Geosciences Ltd		
Date	18/10/2016, 2:53:07 p.m.	*File Name*	R2E 181016.slim



Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
SANDS and SILTS (SB FILLS)		Simple	2e-006	1	0.4	General
Very stiff SILTS		Simple	1e-007	2	0.4	Silt
Med dense fine to med SANDS		Simple	5e-005	1	0.4	Sand
Inferred med dense SANDS		Simple	0.0005	1	0.4	Sand

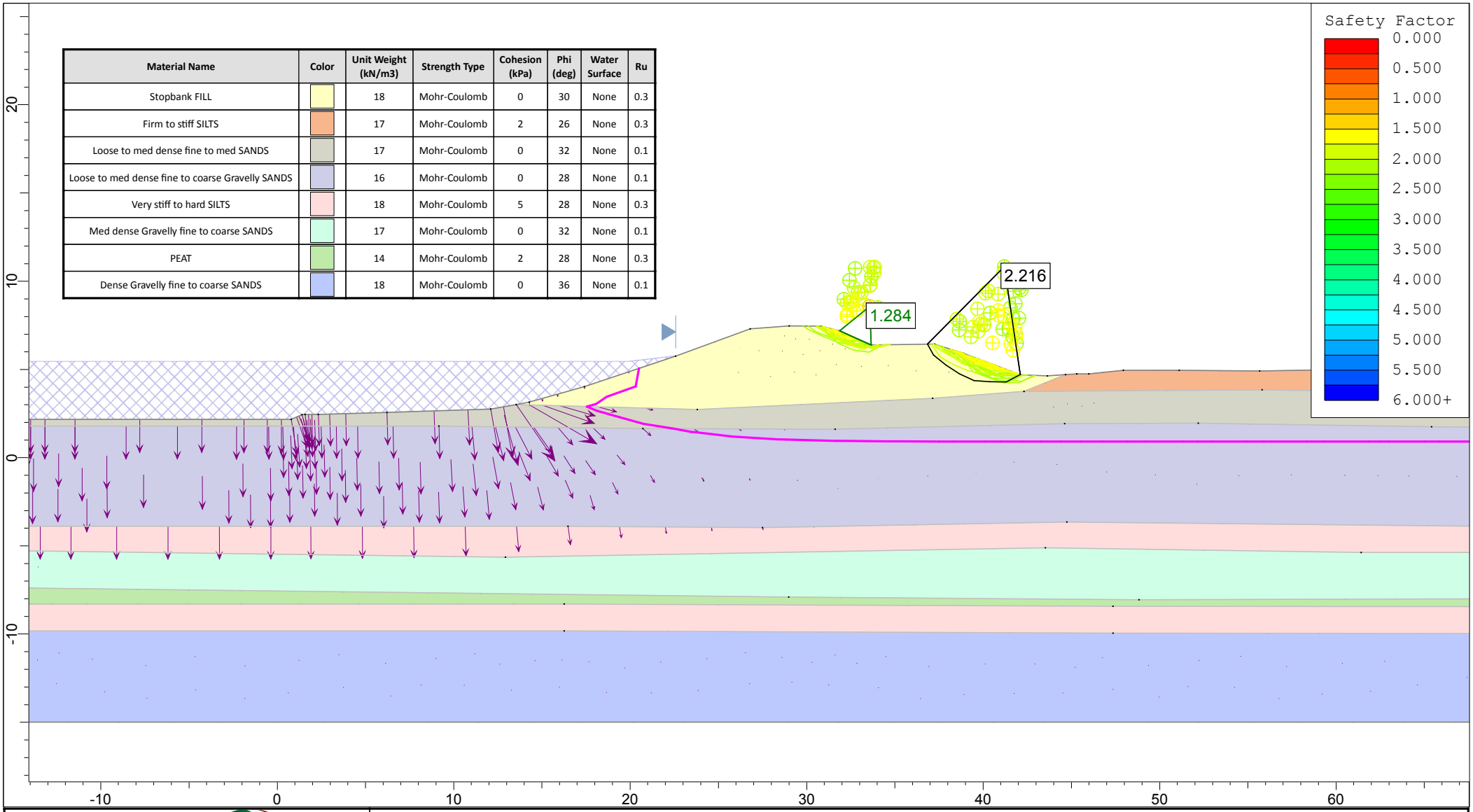
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R2E: Seepage - day 10 of flood event		
Drawn By OMG	*Scale* 1:125	*Company* CMW Geosciences Ltd	
Date 18/10/2016, 2:53:07 p.m.		*File Name* R2E 181016.slim	

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank FILL		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff SILTS		17	Mohr-Coulomb	2	26	None	0.3
Loose to med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Loose to med dense fine to coarse Gravelly SANDS		16	Mohr-Coulomb	0	28	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Gravelly fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	28	None	0.3
Dense Gravelly fine to coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1

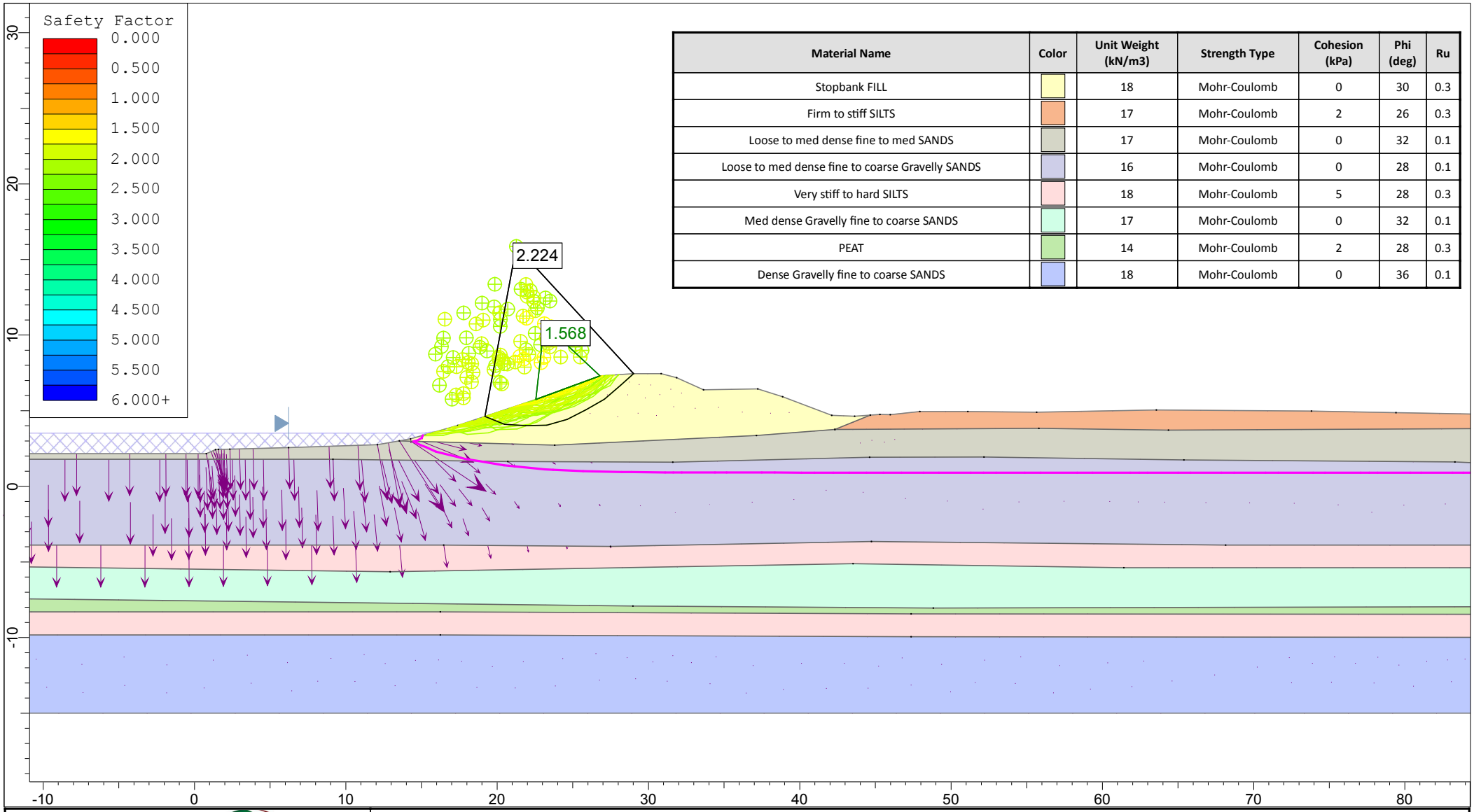


CMW Geosciences (NZ) Ltd

Checked Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3A: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	28/09/2016, 2:55:48 p.m.	*File Name*	R3A_RS.slim



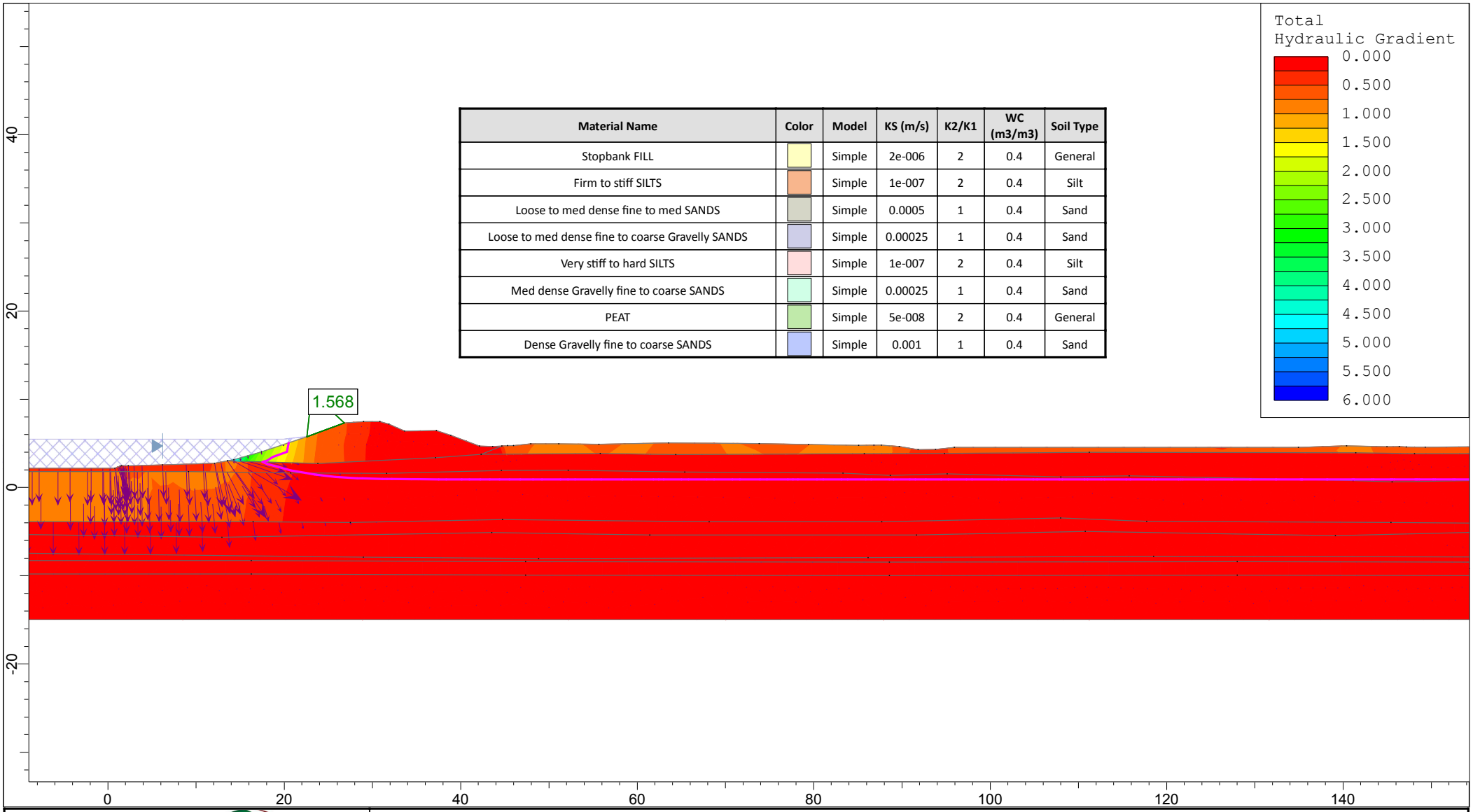
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Ru
Stopbank FILL		18	Mohr-Coulomb	0	30	0.3
Firm to stiff SILTS		17	Mohr-Coulomb	2	26	0.3
Loose to med dense fine to med SANDS		17	Mohr-Coulomb	0	32	0.1
Loose to med dense fine to coarse Gravelly SANDS		16	Mohr-Coulomb	0	28	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	0.3
Med dense Gravelly fine to coarse SANDS		17	Mohr-Coulomb	0	32	0.1
PEAT		14	Mohr-Coulomb	2	28	0.3
Dense Gravelly fine to coarse SANDS		18	Mohr-Coulomb	0	36	0.1

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3A: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:350
Company	CMW Geosciences Ltd		
Date	28/09/2016, 2:55:48 p.m.	*File Name*	R3A.slim

Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Stopbank FILL		Simple	2e-006	2	0.4	General
Firm to stiff SILTS		Simple	1e-007	2	0.4	Silt
Loose to med dense fine to med SANDS		Simple	0.0005	1	0.4	Sand
Loose to med dense fine to coarse Gravelly SANDS		Simple	0.00025	1	0.4	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Med dense Gravelly fine to coarse SANDS		Simple	0.00025	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Dense Gravelly fine to coarse SANDS		Simple	0.001	1	0.4	Sand



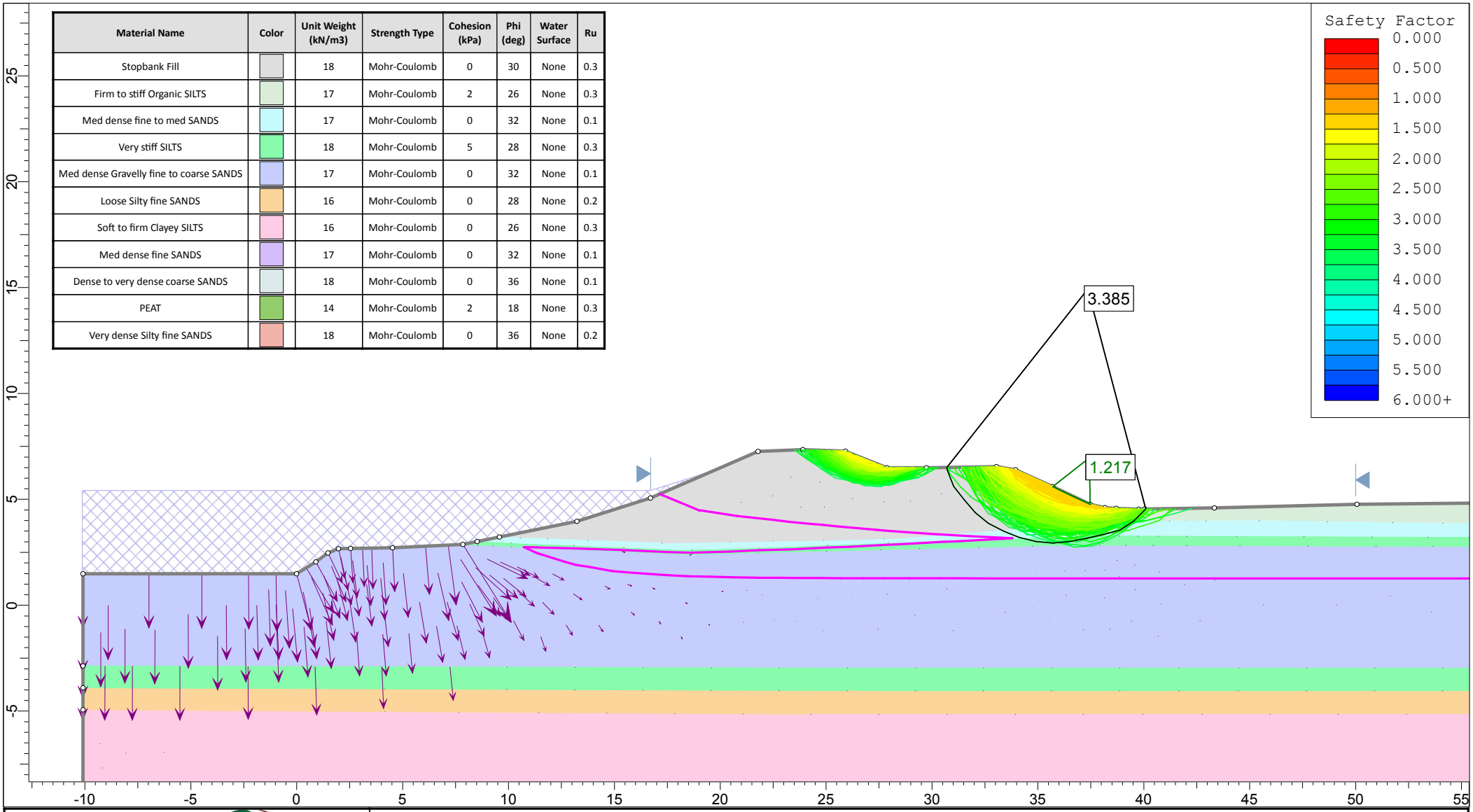
CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3A: Seepage - day 14 of flood event		
Drawn By	OMG	*Scale*	1:600
Company	CMW Geosciences Ltd		
Date	28/09/2016, 2:55:48 p.m.	*File Name*	R3A.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff Organic SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Gravelly fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Loose Silty fine SANDS		16	Mohr-Coulomb	0	28	None	0.2
Soft to firm Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Med dense fine SANDS		17	Mohr-Coulomb	0	32	None	0.1
Dense to very dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Very dense Silty fine SANDS		18	Mohr-Coulomb	0	36	None	0.2

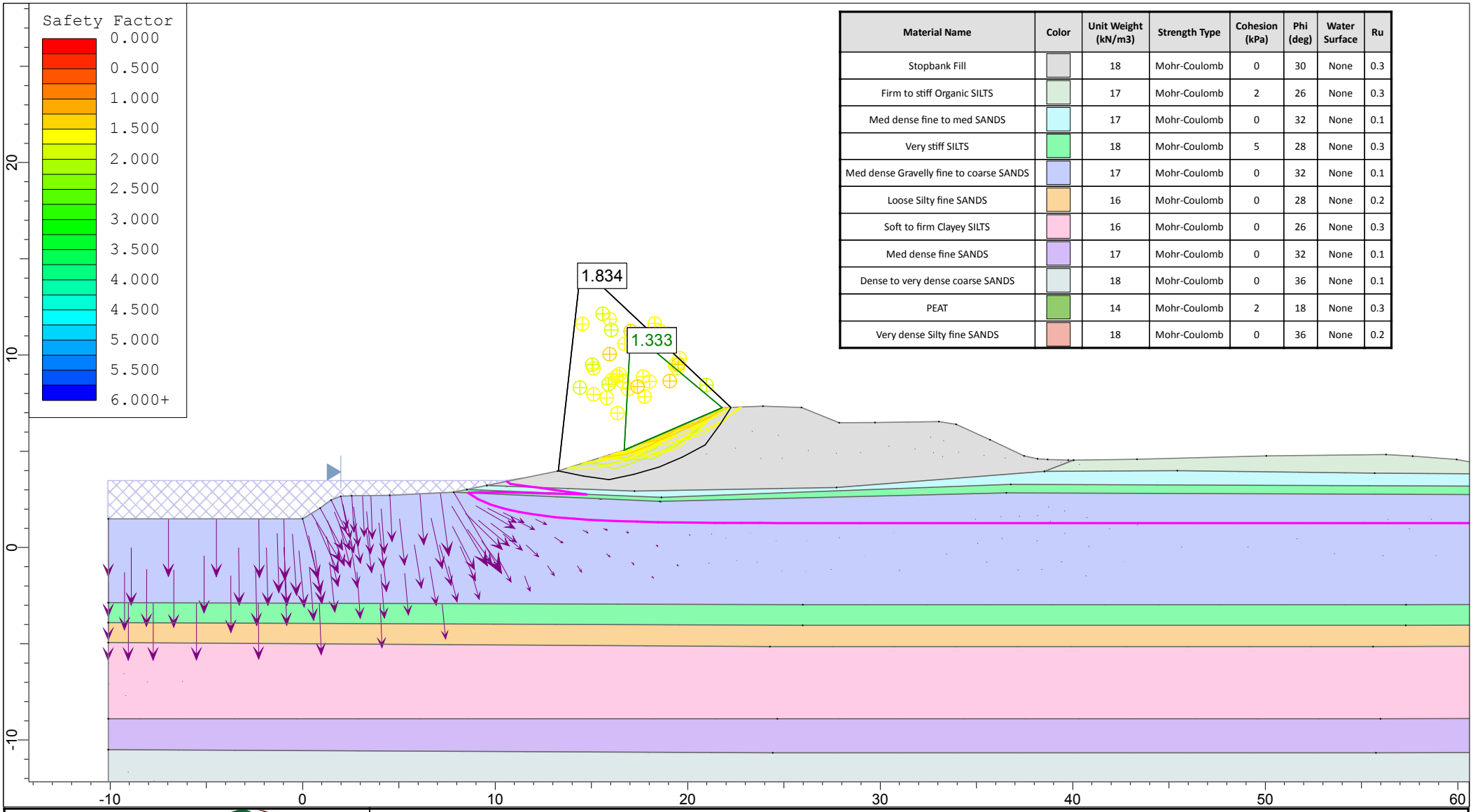


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3B: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:250
Company	CMW Geosciences Ltd		
Date	28/09/2016, 4:13:08 p.m.	*File Name*	R3B_RS.slim

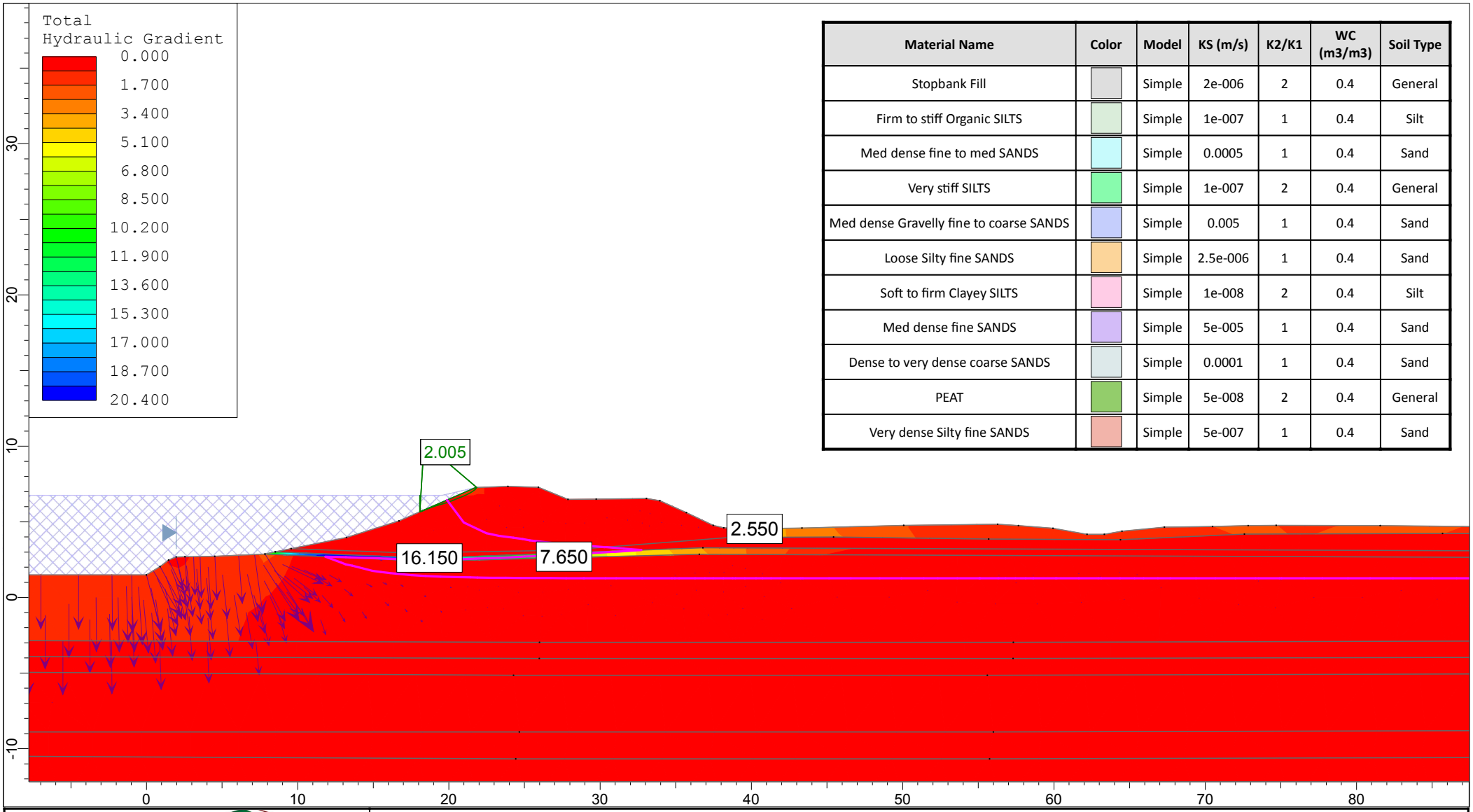


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff Organic SILTS		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Gravelly fine to coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Loose Silty fine SANDS		16	Mohr-Coulomb	0	28	None	0.2
Soft to firm Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Med dense fine SANDS		17	Mohr-Coulomb	0	32	None	0.1
Dense to very dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
PEAT		14	Mohr-Coulomb	2	18	None	0.3
Very dense Silty fine SANDS		18	Mohr-Coulomb	0	36	None	0.2

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3B: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:275
Company	CMW Geosciences Ltd		
Date	28/09/2016, 4:13:08 p.m.	*File Name*	R3B.slim



Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Stopbank Fill		Simple	2e-006	2	0.4	General
Firm to stiff Organic SILTS		Simple	1e-007	1	0.4	Silt
Med dense fine to med SANDS		Simple	0.0005	1	0.4	Sand
Very stiff SILTS		Simple	1e-007	2	0.4	General
Med dense Gravelly fine to coarse SANDS		Simple	0.005	1	0.4	Sand
Loose Silty fine SANDS		Simple	2.5e-006	1	0.4	Sand
Soft to firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense fine SANDS		Simple	5e-005	1	0.4	Sand
Dense to very dense coarse SANDS		Simple	0.0001	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Very dense Silty fine SANDS		Simple	5e-007	1	0.4	Sand

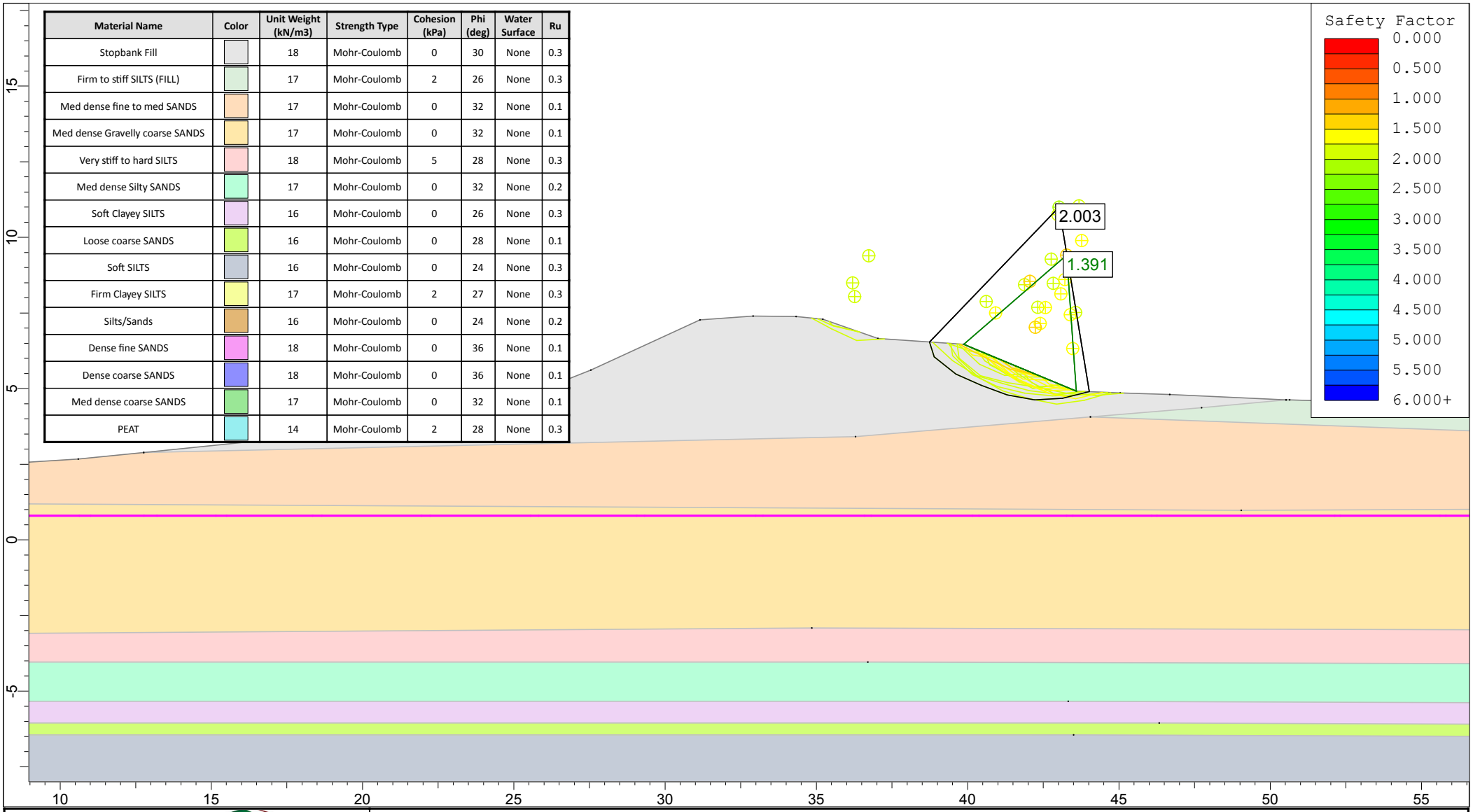
CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3B: Seepage - day 8 of flood event - maximum hydraulic gradient		
Drawn By	OMG	*Scale*	1:350
Company	CMW Geosciences Ltd		
Date	28/09/2016, 4:13:08 p.m.	*File Name*	R3B.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff SILTS (FILL)		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Gravelly coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Silts/Sands		16	Mohr-Coulomb	0	24	None	0.2
Dense fine SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	28	None	0.3

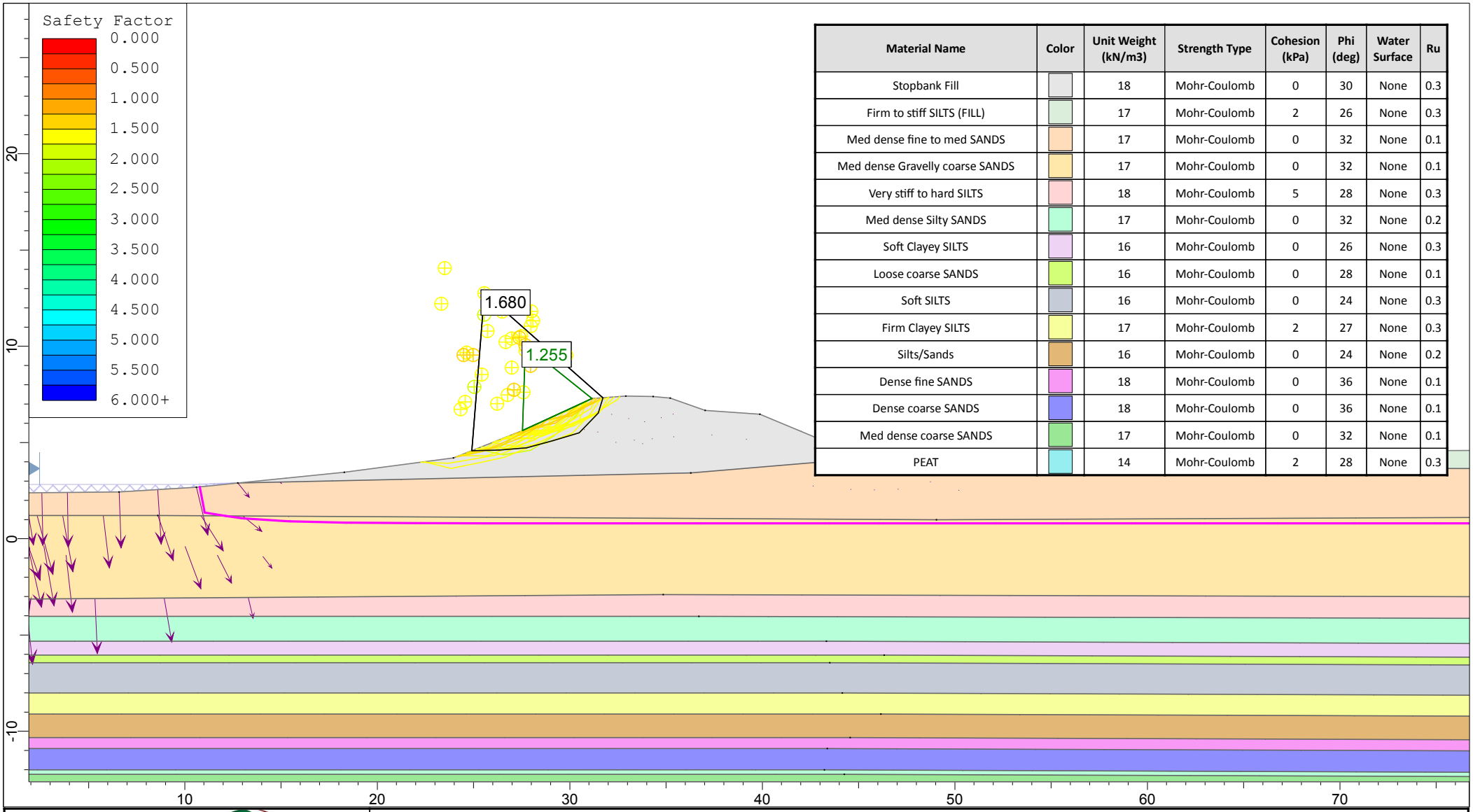


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3C: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:175
Company	CMW Geosciences Ltd		
Date	29/09/2016, 9:57:48 a.m.	*File Name*	R3C_RS.slim



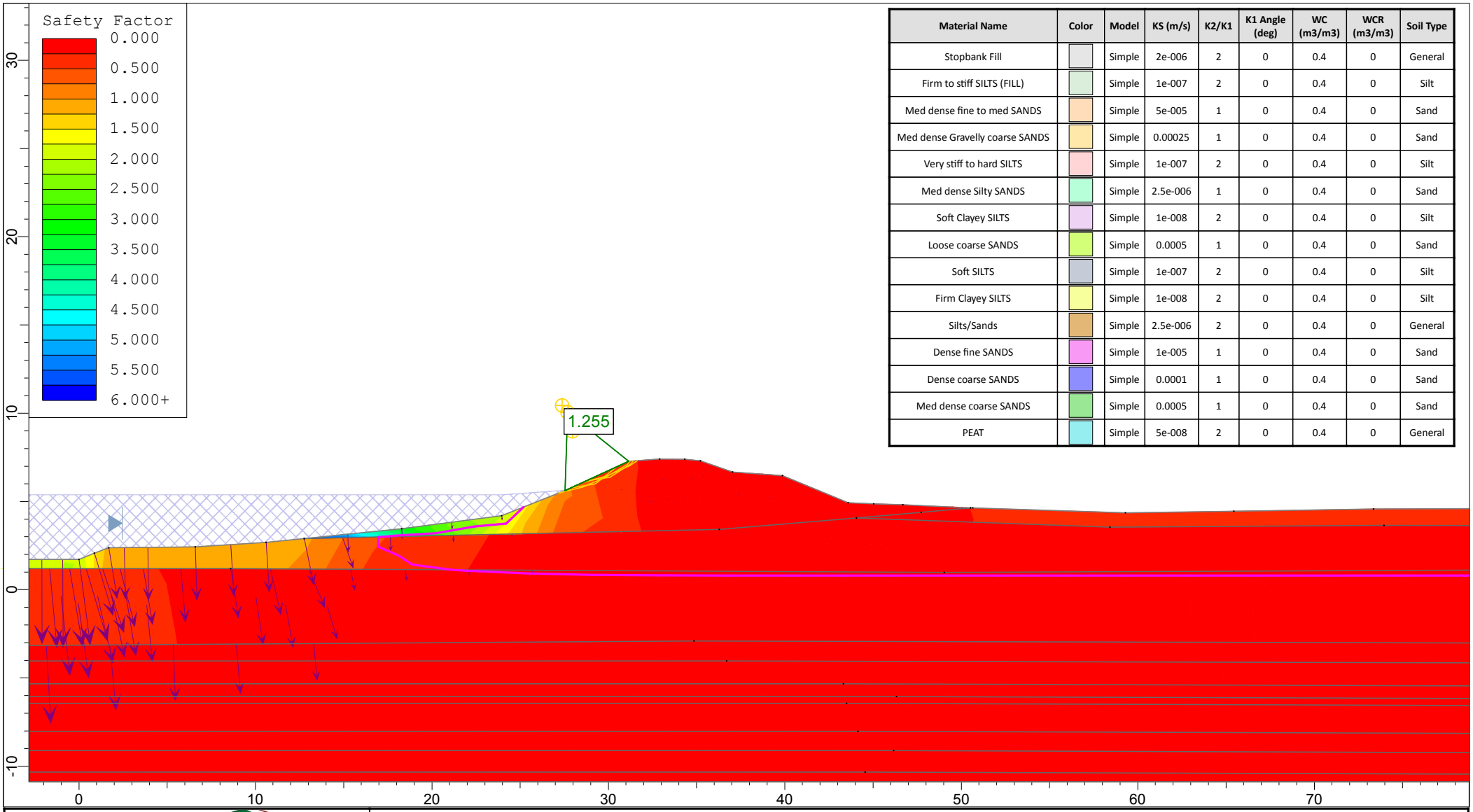
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff SILTS (FILL)		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Gravelly coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Silts/Sands		16	Mohr-Coulomb	0	24	None	0.2
Dense fine SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	28	None	0.3

CMW Geosciences (NZ) Ltd

Checked Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3C: Slope stability - left side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:275
Company	CMW Geosciences Ltd		
Date	29/09/2016, 9:57:48 a.m.	*File Name*	R3C.slim



Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	WC (m3/m3)	WCR (m3/m3)	Soil Type
Stopbank Fill		Simple	2e-006	2	0	0.4	0	General
Firm to stiff SILTS (FILL)		Simple	1e-007	2	0	0.4	0	Silt
Med dense fine to med SANDS		Simple	5e-005	1	0	0.4	0	Sand
Med dense Gravelly coarse SANDS		Simple	0.00025	1	0	0.4	0	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0	0.4	0	Silt
Med dense Silty SANDS		Simple	2.5e-006	1	0	0.4	0	Sand
Soft Clayey SILTS		Simple	1e-008	2	0	0.4	0	Silt
Loose coarse SANDS		Simple	0.0005	1	0	0.4	0	Sand
Soft SILTS		Simple	1e-007	2	0	0.4	0	Silt
Firm Clayey SILTS		Simple	1e-008	2	0	0.4	0	Silt
Silts/Sands		Simple	2.5e-006	2	0	0.4	0	General
Dense fine SANDS		Simple	1e-005	1	0	0.4	0	Sand
Dense coarse SANDS		Simple	0.0001	1	0	0.4	0	Sand
Med dense coarse SANDS		Simple	0.0005	1	0	0.4	0	Sand
PEAT		Simple	5e-008	2	0	0.4	0	General

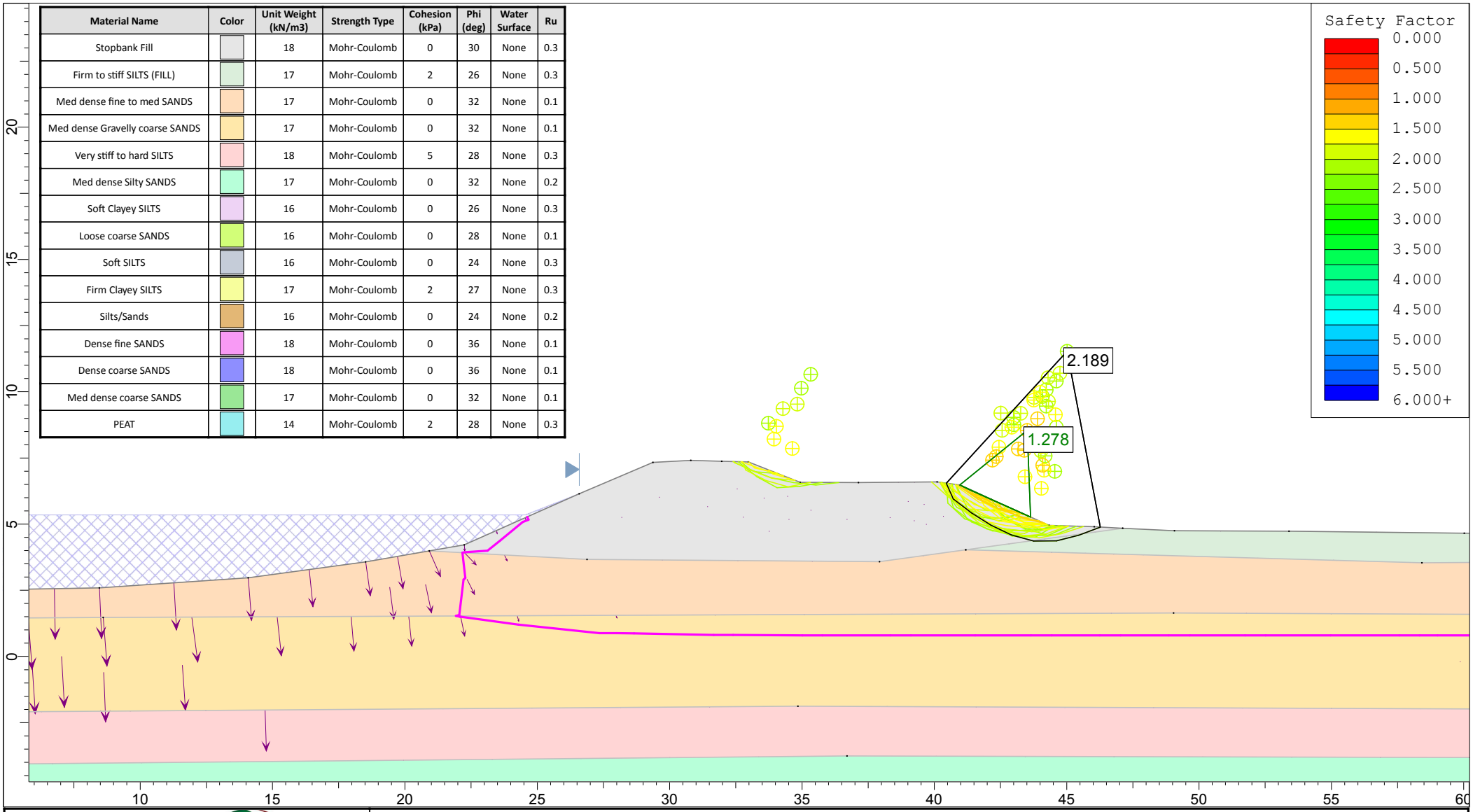
CMW Geosciences (NZ) Ltd

Chen Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3C: Seepage - day 14 of flood event		
Drawn By OMG	*Scale* 1:300	*Company*	CMW Geosciences Ltd
Date 29/09/2016, 9:57:48 a.m.		*File Name*	R3C.slim

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff SILTS (FILL)		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Gravelly coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Silts/Sands		16	Mohr-Coulomb	0	24	None	0.2
Dense fine SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	28	None	0.3

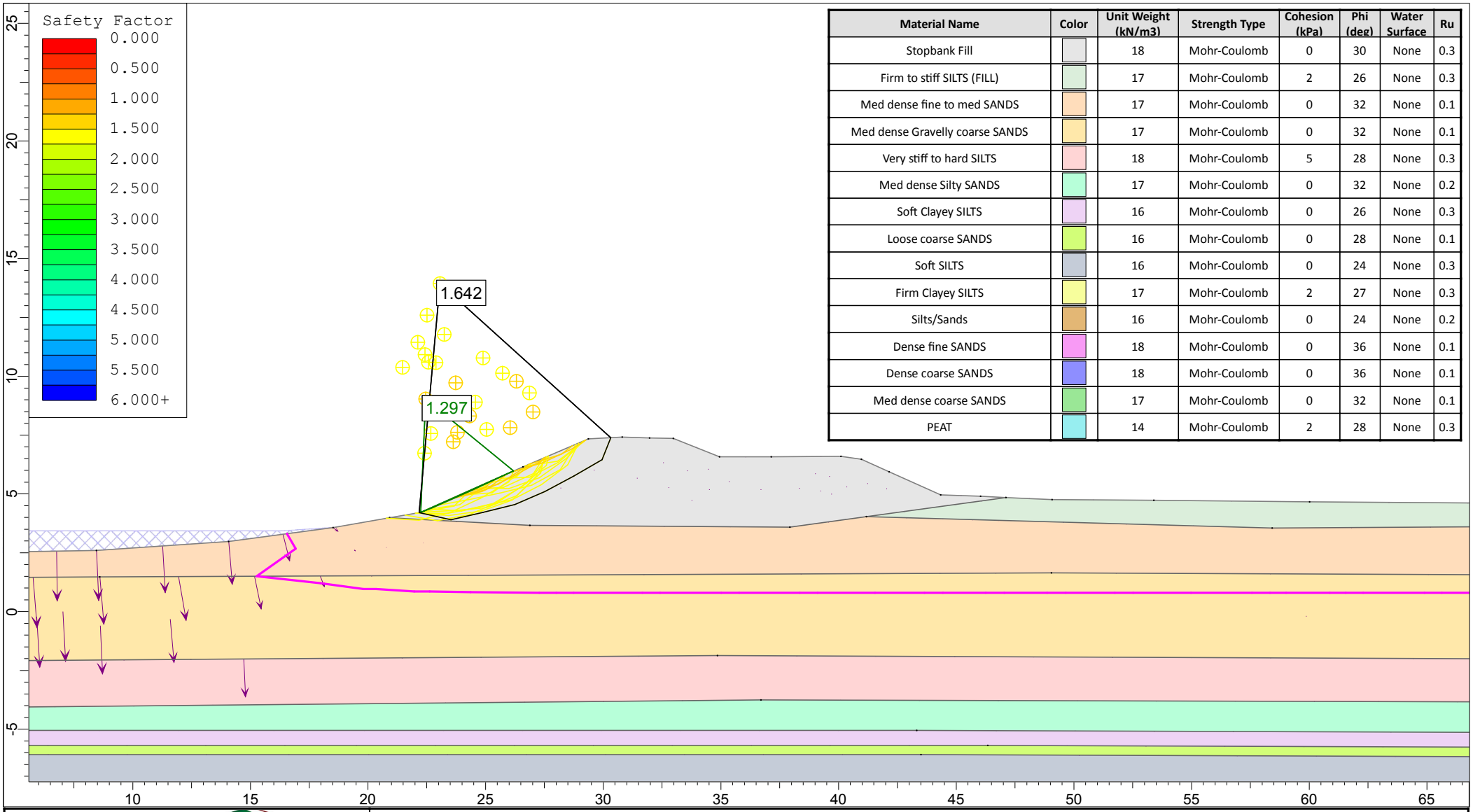


CMW Geosciences (NZ) Ltd

Cheesman Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3D: Slope stability - right side - lowest factor of safety through stopbank		
Drawn By	OMG	*Scale*	1:200
Company	CMW Geosciences Ltd		
Date	29/09/2016, 11:21:19 a.m.	*File Name*	R3D_RS.slim

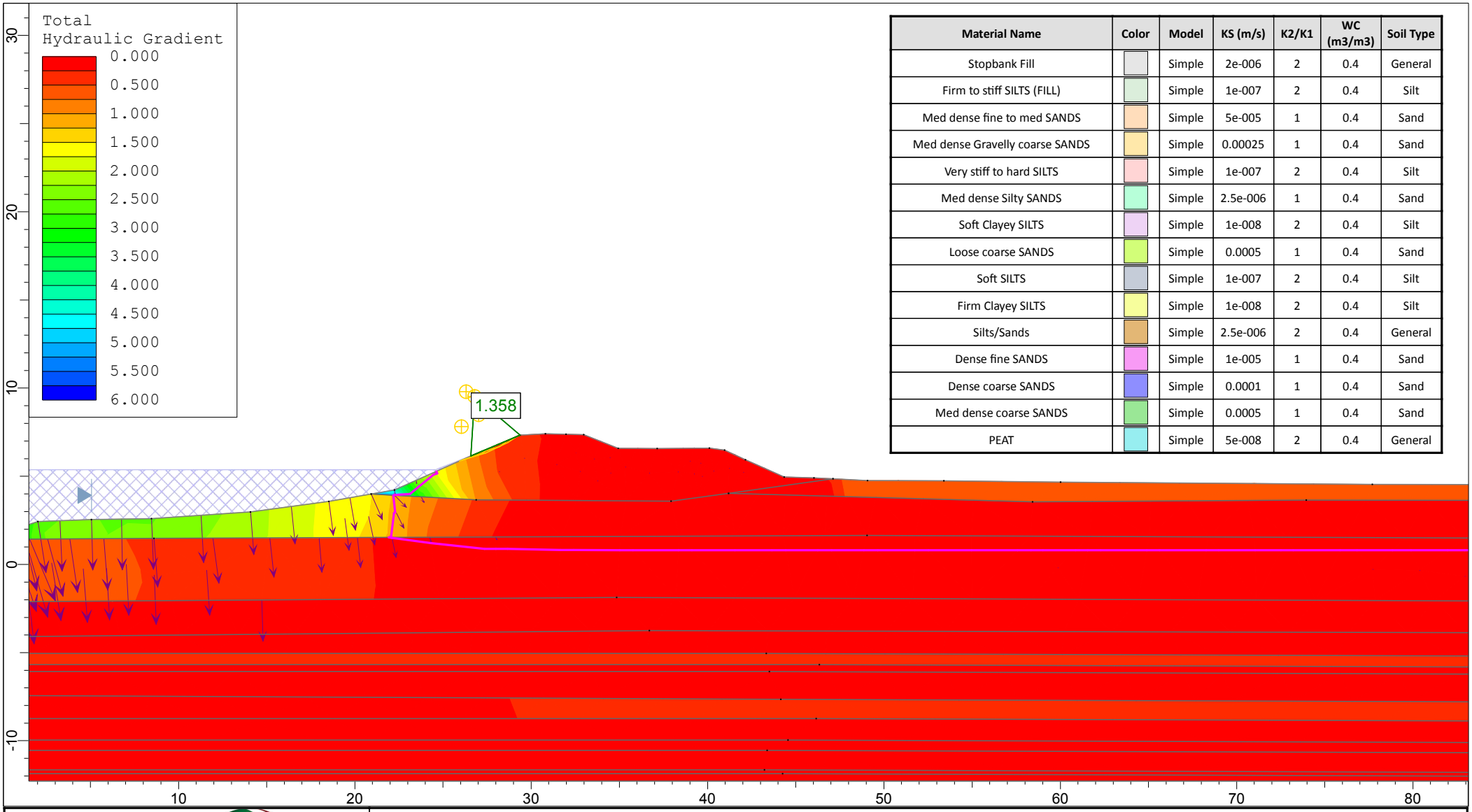


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Stopbank Fill		18	Mohr-Coulomb	0	30	None	0.3
Firm to stiff SILTS (FILL)		17	Mohr-Coulomb	2	26	None	0.3
Med dense fine to med SANDS		17	Mohr-Coulomb	0	32	None	0.1
Med dense Gravelly coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
Very stiff to hard SILTS		18	Mohr-Coulomb	5	28	None	0.3
Med dense Silty SANDS		17	Mohr-Coulomb	0	32	None	0.2
Soft Clayey SILTS		16	Mohr-Coulomb	0	26	None	0.3
Loose coarse SANDS		16	Mohr-Coulomb	0	28	None	0.1
Soft SILTS		16	Mohr-Coulomb	0	24	None	0.3
Firm Clayey SILTS		17	Mohr-Coulomb	2	27	None	0.3
Silts/Sands		16	Mohr-Coulomb	0	24	None	0.2
Dense fine SANDS		18	Mohr-Coulomb	0	36	None	0.1
Dense coarse SANDS		18	Mohr-Coulomb	0	36	None	0.1
Med dense coarse SANDS		17	Mohr-Coulomb	0	32	None	0.1
PEAT		14	Mohr-Coulomb	2	28	None	0.3

CMW Geosciences (NZ) Ltd
Cheetham Morton Woodward

Project	Rangitaiki River and Floodway, Edgecumbe			
Analysis Description	Cross section R3D: Slope stability - left side - lowest factor of safety through stopbank			
Drawn By	OMG	*Scale*	1:225	*Company* CMW Geosciences Ltd
Date	29/09/2016, 11:21:19 a.m.			*File Name* R3D.slim

SLIDEINTERPRET 6.035



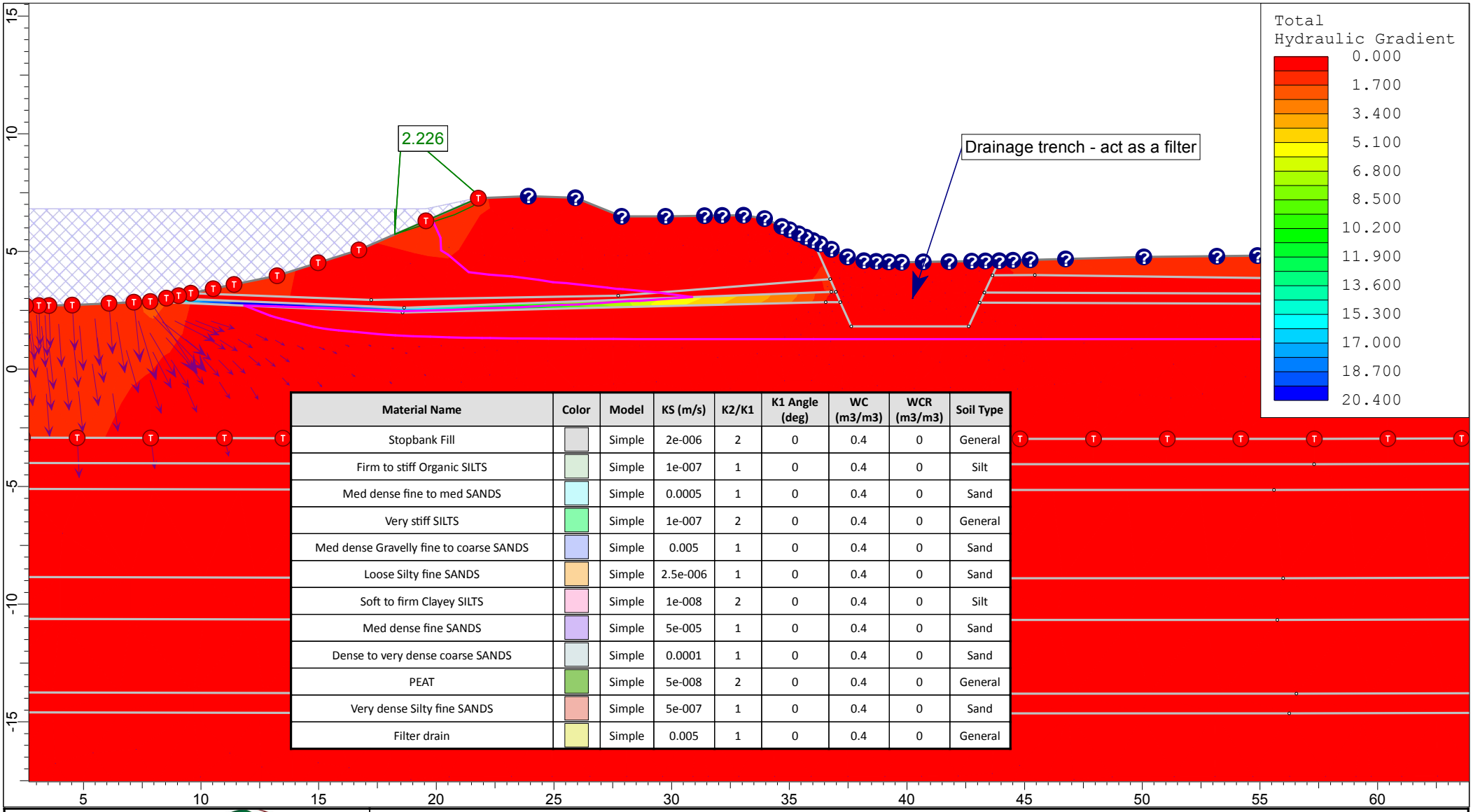
Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Stopbank Fill		Simple	2e-006	2	0.4	General
Firm to stiff SILTS (FILL)		Simple	1e-007	2	0.4	Silt
Med dense fine to med SANDS		Simple	5e-005	1	0.4	Sand
Med dense Gravelly coarse SANDS		Simple	0.00025	1	0.4	Sand
Very stiff to hard SILTS		Simple	1e-007	2	0.4	Silt
Med dense Silty SANDS		Simple	2.5e-006	1	0.4	Sand
Soft Clayey SILTS		Simple	1e-008	2	0.4	Silt
Loose coarse SANDS		Simple	0.0005	1	0.4	Sand
Soft SILTS		Simple	1e-007	2	0.4	Silt
Firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Silts/Sands		Simple	2.5e-006	2	0.4	General
Dense fine SANDS		Simple	1e-005	1	0.4	Sand
Dense coarse SANDS		Simple	0.0001	1	0.4	Sand
Med dense coarse SANDS		Simple	0.0005	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General

CMW Geosciences (NZ) Ltd

Cheetham Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross section R3D: Seepage - day 14 of flood event		
Drawn By	OMG	*Scale*	1:300
Company	CMW Geosciences Ltd		
Date	29/09/2016, 11:21:19 a.m.	*File Name*	R3D.slim



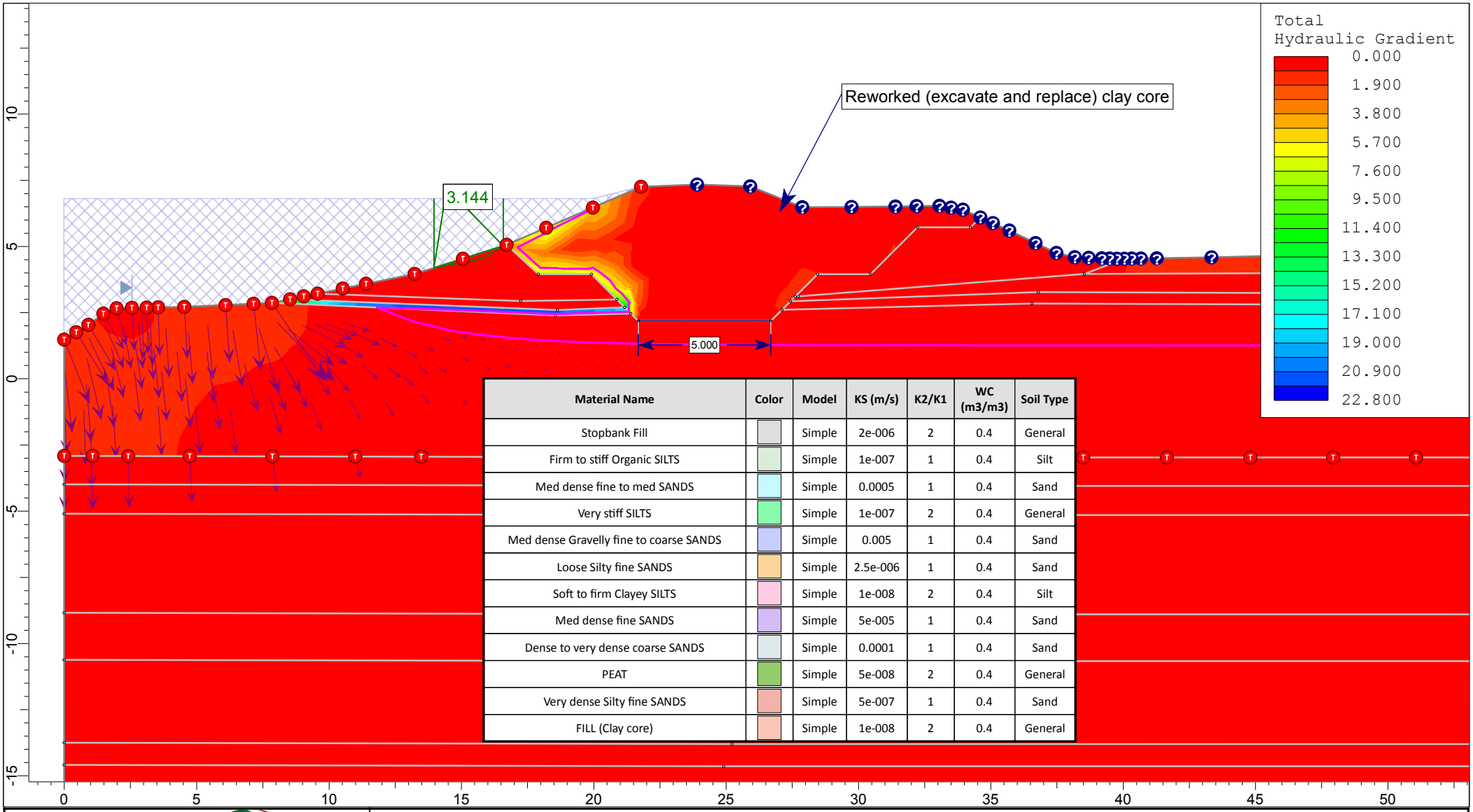
Material Name	Color	Model	KS (m/s)	K2/K1	K1 Angle (deg)	WC (m3/m3)	WCR (m3/m3)	Soil Type
Stopbank Fill		Simple	2e-006	2	0	0.4	0	General
Firm to stiff Organic SILTS		Simple	1e-007	1	0	0.4	0	Silt
Med dense fine to med SANDS		Simple	0.0005	1	0	0.4	0	Sand
Very stiff SILTS		Simple	1e-007	2	0	0.4	0	General
Med dense Gravelly fine to coarse SANDS		Simple	0.005	1	0	0.4	0	Sand
Loose Silty fine SANDS		Simple	2.5e-006	1	0	0.4	0	Sand
Soft to firm Clayey SILTS		Simple	1e-008	2	0	0.4	0	Silt
Med dense fine SANDS		Simple	5e-005	1	0	0.4	0	Sand
Dense to very dense coarse SANDS		Simple	0.0001	1	0	0.4	0	Sand
PEAT		Simple	5e-008	2	0	0.4	0	General
Very dense Silty fine SANDS		Simple	5e-007	1	0	0.4	0	Sand
Filter drain		Simple	0.005	1	0	0.4	0	General

CMW Geosciences (NZ) Ltd

Check Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe		
Analysis Description	Cross Section R3B: Effect of drainage trench		
Drawn By OMG	*Scale* 1:225	*Company*	CMW Geosciences Ltd
Date 28/09/2016, 4:13:08 p.m.		*File Name*	R3B_trench.slim



Material Name	Color	Model	KS (m/s)	K2/K1	WC (m3/m3)	Soil Type
Stopbank Fill		Simple	2e-006	2	0.4	General
Firm to stiff Organic SILTS		Simple	1e-007	1	0.4	Silt
Med dense fine to med SANDS		Simple	0.0005	1	0.4	Sand
Very stiff SILTS		Simple	1e-007	2	0.4	General
Med dense Gravelly fine to coarse SANDS		Simple	0.005	1	0.4	Sand
Loose Silty fine SANDS		Simple	2.5e-006	1	0.4	Sand
Soft to firm Clayey SILTS		Simple	1e-008	2	0.4	Silt
Med dense fine SANDS		Simple	5e-005	1	0.4	Sand
Dense to very dense coarse SANDS		Simple	0.0001	1	0.4	Sand
PEAT		Simple	5e-008	2	0.4	General
Very dense Silty fine SANDS		Simple	5e-007	1	0.4	Sand
FILL (Clay core)		Simple	1e-008	2	0.4	General

CMW Geosciences (NZ) Ltd

Client: Morton Woodward

SLIDEINTERPRET 6.035

Project	Rangitaiki River and Floodway, Edgecumbe				
Analysis Description	Cross Section R3B: Effect of clay cut-off core				
Drawn By	OMG	*Scale*	1:200	*Company*	CMW Geosciences Ltd
Date	28/09/2016, 4:13:08 p.m.			*File Name*	R3B_cutoff.slim