GEOTECHNICAL INVESTIGATION

DUPLICATION OF BUSSELL HIGHWAY

HUTTON ROAD TO SABINA RIVER

BG & E

WML
accessible expertise

Distribution Record:

Revision	Reviewed By	Date Issued	Purpose of Issue	Issued To
A	Simon Marks	04/08/2016	Draft	-
0	Paul Foley	05/08/2016	Draft for comments	Jonathon Haylock (MRWA)
2	Paul Foley	21/09/2016	Final	Jonathon Haylock (MRWA)
3	Paul Foley	25/11/2016	Revised Final	Jonathon Haylock (MRWA)
4	Paul Foley	24/02/2017	Revised Final	Jonathon Haylock (MRWA)

Prepared by: Alex Pope

Signed: 

Date: 24 February 2017

WML Name: Duplication of Bussell Hwy, Hutton to Sabina

WML Project No: 6897

About your geotechnical investigation and report…….

A geotechnical investigation is planned and conducted solely for the intended recipient of the report and for the purposes stated in the report. The report should not be reproduced in whole or part without agreement of WML Consultants.

A geotechnical investigation is planned and conducted based upon the information about the site and proposed works that is made available to WML Consultants, as stated in the report.

A geotechnical investigation typically includes investigation and testing at a few isolated locations. The choice of the locations is usually made by the author having consideration for the nature of the site and proposed works. Conditions for the remainder of the site are necessarily extrapolated from the conditions observed at the locations investigated. Thus the report will contain a mixture of facts, interpretation and professional judgement. Facts will usually be confined to a description of the fieldwork carried out, the observations made and any results of laboratory testing. However, field notes and logs contain estimates of conditions observed at the time, and may differ from the results obtained from subsequent laboratory testing of samples. Other comments and conclusions should be considered as interpretation and professional judgement, unless specifically stated otherwise.

As the nature of geotechnical conditions is so variable WML Consultants accepts no liability or responsibility for the conditions encountered beyond the limits of our investigation. Such conditions may exist between test locations or in deeper strata than observed than can reasonably be interpreted from the limited extent of this investigation.

For various reasons (e.g. seasonal effects), the site conditions encountered during construction may differ from those observed or extrapolated from the initial investigation. In this instance the recommendations in the geotechnical report may not be appropriate and it is strongly recommended WML Consultants be requested to inspect the different conditions, review the initial report and provide follow-up advice. Unless specifically allowed for in the brief, the follow-up review will attract an additional fee.

EXECUTIVE SUMMARY

It is proposed to duplicate the existing section of Bussell Highway between Capel and Busselton in Western Australia so that both directions of traffic will be dual lane. Currently the highway comprises a single lane in two directions with a number of short overtaking lanes along the route.

A geotechnical investigation was undertaken by WML Consultants along the proposed centreline of the new alignment (35m offset from the existing edgeline). Geotechnical information is already available for a portion of the highway. This report presents the findings of the investigation approximately 12km in length between SLK 32 and 44 (Hutton Rd to Sabina River). The objectives were to describe the sub-surface profile at regular chainage increments so that geotechnical information is available at the proposed subgrade level. The investigation excluded proposed bridge sites, which were to be done by others.

The fieldwork was carried out between 12 and 22 April 2016 by two geotechnical engineers from WML. The fieldwork consisted of:

- 25 Electric Friction Cone Penetrometer Tests (EFCPT) at 22 locations, typically 5m depth. Occasional early refusal was encountered.
- 67 hand-augered boreholes (HA), typically to 2m depth but was extended up to 4m in locations where extensive cut was required to reach the proposed subgrade level. This included in-situ density and strength testing.
- 11 groundwater Monitoring Wells (MW), installation varied between 1.9m – 6.1m depth.

Areas over the route have been mined and rehabilitated by Iluka Resources Limited (Iluka) and Cristal at locations CH31200, CH32100 – CH33200 and CH34600 – CH41000 (these are lease areas only, actual disturbances within these areas is unclear).

The sub-surface profile generally comprised undulating sand dunes to the northern third of the route that transitioned to gentle, more low-lying topography and consistent soil profiles. The southern third was more variable with occasional clayey sands at depth. The majority of the boreholes comprised:

1. Orange (occasionally pale grey overlying), fine to medium grained, medium dense occasionally loose, **SAND** with a trace of silt. (Bassendean Sand), overlying
2. Occasionally dark red mottled brown, very dense, variably iron-cemented sand, **GRAVEL** (Coffee Rock) at variable depths. Often causing refusal with a hand-auger. Occasionally fine to coarse gravel within the sand matrix of the above layer.

Most areas are suitable for pavement construction, however compaction of near surface loose sands appeared to be the most common issue requiring remediation. Some localised areas will require excavation and replacement techniques.

Groundwater was present during the investigation in a number of boreholes, typically 2-3m below the surface. These levels were monitored with temporary monitoring wells that were installed over the route. The majority of the drains contain flowing water throughout winter resulting in groundwater typically within 1m of the surface.

CONTENTS

1 INTRODUCTION 5

2 SITE SETTING 6

2.1 Site Location and Description 6
2.2 Geology 7
2.3 Hydrology & Hydrogeology 9
2.4 Mining Rehabilitation Areas 9

3 GROUND INVESTIGATION 10

3.1 Service Location 10
3.2 Fieldwork 10
3.3 Groundwater Monitoring Wells 11

4 LABORATORY TESTING 12

4.1 Geotechnical Testing 12
4.2 Acid Sulphate Soils (ASS) 14

5 FINDINGS OF INVESTIGATION 16

5.1 Soil Types 16
5.2 Coffee Rock 18
5.3 Electric Friction Cone Penetrometer Testing (EFCPT) 19
5.4 Groundwater 20

6 RECOMMENDATIONS 22

6.1 Summary 22
6.2 Unsuitable Subgrade Material 22
6.3 Culvert Bearing Capacity 23
6.4 Design Subgrade CBR 24
6.5 ASS 24
6.6 Site Preparation 24
6.7 Safety in Design 25

7 REFERENCES 26

FIGURES

DRAWINGS

APPENDIX A

Borehole Logs

APPENDIX B

EFCPT Results

APPENDIX C

LABORATORY TEST RESULTS

APPENDIX D

SAND MINING AREAS

APPENDIX E

ASS RISK MAPS

1 INTRODUCTION

It is proposed to duplicate the existing section of Bussell Highway between Capel and Busselton in Western Australia so that both directions of traffic will be dual lane. This is over an approximate length of 18km between Straight Line Kilometre (SLK) 26.2 and SLK 44.0. Currently the highway comprises a single lane in two directions with a number of short overtaking lanes along the route.

WML Consultants (WML) was engaged by BG & E on behalf of Main Roads Western Australia (MRWA) to carry out a geotechnical investigation along the proposed route. Geotechnical information is already available for a portion of the highway. This report presents the findings of the investigation approximately 12km in length between SLK 32 and 44 (Hutton Rd to Sabina River), with information to be used for design and tender purposes. For the purposes of this report, locations will be referred to in chainages (CH) based on the concept design (WML, April 2016), however they closely relate to the SLK to within typically 50m.

The objectives for the investigation are summarised below:

- To investigate along the proposed centerline of the new alignment (35m offset from the existing edgeline). The investigation was to exclude bridge sites and their immediate approaches, which were to be done by others. These sites included CH34550 Ludlow River, CH41250 (Bridge 1368 - Wonnerup South Rd) and CH43550 (Bridge 1369 - Sabina River).
- To describe the sub-surface profile at regular chainage increments so that geotechnical information is available on the proposed subgrade level.
- To collect and submit representative samples to a materials laboratory (NATA accredited) for testing.
- To undertake Electric Friction Cone Penetrometer Tests (EFCPT) at regular chainage increments to a nominal depth of 5m. These are to be focused generally on existing culvert locations with the intention future culverts will be required at these positions. Information for the proposed foundations and construction of the culverts will be required.
- To undertake Acid Sulphate Soil (ASS) sampling and testing at culvert locations where excavation is highly likely for foundation preparation.
- To install of a number of temporary groundwater Monitoring Wells (MW) along the route to gain additional short-term groundwater data leading up to construction.

2 SITE SETTING

2.1 Site Location and Description

Capel is located approximately 212km south of Perth in Western Australia. Bussell Highway is the most direct link from Capel to Busselton, a further 26km from the town centre. Currently the highway between Capel and Busselton mostly comprises a single lane in two directions with a number of short overtaking lanes along the route and a short length of dual carriageway.

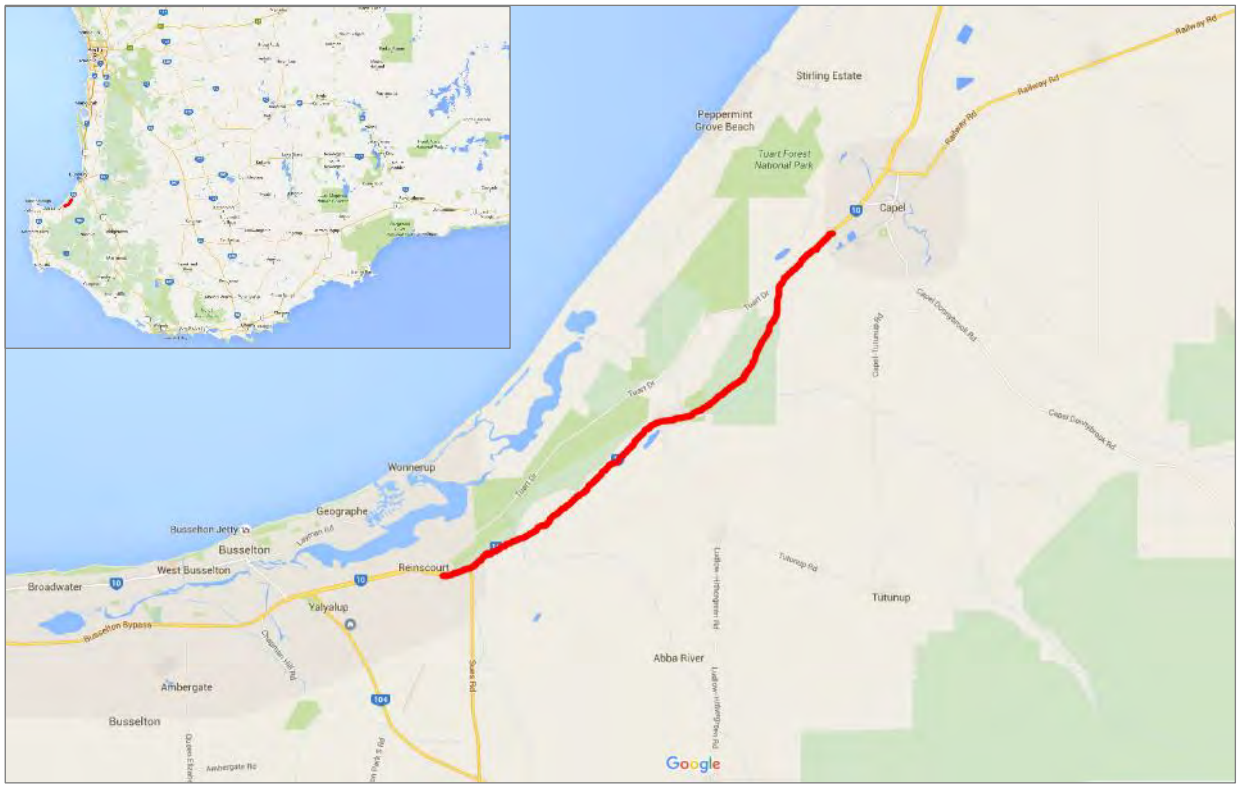


Figure 1: Site Location between Busselton and Capel, Western Australia (Google Maps)

2.2 Geology

The general geology of the site is described on the Geological Survey of Western Australia 1:50,000 Environmental Geology Series map of Capel and Busselton (1987). The local geology comprises mainly of the following map units: SAND (S_8), SAND (S_7), rehabilitated Mine Site, Sandy SILT (Ms_2) and alluvial deposits such as silty SANDS (Sm_1) and clayey SANDS (Msc_1) at the Ludlow, Abba and Sabina River Bridge sites. The existing highway and proposed alignment generally follows the Bassendean Sand ridge which has been mined and rehabilitated.

Areas of alluvium are confined to the rivers and bridge sites, however between Sues Rd and Wonnerup South Rd there are also small 'marsh' areas comprising Peaty Clay (Cps_1). This was consistent with hand-augers CH41665 and CH41900.

Map Key	Description	Origin
S_7	SAND – pale and olive-yellow, medium to coarse-grained, sub-angular quartz, moderately sorted, of residual origin modified by marine inundation.	Sand derived from Tamala Limestone
S_8	SAND – very light grey at surface, yellow at depth, fine to medium grained sub-rounded quartz, local concentrations of heavy minerals, local development of coffee rock, moderately well sorted	Bassendean Sand
Ms_2	SANDY SILT – strong brown to mid-grey, mottled, blocky, disseminated fine sand, hard when dry, of alluvial origin.	Guildford Formation
Sm_1	SILTY SAND – strong brown, fine to medium-grained, quartz, variable silt content	Alluvium
Msc_1	CLAYEY SANDY SILT – pale brown, angular to rounded sand, low cohesion, of alluvial origin	Alluvium
Cps_1	PEATY CLAY – dark grey and soft, variable organic content, variable quartz sand content, of lacustrine origin dark grey and soft, variable organic	Swamp Deposits
	Rehabilitated mine site	

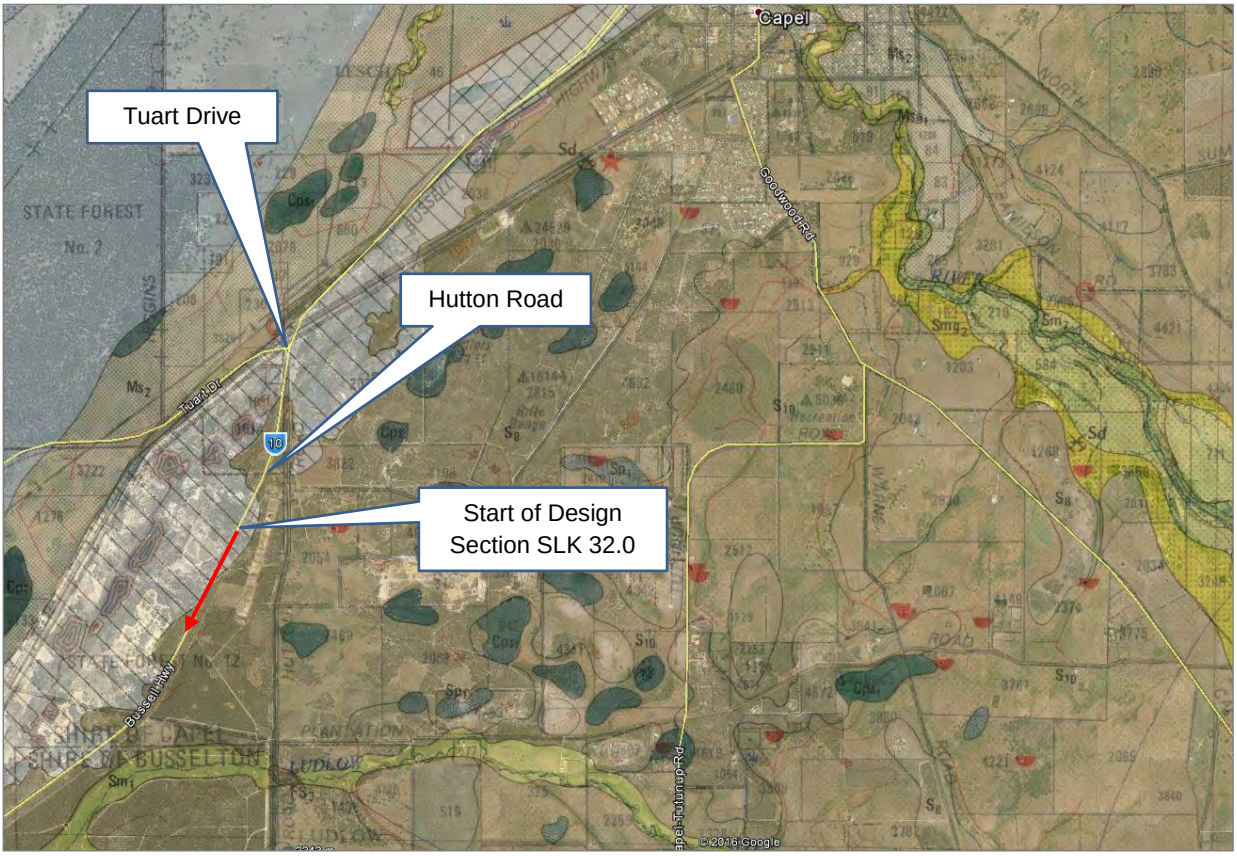


Figure 2: Geological Map 'Capel' overlayed onto Google Earth

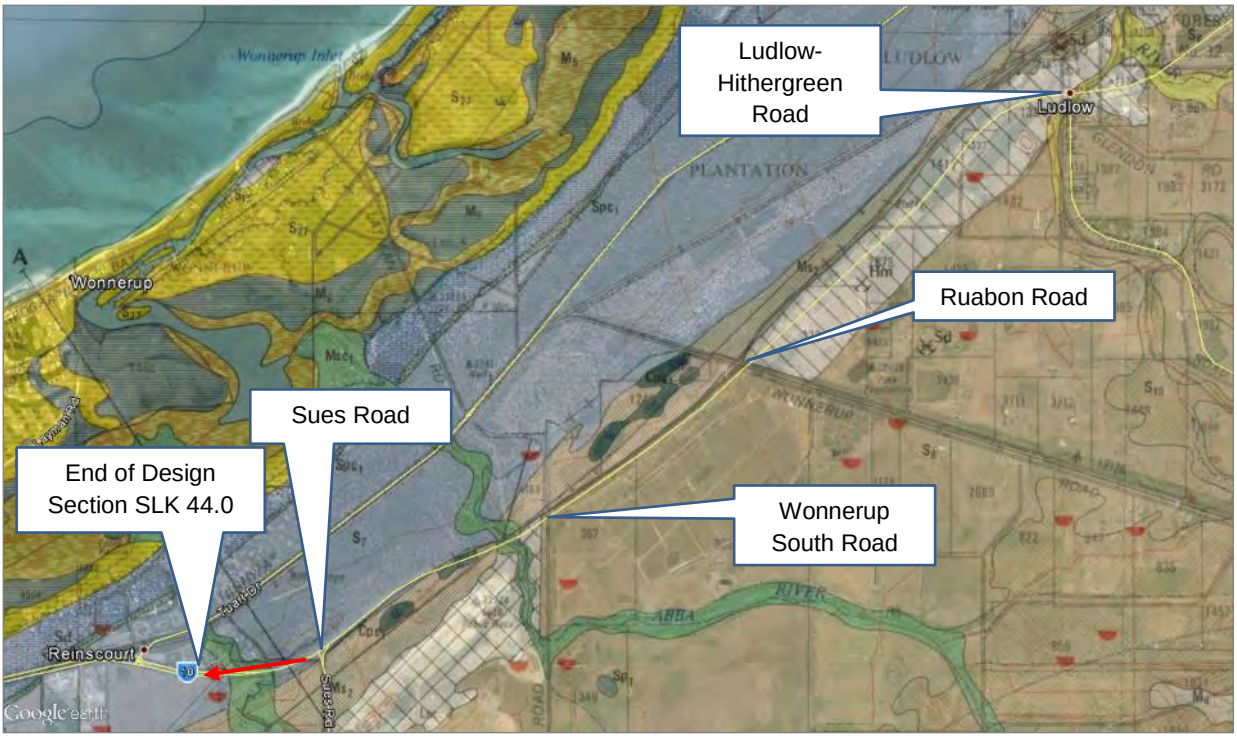


Figure 3: Geological Map 'Busselton' overlayed onto Google Earth

2.3 Hydrology & Hydrogeology

The land generally falls to the north west and is drained by the Ludlow, Abba and Sabina Rivers into the Wonnerup Estuary and adjacent wetlands. Except on the higher Bassendean dunes and deep sand mine site rehabilitation, the flat terrain and high water table causes the area to be prone to flooding and waterlogging in winter.

2.4 Mining Rehabilitation Areas

The geological maps indicate areas that have been mined and rehabilitated by Iluka Resources Limited (Iluka) and Cristal (Figures 2 and 3). Not included on the maps is an area between Ruabon Rd and Wonnerup South Rd which was described in Iluka's Annual Environmental Report South Capel (2011). The Busselton Geological map also indicates mining activity occurring on Bussell Hwy south-west of the intersection with Wonnerup South Rd, however based on an environmental application by Cristal summarising the current mined areas (Appendix D), no mining activity was undertaken in or near the road reserve.

The following range of chainages are within the mining operations disturbance footprint, please note these are lease areas only, actual disturbances within these areas is unclear:

- CH31200
- CH32100 – CH33200
    - Evidence of tailings deposits on the surface were found in the borehole logs at CH32900 and CH33020
- CH34600 – CH41000

3 GROUND INVESTIGATION

3.1 Service Location

Separate and prior to the investigation, Cables Locates were engaged to physically locate and mark the underground services along the road reserve between Capel and Sabina. These markers were then picked up by a surveyor. Additionally, a “Dial before You Dig” search for services was carried out before any excavation occurred and drawings were on-site at all times.

Generally, little to no underground services on the southern/eastern side of Bussell Hwy (proposed centerline) were present apart from the occasional cross-over point. All services were easily visible from the potholing by Cable Locates and the fieldwork remained at an appropriate distance.

3.2 Fieldwork

The fieldwork was carried out between 12 and 22 April 2016 by two geotechnical engineers from WML. The fieldwork consisted of:

- 25 Electric Friction Cone Penetrometer Tests (EFCPT) at 22 locations, typically 5m depth. Occasional early refusal was encountered.
- 67 hand-augered boreholes (HA), typically to 2m depth but was extended up to 4m in locations where excessive cut was required to reach the proposed subgrade level.
- 55 Perth Sand Penetrometer tests (PSP) to 1m depth
- 9 in-situ hand Shear Vane tests (SV)
- 11 groundwater Monitoring Wells (MW), installation varied between 1.9m – 6.1m depth

On the northern section of the job, between CH31000 and CH34000, access with a machine (EFCPT rig or excavator) was extremely difficult without extensive clearing of vegetation being undertaken first. These locations were undertaken with a hand-auger or were re-located closer to the existing highway. Some locations also had steep (1V:3H) embankments up to 4m high adjacent to the existing highway.

The sampling of representative materials, GPS location and photographs were also taken of the test sites. All EFCPT’s were undertaken by Probedrill Pty Ltd using a 22 tonne 6 Wheel-Drive truck rig (Merc). All hand-augers were undertaken using a 110mm diameter sand auger with extension rods to allow up to 4m depth. The locations of the EFCPT’s, boreholes and monitoring wells are shown on a series of Drawings 6897-G-100 to 6897-G-105. The borehole logs and EFCPT results are presented in Appendix A and B respectively.

3.3 Groundwater Monitoring Wells

Using the borehole left open from the EFCPT, a slotted 20mm PVC pipe was inserted as deep as possible for use as a temporary monitoring well. The target depth was 5m however shallow groundwater or dry sand sometimes collapsed the open borehole before allowing the full depth well to be placed. The stick-up of the pipe was generally cut off level with the ground and a small green garden cover placed over the top. No bentonite sealing or backfilling was undertaken.

Table 1: Summary of Monitoring Wells Installed

Chainage	MGA Easting	MGA Northing	Estimated* Ground RL (m)	Base Depth (m)	Stick-up (m)	Position Base/Crest of Drain
31540	362466	6281892	14.10	1.8	0.7	base
32760	361827	6280876	16.80	2.54	1.0	base
34315	360578	6279945	12.50	3.2	0	base
35225	359758	6279616	11.50	1.2	0	crest
36555	358660	6278988	13.30	6.1	0	crest
37810	357794	6278080	11.20	3	0	base
38730	357129	6277444	9.50	4.05	0	crest
40225	355976	6276504	9.00	3.7	0	crest
41660	354761	6275752	7.25	4.1	0	crest
43285	353401	6274887	5.75	1.6	0.9	base
43755	352945	6274795	4.75	2.4	0	base

* Levels estimated from supplied survey

4 LABORATORY TESTING

4.1 Geotechnical Testing

Selected soil samples collected during the investigation were sent to Civitest Australia, a NATA accredited laboratory in Bunbury, WA for geotechnical classification testing purposes. The following tests were requested for various samples:

- 31 tests - Particle Size Distribution (PSD) and Plasticity Index (PI) with Linear Shrinkage (LS) undertaken to MRWA Specification.
- 9 tests - California Bearing Ratio (CBR) with 6x2.25kg plates of surcharge (Engineering Road Note 9 guide for a 300mm thick pavement) including a Maximum Modified Dry Density (MMDD) to 95%.

A summary of the test results are presented below with the certificates attached in Appendix C.

Table 2: Laboratory Test Results Summary

Chainage	Sample Depth (m)	MDD (t/m^3)	OMC (%)	CBR (%)	Fines <75µm	Sand 75µm-2.36mm	Gravel >2.36mm	LL (%)	PL (%)	PI (%)	LS (%)
31200	0.1-0.4				1	99	0	NO	NP	0	0
31740	0.2-0.4				1	99	0	NO	NP	0	0
32000	1.0-1.3	1.811	13.2	35	3	97	0	NO	NP	0	0
32500	2.6-2.9	1.765	13	35	5	95	0	NO	NP	0	0
32600	2.3-2.6				18	73	9	NO	NP	0	0.8
32900	0.1-0.5				97	3	0	63.9	27.2	36.7	11
33200	3.8-4.0				8	91	1	NO	NP	0	0
33200	2.3-2.5				1	99	0	NO	NP	0	0
33320	3.7-4.0	1.881	10.8	45	8	91	1	NO	NP	0	0
33600	1.3-1.6	1.76	12.7	40	3	97	0	NO	NP	0	0
33800	1.5-1.8				6	94	0	NO	NP	0	0
34315	0.3-0.6				3	97	0	NO	NP	0	0
35070	0.1-0.5	1.699	16	25	1	99	0	NO	NP	0	0
36100	0.3-0.5				1	99	0	NO	NP	0	0
36230	0.3-0.5	1.723	14.6	25	1	99	0	NO	NP	0	0
36550	0.7-1.0				2	97	1	NO	NP	0	0
37300	0.5-0.8				1	99	0	NO	NP	0	0
38080	0.3-0.5	1.722	13.6	25	1	99	0	NO	NP	0	0
38735	0.3-0.5				2	98	0	NO	NP	0	0
39360	0.2-0.4				1	99	0	NO	NP	0	0
39880	0.2-0.5				2	98	0	NO	NP	0	0
41000	0.3-0.5	1.96	10.5	40	9	74	17	NO	NP	0	0
41100	0.3-0.5				9	91	0	NO	NP	0	0
41370	0.3-0.5	1.662	11.4	30	2	98	0	NO	NP	0	0
41900	0.2-0.4				48	52	0	71.5	19.2	52.3	15.2
42800	0.4-0.6				2	98	0	NO	NP	0	0
43275	0.2-0.5				3	97	0	NO	NP	0	0
43500	0.2-0.4				2	98	0	NO	NP	0	0
43500	0.7-0.9				4	96	0	NO	NP	0	0
43620	0.4-0.6				3	97	0	NO	NP	0	0
43755	0.3-0.5				13	85	2	NO	NP	0	0

4.2 Acid Sulphate Soils (ASS)

Hand-augers undertaken at the base of a drain or at potential culvert locations, had samples collected for ASS testing. The use of 'Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes, June 2015' prepared by the Department of Environmental Regulation as a guideline was followed. The ASS Risk Maps are presented in Appendix E.

Samples were collected at 0.25m intervals to a depth of 1.5m in plastic zip-lock bags. The air was squeezed out from inside and then immediately placed on ice in an esky. The samples were frozen at the end of the day. All samples were then sent to South West Chemical Services (SWCS) for preliminary ASS testing. Based on the Field Test results, select samples were sent to MPL Laboratories in Perth for SPOCAS testing in accordance with NATA accreditation No. 2901.

The following tests were requested:

- 121 tests at 22 locations – ASS Field test, assessed against:
  - $pH_f < 4$
  - $pH_{fox} < 3$
  - the change in pH was > 2 (where the resultant pH_{fox} was < 3)
  - strong reaction following the addition of hydrogen peroxide
- 7 tests at 6 locations – ASS SPOCAS test, assessed against:
  - QASSIT "Acid Sulphate Soils Laboratory Methods Guidelines" 2004 AE McInea and CR Ahem.

Samples have been oven-dried and remain at the laboratory should further analysis be required. The certificates attached in Appendix C. A summary is presented below where positive results were recorded for Field Tests, and the guidelines were exceeded for the SPOCAS tests (yellow highlight indicates criteria exceedance):

Table 3: Summary of ASS Field Tests with a positive result

Chainage	Depth (m)	Description	pH_f	pH_{fox}	pH_f - pH_{fox}	Reaction	Fizz Test
35235	0.50	Brown/grey sand f-m grained	5.70	2.40	3.30	L	None
35235	0.75	White coarse sand wet	5.65	**2.15**	**3.50**	N	None
35235	1.00	White coarse sand wet	5.70	**2.65**	**3.05**	N	None
35235	1.25	White coarse sand wet	5.80	**2.80**	**3.00**	N	None
38830	1.25	Dark grey/brown clayey sand	7.40	3.55	**3.85**	M	None
39880	1.50	Yellow sand f-m grained wet some black organics	6.80	3.65	**3.15**	N	None
41670	0.25	Grey crumbly clay + white grains	8.30	8.15	0.15	**X-V**	XX
41670	0.50	Light yellow/grey crumbly clay + coarse white grains	8.50	8.50	0.00	**X-V**	XXX
41670	0.75	Light yellow/grey crumbly clay + coarse white grains	8.75	8.85	-0.10	**X-V**	XXX

Reaction Rating: N = none; L = low; M = medium; H = high; X = extreme; V = volcanic

Table 4: Summary of ASS SPOCAS Tests with a positive result

Analyte	Units	CH41670 0.5m
Acidity – Excess Acid Neutralising Capacity (ANC)	Mole H+/t	51
Sulfidic – Excess Acid Neutralising Capacity (ANC)	%S	16
Net Acidity, excluding ANC	Mole H+/t	**38**
Net Acidity, excluding ANC	%S	**0.061**
Liming Rate, excluding ANC	Kg $CaCO_3$/t	**2.9**

5 FINDINGS OF INVESTIGATION

5.1 Soil Types

The soil profile over the length of the job was reasonably consistent and has been summarised below in common sections. Minor variations exist within a number of boreholes such as occurrence of gravel, occasional clay bands or presence of coffee rock. Depths of topsoil generally ranged between 50mm to 300mm with the presence of roots generally occurring deeper in the profile at the northern end of the route where dense vegetation was present. The presence of coffee rock was present throughout the entire length of the route.

5.1.1 CH31400 – CH31850

Generally a lower lying area, with dense vegetation. The test location for CH31540 at a culvert was offset only 15m from the existing edge line, also targeting the base of the drain.

1. Moist, dark grey, fine to medium grained, **silty SAND** with some fine to medium roots. (Topsoil), overlying
2. Moist, pale grey, fine to medium grained, loose to medium dense, **SAND** with a trace of silt. (Bassendean Sand), overlying
3. Occasionally dark red mottled brown, very dense, variably iron-cemented sand, **GRAVEL** at variable depths. Occasionally fine to coarse gravel within the sand matrix of the above layer. (Coffee Rock)

5.1.2 CH32000 – CH35070

Generally comprised undulating high dunes and embankments adjacent to the existing highway. Dense vegetation and steep slopes limited machine access in many locations.

1. Moist, brown, fine to medium grained, **SAND** with some silt and a trace to some fine to medium roots. (Topsoil), overlying
2. Moist, orange (occasionally pale grey overlying), fine to medium grained, medium dense occasionally loose, **SAND** with a trace of silt. (Bassendean Sand), overlying
3. Occasionally dark red mottled brown, very dense, variably iron-cemented sand, **GRAVEL** at variable depths. Occasionally fine to coarse gravel within the sand matrix of the above layer. (Coffee Rock)

Evidence was found of tailings deposits on the surface of CH32900 and CH33020 to 1m and 0.5m depth respectively. This material comprised a highly plastic, brown, very stiff, CLAY which is consistent with tailings and the extent is confirmed by the Geological Map ‘Capel’.

A hand-auger was undertaken at CH34600 on the southern side of Ludlow Bridge, the approach possibly comprised a laydown pad approximately 80m in length and 20m in width adjacent to the existing shoulder embankment, for possible previous bridgeworks. Evidence as fill was clear as limestone base course was used with a compacted dense sand with traces of bluemetal gravel throughout. The underlying natural material comprised a pale brown mottled brown, fine grained, stiff, **sandy CLAY** with a layer of geotextile placed at the interface. An additional borehole, CH34615 was undertaken in the low-lying area further to the south adjacent to the fill and confirmed the soil profile. Shear vane readings indicate the in-situ undrained shear strength is at least 90kPa.

5.1.3 CH35235 – CH35800

Variably sand to gravel conditions.

5.1.4 CH36100 – CH40850

This section was the most consistent. This section also falls within the mined areas.

1. Moist, brown, fine to medium grained, **SAND** with some silt and a trace to some grass roots. (Topsoil), overlying
2. Moist, yellow-brown, fine to medium grained, medium dense occasionally loose, **SAND** with a trace of silt. (Bassendean Sands, possibly reworked from mining activities)

CH39510 undertaken at a culvert location comprised a yellow tending brown, fine to medium grained, medium dense, **SAND** over its length. However, at 0.9m depth, a 150mm thick layer of wet, brown, very soft, **CLAY** was present. It was highly plastic yet quite difficult to roll in the hand as it contained almost no shear strength or ability to hold it's own shape. The clay was saturated as the groundwater was present and level with the layer. A similar clay band was found in CH38950, CH39880 and CH41370, however as groundwater was at a lower level they weren't as soft.

5.1.5 CH41000 – CH43755

1. Moist, brown, fine to medium grained, **SAND** with some silt and a trace to some grass roots. (Topsoil), overlying
2. Moist, brown to grey, fine to medium grained, medium dense occasionally loose, **SAND** with a trace of silt to some silt, overlying
3. Moist, brown mottled orange, stiff to very stiff / medium dense, fine to medium grained, **clayey SAND / sandy CLAY**, overlying
4. Occasionally dark red mottled brown, very dense, variably iron-cemented sand, **GRAVEL** at variable depths. Occasionally fine to coarse gravel within the sand matrix of the above layer. (Coffee Rock)

CH40665 and CH41900 were consistent with geological map comprising alluvium of highly plastic, firm, **CLAY** with eventual refusal upon limestone cobbles at 0.8m depth.

5.2 Coffee Rock

Locations are listed below that contained some form of iron-cemented layer or coffee rock, whether it be weakly cemented or just contain some gravel sized particles within a sand matrix:

Table 5: Locations and depths where iron-cementing was observed

Chainage	Depth (m)	Chainage	Depth (m)	Chainage	Depth (m)
31400	0.8-1.0	34000	1.5-2.0	40230	0.0-1.1
31540	0.4-2.0	34200	1.3-2.0	40850	0.5
31740	1.7-1.9	34315	1.9-2.0	41100	0.9-1.3
32200	1.6-1.9	34900	1.9	41370	1.5
32300	1.4-1.6	35235	0.0-0.4	42500	1.2-1.5
32400	1.2-1.6	35620	0.1-0.4; 1.8	42800	1.4-1.9
32500	3.5-3.9	35800	1.2-1.8	43085	0.2-1.1
32600	0.9-2.5	38950	0.9-1.0	43275	1.8-2.0
33600	2.3-3.0	39360	1.3-1.6	43400	1.1-1.8
33800	2.1-2.6	39880	1.6-1.8	43500	1.0-1.5

Of these locations, refusal on at least moderately cemented coffee rock / gravel with a hand-auger is also listed below:

Table 6: Locations and depths of Refusal with a hand-auger on Coffee Rock (or limestone)

Chainage	Depth (m)	Chainage	Depth (m)	Chainage	Depth (m)
31400	1.0	34315	2.0	41370	1.5
31740	1.9	34900	1.9	41670	0.8
32200	1.9	35620	1.8		(Limestone)
32300	1.6	39880	1.8	41900	0.8
32500	3.9	40230	0.0*		(Limestone)
32600	2.5	40850	0.5		
33800	2.6	41100	1.3		

*Note *: Hand-auger refused upon multiple attempts at 0.0m depth, however one attempt was able to achieve 1.1m depth, which has been logged accordingly*

5.3 Electric Friction Cone Penetrometer Testing (EFCPT)

At each of the culvert locations (due to access issues, CH31880 and CH32760 were not undertaken), an EFCPT was undertaken to a target depth of 5m. Where possible, the test was undertaken at the base of the drainage path so as to increase the likelihood of observing potential soft/loose material. All other positions were undertaken at the crest of the drain.

The following table identifies EFCPT's with any readings in sand with a q_c tip resistance below 5MPa, clayey material with a q_c below 1MPa and where refusal occurred. This table does not include loose sand conditions on the surface that frequently occurred to approximately 0.5m depth.

Table 7: EFCPT results where loose sands, soft clays and refusal occurred

Chainage	Depth (m)	Comment
32300	0.0-1.6	Loose sand
35620	1.9	Refusal 100MPa
	1.3	Refusal 100MPa
36230	4.2	Refusal 100MPa
36555	4.8-5.4	Loose sand
	5.4-5.6	Soft clay
37970	4.7-4.8	Soft clay
38400	2.7-3.8	Loose sand
	3.9-4.0	Soft clay
38730	3.6-3.7	Soft clay
38950	2.5-2.9	Loose sand
	2.9-3.5	200mm bands of soft clay
39500	1.7	Refusal 100MPa
	1.8	Refusal 100MPa
40225	2.1-2.2	Soft clay
40850	1.3	Refusal 100MPa
	3.4	Refusal 100MPa
41660	0.0-0.5	Soft clay
	2.6-2.7	Soft clay
43275	0.0-1.8	Loose sand
43755	2.5-3.5	Loose sand

Where locations refused with the EFCPT test, refusal was also encountered with a hand-auger. At CH39510 the hand-auger refused at 1.7m on what was possibly a large root, however the EFCPT also refused nearby at a similar depth. It is most likely that the root was in fact coffee rock.

5.4 Groundwater

Groundwater was observed occasionally in hand-augers and monitoring wells over the route. The Bureau of Meteorology (BOM) states the 2016 rainfall to the date of fieldwork (22 April 2016) for the year for Busselton is 128mm. Whilst at this point in the year there have been a number of rainfall events, the groundwater would still be near it's seasonal low. The following table lists the locations and depths of groundwater observed during the investigation:

Table 8: Locations of observed groundwater during fieldwork (22 April 2016)

Chainage	Depth (m)	RL (m)	Chainage	Depth (m)	RL (m)	Chainage	Depth (m)	RL (m)
31540	1.50	12.60	36555	5.48	7.82	39510	1.18	7.72
32760	>2.54	<14.26	37820	1.50	9.50	39880	1.23	7.67
34315	2.92	9.58	37970	2.05	9.7	40225	1.42	7.58
34615	0.70	10.40	38400	1.95	8.45	40230	0.30	7.45
34900	1.70	11.00	38735	2.00	7.50	40850	1.3	7.45
35070	1.95	10.85	38740	1.10	7.70	41660	2.74	4.51
35235	0.15	10.25	38830	1.76	6.64	43285	0.40	5.15
35620	1.50	9.80	38950	2.00	7.40	43755	2.27	2.48
36230	3.8	8.60	39360	1.80	7.70			

The only surface water, flowing or stagnant, observed during the investigation was at a culvert at CH40230. Following the last water reading (16 August 2016), all drains and culverts are flowing or have water pooling at their base except for CH32760 and CH34315.

Figure 4 below shows readings from monitoring wells over the route between April and August 2016. Figure 5 compares the rainfall received for 2016 against the mean rainfall for three BoM weather stations Capel North, Ludlow and Busselton Airport. This has been an above average winter for 2016 so far. This has been the highest rainfall on record (dating back to 1985) for Ludlow during July.

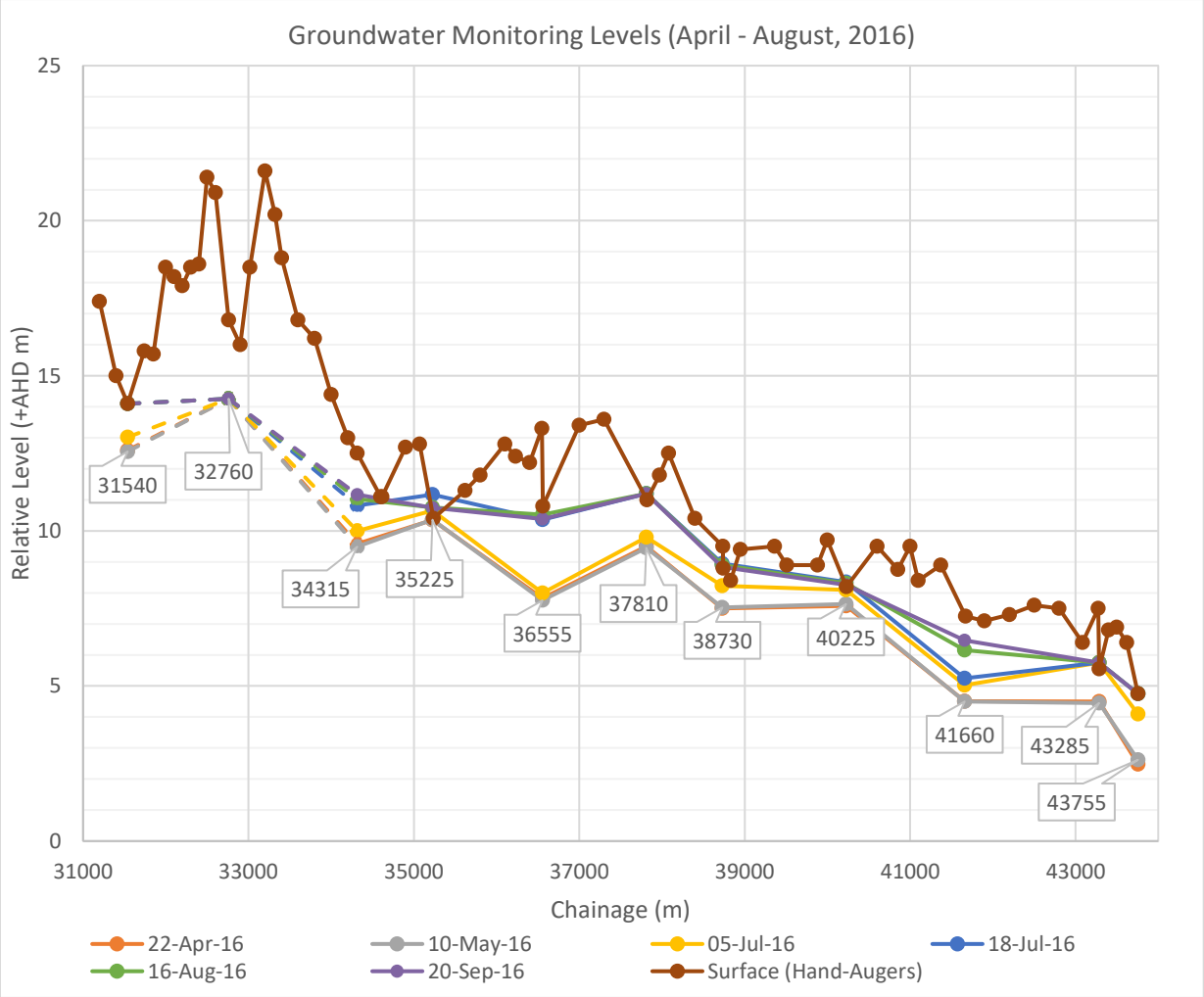


Figure 4: Groundwater Levels from MW (dashed line at CH32760 indicates dry reading to depth)

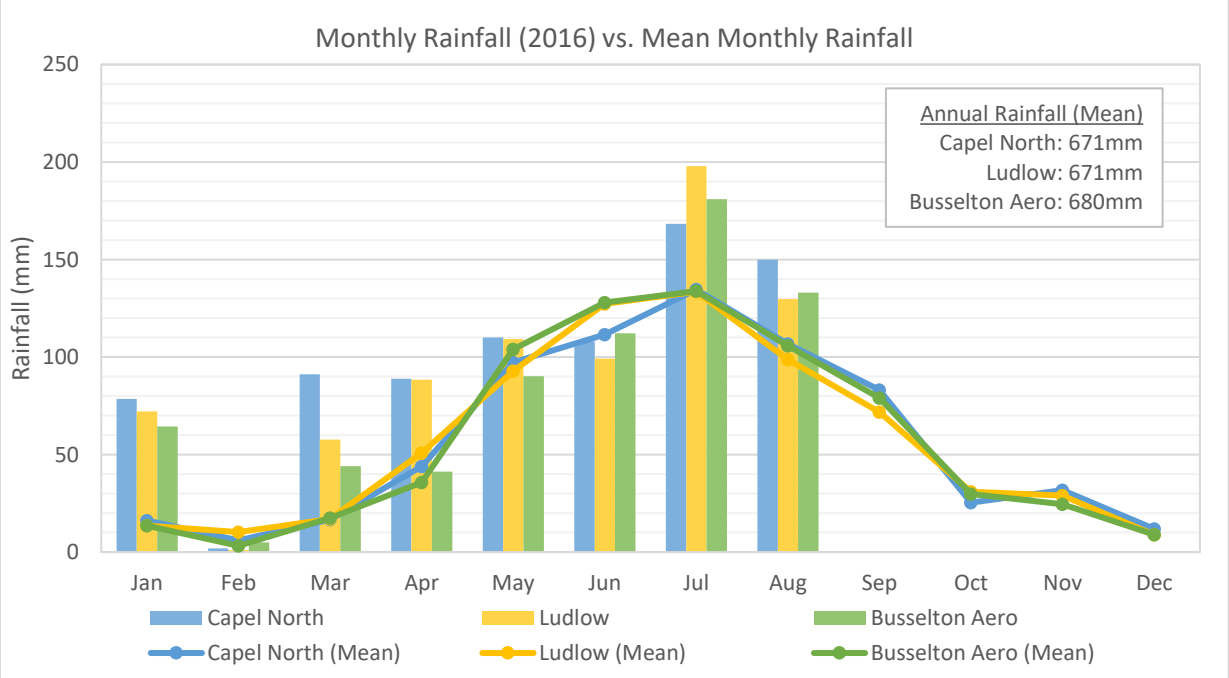


Figure 5: Rainfall Data from three nearest stations (BoM)

6 RECOMMENDATIONS

6.1 Summary

The sub-surface profile generally comprised undulating sand dunes to the northern third of the route that transitioned to gentle, more low-lying topography and consistent soil profiles. The southern third was more variable with occasional clayey sands at depth. The majority of the boreholes comprised:

1. Orange (occasionally pale grey overlying), fine to medium grained, medium dense occasionally loose, **SAND** with a trace of silt. (Bassendean Sand), overlying
2. Occasionally dark red mottled brown, very dense, variably iron-cemented sand, **GRAVEL** (Coffee Rock) at variable depths. Often causing refusal with a hand-auger. Occasionally fine to coarse gravel within the sand matrix of the above layer.

Most areas are suitable for pavement construction, however compaction of near surface loose sands appeared to be the most common issue requiring remediation. Some localised areas will require excavation and replacement techniques.

Groundwater was present during the investigation in a number of boreholes, typically 2-3m below the surface. These levels were monitored with temporary monitoring wells that were installed over the route. The majority of the drains contain flowing water throughout winter resulting in groundwater typically within 1m of the surface.

6.2 Unsuitable Subgrade Material

The following material types and areas have been identified having the potential to cause subgrade strength and settlement issues for the proposed pavement. The recommendations for remediation should be read in conjunction with the section ‘Site Preparation’.

6.2.1 Soft Near Surface Clay

The HA at CH31540 culvert location indicated approximately 0.4m of CLAY bands and SAND with some roots and organics on the surface. The underlying material comprises suitable medium dense tending dense, SAND with some fine to coarse coffee rock gravel. The top 0.4m of the drain area should be excavated and replaced with clean compacted sand fill.

At CH32900 very stiff CLAY to 1.0m was excavated from a low-lying area. At the time of the investigation, the clay remained very stiff and posed no subgrade strength issues. However, this may potentially soften during the winter rains and should be monitored prior to works beginning as it may require excavation if soft or disturbed whilst wet. The surface should be shaped so water cannot pool.

Between CH41500 – CH42100 exists a low-lying area that comprises soft to firm sandy CLAY in the upper 0.8m. Limestone gravel increases in content with depth and eventual refusal on Limestone at 0.8m occurs. The Geological map defines this area quite clearly as ‘Swamp Deposits’ and is consistent with the investigation results. Groundwater is typically 1-2m below the surface however surface water from rainfall pools and does not drain. The upper 0.5m of this material should be excavated and replaced with a material that is non-sensitive to moisture such as limestone.

6.2.2 Loose Near Surface Sand

To reduce the need to excavate and compact back up in layers, Dynamic Compaction may be utilized where loose sands have been identified, ie rollers with high impact energy. Selection of the particular model and methodology should be recommended by the contractor and consider the local ground conditions and limitations. In the event underground services are within the vicinity of the compaction works, an exclusion zone of at least 10m should be maintained so not to cause damage. This work is recommended during summer months only as high groundwater highly influences the effectiveness.

CH31900 – CH32450, PSP and EFCPT testing indicate loose to medium dense sand in the upper 1.0 – 1.5m of the existing surface.

CH34700 – CH35400, PSP testing has low blow counts in the upper 0.8m.

CH43150 – 43550, PSP and EFCPT testing indicate loose sands in at least the upper 1.0m, this includes the upper 1.0m of the base of the drain at CH43285.

6.2.3 Loose Sand / Soft Clay at Depth

Based upon the EFCPT results, in some areas, loose sands were encountered at depth. This was occasionally overlying a thin soft band of clayey material. Considering the thicknesses of the layers and their depths, any resulting settlement will be negligible. No additional remediation beyond typical site preparation is required. The identified areas are listed below for reference.

In the areas defined as having historical mining activity, the sub-surface profile typically comprises yellow sand (no coffee rock), medium dense tending very loose overlying a firm to stiff clay layer, typically at 2.0-4.0m depth. This profile has been identified between CH37800–CH39400, however may begin and end as early as CH36000 – CH39900. At the northern and southern extents, potential evidence of mining excavation only extends to 1.0-2.0m depth as coffee rock remains in place but thin clay bands are present at about 1.0m depth.

Within this potential area, the drain at CH36550 shows loose sand at the base tending medium dense, however at depth, sand tends to loose conditions between 4.9-5.4m depth and overlies soft clay between 5.4-5.6m.

6.3 Culvert Bearing Capacity

Shallow foundation systems comprising slab, pad and strip footings founded in the shallow sand or clayey materials should be able to support the proposed structures, providing site preparation is carried out as described in the section below ‘Site Preparation’. Controlled granular fill material and areas of natural sand that has been compacted in accordance with the ‘Site Preparation’ section may have the following design parameters assigned to them detailed in Table 9.

An allowable bearing pressure of 100 kPa is recommended for foundation design of strip and pad footings. This should ensure that total and differential settlements will be less than 5 mm. It should be noted that the above bearing pressure could be refined and possibly increased once details about the proposed buildings, foundation loads and foundation levels are known.

Table 9: Design parameters for typical remediated natural sand and imported sand fill

Material	Parameter	Value	Unit
SAND, fine to medium grained, medium dense	Angle of Internal Friction, ϕ'	33	degrees
	Bulk Unit Weight, γ	19	kN/m^3
	Cohesion, c	0	kPa

6.4 Design Subgrade CBR

Please refer to WML Report 5619-G-R-001-A-Pavement Design Report dated 8 June 2016.

6.5 ASS

Based on the test results from the investigation, only one sample returned confirmation of ASS. Should any excavation be required for the installation of a culvert at CH35230, it is recommended to undertake ASS remediation measures. No other areas show evidence of ASS or require remediation.

6.6 Site Preparation

Site Preparation shall be undertaken to MRWA Specification 302 – Earthworks in combination with, but not limited to, the following recommendations:

- Topsoil is typically 100mm thick but can occur up to 300mm in some places. Minor quantities of various road-side waste (broken glass etc) exist on the surface which should also be removed.
- The removal of trees shall include the grubbing of their full root system. Where excessive excavation is required to remove the roots, replacement with clean, compacted sand backfill shall occur.
- Compaction compliance and frequency of testing shall be in-line with the MRWA Specification 302 for sands and should achieve:
    - Embankment Foundation 90% (Characteristic Dry Density Ratio)
    - Embankment Construction 95% (Characteristic Dry Density Ratio)
    - Subgrade 96% (Characteristic Dry Density Ratio)
- Additionally, a site calibrated Perth Sand Penetrometer could be used to easily and frequently test compaction as a guide. Testing will be required to increase with depth with each successive 300mm increment to at least 1m depth at all subgrade and layer heights.
- Except on the higher Bassendean dunes and deep sand mine site rehabilitation, the flat terrain and high water table causes the area to be prone to flooding and waterlogging in winter. Works should be delayed to the summer months to allow the groundwater to recede. This will allow for effective site remediation, services and culvert installation. However, some localised areas may still require dewatering in summer (CH35235 and CH40230 as examples). Should groundwater be within 0.5m of the exposed subgrade surface for proof-compaction or subgrade preparation, alternative compaction techniques will be required (such as the high impact energy rolling).

6.7 Safety in Design

This project has design elements, however these elements are considered rudimentary with the associated risks and hazards being widely known and understood. Any competent person carrying out this type of work should be aware of these hazards and apply standard industry practices to mitigate the risks.

7 REFERENCES

1. Geological Series Map 1:50,000 Scale ‘Busselton’ and ‘Capel’
2. Main Roads Western Australia, Procedure for the Design of Road Pavements, Engineering Road Note 9, 2013
3. Main Roads Western Australia, Specification 302 – Earthworks, Issue 07/10/2015
4. Department of Environmental Regulation, Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes, June 2015
5. AS 1726:1993 – Geotechnical Site Investigations

FIGURES

Photo 1: CH31400

Photo 2: CH32000

Photo 3: CH33400

Photo 4: CH34600 geofabric evidence

Photo 5: CH35235

Photo 6: CH32000

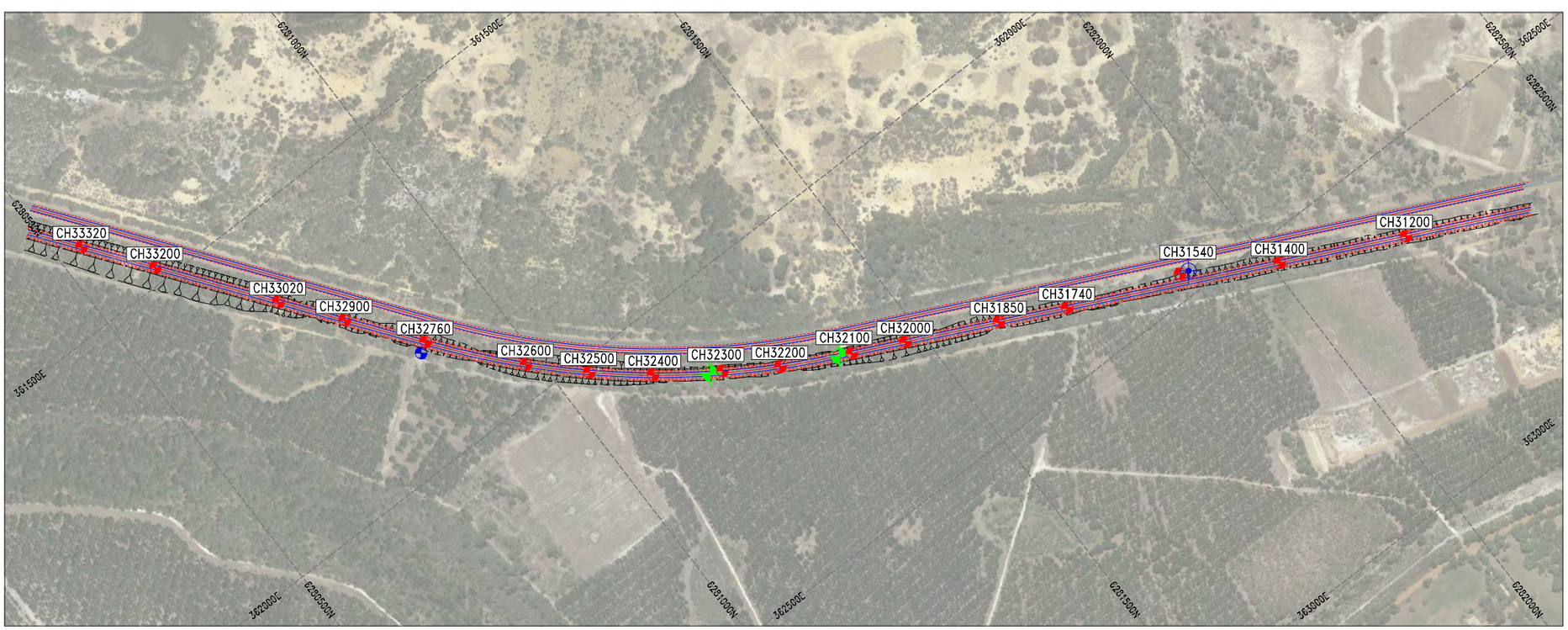
Photo 7: CH36400

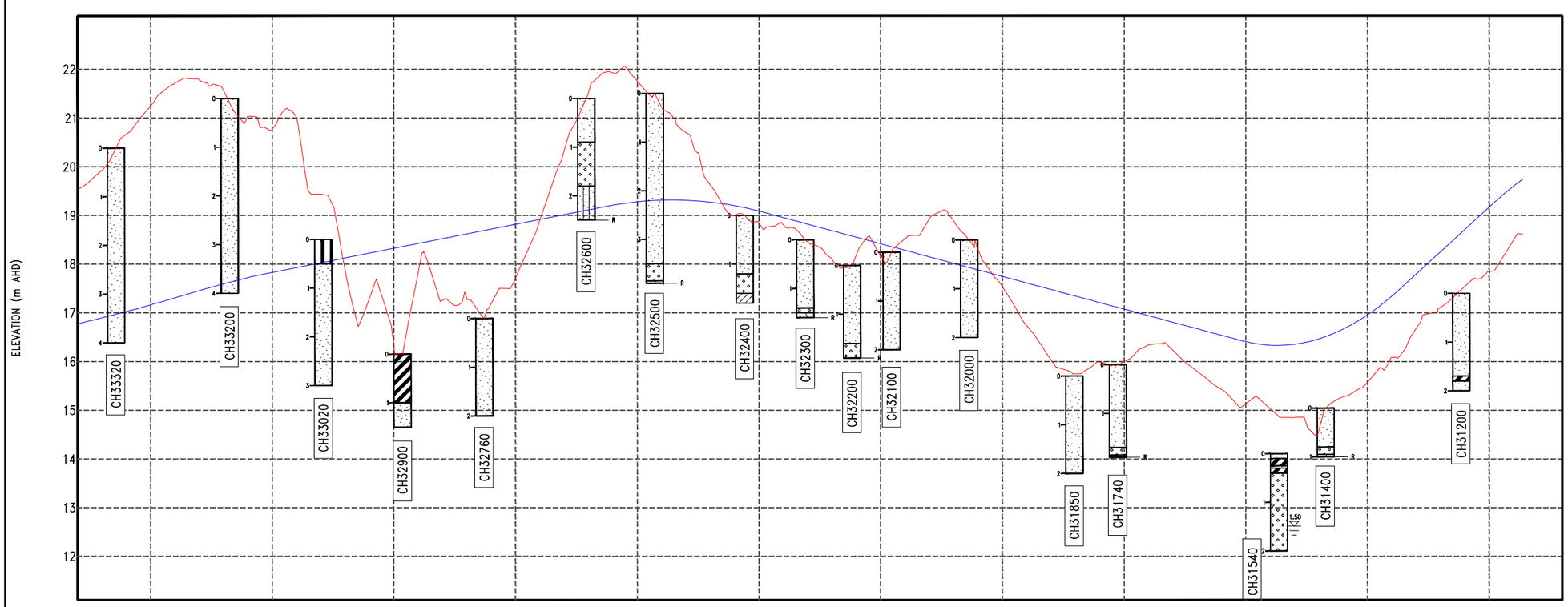
Photo 8: CH39510 soft clay at 1.0m depth

Photo 9: CH41900 limestone gravel entering near base of borehole

Photo 10: CH43400 water added to top material to catch in auger

DRAWINGS





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 471 531 www.wml.com.au
Bunbury - Head Office: 1st Floor 62 Wittenoom St Bunbury WA 6230, PO Box 2023 Bunbury WA 6231, T +61 8 9722 3544
Kalgoorlie: Suite 1, 45 Brookman St Kalgoorlie WA 6430, PO Box 10309 Kalgoorlie WA 6433, T +61 8 9021 1811
Mandurah: Unit 1/19 Breakwater Pde Mandurah WA 6210, PO Box 4348 Mandurah North WA 6210, T +61 418 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE: * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

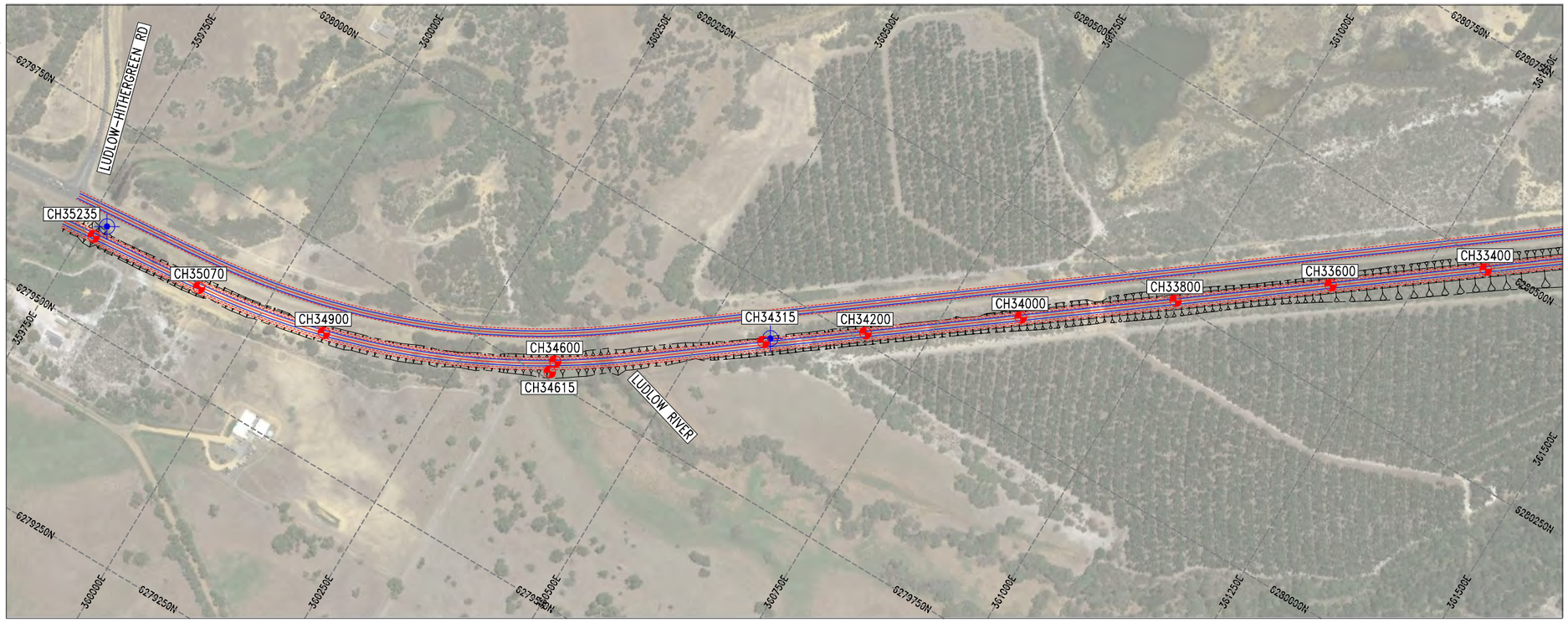
CLIENT: BG&E

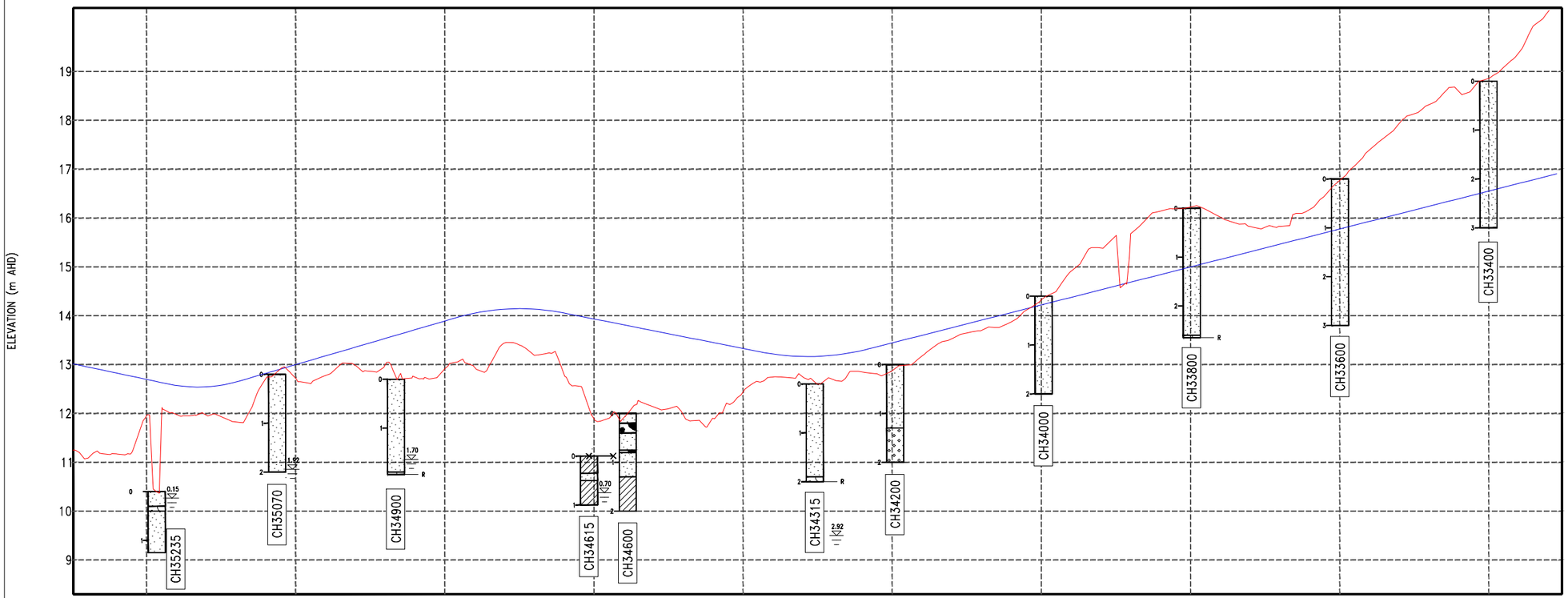
PROJECT: BUSSELL HWY DUPLICATION HUTTON TO SABINA

DRAWING TITLE: GEOTECHNICAL INVESTIGATION FENCE DIAGRAM CH 31200 - 33320

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 6897-G-100 REVISION: B





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 473 531 www.wml.com.au
Bunbury - Head Office
1st Floor 62 Wittenoom St Bunbury WA 6230
PO Box 2023 Bunbury WA 6231
T +61 8 9722 3544
Kalgoorlie
Suite 1, 45 Brookman St Kalgoorlie WA 6430
PO Box 10209 Kalgoorlie WA 6433
T +61 8 9021 1811
Mandurah
Unit 1/19 Breakwater Pde Mandurah WA 6210
PO Box 4348 Mandurah North WA 6210
T +61 419 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

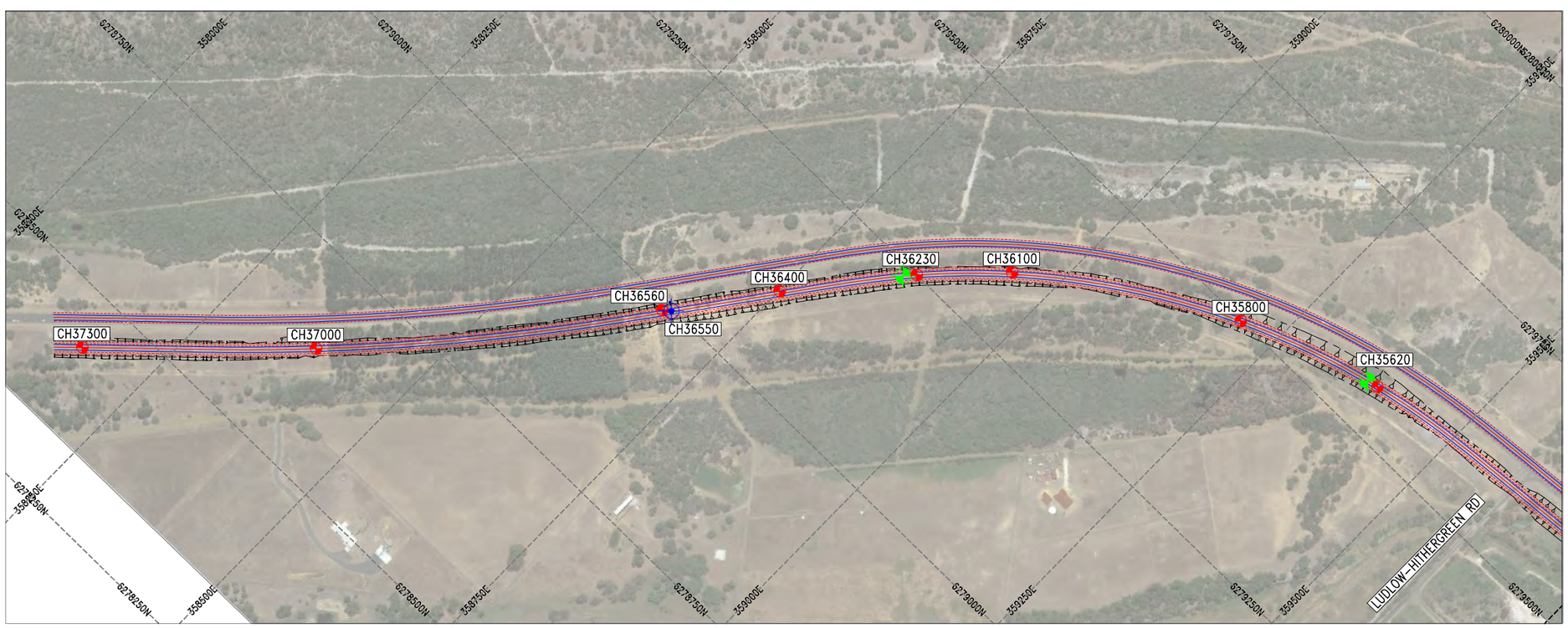
CLIENT
BG&E

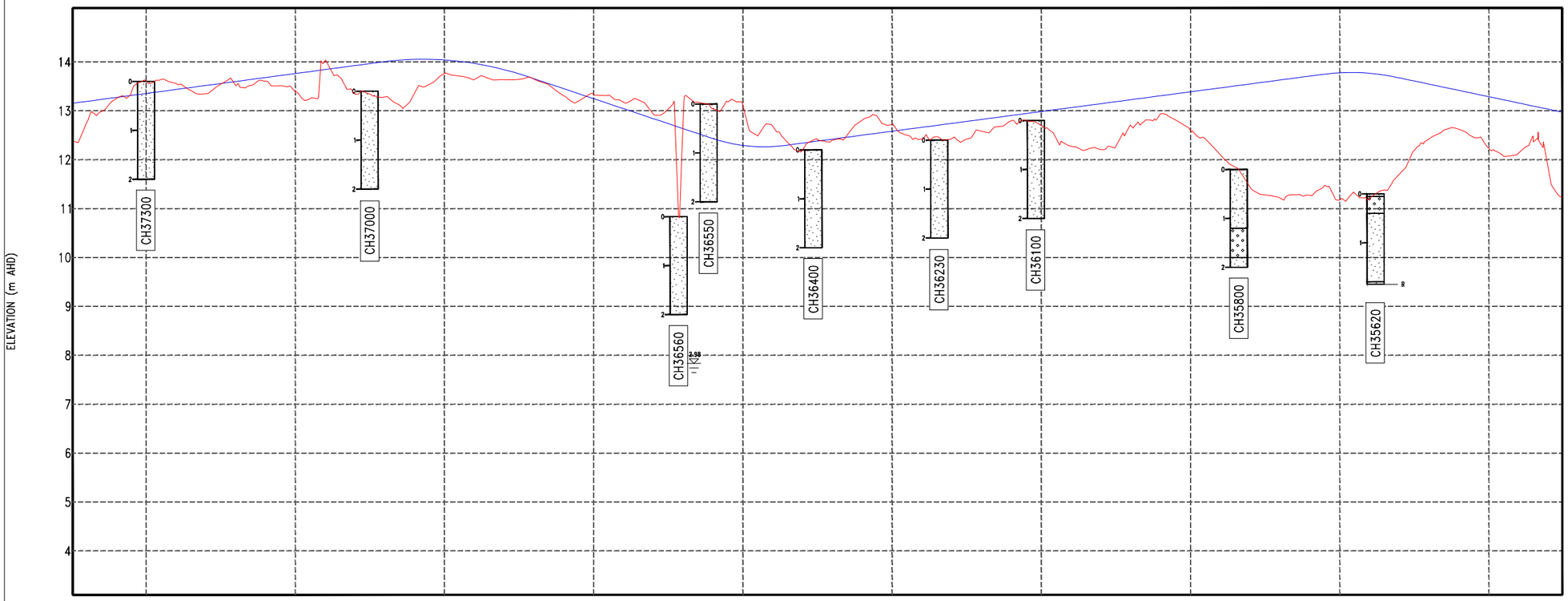
PROJECT
BUSSELL HWY DUPLICATION
HUTTON TO SABINA

DRAWING TITLE
GEOTECHNICAL INVESTIGATION
FENCE DIAGRAM
CH 33400 - 35235

DRAWING NUMBER
6897-G-101

REVISION
B





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 471 531 www.wml.com.au
Bunbury - Head Office
1st Floor 62 Wittenoom St Bunbury WA 6230
PO Box 2023 Bunbury WA 6231
T +61 8 9722 3544
Kalgoorlie
Suite 1, 45 Brookman St Kalgoorlie WA 6430
PO Box 10309 Kalgoorlie WA 6433
T +61 8 9021 1811
Mandurah
Unit 1/10 Breakwater Pde Mandurah WA 6210
PO Box 4348 Mandurah North WA 6210
T +61 419 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE: * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

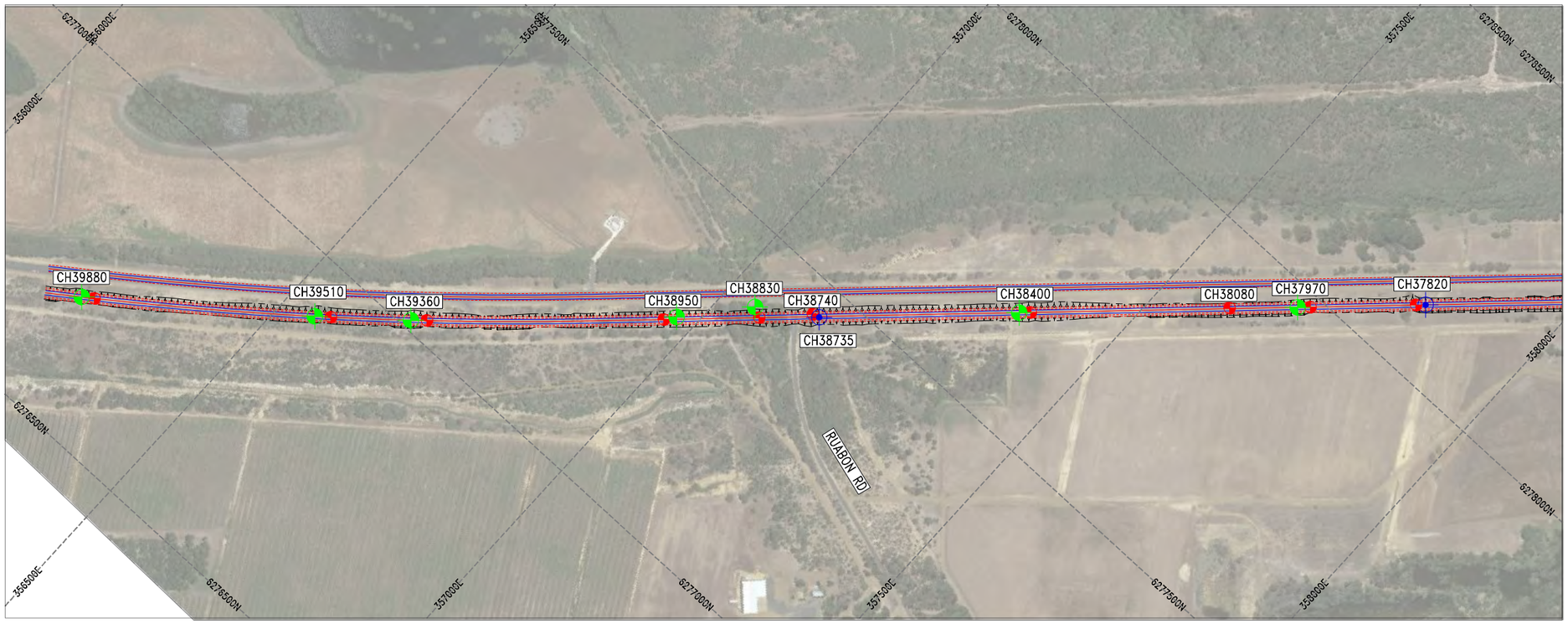
CLIENT: BG&E

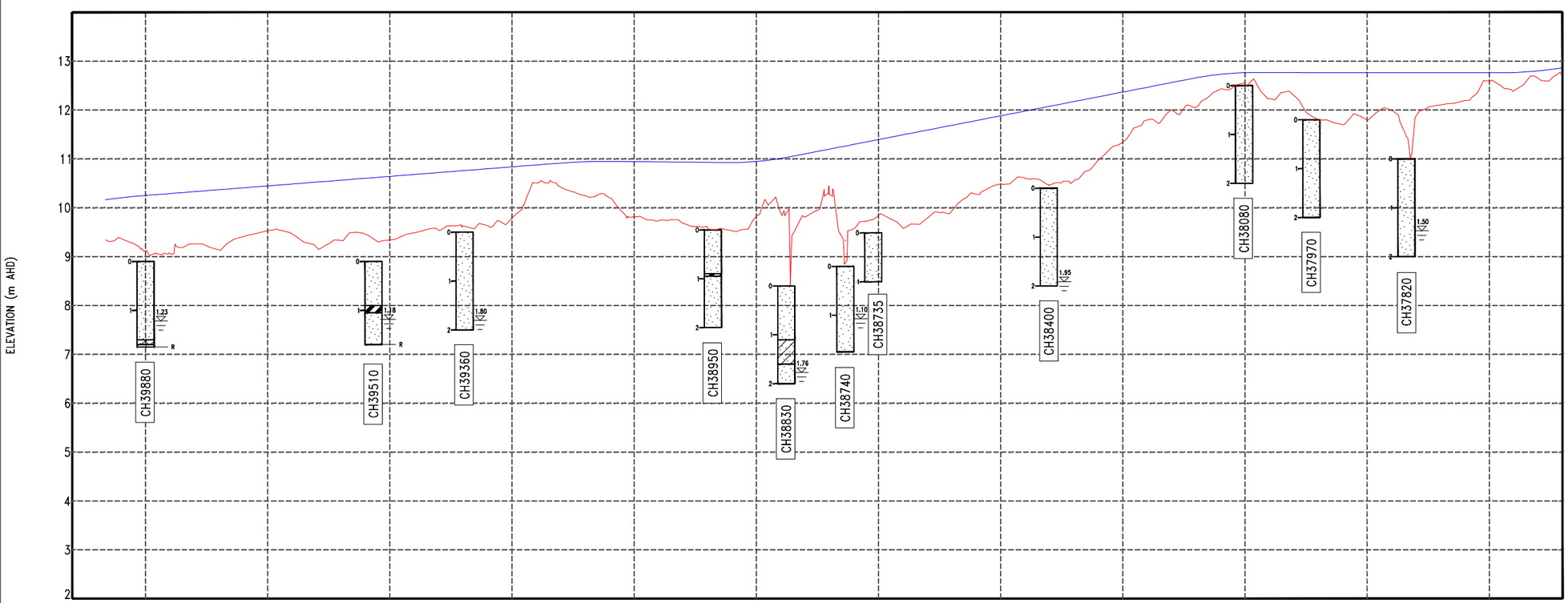
PROJECT: BUSSELL HWY DUPLICATION
HUTTON TO SABINA

DRAWING TITLE: GEOTECHNICAL INVESTIGATION
FENCE DIAGRAM
CH 35620 - 37300

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 6897-G-102
REVISION: B





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 473 531 www.wml.com.au
Bunbury - Head Office: 1st Floor 62 Wittenoom St Bunbury WA 6230, PO Box 2023 Bunbury WA 6231, T +61 8 9722 3544
Kalgoorlie: Suite 1, 45 Brookman St Kalgoorlie WA 6430, PO Box 10209 Kalgoorlie WA 6433, T +61 8 9021 1811
Mandurah: Unit 1/19 Breakwater Pde Mandurah WA 6210, PO Box 4348 Mandurah North WA 6210, T +61 418 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

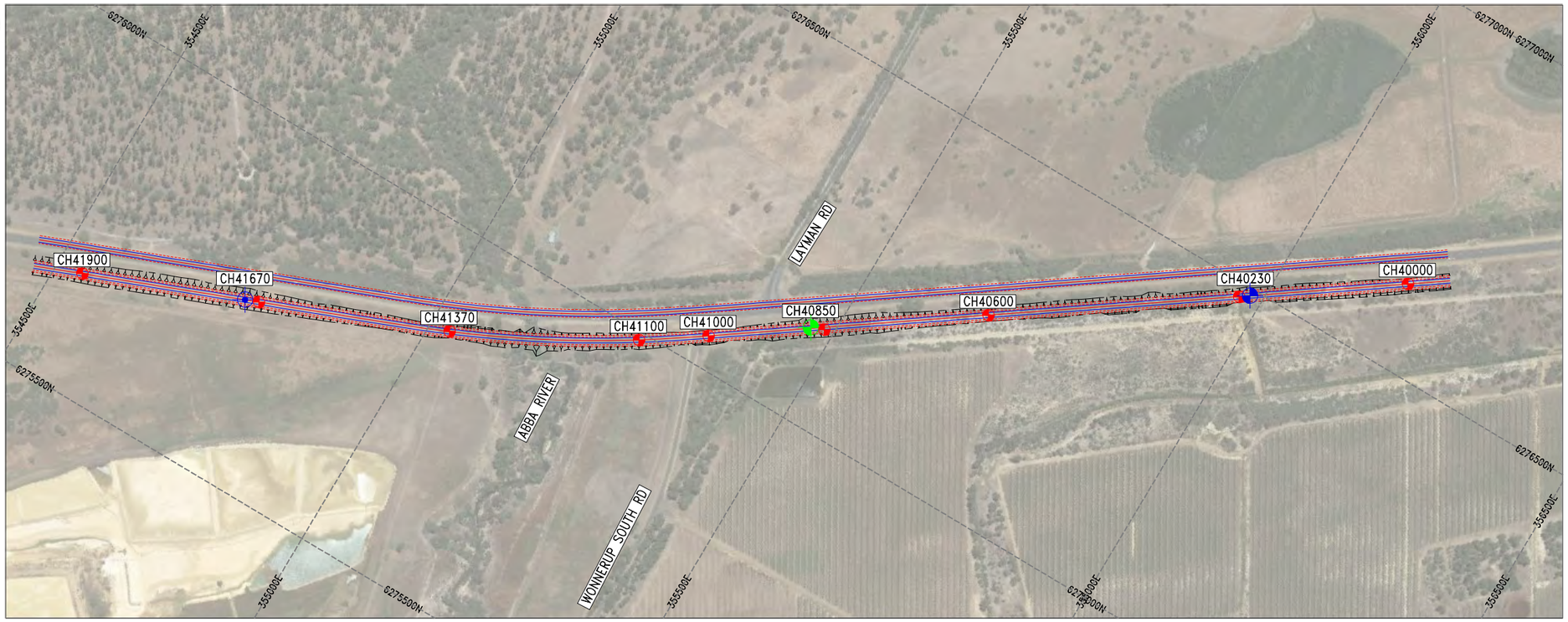
CLIENT: BG&E

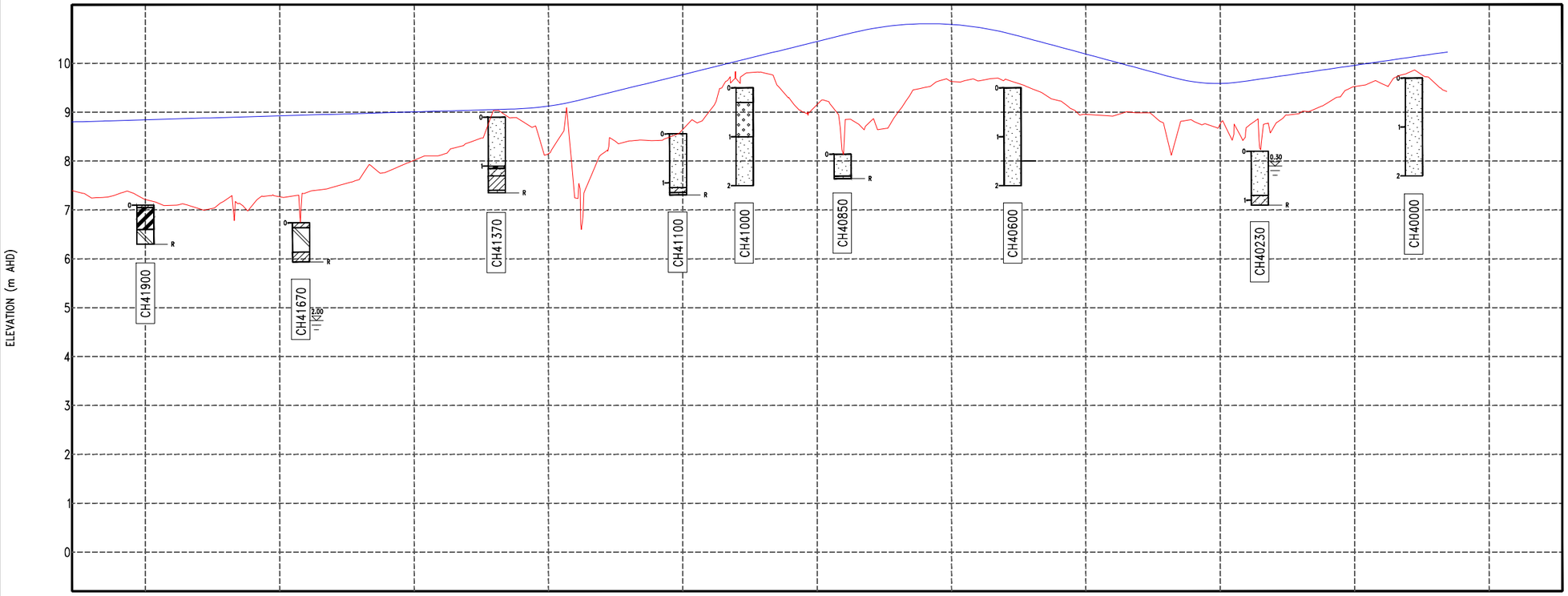
PROJECT: BUSSELL HWY DUPLICATION HUTTON TO SABINA

DRAWING TITLE: GEOTECHNICAL INVESTIGATION FENCE DIAGRAM CH 37820 - 39880

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 6897-G-103 REVISION: B





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface (Proposed Centreline)

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 471 531 www.wml.com.au
Bunbury - Head Office: 1st Floor 62 Wittenoom St Bunbury WA 6230, PO Box 2023 Bunbury WA 6231, T +61 8 9722 3644
Kalgoorlie: Suite 1, 45 Brookmen St Kalgoorlie WA 6430, PO Box 10209 Kalgoorlie WA 6433, T +61 8 9021 1811
Mandurah: Unit 1/19 Breakwater Pde Mandurah WA 6210, PO Box 4348 Mandurah North WA 6210, T +61 419 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE: * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

CLIENT: BG&E

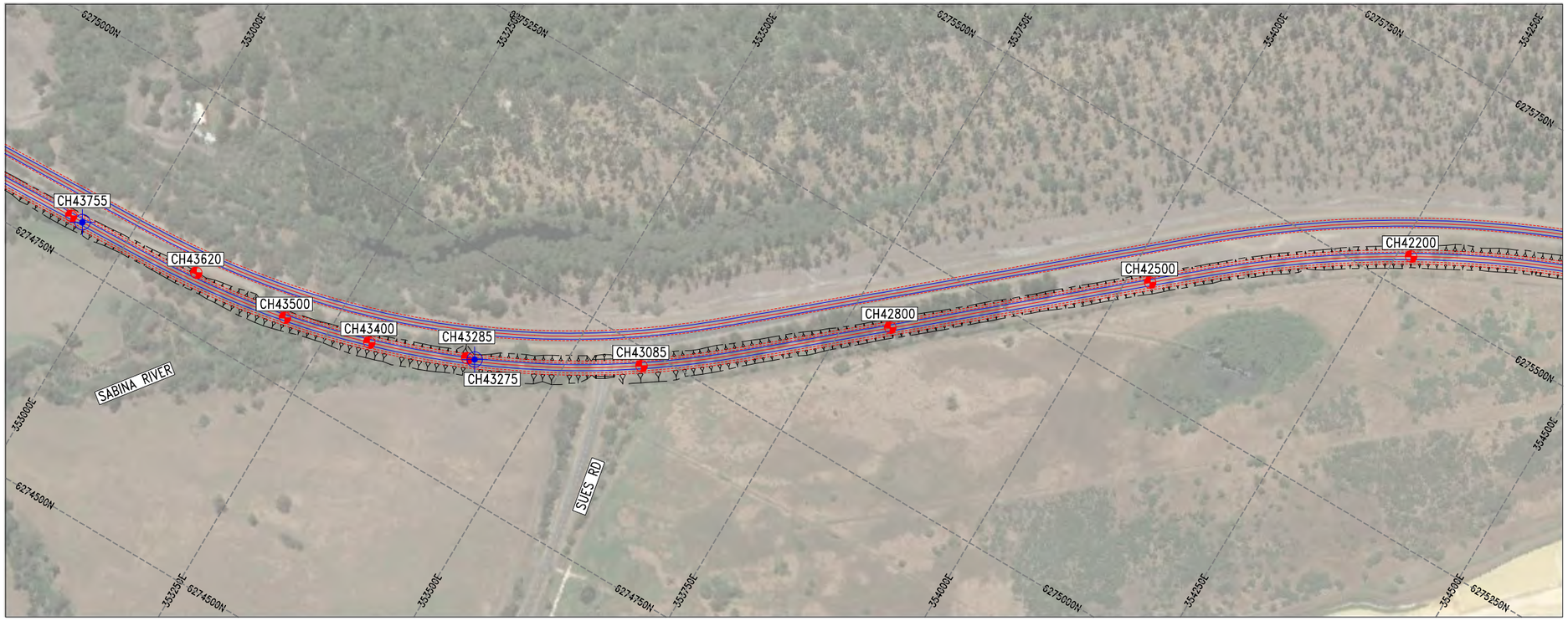
PROJECT: BUSSELL HWY DUPLICATION HUTTON TO SABINA

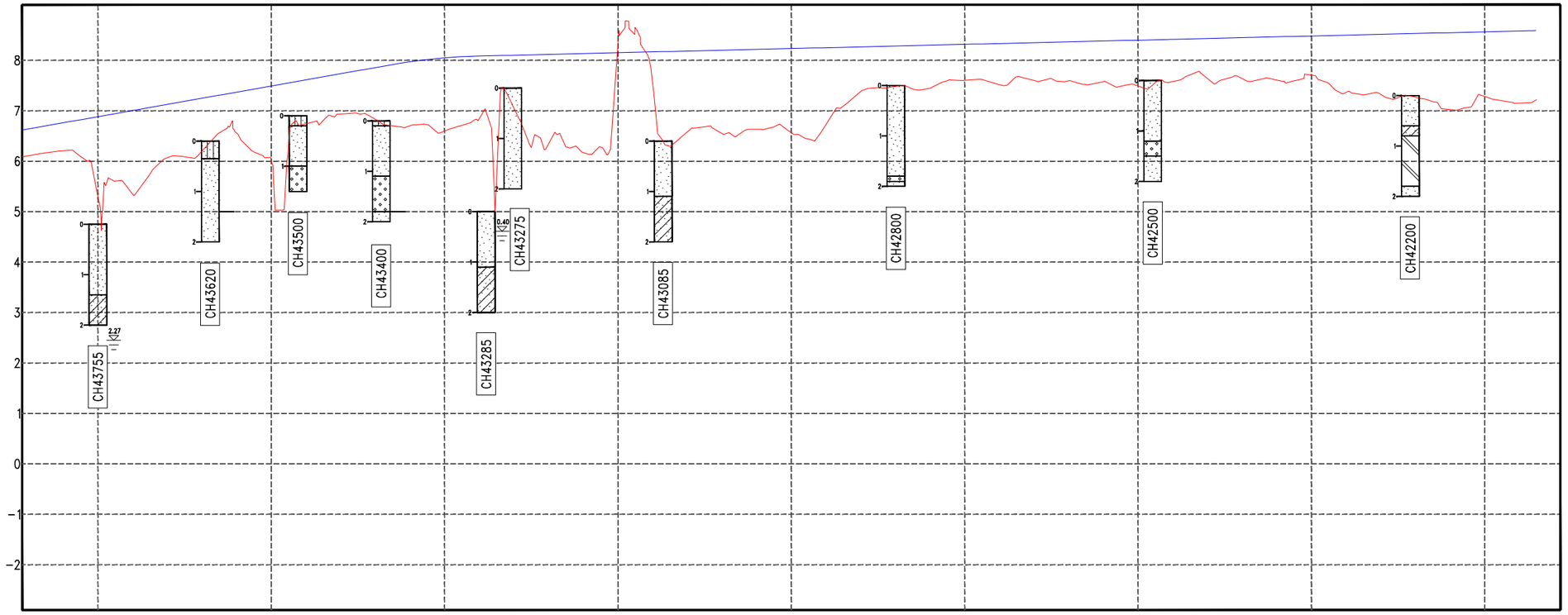
DRAWING TITLE: GEOTECHNICAL INVESTIGATION FENCE DIAGRAM CH 40000 - 41900

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 6897-G-104

REVISION: B





MAP KEY

- Hand Auger
- EFCPT
- EFCPT with Monitoring Well
- Monitoring Well
- Groundwater Level (22/04/16)
- Refusal with Hand Auger
- Design Surface (Preliminary April '16)
- Existing Surface

MATERIAL GRAPHIC

- USCS Poorly-graded Sand
- USCS Well-graded Sand
- USCS Silty Sand
- USCS Clayey Sand
- USCS Poorly-graded Gravel
- USCS Well-graded Gravel
- USCS Clayey Gravel
- USCS Low Plasticity Clay
- USCS Low to High Plasticity Clay
- USCS High Plasticity Clay
- USCS Elastic Silt

DATUM	A.H.D
GRID	MGA ZONE 50

SCALE NOT TO SCALE

A1

CONSULTING ENGINEERS
WML CONSULTANTS
WML Consultants Pty Ltd ABN 36 092 471 531 www.wml.com.au

Bunbury - Head Office
1st Floor 62 Wittenoom St Bunbury WA 6230
PO Box 2023 Bunbury WA 6231
T +61 8 9722 3644

Kalgoorlie
Suite 1, 45 Brookman St Kalgoorlie WA 6430
PO Box 10309 Kalgoorlie WA 6433
T +61 8 9021 1811

Mandurah
Unit 1/19 Breakwater Pde Mandurah WA 6210
PO Box 4348 Mandurah North WA 6210
T +61 419 312 786

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	FINAL ISSUE		14/11/16	GT
A	ISSUED FOR CLIENT REVIEW		21/09/16	GT

NOTE: * INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING OR LAST REVISION OF DRAWING

NAMES PRINTED IN FULL		DATE
DESIGNED	A POPE	05/16
DRAWN	G TOMASINI	05/16
VERIFIED		
APPROVED		

CLIENT: BG&E

PROJECT: BUSSELL HWY DUPLICATION HUTTON TO SABINA

DRAWING TITLE: GEOTECHNICAL INVESTIGATION FENCE DIAGRAM CH 42200 - 43755

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 6897-G-105

REVISION: B

APPENDIX A

BOREHOLE LOGS

HAND AUGER: CH31200

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 17.40 m AHD
JOB NO.: 6897	POSITION: 362629.0 m E 6282194.0 m N	CHAINAGE: 31200.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	0.10m PSD / PI 0.40m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 13 0.80 - 1.10 10		SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots. *TOPSOIL.*
				SP	Moist, yellow, medium dense, fine to medium grained, **SAND**. *Trace of tree roots in upper 0.4m.*
	1.7			CH	Moist, brown, stiff, **CLAY** with some fine to medium roots. *Decayed roots potentially origin of clay..*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH31400

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 15.00 m AHD
JOB NO.: 6897	POSITION: 362543.0 m E 6282013.0 m N	CHAINAGE: 31400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 11		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**. *10mm root at 0.2m.*
	0.5			SW	Moist, brown, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel is angular, moderately cemented sand, PSP refusal at 0.85m.*
	1.0			GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
					Hole Terminated at 1.00 m Refusal
	1.5				
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH31540

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 14.10 m AHD
JOB NO.: 6897	POSITION: 362466.0 m E 6281892.0 m N	CHAINAGE: 31540.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, brown mottled orange, medium dense, fine to medium grained, **SAND** with some fine roots.
		Perth Sand Penetrometer		CH	Moist, brown, stiff, **CLAY** with some fine roots and some fine to medium grained sand.
		Depth (m) Blows		SP	Moist, brown mottled orange, medium dense, fine to medium grained, **SAND** with some fine roots.
		0.20 - 0.50 7		CH	Moist, cream mottled orange, stiff, **CLAY** with some fine roots and some fine to medium grained sand.
	0.5	0.50 - 0.80 14 0.80 - 1.10 21		SW	Moist, pale grey mottled orange, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel angular coffee rock.*
1.5m	1.0				
	1.5			SW	Wet, orange, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel angular coffee rock.*
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH31740

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 15.80 m AHD
JOB NO.: 6897	POSITION: 362396.0 m E 6281706.0 m N	CHAINAGE: 31740.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				SP	Moist, dark grey, loose, fine to medium grained, **silty SAND** with a trace of fine to medium roots. *TOPSOIL.*
		0.20m PSD / PI 0.40m		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 4 0.50 - 0.80 8 0.80 - 1.10 14			
	1.0				
	1.5				
				SW	Moist, brown, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel angular weakly cemented coffee rock.*
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	2.0				Hole Terminated at 1.90 m Refusal
	2.5				
	3.0				

HAND AUGER: CH31850

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 15.70 m AHD
JOB NO.: 6897	POSITION: 362348.0 m E 6281608.0 m N	CHAINAGE: 31850.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 3 0.50 - 0.80 7 0.80 - 1.10 9 Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 3 0.50 - 0.80 15 0.80 - 1.10 23		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5			SP	Moist, cream mottled orange, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH32000

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.50 m AHD
JOB NO.: 6897	POSITION: 362284.0 m E 6281473.0 m N	CHAINAGE: 32000.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 2 0.50 - 0.80 3 0.80 - 1.10 4 1.10 - 1.40 5 1.40 - 1.70 5 1.70 - 2.00 7			Moist, orange, loose, fine to medium grained, **SAND**.
	0.5				
	1.0	1.00m CBR / PSD / PI		SP	
		1.30m			
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH32100

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.20 m AHD
JOB NO.: 6897	POSITION: 362241.0 m E 6281383.0 m N	CHAINAGE: 32100.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 6 0.50 - 0.80 14 0.80 - 1.10 12		SP	Moist, orange brown, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH32200

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 17.90 m AHD
JOB NO.: 6897	POSITION: 362195.0 m E 6281294.0 m N	CHAINAGE: 32200.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND**.
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 6 0.50 - 0.80 8 0.80 - 1.10 7			
	0.5			SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	1.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	1.5			SW	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel angular coffee rock.*
				SW	Dry, pale grey mottled orange, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel angular coffee rock.*
	2.0				Hole Terminated at 1.90 m Refusal
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH32300

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.50 m AHD
JOB NO.: 6897	POSITION: 362142.0 m E 6281209.0 m N	CHAINAGE: 32300.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 6 0.50 - 0.80 7 0.80 - 1.10 7		SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	1.0			SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	1.5			SW	Moist, brown, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel is angular, moderately cemented sand, PSP refusal at 0.85m.*
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	2.0				Hole Terminated at 1.60 m Refusal
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH32400**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.60 m AHD
JOB NO.: 6897	POSITION: 362084.0 m E 6281128.0 m N	CHAINAGE: 32400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
				SP	Moist, grey, loose, fine to medium grained, **SAND**.
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 1 0.50 - 0.80 5 0.80 - 1.10 5		SP	Moist, cream, loose, fine to medium grained, **SAND**.
	0.5				
	1.0				
				SW	Moist, brown, medium dense, fine to coarse grained, **gravelly SAND** with a trace of silt. *Gravel rounded moderately cemented sand.*
	1.5				
				CL	Dry, cream mottled orange, very stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 1.80 m Hard Digging
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH32500

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 21.40 m AHD
JOB NO.: 6897	POSITION: 362020.0 m E 6281051.0 m N	CHAINAGE: 32500.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**. *Trace of medium roots at 2.9-3.4m.*
	1.0				
	1.5				
	2.0				
	2.5	2.60m CBR / PSD / PI			
		2.90m			
	3.0				
	3.5			SW	Moist, orange brown, medium dense, fine to coarse grained, **gravelly SAND** with a trace of silt. *Gravel rounded moderately cemented sand.*
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	4.0				Hole Terminated at 3.90 m Refusal

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH32600**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 20.90 m AHD
JOB NO.: 6897	POSITION: 361950.0 m E 6280980.0 m N	CHAINAGE: 32600.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	1.0			SW	Moist, orange brown, medium dense, fine to coarse grained, **gravelly SAND** with a trace of silt. *Gravel rounded moderately cemented sand.*
	1.5			SW	Moist, orange brown, medium dense, fine to medium grained, **SAND** with some clay and some fine to medium gravel.
	2.0	2.30m PSD / PI		SM	Dry, orange, medium dense, fine to medium grained, **silty SAND** with some fine to medium gravel. *Gravel rounded weakly cemented sand.*
	2.5	2.50m			Hole Terminated at 2.50 m Refusal
	3.0				

HAND AUGER: CH32760

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 16.80 m AHD
JOB NO.: 6897	POSITION: 361827.0 m E 6280876.0 m N	CHAINAGE: 32760.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 12 0.50 - 0.80 20 0.80 - 1.10 19		SP	Moist, orange, loose, fine to medium grained, **SAND**. *Dry from 1.8m.*
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH32900

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 16.00 m AHD
JOB NO.: 6897	POSITION: 361722.0 m E 6280797.0 m N	CHAINAGE: 32900.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0	0.20m PSD / PI 0.35m In-situ VS P>120kPa 0.50m 0.70m In-situ VS P>120kPa Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 10 0.80 - 1.10 18		CH	Moist, brown, very stiff, **CLAY** with a trace of fine to medium roots.
	1.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	1.5				Hole Terminated at 1.50 m Target depth
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33020**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.50 m AHD
JOB NO.: 6897	POSITION: 361636.0 m E 6280732.0 m N	CHAINAGE: 33020.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			MH	Moist, brown, very stiff, **SILT** with a trace of fine roots. *Drain not shown on survey, testing undertaken within base approximately 0.7m below general area.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5				
	2.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**. *Interbedded with layers of brown, very stiff, CLAY with a trace of fine roots.*
	2.5			SP	Moist, pale grey mottled orange, medium dense, fine to medium grained, **SAND** with some fine to medium gravel. *Gravel rounded weakly cemented clayey sand.*
	3.0				Hole Terminated at 3.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33200**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 21.60 m AHD
JOB NO.: 6897	POSITION: 361476.0 m E 6280612.0 m N	CHAINAGE: 33200.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5			SP	As above, fine to coarse grained
	2.0	2.30m PSD / PI 2.50m			
	2.5				
	3.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	3.5	3.80m PSD / PI 4.00m			
	4.0				Hole Terminated at 4.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33320**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 20.20 m AHD
JOB NO.: 6897	POSITION: 361380.0 m E 6280540.0 m N	CHAINAGE: 33320.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**. *Dry from 1.8m.*
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				
	3.5	3.70m CBR / PSD / PI			
	4.0	4.00m			Hole Terminated at 4.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33400**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 18.80 m AHD
JOB NO.: 6897	POSITION: 361316.0 m E 6280492.0 m N	CHAINAGE: 33400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				Hole Terminated at 3.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33600**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 16.80 m AHD
JOB NO.: 6897	POSITION: 361156.0 m E 6280372.0 m N	CHAINAGE: 33600.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	1.0				
		1.30m CBR / PSD / PI			
	1.5	1.60m			
	2.0				
	2.5			SP	Dry, orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel. *Gravel rounded weakly cemented sand.*
	3.0				Hole Terminated at 3.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH33800**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 16.20 m AHD
JOB NO.: 6897	POSITION: 360996.0 m E 6280252.0 m N	CHAINAGE: 33800.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
	0.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5	1.50m PSD / PI			
		1.80m			
	2.0			SP	As above, trace of fine to medium gravel weakly cemented sand rounded.
	2.5			GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
					Hole Terminated at 2.65 m Refusal
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH34000**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 14.40 m AHD
JOB NO.: 6897	POSITION: 360837.0 m E 6280131.0 m N	CHAINAGE: 34000.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 4 0.50 - 0.80 8 0.80 - 1.10 10		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	0.5			SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5			SP	Dry, orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel. *Gravel rounded weakly cemented sand.*
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH34200**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 13.00 m AHD
JOB NO.: 6897	POSITION: 360677.0 m E 6280011.0 m N	CHAINAGE: 34200.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 6 0.50 - 0.80 12 0.80 - 1.10 14		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0				
	1.5			SW	Moist, cream, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of silt. *Gravel is angular, moderately cemented sand, PSP refusal at 0.85m.*
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH34315

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.50 m AHD
JOB NO.: 6897	POSITION: 360576.0 m E 6279942.0 m N	CHAINAGE: 34315.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, grey, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
		0.30m PSD / PI			Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	0.5	0.60m			
	1.0			SP	
	1.5				
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	2.0				Hole Terminated at 2.00 m Refusal
	2.5				
▽ 2.92m	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH34600**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.00 m AHD
JOB NO.: 6897	POSITION: 360355.0 m E 6279774.0 m N	CHAINAGE: 34600.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some fine to medium gravel and some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 25 0.50 - 0.80 22 0.80 - 1.10 13 1.10 - 1.40 17 1.40 - 1.70 14 1.70 - 2.00 19		GW	Moist, cream, dense, fine to coarse, **sandy GRAVEL** with some silt. *limestone - BASE COURSE.*
	0.5			SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of fine gravel and a trace of silt. *FILL.*
				GW	Moist, cream, dense, fine to coarse, **sandy GRAVEL** with some silt. *limestone - BASE COURSE.*
	1.0			SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of silt. *FILL.*
	1.5			CL	Moist, pale brown mottled brown, stiff, fine grained, **sandy CLAY**. *layer of geotextile at top of layer.*
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH34615**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 11.10 m AHD
JOB NO.: 6897	POSITION: 360356.0 m E 6279759.0 m N	CHAINAGE: 34615.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			CL	Moist, dark brown, firm, fine grained, **silty CLAY** with some fine roots.
				CL	Moist, pale brown mottled brown, stiff, fine grained, **sandy CLAY**. .
		0.30m In-situ VS P=90kPa		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of clay.
	0.5				
0.7m		0.80m In-situ VS P>120kPa		CL	Wet, grey mottled orange, very stiff, fine to medium grained, **gravelly sandy CLAY**.
	1.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 6 0.50 - 0.80 8 0.80 - 1.10 18			Hole Terminated at 1.00 m Target depth
	1.5				
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH34900**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.70 m AHD
JOB NO.: 6897	POSITION: 360082.0 m E 6279652.0 m N	CHAINAGE: 34900.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer		SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
		Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 5 0.80 - 1.10 11			Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0			SP	
	1.5				
1.7m ▽					
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	2.0				Hole Terminated at 1.95 m Refusal
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH35070**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.80 m AHD
JOB NO.: 6897	POSITION: 359915.0 m E 6279619.0 m N	CHAINAGE: 35070.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	0.10m CBR / PSD / PI 0.50m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 4 0.50 - 0.80 4 0.80 - 1.10 7		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
1.95m	2.0				Hole Terminated at 2.00 m Target depth

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH35235**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 10.40 m AHD
JOB NO.: 6897	POSITION: 359750.0 m E 6279604.0 m N	CHAINAGE: 35235.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
0.15m	0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 14 0.80 - 1.10 17		SP	Wet, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium gravel.
				GP	Wet, dark brown, medium dense, fine to coarse, **sandy GRAVEL**.
	0.5			SP	Wet, grey, medium dense, coarse grained, **SAND**. *groundwater extreme flow rate.*
	1.0			SP	Wet, pale grey blue, medium dense, fine to coarse grained, **SAND**.
	1.5				Hole Terminated at 1.25 m Wet Collapse
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH35620**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 11.30 m AHD
JOB NO.: 6897	POSITION: 359370.0 m E 6279557.0 m N	CHAINAGE: 35620.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium gravel. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 20 0.50 - 0.80 31 0.80 - 1.10 36		SW	Moist, brown, dense, fine to coarse grained, **gravelly SAND** with some silt and a trace of cobbles. *gravel angular to rounded well cemented sand fine to coarse.*
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0			SP	Moist, pale brown mottled orange, dense, fine to medium grained, **SAND** with a trace of silt.
1.5m	1.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	2.0				Hole Terminated at 1.85 m Refusal
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH35800**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 11.80 m AHD
JOB NO.: 6897	POSITION: 359200.0 m E 6279499.0 m N	CHAINAGE: 35800.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 18 0.80 - 1.10 16		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	1.5			SW	Moist, dark red brown, very dense, fine to medium grained, **gravelly SAND** with a trace of silt. *gravel fine to coarse weakly cemented sand rounded.*
	2.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
					Hole Terminated at 2.00 m Target depth

HAND AUGER: CH36100

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.80 m AHD
JOB NO.: 6897	POSITION: 358947.0 m E 6279338.0 m N	CHAINAGE: 36100.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
	0.30m				
		PSD / PI		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
		0.50m			
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 12 0.80 - 1.10 18			
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH36230

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.40 m AHD
JOB NO.: 6897	POSITION: 358855.0 m E 6279247.0 m N	CHAINAGE: 36230.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.30m CBR / PSD / PI 0.50m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 8 0.50 - 0.80 15 0.80 - 1.10 15		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH36400

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.20 m AHD
JOB NO.: 6897	POSITION: 358751.0 m E 6279112.0 m N	CHAINAGE: 36400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 14 0.80 - 1.10 11		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH36550

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 13.30 m AHD
JOB NO.: 6897	POSITION: 358660.0 m E 6278988.0 m N	CHAINAGE: 36550.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 14 0.50 - 0.80 33 0.80 - 1.10 35		SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
	0.5	0.70m PSD / PI 1.00m		SP	Moist, brown, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of fine roots. *FILL.*
	1.0			SP	Moist, yellow, very dense, fine to medium grained, **SAND**. *dry from 0.8m.*
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH36560**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 10.80 m AHD
JOB NO.: 6897	POSITION: 358651.0 m E 6278981.0 m N	CHAINAGE: 36560.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 1 0.50 - 0.80 9 0.80 - 1.10 21			Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0			SP	
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
▽ 2.98m	3.0				

HAND AUGER: CH37000

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 13.40 m AHD
JOB NO.: 6897	POSITION: 358378.0 m E 6278643.0 m N	CHAINAGE: 37000.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 18 0.80 - 1.10 18		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH37300

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 13.60 m AHD
JOB NO.: 6897	POSITION: 358163.0 m E 6278434.0 m N	CHAINAGE: 37300.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 9 0.80 - 1.10 15		SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.50m PSD / PI		SP	Moist, cream banded yellow, medium dense, fine to medium grained, **SAND**.
	0.5	0.80m		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH37820**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 11.00 m AHD
JOB NO.: 6897	POSITION: 357792.0 m E 6278079.0 m N	CHAINAGE: 37820.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 13 0.80 - 1.10 16		SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
1.5m	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH37970

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 11.80 m AHD
JOB NO.: 6897	POSITION: 357680.0 m E 6277971.0 m N	CHAINAGE: 37970.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 8 0.50 - 0.80 16 0.80 - 1.10 25		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH38080

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 12.50 m AHD
JOB NO.: 6897	POSITION: 357600.0 m E 6277895.0 m N	CHAINAGE: 38080.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
	0.30m				
		CBR / PSD / PI		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5	0.50m			
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 12 0.80 - 1.10 13			
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH38400**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 10.40 m AHD
JOB NO.: 6897	POSITION: 357369.0 m E 6277674.0 m N	CHAINAGE: 38400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 16 0.80 - 1.10 18			Moist, yellow, medium dense, fine to medium grained, **SAND**.
	0.5				
	1.0			SP	
	1.5				
▽ 1.95m	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH38735**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.50 m AHD
JOB NO.: 6897	POSITION: 357129.0 m E 6277444.0 m N	CHAINAGE: 38735.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.30m			
		PSD / PI		SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
		0.50m			
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 18 0.50 - 0.80 32 0.80 - 1.10 31			
	1.0				Hole Terminated at 1.00 m Target depth
▽ 2.00m	1.5				
	2.0				
	2.5				
	3.0				

HAND AUGER: CH38740

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.80 m AHD
JOB NO.: 6897	POSITION: 357125.0 m E 6277447.0 m N	CHAINAGE: 38740.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, cream, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *topsoil varies, other areas within drain can be up to 300mm..*
		Perth Sand Penetrometer		SP	Moist, cream, medium dense, fine to medium grained, **SAND** with a trace of fine roots.
		Depth (m) Blows 0.20 - 0.50 8 0.50 - 0.80 15 0.80 - 1.10 22		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
▽ 1.1m	1.0			SP	Moist, yellow, medium dense, fine to coarse grained, **SAND**.
	1.5				Hole Terminated at 1.75 m Wet Collapse
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH38830

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.40 m AHD
JOB NO.: 6897	POSITION: 357058.0 m E 6277377.0 m N	CHAINAGE: 38830.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 5 0.50 - 0.80 8 0.80 - 1.10 11		SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	0.5			SP	As above, brown mottled grey
	1.0			SC	Moist, grey, medium dense, fine to medium grained, **clayey SAND**.
▽ 1.76m	1.5			SP	Moist, grey mottled brown, medium dense, fine to medium grained, **SAND** with a trace of clay.
	2.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	2.5				Hole Terminated at 2.00 m Target depth
	3.0				

HAND AUGER: CH38950

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.40 m AHD
JOB NO.: 6897	POSITION: 356968.0 m E 6277298.0 m N	CHAINAGE: 38950.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
				SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 13 0.50 - 0.80 26 0.80 - 1.10 24			
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
				CH	Moist, brown, stiff, **CLAY** with a trace of fine gravel and a trace of fine roots. *thin layer, gravel weakly cemented sand.*
	1.0			SP	Moist, cream, medium dense, fine to medium grained, **SAND**.
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH39360**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.50 m AHD
JOB NO.: 6897	POSITION: 356670.0 m E 6277021.0 m N	CHAINAGE: 39360.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.20m			Moist, pale grey, medium dense, fine to medium grained, **SAND**.
		PSD / PI			
		0.40m			
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 12 0.50 - 0.80 23 0.80 - 1.10 29		SP	
	1.0				
				SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of fine to coarse gravel.
	1.5			SP	Moist, yellow brown, medium dense, fine grained, **SAND** with a trace of fine to medium gravel and some silt.
1.8m ▽				SP	Moist, brown, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH39510**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.90 m AHD
JOB NO.: 6897	POSITION: 356551.0 m E 6276930.0 m N	CHAINAGE: 39510.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 16 0.80 - 1.10 7 1.10 - 1.40 16 1.40 - 1.70 15		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.0			CH	Wet, brown, very soft, **CLAY**. *Barely holds shape, saturated, possibly silt? difficult to roll in hand.*
▽ 1.18m				SP	Wet, brown, medium dense, fine to medium grained, **SAND**. *Refusal on large partially decayed root.*
	1.7				Hole Terminated at 1.70 m Refusal
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH39880**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.90 m AHD
JOB NO.: 6897	POSITION: 356262.0 m E 6276693.0 m N	CHAINAGE: 39880.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
					Moist, yellow, medium dense, fine to medium grained, **SAND**.
		0.20m PSD / PI			
	0.5	0.50m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 25 0.80 - 1.10 32		SP	
▽ 1.23m	1.0				
	1.5			GC	Wet, brown, dense, fine to coarse, **clayey GRAVEL**. *moderately cemented sand as gravel in a matrix of the very soft clay found in CH39510.*
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
					Hole Terminated at 1.75 m Refusal
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH40000**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.70 m AHD
JOB NO.: 6897	POSITION: 356166.0 m E 6276620.0 m N	CHAINAGE: 40000.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10 0.50 - 0.80 20 0.80 - 1.10 25		SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine to medium gravel. *TOPSOIL.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5			SP	Moist, orange, medium dense, fine to medium grained, **SAND**.
	2.0			SP	Moist, brown, medium dense, fine to medium grained, **SAND**.
	2.5				Hole Terminated at 2.00 m Target depth
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH40230

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.20 m AHD
JOB NO.: 6897	POSITION: 355978.0 m E 6276487.0 m N	CHAINAGE: 40230.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
0.3m	0			SP	Wet, brown, medium dense, fine to medium grained, **SAND** with some medium to coarse gravel and a trace of cobbles. *Cobbles moderately cemented sand. Drain flowing but groundwater is not equal to flow surface.*
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 12 0.50 - 0.80 17 0.80 - 1.10 20		SP	Wet, pale grey mottled orange, dense, fine to medium grained, **SAND** with some medium to coarse gravel and a trace of cobbles.
	1.0			SC	Wet, grey mottled brown, dense, fine to medium grained, **clayey SAND** with a trace of cobbles. *Refusal on cobble in multiple holes at various depths between GL and 1.1m.*
	1.5				Hole Terminated at 1.10 m Refusal
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH40600**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.50 m AHD
JOB NO.: 6897	POSITION: 355676.0 m E 6276275.0 m N	CHAINAGE: 40600.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 16 0.50 - 0.80 25 0.80 - 1.10 23		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
	1.5			SP	Moist, pale brown mottled orange, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH40850

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.50 m AHD
JOB NO.: 6897	POSITION: 355468.0 m E 6276130.0 m N	CHAINAGE: 40850.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 10		SP	Moist, yellow, medium dense, fine to medium grained, **SAND**. *PSP refusal at 0.65m.*
	0.5			GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
					Hole Terminated at 0.50 m Refusal
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH41000**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 9.50 m AHD
JOB NO.: 6897	POSITION: 355349.0 m E 6276045.0 m N	CHAINAGE: 41000.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of medium to coarse gravel and a trace of cobbles.
		0.30m			
		CBR / PSD / PI		SW	Moist, brown, medium dense, fine to medium grained, **gravelly SAND** with some silt.
		0.50m			
	0.5				
	1.0			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt.
	1.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND**.
				SP	Moist, brown mottled orange, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS
WML CONSULTANTS

HAND AUGER: CH41100

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.40 m AHD
JOB NO.: 6897	POSITION: 355267.0 m E 6275989.0 m N	CHAINAGE: 41100.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0	0.30m		SP	Moist, dark brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		PSD / PI 0.50m		SP	Moist, brown, medium dense, fine to medium grained, **SAND**.
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 9 0.50 - 0.80 7 0.80 - 1.10 8		SP	Moist, cream mottled orange, medium dense, fine to medium grained, **SAND**.
	1.0			SC	Moist, orange mottled cream, medium dense, fine to medium grained, **clayey SAND** with a trace of fine to medium gravel.
				GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
	1.5				Hole Terminated at 1.25 m Refusal
	2.0				
	2.5				
	3.0				

HAND AUGER: CH41370

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 8.90 m AHD
JOB NO.: 6897	POSITION: 355029.0 m E 6275861.0 m N	CHAINAGE: 41370.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.30m CBR / PSD / PI		SP	Moist, pale grey mottled orange, medium dense, fine to medium grained, **SAND**.
	0.5	0.50m <u>Perth Sand Penetrometer</u> Depth (m) Blows 0.20 - 0.50 9 0.50 - 0.80 14 0.80 - 1.10 16			
	1.0			CH	Wet, orange mottled dark brown, very soft, **CLAY**. *Barely holds shape, saturated, possibly silt? difficult to roll in hand.*
				SC	Moist, dark brown, medium dense, fine to medium grained, **clayey SAND**.
				CL	Moist, dark brown mottled orange, very stiff, fine to medium grained, **sandy CLAY**.
	1.5			GP	Moist, dark red mottled brown, very dense, coarse, **GRAVEL**. *Well cemented sand / COFFEE ROCK.*
					Hole Terminated at 1.55 m Refusal
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH41670**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 6.50 m AHD
JOB NO.: 6897	POSITION: 354756.0 m E 6275750.0 m N	CHAINAGE: 41670.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				CL	Moist, dark brown, firm, fine grained, **silty CLAY** with some fine roots. *TOPSOIL.*
		0.15m In-situ VS P=30kPa		CI	Moist, grey, stiff, fine to medium grained, **sandy CLAY**.
	0.5	0.50m In-situ VS P=84kPa		CI	As above, with a trace of fine gravel, limestone gravel?.
				CL	Moist, grey mottled cream, very stiff, **gravelly CLAY** with a trace of cobbles. *possible fine to coarse limestone gravel sub rounded.*
2.00m	1.0 1.5 2.0 2.5 3.0				Hole Terminated at 0.80 m Refusal

HAND AUGER: CH41900

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 7.10 m AHD
JOB NO.: 6897	POSITION: 354538.0 m E 6275663.0 m N	CHAINAGE: 41900.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		0.05m In-situ VS P=30kPa 0.20m PSD / PI 0.40m		CL	Moist, dark brown, firm, fine grained, **silty CLAY** with some fine roots. *TOPSOIL.*
				CH	Moist, grey, firm, **sandy CLAY**.
	0.5	0.50m In-situ VS P=66kPa 0.65m In-situ VS P>130kPa		CI	Moist, grey mottled cream, very stiff, **sandy CLAY** with some fine to medium gravel. *refusal on cobble.*
					Hole Terminated at 0.80 m Refusal
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				

HAND AUGER: CH42200

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 7.30 m AHD
JOB NO.: 6897	POSITION: 354265.0 m E 6275538.0 m N	CHAINAGE: 42200.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Dry, brown, loose, fine to medium grained, **SAND** with some silt and some fine to medium roots. *top 300mm heavily disturbed from pine tree logging activities, large roots on surface of general area.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 14 0.50 - 0.80 23 0.80 - 1.10 21		SP	Moist, cream, medium dense, fine to medium grained, **SAND** and a trace of fine to medium roots.
	0.5			SC	Moist, brown, dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium roots.
	1.0			Cl	Moist, orange mottled brown, very stiff, fine to medium grained, **sandy CLAY** and a trace of fine to medium roots.
	1.5			SP	Moist, pale grey, dense, fine to medium grained, **SAND** with a trace of clay.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH42500**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 7.60 m AHD
JOB NO.: 6897	POSITION: 354025.0 m E 6275360.0 m N	CHAINAGE: 42500.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine to medium roots. *top 300mm heavily disturbed from pine tree logging activities, large roots on surface of general area.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 9 0.50 - 0.80 15 0.80 - 1.10 21		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**. *medium root at 1.0m.*
	1.0				
	1.5			SW	Moist, dark red brown, very dense, fine to medium grained, **gravelly SAND** with a trace of silt. *gravel fine to coarse weakly cemented sand rounded.*
				SP	Moist, brown, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH42800**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 7.50 m AHD
JOB NO.: 6897	POSITION: 353797.0 m E 6275164.0 m N	CHAINAGE: 42800.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0			SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine to medium roots. *top 300mm heavily disturbed from pine tree logging activities, large roots on surface of general area.*
				SP	Moist, dark brown, medium dense, fine to medium grained, **SAND** with a trace of fine to medium roots and some silt.
		0.40m PSD / PI		SP	Moist, cream, medium dense, fine to medium grained, **SAND** and a trace of fine to medium roots.
	0.5	0.60m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 7 0.50 - 0.80 13 0.80 - 1.10 13			
	1.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	1.5			SP	Moist, yellow mottled orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel. *gravel fine to coarse weakly cemented sand rounded.*
				SW	Moist, dark red brown, very dense, fine to medium grained, **gravelly SAND** with a trace of silt. *gravel fine to coarse weakly cemented sand rounded.*
	2.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND**.
					Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH43085

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 6.40 m AHD
JOB NO.: 6897	POSITION: 353576.0 m E 6274981.0 m N	CHAINAGE: 43085.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of fine gravel. *gravel angular moderately cemented sand.*
	1.0				
	1.5			SC	Moist, grey brown, dense, fine to medium grained, **clayey SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH43275**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 7.50 m AHD
JOB NO.: 6897	POSITION: 353409.0 m E 6274890.0 m N	CHAINAGE: 43275.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0			SP	Dry, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.20m PSD / PI		SP	Dry, yellow banded grey, very loose, fine to medium grained, **SAND**. *FILL.*
	0.5	0.50m Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 2 0.50 - 0.80 2 0.80 - 1.10 6		SP	Dry, yellow, medium dense, fine to medium grained, **SAND**.
	1.0				
	1.5				
				SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with some fine to coarse gravel. *gravel weakly cemented sand angular.*
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH43285

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 5.55 m AHD
JOB NO.: 6897	POSITION: 353401.0 m E 6274887.0 m N	CHAINAGE: 43285.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, yellow, very loose, fine to medium grained, **SAND** with some fine roots.
0.4m ▽	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 2 0.50 - 0.80 4 0.80 - 1.10 4		SP	Moist, yellow, very loose, fine to medium grained, **SAND** with some fine roots.
	1.0			SP	Wet, pale grey, loose, fine to medium grained, **SAND** with some fine roots.
	1.5			SC	Moist, brown mottled orange, medium dense, fine to medium grained, **SAND** with some clay.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH43400

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 6.80 m AHD
JOB NO.: 6897	POSITION: 353296.0 m E 6274845.0 m N	CHAINAGE: 43400.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SM	Dry, dark brown, loose, fine to medium grained, **silty SAND** with some fine to medium roots. *TOPSOIL.*
		Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 4 0.50 - 0.80 4 0.80 - 1.10 6		SP	Dry, dark brown, loose, fine to medium grained, **SAND** with some silt.
	0.5			SP	Dry, brown, medium dense, fine to medium grained, **SAND**.
	1.0			SW	Dry, orange brown, very dense, fine to medium grained, **gravelly SAND** with a trace of silt. *weakly cemented matrix, gravel angular fine to coarse moderately cemented sand.*
	1.5			SP	Dry, cream, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH43500**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 6.90 m AHD
JOB NO.: 6897	POSITION: 353199.0 m E 6274820.0 m N	CHAINAGE: 43500.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0	0.20m		SM	Dry, dark brown, loose, fine to medium grained, **silty SAND** with some fine to medium roots. *TOPSOIL.*
		PSD / PI 0.40m		SP	Dry, dark brown, loose, fine to medium grained, **SAND**.
	0.5	0.70m			
		PSD / PI 0.90m		SP	Dry, brown, medium dense, fine to medium grained, **SAND**.
	1.0	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 4 0.50 - 0.80 6 0.80 - 1.10 8		SW	Dry, orange brown, very dense, fine to medium grained, **gravelly SAND** with a trace of silt. *weakly cemented matrix, gravel angular fine to coarse moderately cemented sand.*
	1.5				Hole Terminated at 1.50 m Hard Digging
	2.0				
	2.5				
	3.0				

CONSULTING ENGINEERS WML CONSULTANTS	**HAND AUGER: CH43620**	SHEET: 1 OF 1
CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 6.40 m AHD
JOB NO.: 6897	POSITION: 353086.0 m E 6274812.0 m N	CHAINAGE: 43620.0 m

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SM	Dry, dark brown, loose, fine to medium grained, **silty SAND** with some fine to medium roots. *TOPSOIL.*
		0.40m PSD / PI		SP	Dry, brown, medium dense, fine to medium grained, **SAND** with a trace of silt.
	0.5	0.60m <u>Perth Sand Penetrometer</u> Depth (m) Blows 0.20 - 0.50 15 0.50 - 0.80 22 0.80 - 1.10 19			
	1.0				
	1.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND**.
	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

HAND AUGER: CH43755

SHEET: 1 OF 1

CLIENT: Main Roads Western Australia	CONTRACTOR: WML Consultants	LOGGED: AP
PROJECT: Geotechnical Investigation	MACHINE: Hand-Auger	LOGGED DATE: 18/04/2016
LOCATION: Bussell Hwy Duplication, Hutton to Sabina	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL: 4.75 m AHD
JOB NO.: 6897	POSITION: 352945.0 m E 6274795.0 m N	CHAINAGE: 43755.0 m

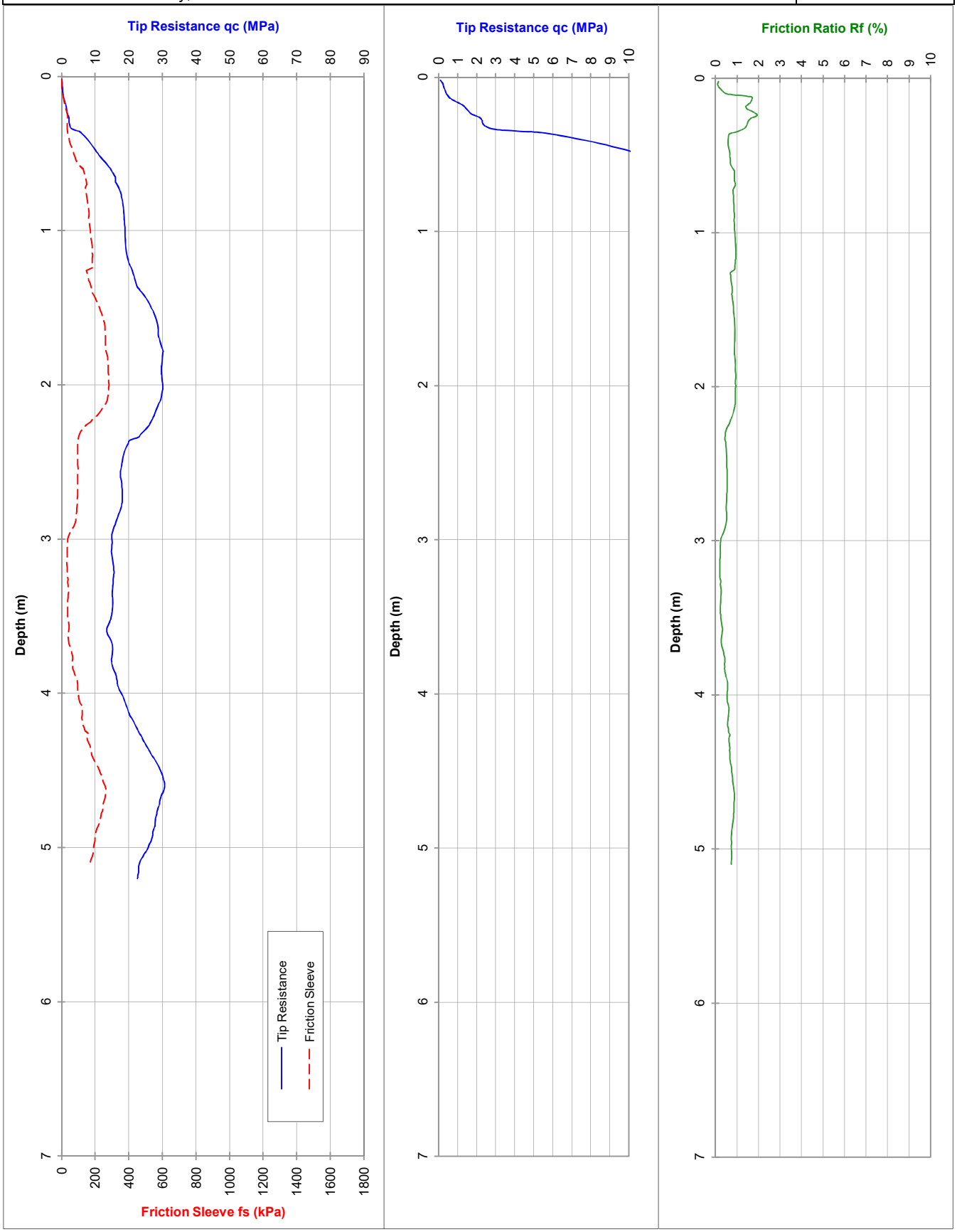
WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0			SP	Moist, brown, loose, fine to medium grained, **SAND** with some silt and a trace of fine roots. *TOPSOIL.*
		0.30m PSD / PI 0.50m		SP	Moist, dark brown, dense, fine to medium grained, **SAND** with some silt and a trace of fine roots. *weakly cemented matrix.*
	0.5	Perth Sand Penetrometer Depth (m) Blows 0.20 - 0.50 32 0.50 - 0.80 34 0.80 - 1.10 27		SP	Moist, brown, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
	1.5			SC	Moist, orange mottled dark grey, medium dense, fine to medium grained, **clayey SAND**.
				SC	As above, dark grey
▽ 2.27m	2.0				Hole Terminated at 2.00 m Target depth
	2.5				
	3.0				

APPENDIX B

EFCPT RESULTS

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 14.5	**CH31540**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 362466mE; 6281892mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.5

20mm standpipe installed to (m): 2.6

Refusal:

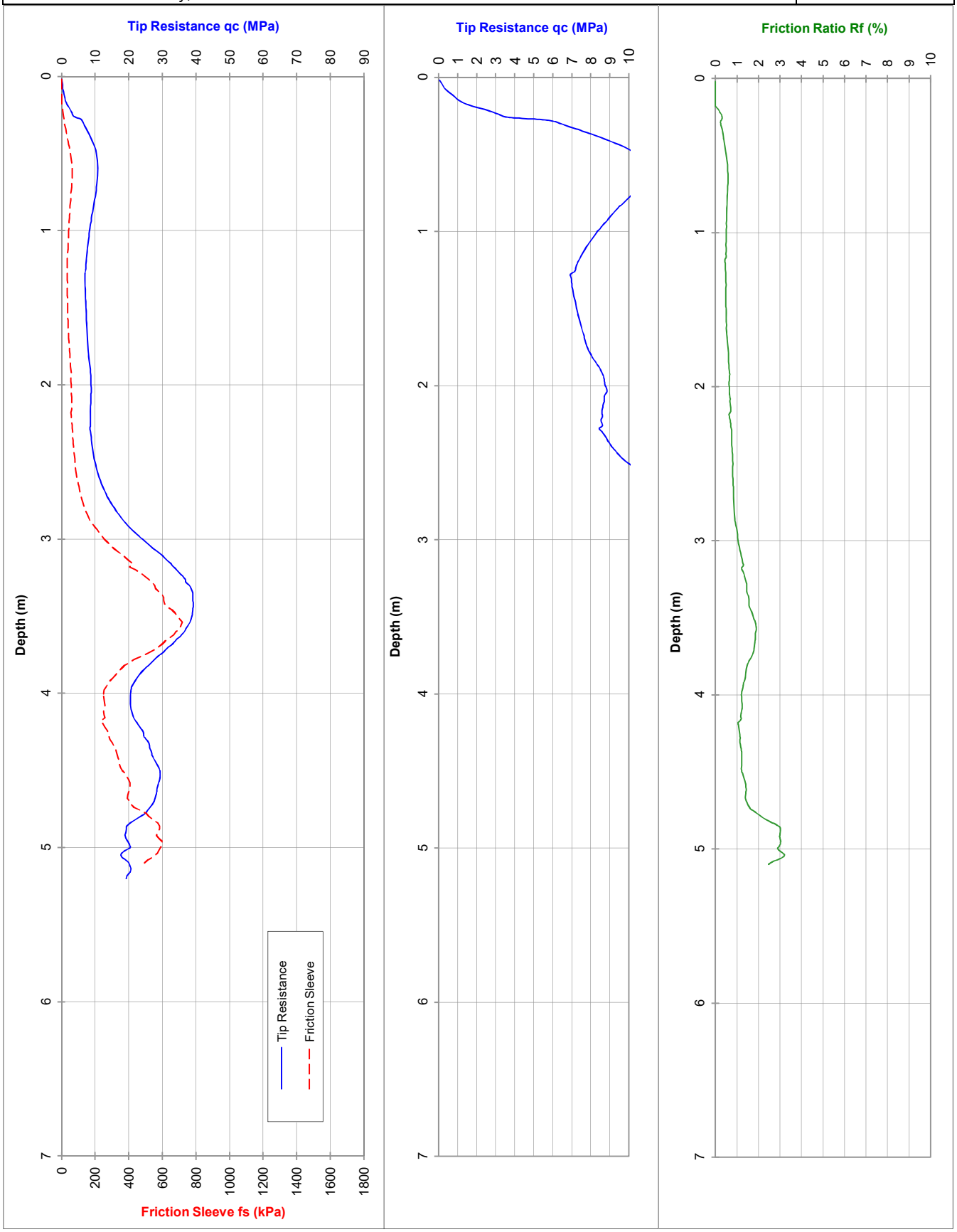
Cone I.D.: EC147

File: WM0181G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 18.25	**CH32100**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 362241mE; 6281383mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 5.0

Dummy probe to (m):

Refusal:

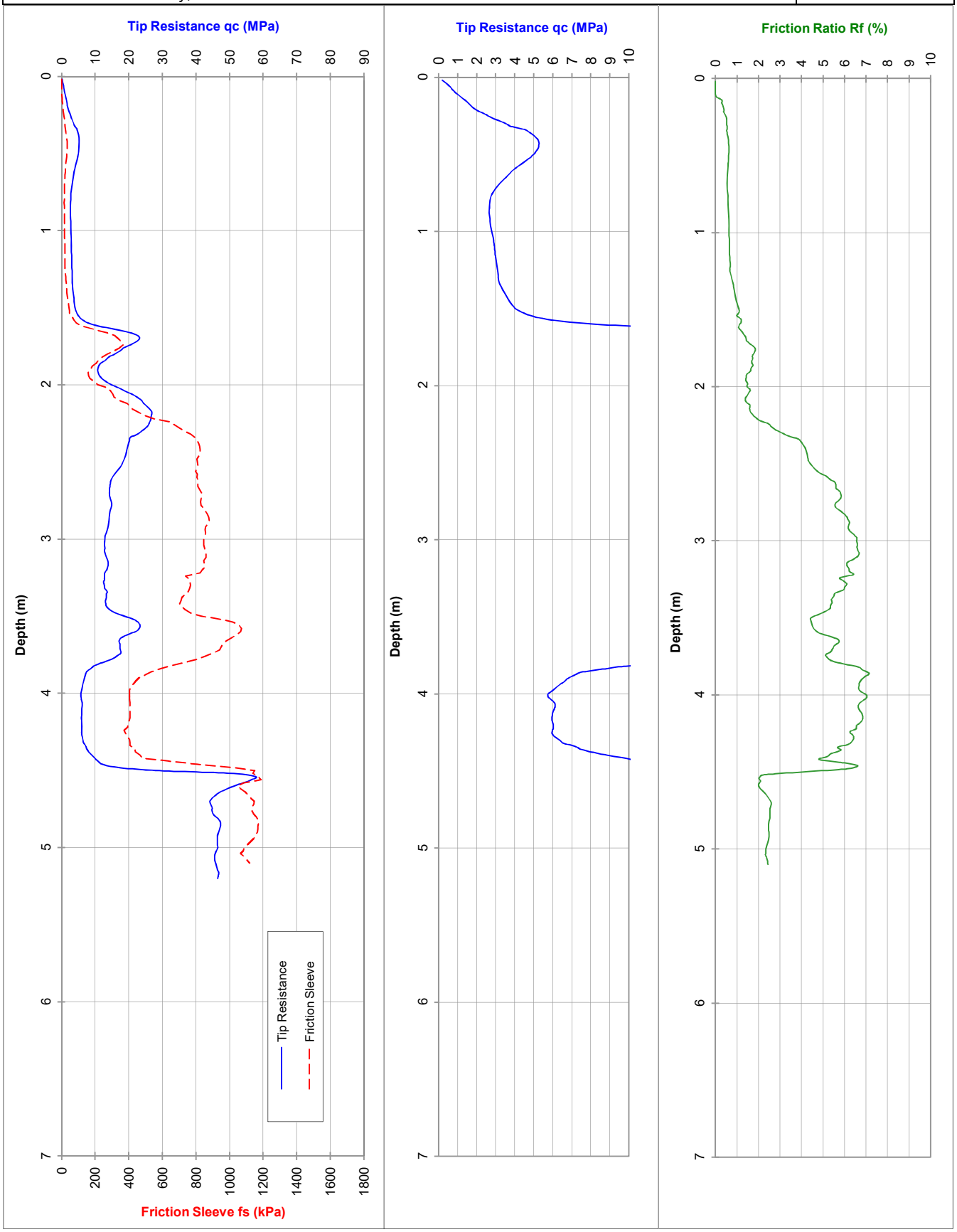
Cone I.D.: EC147

File: WM0182G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 18.5	**CH32300**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 362142mE; 6281209mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 5.1

Dummy probe to (m):

Refusal:

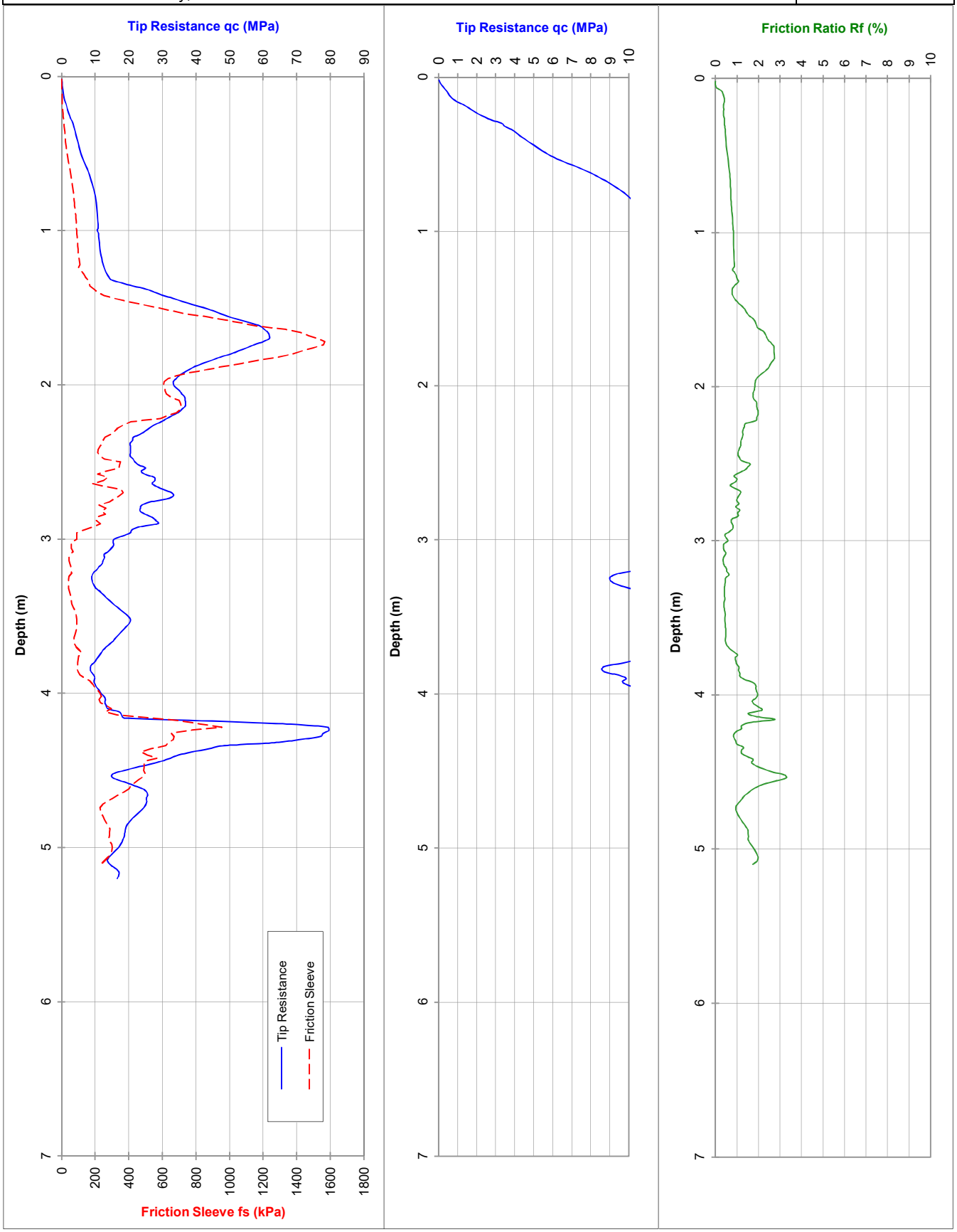
Cone I.D.: EC147

File: WM0183G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 12.5	**CH34315**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 360578mE; 6279945mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 3.1

20mm standpipe installed to (m): 3.2

Refusal:

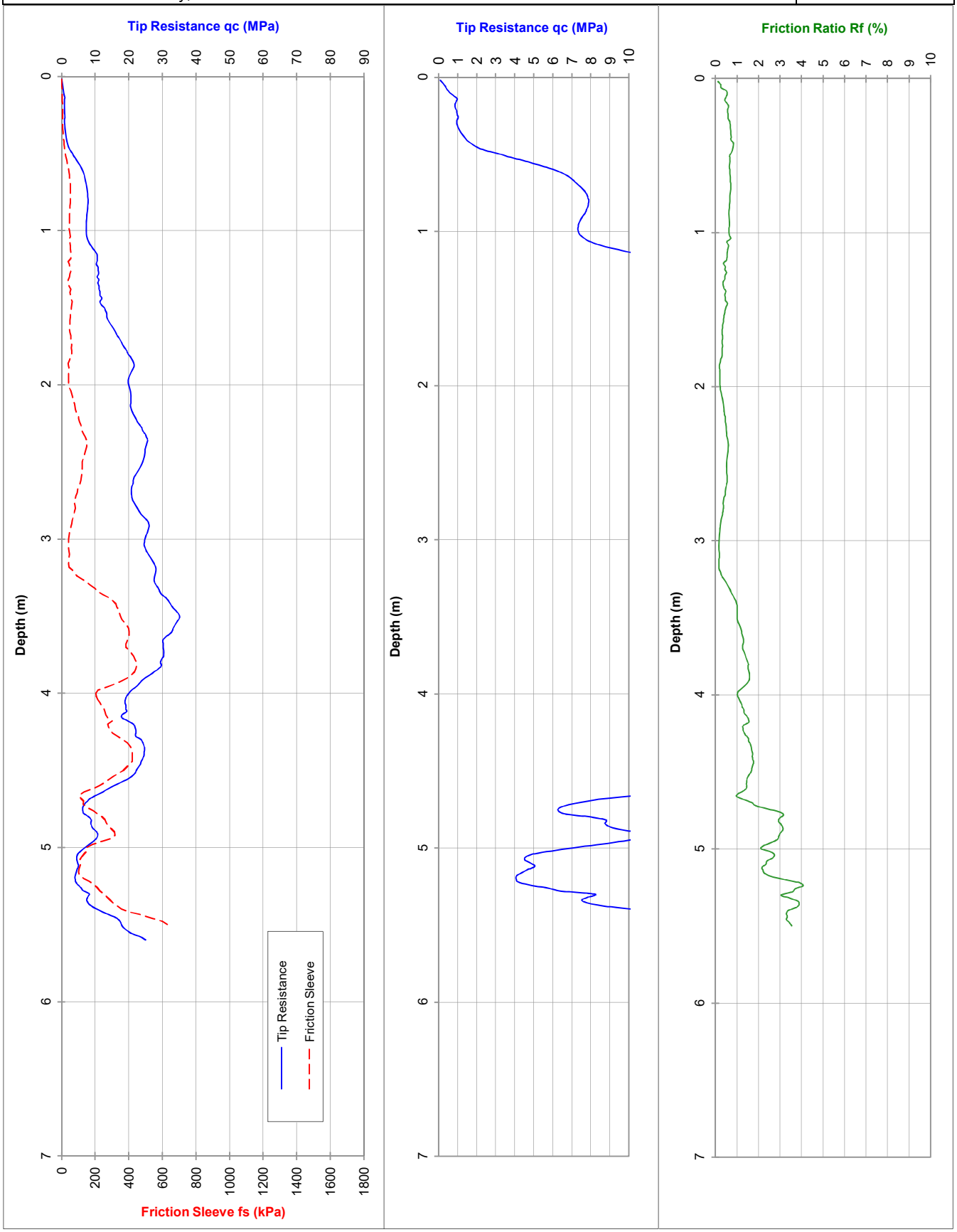
Cone I.D.: EC147

File: WM0159G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 11.5	**CH35225**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 359760mE; 6279604mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.1

20mm standpipe installed to (m): 1.2

Refusal:

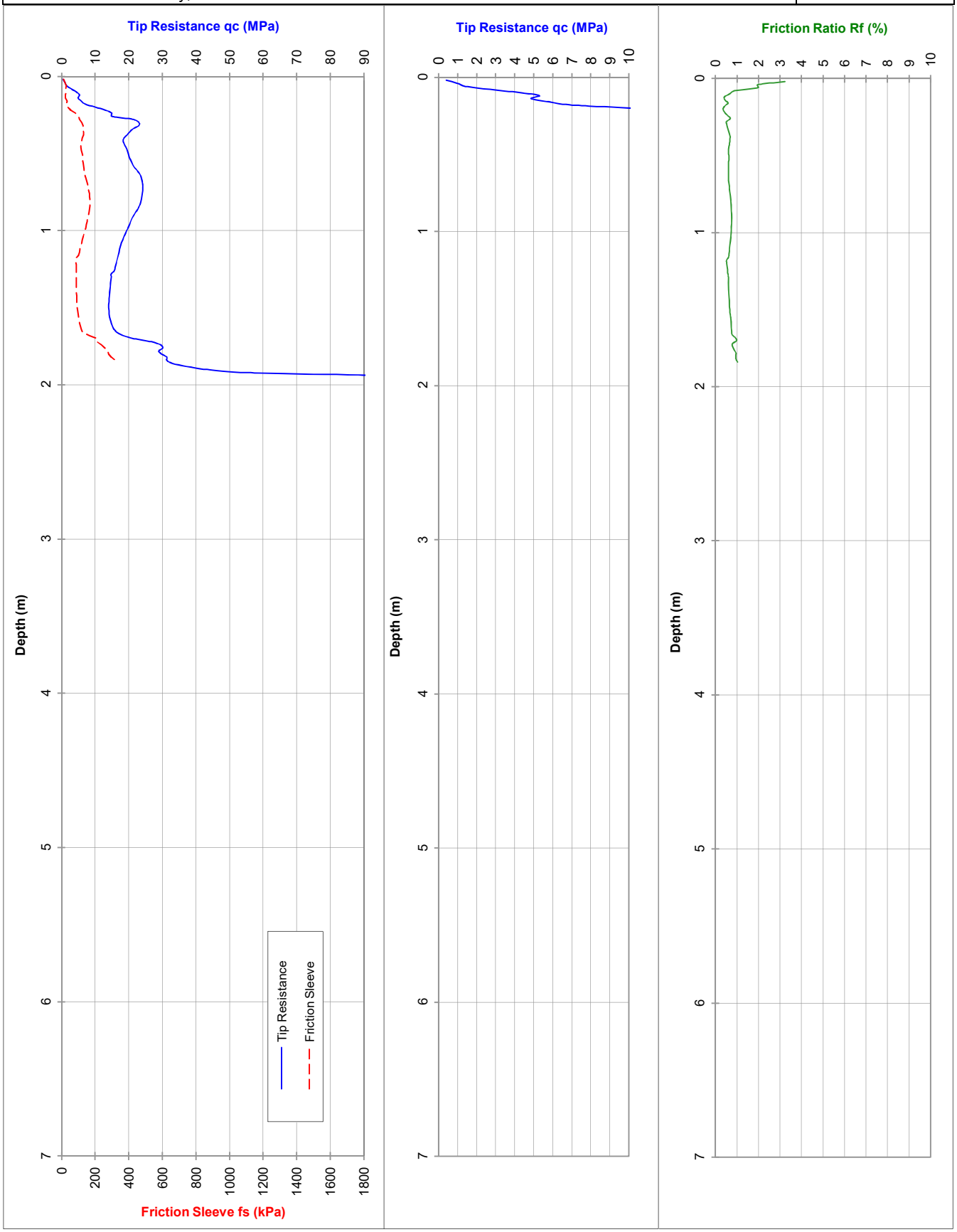
Cone I.D.: EC147

File: WM0160G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 11.5	**CH35620**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 359370mE; 6279557mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 1.2

Dummy probe to (m):

Refusal: 100MPa

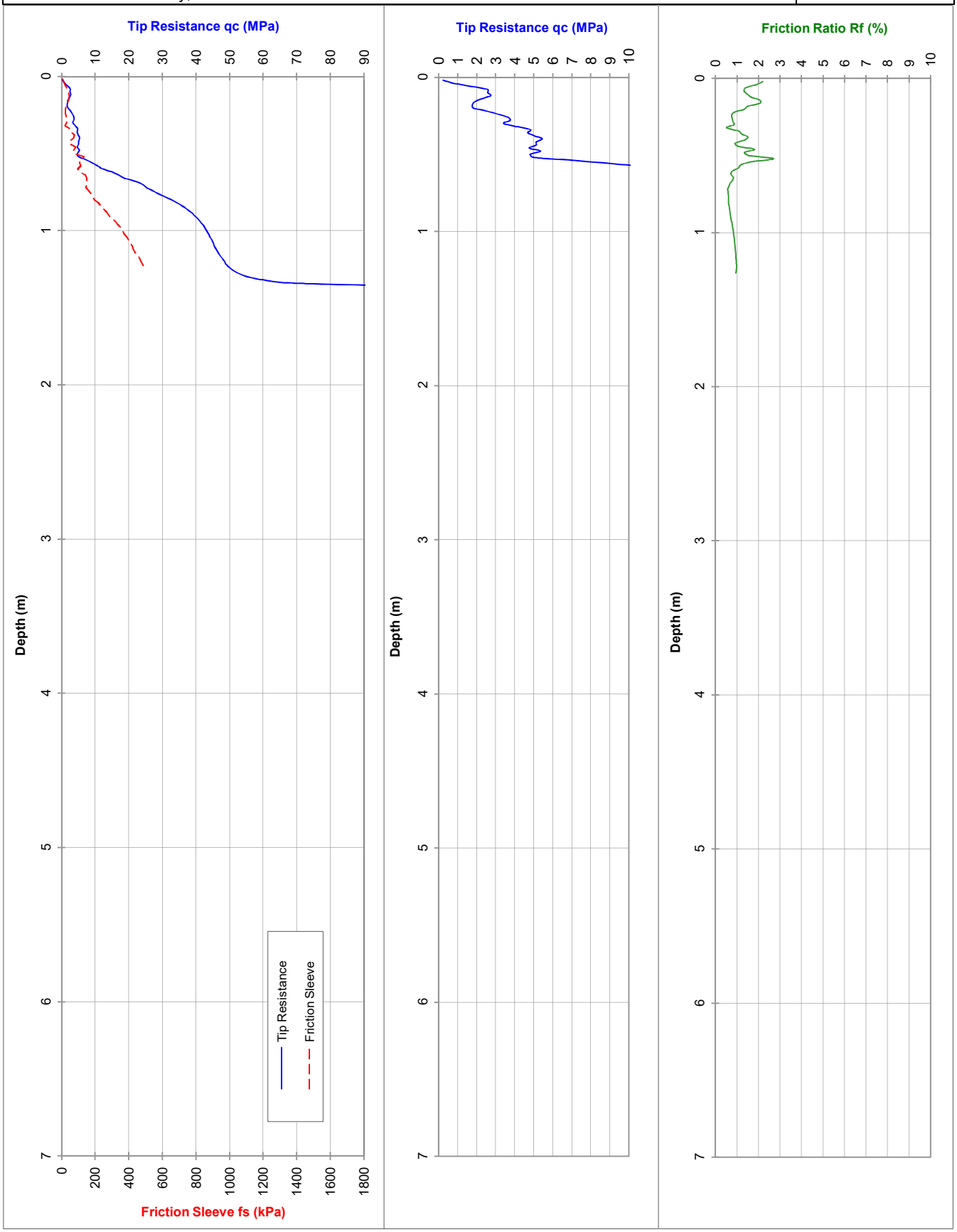
Cone I.D.: EC147

File: WM0161G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 11.5	**CH35620A**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 359370mE; 6279557mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 1.3

Dummy probe to (m):

Refusal: 100MPa

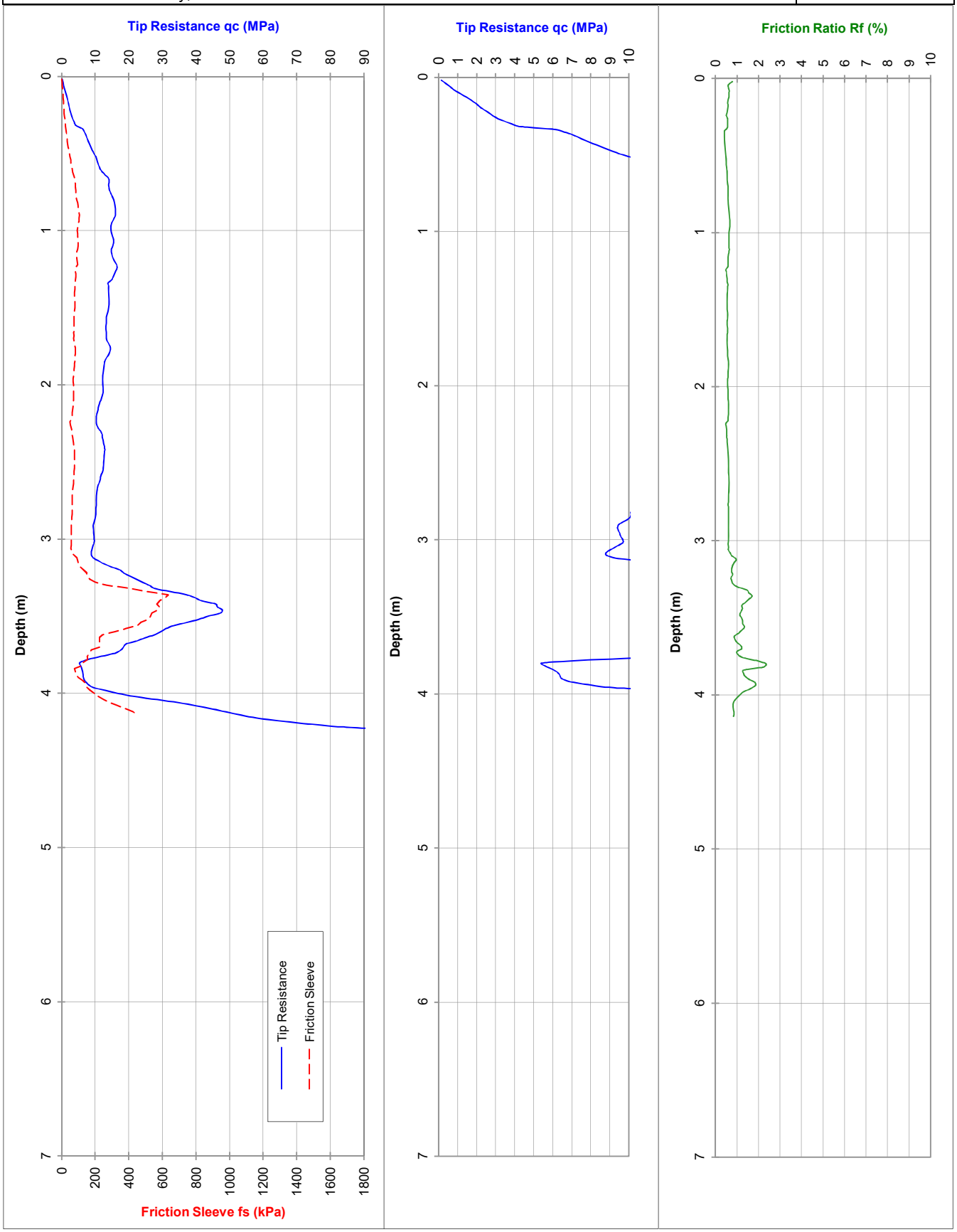
Cone I.D.: EC147

File: WM0162G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 12.5	**CH36230**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 358855mE; 6279247mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 3.8

Dummy probe to (m):

Refusal: 106MPa

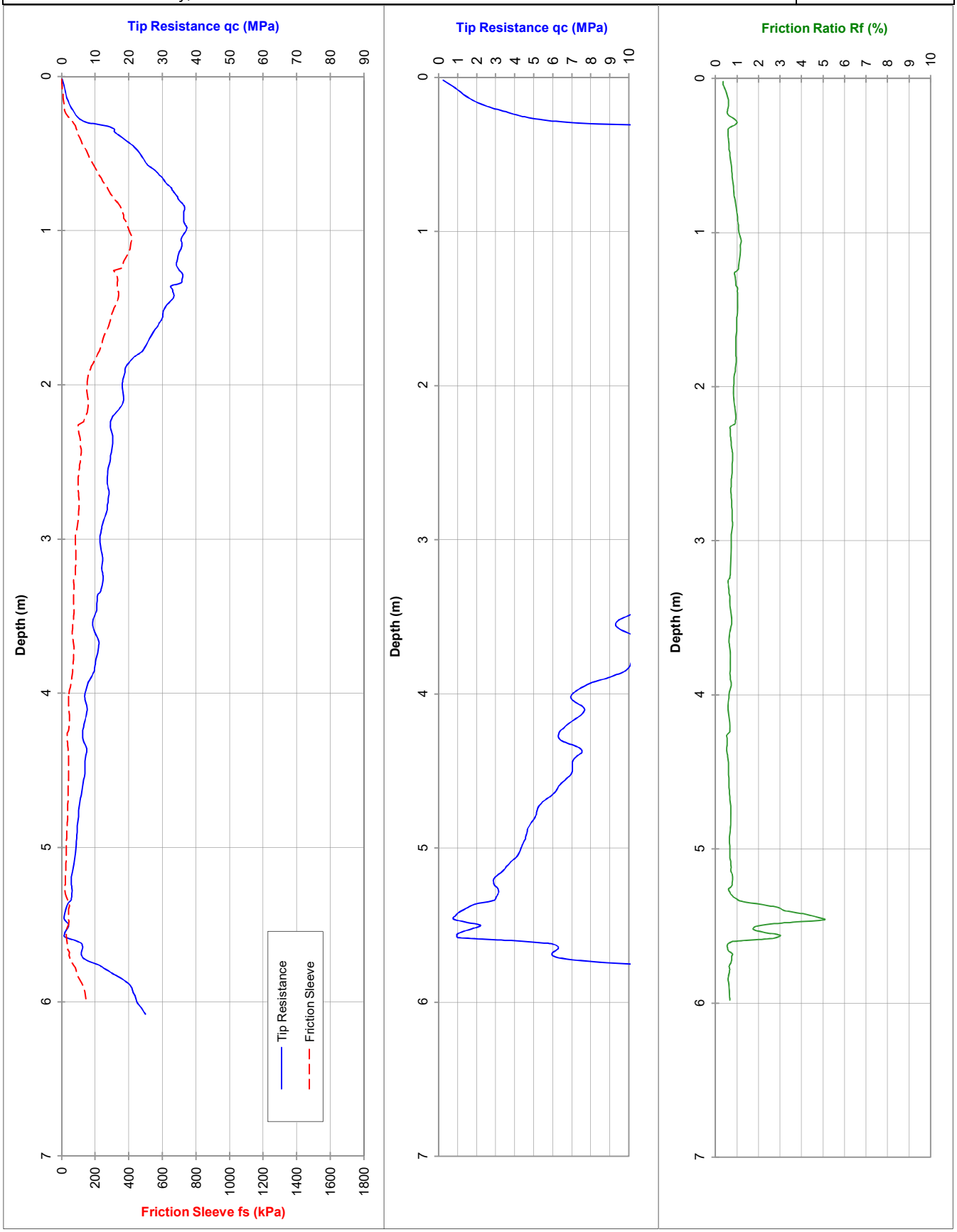
Cone I.D.: EC147

File: WM0163G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 13	**CH36555**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 358660mE; 6278988mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 5.35

20mm standpipe installed to (m): 6.0

Refusal:

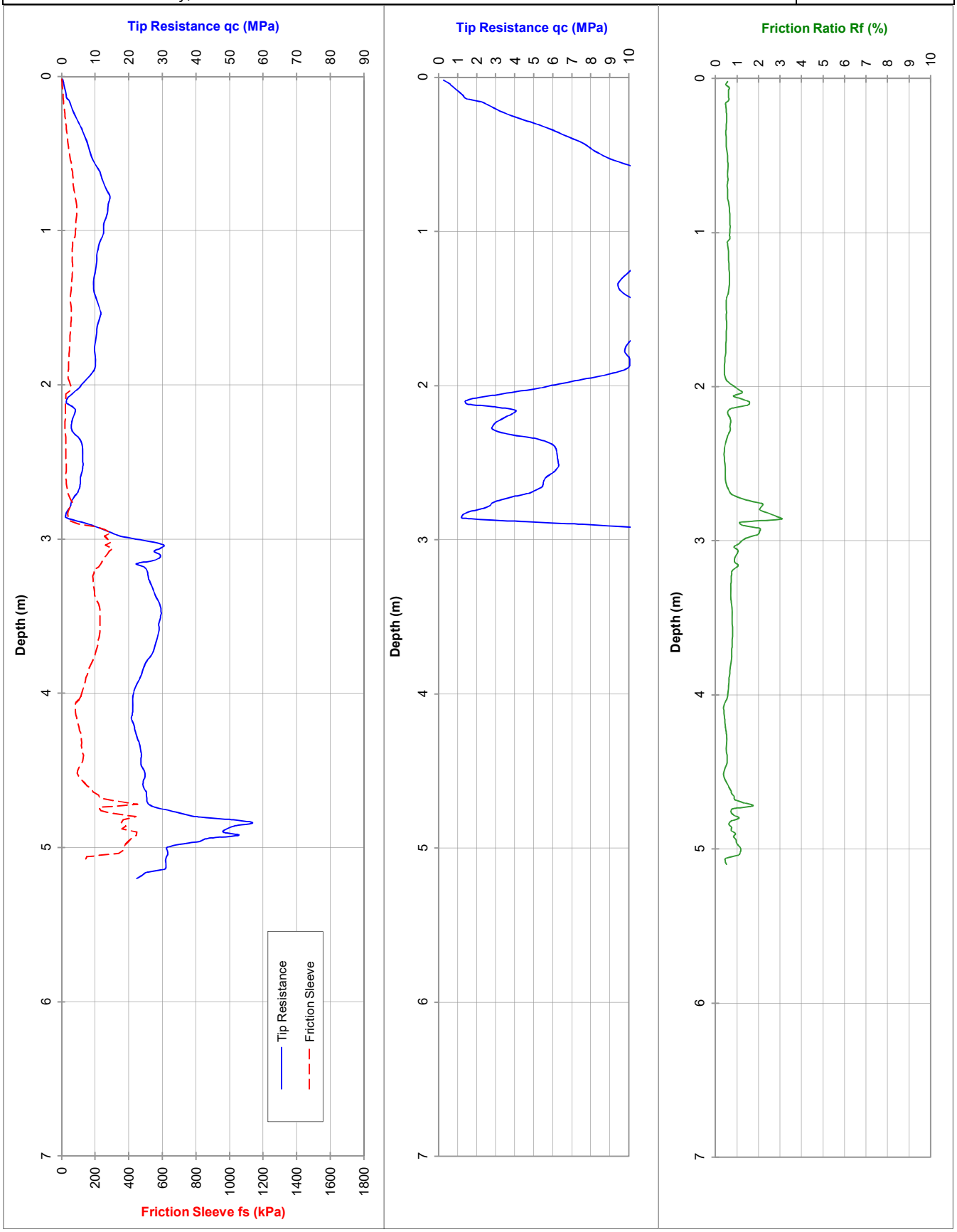
Cone I.D.: EC147

File: WM0164G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 11	**CH37810**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 357794mE; 6278080mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.7

20mm standpipe installed to (m): 3.0

Refusal:

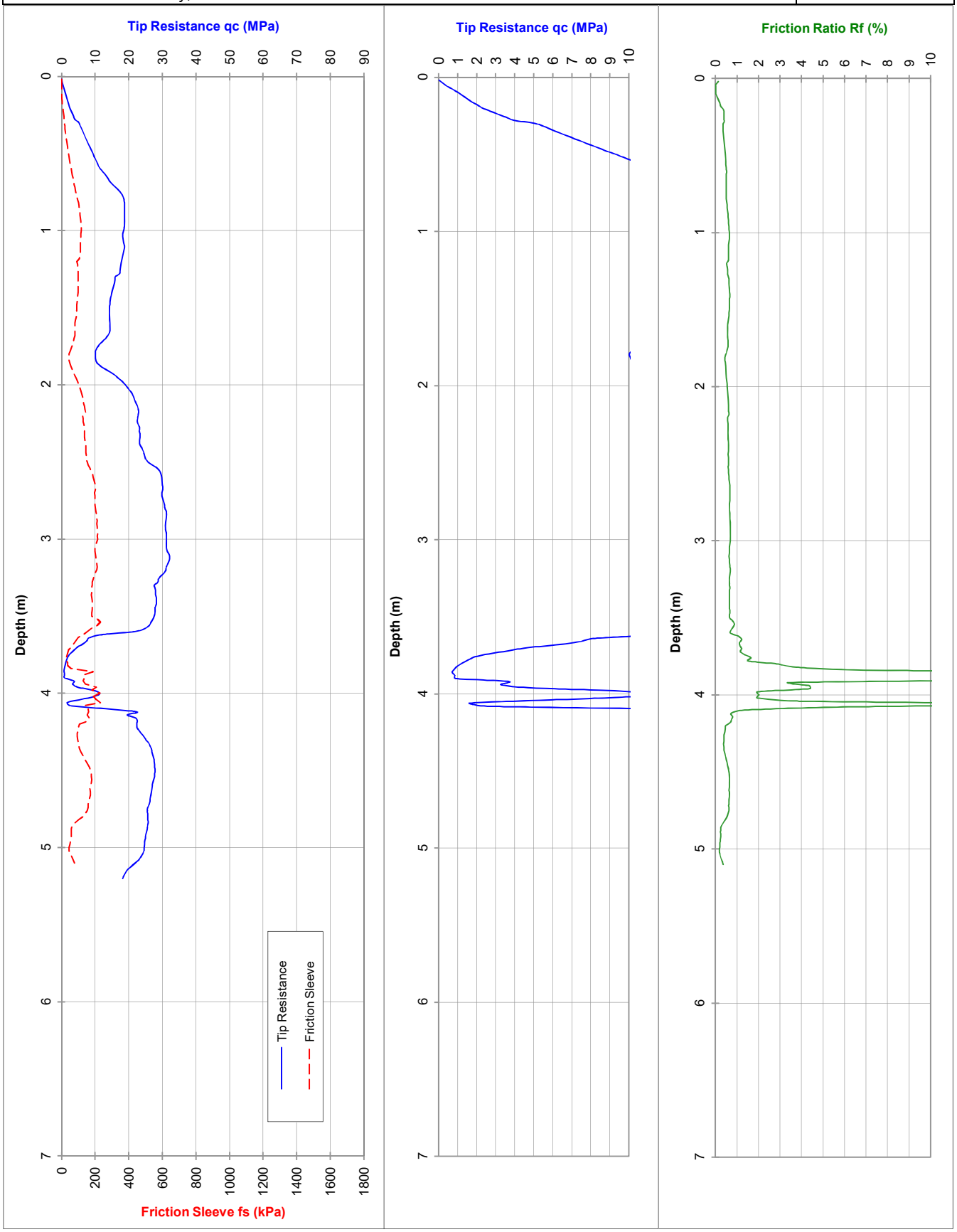
Cone I.D.: EC147

File: WM0165G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 11.75	**CH37970**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 357680mE; 6277971mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 2.05

Dummy probe to (m):

Refusal:

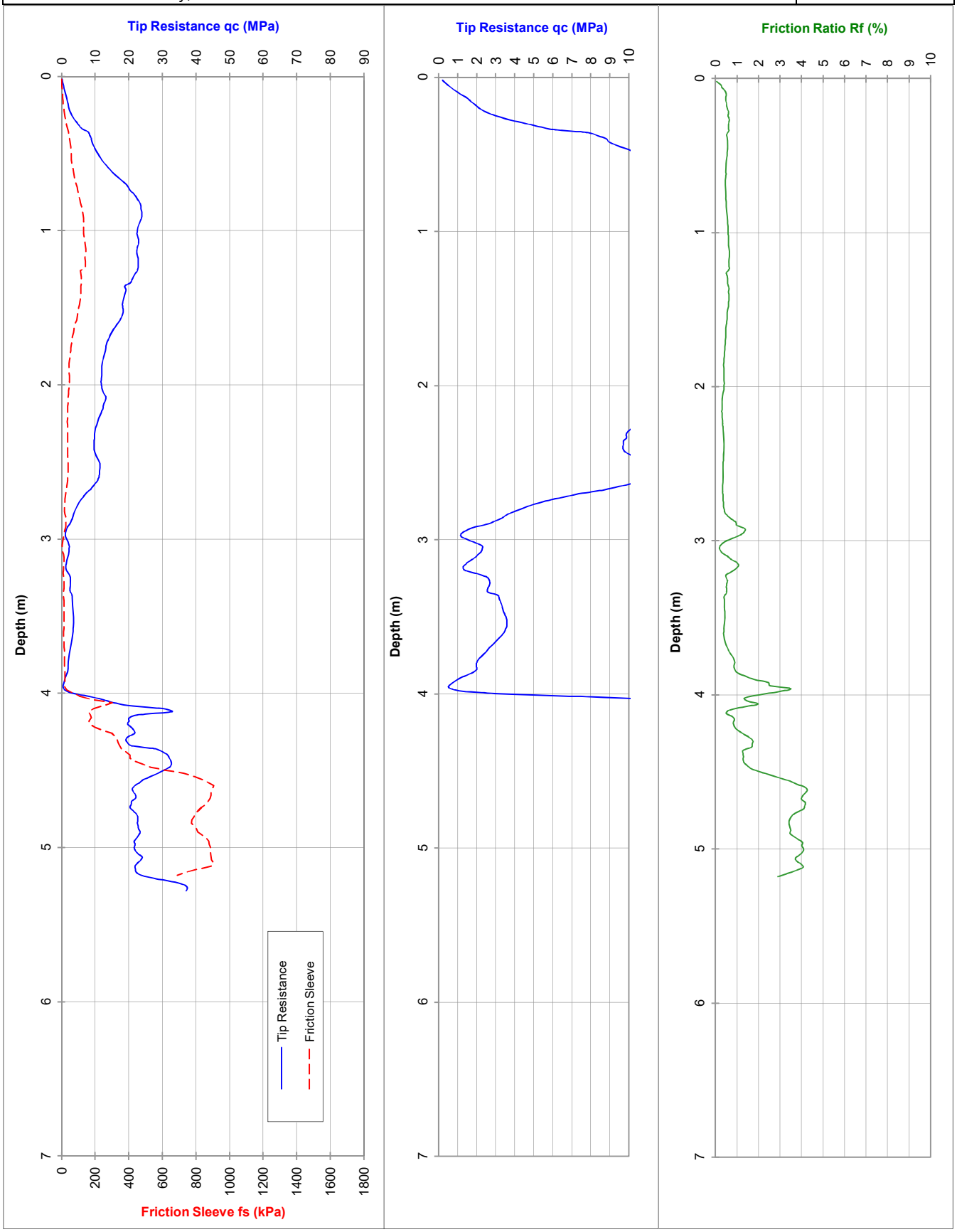
Cone I.D.: EC147

File: WM0166G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 10.75	**CH38400**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 357369mE; 6277674mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 2.0

Dummy probe to (m):

Refusal:

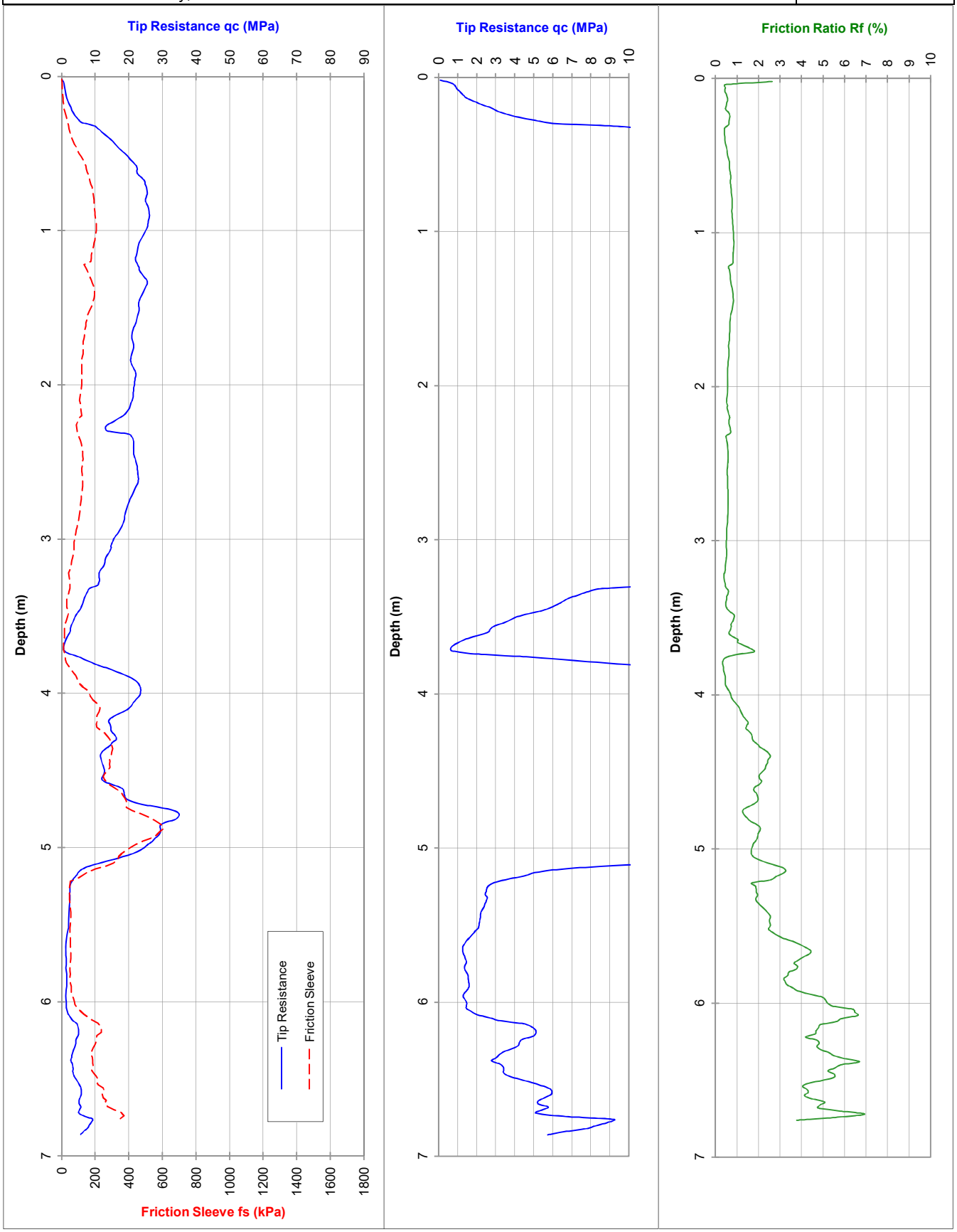
Cone I.D.: EC147

File: WM0167G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9.5	**CH38730**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 357125mE; 6277447mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 2.0

20mm standpipe installed to (m): 4.05

Refusal:

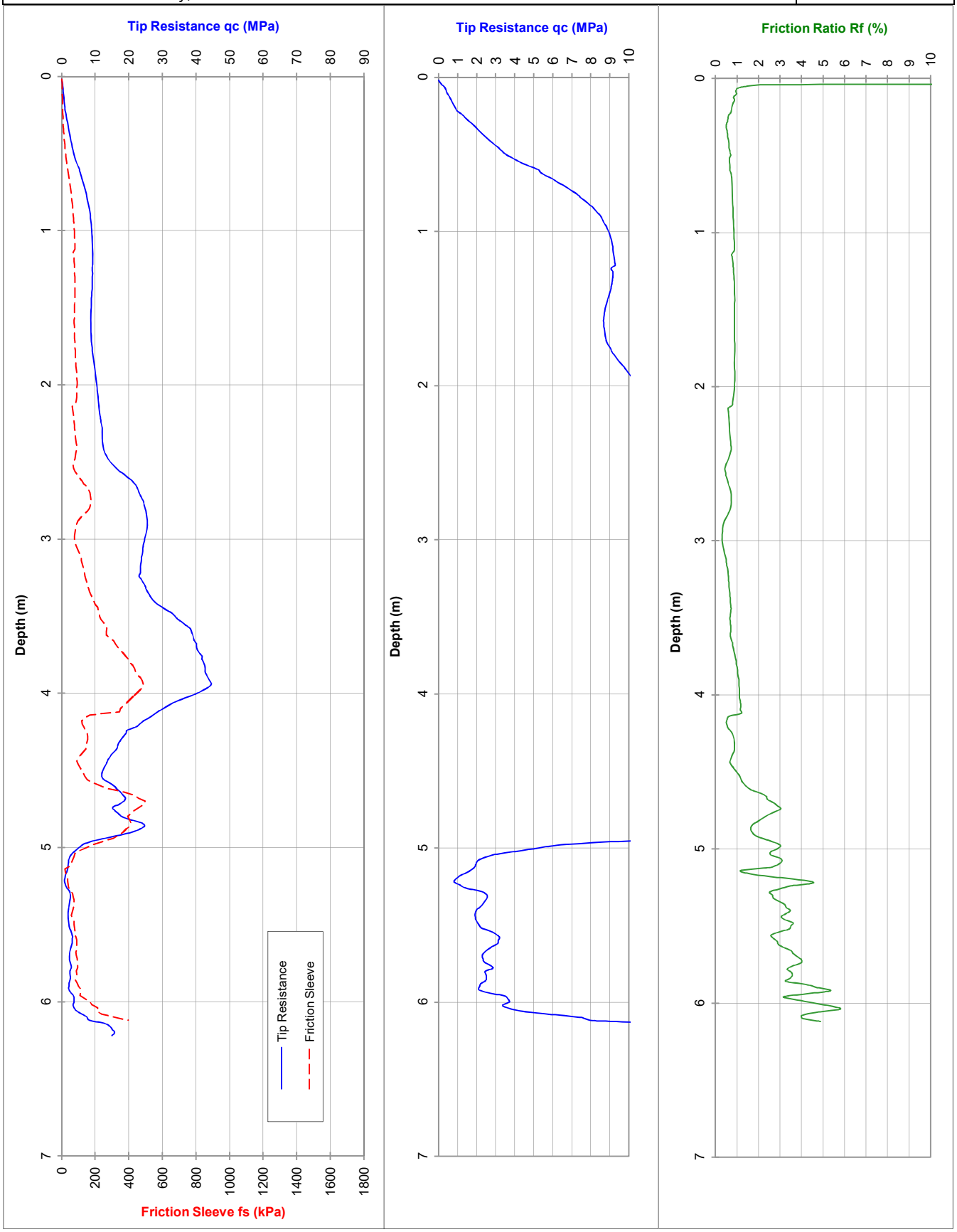
Cone I.D.: EC147

File: WM0168G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9.75	**CH38820**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 357056mE; 6277395mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 2.65

Dummy probe to (m):

Refusal:

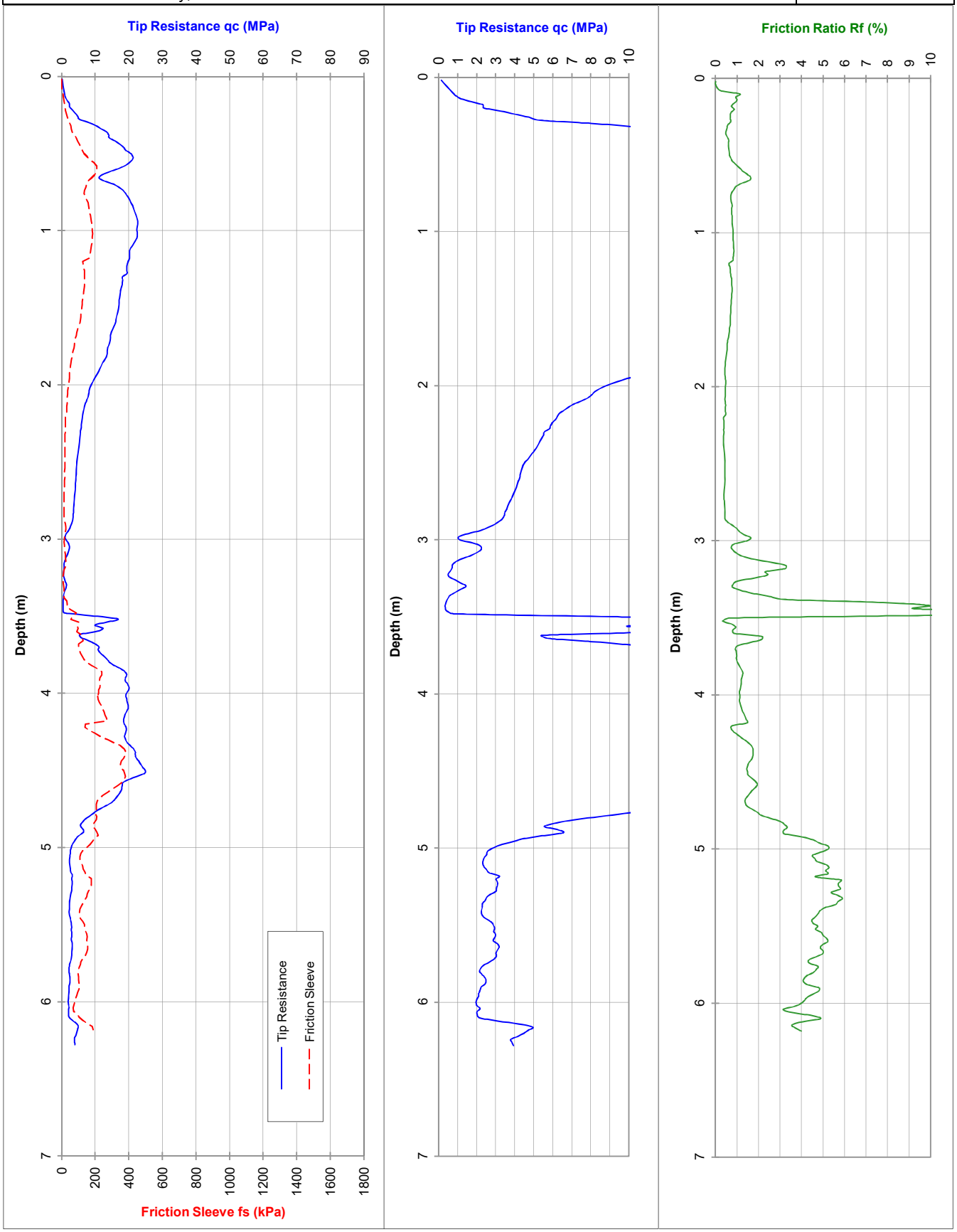
Cone I.D.: EC147

File: WM0169G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9.5	**CH38950**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 356971mE; 6277293mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 2.0

Dummy probe to (m):

Refusal:

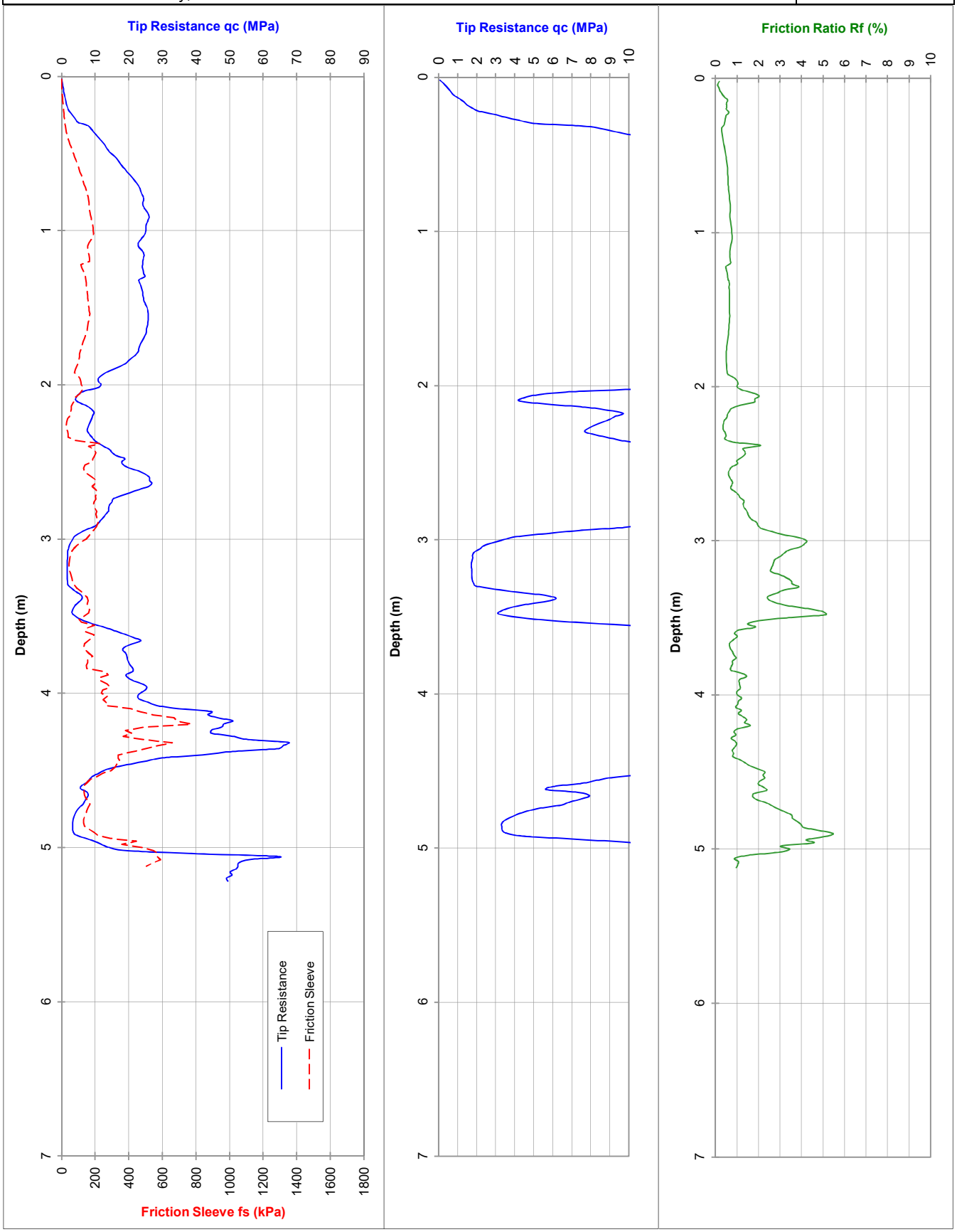
Cone I.D.: EC147

File: WM0170G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9.5	**CH39360**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 356666mE; 6277018mN	12-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.75

Dummy probe to (m):

Refusal:

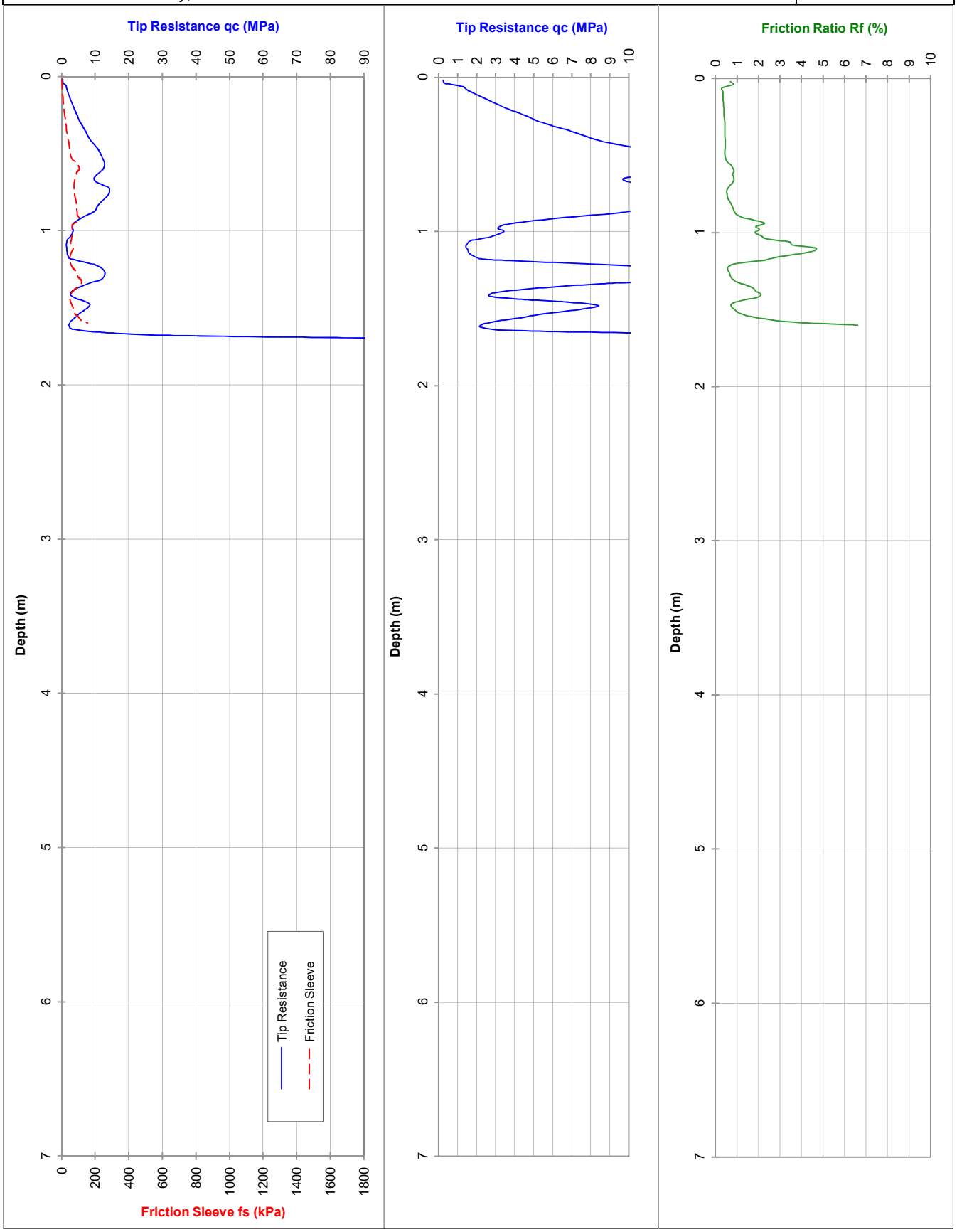
Cone I.D.: EC147

File: WM0171G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9	**CH39500**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 356556mE; 6276918mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.0

Dummy probe to (m):

Refusal: 100MPa

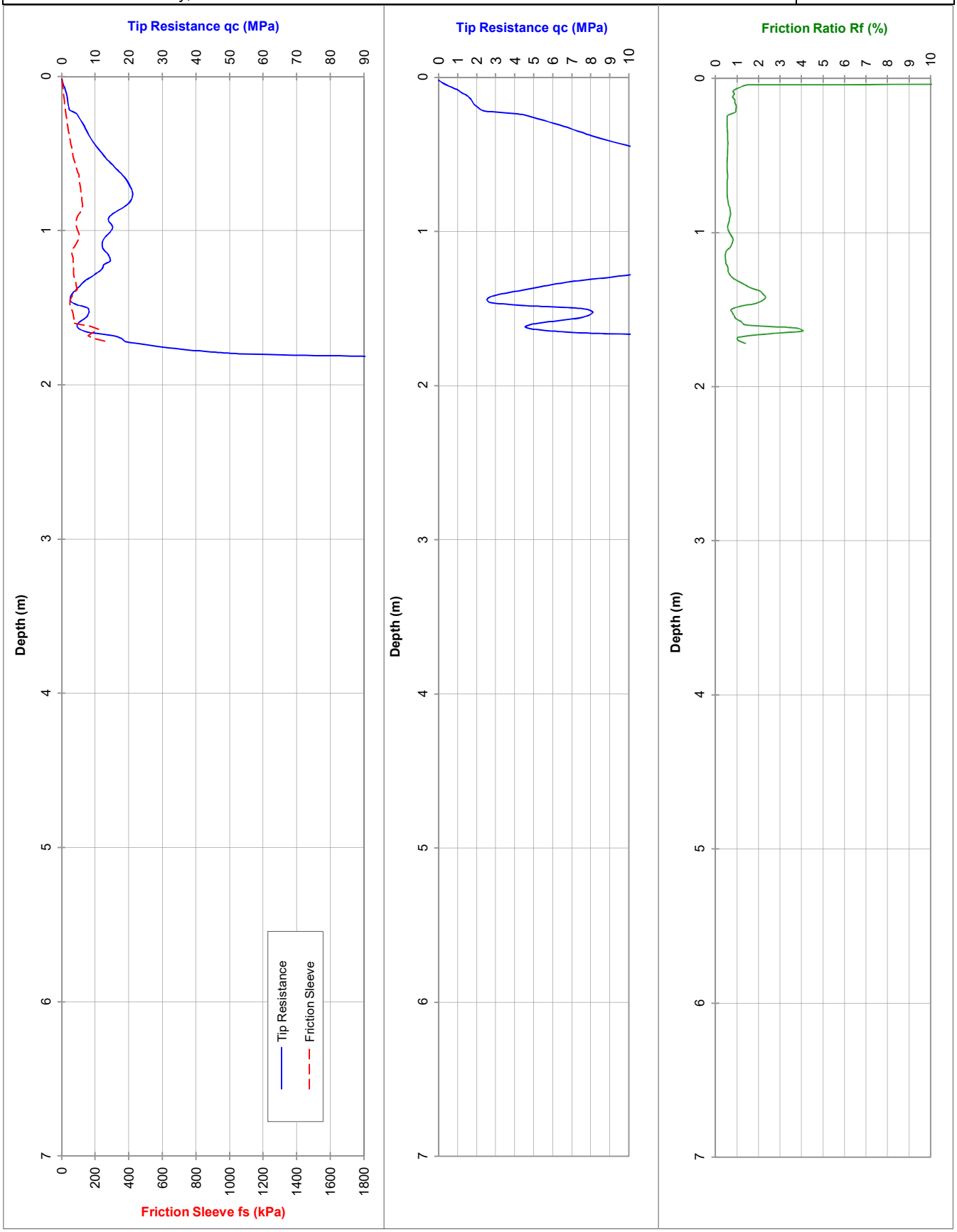
Cone I.D.: EC147

File: WM0172G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9	**CH39500A**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 356556mE; 6276918mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.1

Dummy probe to (m):

Refusal: 101MPa

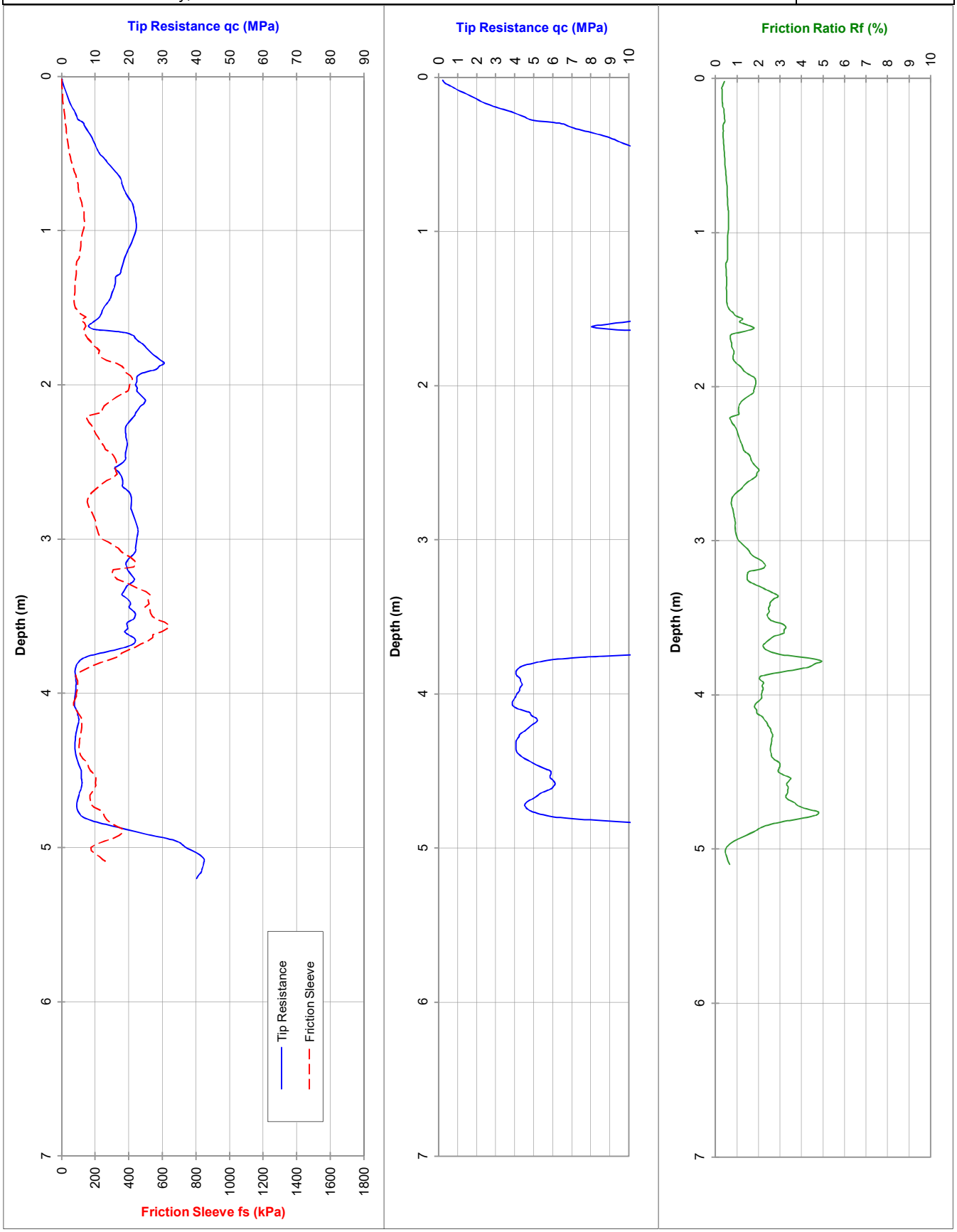
Cone I.D.: EC147

File: WM0173G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 9	**CH39880**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 356262mE; 6276693mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.3

Dummy probe to (m):

Refusal:

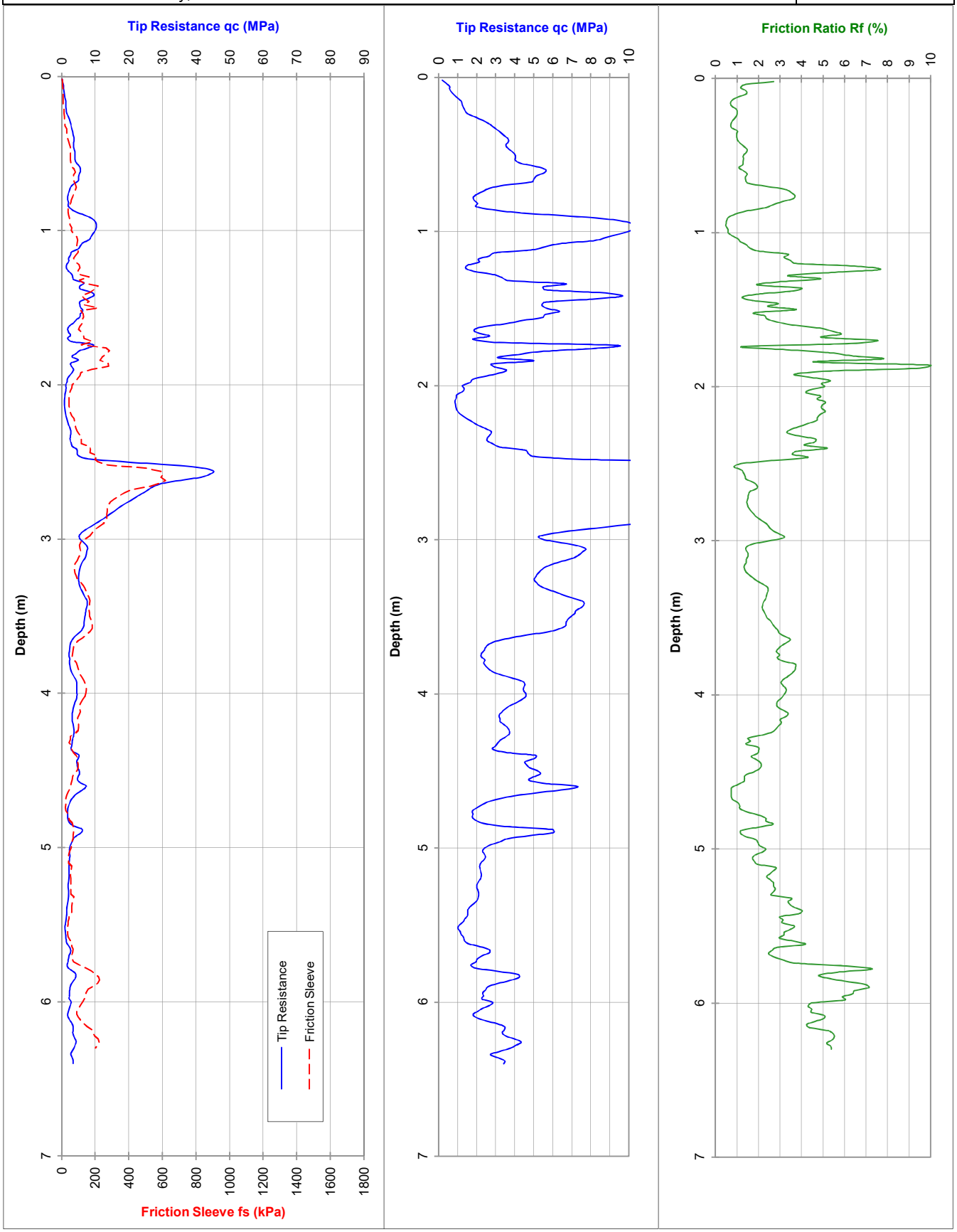
Cone I.D.: EC147

File: WM0174G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 8.75	**CH40225**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 355974mE; 6276499mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.3

20mm standpipe installed to (m): 3.7

Refusal:

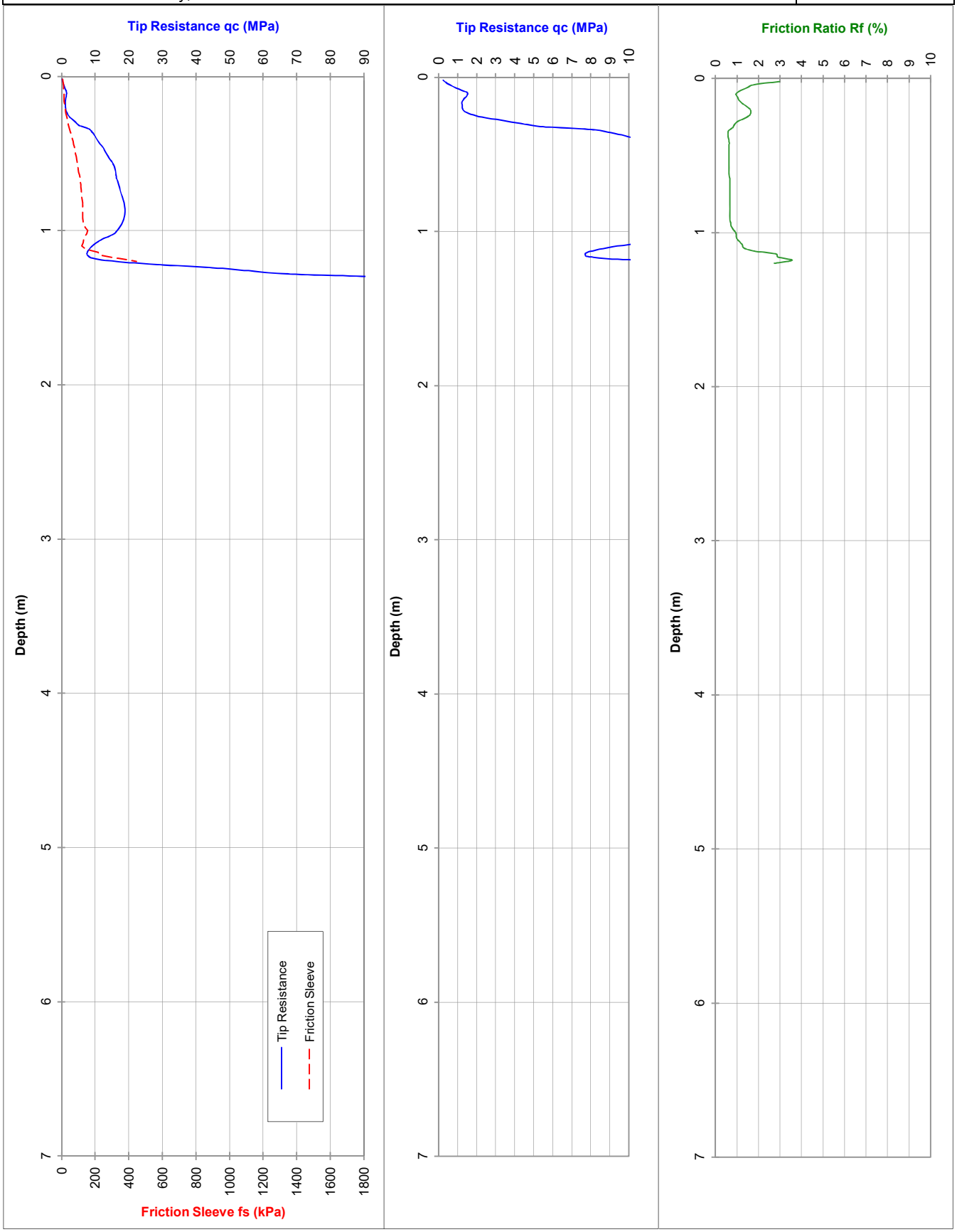
Cone I.D.: EC147

File: WM0175G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 8.75	**CH40850**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 355476mE; 6276131mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 1.3

Dummy probe to (m):

Refusal: 95MPa

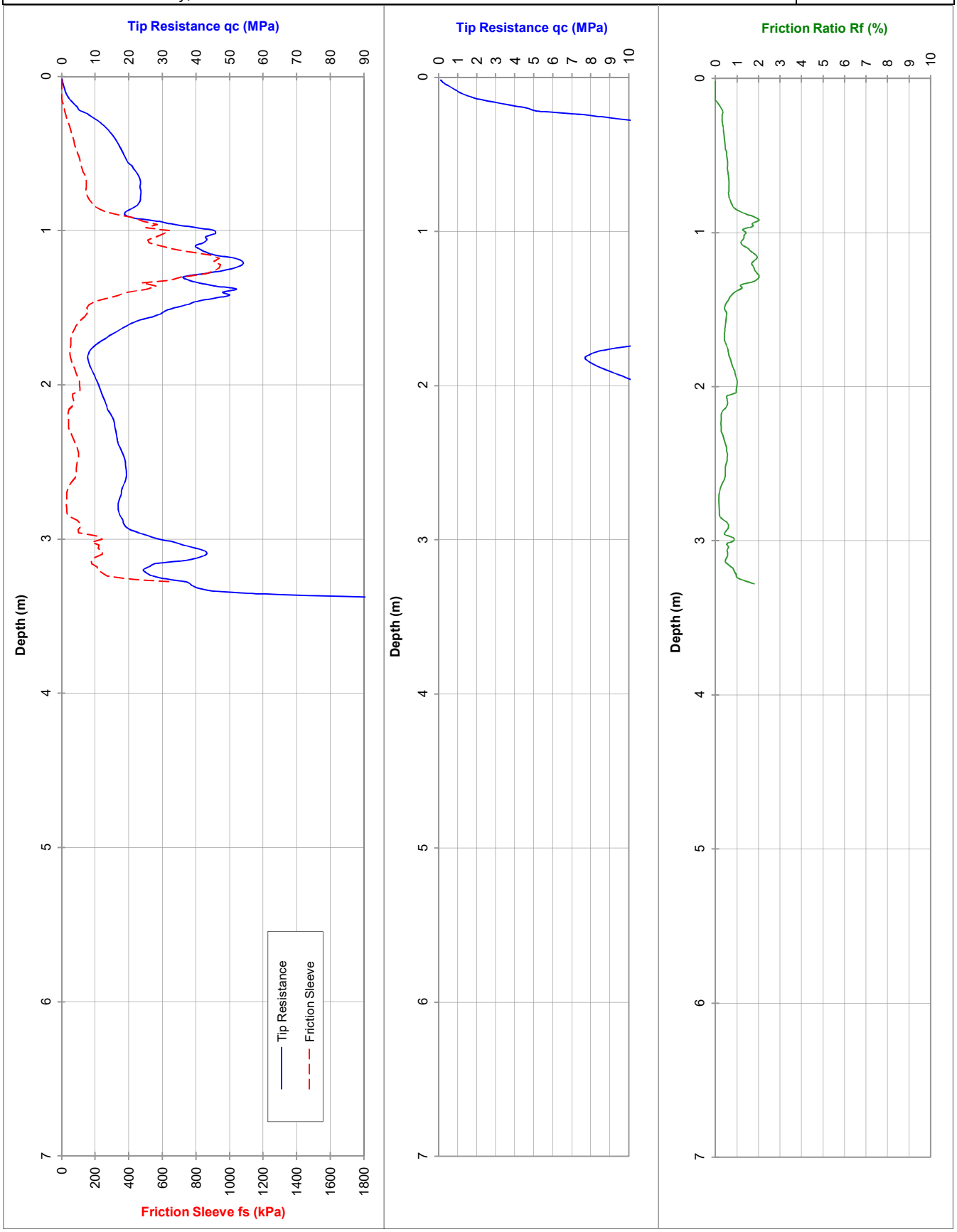
Cone I.D.: EC147

File: WM0176G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 8.75	**CH40850A**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 355476mE; 6276131mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.3

Dummy probe to (m):

Refusal: 95MPa

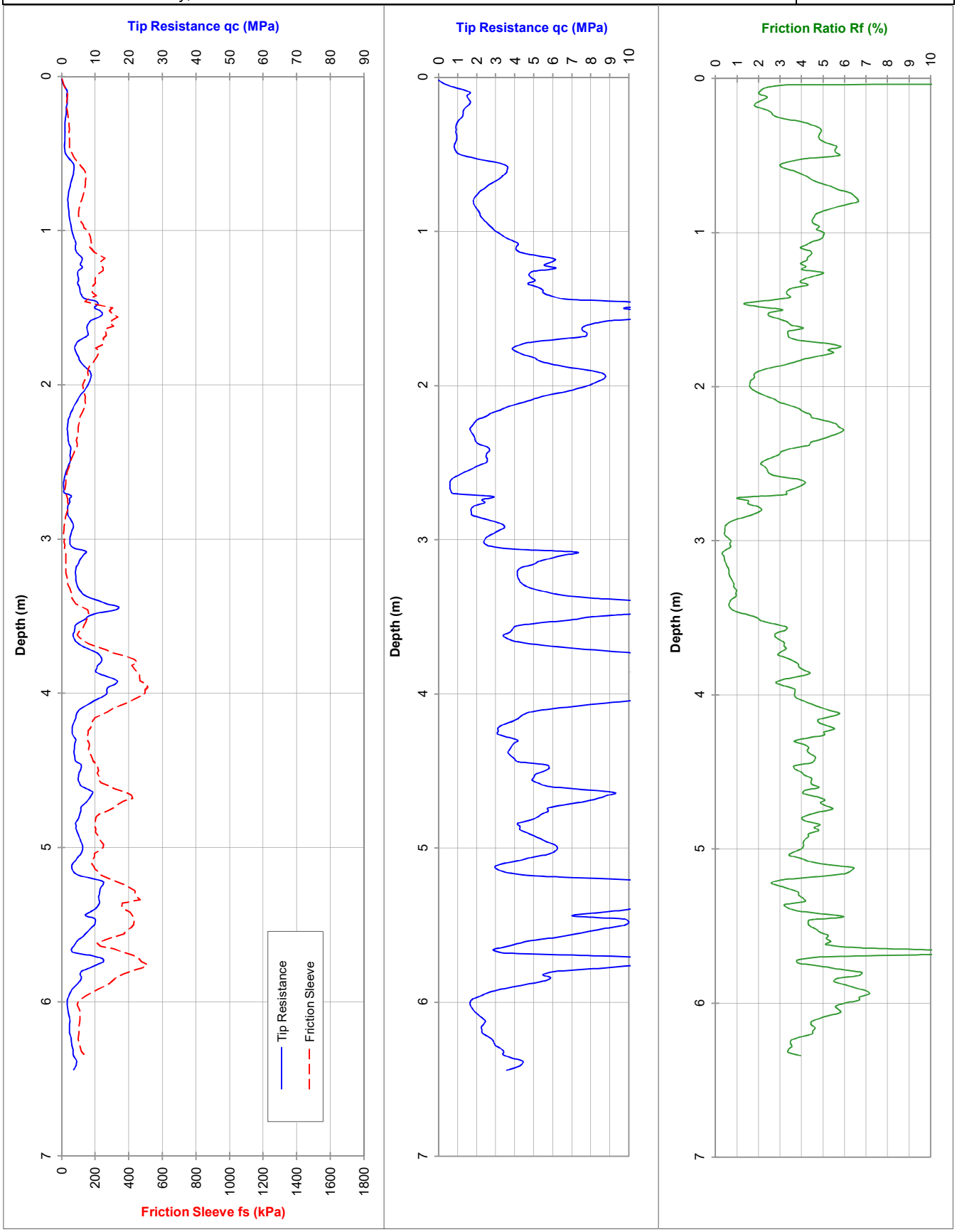
Cone I.D.: EC147

File: WM0177G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 7.25	**CH41660**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 354759mE; 6275756mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 2.7

20mm standpipe installed to (m): 4.1

Refusal:

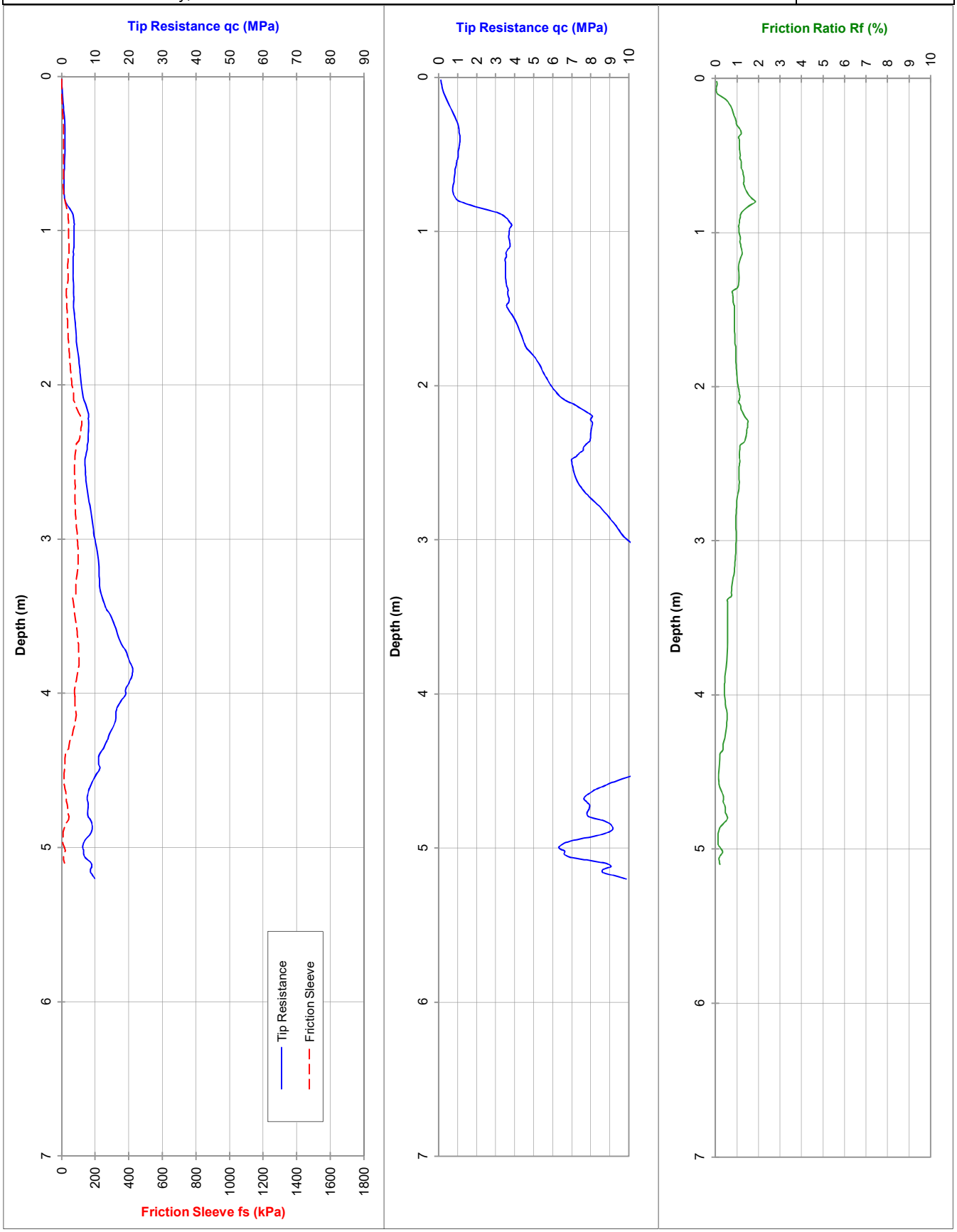
Cone I.D.: EC147

File: WM0178G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 7.5	**CH43275**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 353409mE; 6274890mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): Dry to 2.9

20mm standpipe installed to (m): 2.5

Refusal:

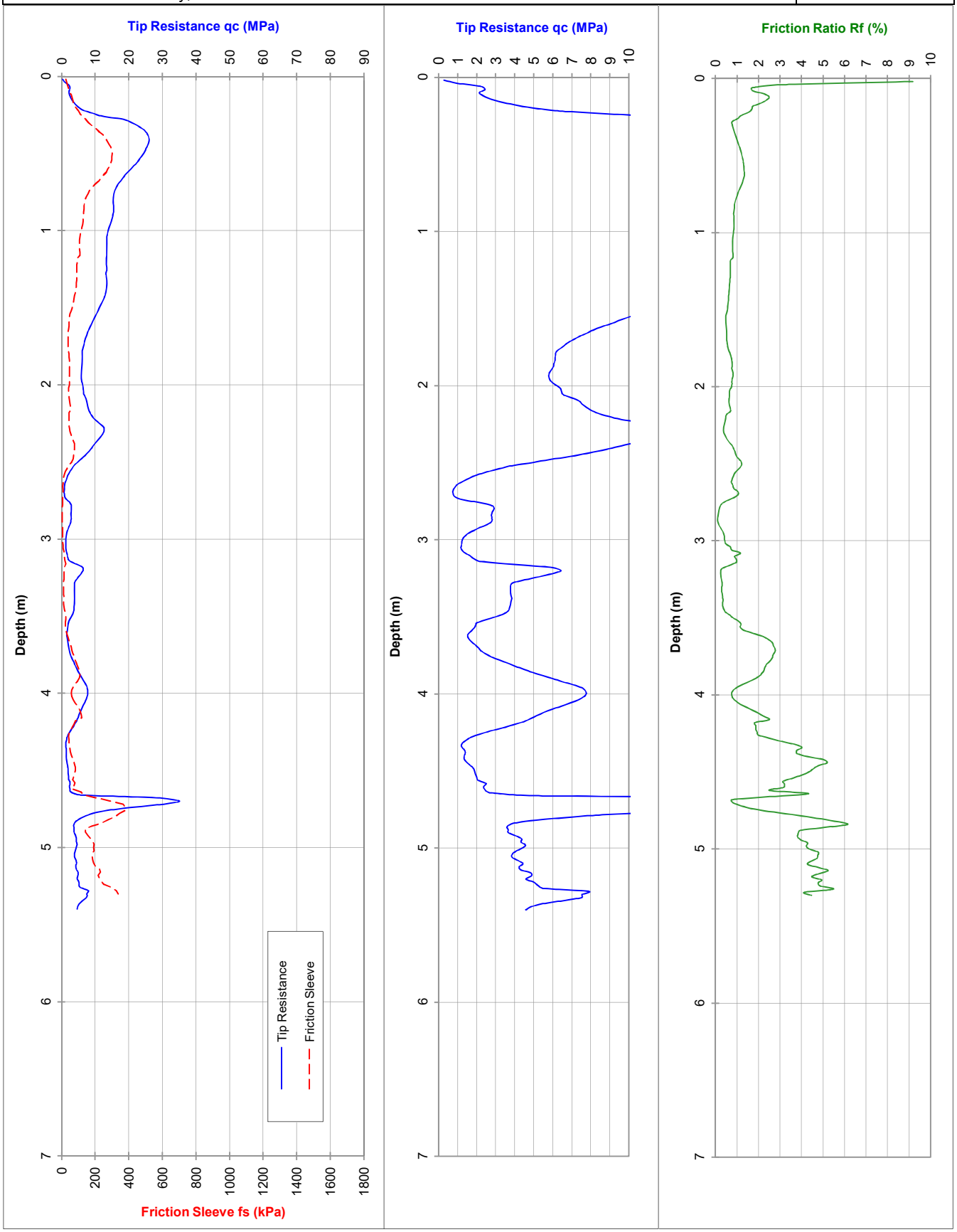
Cone I.D.: EC147

File: WM0179G

Rig Type: 22 tonne truck (Merc)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Main Roads Western Australia	Job No.: 6897	Probe I.D
PROJECT: Bussell Hwy Duplication	RL (m): 5	**CH43755**
LOCATION: Bussell Hwy, Hutton to Sabina	Co-ords: 352945mE; 6274795mN	13-Apr-16



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. Water (m): 1.6

20mm standpipe installed to (m): 2.4

Refusal:

Cone I.D.: EC147

File: WM0180G

Rig Type: 22 tonne truck (Merc)

APPENDIX C

LABORATORY TEST RESULTS

CIVITEST Australia

TEST REPORT

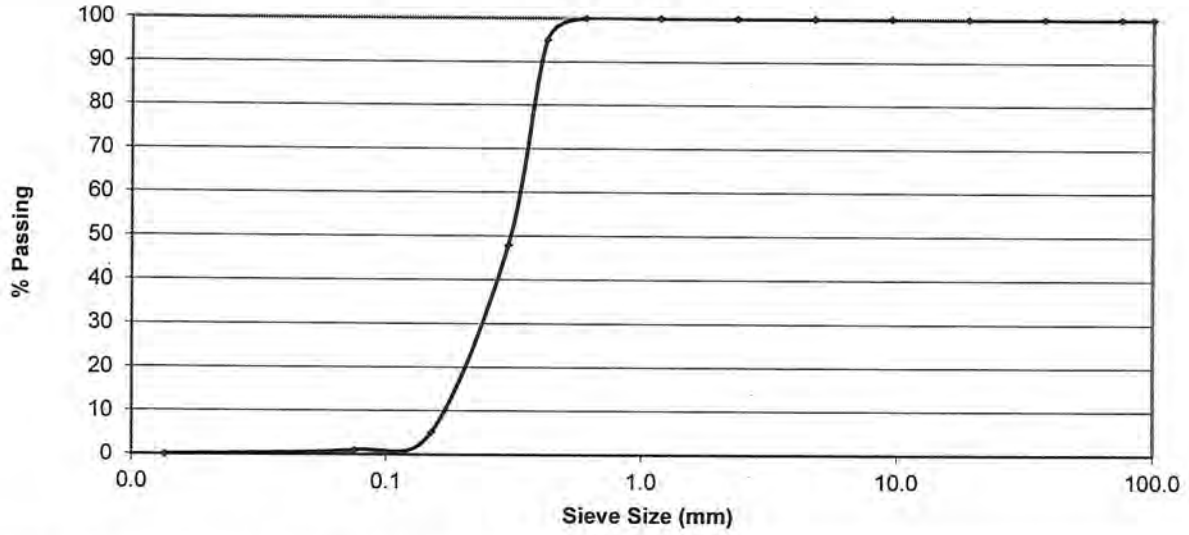
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 31200.

SAMPLE NO: CT 57036
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.1 - 0.4m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	100
19.0 mm	100	0.425 mm	95
9.50 mm	100	0.300 mm	48
4.75 mm	100	0.150 mm	5
2.36 mm	100	0.075 mm	1
		0.0135 mm	0

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =24.2%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57036 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

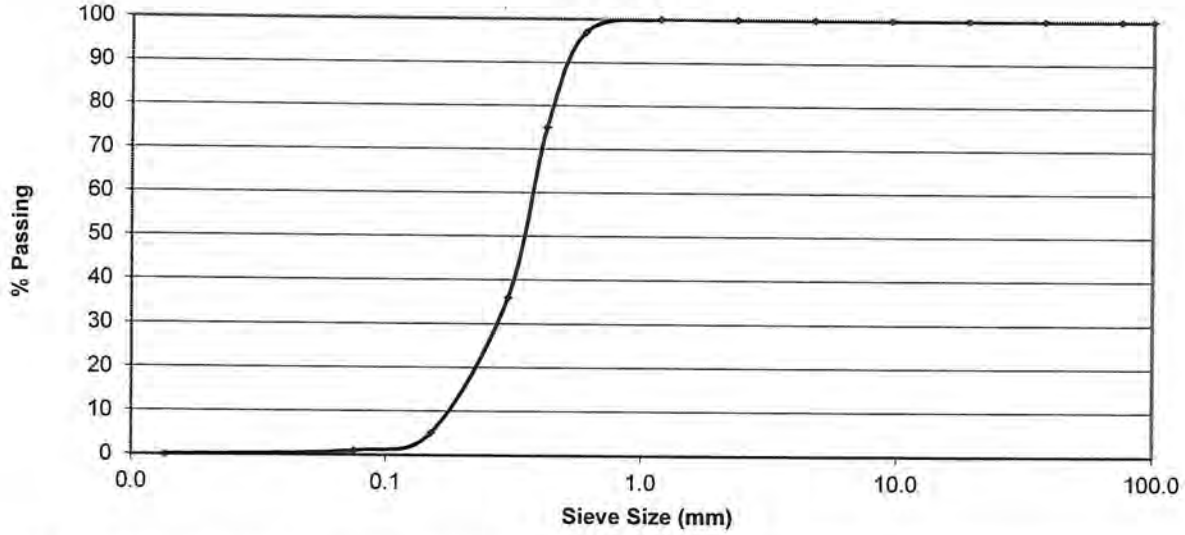
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 31740.

SAMPLE NO: CT 57038
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.2 - 0.4m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	97
19.0 mm	100	0.425 mm	75
9.50 mm	100	0.300 mm	36
4.75 mm	100	0.150 mm	5
2.36 mm	100	0.075 mm	1
		0.0135 mm	0

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =26.9%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57038 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

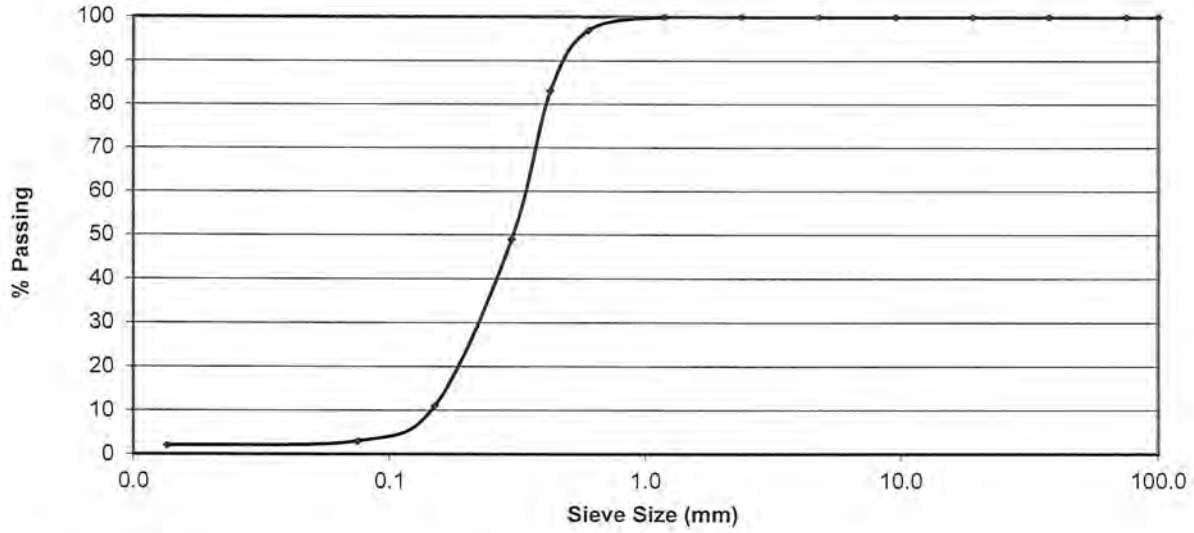
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 32000.

SAMPLE NO: CT 57031
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 1.0 - 1.3m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	97	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	83	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	49	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	11	Length of Mould mm	250
2.36 mm	100	0.075 mm	3	Sample history	Air Dried
		0.0135 mm	2	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57031 / 1

NATA
WORLD RECOGNISED ACCREDITATION

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

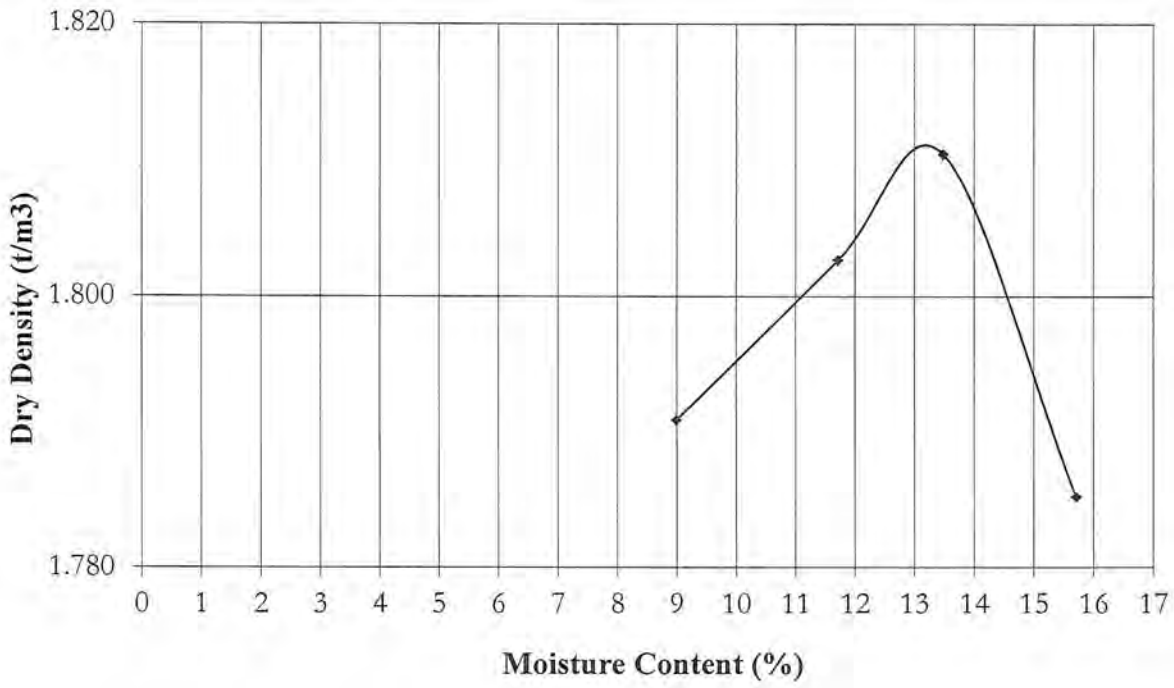
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 32000.

SAMPLE NO: CT 57014
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 21-Apr-16
DEPTH mm: 1.0 - 1.3m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.811 **OMC (%)** 13.2



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57014 / 1

NATA
WORLD RECOGNISED ACCREDITATION

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 32000.

SAMPLE NO: CT 57014
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 29-Apr-16
DEPTH mm: 1.0 - 1.3m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.81	95.0
OMC (%)	13.0	100.0
Compactive Effort Used		
Blows per Layer (Average)	18	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	12.9	97.5
Top 30mm	14.9	113.0
Remainder	16.4	124.5
Entire Sample	16.5	125.0
Dry Density (t/m^3)		
At Compaction	1.72	95.0
After Soaking	1.72	95.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	35	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57014 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 32500.

SAMPLE NO: CT 57023
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 28-Apr-16
DEPTH: 2.6 - 2.9m

PARTICLE SIZE DISTRIBUTION

WA 115.1

PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	98	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	87	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	57	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	14	Length of Mould mm	250
2.36 mm	100	0.075 mm	5	Sample history	Air Dried
		0.0135 mm	4	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57023 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

CIVITEST Australia

TEST REPORT

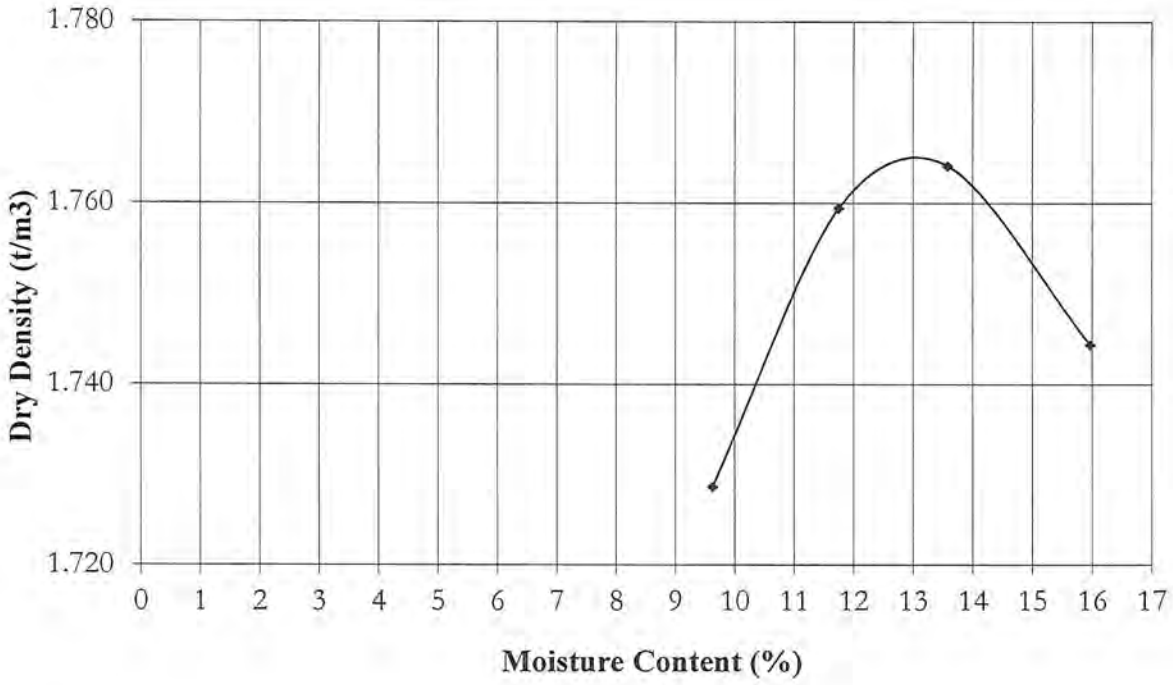
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 32500.

SAMPLE NO: CT 57015
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 21-Apr-16
DEPTH mm: 2.6 - 2.9m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.765 **OMC (%)** 13.0



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57015 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 32500.

SAMPLE NO: CT 57015
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 23-Apr-16
DEPTH mm: 2.6 - 2.9m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.77	95.0
OMC (%)	13.0	100.0
Compactive Effort Used		
Blows per Layer (Average)	18	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	12.9	99.0
Top 30mm	15.4	118.0
Remainder	16.6	127.5
Entire Sample	17.3	133.0
Dry Density (t/m^3)		
At Compaction	1.67	95.0
After Soaking	1.67	95.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	35	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57015 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

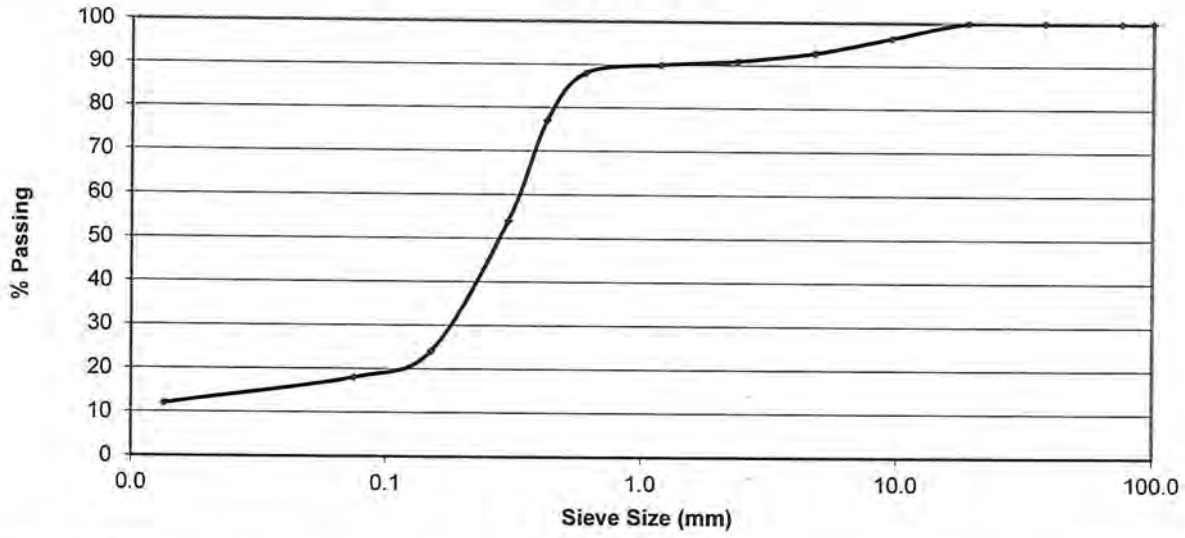
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 32600.

SAMPLE NO: CT 57037
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 2.3 - 2.6m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	90
37.5 mm	100	0.600 mm	88
19.0 mm	100	0.425 mm	77
9.50 mm	96	0.300 mm	54
4.75 mm	93	0.150 mm	24
2.36 mm	91	0.075 mm	18
		0.0135 mm	12

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.8
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57037 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025
This document shall not be reproduced, except in full

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

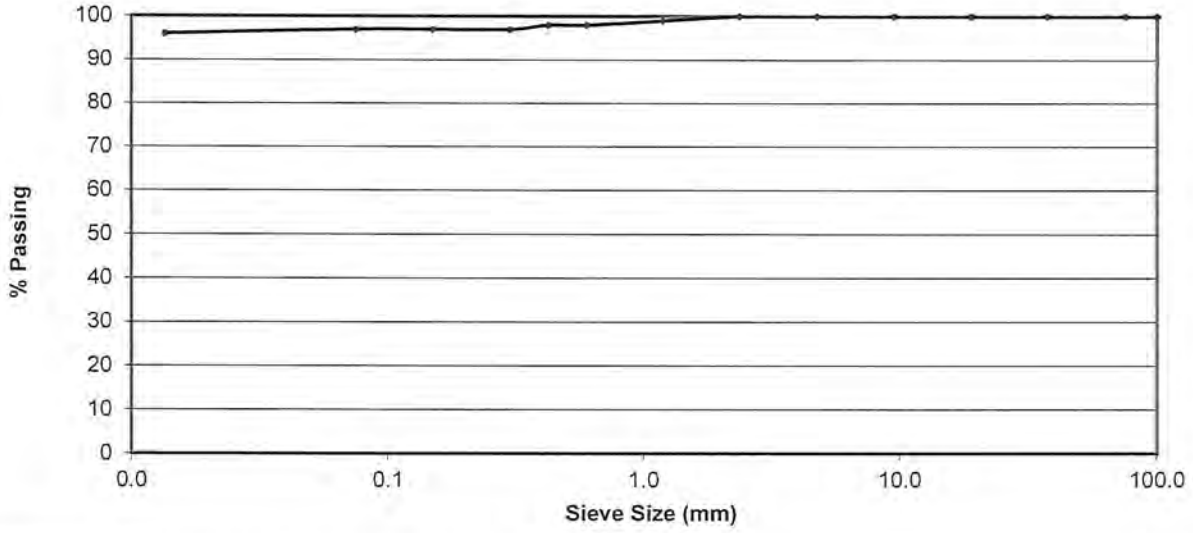
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 32900.

SAMPLE NO: CT 57029
JOB NO: 24-1-413
FIELD DESCRIPTION: CLAY.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 0.1 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	63.9
75.0 mm	100	1.180 mm	99	Plastic Limit % WA 121.1	27.2
37.5 mm	100	0.600 mm	98	Plasticity Index % WA 122.1	36.7
19.0 mm	100	0.425 mm	98	Linear Shrinkage % WA 123.1	11.0
9.50 mm	100	0.300 mm	97	Length of Mould mm	127
4.75 mm	100	0.150 mm	97	Sample history	Air Dried
2.36 mm	100	0.075 mm	97	Sample Preparation Method	Dry Sieved
		0.0135 mm	96	Nature of Shrink	-

Notes:

Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 11-May-16
Report Number: CT 57029 / 1

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025
This document shall not be reproduced, except in full

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

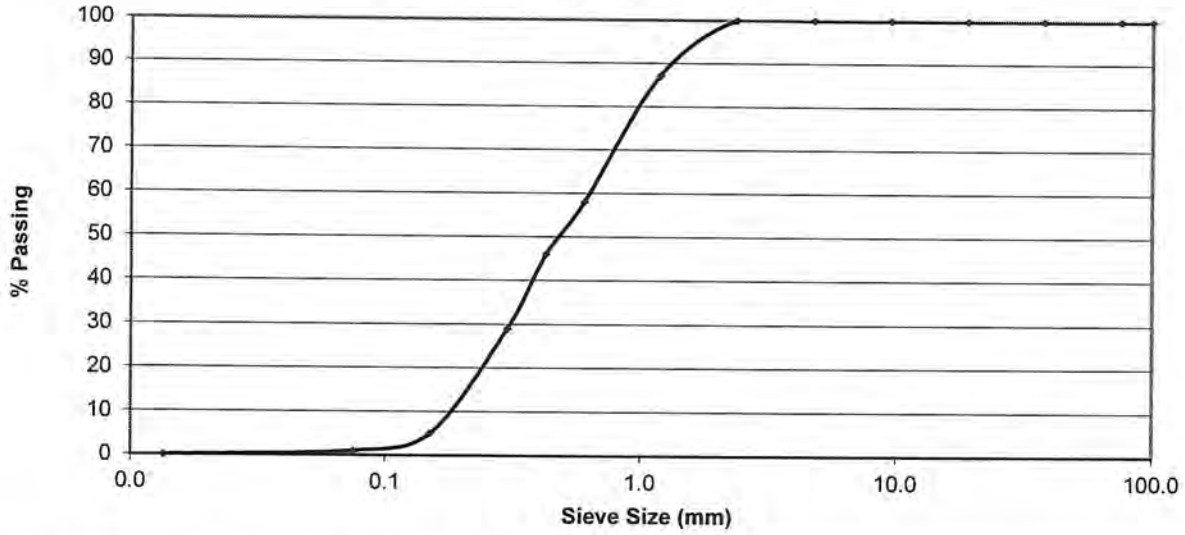
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 33200.

SAMPLE NO: CT 57039
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 2.3 - 2.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	87
37.5 mm	100	0.600 mm	58
19.0 mm	100	0.425 mm	46
9.50 mm	100	0.300 mm	29
4.75 mm	100	0.150 mm	5
2.36 mm	100	0.075 mm	1
		0.0135 mm	0

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =23%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57039 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

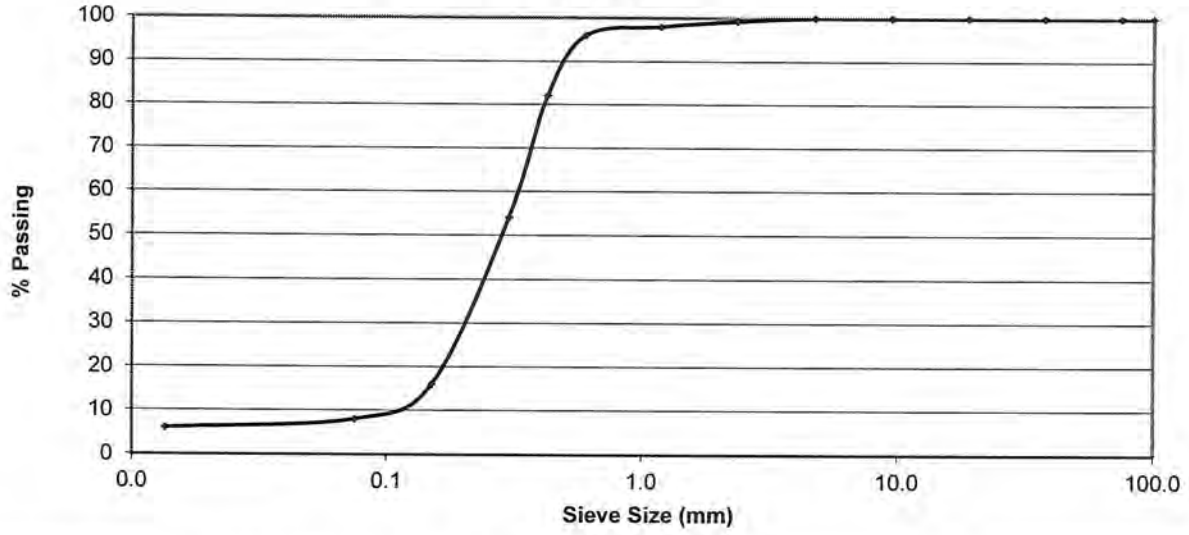
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 33200.

SAMPLE NO: CT 57035
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 3.8 - 4.0m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	98
37.5 mm	100	0.600 mm	96
19.0 mm	100	0.425 mm	82
9.50 mm	100	0.300 mm	54
4.75 mm	100	0.150 mm	16
2.36 mm	99	0.075 mm	8
		0.0135 mm	6

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =22.3%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57035 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

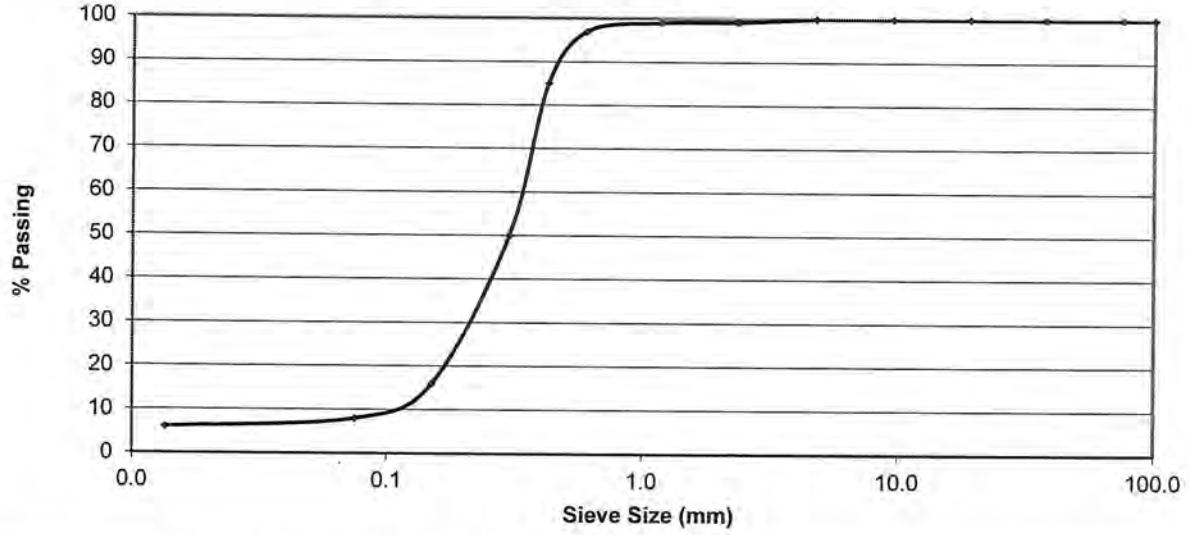
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 33320.

SAMPLE NO: CT 57033
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 3.7 - 4.0m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	99
37.5 mm	100	0.600 mm	97
19.0 mm	100	0.425 mm	85
9.50 mm	100	0.300 mm	50
4.75 mm	100	0.150 mm	16
2.36 mm	99	0.075 mm	8
		0.0135 mm	6

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =24.2%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57033 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

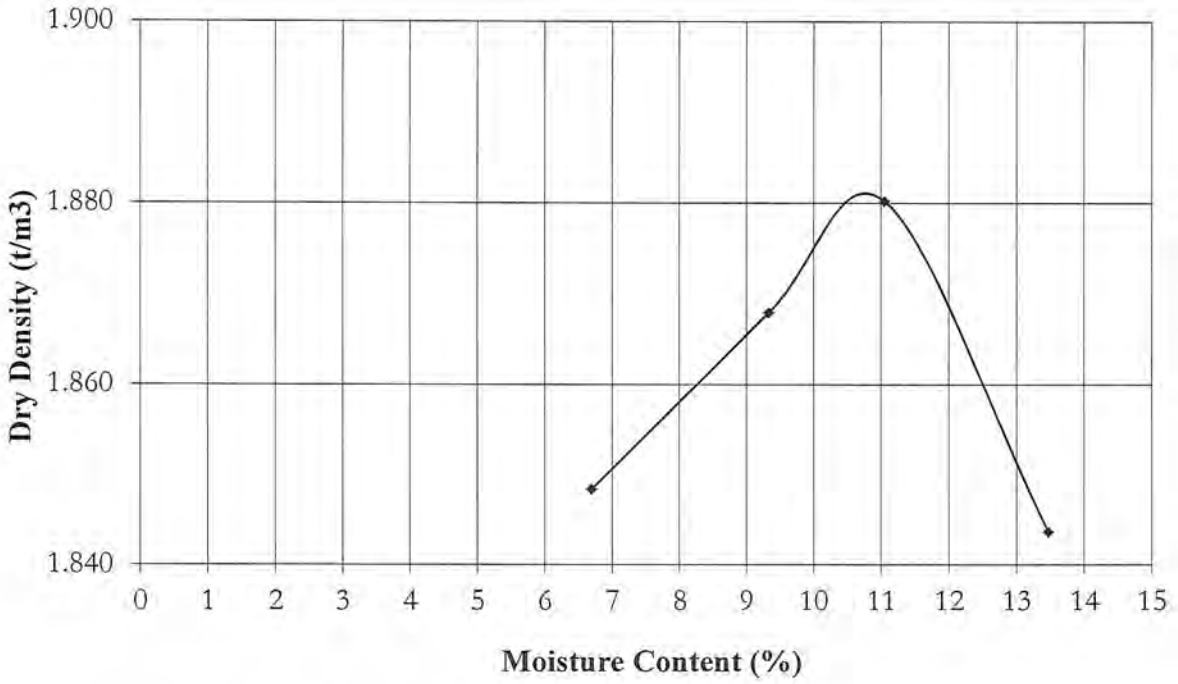
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 33320.

SAMPLE NO: CT 57016
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 21-Apr-16
DEPTH mm: -

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.881 **OMC (%)** 10.8



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57016 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 33320.

SAMPLE NO: CT 57016
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 23-Apr-16
DEPTH mm: -

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.88	95.0
OMC (%)	11.0	100.0
Compactive Effort Used		
Blows per Layer (Average)	18	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	10.8	99.0
Top 30mm	13.7	126.0
Remainder	12.8	118.5
Entire Sample	14.3	132.0
Dry Density (t/m^3)		
At Compaction	1.78	95.0
After Soaking	1.78	95.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	45	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57016 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

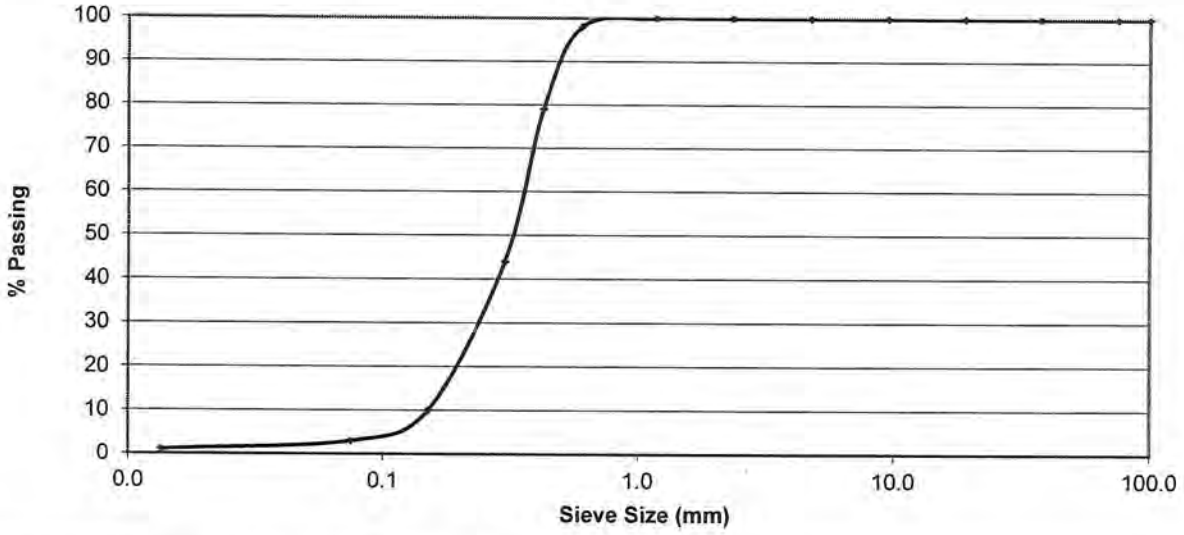
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 33600.

SAMPLE NO: CT 57034
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 1.3 - 1.6m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	98	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	79	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	44	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	10	Length of Mould mm	250
2.36 mm	100	0.075 mm	3	Sample history	Air Dried
		0.0135 mm	1	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =24.5%
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 09-May-16
Report Number: CT 57034 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025
This document shall not be reproduced, except in full

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

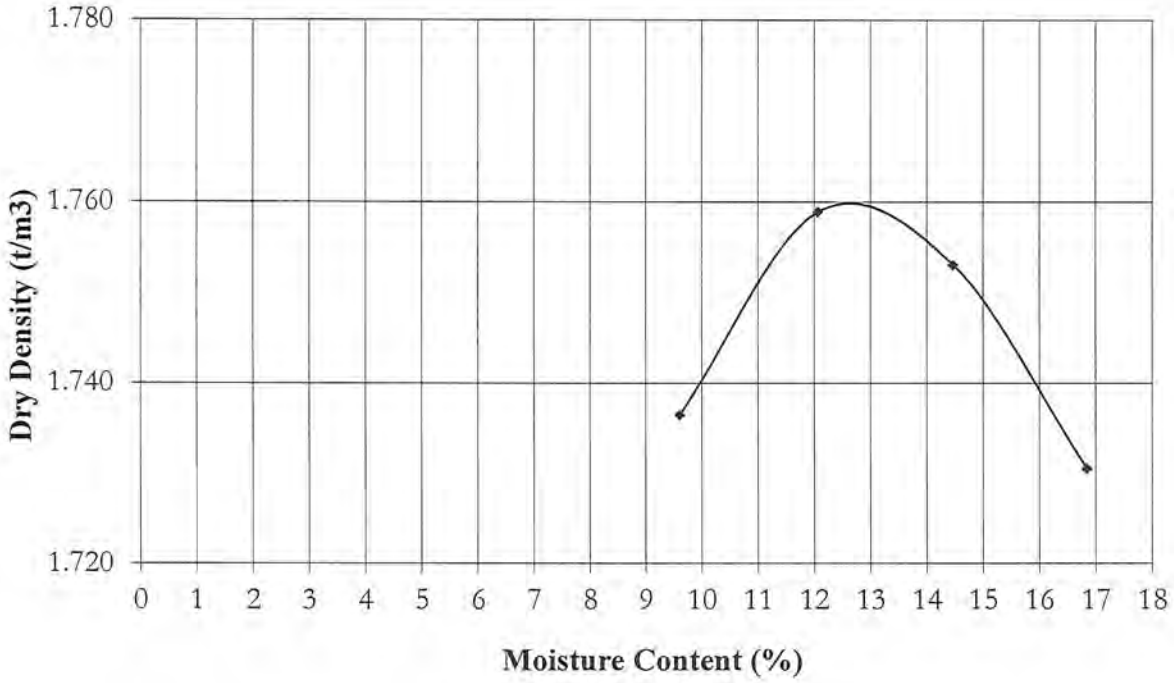
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 33600.

SAMPLE NO: CT 57017
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 21-Apr-16
DEPTH mm: -

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.760 **OMC (%)** 12.7



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57017 / 1

NATA Accredited Laboratory No. 14165 Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 33600.

SAMPLE NO: CT 57017
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 23-Apr-16
DEPTH mm: -

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.76	95.0
OMC (%)	12.5	100.0
Compactive Effort Used		
Blows per Layer (Average)	18	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	12.6	99.5
Top 30mm	15.5	122.5
Remainder	15.7	123.5
Entire Sample	17.1	134.5
Dry Density (t/m^5)		
At Compaction	1.67	95.0
After Soaking	1.68	95.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	40	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57017 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 33800.

SAMPLE NO: CT 57025
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 1.5 - 1.8m

PARTICLE SIZE DISTRIBUTION

WA 115.1

PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	98	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	85	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	57	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	18	Length of Mould mm	250
2.36 mm	100	0.075 mm	6	Sample history	Air Dried
		0.0135 mm	3	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57025 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

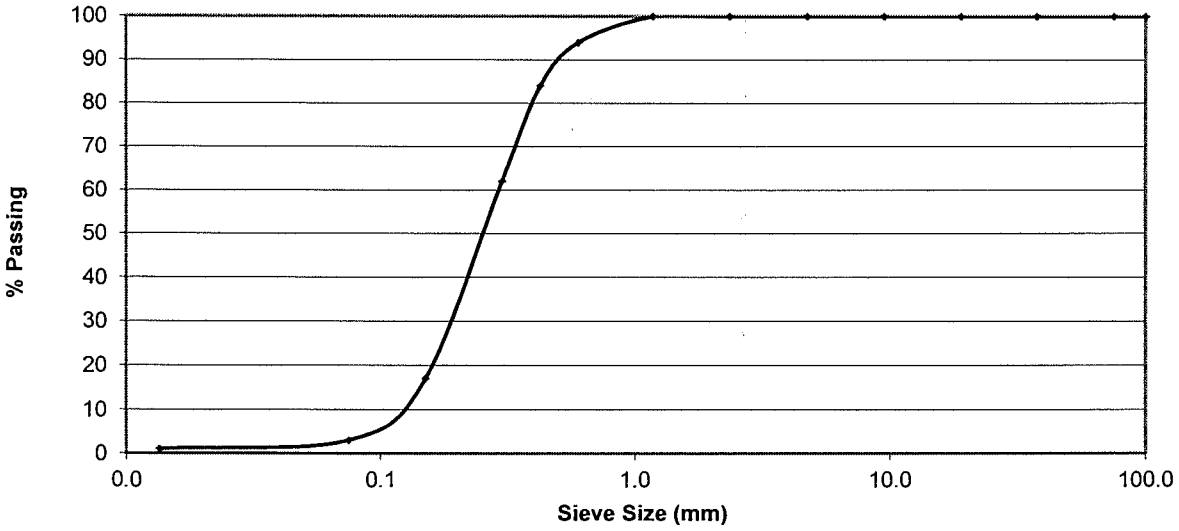
PROPOSED USE: -
CLIENT REF: CH 34315

SAMPLE NO: CT 57026
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 28-Apr-16
DEPTH: 0.3 - 0.60m

This test report is a re-issue and replaces previous test report CT 57026 / 1

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	94
19.0 mm	100	0.425 mm	84
9.50 mm	100	0.300 mm	62
4.75 mm	100	0.150 mm	17
2.36 mm	100	0.075 mm	3
		0.0135 mm	1

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: S. McMahon
Date: 16-May-16
Report Number: CT 57026 / 2

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

CIVITEST Australia

TEST REPORT

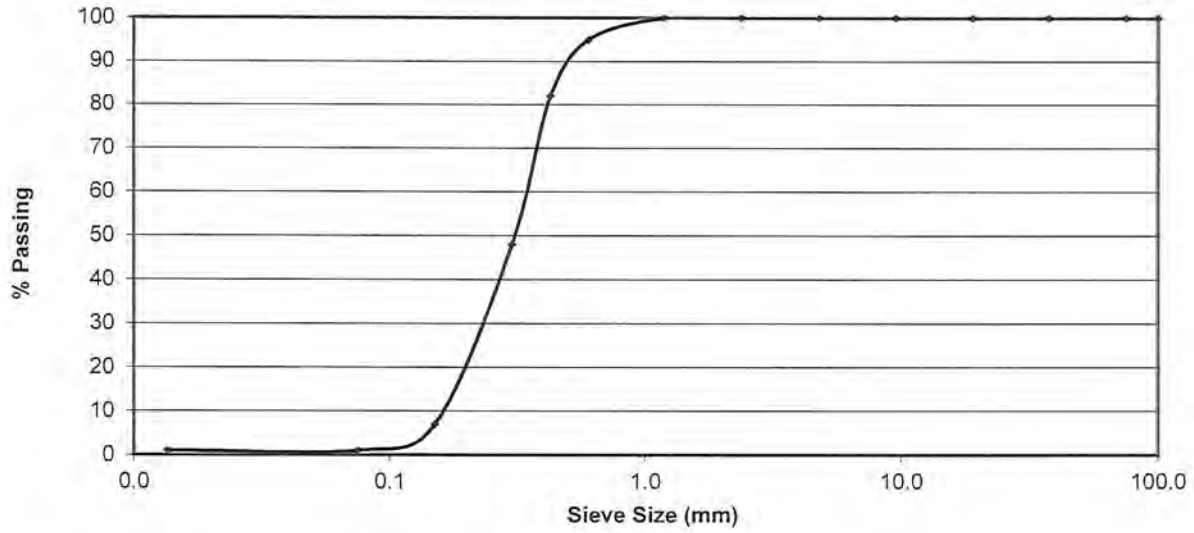
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 35070.

SAMPLE NO: CT 57028
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 0.1 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	95	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	82	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	48	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	7	Length of Mould mm	250
2.36 mm	100	0.075 mm	1	Sample history	Air Dried
		0.0135 mm	1	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57028 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

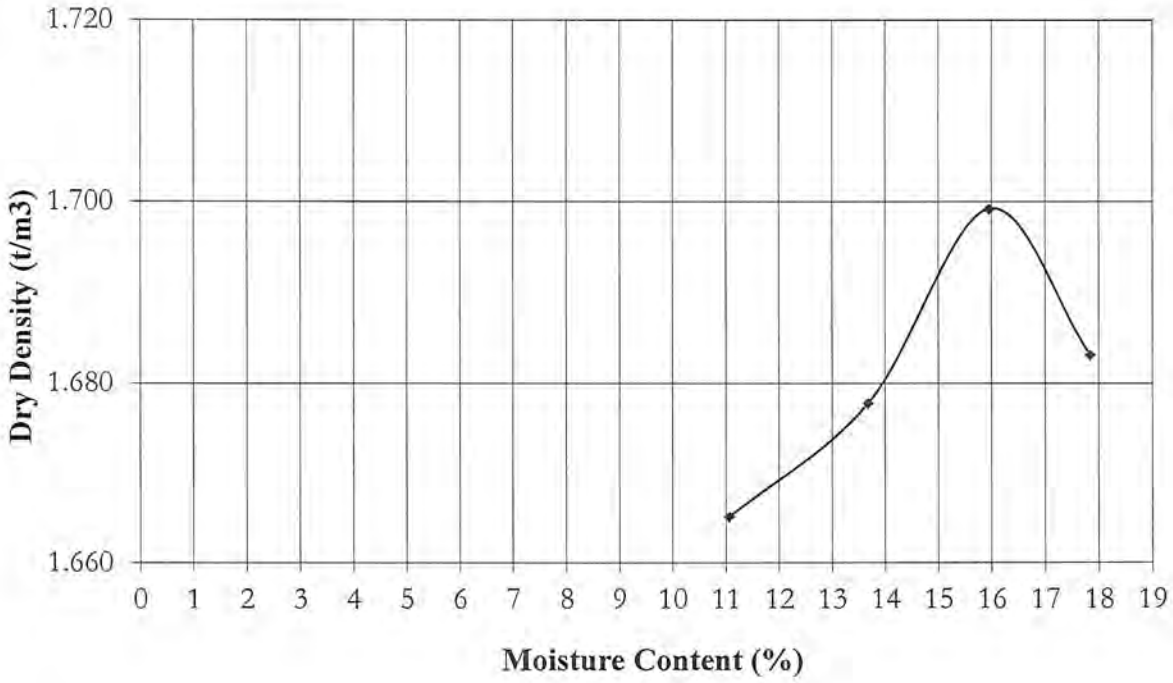
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 35070.

SAMPLE NO: CT 57042
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 28-Apr-16
DEPTH mm: 0.1 - 0.5m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.699 **OMC (%)** 16.0



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57042 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 35070.

SAMPLE NO: CT 57042
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 29-Apr-16
DEPTH mm: 0.1 - 0.5m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.70	95.0
OMC (%)	16.0	100.0
Compactive Effort Used		
Blows per Layer (Average)	16	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	15.5	97.0
Top 30mm	15.2	95.0
Remainder	16.9	105.5
Entire Sample	17.1	106.5
Dry Density (t/m^3)		
At Compaction	1.62	95.5
After Soaking	1.62	95.5
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	25	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57042 / 1

NATA WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

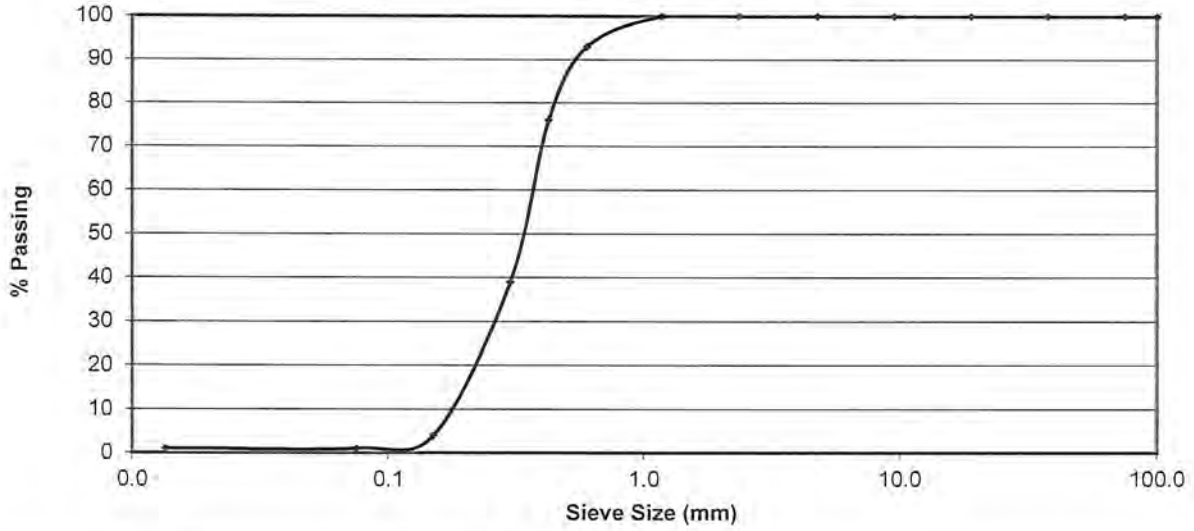
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 36100.

SAMPLE NO: CT 57027
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	100	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	93	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	76	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	39	Length of Mould mm	250
4.75 mm	100	0.150 mm	4	Sample history	Air Dried
2.36 mm	100	0.075 mm	1	Sample Preparation Method	Dry Sieved
		0.0135 mm	1	Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57027 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

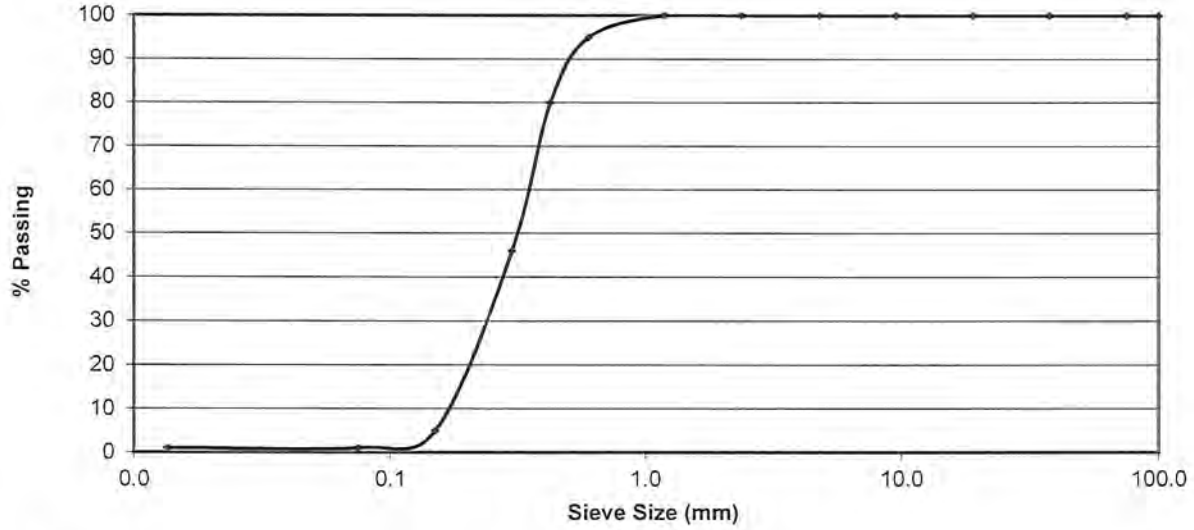
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 36230.

SAMPLE NO: CT 57030
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing		
75.0 mm	100	1.180 mm	100	Liquid Limit % WA 120.2	Not Obtainable
37.5 mm	100	0.600 mm	95	Plastic Limit % WA 121.1	Non-Plastic
19.0 mm	100	0.425 mm	80	Plasticity Index % WA 122.1	NP
9.50 mm	100	0.300 mm	46	Linear Shrinkage % WA 123.1	0.0
4.75 mm	100	0.150 mm	5	Length of Mould mm	250
2.36 mm	100	0.075 mm	1	Sample history	Air Dried
		0.0135 mm	1	Sample Preparation Method	Dry Sieved
				Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57030 / 1

NATA
WORLD RECOGNISED ACCREDITATION

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

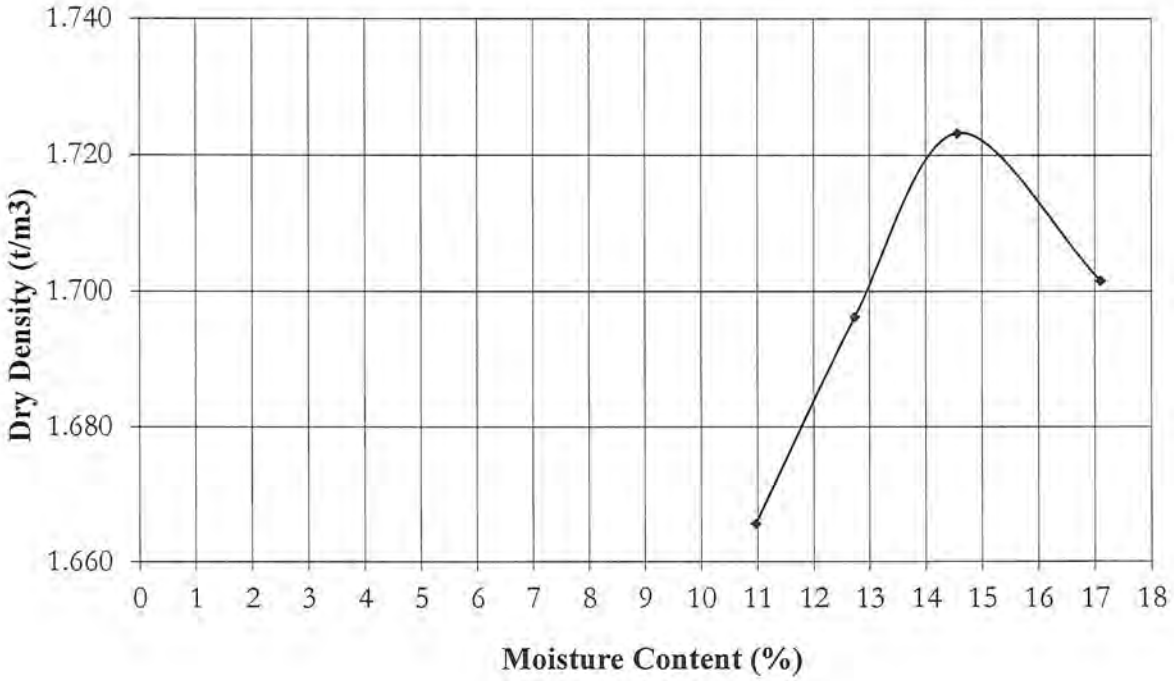
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 36230.

SAMPLE NO: CT 57041
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 28-Apr-16
DEPTH mm: 0.3 - 0.5m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.723 **OMC (%)** 14.6



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57041 / 1

NATA
WORLD RECOGNISED ACCREDITATION

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 36230.

SAMPLE NO: CT 57041
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 29-Apr-16
DEPTH mm: 0.3 - 0.5m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.72	95.0
OMC (%)	14.5	100.0
Compactive Effort Used		
Blows per Layer (Average)	17	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	14.9	102.5
Top 30mm	15.3	105.0
Remainder	15.8	108.5
Entire Sample	16.5	113.5
Dry Density (t/m^3)		
At Compaction	1.63	94.5
After Soaking	1.63	94.5
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	25	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57041 / 1

NATA
WORLD RECOGNISED ACCREDITATION

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 36550.

SAMPLE NO: CT 57024
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 28-Apr-16
DATE P.I. TESTED: 29-Apr-16
DEPTH: 0.7 - 1.0m

PARTICLE SIZE DISTRIBUTION

WA 115.1

PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	99	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	94	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	82	Linear Shrinkage % WA 123.1	0.0
9.50 mm	99	0.300 mm	54	Length of Mould mm	250
4.75 mm	99	0.150 mm	8	Sample history	Air Dried
2.36 mm	99	0.075 mm	2	Sample Preparation Method	Dry Sieved
		0.0135 mm	1	Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57024 / 1

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

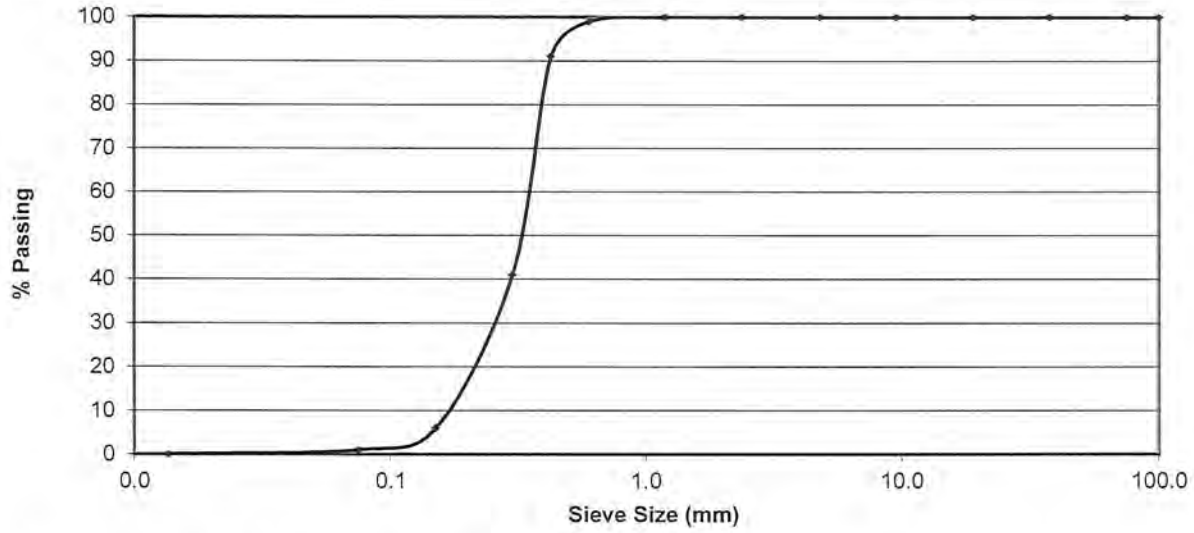
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 37300.

SAMPLE NO: CT 57032
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 03-May-16
DEPTH: 0.5 - 0.8m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	100	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	99	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	91	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	41	Length of Mould mm	250
4.75 mm	100	0.150 mm	6	Sample history	Air Dried
2.36 mm	100	0.075 mm	1	Sample Preparation Method	Dry Sieved
		0.0135 mm	0	Nature of Shrink	-

Notes: ##
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57032 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

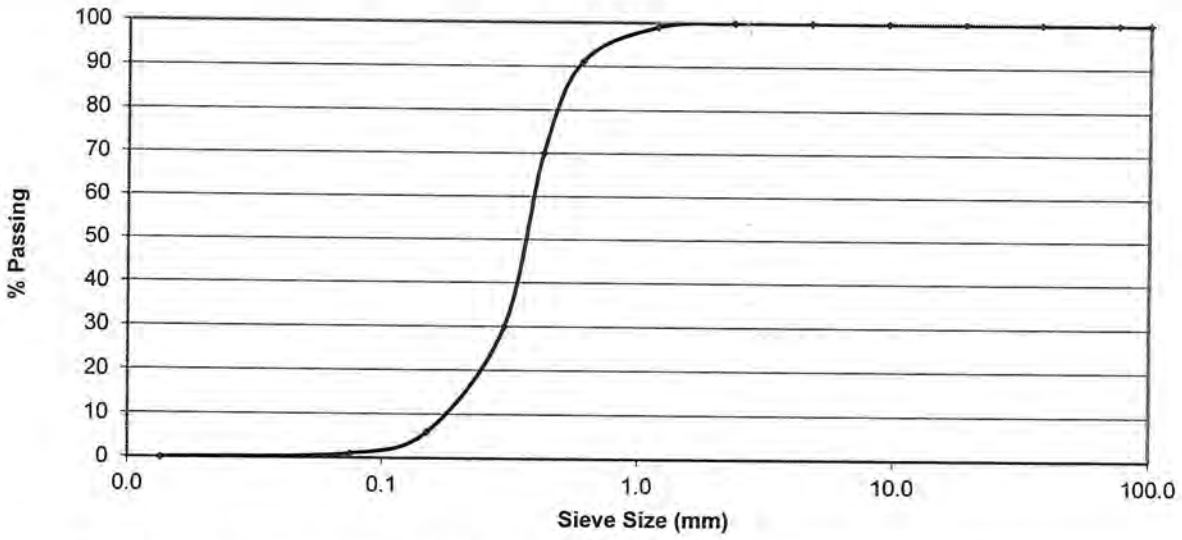
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 38080.

SAMPLE NO: CT 57086
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.3 - 0.5m.

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	99
37.5 mm	100	0.600 mm	91
19.0 mm	100	0.425 mm	70
9.50 mm	100	0.300 mm	30
4.75 mm	100	0.150 mm	6
2.36 mm	100	0.075 mm	1
		0.0135 mm	0

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =25.4%
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57086 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

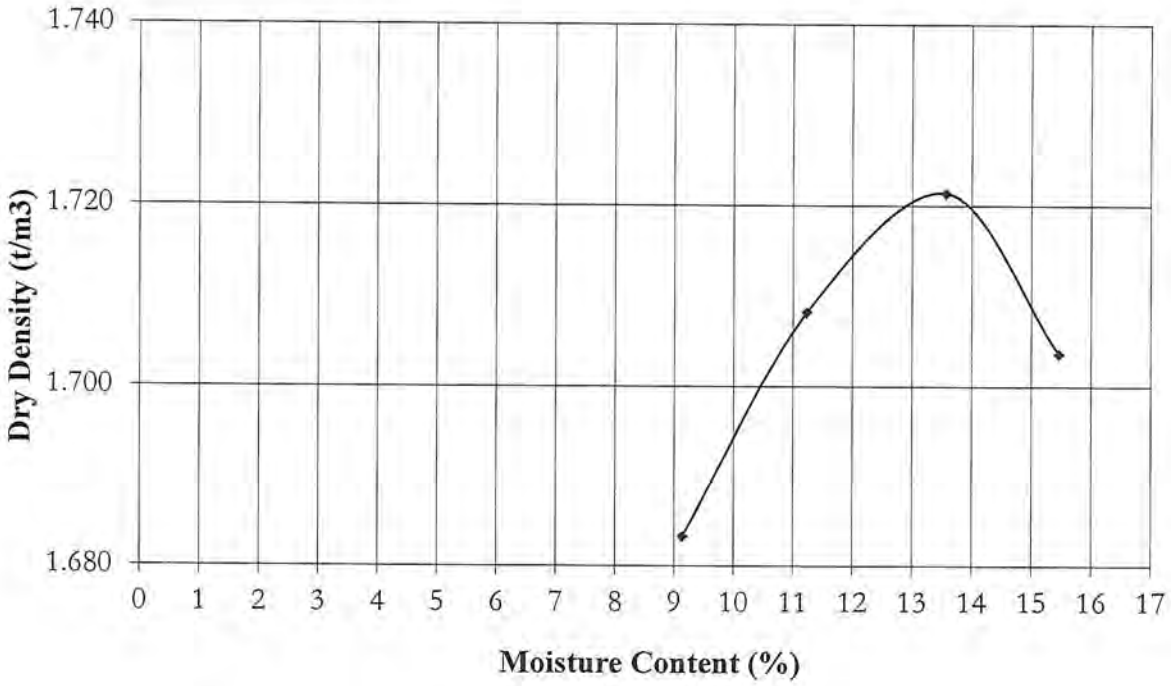
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 38080.

SAMPLE NO: CT 57086
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND
DATE TESTED: 04-May-16
DEPTH mm: 0.3 - 0.5m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.722 **OMC (%)** 13.6



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57086 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 38080.

SAMPLE NO: CT 57086
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND
DATE COMPACTED: 05-May-16
DEPTH mm: 0.3 - 0.5m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.72	95.0
OMC (%)	13.5	100.0
Compactive Effort Used		
Blows per Layer (Average)	17	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	12.9	95.0
Top 30mm	15.4	113.5
Remainder	16.0	117.5
Entire Sample	17.0	125.0
Dry Density (t/m^3)		
At Compaction	1.65	96.0
After Soaking	1.66	96.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	25	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57086 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

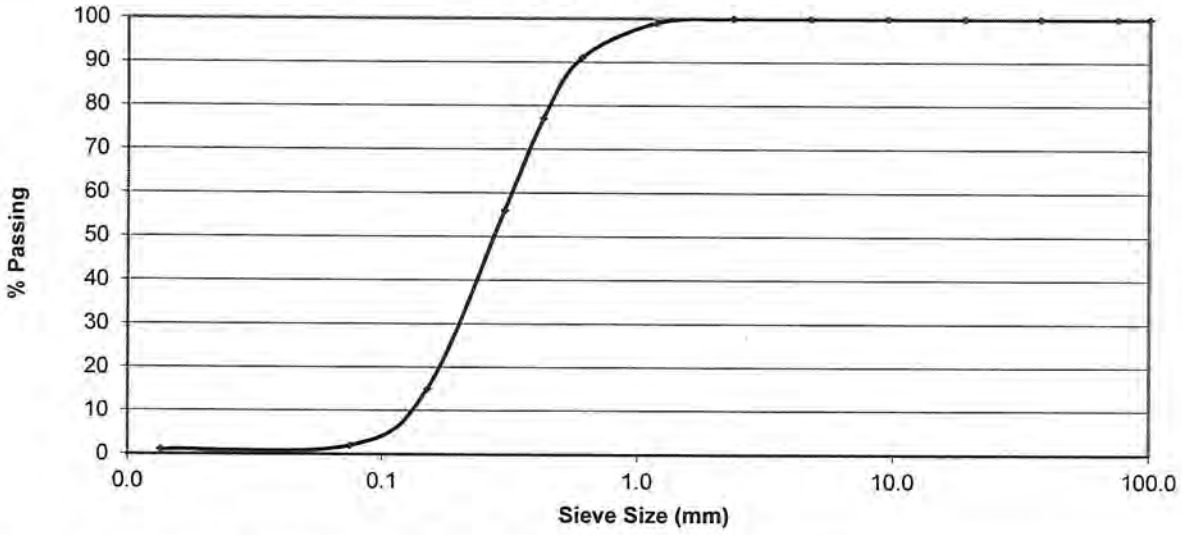
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 38735.

SAMPLE NO: CT 57087
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.3 - 0.5m.

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	99
37.5 mm	100	0.600 mm	91
19.0 mm	100	0.425 mm	77
9.50 mm	100	0.300 mm	56
4.75 mm	100	0.150 mm	15
2.36 mm	100	0.075 mm	2
		0.0135 mm	1

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =26.1%
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57087 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

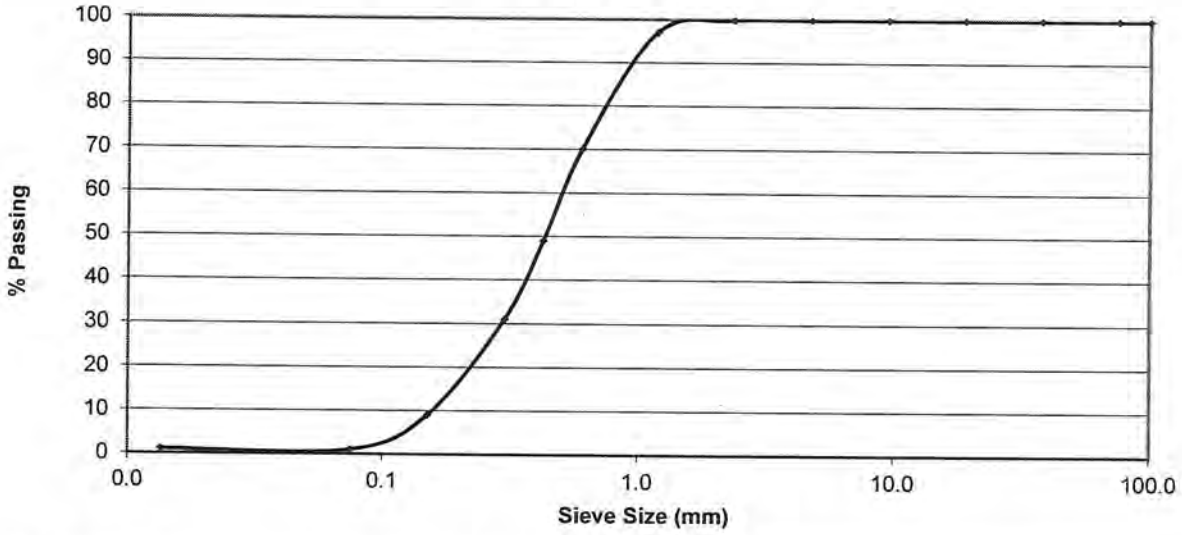
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 39360.

SAMPLE NO: CT 57088
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.2 - 0.4m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	97
37.5 mm	100	0.600 mm	70
19.0 mm	100	0.425 mm	49
9.50 mm	100	0.300 mm	31
4.75 mm	100	0.150 mm	9
2.36 mm	100	0.075 mm	1
		0.0135 mm	1

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: Moisture content of sample taken for shrinkage =26.8%
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57088 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

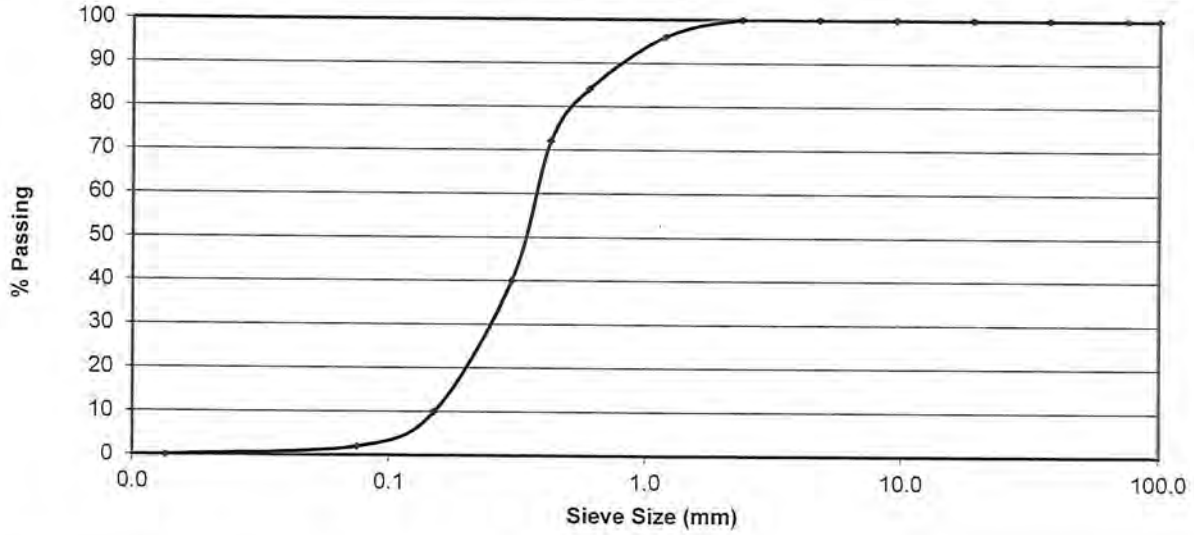
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 39880.

SAMPLE NO: CT 57089
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.2 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	96	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	84	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	72	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	40	Length of Mould mm	250
4.75 mm	100	0.150 mm	10	Sample history	Air Dried
2.36 mm	100	0.075 mm	2	Sample Preparation Method	Dry Sieved
		0.0135 mm	0	Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57089 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

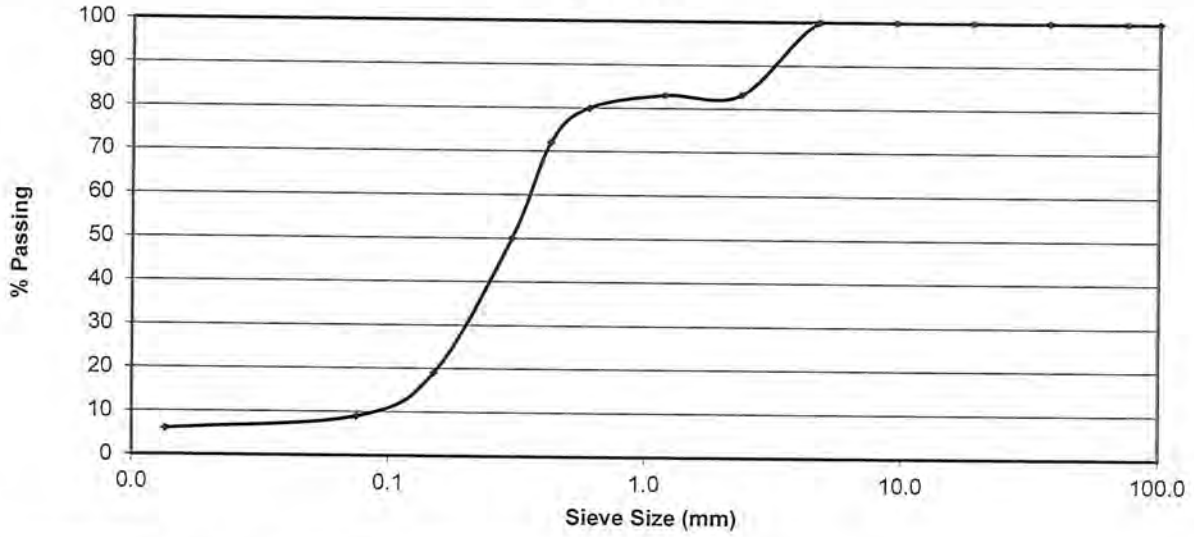
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 41000.

SAMPLE NO: CT 57090
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	83
37.5 mm	100	0.600 mm	80
19.0 mm	100	0.425 mm	72
9.50 mm	100	0.300 mm	50
4.75 mm	100	0.150 mm	19
2.36 mm	83	0.075 mm	9
		0.0135 mm	6

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57090 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

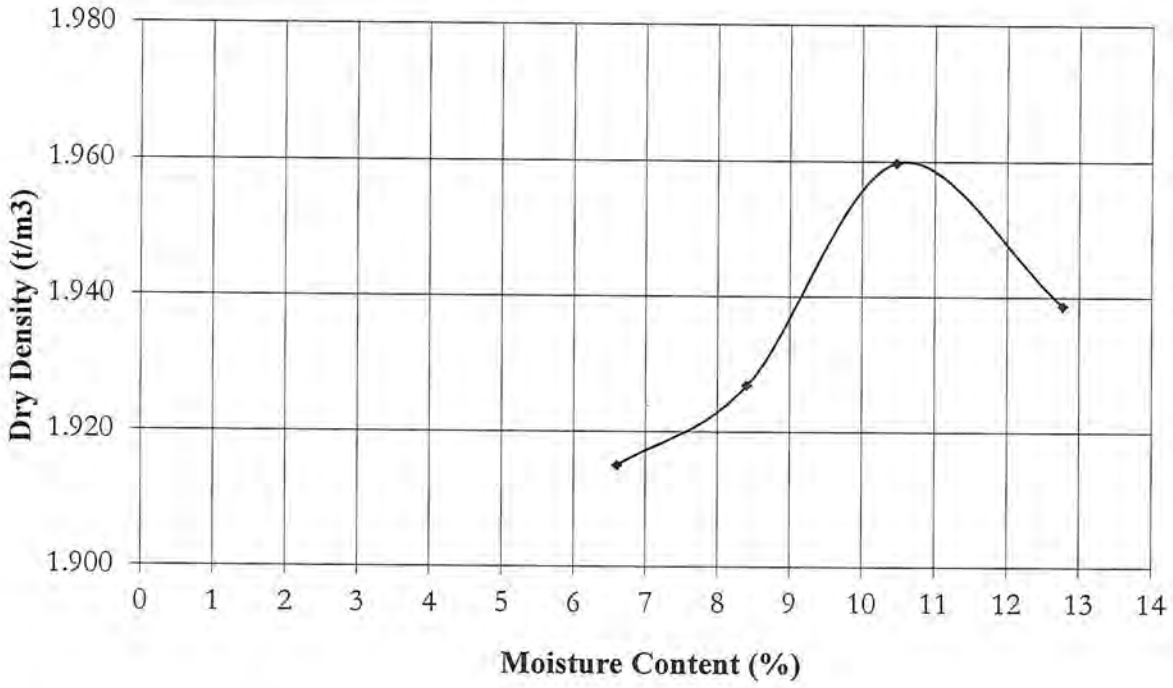
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 41000.

SAMPLE NO: CT 57090
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 03-May-16
DEPTH mm: 0.3 - 0.5m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.960 **OMC (%)** 10.5



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57090 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 41000.

SAMPLE NO: CT 57090
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 05-May-16
DEPTH mm: 0.3 - 0.5m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days)	
MDD Data	**Result**	**Ratio %**
MDD (t/m^3)	1.96	95.0
OMC (%)	10.5	100.0
Compactive Effort Used		
Blows per Layer (Average)	17	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	10.5	100.5
Top 30mm	14.8	140.5
Remainder	13.2	126.0
Entire Sample	13.3	126.5
Dry Density (t/m^3)		
At Compaction	1.85	94.5
After Soaking	1.85	94.5
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	40	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57090 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

CIVITEST Australia

TEST REPORT

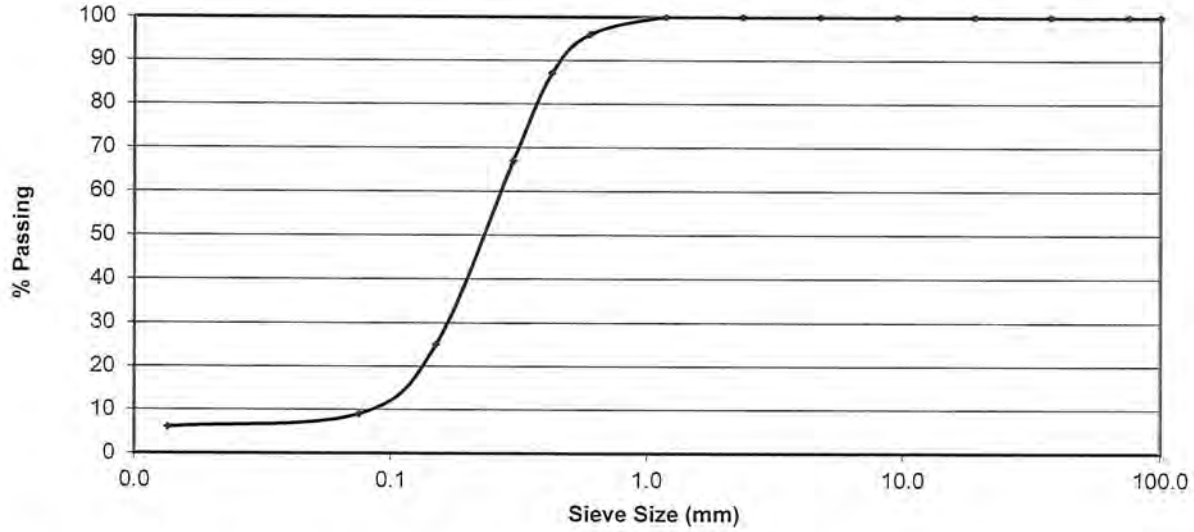
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 41100.

SAMPLE NO: CT 57091
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 03-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	100	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	96	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	87	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	67	Length of Mould mm	250
4.75 mm	100	0.150 mm	25	Sample history	Air Dried
2.36 mm	100	0.075 mm	9	Sample Preparation Method	Dry Sieved
		0.0135 mm	6	Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57091 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

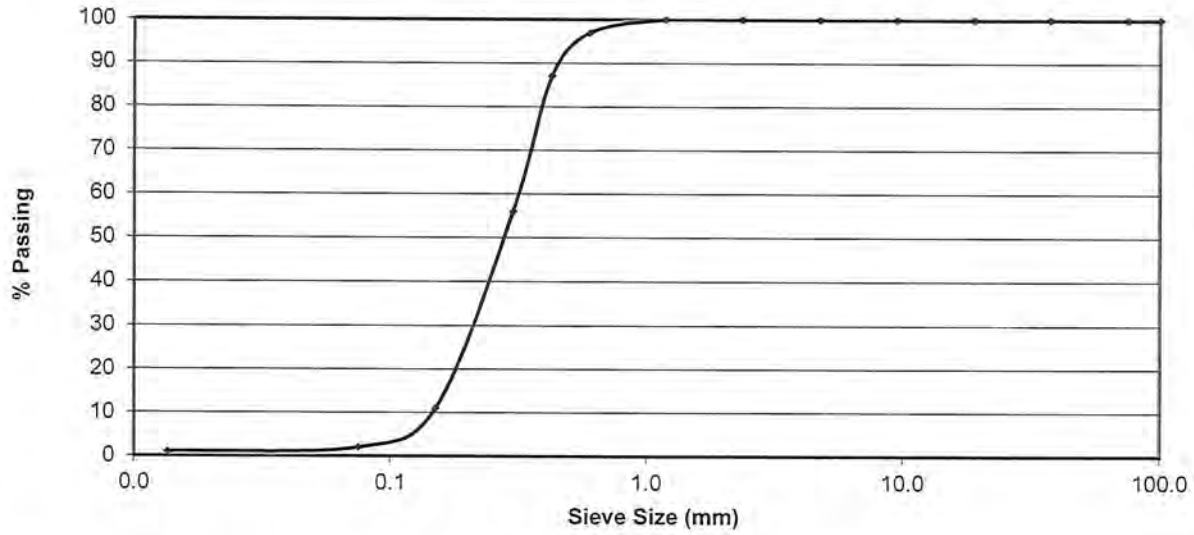
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 41370.

SAMPLE NO: CT 57092
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	100	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	97	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	87	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	56	Length of Mould mm	250
4.75 mm	100	0.150 mm	11	Sample history	Air Dried
2.36 mm	100	0.075 mm	2	Sample Preparation Method	Dry Sieved
		0.0135 mm	1	Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57092 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

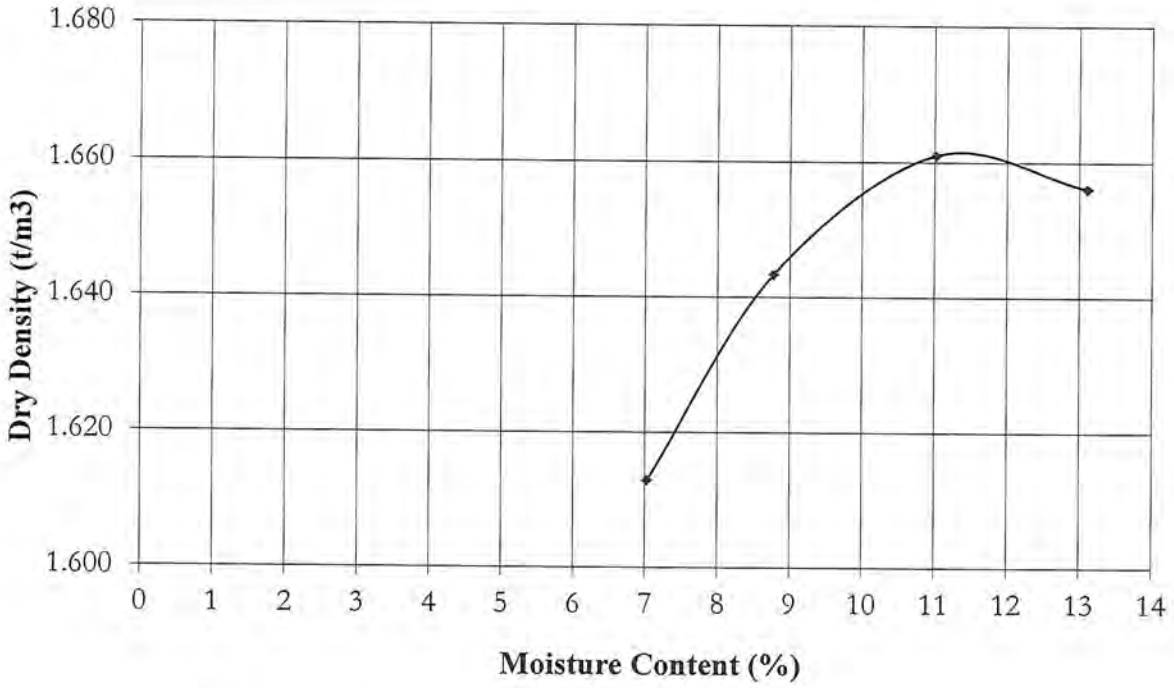
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 41370.

SAMPLE NO: CT 57092
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE TESTED: 03-May-16
DEPTH mm: 0.3-0.5m

MODIFIED MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT

WA 133.1

MDD (t/m3) 1.662 **OMC (%)** 11.4



% Retained on 19mm Sieve & Excluded 0

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57092 / 1

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025
This document shall not be reproduced, except in full

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.
-
PROPOSED USE: -
CLIENT REF: CH 41370.

SAMPLE NO: CT 57092
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE COMPACTED: 05-May-16
DEPTH mm: 0.3-0.5m

CALIFORNIA BEARING RATIO

WA 141.1

	SOAKED (4 Days) Result	Ratio %
MDD Data		
MDD (t/m^3)	1.66	95.0
OMC (%)	11.5	100.0
Compactive Effort Used		
Blows per Layer (Average)	16	
Layers	5	
Rammer Weight (kg)	4.9	
Moisture Contents (%)		
At Compaction	10.7	94.0
Top 30mm	21.1	184.5
Remainder	20.9	183.5
Entire Sample	21.1	185.0
Dry Density (t/m^3)		
At Compaction	1.58	95.0
After Soaking	1.58	95.0
Surcharge (kg)	13.5	
Swell %	0.0	
California Bearing Ratio (%)	30	@2.5 mm
% Retained on 19mm Sieve	0	

Notes:
Site selected by client
Site sampled by Client

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57092 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

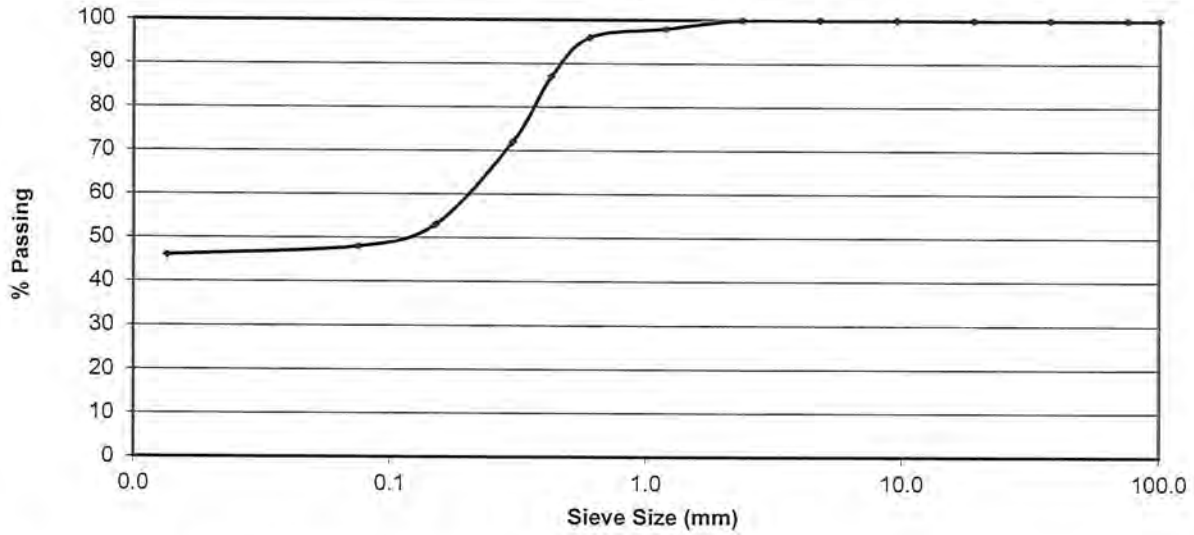
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 41900.

SAMPLE NO: CT 57093
JOB NO: 24-1-413
FIELD DESCRIPTION: CLAY.
DATE PSD TESTED: 02-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.2 - 0.4m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	71.5
75.0 mm	100	1.180 mm	98	Plastic Limit % WA 121.1	19.2
37.5 mm	100	0.600 mm	96	Plasticity Index % WA 122.1	52.3
19.0 mm	100	0.425 mm	87	Linear Shrinkage % WA 123.1	15.2
9.50 mm	100	0.300 mm	72	Length of Mould mm	250
4.75 mm	100	0.150 mm	53	Sample history	Air Dried
2.36 mm	100	0.075 mm	48	Sample Preparation Method	Dry Sieved
		0.0135 mm	46	Nature of Shrink	-

Notes:

Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57093 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

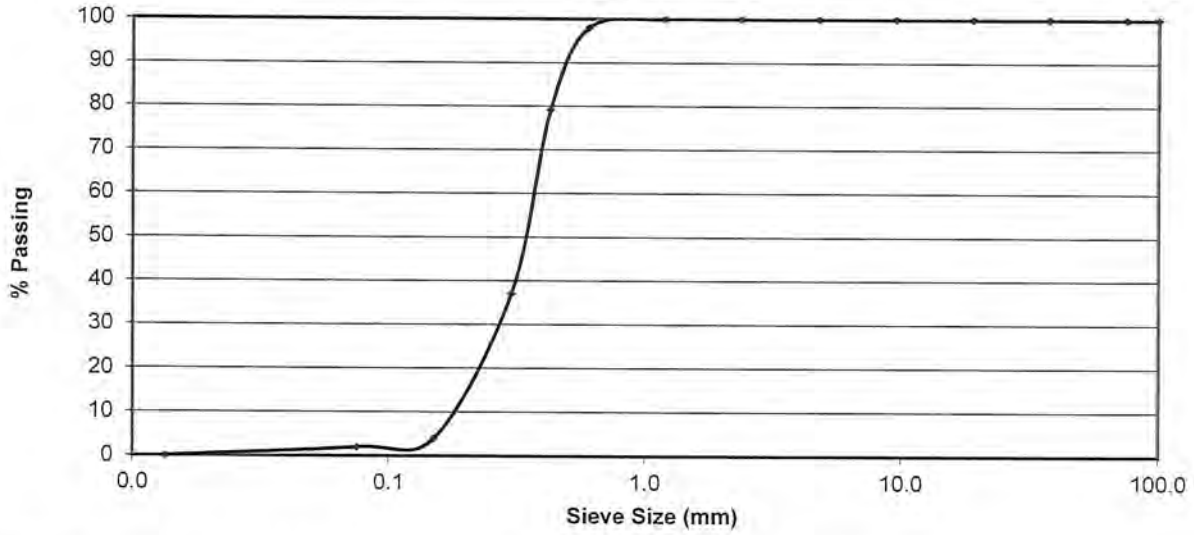
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 42800.

SAMPLE NO: CT 57094
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.4 - 0.6m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1				PLASTICITY INDEX & LINEAR SHRINKAGE	
Sieve Size mm	% Retained				
37.5	0				
Sieve Size	% Passing	Sieve Size	% Passing	Liquid Limit % WA 120.2	Not Obtainable
75.0 mm	100	1.180 mm	100	Plastic Limit % WA 121.1	Non-Plastic
37.5 mm	100	0.600 mm	98	Plasticity Index % WA 122.1	NP
19.0 mm	100	0.425 mm	79	Linear Shrinkage % WA 123.1	0.0
9.50 mm	100	0.300 mm	37	Length of Mould mm	250
4.75 mm	100	0.150 mm	4	Sample history	Air Dried
2.36 mm	100	0.075 mm	2	Sample Preparation Method	Dry Sieved
		0.0135 mm	0	Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57094 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

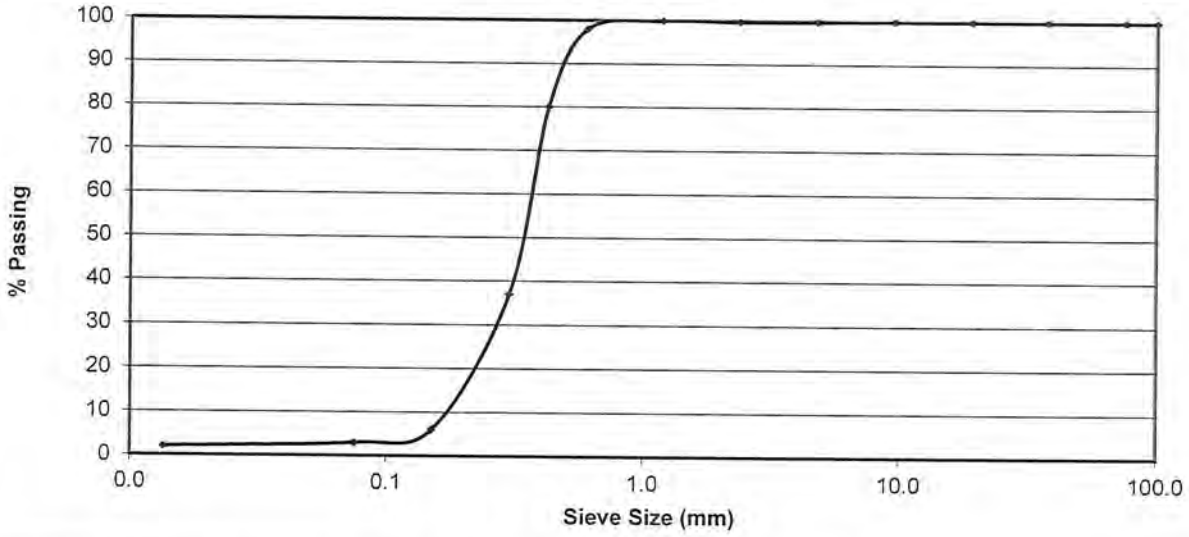
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 43275.

SAMPLE NO: CT 57096
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.2 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	98
19.0 mm	100	0.425 mm	80
9.50 mm	100	0.300 mm	37
4.75 mm	100	0.150 mm	6
2.36 mm	100	0.075 mm	3
		0.0135 mm	2

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57096 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

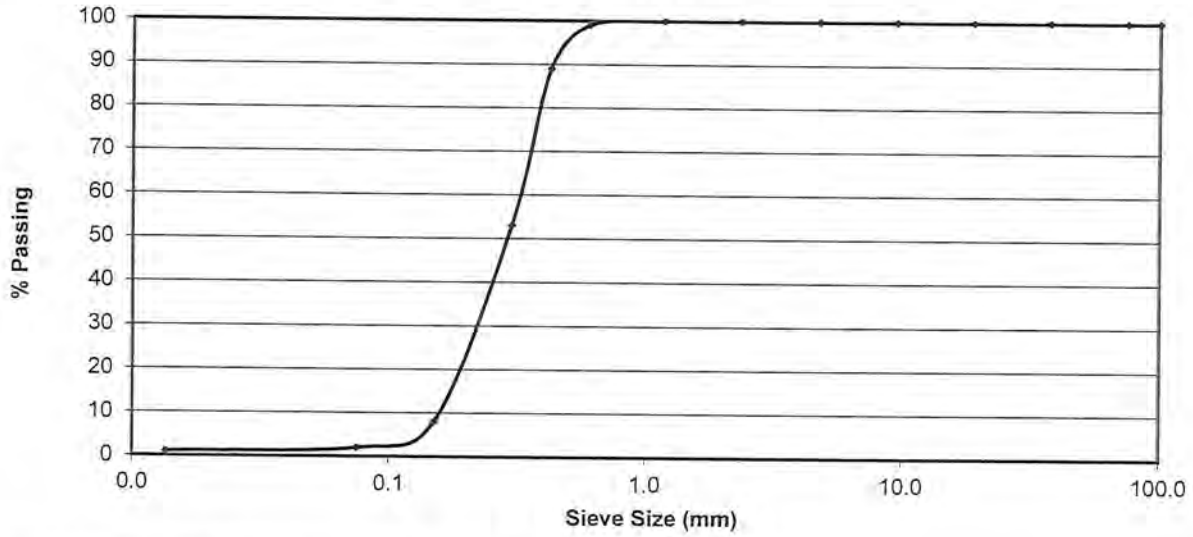
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 43500.

SAMPLE NO: CT 57095
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 04-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.2 - 0.4m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	99
19.0 mm	100	0.425 mm	89
9.50 mm	100	0.300 mm	53
4.75 mm	100	0.150 mm	8
2.36 mm	100	0.075 mm	2
		0.0135 mm	1

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57095 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

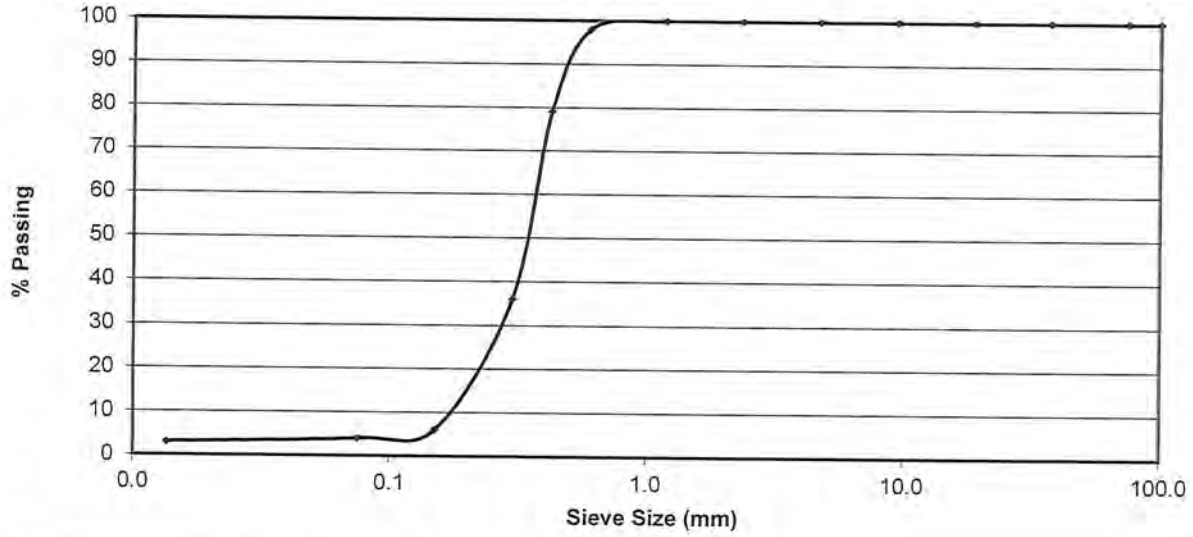
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 43500.

SAMPLE NO: CT 57097
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 03-May-16
DATE P.I. TESTED: 05-May-16
DEPTH: 0.7 - 0.9m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	98
19.0 mm	100	0.425 mm	79
9.50 mm	100	0.300 mm	36
4.75 mm	100	0.150 mm	6
2.36 mm	100	0.075 mm	4
		0.0135 mm	3

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57097 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

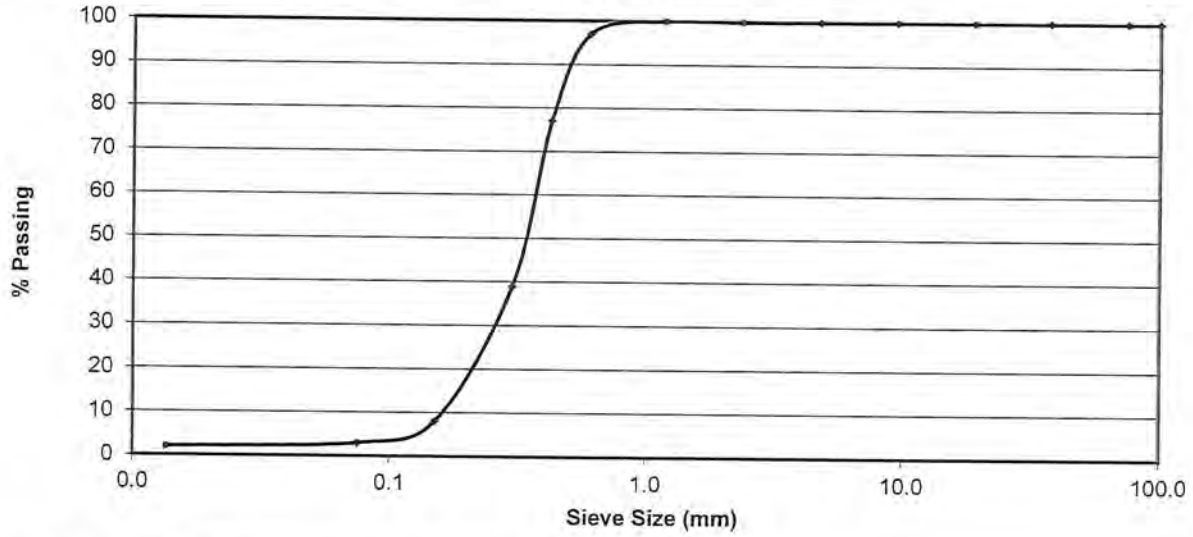
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 43620.

SAMPLE NO: CT 57098
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 03-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.4 - 0.6m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	100
37.5 mm	100	0.600 mm	97
19.0 mm	100	0.425 mm	77
9.50 mm	100	0.300 mm	39
4.75 mm	100	0.150 mm	8
2.36 mm	100	0.075 mm	3
		0.0135 mm	2

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57098 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165 Accredited for compliance with ISO/IEC 17025 This document shall not be reproduced, except in full

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

CIVITEST Australia

TEST REPORT

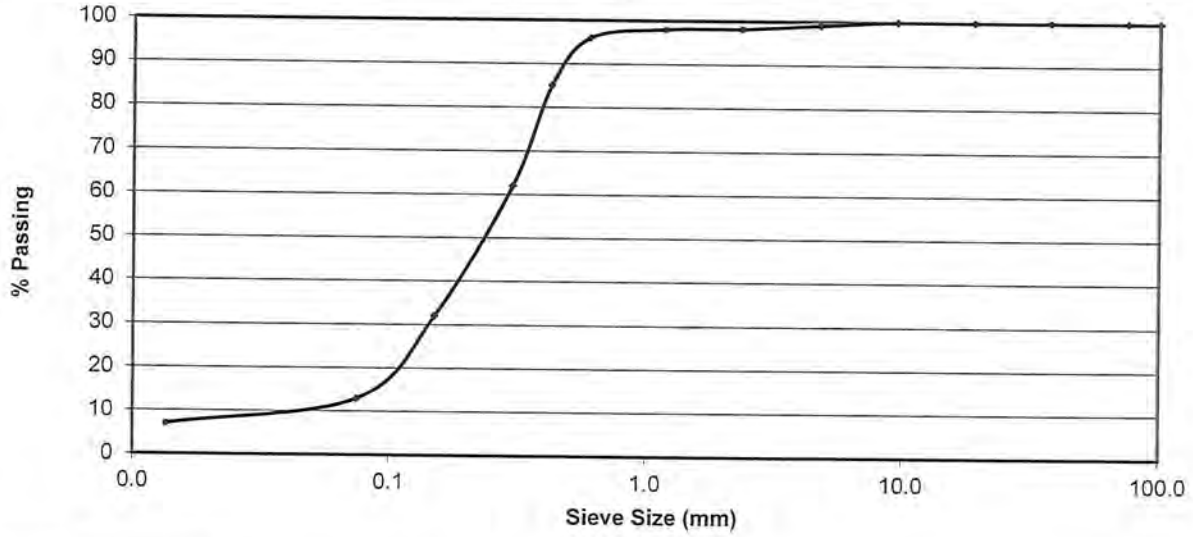
CLIENT: W.M.L Consultants.
PROJECT: Bussell Highway Upgrade.
LOCATION: Bussell Highway.

PROPOSED USE: -
CLIENT REF: CH 43755.

SAMPLE NO: CT 57099
JOB NO: 24-1-413
FIELD DESCRIPTION: SAND.
DATE PSD TESTED: 03-May-16
DATE P.I. TESTED: 06-May-16
DEPTH: 0.3 - 0.5m

PARTICLE SIZE DISTRIBUTION

WA 115.1



PARTICLE SIZE DISTRIBUTION WA 115.1			
Sieve Size mm	% Retained		
37.5	0		
Sieve Size	**% Passing**	**Sieve Size**	**% Passing**
75.0 mm	100	1.180 mm	98
37.5 mm	100	0.600 mm	96
19.0 mm	100	0.425 mm	85
9.50 mm	100	0.300 mm	62
4.75 mm	99	0.150 mm	32
2.36 mm	98	0.075 mm	13
		0.0135 mm	7

PLASTICITY INDEX & LINEAR SHRINKAGE	
Liquid Limit % WA 120.2	Not Obtainable
Plastic Limit % WA 121.1	Non-Plastic
Plasticity Index % WA 122.1	NP
Linear Shrinkage % WA 123.1	0.0
Length of Mould mm	250
Sample history	Air Dried
Sample Preparation Method	Dry Sieved
Nature of Shrink	-

Notes: ##
Site selected in accordance with WA 0.1
Site sampled in accordance with WA 100.1

Approved Signatory: Franco Harkins
Date: 10-May-16
Report Number: CT 57099 / 1

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory No. 14165
Accredited for compliance with ISO/IEC 17025

Bunbury Base Laboratory
Ph: 08 9726 2204 Fax: 08 9726 2203
PO Box 5068, Bunbury WA 6231
29 Halifax Drive, Bunbury WA 6230

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
ABN 71 111 052 218
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email admin@swchemservices.com.au

Certificate of Analysis

Client Name:	WML Consultants Attn: Alex Pope		
Address:	PO Box 2023, Bunbury, WA, 6231		
Phone No:	9722 3544	Email:	apope@wml.com.au
Lab No:	8828	Order No:	
Date samples received:	3/05/16	Report date:	11/05/16

Sample details: 121 soil samples received 3/05/16 ex Bussell Highway

Samples were labelled:
Ch 31540 18/04/16 0.25 to 1.50m 6 samples
Ch 31850 18/04/16 0.25 to 1.50m 6 samples
Ch 32760 19/04/16 0.25 to 1.50m 6 samples
Ch 34315 19/04/16 0.25 to 1.50m 6 samples
Ch 35235 20/04/16 0.25 to 1.25m 5 samples
Ch 35620 20/04/16 0.25 to 1.50m 6 samples
Ch 36230 20/04/16 0.25 to 1.50m 6 samples
Ch 36560 20/04/16 0.25 to 1.50m 6 samples
Ch 37820 20/04/16 0.25 to 1.50m 6 samples
Ch 37970 21/04/16 0.25 to 1.50m 6 samples
Ch 38400 22/04/16 0.25 to 1.50m 6 samples
Ch 38740 22/04/16 0.25 to 1.50m 6 samples
Ch 38830 22/04/16 0.25 to 1.50m 6 samples
Ch 38950 22/04/16 0.25 to 1.50m 6 samples
Ch 39360 22/04/16 0.25 to 1.50m 6 samples
Ch 39510 22/04/16 0.25 to 1.50m 6 samples
Ch 39880 22/04/16 0.25 to 1.50m 6 samples
Ch 40230 22/04/16 0.25 to 1.00m 4 samples
Ch 40850 22/04/16 0.25 1 sample
Ch 41670 22/04/16 0.25 to 0.75m 3 samples
Ch 43285 21/04/16 0.25 to 1.50m 6 samples
Ch 43755 21/04/16 0.25 to 1.50m 6 samples

Samples were collected by WML and immediately placed in sealed bags, which were then placed on ice in an Esky, then frozen prior to delivery to SWCS.
A portion of the sample was removed for Field pHf and pHfox testing the remainder was then returned to a freezer pending further instructions.

Scope of Work: Acid Sulphate Soils Field Tests pH_F, pH_{FOX}, Reaction rating, Fizz test
Preservation of retained samples, Interpretation of results.

Test Methods: Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 Section H:Field Tests June 2004, Queensland Government, Natural Resources, Mines and Energy.
Identification & Investigation of Acid Sulphate Soils and acidic landscapes, prepared by Department of Environmental Regulation, WA June 2015
pH tested using Eutech WP pHScan BNC with Ionode Intermediate Junction pH combination electrode IJ48F calibrated according to manufacturer's instructions.

Test Results:

The 121 field test results were assessed using the following criteria

a) pH_f less than 4
b) pH_{fox} less than 3 and /or
c) the change in pH was greater than 2 (where the resultant pH_{fox} was less than 3) and/or
d) there was a strong reaction following addition of hydrogen peroxide

Results meeting these criteria have been highlighted.
There were 0 tests where the pHf was less than 4.
There were 4 tests where the pHfox was less than 3
There were 4 tests where the change in pH was greater than 2 where the resultant pHfox was less than 3
There were 3 tests that showed a strong reaction with the addition of hydrogen peroxide
There were 3 positive calcareous reactions seen.

Comments:

1. I would recommend that samples from
   Ch 31540 1250 mm
   Ch 31850 1000 mm
   Ch 34315 1000 mm
   Ch 35235 750 mm
   Ch 38830 1250 mm
   Ch 39510 1500 mm
   Ch 39880 1500 mm
   Ch 41670 500 mm
   should be dried and analysed using the SPOCAS method.
   These samples are primarily those that gave a reaction, had high ΔpH values, had some level of clay present or were primarily grey sands which it has been determined may contain micro-crystalline pyrites.

David Dodds
Dip.App.Chem. A.G.Inst.Tech.

Lab No: 8828 Date Sampled: 18/04/16
Hole No: Ch 31540 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	brown sandy clay	4.45	3.30	1.15	L	None
500 mm	brown sand f-m grained	5.45	3.85	1.60	N	None
750 mm	light brown/grey sand f-m grained	5.95	4.40	1.55	N	None
1000 mm	grey sand f-m grained	6.15	4.70	1.45	N	None
1250 mm	grey/yellow f-m sand	6.35	4.75	1.60	N	None
1500 mm	orange/yellow and grey f-m sand	5.80	4.45	1.35	N	None

Lab No: 8828 Date Sampled: 18/04/16
Hole No: Ch 31850 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	light brown/grey f-m grained sand	4.60	3.35	1.25	N	None
500 mm	light brown/grey f-m grained sand	4.80	3.95	0.85	N	None
750 mm	light brown/grey f-m grained sand	5.35	4.75	0.60	N	None
1000 mm	light brown/grey f-m grained sand	5.85	4.95	0.90	N	None
1250 mm	light brown/grey f-m grained sand	5.90	4.85	1.05	N	None
1500 mm	light brown/grey f-m grained sand	5.50	4.90	0.60	N	None

Lab No: 8828 Date Sampled: 19/04/16
Hole No: Ch 32760 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	yellow sand f-m grained	5.70	4.25	1.45	N	None
500 mm	yellow sand f-m grained	6.05	4.75	1.30	N	None
750 mm	yellow sand f-m grained	6.30	4.75	1.55	N	None
1000 mm	yellow sand f-m grained	6.30	4.80	1.50	N	None
1250 mm	yellow sand f-m grained	6.45	4.75	1.70	N	None
1500 mm	yellow sand f-m grained	6.50	4.75	1.75	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 19/04/16
Hole No: Ch 34315 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	grey f-m grained sand	4.85	4.00	0.85	N	None
500 mm	light grey/brown sand f-m grained	5.00	4.20	0.80	N	None
750 mm	light brown/grey f-m grained sand	4.85	4.10	0.75	N	None
1000 mm	light brown/grey f-m grained sand	4.90	4.25	0.65	N	None
1250 mm	light brown/grey f-m grained sand	5.00	4.25	0.75	N	None
1500 mm	light brown/grey f-m grained sand	4.75	4.45	0.30	N	None

Lab No: 8828 Date Sampled: 20/04/16
Hole No: Ch 35235 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	brown f-m grained sand damp	5.65	3.25	2.40	L	None
500 mm	brown/grey sand grained + white coarse sand wet	5.70	**2.40**	**3.30**	L	None
750 mm	white coarse sand wet	5.65	**2.15**	**3.50**	N	None
1000 mm	white coarse sand wet	5.70	**2.65**	**3.05**	N	None
1250 mm	white coarse sand wet	5.80	**2.80**	**3.00**	N	None

Lab No: 8828 Date Sampled: 20/04/16
Hole No: Ch 35620 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.12			
250 mm	brown/grey f-m grained sand + gravel	5.40	3.90	1.50	N	None
500 mm	yellow/brown sand f-m grained	6.00	4.65	1.35	N	None
750 mm	yellow/brown sand f-m grained	5.95	4.45	1.50	N	None
1000 mm	yellow/brown sand f-m grained	6.10	4.50	1.60	N	None
1250 mm	yellow/brown sand f-m grained damp	6.15	4.60	1.55	N	None
1500 mm	grey/yellow/brown sand f-m grained damp	6.55	5.05	1.50	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 20/04/16
Hole No: Ch 36230 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	yellow sand f-m grained	6.00	4.85	1.15	N	None
500 mm	yellow sand f-m grained	6.25	4.95	1.30	N	None
750 mm	yellow sand f-m grained	6.15	4.90	1.25	N	None
1000 mm	yellow sand f-m grained	6.25	5.20	1.05	N	None
1250 mm	yellow sand f-m grained	6.75	5.20	1.55	N	None
1500 mm	yellow sand f-m grained	6.35	5.20	1.15	N	None

Lab No: 8828 Date Sampled: 20/04/16
Hole No: Ch 36560 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	dark brown f-m grained sand	6.50	4.45	2.05	L	None
500 mm	yellow sand f-m grained	6.35	4.75	1.60	N	None
750 mm	yellow sand f-m grained	6.60	4.90	1.70	N	None
1000 mm	yellow sand f-m grained	6.75	4.95	1.80	N	None
1250 mm	yellow sand f-m grained	6.75	5.30	1.45	N	None
1500 mm	yellow sand f-m grained	6.80	5.25	1.55	N	None

Lab No: 8828 Date Sampled: 20/04/16
Hole No: Ch 37820 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	yellow sand f-m grained	6.50	5.20	1.30	N	None
500 mm	yellow sand f-m grained	6.70	5.15	1.55	M	None
750 mm	yellow sand f-m grained	6.70	5.20	1.50	N	None
1000 mm	yellow sand f-m grained	6.75	5.40	1.35	N	None
1250 mm	yellow sand f-m grained	6.70	4.90	1.80	N	None
1500 mm	yellow sand f-m grained wet	6.55	5.00	1.55	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 21/04/16
Hole No: Ch 37970 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	yellow sand f-m grained	5.85	4.55	1.30	N	None
500 mm	yellow sand f-m grained	6.45	4.80	1.65	N	None
750 mm	yellow sand f-m grained	6.45	4.80	1.65	N	None
1000 mm	yellow sand f-m grained	6.60	4.75	1.85	N	None
1250 mm	yellow sand f-m grained	5.95	4.65	1.30	N	None
1500 mm	yellow sand f-m grained	6.65	4.75	1.90	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 38400 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	yellow sand f-m grained	6.40	4.90	1.50	N	None
500 mm	yellow sand f-m grained	6.25	4.80	1.45	N	None
750 mm	yellow sand f-m grained	6.35	4.85	1.50	N	None
1000 mm	yellow sand f-m grained	5.95	5.05	0.90	N	None
1250 mm	yellow sand f-m grained	6.30	5.10	1.20	N	None
1500 mm	yellow sand f-m grained	6.75	5.10	1.65	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 38740 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	yellow sand f-m grained	6.35	4.60	1.75	N	None
500 mm	yellow sand f-m grained	6.85	5.20	1.65	L	None
750 mm	yellow sand f-m grained	6.90	5.05	1.95	N	None
1000 mm	yellow sand f-m grained damp	6.85	4.95	1.90	N	None
1250 mm	yellow sand f-m grained wet	7.00	4.80	2.20	N	None
1500 mm	yellow sand m-c grained wet	6.65	4.10	2.55	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 38830 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	brown f-m grained sand	6.45	4.60	1.85	L	None
500 mm	brown f-m grained sand	6.65	4.75	1.90	N	None
750 mm	brown f-m grained sand	7.10	5.15	1.95	N	None
1000 mm	grey/brown f-m grained sand	7.25	5.65	1.60	N	None
1250 mm	dark grey/brown clayey sand	7.40	3.55	**3.85**	M	None
1500 mm	grey/yellow clayey sand	6.75	5.60	1.15	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 38950 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	grey/yellow sand f-m grained	6.60	4.80	1.80	N	None
500 mm	grey/yellow sand f-m grained	6.45	4.60	1.85	N	None
750 mm	grey/yellow sand f-m grained	6.20	4.50	1.70	N	None
1000 mm	grey/yellow sand f-m grained	6.55	4.50	2.05	N	None
1250 mm	grey/yellow sand f-m grained	6.60	4.65	1.95	N	None
1500 mm	grey/yellow sand f-m grained	6.45	4.80	1.65	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 39360 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	light brown f-m grained sand	6.25	4.85	1.40	N	None
500 mm	light brown f-m grained sand	6.45	5.05	1.40	N	None
750 mm	light brown f-m grained sand	6.80	5.00	1.80	N	None
1000 mm	light brown f-m grained sand	6.95	5.10	1.85	N	None
1250 mm	light brown/yellow f-m-c grained sand	6.50	5.60	0.90	L	None
1500 mm	light brown/yellow f-m-c grained sand + carbon	6.10	4.10	2.00	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 39510 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.11			
250 mm	yellow sand f-m grained	6.55	5.20	1.35	N	None
500 mm	yellow sand f-m grained	6.35	5.20	1.15	N	None
750 mm	yellow sand f-m grained	6.75	5.10	1.65	N	None
1000 mm	yellow/green silty sand wet some organics	6.60	4.65	1.95	L-M	None
1250 mm	yellow sand f-m grained damp	6.80	4.40	2.40	N	None
1500 mm	yellow clayey sand damp	6.40	3.90	2.50	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 39880 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	yellow sand f-m grained	6.25	5.15	1.10	N	None
500 mm	yellow sand f-m grained	6.30	5.15	1.15	N	None
750 mm	yellow sand f-m grained	6.35	5.15	1.20	N	None
1000 mm	yellow sand f-m grained damp	6.40	5.35	1.05	N	None
1250 mm	yellow sand f-m grained damp	6.75	5.40	1.35	N	None
1500 mm	yellow sand f-m grained wet some black organics	6.80	3.65	**3.15**	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 40230 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	grey/brown f-m grained sand	7.05	5.90	1.15	L	None
500 mm	grey/brown f-m grained sand	7.20	5.75	1.45	N	None
750 mm	grey f-m grained sand	7.10	5.55	1.55	N	None
1000 mm	grey/green clayey sand	6.40	6.20	0.20	M	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 40850 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	yellow f-m grained sand	6.25	5.30	0.95	N	None

Lab No: 8828 Date Sampled: 22/04/16
Hole No: Ch 41670 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	grey crumbly clay + white grains	8.30	8.15	0.15	X-V	XX
500 mm	light yellow/grey crumbly clay + coarse white grains	8.50	8.50	0.00	X-V	XXXX
750 mm	light yellow/grey crumbly clay + coarse white grains	8.75	8.85	-0.10	X-V	XXXX

Lab No: 8828 Date Sampled: 21/04/16
Hole No: Ch 43285 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	light brown f-m grained sand	5.25	4.45	0.80	L	None
500 mm	light brown f-m grained sand	5.00	4.25	0.75	N	None
750 mm	light brown f-m grained sand	4.80	4.80	0.0	N	None
1000 mm	light brown f-m grained sand damp	5.90	4.45	1.45	L	None
1250 mm	grey/orange clayey sand damp	6.30	5.15	1.15	L	None
1500 mm	grey/orange clayey sand damp	6.60	5.50	1.10	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

Lab No: 8828 Date Sampled: 21/04/16

Hole No: Ch 43755 Location: Bussell Hwy

Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
			pH_{H2O2}=5.04			
250 mm	brown/grey top soil f-m grained	5.80	5.20	0.60	L	None
500 mm	grey/brown f-m grained sandy top soil	7.05	5.80	1.25	N	None
750 mm	grey/yellow sand f-m grained	7.35	6.05	1.30	N	None
1000 mm	light brown sand f-m grained	7.30	5.95	1.35	N	None
1250 mm	light brown sand f-m grained	7.75	6.20	1.55	N	None
1500 mm	light brown clayey sand damp	6.05	5.25	0.80	N	None

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
ABN 71 111 052 218
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email admin@swchemservices.com.au

Certificate of Analysis

Client Name:	WML Consultants Attn: Alex Pope		
Address:	PO Box 2023, Bunbury, WA, 6231		
Phone No:	9722 3544	Fax:	9722 3599
Lab No:	8828	Order No:	
Date samples received:	3/05/16	Report date:	20/05/16

Sample details: 121 soil samples received 3/05/16 ex Bussell Highway

Samples were labelled:
Ch 31540 18/04/16 0.25 to 1.50m 6 samples
Ch 31850 18/04/16 0.25 to 1.50m 6 samples
Ch 32760 19/04/16 0.25 to 1.50m 6 samples
Ch 34315 19/04/16 0.25 to 1.50m 6 samples
Ch 35235 20/04/16 0.25 to 1.25m 5 samples
Ch 35620 20/04/16 0.25 to 1.50m 6 samples
Ch 36230 20/04/16 0.25 to 1.50m 6 samples
Ch 36560 20/04/16 0.25 to 1.50m 6 samples
Ch 37820 20/04/16 0.25 to 1.50m 6 samples
Ch 37970 21/04/16 0.25 to 1.50m 6 samples
Ch 38400 22/04/16 0.25 to 1.50m 6 samples
Ch 38740 22/04/16 0.25 to 1.50m 6 samples
Ch 38830 22/04/16 0.25 to 1.50m 6 samples
Ch 38950 22/04/16 0.25 to 1.50m 6 samples
Ch 39360 22/04/16 0.25 to 1.50m 6 samples
Ch 39510 22/04/16 0.25 to 1.50m 6 samples
Ch 39880 22/04/16 0.25 to 1.50m 6 samples
Ch 40230 22/04/16 0.25 to 1.00m 4 samples
Ch 40850 22/04/16 0.25m 1 sample
Ch 41670 22/04/16 0.25 to 0.75m 3 samples
Ch 43285 21/04/16 0.25 to 1.50m 6 samples
Ch 43755 21/04/16 0.25 to 1.50m 6 samples

Following field testing all samples were dried for 48 hours at 85 °C in preparation for SPOCAS testing.

The following samples were selected for full SPOCAS analysis
Ch 31540 1250 mm
Ch 31850 1000 mm
Ch 34315 1000 mm
Ch 35235 750 mm
Ch 35235 1000 mm
Ch 39510 1500 mm
Ch 41670 500 mm

Scope of Work: Full SPOCAS analysis on the samples to confirm the Field Test result and to determine an effective liming rate for the production of an ASSMP.

Test Methods: Soil samples analysed in accordance with QASSIT “Acid Sulphate Soils Laboratory Methods Guidelines” 2004 AE McInea and CR Ahern.
Soil samples were collected by WML, refrigerated, transported to the laboratory for

field testing.
Samples were analysed by MPL Laboratories, Perth in accordance with NATA accreditation no 2901
Results are reported on MPL Certificate of Analysis 180810

Test Results: see below

Comments:

1. Overall 1 sample had a Net Acidity without ANCE of >0.03%S.

2. The sample breaching the 0.03% Sulphur guideline was Ch 41760 500 mm with a % Sulphur content of 0.061%

3. The calculated Liming Rate for this material is 2.9 kg/tonne, based on a fineness factor of 2 and Calcium Carbonate at 100% ENV. The liming rate should be adjusted to compensate for the actual ENV of the neutralising agent used.

4. This sample also has a significant Acid Neutralising Capacity equivalent to 16% Sulphur.

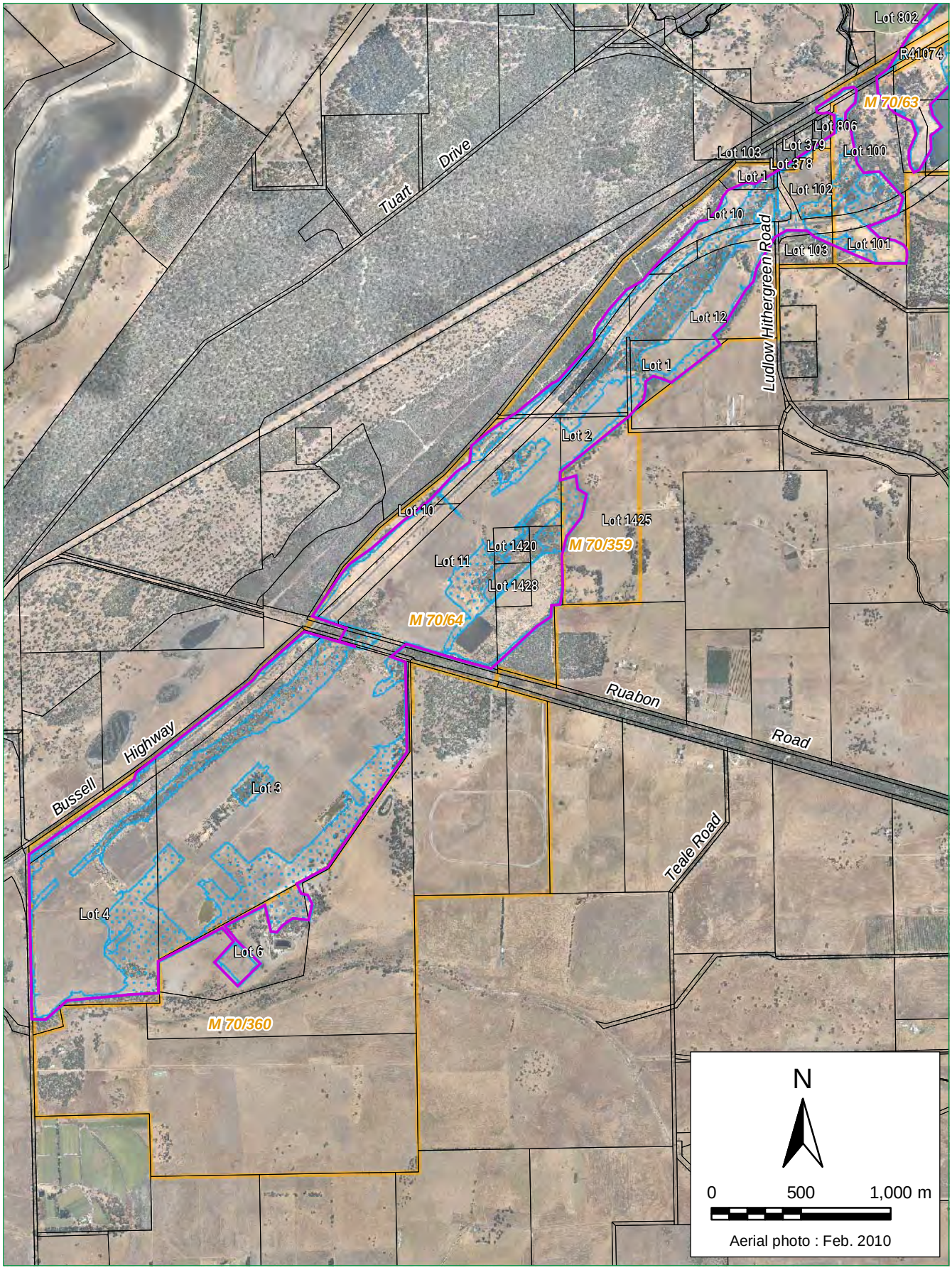
David Dodds
Dip.App.Chem. A.G.Inst.Tech

Analyte	Method Reference	PQL	Units	Ch 31540 1250 mm	Ch 31850 1000 mm	Ch 34315 1000 mm	Ch 35235 750 mm	Ch 35235 1000 mm
pH f				6.35	5.85	4.90	5.65	5.70
pHfox				4.75	4.95	4.25	2.15	2.65
ΔpH				1.60	0.90	0.65	3.50	3.05
pH KCl	23A	0.1	pH unit	6.1	6.2	5.7	6.0	6.1
pH Ox	23B	0.1	pH unit	6.2	6.3	4.3	4.3	5.1
Acidity Trail								
Titratable Actual Acidity	23F	5	mole H+/t	<5	<5	<5	<5	<5
Titratable Peroxide Activity	23G	5	mole H+/t	<5	<5	8.5	<5	<5
Titratable Sulphidic Activity	23H	5	mole H+/t	<5	<5	7.3	<5	<5
sulfidic - Titratable Actual Acidity	s-23F TAA	0.01	% pyrite S	<0.01	<0.01	<0.01	<0.01	<0.01
sulfidic - Titratable Peroxide Acidity	s-23G TPA	0.01	% pyrite S	<0.01	<0.01	0.014	<0.01	<0.01
sulfidic - Titratable Sulfidic Acidity	s-23H TSA	0.01	% pyrite S	<0.01	<0.01	0.012	<0.01	<0.01
Sulphur Trail								
KCl extractable Sulphur	23Ce	0.005	%S	0.006	<0.005	<0.005	<0.005	<0.005
Peroxide Sulphur	23De	0.005	%S	<0.005	<0.005	<0.005	0.012	0.008
Peroxide Oxidisable Sulphur	23E Spos	0.005	%S	<0.005	<0.005	<0.005	0.009	<0.005
acidity-peroxide Oxidisable Sulphur	a-23E	5	mole H+/t	<5.0	<5	<5	5.9	<5
Calcium Values								
KCl extractable Calcium	23Vh	0.005	%Ca	<0.005	<0.005	<0.005	<0.005	<0.005
Peroxide Calcium	23Wh	0.005	%Ca	0.006	<0.005	0.006	0.006	0.006
Acid Reacted Calcium	23X	0.005	%Ca	<0.005	<0.005	<0.005	<0.005	<0.005
acidity- Acid Reacted Calcium	a-23X	5	mole H+/t	<5	<5	<5	<5	<5
sulfidic - Acid Reacted Calcium	s-23X	0.005	%S	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium Values								
KCl extractable Magnesium	23Sm	0.005	%Mg	<0.005	<0.005	<0.005	<0.005	<0.005
Peroxide Magnesium	23Tm	0.005	%Mg	<0.005	<0.005	<0.005	<0.005	<0.005
Acid Reacted Magnesium	23U	0.005	%Mg	<0.005	<0.005	<0.005	<0.005	<0.005
acidity- Acid Reacted Magnesium	a-23U	5	mole H+/t	<5	<5	<5	<5	<5
sulfidic - Acid Reacted Magnesium	s-23U	0.005	%S	<0.005	<0.005	<0.005	<0.005	<0.005
Acid Neutralising Capacity								
acidity - Excess Acid Neutralising Capacity	a-23Q	5	mole H+/t	NT	NT	NT	NT	NT
sulfidic – Excess Acid Neutralising Capacity	s-23Q	0.005	%S	NT	NT	NT	NT	NT
Acid Base Accounting								
Net Acidity excluding ANC		10	mole H+/t	<10	<10	<10	<10	<10
Net Acidity excluding ANC		0.01	%S	<0.01	<0.01	<0.01	0.011	<0.01
Liming Rate excluding ANC		0.75	kg CaCO3/t	<0.75	<0.75	<0.75	<0.75	<0.75

Analyte	*Method Reference*	*PQL*	*Units*	*Ch 39510 1500 mm*	*Ch 41760 500 mm*			
pH f				6.40	8.50			
pHfox				3.90	8.50			
∆pH				2.50	0.00			
pH KCl	23A	0.1	pH unit	6.2	9.1			
pH Ox	23B	0.1	pH unit	5.3	10.0			
Acidity Trail								
Titratable Actual Acidity	23F	5	mole H+/t	<5	<5			
Titratable Peroxide Activity	23G	5	mole H+/t	<5	<5			
Titratable Sulphidic Activity	23H	5	mole H+/t	<5	<5			
sulfidic - Titratable Actual Acidity	s-23F TAA	0.01	% pyrite S	<0.01	<0.01			
sulfidic - Titratable Peroxide Acidity	s-23G TPA	0.01	% pyrite S	<0.01	<0.01			
sulfidic - Titratable Sulfidic Acidity	s-23H TSA	0.01	% pyrite S	<0.01	<0.01			
Sulphur Trail								
KCl extractable Sulphur	23Ce	0.005	%S	<0.005	0.007			
Peroxide Sulphur	23De	0.005	%S	0.007	0.068			
Peroxide Oxidisable Sulphur	23E Spos	0.005	%S	<0.005	0.061			
acidity-peroxide Oxidisable Sulphur	a-23E	5	mole H+/t	<5	38			
Calcium Values								
KCl extractable Calcium	23Vh	0.005	%Ca	<0.005	0.39			
Peroxide Calcium	23Wh	0.005	%Ca	0.007	13			
Acid Reacted Calcium	23X	0.005	%Ca	<0.005	13			
acidity- Acid Reacted Calcium	a-23X	5	mole H+/t	<5	6500			
sulfidic - Acid Reacted Calcium	s-23X	0.005	%S	<0.005	10			
Magnesium Values								
KCl extractable Magnesium	23Sm	0.005	%Mg	<0.005	0.14			
Peroxide Magnesium	23Tm	0.005	%Mg	0.006	1.1			
Acid Reacted Magnesium	23U	0.005	%Mg	<0.005	0.92			
acidity- Acid Reacted Magnesium	a-23U	5	mole H+/t	<5	761			
sulfidic - Acid Reacted Magnesium	s-23U	0.005	%S	<0.005	1.2			
Acid Neutralising Capacity								
acidity - Excess Acid Neutralising Capacity	a-23Q	5	mole H+/t	NT	51			
sulfidic – Excess Acid Neutralising Capacity	s-23Q	0.005	%S	NT	16			
Acid Base Accounting								
Net Acidity excluding ANC		10	mole H+/t	<10	**38**			
Net Acidity excluding ANC		0.01	%S	<0.01	**0.061**			
Liming Rate excluding ANC		0.75	kg CaCO3/t	<0.75	**2.9**			

APPENDIX D

SAND MINING AREAS



Legend

- Project Area
- Tenements
- Infrastructure
- Residue Disposal
- Solar Drying Dam

ANNUAL ENVIRONMENTAL REPORT
2011

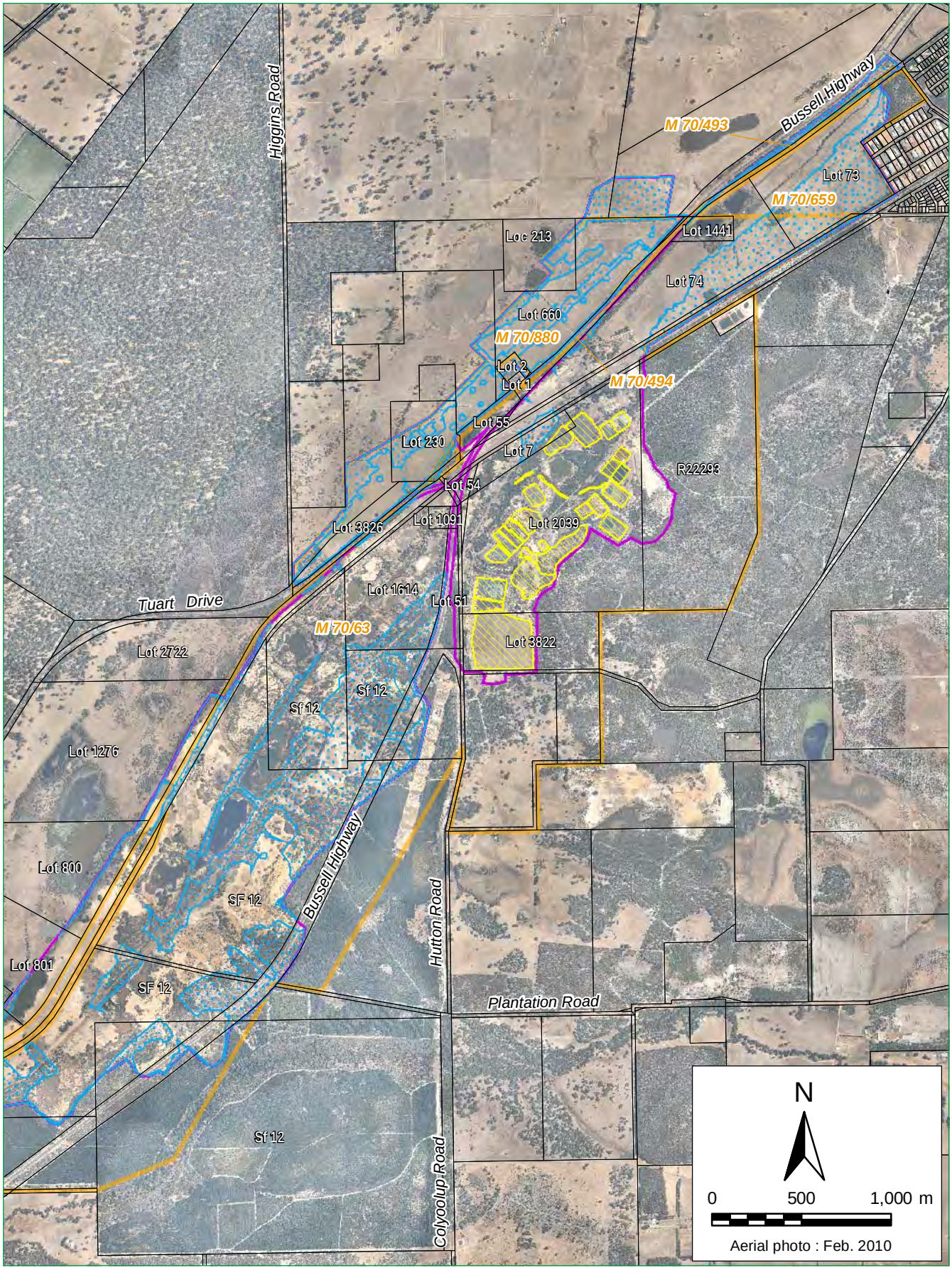
SOUTH CAPEL (SOUTHERN AREA)

INFRASTRUCTURE

ILUKA

ORIG: N.Evans DRAWN: D.G.S. SCALE: 1:30,000 (A4) DATE: March 2012 DWG No: 36881 ver.10

FIGURE:2-2 b



Legend

- Project Area
- Tenements
- Infrastructure
- Residue Disposal
- Solar Drying Dam

ANNUAL ENVIRONMENTAL REPORT
2011

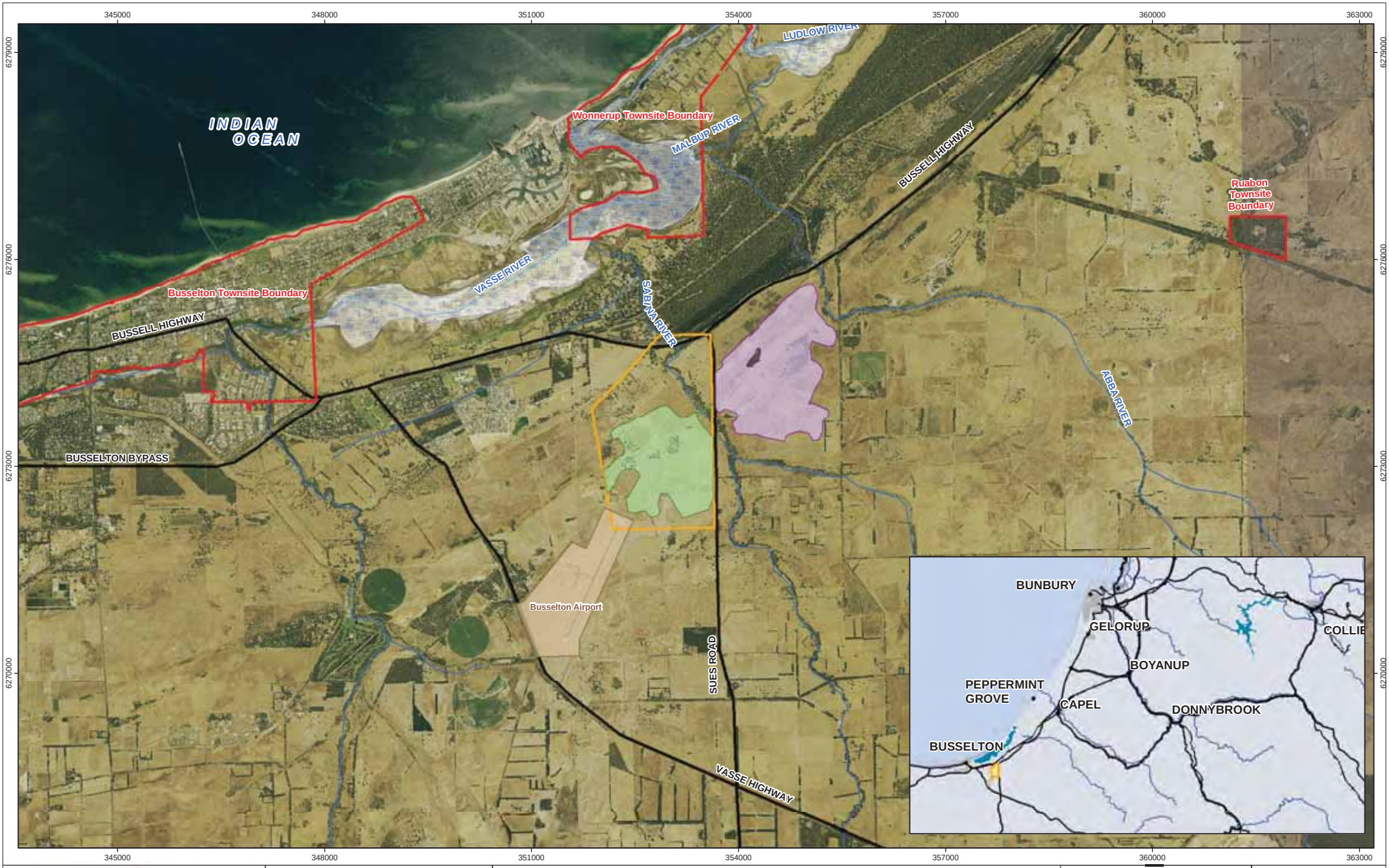
SOUTH CAPEL (NORTHERN AREA)

INFRASTRUCTURE

ILUKA

ORIG: N.Evans DRAWN: D.G.S. SCALE: 1:30,000 (A4) DATE: March 2012 DWG No: 36880 ver.10

FIGURE: 2-2 c



ennovate environmental consulting

Figure:	1	Date:	23/09/13
Sheet Size:	A3	Status:	Final
Drawn by GSM	Requested by ND	GSM Reference Fig_1_reg_loc	

CRISTAL
Brilliance inspired by titanium

Wonnerup South Project
Regional Setting
Figure 1

Legend

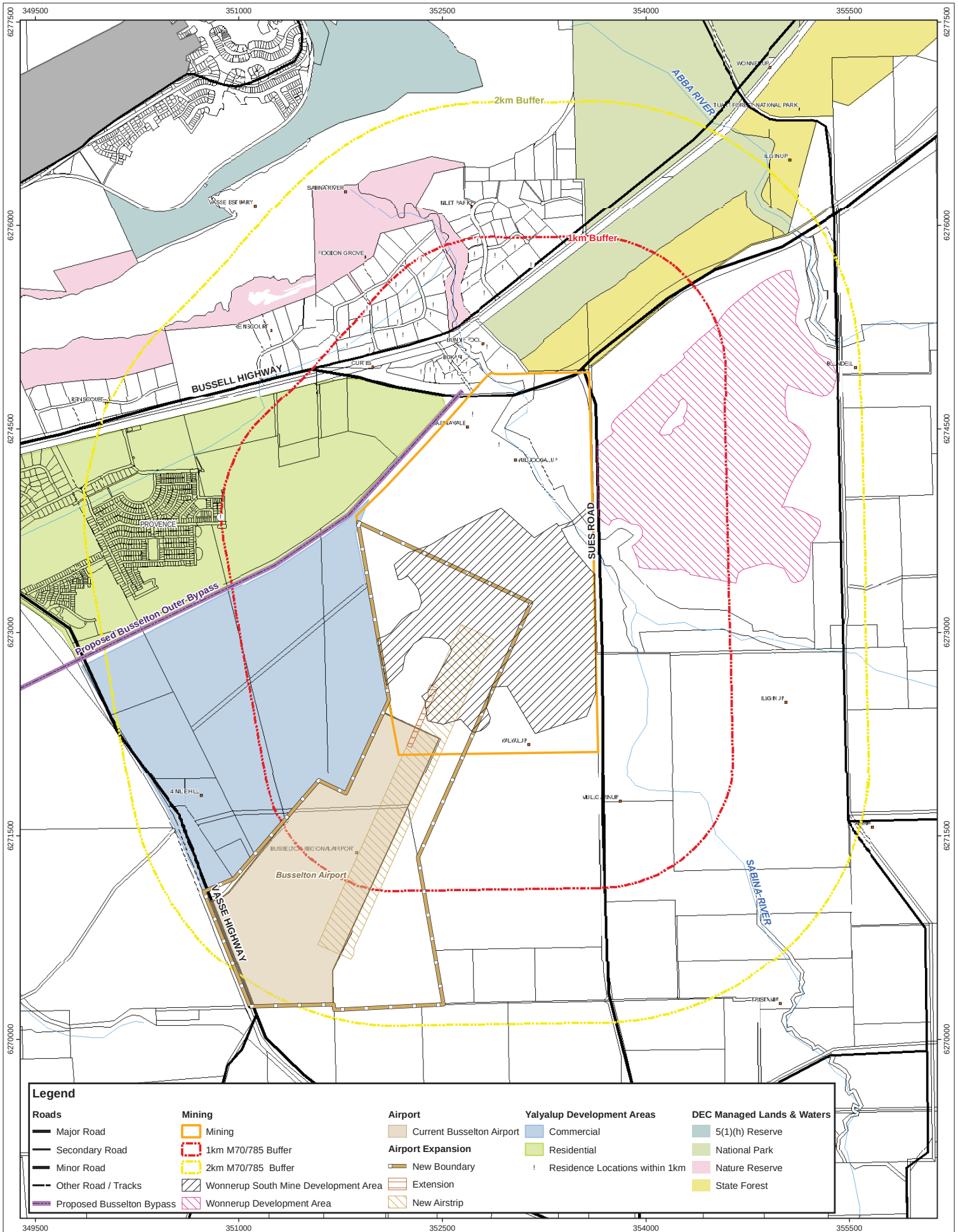
- Wonnerup Mine Development Area
- Wonnerup South Mine Development Area
- Project Area
- Busselton Airport
- Vasse-Wonnerup wetland (Ramsar site)

0 500 1,000 1,500 2,000
Meters

1:50,000

Datum: GDA94 Projection: MGA Zone 50

GRIFFIN SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226



GRIFFIN SPATIAL & MAPPING

ennovate environmental consulting

WONNERUP SOUTH

Wonnerup South Project
Surrounding Land Users and Zoning

Figure 3

CRISTAL
Brilliance inspired by titanium

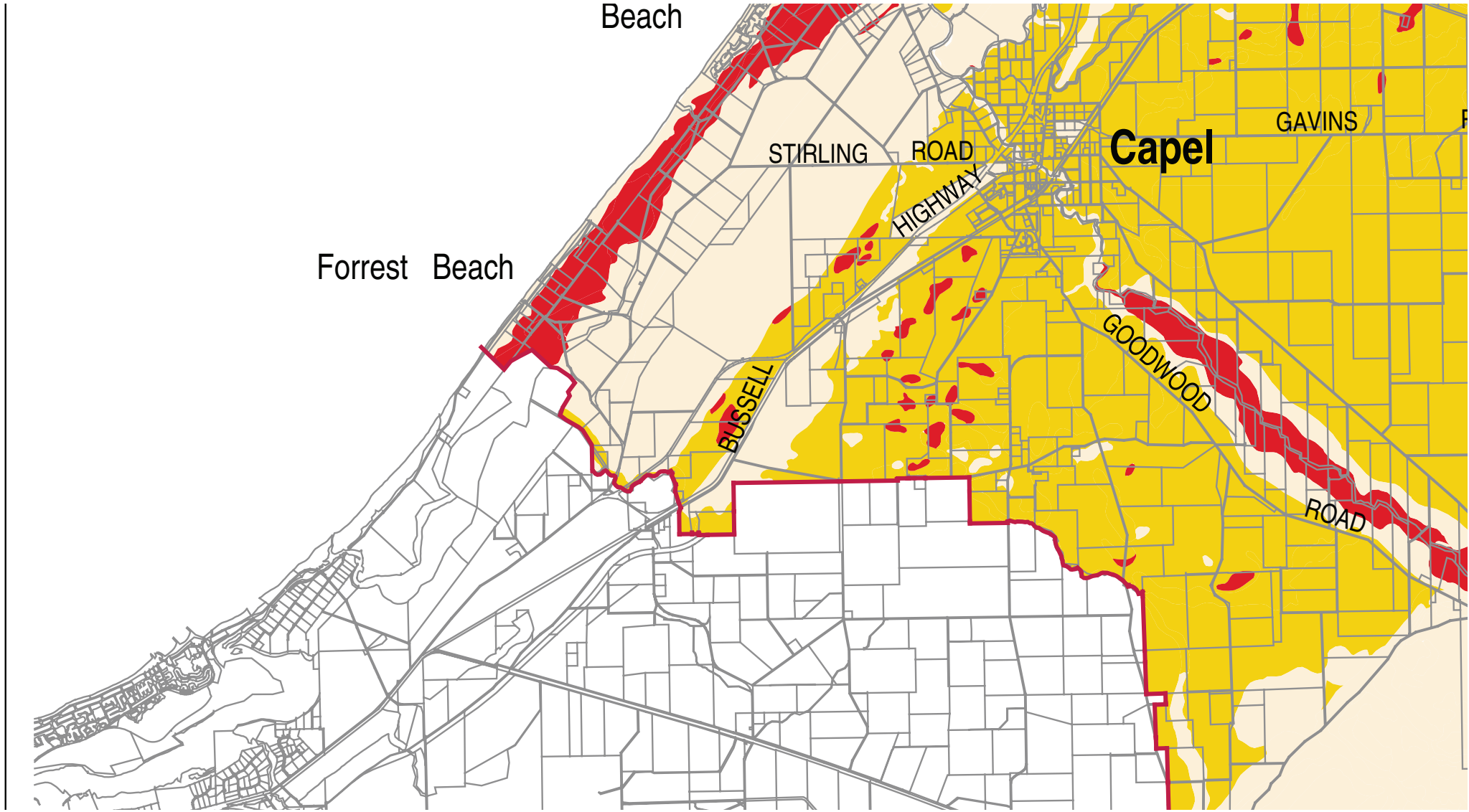
ennovate environmental consulting		Date:	23/09/2013
Sheet Size:	A3	Status:	FINAL
Drawn by GSM	Requested by ND	Internal Reference Fig3_residence	

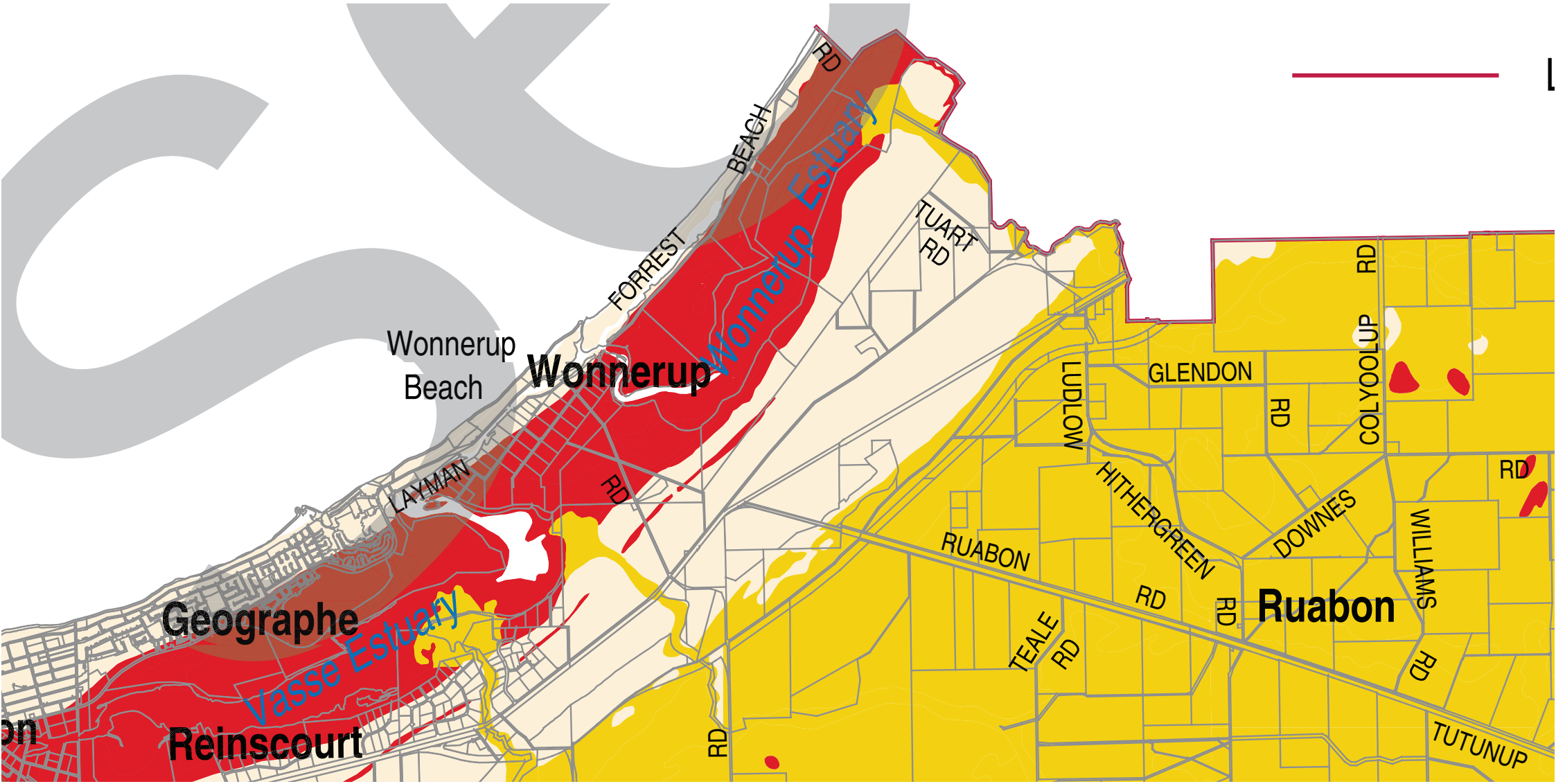
0 250 500 750 1,000 1,250
Meters
1:25,000

Datum: GDA94 Projection: MGA Zone 50

APPENDIX E

ASS RISK MAPS


Beach
Forrest Beach
STIRLING ROAD
HIGHWAY
Capel
GAVINS
BUSSELL
GOODWOOD
ROAD


Wonnerup Beach
Wonnerup
Wonnerup Estuary
Vasse Estuary
Geographe
Reinscourt
Ruabon
GLENDON
RUABON
TUTUNUP
FORREST
BEACH
TUART
RD
LAYMAN
LUDLOW
COLYOOLUP
HITHERGREEN
DOWNES
WILLIAMS
TEALE