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Geotechnical Report
Level One Inspection and Testing

Lavender Estate Stage 4 & 5
Officer

Prepared for:

Streetworks Pty Ltd
4 Len Thomas Place
Narre Warren Victoria 3805

PROJECT No: 8964

21 December 2016

Version 2

Prepared by:

TERRA FIRMA LABORATORIES
Geotechnical Inspection and Testing Authority

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Geotechnical Report Level One Inspection and Testing
Lavender Estate Stage 4 & 5

1. Introduction

Terra Firma Laboratories was engaged by *Streetworks Pty Ltd* as the geotechnical inspection and testing authority to provide Level 1 supervision and testing works on the earthworks component for Lavender Estate Stage 4 & 5. This work was conducted over the period of 10/06/2016 to 14/12/2016.

This report presents that the allotment earthworks was carried out in accordance with *AS3798-2007 Guidelines for Earthworks for Commercial and Residential Development* and in compliance with the compaction control specifications established by the contractor.

2. Scope of Works

2.1. Areas of work

The areas of work included lots 401, 402, 403, 404, 405, 406, 407, 408, 501, 502, 503, 504 and 505. The site will be a Residential estate.

The area on which fill was placed is shown on site plan (Appendix 1) based on drawings prepared by Dalton Consulting Engineers and provided by Streetworks Pty Ltd.

The supervision work by *Terra Firma Laboratories* involved both inspection of sub grade preparation work and full time inspection and testing of fill placement.

2.2. Specification

The placement of fill on the areas of work was to be carried out in accordance with *AS3798-2007 Guidelines for Earthworks for Commercial and Residential Development,* as directed by *Streetworks Pty Ltd*. At all times during placement of fill materials Terra Firma Laboratories maintained a Geotechnical Technician on site to perform the supervision and testing as required by AS3798-2007.

A technical specification for compaction control requirements was provided by Streetworks Pty Ltd and established that: As referenced from AS3798-2007 (Section 5.2) establishes a specification requirement for a minimum density ratio of not less than 95% noting that soils containing more than 20% of particles coarser than 37.5mm cannot be tested for relative compaction using the procedures of AS1289.

Field density testing shall be undertaken at a frequency of not less than 3 tests per visit.

Test Rolling is required for all layers of structural fill and materials within 150mm of permanent subgrade level so as to withstand test rolling without visible deformation or springing. Corrective action is required where unstable areas exceed 20% of the area being considered by test rolling.

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3. Inspection and Testing

3.1. Sub-Grade Preparation

Subgrade preparation involved stripping the site down of topsoil and organic matter to a depth of approximately 200mm below existing levels detailed on the site plans. The sub-grade area was then proof-rolled to determine soft or otherwise unsuitable zones and such zones rectified as necessary. The sub-grade was watered and scarified prior to fill placement to aid layer bonding.

3.2. Fill materials

The materials used as fill were locally sourced and observed to generally consist of Silty Clay, sourced from stockpiled materials on site. No particles greater than 150mm were observed. The fill was nominated as clean fill by the contractor.

3.3. Fill Construction

The contractor had the following plant available on-site during the construction period for use in the fill placement:

- Dump Truck
- Excavator
- Dozer
- Pad foot Roller
- Compactor
- Water Cart
- Smooth Drum Roller

All fill was placed in layers of thicknesses not exceeding 300mm. *The work area was typically a 2 or 3 lot area on any one particular day*. At the completion of a placed layer, compaction testing was performed to confirm appropriate compaction had been achieved and supported the observations made.

It was observed that finished levels were in accordance with levels marked on site by survey. These levels are shown on site plans attached in Appendix 1.

The final 300mm of fill placed across the site was placed as a topsoil layer/ growing medium and should be considered as non structural, as it was placed in an uncontrolled manner, as allowed by specifications.

4. Compaction Control Testing

Testing comprised of a total of 19 in-situ density tests, with a summary of results included in Appendix 2. Test Reports are referenced in Appendix 3.

Test numbers 8, 10, 16 and 17 originally failed to meet specification. *Streetworks Pty Ltd* were notified and asked to rework the area appropriately. Upon adequate reworking *Terra Firma Laboratories* would perform a retest; this process would continue until a minimum compaction effort of 95% was achieved.

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It should be noted that the tests are a representation of the fill placed and support the visual assessment of the works completed. Each lot does not necessarily require a compaction test to comply. The compaction control testing indicated that the engineered fill on all lots complied with the technical specification.

5. Uncontrolled Works

Terra Firma Laboratories cannot verify any works completed by others after the final date specified in the introduction. Uncontrolled works may include, but not limited to trenching for services, cut and fill works for slab preparation or subsequent removal of vegetation and back fill of holes.

6. Clean Fill

Terra Firma Laboratories cannot guarantee that the material used as a filling medium is free from chemical or other contamination.

7. Statement of Compliance

Inspections and testing of the fill areas at this site indicate that both sub grade preparation and fill placement have been conducted in accordance with the specification and that the completed fill areas of greater than 300mm, as shown on the site plan attached, and not any preceding the 10/06/2016 or work completed after the 14/12/2016, may be certified as being compliant with the specification.

For and on behalf of
Terra Firma Laboratories,

T Seymour

Tom Seymour
Lab Manager

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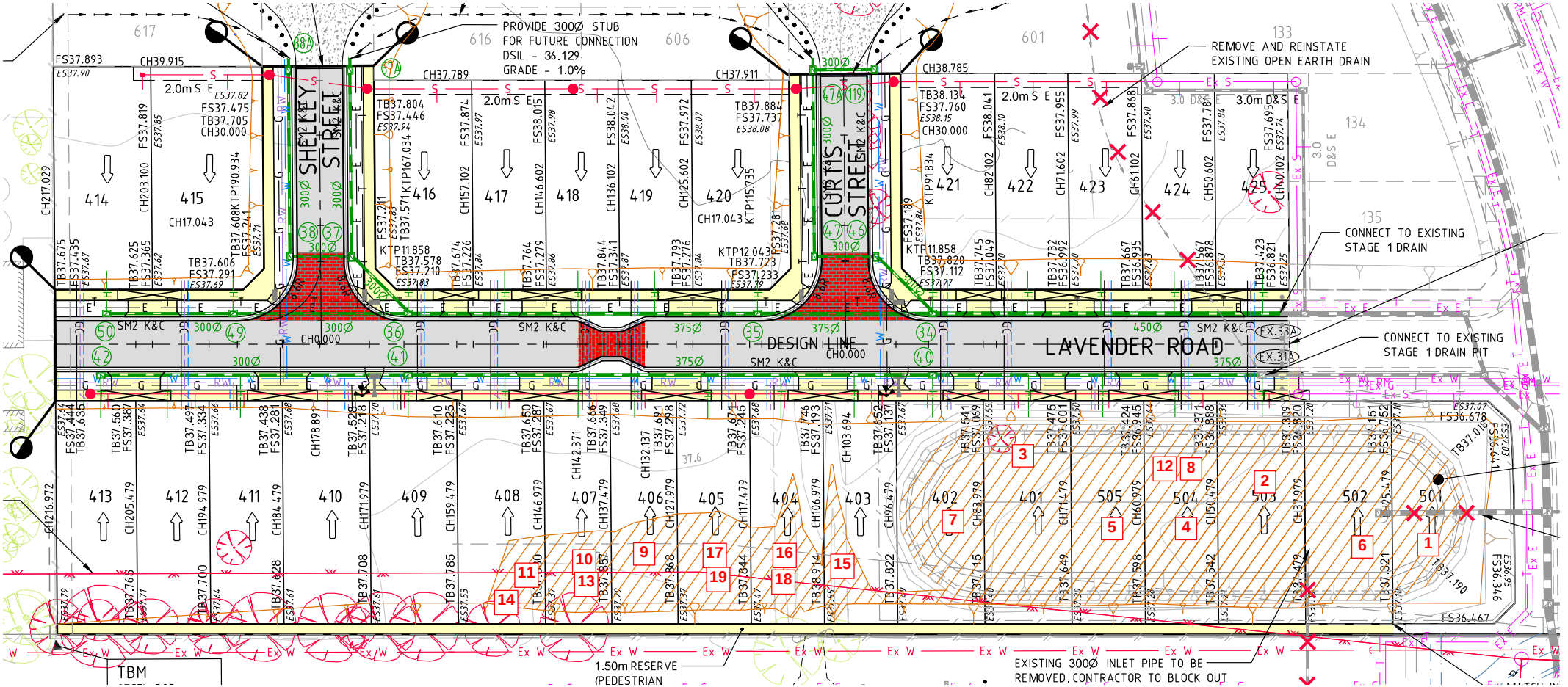
APPENDICES
Appendix 1: Site Plans
Appendix 2: Test Summary
Appendix 3: Test Reports



terra firma laboratories

12 Enterprise Ave
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Vic 3806

Test Location Plan

Client : Streetworks Pty Ltd

Project : Lavender Estate Stage 4 & 5

Scale
NTS

Level One Test Summary

Client: Streetworks Pty Ltd **Specification:** 95%
Project: Lavender Estate Stage 4 & 5 **Project No:** 8964

Date:	Test Number:	Layer:	Retest of:	Density:	Pass/Fail:	Lot No:	Report No:
10/06/2016	1	L2		96	PASS	501	8964-1
10/06/2016	2	L3		100	PASS	503	8964-1
14/06/2016	3	L4		99	PASS	401	8964-2
14/06/2016	4	L5		102	PASS	504	8964-2
9/08/2016	5	L1		97.5	PASS	505	8964-3
9/08/2016	6	L2		96.5	PASS	502	8964-3
9/08/2016	7	L5		97.5	PASS	402	8964-3
10/08/2016	8	L7		94.5	FAIL	504	8964-4
10/08/2016	9	L1		96.5	PASS	406	8964-4
10/08/2016	10	L2		94	FAIL	407	8964-4
10/08/2016	11	L2		97	PASS	408	8964-4
15/08/2016	12	L7	8	97	PASS	504	8964-5
15/08/2016	13	L2	10	95	PASS	407	8964-5
15/08/2016	14	L3		95	PASS	408	8964-5
13/12/2016	15	FL		100	PASS	403	8964-6
13/12/2016	16	FL		91.5	FAIL	404	8964-6
13/12/2016	17	FL		93	FAIL	405	8964-6
14/12/2016	18	FL	16	102.5	PASS	404	8964-7
14/12/2016	19	FL	17	95	PASS	405	8964-8

COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

terra firma laboratories

12 Enterprise Avenue Berwick Vic 3806

ph 97695799 fax 97694799

report No 8964-1

date of issue 24-Jun-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate ST 4&5
Location	Officer

Feature	Block Fill
Layer thickness (mm)	300

tested by	KC
time	All Day
date	10-Jun-2016
checked by	SB

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		**1**	**2**				
location	Lot No	501	503				
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	Layer 2	Layer 3				
measurement depth	mm	275	275				
field wet density	t/m^3	2.04	2.09				
field dry density	t/m^3	1.76	1.82				
field moisture content	%	15.7	14.8				
laboratory compaction procedure AS1289 5.7.1							
compactive effort		standard	standard				
oversize material retained on AS sieve	mm	19.0	19.0				
percent of oversize material	wet	0	0				
peak converted wet density	t/m^3	2.12	2.09				
adjusted peak converted wet density	t/m^3	-	-				
moisture variation from OMC (-dry,+wet)%		1.5	0.5				
Moisture ratio	**%**	**110.5**	**102.5**				
Hilf density ratio (R_{HD})	**%**	**96.0**	**100.0**				

material description

Sandy CLAY

NATA ACCREDITED FOR TECHNICAL COMPETENCE

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Accredited for compliance with ISO/IEC 17025

LABORATORY ACCREDITATION No **15357**

Approved Signature

S Benbow

COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

terra firma laboratories

12 Enterprise Avenue Berwick Vic 3806

ph 97695799 fax 97694799

report No 8964-2

date of issue 24-Jun-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate ST 4&5
Location	Officer

Feature	Block Fill
Layer thickness (mm)	300

tested by	KC
time	All Day
date	14-Jun-2016
checked by	SB

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		**3**	**4**				
location	Lot No	401	504				
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	layer 4	layer 5				
measurement depth	mm	275	275				
field wet density	t/m^3	2.05	2.13				
field dry density	t/m^3	1.74	1.93				
field moisture content	%	17.2	10.4				
laboratory compaction procedure AS1289 5.7.1							
compactive effort		standard	standard				
oversize material retained on AS sieve	mm	19.0	19.0				
percent of oversize material	wet	0	0				
peak converted wet density	t/m^3	2.07	2.09				
adjusted peak converted wet density	t/m^3	-	-				
moisture variation from OMC (-dry,+wet)%		-0.5	-0.5				
Moisture ratio	**%**	**96.5**	**95.0**				
Hilf density ratio (R_{HD})	**%**	**99.0**	**102.0**				

material description

Sandy CLAY

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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

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12 Enterprise Avenue Berwick Vic 3806

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report No 8964-3

date of issue 12-Aug-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate Stage 4 & 5
Location	Officer

Feature	Block Fill
Layer thickness (mm)	300

tested by	AK
time	All Day
date	09-Aug-2016
checked by	DB

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		**5**	**6**	**7**			
location Lot No		505	502	402			
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	L1	L2	L5			
measurement depth	mm	275	275	275			
field wet density	t/m^3	2.04	2.02	2.04			
field dry density	t/m^3	1.72	1.70	1.70			
field moisture content	%	18.8	18.7	20.1			
laboratory compaction procedure AS1289 5.7.1							
compactive effort		standard	standard	standard			
oversize material retained on AS sieve	mm	19.0	19.0	19.0			
percent of oversize material	wet	0	0	0			
peak converted wet density	t/m^3	2.09	2.09	2.09			
adjusted peak converted wet density	t/m^3	-	-	-			
moisture variation from OMC (-dry,+wet)%		1.5	2.0	1.5			
Moisture ratio	**%**	**109.0**	**112.0**	**108.5**			
Hilf density ratio (R_{HD})	**%**	**97.5**	**96.5**	**97.5**			

material description

Sandy CLAY

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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

terra firma laboratories

12 Enterprise Avenue Berwick Vic 3806

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report No 8964-4

date of issue 12-Aug-2016

Client	Streetworks	Feature	Block Fill	tested by	AK
Client address	4 Len Thomas Place, Narre Warren, 3805			time	All Day
Project	Lavender Estate Stage 4 & 5	Layer thickness (mm)	300	date	10-Aug-2016
Location	Officer			checked by	DB

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		**8**	**9**	**10**	**11**		
location Lot No		504	406	407	408		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	L7	L1	L2	L2		
measurement depth	mm	275	275	275	275		
field wet density	t/m^3	2.02	2.02	2.02	2.06		
field dry density	t/m^3	1.70	1.68	1.73	1.74		
field moisture content	%	18.5	20.5	16.5	18.4		
laboratory compaction procedure AS1289 5.7.1							
compactive effort		standard	standard	standard	standard		
oversize material retained on AS sieve	mm	19.0	19.0	19.0	19.0		
percent of oversize material	wet	0	0	0	0		
peak converted wet density	t/m^3	2.14	2.10	2.15	2.13		
adjusted peak converted wet density	t/m^3	-	-	-	-		
moisture variation from OMC (-dry,+wet)%		3.5	2.0	1.5	3.5		
Moisture ratio	**%**	**122.0**	**110.5**	**109.5**	**123.0**		
Hilf density ratio (R_{HD})	**%**	**94.5**	**96.5**	**94.0**	**97.0**		

material description

Sandy CLAY

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COMPACTION ASSESSMENT
BY NUCLEAR GAUGE METHOD

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report No 8964-5
date of issue 19-Aug-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate Stage 4 & 5
Location	Officer

chainage	Lot Fill
Layer thickness (mm)	300

tested by	AK
time:	All Day
date:	15-Aug-2016
checked by	DB

test procedures AS1289.2.1.1 & 5.8.1

test No		12	13	14			
location Lot No		504 Retest of 8	407 Retest of 10	408			
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	L7	L2	L3			
measurement depth	mm	275	275	275			
field wet density	t/m^3	2.05	2.05	2.06			
field dry density	t/m^3	1.69	1.67	1.74			
field moisture content	%	21.0	23.5	18.5			
laboratory compaction procedure AS1289.5.1.1 Standard Compaction							
standard maximum dry density	t/m^3	**1.74**	**1.76**	**1.83**			
standard optimum moisture content	%	**16.0**	**16.0**	**15.0**			
test procedure AS1289.5.4.1							
oversize material retained on AS sieve	mm	19.0	19.0	19.0			
percent of oversize material	wet	0	0	0			
percent of oversize material	dry	0	0	0			
adjusted standard maximum dry density	t/m^3	0.00	0.00	0.00			
adjusted standard optimum moisture content	%	0.0	0.0	0.0			
moisture variation (-dry,+wet)	%	5.0	7.0	4.0			
moisture ratio (R_m)	**%**	132.0	144.5	125.5			
dry density ratio (R_D)	**%**	**97.0**	**95.0**	**95.0**			

material description

Silty CLAY

compaction test details

date mat'l sampled	15-Aug-2016
material source	On site
material stabilised	
time elapsed	

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COMPACTION ASSESSMENT
BY NUCLEAR GAUGE METHOD

report No 8964-6
date of issue 15-Dec-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate Stage 4 & 5
Location	Officer

chainage	Block Fill
Layer thickness (mm	300

tested by	BM
time:	12:45 PM
date:	13-Dec-2016
checked by	DB

test procedures AS1289.2.1.1 & 5.8.1

test No		**15**	**16**	**17**			
location Lot No		403	404	405			
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	FL	FL	FL			
measurement depth	mm	275	275	275			
field wet density	t/m^3	2.12	1.97	1.97			
field dry density	t/m^3	1.79	1.58	1.58			
field moisture content	%	18.5	24.5	24.5			
laboratory compaction procedure AS1289.5.1.1 Standard Compaction							
standard maximum dry density	t/m^3	**1.79**	**1.73**	**1.70**			
standard optimum moisture content	%	**14.5**	**17.5**	**18.0**			
test procedure AS1289.5.4.1							
oversize material retained on AS sieve	mm	19.0	19.0	19.0			
percent of oversize material	wet	0	0	0			
percent of oversize material	dry	0	0	0			
adjusted standard maximum dry density	t/m^3	0.00	0.00	0.00			
adjusted standard optimum moisture content	%	0.0	0.0	0.0			
moisture variation (-dry,+wet)	%	4.0	7.0	6.5			
moisture ratio (R_m)	**%**	128.0	138.5	136.0			
dry density ratio (R_D)	**%**	**100.0**	**91.5**	**93.0**			

material description

Silty CLAY

compaction test details

date mat'l sampled	13-Dec-2016
material source	On site
material stabilised	
time elapsed	

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Approved Signature
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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

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report No 8964-7

date of issue 15-Dec-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate Stage 4 & 5
Location	Officer

Feature	Block Fill
Layer thickness (mm)	300

tested by	BM
time	10:30 AM
date	14-Dec-2016
checked by	DB

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		**18**					
location Lot No Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)		404 Retest 16					
depth from F.S.L.	m	FL					
measurement depth	mm	275					
field wet density	t/m^3	2.11					
field dry density	t/m^3	1.81					
field moisture content	%	16.6					
laboratory compaction procedure AS1289 5.7.1							
compactive effort		standard					
oversize material retained on AS sieve	mm	19.0					
percent of oversize material	wet	0					
peak converted wet density	t/m^3	2.06					
adjusted peak converted wet density	t/m^3	-					
moisture variation from OMC (-dry,+wet)%		1.0					
Moisture ratio	**%**	**106.0**					
Hilf density ratio (R_{HD})	**%**	**102.5**					

material description

Sandy CLAY

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COMPACTION ASSESSMENT
BY NUCLEAR GAUGE METHOD

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report No 8964-8
date of issue 15-Dec-2016

Client	Streetworks
Client address	4 Len Thomas Place, Narre Warren, 3805
Project	Lavender Estate Stage 4 & 5
Location	Officer

chainage	Block Fill
Layer thickness (mm	300

tested by	BM
time:	10:30 AM
date:	14-Dec-2016
checked by	DB

test procedures AS1289.2.1.1 & 5.8.1

test No		**19**					
location Lot No		405 Retest 17					
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	FL					
measurement depth	mm	275					
field wet density	t/m^3	2.04					
field dry density	t/m^3	1.73					
field moisture content	%	18.5					
laboratory compaction procedure AS1289.5.1.1 Standard Compaction							
standard maximum dry density	t/m^3	**1.82**					
standard optimum moisture content	%	**13.5**					
test procedure AS1289.5.4.1							
oversize material retained on AS sieve	mm	19.0					
percent of oversize material	wet	0					
percent of oversize material	dry	0					
adjusted standard maximum dry density	t/m^3	0.00					
adjusted standard optimum moisture content	%	0.0					
moisture variation (-dry,+wet)	%	5.0					
moisture ratio (R_m)	**%**	138.0					
dry density ratio (R_D)	**%**	**95.0**					

material description

Sandy CLAY

compaction test details

date mat'l sampled	14-Dec-2016
material source	On site
material stabilised	
time elapsed	

NATA ACCREDITED FOR TECHNICAL COMPETENCE

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LABORATORY ACCREDITATION No **15357**

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D Burgess