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**Geotechnical Report
Level One Inspection and Testing**

**Riverwalk Estate Stage 19A
Werribee**

Prepared for:

**Excell Gray Bruni
12 Allied Drive
Tullamarine**

Project 9222

14 December 2017.

Prepared by:

TERRA FIRMA LABORATORIES
Geotechnical Inspection and Testing Authority

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Geotechnical Report Level One Inspection and Testing Riverwalk Estate Stage 19A

1. Introduction

Terra Firma Laboratories was engaged by *Excell Gray Bruni* as the geotechnical inspection and testing authority to provide Level 1 supervision and testing works on the earthworks component for Riverwalk Estate Stage 19A. This work was conducted over the period of 14/11/2017 to 24/11/2017.

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 1903 through to 1913. 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 SMEC urban development and provided by *Excell Gray Bruni*.

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 *Excell Gray Bruni*. 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 *Excell Gray Bruni* 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.

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:

- Dozer
- Pad foot Roller
- Grader
- Dump Trucks
- Water Cart

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

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 14/11/2017 or work completed after the 24/11/2017, may be certified as being compliant with the specification.

For and on behalf of
Terra Firma Laboratories,



Tom Seymour
Lab Manager



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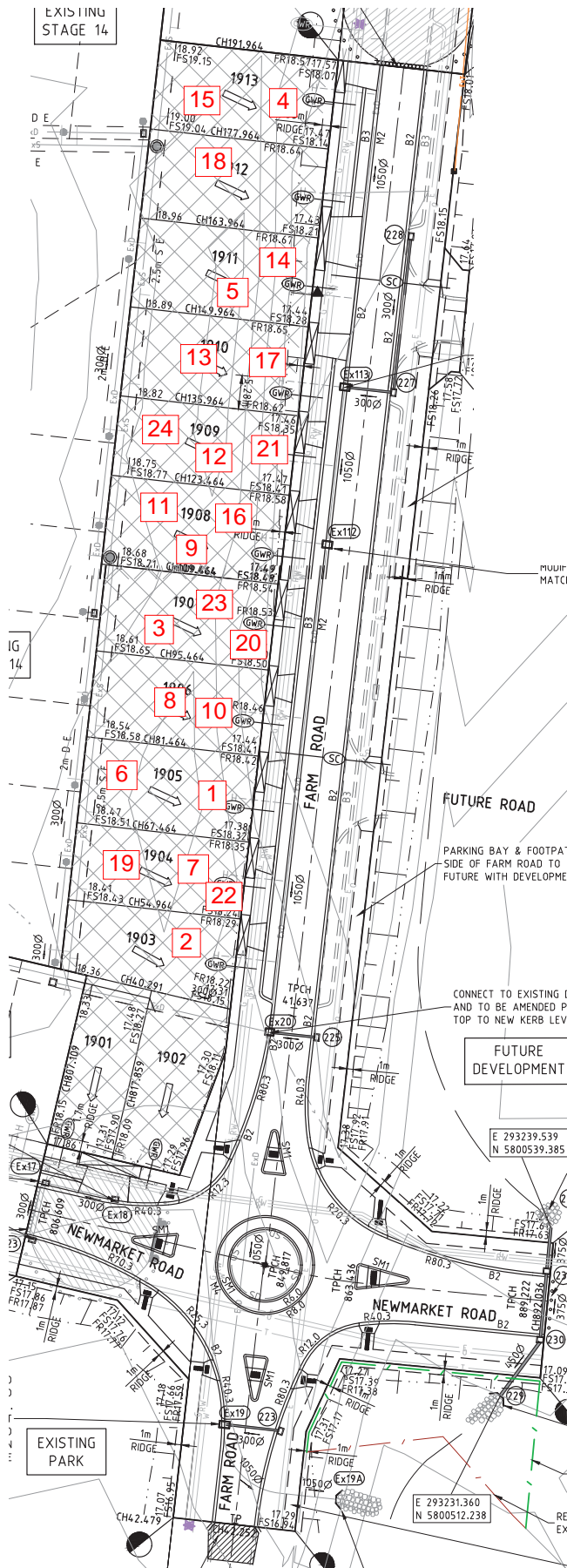
ABN: 11 925 206 385

APPENDICES

Appendix 1: Site Plans

Appendix 2: Test Summary

Appendix 3: Test Reports



47 National Avenue
Pakenham VIC 3810

Test Location Plan

Client: Excell Gray Bruni

Project: Riverwalk Estate Stage 19A

Scale
NTS



Level One Test Summary Test Summary

Client: Excell Gray Bruni **Specification:** 95%
Project: Riverwalk Estate 19A **Project No:** 9992

Date:	Test Number:	Layer:	Retest of:	Density:	Pass/Fail:	Lot No:	Report No:
14/11/2017	1	L1		100	Pass	1905	9992-1
14/11/2017	2	L1		100.5	Pass	1903	9992-1
14/11/2017	3	L1		100.5	Pass	1907	9992-1
15/11/2017	4	L1		96.5	Pass	1913	9992-2
15/11/2017	5	L1		97	Pass	1911	9992-2
15/11/2017	6	L2		97	Pass	1905	9992-2
17/11/2017	7	L3		96	Pass	1904	9992-3
17/11/2017	8	L3		96.5	Pass	1906	9992-3
17/11/2017	9	L3		98	Pass	1908	9992-3
20/11/2017	10	L4		99.5	Pass	1906	9992-4
20/11/2017	11	L4		99.5	Pass	1908	9992-4
20/11/2017	12	L4		98.5	Pass	1909	9992-4
21/11/2017	13	L3		97.5	Pass	1910	9992-5
21/11/2017	14	L2		95.5	Pass	1911	9992-5
21/11/2017	15	L2		99	Pass	1913	9992-5
21/11/2017	16	L5		95.5	Pass	1908	9992-5
21/11/2017	17	L5		98	Pass	1910	9992-5
21/11/2017	18	L5		97	Pass	1912	9992-5
22/11/2017	19	L6		97.5	Pass	1904	9992-7
22/11/2017	20	L6		96.5	Pass	1907	9992-7
22/11/2017	21	L6		97	Pass	1909	9992-7
24/11/2017	22	L7		99.5	Pass	1904	9992-6
24/11/2017	23	L7		100	Pass	1907	9992-6
24/11/2017	24	L7		101.5	Pass	1909	9992-6



COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terraforma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-1R
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by JP
 time All Day
 date 14-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		1	2	3		
location	Lot No	1905	1903	1907		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 1	Layer 1	Layer 1		
measurement depth	mm	275	275	275		
field wet density	t/m ³	1.84	2.01	1.94		
field dry density	t/m ³	1.62	1.78	1.70		
field moisture content	%	13.6	13.3	13.7		

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	1.84	2	1.93		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-2.5	-2.5	-2.0		
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Moisture ratio	%	85.5	85.5	89.0		
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Hilf density ratio (R_{HD})	%	100.0	100.5	100.5		
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material description

Silty CLAY



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian national standards requirements.
 Accredited for compliance with ISO/IEC 17025

Approved Signature

R Schembri



COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terra Firma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-2
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by JP
 time All Day
 date 15-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		4	5	6		
location	Lot No	1913	1911	1905		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 1	Layer 1	Layer 2		
measurement depth	mm	275	275	275		
field wet density	t/m ³	2.01	1.98	2.05		
field dry density	t/m ³	1.73	1.71	1.78		
field moisture content	%	16.0	15.2	14.9		

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	2.08	2.035	2.11		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-1.5	-1.5	-1.5		
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Moisture ratio	%	91.0	90.5	90.5		
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Hilf density ratio (R_{HD})	%	96.5	97.0	97.0		
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material description

Silty CLAY



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 R Schembri



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BY NUCLEAR GAUGE METHOD

Terra Firma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-3
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by SP
 time ALL DAY
 date 17-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		7	8	9		
location	Lot No	1904	1906	1908		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 3	Layer 3	Layer 3		
measurement depth	mm	275	275	275		
field wet density	t/m ³	2.08	2.04	1.99		
field dry density	t/m ³	1.74	1.72	1.59		
field moisture content	%	20.0	18.9	25.2		

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	2.17	2.115	2.025		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-2.0	-1.0	-1.5		
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Moisture ratio	%	91.0	94.0	94.5		
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Hilf density ratio (R_{HD})	%	96.0	96.5	98.0		
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material description

Silty CLAY



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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terra Firma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-4
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by JP
 time All Day
 date 20-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		10	11	12		
location	Refer to Site Plan	1906	1908	1909		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 4	Layer 4	Layer 4		
measurement depth	mm	275	275	275		
field wet density	t/m ³	2.07	2.08	2.02		
field dry density	t/m ³	1.81	1.79	1.74		
field moisture content	%	14.0	16.1	16.1		

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	2.08	2.09	2.05		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-1.5	-3.0	-1.5		
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Moisture ratio	%	90.5	84.5	90.5		
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Hilf density ratio (R_{HD})	%	99.5	99.5	98.5		
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material description

Silty CLAY



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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terraforma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-5
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by JP
 time All Day
 date 21-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		13	14	15	16	17	18
location	Lot No	1910	1911	1913	1908	1910	1912
Sampling procedures AS1289.1.1.1,1.2.1-Clause 6.4(b)							
depth from F.S.L.	m	Layer 3	Layer 2	Layer 2	Layer 5	Layer 5	Layer 5
measurement depth	mm	275	275	275	275	275	275
field wet density	t/m ³	2.12	2.03	2.18	2.04	2.10	1.97
field dry density	t/m ³	1.79	1.77	1.90	1.76	1.77	1.66
field moisture content	%	18.5	14.5	14.9	15.5	18.5	18.6

laboratory compaction procedure AS1289 5.7.1

compactive effort		standard	standard	standard	standard	standard	standard
oversize material retained on AS sieve	mm	19.0	19.0	19.0	19.0	19.0	19.0
percent of oversize material	wet	0	0	0	0	0	0
peak converted wet density	t/m ³	2.175	2.12	2.2	2.135	2.14	2.025
adjusted peak converted wet density	t/m ³	-	-	-	-	-	-

moisture variation from OMC (-dry,+wet)%		-2.0	-1.5	-2.5	-1.5	-1.5	-1.5
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Moisture ratio	%	90.5	90.5	84.5	91.0	91.0	93.0
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Hilf density ratio (R_{HD})	%	97.5	95.5	99.0	95.5	98.0	97.0
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material description

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Approved Signature

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COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terraforma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-6
 date of issue 06-Dec-2017

Client Excell Gray Bruni
 Client address 12 Allied Drive, Tullamarine, 3043
 Project Riverwalk Estate Stage 19A Level One
 Location Werribee

Location Lot Fill
 Layer thickness (mm) 300

tested by JP
 time 11:15 AM
 date 24-Nov-2017
 checked by RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		22	23	24		
location	Lot No	1904	1907	1909		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 7	Layer 7	Layer 7		
measurement depth	mm	275	275	275		
field wet density	t/m ³	2.02	2.04	2.07		
field dry density	t/m ³	1.79	1.82	1.80		
field moisture content	%	12.8	12.0	14.5		

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	2.035	2.045	2.04		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-1.5	-1.5	-1.0		
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Moisture ratio	%	88.5	90.0	92.5		
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Hilf density ratio (R_{HD})	%	99.5	100.0	101.5		
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LABORATORY ACCREDITATION No 15357


 Approved Signature
 R Schembri



COMPACTION ASSESSMENT

BY NUCLEAR GAUGE METHOD

Terraforma Laboratories - Deer Park Laboratory
 Factory 6 / 22-24 Westwood Drive, Deer Park Phone No: 8348 5596

report No 9992-7
 date of issue 06-Dec-2017

Client	Excell Gray Bruni
Client address	12 Allied Drive, Tullamarine, 3043
Project	Riverwalk Estate Stage 19A Level One
Location	Werribee

Location	Lot Fill
Layer thickness (mm)	300

tested by	SP
time	All Day
date	22-Nov-2017
checked by	RS

Field density test procedure AS1289.2.1.1 and 5.8.1

Test No		19	20	21		
location	Lot No	1904	1907	1909		
Sampling procedures AS1289.1.1,1.2.1-Clause 6.4(b)						
depth from F.S.L.	m	Layer 6	Layer 6	Layer 6		
measurement depth	mm	275	275	275		
field wet density	t/m ³	1.98	1.91	1.97		
field dry density	t/m ³	1.71	1.65	1.70		
field moisture content	%	15.4	15.6	15.6		

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	2.03	1.975	2.03		
adjusted peak converted wet density	t/m ³	-	-	-		

moisture variation from OMC (-dry,+wet)%		-1.5	-1.5	-1.5		
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Moisture ratio	%	92.5	91.0	91.0		
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Hilf density ratio (R_{HD})	%	97.5	96.5	97.0		
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