APPENDIX D1 GEOTECHNICAL REPORT BY DOUGLAS PARTNERS

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Solar Farm
Goolma Road, Wellington, NSW

Prepared for
First Solar (Australia) Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed solar farm at Goolma Road, Wellington, NSW. The investigation was commissioned in an email by Mirjam Tome of First Solar (Australia) Pty Ltd and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal NCL170734 (Rev 1) dated 20 December 2017.

It is understood that the proposed development is to consist of a photovoltaic (PV) solar generating plant, including electricity generating equipment, in addition to access roads, service trenching, drainage works and a transmission line connecting with the existing Wellington Substation to the south of the site. The details of the development are further described in Section 7 of this report.

The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site, in order to provide comment on the following:

- Site description, geology and site observations;
- Subsurface and groundwater conditions at the field test locations;
- Site classification for soil reactivity, based on the methods in AS 2870 – 2011 (Ref 1);
- Subgrade design parameters, including California bearing ratio (CBR) values for pavement design by others;
- Suitable pile footing options, including:
    - Ultimate unfactored end bearing and shaft adhesion pressures for the design of axially loaded piles in compression and uplift; and
    - Lateral loading parameters for piles;
- Recommendations for erosion control and prevention measures, including advice on erosion management during earthworks;
- Results of soil electrical resistivity (ER) testing, for interpretation by others; and
- Recommendations for additional investigation (if appropriate).

The investigation included the drilling of fourteen boreholes, excavation of twenty test pits, soil ER testing at ten locations, and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

2. Site Description

The site is located within two adjacent rural properties situated just outside the town of Wellington, NSW, and is bounded by Goolma Road to the south and east, Cobbora Road and neighbouring properties to the west, and further rural farmland to the north.

The overall site area is approximately 492 hectares (Ha), and is currently used for agricultural purposes. The proposed solar arrays are understood to occupy approximately 256 Ha of the project area. The proposed transmission line will connect with the existing Wellington Substation, which is located to the immediate south of the project boundary along Goolma Road.

The site topography is relatively level to slightly undulating across the majority of the site. Based on information provided by the client, the surface level at the site is about 360 m AHD.

A summary of observed site features includes those described below:

- Isolated rock outcrop areas;
- Natural watercourses (Wuuluman Creek and tributaries), draining approximately east-west through the centre of the site (predominantly dry at the time of investigation);
- Site vegetation typically comprised short grass and prickly weeds with sparse trees.

The general features of the site are shown in Figures 1 to 6, below.

Figure 1: Overview of site's southern portion (at Test Pit 10, facing approximately north-east)

Figure 2: Overview of site's far-western portion (at Test Pit 15, facing approximately north-east)

Figure 3: Overview of site's western / central portion (at Bore 24, facing approximately south)

Figure 4: Overview of site's eastern / central portion (at Bore 26, facing approximately south)

Figure 5: Overview of site's north-eastern portion (at Test Pit 16, facing approximately south)

Figure 6: Overview of site's south-eastern portion (at Test Pit 17, facing approximately north)

3. Desktop Data Review

A desktop review of available information was undertaken as part of the investigation. This included assessment of the following:

- Regional geology;
- Soil landscape mapping;
- Acid sulfate soil mapping; and
- Previous nearby investigations by DP.

The results of the desktop data review are discussed in more detail in Sections 3.1 to 3.4.

3.1 Regional Geology

Reference to the Geological Survey of NSW State-wide Geodatabase, 1:250,000 scale geology map indicates that the site is predominantly underlain by the Oakdale Formation of the Cabonne Group, typically comprising volcanic sandstone and basalt. The far north-eastern portion of the site, however, is mapped as being underlain by the Mumbil Group, a sedimentary unit comprising siltstone and shale.

3.2 Soil Landscape Mapping

Reference to the 1:250 000 soil landscapes map for Dubbo indicates that the site soils are Bodangora soils of the Euchrozems soil landscape group.

Reference to the NSW Office of Water eSpade website indicates that several previous soil samples were taken either on site (including one just north of Wuuluman Creek and within the Aboriginal Heritage buffer zone) or in the immediate surrounding area. A review of the associated reports (Reports 1004444 [locations 64, 75 and 95], 1000224 and 1000349) indicate the following in relation to the near surface soils:

- The soils have a slight to moderate erosion hazard;
- They generally have a moderate to strong pedality;
- pH levels ranging from around 6 to 9.

A copy of these reports is included in Appendix C and the approximate location of the samples shown on Drawing 1.

3.3 Acid Sulfate Soil Risk Mapping

No acid sulfate soil risk mapping by the Department of Land Water Conservation (DLWC) is available for the site. However, given that the elevation of the site is around RL 300 m AHD and acid sulfate soils exist in some coastal areas where the elevation is below RL 10 AHD, but more generally below RL 5 AHD, DP does not consider ASS to be present at the site and they are not discussed further in this report.

3.4 Previous Nearby DP Investigations

Previous work undertaken by DP to the immediate east of the project boundary, in connection with the recently constructed correctional facility, indicated a predominately clayey profile to depths of up to approximately 10 m (limit of investigation). It is noted that, although the site lies in close proximity to the subject site, the subsurface conditions in each are characterised by different geological units.

Laboratory testing undertaken during the previous investigation included shrink-swell testing and CBR testing on the clay soils. The two shrink-swell tests returned values of 1.1% and 2.0% whereas the two CBR tests returned values of 6%.

4. Field Work Methods

4.1 Overview

The field work was undertaken in the period 8 to 12 January 2018, and comprised the following:

- Excavation of test pits;

- Drilling of test bores; and
- Electrical resistivity testing.

The test locations were set out by DP engineers to provide a geographic spread across the site and where access allowed. GPS coordinates (MGA) were recorded on the logs at all test locations, and were measured using a handheld receiver, which has a nominal accuracy of about ±10 m. The test locations are shown in Drawing 1, attached in Appendix F.

The subsurface soil, rock and groundwater conditions were logged on site by DP personnel, who also recovered representative samples for identification purposes and laboratory testing.

These investigation methods are discussed in more detail in Sections 4.2 to 4.4 below.

4.2 Test Pits

Excavation of twenty test pits (Pits 1 to 20). The pits were excavated to depths ranging between 1.75 m and 3.3 m depth, using a 14 tonne tracked excavator, equipped with a 450 mm wide bucket with rock teeth The pits were excavated to depths ranging from 1.7 m to 3.3 m but, more generally, to 3 m.

Dynamic cone penetrometer (DCP) tests were undertaken at seventeen test locations to depths of up 0.9 m (based on a target depth of 1.2 m), to provide additional information on the near surface soil strength consistency / relative density.

In situ testing comprising pocket penetration (pp) tests on cohesive materials were undertaken at selected depths within test pits, as appropriate.

4.3 Test Bores

Drilling of fourteen boreholes (Bores 21 to 34) using a purpose built geotechnical drilling rig. The bores were drilled to depths ranging from 1.8 m to 5.0 m using solid flight auger methods. Standard penetration tests (SPT) were undertaken at roughly 1.5 m depth intervals in the soil and weathered rock.

Dynamic cone penetrometer (DCP) tests were carried out at in Bore 25 to 0.45 m depth to allow an assessment of the strength of near surface soils and potential indication of depth to rock.

Standard penetration tests (SPTs) were carried out at regular intervals in most bores from 1 m depth.

4.4 Soil Electrical Resistivity (ER) Testing

For the ER testing, an ABEM SAS3000C Terrameter transmitter/receiver was used to take vertical electrical soundings (VES), in accordance with the four point "Wenner" soil resistivity method, as summarised in Appendix D of AS/NZS 1768 – 2007 (Ref 11). Measurements were carried out at ten selected locations (defined as Arrays ER101 to ER110 as shown on Drawing 1), for which coordinates were obtained with a handheld GPS as outlined above.

At each location, a centrally located and orthogonally oriented sounding was carried out to test for anisotropy in the results, which may indicate lateral variations in site conditions contrary to the assumptions of the sounding method (i.e. horizontal, homogeneous and isotropic layering) and as some measure of assessing interference (potentially services such as electricity).

The field testing was carried out by a geotechnical engineer and the results are presented in Appendix D.

5. Field Work Results

5.1 Bores and Pits

The subsurface conditions encountered in the test locations are presented within the detailed borehole logs and test pit logs in Appendix B, together with notes explaining classification methods and descriptive terms used on the logs. The results of the DCP tests are presented graphically on the logs and are reported on the attached dynamic penetrometer test result sheet. Note that the test pits are presented at a different vertical scale to that of the borehole logs.

The investigation yielded the presence of the following units:

- UNIT 1: Predominantly silt topsoil to depths of 0.0 m to 0.25 m, but more typically 0.02 m;
- UNIT 2.1: Gravelly clay / clayey gravel (hard / dense);
- UNIT 2.2: Hard silty clays with trace to some sand and gravel; and
- UNIT 3: Medium to high strength volcanic (meta) sandstone / siltstone, typically within a completely weathered matrix. Siltstone (sedimentary unit) was encountered atop a hill crest in the north-eastern portion of the site (Test Pit 16), with bedding plane orientated at approximately 20 degrees inclined towards the west.

The results of in situ testing and general site observations indicate that the clay units encountered were hard and residual (typical of completely weathered rock).

A summary of the subsurface conditions encountered can be further summarised, categorised into the above units as shown in Table 1 and Table 2 below.

Table 1: Summary of Subsurface Conditions (Test Pits)

Test Pit ID	Depth to Each Unit (m)				Depth of Investigation (m)
	Unit 1 Topsoil	Unit 2.1 Gravelly Clay	Unit 2.2 Silty Clay	Unit 3 Bedrock	
1	0.0	0.14	1.2	NE	3.0
2	0.0	0.25	0.75[1,a]	NE	3.0
3	0.0	NE	0.1	1.8	3.0
4	0.0	0.1	0.35	0.9	2.65 (Ref)
5	0.0	NE	0.1	0.7	1.75 (Ref)
6	0.0	NE	0.03[2]	NE	3.0
7	0.0	NE	0.12	1.9	3.0
8	0.0	NE	0.14	2.3	3.0
9	0.0	NE	0.18	1.0	3.0
10	0.0	NE	0.02	0.6	1.9 (Ref)
11	0.0	NE	0.2	NE	3.0
12	0.0	NE	0.25	0.8	3.0
13	0.0	NE	0.03	1.7	3.0
14	0.0	0.04	0.4	NE	3.0
15	0.0	NE	0.14[3]	NE	3.3
16	0.0	NE	NE	0.1	2.4 (Ref)
17	0.0	NE	0.1	0.7	3.0
18	0.0	NE	0.25	NE	3.0
19	0.0	0.12	0.45	NE	3.0
20	0.0	NE	0.03[1,b]	NE	3.0

Notes to Table 1

NE = Not encountered

Ref = Refusal of excavator

(1) Sandy clay from: a) 1.4m, b) 1.6m

(2) Sandy silt to 0.5m

(3) Sandy silty clay

Table 2: Summary of Subsurface Conditions (Boreholes)

Bore ID	Depth to Each Unit (m)				Depth of Investigation (m)
	Unit 1 Topsoil	Unit 2.1 Gravelly Clay	Unit 2.2 Silty Clay	Unit 3 Bedrock	
21	NE(1)	NE	0.0	2.0(2)	5.0
22	0.0	0.02	NE	0.7	5.0
23	NE(1)	NE	0.0	NE	5.0
24	NE(1)	NE	0.0	2.8(2)	4.5 (Ref)
25	NE(1)	NE	0.0	2.0	4.7 (Ref)
26	0.0	NE	0.02	1.2	2.0 (Ref)
27	NE(1)	3.5(3)	0.0	NE	5.0
28	NE(1)	NE	0.0	NE(4)	3.82 (Ref)
29	NE(1)	NE	0.0	NE	5.0
30	0.0	NE	0.15	1.15	1.8 (Ref)
31	0.0	NE	0.02	0.8	4.9 (Ref)
32	NE(1)	NE	0.0	NE	3.1 (Ref)
33	NE(1)	NE	0.0	4.0	4.2 (Ref)
34	NE(1)	NE	0.0	NE	5.0

Notes to Table 2

NE = Not encountered

Ref = Refusal of drilling rig (TC-bit)

(1) Topsoil not logged in some boreholes due to difficulty discerning between surface layer boundaries

(2) Siltstone (sedimentary unit)

(3) Clayey gravel

(4) Rock structure evident from 2.5 m

Groundwater

No free groundwater was observed in the test pits or the bores during the period they remained opened, except that slight seepage was observed within the base of Test Pit 14 (situated immediately adjacent to, and between, two tributaries of Wuuluman Creek).

It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

6. Laboratory Testing

6.1 Geotechnical Laboratory Testing

Laboratory testing was carried out on samples retrieved from the pits and bores at DP's NATA accredited laboratories. Each sample was submitted to the laboratory for one or more of the following:

- Shrink-swell testing;
- CBR / Standard Compaction;
- Atterberg Limits;
- Particle size distribution (grading) test; or
- Emerson class number test.

For the CBR testing each sample was compacted to approximately 100% Standard dry density ratio at the estimated optimum moisture content and then soaked for four (4) days under a surcharge loading of 4.5 kg prior to testing.

The detailed results are presented in Appendix E and are further summarised in Table 3 to Table 7, as follows:

- Table 3: Results of Laboratory Testing – Shrink-Swell Testing;
- Table 4: Results of Laboratory Testing – California Bearing Ratio;
- Table 5: Results of Laboratory Testing – Atterberg Limits;
- Table 6: Results of Laboratory Testing – Gradings; and
- Table 7: Results of Laboratory Testing - Emerson Testing .

Table 3: Results of Laboratory Testing – Shrink-Swell Testing

Pit / Bore	Depth (m)	Description	FMC (%)	Iss (%)	Shrink (%)	Swell (%)	PP result prior to soaking (kPa)	PP result after to soaking (kPa)
2	0.85 – 1.3	Red brown mottled white SILTY CLAY	20.2	3.9	3.9	6.3	>600	200
6	0.55 – 0.82	Red brown SILTY CLAY with trace sand	14.7	0.6	1.1	-1.6	>600	85
7	0.55 – 0.95	Red brown SILTY CLAY with some gravel and trace sand	21.9	2.3	3.0	2.4	>600	350
11	0.45 – 0.9	Red brown SILTY CLAY with trace sand	19.7	1.7	2.6	0.8	>600	120
13	0.35 – 0.8	Red brown SILTY CLAY with trace sand	19.6	1.2	1.6	1.2	>600	115
14	0.95 – 1.25	Red brown SILTY CLAY with some sand	14.6	1.5	2.3	0.7	>600	470
15	0.65 – 0.91	Red brown SANDY SILTY CLAY with trace gravel	16.6	0.6	1.0	-0.9	>600	60
18	0.75 – 1.2	Red brown SILTY CLAY with trace sand	15.2	1.4	2.0	0.9	>600	160
21	0.4 – 0.69	Red brown SILTY CLAY with trace sand and gravel	17.6	0.8	1.4	0.2	>600	125
28	0.5 - 0.76	Red brown SILTY CLAY with trace sand	18.4	2.0	3.5	0.2	570	510
29	1.0 – 1.2	Red brown SILTY CLAY with trace sand	18.4	2.4	2.6	3.3	>600	220
32	0.5 – 0.73	Red brown SILTY CLAY with some sand	18.6	0.9	1.7	-0.2	>600	75
33	0.3 – 0.55	Red brown SILTY CLAY with trace sand	16.2	0.5	0.9	-1.2	>600	80

Notes to Table 3:

FMC - Field moisture content   Iss Shrink-swell index

PP Pocket penetrometer

Table 4: Results of Laboratory Testing – California Bearing Ratio

Pit/Bore	Depth (m)		Description	FMC (%)	OMC (%)	MDD (t/m^3)	CBR (%)	Swell (%)
	From	To						
2	0.5	0.6	Red brown GRAVELLY CLAY with trace silty	10.8	14.5	1.86	10	1.5
3	0.3	0.4	Red brown SILTY CLAY with trace sand	18.9	25.0	1.6	13	0.5
6	0.3	0.4	Brown SANDY SILT with trace clay	10.3	16.0	1.77	10	0.5
8	0.3	0.4	Red brown SILTY CLAY with trace gravel	16.7	21.5	1.6	11	1.0
9	0.4	0.5	Red brown SILTY CLAY with trace sand	18.0	25.0	1.52	9	0.5
10	0.2	0.4	Red brown SILTY CLAY with trace sand and gravel	12.1	17.5	1.8	13	0.5
12	0.5	0.6	Red brown SANDY SILTY CLAY	8.4	14.5	1.88	11	-0.5
15	0.4	0.6	Red brown SILTY CLAY with trace sand	12.0	18.0	1.68	8	2.0
18	0.3	0.4	Red brown SANDY SILTY CLAY	8.7	14.5	1.85	10	0.5
19	0.3	0.4	Red brown GRAVELLY SILTY CLAY	8.6	14.0	1.89	10	0.0

Table 5: Results of Laboratory Testing – Atterberg Limits

Pit/Bore	Depth (m)	Description	FMC (%)	LL (%)	PL (%)	PI (%)	Linear Shrinkage (%)
1	0.4 – 0.5	Red brown GRAVELLY CLAY with trace silt	8.0	35	13	22	-
7	0.4 – 0.5	Red brown SILTY CLAY with some gravel	19.0	53	14	39	-
8	1.5	Red brown SILTY CLAY with trace gravel	14.6	66	17	49	13
17	0.2 – 0.2	Extremely weathered meta-SILTSTONE	13.2	40	18	22	-
21	1 – 1.45	Red brown SILTY CLAY with trace sand	12.1	45	13	32	-
22	0.5	Red brown GRAVELLY SILTY CLAY	8.2	33	16	17	-
24	0.1	Red brown SILTY CLAY with some sand	15.7	36	15	21	-
24	0.5	Red brown SILTY CLAY with some sand	18.3	64	15	49	-
24	0.85	Pale brown SILTY CLAY with trace sand	10.3	40	10	30	13.5
25	0.5	Red brown SILTY CLAY with trace sand	16.6	55	14	41	-
25	1 – 1.45	Red brown SILTY CLAY with trace sand	16.6	61	21	40	-
26	0.1	Red brown SILTY CLAY with trace sand	4.1	23	19	4	-
27	0.5	Red brown SILTY CLAY with trace sand	18.3	66	13	53	17
27	1 – 1.45	Red brown SILTY CLAY with trace sand	15.3	60	13	47	-
28	2.5 – 2.95	Red brown SILTY CLAY with trace gravel	19.7	61	23	38	-
29	1.5 – 1.95	Red brown SILTY CLAY with trace sand	15.4	66	13	53	-
30	0.5	Pale brown SILTY CLAY with trace gravel	8.7	42	13	29	-
31	0.2	Red brown SILTY CLAY with some gravel	8.0	37	15	22	-
33	1 – 1.45	Red brown SILTY CLAY with trace sand	20.6	72	16	56	13
33	2.5 – 2.95	Red brown SILTY CLAY with trace sand	17.3	61	12	49	-
34	2.5 – 2.95	Red brown SILTY CLAY with trace sand	10.3	34	14	20	-

Table 6: Results of Laboratory Testing – Gradings

Pit/Bore	Depth (m)	Description	Silt and clay (%)	Sand (%)	Gravel (%)
1	0.4 – 0.5	Clayey gravel with sand	29	16	55
3	0.3 – 0.4	Silty clay with trace sand and gravel	81	11	8
4	0.4 – 0.5	Silty clay with gravel and trace sand	73	11	16
6	0.3 – 0.4	Sandy silt with trace gravel	60	36	4
7	0.4 – 0.5	Silty clay with sand and trace gravel	72	17	11
9	0.4 – 0.5	Silty clay with sand and trace gravel	81	16	3
12	0.5 – 0.6	Sandy silty Clay with trace gravel	52	38	10
13	0.4 – 0.5	Silty clay with sand and trace gravel	78	19	3
14	0.5 – 0.6	Silty clay with sand and trace gravel	73	22	5
14	2.5	Clayey sand with trace gravel	45	53	2
17	0.2 – 0.4	Silty clay with sand and gravel	56	18	26
18	0.3 – 0.4	Sandy silty clay with trace gravel	64	34	2
19	0.3 – 0.4	Silty clay with gravel and trace sand	71	4	25
28	1 – 1.45	Silty clay with sand and trace gravel	77	20	3
32	1 – 1.45	Silty clay with trace sand	90	10	0

Table 7: Results of Laboratory Testing - Emerson Testing

Pit / Bore	Depth (m)	Description	Emerson Class No
4	0.6	Red brown SILTY CLAY with some gravel	5
10	0.4	Red brown SILTY CLAY with trace sand	5
11	0.4	Red brown SILTY CLAY with trace sand	5
12	0.4	Red brown SANDY SILTY CLAY	5
17	0.5	Red brown SILTY CLAY with some gravel	5
18	0.2	Red brown SILY CLAY with trace sand	5
20	0.5	Red brown SILTY CLAY with trace sand	5
21	0.1	Red brown SILTY CLAY with trace sand	5
22	0.5	Red brown GRAVELLY SILTY CLAY with trace sand	5
24	0.1	Red brown SILTY CLAY with some sand	6
24	0.5	Red brown SILTY CLAY with some sand	5
24	0.85	Pale brown SILTY CLAY with trace sand	4
25	0.5	Red brown SILTY CLAY with trace sand and gravel	5
26	0.1	Red brown SILTY CLAY with trace sand	6
27	0.5	Red brown SILTY CLAY with trace sand	3
28	0.1	Red brown SILTY CLAY with trace sand	4
29	0.1	Red brown SILTY CLAY with trace sand	3
30	0.5	Pale brown SILTY CLAY with trace gravel	5
32	0.1	Red brown SILTY CLAY with some sand	5

Notes to Table 7

Emerson Class No (AS1289.3.8.1)

6.2 Geo-chemical

Fifteen selected soil samples were submitted to Envirolab Service Pty Ltd for analysis of the following:

- Soil aggressiveness / durability testing, comprising the following analytes:
  - pH;
  - Electrical conductivity (EC);
  - Sulphates (SO_4); and
  - Chlorides (Cl).
- Soil agronomy / agricultural tests on topsoil material, as follows:
  - pH;
  - EC;
  - Exchangeable sodium percentage (ESP);
  - Cation exchange capacity (CEC);
  - Colwell phosphorus (Colwell P);
  - Phosphorus buffering index (PBI);
  - Calcium: magnesium ratio (Ca: Mg);
- Soil agronomy / agricultural tests on deeper soils, as follows:
  - pH;
  - EC;
  - Emerson aggregate (dispersion).

Detailed laboratory report sheets are provided in Appendix E and are summarised in Table 8 to Table 10, below.

Table 8: Results of Aggressivity Testing

Pit	Depth (m)	Description	Soil Condition	pH (concrete)	pH (steel)	Resistivity[1] (Ω.cm) (steel)	SO_4 (ppm) (concrete)	Cl (ppm) (steel)
1	1.3	Red brown SILTY CLAY	B	7.5	7.5	25000	<10	10
2	2	Pale brown SANDY CLAY	B	6.9	6.9	2000	120	570
4	0.2	Brown GRAVELLY CLAY	B	7	7	33333	<10	10
5	0.4	Red brown SILTY CLAY	B	6.8	6.8	100000	<10	<10
6	2	Red brown SANDY SILTY CLAY	B	9.2	9.2	5556	45	80
8	0.7	Red brown SILTY CLAY	B	7.9	7.9	43478	<10	<10
8	2	Grey and brown SILTY CLAY	B	9	9	19608	<10	20
9	0.6	Red brown SILTY CLAY	B	8.1	8.1	10000	<10	<10
11	1.5	Red brown SILTY CLAY	B	8.7	8.7	13889	<10	<10
12	1.2	Extremely low strength meta SILTSTONE	B	8	8	66667	<10	<10
14	0.2	Grey GRAVELLY SILTY CLAY	B	5.7	5.7	14925	22	79
15	1	Red brown SANDY SILTY CLAY	B	7.5	7.5	12987	21	21
18	1.5	Red brown SILTY CLAY	B	8.4	8.4	16129	<10	<10
19	2	Red brown SILTY CLAY	B	8.3	8.3	8333	<10	<10

Notes to Table 8

	Non-aggressive
	Mildly aggressive
	Moderately aggressive
	Severely Aggressive
	Very Severe

NT

1 Resistivity calculated based on inverse of conductivity in aqueous solution results

Scale of aggressivity based on threshold values given in AS 2159 – 2009: Piling – Design and Installation.

Table 9: Results of Laboratory Testing – Agronomy Testing

Pit / Bore	Depth (m)	Description	Soil pH	Electrical Conductivity (µS/cm)	Phosphorus (Colwell) (mg/kg)	Phosphorus Buffer Index (mg/kg)	Exchangeable Ca (meq/100g)	Exchangeable K (meq/100g)	Exchangeable Mg (meq/100g)	Exchangeable Na (meq/100g)	Cation Exchange Capacity (meq/100g)	ESP (%)	Calcium (mg/kg)	Magnesium (mg/kg)
3	0.05	Brown clayey silt (topsoil)	7.2	100	25	760	15	3.1	3.7	<0.1	22	<1	3100	1900
8	0.05	Brown sandy silt (topsoil)	6.8	100	31	570	13	2.2	3.9	<0.1	19	<1	2900	2400
9	0.1	Brown slightly sandy silt (topsoil)	7	91	63	480	19	3.3	3.7	<0.1	26	<1	4000	1200
12	0.01	Brown slightly sandy silt (topsoil)	5.5	300	97	560	6.6	2.5	1.7	<0.1	11	<1	1900	3000
13	0.01	Brown sandy silt (topsoil)	5.9	160	30	600	10	2.3	3.4	<0.1	16	<1	2700	1900
17	0.05	Brown clayey silt (topsoil)	6.3	150	42	560	13	3.9	3.2	<0.1	20	<1	2900	1400
18	0.01	Brown sandy silt (topsoil)	5.5	340	58	350	7.5	2.4	2.1	<0.1	12	<1	1700	1800
22	0.05	Brown slightly sandy silt (topsoil)	6.1	110	58	1600	9.3	2.1	2.3	<0.1	14	<1	1400	1800

Notes to Table 9

ESP = exchangeable sodium percentage

Table 10: Results of Laboratory Testing – Agronomy Testing (Continued)

Pit / Bore	Depth (m)	Description	pH	Electrical Conductivity (µS/cm)	Emerson Aggregate
1	0.5	Red brown GRAVELLY CLAY/CLAYEY GRAVEL	6.9	21	3b
3	0.5	Red brown SILTY CLAY	6.7	34	5
4	0.5	Red brown SILTY CLAY	7.1	38	5
7	0.5	Red brown SILTY CLAY	6.9	41	5
7	2	Extremely low strength meta-SILTSTONE	8.3	75	3b
9	0.9	Red brown SILTY CLAY	8.3	72	5
13	0.05	Red brown SILTY CLAY	7.9	64	7
13	1.2	Red brown SILTY CLAY	8.7	500	3b
14	0.6	Red brown SILTY CLAY	7.9	42	4
14	0.9	Red brown SILTY CLAY	8.4	120	3b
17	0.3	Red brown SILTY CLAY	7.6	28	5
18	2.2	Red brown SILTY CLAY	8.6	270	1
19	1	Red brown SILTY CLAY	8.1	24	3b
24	2.5	Pale brown SILTY CLAY	9.1	73	4
32	0.05	Red brown SILTY CLAY	7.5	15	5
32	2	Red brown SILTY CLAY	8.2	110	4

Notes to Table 10: 3b = moderate to slight dispersion of the remould

6.3 Electrical Resistivity

Electrical resistivity testing was undertaken at 10 locations across the site. The vertical electrical sounding sheets are provided in Appendix D. All field measurements were considered stable and repeatable.

7. Proposed Development

It is understood that the proposed development is to comprise a solar farm array over parts of the site. The farm will include photovoltaic solar generating plant, including electricity generating equipment, in addition to access roads, service trenching, drainage works and a transmission line connecting with the Wellington Substation.

No information in relation to the loads on piles has been provided to DP.

8. Comments

8.1 Appreciation of Site Conditions

The pertinent characteristics of the site and subsurface conditions are further summarised as follows:

- Variable depth to bedrock, ranging from 0.1 m (Pit 16) to greater than 3 m depth in the pits/bores. It is also noted that rock outcrops were observed throughout the site;
- The strength of the bedrock was generally extremely low to very low strength, however, higher strength rock is exposed within the outcrops. Excavator refusal was encountered in a number of pits across the site as shown in Table 1;
- Groundwater was not generally encountered in the pits or bores within the investigation depths. It is possible, however, that groundwater seepage may be encountered at the soil rock interface; and
- Testing of the clay soils indicates that it is of intermediate to high plasticity, although only moderate shrink-swell indices were returned during testing. It is noted, however, that appreciable softening occurring in the majority of the samples during the soaking phase (in some instances softening from greater than 600 kPa to less than 80 kPa).

8.2 Soil and Rock Properties

Table 11, below, outlines the generalised material and strength properties for the different types of soil and rock that were encountered in the field investigation.

Table 11: Suggested Material and Strength Parameters

Material	Unit Weight (kN/m^3)	Drained Cohesion, c' (kPa)	Drained Angle of Friction, ϕ' (degrees)	Undrained Shear Strength, Cu (kPa)
Residual Clay and Sandy Clay				
Unit 2.1 and 2.2 - Hard	19 – 22	3 – 6	25 – 29	50 – 100[(3)]
Bedrock				
Unit 3 - Extremely low to very low strength or stronger	20 – 23	5 – 10	28 – 33	300 – 500
Engineered Level 1 filling[(2)]	19 - 21	2 - 3	25 - 28	75 – 100

Note to Table 11

(1) Lower bound properties should be used (with the exception of Unit Weight) unless higher values can be substantiated by testing.
(2) Filling compacted under Level 1 testing and inspection to at least 98% Standard maximum dry density ratio
(3) The suggested undrained shear strength has been reduced owing to the appreciable softening during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

8.3 Soil Aggressiveness

The results of pH, chloride and sulphate ion concentration analyses (refer Table 8 of Section 6.2) indicate that, in general, the soils are classed either as a “non-aggressive” exposure classification for concrete piles and “non-aggressive to mildly aggressive” for steel piles with respect to resistivity. Reference should be made to Tables 6.4.3 of AS 2159 – 2009 (Ref 1) to determine the minimum concrete cover to reinforcement required (for concrete piles), based on this exposure classification, and the minimum concrete strength appropriate for the indicated site conditions.

8.4 Soil Classification

The results of the laboratory testing indicate that the residual silty clay soils are generally intermediate to high plasticity clay (CI to CH) soils, in accordance with the USCS, which would generally be expected to exhibit a moderate to high potential for volumetric changes (i.e. shrinkage and swelling) in response to variations in moisture content. The clay soils with less sand content are of high plasticity. Figure 1, below shows the results of the Atterberg limits testing.

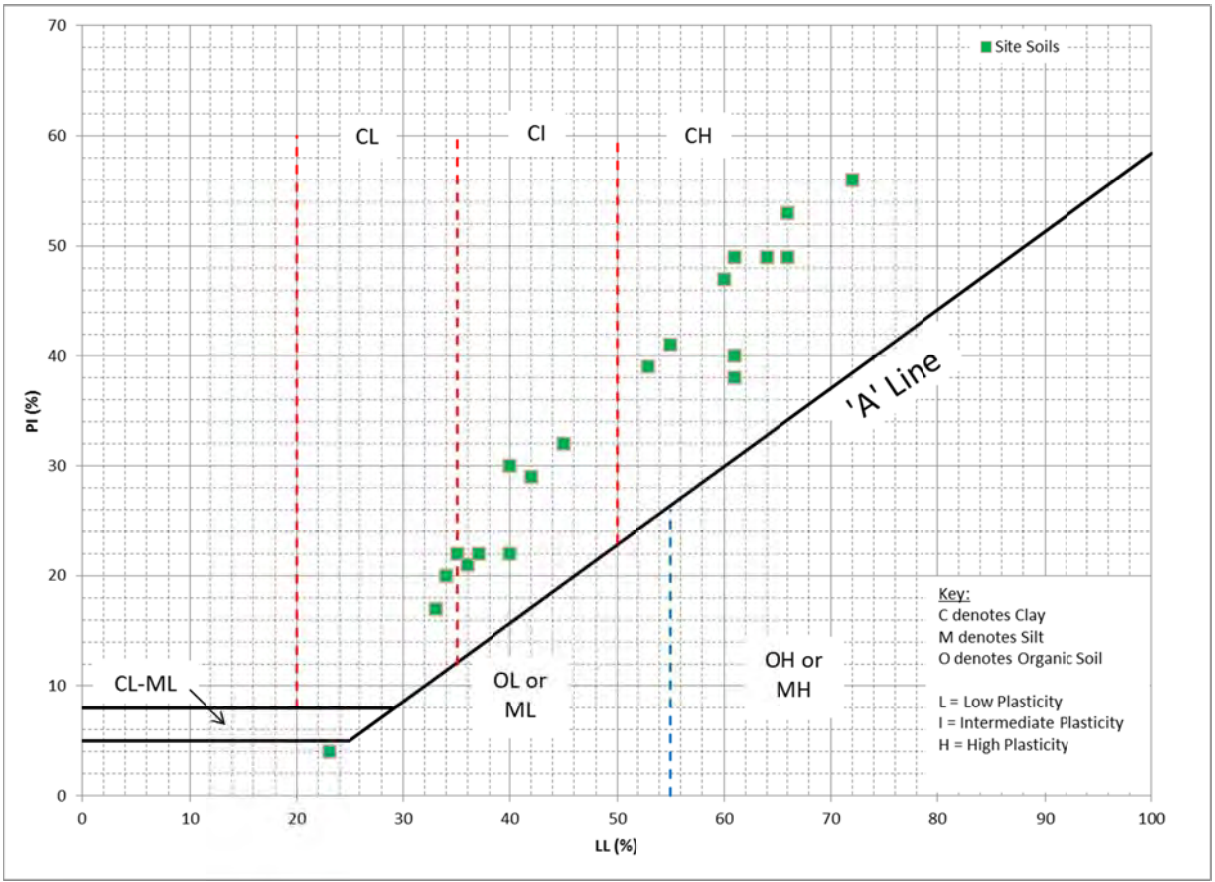


Figure 1: Results of Atterberg limit determinations

8.5 Soil Erosion Dispersion Potential

Testing was undertaken on soil samples retrieved from the bores and pits within the upper 1 m of the soil profile. The Emerson testing returned predominantly a value of 5, indicating a low risk of dispersion. A number of samples of the silty clay, however, returned values of 3 and 4, which is indicative of an increased propensity for dispersion. Figure 2 below shows the results of the Emerson testing with depth and Figure 3 shows a histogram of the results.

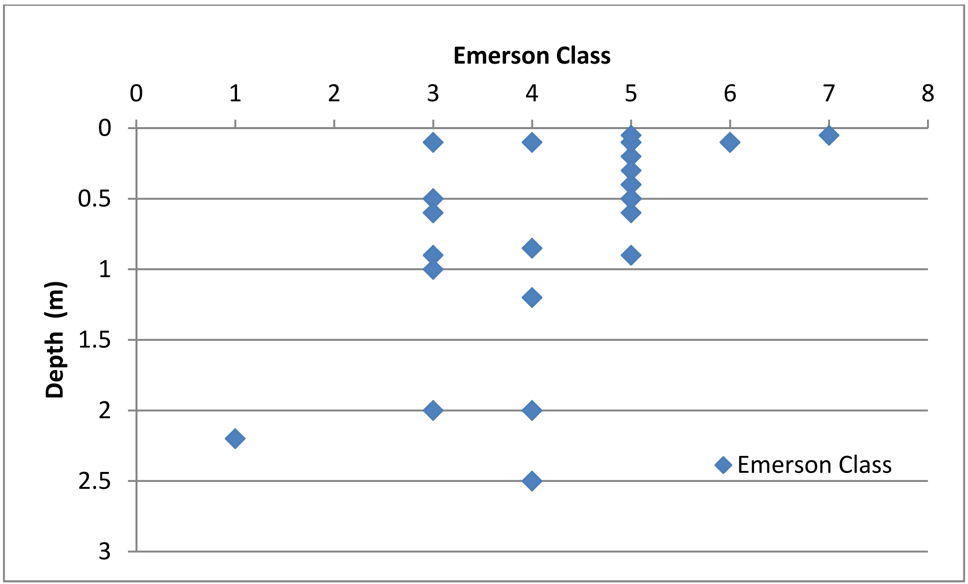


Figure 2: Graphical Representation of Emerson Class testing

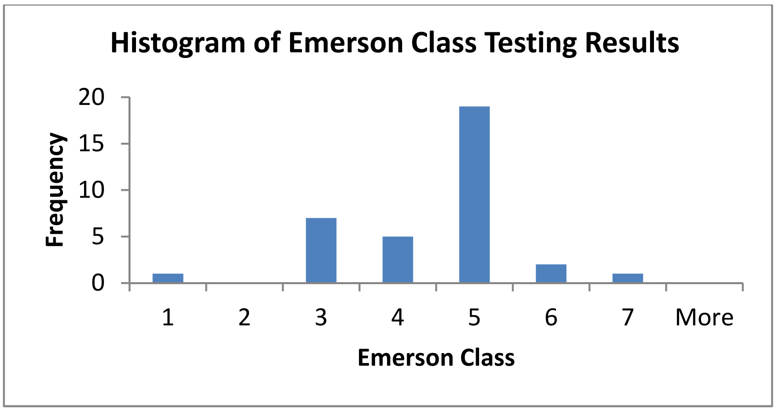


Figure 3: Histogram of Emerson Class testing results

The results of the electrical conductivity testing returned values ranging from 28 to 500 µS/cm, but generally below 300 µS/cm. Using a textural classification conversion factor of 8 for light to medium clays, this converts to an ECe in the range of around 0.1 to 4 dS/m, but generally less than 2.5 dS/m. Generally saline soils are defined as those having a ECe of greater than 4 dS/m. Therefore, the soils tested from the site are considered to be non-saline.

All eight samples testing for exchangeable sodium percentage (ESP) returned results of less than 1, which is not indicative of dispersive soils. These soils are classified as non-sodic in nature.

The results of the chemical testing were also used to derive the Calcium:Magnesium ratio. The eight samples tested returned ratios ranging from 0.38 to 1.2. Reference to information provided on the Department of Agriculture website (Vegetable SOILpak) indicates that soils with a Ca:Mg ratio of less than 1 have a propensity to disperse.

Therefore, based on the results of the investigation, it is considered that the soils have a slight to moderate propensity for erosion. In this regard, minor signs of erosion (rilling) were noted in areas across the site.

The definitions in the eSpade website indicate that a slight hazard is defined as "the combination of slope, runoff / run-on and soil erodibility is such that no appreciable erosion damage is likely to take place". Similarly, a moderate hazard is defined as "significant short-term soil erosion may occur as a result of the combination of steep gradient, high soil erodibility and adverse runoff/run-on factors. Control can be obtained with such management techniques as topsoiling, vegetative techniques, phasing development and the implementation of structural works".

Measures to further reduce the risk of erosion and dispersion of the site soils and any fill platforms are discussed in Section 8.9 of this report.

8.6 Excavation Conditions

Based on the results of the test pits (using a 14 tonne excavator) and the test bores, it is considered that excavation of the soils and the extremely low strength rock is expected to be generally achievable using conventional machinery such as a 20 tonne hydraulic excavator to depths of up to test pit refusal. Refusal was encountered in a number of the pits and bores at depths ranging from 1.6 to 2.0 m. It is noted, however, that penetration of up to 1.5 m into the bedrock was achieved using the excavator.

The results of the bores indicated that the rock was initially low to very low strength but increased in strength to at least low / medium strength within about 0.5 m to 1.5 m depth. Standard penetration testing in the bedrock generally refused after about 0.3 m penetration into the bedrock.

The refusal depths in the pits may correspond to depths at which light ripping methods would refuse and medium / heavy ripping may be required. It is important to note, however, that excavatability of rock is dependent not only on rock strength, but also on the presence, orientation and extent of discontinuities such as jointing / bedding and fracturing of the rock, the presence of favourable and adverse bedding planes, presence of groundwater and other factors. For example, low strength rock with few discontinuities may be more difficult to excavate than highly fractured, high strength rock. It is noted that isolated outcrops of bedrock are present throughout the site. Differential weathering within these outcrops may result in higher strength characteristics and hence greater difficulty during excavation.

Additional investigation, including cored bores and seismic refraction surveys, should be undertaken if assessment of rock rippabilities is important to project costings.

8.7 Geotechnical Reuse of Excavated Materials

The investigation encountered topsoil, gravelly clay and silty clay, underlain by siltstone bedrock.

It is recommended that the grass vegetation and topsoil be stripped from the surface and stockpiled for re-use in landscaping, where required. It is suggested that topsoil contain at least 20% (by volume) organic materials, and the use of fertilisers may be used to promote growth within topsoil.

The gravelly clay and silty clay is considered geotechnically suitable for re-use as engineered filling; however, depending on soil moisture conditions during construction moisture conditioning, either wetting up or drying back should be allowed for. Due to potential reactive movements of this material and potential for poor trafficability when wet (i.e. exposed to moisture ingress) it is preferred that these materials be used at least 0.6 m below the finished site surface to reduce the surface heave movements of the fill platform and also due to poor trafficability when wet.

The excavated rock is considered geotechnically suitable for re-use as engineered fill. Rock particles greater than 200 mm produced during excavation will require crushing to render them suitable for re-use within either bulk filling or unsealed pavements. Adding moisture to rock fill is likely to be required during construction.

If excavated material is to be removed off the site, then a waste classification assessment will generally be required. The scope of the current geotechnical investigation did not include sampling and testing for waste classification or contamination assessment purposes, as it is expected that all excavated materials will be re-used on site. If required to be taken off site, all excavated materials will need to be disposed of in accordance with the current Waste Classification Guidelines (NSW EPA 2014). This includes any filling and natural materials, such as may be removed from site. Accordingly, environmental testing would need to be carried out to classify spoil to be taken off site. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site.

No obvious signs of contamination were observed during the field work.

8.8 Site Preparation and Earthworks Procedures

The following site preparation and earthworks procedures are recommended for the placement of engineered filling across the site:

- Strip all vegetation and topsoil which contains organic matter (generally less than 0.1 m encountered during this investigation) and grub out all significant roots;
- The exposed material surface should be inspected by a geotechnical engineer to check for excessively wet areas or weak zones, which may require removal and replacement. There is a high risk that the upper clay material may soften in the event that they become wet;
- Approved filling should be placed in near-level, loose layer thicknesses not exceeding 300 mm and compacted to a range of 100% to 103% Standard dry density ratio, at a moisture content within the range from -4% OMC to OMC where OMC is the Standard optimum moisture content;

- Earthworks construction procedures should be subject to Level 1 geotechnical inspections and testing as detailed in AS 3798 – 2007 (Ref 2), which requires field density testing within each layer of filling, together with careful control of moisture content, layer thickness, compaction achieve and material constituents. At this site, it is important to recognise that the site-won material will comprise a combination of residual clays and excavated weathered bedrock. If upper bound strength parameters are to be attributed to the placed engineered filling, careful selection of filling materials (i.e. mixing of clays and excavated rock) should be undertaken to improve the filling characteristics; and
- The success of the earthworks relies heavily upon the competency of the earthworks contractor and of the geotechnical testing and inspection authority (GITA).

Further comments on additional measures to reduce the risk of erosion across the site are provided in Section 8.9. Similarly, comments on site trafficability are provided in Section 8.10.

Reference should also be made to Section 8.15.2 which provides additional measures in the event that lateral pile capacity design is to consider ignoring a lesser depth of the design crack for the site.

8.9 Erosion Reduction Methods

The laboratory testing indicated that the silty clay generally has a slight to moderate susceptibility to dispersion/erosion; however, a number of samples indicated a slightly higher risk (returning Emerson class results of 3 and 4). This risk of erosion can be reduced provided the following are undertaken:

- Compaction of fill to at least 98% Standard compaction as outlined below:
- Moisture conditions of the clay materials within the ‘borrow area’ to the moisture content range described in Section 8.8;
- Fill material (i.e. gravelly clays and clays) are appropriately compacted, moisture conditioned and slopes battered at a maximum of 3H:1V;
- Fill bench with batter slopes of 3H:1V which will allow ease of access for maintenance of batter vegetation and drainage;
- Permanent batter slopes should be vegetated as soon as possible, to reduce the risk of significant soil erosion occurring;
- Topsoil (with minimum thickness of 100 mm and a maximum of 200 mm thickness) and vegetation to be provided on exposed batters or cuts. Hydro-mulching should be considered to promote growth;
- Adequate surface drainage is provided to reduce surface and seepage water flows;
- Contour drains along the crest of both cut and filling batters should be provided to reduce the potential for erosion. Such drains should be vegetated or gravel-lined, as appropriate for the expected flows;
- An upslope diversion bund or swale drain to divert overland away from the site;
- Erosion protection such as rip-rap or concrete at high flow drainage points;
- Short term erosion measures such as silt fencing, hay bales etc., where required during construction;

- Such drains should be vegetated or concrete-lined, as appropriate for the expected flows. The use of rip-rap (rockfill) blankets or extensive re-vegetation may be required to dissipate stormwater flows at the location of drain outlets or previously eroded areas if encountered; and
- Earthfill adjacent to pipes and other structures passing through embankments should be stabilised with hydrated lime or gypsum, to reduce the shrink-swell and soil erosion potential. Preliminary planning may be based on a dosage rate of 2-3% (by dry mass) with the final rate determined by a programme of laboratory stabilisation trials.

8.10 Site Trafficability

The use of site-won crushed rock filling (with particles less than two-thirds of the layer thickness) is expected to be suitable for a working platform during construction, if required, and also for a temporary surface layer for unformed roads and temporary access pavement for construction.

An imported roadbase gravel material is expected to be more suited for long term use within the access roads.

8.11 Pavement

The layout of any proposed roads is not known at this stage. It is likely that a series of roads will be constructed across the site.

8.11.1 Pavement Design Subgrade CBR

The anticipated subgrade conditions are expected to comprise natural silty clay or sandy clay, or engineered fill. Depending on the final bulk earthworks, bedrock may also be exposed at nominal subgrade level. Figure 4, below, shows the results of the 4 day soaked CBR testing undertaken on samples across the site.

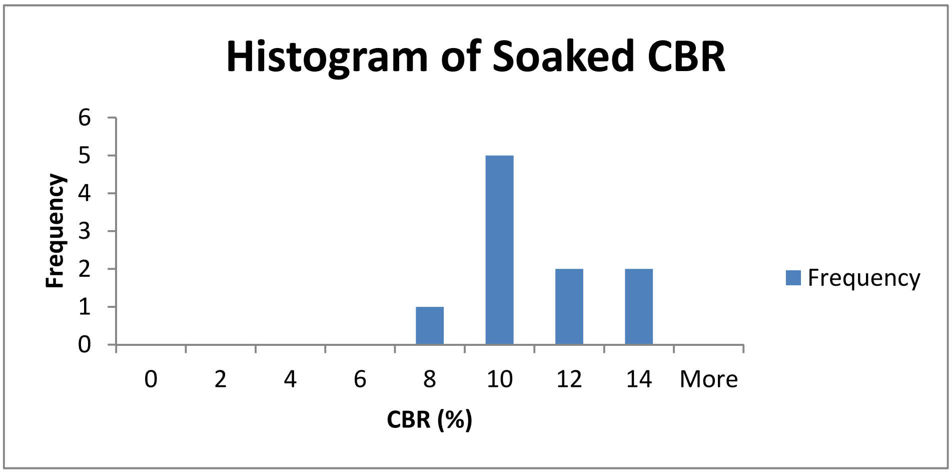


Figure 4: Histogram of Soaked CBR results

Based on the investigation results and Douglas Partners' experience with such soils and weathered rock, the design subgrade CBR value of 7% for the clayey soils and 10% for re-used rock as fill materials should be adopted.

If the subgrade moisture content becomes wet of optimum moisture content at the time of construction, drying back to near optimum moisture content or use of a select layer, to facilitate compaction of overlying pavement materials may be required, but, is dependent on soil moisture conditions at the time of construction. In this regard, the subgrade samples tested indicate field moisture contents ranging from 4% dry to 7% dry of optimum moisture content (OMC) at the time of investigation.

Geotechnical inspection should be undertaken during construction to confirm the subgrade conditions and the requirements for subgrade improvements (such as select layers, moisture reconditioning, bridging layers, removal and replacement of localised areas, and or lime stabilisation etc.), if required.

The subgrade parameters presented above are dependent on the provision and maintenance of adequate surface drainage for all pavements. Adequate surface drainage should be provided to avoid water ponding at the surface and minimise the ingress of water in to the pavement materials.

8.11.2 Pavement Subgrade

The following subgrade preparation measures are recommended for preparation of the pavement subgrade:

- Excavate to design subgrade level. The surface should be sloped to ensure water does not pond over the materials;
- Strip all vegetation and topsoil which contains organic matter (generally about 0.1 m encountered during this investigation) and grub out all significant roots;
- The exposed subgrade material surface should be inspected by a geotechnical engineer to check for excessively wet areas or weak zones, and assess if pavement should be constructed over natural subgrade or of subgrade treatment such as drying back, removal and replacement, select and/or bridging layer if required. There is a risk that the silty sand may soften in the event that they become wet;
- Where suitable subgrades are encountered, the subgrade should be compacted to at least 100% Standard dry density ratio, as measured by AS 1289.5.1.1, at a moisture content within the range from -4% OMC to -1% OMC, where OMC is the optimum moisture content as measured by AS 1289.5.1.1;
- For new filling to raise the subgrade level, place and compact the engineered fill with a CBR of not less than the design subgrade CBR to 100% Standard dry density ratio, at a moisture content within the range from -3% (dry) of OMC to OMC;
- Earthworks construction procedures should be subject to Level 2 geotechnical inspections and testing as detailed in AS 3798 – 2007 (Ref 2), which requires at least one field density test per layer of filling placed for each designed lot;
- Placement and compaction of pavement gravels.

8.12 Site Classification

Site classification of foundation soil reactivity provides an indication of the propensity of the ground surface to move with seasonal variation in moisture. Based on procedures presented in AS 2870-2011 (Ref 5) and on results from this investigation comments on site classification for the proposed development is presented below.

A total of 13 shrink-swell tests were undertaken across the solar farm site. Figure 5, below shows a distribution of the test results. The majority of the test results indicate that the site soils have a shrink-swell index of less than 2.5%, although they ranged from 0.5% to 3.9%. No clear correlation between geology or soil landscape across the site was noted. Figure 5, below, shows a histogram of the results of shrink-swell testing undertaken across the site. The average of the shrink-swell values is 1.5%. Using a 90% confidence interval, a design Iss value of 3.0% was adopted for the analysis.

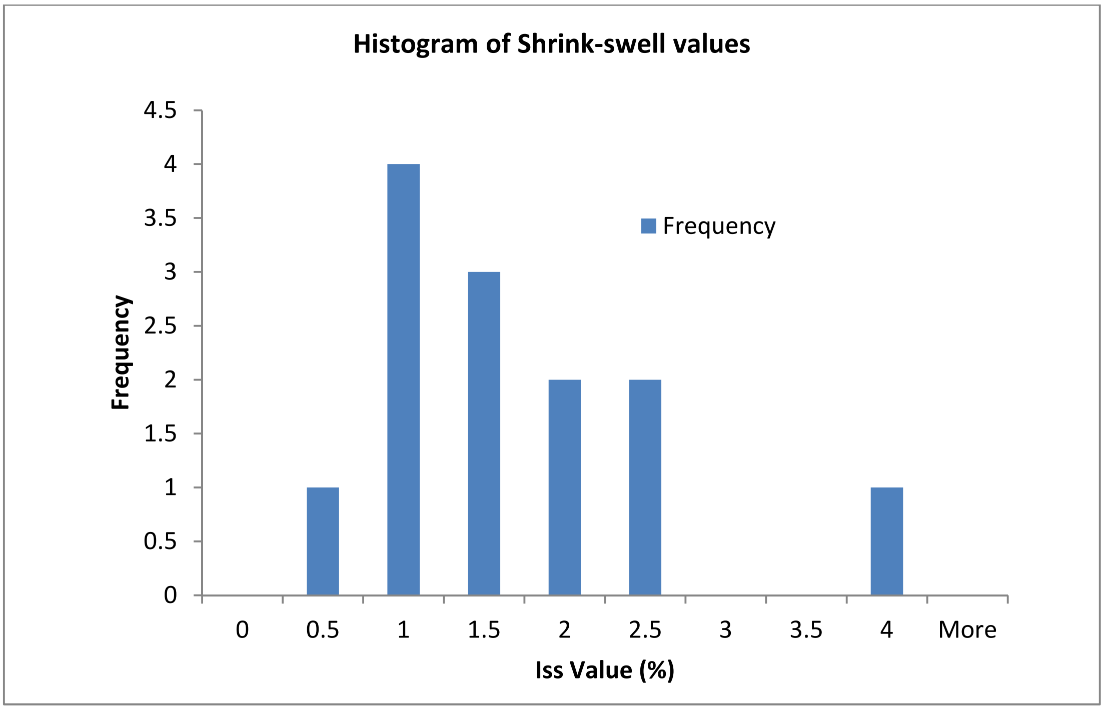


Figure 5: Histogram of Shrink-swell testing results

Reference to the plasticity index testing indicates that the majority of the clay soils are of intermediate to high plasticity.

It should be noted that standard designs within AS 2870 for site classifications which are based on characteristic surface movements only apply to structures of similar size and flexibility to residential buildings and do not apply to industrial structures. Similar principles in design for reactivity / movement, however, should be incorporated into design, construction and maintenance.

The dominant factor for site classification at this site is the depth to bedrock. Table 12, below shows the estimated characteristic surface movement based on the depth to bedrock. These are based on the 90% confidence value of Iss from the site, methods outlined in AS2870 (Ref 5) and information provided by Barnett and Kingsland (Ref 6) which indicates that the site is located in a dry temperate zone and hence has a depth of design suction change (Hs) of 3.0 m. A design crack depth factor of 0.5 has been adopted. There are numerous rock outcrops across the site and hence the depth to rock is expected to vary considerably.

Table 12: Estimated Characteristic Surface Movements

Depth to Bedrock (m)	Estimated Characteristic Surface Movement (ys) (mm)
0.5	20 to 25
1.0	30 to 35
1.5	40 to 45
2.0	50 to 55
2.5 or greater	55 to 60

It is noted that some areas of the site contain rock outcropping and negligible characteristic surface movement would be anticipated in these areas.

Site classification, as above, is based on the information obtained from site observations, test locations and on the results of laboratory testing, and has involved some interpolation between data points. In the event that the conditions encountered during construction are different to those presented in this report, it is recommended that advice be obtained from this office. It is recommended that footing inspections should be carried out during construction to confirm suitable foundation materials for shallow footings.

The above classifications should be revised following earthworks (filling or cutting) as required by AS 2870-2011. The classification would depend on the depth and type of material used as well as the level of compaction and level of quality control. Placement of reactive clay filling would be likely to have an adverse effect on site classification.

It should be noted that the site classifications are dependent on proper site maintenance, which should be carried out in accordance with the attached CSIRO Sheet BTF-18, “Foundation Maintenance and Footing Performance: A Homeowners Guide” and with AS 2870- 2011.

Masonry walls of any proposed buildings should be articulated in accordance with TN61 (Ref 7) to reduce the effects of differential movement.

8.13 High Level Footings

It is not known whether any structures, other than PV panels, are proposed for the site. Minor structures may be supported on high level footings. Strip and pad footings up to 1 m and 2 m wide respectively, founded at least 0.5 m deep below the finished ground surface may be sized using the allowable values indicated in Table 13.

Table 13: High Level Footing Design Bearing Pressure (Allowable)

Material	Maximum Allowable Bearing Pressure (kPa)[1]
Hard silty clay or gravelly clay	100
Very low strength bedrock	500
Engineered Level 1 filling[2]	150

Notes to Table 13:

[1] Bearing capacity based on conditions at time of field work and assuming no abnormal soil moisture conditions.

[2] Filling compacted under Level 1 testing and inspection to at least 98% Standard maximum dry density ratio

[3] The suggested allowable bearing pressure has been reduced owing to the appreciable softening during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

Where limit state methods are used to design the high level footings, the above maximum allowable bearing pressures should be multiplied by the adopted safety factor of 2.5 to obtain an ultimate unfactored geotechnical strength ($R_{d,ug}$). The $R_{d,ug}$ is then multiplied by a suitable geotechnical strength reduction factor (ϕ_g) to obtain the design geotechnical strength ($R_{d,g}$).

For high level pad or strip footings founded in the materials as given in Table 13 above, it is considered that settlements under such applied loading will be less than about 1% of the footing width. Settlement is independent of, and possibly additional to, reactive clay movements.

Masonry wall, if proposed, should be articulated in accordance with C&CAA TN61 (Ref 7).

8.14 Reactive Soil Considerations

8.14.1 Seasonal Soil Cracking

It is anticipated that shrink-swell related uplift pressures and movements could be more critical than the relatively light pile loads applied by the panels.

Published information consistently indicates that the pile portions founded within the 'active' zone of soil (3 m depth for this site) will experience uplift force and displacements during clay swelling phases. Information on the converse effects of soil shrinkage during drying on pile performance is less clear, although it is logical to assume a lesser impact on vertical pressures as the soil potentially shrinks away from the pile.

The magnitude of shrink-swell induced vertical pile movement will be largely governed by the depth of pile penetration, with increased penetration (ideally as deep as practicable below the 'active' zone) correspondingly reducing the predicted pile head movements relative to the predicted surface movements. For shallower piles, the vertical movement is likely to increase (relative to the predicted surface movements), together with a corresponding increased risk/rate of progressive pile jacking.

The relationship between pile penetration and reduction in vertical movement is difficult to predict, with limited information to develop relationships for predicting uplift forces and movement from soil swell, especially for piles founding entirely within the active zone. Variance in soil shear strength with depth as well as pile shape, weather patterns and hence seasonal soil moisture content variations also add to the complexity of predicting pile performance.

Reference to Barnett and Kingsland (Ref 6) indicates that the site lies within a 'dry temperate' zone. The depth of design suction change (H_s) is 3 m and the crack depth factor is 0.5 (i.e. 1.5 m design crack depth for the purposes of AS 2870 (Ref 5)). Local variations in Thornthwaite Moisture Index (TMI) probably exist, and the mapping used by Barnett and Kingsland was broad scale. It is therefore possible that the depth of cracking at this site differs from the above value, but in the absence of more detailed monitoring, this value should be considered first and foremost for design purposes. The site is located in a dry temperate zone and is not anticipated to experience extreme seasonal fluctuations in climatic and soil moisture conditions which may occur in, for instance, the tropics. Therefore, considering the climatic conditions together with the presence of granitic-derived soils, it is suggested that separate design for "dry season" and "wet season" is not appropriate at this site.

In a low redundancy piling scenario, it would usually be recommended that no contribution to vertical or lateral load carrying capacity be considered for this 'design' crack depth. It is anticipated that the piles for the PV trackers would be a relatively high redundancy piling system and as such a less conservative approach could be adopted, provided that further precautions are taken for the variation in soil strength with moisture. This is further discussed in Section 8.15.2.

Elastic solutions are presented by Poulos and Davis (Ref 8) for "piles in swelling and shrinking soils". The soil is treated as an overconsolidated clay and pile movement is estimated as a function of pile length, with respect to H_s, characteristic surface movement and of pile properties. It is recommended that analyses should be undertaken to predict pile movements in the reactive clay soils.

Another method of mitigating cracking and shrink-swell movement effects is surface sealing to reduce seasonal moisture variations, however this may not be economically feasible. Therefore, careful attention should be given to positive site drainage to minimise the potential for water ponding that would exacerbate the soil swelling as well as subgrade softening, followed by excessive cracking in dry weather.

8.14.2 Reactive Soil Movements

Reactive soil movements, and the basis of their prediction, are described in Section 8.14 above and estimated shrink-swell movements are shown in Table 12.

As indicated, the range of predicted movements at the site is largely a function of the variable depth to rock which is expected to be 'stable' with respect to shrink-swell movements.

8.14.3 Ground Moisture Conditions

To assess the variation in moisture at the site, laboratory testing incorporated measurement of field moisture content at approximately 0.5 m depth intervals. The measured moisture contents have been plotted in Figure 6 below.

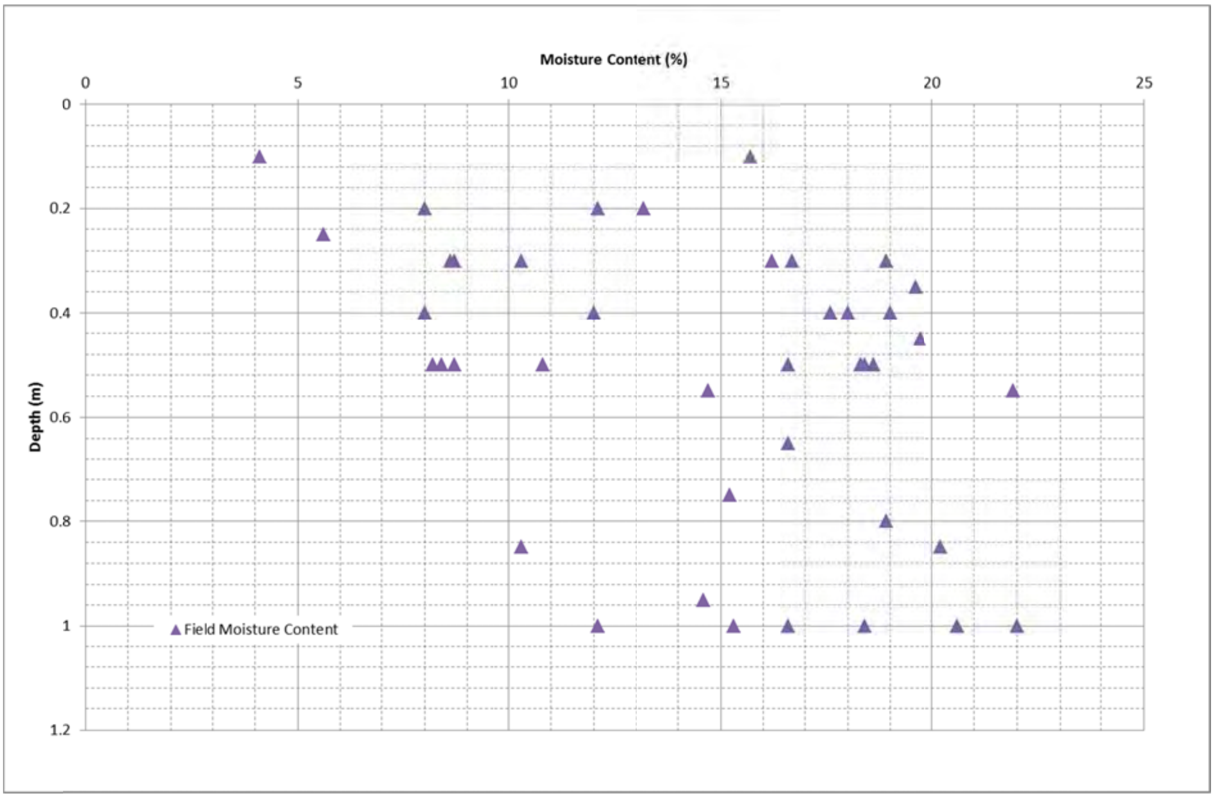


Figure 6: Field moisture content versus depth of sample

Field moisture contents, as a ratio of liquid limit, are also presented as a normalised plot against depth in Figure 7 to 'smooth' out the effect of soil type.

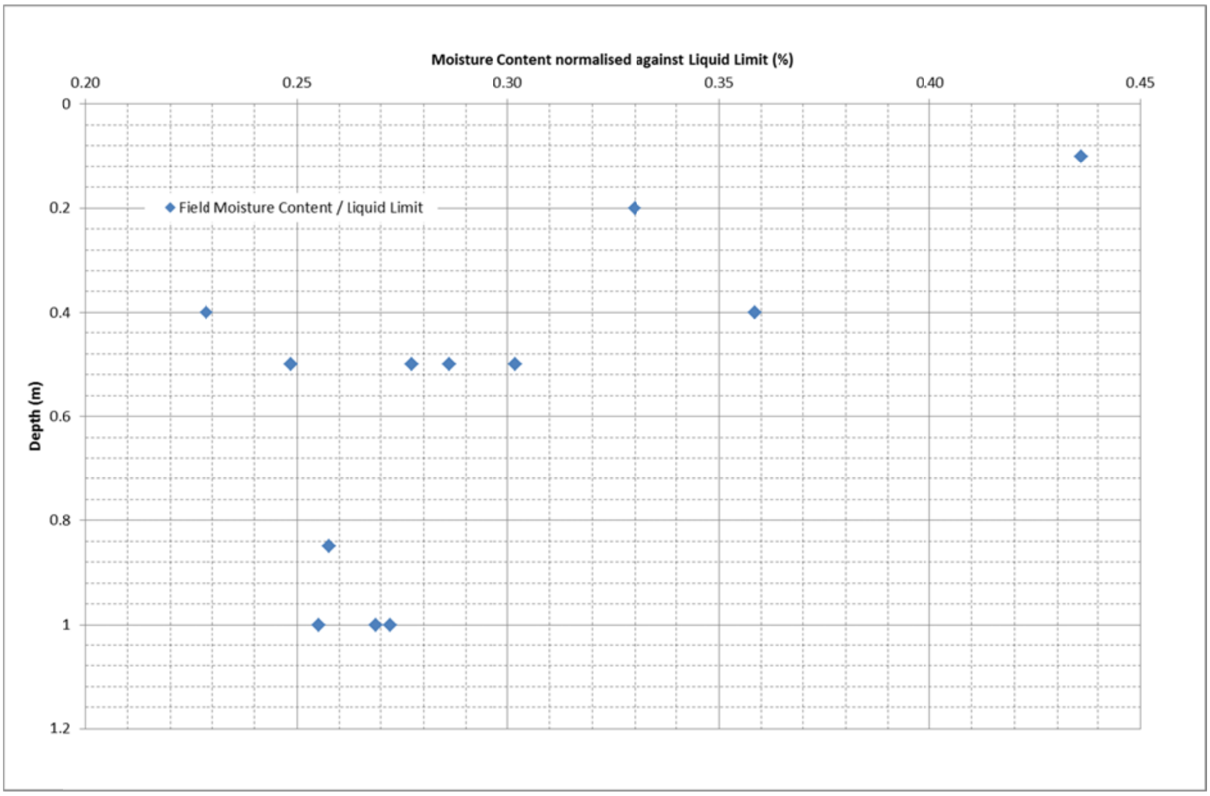


Figure 7: Field moisture content normalised against liquid limit with depth

The plot in Figure 7 indicates a possible trend toward decreasing soil moisture within the depth range from 0.2 m to 0.5 m, although the number of points is relatively low and an appreciably larger number of Atterberg limits tests would be required to examine this trend in more detail.

Figure 8 shows a plot of Iss against FMC and Figure 9 shows a normalised plot of the FMC ratio to I_{ss} value against depth to assess the possibility of trends in the clay soil. As can been seen in the following figures, a clear trend is not apparent.

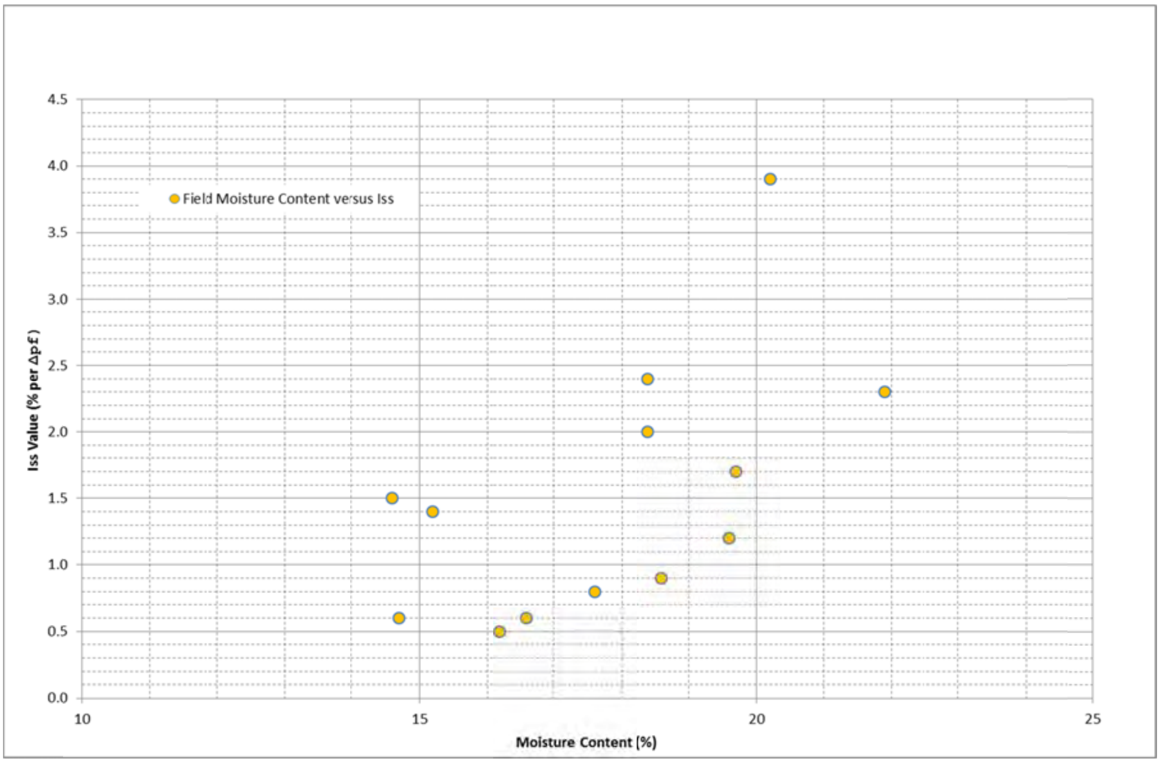


Figure 8: Moisture content versus Iss value

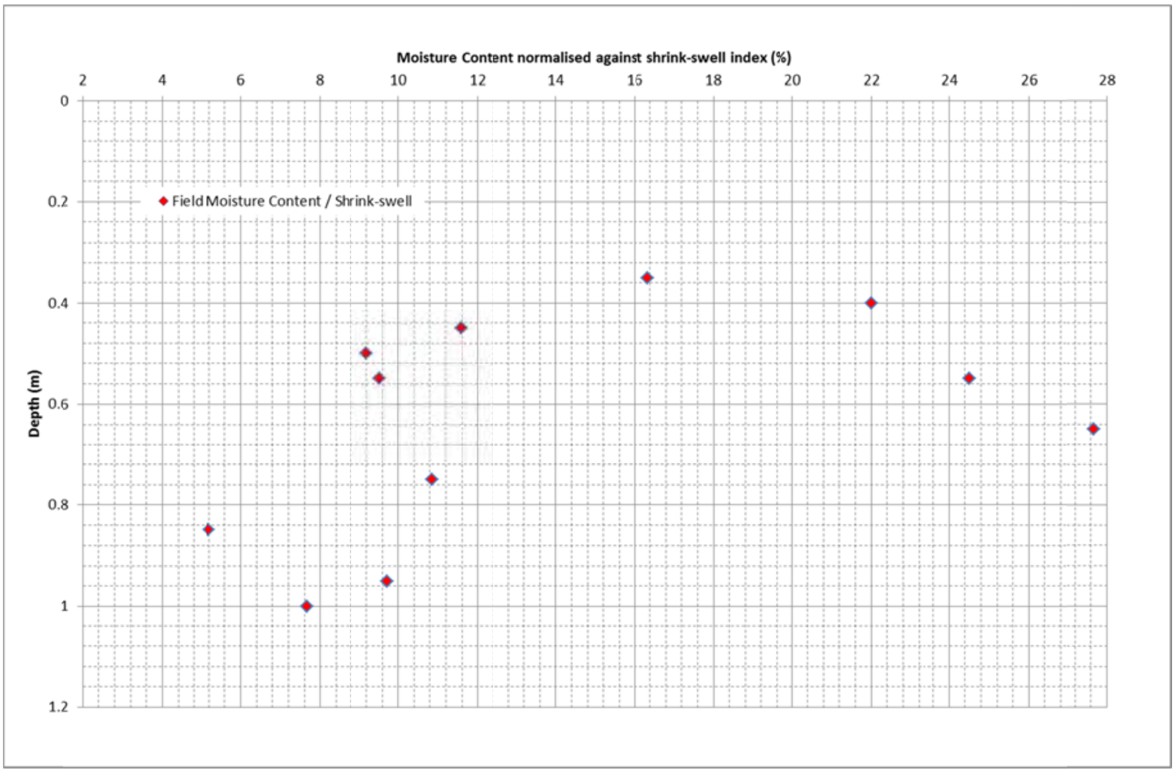


Figure 9: Field moisture content normalised with shrink-swell index against depth

8.14.4 Swelling Pressures

Soil jacking is a heave phenomenon that occurs in heavy clay profiles in areas with significant seasonal soil moisture variations. Uplift forces are generated on pile shafts in the upper soil profile due to swelling of the clay after soil cracks have closed and all volumetric strain is translated to vertical strain. When this occurs to piles that have been driven to insufficient depth, they can be 'jacked' upwards.

The results of the thirteen tests undertaken returned Iss values ranging from 0.5% to 3.9% although all but one of the tests returned values of less than 2.5%.

Swell pressure testing has not been carried out for this site and hence estimates of the likely swell pressures experienced by the piles is not able to be provided. It is noted that seasonal jacking is likely to be small, although over the design life of the project the cumulative movements could be significant.

8.15 Piles

It is understood that the foundations to support the solar panels will likely comprise driven UC steel piles. Where shallow rock is present and piles are unable to be driven to the required depth, it is understood that a pilot hole smaller than the pile will be drilled, backfilled with soil, and then the pile driven.

8.15.1 Driven Piles

Driven steel piles are understood to be proposed to support the solar panels. It is anticipated that the piles would be driven to refusal. The capacity of the piles should be verified using recognised pile driving formulae, such as Hiley.

It is anticipated that the piles would be able to be driven through the residual soils and into the extremely low strength bedrock. Excavator refusal was encountered in a number of the pits and bores at depths ranging from 1.75 m to 4.9 m. It is noted, however, that penetration of up to 2 m into the bedrock was achieved using the excavator.

The piles are likely to refusal on the very low strength or stronger bedrock generally where backhoe refusal was encountered but this would depend on the type and capacity of pile driving equipment.

The depth to rock and the strength of the bedrock are anticipated to vary across the site. It is therefore strongly recommended that pile driving trials are undertaken at a number of locations across the site. It is understood that where shallow refusal is encountered during the driving of piles, the auger drilling of a small pilot bore may be undertaken to allow greater penetration for the driven piles.

The ultimate parameters shown in Table 14 are suggested for the design of driven steel piles with length on diameter ratios of at least four, subject to vertical compressive and uplift loads. The shaft adhesion developed over the upper 1.5 m (estimated crack depth due to seasonal shrink-swell movement) should be ignored in compressive and tensile load capacity calculations due to seasonal soil cracking, unless the ground adjacent to the piles is paved and draining away from the structure (a fall of at least 2% for a distance of approximately 500 mm from the pile in all directions.

Table 14: Ultimate Unfactored Driven Steel Pile Design Parameters – Vertical Load

Material	Ultimate Unfactored Pressure, $R_{d,ug}$ (kPa)		
	Shaft Adhesion		End Bearing
	Compression	Tension	
Controlled filling placed in accordance with this report	40		N/A
Hard silty and sandy clay	70		1800
Dense (or denser) sand	$15H_2^{\#}$	$8H_2^{\#}$	$1800^{\#}$
Extremely low to very low strength bedrock	180*		2000*

Notes to Table 14:

H_1 – depth to pile toe (in metres), limiting value of 15 MPa

H_2 – depth to centre of pile shaft within sand layer (in metres), limited to 15 times pile diameter

– values are based on effective stress condition. Values quoted are for fully submerged conditions, for conservative estimation of contribution. Roughly double these values would apply for dry conditions.

* - the extent and condition of the weathered bedrock must be further investigated prior to design.

The pile parameters presented above are unfactored ultimate values. A factor of safety of 2.5 should be applied to all ultimate values for working stress analysis. Alternatively, a basic geotechnical strength reduction factor (ϕ_{gb}) is recommended for limit state design of piles in accordance with AS 2159 – 2009 (Ref 1). The appropriate (ϕ_g) should be derived by the designer based on the data presented in this report, the method of soil strength assessment used in this investigation and after assessing the overall design average risk rating (ARR) for the site, design, level of redundancy and installation risk factors anticipated for the proposed piling system.

To assist with this process, individual risk ratings for the geotechnical components which affect the ARR for the site are shown in Table 15 below. The value of ϕ_g for pile design should be assessed from the ARR by the pile designer, having due regard to the principal loading conditions that could affect the piles.

The rationale for the suggested IRR values provided below for the geotechnical components is as follows:

- **Geological complexity of site** The results of the investigation show that whilst two dominant geological units are present at the site, the depth to rock (which has a major influence of pile design). The pits and bores generally encountered rock at depths ranging from about 0.7 m to over 4 m, although bedrock was encountered in Pit 16 at 0.1 m depth. Therefore a moderate risk has been associated with this component;
- **Extent of ground investigation** The investigation was limited to twenty pits and fourteen bores across the site which is in the order of 520 hectares, which equates to an equivalent grid of about 400 m. This is considered limited coverage for the broad scale investigation. Therefore a very low to moderate risk has been associated with this component; and
- **Amount and quality of geotechnical data** The investigation programme included in-situ testing of strength (pocket penetrometer and dynamic penetrometer testing) together with about seventeen shrink-swell or linear shrinkage tests. Therefore, a moderate risk has been associated with this component.

Table 15: Derivation of geotechnical reduction factor and average risk rating

Risk Factor	Weighting factor (w_i)	Typical description of risk circumstances for individual risk rating (IRR) 1 (Very low risk)	3 (Moderate)	5 (Very high risk)	Assigned Risk Factor (1 to 5)	w_i IRR_i
Site						
Geological complexity of site	2	Horizontal strata, well-defined soil & rock Characterstics	Some variability over site, but without abrupt changes in stratigraphy	Highly variable profile or presence of karstic features or steeply dipping rock levels or faults present on site, or combinations of these	3	6
Extent of ground investigation	2	Extensive drilling investigation covering whole site to an adequate depth	Some boreholes extending at least 5 pile diameters below the base of the proposed foundation level	Very limited investigation with few shallow boreholes	3	6
Amount & quality of geotechnical data	2	Detailed information on strength & compressibility of the main strata	CPT probes over full depth of proposed piles or boreholes confirming rock as proposed founding level for piles	Limited amount of simple insitu testing (eg SPT) or index tests only	3	6

8.15.2 Lateral Capacity

Lateral capacity of the piles could be assessed using Broms method. The suggested design parameters are provided in Table 16.

Table 16: Soil / Rock Parameters for Pile Design (unfactored)

Soil Strata	Undrained Shear Strength (kPa)[1]	Youngs Modulus E' (MPa)	Ultimate Passive Pressure (kPa)
Crack depth	Ignore (see below for further comment)		
Unit 2.2 - Hard clays, sandy clays and clayey sands	150	30	300
Unit 3 - Extremely low to low strength bedrock	300 - 500	60	400

Notes to Table 16

(1) The suggested undrained shear strength has been reduced owing to the appreciable softening during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

The values shown in Table 16 are sections of the pile which are in full contact with the soil. It should be recognised that there is a possibility that shrinkage cracking could coincide with the soil/pile interface. The depth of such cracks could approach the design crack depth of 1.5 m for this site. Therefore, it would be prudent to ignore the upper 1.5 m of the soil profile for lateral pile capacities. Some reduction in the design depth of cracking to be ignored in the design may be possible depending on the sensitivity and criticality of the specific componentry supported by the pile. For instance, it would be prudent to assume the full design depth of cracking (i.e. 1.5 m at this site) where the effects of potential uplift and lateral movements cannot be tolerated.

Provided the following additional precautions are undertaken for the variation in soil strength with fluctuations in moisture content and a high level of redundancy is incorporated into the design (i.e. tolerance for potential movements), the ground from 1 m to 1.5 m (lower third of the design crack) could be included in the lateral loading calculations as the cracking would be minor and not sufficient to significantly impact soil performance:

- Adequate and maintained surface drainage;
- Careful backfill of service trenches (i.e. limited use of permeable backfill materials so as not to provide a conduit for groundwater or a high level of connectivity with surface water);
- No planting of trees close to structures; and
- No excessive or irregular watering close to structures.

Further comments on site maintenance, vegetation and drainage measures for reactive sites are provided in CSIRO BTF 18 (Ref 10). These include measures which are possibly not relevant to this site given the proposed development but should be considered where relevant. This includes measures such as expedient repair of plumbing leaks.

If a lesser value is to be considered for such possible cracking it is recommended that measurement of seasonal cracking is undertaken to determine site specific crack depth values. The importance of this consideration is somewhat dependent on the aperture of the cracking and the tolerance of the piles to lateral displacement (i.e. if there is flexibility incorporated into the design of the system greater lateral deflections are likely to be readily accommodated).

9. Recommended Additional Investigation

Given the size of the site and the complexity of the ground conditions, it is considered that the investigation undertaken to date should be considered preliminary in nature. For detailed design, it is recommended that additional investigation is undertaken to provide a greater density of subsurface investigation across the site. The investigation should include additional test pits to establish the depth to bedrock, where encountered within the likely pile driving depths, reactive soil conditions and likely swell pressures.

10. References

1. Australian Standard AS 2159–2009, “Piling – design and installation”, Standards Australia.
2. Australian Standard AS 3798-2007 “Guidelines on Earthworks for Commercial and Residential Developments”, Standards Australia.
3. “Guide to Pavement Technology, Part 6: Unsealed Pavements, Austroads AGPT06/12 September 2009.
4. Australian Standards AS 1170.4-2007, *Structural design actions, Part 4: Earthquake actions in Australia*, October 2007, Standards Australia.
5. Australian Standard AS 2870-2011 "Residential Slabs and Footings", 2011, Standards Australia.
6. I.C.Barnett and R.I. Kingsland, “Assignment of AS2870 Soil Suction Change Profile Parameters to TMI Derived Climatic Zones for NSW”, 8th Australia New Zealand Conference on Geomechanics, Hobart.
7. Cement Concrete & Aggregates Australia, Technical Note 61, “Articulated Walling”.
8. Poulos H.G, and E.H. Davis, “Pile Foundation Analysis and Design”, John Wiley & Sons, 1980.
9. Nelson JD and Miller DJ, “Foundation Engineering for Expansive Soils”, John Wiley and Sons Inc, 2015.
10. BTF18, “Foundation Maintenance and Footing Performance: A Homeowner’s Guide”, CSIRO 2003.
11. Australian Standards AS/NZS 1768:2007, *Lightning protection.*

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Goolma Road, Wellington with reference to DP's proposal NCL170734 dated 20 December 2017 and acceptance received from First Solar on 20 December 2017. The work was carried out under a consultancy agreement between DP and First Solar dated 2 January 2018. This report is provided for the exclusive use of First Solar for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

CSIRO Sheet BTF 18
About This Report
Sampling Methods
Soil and Rock Descriptions
Symbols and Abbreviations

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

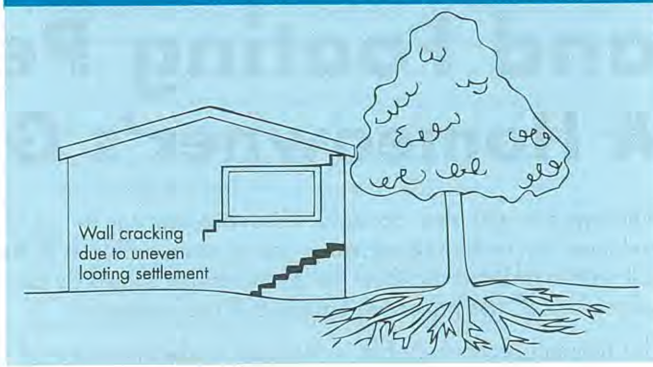
Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Trees can cause shrinkage and damage



Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

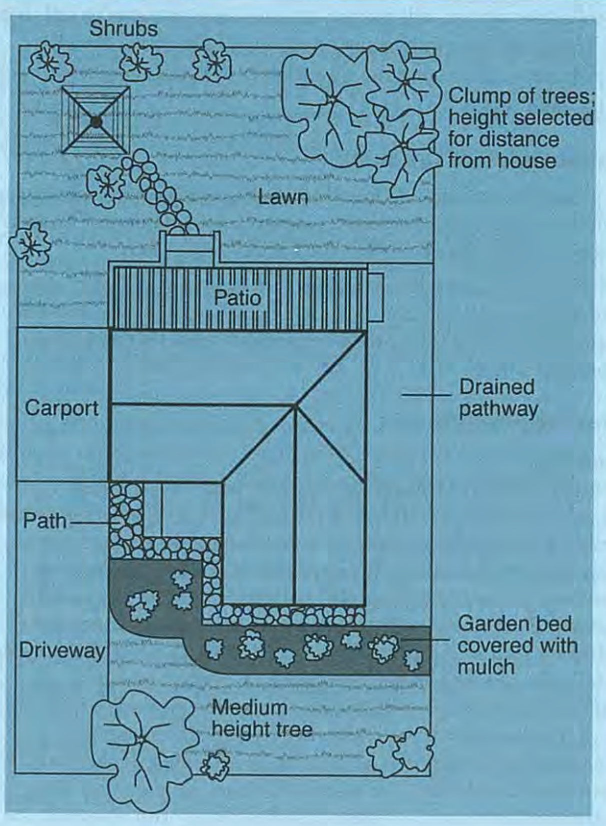
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

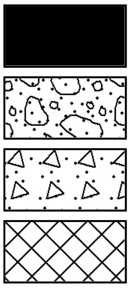
Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

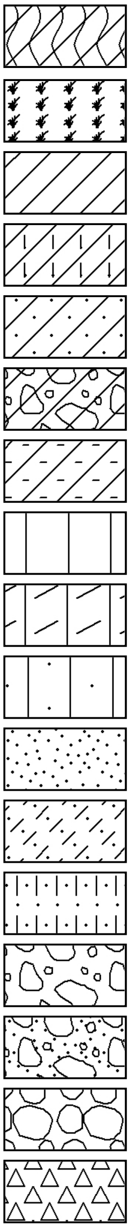
Graphic Symbols for Soil and Rock

General



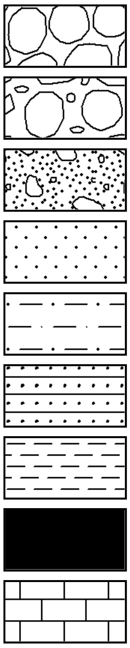
- Asphalt
- Road base
- Concrete
- Filling

Soils



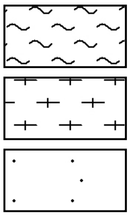
- Topsoil
- Peat
- Clay
- Silty clay
- Sandy clay
- Gravelly clay
- Shaly clay
- Silt
- Clayey silt
- Sandy silt
- Sand
- Clayey sand
- Silty sand
- Gravel
- Sandy gravel
- Cobbles, boulders
- Talus

Sedimentary Rocks



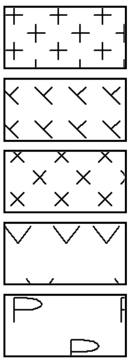
- Boulder conglomerate
- Conglomerate
- Conglomeratic sandstone
- Sandstone
- Siltstone
- Laminite
- Mudstone, claystone, shale
- Coal
- Limestone

Metamorphic Rocks



- Slate, phyllite, schist
- Gneiss
- Quartzite

Igneous Rocks



- Granite
- Dolerite, basalt, andesite
- Dacite, epidote
- Tuff, breccia
- Porphyry

Appendix B

Test Pit Logs (Test Pits 1 to 20)
Photoplates (Test Pits 1 to 20)
Borehole Logs (Bores 21 to 34)

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 685150
NORTHING: 6400915

PIT No: 1
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.14	TOPSOIL - Brown gravelly silt topsoil, with trace to some fine to coarse grained sand clay and rootlets		D	0.05				
	1.2	GRAVELLY CLAY / CLAYEY GRAVEL - (Hard / dense), red-brown gravelly clay / clayey gravel, gravel portion subrounded up to 50mm in size, trace to some silt and fine to coarse grained sand, (M<Wp / humid)		D	0.3				
				B	0.4–0.5				
	3.0	SILTY CLAY - Hard, red/orange/brown mottled off-white silty clay, with trace to some fine to coarse grained sand, trace subrounded gravel up to 15mm in size, M<Wp (possible tuffaceous zones)		D	1.3				
				D	2.0				
				D	3.0				
		Pit discontinued at 3.0m, limit of investigation							

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684992
NORTHING: 6401177

PIT No: 2
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		TOPSOIL - Brown gravelly silt topsoil, with trace to some fine to coarse grained sand and clay, abundant organics		D	0.05				
	0.25	GRAVELLY CLAY / CLAYEY GRAVEL - (Hard), red-brown gravelly clay / clayey gravel, gravel portion subrounded up to 50mm in size, trace to some silt and fine to coarse grained sand, (M<Wp)		B	0.5 0.6				
	0.75	SILTY CLAY - Hard, red-brown mottled off-white silty clay, with trace to some fine to coarse grained sand and subrounded gravel up to 15mm in size, M<Wp (possible tuffaceous zones)		D U_{50}	0.8 0.85 1.3				
	1.4	SANDY CLAY - Hard, pale brown sandy clay, fine to coarse grained, with trace silt and subrounded gravel up to 10mm in size, M≤Wp (completely weathered rock)		D	2.0				
	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0				

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

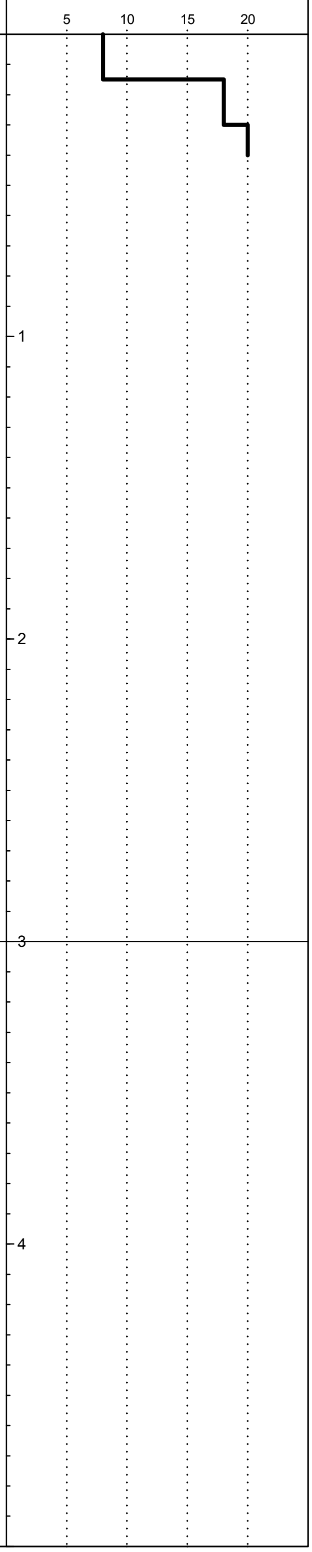
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684728
NORTHING: 6400751

PIT No: 3
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.1	TOPSOIL - Brown clayey silt topsoil, with some fine to coarse grained sand and rootlets		D	0.05			
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to coarse grained sand and subrounded gravel up to 20mm in size, M<Wp		B	0.3 – 0.4			
				U_{50}	0.6 – 0.94			
				D	1.0			
	1.8	META SILTSTONE - (Very low strength, highly weathered to moderately weathered), grey and brown meta siltstone		D	2.2			
		From 2.4m, (low to medium and high strength, moderately weathered to slightly weathered), slow excavation progress		D	2.8			
	3.0	Pit discontinued at 3.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

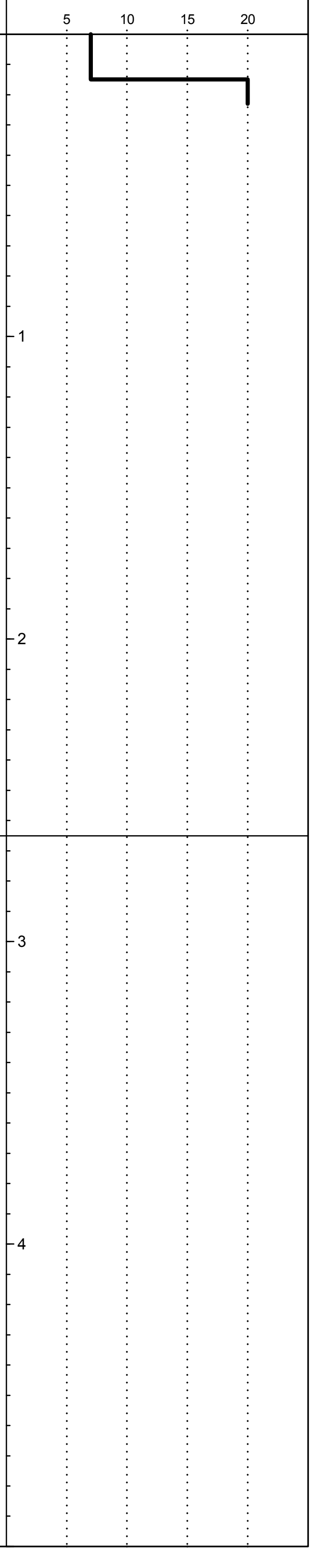
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684503
NORTHING: 6401314

PIT No: 4
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.1	TOPSOIL - Brown slightly sandy silt, fine to coarse grained, with some organics and subrounded gravel up to 20mm in size, trace to some clay		D	0.05			
				D	0.2			
	0.35	GRAVELLY CLAY - Hard, brown gravelly clay, gravel portion subrounded up to 30mm in size, trace organics and fine to coarse grained sand, M<Wp			0.4			
				B				
					0.5			
		SILTY CLAY - Hard, red-brown silty clay, with some subrounded gravel up to 30mm in size, M<Wp		D	0.6			
	0.9	META SILTSTONE - (Low to medium and high strength), moderately weathered to slightly weathered), grey and brown meta siltstone, within extremely low strength matrix (soil like properties)		D	1.0			
				D	1.8			
		From 2.0m, slow excavation progress (matrix less weathered)						
	2.65	Pit discontinued at 2.65m, refusal due to slow excavation progress						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket
LOGGED: Ballinger
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

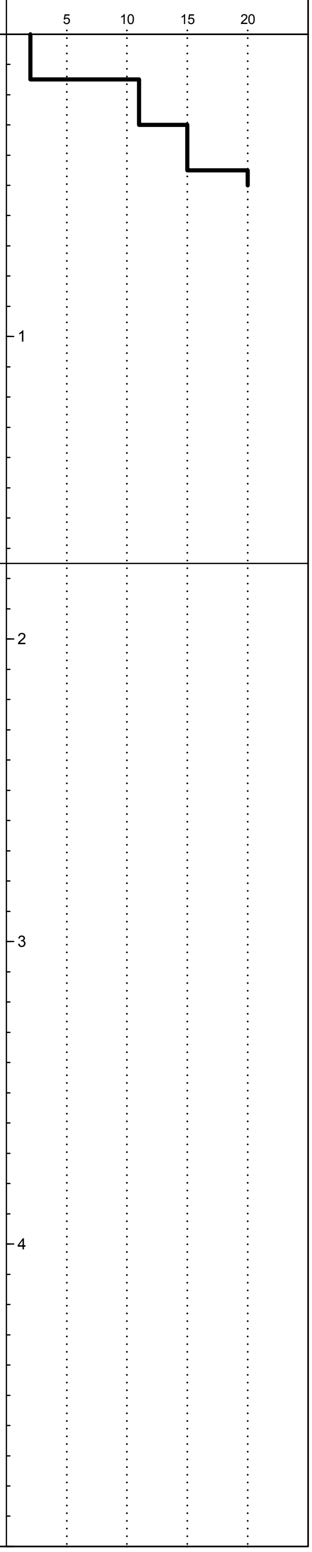
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684395
NORTHING: 6401736

PIT No: 5
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
	0.1	TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some clay and organics		D	0.05			
	0.7	SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand and subrounded gravel up to 15mm in size, M<Wp		D	0.4			
	1.75	META SILTSTONE - (Low to medium strength, highly weathered to moderately weathered), grey and brown meta siltstone, within extremely low strength matrix (soil like properties) From 1.0m, (medium to high strength, moderately weathered to slightly weathered), slow excavation progress (matrix less weathered)		D	0.8			
				D	1.2			
				D	1.7			
		Pit discontinued at 1.75m, refusal						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 682782
NORTHING: 6401179

PIT No: 6
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling Type	Sampling Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.03	SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand, trace organics, M<Wp		D	0.01				
		SANDY SILT - Hard, brown sandy silt, fine to coarse grained, with trace to some clay, trace organics, M<Wp		B	0.3				
				D	0.4				
	0.5	SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand, M<Wp		U_{50}	0.55–0.82				
	1			D	1.2				1
	2			D	2.0				2
	3 3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0				3
	4								4

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 638020
NORTHING: 6401757

PIT No: 7
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments	Water
		TOPSOIL - Red-brown clayey silt topsoil, with some fine to coarse grained sand and organics	D	0.05			
	0.12	SILTY CLAY - Hard, red-brown silty clay, with fine to coarse grained sand, subrounded gravel (siltstone fragments) up to 20mm in size and organics, M<Wp	D	0.3			
			B	0.4–0.5			
		From 0.6m, with trace gravel and sand	U_{50}	0.55–0.98			
			D	1.0			
	1.9	META SILTSTONE - (Extremely low strength, extremely weathered) grey and brown meta siltstone	D	2.0			
		From 2.4m, (low to medium strength, moderately weathered)	D	2.5			
		From 2.6m, slow excavation progress					
	3.0	Pit discontinued at 3.0m, limit of investigation	D	3.0			

Dynamic Penetrometer Test (blows per 150mm)

0.0–0.15	20 (refusal)

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684200
NORTHING: 6400911

PIT No: 8
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		TOPSOIL - Brown sandy silt topsoil, with some clay and organics, trace subrounded gravel up to 20mm in size		D	0.05				
	0.14	SILTY CLAY - Hard, red-brown silty clay, with trace to some subrounded gravel up to 10mm in size, M<Wp		B	0.3 0.4				
				D	0.7				
	1.4	SILTY CLAY - Hard, grey and brown silty clay, with some fine to coarse grained sand and subrounded gravel (siltstone fragments) up to 50mm in size, M<Wp (completely weathered rock)		D	1.5				
				D	2.0				
	2.3	META SILTSTONE - (Low to medium strength, highly weathered to moderately weathered) grey and brown meta siltstone							
	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0				

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684336
NORTHING: 6399978

PIT No: 9
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - Brown slightly sandy silt topsoil, fine to medium grained, with some clay and rootlets		D	0.1				
	0.18	SILTY CLAY - Hard, red-brown silty clay, with fine to medium grained sand and trace subrounded gravel up to 20mm in size, M<Wp		D	0.3				
				B	0.4–0.5				
				D	0.6				
				D	0.9				
1	1.0	META SILTSTONE - (Very low to low strength, highly weathered), grey and brown meta siltstone		D	1.4				
2		From 1.8m, (medium to high strength, moderately weathered to slightly weathered and fresh, within extremely weathered matrix (soil like properties))		D	2.2				
3	3.0	Pit discontinued at 3.0m, limit of investigation							
4									

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

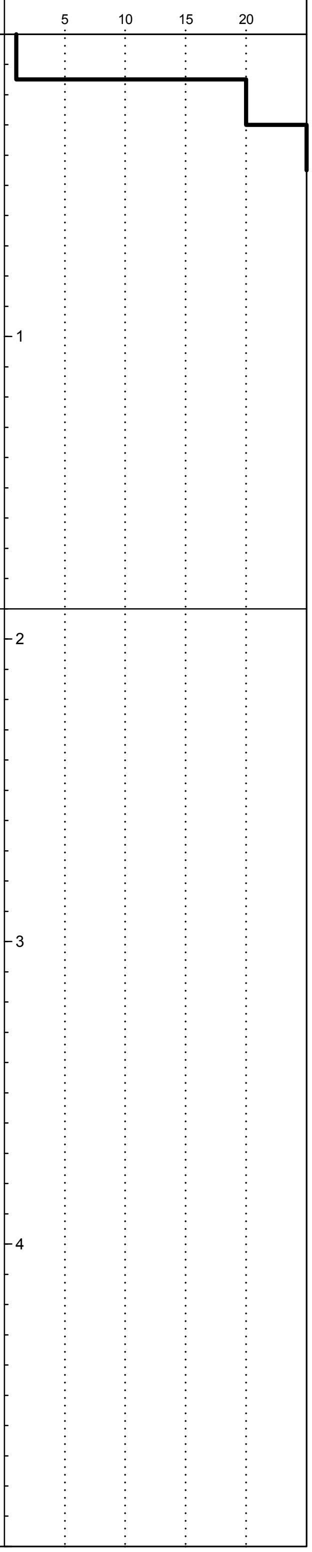
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683647
NORTHING: 6399600

PIT No: 10
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
	0.02	TOPSOIL - Red-brown sandy silt topsoil, fine to medium grained, with some organics, trace subrounded gravel up to 10mm in size		D	0.01			
		SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand, trace organics and subangular gravel up to 5mm in size, M<Wp		B	0.2			
				D	0.4			
				U_{50}	0.57			
	0.6	META SANDSTONE - (Low to medium strength, highly weathered to moderately weathered) grey stained red/orange/brown meta sandstone		D	1.0			
		From 1.7m, (medium to high strength, moderately weathered to slightly weathered)		D	1.8			
	1.9	Pit discontinued at 1.9m, refusal						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket
LOGGED: Ballinger
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683424
NORTHING: 6400433

PIT No: 11
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.04	TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some organics and clay		D	0.01				
				D	0.1				
	0.2	SANDY SILT - Hard, brown sandy silt, fine to coarse grained, with trace to some clay, trace organics, M<Wp		D	0.25				
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to coarse grained sand, trace organics, M<Wp		D	0.4				
				U_{50}	0.45–0.9		pp = 450		
				D	1.5				
		From 2.0m, with trace to some sand, trace subrounded gravel up to 15mm in size							
				D	2.2				
	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0				

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket
LOGGED: Ballinger
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683345
NORTHING: 6401062

PIT No: 12
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

Depth (m)	Description of Strata	Sampling Type	Sampling Depth	Sample	Results & Comments	Water
0.02	TOPSOIL - Brown slightly sandy silt topsoil, fine to coarse grained, with some clay, abundant organics	D	0.01			
0.25	SANDY SILT - Hard, brown sandy silt, fine to coarse grained, with trace to some clay, trace organics, M<Wp	D	0.2			
	SANDY SILTY CLAY - Hard, red-brown sandy silty clay, fine to coarse grained, with trace gravel, M<Wp	D	0.4			
		B	0.5–0.6			
0.8	META SILTSTONE - (Extremely low to very low strength, extremely weathered to highly weathered), grey and red brown meta siltstone	D	1.2			
	From 2.0m (low strength, highly weathered), within extremely weathered matrix (soil-like properties))	D	2.0			
		D	2.5			
3.0	From 2.8m, (low to medium and high strength, moderately weathered to slightly weathered, within extremely weathered matrix (soil like properties))	D	3.0			
	Pit discontinued at 3.0m, limit of investigation					

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20 — no results recorded.

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

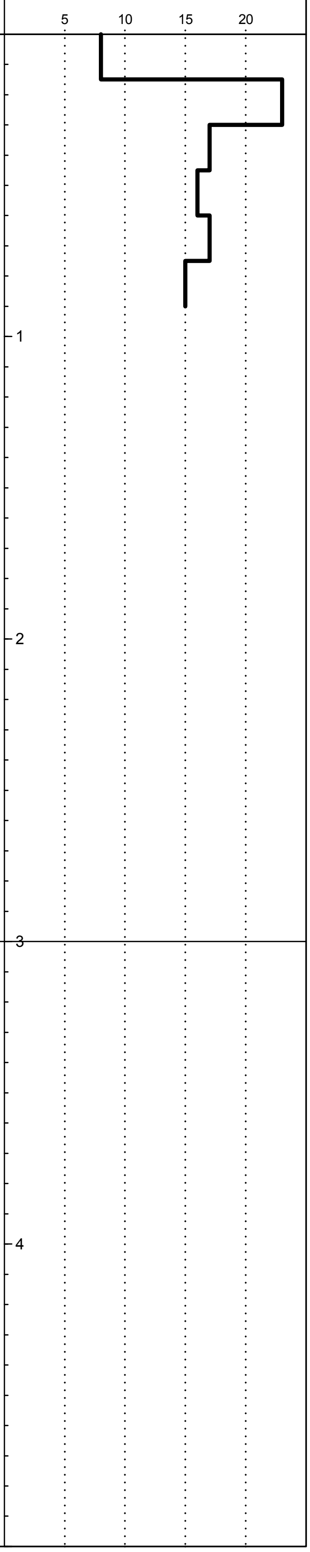
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683230
NORTHING: 6400716

PIT No: 13
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
	0.03	TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some organics and clay		D	0.01			
		SILTY CLAY - Hard, red-brown silty clay, with fine to coarse grained sand and trace gravel, trace organics, M<Wp		B	0.35 - 0.8			
				U_{50}	0.4 - 0.6			
	1			D	1.2			
	1.7	META SILTSTONE - (Very low to low and medium strength, highly weathered to moderately weathered within extremely low strength matrix (soil like properties), grey and brown meta siltstone (ripped fragments typically up to 100mm in size)						
	2			D	2.0			
		From 2.5m, (extremely low to very low strength, extremely weathered to highly weathered)		D	2.5			
	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0			

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 682402
NORTHING: 6401110

PIT No: 14
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

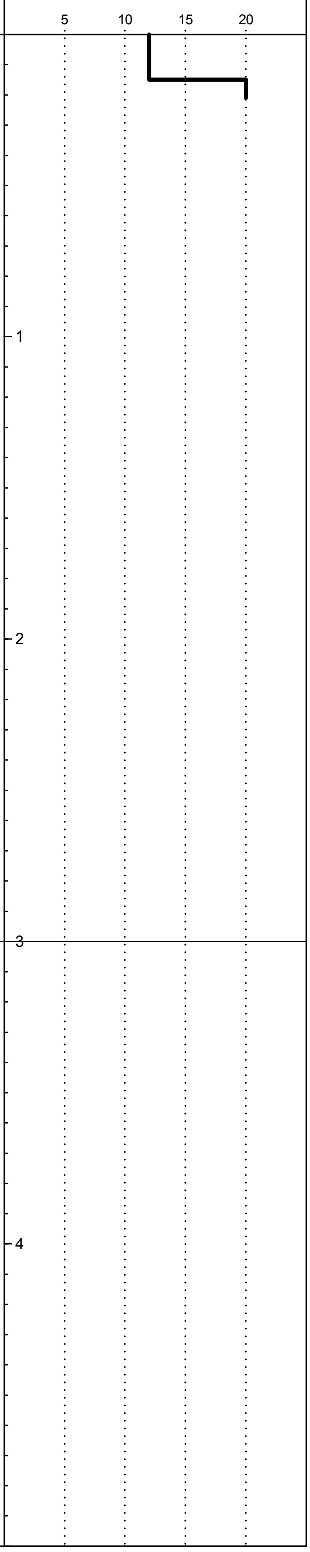
RL	Depth (m)	Description of Strata
	0.04	TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some organics and clay
	0.4	GRAVELLY SILTY CLAY - Hard, red-brown gravelly silty clay, gravel portion subrounded up to 15mm in size, trace fine to coarse grained sand, M<Wp
		SILTY CLAY - Hard, red-brown, silty clay, with fine to coarse grained sand and trace gravel, M<Wp
		From 1.2m, M⩾Wp
		From 2.0m, M>Wp From 2m depth, becoming clayey sand
	3.0	Pit discontinued at 3.0m, limit of investigation

Sampling & In Situ Testing

Type	Depth	Sample	Results & Comments
D	0.01		
D	0.2		
B	0.5 – 0.6		
D	0.9		
U_{50}	0.95 – 1.25		
D	2.5		
D	3.0		

Water

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: Slight seepage observed in base (at 3.0m depth) while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

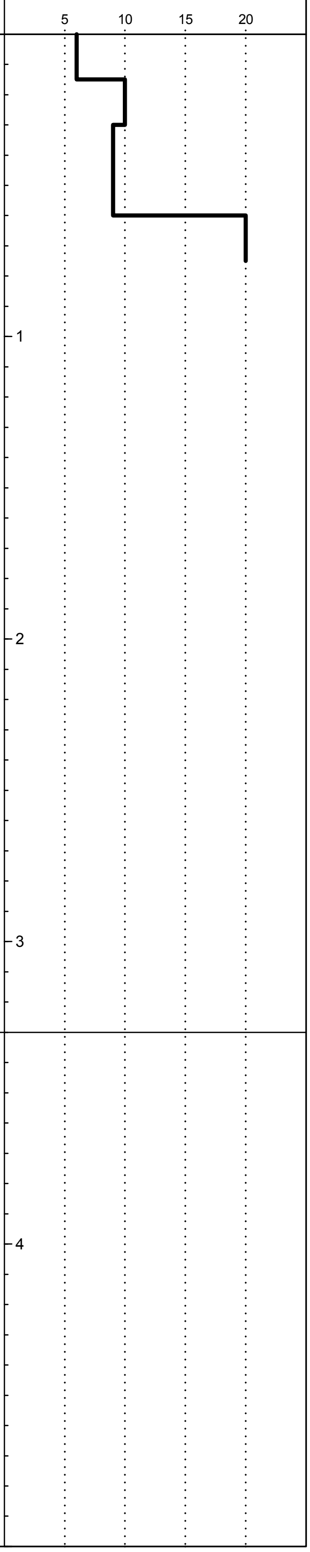
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 681973
NORTHING: 6401048

PIT No: 15
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
		TOPSOIL - Red-brown silty clay topsoil, with trace to some fine to coarse grained sand and subrounded gravel up to 10mm in size, abundant rootlets		D	0.05			
	0.14	SANDY SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand, trace subrounded gravel up to 10mm in size, M<Wp		D	0.4			
				B	0.5–0.6			
				U_{50}	0.65–0.91			
	1			D	1.0			
	2	From 2.0m, M≪Wp		D	2.0			
	3							
	3.3	Pit discontinued at 3.3m, limit of investigation						
	4							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: Slight seepage observed in base (at 3.0m depth) while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684889
NORTHING: 6401603

PIT No: 16
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		TOPSOIL - Brown clayey sandy silt topsoil, with some subrounded gravel up to 30mm in size		D	0.01				
	0.1	META SILTSTONE - (Low to medium strength, highly weathered to moderately weathered), grey stained red/orange/brown meta siltstone		D	0.3				
	1	From 1.1m, (medium to highly strength, to slightly weathered to fresh stained)		D	1.2				
		From 1.7m, (fresh stained to fresh)							
	2			D	2.2				
	2.4	Pit discontinued at 2.4m, practical refusal due to slow excavation progress							
	3								
	4								

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket
LOGGED: Ballinger
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

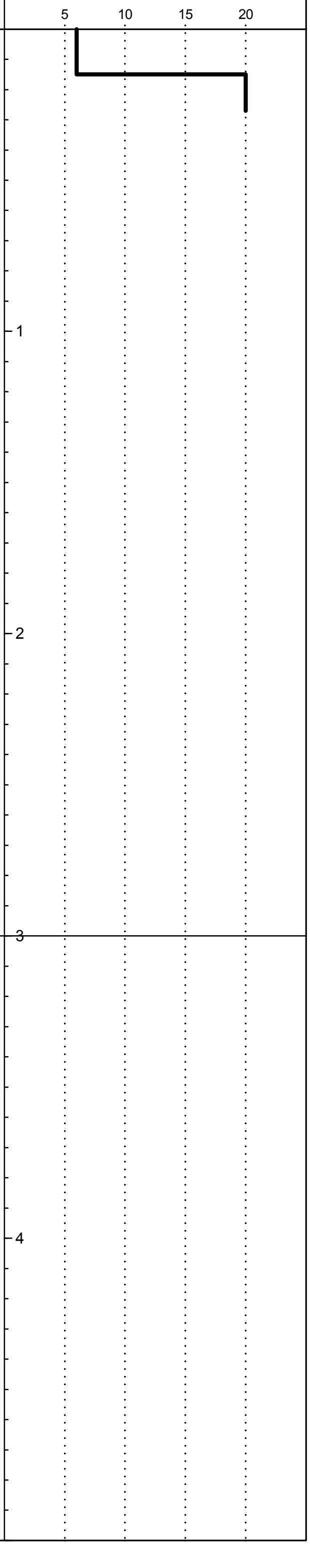
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684910
NORTHING: 6400128

PIT No: 17
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
		TOPSOIL - Brown clayey silt topsoil, with some fine to coarse grained sand and rootlets		D	0.05			
	0.1	SILTY CLAY - Hard, red brown silty clay, with some to slightly gravelly, gravel portion subrounded up to 50mm in size, some fine to coarse grained sand, M<Wp		B	0.2–0.4			
				D	0.5			
	0.7	META SILTSTONE - (Low to medium strength, highly weathered to moderately weathered), grey and brown meta siltstone, within extremely weathered matrix (soil-like properties)		D	0.8			
		From 2.4m, (medium to high strength, slightly weathered to fresh), slow excavation progress (matrix less weathered)		D	2.5			
	3.0	Pit discontinued at 3.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

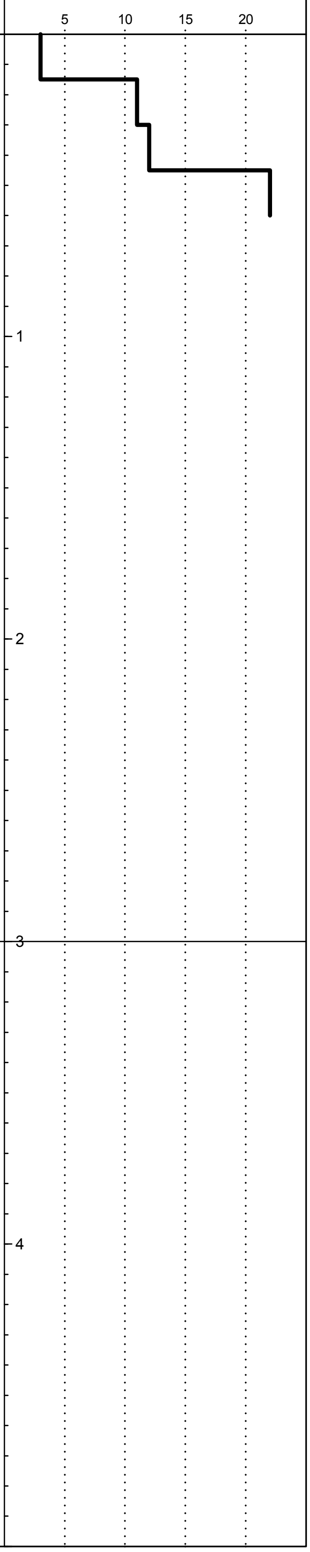
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 682978
NORTHING: 6400578

PIT No: 18
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.03	TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some organics and clay		D	0.01			
	0.25	SILTY CLAY - Hard, red-brown silty clay, with fine to coarse grained sand, trace organics, M<Wp		D	0.2			
	0.6	SANDY SILTY CLAY - Hard, red-brown sandy silty clay, fine to coarse grained, M<Wp		D	0.5			
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to coarse grained sand, trace organics, M<Wp		U_{50}	0.75–1.2			
				D	1.5			
				D	2.2			
3	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0			

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683765
NORTHING: 6401490

PIT No: 19
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - Brown sandy silt topsoil, fine to coarse grained, with some clay and organics		D	0.05				
	0.12	SILTY CLAY - Hard, red-brown silty clay with gravel, gravel portion comprising subrounded siltstone fragments up to 15mm in size, trace fine to coarse grained sand and organics, M<Wp		D	0.25–0.3				
				D	0.4				
	0.45	SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand and subrounded gravel (siltstone fragments) typically up to 10mm in size, M<Wp		D	1.0				
				D	2.0				
	3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0				

RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

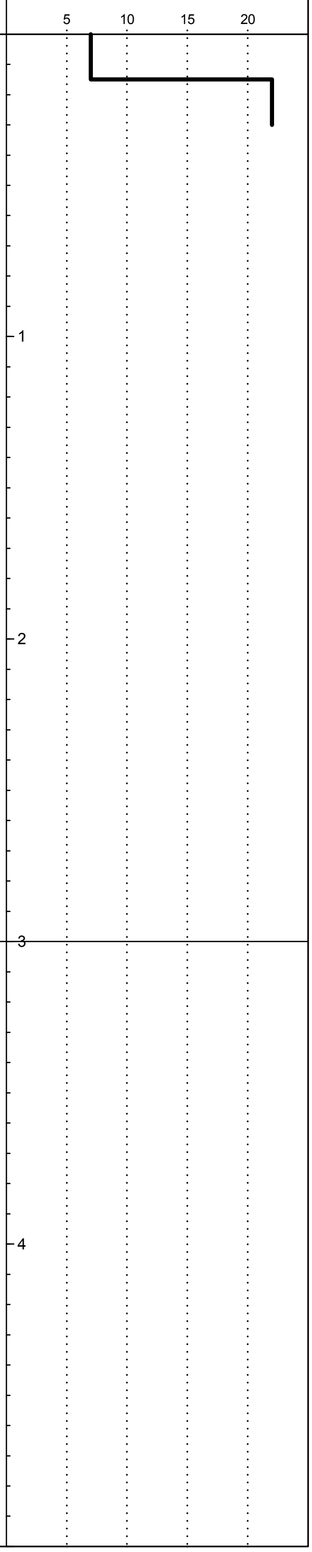
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683870
NORTHING: 6400391

PIT No: 20
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
	0.03	TOPSOIL - Red-brown sandy silt topsoil, fine to medium grained, with some organics, trace subrounded gravel up to 10mm in size		D	0.01			
		SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand and subrounded gravel (weathered rock fragments), M<Wp			0.2		pp >400	
				D	0.45 0.5			
				U_{50}				
	1				0.9			
				D	1.0			
				D	1.5			
	1.6	SANDY CLAY - Hard, brown sandy clay, fine to coarse grained, with trace to some silt and subrounded gravel / cobbles up to 150mm in size (completely weathered rock), M<Wp						
	2			D	2.2			
	3 3.0	Pit discontinued at 3.0m, limit of investigation		D	3.0			
	4							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Hyundai 14 Tonne Excavator with 450mm wide toothed bucket **LOGGED:** Ballinger **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed while pit remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Pit 1

Douglas Partners Geotechnics / Environment / Groundwater	Geotechnical Investigation	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	1
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 2

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91063.00
	Proposed Solar Farm	PLATE No:	2
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 3

Douglas Partners — Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	3
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 4

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	4
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 5

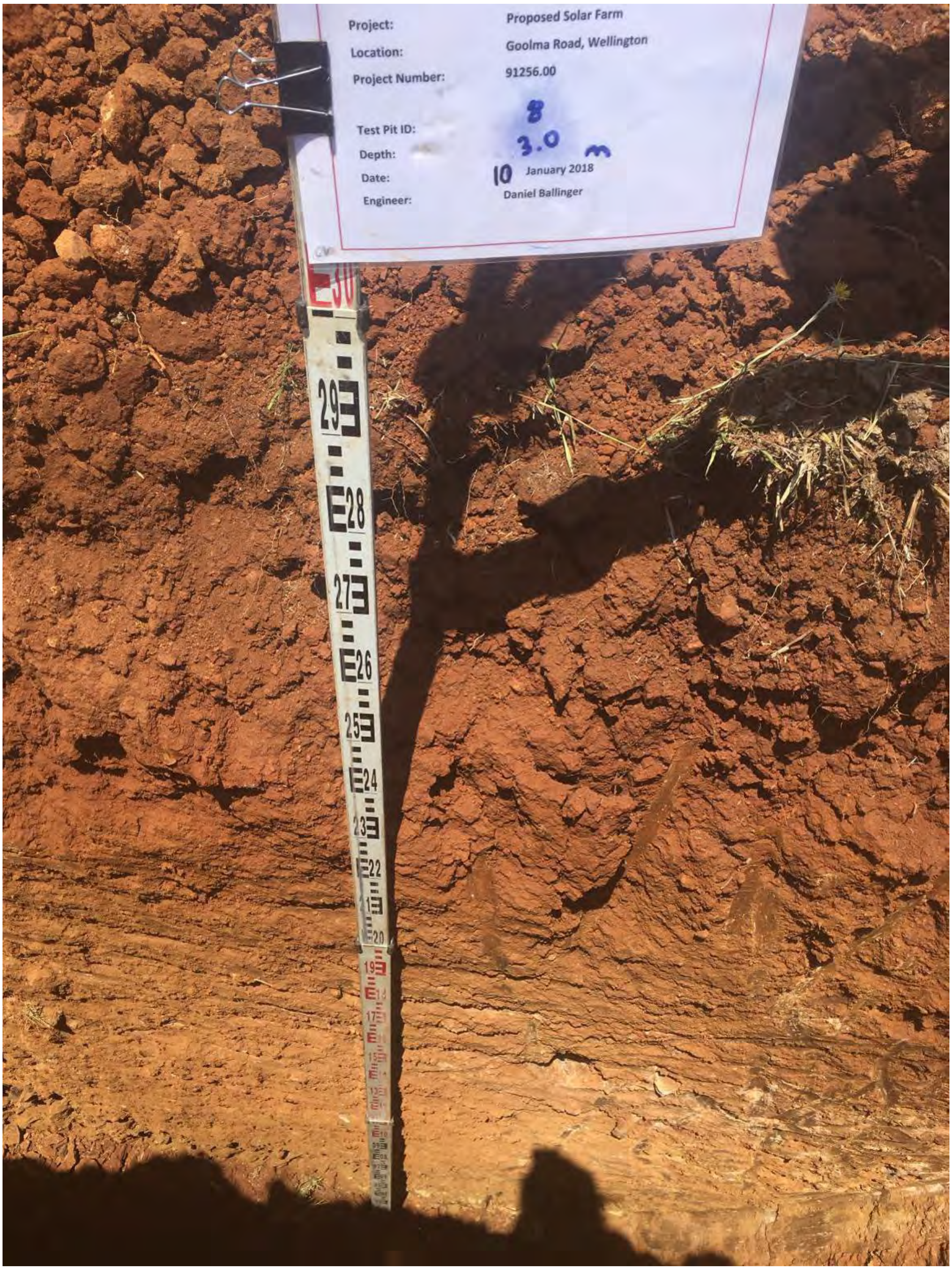
Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	5
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 6

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	6
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 7

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	7
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18



Pit 8

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	8
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 9

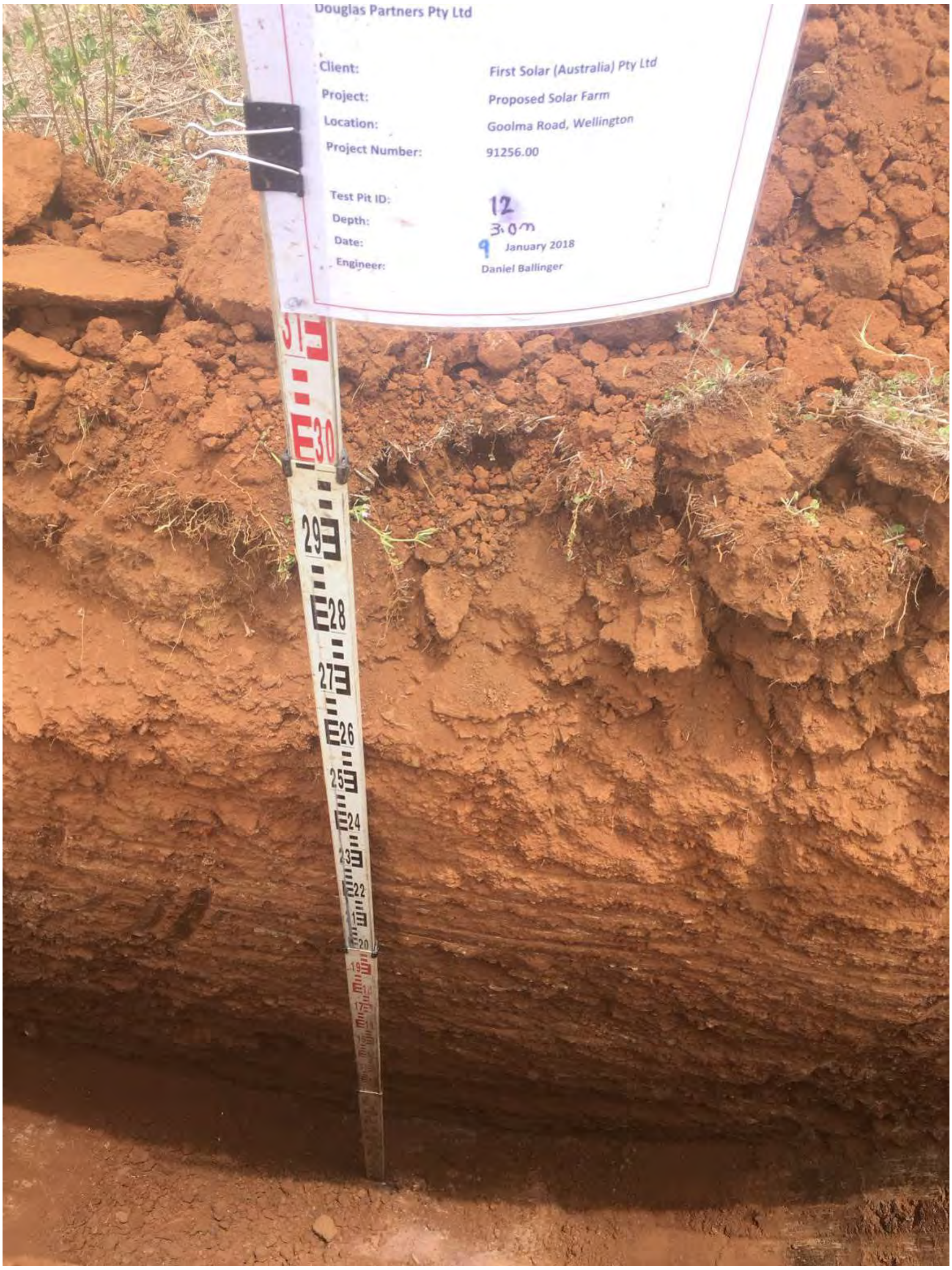
Douglas Partners Geotechnics / Environment / Groundwater	Geotechnical Investigation	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	9
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 10

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	10
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 11

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	11
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18



Pit 12

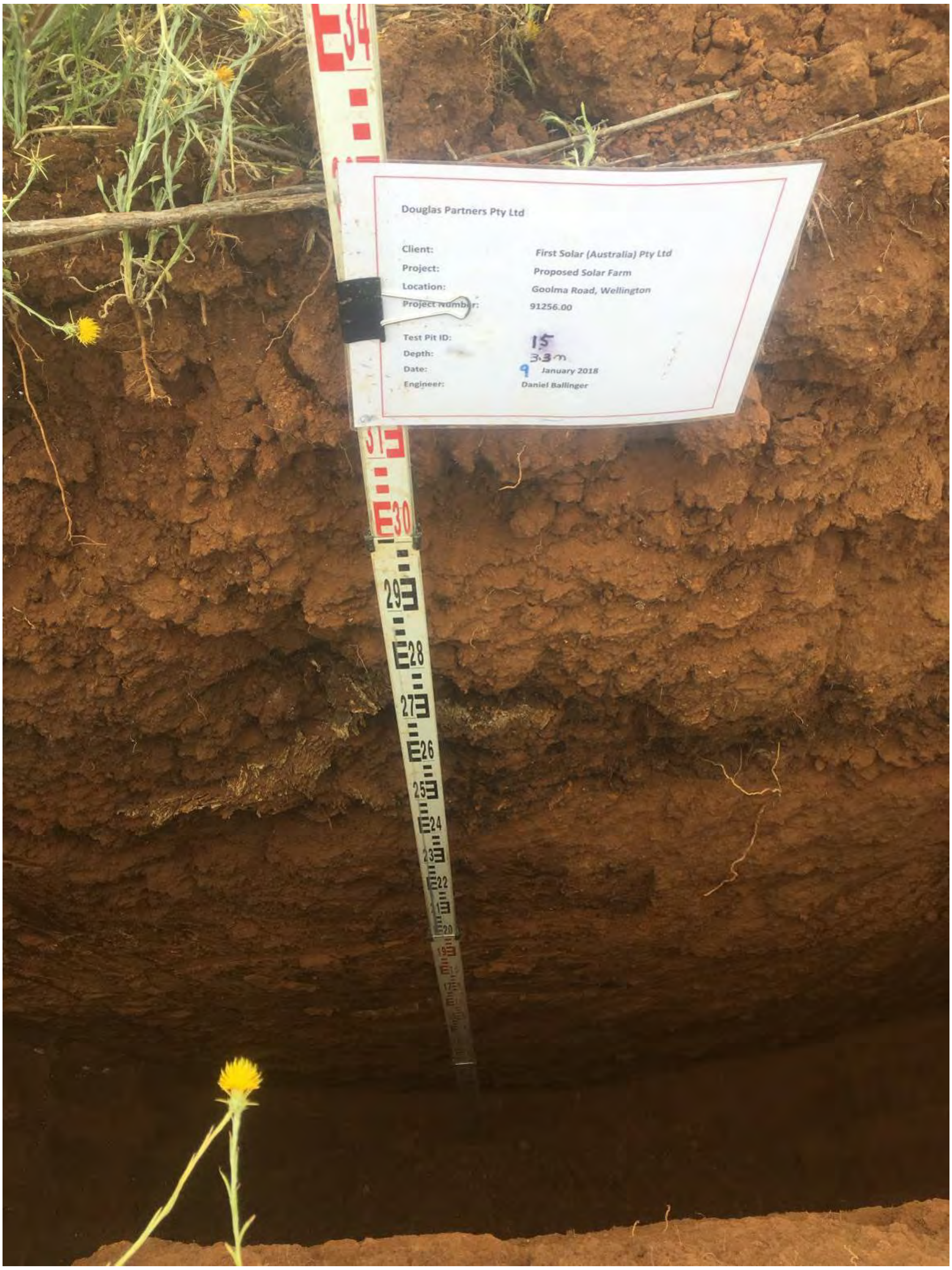
Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	12
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 13

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	13
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

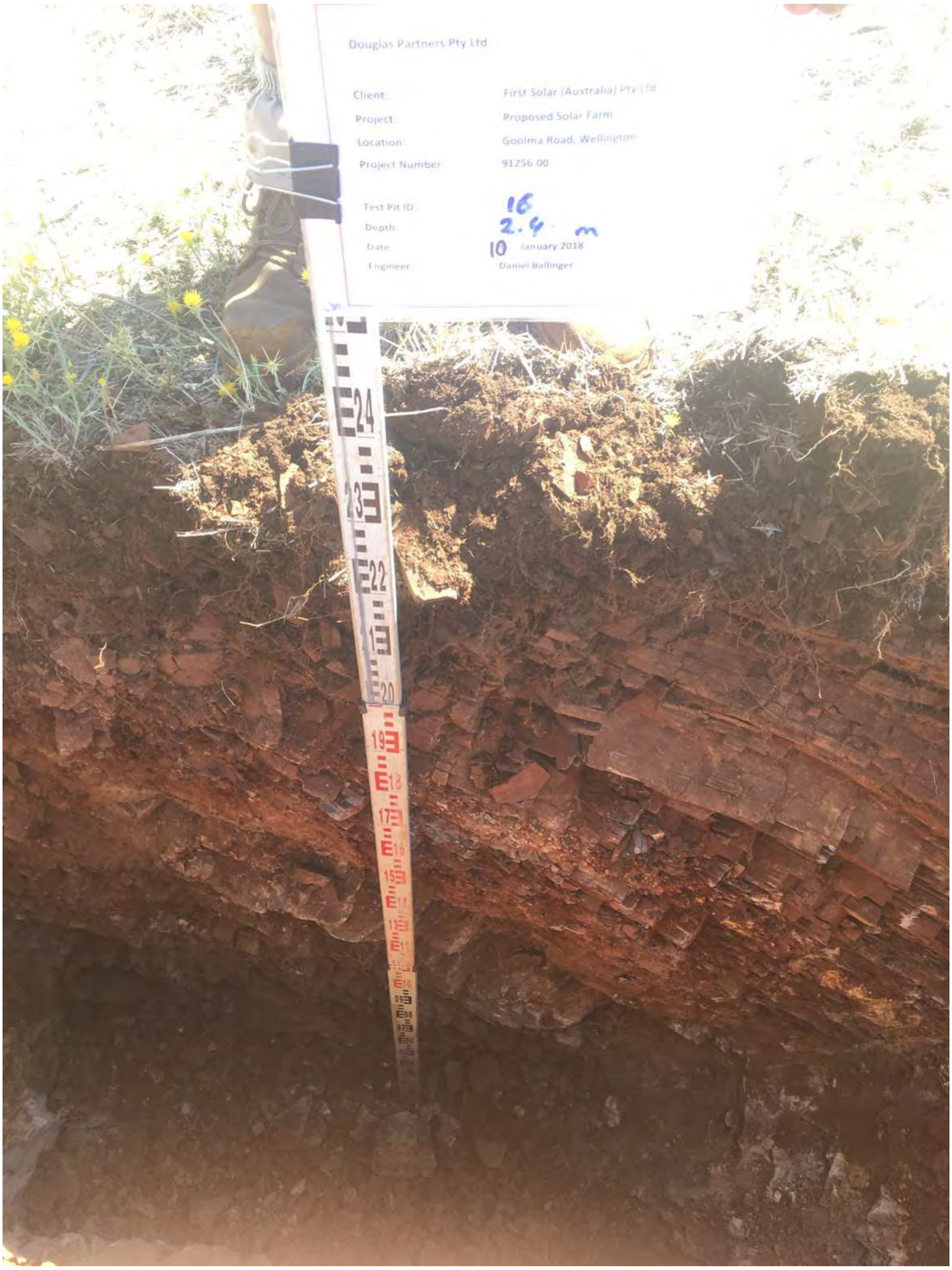
Pit 14

Douglas Partners — Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	14
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18



Pit 15

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	15
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18



Pit 16

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation** **Proposed Solar Farm** **Goolma Road, Wellington, NSW**	PROJECT:	91256.00
		PLATE No:	16
		REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 17

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	17
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 18

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	18
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 19

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	19
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

Pit 20

Douglas Partners Geotechnics / Environment / Groundwater	**Geotechnical Investigation**	PROJECT:	91256.00
	Proposed Solar Farm	PLATE No:	20
	Goolma Road, Wellington, NSW	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	22-Feb-18

BOREHOLE LOG

CLIENT:	First Solar (Australia) Pty Ltd	**SURFACE LEVEL:**	--	**BORE No:**	21
PROJECT:	Proposed Solar Farm	**EASTING:**	685248	**PROJECT No:**	91256.00
LOCATION:	Goolma Road, Wellington	**NORTHING:**	6401373	**DATE:**	11/1/2018
		DIP/AZIMUTH:	90°/--	**SHEET**	1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to coarse grained sand and subrounded gravel (siltstone fragments) up to 10mm in size, M<Wp		A	0.1				
					0.4				
				U_{50}	0.69		pp >400		
1		From 0.9m, grading to rock			1.0				
				S	1.45		10,21,21 N = 42		
2	2.0	SILTSTONE - (Extremely low to very low strength, extremely weathered to highly weathered) red-brown mottled off-white siltstone							
				S	2.5 / 2.87		9,21,15/70 refusal		
3									
	3.5	SILTSTONE - (Low to medium strength, moderately weathered to slightly weathered), grey and brown siltstone							
4				S	4.0 / 4.05		12/50,-,- refusal		
5	5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 5m

WATER OBSERVATIONS: No free groundwater observed while bore remained open

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684577
NORTHING: 6401685
DIP/AZIMUTH: 90°/--

BORE No: 22
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.02	TOPSOIL - Brown slightly sandy silt topsoil, fine to medium grained, with trace clay and subrounded gravel, abundant organics		A	0.01				
		GRAVELLY SILTY CLAY - Hard, red-brown gravelly silty clay, gravel portion subrounded up to 30mm in size, trace fine to medium grained sand, M<Wp		A	0.5				
	0.7	META SILTSTONE - (Very low to low strength, highly weathered to moderately weathered), grey and brown meta siltstone		A	0.85				
	1			S	1.0 1.05		15/50mm,-,- refusal		
		From 1.5m, (low to medium strength, moderately weathered to slightly weathered), increased drilling resistance							
	2			A	2.0				
	3								
	4			A	4.5				
	5 / 5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683937
NORTHING: 6401781
DIP/AZIMUTH: 90°/--

BORE No: 23
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Hard), red-brown silty clay, with trace fine sized subangular gravel, M<Wp		A	0.1				
				A	0.5				
	1	From 1.0m, medium to coarse sized subangular gravel (meta-siltstone) (increased drilling resistance in parts)		S	1.0 – 1.15		25 refusal		
	2								
				S	2.5 – 2.8		11,25,- refusal		
	3								
	4	From 4.0m, some rock structure evident		S	4.0 – 4.34		10,25,10/40mm refusal		
				A	4.95				
	5 5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683091
NORTHING: 6401472
DIP/AZIMUTH: 90°/--

BORE No: 24
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Hard), red-brown silty clay, with some fine grained sand and trace fine to medium sized subangular gravel, M ⩽Wp		A	0.1				
				A	0.5				
	0.8	SILTY CLAY - Hard, pale brown silty clay, with trace fine grained sand (extremely weathered siltstone), M<Wp		A	0.85				
	1			S	1.0 – 1.45		9,13,15 N = 28		
	2								
				S	2.5 – 2.82		16,24,5/20mm refusal (bouncing)		
	2.8	SILTSTONE - Very low to low strength, highly weathered, pale brown siltstone							
	3								
	4			S	4.0 – 4.07		12/70mm refusal (bouncing)		
				A	4.45				
	4.5	Bore discontinued at 4.5m, TC-bit refusal							
	5								

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 4.5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

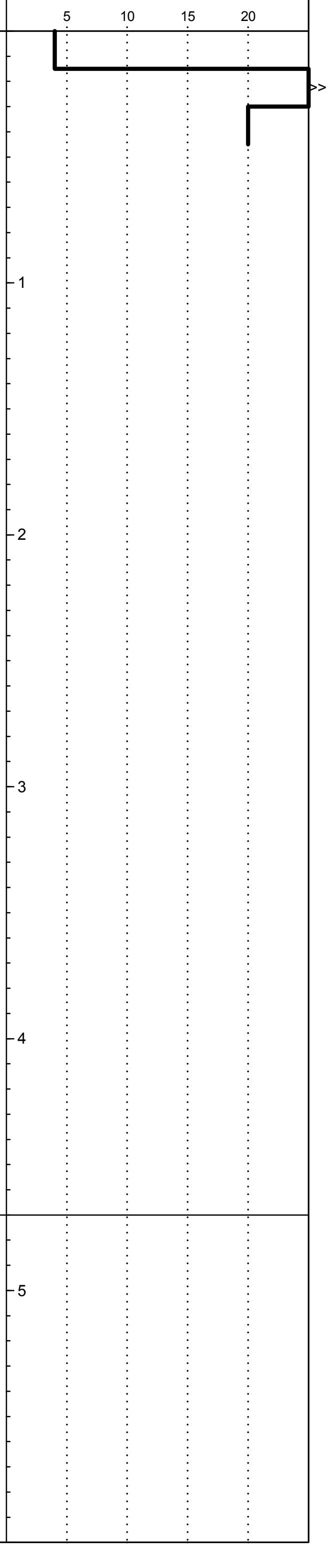
CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683990
NORTHING: 6401289
DIP/AZIMUTH: 90°/--

BORE No: 25
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
		SILTY CLAY - Hard, red-brown silty clay, with trace fine grained sand and fine sized subangular gravel, M<Wp		A	0.1			
				A	0.5			
				S	1.0 – 1.45		10,14,15 N = 29	
	2.0	META SILTSTONE - (Very low to low strength, highly weathered to moderately weathered), grey and brown meta siltstone		S	2.5 – 2.65		35,-,- refusal	
		From 3.5m, (low to medium strength, moderately weathered to slightly weathered)		S	4.0 – 4.04		10/40mm,-,- refusal (bouncing)	
				A	4.5			
	4.7	Bore discontinued at 4.7m, TC-bit refusal						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 4.7m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684690
NORTHING: 6401075
DIP/AZIMUTH: 90°/--

BORE No: 26
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.02	TOPSOIL - Brown clayey silt topsoil, with trace to some fine to coarse grained sand, abundant rootlets		D D	0.01 0.1				
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to medium grained sand and subrounded gravel (siltstone fragments) up to 10mm in size, M<Wp		U_{50}	0.25 0.63				
	1	From 1.0m, grading to rock			1.0				
	1.2	META SILTSTONE - (Extremely low to very low strength, extremely weathered to highly weathered), grey and brown meta siltstone			1.45		13,19,20 N = 39		
		From 1.5m, (low to medium strength, moderately weathered to slightly weathered)		D	1.6				
	2 2.0	Bore discontinued at 2.0m, TC-bit refusal							
	3								
	4								
	5								

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 2m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 682026
NORTHING: 6401320
DIP/AZIMUTH: 90°/--

BORE No: 27
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Hard) red brown silty clay, with trace fine to medium grained sand, M<Wp		A	0.1				
				A	0.5				
	1			S	1.0 – 1.45		6,8,13 N = 21		
		From 1.3m, trace fine sized gravel							
	2								
				S	2.5 – 2.95		pp >400 15,21,26 N = 47		
	3								
	3.5	CLAYEY GRAVEL - Medium dense, red-brown, fine sized subangular clayey gravel, moist to wet							
	4			S	4.0 – 4.45		6,8,5 N = 13		
				A	4.95				
	5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 682980
NORTHING: 6400975
DIP/AZIMUTH: 90°/--

BORE No: 28
PROJECT No: 91256.00
DATE: 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Very stiff), red-brown silty clay, with trace fine grained sand, M⩽Wp		A	0.1				
		From 0.5m, hard		A	0.5		pp = 350		
					0.73		pp = 500-550		
	1	From 1m, very stiff to hard lenses of fine to medium grained sand and fine sized subrounded gravels		S	1.0 - 1.45		3,4,8 N = 12		
	2.0	SILTY CLAY - Hard, red-brown silty clay, slightly gravelly, with fine to medium sized subangular / subrounded gravel, M<Wp		A	2.0				
		From 2.5m, some rock structure evident		S	2.5 - 2.95		12,14,18 N = 32		
				A	3.4				
				S	3.4 - 3.82		10,20,25/120 refusal		
	3.82	Bore discontinued at 3.82m, TC-bit refusal (on possible bedrock)							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 3.4m, SPT sampler to 3.82m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683315
NORTHING: 6400844
DIP/AZIMUTH: 90°/--

BORE No: 29
PROJECT No: 91256.00
DATE: 9 - 10/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Hard), red-brown silty clay, with trace fine grained sand, rootlets in top 500mm		A	0.1				
				A	0.5				
	1			U50	1.0 – 1.2		pp >600		
				S	1.5 – 1.95		pp >400 6,9,11 N = 20		
	2	From 2.0m, trace to some fine sized gravel							
				S	2.5 – 2.95		pp >500 6,8,14 N = 22		
	3								
	4			S	4.0 – 4.45		pp >600 8,16,20 N = 36		
				A	4.95				
	5 5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683659
NORTHING: 6400545
DIP/AZIMUTH: 90°/--

BORE No: 30
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.15	TOPSOIL - Brown silty clay topsoil, with some rootlets, dry to humid		A	0.1				
	1.15	SILTY CLAY - (Hard), pale brown silty clay, with trace fine to medium sized gravel, M<Wp		A	0.5				
				S	1.0–1.15		29/140mm refusal		
	1.8	META SANDSTONE - (Low strength, highly weathered), light brown, meta sandstone		A	1.5				
				A	1.8				
		Bore discontinued at 1.8m, slow progress with TC-bit							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 1.8m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684164
NORTHING: 6400640
DIP/AZIMUTH: 90°/--

BORE No: 31
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.02	TOPSOIL - Brown slightly sandy silt topsoil, fine to coarse grained, with trace to some clay and subangular gravel / cobbles abundant organics		D	0.2				
		SILTY CLAY - Hard, red-brown silty clay, with some subrounded gravel (siltstone fragments) up to 20mm in size, M<Wp		U_{50}	0.3 – 0.61				
	0.8	META SILTSTONE - (Extremely low to very low strength, extremely weathered to highly weathered), grey and brown meta siltstone		S	1.0 – 1.15		27,-,- refusal		
		From 1.1m, (very low to low and medium strength, moderately weathered to slightly weathered)		D	2.0				
				S	2.5 – 2.7		25,12/50mm,- refusal		
		From 4.3m, (low to medium strength, slightly weathered)							
	4.9	Bore discontinued at 4.9m, TC-bit refusal							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 4.9m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 683672
NORTHING: 6400107
DIP/AZIMUTH: 90°/--

BORE No: 32
PROJECT No: 91256.00
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - (Hard), red-brown silty clay, with trace fine grained sand, M<Wp		A	0.1				
				A	0.5				
				U_{50}	0.73		pp >600		
	1			S	1.0 – 1.45		8,17,18 N = 35		
	2	From 2.0m, trace medium sized subangular gravel		A	2.0				
				S	2.5 – 2.89		4,12,8/90mm refusal		
	3.1	Bore discontinued at 3.1m, TC-bit refusal (on possible bedrock)							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Fulham **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 3.1m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684057
NORTHING: 6399769
DIP/AZIMUTH: 90°/--

BORE No: 33
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - Hard, red-brown silty clay, with trace fine to medium grained sand and subrounded gravel up to 10mm in size, M<Wp		D	0.1				
				U_{50}	0.3 0.55				
	1			S	1.0 1.45		9,10,12 N = 22		
		From 1.4m, grey and brown, with trace to some sand and gravel / cobbles (medium to high strength meta siltstone)		D	1.5				
	2								
				S	2.5 2.95		7,11,20 N = 31		
	3								
		From 3.4m, increased drilling resistance (probable increase in gravel / cobble proportion)							
	4 4.0	META SILTSTONE - (Medium strength, slightly weathered), grey and brown meta siltstone		S	4.0 4.01		5/10mm,-,- refusal		
	4.2	Bore discontinued at 4.2m, TC-bit refusal							
	5								

RIG: Douglas CMG Scout **DRILLER:** Ballinger **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 4.2m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: First Solar (Australia) Pty Ltd
PROJECT: Proposed Solar Farm
LOCATION: Goolma Road, Wellington

SURFACE LEVEL: --
EASTING: 684878
NORTHING: 6400346
DIP/AZIMUTH: 90°/--

BORE No: 34
PROJECT No: 91256.00
DATE: 11/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
		SILTY CLAY - Hard, red-brown silty clay, with trace to some fine to coarse grained sand and subrounded gravel up to 10mm in size, M<Wp		D	0.1				
		From 0.7m to 1.2m, (high strength) meta siltstone cobbles							
	1								
	2			D	2.0				
					2.5		12,15,21 N = 36		
					2.95				
	3								
	4	From 4.0m, brown and grey (completely weathered rock)			4.0		16,21,15/50 refusal		
					4.35				
	5								
	5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Douglas CMG Scout **DRILLER:** Hennessey **LOGGED:** Ballinger **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 5m
WATER OBSERVATIONS: No free groundwater observed while bore remained open
REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

eSpade Soil Technical Reports

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

SITE DETAILS:

Survey:	Recharge Validation (1004444)
Profile:	64
Location:	64

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WELLINGTON (8632)	Locational Accuracy:	Other
MGA Easting:	682538	MGA Northing:	6401346
MGA Zone:	55		

PROFILE DETAILS:

Described by:	Mr Paul Smith	Profile Date:	Jan 23, 2004
Nature of Exposure:	core sample	Photo Taken:	profile
Base of observation:	layer continues	No of Layers:	6

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Dermosol, Red, medium, non gravelly, loamy, clayey		
Great Soil Group:		Northcote PPF:	Gn3.13
Soil Taxonomy:		Atlas(Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:			
Elevation:		Aspect:	

LANDFORM:

Site Morphology:	lower slope	Site Process:	
Slope Morphology:		Local Relief:	
Landform Pattern:	hills	Landform Element:	
Plan Curvature:		Position in Landform Element:	
Microrelief:		Microrelief depth:	

Microrelief extent:

LITHOLOGY:

Solum PM:

Substrate:

Rock Outcrop:

Rock Outcrop (BSAL):

Outcrop Same As:

Substrate Strength:

Weathering & Alteration:

Discontinuities:

Fragment Amount:

VEGETATION:

Vegetation Formation:

Vegetation Community:

Growth Form(s):

Crown Separation Ratio:

Upper Stratum Height:

SITE CONDITION:

Ground Cover %:

Site Disturbance:

Current Condition:

Expected Dry Condition:

Expected Wet Condition:

Estimated Effective Rooting Depth:

LAND USE:

Site: improved pasture

General Area: volun./native pasture, improved pasture, cropping

Land Use Vegetation Species:

Prior Land Use:

HYDROLOGY:

Presence of Free Water:

Free Water Depth:

Run-on:

Runoff:

Permeability:

Profile Drainage:

Free Water pH:

Free Water EC:

EROSION:

Wind exposure:

Erosion Hazard:

SALINITY:

Salinity:

Salt Outbreak Mapping:		Salt Outbreak Vegetation Species:	
EM Measurement 1 Type:		EM Measurement 1 horizontal:	
EM Measurement 1 vertical:			
EM Measurement 2 Type:		EM Measurement 2 horizontal:	
EM Measurement 2 vertical:			

FIELD NOTES:

LAYER 0

Depth:	0.00 - 0.00 m		
Layer Notes:			
Vesicles:		Ped porosity:	

LAYER 1

Depth:	0.00 - 0.15 m		
Layer Notes:			

TEXTURE:	sandy loam

COLOUR:

Moist:	dark yellowish brown (dark brown) (10YR 3/4)

FIELD CHEMICAL TESTS:

pH:	5.5 (Not recorded)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	
Dominant Peds:	2 - 5 mm, crumb	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 2

Depth:	0.15 - 0.40 m
Layer Notes:	

TEXTURE:	clay loam		
COLOUR:			
Moist:	red (10R 4/6)		
FIELD CHEMICAL TESTS:			
pH:	6.0 (Not recorded)	Field EC:	
HCl:		H2O2:	
AgNO3:			
STRUCTURE:			
Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:	5 - 10 mm, platy	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 3

Depth:	0.40 - 0.92 m		
Layer Notes:			
TEXTURE:	light clay		
COLOUR:			
Moist:	red (10R 4/8)		
FIELD CHEMICAL TESTS:			
pH:	8.0 (Not recorded)	Field EC:	
HCl:		H2O2:	
AgNO3:			
STRUCTURE:			
Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:	5 - 10 mm, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 4

Depth:	0.92 - 1.00 m
Layer Notes:	
TEXTURE:	light clay
COLOUR:	
Moist:	red (reddish brown) (2.5YR 4/6)
FIELD CHEMICAL TESTS:	

pH:	8.5 (Not recorded)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:	10 - 20 mm, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 99

Layer Notes:

Vesicles:		Ped porosity:	

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

Report generated on 2/12/2018 at 1:59 PM

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

SITE DETAILS:

Survey:	Recharge Validation (1004444)
Profile:	75
Location:	75 Netta Lee

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	DUBBO (8633)	Locational Accuracy:	Other
MGA Easting:	684356	MGA Northing:	6402513
MGA Zone:	55		

PROFILE DETAILS:

Described by:	Ms Helen Wheeler	Profile Date:	Jan 27, 2004
Nature of Exposure:	core sample	Photo Taken:	
Base of observation:	equipment/auger refusal	No of Layers:	6

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Chromosol, Brown, medium, non gravelly, loamy, clayey		
Great Soil Group:		Northcote PPF:	Dr4.12
Soil Taxonomy:		Atlas(Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:			
Elevation:		Aspect:	

LANDFORM:

Site Morphology:	mid-slope	Site Process:	
Slope Morphology:		Local Relief:	
Landform Pattern:	low hills	Landform Element:	
Plan Curvature:		Position in Landform Element:	
Microrelief:		Microrelief depth:	

Microrelief extent:

LITHOLOGY:

Solum PM:

Substrate:

Rock Outcrop:

Rock Outcrop (BSAL):

Outcrop Same As:

Substrate Strength:

Weathering & Alteration:

Discontinuities:

Fragment Amount:

VEGETATION:

Vegetation Formation:

Vegetation Community:

Growth Form(s):

Crown Separation Ratio:

Upper Stratum Height:

SITE CONDITION:

Ground Cover %:

Site Disturbance:

Current Condition:

Expected Dry Condition: soft

Expected Wet Condition: firm

Estimated Effective Rooting Depth:

LAND USE:

Site: improved pasture

General Area: improved pasture, cropping

Land Use Vegetation Species:

Prior Land Use:

HYDROLOGY:

Presence of Free Water:

Free Water Depth:

Run-on:

Runoff:

Permeability:

Profile Drainage:

Free Water pH:

Free Water EC:

EROSION:

Wind exposure:

Erosion Hazard: moderate

SALINITY:

Salinity:

Salt Outbreak Mapping:		Salt Outbreak Vegetation Species:	
EM Measurement 1 Type:		EM Measurement 1 horizontal:	
EM Measurement 1 vertical:			
EM Measurement 2 Type:		EM Measurement 2 horizontal:	
EM Measurement 2 vertical:			

FIELD NOTES:

LAYER 0

Depth:	0.00 - 0.00 m		
Layer Notes:			
Vesicles:		Ped porosity:	

LAYER 1 A horizon

Depth:	0.00 - 0.10 m		
Layer Notes:			
TEXTURE:	loam		

COLOUR:

Moist:	dark reddish brown (5YR 3/3)

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:		Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 2 B21 horizon

Depth:	0.10 - 0.55 m
Layer Notes:	
TEXTURE:	light medium clay

COLOUR:

Moist:	dark brown (7.5YR 3/4)

FIELD CHEMICAL TESTS:

pH:	7.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

LAYER 3	B21 horizon
Depth:	0.55 - 0.80 m
Layer Notes:	

TEXTURE:	light medium clay

COLOUR:

Moist:	strong brown (brown) (7.5YR 4/6)

FIELD CHEMICAL TESTS:

pH:	7.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	1 - 2 mm, polyhedral	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

SEGREGATIONS:

Type:	manganiferous	Amount:	very few (< 2%)
Strength:		Form:	nodules
Size:	fine (< 2 mm)		

LAYER 4	B23 horizon
Depth:	0.80 - 1.00 m
Layer Notes:	

TEXTURE:	light medium clay

COLOUR:

Moist:	yellowish brown (10YR 5/6)		

FIELD CHEMICAL TESTS:

pH:	7.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:	< 1 mm, granular	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)
Distribution:		Orientation:	
Weathering:		Shape:	
Size:	fine gravel (2-6 mm)		

SEGREGATIONS:

Type:	manganiferous	Amount:	few (2% - 10%)
Strength:		Form:	nodules
Size:	fine (< 2 mm), medium (2 -6 mm)		

LAYER 99

Layer Notes:			
Vesicles:		Ped porosity:	

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

Report generated on 2/12/2018 at 2:01 PM

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

SITE DETAILS:

Survey:	WELLINGTON RESEARCH CENTRE (1000349)
Profile:	2
Location:	KURRAMON PADDOCK

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WELLINGTON (8632)	Locational Accuracy:	Other
MGA Easting:	683413	MGA Northing:	6401984
MGA Zone:	55		

PROFILE DETAILS:

Described by:	Mr John Lawrie	Profile Date:	Sep 07, 1988
Nature of Exposure:	core sample	Photo Taken:	
Base of observation:		No of Layers:	6

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	Ebz
Aust. Soil Classification:			
Great Soil Group:	Euchrozem	Northcote PPF:	Gn3.13
Soil Taxonomy:		Atlas(Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	2% (measured)		
Elevation:		Aspect:	

LANDFORM:

Site Morphology:	mid-slope	Site Process:	
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Plan Curvature:		Position in Landform Element:	
Microrelief:		Microrelief depth:	

Microrelief extent:

LITHOLOGY:

Solum PM:	fine-basic	Substrate:	fine-basic
Rock Outcrop:	Nil	Rock Outcrop (BSAL):	
Outcrop Same As:		Substrate Strength:	
Weathering & Alteration:			
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Formation:	dry sclerophyll forest
Vegetation Community:	
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:		Site Disturbance:	cleared, no cultivation
Current Condition:	gravelly	Expected Dry Condition:	hard set
Expected Wet Condition:		Estimated Effective Rooting Depth:	

LAND USE:

Site:	cropping	General Area:	cropping
Land Use Vegetation Species:		Prior Land Use:	

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Runoff:	low
Permeability:		Profile Drainage:	imperfectly drained
Free Water pH:		Free Water EC:	

EROSION:

Wind Erosion:	none
Sheet Erosion:	moderate, stable

Wind exposure:

Erosion Hazard: moderate

SALINITY:

Salinity: no salting evident

Salt Outbreak Mapping:

Salt Outbreak Vegetation Species:

EM Measurement 1 Type:

EM Measurement 1 horizontal:

EM Measurement 1 vertical:

EM Measurement 2 Type:

EM Measurement 2 horizontal:

EM Measurement 2 vertical:

FIELD NOTES: Plow pan at 7cm. Field pea crop.

LAYER 0

Depth: 0.00 - 0.00 m

Layer Notes:

Vesicles:

Ped porosity:

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	very few (< 2%)
Distribution:		Orientation:	reoriented
Weathering:	non-weathered	Shape:	angular
Size:	fine gravel (2-6 mm)		

LAYER 1 A11 horizon

Depth: 0.00 - 0.10 m

Layer Notes: Fine sand present.

TEXTURE: silty clay

COLOUR:

Moist: dark reddish brown (5YR 3/4)

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	smooth-faced peds
Dominant Peds:	10 - 20 mm	Subdominant Peds:	2 - 5 mm

Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	porous

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	few (2-10%)
Distribution:		Orientation:	reoriented
Weathering:	non-weathered	Shape:	angular
Size:	fine gravel (2-6 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: wet

SAMPLE TAKEN: unspecified

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 2 A12 horizon

Depth: 0.10 - 0.35 m

Layer Notes: Fine sand present. Dominant peds 10-50mm.

TEXTURE: silty clay

COLOUR:

Moist: (very dark reddish brown) (5YR 2/4)

FIELD CHEMICAL TESTS:

pH:	7.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	smooth-faced peds
Dominant Peds:	10 - 20 mm	Subdominant Peds:	2 - 5 mm

Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	porous

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	very few (< 2%)
Distribution:		Orientation:	reoriented
Weathering:	weakly weathered	Shape:	sub-angular
Size:	fine gravel (2-6 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	no change	Disruptive Test:	moderately firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moist

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 3 B1 horizon

Depth: 0.35 - 0.55 m

Layer Notes: Fine sand present.

TEXTURE: light clay

COLOUR:

Moist: dark reddish brown (5YR 3/4)

FIELD CHEMICAL TESTS:

pH:	8.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	smooth-faced peds
Dominant Peds:	10 - 20 mm	Subdominant Peds:	2 - 5 mm
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	porous

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	many (20-50%)
Distribution:		Orientation:	reoriented
Weathering:	weakly weathered	Shape:	sub-angular
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moist

SAMPLE TAKEN: unspecified

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	irregular

LAYER 4 B21 horizon

Depth: 0.55 - 0.90 m

Layer Notes: Fine sand present.

TEXTURE: light medium clay

COLOUR:

Moist: (reddish brown) (5YR 4/8)

FIELD CHEMICAL TESTS:

pH:	8.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	smooth-faced peds
Dominant Peds:	10 - 20 mm	Subdominant Peds:	2 - 5 mm
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	porous

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	abundant (50-90%)
Distribution:		Orientation:	reoriented
Weathering:	weakly weathered	Shape:	sub-angular, angular
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	very sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moist

SAMPLE TAKEN: unspecified

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	wavy

LAYER 5 B22 horizon

Depth: 0.90 - 1.00 m

Layer Notes: Coarse sand present. Strongly weathered coarse fragments alsopresent. ***Lower depth recorded was same as upper depth for this layer, layer depth given is nominal***

TEXTURE: medium clay

COLOUR:

Moist: strong brown (brown) (7.5YR 4/6)

MOTTLES:

Dominant Mottles:

Type:	unspecified	Colour:	yellow
Contrast:	distinct	Abundance:	< 2%

FIELD CHEMICAL TESTS:

pH:	9.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	20 - 50 mm	Subdominant Peds:	2 - 5 mm
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	porous

COARSE FRAGMENTS:

Type:	metamorphic	Amount:	common (10-20%)
Distribution:		Orientation:	reoriented
Weathering:	weakly weathered	Shape:	angular
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	manganiferous	Amount:	very few (< 2%)
Strength:		Form:	nodules
Size:	coarse (6-20 mm)		

CONSISTENCE:

Degree of Plasticity:		Stickiness:	very sticky
Texture Modifier:	increase < 2 Grades	Disruptive Test:	moderately firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moist

SAMPLE TAKEN: unspecified

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

Report generated on 2/12/2018 at 2:03 PM

To contact us, email: soils@environment.nsw.gov.au

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

SITE DETAILS:

Survey:	SOIL STRUCTURE & MANAGEMENT (1000224)
Profile:	5
Location:	WELLINGTON SCS DRIVEWAY

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WELLINGTON (8632)	Locational Accuracy:	1:50 000
MGA Easting:	685363	MGA Northing:	6401684
MGA Zone:	55		

PROFILE DETAILS:

Described by:	Mr Brian Murphy	Profile Date:	Jan 30, 1990
Nature of Exposure:	core sample	Photo Taken:	
Base of observation:		No of Layers:	8

SOIL AND MAP CODES:

Geology Map Code:	Su	Soil Map Code:	EBZ
Aust. Soil Classification:			
Great Soil Group:	Euchrozem	Northcote PPF:	Gn3.13
Soil Taxonomy:		Atlas(Northcote) Code:	Mo3
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	3% (measured)		
Elevation:	380.0 m	Aspect:	east

LANDFORM:

Site Morphology:	lower slope	Site Process:	residual
Slope Morphology:	waning	Local Relief:	
Landform Pattern:	low hills	Landform Element:	hillslope
Plan Curvature:		Position in Landform Element:	
Microrelief:	none	Microrelief depth:	

Microrelief extent:

LITHOLOGY:

Solum PM:	andesite, fine-intermediate	Substrate:	andesite, fine-intermediate, colluvium
Rock Outcrop:	Nil	Rock Outcrop (BSAL):	
Outcrop Same As:		Substrate Strength:	moderately strong
Weathering & Alteration:	calcified		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Formation:	woodland grass understorey
Vegetation Community:	
Growth Form(s):	tussock grass, tree
Crown Separation Ratio:	sparse(0.25:1-20:1)
Upper Stratum Height:	20.01 - 35.0 m

SITE CONDITION:

Ground Cover %:	100.00	Site Disturbance:	limited clearing
Current Condition:	soft	Expected Dry Condition:	loose
Expected Wet Condition:		Estimated Effective Rooting Depth:	

LAND USE:

Site:	volun./native pasture	General Area:	improved pasture, cropping
Land Use Vegetation Species:		Prior Land Use:	

HYDROLOGY:

Presence of Free Water:	none	Free Water Depth:	
Run-on:	moderate	Runoff:	moderate
Permeability:	moderately permeable	Profile Drainage:	well drained
Free Water pH:		Free Water EC:	

EROSION:

Wind Erosion:	none
Sheet Erosion:	minor, stable
Rill Erosion:	none
Gully Erosion:	none
Wind exposure:	
Erosion Hazard:	moderate

SALINITY:

Salinity: no salting evident

Salt Outbreak Mapping:

Salt Outbreak Vegetation Species:

EM Measurement 1 Type:

EM Measurement 1 horizontal:

EM Measurement 1 vertical:

EM Measurement 2 Type:

EM Measurement 2 horizontal:

EM Measurement 2 vertical:

FIELD NOTES:

LAYER -1

Depth: -0.10 - 0.00 m

Layer Notes:

Vesicles:

Ped porosity:

LAYER 0

Depth: 0.00 - 0.00 m

Layer Notes:

Vesicles:

Ped porosity:

COARSE FRAGMENTS:

Type: not evident

Amount:

Distribution:

Orientation:

Weathering:

Shape:

Size:

LAYER 1

Depth: 0.00 - 0.10 m

Layer Notes:

TEXTURE: clay loam

COLOUR:

Moist:	dark reddish brown (5YR 3/4)		

MOTTLES:

Dominant Mottles:			
Type:	not evident	Colour:	
Contrast:		Abundance:	

FIELD CHEMICAL TESTS:

pH:		Field EC:	
HCl:		H2O2:	no effervescence
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm, sub-angular blocky	Subdominant Peds:	5 - 10 mm, sub-angular blocky
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	few (< 10%)
Distinctiveness:	distinct		

COARSE FRAGMENTS:

Type:	as parent material	Amount:	very few (< 2%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:	strongly weathered	Shape:	angular
Size:	fine gravel (2-6 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	common (10-25/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	none	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:			

<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	
Macropores:			
<1 mm size:	few (<1/10 x 10mm)	1-2 mm size:	few (<1/10 x 10mm)
2-5 mm size:	common (1-5/10 x 10mm)	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	slightly plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 2

Depth:	0.10 - 0.20 m
Layer Notes:	

TEXTURE: light clay

COLOUR:

Moist:	dark reddish brown (2.5YR 3/4)

MOTTLES:

Dominant Mottles:			
Type:	not evident	Colour:	
Contrast:		Abundance:	

FIELD CHEMICAL TESTS:

pH:		Field EC:	
HCl:		H2O2:	no effervescence
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	20 - 50 mm, sub-angular blocky	Subdominant Peds:	10 - 20 mm, polyhedral
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	common (10-50%)
Distinctiveness:	distinct		

COARSE FRAGMENTS:

Type:	as parent material	Amount:	very few (< 2%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:	strongly weathered	Shape:	sub-rounded
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	few (1-10/10x10cm)	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:

<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	

Macropores:

<1 mm size:	few (<1/10 x 10mm)	1-2 mm size:	few (<1/10 x 10mm)
2-5 mm size:	none	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	moderately plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 3

Depth: 0.20 - 0.40 m

Layer Notes:

TEXTURE: light clay

COLOUR:

Moist:	dark reddish brown (2.5YR 3/4)		

MOTTLES:

Dominant Mottles:

Type:	not evident	Colour:	
Contrast:		Abundance:	

FIELD CHEMICAL TESTS:

pH:		Field EC:	
HCl:		H2O2:	no effervescence
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	50 - 100 mm, sub-angular blocky	Subdominant Peds:	10 - 20 mm, polyhedral
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	many (> 50%)
Distinctiveness:	distinct		

COARSE FRAGMENTS:

Type:	as parent material	Amount:	very few (< 2%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:	strongly weathered	Shape:	sub-rounded
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	few (1-10/10x10cm)	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:

<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	

Macropores:

<1 mm size:	common (1-5/10 x 10mm)	1-2 mm size:	none
2-5 mm size:	none	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	moderately plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 4

Depth: 0.40 - 0.61 m

Layer Notes:

TEXTURE: light clay

COLOUR:

Moist: dark red (dark reddish brown) (2.5YR 3/6)

MOTTLES:

Dominant Mottles:

Type:	not evident	Colour:	
Contrast:		Abundance:	

FIELD CHEMICAL TESTS:

pH:		Field EC:	
HCl:		H2O2:	effervescence
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	50 - 100 mm, sub-angular blocky	Subdominant Peds:	10 - 20 mm, polyhedral
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	many (> 50%)

Distinctiveness:	distinct

COARSE FRAGMENTS:

Type:	as parent material	Amount:	very few (< 2%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:	strongly weathered	Shape:	sub-rounded
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	few (1-10/10x10cm)	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:

<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	

Macropores:

<1 mm size:	few (<1/10 x 10mm)	1-2 mm size:	none
2-5 mm size:	none	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	moderately plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 5

Depth:	0.61 - 0.72 m
Layer Notes:	

TEXTURE: light clay

COLOUR:

Moist:	dark red (dark reddish brown) (2.5YR 3/6)		

MOTTLES:

Dominant Mottles:

Type:	not evident	Colour:	
Contrast:		Abundance:	

FIELD CHEMICAL TESTS:

pH:		Field EC:	
HCl:		H2O2:	effervescence
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	50 - 100 mm, sub-angular blocky	Subdominant Peds:	10 - 20 mm, polyhedral
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	many (> 50%)
Distinctiveness:	distinct		

COARSE FRAGMENTS:

Type:	as parent material	Amount:	few (2-10%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:		Shape:	sub-rounded
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	few (1-10/10x10cm)	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:			
<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	
Macropores:			
<1 mm size:	few (<1/10 x 10mm)	1-2 mm size:	none
2-5 mm size:	none	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	moderately plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 6

Depth:	0.72 - 0.95 m
Layer Notes:	

TEXTURE: light clay

COLOUR:

Moist:	red (reddish brown) (2.5YR 4/6)

MOTTLES:

Dominant Mottles:			
Type:	weathered	Colour:	red
Contrast:		Abundance:	2% - 10%
Subdominant Mottles:			
Type:	unspecified	Colour:	yellow
Contrast:		Abundance:	2% - 10%

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	50 - 100 mm, sub-angular blocky	Subdominant Peds:	10 - 20 mm, polyhedral
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

PED COATING:

Type:	slickensides	Amount:	common (10-50%)
Distinctiveness:	distinct		

COARSE FRAGMENTS:

Type:	as parent material	Amount:	few (2-10%)
Distribution:	dispersed	Orientation:	reoriented
Weathering:	strongly weathered	Shape:	sub-rounded
Size:	gravel (6-20 mm)		

PANS:

Type:	not evident	Cementation:	
Continuity:		Structure:	

SEGREGATIONS:

Type:	not evident	Amount:	
Strength:		Form:	
Size:			

ROOTS:

<1 mm size:	few (1-10/10x10cm)	1-2 mm size:	few (1-10/10x10cm)
2-5 mm size:	few (1-10/10x10cm)	>5 mm size:	none

SOIL FAUNA:

Activity:	none	Type:	

CRACKS AND MACROPORES:

Cracks:			
<5 mm width:	none	5-10 mm width:	none
10-20 mm width:	none	20-50 mm width:	none
>50 mm width:	none	Unspecified width:	
Macropores:			
<1 mm size:	few (<1/10 x 10mm)	1-2 mm size:	none
2-5 mm size:	none	>5 mm size:	none
Unspecified size:			

CONSISTENCE:

Degree of Plasticity:	moderately plastic	Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: dry

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

Report generated on 2/12/2018 at 2:04 PM

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

SITE DETAILS:

Survey:	Recharge Validation (1004444)
Profile:	95
Location:	95

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	WELLINGTON (8632)	Locational Accuracy:	Other
MGA Easting:	684084	MGA Northing:	6400184
MGA Zone:	55		

PROFILE DETAILS:

Described by:	Ms Helen Wheeler	Profile Date:	Jan 28, 2004
Nature of Exposure:	core sample	Photo Taken:	profile
Base of observation:	layer continues	No of Layers:	6

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Dermosol, Red, medium, non gravelly, clay loamy, clayey		
Great Soil Group:		Northcote PPF:	Dr4.12
Soil Taxonomy:		Atlas(Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:			
Elevation:		Aspect:	

LANDFORM:

Site Morphology:		Site Process:	
Slope Morphology:		Local Relief:	
Landform Pattern:	low hills	Landform Element:	
Plan Curvature:		Position in Landform Element:	
Microrelief:	none	Microrelief depth:	

Microrelief extent:

LITHOLOGY:

Solum PM:	Substrate:
Rock Outcrop:	Rock Outcrop (BSAL):
Outcrop Same As:	Substrate Strength:
Weathering & Alteration:	
Discontinuities:	
Fragment Amount:	

VEGETATION:

Vegetation Formation:

Vegetation Community:

Growth Form(s):

Crown Separation Ratio:

Upper Stratum Height:

SITE CONDITION:

Ground Cover %:	Site Disturbance: rainfed cultivation
Current Condition:	Expected Dry Condition:
Expected Wet Condition:	Estimated Effective Rooting Depth:

LAND USE:

Site: cropping	General Area: improved pasture, cropping
Land Use Vegetation Species:	Prior Land Use:

HYDROLOGY:

Presence of Free Water:	Free Water Depth:
Run-on:	Runoff:
Permeability:	Profile Drainage:
Free Water pH:	Free Water EC:

EROSION:

Wind exposure:

Erosion Hazard: slight

SALINITY:

Salinity:	no salting evident		
Salt Outbreak Mapping:		Salt Outbreak Vegetation Species:	
EM Measurement 1 Type:		EM Measurement 1 horizontal:	
EM Measurement 1 vertical:			
EM Measurement 2 Type:		EM Measurement 2 horizontal:	
EM Measurement 2 vertical:			

FIELD NOTES: Red Dermosol

LAYER 0

Depth:	0.00 - 0.00 m		
Layer Notes:			
Vesicles:		Ped porosity:	

LAYER 1	A horizon		
Depth:	0.00 - 0.15 m		
Layer Notes:			

TEXTURE: clay loam

COLOUR:

Moist:	dark brown (7.5YR 3/3)
General Colour:	brown

FIELD CHEMICAL TESTS:

pH:	6.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:	2 - 5 mm, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

COARSE FRAGMENTS:

Type:	not identified	Amount:	none
Distribution:		Orientation:	

Weathering:		Shape:	
Size:			

SAMPLE TAKEN: disturbed

LAYER 2	B21 horizon		
Depth:	0.15 - 0.04 m		
Layer Notes:			

TEXTURE: light medium clay

COLOUR:

Moist:	dark brown (7.5YR 3/4)		
General Colour:	brown		

FIELD CHEMICAL TESTS:

pH:	6.0 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	
Dominant Peds:	5 - 10 mm, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

COARSE FRAGMENTS:

Type:	not identified	Amount:	none
Distribution:		Orientation:	
Weathering:		Shape:	
Size:			

SAMPLE TAKEN: disturbed

LAYER 3	B22 horizon		
Depth:	0.04 - 1.03 m		
Layer Notes:			

TEXTURE: medium clay

COLOUR:

Moist:	dark red (dark reddish brown) (2.5YR 3/6)		
General Colour:	brown		

FIELD CHEMICAL TESTS:

pH:	7.5 (Raupach)	Field EC:	
HCl:		H2O2:	
AgNO3:			

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	
Dominant Peds:	, sub-angular blocky	Subdominant Peds:	
Artificial Aggregates:		SOILpak score:	
Vesicles:		Ped porosity:	

COARSE FRAGMENTS:

Type:	not identified	Amount:	none
Distribution:		Orientation:	
Weathering:		Shape:	
Size:			

SEGREGATIONS:

Type:	manganiferous	Amount:	very few (< 2%)
Strength:		Form:	nodules
Size:			

SAMPLE TAKEN: disturbed

LAYER 4

Depth: 1.03 - 1.13 m

Layer Notes: < 1% sand <1 mm.
Fragments appear to be sediments
Lower depth not recorded for this layer, depth given here is nominal.

TEXTURE: coarse medium sandy clay

Vesicles:		Ped porosity:	

COARSE FRAGMENTS:

Type:	not identified	Amount:	very few (< 2%)
Distribution:		Orientation:	
Weathering:		Shape:	
Size:	gravel (6-20 mm)		

LAYER 99

Layer Notes:

Vesicles:		Ped porosity:	

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

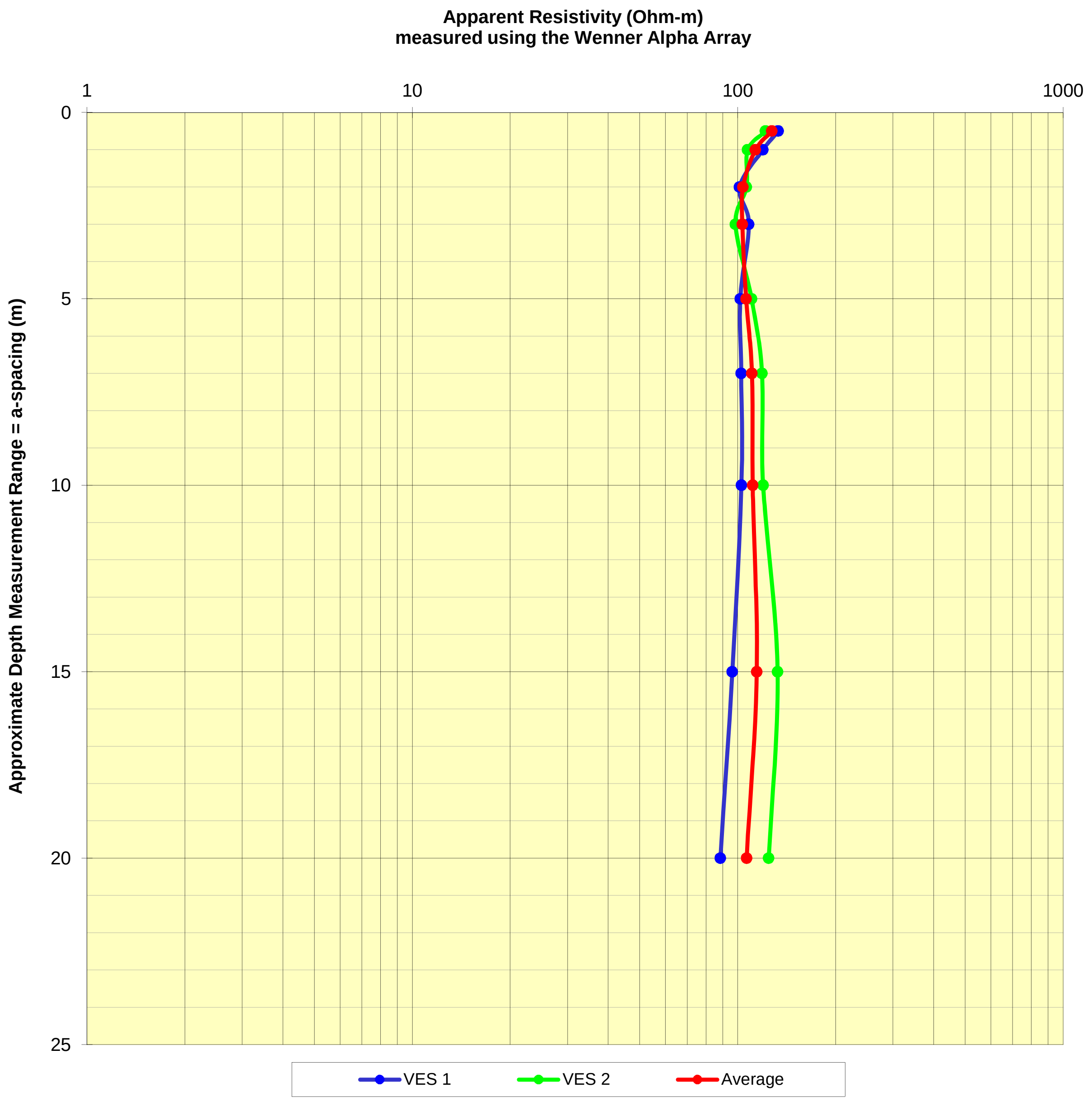
Report generated on 2/12/2018 at 1:54 PM

Appendix D

Results of Electrical Resistivity Testing (ER101 to ER110)

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = 2πaR)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	42.40	38.70	40.55	133.20	121.58	127.39
1	19.02	17.08	18.05	119.51	107.32	113.41
2	8.06	8.46	8.26	101.28	106.31	103.80
3	5.74	5.22	5.48	108.20	98.39	103.30
5	3.24	3.51	3.38	101.79	110.27	106.03
7	2.33	2.70	2.52	102.48	118.75	110.62
10	1.63	1.91	1.77	102.63	119.70	111.16
15	1.02	1.41	1.21	96.26	132.57	114.41
20	0.70	0.99	0.85	88.39	124.57	106.48

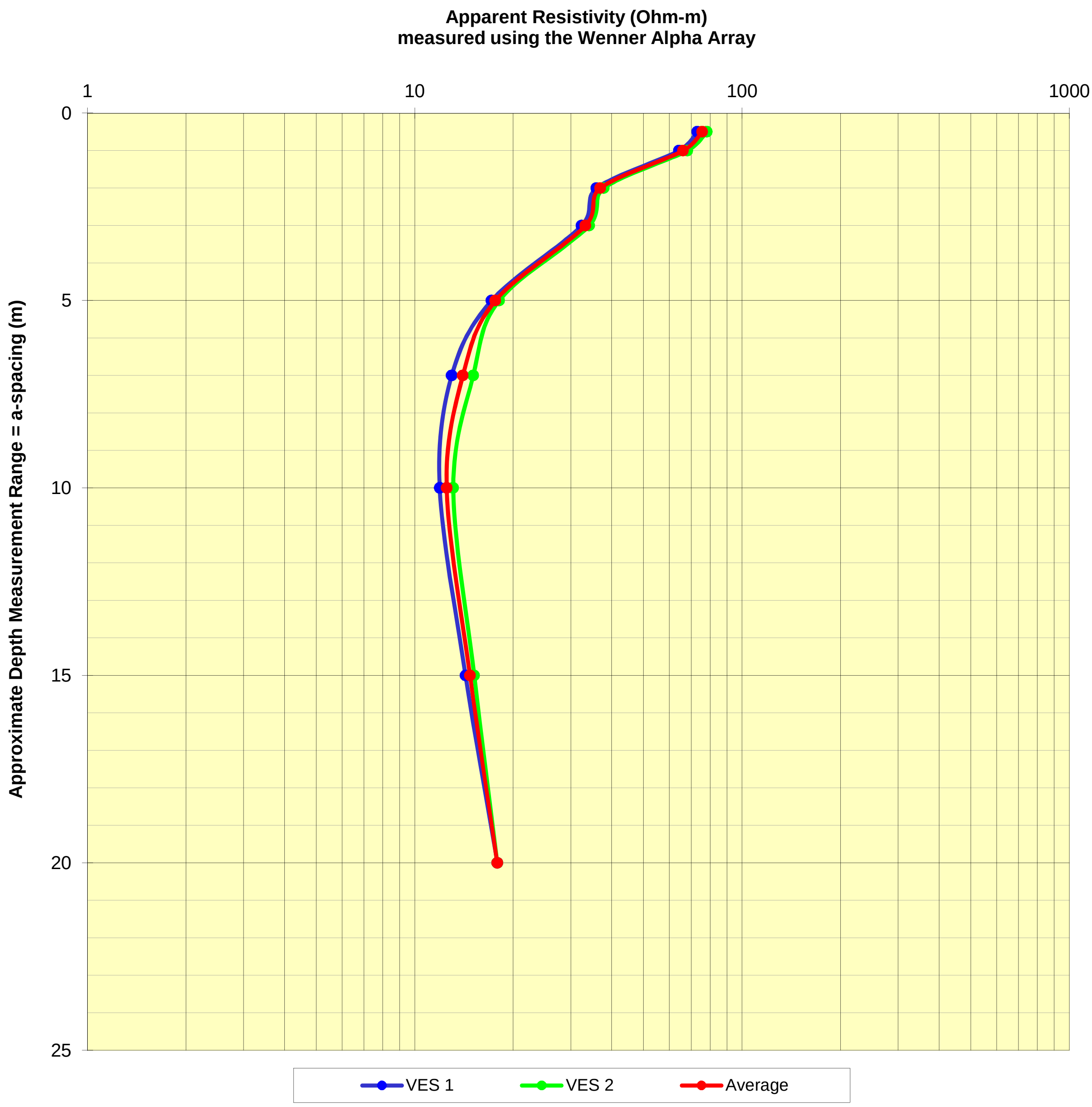
Location:	101		**Centre E, N:**	684 908 mE, 6 401 479 mN GDA94 Zone 56
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	1
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	11-Jan-18

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = $2\pi aR$)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	23.25	24.87	24.06	73.04	78.13	75.59
1	10.21	10.83	10.52	64.15	68.05	66.10
2	2.86	3.01	2.94	35.94	37.82	36.88
3	1.72	1.81	1.76	32.36	34.13	33.24
5	0.55	0.58	0.56	17.17	18.09	17.63
7	0.29	0.34	0.32	12.97	15.09	14.03
10	0.19	0.21	0.20	11.92	13.12	12.52
15	0.15	0.16	0.16	14.30	15.19	14.75
20	0.14	0.14	0.14	17.87	17.87	17.87

Location:	102		**Centre E, N:**	684 810 mE, 6 400 752 mN GDA94 Zone 56
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo

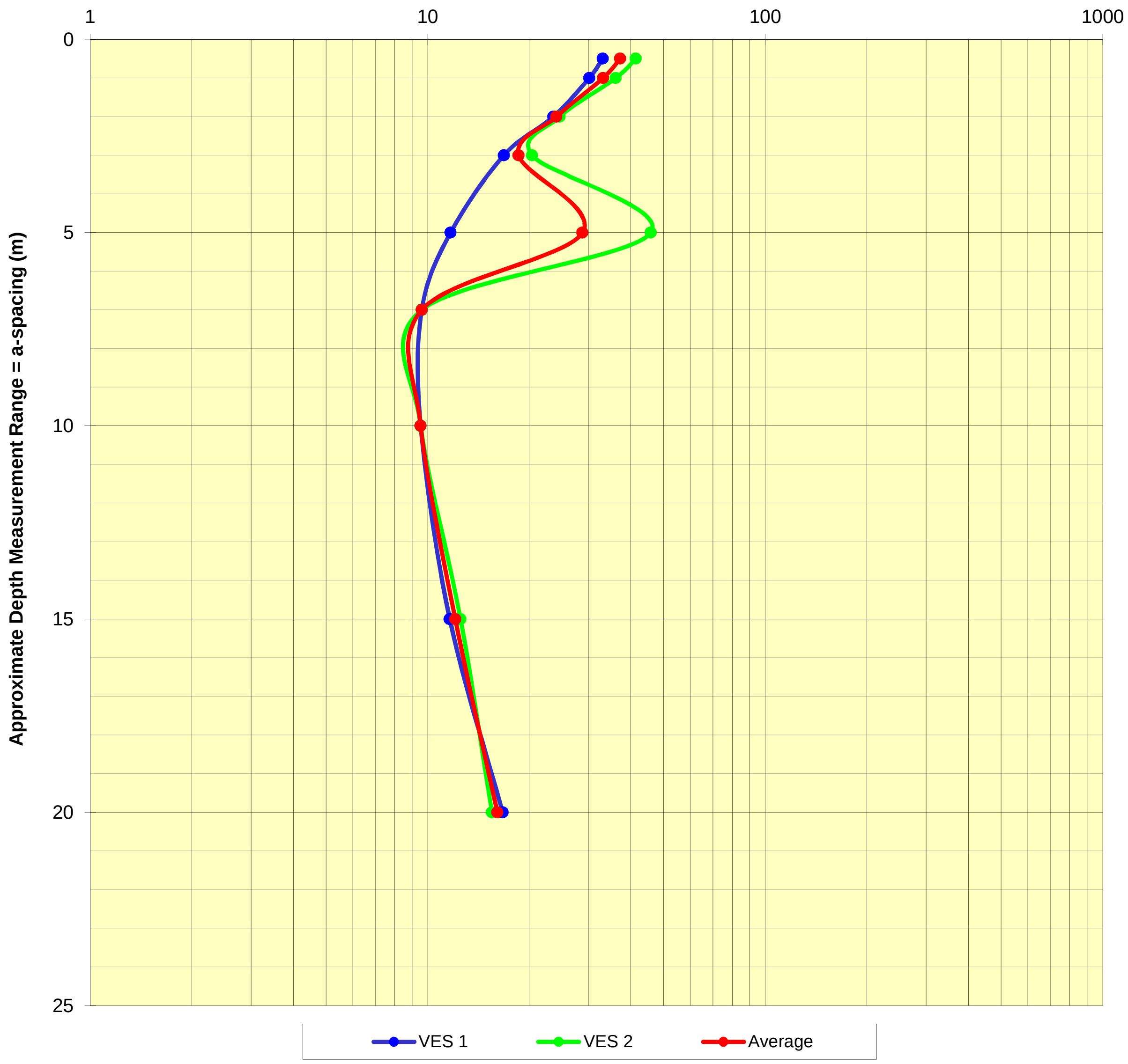


Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	2
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	11-Jan-18

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = 2πaR)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	10.50	13.16	11.83	32.99	41.34	37.17
1	4.79	5.74	5.27	30.10	36.07	33.08
2	1.87	1.96	1.92	23.54	24.60	24.07
3	0.89	1.08	0.99	16.80	20.39	18.60
5	0.37	1.46	0.91	11.69	45.80	28.74
7	0.22	0.22	0.22	9.60	9.60	9.60
10	0.15	0.15	0.15	9.53	9.53	9.53
15	0.12	0.13	0.13	11.62	12.51	12.07
20	0.13	0.12	0.13	16.68	15.49	16.09

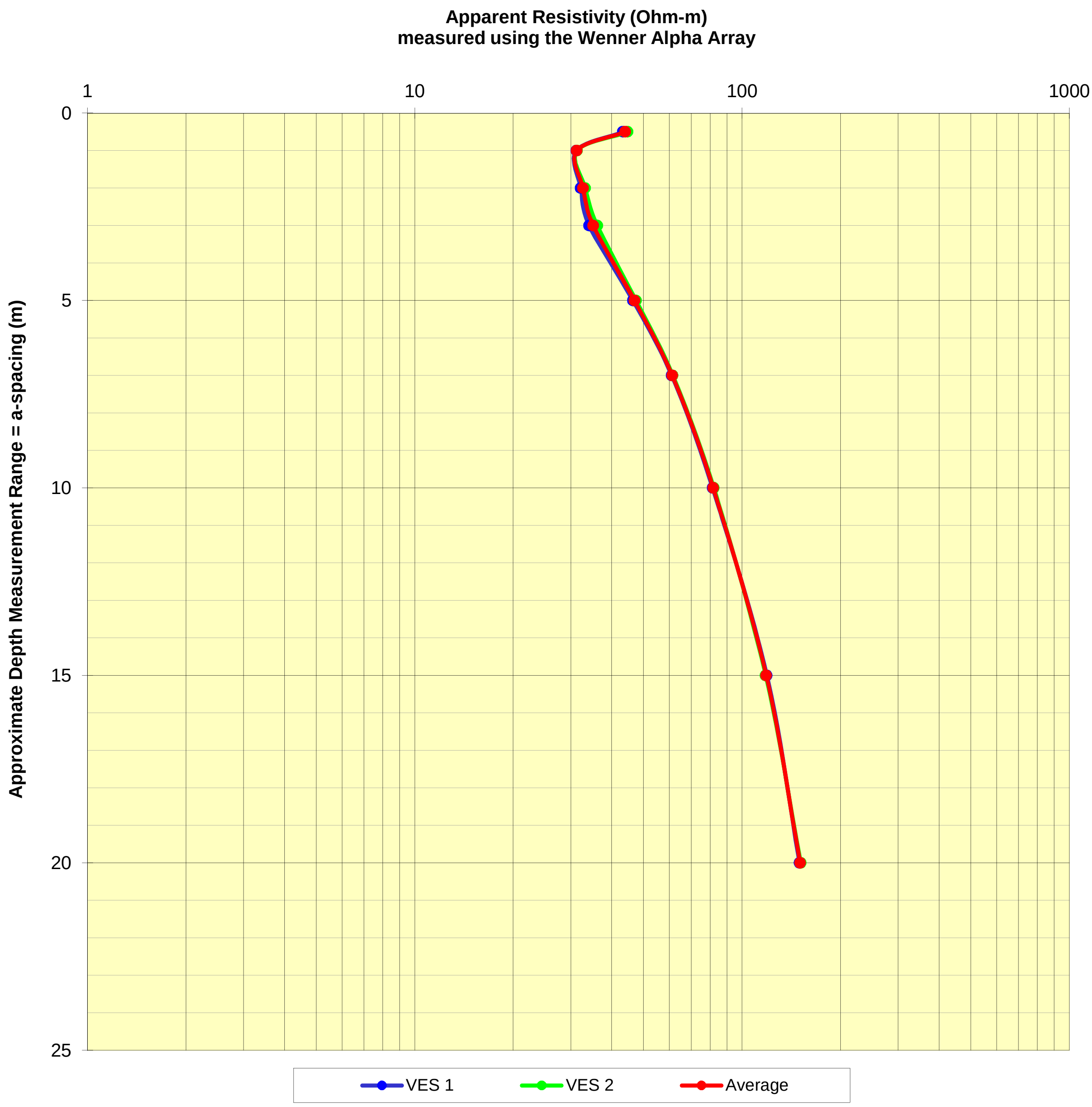
Location:	103		**Centre E, N:**	684 429 mE, 6 399 929 mN GDA94 Zone 56
Orientations:	E - W	N - S	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo

Apparent Resistivity (Ohm-m)
measured using the Wenner Alpha Array



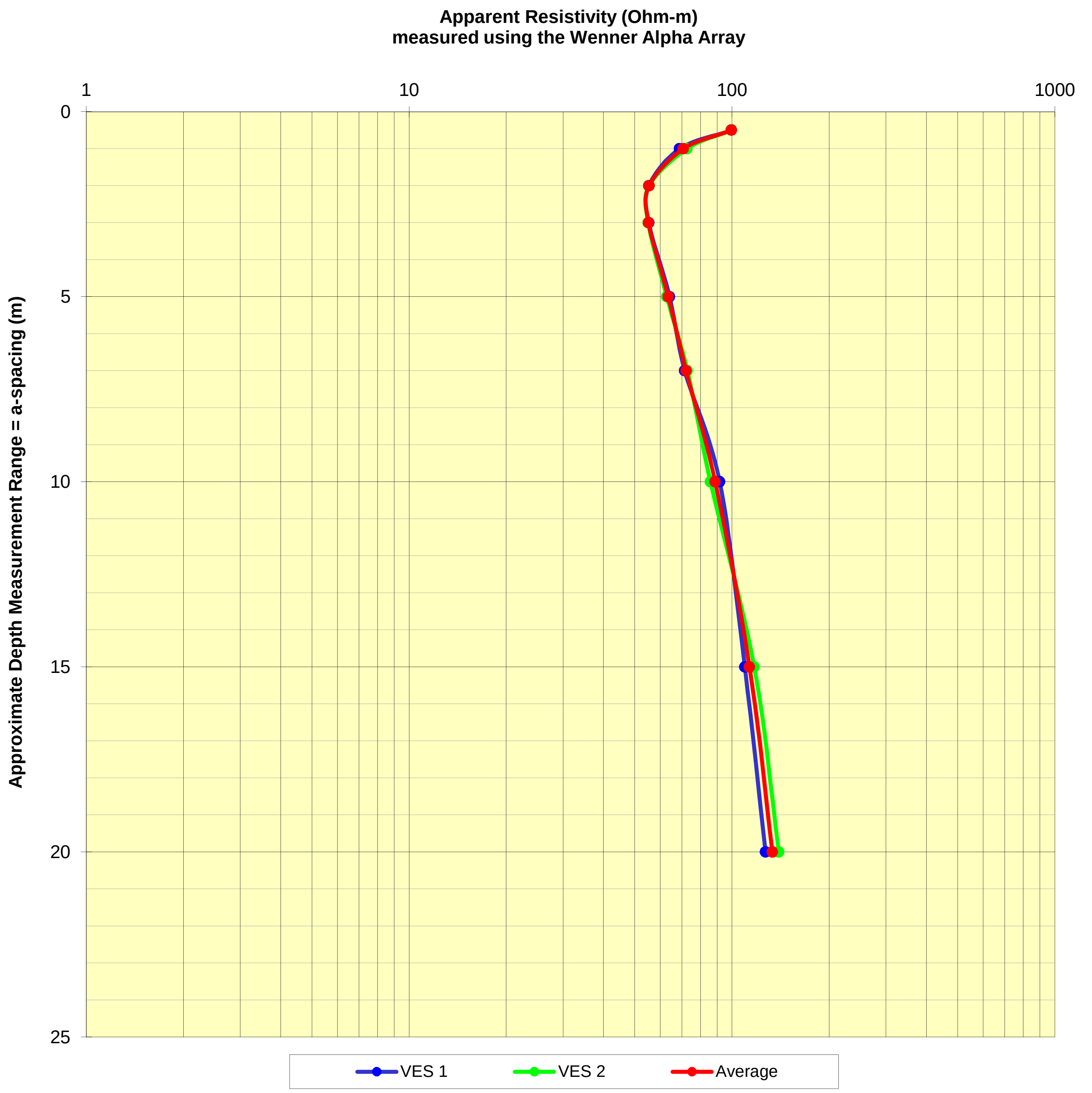
Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	3
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	12-Jan-18

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity ($\rho_a = 2\pi aR$)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	13.78	14.21	14.00	43.29	44.64	43.97
1	4.96	4.98	4.97	31.16	31.29	31.23
2	2.56	2.64	2.60	32.17	33.18	32.67
3	1.81	1.92	1.86	34.13	36.11	35.12
5	1.48	1.51	1.49	46.45	47.42	46.93
7	1.39	1.40	1.39	60.96	61.41	61.19
10	1.29	1.30	1.30	81.32	81.96	81.64
15	1.26	1.25	1.26	119.10	118.14	118.62
20	1.19	1.20	1.20	149.87	151.14	150.51
Location:	104		**Centre E, N:**	684 163 mE, 6 401 685 mN GDA94 Zone 56		
Orientations:	E - W	N - S	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo		



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	4
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	9-Jan-18

Electrode a-spacing (m)	Resistance (R)			Apparent Resistivity (ρ_a = 2πaR)		
	VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	31.70	31.70	31.70	99.59	99.59	99.59
1	10.96	11.54	11.25	68.86	72.51	70.69
2	4.40	4.41	4.41	55.29	55.42	55.35
3	2.93	2.92	2.93	55.23	55.04	55.13
5	2.04	2.00	2.02	64.09	62.83	63.46
7	1.62	1.65	1.64	71.38	72.75	72.07
10	1.46	1.37	1.41	91.60	85.80	88.70
15	1.16	1.24	1.20	109.54	117.18	113.36
20	1.01	1.11	1.06	127.08	139.71	133.40
Location:	105		**Centre E, N:**	684 103 mE, 6 400 778 mN GDA94 Zone 56		
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo		

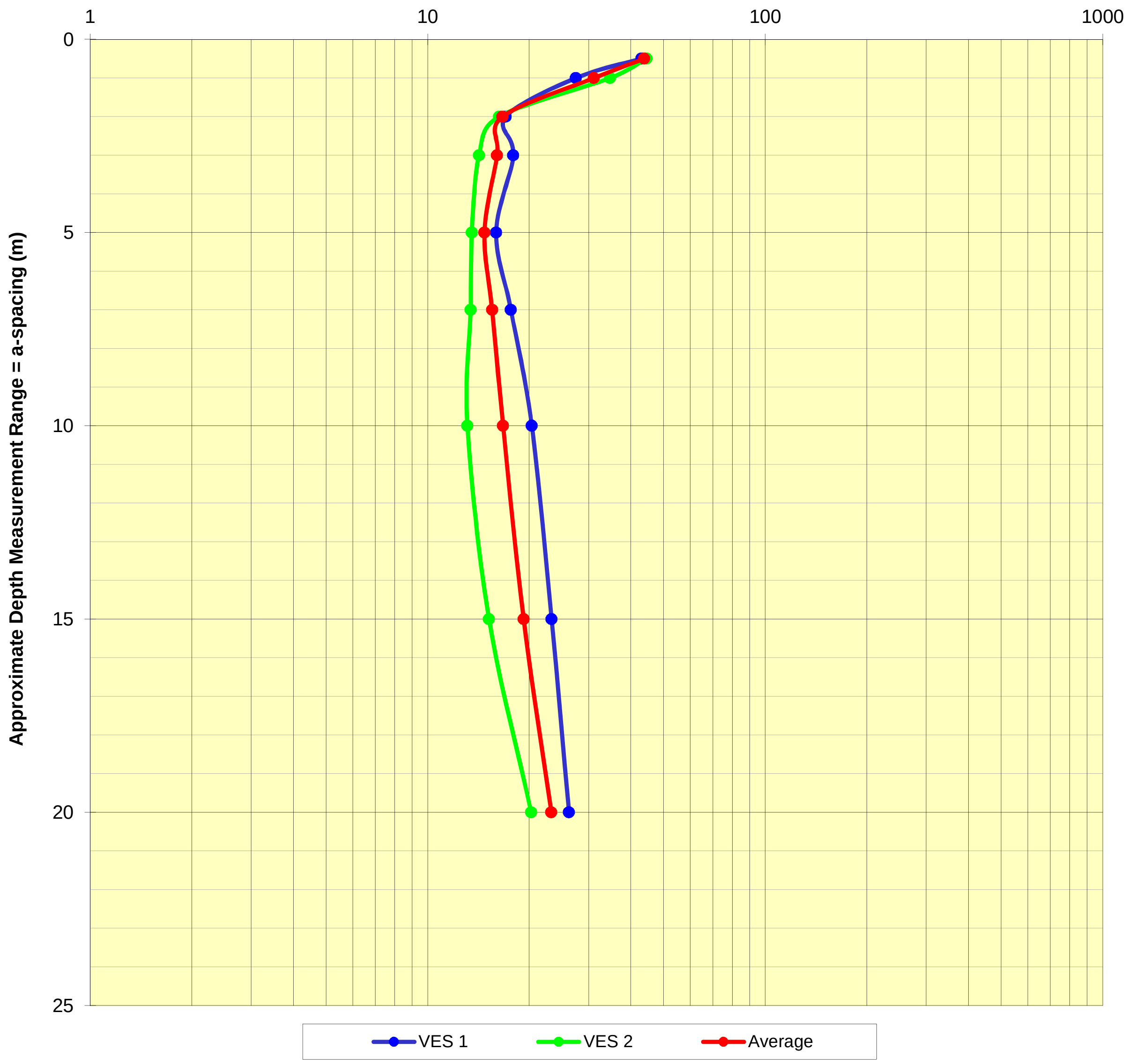


Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	5
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	12-Jan-18

Electrode a-spacing (m)	Resistance (R) VES 1 (Ω)	Resistance (R) VES 2 (Ω)	Resistance (R) Average (Ω)	Apparent Resistivity (ρ_a = 2πaR) VES 1 (Ω-m)	Apparent Resistivity (ρ_a = 2πaR) VES 2 (Ω-m)	Apparent Resistivity (ρ_a = 2πaR) Average (Ω-m)
0.5	13.69	14.16	13.93	43.01	44.48	43.75
1	4.37	5.52	4.95	27.46	34.68	31.07
2	1.36	1.29	1.32	17.03	16.26	16.65
3	0.95	0.75	0.85	17.93	14.19	16.06
5	0.51	0.43	0.47	15.95	13.51	14.73
7	0.40	0.30	0.35	17.63	13.39	15.51
10	0.32	0.21	0.27	20.34	13.12	16.73
15	0.25	0.16	0.20	23.28	15.19	19.24
20	0.21	0.16	0.18	26.23	20.26	23.24

Location:	106		**Centre E, N:**	683 686 mE, 6 400 084 mN GDA94 Zone 56
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo

Apparent Resistivity (Ohm-m)
measured using the Wenner Alpha Array

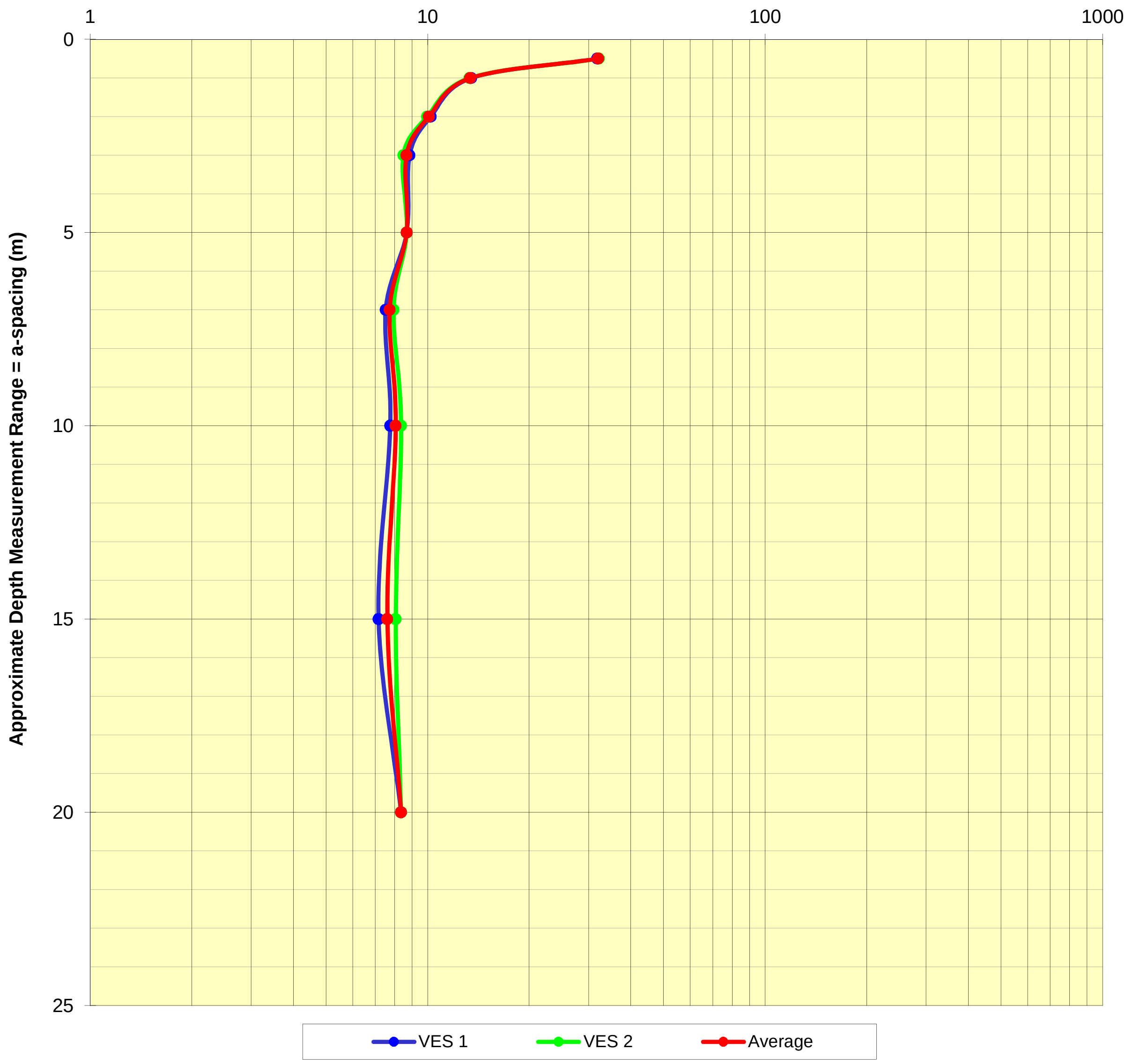


Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	6
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	9-Jan-18

Electrode a-spacing (m)	Resistance (R) VES 1 (Ω)	Resistance (R) VES 2 (Ω)	Resistance (R) Average (Ω)	Apparent Resistivity (ρ_a = 2πaR) VES 1 (Ω-m)	Apparent Resistivity VES 2 (Ω-m)	Apparent Resistivity Average (Ω-m)
0.5	10.14	10.24	10.19	31.86	32.17	32.01
1	2.14	2.12	2.13	13.45	13.32	13.38
2	0.81	0.79	0.80	10.20	9.95	10.08
3	0.47	0.45	0.46	8.84	8.47	8.65
5	0.28	0.28	0.28	8.66	8.66	8.66
7	0.17	0.18	0.18	7.51	7.92	7.72
10	0.12	0.13	0.13	7.75	8.34	8.04
15	0.08	0.09	0.08	7.15	8.04	7.60
20	0.07	0.07	0.07	8.34	8.34	8.34

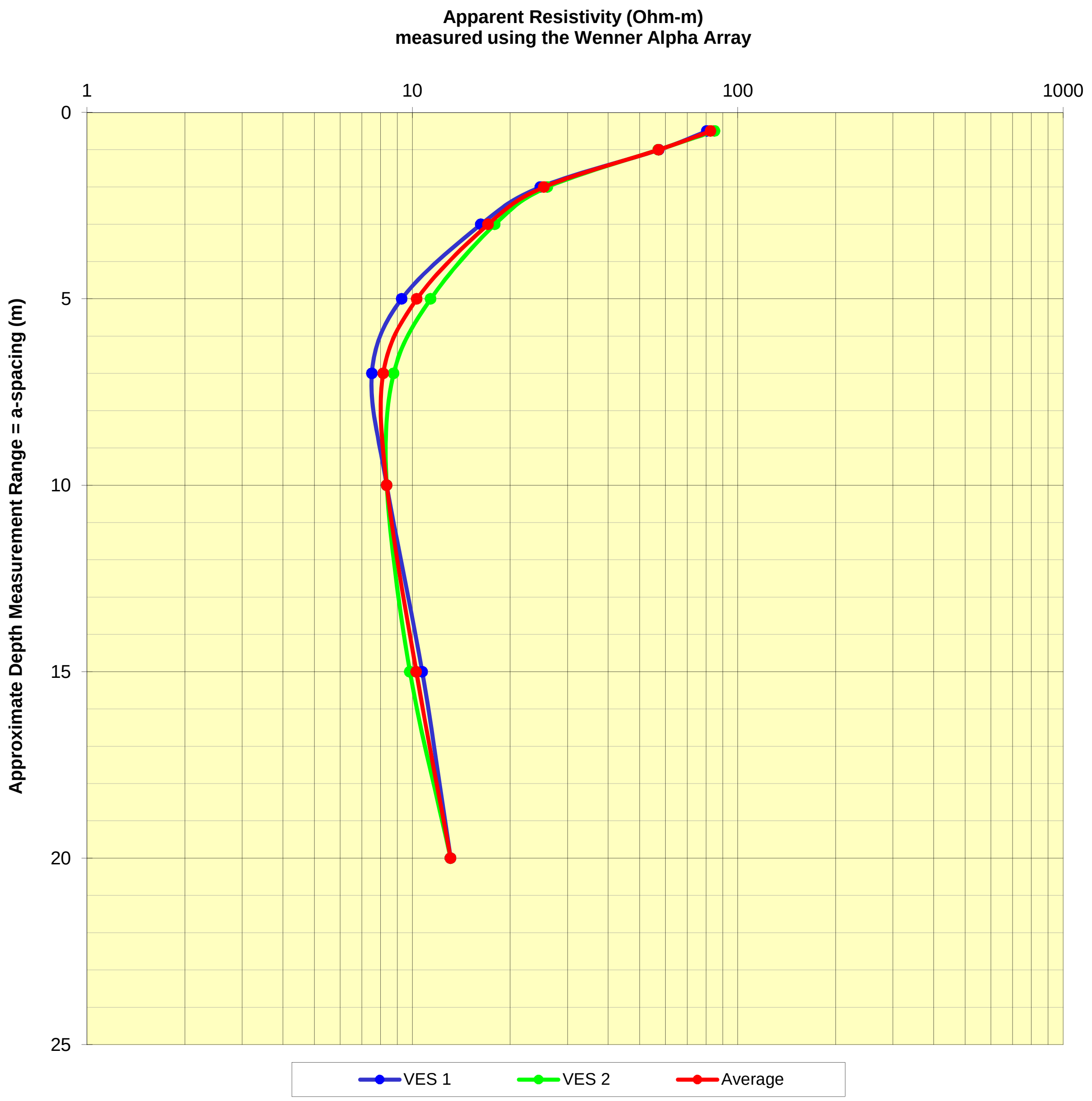
Location:	107		**Centre E, N:**	683 161 mE, 6 401 752 mN GDA94 Zone 56
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo

Apparent Resistivity (Ohm-m)
measured using the Wenner Alpha Array



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	7
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	9-Jan-18

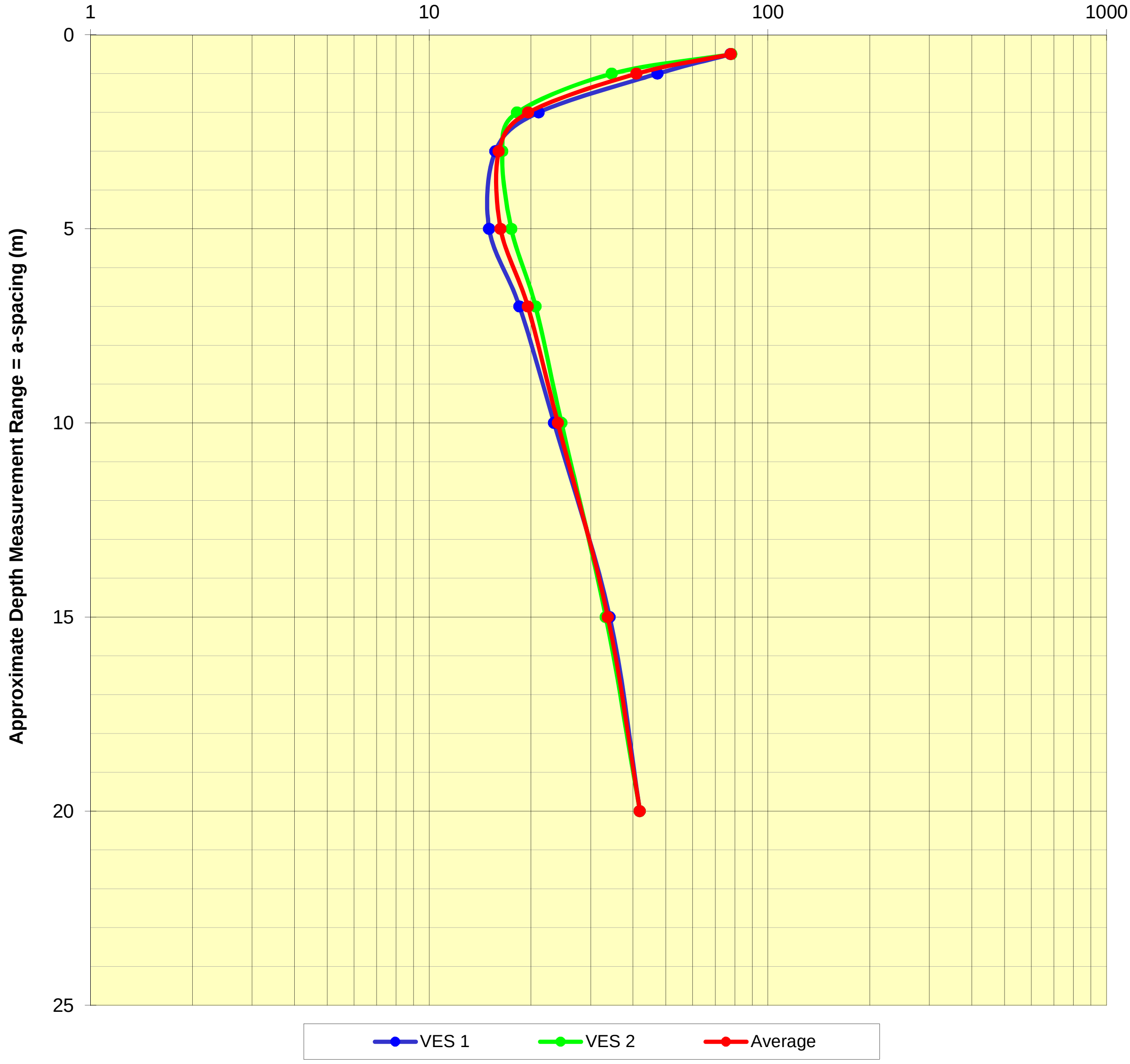
Electrode a-spacing (m)	Resistance (R) VES 1 (Ω)	Resistance (R) VES 2 (Ω)	Resistance (R) Average (Ω)	Apparent Resistivity (ρ_a = 2πaR) VES 1 (Ω-m)	Apparent Resistivity VES 2 (Ω-m)	Apparent Resistivity Average (Ω-m)
0.5	25.56	27.01	26.29	80.30	84.85	82.58
1	9.11	9.07	9.09	57.24	56.99	57.11
2	1.97	2.07	2.02	24.73	26.01	25.37
3	0.86	0.95	0.91	16.24	17.93	17.09
5	0.29	0.36	0.33	9.27	11.38	10.32
7	0.17	0.20	0.18	7.51	8.76	8.13
10	0.13	0.13	0.13	8.34	8.34	8.34
15	0.11	0.10	0.11	10.72	9.83	10.28
20	0.10	0.10	0.10	13.11	13.11	13.11
Location:	108		**Centre E, N:**	683 227 mE, 6 400 882 mN GDA94 Zone 56		
Orientations:	N - S	E - W	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo		



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	8
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	11-Jan-18

Electrode a-spacing (m)	Resistance (R) VES 1 (Ω)	VES 2 (Ω)	Average (Ω)	Apparent Resistivity (ρ_a = 2πaR) VES 1 (Ω-m)	VES 2 (Ω-m)	Average (Ω-m)
0.5	24.70	24.84	24.77	77.60	78.04	77.82
1	7.52	5.51	6.52	47.25	34.62	40.93
2	1.67	1.45	1.56	21.05	18.19	19.62
3	0.83	0.87	0.85	15.68	16.43	16.05
5	0.48	0.56	0.52	15.03	17.48	16.25
7	0.42	0.47	0.44	18.48	20.62	19.55
10	0.37	0.39	0.38	23.37	24.58	23.98
15	0.36	0.35	0.36	34.15	33.24	33.69
20	0.33	0.33	0.33	41.90	41.90	41.90
Location:	109		**Centre E, N:**	683 381 mE, 6 400 402 mN GDA94 Zone 56		
Orientations:	E - W	N - S	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo		

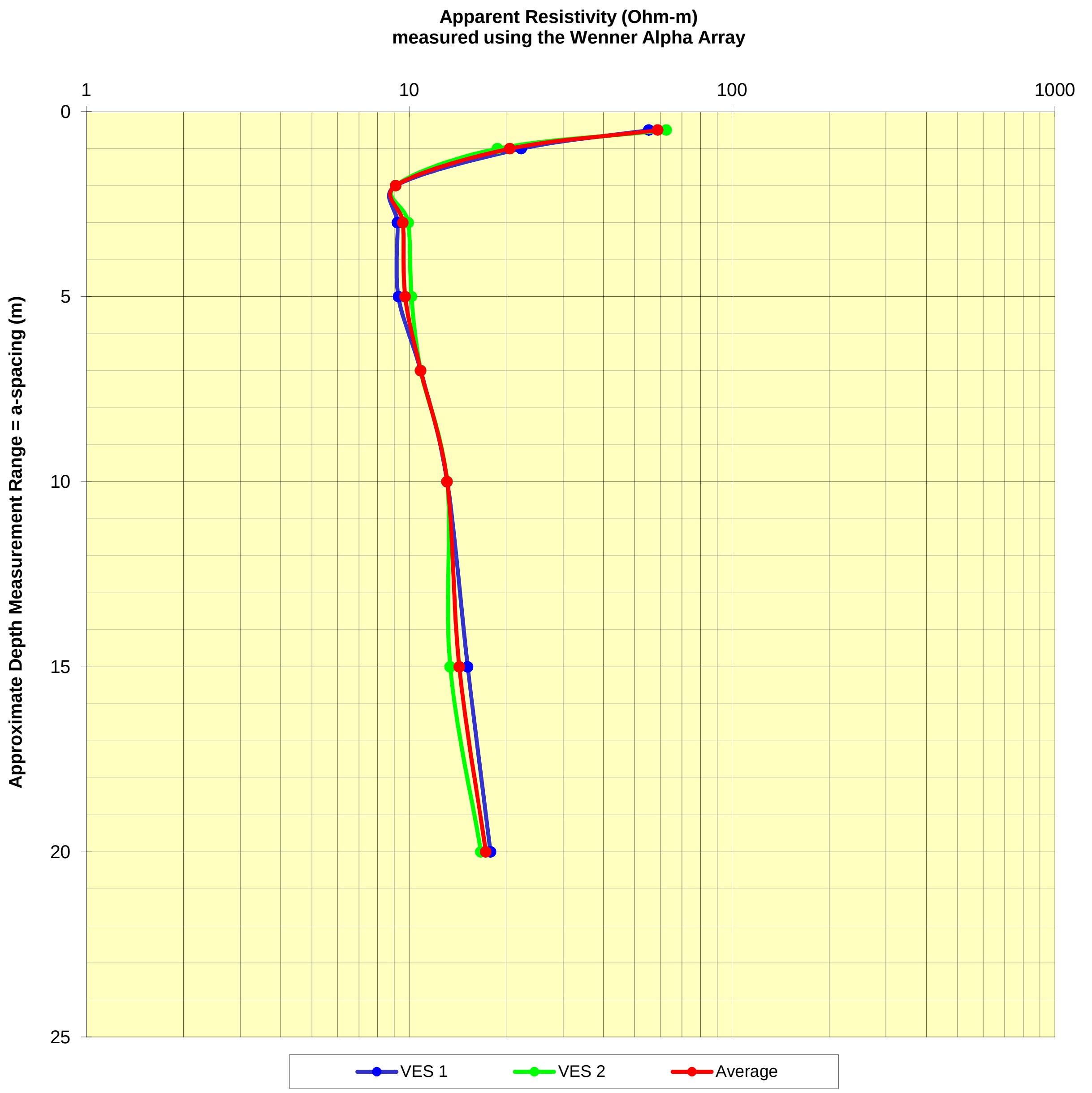
Apparent Resistivity (Ohm-m)
measured using the Wenner Alpha Array



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	9
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	11-Jan-18

Electrode a-spacing (m)	Resistance (R) VES 1 (Ω)	Resistance (R) VES 2 (Ω)	Resistance (R) Average (Ω)	Apparent Resistivity (ρ_a = 2πaR) VES 1 (Ω-m)	Apparent Resistivity (ρ_a = 2πaR) VES 2 (Ω-m)	Apparent Resistivity (ρ_a = 2πaR) Average (Ω-m)
0.5	17.61	19.92	18.77	55.32	62.58	58.95
1	3.54	2.99	3.27	22.24	18.79	20.51
2	0.72	0.72	0.72	9.09	9.09	9.09
3	0.49	0.53	0.51	9.20	9.94	9.57
5	0.29	0.32	0.31	9.27	10.17	9.72
7	0.25	0.25	0.25	10.86	10.86	10.86
10	0.21	0.21	0.21	13.12	13.12	13.12
15	0.16	0.14	0.15	15.19	13.41	14.30
20	0.14	0.13	0.14	17.87	16.68	17.28

Location:	110		**Centre E, N:**	682 432 mE, 6 401 096 mN GDA94 Zone 56
Orientations:	E - W	N - S	**Equipment:**	Fluke 1625 Advanced Earth / Ground Tester Geo



Douglas Partners Geotechnics / Environment / Groundwater	**Vertical Electrical Sounding (VES)**	PROJECT:	91256.00
	Proposed Solar Farm	Plot No:	10
	Goolma Road, Wellington	REV:	0
	CLIENT: First Solar (Australia) Pty Ltd	DATE:	10-Jan-18

Appendix E

Results of Laboratory Testing

Material Test Report

Douglas Partners
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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Peter Gorseski
Earthworks Manager

NATA Accredited Laboratory Number: 828

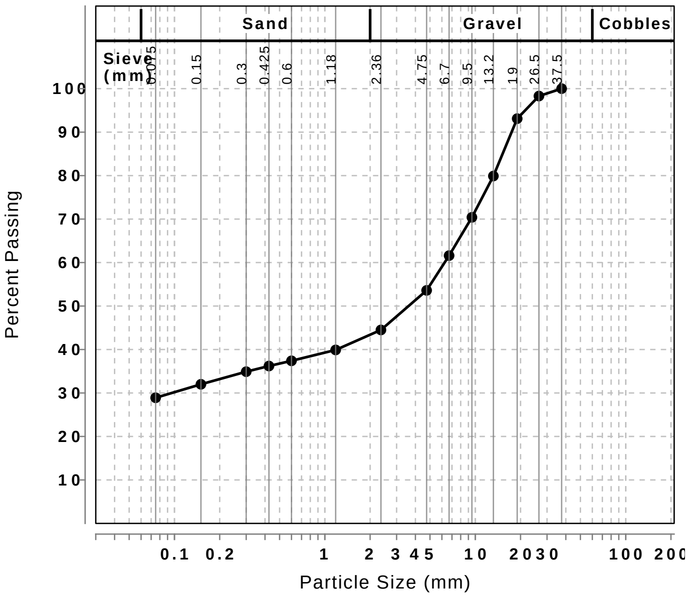
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705A
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**1 (0.4 - 0.5m)**
Material:	Gravelly Clay / Clayey Gravel

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
37.5 mm	**100**		
26.5 mm	**98**		
19 mm	**93**		
13.2 mm	**80**		
9.5 mm	**70**		
6.7 mm	**62**		
4.75 mm	**54**		
2.36 mm	**45**		
1.18 mm	**40**		
0.6 mm	**37**		
0.425 mm	**36**		
0.3 mm	**35**		
0.15 mm	**32**		
0.075 mm	**29**		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.0

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	35		
Plastic Limit (%)	13		
Plasticity Index (%)	**22**		

Particle Size Distribution



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705B
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**2 (0.5 - 0.6m)**
Material:	Gravelly Clay / Clayey Gravel

Douglas Partners
Geotechnics / Environment / Groundwater

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Earthworks Manager

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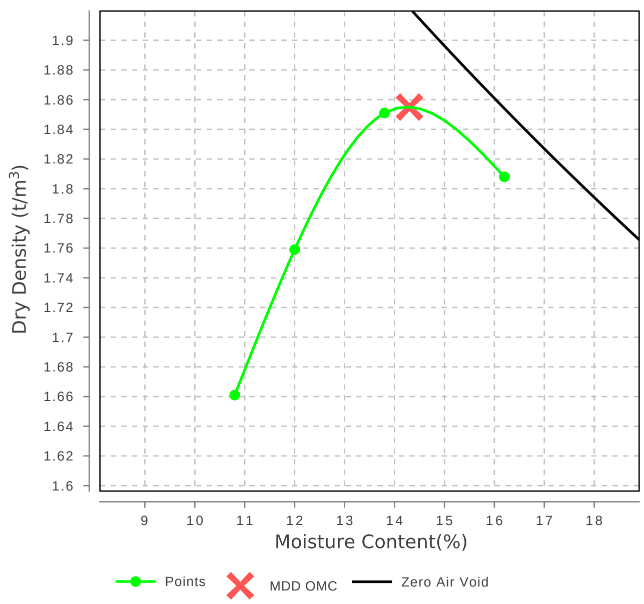
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.8

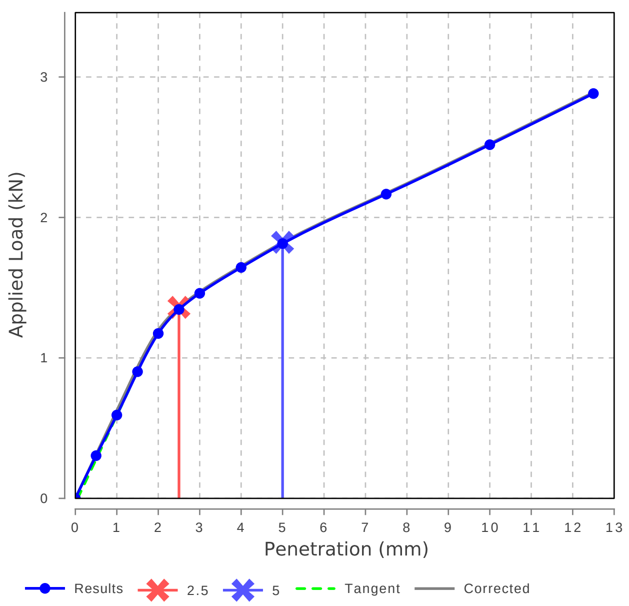
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.86
Optimum Moisture Content (%)	14.5
Oversize Sieve (mm)	19.0
Oversize Material (%)	4.2

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.86		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	101.0		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.85		
Field Moisture Content (%)	10.8		
Moisture Content at Placement (%)	14.1		
Moisture Content Top 30mm (%)	18.3		
Moisture Content Rest of Sample (%)	15.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.2		

Moisture Density Relationship



California Bearing Ratio



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd
	Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705C
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**2 (0.85 - 1.3m)**
Material:	Silty Clay

Douglas Partners
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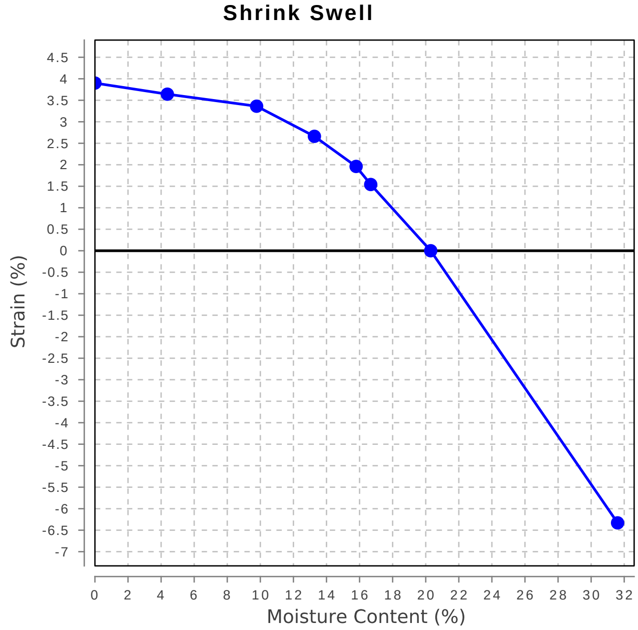
Earthworks Manager

NATA Accredited Laboratory Number: 828

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**3.9**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**3.9**
Estimated % by volume of significant inert inclusions	15
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	20.3

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	200
Initial Moisture Content (%)	20.2
Final Moisture Content (%)	31.6
Swell (%)	**6.3**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd
	Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705D
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**3 (0.3 - 0.4m)**
Material:	Silty Clay

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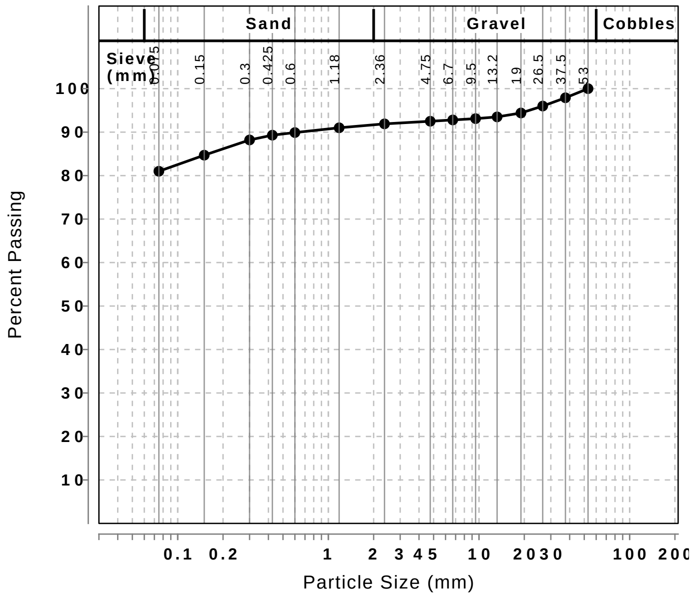
Earthworks Manager

NATA Accredited Laboratory Number: 828

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
53 mm	**100**		
37.5 mm	**98**		
26.5 mm	**96**		
19 mm	**94**		
13.2 mm	**94**		
9.5 mm	**93**		
6.7 mm	**93**		
4.75 mm	**93**		
2.36 mm	**92**		
1.18 mm	**91**		
0.6 mm	**90**		
0.425 mm	**89**		
0.3 mm	**88**		
0.15 mm	**85**		
0.075 mm	**81**		

Particle Size Distribution



Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705D
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **3 (0.3 - 0.4m)**
Material: Silty Clay

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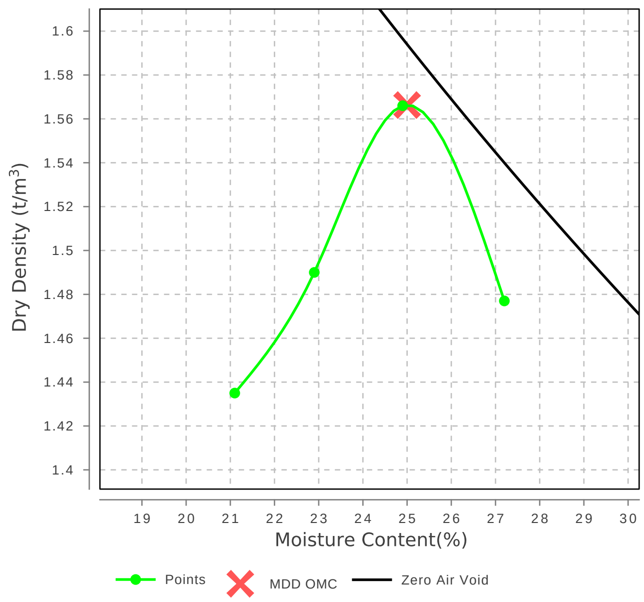
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.9

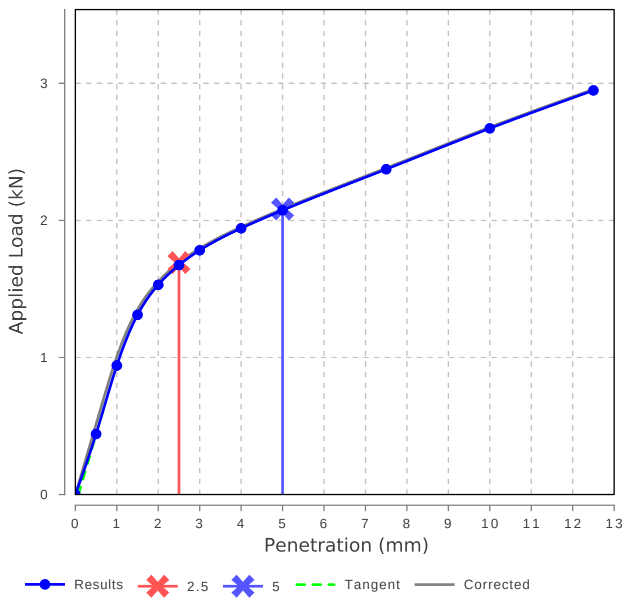
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.57
Optimum Moisture Content (%)	25.0
Oversize Sieve (mm)	19.0
Oversize Material (%)	4.7

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**13**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.57		
Optimum Moisture Content (%)	25.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.55		
Field Moisture Content (%)	18.9		
Moisture Content at Placement (%)	24.6		
Moisture Content Top 30mm (%)	29.0		
Moisture Content Rest of Sample (%)	25.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.7		

Moisture Density Relationship



California Bearing Ratio



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd
	Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705F
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**4 (0.4 - 0.5m)**
Material:	Silty Clay

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NATA
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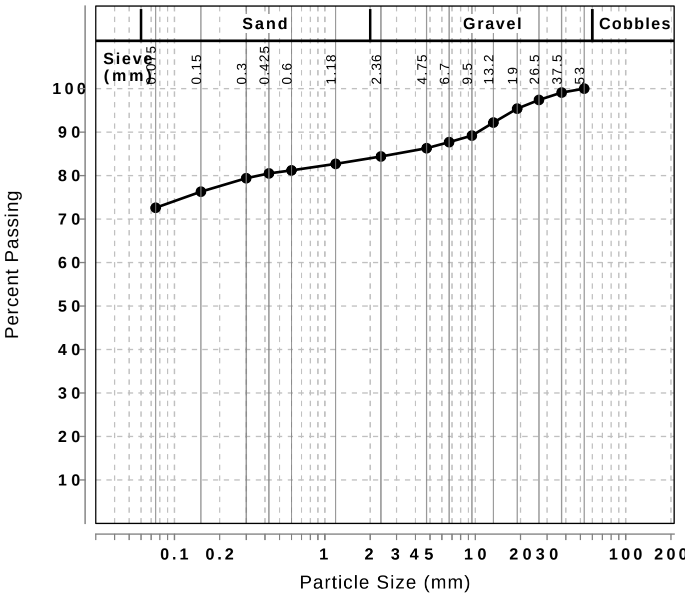
Approved Signatory: Peter Gorseski
Earthworks Manager

NATA Accredited Laboratory Number: 828

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
53 mm	**100**		
37.5 mm	**99**		
26.5 mm	**97**		
19 mm	**95**		
13.2 mm	**92**		
9.5 mm	**89**		
6.7 mm	**88**		
4.75 mm	**86**		
2.36 mm	**84**		
1.18 mm	**83**		
0.6 mm	**81**		
0.425 mm	**81**		
0.3 mm	**79**		
0.15 mm	**76**		
0.075 mm	**73**		

Particle Size Distribution



Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705G
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **6 (0.3 - 0.4m)**
Material: Sandy Silt

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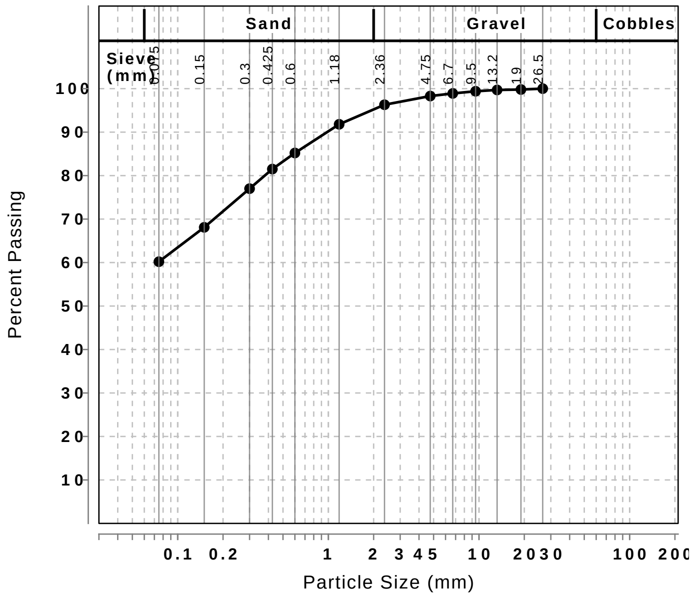
Earthworks Manager
NATA Accredited Laboratory Number: 828

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**99**		
6.7 mm	**99**		
4.75 mm	**98**		
2.36 mm	**96**		
1.18 mm	**92**		
0.6 mm	**85**		
0.425 mm	**82**		
0.3 mm	**77**		
0.15 mm	**68**		
0.075 mm	**60**		

Particle Size Distribution



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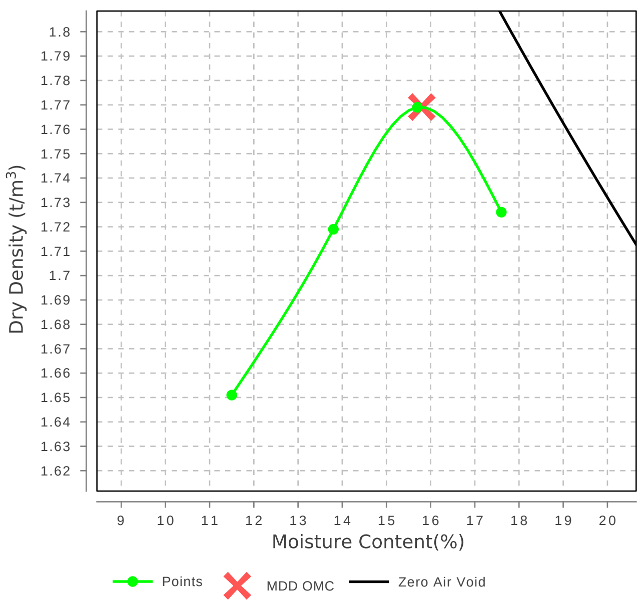
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705G
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**6 (0.3 - 0.4m)**
Material:	Sandy Silt

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.3

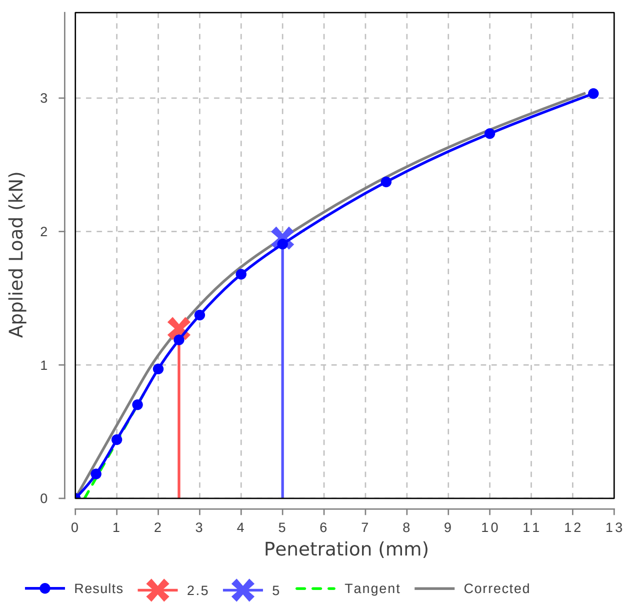
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.77
Optimum Moisture Content (%)	16.0
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.1

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.77		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.75		
Field Moisture Content (%)	10.2		
Moisture Content at Placement (%)	15.7		
Moisture Content Top 30mm (%)	20.1		
Moisture Content Rest of Sample (%)	16.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.1		

Moisture Density Relationship



California Bearing Ratio



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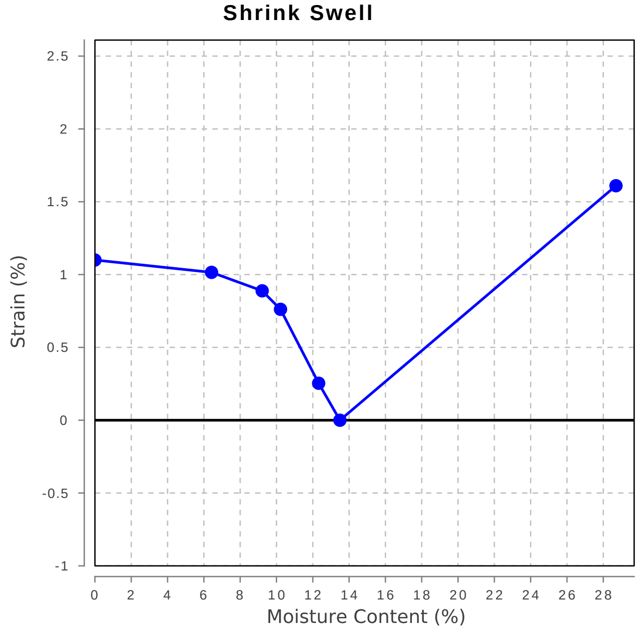
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705H
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**6 (0.55 - 0.82m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.6**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.1**
Estimated % by volume of significant inert inclusions	5
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	13.5

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	85
Initial Moisture Content (%)	14.7
Final Moisture Content (%)	28.7
Swell (%)	**-1.6**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705I
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **7 (0.4 - 0.5m)**
Material: Silty Clay

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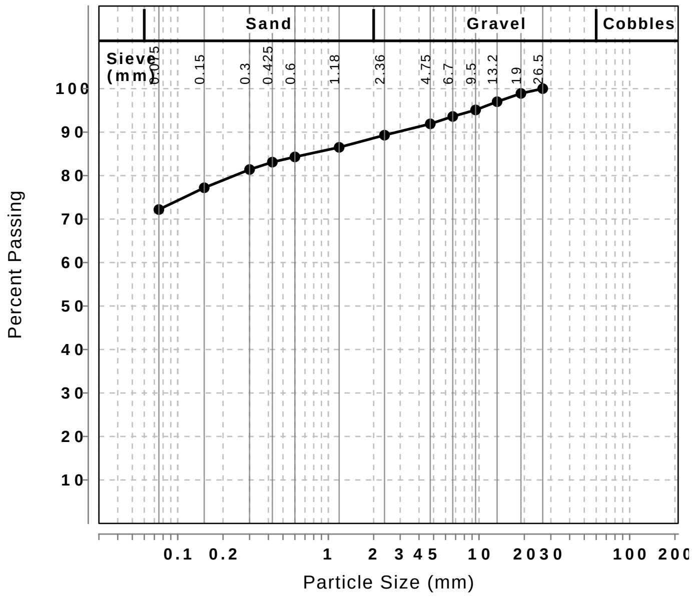
Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**99**		
13.2 mm	**97**		
9.5 mm	**95**		
6.7 mm	**94**		
4.75 mm	**92**		
2.36 mm	**89**		
1.18 mm	**87**		
0.6 mm	**84**		
0.425 mm	**83**		
0.3 mm	**81**		
0.15 mm	**77**		
0.075 mm	**72**		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	19.0

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	53		
Plastic Limit (%)	14		
Plasticity Index (%)	**39**		

Particle Size Distribution



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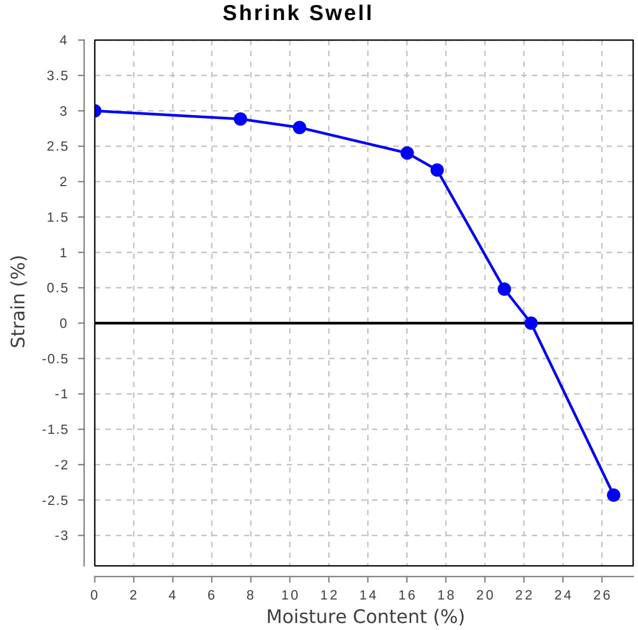
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705J
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **7 (0.55 - 0.95m)**
Material: Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**2.3**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**3.0**
Estimated % by volume of significant inert inclusions	10
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	22.4

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	350
Initial Moisture Content (%)	21.9
Final Moisture Content (%)	26.6
Swell (%)	**2.4**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705K
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **8 (0.3 - 0.4m)**
Material: Silty Clay

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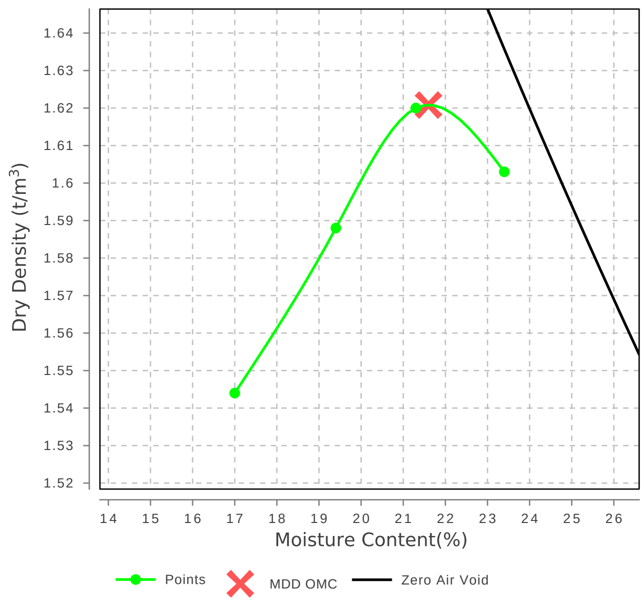
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.7

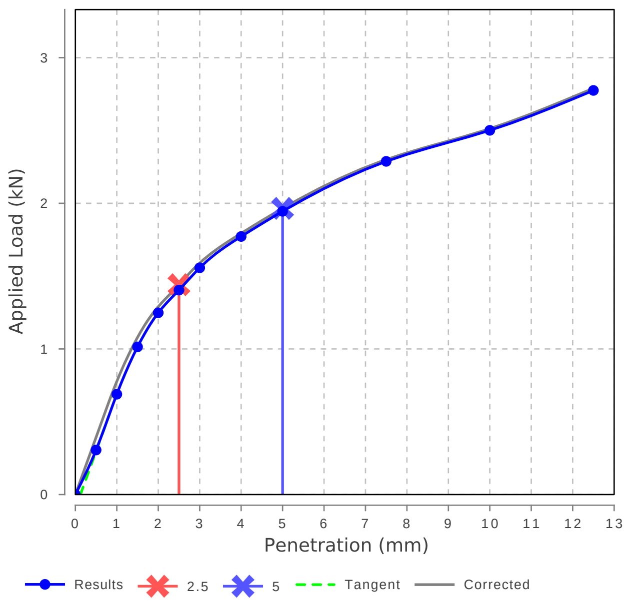
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.62
Optimum Moisture Content (%)	21.5
Oversize Sieve (mm)	19.0
Oversize Material (%)	3.1

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.62		
Optimum Moisture Content (%)	21.5		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.59		
Field Moisture Content (%)	16.7		
Moisture Content at Placement (%)	21.7		
Moisture Content Top 30mm (%)	25.0		
Moisture Content Rest of Sample (%)	22.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	3.1		

Moisture Density Relationship



California Bearing Ratio



Material Test Report

Report Number:	**91256.00-1**
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Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd
	Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705L
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**9 (0.4 - 0.5m)**
Material:	Silty Clay

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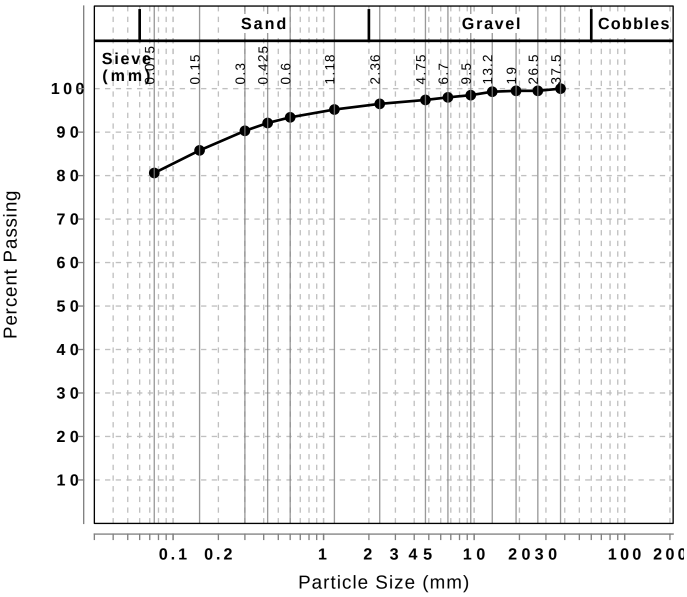
Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
37.5 mm	**100**		
26.5 mm	**100**		
19 mm	**100**		
13.2 mm	**99**		
9.5 mm	**99**		
6.7 mm	**98**		
4.75 mm	**97**		
2.36 mm	**97**		
1.18 mm	**95**		
0.6 mm	**93**		
0.425 mm	**92**		
0.3 mm	**90**		
0.15 mm	**86**		
0.075 mm	**81**		

Particle Size Distribution



Material Test Report

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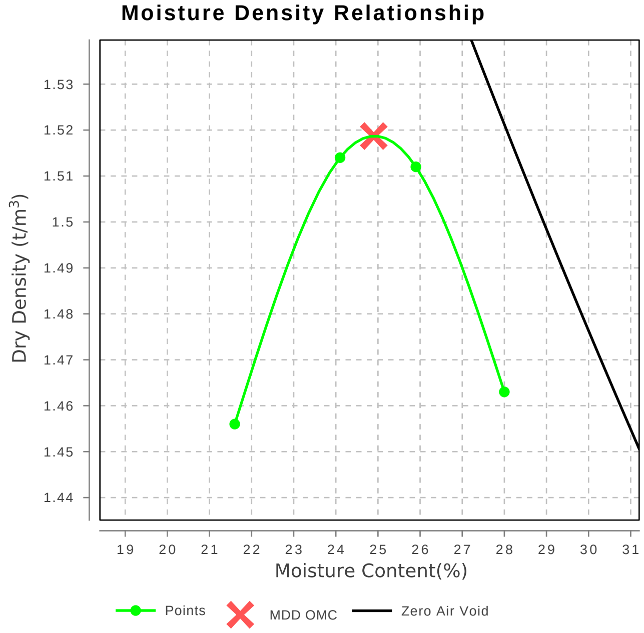
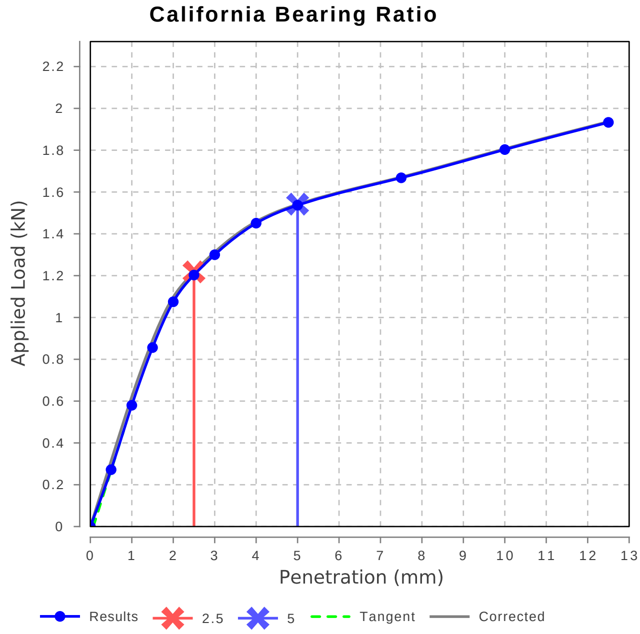
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705L
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**9 (0.4 - 0.5m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.0

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.52
Optimum Moisture Content (%)	25.0
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**9**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.52		
Optimum Moisture Content (%)	25.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m^3)	1.50		
Field Moisture Content (%)	18.0		
Moisture Content at Placement (%)	24.4		
Moisture Content Top 30mm (%)	28.3		
Moisture Content Rest of Sample (%)	26.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		





Material Test Report

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Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705M
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**10 (0.2 - 0.4m)**
Material:	Silty Clay

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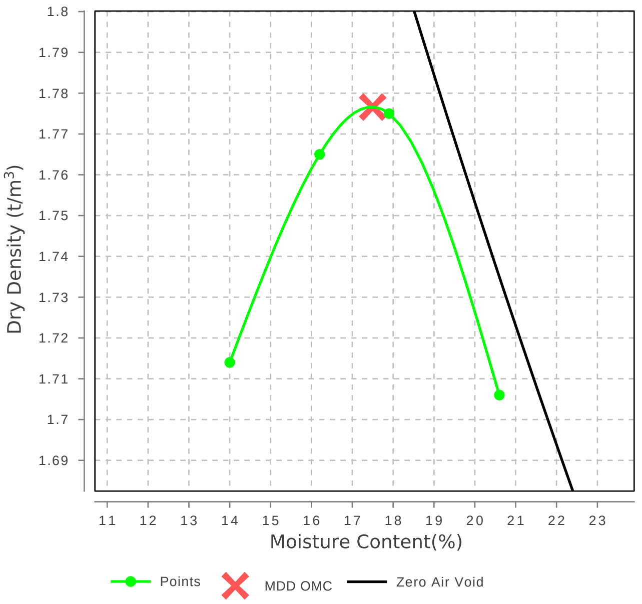
Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	12.1

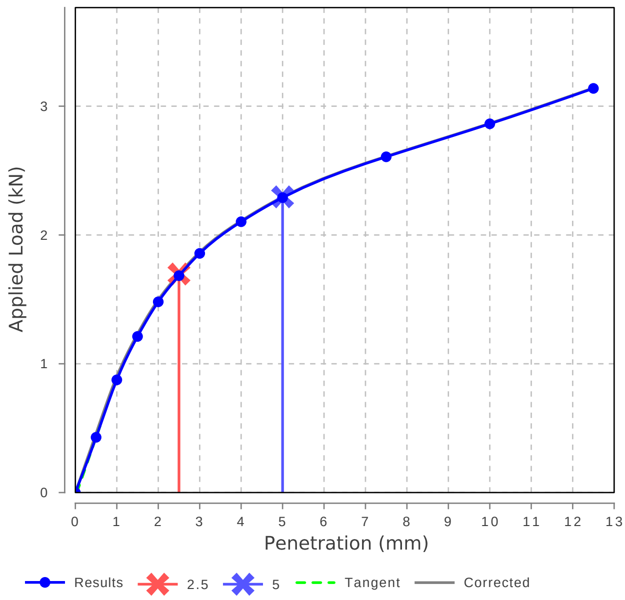
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.78
Optimum Moisture Content (%)	17.5
Oversize Sieve (mm)	19.0
Oversize Material (%)	6.8

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**13**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.78		
Optimum Moisture Content (%)	17.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.77		
Field Moisture Content (%)	12.1		
Moisture Content at Placement (%)	17.2		
Moisture Content Top 30mm (%)	19.9		
Moisture Content Rest of Sample (%)	18.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	6.8		

Moisture Density Relationship



California Bearing Ratio



Material Test Report

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Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705O
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**11 (0.45 - 0.9m)**
Material:	Silty Clay

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Earthworks Manager

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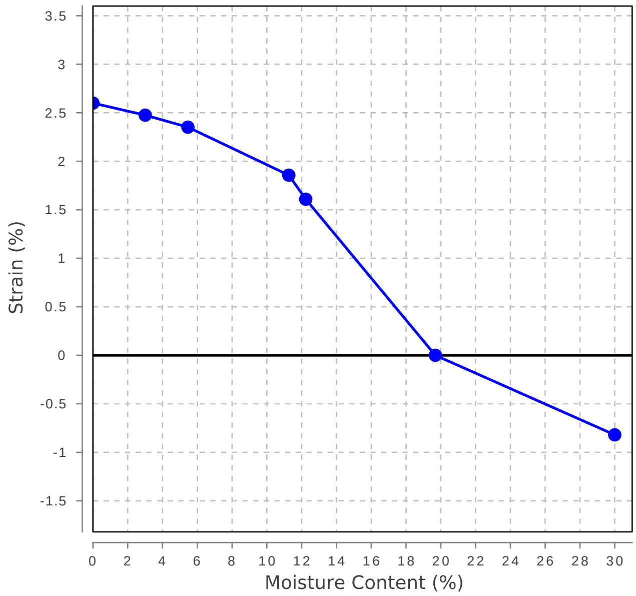
Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.7**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.6**
Estimated % by volume of significant inert inclusions	5
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	19.7

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	120
Initial Moisture Content (%)	18.2
Final Moisture Content (%)	30.0
Swell (%)	**0.8**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	

Shrink Swell



Material Test Report

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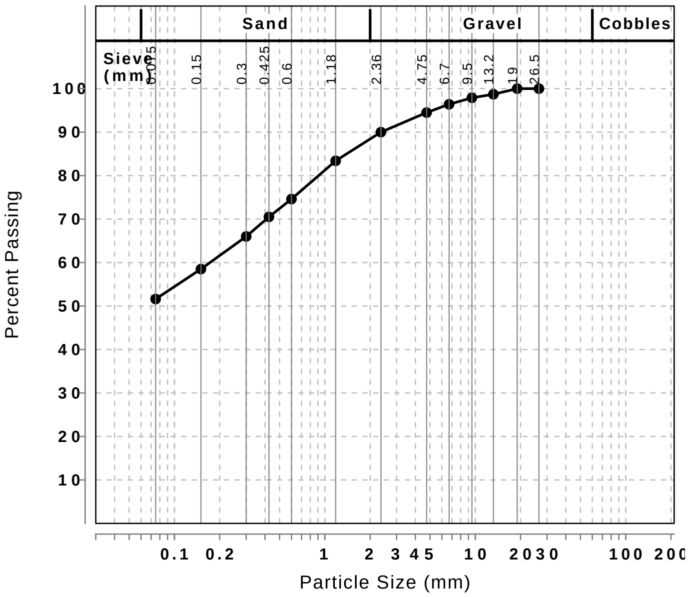
Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705P
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **12 (0.5 - 0.6m)**
Material: Sandy Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**100**		
13.2 mm	**99**		
9.5 mm	**98**		
6.7 mm	**96**		
4.75 mm	**95**		
2.36 mm	**90**		
1.18 mm	**83**		
0.6 mm	**75**		
0.425 mm	**71**		
0.3 mm	**66**		
0.15 mm	**59**		
0.075 mm	**52**		

Particle Size Distribution



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Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705P
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**12 (0.5 - 0.6m)**
Material:	Sandy Silty Clay

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Earthworks Manager

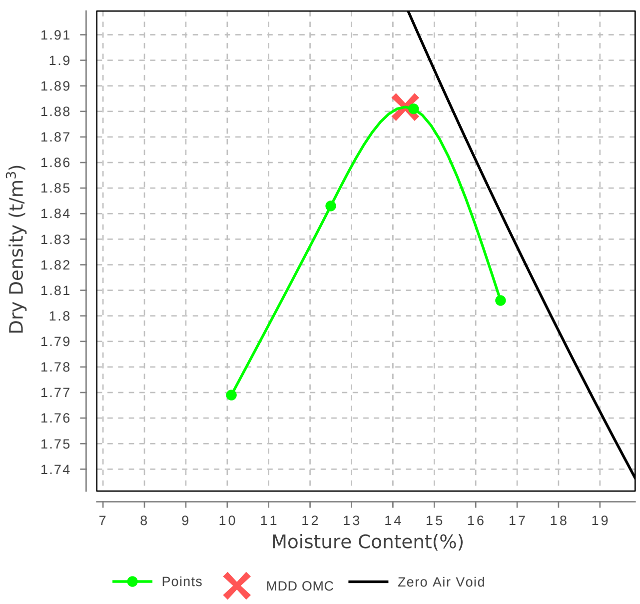
NATA Accredited Laboratory Number: 828

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.4

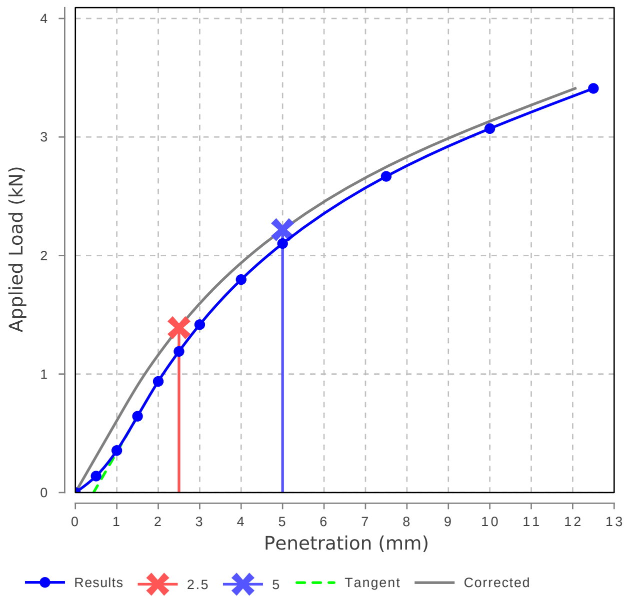
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.88
Optimum Moisture Content (%)	14.5
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.88		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.88		
Field Moisture Content (%)	8.4		
Moisture Content at Placement (%)	14.3		
Moisture Content Top 30mm (%)	16.6		
Moisture Content Rest of Sample (%)	14.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Moisture Density Relationship



California Bearing Ratio



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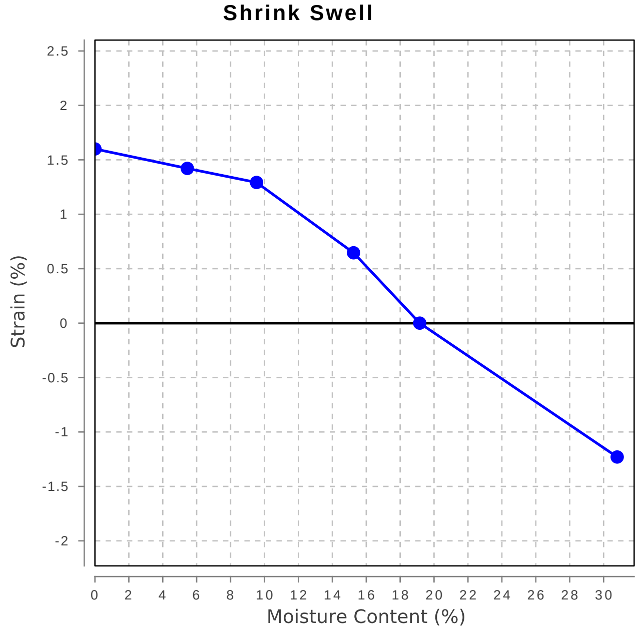
NATA Accredited Laboratory Number: 828

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705Q
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **13 (0.35 - 0.8m)**
Material: Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.2**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.6**
Estimated % by volume of significant inert inclusions	0
Cracking	Fragmented
Crumbling	Yes
Moisture Content (%)	19.2

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	115
Initial Moisture Content (%)	19.6
Final Moisture Content (%)	30.8
Swell (%)	**1.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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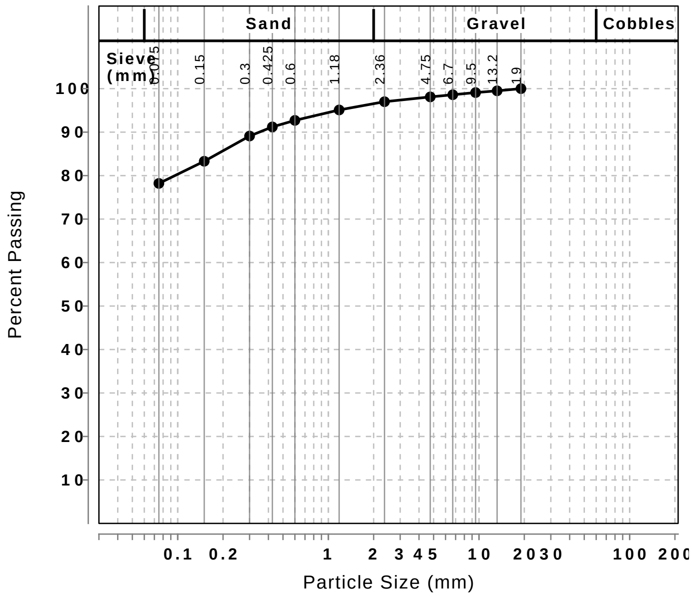
Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705R
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **13 (0.4 - 0.6m)**
Material: Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**99**		
6.7 mm	**99**		
4.75 mm	**98**		
2.36 mm	**97**		
1.18 mm	**95**		
0.6 mm	**93**		
0.425 mm	**91**		
0.3 mm	**89**		
0.15 mm	**83**		
0.075 mm	**78**		

Particle Size Distribution



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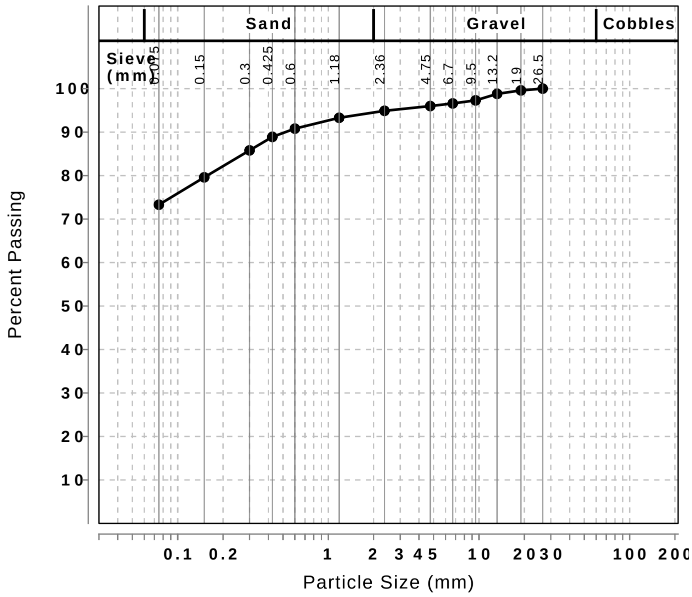
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705S
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **14 (0.5 - 0.6m)**
Material: Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
26.5 mm	**100**		
19 mm	**100**		
13.2 mm	**99**		
9.5 mm	**97**		
6.7 mm	**97**		
4.75 mm	**96**		
2.36 mm	**95**		
1.18 mm	**93**		
0.6 mm	**91**		
0.425 mm	**89**		
0.3 mm	**86**		
0.15 mm	**80**		
0.075 mm	**73**		

Particle Size Distribution



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Issue Number:	1
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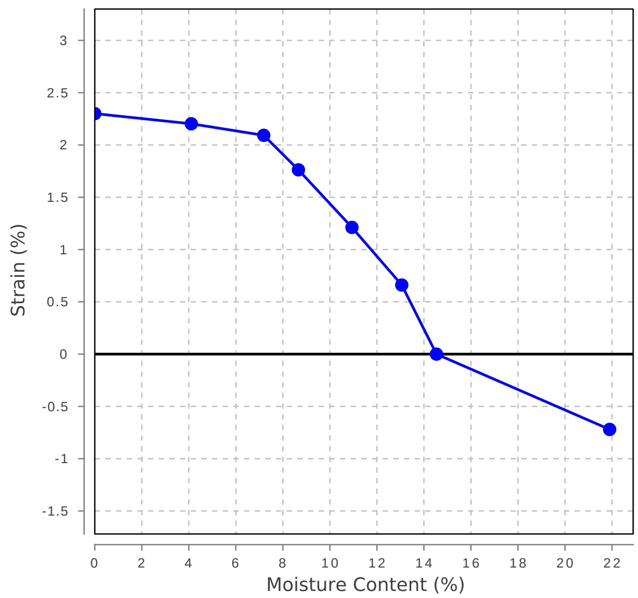
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705T
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**14 (0.95 - 1.25m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.5**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.3**
Estimated % by volume of significant inert inclusions	30
Cracking	Highly Cracked
Crumbling	No
Moisture Content (%)	14.5

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	470
Initial Moisture Content (%)	14.6
Final Moisture Content (%)	21.9
Swell (%)	**0.7**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	

Shrink Swell



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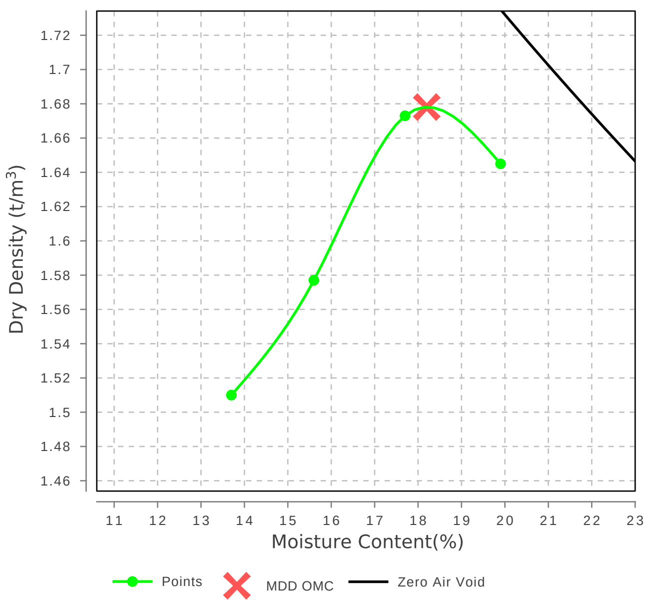
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705U
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **15 (0.4 - 0.6m)**
Material: Sandy Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	12.0

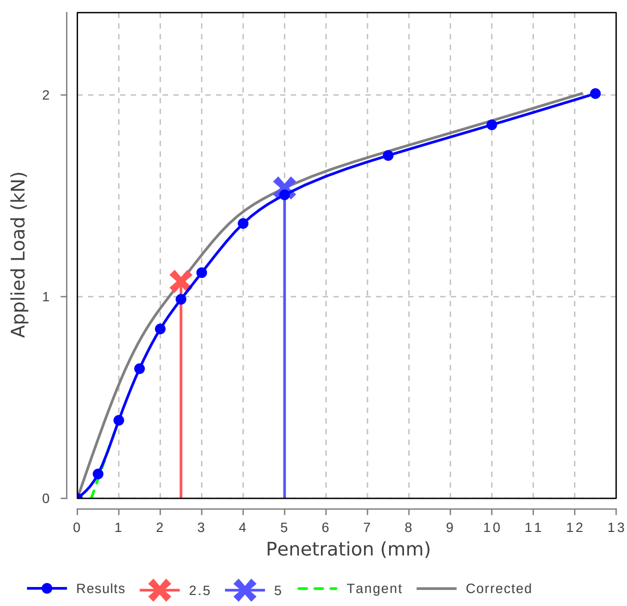
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.68
Optimum Moisture Content (%)	18.0
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**8**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.68		
Optimum Moisture Content (%)	18.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.64		
Field Moisture Content (%)	12.0		
Moisture Content at Placement (%)	18.1		
Moisture Content Top 30mm (%)	23.7		
Moisture Content Rest of Sample (%)	20.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Moisture Density Relationship



California Bearing Ratio



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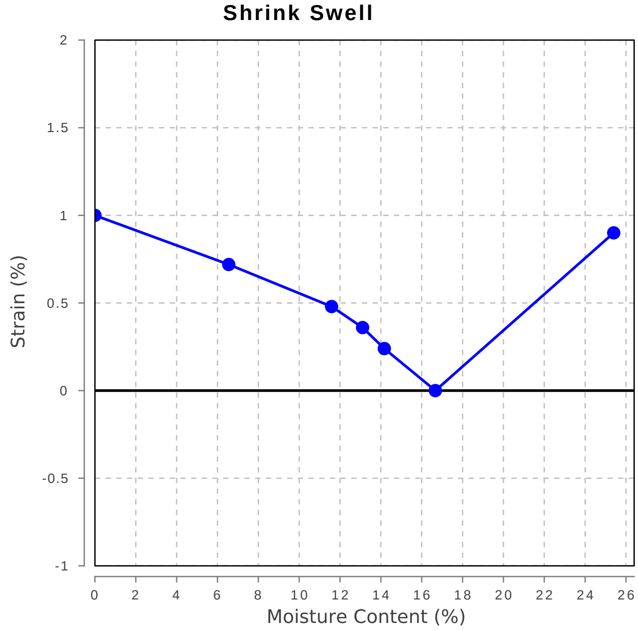
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705V
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**15 (0.65 - 0.91m)**
Material:	Sandy Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.6**
Visual Description	Sandy Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.0**
Estimated % by volume of significant inert inclusions	5
Cracking	Moderately Cracked
Crumbling	No
Moisture Content (%)	16.7

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	60
Initial Moisture Content (%)	16.6
Final Moisture Content (%)	25.4
Swell (%)	**-0.9**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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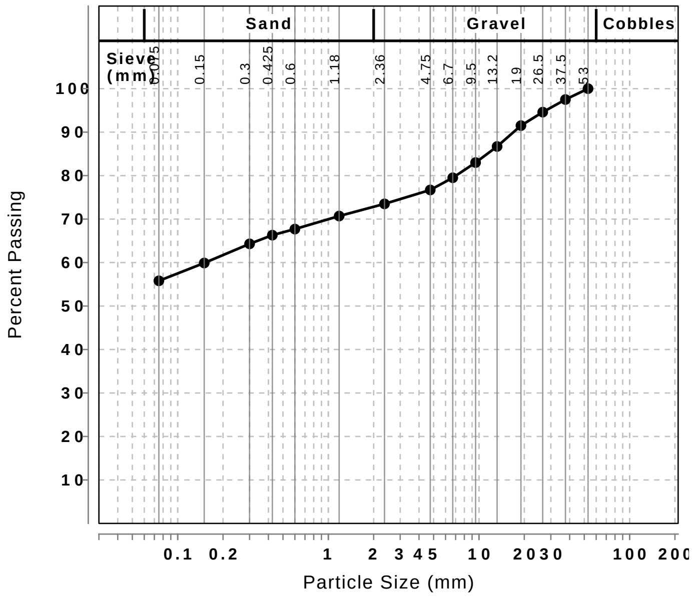
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705W
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**17 (0.2 - 0.4m)**
Material:	Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
53 mm	**100**		
37.5 mm	**98**		
26.5 mm	**95**		
19 mm	**92**		
13.2 mm	**87**		
9.5 mm	**83**		
6.7 mm	**80**		
4.75 mm	**77**		
2.36 mm	**74**		
1.18 mm	**71**		
0.6 mm	**68**		
0.425 mm	**66**		
0.3 mm	**64**		
0.15 mm	**60**		
0.075 mm	**56**		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	13.2

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	40		
Plastic Limit (%)	18		
Plasticity Index (%)	**22**		

Particle Size Distribution



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705X
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**18 (0.3 - 0.4m)**
Material:	Sandy Silty Clay

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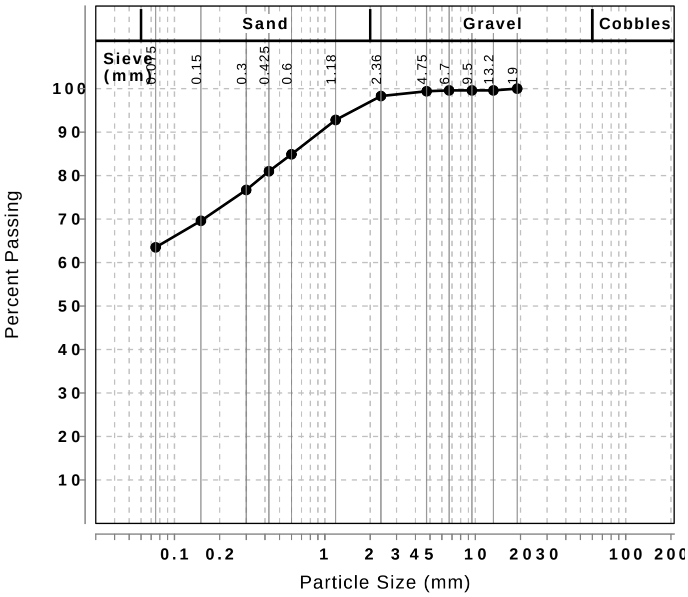
Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**99**		
2.36 mm	**98**		
1.18 mm	**93**		
0.6 mm	**85**		
0.425 mm	**81**		
0.3 mm	**77**		
0.15 mm	**70**		
0.075 mm	**64**		

Particle Size Distribution



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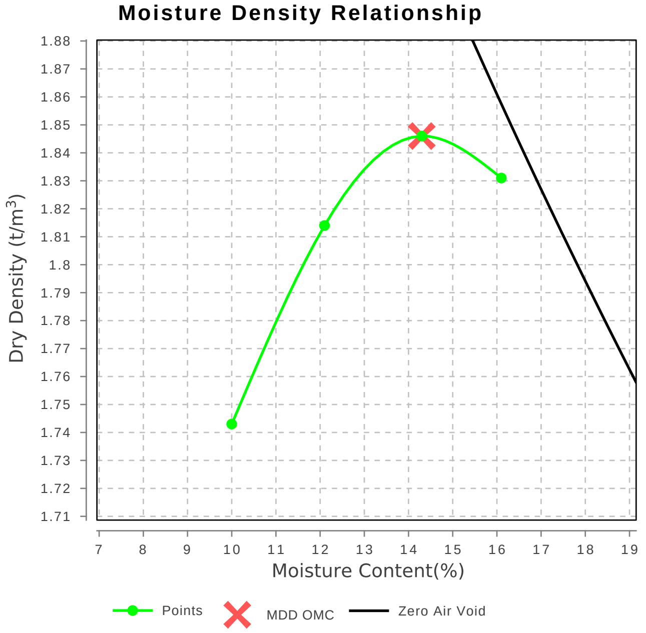
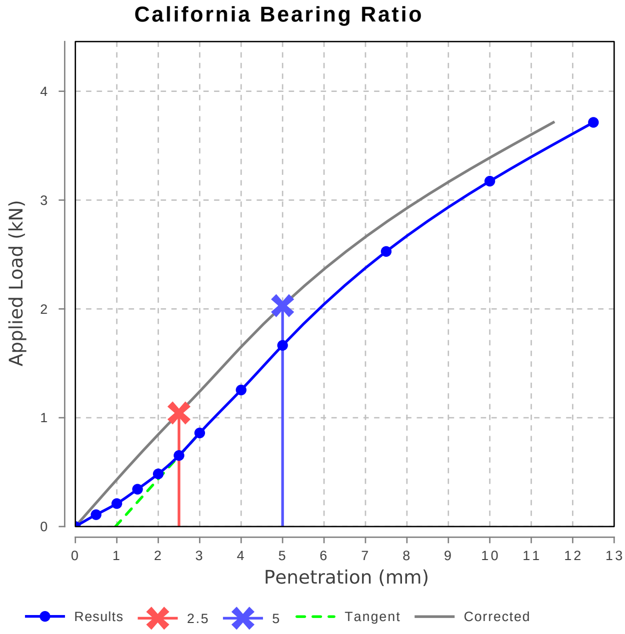
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705X
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **18 (0.3 - 0.4m)**
Material: Sandy Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.7

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.85
Optimum Moisture Content (%)	14.5
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.85		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.83		
Field Moisture Content (%)	8.7		
Moisture Content at Placement (%)	14.4		
Moisture Content Top 30mm (%)	15.7		
Moisture Content Rest of Sample (%)	14.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		





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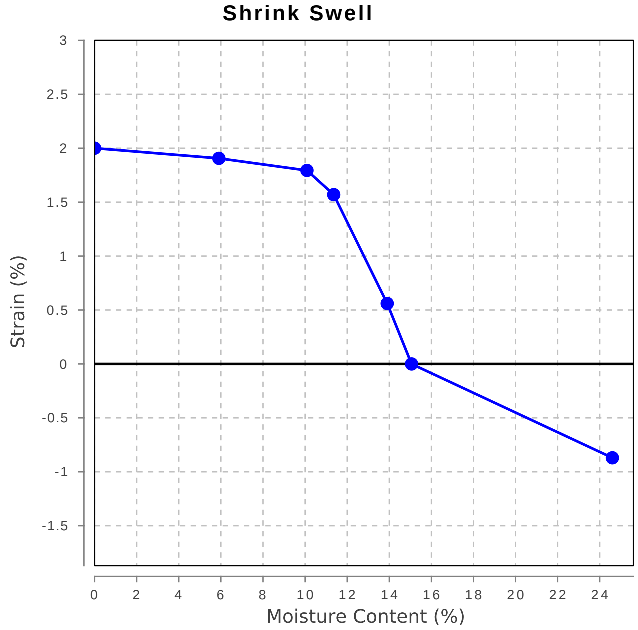
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705Y
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**18 (0.75 - 1.2m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.4**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.0**
Estimated % by volume of significant inert inclusions	5
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	15.1

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	160
Initial Moisture Content (%)	15.2
Final Moisture Content (%)	24.6
Swell (%)	**0.9**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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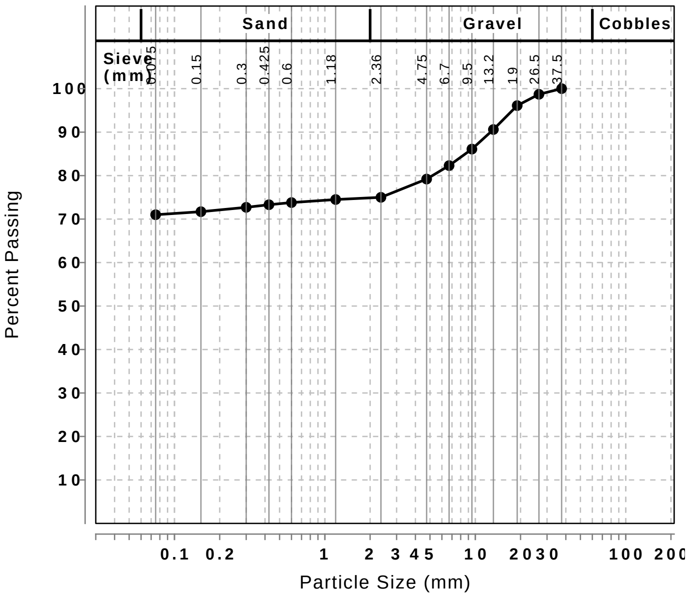
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705Z
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**19 (0.3 - 0.4m)**
Material:	Gravelly Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
37.5 mm	**100**		
26.5 mm	**99**		
19 mm	**96**		
13.2 mm	**91**		
9.5 mm	**86**		
6.7 mm	**82**		
4.75 mm	**79**		
2.36 mm	**75**		
1.18 mm	**75**		
0.6 mm	**74**		
0.425 mm	**73**		
0.3 mm	**73**		
0.15 mm	**72**		
0.075 mm	**71**		

Particle Size Distribution



Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Peter Gorseski
Earthworks Manager

NATA Accredited Laboratory Number: 828

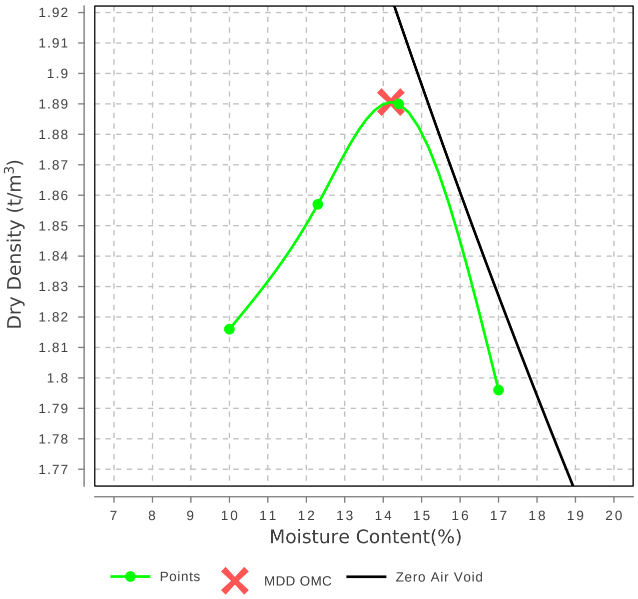
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705Z
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**19 (0.3 - 0.4m)**
Material:	Gravelly Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.6

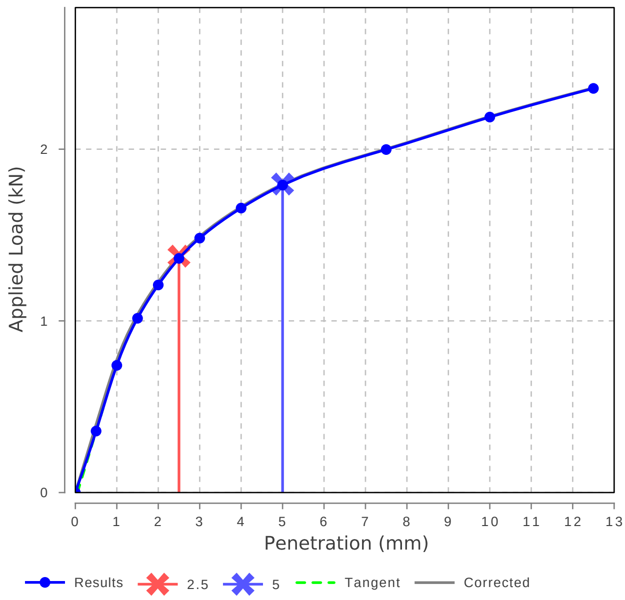
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
No. Layers	3
No. Blows / Layer	25
Maximum Dry Density (t/m^3)	1.89
Optimum Moisture Content (%)	14.0
Oversize Sieve (mm)	19.0
Oversize Material (%)	0.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.89		
Optimum Moisture Content (%)	14.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	1.88		
Field Moisture Content (%)	8.6		
Moisture Content at Placement (%)	14.0		
Moisture Content Top 30mm (%)	17.7		
Moisture Content Rest of Sample (%)	14.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Moisture Density Relationship



California Bearing Ratio



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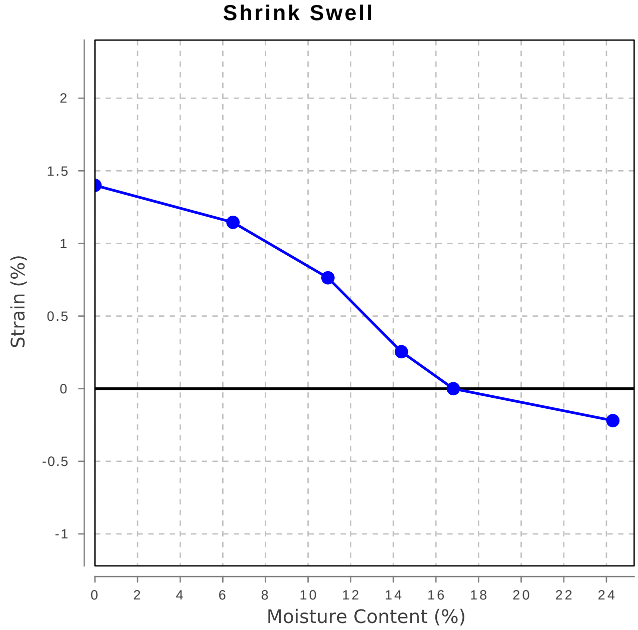
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AB
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**21 (0.4 - 0.69m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.8**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.4**
Estimated % by volume of significant inert inclusions	5
Cracking	Fragmented
Crumbling	Yes
Moisture Content (%)	16.8

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	125
Initial Moisture Content (%)	17.6
Final Moisture Content (%)	24.3
Swell (%)	**0.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AC
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**26 (0.25 - 0.63m)**
Material:	Silty Clay

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Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	33		
Plastic Limit (%)	24		
Plasticity Index (%)	**9**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	4.0		
Cracking Crumbling Curling	Cracking		

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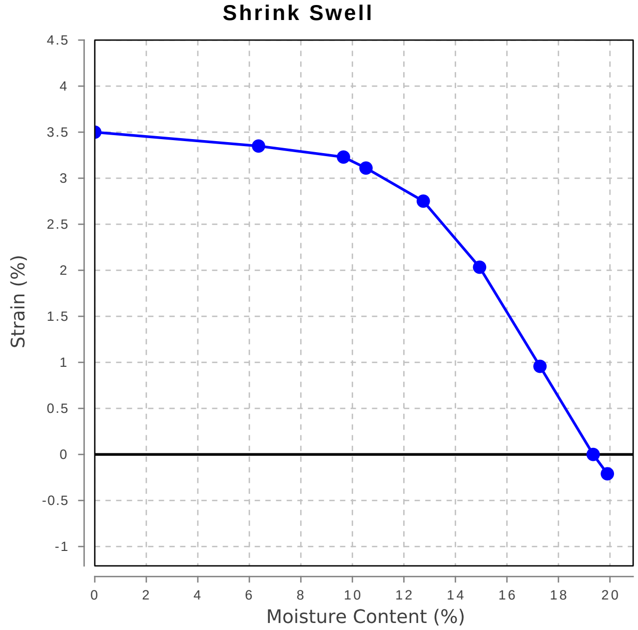
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AD
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**28 (0.5 - 0.73m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**2.0**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**3.5**
Estimated % by volume of significant inert inclusions	10
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	19.3

Swell Test	
Initial Pocket Penetrometer (kPa)	570
Final Pocket Penetrometer (kPa)	510
Initial Moisture Content (%)	18.4
Final Moisture Content (%)	19.9
Swell (%)	**0.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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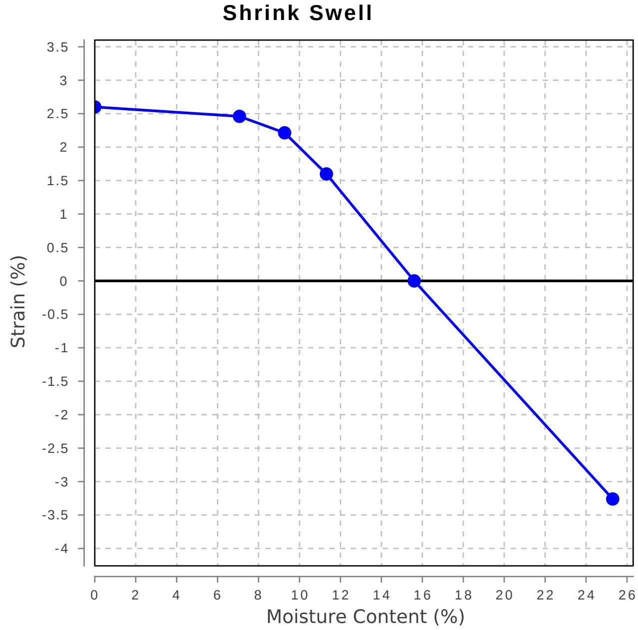
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AE
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**29 (1.0 - 1.2m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**2.4**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.6**
Estimated % by volume of significant inert inclusions	5
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	15.6

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	220
Initial Moisture Content (%)	18.4
Final Moisture Content (%)	25.3
Swell (%)	**3.3**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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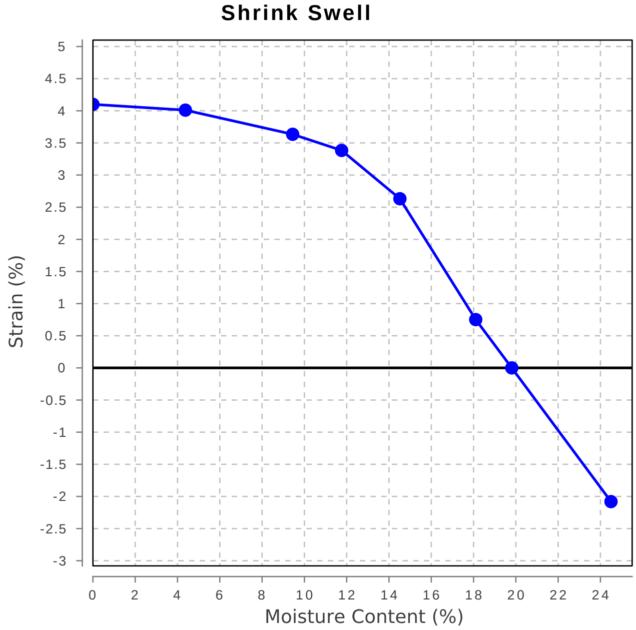
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AF
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**31 (0.3 - 0.61m)**
Material:	Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**2.9**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**4.1**
Estimated % by volume of significant inert inclusions	5
Cracking	
Crumbling	No
Moisture Content (%)	19.8

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	75
Initial Moisture Content (%)	19.7
Final Moisture Content (%)	24.5
Swell (%)	**2.1**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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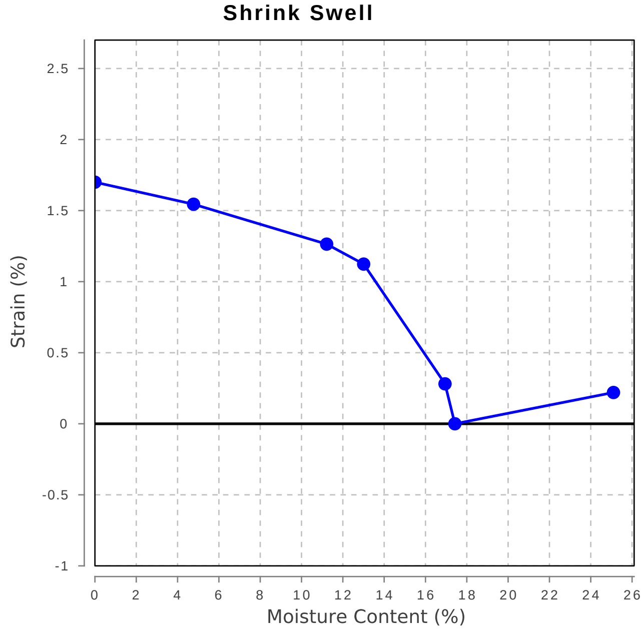
Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AG
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **32 (0.5 - 0.73m)**
Material: Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.9**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.7**
Estimated % by volume of significant inert inclusions	5
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	17.4

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	80
Initial Moisture Content (%)	18.6
Final Moisture Content (%)	25.1
Swell (%)	**-0.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AH
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **33 (0.3 - 0.55m)**
Material: Silty Clay

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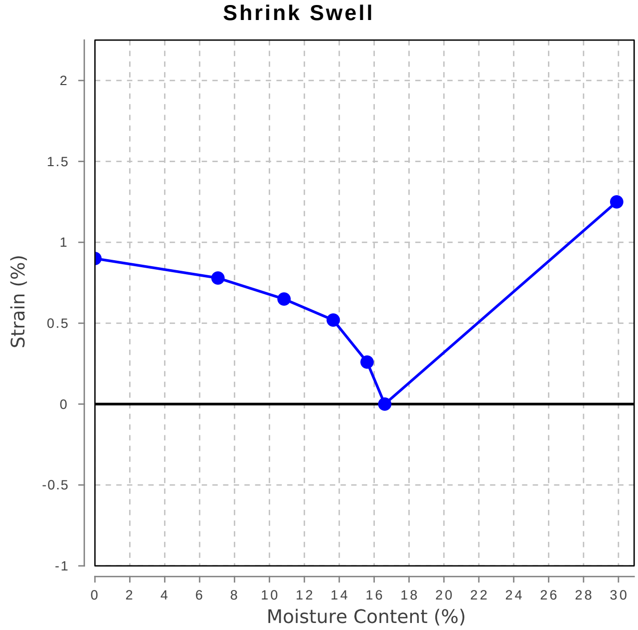
Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**0.5**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**0.9**
Estimated % by volume of significant inert inclusions	5
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	16.6

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	50
Initial Moisture Content (%)	16.2
Final Moisture Content (%)	29.9
Swell (%)	**-1.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AI
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**33 (1.0 - 1.45m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.6

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	72		
Plastic Limit (%)	16		
Plasticity Index (%)	**56**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	Curling		

Material Test Report

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Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AJ
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**33 (2.5 - 2.95m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	61		
Plastic Limit (%)	12		
Plasticity Index (%)	**49**		

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Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AK
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**34 (2.5 - 2.95m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	34		
Plastic Limit (%)	14		
Plasticity Index (%)	**20**		

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Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AL
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **31 (0.2m)**
Material: Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.0

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	37		
Plastic Limit (%)	15		
Plasticity Index (%)	**22**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

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Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AM
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**26 (0.1m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	4.1

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	23		
Plastic Limit (%)	19		
Plasticity Index (%)	**4**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	Silty CLay		
Nature of Water	Distilled		
Temperature of Water (^oC)	26		

Material Test Report

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Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AN
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**21 (1.0 - 1.45m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	12.1

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	45		
Plastic Limit (%)	13		
Plasticity Index (%)	**32**		

Material Test Report

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Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AO
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **22 (0.5m)**
Material: Gravelly Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.2

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	33		
Plastic Limit (%)	16		
Plasticity Index (%)	**17**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Gravelly Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd
	Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AP
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**25 (1.0 - 1.45m)**
Material:	Silty Clay

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Earthworks Manager

NATA Accredited Laboratory Number: 828

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.6

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	61		
Plastic Limit (%)	21		
Plasticity Index (%)	**40**		

Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AQ
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**27 (1.0 - 1.45m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	60		
Plastic Limit (%)	13		
Plasticity Index (%)	**47**		

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AR
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **24 (0.1m)**
Material: Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.7

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	36		
Plastic Limit (%)	15		
Plasticity Index (%)	**21**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AS
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **24 (0.5m)**
Material: Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	64		
Plastic Limit (%)	15		
Plasticity Index (%)	**49**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AT
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **30 (0.5m)**
Material: Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	8.7

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	42		
Plastic Limit (%)	13		
Plasticity Index (%)	**29**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

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NATA Accredited Laboratory Number: 828

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AU
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **10 (0.4m)**
Material: Silty Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AV
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **20 (0.5m)**
Material: Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AW
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **11 (0.4m)**
Material: Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705AX
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **12 (0.4m)**
Material: Sandy Silty Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Sandy Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^oC)	26		

Material Test Report

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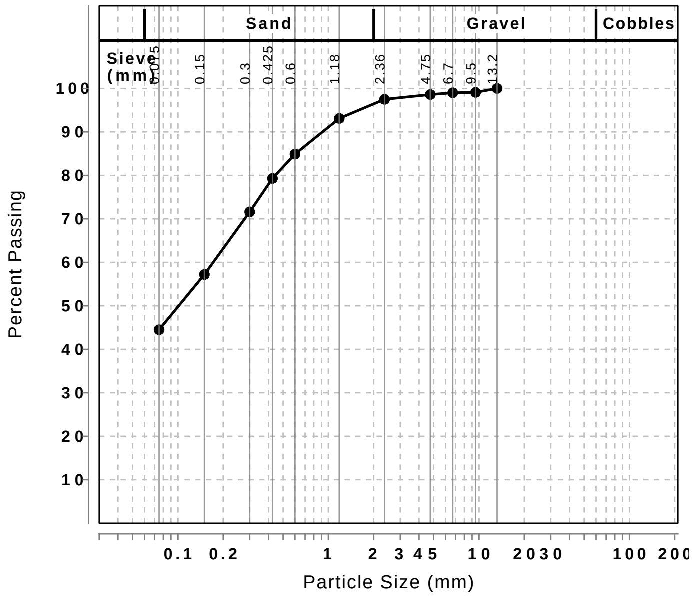
Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705AY
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**14 (2.5m)**
Material:	Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
13.2 mm	**100**		
9.5 mm	**99**		
6.7 mm	**99**		
4.75 mm	**99**		
2.36 mm	**98**		
1.18 mm	**93**		
0.6 mm	**85**		
0.425 mm	**79**		
0.3 mm	**72**		
0.15 mm	**57**		
0.075 mm	**45**		

Particle Size Distribution



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BA
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**19 (3.0m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	12.3

Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BB
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**1 (2.0m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.5

Material Test Report

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Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BC
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**2 (0.8m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.9

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BD
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **4 (0.6m)**
Material: Silty Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BE
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **8 (1.5m)**
Material: Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	14.6

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	66		
Plastic Limit (%)	17		
Plasticity Index (%)	**49**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	Curling		

Material Test Report

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Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BF
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **17 (0.5m)**
Material: Silty Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BG
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **18 (0.2m)**
Material: Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

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NATA Accredited Laboratory Number: 828

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BH
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **21 (0.1m)**
Material: Silty Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		

Material Test Report

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Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BI
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**25 (0.5m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.6

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	55		
Plastic Limit (%)	14		
Plasticity Index (%)	**41**		

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

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

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Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BJ
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**27 (0.5m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	66		
Plastic Limit (%)	13		
Plasticity Index (%)	**53**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	17.0		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BK
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**24 (0.85m)**
Material:	Silty Clay

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Earthworks Manager

NATA Accredited Laboratory Number: 828

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.3

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	40		
Plastic Limit (%)	10		
Plasticity Index (%)	**30**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	None		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		
* Mineral Present	Carbonate		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BL
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **32 (0.1m)**
Material: Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BM
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **29 (0.1m)**
Material: Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BN
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**28 (0.1m)**
Material:	Silty Clay

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	Silty Clay		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	26		
* Mineral Present	Carbonate		

Material Test Report

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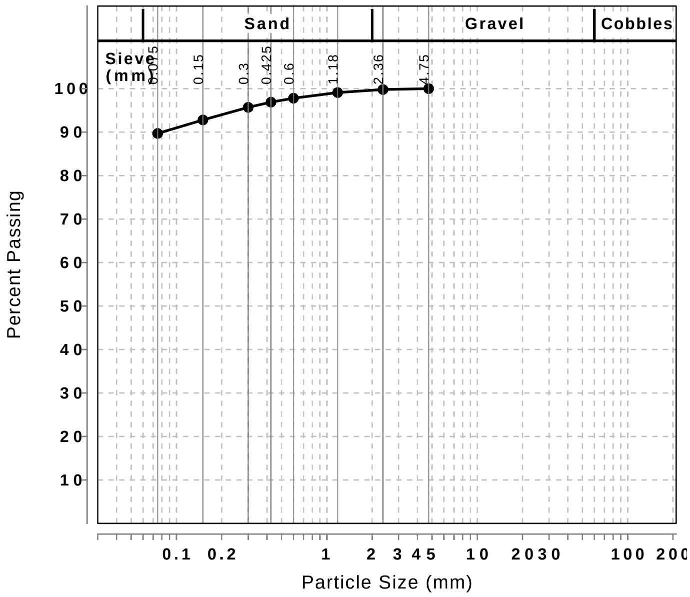
Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BO
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **32 (1.0 - 1.45m)**
Material: Silty Clay

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**99**		
0.6 mm	**98**		
0.425 mm	**97**		
0.3 mm	**96**		
0.15 mm	**93**		
0.075 mm	**90**		

Particle Size Distribution



Material Test Report

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BP
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**29 (1.5 - 1.95m)**
Material:	Silty Clay

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Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.4

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	66		
Plastic Limit (%)	13		
Plasticity Index (%)	**53**		

Material Test Report

Report Number: **91256.00-1**
Issue Number: 1
Date Issued: 22/02/2018
Client: First Solar (Australia) Pty Ltd
Level 3, SYDNEY NSW 2000
Project Number: 91256.00
Project Name: Proposed Solar Farm
Project Location: Goolma Road, Wellington
Work Request: 1705
Sample Number: 18-1705BQ
Date Sampled: 11/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **28 (1.0 - 1.45m)**
Material: Silty Clay

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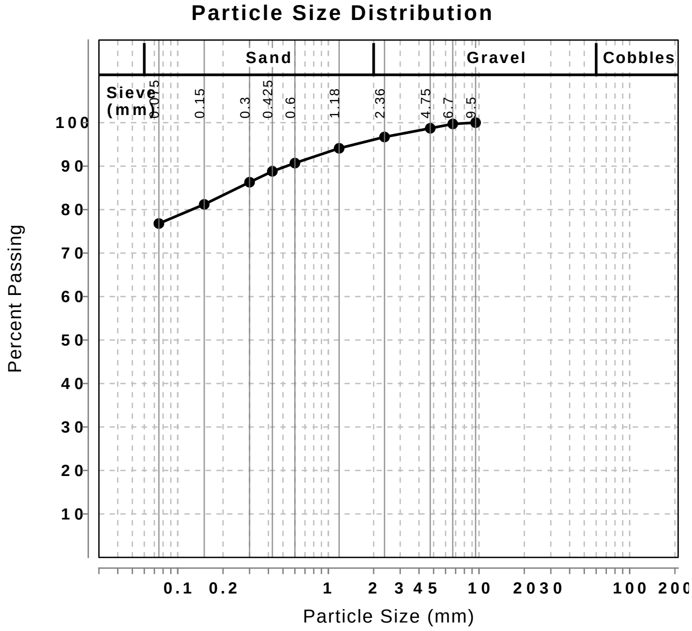
Earthworks Manager
NATA Accredited Laboratory Number: 828

Particle Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**99**		
2.36 mm	**97**		
1.18 mm	**94**		
0.6 mm	**91**		
0.425 mm	**89**		
0.3 mm	**86**		
0.15 mm	**81**		
0.075 mm	**77**		



Material Test Report

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Approved Signatory: Peter Gorseski
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NATA Accredited Laboratory Number: 828

Report Number:	**91256.00-1**
Issue Number:	1
Date Issued:	22/02/2018
Client:	First Solar (Australia) Pty Ltd Level 3, SYDNEY NSW 2000
Project Number:	91256.00
Project Name:	Proposed Solar Farm
Project Location:	Goolma Road, Wellington
Work Request:	1705
Sample Number:	18-1705BR
Date Sampled:	11/01/2018
Sampling Method:	Sampled by Engineering Department
Sample Location:	**28 (2.5 - 2.95m)**
Material:	Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	19.7

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	61		
Plastic Limit (%)	23		
Plasticity Index (%)	**38**		

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CERTIFICATE OF ANALYSIS 184415

Client Details

Client	Douglas Partners Newcastle
Attention	Michael Gawn
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details

Your Reference	**91256.00**
Number of Samples	24 Soil
Date samples received	02/02/2018
Date completed instructions received	02/02/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	13/02/2018
Date of Issue	15/02/2018

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Results Approved By
Long Pham, Team Leader, Metals
Nick Sarlamis, Inorganics Supervisor

Authorised By

David Springer, General Manager

Misc Inorg - Soil						
Our Reference		184415-1	184415-2	184415-3	184415-4	184415-5
Your Reference	UNITS	3	8	9	12	13
Depth		0.05	0.05	0.1	0.01	0.01
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
pH 1:5 soil:water	pH Units	7.2	6.8	7.0	5.5	5.9
Electrical Conductivity 1:5 soil:water	µS/cm	100	100	91	300	160
Phosphorus (Colwell)	mg/kg	25	31	63	97	30
Phosphorus Buffer Index	mg/kg	760	570	480	560	600

Misc Inorg - Soil						
Our Reference		184415-6	184415-7	184415-8	184415-9	184415-10
Your Reference	UNITS	17	18	22	1	3
Depth		0.05	0.01	0.05	0.5	0.5
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
pH 1:5 soil:water	pH Units	6.3	5.5	6.1	6.9	6.7
Electrical Conductivity 1:5 soil:water	µS/cm	150	340	110	21	34
Emerson Aggregate	-	[NA]	[NA]	[NA]	3b	5.0
Phosphorus (Colwell)	mg/kg	42	58	58	[NA]	[NA]
Phosphorus Buffer Index	mg/kg	560	350	1,600	[NA]	[NA]

Misc Inorg - Soil						
Our Reference		184415-11	184415-12	184415-13	184415-14	184415-15
Your Reference	UNITS	4	7	7	9	13
Depth		0.5	0.5	2.0	0.9	00.5
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
pH 1:5 soil:water	pH Units	7.1	6.9	8.3	8.3	7.9
Electrical Conductivity 1:5 soil:water	µS/cm	38	41	75	72	64
Emerson Aggregate	-	5.0	5.0	3b	5.0	7.0

Misc Inorg - Soil						
Our Reference		184415-16	184415-17	184415-18	184415-19	184415-20
Your Reference	UNITS	14	13	14	17	18
Depth		0.6	1.2	0.9	0.3	2.2
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
pH 1:5 soil:water	pH Units	7.9	8.7	8.4	7.6	8.6
Electrical Conductivity 1:5 soil:water	μS/cm	42	500	120	28	270
Emerson Aggregate	-	3b	4.0	3b	5.0	1.0

Misc Inorg - Soil					
Our Reference		184415-21	184415-22	184415-23	184415-24
Your Reference	UNITS	19	24	32	32
Depth		1.0	2.5-2.85	00.5	2.0
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018
pH 1:5 soil:water	pH Units	8.1	9.1	7.5	8.2
Electrical Conductivity 1:5 soil:water	μS/cm	24	73	15	110
Emerson Aggregate	-	3b	4.0	5.0	4.0

Acid Extractable Cations in Soil						
Our Reference		184415-1	184415-2	184415-3	184415-4	184415-5
Your Reference	UNITS	3	8	9	12	13
Depth		0.05	0.05	0.1	0.01	0.01
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/02/2018	06/02/2018	06/02/2018	06/02/2018	06/02/2018
Date analysed	-	06/02/2018	06/02/2018	06/02/2018	06/02/2018	06/02/2018
Calcium	mg/kg	3,100	2,900	4,000	1,900	2,700
Magnesium	mg/kg	1,900	2,400	1,200	3,000	1,900

Acid Extractable Cations in Soil				
Our Reference		184415-6	184415-7	184415-8
Your Reference	UNITS	17	18	22
Depth		0.05	0.01	0.05
Date Sampled		09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil
Date prepared	-	06/02/2018	06/02/2018	06/02/2018
Date analysed	-	06/02/2018	06/02/2018	06/02/2018
Calcium	mg/kg	2,900	1,700	1,400
Magnesium	mg/kg	1,400	1,800	1,800

ESP/CEC						
Our Reference		184415-1	184415-2	184415-3	184415-4	184415-5
Your Reference	UNITS	3	8	9	12	13
Depth		0.05	0.05	0.1	0.01	0.01
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	06/02/2018	06/02/2018	06/02/2018	06/02/2018	06/02/2018
Exchangeable Ca	meq/100g	15	13	19	6.6	10
Exchangeable K	meq/100g	3.1	2.2	3.3	2.5	2.3
Exchangeable Mg	meq/100g	3.7	3.9	3.7	1.7	3.4
Exchangeable Na	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	meq/100g	22	19	26	11	16
ESP	%	<1	<1	<1	<1	<1

ESP/CEC				
Our Reference		184415-6	184415-7	184415-8
Your Reference	UNITS	17	18	22
Depth		0.05	0.01	0.05
Date Sampled		09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil
Date prepared	-	05/02/2018	05/02/2018	05/02/2018
Date analysed	-	06/02/2018	06/02/2018	06/02/2018
Exchangeable Ca	meq/100g	13	7.5	9.3
Exchangeable K	meq/100g	3.9	2.4	2.1
Exchangeable Mg	meq/100g	3.2	2.1	2.3
Exchangeable Na	meq/100g	<0.1	<0.1	<0.1
Cation Exchange Capacity	meq/100g	20	12	14
ESP	%	<1	<1	<1

Moisture						
Our Reference		184415-1	184415-2	184415-3	184415-4	184415-5
Your Reference	UNITS	3	8	9	12	13
Depth		0.05	0.05	0.1	0.01	0.01
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/02/2018	06/02/2018	06/02/2018	06/02/2018	06/02/2018
Date analysed	-	07/02/2018	07/02/2018	07/02/2018	07/02/2018	07/02/2018
Moisture	%	20	8.9	8.8	15	19

Moisture				
Our Reference		184415-6	184415-7	184415-8
Your Reference	UNITS	17	18	22
Depth		0.05	0.01	0.05
Date Sampled		09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil
Date prepared	-	06/02/2018	06/02/2018	06/02/2018
Date analysed	-	07/02/2018	07/02/2018	07/02/2018
Moisture	%	17	15	7.3

Method ID	Methodology Summary
Ext-054	Analysed by MPL Envirolab
Ext-062	Analysed by East West Enviroag
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
Metals-020	Determination of various metals by ICP-AES.

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/02/2018	1	05/02/2018	05/02/2018		05/02/2018	[NT]
Date analysed	-			05/02/2018	1	05/02/2018	05/02/2018		05/02/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	7.2	7.1	1	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	100	84	17	101	[NT]
Emerson Aggregate	-	0	Ext-062	[NT]	11	5.0	[NT]		[NT]	[NT]
Phosphorus (Colwell)	mg/kg	1	Ext-054	<1	1	25	24	4	111	[NT]
Phosphorus Buffer Index	mg/kg	2	Ext-054	<2	1	760	780	3	102	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	05/02/2018	05/02/2018		05/02/2018	[NT]
Date analysed	-			[NT]	11	05/02/2018	05/02/2018		05/02/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	7.1	7.1	0	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	38	34	11	102	[NT]
Emerson Aggregate	-	0	Ext-062	[NT]	21	3b	[NT]		[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	05/02/2018	05/02/2018		[NT]	[NT]
Date analysed	-			[NT]	21	05/02/2018	05/02/2018		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	21	8.1	8.0	1	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	21	24	24	0	[NT]	[NT]

QUALITY CONTROL: Acid Extractable Cations in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-9	184415-2
Date prepared	-			06/02/2018	1	06/02/2018	06/02/2018		06/02/2018	06/02/2018
Date analysed	-			06/02/2018	1	06/02/2018	06/02/2018		06/02/2018	06/02/2018
Calcium	mg/kg	5	Metals-020	<5	1	3100	2800	10	97	#
Magnesium	mg/kg	5	Metals-020	<5	1	1900	1500	24	98	#

QUALITY CONTROL: ESP/CEC					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/02/2018	1	05/02/2018	05/02/2018		05/02/2018	[NT]
Date analysed	-			06/02/2018	1	06/02/2018	06/02/2018		06/02/2018	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	1	15	15	0	103	[NT]
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	1	3.1	3.1	0	109	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	1	3.7	3.7	0	103	[NT]
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	1	<0.1	<0.1	0	100	[NT]
ESP	%	1	Metals-009	[NT]	1	<1	<1	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Acid Extractable Metals in Soil: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Colwell Phosphorus & Phosphorus Buffer Index analysed by MPL Laboratories. Report No.206405.

Emerson Aggregate analysed by East West. Report no. EW180592
3b = moderate to slight dispersion of the remould.

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12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 183838

Client Details	
Client	Douglas Partners Newcastle
Attention	Michael Gawn
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details	
Your Reference	**91256.00, Wellington**
Number of Samples	14 Soil
Date samples received	24/01/2018
Date completed instructions received	24/01/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details	
Date results requested by	01/02/2018
Date of Issue	31/01/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

David Springer, General Manager

Misc Inorg - Soil						
Our Reference		183838-1	183838-2	183838-3	183838-4	183838-5
Your Reference	UNITS	1	2	4	5	6
Depth		1.3	2.0	0.2	0.4	2.0
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018	25/01/2018
Date analysed	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018	25/01/2018
pH 1:5 soil:water	pH Units	7.5	6.9	7.0	6.8	9.2
Electrical Conductivity 1:5 soil:water	µS/cm	40	500	30	10	180
Chloride, Cl 1:5 soil:water	mg/kg	10	570	10	<10	80
Sulphate, SO4 1:5 soil:water	mg/kg	<10	120	<10	<10	45

Misc Inorg - Soil						
Our Reference		183838-6	183838-7	183838-8	183838-9	183838-10
Your Reference	UNITS	8	8	9	11	12
Depth		0.7	2.0	0.6	1.5	1.2
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018	25/01/2018
Date analysed	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018	25/01/2018
pH 1:5 soil:water	pH Units	7.9	9.0	8.1	8.7	8.0
Electrical Conductivity 1:5 soil:water	µS/cm	23	51	100	72	15
Chloride, Cl 1:5 soil:water	mg/kg	<10	20	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	<10	<10	<10	<10

Misc Inorg - Soil					
Our Reference		183838-11	183838-12	183838-13	183838-14
Your Reference	UNITS	14	15	18	19
Depth		0.2	1.0	1.5	2.0
Date Sampled		09/01/2018	09/01/2018	09/01/2018	09/01/2018
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018
Date analysed	-	25/01/2018	25/01/2018	25/01/2018	25/01/2018
pH 1:5 soil:water	pH Units	5.7	7.5	8.4	8.3
Electrical Conductivity 1:5 soil:water	µS/cm	67	77	62	120
Chloride, Cl 1:5 soil:water	mg/kg	79	21	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	22	21	<10	<10

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	183838-2
Date prepared	-			25/01/2018	1	25/01/2018	25/01/2018		25/01/2018	25/01/2018
Date analysed	-			25/01/2018	1	25/01/2018	25/01/2018		25/01/2018	25/01/2018
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	7.5	7.8	4	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	40	38	5	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	10	10	0	109	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	103	#

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	25/01/2018	25/01/2018		[NT]	[NT]
Date analysed	-			[NT]	11	25/01/2018	25/01/2018		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	5.7	5.8	2	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	67	66	2	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	79	63	23	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	22	22	0	[NT]	[NT]

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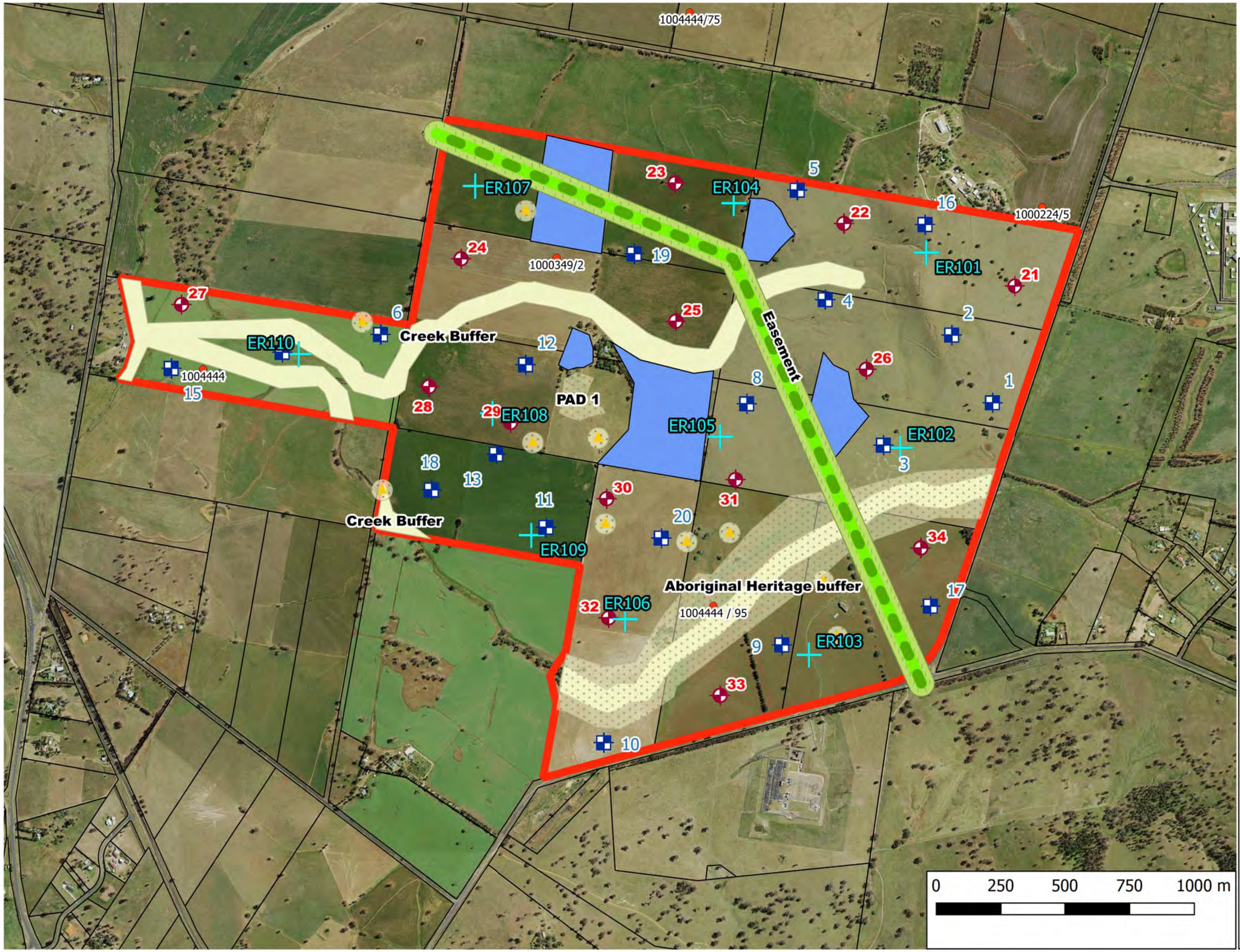
Appendix F

Drawing 1 - Test Location Plan



Locality Plan

Legend

- Test Pit Locations
- Test Bore Locations
- Electrical Resistivity
- Creek Buffer
- Easement
- Land Buffers
- Ecologial Area
- Aboriginal Heritage Buffer
- Site Boundary
- espade soil technical report

Drawing adapted from plans provided by client and SIX maps aerial imagery

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	First Solar (Australia) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:15,000 @ A3	DATE:	22.12.2017

TITLE: **Test Location Plan**
Proposed Solar Farm
Goolma Road, Wellington

N

PROJECT No:	91256.00
DRAWING No:	1
REVISION:	0