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Our Ref: PSM3739-004L Rev 6

13 October 2020

Mirvac Projects Pty Limited
Level 28, 200 George Street
SYDNEY NSW 2000

russell.hogan@mirvac.com

Attention: Russell Hogan

Dear Russell

RE: 788-904 MAMRE ROAD, KEMPS CREEK (LOTS 54-58 - DP259135)
RESULT OF GEOTECHNICAL INVESTIGATIONS

1. Introduction

This document has been prepared in consideration of the Planning Secretary's Environmental Assessment Requirements (SEARs) issued for the proposal (SSD-10448) issued on 30 April 2020. Table 1 below summaries all key issues relevant to this report and how they have been responded to.

Table A – SEARs Compliance.

Key Issue	Requirements	Response/Reference
Soils and Water	An assessment of potential impacts to soil and water resources, topography, hydrology, groundwater, groundwater dependent ecosystems, drainage lines, downstream assets such as the Warragamba Pipelines Corridor, watercourses and riparian lands on or nearby to the site, including mapping and description of existing background conditions and cumulative impacts and measures proposed to reduce and mitigate impacts.	With regards to the groundwater encountered during investigation please refer to Section 4.4 of the letter.
Soils and Water	Consideration of salinity and acid sulphate soil impacts	With regards to the salinity and acid sulphate soil discussion, please refer to Section 6 of this letter.

The investigation works has been undertaken in accordance with PSM following proposals

- PSM3739-001L Rev 1 dated 3 December 2018 for Lot 54-57
- PSM3739-007L dated 9 January 2019 for Lot 58 and

This revised letter includes the following geotechnical investigation:

- Geotechnical investigation between 30 November and 4 December 2018 for Lot 54-57
- Geotechnical investigation on 16 January 2019 for Lot 58.

2. Background

To assist in the geotechnical investigation, we were provided with and reviewed the following documents:

- An image showing the location of the subject site (Lot 54-57) contained within the original request email dated 28 November 2018
- An image showing the location of the subject site (Lot 58) contained within the request email for additional investigation dated 21 December 2018
- Master plan – Estate Stage 1 for Lot 54-57 of the subject site, drawing no. KCK_MR_MP05 Rev A, dated 19 November 2018
- A screenshot of the preliminary cut and fill contour for Lot 54-57 of the subject site.

We understand Mirvac's proposed development for this stage will comprise of warehouses and office combined compounds. Bulk earthworks will be required as part of the development. Based on the screenshot of the preliminary cut and fill contour, we note that the proposed earthworks may comprise:

- Cut depths up to approximately 12 m
- Fill depths up to approximately 5 m.

3. Geotechnical Investigation

As requested by Mirvac, PSM have completed a geotechnical investigation for the area.

3.1 Field Work

The fieldwork was undertaken on 30 November, 3 and 4 of December 2018, 16 of January under the full-time supervision of a PSM geotechnical engineer, who undertook the following tasks:

- Directing the testing locations and drilling
- Preparing engineering logs of the material encountered
- Collection of disturbed soil samples for further testing.

The test locations were recorded with a hand-held GPS unit with a horizontal accuracy of approximately +/- 5 m. Figure 1 presents the test locations.

3.1.1 Test Pits

A total of nineteen (19) test pits (TP1, TP3, TP8 to TP10, TP12, TP13, TP16 to TP21 and TP30 to TP35) were excavated using an 8-tonne excavator. Attachment A1 presents tabulated test pit logs and Attachment B presents photographs for these test pits.

The test pits were excavated to depths of between 1.6 m and 3.5 m.

At the completion of the fieldwork, the test pits were backfilled with excavated spoil and lightly tamped with the excavator bucket. Figure 2 presents selected site photos and Figure 3 presents selected photos of this fieldwork.

3.1.2 Boreholes

A total of eight (8) boreholes (BH1 to BH8) were drilled using a 6.5 tonne track mounted drill rig. Augering through soil was undertaken using a V bit to refusal depth and continued using a "TC" bit. Attachment A2 presents tabulated borehole logs.

The boreholes were drilled to depths of between 3.7 m and 15.0 m.

At the completion of the fieldwork, the boreholes were backfilled with excavated spoil and lightly tamped with a shovel. Figure 4 presents selected photos of this fieldwork.

3.2 Geotechnical Laboratory Results

3.2.1 California Bearing Ratio (CBR)

Five (5) bulk soil samples were recovered for the California Bearing Ration (CBR) testing.

The following sample preparation was undertaken prior to CBR testing:

- Compact to 98% standard MDD, at optimum moisture content (OMC)
- Four (4) day-soaked sample; and
- 4.5 kg surcharge.

Table 1 presents a summary of the CBR test results. The test results are included as Attachment C.

Table 1 – CBR Test Results

Sample ID (depth)	Material Description	Soaked CBR (%)	OMC (%)	Standard Maximum Dry Density (t/m3)	Swell (%)
TP3 (2.0 m)	CLAY	6*	15.1	1.83	0.0
TP8 (1.1 m)	CLAY	4.5*	19.1	1.72	2.0
TP10 (1.5 m)	SHALE	8**	10.5	1.97	0.5
TP12 (3.5 m)	CLAY	1.5*	16.5	1.79	2.5
TP20 (2.0m)	CLAY	1.5*	11.6	1.92	3.0

Note: * Indicates Soaked CBR value at 2.5mm penetration
** Indicates Soaked CBR value at 5.0mm penetration

4. Site Conditions

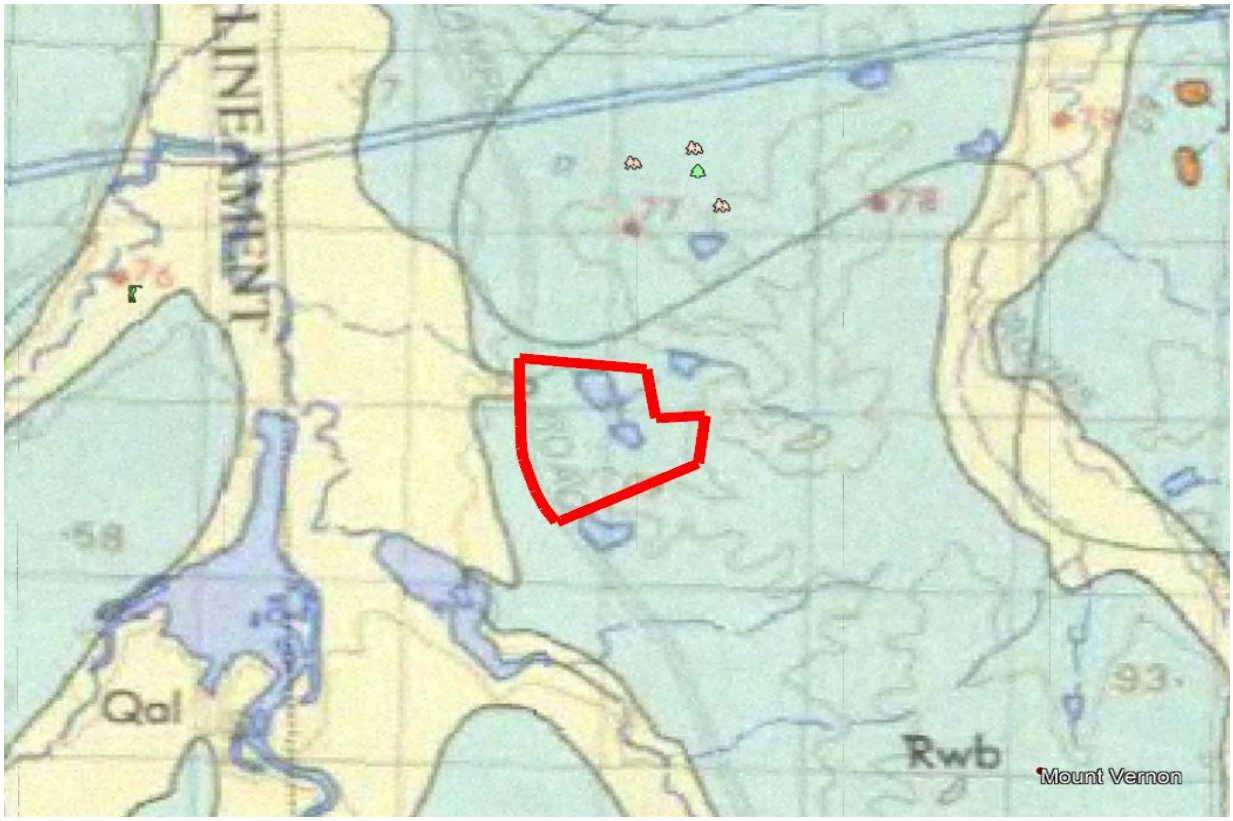
4.1 Geological Setting

The 1:100,000 Geological Map for Penrith indicates that the site is underlain by the following units:

- (Rwb) Bringelly Shale of the Wianamatta Group consisting of shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff.
- (Qal) fluvial fine-grained sand, silt and clay in areas close to South Creek and Kemps Creek.

This unit is only present at the northwest corner of the subject site.

Inset 1 presents the geological map of the site.



Inset 1: Penrith geological map indicating approximate site location

4.2 Surface Conditions

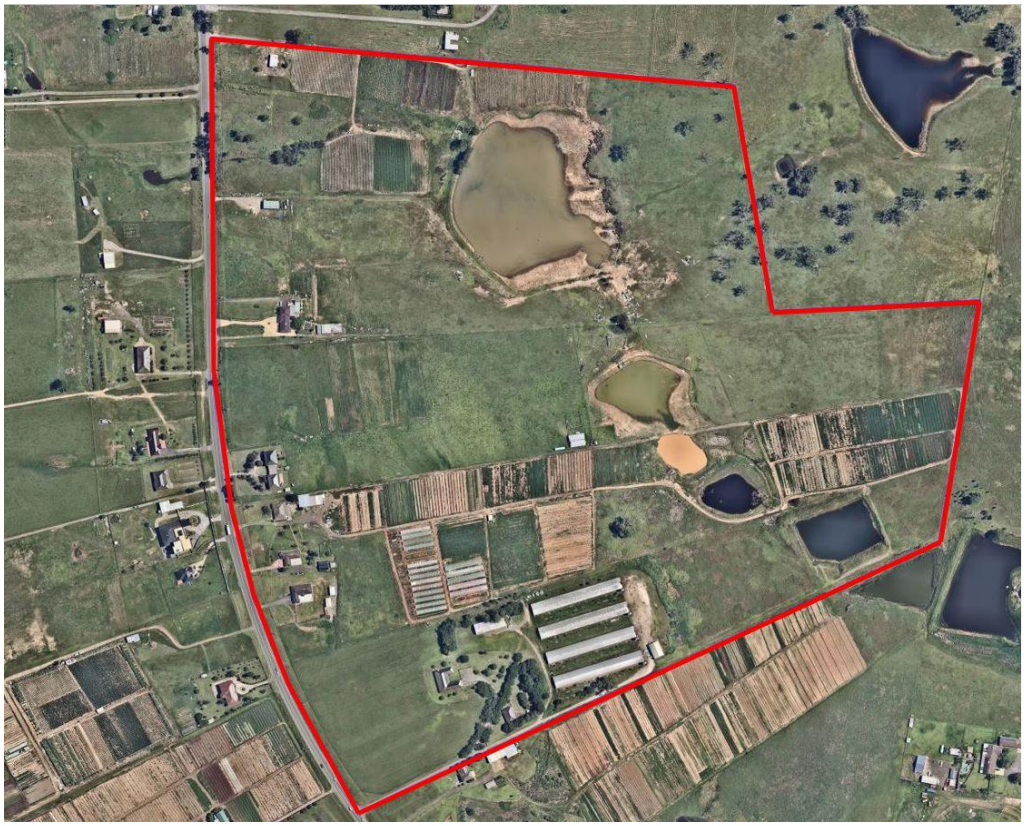
The site is located at 788-864 Mamre Road, Kemps Creek in Lots 54 to 58 in DP259135. The site is approximately 57 ha in area, and it is bounded by Mamre Road to the west, and rural land and properties to the north, east and south.

The ground is generally sloping towards the Badgery's Creek in the southwest. Lots 55 to 58 are generally flat over the western portion of the land, with a rise towards the east. Lot 54 shows a consistent fall from the east to the west (towards Mamre Road).

It is noted that several dams exist at the site, with the largest approximately 2.9 ha in area, spanning over Lot 57 and Lot 58. Historical aerial photographs reveal no obvious signs of backfilling of these dams. We note that the dam is entirely contained within the site boundary (See Inset 2).

The majority of the ground surface was grassed with other areas comprising manmade structures such as farmhouses, sheds and roads.

At the time of fieldwork, the majority of the site consisted of grassed and moderately vegetated areas with farmhouses, sheds, dirt and gravel roads and a number of dams. There are a number of chicken breeding facilities in the middle of Lot 54 (the southmost lot in the subject site).



Inset 2: Nearmap aerial photograph of site condition on 29 December 2018

4.3 Subsurface Conditions

Table 2 shows the approximate depth to the top of the inferred geotechnical units encountered in the test locations.

Table 2 – Summary of inferred subsurface conditions encountered in test locations

Inferred Unit	Inferred top of unit depth below ground surface (m)	Description
TOPSOIL	0.0 to 0.3	Silty CLAY; CLAY; Gravelly CLAY; medium to high plasticity, brown, larger angular shale gravel and smaller sub-rounded gravels, firm to stiff consistency, mostly moist but some dry areas. Rootlets and grasses observed throughout.
FILL	0.0 to 4.5	CLAY; generally low to medium plasticity, moist, firm consistency, with some gravels up to 20 mm in size.
NATURAL SOIL	0.1 to 4.5	CLAY and Silty Clay; medium to high plasticity, moist, at least stiff consistency, stiffness increases with depth, mainly mottled red, brown, orange and pale grey.
BEDROCK	1.0 to 6.5	SHALE; extremely weathered to moderately weathered, extremely to low strength, iron-stained red, brown and grey. Laminations and rock fabric visible in some sections. Decreasing weathering and increasing strength observed as depth increases.

The subsurface conditions encountered within the test locations are summarised in Table 3.

Table 3 – Depth to the top of inferred geotechnical units encountered in test locations

Test ID	Depth to top of inferred geotechnical units (m)				
	TOPSOIL	FILL	NATURAL SOIL	BEDROCK	EOH
TP1	0.0	N/E	0.2	N/E	3.0
TP3	0.0	N/E	0.15	N/E	3.0
TP8	0.0	N/E	0.2	N/E	3.0
TP9	0.0	N/E	0.0	1.9	2.9*
TP10	0.0	N/E	0	1.0	1.7*
TP12	0.0	N/E	0	N/E	3.5
TP13	0.0	N/E	0.2	N/E	3.0
TP16	0.0	N/E	0.15	1.2	1.65*
TP17	0.0	N/E	0.2	N/E	3.1
TP18	0.0	N/E	0.15	1.4	3.0
TP19	0.0	N/E	0.2	2.4	3.0
TP20	0.0	N/E	0.1	2.5	3.0
TP21	0.0	N/E	0.1	3.0	3.5
TP30	0.0	N/E	0.1	N/E	3.0
TP31	0.0	N/E	0.1	N/E	3.0
TP32	0.0	N/E	0.1	N/E	3.1
TP33	0.0	N/E	0.1	N/E	3.0
TP34	0.0	N/E	0.1	N/E	3.0
TP35	0.0	N/E	0.1	N/E	3.0
BH1	N/E	0.0	0.5	3.3	6.8**
BH2	0.0	N/E	0.2	3.0	5.2**
BH3	0.0	N/E	0.2	2.8	5.9**
BH4	0.0	N/E	0.3	4.0	7.8**
BH5	N/E	0.0	4.5	6.5	15.0
BH6	N/E	N/E	0.0	2.8	3.7**
BH7	0.0	N/E	0.3	3.2	6.5**
BH8	N/E	N/E	0.0	1.5	7.0

Note: EOH = End of Hole
N/E = Not Encountered
* = Practical refusal using excavator
** = Practical refusal using drill rig with TC bit

4.4 Groundwater

Groundwater was observed at the following test locations:

- BH5 at 3m depth
- TP1, TP32 and TP35 at 3m depth (minor seepage).

We consider that they are possibly perched water tables. Groundwater was not observed at any other location. No long-term groundwater monitoring was undertaken.

5. Soil Salinity and Aggressivity Investigation

A total of twenty-one (21) disturbed soil samples were collected by a PSM Geotechnical Engineer for testing in an environmental laboratory. Figure 1 presents the test locations.

5.1 Laboratory Results

The disturbed soil samples were sent to a NATA accredited environmental laboratory and the following tests were undertaken:

- Cation Exchange Capacity (CEC) of calcium, magnesium, potassium and sodium
- Exchange sodium percentage
- Salinity (EC 1:5, one-part soil to five parts water)
- Soil pH
- Chlorides
- Sulphates
- Resistivity.

Table 4 presents a summary of the results. The laboratory reports are presented in Attachment F.

Table 4 - Laboratory Testing Results

Sample ID	pH	Electrical Conductivity [µS/cm]	Moisture Content [%]	Chloride by Discrete Analyser [mg/kg]	Soluble Sulfate by ICPAES [mg/kg]	Exchangeable Cations [meq/100g]					ESP [%]
						Ca	Mg	K	Na	CEC	
BH5_4.2m	7.4	106	22.6	690	240	0.6	3.7	0.3	5.3	9.9	53.4
BH5_10.5m	7.4	227	22	280	560	1.1	17.1	0.6	7.8	26.6	29.2
BH4_1.0m	6.0	582	17.3	1200	580	0.9	9	0.1	3.4	13.4	25.2
BH4_5.0m	9.0	245	7.2	430	<100	<0.2	<0.2	<0.2	<0.2	<0.2	-
BH1_4.5m	5.3	594	13.4	820	900	0.2	6.6	0.2	2.8	9.8	28.9
TP16_1.5m	5.0	519	20.5	740	440	<0.1	5.9	0.1	2.1	8.2	25.8
TP17_1.0m	7.0	156	20.1	1060	450	5.4	14.6	0.4	3.3	23.7	14.1
TP10_1.5m	7.0	870	11.0	1410	490	0.6	8.4	0.1	2.0	11.1	17.8
TP18_0.4m	7.2	172	24.0	370	930	9.2	10.8	0.4	1.6	22.0	7.5
TP13_2.8m	5.4	361	13.3	460	320	<0.1	7.6	0.2	3.2	11.0	28.8
TP1_1.5m	8.0	1010	15.0	1730	700	0.3	9.3	0.3	7.1	17.0	41.8
TP21_0.3m	6.0	51	18.4	880	460	4.3	9.8	0.6	0.9	15.6	5.6
TP8_0.3m	8.8	1400	11.8	2460	400	2.0	3.5	<0.2	2.6	8.3	31.6
TP8_2.5m	6.7	41	18.7	960	230	4.2	9.7	0.2	1.1	15.2	7.0
TP3_0.3m	6.6	29	16.8	290	240	3.0	3.7	0.2	0.5	7.4	6.9
TP30_0.1m	6.6	27	9.0	130	30	2.2	6.2	0.2	0.8	9.4	8.6
TP31_1.0m	5.1	601	19.9	1080	200	<0.1	14.8	0.3	9.7	24.8	39.1
TP34_0.1m	7.1	81	13.6	510	70	4.7	10.1	0.6	1.0	16.4	6.2
TP33_0.3m	5.4	774	19.2	1540	<10	1.5	8.0	0.1	4.6	14.2	32.1
TP35_0.7m	5.6	909	14.7	1570	280	1.3	7.3	0.1	7.7	16.5	47.0

5.1.1 5.1.1 Soil Chemistry

The salinity test results, summarised in Table 4 indicate the following:

- pH of the soil samples analysed was in the range of 5.0 to 9.0, with an average of 6.5
- The 1:5 soil to water extraction and subsequent electrical conductivity ($EC_{1:5}$) of the soil samples analysed to be in the range of 27 µS/cm to 1400 µS/cm
- Concentrations of chlorides in samples analysed was in the range of 30 mg/kg to 2460 mg/kg
- Concentrations of soluble sulphate in samples analysed was in the range of less than 20 mg/kg to 930 mg/kg
- Cation Exchange Capacity (CEC) in samples analysed was in the range less than 0.2 meq/100g to 29.4 meq/100g
- Exchange Sodium Percentage (ESP) in samples analysed was in the range of 5.2% to 53.4%.

6. Salinity Assessment

6.1 Salinity

Site Investigations for Urban Salinity (DLWC 2002) classify soil salinity based on electrical conductivity (ECe). The method of conversion from EC1:5 to Ece (electrical conductivity of saturated extract) is based on DLWC (2002) and given by Ece = EC1:5 x M, where M is the multiplication factor based on “Soil Texture Group”.

The “Soil Texture Group” of the samples tested were assessed during our investigation. The salinity classification for the soil samples that were tested are presented in Table 5.

Table 5 – Salinity Classification

Sample ID	EC1:5 (dS/m)	Soil Type	M	ECe (dS/m)	Salinity Class
BH5_4.2m	0.106	Light Medium Clay	8	0.848	Non-saline
BH5_10.5m	0.227	Light Medium Clay	8	1.816	Non-saline
BH4_1.0m	0.582	Heavy Clay	6	3.492	Slightly Saline
BH4_5.0m	0.245	Light Medium Clay	8	1.96	Non-saline
BH1_4.5m	0.594	Light Medium Clay	8	4.752	Moderately Saline
TP16_1.5m	0.519	Heavy Clay	6	3.114	Slightly Saline
TP17_1.0m	0.156	Heavy Clay	6	0.936	Non-saline
TP10_1.5m	0.870	Heavy Clay	6	5.22	Moderately Saline
TP18_0.4m	0.172	Light Medium Clay	8	1.376	Non-saline
TP13_2.8m	0.361	Heavy Clay	6	2.166	Slightly Saline
TP1_1.5m	1.010	Heavy Clay	6	6.06	Moderately Saline
TP21_0.3m	0.051	Light Medium Clay	8	0.408	Non-saline

Sample ID	EC1:5 (dS/m)	Soil Type	M	ECe (dS/m)	Salinity Class
TP8_0.3m	1.400	Light Medium Clay	8	11.2	Very Saline
TP8_2.5m	0.041	Heavy Clay	6	0.246	Non-saline
TP3_0.3m	0.029	Light Medium Clay	8	0.232	Non-saline
TP30_0.1m	0.027	Light Medium Clay	8	0.216	Non-saline
TP31_1.0m	0.601	Light Medium Clay	8	4.808	Moderately Saline
TP34_0.1m	0.081	Light Medium Clay	8	0.648	Non-saline
TP33_0.3m	0.774	Light Medium Clay	8	6.192	Moderately Saline
TP35_0.7m	0.909	Light Medium Clay	8	7.272	Moderately Saline

It is assessed that the majority of the soils on site are classified as “non-saline to moderately saline”, except for the one sample from TP8 that is very saline. We note that TP8 is located in the proposed fill area.

We have referred to Clause 4.8.2 of Australian Standard AS3600-2009 “Concrete Structures” and note that the assessed soil electrical conductivity (ECe) is less than the upper limit of the “B1” exposure classification.

6.2 Corrosivity / Aggressivity

Table 6.4.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for concrete piles based on sulphates in the soil and groundwater, soil and groundwater pH, and chlorides in groundwater. On the basis of the soil sulphates and pH testing completed we assess the exposure classification for concrete piles in the soil to be mild.

Table 6.5.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for steel piles based on resistivity, soil and groundwater pH, and chlorides in soil and groundwater. On the basis of soil chlorides, resistivity and pH testing completed we assess the exposure classification for steel piles in the soil to be non-aggressive.

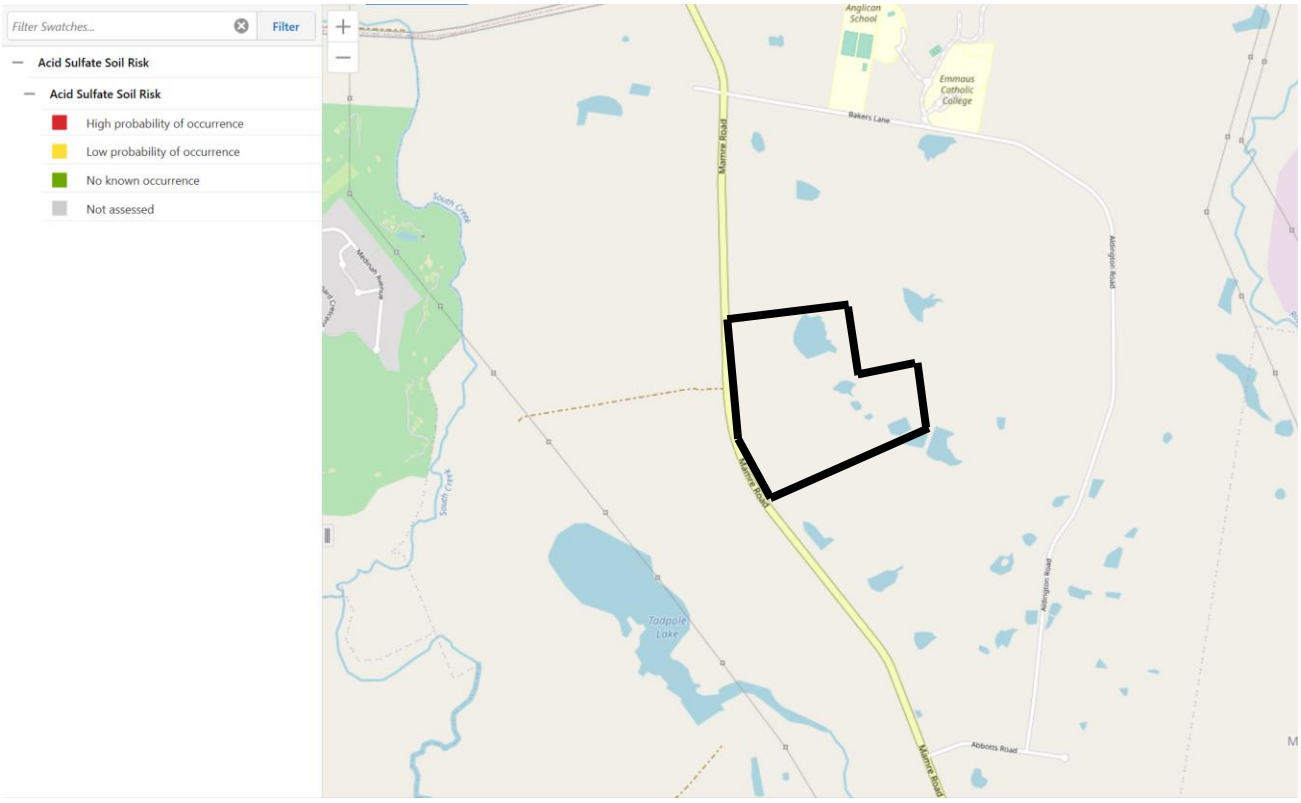
6.3 Sodicity

Sodicity provides a measure of the likely dispersion on wetting and to shrink/swell properties of a soil. Soil sodicity is classified based on the Exchangeable Sodium Percentage (ESP) which is the amount of exchangeable sodium as a percentage of the Cation Exchange Capacity (DLWC, 2002).

The Exchangeable Sodium Percentages calculated from these laboratory results, ranging from 5.6% to 53.4%, indicates that the soils on site range from sodic to highly sodic when compared to criteria listed in “Site Investigations for Urban Salinity”, DLWC (2002).

6.4 Acid Sulphate Soils

Based on the NSW Government SEED (Sharing and Enabling Environmental Data), the site is not located within the areas covered by the Acid Sulphate Soil Risk Map Data. The risk of acid sulphate soils is considered low within this site.



Inset 3: Acid Sulphate Soils Map - Black Outline Defines Approximate Site Boundary

7. Discussion

7.1 Excavation Conditions

Excavation in the Topsoil, Fill, Natural Soil and Bedrock units is expected to be achievable using conventional earth moving equipment with minor rock breaking.

It is our experience that excavatability is heavily dependent on both the operator and the plant used. Any earthworks contractor should satisfy itself with regard to excavatability especially in the bedrock unit.

Please note that the 8-tonne excavator encountered practical refusal in TP9, TP10 and TP16. The 6.5 tonne drill rig encountered TC bit practical refusal (or slow advance) in BH1 to BH4, BH6, BH7 and BH9.

We expect the existing dams will need to be drained and the sediments at the base of the dams need to be excavated / removed prior to filling.

7.2 Permanent and Temporary Batters

The batter slope angles shown in Table 6 are recommended for the design of batters up to 12 m height subject to the following recommendations:

- The batters shall be protected from erosion
- Permanent batters shall be drained
- Temporary batters shall not be left unsupported for more than 2 months without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events
- No buildings, loads or services should be located within 1 batter height of the crest.

If the conditions above cannot be met, further advice should be sought.

Where Fill is not engineered/controlled fill, batter slope angles should be assessed by a geotechnical engineer.

Exposed rock faces should be inspected by a geotechnical engineer or engineering geologist to assess the need for localised rock bolting to control adverse jointing in the Bedrock unit and shotcreting for overall face support.

Table 6 – Batter Slope Angles

Unit		Temporary	Permanent
ENGINEERED FILL		1.5H : 1V	2H : 1V
NATURAL SOIL		1.5H : 1V	2H : 1V
BEDROCK*	(for portion of cut less than or equal to 6 m deep)	0.5 H : 1V	1 H : 1V
	(for portion of cut greater than 6 m deep)	1H : 1V	1.5H : 1V

Note: *: See above requirements regarding inspections.

Proper and suitable safe work method statements and OHS documents need to be developed for works to be undertaken in the vicinity of the crest and toe of batters, including temporary batters for the Bedrock unit.

Steeper batters may be possibly subject to further advice, probably including inspection during construction and possible shotcreting, spot bolting etc.

7.3 Retaining Walls

Cuts in the Fill, Natural Soil and Bedrock units steeper than the recommended permanent batter slopes in Section 6.2 will need to be supported by some form of retaining structure.

The selection of the appropriate retention system is a matter of design. The designer should consider the following factors in making its selection:

- Technical factors
  - Performance
  - Ground conditions (this is addressed below with the design parameters)
  - Surcharge loading and
  - Proximity of structures, buildings and roads, etc.
- Non- technical factors
  - Cost (to build and to maintain)
  - Other constraints such as real estate, neighbouring site / boundary, aesthetics, legislation, etc.

The design of these structures should be based on the following geotechnical properties:

- Effective soil strength parameters in Table 7
- A lateral pressure of 10 kPa for vertical cuts in the BEDROCK units. This is to allow for blocks and rock wedges formed due to adverse defects that may exist within the unit.

Note that design of retention systems may be based on either Ka or Ko earth pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires a wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

Where the design is based on Ko pressures, construction should be carefully controlled to avoid unwanted effects. It should be noted that designing for Ko pressures do not, of themselves, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drainage needs to be designed and constructed properly to prevent pore water pressures from building up behind the retaining walls or appropriate water pressures must be included in the design.

Table 7 – Engineering Parameters of Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m^3)	Soil Effective Strength Parameters		Ultimate Bearing Pressure Under Vertical Centric Loading (kPa)	Allowable Bearing Pressure under Vertical Centric Loading (kPa)	Ultimate Shaft Adhesion Ultimate Shaft Adhesion (kPa)	Elastic Parameters	
		c' (kPa)	*Φ'* (deg)				Young's Modulus (MPa)	Poisson's Ratio
Engineered Fill	18	0	30	420*	150*	N.A.	10	0.3
Natural Soil	18	0	30	420*	150*	N.A.	10	0.3
Bedrock	22	N.A.	N.A.	3000***	700**	50	50	0.25

Note: * Minimum plan dimension of 1 m and embedment depth of at least 0.5 m

** ABP for BEDROCK assumes a settlement of approximately 1% of the least footing dimension for footings in rock.

*** UBP for BEDROCK assumes a settlement of approximately 5% of the least footing dimension for footings in rock.

7.4 Bulk Earthworks Specification, Warehouse facilities – Interim Geotechnical Design Advice

We have prepared separate documents for the following:

- Bulk Earthworks Specification – Refer PSM3739-006S Rev. 4, see Attachment E.
- An Interim Geotechnical Design Advice (IGDA) for the proposed development site – Refer PSM3739-005L Rev.4, see Attachment D.

  The advice (IGDA) for the proposed development has been provided based on the following:

  – The subsurface conditions encountered is as logged and inferred from the site investigations
  – The proposed earthworks will be completed in accordance to the bulk earthworks specification (Attachment E)
  – PSM review the earthworks documents as per the specifications, e.g. earthworks audit, to confirm the advice.

8. General

If at any time, the conditions are found to vary from those described in this report, further advice should be sought.

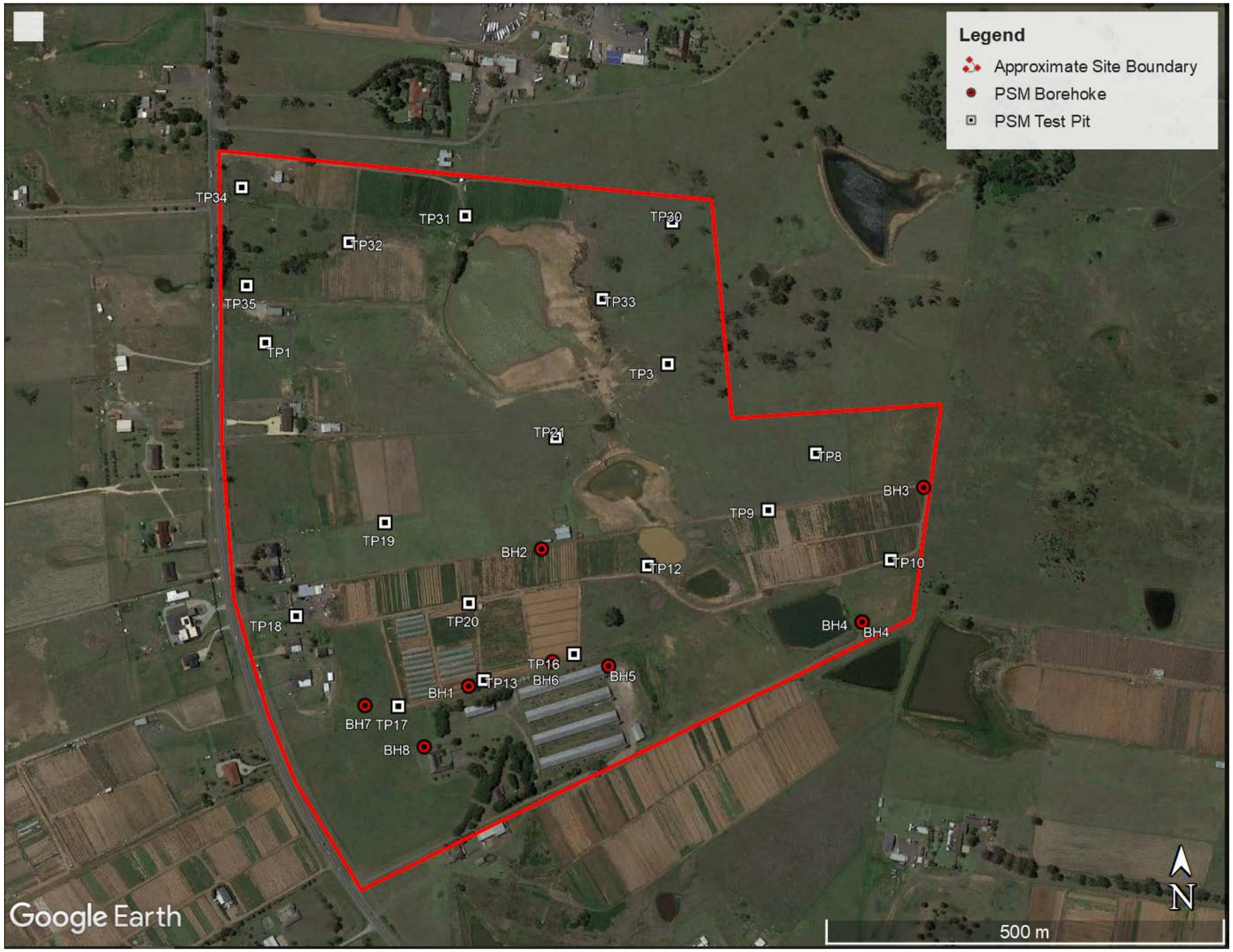
Should there be any queries, do not hesitate to contact the undersigned

For and on behalf of
PELLS SULLIVAN MEYNINK

MATIAS BRAGA
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl.	Figure 1	Test Locations
	Figure 2	Selected Photos (1 of 3)
	Figure 3	Selected Photos (2 of 3)
	Figure 4	Selected Photos (3 of 3)
	Attachment A1	Tabulated Test Pit Logs
	Attachment A2	Tabulated Borehole Logs
	Attachment B	Test Pit Photographs
	Attachment C	CBR testing results
	Attachment D	Environmental testing results
	Attachment E	PSM3739-005L – Interim Geotechnical Design Advice
	Attachment F	PSM3739-006S – Bulk Earthworks Specification



MIRVAC

KEMPS CREEK

788-864 Mamre Road, Kemps Creek NSW

GEOTECHNICAL INVESTIGATION

LOCALITY PLAN

Pells Sullivan Meynink

PSM3739-004L	FIGURE 1

Photo 3 - 8 tonne excavator

Photo 4 - Excavated material

Mirvac

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Kemps Creek, NSW

SELECTED SITE PHOTOS (2 OF 3)

Pells Sullivan Meynink

PSM3739-004L	Figure 3

Photo 5 - Drilling rig

Photo 6 - Augered material

Mirvac

788-864 Mamre Road

Kemps Creek, NSW

SELECTED SITE PHOTOS (3 OF 3)

Photo 5 - Drilling rig

Photo 6 - Augered material

Mirvac

788-864 Mamre Road

Kemps Creek, NSW

SELECTED SITE PHOTOS (3 OF 3)

Attachment A1
Tabulated Test Pit Logs

Attachment A1: Tabulated Test Pit Logs

Test Pit ID	Depth	Material Encountered
TP1	0 – 0.2 m	TOPSOIL; brown, gravels up to 5 mm, sub-rounded. Rootlets present.
	0.2 – 3.0 m	CLAY; clear dark brown layer between 0.3 – 0.5 m. Moist and stiff consistency, medium to high plasticity. Becomes red clay at 0.5 m Becomes mottled grey and orange at 2.0 m
	3.0 m	Hole terminated at 3.0 m.
TP3	0 – 0.15 m	TOPSOIL; Silty CLAY; light brown, dry, rootlets throughout
	0.15 – 3.0 m	CLAY; orange, medium to high plasticity, moist, stiff consistency. Becomes more yellow at 2.0 m.
	3.0 m	Hole terminated at 3.0 m.
TP8	0 – 0.2 m	TOPSOIL; CLAY; light brown, sub-rounded gravels, rootlets throughout.
	0.2 – 3.0 m	CLAY; medium plasticity, red, moist, stiff consistency. Becoming orange with mottled grey at 1.0 m.
	3.0 m	Hole terminated at 3.0 m.

Test Pit ID	Depth	Material Encountered
TP9	0.0 – 1.9 m	CLAY; medium to high plasticity, red, moist, stiff consistency. Becoming grey at 1.5 m, dry.
	1.9 – 2.9 m	SHALE; mainly grey, with highlights of brown and black, highly to extremely weathered, very low strength. Rock fabric visible.
	2.9 m	Refusal at 2.9 m. Hole terminated.
TP10	0 – 1.0 m	CLAY: Brown and light brown, medium plasticity
	1.0 – 1.7 m	SHALE; light brown/orange, extremely weathered in the upper half, laminations faintly visible below 1.4 m.
	1.7 m	Refusal at 1.7 m. Hole terminated.
TP12	0.0 – 3.5 m	CLAY; medium plasticity, red and mottled brown, moist, stiff consistency. Becomes grey at 3.0 m.
	3.5 m	Hole terminated at 3.5 m.

Test Pit ID	Depth	Material Encountered
TP13	0 – 0.2 m	TOPSOIL; brown and dark brown, loose, soft, moist.
	0.2 – 3.0 m	CLAY; brown and mottled orange, high plasticity, moist.
	3.0 m	Hole terminated at 3.0 m
TP16	0 – 0.15 m	TOPSOIL; CLAY; medium plasticity, dark brown and red, rootlets present.
	0.15 – 1.2 m	CLAY; high plasticity, mainly light grey with orange and red, moist, stiff.
	1.2 – 1.65	SHALE; mottled red, dark grey and orange, highly weathered, very low strength.
	1.65 m	Refusal at 1.65 m. Hole terminated.
TP17	0 – 0.2 m	TOPSOIL; Silty CLAY; brown, moist, loose, rootlets present.
	0.2 – 3.1 m	CLAY; medium plasticity, mottled brown, moist, stiff. Becomes mottled grey at 1.8 m.
	3.1 m	Hole terminated at 3.1 m.

Test Pit ID	Depth	Material Encountered
TP18	0 – 0.15 m	TOPSOIL; gravelly silty clay, dry, some sheet-like angular gravels of size 10 – 25 mm, rootlets present.
	0.15 – 1.4 m	CLAY; high plasticity, red and brown with mottled grey, moist, stiff consistency.
	1.4 – 3.0 m	SHALE; high to medium weathering, grey and dark brown, extremely to very low strength.
	3.0 m	Hole terminated at 3.0 m.
TP19	0 – 0.2 m	TOPSOIL; CLAY; low to medium plasticity, moist, dark brown with some sub-rounded gravels of size 2 to 5 mm. Rootlets present.
	0.2 – 2.4 m	CLAY; natural, high plasticity, brown and red, high strength. Becoming light grey and mottled red at 0.8 m. Becoming more light grey at 1.2 m.
	2.4 – 3.0 m	SHALE; grey and iron stained, red, a tint of orange, extremely to highly weathered, extremely low to very low strength. Becoming brown and dark grey at 3.0 m, very low to low strength.
	3.0 m	Hole terminated at 3.0 m.

Test Pit ID	Depth	Material Encountered
TP20	0 – 0.1 m	TOPSOIL; brown, medium plasticity, moist with some rootlets.
	0.1 – 2.5 m	CLAY; red, low to medium plasticity, firm consistency. Becoming mottled grey, stiff consistency at 1.3 m.
	2.5 – 3.0 m	SHALE; highly weathered, light and dark grey, extremely to very low strength.
	3.0 m	Hole terminated at 3.0 m.
TP21	0 – 0.1 m	TOPSOIL; CLAY; medium plasticity, brown, with rootlets.
	0.1 – 3.0 m	CLAY; yellow, medium to high plasticity, moist, stiff consistency. Becoming orange at 0.5 m. Becoming grey at 1.0 m.
	3.0 – 3.5 m	SHALE; highly weathered, grey and red, extremely low to very low strength.
	3.5 m	Hole terminated at 3.5 m.

Test Pit ID	Depth	Material Encountered
TP30	0 – 0.1 m	TOPSOIL; Silty CLAY; brown, non-plastic, with some rootlets, dry and soft consistency.
	0.1 – 2.0 m	CLAY; orange-brown, medium plasticity, moist, stiff consistency. Becoming dark brown at 0.9 m.
	2.0 – 3.0 m	CLAY; grey and orange-brown, medium plasticity, moist and very stiff consistency. Becoming very stiff to hard at 2.6 m.
	3.0 m	Hole terminated at 3.0 m.
TP31	0 – 0.1 m	TOPSOIL; Silty CLAY, trace of gravel; dark brown, non-plastic, sub-angular gravel up to 2 mm with some rootlets, dry and soft to firm consistency.
	0.1 – 3.0 m	CLAY; orange-brown, medium plasticity, moist and very stiff consistency. Becomes grey and mottled red at 0.5 m. Becomes mostly grey and very stiff to hard at 2.0 m.
	3.0 m	Hole terminated at 3.0 m.

Test Pit ID	Depth	Material Encountered
TP32	0 – 0.1 m	TOPSOIL; Silty CLAY with a trace of gravel, pale brown, low plasticity, sub-rounded gravel up to 1 mm with some rootlets, dry and soft to firm consistency.
	0.1 – 0.8 m	CLAY; orange-brown, low to medium plasticity, moist and firm consistency.
	0.8 – 1.2 m	Gravelly CLAY; black, grey and brown, low to medium plasticity, sub-angular gravel up to 5 mm, moist and firm consistency.
	1.2 m – 3.1 m	CLAY; mottled red and grey, medium plasticity, moist and stiff consistency. Becomes grey, orange-brown and very stiff at 2.0 m. Becomes wet at 3.0 m, water ponding at the base of the pit.
	3.1 m	Hole terminated at 3.1 m.

Test Pit ID	Depth	Material Encountered
TP33	0 – 0.1 m	TOPSOIL; Silty CLAY; light brown, low plasticity with some rootlets, dry and firm consistency.
	0.1 – 0.5 m	Silty CLAY; dark brown and black, low to medium plasticity, moist and firm consistency.
	0.5 m – 1.4 m	CLAY, red-brown and grey, medium plasticity, moist and firm consistency.
	1.4 m – 2.0 m	Gravelly CLAY; dark brown and black, low to medium plasticity, sub-angular gravel up to 5 mm, moist and stiff consistency.
	2.0 m – 3.0 m	Gravelly CLAY; grey, orange and black, medium plasticity, sub-angular gravel up to 5 mm, moist and very stiff consistency.
	3.0 m	Hole terminated at 3.0 m.

Test Pit ID	Depth	Material Encountered
TP34	0 – 0.1 m	TOP SOIL; Sandy CLAY with some gravel, red-brown, low plasticity, medium grained sand, sub-angular gravel up to 20 mm with some rootlets, moist and firm consistency. Bricks and building waste observed.
	0.1 m – 0.7 m	CLAY with a trace of gravel; grey and red, low plasticity, sub-rounded gravel up to 5 mm, moist and firm to stiff consistency.
	0.7 m – 1.2 m	Silty CLAY; black-brown, low plasticity, moist and firm consistency.
	1.2 – 2.7 m	CLAY; orange-brown, medium plasticity, moist and stiff consistency. Becomes dark drown and very stiff at 2.0 m.
	2.7 m to 3.0 m	CLAY; grey and orange, medium plasticity, moist and very stiff consistency.
	3.0 m	Hole terminated at 3.0 m.

Test Pit ID	Depth	Material Encountered
TP35	0 – 0.1 m	TOP SOIL; Silty CLAY, pale brown, low plasticity with some rootlets, dry and firm consistency.
	0.1 m – 1.0 m	CLAY; orange-brown, low plasticity, dry and very stiff consistency.
	1.0 m – 2.9 m	Sandy CLAY with a trace of gravel; dark brown and black, low to medium plasticity, sub-angular gravel up to 2 mm, moist and stiff consistency Becomes wet and soft at 2.2 m.
	2.9 m to 3.0 m	CLAY; grey and orange, medium plasticity, moist and very stiff to hard consistency.
	3.0 m	Hole terminated at 3.0 m.

Attachment A2
Tabulated Borehole Logs

Attachment A2: Tabulated Test Pit Logs

Borehole ID	Depth	Material Encountered
BH1	0 – 0.5 m	FILL; CLAY; high plasticity, brown and red, moist, firm consistency.
	0.5 – 3.3 m	CLAY; high plasticity, orange and brown, moist, stiff consistency. Becomes medium plasticity, light grey and mottled red, very stiff consistency at 1.5 m. Becomes grainy at 2 m. Becomes light grey, mottled red and orange at 2.5 m.
	3.3 – 4.0 m	SHALE; dark grey, extremely weathered, excavated as gravels of size 2 – 10 mm, moist. V-bit refusal at 3.5 m. Changed to TC bit.
	4.0 – 6.8 m	SHALE; mottled red, brown and light grey, extremely to highly weathered, extremely low to very low strength, moist, with no fabric observed. Becomes grey and dark grey, moderately weathered, low strength at 5.0 m. Becomes moderately to slightly weathered, low to medium strength at 6.5 m.
	6.8 m	Hole terminated at 6.8 m.

Borehole ID	Depth	Material Encountered
BH2	0 - 0.2 m	TOPSOIL; CLAY; medium to high plasticity, dark brown, moist, firm consistency.
	0.2 – 3.0 m	CLAY; medium plasticity, grey, mottled red and orange, moist, stiff to very stiff consistency. Becomes grainy and hard consistency at 2.0 m.
	3.0 – 5.2 m	SHALE; light grey and mottled red, extremely weathered, very low strength, moist. V-bit refusal at 3.2 m. Changed to TC bit. Becomes light and dark grey, highly to moderately weathered, low strength at 3.5 m. Becomes dark grey, moderately weathered, low strength at 5.0 m.
	5.2 m	TC bit refusal at 5.2 m. Hole terminated at 5.2 m.
BH3	0 – 0.2 m	TOPSOIL; CLAY; high plasticity, black and brown, moist, firm to stiff consistency. Becomes light brown and grey at 0.5 m.
	0.2 – 1.5 m	CLAY; high plasticity, light brown, dry, very stiff consistency. V-bit refusal at 1.5 m. Changed to TC bit.
	1.5 – 2.8 m	CLAY; high plasticity, light grey and orange, dry, hard consistency. Becomes darker and rock texture very faintly visible at 2.0 m.
	2.8 – 5.9 m	SHALE; grey and dark grey, extremely to highly weathered, very low strength, dry. Becomes highly to moderately weathered, low strength at 3.5 m. Becomes dark grey, moderately weathered, medium strength at 5.0 m.
	5.9 m	Hole terminated at 5.9 m.

Borehole ID	Depth	Material Encountered
BH4	0 - 0.3 m	TOPSOIL; CLAY; medium plasticity, dark brown, moist, firm consistency. Rootlets observed throughout.
	0.3 – 4.0 m	CLAY; medium to high plasticity, light brown, moist, stiff consistency. Trace of gravel of size 2 – 10 mm observed at 2.5 m. Increased shale gravel content observed at 3.5 m. V-bit refusal at 4.0 m. Changed to TC bit.
	4.0 – 7.8 m	SHALE; grey and brown, extremely weathered, extremely low strength, moist, with no rock fabric observed. Becomes highly to moderately weathered, very low to low strength at 5.0 m. Becomes grey, dark grey and brown at 6.0 m. Becomes moderately weathered at 7.0 m.
	7.8 m	Hole terminated at 7.8 m.

Borehole ID	Depth	Material Encountered
BH5	0 – 4.5 m	FILL; CLAY; low to medium plasticity, brown, with gravels of size up to 20 mm, moist. Becomes brown, grey and mottled orange, firm consistency at 1.0 m. Becomes grey and dark grey, wet, with gravels of size up to 20 mm at 3.0 m. Rootlets observed at 3.5 m.
	4.5 – 6.5 m	CLAY; high plasticity, mottled red and light grey, wet, stiff consistency. Mottled grey and red shale rock fragments of size up to 30 mm observed at 5.2 m. V-bit refusal at 6.0 m. Changed to TC bit.
	6.5 – 15.0 m	SHALE; light grey, mottled red and orange, extremely weathered, extremely low strength, wet. Becomes grey and dark grey, highly weathered, extremely low to very low strength, with rock fabric faintly visible at 8.5 m.
	15.0 m	Hole terminated at 15.0 m.

Borehole ID	Depth	Material Encountered
BH6	0 – 2.8 m	CLAY; medium plasticity, light grey, brown and orange, trace of gravel of size less than 10 mm, moist, stiff consistency. Becomes light brown, dry, very stiff to hard consistency V-bit refusal at 1.6 m. Changed to TC bit. Becomes grey, dark grey and mottled red, with rock texture not visible at 1.8 m.
	2.8 – 3.7 m	SHALE; grey, brown and red, extremely to highly weathered, extremely to very low strength. Becoming grey and dark grey, highly to moderately weathered, very low to low strength at 3.2 m.
	3.7 m	TC bit refusal at 3.7 m. Hole terminated at 3.7 m.

Borehole ID	Depth	Material Encountered
BH7	0 - 0.3 m	TOPSOIL; Gravelly CLAY; medium to high plasticity, brown, with gravels of size up to 10 mm, moist.
	0.3 – 3.2 m	CLAY; medium to high plasticity, grey and brown, traces of gravel of size 2 – 5 mm, moist, stiff to very stiff consistency. Becomes increasingly grainy at 1.5 m. Becoming grey and dark red, hard consistency with rock fabric not visible at 2.0 m. V-bit refusal at 2.0 m. Changed to TC bit. Becoming light grey and mottled red at 2.5 m.
	3.2 – 6.5 m	SHALE; light and dark grey with a shade of weathered brown, highly to moderately weathered, very low to low strength. Becomes dark grey, moderately weathered, low to medium strength at 5.5 m.
	6.5 m	TC bit refusal at 6.5 m. Hole terminated at 6.5 m.

Borehole ID	Depth	Material Encountered
BH8	0 - 1.5 m	CLAY; high plasticity, brown, moist, stiff consistency. Becomes light brown at 0.5 m. Becomes less moist at 1.0 m and very stiff consistency. V-bit refusal at 1.5 m. Changed to TC bit.
	1.5 – 7.0 m	SHALE; brown and orange, extremely weathered, extremely low to very low strength, with rock fabric not visible. Becomes grey and brown at 2.5 m. Becomes brown, grey and dark grey, highly to moderately weathered, low strength at 3.0 m. Laminations faintly visible from 3.5 – 4.0 m. Becoming grey and dark grey, slightly weathered, medium strength at 6.5 m.
	7.0 m	Hole terminated at 7.0 m.

Attachment B
Test Pit Photographs

Test Pit TP01

Pells Sullivan Meynink

Mirvac **Mamre Road** **Kemps Creek, NSW** **GEOTECHNICAL INVESTIGATION** **TP01**	
PSM3739-004L	**Attachment B**

Test Pit TP03

Pells Sullivan Meynink

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Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION
TP03

PSM3739-004L	**Attachment B**

Test Pit TP08

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP08

PSM3739-004L	**Attachment B**

Test Pit TP09

Pells Sullivan Meynink

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Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION
TP09

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Test Pit TP10

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP10

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Test Pit TP12

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GEOTECHNICAL INVESTIGATION
TP12

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Test Pit TP13

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GEOTECHNICAL INVESTIGATION
TP13

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Test Pit TP16

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GEOTECHNICAL INVESTIGATION
TP16

PSM3739-004L	Attachment B

Test Pit TP17

Pells Sullivan Meynink

Mirvac **Mamre Road** **Kemps Creek, NSW** **GEOTECHNICAL INVESTIGATION** **TP17**	
PSM3739-004L	**Attachment B**

Test Pit TP18

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP18

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Test Pit TP19

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GEOTECHNICAL INVESTIGATION
TP19

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Test Pit TP20

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GEOTECHNICAL INVESTIGATION
TP20

PSM3739-004L	**Attachment B**

Test Pit TP21

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP21

PSM3739-004L	**Attachment B**

Test Pit TP30

Pells Sullivan Meynink

Mirvac **Mamre Road** **Kemps Creek, NSW** **GEOTECHNICAL INVESTIGATION** **TP30**	
PSM3739-004L	**Attachment B**

Test Pit TP31

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP31

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Test Pit TP32

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP32

PSM3739-004L	Attachment B

Test Pit TP33

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GEOTECHNICAL INVESTIGATION
TP33

PSM3739-004L	Attachment B

Test Pit TP34

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GEOTECHNICAL INVESTIGATION
TP34

PSM3739-004L	Attachment B

Test Pit TP35

Pells Sullivan Meynink

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GEOTECHNICAL INVESTIGATION
TP35

PSM3739-004L	Attachment B

Attachment C
CBR testing results

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

SOIL TEST SERVICES
ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink
PSM Job No.: PSM3739

Ref No: L4226E
Report: 1
Report Date: 17/12/2018
Page 1 of 1

TESTPIT NUMBER		TP 3	TP 8	TP 10	TP 12	TP 20
DEPTH (m)		2.0	1.1	1.5	3.5	2.0
Surcharge (kg)		4.5	4.5	4.5	4.5	4.5
Maximum Dry Density (t/m^3)		1.83 STD	1.72 STD	1.97 STD	1.79 STD	1.92 STD
Optimum Moisture Content (%)		15.1	19.1	10.5	16.5	11.6
Moulded Dry Density (t/m^3)		1.79	1.68	1.93	1.76	1.88
Sample Density Ratio (%)		98	98	98	98	98
Sample Moisture Ratio (%)		102	100	95	101	100
Moisture Contents						
Insitu (%)		21.8	20.0	7.1	19.0	10.9
Moulded (%)		15.4	19.1	10.0	16.6	11.6
After soaking and						
After Test, Top 30mm(%)		17.2	25.4	14.5	24.2	18.4
Remaining Depth (%)		17.1	20.3	14.2	17.7	15.6
Material Retained on 19mm Sieve (%)		0	0	14*	0	12*
Swell (%)		0.0	2.0	0.5	2.5	3.0
C.B.R. value:	@2.5mm penetration	6	4.5		1.5	1.5
	@5.0mm penetration			8		

NOTES: Sampled and supplied by client.

- Refer to appropriate Test Pit logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 05/12/2018.
- * Denotes not used in test sample.

NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.

Approved Signatory / Date (D. Treweek) 17/12/18

Attachment D
Environmental Testing Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1836197**	Page	: 1 of 3
Amendment	: **1**		
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: YUN BAI	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: PSM3739 KEMPS CREEK	Date Samples Received	: 30-Nov-2018 15:00
Order number	:	Date Analysis Commenced	: 04-Dec-2018
C-O-C number	: ----	Issue Date	: 12-Dec-2018 14:55
Sampler	: YB/AN		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- Amendment (12/12/2018): This report has been amended and re-released to allow the reporting of additional analytical data.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH5_4.2m	BH5_10.5m	BH4_1.0m	BH4_5.0m	----
			Client sampling date / time	30-Nov-2018 00:00	30-Nov-2018 00:00	30-Nov-2018 00:00	30-Nov-2018 00:00	----
Compound	CAS Number	LOR	Unit	ES1836197-001	ES1836197-002	ES1836197-003	ES1836197-004	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.4	7.4	6.0	9.0	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	106	227	582	245	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	344	736	1890	796	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	22.6	22.0	17.3	7.2	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	0.6	1.1	----	<0.2	----
Exchangeable Magnesium	----	0.2	meq/100g	3.7	17.1	----	<0.2	----
Exchangeable Potassium	----	0.2	meq/100g	0.3	0.6	----	<0.2	----
Exchangeable Sodium	----	0.2	meq/100g	5.3	7.8	----	<0.2	----
Cation Exchange Capacity	----	0.2	meq/100g	9.9	26.6	----	<0.2	----
Exchangeable Sodium Percent	----	0.2	%	53.4	29.2	----	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	0.9	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	9.0	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	3.4	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	13.4	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	25.2	----	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	240	560	580	<100	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	690	280	1200	430	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1836306**	Page	: 1 of 4
Amendment	: **1**		
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: YUN BAI	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: PSM 3739 KEMPS CREEK	Date Samples Received	: 03-Dec-2018 17:45
Order number	:	Date Analysis Commenced	: 06-Dec-2018
C-O-C number	: ----	Issue Date	: 12-Dec-2018 14:44
Sampler	: YUN BAI		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

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This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (12/12/2018): This report has been amended and re-released to allow the reporting of additional analytical data.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH1_4.5m	TP16_1.5m	TP17_1.0m	TP10_1.5m	TP18_0.4m
			Client sampling date / time	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00
Compound	CAS Number	LOR	Unit	ES1836306-001	ES1836306-002	ES1836306-003	ES1836306-004	ES1836306-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.3	5.0	7.0	7.0	7.2
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	594	519	156	870	172
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	1930	1690	507	2830	559
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	13.4	20.5	20.1	11.0	24.0
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	5.4	----	9.2
Exchangeable Magnesium	----	0.1	meq/100g	----	----	14.6	----	10.8
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.4	----	0.4
Exchangeable Sodium	----	0.1	meq/100g	----	----	3.3	----	1.6
Cation Exchange Capacity	----	0.1	meq/100g	----	----	23.7	----	22.0
Exchangeable Sodium Percent	----	0.1	%	----	----	14.1	----	7.5
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.2	<0.1	----	0.6	----
Exchangeable Magnesium	----	0.1	meq/100g	6.6	5.9	----	8.4	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.1	----	0.1	----
Exchangeable Sodium	----	0.1	meq/100g	2.8	2.1	----	2.0	----
Cation Exchange Capacity	----	0.1	meq/100g	9.8	8.2	----	11.1	----
Exchangeable Sodium Percent	----	0.1	%	28.9	25.8	----	17.8	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	900	440	450	490	930
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	820	740	1060	1410	370

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	TP13_2.8m	----	----	----	----
			Client sampling date / time	03-Dec-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1836306-006	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.4**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**361**	----	----	----	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	**1170**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**13.3**	----	----	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**7.6**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	**0.2**	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	**3.2**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**11.0**	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	**28.8**	----	----	----	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	**320**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**460**	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1836377**	Page	: 1 of 3
Amendment	: **2**		
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: YUN BAI	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: PSM3739	Date Samples Received	: 04-Dec-2018 18:00
Order number	:	Date Analysis Commenced	: 06-Dec-2018
C-O-C number	: ----	Issue Date	: 17-Dec-2018 17:12
Sampler	: Angus Nelson		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 5		
No. of samples analysed	: 5		

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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- Amendment (12/12/2018): This report has been amended and re-released to allow the reporting of additional analytical data.
- Amendment (17/12/2018): This report has been amended as a result of a request to change sample identification numbers (IDs). All analysis results are as per the previous report.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	TP1_1.5m	TP21_0.3m	TP8_0.3m	TP8_2.5m	TP3_0.3m
			Client sampling date / time	04-Dec-2018 00:00	04-Dec-2018 00:00	04-Dec-2018 00:00	04-Dec-2018 00:00	04-Dec-2018 00:00
Compound	CAS Number	LOR	Unit	ES1836377-001	ES1836377-002	ES1836377-003	ES1836377-004	ES1836377-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.0	6.0	8.8	6.7	6.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1010	51	1400	41	29
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	3270	165	4540	134	96
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	15.0	18.4	11.8	18.7	16.8
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	0.3	----	2.0	----	----
Exchangeable Magnesium	----	0.2	meq/100g	9.3	----	3.5	----	----
Exchangeable Potassium	----	0.2	meq/100g	0.3	----	<0.2	----	----
Exchangeable Sodium	----	0.2	meq/100g	7.1	----	2.6	----	----
Cation Exchange Capacity	----	0.2	meq/100g	17.0	----	8.3	----	----
Exchangeable Sodium Percent	----	0.2	%	41.8	----	31.6	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	4.3	----	4.2	3.0
Exchangeable Magnesium	----	0.1	meq/100g	----	9.8	----	9.7	3.7
Exchangeable Potassium	----	0.1	meq/100g	----	0.6	----	0.2	0.2
Exchangeable Sodium	----	0.1	meq/100g	----	0.9	----	1.1	0.5
Cation Exchange Capacity	----	0.1	meq/100g	----	15.6	----	15.2	7.4
Exchangeable Sodium Percent	----	0.1	%	----	5.6	----	7.0	6.9
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	700	460	400	230	240
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	1730	880	2460	960	290

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1901534**	Page	: 1 of 4
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: YUN BAI	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: Lot 58, 788 Kemps Creek	Date Samples Received	: 16-Jan-2019 15:30
Order number	: PSM3739	Date Analysis Commenced	: 22-Jan-2019
C-O-C number	: ----	Issue Date	: 25-Jan-2019 15:38
Sampler	: Matias Braga		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

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- Analytical Results

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Signatories

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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

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Where moisture determination has been performed, results are reported on a dry weight basis.

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When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	TP30-0.1m	TP31-1.0m	TP34-0.1m	TP33-0.3m	TP32-1.5m
			Client sampling date / time	16-Jan-2019 13:30	16-Jan-2019 12:00	16-Jan-2019 09:00	16-Jan-2019 01:00	16-Jan-2019 10:00
Compound	CAS Number	LOR	Unit	ES1901534-001	ES1901534-002	ES1901534-003	ES1901534-004	ES1901534-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.6	5.1	7.1	5.4	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	27	601	81	774	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.0	19.9	13.6	19.2	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	37000	1660	12300	1290	1920
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	2.2	<0.1	4.7	1.5	----
Exchangeable Magnesium	----	0.1	meq/100g	6.2	14.8	10.1	8.0	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.3	0.6	0.1	----
Exchangeable Sodium	----	0.1	meq/100g	0.8	9.7	1.0	4.6	----
Cation Exchange Capacity	----	0.1	meq/100g	9.4	24.8	16.4	14.2	----
Exchangeable Sodium Percent	----	0.1	%	8.6	39.1	6.2	32.1	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	200	70	<10	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	130	1080	510	1540	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	TP35-0.7m	----	----	----	----
			Client sampling date / time	16-Jan-2019 11:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1901534-006	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.6**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**909**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**14.7**	----	----	----	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**1100**	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**1.3**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**7.3**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	**0.1**	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	**7.7**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**16.5**	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	**47.0**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**280**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**1570**	----	----	----	----

Attachment E
PSM3739-005L-Interim Geotechnical Design Advice

Level 6, 500 Queen Street
GPO Box 3244
Brisbane QLD 4000
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F +61 7 3252 5516
E mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM3739-005L Rev 6

13 October 2020

Mirvac Project Pty Ltd
Level 28, 200 George Street
SYDNEY NSW 2000

russell.hogan@mirvac.com

Attention: Russell Hogan

Dear Russell

RE: 788-864 MAMRE ROAD KEMPS CREEK
INTERIM GEOTECHNICAL DESIGN ADVICE

1. Introduction

This letter provides interim geotechnical design advice (IGDA) for the proposed development at 788-904 Mamre Road, Kemps Creek. This interim advice will be issued as final on completion of the bulk earthworks.

Figure 1 presents the locality plan.

We are not aware of any performance requirements for the proposed development.

2. Bulk Earthworks

The design advice in the following sections is provided on the basis that:

- The bulk earthworks on site to be completed in accordance with a PSM Specification, currently PSM3739-006S-REV5 (the Specification)
- PSM to audit the earthworks to confirm the advice in this letter at the completion of the bulk earthworks.

The Specification allows for a broad range of fill to be incorporated into the earthworks. Fill placed in accordance with the Specification will be well compacted under tight site supervision. The subgrade will be stiff or better.

The Specification complies with the intent of AS 3798-2007 “Guidelines on earthworks for commercial and residential developments” and is intended to specify the minimum requirements to achieve a fill with the properties provided in Section 3 of this letter. The Specification is generally in accordance with AS3798-2007, but for this site it allows Blended Topsoil Fill and Compacted Insitu Topsoil.

The Specification requires close inspection, frequent testing and external auditing of the earthworks to provide a high level of confidence that the completed work complies with the Specification. The Specification will only be varied with the consent of PSM to ensure that this interim design advice is able to be confirmed at the completion of the earthworks.

We have based our assessment of moduli on numerous plate load tests (PLTs) completed on VENM / ENM fills by PSM.

If the structural or civil engineer requires engineering properties different to those provided in Section 3 then the specification can be modified such that these properties will be obtained in the final earthworks.

This allows the additional cost of the earthworks to be balanced against any economies achieved in other parts of the works.

3. Design Advice

3.1 All Areas

This section provides interim design advice for all areas where the bulk earthworks has been undertaken in accordance with the Specification. Note, this advice allows for Blended Topsoil Fill and Compacted Insitu Topsoil Subgrade (Refer PSM3739-006S-REV5).

3.2 Site Classification

While the proposed development is out of scope of AS2870-2011 “Residential slabs and footings”, we assess that, for the natural site, cut and fill placed in accordance with the Specification, the characteristic surface movement, y_s, would be in the range 40 mm to 60 mm and thus would classify the site as Class H1. The civil and structural engineers should consider likely heave / settlement due to the effect of climatic factors in their designs.

We recommend that all structures and services be detailed such that they preclude any local wetting up or drying out of the subgrade after initial equilibrium is reached following construction of the slab and that the subgrade be within specification at the time of construction of the slab. We note that normal mounding or sagging away from the perimeter of covered areas will still occur and perimeters, or open joints, will still respond to environmental changes.

For effectively sealed areas away from the perimeter, the design should allow for the following:

- Differential mound movement, y_m = 20 mm. We note that this is not the total heave or settlement but the estimated local heave or settlement due to fill variability
- Tilts of up to approximately 1 in 300.

Mounds at perimeters or penetrations of slabs open to the environment can be taken to be as per AS2870-2011 for y_s = 55 mm.

The designer should consider variation of fill depth across any area. It is our opinion that creep settlements can be ignored for fill of this depth placed in accordance with the Specification. Further the designer should consider the impact of any delay in construction of slabs and pavements following completion of the bulk earthworks.

3.3 Foundations

The following section provides advice and parameters that may be used when proportioning footings.

Where adjacent foundation details differ (e.g. pile and pad, differing loads or ground conditions) differential settlement will need to be assessed.

3.3.1 Pad Footings

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads presented in Table 1.

Table 1 - Engineering Parameters of Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m3)	Soil Effective Strength Parameters		Ultimate Bearing Pressure Under Vertical Centric Loading (kPa)	Allowable Bearing Pressure under Vertical Centric Loading (kPa)	Ultimate Shaft Adhesion Ultimate Shaft Adhesion (kPa)	Elastic Parameters	
		c' (kPa)	Φ' (deg)				Young's Modulus (MPa)	Poisson's Ratio
Engineered Fill	18	0	30	420*	150*	N.A.	10	0.3
Natural Soil	18	0	30	420*	150*	N.A.	10	0.3
Bedrock	22	N.A.	N.A.	3000***	700**	50	50	0.25

Note: * Minimum plan dimension of 1 m and embedment depth of at least 0.5 m

** ABP for BEDROCK assumes a settlement of approximately 1% of the least footing dimension for footings in rock.

*** UBP for BEDROCK assumes a settlement of approximately 5% of the least footing dimension for footings in rock.

If the base of a pad footing is founded between 0 and 2 m above the "Compacted Insitu Topsoil", then an additional 20 mm should be added to the settlement calculation.

Higher ABPs may be available, but these depend on the size, depth, loads, etc. and would be subject to specific advice.

Footing settlement can be assessed based on the subgrade Young's moduli provided in Table 1. We recommend that PSM inspect a representative sample of the footings during construction, to confirm the advice provided in this letter.

3.3.2 Slabs

The design of the slabs for the warehouse can be based on a subgrade with the following Young's moduli:

- For slabs founded on ENGINEERED FILL or NATURAL SOIL:
  - Long term Young's modulus (E_{LT}) of 10 MPa
  - Short term Young's modulus (E_{ST}) of 15 MPa.
- For slabs founded on BEDROCK:
  - Long term Young's modulus (E_{LT}) of 50 MPa
  - Short term Young's modulus (E_{ST}) of 75 MPa.

The design of the slabs on ground should consider the effects of differential settlement due to varying founding conditions, pattern loading, and the shrink swell effects discussed in Section 3.2.

3.4 Pavements

Results of CBR testing indicate a soaked CBR value of between 1.5% and 8% (Ref. PSM3739-004L).

We recommend a design CBR value of 2.0% is adopted for pavement design. Particular attention should be paid to preserving the equilibrium moisture content in the subgrade as zones that become saturated may exhibit lower CBR strengths.

Higher values, particularly in areas of significant cut, may be provided on completion of testing on the finished bulk earthworks or if, on request, the Specification is varied to obtain such higher value on fill.

3.5 General

We note that the final bulk earthworks subgrade will require proof rolling and plate load testing to confirm the properties provided and may require some boxing out and refilling, etc. Plate load testing during the filling will be required where blended topsoil has been used.

We understand that the structural engineer should be able to design an efficient slab and shallow footings for these geotechnical conditions. If assessed deformation and settlement is an issue, then our advice can be further refined if required.

We note that desiccation and/or wetting up of the pad surface is possible should it be exposed to the elements for an extended period of time, particularly at completion of the bulk earthworks prior to the builder taking responsibility for the pad. To reduce the likelihood of this and preserve the pad condition we recommend the following should be considered following completion of the bulk earthworks:

- Placement of a sacrificial layer comprising road base or other equivalent material
- Grade the pad surface to reduce the extent and severity of standing water during and after weather events
- Minimise the time between the completion of earthworks and the builder commencing construction of the warehouse roof
- Limit vehicular and plant access until a roof has been installed.

Alternately, the developer or builder may have to undertake some surficial remediation if the pad is to comply with the requirements of this IGDA (i.e. comply with the PSM Specification) at the time of construction.

It is PSM's opinion that it should be the builder's responsibility to maintain the condition of the pad after the handover date and accept the risk that comes with modifying excavation levels and weather. There should be a strict transfer of the risk. We recommend that building tenderers be required to indicate how they intend to manage this risk.

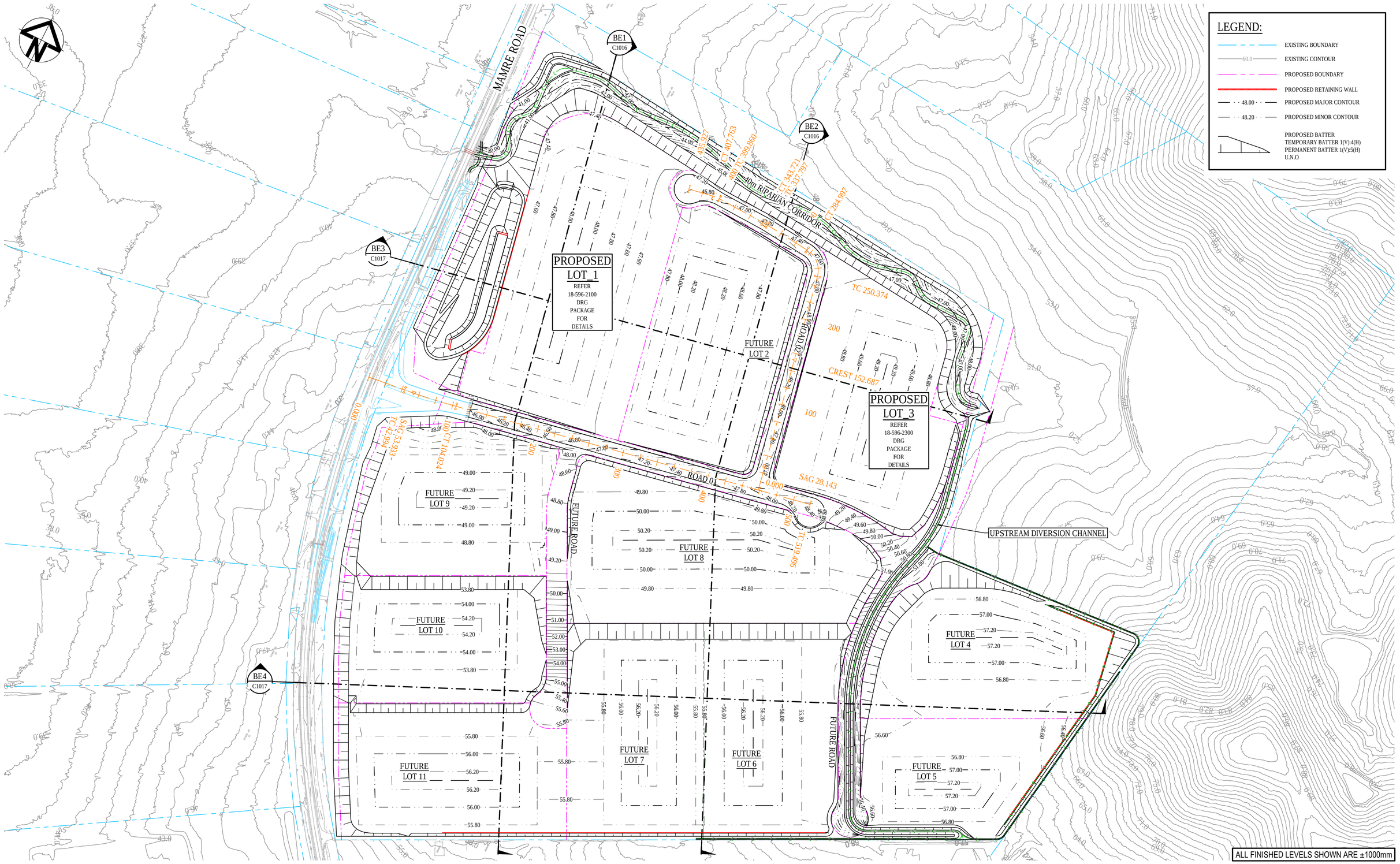
Should there be any queries, do not hesitate to contact the undersigned.

For and on behalf of
PELLS SULLIVAN MEYNINK

MATIAS BRAGA
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl. Figure 1 Locality Plan



Issue	Description	Date
B	ISSUED FOR DEVELOPMENT APPLICATION	12-10-20
A	ISSUED FOR DEVELOPMENT APPLICATION	15-05-20

Bar Scales

0 50 100 150 200m

1 : 2000 @ A1

Client

mirvac

Scales	1:2000
Grid	MGA
Height Datum	AHD
Drawn	PDK
Designed	PDK
Checked	AT
Approved	AM

Project

ASPECT INDUSTIAL ESTATE
MAMRE ROAD,
KEMPS CREEK
STAGE 1

Title

BULK EARTHWORKS
CONTOUR PLAN

Civil Engineers and Project Managers
at&l
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ABN 96 130 882 405
Tel: 02 9439 1777
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Status
FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION

A1

Project - Drawing No.
18-596-C1020

Issue
B

100mm on Original

F:\18-596 Mamre Road\6.0 Drgs\Civil\Final\1000_STAGE 1 SSD\18-596-C1020.dwg

Attachment F
PSM3739-006S – Bulk Earthworks Specification

788-864 Mamre Road, Kemps Creek NSW

Bulk Earthwork Specification. Filling, Cutting and Testing (with Blended Topsoil and Compacted Insitu "Topsoil")

PSM3739-006S Rev 6 13 October 2020

Table of Contents

List of Appendices

1 Scope

This specification details the requirements for the bulk earthworks to be undertaken at 788-864 Mamre Road, Kemps Creek. The area where this specification is applicable is shown in Figure 1. This includes areas where material is filled or cut to bulk earthworks level (BEL) within the site for lots 54 to 58.

Fill placed in accordance with this specification is denoted as Engineered Fill.

This specification does not address any environmental, contamination or erosion issues with respect to the fill material.

There is a HOLD POINT on placing fill in Section 2.4 of this Specification.

2 Filling Works

2.1 Subgrade Preparation

The condition of the subgrade should be assessed immediately prior to the commencement of filling.

All Engineered Fill is to be placed on one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Compacted Insitu Topsoil as defined in Section 2.1.1 as approved by PSM.
4. Engineered compacted fill placed in accordance with this or other approved specifications for which the Geotechnical Inspection and Testing Authority (GITA) has a Level 1 certificate certifying compliance with that approved specification AND of at least stiff consistency.
5. Existing fill and other materials as approved by PSM.

It is likely sediment within existing dams will be required to be removed for the subgrade to meet the above requirement.

Proof rolling shall only be undertaken under the direction of PSM. PSM may also direct a bridging layer of Engineered Fill be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) of between 98% and 102%. Any such layer shall be a Lot under Clause 5.3.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be moisture conditioned and compacted to be in accordance with Clauses 2.5 and 2.6 of this specification.

Engineered Fill shall be placed only on subgrade approved by the GITA as being in accordance with this specification.

2.1.1 Compacted Insitu Topsoil Subgrade

Compacted Insitu Topsoil is defined as follows:

1. Where there is greater than 2 m of Engineered Fill to be placed over the existing subgrade, the following shall be adopted:
    a. Removed shrubs and trees, then
    b. Moisture condition and compact the grass and topsoil insitu.
2. Where there is less than 2 m of Engineered Fill to be placed over the existing subgrade, the following shall be adopted:
    a. Removed shrubs and trees.
    b. Strip grass and dispose, then
    c. assess the subgrade condition in accordance with the subgrade preparation requirements of Clause 2.1 of this specification prior to placement of fill material.

2.2 Base Geometry

The slope of any buried batter shall be less than 1H:1V unless otherwise directed by PSM.

The contractor shall remove or flatten any geometrical obstructions (e.g. protrusions or holes) such that subsequent Engineered Fill can be placed to achieve the requirements of this specification.

Engineered Fill shall be placed only on areas where the base geometry has been approved by the GITA.

2.3 Material

2.3.1 Imported Fill

Imported Engineered Fill is to conform to one of the following definitions:

1. "Virgin excavated natural material" (**VENM**) as defined by the Protection of the Environment Operations Act 1997 No 156, Schedule 1, on Page 209:

   "Virgin excavated natural material (e.g. clay, gravel, sand, soil and rock) that is not mixed with any other waste and that:

   a. has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphide ores or soils, or.
   b. consists of excavated natural materials that meet such criteria as may be approved by the EPA".

2. "Excavated natural material" (**ENM**) as defined by the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A, the excavated natural material exemption 2012:

   "Excavated natural material is naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

   a. been excavated from the ground, and
   b. contains at least 98% (by weight) natural material, and
   c. does not meet the definition of Virgin Excavated Natural Material in the Act.
   d. Excavated Natural Material does not include material that has been located in a hotspot; that has been processed; or that contains asbestos, Acid Sulphate Soils (ASS), Potential Acid Sulphate soils (PASS) or sulfidic ores."

   and which meets the requirements of this exemption.

3. Site Specific Resource Recovery Orders and Exemptions similar to the attached sample in Appendix F; and following approval by PSM.

2.3.2 Blended Topsoil

Blended Topsoil is to comprise existing topsoil blended with materials defined by Clause 2.3.1. Blended Topsoil shall:

- not include grass
- be blended at a maximum ratio of 1 part topsoil to 8 parts site won natural clay, shale, imported fill or other material as approved by PSM
- be thoroughly mixed and homogenous.

The GITA shall assess the above criteria and approve the material as suitable for use as Engineered Fill.

Blended Topsoil shall not be placed within 1.0 m of the final Bulk Earthworks Level (BEL).

2.3.3 All Fill

The Engineered Fill shall be approved by the GITA as suitable for use in a structural fill.

Engineered Fill shall not comprise unsuitable material as defined by Clause 4.3 of AS3798-2007 "Guidelines on earthworks for commercial and residential developments" as:

a. “organic soils, such as many topsoils, severely root-affected subsoils and peat.
b. materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture.
c. materials containing substances which can be dissolved or leached out in the presence of moisture (e.g.: gypsum), or which undergo volume change or loss of strength when disturbed and exposed to moisture (e.g.: some shales and sandstones), unless these matters are specifically addressed in the design.
d. silts, or materials that have the deleterious engineering properties of silt.
e. other materials with properties that are unsuitable for the forming of structural fill; and.
f. fill that contains wood, metal, plastic, boulders or other deleterious material, in sufficient proportions to affect the required performance of the fill."

The GITA shall assess that the proportion of deleterious material in each Lot is not greater than 1% by weight. Deleterious material is defined by Table 3015.3 of the RTA QA Specification 3051 (Edition 5 June 1998) as:

“Type III: Rubber, Plastic, Bitumen, Paper, Cloth, Paint, Wood and Other Vegetable Matter”.

If the GITA is not able to visually assess the above criterion, the GITA shall arrange appropriate testing.

All Engineered Fill particles shall be able to be incorporated within a single layer. Further, less than 30% of particles shall be retained on the 37.5 mm sieve.

Engineered Fill shall be able to be tested in accordance with the Standard Compaction method (AS1289.5.4.1) or Hilf test method (AS1289.5.7.1). These methods require less than 20% retained on the 37.5 mm sieve. Where between 20% and 30% of particles are retained on the 37.5 mm sieve the above test methods shall still be adopted and test reports annotated appropriately.

These requirements should be met by the material after placement and compaction.

Only material approved by the GITA shall be placed as Engineered Fill.

2.4 Fill Zonation and Placement

HOLD POINT

Process Held	Placing Of Fill
Submission detail	The Contractor / GITA submit to PSM a Weekly Certificate as defined in Clause 6.2.1 of this specification for the earthworks completed to the previous Saturday no later than 5 pm of the subsequent Wednesday.
Release of Hold Point	PSM to confirm receipt of Weekly Certificate and recommend release of Hold Point if initial assessment of the Weekly Certificate indicates it complies with requirements of this specification. The contract superintendent should then release the Hold Point if it considers appropriate.

Engineered Fill shall be placed in accordance with the following requirements:

1. In near horizontal, laterally extensive layers of uniform material and thickness, deposited systematically across the work area as determined by the GITA.
2. The compacted thickness of each layer shall be equal to or less than 300 mm.
3. Where Engineered Fill is placed on a subgrade comprising Compacted Insitu Topsoil, the compacted thickness of the first layer shall be less than or equal to 150 mm.

Engineered Fill shall only be placed on subgrade in accordance with this specification and approved by the GITA.

The following particular fill zonation requirements apply for this site:

1. Blended Topsoil as defined in Cl. 2.3.2 shall not be placed above BEL-1.0 m.

2.5 Compaction

Engineered Fill shall be placed and compacted to a Dry or Hilf Density Ratios (Standard Compaction) of between 98% and 102%.

The insitu density shall be measured over the full depth of each layer placed.

2.6 Moisture Control

The placement moisture variation or Hilf moisture variation shall be controlled to be between 2% dry of optimum and 2% wet of optimum.

Placement moisture content of the Engineered Fill shall be measured.

3 Cutting

3.1 Subgrade Condition

The subgrade is to comprise one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Existing fill and other materials as approved by PSM.

Proof rolling shall only be undertaken under the direction of PSM.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be excavated and filled to the BEL in accordance with this specification.

4 Survey

4.1 Filling Areas

The survey requirements are as follows:

1. Any approved subgrade shall be surveyed prior to first filling such that subgrade levels are established to within ± 0.1 m. The area subject to approval shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
2. The Lot boundaries shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
3. The location of the field density tests shall be assessed and shown on the Lot boundary plan drawing to an accuracy of at least +/-5 m in plan.
4. The elevation of the field density tests shall be surveyed to an accuracy of +/-0.05 m.

The plan drawing shall show at the boundaries of the site and other identifiable site features, so as to allow the location of the lots and the test to be recoverable.

4.2 Cutting Areas

Any approved subgrade for cut areas shall be surveyed such that subgrade levels are established to within ± 0.1 m.

5 Inspection and Testing

5.1 Role of the GITA

The Geotechnical Inspection and Testing Authority (GITA) shall be contracted to document and certify that the works undertaken by the contractor has been completed in accordance with the relevant design and specifications.

5.2 Level 1 Control

The GITA shall adopt Level 1 responsibility as described in Section 8.2 of AS 3798-2007 "Guidelines on earthworks for commercial and residential developments":

"The primary objective of Level 1 Inspection and Testing is for the geotechnical inspection and testing authority (GITA) to be able to express an opinion on the compliance of the work. The GITA is responsible for ensuring that the inspection and testing are sufficient for this purpose.

The geotechnical inspection and testing authority need to have competent personnel on site at all times while earthwork operations are undertaken. Such operations include:

- Completion of removal of topsoil
- Placing of imported or cut material
- Compaction and adding/removal of moisture
- Trenching and backfilling
- Test rolling
- Testing.

The superintendent should agree a suitable inspection and testing plan prior to commencement of the works.

On completion of the earthworks, the GITA will usually be required to provide a report setting out the inspections, sampling and testing it has carried out, and the locations and results thereof. Unless very unusual conditions apply, the GITA should also be able to express an opinion that the works (as far as it has been able to determine) comply with the requirements of the specification and drawings."

For this particular contract, Level 1 responsibility includes:

1. Lot testing as per Clause 5.3 of this specification.
2. A frequency of compaction testing not less than that specified in Clause 5.4 of this specification.
3. The GITA documenting and reporting its activity in the terms required by Clause 6 of this specification.
4. The GITA undertaking adequate inspections and testing to comply with the above requirements and to be able to certify the fill in the terms required by Clause 6 of this specification.

5.3 Lot Testing

This specification requires lot testing to be undertaken.

A Lot is defined as a single layer of Engineered Fill consisting of uniform material which has undergone similar treatment.

Lot testing comprises the following:

1. A Lot shall be identified by the Contractor or the GITA with a Lot Number and presented for testing.
2. A Lot shall be deemed to be in accordance with the specification if all the tests undertaken within the Lot are in accordance with the specification, i.e. "a none to fail basis".
3. If any one test undertaken within a Lot fails, the whole of the Lot shall be reworked and retested.

Any portion of the placed Engineered Fill must be part of a single lot and all Lots will require approval by the GITA.

5.4 Testing Frequency (Compaction Testing)

The frequency of compaction testing for each lot shall not be less than the greater of:

1. For lot less than 50 m^3
   a. 1 test per lot.
2. For lot between 50 m^3 and 100 m^3
   a. 2 tests per lot.
3. For lot greater than 100 m^3
   a. 1 test per 300 m^3 of material placed as Blended Topsoil as defined in Clause 2.3.2 of this specification
   b. 1 test per 500 m^3 of material placed
   c. 3 tests per lot.

A laboratory moisture content test shall be undertaken for each field density test.

5.5 Proof Rolling and Plate Load Testing

Proof rolling, together with minor boxing out and refilling, of the upper surface of the bulk earthworks will be undertaken as directed by PSM. The plant to be adopted depends upon the design loads adopted by the structural engineers for each section of the site.

Plate load testing shall be undertaken at the direction of PSM at the following stages:

1. Prior to placement of Engineered Fill where the subgrade comprises Compacted Insitu Topsoil.
2. Following placement and compaction of the first two (2) layers of Blended Topsoil and subsequently as directed by PSM. The expected test frequency is 1 test per 5000 m^3 of Blended Topsoil.
3. At final bulk earthworks level (BEL). Expected test frequency is approximately a day of testing for each building pad.

The contractor is to make a suitable reaction (e.g. 20 tonne excavator) available for the tests.

5.6 Inspection, Testing and Survey

The GITA shall at least undertake the following tasks:

Cut areas

1. Identify the subgrade as one of the three (3) subgrade types listed in Clause 3.1 of this specification and assess that the subgrade condition of cut areas is in accordance with the subgrade condition requirements of Clause 3.1 of this specification. If the cut subgrade has been approved by PSM, the GITA will be required to reference the approval in its weekly report.
2. Should Engineered Fill be required to fill overcut areas, assess that filling has been placed in accordance with this specification.

Fill areas

3. For fill areas, identify the subgrade as one of the five (5) subgrade types listed in Clause 2.1 of this specification and assess that the subgrade condition of any area prior to placement of fill material is in accordance with the subgrade preparation requirements of Clause 2.1 of this specification. For the following subgrade types, GITA needs to include / refer to PSM approval in its weekly report:
   a. Compacted Insitu Topsoil as defined in Section 2.1.1 as approved by PSM
   b. Existing fill and other materials as approved by PSM.
4. Assess that the base geometry of any area prior to placement of fill material is in accordance with the base geometry requirements of Clause 2.2 of this specification.
5. For each Lot, identify the material as either Site Won, Imported or Blended Topsoil as defined in Clause 2.3 of this specification and assess that the material placed is in accordance with the fill material requirements of Clause 2.3 of this Specification.
6. Assess that Blended Topsoil placed is in accordance with the requirements of Clause 2.3.2 and Clause 2.3.3 of this specification.

7. Assess the proportion of deleterious material is in accordance with the requirements of Clause 2.3.3 of this Specification.
8. Assess that the Engineered Fill has been placed in accordance with the requirements for fill zonation and placement of Clause 2.4 of this specification.
9. Assess that each Lot as presented for approval by the contractor is in accordance with the requirements for Lot definition of Clause 5.3 of this specification.
10. Ensure that the survey requirements in Clause 5 of this specification have been completed.
11. Estimate the approximate volume of Engineered Fill placed in each Lot presented for approval.
12. Conduct Lot testing in accordance with the construction control testing requirements of Clauses 5.3 and 5.4 of this specification.
13. Assess that the compaction of each Lot is in accordance with the requirements of Clause 2.5 of this specification. The GITA shall select a depth of insitu density tests that allows the density of the full layer to be assessed.
14. Assess that the moisture variation of each Lot is in accordance with the requirements for moisture control in Clause 2.6 of this specification.
15. Conduct material property testing in accordance with the material testing requirements in this specification.

6 Reporting and Certification

6.1 Reporting

The GITA shall produce at least the following reports:

1. *VENM / ENM Validation Reports*. Such a report shall transmit the VENM or ENM validation certificates for the fill imported to site.

2. *Subgrade Approval Reports* (a sample is attached). Such a report shall:

- Document assessments undertaken for tasks 1 and task 3 of Clause 5.6 including reporting the subgrade type
- Document the subgrade survey that has been undertaken
- Approve or reject the subgrade condition and base geometry for filling, based on tasks 3 and 4 of Clause 5.6
- Approve or reject the subgrade condition for cut areas based on task 1.

3. *Lot Approval Reports* (a sample is attached). Such a report shall:

- Document assessments, testing and survey undertaken for tasks 3 to 15 of Clause 5.6.
- Report material identification undertaken for task 5 of Clause 5.6
- Report the assessed proportion of deleterious material for task 7 of Clause 5.6
- Report the results of testing undertaken for task 12 of Clause 5.6
- Approve or reject lots based on tasks 13 and 14 of Clause 5.6.

4. Material Testing Reports. Such a report shall:

- Report the results of material property testing undertaken for task 15 of Clause 5.6.

5. *Daily Reports* (a sample is attached). Such a report shall be completed daily and shall:

- Document time spent on site by the GITA personnel
- List subgrade assessments and approvals undertaken each day with reference to relevant Subgrade Approval Report(s)
- List Lots presented, accepted and approved or rejected each day, with reference to relevant Lot Approval Report(s)
- List survey undertaken each day as for task 10 of Clause 5.6 and not already documented in the Subgrade or Lot Approval Reports.
- Document other relevant activities undertaken on site that day (site instructions, breakdowns, compaction equipment used, etc.).

6.2 Certification

6.2.1 Weekly Certificates

The GITA shall produce a Weekly Certificate for any week in which earthworks are undertaken in accordance with this specification. The Weekly Certificate will cover all works from the previous Weekly Certificate until the end of work on a Saturday.

The Weekly Certificate shall transmit the following:

- Copy or reference to the complete specification document(s)
- Subgrade Approval Reports
- Lot Approval Reports
- Material property testing reports
- Daily Reports
- Survey of subgrade geometry prior to filling or in cut areas
- Plan survey drawing showing lot boundaries and location of density tests
- Survey documenting filling undertaken to date and showing location of testing
- Provide an Excel spreadsheet presenting the results of the week's acceptance testing completed by the GITA.

And certify that:

"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM3739-006S Rev XX dated XXX)."

6.2.2 Interim or Final Filling Certificate

At the completion of the bulk earthworks, or as requested by the Client, the GITA shall provide an Interim or Final Filling Certificate which shall:

1. Transmit a reference list of the Weekly Certificates.
2. Provide an Excel spreadsheet presenting the results of all the acceptance testing completed by the GITA.
3. Certify that *"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM3739-006S Rev XX dated XXX)."*

Brisbane

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West Perth WA 6005
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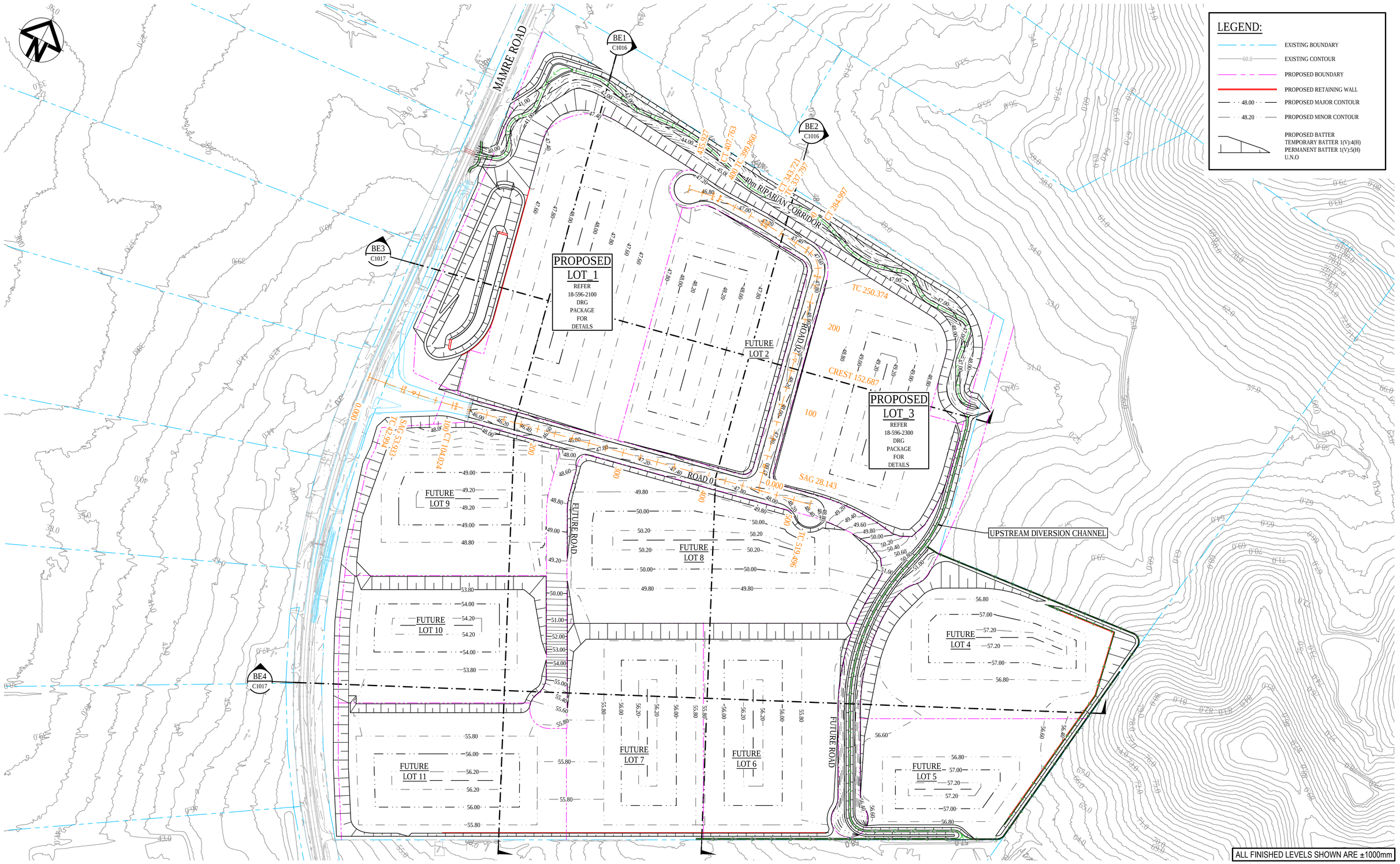
Appendix A
Figure 1



Issue	Description	Date
B	ISSUED FOR DEVELOPMENT APPLICATION	12-10-20
A	ISSUED FOR DEVELOPMENT APPLICATION	15-05-20

Bar Scales

0 50 100 150 200m

1 : 2000 @ A1

Client

mirvac

Scales	1:2000
Grid	MGA
Height Datum	AHD
Drawn	PDK
Designed	PDK
Checked	AT
Approved	AM

Project

ASPECT INDUSTIAL ESTATE
MAMRE ROAD,
KEMPS CREEK
STAGE 1

Title

BULK EARTHWORKS
CONTOUR PLAN

Civil Engineers and Project Managers
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Status
FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION

A1

Project - Drawing No.
18-596-C1020

Issue
B

100mm on Original

F:\18-596 Mamre Road\6.0 Drgs\Civil\Final\1000_STAGE 1 SSD\18-596-C1020.dwg

Appendix B
Subgrade Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

SUBGRADE APPROVAL REPORT

Client:	Contractor:
Job number:	Report number:
Project:	Technician:

Subgrade areas assessed:

Area ID	Date	Approximate extent	Subgrade description	Geometry summary	Specification reference	Compliance (Pass/Fail)	Survey reference	Approved (Yes/No)

COMMENTS:

Signed: Date:

Appendix C
Lot Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

LOT APPROVAL REPORT

Client:	Report number:
Job number:	Report date:
Project:	Technician:
Contractor:	Test methods:

LOT ID:			**Sheet**	**of**
Retest (Yes/No)			Original test report number:	
Specification reference				
Location:				
Lot boundary survey reference/location:				
Materials description:	*(MATERIAL TYPE, colour, minor components, maximum particle size)*			
Material identification:	*(Identify the material as defined in Clause 2.3.1, Clause 2.3.2 or Clause 2.3.3 of the Specification)*			
Deleterious material assessment:	*(Report proportion of deleterious material)*			
Layer thickness:				
Accepted as Lot: (Yes/No)			Date:	
Approximate volume (m3)			Number of tests required:	

Test ID No.				
Test soil description				
Date tested:				
Grid reference				
Surveyed test locations (RL,E,N)				
Test depth (mm)				
Max size (mm)				
% Oversize material (wet)				
Field wet density (t/m^3)				
Field moisture content (%)				
PWCD (t/m^3)				
Compactive effort				
Moisture variation (%)				
HILF density ratio (%)				
TEST (Pass/Fail)				

LOT APPROVAL	(Pass/Fail)	Signed:	Date:

Appendix D
Daily Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

DAILY REPORT

Client:	Report number:
Job number:	Report date:
Project:	
Location:	Level of testing: Level 1
Contractor	Technician:
Time on site:	
Time off site:	

1. Subgrade Approval

Areas ID	Subgrade Approval Report No:	Comments

2. Lot Approval

Lot ID	Lot Approval Report No:	Comments

3. Survey

Type of survey	Survey undertaken by:	Reference

4. Instructions received on site

5. Instructions given on site

COMMENTS:

Signed: Date:

Appendix E
Certification Letter (Sample Only)

Our Ref:

Date:

Addressed to: Earthwork Contractor

Attention: Earthwork Contractor Representative

Dear

RE: SAMPLE INTERIM (OR FINAL) FILLING CERTIFICATE
INDUSTRIAL DEVELOPMENT, BULK EARTHWORKS
CERTIFICATION OF EARTHWORKS
BETWEEN [DATE OF COMMENCEMENT] AND [DATE OF COMPLETION]

In the period between [date start] and [date finish] the contractor has undertaken earthworks in areas XXX and XXX.

During the above period:

- The GITA has prepared the following Subgrade Approval Reports:

1. Subgrade Approval Report No 1
2. ……

- The GITA has prepared the following Lot Approval Reports:

1. Lot Approval Report No 1
2. ……

- The GITA has prepared the following Daily Reports:

1. Daily Report No 1……
2. ……

- The following subgrade survey was undertaken:

1. Subgrade Survey reference……
2. ……

- The following weekly survey was undertaken:

1. Weekly survey of week ending …….reference……..
2. ……

Copies of all the above documents are attached.

The GITA certifies that all the earthworks undertaken in the above stated period are documented in the above reports and have been undertaken in accordance with the Specifications (ref. PSM3739-006S REV4, dated XXX) a copy of which is attached, with the exception of:

1. List outstanding issues (not approved subgrade, lots, unsuitable material, failed tests etc.)
2. ……..

Signed

GITA

Appendix F
Resource Recovery Order and Exemptions Example

Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014

The Rozelle Interchange tunnel spoil order 2019

Introduction

This order, issued by the Environment Protection Authority (EPA) under clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 (Waste Regulation), imposes the requirements that must be met by suppliers of Rozelle Interchange tunnel spoil to which 'the Rozelle Interchange tunnel spoil exemption 2019' applies. The requirements in this order apply in relation to the supply of Rozelle Interchange tunnel spoil for application to land as engineering fill, or for use in earthworks, or for use as an alternative raw material in the manufacture of bricks, or applied to land within the road corridor for public road related activities including road construction, maintenance and installation of road infrastructure facilities.

1. Waste to which this order applies

1.1. This order applies to Rozelle Interchange tunnel spoil. In this order, Rozelle Interchange tunnel spoil means approximately 7 million cubic meters of naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that:

(a) has been generated from the WestConnex M4-M5 Link Rozelle Interchange Tunnel Project extending from the M4-M5 Link Tunnel (Leichhardt) to Victoria Road (Balmain);
(b) has been excavated by the use of machinery;
(c) contains no more than 0.4% w/w shotcrete;
(d) has not been contaminated with manufactured chemicals or process residues (except for shotcrete);
(e) does not meet the definition of virgin excavated natural material in the POEO Act; and
(f) may have been processed by intermediate waste facilities licensed by the EPA.

Rozelle Interchange tunnel spoil does not include material that has been mixed with glass fibre plastic reinforced rods and bolts; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

2. Persons to whom this order applies

2.1. The requirements in this order apply to any person who supplies Rozelle Interchange tunnel spoil that has been generated, or recovered by John Holland CPB Contractors Joint Venture ('JHCPBJV').

2.2. This order does not apply to the supply of Rozelle Interchange tunnel spoil to a consumer for land application or at a premises for which the consumer holds a licence under the POEO Act that authorises the carrying out of the scheduled activities on the premises under clause 39 'waste disposal (application to land)'

or clause 40 'waste disposal (thermal treatment)' of Schedule 1 of the POEO Act.

3. Duration

3.1. This order commences on 17 December 2019 and is valid until 17 December 2023 unless revoked by the EPA by notice in writing at an earlier date.

4. Generator requirements

The EPA imposes the following requirements on any generator who supplies Rozelle Interchange tunnel spoil.

Notification

4.1. On or before each transaction, the generator must provide the following to each person to whom the generator supplies the Rozelle Interchange tunnel spoil to:

- a written statement of compliance certifying that all the requirements set out in this order have been met;
- a copy of the 'Rozelle Interchange tunnel spoil exemption 2019'; and
- a copy of the 'Rozelle Interchange tunnel spoil order 2019'.

Record keeping and reporting

4.2. The generator must keep a written record of the name and address of each person to whom the generator supplied Rozelle Interchange tunnel spoil and quantity supplied for a period of six years.

4.3. The generator of Rozelle Interchange tunnel spoil must make information available to the EPA upon request.

5. Processor requirements

The EPA imposes the following requirements on any processor who supplies Rozelle Interchange tunnel spoil that has been processed:

5.1. The processor must only process Rozelle Interchange tunnel spoil by crushing, grinding, separating and screening.

Notification

5.2. On or before each transaction, the processor must provide the following to each person to whom the processor supplies the Rozelle Interchange tunnel spoil to:

- a written statement of compliance certifying that all the requirements set out in this order have been met;
- a copy of the 'Rozelle Interchange tunnel spoil exemption 2019'; and
- a copy of the 'Rozelle Interchange tunnel spoil order 2019'.

Record keeping and reporting

5.3. The processor must keep a written record of the name and address of each person to whom the processor supplied Rozelle Interchange tunnel spoil and quantity supplied for a period of six years.

5.4. The processor of Rozelle Interchange tunnel spoil must make information available to the EPA upon request.

6. Definitions

In this order:

application or apply to land means applying to land by:

- spraying, spreading or depositing on the land;
- ploughing, injecting or mixing into the land; or
- filling, raising, reclaiming or contouring the land.

consumer means:

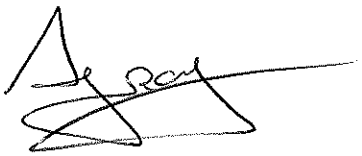
- a person who applies, or intends to apply, Rozelle Interchange tunnel spoil to land; and
- a person who uses, or intends to use, Rozelle Interchange tunnel spoil in connection with a process involving thermal treatment.

generator means a person who generates Rozelle Interchange tunnel spoil for supply to a processor or consumer. The generator in this order is LSBJV.

metal staples means small pieces of metal that resemble the shape of staples, with each staple having an approximate dimension of 35 mm x 1 mm.

processor means a person who processes Rozelle Interchange tunnel spoil into a material in its final form for supply to a consumer.

shotcrete means cement grout reinforced with metal staples used to line the tunnel of the WestConnex Rozelle Interchange project.



17/12/2019

A/Director Office of the Chief Executive

Environment Protection Authority

(by delegation)

Notes

The EPA may amend or revoke this order at any time. It is the responsibility of the generator to ensure it complies with all relevant requirements of the most current order.

In gazetting or otherwise issuing this order, the EPA is not in any way endorsing the supply or use of this substance or guaranteeing that the substance will confer benefit.

The conditions set out in this order are designed to minimise the risk of potential harm to the environment, human health or agriculture, although neither this order nor the accompanying exemption guarantee that the environment, human health or agriculture will not be harmed.

Any person or entity which supplies Rozelle Interchange tunnel spoil should assess whether the material is fit for the purpose the material is proposed to be used for, and whether this use may cause harm. The supplier may need to seek expert engineering or technical advice.

Regardless of any exemption or order provided by the EPA, the person who causes or permits the application of the substance to land must ensure that the action is lawful and consistent with any other legislative requirements including, if applicable, any development consent(s) for managing operations on the site(s).

The supply of Rozelle Interchange tunnel spoil remains subject to other relevant environmental regulations in the POEO Act and Waste Regulation. For example, a person who pollutes land (s. 142A) or water (s. 120), or causes air pollution through the emission of odours (s. 126), or does not meet the special requirements for asbestos waste (Part 7 of the Waste Regulation), regardless of this order, is guilty of an offence and subject to prosecution.

This order does not alter the requirements of any other relevant legislation that must be met in supplying this material, including for example, the need to prepare a Safety Data Sheet. Failure to comply with the conditions of this order constitutes an offence under clause 93 of the Waste Regulation.

Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014

The Rozelle Interchange tunnel spoil exemption 2019

Introduction

This exemption, issued by the Environment Protection Authority (EPA) under clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014 (Waste Regulation), exempts a consumer of Rozelle Interchange tunnel spoil from certain requirements in relation to the application of that waste to land or use as a raw material, provided the consumer complies with the conditions of this exemption.

This exemption should be read in conjunction with 'the Rozelle Interchange tunnel spoil order 2019'. This exemption applies to Rozelle Interchange tunnel spoil that is, or is intended to be, applied to land as engineering fill, or for use in earthworks, or for use as an alternative raw material in the manufacture of bricks, or applied to land within the road corridor for public road related activities including road construction, maintenance and installation of road infrastructure facilities.

1. Waste to which this exemption applies

1.1. This exemption applies to Rozelle Interchange tunnel spoil. In this exemption, Rozelle Interchange tunnel spoil means approximately 7 million cubic meters of naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that:

(a) has been generated from the WestConnex M4-M5 Link Rozelle Interchange Tunnel Project extending from the M4-M5 Link Tunnel (Leichhardt) to Victoria Road (Balmain);
(b) has been excavated by the use of machinery;
(c) contains no more than 0.4% w/w shotcrete;
(d) has not been contaminated with manufactured chemicals or process residues (except for shotcrete);
(e) does not meet the definition of virgin excavated natural material in the POEO Act; and
(f) may have been processed by intermediate waste facilities licensed by the EPA.

Rozelle Interchange tunnel spoil does not include material that has been mixed with glass fibre plastic reinforced rods and bolts; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

2. Persons to whom this exemption applies

2.1. This exemption applies to any person who applies or intends to apply Rozelle Interchange tunnel spoil as set out in 1.1.

3. Duration

3.1. This exemption commences on 17 December 2019 and is valid until 17 December 2023 unless revoked by the EPA by notice in writing at an earlier date.

4. Premises to which this exemption applies

4.1. This exemption applies to the premises at which the consumer's actual or intended application of Rozelle Interchange tunnel spoil is carried out.

5. Exemption

5.1. Subject to the conditions of this exemption, the EPA exempts each consumer from the following provisions of the POEO Act and the Waste Regulation in relation to the consumer's actual or intended application of Rozelle Interchange tunnel spoil to land as engineering fill, or use in earthworks, Public road related activities including road construction, maintenance and installation of road infrastructure facilities, or for use as an alternative input into thermal processes for non-energy recovery purposes in the manufacture of bricks at the premises:

- section 48 of the POEO Act in respect of the scheduled activities described in clauses 39, 40 and 42 of Schedule 1 of the POEO Act;
- Part 4 of the Waste Regulation;
- section 88 of the POEO Act; and
- clause 109 and 110 of the Waste Regulation.

5.2. The exemption does not apply in circumstances where Rozelle Interchange tunnel spoil is received at the premises for which the consumer holds a licence under the POEO Act that authorises the carrying out of the scheduled activities on the premises under clause 39 'waste disposal (application to land)' or clause 40 'waste disposal (thermal treatment)' of Schedule 1 of the POEO Act.

6. Conditions of exemption

The exemption is subject to the following conditions:

6.1. At the time Rozelle Interchange tunnel spoil is received at the premises, it must meet all material requirements for Rozelle Interchange tunnel spoil which are required under 'the Rozelle Interchange tunnel spoil order 2019'.

6.2. Rozelle Interchange tunnel spoil can only be:

6.2.1. applied to land as engineering fill, or use in earthworks; or

6.2.2. applied to land within the road corridor for public road related activities including road construction, maintenance and installation of road infrastructure facilities; or

6.2.3. used as an alternative input into thermal processes for non-energy recovery purposes in the manufacture of bricks at the premises.

6.3. The consumer must keep a written record of the following for a period of six years:

6.3.1. the quantity of Rozelle Interchange tunnel spoil received; and

6.3.2. the name and address of the supplier of Rozelle Interchange tunnel spoil received.

6.4. The consumer must make any records required to be kept under this exemption available to authorised officers of the EPA on request.

6.5. The consumer must ensure that any application of Rozelle Interchange tunnel spoil to land must occur within a reasonable period of time after receipt.

7. Definitions

In this exemption:

application or apply to land means applying to land by:

- spraying, spreading or depositing on the land;
- ploughing, injecting or mixing into the land; or
- filling, raising, reclaiming or contouring the land.

consumer means:

- a person who applies, or intends to apply, Rozelle Interchange tunnel spoil to land; and
- a person who uses, or intends to use, Rozelle Interchange tunnel spoil in connection with a process involving thermal treatment.

generator means a person who generates Rozelle Interchange tunnel spoil for supply to a processor or consumer. The generator in this order is Lendlease Samsung Bouygues Joint Venture ('LSBJV').

metal staples means small pieces of metal that resemble the shape of staples, with each staple having an approximate dimension of 35 mm x 1 mm.

processor means a person who processes Rozelle Interchange tunnel spoil into a material in its final form for supply to a consumer.

shotcrete means cement grout reinforced with metal staples used to line the tunnel of the WestConnex Rozelle Interchange project.

17/12/2019

A/Director Office of the Chief Executive

Environment Protection Authority

(by delegation)

Notes

The EPA may amend or revoke this exemption at any time. It is the responsibility of the consumer to ensure they comply with all relevant requirements of the most current exemption.

In gazetting or otherwise issuing this exemption, the EPA is not in any way endorsing the use of this substance or guaranteeing that the substance will confer benefit.

The conditions set out in this exemption are designed to minimise the risk of potential harm to the environment, human health or agriculture, although neither this exemption nor the accompanying order guarantee that the environment, human health or agriculture will not be harmed.

The consumer should assess whether or not Rozelle Interchange tunnel spoil is fit for the purpose the material is proposed to be used for, and whether this use will cause harm. The consumer may need to seek expert engineering or technical advice.

Regardless of any exemption provided by the EPA, the person who causes or permits the application of the substance to land must ensure that the action is lawful and consistent with any other legislative requirements including, if applicable, any development consent(s) for managing operations on the site(s).

The receipt of Rozelle Interchange tunnel spoil remains subject to other relevant environmental regulations in the POEO Act and the Waste Regulation. For example, a person who pollutes land (s. 142A) or water (s. 120), or causes air pollution through the emission of odours (s. 126), or does not meet the special requirements for asbestos waste (Part 7 of the Waste Regulation), regardless of having an exemption, is guilty of an offence and subject to prosecution.

This exemption does not alter the requirements of any other relevant legislation that must be met in utilising this material, including for example, the need to prepare a Safety Data Sheet (SDS).

Failure to comply with the conditions of this exemption constitutes an offence under clause 91 of the Waste Regulation.