St Vincent's Foundation Pty Ltd

Proposed Residential Subdivision, Precinct A, Lot 64 DP1226839, Rainbow Beach, Lake Cathie

Geotechnical Assessment – Revised Report

Report No. RGS20337.1-AS 30 July 2018





Manning-Great Lakes Port Macquarie Coffs Harbour

RGS20337.1-AS

30 July 2018

St Vincent's Foundation Pty Ltd c-/ King Campbell Pty Ltd PO Box 243 PORT MACQUARIE NSW 2444

Attention: Scott Marchant

Dear Scott,

RE: Proposed Residential Subdivision, Precinct A, Lot 64 DP1226839, Rainbow Beach, Lake Cathie

Geotechnical Assessment – Revised Report

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment of the proposed Precinct A residential development, Rainbow Beach, Lot 64 DP1226839, Ocean Drive, Lake Cathie.

Surface and subsurface conditions at the site and recommendations and advice on foundation conditions are presented in the attached report.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Tim Morris Senior Engineering Geologist

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Figure 1	Investigation Location Plan
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Appendices

- Appendix AResults of Field InvestigationsAppendix BResults of Laboratory Testing
- Appendix C Pavement Thickness Design Sheets



1 INTRODUCTION

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for the Precinct A residential development, Rainbow Beach, Lot 64 DP1226839, Ocean Drive, Lake Cathie.

The proposed development is located in an area of gently to moderately undulating topography situated between Lake Cathie and Bonny Hills. It will involve:

- Significant site regrading works comprising up to approximately 2m of cut and placement of up to 2m of fill;
- Site preparation works for approximately 67 residential lots;
- Construction of retaining walls up to approximately 1m in height;
- Construction of seven sections of road pavement comprising:
 - o Road 1 (Ch30 165m) Collector Road
 - Road 3 (Ch0 27m) Local Street
 - Road 10 (Ch0 215m) Collector
 - Road 26 (Ch0 145m) Local Street
 - Road 25 (Ch0 130m) Local Street
 - Road 28 (Ch0 44m) Local Street
 - Road 29 (Ch0 175m) Local Street
- Construction works for associated infrastructure including water, sewer and stormwater services.

The purpose of the work described herein was to address the following issues:

- A geotechnical model of the Precinct A site that includes general foundation conditions, depth of soil profiles and presence of rock;
- Preliminary site classification to AS2870-2011 Residential Slabs and Footings. Re-classification will be required in areas that undergo future regrade;
- Recommended foundation types, including bearing capacities, expected settlements, and construction methods;
- Pavement thickness design, including material requirements and construction recommendations for the internal roads. Where roads will be constructed on fill embankments further subgrade CBR testing will be required following completion of bulk earthworks to confirm adopted embankment fill CBR values were appropriate;
- Recommendations as to site preparation to support concentrated building loads from foundations, floor slabs and pavements;
- Recommendations as to site preparation requirements for the adjacent Precinct J where excess fill from Precinct A may be placed. Fill thicknesses will be up to approximately 2m;



- Summary of excavation conditions and suitability of excavated material for re-use, including comment on options for blending materials to produce a suitable fill;
- Support of cuts and excavations including design parameters for retaining wall design;
- General recommendations on management of construction and drainage at the site from a geotechnical perspective; and
- Presence of groundwater.

The work was commissioned by Scott Marchant on behalf of St Vincent's Pty Ltd and was undertaken in general accordance with proposal number RGS20337.1-AJ dated 29 November 2017.

2 FIELD WORK

Field work for the assessment was undertaken on 12 December 2017 was based on the supplied drawing titled "GEOTECHNICAL_SETOUT_15.12.2017". Fieldwork included:

- Observation of site and surrounding features relevant to the geotechnical conditions of the site;
- Eleven (11) test pits excavated by a backhoe, logged and sampled by an Engineering Geologist;
- U50 tube samples, collected from representative cohesive soil profiles for site classification purposes; and
- Samples for CBR testing collected from subgrade level.

Engineering logs of the test pits results are presented in Appendix A. The locations of the test pits are shown on Figure 1. They were obtained on site by measurement relative to existing site features.

3 LABORATORY TESTING

Samples retrieved during field work were returned to a NATA registered laboratory for testing which included the following;

- California Bearing Ratio (CBR) testing of samples from subgrade level and proposed cut areas;
- Shrink-swell test for preliminary site classification and footing design, including two tests on bulk samples of material compacted at 98% Standard Compaction to simulate re-use of material in a placed fill platform; and
- Atterberg Limits to assess plasticity properties;

The test results are presented in Appendix B. The results of the laboratory testing are summarised in Table 1. CBR results are presented separately in Table 4, Section 4.4.



Location	Depth (m)	Material Type	Shrink (%)	Swell (%)	Shrink-Swell Index (155)	% Passing 75µm (%)	PI (%)	CBR (%)
TP205	0.2 - 0.7	3 - Colluvial	5.9	-0.8	3.3			
TP206	0.4 - 0.9	5 – Residual	3.8	-0.1	2.1*		53	
TP209	0.4 - 0.8	4 - Alluvial	8.7	0.4	4.9*			
TP214	0.5 – 1.0**	7- HW Dolerite***				15	23	7
TP215	1.7 – 3.0	Mixed clay/rock					26	13
TP217+ TP229	**	50% blend clay and rock				38	45	

Table 1: Summary of Laboratory Test Results

Note: *Shrink-swell testing undertaken on remoulded bulk sample compacted to approximately 98% SMDD ** Mechanical pre-treatment (RMS-T102) undertaken prior to testing

*** Classified (AS 1726:2017) as Sandy Clayey GRAVEL (GC) following mechanical pre-treatment

4 SITE CONDITIONS

4.1 Surface conditions

Precinct A is located on cleared farmland to the south of Ocean Drive in an area of gently to moderately undulating topography where its situated on the south west facing upper to lower slopes of a broad rounded south east plunging ridgeline that is up to 20m AHD in elevation. The lower slopes grade down on to an alluvial plain situated at the toe of the hill.

Surface elevations across Precinct A range from approximately RL 18m along the northern boundary to approximately RL 7.5m in the south western corner. Surface slopes across the site range from approximately 3 - 5° grading down to near flat on the alluvial plain.

An image of the site taken from the NSW Department of Property Information website is reproduced below.





Approximate extent of Precinct A, Lot 64 DP1226839, Rainbow Beach, Lake Cathie outlined in red.

Two large stockpiles are located on the crest of the ridge in the north within the site. It is understood that they will be moved from site prior to commencement of the Precinct A development. Road 1 is located on the western boundary and construction of the road embankment and associated pavement is understood to be commencing shortly.

Surrounding developments include Lake Cathie Public School to the west of the future Road 1, Ocean Drive to the north and open farmland to the south and east where future developments are proposed as part of the Rainbow Beach development.

Ocean Drive is constructed in cut on the northern boundary of Precinct A and extremely to highly weathered dolerite rock is exposed in the cutting. A small farm dam or possible historical borrow pit is located just outside the north east corner of Precinct A in the adjacent Precinct B. Slightly weathered dolerite, massive and high strength was exposed in the wall of the dam excavation. Water was present in the dam at the time of fieldwork.

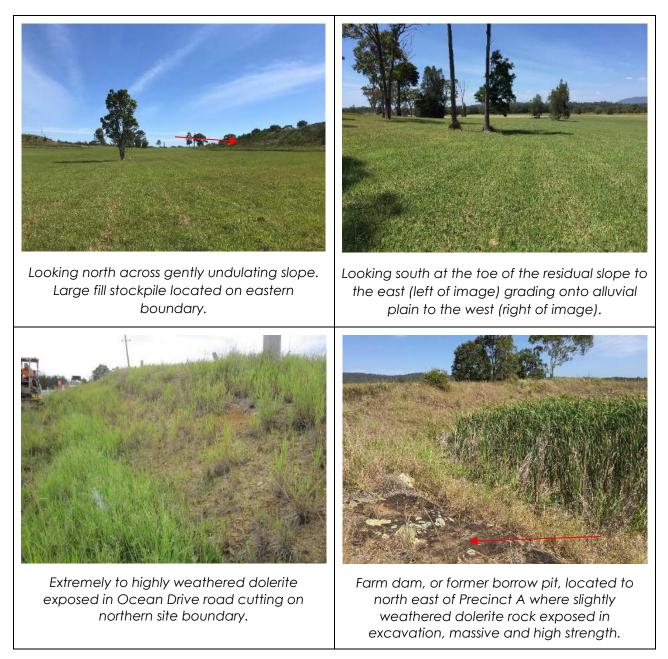
Vegetation comprised grass and scattered trees. Site was trafficable by 4WD at the time of the fieldwork, although RGS has previously undertaken works near the Ocean Drive and Houston Mitchell Drive roundabout when water was pooling on the surface near the commencement of



Road 1 following rainfall. Site trafficability in such conditions in the alluvial plain landscape would be reduced.

Drainage of the site would be via a combination of surface infiltration and overland flow towards the south west.

A selection of images of the site is presented below.





4.2 Subsurface conditions

The site is situated in an area underlain by undifferentiated rocks of the Watonga Formation which can include slate, chert, mudstone and the intrusive Karikeree Meta-dolerite. The Port Macquarie 1:25,000 Quaternary geology sheet indicates an alluvial / colluvial fan and Holocene freshwater swamp are present in the south of the site.

The test pits encountered a variable soil profile as summarised below in Table 2 and Table 3.

Geotechnical Unit	Material	Material Description
1	FILL	Sandy GRAVEL, fine to medium, orange/pale grey/pink
2	TOPSOIL	Clayey SILT to Sandy Silty CLAY, low plasticity, dark grey/black, trace grass roots
3	COLLUVIAL	Gravelly Sandy CLAY, medium plasticity, grey/yellow/pale yellow /pale brown/brown, friable
4	ALLUVIAL	Sandy CLAY, medium plasticity, grey/yellow/pale brown with red/grey/pale brown mottling, stiff to very stiff, some gravel, fine to medium
5	RESIDUAL	Sandy CLAY to CLAY, medium to high plasticity, yellow/pale yellow with grey mottling, very stiff/friable, trace gravel, fine
6	EW DOLERITE	Gravelly Sandy CLAY, medium to high plasticity, yellow/dark grey/ pale brown, friable, trace rock fabric
7	HW/ MW DOLERITE	Highly grading to Moderately Weathered Dolerite with depth, fine grained, pale brown to pale grey, low to high strength, highly fractured to fractured, foliated fabric. Excavated as Sandy Gravel, fine to coarse, angular, trace to some clay. Foliated fabric indicates it has been subject to some regional metamorphism and can be considered to be a meta-dolerite. Moderately weathered dolerite typically resulted in backhoe bucket refusal.

Table 2: Summary of Subsurface Conditions

uo		Depth to Base of Material Layer (m)									
Investigation	Unit 1 Fill	Unit 2 Topsoil	Unit 3 Colluvial	Unit 4 Alluvial	Unit 5 Residual	Unit 6 EW Dolerite	Unit 7 HW Dolerite				
	I	ſerrain A - U	Indulating S	lopes overlyir	ng Weathered	d Dolerite					
TP201		0.2	0.4		0.9	≥1.5					
TP202	0.1				0.4	≥1.5					
TP203	0.1	0.4			1.1		≥1.5				
TP204		0.15	0.5		1.1		≥1.5				
TP205		0.2	0.5		0.7		≥1.0*				
TP206		0.4			≥1.5						
TP207		0.25	0.5		0.9		≥1.5				
TP210		0.4				≥1.5					
TP212		0.3			1.1	≥1.5					
			Terrain B	– Alluvial Flo	odplain						
TP209		0.4		≥1.5							
TP211		0.4		1.1	≥1.5						

Table 3: Summary of Subsurface Conditions

Table Notes:-- Material not encountered

 \geq Base of material layer not encountered

* Backhoe refusal on rock

Groundwater was not encountered. It should be noted that fluctuations in groundwater levels can occur as a result of seasonal variations, temperature, rainfall and other similar factors, the influence of which may not have been apparent at the time of the assessment.

4.3 Geotechnical Terrains

Site observations, test pitting and laboratory testing results indicated two distinct geotechnical profiles on the site that were associated with topographical features. On this basis, the site has been divided into two geotechnical terrains as summarised in the following sections. The approximate distribution of the terrains are delineated on Figure 1.

4.3.1 Terrain A: Undulating Slopes overlying Weathered Dolerite

Encountered on the hill slopes in the north and east of the site. The soil profile typically consisted of colluvial (Unit 3) clay overlaying residual (Unit 5) yellow high plasticity clays. The yellow clays graded



with depth into extremely (Unit 6) to highly weathered dolerite rock (Unit 7). In some locations the highly weathered dolerite graded into moderately weathered dolerite of higher strength which typically resulted in backhoe digging bucket refusal.

Previous experience in the local area indicates that moisture tends to concentrate in the colluvial horizon, above the underlying high plasticity residual clays and this can pose construction issues. The underlying residual clays (Unit 5) are typically highly reactive and have low CBR values.

The residual clays graded into extremely weathered dolerite (Unit 6) comprising gravelly clays which CBR values ranging from 18-19% due presence of gravel bands. The highly weathered dolerite rock (Unit 7) had CBR value of 12%. It is noted that the CBR result for a sample of highly weathered dolerite from TP214 that was subject to mechanical pre-compaction (RMS-T102) was a CBR of 7, indicating the rock may break down during placement and compaction with large plant.



TP208– Colluvial gravelly clays to 0.5m where moisture can concentrate, overlying residual low CBR yellow clay (Unit 5) grading into highly weathered dolerite from 0.9m

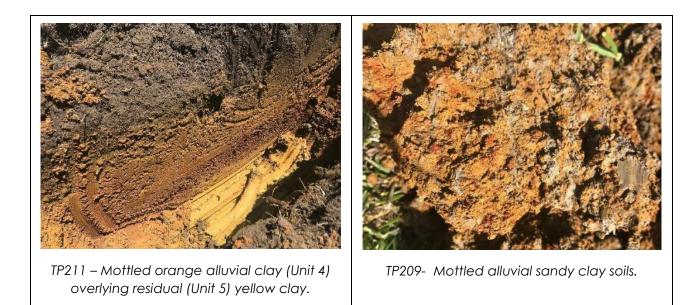


TP203 – Highly weathered dolerite (Unit 7) present from 1.1m below the surface and excavated as low strength gravel.

4.3.2 Terrain B: Alluvial Floodplain

Encountered in the south east of the site below approximately 10m AHD. The profile typically consisted of alluvial clays (Unit 3) overlying residual clays (Unit 5). The alluvial clay had a CBR value of 8% and was highly reactive with a lss value of 4.9%. It is anticipated that this area of the site would be poorly drained following high rainfall events as evidenced by the presence of the shallow field drains. Road in this area will be typically constructed on raised fill embankments.





4.4 Subgrade conditions

A summary of the CBR test results from samples collected at design subgrade level is presented in Table 4.

Sample	Location	Material Description	Terrain	Condition	CBR Swell (%)	CBR
TP201 (0.4-0.7m)	Road 10 Ch0m	5 – Residual	А	+0.16m	0.0	2.5
TP202 (0.4 – 0.7m)	Road 10 Ch100m	6 – EW Dolerite	А	-0.68m	0.5	19
TP203 (0.4 – 0.8m)	Road 10 Ch180m	5 – Residual	А	-0.26m	1.5	5
TP204 (0.5 – 0.9m)	Road 29 Ch100m	5 – Residual	А	-0.07m	3.5	2
TP205 (0.2 – 0.5m)	Road 29 Ch0m	3 - Colluvial	А	+0.38m	3	3
TP206 (0.4 – 0.9m)	Road 26 Ch0m	5 – Residual	A	+0.54m	4.5	3
TP207 (0.9 – 1.3m)	Road 26 Ch110m	7 – HW Dolerite	A	-0.38m	0.5	12
TP209 (0.4 – 0.8m)	Road 25 Ch11m	4 - Alluvial	В	+1.31m	0.5	8
TP210 (0.4 – 0.8m)	Road 25 Ch122m	6 – EW Dolerite	А	+0.71m	0.5	18
TP212 (0.5 – 0.9m)	Road 1 Ch162m	5 – Residual	А	+0.61m	3.5	2

Table 4 - Summary of Subgrade Properties (Depths in m)



5 PROPOSED DEVELOPMENT

The proposed development area in Precinct A is located on cleared farm land in an area of gently to moderately undulating topography that grades down onto an alluvial plain to the south and will involve:

- Site regrading works comprising up to 2m of cut and placement of up to 2m of fill;
- Site preparation works for approximately 67 residential lots;
- Construction of retaining walls up to approximately 1m in height for lot terracing works;
- Construction of seven sections of road pavements for access to the site and connecting minor roads;
- Construction works for associated infrastructure including water, sewer and stormwater services.

6 EARTHWORKS

6.1 Site Preparation

The site is currently vegetated with grass and scattered trees. Areas of the site that are to support foundations or pavements should be stripped to remove all topsoil, root affected or other potentially deleterious material which can be retained on site for re-use in landscaping, or, removed from the site. Topsoil depths ranged from 150 to 400mm and topsoil stripping will likely involve removing about 150 to 300mm of topsoil.

Moisture concentrations have been observed in the colluvial soil profile overlying the residual clay soils on adjacent sites that have similar subsurface profiles. This has sometimes required overexcavation of the colluvial soils, or deep ripping to blend the colluvial soils with the underlying residual clays and allow drying back to occur prior to placement of lot fill.

Weathered dolerite rock will be encountered in deeper excavations at the site, with dolerite at depths of 1m to >1.5m in most test pits as shown on Figures 1 and 2. Where present at the base of the proposed bulk excavation level, consideration should be given to excavating an additional 500mm below subgrade level and then recompacting the excavated material to facilitate construction of future service trenches.

In areas where extensive filling works comprising >1.8m of fill such as in the south of Precinct A and in the adjacent Precinct J, the stripping can be reduced to the removal of the upper approximate 50mm of vegetated and root affected material and the remaining topsoil left in place. It is noted that following prolonged rainfall the remnant topsoil profile may be impacted by moisture and placement of a bridging layer may be required prior to the placement of lot fill. Geotechnical assessment of the subgrade is recommended in such instances.

The site comprises open farm land that has been used for grazing purposes. Past land uses are therefore considered to be non-contaminating. There was no visual or olfactory evidence of contamination or presence of sulfidic ores within the natural soils/ rock. All natural excavated materials removed from the site would be classified in accordance with current NSW EPA waste



classification guidelines as Virgin Excavated Natural Material, and can be disposed of or re-used accordingly.

The origin of the fill stockpiles that are present on site is not known. Should any fill from the stockpiles require removal off-site, it will require assessment for a Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014 in accordance with the Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation of the Environment Operations (Waste) Noter 2014 - the Excavated Natural Material (ENM) Order 2014.

The topsoil and natural clays at the site are considered susceptible to erosion on exposure (i.e. where vegetation is removed) or where exposed to concentrated flows. It is therefore essential that:

- Earthworks should be undertaken progressively, minimising the area and length of time that any part of the site is denuded of vegetation at any one time;
- Re-vegetation or other erosion protection should be undertaken as soon as possible; and
- The erodibility of the soils should be taken into account in the long term stormwater management plan for the site (eg. Sizing and ongoing management or maintenance of detention ponds).

6.2 Excavation and Retention

The test pits were excavated with a backhoe and the test pits on the ridge slopes encountered residual clays (Unit 5), extremely weathered dolerite (recovered as hard clay – Unit 6) and highly to moderately weathered dolerite rock (Unit 7). Slow digging conditions and backhoe refusal at the depths shown on the attached test pit engineering logs were encountered in the weathered dolerite (Unit 7) profile which occurs in Terrain A.

The excavation of clay soils should be achievable with a conventional small to medium sized excavator or backhoe. Bulk excavations within the moderately weathered dolerite at the base of Unit 7 may require ripping with a single tyne ripper prior to excavation by a large (>20T) excavator. An allowance should also be made for the use of hydraulic rock breakers in confined detail excavations such as service trenches where weathered rock is encountered below bulk excavation levels. It is noted that deeper excavations are proposed in the adjacent Precinct B and C sites and that weathered dolerite rock was encountered at shallower levels. Specific excavation advice will be provided for such conditions in the geotechnical assessment that is currently being prepared for those sites.

The materials encountered to excavation depth were such that for bulk excavation in a direct cut to fill operation, the use of scrapers in clay soils and ripped materials may provide efficiencies in comparison with the use of excavators and trucks. Pre-ripping by large bulldozer may be required where weathered rock is present in deeper cuts. Scraper trafficability in Terrain B may be restricted following periods of prolonged rainfall.

Entry into unsupported trenches deeper than 1.2m should be avoided and appropriate signage and barricading should be installed around all open excavations. Excavation design should take



into account maximum batter angle and setback requirements for vehicle traffic as detailed in the Excavation Work Code of Practice (Safe Work Australia – 2014).

Temporary excavations up to 2.0m high (during construction) in controlled fill, residual soils and extremely weathered rock can be battered at 1.H:1V. Permanent slopes shall be battered no steeper than 2H:1V and will require re-vegetation or other erosion protection. In weathered rock, subject to geotechnical appraisal on bulk excavation, steeper batters may be adopted, but are likely to require face protection by shotcrete or similar.

Where site constraints preclude the use of such batters, excavations should be supported by temporary shoring or permanent support as appropriate. Retaining walls are proposed in some areas of the site.

Gravity or cantilever retaining walls can be designed on the basis of the parameters presented in Table 5 for walls retaining natural clays or clay fill. Design can be undertaken on the basis of a triangular lateral earth pressure distribution using the characteristic earth pressure coefficients and subsoil parameters provided and should include assessment of the overall stability of the wall.

Material	Unit Weight, Y	Effective Friction Angle	Effective Cohesion, c'	Active Earth Pressure Coefficient, ka	At Rest Earth Pressure Coefficient, ko	Passive Earth Pressure Coefficient, k _p
Controlled Fill (Blended clay)	20 kN/m ³	28°	5 kPa	0.36	1.13	2.76
3 – Colluvial Clay	20 kN/m ³	25°	5 kPa	0.41	1.14	2.46
5 – Residual Clay (Yellow)	20 kN/m ³	25°	5 kPa	0.41	1.14	2.46
6– EW Dolerite (Clay)	20 kN/m ³	28°	10 kPa	0.36	1.13	2.76

Table 5:	Retention	Design	Parameters
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The earth pressure coefficients detailed in Table 5 have been calculated using Rankine's Theory assuming level backfill. The retaining wall designer should ensure that the use of this method is appropriate for the individual retaining wall(s). Any surcharge affecting the walls such as adjacent footings, adjacent retaining walls and their backfill, or sloping surfaces, should be allowed for in the design.

6.3 Suitability of Site Soils for Use as Engineering Fill

Terrain A: Undulating Slopes with Weathered Dolerite

The yellow/brown residual clay (Unit 5) soils that are present are moderately to highly reactive and are not recommended for reuse as controlled fill due to their significant shrink-swell potential. If they



must be used due to site cut/fill balances then it is recommended that they are blended with highly weathered dolerite (Unit 7) rock material at a ratio of 1:1 to reduce the potential reactivity.

Reuse of the weathered dolerite rock as engineering fill or road embankment fill will be possible, however, any oversize material (>100mm) will require screening or further breaking down using large compaction plant. Mechanical pre-treatment of the weathered dolerite rock samples was undertaken prior to testing to simulate placement and compaction and this process resulted in a lower CBR value of 7 than might typically be encountered for weathered rock. Should slightly weathered dolerite be encountered in the base of the deep cuts it may be excavated in large boulders that will not break down upon compaction and would require either sorting or crushing with suitable plant.

A blend of 50% residual clay and 50% weathered dolerite gravel was prepared from recovered materials in the adjacent Precinct B (TP217 + TP229) then subject to mechanical pre-treatment to simulate placement and compaction. Following pre-treatment the blended material had a PI of 45 and 38% of the sample was <75µm, however, it is classified as a Sandy Clayey GRAVEL in accordance with AS1726-2017. The weighted PI (PI x fraction passing 425µm) of the blended material for volume change.

The high PI indicates the material is likely to be moisture sensitive despite the gravel content and proposed reuse of the blended material should therefore allow for potential reworking and moisture conditioning time that may be required if prolonged rainfall occurs. This may include grading of the subgrade towards embankment shoulders or edges of fill platforms and temporary drainage diversion measures to prevent water pooling on the surface.

Achieving a thorough blend of clay and weathered rock gravels will be difficult and potentially costly due to additional handling and placing requirements. Blending may be attempted by placing approximately 150mm of weathered rock fill and then overlaying with a layer of 150mm of clay fill before cross ripping to 300mm and then compacting with a pad foot roller. If site conditions permit, the use of scrapers sourcing different materials from different cuts for alternating layers may result in a more efficient blending methodology but will require close supervision.

Terrain B: Alluvial Floodplain

Due to the low-lying nature of the alluvial depression, excavation works are expected to be minor this terrain, however, soils that may be encountered during service trenching comprising topsoil (Unit 2) and alluvial clay (Unit 4). The topsoil has a high clay content and may be difficult to reuse for landscaping purposes. The alluvial clay soils are moderately to highly reactive and are not recommended for reuse as controlled fill due to their significant shrink-swell potential unless they can be blended with weathered rock as per Terrain A.



6.4 Bulking Factors

Based on test results and previous experience with similar soils, material properties and potential bulking factors are presented in Table 6. Bulking factors will require revision once earthworks commence and reconciliation of cut and placed material volumes and density test results can be undertaken.

Material Type	Field Moisture Content (%)	Optimum Moisture Content (%)	Maximum Dry Density (t/m³)	Cut to Truck (Loose Bulking Factor)	Cut to Fill Platform** (Compacted bulking factor)
Clay Soils	23.2 - 32.8	24 - 27.9	1.49 – 1.58	1.3	1
Blend of Clay and Rock	15.4	14.3	1.87	N/A	N/A
EW/ HW Rock	8 – 10.5	12.2 – 14.4	1.92 - 2.07	1.4	1 – 1.1
Slightly Weathered/ Fresh Rock	N/A	N/A	N/A	1.5	1.2

Table 6: Material Properties* and Bulking Factor
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* From CBR test results (100% Standard Compaction)

** Assuming average 98% Standard Compaction

6.5 Fill Placement and Compaction Control

All fill placed for the support of structures or pavements should be placed and compacted as outlined below:

- After unsuitable material (including topsoil) has been stripped the exposed natural subgrade should be proof roll tested in the presence of a suitably experienced geotechnical practitioner to highlight any soft, wet or excessively deflecting areas. Where these are encountered they should be over-excavated and removed to spoil and either re-used on site as non-structural landscaping material or removed from the site. Excavated areas should be backfilled with an approved granular material;
- Topsoil material below the root zone in the alluvial plain (Terrain B) has a high clay content and may therefore be difficult to reuse as landscaping material;
- In areas where extensive filling works comprising >1.8m of fill such as in the adjacent Precinct J, stripping can be reduced to the removal of the upper approximate 50mm of vegetated and root affected material and the remaining topsoil left in place. Moisture conditioning of the exposed soils will then be required prior to placement of site won fill. Use of site won weathered rock as a bridging layer may be required, pending geotechnical assessment. It is noted that in areas of soft soils identified in the previous Douglas Partners assessment in the adjacent Precincts, that there is a potential for consolidation settlement and an appropriate filling plan will be required for these areas;



- Previous experience in the general area with the yellow residual clay soils (Unit 5) in Terrain A has revealed that they can be difficult to bridge when over-wet and incorporation of a granular bridging layer or potentially a rock drainage blanket may be required before placement of fill and it is recommended that an allowance be made for such conditions. The bridging layer may comprise site won weathered rock, if available. Alternatively, consideration could be given to over-excavation of the clay to weathered rock, blending the excavated clay soils with site won weathered rock and then replacement of the blended material to design level. Treatment of the clay foundation with 2% quick lime to 300mm depth to form a suitable compaction surface and to minimise excavation and replacement works is another alternative treatment;
- In areas where pavements are proposed, the subgrade will be required to be within ±2% of OMC prior to placement of pavement layers. Moisture conditioning of the subgrade may be required prior to compaction;
- The yellow residual clay (Unit 5) soils are typically low CBR and where encountered at road subgrade level are likely to require excavation and replacement with suitable granular material and it is recommended that an allowance be made for such conditions;
- The investigation was undertaken following a period of dry weather, however, over-wet subgrade conditions are likely to be encountered in the alluvial Terrain B in the south of the site following high rainfall events and subgrade improvement works may then be required in this area prior to filling. Treatment of the exposed subgrade with quick lime, incorporation of a granular bridging layer, or, potentially a rock drainage blanket may be required before placement of fill pending geotechnical assessment and it is recommended that an allowance be made for such conditions;
- Where weathered rock is exposed at subgrade level it will require ripping to a depth of 300mm below subgrade level and re-compaction to break up preferential drainage paths that concentrate water beneath the pavement or potential residential lots;
- Maximum particle size for general lot fill is 100mm;
- Careful management of the moisture sensitive blended clay and rock material will be required during and after placement as fill. This may include grading of the subgrade towards embankment shoulders, or, edges of fill platforms and temporary drainage diversion measures to prevent water pooling on the surface;
- Where surface slopes are more than 7° the existing surface should be benched prior to placement of fill to provide a level surface suitable for compaction. Each bench will require a minimum width of 3m to allow access for compaction equipment;
- Proposed fill material should comprise suitable fill as defined in AS 3798-2007 Guidelines on Earthworks for Residential and Commercial Developments. Inspection by a geotechnical authority may be required to confirm suitability of proposed fill material;
- Where filling is required beneath structures, approved fill should be placed in layers not exceeding 250 mm loose thickness and compacted to a minimum dry density ratio of not less than 95% of standard compaction. Clay fill should be placed and maintained at no more than ±2% of standard optimum moisture content;



- Where filling is required beneath pavement layers, suitable fill should be placed in layers not exceeding 300 mm loose thickness and compacted to a minimum dry density ratio of 98% standard compaction. The top 300mm of natural subgrade below pavements or the final 300mm of placed road subgrade fill should be compacted to a minimum density ratio of 100% Standard Compaction. Clay fill should be placed and maintained within 2% of standard optimum moisture content;
- Where site won weathered rock is used as a bridging layer, a maximum particle size of 300mm is recommended. Bridging layer material should be tracked in layers not exceeding 500mm loose thickness and then compacted with a minimum six passes by a large compactor (>12T) before being proof rolled under the direction of a geotechnician. The number of passes may require revision depending on material properties. Loss of fines from overlying placed fill may occur where there are large voids present if the rock fill does not break down during compaction. A geo-fabric separation layer may be placed above the rock fill to prevent loss of fines. This will need to be assessed upon placement of excavated rock fill material;
- All fill for the support of structures should be placed and compacted in accordance with the recommendations outlined in AS3798-2007 Guidelines on Earthworks for Residential and Commercial Developments, under Level 1 supervision. Areas of the site that are filled to support pavements should be filled under Level 2 supervision and testing.

7 FOUNDATIONS (Site Classification)

AS2870-2011, 'Residential Slabs and Footings', sets out criteria for the classification of a site and the design and construction of a footing system for a single dwelling house, townhouse or a similar structure.

Based on encountered profiles, previous experience with similar soil types in the general vicinity and shrink-swell testing undertaken on collected insitu samples and recompacted samples, estimated surface movements based on potential development conditions are summarised in Table 7.



Development Condition	-		Estimated Surface Movement ys (mm)	Potential Site Classification							
	Terrain A – Undulating Slopes with Weathered Dolerite										
On Grade	Unit 5 – Residual Clay	2 – 4.5	20 - 60mm	M / H1							
Cut (>0.75m)	Unit 7 – Dolerite Rock	0 – 1.5	10 - 25mm	S/ M							
Fill (>0.75m)	Unit 4A – Residual Clay as Fill	2 - 4.5	35 - 70mm	M / H2							
Fill (>0.75m)	Blend Clay/Rock	1 – 2.5	20 - 40mm	М							
Terrain B – Alluvial Plain											
Fill (>0.5m)	Blend Clay/Rock	1 – 2.5	20 - 40mm	М							

Table 7: Summary of Potential Site Classifications

In summary, the following comments are made with relation to the potential site classifications outlined in Table 7:

- The potential site classifications are preliminary in nature and will require confirmation following site re-grading once final site levels and natural/fill soil profiles are known;
- The natural profile in Terrain A can vary from weathered rock to highly reactive clays and the existing site profiles have potential site classifications ranging from M to H1;
- A cut profile in Terrain A can vary from weathered rock to highly reactive clays and the cut site profiles have potential site classifications ranging from S to H1;
- The natural profiles in Terrain B are moderately to highly reactive and the existing site profiles have a potential site classification ranging from M to H2;
- If site won highly reactive residual yellow clay from Terrain A is used as engineering fill it can result in Class H1 or H2 site classifications. It is therefore recommended that if the yellow clay must be used, that it be blended at a ratio of 1:1 with site won weathered rock to reduce the potential reactivity. Testing of the blended material is recommended to confirm the potential reactivity. Based on previous experience with the blended gravel / clay fill material a Class M site classification is possible;
- Use of clay fill imported from other sites should be avoided until the properties of the imported material have been assessed.

It is noted that all fill for the support of structures should be placed and compacted in accordance with the recommendations outlined in AS3798-2007 under Level 1 inspection and testing to be considered as Controlled Fill.



8 PAVEMENT DESIGN

8.1 Proposed Works

The proposed development includes construction of seven sections of road pavements for access to the site and connecting minor roads as shown on Figure 1. Site regrading works comprising up to 2m of cut and placement of up to 2m of fill will be required for these sections of road.

Representative samples of subgrade soils were collected for CBR testing from subgrade level and proposed fill source areas based on the supplied cut /fill plan. Results of the subgrade testing was summarised in Table 4.

8.2 Design Parameters

With reference to Port Macquarie Hastings Aus-Spec, options for pavement design considered the following:

- Local Street design traffic loading = 5×10^5 ESA;
- Collector Road design traffic loading = 1 x 10⁶ ESA;
- Port Macquarie Hastings Council Aus-Spec requires an AC seal for each section of road.
 - AC10 is proposed for 40mm AC on Collector Roads; and
 - AC10 is proposed for 30mm AC on Local Streets
- Design levels range from approximately 2m embankment fill to 2m cut below existing surface level;
- Terrain A Design CBR for residual yellow clay of 2%;
- Terrain A Design CBR for weathered rock of 10%;
- The residual clay and weathered rock profile in Terrain A can be highly irregular. It is
 therefore proposed that pavements in Terrain A where weathered rock subgrade is
 anticipated, are boxed out to nominal design thickness and a geotechnical assessment of
 the exposed subgrade undertaken. Where residual yellow clays are present, excavation
 and replacement of the subgrade with a Select Fill layer (CBR >15 and PI <15) of minimum
 300mm thickness will be required. It is noted that this may need to be thickened or replaced
 with a rock blanket where the clay profile is thick and /or over-wet;
- For low CBR residual clays an alternative treatment is in-situ stabilisation with quick lime to reduce moisture content, improve the material handling properties and in-situ CBR. This results in reduced pavement thickness and excavation and replacement of high plasticity clay soils which are typically not suitable for reuse without blending with weathered rock. Based on previous lime trials undertaken on similar clay soils a nominal treatment would be stabilisation with 3.5% quicklime to 300mm depth which may result in a design CBR of 8%. If this is a preferred option, then lime stabilisation trials are recommended. Roads with a consistent low CBR subgrade where this treatment may be appropriate includes Roads 28 and 29;
- Terrain B Alluvial Depression: Fill embankments are proposed across most of this terrain. It is assumed that site won yellow clay (Unit 5) blended with weathered dolerite (Unit 7) will be



used for embankment fill construction. A design CBR of 7% has been adopted based on laboratory testing of blended materials. Further testing is recommended during fill blending and CBR testing will also be required at subgrade level following completion of fill embankment construction to confirm the design CBR is appropriate.

8.3 Pavement Design Parameters

Flexible pavement thickness designs based on Austroads design procedures with reference to the empirical design chart (Figure 8.4) are summarised in Table 8 for subgrade soils in their existing condition without lime stabilisation.



Road	Design Category	Chainage	Development Condition	Subgrade	Subgrade Design CBR	AC (mm)	Base (mm)	Subbase (mm)	Granular Select (mm)	Design Thickness # (mm)	Total Actual Thickness (mm)
1	Collector	Ch30 - 165	Fill	Embankment Fill	7	40	140	150		330	330@
3	Local Street	Ch0 – 27	Fill	Embankment Fill	7	30	120	150		300	300@
10	Collector	Ch0 - 170	Cut	6 – EW Dolerite 7 – HW Dolerite	10	40	140	150	**	240	330
10	Collector	Ch170 - 215	Ongrade / Cut	5 – Residual Clay 6 – EW Dolerite	2	40	140	150	300	630	630@
25	Local Street	Ch0 - 80	Fill	Embankment Fill	7	30	120	150		300	300@
25	Local Street	Ch80 -130	Ongrade / Cut	6 – EW Dolerite	10	30	120	150	**	270	300
26	Local Street	Ch0 - 48	Fill	Embankment Fill	7	30	120	150		300	300@
26	Local Street	Ch48 – 145	Ongrade / Cut	5 - Residual 6- EW Dolerite	2	30	120	150	280	580	580@
28	Local Street	Ch0 – 44	Cut	6 – EW Dolerite 7 – HW Dolerite	10	30	120	150	**	240	300
29	Local Street	Ch0 – 175	Ongrade / Cut	3 – Colluvial 5 – Residual	2	30	120	150	280	580	580@

Table 8 – Flexible Pavement Thickness Design Summary

** Replacement of residual yellow clay subgrade required where identified following subgrade assessment, with minimum 300mm Select Fill = CBR>15, PI<12 and maximum particle size <100mm

Design thickness based on Austroads design procedures with reference to the empirical design chart (Figure 8.4)

[®] Density testing required as the AC is included in the design thickness.



8.4 Pavement Construction

Construction recommendations for specific pavement designs are included in the appended Pavement Thickness Design Sheets. In addition, the following general construction advice is given:

- A geotechnical assessment of the roads should be undertaken following boxing out of pavement areas to assess the need for localised areas requiring subgrade replacement or other treatment. Particular attention should be paid to cut/ fill boundaries, zones of moisture concentration and the presence of yellow clay soils or colluvial gravel lenses at subgrade level;
- The residual clay and weathered rock profile in Terrain A can be highly irregular. It is
 therefore proposed that pavements in Terrain A be boxed out to nominal design thickness
 where weathered rock subgrade is anticipated, and a geotechnical assessment of the
 exposed subgrade be undertaken. Where residual yellow clays are present, excavation and
 replacement of the subgrade with a Select Fill layer (CBR >15 and PI <15) of minimum
 300mm thickness will be required. It is noted that this may need to be thickened or replaced
 with a rock blanket where the clay profile is thick and /or over-wet;
- Preparation of areas for road construction should involve stripping of all topsoil to spoil or stockpile for re-use as landscaping material only;
- Proof roll the exposed subgrade to highlight any loose, soft, wet, or heaving areas. Where such areas are identified they should be removed and replaced with approved granular or Select Fill to design subgrade level;
- At the time of the field investigation, moisture content of the clay subgrade was above standard Optimum Moisture Content (OMC) at several locations. Drying back and moisture conditioning of the subgrade may therefore be required prior to compaction and make take several days depending on weather conditions;
- Where potentially poor drainage conditions were observed during the investigation in Terrain B, there may be a need for a 300mm rock drainage blanket wrapped in heavy duty geo-fabric (RMC Class C or greater) to provide a suitable compaction surface following extended rainfall. This should be allowed for but will firstly require further geotechnical assessment following stripping;
- Where filling is required beneath pavement layers, suitable fill should be placed in layers not exceeding 300 mm loose thickness and compacted to a minimum dry density ratio of 98% Standard Compaction. The top 300mm of natural subgrade below pavements or the final 300mm of placed road subgrade fill should be compacted to a minimum density ratio of 100% Standard Compaction or as specified in the applicable pavement thickness design sheet(s);
- Where weathered rock is exposed at subgrade level during reconstruction or widening it would require ripping to a depth of 300mm below base of pavement and re-compaction to break up preferential drainage paths that concentrate water beneath the pavement;
- Select Fill (CBR>15 and PI<15) should be placed in layers not exceeding 300mm loose thickness and compacted to 100% Standard compaction;
- Select Fill and pavement gravels should be placed and maintained at 60% to 90% of Optimum Moisture Content;



- DGS sub-base material should be placed in layers not exceeding 200mm loose thickness and compacted to 95% Modified Compaction;
- DGB base material should be placed and compacted to 98% Modified Compaction;
- Place AC seal as per Council requirements;
- Where final sealing cannot be undertaken within a few days of completion of the base course, a primer seal should be used to protect the pavement and maintain equilibrium moisture content;
- Should wet weather occur prior to final sealing, the base course should be allowed to dry back to not more than 90% of Optimum Moisture Content prior to sealing. Trapping of excess moisture below the final seal will significantly reduce pavement life;
- Care will be required to promote subsurface drainage to avoid accumulation of water in the pavement profile. Subsoil drains should therefore be installed and extend to 300mm below base of pavement.

9 LIMITATIONS

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

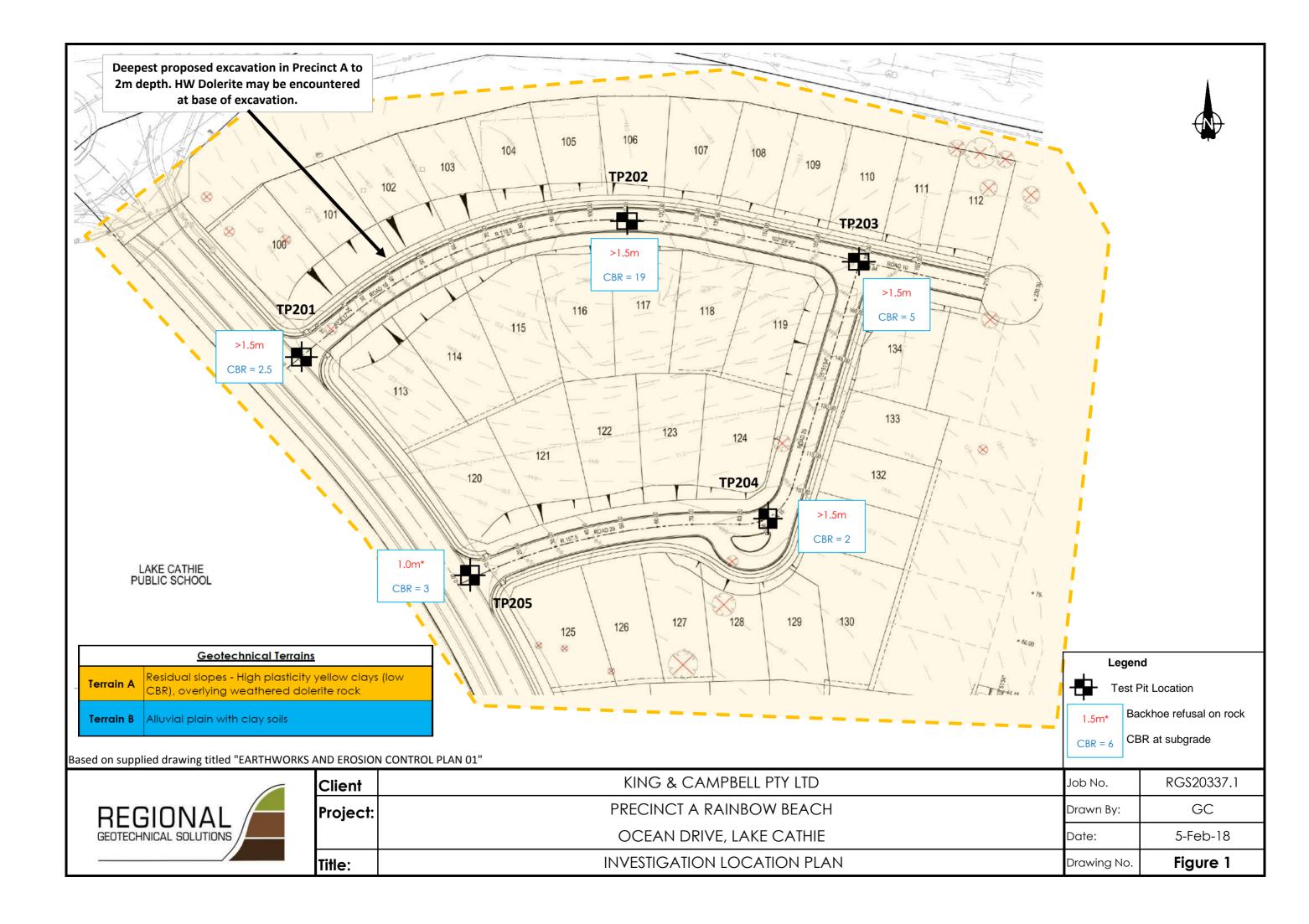
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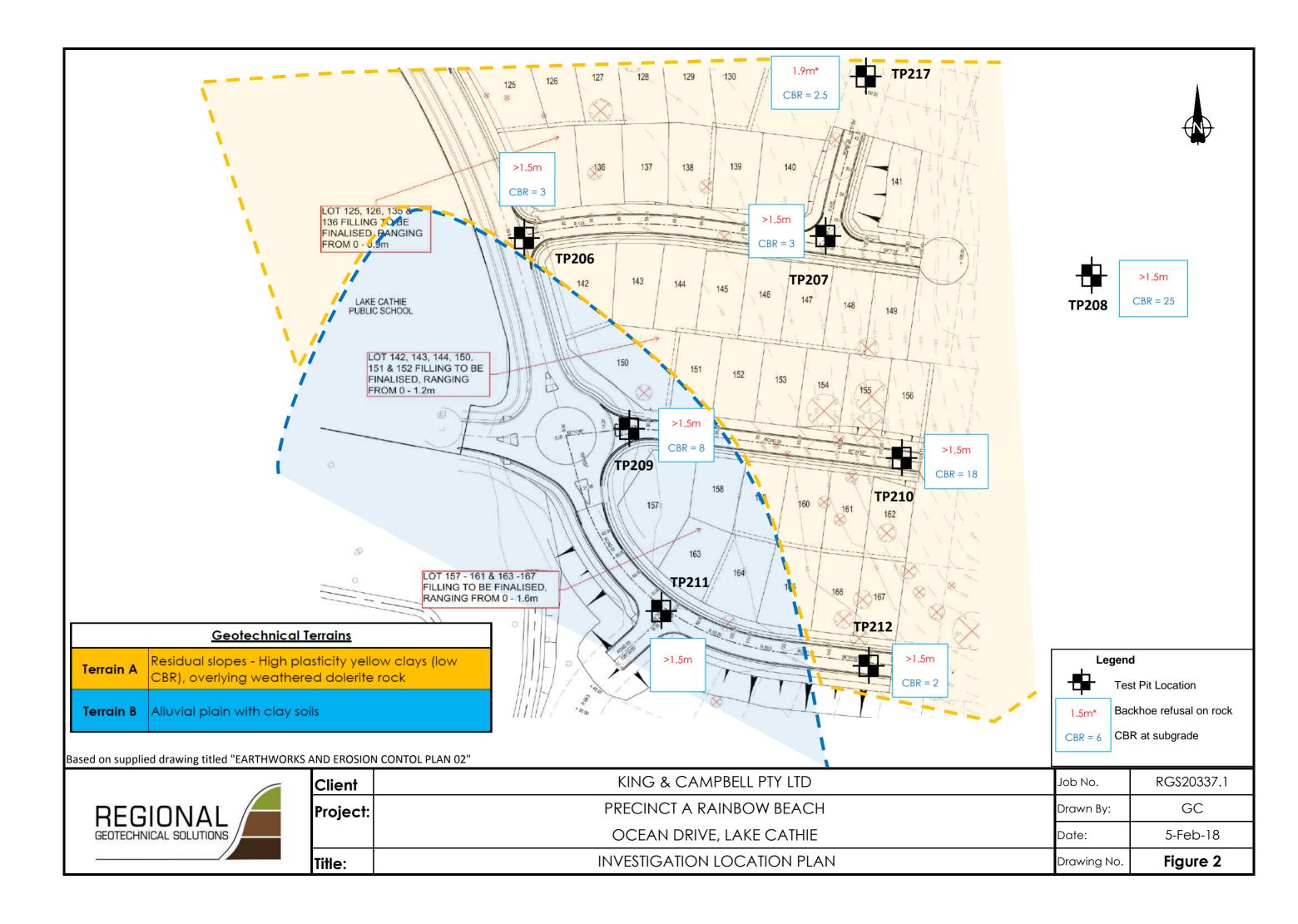
Regional Geotechnical Solutions Pty Ltd

Tim Morris Senior Engineering Geologist



Figure







Appendix A

Results of Field Investigations

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				Т	EST LO	OCAT	ION: Road 10 Ch0m				DATE	:	12/18/17
		IENT TYPI T LENGTH		Backh 2.0 m		IDTH:	easting: 0.5 m Northing:	48370 650749		SURF.		RL:	11.0 m AHD
	Drill	ing and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
BUCKET	Not Encountered					CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, Sand fine to medium grained, traces roots tup to 5mm	, dark of grass	M M M M M M M M M M M M M M M M M M M	Fb			TOPSOIL
50mm TOOTHED BUCKE1		0.40m				СН	Gravelly Sandy CLAY: Medium plasticity, yellow/grey, Sand fine to medium grained, fine to medium grained, subangular 0.40m	Gravel					COLLUVIAL
450mm 1		CBR 0.70m	10. <u>5</u>	0.5		СН	Sandy CLAY: Medium to high plasticity, ye Sand fine to medium grained, some Grave medium grained, subangular	llow, I, fine to		Fb / VSt	HP	350	RESIDUAL SOIL
			10. <u>0</u>	 - 1. <u>0</u> 		СН	0.90m Gravelly Sandy CLAY: Medium plasticity, yellow/dark grey, Sand fine to medium grai Gravel fine to medium grained, subangular Rock fabric		f				EXTREMELY WEATHERE DOLERITE
			9.5	1.5			1.50m Hole Terminated at 1.50 m						
			9. <u>0</u> 8.5		· · ·								
<u>Wat</u> ▼	Wat (Dat ∙ Wat I Wat I ta Cha	er Level e and time sh er Inflow er Outflow anges radational or			50mm Bulk s Enviro Acid S Bulk S	n Diame ample f onmenta Sulfate S Sample	ter tube sample or CBR testing al sample Soil Sample	Consis VS S VS St VSt H Fb Densit	Very Soft Soft Firm Stiff Very Stiff Hard Friable ¥ V	V	<: 2: 50 10 20 20 20	CS (kP# 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15%
	tra D(ansitional stra efinitive or dis rata change		PID DCP(x-y) HP	Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)		L ME D VD) N D	oose lediur lense 'ery D		Density Index 15 - 35% e Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

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	Drill	ling and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component	//particle s	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
KET	tered					GP	FILL: Sandy GRAVEL, fine, subangular, 0.10m orange/pale grey, Sand fine to medium grai	ned	D				FILL
450mm TOOTHED BUCKE1	Not Encountered		17. <u>5</u>			СН	Sandy CLAY: Medium to high plasticity, yel Sand fine to medium grained, traces o Grav medium grained, subangular, Dolerite	llow,	M < Wp	Fb / VSt	HP	320	RESIDUAL SOIL
nm TC		0.40m		-		СН	0.40m Gravelly Sandy CLAY: Medium to high pla	sticity,	-			-	
450n		CBR		0.5			pale yellow/pale brown, trace of pale grey, s to medium grained, Gravel fine to coarse gr subangular, traces of Rock fabric	Sand fine ained,					DOLERITE
		0.70m	17. <u>0</u>										
			16. <u>5</u>										
				1.5	<u> </u>		1.50m Hole Terminated at 1.50 m						
			16. <u>0</u>										
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				2.5									
			15. <u>0</u>										
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<u>Stra</u>	tra D	anges radational or ansitional stra efinitive or dis rata change	ata	Field Test PID DCP(x-y) HP	Photoi Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) imeter test (UCS kPa)	Density	Friable V L MD D VD	La D M D	ery Lo oose lediun ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

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METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
KET	ered		-	-		GP	FILL: Sandy GRAVEL, fine to medium grain 0.10m subrounded, pink, Sand fine to medium	ned,	D				FILL
450mm TOOTHED BUCKET	Not Encountered	0.40m	14. <u>0</u>			CL	TOPSOIL: Sandy Silty CLAY, dark grey, S to medium, traces of grass roots up to 5mr	and fine n	M < W _P	Fb			TOPSOIL
450mm		CBR		0.5		СН	Sandy CLAY: Medium to high plasticity, ye yellow, with pale grey mottling, Sand fine to grained, some Gravel, fine grained, subany trace rock fabric	medium		Fb / VSt	ΗP	220	RESIDUAL SOIL TO EXTREMELY WEATHERE DOLERITE
		<u>0.80m</u>	13. <u>5</u>	- - - 1.0_									
			13. <u>0</u>			<u>+</u>	 1.10m DOLERITE: Fine grained, pale yellow/pale blue/pale grey, highly fractured, foliated, me high strength, excavated as Sandy GRAVE 1.50m 	edium to EL					HIGHLY WEATHERED DOLERITE
				-			Hole Terminated at 1.50 m						
			12. <u>5</u>	2.0									
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	Wat (Dat Wat	er Level e and time sł er Inflow er Outflow anges	nown)	Notes, Sa U₅ CBR E ASS B	50mm Bulk s Enviro Acid S	i Diame ample f	ter tube sample or CBR testing al sample Soil Sample	S F St VSt H	ency Very Soft Soft Firm Stiff Very Stiff Hard Friable		-29 29 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u></u>	Gi tra De	radational or ansitional stra efinitive or dis rata change	ita	Field Test PID DCP(x-y) HP	Photoi Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	<u>Density</u>	V L ME D VD	L N D	'ery Lo oose Iediur)ense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

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CKET	Itered					CL	TOPSOIL: Sandy Silty CLAY, low plasticity, grey, trace of grass roots up to 5mm	dark	× ×	Fb			TOPSOIL
50mm TOOTHED BUCKET	Not Encountered					СН	0.15m Gravelly Sandy CLAY: Medium plasticity, p yellow/pale brown, Sand fine to medium gra	ale	Σ				COLLUVIAL
OTHI	Not						Gravel fine to medium grained	,					
m TC			10. <u>0</u>	1									
450n		0.50m		0.5		СН	0.50m CLAY: Medium to high plasticity, yellow with mottling, traces of Gravel, fine grained, suba	grey		VSt	HP	300	RESIDUAL SOIL
							mouning, races of Gravel, lifte grained, SUD2	uyulal					
		CBR											
		0.90m	9.5										
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				-		1	1.10m DOLERITE: Fine grained, pale grey/pale						EXTREMELY TO HIGHLY
							yellow/pale blue, highly fractured, foliated, m high strength, excavated as Sandy GRAVEI		D				WEATHERED DOLERITE
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	Dril	ling and Sar	npling				Material description and profile information				Fiel	d Test	
(0	NOI			Z	ζ	0		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered	0.20m		-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity, grey, Sand fine to medium grained, traces of roots up to 5mm		M < W	Fb			TOPSOIL
HED I	ot Enc	0.20m		-		СН	0.20m Gravelly Sandy CLAY: Medium to high pla yellow/dark brown, Sand fine to medium gra						COLLUVIAL
TOOT	ž	CBR		-			Gravel, fine to medium grained, subangular						
L mm		0.50m		0.5			0.50m					000	
45(U50		_		СН	Sandy CLAY: Medium to high plasticity, ye Sand fine to medium grained, traces of Gra grained, subangular	llow, vel, fine		Fb / VSt	- HP	300	RESIDUAL SOIL
		0.70m		-	////// 	1	0.70m DOLERITE: Fine grained, pale yellow/pale fractured to highly fractured, medium to highly				1		HIGHLY WEATHERED DOLERITE
				-	XX		strength, excavated as Sandy GRAVEL						
				1.0	$\langle \rangle \rangle$		1.00m						
							Hole Terminated at 1.00 m Refusal						
				-	-								
				-	-								
				1. <u>5</u>	-								
				-	-								
				-	-								
				-	-								
				-	-								
				2. <u>0</u>	-								
				-	-								
				-	-								
				-	-								
				- 2.5	-								
				2.3	1								
				-	1								
				-	1								
150	END:			Notor 8-			e	Consist				CS (kPa	Moieturo Condition
LEG Wate				Notes, Sa				1	Very Sof	t	<	25	D Dry
Ţ		ter Level te and time s	hown	U₅₀ CBR	Bulk s	ample f	er tube sample or CBR testing	F	Soft Firm		50	5 - 50 0 - 100	W Wet
►	Wat	ter Inflow		E ASS	Acid S	Sulfate S	l sample ioil Sample	VSt	Stiff Very Stif	f	20	00 - 200 00 - 400	F Contraction of the second se
◀ <u>St</u> ra		ter Outflow anges		В	Bulk S	Sample		1	Hard Friable		>/	400	
	G	radational or ansitional stra	ata	Field Test PID	_	ionisatio	n detector reading (ppm)	<u>Density</u>	V L		'ery Lo oose	oose	Density Index <15% Density Index 15 - 35%
	_ D	efinitive or di		DCP(x-y) HP	Dynar	nic pene	etrometer test (test depth interval shown) meter test (UCS kPa)		MI D	D N		n Dense	-
	st	rata change					· · · ·		VE		ery D		Density Index 85 - 100%

0. 53				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP206
R	EG	IONA			LIENT		King & Campbell			Ρ	AGE	:	1 of 1
GEU	TECHN	ILAL SULUTI			ROJE						OB		RGS20337.1
					ITE LC							GED B	
				Т	EST LO	OCAT	ION: Road 26 Ch0m			D	ATE		12/18/17
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	483782 6507352		SURF/		RL:	7.4 m AHD
		ing and Sam					Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered	0.40m	7.0			CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, Sand fine to medium grained, traces roots up to 5mm		M < W _P	Fb			TOPSOIL
450mm ⁻		CBR		- 0. <u>5</u> 		СН	CLAY: Medium to high plasticity, yellow wit mottling, traces of Gravel, fine grained, sub	h grey brounded		VSt	HP		RESIDUAL SOIL
		0.90m	6.5	; - 1. <u>0</u> 									
			6. <u>0</u>	- <u>1.5</u>			^{1.50m} Hole Terminated at 1.50 m						
			5. <u>5</u>	 - 2.0_	-								
			5. <u>C</u>	 - 2.5_	-								
			4.5		-								
<u>Wat</u> ▼	Wat (Dat - Wat I Wat ata Cha	radational or		I Notes, Sa CBR E ASS B Field Test PID	50mm Bulk s Envirc Acid S Bulk S	n Diame ample f onmenta Sulfate \$ Sample	ts ter tube sample for CBR testing al sample Soil Sample on detector reading (ppm)	S S F F St S VSt N H F	I Very Soft Soft Firm Stiff Very Stiff Hard Friable V L	V	<2 2 50 10 20	I I CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	Moisture Condition D Dry M Moist W Wet Wp Plastic Limit WL Liquid Limit Density Index <15%
	D	ansitional stra efinitive or dis rata change		DCP(x-y) HP	Dynar	nic pen	etrometer test (test depth interval shown) ometer test (UCS kPa)		MD D VD	M D			

0:::				E	NGI	NEE	RING LOG - TEST PIT			т	EST		NO: TP207
R	ĘG	IONA			LIENT		King & Campbell			Ρ	AGE	:	1 of 1
GEU	TECHN	NGAL SULUTIU	NS	P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
-				S	ITE LC	CATI	ON: Precint A Rainbow Beach			L	OGO	GED E	BY: GC
				Т	EST LO	OCAT	ON: Road 26 Ch110m			D	ATE		12/18/17
		IENT TYPE: T LENGTH:		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	483895 6507350		SURF/		RL:	AHD
	Drill	ing and Samp	oling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
D BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, Sand fine to medium grained, traces roots up to 5mm	, dark of grass	M < W _P	Fb			TOPSOIL
OOTHE	Not E			_		GP CH	0.25m 0.30m Sandy GRAVEL: Fine grained, subangular grey/pale grey	/	D Å	Fb	-		COLLUVIAL
450mm TOOTHED				0. <u>5</u>			Gravelly Sandy CLAY: Medium plasticity, traces of orange/yellow, Gravel fine to coar grained, subangular, Sand fine to medium	rse grained	ž	VSt	-		RESIDUAL SOIL
4				-		СН	CLAY: Medium to high plasticity, yellow wit mottling, traces of Gravel, fine grained, sub			VSt	ΗP	220	
		0.90m		- 1. <u>0</u>	///// }````		0.90m DOLERITE: Fine grained, grey/dark blue, f to high fractured, medium to high strength,	ractured			-		HIGHLY TO MODERATEL WEATHERED DOLERITE
		CBR		-	/// //// ////		excavated as Sandy GRAVEL						
		1.30m		-	$\langle \rangle \rangle$								
				_									
				1.5	$\langle \langle \langle \rangle$		1.50m Hole Terminated at 1.50 m						
				-									
				-									
				2.0									
				-									
				-									
				2.5									
				-									
				-									
				-									
LEG	END:		<u>i</u>	Notes, Sa	mples a	nd Tes	<u>s</u>	Consiste				CS (kPa	
Wate	Wat (Dat	er Level e and time sho	own)	U ₅₀ CBR E	Bulk s Envirc	ample f	ter tube sample or CBR testing I sample	S S F F St S	/ery Soft Soft Tirm Stiff		25 50 10	25 5 - 50 0 - 100 00 - 200	5
 <u>Str</u> at		er Inflow er Outflow anges	'	ASS B		Sulfate S Sample	ioil Sample	н н	′ery Stiff lard riable			00 - 400 400	- ·
	Gi tra	radational or ansitional strata efinitive or disti	a	Field Test PID DCP(x-y)	Photo		n detector reading (ppm) etrometer test (test depth interval shown)	<u>Density</u>	V L MD	Lo	ery Lo oose lediur	oose n Dense	Density Index <15% Density Index 15 - 35% e Density Index 35 - 65%
		rata change		HP	Hand	Penetro	meter test (UCS kPa)		D VD		ense ery D		Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP208
R	EG	IONA	L/	C C	LIENT	:	King & Campbell			P	PAGE	:	1 of 1
GEO	TECHN	IICAL SOLUTIO		P	ROJE	CT NA	ME: Residential Subdivision			J	OB I	NO:	RGS20337.1
-				S	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OGC	GED B	Y: GC
				т	EST L	OCAT	ON: Road 26 Ch150m			C	DATE	:	12/18/17
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	0.5 m NORTHING:			SURF. DATU		RL:	AHD
	Drill	ing and Sam	npling			1	Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
ED BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, Sand fine to medium grained, traces roots up to 5mm	, dark of grass	M < Wp	Fb			TOPSOIL
450mm TOOTHED	Not E					СН	Gravelly Sandy CLAY: Medium plasticity, brown/pale brown, Sand fine to medium gravel fine - subrounded, traces of red	— — — ained,					COLLUVIAL
450r				- U. <u>5</u>		CH	Sandy CLAY: Medium to high plasticity, ye pale grey mottling, Sand fine to medium gra traces of Gravel, fine to medium grained, s	ained,		Fb / VSt	HP	220	RESIDUAL SOIL
		0.90m		- - 1. <u>0</u>			0.90m DOLERITE: Fine grained, pale yellow, pale fractured to highly fractured, low to medium	e grey, n strengt	h,				HIGHLY TO MODERATEL WEATHERED DOLERITE
		CBR		-			excavated as Sandy GRAVEL						
		1.30m		-	$\left \right\rangle$ $\left \right\rangle$ $\left \right\rangle$ $\left \right\rangle$ $\left \right\rangle$ $\left \right\rangle$ $\left \right\rangle$								
				- 1.5			Hole Terminated at 1.50 m						
				-									
				- 2. <u>0</u>									
				-									
				- 2. <u>5</u>									
				-									
1.50					melar			0					Majatura Oraditi
<u>Wat</u> ▼	Wat (Dat Wat Wat	er Level e and time sh er Inflow er Outflow		Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	s ter tube sample or CBR testing il sample soil Sample	VS S F St VSt H	istency Very Sol Soft Firm Stiff Very Stiff Hard Friable		<2 25 50 10 20	<u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	tra D(anges radational or ansitional strat efinitive or dist rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Densi	Friable ty V L M D VI	L D M D	'ery Lo oose lediun ense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 35 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	io: TP209
R	EG	IONA	L/	C C	LIENT	:	King & Campbell			Ρ	AGE	:	1 of 1
GEO	TECHN	NICAL SOLUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
				S	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OG(GED B	Y: GC
				т	EST L	OCAT	ION: Road 25 Ch11m			D	OATE	:	12/18/17
		IENT TYPI T LENGTI		Backh 2.0 m		IDTH:	0.5 m EASTING:	483797 6507270		SURF. DATU		RL:	6.4 m AHD
	Drill	ing and San	npling				Material description and profile information			-	Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered	0.40	6.0			ML	TOPSOIL: Clayey SILT, dark grey/black		M				TOPSOIL
450mm T		0.40m CBR		- 0. <u>5</u> 		СН	<u>0.40m</u> Sandy CLAY: Medium plasticity, grey, with brown mottling, some Gravel, fine to mediu grained, subangular/subrounded	red/pale m	M < W	Fb / VSt	HP	220	
		<u>0.80m</u>	5. <u>5</u>	- - - - - - - - - - - - - - -									
			5.0_	- - - - - - - - - - - - - - - - - - -			1.50m Hole Terminated at 1.50 m						
				- - -			noe reminated at 1.30 m						
			4.5] -									
			4. <u>0</u>	- 2.5									
			3. <u>5</u>										
<u>Wat</u> ▼	Wat (Dat • Wat	er Level e and time sl er Inflow er Outflow anges	hown)	Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	ts ter tube sample for CBR testing al sample Soil Sample	S S F F St S VSt V H F	n cy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable		<: 2: 5(1) 2(CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u></u>	Gi tra De	radational or ansitional stra efinitive or dis rata change	ata	Field Tes PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)	Density	V L ME D VD	La D M D	ery Lo oose lediur ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP210
R	EG		AL /	c	LIENT	:	King & Campbell			P	PAGE	:	1 of 1
ĜEŌ	TECHN	NÎCĂE SOLUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	ОВ	NO:	RGS20337.1
				s	ITE LC	CATI	ON: Precint A Rainbow Beach			L	.OGG	GED B	Y: GC
				т	EST L	OCAT	ION: Road 25 Ch122m			0	DATE	:	12/18/17
		IENT TYP T LENGTI		Backh 2.0 m		IDTH:	0.5 m NORTHING:	48389 650728		SURF. DATU		RL:	AHD
	Drill	ing and San	npling			1	Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered	0.40m		-		CL	TOPSOIL: Sandy Silty CLAY, dark grey, S to medium grained, traces of Gravel, fine tr grained, subangular, traces of grass roots	o medium		Fb			TOPSOIL
450mm T		U50 CBR 0.70m 0.80m		- 0. <u>5</u> - - - 1. <u>0</u>		СН	Gravelly Sandy CLAY: Medium to high pla yellow/pale brown, Sand fine to medium gr Gravel fine to coarse grained, subangular, traces of rock fabric	ained.		Fb / VSt	HP	300	EXTREMELY WEATHERE DOLERITE
				- - 1.5			^{1.50m} Hole Terminated at 1.50 m						
				- - 2.0_ - -									
Wat		er Level		- 2.5 2.5 - - - - - - - - - - - - - - - - - - -	50mm	n Diame	ter tube sample	Consis VS S	Very Sof Soft	t	<: 2	CS (kP2 25 5 - 50	D Dry M Moist
- ►	(Dat ∙ Wat I Wat Ita Cha G tra	e and time sl er Inflow er Outflow anges radational or ansitional stra	hown) ata	CBR E ASS B Field Test PID	Enviro Acid S Bulk S ts Photo	onmenta Sulfate S Sample ionisatio	or CBR testing Il sample Soil Sample on detector reading (ppm)	F St VSt H Fb Density	L	V	10 20 >/ /ery Lo oose		W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35% Density Index 66%
	D	ansitional stra efinitive or dis rata change		DCP(x-y) HP	Dynar	nic pen	etrometer test (test depth interval shown) meter test (UCS kPa)		L MI D VI	D N D			

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	io: TP211
R	EG	IONA	L/	C	LIENT	:	King & Campbell			Ρ	AGE	:	1 of 1
GEO	TECHN	IICAL SOLUTIO		PI	ROJE	CT NA	ME: Residential Subdivision			J	OB I	NO:	RGS20337.1
				S	ITE LC	CATI	ON: Precint A Rainbow Beach			L	OGC	GED B	Y: GC
				TI	EST LO	OCAT	ION: Road 1 Ch80m			D	ATE	:	12/18/17
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48385 650722		SURF.		RL:	AHD
	Drill	ing and Sam	pling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Clayey SILT, dark grey/black, tra grass roots up to 5mm	aces of	M < w _P	Fb			TOPSOIL
450mm TOO1	Z			0.5		СН	<u>0.40m</u> Sandy CLAY: Medium to high plasticity, ye brown with grey/red mottling, some Gravel grained, subrounded	 llow/pale fine		Fb / S	HP	200	ALLUVIAL
						СН	At 0.9m, colour change to red with yellow n <u>1.10m</u> CLAY: Medium to high plasticity, yellow	nottling	> W _P	St	HP	150	RESIDUAL SOIL
							1.50m		~ W				
				-			Hole Terminated at 1.50 m						
				2.0									
				- 2. <u>5</u> -									
150					miner	nd Tec		Consid	tonov			CS (I-P-) Moieturo Condition
<u>Wat</u>	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow anges	iown)	Notes, San U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	i Diame ample f	ter tube sample or CBR testing al sample Soil Sample	Consist VS S F St VSt H Fb	tency Very Soft Soft Firm Stiff Very Stiff Hard Friable		<2 25 50 10 20	<u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u></u>	Gi tra De	radational or Insitional strat efinitive or dis rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Density		D Lo D	ery Lo bose lediun ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP212
R	EG	IONA	AL /	c	LIENT	:	King & Campbell			P	PAGE	:	1 of 1
GEU	TECHN	NICAL SULUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	OB I	NO:	RGS20337.1
-				S	ITE LC	CATI	ON: Precint A Rainbow Beach					GED B	
				т	EST LO	OCAT	ION: Road 1 Ch162m			D	DATE		12/18/17
		IENT TYPI T LENGTI		Backh 2.0 m		IDTH:	0.5 m EASTING:	48388 650719		SURF. DATU		RL:	7.8 m AHD
	Drill	ing and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered		7.5			ML	TOPSOIL: Clayey SILT, dark grey/black, tra grass roots up to 5mm	aces of	D	Fb			TOPSOIL
450mm TOOT	ž	<u>0.50m</u>		0.5		СН	0.30m CLAY: Medium to high plasticity, yellow, tra Gravel, fine grained, subangular		M > w _P	St	- HP	150	RESIDUAL SOIL
		CBR 0.90m	7. <u>0</u>										
			6. <u>5</u>	1. <u>0</u> 1.5		CH	1.10m Gravelly Sandy CLAY: Medium to high pla yellow/pale blue/pale grey, Sand fine to me grained, Gravel fine to medium grained, sul traces of rock fabric	dium	> v	Fb / S	t		EXTREMELY WEATHERE DOLERITE
			6.0	 - 2. <u>0</u>			Hole Terminated at 1.50 m						
			5. <u>5</u> -										
1 50			5. <u>0</u>									00 // 0	
<u>Wat</u> ▼	Wat (Dat Wat Wat	er Level le and time sl er Inflow er Outflow	hown)	Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	i Diame ample t onmenta	ts ter tube sample for CBR testing al sample Soil Sample	Consis VS S F St VSt H Fb	Very Soft Soft Firm Stiff Very Stiff Hard		<2 25 50 10 20	<u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400	Moisture Condition D Dry M Moist W Wet Wp Plastic Limit WL Liquid Limit
<u>Stra</u>	tra D	anges radational or ansitional stra efinitive or dis rata change	ata	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Pb Densit	Friable V L MD D VD	L N D	'ery Lo oose lediun ense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			T	EST	PIT N	io: TP213
R	EG		L	– c	LIENT	:	King & Campbell			F	PAGE	:	1 of 1
ĞEÖ	TECHN	IICAL SOLUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
				s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OGC	GED B	SY: GC
				т	EST L	OCAT	ON: Road 1 Ch220m			0	DATE	:	12/18/17
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:			SURF DATU		RL:	AHD
	Drill	ing and Sam	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
D BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, traces of grass roots up to 5mm	, dark	م م ع	Fb			TOPSOIL
450mm TOOTHED		0.30m CBR 0.70m		- 0. <u>5</u> -		СН	Gravelly Sandy CLAY: Medium to high pla yellow/pale brown, Sand fine to medium gra Gravel fine to medium grained, subangular	ained,		Fb/S	t HP	180	EXTREMELY WEATHERE DOLERITE
				- - 1. <u>0</u> - -			DOLERITE: Fine grained, pale yellow/pale grey/pale blue, fractured to highly fractured medium strength, excavated as Sandy GR	, low to					HIGHLY TO MODERATEL WEATHERED DOLERITE
				1.5	>>>		1.50m Hole Terminated at 1.50 m						
	Wat (Dat Wat Wat	er Level e and time sh er Inflow er Outflow	iown)	U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	s er tube sample or CBR testing I sample oil Sample	VS S F St VSt H	stency Very Sof Soft Firm Stiff Very Stif Hard		<2 2 50 10 20	<u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	tra De	anges radational or insitional stra efinitive or dis rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pene	n detector reading (ppm) trometer test (test depth interval shown) meter test (UCS kPa)	Fb Densit	Friable Ly V Mi D VI	L D N C	′ery Lo oose ⁄lediur)ense ′ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 35 - 65% Density Index 85 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP214
R	EG				LIENT		King & Campbell			-	PAGE		1 of 1
GEU	TECHN	IUAL SULUT			ROJE						OB		RGS20337.1
-												GED B -	
						OCAI	ON: Road 27 Ch150m				DATE		12/18/17
		IENT TYP T LENGTI		Backh 2.0 m		IDTH:	0.5 m EASTING:			SURF. DATU		RL:	AHD
	Drill	ing and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
D BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity, grey, Sand fine to medium grained, traces or roots up to 5mm		M < W	Fb			TOPSOIL
450mm TOOTHED		0.50m		0.5		СН	Gravelly Sandy CLAY: Medium plasticity, yellow/pale brown, traces of red, Sand fine medium grained, Gravel fine to coarse grain subangular	to ned,		Fb / S	HP t	180	RESIDUAL SOIL
450n		<u>0.50m</u> B					DOLERITE: Fine grained, pale yellow/pale brown/dark blue, highly fractured, medium s excavated as Sandy GRAVEL	strength,					HIGHLY TO MODERATEL WEATHERED DOLERITE
		<u>1.00m</u>		1.0_ - - - - - - - - - - - - - - - - - - -									
				2.0			^{2.20m} Hole Terminated at 2.20 m Refusal due to Rock						
				- 2.5									
LEG	END:			Notes, Sa	mples a	nd Tee	s	Conei	stency		 	CS (kPa	Moisture Condition
	e r Wat (Dat ∙ Wat	er Level e and time sl er Inflow er Outflow anges	hown)	U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	ter tube sample or CBR testing Il sample Soil Sample	VS S St VSt H Fb	Very Soft Soft Firm Stiff Very Stiff Hard Friable		<2 2 50 10 20	<u>CS (RPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 200 400	D Dry M Moist W Wet W _p Plastic Limit
	Gi tra De	radational or ansitional stra efinitive or dis rata change		Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	<u>Densit</u>		La D M D	'ery Lo oose lediur lense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

R	EG	IONA IICAL SOLUTI		C P S	LIENT: ROJEC ITE LO	CT NA				P/ JC LC	AGE OB I	NO: GED B	1 of 1 RGS20337.1
				Backh				974 m		URFA		RL:	
TES				2.0 m	W	DTH:	0.5 m NORTHING: 65073	333 m	D	ATUN		d Test	AHD
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	Material description and profile information MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components		CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
450mm TOOTHED BUCKET	Not Encountered	1.70m		- - - - - - - - - - - - - - - - - - -			MULCH						FILL
		в		- 2.0_ - - -		СН	Gravelly Sandy CLAY: Medium plasticity, red/brown, Sand fine to medium grained, Gravel fir to medium grained Sandy CLAY: Medium to high plasticity, yellow/pał brown, with grey mottling, Sand fine to medium grained, traces of Gravel, fine to medium grained, subangular		M < W _P	Fb / VSt	HP	150	RESIDUAL SOIL
Wat		<u>3.00m</u>	1	2.5			DOLERITE: Fine grained, pale yellow/pale grey, highly fractured, low to medium strength, excavate as Sandy GRAVEL 300m as Hole Terminated at 3.00 m VS S	istency	Soft		<2	CS (kPa 25 5 - 50	HIGHLY TO MODERATEL WEATHERED DOLERITE
	(Dat Wat Wat I Wat ta Cha tra U U	er Level e and time sh er Inflow er Outflow anges radational or insitional stra efinitive or dis rata change	nown) <u>i</u> ta	U₅0 CBR E ASS B Field Test PID DCP(x-y) HP	Bulk s Enviro Acid S Bulk S <u>s</u> Photoi Dynan	ample f nmenta sulfate S ample onisation	r tube sample S r CBR testing F sample St vSt H Fb Dens n detector reading (ppm) rrometer test (test depth interval shown) neter test (UCS kPa)	Firm Stiff Very Harc Frial	v Stiff	Lo Me De	50 10 20 >2 ery Lo iose ediun ense	0 - 100 00 - 200 00 - 400 400	W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%

D							RING LOG - TEST PIT King & Campbell				EST	PIT N	ID: TP216
GEO	TECHN	IONA			ROJE		- ·				OB I		RGS20337.1
				s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OGQ	GED B	SY: GC
				т	EST LO	CAT	ON: Road 28 Ch150m			C	DATE	:	12/19/17
EQ	UIPN		E:	Backh	oe		EASTING:	48393	30 m 🖇	SURF	ACE	RL:	
TE	ST PI	T LENGTH	-1:	2.0 m	W	DTH:	0.5 m NORTHING:	650750	02 m	DATU	M:		AHD
	Drill	ing and Sam	npling	1		_	Material description and profile information				Fiel	ld Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
HED BUCKET	Not Encountered			-		СН	FILL: Sandy CLAY, medium plasticity, brow fine to medium grained, traces of grass roo 5mm	vn, Sand ts up to	M < Wp	Fb			FILL
450mm TOOTHED BUCKE1	N			- - 0. <u>5</u>		CL	0.30m TOPSOIL: Sandy Silty CLAY, black/dark gr Sand fine to medium grained, traces of gra up to 5mm	rey, ss roots					TOPSOIL
		0.60m CBR		-		СН	Gravelly Sandy CLAY: Medium to high pla yellow/pale brown/pale grey, Sand fine to n grained, subangular	asticity, nedium		Fb / VSt	- HP	220	EXTREMELY WEATHERE DOLERITE
		1.00m		- 1. <u>0</u>									
				-									
				1. <u>5</u>									
							200-						
				2.0	11111		2.00m Hole Terminated at 2.00 m						
				-									
				2.5									
				-									
LEG Wat	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow	nown)	U₅₀ CBR E ASS B	50mm Bulk s Enviro	Diame ample f nmenta	S ter tube sample or CBR testing Il sample Soil Sample	Consis VS S F St VSt H	tency Very Soft Soft Firm Stiff Very Stiff Hard		<: 2: 5(1) 2(25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet D W _p Plastic Limit
<u>Stra</u>	tra De	anges radational or ansitional stra efinitive or dis rata change		Field Test PID DCP(x-y) HP	Photoi Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Densit	Friable L L D VE	L D N D	'ery Lo oose Iediur)ense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% e Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

	EG	IONA IICAL SOLUTIC		C P S	LIENT ROJEO ITE LC	: CT NA DCATI				P J L	AGE OB I	NO: Ged e	1 of 1 RGS20337.1
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48393		SURF.		RL:	AHD
		ing and Sam		2.0 m			Material description and profile information	000740				d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered			-		CL	TOPSOIL: Clayey SILT, black/dark grey, tra grass roots up to 5mm	aces of	D	Fb			TOPSOIL
450mm				0.5		CH	Gravelly Sandy CLAY: Medium plasticity, p brown, traces of red, Sand fine to coarse gr Gravel fine grained, subangular	ained,		St	·HP	120	COLLUVIAL RESIDUAL SOIL
		0.90m CBR 1.30m		- 1.0_ - -		Сп 	Gravel fine grained, subangular			51			
				1. <u>5</u> - -			DOLERITE: Fine grained, pale yellow/pale brown/dark blue, fractured medium to high s excavated as Sandy GRAVEL	strength,					HIGHLY TO MODERATEL WEATHERED DOLERITE
				2.0			Refusal due to Rock						
Wate	Wat (Dat Wat	er Level e and time sho er Inflow er Outflow	own)	U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	ter tube sample or CBR testing al sample Soil Sample	Consist VS S F St VSt H	tency Very Soft Soft Firm Stiff Very Stiff Hard		<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet D W _p Plastic Limit
<u>Stra</u>	 tra D(anges radational or ansitional strat efinitive or dist rata change	a	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Density	Friable V L MD D VD	D D	ery Lo bose lediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% e Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGII	NEE	RING LOG - TEST PIT			т	EST	PIT N	io: TP218
R	EG	IONAL VICAL SOLUTION		CL	IENT		King & Campbell			Ρ	PAGE	≣:	1 of 1
GEO	TECHN	NCAL SOLUTION		PF	ROJEC	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
				SI	TE LO	CATI	ON: Precint A Rainbow Beach			L	.OGC	GED B	SY: GC
				TE	EST LO	DCAT	ION: Road 26 Ch399m			D	DATE	:	12/19/17
		IENT TYPE: T LENGTH:		ackho .0 m		IDTH:	0.5 m NORTHING	48408 650747		SURF. DATU		RL:	AHD
	Drill	ing and Sampl	ing				Material description and profile information				Fiel	d Test	
METHOD	WATER			EPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plastici characteristics,colour,minor componer	ty/particle its	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy Silty CLAY, low plasticity grey, Sand fine to medium grained, traces roots up to 5mm	v, dark of grass	M < Wp	Fb			TOPSOIL
450mm TOOTHED BUCKET	Not Ene					СН	Gravelly Sandy CLAY: Medium plasticity, brown/red, Sand fine to medium grained, C grained, subangular	pale Gravel fine					COLLUVIAL
450mm 7				0.5		СН	Sandy CLAY: Medium to high plasticity, ye brown, Sand fine to medium grained, some fine to medium grained, subangular	ellow/pale e Gravel,		Fb / VSt	HP	350	RESIDUAL SOIL
		<u>0.80m</u>		1.0	///// >>>> >>>> >>>>>>>>>>>>>>>>>>>>>>		0.80m DOLERITE: Fine grained, grey/dark blue, medium to high strength, excavated as Sa GRAVEL	fractured, ndy			_		HIGHLY TO MODERATEL WEATHERED DOLERITE
		В											
		1.50m		1.5	<u>}}}</u>		1.50m Hole Terminated at 1.50 m						
				- - 2.0_			Refusal						
				- - - 2.5									
				-									
	Wat (Dat Wat Wat ta Cha	-	vn) E ASS B	२	50mm Bulk s Enviro Acid S Bulk S	Diame ample f nmenta	ter tube sample or CBR testing al sample Soil Sample	Consis VS S F St VSt H Fb	Very Soft Soft Firm Stiff Very Stiff Hard Friable		<2 2 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
	tra De	radational or ansitional strata efinitive or distic rata change	PI	ID P(x-y)	Photoi Dynan	nic pene	on detector reading (ppm) etrometer test (test depth interval shown) imeter test (UCS kPa)		2 V L MD D VD	Lo M D	oose	n Dense	Density Index 15 - 35%

0				E	NGII	NEE	RING LOG - TEST PIT			т	EST	PIT N	io: TP219
R	EG	IONAL VICAL SOLUTION					King & Campbell			P	PAGE	:	1 of 1
GEO	TECHN	NICAL SOLUTION		PF	ROJEC	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
-				SI	TE LO	CATI	DN: Precint A Rainbow Beach			L	.OGC	GED B	SY: GC
				TE	EST LO	DCAT	ON: Road 10 Ch480m			C	DATE	:	12/19/17
		IENT TYPE: T LENGTH:		Backho 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48415 650743		SURF. DATU		RL:	AHD
	Drill	ing and Samp	ling				Material description and profile information		_		Fiel	d Test	
METHOD	WATER	SAMPLES	RL D (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey		D	Fb			TOPSOIL
450mm TOOTHED BUCKET	Not Enc					СН	0.20m Gravelly Sandy CLAY: Medium plasticity, brown/red, Sand fine to medium grained, G to subrounded	Gravel fine	M < W				COLLUVIAL
450mm T(<u>0.40m</u> U50		0.5		СН	0.40m Sandy CLAY: Medium to high plasticity, ye brown with grey mottling, Sand fine to med Gravel, fine to medium rained, subangular	llow/pale ium, some		Fb / VSt	- HP	320	RESIDUAL SOIL
		0.70m											
		<u>0.80m</u>			///// }		0.80m DOLERITE: Fine grained, pale grey/brown blue, fractured to highly fractured, medium strength, excavated as Sandy GRAVEL	/dark to high			1		HIGHLY TO MODERATE WEATHERED DOLERITE
		CBR		1. <u>0</u>	>>> >>> >>>>								
		<u>1.20m</u>		- - -	$\langle \rangle \rangle$								
				1.5	$\langle \rangle \rangle$		1.50m Hole Terminated at 1.50 m						
				-			Refusal due to Rock						
				-									
				2.0									
				-									
				2.5									
				-									
				-									
	SEND:		<u>No</u>	tes, San	nples ai	nd Test	<u>s</u>	Consist				CS (kPa	-
- -	Wat (Dat • Wat	er Level e and time show er Inflow	wn) CB E AS	S	Bulk s Enviro Acid S	ample f nmenta sulfate S	er tube sample or CBR testing I sample oil Sample	S F St VSt	Very Soft Soft Firm Stiff Very Stiff		25 50 10 20	25 5 - 50 0 - 100 00 - 200 00 - 400	P
Stra	i <u>ta Ch</u> a G	er Outflow anges radational or ansitional strata		e ld Tests PID	-	·	n detector reading (ppm)		Hard Friable V L		>/ ery Lo oose	400 Dose	Density Index <15% Density Index 15 - 35%
	D	efinitive or distic rata change	t DC	CP(x-y) HP	Dynan	nic pene	etrometer test (test depth interval shown) meter test (UCS kPa)		ME D VD	D	lediur Iense Iery D	n Dense ense	 Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

					NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	io: TP220
R	EG	IONA	AL /	C C	LIENT	:	King & Campbell			P	PAGE	≣:	1 of 1
GEO	TECHN	NCAL SOLUT	IONS		ROJE					J	OB	NO:	RGS20337.1
				s	ITE LC	CATI	ON: Precint A Rainbow Beach			L	.OGC	GED B	
				Т	EST L	OCAT	ION: Precint A Rainbow Beach			0	DATE		12/19/17
		IENT TYP T LENGTI		Backh 2.0 m		IDTH:	0.5 m NORTHING:	484120 6507360		SURF. DATU		RL:	AHD
	Drill	ing and San	npling	_		1	Material description and profile information		1		Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
HED BUCKET	Not Encountered			-		ML	TOPSO8IL: Sandy SILT, dark grey, Sand f medium grained	ine to	D	Fb			TOPSOIL
450mm TOOTHED	Ň			0.5		СН	Gravelly Sandy CLAY: Medium plasticity, brown/red, Sand fine to medium grained, G to medium gained, subangular	ravel fine	A « N				COLLUVIAL
450		0.80m		-		СН	0.50m Sandy CLAY: Medium to high plasticity, ye brown, Sand fine to medium grained, Grave medium grained, traces of Rock fabric 0.80m	llow/pale el fine to	-	Fb / VSt	HP	220	EXTREMELY WEATHERE DOLERITE
		0.0011		- 1. <u>0</u> -		1	DOLERITE: Fine grained, pale grey/pale bl highly fractured, foliated, low to medium str excavated as Sandy GRAVEL				_		
		В		- 1. <u>5</u> - -									
		2.00m		2.0	KK		2.00m						
				- - 2. <u>5</u> - - -			Hole Terminated at 2.00 m						
	Wat (Dat Wat Wat ta Cha Gi	radational or		Notes, Sa U ₅₀ CBR E ASS B Field Tess	50mm Bulk s Enviro Acid S Bulk S	n Diame ample f onmenta Sulfate S Sample	ter tube sample or CBR testing al sample Soil Sample	S S F F St S VSt V H H	ery Soft oft irm tiff ery Stiff ard riable V	V	<: 2: 50 10 20 20 20	CS (kP 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15%
	De	ansitional stra efinitive or dis rata change		PID DCP(x-y) HP	Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)		L ME D VC	D N	oose lediur Iense Iery D		Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

R	EG	IONA NICAL SOLUTI		CI PI SI	LIENT ROJE ITE LC	: CT NA DCATI				P J L	age ob i	NO: Ged e	1 of 1 RGS20337.1
		IENT TYPE T LENGTH		Backho 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	484121		SURF. DATU		RL:	AHD
		ing and Sam		2.0 m			Material description and profile information	000120			1	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen	y/particle ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey, Sand fir medium grained, traces of grass roots up to		D	Fb			TOPSOIL
п ТООТНЕ	Not E			-		СН	0.25m Gravelly Sandy CLAY: Medium plasticity, brown/red/brown, Sand fine to medium grai 0.40m Gravel fine to medium grained, subangular Cravelly Sandy CLAY: Medium plasticity	ined,	M < W	Fb/S	f		COLLUVIAL EXTREMELY WEATHERE
450mn				0.5		CH	Gravelly Sandy CLAY: Medium plasticity, yellow/dark brown, traces of dark blue, San medium grained, Gravel fine to coarse, sub traces of Cobbles up to 200mm, traces of E up to 400mm	angular,		FD / S	HP	180	DOLERITE
		1.40m CBR 1.90m		- 1.5_ - -			1.90m						
				2. <u>0</u> - - 2. <u>5</u> -			Hole Terminated at 1.90 m Refusal due to Bounlders						
<u>Wat</u> ▼	Wat (Dat Wat Wat I Wat	radational or		U₅₀ CBR E ASS B <u>Field Test</u> PID	50mm Bulk s Enviro Acid S Bulk S	n Diame ample f onmenta Sulfate \$ Sample	ter tube sample for CBR testing al sample Soil Sample	S S F F St S VSt V H F	ency /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L	V	<2 25 50 10 20	CS (kP: 25 5 - 50 0 - 100 00 - 200 00 - 400 400 5005e	D Dry M Moist W Wet W _p Plastic Limit
	De	ansitional stra efinitive or dis rata change		DCP(x-y) HP	Dynar	nic pen	etrometer test (lest depth interval shown) ometer test (UCS kPa)			D M D		n Dense ense	•

				Ē	NGI	NEE	RING LOG - TEST PIT			1	EST	PIT N	io: TP222
R	EG		AL /	C C	LIENT	:	King & Campbell			F	PAGI	E:	1 of 1
ĞEÖ	TECHN	JIČAL SOLUT		P	ROJE	CT NA	ME: Residential Subdivision			J	ЮВ	NO:	RGS20337.1
				s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OG	GED B	Y: GC
				Т	EST L	OCAT	ON: Road 1 Ch375m			0	DATE	:	12/19/17
		IENT TYP T LENGTI		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:			SURF DATU		RL:	AHD
	Drill	ing and Sar	npling				Material description and profile information				Fiel	ld Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered					ML	TOPSOIL: Clayey SILT, dark grey, traces or roots up to 5mm	of grass	D	Fb			TOPSOIL
450mm ⁻				0.5		СН	Gravelly Sandy CLAY: Medium plasticity, 0.50m brown/yellow, traces of red, Sand fine to m Gravel, fine to medium grained, subangula CLAY: Medium to high plasticity, yellow, tra Gravel, fine grained, subangular	edium, r	M ≥ M	VSt	- HP	350	COLLUVIAL RESIDUAL SOIL
				1. <u>0</u> -									
				1.5			1.50m						
				1.5			Hole Terminated at 1.50 m						
				-	1								
				-	1								
				-	1								
				-	-								
				2.0	-								
				-	-								
				-	-								
				2. <u>5</u>	-								
					-								
					-								
LEG	BEND:			Notes, Sa	mples a	nd Tes	<u>s</u>		stency			CS (kPa	
Wat	Wat (Dat	er Level e and time s	hown)	U₅₀ CBR E	Bulk s Enviro	ample i	ter tube sample or CBR testing Il sample	VS S F St	Very So Soft Firm Stiff		2 5 1	25 5 - 50 0 - 100 00 - 200	
		er Inflow er Outflow		ASS B		Sulfate S Sample	Soil Sample	VSt H	Very Sti Hard	f		00 - 400 400	W _L Liquid Limit
<u>Stra</u>		anges radational or ansitional stra		Field Tes	ts	·	on detector reading (ppm)	Fb Densit	Friable y V L		/ery Lo		Density Index <15% Density Index 15 - 35%
	De	efinitive or dis rata change		DCP(x-y) HP	Dynar	nic pen	etrometer test (test depth interval shown) meter test (UCS kPa)		M D V				

							RING LOG - TEST PIT			т	EST	PIT N	
R	EG	IONA					King & Campbell				PAGE		1 of 1
GLU	LOUIN	ICAL SOLUTI			ROJE						OB		RGS20337.1
												GED B -	
				Т	EST LO	CAT	ON: Road 25 Ch225m				DATE	:	12/19/17
		IENT TYPI T LENGTI		Backh 2.0 m		IDTH:	0.5 m EASTING:	48400 650720		SURF. DATU		RL:	AHD
	Drill	ing and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered			-		ML CH	TOPSOIL: Sandy SILT, dark grey, Sand fin medium grained, traces of grass roots up to 0.40m Sandy CLAY: Medium to high plasticity, pal	• 5mm	D	Fb Fb/	- HP	220	TOPSOIL RESIDUAL SOIL
450m		<u>0.70m</u>		0. <u>5</u> - -			0.75m DOLERITE: Fine grained, pale grey/pale bl highly fractured, foliated, low to medium stree	– – – – Je,	_	VSt	_		HIGHLY TO MODERATEL WEATHERED DOLERITE
		CBR 1.10m		- 1. <u>0</u> - - - 1. <u>5</u> -	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		excavated as Sandy GRAVEL						
					$\langle \rangle \rangle$		1.80m						
				- 2.0_ - - - 2.5_ - - - - - -			Hole Terminated at 1.80 m Refusal due to Rock						
LEG	END:			Notes, Sa	mples a	nd Tee	s	Coneie	stency		 	CS (kPa	Moisture Condition
<u>Wat</u> ▼	er Wat (Dat Wat I Wat ta Cha	-	hown)	Notes, Sa U₅₀ CBR E ASS B Field Test	50mm Bulk s Envirc Acid S Bulk S	Diame ample f	s ter tube sample or CBR testing il sample soil Sample	Consis VS S F St VSt H Fb Densit	Very Soft Soft Firm Stiff Very Stiff Hard Friable		<2 2 50 10 20	25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
	tra De	radational or ansitional stra efinitive or dis rata change	ata	PID DCP(x-y) HP	Photoi Dynan	nic pen	n detector reading (ppm) trometer test (test depth interval shown) meter test (UCS kPa)	Densit	Y V L D VD	Lo M D	oose	n Dense	Density Index 15 - 35%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	IO: TP224
R	EG	IONA	L/	C	LIENT	:	King & Campbell			P	AGE	:	1 of 1
GEO	TECHN	NICAL SOLUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
				S	ITE LO	CATI	ON: Precint A Rainbow Beach			L	OGO	GED B	Y: GC
				Т	EST L	OCAT	ION: Road 1 Ch460m			D	ATE	:	12/19/17
		IENT TYPE T LENGTH		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48420 650723		SURF. DATU		RL:	AHD
	Drill	ing and Sam	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
450mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey/black, Sandy SILT, dark grey/black, Sandy to medium grained, traces of grass roots up		D	Fb			TOPSOIL
450mm T(СН	0.40m Sandy CLAY: Medium to high plasticity, ye brown, with grey mottling, traces of Gravel, subangular		M < W _P	VSt	- HP	220	RESIDUAL SOIL
				- 1. <u>5</u> -			1.40m DOLERITE: Fine grained, dark blue/pale b pale grey, fractured, medium to high streng Clay seams, excavated as Clayey GRAVE	th, some			-		HIGHLY WEATHERED DOLERITE
				- 2.0_ - - - 2.5_ - -			Hole Terminated at 1.75 m						
<u>Wat</u>	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow anges	nown)	U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S Bulk S	i Diame ample f	ts ter tube sample for CBR testing al sample Soil Sample	Consis VS F St VSt H Fb	Very Soft Soft Firm Stiff Very Stiff Hard Friable	:	<: 2! 50 10 20 >4	CS (kPz 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
	tra De	radational or ansitional stra efinitive or dis rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)	<u>Densit</u>	2 V L ME D VE	L D M D	ery Lo oose lediur ense ery D	n Dense	Density Index 15 - 35%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	IO: TP225
R	EG	SIONA	۱L	 c	LIENT	:	King & Campbell			P	AGE	:	1 of 1
ĞEŌ	TECHN	NICAL SOLUT		P	ROJE	CT NA	ME: Residential Subdivision			J	ов і	NO:	RGS20337.1
				s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	OGO	GED B	Y: GC
				т	EST L	OCAT	ION: Road 2 Ch160m			D	ATE	:	12/19/17
		MENT TYP		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48421 650733		SURF. DATU		RL:	AHD
	Drill	ling and Sar	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
450mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey, Sand fin medium grained, traces of grass roots up to		D	Fb			TOPSOIL
450mm TOOT	Z			0. <u>5</u>		CH	Gravelly Sandy CLAY: Medium plasticity, brown, traces of yellow/red, Sand fine to me grained, Gavel fine grained, subangular	 pale edium	M < W				COLLUVIAL
				- - - 1. <u>0</u> -		СН	CLAY: Medium to high plasticity, yellow with mottling	n grey	M > Wp	St	- HP	180	RESIDUAL SOIL
				1.5			^{1.50m} Hole Terminated at 1.50 m						
				- - 2.0_ -	-								
				- 2. <u>5</u> - - -	-								
LEG	END:			Notes, Sa	mples a	Ind Test	s	Consist	encv		 	CS (kPa	a) Moisture Condition
<u>Wat</u> ►	er Wat (Dat Wat Wat	ter Level te and time s ter Inflow ter Outflow	hown)	U ₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame sample f onmenta	ter tube sample or CBR testing Il sample soil Sample	VS S F St VSt H	Very Sof Soft Firm Stiff Very Stiff Hard		<2 25 50 10 20	<u>25</u> 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	G tra D	anges radational or ansitional stra efinitive or dis irata change		Field Test PID DCP(x-y) HP	Photo Dynai	mic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Density	Friable V L MI D VE	La D M D	ery Lo oose lediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP226
R	EG		L	C C	LIENT	:	King & Campbell			Р	AGE	:	1 of 1
ĜEŬ	TECHN	JIČAL SOLUTI(P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
				s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	OGO	GED B	Y: GC
				т	EST L	OCAT	ION: Road 2 Ch50m			D	ATE		12/19/17
				Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48423		SURF.		RL:	AHD
16		ing and Sam		2.0 m	vv		Material description and profile information	000740	9 m L		1	d Test	AND
						N				۲			
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor components		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
50mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey, Sand fine medium grained, traces of grass roots up to	e to 5mm	D	Fb			TOPSOIL
450mm 7						СН	Gravelly Sandy CLAY: Medium plasticity, p brown/pale orange, with red mottling, Sand f medium grained, Gravel fine to subangular	ale îne to	M > W	Fb / S	HP	120	COLLUVIAL
				- 1. <u>0</u> - -		СН	1.00m CLAY: Medium to high plasticity, yellow, mottling, traces or Gravel, fine, subangul		,	St	HP	150	RESIDUAL SOIL
				- 1.5			1.50m						
							Hole Terminated at 1.50 m						
<u>Wat</u> ►	Wat (Dat - Wat Wat	er Level e and time sh er Inflow er Outflow	iown)	Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	S ter tube sample or CBR testing Il sample Soil Sample	S F St VSt H	Very Soft Soft Firm Stiff Very Stiff Hard		<2 2 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	tra D(anges radational or ansitional stra efinitive or dis rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Density	Friable V L MD D VD	Lo M D	ery Lo bose lediur ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

					E	INGI	NEE	RING LOG - TEST PIT			т	EST		IO: TP227
F	RΕ	GI		۱L	– c	LIENT	:	King & Campbell			P	AGE	:	1 of 1
ĠE	OTEC	CHNIC	CAL SOLUT		P	ROJE	CT NA	ME: Residential Subdivision			J	ОΒΙ	NO:	RGS20337.1
<u>.</u>		_			s	ITE LO	CATI	ON: Precint A Rainbow Beach			L	OGC	GED B	Y: GC
					т	EST L	OCAT	ON: Precint A Rainbow Beach			C	ATE		12/19/17
			ENT TYP		Backh 2.0 m		IDTH:	EASTING: 0.5 m NORTHING:	48429 650739		SURF. DATU		RL:	AHD
F	C	Drillin	g and San	npling				Material description and profile information				Fiel	d Test	
						0	NOI			u z	ς	0		
METHOD	WATER		SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
D BUCKET	Encountered				-		ML	TOPSOIL: Sandy SILT, dark grey, Sand fir medium, traces of grass roots up to 5mm	ie to	D	Fb			TOPSOIL
THE								0.30m						
450mm TOOTHED BUCKET					- 0. <u>5</u>		СН	Gravelly Sandy CLAY: Medium plasticity, brown, traces of red, Sand fine to medium Gravel fine, subrounded		M < W _P				COLLUVIAL
					-		СН	0.60m Sandy CLAY: Medium to high plasticity, ye brown with grey mottling, some Gravel, fine medium grained, subangular	llow/pale to		Fb / VSt	HP	300	RESIDUAL SOIL TO EXTREMELY WEATHERED DOLERITE
5					- - 1.0									
20								1.10m						
					-			DOLERITE: Fine to medium grained, pale brown/pale yellow/dark blue, highly fracture medium to high strength	d,					HIGHLY TO MODERATELY WEATHERED DOLERITE
					- 1. <u>5</u>									
						///		1.60m Hole Terminated at 1.60 m						
					- - 2.0_	-		Refusal due to Rock						
					-	-								
					2.5_	-								
					-	-								
	GEN	ID:		T	Notes, Sa	mples a	nd Test	s	Consist	tencv		U	CS (kPa	a) Moisture Condition
Wa	ater					-			VS S	Very Sof Soft	t	<2	25	D Dry M Moist
	-		[.] Level and time sl	hown	U₅₀ CBR	Bulk s	ample f	ter tube sample or CBR testing	F	Firm		50	5 - 50 0 - 100	W Wet
►	,		Inflow		E ASS			I sample Soil Sample	St VSt	Stiff Very Stiff	f		00 - 200 00 - 400	F
			Outflow		В	Bulk S	Sample		H Fb	Hard Friable		>4	400	
	<u>rata (</u>	Gra tran Defi	iges dational or isitional stra initive or dis ta change		Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Density		L D M D	ery Lo oose lediun ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP228
R	EG	IONA	L	C	LIENT	:	King & Campbell			Ρ	PAGE	:	1 of 1
GEÒ	TECHN	NÎCĂE SOLUTIO		P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
-				S	ITE LO	CATI	ON: Precint A Rainbow Beach			L	.OGC	GED B	Y: GC
				т	EST L	OCAT	ON: Precint A Rainbow Beach			D	OATE		12/19/17
EQ	UIPN		:	Backh	oe		EASTING:	4843	34 m 💲	SURF	ACE	RL:	
TE				2.0 m	w	IDTH:		65074	35 m I	DATU	1		AHD
	Drill	ing and Sam	pling			z	Material description and profile information			~	Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics,colour,minor component	//particle is	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
50mm TOOTHED BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey, traces o roots up to 5mm	f grass	D	Fb			TOPSOIL
450mm TO(0.5		СН	Gravelly Sandy CLAY: Medium plasticity, p brown/yellow, Sand fine to medium grained fine, subangular	 oale , Gravel,	M « W				COLLUVIAL
				-		СН	Sandy CLAY: Medium to high plasticity, pa brown/yellow, with grey mottling, Sand fine medium grained, some Gravel, fine to coars grained, subangular	to		Fb / VSt	HP	220	RESIDUAL SOIL
				- 1. <u>0</u>			SLATE: Fine grained, pale yellow/pale brov grey, fractured to highly fractured, foliated, r to high strength, excavated as Sandy GRA' Hole Terminated at 1.10 m	medium					HIGHLY TO MODERATEL WEATHERED SLATE
				2. <u>5</u>									
Wat	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow	iown)	− - - - - - - - - - - -	50mm Bulk s Enviro Acid S	n Diame ample f	s ter tube sample or CBR testing il sample soil Sample	Consis VS F St VSt H	tency Very Soft Soft Firm Stiff Very Stiff Hard		<2 2 50 10 20	CS (kP 2 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	ata Cha G tra D		ta	□ Field Test PID DCP(x-y) HP	: <u>s</u> Photo Dynar	ionisatio	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Densit	Friable	Lo M D	'ery Lo oose	oose n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			т	EST	PIT N	o: TP229
R	EG	IONA	L/		LIENT		King & Campbell			Ρ	AGE	:	1 of 1
GEO	TECH	NICAL SOLUTI		P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
-				S	ITE LC	CATI	ON: Precint A Rainbow Beach			L	OGO	GED B	Y: GC
				т	EST LO	OCAT	ION: Near existing dwelling			D	ATE	:	12/19/17
		MENT TYPE		Backh 2.0 m		IDTH:	0.5 m EASTING:			SURF.		RL:	AHD
	Dril	ling and Sam	npling				Material description and profile information				Fiel	d Test	
дон	TER		RL	DEPTH	UHC DHC	ICATION BOL	MATERIAL DESCRIPTION: Soil type, plasticit	/particle	rure Ition	TENCY SITY	Type	sult	Structure and additional observations
METHOD	WATER	SAMPLES	(m)	(m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	characteristics,colour,minor componen	ts	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
BUCKET	Not Encountered			-		ML	TOPSOIL: Sandy SILT, dark grey/black, Sato medium grained, traces of grass roots up	and fine o to 5mm	D	Fb			TOPSOIL
50mm TOOTHED BUCKET	Not Enc			-		СН	0.20m Gravelly Sandy CLAY: Medium plasticity, I traces of yellow/red, Sand fine to medium g Gravel, fine, subangular	brown, Irained,	M N ×				COLLUVIAL
50mm TO		0.50m		0. <u>5</u>			0.50m						
4				-			DOLERITE: Fine grained, pale grey/dark b traces of fractured, foliated, some Clay sea excavated as Sandy Clayey GRAVEL	lue, ms,					HIGHLY TO MODERATEL WEATHERED DOLERITE
		В		-									
				- 1. <u>0</u>									
		1.10m		-	$\langle \rangle \rangle \rangle$		1.10m Hole Terminated at 1.10 m Refusal due to Rock						
				- 1. <u>5</u> -	-								
				- 2. <u>0</u> -	-								
				-	-								
				-	-								
				-	-			1					
Wat	Wat (Dai - Wat	ter Level te and time sh ter Inflow ter Outflow	nown)	Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	i Diame ample f	ter tube sample or CBR testing al sample Soil Sample	Consis VS S F St VSt H	Very Soft Soft Firm Stiff Very Stiff Hard		<2 2 50 10 20	<u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
<u>Stra</u>	G tra D	anges radational or ansitional stra efinitive or dis rata change		Field Test PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Fb Density	Friable V L MD D VD	Lo M D	ery Lo bose lediur ense ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%

				E	NGI	NEE	RING LOG - TEST PIT			г	EST	PIT N	o: TP230
R	EG	ION/	۱L /	<u>с</u>	LIENT	:	King & Campbell			F	PAGE	≣:	1 of 1
GEC	TECH	NICAL SOLUT	IONS	P	ROJE	CT NA	ME: Residential Subdivision			J	OB	NO:	RGS20337.1
					ITE LO					L	.OGC	GED B	Y: GC
				Т	EST L	OCAT	ON: Road 1 Ch560m				DATE	:	12/19/17
		MENT TYP		Backh 2.0 m		IDTH:	0.5 m EASTING:	4843 65072		SURF DATU		RL:	AHD
<u> </u>		ling and Sar					Material description and profile information				1	d Test	
					0	NOI				5	0		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor component		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
ED BUCKET	Not Encountered			-		CL	TOPSOIL: Sandy CLAY, dark grey, Sand fi medium grained, traces of grass roots up to	ine to 5 5mm	M < Wp	Fb			TOPSOIL
450mm TOOTHED BUCKET	Not			- 0. <u>5</u>		СН	0.30m Sandy CLAY: Medium to high plasticity, pa brown/yellow, Sand fine medium, some Gra to coarse, subangular			Fb / VSt	- HP	250	EXTREMELY WEATHERED DOLERITE
		0.90m 0.20m B		- - 1. <u>0</u>			0.90m DOLERITE: Fine grained, pale brown/dark pale grey, fractured, medium to high streng excavated as Sandy GRAVEL	blue, th,			_		HIGHLY TO MODERATELY DOLERITE
					<u> </u>		1.20m Hole Terminated at 1.20 m Refusal due to Rock						
, LEC Wat				- 1.5_ - - - 2.0_ - - - - - - - - - - - - - - - - - - -									
				Notes 6-	mplas -	nd Terr	e	Const	tonov			CS /L-D-	
	Wat (Da Wat	ter Level te and time s ter Inflow ter Outflow	hown)	Notes, Sa U₅₀ CBR E ASS B	50mm Bulk s Enviro Acid S	n Diame ample f	s ter tube sample or CBR testing I sample ioil Sample	Consis VS S F St VSt H	Very Soft Soft Firm Stiff Very Stiff Hard		<2 2 50 10 20	ICS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	 Moisture Condition D Dry M Moist W Wet W_p Plastic Limit W_L Liquid Limit
<u>Stra</u>	tra D	anges radational or ansitional stra efinitive or di rata change		Field Test PID DCP(x-y) HP	Photo Dynar	nic pene	n detector reading (ppm) trometer test (test depth interval shown) meter test (UCS kPa)	Fb Densit	Friable Y V L M D VI	L D N C	'ery Lo oose lediur)ense 'ery D	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 65 - 100%



Appendix B

Laboratory Test Results

Regional Geotechnical Solutions RGS20337.1-AS 30 July 2018



Client:	Regional Geotechnical Solutions F 44 Bent Street Wingham NSW 2429	'ty Ltd	Accredited for compliance with ISC Testing The results of the tests, calibration measurements included in this doo to Australian/national standards	s and/or
Principal: Project No.: Project Name:	MNC16P-0001 Various Testing		Approved Signatory: Brent Cullen (Senior Geotechnician) NATA Accredited Laboratory Numi Date of Issue: 17/01/2018	ber: 18686
Sample Det				
Sample ID:	NEW18W-0006S01	Lot No.: -		
-	lo.: RGS20337.1	Date Sampled: 2	1/12/2017	
	od: Sampled by Client			
Specification:	No Specification		On-Site	
ocation:	TP201 - (0.4 - 0.7m)		lay	
roject Locatio	on: Precinct A/B/C, Rainbow Beach	i, NSW		
.oad vs Pe	netration	Test	Results	
0.8 ₁			AS 1289.6.1.1	0 F
			· · · · · · · · · · · · · · · · · · ·	2.5
			, , ,	1.58 24.0
0.7				24.0 1.58
- :				100
0.6 - · · · ·				24.5
0.0				102
Ť.				1.58
7 0.5				100
8				35.0
ston			Content of Remaining Depth (%):	25.9
0.4				Standard
		Surchar	ge Mass (kg):	4.50
0		Period c	f Soaking (Days):	
oad c			e Material (%):	~ ~
Coad on Piston (KN)	7			0.0
0 Foad	/			0.0
0.3 0.2	/	Oversize	- Moisture Content	
-	/	Oversize	- Moisture Content	0.0 26.5
-	/	Oversize	- Moisture Content	
-	/	Oversize	- Moisture Content	
0.2		Oversize	- Moisture Content	
0.2	/	Oversize	- Moisture Content	
0.2	0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	Field Mc	- Moisture Content	

Comments

Laboratory Density Ratio (LDR): 99.5% Laboratory Moisture Ratio (LMR): 102.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Client	t:	a Bearing Ratio Regional Geotechnical Solutions Pt 44 Bent Street Wingham NSW 2429	•	Accredited for compliance with IS Testing The results of the tests, calibratio measurements included in this de to Australian/national standards	ns and/or
Principal: Project No.: Project Name:		MNC16P-0001 Various Testing		WORLD RECOGNISED ACCREDITATION BACCREDITATION ACCREDITATION ACCREDITATION BACCREDITATION ACCREDITATION ACCREDITATION ACCREDITATION BALL ADDRESS ACCREDITATION ACCREDITATIO	
<mark>Sam</mark> j Sampl	ple Deta	ils NEW18W-0006S02	Lot No.:	-	
Test R	equest No	d: Sampled by Client	Date Sample	ed: 21/12/2017	
Specif	ication:	No Specification	Source:	On-Site	
Locati		TP202 - (0.4 - 0.7m)	Material:	Clay	
Projec	t Location	: Precinct A/B/C, Rainbow Beach,	NSW		
Load	l vs Pen	etration		Test Results	
}	9.0+		······	AS 1289.6.1.1	
				CBR At 5.0mm (%):	19
				Maximum Dry Density (t/m ³):	2.01
	8.0 - · · · · · ·		/	Optimum Moisture Content (%):	12.2
	-			Dry Density before Soaking (t/m ³):	2.01
	7.0			Density Ratio before Soaking (%): Moisture Content before Soaking (%):	100 11.7
	_ :			Moisture Ratio before Soaking (%):	96
	<u> </u>			Dry Density after Soaking (////////////////////////////////////	2.01
F	6.0			Density Ratio after Soaking (%):	100
(kh	-			Swell (%):	0.5
ton	5.0	· · · · · · · · · · · · · · · · · / ·		Moisture Content of Top 30mm (%):	14.5
Pis				Moisture Content of Remaining Depth (%):	13.7
L.	4.0			Compactive Effort:	Standard
0				Surcharge Mass (kg):	4.50
oad c	Ť i			Period of Soaking (Days):	4
Load on Piston (kN)	3.0		$= \{1, \dots, n\} + \dots + \{1, \dots, n\} + \dots + \{n, \dots, n\}$	Oversize Material:	Excluded
Load c				Oversize Material (%):	31.5
Load c	-			Moisture Content ———	
Load c	2.0				
Load c	2.0	1		Field Moisture Content (%):	9.2
Load c	2.0	/			9.2
Load c	1.0	/			9.2
Load c	÷	2.0 3.0 4.0 5.0 6.0 7.0 8.0	9.0 10.0 11.0 12.0 13.0		9.2

Comments

Laboratory Density Ratio (LDR): 100.5% Laboratory Moisture Ratio (LMR): 96.0% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Client:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429		Accredited for compliance with Testing The results of the tests, calibra measurements included in this to Australian/national standard	ations and/or document are tracea
Principal: Project No.: Project Name:	MNC16P-0001 Various Testing		Approved Signatory: Brent Cul (Senior Geotechnician) NATA Accredited Laboratory N Date of Issue: 23/01/2018	
Sample De Sample ID:	tails NEW18W-0006S03	Lot No.:	<u>-</u>	
est Request I	No.: RGS20337.1 Nod: Sampled by Client	Date Sampled:	21/12/2017	
Specification:	No Specification	Source:	On-Site	
ocation:	TP203 - (0.4 - 0.8m)	Material:	Clay	
roject Locatio	on: Precinct A/B/C, Rainbow Beach, N	ISW		
.oad vs Pe	netration	Te	est Results	
1.3⊤····			AS 1289.6.1.1	
1.0 L			3R At 2.5mm (%):	5.0
1.2 - · · · ·		Ma	ximum Dry Density (t/m ³):	1.55
+			timum Moisture Content (%):	26.4
1.1 + · · · ·			Density before Soaking (t/m³):	1.56
1.0			nsity Ratio before Soaking (%):	101
1.0			isture Content before Soaking (%):	25.9
0.9	an in den her in 🔁		isture Ratio before Soaking (%):	98
~ [‡]		35 76 35 76 85	Density after Soaking (t/m³):	1.54
Š 0.8	un sun sun y∕r u han sun sun sun	a a a a a	nsity Ratio after Soaking (%):	99
			ell (%):	1.5
u at			isture Content of Top 30mm (%): isture Content of Remaining Depth (%	32.8
Diston			isture Content of Remaining Depth (7	
			moactive Effort	Standard
ad on Piston	7	Co	mpactive Effort: rcharge Mass (kg):	Standard
Sid +	. /	Co Su	rcharge Mass (kg):	4.50
		Co Sui Pei	•	
0.7 0.6 0.6 0.5 0.5 0.4	/	Co Sui Pei	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%):	4.50 4
	/	Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%): —— Moisture Content ———	4.50 4 0.0
0.4		Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%):	4.50 4
0.4		Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%): —— Moisture Content ———	4.50 4 0.0
0.4		Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%): —— Moisture Content ———	4.50 4 0.0
0.4	/	Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%): —— Moisture Content ———	4.50 4 0.0
0.4	0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	Co Sui Pei Ov	rcharge Mass (kg): riod of Soaking (Days): ersize Material (%): —— Moisture Content ———	4.50 4 0.0

Comments

Laboratory Density Ratio (LDR): 100.5% Laboratory Moisture Ratio (LMR): 98.0% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Client:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429		Accredited for compliance with IS Testing The results of the tests, calibratio measurements included in this do to Australian/national standards	ns and/or
Principal: Project No.: Project Name	MNC16P-0001 : Various Testing		WORLD RECOGNISED ACCREDITATION	
Sample De Sample ID:	tails NEW18W-0006S04	Lot No.:		
Test Request	No.: RGS20337.1 hod: Sampled by Client	Date Sampled:	: 21/12/2017	
Specification:	No Specification	Source:	On-Site	
Location:	TP204 - (0.5 - 0.9m)	Material:	Clay	
Project Locati	on: Precinct A/B/C, Rainbow Beach, N	SW		
Load vs Pe	enetration	T	Test Results	
0.9			AS 1289.6.1.1	
		i i i i i i i i i i i i i i i i i i i	CBR At 2.5mm (%):	2.0
			faximum Dry Density (t/m ³):	1.57
0.8 + · · ·			Optimum Moisture Content (%):	25.9
-			Ory Density before Soaking (t/m ³):	1.56
0.7			Density Ratio before Soaking (%):	99
			loisture Content before Soaking (%):	26.4
			loisture Ratio before Soaking (%):	102
0.6+			Dry Density after Soaking (t/m ³):	1.51
			Density Ratio after Soaking (%):	96
-				25
(k N) 0.5 - · · ·		s i s	Swell (%):	3.5
Piston (kN)		S M	loisture Content of Top 30mm (%):	43.0
on Piston (kN)		S M M	Noisture Content of Top 30mm (%): Noisture Content of Remaining Depth (%):	43.0 28.7
ad on Piston (KN)		S M M C	Noisture Content of Top 30mm (%): Noisture Content of Remaining Depth (%): Compactive Effort:	43.0 28.7 Standard
on Pist		S M M C S	Noisture Content of Top 30mm (%): Noisture Content of Remaining Depth (%):	43.0 28.7
(KN) 		S M C S P	Noisture Content of Top 30mm (%): Noisture Content of Remaining Depth (%): Compactive Effort: Surcharge Mass (kg):	43.0 28.7 Standard 4.50
0.3		S M C S P	Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days): Oversize Material (%):	43.0 28.7 Standard 4.50 4
(757) 1000-100		S M M C S P O	Noisture Content of Top 30mm (%): Noisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days):	43.0 28.7 Standard 4.50 4
0.3		S M M C S P O	Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days): Oversize Material (%): Moisture Content ———	43.0 28.7 Standard 4.50 4 0.0
0.3		S M M C S P O	Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days): Oversize Material (%): Moisture Content ———	43.0 28.7 Standard 4.50 4 0.0
0.3		S M M C S P O	Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days): Oversize Material (%): Moisture Content ———	43.0 28.7 Standard 4.50 4 0.0
0.3	0 20 30 40 50 60 70 80 5	S M M C S P O	Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Burcharge Mass (kg): Period of Soaking (Days): Oversize Material (%): Moisture Content ———	43.0 28.7 Standard 4.50 4 0.0

Comments

Laboratory Density Ratio (LDR): 99.5% Laboratory Moisture Ratio (LMR): 102.0% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Client:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429		Accredited for compliance with IS Testing The results of the tests, calibratio measurements included in this do to Australian/national standards	ns and/or
Principal: Project No.: Project Name	MNC16P-0001 : Various Testing		WORLD RECOGNISED ACCREDITATION NATA Accredited Laboratory Nun Date of Issue: 17/01/2018	
ample De				
ample ID:	NEW18W-0006S06	Lot No.:	-	
-	No.: RGS20337.1 hod: Sampled by Client	Date Sampleo	d: 21/12/2017	
pecification:		Source:	On-Site	
ocation:	TP205 - (0.2 - 0.5m)	Material:	Clay	
	on: Precinct A/B/C, Rainbow Beach, N			
	enetration		Test Results AS 1289.6.1.1	
0.9			CBR At 2.5mm (%):	3.0
-		A A A A	Maximum Dry Density (t/m ³):	1.49
0.8 - · · ·			Optimum Moisture Content (%):	27.6
_		e e e xt ree i	Dry Density before Soaking (t/m ³):	1.49
0.7 + · · ·			Density Ratio before Soaking (%):	100
0.7			Moisture Content before Soaking (%):	27.6
-			Moisture Ratio before Soaking (%):	100
0.6+	in a standard and a standard for the standard standard standard standard standard standard standard standard s	15 YO 10 YO 10	Dry Density after Soaking (t/m ³):	1.44
Ĵ -		A A A A A	Density Ratio after Soaking (%):	97
Load on Piston (KN)	in in in in <i>F</i> ordanian		Swell (%):	3.0
isto			Moisture Content of Top 30mm (%):	36.8
			Moisture Content of Remaining Depth (%):	
0.4	<u>han han han han han han han han han han </u>		Compactive Effort:	Standard
– Loa			Surcharge Mass (kg):	4.50 4
0.3 - · · ·	. 🖌	양 30 성 20 성	Period of Soaking (Days): Oversize Material (%):	4
- 6				0.0
			Moisture Content	
02+			Field Moisture Content (%):	27.6
0.2+				
0.2+	{····}·{·{·}·			
0.1	.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9	9.0 10.0 11.0 12.0 13.0		

Comments

Laboratory Density Ratio (LDR): 100.0% Laboratory Moisture Ratio (LMR): 100.0% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Califo	rnia Bearing Ratio T	est Report No: CBR:NEW18W-0006
Client:	Regional Geotechnical Solutions Pty I 44 Bent Street Wingham NSW 2429	td Accredited for compliance with ISO/IEC 17025 Testing The results of the tests, calibrations and/or measurements included in this document are t to Australian/national standards
Principal: Project No. Project Nar	: MNC16P-0001 me: Various Testing	WORLD RECOGNISED ACCREDITATION
Sample [Details	
Sample ID:	NEW18W-0006S07	Lot No.: -
Test Reque	st No.: RGS20337.1	Date Sampled: 21/12/2017
Sampling M	lethod: Sampled by Client	
Specificatio	n: No Specification	Source: On-Site
Location:	TP206 - (0.4 - 0.9m)	Material: Clay
Project Loc	ation: Precinct A/B/C, Rainbow Beach, N	SW
Load vs	Penetration	Test Results
0.9 T		AS 1289.6.1.1
-		CBR At 2.5mm (%): 3.0
0.8		Maximum Dry Density (t/m ³): 1.70 Optimum Moisture Content (%): 21.3
0.0		Optimum Moisture Content (%):21.3Dry Density before Soaking (t/m³):1.71
		Density Ratio before Soaking (%): 101
0.7		Moisture Content before Soaking (%): 20.8
-		Moisture Ratio before Soaking (%): 98
0.6++	a in the second se	Dry Density after Soaking (t/m³): 1.64
2 -		Density Ratio after Soaking (%): 96
Load on Piston (kN)		Swell (%): 4.5
isto		Moisture Content of Top 30mm (%): 29.7
		Moisture Content of Remaining Depth (%): 22.0
0.4	 je je - je - je - je - je - je 	Compactive Effort: Standard
- Los		Surcharge Mass (kg):4.50Period of Soaking (Days):4
0.3 -		Oversize Material (%): 0.0
-	🗡 a la constante da constant	
0.2-	7	Moisture Content ——
0.2		Field Moisture Content (%): 23.2
0.1-		
0.0	1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 §	
0.0		
	Penetration (mm)	

Comments

Laboratory Density Ratio (LDR): 100.5% Laboratory Moisture Ratio (LMR): 97.5% Method of establishing plasticity level: Liquid Limit (AS 1289.3.1.1) Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



QUALTEST Laboratory (NSW) Pty Ltd (20708) 8 Ironbark Close Warabrook NSW 2304

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- т٠ 02 4960 9775
- F: E: W: E: admin@qualtest.com.au W: www.qualtest.com.au ABN: 98 153 268 896



Comments

Laboratory Density Ratio (LDR): 100.5 Laboratory Moisture Ratio (LMR): 96.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Principal: Project No.:	Wingham NSW 2429		Testing The results of the tests, calibratic measurements included in this d to Australian/national standards	SO/IEC 17025 - ons and/or locument are traceab
•	MNC16P-0001 Various Testing		WORLD RECOGNISED ACCREDITATION B. C.C.REDITATION B. C.C.REDITATION NATA Accredited Laboratory Nul Date of Issue: 23/01/2018	
Sample Det				
Sample ID:	NEW18W-0006S09	Lot No.:	-	
-	No.: RGS20337.1	Date Samp	led: 21/12/2017	
Sampling Meth Specification:	nod: Sampled by Client	Sourcos	On-Site	
ocation:	No Specification TP208 - (0.9 - 1.3m)	Source: Material:	Gravel	
	on: Precinct A/B/C, Rainbow Beach, N		Glaver	
-				
_oad vs Pe	netration		Test Results	
11.0+•••	ferenderen ferenderen ferenderen ferenderen feren	[CBR At 5.0mm (%):	25
+			Maximum Dry Density (t/m ³):	2.07
10.0+	****		Optimum Moisture Content (%):	11.8
Ť		: : /. 📌 : :	Dry Density before Soaking (t/m ³):	2.06
9.0 + · · ·	· · · · · · · · · · · · · · · · · · ·		Density Ratio before Soaking (%):	100
			Moisture Content before Soaking (%):	12.3
8.0			Moisture Ratio before Soaking (%):	104
∂ 7.0+···			Dry Density after Soaking (t/m³): Density Ratio after Soaking (%):	2.06 99
¥	<u>/</u> /-		Swell (%):	99 0.0
6.0 +···		· · · · · · · · · · · · · · · · · · ·	Moisture Content of Top 30mm (%):	13.3
Pis +			Moisture Content of Remaining Depth (%)	
Coad on Piston (KN)	ter en ter e	{····{····}···{···{···{	Compactive Effort:	Standard
	······		Surcharge Mass (kg):	4.50
4.0++++	terre terre i ser terre 🖍 este en terre i ser terre	(enderse) endersed	Period of Soaking (Days):	4
+			Oversize Material:	Excluded
3.0+	ter		Oversize Material (%):	12.5
			Moisture Content —	
2.0	· /		Field Moisture Content (%):	8.0
1.0	. 🥂 i 📖 i i i i i i i			
0.0				
0.0 1	1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9	0.0 10.0 11.0 12.0 13.0		

Comments

Laboratory Density Ratio (LDR): 99.5% Laboratory Moisture Ratio (LMR): 104.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs

Form No: 18986, Report No: CBR:NEW18W-0006--S09



Client:	ia Bearing Ratio Te Regional Geotechnical Solutions Pty Ltd 44 Bent Street Wingham NSW 2429		Accredited for compliance with IS Testing The results of the tests, calibratic measurements included in this du to Australian/national standards	ons and/or
Principal: Project No.: Project Name:	MNC16P-0001 Various Testing		WORLD RECOGNISED ACCREDITATION B. CULL Approved Signatory: Brent Culler (Senior Geotechnician) NATA Accredited Laboratory Nur Date of Issue: 17/01/2018	
Sample Det				
Sample ID:	NEW18W-0006S10	Lot No.:	-	
Sampling Metho	 b.: RGS20337.1 bd: Sampled by Client 	Date Sampled	l: 21/12/2017	
Specification:	No Specification	Source:	On-Site	
_ocation:	TP209 - (0.4 - 0.8m)	Material:	Clay	
roject Locatio	n: Precinct A/B/C, Rainbow Beach, NSV	V		
.oad vs Per	netration	•	Test Results	
τi			AS 1289.6.1.1	
1.5			CBR At 2.5mm (%):	8
1.5			Maximum Dry Density (t/m³):	1.57
1.4			Optimum Moisture Content (%):	26.4
1.3	and a state of the		Dry Density before Soaking (t/m³):	1.56 99
t i			Density Ratio before Soaking (%):	
1.2			Moisture Content before Soaking (%): Moisture Ratio before Soaking (%):	26.9 102
1.1 + · · · ·	na garaga yang sangarang sangarang sangar		Dry Density after Soaking (76).	1.56
7 1.0		Ye Ko Ye Ko	Density Ratio after Soaking (%):	99
Coad on Piston (KN)		24 24 24 24 24	Swell (%):	0.5
6.0 j	📕 ya ja ja na jawa jawa ja na jawa ja na		Moisture Content of Top 30mm (%):	29.9
B 0.8			Moisture Content of Remaining Depth (%):	
5 j			Compactive Effort:	Standard
0.7			Surcharge Mass (kg):	4.50
J oc J	· · · · · · · · · · · · · · · · · · ·		Period of Soaking (Days):	4
- 0.6			Oversize Material (%):	0.0
0.5				
0.0			——— Moisture Content ———	
0.5			Moisture Content Field Moisture Content (%):	26.3
0.5				26.3
0.5				26.3

Comments

Laboratory Density Ratio (LDR): 99.5% Laboratory Moisture Ratio (LMR): 101.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Californ	ia Bearing Ratio	Test Report	Report No: CBR:NEW18	W-0006S12
Client: Principal: Project No.: Project Name:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429 MNC16P-0001 Various Testing	/ Ltd	Accredited for compliance with Testing The results of the tests, calibrar measurements included in this to Australian/national standards B. Cultur Approved Signatory: Brent Cull (Senior Geotechnician) NATA Accredited Laboratory N Date of Issue: 23/01/2018	tions and/or document are traceal s len
Sample Det Sample ID:	ails NEW18W-0006S12	Lot No.:	-	
•	lo.: RGS20337.1 od: Sampled by Client	Date Sampl	ed: 21/12/2017	
pecification:	No Specification	Source:	On-Site	
ocation:	TP210 - (0.4 - 0.8m)	Material:	Clay	
Project Locatio	n: Precinct A/B/C, Rainbow Beach,	NSW		
oad vs Pe	netration		Test Results	
6.0 _T			AS 1289.6.1.1	
0.0			CBR At 5.0mm (%):	18
- :			Maximum Dry Density (t/m ³):	1.92
			Optimum Moisture Content (%):	14.4
5.0			Dry Density before Soaking (t/m ³):	1.93
			Density Ratio before Soaking (%):	100
+			Moisture Content before Soaking (%):	13.9
			Moisture Ratio before Soaking (%):	96
4.0			Dry Density after Soaking (t/m ³):	1.92
Ŷ			Density Ratio after Soaking (%):	100
u l			Swell (%):	0.5
	a da anti-sector de la companya de l		Moisture Content of Top 30mm (%):	16.8
ц <u>3.0</u>			Moisture Content of Remaining Depth (%	Standard
Load on Piston (kN)			Compactive Effort: Surcharge Mass (kg):	4.50
Ľ			Period of Soaking (Days):	4.50
2.0			Oversize Material:	Excluded
			Oversize Material (%):	4.7
			Moisture Content ———	
0.00	0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	9.0 10.0 11.0 12.0 13.0	Field Moisture Content (%):	10.5
	2.0 0.0 7.0 0.0 1.0 0.0	0.0 10.0 11.0 12.0 13.0	11	
0.0 1.0	Penetration (mm)			

Comments

Laboratory Density Ratio (LDR): 100.5% Laboratory Moisture Ratio (LMR): 96.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Californ	ia Bearing Ratio	Test Report	Report No: CBR:NEW18	W-0006S12
Client: Principal: Project No.: Project Name:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429 MNC16P-0001 Various Testing	/ Ltd	Accredited for compliance with Testing The results of the tests, calibrar measurements included in this to Australian/national standards B. Cultur Approved Signatory: Brent Cull (Senior Geotechnician) NATA Accredited Laboratory N Date of Issue: 23/01/2018	tions and/or document are traceal s len
Sample Det Sample ID:	ails NEW18W-0006S12	Lot No.:	-	
•	lo.: RGS20337.1 od: Sampled by Client	Date Sampl	ed: 21/12/2017	
pecification:	No Specification	Source:	On-Site	
ocation:	TP210 - (0.4 - 0.8m)	Material:	Clay	
Project Locatio	n: Precinct A/B/C, Rainbow Beach,	NSW		
oad vs Pe	netration		Test Results	
6.0 _T			AS 1289.6.1.1	
0.0			CBR At 5.0mm (%):	18
- :			Maximum Dry Density (t/m ³):	1.92
			Optimum Moisture Content (%):	14.4
5.0			Dry Density before Soaking (t/m ³):	1.93
			Density Ratio before Soaking (%):	100
+			Moisture Content before Soaking (%):	13.9
			Moisture Ratio before Soaking (%):	96
4.0			Dry Density after Soaking (t/m ³):	1.92
Ŷ			Density Ratio after Soaking (%):	100
u l			Swell (%):	0.5
	a da anti-sector de la companya de l		Moisture Content of Top 30mm (%):	16.8
ц <u>3.0</u>			Moisture Content of Remaining Depth (%	Standard
Load on Piston (kN)			Compactive Effort: Surcharge Mass (kg):	4.50
Ľ			Period of Soaking (Days):	4.50
2.0			Oversize Material:	Excluded
			Oversize Material (%):	4.7
			Moisture Content ———	
0.00	0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	9.0 10.0 11.0 12.0 13.0	Field Moisture Content (%):	10.5
	2.0 0.0 7.0 0.0 1.0 0.0	0.0 10.0 11.0 12.0 13.0	11	
0.0 1.0	Penetration (mm)			

Comments

Laboratory Density Ratio (LDR): 100.5% Laboratory Moisture Ratio (LMR): 96.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Client:	Regional Geotechnical Solutions Pty 44 Bent Street Wingham NSW 2429	-	Accredited for compliance with I Testing The results of the tests, calibrati measurements included in this o to Australian/national standards	ons and/or locument are traceal
Principal: Project No.: Project Name:	MNC16P-0001 Various Testing		WORLD RECOGNISED ACCREDITATION	
Sample Det				
Sample ID:	NEW18W-0006S13	Lot No.:	-	
-	lo.: RGS20337.1 od: Sampled by Client	Date Sample	ed: 21/12/2017	
Specification:	No Specification	Source:	On-Site	
Location:	TP212 - (0.5 - 0.9m)	Material:	Clay	
	n: Precinct A/B/C, Rainbow Beach, N		Oldy	
Load vs Pe	netration		Test Results	
0.8			AS 1289.6.1.1	
-			CBR At 2.5mm (%):	2.0
			Maximum Dry Density (t/m³): Optimum Moisture Content (%):	1.52 27.9
0.7+····			Dry Density before Soaking (t/m ³):	27.9 1.52
- :			Density Ratio before Soaking (%):	100
0.6			Moisture Content before Soaking (%):	28.4
			Moisture Ratio before Soaking (%):	101
T i			Dry Density after Soaking (t/m³):	1.47
2 0.5-····			Density Ratio after Soaking (%):	96
			Swell (%):	3.5
isto			Moisture Content of Top 30mm (%):	43.3
G 0.4	· · · · · · · · · · · · · · · · · · ·		Moisture Content of Remaining Depth (%)	
Coad on Piston (KN)			Compactive Effort: Surcharge Mass (kg):	Standard 4.50
9 _{0.3}			Period of Soaking (Days):	4.50
			Oversize Material (%):	0.0
0.2			Moisture Content ———	
-1			Field Moisture Content (%):	32.8
0.1				
1				
0.0		- 		
0.0	0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	9.0 10.0 11.0 12.0 13.0		

Comments

Laboratory Density Ratio (LDR): 99.5% Laboratory Moisture Ratio (LMR): 101.5% Method of establishing plasticity level: Visual Assessment Moisture Content Method Performed as Per AS1289.2.1.1. Sample curing time: 48 hrs



Material Test Report			Issue No: 1
4 V Principal:	Regional Geotechnical Solutions Pty Ltd 4 Bent Street Vingham NSW 2429 /INC16P-0001 /arious Testing	WORLD RECOGNISED	Accredited for compliance with ISO/IEC 17025 - Testing The results of the tests, calibrations and/or measurements included in this document are traceabl to Australian/national standards Approved Signatory: Dane Cullen (Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 30/01/2018

Sample ID: Sampling Method: Date Sampled:	NEW18W-0006S07 Sampled by Client 21/12/2017
Source:	On-Site
Material:	Clay
Specification:	No Specification
Project Location:	Precinct A/B/C, Rainbow Beach, NSW
Lot. No	-
TRN	RGS20337.1
Sample Location:	TP206 - (0.4 - 0.9m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	13.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	72	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	53	

Comments



nrin	K SW	vell Inc	iex R	epori	[
lient:	44	gional Geoteo Bent Street Igham NSW		utions Pty I	Ltd			Testi The measure	ng results of the te	ests, calibratic uded in this de	SO/IEC 17025 - ons and/or ocument are trac
rincipal:							NA	A DI	ma		
roject No	.: MN	C16P-0001						Appr	oved Signatory	v: Dane Culler	h
roject Na	me: Var	ious Testing						ITATION NAT	ior Geotechnic A Accredited L of Issue: 10/0	ian) .aboratory Nur	
ample											
mple ID:		NEW18W-00				Client San	-	0	Olivert		
est Reque aterial:	est No.:	RGS20337.1 Clay				Sampling		Sampled by 21/12/2017	Client		
ource:		On-Site				Date Sam Date Subr		4/01/2018			
burce. Decificatio	on.	No Specifica	tion			Date Subi	initieu.	4/01/2010			
oject Loc		Precinct A/B		Beach NS	W						
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orehole N		TP205	01111)								
prehole D											
well Te					89.7.1.1	Shrink				AS	1289.7. 1
									5.9		
			-0.	-		Shrink on		-			
oisture C	ontent b	efore (%):	29	.4		Shrinkage	e Moisture	Content (%	6): 28.1		
oisture C	ontent be ontent af	efore (%): ter (%):	29 35	.4 .5		Shrinkage Est. inert	e Moisture material (%	Content (% %):	6): 28.1 2%		
oisture C oisture C st. Unc. C	ontent be ontent af comp. Str	efore (%): ter (%): ength befor	29 35 e (kPa): 45	.4 .5 0		Shrinkage Est. inert Crumbling	e Moisture material (% g during sl	Content (% %): hrinkage:	6): 28.1 2% Nil		
oisture C oisture C st. Unc. C st. Unc. C	ontent b ontent af comp. Str comp. Str	efore (%): ter (%):	29 35 e (kPa): 45	.4 .5 0		Shrinkage Est. inert Crumbling	e Moisture material (%	Content (% %): hrinkage:	6): 28.1 2%		
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Comments



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Client:	Regional Geo 44 Bent Stree Wingham NS	et	utions Pty L	td			Testi The i meas	results of the te	sts, calibratio	
Principal: Project No.: Project Name:	MNC16P-000 Various Testi					the second se	DITATION NAT	oved Signatory: ior Geotechnicia A Accredited La of Issue: 15/01	an) Iboratory Nun	
ample Det	tails									
ample ID:		/-0006S07			Client Sa	mple ID:				
est Request N	No.: RGS2033	37.1			Sampling	g Method:	Sampled by	Client		
aterial:	Clay				Date San	npled:	21/12/2017			
ource:	On-Site				Date Sub	mitted:	4/01/2018			
pecification:	No Speci	fication								
roject Locatio		A/B/C, Rainbow	Beach, NSV	V						
ample Location		0.4 - 0.9m)								
orehole Num										
orenole Dept	h (m): 0.4 - 0.9									
well Test			AS 128	39.7.1.1	Shrink	Test			AS [·]	1289.7.1.
well on Satur		-0	.1		11	n drying (%	-	3.8		
	ont boforo (%)	23	22				Contont (0/	1. 22 5		
					-	ge Moisture	-	9. 22.5		
loisture Conte	ent after (%):	24	1.2		Est. iner	t material (%):	10%		
loisture Conte st. Unc. Com	ent after (%): p. Strength be	24 fore (kPa): 30	1.2)0		Est. iner Crumblin	t material (ng during s	%): shrinkage:	10% Nil	-	
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oisture Conte st. Unc. Comp st. Unc. Comp hrink Swe	ent after (%): p. Strength bef p. Strength aft	24 fore (kPa): 30	1.2)0	Shrinkage	Est. iner Crumblin Cracking	t material (ng during s g during sh	%): shrinkage:	10% Nil		
oisture Conte st. Unc. Comp st. Unc. Comp hrink Swe	ent after (%): p. Strength bef p. Strength aft	24 fore (kPa): 30	1.2)0	Shrinkage	Est. iner Crumblin Cracking	t material (ng during s g during sh	%): shrinkage:	10% Nil		
oisture Conte st. Unc. Comp st. Unc. Comp hrink Swe	ent after (%): p. Strength bel p. Strength after all	24 fore (kPa): 30	1.2)0	Shrinkage	Est. iner Crumblin Cracking	t material (ng during s g during sh	%): shrinkage:	10% Nil		
toisture Contest. Unc. Comp st. Unc. Comp hrink Swe	ent after (%): p. Strength bel p. Strength after all	24 fore (kPa): 30	1.2)0	Shrinkage	Est. iner Crumblin Cracking	t material (ng during s g during sh	%): shrinkage:	10% Nil		
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Shrink Swell (%) Esh - 5.1 (%) Esh - 5.1 (%) Esh - 5.1	ent after (%): p. Strength bel p. Strength after ell o o o o o o o o o o o o o	24 fore (kPa): 30	1.2)0	Shrinkage	Est. iner Crumblin Cracking	t material (ng during s g during sh	%): shrinkage:	10% Nil		
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Shrink Swell (%) Esh - 5.1 (%) Esh - 5.1 (%) Esh - 5.1	ent after (%): p. Strength bef p. Strength aft ell 0 0 0 0 0 0 0 0 0 0 0 0 0	24 fore (kPa): 30 er (kPa): 27	1.2 00 70	20.0	Est. iner Crumblin Cracking	t material (ng during s g during sh Sw ell	%): shrinkage: rinkage:	10% Nil Moderat		50.0

Comments

* Shrink swell remoulded at approximately 98% SMDD & at OMC



Shrink S	Swell Inc	lex R	eport	t			Repor	t No: SSI:	NEW18V	V-0006S10 Issue No: 1
Client:	Regional Geotec 44 Bent Street Wingham NSW		utions Pty	Ltd			Λ T T n	ccredited for con esting he results of the neasurements ind Australian/natio	tests, calibratio	
Principal: Project No.: Project Name:	MNC16P-0001 Various Testing						DITATION	pproved Signato Senior Geotechn IATA Accredited ate of Issue: 15/	Laboratory Nur	
Sample Deta	ails									
Sample ID: Fest Request No Material:	NEW18W-00 o.: RGS20337.1 Clay				Client Sa Sampling Date Sam	Method: pled:	Sampled 21/12/20	17		
Source: Specification: Project Locatior		/C, Rainbow	Beach, NS	W	Date Sub	mitted:	4/01/2018	3		
Sample Location Borehole Numb Borehole Depth	er: TP209	- 0.8m)								
-	nt before (%):	. ,	4 .5 .3 0	89.7.1.1	Shrink or Shrinkag Est. inert Crumblir	l est n drying (% e Moisture material (ng during s during sh	Content %): hrinkage	5%	AS	1289.7.1.
Shrink Swel	-	(KPa): 90			Cracking	auring sh	nnkage:			
				Shrinkage	٠	Sw ell				
10.0 MS (-									
Shrink (%) Esh - Swell (%)	-						-	<u>ب</u>		
Shrink (%) E	-				~					
						1		E.		
-10.0				5	•		÷.		1	
-10.0	5.0	10.0	15.0	20.0 Mois	25.0 sture Content	30.0 : (%)	35.0	40.0	45.0	50.0

Comments

* Shrink swell remoulded at approximately 98% SMDD & at OMC



Appendix C

Pavement Thickness Design Sheets

FLEXIBLE PAVEMENT THICKNESS DESIGN - Fill Embankment

CLIENT:	King & Campbell		Job No.:	RGS20337.1	REGIO	ו אות
PROJECT:	Proposed Resider	ntial Development			GEOTECHNICA	L SOLUTIONS
LOCATION:	Precinct A, Rainb	ow Beach			Date:	30-Jul-18
ROAD NAME:		Road 1	Refer to d	rawing:	Figu	
Chainage Inte	erval (m):	Fill Embankment		ification ref:	PMHC A	
Road Classific	ation:	Collector Road	Design Tra	ffic:	1 x 10	•
Pavement De	sign Methodology	Empirical with reference to Austro	oads Part 2			
		Sub	grade Conditions			
Expected subgr	rade:	Embankment fill on Alluvial Terrain E	3			
Adopted Subgr	ade CBR value:	7 - To be confirmed	Required	d subgrade compaction:	100% Sta	andard Compaction
		replaced with approved granular fill. Place pavement layers as specifed.	vement Design			
Recommende	d Pavement Layer 1			aterial requirements	Requi	red Compaction
	se thickness (mm):	40		ncil requirements*		
Base thickness		140		ying to Hastings AUSPEC	98% Mo	dified Compaction
Sub-base thick	kness (mm):	150	DGS20 or DGS40 comp	lying to Hastings AUSPEC	95% Mo	dified Compaction
Select thickne	ss (mm):		CBR>15; PI<12; Ma:	A Particle size 100mm	100% Sta	andard Compaction
Total thicknes	s (mm):	330	*Note: AC laye	r to be underlain by prime	er. AC density te	sting required.
			Definitions:			
Design traffic load	ing:	The anticipated number of equivalent standar	rd axles (ESA), as defined by AUS	TROADS, in the design lane duri	ng the design life of	the pavement.
Modified Compact	ion:	Minimum required dry density ratio (AS1289 maximum dry density obtained using AS1289		of the calculated field dry density	y (AS1289 5.3.1-200	4 or equivalent) to the
Standard Compact	ion:	Minimum required dry density ratio (AS1289 maximum dry density obtained using AS1289	5.4.1-2007) defined as the ratio	of the calculated field dry densit	y (AS1289 5.3.1-200	4 or equivalent) to the
Density Index:		Minimum required Density Index AS1289 5.6. values of maximum and minimum density obt			S1289 5.3.1-2004 or	r equivalent to the laborato
Note:	Pavement designs	assume appropriate drainage is install	ed and maintained. Refer	to Regional Geotechnical	Solutions Repor	rt No. RGS20337.1-AS
	for recommendation	ons regarding drainage.		-		

FLEXIBLE PAVEMENT THICKNESS DESIGN - Weathered Rock

	Precinct A, Rainbo	Road 10 Ch0 - 170m Collector Road Empirical with reference to Austr Sub EW/HW Dolerite	Refer to drawing: Road classification ref: Design Traffic: roads Part 2 Ograde Conditions	GEOTECHNICAL SOLUTIONS Date: 30-Jul-18 Figure 1 PMHC Aus-Spec 1 x 10 ⁶ ESA
ROAD NAME: Chainage Interval Road Classification Pavement Design Expected subgrade: Adopted Subgrade C Potential construction	I (m): on: Methodology : : CBR value: ion or	Road 10 Ch0 - 170m Collector Road Empirical with reference to Austr Sub EW/HW Dolerite	Road classification ref: Design Traffic: roads Part 2	Figure 1 PMHC Aus-Spec
Chainage Interval Road Classification Pavement Design Expected subgrade: Adopted Subgrade C Potential construction	Methodology Methodology CBR value: ion or	ChO - 170m Collector Road Empirical with reference to Austr Sub EW/HW Dolerite	Road classification ref: Design Traffic: roads Part 2	Figure 1 PMHC Aus-Spec
Chainage Interval Road Classification Pavement Design Expected subgrade: Adopted Subgrade C Potential construction	Methodology Methodology CBR value: ion or	Collector Road Empirical with reference to Austr Sub EW/HW Dolerite	Road classification ref: Design Traffic: roads Part 2	PMHC Aus-Spec
Road Classification Pavement Design Expected subgrade: Adopted Subgrade C Potential construction	Methodology Methodology CBR value: ion or	Collector Road Empirical with reference to Austr Sub EW/HW Dolerite	Design Traffic: roads Part 2	·
Expected subgrade: Adopted Subgrade C Potential construction	: CBR value: ion or	Suk EW/HW Dolerite		
Adopted Subgrade C Potential construction	CBR value: ion or	EW/HW Dolerite	ograde Conditions	
Adopted Subgrade C Potential construction	CBR value: ion or		-	
Potential construction	ion or			
		10	Required subgrade compaction:	100% Standard Compaction
		yellow clay exposed, excavate to 30 as specifed.	e identified they should be removed and replaced wi 00mm, or, weathered rock and replace with Select Fill avement Design	
Recommended Pa	avement Laver T		Recommended Material requirements	Required Compaction
Wearing course th	-	40	AC10 as Per Council requirements*	
Base thickness (mr		140	DGB20 material complying to Hastings AUSPEC	98% Modified Compaction
Sub-base thickness	ss (mm):	150	DGS20 or DGS40 complying to Hastings AUSPEC	95% Modified Compaction
Select thickness (m	mm):		CBR>15; PI<12; Max Particle size 100mm	100% Standard Compaction
Total thickness (mi	nm):	330	*Note: AC layer to be unde	erlain by primer
			Definitions:	
Design traffic loading:		The anticipated number of equivalent stands	ard axles (ESA), as defined by AUSTROADS, in the design lane durin	ng the design life of the pavement.
Modified Compaction:		Minimum required dry density ratio (AS1289) maximum dry density obtained using AS1289	9 5.4.1-2007) defined as the ratio of the calculated field dry density 9 5.2.1-2003 or equivalent.	y (AS1289 5.3.1-2004 or equivalent) to the
standard Compaction:			95.4.1-2007) defined as the ratio of the calculated field dry density	γ (AS1289 5.3.1-2004 or equivalent) to the
Density Index:		Minimum required Density Index AS1289 5.6 values of maximum and minimum density of	5.1-1998, defined as the ratio of field dry density determined by AS otained by AS1289 5.5.1-1998 or equivalent	51289 5.3.1-2004 or equivalent to the laborator
Note: Pa fo		assume appropriate drainage is instal		

FLEXIBLE PAVEMENT THICKNESS DESIGN - Low CBR

	King & Campbell			Job No.:	RGS20337.1	REGI	ΩΝΔΙ /
PROJECT:	Proposed Resider	ntial Development				GEOTECHNIC	AL SOLUTIONS
LOCATION:	Precinct A, Rainb	ow Beach					20.1.1.40
ROAD NAME:		Road 10		Refer to d	rawing:	Date:	30-Jul-18 ure 1
Chainage Inter	n/al (m):	Ch170 - 215			sification ref:	-	Aus-Spec
Road Classifica		Collector Road		Design Tra			0^{6} ESA
	sign Methodology	Empirical with reference to a	Austroads Part 2	Design in		1.1	
	5.511 1112 1104 0105 7			ditions			
Expected subgra	ade:	Residual/EW Dolerite	Subgrade Cor	iuitions			
Adopted Subgra		2		Require	d subgrade compaction:	100% 5	tandard Compaction
Potential constr		2		Require		100%3	
			Pavement D	esign			
Recommende	d Pavement Layer 1	Thickness:	Recon	nmended M	aterial requirements	Requ	irad Compaction
Wearing cours	e thickness (mm):	40	AC	10 as Per Cou	ncil requirements*		ired Compaction
	(mm).						
Base thickness	s (mm):	140	DGB20 m	naterial comp	lying to Hastings AUSPEC	98% M	odified Compaction
Base thickness Sub-base thick		140			lying to Hastings AUSPEC		
	mess (mm):		DGS20 or	DGS40 comp		2 95% M	odified Compaction
Sub-base thick	xness (mm): ss (mm):	150	DGS20 or CBR>2	DGS40 comp L5; PI<12; Ma	lying to Hastings AUSPEC	2 95% M 100% S	odified Compaction odified Compaction tandard Compaction
Sub-base thick Select thicknes	xness (mm): ss (mm):	150 300	DGS20 or CBR>2	DGS40 comp 15; PI<12; Ma Note: AC laye	lying to Hastings AUSPEC	2 95% M 100% S	odified Compaction odified Compaction tandard Compaction
Sub-base thick Select thicknes	xness (mm): ss (mm): s (mm):	150 300	DGS20 or CBR>2 *I Definitio	DGS40 comp 15; PI<12; Ma Note: AC laye ns:	llying to Hastings AUSPEC x Particle size 100mm er to be underlain by prim	2 95% M 100% S her. AC density to	odified Compaction odified Compaction tandard Compaction esting required.
Sub-base thick Select thicknes Total thickness	ness (mm): ss (mm): s (mm):	150 300 630 The anticipated number of equivalent Minimum required dry density ratio (<i>i</i> maximum dry density obtained using	DGS20 or CBR>: * Definitio standard axles (ESA), a AS1289 5.4.1-2007) def AS1289 5.2.1-2003 or e	DGS40 comp 15; PI<12; Ma Note: AC laye ns: as defined by AU fined as the ratic equivalent.	lying to Hastings AUSPEC x Particle size 100mm er to be underlain by prim STROADS, in the design lane du of the calculated field dry den	2 95% M 100% S her. AC density to uring the design life sity (AS1289 5.3.1-2	odified Compaction odified Compaction tandard Compaction esting required. of the pavement.
Sub-base thick Select thicknes Total thickness Design traffic loadi	aness (mm): ss (mm): s (mm): ing:	150 300 630 The anticipated number of equivalent Minimum required dry density ratio (/	DGS20 or CBR>: * Definitio standard axles (ESA), a A\$1289 5.4.1-2007) def A\$1289 5.2.1-2003 or e A\$1289 5.4.1-2007) def	DGS40 comp 15; PI<12; Ma Note: AC laye ns: as defined by AU fined as the ratic equivalent.	lying to Hastings AUSPEC x Particle size 100mm er to be underlain by prim STROADS, in the design lane du of the calculated field dry den	2 95% M 100% S her. AC density to uring the design life sity (AS1289 5.3.1-2	odified Compaction odified Compaction tandard Compaction esting required. of the pavement.
Sub-base thick Select thickness Total thickness Design traffic loadi Modified Compacti	aness (mm): ss (mm): s (mm): ing:	150 300 630 The anticipated number of equivalent Minimum required dry density ratio (<i>i</i> maximum dry density obtained using Minimum required dry density ratio (<i>i</i>	DGS20 or CBR>: * Definitio standard axles (ESA), a A\$1289 5.4.1-2007) def A\$1289 5.4.1-2007) def A\$1289 5.4.1-2007) def A\$1289 5.4.1-2003 or e 289 5.6.1-1998, defined	DGS40 comp 15; PI<12; Ma Note: AC laye ns: as defined by AU rined as the ratio equivalent. ined as the ratio equivalent. d as the ratio of	lying to Hastings AUSPEC x Particle size 100mm er to be underlain by prim STROADS, in the design lane du of the calculated field dry den i of the calculated field dry den field dry density determined by	2 95% M 100% S her. AC density to uring the design life sity (AS1289 5.3.1-2 sity (AS1289 5.3.1-2	odified Compaction odified Compaction tandard Compaction esting required. of the pavement. 2004 or equivalent) to the 2004 or equivalent) to the

FLEXIBLE PAVEMENT THICKNESS DESIGN - Low CBR

FLEXIBLE	PAVEMENT 1	THICKNESS DESIGN - Lov	w CBR				
CLIENT:	King & Campbell			Job No.:	RGS20337.1	REGI	ONAL 🚄
PROJECT:	Proposed Resider	ntial Development				GEOTECHNIC	AL SOLUTIONS
LOCATION:	Precinct A, Rainbo	ow Beach					
						Date:	30-Jul-18
ROAD NAME:		Road 26 and 29		Refer to d	rawing:	Fig	ure 1
Chainage Inter	rval (m):	Residual Yellow Clay - Low CBR		Road class	ification ref:		Aus-Spec
Road Classifica	ation:	Local Street		Design Tra	ffic:	5 x 1	0 ⁵ ESA
Pavement Des	ign Methodology	Empirical with reference to Austro	oads Part 2				
		Sub	grade Cono	ditions			
Expected subgra	ade:	Residual Clay - Terrain A					
Adopted Subgra	de CBR value:	2		Require	d subgrade compaction:	100% S	tandard Compaction
		works. Grade subgrade towards road or heaving areas. Where such areas a 280mm layer of Select Fill (CBR >15 a	are identified and PI<12) to s	they should subgrade de	be removed and replaced	d with approved	l granular fill. Place
			vement De	-		<u> </u>	
	d Pavement Layer T				aterial requirements	Requ	ired Compaction
Wearing cours	e thickness (mm):	30	AC1	0 as Per Cou	ncil requirements*		
Base thickness	(mm):	120	DGB20 ma	aterial comp	ying to Hastings AUSPEC	98% M	lodified Compaction
Sub-base thick	ness (mm):	150	DGS20 or I	DGS40 comp	lying to Hastings AUSPEC	95% M	Iodified Compaction
Select thicknes	ss (mm):	280	CBR>15	5; PI<12; Ma	x Particle size 100mm	100% S ⁴	tandard Compaction
Total thickness	s (mm):	580	*N	ote: AC laye	r to be underlain by prim	er. AC density t	esting required.
			Definition	s:			
Design traffic loadii	ng:	The anticipated number of equivalent standar	rd axles (ESA), as	defined by AU	STROADS, in the design lane du	ring the design life	of the pavement.
Modified Compacti		Minimum required dry density ratio (AS1289 maximum dry density obtained using AS1289	5.2.1-2003 or eq	uivalent.			
Standard Compacti	on:	Minimum required dry density ratio (AS1289 maximum dry density obtained using AS1289			of the calculated field dry dens	sity (AS1289 5.3.1-2	2004 or equivalent) to the
Density Index:		Minimum required Density Index AS1289 5.6. laboratory values of maximum and minimum				AS1289 5.3.1-2004	or equivalent to the
Note:	-	assume appropriate drainage is installe regarding drainage.	ed and mainta	ined. Refer	to Regional Geotechnical	Solutions Repo	rt No. RGS20337.1-AS for

FLEXIBLE PAVEMENT THICKNESS DESIGN - Fill Embankment

	King & Campbell		Job No.: RGS20337.1	BEGIONAL /
PROJECT:	Proposed Resider	ntial Development		GEOTECHNICAL SOLUTIONS
LOCATION:	Precinct A, Rainb	ow Beach		 Date: 30-Jul-18
ROAD NAME:		Road 3, 25 and 26	Refer to drawing:	Figure 1
Chainage Inte	erval (m):	Fill Embankment	Road classification ref:	PMHC Aus-Spec
Road Classific		Local Street	Design Traffic:	5 x 10 ⁵ ESA
Pavement De	sign Methodology	Empirical with reference to Austro	pads Part 2	
		Sub	grade Conditions	
Expected subgr	rade:	Embankment fill on Alluvial Terrain E	3	
Adopted Subgr	ade CBR value:	7 - To be confirmed	Required subgrade compaction:	100% Standard Compaction
		Place pavement layers as specifed.	Compact and take CBR samples at subgrade level	to confirm design CBR is appropriate.
Recommende	d Pavement Laver T	hickness	Recommended Material requirements	Required Compaction
	ed Pavement Layer T		Recommended Material requirements	Required Compaction
Wearing cours	se thickness (mm):	30	AC10 as Per Council requirements*	
Wearing cours Base thickness	se thickness (mm): s (mm):	30 120	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC	98% Modified Compaction
Wearing cours Base thickness Sub-base thick	se thickness (mm): s (mm): kness (mm):	30	AC10 as Per Council requirements*	98% Modified Compaction
Wearing cours Base thickness Sub-base thick Select thickne	se thickness (mm): s (mm): kness (mm): ess (mm):	30 120	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC	 98% Modified Compaction 95% Modified Compaction 100% Standard Compaction
Wearing cours Base thickness Sub-base thick Select thickne	se thickness (mm): s (mm): kness (mm): ess (mm):	30 120 150	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC CBR>15; PI<12; Max Particle size 100mm	 98% Modified Compaction 95% Modified Compaction 100% Standard Compaction
Wearing cours Base thickness Sub-base thick Select thicknes Total thicknes	se thickness (mm): s (mm): kness (mm): ess (mm):	30 120 150 300	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC CBR>15; PI<12; Max Particle size 100mm *Note: AC layer to be underlain by prim	 98% Modified Compaction 95% Modified Compaction 100% Standard Compaction AC density testing required.
Wearing cours Base thickness Sub-base thick Select thicknes Total thicknes Design traffic load	se thickness (mm): s (mm): kness (mm): ess (mm): ss (mm): ing:	30 120 150 300 The anticipated number of equivalent standar Minimum required dry density ratio (AS1289 Smaximum dry density obtained using AS1289 Smaximum dry density dry density dry density dry dry dry dry dry dry dry dry dry dr	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC CBR>15; PI<12; Max Particle size 100mm *Note: AC layer to be underlain by prim Definitions: rd axles (ESA), as defined by AUSTROADS, in the design lane du 5.4.1-2007) defined as the ratio of the calculated field dry dens 5.2.1-2003 or equivalent.	98% Modified Compaction 95% Modified Compaction 100% Standard Compaction ner. AC density testing required. ring the design life of the pavement. ity (AS1289 5.3.1-2004 or equivalent) to the
Wearing cours Base thickness Sub-base thick Select thicknes Total thicknes Design traffic load	se thickness (mm): s (mm): kness (mm): ess (mm): ss (mm): ing:	30 120 150 300 The anticipated number of equivalent standar Minimum required dry density ratio (AS1289 Smaximum dry density obtained using AS1289 Smaximum dry density dry density dry density dry dry dry dry dry dry dry dry dry dr	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC CBR>15; PI<12; Max Particle size 100mm *Note: AC layer to be underlain by prim Definitions: rd axles (ESA), as defined by AUSTROADS, in the design lane du 5.4.1-2007) defined as the ratio of the calculated field dry dens 5.2.1-2003 or equivalent. 5.4.1-2007) defined as the ratio of the calculated field dry dens	98% Modified Compaction 95% Modified Compaction 100% Standard Compaction ner. AC density testing required. ring the design life of the pavement. ity (AS1289 5.3.1-2004 or equivalent) to the
Wearing cours Base thickness Sub-base thick Select thicknes Total thicknes	se thickness (mm): s (mm): kness (mm): ess (mm): ss (mm): ing:	30 120 150 300 The anticipated number of equivalent standar Minimum required dry density ratio (AS1289 9 maximum dry density obtained using AS1289 9 Minimum required dry density ratio (AS1289 9 maximum dry density obtained using AS1289 9 Minimum required dry density ratio (AS1289 9 Minimum dry density obtained using AS1289 9	AC10 as Per Council requirements* DGB20 material complying to Hastings AUSPEC DGS20 or DGS40 complying to Hastings AUSPEC CBR>15; PI<12; Max Particle size 100mm *Note: AC layer to be underlain by prim Definitions: rd axles (ESA), as defined by AUSTROADS, in the design lane du 5.4.1-2007) defined as the ratio of the calculated field dry dens 5.1.1-2003 or equivalent. 5.1.1-2003 or equivalent. 1-1998, defined as the ratio of field dry density determined by	98% Modified Compaction 95% Modified Compaction 100% Standard Compaction 100% Standard Compaction er. AC density testing required. ring the design life of the pavement. ity (AS1289 5.3.1-2004 or equivalent) to the ity (AS1289 5.3.1-2004 or equivalent) to the

FLEXIBLE PAVEMENT THICKNESS DESIGN - Weathered Rock

CLIENT:	King & Campbell		Job No.: RGS20337.1	REGI	IANCI
PROJECT:	Proposed Resider	ntial Development		GEOTECHNICA	AL SOLUTIONS
LOCATION:	Precinct A, Rainb	ow Beach		Date:	30-Jul-18
ROAD NAME:		Road 25 and 28	Refer to drawing:		ure 1
Chainage Inte	erval (m):	Weathered Rock	Road classification ref:	PMHC A	Aus-Spec
Road Classific	ation:	Local Street	Design Traffic:	5 x 10	D ⁵ ESA
Pavement De	sign Methodology	Empirical with reference to Austro	oads Part 2		
		Sub	grade Conditions		
Expected subgr	rade:	EW/HW Dolerite			
Adopted Subgr	ade CBR value:	10	Required subgrade compaction:	. 100% St	andard Compaction
		yellow clay exposed, excavate to 300 as specifed.	e identified they should be removed and replaced Dmm, or, weathered rock and replace with Select		
Recommende	d Pavement Layer 1		Recommended Material requirements	Requi	red Compaction
	se thickness (mm):	30	AC10 as Per Council requirements*		
Base thickness	· · ·	120	DGB20 material complying to Hastings AUSPE	 C98% M(odified Compaction
Sub-base thick	· ·	150	DGS20 or DGS40 complying to Hastings AUSPE	C 95% Mr	odified Compaction
Select thickne	ss (mm):		CBR>15; PI<12; Max Particle size 100mm	100% St	andard Compaction
Total thicknes	s (mm):	300	*Note: AC layer to be un	Iderlain by primer	
			Definitions:		
Design traffic load	ing:	The anticipated number of equivalent standar	rd axles (ESA), as defined by AUSTROADS, in the design lane d	uring the design life of	f the pavement.
Modified Compact		maximum dry density obtained using AS1289			
Standard Compact	tion:	Minimum required dry density ratio (AS1289 maximum dry density obtained using AS1289	5.4.1-2007) defined as the ratio of the calculated field dry der 5.1.1-2003 or equivalent.	isity (AS1289 5.3.1-200	04 or equivalent) to the
Density Index:		Minimum required Density Index AS1289 5.6. values of maximum and minimum density obt	1-1998, defined as the ratio of field dry density determined by tailed by AS1289 5.5.1-1998 or equivalent	AS1289 5.3.1-2004 o	r equivalent to the laboratory
Note:	Pavement designs	assume appropriate drainage is install	ed and maintained. Refer to Regional Geotechnic	al Solutions Repo	rt No. RGS20337.1-AS
	for recommendati	ons regarding drainage.			