

Certainty Wealth

Geotechnical Assessment

Proposed Sanctuary Residential Estate

344 John Oxley Drive, Thrumster

Report No. RGS21087.1-AC

2 June 2021



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Certainty Wealth
c-/ Land Dynamics Australia
77 Lord Street
PORT MACQUARIE NSW 2444

Attention: Graham Burns

Dear Graham

**RE: Proposed Sanctuary Residential Estate – 344 John Oxley Drive, Thrumster
Geotechnical Assessment**

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for the proposed Sanctuary residential development at 344 John Oxley Drive, Lot 1 DP 1245588, Thrumster.

Surface and subsurface conditions at the site and recommendations and advice on foundation conditions, excavation conditions and flexible pavement design are presented in the attached report.

If you have any questions regarding this project, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by



Tim Morris

Associate Engineering Geologist

Reviewed by



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1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd have undertaken a geotechnical assessment of the proposed Sanctuary residential estate at 344 John Oxley Drive, Lot 1 DP 1245588, Thrumster.

The development is for a large-scale residential subdivision with eight proposed stages and will involve:

- Site regrading works with up to approximately 6m cut and placement of up to approximately 3m fill;
- Construction of a road embankment with culverts across a drainage depression in the west of the site;
- Site preparation works for potentially eight stages of residential development, comprising up to approximately 207 residential lots;
- Construction of 12 sections of road pavements within the site. Road classifications have not yet been provided;
- Construction of retaining walls up to approximately 1.5m in height may be required with proposed lot terracing works;
- Installation of light poles at regular intervals which will have a bored pile foundation with a rag bolt type assembly; and
- Construction works for associated infrastructure including water, sewer and stormwater services.

The purpose of the assessment was to provide comments and recommendations on the following:

- Subsurface conditions including the presence of fill, depth to weathered rock and groundwater (if encountered);
- A geotechnical model of the site that includes general foundation conditions and the depth of the soil profiles;
- Preliminary site classifications to AS2870-2011 Residential Slabs and Footings for soil landscapes present;
- Foundation conditions including the presence of rock;
- Recommended foundation types, including bearing capacities, expected settlements, and construction methods;
- Excavation conditions and suitability of excavated material for re-use;
- Pavement thickness design for Stage 1 and 2 only (Road No's 1 to 4, 7 and 10), including material requirements and construction recommendations for the internal roads which are likely to comprise Collector Roads and Local Streets as defined in Port Macquarie Hastings Council Aus-Spec. 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;
- 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;
- Presence of groundwater;



- Suitability of site soils for stormwater basin construction; and
- Geotechnical design parameters for proposed light poles that are likely to be supported on bored concrete piers.

The work was commissioned by Graham Burns on behalf of Land Dynamics Australia Pty Ltd and was undertaken in accordance with proposal number RGS21087.1-AA dated 12 March 2021.

2 METHODOLOGY

Field work for the assessment was undertaken on 23 February 2021 and 15 April 2021 and was based on the supplied drawing titled "344 JOHN OXLEY DRIVE THURMSTER OVERALL CONCEPT STAGING PLAN". Fieldwork was undertaken by an Engineering Geologist from RGS and included:

- Observation of site features and surrounding features relevant to the geotechnical conditions of the site;
- Twenty-four test pits undertaken with a 20t excavator to depths of between 1.5 and 5.0m;
- Collection of samples for subsequent laboratory testing.

Engineering logs of the test pits are presented in Appendix A. Coordinates of investigation locations were recorded using a handheld GPS and the coordinates are shown on the engineering logs. Reduced levels at the test pit locations were estimated from the supplied drawings and are shown on the engineering logs.

3 LABORATORY TESTING

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

- Soil volume change over an extreme range of moisture content (shrink / swell index) on one U50 sample;
- Soil volume change over an extreme range of moisture content (shrink / swell index) on three bulk sample of material that had been compacted at 98% Standard Compaction to simulate re-use of material in a placed fill platform;
- CBR testing of ten samples considered representative of the subgrade materials encountered;
- Emerson dispersion; and
- Atterberg Limits testing on selected samples.

The laboratory shrink-swell, Atterberg Limits and Emerson dispersion test results are summarised in Table 1. Laboratory CBR test results are summarised in Section 4.3. Laboratory test result sheets are presented in Appendix B.



Table 1: Laboratory Testing Summary

Location	Depth	Material	Emerson Class	Plasticity Index (%)	Shrink Swell Index (%)
Hill - A	2.0 – 3.0	Unit 5B: Extremely Weathered Dolerite**	-	-	1.1
TP2	0.5 – 0.6	Unit 4B: Sandy CLAY	2	43	
TP3	0.4 – 0.8	Unit 4A: Sandy CLAY	-	-	3.4
TP11	0.3 – 0.6	Unit 4A: Sandy CLAY**	-	-	3.2
TP21	0.5 – 1.0	Unit 5B: Extremely Weathered Dolerite**	-	-	3.3

Note: * Afterberg Limits testing undertaken on U50 sample that crumbled upon extraction
 ** Test undertaken on bulk sample recompacted at 98% Standard Compaction

4 SITE CONDITIONS

4.1 Surface Conditions

The site comprises approximately 45 hectares of undeveloped rural land situated in gently to moderately undulating topography that includes two low hills in the north and south of the site with surface elevations of up to 16m AHD in the north and 18m AHD in the south. The hills are joined by a low saddle with surface elevations of about 6m AHD. Broad, low lying alluvial depressions are present to the east and west of the saddle and the intermittent drainage lines present within the depressions drain generally towards the north. The inferred extent of the alluvial depressions is shown on Figure 1.

A satellite image that shows the location of the site and the site setting is reproduced in Plate 1.

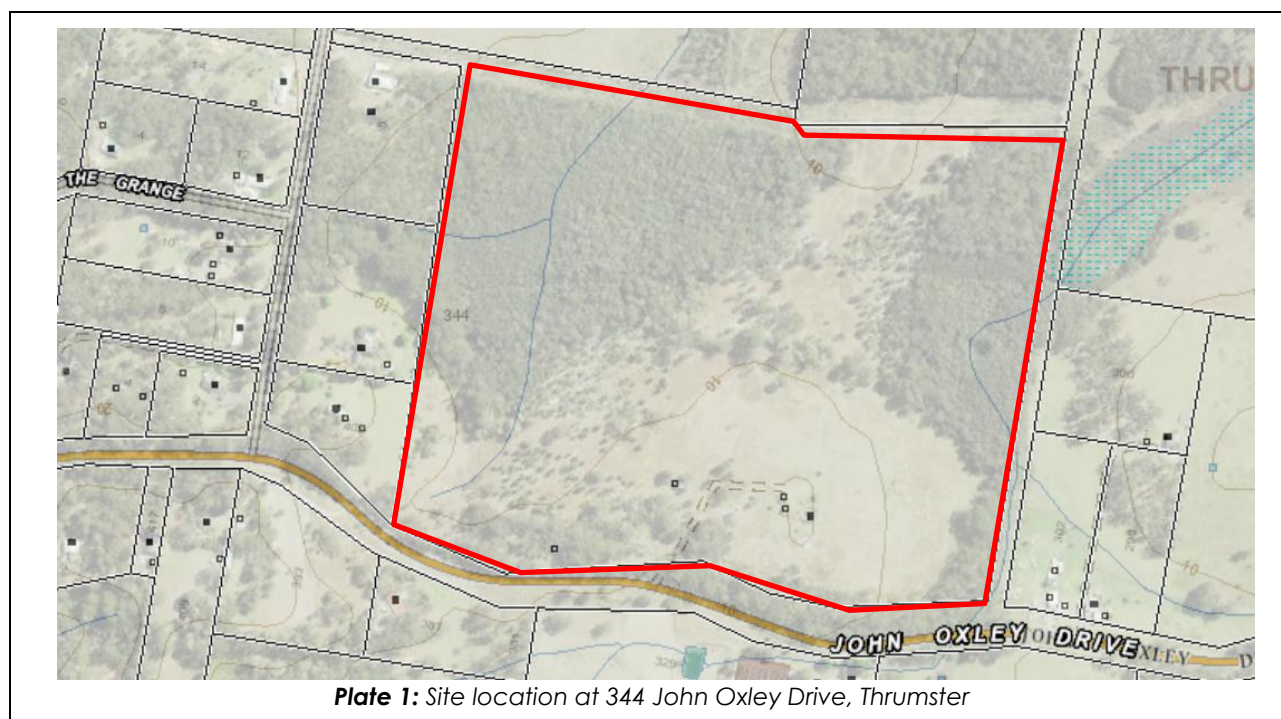


Plate 1: Site location at 344 John Oxley Drive, Thrumster



The areas of proposed development are typically located near the centre of the site and are mostly cleared with scattered large eucalypts. Thick vegetation is present in the low-lying areas to the east and west.

Drainage of the site is via a combination of surface infiltration and overland flow towards the two drainage lines in the east and west of the site. The site is generally well drained on the ridge slopes and poorly drained on the lower slopes and adjacent alluvial depressions. Fieldwork was undertaken following a period of wet weather and vehicle access was restricted to 4WD in the centre of the site on the crest of the low saddle where surface water was present.

A dilapidated farmhouse is present on the crest of the hill in the south of the site, with a gravel access track connecting from John Oxley Drive.

Typical site photographs are presented below.



Looking east from TP2 across undulating residual terrain. Some scattered mature eucalypts remain.



Looking from TP5, to the north across the low-lying depression and onwards to Stage 7 and 8.



Looking west from TP1. Surface soils disturbed by tree removal and some stump holes are likely to be present.



Low lying saddle between TP6 and TP7 near proposed Road 1 alignment. Surface water present and vehicle access restricted to 4WD.



4.2 Subsurface Conditions

The site is located in an area of gently to moderately undulating topography that is underlain by deeply weathered geological units of the Port Macquarie Block which includes slate, chert, basalt, serpentinite and dolerite. Alluvial soils are likely to be present in the low-lying areas of the site which are also likely to be poorly drained.

Reference to the Wauchope Acid Sulfate Soil (ASS) Risk Map (DLWC, 2000) indicates there is a high probability of ASS in the alluvial depression near the eastern boundary, however, it is located outside the area of the proposed development. The proposed development areas are shown as no known occurrence of ASS.

The materials encountered during the investigation are summarised in Table 2. Further details are presented on the attached engineering logs.

Table 2: Summary of Geotechnical Units

Unit	Material	Material Description
UNIT 1	TOPSOIL/ FILL	Sandy SILT, low plasticity, dark brown, trace grass roots
UNIT 2	SLOPEWASH	Silty CLAY, pale grey
UNIT 3	ALLUVIUM	Gravelly Silty CLAY, medium plasticity, pale grey / white with red mottling, very stiff with rounded gravel, fine to medium. Inferred Pleistocene alluvial deposits.
UNIT 4A	RESIDUAL (Orange)	Sandy CLAY, medium plasticity, orange/red, increasing pale mottling with depth, stiff to very stiff
UNIT 4B	RESIDUAL (Yellow)	CLAY, medium plasticity, yellow, stiff
UNIT 5A	Extremely Weathered SLATE	Silty CLAY, white / pale grey, very stiff, Gravelly Silty CLAY, pale grey / white with red / yellow mottling, very stiff
UNIT 5B	Extremely Weathered DOLERITE	Sandy CLAY, yellow with grey mottling, very stiff, some rock fabric and trace gravel, low strength.
UNIT 6A	Highly Weathered SLATE	SLATE, white / pale grey, with red staining, fissile, inferred very low to low strength
UNIT 6B	Highly Weathered DOLERITE	DOLERITE, pale grey/brown with orange mottling, massive, inferred very low to medium strength, slow digging with 20T excavator.



Table 3: Summary of Subsurface Materials

Investigation	Depth to Base of Material Layer (m)									
	UNIT 1 TOPSOIL/FILL	UNIT 2 SLOPE WASH	UNIT 3 ALLUVIUM	UNIT 4A RESIDUAL (Orange)	UNIT 4B RESIDUAL (Yellow)	UNIT 5A EW SLATE	UNIT 5B EW DOLERITE	UNIT 6A HW SLATE	UNIT 6B HW DOLERITE	Water Inflow (m)
Hill-A	0.0 – 0.2	--	--	0.2 – 0.7	--	--	2.0 – 5.2	--	0.7 – 2.0	--
Hill-B	0.0 – 0.15	--	--	0.15 – 0.4	--	--	2.0 – 3.5	--	0.4 – 2.0	--
TP1	0.0 – 0.25	--	--	0.25 – 0.7	--	0.7 – 1.3	--	1.3 ≥ 2.0	--	--
TP2	0.0 – 0.35	--	--	0.35 – 1.0	0.35 – 1.0	--	1.0 – 1.5	--	1.5 ≥ 2.0	--
TP3	0.0 – 0.3	--	--	0.3 ≥ 2.0	--	--	--	--	--	--
TP4	0.0 – 0.25	--	--	0.25 – 1.2	--	1.2 ≥ 2.0	--	--	--	--
TP5	0.0 – 0.25	--	--	0.25 – 1.3	--	1.3 ≥ 2.0	--	--	--	--
TP6	0.0 – 0.2	0.2 – 0.25	0.25 ≥ 1.5	--	--	--	--	--	--	1.1
TP7	0.0 – 0.25	0.25 – 0.3	0.3 ≥ 1.5	--	--	--	--	--	--	--
TP8	0.0 – 0.3	--	0.3 ≥ 1.5	--	--	--	--	--	--	--
TP9	0.0 – 0.3	--	0.3 ≥ 2.0	--	--	--	--	--	--	--
TP10	0.0 – 0.1	0.1 – 0.25	0.25 ≥ 2.0	--	--	--	--	--	--	1.8
TP11	0.0 – 0.1	0.1 – 0.25	--	0.25 – 1.1	--	1.1 ≥ 1.8	--	--	--	--
TP12	0.0 – 0.1	0.1 – 0.3	--	0.3 – 1.0	--	1.0 ≥ 2.0	--	--	--	--
TP13	0.0 – 0.1	0.1 – 0.25	--	0.25 ≥ 2.2	--	--	--	--	--	--
TP14	0.0 – 0.3	--	--	0.3 ≥ 2.5	--	--	--	--	--	--



Investigation	Depth to Base of Material Layer (m)									
	UNIT 1 TOPSOIL/FILL	UNIT 2 SLOPE WASH	UNIT 3 ALLUVIUM	UNIT 4A RESIDUAL (Orange)	UNIT 4B RESIDUAL (Yellow)	UNIT 5A EW SLATE	UNIT 5B EW DOLERITE	UNIT 6A HW SLATE	UNIT 6B HW DOLERITE	Water Inflow (m)
TP15	0.0 – 0.25	0.25 – 0.4	--	0.4 ≥ 1.5	--	--	--	--	--	--
TP16	0.0 – 0.3	--	--	0.3 ≥ 1.5	--	--	--	--	--	--
TP17	0.0 – 0.25	--	--	0.25 – 1.25	--	--	1.25 ≥ 1.5	--	--	--
TP18	0.0 – 0.25	0.25 – 0.4	--	0.4 – 1.2	--	1.2 ≥ 2.0	--	--	--	--
TP19	0.0 – 0.25	0.25 – 0.4	--	0.4 – 0.8	--	0.8 – 1.5	--	1.5 ≥ 5.0	--	--
TP20	0.0 – 0.25	0.25 – 0.3	--	0.3 – 0.8	--	0.8 – 1.7	--	1.7 ≥ 2.0	--	--
TP21	0.0 – 0.25	--	--	0.25 – 0.5	--	--	0.5 – 1.0	--	1.0 ≥ 1.5	--
TP22	0.0 – 0.25	--	--	0.25 – 1.0	--	1.0 ≥ 1.5	--	--	--	--

Note: ≥ Indicates that base of material layer was not encountered
 -- Indicates that the material was not encountered at the test location



Groundwater inflow was encountered at TP6 and TP10 at the levels shown in Table 3. 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 Subgrade Conditions

A summary of CBR test results is presented in Table 3.

Table 3: CBR Testing Summary

Investigation	Depth (m)	Location	Material	MDD (t/m ³)	Swell (%)	CBR (%)
TP4	0.3 – 0.7	Road 10	Unit 4A - Residual CLAY	1.542	0.2	7.0
TP5	0.7 – 1.2	Road 10	Unit 4A - Residual CLAY	1.416	0.6	13.0
TP6	0.6 – 0.9	Road 11	Unit 3 - Alluvium	1.590	1.0	1.0
TP11	0.5 – 0.7	Road 13	Unit 4A - Residual CLAY (Overburden)	1.379	0.6	10.0
TP11	1.1 – 1.4	Road 13	Unit 5A – EW Slate (Subgrade)	1.597	1.8	7.0
TP16	0.4 – 0.8	Road 1	Unit 4A - Residual CLAY	1.283	0.4	7.0
TP17	0.7 – 1.0	Road 2	Unit 5B – EW Dolerite	1.422	0.8	4.0
TP18	1.3 – 1.7	Road 2 / Road 3 intersection	Unit 5A – EW Slate	1.420	0.7	1.5
TP19	4.5 – 5.0	Road 4	Unit 6B – HW Slate	1.630	1.5	12.0
TP20	1.3 – 1.7	Road 2 / Road 4 intersection	Unit 5A – EW Slate	1.628	3.1	3.5

5 EARTHWORKS

5.1 Site Preparation

The site is 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 including uncontrolled fill in back filled tree stump holes which can be retained on site for re-use in landscaping. Topsoil depths ranged from 150 to 400mm.

It is noted that in some locations the topsoil is underlain by a layer of slopewash soils (Unit 2) approximately 100mm - 200mm thick, above the underlying clays. Past experience with this material indicates moisture will concentrate in the slopewash layer and it will be extremely difficult to work, resulting in wet, soft soils under the vibration effects of construction or compaction equipment. Where such soils are exposed at pavement subgrade level or at foundation level below proposed fill embankments, they should be removed down to clay soils and replaced with site won clay to design subgrade level.



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 flow. The clay soils at TP2 are considered dispersible (Emerson Class 2). 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).

5.2 Excavation Conditions

Slow digging conditions for the 20T excavator were encountered at TP19 and TP HILL-A and HILL-B which were excavated to depths of up 5.2m near the crest of the southern hill (Proposed Lot 51). A single tyne ripper was used to break up a band of highly weathered dolerite (Unit 6B) of very low to medium strength that was present from 0.4m to 2m. The band of rock was underlain by clay soils (Unit 5B) that were excavated with a toothed bucket to the limit of investigation.



TP-HILL B: Single tyne ripper used to break up band of low strength dolerite rock.



TP-HILL A: Band of highly weathered dolerite rock present from 0.7m to 2m was underlain by clay soils to 5.2m.

Bulk excavations within the Unit 6A and 6B weathered rock are likely to require ripping prior to excavation by a large excavator. Some allowance should also be made, for the use of hydraulic rock breakers for when bands of high strength rock are encountered in confined detail excavations such as for footings and service trenches. Previous experience in the area has revealed that the weathering can result in a highly irregular soil/rock profile.

Groundwater inflow was encountered at TP6 and TP10 on the low ridge saddle,

Entry into unsupported trenches deeper than 1.0m 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 – 2020).



The presence of weathered rock at the base of deep cuts may pose construction issues for residential dwelling construction, including the use of hydraulic rock breakers for when bands of high strength rock are encountered.

5.3 Reuse of Site Won Materials

Topsoil or slopewash is not suitable for reuse as engineered fill. This material may be reused for landscaping purposes.

The orange/red residual clay (Unit 4A), extremely weathered slate and dolerite (Units 5A and 5B) clay soils will be suitable for use as engineering fill provided they are placed in accordance with the recommendations presented in this report. The materials are moderately reactive, however, and an allowance should be made for their shrink-swell potential during the design phase for fill platform construction. In addition, the material may be over-wet and drying back may be required before the material is suitable for reuse.

The yellow/pale brown residual clay (Unit 4B) soils overlying the dolerite in TP2 is highly reactive and not recommended for reuse as controlled fill due to high shrink-swell potential. If they must be used due to site cut/fill balances then it may be possible to blend with highly weathered rock (Unit 6A/6B) rock material at a ratio of 1:1 to reduce the potential reactivity.

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 large pad foot roller.

The yellow/pale brown residual clay (Unit 4B) soils and pale coloured extremely weathered rock (Unit 5A/5B) typically have low CBR and are not suitable for reuse in the upper profile of road embankments.

Reuse of the low strength weathered dolerite or slate rock (Unit 6A/6B) 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.

Due to the variable properties of the clay soils that will be encountered such as high reactivity or low CBR, it is critical that excavated materials be closely monitored and stockpiled separately into stockpiles that are suitable for reuse as general fill (Unit 4A: orange/red clay) and weathered rock (Unit 6), or, unsuitable for use as general fill.

Selected images are presented below to illustrate the variable profiles that may be encountered during excavation works.



TP2: Pale yellow residual clay (Unit 4B), that is typically highly reactive and low CBR. Generally not suitable for reuse as engineering fill unless blended with weathered rock.



TP4: Orange/red residual clay Unit 4A, typically of medium CBR, overlying white clays (Unit 5A) of typically low CBR that should be stockpiled separately during regrading works.

5.4 Retention

Temporary excavations up to 2.0m deep (during construction) in residual soils and weathered rock above the water table 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.

Where site constraints preclude the use of such batters, excavations should be supported by temporary shoring or permanent support as appropriate.

Gravity or cantilever retaining walls can be designed on the basis of the parameters presented in Table 4 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.

Table 4: Retention Design Parameters

Material	Unit Weight, γ	Effective Friction Angle	Effective Cohesion, c'	Active Earth Pressure Coefficient, k_a	At Rest Earth Pressure Coefficient, k_o	Passive Earth Pressure Coefficient, k_p
UNIT 4A/4B Residual	18	25°	5	0.41	0.58	2.46
UNIT 5A/B EW Rock	19	25°	5	0.41	0.58	2.46
UNIT 6A/B HW Rock	21	35°	50 kPa	0.27	N/A	3.7



The earth pressure coefficients detailed in Table 4 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.

5.5 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 and slopewash) 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 re-used on site as non-structural landscaping material or removed from the site. Excavated areas should be backfilled with an approved granular material;
- In areas where pavements are proposed, the subgrade will be required to be within $\pm 2\%$ of OMC prior to placement of pavement layers. Moisture conditioning of the subgrade may be required prior to compaction;
- Previous experience in the general area with the yellow residual clay soils (Unit 4B) has found that they can be difficult to bridge when over-wet. Over-wet conditions were also encountered at the toe of the slopes and the ridge saddle along the alignment of proposed Road 1. Subgrade improvement works are likely to be required in these areas 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 and road embankment fill is 100mm;
- Careful management of clay fill will be required during and after placement. 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 $\pm 2\%$ 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; and

- 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.

6 FOUNDATIONS

6.1 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 in-situ samples and recompacted samples, estimated surface movements (excluding tree effects) based on potential development conditions are summarised in Table 5.

Table 5: Summary of Potential Site Classifications

Development Condition	Subsurface Soil Unit	Adopted Shrink Swell Index (I_{ss})	Estimated Surface Movement y_s (mm)	Potential Site Classification
On Grade	Unit 4B – Residual Clay (Yellow)	4.0	40 - 60mm	M - H2
On Grade	Unit 4B – Residual Clay (Red)	2.0 – 4.0	20 - 40mm	M / H1
Cut (>0.75m)	Unit 5A/5B – EW Rock	2.0 – 4.0	30 - 50mm	M / H1
Cut (>0.75m)	Unit 6A/6B – HW Rock	1.0 – 2.0	20 – 30mm	M
Fill (>0.75m)	Site won clay fill	2.0 – 4.0	30 - 50mm	M / H1

In summary, the following comments are made with relation to the potential site classifications outlined in Table 5:

- 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;
- Lots where large trees are to be removed will be classified as Class P due to abnormal moisture conditions that can develop below and around the structure/tree footprint. Soil moisture concentrations may reach equilibrium approximately 12 months after removal of the tree/structure;
- The natural profiles can have potential site classifications ranging from M to H2;
- The residual yellow clay soils (Unit 4B) are highly reactive and their reuse as engineering fill is not recommended. The reactivity of the residual clays (Unit 4B) that are present could be



reduced by blending with site won weathered rock. Further testing is recommended to assess properties of the blended materials; and

- 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.

6.2 Light Poles

Light poles are proposed within the subject sections of road reserves at regular intervals. It is understood that they will have a bored pile foundation with a rag bolt type assembly. Experience with similar foundation systems indicates that the bored piles are typically 0.6m diameter and 1.8m length.

Site regrading works will be undertaken as part of the proposed works which may include cut and placement of fill. It is assumed that all filling works will be undertaken under Level 1 inspection and monitoring as defined in AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

Shallow bored pile design parameters for the anticipated site conditions are presented in Table 6.

Table 6: Light Pole Foundation Design Parameters

Material	Unit Weight, γ	Allowable End Bearing Pressure (kPa)	Allowable Skin Friction (kPa)	Limiting Lateral Yield Pressure (kPa)
Controlled Clay Fill (Very Stiff)	19kN/m ³	150	15	100
Unit 4: Residual Clays (Very Stiff)	19kN/m ³	150	15	100
Unit 5: EW Rock (Very Stiff)	19kN/m ³	150	15	100
Unit 6: Weathered Rock (Low strength or greater)	20kN/m ³	500	50	300

The following points are considered in relation to the parameters provided in Table 6:

- Piles are to be founded below any topsoil or uncontrolled clay fill in residual clay soils or Controlled Clay Fill of at least very stiff strength, or, in weathered rock of at least low strength;
- Limiting lateral yield pressure and skin friction should be ignored in the upper 1.5 x pile diameter below surface;
- Piles must be founded outside or below the zone of influence of existing or proposed service trenches; and



- At least the initial stages of footing excavation should be observed by a suitably experienced Geotechnical Professional to assess that the recommended founding material has been reached and to check initial assumptions about foundation conditions and possible variations between investigation locations.

It is noted that bored pile excavations in weathered rock (Unit 6) may encounter shallow refusal and some allowance should be made for the use of hydraulic rock breakers for when bands of high strength rock are encountered.

7 PAVEMENT DESIGN

7.1 Design Parameters

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

- Road 3 = Access Place design traffic loading = 7×10^4 ESA;
- Road 2, 4, 7 and 10 = Local Street design traffic loading = 5×10^5 ESA;
- Road 1 = Collector Road design traffic loading = 1×10^6 ESA

7.2 General Road Conditions

The following points are noted about the area of the proposed road alignments:

- Road 1 will be constructed mostly around the toe of the residual slopes and across the low saddle, where over-wet subgrade conditions are likely to be encountered. The road is expected to be constructed near grade or with up to approximately 1.5 m of fill through low-lying areas;
- Road 2 (Stage 1 only), will be constructed mostly in cut with finished pavement surface levels up to 1.2m below existing surface levels;
- Road 3 will be constructed in cut with finished pavement surface levels up to approximately 1.3m below existing surface levels;
- Road 4 will be constructed in cut with finished pavement surface levels up to approximately 6m below existing surface levels;
- Road 7 (Stage 2 only) will be constructed in cut with finished pavement surface levels up to approximately 2.5m below existing surface levels;
- Road 10 (Stage 2 only) will be constructed in cut with finished pavement surface levels up to approximately 0.7m below existing surface levels;
- The proposed pavements will have kerb and gutter to collect stormwater;
- Port Macquarie Hastings Council Aus-Spec indicates a minimum of 25mm AC7 seal is required for Local Streets and 40mm AC10 for Collector Roads;
- AC thickness of <30mm is not included in the pavement structural thickness design;
- A minimum base thickness of 140mm has been adopted to assist construction, following discussions with local civil contractors;
- A minimum subbase thickness of 150mm has been adopted for constructability;
- Variable subgrade conditions are anticipated and may include bands of weathered rock between bands of clay. A geotechnical assessment is therefore recommended following



boxing out to assess the extent of the different subgrades and whether the nominated pavement design chainage intervals are appropriate;

- Drainage conditions within the area of the proposed pavement alignment are likely to be via overland flow and subsurface infiltration into the topsoil and slopewash materials;
- Variable subgrade conditions are anticipated in individual sections of road; and
- Over-wet foundation conditions for the proposed fill embankment along the alignment of Road 1 may be encountered as discussed in Section 5.5. Subgrade improvement works are likely to 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.

7.3 Subgrade

Subgrade conditions are variable and range from red residual clay to low CBR pale coloured clays to weathered rock. Proposed cut depths will remove most of the higher CBR material (Unit 4A) and expose the underlying lower CBR clays (Unit 5A/B).

The source of the proposed road embankment fill for Road 1 is likely to be derived from the deep cuts proposed in Stage 1 and 2.

Based on the subsurface profiles observed and the results of in-situ testing the following design subgrade CBR's have been adopted:

- Unit 3: Alluvial clay = CBR 1
- Unit 4A: Residual orange/red clays CBR = 7
- Unit 5A: Extremely weathered siltstone as clay CBR = 2
- Unit 5B: Extremely weathered dolerite as clay CBR = 4
- Unit 6: Weathered Rock CBR = 10
- Site won clay embankment fill CBR = 4

Sections of road where embankment fill will be placed will require CBR testing following completion of bulk earthworks.

A geotechnical assessment of exposed subgrades following boxing out is recommended to delineate the extent of the variable subgrade conditions present.

Previous experience with the weathered dolerite rock has found that the clay/rock profile can vary sharply, resulting in variable subgrade conditions.

7.4 Moisture Environment

The Unit 5B extremely weathered rock clays are considered highly expansive soils as defined in Austroads Part 2 with CBR swells during soaking of up to 3.1%. Extreme moisture variations in these soils can potentially produce soil volume changes. Austroads Part 2 (2017) presents a series of options that could be adopted for highly expansive subgrades to assist in limiting the effects of potential soil volume changes:



- Provide a low permeability capping layer above the expansive subgrade such as a dense graded gravel with a PI>4%. The capping layer should have a thickness of at least 200mm and should extend at least 500mm past the edge of pavement (i.e. lip of kerb). A 250mm Select Fill layer (CBR>15 and PI<15) has therefore been incorporated into the pavement design;
- Construct the pavement when the subgrade is near its long term equilibrium soil moisture content (EMC). It is recommended that where possible the subgrade moisture content be less than OMC prior to placement of pavement layers;
- Install subsoil drains on both sides of the pavement ensuring that they do not extend more than 150mm into the expansive subgrade. The drains cannot be restricted to within the pavement layers as recommended in Austroads for expansive clays as they require adequate fall for drainage. It is noted that there will be large service trenches immediately adjacent to the pavements which will have a greater influence on the moisture conditions in the subgrade and soils adjacent to the pavement than the subsoil drains;
- Restrict planting of trees and shrubs close to the pavement;
- Following construction of pavement and placement of primer seal, an assessment can then be made on whether to place the AC or delay the placement of the AC based on weather conditions at the time.

7.5 Pavement Design

Pavement thickness design sheets based on PMHC AUS-SPEC and AUSTRROADS Part 2 (2019) with reference to the Austroads empirical design chart (Figure 8.4) are presented in Appendix C. Nominal pavement types are proposed and summarised in Table 7.

Table 7 - Nominal Pavement Types (Thickness in mm)

Pavement	Type 1 Collector	Type 2A Local Street	Type 2B Local Street	Type 2C Local Street	Type 2D Local Street	Type 3 Access
Design Traffic	1 x 10 ⁶ ESA	5 x 10 ⁵ ESA	5 x 10 ⁵ ESA	5 x 10 ⁵ ESA	5 x 10 ⁵ ESA	7 x 10 ⁴ ESA
Subgrade Material	Clay Fill 5B: EW Dolerite	6: Rock	4A: Clay	5A: Clay	5A: Clay	5A: Clay
Subgrade Design CBR	4	10	7	2	4	2
Asphalt	40 (AC10)	25 (AC7)	25 (AC7)	25 (AC7)	25 (AC7)	25 (AC7)
Base Course	140	140	140	140	140	140
Subbase	260	150	170	150	270	150
Select Fill (CBR>15, PI<15)	--	--	--	290	--	200
Total Thickness	440	315	335	605	435	515

Nominal pavement design types for each subject pavement interval are summarised in Table 8.



Table 8 – Pavement Design Summary

Road	Chainage (m)	Classification	Subgrade	Design CBR	Nominal Pavement	Total Pavement Thickness (mm)
1	40 – 690m	Collector	Clay Fill	4	Type 1	440
2	220 – 490m	Local Street	Cut: Unit 5A Clay	2	Type 2C	605
3	0 – 41m	Access Place	Cut: Unit 5A Clay	2	Type 3	515
4	0 – 175m	Local Street	Cut: Unit 6 Rock	10	Type 2A	315
7	400 – 550m	Local Street	Cut: Unit 5B	4	Type 2D	435
10	240 – 345m	Local Street	Ongrade: Unit 4A	7	Type 2B	335

7.6 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:

- After unsuitable material (including topsoil and slopewash) 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;
- 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 given to cut/fill boundaries;
- Over-wet foundation conditions for the proposed fill embankment along the alignment of Road 1 may be encountered as discussed in Section 5.5. Subgrade improvement works are likely to 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;
- Grade subgrade down towards shoulders;
- 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 (CBR >15, PI<12) to design subgrade level;
- Drying back and moisture conditioning of the subgrade may be required prior to 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;
- Pavement gravels should be placed and maintained at 60% to 90% of Optimum Moisture Content;



- DGS sub-base material should be placed and compacted to a minimum 95% Modified Compaction;
- DGB base material should be placed and compacted to a minimum 98% Modified Compaction;
- 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.

7.7 Drainage

Care will be required to promote subsurface drainage to avoid accumulation of water in the pavement profile. To achieve this, we recommend that:

- Subsoil drains be constructed to 300mm below base of pavement on both sides of the road;
- It is critical that granular pavement materials extend laterally to the subsoil drains to allow lateral drainage and prevent ponding of water within the pavement edges.

8 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Geotechnical site investigation is based on data collection, judgment, experience, and opinion. By its nature, it is less exact than other engineering disciplines. The findings presented in this report and used as the basis for the 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.

The recommended depth and properties of any soil, rock, groundwater, or other material referred to in this report is an engineering estimate based on the information available at the time of its writing. The estimate is influenced and limited by the fieldwork method and testing carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

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.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Tim Morris

Associate Engineering Geologist

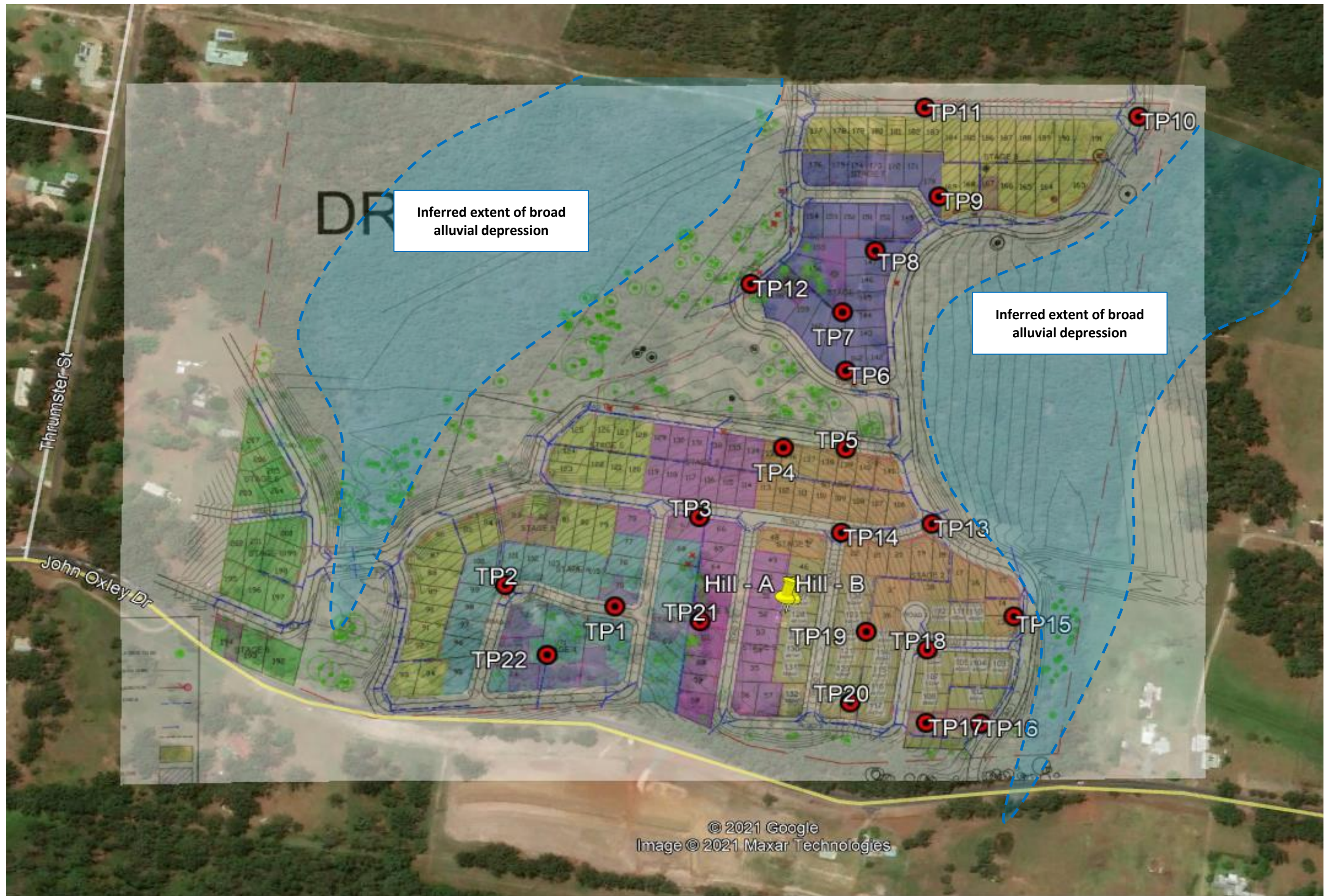
Reviewed by

Steve Morton

Principal Geotechnical Engineer




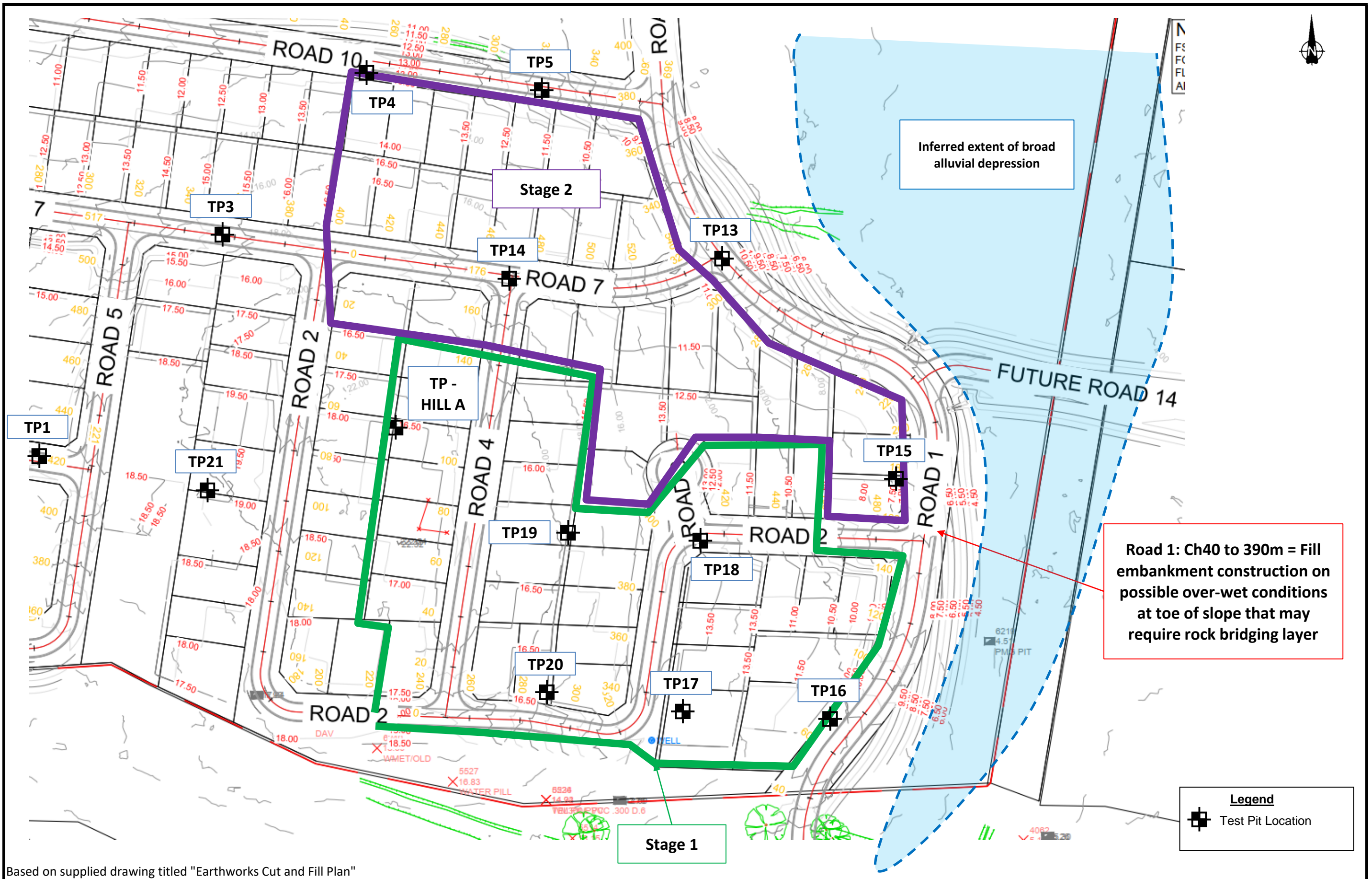
Figures




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Image © 2021 Maxar Technologies

Based on supplied drawing titled " 344 John Oxley Highway, Thrumster Overall Concept Staging Plan "

	Client:	Land Dynamics Australia	Job No.	RGS21087.1
	Project:	Proposed Residential Subdivision	Drawn By:	DS
		344 John Oxley Highway, Thrumster	Scale:	NTS
	Title:	INVESTIGATION LOCATION PLAN	Date:	17-May-21
			Figure No.	1



Based on supplied drawing titled "Earthworks Cut and Fill Plan"

 REGIONAL GEOTECHNICAL SOLUTIONS	Client:	LAND DYNAMICS AUSTRALIA	Job No.	RGS21087.1
	Project:	PROPOSED SANCTUARY DEVELOPMENT	Drawn By:	TM
	Title:	344 JOHN OXLEY HIGHWAY THRUMSTER	Scale:	NTS
		INVESTIGATION LOCATION PLAN - STAGES 1 AND 2	Date:	17-May-21
			Figure No.	2



Appendix A

Results of Field Investigations



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 6 / Ch120m

TEST PIT NO: TP1
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485176 m **SURFACE RL:** 14.2 m
TEST PIT LENGTH: 3.0 m **WIDTH:** 1.0 m **NORTHING:** 6519758 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered	B	14.0	0.25m	MH	FILL	Sandy Clayey SILT, dark grey, traces of grass roots to 5mm	D	Fb			FILL/TOPSOIL
			13.5	0.70m	CH		Sandy CLAY medium to high plasticity, orange with grey mottling, sand fine to medium grained, traces of gravel, fine grained, subangular.	M < WP	Fb / VSt	HP	380	RESIDUAL
			13.0		CH		Silty CLAY medium to high plasticity, white/pale grey, with traces of yellow mottling, some rock fabric.			HP	380	EXTREMELY WEATHERED SLATE
			12.5				SLATE fine grained, white/pale grey, very low to low strength, recovered as Sandy GRAVEL.					
			12.0	2.00m			Hole Terminated at 2.00 m					

RG LIB 1.04.5.G.LB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile>> 19/05/2021 16:03 10.02.00.04 Dageel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 7 / Ch40m

TEST PIT NO: TP2
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485079 m **SURFACE RL:** 9.6 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519777 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		9.5			MH	FILL Sandy Clayey SILT, dark grey, traces of grass roots to 5mm	M	Fb			FILL/TOPSOIL
				0.35m		CH	CLAY medium to high plasticity, yellow.	M > W _p	Fb / St	HP	180	RESIDUAL
				0.5						HP	190	
				1.0		CH	Sandy CLAY medium plasticity, yellow with grey mottling, sand fine to medium grained, traces of rock fabric.		Fb / VSt	HP	300	EXTREMELY WEATHERED DOLERITE
				1.5			DOLERITE fine to medium grained, yellow, low to medium strength, some clay seams, excavated as Sandy GRAVEL.					HIGHLY WEATHERED DOLERITE
				2.0			Hole Terminated at 2.00 m					

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile> 19/05/2021 16:03 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 7 / Ch200m

TEST PIT NO: TP3
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485250 m **SURFACE RL:** 8.5 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519840 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered	U50	8.0	0.5		MH	TOPSOIL Sandy Clayey SILT, dark grey.	D	Fb			TOPSOIL
						CH	Sandy CLAY medium plasticity, red, traces of gravel, fine grained, subrounded ironstone.	M < w _p	Fb / VSt	HP	380	RESIDUAL
			7.5	1.0						HP	380	
			7.0	1.5						HP	350	
			6.5	2.0			Hole Terminated at 2.00 m					

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

- U₅₀ 50mm Diameter tube sample
- CBR Bulk sample for CBR testing
- E Environmental sample
- ASS Acid Sulfate Soil Sample
- B Bulk Sample

Field Tests

- PID Photoionisation detector reading (ppm)
- DCP(x-y) Dynamic penetrometer test (test depth interval shown)
- HP Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)	Moisture Condition	
VS	Very Soft	<25	D	Dry
S	Soft	25 - 50	M	Moist
F	Firm	50 - 100	W	Wet
St	Stiff	100 - 200	W _p	Plastic Limit
VSt	Very Stiff	200 - 400	W _L	Liquid Limit
H	Hard	>400		
Fb	Friable			
Density				
V	Very Loose		Density Index <15%	
L	Loose		Density Index 15 - 35%	
MD	Medium Dense		Density Index 35 - 65%	
D	Dense		Density Index 65 - 85%	
VD	Very Dense		Density Index 85 - 100%	

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ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 10 / Ch260m

TEST PIT NO: TP4
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485324 m **SURFACE RL:** 12.4 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519901 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		12.0	0.5		MH	TOPSOIL Sandy Clayey SILT, dark grey/dark brown, traces of tree roots to 200mm	D	Fb			TOPSOIL
						CH	Sandy CLAY medium to high plasticity red/orange, sand fine to medium grained.	M < w _p	Fb / VSt	HP	250	RESIDUAL
						CH	Gravelly Silty CLAY medium to high plasticity, pale brown/white with red/yellow mottling, gravel fine to coarse grained, subangular slate, some rock fabric.			HP	280	EXTREMELY WEATHERED SLATE
						Hole Terminated at 2.00 m						

RG LIB 1.04.5.G.L.B. Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile> 19/05/2021 16:03 10.02.00.04 Dargel Lab and In Situ Tool

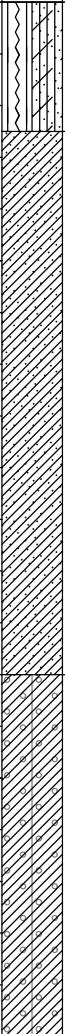
LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft S Soft F Firm St Stiff VSt Very Stiff H Hard Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	

ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 10 / Road1

TEST PIT NO: TP5
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485379 m **SURFACE RL:** 8.6 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519903 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered	CBR	8.5	0.30m		MH	TOPSOIL Sandy Clayey SILT, dark brown, traces of tree roots to 50mm	M	Fb			TOPSOIL
			8.0	0.70m		CH	Sandy CLAY medium to high plasticity red/orange.	M < w _p	Fb / VSt	HP	270	RESIDUAL
			7.5			CH	Gravelly Silty CLAY medium to high plasticity, white/pale grey, red/yellow mottling, gravel fine to coarse grained, subangular slate, some rock fabric.			HP	270	EXTREMELY WEATHERED SLATE
			6.5				Hole Terminated at 2.00 m					

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

- U₅₀ 50mm Diameter tube sample
- CBR Bulk sample for CBR testing
- E Environmental sample
- ASS Acid Sulfate Soil Sample
- B Bulk Sample

Field Tests

- PID Photoionisation detector reading (ppm)
- DCP(x-y) Dynamic penetrometer test (test depth interval shown)
- HP Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)	Moisture Condition	
VS	Very Soft	<25	D	Dry
S	Soft	25 - 50	M	Moist
F	Firm	50 - 100	W	Wet
St	Stiff	100 - 200	W _p	Plastic Limit
VSt	Very Stiff	200 - 400	W _L	Liquid Limit
H	Hard	>400		
Fb	Friable			
Density		V	Density Index <15%	
L	Loose		Density Index 15 - 35%	
MD	Medium Dense		Density Index 35 - 65%	
D	Dense		Density Index 65 - 85%	
VD	Very Dense		Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Road 11

TEST PIT NO: TP6
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485379 m **SURFACE RL:** 8.0 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519975 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket		CBR	7.5	0.5		MH	TOPSOIL Sandy Clayey SILT, dark brown, traces of grass roots to 5mm	M	Fb			TOPSOIL	
						CL	Silty CLAY low to medium plasticity, pale grey.	M > Wp	Fb		SLOPEWASH		
						CH	Sandy CLAY medium plasticity, pale brown with yellow, orange/red mottling.	M < Wp	Fb / VSt	HP	300	ALLUVIAL	
						CH	Gravelly Silty CLAY medium to high plasticity, pale grey/white with red mottling.		HP	350			
			7.0	1.0									
			6.5	1.5									
Hole Terminated at 1.50 m													

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

- U₅₀ 50mm Diameter tube sample
- CBR Bulk sample for CBR testing
- E Environmental sample
- ASS Acid Sulfate Soil Sample
- B Bulk Sample

Field Tests

- PID Photoionisation detector reading (ppm)
- DCP(x-y) Dynamic penetrometer test (test depth interval shown)
- HP Hand Penetrometer test (UCS kPa)

Consistency	UCS (kPa)	Moisture Condition
VS Very Soft	<25	D Dry
S Soft	25 - 50	M Moist
F Firm	50 - 100	W Wet
St Stiff	100 - 200	W _p Plastic Limit
VSt Very Stiff	200 - 400	W _L Liquid Limit
H Hard	>400	
Fb Friable		
Density		
V Very Loose		Density Index <15%
L Loose		Density Index 15 - 35%
MD Medium Dense		Density Index 35 - 65%
D Dense		Density Index 65 - 85%
VD Very Dense		Density Index 85 - 100%

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile>> 19/05/2021 16:03 10.02.00.04 Dargel Lab and In Situ Tool



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Ch 520m

TEST PIT NO: TP7
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485376 m **SURFACE RL:** 8.2 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6520029 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered			8.0		MH	TOPSOIL Sandy Clayey SILT, dark grey, traces of grass roots to 5mm	M	Fb			TOPSOIL
						CL	0.25m Silty CLAY medium plasticity, grey.	M < Wp	Fb			SLOPEWASH
						CH	0.30m Sandy CLAY medium plasticity, pale brown with red mottling.	M < Wp	Fb / VSt	HP	300	ALLUVIAL
						CH	0.40m Sandy Silty CLAY medium to high plasticity, white/pale grey with red mottling, some gravel, fine to coarse grained subrounded ironstone.	M < Wp	Fb / VSt	HP	250	
				1.5			Hole Terminated at 1.50 m					

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

- U₅₀ 50mm Diameter tube sample
- CBR Bulk sample for CBR testing
- E Environmental sample
- ASS Acid Sulfate Soil Sample
- B Bulk Sample

Field Tests

- PID Photoionisation detector reading (ppm)
- DCP(x-y) Dynamic penetrometer test (test depth interval shown)
- HP Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)	Moisture Condition	
VS	Very Soft	<25	D	Dry
S	Soft	25 - 50	M	Moist
F	Firm	50 - 100	W	Wet
St	Stiff	100 - 200	W _p	Plastic Limit
VSt	Very Stiff	200 - 400	W _L	Liquid Limit
H	Hard	>400		
Fb	Friable			
Density				
V	Very Loose		Density Index <15%	
L	Loose		Density Index 15 - 35%	
MD	Medium Dense		Density Index 35 - 65%	
D	Dense		Density Index 65 - 85%	
VD	Very Dense		Density Index 85 - 100%	

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile> 19/05/2021 16:03 10.02.00.04 Dargel Lab and In Situ Tool



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Road 12

TEST PIT NO: TP8
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485405 m **SURFACE RL:** 7.9 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6520086 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered		7.5	0.5		MH	FILL Sandy Clayey SILT, dark grey, traces of grass roots to 5mm	M	Fb			FILL/TOPSOIL	
						0.30m	CH	Sandy CLAY medium plasticity, pale brown with orange mottling.	M < w _p	Fb / VSt	HP	300	ALLUVIAL
						0.60m	CH	Gravelly Sandy CLAY medium to high plasticity, pale grey/grey with traces of orange mottling.			HP	300	
			6.5	1.5			Hole Terminated at 1.50 m						

RG LIB 1.04.5.G.LB_Log_RG_NON-CORED BOREHOLE - TEST PIT_RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile>> 19/05/2021 16:03 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Ch 740m

TEST PIT NO: TP9
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485461 m **SURFACE RL:** 4.5 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6520136 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		4.0	0.5		MH	TOPSOIL Sandy Clayey SILT, dark grey, traces of grass roots to 5mm	M				TOPSOIL
						CH	0.30m Sandy CLAY medium plasticity, red with pale brown mottling, traces of gravel, fine grained, subangular.	M > w _p	Fb / St	HP	150	ALLUVIAL
						CH	0.90m Gravelly Sandy CLAY medium to high plasticity, mape grey with pale brown mottling, gravel, some rock fabric.	M < w _p		HP	160	
			2.5	2.0		2.00m	Hole Terminated at 2.00 m					

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LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	

ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Road 13

TEST PIT NO: TP10
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: DS
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** **SURFACE RL:** 4.5 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	
1000mm Toothed Bucket			4.0	0.5		MH	FILL Sandy SILT, low plasticity, brown-grey, sand fine to coarse grained.	M < WP			FILL/TOPSOIL
						CL	Sandy Silty CLAY medium plasticity, brown, sand fine to coarse grained.			SLOPEWASH	
						CH	Sandy CLAY medium plasticity, red/mottled pale grey, sand fine to coarse grained.	M > WP	Fb / VSt	ALLUVIAL	
						CH	Gravelly Silty CLAY medium plasticity, red/yellow mottling, gravel fine to coarse grained, subangular.				
			3.5	1.0							
			3.0	1.5							
			2.5	2.0							
							Hole Terminated at 2.00 m				

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

U₅₀ 50mm Diameter tube sample
 CBR Bulk sample for CBR testing
 E Environmental sample
 ASS Acid Sulfate Soil Sample
 B Bulk Sample

Field Tests

PID Photoionisation detector reading (ppm)
 DCP(x-y) Dynamic penetrometer test (test depth interval shown)
 HP Hand Penetrometer test (UCS kPa)

Consistency	UCS (kPa)	Moisture Condition
VS Very Soft	<25	D Dry
S Soft	25 - 50	M Moist
F Firm	50 - 100	W Wet
St Stiff	100 - 200	W _p Plastic Limit
VSt Very Stiff	200 - 400	W _L Liquid Limit
H Hard	>400	
Fb Friable		
Density	V Very Loose	Density Index <15%
	L Loose	Density Index 15 - 35%
	MD Medium Dense	Density Index 35 - 65%
	D Dense	Density Index 65 - 85%
	VD Very Dense	Density Index 85 - 100%



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 13 / Ch 50m

TEST PIT NO: TP11
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: DS
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** **SURFACE RL:** 14.9 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered					ML	FILL Sandy SILT	M < WP				FILL/TOPSOIL
						CL	Sandy CLAY low plasticity brown, sand fine to coarse grained.					
		0.30m				CL	Sandy CLAY medium plasticity, red, sand fine to coarse grained.	M > WP				RESIDUAL
		B 0.50m										
		CBR 0.70m										
						CH	Gravelly Silty CLAY medium plasticity, red/mottled yellow, gravel fine to coarse grained, subangular.					EXTREMELY WEATHERED SLATE
							Hole Terminated at 1.80 m					

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose Density Index <15% L Loose Density Index 15 - 35% MD Medium Dense Density Index 35 - 65% D Dense Density Index 65 - 85% VD Very Dense Density Index 85 - 100%		



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 11 / Ch 170m

TEST PIT NO: TP12
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: DS
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** **SURFACE RL:** 7.3 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered					ML	FILL: Sandy SILT, low plasticity, brown, sand fine to coarse grained.	$< w_p$				FILL/TOPSOIL	
		0.30m	7.0		CL	Sandy Silty CLAY: low plasticity, brown, sand fine to coarse grained.	$M < w_p$ to $M \sim w_p$					SLOPEWASH	
		U50		0.5		CH	Sandy CLAY: medium plasticity, red, sand fine to coarse grained.	$M > w_p$					RESIDUAL
		0.50m		0.70m		CH	Gravelly Silty CLAY: low to medium plasticity, red/mottled yellow, gravel fine to coarse grained, sub angular.	$M \sim w_p$					EXTREMELY WEATHERED SLATE
				2.0			Hole Terminated at 2.00 m						

RG LIB 1.04.5.G.LB_Log_RG_NON-CORED BOREHOLE - TEST PIT_RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Road 7

TEST PIT NO: TP13
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: DS
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** **SURFACE RL:** 9.4 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered		9.0	0.5		SM	TOPSOIL: Silty SAND, fine to coarse grained, brown.	D - M	VSt			TOPSOIL	
						CL	Sandy Silty CLAY: brown, fine to coarse grained.	M < Wp			SLOPEWASH		
						CH	Sandy CLAY red, sand fine to coarse grained.	M > Wp			RESIDUAL		
			8.5	1.0									
			8.0	1.5									
			7.5	2.0									
			7.0				Hole Terminated at 2.20 m						

LEGEND:

Water

- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes

- Gradational or transitional strata
- Definitive or distinct strata change

Notes, Samples and Tests

U₅₀ 50mm Diameter tube sample
 CBR Bulk sample for CBR testing
 E Environmental sample
 ASS Acid Sulfate Soil Sample
 B Bulk Sample

Field Tests

PID Photoionisation detector reading (ppm)
 DCP(x-y) Dynamic penetrometer test (test depth interval shown)
 HP Hand Penetrometer test (UCS kPa)

Consistency	UCS (kPa)	Moisture Condition
VS Very Soft	<25	D Dry
S Soft	25 - 50	M Moist
F Firm	50 - 100	W Wet
St Stiff	100 - 200	W _p Plastic Limit
VSt Very Stiff	200 - 400	W _L Liquid Limit
H Hard	>400	
Fb Friable		
Density	V Very Loose	Density Index <15%
L Loose	MD Medium Dense	Density Index 15 - 35%
D Dense	VD Very Dense	Density Index 35 - 65%
		Density Index 65 - 85%
		Density Index 85 - 100%

RG LIB 1.04.5.G.LB_Log RG NON-CORED BOREHOLE - TEST PIT - RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 4 / Road 7

TEST PIT NO: TP14
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: DS
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** **SURFACE RL:** 17.1 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** **DATUM:** AHD

Drilling and Sampling				Material description and profile information						Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
1000mm Toothed Bucket	Not Encountered		17.0			ML	TOPSOIL: Sandy SILT, low plasticity, brown, sand fine to coarse grained.	M ~ w _p	VSt			TOPSOIL
				0.30m		CH	Sandy CLAY: red, sand fine to coarse grained.	M > w _p				RESIDUAL
			15.0	2.0			Hole Terminated at 2.00 m					

RG LIB 1.04.5.G.L.B. Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Road 2

TEST PIT NO: TP15
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485528 m **SURFACE RL:** 6.7 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519748 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		6.5			MH	Sandy Clayey SILT: dark grey, traces of grass roots to 5mm.	M	Fb	HP	300	TOPSOIL
						MH	Sandy Clayey SILT: pale brown.					SLOPEWASH
						CH	Sandy CLAY medium to high plasticity red/orange with pale brown mottling, sand fine to medium grained.	M < Wp	Fb / VSt	HP	350	RESIDUAL
			1.5	1.50m			Hole Terminated at 1.50 m					

RG LIB 1.04.5.G.LB. Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 1 / Ch60m

TEST PIT NO: TP16
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485498 m **SURFACE RL:** 10.0 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519050 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		9.5	0.5		MH	TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb			TOPSOIL
						CH	Sandy CLAY: medium plasticity, red/orange, sand fine to medium grained, traces of gravel fine grained, sub angular.	M < Wp	Fb / VSt	HP	380	RESIDUAL
			9.0	1.0			Some pale brown mottling			HP	390	
			8.5	1.5			Hole Terminated at 1.50 m					

RG LIB 1.04.5.G.L.B. Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample		Consistency VS Very Soft S Soft F Firm St Stiff VSt Very Stiff H Hard Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)		Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 2 / Ch320m

TEST PIT NO: TP17
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485450 m **SURFACE RL:** 14.6 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519651 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered	CBR	14.5	0.25m	MH	TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb				TOPSOIL
			14.0	0.70m	CH	Sandy CLAY: medium to high plasticity, orange/red with pale brown mottling.	M > Wp	Fb / VSt	HP	250		RESIDUAL
			13.5	1.00m	CH	Silty CLAY: medium plasticity, pale brown/white with traces of gravel fine to medium grained, sub angular, iron oxide staining.			HP	220		EXTREMELY WEATHERED DOLERITE
			13.0	1.50m		Hole Terminated at 1.50 m						

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP18
CLIENT: Land Dynamics Australia

PAGE: 1 of 1

PROJECT NAME: Sanctuary Development

JOB NO: RGS21087.1

SITE LOCATION: 344 John Oxley Drive, Thrumster

LOGGED BY: GC





TEST LOCATION: Road 2 / Ch400m

DATE: 15/4/21






EQUIPMENT TYPE: 20T Excavator

EASTING: 485451 m **SURFACE RL:** 13.4 m

TEST PIT LENGTH: **WIDTH:**
NORTHING: 6519718 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information						Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
1000mm Toothed Bucket	Not Encountered			13.0		MH	TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb			TOPSOIL
						CL	Sandy Silty CLAY: medium plasticity, pale brown.	M > WP	Fb		SLOPEWASH	
						CH	Sandy CLAY: medium to high plasticity, orange/red with pale brown mottling.	M < WP	Fb / VSt	HP	250	RESIDUAL
						CH	Silty CLAY: medium to high plasticity, white/pale grey, with traces of red mottling, some gravel fine grained, sub rounded.	HP	350	EXTREMELY WEATHERED SLATE		
				2.0			2.00m	Hole Terminated at 2.00 m				

RG LIB 1.04.5.G.L.B. Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1-22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dageal Lab and In Situ Tool

LEGEND:	Notes, Samples and Tests	Consistency	UCS (kPa)	Moisture Condition
Water  Water Level (Date and time shown)  Water Inflow  Water Outflow Strata Changes  Gradational or transitional strata  Definitive or distinct strata change	U₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	VS Very Soft S Soft F Firm St Stiff VSt Very Stiff H Hard Fb Friable	<25 25 - 50 50 - 100 100 - 200 200 - 400 >400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
		Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense		Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 4 / Ch100m

TEST PIT NO: TP19
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485397 m **SURFACE RL:** 21.5 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519735 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered	0.90m	21.0	0.5		MH	TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb	HP	350	TOPSOIL	
						ML	Sandy SILT: pale brown.	M < w _p	Fb / VSt			SLOPEWASH	
						CH	Sandy CLAY medium plasticity, orange/red, sand fine to medium grained, traces of gravel, fine grained, subangular.					RESIDUAL	
						CH	Gravelly Silty CLAY: medium to high plasticity, white/pale grey with traces of red mottling, gravel fine to coarse grained, subangular, slate some rock fabric.					EXTREMELY WEATHERED SLATE	
						SLATE: fine to medium grained, pale grey/white, very coarse to coarse strength, foliated, some clay seams.	HIGHLY WEATHERED SLATE						
1.50m	20.0	1.5	5.00m	Hole Terminated at 5.00 m									
		1.50m	20.5	1.0									
		4.50m	17.0	4.5			Colour change to yellow/pale brown.						
		5.00m	16.5	5.0									

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFiles> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose Density Index <15% L Loose Density Index 15 - 35% MD Medium Dense Density Index 35 - 65% D Dense Density Index 65 - 85% VD Very Dense Density Index 85 - 100%		



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 2 / Road 4

TEST PIT NO: TP20
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485383 m **SURFACE RL:** 19.3 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519670 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered		19.0	0.25m		MH	TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb	HP	350	TOPSOIL	
						ML	Sandy SILT: pale brown.					SLOPEWASH	
						CH	Sandy CLAY: medium plasticity, red/orange, sand fine to coarse grained, traces of gravel, fine grained, subangular.	M < W _p	Fb / VSt			RESIDUAL	
						CH	Gravelly Silty CLAY: medium to high plasticity, white/pale grey, gravel fine to coarse grained, subangular, slate.					EXTREMELY WEATHERED SLATE	
							SLATE: dark grey/white, very low to low strength.					HIGHLY WEATHERED SLATE	
			18.0	1.5									
			17.5	2.0									
			17.0				Hole Terminated at 2.00 m						

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFiles> 19/05/2021 16:04 10.02.00.04 Dargel Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose Density Index <15% L Loose Density Index 15 - 35% MD Medium Dense Density Index 35 - 65% D Dense Density Index 65 - 85% VD Very Dense Density Index 85 - 100%		



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 5 / Road 6

TEST PIT NO: TP21
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485251 m **SURFACE RL:** 17.0 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519745 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result	
1000mm Toothed Bucket	Not Encountered		17.0				TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb			TOPSOIL	
		0.50m		0.5			Sandy CLAY: medium plasticity, dark brown/pale brown with traces of red mottling.	M < w _p	Fb / VSt	HP	350	RESIDUAL	
		CBR		16.5		CH		Sandy Silty CLAY: medium plasticity, pale brown/pale grey, some rock fabric, traces of gravel fine to coarse grained, subangular.			HP	300	EXTREMELY WEATHERED DOLERITE
		1.00m		16.0				DOLERITE: fine to medium grained, dark grey, medium to high strength.					HIGHLY WEATHERED DOLERITE
			15.5	1.5			Hole Terminated at 1.50 m						

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dageal Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose Density Index <15% L Loose Density Index 15 - 35% MD Medium Dense Density Index 35 - 65% D Dense Density Index 65 - 85% VD Very Dense Density Index 85 - 100%		



ENGINEERING LOG - TEST PIT

CLIENT: Land Dynamics Australia
PROJECT NAME: Sanctuary Development
SITE LOCATION: 344 John Oxley Drive, Thrumster
TEST LOCATION: Road 5 / Ch140m

TEST PIT NO: TP22
PAGE: 1 of 1
JOB NO: RGS21087.1
LOGGED BY: GC
DATE: 15/4/21

EQUIPMENT TYPE: 20T Excavator **EASTING:** 485117 m **SURFACE RL:** 16.2 m
TEST PIT LENGTH: **WIDTH:** **NORTHING:** 6519714 m **DATUM:** AHD

Drilling and Sampling				Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type		Result
1000mm Toothed Bucket	Not Encountered		16.0	0.25m			TOPSOIL: Sandy Clayey SILT, dark grey, traces of grass roots to 5mm.	M	Fb			TOPSOIL
			15.5	0.5		CH	Sandy CLAY: medium to high plasticity, pale brown, sand fine grained.	M < w _p	Fb / VSt	HP	350	RESIDUAL
			15.0	1.0		CH	Sandy Silty CLAY: medium plasticity, white/pale grey, some rock fabric.			HP	300	EXTREMELY WEATHERED SLATE
			14.5	1.50m			Hole Terminated at 1.50 m					

RG LIB 1.04.5.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS21087.1 LOGS TP1+22.GPJ <-DrawingFile>> 19/05/2021 16:04 10.02.00.04 Dageal Lab and In Situ Tool

LEGEND: Water Water Level (Date and time shown) Water Inflow Water Outflow Strata Changes Gradational or transitional strata Definitive or distinct strata change	Notes, Samples and Tests U ₅₀ 50mm Diameter tube sample CBR Bulk sample for CBR testing E Environmental sample ASS Acid Sulfate Soil Sample B Bulk Sample	Consistency VS Very Soft <25 S Soft 25 - 50 F Firm 50 - 100 St Stiff 100 - 200 VSt Very Stiff 200 - 400 H Hard >400 Fb Friable	UCS (kPa) <25 25 - 50 50 - 100 100 - 200 200 - 400 >400	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)	Density V Very Loose L Loose MD Medium Dense D Dense VD Very Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%	



Appendix B

Laboratory Test Result Sheets

Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864A
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 07/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP4, Depth: 0.3-0.7
Material Source: Insitu



Pacific Blue Metal Pty Ltd
 Possum Brush Laboratory
 113-116 Possum Brush Road Possum Brush NSW 2430
 Phone: (02) 6554 3206
 Fax: (02) 6554 3250
 Email: labmanager@pacificbluemetal.com.au

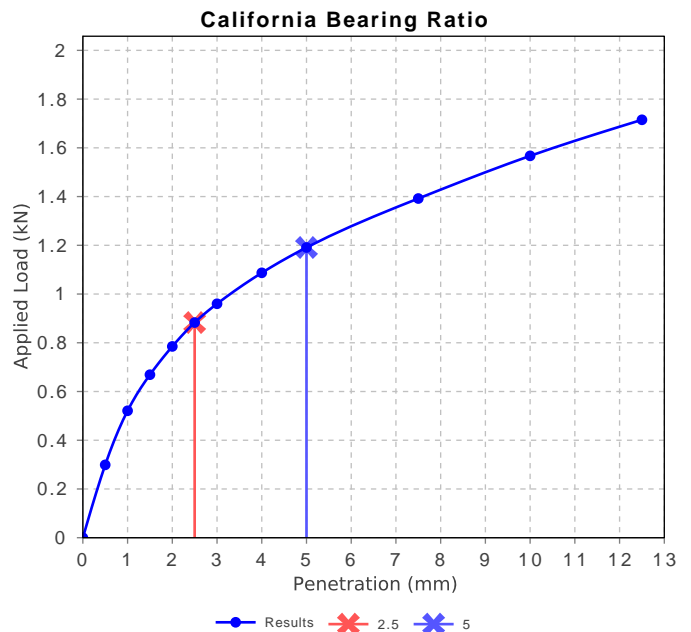
Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	2.5 mm		
CBR %	7.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.542		
Optimum Moisture Content (%)	26.8		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	101		
Dry Density after Soaking (t/m ³)	1.534		
Field Moisture Content (%)	26.7		
Moisture Content Top 30mm (%)	39.1		
Moisture Content Full Depth (%)	38.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.2		
Material Retained on 19mm (%)	1		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864B
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP5, Depth: 0.7-1.2
Material Source: In situ



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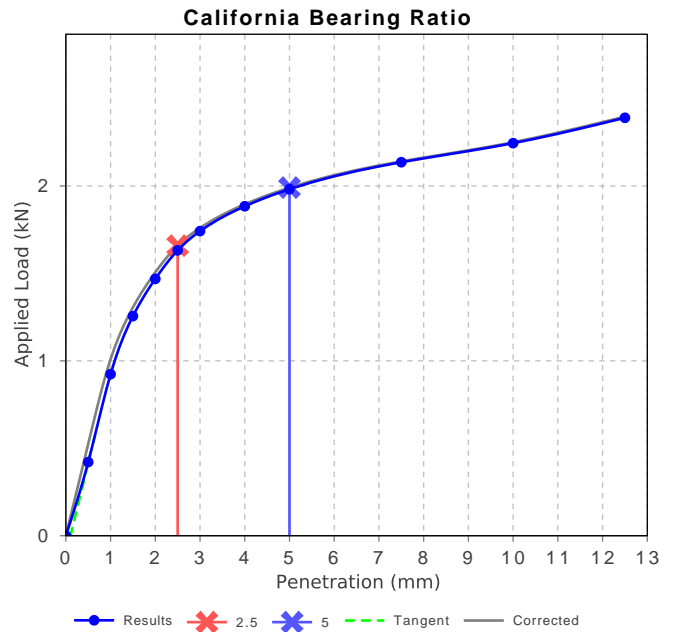
Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	2.5 mm		
CBR %	13.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.416		
Optimum Moisture Content (%)	32.5		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.412		
Field Moisture Content (%)	34.2		
Moisture Content Top 30mm (%)	36.7		
Moisture Content Full Depth (%)	34.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.6		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864C
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP6, Depth: 0.6-0.9
Material Source: Insitu



Pacific Blue Metal Pty Ltd
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 Email: labmanager@pacificbluemetal.com.au

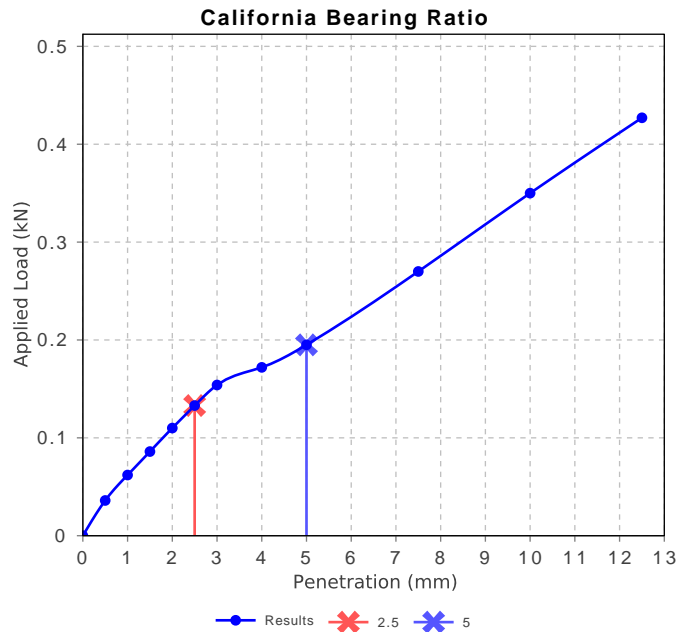
Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	2.5 mm		
CBR %	1.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.590		
Optimum Moisture Content (%)	24.0		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.575		
Field Moisture Content (%)	28.6		
Moisture Content Top 30mm (%)	34.1		
Moisture Content Full Depth (%)	28.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.0		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864D
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP11, Depth: 0.5-0.7
Material Source: In situ



Pacific Blue Metal Pty Ltd
 Possum Brush Laboratory
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 Email: labmanager@pacificbluemetal.com.au

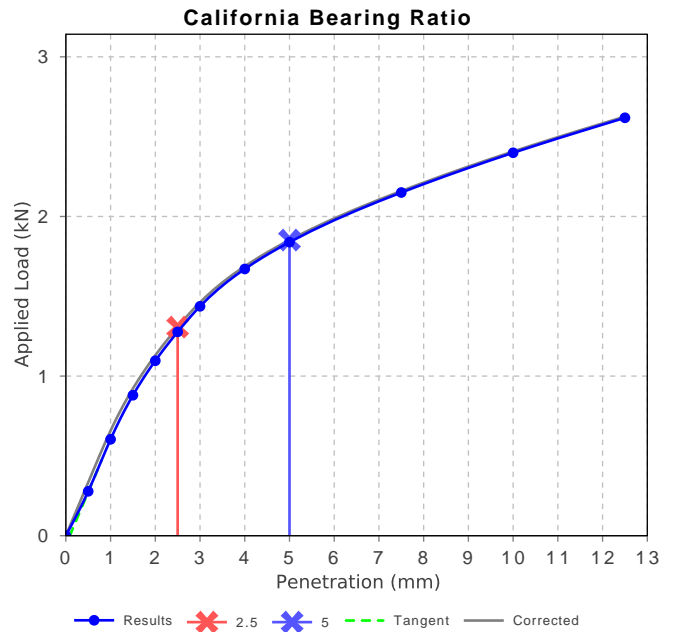
Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	2.5 mm		
CBR %	10.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.379		
Optimum Moisture Content (%)	35.1		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.373		
Field Moisture Content (%)	37.9		
Moisture Content Top 30mm (%)	39.6		
Moisture Content Full Depth (%)	36.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.6		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864E
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 03/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP11, Depth: 1.1-1.4
Material Source: In situ



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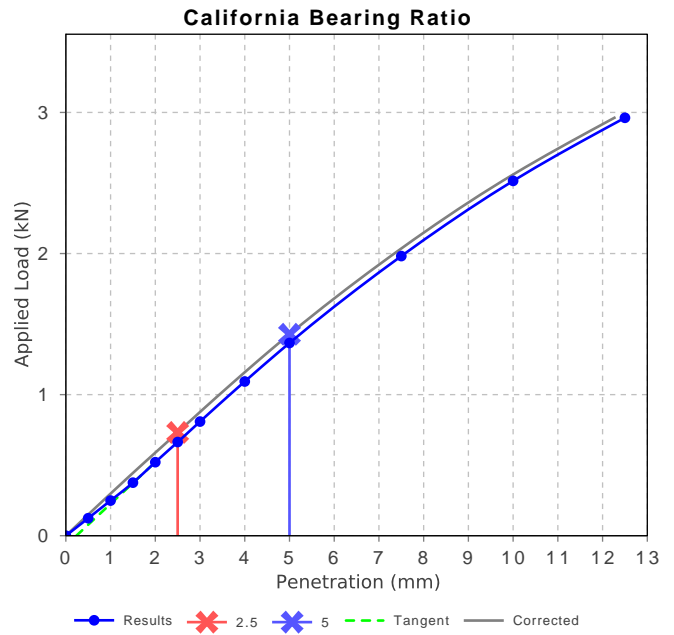
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Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	5 mm		
CBR %	7.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.597		
Optimum Moisture Content (%)	24.5		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.570		
Field Moisture Content (%)	24.4		
Moisture Content Top 30mm (%)	28.6		
Moisture Content Full Depth (%)	25.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.8		
Material Retained on 19mm (%)	2		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	2		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864F
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP16, Depth: 0.4-0.8
Material Source: Insitu



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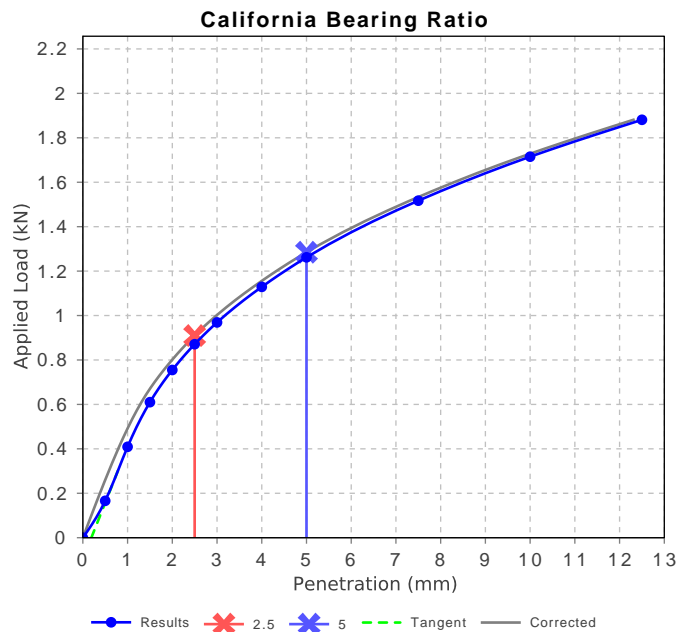
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Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	2.5 mm		
CBR %	7.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.283		
Optimum Moisture Content (%)	40.3		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	98		
Dry Density after Soaking (t/m ³)	1.285		
Field Moisture Content (%)	41.9		
Moisture Content Top 30mm (%)	42.9		
Moisture Content Full Depth (%)	41.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.4		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864G
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP17, Depth: 0.7-1.0
Material Source: Insitu



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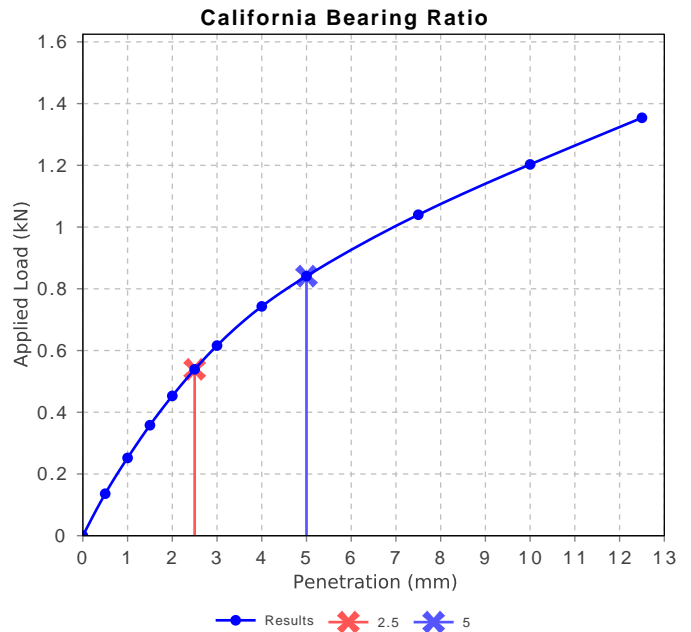
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Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	5 mm		
CBR %	4.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.422		
Optimum Moisture Content (%)	30.2		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.412		
Field Moisture Content (%)	38.6		
Moisture Content Top 30mm (%)	39.4		
Moisture Content Full Depth (%)	32.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.8		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864H
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP18, Depth: 1.3-1.7
Material Source: Insitu



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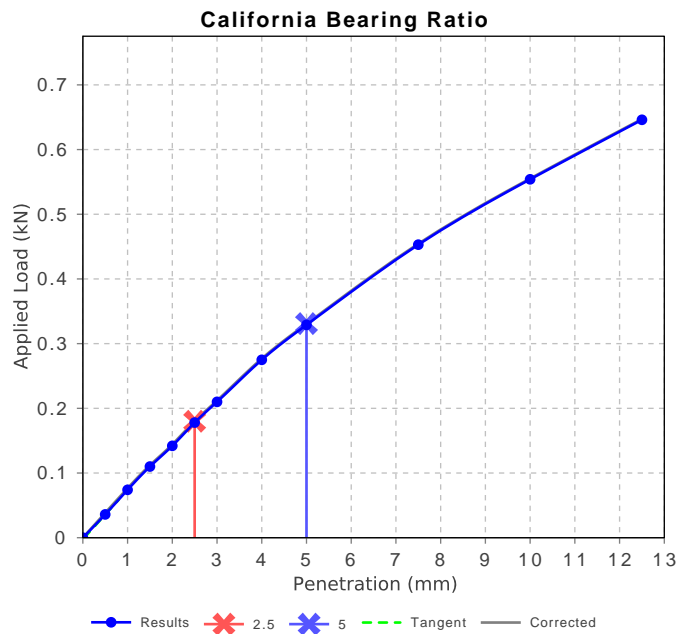


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Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	5 mm		
CBR %	1.5		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.420		
Optimum Moisture Content (%)	29.8		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	99		
Dry Density after Soaking (t/m ³)	1.416		
Field Moisture Content (%)	30.7		
Moisture Content Top 30mm (%)	40.8		
Moisture Content Full Depth (%)	34.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.7		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864I
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 06/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP19, Depth: 4.5-5.0
Material Source: Insitu



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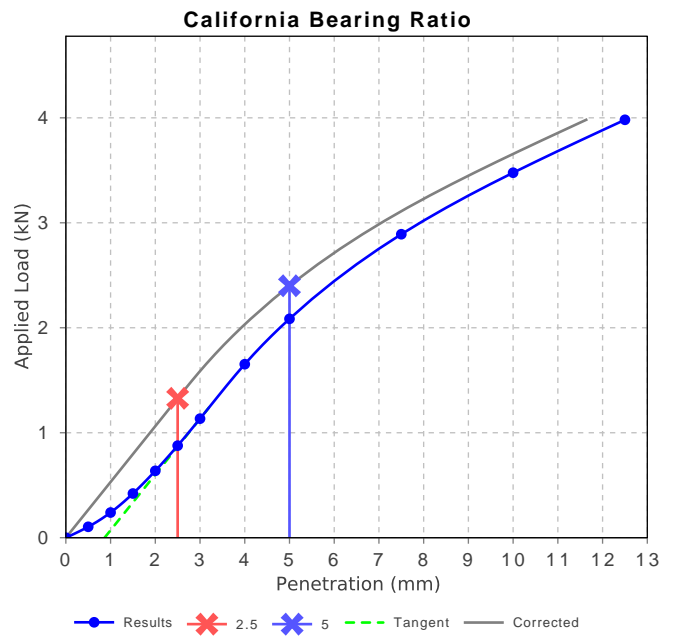
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Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	5 mm		
CBR %	12.0		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.630		
Optimum Moisture Content (%)	21.7		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	100		
Dry Density after Soaking (t/m ³)	1.603		
Field Moisture Content (%)	20.1		
Moisture Content Top 30mm (%)	26.9		
Moisture Content Full Depth (%)	24.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.5		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: P21416-1
Issue Number: 1
Date Issued: 12/05/2021
Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street, Wingham NSW 2429
Contact: Steve Morton
Project Number: P21416
Project Name: Sanctuary Development
Project Location: 344 John Oxley Drive, Thrumster
Client Reference: RGS21087.1
Work Request: 2864
Sample Number: 21-2864J
Date Sampled: 20/04/2021
Dates Tested: 20/04/2021 - 03/05/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: TP20, Depth: 1.3-1.7
Material Source: Insitu



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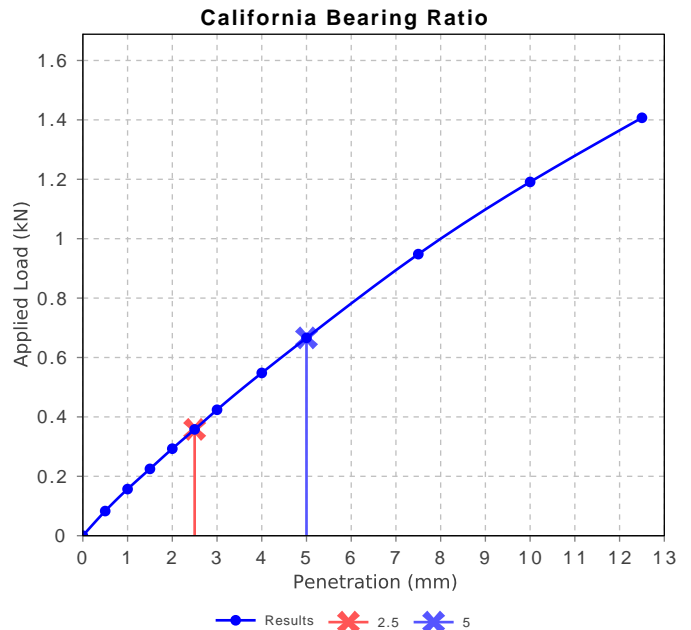


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tom Paulsen
 Senior Tech

NATA Accredited Laboratory Number: 16993

California Bearing Ratio (RMS T117 & T120)		Min	Max
CBR taken at	5 mm		
CBR %	3.5		
Method of Compactive Effort	Standard		
Method used to Determine MDD	RMS T111 & T120		
Maximum Dry Density (t/m ³)	1.628		
Optimum Moisture Content (%)	21.8		
Target Laboratory Density Ratio (%)	100		
Laboratory Density Ratio (%)	100		
Target Laboratory Moisture Ratio (%)	100		
Laboratory Moisture Ratio (%)	100		
Dry Density after Soaking (t/m ³)	1.572		
Field Moisture Content (%)	22.2		
Moisture Content Top 30mm (%)	28.9		
Moisture Content Full Depth (%)	25.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	3.1		
Material Retained on 19mm (%)	0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Report No: SSI:NEW21W-1729-S05

Issue No: 1

Shrink Swell Index Report

Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street
 Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing



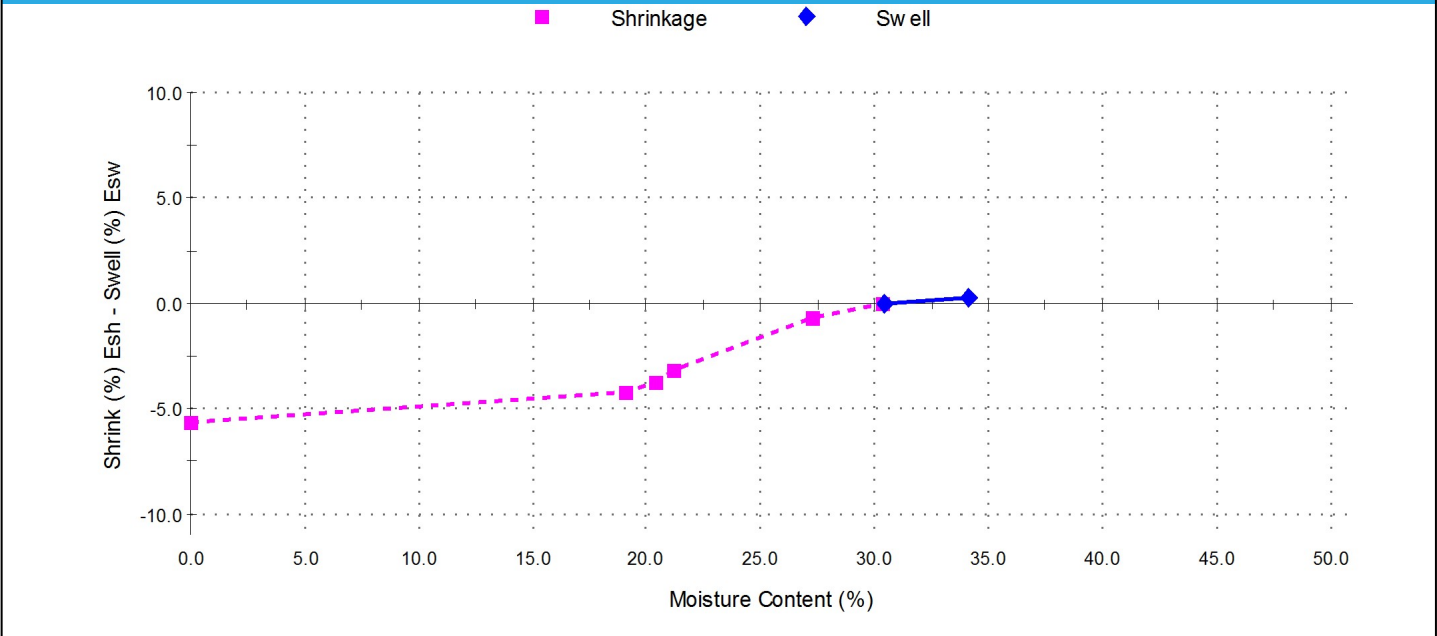
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 Results provided relate only to the items tested or sampled.
B. Cullen
 Approved Signatory: Brent Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 6/05/2021

Sample Details

Sample ID: NEW21W-1729-S05 **Test Request No.:** RGS21087.1
Sampling Method: The results outlined below apply to the sample as received
Material: Clay **Date Sampled:** 20/04/2021
Source: On Site **Date Submitted:** 29/04/2021
Specification: No Specification
Project Location: 344 John Oxley Drive, Thrumster, NSW
Sample Location: TP21 - (0.5 - 1.0m)
Date Tested: 29/04/2021

Swell Test AS 1289.7.1.1		Shrink Test AS 1289.7.1.1	
Swell on Saturation (%):	0.3	Shrink on drying (%):	5.7
Moisture Content before (%):	30.4	Shrinkage Moisture Content (%):	30.3
Moisture Content after (%):	34.1	Est. inert material (%):	10%
Est. Unc. Comp. Strength before (kPa):	140	Crumbling during shrinkage:	Nil
Est. Unc. Comp. Strength after (kPa):	300	Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 3.3

Comments

Report No: SSI:NEW21W-1729-S04

Issue No: 1

Shrink Swell Index Report

Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street
 Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing



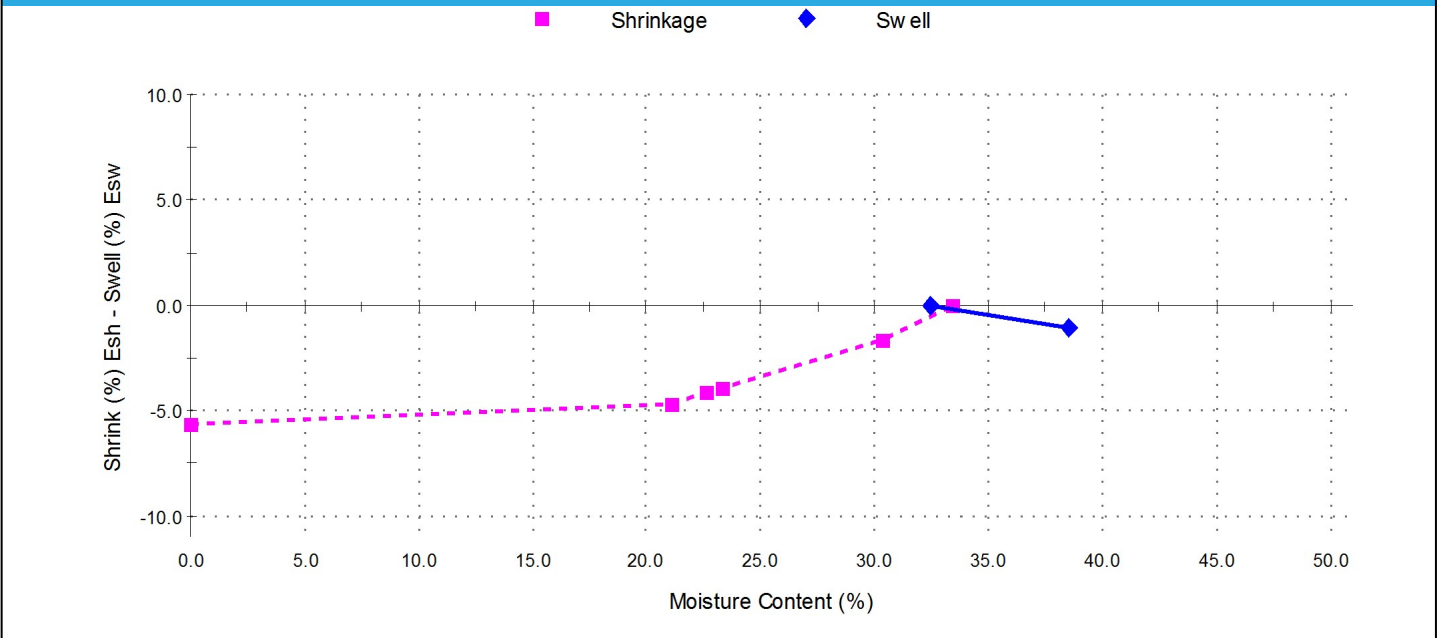
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 Results provided relate only to the items tested or sampled.
B. Cullen
 Approved Signatory: Brent Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 6/05/2021

Sample Details

Sample ID: NEW21W-1729-S04 **Test Request No.:** RGS21087.1
Sampling Method: The results outlined below apply to the sample as received
Material: Clay **Date Sampled:** 20/04/2021
Source: On Site **Date Submitted:** 29/04/2021
Specification: No Specification
Project Location: 344 John Oxley Drive, Thrumster, NSW
Sample Location: TP11 - (0.3 - 0.6m)
Date Tested: 29/04/2021

Swell Test		AS 1289.7.1.1	Shrink Test		AS 1289.7.1.1
Swell on Saturation (%):	-1.1		Shrink on drying (%):	5.7	
Moisture Content before (%):	32.4		Shrinkage Moisture Content (%):	33.4	
Moisture Content after (%):	38.5		Est. inert material (%):	1%	
Est. Unc. Comp. Strength before (kPa):	270		Crumbling during shrinkage:	Nil	
Est. Unc. Comp. Strength after (kPa):	250		Cracking during shrinkage:	Minor	

Shrink Swell



Shrink Swell Index - Iss (%): 3.2

Comments

Sample remoulded at estimated OMC and approximately 98% Standard Compaction

Report No: SSI:NEW21W-1729-S03

Issue No: 1

Shrink Swell Index Report

Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street
 Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing



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Results provided relate only to the items tested or sampled.

B. Cullen

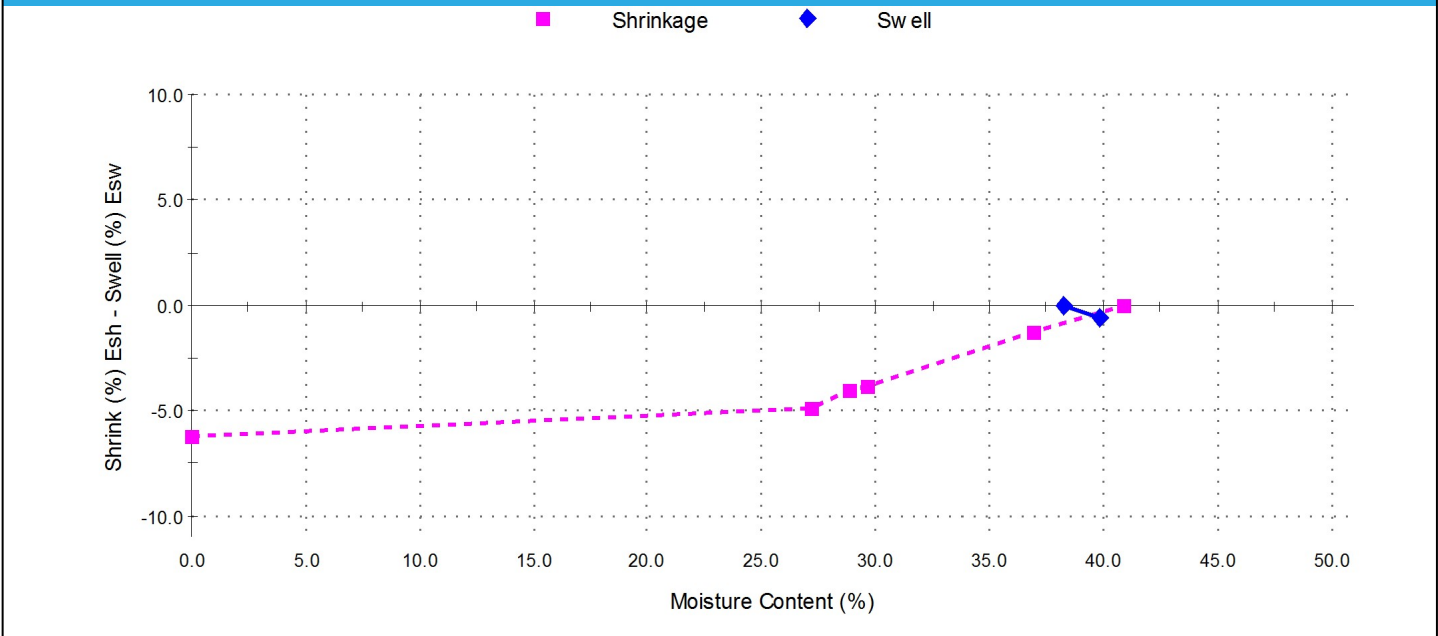
Approved Signatory: Brent Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 6/05/2021

Sample Details

Sample ID: NEW21W-1729-S03 **Test Request No.:** RGS21087.1
Sampling Method: The results outlined below apply to the sample as received
Material: Clay **Date Sampled:** 20/04/2021
Source: On Site **Date Submitted:** 29/04/2021
Specification: No Specification
Project Location: 344 John Oxley Drive, Thrumster, NSW
Sample Location: TP3 - (0.4 - 0.8m)
Date Tested: 29/04/2021

Swell Test AS 1289.7.1.1		Shrink Test AS 1289.7.1.1	
Swell on Saturation (%):	-0.6	Shrink on drying (%):	6.2
Moisture Content before (%):	38.2	Shrinkage Moisture Content (%):	40.9
Moisture Content after (%):	39.9	Est. inert material (%):	1%
Est. Unc. Comp. Strength before (kPa):	140	Crumbling during shrinkage:	Nil
Est. Unc. Comp. Strength after (kPa):	310	Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 3.4

Comments

Report No: SSI:NEW21W-1729-S01

Issue No: 1

Shrink Swell Index Report

Client: Regional Geotechnical Solutions Pty Ltd
 44 Bent Street
 Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing



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Results provided relate only to the items tested or sampled.

B. Cullen

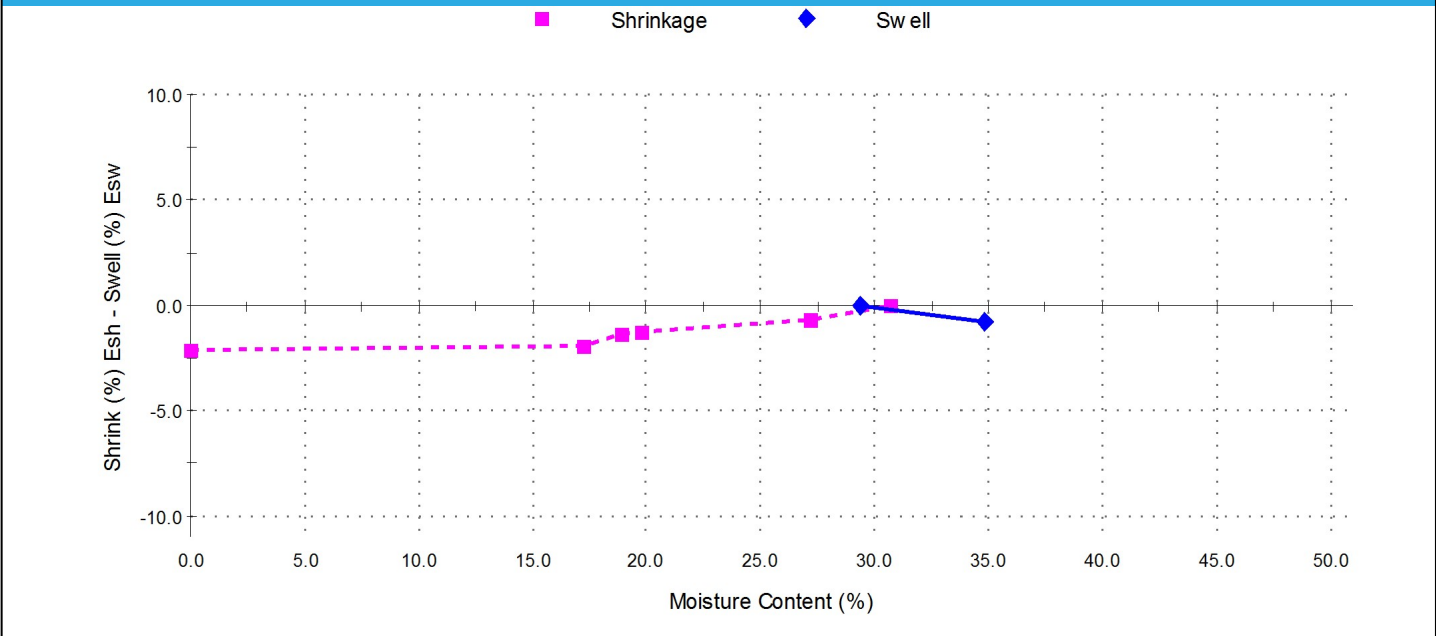
Approved Signatory: Brent Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 6/05/2021

Sample Details

Sample ID: NEW21W-1729-S01 **Test Request No.:** RGS21087.1
Sampling Method: The results outlined below apply to the sample as received
Material: Clay **Date Sampled:** 20/04/2021
Source: On Site **Date Submitted:** 29/04/2021
Specification: No Specification
Project Location: 344 John Oxley Drive, Thrumster, NSW
Sample Location: Hill - A - (2.0 - 3.0m)
Date Tested: 29/04/2021

Swell Test AS 1289.7.1.1		Shrink Test AS 1289.7.1.1	
Swell on Saturation (%):	-0.8	Shrink on drying (%):	2.1
Moisture Content before (%):	29.4	Shrinkage Moisture Content (%):	30.7
Moisture Content after (%):	34.8	Est. inert material (%):	5%
Est. Unc. Comp. Strength before (kPa):	210	Crumbling during shrinkage:	Nil
Est. Unc. Comp. Strength after (kPa):	190	Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 1.1

Comments

Sample remoulded at estimated OMC and approximately 98% Standard Compaction

Report No: MAT:NEW21W-1729-S02
Issue No: 1

Material Test Report

Client: Regional Geotechnical Solutions Pty Ltd
44 Bent Street
Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing



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

Results provided relate only to the items tested or sampled.



Approved Signatory: Brent Cullen
(Senior Geotechnician)

NATA Accredited Laboratory Number: 18686

Date of Issue: 7/05/2021

Sample Details

Sample ID: NEW21W-1729-S02
The results outlined below apply to the sample as received
Date Sampled: 20/04/2021
Source: On Site
Material: Clay
Specification: No Specification
Project Location: 344 John Oxley Drive, Thrumster, NSW
TRN: RGS21087.1
Sample Location: TP2 - (0.5 - 0.6m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	14.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	67	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	43	
Date Tested		6/05/2021	
Emerson Class Number	AS 1289.3.8.1 - 2017	2	
Soil Description		CLAY	
Type of Water		Distilled	
Date Tested		30/04/2021	

Comments

N/A



Appendix C

Pavement Thickness Design Sheets

FLEXIBLE PAVEMENT THICKNESS DESIGN - TYPE 1

CLIENT: Land Dynamics Australia
PROJECT: Proposed Residential Subdivision
LOCATION: 344 John Oxley Drive, Thrumster

Job No.: RGS21087.1



Date: 19-May-21

ROAD NAME:	Road 1	Refer to drawing:	Figure 1
Chainage Interval (m):	--	Road classification ref:	PMHC Aus-Spec
Road Classification:	Collector Road	Design Traffic:	1 x 10 ⁶ ESA
Pavement Design Methodology	Empirical with reference to Austroads Part 2		
Subgrade Conditions			
Expected subgrade:	Clay Embankment Fill of CBR≥4		
Adopted Subgrade CBR value:	4	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	In areas of road construction, strip all vegetation, root affected soils and topsoil and 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 fill. It is noted that the embankment foundation is likely to be over-wet and may require placement of a granular or rock bridging layer to provide a suitable surface for placement of clay fill, pending geotechnical assessment. At design subgrade level, CBR testing will be required to assess embankment fill properties. Grade subgrade towards road edge to assist drainage. Place pavement layers as specified.		
Pavement Design			
Recommended Pavement Layer Thickness:		Recommended Material requirements	Required Compaction
Wearing course thickness (mm):	40	AC10 as Per PMHC requirements*	3%< Insitu Air Voids <8%
Base thickness (mm):	140	DGB20 material complying to PMHC AUSPEC	98% Modified Compaction
Sub-base thickness (mm):	260	DGS20 or DGS40 complying to PMHC AUSPEC	95% Modified Compaction
Select thickness (mm):	--	CBR>15; PI<12; Max Particle size 100mm	100% Standard Compaction
Total thickness (mm):	440	*Note: AC layer to be underlain by 7mm primer seal	
Definitions:			
Design traffic loading:	The anticipated number of equivalent standard axles (ESA), as defined by AUSTRROADS, in the design lane during the design life of the pavement.		
Modified Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.		
Standard Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.		
Density Index:	Minimum required Density Index AS1289 5.6.1-1998, defined as the ratio of field dry density determined by AS1289 5.8.1-2004 or equivalent to the laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent		
Note:	Pavement designs assume appropriate drainage is installed and maintained. Refer to Regional Geotechnical Solutions Report No. RGS21087.1-AB for recommendations regarding drainage.		

FLEXIBLE PAVEMENT THICKNESS DESIGN - TYPE 2A

CLIENT: Land Dynamics Australia
PROJECT: Proposed Residential Subdivision
LOCATION: 344 John Oxley Drive, Thrumster

Job No.: RGS21087.1



Date: 19-May-21

ROAD NAME:	Road 10	Refer to drawing:	Figure 1
Chainage Interval (m):	--	Road classification ref:	PMHC Aus-Spec
Road Classification:	Local Street	Design Traffic:	5 x 10 ⁵ ESA
Pavement Design Methodology	Empirical with reference to Austroads Part 2		
Subgrade Conditions			
Expected subgrade:	Residual Clay. Possible bands of weathered rock in Road 4		
Adopted Subgrade CBR value:	7	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	In areas of road construction, strip all vegetation, root affected soils and topsoil and 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 fill. Where rock is encountered at subgrade level, rip to 300mm and recompact to break up drainage paths. Grade subgrade towards road edge to assist drainage. Place pavement layers as specified.		
Pavement Design			
Recommended Pavement Layer Thickness:		Recommended Material requirements	Required Compaction
Wearing course thickness (mm):	25	AC7 as Per PMHC requirements*	
Base thickness (mm):	140	DGB20 material complying to PMHC AUSPEC	98% Modified Compaction
Sub-base thickness (mm):	170	DGS20 or DGS40 complying to PMHC AUSPEC	95% Modified Compaction
Select thickness (mm):	--	CBR>15; PI<12; Max Particle size 100mm	100% Standard Compaction
Total thickness (mm):	335	*Note: AC layer to be underlain by 7mm primer seal	
Definitions:			
Design traffic loading:	The anticipated number of equivalent standard axles (ESA), as defined by AUSTROADS, in the design lane during the design life of the pavement.		
Modified Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.		
Standard Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.		
Density Index:	Minimum required Density Index AS1289 5.6.1-1998, defined as the ratio of field dry density determined by AS1289 5.8.1-2004 or equivalent to the laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent		
Note:	Pavement designs assume appropriate drainage is installed and maintained. Refer to Regional Geotechnical Solutions Report No. RGS21087.1-AB for recommendations regarding drainage.		

FLEXIBLE PAVEMENT THICKNESS DESIGN - TYPE 2B

CLIENT: Land Dynamics Australia
PROJECT: Proposed Residential Subdivision
LOCATION: 344 John Oxley Drive, Thrumster

Job No.: RGS21087.1



Date: 19-May-21

ROAD NAME:	Road 2	Refer to drawing:	Figure 1
Chainage Interval (m):	--	Road classification ref:	PMHC Aus-Spec
Road Classification:	Local Street	Design Traffic:	5 x 10 ⁵ ESA
Pavement Design Methodology	Empirical with reference to Austroads Part 2		
Subgrade Conditions			
Expected subgrade:	Low CBR - Residual Clay / Extremely Weathered Slate		
Adopted Subgrade CBR value:	2	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	<p>In areas of road construction, strip all vegetation, root affected soils and topsoil and 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 fill. The subgrades are moisture sensitive and prone to water retention and strength loss during wet weather. Adopt a select layer at base of pavement to assist construction, reduce potential for shear failure, and reduce overall pavement thickness required. Place 290mm layer of Select Fill (CBR >15 and PI<12) to subgrade design. Grade subgrade towards road edge to assist drainage. Place pavement layers as specified.</p>		
Pavement Design			
Recommended Pavement Layer Thickness:	Recommended Material requirements	Required Compaction	
Wearing course thickness (mm):	25	AC7 as Per PMHC requirements*	
Base thickness (mm):	140	DGB20 material complying to PMHC AUSPEC	98% Modified Compaction
Sub-base thickness (mm):	150	DGS20 or DGS40 complying to PMHC AUSPEC	95% Modified Compaction
Select thickness (mm):	290	CBR>15; PI<12; Max Particle size 100mm	100% Standard Compaction
Total thickness (mm):	605	*Note: AC layer to be underlain by 7mm primer seal	
Definitions:			
Design traffic loading:	The anticipated number of equivalent standard axles (ESA), as defined by AUSTRROADS, in the design lane during the design life of the pavement.		
Modified Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.		
Standard Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.		
Density Index:	Minimum required Density Index AS1289 5.6.1-1998, defined as the ratio of field dry density determined by AS1289 5.8.1-2004 or equivalent to the laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent		
Note:	Pavement designs assume appropriate drainage is installed and maintained. Refer to Regional Geotechnical Solutions Report No. RGS21087.1-AB for recommendations regarding drainage.		

FLEXIBLE PAVEMENT THICKNESS DESIGN - TYPE 2C

CLIENT: Land Dynamics Australia
PROJECT: Proposed Residential Subdivision
LOCATION: 344 John Oxley Drive, Thrumster

Job No.: RGS21087.1



Date: 19-May-21

ROAD NAME:	Road 7	Refer to drawing:	Figure 1
Chainage Interval (m):	--	Road classification ref:	PMHC Aus-Spec
Road Classification:	Local Street	Design Traffic:	5 x 10 ⁵ ESA
Pavement Design Methodology	Empirical with reference to Austroads Part 2		
Subgrade Conditions			
Expected subgrade:	Extremely Weathered Dolerite		
Adopted Subgrade CBR value:	4	Required subgrade compaction:	100% Standard Compaction
Potential construction or performance issues:	<p>In areas of road construction, strip all vegetation, root affected soils and topsoil and 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 fill. The subgrades are moisture sensitive and prone to water retention and strength loss during wet weather. Adopt a select layer at base of pavement to assist construction, reduce potential for shear failure, and reduce overall pavement thickness required. Place 290mm layer of Select Fill (CBR >15 and PI<12) to subgrade design. Grade subgrade towards road edge to assist drainage. Place pavement layers as specified.</p>		
Pavement Design			
Recommended Pavement Layer Thickness:		Recommended Material requirements	Required Compaction
Wearing course thickness (mm):	25	AC7 as Per PMHC requirements*	
Base thickness (mm):	140	DGB20 material complying to PMHC AUSPEC	98% Modified Compaction
Sub-base thickness (mm):	270	DGS20 or DGS40 complying to PMHC AUSPEC	95% Modified Compaction
Select thickness (mm):		CBR>15; PI<12; Max Particle size 100mm	100% Standard Compaction
Total thickness (mm):	435	*Note: AC layer to be underlain by 7mm primer seal	
Definitions:			
Design traffic loading:	The anticipated number of equivalent standard axles (ESA), as defined by AUSTRROADS, in the design lane during the design life of the pavement.		
Modified Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.		
Standard Compaction:	Minimum required dry density ratio (AS1289 5.4.1-2007) defined as the ratio of the calculated field dry density (AS1289 5.8.1-2004 or equivalent) to the maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.		
Density Index:	Minimum required Density Index AS1289 5.6.1-1998, defined as the ratio of field dry density determined by AS1289 5.8.1-2004 or equivalent to the laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent		
Note:	Pavement designs assume appropriate drainage is installed and maintained. Refer to Regional Geotechnical Solutions Report No. RGS21087.1-AB for recommendations regarding drainage.		