

de Groot and Benson Pty Ltd

Preliminary Geotechnical Assessment

Proposed Residential Subdivision

54 Pullen Street, Woolgoolga

Report No. RGS33955.1-AB

27 November 2023



RGS33955.1-AB

27 November 2023

de Groot and Benson Pty Ltd
236 Harbour Drive
COFFS HARBOUR NSW 2450

Attention: Graham Knight

Dear Graham,

**RE: Proposed Residential Subdivision – 54 Pullen Street, Woolgoolga
Preliminary Geotechnical Assessment**

Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for a residential subdivision proposed at 54 Pullen Street, Woolgoolga NSW.

The purpose of the assessment was to provide a "Due Diligence" assessment as part of the conditions of sale. This preliminary advice and guidance on geotechnical conditions can also be used to inform planning and preliminary design.

Presented herein are comments and recommendations regarding the presence of acid sulfate soils, earthworks, foundations, and pavement construction. A preliminary desk top assessment is also included to assess the risk of gross site contamination.

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

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

Prepared by



Joel Babbage

Geotechnical Engineer

Reviewed by



Adam Holzhauser

Principal Geotechnical Engineer



Table of Contents

1	INTRODUCTION	1
2	METHODOLOGY	1
3	SITE CONDITIONS	2
3.1	Surface Conditions	2
3.2	Subsurface Conditions	3
4	ACID SULFATE SOILS	4
4.1	ASS Formation.....	4
4.2	Risk Mapping	4
4.3	Summary & Conclusions Regarding ASS.....	5
5	GEOTECHNICAL CONSTRAINTS.....	5
6	EARTHWORKS.....	6
6.1	Site Preparation.....	6
6.2	Excavation Conditions	6
6.3	Suitability of Site Soils for Reuse	7
6.4	Earth Retention.....	7
6.5	Fill Placement & Compaction Control	9
7	FOUNDATIONS	9
7.1	Preliminary Site Classification.....	9
7.2	Foundation Options & Design Parameters	10
8	PAVEMENTS.....	11
9	LIMITATIONS.....	11

Figures

Figure 1 Test Location Plan

Appendices

Appendix A Results of Field Investigations

Appendix B Laboratory Test Result Sheets

1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd (RGS) have undertaken a geotechnical assessment for a residential subdivision that is proposed at 54 Pullen Street, Woolgoolga (Lot 12 DP1059040).

The provided concept plan prepared by de Groot and Benson (dated 22 July 2023) indicates that the development is likely to include the following:

- Twenty-two (22) residential lots that range between 451m² and 1,589m²;
- Construction of a new stormwater detention basin or extension of existing basin;
- Construction of pavements; and
- The installation of underground services.

Cut and fill earthworks in the order of up to 3m are proposed over the site. Batters are nominated as 3H:1V along the northern and western boundary. It is understood that the lots will be relatively level with retaining walls up to 2m.

The purpose of the geotechnical 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);
- Acid sulfate soils – presence of and need for an acid sulfate soil management plan.
- Site Earthworks – Excavation conditions, fill placement and compaction control, retention and retaining wall design parameters;
- Foundations – Shallow foundation design parameters and preliminary site classification to AS2870-2011 '*Residential Slabs and Footings*'; and
- Pavements – Subgrade CBR values and pavement construction guidance.
- Desktop assessment of risk of gross site contamination.

2 METHODOLOGY

Field work for the assessment was undertaken by RGS on 2 November 2023 and included the following:

- Observation of site features and surrounding features relevant to the geotechnical conditions of the site;
- Twelve (12) boreholes to depths of up to 3m with a 4WD mounted drill rig;
- Dynamic Cone Penetrometer (DCP) testing adjacent to select boreholes as considered appropriate for the materials encountered;
- Collection of samples for subsequent laboratory testing. The following tests were undertaken:
 - Two shrink-swell tests; and
 - Two 4-day soaked CBR tests;

Engineering logs of the boreholes are presented in Appendix A. Test locations are shown on the attached Figure 1 and were obtained by measurements to prominent site features.



Looking northwest across the northern portion of the sit. Vacant grazing land with bushland in the background.



Looking towards stockyards in proposed Lot 16.



Looking north from the centre of the site towards Woolgoolga Creek. The site is gently sloping in this area.



Looking south from the north western corner of the site. Western portion of the site has steeper slopes.

3.2 Subsurface Conditions

The NSW Government 'MinView' Geological Survey of NSW indicates that the site is underlain by the Coramba Beds which comprise siltstone, siliceous siltstone and mudstone.

The materials encountered within the boreholes undertaken during the investigation are summarised below. Further details are presented on the engineering logs in Appendix A.

Topsoil: - Silty clay, low plasticity to depths of up to 0.3.

Slopewash: - Silty clay, medium to high plasticity, very stiff to hard and friable was encountered north-western portion of the site which extended to depths of 0.7 to 1.0m.

Residual: - Silty clay, medium, very stiff to hard and friable was encountered below the topsoil and slopewash. The residual soils graded into weathered meta-siltstone in some of the boreholes.

Weathered Meta-siltstone: - Highly weathered meta-siltstone was encountered in some of the boreholes, predominately through the upper crest and flanks of the ridgeline. Where encountered

meta-siltstone was between 1.25 to 2.5m and was assessed to be low to medium strength, highly fractured.

Groundwater was not observed within the boreholes during the limited time that they remained open. Groundwater levels do fluctuate due to inclement weather, seasonal variations, or due to reasons that may not have been apparent at the time of the site investigation.

A summary of the laboratory shrink-swell and CBR test results is presented in Table 1. Laboratory test result sheets are presented in Appendix B.

Table 1: Summary of Laboratory Test Results

Sample Location	Sample Depth (m)	Shrink-Swell Index (%)	CBR Swell (%)	CBR (%)
BH4	0.5 to 0.9	1.2	--	--
BH5	0.2 to 1.2	--	1.0	8
BH8	0.3 to 0.7	2.9	--	--
BH9	0.25 to 0.6	--	1.0	4.5

4 ACID SULFATE SOILS

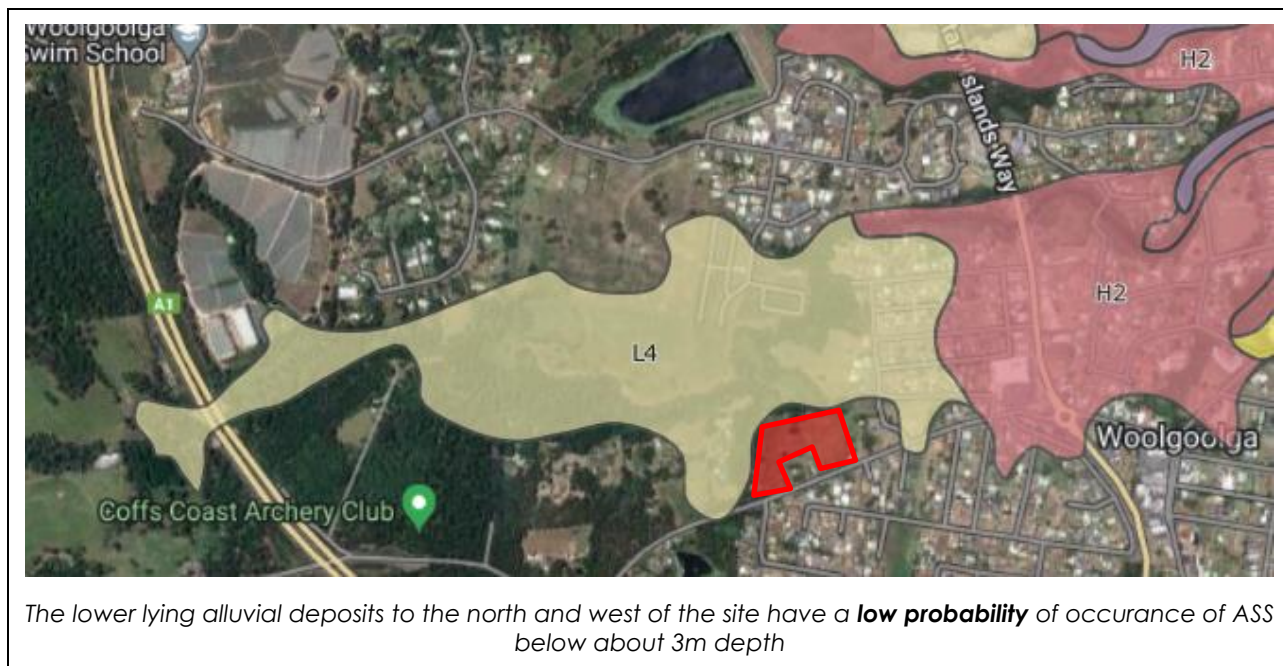
4.1 ASS Formation

Acid Sulfate Soils (ASS) produce sulphuric acid when exposed to oxygen due to the presence of iron sulphides in the form of pyrite within the soil matrix. These soils form when iron-rich sediments are deposited in saltwater or brackish water environments. Prior to oxidation, these pyritic soils are referred to as Potential ASS. ASS that have produced acid as a result of oxidation are referred to as Actual ASS. ASS typically occur in natural, low-lying coastal depositional environments below approximately 5m AHD. In the field ASS are generally identified as saline sediments such as alluvial or estuarine soils or bottom sediments in creeks and estuaries.

4.2 Risk Mapping

Reference to the National Acid Sulfate Soils Guidance (*Water Quality Australia 2018*) provides a summary of general site conditions (Table 2.1) that can be indicative of Potential and Actual ASS. The geomorphology of the site does not conform to those typically expected of ASS.

An extract from the NSW Government SEED website is presented below and indicates that the surrounding alluvial areas associated with Woolgoolga Creek and its tributaries have a Low Probability at depths of >3m below ground level.



4.3 Summary & Conclusions Regarding ASS

A preliminary assessment has been undertaken to determine the presence of ASS within the site and the need for an ASS Management Plan. No alluvial soils will be disturbed during the earthworks. Therefore, detailed soil sampling and field testing is not required and the site soils within the upper 3m of the soil profile are not considered to be either Actual or Potential ASS.

An ASS Management Plan is therefore not required for excavations up to 3m deep within residual soil profiles.

5 GEOTECHNICAL CONSTRAINTS

The topography comprises undulating residual terrain that falls to the west, north and east with the steepest slopes being along the western side. Slopes are typically less than 12° and no evidence of slope instability was observed during the site assessment. Alluvial terrain is situated to the north.

The site assessment indicates the soil profile comprises topsoil and minor slopewash overlying residual soils that grade into weathered meta-siltstone. Auger refusal was encountered in several boreholes. Refusal is anticipated to have occurred on highly to moderately weathered low strength meta-siltstone. The meta-siltstone is typically highly fractured which aid in its excavatability.

Some minor surface disturbance and irregular surface profiles were observed. This is likely to be associated with historic tree removal and minor surface regrading. No evidence of significant filling, soil or building debris stockpiles or gross contamination or potential contaminating sources were observed.

6 EARTHWORKS

6.1 Site Preparation

Bulk excavations up to about 3m deep are proposed with a cut to fill balance anticipated.

Site preparation works will therefore generally require the removal of vegetation including the stripping of all organic and root affected material. Any deleterious material or material that appears potentially contaminated should also be stripped and appropriately disposed of. These materials are not considered suitable for reuse as engineered fill and should be disposed of offsite, pending appropriate waste classification or exemption, or stockpiled on site where appropriate for later reuse in landscaping areas only.

The boreholes indicate that up to 300mm of topsoil is present across the site with some of the boreholes encountering slopewash in the upper profile.

The soils encountered are cohesive and will be sensitive to moisture. Delays should be expected after rainfall events during and preceding the earthworks stage of the development. The implementation of good site drainage during the initial stages of the development will reduce the risk and extent of delays and will be essential for the successful completion of earthworks at the site. The principle aim of the drainage is to promote controlled surface water run-off, reduce the velocity of flow and to reduce the potential for water to pond. During the initial stages of earthworks, it may be necessary to construct localised sump points and swale drains to enable surface water to be safely removed from the site.

Earthworks across the site should be carefully planned and scheduled to maintain suitable cross-falls to promote controlled runoff of surface water. Adequate silt control and dissipation measures will need to be employed to reduce the potential for silt entering the storm water system to the south and west of the site.

The residual soils generally have a high silt content and may therefore be prone to heaving under repetitive heavy vehicle traffic, even if the subgrade passes an initial proof roll assessment. An earthworks management plan should be developed that considers the following:

- Heavy vehicle haulage routes should be nominated for bulk earthworks and for the importation of pavement materials.
- Where possible, haulage routes should be located on future pavement alignments.
- To reduce the risk of subgrade failures and the need for subgrade improvement/remediation measures a granular working platform could be placed on the haulage route(s). The platform could comprise:
 - 400mm of angular very high strength no fines rockfill with a particle size of between about 70 and 150mm that overlies a Class D geofabric; or
 - 600mm of DGS40 overlying a Class D geofabric. This material could be reused as subbase for other internal pavements; and
- Pavement and subgrade failures can occur under repetitive heavy vehicle movements on partially completed pavements, and due to incomplete drainage (concreters washing out onto unsealed pavement areas, etc).

6.2 Excavation Conditions

Excavations to the required 3m will encounter residual soils that grade into weathered meta-siltstone. Highly to moderately weathered metasiltstone was encountered at depth less than 3m

and auger refusal was encountered on this material in several boreholes. The meta-siltstone is typically highly fractured.

Excavation of the residual soil and extremely to highly weathered meta-siltstone encountered within the depths of the investigation will be achievable with medium to large excavators, or light to medium ripping with medium dozer.

6.3 Suitability of Site Soils for Reuse

Site soils are generally considered suitable for reuse onsite during bulk earthworks as outlined below:

- Residual soil is suitable for reuse as general fill. The material is reactive and the increased reactivity when placed as fill (due to the reduced crack depth) must be considered during foundation design. It is recommended that the residual soil be blended with the underlying less reactive weathered meta-siltstone materials to assist with placement and to reduce the reactivity of the placed materials.
- Extremely weathered meta-siltstone is considered suitable for reuse as general fill; and
- Highly weathered siltstone is considered suitable for reuse as general fill, providing the materials are broken down to achieve a maximum particle size of 100mm during placement. If higher strength or less fractured rock is encountered, the material must be broken down or removed from general fill.

Where earthworks are undertaken following wet weather, reworking of site won materials may be required to dry back the material to within 2% of OMC.

The natural residual soil and weathered siltstone materials would be classified as Virgin Excavated Natural Material (VENM) and may be reused accordingly on another DA approved site.

6.4 Earth Retention

All excavations on site must comply with the NSW Government 'Excavation Work Code of Practice' (2020). Vertical batters should not be undertaken without appropriate engineer designed support measures. Where space permits, temporary or permanent batter slopes (or equivalent benches with a maximum bench height of 1.5m) can be adopted.

Recommended maximum temporary and permanent batters are presented in Table 2. Further geotechnical advice must be sought if seepage is encountered within the batters, or cut/fill batters exceed 3m.

Table 2: Recommended Maximum Temporary & Permanent Batters

Material	Temporary Batter	Permanent Batter
Controlled Fill ¹	1.5H:1V ²	2.5H:1V
Residual Clay	1.5H:1V ²	2.5H:1V
Weathered meta- siltstone	1H:1V	2H:1V

Notes: 1 Fill placed under Level 1 Construction Monitoring & Testing as defined by AS3798-2007 and summarised in Section 6.5.

2 Up to a maximum height of 3m within controlled fill and residual soil.

Where required, engineered retention systems such as cantilevered post and beam style walls, reinforced concrete block walls or mass gravity walls (i.e. gabion baskets, concrete blocks, Gabi blocks, etc.) could be adopted at the site to support permanent excavations / fill.

Retention structures may be designed based on the parameters presented in Table 3. All earth retention structures must consider any permanent or temporary surcharges within the super-structure or behind retention structures (such as traffic loading, construction loading, temporary stockpiles, piezometric levels, etc.).

Table 3: Earth Retention Design Parameters

Material	Unit Weight, γ	Friction Angle, ϕ'	Effective Cohesion, c'	Active Earth Pressure Coefficient, k_a	At Rest Earth Pressure Coefficient, k_o	Passive Earth Pressure Coefficient, k_p
Level 1 Controlled Fill (won from onsite)	19 kN/m ³	26°	5 kPa	0.39	0.8	2.56
Residual Soil	18 kN/m ³	24°	5 kPa	0.42	0.7	2.37
Weathered Meta-Siltstone	20 kN/m ³	26°	10 kPa	0.39	0.8	2.56

The earth pressure coefficients detailed in Table 3 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.

For freestanding retaining walls backfill should comprise free draining granular material. Drainage behind the wall should comprise a geocomposite drain or geotextile wrapped gravel drain at the back of the wall that drains to a geotextile wrapped subsoil drain along the wall toe. The toe drain should discharge to the site storm water system to provide long term drainage behind retaining walls.

6.5 Fill Placement & Compaction Control

Where fill is required to raise the site to design levels for the placement of high level footings or pavements, following removal of topsoil and other unsuitable materials the following outlines the recommended fill placement procedures:

- After unsuitable material has been stripped to expose the underlying alluvial or residual soil, the exposed natural subgrade should be proof roll tested (with a large grader, loaded water cart or the like) in the presence of a suitably experienced geotechnical practitioner to highlight any soft, wet or excessively deflecting areas. Where these are encountered, it is recommended that a Geotechnical Engineer be engaged to provide advice regarding appropriate remedial measures. Once the subgrade has passed proof roll, do not traffic prior to fill placement. Repetitive heavy vehicle movements can result in heave.
- Where the subgrade fails proof roll, remedial measures may include:
 - Removing the low strength material and replacing with granular fill such as select fill or pavement gravel (DGS40). In some instances, clay backfill may be appropriate;
 - Rock bridging layers which would typically comprise between 400 and 500mm of very high strength clean angular no fines rock with a particle size of between about 70 and 150mm, fully wrapped in a Class D geofabric;
 - Placement of a 40kN biaxial or triaxial geogrid over the exposed material and covered with at least say 300mm of pavement gravel (DGS40); and
 - A combination of some of the above measures.
- Fill must comply with the requirements presented within AS3798-2007 and with Section 6.3 of this report.
- 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 within $\pm 2\%$ 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 95% standard compaction, with the upper 300mm of the subgrade being compacted to at least 100% SMDD. Clay fill should be placed and maintained within 2% of standard optimum moisture content; and
- Where filling is required on batters, the material should be over-placed, compacted, and then trimmed back to the required batter to ensure that compaction is achieved to edge of batter.

In accordance with AS3798-2007, it is recommended that Level 1 Construction Monitoring and Testing be implemented for areas of the site that are filled to support structures, while areas of the site that are filled to support pavements should be filled under Level 2 supervision and testing.

7 FOUNDATIONS

7.1 Preliminary 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 similar structure. The preliminary site classifications presented herein are provided on the basis that the performance expectations of AS2870-2011 are acceptable for the proposed structures.

The preliminary site classifications presented herein is based on the following:

- Depth of design suction change of $H_s=1.5\text{m}$.
- Crack depth multiplication factor of 0.5.
- Change in suction at design surface level of $\Delta u=1.2$.
- Shrink-swell index of 2.9% for the residual clay; and
- Mature trees are not located closer than half the mature height of the tree from proposed structures.

Based on the above a preliminary site classification of Class M is assessed. Cut to fill earthworks will be undertaken which will affect the site classification. As a guide provided earthworks are undertaken in accordance the recommendation presented herein using site won material Class M classifications could be achieved for the finished lots. Individual lot classifications are recommended following the completion of bulk earthworks.

Changes to the soil moisture regime resulting from leaking services or the effects of tree roots can affect foundation movement. Appropriate site drainage must be maintained during and post construction and it is recommended that tree removal be undertaken as soon as possible to allow the soil moisture profile to reach equilibrium prior to construction.

Shrink-swell related movements can be affected by alterations to the soil profile by cutting and filling, and by the suction related effects of trees close to the building area. The effects of any such cutting, filling or tree planting should be considered when selecting design values for differential movement across the slab.

7.2 Foundation Options & Design Parameters

The proposed development is likely to comprise the construction of single or double storey residential structures. Based on the subsurface conditions encountered at the site, it is therefore expected that shallow footings comprising of pad/strip footings or raft slabs will be appropriate.

Shallow footings can be designed based on an allowable base bearing pressure of **100kPa** when founded on:

- Fill that has been placed under Level 1 construction monitoring and testing as defined with AS3798-2007.
- Stiff or better residual soil; or
- Extremely to highly weathered meta-siltstone.

It is recommended that all footings for an individual structure be founded on similar materials. All footings, edge beams and internal beams should be founded outside or below the zones of influence resulting from existing or future service trenches, retaining walls or other subsurface structures.

Prior to the placement of concrete, we recommend that footings be observed and assessed by a suitably experienced Geotechnical Engineer to assess that the correct founding material has been achieved.

Footings should be constructed as soon as practical upon reaching the founding depth and the foundations should not be left exposed and allowed to become wet and soften. If construction is delayed, the base of the foundation excavations should be blinded to prevent softening of soils and to provide a working platform for construction of the footings.

8 PAVEMENTS

CBR testing on samples of the existing subgrade returned values of 4.5 % and 8%. Based on experience in the area with similar soil profiles it is recommended that a preliminary design subgrade CBR of 4.5% is adopted for pavement design.

Pavement construction should be undertaken in accordance with the following:

- After excavation to design subgrade level, all topsoil, root affected or deleterious material should be striped to expose a suitable foundation prior to proof roll. If the subgrade fails proof roll geotechnical advice should be sought.
- 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 placed around the perimeter of the pavement(s) to 300mm below the underside of pavement and drain freely to the site stormwater system or other appropriate drainage location.
- Geotechnical assessment should be undertaken following boxing out of pavement areas to assess the need for additional, or deeper, subsoil drains due to potential for isolated seepages to occur in the weathered rock profile in the areas of deep cut.
- Where weathered rock is encountered at subgrade level it should be ripped to 300mm and re-compacted to break up preferential seepage paths.
- Pavement gravels should be placed and maintained at 60% to 90% of Optimum Moisture Content; and
- 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.

9 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



Joel Babbage

Geotechnical Engineer

Reviewed by



Adam Holzhauser

Principal Geotechnical Engineer

Figures



	Client:	de Groot and Benson	Job No.	RGS33955.1
	Project:	Proposed Residential Subdivision	Drawn By:	JB
		64 Pullen Street, Woolgoolga	Scale:	NTS
	Title:	Test Location Plan	Date:	23-Nov-23
			Drawing No.	Figure 1

Appendix A

Results of Field Investigations



ENGINEERING LOG - BOREHOLE

BOREHOLE NO: **BH1**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517854 m

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668581 m

DATUM:

AHD

Drilling and Sampling				Material description and profile information				Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	
AD/T	Not Encountered	CBR 0.10m				CL	TOPSOIL: Silty CLAY, low plasticity, dark brown/brown, trace sand, fine to medium grained, trace of grass roots	M < w _p	St	TOPSOIL
				0.15m		CH	Silty CLAY: Medium to high plasticity, brown/orange-brown, trace sand, fine to medium grained	M > w _p		RESIDUAL HP=350kPa
				0.5m						HP=350kPa
				0.70m		CI	Silty CLAY: Medium plasticity, red/brown with pale grey and grey mottling	M < w _p	H / Fr	
				1.0m						
				1.20m		CI	Silty CLAY: Medium plasticity, pale grey with red and brown mottling		VSt	
				1.5m						HP=320kPa
				2.0m						
				2.00m		CI	Silty CLAY: Medium plasticity, red/brown with pale grey mottling, trace of sand and gravel, fine to medium grained		H / Fr	HP=320kPa EXTREMELY WEATHERED PHYLLITE
				2.5m						
				3.0m						
				3.00m			Hole Terminated at 3.00 m			
				3.5m						

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

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

Density

V Very Loose

L Loose

MD Medium Dense

D Dense

VD Very Dense

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

Density Index <15%

Density Index 15 - 35%

Density Index 35 - 65%

Density Index 65 - 85%

Density Index 85 - 100%



ENGINEERING LOG - BOREHOLE

BOREHOLE NO: **BH2**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517888 m

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668621 m

DATUM: AHD

Drilling and Sampling				Material description and profile information				Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	
AD/T	Not Encountered					CL 0.15m CH 0.5 1.0 1.10m CH 1.5 1.70m CH 2.0 2.5 3.0 3.00m	TOPSOIL: Silty CLAY, low plasticity, dark brown/brown, trace sand, fine to medium grained, trace of grass roots Silty CLAY: Medium to high plasticity, brown/pale brown, some red mottling, trace sand and gravel, fine to medium grained Silty CLAY: Medium to high plasticity, red/brown with grey mottling, trace sand and gravel, fine to medium grained Silty CLAY: Medium to high plasticity, pale grey and red mottling, trace of sand and gravel, fine to medium grained Hole Terminated at 3.00 m	M < w _p M > w _p M < w _p	VSt	TOPSOIL RESIDUAL HP=260kPa HP=230kPa HP=360kPa HP=250kPa HP=370kPa

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

BOREHOLE NO: **BH3**

PAGE: 1 of 1
JOB NO: RGS33955.1
LOGGED BY: AH
DATE: 30/8/23

SURFACE RL:

DATUM: AHD

[illegible]

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 |

Field Tests

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

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 | |

Density

- | 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% | |

BOREHOLE NO: **BH4**

PAGE: 1 of 1
JOB NO: RGS33955.1
LOGGED BY: AH
DATE: 30/8/23

SURFACE RL:

DATUM: AHD

[illegible]

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 |

Field Tests

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

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 | Frangible | |

Density

- | <u>Density</u> | | | |
|----------------|--------------|-------------------------|--|
| 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% | |

Moisture Condition

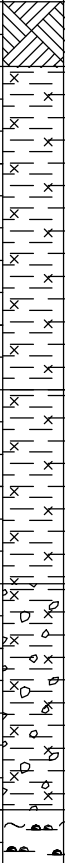
- | | |
|-------|---------------|
| D | Dry |
| M | Moist |
| W | Wet |
| W_p | Plastic Limit |
| W_L | Liquid Limit |

BOREHOLE NO: **BH5**

PAGE: 1 of 1
JOB NO: RGS33955.1
LOGGED BY: AH
DATE: 30/8/23

SURFACE RL:

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations			
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result				
AD/T	Not Encountered	0.20m			CL	0.20m	TOPSOIL: Silty CLAY, low plasticity, dark brown/brown, trace sand, fine to medium grained, trace of grass roots	M < w _p		DCP (0.00-1.00m)	3	TOPSOIL			
		CH			0.20m	Silty CLAY: Medium to high plasticity, orange, trace of sand and gravel, fine to medium grained	3								
		CBR			1.20m	CI	1.20m				Silty CLAY: Medium plasticity, red/brown, pale grey mottling, with some gravel, fine to coarse grained	H - Fr		4	EXTREMELY WEATHERED PHYLLITE/METASILTSTONE
							6								
							8								
							9								
							10								
							11								
							8								
		9													
		1.20m			CI	1.80m	Gravelly Silty CLAY: Medium plasticity, pale orange-brown/pale grey, gravel, fine to coarse grained	D		HP	450	HIGHLY WEATHERED METASILTSTONE			
						2.50m	METASILTSTONE: Grey/pale brown, dry, medium strength, highly fractured, highly weathered								
									2.70m	Hole Terminated at 2.70 m Refusal on Siltstone			HP	380	

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 |

Field Tests

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

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 | Frangible | |

Density

- | 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% | |

Moisture Condition

- | | |
|-------|---------------|
| D | Dry |
| M | Moist |
| W | Wet |
| W_p | Plastic Limit |
| W_L | Liquid Limit |

ENGINEERING LOG - BOREHOLE

CLIENT: de Groot and Benson
PROJECT NAME: Proposed Subdivision
SITE LOCATION: Pullen Street, Woolgoolga
TEST LOCATION: Refer to Figure 1

BOREHOLE NO: **BH6**
PAGE: 1 of 1
JOB NO: RGS33955.1
LOGGED BY: AH
DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
EASTING: 517812 m
NORTHING: 6668620 m
SURFACE RL:
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T	Not Encountered				CL	0.15m	TOPSOIL: Silty CLAY, low plasticity, brown/dark brown, trace sand, fine to medium grained, trace of grass roots Silty CLAY: Medium to high plasticity, orange	M < w _p	VSt - H			TOPSOIL
					CH							RESIDUAL HP=350kPa
					CI	0.70m	Silty CLAY: Medium plasticity, pale orange-brown/pale grey, trace to some gravel, fine to medium grained, trace sand, fine to medium grained	H / Fr	HP=430kPa EXTREMELY WEATHERED METASILTSTONE			
					MS	1.25m			HIGHLY WEATHERED METASILTSTONE			
				1.60m	Hole Terminated at 1.60 m Refusal on Rock							
				2.0								
				2.5						HP	450	
				3.0						HP	380	
				3.5								

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

BOREHOLE NO: **BH7**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517779 m

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668582 m

DATUM: AHD

Drilling and Sampling				Material description and profile information				Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	
AD/T	Not Encountered	CBR 0.30m		0.20m		CL	TOPSOIL: Silty CLAY, low plasticity, dark brown, trace sand and gravel, fine to medium grained, trace of grass roots	M < w _p	VSt - H	TOPSOIL
						CH	Silty CLAY: Medium to high plasticity, orange/brown, trace sand and gravel, fine to medium grained			RESIDUAL HP=350kPa
						CI	Silty CLAY: Medium plasticity, pale orange-brown/pale grey, trace sand and gravel, fine to medium grained			HP=450kPa
								H / Fr		EXTREMELY WEATHERED METASILTSTONE
				1.70m			METASILTSTONE: Pale orange/pale orange-brown, dry, low to medium strength, highly fractured, highly weathered	D		HIGHLY WEATHERED METASILTSTONE
				2.10m			Hole Terminated at 2.10 m Refusal on Rock			
				2.5					HP 450	
				3.0					HP 380	
				3.5						

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

BOREHOLE NO: **BH8**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517724 m

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668549 m

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations	
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result		
AD/T	Not Encountered	U			0.20m	CL	TOPSOIL: Silty CLAY, low plasticity, dark brown/brown, trace sand, fine to medium grained, trace of grass roots	M < w _p	VSt - H	H / Fr	TOPSOIL		
						CH	Silty CLAY: Medium to high plasticity, orange-brown/red-brown, trace sand and gravel, fine to medium grained				RESIDUAL HP=370kPa		
						CH	Silty CLAY: Medium to high plasticity, red-brown with pale brown/pale grey mottling				EXTREMELY WEATHERED METASILTSTONE		
						CI	Silty CLAY: Medium plasticity, pale orange-brown/pale grey, trace to some gravel, fine to medium grained						
							METASILTSTONE: Pale grey/pale orange, dry, medium strength, highly fractured, highly weathered				HIGHLY WEATHERED METASILTSTONE		
				2.00m				D		HP	450		
							Hole Terminated at 2.50 m Refusal on Rock						
										HP	380		
LEGEND:					Notes, Samples and Tests					Consistency		UCS (kPa)	Moisture Condition
Water					U ₅₀ 50mm Diameter tube sample					VS	Very Soft	<25	D Dry
Water Level (Date and time shown)					CBR Bulk sample for CBR testing					S	Soft	25 - 50	M Moist
Water Inflow					E Environmental sample					F	Firm	50 - 100	W Wet
Water Outflow					ASS Acid Sulfate Soil Sample					St	Stiff	100 - 200	W _p Plastic Limit
Strata Changes					B Bulk Sample					VSt	Very Stiff	200 - 400	W _L Liquid Limit
Gradational or transitional strata										H	Hard	>400	
Definitive or distinct strata change										Fb	Friable		
					Field Tests					Density			
					PID Photoionisation detector reading (ppm)					V	Very Loose	Density Index <15%	
					DCP(x-y) Dynamic penetrometer test (test depth interval shown)					L	Loose	Density Index 15 - 35%	
					HP Hand Penetrometer test (UCS kPa)					MD	Medium Dense	Density Index 35 - 65%	
										D	Dense	Density Index 65 - 85%	
										VD	Very Dense	Density Index 85 - 100%	



ENGINEERING LOG - BOREHOLE

BOREHOLE NO: **BH9**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517722 m

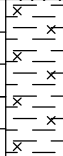
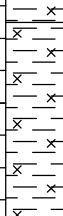
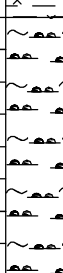
SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668610 m

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations									
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result										
AD/T	Not Encountered	0.45m CBR 0.60m		0.5		CL	0.20m TOPSOIL: Silty CLAY, low plasticity, dark brown, trace sand, fine to medium grained, trace of grass roots	M < w _p	H	DCP (0.00-1.10m)	2	TOPSOIL									
						CH					2	RESIDUAL									
						6															
						8															
						8															
						9															
		1.0			CI	0.75m Silty CLAY: Medium plasticity, pale orange-brown/pale grey, trace to some gravel, fine to medium grained	H / Fr	8	HP=550kPa												
					7																
					7																
					9																
					9																
1.5			1.40m METASILTSTONE: Pale orange/pale grey, dry, medium strength, highly fractured, highly weathered	D		HIGHLY WEATHERED METASILTSTONE															
						2.20m Hole Terminated at 2.20 m Refusal on Rock				HP	450										
											HP	380									

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

- 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

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 - BOREHOLE

BOREHOLE NO: **BH10**

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

EASTING: 517734 m

SURFACE RL:

BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668681 m

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T	Not Encountered					CL	TOPSOIL: Silty CLAY, low plasticity, dark brown, trace sand and gravel, fine to medium grained, trace of grass roots	M < w _p				TOPSOIL
				0.30m		CH	Silty CLAY: Medium to high plasticity, orange-brown, trace to some sand and gravel, fine to medium grained					SLOPEWASH HP=380kPa
				1.00m		CI	Silty Sandy CLAY: Medium plasticity, brown/pale brown, sand, fine to coarse grained, trace to some gravel, fine to medium grained					HP=420kPa
				3.00m								RESIDUAL HP=500kPa
				3.0			Hole Terminated at 3.00 m			HP	380	
				3.5								

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

- 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

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 - BOREHOLE

BOREHOLE NO: BH11**CLIENT:** de Groot and Benson**PAGE:** 1 of 1**PROJECT NAME:** Proposed Subdivision**JOB NO:** RGS33955.1**SITE LOCATION:** Pullen Street, Woolgoolga**LOGGED BY:** AH**TEST LOCATION:** Refer to Figure 1**DATE:** 30/8/23**DRILL TYPE:** RGS Ute Mounted Drill Rig**EASTING:** 517737 m**SURFACE RL:****BOREHOLE DIAMETER:** 100 mm**INCLINATION:** 90°**NORTHING:** 6668700 m**DATUM:** AHD

Drilling and Sampling				Material description and profile information				Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	
AD/T	Not Encountered	0.30m				CL	TOPSOIL: Silty CLAY, low plasticity, dark brown, trace sand and gravel, fine to medium grained, trace of grass roots	M < w _p		TOPSOIL
		ES 0.50m		0.5		CI	Silty CLAY: Medium plasticity, orange-brown, trace sand and gravel, fine to medium grained		H / Fr	SLOPEWASH HP=350kPa
		0.80m				CI	Silty Sandy CLAY: Medium plasticity, brown/pale brown, sand, fine to coarse grained, trace gravel, fine to medium grained			HP=420kPa
		ES 1.00m		1.0						RESIDUAL
		1.30m								
		ES 1.50m		1.5						
		1.80m								
		ES 2.00m		2.0						
		2.30m								
		ES 2.50m		2.5					HP	450
		2.80m								
		ES 3.00m		3.0					HP	380
							Hole Terminated at 3.00 m			
				3.5						

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

BOREHOLE NO: BH12

CLIENT: de Groot and Benson

PAGE: 1 of 1

PROJECT NAME: Proposed Subdivision

JOB NO: RGS33955.1

SITE LOCATION: Pullen Street, Woolgoolga

LOGGED BY: AH

TEST LOCATION: Refer to Figure 1

DATE: 30/8/23

DRILL TYPE: RGS Ute Mounted Drill Rig

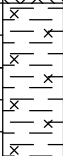
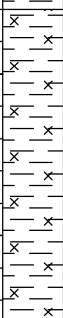
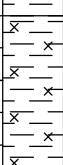
EASTING: 517779 m

SURFACE RL:
BOREHOLE DIAMETER: 100 mm

INCLINATION: 90°

NORTHING: 6668671 m

DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result			
AD/T	Not Encountered			0.5 1.0 1.5 2.0 2.5 3.0		CL	TOPSOIL: Silty CLAY, low plasticity, dark brown, trace sand and gravel, fine to medium grained, trace of grass roots	M < w _p				TOPSOIL		
					0.30m		CH					Silty CLAY: Medium to high plasticity, brown/red-brown, trace sand and gravel, fine to medium grained	VSt - H	HP=280kPa RESIDUAL HP=520kPa
					0.80m		CI					Silty CLAY: Medium plasticity, pale brown/grey with red mottling, trace sand and gravel, fine to medium grained	H	HP=>600kPa
					1.80m		CI	Silty CLAY: Medium plasticity, pale grey, pale orange-brown mottling, with some gravel, fine to medium grained	H / Fr				EXTREMELY WEATHERED METASILTSTONE	
					2.30m			METASILTSTONE: Pale grey/pale orange-brown, dry, medium strength, highly fractured, highly weathered					D	HP=450
					3.00m							Hole Terminated at 3.00 m		
				3.5										

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

Appendix B

Laboratory Test Result Sheets

Material Test Report

Report Number: RGS-624-1
Issue Number: 1
Date Issued: 23/11/2023
Client: Regional Geotechnical Solutions
 14/25-27 Hurley Drive, Coffs Harbour NSW 2450
Contact: Adam Holzhauser
Project Number: RGS-624
Project Name: Proposed Subdivision
Project Location: Pullen Street, Woolgoolga
Client Reference: RGS33955.1
Work Request: 6776
Sample Number: ACTS23-6776B
Date Sampled: 06/11/2023
Dates Tested: 07/11/2023 - 17/11/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Remarks: RGS33955.1
Site Selection: Selected by Client
Sample Location: BH5, Depth: 0.2-1.2



AC TESTING SERVICES
 SOILS | AGGREGATES | CONCRETE

P 0438 857 377 E info@actestingservices.com.au ABN 41 634 083 793
 Nambucca Valley Laboratory 6 West St, Macksville NSW 2447
 Armidale Laboratory Shop 11/215 Mann St, Armidale NSW 2350

Nambucca Heads
 6 West Street Macksville NSW 2447
 Phone: 0438 857 377
 Email: adam@actestingservices.com.au

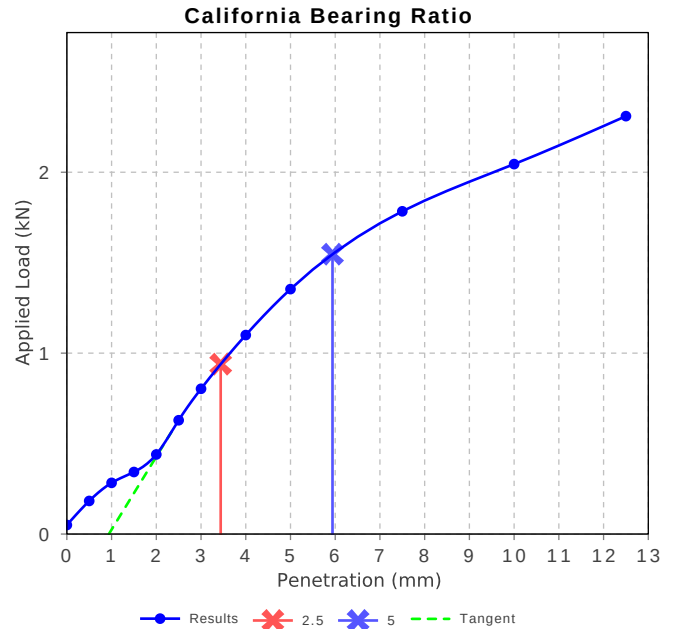


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Adam Crawford
 Lab Manager

NATA Accredited Laboratory Number: 19604

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	8		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual/Tactile		
Maximum Dry Density (t/m ³)	1.44		
Optimum Moisture Content (%)	29.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m ³)	1.42		
Field Moisture Content (%)	25.9		
Moisture Content at Placement (%)	29.0		
Moisture Content Top 30mm (%)	31.1		
Moisture Content Rest of Sample (%)	29.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	28.5		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Report Number: RGS-624-1
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Date Issued: 23/11/2023
Client: Regional Geotechnical Solutions
14/25-27 Hurley Drive, Coffs Harbour NSW 2450
Contact: Adam Holzhauser
Project Number: RGS-624
Project Name: Proposed Subdivision
Project Location: Pullen Street, Woolgoolga
Client Reference: RGS33955.1
Work Request: 6776
Sample Number: ACTS23-6776D
Date Sampled: 06/11/2023
Dates Tested: 07/11/2023 - 17/11/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Remarks: RGS33955.1
Site Selection: Selected by Client
Sample Location: BH9, Depth: 0.25-0.6



AC TESTING SERVICES
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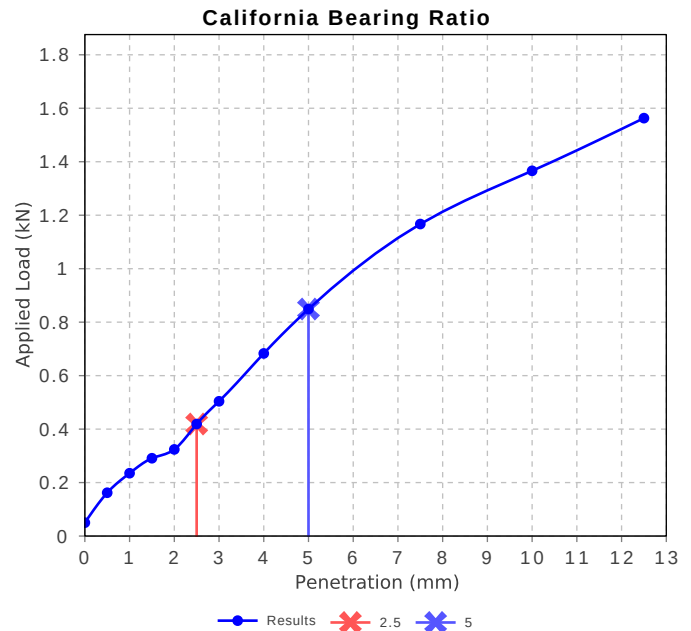


Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Adam Crawford
Lab Manager

NATA Accredited Laboratory Number: 19604

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	4.5		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual/Tactile		
Maximum Dry Density (t/m ³)	1.51		
Optimum Moisture Content (%)	26.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m ³)	1.50		
Field Moisture Content (%)	22.3		
Moisture Content at Placement (%)	26.6		
Moisture Content Top 30mm (%)	27.7		
Moisture Content Rest of Sample (%)	27.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	29.0		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report



AC TESTING SERVICES
SOILS | AGGREGATES | CONCRETE

Report Number: RGS-624-1
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Client: Regional Geotechnical Solutions
14/25-27 Hurley Drive, Coffs Harbour NSW 2450
Contact: Adam Holzhauser
Project Number: RGS-624
Project Name: Proposed Subdivision
Project Location: Pullen Street, Woolgoolga
Client Reference: RGS33955.1
Work Request: 6776
Dates Tested: 07/11/2023 - 08/11/2023
Remarks: RGS33955.1

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Approved Signatory: Adam Crawford
Lab Manager

NATA Accredited Laboratory Number: 19604

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	ACTS23-6776A	ACTS23-6776C			
Date Sampled	06/11/2023	06/11/2023			
Date Tested	08/11/2023	08/11/2023			
Material Source	BH4 0.5-0.9m	BH8 0.3-0.7m			
Sample Location	BH4 (0.5-0.9)	BH8 (0.3-0.7)			
Inert Material Estimate (%)	**	**			
Pocket Penetrometer before (kPa)	500	500			
Pocket Penetrometer after (kPa)	410	480			
Shrinkage Moisture Content (%)	27.4	33.0			
Shrinkage (%)	2.1	2.1			
Swell Moisture Content Before (%)	22.4	22.4			
Swell Moisture Content After (%)	29.7	27.0			
Swell (%)	0.2	6.2			
Shrink Swell Index Iss (%)	1.2	2.9			
Visual Description	**	**			
Cracking	SC	SC			
Crumbling	No	No			
Remarks	**	**			

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.

Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.

NATA Accreditation does not cover the performance of pocket penetrometer readings.