Preliminary Geotechnical Assessment

507 Raymond Terrace Road, Chisholm, NSW

Prepared for: Allam Property Group
EP1977.002 7 April 2021

APPROVED COMPANY ISO 9001 Quality Management Systems
QMS Certification Services

APPROVED COMPANY AS/NZS 4801 Occupational Health & Safety Management Systems
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EP RISK

Preliminary Geotechnical Assessment

507 Raymond Terrace Road, Chisholm, NSW

Allam Property Group
27 Lawson Street
Penrith NSW 2751

7 April 2021

Our Ref: EP1977.002

LIMITATIONS

This Preliminary Geotechnical Assessment was conducted for Allam Property Group for the purpose/s stated in **Section 1**.

EP Risk has prepared this document in good faith but is unable to provide certification outside of areas over which EP Risk had some control or were reasonably able to check. The report also relies upon information provided by third parties. EP Risk has undertaken all practical steps to confirm the reliability of the information provided by third parties and do not accept any liability for false or misleading information provided by these parties.

It is not possible in a Preliminary Geotechnical Assessment to present all data, which could be of interest to all readers of this report. Readers are referred to any referenced investigation reports for further data.

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Table of Contents

List of Tables in Body of Report

List of Attached Figures

List of Appendices

1 Introduction

1.1 Overview

EP Risk Management Pty Ltd (EP Risk) was engaged by Allam Property Group (Allam) to undertake a Preliminary Geotechnical Assessment (the Assessment) of a property located at 507 Raymond Terrace Road, Chisholm, New South Wales (NSW) (the Site). The Site location and regional map is illustrated in **Figure 1**.

It is understood that the Site is proposed to be separated into a two-lot subdivision identified as Lot 310 and 311 in DP 77811 and that Allam only require the Assessment to be undertaken on the larger Lot (Lot 311) to the North of the Site (Study Area). The Study area comprises of an area covering 7.15 ha.

1.2 Objective

The objective of the Assessment is to assess the subsurface profile conditions at the Site to provide preliminary geotechnical advice regarding the Proposed Development and identify any potential geotechnical constraints, provide preliminary pavement advice and preliminary site classifications as part of the due diligence. This assessment was undertaken concurrently with a Preliminary Site Investigation (preliminary contamination assessment) also for due diligence purposes and reported under separate title, reference EP1977.001.

1.3 Scope of Work

The scope of work completed to achieve the objectives included:

- A site walk over and inspection to observe on-site and off-site conditions and determine locations for subsurface investigations.
- Excavation of 10 test pits in targeted areas across the Site to a maximum depth of 2.5 metres below ground level (m BGL).
- Sampling of representative subsurface / subgrade materials encountered during investigation.
- Submission of selected samples in the proposed road locations and allotments to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.
- Based on the results of field investigations and analytical testing, prepare a Preliminary Geotechnical Report in accordance with the relative guidelines for pavement thickness design in accordance with Maitland City Council (Council).
- Preliminary site classification accordance with Australian Standard AS2870-2011 residential slabs and footings.
- Provide comment on any potential geotechnical constrains observed during site inspection and subsurface investigations.

2 Site Description

2.1 Site Identification

The Site Identification details are presented in **Table 1**.

Table 1 – Site Identification

Item	Description
Address	507 Raymond Terrace Road, Chisholm, NSW (**Figure 1**)
Legal description	Lot 31 in Deposited Plan (DP) 77811
Approximate Area	7.15 hectares (ha)
Municipality	Maitland City Council (Council)
Zoning	The Maitland Local Environment Plan (LEP) 2014 identifies the Site as R1 General Residential

2.2 Site Inspection and Observations

As of 25th February 2021, the Site comprised of a large rectangle shaped lot situated to the north of Raymond Terrace Road. The land use comprised of rural lifestyle living with the Site partial cleared of vegetation with the exception of semi mature eucalypt trees scattered across the Site with sparse grass cover and scrubby regrowth predominantly on the northern portion of the site. The Site is located within an area of R1 General Residential zoned land. EP Risk undertook a site inspection on 24th February 2021 comprising of a site walkover and visual assessment to determine suitable locations for subsurface investigations. Topographically the Site is situated within gently undulating terrain. Slope gradients fall north and south to a natural gully/ ephemeral watercourse transecting the centre of the Site with elevations ranging from 17 metres above Australian Height Datum ('m AHD') in the centre of the gully to 28 m AHD in the north and south portions of the Site. There is a small dam located in the centre of the Site within the watercourse. The Site drainage is considered to consist of surface runoff following surface contours migrating across the Site flowing into the dam and watercourse in the centre of the Site. Photographs of main Site features are presented in the photolog attached as **Appendix A**.

3 Investigation Methodology

3.1 Fieldwork

Field investigation was undertaken on the 25th February 2021 and comprised the advancement of ten (10) test pits via a 5 tonne excavator fitted with a 400 mm multipurpose tooth bucket. Test locations were advanced to a maximum depth of 2.5 m BGL. Dynamic Cone Penetrometer (DCP) tests were undertaken adjacent to each location to aid in determining the strength of the subgrade.

All fieldwork including logging of subsurface profiles and collection of samples was carried out by and in the presence of a geotechnical engineer from EP Risk. Test pits were located by handheld GPS from a KMZ file and the approximate locations are shown on **Figure 2**.

Subsurface conditions are summarised in Section 4.2 and detailed in engineering logs in **Appendix B**.

3.2 Laboratory Testing

Laboratory testing on selected samples recovered during fieldwork comprised of the following:

- Four (4) four-day soaked California Bearing Ratio (CBR) tests to assess subgrade strength.
- Four (4) shrink swell index (*Iss*) test.
- Four (4) aggressivity tests.
- Ten (10) point load strength tests.

Results of laboratory testing are detailed in the report sheets attached in **Appendix C** and summarised in Section 4.3 of this report.

4 Investigation Findings

4.1 Published Data

Based on the information contained in the Newcastle Coalfield Regional Geological Map 9231 (Edition 1, 1995) the Site is underlain by the Permian aged Maitland Group, Mulbring Siltstone which typically comprises siltstone and sandstone. Based on the soil landscapes data sourced from the NSW Office of Environment and Heritage (OEH) the Site is located within the Beresfield soil landscape.

Topographically the Site had gentle sloping gradients facing north and south with a gully / ephemeral watercourse transecting the centre of the Site with elevations ranging from 17 metres above Australian Height Datum ('m AHD') in the centre of the gully to 28 m AHD in the north and south portions of the Site. The Site drainage is considered to consist of surface runoff migrating across the Site as overland flowing into the dam and creek at the Site.

4.2 Mining Subsidence

With reference to the Mining Subsidence District Data Source (2016), the Site is not located within a mining subsidence district. No underground mining is shown on the site. There are known underground workings approximately 1.2km to the north west in the Tomago Coal Measures.

4.3 Subsurface Conditions

The subsurface conditions encountered in the test pits advanced across the Site are detailed in the report log sheets, attached in **Appendix B** with locations shown on **Figure 2**. A summary of subsurface conditions is presented in **Table 2**. In general, the subsurface can be summarised as follows:

Table 2 – Geotechnical Units

Unit	Material	Description / Depth Encountered	Comment
1a	Topsoil	Silty SAND: Brown, dry, non plastic, organic material, fine to coarse sand from 0 to 0.4 m BGL	-
2a	Residual	sandy CLAY from 0.2 to 2.4 m BGL	-
3a	XW Sandstone	Dry, fine to coarse grained from 1.5 to >2.5 m BGL.	Extremely weathered of very low to medium strength.

A general summary of the subsurface conditions encountered across the site is presented in **Table 3**.

Table 3 – Summary of subsurface conditions			
Test Pit ID	Depth of Topsoil/ **Fill** (m BGL)	Depth to Rock (mBGL)	Summary of subsurface profile
TP01	0.3	2.0	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP02	0.2	1.5	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP03	0.2	2.1	TOPSOIL (Silty SAND) / Sandy CLAY / XW/DW SANDSTONE
TP04	0.3	1.8	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP05	0.2	2.1	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP06	0.2	2.2	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP07	0.4	2.3	TOPSOIL (Silty SAND) / Sandy CLAY / XW/DWSANDSTONE
TP08	0.3	2.1	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP09	0.3	2.4	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE
TP10	0.3	2.0	TOPSOIL (Silty SAND) / Sandy CLAY / XW SANDSTONE

Groundwater/seepage was not encountered in any of the test pits advanced across the Site at the time of fieldwork. It should be noted that groundwater levels are likely to fluctuate with variations in climatic and Site conditions.

The sandstone bedrock encountered during test pitting was initially extremely weathered and ranged from predominantly very low strength to high strength in the distinctly weathered (DW) sandstone. Higher strength rock could be expected at greater depth than investigation limits, however, is not expected to pose excavation issues with large capacity equipment based on experience on proximate development within the same formation.

Detailed soil profile logs are attached as **Appendix B.**

4.4 Laboratory Results

4.4.1 CBR Results

Results of laboratory CBR results are detailed in report sheets attached in **Appendix C** and summarised in **Table 4**.

Table 4 – Summary Laboratory CBR Test Results							
Test Pit ID	Depth (m BGL)	Material Description	W[1] (%)	SOMC[2] (%)	SMDD[3] (t/m^3)	Swell (%)	CBR (%)
TP01	0.5-1.0	Sandy CLAY	20.8	21.5	1.62	2.5	3[4]
TP02	0.5-1.0	Sandy CLAY	19.4	21.0	1.65	2.0	2.5[5]
TP08	0.5-1.0	Sandy CLAY	22.5	23	1.62	2.0	2.0[8]
TP09	0.5-1.0	Sandy CLAY	21.4	21	1.62	2.5	2.0[9]

CBR samples were remoulded to a target of 100% relative density at approximately standard optimum moisture content (SOMC) and surcharged with 4.5 kg and soaked for four days prior to penetration. DCP testing undertaken at test pit locations indicate in-situ CBR value ranging from 3.5 % to >10% for the sandy

[1] Field moisture content.
[2] Standard Optimum Moisture Content.
[3] Standard Maximum Dry Density.
[4] CBR at 5.0 mm
[5] CBR at 2.5 mm

sandy clay surficial soils which is consistent with laboratory CBR testing undertaken in the laboratory which indicated CBR values of between 2.0% to 3.0%. The underling sandstone has a higher CBR value which will range from CBR 5% to greater than 10% depending on the degree of weathering based on experience on other developments in proximity to the Site. The DCP is moisture sensitive, and it should be noted that testing was undertaken during a relatively long wet period, however, insitu values correlate well with laboratory testing. The field moisture contents ranged between 1.6% below (dry of) SOMC to 0.4 % above (wet of) SOMC at the time of investigation, undertaken following a period of higher than average seasonal rainfall.

The CBR Swell results when compared to Table 5.2 Guide to classification of expansive soils in Austroads [5] indicate that the soils tested have a moderate to marginally highly expansive nature and specific strategies may be required to address potential volume change due to moisture variation in the subgrade. This will largely be dependent on the vertical alignment of roads and the material present within 0.5m of design subgrade level (DSL).

4.4.2 Shrink Swell Test Results

The laboratory *Iss* results are detailed in report sheets attached in **Appendix C** and summarised in **Table 5**.

Table 5 – Summary of Laboratory Shrink Swell Test Results

Test Pit ID	Depth (m BGL)	Soil Type	Esw[6] (%)	Esh[7] (%)	*Iss* (%)
TP03	0.5-1.0	Sandy CLAY	1.4	7.4	4.5
TP05	0.5-1.0	Sandy CLAY	3.7	3.6	3.0
TP06	0.5-1.0	Sandy CLAY	1.4	5.2	3.3
TP110	0.5-1.0	Sandy CLAY	4.4	5.2	4.1

Testing indicated that the surficial residual clay profile across the site is moderately to highly reactive.

4.4.3 Aggressivity Test Results

The laboratory Aggressivity results are detailed in report sheets attached in **Appendix C** and summarised in **Table 6.**

Table 6 – Summary of Laboratory Aggressivity Test Results

Test Pit ID	Depth (m BGL)	Material Description	Cl (mg/kg)	EC (Us/cm)	pH	Resistivity (ohm.m)	SO_4 (mg/kg)
TP03	0.5	Sandy CLAY	500	-	4.9	-	380
TP05	1.0	Sandy CLAY	430	-	5.0	-	420
TP06	0.5	Sandy CLAY	330	-	4.7	-	380
TP10	1.0	Sandy CLAY	380	-	4.9	-	210

Testing and comparison with AS2159-2009[8] indicated subsoil conditions above encountered are mild to non-aggressive exposure of underground concrete structures for soil conditions B (low permeability soils (e.g. silts and clays) for all soils above groundwater. The subsoil conditions encountered above are non-aggressive to underground steel structures for soil conditions B (low permeability soils (e.g. silts and clays) for all soils above groundwater.

[6] Swelling strain
[7] Shrinkage strain
[8] AS2159 Piling – Design and installation by Standards Australia 2009

4.4.4 Point Load Test Results

The laboratory point load testing results are detailed in report sheets attached in **Appendix C** and summarised in **Table 7.**

Table 7 – Summary of Point Load Test Results

Test Pit ID	Depth (m BGL)	Rock Type	Load (kN)	Is (MPa)	Is 50 (MPa)	Rock Strength
TP01	2.5	XW Sandstone	0.86	0.67	0.58	Medium
TP02	2.0	XW Sandstone	0.2	0.071	0.073	Very Low
TP03	2.4	DW Sandstone	1.8	1.2	1.1	High
TP04	2.4	XW Sandstone	0.92	0.84	0.7	Medium
TP05	2.4	XW Sandstone	1.19	0.52	0.51	Medium
TP06	2.4	XW Sandstone	1.19	0.52	0.51	Medium
TP07	2.4	DW Sandstone	4.83	2.3	2.2	High
TP08	2.4	XW Siltstone	1.58	0.96	0.87	Medium
TP09	2.4	XW Siltstone	0.4	0.098	0.11	Low
TP10	4.2	XW Siltstone	1.3	0.54	0.54	Medium

The point load tests indicate that that the strength of the of the bedrock ranges from very low strength in the extremely weathered (XW) sandstone to high strength in the distinctly weathered (DW) sandstone.

5 Preliminary Pavement Thickness Design

5.1 Design Traffic

Design traffic loadings and pavement thickness design calculation has been undertaken by EP Risk in accordance with *Maitland City Council Manual of Engineering Standards* [1].

The design traffic data has been determined on the basis of the following assumptions in **Table 8**.

Table 8 – Recommended Road Type and Design ESA's

Road Type	Roads Identification	Design ESA's
Local - Secondary	TBC	2×10^5
Local - Primary	TBC	5×10^5
Collector - Secondary	TBC	1×10^6
Collector - Primary	TBC	1.5×10^6

Where traffic data varies from the above assumptions a review of pavement design may be required particularly considering connectivity with adjacent developments.

5.1.1 Design Parameters

Pavement thickness has been undertaken in accordance with Austroads AGPT02-17 Guide to Pavement Technology, Part 2: Pavement Structural Design [4] based on the following parameters for site materials.

- Design subgrade CBR of 2% for silty sandy CLAY and 3% for sandy CLAY subgrade placed as controlled fill.
- In situ CBR correlations indicated value in the order of 3.5% to >10% at proposed DSL and will require confirmation following finalisation of vertical and horizontal road layouts,

The design subgrade has been determined in accordance with Section 5 of Austroads 2017 [4] on the basis of both laboratory and field-testing results.

Where filling is undertaken greater than 0.5 m depth, the CBR of the fill material should be undertaken into account for the design CBR. All fill materials should be a minimum of CBR 2.0% or 3% dependent on the pavement thickness option adopted based on 4-day soak when compacted to 100% standard relative density and SOMC.

5.2 Subgrade Preparations

Where construction of a new pavement is proposed, subgrade preparation should be in general accordance with the following procedures.

- Stripping of topsoil.
- Excavation and replacement of any uncontrolled fill as engineered fill in accordance with AS3798-2007 [9].
- Excavation or fill to design subgrade level.
- Static proof-rolling of the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experienced geotechnical consultant.
- Loose or yielding areas should be excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade.

- Where filling or subgrade replacement is required, the materials employed should be free of organics or other deleterious material. The material should also have a maximum particle size of 100mm or one third of the layer thickness, with a soaked CBR > 3% or 6% depending on the pavement option adopted.

Following satisfactory preparation of the subgrade, the pavement should be placed in accordance with the designer's recommendations.

5.2.1 Option 1 – Flexible Unbound Pavement (Clay 2%)

The option of pavement reconstruction utilising flexible unbound pavement materials is detailed in **Table 9.**

Table 9 – Recommended Flexible Unbound Pavement Compositions (Clay 2%)

Road Type	Local - Secondary	Local - Primary	Collector Secondary	Collector – Primary
Wearing Course (mm)	30 AC10*	30 AC10*	50 AC14*	50 AC14*
Basecourse (mm)	150	150	150	150
Subbase (mm)	150	150	180	210
Select (mm)	300	300	300	300
Total Thickness (mm)	630[9]	630[9]	680[9]	710[9]
Subgrade CBR%	min 2%	min 2%	min 2%	min 2%
Allowable DESA	2×10^3	5×10^5	1×10^6	1.5×10^6

Notes:
*AC 14 and AC10 with 10mm primer seal placed under all asphaltic concrete wearing surfaces.

5.2.2 Option 2– Flexible Unbound Pavement (Clay 3%)

The option of pavement reconstruction utilising flexible unbound pavement materials is detailed in **Table 10**.

Table 10 – Recommended Flexible Unbound Pavement Compositions (Clay 5%)

Road Type	Local - Secondary	Local – Primary	Collector - Secondary	Collector – Primary
Wearing Course (mm)	30 AC10*	30 AC10*	50 AC14*	50 AC14*
Basecourse (mm)	150	150	150	150
Subbase (mm)	150	150	150	150
Select (mm)	300	300	300	300
Total Thickness (mm)	630	630[9]	650[9]	650[9]
Subgrade CBR%	min 3%	min 3%	min 3%	min 3%
Allowable DESA	2×10^3	5×10^5	1×10^6	1.5×10^6

Notes: *AC14 and AC10 with 10mm or 7mm primer seal placed under all asphaltic concrete wearing surfaces

[9] Minimum coverage required due to potentially expansive subgrade

5.2.3 Option 3– Flexible Unbound Pavement (Weathered Rock Subgrade >6%)

The option of pavement reconstruction utilising flexible unbound pavement materials is detailed in **11.**

Table 11 – Recommended Flexible Unbound Pavement Compositions (Weathered Rock Subgrade >CBR 6%)

Road Type	Local - Secondary	Local – Primary	Collector - Secondary	Collector – Primary
Wearing Course (mm)	30 AC14*	30 AC10*	50 AC14*	50 AC14
Basecourse (mm)	150	150	150	150
Subbase (mm)	150	150	200	220
Select (mm)	-	-	-	
Total Thickness (mm)	330	330	400	420
Subgrade CBR%	min 6 %	min 6 %	min 6 %	min 6 %
Allowable DESA	2×10^5	5×10^5	1×10^6	1.5×10^6

A minimum of fourteen days duration shall apply following the application of the primer seal prior to application of subsequent asphalt layer(s). That period may be extended or shortened subject to approval by Council.

The determination of an extremely weather (XW) rock subgrade suitable to adopt a CBR 6% subgrade should be undertaken by a geotechnical consultant or suitably qualified council engineer. Extremely weathered siltstone and sandstone breaks down readily to produce low CBR similar to the clay subgrade materials.

DCP testing is recommended at subgrade to determine the appropriate pavement thickness design option to be adopted.

5.3 Materials

5.3.1 Specifications and Compaction Requirements

Pavement materials and compaction requirements for new pavement construction should conform to Council requirements and the following requirements outlined in **Table 12**.

Table 12 – Material specification and compaction requirements

Pavement Course	Material Specification	Compaction Requirements
Base Course DGB20 (Class 1 &2) [4] & NGB20[10]	Material complying with Council Specifications [1] with CBR > 80%, with PI ≤ 6%	Min 98% Modified (AS 1289 5.2.1)
Subbase Subbase quality crushed rock	Material complying with Council Specifications [1] with CBR >30% with PI ≥2≤ 10%	Min 95% Modified (AS 1289 5.2.1)
Select Granular material	Well graded granular material with CBR min 30% and PI ≤15%	Min 100% Standard (AS 1289 5.1.1)
Subgrade or replacement	Minimum CBR ≥3% or as appropriate for the design option.	Min 100% Standard (AS 1289 5.1.1)

[10] NGB and NGS material cannot be used on collector category roads due to higher design traffic.

All granular pavement material quality for any upgrade of the intersection should be in general accordance with RMS QA Specification 3051 [3] and Council Manual of Engineering Standards [1] for Traffic Category B. Minimum testing on all potential imported pavement materials should be in accordance with RMS 3051 Ed 7 [3]. Pre-treatment of material prior to testing would be advisable for materials subject to breakdown.

5.3.2 Wearing Course

Wearing courses should be in accordance with Council's specifications with reference to RMS QA Specifications R106 for Sprayed Bituminous Surfacing for primer seal and RMS QA Specifications R116 for Dense Graded Asphalt. It is noted that a 45mm AC14 wearing course is utilised for collector category in accordance with Council Specifications [1]. 50mm of AC14 has been specified for collector category as recent testing has shown this to be the optimal thickness for durability.

The design and construction of wearing courses should be in in consultation with the preferred supplier taking into account traffic volume and type. All pavement surfaces should be primer sealed prior to the application of the AC wearing course. A minimum delay of 14 days is required after the primer seal before placement of the AC wearing course.

5.3.3 Pavement Drainage

The pavement thickness designs presented above assume drained pavement conditions. The selection, construction and maintenance of appropriate drainage mechanisms would be required for adequate performance. The selection of appropriate construction materials that are relatively insensitive to moisture change is also essential in area subject to periodic inundation, even if for a relatively short period of time.

5.3.4 Inspections

The subgrade will require inspection by an experienced geotechnical consultant after boxing out or filling to design subgrade level. The purpose of inspections is to confirm design parameters, assess the suitability of the subgrade to support the pavement, and delineate areas which may require subgrade replacement or remedial treatment prior to construction. This is particularly important where competent rock subgrade is encountered, and the contractor wishes to transition from the clay pavement design to the weathered rock pavement design.

6 Preliminary Site Classification

Australian Standard AS 2870-2011[5] establishes performance requirements and specific designs for common foundation conditions as well as providing guidance on the design of footing systems using engineering principles. Site classes as defined on Table 2.1 and 2.3 of AS 2870 are presented in **Table 13**.

Table 13 – General Definition of Site Classes

Site Class	Foundation	Characteristic Surface Movement
A	Most sand and rock sites with little or no ground movement from moisture changes	-
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 – 40 mm
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 – 60 mm
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	> 75 mm
A to P	Filled sites (refer to clause 2.4.6 of AS 2870)	-
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.	

Reactive sites are sites consisting of clay soils that swell on wetting and shrink on drying, resulting in ground movements that can damage lightly loaded structures. The amount of ground movement is related to the physical properties of the clay and environmental factors such as climate, vegetation and watering. A higher probability of damage can occur on reactive sites where abnormal moisture conditions occur, as defined in AS 2870, due to factors such as:

- Presence of trees on the building site or adjacent site, removal of trees prior to or after construction, and the growth of trees too close to a footing. The proximity of mature trees and their effect on foundations should be considered when determining building areas within each allotment (refer to AS 2870).
- Failure to provide adequate site drainage or lack of maintenance of site drainage, failure to repair plumbing leaks and excessive or irregular watering of gardens.
- Unusual moisture conditions caused by removal of structures, ground covers (such as pavements), drains, dams, swimming pools, tanks etc.

Regarding the performance of footings systems, AS 2870 states “footing systems designed and constructed in accordance with this Standard on a normal site (see Clause 1.3.2) that is:

a) not subject to abnormal moisture conditions; and
b) maintained such that the original site classification remains valid and abnormal moisture conditions do not develop.

are expected to experience usually no damage, a low incidence of damage category 1 and an occasional incidence of damage category 2.”

Damage categories are defined in Appendix C of AS 2870, which is reproduced in CSIRO Information Sheet BTF 18, Foundation Maintenance and Footing Performance: A Homeowner's Guide attached as **Appendix D**.

The laboratory Shrink Swell test results summarised in **Table 5** indicate that the tested natural sandy clay soils range from moderate to highly reactive, with *Iss* values of 3.0 % to 4.5%. It is noted that reworking of the clay materials could increase reactivity. The *Iss* values were impacted by elevated moisture content due the extended wet season prior to the investigation.

Based on the subsurface profiles encountered during the Investigation and laboratory Shrink Swell test results, along with prior experience on the site and in accordance with the AS 2870-2011; the Site would likely have classification generally ranging from **Class M**, moderately reactive to **Class H2,** highly reactive in existing condition with some area of deeper fill potentially being classified as **Class E,** extremely reactive. Site Classification of **Class S,** slightly reactive and **Class A,** stable may also be applicable where shallow competent rock is encountered, and footing are uniformly founded on competent rock. Any areas of uncontrolled fill or areas disturbed during tree removal and demolition/ removal of structures and services will require remediation to avoid **Class P**, classifications.

Characteristic surface movements in the order of 35 mm to 65 mm has been calculated for the Site in its existing condition. Various conditions for the Site dependent on the soil profile, and potential depth of fill at test locations have also be calculated with characteristic surface movements greater than 75mm calculated for worst case scenarios where highly reactive material is used in deeper fills, which should be preventable with careful earthworks management. Actual site classification will be dependent on the extent or regrade undertaken on Site and the reactivity of material used as fill or exposed at present and final cut levels and the depth to bedrock.

The site classification is preliminary, and soil reactivity will vary across the Site with depth and location.

The above Site classifications and footing recommendations are for the Site conditions present at the time of fieldwork and consequently the Site classification may need to be reviewed with consideration of any site works that may be undertaken after the investigation and this report.

Site works may include:

- Changes to the existing soil profile by cutting and filling.
- Landscaping, including trees removed or planted in the general building area; and
- Drainage and watering systems.

Designs and design methods presented in AS 2870-2011 are based on the performance requirement that significant damage can be avoided if site conditions are properly maintained. Performance requirements and foundation maintenance are outlined in Appendix B of AS 2870. The above site classification assumes that the performance requirements as set out in Appendix B of AS 2870 are acceptable and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.

Details on appropriate site and foundation maintenance practices are presented in Appendix B of AS 2870-2011 and in CSIRO Information Sheet BTF 18, Foundation Maintenance and Footing Performance: A Homeowner's Guide, and the Australian Geoguide (LR8) Hillside Construction Practice.

Adherence to the detailing requirement outlined in Section 5 of AS 2870-2011 is essential, in particular Section 5.6. Additional requirements for Classes M, H1, H2 and E sites, including architectural restrictions, plumbing and drainage requirements.

6.1 Footings

All foundations should be designed by a suitably qualified engineer with reference to site classifications as presented in **Section 6.**

All footings should be founded below any topsoil, slopewash, deleterious soils or uncontrolled fill. All footings for the same structure should be founded on strata of similar stiffness and reactivity to minimise the risk of differential movements.

Potential for differential movement should be considered due to variation in depth to rock and filling across the Site and articulation incorporated into the design.

6.1.1 High Level Footings

High-level footing alternatives could be expected to comprise slabs on ground with edge beams or pad footings for the support of concentrated loads. Such footings designed in accordance with engineering principles and founded in stiff or better soils (below topsoil, slopewash, uncontrolled fill or other deleterious material) may be proportioned on an allowable bearing capacity of 100 kPa.

Where controlled lot filling has been carried out, high-level footing types can be founded below any topsoil onto the engineered fill that is placed and compacted in accordance with AS3798-2007 [2].

Where footings designed in accordance with engineering principles and founded uniformity on extremely weathered rock may be proportioned on an allowable bearing capacity of 400 kPa.

The founding conditions should be assessed by a geotechnical consultant or experienced engineer to confirm suitable conditions.

6.1.2 Piered Footings

Piered footings are considered as an alternative to deep edge beams or high-level footings and provide an alternate founding solution. It is suggested that bored piered footings, founded in stiff or better natural clay could be proportioned on an end bearing pressure of 150 kPa or if founded in competent weathered rock, could be proportioned on an end bearing pressure of 400 kPa and potential higher subject to further assessment.

All footings should be founded below any topsoil, slopewash, deleterious soils or uncontrolled fill. All footings for the same structure should be founded on strata of similar stiffness and reactivity to minimise the risk of differential movements.

Inspection of high level or pier footings excavations should be undertaken to confirm the founding conditions and the base should be cleared of fall-in prior to the formation of the footing.

7 General Construction Considerations

7.1 Excavations

Excavatability conditions have not been assessed beyond the depths to which the test pits were advanced using a 5-tonne excavator. The weathered rock encountered at depths ranging from 1.5 to >2.5 m was estimated by point load testing to range from very low tohigh strength. Refusal was not encountered prior to target depth. Rock was encountered in all ten (10) test pits undertaken ranging from 1.5 m to 2.4 m. It should be noted that rock could potentially be encountered at higher levels outside of the test pit locations resulting in machine refusal at shallower depths. This is particularly relevant if smaller excavation equipment is used. The area is known to have higher strength rock at shallow depths therefore it could be anticipated that hard excavation may be encountered quickly once competent rock is encountered. Based on experience on development proximate to the site, excavation should be achievable with D8 size dozers with single ripper or large capacity excavators.

Where excavation significantly below the depths reached in the test pits and detailed above is proposed it would be considered prudent to make allowance for hydraulic rock hammer excavation or use of large capacity (25-30 tonne) excavator with a single ripper attachment. Considerable caution should be taken during rock excavation using hydraulic rock hammers or jack hammers in proximity to existing structures due to the potential for direct transmission of ground vibration to proximate buildings and structures.

7.2 Excavation Stability

Excavations or trenches in the sandy clay soils and extremely weathered rock could be expected to stand close to vertical in the short-term. Sandy clays were encountered within various areas of the Site down to depths of 2.4 m and unsupported short-term excavations or trenches may undergo some local slumping into the excavation, particularly following heavy or extended rainfall periods.

Where personnel are to enter excavations, options for short-term excavations include benching or battering back of the excavations to 1H:1V or the support of excavations within the residual soil and extremely weathered rock profile.

It is recommended that long-term excavations are either battered at 2H:1V or flatter and protected against erosion or be supported by engineer designed and suitably constructed retaining walls. Excavations may be battered steeper than 2H:1V in rock materials, subject to specific geotechnical assessment. The excavation recommendations provided above should be completed in reference to the Safe Work Australia Code of Practice ‘Excavation Work’, dated 31 July 2014.

7.3 Retaining Walls

All retaining walls should be designed by an engineer. Design of retaining walls should:

- Consider surcharge loading from slopes and structures above the wall.
- Take into account loading from any proposed compaction of fill behind the wall.
- Provide adequate surface and subsurface drainage behind all retaining walls, including a free draining granular backfill to prevent the build-up of hydrostatic pressures behind the wall.
- Utilise materials that are not susceptible to deterioration.
- Ensure walls are founded in materials appropriate for the loading conditions.

Footings for proposed retaining walls should be founded below any topsoil and uncontrolled fill within stiff or better clay or weathered rock. It is recommended to avoid founding retaining walls in the quaternary sediment and retaining walls should be founded in residual soil.

7.4 Filling

Fill should be placed and compacted in accordance with AS 3798-2007 [6]. It is expected that construction of a suitable fill platform to support structural loads, such as ground slabs and stiffened raft slabs, would include the following:

- Stripping of topsoil.
- Proof rolling of the exposed subgrade to detect any weak or deforming areas of subgrade that should be excavated and replaced with compacted fill.
- Site materials will likely require treatment or moisture re-conditioning prior to placement and compaction.
- Placement of fill in horizontal layers with compaction of each layer to a minimum dry density ratio of 95% Standard Relative Density (Australian Standard AS 1289 Clause 5.1.1) in residential areas and at moisture contents of 85-115% of SOMC. Fill within 0.5m of design subgrade in road alignments is to be compacted to 100% standard relative density at a 70-100% of SOMC and preferably as close to SOMC to reduce the potential for volume change in the expansive clays.

All fill should be supported by properly designed and constructed retaining walls or else battered at a slope of 2H:1V or flatter and protected against erosion by vegetation or similar and the provision of adequate drainage.

Materials excavated on Site with the exception of topsoil, and other deleterious materials such as uncontrolled fill, alluvial silts and clays if encountered are considered suitable for re-use as engineering fill. Some materials will likely require treatment or moisture re-conditioning, subject to further assessment and weather conditions prior to and during construction.

It is noted that materials of non-aggressive to mild aggressivity are evident at the Site. Care should be taken in the utilisation of site material to avoid increasing existing site classifications. Reactive materials should preferably be used in the base of deeper fill areas ≥1.2m BGL.

7.5 Subgrade Preparations

Where construction of a new pavement is proposed, subgrade preparation should be in general accordance with the following procedures.

- Excavation to design subgrade level, removal of any uncontrolled fill (any uncontrolled fill material will require removal), with ripping to 300-350mm below design subgrade level and recompact to a minimum 100% of SMDD. Moisture contents should be within 60 to 90% of SOMC but generally within 2% of SOMC for moderately expansive and highly expansive subgrade.
- Static proof-rolling of the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experienced geotechnical consultant.
- Loose or yielding areas should be excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade.
- Where filling or subgrade replacement is required, the materials employed should be free of organics or other deleterious material. The material should also have a maximum particle size of 100mm or one third of the layer thickness, with a soaked CBR > 3% or 5% depending on the pavement option adopted.
- Where a select layer is to be utilised in construction of the pavement. The material shall be well graded granular material with minimum 4 day soaked CBR of 3% and PI ≤15%. The select layer

should be compacted to a minimum 100% of SMDD. Moisture contents should be within 60 to 90% of SOMC.

Following satisfactory preparation of the subgrade, the pavement should be placed in accordance with the requirements of the appropriate section of this report and Council MoES [1] depending on the subgrade type.

7.6 Drainage

The moisture regime associated with a pavement has a major influence on the performance considering the stiffness/strength of the pavement materials is dependent on the moisture content of the material used. Accordingly, to protect the pavement materials from wetting up and softening, particular care would be required to provide a waterproof seal for the pavement materials, together with adequate surface and sub-surface drainage of the pavement and adjacent areas.

Subsoil drainage shall be provided on both sides of the road pavements and in all road stormwater pipe trenches in accordance with Council's standard drawings SD035 and additionally as required by Council, or the geotechnical engineer where for example, drains are considered necessary where sub-soil moisture problems are encountered. The type, location and extent of subsoil drainage may vary depending on pavement materials or in-situ conditions. The subgrade should be constructed with sufficient cross fall (in general 3%) to assist in reducing retention time for moisture entering the pavement. The subsoil drains should be placed under or at the back or kerb and the shoulder sealed with a low permeability material to prevent moisture ingress into the pavement. Sealing of shoulder / verges with low permeability material where kerb and gutter is not employed is recommended to reduce potential for moisture ingress into the pavement.

The pavement thickness designs presented above assume drained pavement conditions. The selection, construction and maintenance of appropriate drainage mechanisms would be required for adequate performance. The selection of appropriate construction materials that are relatively insensitive to moisture change is also essential in area subject to periodic inundation, even if for a relatively short period of time.

Drainage should be in accordance with Section 8 of Chapter 007 CONSTRUCTION – ROADS, DRAINAGE, CONCRETE of the Council MoES.

8 Conclusions and Recommendations

EP Risk was engaged by Allam Property Group to undertake a Preliminary Geotechnical Assessment for a property located at 507 Raymond Terrace Road, Chisholm, NSW. The purpose of the Assessment was to assess the subsurface profile conditions at the Site to provide preliminary geotechnical advice in regards the proposed redevelopment of the Site into a low-density residential development.

The land use comprised of rural lifestyle living with the Site partial cleared of vegetation with the exception of semi mature and juvenile eucalypt trees scattered across the Site with sparse grass cover and scrubby regrowth predominantly on the northern portion of the site. The Site is located within an area of R1 General Residential zoned land. EP Risk undertook a site inspection on 24th February 2021 comprising of a site walkover and visual assessment to determine suitable locations for subsurface investigations. Topographically the Site is situated within gently undulating terrain. Slope gradients fall north and south to a natural gully/ ephemeral watercourse transecting the centre of the Site with elevations ranging from 17 metres above Australian Height Datum ('m AHD') in the centre of the gully to 28 m AHD in the north and south portions of the Site. There is a small dam located in the centre of the Site within the watercourse. The Site drainage is considered to consist of surface runoff following topographic contours migrating across the Site flowing into the dam and ephemeral watercourse in the centre of the Site. Based on the information contained in the Newcastle Coalfield Regional Geological Map 9231 (Edition 1, 1995) the Site is underlain by the Palaeozoic aged Maitland Group, Mulbring Siltstone which typically comprises siltstone and sandstone.

Based on the soil landscapes data sourced from the NSW Office of Environment and Heritage (OEH) the Site is located within the Beresfield soil landscape.

Field investigation was undertaken on the 25 February2021 and comprised the advancement of excavation of ten (10) test pits via 5 tonne excavator fitted with a 400 mm multipurpose bucket. Test locations were advanced to a maximum depth of 2.5 m BGL. Dynamic Cone Penetrometer (DCP) tests were undertaken adjacent to each location to aid in determining the strength of the subgrade.

Pavement designs have been provided for design subgrade CBR's of 2%, 3% and 6%, with flexible and heavily bound options. CBR 2-3 % is considered the predominant subgrade which will be encountered at design level follow regrade. The subgrade materials encountered are moderate to highly expansive in nature and the use of a select material layer will be required for all clay subgrades, which will result in relatively thick pavements.

Preliminary Site Classification indicates that **Class M**, moderately reactive to Class **H2**, highly reactive would be expected in the existing condition and following regrade using onsite materials. Actual Site classifications will be dependent on the depth of rock and earthworks undertaken however careful management of earthworks will be required to avoid higher classifications of potential **Class E**, extremely reactive due to the reactivity of clay soils on Site particularly where used as fill.

Rock was encountered in all ten (10) test pits undertaken within a depth of 2.5m BGL. Refusal was not encountered using a 5-tonne excavator. It would be recommended to undertake trial excavation using a 20-30 tonne excavator where excavation significantly beyond the depth of investigation is proposed.

The point load index results of samples obtained from the extremely weathered to distinctly weathered sandstone encountered across the Site ranges from very low to high strength.

The aggressivity results of samples obtained from the natural residual sandy clay material encountered across the Site is non-aggressive to underground steel structures and non-aggressive to mildly reactive to underground concrete structures.

Minor uncontrolled fill can be expected in isolated areas due to the previous site usage (refer to Preliminary Contamination Site Investigation Report EP1977.001.

9 Closure

From a geotechnical perspective there are no constraints prohibitive to the proposed development as a residential development. Due to the expansive nature of the clay subgrades encountered a select layer will be required to facilitate construction of pavement in line with Council requirements.

Weathered rock encountered at depths ranging from 1.5 – 2.4 m was estimated to be of very low to high strength and refusal was not encountered prior to target depth in all ten (10) test pits where rock was encountered. Based on previous experience on proximate developments the rock should be excavatable with D8 size dozers with single ripper or large capacity excavators.

No groundwater was encountered in the test pits during the investigation. It should be noted that groundwater is likely to fluctuate based of climatic conditions.

No underground mining works or mine subsidence districts have been identified within and adjacent to the proposed residential subdivision development.

The clays across the site are moderately to highly reactive and careful earthworks management will be required to avoid Site Classification of Class E, extremely reactive. The more reactive material should be used in the base of deeper fills at ≥1m below finished surface level.

10 References

[1] Maitland City Council – Manual of Engineering Standards

[2] Austroads AGPT05-11, "Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design," Austroads Ltd, October 2011.

[3] RMS QA Specification 3051 (Ed 7 Rev 0), "Granular Base and Subbase Materials for Surfaced Road Pavements," Roads and Maritime Services, August 2018.

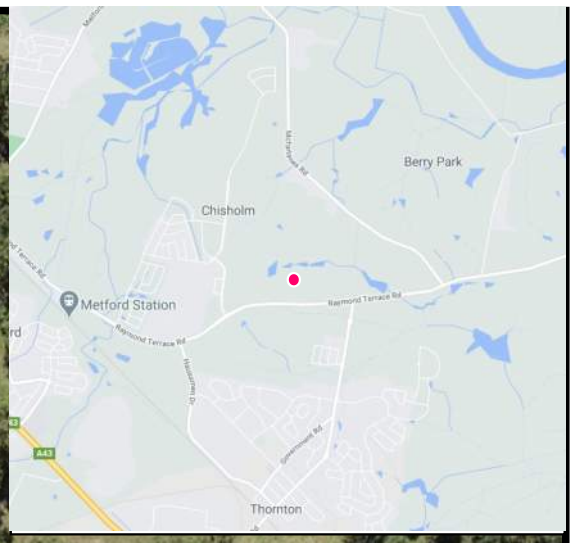
[4] Austroads AGPT02-17, "Guide to Pavement Technology Part 2: Pavement Structural Design," Austroads Ltd, 2017.

[5] Australian Standard AS2870-2011 "Residential slabs and footing"

[6] Australian Standard AS3798-2007 "Guideline on earthworks for commercial and residential developments".

[7] Australian Standard AS2159-2009, "Piling - Design & Installation," Standards Australia, 2009

Figures



EP RISK

Preliminary Geotechnical Assessment
507 Raymond Terrace Road, Chisholm, NSW

Figure 1 - Site Location

www.eprisk.com.a

Job No: EP1977.002
Date: 25/03/2021
Drawing Ref: Fig 1
Version No: v1

N

0 40 80 120 m

Approximate Scale Only

Coordinate System: MGA 56
Drawn by: LK Checked by: JY
Scale of regional map not shown
Source: Near Maps

APPROVED COMPANY ISO 9001 QMS Certification Services
APPROVED COMPANY AS/NZS 4801 QMS Certification Services
APPROVED COMPANY ISO 14001 QMS Certification Services

EP RISK

Preliminary Geotechnical Assessment
507 Raymond Terrace Road, Chisholm, NSW

Figure 2 - Test Pit Locations

www.eprisk.com.au

Job No: EP1977.002
Date: 25/03/2021
Drawing Ref: Fig 2
Version No: v1

N

0 20 40 60 m

Approximate Scale Only

Coordinate System: MGA 56
Drawn by: LK Checked by: JY
Scale of regional map not shown
Source: Near Maps

APPROVED COMPANY ISO 9001 Quality Management Systems QMS Certification Services
APPROVED COMPANY AS/NZS 4801 Occupational Health & Safety Management Systems QMS Certification Services
APPROVED COMPANY ISO 14001 Environmental Management Systems QMS Certification Services

Appendix A
PHOTO LOG

	**Plate 1** **Description:** Silty SAND topsoil layer encountered in the test pits. No anthropogenic material observed. **Date:** 25/02/2021
	**Plate 2** **Description:** Residual Sandy CLAY material encountered across the Site. **Date:** 25/02/2021

	**Plate 3** **Description:** Residual Sandy CLAY colour change from mottled orange and red to mottled grey and orange. **Date: 25/02/2021**
	**Plate 4** **Description:** Extremely weathered sandstone encountered in all the test pits across the Site. **Date: 25/02/2021**

Appendix B
SOIL LOGS

TEST PIT 01

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence Assessment
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.8 m BGL

EASTING - 32°45'42.21"
NORTHING 151°38'34.53"
SURFACE ELEVATION 28 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP01_0.1			TOPSOIL: Silty Sand, fine to coarse grained, loose, non-plastic, brown.	D	3 5 5		
						Sandy CLAY:Grey mottled red and orange, medium to high plasticity, fine sand, near the plastic limit. Residual.		2 2	Stiff	
0.5		250	TP01_0.5 ASS01_0.5 CBR_0.5_1.					3 4 4		
								5 7	Very stiff	
1		300	ASS02_1.0					7 8		
									Very stiff to Hard	
1.5		350								
		400								
2						Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular sandstone gravels, low - moderate strength				
2.5			Point Load							
						EOI at 2.8m				

TEST PIT 02

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence Assessment
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.1 m BGL

EASTING - 32°45'41.78"
NORTHING 151°38'30.69"
SURFACE ELEVATION 27 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP02_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	3 5		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		4 5 5 4 5 5 5	Stiff to very stiff	
0.5		250	TP02_0.5 ASS03_0.5 CBR_0.5_1.							
						As above but grey		6		
1		300	ASS04_1.0						Very stiff	
		350								
1.5						Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength				
2			Point Load							
						Redusal at 2.1 m on sandstone.				

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TEST PIT 03

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'40.41"
NORTHING 151°38'32.82"
SURFACE ELEVATION 28 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP03_0.1			TOPSOIL: Silty SAND: Brown fine to coarse grained, loose, non-plastic, organic material.	D	3		
								2		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		2	Stiff to very stiff.	
								2		
0.5		150	TP03_0.5, ASS05_0.5, AGG					2		
								3		
								5		
								4		
								4		
1		250	ASS06_1.0			As above but grey				
1.5		300								
2						Extremely weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength				
			Point Load							
2.5						End of Investigation at 2.5 m BGL				

produced by ESlog.ESdat.net on 26 Mar 2021

TEST PIT 04

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence Assessment
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'39.29"
NORTHING 151°38'34.96"
SURFACE ELEVATION 27 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP04_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	5		
								8		
								6		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		3	Stiff.	
0.5		150	TP04_0.5, ASS07_0.5					3		
								3		
								3		
								4		
								4		
1		300	ASS08_1.0					3		
								3		
								4		
								12	Very stiff.	
1.5		350								
						Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
2										
			Point Load							
2.5						End of investigation at 2.5 m BGL				

Disclaimer This log is intended for environmental and geotechnical purposes.

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TEST PIT 05

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence Assessment
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'38.14"
NORTHING 151°38'33.17"
SURFACE ELEVATION 25 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP05_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	5		
								4		
						Sandy CLAY: Red, medium to high plasticity, coarse sand. Residual.		2	Stiff to very stiff.	
								2		
			TP05_0.5, ASS09_0.5					2		
0.5		200						4		
						As above but grey		5		
								4		
								5		
								5		
1		250	ASS010_1.0					5		
								7		
									Very stiff	
1.5		300								
2		350								
						Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
			Point Load							
2.5						End of Investigation at 2.5 m BGL				

TEST PIT 06

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'35.04"
NORTHING 151°38'32.25"
SURFACE ELEVATION 22 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP06_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	4 3 3		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		4	Stiff	
0.5		150	TP06_0.5 ASS11_0.5 SSI					4 4 3 4 4 4 4		
1		200	ASS12_1.0			As above but grey		4		
								5 6	Very stiff	
1.5		300								
2		350								
			Point Load TP06_2.4			Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
2.5						End of Investigation at 2.5 m BGL.				

TEST PIT 07

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'34.95"
NORTHING 151°38'35.83"
SURFACE ELEVATION 20 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP07_0.1			TOPSOIL: Silty SANDL Brown, fine to coarse grained, loose, non-plastic, organic material.	D	3		
								3		
								5		
								3		
0.5		150	TP07_0.5 ASS13_0.5			Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		4	Very stiff.	
								3		
								4		
								5		
								5		
1		200	ASS14_1.0			As above but no sand.				
1.5		300								
2		350								
			Point Load TP07_2.4			Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
2.5						End of Investigation at 2.5 m BGL.				

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TEST PIT 08

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'31.99"
NORTHING 151°38'32.45"
SURFACE ELEVATION 26 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP08_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	2		
								1		
								1		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		2	Stiff to very stiff.	
								2		
0.5		200	TP08_0.5 ASS15_0.5 CBR, TP08_0.5_1					2		
								3		
								4		
								5		
								5		
1		250	ASS16_1.0			As above but grey		6		
								5		
								6		
								6		
1.5		300								
2		350				Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
			Point Load TP08_2.4							
2.5						End of Investigation at 2.5 m BGL.				

produced by ESlog.ESdat.net on 26 Mar 2021

TEST PIT 09

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'32.45"
NORTHING 151°38'36.13"
SURFACE ELEVATION 23 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP09_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	3		
								3		
								3		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		2	Firm	
								1		
0.5		250	TP09_0.5					2		
			ASS17_0.5							
			CBR, TP09_0.5_1					3	Stiff	
								3		
								4		
						As above but grey		4		
1		250								
			ASS18_1.0					5	Very Stiff	
								6		
								7		
1.5		300								
2		350								
			Point Load							
			TP09_2.4			Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
2.5						End of Investigation at 2.5 m BGL.				

produced by ESlog.ESdat.net on 26 Mar 2021

TEST PIT 10

PROJECT NUMBER EP1977
PROJECT NAME Due Diligence
CLIENT Allam Property Group
ADDRESS 570 Raymond Terrace Rd, Chisholm NSW

DRILLING DATE 25/02/2021
DRILLING COMPANY Lovett's Earthmoving
DRILLER RN
DRILLING METHOD 400mm Bucket
TOTAL DEPTH 2.5 m BGL

EASTING - 32°45'30.55"
NORTHING 151°38'34.51"
SURFACE ELEVATION 27 m AHD
LOGGED BY GR
CHECKED BY LK

COMMENTS

Depth (m)	PID	PP (kPa)	Samples	Is Analysed?	Graphic Log	Material Description: Soil type, plasticity/particle characteristics, colour, minor components	Moisture	DCP	Consistency	Additional Observations
			TP10_0.1			TOPSOIL: Silty SAND: Brown, fine to coarse grained, loose, non-plastic, organic material.	D	3		
								2		
								3		
						Sandy CLAY: Grey mottled red and orange, medium to high plasticity, fine sand, near plastic limit. Residual.		2	Stiff	
								3		
0.5		200	TP10_0.5					2		
			ASS19_0.5					2		
			SSI					4		
								4		
						As above but grey		4		
1		300						5	Very stiff	
			ASS20_1.0					5		
								6		
1.5		350								
2						Extremely Weathered SANDSTONE: Grey and red, fine to coarse grained, fine to medium sub angular gravels, low - moderate strength.				
			Point Load							
			TP10_2.4							
2.5						End of Investigation at 2.5 m BGL.				

produced by ESlog.ESdat.net on 26 Mar 2021

Appendix C
LABORATORY TEST RESULTS

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC21S-01393
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC00307AA
Project Name:	EP1977 - Chisholm Assessment
Lot No.:	- **TRN:** -

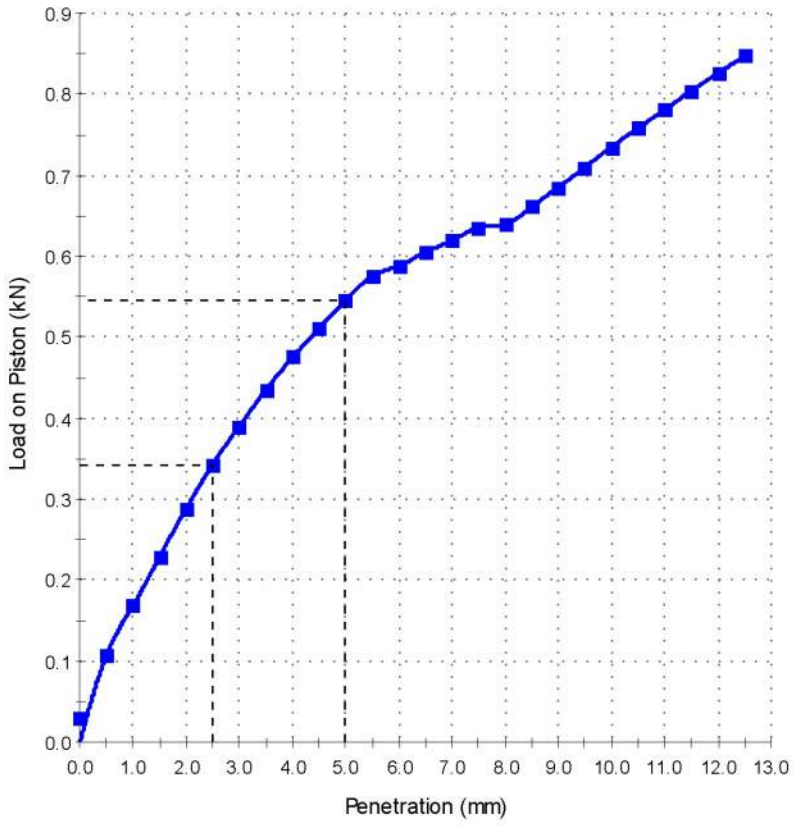
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID:	NEWC21S-01393	**Sampling Method:**	Submitted by client
Client ID:	-	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	4/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP01 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 5.0mm (%):	**3.0**
Dry Density before Soaking (t/m³):	1.62
Density Ratio before Soaking (%):	100.0
Moisture Content before Soaking (%):	21.7
Moisture Ratio before Soaking (%):	100.0
Dry Density after Soaking (t/m³):	1.58
Density Ratio after Soaking (%):	97.0
Swell (%):	2.5
Moisture Content of Top 30mm (%):	28.6
Moisture Content of Remaining Depth (%):	26.8
Compaction Hammer Used:	Standard
	AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	57
Plasticity Determination Method:	Visual/Tactile
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	20.8

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC21S-01394
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC00307AA
Project Name:	EP1977 - Chisholm Assessment
Lot No.:	- **TRN:** -

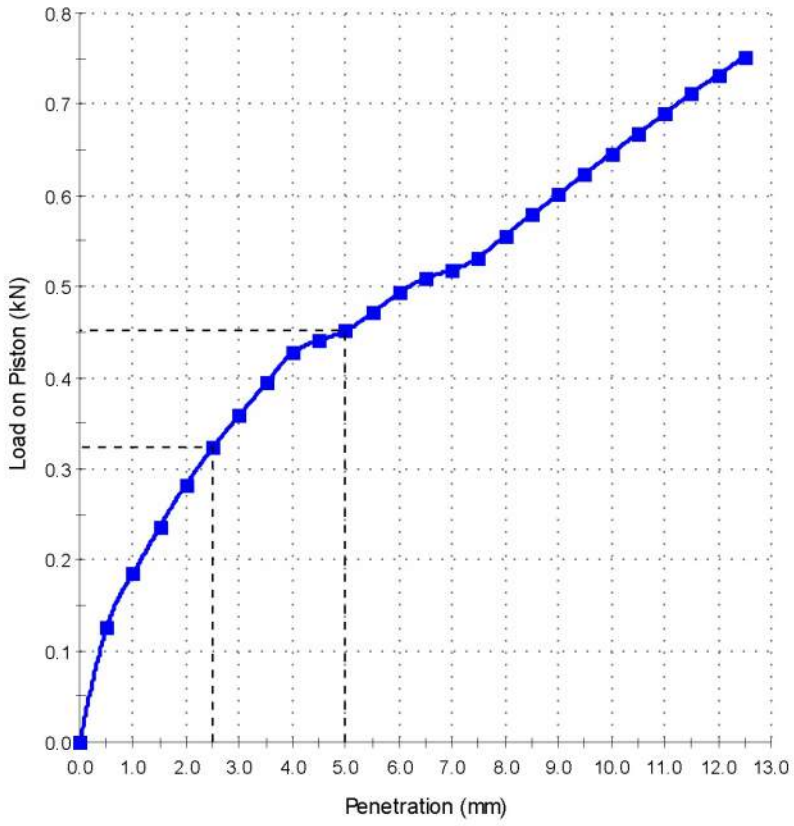
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID:	NEWC21S-01394	**Sampling Method:**	Submitted by client
Client ID:	-	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	4/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP02 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**2.5**
Dry Density before Soaking (t/m³):	1.64
Density Ratio before Soaking (%):	99.5
Moisture Content before Soaking (%):	21.2
Moisture Ratio before Soaking (%):	102.0
Dry Density after Soaking (t/m³):	1.61
Density Ratio after Soaking (%):	98.0
Swell (%):	2.0
Moisture Content of Top 30mm (%):	27.6
Moisture Content of Remaining Depth (%):	23.5
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	
Plasticity Determination Method:	Visual/Tactile
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	19.4

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC21S-01398
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC00307AA
Project Name:	EP1977 - Chisholm Assessment
Lot No.:	- **TRN:** -

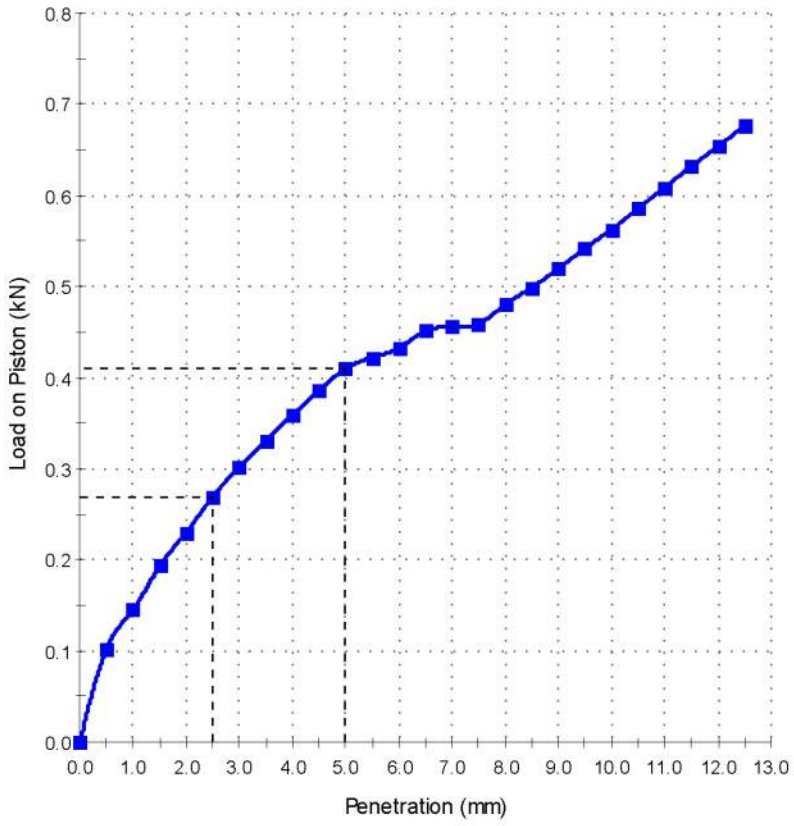
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID:	NEWC21S-01398	**Sampling Method:**	Submitted by client
Client ID:	-	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	4/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP08 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 5.0mm (%):	**2.0**
Dry Density before Soaking (t/m³):	1.61
Density Ratio before Soaking (%):	100.0
Moisture Content before Soaking (%):	23.3
Moisture Ratio before Soaking (%):	101.0
Dry Density after Soaking (t/m³):	1.58
Density Ratio after Soaking (%):	97.5
Swell (%):	2.0
Moisture Content of Top 30mm (%):	30.0
Moisture Content of Remaining Depth (%):	24.9
Compaction Hammer Used:	Standard
	AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	33
Plasticity Determination Method:	Visual/Tactile
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	22.5

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC21S-01399
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC00307AA
Project Name:	EP1977 - Chisholm Assessment
Lot No.:	- **TRN:** -

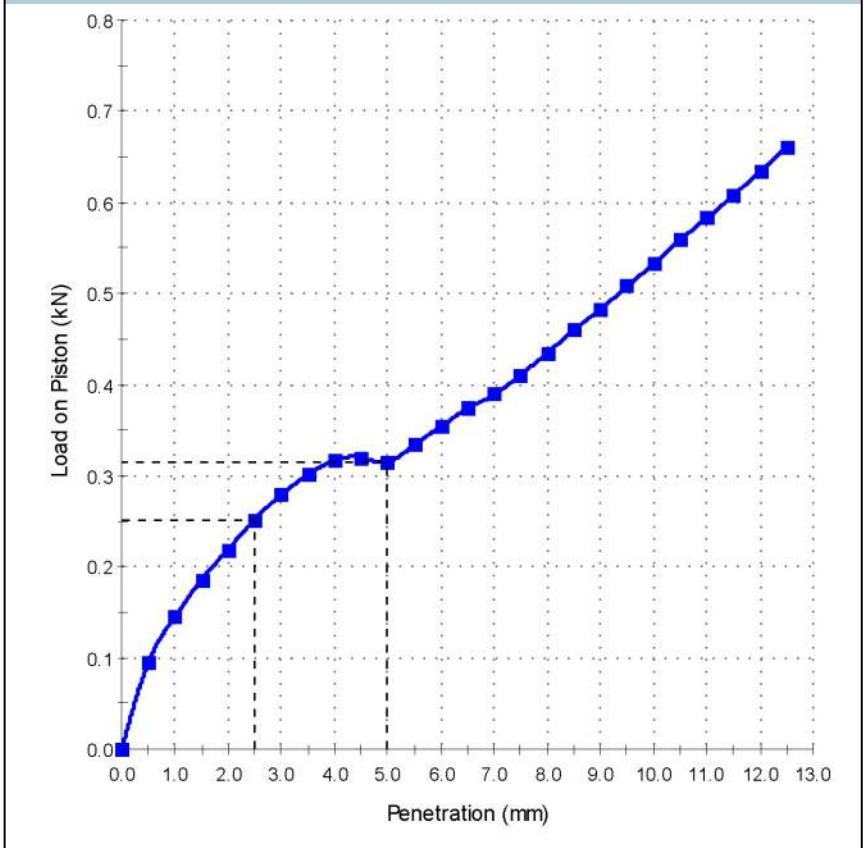
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID:	NEWC21S-01399	**Sampling Method:**	Submitted by client
Client ID:	-	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	4/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP09 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**2.0**
Dry Density before Soaking (t/m³):	1.62
Density Ratio before Soaking (%):	100.0
Moisture Content before Soaking (%):	21.2
Moisture Ratio before Soaking (%):	100.5
Dry Density after Soaking (t/m³):	1.58
Density Ratio after Soaking (%):	97.5
Swell (%):	2.5
Moisture Content of Top 30mm (%):	30.2
Moisture Content of Remaining Depth (%):	23.9
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	55
Plasticity Determination Method:	Visual/Tactile
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	21.4

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC21S-01393-1
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID / Client ID: NEWC21S-01393 / -
Date Sampled: 25/02/2021
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client
Project Location: Chisholm, NSW
Sample Location: TP01 - 0.5 - 1.0m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	20.8	
Date Tested		1/03/2021	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.62**	
Standard OMC (%)		**21.5**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		63	
LL Method		Visual / Tactile Assessment	
Date Tested		1/03/2021	
CBR at 5.0mm (%)	AS 1289.6.1.1	**3.0**	
Dry Density before Soaking (t/m³)		1.62	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		21.7	
Moisture Ratio before Soaking (%)		100.0	
Dry Density after Soaking (t/m³)		1.58	
Density Ratio after Soaking (%)		97.0	
Swell (%)		2.5	
Moisture Content of Top 30mm (%)		28.6	
Moisture Content of Remaining Depth (%)		26.8	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		57	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		4/03/2021	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC21S-01394-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID / Client ID: NEWC21S-01394 / -
Date Sampled: 25/02/2021
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client
Project Location: Chisholm, NSW
Sample Location: TP02 - 0.5 - 1.0m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	19.4	
Date Tested		1/03/2021	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.65**	
Standard OMC (%)		**21.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		63	
LL Method		Visual / Tactile Assessment	
Date Tested		1/03/2021	
CBR at 2.5mm (%)	AS 1289.6.1.1	**2.5**	
Dry Density before Soaking (t/m³)		1.64	
Density Ratio before Soaking (%)		99.5	
Moisture Content before Soaking (%)		21.2	
Moisture Ratio before Soaking (%)		102.0	
Dry Density after Soaking (t/m³)		1.61	
Density Ratio after Soaking (%)		98.0	
Swell (%)		2.0	
Moisture Content of Top 30mm (%)		27.6	
Moisture Content of Remaining Depth (%)		23.5	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		4/03/2021	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC21S-01398-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Sample Details

Sample ID / Client ID: NEWC21S-01398 / -
Date Sampled: 25/02/2021
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client
Project Location: Chisholm, NSW
Sample Location: TP08 - 0.5 - 1.0m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	22.5	
Date Tested		1/03/2021	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.62**	
Standard OMC (%)		**23.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		87	
LL Method		Visual / Tactile Assessment	
Date Tested		2/03/2021	
CBR at 5.0mm (%)	AS 1289.6.1.1	**2.0**	
Dry Density before Soaking (t/m³)		1.61	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		23.3	
Moisture Ratio before Soaking (%)		101.0	
Dry Density after Soaking (t/m³)		1.58	
Density Ratio after Soaking (%)		97.5	
Swell (%)		2.0	
Moisture Content of Top 30mm (%)		30.0	
Moisture Content of Remaining Depth (%)		24.9	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		33	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		4/03/2021	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC21S-01399-1
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 10/03/2021

Sample Details

Sample ID / Client ID: NEWC21S-01399 / -
Date Sampled: 25/02/2021
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client
Project Location: Chisholm, NSW
Sample Location: TP09 - 0.5 - 1.0m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	21.4	
Date Tested		1/03/2021	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.62**	
Standard OMC (%)		**21.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		63	
LL Method		Visual / Tactile Assessment	
Date Tested		1/03/2021	
CBR at 2.5mm (%)	AS 1289.6.1.1	**2.0**	
Dry Density before Soaking (t/m³)		1.62	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		21.2	
Moisture Ratio before Soaking (%)		100.5	
Dry Density after Soaking (t/m³)		1.58	
Density Ratio after Soaking (%)		97.5	
Swell (%)		2.5	
Moisture Content of Top 30mm (%)		30.2	
Moisture Content of Remaining Depth (%)		23.9	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		55	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		4/03/2021	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Shrink Swell Index Report

Report No: SSI:NEWC21S-01395
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/03/2021

Sample Details

Sample ID:	NEWC21S-01395	**Sampling Method:**	Submitted by client
Date Sampled:	25/02/2021	**Material:**	Existing Ground
Date Submitted:	26/02/2021	**Source:**	On-Site
Date Tested:	2/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP03 - 0.5 - 1.0m		
Borehole Number:	-		
Borehole Depth (m):	-		

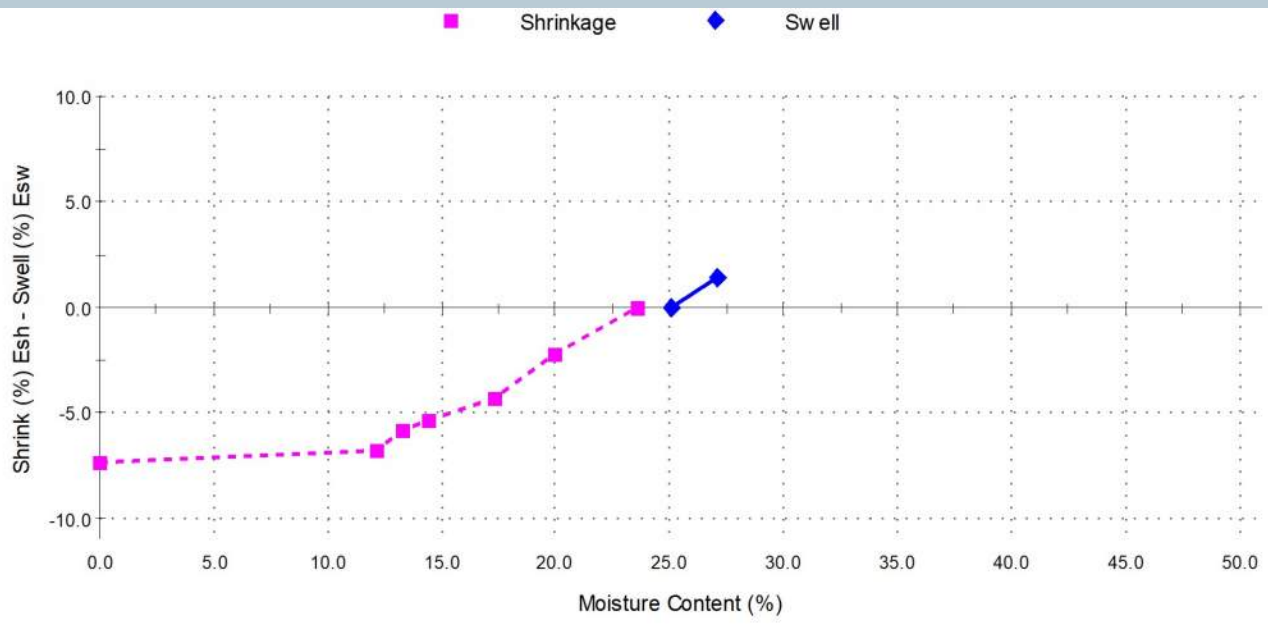
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	1.4
Moisture Content before (%):	25.1
Moisture Content after (%):	27.1
Est. Unc. Comp. Strength before (kPa):	180
Est. Unc. Comp. Strength after (kPa):	160

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	7.4
Shrinkage Moisture Content (%):	23.6
Est. inert material (%):	5-10
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 4.5

Comments

Clay, high plasticity, mottled orange/ brown.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Shrink Swell Index Report

Report No: SSI:NEWC21S-01396
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/03/2021

Sample Details

Sample ID:	NEWC21S-01396	**Sampling Method:**	Submitted by client
Date Sampled:	25/02/2021	**Material:**	Existing Ground
Date Submitted:	26/02/2021	**Source:**	On-Site
Date Tested:	1/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP05 - 0.5 - 1.0m		
Borehole Number:	-		
Borehole Depth (m):	-		

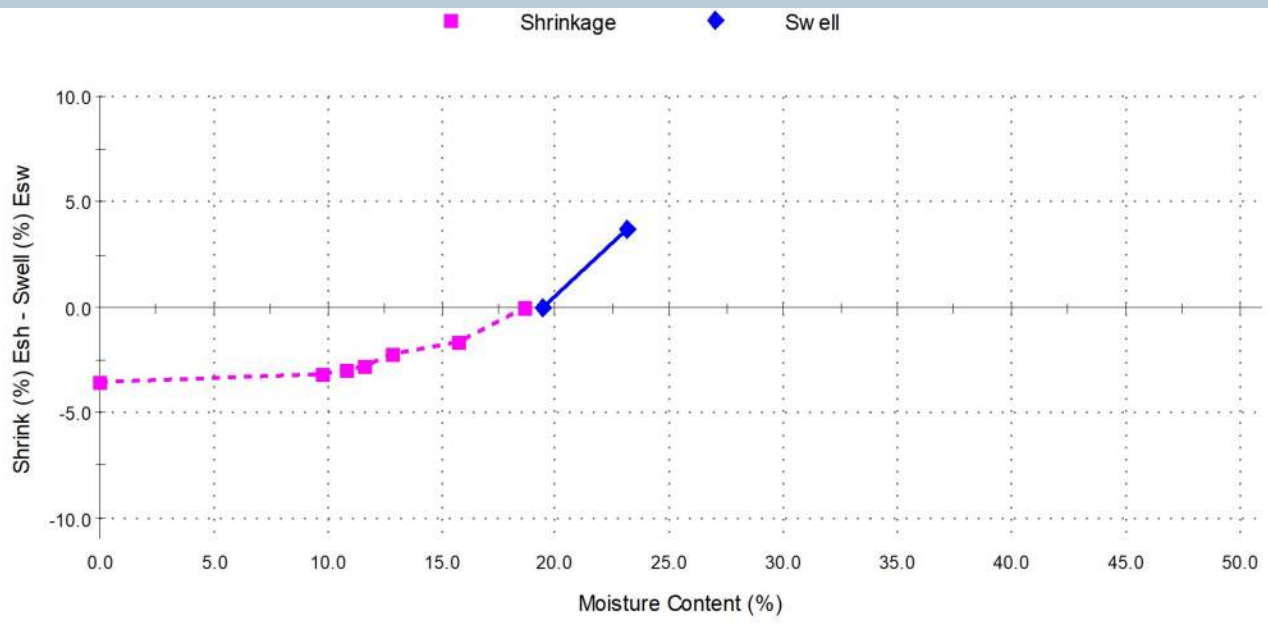
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	3.7
Moisture Content before (%):	19.5
Moisture Content after (%):	23.2
Est. Unc. Comp. Strength before (kPa):	220
Est. Unc. Comp. Strength after (kPa):	160

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	3.6
Shrinkage Moisture Content (%):	18.6
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 3.0

Comments

Clay, high plasticity, mottled grey/orange.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Shrink Swell Index Report

Report No: SSI:NEWC21S-01397
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/03/2021

Sample Details

Sample ID:	NEWC21S-01397	**Sampling Method:**	Submitted by client
Date Sampled:	25/02/2021	**Material:**	Existing Ground
Date Submitted:	26/02/2021	**Source:**	On-Site
Date Tested:	1/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP06 - 0.5 - 1.0m		
Borehole Number:	-		
Borehole Depth (m):	-		

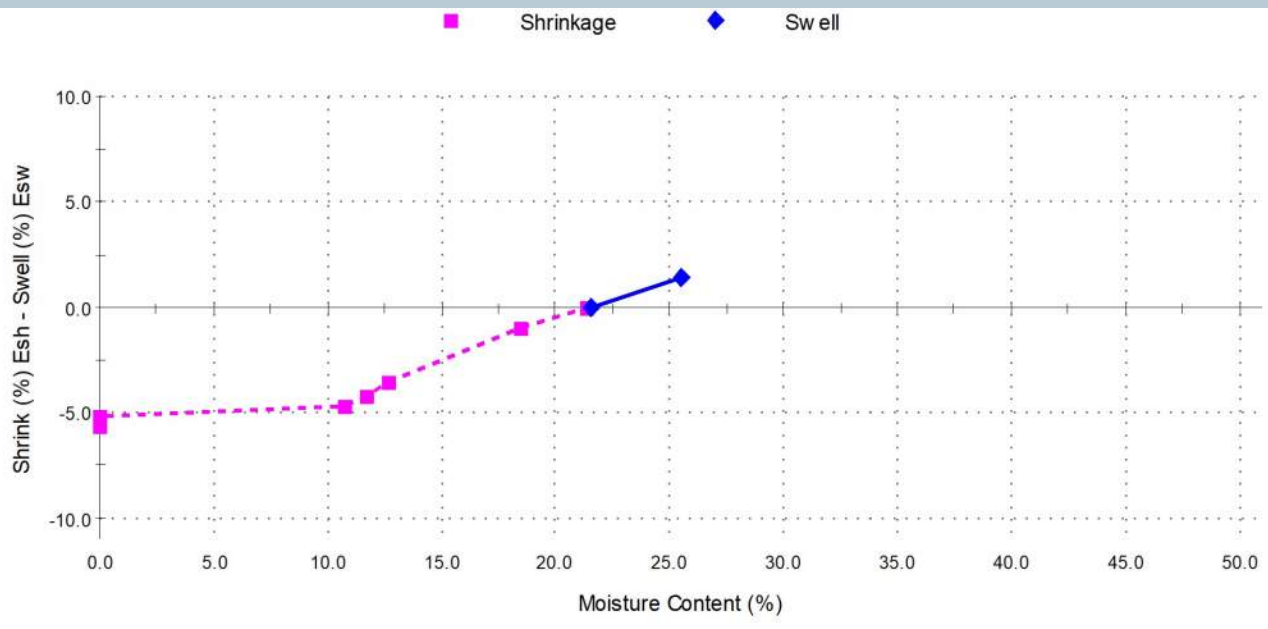
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	1.4
Moisture Content before (%):	21.6
Moisture Content after (%):	25.5
Est. Unc. Comp. Strength before (kPa):	250
Est. Unc. Comp. Strength after (kPa):	120

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	5.2
Shrinkage Moisture Content (%):	21.3
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 3.3

Comments

Clay, high plasticity, mottled grey/orange.
Sample was remoulded.

Newcastle Laboratory

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16 Callistemon Close
Warabrook NSW 2304

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Shrink Swell Index Report

Report No: SSI:NEWC21S-01400
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/03/2021

Sample Details

Sample ID:	NEWC21S-01400	**Sampling Method:**	Submitted by client
Date Sampled:	25/02/2021	**Material:**	Existing Ground
Date Submitted:	26/02/2021	**Source:**	On-Site
Date Tested:	8/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP10 - 0.5 - 1.0m		
Borehole Number:	-		
Borehole Depth (m):	-		

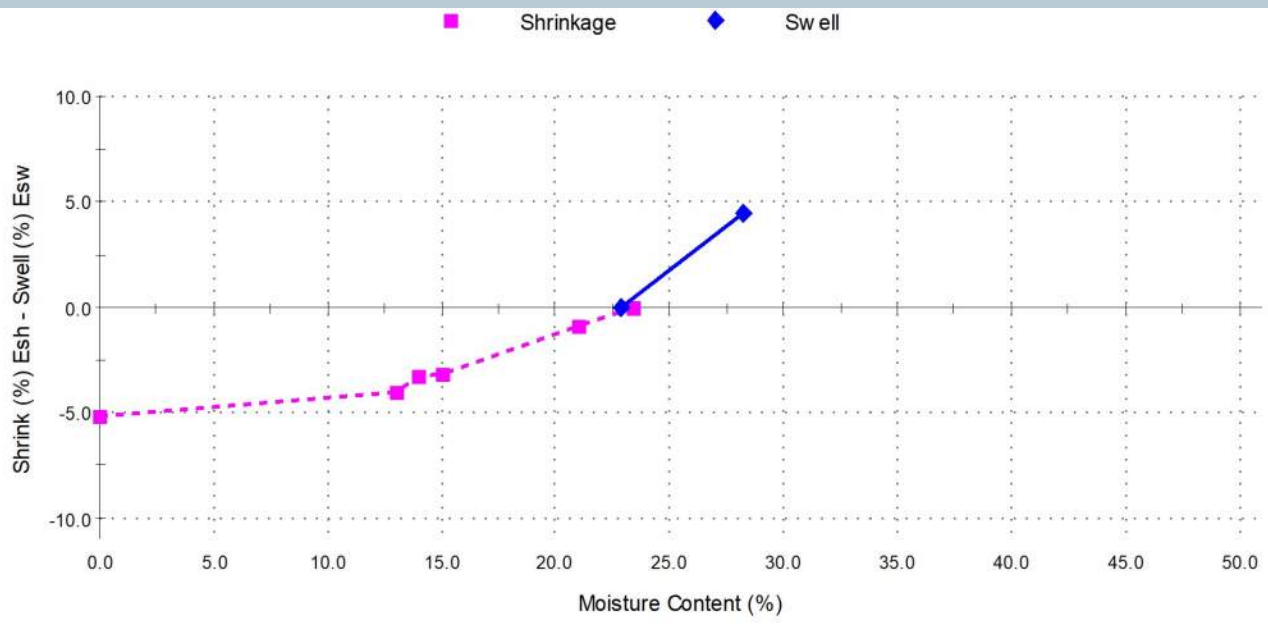
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	4.4
Moisture Content before (%):	22.8
Moisture Content after (%):	28.3
Est. Unc. Comp. Strength before (kPa):	350
Est. Unc. Comp. Strength after (kPa):	160

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	5.2
Shrinkage Moisture Content (%):	23.4
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 4.1

Comments

Sample was remoulded.
Clay, high plasticity, mottled orange/grey.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
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Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: RS:NEWC21S-01401
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01401	**Sampling Method:**	Submitted by client
Field ID:	00009	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP01 - 2.5m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	Rock Type	Location	Sample Dimensions	Depth	P kN	Is MPa	Is(50) MPa	Failure Mode	P kN	Is MPa	Is(50) MPa	Failure Mode	Ia(50) MPa
1	mudstone								0.86	0.67	0.58	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Rock Strength Report

Report No: RS:NEWC21S-01402
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01402	**Sampling Method:**	Submitted by client
Field ID:	00010	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP02 - 2.0m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	mudstone								0.20	0.071	0.073	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: RS:NEWC21S-01403
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01403	**Sampling Method:**	Submitted by client
Field ID:	00011	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP03 - 2.4m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	mudstone								1.80	1.2	1.1	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

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16 Callistemon Close
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Phone: +61 2 4016 2300

Report No: RS:NEWC21S-01404
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01404	**Sampling Method:**	Submitted by client
Field ID:	00012	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP04 - 2.4m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	mudstone								0.92	0.84	0.70	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Rock Strength Report

Report No: RS:NEWC21S-01405
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01405	**Sampling Method:**	Submitted by client
Field ID:	00013	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP05 - 2.4m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	mudstone								1.19	0.52	0.51	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: RS:NEWC21S-01406
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01406	**Sampling Method:**	Submitted by client
Field ID:	00014	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP06 - 2.4m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	siltstone								1.19	0.52	0.51	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: RS:NEWC21S-01407
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID:	NEWC21S-01407	**Sampling Method:**	Submitted by client
Field ID:	00015	**Material:**	Existing Ground
Date Sampled:	25/02/2021	**Source:**	On-Site
Date Submitted:	26/02/2021	**Specification:**	No Specification
Date Tested:	16/03/2021		
Project Location:	Chisholm, NSW		
Sample Location:	TP07 - 2.4m		
Test Method:	AS 4133.4.1		

General Details

Test Machine:	19595	**Storage History:**	Unknown
Moisture Condition:	D	**Loading Rate:**	30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	**Rock Type**	**Location**	**Sample Dimensions**	**Depth**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**P kN**	**Is MPa**	**Is(50) MPa**	**Failure Mode**	**Ia(50) MPa**
1	siltstone								4.83	2.3	2.2	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Rock Strength Report

Report No: RS:NEWC21S-01408
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Sample Details

Sample ID: NEWC21S-01408
Field ID: 00016
Date Sampled: 25/02/2021
Date Submitted: 26/02/2021
Date Tested: 16/03/2021
Project Location: Chisholm, NSW
Sample Location: TP08 - 2.4m
Test Method: AS 4133.4.1

Sampling Method: Submitted by client
Material: Existing Ground
Source: On-Site
Specification: No Specification

General Details

Test Machine: 19595
Moisture Condition: D

Storage History: Unknown
Loading Rate: 30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	Rock Type	Location	Sample Dimensions	Depth	P kN	Is MPa	Is(50) MPa	Failure Mode	P kN	Is MPa	Is(50) MPa	Failure Mode	Ia(50) MPa
1	mudstone								1.58	0.96	0.87	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Rock Strength Report

Report No: RS:NEWC21S-01409
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 16/03/2021

Sample Details

Sample ID: NEWC21S-01409
Field ID: 00017
Date Sampled: 25/02/2021
Date Submitted: 26/02/2021
Date Tested: 16/03/2021
Project Location: Chisholm, NSW
Sample Location: TP09 - 2.4m
Test Method: AS 4133.4.1

Sampling Method: Submitted by client
Material: Existing Ground
Source: On-Site
Specification: No Specification

General Details

Test Machine: 19595
Moisture Condition: D

Storage History: Unknown
Loading Rate: 30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	Rock Type	Location	Sample Dimensions	Depth	P kN	Is MPa	Is(50) MPa	Failure Mode	P kN	Is MPa	Is(50) MPa	Failure Mode	Ia(50) MPa
1	mudstone								0.40	0.098	0.11	substance	

Comments

Samples tested and reported as received from client.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Rock Strength Report

Report No: RS:NEWC21S-01410
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC00307AA
Project Name: EP1977 - Chisholm Assessment
Lot No.: - **TRN:** -

Sample Details

Sample ID: NEWC21S-01410
Field ID: 00018
Date Sampled: 25/02/2021
Date Submitted: 26/02/2021
Date Tested: 16/03/2021
Project Location: Chisholm, NSW
Sample Location: TP10 - 2.4m
Test Method: AS 4133.4.1

Sampling Method: Submitted by client
Material: Existing Ground
Source: On-Site
Specification: No Specification

General Details

Test Machine: 19595
Moisture Condition: D

Storage History: Unknown
Loading Rate: 30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	Rock Type	Location	Sample Dimensions	Depth	P kN	Is MPa	Is(50) MPa	Failure Mode	P kN	Is MPa	Is(50) MPa	Failure Mode	Ia(50) MPa
1	mudstone								1.30	0.54	0.54	substance	

Comments

Samples tested and reported as received from client.

Appendix D
CSIRO INFORMATION SHEET BTF 18

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

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

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

Soil Types

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

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

Causes of Movement

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

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

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

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

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

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

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

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

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

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

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

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

Water Service and Drainage

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

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

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

Seriousness of Cracking

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

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

Prevention/Cure

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

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

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

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

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

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

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

Appendix E
DEVELOPMENT PLANS

ESK-011-012-B

PROPOSED LOT REQUIRE TURNING HEAD OR THROUGH ROAD.

LAND SWAP TO LOT 30 DP778111
TOTAL AREA = 2,111m²
ROAD AREA = 678m²
LOT AREA = 1,433m²

RESIDUE DEVELOPMENT SUBJECT TO LAND SWAP.

LAND SWAP TO ALLAM
TOTAL AREA = 1,415m²
ROAD AREA = 131m²
LOT AREA = 1,284m²

PROPOSED LOTS SUBJECT TO REMOVAL OF UPSTREAM DAM.

LOT 30
DP778111

PROPOSED LOTS

LOT 31
DP778111

LAND SWAP TO LOT 30 DP778111
AREA = 2,241m²
ROAD AREA = 712m²
LOT AREA = 1,529m²

RESIDUE DEVELOPMENT SUBJECT TO LAND SWAP.

LAND SWAP TO ALLAM
TOTAL AREA = 2,263m²
ROAD AREA = 172m²
LOT AREA = 2,091m²

RESIDUE DEVELOPMENT SUBJECT TO LAND SWAP.

NO DA
CONCEPT ONLY

STAGE 1

NO DA
CONCEPT ONLY

STAGE 2

NO DA
CONCEPT ONLY

PROPOSED
STORMWATER BASIN

LOT 100
DP847510

DA
APPROVED

LOT 662
DP733736

LEGEND

- SITE BOUNDARY
- LAND SWAP BOUNDARY
- PROPOSED LOT BOUNDARY
- DA LODGED LOT BOUNDARY
- INDICATIVE FUTURE LOT BOUNDARY
- LAND SWAP AREA - LOT 31 LOTS
- LAND SWAP AREA - LOT 31 ROAD
- LAND SWAP AREA - ALLAM LOTS
- LAND SWAP AREA - ALLAM ROAD

LOT BREAKDOWN

STAGE 1	59 LOTS
STAGE 2	31 LOTS
RESIDUE	6,830m²
PARK	5,000m²

CONCEPT ONLY

ver.	date	comment	drawn	pm
B	23.10.2020	UPDATED LAYOUT AS PER COMMENTS	PB	MK

level information: DATUM: N/A; CONTOUR INTERVAL: N/A

scale (A1 original size): A1 1:1000 — 0 25 50m — A3 1:2000

notes

working beyond expectations

drawing title: CONCEPT LOT LAYOUT

location: RAYMOND TERRACE RD, CHISHOLM, NSW

council: MAITLAND CITY COUNCIL

dwg ref: ESK-011

client: ALLAM PROPERTY GROUP

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ESK-011-012-B

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NO DA
CONCEPT ONLY

NO DA
CONCEPT ONLY

NO DA
CONCEPT ONLY

DA
APPROVED

PROPOSED LOTS

LOT 30
DP778111

LOT 31
DP778111

LOT 100
DP847510

LOT 662
DP733736

PROPOSED
STORMWATER BASIN

160 2949m²
161 3538m²
162 PROPOSED PARK 5001m²
232 191m²
233 153m²

LEGEND

- SITE BOUNDARY
- LAND SWAP BOUNDARY
- PROPOSED LOT BOUNDARY
- DA LODGED LOT BOUNDARY
- FUTURE LOT BOUNDARY
- PROPOSED RESIDENTIAL LOT
- PROPOSED RESIDUE LOT
- LAND SWAP AREA - LOT 31 LOTS
- LAND SWAP AREA - LOT 31 ROAD
- LAND SWAP AREA - ALLAM LOTS
- LAND SWAP AREA - ALLAM ROAD

LOT BREAKDOWN

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CONCEPT ONLY

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
B	23.10.2020	UPDATED LAYOUT AS PER COMMENTS	PB	MK	DATUM: N/A CONTOUR INTERVAL: 5m	A1 1:1000 / A3 1:2000 (0, 25, 50m)	

working beyond expectations

drawing title:

CONCEPT LOT LAYOUT

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