

25 September, 2024

Hi tech Modular Homes
1355 The Northern Rd
Bringelly NSW

FAO: Ali Semerci

**Geotechnical Investigation – Site Classification and Effluent Disposal Investigation for 24
Brewers Lane, Saint Fillan, NSW**

Introduction

Macquarie Geotechnical Pty Ltd (MG) has undertaken a geotechnical investigation at the above site. This work was completed to classify the subject site in accordance with Australian Standard AS2870 2011 "Residential Slabs and Footings" and was carried out with reference to Australian Standard AS1726 2017 "Geotechnical Site Investigations".

Additionally, works were completed to evaluate the site for on-site disposal of domestic effluent in accordance with AS1547 - 2012 "Disposal Systems for Effluent from Domestic Premises", and the combined NSW government departments Environmental Health Protection Guidelines (EHPG); "On-site Sewage Management for Single Households" (1998).

Brief Desk Study and Site History

No evidence of earthworks/filling or former buildings have been identified from historical images.

Geology

The site is underlain by Quartz Monzonite which is predominantly Leucocratic coarse-grained to megacrystic porphyritic quartz monzonite, minor granite.

Fieldwork

Four test boreholes were drilled and logged on the 29th of August 2024 by an Engineering Geologist from our Bathurst office. The boreholes were drilled using a 4wd mounted Innovative Sampla 24LT.

In situ testing comprised of Dynamic Cone Penetration (DCP) testing adjacent to the boreholes.

Samples were collected at 0.5m depth intervals and two samples were selected and tested for Linear shrinkage in accordance with AS1289 3.4.1.

Location



Figure 1: Site Location



Approximate Site Location



Figure 2: Site Location

Results

The subsurface conditions at the site are summarised in Table 1;

Table 1: Sub-surface conditions

Depth (m)	Material Description
0.00 – 0.10	FILL: Sandy GRAVEL: light brown, sand is fine to coarse, gravel is angular to subangular, fine to medium.
0.10 – 0.70	Gravelly SAND trace clay: orange, sand is fine to coarse, gravel is subangular to angular fine to coarse. Medium dense to dense (RESIDUAL)
0.70 – 2.00	Gravelly SAND: light brown, sand is fine to coarse, gravel is subangular to angular fine to coarse. Medium dense to dense (RESIDUAL)
2.00 – 2.25	Sandy GRAVEL: light brown, sand is fine to coarse, gravel is subangular to angular, fine to coarse (very dense) (Extremely weathered material)

Notes: Groundwater was not encountered.

Table 3: DCP test results summary

Borehole ID	BH01 (DCP1)	DCP2 (North East Corner of the proposed structure)	DCP 3 (South East Corner of the proposed structure)
Depth (mm)	Number of Blows/100mm		
0 – 100	5	3	5
100 – 200	8	2	3
200 – 300	10	3	2
300 – 400	12	3	6
400 – 500	17	4	12
500 – 600	22	6	25+
600 – 700	-	7	-
700 – 800	-	5	-
800 – 900	-	8	-
900 – 1000	-	22	-
1000 – 1100	-	25+	-

Discussion & Recommendations

The classification of a site involves a number of geotechnical factors such as depth of bedrock, the nature and extent of subsurface soils and any specific problems (slope stability, soft soils, filling, reactivity, etc).

In accordance with AS2870 2011 the proposed development site will have an anticipated surface movement (Y_s) of less than 20mm and is classified as “Class S”.

An appropriate footing system should be designed in accordance with the above code to accommodate these anticipated movements. The possibility of additional movements, due to

abnormal moisture variations, should be minimised by proper "site management" procedures as provided on the attached sheet.

It should be noted that this assessment is based on site conditions being represented by the natural soil profile. Any change in conditions noted during development, including cut or fill should be referred to Macquarie Geotechnical for appropriate inspection and assessment.

The recommended footing design parameters are presented in Table 2 below:

Table 2: Summary of Geotechnical Design Parameters – Bearing Pressure

Layer Depth Range (m)	Material Description (USCS)	Allowable Bearing Pressure (kPa)
0.00 – 0.10	FILL (Sandy GRAVEL)*	Unsuitable for construction
0.10 – 2.25	Gravelly SAND/Sandy GRAVEL*	100

Note: *Visual Description

Assessment for On-site Effluent Disposal

Results

The boreholes drilled at the site were used to determine the indicative permeability of the site soils. The assessment was based on the observed soil texture and structure and the indicative information in AS1547:2012 – Table 5.2.

The assessment is summarised in Table 3 below:

Table 3: Permeability Assessment

Test No.	Soil Category	Soil Texture	Soil Structure	Indicative Permeability (m/day)	Average Permeability (m/day)
BH01	1	Gravels and Sands	Structureless (massive)	>3.0	>3.0
BH02	1	Gravels and Sands	Structureless (massive)	>3.0	
BH03	1	Gravels and Sands	Structureless (massive)	>3.0	
BH04	1	Gravels and Sands	Structureless (massive)	>3.0	

Based on the foregoing, a permeability of 3m/day was adopted for design.

Discussion & Recommendations

The total design wastewater flow for this site is based on a two bedroom house.

The design effluent flow is based on the number of bedrooms in the house and assumes occupancy of one person per bedroom plus additional two persons.

With reference to Table H1 of AS1547:2012 and assuming a non-reticulated water supply and water reduction facilities are installed the flow allowance would be 120 L/person/day.

Water reduction facilities must include combined use of reduced flush 6/3 litre water closets, shower flow restrictors, aerator faucets, front load washing machines and flow control valves on all water-use outlets.

This gives a total flow calculated as follows:

$$\begin{aligned}
N_{Bedrooms} &= 2 \\
Q_{Daily} &= 120 \times N_{Bedrooms} + 120 \times 2 \\
&= 120 \times 2 + 120 \times 2 \\
&= 480 \text{ L/day}
\end{aligned}$$

Therefore, a total flow of 480 L/day was used to calculate wastewater disposal requirements.

We note that the effluent flow rates have been based on two-bedroom house. If a larger sized dwelling is to be constructed on this site, please contact Macquarie Geotechnical for additional geotechnical advice.

Disposal Systems

We advise that the disposal of domestic effluent on-site is feasible for the subject site within the recommended disposal envelope indicated on the attached site plan using an absorption bed system with standard septic tank for primary treatment.

Permeability and Design Effluent Loading

As noted previously the permeability of the site soils is 3m/day. With reference to Table L1 of AS1547:2012 a Design Loading Rate (DLR) of 35 mm/day was adopted for design of the Absorption Bed System.

Absorption Bed System

Bed dimensions were determined from the following relationship:

$$L_{bed} = \frac{Q_{Daily}}{DLR \times W}$$

Where:

$$L_{bed} = \text{Bed Length (m)}$$

$$Q_{Daily} = \text{Daily Effluent Flow (L/day)}$$

$$DLR = \text{design rate in } \frac{\text{mm}}{\text{day}}$$

$$W = \text{width in m (3.0m for absorption bed)}$$

Therefore,

$$\begin{aligned}
L_{bed} &= \frac{480}{35 \times 3} \\
&= 4.5
\end{aligned}$$

Total bed length required is 5m which should be constructed along elevation contours and effluent should be distributed evenly using a splitter box or sequencing valve.

Wet Weather Storage and Septic Tank

The water balance calculations are attached and indicate that wet weather storage would not be required.

Minimum septic tank sizes are prescribed in Table J1 of AS1547:2012. Based on the average daily flow rate, a septic tank with a minimum capacity of **3,000L** shall be used.

Installation and General Requirements

The following paragraphs outline installation and general requirements for the effluent disposal system.

- The area be sited within the recommended area indicated on the site plan (Figure 1 attached) in a location receiving good sunlight and exposure to prevailing breezes and where possible away from general access and play areas;
- A suitable diversion drain should be installed on the high side of the disposal area to minimise run on surface storm water flows.
- A storm water diversion berm should be constructed on the uphill perimeter of the tank top to prevent the infill of surface runoff into the tank.
- The area be located so that the following minimum horizontal set back distances are complied with:
 - 3m from any property boundary or residence if higher than the disposal area; or 6m from any property boundary or residence if lower than the disposal area;
 - 3m from any pathway or walkway;
 - 6m from the edges of a swimming pool.
 - 40m from any dams or water courses.
- Planting of suitable vegetation shall be carried out prior to commissioning of the system. The design assumes that a perennial pasture will be planted over the area; if alternative vegetation is contemplated then further geotechnical advice should be obtained.

Conclusion

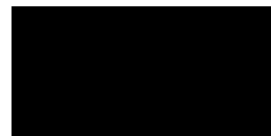
The findings of our report were based on our fieldwork, in-situ testing, laboratory testing, technical assessment and local knowledge for this site.

We trust the foregoing is sufficient for your present purposes, and if you have any questions please contact the undersigned.

Yours sincerely



Konstantine Routledge
Geotechnical Engineer
BSc (Physical Geography and Geology)



Martin Williams
Principal Geotechnical Engineer
MSc CPEng CGeol

Attached: Limitations of Geotechnical Site Investigation
 Reactive Soils Notes

References: Australian Standard 1726 – 2017 Geotechnical Site Investigations
 Australian Standard 2870 – 2011 *Residential Slabs and Footings*
 Australian Standard 1547 – 2012 On-Site Effluent Disposal

LIMITATIONS OF GEOTECHNICAL SITE INVESTIGATION

Scope of Services

This report has been prepared for the Client in accordance with the Services Engagement Form (SEF), between the Client and Macquarie Geotechnical.

Reliance on Data

Macquarie Geotechnical has relied upon data and other information provided by the Client and other individuals. Macquarie Geotechnical has not verified the accuracy or completeness of the data, except as otherwise stated in the report. Recommendations in the report are based on the data.

Macquarie Geotechnical will not be liable in relation to incorrect recommendations should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

Geotechnical Investigation

Findings of Geotechnical Investigations are based extensively on judgment and experience. Geotechnical reports are prepared to meet the specific needs of individual clients. This report was prepared expressly for the Client and expressly for the Clients purposes.

This report is based on a subsurface investigation, which was designed for project-specific factors. Unless further geotechnical advice is obtained this report cannot be applied to an adjacent site nor can it be used when the nature of any proposed development is changed.

Limitations of Site investigation

As a result of the limited number of sub-surface excavations or boreholes there is the possibility that variations may occur between test locations. The investigation undertaken is an estimate of the general profile of the subsurface conditions. The data derived from the investigation and laboratory testing are extrapolated across the site to form a geological model. This geological model infers the subsurface conditions and their likely behavior with regard to the proposed development.

The actual conditions at the site might differ from those inferred to exist.

No subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Time Dependence

This report is based on conditions, which existed at the time of subsurface exploration. Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report.

Macquarie Geotechnical should be kept apprised of any such events, and should be consulted for further geotechnical advice if any changes are noted.

Avoid Misinterpretation

A geotechnical engineer or engineering geologist should be retained to work with other design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

No part of this report should be separated from the Final Report.

Sub-surface Logs

Sub-surface logs are developed by geoscientific professionals based upon their interpretation of field logs and laboratory evaluation of field samples. These logs should not under any circumstances be redrawn for inclusion in any drawings.

Geotechnical Involvement During Construction

During construction, excavation frequently exposes subsurface conditions. Geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendations and should make their own enquiries and obtain independent advice in relation to such matters

Macquarie Geotechnical assumes no responsibility and will not be liable to any other person or organisations for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisations arising from matters dealt with or conclusions expressed in the report.

Other limitations

Macquarie Geotechnical will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Other Information

For further information reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, 1987.

DESIGN & MAINTENANCE PRECAUTIONS FOR REACTIVE SOILS

These precautions apply to residential masonry buildings founded on reactive clay soils. Such soils are prone to shrink/swell movements due to moisture variations caused by natural or artificial causes.

The owner should appreciate that on reactive clays it is virtually impossible to design an economic foundation system that will totally prevent movement. Some minor aesthetic cracking, while undesirable, is likely to occur in a significant proportion of houses. The basic design philosophy is to minimise any cracking and provide a serviceable structure. It is thus a compromise between economy and performance.

The following design precautions are recommended to minimise cracking from reactive soil movements:

- All surface water runoff must be directed away from the building by appropriate grading in order to prevent ponding near foundations. Site drainage should form part of the building contract. Leaking plumbing or blocked drains should be repaired promptly and site grading maintained to prevent ponding near foundations.
- Peripheral pathways, with impermeable underliner, should be provided around the building to improve site drainage and assist in the stabilisation of moisture conditions near foundations.
- All brickwork should be suitably articulated into discrete units to accommodate the expected movements. Brickwork over doors and windows should be avoided.
- Internal and external walls should be arranged along straight lines, where possible. All house drains and water pipes should be provided with sufficient flexibility to accommodate the expected differential movements (between foundation and uncovered outside area) at the level of the service.
- The extension of services through slabs should be avoided where possible in order to prevent hidden leaks under the slab area. Most plumbing fixtures can be arranged to exit through outside walls.
- Septic systems should be located so as not to influence the house or neighbouring foundations.
- Subgrades beneath elevated and well-ventilated floors should be covered with an impermeable liner (with protective soil blanket) to minimise excessive desiccation.

In addition, certain other site management precautions must be adhered to during the life of the structure. These precautions generally relate to the control of abnormal moisture variations due to the effects of drainage and vegetation. Recommendations on site management precautions are contained in the following section.

- Leaking plumbing or blocked drains should be repaired promptly and site grading maintained to prevent ponding near foundations. Garden watering, particularly by fixed systems, should be controlled to avoid over-watering. Proper garden maintenance should produce year round uniform moisture conditions.
- Trees and some shrubs can cause a substantial drying and shrinking of reactive clays, additional to that experienced in a drought or a long dry spell. This effect is most likely to result in damage when added to the drying effects from a drought or a long dry spell. Trees should be planted at a substantial distance from the house. The distance depends upon the species and soil conditions, but generally a distance equal to 75% of the mature height is a minimum.
- Problems during a drought can be minimised by extensive pruning (thus reducing water demand) and/or providing trees with adequate water. Frequent moderate watering during dry periods should minimise the risk of the tree extracting excessive moisture from beneath the foundation of the house. The owner should also immediately undertake this action if brickwork cracking due to tree drying is noticed. Most reactive clay failures can be minimised by controlling the combined drying effects of trees and drought.

Reference should be made to Appendix A of AS2870.2 "Residential Slabs. and Footings" and CSIRO 10-91 "A Guide to Home Owners on Foundation Maintenance and Footing Performance" for more detailed recommendations regarding Design and Site management precautions

Geotechnical Explanatory Notes

Soil Description

In engineering terms soil includes every type of uncemented or partially cemented inorganic material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from the Unified Soil Classification system and a soil symbol is used to define a soil layer as follows:

UNIFIED SOIL CLASSIFICATION

The appropriate symbols are selected on the result of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

USC Symbol	Description
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty Soil

MOISTURE CONDITION

Dry – Cohesive soils are friable or powdery
Cohesionless soil grains are free-running

Moist – Soil feels cool, darkened in colour
Cohesive soils can be moulded
Cohesionless soil grains tend to adhere

Wet – Cohesive soils usually weakened
Free water forms on hands when handling

For cohesive soils the following codes may also be used:

MC>PL Moisture Content greater than the Plastic Limit.
MC~PL Moisture Content near the Plastic Limit.
MC<PL Moisture Content less than the Plastic Limit.

PLASTICITY

The potential for soil to undergo change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (LL) is as follows:

Description of Plasticity	LL (%)
Low	<35
Medium	35 to 50
High	>50

COHESIVE SOILS – CONSISTENCY

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are assessed by the shear strength of the soil as observed visually, by the pocket penetrometer values and by resistance to deformation to hand moulding.

A Pocket Penetrometer may be used in the field or the laboratory to provide approximate assessment of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Strength	Symbol	Pocket Penetrometer Reading (kPa)
Very Soft	VS	< 25
Soft	S	20 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	> 400

COHESIONLESS SOILS – RELATIVE DENSITY

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration or the Standard Penetration Test (SPT) ‘N’ values. Other condition terms, such as friable, powdery or crumbly may also be used.

The Standard Penetration Test (SPT) is carried out in accordance with AS 1289, 6.3.1. For completed tests the number of blows required to drive the split spoon sampler 300 mm are recorded as the N value. For incomplete tests the number of blows and the penetration beyond the seating depth of 150 mm are recorded. If the 150 mm seating penetration is not achieved the number of blows to achieve the measured penetration is recorded. SPT correlations may be subject to corrections for overburden pressure and equipment type.

Term	Symbol	Density Index	N Value (blows/0.3 m)
Very Loose	VL	0 to 15	0 to 4
Loose	L	15 to 35	4 to 10
Medium Dense	MD	35 to 65	10 to 30
Dense	D	65 to 85	30 to 50
Very Dense	VD	>85	>50

COHESIONLESS SOILS PARTICLE SIZE DESCRIPTIVE TERMS

Name	Subdivision	Size
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	19 mm to 63 mm
	medium	6.7 mm to 19 mm
	fine	2.36 mm to 6.7 mm
Sand	coarse	600 µm to 2.36 mm
	medium	210 µm to 600 µm
	fine	75 µm to 210 µm

Rock Description

The rock is described with strength and weathering symbols as shown below. Other features such as bedding and dip angle are given.

ROCK QUALITY

The fracture spacing is shown where applicable and the Rock Quality Designation (RQD) or Total Core Recovery (TCR) is given where:

$$\text{RQD (\%)} = \frac{\text{Sum of Axial lengths of core } > 100\text{mm long}}{\text{total length considered}}$$

$$\text{TCR (\%)} = \frac{\text{length of core recovered}}{\text{length of core run}}$$

ROCK STRENGTH

Rock strength is described using AS1726 and ISRM – Commission on Standardisation of Laboratory and Field Tests, "Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index", as follows:

Term	Symbol	Point Load Index Is(50) (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	>10

ROCK MATERIAL WEATHERING

Rock weathering is described using the following abbreviation and definitions used in AS1726:

Abbreviation	Term
RS	Residual soil
XW	Extremely weathered
DW	Distinctly weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
FR	Fresh

DEFECT SPACING/BEDDING THICKNESS

Measured at right angles to defects of same set or bedding.

Term	Defect Spacing	Bedding
Extremely closely spaced	<6 mm	Thinly Laminated
	6 to 20 mm	Laminated
Very closely spaced	20 to 60 mm	Very Thin
Closely spaced	0.06 to 0.2 m	Thin
Moderately widely spaced	0.2 to 0.6 m	Medium
Widely spaced	0.6 to 2 m	Thick
Very widely spaced	>2 m	Very Thick

DEFECT DESCRIPTION

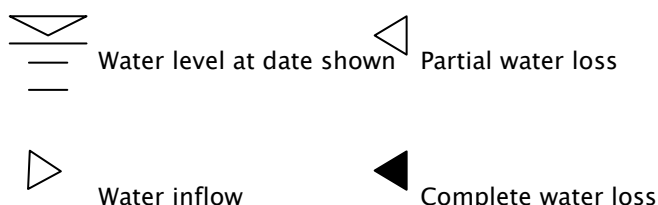
Type:	Description
B	Bedding
F	Fault
C	Cleavage
J	Joint
S	Shear Zone
D	Drill break

Planarity/Roughness:

Class	Description
I	rough or irregular, stepped
II	smooth, stepped
III	slickensided, stepped
IV	rough or irregular, undulating
V	smooth, undulating
VI	slickensided, undulating
VII	rough or irregular, planar
VIII	smooth, planar
IX	slickensided, planar

The inclination if defects are measured from perpendicular to the core axis.

WATER



Groundwater not observed: The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.








Groundwater not encountered: The borehole/test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

Graphic Symbols for Soils and Rocks





Typical symbols for soils and rocks are as follows. Combinations of these symbols may be used to indicate mixed materials such as clayey sand.

Soil Symbols




Main components

	CLAY - CL
	CLAY - CH
	SAND
	GRAVEL
	BOULDERS / COBBLES
	TOPSOIL
	SILT

Minor Components









	Clayey
	Silty
	Sandy
	Gravelly

Other




	FILL
	BITUMEN
	CONCRETE

Rock Symbols




Sedimentary Rocks

	SANDSTONE
	SILTSTONE
	CLAYSTONE, MUDSTONE
	SHALE
	LAMINITE
	ASPHALT
	LIMESTONE
	CONGLOMERATE

Igneous Rocks

	GRANITE
	BASALT
	UNDIFFERENTIATED IGNEOUS

Metamorphic Rocks

	SLATE, PHYLLITE, SCHIST
	GNEISS
	QUARTZITE

Engineering Classification of Shales and Sandstones in the Sydney Region – A Summary Guide

The Sydney Rock Class classification system is based on rock strength, defect spacing and allowable seams as set out below. All three factors must be satisfied.

CLASSIFICATION FOR SANDSTONE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>24	>600	<1.5
II	>12	>600	<3
III	>7	>200	<5
IV	>2	>60	<10
V	>1	N.A.	N.A.

CLASSIFICATION FOR SHALE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>16	>600	<2
II	>7	>200	<4
III	>2	>60	<8
IV	>1	>20	<25
V	>1	N.A.	N.A.

UNIAXIAL COMPRESSIVE STRENGTH (UCS)

For expedience in field/construction situations the uniaxial (unconfined) compressive strength of the rock is often inferred, or assessed using the point load strength index (I_{s50}) test (AS 4133.4.1 – 1993). For Sydney Basin sedimentary rocks the uniaxial compressive strength is typically about $20 \times (I_{s50})$ but the multiplier may range from about 10 to 30 depending on the rock type and characteristics. In the absence of UCS tests, the assigned Sydney Rock Class classification may therefore include rock strengths outside the nominated UCS range.

DEFECT SPACING

The terms relate to spacing of natural fractures in NMLC, NQ and HQ diamond drill cores and have the following definitions:

Defect Spacing (mm)	Terms Used to Describe Defect Spacing ¹
>2000	Very widely spaced
600 – 2000	Widely spaced
200 – 600	Moderately spaced
60 – 200	Closely spaced
20 – 60	Very closely spaced
<20	Extremely closely spaced

¹After ISO/CD14689 and ISRM.

ALLOWABLE SEAMS

Seams include clay, fragmented, highly weathered or similar zones, usually sub-parallel to the loaded surface. The limits suggested in the tables relate to a defined zone of influence. For pad footings, the zone of influence is defined as 1.5 times the least footing dimension. For socketed footings, the zone includes the length of the socket plus a further depth equal to the width of the footing. For tunnel or excavation assessment purposes the defects are assessed over a length of core of similar characteristics.

Source: Based on Pells et al (1978), as revised by Pells et al (1998).

Pells, P.J.N, Mostyn, G. and Walker, B.F. – Foundations on Sandstone and Shale in the Sydney Region. Australian Geomechanics Journal, No 33 Part 3, December 1998.

Summary of Soil Logging Procedures

Coarse Material: grain size - colour - particle shape - secondary components - minor constituents - moisture condition - relative density - origin - additional observations.

Fine Material: plasticity - colour - secondary components - minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Guide to the Description, Identification and Classification of Soils				
Major Divisions		SYMBOL	Typical Names	
> 200mm		BOULDERS		
60 to 200mm		COBBLES		
COARSE GRAINED SOILS	More than 65% by dry mass less than 63mm is greater than 0.075mm	GRAVEL	More than 50% of coarse fraction > 2.36mm	
		Gravelly Soils	More than 50% of coarse fraction > 2.36mm	
		SANDS	More than 50% of coarse fraction < 2.36mm	
		Sandy Soils	More than 50% of coarse fraction < 2.36mm	
FINE GRAINED SOILS	More than 35% by dry mass less than 60mm is less than 0.075mm	Liquid Limit < 50%		
		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts	
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.	
	Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.	

Grain sizes	Gravel		Sand	
	Coarse -	63 to 19mm	Coarse -	2.36 to 0.6mm
	Medium -	19 to 6.7 mm	Medium -	0.6 to 0.21mm
	Fine -	6.7 to 2.36mm	Fine -	0.21 to 0.075mm

GEOLOGICAL ORIGIN:-

- Fill** - artificial soils / deposits
- Alluvial** - soils deposited by the action of water
- Aeolian** - soils deposited by the action of wind

- Topsoil** - soils supporting plant life containing significant organic content
- Residual** - soils derived from insitu weathering of parent rock.
- Colluvial** - transported debris usually unsorted, loose and deposited

Field Identification of Fine Grained Soils - Silt or Clay?

Dry Strength - Allow the soil to dry completely and then test its strength by breaking and crumbling between the fingers.
 High dry strength - Clays; Very slight dry strength - Silts.
Toughness Test - the soil is rolled by hand into a thread about 3mm in diameter. The thread is then folded and re-rolled repeatedly until it has dried sufficiently to break into lumps. In this condition inorganic clays are fairly stiff and tough while inorganic silts produce a weak and often soft thread which may be difficult to form and readily breaks and crumbles.
Dilatancy Test - Add sufficient water to the soil, held in the palm of the hand, to make it soft but not sticky. Shake horizontally, striking vigorously against the other hand several times. Dilatancy is indicated by the appearance of a shiny film on the surface of the soil. If the soil is then squeezed or pressed with the fingers, the surface becomes dull as the soil stiffens and eventually crumbles. These reactions are pronounced only for predominantly silt size material. Plastic clays give no reaction.

Descriptive Terms for Material Portions			
COARSE GRAINED SOILS		FINE GRAINED SOILS	
% Fines	Term/Modifier	% Coarse	Term/Modifier
< 5	Omit, or use "trace"	≤ 15	Omit, or use "trace"
> 5, ≤ 12	"with clay/silt" as applicable	> 15, ≤ 30	"with sand/gravel" as applicable
> 12	Prefix soil as "silty/clayey"	> 30	Prefix as "sandy/gravelly"

Moisture Condition	
<i>for non-cohesive soils:</i>	
Dry -	runs freely through fingers.
Moist -	does not run freely but no free water visible on soil surface.
Wet -	free water visible on soil surface.
<i>for cohesive soils:</i>	
MC > PL	Moisture content estimated to be greater than the plastic limit.
MC ~ PL	Moisture content estimated to be approximately equal to the plastic limit. The soil can be moulded
MC < PL	Moisture content estimated to be less than the plastic limit. The soil is hard and friable, or powdery.

The plastic limit (PL) is defined as the moisture content (percentage) at which the soil crumbles when rolled into threads of 3mm dia.

Consistency - For Clays & Silts		
Description	UCS (kPa)	Field guide to consistency
Very soft	< 25	Exudes between the fingers when squeezed in hand
Soft	25 - 50	Can be moulded by light finger pressure
Firm	50 - 100	Can be moulded by strong finger pressure
Stiff	100 - 200	Cannot be moulded by fingers. Can be indented by thumb.
Very stiff	200 - 400	Can be indented by thumb nail
Hard	> 400	Can be indented with difficulty by thumb nail
Friable	-	Crumbles or powders when scraped by thumbnail

Relative Density for Gravels and Sands		
Description	SPT "N" Value	Density Index (ID) Range %
Very loose	0 - 4	< 15
Loose	4 - 10	15 - 35
Medium dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very dense	> 50	> 85

Summary of Rock Logging Procedures

Description order: constituents - rock name - grain size - colour - weathering - strength - minor constituents - additional observations.

- minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Definition - Sedimentary Rock	
Conglomerate	more than 50% of the rock consists of gravel (>2mm) sized fragments
Sandstone	more than 50% of the rock consists of sand (0.06 to 2mm) sized grains
Siltstone	more than 50% of the rock consists of silt sized granular particles and the rock is not laminated
Claystone	more than 50% of the rock consists of clay or mica material and the rock is not laminated
Shale	more than 50% of the rock consists of clay or silt sized particles and the rock is laminated

Weathering		
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a change in volume but the soil has not significantly transported.
Extremely Weathered	EW	Rock is weathered to such an extent that it has 'soil' properties; ie. it either disintegrates or can be remoulded, in water.
Distinctly Weathered	DW	Highly Weathered (HW) - Rock is wholly discoloured and rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals Moderately Weathered (MW) - The whole of the rock is discoloured, usually by iron staining and bleaching. Shows little or no change in rock strength.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Stratification			
thinly laminated	<6mm	medium bedded	0.2 - 0.6m
laminated	6 - 20mm	thickly bedded	0.6 - 2m
very thinly bedded	20 - 60mm	very thickly bedded	>2m
thinly bedded	60mm - 0.2m		

Discontinuities					
order of description: depth - type - orientation - spacing - roughness / planarity - thickness - coating					
	Type	Class	Roughness/Planarity	Class	Roughness/Planarity
B	Bedding	I	rough or irregular, stepped	VI	slickensided, undulating
F	Fault	II	smooth, stepped	VII	rough or irregular, planar
C	Cleavage	III	slickensided, stepped	VIII	smooth, planar
J	Joint	IV	rough or irregular, undulating	IX	slickensided, planar
S	Shear Zone	V	smooth, undulating		
D	Drill break				

Rock Strength			
Term		Is (50)	Field Guide
Very low	VL	0.03	Material crumbles under firm blows with sharp end of pick; can be peeled with knife. Pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1	
Medium	M	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
High	H	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.
Very High	VH	3	A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Extremely High	EH	10	A piece of core 150 mm long x 50 mm dia. May be broken readily with hand held hammer. Cannot be scratched with pen knife.
			A piece of core 150 mm long x 50 mm dia. Is difficult to break with hand held hammer. Rings when struck with a hammer.

* - rock strength defined by point load strength (Is 50) in direction normal to bedding






Degree of fracturing	
fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
highly fractured	Core lengths are generally less than 20mm - 40mm with occasional fragments.
fractured	Core lengths are mainly 30mm - 100mm with occasional shorter and longer lengths
slightly fractured	Core lengths are generally 300mm - 1000mm with occasional longer sections and shorter sections of 100mm -- 300mm.
unbroken	The core does not contain any fracture.

- spacing of all types of natural fractures, but not artificial breaks, in cored bores.


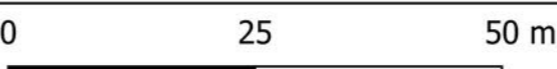
The fracture spacing is shown where applicable and the Rock Quality Designation is given by:

$$RQD (\%) = \frac{\text{sum of unbroken core pieces 100 mm or longer}}{100}$$



-  Borehole locations
-  Contour
-  Lot Boundary
-  Proposed development
-  Proposed disposal envelope

Note:
Basemap imagery provided by Google Satellite.

MACQUARIE GEO TECH	Client: Hi-Tech Modular Homes	Drawn: KR	G24546 - Site Plan		Project ID: G24546	
	Project: 24 Brewers Lane Saint Fillans SCEDI	Checked: JH				Drawing ID: G24546-001
	Location: 24 Brewers Lane Saint Fillans	Date: 24-09-25			Scale - 1:907 at A3	
Macquarie Geotechnical Pty Ltd 3 Watt Drive, Bathurst NSW 2795 - www.macgeo.com.au		CRS: WGS 84 / Pseudo-Mercator (EPSG:3857)				

Absorption Bed Water Balance Calculations								
Month	Evaporation mm	ET =0.75 Evaporation mm	Rainfall mm	Rr=0.75R Rainfall mm	LTAR (DLR*Days) mm	Disposal Rate mm	Application Rate Litres	Area m ²
Jan	222.00	166.50	67.90	50.93	1085	1200.58	14880	12.39
Feb	192.00	144.00	62.90	47.18	980	1076.83	13440	12.48
Mar	144.00	108.00	52.50	39.38	1085	1153.63	14880	12.90
April	90.00	67.50	43.80	32.85	1050	1084.65	14400	13.28
May	48.00	36.00	48.90	36.68	1085	1084.33	14880	13.72
June	30.00	22.50	54.90	41.18	1050	1031.33	14400	13.96
July	33.00	24.75	52.90	39.68	1085	1070.08	14880	13.91
August	48.00	36.00	52.20	39.15	1085	1081.85	14880	13.75
Sept	78.00	58.50	52.40	39.30	1050	1069.20	14400	13.47
October	120.00	90.00	59.40	44.55	1085	1130.45	14880	13.16
November	165.00	123.75	61.80	46.35	1050	1127.40	14400	12.77
December	210.00	157.50	65.10	48.83	1085	1193.68	14880	12.47
Av Area								13.19

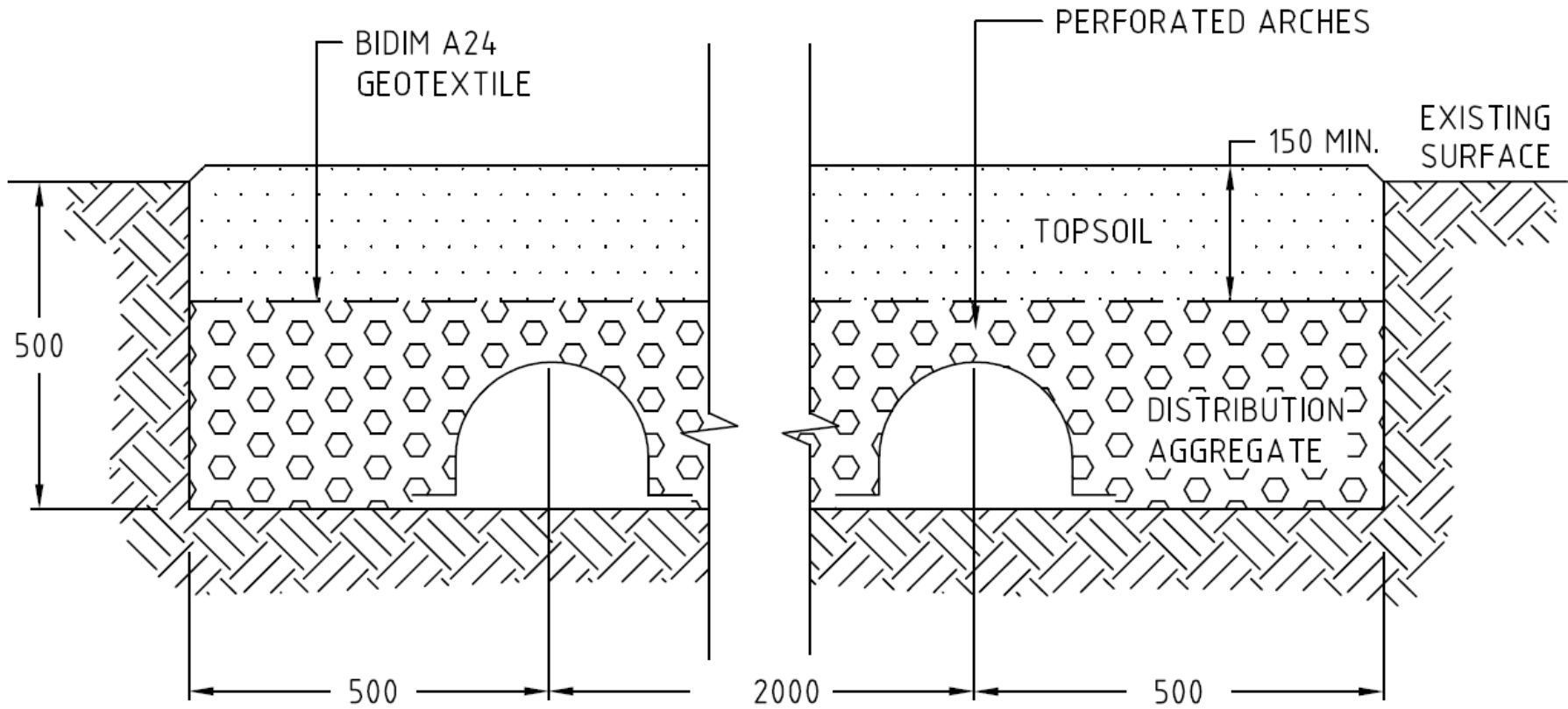
No. Persons 4

DLR 35

Flow/Person 120

Void Ratio (n) 0.30

Month	Trial	Application Rate mm	Disposal Rate mm	Net Storage (S) mm	Depth Increase S/n mm	Depth at End of Month	Increase mm	Computed Depth mm
	15.00							
Jan		992.00	1200.58	-208.58	-695.25	0	-695.25	0.00
Feb		896.00	1076.83	-180.83	-602.75	0	-602.75	0.00
Mar		992.00	1153.63	-161.63	-538.75	0	-538.75	0.00
April		960.00	1084.65	-124.65	-415.50	0	-415.50	0.00
May		992.00	1084.33	-92.33	-307.75	0	-307.75	0.00
June		992.00	1031.33	-39.33	-131.08	0	-131.08	0.00
July		992.00	1070.08	-78.08	-260.25	0	-260.25	0.00
August		992.00	1081.85	-89.85	-299.50	0	-299.50	0.00
Sept		960.00	1069.20	-109.20	-364.00	0	-364.00	0.00
October		992.00	1130.45	-138.45	-461.50	0	-461.50	0.00
November		960.00	1127.40	-167.40	-558.00	0	-558.00	0.00
December		992.00	1193.68	-201.68	-672.25	0	-672.25	0.00



Material Test Report

Report Number: B24002-78
Issue Number: 1
Date Issued: 20/09/2024
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: Craig Green
Project Number: B24002
Project Name: GEO/Drillers-Bathurst Laboratory Testing
Project Location: G24546 - Hi Tech Modular Homes - 24 Brewers Lane
Work Request: 5634
Sample Number: BTH-5634A
Date Sampled: 29/08/2024
Dates Tested: 12/09/2024 - 18/09/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: In accordance with the test method
Sample Location: BH1 , Depth: 0.50-1.00
Lot No: G24546

MACQUARIE GEO TECH

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au



Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager

Laboratory Accreditation Number: 14874

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	8.0		
Cracking Crumbling Curling	None		

Material Test Report

Report Number: B24002-78
Issue Number: 1
Date Issued: 20/09/2024
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: Craig Green
Project Number: B24002
Project Name: GEO/Drillers-Bathurst Laboratory Testing
Project Location: G24546 - Hi Tech Modular Homes - 24 Brewers Lane
Work Request: 5634
Sample Number: BTH-5634B
Date Sampled: 29/08/2024
Dates Tested: 12/09/2024 - 18/09/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: In accordance with the test method
Sample Location: BH1 , Depth: 1.00-1.50
Lot No: G24546

MACQUARIE GEO TECH

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Approved Signatory: Barry Froebel
Laboratory Manager
Laboratory Accreditation Number: 14874

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	4.5		
Cracking Crumbling Curling	Cracking		