GEO-ENVIRONMENTAL

SOLUTIONS

GEOTECHNICAL ASSESSMENT

52 Richardsons Road, Sandford

CLIENT

JMG

May 2020





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1 Introduction

Geo-Environmental Solutions Pty Ltd (GES) were contracted by Johnstone, McGee and & Gandy PTY LTD (JMG) to prepare a geotechnical assessment for a proposed subdivision at Sandford. The proposed development is located at cadastral title (CT 158742/9) located at 52 Richardson Road, Sandford (The Site). GES are to undertake a geotechnical assessment of the proposed development in conjunction with the requirements of the Clarence Interim Planning Scheme 2015.

GES have undertaken this assessment through using site observations and investigation, photographs and publicly available datasets. Estimations are determined by approximation with regional information applied where appropriate to site specific information. Data collection and site-specific modelling was undertaken in assessment of the site.

2 Objectives

The objective of the site investigation is to:

- Assess the subsurface conditions at the site relevant to the proposed development;
- Identify which codes need to be addressed and identify the relevant performance criteria relevant to the project which need addressing;
- Provide factual data from the test holes drilled on site
- Provide preliminary geotechnical recommendations and construction considerations;
- Recommendations for further investigation works to confirm assumptions made within this report.

3 Site Details

3.1 Project Area Land Title

The land studied in this report is defined by the following title reference:

- CT 158742/9

This parcel of land is referred to as the 'Site' and/or the 'Project Area' in this report.

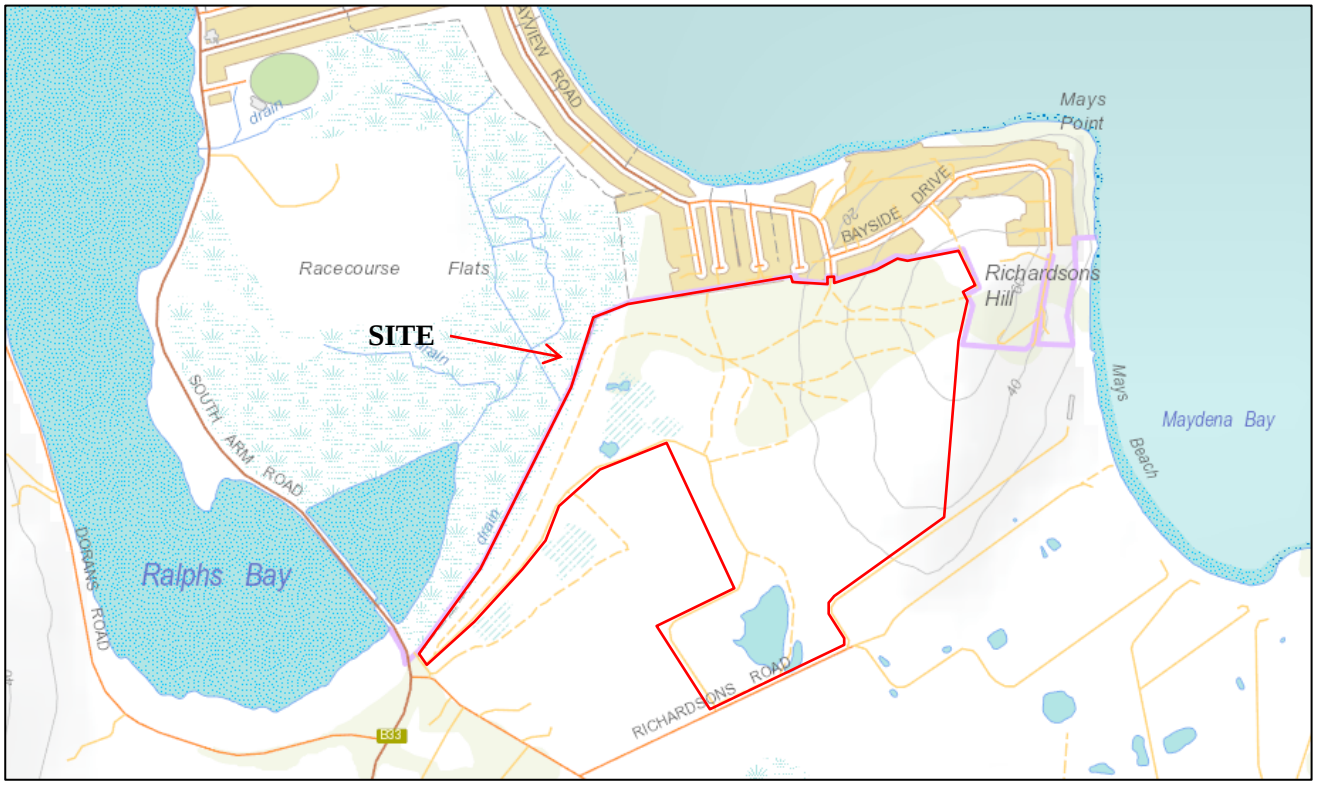


Figure 1 Regional Location of Project Area (The LIST)



Figure 2 Local Project Area Setting (The LIST)

4 Planning

4.1 Interim Planning Scheme Overlays

This report presents a summary of the site pertaining to interim planning overlays, particularly landslide hazard and coastal inundation of the Clarence Council Interim Planning Scheme 2015. The planning overlay for acid sulfate soil has been included for completeness of the report.

4.1.1 Coastal Acid Sulfate Soils

The proposed site is within the low coastal acid sulfate soils overlay (Figure 3). The coastal acid sulfate soils overlay is present on the five (5) large lots on the western side of the site.

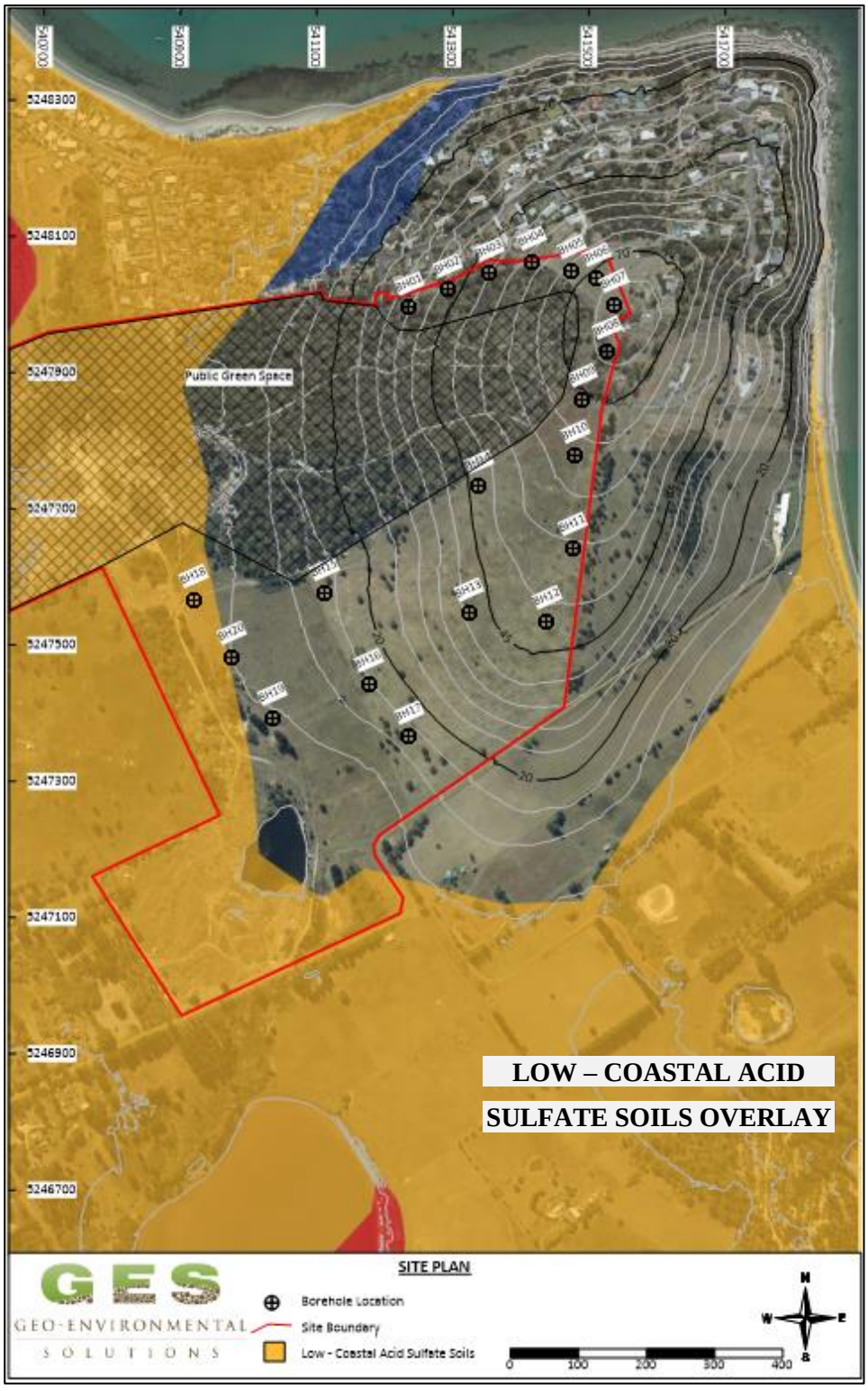


Figure 3 Coastal Acid Sulfate Soils Overlay at the Site (The LIST).

4.1.1.1 Acid Sulfate Soils Code (ASSC)

This code is not used in the Clarence Interim Planning Scheme. However, it may be called on to be addressed. As such, it has been included in this report for fullness.

4.1.2 Landslide Hazard

The proposed site is within the Landslide Hazard Map – Hazard Bands overlay (Figure 4). There is a small area of the northern portion of the site within the Low Landslide Hazard zone.



Figure 4 Landslide Hazard Map – Hazard Bands (The LIST).

4.1.2.1 Landslide Hazard Code (LHC)

The extent of the excavation works is currently unknown. However, it is assumed that some of it will encroach on the Low Landslip Hazard Area, and there are no acceptable solutions for 'Buildings and Works, other than Minor Extensions' in a Landslip Hazard Area, the E3.7.1 P1 performance criteria will need to be addressed.

Performance criteria has been addressed in Table 4.

4.1.3 Coastal Inundation Hazard

The proposed site is within the Coastal Inundation Hazard Map – Hazard Bands overlay (Figure 5). There is a small area of the western portion of the site within the Low and Medium Coastal Inundation Hazard zone.



Figure 5 Coastal Inundation Hazard – Hazard Bands (The LIST). Construction setback zone indicated by black and white stripe polygon.

4.1.3.1 Inundation Prone Areas Code (IPAC)

The location of construction works is currently unknown. However, portions of lots 148 and 149 lay within the low and medium Coastal Inundation Hazard Area. To avoid requirement to satisfy the E15.5.1 performance criteria a 50m construction setback to northwest and western boundaries of Lot 148 and the western boundary of Lot 149 is strongly recommended.

4.2 Site Geomorphology and Proposed Works

The proposed subdivision is comprised of 155 lots between 540m^2 and 3.30ha in size with a balance lot of 8.24ha. The proposed subdivision is located on the western, north-western and south-western aspects of Richardsons Hill, with the eastern boundary of the site is situated along the south trending ridge of Richardsons Hill. The site contains a mixture of pasture with sporadic tree cover and a large woodland area is located within the central and northern portions of the site. Majority of the proposed lots are located on pasture with sporadic tree cover. The southernmost lot contains a large pond. Multiple farm tracks cross the site.

The five lots within the western portion of the site (including the balance lot) are situated at the base of Richardsons Hill and are on generally flat <2° land. The remaining lots are primarily situated on gentle (~5-10°) west, northwest and southwest sloping topography.

The proposed development comprises a 155-lot subdivision with multiple roadways, foot accessways and a 35.6ha public open space where the existing woodland area is situated. The proposed development plan is attached in appendix 4 of this report.

5 Site Mapping

5.1 Site Geology

Based on the MRT 1:250,000 Mineral Resources Tasmania (MRT) mapping of the site geology comprises of the following geological units:

- **Quaternary Windblown Sand Deposits (Map Unit – Qhw);**
- **Permian Sandy Mudstone, Siltstone, Sandstone and Mudstone (Map Unit – Pm and Ps) potentially metamorphosed by Jdl intrusion**;
- **Jurassic Dolerite (Map Unit – Jdl).**

Majority of the site is underlain by a thin mantling of Quaternary-aged windblown sand deposits atop of Permian Sandy Mudstone, Siltstone, Sandstone and Mudstone. Boreholes BH18 – BH20 within the lower lots are underlain by Quaternary-aged windblown sand deposits to a minimum of 1.4m with AMS Power Probe refusal occurring in dense, well sorted sands in BH18 and BH20. Evidence of Jurassic-aged dolerite intrusion was encountered in borehole BH08 with Quaternary-aged windblown sand deposits atop residual dolerite soils and AMS Power Probe refusal at 1.3m on dolerite.

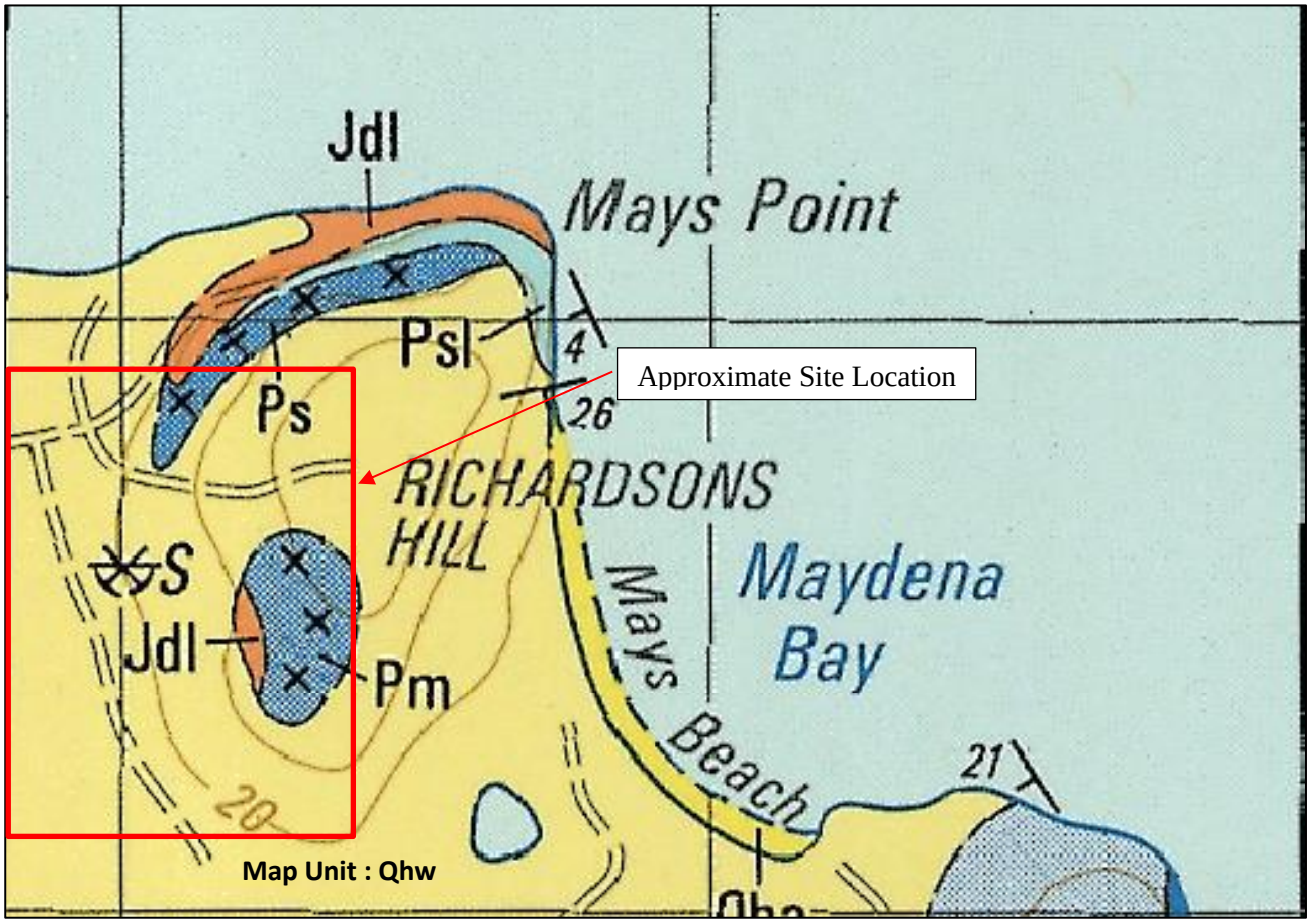


Figure 6. Site Geology (Extract from 1:50,000 Sorell – Geological Survey of Tasmania)

5.2 Field Investigation

A geotechnical investigation was carried out by GES on 28th April 2020. A total of 20 no. push probe boreholes were carried out (BH01 to BH20) to a maximum investigation depth of 3.0 m below ground surface level with Dynamic Cone Penetrometer (DCP) testing alongside boreholes >1.5m in depth. location of the boreholes has been presented in Figure 2 and Appendix 4 Development Plan.

During the investigation, variable ground conditions were encountered with overlying SANDS ranging from 0.2m near the apex of Richardsons Hill to >3.0m below ground surface in the western portion of the site within the lower lots.

Depth of overlying soils across site was typically shallow with refusal on Permian-aged sandstone and siltstone in Boreholes BH01-BH07 and BH09-BH17, and Jurassic-aged dolerite in BH08 between 0.5m and 1.3m depth below surface. Refusal on dense Quaternary-aged SAND occurred in boreholes BH18 and BH20. In BH19 the Quaternary-aged sediments extend to >3.0m. Typical soil profiles are shown in Tables 1-3.

Table 1 Borehole log of BH06

BH06 **Depth (m)**	**Description**
0.00 – 0.10	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.
0.10 – 0.20	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.
0.20 – 0.40	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.
0.40– 0.5+	SILTSTONE recovered as Clayey SILT: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.5m.

Table 2 Borehole log of BH08

BH08 Depth (m)	Description
0.00 – 0.20	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.
0.20 – 0.40	SAND with trace clay; Orange-brown, fine to medium grained, moist, medium dense.
0.40 – 0.70	CLAY with minor sand and trace gravel: Dark brown mottled orange and pale yellow, moist, low plasticity, stiff to very stiff.
0.70 – 1.0	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.
1.0 – 1.3+	Sandy gravelly CLAY: Grey-brown mottled orange, medium plasticity, moist, very stiff. Gravels are angular to sub-angular doloerite. Refusal at 1.3m on dolerite.

Table 3 Borehole log of BH20

BH20 Depth (m)	Description
0.00 – 0.20	TOPSOIL - SAND: Dark grey, moist.
0.20 – 0.40	SAND: Pale brown, fine to medium grained, wet.
0.40 – 0.70	SAND: Dark orange mottled grey, fine to medium grained, wet, tight.
0.70 – 1.2	Clayey SAND: Pale brown mottled orange, wet to moist.
1.2 – 2.0+	SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, low plasticity. Refusal on dense sand at 2.0m.

6 Dispersive Soil Assessment

The dispersive soil assessment is basic in nature and does not account for the entirety of the site with soil samples only taken from select boreholes throughout the site.

6.1 Soil sampling and testing

A total of 3 samples were taken at the site for assessment of dispersion. An Emerson (1968) Dispersion test was conducted to determine if these samples were dispersive.

The results showed that the soils on site have low dispersive characteristics throughout the site with results from Emerson (1968) Dispersion testing returning 3 samples at Class 2(1).

6.2 Discussion of results

Only clay materials are subject to dispersion, such that only clay samples from a number of bore holes have been tested. As noted in the previous sections, soil depth, and in particular the depth of the surface cover of windblown sand varies greatly across the site. Care should be taken interpreting the results as the geology and in turn dispersion characteristics can vary throughout the site. This report is in no way a comprehensive investigation into dispersive soils for the entire site.

7 Potential Geotechnical Risks

A number of geotechnical risk scenarios have been considered for the residential development; risk of land instability, risk of inundation/flooding, risk of foundation failure, and erosion risk. The level of risk associated with any possible event is described in terms of likelihood and consequence (see appendix 1 for an explanation of terminology). That is, how likely is the event to occur (eg rare, unlikely, likely possible etc), and what is the consequence of the event (eg loss of life, serious capital damage, limited capital damage, localised erosion etc).

Based upon an assessment of the site and the likely risks, the overall geotechnical risk associated with the development is rated as low (see Table 4 -geotechnical risk summary). The level of risk is therefore acceptable and there is no serious geotechnical impediment to the proposed development. The one factor identified that must be addressed in standard AS2870 testing for construction is the possible presence of dispersive soils and erosion that may result from excavation. It is also recommended that dispersive soil assessment be undertaken once infrastructure plans are developed to ensure any excavations for infrastructure do not cause unnecessary erosion.

Table 4 Summary of geotechnical hazards, consequences and risk, with suggested treatment options

Hazard	Likelihood of occurrence	Consequences to property	Level of risk to property	Treatment options
Surface erosion	Likely	Minor	Moderate	Soil and Water Management Plan (SWMP)
Subsoil or tunnel erosion	Possible	Medium	Moderate	Dispersion testing of subsoils as part of AS2870 assessment and management plans
Soil creep	Unlikely	Minor	Low	None required
Shallow seated landslide (eg. Debris slide/flows)	Unlikely	Minor	Low	Adequate AS2870-2011 assessment & SWMP
Deep seated landslide (eg. Boulder bed/talus instability)	Barely credible	Major	Very Low	None required
Excessive foundation movement (eg. Due to extremely reactive soils)	Unlikely	Medium	Low	Thorough AS2870-2011 assessment and appropriate engineering foundation design
Foundation failure (eg. Excessive settlement, fill failure)	Unlikely	Major	Moderate	Thorough AS2870-2011 assessment and appropriate engineering foundation design
Flooding or inundation	Possible	Minor	Moderate	Adequate stormwater design as part of detailed engineering for the development. 50m construction setback zone for northwest and western boundaries of Lot 148 and the western boundary of Lot 149
Site contamination	Possible	Minor	Moderate	Visual inspection of site/soils and review of prior activities

8 Construction Considerations and Recommendations

8.1.1 Site Excavation Considerations

- Excavation of fill materials and natural soils to 1.0m depth at all locations is likely to be achieved with relative ease with conventional hydraulic excavation machinery;
- Excavation of rock including use of a rock breaker may be necessary for excavations exceeding 1.0m depth in the elevated areas of the site;
- It is recommended for earthworks activities to be carried out during drier periods of the year. If this is carried out, the risk of water ponding, trafficability and clay softening (reducing shear strength of foundation material) will be reduced;
- All surface water should be diverted away from the excavations where practicable;
- Care should also be taken due to the underground services if present on site. Especially for critical water main services within proposed lots 18-21; and
- It is recommended that excavations be observed by a Geotechnical Engineer/Geologist during construction to ensure that founding conditions are consistent with those on which the design recommendations are based.

8.1.2 Subdivision Construction Considerations

Conventional foundation designs are likely to be suitable for residential construction on this site provided sufficient founding depth.

It is recommended that:

- All construction areas have complete AS2870 testing including dispersive soils assessment prior to design and construction For areas of proposed shallow foundations all foundations must penetrate through the topsoils and into the residual soil below approximately 0.5m depth or onto weathered gravels/rock.
- Conventional pad footings are likely to be suitable only if excavated to sufficient depth and bearing.
- Dependent upon the final foundation design chosen and the loads supported, pile foundations may be required, and all piles should be driven or bored into underlying well consolidated natural soil or gravels/rock at depth– pile foundation parameters should then be calculated once likely pile dimensions have been determined
- Levelling and compaction of footprints with either natural rock fill or imported Class 1 fill should follow AS 1289 5.1.1
- All earthworks onsite be compliant with AS3798-2007 “Guidelines for Earthworks on commercial and residential subdivision”
- Stormwater be connected as soon as any roofing is sealed.
- Drainage of the ground surface and pavements be designed to flow away from footing areas and towards stormwater discharge points.
- All construction onsite should be achieved following the ‘Good Hillside Construction Practice Australian Geoguide LR8’.

8.1.3 Pavement and Roading Considerations

Where practical, it is recommended that pavements be constructed in the drier months of the year given that wet weather makes subgrade preparation and compaction very difficult. Management of the moisture content of the subgrade is therefore critical and it may be necessary to add water to achieve optimal compaction if it is too dry. Alternatively, if the subgrade is too moist then hydrated lime can be added to reduce moisture contents. Moisture content should be measured in accordance with AS1289.5.1.2 by a suitably qualified person.

It is further recommended that:

- Pavement and floor slab sub grades should involve the stripping of all vegetation including root material as well as the topsoil to expose the underlying natural soil with good bearing capacities (note dispersion testing and assessment to be completed prior).
- This surface should be rolled to a dry density ratio as stipulated in AS1289.5.1.2 with any incompactable, loose or moist material being removed.
- Backfilling and levelling should be carried out with Class 3 20-40mm crushed Basalt and compacted to 98% maximum dry density as stipulated in AS1289.5.1.2.
- Pavement construction should be commenced immediately after the subgrade has been rolled.
- Consideration should be given to subgrade drainage so that the watertable is maintained at least 400mm below the underside of pavements. Alternatively, a lower Californian Bearing Ratio (CBR) should be used in the design.
- Pavements should be designed with an estimated CBR value of 3% (based upon controlled compaction of existing layers or natural soils) although this may be increased with further stabilisation of the subgrade using lime or cement – further bulk sampling and testing recommenced on road alignments prior to detailed design.

9 Conclusions and Recommendations

It is recommended that during construction that GES be notified of any major variation to the soil conditions as predicted in this report. The geotechnical investigation has found that ground conditions over the proposed areas of development show limited geotechnical impediments to construction. Conventional foundation designs are likely to be suitable for residential construction founded in the natural subsoils with adequate bearing capacity.

The following conclusions and recommendations are made:

- The site is suitable for residential development and the geotechnical risk is generally rated as low
- The geotechnical risk related to dispersive soils is rated as low and provided adequate testing and management is implemented the risk is considered acceptable
- The geotechnical risk related to landslip hazard is low and acceptable
- Thorough AS2870 testing and assessment must be completed prior to residential construction
- Future AS2870 assessment must include dispersion testing and classification
- Further detailed testing for pavements and infrastructure will be required and is to include appropriate CBR tests and dispersive soil tests
- If dispersive soils are confirmed on site then all design and construction must adhere to the DPIWE Dispersive soils management publication (Hardie 2009)
- All earthworks onsite must be compliant with AS3798-2007 “Guidelines for Earthworks on commercial and residential developments”
- Soil and water management plans and infrastructure must be in place for all construction activities



David Lee BSc.

Engineering Geologist

10 References

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AGS (2007b). Commentary on Guideline for Landslide Susceptibility, Hazard and Risk Zoning. Australian Geomechanics, Vol 42 No 1 March 2007

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AGS (2007d). Commentary on Practice Notes Guidelines for Landslide Risk Management. Australian Geomechanics Vol 42 No 1 March 2007

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AS1726 (2017). Australian Standard. Geotechnical site investigations. Prepared by Committee CE-015, Site Investigations. Approved on behalf of the Council of Standards Australia on 7 April 2017 and published on 2 May 2017.

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Appendix 1 Quantitative Risk Assessment Tables

Likelihood & Consequence Index

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

Qualitative Risk Matrix

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or L (5)
B - LIKELY	10^{-2}	VH	VH	H	M	L
C - POSSIBLE	10^{-3}	VH	H	M	M	VL
D - UNLIKELY	10^{-4}	H	M	L	L	VL
E - RARE	10^{-5}	M	L	L	VL	VL
F - BARELY CREDIBLE	10^{-6}	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Appendix 2 Quantitative Risk Assessment

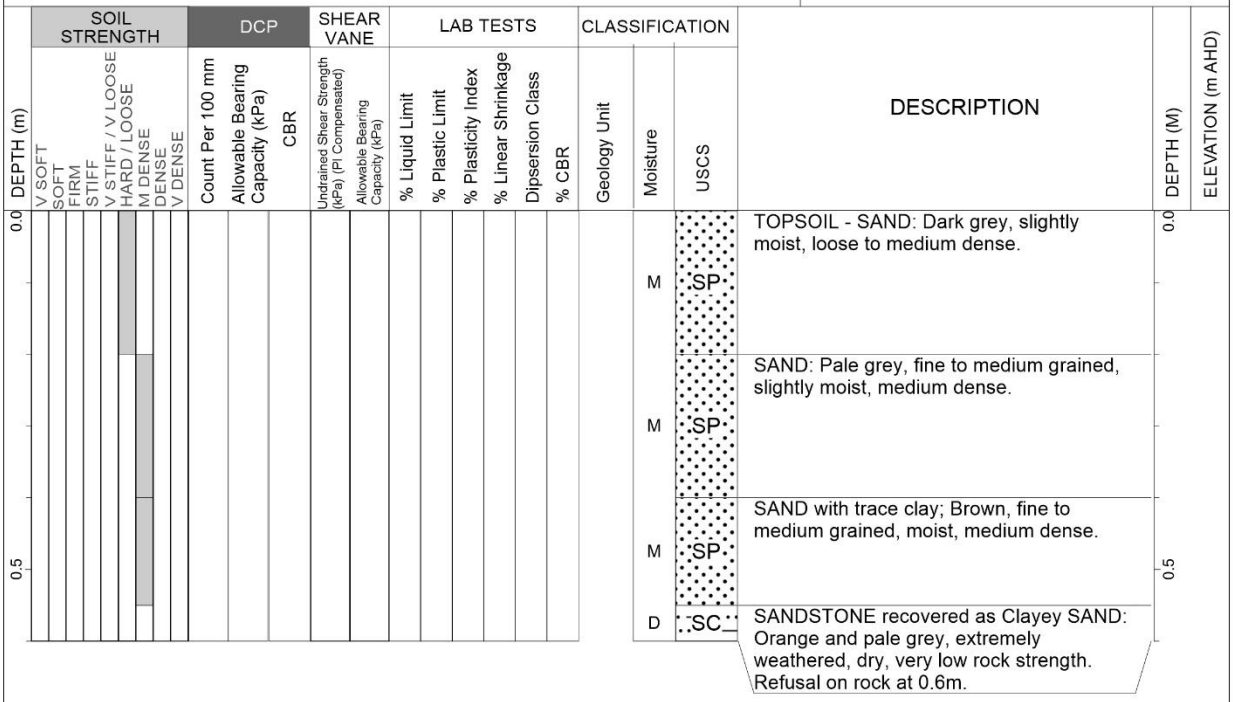
Performance Criteria E3.7.1 P1 **Buildings and works must satisfy all of the following:**	**Relevance**	**Management Options**	**Managed (treated) Risk Assessment**			**Further Assessment Required**
			Consequence	**Likelihood**	**Risk**	
(a) no part of the buildings and works is in a High Landslide Hazard Area;	NA					
(b) the landslide risk associated with the buildings and works is either: (i) acceptable risk (means a risk society is prepared to accept as it is. That is; without management or treatment); or (ii) capable of feasible and effective treatment through hazard management measures, so as to be tolerable risk. The residual tolerable risk may be assessed using either qualitative or qualitative methods in the landslide risk assessment either: (a) if using the AGS qualitative risk assessment method apply the "As Low As Reasonably Possible (ALARP)" principle with the residual tolerable risk level no higher than a "moderate" risk level under the AGS 2007(c) risk method; or (b) if using the AGS quantitative risk assessment method then the tolerable loss of life for the person most at risk as suggested by the AGS 2007(c) to be: (i) if existing slope / existing development: 10-4 / annum; (ii) if new constructed slope / new development / existing landslide: 10-5 / annum.	Acceptable risk	Founding buildings located within the low landslide hazard band within the underlying weathered bedrock.	Minor	Unlikely	Low	Thorough AS2870-2011 assessment and appropriate engineering foundation design

Performance Criteria E3.7.3 P1 **Major works must satisfy all of the following (same as 3.7.1P3):**	**Relevance**	**Management Options**	**Managed (treated) Risk Assessment**			**Further Assessment Required**
			Consequence	**Likelihood**	**Risk**	
(a) no part of the works is in a High Landslide Hazard Area; (b)the landslide risk associated with the works is either: (i) acceptable risk; or (ii)capable of feasible and effective treatment through hazard management measures, so as to be tolerable risk.	Acceptable risk	Founding building located within the low landslide hazard band within the underlying weathered bedrock.	Minor	Unlikely	Low	Thorough AS2870-2011 assessment and appropriate engineering foundation design

Appendix 3 Borehole Logs

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH01**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.6**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH02

CLIENT: **JMG**

EASTING (GDA94):

LOCATION: **Sandford**

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.6**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	SP	SAND with trace clay; Brown, fine to medium grained, moist, medium dense.		
0.5														D	SC	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.6m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH03

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.7**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

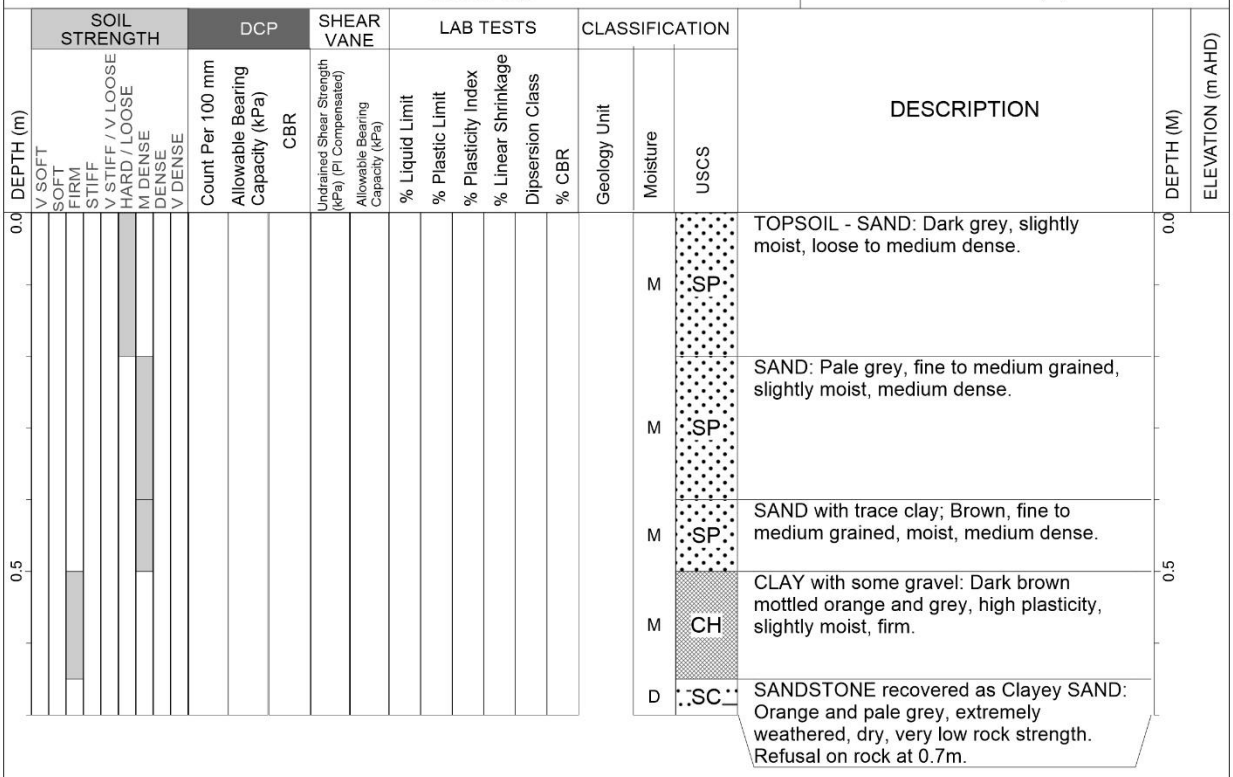
DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	SP	SAND with trace clay; Brown, fine to medium grained, moist, medium dense.		
0.5														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.	0.5	
														D	SC	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.7m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH04**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.7**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH05**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.65**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
0.5														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.	0.5	
														D	ML	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.65m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH06

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH (V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE)	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.		
0.5														D	ML	SILTSTONE recovered as Clayey SILT: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.5m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH07

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.7**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.		
0.5														D	ML	SILTSTONE recovered as Clayey SILT: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.7m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH08**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.3**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	SP	SAND with trace clay; Orange-brown, fine to medium grained, moist, medium dense.		
0.5														M	CL	CLAY with minor sand and trace gravel: Dark brown mottled orange and pale yellow, moist, low plasticity, stiff to very stiff.	0.5	
														M	CH	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.		
1.0														M	CI	Sandy gravelly CLAY: Grey-brown mottled orange, medium plasticity, moist, very stiff. Gravels are angular to sub-angular doloerite. Refusal at 1.3m on dolerite.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH09

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

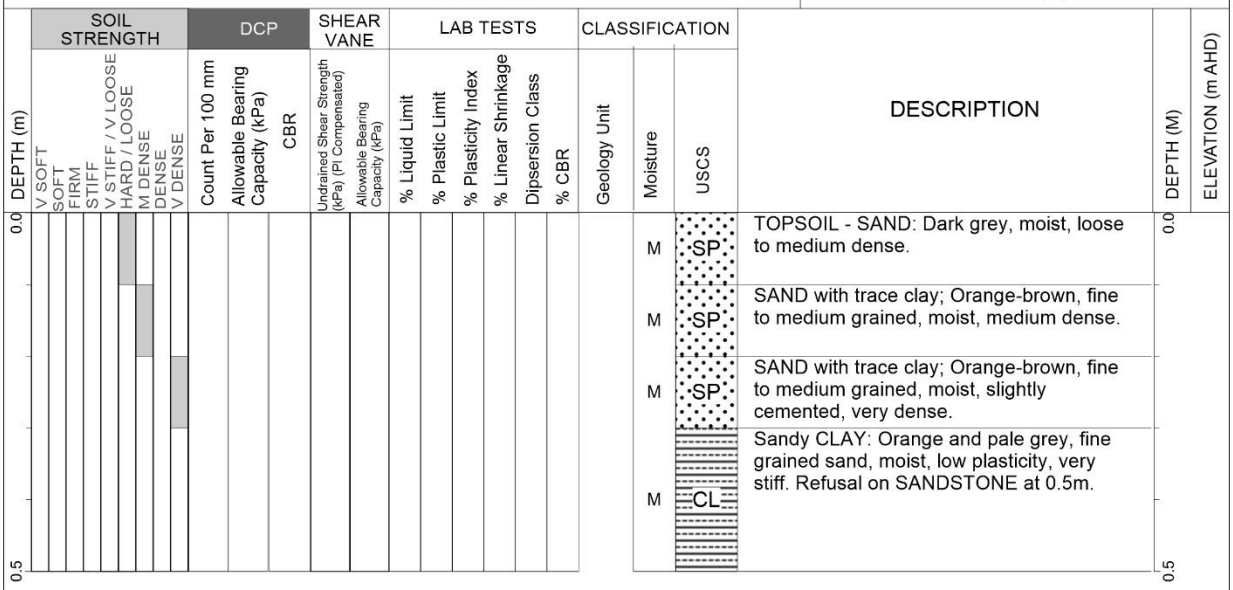
SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

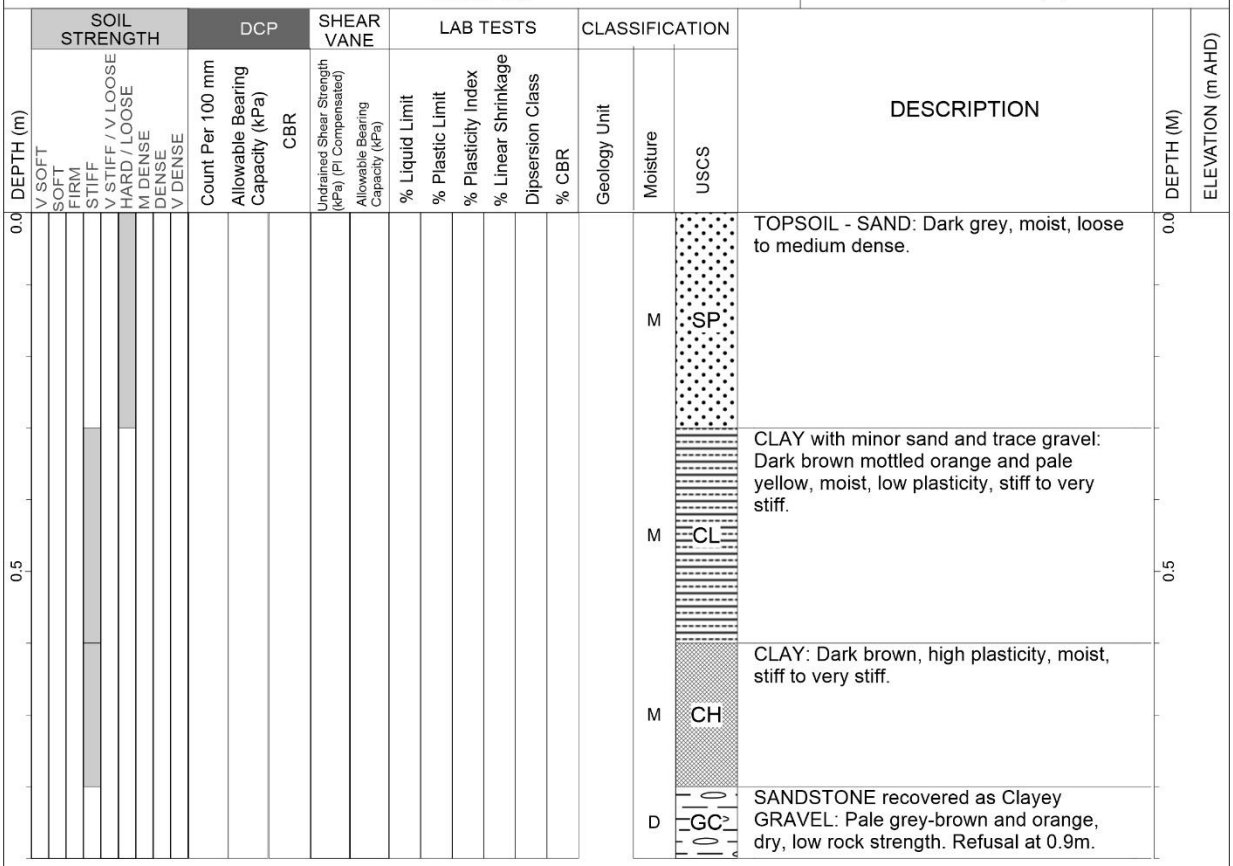
DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH10**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.9**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH11**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.7**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / HARD / V LOOSE / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CH	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.		
0.5														D	GC	SANDSTONE recovered as Clayey GRAVEL: Pale grey-brown and orange, dry, low rock strength. Refusal at 0.7m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH12**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.2**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / HARD / V LOOSE / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CI	Gravelly CLAY: Dark brown, moist, medium plasticity, stiff.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff.	0.5	
1.0														M	CL	Gravelly, silty CLAY: Yellow-brown mottled white, moist, low plasticity, stiff. Refusal on rock at 1.2m.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH13

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CI	Gravelly CLAY: Dark brown, moist, medium plasticity, stiff.		
0.5														M	CL	Gravelly, silty CLAY: Yellow-brown mottled white, moist, low plasticity, stiff. Refusal on rock at 0.5m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH14

CLIENT: **JMG**

EASTING (GDA94):

LOCATION: **Sandford**

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

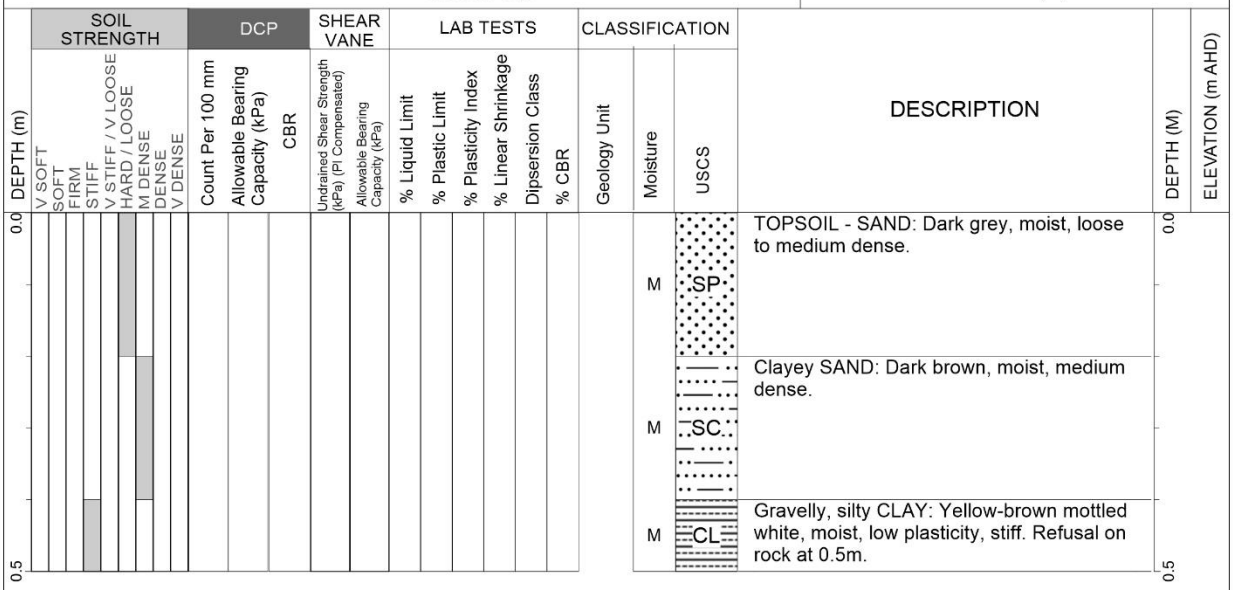
SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH15

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.9**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
														W	CI	Gravelly CLAY: Dark brown, moist to wet, medium plasticity, stiff.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff. Refusal on rock at 0.9m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH16**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.3**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, medium to high plasticity, very stiff.	0.5	
1.0														M	SC	Clayey SAND: Orange and pale grey, moist, very dense. Refusal at 1.3m.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH17**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.3**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
0.5														M	SC	Clayey SAND: Orange and pale grey, moist, very dense.	0.5	
1.0														M	GC	SILTSTONE recovered at Clayey GRAVEL: Orange and pale grey, moist, low rock strength. Refusal at 1.3m.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH18**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.4**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CI	Gravelly CLAY: Dark brown, moist, medium plasticity, stiff.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff.	0.5	
1.0														M	CL	Gravelly, silty CLAY: Yellow-brown mottled white, moist, low plasticity, stiff.	1.0	
														M	SC	SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, very dense. Refusal on dense sand at 1.4m.		

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT - T: 03 6223 1839 | Page 1 of 1

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH19

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **3**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH	DCP Count Per 100 mm	DCP Allowable Bearing Capacity (kPa)	DCP CBR	SHEAR VANE Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE Allowable Bearing Capacity (kPa)	LAB TESTS % Liquid Limit	% Plastic Limit	% Plasticity Index	% Linear Shrinkage	Dipsersion Class	% CBR	CLASSIFICATION Geology Unit	Moisture	USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0	V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	1	30	2										M	SP	TOPSOIL - SAND: Dark grey, moist.	0.0	
		1	30	2														
		2	55	4										W	SP	SAND: Pale brown, fine to medium grained, wet.		
		3	85	6														
0.5		6	170	13										M	SC	Clayey SAND: Brown mottled orange, moist.	0.5	
		9	250	20														
		12	335	27														
		13	365	30										W	SP	SAND: Orange, fine to medium grained, wet.		
1.0		13	365	30													1.0	
		12	335	27														
		11	310	25														
		7	195	15														
		5	140	10														
1.5		5	140	10										W	CI	Sandy CLAY: Pale brown-grey mottled orange, wet to moist, medium plasticity.	1.5	
		4	110	8														
		9	250	20														
		13	365	30														
2.0		16	450	37													2.0	
		20	560	48														
														M	SP	SAND: Pale grey mottled orange, moist, dense.		
2.5																	2.5	
														M	CI	Sandy CLAY: Pale brown-grey mottled orange, moist, medium plasticity, very stiff. Lower boundary undefined.		
3.0																	3.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH20

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **2**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH	DCP Count Per 100 mm	DCP Allowable Bearing Capacity (kPa)	DCP CBR	SHEAR VANE Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE Allowable Bearing Capacity (kPa)	LAB TESTS % Liquid Limit	% Plastic Limit	% Plasticity Index	% Linear Shrinkage	Dipsersion Class	% CBR	CLASSIFICATION Geology Unit	Moisture	USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0	V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	1	30	2										M	SP	TOPSOIL - SAND: Dark grey, moist.	0.0	
		1	30	2														
		1	30	2										W	SP	SAND: Pale brown, fine to medium grained, wet.		
		2	55	4														
0.5		6	170	13												SAND: Dark orange mottled grey, fine to medium grained, wet, tight.	0.5	
		10	280	22										W	SP			
		7	195	15														
		9	250	20												Clayey SAND: Pale brown mottled orange, wet to moist.		
1.0		9	250	20													1.0	
		12	335	27										M	SC			
		10	280	22														
		12	335	27														
1.5		4	110	8												SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, low plasticity. Refusal on dense sand at 2.0m.	1.5	
		5	140	10														
		7	195	15														
		4	110	8										M	SC			
		8	225	17														
		15	420	35														
2.0		20	560	48													2.0	

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Appendix 4 Development Plan

