

# Preliminary Geotechnical Investigation Report

## Civil Engineering at Stirling Golf Club

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<b>Job Number</b>	275203
<b>Client</b>	Venture Capital Developments Pty Ltd
<b>Site</b>	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
<b>Date</b>	04/05/2021
<b>Revision</b>	0

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**Document Status**

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## 1.0 Introduction

FMG Engineering (FMG) has been commissioned to undertake a preliminary geotechnical investigation at Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152 for a Development Application to develop the site as Mount Lofty Golf Estate. The approximate site extents are shown below in Figure 1.



Figure 1: Site location

### 1.1 Proposed development and objectives

We understand from the documents and discussions provided that the proposed Mount Lofty Golf Estate development comprises accommodation Chalets, hotel, restaurant, pro shop, carpark and amphitheatre etc. Maximum building height of two-storey is proposed. We have been provided with the following drawings on which we have based this assumption.

- *MOUNT LOFTY COURSE MASTER PLAN*

A preliminary geotechnical investigation was required to better understand the top soil profiles and to classify the site soils. The approved scope of work can be found in our Fee Proposal letter (EST23936).

### 1.2 Reporting

This report summarizes the methodology adopted and the works undertaken during the site investigation, followed by the investigation findings and site classification. Borelogs are appended.

## 2.0 Preliminary / Desktop study

### 2.1 Site description

The site investigation area is located within the established Stirling Golf Club site. The site is approximately 20km South East of the Adelaide CBD and 0.5km off South Eastern Freeway. The site is near the toe of a hill sloping down towards the north, and terraced for buildings and carpark. A small dam and creek are noted north of the proposed development. A significant number of trees are present on site and on surrounding lands.

Surrounding site conditions comprise:

- North: Golf court
- East: Vacant land
- South: Golf court and Golflinks Road on upper hill
- West: Mount George

### 2.2 Geology

The South Australian Department for Energy and Mining online GIS database "SARIG" indicates that the regional near surface geology across the entire site to be Barossa Complex, described as Metamorphic rocks with retrograde metamorphism; metasediments, strongly banded parallel to gneissic foliation; minor intrusive granitic, pegmatitic and amphibolitic dykes. Granulite facies metapelites.

Nearby boreholes in the SARIG and FMG database indicate that the weathered rock bed could be at shallow depth (0.5m from shallowest record).

## 3.0 Site investigation and results

### 3.1 Methodology

Independent service locating was undertaken by ILS prior to drilling.

Borehole were located according to verbal advice provided by yourselves, and are shown on the site plan included in Appendix A. As advised, an additional borehole than proposed in our initial proposal was added. A total of 11 Boreholes were drilled using a Rockmaster 4WD mounted drill rig owned and operated by SPK Geodrill under the supervision of a Geotechnical Engineering on 29<sup>th</sup> April 2021.

Thick walled tubes were used to recover relatively continuous cores. Tubes were progressed by pushing the tube against the weight of the vehicle, by a high-frequency hydraulic hammer, and rotation of the tubes.

Only BH10 was terminated at the target depth, the rest of boreholes were all terminated when high resistance was encountered to push tubes. Depth achieved ranged from 0.4m to 4.0m. Recovered samples were placed in trays and transported to our laboratory for logging.

Visual tactile logging was carried out in accordance with AS1726 by an experienced Soil Technician and checked by Geotechnical Engineer. Borelogs are included in Appendix B.

A summary of achieved depths is shown in Table 1.

*Table 1 Summary of achieved depths*

TEST	DEPTH ACHIEVED (m)	TEST	DEPTH ACHIEVED (m)
<b>BH01</b>	2.2	<b>BH07</b>	0.4
<b>BH02</b>	2.8	<b>BH08</b>	1.8
<b>BH03</b>	2.3	<b>BH09</b>	2.1
<b>BH04</b>	1.2	<b>BH10</b>	4.0
<b>BH05</b>	2.1	<b>BH11</b>	3.0
<b>BH06</b>	1.6		

### 3.2 Summary of subsoil conditions

A description of the materials encountered during the investigation is included in the borehole log included in Appendix B and a generalised summary can be found in the table below. It should be noted that pocket penetrometer readings included on the logs indicate an approximation of unconfined shear strength and have been used in the interpretation of the allowable bearing capacities given in the footing recommendations section.

High resistance encountered to the drilling is interpreted as weathered rock. Weathering is likely to decrease with depth, with an increase in rock strength. It should be noted that the drilling method used does not provide any information regarding defects or bedding of the rock, and hence can not provide any data on the strength nor stability of the rock mass.

Table 2 outlines a summary of subsurface conditions.

*Table 2 Summary of subsurface conditions*

MATERIAL	DEPTH ENCOUNTERED (m)					
	BH01	BH02	BH03	BH04	BH05	BH06
<b>Fill</b>	0-0.2	0-0.35	N.E	N.E	0-0.2	0-0.2
<b>Natural soils</b>	0.2-1.8	0.35-2.6	0-1.6	0-0.7	0.2-1.5	0.2-1.3
<b>Rock</b>	1.8-2.2	2.6-2.8	1.6-2.3	0.7-1.2	1.5-2.1	1.3-1.6

MATERIAL	DEPTH ENCOUNTERED (m)				
	BH07	BH08	BH09	BH10	BH11
<b>Fill</b>	0-0.2	0-0.3	0-0.65	0-1.4	0-0.25
<b>Natural soils</b>	0.2-0.3	0.3-1.4	0.65-1.7	1.4-4.0	0.25-2.8
<b>Rock</b>	0.3-0.4	1.4-1.8	1.7-2.1	N.E	2.8-3.0

N.E Not Encountered

The natural subsurface conditions encountered in the boreholes are considered consistent with the regional geology from our desktop study.

### 3.3 Groundwater

Groundwater was not observed during drilling. It should be noted that the occurrence of groundwater may vary seasonally with rainfall intensity and duration.

### 3.4 Site classification

Free swell  $y_s$  values have been calculated in accordance with AS2870-2011. Although AS2870-2011 is considered appropriate for this application the design should be based on engineering principles.

The site in its current condition is classified as CLASS **P** (problem site) due to the presence of fill and trees and **M-D** due to soil reactivity.

The characteristic surface movement due to soil shrinking and swelling ( $y_s$ ) has been calculated in accordance with AS2870-2011 "Residential Slabs and Footings" (to the nearest 5mm). Taking into account the effects of trees in accordance with AS2870-2011, the additional characteristic surface movement due to ground tree effects ( $y_t$ ) has also been calculated.

- $y_s = 35\text{mm}$
- $y_t = 15\text{mm}$

The site classification is strongly related to depth of the rock. Locations where rock is shallow have lower shrink-swell potential. Values of heave  $y_s$  vary from 2mm at Borehole 7 to 37mm at Boreholes 2 and 11.

It must be emphasised that in classifying this site, FMG Engineering did not place sole reliance on the borelog as a means of being an absolute representation of all subsurface features existing at this site. The following have also been taken into consideration.

- The broad experience of FMG Engineering
- Well established and relevant local knowledge of the general behavioural characteristics of foundation soils in the vicinity of the site
- Specific geotechnical reports and classification on adjacent sites which were referred to
- FMG Engineering's vast experience relating to past performance of existing structures in the general area
- Published geological maps
- Engineering assessment of the likely characteristic surface movement ( $y_s$ ) based on estimated  $I_{ps}$  values as noted on the borelog.  $I_{ps}$  values are based on Shrink Swell tests ( $I_{ss}$ ) carried out in a laboratory on similar soils to this site
- It can occasionally be difficult to distinguish between natural soil and controlled FILL during testing. It is also impossible to distinguish between uncontrolled FILL and controlled FILL without appropriate information. It shall be the Client's responsibility to determine whether any controlled FILL exists on the site, and to provide FMG with the relevant Certificate(s) at the time of our engagement, prior to the fieldwork being carried out. FMG takes no responsibility for any additional costs which may be incurred due the presence of Controlled FILL which is not detected during our testing, and which is instead logged as either (uncontrolled) FILL or natural soil.

## 4.0 Important notes about the interpretation and use of this geotechnical report

These notes are offered to help in the interpretation of your Geotechnical Report.

The level of investigation and degree of certainty required is dependent upon the complexity of the proposed construction.

Should a more conclusive assessment be required regarding the subsoil conditions at the property, FMG Engineering can arrange to undertake a more detailed study including further sampling and laboratory testing. There will always be uncertainties arising from the practical limitations of the extent and nature of site testing and localised changes in soil conditions may not be found in any cause.

This report should be read as a whole. Borelogs should not be separated from the body of the report and interpreted independently. The whole of this report should be provided to contractors in order to provide the best available information to the contractors. To avoid any misinterpretation of the contents of the report consult the geotechnical engineer for any queries or proposed changes or unexpected conditions.

### 4.1 The limitations of a geotechnical investigation

Although the information provided by a geotechnical investigation can reduce exposure to such risks, no geotechnical investigation, however diligently carried out, can eliminate them. Even a rigorous professional assessment may fail to detect all subsoil and ground water variations on a site. The geology of the site may make predicting changes difficult.

A geotechnical investigation is based upon a unique set of project conditions.

Your report should not be used:

- When the nature of the proposed development or use is changed, for example if a residential development is proposed instead of a commercial one
- When the size or configuration of the proposed development is altered
- When the location or orientation of the proposed structure is modified
- When there is a change of ownership
- For application to an adjacent site.

The circumstances about a particular development or contract may require a specified approach to the assessment of soil and groundwater conditions.

To help avoid costly problems, refer to your consultant to determine how any factors which have changed subsequent to the date of the report may affect our recommendations.

### 4.2 Geotechnical 'findings' are professional estimates

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions



and the nature and homogeneity of subsurface conditions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration programme, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise its impact. For this reason, owners should retain the services of their consultants through the development stage, to identify variations, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site or during the tender process.

A report prepared for the purposes of the geotechnical engineer's direct client may not meet the objectives of a third party or contractor. Consult the geotechnical engineer for guidance in the application of the report to your purposes.

### **4.3 Unforeseen conditions**

Should conditions encountered on site be markedly different from those anticipated and described in this report then FMG Engineering should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows reinterpretation and assessment of the implications for future work.

### **4.4 Safety in design**

This Geotechnical Report presents factual information about the soil conditions at the subject site. This may be used for design purposes. At the time that this report was prepared, FMG Engineering were not informed of the details at the proposed building (workplace) to be constructed. Consequently, FMG Engineering have not carried out a Preliminary Hazard Analysis nor been able to consider Safety in Design for the proposed development. It is the responsibility of the designer to use the information contained within this report when undertaking a Safety in Design assessment for the specific development.

Please contact FMG Engineering if Safety in Design analysis is required as the project develops.



# **Appendix A**

Site plan





# **Appendix B**

**Borelogs**

**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description					Observations								
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations					
PT	Groundwater Not Encountered	PP: 0.50m 400kPa	1	1	[Cross-hatch]	FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL					
					[Dotted]	SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL					
					[Horizontal lines]	CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM					
					[Vertical lines]	CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%							
					[Dotted]	SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.3%							
					[Horizontal lines]	CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%							
					[Vertical lines]		WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL					
					[Vertical lines]		WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 2.20m - Refusal	M	H	0%		BEDROCK					
								2	2								
								?	3								

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p>[No resistance symbol] No resistance [Step symbol] range to refusal</p>	<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>	<p><b>Photo</b></p>
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**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description					Observations				
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
PT	Groundwater Not Encountered	PP: 0.50m 400kPa	1	1		FILL	GRAVELLY SAND: black to orange brown; of low plasticity; with clay / silt; sand, medium grained; gravel, angular, up to 20mm; moist; loose; some roots, glass pieces were observed.	M	L	0.3%			FILL
						SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L-MD	0.5%		TOPSOIL	
						CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM	
						CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%			
						CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%			
						SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L-MD	0.3%			
			2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 2.80m - Refusal	M	H	0%		BEDROCK	
			?	3									

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow ▽ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p>▨ No resistance ▨ range to refusal</p>	<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p> <p>&gt; PL = PL &lt; PL</p>	<p><b>Photo</b></p>
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**Engineering Log - Borehole**

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Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

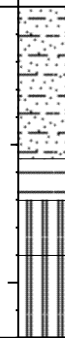
Drilling Information				Soil Description					Observations				
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT	Groundwater Not Encountered			1	1		SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%	ALLUVIUM	
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%	RESIDUAL SOIL	
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%	BEDROCK	
				2	2		Hole Terminated at 2.30m - Refusal						
				?	3								

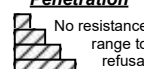
<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p> No resistance range to refusal</p>	<p><b>Photo</b></p>
<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>			

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PT	Groundwater Not Encountered			1	1		SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L-MD	0.5%	100	TOPSOIL
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%	200	ALLUVIUM
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%	300	RESIDUAL SOIL
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 1.20m - Refusal	M	H	0%	400	BEDROCK
				2	2								
				3	3								

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow ▲ Partial Loss ▲ Complete Loss</p>	<p><b>Photo</b></p>
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Drilling Information				Soil Description					Observations				
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT	Groundwater Not Encountered		PP: 0.50m 400kPa	1	1		FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
				2	2		WEATHERED SILTSTONE: fragmented pieces, non-plastic, pale yellow cream. Hole Terminated at 2.10m - Refusal	M	H	0%		BEDROCK	
				?	3								

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>	<p><b>Penetration</b></p> <p> No resistance range to refusal</p>	<p><b>Photo</b></p>
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**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description						Observations		
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT	Groundwater Not Encountered	PP: 0.50m 400kPa	1	1	[Cross-hatch pattern]	FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
					[Dotted pattern]	SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
					[Horizontal lines]	CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	Vst	3.5%		ALLUVIUM
					[Horizontal lines]	CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
					[Horizontal lines]	CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
					[Vertical lines]		WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
					[Vertical lines]		WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 1.60m - Refusal	M	H	0%		BEDROCK
			2	2								
			3	3								

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p>[No resistance symbol] No resistance [Step pattern symbol] range to refusal</p>	<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p> <p>&gt; PL = PL &lt; PL</p>	<p><b>Photo</b></p>
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**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description						Observations			
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Water Not Encountered					FILL SC-SM	GRAVELLY SAND: pale orange brown; of non plasticity; with clay / silt; sand, medium to fine grained; gravel, angular, up to 50mm; dry to moist; loose.	D - M M M	L L - MD H	0% 0.5% 0%	100 200 300 400 500	FILL TOPSOIL BEDROCK
				1	1			CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.					
				2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 0.40m - Refusal					
				3	3								

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow ▲ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p> No resistance range to refusal</p>	<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>	<p><b>Photo</b></p>
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**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description						Observations			
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
PT	Groundwater Not Encountered	PP: 0.40m 400kPa	1	1		FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 25mm; dry to moist; loose; old paving base and bitumen.	D - M	L	0%	100	FILL	
						CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%	200		ALLUVIUM
						CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%	300		
						CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%	400		
							WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%	500		RESIDUAL SOIL
			2	2		WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 1.80m - Refusal	M	H	0%		BEDROCK		
			3	3									

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p> No resistance range to refusal</p>	<p><b>Photo</b></p>
<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>			

**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description					Observations				
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations	
PT	Groundwater Not Encountered	PP: 0.80m 400kPa	1	1		FILL	SILTY SAND: pale orange brown; of low plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose; bitumen concrete fragments.	D - M	L	0.3%			FILL
						SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL	
						CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM	
						CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%			
						CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%			
							WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL	
							WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 2.10m - Refusal	M	H	0%		BEDROCK	
			?	3									

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	<p><b>Penetration</b></p> <p> No resistance range to refusal</p>	<p><b>Photo</b></p>
<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>			

**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description					Observations					
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations		
PT	Groundwater Not Encountered	PP: 1.50m 400kPa	1	1	[Cross-hatched]	FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL		
						FILL	SILTY SANDY CLAY: black brown; of low plasticity, trace gravel; gravel, angular, up to 30mm; moist; firm.	M	F	0.5%				
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%			ALLUVIUM
				2		CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%				
						SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.3%				
			3			CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%				
Hole Terminated at 4.00m - Target depth														

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>
<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Penetration</b></p> <p>[Diagonal lines] No resistance [Staircase] range to refusal</p>
<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>	

**Engineering Log - Borehole**

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd	Commenced: 29/04/2021
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed: 29/04/2021
Hole Location:	Logged By: PP
Hole Position: Coordinate System: MGA94 54H	Checked By: FF
Drill Model: Rockmaster	RL Surface:
Drill Operator: SPK GeoDrill Pty Ltd	Hole Diameter: 50mm
	Datum:

Drilling Information				Soil Description						Observations									
Method	Penetration	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations							
PT	Groundwater Not Encountered	PP: 0.60m 400kPa	1	1	[Cross-hatched]	FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL							
						[Dotted]	SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL						
						[Horizontal lines]	CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM						
								2	2	[Vertical lines]	CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%				
											CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%				
			3	3	[Vertical lines]		WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL							
													BEDROCK						
							WEATHERED SILTSTONE: fragmented pieces, non-plastic, pale yellow cream. Hole Terminated at 3.00m - Refusal												

<p><b>Method</b></p> <p>PT - Push tube</p>	<p><b>Consistency / Relative Density</b></p> <p>VS - Very Soft S - Soft F - Firm Vst - Very Stiff H - Hard VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense</p>	<p><b>Water</b></p> <p>▽ Level (Date) ▽ Inflow △ Partial Loss ▲ Complete Loss</p>	Photo
<p><b>Samples and Tests</b></p> <p>U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test PP - Pocket Penetrometer</p>	<p><b>Moisture Condition</b></p> <p>D - Dry M - Moist W - Wet</p>	<p><b>Plastic Limit</b></p> <p>&gt; PL = PL &lt; PL</p>	
<p><b>Classification Symbols and Soil Descriptions</b></p> <p>Based on Unified Soil Classification System</p>	<p><b>Penetration</b></p> <p>[No resistance] [Step 1] range to [Step 2] refusal</p>		

# Borelogs and laboratory test results

## Soil description notes

The dominant soil constituents are given in capital letters followed by secondary textures. The dominant feature is determined from the Unified Soil Classification System and a soil symbol is used to define a soil layer as follows:

*Table 3 Borelog symbols*

USC SYMBOL	SYMBOL MEANING
<b>GW</b>	Well graded gravel
<b>GP</b>	Poorly graded gravel
<b>GM</b>	Silty gravel
<b>GC</b>	Clayey gravel
<b>SW</b>	Well graded sand
<b>SP</b>	Poorly graded sand
<b>SM</b>	Silty sand
<b>SC</b>	Clayey sand
<b>ML</b>	Silt of low plasticity
<b>CL</b>	Clay of low plasticity
<b>OL</b>	Organic soil of low plasticity
<b>CI</b>	Clay of intermediate plasticity
<b>MH</b>	Silt of high plasticity
<b>CH</b>	Clay of high plasticity
<b>OH</b>	Organic soil of high plasticity
<b>Pt</b>	Peaty soil

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

## Plasticity

The potential for undergoing 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 (%) is as follows:

*Table 4 Description of plasticity*

DESCRIPTION OF PLASTICITY	LIQUID LIMIT FOR SILT (%)	LIQUID LIMIT FOR CLAY (%)
<b>Low</b>	≤ 50	≤ 35
<b>Medium</b>	Not Applicable	>35 - ≤ 50
<b>High</b>	>50	>50

## Condition

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 fixed by the shear strength of the soil as observed visually by the pocket penetrometer values and resistance to deformation to hand moulding.



Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silt and sandy materials, and these are usually based on resistance to drilling penetration. Other condition terms, such as friable, powdery or crumbly may also be used.

## Moisture content

For cohesive soils, the following code is used:

*Table 5 Code for cohesive soils*

SYMBOL	PLASTIC CONDITION	MOISTURE CONDITION
<b>MC≈LL</b>	Moisture content near the liquid limit	Moist to wet
<b>MC&lt;LL</b>	Moisture content less than liquid limit	Moist to wet
<b>MC&gt;PL</b>	Moisture content greater than plastic limit	Damp to moist
<b>MC≈PL</b>	Moisture content near the plastic limit	Damp to moist
<b>MC&lt;≈PL</b>	Moisture content less than or equal to plastic limit	Dry to damp to moist
<b>MC&lt;PL</b>	Moisture content less than plastic limit	Dry to damp
<b>MC&lt;&lt;PL</b>	Moisture content much less than plastic limit	Dry

For cohesionless soils, the following code is used:

*Table 6 Code for cohesionless soils*

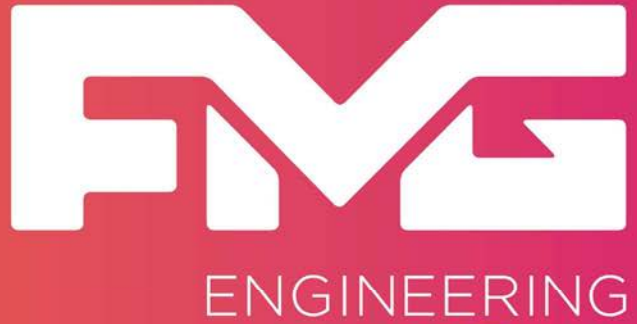
MOISTURE CONDITION	DEGREE OF SATURATION
<b>Dry</b>	0
<b>Humid</b>	1 to 25
<b>Damp</b>	25 to 50
<b>Moist</b>	50 to 75
<b>Wet</b>	75 to 99
<b>Saturated</b>	100

## Cohesive consistency – Pocket penetrometer (PP)

The instrument is used in the field or the laboratory to provide approximate determination of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

*Table 7 Values for cohesive consistency*

STRENGTH	SYMBOL	READINGS (kPa)
<b>Very Soft</b>	VS	<25
<b>Soft</b>	S	25 to 50
<b>Firm</b>	F	50 to 100
<b>Stiff</b>	St	100 to 200
<b>Very Stiff</b>	VSt	200 to 400
<b>Hard</b>	H	>400



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