



USGA Rootzone Suitability

USGA Recommendations for Putting Green Construction (2004 Revisions)

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Tel: 1300 30 40 80 Fax: 1300 64 46 89

Mailing Address: PO Box 357 Pennant Hills NSW 1715 Em: info@sesl.com.au Web: www.sesl.com.au

ABN 70 106 810 708

Batch N°: 46540	Sample N°: 1	Date Received: 30/1/18	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
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Client Name: Gippsland Premium Quarries Pty Ltd (GPQ)	Project Name: PSA & USGA analysis
Client Contact: Ian McPherson	SESL Quote N°:
Client Order N°:	Sample Name: Historic
Address: PO Box 1 NERIM Junction VIC 3832	Description: Soil
	Test Type: PSA_US, HC_USGA

SUMMARY AND RECOMMENDATIONS

This sample was assessed for its particle size grading and hydraulic conductivity.

The material is dominated by particles in the medium to fine sand range. Silt and clay fractions are low.

Hydraulic conductivity is very satisfactory.

These sands will be blended with organics to determine optimum blends for sportsfield turf.

PARTICLE SIZE EVALUATION

SIEVE DATA				USGA SPECIFICATION		RESULT
Size (mm)	Fraction	% Passing by mass	% Retained by mass	Individual	Group	Comments
3.35	Medium gravel	99.99	<0.01	0%		Suitable
2.00	Fine gravel	99.72	0.27	<3%		Suitable
1.00	Very coarse sand	96.88	2.8		<10%	Total: 3.07% Suitable
0.50	Coarse sand	83.1	14		>60%	Total: 45% Generally unsuitable
0.25	Medium sand	52.58	31			Generally unsuitable
0.15	Fine sand	19.22	33	<20%		Generally unsuitable
0.106	Fine Sand	8.3	11			
0.053	Very fine sand	4.03	4.3	<5%		Suitable
0.02	Silt	2.98	1.1		<10%	Total: 8.36% Suitable
0.002	Fine Silt	1.66	1.3	<5%		Suitable
<0.002	Clay	0%	1.66	<3%		Suitable



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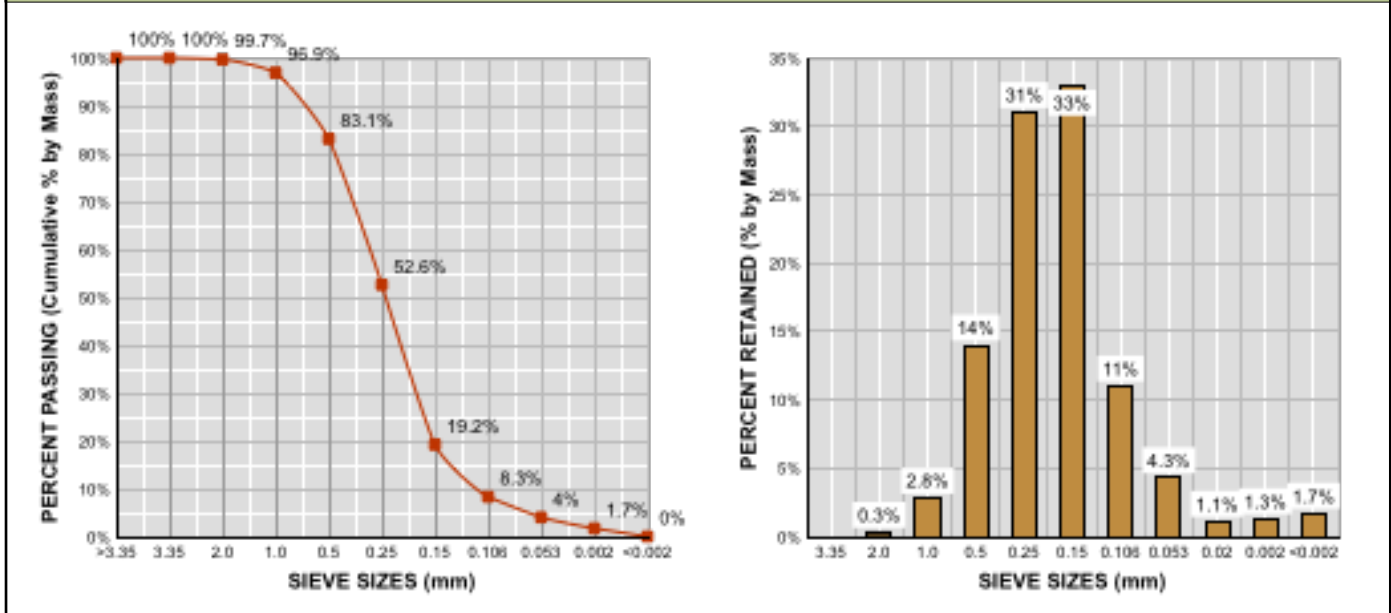
Mailing Address: PO Box 357
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PARTICLE SIZE DISTRIBUTION GRAPHS

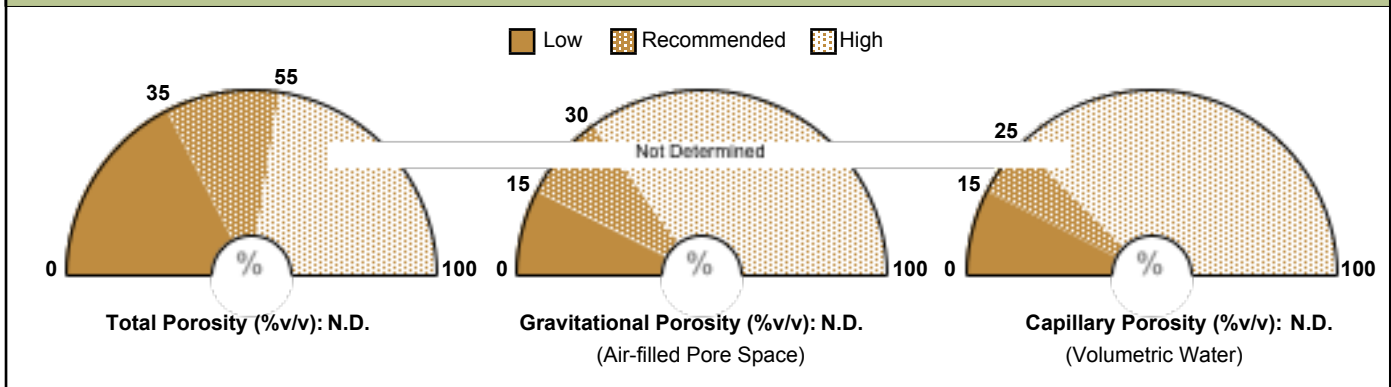


CUMULATIVE FRACTIONS
(% by mass)
Gravel (>2.0mm): 0.3%, Acceptable
Sand (2.0mm to >0.053mm): 96.1%, Acceptable
Silt (0.053mm to 0.002mm): 1.3%, Acceptable
Clay (<0.002mm): 1.66%, Acceptable
Total Fines (<0.15mm):

D VALUES	
D ₉₅ :	0.93
D ₉₀ :	0.75
D ₈₅ :	0.57
D ₆₀ :	0.31
D ₅₀ :	0.24
D ₁₅ :	0.12
D ₁₀ :	0.09
D ₅ :	0.06

PERFORMANCE FACTORS
BRIDGING FACTOR: A Drainage Gravel compatible with this material will have a D ₁₅ of ≤ 4.55
PERMEABILITY FACTOR: A Drainage Gravel compatible with this material will have a D ₁₅ of ≥ 0.62
GRADATION INDEX: D ₉₀ /D ₁₀ : 8.23 Generally unacceptable, prone to packing
COEFFICIENT OF UNIFORMITY: D ₆₀ /D ₁₀ : 3.41 Generally acceptable
FINENESS MODULUS: 1.5 – Generally unacceptable, too fine

PORE DISTRIBUTION





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SATURATED HYDRAULIC CONDUCTIVITY (Ksat)		
Result (mm/hr)	Comment	Ksat mm/hr
161	Acceptable, normal range	
Starting out at the upper end of the range may allow the mix to remain within the desired Ksat range over a greater number of years as the tendency is for the rate to slowly decline with time.		

OTHER PROPERTIES					
Property	Result	Comment	Property	Result	Comment
Particle Density (g/cm ³):		No requirement	Weathering Stability:		Not determined
Bulk Density (g/cm ³):	N.D.	No requirement	by Sodium Sulphate Soundness		
Organic Matter (%w/v):	-	Did not test	Mechanical Stability:		Not determined
pH in H ₂ O (1:5):	-	Did not test	by LA Abrasion Test		
pH in CaCl ₂ (1:5):	-	Did not test	Particle Shape: Shape not tested, sphericity not tested.		
EC (dS/m) (1:5):	-	Did not test	The USGA does not provide any recommendation on particle shape but the following general principles apply. Generally materials that are suitable for Greens construction cover the angular to sub-rounded group. Theoretically sphericity will have an impact but little is known or certainly written about the impact of particle sphericity on turf growth and material function.		
Liming Value (%CaCO ₃):	-				

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Consultant:  Declan McDonald	Authorised Signatory:  Declan McDonald	Date Report Generated 9/02/2018
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Understanding your SESL USGA Report

This document details the physical performance characteristics as recommendations of the USGA Green Section for the construction of golf greens. It does not present any information or guidance on the chemical properties of the material that are arguably of equal significance and importance. SESL strongly recommend that a thorough chemical assay be conducted on the material prior to its use.

SESL is a registered participant in the USGA Green Section Proficiency Testing Program conducted by Colorado State University – Department of Soil and Crop Sciences. Favourable proficiency testing data demonstrates SESL's competence to clients, accreditation bodies and other external entities. Participation also provides invaluable feedback in the internal monitoring of the SESL quality system.

In addition to its participation in the USGA Green Section Proficiency Testing Program, SESL monitors and checks its performance (accuracy and repeatability) through:

- inter-laboratory comparisons;
- intra-laboratory comparisons; and
- repeatability studies.

The purpose of these activities is to provide interested parties with objective evidence of SESL's capacity to produce data that is both accurate and repeatable for the activities listed.

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METHOD REFERENCES:

Particle Density:
ASTM D854-02
Particle Size Analysis:
ASTM F1632-03
Bulk Density and Water Retention
ASTM F1815-06 Test method B
Saturated Hydraulic Conductivity:
ASTM F1815-06 Test method A
Total Porosity and Pore Distribution:
ASTM F1815-06 Test methods C and D
Sodium Sulphate Soundness:
ASTM-C88
LA Abrasion Test:
ASTM-C131
Organic Matter:
Charman & Roper 2000
Particle Shape:
Brown & Thomas 1986

END OF REPORT

Client: Gippsland Premium Quarries Pty Ltd (GPQ), Contact: Ian McPherson, Client Job N°: , Client Order N°:
Project Name: PSA & USGA analysis, Test Type:
Batch N°: 46540, Sample N°: 1, Sample Name: Historic

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Web: www.sesl.com.au

ABN 70 106 810 708

Batch N°: 46540	Sample N°: 2	Date Received: 30/1/18	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
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Client Name: Gippsland Premium Quarries Pty Ltd (GPQ)	Project Name: PSA & USGA analysis
Client Contact: Ian McPherson	SESL Quote N°:
Client Order N°:	Sample Name: Intermediate
Address: PO Box 1 NERIM Junction VIC 3832	Description: Soil
	Test Type: PSA_US, HC_USGA

SUMMARY AND RECOMMENDATIONS

This sample was assessed for its particle size grading and hydraulic conductivity.

The material is dominated by particles in the medium to fine sand range. Silt and clay fractions are low.

Hydraulic conductivity is very satisfactory.

These sands will be blended with organics to determine optimum blends for sportsfield turf.

PARTICLE SIZE EVALUATION

SIEVE DATA				USGA SPECIFICATION		RESULT
Size (mm)	Fraction	% Passing by mass	% Retained by mass	Individual	Group	Comments
3.35	Medium gravel	99.99	<0.01	0%		Suitable
2.00	Fine gravel	99.93	0.06	<3%	<10%	Suitable
1.00	Very coarse sand	97.81	2.1			Total: 2.16% Suitable
0.50	Coarse sand	85.62	12		>60%	Total: 44% Generally unsuitable
0.25	Medium sand	53.85	32			Generally unsuitable
0.15	Fine sand	19.61	34	<20%		
0.106	Fine Sand	8.11	12			
0.053	Very fine sand	3.59	4.5	<5%	<10%	Suitable
0.02	Silt	2.17	1.4			Total: 8.07% Suitable
0.002	Fine Silt	1.72	0.45	<5%		Suitable
<0.002	Clay	0%	1.72	<3%		Suitable



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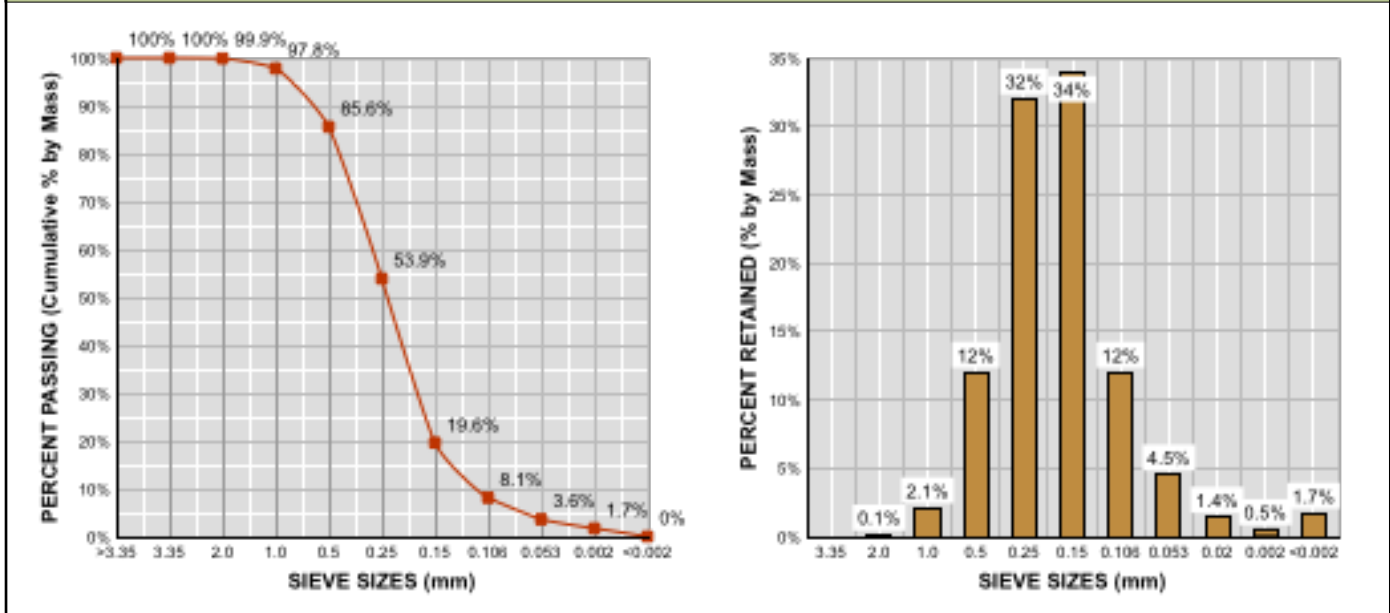
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PARTICLE SIZE DISTRIBUTION GRAPHS

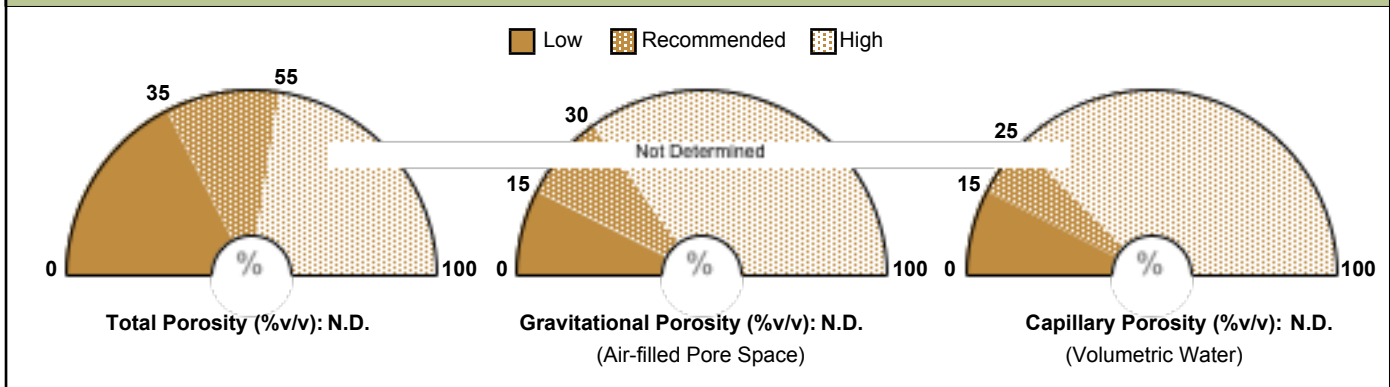


CUMULATIVE FRACTIONS
(% by mass)
Gravel (>2.0mm): 0.1%, Acceptable
Sand (2.0mm to >0.053mm): 96.6%, Acceptable
Silt (0.053mm to 0.002mm): 0.45%, Acceptable
Clay (<0.002mm): 1.72%, Acceptable
Total Fines (<0.15mm):

D VALUES	
D ₉₅ :	0.88
D ₉₀ :	0.68
D ₈₅ :	0.50
D ₆₀ :	0.30
D ₅₀ :	0.24
D ₁₅ :	0.12
D ₁₀ :	0.09
D ₅ :	0.06

PERFORMANCE FACTORS
BRIDGING FACTOR: A Drainage Gravel compatible with this material will have a D ₁₅ of ≤ 3.96
PERMEABILITY FACTOR: A Drainage Gravel compatible with this material will have a D ₁₅ of ≥ 0.61
GRADATION INDEX: D ₉₀ /D ₁₀ : 7.4 Generally unacceptable, prone to packing
COEFFICIENT OF UNIFORMITY: D ₆₀ /D ₁₀ : 3.25 Generally acceptable
FINENESS MODULUS: 1.4 – Generally unacceptable, too fine

PORE DISTRIBUTION





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SATURATED HYDRAULIC CONDUCTIVITY (Ksat)		
Result (mm/hr)	Comment	Ksat mm/hr
140	Unacceptable	
Starting out at the upper end of the range may allow the mix to remain within the desired Ksat range over a greater number of years as the tendency is for the rate to slowly decline with time.		

OTHER PROPERTIES					
Property	Result	Comment	Property	Result	Comment
Particle Density (g/cm³):		No requirement	Weathering Stability:		Not determined
Bulk Density (g/cm³):	N.D.	No requirement	by Sodium Sulphate Soundness		
Organic Matter (%w/v):	-	Did not test	Mechanical Stability:		Not determined
pH in H₂O (1:5):	-	Did not test	by LA Abrasion Test		
pH in CaCl₂ (1:5):	-	Did not test	Particle Shape: Shape not tested, sphericity not tested.		
EC (dS/m) (1:5):	-	Did not test	The USGA does not provide any recommendation on particle shape but the following general principles apply. Generally materials that are suitable for Greens construction cover the angular to sub-rounded group. Theoretically sphericity will have an impact but little is known or certainly written about the impact of particle sphericity on turf growth and material function.		
Liming Value (%CaCO₃):	-				

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Consultant:  Declan McDonald	Authorised Signatory:  Declan McDonald	Date Report Generated 9/02/2018
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Particle Size Analysis:
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Bulk Density and Water Retention
ASTM F1815-06 Test method B
Saturated Hydraulic Conductivity:
ASTM F1815-06 Test method A
Total Porosity and Pore Distribution:
ASTM F1815-06 Test methods C and D
Sodium Sulphate Soundness:
ASTM-C88
LA Abrasion Test:
ASTM-C131
Organic Matter:
Charman & Roper 2000
Particle Shape:
Brown & Thomas 1986

END OF REPORT

Client: Gippsland Premium Quarries Pty Ltd (GPQ), **Contact:** Ian McPherson, **Client Job N°:** , **Client Order N°:**
Project Name: PSA & USGA analysis, **Test Type:**
Batch N°: 46540, **Sample N°:** 2, **Sample Name:** Intermediate

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ABN 70 106 810 708

Batch N°: 46540	Sample N°: 3	Date Received: 30/1/18	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
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Client Name: Gippsland Premium Quarries Pty Ltd (GPQ)	Project Name: PSA & USGA analysis
Client Contact: Ian McPherson	SESL Quote N°:
Client Order N°:	Sample Name: Fresh
Address: PO Box 1 NERIM Junction VIC 3832	Description: Soil
	Test Type: PSA_US, HC_USGA

SUMMARY AND RECOMMENDATIONS

This sample was assessed for its particle size grading and hydraulic conductivity.

The material is dominated by particles in the medium to fine sand range. Silt and clay fractions are low.

Hydraulic conductivity is satisfactory.

These sands will be blended with organics to determine optimum blends for sportsfield turf.

PARTICLE SIZE EVALUATION

SIEVE DATA				USGA SPECIFICATION		RESULT
Size (mm)	Fraction	% Passing by mass	% Retained by mass	Individual	Group	Comments
3.35	Medium gravel	100	<0.01	0%		Suitable
2.00	Fine gravel	99.82	0.18	<3%		Suitable
1.00	Very coarse sand	96.57	3.3		<10%	Total: 3.48% Suitable
0.50	Coarse sand	83.79	13		>60%	Total: 40% Generally unsuitable
0.25	Medium sand	56.8	27			Generally unsuitable
0.15	Fine sand	23.48	33		<20%	Generally unsuitable
0.106	Fine Sand	10.04	13			
0.053	Very fine sand	4.14	5.9		<5%	Generally unsuitable
0.02	Silt	2.67	1.5		<10%	Total: 10.06% Generally unsuitable
0.002	Fine Silt	2.27	0.39		<5%	Suitable
<0.002	Clay	0%	2.27		<3%	Suitable



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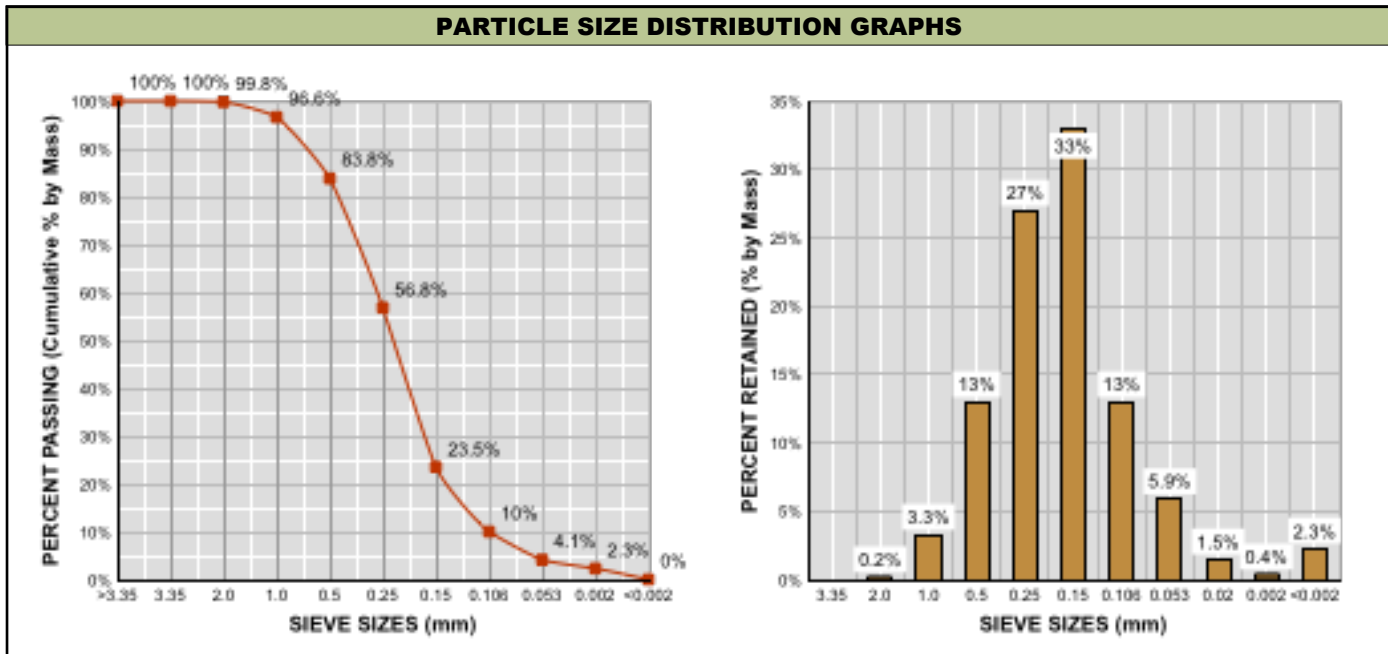
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CUMULATIVE FRACTIONS

(% by mass)

Gravel (>2.0mm):
0.2%, Acceptable

Sand (2.0mm to >0.053mm):
95.2%, Acceptable

Silt (0.053mm to 0.002mm):
0.39%, Acceptable

Clay (<0.002mm):
2.27%, Acceptable

Total Fines (<0.15mm):

D VALUES

D ₉₅ :	0.94
D ₉₀ :	0.74
D ₈₅ :	0.55
D ₆₀ :	0.28
D ₅₀ :	0.23
D ₁₅ :	0.11
D ₁₀ :	0.08
D ₅ :	0.06

PERFORMANCE FACTORS

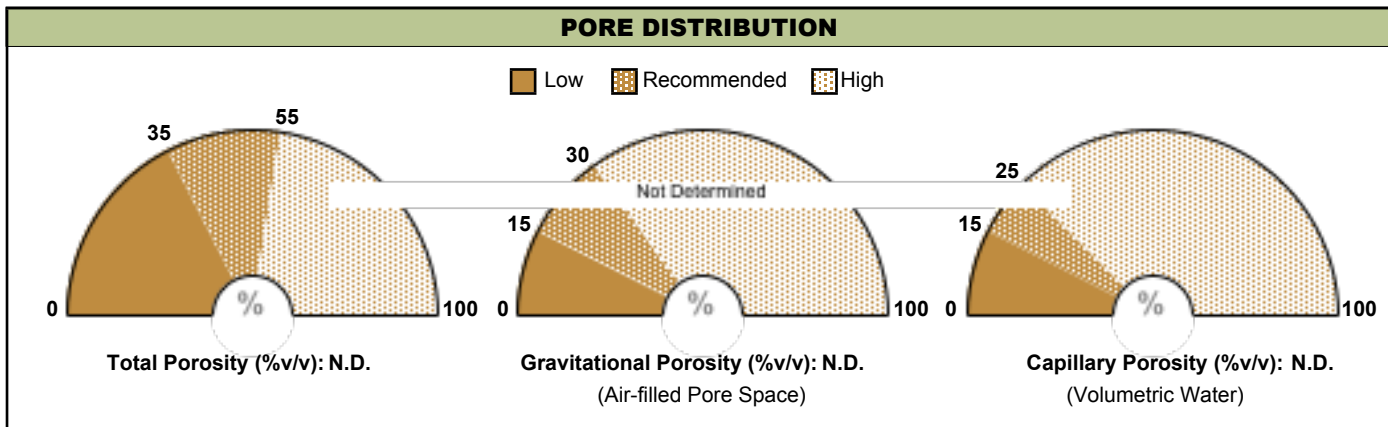
BRIDGING FACTOR:
A Drainage Gravel compatible with this material will have a D₁₅ of ≤ **4.38**

PERMEABILITY FACTOR:
A Drainage Gravel compatible with this material will have a D₁₅ of ≥ **0.54**

GRADATION INDEX:
D₉₀/D₁₀: **9.02** Generally unacceptable, prone to packing

COEFFICIENT OF UNIFORMITY:
D₆₀/D₁₀: **3.39** Generally acceptable

FINENESS MODULUS:
1.4 - Generally unacceptable, too fine





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SATURATED HYDRAULIC CONDUCTIVITY (Ksat)		
Result (mm/hr)	Comment	Ksat mm/hr
111	Unacceptable	
Starting out at the upper end of the range may allow the mix to remain within the desired Ksat range over a greater number of years as the tendency is for the rate to slowly decline with time.		

OTHER PROPERTIES					
Property	Result	Comment	Property	Result	Comment
Particle Density (g/cm³):		No requirement	Weathering Stability:		Not determined
Bulk Density (g/cm³):	N.D.	No requirement	by Sodium Sulphate Soundness		
Organic Matter (%w/v):	-	Did not test	Mechanical Stability:		Not determined
pH in H₂O (1:5):	-	Did not test	by LA Abrasion Test		
pH in CaCl₂ (1:5):	-	Did not test	Particle Shape: Shape not tested, sphericity not tested.		
EC (dS/m) (1:5):	-	Did not test	The USGA does not provide any recommendation on particle shape but the following general principles apply. Generally materials that are suitable for Greens construction cover the angular to sub-rounded group. Theoretically sphericity will have an impact but little is known or certainly written about the impact of particle sphericity on turf growth and material function.		
Liming Value (%CaCO₃):	-				

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ASTM F1815-06 Test method B
Saturated Hydraulic Conductivity:
ASTM F1815-06 Test method A
Total Porosity and Pore Distribution:
ASTM F1815-06 Test methods C and D
Sodium Sulphate Soundness:
ASTM-C88
LA Abrasion Test:
ASTM-C131
Organic Matter:
Charman & Roper 2000
Particle Shape:
Brown & Thomas 1986

END OF REPORT

Client: Gippsland Premium Quarries Pty Ltd (GPQ), **Contact:** Ian McPherson, **Client Job N°:** , **Client Order N°:**
Project Name: PSA & USGA analysis, **Test Type:**
Batch N°: 46540, **Sample N°:** 3, **Sample Name:** Fresh

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