



Turf Rootzone Assessment - sport and amenity turf surfaces



Sydney Environmental & Soil Laboratory Pty Ltd
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Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessments

Batch N°: **9921A** Sample N°: **1**

Report Status: Draft Final

CLIENT DETAILS:

Name: **Ward Civil & Environmental**
Attn: **Brendan Smith**
Client Job N°: **543**
Client Order N°:
Address: **PO Box 1067
NORTH RYDE BC NSW 1670**

PROJECT DETAILS:

Project Name: **Pasminco Cell Revegetation**
Location: **Cockle Creek**
SESL Quote N°:
Date Received: **14/5/09**

SAMPLE DETAILS:

Sample Name: **Pitnacree Sample # 1 - Tree**
Test Type: **Text, Struct , EAT, USPSA**

DISCUSSION AND RECOMMENDATIONS

Emerson Aggregate Test: 5.2
Permeability Class (Soil Conservation of NSW) : Moderately Rapid
D30 (see PSA below) : 0.039

PARTICLE SIZE ANALYSIS

Size (mm)	Fraction	% Passing by mass	% Retained by mass	D VALUES	
3.35	Medium gravel	100.0%	0.0%	D₁₀₀:	2.000
2.00	Fine gravel	100.0%	0.0%	D₉₀:	0.150
1.00	V. coarse sand	100.0%	0.0%	D₈₅:	0.139
0.50	Coarse sand	99.9%	0.1%	D₆₀:	0.090
0.25	Medium sand	99.2%	0.7%	D₅₀:	0.073
0.15	Fine sand	90.0%	9.2%	D₃₅:	0.047
0.106	Fine Sand	69.5%	20.5%	D₃₀:	0.039
0.053	Very fine sand	38.2%	31.3%	D₂₅:	0.030
0.02	Silt	19.0%	19.2%	D₁₅:	0.012
0.002	Fine Silt	10.5%	8.5%	D₁₀:	0.002
<0.002	Clay	0%	10.5%	D₅:	0.001

Coefficient of Uniformity (Cu): 47.18 - Significant risk of particle packing - generally unsuitable without specific management input (i.e. compaction relief/aeration).

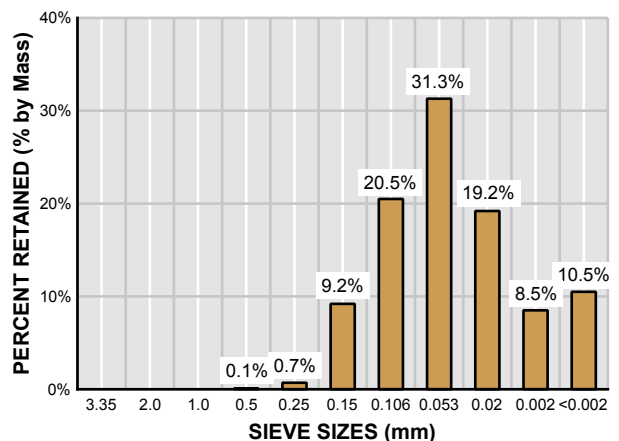
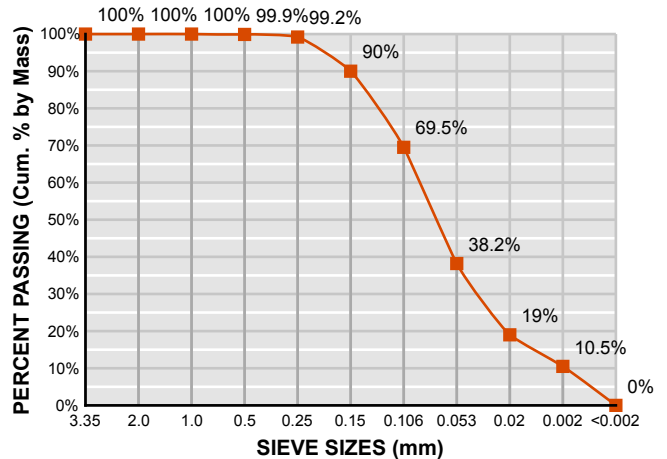
Coefficient of Curvature (Cc): 8.82

Gradation Index (GI): 78.72 - Significant risk of particle packing - generally unsuitable without specific management input (i.e. compaction relief/aeration).

Fineness Modulus (Fm): .1 - Dominated by very fine particles (i.e. clay, silt, very fine sand). *Note: Typical range for sportsfield rootzone is 1.7 to 2.5*

Particle Distribution: Poorly graded
Note: Poorly graded soils are either uniformly graded or gap graded. Well graded soils have even distribution of particles across a wide range of particle sizes and are prone to dense packing. As a rule, well graded soils should be avoided for sportsfields and other high traffic surfaces that are subject to considerable compactive forces.

PARTICLE SIZE DISTRIBUTION GRAPHS





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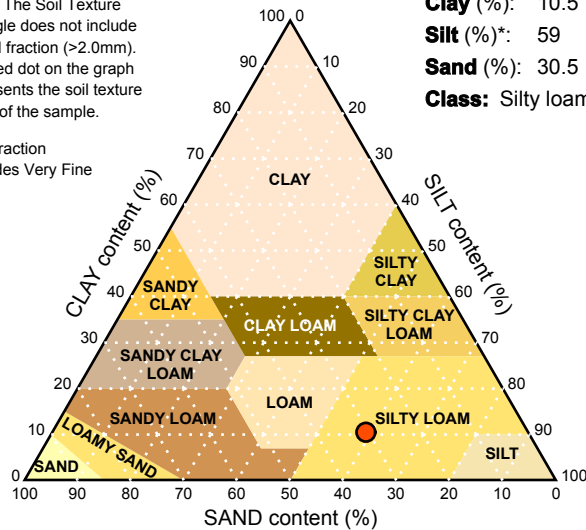
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SOIL TEXTURE TRIANGLE AND DERIVED VALUES

Note: The Soil Texture Triangle does not include gravel fraction (>2.0mm). The red dot on the graph represents the soil texture class of the sample.

*Silt fraction includes Very Fine Sand



Predicted soil properties calculated from PSA values

Fineness Modulus (Fm):	.1
Effective particle diameter - D _{eff} (mm):	0.012
Median particle diameter - D _{med} (mm):	0.073 Very fine sand
Saturation (cm ³ water/cm ³):	0.44
Field capacity (cm ³ water/cm ³):	0.27
Permanent wilting point (cm ³ water/cm ³):	0.1
Available water capacity (cm ³ water/cm ³):	0.17 (17% v/v)
Total porosity* (%v/v):	44 (Typically 25 – 35%v/v)
Water-filled porosity* (%v/v):	27 (Typically 8 – 15%v/v)
Air-filled porosity* (%v/v):	17 (Typically 10 – 28%v/v)
Critical Tension (mm):	5950

* at Field Capacity

Predicted Ksat results (based on PSA)

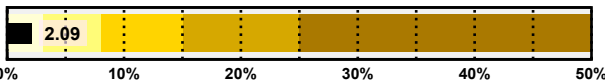
Bulk Density (g/cm ³):	1.48
Saturated Hydraulic Conductivity using D _{eff} (mm/hr):	4
Saturated Hydraulic Conductivity (mm/hr):	27

Particle shape: Shape not tested, sphericity not tested.

ORGANIC MATTER

Organic Matter (%w/v): 2.09

Very low. Mineral soil with very low organic matter - generally suitable.



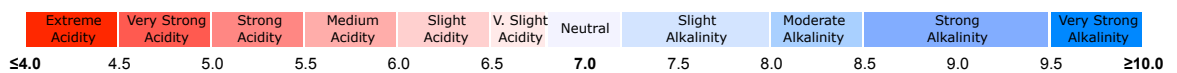
Actual Ksat results (Laboratory determination)

Field core method (cm/hr): Did not test.

Repacked core method:	Point	Ksat (mm/hr)	Bulk Density (g/cm ³)
8 drops:	D.N.T.	D.N.T.	D.N.T.
16 drops:	D.N.T.	D.N.T.	D.N.T.
32 drops:	D.N.T.	D.N.T.	D.N.T.

pH and ELECTRICAL CONDUCTIVITY

pH Analysis



pH in H₂O (1:5)

7.3

pH in CaCl₂ (1:5)

6.4

Electrical Conductivity (dS/m)



Electrical Conductivity by Saturated Extract (EC, dS/m): 0.285

Non-saline. Salinity effects on plants are mostly negligible.

Consultant: Ryan Jacka

Authorised Signatory: Murray Fraser

Date of Report: 20/05/2009

METHOD REFERENCES:

Particle Size Analysis: ASTM F 1632-03
Organic Matter: Charman & Roper 2000
Saturated Hydraulic Conductivity and Bulk Density: Department Urban Services, ACT Government 1993. Canberra Landscape Guidelines, Soil Testing Procedure LG B22.
pH and Electrical Conductivity: Bradley et al (1983)
Effective Particle Diameter, Predicted Ksat, and Predicted Critical Tension: Stewart, V.I. (1994) Sports Turf: Science, construction, and maintenance.

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Report Status: Draft Final

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 Attn: **Brendan Smith**
 Client Job N°: **543**
 Client Order N°:
 Address: **PO Box 1067 NORTH RYDE BC NSW 1670**

PROJECT DETAILS:

Project Name: **Pasminco Cell Revegetation**
 Location: **Cockle Creek**
 SESL Quote N°:
 Date Received: **14/5/09**

SAMPLE DETAILS:

Sample Name: **Pitnacree Sample # 2 - Levee Bank**
 Test Type: **Text, Struct , EAT, USPSA**

DISCUSSION AND RECOMMENDATIONS

Emerson Aggregate Test: 3.2
 Permeability Class (Soil Conservation of NSW) : Moderately Rapid
 D30 (see PSA below) : 0.091

PARTICLE SIZE ANALYSIS

Size (mm)	Fraction	% Passing by mass	% Retained by mass	D VALUES	
3.35	Medium gravel	100.0%	0.0%	D₁₀₀:	1.000
2.00	Fine gravel	100.0%	0.0%	D₉₀:	0.191
1.00	V. coarse sand	100.0%	0.0%	D₈₅:	0.156
0.50	Coarse sand	100.0%	0.0%	D₆₀:	0.127
0.25	Medium sand	98.6%	1.3%	D₅₀:	0.117
0.15	Fine sand	84.1%	14.5%	D₃₅:	0.100
0.106	Fine Sand	38.3%	45.9%	D₃₀:	0.091
0.053	Very fine sand	9.5%	28.8%	D₂₅:	0.082
0.02	Silt	6.0%	3.5%	D₁₅:	0.063
0.002	Fine Silt	4.0%	2.0%	D₁₀:	0.054
<0.002	Clay	0%	4.0%	D₅:	0.011

Coefficient of Uniformity (Cu): 2.35 - Optimal range for sportsfield applications.

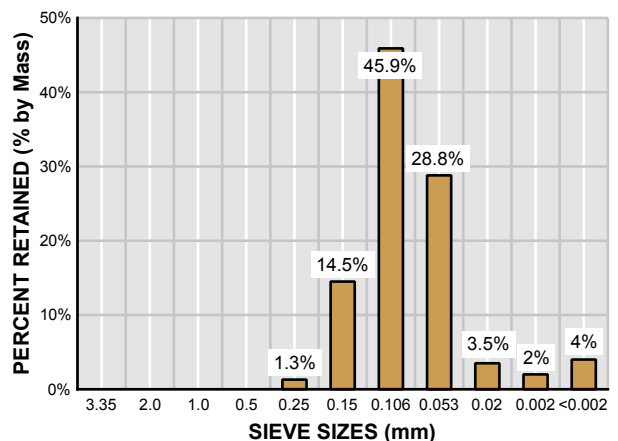
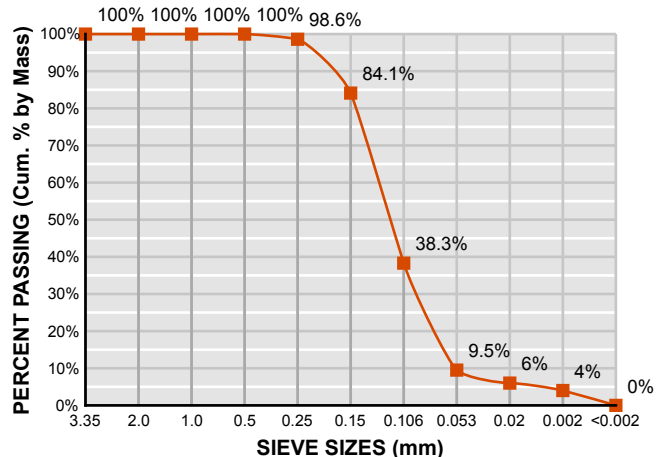
Coefficient of Curvature (Cc): 1.2

Gradation Index (Gi): 3.53 - Optimal range for sportsfield applications.

Fineness Modulus (Fm): .2 - Dominated by very fine particles (i.e. clay, silt, very fine sand). Note: Typical range for sportsfield rootzone is 1.7 to 2.5

Particle Distribution: Poorly graded
 Note: Poorly graded soils are either uniformly graded or gap graded. Well graded soils have even distribution of particles across a wide range of particle sizes and are prone to dense packing. As a rule, well graded soils should be avoided for sportsfields and other high traffic surfaces that are subject to considerable compactive forces.

PARTICLE SIZE DISTRIBUTION GRAPHS





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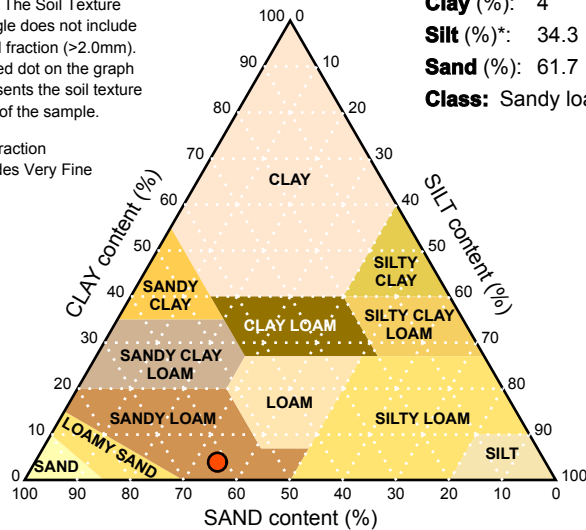
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SOIL TEXTURE TRIANGLE AND DERIVED VALUES

Note: The Soil Texture Triangle does not include gravel fraction (>2.0mm). The red dot on the graph represents the soil texture class of the sample.

*Silt fraction includes Very Fine Sand



Predicted soil properties calculated from PSA values

Fineness Modulus (Fm):	.2
Effective particle diameter - D _{eff} (mm):	0.082
Median particle diameter - D _{med} (mm):	0.117 Fine sand
Saturation (cm ³ water/cm ³):	0.36
Field capacity (cm ³ water/cm ³):	0.19
Permanent wilting point (cm ³ water/cm ³):	0.07
Available water capacity (cm ³ water/cm ³):	0.12 (12% v/v)
Total porosity* (%v/v):	36 (Typically 25 – 35%v/v)
Water-filled porosity* (%v/v):	19 (Typically 8 – 15%v/v)
Air-filled porosity* (%v/v):	17 (Typically 10 – 28%v/v)
Critical Tension (mm):	870.7

* at Field Capacity

Predicted Ksat results (based on PSA)

Bulk Density (g/cm ³):	1.7
Saturated Hydraulic Conductivity using D _{eff} (mm/hr):	108
Saturated Hydraulic Conductivity (mm/hr):	52

Particle shape: Shape not tested, sphericity not tested.

ORGANIC MATTER

Organic Matter (%w/v): 0.42

Very low. Mineral soil with very low organic matter - generally suitable.



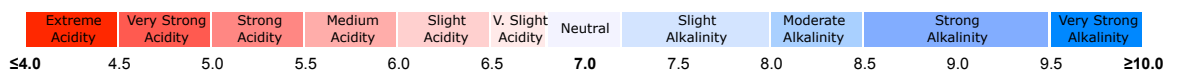
Actual Ksat results (Laboratory determination)

Field core method (cm/hr): Did not test.

Repacked core method:	Point	Ksat (mm/hr)	Bulk Density (g/cm ³)
8 drops:	D.N.T.	D.N.T.	D.N.T.
16 drops:	D.N.T.	D.N.T.	D.N.T.
32 drops:	D.N.T.	D.N.T.	D.N.T.

pH and ELECTRICAL CONDUCTIVITY

pH Analysis



pH in H₂O (1:5)

7.3

pH in CaCl₂ (1:5)

6.2

Electrical Conductivity (dS/m)



Electrical Conductivity by Saturated Extract (EC, dS/m): 0.28

Non-saline. Salinity effects on plants are mostly negligible.

Consultant: Ryan Jacka

Authorised Signatory: Murray Fraser

Date of Report: 20/05/2009

METHOD REFERENCES:

Particle Size Analysis: ASTM F 1632-03
Organic Matter: Charman & Roper 2000
Saturated Hydraulic Conductivity and Bulk Density: Department Urban Services, ACT Government 1993. Canberra Landscape Guidelines, Soil Testing Procedure LG B22.
pH and Electrical Conductivity: Bradley et al (1983)
Effective Particle Diameter, Predicted Ksat, and Predicted Critical Tension: Stewart, V.I. (1994) Sports Turf: Science, construction, and maintenance.

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Batch N°: **9921A** Sample N°: **3**

Report Status: Draft Final

CLIENT DETAILS:

Name: **Ward Civil & Environmental**
 Attn: **Brendan Smith**
 Client Job N°: **543**
 Client Order N°:
 Address: **PO Box 1067**
NORTH RYDE BC NSW 1670

PROJECT DETAILS:

Project Name: **Pasminco Cell Revegetation**
 Location: **Cockle Creek**
 SESL Quote N°:
 Date Received: **14/5/09**

SAMPLE DETAILS:

Sample Name: **Pitnacree Sample # 3 - Dam**
 Test Type: **Text, Struct , EAT, USPSA**

DISCUSSION AND RECOMMENDATIONS

Emerson Aggregate Test: 5.2
 Permeability Class (Soil Conservation of NSW) : Moderately Rapid
 D30 (see PSA below) : 0.023

PARTICLE SIZE ANALYSIS

Size (mm)	Fraction	% Passing by mass	% Retained by mass	D VALUES	
3.35	Medium gravel	97.7%	2.3%	D₁₀₀:	7.453
2.00	Fine gravel	96.9%	0.8%	D₉₀:	0.441
1.00	V. coarse sand	95.7%	1.3%	D₈₅:	0.322
0.50	Coarse sand	92.5%	3.2%	D₆₀:	0.114
0.25	Medium sand	82.0%	10.5%	D₅₀:	0.072
0.15	Fine sand	68.1%	13.9%	D₃₅:	0.033
0.106	Fine Sand	58.2%	9.9%	D₃₀:	0.023
0.053	Very fine sand	45.5%	12.7%	D₂₅:	0.015
0.02	Silt	28.5%	17.0%	D₁₅:	0.002
0.002	Fine Silt	16.0%	12.5%	D₁₀:	0.001
<0.002	Clay	0%	16.0%	D₅:	0.001

Coefficient of Uniformity (Cu): 91.21 - Significant risk of particle packing - generally unsuitable without specific management input (i.e. compaction relief/aeration).

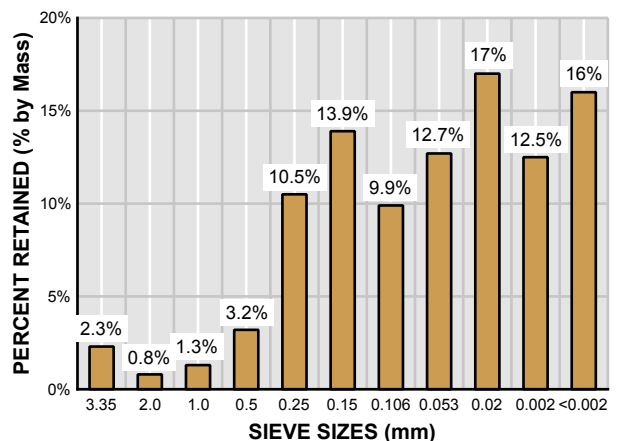
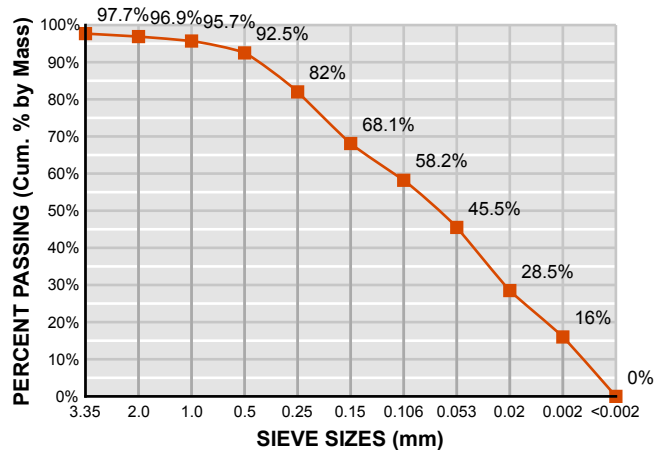
Coefficient of Curvature (Cc): 3.68

Gradation Index (GI): 352.96 - Significant risk of particle packing - generally unsuitable without specific management input (i.e. compaction relief/aeration).

Finesness Modulus (Fm): .7 - Dominated by very fine particles (i.e. clay, silt, very fine sand). *Note: Typical range for sportsfield rootzone is 1.7 to 2.5*

Particle Distribution: Poorly graded
Note: Poorly graded soils are either uniformly graded or gap graded. Well graded soils have even distribution of particles across a wide range of particle sizes and are prone to dense packing. As a rule, well graded soils should be avoided for sportsfields and other high traffic surfaces that are subject to considerable compactive forces.

PARTICLE SIZE DISTRIBUTION GRAPHS





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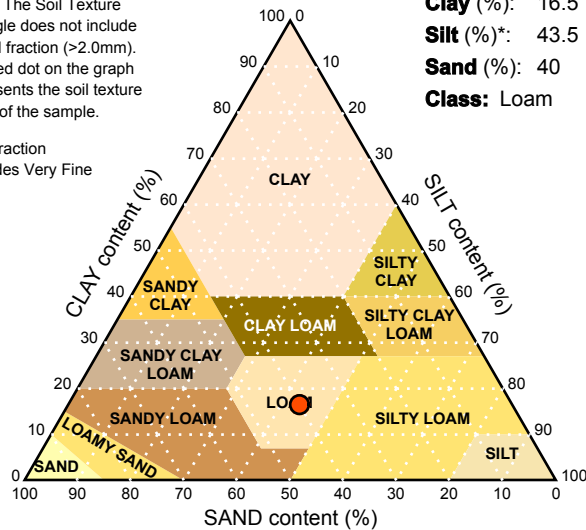
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SOIL TEXTURE TRIANGLE AND DERIVED VALUES

Note: The Soil Texture Triangle does not include gravel fraction (>2.0mm). The red dot on the graph represents the soil texture class of the sample.

*Silt fraction includes Very Fine Sand



Predicted soil properties calculated from PSA values

Fineness Modulus (Fm):	.7
Effective particle diameter - D _{eff} (mm):	0.002
Median particle diameter - D _{med} (mm):	0.072 Very fine sand
Saturation (cm ³ water/cm ³):	0.46
Field capacity (cm ³ water/cm ³):	0.25
Permanent wilting point (cm ³ water/cm ³):	0.11
Available water capacity (cm ³ water/cm ³):	0.14 (14% v/v)
Total porosity* (%v/v):	46 (Typically 25 – 35%v/v)
Water-filled porosity* (%v/v):	25 (Typically 8 – 15%v/v)
Air-filled porosity* (%v/v):	21 (Typically 10 – 28%v/v)
Critical Tension (mm):	35700

* at Field Capacity

Predicted Ksat results (based on PSA)

Bulk Density (g/cm ³):	1.43
Saturated Hydraulic Conductivity using D _{eff} (mm/hr):	0
Saturated Hydraulic Conductivity (mm/hr):	13

Particle shape: Shape not tested, sphericity not tested.

ORGANIC MATTER

Organic Matter (%w/v): 2.57

Very low. Mineral soil with very low organic matter - generally suitable.



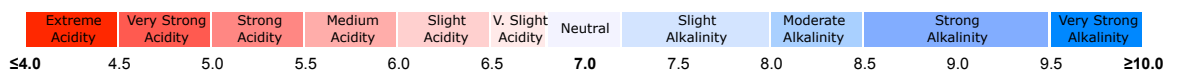
Actual Ksat results (Laboratory determination)

Field core method (cm/hr): Did not test.

Repacked core method:	Point	Ksat (mm/hr)	Bulk Density (g/cm ³)
8 drops:	D.N.T.	D.N.T.	D.N.T.
16 drops:	D.N.T.	D.N.T.	D.N.T.
32 drops:	D.N.T.	D.N.T.	D.N.T.

pH and ELECTRICAL CONDUCTIVITY

pH Analysis



pH in H₂O (1:5)

7.3

pH in CaCl₂ (1:5)

6.4

Electrical Conductivity (dS/m)



Electrical Conductivity by Saturated Extract (EC, dS/m): 0.475

Non-saline. Salinity effects on plants are mostly negligible.

[Signature]

Consultant: Ryan Jacka

[Signature]

Authorised Signatory: Murray Fraser

Date of Report: 20/05/2009

METHOD REFERENCES:

Particle Size Analysis: ASTM F 1632-03
Organic Matter: Charman & Roper 2000
Saturated Hydraulic Conductivity and Bulk Density: Department Urban Services, ACT Government 1993. Canberra Landscape Guidelines, Soil Testing Procedure LG B22.
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