

## APPENDIX 1: SOIL DATA

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### SOIL SAMPLING AND ANALYTICAL METHODS

The range of physical and chemical analyses that were undertaken in this project varied between sites because of changing research directions over time. Full details are provided in the main text. With the exception of data from Plot 15 (EP38) The Crater and Plot 19 (EP 43) Mount Baldy, the analytical results in this Appendix are derived from a detailed and systematic soil survey in which, within each plot, soil samples for chemical analyses were sub-sampled from bulked samples collected at five randomly located positions using four adjacent auger holes (i.e. a total of 20 holes per plot). The standard sampling intervals were 0-0.05, 0.05-0.1, 0.1-0.2, 0.2-0.3, 0.3-0.6, 0.6-0.90 and 0.9-1.20 m.

When possible, a soil pit site was selected adjacent to the plot boundary in an area representative of the aspect and slope of the plot. These pits were excavated typically to a depth of 2 m and the morphology of the profile was described. Field texture classes were assigned according to Northcote (1979) and colour descriptions were made using the Munsell nomenclature following Soil Survey Staff (1951). In the walls of the pits, four bulk density samples were taken at various depths by firing a thin walled brass cylinder (50 mm long by 74 mm internal diameter) vertically into the exposed profile using a modified Ramset nail gun. Bulk density determinations were recorded as the mean of four samples at each designated depth.

With the exception of data from Plot 15 (EP38) The Crater, all chemical analyses were conducted at the analytical laboratory in Atherton. Soil pH was measured in 1:5 soil/water, 1:5 soil/1N KCl and 1:5 soil/0.01M CaCl<sub>2</sub> suspensions using a glass electrode with calomel electrode reference. Organic carbon was determined using the Walkey and Black (1934) wet oxidation method. Total nitrogen was measured using a modification of the Kjeldahl method (Honda 1962). In the initial survey only, total P was determined by a rapid perchloric acid digestion procedure (Summers and Nelson 1972). The method of Gillman (1979) was used for an estimation of CEC and exchangeable cations. Cations of Ca, Mg, K and Na were extracted with 0.1M BaCl<sub>2</sub>. Acidity and Al extracted by KCl were determined by the method of Yuan (1959).

All particle size analyses undertaken prior to 2003 were carried out in Atherton by the sieve and pipette method (Coventry and Fett 1979) with size limits based on the International System (silt 2µm to 20 µm, fine sand 20 µm to 200 µm).

For Plot 19 (EP 43) Mount Baldy, the particle size analyses were undertaken in 2003 at CSIRO Land and Water facilities in Glen Osmond, South Australia. For these samples oven-dry moisture content and moisture factor were determined using method 2A1 in Rayment and Higginson (1992). A sub-sample of as-received soil was dried overnight at 105°C and the moisture content calculated from the weight loss on an oven-dry basis:

$$M\% = 100 \cdot (\text{wt moisture}) / (\text{wt oven-dry soil})$$

This is reported on an oven-dry basis. A moisture factor is used to convert the PSA analytical data (and other data as appropriate) determined on the as-received basis to an oven-dry basis by multiplying the as-received result by the moisture factor where M.F. = (100+M%)/100.

Particle size was determined by removing the organic matter with hydrogen peroxide treatment, dispersion using sodium carbonate / sodium hexametaphosphate solution then determining the silt and clay fractions by pipette aliquot after sedimentation. Coarse and fine sand fractions were then determined by wet sieving and weighing. The method is a slight modification of the USDA Soil Survey Laboratory Methods Manual method 3A1 (USDA 1996). The modification is that the peroxide-treated sample is not oven dried to determine the residual weight as this can cause dispersion difficulties.

In more detail, 10 g soil is treated with dilute hydrogen peroxide to remove organic cementing agents. After removing excess soluble salts the sample is transferred to 250 ml PP bottle using water. A sodium carbonate / sodium hexametaphosphate solution is added to aid dispersion and the sample mixed end-over-end for 16 hours. The sample is transferred to a 500 ml PP measuring cylinder, diluted to 500 ml and mixed. The sample is maintained at constant temperature. At time zero the sample was agitated and at an appropriate time (12 mins at 20°C) a 25 ml aliquot was pipetted out from a depth of 250 mm into a weighed vial, oven dried and the weight of residue less weight of dispersing agent determined as silt+clay. Subsequently at an appropriate time (20 hours at 20°C) a 25 ml aliquot was again pipetted out from a depth of 250 mm into a weighed vial, oven dried and the weight of residue less weight of dispersing agent determined as clay. Silt is determined by difference. A blank was carried through the procedure to determine the contribution of the dispersing agent to the residue weight. Clay is defined as behaving like a spherical particle with a density of 2.65 g cc<sup>-1</sup> and a diameter of less than 2 µm. Silt is defined as behaving like a spherical particle with a density of 2.65 g cc<sup>-1</sup> and a diameter of between 2 and 20 µm. Excess silt and clay was syphoned off and the residue transferred to a 600 ml beaker. Water was added and the suspension mixed and allowed to settle for an appropriate time so that particles greater than 20 µm had settled 100 mm (4 mins 45 secs at 20°C) and the suspension syphoned off. This was repeated until there was no more silt or clay in the suspension - usually about 5 or 6 times. The clear supernatant was syphoned off and the sand wet-sieved through a 212 µm sieve to separate fine and coarse sand which was dried and weighed. The individual fractions were calculated, the moisture factor applied and the sum determined as a check on integrity of the analysis.

Particle density analysis utilized the methods specified by Blake (date unknown, Paper No. 4949 of the Scientific Journal Series, Minnesota Agr. Exp. Sta., St. Paul following the procedures set out in Am. Soc. Testing Mater., 1958, p.80 and U.S. Dept. Agr., 1954, p.122). Full details of these methods are recorded in the soil records section of the Permanent Plot files.

Soil moisture retention characteristics and hydraulic conductivity were determined in the Atherton analytical laboratory using standard pressure plate techniques. Details of the methods employed are provided at the conclusion of this appendix.

As no stratified soil data were available from Plot 15 (EP38) The Crater, a site with a complex geomorphic setting, a detailed sampling program, stratified both by landform element position and depth, was undertaken in 2000 specifically to address possible confusion relating to the soil nutrient status, rock outcrops and the forest structural typology in the vicinity of this plot. These analyses were conducted at the CSIRO Land and Water facilities at Townsville, North Queensland, and in Glen Osmond, South Australia using the standard techniques (the alpha-numeric code reference) of Rayment and Higginson (1992): pH by a 1:5 soil/water suspension [4A1]; electrical conductivity in a soil/water suspension [3A1]; exchange acidity (hydrogen and aluminium) by 1M potassium chloride [15G1], Yuan (1959); exchangeable bases and cation exchange capacity by compulsive exchange [15E1], 0.1M BaCl<sub>2</sub>/0.1M NH<sub>4</sub>Cl (Gillman and Sumpter 1986); bicarbonate-extractable phosphorus [9B2], 0.5M NaHCO<sub>3</sub> (Colwell 1963), and colorimetric finish based on the method of Murphy and Riley (1962). Total organic carbon was determined by a 1994 Leco CNS-2000 high

temperature resistance furnace with infrared detection of total carbon only [cf 6B3]. Total nitrogen was determined using a Leco CNS-2000 high temperature resistance furnace using thermal conductivity for the detection of nitrogen after the sample is combusted in the high temperature resistance furnace (see Etheridge et al 1998, Matejovic 1997). Details of the CNS-2000 multi-functional analyser are given at the conclusion of this appendix.

## ANALYTICAL DATA

**Table 1:** Plot 1 (EP2) Downfall Creek – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.10	Light brownish grey (10YR6/2); sandy clay loam; moderate 5-10mm subangular blocky; <5mm cracks; dry; slightly sticky; normal plasticity; 2-10% 6-20mm, angular, dispersed granite gravel; abundant roots; abrupt smooth change to -
0.10 to 0.20	Pale brown (10YR6/3); coarse sandy clay loam; moderate 5-10mm subangular blocky; <5mm cracks; dry; slightly sticky; normal plasticity; 2-10% 6-20mm, angular, dispersed granite gravel; many roots; abrupt wavy change to -
0.20 to 0.30	Pale brown (10YR6/3); coarse sandy clay loam; moderate 5-10mm subangular blocky; <5mm cracks; dry; moderately strong; slightly sticky; normal plasticity; 2-10% 6-20mm, angular, dispersed granite gravel; common roots; clear irregular change to -
0.30 to 0.60	Very pale brown (10YR7/3); coarse sandy loam; moderate 5-10mm subangular blocky; <5mm cracks; dry; moderately strong; slightly sticky; normal plasticity; 2-10% 6-20mm, angular, stratified, granite gravel; few roots; clear irregular change to -
0.60 to 1.30	Very pale brown (10YR8/3); loamy coarse sandy; massive; <5mm cracks; dry; moderately strong; non-sticky normal plasticity; 10-20% 6-20mm, angular, undisturbed granite gravel; few roots.

**Table 2:** Plot 1 (EP2) Downfall Creek – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.10	1.30	5.0	4.8	-	3.75	-	7.60	1.53	0.39	0.16	0.08	0.29	0.37	9.3	10.05
0.10 - 0.20	-	5.2	4.7	-	1.60	-	3.20	0.82	0.36	0.14	0.17	0.21	0.38	4.8	4.90
0.20 - 0.30	1.40	5.2	4.6	-	1.35	-	2.20	0.72	0.29	0.12	0.45	0.23	0.68	3.6	1.01
0.30 - 0.60	1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.60 - 0.90	-	5.1	4.2	-	0.30	-	0.19	0.55	0.67	0.25	2.14	0.16	2.30	2.8	3.96
0.90 - 1.20	-	5.2	4.2	-	0.15	-	0.24	0.63	0.36	0.32	1.97	0.21	2.18	2.5	3.73

**Table 3:** Plot 1 (EP2) Downfall Creek – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.02 - 0.07	1.329	0.316	0.237	0.197	0.181	0.174	0.145	0.139	0.126
0.22 - 0.27	1.438	0.273	0.215	0.179	0.166	0.146	0.125	0.097	0.092
0.45 - 0.50	1.484	0.254	0.226	0.187	0.171	0.150	0.133	0.150	0.098

**Table 4:** Plot 1 (EP2) Downfall Creek – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.02 - 0.07	9.3*	9.3
0.20 - 0.25	4.7	
0.20 - 0.25	6.3	
0.20 - 0.25	11.5	
0.20 - 0.25	12.9	8.85
0.22 - 0.27	6.4	
0.22 - 0.27	7.4	
0.22 - 0.27	22.5	
0.22 - 0.27	9.3	11.4
0.40 - 0.45	1.6	
0.40 - 0.45	3.3	
0.40 - 0.45	1.5	
0.40 - 0.45	3.1	2.4

\* Soil collapsed in other replicate cylinders.

**Table 5:** Plot 1 (EP2) Downfall Creek – soil particle size mean data for samples collected in the original soil survey (data from file notes).

Depth (m)	Sand %	Silt %	Clay %
0.00-0.30	61	22	17

**Table 6:** Plot 1 (EP2) Downfall Creek – soil particle density data for samples collected in the original soil survey (data from file notes).

Profile depth (m)	Sample depth (m)	Particle density (kg m <sup>-3</sup> )
0.20-0.30	0.07-0.12	2.55
0.30-0.60	0.35-0.40	2.58

**Table 7:** Plot 2 (EP3) Mount Haig – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark brown (7.5YR3/4); loam; strong 5-10mm subangular blocky; moist; very weak; <2% 2-6mm, angular, dispersed, quartz gravel; abundant roots; abrupt smooth change to -
0.05 to 0.08	Strong brown (7.5YR5/8); 20-50% 15 - 30mm distinct brown (7.5YR5/4) mottles; strong 5-10mm subangular blocky; moist; very weak; <2% 2-6mm, angular, dispersed, quartz gravel; abundant roots; abrupt smooth change to -
0.08 to 0.30	Reddish yellow (7.5YR6/8); 10-20% 5-15mm distinct mottles; sandy clay loam; moderate 5-10mm subangular blocky; rough-ped fabric; moist; moderately weak; <2% 2-6mm, angular, dispersed, quartz gravel; many roots; gradual wavy change to -
0.30 to 0.60	Yellowish red (5YR5/8); sandy light clay; moderate 20-50mm subangular blocky; smooth-ped fabric; moist; moderately firm; 2-10% 2-6mm, angular, dispersed, quartz gravel; common roots;
0.60 to 0.90	Yellowish red (5YR5/8); <5mm prominent mottles; light clay; moderate 20-50mm subangular blocky; smooth-ped fabric; moist; moderately firm; <2% 2-6mm; angular, dispersed, quartz gravel; few roots; diffuse irregular change to -
0.90 to 1.50	Red (2.5YR4/8); <5mm prominent mottles; light clay; weak 10-20mm subangular blocky; smooth-ped fabric; moist; moderately firm; <2% 2-6mm; angular, dispersed, quartz gravel; few roots.

**Table 8:** Plot 2 (EP3) Mount Haig – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	0.79	4.4	4.0	4.0	11.8	-	0.30	1.33	0.49	0.27	2.64	0.24	2.88	6.88	5.27
0.50 - 0.10	-	4.6	4.0	4.0	5.84	-	0.10	0.38	0.13	0.17	2.56	0.00	2.56	4.10	3.34
0.10 - 0.20	-	4.6	4.0	4.1	3.75	-	0.07	0.31	0.18	0.12	2.04	0.00	2.04	2.68	2.72
0.20 - 0.30	0.92	4.6	4.1	4.2	2.12	-	0.07	0.37	0.12	0.14	1.92	0.00	1.92	3.20	2.62
0.30 - 0.60	1.30	4.7	4.2	4.2	1.56	-	0.05	0.34	0.06	0.11	1.44	0.00	1.44	2.40	2.00
0.60 - 0.90	1.40	4.6	4.2	4.2	1.11	-	0.01	0.21	0.07	0.09	1.84	0.04	1.88	3.20	2.26
0.90 - 1.20	-	4.2	-	-	1.08	-	0.05	0.15	0.07	0.09	2.00	0.03	2.03	-	2.39
1.20 - 1.50	-	4.2	-	-	0.99	-	0.03	0.14	0.05	0.10	1.96	0.12	2.08	-	2.40
1.50 - 1.80	-	4.2	-	-	0.93	-	0.03	0.14	0.08	0.09	2.64	0.05	2.69	-	3.03
1.80 - 2.10	-	4.2	-	-	0.72	-	0.01	0.13	0.08	0.09	1.80	0.00	-	-	-
2.10 - 2.40	-	4.2	-	-	0.90	-	0.01	0.11	0.06	0.11	1.96	0.16	-	-	-

**Table 9:** Plot 2 (EP3) Mount Haig – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.20 - 0.25	0.928	0.697	0.545	0.505	0.449	0.392	0.371	0.267	0.222
0.45 - 0.50	1.226	0.411	0.407	0.379	0.361	0.348	0.322	-	0.257
0.75 - 0.80	1.388	0.330	0.323	0.312	0.298	0.291	0.275	-	0.238

**Table 10:** Plot 2 (EP3) Mount Haig – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.20 - 0.25	17.0	
0.20 - 0.25	4.7	
0.20 - 0.25	6.3	
0.20 - 0.25	11.5	
0.20 - 0.25	12.9	10.5

**Table 11:** Plot 2 (EP3) Mount Haig – soil particle size data for samples collected on 20.10.1983 from a soil pit adjacent to the plot on granitic soil.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
0.00 - 0.05	25	7	24	44
0.05 - 0.10	36	6	10	48
0.10 - 0.20	25	8	11	56
0.20 - 0.30	-	-	-	-
0.30 - 0.60	-	-	-	-
0.60 - 0.90	26	7	18	49
0.90 - 1.20	24	8	19	49
1.20 - 1.50	20	8	16	56
1.80 - 2.10	-	-	-	-
2.10 - 2.40	-	-	-	-

**Table 12:** Plot 3 (EP4) Little Pine Creek – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark yellowish brown (10YR4/4); 10-20% 5-15mm faint mottles; sandy light clay; moderate 10-20mm subangular blocky; moist; moderately weak; slightly sticky; abundant roots; abrupt smooth change to -
0.05 to 0.20	Dark yellowish brown (10YR4/6); 2-10% 5-15mm faint mottles; sandy light clay; moderate 20-50mm subangular blocky; moist; moderately weak; non sticky; abundant roots; clear wavy change to -
0.20 to 0.90	Strong brown (7.5YR5/8); light medium clay; weak 50-100mm angular blocky; rough-ped fabric; moist; moderately firm; slightly sticky; many roots; gradual wavy change to -
0.9 to 1.20	Reddish yellow (7.5YR6/8); light medium clay massive; earthy fabric; moist; very firm; <10% of ped faces or walls coated with cutans; common roots; gradual irregular change to -
1.20 to 1.50	Red (2.5YR5/8); light medium clay; weak 100-200mm angular blocky; smooth-ped fabric; moist; very firm; <10% of ped faces or walls coated with cutans; few roots; diffuse irregular change to -
1.50 to 2.90	Red (2.5YR5/8); 20-50% 15-30mm distinct mottles; sandy light clay; massive; moist; very firm; weakly cemented; few roots.

**Table 13:** Plot 3 (EP4) Little Pine Creek – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
											(cmol(+) kg <sup>-1</sup> )				(cmol(+) kg <sup>-1</sup> )
0.00 - 0.05	0.84	4.9	4.4	4.0	3.54	0.295	1.12	1.36	0.33	0.07	0.63	0.13	0.76	4.10	3.70
0.05 - 0.10	-	4.8	4.3	4.0	3.15	0.2549	0.33	0.71	0.25	0.05	0.86	0.21	1.08	2.90	2.47
0.10 - 0.20	1.07	4.8	4.3	4.0	1.69	0.154	0.12	0.38	0.15	0.02	1.05	0.19	1.13	2.20	1.85
0.20 - 0.30	-	4.8	4.3	-	1.20	0.1109	0.04	0.45	0.10	0.02	0.63	0.07	0.95	2.10	1.61
0.30 - 0.60	1.21	4.8	4.4	-	0.67	0.0659	0.02	0.46	0.07	0.00	0.97	0.03	0.95	2.20	1.55
0.60 - 0.90	1.37	4.8	4.3	-	0.28	0.0327	0.02	0.38	0.06	0.00	0.97	0.14	1.10	2.30	1.61
0.90 - 1.20	1.34	4.8	4.3	-	0.11	0.010	0.03	0.32	0.06	0.02	1.29	0.19	1.43	2.30	1.91
1.20 - 1.50	-	4.8	4.3	-	0.06	0.004	0.02	0.37	0.06	0.02	1.67	0.15	1.81	2.50	2.34
1.50 - 1.80	1.35	4.8	4.3	-	0.06	0.005	0.22	0.34	0.06	0.02	1.85	0.17	1.94	2.98	2.63
1.80 - 2.10	-	4.8	4.3	-	0.06	0.0545	0.0	0.29	0.06	0.00	2.04	0.15	2.06	2.98	2.46
2.10 - 2.40	-	4.8	4.3	-	0.06	0.002	0.02	0.26	0.06	0.00	2.11	0.16	2.21	3.20	2.62

**Table 14:** Plot 3 (EP4) Little Pine Creek – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.02 - 0.07	1.181	0.431	0.388	0.327	0.313	0.297	0.269	0.180	0.182
0.07 - 0.12	1.243	0.402	0.373	0.289	0.270	0.254	0.230	0.180	0.182
0.35 - 0.40	1.503	0.330	0.326	0.241	0.232	0.227	0.209	0.193	0.178
0.85 - 0.90	1.574	0.225	0.253	0.245	0.239	0.223	0.149	0.200	0.288
1.20 - 1.25	1.543	0.263	0.266	0.255	0.247	0.229	0.169	0.211	0.223

**Table 15:** Plot 3 (EP4) Little Pine Creek – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.02 - 0.07	5.9	
0.02 - 0.07	4.0	
0.02 - 0.07	8.3	
0.02 - 0.07	5.8	<b>6.0</b>
0.07 - 0.12	2.6	
0.07 - 0.12	2.9	
0.07 - 0.12	3.4	<b>3.0</b>
0.35 - 0.40	2.3	<b>2.3</b>
1.21 - 1.25	6.5	
1.21 - 1.25	2.9	<b>4.7</b>

**Table 16:** Plot 3 (EP4) Little Pine Creek – soil particle size data for samples collected from four positions in soil pits adjacent to the plot on granitic soil.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Position 1</b>				
0.00 - 0.05	47	12	11	30
0.05 - 0.10	45	12	12	31
0.10 - 0.15	41	11	13	35
0.15 - 0.20	40	11	13	36
0.20 - 0.30	38	11	14	37
0.30 - 0.60	35	10	18	37
0.60 - 0.90	32	7	27	34
0.90 - 1.20	29	9	29	33
1.20 - 1.50	36	9	23	32
1.50 - 1.80	33	6	28	33
1.80 - 2.10	29	5	35	31
2.10 - 2.40	31	6	40	23
2.40 - 2.70	31	5	41	23
<b>Position 2</b>				
0.0 - 0.05	42	16	11	31
0.05 - 0.10	43	16	11	30
0.10 - 0.20	43	16	11	30
0.20 - 0.30	40	16	13	31
0.30 - 0.60	38	16	13	33
0.60 - 0.90	38	13	17	32
0.90 - 1.20	28	11	27	34
1.20 - 1.50	27	10	32	31
1.50 - 1.80	29	11	36	24
1.80 - 2.10	35	13	31	21
2.10 - 2.40	32	12	39	17
2.40 - 2.70	31	12	39	18
<b>Position 3</b>				
0.0 - 0.05	37	19	11	33
0.05 - 0.10	45	18	9	28
0.10 - 0.20	43	20	9	28
0.20 - 0.30	42	20	9	29
0.30 - 0.60	47	18	9	26
0.60 - 0.90	40	19	12	29
0.90 - 1.20	35	15	15	35
1.20 - 1.50	29	8	22	41
1.50 - 1.80	31	6	32	31
1.80 - 2.10	31	7	36	26
2.10 - 2.40	30	8	37	25
2.40 - 2.70	29	10	36	25
2.70 - 3.00	32	11	34	23



Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Position 4</b>				
0.0 - 0.05	48	12	11	29
0.05 - 0.10	46	12	12	30
0.10 - 0.20	44	12	7	37
0.20 - 0.30	38	13	14	35
0.30 - 0.60	31	14	17	38
0.60 - 0.90	22	18	23	37
0.90 - 1.20	17	25	29	29
<b>Position 4 variant – red colour to the bottom of the profile</b>				
1.20 - 1.50	28	9	38	25
1.50 - 1.80	30	10	38	22
1.80 - 2.10	22	14	42	22
2.10 - 2.40	22	15	42	21
2.40 - 2.70	28	15	38	19
2.70 - 3.00	32	10	40	18
<b>Position 4 variant – yellow colour to the bottom of the profile</b>				
1.20 - 1.50	22	33	25	31
1.50 - 1.80	25	31	22	22
1.80 - 2.10	27	34	21	18
2.10 - 2.40	22	27	30	21
2.40 - 2.70	17	33	31	19
2.70 - 3.00	21	43	23	13

**Table 17:** Plot 3 (EP4) Little Pine Creek – soil particle density data for samples collected from a soil pit adjacent to the plot on granitic soil.

Profile depth (m)	Sample depth (m)	Particle density (kg m <sup>-3</sup> )
<b>Position 1</b>		
0.10 – 0.15	7-12	2.55
0.30 – 0.60	35-40	2.58
0.60 – 0.90	85-90	2.62
<b>Position 2</b>		
0.10 – 0.20	7-12	2.55
0.30 – 0.60	35-40	2.58
0.60 – 0.90	85-90	2.62

**Table 18:** Plot 4 (EP9) Robson Logging Area – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.10	Strong brown (7.5YR5/8); silty clay loam; moderate 10-20mm subangular blocky; moist; 2-10% 20-60mm, subangular, dispersed, quartz gravel; abundant roots; clear smooth change to -
0.10 to 0.20	Strong brown (7.5YR5/8); silty clay loam; moderate 10-20mm subangular blocky; moist; 2-10% 20-60mm, subangular, dispersed, quartz gravel; many roots; clear smooth change to -
0.20 to 0.40	Yellowish red (5YR5/8); silty clay loam; weak 20-50mm angular blocky; moist; 2-10% 20-60mm, subangular, dispersed, quartz gravel; common roots; gradual smooth change to -
0.40 to 0.90	Reddish yellow (5YR6/8); 2-10% 5-15mm distinct strong brown (7.5YR5/6) mottles; light medium clay; weak 20-50mm angular blocky; moist; 2-10% 20-60mm, subangular, dispersed, quartz gravel; common roots; gradual smooth change to -
0.90 to 1.20	Reddish yellow (5YR6/8); 2-10% 5-15mm distinct strong brown (7.5YR5/6) mottles; light medium clay; weak 20-50mm angular blocky; moist; 2-10% 20-60mm, subangular, dispersed, quartz gravel; few roots; diffuse smooth change to -
1.20 to 1.80	Reddish yellow (5YR6/8); 2-10% 5-15mm distinct strong brown (7.5YR5/6) mottles; light medium clay; moderate 10-20mm subangular blocky; moist; <2% 20-60mm, subangular, dispersed, quartz gravel; few roots.

**Table 19:** Plot 4 (EP9) Robson Logging Area – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H			
0.00– 0.10	-	-	-	-	2.91	-	0.13	0.18	0.24	0.11	1.89	0.35	0.00	1.70	2.90
0.10 - 0.20	1.10	4.4	3.8	3.8	2.52	-	0.06	0.13	0.22	0.09	1.54	0.70	2.24	1.30	2.74
0.20 - 0.30	-	4.3	4.0	4.0	1.29	-	0.03	0.10	0.19	0.10	1.26	0.50	2.24	1.00	2.18
0.30 - 0.60	1.20	4.4	4.2	4.0	0.77	-	0.03	0.07	0.35	0.99	1.30	0.41	1.76	1.00	3.15
0.60 - 0.90	1.40	4.4	4.2	4.0	0.30	-	0.03	0.08	0.23	0.09	1.36	0.30	1.71	0.90	2.09
0.90 - 1.20	1.60	4.6	4.2	4.0	0.30	-	0.01	0.15	0.12	0.09	1.84	0.60	1.66	2.10	2.81
0.20 - 1.80	1.50	4.7	4.2	3.9	0.03	-	0.01	0.29	0.10	0.09	3.48	1.08	2.44	2.70	5.05
1.80 - 2.10	-	4.5	4.1	3.8	0.06	-	0.03	0.08	0.18	0.08	1.02	0.31	4.56	1.08	1.70
2.10 - 2.40	-	4.6	4.2	4.1	0.06	-	0.03	0.07	0.12	0.07	1.09	0.25	1.33	-	-

**Table 20:** Plot 4 (EP9) Robson Logging Area – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.10 - 0.15	1.067	0.508	0.428	0.378	0.352	0.320	0.274	-	0.166
0.30 - 0.35	1.219	0.417	0.391	0.322	0.294	0.256	0.233	-	0.148
0.60 - 0.65	1.446	0.296	0.288	0.251	0.229	0.203	0.183	-	0.152
1.00 - 1.05	1.619	0.234	0.226	0.219	0.207	0.199	0.185	-	0.171
1.50 - 1.55	1.495	0.311	0.312	0.307	0.302	0.292	0.286	-	0.304

**Table 21:** Plot 4 (EP9) Robson Logging Area – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.10 - 0.15	15.2	
0.10 - 0.15	15.2	
0.10 - 0.15	18.8	
0.10 - 0.15	17.2	<b>16.6</b>
0.30 - 0.35	14.6	
0.30 - 0.35	17.5	
0.30 - 0.35	11.9	
0.30 - 0.35	12.4	<b>14.1</b>
0.60 - 0.65	1.1	<b>1.1</b>
1.00 - 1.05	2.1	<b>2.1</b>

**Table 22:** Plot 4 (EP9) Robson Logging Area – soil particle size mean data for samples collected in the original soil survey (data from file notes).

Depth (m)	Sand %	Silt %	Clay %
0.00 - 0.30	70	10.3	19.7

**Table 23:** Plot 5 (EP18) Mount Lewis – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark brown (10YR3/3); loamy sand; weak 10-20mm subangular blocky; earthy fabric; <5mm cracks; moist; very weak; non-sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, abundant roots; abrupt smooth change to -
0.05 to 0.10	Dark brown (10YR4/3); loamy sand; weak 10-20mm subangular blocky; earthy fabric; <5mm cracks; moist; very weak; non-sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, abundant roots; clear smooth change to -
0.10 to 0.30	Dark yellowish brown (10YR4/4); coarse sandy loam; weak 10-20mm subangular blocky; earthy fabric; <5mm cracks; moist; moderately weak; non-sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, many roots; gradual wavy change to -
0.30 to 0.60	Strong brown (7.5YR5/6); coarse sandy clay loam; weak 10-20mm subangular blocky; earthy fabric; <5mm cracks; moist; moderately weak; non-sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, common roots; diffuse irregular change to -
0.60 to 0.90	Strong brown (7.5YR5/6); clay loam; weak 10-20mm subangular blocky; earthy fabric; <5mm cracks; moist; moderately firm; slightly sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, few roots; diffuse irregular change to -
0.90 to 1.20	Clay loam; moderate; smooth-ped fabric; moist; moderately firm; slightly sticky; normal plasticity; 10-20% 2-6mm, subangular, undisturbed, quartz gravel, <10% of ped faces or walls coated with cutans; 2-10% 20-60mm ferruginous soft segregations; few roots; diffuse irregular change to -
1.20 to 1.50	Clay loam; moderate; smooth-ped fabric; moist; very strong; 20-50% 6-20mm, angular, undisturbed, granite gravel, <10% of ped faces or walls coated with cutans; discontinuous; few roots.

**Table 24:** Plot 5 (EP18) Mount Lewis – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	-	4.0	3.8	3.8	8.43	-	1.07	1.17	0.59	0.32	5.15	3.30	8.45	4.00	11.6
0.05 - 0.10	1.10	4.4	4.1	4.2	4.23	-	0.17	0.24	0.28	0.16	4.47	2.08	6.55	1.90	7.40
0.10 - 0.20	-	4.4	4.2	-	3.84	-	0.10	0.15	0.16	0.12	1.36	0.12	1.48	1.90	2.01
0.20 - 0.30	1.30	4.6	4.2	-	2.86	-	0.07	0.11	0.17	0.12	1.04	0.00	1.04	1.50	1.51
0.30 - 0.60	-	4.5	4.4	-	1.64	-	0.07	0.05	0.11	0.09	0.22	0.11	0.33	0.70	0.65
0.60 - 0.90	-	4.4	4.3	-	1.13	-	0.03	0.05	0.11	0.09	0.53	0.13	0.66	0.40	0.94
0.90 - 1.20	-	4.4	4.4	-	0.82	-	0.05	0.05	0.17	0.08	0.40	0.08	0.48	-	0.83
1.20 - 1.50	-	4.4	4.4	-	0.72	-	0.03	0.05	0.17	0.09	0.32	0.11	0.43	-	0.77

**Table 25:** Plot 5 (EP18) Mount Lewis – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.05 – 0.10	1.072	0.491	0.444	0.383	0.361	0.306	0.275	0.221	0.166
0.20 – 0.25	1.337	0.343	0.328	0.273	0.252	0.229	0.207	0.130	0.127

**Table 26:** Plot 5 (EP18) Mount Lewis – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.05 - 0.10	33.2	
0.05 - 0.10	26.6	
0.05 - 0.10	29.3	
0.05 - 0.10	31.3	<b>30.1</b>
0.20 - 0.25	4.4	
0.20 - 0.25	31.9	
0.20 - 0.25	18.1	
0.20 - 0.25	27.9	<b>20.6</b>

**Table 27:** Plot 6 (EP19) Garrawalt – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Very dark greyish brown (10YR3/2); clay loam; moderate 2-5mm angular blocky; rough-ped fabric; moist; moderately weak; non sticky; abundant roots; abrupt smooth change to -
0.05 to 0.20	Dark greyish brown (10YR4/2); clay loam; moderate 2-5mm angular blocky; rough-ped fabric; moist; moderately weak; slightly sticky; many roots; abrupt wavy change to -
0.20 to 0.30	Brown (7.5YR5/4) 10-20% 5-15mm distinct very greyish brown (10YR3/2) mottles; sandy clay loam; moderate 5-10mm subangular blocky; rough-ped fabric; moist; moderately weak; slightly sticky; common roots clear wavy change to -
0.30 to 0.40	Brown (7.5YR5/4) 2-10% <5mm distinct very greyish brown (10YR3/2) mottles; sandy clay loam; moderate 10-20mm subangular blocky; rough-ped fabric; moist; moderately weak; slightly sticky; common roots clear wavy change to -
0.40 to 0.60	Reddish yellow (7.5YR6/6); 2-10% <5mm faint pinkish grey (7.5YR7/3) mottles; sandy clay loam; moderate 10-20mm angular blocky; rough-ped fabric; moist; moderately firm; slightly sticky; <10% of ped faces or walls coated with cutans; few roots; gradual irregular change to -
0.60 to 0.90	Reddish yellow (7.5YR6/6); 10-20% 5-15mm distinct pinkish grey (7.5YR7/2) mottles; sandy clay loam; moderate 20-50mm angular blocky; rough-ped fabric; moist; moderately firm; <10% of ped faces or walls coated with cutans; few roots.

**Table 28:** Plot 6 (EP19) Garrawalt – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	-	4.2	3.9	-	11.5	0.790	2.34	1.94	0.40	0.18	4.79	0.00	-	8.80	9.65
0.05 - 0.10	-	4.4	4.0	-	7.98	0.588	0.71	0.62	0.24	0.13	4.53	0.00	-	6.20	6.23
0.10 - 0.20	0.89	4.4	4.0	-	5.89	0.404	0.31	0.31	0.19	0.11	4.34	0.00	-	5.00	5.26
0.20 - 0.30	1.03	4.4	4.0	-	3.16	0.223	0.21	0.19	0.12	0.08	4.42	0.00	4.42	4.10	5.02
0.30 - 0.60	1.21	4.4	4.0	-	0.70	0.088	0.09	0.12	0.09	0.06	7.60	0.55	8.24	5.90	8.60
0.60 - 0.90	1.36	4.5	3.9	-	0.22	0.033	0.07	0.16	0.07	0.08	10.80	0.65	11.50	-	11.83
0.90 - 1.20	-	4.6	3.8	-	0.15	0.026	0.07	0.20	0.07	0.08	10.50	0.87	11.40	7.80	11.79
1.20 - 1.50	-	4.4	3.8	-	0.13	0.012	0.07	0.22	0.08	0.08	8.95	0.69	9.64	7.30	10.09
1.50 - 1.80	-	4.4	3.8	-	0.10	0.015	0.07	0.27	0.09	0.06	7.92	0.87	8.79	7.20	9.28
1.80 - 2.10	-	4.5	3.8	-	0.06	0.003	0.07	0.27	0.09	0.06	7.00	0.34	7.34	6.40	7.83

**Table 29:** Plot 6 (EP19) Garrawalt – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.10 – 0.15	0.846	0.739	0.651	0.541	0.522	0.467	0.427	0.301	0.262
0.22 – 0.27	1.055	0.506	0.484	0.391	0.382	0.340	0.323	0.280	0.240
0.32 – 0.37	1.208	0.407	0.394	0.352	0.336	0.315	0.305	0.272	0.239
0.50 – 0.55	1.362	0.348	0.336	0.318	0.309	0.298	0.287	0.275	0.221

**Table 30:** Plot 6 (EP19) Garrawalt – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.22 - 0.27	8.6	
0.22 - 0.27	10.1	
0.22 - 0.27	8.0	
0.22 - 0.27	11.9	<b>9.7</b>
0.32 - 0.37	1.3	
0.32 - 0.37	0.2	
0.32 - 0.37	1.3	<b>0.9</b>
0.50 - 0.55	12.9	
0.50 - 0.55	1.3	
0.50 - 0.55	2.4	
0.50 - 0.55	11.1	<b>6.9</b>

**Table 31:** Plot 6 (EP19) Garrawalt – soil particle size data for samples collected from two positions in a soil pit adjacent to the plot.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Position 1</b>				
0.00 - 0.05	16	10	28	46
0.05 - 0.10	21	10	28	41
0.10 - 0.20	19	12	23	46
0.20 - 0.30	24	11	29	36
0.30 - 0.60	20	10	26	44
0.60 - 0.90	20	14	24	42
0.90 - 1.20	23	16	25	36
1.20 - 1.50	23	16	25	36
1.50 - 1.80	25	14	27	34
1.80 - 2.10	34	11	25	30
<b>Position 2</b>				
0.00 - 0.05	19	9	29	43
0.05 - 0.10	20	10	29	41
0.10 - 0.20	27	9	27	37
0.20 - 0.30	25	9	31	35
0.30 - 0.60	22	10	27	41
0.60 - 0.90	18	8	27	47
0.90 - 1.20	21	11	27	41
1.20 - 1.50	24	12	28	36
1.50 - 1.80	21	12	30	37

**Table 32:** Plot 7 (EP29) Mount Fisher – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark yellowish brown (10YR3/4); sandy loam.
0.05 to 0.10	Dark yellowish brown (10YR4/6); sandy clay loam.
0.10 to 0.20	Yellowish brown (10YR5/6); clay loam; fine sand.
0.20 to 0.30	Brownish yellow (10YR6/8); silty medium clay.
0.30 to 0.60	Yellowish brown (10YR5/8); silty medium clay.

**Table 33:** Plot 7 (EP29) Mount Fisher – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	0.86	4.0	3.6	3.8	6.30	-	0.65	0.55	0.22	0.10	3.08	0.39	3.47	-	4.99
0.05 - 0.10	0.86	4.1	3.7	4.0	4.67	-	0.37	0.32	0.16	0.09	2.76	0.72	3.48	-	4.42
0.10 - 0.20	1.15	4.1	3.8	4.3	2.71	-	0.22	0.18	0.11	0.06	1.53	0.20	1.73	-	2.30
0.20 - 0.30	1.15	4.3	4.0	4.5	1.84	-	0.17	0.12	0.09	0.05	0.85	0.09	0.94	-	1.37
0.30 - 0.60	1.28	4.4	4.1	4.6	1.14	-	0.13	0.09	0.08	0.05	0.61	0.61	1.22	-	1.57
0.60 - 0.90	1.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**Table 34:** Plot 7 (EP29) Mount Fisher – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.02 – 0.07	0.863	0.741	0.654	0.58	0.555	0.522	0.493		0.163
0.20 – 0.25	1.154	0.448	0.444	0.419	0.400	0.380	0.352		0.116
0.40 – 0.45	0.276	0.382	0.378	0.342	0.328	0.31	0.275		0.122

**Table 35:** Plot 7 (EP29) Mount Fisher – soil particle size mean data for samples collected in the original soil survey (data from file notes).

Depth (m)	Sand %	Silt %	Clay %
0.00 - 0.30	54.8	32.0	13.2

**Table 36:** Plot 8 (EP30) Agapetes Logging Area – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Brown (7.5YR4/4); sandy light clay; moderate 5-10mm angular blocky; rough-ped fabric; moist; moderately weak; 20-50% 2-6mm, angular, dispersed, quartz gravel; many roots; sharp smooth change to -
0.05 to 0.10	Strong brown (7.5YR4/6); light clay; moderate 5-10mm angular blocky; rough-ped fabric; moist; moderately weak; 10-20% 2-6mm, angular, dispersed, quartz gravel; many roots; abrupt smooth change to -
0.10 to 0.20	Yellowish red (5YR4/6); light medium clay; moderate 5-10mm angular blocky parting to moderate subangular blocky; smooth-ped fabric; moist; moderately firm; 2-10% 2-6mm, angular, dispersed, quartz gravel; common roots; clear wavy change to -
0.20 to 0.30	Red (2.5YR4/6); light medium clay; moderate 5-10mm angular blocky parting to moderate subangular blocky; smooth-ped fabric; moist; moderately firm; 2-10% 2-6mm, angular, dispersed, quartz gravel; common roots; gradual wavy change to -
0.30 to 0.60	Red (2.5YR4/6); medium clay; moderate 5-10mm angular blocky parting to moderate subangular blocky; smooth-ped fabric; moist; very firm; 2-10% 2-6mm, angular, dispersed, quartz gravel; <10% of ped faces or walls coated with cutans; few roots; diffuse wavy change to -
0.60 to 0.90	Red (2.5YR4/6); sandy medium clay; moderate 5-10mm angular blocky parting to moderate subangular blocky; smooth-ped fabric; moist; very firm; 2-10% 2-6mm, angular, dispersed, quartz gravel; <10% of ped faces or walls coated with cutans; few roots;
0.90 to 1.20	Red (2.5YR4/6); sandy medium clay; moderate 10-20mm angular blocky; smooth-ped fabric; moist; very firm; 10-20% 2-6mm, angular, dispersed, quartz gravel;
1.20 to 1.50	Red (10R4/6); sandy medium clay; smooth-ped fabric; moist; very firm; 10-20% 2-6mm, angular, dispersed, quartz gravel; <2% 6-20mm ferruginous soft segregations;
1.50 to 1.80	Red (10R4/6); sandy medium clay; smooth-ped fabric; moist; very firm; 10-20% 2-6mm, angular, dispersed, quartz gravel.

**Table 37:** Plot 8 (EP30) Agapetes Logging Area – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H			
0.00 - 0.05	0.94	4.4	4.0	-	6.06	-	1.30	1.67	0.34	0.14	-	-	-	3.30	3.45
0.05 - 0.10	-	4.4	4.2	-	3.42	-	0.22	0.63	0.24	0.11	1.39	1.84	3.23	3.50	4.43
0.10 - 0.20	-	4.6	4.2	-	3.91	-	0.22	0.78	0.26	0.11	1.54	1.47	3.01	3.00	4.38
0.20 - 0.30	1.20	4.6	4.2	-	2.27	-	0.10	0.48	0.15	0.09	1.12	0.24	1.36	2.90	2.18
0.30 - 0.60	1.40	4.6	4.2	-	1.33	-	0.08	1.08	0.10	0.05	0.72	0.16	0.88	2.70	2.19
0.60 - 0.90	-	4.8	4.2	-	0.48	-	0.05	1.52	0.17	0.05	0.24	0.09	0.33	2.70	2.12
0.90 - 1.20	1.40	4.7	4.2	-	-	-	0.07	0.64	0.16	0.05	0.89	0.24	1.13	2.20	2.05
1.20 - 1.50	-	-	-	-	-	-	0.05	0.35	0.11	0.04	1.13	0.19	1.32	-	1.87
1.50 - 1.80	-	-	-	-	-	-	0.08	0.35	0.11	0.04	1.27	0.32	1.59	-	2.17



**Table 38:** Plot 8 (EP30) Agapetes Logging Area – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.00 – 0.05	0.937	0.547	0.479	0.423	0.407	0.379	0.341	0.212	0.193
0.20 – 0.25	1.263	0.383	0.349	0.325	0.302	0.277	0.259	0.215	0.204
0.40 – 0.45	1.350	0.365	0.350	0.287	0.277	0.273	0.257	0.212	0.211
1.00 – 1.05	1.385	0.319	0.293	0.268	0.259	0.253	0.240	0.209	0.209

**Table 39:** Plot 8 (EP30) Agapetes Logging Area – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.0 - 0.05	7.7	
0.0 - 0.05	25.9	
0.0 - 0.05	40.7	
0.0 - 0.05	13.0	<b>21.8</b>
0.20 - 0.25	7.2	
0.20 - 0.25	6.4	
0.20 - 0.25	8.0	
0.20 - 0.25	18.1	
0.20 - 0.25	24.8	<b>12.9</b>
0.40 - 0.45	6.9	
0.40 - 0.45	2.3	
0.40 - 0.45	6.5	<b>5.2</b>
1.0 - 1.05	7.9	
1.0 - 1.05	7.4	<b>7.6</b>

**Table 40:** Plot 9 (EP31) Woopen Creek – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark yellowish brown (10YR4/4); sandy clay loam; non-sticky; slightly plastic; normal plasticity;
0.05 to 0.10	Dark yellowish brown (10YR4/4); sandy clay loam; non-sticky; slightly plastic; normal plasticity;
0.10 to 0.20	Dark yellowish brown (10YR4/6); sandy clay loam; slightly-sticky; moderately plastic; normal plasticity;
0.20 to 0.30	Dark yellowish brown (10YR4/6); clay loam; slightly sticky; very plastic; normal plasticity;
0.30 to 0.60	Strong brown (7.5YR4/6) light clay; slightly sticky; very plastic; normal plasticity;
0.60 to 0.90	Strong brown (7.5YR4/6) light medium clay; moderately sticky; very plastic; normal plasticity.

**Table 41:** Plot 9 (EP31) Woopen Creek – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
											(cmol(+) kg <sup>-1</sup> )				(cmol(+) kg <sup>-1</sup> )
0.00 - 0.05	-	4.3	4.1	4.2	2.17	-	0.43	0.26	0.15	0.08	1.34	0.21	1.55	-	2.47
0.05 - 0.10	-	4.3	4.2	4.3	2.23	-	0.40	0.25	0.15	0.09	1.03	0.00	1.03	-	1.92
0.10 - 0.20	-	4.2	4.2	4.4	1.45	-	0.25	0.16	0.12	0.06	0.73	0.10	0.83	-	1.42
0.20 - 0.30	-	4.2	4.2	4.5	1.17	-	0.22	0.15	0.09	0.05	0.62	0.08	0.80	-	1.21
0.30 - 0.60	-	4.4	4.4	4.6	0.54	-	0.17	0.15	0.09	0.05	0.36	0.21	0.57	-	1.03
0.60 - 0.90	-	4.5	4.4	4.6	0.41	-	0.15	0.18	0.11	0.05	0.48	0.18	0.66	-	1.15

**Table 42:** Plot 9 (EP31) Woopen Creek – soil particle size mean data for samples collected in the original soil survey (data from file notes).

Depth (m)	Sand %	Silt %	Clay %
0 00 - 0.30	86	6	5.7

**Table 43:** Plot 10 (EP32) Mcllwraith Range – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Very dark greyish brown (10YR3/2); sandy clay loam; moist; friable; moderate 5-10mm subangular blocky; rough ped fabric; macropores; <5mm and 5-10mm cracks; very weak; normal plasticity; abundant roots; abrupt smooth change to -
0.05 to 0.20	Yellowish brown (10YR5/4); many, medium, brown (10YR4/3) mottles; moist; friable; sandy clay loam; moderate 5-20mm subangular blocky; rough ped fabric; macropores; <5mm and 5-10mm cracks; very weak; normal plasticity; many roots; gradual wavy change to -
0.20 to 0.45	Brownish yellow (10YR6/6); common, medium yellowish brown (10YR5/4) mottles; moist; sandy clay loam; <2% 2-6mm rounded, dispersed gravel; slightly hard, friable; moderate 10-20mm subangular blocky; rough ped fabric; macropores; <5mm cracks; moderately weak; normal plasticity; <2% 2-6mm ferruginous nodules; common roots; gradual wavy change to -
0.45 to 0.60	Brownish yellow (10YR6/6); moist; light clay; 2-10% 2-6mm rounded, subangular, dispersed quartz gravel; weak 20-50mm angular blocky; slightly hard to friable; rough ped fabric; macropores; <5mm cracks; moderately weak; normal plasticity; 2-10% 2-6mm ferruginous nodules; common roots; gradual wavy change to -
0.60 to 0.90	Reddish yellow (7.5YR6/8); moist; light clay; 25-50% 6-20mm rounded subangular dispersed quartz gravel; weak 20-50mm angular blocky; rough ped fabric; macropores; <5mm cracks; moderately firm; normal plasticity; 20-50% 6-20mm ferruginous nodules; few roots; gradual irregular change to -
0.90 to 1.20	Reddish yellow (7.5YR6/8); common coarse red (2.5YR5/8) mottles; moist; medium clay 2-10% 6-20mm rounded subangular dispersed quartz gravel; weak 20-50mm angular blocky; rough ped fabric; moderately firm; normal plasticity; slightly sticky; 20-50% 6-60mm ferruginous segregations; few roots; gradual irregular change to -
1.20 to 1.50	Reddish yellow (7.5YR7/8); medium clay; rounded ironstone segregations.

**Table 44:** Plot 10 (EP32) Mcllwraith Range – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	1.08	3.8	-	3.7	4.59	0.298	0.28	0.49	0.15	0.10	1.18	0.27	1.45	3.50	2.47
0.05 - 0.10	-	3.7	-	3.9	2.92	0.214	0.10	0.22	0.11	0.07	1.23	0.17	1.40	2.30	1.90
0.10 - 0.20	1.31	3.7	-	4.1	1.88	0.132	0.05	0.12	0.07	0.04	0.96	0.03	0.99	1.60	1.27
0.20 - 0.30	-	3.5	-	4.2	1.38	0.118	0.03	0.08	0.05	0.04	0.78	0.00	0.76	1.10	0.98
0.30 - 0.45	1.54	3.6	-	4.2	0.96	0.072	0.03	0.07	0.05	0.03	0.70	0.00	0.69	1.00	0.88
0.45 - 0.60	1.54	3.6	-	4.2	0.58	0.056	0.03	0.07	0.04	0.03	0.69	0.00	0.62	1.00	0.86
0.60 - 0.90	-	3.5	-	4.3	0.32	0.038	0.03	0.08	0.02	0.03	0.68	0.00	0.61	1.50	0.84
0.90 - 1.20	1.12	3.6	-	4.3	0.12	0.002	0.03	0.26	0.03	0.03	0.77	0.00	0.68	1.80	1.12
1.20 - 1.50	-	3.6	-	4.3	0.07	0.002	0.03	0.27	0.02	0.04	0.94	0.00	0.87	1.90	1.30
1.50 - 1.80	-	3.4	-	4.2	0.21	0.013	-	-	-	-	0.95	0.00	0.92	-	-
1.80 - 2.10	-	3.4	-	4.2	0.24	0.014	-	-	-	-	1.18	0.00	1.10	-	-
2.10 - 2.40	-	3.5	-	4.0	0.27	0.028	-	-	-	-	1.25	0.13	1.38	-	-

**Table 45:** Plot 10 (EP32) Mcllwraith Range – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.10 – 0.15	1.315	0.339	0.330	0.254	0.214	0.167	0.149	0.096	0.093
0.30 – 0.35	1.495	0.249	0.242	0.180	0.166	0.135	0.114	0.093	0.089
0.50 – 0.55	1.569	0.224	0.210	0.159	0.145	0.102	0.103	0.096	0.089

**Table 46:** Plot 10 (EP32) Mcllwraith Range – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.0 - 0.05	3.4	
0.0 - 0.05	3.4	
0.0 - 0.05	18.6	<b>8.5</b>
0.10 - 0.15	2.1	
0.10 - 0.15	4.3	
0.10 - 0.15	2.5	
0.10 - 0.15	3.1	<b>3.0</b>
0.30 - 0.35	1.5	
0.30 - 0.35	1.3	
0.30 - 0.35	0.6	
0.30 - 0.35	1.3	<b>1.2</b>
0.50 - 0.55	2.0	
0.50 - 0.55	2.8	
0.50 - 0.55	3.4	
0.50 - 0.55	4.3	<b>3.1</b>

**Table 47:** Plot 10 (EP32) Mcllwraith Range – soil particle size mean data for samples collected in the original soil survey (data from laboratory sheet, n=8).

Depth (m)	Sand %	Silt %	Clay %
0.00 - 0.30	78.6	7.2	14.2

**Table 48:** Plot 10 (EP32) McIlwraith Range – soil particle size data for samples collected from two positions in a soil pit adjacent to the plot.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Position 1</b>				
0.0 – 0.5	56	24	3	17
0.5 – 0.10	50	29	3	18
0.10 – 0.20	53	26	3	18
0.20 – 0.30	55	23	3	19
0.30 – 0.45	53	23	5	19
0.45 – 0.60	45	28	5	22
0.60 – 0.90	45	22	8	25
0.90 – 1.20	41	12	19	28
1.20 – 1.50	47	10	20	23
1.50 – 1.80	46	15	20	19
1.80 – 2.10	-	-	-	-
2.10 – 2.40	40	13	28	19
<b>Position 2</b>				
0.0 – 0.5	53	24	4	19
0.5 – 0.10	48	28	4	20
0.10 – 0.20	48	29	3	20
0.20 – 0.30	48	28	3	21
0.30 – 0.45	48	28	3	21
0.45 – 0.60	-	-	-	-
0.60 – 0.90	48	23	7	22
0.90 – 1.20	36	15	20	29
1.20 – 1.50	38	13	22	17

**Table 49:** Plot 11 (EP33) Curtain Fig – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark reddish brown (5YR2.5/2); silty clay; moderate, medium and fine angular blocky; crumbly; friable; abundant roots; very porous; occasional stones; common gravel
0.05 to 0.10	Dark reddish brown (5YR2.5/2); silty clay loam; angular blocky; less crumbly; friable; common roots
0.10 to 0.20	Dark reddish brown (5YR2.5/2); silty clay; angular blocky; less crumbly; friable; common roots
0.20 to 0.30	Dark reddish brown (5YR3/2); silty clay; moderate, medium subangular blocky; friable; slightly less porous; common stones
0.30 to 0.60	Dark reddish brown (5YR2.5/2 - 3/2); silty clay-clay; moderate, medium subangular blocky; firm; friable; occasional roots
0.60 to 0.90	Dark reddish brown (5YR3/2); clay; incomplete angular blocky; firm; few roots; occasional stones
0.90 to 1.20	Dark reddish brown (5YR3/2); clay; massive; firm; few roots; occasional stones
1.20 to 1.50	Dark reddish brown (5YR3/2); clay; massive; very firm; few roots; few stones
1.50 to 1.80	Dark brown (7.5YR4/2 - 3/2) with grey mottles; silty clay; massive; very firm; rare roots; occasional weathered stones.

**Table 50:** Plot 11 (EP33) Curtain Fig – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	0.78	6.2	6.3	6.0	7.39	0.726	36.01	7.47	1.09	0.13	0.00	0.10	-	22.90	44.70
0.05 - 0.10	-	6.0	6.1	6.0	5.27	0.60	29.41	5.85	0.78	0.11	0.00	0.09	-	23.60	36.20
0.10 - 0.20	0.85	5.8	6.0	5.7	3.73	0.469	21.91	4.33	0.60	0.09	0.01	0.08	-	17.50	26.40
0.20 - 0.30	-	5.7	6.1	5.8	2.37	0.316	15.43	2.91	0.52	0.09	0.00	0.07	-	14.10	19.00
0.30 - 0.60	1.01	5.6	6.0	5.6	1.02	0.121	8.04	1.70	0.25	0.09	0.01	0.07	-	8.00	10.10
0.60 - 0.90	-	5.4	5.6	5.5	0.66	0.071	5.80	1.96	0.40	0.08	0.00	0.06	-	8.50	8.23
0.90 - 1.20	1.04	4.9	5.4	5.2	0.23	0.034	4.81	2.03	0.57	0.12	0.00	0.05	-	7.70	7.53
1.20 - 1.50	1.03	4.8	5.3	5.0	0.19	0.020	5.41	2.45	0.57	0.23	-	-	-	8.30	-
1.50 - 1.80	-	5.0	5.3	5.1	0.17	0.021	5.69	2.56	0.35	0.29	-	-	-	8.30	-
1.80 - 2.10	-	5.2	5.6	5.3	0.19	0.024	5.88	3.03	0.38	0.59	-	-	-	8.70	-
2.10 - 2.40	-	5.2	5.6	5.1	0.33	0.038	5.38	2.87	0.19	0.83	-	-	-	7.80	-

**Table 51:** Plot 11 (EP33) Curtain Fig – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.03 - 0.08	0.983	0.633	0.611	0.542	0.521	0.484	0.442	-	0.385
0.12 - 0.17	1.106	0.529	0.443	0.419	0.402	0.382	0.363	-	0.287
0.40 - 0.45	0.213	0.451	0.443	0.419	0.402	0.382	0.363	-	0.287
0.75 - 0.80	0.301	0.404	0.395	0.383	0.368	0.350	0.334	-	0.303
1.20 - 1.25	0.306	0.402	0.397	0.388	0.378	0.364	0.347	-	

**Table 52:** Plot 11 (EP33) Curtain Fig – soil hydraulic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.03 - 0.08	1.4	
0.03 - 0.08	2.6	
0.03 - 0.08	1.5	
0.03 - 0.08	1.1	<b>1.7</b>
0.12 - 0.17	0.7	<b>0.7</b>
0.40 - 0.45	too slow	-

**Table 53:** Plot 11 (EP33) Curtain Fig – soil particle size data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Sample 1</b>				
0 00 - 0.05	6	8	39	47
0.05 - 0.10	8	22	31	39
0.10 - 0.20	9	8	35	48
0.20 - 0.30	6	5	34	55
0.30 - 0.60	3	4	26	67
0.60 - 0.90	2	5	23	70
0.90 - 1.20	2	4	21	73
1.20 - 1.50	1	5	20	74
1.50 - 1.80	3	8	28	61
1.80 - 2.10	9	11	31	49
2.10 – 2.40	5	9	35	51
<b>Sample 2</b>				
0 00 - 0.05	10	8	62	20
0.05 - 0.10	9	7	46	38
0.10 - 0.20	8	9	46	37
0.20 - 0.30	9	9	41	41
0.30 - 0.60	8	9	37	46
0.60 - 0.90	9	14	30	47
0.90 - 1.20	8	15	23	54
1.20 - 1.50	7	14	38	40
1.50 - 1.80	15	20	25	40
1.80 - 2.10	13	17	25	45
2.10 – 2.40	13	15	30	42
<b>Sample 3</b>				
0 00 - 0.05	17	8	35	40
0.05 - 0.10	3	4	42	51
0.10 - 0.20	6	5	37	52
0.20 - 0.30	2.5	4.5	28	65
0.30 - 0.60	1	4	24	71
0.60 - 0.90	0.5	4.5	25	70
0.90 - 1.20	1	5	22	72
1.20 - 1.50	1.5	5.5	22	71
1.50 - 1.80	4	7	23	66
1.80 - 2.10	5	10	27	58
2.10 - 2.40	27	21	27	25
2.40 - 2.70	16	12	36	36
<b>Sample 4</b>				
0 00 - 0.05	16	13	38	33
0.05 - 0.10	13	12	37	38
0.10 - 0.20	8	5	39	48

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
0.20 - 0.30	2	5	44	49
0.30 - 0.60	1	3	27	69
0.60 - 0.90	1	3	25	71
0.90 - 1.20	0.5	4	21.5	74
1.20 - 1.40	0.5	3.5	21	75
1.40 - 1.50	2	6	25	67
1.50 - 1.80	3	6	22	69
1.80 - 2.10	-	-	-	-
2.10 - 2.40	18	19	36	27

**Table 54:** Plot 11 (EP33) Curtain Fig – soil particle density data for samples collected from a soil pit adjacent to the plot on granitic soil.

Profile depth (m)	Sample depth (m)	Particle density (kg m <sup>-3</sup> )
<b>Position 3</b>		
0.10 – 0.20	0.12 – 0.17	2.74
0.30 – 0.60	0.40 – 0.45	2.82
0.60 – 0.90	0.75 – 0.80	2.84
<b>Position 4</b>		
0.10 – 0.20	0.12 – 0.17	2.78
0.30 – 0.60	0.40 – 0.45	2.88
0.60 – 0.90	0.75 – 0.80	2.85

**Table 55:** Plot 12 (EP34) Russell River – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 - 0.05	Dark brown (7.5YR3/4); clayey sand; non-sticky; non-plastic;
0.05 - 0.10	Strong brown (7.5YR4/6); sandy clay loam; slightly sticky; slightly plastic;
0.10 - 0.20	Strong brown (7.5YR4/6); clay loam; slightly sticky; moderately plastic;
0.20 - 0.30	Strong brown (7.5YR4/6); clay loam; slightly sticky; moderately plastic;
0.30 - 0.60	Reddish brown (5YR4/4); clay loam; slightly sticky; very plastic;
0.60 - 0.90	Reddish brown (5YR4/4); clay loam; moderately sticky; very plastic.



**Table 56:** Plot 12 (EP34) Russell River – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
											(cmol(+) kg <sup>-1</sup> )				
0.00 - 0.05	-	4.5	4.4	4.4	5.87	-	2.20	1.05	0.45	0.09	0.46	0.17	0.63	-	4.42
0.05 - 0.10	-	4.6	4.4	4.5	4.61	-	1.22	0.66	0.27	0.09	0.36	0.25	0.61	-	2.58
0.10 - 0.20		4.4	4.2	4.6	2.97	-	0.62	0.43	0.17	0.08	0.14	0.14	0.28	-	1.58
0.20 - 0.30	-	4.4	4.4	4.8	2.11	-	0.67	0.45	0.12	0.06	0.13	0.13	0.26	-	1.56
0.30 - 0.60	-	4.2	4.3	4.8	1.19	-	0.53	0.61	0.12	0.09	0.11	0.11	0.22	-	1.57
0.60 - 0.90	-	4.2	4.2	4.4	0.75	-	0.40	0.59	0.12	0.10	0.98	0.15	1.13	-	2.34

**Table 57:** Plot 12 (EP34) Russell River – soil particle size mean data for samples collected in the original soil survey (file data sheet, n=5).

Depth (m)	Sand %	Silt %	Clay %
0 00 - 0.30	91.0	5.2	3.8

**Table 58:** Plot 13 (EP35) Whyanbeel – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 - 0.10	Brown to dark brown (10YR4/3); light clay; 2-25mm angular to subangular blocky; moderately plastic; normal plasticity; slightly sticky; friable; abundant roots
0.10- 0.20	Strong brown (7.5YR5/6); light medium clay; angular blocky; friable; moderately plastic; normal plasticity; moderately sticky; occasional roots; occasional gravel
0.20 - 0.30	Strong brown (7.5YR5/7); light medium clay; friable; moderately plastic; normal plasticity; moderately sticky; occasional roots; occasional gravel
0.30 - 0.60	Reddish yellow (5YR6/8) common fine mottles; medium heavy clay; firm; moderately plastic; normal plasticity; moderately sticky; rare roots; occasional fine gravel
0.60 - 0.90	Strong brown (7.5YR5/8); few mottles; medium clay; firm; moderately sticky; rare roots; rare gravel.

**Table 59:** Plot 13 (EP35) Whyanbeel – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
											(cmol(+) kg <sup>-1</sup> )				
0.00 - 0.05	-	3.8	3.5	3.3	3.60	-	0.25	0.43	0.53	0.16	3.84	1.05	-	-	6.26
0.05 - 0.10	-	3.8	3.6	3.4	2.84	-	0.20	0.32	0.25	0.12	3.77	0.85	0.00	5.51	-
0.10 - 0.20	-	3.8	3.7	3.6	1.34	-	0.17	0.21	0.20	0.09	3.37	0.81	0.00	4.85	-
0.20 - 0.30	-	3.6	3.8	3.7	0.70	-	0.13	0.19	0.29	0.08	2.42	0.40	0.00	3.51	-
0.60 - 0.90	-	3.6	3.8	3.8	0.37	-	0.12	0.20	0.35	0.07	2.32	0.11	0.00	3.17	-

**Table 60:** Plot 13 (EP35) Whyanbeel – soil particle size mean data for samples collected in the original soil survey (file data sheet, n=5).

Depth (m)	Gravel %	Sand %	Silt %	Clay %
0.00 - 0.30	12.6	45.8	20.6	21.0

**Table 61:** Plot 14 (EP37) Eungella – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.10	Brown (7.5YR4/2) sandy clay loam; moderate 2-5mm subangular blocky; rough-ped fabric; 5-10mm cracks; moderately weak; slightly sticky; normal plasticity; abrupt roots; abrupt smooth change to -
0.10 to 0.20	Dark brown (7.5YR3/4); fine sandy clay loam; moderate 5-10mm subangular blocky; rough-ped fabric; 5-10mm cracks; moderately weak; slightly sticky; normal plasticity; many roots; clear wavy change to -
0.20 to 0.30	Reddish brown (5YR4/4) fine sandy clay loam; moderate 5-10mm subangular blocky; rough-ped fabric; 5-10mm cracks; very weak; slightly sticky; normal plasticity; many roots; clear wavy change to -
0.30 to 0.70	Reddish brown (2.5YR4/4) clay loam; moderate 10-20mm subangular blocky; rough-ped fabric; moderately firm; slightly sticky; normal plasticity; < 2% 200-600mm, subangular, dispersed igneous rock (unidentified) gravel; <10% of ped faces or walls coated with cutans; common roots; clear wavy change to -
0.70 to 0.90	Reddish brown (5YR4/4) light clay; moderate 10-20mm subangular blocky; rough-ped fabric; moderately firm; slightly sticky; normal plasticity; <10% of ped faces or walls coated with cutans; few roots; gradual wavy change to -
0.90 to 1.50	Brown (7.5YR5/4) light medium clay; moderate 20-50mm subangular blocky; rough-ped fabric; very firm; moderately sticky; normal plasticity; <10% of ped faces or walls coated with cutans; few roots; gradual change to -
1.50 to 1.80	Brown (7.5YR5/4) light medium clay to -
1.80 to 2.10	Yellowish brown (10YR5/4) light medium clay.

**Table 62:** Plot 14 (EP37) Eungella – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H			
0.00 - 0.05	0.72	5.0	4.9	4.6	8.02	0.793	10.5000	3.66	0.67	0.13	0.10	0.00	0.00	12.80	14.90
0.05 - 0.10	-	5.0	4.9	4.6	6.86	0.70	8.02	2.50	0.39	0.12	0.25	0.00	0.00	9.40	11.00
0.10 - 0.20	0.77	4.9	4.9	4.6	4.87	0.803	5.37	1.67	0.20	0.11	0.26	0.00	0.26	8.00	7.61
0.20 - 0.30	0.93	4.7	4.8	4.6	2.81	0.293	2.77	0.97	0.11	0.09	0.16	0.00	0.00	5.10	3.94
0.30 - 0.60	0.87	4.2	4.5	4.4	0.87	0.130	0.86	0.65	0.08	0.06	0.33	0.00	0.33	3.30	1.98
0.60 - 0.70	0.94	4.0	4.2	4.1	0.93	0.080	0.56	0.61	0.09	0.03	0.77	0.04	0.72	3.30	2.10
0.70 - 0.09	1.15	3.8	-	4.0	0.68	0.053	0.43	0.67	0.10	0.03	1.22	0.11	1.33	3.20	2.56
0.09 - 1.20	-	3.7	4.0	3.8	0.52	0.055	0.09	0.45	0.04	0.04	2.11	0.22	2.33	3.10	2.95
1.20 - 1.50	-	3.6	3.9	3.8	0.36	0.023	0.05	0.38	0.02	0.03	2.32	0.28	2.60	2.50	3.08
1.50 - 1.80	-	3.6	3.9	4.0	0.18	0.012	0.07	0.28	0.03	0.03	2.07	0.37	2.44	2.40	2.85
1.80 - 2.10	-	3.6	3.8	4.0	0.15	0.015	0.03	0.23	0.03	0.04	2.53	0.40	2.93	2.50	3.26

**Table 63:** Plot 14 (EP37) Eungella – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.02 - 0.07	0.724	0.991	0.851	0.781	0.751	0.685	0.619	0.0359	0.0320
0.10 - 0.15	0.769	0.947	0.804	0.774	0.713	0.664	0.597	0.0337	0.0290
0.20 - 0.25	0.855	0.772	0.658	0.637	0.605	0.547	0.502	0.0472	0.0284
0.50 – 0.55	0.933	0.673	0.653	0.600	0.560	0.515	0.478	0.0327	0.0286
0.80 – 0.85	1.156	0.483	0.466	0.442	0.421	0.398	0.371	0.0343	0.0324

**Table 64:** Plot 14 (EP37) Eungella – soil hydraulic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.50-0.55	0.0	
0.50-0.55	9.0	
0.50-0.55	0.3	
0.50-0.55	10.8	<b>5.0</b>
0.80-0.85	6.7	
0.80-0.85	15.5	
0.80-0.85	3.1	
0.80-0.85	5.3	<b>7.7</b>

**Table 65:** Plot 14 (EP37) Eungella – soil particle size data for samples collected from a soil pit adjacent to the plot on basaltic soil.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
<b>Position A</b>				
0.00-0.05	5	18	37	60
0.05-0.10	6	35	24	35
0.10-0.20	6	45	20	28
0.20-0.30	5	41	19	35
0.30-0.60	2	11	25	62
0.60-0.70	3	6	22	69
0.70-0.90	2	6	23	69
0.90-1.20	2	4	27	67
1.20-1.50	1	4	29	66
1.50-1.80	3	5	34	58
1.80-2.10	2	8	32	58
<b>Position B</b>				
0.00-0.05	4	8	45	43
0.05-0.10	-	-	-	-
0.10-0.20	5	47	25	23
0.20-0.30	6	37	21	36
0.30-0.60	2	10	24	64
0.60-0.70	2	6	23	69
0.70-0.90	2	5	23	70
0.90-1.20	1	4	25	70
1.20-1.50	2	4	28	66

**Table 66:** Plot 15 (EP38) The Crater – soil chemical analysis data for soil samples collected from contrasting lower and upper slope positions across the 0.5 ha plot. Data represent samples taken during 2000 from bulked soil from three auger holes (within one metre of each other) at both the lower and upper slope positions. Analytical methods are detailed in the main text. (NB. data format for this table varies from other sites.)

Depth (m)	pH 1:5 H <sub>2</sub> O	EC dS m <sup>-1</sup>	Org. C %	Tot. N %	Exchangeable cations				P Bicarb	H + Al	CEC
					Ca	Mg	K	Na			
					(cmol(+) kg <sup>-1</sup> )				mg/kg	(cmol(+) kg <sup>-1</sup> )	(cmol(+) kg <sup>-1</sup> )
<b>Upper slope samples (predominantly rhyolitic soil parent material)</b>											
0.00 - 0.10	6.2	0.11	7.80	0.66	20.0	3.90	0.27	0.06	16	0.12	14.0
0.10 - 0.20	6.1	0.08	5.75	0.53	11.0	2.70	0.21	0.08	9	0.11	11.0
0.20 - 0.30	5.9	0.06	4.15	0.38	6.1	1.70	0.12	0.07	8	0.15	5.8
0.30 - 0.45	5.8	0.04	1.95	0.16	1.9	0.67	0.07	0.12	6	0.24	2.6
0.45 - 0.60	6.1	0.02	0.55	0.03	1.1	0.46	0.03	0.07	3	0.19	2.3
0.60 - 0.90	6.1	0.02	0.39	0.01	1.3	1.10	0.04	0.09	1	0.12	2.6
<b>Lower slope samples (valley infill with basaltic influence)</b>											
0.00 - 0.10	6.5	0.21	15.90	1.02	48.00	14.00	0.73	0.21	32	0.17	19.0
0.10 - 0.20	6.5	0.17	12.50	0.89	43.00	9.90	0.45	0.15	19	0.19	19.0
0.20 - 0.30	6.6	0.13	9.45	0.71	39.00	7.40	0.31	0.14	14	0.08	21.0
0.30 - 0.45	6.6	0.09	6.35	0.51	14.00	5.30	0.15	0.12	9	0.09	15.0
0.45 - 0.60	6.7	0.05	3.15	0.25	7.4	3.20	0.06	0.11	8	0.08	8.2
0.60 - 0.90	6.6	0.04	1.75	0.10	4.1	3.20	0.06	0.19	5	0.06	6.0

**Table 67:** Plot 15 (EP38) The Crater – soil bulk density data for soil samples collected from upper, mid- and lower slope positions across the 0.5 ha plot. Data represent hammer-driven core samples taken during 2002 from small soil pits. (NB. data format for this table varies from that of other sites.)

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Notes
<b>Upper slope (Peg A at northeast corner of plot)</b>		
0.0 – 0.025	0.66	Sandy loam (coarse sand, granitic); black to very dark grey
0.10 – 0.15	0.81	Sandy loam (fine sand only); grey changing to yellow grey at depth
0.25 – 0.50	0.82	
0.50 – 0.55	0.99	
<b>Upper slope (2 m from subplot M corner peg)</b>		
0.0 – 0.05	0.64	
0.10 – 0.15	0.91	One piece of granitic gravel 5 cm diameter and 3 pieces of weathered basalt sampled in profile
0.25 – 0.30	0.98	
0.50 – 0.55	1.38	
<b>Midslope (at mid-plot position, 2 m downslope from J/F/K/G peg)</b>		
0.0 – 0.05	0.57	
0.25 – 0.30	0.87	
0.50 – 0.55	1.05	
<b>Lower slope (5 m downslope from C/D edge peg towards D corner peg)</b>		
0.0 – 0.05	0.37	
0.10 – 0.15	0.71	Gradual transition throughout profile; 1 piece of gravel and 1 piece of basalt
0.25 – 0.30	0.78	Weathered basalt fragment at 30 cm depth
0.50 – 0.55	1.06	Charcoal abundant at 0.50 to 0.55 cm depth
<b>Lower slope (outside the plot adjacent to plot P on the L plot side of the big figtree)</b>		
0.0 – 0.05	0.48	
0.10 – 0.15	0.86	
0.25 – 0.30	0.88	
0.50 – 0.55	1.40	

**Table 68:** Plot 16 (EP40) Agapetes Scientific Area – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Greyish brown (10YR5/2); sandy loam; moderate subangular blocky; moderately strong; non-sticky; non-plastic; normal plasticity; 2-6mm subangular, dispersed, igneous rock (unidentified) gravel
0.05 to 0.10	Light brown (7.5YR6/4); sandy loam; weak granular; moderately strong; non-sticky; slightly plastic; normal plasticity; 2-6mm subangular, dispersed, igneous rock (unidentified) gravel
0.10 to 0.20	Pink (7.5YR7/4); sandy loam; moderately weak; non-sticky; moderately plastic; normal plasticity; 2-6mm subangular, dispersed, igneous rock (unidentified) gravel
0.20 to 0.30	Reddish yellow (7.5YR6/6); loamy sand; weak subangular blocky; moderately weak; non-sticky; moderately plastic; normal plasticity; 2-6mm subangular, dispersed, igneous rock (unidentified) gravel
0.30 to 0.60	Reddish yellow (7.5YR6/6); sandy loam; moderately weak; non-sticky; moderately plastic; normal plasticity; 2-6mm subangular, dispersed, igneous rock (unidentified) gravel
0.60 to 0.90	Pink (7.5YR7/4); sandy loam.

**Table 69:** Plot 16 (EP40) Agapetes Scientific Area – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H			
		(cmol(+) kg <sup>-1</sup> )					(cmol(+) kg <sup>-1</sup> )		(cmol(+) kg <sup>-1</sup> )		(cmol(+) kg <sup>-1</sup> )				
0.00 - 0.05	1.07	5.6	5.6	5.2	5.81	-	17.0	2.03	0.51	0.17	0.27	0.20	0.47	10.10	20.18
0.05 - 0.10	1.07	5.4	5.6	4.6	3.15	-	5.67	1.28	0.56	0.18	0.46	0.28	0.74	6.40	8.43
0.10 - 0.20	1.36	5.4	4.9	4.4	2.06	-	3.33	1.17	0.52	0.24	0.74	0.06	0.80	4.50	6.06
0.20 - 0.30	1.36	5.0	4.4	4.3	1.66	-	1.23	0.35	0.54	0.24	1.86	0.03	1.89	3.10	4.25
0.30 - 0.60	-	5.0	4.4	4.4	0.88	-	0.47	0.19	0.38	0.23	1.72	0.00	1.72	2.50	2.99
0.60 - 0.90	-	5.2	4.6	4.3	0.45	-	1.50	0.49	0.34	0.31	1.31	0.15	1.46	3.70	4.10

**Table 70:** Plot 16 (EP40) Agapetes Scientific Area – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.02 - 0.07	1.084	0.385	0.312	0.235	0.22	0.203	0.195	0.194	0.115
0.15 - 0.20	1.358	0.288	0.267	0.222	0.21	0.200	0.188	0.122	0.098
0.40 - 0.45	1.455	0.300	0.269	0.222	0.20	0.187	0.176	0.124	0.057
0.70 - 0.75	1.418	0.305	0.285	0.222	0.20	0.172	0.155	0.090	0.076

**Table 71:** Plot 16 (EP40) Agapetes Scientific Area – soil hydraulic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.02 - 0.07	18.6	<b>18.6</b>
0.15 - 0.20	2.6	
0.15 - 0.20	1.0	<b>1.8</b>
0.40 - 0.45	1.9	
0.40 - 0.45	5.1	
0.40 - 0.45	5.1	
0.40 - 0.45	1.2	<b>3.3</b>

**Table 72:** Plot 17 (EP41) Oliver Creek – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Very dark greyish brown (10YR3/2); clay loam; abundant surface cobbles and gravel
0.05 to 0.10	Dark yellowish brown (10YR3/4); light clay
0.10 to 0.20	Dark yellowish brown (10YR3/4); light clay
0.20 to 0.30	Dark yellowish brown (10YR3/6); light medium clay
0.30 to 0.55	Dark yellowish brown (10YR3/6); medium clay

**Table 73:** Plot 17 (EP41) Oliver Creek – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
											(cmol(+) kg <sup>-1</sup> )				
0.00 - 0.05	-	4.6	4.4	4.3	6.01	-	0.53	0.82	0.56	0.18	1.23	0.15	1.38	-	3.47
0.05 - 0.10	-	4.6	4.3	4.4	4.15	-	0.53	0.82	0.53	0.17	1.09	0.22	1.31	-	3.36
0.10 - 0.20	-	4.5	4.2	4.4	2.38	-	0.25	0.43	0.56	0.15	1.13	0.13	1.26	-	2.65
0.20 - 0.30	-	4.6	4.2	4.4	1.77	-	0.22	0.48	0.60	0.15	1.21	0.15	1.36	-	2.81
0.30 - 0.60	-	4.6	4.2	4.4	1.01	-	0.20	0.30	0.33	0.10	0.85	0.04	0.85	-	1.78

**Table 74:** Plot 17 (EP41) Oliver Creek – soil particle size mean data for samples collected in the original soil survey (data from file notes, n=5).

Depth (m)	Gravel %	Sand %	Silt %	Clay %
0.00 - 0.30	61.8	24.8	8.2	5.4



**Table 75:** Plot 18 (EP42) Iron Range – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Very dark grey (10YR3/1); fine sandy loam; weak 5-10mm parting to moderate 2-5mm cast; rough-ped fabric; <5mm cracks; very weak; non-sticky; abundant roots; abrupt smooth change to-
0.05 to 0.10	Very dark greyish brown (10YR3/2); fine sandy loam; weak 5-10mm parting to moderate 2-5mm cast; rough-ped fabric; <5mm cracks; very weak; non-sticky; many roots; abrupt smooth change to-
0.10 to 0.30	Dark brown (10YR3/3); fine sandy loam; weak 10-20mm parting to moderate 2-5mm cast; rough-ped fabric; <5mm cracks; very weak; non-sticky; many roots; abrupt smooth change to
0.30 to 0.60	Brown (10YR4/3); 10-20% 5-15mm distinct light yellowish brown (10YR6/4) mottles; fine sandy loam; weak 20-50mm angular blocky; rough-ped fabric; <5mm cracks; moderately weak; non-sticky; common roots; diffuse smooth change to-
0.60 to 1.50	Dark yellowish brown (10YR4/4); 2-10% 5-15mm distinct yellowish brown (10YR6/4) mottles; fine sandy loam; weak 50-100mm angular blocky; rough-ped fabric; <5mm cracks; moderately weak; non-sticky; few roots; diffuse smooth change to-
1.50 to 1.80	Dark yellowish brown (10YR4/6); 2-10% 5-15mm faint dark yellowish brown (10YR4/4) mottles; fine sandy loam; weak 50-100mm angular blocky; rough-ped fabric; <5mm cracks; moderately weak; non-sticky; few roots.

**Table 76:** Plot 18 (EP42) Iron Range – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC		
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al					H	
											(cmol(+) kg <sup>-1</sup> )					(cmol(+) kg <sup>-1</sup> )	
0.00 - 0.05	-	5.2	5.0	4.6	2.13	0.169	4.05	2.06	0.25	0.09	0.03	0.06	0.09	5.90	6.54		
0.05 - 0.10	-	5.1	4.7	4.4	1.53	0.145	2.49	1.34	0.15	0.07	0.18	0.09	0.27	4.20	4.32		
0.10 - 0.20	1.27	4.9	4.5	4.2	1.11	0.110	3.29	1.11	0.19	0.06	0.36	0.10	0.46	3.40	5.11		
0.20 - 0.30	-	5.0	4.4	4.0	0.40	0.075	2.29	0.85	0.10	0.05	0.66	0.11	0.77	2.80	4.06		
0.30 - 0.60	1.45	5.1	4.6	4.0	0.43	0.043	2.65	1.18	0.18	0.08	0.37	0.12	0.49	3.00	4.58		
0.60 - 0.90	-	5.4	4.8	4.2	0.24	0.020	1.41	0.94	0.04	0.06	0.13	0.11	0.24	3.10	2.69		
0.09 - 1.20	1.43	-	-	-	0.23	0.015	1.28	1.02	0.14	0.05	0.18	0.16	0.34	-	2.83		
1.20 - 1.50	-	-	-	-	0.16	0.014	1.18	1.33	0.09	0.05	0.05	0.18	0.23	3.20	2.88		
1.50 - 1.80	-	-	-	-	0.15	0.015	0.99	1.48	0.06	0.05	0.04	0.17	0.21	3.10	2.79		

**Table 77:** Plot 18 (EP42) Iron Range – soil particle size data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Course sand %	Fine sand %	Silt %	Clay %
0.00 - 0.05	6	73	7	14
0.05 - 0.10	6	73	7	16
0.10 - 0.20	6	72	7	15
0.20 - 0.30	4	73	8	15
0.30 - 0.60	3	70	10	17
0.60 - 0.90	2	71	9	18
0.90 - 1.20	3	69	9	19
1.20 - 1.50	2	70	9	19
1.50 - 1.80	2	71	9	18

**Table 78:** Plot 19 (EP43) Mount Baldy – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.05	Dark brown (7.5YR3/2); 5-15mm very dark grey (7.5YR3/1) mottles; light clay; moderate 5-10mm subangular blocky; rough-ped fabric; moist; very weak; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; abundant roots; abrupt smooth change to-
0.05 to 0.10	Brown (7.5YR4/2); 10-20% 5-15mm dark brown (7.5YR3/2) mottles; light clay; moderate 5-10mm subangular blocky; rough-ped fabric; moist; very weak; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; abundant roots; clear wavy change to-
0.10 to 0.20	Brown (7.5YR5/4); 10-20% 5-15mm faint brown (7.5YR4/2) mottles; light clay; moderate 5-10mm subangular blocky; rough-ped fabric; moist; very weak; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; many roots; gradual irregular change to-
0.20 to 0.48	Strong brown (7.5YR5/5); 2-10% 5-15mm faint brown (7.5YR4/4) mottles; light clay; moderate 5-10mm subangular blocky; rough-ped fabric; moist; very weak; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; common roots; diffuse irregular change to-
0.48 to 0.75	Brown (7.5YR4/4); 20-50% 5-15mm faint brown (7.5YR4/2) mottles; medium clay; weak 5-10mm subangular blocky; rough-ped fabric; moist; very firm; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; <10% of ped faces or walls coated with cutans; few roots; diffuse irregular change to-
0.75 to 1.10	Strong brown (7.5YR5/5); 2-10% <5mm weak red (2.5YR4/2) mottles; heavy clay; massive 5-10mm subangular blocky; moist; very firm; 2-10% 6-20mm subrounded, dispersed, igneous rock (unidentified) gravel; <10% of ped faces or walls coated with cutans; few roots; diffuse irregular change to-
1.10 to 1.50	Reddish yellow (7.5YR6/6); 20-50% <5mm weak red (2.5YR4/2) mottles; massive 5-10mm subangular blocky; moist; very firm; <10% of ped-faces or walls coated with cutans; few roots
1.50 to 2.00	Reddish yellow (7.5YR6/5); 20-50% <5mm weak red (2.5YR4/2) mottles.

**Table 79:** Plot 19 (EP43) Mount Baldy – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch.	Comp.	Sum.
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H	acid.	CEC	CEC
0.00 - 0.05	0.80	4.8	4.4	-	5.75	-	1.63	1.27	0.55	0.91	1.40	0.46	1.86	-	6.22
0.05 - 0.10	-	4.8	4.3	-	3.81	-	0.43	0.53	0.35	0.06	1.90	0.49	2.39	-	3.76
0.10 - 0.20	-	4.7	4.2	-	2.42	-	0.13	0.28	0.25	0.06	1.74	0.73	2.47	-	3.19
0.20 - 0.30	1.20	4.8	4.3	-	1.42	-	0.13	0.24	0.15	0.05	1.69	0.47	2.16	-	2.73
0.30 - 0.60	-	4.6	4.3	-	0.82	-	0.08	0.16	0.11	0.04	1.44	0.38	1.82	-	2.21
0.60 - 0.90	1.30	4.6	4.2	-	0.60	-	0.08	0.20	0.08	0.04	2.26	0.58	2.84	-	3.24
0.09 - 1.20	1.50	4.6	4.1	-	0.34	-	0.07	0.15	0.09	0.04	2.52	0.48	3.00	-	3.35
1.20 - 1.50	-	4.6	4.0	-	0.18	-	0.07	0.08	0.11	0.04	3.12	0.66	3.78	-	4.08
1.50 - 2.00	1.50	4.5	4.0	-	0.15	-	0.10	0.07	0.12	0.04	3.43	0.96	4.39	-	4.72

**Table 80:** Plot 19 (EP43) Mount Baldy – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures					
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa*	100 kPa*
0.02 - 0.07	0.800	0.778	0.663	0.557	0.525	0.485	0.440
0.25 - 0.30	0.933	0.404	0.396	0.359	0.341	0.326	0.312
0.60 - 0.65	1.323	0.331	0.326	0.283	0.265	0.253	0.225
0.90 - 0.95	1.098	0.286	0.278	0.252	0.240	0.231	0.220

\* An entry in the laboratory records indicates that determinations for 33kPa and 100 kPa were undertaken using the lower cylinder only.

**Table 81:** Plot 19 (EP43) Mount Baldy – soil hydraulic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity $K_s$ (mm minute <sup>-1</sup> )	Mean $K_s$ for depth interval (mm minute <sup>-1</sup> )
0.02 - 0.07	8.76	
0.02 - 0.07	12.06	
0.02 - 0.07	23.22	
0.02 - 0.07	20.04	<b>16.02</b>
0.25 - 0.30	0.78	
0.25 - 0.30	1.14	<b>0.96</b>
0.25 - 0.30	too slow	
0.60 - 0.65	6.54	
0.60 - 0.65	2.16	
0.60 - 0.65	3.18	<b>3.96</b>
0.60 - 0.65	too slow	
0.90 - 0.95	too slow	
0.90 - 0.95	too slow	
0.90 - 0.95	too slow	
1.50 - 1.55	too slow	
1.50 - 1.55	too slow	
1.50 - 1.55	too slow	

**Table 82:** Plot 19 (EP43) Mount Baldy – soil particle size data for samples collected from four locations within the plot.

Depth (m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Total %
<b>Sample 1 (at tree E3)</b>					
0.00 - 0.05	16.5	11.2	33.3	29.3	90.4
0.05 - 0.10	18.0	10.5	27.8	34.2	90.4
0.10 - 0.20	14.5	11.4	37.2	31.4	94.4
0.20 - 0.30	15.5	12.5	37.2	31.4	96.5
0.30 - 0.60	14.5	14.2	38.4	31.0	98.2
0.60 - 0.90	13.5	13.9	33.3	39.5	100.1
<b>Sample 2 (at tree C19)</b>					
0.00 - 0.05	15.8	15.2	32.5	28.0	91.5
0.05 - 0.10	15.4	16.2	33.5	29.4	94.5
0.10 - 0.20	16.1	15.6	33.9	30.5	96.1
0.20 - 0.30	15.9	16.0	34.8	30.3	97.0
0.30 - 0.60	15.3	17.9	34.3	30.6	98.1
0.60 - 0.90	11.6	16.7	30.3	40.1	98.8
<b>Sample 3 (at tree P23)</b>					
0.00 - 0.05	19.5	15.6	29.6	23.5	88.1
0.05 - 0.10	17.8	16.3	31.4	25.0	90.6
0.10 - 0.20	15.9	17.6	32.5	25.8	91.7
0.20 - 0.30	15.3	18.0	33.3	26.5	93.2
0.30 - 0.60	16.6	19.1	33.1	27.0	95.6
0.60 - 0.90	19.2	21.7	32.4	24.3	97.6
<b>Sample 4 (at tree I22)</b>					
0.00 - 0.05	25.6	7.7	29.0	27.6	89.9
0.05 - 0.10	23.5	7.9	30.2	29.6	91.1
0.10 - 0.20	19.7	8.3	38.5	25.4	91.8
0.20 - 0.30	18.0	9.0	33.9	32.3	93.3
0.30 - 0.60	19.1	9.7	35.0	32.1	95.9
0.60 - 0.90	22.0	13.3	33.0	28.8	97.0

**Table 83:** Plot 20 (EP44) Fantail Logging Area – a soil profile description based on a soil pit adjacent to the plot.

Horizon depth (m)	Description
0 to 0.03	Brown (7.5YR4/4); sandy clay loam; single grain; very weak; 20-50% 2-6mm angular, dispersed, quartz gravel; abundant roots; sharp smooth change to-
0.03 to 0.05	Strong brown (7.5YR4/6); clay loam; fine sandy; moderate 5-10mm subangular blocky; rough-ped fabric; moderately weak; 10-20% 2-6mm angular, dispersed, quartz gravel; many roots; abrupt smooth change to-
0.05 to 0.10	Yellowish red (5YR4/6); clay loam; fine sandy; moderate 5-10mm subangular blocky; rough-ped fabric; moderately weak; 10-20% 2-6mm angular, dispersed, quartz gravel; common roots; smooth change to-
0.10 to 0.30	Red (2.5YR4/6); sandy clay loam; weak 5-10mm subangular blocky; earthy fabric; moderately weak; 2-10% 2-6mm angular, dispersed, quartz gravel; common roots; clear smooth change to-
0.30 to 0.60	Red (2.5YR4/6); light medium clay; weak 10-20mm angular blocky; moderately firm; normal plasticity; 10-20% 2-6mm angular, dispersed, quartz gravel; few roots; gradual smooth change to-
0.60 to 0.90	Red (2.5YR4/6); light medium clay; weak 20-50mm angular blocky; rough-ped fabric; very firm; 10-20% 2-6mm angular, dispersed, quartz gravel; few roots; diffuse smooth change to-
0.90 to 1.80	Red (2.5YR4/6); light medium clay; weak 20-50mm angular blocky; rough-ped fabric; very firm; 10-20% 2-6mm angular, dispersed, quartz gravel; gradual smooth change to-
1.80 to 2.40	Red (2.5YR4/8); light medium clay; weak 20-50mm angular blocky; 10-20% 2-6mm angular, dispersed, quartz gravel.

**Table 84:** Plot 20 (EP44) Fantail Logging Area – soil chemical analysis data for soil samples collected from five random positions across the 0.5 ha plot. Analytical methods are detailed in the main text.

Depth (m)	Bulk density (Mg m <sup>-3</sup> )	pH 1:5			Org. C %	Tot. N %	Exchangeable cations				Acid H		Exch. acid.	Comp. CEC	Sum. CEC
		H <sub>2</sub> O	CaCl <sub>2</sub>	KCl			Ca	Mg	K	Na	Al	H			
							(cmol(+) kg <sup>-1</sup> )				(cmol(+) kg <sup>-1</sup> )		(cmol(+) kg <sup>-1</sup> )	(cmol(+) kg <sup>-1</sup> )	
0.00 - 0.05	1.10	4.4	4.0	4.0	10.4	-	1.50	2.42	0.51	0.24	0.78	0.82	1.60	4.90	6.27
0.05 - 0.10	1.10	4.4	4.2	4.2	5.37	-	0.27	0.80	0.26	0.14	0.58	0.41	0.99	3.80	2.46
0.10 - 0.20	1.21	4.6	4.3	4.3	3.86	-	0.10	0.57	0.16	0.12	0.52	0.34	0.86	2.80	1.81
0.20 - 0.30	1.21	4.2	4.1	4.5	2.31	-	0.10	0.24	0.06	0.05	0.38	0.17	0.55	2.50	1.00
0.30 - 0.60	1.34	4.5	4.2	4.5	1.37	-	0.08	0.17	0.04	0.05	0.72	0.00	0.72	2.30	1.06
0.60 - 0.90	1.43	4.6	4.2	4.4	1.03	-	0.07	0.15	0.04	0.06	0.77	0.05	0.82	1.70	1.14
0.09 - 1.20	1.43	4.5	4.2	-	0.91	-	0.07	0.22	0.04	0.06	0.60	0.06	0.66	-	1.05
1.20 - 1.50	-	4.6	4.2	-	0.70	-	0.07	0.43	0.03	0.04	0.40	0.04	0.44	-	1.01
1.50 - 1.80	-	4.6	4.2	-	0.55	-	0.07	0.55	0.05	0.04	0.34	0.06	0.40	-	1.11
1.80 - 2.10	-	4.6	4.3	-	0.36	-	0.07	0.57	0.05	0.04	0.22	0.00	0.22	-	0.95

**Table 85:** Plot 20 (EP44) Fantail Logging Area – soil bulk density and moisture characteristic data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Soil bulk density (Mg m <sup>-3</sup> )	Gravimetric moisture content (kg kg <sup>-1</sup> ) at various suction pressures							
		0 kPa	1 kPa	5 kPa	10 kPa	33 kPa	100 kPa	300 kPa	1500 kPa
0.05 - 0.10	1.103	0.484	0.472	0.426	0.404	0.364	0.337	0.204	0.211
0.18 - 0.23	1.204	0.405	0.396	0.340	0.318	0.292	0.275	0.214	0.212
0.45 - 0.50	1.342	0.325	0.314	0.285	0.269	0.284	0.243	0.202	0.187
0.80 - 0.85	1.445	0.274	0.266	0.239	0.225	0.211	0.201	0.197	0.193

**Table 86:** Plot 20 (EP44) Fantail Logging Area – soil hydraulic conductivity data for samples collected from a soil pit adjacent to the plot.

Depth (m)	Saturated hydraulic conductivity K <sub>s</sub> (mm minute <sup>-1</sup> )	Mean K <sub>s</sub> for depth interval (mm minute <sup>-1</sup> )
0.05 - 0.10	6.3	
0.05 - 0.10	0.7	
0.05 - 0.10	17.8	
0.05 - 0.10	21.8	<b>11.7</b>
0.18 - 0.23	1.4	
0.18 - 0.23	11.3	
0.18 - 0.23	6.6	
0.18 - 0.23	15.5	<b>8.7</b>
0.80 - 0.85	1.1	
0.80 - 0.85	19.3	<b>10.2</b>

**Table 87:** Plot 20 (EP44) Fantail Logging Area – soil particle size data for samples collected within the plot during the original soil survey bulked from 0.0 to 0.3 m depth (data from file records).

Sample location (Subplot corners)	Soil Register Number	pH	Sand %	Clay %	Silt %
ABEF	1179	4.7	57.71	33.8	3.45
CDGH	1180	4.9	71.89	22.48	5.62
KLOP	1181	4.6	57.91	35.54	6.55
GHJK	1182	4.6	62.44	30.04	7.51
IJMN	1183	4.5	60.64	33.73	5.62
Means		<b>4.7</b>	<b>62.1</b>	<b>31.1</b>	<b>5.8</b>

**Table 88:** Plot 20 (EP44) Fantail Logging Area – soil particle density data for samples collected from unknown locations at the plot.

Profile depth (m)	Sample depth (m)	Particle density (kg m <sup>-3</sup> )
<b>Position 1</b>		
0.20 – 0.30	0.18 – 0.23	2.54
0.30 – 0.60	0.45 – 0.50	2.56
0.60 – 0.90	0.90 – 0.85	2.47
<b>Position 2</b>		
0.20 – 0.30	0.18 – 0.23	2.59
0.60 – 0.90	0.90 – 0.85	2.48



## CNS-2000 MULTI FUNCTIONAL ANALYSER

### A. Beech

In brief, the CNS-2000 is a multi-functional analyser, which combines three inter-dependant modules. The Determinator unit houses the ballast tank, C, N and S detectors and a computer that is accessed by a touch sensitive screen. The Furnace unit combusts the samples in a sealed, temperature controlled combustion tube and the Autoloader can hold and process a maximum of 49 samples/standards for analysis at any one time.

The sample to be analysed is weighed into a ceramic boat and loaded into the purge block of the combustion furnace, which is then sealed and purged of all atmospheric gases. The boat containing the sample is then pushed into the 'hot spot' (1200°C for plant material or 1350°C for soils) of the horizontal tube furnace and combusted in an atmosphere of oxygen (UHP - 99.99%), which converts elemental carbon, nitrogen and sulphur into CO<sub>2</sub>, N<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub>. The combustion gases are collected into a ballast tank and equilibrated. An aliquot of the gas mixture is taken for nitrogen analysis. Using Helium as a carrier gas, it passes through a catalyst heater (Cu), which converts NO<sub>x</sub> to N<sub>2</sub>, before flowing through the TC (thermal conductivity) cell to determine N<sub>2</sub>. The remaining gas in the ballast tank is passed through two IR (infrared) cells to determine the carbon and sulphur content. The resulting values are calculated, using the weight of the sample, to give an answer in percentage (%) for each of the elements analysed.

## LABORATORY PROCEDURES FOR SOIL-WATER STUDIES

Notes by Ian S. Webb, dated 1983

### Objectives

The laboratory procedures described below are for measuring soil physical properties of importance in assessing the transmission and retention of water by soil and in identifying soil layers likely to form barriers to water movement and root growth.

The procedures given are for determining:

1. Saturated hydraulic conductivity of undisturbed cores,  $K_{sat}$ ;
2. The desorption soil moisture characteristic, the  $\Psi_{(\theta)}$  function; and
3. The bulk density of undisturbed soil cores.

These properties and functions are of fundamental importance in soil-water and soil-water-plant relationships. They are required for the routine prediction of profile available water holding capacity, estimation of the pore size distribution in soils, computation of the  $K_{(\theta)}$  function (the change in hydraulic conductivity,  $K$ , with volumetric water content,  $\theta$ ) and in soil water balance studies.

These laboratory determinations will be made on soil samples from the principal horizons of profile pits at the QRS tropical rainforest permanent plots.

## **Samples**

Two or three types of soil sample will be used in these procedures, namely vertical cores (50 mm high by 74 mm diameter), undisturbed fragments from the cores and air-dried, sieved (<2 mm) "fine earth". Four replicate cores are collected from each horizon in the field as soil heterogeneity is usually large. The methods for collection, transport, storage and handling of the core samples aim to minimise the disturbance of the natural soil by compaction, distortion, smearing, premature drying, biological activity and collection etc.

Procedures for procuring undisturbed cores in the field using a gun-driven ("Ramset") samples are given by McIntyre (1974). The gun-driven corer has been found to cause less disturbance to moist, soft-medium consistent soils than hammer-driven corers (McIntyre and Barrow 1971).

The methods given below apply to moist, stable soils. Other procedures are required for unstable or expansive soils. Cores with large channels (several millimetres in diameter) are unsuited to the laboratory determination of saturated hydraulic conductivity ( $K_{sat}$ ).

## **Equipment Required for Hydraulic Conductivity / Moisture Retention Tests**

- Plastic cover for low-tension plate. (c. 280 mm diameter by 150 mm high).
- Contact material, 5-50  $\mu\text{m}$ .
- Containers (with lids) for weighing core samples when wet.
- Sealant for edges of cores.
- Waterproof tape for joining brass cylinders.
- Cloth to go under cores for  $K_s$  test.
- 4 strips 1" x 1/8" x 10 1/2" (i.e. 25 x 3 x 267 mm) to support rack.

## **Laboratory Measurement of Saturated Hydraulic Conductivity ( $K_{sat}$ )**

For non-expanding soils estimation may be made in the laboratory of the saturated hydraulic conductivity of soil cores. The results obtained in the laboratory frequently do not correlate very closely with field measurements of hydraulic conductivity. However the field methods are not suited to routine measurements. The laboratory procedure is suitable for obtaining approximate values for  $K_s$ . High precision in the measurement is not normally justified.

Precautions should be taken to minimise disturbance to soil cores whilst sampling and transporting cores to the laboratory. In particular check for large pores artificially created at the wall of the cores. These can be sealed off with relatively impermeable material. Cores with large channels or holes where roots or stones have been pulled out in sampling should be rejected.

### ***Sample Preparation and Wetting***

Trim the cores at each end until level with the brass cylinder. If the surface has been smeared, pick it lightly with a sharp pointed instrument (the indentations on the lower surface will later be filled by contact material in the drainage tests). Attach a second cylinder to the (upper) non-bevelled edge with waterproof tape or wide elastic band. Place a 70 mm filter paper on the upper surface of the core. Place the core assembly on a 10 mm filter paper on a blotting-paper suction plate (Loveday 1974, A2-11, A2-12) and commence capillary wetting with the base of the core >50 mm (probably 100 mm, value missing from notes) above the

free water surface. After 2 days reduce the suction to 50 mm for 2 days, then to 0 mm until flooded. The water used should be freshly distilled or de-aired (Loveday, 1974, 4-57).

### **Measurement of Hydraulic Conductivity**

Allow water to pass up through core for several hours, removing water from the upper cylinder by suction (tube) as required, then measure the quantity of water passing through the core in a known period of time. No more than about 6 mm of water should be allowed to accumulate in the upper cylinder or the hydraulic head will be reduced too much. At suitable intervals remove the water from the upper ring into a measuring cylinder by suction and record the total volume of water collected,  $Q$ , in time,  $t$ . The hydraulic conductivity,  $K_{sat}$ , by this arrangement is given by:

$$K_{sat} = \frac{Q}{t} \cdot \frac{l}{\pi R^2 \Delta \phi}, \text{ from Darcy's Law,}$$

Where  $l$  is the length of the test sample,

$R$  is the radius of the core,

And  $\Delta \phi$  is the mean hydraulic head difference ( $\phi^2 - \phi^1$ ) (see Appendix 1 Figure 1).

(In this case,  $l$ , the length of the core, is a standard 50 mm, being length of the brass cylinders,  $R$ , the radius of the soil core, is a standard of 37 mm, and  $\Delta \phi$ , the average head difference, is a near-constant value of 37.5 mm in this apparatus.)

### **Moisture Retention by Soils (Undisturbed Cores) at Low Matric Potentials ( $\theta$ -1 to -10 kPa)**

The following method is used to determine the quantity of water retained by soils at matric potentials in the range -1 to -15 kPa (0.01 - 0.15 bar). Soil water in this range of low matric potentials is held in the larger pores, hence the need to use soil samples that are as far as possible undisturbed. For a well-drained soil, the water held at "field capacity", that is "the percentage of water remaining in the soil 2 or 3 days after having been saturated and after free drainage has practically ceased" (Rich, 1971), is commonly found to be in equilibrium with a matric potential of -5 to -10 kPa (0.05-0.10 bar).

The laboratory determination of moisture retention by soil in this low matric potential range uses undisturbed soil cores and the ceramic-epoxy suction plate with a hanging water column. Measurements will be made at matric potentials of -1.0, -5.0 and -10.0 kPa (water column suctions of 102, 510 and 1020 mm respectively). Some details of the equipment and procedures are given in Loveday (1974) and reference to the relevant paragraphs is given for each of the steps listed below.

Step		Equipment	Procedure
1.	Sample preparation.		4-14
2.	Wetting to saturation.	A2-11	4-6, A2-12, Note 1, 4-11, 4-13
3.	Weigh the (nearly) saturated core.		(4-60), Note 2
4.	Position the wetted core on the ceramic-epoxy plate connected to the hanging water column wetted contact material (4-55).	A2-5, A2-6	4-7, 4-22, Note 3
5.	Establish equilibrium with water columns of 102, 510 and 1020 mm successively.	A2-15, A2-20, Figure A2-5	4-22, 4-61, 4-62, (6-30)
6.	Weigh the wet soil and cylinder in a container (remove contact material first) after each equilibrium.		6-30 (3) (4) (6) (7)
7.	Continue moisture retention measurements on the cores on the "1-bar ceramic" plate for matric potentials in the range -15 to -100 kPa  OR		See methods sheets for intermediate range of matric potentials.
8.	Remove suitable soil fragments for the measurements at -33 and -100 kPa, and then determine the oven-dry weight of the soil. Subsequently the oven-dry weight of the fragments will be added this weight for the calculation required.		
9.	Calculate the gravimetric and volumetric water content of the soil at each matric potential.		6-30 (10), Note 4

**Note 1**

For those samples for which laboratory hydraulic conductivity ( $K_{sat}$ ) is to be measured, the wetting process will precede the conductivity measurements. After weighing for water content at (near) saturation the cores can be transferred directly to the ceramic-epoxy plate, retaining the saturated filter paper as contact material.

**Note 2**

Wipe excess water from the cylinder and immediately place in a container for weighing, with the minimum loss of water by drainage.

**Note 3**

Filter paper may be used as the contact material for the 102 mm suction but the silt-sized particulate material should be used at 510 mm and 1020 mm suctions.

**Note 4**

The measurements required are:

$M_1$  ( $M_5$ ,  $M_{10}$ ) = wet mass of soil of matric potential of -1 kPa (-5 kPa, -10 kPa).

$V_B$  = bulk volume at -10 kPa, for non-expensive soils this will be very close to the volume of the cylinder (= 0.215 l).

$M_S$  = mass of oven-dry soil (final measurement on core)

## Moisture Retention by Soils (Undisturbed Fragments or Cores) at Intermediate Matric Potentials ( $\theta_{-10}$ to $\theta_{-100}$ kPa)

The following methods are used to determine the quantity of water retained by soils at matric potentials in the range -15 to -100 kPa (0.15-1.0 bar). In general, soil water held between -10 and -100 kPa matric potential (0.1-1.0 bar) is considered to be readily available to plant roots in humid regions. Soil cores can be used for the intermediate range, but equilibrium times are rather long due to the height of the samples. Although more difficult to handle, quicker results should be obtained using relatively undisturbed fragments of soils.

The method given below for the use of core samples. Measurements will be made at -33 and -100 kPa pressure on the "1-bar ceramic" plate in the pressure chamber. Some details of the necessary equipment and procedures are given in Loveday (1974) and reference is made to the relevant paragraphs for the steps listed below:

Step		Equipment	Procedure
1.	Wetting.		Note 1, 4 – 24
2.	Positioning of the wetted sample on the "1 bar ceramic" plate.	4-21, A2-5, A2-6, A2-24 to A2-27, A2-30	4-24
3.	Establishment of equilibrium with gas pressures of 33 and 100 kPa (4.8 and 14.5 psi).	4-21(2)	4-24, Note 2
4.	Weighing of the equilibrated cores.		6-30 (3) (4) (6) (7)
5.	Determination of the oven-dry weight of soil.	4-25	4-26, 6-30 (9)
6.	Calculation of the soil bulk density and volumetric water contents at matric potentials of -33 and -100 kPa.		6-30 (10), Note 3

### Note 1

For stable soils handled carefully the same set of cores used in the measurements at low suctions can be equilibrated on the "1-bar ceramic" plate, adding fresh wet contact material on the base of the core after each weighing (Loveday 1974, para. 6-30(6) and (7)). In this case no further wetting is required as measurements are made at successively higher matric potentials.

Alternatively wet the cores or fragments by capillary wetting (see Loveday, 1974, sections 4-6, 4-9, 4-11, 4-13, 4-14, 4-57, 4-58).

### Note 2

Equilibrium time on pressure plates will vary markedly with pressure and height of sample. Cores and fragments with reasonable structure may take up to 7 days. The temperature of the equipment should be held reasonably constant.

### Note 3

The measurements required are:

$M_{33}$  = wet mass of soil at matric potential of -33 kPa (= gross mass of wet soil, brass cylinder, weighing container etc less mass of brass cylinder, weighing container, etc.).

$M_{100}$  = wet mass of soil at matric potential of -100 kPa.

$V_B$  = bulk volume at -10 kPa: for non-expansive soils this will be very close to the volume of the cylinder (= 0.215 l).

$M_S$  = mass of oven-dried soil (mass of solids)

### Moisture Retention by Soil (Fine Earth) at High Matric Potentials ( $\theta_{-1500 \text{ kPa}}$ )

The following method is used to determine the quality of water retained by soils at matric potentials in the range -200 to -1500 kPa (2-15 bar). Soil water in this range is held by very fine pores and is little affected by changes in structure. In order to keep equilibrium times for drainage tolerably short it is convenient to use "fine earth" (air dried soil less than 2 mm) or small fragments (less than 5 mm high). Numerous studies have shown that moisture held at matric potentials in excess of 1500 kPa is unavailable to most plants. The permanent wilting percentage of many soils is closely matched by the moisture retained by soil samples equilibrated in a pressure chamber with an applied pressure of 1500 kPa (15 bar).

Measurements will be made at matric potentials of -300 and -1500 kPa (3 and 15 bar) on a "15-bar ceramic" plate in the pressure chamber. Fresh samples of "fine earth" are used at each pressure. The procedure (following Loveday 1974) is as follows:

Step	Procedure
1.	Wetting directly on pressure plate. 4-47, 6-32, 6-22, A2-24, A2-26, 4-52, 4-63, A2-28, A2-29, 4-52, A2-30, Note 1
2.	Draining. 4-52, 4-63, A2-28, A2-29
3.	Establish equilibrium. 4-52, A2-30, Note 1
4.	Release pressure, weigh moist soil. 6-32 (5)
5.	Oven-dry soil and re-weigh when cool. 6-32(5)
6.	Calculation the gravimetric and volumetric water content of the soil at each matric potential. 6-22(7), Note 2

#### Note 1

If air dried fine earth 2 cm deep is used at 300 kPa and 7-10mm air-dried fine earth at 1500 kPa, equilibrium times will generally be in the range 4-7 days.

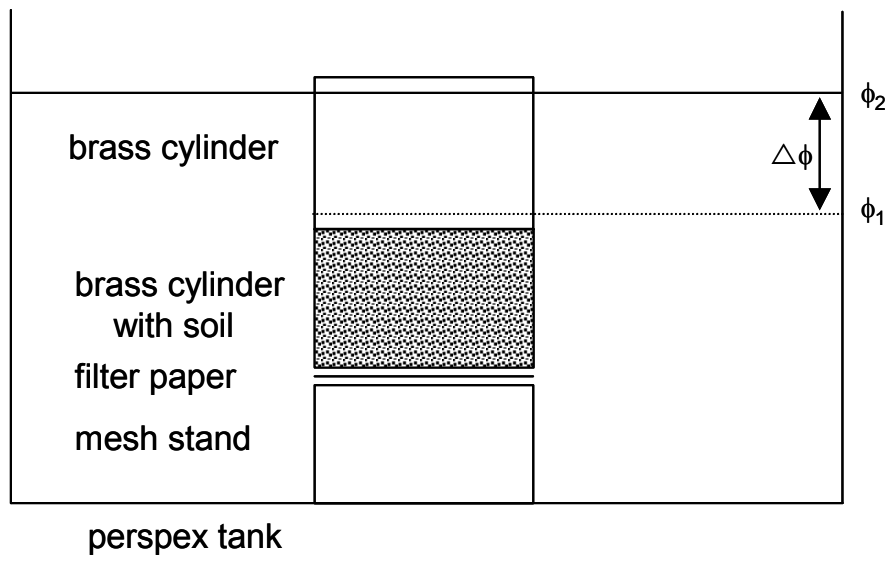
#### Note 2

The measurements required are:

$M_{300}$  ( $M_{1500}$ ) = wet mass of soil at matric potential of -300 kPa (-1500 kPa).

$M_S$  = mass of oven-dried soil.

$D_B$  = bulk density (at -10 kPa).



**Figure 1:** A diagrammatic representation of the apparatus used in Saturated Hydraulic Conductivity  $K_S$  determinations in the laboratory at Atherton for soils of the CSIRO Permanent Plots.