

## COMMON SOILS WITHIN THE MOOLORT LANDCARE GROUP AREA



**COMMON SOILS WITHIN THE  
MOOLORT LANDCARE GROUP AREA**

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## 1. INTRODUCTION

### 1.1 Study Rationale

In late 1991 the 'Moolort LandCare Group' (MLG) approached the Landcare Planning Support Section of the then Department of Conservation and Environment and requested support in mapping and describing the major soil types in their area. The group were intending to use this information to improve the management of their land and so increase productivity and reduce degradation.

### 1.2 Location of the study area

The MLG is situated in North central Victoria, approximately 125 km north-west of Melbourne and 6 km east of the City of Maryborough (refer Figure 1). It is approximately 200 km<sup>2</sup> in size and is bounded on the eastern flank by the Loddon River and the western flank by Tullaroop/Deep Creek (refer Figure 2).



Figure 1. Location of the Moolort LandCare Group

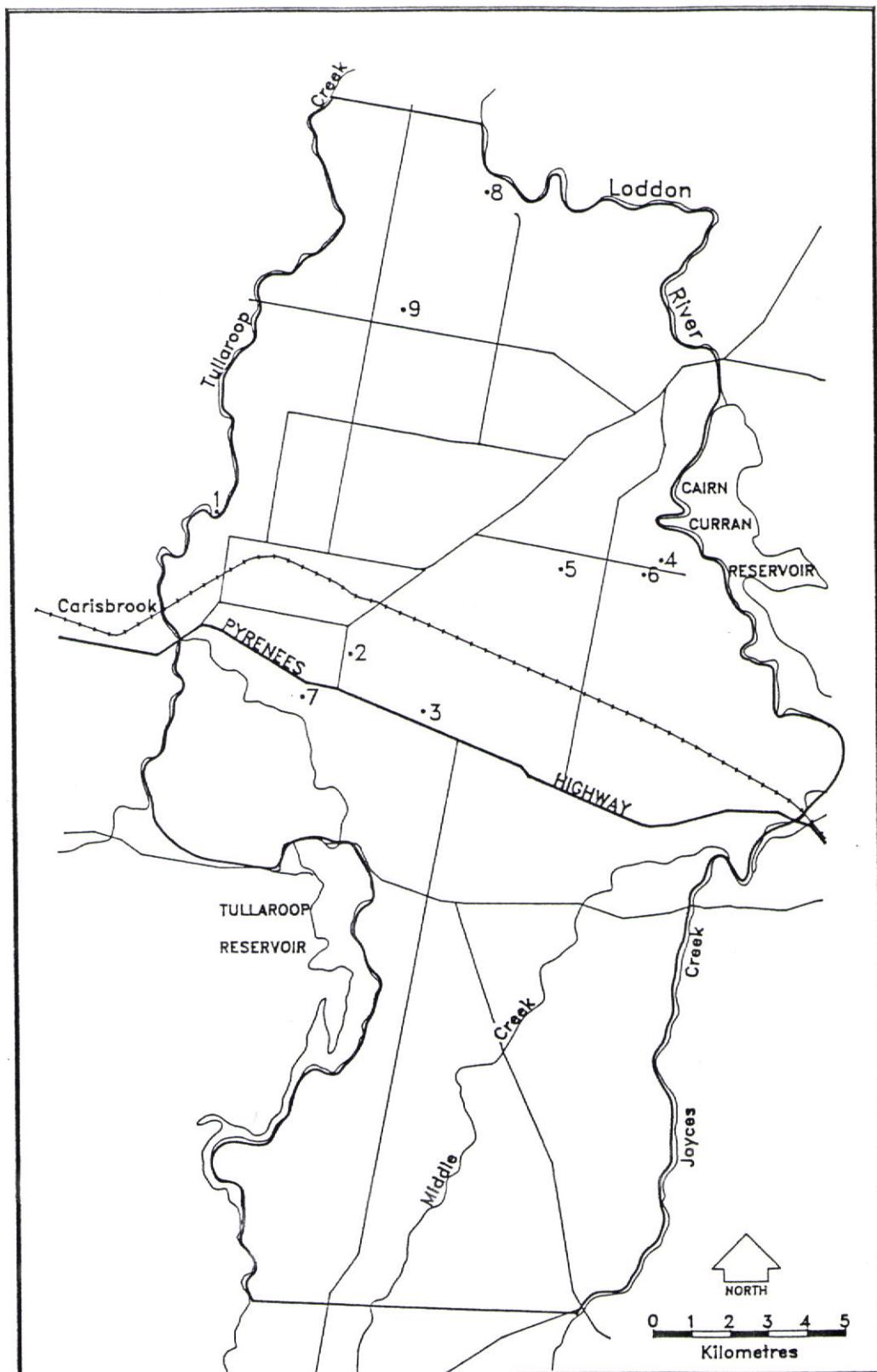


Figure 2. The Moolort LandCare Group area and site locations

### 1.3 Objectives

The broad objective of this study is to provide land and soil information to the Moolort LandCare Group that will assist in the management of their land and so increase productivity and reduce degradation.

Specific objectives:

- i) Assist landowners in describing and understanding the soils on their properties.
- ii) Conduct detailed laboratory and field analyses on the common soil types.
- iii) Produce a booklet describing the common soil types.

## 2. GENERAL CHARACTERISTICS OF THE MOOLORT LANDCARE GROUP AREA

The majority of the information in this section has been taken from Schocknecht, N.R. (1988). *Land inventory of the Loddon River catchment*. Land Protection Division. Department of Conservation, Forests and Lands, Victoria.

### 2.1 Geology and Physiography

The MLG is situated in the original Loddon River Valley which was filled with a basalt flow, in the Quaternary Period, that caused the River to move towards the East. Consequently the geology of the MLG area is essentially Quaternary olivine basalt overlying Ordovician sandstone and shale, which outcrops intermittently, and old river beds which are now known as deep leads. A range of metamorphosed Ordovician sedimentary rock occurs in the north east adjacent to Lake Cairn Curran. The Riverine Plain, which extends to the Murray River, exists in the very north of the study area.

The basalt plain is gently undulating with common slopes between 1 and 3%. The southern third of the study area is characterised by numerous areas of relatively poor drainage and heavy dark soils. The remainder of the area is better drained and generally featureless except for occasional rock outcrops and swamps. Two volcanic hills occur in the area; Bald Hill and Sheoak Hill. Both are extinct eruption points.

### 2.2 Climate

The MLG lies in a slight rainfall shadow that is associated with the Loddon River valley. The southern parts receive approximately 540 mm/year while the very north, 470 mm/year. The wettest months are June and August.

Average daily maximum temperatures in Maryborough range between 29.3°C (January) to 12°C (July) and average minimums between 14°C (February) and 2.9°C (July). Plant growth generally ceases when temperatures drop below 6°C. These temperatures occur in the months of May through to September.

### 2.3 Vegetation

The original vegetation of the MLG area has been mostly cleared, although naturally the structural form was likely open woodlands and grasslands with scattered trees. The species are predominantly Buloke and Grey Box with some Yellow Box. River Red Gum lines the watercourses and swamps.

## 2.4 Land use

The MLG area on the basalt plains is generally regarded as high quality agricultural land. The dominant land use is broadacre cropping in rotation with sheep grazing. Minor land uses include beef production and irrigated lucerne.

## 2.5 Land degradation

The major form of land degradation currently in the MLG area is dryland salinity which is occurring in the low lying swamps and drainage courses. This is generally the result of saline discharge occurring in underlying Ordovician bedrock which is close to, or at the soil surface (P. Kevin, pers. comm.).

Sheet erosion is likely on many cropping soils due to the dispersive nature of the top soils.

## 3. GENERAL METHODOLOGY

Initially a pilot group was selected from within the whole LandCare group to work through the mapping exercise. Members were asked to prepare a plan of their own properties which included features such as rock outcrop, swampy depressions and slopes as well as soil types. These maps were all collated and discussed as a group. From this discussion and a field trip it was determined that nine major soil types were reoccurring throughout the area.

A representative and undisturbed site was selected for each soil type (see Figure 2 for location of sites) and a pit dug with a backhoe at each down to 1.5 m or bedrock. Soil profiles were then described in detail and samples collected for full physical and chemical analyses. Hydraulic conductivity properties of the soil profiles were measured using the 'Double ring infiltration' method.

The results, including soil characteristics and interpreted limitations of each soil type, were presented to the entire LandCare group. Discussions were held on the practical performance of each of the soils in agriculture and their possible future management. It was decided that the soils studied were a good representation of the major soil types in the area.

## 4. DETAILED SOIL AND SITE DESCRIPTIONS

Nine major soil types were identified in the study area. Each soil type and its associated landscape has been described in a two page format.

The results presented are site specific but can be extrapolated to represent similar soils and landscapes throughout the MLG.

Site 1: Alluvium, terrace (Deep Creek)

Location: J.Williamson

Occurrence: Uncommon

**General Description:** A narrow terrace associated with the Deep/Tullaroop Creek, formed as a result of overbank flow and deposition. Formation is relatively recent as indicated by the two distinct layers of material representing two periods of flooding which have undergone little profile development. The soils of the top layer are structureless pale brown sandy clay loams and loams and the bottom layer weakly structured black clays.

### Site characteristics:

Slope common: range:	1% 0-2%	Depth seasonal watertable:	> 2 m
Rock outcrop:	0%	Potential recharge to groundwater:	Low
Depth to hardrock:	> 2 m	Drainage:	Well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
	Sheet/rill	Gully			
Susceptibility	Low	Moderate	Low	High	Moderate
Incidence	Low	Low	Low	Moderate	Low

### Soil profile characteristics:

Permeability: Rapid	(average 879 mm/day, range 416 - 1 667 mm/day)
Water storage capacity for plant growth:	Very high (257 mm H <sub>2</sub> O)
Shrink/swell (B horizon):	Low (9.5%)

### \* Interpretation of soil analyses

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
1A	4.5 **	< 1	VL	L	S	S	S	H	M
1C1	5.8	< 1	VL	L	D	D	S	VL	M
1C2	6.1	< 1	VL	L	D	D	S	VL	M
2B1	6.0	< 1	VL	H	S	D	S	VH	M
2B2	6.2	< 1	VL	H	S	D	S	L	M

VL : Very Low; L : Low; M : Moderate; H : High;

VH : Very High; D : Deficient; S : Satisfactory; T : Toxic;

\*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



- 1A 0 - 18cm Pale brown fine sandy clay loam, structureless, high organic matter content, pH 4.5
- 1C1 18 - 45cm Pale brown sandy loam, structureless, pH 5.8
- 1C2 45 - 72cm Very pale brown silty loam, structureless, pH 6.1
- 2B1 72 - 103cm Black light clay, weak structure, pH 6.0
- 2B2 103cm+ Black medium clay, weak structure, pH 6.2

Pale brown fine sandy loam and sandy loam over black clay  
(Factual Key Uc/Uf6.11)

### **Favourable attributes:**

Deep profile, good water storage, deep top soil

### **Limitations for agriculture:**

Dispersive top soil, lack of structure, low nutrient status in topsoil

### **Comments from landholders:**

- Erodes when cultivated

### **Suggested management:**

- Lime to increase pH
- Fertilizers to increase nutrient status
- Direct drilling/minimum tillage and stubble retention to protect topsoil from erosion
- Gypsum to reduce dispersion of topsoil

## Site 2: Basalt cone, gentle slope

Location: B. Hurse

Occurrence: Uncommon

**General Description:** The eastern facing side slopes of the basalt cone, Bald Hill. A well drained, well structured deep soil that has a gradual increase in clay content with depth. Calcium carbonate nodules occur deep in the profile. The low pH in the top soil at this particular site has probably been caused by the presence of cypress trees. This soil is highly susceptible to sheet erosion.

### Site characteristics:

Slope common: range:	7 % 5 - 9 %	Depth seasonal watertable:	> 10 m
Rock outcrop:	< 2 %	Potential recharge to groundwater:	High
Depth to hardrock:	> 1.5 m	Drainage:	Well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
Susceptibility	Moderate	Low	Very low	Very low	Low
Incidence	Moderate	Very low	Very low	Nil	Low

### Soil profile characteristics:

Permeability: Rapid	(average 561 mm/day, range 275 - 1 000 mm/day)		
Water storage capacity for plant growth:	High	(260 mm H <sub>2</sub> O)	
Shrink/swell (B horizon):	Low	(9.5 %)	

### Interpretation of soil analyses \*

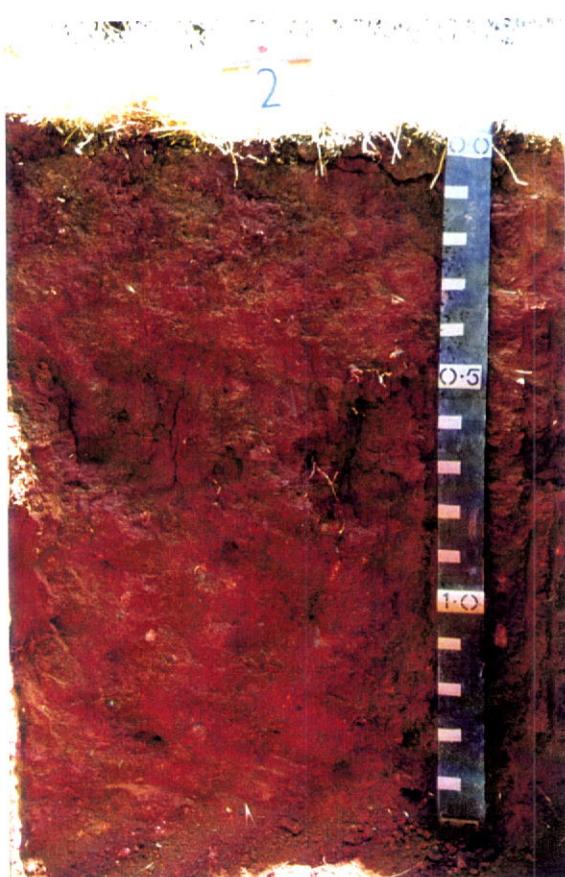
Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	Al	Organic matter	Dispersibility
A	4.4**	2.3	VL	M	S	S	T	H	M
B21	4.7	1.5	VL	M	S	S	T	VL	M
B22	7.1	< 1	VL	VH	D	S	S	VL	VH
B3	8.0	12.5	VL	VH	D	S	S	VL	VH

VL : Very Low; L : Low; M : Moderate; H : High;

VH : Very High; D : Deficient; S : Satisfactory; T : Toxic; \*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A	0 - 22cm	Dark reddish brown light clay, moderately structured, very few basalt fragments, high organic matter, pH 4.4
B21	22 - 46cm	Reddish brown medium clay, weakly structured, few basalt fragments, pH 4.7
B22	46 - 97cm	Yellowish red heavy clay, strongly structured, pH 7.1
BC	97 - 150cm+	Dark reddish brown medium-heavy clay, strongly structured, common calcium carbonate nodules, pH 8.0

Red, structured, gradational soil  
(Factual Key Gn3.13)

### **Favourable attributes:**

Deep profile, structured top soil, good water storage, moderate nutrient status in top soil

### **Limitations for agriculture:**

Dispersive top soil, moderately susceptible to sheet erosion, rapid permeability so requires good rainfall, aluminium toxicity (lucerne very susceptible)

### **Comments from landholders:**

- Needs high rainfall to produce high crop yields, very susceptible to erosion under cultivation

### **Suggested management:**

- Direct drilling to maintain organic matter cover and topsoil structure and so reduce runoff and erosion and increase water retention
- Apply lime to increase pH and to reduce aluminium content for plants such as lucerne, perhaps best suited to phalaris
- Gypsum to reduce dispersion in topsoil.

<b>Site 3: Basalt, very gentle slope</b>	<b>Location:</b> B. Hurse
	<b>Occurrence:</b> Common

**General Description:** A gently sloping grey cracking heavy clay that forms a gilgai complex (lumps & hollows) through shrinking and expanding with moisture variation. Is poorly drained when wet. Usually found in the lower parts of the landscape.

### Site characteristics:

Slope common: range:	3% 1 - 4%	Depth seasonal watertable: 5m
Rock outcrop:	0%	Potential recharge to groundwater: Low
Depth to hardrock:	> 1.5m	Drainage: Poorly drained

Land degradation:		Water erosion		Wind erosion	Salting	Acidification
Susceptibility	Incidence	Sheet/rill	Gully			
Moderate	Low	Low	Very low	Very low	Moderate	Low
Very low	Very low	Very low	Very low	Very low	Very low	Low

### Soil profile characteristics:

Permeability: Slow	(Average 15 mm/day, range 0 - 45 mm/day)
Water storage capacity for plant growth:	Very high (260 mm H <sub>2</sub> O)
Shrink/swell (B horizon):	Medium (16.5%)

### Interpretation of soil analyses \*

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
A1	4.9	<1.0	VL	H	D	S	S	H	M
A2	5.3	1.5	VL	M	D	S	S	L	M
B21	7.0	<1.0	VL	VH	D	S	S	L	H
B22	7.8	4.4	L	VH	D	S	S	VL	L

VL : Very Low;

L : Low;

M : Moderate;

H : High;

VH : Very High;

D : Deficient;

S : Satisfactory;

T : Toxic;

\*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



- A1 0 - 7 cm Grey heavy clay, strongly structured, self mulching, cracking, high organic matter, pH 4.9
- A2 7 - 19 cm Grey medium clay, structureless, cracking, pH 5.3
- B21 19 - 75 cm Dark grey heavy clay, strongly structured, cracking, common basalt gravel, pH 7.0
- B22 75 - 142 cm Light brownish grey heavy clay, weakly structured, cracking, common basalt gravel, common calcium carbonate nodules, pH 7.8

Grey, cracking, self mulching heavy clay  
(Factual Key Ug4)

### **Favourable attributes:**

Topsoil is strongly structured and has a high nutrient status, good water storage, good relationship between permeability and average rainfall - suited to climate, deep profile.

### **Limitations for agriculture:**

Shallow and dispersive topsoil, susceptible to sheet erosion particularly when sloping, is sometimes rocky, slow permeability so could become waterlogged with heavy rain.

### **Comments from landholders:**

- High production in most years, yet can have problems with waterlogging which effects plant growth and cultivation timing.
- In pasture phase best suited to perennials, ie. lucerne.
- Can withstand longer cropping rotations.

### **Suggested management:**

- Direct drilling to make use of optimum time of sowing
- Stubble retention and direct drilling to minimise dispersion in topsoil
- Apply gypsum to reduce dispersion in topsoil.

## Site 4: Basalt, gentle crest

Location: J. Bryant

Occurrence: Common

**General Description:** Gentle, non rocky basalt crests. These soils are red duplex with hardsetting topsoils, bleached A2 horizons with many ironstone fragments (buckshot) and mottled subsoils. At this specific site, which has not been cultivated, worm tubules are common. Calcium carbonate nodules occur at depth.

### Site characteristics:

Slope common: 0%	Depth seasonal watertable: 5 - 10m
range: 0 - 2%	
Rock outcrop: 0%	Potential recharge to groundwater: Low/moderate
Depth to hardrock: > 1.5m	Drainage: Moderately well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
	Sheet/rill	Gully			
Susceptibility	Low	Low	Low	Very low	High
Incidence	Low	Very low	Low	Nil	Low

### Soil profile characteristics:

Permeability: Moderate (Average 187 mm/day, range 1 - 284 mm/day)
Water storage capacity for plant growth: Very high (264 mm H <sub>2</sub> O)
Shrink/swell (B horizon): Medium (15.5%)

### Interpretation of soil analyses \*

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
A1	4.8	30.1	VL	M	D	S	S	VH	M
A2	4.8	40.9	VL	M	D	S	S	L	M
B21	6.7	7.6	VL	H	D	S	S	VL	H
B22	8.3	9.2	VL	VH	D	S	S	VL	VH
B23	8.5	16.2	VL	VH	D	S	S	VL	M

VL : Very Low;

L : Low;

M : Moderate;

H : High;

VH : Very High;

D : Deficient;

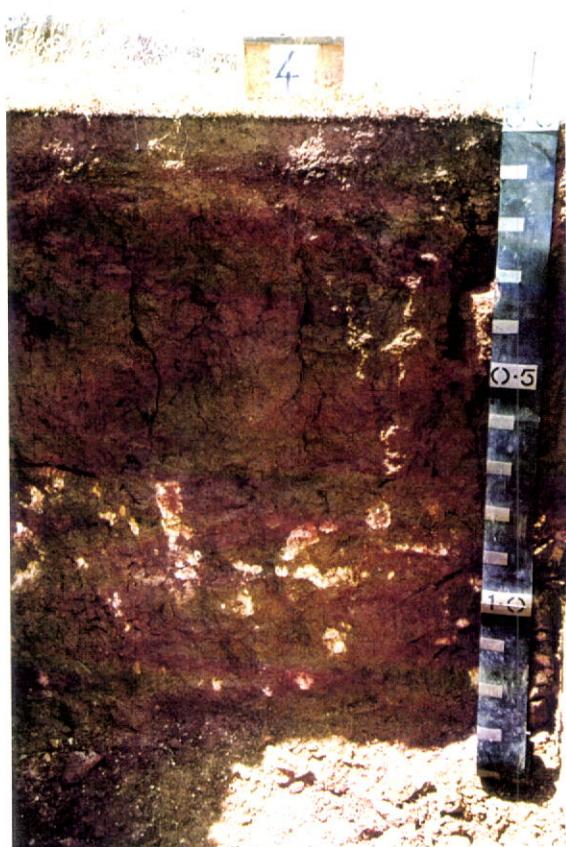
S : Satisfactory;

T : Toxic;

\*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A1 0 - 7 cm Dark brown clay loam, structureless, many ironstone gravel fragments (buckshot), very high organic matter, pH 4.8

A2 7 - 17 cm Bleached hardsetting light medium clay, structureless, many ironstone gravel fragments, pH 4.8

B21 17 - 43 cm Reddish brown heavy clay, moderately structured, a few worm tubules, common ironstone gravel fragments, pH 6.7

B22 43 - 81 cm Yellowish red heavy clay with common mottles, moderately structured, common worm tubules, a few ironstone gravel fragments, pH 8.3

B23 81 - 137 cm Light yellowish brown medium heavy clay, weakly structured, many worm tubules and calcium carbonate nodules, pH 8.5.

Mottled, red duplex soil with a hardsetting topsoil and bleached gravelly A2 horizon  
(Factual Key Dr 3.43)

### **Favourable attributes:**

Moderate nutrient status in topsoil, deep profile, good water storage, soil permeability rate suited to average rainfall.

### **Limitations for agriculture:**

Shallow structureless and dispersive top soil, high gravel (buckshot) content in topsoil and in bleached horizon, impermeable layer at the top of the subsoil.

### **Comments from landholders:**

- Suited to deep rooted crops and perennial pasture plants ie. lucerne, safflower and canola.
- Cultivation exacerbates hard impermeable layer at the top of the subsoil
- Waterlogging sometimes occurs in topsoil because of impermeable layer

### **Suggested management:**

- Favour deep rooted pastures and crops
- Deep rooted species will break open impermeable layer and access high nutrient status in subsoil, deep ripping will also break impermeable layer.
- Direct drilling/minimum tillage and stubble retention to protect topsoil from erosion
- Gypsum application to reduce dispersion in topsoil

## Site 5: Sedimentary, gentle crest

Location: G. Michelson

Occurrence: Uncommon

**General Description:** A gentle sedimentary crest outcropping in the basalt plain. The soils are shallow red duplex. Quartz fragments are found within the soil profile and on the surface. Water permeability is slightly impeded as indicated by the bleached horizon and mottled subsoil, but infiltration into the underlying bed rock is still high due to the shallow soil profile.

### Site characteristics:

Slope common: 1%	Depth seasonal watertable: 5 m
range: 0 - 2%	
Rock outcrop: 0%	Potential recharge to groundwater: High
Depth to hardrock: 0.7 m	Drainage: Well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
	Sheet/rill	Gully			
Susceptibility	Low	Moderate	Low	Low	High
Incidence	Low	Very low	Low	Nil	Low

### Soil profile characteristics:

Permeability: Moderate (Average 268 mm/day, range 5 - 500 mm/day)
Water storage capacity for plant growth: Low (93 mm H <sub>2</sub> O)
Shrink/swell (B horizon): Low (10.5%)

### Interpretation of soil analyses\*

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	Al	Organic matter	Dispersibility
A1	5.1	3.1	VL	L	D	S	S	VH	M
A2	5.1	27.4	VL	VL	D	S	S	L	M
B21	6.2	1.7	VL	M	D	S	S	L	M
B22	6.0	3.4	VL	M	D	S	S	VL	VH

VL : Very Low;

L : Low;

M : Moderate;

H : High;

VH : Very High; D : Deficient; S : Satisfactory; T : Toxic; \*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A1	0 - 11cm	Reddish brown fine sandy clay loam, structureless, very high organic matter, pH 5.1
A2	11 - 21cm	Bleached fine sandy clay loam, structureless, hardsetting, common quartz fragments, pH 5.1
B21	21 - 37cm	Dark reddish brown heavy clay with many faint brown mottles, strongly structured, pH 6.2
B22	37 - 62cm	Reddish brown heavy clay with common brown mottles, strongly structured, a few quartz fragments, pH 6.0
C	62cm	Rock

Mottled red duplex soil with a hardsetting topsoil, a bleached A2 horizon and a structured subsoil  
(Factual Key Dr3.42)

### **Favourable attributes:**

Good relationship between permeability and rainfall

### **Limitations for agriculture:**

Shallow profile, low water storage, dispersive topsoil, structureless topsoil, low nutrient status in topsoil.

### **Comments from landholders:**

- Topsoil compacts and runoff is high on side slopes
- Low nutrient status
- Problems with salting on lower slopes.

### **Suggested management:**

- Minimum tillage/direct drilling
- Fertilizers and stubble retention to protect erodible topsoil
- Apply gypsum to reduce dispersion in the topsoil

**Site 6: Basalt, rock outcrop**

**Location: J. Bryant**

**Occurrence: Common**

**General Description:** The soils associated with rock outcrop on the very gentle basalt slopes are variable. Often the rocks are only floaters with moderately deep red duplex soils beneath. One of these profiles has been described below. Other outcrops, such as occur on Sheoak Hill and in rocky seams, have shallow red loamy soils. Grey cracking soils described in site 3, can also be associated with rock.

### Site characteristics:

Slope common: 2%	1 - 5%	Depth seasonal watertable: 5 - 10m
Potential recharge to groundwater: High		
Rock outcrop: 20%		
Depth to hardrock: > 1 m		Drainage: Well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
	Sheet/rill	Gully			
Susceptibility	Moderate	Low	Very low	Low	Moderate
Incidence	Low	Very low	Very low	Nil	Low

### Soil profile characteristics:

Permeability: Moderate (Average 320 mm/day, range 233 - 379 mm/day)
Water storage capacity for plant growth: High (163 mm H <sub>2</sub> O)
Shrink/swell (B horizon): Moderate (14 %)

### Interpretation of soil analyses\*

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
A1	4.7	15.7	VL	M	D	S	S	H	M
B21	5.2	2.8	VL	M	D	S	S	L	M
B22	5.9	2.4	VL	H	D	S	S	VL	M
B23	6.5	0.7	VL	H	D	S	S	VL	VH

VL : Very Low;

L : Low;

M : Moderate;

H : High;

T : Toxic;

\*\* : Strongly Acidic

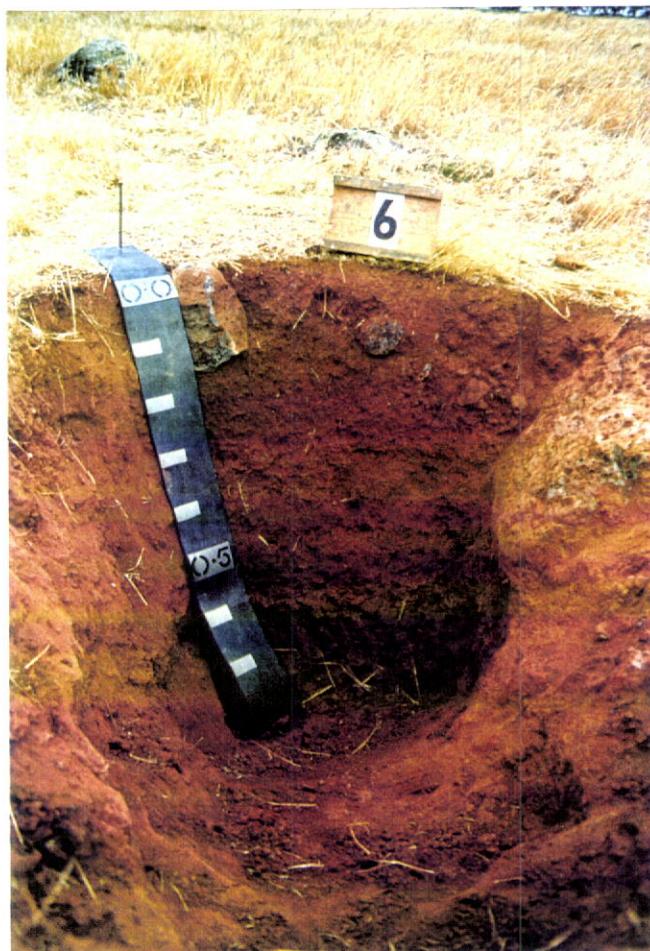
VH : Very High;

D : Deficient;

S : Satisfactory;

\* See Appendix 1 for analytical results

## Soil Profile



A 0 - 12cm Reddish brown clay loam, structureless, many basalt fragments, high organic matter, high iron content, pH 4.7

B21 12 - 36cm Dark red medium clay strongly structured, common basalt fragments, high iron content, pH 6.0

B22 36 - 59cm Brownish yellow medium - heavy clay with abundant red mottles, strongly structured, a few basalt fragments, high iron content, pH 5.9

B23 59cm+ Greyish brown heavy clay with abundant brownish yellow and dark red mottles, moderately structured, high iron content pH 6.5

Mottled red duplex soil with a hardsetting topsoil and strongly structured subsoil  
(Factual Key Dr3.12)

### **Favourable attributes:**

Moderate nutrient status in topsoil, good water storage, good permeability/rainfall relationship.

### **Limitations for agriculture:**

Structureless and dispersive topsoil, rock outcrop

### **Comments from landholders:**

- Well drained
- Lack of water in dry years
- More productive than 'buckshot' country
- Rock outcrop restricts crop establishment

### **Suggested management:**

- Minimum tillage and stubble retention to protect topsoils
- Gypsum application to reduce dispersion in topsoils

## Site 7: Basalt cone, very gentle slope

Location: Quarry

Occurrence: Uncommon

**General Description:** An outwash fan on the southern slopes of the basalt cone, Bald Hill. The soils are deep red duplex with hardsetting topsoils and calcium carbonate nodules deep in the profile. The soils are similar to those on the gentle crests and slopes (sites 4 and 9) but are more permeable and better drained. Nutrient status is high in the subsoil but low in the A2 horizon.

### Site characteristics:

Slope common: range:	3% 2 - 4%	Depth seasonal watertable:	> 10 m
Rock outcrop:	0%	Potential recharge to groundwater:	High
Depth to hardrock:	1.8 m	Drainage:	Well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
	Sheet/rill	Gully			
Susceptibility	Low	Low	Moderate	Very low	High
Incidence	Low	Very low	Low	Nil	Low

### Soil profile characteristics:

Permeability: Moderate (Average 318 mm/day, range 85 - 539 mm/day)
Water storage capacity for plant growth: Very high (254 mm H <sub>2</sub> O)
Shrink/swell (B horizon): Medium (16.5 %)

### Interpretation of soil analyses \*

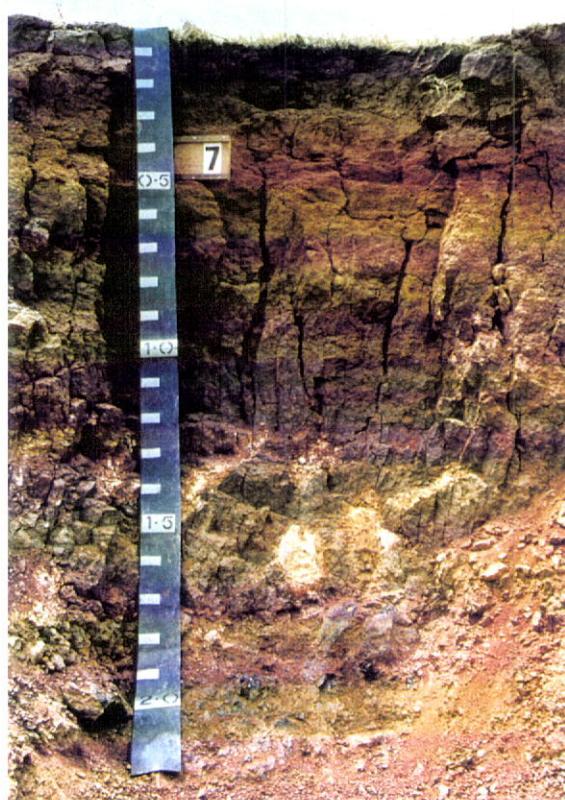
Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
A1	6.7	24.6	VL	M	S	S	S	H	M
A2	5.6	16.6	VL	L	D	S	S	L	M
B21	6.0	< 1.0	VL	H	D	S	S	VL	M
B22	6.8	1.7	VL	H	D	S	S	VL	VH
B23	8.3	12.2	VL	VH	D	S	S	VL	VH

VL : Very Low; L : Low; M : Moderate; H : High;

VH : Very High; D : Deficient; S : Satisfactory; T : Toxic; \*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A1	0 - 2cm	Dark brown loam fine sandy, moderately structured, many ironstone fragments (buckshot), high organic matter, pH 6.7
A2	2 - 25cm	Reddish brown hardsetting clay loam, structureless, abundant ironstone, pH 5.6
B21	25 - 58cm	Red light medium clay with a few yellow mottles, moderately structured, a few ironstone fragments, pH 6.0
B22	58-122cm	Yellowish brown medium clay with common red mottles, strongly structured, pH 6.8
B23	122 - 184cm	Yellowish brown light clay with a few yellow mottles, strongly structured, abundant calcium carbonate nodules, pH 8.3
C	184cm +	

Mottled red duplex soil with a hardsetting topsoil, a structured subsoil and calcium carbonate nodules at depth.  
(Factual Key Dr3.23)

### Favourable attributes:

Strongly structured red topsoil with a moderate nutrient status, deep profile, good water storage, good relationship between permeability and rainfall.

### Limitations for agriculture:

Very shallow topsoil, dispersive topsoil, moderate gravel content in topsoil, low nutrient status in A2 horizon.

### Comments from landholders:

- Good under irrigation because permeable, particularly lucerne

### Suggested management:

- Deep rooted perennials and crops, will access nutrients and calcium carbonate in subsoil
- Deep rooted perennials and direct drilling will protect shallow topsoil
- Gypsum to reduce dispersion

Site 8: Alluvium, plain

Location: B &amp; A Dixon

Occurrence: Uncommon

**General Description:** The Riverine plain that occurs in the north of the study area and continues to the Murray River. The soils are red duplex with hardsetting topsoils, a bleached A2 horizon that is low in nutrients and a highly dispersive horizon in the top of the subsoil which becomes soupy quickly with water.

### Site characteristics:

Slope common: range:	0% 0 - 1%	Depth seasonal watertable:	5 m
Rock outcrop:	0%	Potential recharge to groundwater:	Low
Depth to hardrock:	> 2 m	Drainage:	Moderately well drained

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
Susceptibility	Sheet/rill	Gully			
Incidence	Very low	Moderate	High	Moderate	Low
	Very low	Very low	Low	Nil	Low

### Soil profile characteristics:

Permeability: Slow	(Average 10 mm/day, range 0 - 17 mm/day)
Water storage capacity for plant growth:	High (187 mm H <sub>2</sub> O)
Shrink/swell (B horizon):	Low (7.5 %)

### Interpretation of soil analyses\*

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	Al	Organic matter	Dispersibility
A1	4.3**	3.2	VL	L	S	S	T	VH	M
A2	4.6	<1.0	VL	VL	S	S	T	VL	M
B21	5.8	2.0	VL	M	D	S	S	VL	H
B22	8.1	1.5	VL	H	D	S	S	VL	M
B23	8.2	3.6	VL	H	D	S	S	VL	M

VL : Very Low; L : Low; M : Moderate; H : High;

VH : Very High; D : Deficient; S : Satisfactory; T : Toxic;

\*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A1	0 - 8cm	Dark brown fine sandy loam, structureless, very high organic matter, pH 4.3
A2	8 - 28cm	Bleached fine sandy loam, structureless, pH 4.6
B21	28 - 71cm	Yellowish red light clay with a few brown mottles, weakly structured, pH 5.8
B22	71 - 92cm	Light grey light clay with a few red and yellow mottles, structureless, common manganese nodules, pH 8.1
B23	92 - 131cm	Light brownish grey medium clay with many yellowish red mottles, moderately structured, pH 8.2
C	131cm	

Mottled red duplex soil with a hardsetting topsoil, a bleached A2 horizon and a weakly structured subsoil.  
(Factual Key Dr 3.43)

### **Favourable attributes:**

Deep profile, good relationship between permeability and rainfall.

### **Limitations for agriculture:**

Shallow and dispersive topsoil, weakly structured topsoil with a low nutrient status, susceptible to wind erosion, aluminum toxicity, acidic.

### **Comments from landholders:**

- Susceptible to erosion
- Becomes very soupy when wet therefore easily compacted.

### **Suggested management:**

- Minimum tillage and stubble retention to protect topsoil
- Lime to increase pH and reduce aluminium toxicity
- Fertilizers to increase nutrient status
- Gypsum to reduce dispersion

**Site 9: Basalt, very gentle slope**
**Location: D. Symons**
**Occurrence: Common**

**General Description:** The soils on these very gentle basalt slopes are similar to those on the gentle crests. Slightly poorer drainage produces a more pronounced bleached horizon where the water sits on top of the impermeable clay subsoil which is highly dispersible.

**Site characteristics:**

Slope common: 2%	Depth seasonal watertable: 5 - 10 m
range: 1 - 3%	
Rock outcrop: 0%	Potential recharge to groundwater: Low - moderate

Depth to hardrock: > 1.5 m

Drainage: Moderately well drained
-----------------------------------

Land degradation:	Water erosion		Wind erosion	Salting	Acidification
Susceptibility	Sheet/rill	Gully	Very low	Very low	High
Incidence	Low	Low	Very low	Very low	Low

**Soil profile characteristics:**

Permeability: Moderate (Average 120 mm/day, range 26 - 371 mm/day)
Water storage capacity for plant growth: Very high (280 mm H <sub>2</sub> O)
Shrink/swell (B horizon): High (19 %)

**Interpretation of soil analyses\***

Horizon	pH (CaCl <sub>2</sub> )	Gravel %	E.C. (salts)	Nutrient status	P	K	AI	Organic matter	Dispersibility
A11	5.1	7.7	VL	M	S	S	S	VH	M
A12	4.9	36.3	VL	L	D	S	S	L	M
A2	4.5**	61.8	VL	VL	D	S	S	VL	M
B21	5.2	22.1	VL	M	D	S	S	VL	H
B22	7.6	2.5	VL	H	D	S	S	VL	H
B23	8.3	14.4	VL	VH	D	S	S	VL	H

VL : Very Low;

L : Low;

M : Moderate;

H : High;

VH : Very High;

D : Deficient;

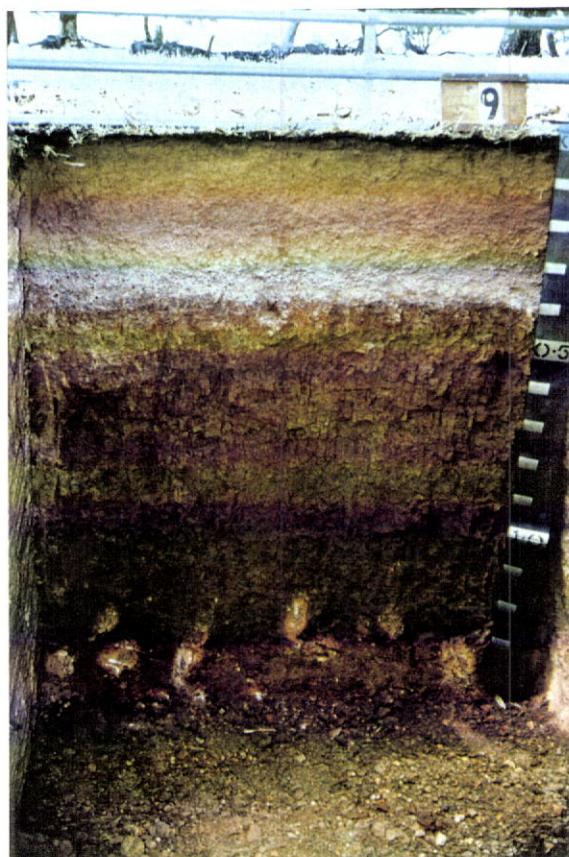
S : Satisfactory;

T : Toxic;

\*\* : Strongly Acidic

\* See Appendix 1 for analytical results

## Soil Profile



A11	<u>0 - 5cm</u> Dark reddish brown loam, structureless, a few ironstone fragments (buckshot), very high organic matter, pH 5.1
A12	<u>5 - 22cm</u> Reddish yellow fine sandy clay loam, structureless, many ironstone gravel fragments, pH 4.9
A2	<u>22 - 38cm</u> Bleached, hardsetting fine sandy loam, structureless, abundant ironstone, pH 4.5
B21	<u>38 - 54cm</u> Pale brown light clay with many red mottles, moderately structured, many ironstone fragments, pH 5.2
B22	<u>54 - 119cm</u> Light yellowish brown medium heavy clay with abundant red mottles, strongly structured, pH 7.6
B23	<u>119cm+</u> Light brown medium clay with a few red mottles, moderately structured, many calcium carbonate nodules, and a few manganese nodules, pH 8.3

Mottled red duplex soil with a hardsetting topsoil, a bleached A2 horizon and calcium carbonate nodules at depth.  
(Factual Key Dr3.43)

### **Favourable attributes:**

Deep topsoil and deep profile, good water storage, good relationship between permeability and rainfall, low susceptibility to degradation, moderate nutrient status in topsoil.

### **Limitations for agriculture:**

Dispersive and structureless topsoil, high gravel content in topsoil, very low nutrient status in bleached horizon.

### **Comments from landholders:**

- Low fertility in buckshot horizon, often found under remaining woodlots because 'poorer' country
- Topsoil needs improving.

### **Suggested management:**

- Favour deep rooted pastures and crops
- Gypsum application to reduce dispersion in topsoil
- Deep rooted species will break open impermeable layer and access high nutrient status in subsoil deep ripping will also break impermeable layer.
- Direct drilling/minimum tillage and stubble retention to protect topsoil from erosion

## APPENDIX 1. PHYSICAL AND CHEMICAL LABORATORY RESULTS

Soil Type		Soil Depth (cm)		Soil Color		Soil Texture		Soil Plasticity		1:5 Soil Water Suspension		PH 1:5 Soil CAC12 Suspension		Organic Carbon (W & B) %		Total Nitrogen %		Available K ug/g		Mg+ meq/100g		K+ meq/100g		Na+ meq/100g		Al+++ ug/g		Mn++ ug/g		H+ ug/g		Cat Ex Cap meq/100g		Exchangable Cations				
Tbf	MO2	92 0059 A	0 - 220	3.2	2.3	2	48	22	28	E3	5.3	0.110	0.003	4.4	2.1	0.24	708	83.0	4.7	1.5	2.2	0.1	30	50	16.7													
Tbf	MO3	92 0063 A1	0 - 70	4.8	<1.0	1	41	22	36	E3	5.9	0.080	4.9	2.1	0.22	349	3.1	11.7	5.7	1.0	0.3	<5	57	12.2														
Tbf	MO4	92 0067 A1	0 - 70	3.3	30.1	13	45	21	21	E3	5.9	0.140	0.003	4.8	3.6	0.32	720	3.3	5.6	2.1	0.3	5	60	14.0														
Tbf	MO5	92 0072 A1	0 - 110	2.1	3.1	6	57	15	22	E3	6.0	0.140	0.003	5.1	2.6	0.21	320	4.9	1.5	1.0	0.3	<5	24	10.6														
Tbf	MO6	92 0076 A1	0 - 120	3.5	15.7	7	50	18	25	E3	5.7	0.080	4.7	2.1	0.20	518	3.6	4.1	2.9	1.7	0.1	10	81	13.0														
Tbf	MO7	92 0077 B21	120 - 360	6.1	2.8	2	17	3	78	E3	50.6	27.2	23.4	14.4	6.6	0.050	5.2	0.6	0.09	380	<1.0	5.2	9.2	1.3	1.1	7	<5	15.3										
Tbf	MO8	92 0078 B22	360 - 590	6.7	2.4	1	7	1	91	E3	46.2	26.2	20.0	10.4	6.8	0.100	<0.01	6.2	0.7	0.09	486	5.9	0.5	0.07	297	<1.0	5.6	12.3	1.1	3.0	<5	15.0						
Tbf	MO9	92 0079 B23	590+	7.6	0.7	1	7	4	88	E1	7.3	0.150	0.002	6.0	0.3	0.07	526	3.4	10.8	2.0	2.5	<5	5	4.5	<5	11.0	6.5	0.4	0.06	301	<1.0							

Map Unit	Site Number	Laboratory Number	Horizon Depth mm	Particle Size Distribution			Soil Plasticity			1:5 Soil Water Suspension			Exchangable Cations															
				Gravel >2mm %	Fine Sand %	Coarse Sand %	Fine Silt %	Silt %	Clay %	Fines <74um %	Plastic Limit %	Plasticity Index %	Linear Shrinkage %	EC 25 C ds/m	EC 200 C ds/m	K+ meq/100g	Mg++ meq/100g	Na+ meq/100g	Al+++ ug/g	Mn++ ug/g	H+ meq/100g	Cat. Ex Cap. meq/100g						
Tbf	MO7	92 0080 A1	0 - 20	3.6	24.6	14	47	19	20	E3	7.3	0.200	0.004	6.7	2.2	0.20	918	13.9	8.9	4.3	1.6	0.3	<5	12	6.0			
	92 0081 A2	20 - 250	1.7	16.6	15	52	22	11	E3		6.7	0.040		5.6	0.8	0.11	190	3.0	3.7	2.0	0.5	0.2	<5	12	6.2			
	92 0082 B21	250 - 580	6.6	<1.0	2	7	2	89	E3	58.3	15.1	43.2	16.5	7.0	0.100	6.0	0.5	0.09	152	<1.0	6.9	11.4	0.7	1.2	<5	<5	13.7	
	92 0083 B22	580 - 1220	7.3	1.7	1	8	3	88	E2					7.8	0.320	0.015	6.8	0.2	0.06	496	<1.0	6.7	15.2	1.8	4.3	<5	<5	7.8
	92 0084 B23	1220 - 1840	6.5	12.2	7	20	10	63	E2		9.2	0.760	0.035	8.3	0.1	<0.05	272	<1.0	22.3	14.3	1.5	7.3	<5	<5	<10			
Qap	MO8	92 0085 A1	0 - 80	2.0	3.2	1	71	15	13	E3				5.4	0.150	0.004	4.3	3.4	0.28	642	58.0	2.7	0.9	1.6	0.1	25	19	15.9
	92 0086 A2	80 - 280	0.5	<1.0	1	73	14	12	E3		5.8	0.050		4.6	0.5	0.05	239	12.7	1.1	0.5	0.6	0.1	18	6	5.1			
	92 0087 B21	280 - 710	2.6	2.0	2	39	17	42	E2	32.9	30.9	2.0	7.6	7.0	0.120	0.001	5.8	0.3	<0.05	570	2.5	2.8	7.2	1.5	0.8	<5	<5	5.6
	92 0088 B22	710 - 920	2.1	1.5	4	42	28	25	E3					8.9	0.250	0.001	8.1	0.1	<0.05	436	<1.0	12.9	8.7	1.2	1.2	<5	<5	0.5
	92 0089 B23	920 - 1310	3.9	3.6	1	32	17	50	E3					8.9	0.530	0.027	8.2	0.1	<0.05	506	<1.0	9.0	13.1	1.4	3.4	<5	<5	0.8
Tbf	MO9	92 0090 A1	0 - 50	3.0	7.7	11	55	17	17	E3				6.0	0.130	0.003	5.1	4.5	0.29	524	11.0	11.1	1.5	1.1	0.1	<5	43	13.3
	92 0091 A12	50 - 220	1.3	36.3	12	64	11	13	E3		5.8	0.080		4.9	0.7	0.05	260	<1.0	2.1	1.5	0.7	0.1	6	<5	5.6			
	92 0092 A2	220 - 380	0.6	61.8	16	61	12	11	E3					5.7	0.040		4.5	0.2	<0.05	119	<1.0	0.3	1.1	0.2	0.1	12	<5	3.4
	92 0093 B21	380 - 540	4.6	22.1	5	20	5	70	E2	47.5	21.6	25.9	18.7	6.0	0.610	0.063	5.2	0.2	<0.05	220	<1.0	2.3	8.9	0.9	4.6	6	<5	11.7
	92 0094 B22	540 - 1190	6.4	2.5	2	14	9	75	E2					8.4	0.760	0.065	7.6	0.1	<0.05	387	<1.0	7.2	14.8	1.4	8.0	<5	<5	4.7
	92 0095 B23	1190+	5.2	14.4	5	27	14	54	E2		9.1	0.950	0.058	8.3	0.1	<0.05	214	<1.0	20.4	13.1	1.1	7.2	<5	<5	0.2			