

DEPARTMENT OF AGRICULTURE

SOILS OF THE BENDIGO DISTRICT

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TABLE OF CONTENTS

INTRODUCTION.....	3
Purpose of the Investigation	3
LAND SYSTEMS.....	3
GEOLOGY.....	10
Ordovician.....	10
Silurian - Lower Devonian Rocks	10
Granitic Rocks.....	10
DESCRIPTION OF THE SOILS	10
Soils of the 212131 Land System	10
Soils of the 213131 Land System	11
Soils of the 313132 Land System	14
Granitic Soils of the 321231 Land System	16
Basaltic Soils of the 352123 Land System	18
Soils of the 254112 Land System	18
PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS.....	20
Particle Size Distribution.....	20
Chloride.....	20
pH.....	20
Potassium and Organic Carbon in Surface Soils	21
Exchangeable Cations.....	21
ACKNOWLEDGEMENTS.....	23

LIST OF FIGURES

Figure 1 – Land Systems 212131	4
Figure 2 – Land System 313131.....	5
Figure 3 – Land System 313132.....	6
Figure 4 – Land System 321231.....	7
Figure 5 – Land System 352123.....	8
Figure 6 – Land System 254112.....	9

LIST OF TABLES

Table 1 - Clay Content of the Soil Types	20
Table 2 - Calcium / Magnesium and Calcium/Sodium ratios, and Exchangeable sodium percentage (ESP)	21

APPENDICES

Appendix 1 – Legend	26
Appendix 2 – Surface Texture, profile pH Range and average profile chloride (Cl) % for the main soils in Bendigo District.	27
Appendix 3 – Analytical Data for Representative Profiles.....	29
Appendix 4 – Site Localities	31

SOILS OF THE BENDIGO DISTRICT

E. H. Mikhail, Soils Officer.

INTRODUCTION

A soil investigation has been carried out over an area of about 1,200 square kilometres (topography maps 1:100,000 scale; Bendigo sheet No. 7724 and Heathcote sheet No.7824). The investigation is related to the Land System survey conducted by the Soil Conservation Authority (S.C.A.).

Six land systems, which are broadly distributed in the district, were partly or fully covered in this report.

Purpose of the Investigation

The investigation was intended to serve two purposes:

- i) To provide an overall picture of soil distribution in part of the Bendigo District, and
- ii) To provide detailed soil descriptions for local departmental officers for their advisory recommendations.

LAND SYSTEMS

A land system is a group of soil components grouped together and having, in common, major feature of climate, geology, bed rock, topography, landscape and, where appropriate, other minor features. Each feature is enumerated.

This report covers whole or part of the following land systems-

212131
213131
254112
313132
321231
352123

The first three land systems occur in the northern half of Bendigo and Heathcote areas. They have a similar climate and their geological units include basalt, granite and sedimentary calcareous bedrock. The other land systems occur in the southern half of the two areas.

Diagrams for these land systems are shown in figures 1 to 6.

Figure 1 – Land Systems 212131

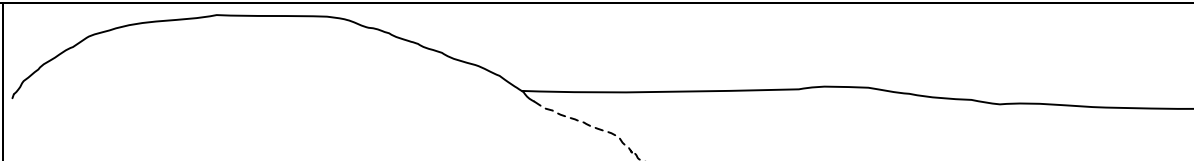
LAND SYSTEM 212131		
Component	1	2
Climate (Average)	Annual rainfall: 425-500 mm	
Geology	Cambrian diabase with interbedded cherts and shales	
Topography:		
Landform	Predominantly diabase	Colluvium from diabase
Position	Prominent N-S Ridge	
Av. Sideslope ^o	Crest 10	Fan 3
Native Vegetation:		
Structure	Woodland?	
Association	Grey box, white box, yellow box	
Soil:		
Group	Stony red gradation soil, fine structure	Red calcareous clay soil, uniform texture
Surface texture	Clay loam	Clay
Permeability	High	Moderate
Present Land Use	Cropping, grazing. No timber reserves	
Hazards	High sheet erosion. High salting at junction with other land units.	

Figure 2 – Land System 313131

<p>LAND SYSTEM 213131</p>					
<p>Component Climate (Average) Geology Land Form Position Av. Sideslope° Native Vegetation Structure Association Soil Group Surface structure Permeability Present Land Use Hazards</p>	<p>1</p>	<p>2</p>	<p>3</p>	<p>4</p>	<p>5</p>
	<p>Annual Rainfall: 425-500 mm</p>				
	<p>Lower Palaeozoic slates and sandstones, interbedded, steeply-dripping with quartz reefs. Strike approximately N-S.</p>				<p>Alluvium</p>
	<p>Gentle low ridges NW-NE trend</p>				
	<p>Sharper crests 6</p>	<p>Gentle crests 4</p>	<p>Upper slopes 3</p>	<p>Lower slopes 2</p>	<p>Swales 1</p>
	<p>Open forest Red box, red stringybark, red ironbark</p>	<p>Red ironbark, grey box</p>	<p>Yellow gum, grey box</p>	<p>Yellow gum, grey box</p>	<p>Yellow gum, grey box</p>
	<p>Shallow stony gradational soils Stony loam</p>	<p>Red sodic duplex soils Gravelly loam</p>	<p>Red sodic duplex soils, coarse structure Gravelly loam</p>	<p>Yellow sodic duplex soils, coarse structure Gravelly loam</p>	<p>Yellow sodic duplex soils Clay loam</p>
	<p>Moderate</p>	<p>Moderate</p>	<p>Low</p>	<p>Very Low</p>	<p>Moderate</p>
	<p>Mainly grazing, forestry, nature conservation, recreation.</p>				
	<p>Runoff causes deterioration of streams by siltation, erosion, salting</p>				
	<p>High sheet erosion</p>			<p>Moderate sheet erosion</p>	<p>High gullying, Moderate salting</p>

Figure 3 – Land System 313132

LAND SYSTEM 313132					
Component Climate (Average) Geology Topography Land Form Position Av. Sideslope° Native Vegetation Structure Association Soil Group Surface Texture Permeability Present Land use Hazards	1	2	3	4	5
	Annual rainfall: 500-625 mm				
	Lower Palaeozoic slates and sandstones, interbedded, steeply dipping, with quartz reefs. Strike approximately N-S.				
	Gentle low ridges – NW-NE trend				Alluvium
	Sharp crests 6	Gentle crests 4	Upper slopes 3	Lower slopes 2	Swales 1
	Open forest Red box, red stringybark, red ironbark	Red ironbark, grey box		Yellow gum, grey box	
	Shallow stony gradational soils Stony loam Moderate	Red sodic duplex soils		Yellow sodic duplex soils, coarse structure	Yellow sodic duplex soils
	Stony loam Moderate	Red sodic duplex soils, coarse structure Gravelly loam Low		Very Low	
	Cleared-grazing. Timbered – forestry, nature conservation, recreation. Runoff causes deterioration of streams by siltation, erosion, salting.				
	High sheet erosion			Moderate sheet erosion Moderate gullying	
					High gullying Moderate salting


Figure 4 – Land System 321231

<p>LAND SYSTEM 321231</p>				
<p>Component Climate (Average) Geology Topography Land Form Position Av. Sideslope° Native Vegetation Structure Association Soil Group Surface Texture Permeability Present Land Use Hazards</p>	<p>1</p> <p>Crests with rock outcrop 5</p> <p>Open forest Yellow box, long leaf box, red box, grey box, broad leaf peppermint</p> <p>Yellow sodic, duplex soils, coarse structure</p> <p>Moderate</p> <p>Low sheet erosion, low salting</p>	<p>2</p> <p>Crests 3</p> <p>Gentle slopes approximately N-S</p> <p>Mottled duplex soils with ironstone</p> <p>Coarse sandy loam</p> <p>Grazing, occasional cropping</p>	<p>3</p> <p>Long slopes 2</p> <p>Woodland Red gum, yellow box, grey box, long leaf box</p> <p>Mottled duplex soils with ironstone</p> <p>Very Low</p> <p>High gullying, low salting</p>	<p>4</p> <p>Alluvium</p> <p>Drainage lines 1</p> <p>Red gum</p> <p>Yellow sodic duplex soils</p> <p>Moderate</p>
<p>Annual rainfall: 500-625 mm Granodiorite</p>				

Figure 5 – Land System 352123

LAND SYSTEM 352123						
Component	1	2	3	4	5	
Climate (Average)	Annual rainfall: 500-625 mm					
Geology	Basalt			Alluvium	Colluvium from Basalt	
Topography	Undulating plains					
Land Form	Highest, level areas	Rises	Scarp	Creek flat	Scarp	
Position	0	3	5	1	10	
Av. Sideslope ^o						
Native Vegetation	Woodland	Open Woodland				Open forest,
Structure	Red gum	Red gum				Yellow box, grey box
Association	Grey box					
Soil						
Group	Grey calcareous sodic clay soils, uniform texture	Red brown stony shallow gradational soils	Red brown stony shallow gradational soils	Black cracking clay soils, uniform texture	Stony red gradational soils	
Surface texture	Clay	Clay loam	Clay loam	Clay	Loam	
Permeability	Very Low	Moderate	Moderate	Very Low	Moderate	
Present Land Use	Grazing, timbered areas rare					
Hazards	Low salting	Slight sheet erosion	Moderate sheet erosion	Low gullyng	Moderate sheet erosion	

Figure 6 – Land System 254112

<p>LAND SYSTEM 254112</p>			
<p>Component Climate (Average) Geology Topography Land Form Position Av. Sideslope° Native Vegetation Structure Association Soil Group Surface texture Permeability Present Land Use Hazards</p>	<p>1</p> <p>Plains Prior stream levees 1 Woodland Grey box, yellow gum, buloke Red calcareous sodic duplex soils Loam Moderate Dryland cropping and grazing, some irrigation districts, timber reserves rare except along creeks and rivers Deterioration of topsoil structure by over-cultivation</p>	<p>2</p> <p>Annual rainfall: 375-500 m Quaternary fluvatile siliceous deposits, usually overlain by calcareous dust Flat plains 0-1 Grassland Spear, wallaby, kangaroo grasses Calcareous sodic clay soils, uniform texture Clay Low Salting especially under irrigation.</p>	<p>3</p> <p>Present flood plains 0-1 Open Forest Red gum, black box Variable grey soils Variable Variable Deposition of alluvium at lower levels.</p>

GEOLOGY

Ordovician

Rock units consist of massive sandstones and grits which may be interbedded with the shales and slates. The similarity of appearance of the Ordovician rocks makes it impossible to separate various rock groups by lithology. All the sub-divisions are based on the evolutionary sequence of the contained fossils which are mostly graptolitic.

Several areas containing older rocks surrounded by belts of younger rocks, have been recognized e.g. the one extending from Heathcote to Axedale and one around Bendigo. In between these there are areas in which Middle Ordovician rocks appear, e.g. on certain isolated areas in the complexly faulted Heathcote area.

Silurian - Lower Devonian Rocks

These are found only east of the Heathcote-Colbinabbin Cambrian belt. Their general structure is that of a very big synclinal area lying immediately east of the Mt Ida and Heathcote fault line. The thick sandstones, often abundantly fossiliferous and containing in places odd pebbles, merge into inter bedded Conglomerates.

Granitic Rocks

The area includes portions of two major granitic masses which are the Harcourt and Pyalong massifs. The former is a granodiorite rich in xenoliths of the invaded lower palaeozoic sediments, and is associated with numerous minor intrusion of aplites and pegmatite. The latter is a complex intrusion with a core of granodiorite and an annular rim of porphyritic granite.

Along the Heathcote-Colbinabbin anticlinorium is the belt of Cambrian rocks lying between the Mt Ida and Knowles East faults (which have a general northerly direction), and their continuation in the McIvor and Heathcote faults (which run south easterly).

Silurian –Lower Devonian rocks and Ordovician rocks are separated by the Heathcote–Colbinabbin belt. This is an extremely complex belt formed by parallel shear and cross fractures the effect of which is to cause the older rocks along the major faults to override the younger.

DESCRIPTION OF THE SOILS

Soils of the 212131 Land System

Soils occurring on crests and long slopes of north-south ridges.

TYPE - 12 SC

Red-brown clay loams over medium clay to heavy clays, with buckshot and rock fragments.

A ₂	0 to 6/13 cm	red-brown clay loam to light clay.
B ₂	6/13 to 22/28 cm	red-brown medium clay to heavy clay, sometimes with buckshot and rock fragments.
B ₂	22/28 to 100+ cm	red–brown medium clay to heavy clay, sometimes yellowish grey with red brown at 80 cm.

Soils occurring on long slopes.

TYPE - 12 C

Red-brown clay loams over medium clays.

A	0 to 6 cm	red-brown light clay,
B ₂	6 to 22 cm	red-brown medium clay, with small buckshot.
B ₂	22 to 80 cm	yellowish brown with yellowish grey mottling medium clay to heavy clay, with slight stone and buckshot.
	80 to 90 cm	yellowish grey with yellow-grey and yellowish brown mottling heavy clay, with slight to moderate hard lime.
	90 to 100+ cm	red-brown with yellowish brown and yellowish grey mottling heavy clay, with small buckshot.

Soils occurring on flats

TYPE - 12 F

Dull greyish brown light clay over medium clay to heavy clay with moderate hard lime.

A ₁	0 to 7 cm	dull greyish brown light clay.
B ₁	7 to 70 cm	dark grey-brown medium clay to heavy clay, with trace of soft and hard lime.
B ₂	70 to 100+ cm	dull greyish brown heavy clay, with slight to moderate hard and soft lime.

Soils of the 213131 Land System

Sedimentary siliceous soils

TYPE - 13SC

Brown clay loams over light clays with weathered sedimentary rock. These soils occur on sharp crests of high ridges.

A ₁	0 to 10/22 cm	dull brown to red-brown fine sandy clay loam to clay loam
B ₁	10/22 to 15/30 cm	red-brown light clay, with slight to moderate rock fragments.
B _C	15/30 to 72/75 cm	red-brown light clay or medium clay, with heavy sandstone fragments.
B _C	42/75 to 100+ cm	yellowish grey with yellowish brown and red-dish brown mottled light clay or fine sandy clay loam, with heavy weathered sedimentary rock.

TYPE - 13C

Dull greyish brown loams over clays with weathered sedimentary rock. These soils occur on crests of gentle ridges.

A ₁	0 to 5/10 cm	dull greyish brown to brown loam to fine sandy clay loam, sharply separated from.
B ₁	15/20 to 50 cm	brown or yellow-brown with reddish brown, yellowish brown and grey-brown light clay, occasionally medium clay, with slight stone.
B ₂	50 to 100 cm	brown with yellowish brown and yellowish grey medium clay, with moderate to light stone.

Variant - Sandy clay to fine sandy clay loam occurring below 75cm.

TYPE - 13US

Dull brown to red-brown fine sandy clay loams over sandy clays. These soils occur on the upper slopes of ridges.

A ₁	0 to 8/15 cm	dull brown to red-brown fine sandy clay loam.
A ₂	8/15 to 15/25 cm	light brown to light reddish brown fine sandy clay loam.
B ₁	15/25 to 32/50 cm	red –brown sandy clay with slight stone.
B ₂	32/50 to 100+ cm	red-brown or yellowish brown with red-brown sandy clay or light clay with moderate stone. dull reddish brown fine sandy clay loam over medium clay.

TYPE - 13GS

These soils occur on long gentle slopes. Grey brown loams over medium clays. A₂ horizons present.

A ₁	0 to 12 cm	grey–brown loam, friable.
A ₂	12 to 25 cm	pale grey-brown with light brown sporadic, bleach gravelly loam, extremely hard with stone fragments.
B ₁	25 to 57 cm	reddish brown with light brown and yellowish grey mottling, sandy clay loam extremely hard with heavy gravel and stone.
B ₂	57 to 107 cm	brown wit reddish brown and yellowish brown and grey mottling, medium clay (sandy) sub-angular blocky structure, friable m with heavy gravel and stone.
	107 to 127 cm	brown with yellowish grey and yellowish brown mottling, sandy clay to medium clay (sandy), angular blocky structure, hard when dry, with slight gravel and stone.

TYPE - 13SL

Alluvial Soils occurring in swales. Greyish brown sandy loams over sandy clay loams. A₂ horizons present.

A ₁	0 to 12 cm	greyish brown to dark brown sandy loam.
A ₂	12 to 25 cm	light brown or yellowish brown sandy clay loam.
B ₁	25 to 45/62 cm	yellowish brown sandy clay loam to sandy clay with slight stone.
B ₂	45/62 to 100+ cm	yellowish brown with yellowish grey sandy clay loam to sandy clay with slight stone.

TYPE - 13S2

Dull greyish brown loams over sandy clay loams. A₂ horizons present.

A ₁	0 to 3 cm	dull greyish brown loam, friable when moist.
	3 to 11 cm	greyish brown light fine sandy clay loam, friable when moist.
A ₂	11 to 18 cm	pale greyish brown conspicuous bleach, fine sandy clay loam.
B ₁	18 to 40 cm	greyish yellowish brown with yellowish grey and yellowish brown mottling, fine sandy clay loam.
	40 to 52 cm	dull brown with yellowish grey and dull yellowish brown mottling, fine sandy clay loam heavy.
B ₂	52 to 70 cm	dull brown with yellowish grey mottling, fine sandy clay loam platy structure.

TYPE - 13S3

Brownish grey fine sandy clay loams over light clays. A₂ horizons present.

A ₁	0 to 10 cm	brownish grey fine sandy clay loam.
A ₂	10 to 26 cm	light brownish grey clay loam.
B ₁	26 to 75+ cm	yellow-brown with yellowish brown and red-brown light clay.
B ₂	75 to 100+ cm	yellow-brown with yellowish brown and red-brown fine sandy clay to fine sandy clay loam.

TYPE - 13S4

Red brown clay loams over light clays. Gravelly loam A₂ horizons present.

A ₁	0 to 12 cm	red-brown clay loam.
	12 to 35 cm	red-brown light clay.
A ₂	35 to 50 cm	red-brown gravelly loam.
	50 to 70 cm	light brown fine sandy loam.
	70 to 85 cm	yellowish grey loam with slight gravel.

B 85 to 100+ cm brown with yellowish brown and yellow-grey mottled light clay.

TYPE - 13S5

Greyish brown clay loams over medium clays (sandy). Bleached A₂ horizons present.

A₁ 0-11 cm greyish brown clay loam.

A₂ 11-25 cm light grey with yellowish brown, sporadic bleach, sandy clay loam, hard when dry.

B₁ 25-55 cm yellowish grey with yellowish brown mottled medium clay (sandy), hard when dry.

B₂ 55-60 cm greyish yellow-brown with slight yellowish grey mottled sandy clay, hard when dry.

60 –90 cm yellow–brown with slight yellowish grey mottled silty clay, hard when dry.

90 – 100+cm reddish brown with slight yellowish grey fine sandy clay loam, friable when moist.

TYPE - 13S6

Greyish brown light clays over heavy clays.

A 0 to 7 cm greyish brown light clay.

B₁ 7 to 70 cm dark grey-brown medium clay to heavy clay, with trace of hard lime.

B₂ 70 to 100+ cm dull greyish brown heavy clay, with slight to moderate hard lime.

Soils of the 313132 Land System

TYPE - 13SC 3

Shallow stony soils with sandy loam surfaces over sandy clays. These soils occur on sharp crests.

A 0 to 10 cm grey-brown loam with stone fragments.

B₂ 10 to 20 cm reddish brown fine sandy clay loam with slight stone.

B₂ 20 to 30 cm red-brown with yellow-brown mottled light clay with heavy rock.

30 to 40 cm yellowish brown with yellow-brown and yellowish grey mottled light clay with moderate rock.

40 to 85 cm yellowish grey-brown clay loam with heavy rock.

TYPE - 13 GS3

Shallow stony soils with sandy loam surfaces over sandy clays. A₂ horizons present. These soils occur on gentle slopes.

A₁ 0 to 7 cm greyish brown sandy loam with heavy gravel and rock fragments.

A₂ 7 to 22 cm light brown sandy loam with heavy gravel and rock.

B ₁	22 to 29 cm	red-brown with light brown sandy clay, with light gravel and rock fragments.
B ₂	29 to 70cm	red-brown with yellowish brown and yellowish grey light clay, with slight to moderate small rock fragments.
	70 to 100cm	yellow-brown with red-brown and yellowish grey mottled sandy clay, with slight to moderate rock.

TYPE - 13MS3

Shallow stony soils with dull greyish brown loam surfaces over light clays. A₂ horizons present. These soils occur on mid slopes of gentle and higher hills.

A ₁	0 to 7 cm	dull greyish brown loam with gravel and rock fragments.
A ₂	7 to 20 cm	light brown sandy loam with slight gravel and rock.
B ₁	20 to 42 cm	reddish brown with yellowish brown and slight yellowish grey mottled sandy clay to medium clay (sandy), with rock.
B ₂	42 to 52 cm	yellow-brown with yellowish brown and yellowish grey mottled light clay, with rock fragments.
	52 to 70 cm	red-brown with yellowish brown and slight yellowish grey coarse sandy clay, with gravel
	70 to 77 cm	yellowish brown with slight reddish brown and yellowish grey mottled sandy clay, with gravel.
	77 to 95 cm	yellowish brown with dark brown and yellowish grey silty clay, with slight gravel.
	95+ cm	yellow-brown with light yellowish grey silty clay, with gravel and sand.

TYPE - 13SW1

Grey-brown sandy clay loam surfaces over medium clay. A₂ horizons present. These soils occur in swales.

A ₁	0 to 10 cm	dull grey-brown light sandy clay loam.
A ₂	10 to 25 cm	light grey-brown with light grey light sandy loam.
	25 to 35 cm	light brown with light grey-brown light sandy loam.
B ₁	35 to 50 cm	yellow-brown with light brown and slight yellowish grey mottled sandy clay, with rock fragments.
B ₂	50 to 65 cm	yellow-brown with dark brown and red-brown mottled medium clay (sandy).
	65 to 90 cm	yellowish brown with red-brown mottled sandy clay (heavy), with gravel.
	90 to 120 cm	yellowish brown with light grey heavy clay.

TYPE - 13SW2

Brownish grey clay loam surfaces over medium clays.

A	0 to 9 cm	brownish grey clay loam.
B ₁	9 to 25 cm	brownish grey with grey medium clay (fine sandy).
B ₂	25 to 90 cm	yellowish grey with yellowish brown medium clay with slight hard lime.

TYPE - 13SW3

Grey-brown gravelly loams over clays.

A ₁	0 to 10 cm	grey-brown gravelly loam.
A ₂	10 to 16 cm	light grey-brown gravelly loam.
B ₁	16 to 25 cm	light yellowish grey with yellowish brown mottled sandy clay loam.
B ₂	25 to 100 cm	yellow-brown with slight yellowish grey light clay to medium clay.

Granitic Soils of the 321231 Land System

TYPE - 21C

Grey brown gravelly loams over sandy materials. A₂ horizons present.

These soils occur on crests and gentle ridges.

A ₁	0 to 7/10 cm	dull brown to dull grey-brown coarse sandy to gravelly loam.
	7/10 to 15/25 cm	grey-brown to greyish brown coarse sandy to gravelly loam, sharply separated from:
A ₂	15/25 to 25/40 cm	pale greyish brown coarse sandy to gravelly loam, sharply separated from:
B ₁	25/40 to 60/80 cm	yellowish brown weakly mottled with yellowish grey to grey with yellowish brown, occasionally red-brown, sandy clay to medium clay (sandy), grades into:
B ₂	60/80 to 100+ cm	grey with yellowish grey and yellowish brown mottled sandy clay to medium clay (sandy).

TYPE - 21LS

Grey-brown gravelly loams over clays. ‘Sandy clay deep subsoils.’ These soils occur on the long slopes of high and low hills.

A ₁	0 to 10 cm	grey-brown to dull grey-brown coarse sandy to gravelly loam, occasionally gravelly sandy clay loam, sharply separated from:
A ₂	10 to 14/25 cm	pale greyish brown coarse sandy loam, sharply separated from:
B ₁	14/25 to 40/60 cm	yellow-brown with red-brown and grey mottled, or yellowish greyish brown with yellowish grey mottled light clay, occasionally heavy clay:

B ₂	40/60 to 85 cm	red-brown with yellowish brown and yellowish grey mottled, yellowish brown with yellowish grey light clay:
	85 to 100 cm	grey with reddish brown sandy clay.

TYPE - 21DL1

Grey coarse sandy loams over coarse sandy clay loams. A₂ horizons present. These soils occur along drainage lines.

A ₁	0 to 8/22 cm	dull grey-brown to dark brownish grey coarse sandy loam, occasionally coarse sandy clay loam, sharply separated from;
A ₂	8/22 to 15/40 cm	pale grey-brown sandy loam, sharply separated from;
B ₁	15/40 to 25/70 cm	yellowish brown or grey coarse sandy clay to sandy clay.
B ₂	25/70 to 40/8 cm	yellowish brown with light yellowish grey to dark grey coarse sandy clay, occasionally medium clay.
	40/85 to 95 cm	grey with yellowish brown sandy clay, occasionally medium to heavy clay.
	90 to 105 cm	dark grey with yellowish brown mottled coarse sandy clay loam.
	105 to 130 cm	dark grey with yellowish brown coarse sandy clay loam, with light gravel.

TYPE - DL2

Gravelly soil with dull grey-brown coarse sandy loam surfaces over medium clays. A₂ horizons present.

A ₁	0 to 8 cm	dull grey-brown coarse sandy loam.
	8 to 25 cm	grey-brown coarse sandy loam with gravel.
A ₂	25 to 40 cm	light grey brown light sandy clay loam with moderate gravel.
B ₁	40 to 54 cm	grey with yellowish brown sandy clay.
B ₂	54 to 90 cm	grey with red-brown mottled medium clay
	90 – 100+ cm	grey with slight yellowish brown medium clay to heavy clay.

TYPE - 21DL3

Gravelly soils with dark brownish grey sandy loam surfaces over coarse sandy clay loams. A₂ horizons present.

A ₁	0 to 22 cm	dark brownish grey sandy loam.
A ₂	40 to 75 cm	light greyish brown with yellowish brown loamy sand with gravel.
B ₁	40 to 75 cm	yellowish grey with greyish brown sandy loam with gravel.
B ₂	75 to 105 cm	dark grey with yellowish brown mottled coarse sandy clay with gravel.

Basaltic Soils of the 352123 Land System

TYPE - 52BC

Brownish grey clay loams or light clays over medium to heavy clays. These soils occur on broad crests of high ridges.

A	0 to 12 cm	dull brownish grey clay loam.
B ₁	12 to 40cm	brownish grey medium clay sandy.
B ₂	40 to 70cm	yellowish grey sandy clay to medium clay sandy.
	60 to 100 cm	yellowish grey medium clay with trace of hard lime.

Dark grey-brown light clay surfaces over heavy clays.

A	0 to 16 cm	dark grey–brown light clay.
B ₁	16 to 50 cm	yellowish grey with slight yellowish brown heavy clay.
B ₂	50 to 60 cm	yellowish brownish grey medium to heavy clay.
	60 to 100+ cm	dark grey with yellowish grey heavy clay with slight hard lime.

Soils of the 254112 Land System

TYPE - 54F1

These soils occur on flats. Greyish brown fine sandy clay loams over reddish brown medium clays. Bleached. A₂ horizons present.

A ₁	0 to 8/10 cm	greyish brown to dull reddish brown fine sandy clay loam, sharply separated from:
A ₂	8/10 to 18 cm	pale reddish brown fine sandy clay loam, weakly bleached, sharply separated from:
B ₁	18 to 60 cm	red-brown light clay to medium clay:
B ₂	60 to 70/85 cm	reddish brown with yellowish brown to yellowish brown with yellowish grey mottled medium clay, with slight soft lime:
	70/85 to 100+ cm	yellowish grey with yellowish brown medium clay to light clay, with moderate hard and soft lime.

TYPE - 54F2

Grey–brown light clays over medium clays. Bleached A₂ horizons present.

A ₁	0 to 12/16 cm	grey-brown light clay:
A ₂	12/16 to 19/25 cm	pale grey-brown with pale greyish brown sandy clay loam, weakly bleached sharply separated from:
B ₁	19/25 to 65 cm	dull yellowish greyish brown medium clay to heavy clay:
B ₂	65 to 90 cm	yellowish brown medium clay:
	90 to 100+ cm	yellowish brown light clay.

TYPE - 54F3

Reddish brown fine sandy loams over reddish brown light clays. Lime present in subsoils.

A ₁	0 to 6/15 cm	reddish brown fine sandy loam to fine sandy clay loam:
	6/15 to 15/20 cm	reddish brown sandy clay loam to fine sandy clay:
B ₁	15/20 to 40 cm	reddish brown light clay, friable:
B ₂	40 to 70 cm	reddish brown with slight yellowish brown light clay, friable:
	70 to 120 cm	reddish brown with slight yellowish brown clay, friable, with slight to moderate hard and soft lime.

TYPE - 54F4

Greyish brown fine sandy loams over reddish brown medium clays. Lime accumulations in deep subsoils.

A	0 to 10 cm	greyish brown fine sandy clay loam:
B ₁	10 to 50 cm	reddish brown medium clay:
B ₂	50 to 150 cm	yellowish brown medium clay with slight hard and soft lime.

TYPE - 54F5

Brownish grey light clay surfaces over heavy clays.

A	0 to 5 cm	brownish grey medium clay, blocky structure.
B ₁	5 to 20 cm	dark dull brown heavy clay, blocky structure, extremely hard dry.
B ₂	20 to 30 cm	yellowish brown heavy clay, angular blocky structure, with slight hard lime
	75 to 100+ cm	yellowish brown with yellowish grey medium clay, with slight hard lime.

PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

Field and laboratory data for 15 profiles, taken from different soil types in the six land systems, are given in appendix 3. This data is discussed briefly in the following paragraphs.

Particle Size Distribution

All the profile samples, with the exception of soil types 12F, 13S2, 13SC, 21C and 13SW3, are characterised by high clay contents in their B₁ horizons. The prevalent clayey nature of the subsoils is illustrated by the selected profiles, given in table 1.

The non-clay fraction is high in all profiles with the exception of those of the soils of Land System 321231. In this land system B₀ horizons are very low in coarse sand. The fine sand to silt ratio often decreases from the A to the B1 horizon with the exception of soil types 13gs and 12F. This trend indicates the dominance of weathering of the silt fraction in the A horizons, over any eluviation of silt.

High amounts of rock fragments are present in almost all soil types which occur on crests or slopes in land systems 212131, 213131, while high amounts of gravels are present in Land System 321231.

The high clay contents and the fine grading of the non-clay fractions draws attention to the possibility of low permeabilities in the subsoils. However, adverse particle size distribution is countered by good structural characteristics in at least some of the soil types, e.g. types 12SC and 12F are well structured and water does not remain on soil surfaces for long periods after rain.

Chloride

(Determined by electrometric titration method of Best)

Chloride ion concentration is generally low. Average values for chloride for soil profiles vary with locality. The highest average profile chloride figures in map 1 are 0.273, 0.096, 0.088, 0.061 and 0.062 for profiles Nos. 18, 15, 43, 4, 36, and 37 respectively. Salt (NaCl), which can be calculated from the chloride value by multiplying by 1.65, necessarily follows the chloride figure.

These are spot values. Actual concentrations probably vary widely with locality and season.

pH

(Determined on the 1:5 soil to water suspension by the glass electrode)

Generally, all the soil profiles show a consistent trend of pH increase with depth. All the surface soils are strongly to slightly acid (4.8 to 6.7). In the deep subsoils, types 12SC and 52BC have a pH value of 8.9 and types 54F1 to 54F5, have pH values varying from 8.2 to 8.7. The only soil type, 21GS in Land System 321231 has a strongly alkaline deep subsoil.

Table 1 - Clay Content of the Soil Types

Land System	Soil Type	Profile No. Site	Surface A Horizon		Subsoil B1 Horizon	
			Depth (cm)	Clay %	Depth (cm)	Clay %
212131	12SC	12	0-8	29	8-30	66
	12F	13	0-6	23	20-40	30
213131	13S2	1	0-3	13	3-11	17
	13SC	2	0-5	20	20-30	29
	13GS	3	0-12	22	57-107	54
	13GS	15	0-11	28	25-40	63
	13S5	14	0-10	16	16-25	40
321231	21LS	4	0-10	10	30-40	65
	21 C	5	0-10	6	65-85	25
	21GS	6	0-8	14	45-75	50

Land System	Soil Type	Profile No. Site	Surface A Horizon		Subsoil B1 Horizon	
			Depth (cm)	Clay %	Depth (cm)	Clay %
254112	54F1	8	0-10	24	10-30	68
	54F2	7	0-12	29	19-60	72
	54F5	9	0-5	28	5-20	54
313132	13SW3	11	0-10	11	16-25	17
352123	52BC	10	0-8	43	8-16	57

Potassium and Organic Carbon in Surface Soils

Some chemical analysis of 15 surface samples from 15 soil sites, are presented in appendix 3. The organic matter contents (organic carbon X 1.72) Walkley and Black's method for organic carbon) of the surface soils are moderate in Land Systems 212131, 313132 and 352123, where the range found is 2.4 to 3.8 percent. Surface soil organic matter is low in Land Systems 254112 and 321231, (with the exception of type 21GS,) the range found being 1.0 to 2.0 percent.

Soil potassium, (determination on 1:20 soil HCl 0.05M suspension) is commonly referred to as available potassium. Figure for the surface soil, indicate that the available potassium is very low to low in the soils of Land Systems 321231, 313132 and 352123. The figures for the soils of Land Systems 213131 and 212131 are moderate. The highest figures are for soils of the 252114 Land System.

Exchangeable Cations

The exchangeable cations (data presented in appendix 3) include calcium, magnesium, potassium, sodium (determined in ammonium chloride leached at pH 8.5) and hydrogen, (determined by BaCl-Triethenolamine method as modified by Peech et al 1962). The data is for selected horizons and is expressed both as total amounts per 100g of soil, and as percentage of cation exchange capacity which, in this case, is the sum of the individual cations.

The exchange complex of surface horizon soils in all profiles is strongly dominated by hydrogen (40 to 86 percent), except in the case of soils 54F2 and 52BC where the figures for exchangeable hydrogen are 24 and 30 percent respectively.

The exchangeable sodium percentage (ESP), calcium/magnesium ratio (Ca/Mg) and calcium /sodium ratio (Ca/Na) are of agricultural interest since they are the soil factors controlling dispersion of the clay and hence the permeability of the soil. Table 2 shows that the Ca/Mg and Ca/Na ratios decrease with depth in all profiles.

Table 2 - Calcium / Magnesium and Calcium/Sodium ratios, and Exchangeable sodium percentage (ESP)

Soil Type	Depth (cm)	Calcium/Magnesium ratio, Ca/Mg	Calcium/Sodium ratio, Ca/Na	ESP
21C	0-10	11.5	23.0	1
	40-65	6.1	61.0	1
	65-85	2.1	51.0	1
21LS	0-10	5.0	15.0	1
	30-40	0.7	3.7	8
21LS	0-8	5.0	12.5	2
	8-23	1.1	5.0	3
	23-45	0.4	1.8	5
	45-75	0.4	1.5	11
	75-100	0.5	1.6	15

Soil Type	Depth (cm)	Calcium/Magnesium ratio, Ca/Mg	Calcium/Sodium ratio, Ca/Na	ESP
12F	0-6	3.5	45.0	1
	20-40	3.9	25.5	2
	60-80	1.5	20.5	2
12SC	0-8	2.5	16.0	2
	8-30	1.5	14.3	3
	75-100	0.6	2.6	11
13S5	0-10	2.4	9.7	3
	16-25	0.8	2.2	10
	60-80	0.1	0.8	21
54F1	0-10	2.0	9.3	3
	18-30	0.8	2.7	10
54F5	0-5	1.8	6.7	3
	5-20	1.5	4.7	7
	30-50	0.9	3.0	10
52BC	0-8	1.7	9.8	4
	8-16	1.4	8.4	5
	45-55	1.2	3.5	12
	55-68	1.0	2.5	16
	68-80	0.8	2.0	17
13S2	0-3	1.2	10.5	2
	3-11	0.8	19.0	1
	40-52	0.6	3.0	6
13SW3	0-10	1.2	7.0	2
	16-25	0.9	4.0	2
54F2	0-12	1.0	8.3	4
	19-60	0.7	1.9	16
13SC	0-5	1.0	0.6	5
	20-30	0.1	0.3	3
13GS	0-11	0.5	2.5	2
	25-40	0.1	0.4	5
	55-60	0.05	0.2	13
13GS	0-12	0.1	0.3	3
	12-25	0.2	0.5	2
	57-107	0.1	0.1	14

The ratio changes such that the value for magnesium, in the deeper subsoil horizons, is usually more than twice that for calcium.

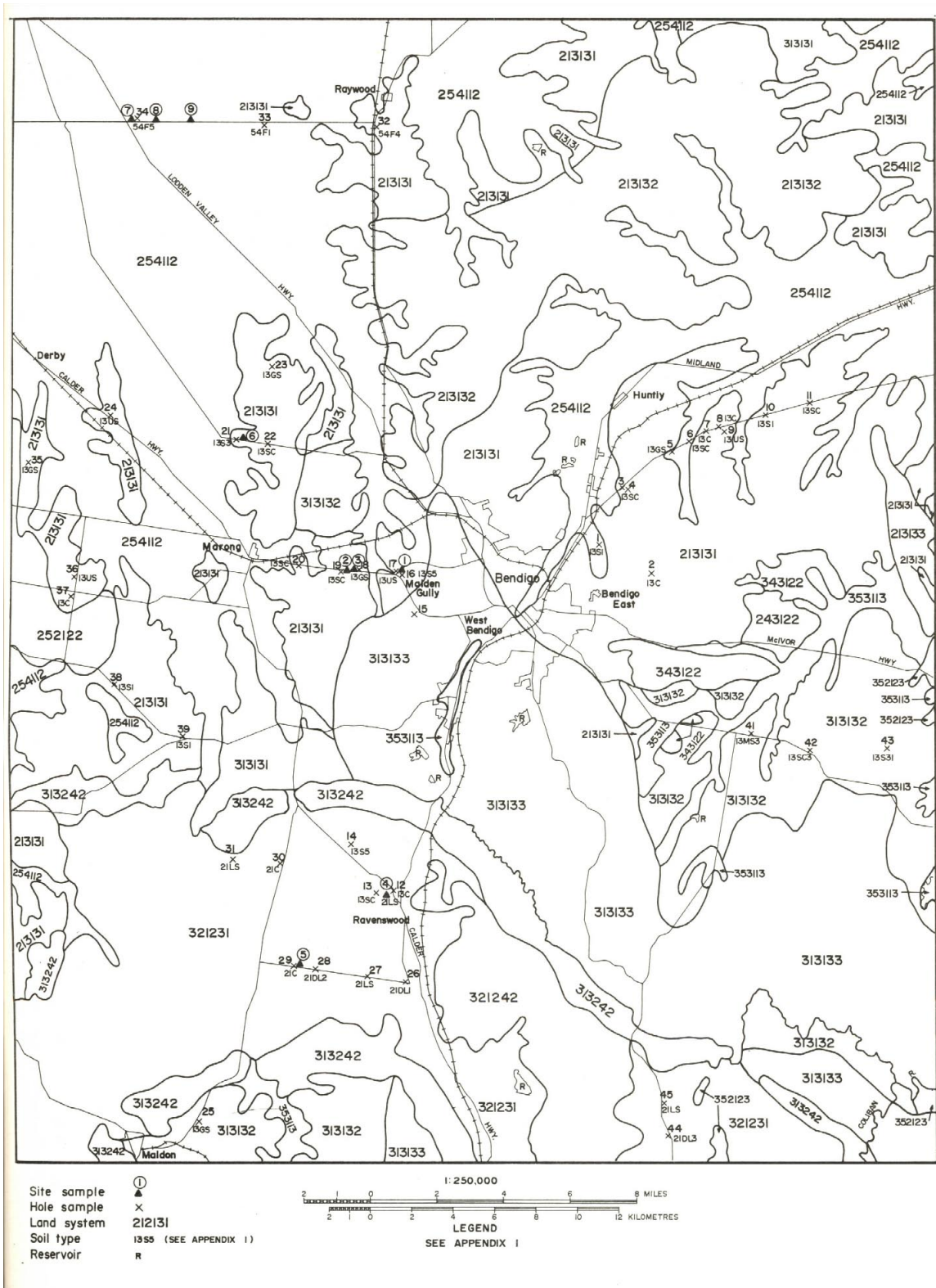
In all profiles except those of soil types 21C and 12F, ESP values are very low in surface soils and increase with depth up to values of 10 to 21 below 60cm.

ACKNOWLEDGEMENTS

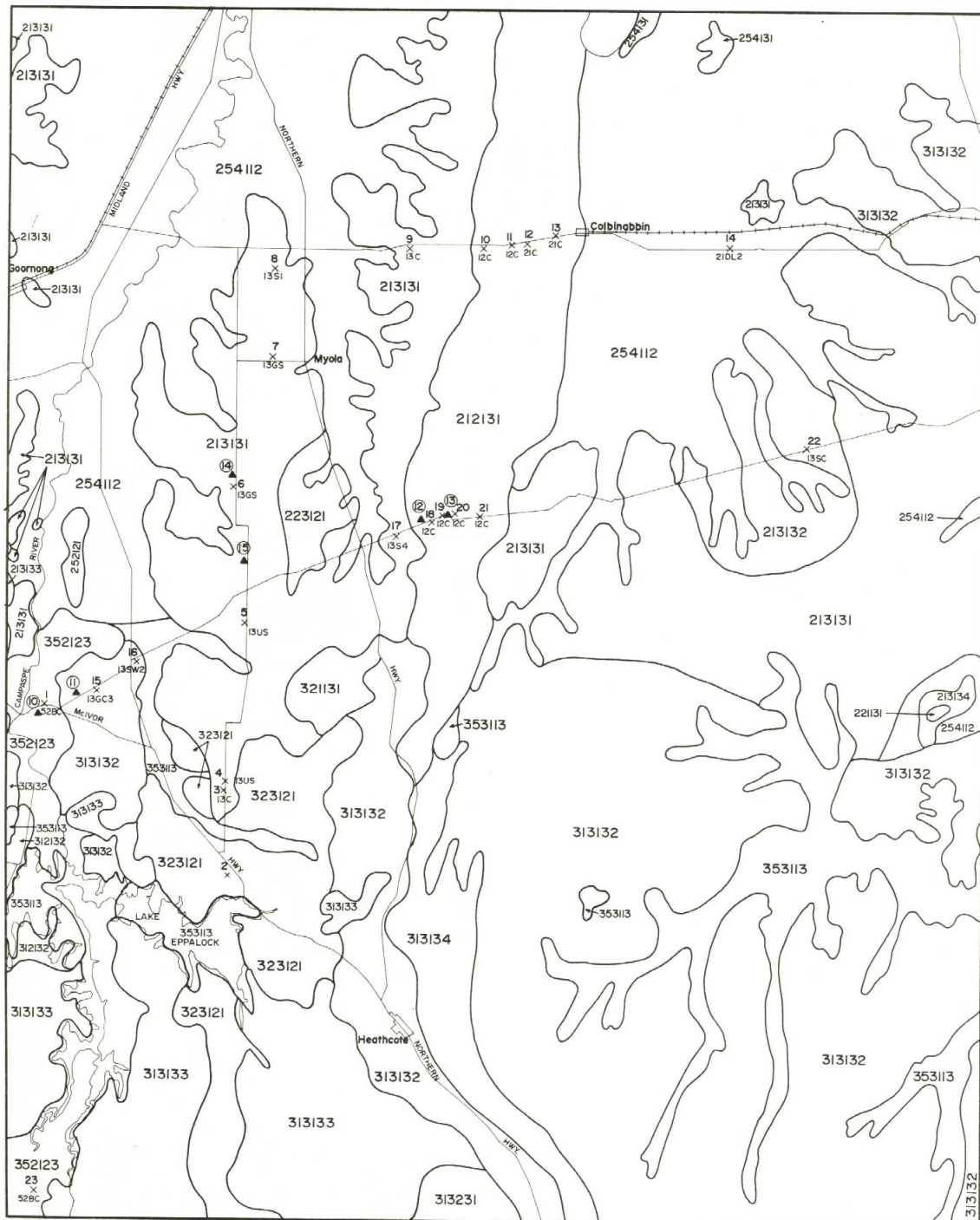
Thanks are due Messrs. J.N. Rowan and M. Lorimer, S.C.A.; for their cooperation and for providing Land System maps and figures, to Mr. J. Addison for his great help in the analysis; and also to Mr. D. Cam, Mrs. G. Rezk and Miss A. Paterson for chemical and mechanical analysis.

Last but not least, mention must be made of the landholders who, without exception, freely allowed access to their properties.

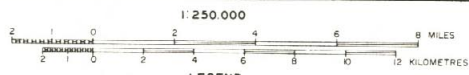
Map 1 – Soils of the Bendigo Area Land Systems



Map 2 – Soils of the Heathcote area Land Systems



Site sample 
 Hole sample 
 Land system 212131
 Soil type 13S5 (SEE APPENDIX 1)



LEGEND
 SEE APPENDIX 1

Appendix 1 – Legend

Symbol, geology for each land system, together with topography, classification and drainage class for major soils within each land system.

Land System	Soil Type	Symbol	Geology	Topography	Classification			Reaction ^(b)	Drainage Class ^(a*)
					Great Soil Group ^(d)	Northcote ^(c xxx)			
212131	Crest 1	12SC	Predominantly diabase Colluvium from diabase	Crest	NSG	Gn)))	Slightly Acid passing to strongly alkaline	A B
	Crest 1	12C		Long slope	NSG	Gn			
	Flat 1	12F		Fan	Black earth	Gn			
213131	Sharp Crest 2	13SC	Lower Palaeozoic slates and sandstones, interbedded, steeply- dipping with quartz reefs. Alluvium	Sharp crest	NSG	Gn))	Strongly acid to slightly alkaline passing to slight acid to strongly alkaline	B B C/B C/D B B B B B B
	Crest 2	13C		Gentle crest	Red podzolic	GN			
	Upper slope 2	13US		Upper slope	NSG	Gn			
	Gentle slope 2	13GS		Swales	Solodized solonetz	D			
	Swale 1	13S1			And solodic soils	D			
	Swale 2	13S2		Lateritic podzolic soils	Um				
	Swale 3	13S3			Gn				
	Swale 4	13S4			D				
	Swale 5	13S5			D				
	Swale 5	13S6			NSG	Ug			
313132	Sharp crest e	13SC3	Lower palaeozoic sandstones and slates interbedded, steeply dipping, with quartz reefs. Alluvium	Sharp crest	Non-calcic brown soils	D))))))))))))))))))	Moderately acid passing to strongly alkaline Moderately acid Moderately acid Moderately Acid Strongly acid passing to strongly alkaline Moderately acid	B B C/D B/C B/C
	Gentle slope 3	13GS3		Gentle crest	Non-calcic brown soils	D			
	Mid slope 3	13MS3		Mid slope	Lateritic podzolic soils	D			
	Swale 7	13SW1		Swales	Lateritic podzolic soils	D			
	Swale 8	13SW2			NSG	D			
	Swale 9	13SW3			Yellow podzolic soils	D			
321231	Crest 4	21C	Granodiorite	Crest with granite	Yellow podzolic soils	D)))))))))))))))	Strongly acid Strongly to slightly acid	B C/D B B B
	Long slope 4	21LS		Long slope	Yellow podzolic soils	D			
	Drain line 1	21DL1		Alluvium	Yellow podzolic soils	D			
	Drain line 2	21DL2			NSG	Gn			
	Drain line 3	21DL3			Yellow podzolic soils	D			
352123	Broad crest 5	52BC	Basalt		Broad crest	NSG	D))))))	Slight acid passing to slightly alkaline
	Broad crest 6	52BC		Grey clay of the grey, brown and red clays	Gn				
254112	Flat 2	54F1	Quaternary fluvialite siliceous deposits, usually overlaid by calcareous dust	Prior stream levees	Red brown earth	D))))))))))))))))))	Slight acid surface passing to very strongly alkaline	B/C C/D B/C C/D C/D
	Flat 3	54F2		Flat plain	Solodized solonetz and solodic soils	D			
	Flat 4	54F3		Prior stream levees	Solodic soils	D			
	Flat 5	54F4		Flat plain	Red brown earth	D			
	Flat 6	54F5		Flat plain	Red brown earth	D			
					Flat plain	Grey brown clay of the grey, brown and red clays			

* Estimated from permeability by Soil Conservation Authority

XX Soils classified to the Division and sometimes Sub-Division levels

(a) Drainage Class: subjective assessment of surface and soil permeability (A) rapid, (B) moderate; (C) low; (D) very low

(b) Reaction: very strongly acid pH 4.5-4.9; Strongly acid, pH 5.0-5.5; Moderately acid, pH 5.6-6.0
Slightly acid, pH 6.1-6.9; Neutral, pH 7.0
Slightly alkaline, pH 7.1-7.9; Moderately alkaline, pH 8.0-8.5
Strongly alkaline, pH 8.6-9.0; Extremely alkaline, greater than 9.5
Very strongly alkaline, pH 9.1-9.5

(c) Northcote, K.H. (1960) – A factual key for the recognition of Australian Soils. 3rd Ed. (Rellim; Glenside SA)

(d) Great Soil Groups are based on Stace et al (1968). "A Handbook of Australian Soils" (Rellim; Glenside SA)

Appendix 2 – Surface Texture, profile pH Range and average profile chloride (Cl) % for the main soils in Bendigo District.

Map No.	Hole No.	Soil texture of A Horizons	Profile pH Range	Average profile Cl % x 10 ⁻³
Land System 212131				
<i>Flat and Gentle Slope</i>				
Map 2	10	Cl-LC	6.1-8.3	30
	12	Cl	6.1-9.0	5
	13	LC	7.6-9.0	9
	18	Fscl	6.5-8.8	9
<i>Sharp Crest</i>				
	21	Cl	6.3-9.3	22
Land System 213131				
<i>Flat</i>				
Map 1	1	Fscl	6.0-7.7	8
	5	Fscl	5.4-6.0	8
	16	Fscl	5.4-6.9	35
Map 2	17	Cl	7.6-7.9	39
Map 1	39	Sl	7.0-8.6	23
<i>Crest</i>				
Map 1	2	SC	5.7-7.8	45
	3	Fsc	5.7-4.8	43
	8	Fsc	5.5-5.7	13
	19	Cl	5.9-5.3	32
	20	Fscl	4.5-6.1	61
	22	Fscl	4.4-7.9	66
	37	Fscl	7.1-9.6	9
Map 2	13	LC	6.1-7.6	15
	11	Cl	7.5-7.6	5
<i>Upper Slope</i>				
Map 1	4	Fscl	5.0-6.7	81
	7	Fscl	5.2-5.9	43
	24	Fscl	6.3-7.3	5
	36	Fscl	6.1-8.6	61
Map 2	9	Fscl	6.4-9.0	12
<i>Gentle Slope</i>				
Map 1	18	Fscl	6.2-6.5	273
	23	Fscl	6.9-8.9	20
	32	Fscl	6.2-9.0	29
	35	Fscl	6.4-9.0	12
Land System 254112				
Map 1	33	Fscl	6.5-7.9	12
	34	LC	6.6-8.0	62
	32	Fscl	6.2-9.0	29
Map 2	14	Cl	6.5-9.6	15
	8	Scl (et)	6.5-9.6	11
Land System 321231				
<i>Drain Line</i>				
Map 1	14	Sl	6.4-7.6	32
	28	Sl (Cse)	5.9-6.1	11
	44	Sl	6.7-7.8	7

Map No.	Hole No.	Soil texture of A Horizons	Profile pH Range	Average profile Cl % x 10 ⁻³
<i>Crest</i>				
Map 1	13	Sl (Cse)	5.5-6.1	7
	30	Sl (Cse)	5.5-4.9	7
	42	L	5.5-8.5	15
Map 2	15		6.2-6.7-5.6	10
<i>Long slope</i>				
Map 1	12	Sl	6.0-5.8	8
	27	Sl	5.5-5.3	2
	29	Sl (Cse)	6.2-6.7	10
	31	ScI (gravel)	5.3-7.0	10
	45	L (gravel)	6.3-6.7-5.4	10
Land System 313132				
<i>Sharp crest</i>				
Map 1	42	L	5.5-8.5	15
<i>Gentle slope</i>				
Map 1	25	L (gravel)	5.2-5.9	4
Map 2	15	Sl	5.6-6.7	10
<i>Mid slope</i>				
Map 1	41	L (gravel)	5.5-6.5	21
<i>Swale</i>				
Map 1	43	ScI	5.7-6.9	88
Map 2	16	Cl	5.7-8.9	6
Map 2	Type 11	L (gravel)	5.9-6.3	4
Land System 352123				
Map 2	23	LC	6.3-7.7	6

Sample No	Depth (cm)	Field Texture	pH	Moisture 15 atmosphere %	Coars e Sand %	Fine Sand %	Silt %	Clay %	Loss on Acid Treatment %	Chloride % x 10 ⁻³	Organic Carbon %	Exchangeable Cations me% - milliequivalents per 100 g of soil % - percentage of total Metal Cations										CEC	
												Ca		Mg		K		Na		H			
												me%	%	me%	%	me%	%	me%	%	me%	%		
Land System 254112 (54F5): Profile 9: Map 1																							
13816	0-5	LC	6.3	11.1	15.1	31.5	19.5	28.3	1.1	11	1.7	5.6	23	3.1	13	0.8	3	0.8	3	13.7	57	24.0	
17	5-20	HC	7.0	21.6	7.9	22.7	14.2	53.6	1.2			11.2	33	7.5	22	1.0	3	2.5	7	11.4	34	33.6	
18	20-30	HC	8.5																				
19	30-50	MC	8.6																				
20	50-75	MC	8.8									3	13.2	30	14.1	32	1.1	2	4.2	10	11.6	26	44.1
21	75-100	MC	8.7																				
Land System 352123 (52BC): Profile 10: Map 2																							
13822	0-8	LC	6.7	22.5	11.0	25.7	16.3	42.5	1.6	10	2.6	12.4	39	7.3	23	1.0	3	1.3	4	9.6	30	31.6	
23	8-16	MC	7.1	26.9	9.3	18.8	13.4	57.2	1.9	10		16.5	42	11.7	30	1.4	4	1.9	5	7.7	19	39.2	
24	16-25	MC-HC	7.2																				
25	25-45	MC-HC	7.7																				
26	45-55	MC (FS)	8.5		16.4	28.1	14.4	40.6	1.4			10.8	42	9.1	35	0.6	2	3.1	12	2.4	9	26.0	
27	55-68	MC (FS)	8.9		14.4	27.3	15.0	41.4	1.8	21		10.1	38	10.6	39	5.0	2	4.3	16	1.4	5	26.9	
28	68-80	HC	8.9									11.1	34	14.0	43	0.6	2	5.5	17	1.5	5	32.7	
Land System 313132 (13SW3): Profile 11: Map 2																							
13830	0-10	GrL	6.3	4.6	27.7	48.2	8.4	11.1	0.9	5	1.2	1.2	14	1.0	12	0.2	2	0.2	2	6.0	70	8.6	
31	10-16	GrL																					
32	16-25	SCL	5.6	6.5	16.1	39.0	23.6	17.2	1.1	7		0.8	8	0.9	9	0.3	3	0.2	2	7.8	78	10.0	
33	25-45	FSC-LC	5.8																				
34	45-55	LC-MC	5.9																				
35	55-65	LC	6.0																				
36	65-85	LC	6.0																				
37	85-100	LC	6.1																				
Land System 212131 (12SC): Profile 12: Map 2																							
13838	0-8	LC	6.0	14.4	7.8	31.5	20.6	29.1	1.5	6	3.1	8.6	32	3.5	13	0.4	2	0.4	2	13.7	51	26.6	
39	8-30	HC	7.0	26.9	4.0	16.1	12.8	65.8	2.2	5		19.2	43	13.0	29	0.2	1	1.3	3	11.4	25	45.1	
40	30-60	HC	7.5																				
41	60-75	HC	8.3																				
42	75-100	SC-MD (S)	8.9									10.0	28	16.7	46	0.2	1	5.0	11	5.0	14	36.0	
Land System 212131 (12F): Profile 13: Map 2																							
13843	0-6	FSC	6.4	15.5	10.9	30.7	23.7	23.4	2.1	10	2.4	13.0	45	3.8	13	0.3	1	0.3	1	11.6	40	29.0	
44	6-20	LC	6.7							4													
45	20-40	LC	6.8	12.6	11.2	32.7	19.5	29.5	1.8	4		12.5	51	3.2	13	0.2	1	0.4	2	8.4	34	24.7	
46	40-60	MC	6.9							6													
47	60-80	MC																					
48	80-100	MC	6.6							17													
Land System 213131 (13S5): Profile 14: Map 2																							
13849	0-10	SCL	6.4	5.8	28.7	39.4	13.7	16.2	0.5	7	1.2	3.1	29	1.3	12	0.6	6	0.3	3	5.5	51	10.8	
50	10-16	SCL	6.5							11													
51	16-25	SC	6.8	12.6	20.2	30.0	13.1	38.9	0.5	16		3.2	22	4.2	29	0.8	6	1.4	10	4.8	33	14.4	
52	25-40	SC-MC (S)	7.2							22													
53	40-60	MC (S)	7.6							26													
54	60-80	MC (S)	7.8							32		2.9	16	7.8	43	1.0	6	3.7	21	2.6	14	18.0	
55	80-90	SC	8.0							38													
56	90-100	SC																					
Land System 213131 (13GS): Profile 15: Map 2																							
13857	0-11	SCL	5.9	11.7	3.3	39.6	21.9	28.2	0.9	4	3.7	0.9	5	2.2	11	0.5	3	0.4	2	15.4	79	19.4	
58	11-25	SCL (h)	5.9																				
59	25-40	MC (S)	6.0	11.5	10.7	37.8	16.6	36.3	0.6	4		0.2	2	3.3	27	0.5	4	0.6	5	7.5	62	12.1	
60	40-55	MC (FS)	6.4																				
61	55-60	SC	6.3																				
62	60-90	SiC	6.3									0.2	2	4.2	41	0.3	3	1.3	13	4.1	41	10.1	

Appendix 4 – Site Localities

Soil Type	Profile No.	Locality (Standard Reference)	Map Sheet
13S2	1	BV512302	Scale 1:100,000 Bendigo sheet 7724 Vic Edition 2-AAS Series R 652
13SC	2	BV49299	
13GS	3	BV486299	
21LS	4	BV509143	
21C	5	BV468108	
21LS	6	BV432363	
54F2	7	BV375515	
54F1	8	BV387515	
54F5	9	BV404516	
52BC	10	CV784253	Scale 1:100,000 Heathcote sheet 7824 Vic Edition 2-AAS Series R 652
13SW3	11	CV802262	
12SC	12	CV954346	
12F	13	CV966349	
13SF	14	CV861365	
13GS	15	CV876324	