Soils of the Nangiloc-Colignan Irrigation Area

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ABSTRACT

This report represents the results of a detailed soil survey of the Nangiloc-Colignan irrigation area in north western Victoria. The basic mapping unit used was the soil type. The soil type maps accompanying the report are contained in an envelope at the back of the folder.

Soil profiles representative of the main soil types were analysed for a number of chemical parameters which include pH, electrical conductivity (E.C.), chloride as sodium chloride, calcium carbonate, exchangeable cations, total kjeldahl nitrogen and organic carbon. Physical analysis included ultimate particle analysis. Soil salinity is discussed with regard to the various soil types.

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ACKNOWLEDGEMENTS

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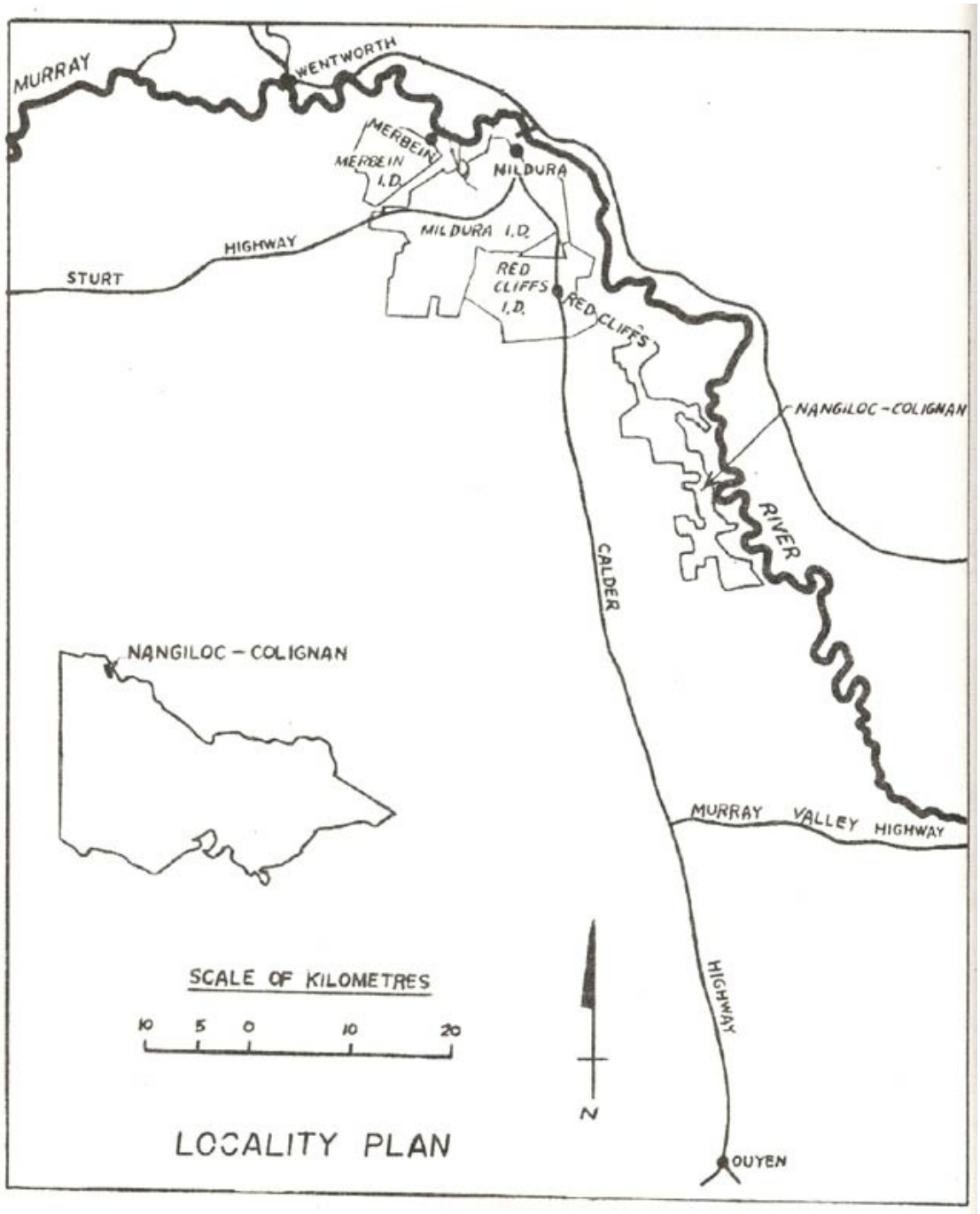
Many people in both organisations have contributed to the soil survey. However, special mention is made of officers of the then State Rivers and Water Supply Commission; Mr P Robinson, Chief Irrigation Officer and Mr A Webster, Senior Irrigation Research Officer, for organising the assistance provided, and the present and past District Engineers Messrs. I Anders, M McLean, J Bowen and other officers at the Red Cliffs District Office and at the Mildura Horticultural Research Institute, Irymple, for either directly or indirectly providing assistance of various kinds to the authors.

Among present and past colleagues in the Department of Agriculture and Rural Affairs first mention must be made of Mr W I Walbran, past Principal Soils Chemist and Mr J W Newell, past Senior Soils Officer for their supervision and valuable advice and of Dr. K I Peverill, Assistant Director Primary Industry Branch, for his assistance in editing the report. Special mention must be made of Mr J M Addison, Past Senior Analytical Chemist and his staff for carrying out the chemical analyses. Special thanks to Mrs Phil Heponstall and Ms A Dawgiert for the typing of the report.

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

To all of these people the authors extend their sincere thanks.

Figure 1 – Locality Plan



1. INTRODUCTION

This report presents the results of a detailed soil survey of about 11,000 ha of horticultural land in the County of Karkarooc, Victoria. Although field work was completed in 1975, lack of resources delayed publication until the present time.

The Nangiloc-Colignan area which includes dune ridges, swales and river flats, is about 25 km long and up to 6 km wide. The area is adjacent to the River Murray and south-east of the Red Cliffs Irrigation District in North-Western Victoria (Locality Plan). The predominant form of irrigated land use is horticulture.

The rapid expansion in this area is a reflection of the fact that Mallee type soils, which have irrigation water available close to existing settled areas, are a scarce resource in considerable demand. The area authorised for irrigation on development was 5,300 ha "net" on 155 holdings. However, the area actually irrigated in the 1977/78 season amounted to only 3,945 ha.

1.1 Original Farms and Production

The original subdivision of the area provided for leasehold tenure (at less than a dollar an acre in 1913) for returned soldiers from the First World War. Subdivision of portion of each 640 acre area of production land was made for wheat farming.

Many people were forced to leave the land during the depression in the 1930's and the land reverted to freehold in the 1960's.

Private irrigation was carried out at least as early as 1921 by Mr. Tanko at Nangiloc when he irrigated an area of about two acres (planted with vegetables) by pumping from the River Murray with a two inch hand pump.

Although citrus and vines have been grown in the area since 1928, most of the development has taken place over the 15 years prior to the survey.

Table 1 shows the areas of different land use from the 1973/74 to the 1977/78 season.

Table 1 - Areas (hectares) of Land Use Under Irrigation (1973/74 to the 1977/78 seasons)

Year	Citrus	Vine	Market Garden	Pasture & Lucerne	Orchards & Others	Total
1973/74	943	836	615	263	302	2959
1944/75	1121	1124	690	165	174	3274
1975/76	1207	1104	685	135	331	3462
1976/77	1317	1170	814	320	207	3828
1977/78	1344	1176	853	342	230	3945

Citrus and vines were the most important primary industries, i.e. together they occupied more than 60% of the irrigated land over that period.

The citrus area increased more than 6 fold between 1958 and 1978 and during the same period the vine area increased more than 39 fold.

Citrus orchards were established at Colignan, Nangiloc, Iraak and Karadoc in 1928, 1930, 1938 and 1963 respectively. The first vineyards were established at Iraak, Karadoc, Colignan and Nangiloc in 1938, 1939, 1953 and 1963 respectively. The first area planted with avocados was at Nangiloc in 1972.

2. PURPOSE AND USE

The detailed soil survey was carried out at the request of the State Rivers and Water Supply Commission in 1970, with the primary objective of assisting in any proposed drainage scheme for the area.

Because of the urgent demand by farm advisers and growers for information relevant to their particular needs, this report includes basic data on soil morphology, soil physical and chemical properties, soil salinity and sodicity.

An additional reason for the survey is its use as a guide to new areas for growing citrus and vines. The information should assist in planning drainage schemes and in assessing their influence on soil salinity. The survey was commenced in late 1970 and was completed in 1975.

Maps and map legends enable soil types and many individual features of the soils to be identified at any point without reference to the text. Detailed technical data are given in the appendices. The "index to sheets" is contained both in the report (see page 65) and in the envelope containing the soil maps.

2.1 Advice on How to Use the Report

2.1.1 Locate your property

To find your property on the soil map, first turn to the "index to soil map" sheets at the back of the report (see page 65). This is a small plan of the whole area with the soil map sheets shown as numbered rectangles. From key features on the plan, locate the approximate position of your property and note the rectangle number. The soil maps are contained in a separate envelope. Refer to the soil map with this number. The roads and the parish allotment numbers will enable you to locate your property. Mark its outline on the soil map, remembering to consider the scale. Where map sheets overlap, the edges of the overlapping sheets have been marked as dashed boundaries. This enables the area mapped into soil units to be seen as continuous throughout the Nangiloc-Colignan district.

In areas where expansion was considered much less likely site density was reduced resulting in fewer soil map boundaries per unit area. For each of the 8 soil map sheets where this situation occurred the borders between areas mapped using different site densities are indicated.

2.1.2 Know your soil types

You can learn more about your own soil types and other map units in the section "Description of the Soil Types". However, it is not necessary to read about all other soil types and units in the area.

As referred to in Section 3.1 (General Procedure) morphological soil types are recognised on the basis of a number of observable features e.g. colour and texture. However, it should be appreciated that because of the variations of individual features across an area and because only a very small proportion of the total soil mass is observed, even in a large scale survey, a soil map unit is never completely homogeneous for a morphological soil type. In typical large scale surveys up to one sixth of the area of a map unit may be occupied by soils other than the named soil type.

2.1.3 Reference sites

Places where soil profiles have been sampled and analysed are marked by numbered triangles on the detailed soil maps.

2.2 Advisory Services

Questions regarding irrigation and drainage layout, irrigation technique, horticulture management and soil salinity should be discussed with extension officers of the Department of Agriculture and Rural Affairs at Mildura and State Rivers and Water Supply Commission, Red Cliffs. With regard to disposal of irrigation drainage effluent, consultation with State Rivers and Water Supply Commission officer is essential since this effluent may not be disposed of to the River Murray.

3. SOIL SURVEY METHODS

3.1 General Procedure

The senior author, who was responsible for field operations, walked over the land and bored holes at intervals varying from 20 to 150m depending on the complexity of the soil pattern for the higher site density areas and varying from 100 to 400m for the lower site density areas. The soil profile at each site was exposed with a 10 cm Jarrett auger, usually to a depth of 180 cm, but sometimes to 120 cm or 270 cm and the soil classified into its soil type. To do this, the surveyor examined the various horizons

in the profile and noted their texture, friability, colour, thickness, and the visual presence of lime, iron concretions and gypsum crystals. Explanations of many of the terms used are given in Appendix I.

The soil type at each site examined was marked on an aerial photograph (scale 1:8,000) and a boundary drawn to show where one soil type changed to another. Surface features such as change of slope, depressions and rises, which often shown on aerial photos, were helpful in determining where the change had occurred. However, it should be appreciated that a soil boundary line shown on a soil map represents a zone of transition. This zone may be narrow which means that the soil change covers only a few metres, or it may be gradual with the transitional zone extending over 20 or more metres.

Preliminary soil maps at a scale of 1:8,000 were constructed by transferring soil boundaries from aerial photographs to suitable base plans. These are the relevant standard areas of the Military Map Series with the parishes and allotments shown.

It has been necessary to reduce the size of the soil maps for publication, consequently, the scale of the maps in this report has been reduced to 1:16,000.

3.2 Routine Sampling and Analysis

During the coarse of the survey, samples were collected for salt analysis from three standard depths from each of 4,900 sites. The standard depths for collection were 30-60, 90-120 and 150-180 cm. The only analysis carried out was chloride subsequently reported as sodium chloride percentage.

3.3 Analyses of Typical Soils

Comprehensive laboratory analyses for physical and chemical properties were carried out on soils sampled at 41 sites considered to be representative of soil types. Data from these analyses are presented in Appendix II. Sixteen of the sites were grassland which had never been cultivated or had been worked to only a small extent many years earlier.

The analytical methods used are referred to in Appendix III. Further detail is contained in the State Chemistry Laboratory's Chemical Methods Book. All analyses were carried out in air-dried soil passing through a 2 mm sieve. For organic carbon and total nitrogen determinations, the samples were ground until all material passed through a 0.2 mm diameter sieve. All results except pH and gravel are reported on an oven-dry basis. Gravel is reported as a percentage of the field sample.

4. SOIL MORPHOLOGY AND SOIL TYPES

4.1 General Characteristics of the Soils

The Nangiloc-Colignan irrigation area, as a whole, is not comparable with Merbein, Red Cliffs or Robinvale in terms of most of the soil types present, although certain soil types are common to all areas. Most of the soils belong to the "Solonized brown soil" group (Prescott, 1944), earlier known as "Mallee soils" (Prescott, 1931). General features of this group of soils are the brown colour and alkaline nature of the soil profile, the presence of calcium carbonate and soluble salts increasing with depth, and the presence of a significant proportion of sodium in the ion exchange complex.

The lightest textured soil types are found on the east west dunes. The textures are sand overlying sandy loam or sandy clay loam. The interdune and hollow soil have surface textures varying from sand to sandy clay while the subsoils vary in texture from sandy clay loam to heavy clay. This pattern of textural gradation occurs where there are sequences of parallel ridges. Coarseness is conferred on the soil textures generally by a high proportion of coarse sand in the sand fraction, together with a near absence of particles of silt size.

Whilst brown and red-brown are the dominant soil colours, some soils are dull brown or grey. The more extensive areas of such soils are associated with depressions of flat situations.

The distribution of calcium carbonate is variable. Much of the calcium carbonate is present as lime concretions. The depth at which lime appears in quantity is usually from about 45 to 120 cm from the surface, however, there are some soils with limestone at, or just beneath the surface. Soils with lime concretions increase from south to north.

4.2 Description of the Soil Types

Sixty-two soil types and eighteen soil phases were identified and mapped.

The profiles described represent averages for the soil types and phases recorded in this survey. Variations from the normal profile are indicated where these occur.

The soil types have been divided into eight groups corresponding to eight landscape units as follows:

Unit A – Soils of the sand dunes
Unit B – Soils of the sandy flats and interdune hollows
Unit C – Soils of the Black Box flats
Unit D – Soils of the Red gum flats
Unit E – Soils of the Flood Plain
Unit F – Soils of the Lunettes
Unit G – Soils of the Swamps

4.2.1 Unit A – Soils of the sand dunes

The surface textures of the soil types in this unit are not heavier than sandy loam, while the deep subsoils vary in texture from sand to sandy clay. The unit contains the following soils:

Barmera sand
Barmera sandy loam
Barmera sandy loam, shallow phase
Berrama sandy loam
Berrama sandy loam, shallow phase
Berri sand
Moorook sand
Moorook sandy loam
Murray sand
Murray sand, deep phase
Murray sand, shallow phase
Nowingi sand
Nowingi sand, shallow phase
Winkie sand
Winkie sand, deep phase
Type C
Type 1
Type 2
Type 3
Type 16
Type 17
Type 18

SOIL DESCRIPTIONS

Barmera sand

This type occurs on the middle and lower slopes of the sand dunes.

0 – 20 cm Dull brown sand.

20 – 60 cm Reddish brown loamy sand to sandy loam

60 – 90 cm Reddish brown to light brown sandy clay loam; moderate to light hard and soft lime.

Barmera sandy loam

This type also occurs on the middle and lower slopes of the dunes.

0 – 15 cm	Brown to dull brown loamy sand to sandy loam.
15 – 75 cm	Reddish brown to brown sandy loam.
75 – 150 cm	Reddish brown to light brown sandy clay loam; moderate to light hard and soft lime.
150 – 175 cm	Light brown or yellowish brown sandy clay loam to sandy clay; moderate hard and soft lime.

Barmera sandy loam, shallow phase

This type occurs on the lower slopes of the sand dunes.

0 – 20 cm	Dull brown to brown sandy loam.
20 – 60 cm	Dark red-brown to reddish brown sandy loam.
60 – 110 cm	Reddish brown sandy clay loam; slight to moderate hard and soft lime.
110 – 175 cm	Reddish brown to light brown sandy clay; moderate hard and soft lime.

Berrama sandy loam

This soil type is widespread in the area, occurring on the crests of the lower sand ridges and the higher and mid-slopes of the sand dunes.

0 – 30 cm	Dull brown to yellowish reddish brown sandy loam.
30 – 120 cm	Red-brown to light brown light sandy clay loam to sandy clay loam; moderate to light hard and soft lime.
120 – 150 cm	Light brown or reddish brown with grey-brown mottled light sandy clay loam to sandy clay loam; light hard and soft lime.
150 – 175 cm	Reddish brown or light brown, frequently mottled with yellowish brown and light yellowish brown and light yellowish greyish brown, sandy loam or loamy sand; moderate to light hard and soft lime.

Sandy clay occasionally occurs between 90 and 120 cm.

Berrama sandy loam, shallow phase

This soil type occurs on the gentle slopes of the lower sand ridges.

0 – 30 cm	Dull brown loamy sand.
30 – 60 cm	Light brown light sandy clay loam; heavy hard lime.
60 – 90 cm	Light brown light sandy clay loam; light to heavy hard and soft lime.
90 – 155 cm	Yellowish brown with slight yellowish grey mottled sandy clay loam to sandy loam; hard and soft lime.
155 – 175 cm	Yellowish brown or light brown with grey brown and slight yellowish grey mottled light sandy clay loam to sandy loam; moderate to light hard and soft lime.

Berri sand

A small area of this soil type occurs on the lower slopes of a sand dune below Murray sand.

0 – 20 cm	Dull brown sand
20 – 60 cm	Light reddish brown or brown sand.
60 – 110 cm	Light brown sand or sandy loam.
110 – 175 cm	Red-brown or light brown sandy clay loam; slight to light lime; sometimes weakly cemented; rarely with slight rubble.

The depth of the surface horizon can vary from 20 to 30 cm.

Moorook sand

This soil type occurs on the crests of the sand dunes.

0 – 30 cm	Greyish brown sand to loamy sand.
30 – 60 cm	Dull reddish brown loamy sand to sandy loam; slight hard and soft lime.
60 – 150 cm	Light grey-brown, or light brown with grey-brown, sandy loam to light sandy clay loam; light to heavy hard and soft lime.
150 – 175 cm	Light brown, or light grey-brown with grey-brown, sandy loam to loamy sand; moderate to light lime.

Moorook sandy loam

This soil type occurs on the upper moderate slopes of the sand dunes.

0 – 30 cm	Grey-brown loamy sand to sandy loam.
30 – 60 cm	Grey-brown to yellowish greyish brown sandy loam to light sandy clay loam; moderate to light hard and soft lime.
60 – 175 cm	Light yellowish brown, or yellowish brown with grey-brown, sandy clay loam to light sandy clay loam; light hard and soft lime. Sandy loam occasionally occurs at 120 cm and continues to 180 cm.

Murray sand

In this area, Murray sand occurs on slopes below Murray sand deep phase, Winki sand deep phase, and Nowingi sand deep phase. It also occurs in hollows on the sand dunes.

0 – 12 cm	Brown to dull brown sand.
12 – 145 cm	Light red-brown to light brown sand.
145 – 175 cm	Red brown to yellowish reddish brown sandy loam; trace to slight soft lime.

The immediate surface horizon can vary from 15 to 30 cm in depth.

Murray sand, deep phase

This phase is widespread in the area, occurring on the crests and slopes of the sand dunes.

0 – 12 cm Dull brown to brown sand.

12 – 65 cm Red-brown to brown sand.

65 – 175 cm Reddish brown to yellowish reddish brown sand.

The surface horizon can vary from 15 cm to 30 cm in depth.

Murray sand, shallow phase

This soil type occurs on the higher and mid-slopes of sand dunes.

0 – 25 cm Dull brown to loamy sand.

25 – 60 cm Reddish brown to dull brown sand to loamy sand.

60 – 90 cm Yellowish reddish brown to reddish brown loamy sand to sandy loam.

90 – 155 cm Yellowish reddish brown sandy loam; trace of soft lime.

155 – 175 cm Light brown to yellowish reddish brown light sandy clay loam to sandy clay; trace of soft lime.

Nowingi sand

This soil type is widespread in the area, occurring on the crests and slopes of the sand dunes.

0 – 25 cm Dull brown to yellowish grey-brown sand.

25 – 110 cm Greyish yellowish brown to brown sand.

110 – 175 cm Yellowish brown to light yellow-brown sand.

The surface horizon can vary in depth from 20 to 60 cm. In some situations, the subsoil below 120 cm is yellowish reddish brown in colour. Areas inscribed “heavy profile” have sandy loam from 90 to 120 cm depth. Shallow lime may be found in areas which have been affected by erosion.

Nowingi sand, shallow phase

This phase occurs on the lower slopes of the sand dunes, usually below Winkie sand, deep phase and Nowingi sand, deep phase.

0 – 30 cm Dull brown to yellowish grey-brown sand.

30 – 90 cm Greyish yellow-brown to yellowish brown sand.

90 – 120 cm Yellowish brown sandy loam.

120 – 175 cm Yellowish grey-brown to light yellow-brown light sandy loam to light sandy clay loam; sometimes a trace of lime. Shallow lime could be found in areas which have been affected by erosion.

Winkie sand

This soil type occurs on the crests and higher slopes of the sand dunes.

0 – 20 cm Brown to dull brown loose sand.

20 – 100 cm Reddish brown or yellowish reddish brown sand.

100 – 150 cm Yellowish reddish brown loamy sand; trace to slight soft loam.

150 – 175 cm Yellowish reddish brown sandy loam; slight hard and soft lime.

Winkie sand, deep phase

This soil type is widespread in the area, occurring on the crests and slopes of the sand dunes. It differs from Winkie sand in the absence of lime throughout the profile to 180 cm and in the absence of textures heavier than sand to this depth.

0 – 25 cm Brown to greyish brown sand.

25 – 175 cm Brown to yellowish reddish brown sand.

The inscription "heavy profile" covers a few occurrences where a layer of sandy loam occurs between 90 and 120 cm.

Type C

This soil type occurs in depressions between sand ridges.

0 – 25 cm Greyish brown to dull red brown loamy sand.

25 – 90 cm Red-brown sandy loam.

90 – 120 cm Red-brown sandy clay loam.

120 – 140 cm Red-brown sandy clay loam "heavy".

140 – 175 cm Red-brown sandy clay loam; slight hard and soft lime.

Type 1

This is a very minor type occurring only in two small depressions.

0 – 25 cm Brownish grey sand.

25 – 175 cm Grey-brown sand.

Type 2

This minor type is present in small areas on lower slopes or in depressions below Winkie sand or Nowingi sand, shallow phase.

0 – 12 cm Dull brown or grey-brown sand.

12 – 75 cm Yellowish reddish brown sand.

75 – 95 cm Reddish brown sand.

95 – 120 cm Yellowish greyish brown loamy sand or sandy loam; sometime slight soft lime.

120 – 130 cm Reddish brown with yellowish brown and yellowish grey mottled sandy clay loam; slight soft lime.

130 – 175 cm Greyish yellow to yellow-brown sandy clay loam; slight to moderate soft lime.

For this unit the inscription "d.p." inscriptions and deep profile on the soil map indicate that line is absent from the profile to 180 cm depth.

Type 3

This minor type occurs in depressions associated with dunes of Murray sand, deep phase.

0 – 30 cm Dull reddish loamy sand.

30 – 75 cm Reddish brown sandy clay loam.

75 – 125 cm Yellowish reddish brown sandy clay loam; slight soft lime.

125 – 170 cm Brown with yellowish brown and reddish brown mottled sandy clay loam; slight soft lime.

170 – 175 cm Yellowish grey with grey and reddish brown mottled sandy clay; moderate soft and hard lime.

Type 16

This type occurs on the crests of the sand dunes.

0 – 75 cm Yellowish reddish brown sand.

75 – 175 cm Light reddish brown loamy sand to sandy loam; moderate to light hard and soft lime.

Type 17

This type occurs on the mid and lower slopes of the sand dunes.

0 – 30 cm Dull greyish brown loamy sand.

30 – 65 cm Yellowish reddish brown loamy sand.

65 – 115 cm Reddish brown sandy loam to sandy clay loam; slight to moderate hard and soft lime.

115 – 175 cm Yellowish grey with yellowish brown and brown mottled sandy clay loam or sandy clay; moderate hard and soft lime.

Type 18

This type occurs on the lower slopes of the sand dunes.

0 – 8 cm Brown loamy sand.

8 – 75 cm Grey-brown loamy sand.

75 – 105 cm Grey-brown sandy clay loam.

105 – 130 cm Yellowish brown with reddish brown and yellowish grey mottled sandy clay loam; slight hard lime.

130 – 170 cm Red-brown with yellowish brown and yellowish grey sandy clay loam; slight hard lime.

170 – 175 cm Reddish brown with yellowish brown and slight yellowish grey mottled sandy clay loam; moderate hard lime.

4.2.2 Unit B – Soils of the sandy flats and interdune hollows

The surface textures of the soil types in this unit vary from sand to sandy clay, while the subsoils may vary in texture from sandy clay loam to heavy clay. The Unit contains the following soils:

Belar clay loam
Chalka sand
Chalka sand, light deep subsoil phase
Chalka sandy loam
Kamka sandy loam
Kamka sandy loam, shallow phase
Coomeala sandy loam
Coomeala sandy loam, light deep subsoil phase
Coomeala loam
Nangiloc sandy loam
Nangiloc sandy clay loam, shallow phase
Nangiloc sandy clay loam, shallow phase, light deep subsoil
Nangiloc sandy clay
Nookamka sandy loam
Type 4
Type 5
Type 6
Type 7
Type 8
Type 9
Type 10
Type 11
Type 12
Type 13
Type 19
Type 20
Type d1
Type d2
Type d3
Type d4
Type d5

SOIL DESCRIPTIONS

Belar clay loam

This soil type occurs at the lowest elevation in broad flat hollows between sand ridges.

0 – 20 cm Dark red-brown sandy clay loam.

20 – 50 cm Red-brown medium clay.

50 – 160 cm Reddish brown medium clay; moderate to light hard lime.

160 – 175 cm Reddish brown light clay; moderate hard lime.

Chalka sand

This soil type occurs in broad hollows between sand dunes.

0 – 10 cm	Brownish grey to grey sand.
10 – 30 cm	Light brownish grey sand; weakly bleached in the lower part of the horizon.
30 – 60 cm	Light yellowish grey sandy clay; traces of soft lime.
60 – 75 cm	Yellowish brown with light yellowish grey mottling sandy clay; heavy soft lime in pockets.
75 – 150 cm	Light yellowish grey with yellowish brown and red-brown mottled sandy clay' lime and scattered manganiferous concretions.
150 – 175 cm	Grey with yellowish brown mottled sandy medium clay; moderate soft and hard lime.

In the area inscribed "deep surface", the depth to the B horizon is about 50 cm. The areas inscribed "sandy loam surface" are identical with Chalka sand except that the surface horizons have sandy loam to loamy sand textures.

Chalka sand, light deep subsoil phase

This phase occurs in broad hollows between sand dunes either alone or at slightly higher levels than Chalka sand.

0 – 25 cm	Brownish grey sand weakly bleached in the lower part.
25 – 60 cm	Grey with grey-brown mottled sandy clay; slight soft lime.
60 – 90 cm	Yellowish brown with reddish brown, yellowish grey and grey mottled sandy clay loam; slight soft lime.
90 – 160 cm	Yellowish brown with grey mottled sandy clay loam or sandy loam; slight soft lime.
160 – 175 cm	Yellowish grey with grey and yellowish brown mottled sandy loam; slight soft lime to 180 cm then light hard lime to 185 cm.

Chalka sandy loam

0 – 25 cm	Grey sandy loam.
25 – 35 cm	Light yellowish grey sandy clay loam.
35 – 65 cm	Yellowish grey sandy clay to medium clay sandy; slight hard lime.
65 – 145 cm	Light yellowish grey medium clay sandy; moderate to heavy hard lime.
145 – 175 cm	Yellow brown with yellowish grey mottled sandy clay; slight hard and soft lime.

Coomealla sandy loam

This soil type occurs on the lower slopes of the sand dunes.

0 – 25 cm	Dull brown to greyish brown sandy loam.
25 – 40 cm	Grey-brown sandy clay loam; slight to moderate hard and soft lime.
40 – 90 cm	Greyish brown sandy clay loam to sandy clay; moderate to light hard and soft lime.

90 – 150 cm Light brown or yellowish brown with grey-brown mottled sandy clay loam to sandy clay, occasionally medium clay sandy; moderate hard and soft lime.

150 – 175 cm Light brown or yellowish brown with grey-brown and sometimes yellowish grey mottled sandy clay loam to sandy clay; slight to moderate hard and soft lime.

Coomealla sandy loam, light deep subsoil phase

This soil phase occurs on intermediate slopes.

0 – 25 cm Dull brown to grey brown sandy loam.

25 – 40 cm Grey-brown light sandy clay loam to sandy clay loam; trace to slight hard and soft lime.

40 – 90 cm Grey-brown sandy clay loam to sandy clay; moderate to heavy hard and soft lime.

90 – 150 cm Light brown or yellowish brown sandy clay loam; moderate hard and soft lime.

150 – 175 cm Yellowish greyish brown or light brown occasionally mottled with yellowish brown and yellowish grey light sandy clay loam or sandy loam; slight hard and soft lime.

Coomealla loam

This soil type occurs on the lower slopes and in hollows between the sand dunes.

0 – 30 cm Grey brown sandy clay loam or clay loam; trace to slight hard and soft lime.

30 – 65 cm Greyish brown to grey brown fine sandy clay loam to light clay; light to heavy hard and soft lime.

65 – 90 cm Yellowish brown, sometimes mottled with yellowish greyish brown and slight yellowish grey sandy clay or medium clay sandy; light hard and soft lime.

90 – 175 cm Yellowish brown with yellow-brown and slight yellowish grey sandy clay to medium clay; slight to moderate hard and soft lime.

Kamka sandy loam

This soil type occurs on the lower slopes of high dunes, gentle slopes of low dunes and in hollows between sand dunes.

0 – 25 cm Dull brown to brown loamy sand to sandy loam.

25 – 45 cm Reddish brown or red-brown sandy clay loam.

45 – 85 cm Reddish brown sandy clay loam or sandy clay; sometimes slight hard and soft lime.

85 – 175 cm Reddish brown, red-brown or light brown sandy clay loam or sandy clay; moderate to light hard and soft lime.

For this unit the inscription “ds” on the soil map indicates that the depth to sandy clay loam is about 45 cm.

Kamka sandy loam, shallow phase

This soil type occurs on the lower slopes of high dunes, gentle slopes of low dunes and in hollows between sand dunes.

0 – 25 cm	Dull brown to brown sandy loam.
25 – 55 cm	Reddish brown to red-brown sandy clay loam.
55 – 125 cm	Reddish brown, sometimes mottled with red-brown and brown, sandy clay; moderate hard and soft lime.
125 – 175 cm	Reddish brown or light brown sandy clay or sandy clay loam; moderate hard and soft lime.

For this unit the inscription “ss” on the soil map indicates that the depth to sandy clay is only about 20 cm.

Nangiloc sandy loam

This soil type occurs on the gentle slopes of low dunes and in the hollows between sand dunes.

0 – 20 cm	Dull red-brown to brown loamy sand to sandy loam.
20 – 55 cm	Red-brown to dull brown sandy loam or sandy clay loam.
55 – 115 cm	Red-brown to brown sandy clay loam to sandy clay; moderate to light hard and soft lime.
115 – 130 cm	Grey-brown or yellow-brown, with yellowish grey and brown mottled sandy clay or medium clay; moderate to heavy hard and soft lime.
130 – 175 cm	Yellowish grey or grey, with reddish brown and yellowish brown mottled medium clay; moderate to heavy hard lime.

Nangiloc sandy clay loam

This soil type occurs in hollows between sand dunes and in depressions

0 – 20 cm	Brown sandy loam or sandy clay loam.
20 – 40 cm	Brown to reddish brown sandy clay loam or clay loam.
40 – 60 cm	Reddish brown light clay.
60 – 120 cm	Reddish brown light clay to medium clay; moderate hard and soft lime.
120 – 150 cm	Yellowish brown with yellowish grey, brown and light brown mottled medium clay; moderate hard lime.
150 – 175 cm	yellowish grey, or greyish yellow with yellowish brown, brown and reddish brown mottling, or greyish brown and grey mottled, light clay or medium clay; moderate to light hard lime.

Nangiloc sandy clay loam, shallow phase

This soil type occurs in flat hollows between sand dunes.

0 – 20 cm	Dull red-brown to dull greyish brown sandy loam to sandy clay loam.
20 – 30 cm	Red-brown to reddish brown sandy clay loam to sandy clay.
30 – 90 cm	Reddish brown to greyish brown sandy clay loam to sandy clay; moderate to heavy hard and soft lime.
90 – 120 cm	Brown with yellowish grey mottled, or brownish yellow-grey variously mottled sandy clay; moderate to light hard lime.
120 – 135 cm	Yellowish grey with yellowish brown and brown mottled sandy clay; slight to moderate hard lime.
135 – 175 cm	Yellowish grey with yellowish brown mottled light clay to medium clay; slight to moderate hard lime.

Nangiloc sandy clay loam shallow phase, light deep subsoil

The description of this soil type is similar to Nangiloc sandy clay loam shallow phase to 145 cm depth, below which soil with the following description occurs.

145 – 172 cm	Yellow brown with yellowish grey mottled sandy clay.
172 – 175 cm	Red brown sandy loam.
175 – 200 cm	Light yellowish grey silty clay.

Nangiloc sandy clay

This soil type occurs in flats and hollows between sand dunes and in depressions.

0 – 15 cm	Reddish brown to brown sandy clay loam or sandy clay.
15 – 50 cm	Brown to light brown light to medium clay; slight to moderate hard lime.
50 – 75 cm	Reddish brown to light brown light clay or medium clay; moderate to heavy hard lime.
75 – 115 cm	Yellowish brown light clay to medium clay; light hard lime.
115 – 175 cm	Yellowish brown with yellowish grey, or yellow-grey variously mottled medium clay to heavy clay; slight to moderate hard lime.

Nookamka sandy loam

This soil type occurs in hollows between sand dunes.

0 – 25 cm	Reddish brown loamy sand.
25 – 50 cm	Reddish brown sandy loam.
50 – 90 cm	Reddish brown to light reddish brown sandy clay loam; slight to moderate hard and soft lime.
90 – 175 cm	Reddish brown to light brown sandy clay; moderate hard and soft lime.

Type 4

This soil type occurs on small flat areas near the Murray River and in broad hollows between sand dunes.

0 – 60 cm	Brownish grey to grey-brown sand.
60 – 105 cm	Yellowish brown with yellow-brown and grey mottled sandy loam; weakly bleached in the upper part.
105 – 115 cm	Yellowish brown with yellow-brown sandy clay loam or sandy clay; trace of soft lime.
115 – 150 cm	Light yellow-grey with yellow-brown mottled sandy clay loam or sandy clay, the light grey component decreasing with depth; slight soft lime.
150 – 175 cm	Light yellow-grey with yellow-brown and red-brown mottled sandy clay loam or sandy clay; hard and cemented when dry.

The surface horizon can vary in depth from 60 to 90 cm.

Type 5

This minor type occurs on lower slopes and in hollows between Winkie sand deep phase, and Nowingi sand deep phase.

0 – 40 cm	Dull brown or reddish brown sand.
40 – 100 cm	Light brown to reddish brown sand or sandy loam.
100 – 140 cm	Reddish brown with slight yellowish brown or yellowish grey mottled sandy loam.
140 – 175 cm	greyish yellow sandy loam or sandy clay loam; trace to slight hard and soft lime; medium to heavy clay textures occur between 185 and 205 cm.

The surface horizon can vary from 25 to 60 cm in depth.

Type 6

This is a very minor type occurring in hollows between sand dunes.

0 – 30 cm	Reddish brown loamy sand.
30 – 35 cm	Light brown loamy sand; weakly bleached.
35 – 60 cm	Brown with yellowish brown mottled sandy clay loam or sandy clay.
60 – 120 cm	Yellowish brown with yellowish grey and brown mottled sandy clay loam or sandy clay; slight soft lime.
120 – 170 cm	Greyish yellow with yellowish grey mottled sandy clay loam to sandy clay; moderate hard lime.
170 – 175 cm	Yellowish grey with grey and yellowish brown mottled sandy clay loam; light hard lime.

Type 7

This minor type occurs in broad hollows between sand dunes.

0 – 25 cm	Greyish brown sandy loam
25 – 60 cm	Brown loamy sand to sandy loam
60 – 90 cm	Brown or reddish brown with brown and yellowish grey mottled sandy clay loam; sometimes slight lime.
90 – 115 cm	Reddish brown with yellowish brown and yellowish grey mottled sandy clay loam or sandy clay; slight soft and hard lime.
115 – 175 cm	Yellowish grey with grey, yellowish brown and reddish brown mottled sandy clay loam or sandy clay; slight hard lime.

Sandy clay always occurs before 150 cm.

Type 8

This minor type occurs on slopes below Nowingi sand shallow phase and in the hollows between sand dunes.

0 – 10 cm	Dull greyish brown sandy loam.
10 – 25 cm	Greyish brown sandy loam
25 – 45 cm	Mottled reddish brown and yellowish brown sandy clay loam.
45 – 60 cm	Light yellowish brown with brown and reddish brown mottled sandy clay loam or sandy clay; slight soft and hard lime.
60 – 90 cm	Yellowish brown with reddish brown sandy clay loam.
90 – 175 cm	Light yellow-grey with yellowish brown heavy clay; slight to light lime.

The heavy clay horizon may occur as deep as 120 cm.

Type 9

This minor type occurs on the lower slopes and in the less pronounced depressions between sand dunes.

0 – 30 cm	Dull brown sandy loam.
30 – 45 cm	Red-brown sandy clay loam; slight soft lime.
45 – 60 cm	Red-brown sandy clay loam.
60 – 100 cm	Light reddish brown sandy clay; moderate soft and hard lime.
100 – 120 cm	Brown sandy clay; moderate soft and hard lime; impenetrable.

Type 10

This minor type occurs in hollows between sand dunes.

0 – 35 cm	Dull brown sandy loam.
35 – 75 cm	Brown with yellowish brown and grey mottled sandy clay; slight soft lime.
75 – 175 cm	Yellowish brown with yellowish grey and brown mottled sandy clay; moderate hard lime.

Type 11

A very minor type occurring in broad hollows between sand dunes.

0 – 25 cm	Brownish grey to grey-brown sand.
25 – 55 cm	Light grey to light brownish grey sand.
55 – 90 cm	Yellowish grey with grey mottled sandy clay; slight soft lime.
90 – 140 cm	Yellowish brown with yellowish grey and grey mottled sandy clay; slight hard and soft lime.
140 – 175 cm	Yellowish brown and light yellowish grey medium clay; light soft and hard lime.

The surface horizon can vary from 25 to 40 cm in depth.

Type 12

This minor type occurs in pronounced depressions in areas of Chalka sand.

0 – 23 cm	Brownish grey sandy loam.
23 – 38 cm	Yellowish grey sandy clay loam.
38 – 53 cm	Yellow-grey sandy clay.
53 – 63 cm	Yellow-grey with yellow-brown mottled medium clay.
63 – 88 cm	Yellow-brown and yellow-grey with slight red-brown mottled sandy clay; light to moderate hard lime and small black concretions.
88 – 120 cm	Yellowish brown and yellowish grey with reddish brown mottled sandy clay to sandy clay loam; slight hard lime and soft black concretions
120 – 170 cm	Light yellowish grey with reddish brown mottled sandy clay loam to sandy clay; slight hard lime.
170 – 175 cm	Yellowish brown with grey and brown mottled medium clay; light to moderate hard lime.

Type 13

This is a very minor type occurring only in two small depression areas.

0 – 10 cm	Grey-brown sandy loam.
10 – 30 cm	Brown, or yellowish brown with grey-brown mottled light clay; slight soft and hard lime.
30 – 50 cm	Greyish reddish brown light clay; slight soft and hard lime.
50 – 120 cm	Red brown to brown light clay; light hard lime; impenetrable.

Type 19

This minor type occurs on gentle slopes of the sand dunes.

0 – 10 cm	Grey-brown sandy loam to sandy clay loam.
10 – 50 cm	Grey-brown sandy loam to sandy clay loam; slight hard and soft lime.
50 – 90 cm	Greyish brown sandy clay loam to clay loam; slight hard and soft lime.
90 – 125 cm	Light brown or yellowish brown sandy clay loam or light clay; moderate hard and soft lime.
125 – 175 cm	Yellowish grey-brown with yellowish grey and yellowish brown sandy clay loam to sandy clay; slight to moderate hard and soft lime and slight gypsum.

Type 20

This is a very minor type occurring in two small areas on lower slopes and in hollows between the sand dunes.

0 – 25 cm	Brown sandy loam.
25 – 50 cm	Brown fine sandy clay loam.
50 – 90 cm	Brown light clay; slight hard lime.
90 – 110 cm	Yellowish brown with yellowish grey mottled light clay to medium clay; slight hard lime and slight gypsum.
110 – 145 cm	Yellowish grey with yellowish brown mottled heavy clay; slight gypsum.
145 – 175 cm	Yellowish grey with yellowish brown fine sandy clay with mica.

Type di – Light profile depression soils

These soils occur near the bottom of slopes or on flats between sand dunes.

0 – 15 cm	Grey-brown to brownish grey sandy loam.
15 – 30 cm	Light grey-brown or yellowish grey fine sandy clay loam.
30 – 40 cm	Light greyish brown or yellowish grey fine sandy clay; slight soft and hard lime.
40 – 70 cm	Greyish brown or yellowish grey sandy clay; moderate soft and hard lime.

70 – 90 cm Greyish brown or yellowish grey with slight brown sandy clay; slight to moderate soft and hard lime.

90 – 100 cm Yellowish grey with yellowish brown mottled sandy clay; slight soft lime.

100 – 120 cm Yellow brown with yellowish grey fine sandy clay; slight hard lime.

120 – 175 cm Yellowish grey with yellowish brown mottled fine sandy clay; light soft and hard lime.

Type d2 – Heavy brown depression soils

These soils occur in depressions between sand dunes.

0 – 30 cm Brown to dull brown sandy loam or sandy clay loam.

30 – 55 cm Red-brown to reddish brown sandy clay to medium clay sandy; moderate soft and hard lime.

55 – 110 cm Reddish brown with brown and light brown mottled sandy clay to medium clay sandy; moderate hard and soft lime.

110 – 175 cm Red-brown with reddish brown and light brown mottled sandy clay; slight hard and soft lime.

Type d3 – Grey and grey-brown depression soils

These soils are widely distributed and occur in hollows between sand dunes and on black box flats.

0 – 10 cm Grey brown or grey sandy clay loam, occasionally light clay.

10 – 40 cm Dark grey light clay to medium clay; slight hard lime.

40 – 60 cm Yellowish grey medium clay; slight hard and soft lime.

60 – 100 cm Yellowish brown with yellowish grey mottled light clay to medium clay; light to moderate hard and soft lime.

100 – 168 cm Yellowish brown with yellowish grey mottled light clay to medium clay; light to moderate hard and soft lime.

168 – 175 cm Yellowish grey with slight yellowish brown mottled heavy clay; slight soft lime.

"Gypseous" on the soil map indicates that gypsum is present in the profile at the depth varying from 70 to 150 cm.

Type d4 – Heavy depression soils with light deep subsoils

These soils occur in hollows between sand dunes.

0 – 20 cm Grey brown to grey sandy clay loam to sandy clay.

20 – 100 cm Yellowish grey brown to yellowish grey medium clay; slight hard and soft lime.

100 – 140 cm Yellowish grey with yellowish brown mottled sandy clay; moderate hard and soft lime.

140 – 160 cm Yellowish grey with yellowish brown mottled sandy clay loam; slight to moderate hard and soft lime.

160 – 175 cm Yellowish brownish grey with yellowish grey and yellowish brown mottled silty clay loam to clayey sand sometimes with mica.

Type d5

0 – 25 cm Grey to yellowish grey sandy clay loam to sandy clay.

25 – 60 cm Yellowish grey with yellowish brown mottled medium clay or medium clay sandy; slight hard and soft lime.

60 – 125 cm Reddish brown with yellowish grey and yellow– grey medium clay; moderate hard and soft lime

125 – 175 cm Yellowish grey with light brown medium clay to heavy clay; moderate to heavy hard lime.

4.2.3 Unit C – Soils of the black box flats

The surface textures of the soil types in this unit range from sandy clay to medium clay, while the subsoils vary from sandy clay to heavy clay in texture. The unit contains the following soils:

Colignan clay
Colignan clay, light profile phase
Type 14
Type 15

SOIL DESCRIPTION

Colignan clay

This soil type occurs on the box flats adjoining the Murray River or its present flood plain.

0 – 8 cm Brownish grey light clay.

8 – 20 cm Grey heavy clay.

20 – 40 cm Grey heavy clay; trace of soft lime.

40 – 60 cm Slightly yellowish grey heavy clay; trace of soft lime.

60 – 110 cm Yellowish grey heavy clay; slight soft lime.

110 – 130 cm Yellowish grey with yellowish brown mottled heavy clay; trace to slight hard lime.

130 – 150 cm Yellowish grey with yellowish brown and yellow-brown mottled heavy clay; slight hard lime; manganiferous inclusions.

150 – 170 cm Yellowish brown with light grey mottled medium clay; slight hard lime.

Colignan clay, light profile phase

This phase occurs with Colignan clay at a slightly higher level.

0 – 8 cm Brownish grey medium clay.

8 – 30 cm Slightly yellowish grey heavy clay; trace of hard lime.

30 – 68 cm Yellowish grey heavy clay; trace of hard lime.

68 – 95 cm Yellowish grey with slight yellow-brown mottled heavy clay; sand veins and slight soft lime.

95 – 113 cm Grey with yellow-brown heavy clay; slight soft lime

113 – 138 cm Yellow-brown with grey mottled medium clay; light hard lime.

138 – 175 cm Grey and yellowish brown with yellow-brown mottled light clay; trace of hard lime; manganiferous inclusions at 160 cm.

Type 14

This soil type occurs on the box flats adjoining the present flood plain of the Murray River.

0 – 18 cm Grey medium clay; trace of soft lime.

18 – 50 cm Dull grey medium clay; trace of soft lime.

50 – 70 cm yellowish grey medium clay; trace of soft lime.

70 – 125 cm Yellowish grey medium clay; trace of soft lime.

125 – 175 cm Yellowish brown with grey mottled medium clay; slight soft and hard lime; scattered soft manganiferous inclusions.

For this unit the inscription “sandy surface” on the soil map indicates that the surface has about 8 cm of sandy clay.

Type 15

This very minor type occurs in pronounced depressions associated with Type 4.

0 – 10 cm Grey-brown to brownish grey sandy clay.

10 – 110 cm Yellowish grey medium clay sandy; slight soft lime.

110 – 150 cm Grey-brown or yellowish grey with grey and brown mottled light to medium clay; slight to light hard lime.

150 – 175 cm Yellowish brown with grey mottled medium clay; light to moderate hard lime.

For this unit the inscription “gypseous” on the soil map indicates that gypsum is present in the profile at depths between 80 and 140 cm.

4.2.4 Unit D – Soils of the red gum flats

The surface textures of the soil types in this unit range from sandy loam to sandy clay, while the subsoils vary from sandy clay loam to heavy clay. The unit contains the following soils:

Type G1
Type G1, light phase
Type G2

SOIL DESCRIPTIONS

Type G1

This is a very minor type occurring only on a former flood plain of the Murray River near Iraak.

0 – 25 cm	Dark brownish grey sandy clay loam to sandy clay.
25 – 45 cm	Yellowish grey-brown with yellowish brown mottled sandy clay loam to sandy clay; slight to moderate soft lime and visible mica.
45 – 125 cm	Yellowish grey-brown with yellowish brown mottled sandy clay, occasionally medium clay; moderate soft lime and visible mica.
125 – 150 cm	Dark brownish grey sandy clay to sandy clay loam; slight soft lime and visible mica.
150 – 175 cm	Yellowish brown with yellowish grey sandy clay loam to sandy clay; visible mica.

Type G1, light phase

0 – 45 cm	Grey-brown sandy loam
45 – 60 cm	Grey-brown light sandy clay loam; visible mica and moderate soft and hard lime.
60 – 100 cm	Yellow-brown sandy clay; visible mica and moderate hard and soft lime.
100 – 130 cm	Yellow-brown sandy clay loam to sandy clay.
130 – 175 cm	Yellowish grey-brown light sandy clay loam; slight soft lime and visible mica.

Type G2

This minor type occurs in the same locality as G1 but lower in the landscape.

0 – 25 cm	Dark brownish grey clay loam.
25 – 55 cm	Yellowish grey-brown with slight yellowish brown sandy clay; slight to moderate soft lime and visible mica.
55 – 90 cm	Yellowish grey-brown with yellowish brown medium clay; slight soft lime and visible mica.
90 – 140 cm	Yellowish grey with slight yellowish brown medium clay; slight soft lime and visible mica.
140 – 175 cm	Yellowish grey-brown with yellowish brown mottled heavy clay; slight soft lime.

4.2.5 Unit E – Soils of the flood plain

The following soil types occur on flats adjoining the present flood plain. The surface textures of the soil types in this unit range from sandy loam to light clay, while the subsoil textures vary from fine sandy clay to medium clay. There are no landscape features which consistently identify these soil types.

The unit contains the following soils:

Type A
Type B
Type B, shallow phase
Type B, grey phase

Type B, grey phase, light deep subsoil
Type E
Type E, grey phase
Type E, rubbly phase
Type F

SOIL DESCRIPTIONS

Type A

0 – 20 cm	Greyish brown to brown sandy clay loam.
20 – 35 cm	Dull brown fine sandy clay loam.
35 – 80 cm	Yellowish brown with slight yellowish grey mottled light clay.
80 – 100 cm	Yellowish brown with yellowish grey mottled medium clay.
100 – 145 cm	Yellowish grey with light yellowish brown mottled medium clay; slight lime.
145 – 175 cm	Yellowish brown with yellowish grey mottled heavy clay; moderate hard and soft lime.

Type B

0 – 15 cm	Reddish brown to brown sandy clay loam.
15 – 90 cm	Reddish brown to brown light clay; finely aggregated structure; very friable when moist.
90 – 120 cm	Yellowish brown occasionally with yellowish grey mottled light clay to medium clay.
120 – 175 cm	Yellowish grey with yellowish brown mottled medium clay to heavy clay; slight soft lime.

Type B, shallow phase

0 – 25 cm	Dull brown sandy loam.
25 – 75 cm	Greyish yellowish brown fine sandy clay; finely aggregated structure; friable when moist; moderate soft lime.
75 – 110 cm	Yellowish brown fine sandy clay; friable; slight soft lime.
110 – 150 cm	Yellowish brown with yellowish grey mottled medium clay; moderate soft lime.
150 – 175 cm	Yellow-brown with yellowish grey mottled medium clay.

Type B, grey phase

0 – 35 cm	Dark grey fine sandy clay.
35 – 50 cm	Light yellowish grey medium clay sandy; light hard and soft lime.
50 – 75 cm	Light yellowish brown with yellow-brown mottled medium clay sandy; finely aggregated structure; very friable when moist; moderate soft lime.

75 – 115 cm	Yellow-brown with reddish brown and light yellowish grey mottled medium clay sandy; friable when moist; moderate soft lime.
115 – 145 cm	Yellowish grey with yellow-brown and reddish brown mottled medium clay; slight soft lime.
145 – 175 cm	Yellow-grey with reddish brown and yellowish brown mottled dense heavy clay

Type B, grey phase, light deep subsoil

0 – 15 cm	Brownish grey fine sandy clay loam.
15 – 50 cm	Dark grey brown sandy clay.
50 – 65 cm	Yellowish brown sandy clay finely aggregated structure; friable when moist.
65 – 120 cm	Yellowish grey with yellowish brown mottled sandy clay loam; slight to moderate soft lime.

Type E

0 – 20 cm	Grey-brown clay loam to light clay.
20 – 90 cm	Yellow-brown medium clay.
90 – 120 cm	yellowish brown medium clay; occasionally slight gypsum.
120 – 160 cm	Yellowish-brown with yellowish grey medium clay; slight gypsum.
160 – 175 cm	Yellow-grey with yellowish brown mottled medium to heavy clay; gypsum in pockets.

Type E, grey phase

0 – 15 cm	Grey light clay.
15 – 60 cm	Yellow-grey to dark grey heavy clay.
60 – 100 cm	Yellowish greyish brown or yellowish brown with yellowish grey mottled medium clay.
100 – 120 cm	Yellowish brown with yellowish grey mottled medium clay to light clay; trace of gypsum.

Type E, rubbly phase

0 – 20 cm	Brownish grey fine sandy clay.
20 – 40 cm	Yellowish grey light clay.
40 – 80 cm	Yellowish grey with slight yellowish brown light clay; slight lime.
80 – 130 cm	Yellowish brown with yellowish grey light clay to medium clay.
130 – 175 cm	Yellowish brown with yellowish grey medium clay; rubble present.

Type F

0 – 15 cm	Grey-brown light fine sandy clay loam.
15 – 90 cm	Yellowish greyish brown light clay, slight soft lime.
90 – 105 cm	Yellowish grey with yellowish brown mottled light clay; slight lime.
105 – 175 cm	Yellowish grey with slight yellowish brown mottled medium clay; slight to light soft and hard lime.

4.2.6 Unit F – Soils of the lunettes

This unit comprises the lunettes on the eastern perimeter of Lake Iraak. Surface textures range from sand to sandy clay, while the subsoils vary in texture from sandy clay loam to medium clay. The unit contains the following soils:

Type L1
Type L2
Type L3
Type L4
Type L5

SOIL DESCRIPTIONS

Type L1

0 – 20 cm	Dull brown clay loam to light clay.
20 – 65 cm	Grey-brown to greyish brown clay loam to light clay; slight to moderate lime.
65 – 155 cm	Brownish grey light clay; slight soft lime and slight gypsum.
155 – 175 cm	Grey brown light clay; slight soft lime and slight gypsum.

Type L2

0 – 25 cm	Dull red-brown to grey-brown sandy clay loam.
25 – 90 cm	Greyish brown to yellowish brownish grey clay loam to light clay; slight to moderate soft lime.
90 – 150 cm	Yellowish brownish grey light clay; slight soft lime and slight gypsum.
150 – 175 cm	Yellowish brownish grey to light yellowish grey sandy clay loam; slight soft lime and gypsum.

Type L3

0 – 20 cm	Dull brown sandy clay.
20 – 55 cm	Reddish brown medium clay; slight to moderate soft lime.
55 – 90 cm	Yellowish grey-brown medium clay; moderate soft lime.
90 – 150 cm	Yellowish brownish grey medium clay; slight soft lime and moderate gypsum.
150 – 175 cm	Yellowish grey medium clay to light clay; slight gypsum.

Although the soils within this unit occupy an elevated position in the landscape they are considered to be of doubtful value for irrigated agriculture.

Type L4

0 – 20 cm	Grey-brown fine sandy clay loam.
20 – 45 cm	Yellowish grey-brown fine sandy clay.
45 – 125 cm	Yellowish brownish grey fine sandy clay loam to fine sandy clay; moderate gypsum.
125 – 160 cm	Reddish brown sandy loam; slight gypsum.
160 – 175 cm	Reddish brown sandy clay loam; slight gypsum.

Type L5

0 – 30 cm	Reddish brown sand.
30 – 45 cm	Yellowish grey loamy sand.
45 – 55 cm	Yellowish grey sandy clay loam.
55 – 85 cm	Yellowish grey with yellowish brown mottled sandy clay; slight to moderate soft and hard lime
85 – 110 cm	Yellowish brown with yellowish grey mottled medium clay fine sandy; moderate soft and hard lime.
110 – 125 cm	Yellowish greyish brown with yellowish brown and yellowish grey mottled sandy clay; moderate lime and visible mica.
125 – 175 cm	Yellow-grey with yellowish grey and yellow-brown mottled silty clay; moderate soft and hard lime and visible mica.

4.2.7 Unit G – Soils of the swamp

The surface textures of the soil types in this unit vary from loamy sand to light clay, while the subsoils vary in texture from sandy clay loam to heavy clay. The unit contains the following soils:

Type SF_1
Type SF_2
Type SF_3
Type SF_4
Type SF_5

SOIL DESCRIPTIONS

Type SF_1

0 – 20 cm	Grey-brown fine sandy clay loam to fine sandy clay.
20 – 50 cm	Grey brown to brownish grey light clay to medium clay; slight soft and hard lime.
50 – 80 cm	Yellowish brown medium clay; slight soft and hard lime.
80 – 140 cm	Yellowish grey with yellowish brown mottled medium clay sandy; moderate soft and hard lime.
140 – 175 cm	Yellowish grey with yellowish brown mottled medium clay.

Type SF_2

0 – 20 cm	Reddish brown to brown sandy loam.
20 – 30 cm	Yellowish grey or brownish grey fine sandy clay
30 – 50 cm	Yellowish brownish grey medium clay.
50 – 90 cm	Yellowish brown with yellowish grey mottled medium clay; slight soft and hard lime.
90 – 110 cm	Yellowish grey with yellowish brown mottled medium clay; moderate soft and hard lime.
110 – 120 cm	Yellowish grey medium clay; slight soft and hard lime.

Type SF_3

0 – 20 cm	Brown clay loam to light clay
20 – 40 cm	Dull brown medium clay.
40 – 70 cm	Yellowish brown medium clay; slight soft and hard lime.
70 – 100 cm	Yellowish grey with yellowish brown mottled medium clay to heavy clay; slight lime occasionally with visible mica.
100 – 135 cm	Yellowish grey medium clay; moderate hard lime; occasionally gypsum.
135 – 175 cm	Yellowish grey with yellowish brown mottled light clay to medium clay; slight hard lime; occasionally gypsum.

Type SF_4

0 – 20 cm	Reddish brown sandy loam.
20 – 45 cm	Brown fine sandy clay to medium clay sandy.
45 – 85 cm	Light brown medium clay sandy; slight soft and hard lime.
85 – 95 cm	Yellowish brown medium clay; slight hard and soft lime.
95 – 155 cm	Yellowish brown with slight yellowish grey medium clay sandy; slight to light hard and soft lime.
155 – 175 cm	Yellow-brown with yellowish brown and yellowish grey fine sandy clay; slight hard lime.

Type SF_5

0 – 35 cm	Reddish brown loamy sand.
35 – 45 cm	Greyish brown light sandy clay loam.
45 – 60 cm	Grey-brown sandy clay loam; slight soft and hard lime
60 – 120 cm	Yellowish grey-brown fine sandy clay; light hard and soft lime.
120 – 140 cm	Yellowish brownish grey sandy clay; slight soft and hard lime.
140 – 170 cm	Yellowish brownish grey sandy clay; light hard and soft lime.

170 – 175 cm Yellowish grey-brown sandy clay loam; slight soft and hard lime.

4.2.8 Unclassified soil

One small area with heavy surface limestone has not been classified but is delineated and inscribed "heavy lime" on the soil map.

5. PHYSICAL PROPERTIES OF THE SOILS

5.1 Ultimate Particle Analysis

The method used was that described by Mikhail and Briner (1978). In this method, organic matter in the soil was removed by sodium hypochlorite and the soils dispersed with sodium hydroxide in an ultrasonic bath. The fractions were determined by Plummet balance (Hutton, 1955) and sieving techniques.

Soils of the Colignan and Nangiloc area vary widely in physical composition, e.g. from wind-blown sand to clay. This is illustrated by Table 2 which presents weighted average clay contents to 175 cm depth for representative soil types, the figures being derived from those given in Appendix II.

Table 2 - Weighted Average clay content to 175 cm depth for a selection of the Nangiloc-Colignan soils

Soil Type	Clay %	Soil Type	Clay %
Nowingi sand	2	Barmera sandy loam, shallow phase	15
Winkie sand, deep phase	3	Coomealla loam	15
Murray sand, deep phase	5	Kamka sandy loam, shallow phase	18
Winkie sand, deep phase	6	Chalka sand	21
Murray sand	6	Type 8	24
Moorook sand	6	Type 12	24
Barmera sandy loam	7	Nangiloc sandy clay loam	27
Winkie sand	8	Nangiloc sandy clay loam, shallow phase	27
Type 4	9	Nangiloc sandy clay	27
Berri sand	10	Type d1	32
Barmera sand	11	Type d3	50
Coomealla sandy loam	11	Colignan clay	54
Kamka sandy loam	11	Colignan clay light phase	54
Nangiloc	13	Type 14	55

The main physical features of the various soil types are summarised in this table which indicates the relative heaviness of the subsoil, a feature of particular interest in connection with plant growth, irrigation and drainage. The lighter textures occur in the sand dune soils (Unit A soils) and part of Unit B soils. Kamka sandy loam shallow phase, Chalka sand, Type 8, Nangiloc sandy clay loam, Nangiloc sandy clay loam shallow phase, Nangiloc sandy clay and Type d1 have moderate average clay contents. The figures for Type d3 and the soils of Unit C reflect the influence of heavy subsoil characteristics.

Sand is the dominant fraction in the majority of the soils. Although silt is commonly found in Mallee soils, values of less than 5% are frequent and only Colignan clay, Nangiloc sandy clay, Nangiloc sandy clay loam, Type d3 and Type 14 profiles contain more than 10% of this fraction.

6. CHEMICAL PROPERTIES OF THE SOILS

6.1 pH

Soil reaction was determined using a glass electrode in a 1:5 soil:water suspension shaken for one hour. Individual values for the horizons of the soil type profiles are given in Appendix II. The values range from 6.3 to 10.2. Table 3 gives the pH values for surface, subsoil and deep subsoil samples. These samples were taken at the 0-15 cm, 15-90 cm, and 90-180 cm depths respectively.

Table 3 - Frequency distribution of the reaction values (pH) of the soils

Depth cm	No. of samples	6.3-6.9	7.0-7.4	7.5-	8.0-	8.5-	9.0-	9.5-	10.0-
0-15	41	2	9	6	7	15	2		
15-90	144	3	8	4	16	40	45	19	9
90-180	116				5	18	40	30	23

Table 3 indicates the strongly alkaline nature of the soil profiles. For the subsoils and deep subsoils the high proportion of values in the range pH 8.5 to 10.4 suggests the dominance of sodium and magnesium, rather than calcium on the exchange complex. Salinisation and sodicity are therefore suggested as major factors in the pedogenesis of the soils.

6.2 Calcium Carbonate

Most of the soil types are highly calcareous. Concretionary lime (greater than 2 mm in diameter) reaches its maximum concentration in mid and lower slope soils. It is also present in some dune crest soil types; Berrama sandy loam, Berrama sandy loam shallow phase and 16. The highly Calcarous soils become more common towards Karadoc. Most of the dunes south of the area are either lime free or contain only slight amounts up to the 180 cm depth. The major concentration of lime occurs between 30 cm and 60 cm and ranges from 15 to 70 percent by weight of the total soils.

Calcium carbonate may be present as hard concretions, soft lime in pockets, panned lime or finely divided lime detectable only using acid. Lime in these soils plays an important part in the determination of physical properties such as available water content and plant root penetration, e.g. on such soils as Berrama sandy loam shallow phase. In this particular soil type, a layer or hardpan of lime can occur. Vine roots have been found to be restricted to surface soils i.e. hardpans have prevented root penetration. Lime also determines the pH of the soil which increases with higher lime contents.

6.3 Cation Exchange Capacity

Exchangeable calcium, magnesium, potassium, sodium and hydrogen were determined for almost all horizons at each type site. The methods used are listed in Appendix III and the results are tabulated in Appendix II as milliequivalent of each cation per 100 grams of oven dried soils and as percent of the cation exchange capacity (C.E.C.) which is taken as the total of the separate cations. The C.E.C. depends primarily on the percentage of clay minerals present.

With the exception of Group C soils, calcium is the dominant cation of the surface soils. Group C soil profiles generally have slightly lower proportions of calcium in their surface horizons. A common feature of these soils is the marked decrease in exchangeable calcium percentage with depth and an increase in magnesium and sodium. Exchangeable sodium percentage (ESP) generally exceeds 15% in the deep subsoils.

However, irrigation followed by effective drainage will usually result in a dramatic decrease in the ESP of the deep subsoil. Exchangeable potassium percentages are relatively high in soils under citrus, vine and vegetables i.e. range from 9 to 19%. In uncropped land exchangeable potassium percentages range between 4 and 6%.

6.4 Nitrogen and Organic Carbon

Individual figures for total nitrogen percentages and organic carbon percentage for the surface soil of the type soils are given in Appendix II. Total nitrogen figures range from 0.01 to 0.15% and the organic carbon values range from 0.11 to 1.91%. For most of the soil types, the C:N ratios (8.7 to 14.4) are within the normal range. Exceptions are Murray sand deep phase profile No. 5, Nowingi sand heavy profile No. 6 and Kamka sandy loam shallow phase profile No. 22. These profiles which have the wider ratios of 17.1, 18.0 and 18.8 respectively, may contain undecomposed organic matter as a residue from recent land clearing operations.

Table 4 presents a summary of the data for each texture group. All soils however can be regarded as being low in organic matter.

Table 4 - Average nitrogen and organic carbon percentages in surface soils

Soil Texture Group	No. of Soils	Total N %	Total OC %	C/N Ratio
Sand to loamy sand	20	0.032	0.42	13.2
Sandy loam to light sandy clay loam	13	0.054	0.67	12.3
Sandy clay loam to sandy clay	5	0.060	0.69	11.6
Light clay to medium clay	3	0.115	1.30	11.3

It is possible that the higher total organic carbon to total nitrogen ratios of the lighter textured soils reflect the situation in which land clearing operations on the sand dunes leave a residue of undecomposed organic matter.

7. SOIL SALINITY

7.1 Saline Soils

These are soils in which the concentration of total soluble salts is sufficiently high to affect plant growth adversely, or is above some arbitrary level set to separate saline from non-saline soils. A concentration of 0.100% total soluble salts has been mentioned as the lower limit at which plants begin to be affected and an appropriate level at which to separate saline from non-saline soils. However some horticultural crops e.g. beans and citrus react adversely to concentrations as low as 0.05%. The USDA Salinity Laboratory arbitrarily defines a saline soil as having an electrical conductivity of more than 4 millimho/cm in the saturation extract at 25^{o}C. This corresponds to about 0.05% soluble salts in sandy soils and 0.25% in clay soils. However, plants vary in their tolerance of salinity. The salt tolerance of the plants grown must be included in any consideration of harmful levels of soluble salts in soils. The clay of saline soils tends to be flocculated and the permeability of such soils is usually satisfactory except when the clay content in very high.

7.2 Soil Salinity in the Nangiloc-Colignan Area

In the virgin state many of the area's soils which have been classified as suitable for horticulture have low to moderate salinity levels in terms of total soluble salts (TSS) and chloride and have conspicuously high exchangeable sodium percentage (ESP) values in the subsoils.

Under low rainfall, varying amounts of soluble salts have accumulated in the soil. This accumulation is due firstly to the original parent material, which contained a considerable amount of salt, and secondly to the high evaporation rate bringing salt to the surface by capillarity.

The average salt content of a soil type is related to the clay content in the profile and to the proximity of a clay layer to the surface. The Topographic situation must also be considered in conjunction with the degree of salinity of the soil when assessing the salt risk in the area under irrigation. In general, areas in which a majority of the soils examined show more than 0.100% of sodium chloride as the average of the three layers are not suitable for horticulture. Areas where the 0.03% level is exceeded are not suitable for citrus.

Leaching of salt into the deep subsoil is necessary to reduce the natural salt content in the root zone to a safe level. Normally this is an initial effect under irrigation and takes place most readily in the light soils situated high in the landscape. Average salt contents in soil types with sandy loam to clay loam and sandy clay to light or medium clay surface textures are higher than in those types with heavier textures.

The Colignan and Nangiloc soil series, and Belar clay loam, d1, d4, 14, and 15, Coomealla loam and Coomealla clay loam soil types are inherently saline and will require careful management in order to avoid salt problems.

In most cases, chloride and total soluble salts (as estimated by the electrical conductivity (1:5) method) are very low to moderate throughout the root zone, but in certain soil types examined, concentrations of soluble salts have risen to toxic levels. The worst soil types were Nangiloc sand clay, Colignan clay, Colignan clay light phase, Colignan clay gypseous phase, 15, d3 gypseous and L4. With the exception of L4 (lunette soils), these soils occur on the flats. These soils show high salt concentrations in the average profile, with figures approaching 1.25% sodium chloride for the deeper subsoils. The other soil

types which are not recommended for citrus because of a high lime content throughout the profile, or a profile concentration in excess of 0.03% sodium chloride, are Moorook sand, Moorook sandy loam, Chalka sand, Chalka sandy loam and the unnamed soil types 7, 9, 10, 11, 13 and 16.

The increase in concentration of sodium chloride down the profile is gradual in the uniform-textured profiles and sharp in the gradational and duplex textured profiles. As the rainfall is normally insufficient to leach the salt from the soil profile, salt has accumulated in subsoils at depths depending on the permeability of the soils. The highest concentration occur in the heavy textured soils.

It is important to recognise that the natural distribution of salt is such that appreciable amounts may occur at variable depths in the layers beneath practically all of the soils in the area and that some movement of this salt is inevitable under irrigation.

7.3 Soil Salinity Survey

The systematic evaluation of salinity included the chloride (as sodium chloride) analysis of more than 13,000 soil samples from more than 4,900 sites. The soil samples were taken from the 30-60, 90-120 and 150-180 cm levels. These depths were chosen since horticulture is the major current and projected future use of the area and since it is considered that tree roots would be affected by chloride accumulation through the profile to a depth of at least 180 cm.

The salt status of the main soil types is shown in Table 5. The chloride (as sodium chloride) content increases with depth in the profile in nearly all soil types. Chloride accumulation in the 90-120 cm and 150-180 cm zones reflects the average chloride for the entire profile to the 180 cm depth. Table 5 also shows the averages of the salt contents of the three layers of the main soil types. Using these figures as an index of salinity, the three major soil groups are seen to be, in approximate descending order of salinity, Unit C, Unit B and Unit A.

Table 5 - Average sodium chloride percentages of the main soil types

Soil Type	Depth (cm)	Mean Na Cl %	Average of the three layers %	No. of Samples
Unit A				
Barmera sand	30-60 90-120 150-180	0.006 0.021 0.031	0.019	81 81 78
Barmera sandy loam	30-60 90-120 150-180	0.008 0.030 0.039	0.026	236 236 214
Barmera sandy loam, shallow phase	30-60 90-120 150-180	0.015 0.039 0.097	0.050	50 50 50
Berrama sandy loam	30-60 90-120 150-180	0.006 0.016 0.014	0.011	276 276 0276
Berrama sandy loam, shallow phase	30-60 90-120 150-180	0.009 0.024 0.035	0.023	88 82 77
Berri sand	30-60 90-120 150-180	0.005 0.010 0.014	0.010	614 614 600
Moorook sand	30-60 90-120 150-180	0.009 0.061 0.050	0.040	12 12 10
Moorook sandy loam	30-60 90-120 150-180	0.013 0.089 0.108	0.070	32 32 31

Soil Type	Depth (cm)	Mean Na Cl %	Average of the three layers %	No. of Samples
Murray sand	30-60	0.005		346
	90-120	0.006	0.007	346
	150-180	0.009		346
Murray sand, deep phase	30-60	0.004		315
	90-120	0.006	0.006	312
	150-180	0.007		311
Murray sand, shallow phase	30-60	0.005		71
	90-120	0.007	0.009	71
	150-180	0.015		71
Nowingi sand	30-60	0.004		171
	90-120	0.004	0.004	171
	150-180	0.005		171
Winkie sand	30-60	0.004		123
	90-120	0.005	0.006	123
	150-180	0.008		123
Winkie sand, deep phase	30-60	0.004		333
	90-120	0.004	0.004	332
	150-180	0.005		328
Type 2	30-60	0.004		62
	90-120	0.007	0.009	61
	150-180	0.015		60
Type 16	30-60	0.005		71
	90-120	0.011	0.009	71
	150-180	0.012		70
Unit B				
Belar clay loam	30-60	0.021		7
	90-120	0.127	0.090	7
	150-180	0.123		7
Chalka sand	30-60	0.027		35
	90-120	0.045	0.47	32
	150-120	0.068		18
Chalka sandy loam	30-60	0.015		21
	90-120	0.030	0.030	21
	150-180	0.057		13
Chalka sandy loam, light deep subsoil	30-60	0.034		16
	90-120	0.049	0.041	16
	150-180	0.041		14
Kamka sandy loam	30-60	0.010		269
	90-120	0.034	0.028	268
	150-180	0.040		268
Kamka sandy loam, shallow phase	30-60	0.014		121
	90-120	0.052	0.045	119
	150-180	0.068		115
Coomealla sandy loam	30-60	0.022		34
	90-120	0.084	0.066	34
	150-180	0.094		32
Coomealla loam	30-60	0.026		18
	90-120	0.148	0.095	18
	150-180	0.112		17
Nangiloc sandy loam	30-60	0.058		93
	90-120	0.098	0.097	93
	150-180	0.134		89
Nangiloc sandy clay loam	30-60	0.059		77
	90-120	0.120	0.123	77
	150-180	0.190		73

Soil Type	Depth (cm)	Mean Na Cl %	Average of the three layers %	No. of Samples
Nangiloc sandy clay	30-60	0.148	0.211	44
	90-120	0.213		43
	150-180	0.273		42
Type 4	30-60	0.005	0.011	65
	90-120	0.010		60
	150-180	0.017		57
Type 7	30-60	0.010	0.057	61
	90-120	0.059		39
	150-180	0.102		36
Type d1	30-60	0.062	0.087	105
	90-120	0.095		104
	150-180	0.103		103
Type d2	30-60	0.036		76
	90-120	0.083		76
	150-180	0.090		71
Type d3	30-60	0.082	0.180	159
	90-120	0.175		159
	150-180	0.213		154
Type d3 (gypseous)	30-60	0.941	1.053	6
	90-120	1.251		6
	150-180	0.969		6
Type d4	30-60	0.153	0.182	72
	90-120	0.189		72
	150-180	0.204		67
Unit C				
Colignan clay	30-60	0.108	0.301	41
	90-120	0.328		41
	150-180	0.468		19
Colignan clay, light profile	30-60	0.350	0.468	29
	90-120	0.558		29
	150-180	0.493		19
Colignan clay (gypseous)	30-60	0.144	0.311	13
	90-120	0.402		13
	150-180	0.387		13
Type 14	30-60	0.105	0.163	12
	90-120	0.209		11
	150-180	0.174		1
Type 15	30-60	0.212	0.265	9
	90-120	0.213		9
	150-180	0.317		9

The salinity hazard layers which have sodium chloride concentrations greater than 0.05% are shown in Table 6.

Table 6 - Chloride (as sodium chloride) concentrations greater than 0.05% in different layers of the main soil types

Layer (cm)	Soil Type
0-30	Colignan series, Nangiloc sandy clay, d1, d3, d4, 14 and 15.
30-60	Kamka sandy loam shallow phase, Nangiloc sandy loam, Nangiloc sandy clay loam, L2, L4 and 7
60-90	Coomealla sandy loam d2, SF1, SF2, SF3, SF4 and SF5.
90-120	Belar clay loam, Moorook sand, Moorook sandy loam, Kamka sandy loam shallow phase, Coomealla loam, 7, 9, 10, 13 and 20
120-150	1, 8 and 12.
150-180	Chalka sand, Chalka sandy loam and Barmera sandy loam shallow phase

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APPENDIX I - Explanation of Terms

Soil Texture

Most soils are mixtures of coarse and fine sand, silt and clay. However, the proportions of each fraction determine what is known as the texture of the soil. It is a measure of the behaviour of a small handful of soil when moistened and kneaded into a ball and then pressed out between thumb and forefinger.

The texture of a soil is determined by wetting the soil in the hand and feeling the wetted soil by pressing with the thumb and fingers. In case of sandy soils, just sufficient water is used to thoroughly wet the soil after mixing, without it being possible to squeeze water out of the soil by applied pressure. In the case of the heavier soils, i.e. containing more clay, the soil is thoroughly mixed with water until it just does not stick to the fingers when pressed. Texture is affected by other soil properties such as, the type of clay mineral, organic matter, oxides, lime, exchangeable cations and strong fine aggregation.

Soil Structure

Soil materials are either structured or structureless according to whether their ultimate particles are aggregated or uniformly disturbed. If the soil material is aggregated, it will show a tendency to break down into fragments when stress is applied. A structureless coherent soil material shows no predisposition to any particular size or shape when stress is applied. The type and kind of structure is determined by the shape or form of the natural aggregates into which the soil material will fall when a stress is applied to it.

Soil Profile

A soil profile consists of an arrangement of soil horizons or layers which tend to follow the topographic features of the landscape. Two general horizons are formed, an immediate surface horizon and a subsurface horizon. Their formation is governed by the forces of the immediate climate, temperature and rainfall, and by the external and internal drainage conditions.

Soil Horizon

This is a layer of soil with similar characteristics throughout Horizons may be distinguished by differences in one or more of the following characteristics: colour, texture, structure, consistence, organic matter content or the presence of lime, gypsum or iron oxide concretions.

Soil Type

This is a group of soils with the same profile characteristics, including the texture of the surface soil. It is also the unit of soil mapping used in this survey.

Soil Phase

This is a modification of a soil type in which one feature is accentuated without altering the main profile form.

Bleached Horizon

This is an A_2 horizon that has become pale in colour due to leaching.

Concretions

These are local concentrations of chemical compounds deposited in the form of hard and more or less rounded modules of various sizes.

Ferruginous Concretions

These are concretions, mainly of iron oxide, commonly deposited in the A_2 and B_1 horizons, but sometimes occurring on the surface and in other parts of the profile.

Gypsum

This is chemically known as hydrated calcium sulphate.

Lime

This is calcium carbonate, either finely divided, or in the form of soft or hard concretions.

APPENDIX II - Analytical Data for Representative Profiles

Symbols used: S, Sand; LS, Loamy Sand; SL, Sandy Loam; LSCL, Light Sandy Clay Loam; FSCL, Fine Sandy Clay Loam; SCL, Sandy Clay Loam; SLC, Sandy Light Clay; FSC, Fine Sandy Clay; SC, Sandy Clay; LC, Light Clay; MC, Medium Clay; HC, Heavy Clay; EC, Electrical Conductivity. A blank space indicates that the analysis has not been done; a dash indicates that only a trace or none of the constituent was present.

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations m.e. % - Milliequivalents per 100 g of soil % - Percentage of cation exchange capacity									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Barmera Sand: Profile 15 – Soil Map Sheet 8 Unit A																							
0 – 20	S	8.6	2.0	-	46.8	46.7	1.0	4.5	0.3	50	0.005			3.2	67	0.7	15	0.4	8	0.1	2	0.4	8
– 40	LS	8.7	2.0	-	40.6	51.6	1.3	5.5	1.0	50	0.006			3.3	69	1.0	21	0.2	4	0.1	2	0.2	4
– 57	LS	8.7	1.0	-	43.8	54.3	1.4	3.7		40	0.005			2.2	67	1.0	28	0.1	3	0.1	3	0.2	6
– 90	LSCL	10.0	5.0	-	41.4	45.0	2.0	10.1	1.1	250	0.004			1.7	24	2.7	38	0.5	7	2.2	31	-	-
– 115	SCL	10.0	8.0	-	32.5	44.8	1.5	19.3	3.9	530	0.043			2.0	18	3.2	29	0.8	7	5.0	45	-	-
– 147	SCL	10.0	7.0	1.0	35.4	41.1	1.8	17.8	4.6	540	0.052			2.0	19	3.1	29	0.8	7	4.8	45	-	-
– 170	SCL	10.0	7.0	-	35.1	39.2	1.5	15.7	8.6	500	0.048			2.0	21	2.6	27	0.7	7	4.2	44	-	-
– 210	SCL	10.0	6.0	1.0	37.2	44.3	1.5	14.2	2.9	480	0.044			1.8	20	2.5	28	0.6	7	3.9	44	-	-
Berrama Sandy Loam: Profile 38 – Soil Map Sheet 6 Unit A																							
0 – 17	SL	8.2		-	39.8	43.3	25	10.1	1.7	100	0.005	0.101	1.22	6.4	61	1.5	14	0.9	9	0.1	1	1.5	14
– 45	LSCL	8.4		-	36.0	43.4	3.1	15.7	1.2	110	0.004			6.8	64	1.7	16	0.9	8	0.2	2	1.0	94
– 62	SCL	8.6		-	32.9	34.8	3.1	27.2	2.2	140	0.004			9.5	60	3.5	22	1.6	10	0.4	3	0.7	
– 97	SC	9.0		2.2	31.6	33.1	2.6	21.9	12.6	150	0.005												
– 125	SC	9.2		1.7	37.0	36.3	2.0	18.8	6.3	160	0.005												
– 142	SCL	9.3		10.1	33.0	35.9	1.5	18.8	10.0	170	0.004			3.0	28	6.0	56	1.3	12	0.5	5	-	-
– 157	LSCL	9.3		3.9	32.3	30.4	1.5	11.6	15.4	130	0.005			1.8	25	4.2	58	0.9	12	0.4	5	-	-
– 172	SL	9.3		17.3	33.0	32.1	1.0	7.1	15.9	110	0.004			1.5	29	2.9	57	0.5	10	0.2	4	-	-
Barmera Sandy Loam: Profile 17 – Soil Map Sheet 8 Unit A																							
0 – 15	LS-	7.6	1.5	-	52.7	41.4	1.8	3.5	0.3	40	0.004	0.026	0.26	1.9	46	0.5	12	0.2	5	0.1	2	1.4	34
– 45	SL	7.1	3.5	-	54.5	34.9	1.3	8.6	0.7	40	0.004			3.5	50	1.2	17	0.3	4	0.1	1	1.9	27
– 67	LSCL	8.5	3.9	-	42.9	42.7	2.0	10.6	1.3	120	0.003			5.1	77	1.1	17	0.2	3	0.2	3	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Barmera Sandy Loam: Profile 17 – Soil Map Sheet 8 (Cont'd) Unit A																							
0 – 85	LSCL	8.7	4.9	-	39.9	38.7	0.5	14.7	5.9	100	0.004			7.5	85	0.7	8	0.3	3	0.3	3	-	-
– 137	SCL	9.0	4.2	-	38.2	38.0	0.0	12.7	12.7	100	0.004			5.5	82	0.8	12	0.2	3	0.2	3	-	-
– 165	SCL	9.0	3.8	10.1	40.8	43.4	0.0	4.3	4.3	110	0.004			4.6	75	1.0	16	0.3	5	0.2	3	-	-
– 200	SCL	9.0	4.4	18.8	44.7	32.3	0.0	10.5	10.5	110	0.004			4.1	66	1.6	26	0.3	5	0.2	3	-	-
Berrama Sandy Loam: Profile 13 – Soil Map Sheet 8 Unit A																							
0 – 15	LS	8.2	2.1	-	46.8	44.4	1.8	5.5	0.8	60	0.011	0.028	0.32	4.4	75	0.7	12	0.4	7	0.1	2	0.3	5
– 47	LS	8.7	3.3	-	39.0	49.6	1.0	8.1	1.2	80	0.005			5.5	80	1.0	14	0.3	4	0.1	1	-	-
– 60	SL	8.8	4.0	-	37.6	48.6	1.0	9.6	3.1	90	0.005			5.8	75	1.5	19	0.3	4	0.1	1	-	-
– 95	SCL	8.9	10.0	-	38.5	38.4	2.5	12.2	8.2	100	0.004			6.0	65	2.6	28	0.4	4	0.2	2	-	-
– 127	LSCL	9.4	10.0	-	41.5	43.5	1.5	12.1	1.9	130	0.007			3.6	49	2.4	32	0.5	7	0.9	12	-	-
– 152	LSCL	9.8	10.0	3.3	33.9	38.1	0.8	16.2	10.3	260	0.007			2.9	32	3.1	34	0.8	9	2.3	25	-	-
– 185	LSCL	10.0	10.0	0.7	31.1	36.4	0.8	10.6	21.8	310	0.004			1.6	25	1.6	25	0.7	11	2.4	38	-	-
– 215		10.2	5.0	-	33.7	35.8	1.5	8.0	19.9	320	0.006			1.3	25	0.9	18	0.5	10	2.4	47	-	-
– 235		10.2	4.0	5.0	33.5	35.9	0.5	6.5	23.9	330	0.004			0.9	20	0.8	17	0.5	11	2.4	52	-	-
– 270		10.2	4.0	2.4	40.6	37.9	1.5	6.0	11.8	340	0.004			0.7	16	0.7	16	0.5	12	2.4	56	-	-
Berrama Sandy Loam, Shallow Phase: Profile 24 – Soil Map Sheet 8 Unit A																							
0 – 15	SL	8.0	4.0	-	33.3	53.6	2.6	11.4	0.6	60	0.005	0.062	0.72	4.2	52	1.6	20	0.8	10	0.1	1	1.4	17
– 27	SL	8.1	4.0	-	34.9	52.9	3.2	12.7	1.5	60	0.004	0.039	0.47	4.6	55	1.7	20	0.6	7	0.1	1	1.3	16
– 50	SCL	8.4	5.0	-	40.8	37.3	4.1	17.3	0.8	60	0.005			6.6	66	2.2	22	0.2	2	0.2	2	0.8	8
– 70	SCL	8.8	7.0	-	38.7	34.6	4.6	21.5	1.4	120	0.004			8.0	68	3.4	29	0.3	3	trace		-	-
– 107	SCL	8.9	8.0	-	44.7	24.5	0.5	22.4	8.5	170	0.005			8.5	58	5.3	36	0.3	2	0.5	3	-	-
– 150	LSCL	9.2		-	47.5	30.5	0.5	8.6	13.1	150	0.014			1.9	50	1.5	40	0.1	3	0.3	8	-	-
– 185	LSCL	9.7		7.3	51.4	31.4	1.0	9.0	3.4	180	0.024			1.3	26	2.5	50	0.3	6	0.9	18	-	-
– 212	SL-SCL	9.9		3.7	45.5	39.9	10.1	2.5	5.4	200	0.017			3.0	34	4.5	51	0.2	2	1.2	13	-	-
– 237		9.9		8.3	53.4	28.2	10.1	2.0	10.4	210	0.015												
– 257		10.0		24.9	42.3	29.9	0.5	6.5	12.8	200	0.015			2.4	31	3.9	50	0.3	4	1.2	15	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Berri Sand: Profile 39 – Soil Map Sheet 5 Unit A																							
0 – 12	LS	8.5			46.5	38.9	2.0	10.1	7.6	70	0.005	0.030	0.38	3.9	62	1.0	16	0.5	8	0.2	3	0.7	11
– 60	LS	8.4		-	42.1	41.9	2.5	11.6	0.6	60	0.004			4.3	62	1.5	22	0.3	4	0.2	3	0.6	9
– 72	LSCL	8.5		-	39.4	36.2	2.6	20.4	0.9	70	0.005			5.6	56	3.0	30	0.3	3	0.3	3	0.8	8
– 90	SCL	8.5		-	36.0	33.1	2.1	28.8	1.0	80	0.004			7.1									
– 120	SCL	9.0		7.2	33.4	29.9	1.5	23.5	9.6	120	0.005			7.1	55	4.8	37	0.5	4	0.5	4	-	-
– 135	SCL	9.2		2.1	35.1	38.4	2.0	16.8	6.0	110	0.005												
– 180	SCL	9.5		-	37.6	39.7	2.5	12.7	8.3	130	0.005			2.8	41	2.6	38	0.8	12	0.7	10	-	-
– 210	LSCL	9.7		4.0	33.9	36.9	2.0	12.1	12.8	160	0.005												
Berri Sand: Profile 25 – Soil Map Sheet 6 Unit A																							
0 – 12	S	7.1	2.0	-	52.2	40.4	0.5	4.5	0.9	30	0.003	0.022	0.30	1.3	65	0.3	15	0.3	15	0.1	5		
– 55	LS	8.7	4.0	-	45.6	40.9	0.8	9.0	1.8	100	0.004			4.7	82	0.6	11	0.3	5	0.1	2	-	-
– 95	SL	9.0	5.0	-	41.0	40.9	0.5	10.1	4.5	130	0.013			4.8	77	1.0	16	0.2	3	0.2	3	-	-
– 140	SCL	9.1	4.0	-	36.6	40.3	0.0	13.1	9.9	150	0.013			3.5	61	1.6	23	0.3	5	0.3	5	-	-
– 180	SL-LSCL	9.2		-	44.5	41.6	0.8	10.0	2.0	190	0.015			1.4	22	2.5	40	0.5	8	0.3	5	1.6	25
– 210	LSCL	9.2		-	43.7	38.0	0.8	7.5	7.8	230	0.031												
– 240	LSCL	9.1		-	40.0	47.5	0.5	10.1	1.1	180	0.019												
– 270	LSCL	9.2		-	36.2	47.3	0.8	8.5	6.4	140	0.11			1.8	27	2.1	32	0.4	6	0.2	3	2.0	31
Berri Sand: Profile 16 – Soil Map Sheet 8 Unit A																							
0 – 10	LS	7.4	2.0	-	46.0	48.1	1.8	3.0	0.4	40	0.004	0.033	0.39	2.0	43	0.4	9	0.3	7	0.1	2	1.8	39
– 30	LS	7.0	4.0	-	41.2	46.5	1.5	10.1	1.0	40	0.004	0.038	0.46	3.7	46	1.2	15	0.5	6	0.1	1	2.6	32
– 42	LS	7.6	4.1	-	36.9	48.8	1.0	11.1	1.5		0.005			5.0	56	1.7	19	0.6	7	0.2	2	1.5	17
– 60	LS	8.7	3.5	-	44.0	44.1	1.8	9.1	1.3		0.004			5.4	77	1.0	14	0.4	6	0.2	3	-	-
– 90	SL	8.8	3.7	-	43.4	43.0	1.5	9.6	2.5		0.004			5.5	77	1.0	14	0.4	6	0.2	3	-	-
– 120	LSCL	8.9	41	-	37.9	44.9	1.5	9.1	6.5		0.014			6.1	78	1.1	14	0.4	5	0.2	3	-	-
– 142	SCL	8.9	3.8	-	37.5	45.2	1.5	9.6	2.7		0.017			5.4	74	1.4	19	0.3	4	0.2	3	-	-
– 165	SCL	9.0	4.2	-	37.2	45.6	1.8	10.1	4.9		0.013			5.0	72	1.4	20	0.3	4	0.2	3	-	-
– 210	SCL	9.1	5.5	-	32.9	40.7	1.5	14.2	10.2		0.018			5.4	62	2.5	29	0.4	5	0.4	5	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%
Chalka Sand: Profile 4 – Soil Map Sheet 10 Unit B																							
0 – 10	S	7.6	0.6	-	45.8	45.8	2.0	4.5	0.6	30	0.002	0.041	0.59	2.4	52	0.6	13	0.4	9	0.1	2	1.2	26
– 30	S	7.8	0.6	-	45.4	48.5	2.0	3.0	0.6	20	0.003	0.021	0.25	1.7	42	0.4	10	0.2	5	0.1	3	1.6	40
– 60	SC	8.9	2.0	-	34.0	33.4	1.0	28.6	2.0		0.006			8.2	56	5.2	35	1.0	7	0.3	2	-	-
– 75	SC	9.3	9.9	8.3	27.5	29.8	0.5	32.0	9.9		0.008			7.7	50	6.1	40	1.0	7	0.5	3	-	-
– 105	SC	9.0	2.8	1.4	31.1	39.1	1.3	25.0	2.8		0.008			5.9	46	5.4	42	0.9	7	0.6	5	-	-
– 130	SC	9.6	1.8	-	27.2	35.4	5.7	30.8	1.8		0.014			4.6	37	5.8	46	0.8	6	1.4	11	-	-
Colignan Clay: Profile 1 – Soil Map Sheet 10 Unit C																							
0 – 7	LC	6.3		-	8.3	25.9	19.9	47.0	2.5	500	0.065	0.150	1.91	10.6	38	8.2	30	1.5	5	0.9	3	6.6	24
– 20	HC	7.3		0.2	5.1	29.0	16.4	48.2	2.7	480	0.066	0.059	0.62	10.5	41	8.4	33	1.1	4	2.2	8	3.5	14
– 39	HC	8.8		1.0	4.5	21.9	15.1	55.1	3.6	710	0.099			11.9	41	10.1	35	1.5	5	4.2	14	1.5	5
– 60	HC	8.7		0.4	2.6	21.1	16.2	58.4	2.9	1000	0.140			8.6	32	9.5	35	1.4	5	6.1	23	1.5	6
– 110	HC	8.8		0.2	1.8	15.5	17.1	63.8	2.8	1330	0.201			9.7	26	13.3	35	1.7	5	11.3	30	1.5	4
– 130	HC	8.3		0.1	2.2	17.5	17.1	61.5	2.9	1630	0.246			6.7	21	11.2	36	1.3	4	9.8	31	2.3	7
– 152	HC	8.9		3.4	1.8	20.3	19.4	55.4	4.9	1700	0.246			6.5	23	10.6	37	1.2	4	10.7	37	-	-
– 182	HC	8.9		11.9	0.8	14.0	36.7	43.7	6.2	1550	0.242			5.1	25	7.9	39	0.9	4	6.2	31	-	-
– 205	HC	8.9		4.7	0.9	29.8	25.8	33.5	6.3	1440	0.387			4.2	24	7.0	40	0.7	4	5.4	31	-	-
– 220	LC	8.7		7.4	0.6	23.5	23.2	32.5	5.5	1600	0.403			4.0	24	7.2	43	0.6	4	4.9	29	-	-
Colignan Clay Light Profile: Profile 2 – Soil Map Sheet 10 Unit C																							
0 – 7	MC	7.1		0.3	4.8	27.4	11.7	51.5	2.6	110	0.011	0.096	1.10	10.8	43	5.7	22	1.5	6	1.3	5	6.1	24
– 30	HC	8.3		0.2	4.5	24.4	10.9	55.7	2.9	220	0.021	0.061	0.41	12.6	41	10.9	36	1.5	5	2.7	9	2.8	9
– 67	HC	8.9		1.1	2.4	18.3	12.2	63.5	3.9	690	0.099			11.6	35	12.5	38	1.5	5	5.5	17	1.7	5
– 95	HC	8.4		0.4	2.2	17.9	14.0	64.7	3.1	1780	0.270			9.7	2.8	12.7	37	1.5	4	9.5	28	0.7	2
– 112	HC	8.4		0.3	2.3	14.0	14.8	66.8	2.7	1600	0.311			8.5	25	12.1	35	1.5	4	10.6	31	1.9	55
– 117	HC			0.5	2.0	22.4	12.2	59.4	3.2					7.6	25	11.1	36	1.3	4	9.5	31	1.4	5
– 137	MC	8.7		1.0	1.5	31.4	24.2	40.0	3.4	1820	0.275			6.5	31	7.8	37	0.9	4	5.9	28	-	-
– 192	LC	8.4		0.1	1.2	46.3	24.2	28.3	1.3	1520	0.247			4.9	29	6.4	37	0.6	4	4.5	26	0.7	4
– 225	MC	7.9		-	0.7	37.3	21.0	30.5	1.8	1530	0.385			4.8	26	6.9	37	0.5	3	5.5	29	1.0	5

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
														m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Coomealla Sandy Loam: Profile 27 – Soil Map Sheet 6 Unit B																							
0 – 15	SL	8.8	5.0	-	41.7	39.4	4.5	11.1	4.0	110	0.004	0.058	0.60	6.2	75	0.8	10	1.2	14	0.1	1	-	-
– 35	LSCL	8.8	5.0	-	37.7	42.0	4.3	11.6	3.9	110	0.004	0.051	0.45	6.1	76	0.8	10	0.9	11	0.2	3	-	-
– 47	SCL	8.9	6.1	2.8	35.2	35.4	6.0	13.1	8.5	140	0.007			6.4	67	1.2	12	1.9	20	0.1	1	-	-
– 67	SCL			-																			
– 100	SCL	9.4		5.4	27.8	30.7	1.8	9.0	15.0	130	0.004			2.2	35	3.5	56	0.3	5	0.3	5	-	-
– 157	LSCL	10.0		-	54.0	30.7	1.5	6.5	9.2	190	0.005			0.8	23	1.5	43	0.2	6	1.0	29	-	-
– 175	LSCL	10.1		-	54.4	31.8	1.8	9.6	1.8	310	0.024												
– 192	LSCL	10.1		7.4	41.3	34.6	5.1	16.2	2.9	450	0.051												
– 197	SC-MC	9.7		-	19.8	35.1	10.6	34.1	2.9	710	0.086			2.0	12	7.4	43	0.7	4	7.2	42	-	-
Coomealla Loam: Profile 28 – Soil Map Sheet 6 Unit B																							
0 – 15	LSCL	8.8	4.8	-	42.0	38.8	9.2	8.7	0.7	90	0.003	0.046	0.62	7.3	76	0.9	9	1.3	14	0.1	1	-	-
– 72	SC	9.3	7.1	-	29.3	32.4	2.8	16.2	14.3	130	0.004			9.7	69	3.1	22	0.5	4	0.7	5	-	-
– 90	SC	9.8		34.0	27.0	32.1	9.2	16.3	16.7	280	0.033												
– 120	SC	9.9		33.9	30.1	22.7	2.9	16.8	14.2	470	0.080			3.3	30	4.4	40	0.5	5	2.8	25	-	-
– 160	SC	9.8		36.7	35.1	26.5	2.5	15.3	12.5	560	0.101												
– 185	SC	9.7		5.6	38.9	35.3	4.4	18.4	2.7	600	0.108			2.5	23	4.9	45	0.5	5	3.1	27	-	-
– 195	SC	9.4		-	30.3	42.7	7.1	19.4		610	0.121												
– 210	LC	9.4		-	23.8	39.5	12.6	24.1		760	0.153												
Kamka Sandy Loam: Profile 36 – Soil Map Sheet 6 Unit B																							
0 – 10	SL	7.3	2.4	-	39.1	51.7	1.0	4.5	0.9	50	0.004	0.036	0.50	4.0	56	0.6	8	0.3	4	0.2	2	2.0	28
– 20	SL	6.7	1.3	-	45.4	44.4	1.5	6.5	0.2	40	0.004	0.030	0.39	5.4	60	0.4	4	0.4	4	0.2	2	2.6	29
– 45	SL	8.2	3.3	-	34.7	50.1	2.0	10.1	1.4	150	0.004			4.6	68	1.0	15	0.4	6	0.2	3	0.6	9
– 80	LSCL	8.8	3.8	-	45.6	38.7	2.0	11.6	1.7	170	0.008			3.5	56	2.0	32	0.4	6	0.3	5	-	-
– 92	SCL	9.2		-	46.0	38.5	2.0	11.1	1.7	100	0.004												
– 122	SCL	9.3		-	44.2	37.9	1.5	13.1	4.1	120	0.005			2.4	35	3.6	53	0.6	9	0.2	3	-	-
– 142	SCL-SC	9.3		-	43.8	38.6	1.0	13.6	2.4	130	0.004			2.3	32	3.8	54	0.5	7	0.5	7	-	-
– 175	SCL-SC	9.5		-	41.9	38.6	1.0	14.7	2.0	160	0.007			1.7	46	1.4	38	0.4	11	0.2	5	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Kamka Sandy Loam, Shallow Phase: Profile 22 – Soil Map Sheet 8 Unit B																							
0 – 15	SL	8.7	5.0	-	42.4	40.3	4.5	7.5	3.0	120	0.004	0.066	1.24	6.9	71	1.8	19	0.8	8	0.2	2	-	-
– 32	SCL	9.3	5.0	-	37.5	45.1	4.5	11.1	1.9	150	0.004	0.033	0.41	4.0	47	2.7	31	0.8	9	1.1	13	-	-
– 40	SCL-SC	9.9	14.0	-	35.8	32.3	4.6	23.1	4.3	400	0.004			3.8	25	4.8	31	1.5	10	5.3	34	-	-
– 82	SC	10.1	11.0	9.9	34.3	29.6	2.6	21.4	11.8	720	0.062			2.3	16	3.1	21	1.3	9	7.9	54	-	-
– 130	SCL-SC	9.8	9.0	14.3	36.8	30.3	3.1	18.4	10.4	1600	0.355			1.7	13	2.6	20	0.7	5	8.1	62	-	-
– 180	SC-MC	9.4	12.0	1.3	28.1	33.3	6.2	25.7	7.7	2120	0.514			2.0	12	3.6	21	0.8	5	10.9	63	-	-
– 200	MC	9.4		6.3	25.6	29.7	10.3	19.0	14.5	2360	0.599			3.0	18	3.5	21	0.7	4	9.4	57	-	-
– 230	SC-MC	9.4		30.3	24.2	36.5	10.3	19.5	10.5	2350	0.598												
– 270	MC-LC	9.4		7.1	17.7	37.9	10.3	22.7	3.3	2130	0.527			1.4	9	3.7	23	0.6	4	10.4	65	-	-
Kamka Sandy Loam, Shallow Phase: Profile 37 – Soil Map Sheet 6 Unit B																							
0 – 10	SL	7.4	2.4	-	48.2	42.7	0.5	4.5	0.6	40	0.004	0.041	0.46	2.2	24	3.4	37	0.5	5	0.8	9	2.4	26
– 30	LSCL	6.7	3.0	-	45.0	41.2	2.5	8.6	0.4	30	0.005	0.027	0.35	2.6	37	0.6	8	0.5	7	0.1	1	3.3	46
– 45	LSCL	7.0	5.0	-	43.3	39.9	2.5	12.1	0.6	40	0.004			2.8	42	1.1	17	0.6	9	0.1	2	2.0	30
– 60	SCL	7.6	3.4	-	46.6	38.4	2.5	11.6	0.5	30	0.004												
– 85	SCL	8.1	4.4	-	48.3	35.3	3.0	12.7	0.8	50	0.004			3.5	43	2.8	35	0.5	6	0.3	4	1.0	12
– 147	SCL-SC	9.1		3.5	36.5	33.1	0.5	19.9	4.9	180	0.010			5.4	45	4.5	38	0.9	8	1.1	9	-	-
– 162	SCL	9.3		10.7	44.8	33.1	1.5	19.8	1.3	160	0.007			2.9	34	4.0	47	0.6	7	1.0	12	-	-
Moorook Sand: Profile 32 – Soil Map Sheet 8 Unit A																							
0 – 22	LS	8.9	3.0	-	55.2	33.8	3.0	5.5	2.2	90	0.005	0.042	0.54	4.8	63	1.7	22	0.9	12	0.2	3	-	-
– 37	LS-SL	9.0	3.4	1.3	42.3	43.4	1.5	6.6	4.8	110	0.004			4.8	67	1.8	25	0.5	7	0.1	1	-	-
– 57	LSCL	9.2	4.7	54.0	40.0	35.2	2.5	6.1	12.6	110	0.005			4.2	61	2.3	33	0.3	4	0.1	1	-	-
– 80	LSCL	9.3	3.7	4.5	39.0	35.4	2.5	6.0	14.05	110	0.004				61		33		4		1		
– 100	LSCL	9.3		-	50.6	32.1	2.5	4.5	13.0	120	0.010			1.4	23	4.2	70	0.3	5	0.1	1	-	-
– 150	SL	9.3		-	50.1	30.6	1.5	4.5	13.1	100	0.005												
– 175	LSCL-SL	9.7		-	50.6	39.0	1.5	5.5	2.7	120	0.004			1.1	25	2.5	57	0.3	7	0.5	11	-	-
– 225	LSCL-SL	9.8		-	54.8	33.9	1.0	5.5	2.9	150	0.005												
– 240	LSCL-SL	10.0		-	51.3	37.2	1.5	7.0	3.0	220	0.010			0.6	14	2.2	51	0.3	7	1.2	28	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Murray Sand, Deep Phase: Profile 5 – Soil Map Sheet 10 Unit A																							
0 – 15	S	7.2		-	43.9	52.1	0.0	4.1	0.5	40	0.004	0.038	0.65	1.7	50	0.4	12	0.2	6	0.1	3	1.0	30
– 65	S	7.3		-	43.4	50.8	0.5	4.6	0.5	20	0.003			1.3	42	0.4	13	0.2	6	0.2	6	1.0	32
– 92	S	8.1		-	35.8	58.4	0.2	4.5	0.3	30	0.004			1.2	48	0.3	12	0.2	8	0.2	8	0.6	24
– 155	S	8.4		-	42.1	51.6	0.2	5.0	0.4	70	0.008			0.9	35	0.5	19	0.2	8	0.2	8	0.8	31
– 250	S	8.6		-	47.8	46.1	0.2	4.0	0.4	60	0.005			1.1	52	0.4	19	0.2	9	0.2	9	0.2	9
– 280	S	8.8		-	60.2	34.5	0.0	4.0	0.4	70	0.003			0.9	45	0.7	35	0.2	10	0.2	10	-	-
– 360	S	8.9		-	55.2	38.0	0.0	5.0	0.6	70	0.004			0.8	40	0.8	40	0.2	10	0.2	10	-	-
Murray Sand: Profile 31 – Soil Map Sheet 5 Unit A																							
0 – 17	S-LC	8.6	2.8	-	44.0	44.4	2.0	6.1	3.2	80	0.005	0.042	0.53	4.0	68	1.0	17	0.6	10	0.1	2	0.2	3
– 30	LS	8.7	2.8	-	39.4	49.2	3.8	7.6	1.1	90	0.007	0.034	0.42	4.2	72	0.9	15	0.6	10	0.1	2	-	-
– 90	LS	8.9	3.2	-	41.8	46.2	1.5	8.1	2.1	90	0.004												
– 145	LS	8.9	3.2	-	40.1	46.0	1.5	9.1	3.5	90	0.004			3.2	60	1.7	31	0.4	7	0.1	2	-	-
– 165	SL	9.1		-	26.0	40.9	1.8	13.2	15.3	120	0.007												
– 182	SL-LS	9.2		-	31.5	50.0	1.5	11.6	5.3	110	0.004			2.5	38	3.3	50	0.7	11	0.1	2	-	-
– 197	SL	9.3		-	33.9	54.8	2.5	6.5	2.3	100	0.006												
– 227	SL	9.5		-	36.1	50.3	1.3	11.6	0.8	130	0.006												
– 250	SL-LSCL	9.6		-	36.4	49.8	1.8	11.6	0.9	190	0.006												
– 280	LSCL	9.7		-	28.2	40.7	1.0	13.6	12.2	230	0.004			2.0	27	2.9	40	0.8	11	1.6	22	-	-
Murray Sand: Profile 26 – Soil Map Sheet 6 Unit A																							
0 – 10	LS	7.0	3.0	-	18.5	54.6	1.0	4.0	0.3	40	0.004	0.035	0.34	1.8	45	0.4	10	0.3	7	0.04	1	1.5	37
– 22	LS	6.7	3.0	-	42.0	49.2	2.5	6.0	0.6	30	0.004	0.026	0.34	2.1	42	0.5	10	0.1	2	0.2	4	0.1	42
– 67	LS	7.2	5.0	-	36.6	54.0	1.0	8.0	2.2	30	0.004												
– 145	LS	8.6		-	33.2	58.2	2.8	6.5	0.9	90	0.004			3.6	77	0.8	17	0.1	2	0.2	4	-	-
– 170	LS-SL	9.0		2.7	37.3	54.9	2.0	6.0	1.8	170	0.012												
– 230	LS-SL	9.1		-	33.1	57.9	1.5	8.0	1.0	80	0.005			2.8	38	1.4	19	1.3	18	0.1	1	1.7	23

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Murray Sand: Profile 23 – Soil Map Sheet 8 Unit A																							
0 – 22	S-LS	7.3	2.0	-	36.9	55.5	2.0	4.0	0.7	40	0.008	0.027	0.39	1.8	44	0.4	10	0.2	5	0.1	2	1.6	39
– 115	LS	7.1	2.0	-	43.4	48.9	2.5	5.5	0.8	20	0.006			2.3	51	0.6	13	0.1	2	0.1	2	1.4	31
– 145	LS	8.8	2.0	-	49.3	43.0	2.5	3.0	0.6	70	0.004			2.3	74	0.6	10	0.1	3	0.1	3	-	-
– 180	SL	8.9	4.0	-	48.4	37.2	2.0	10.6	2.4	100	0.003			4.1	65	1.8	29	0.2	3	0.2	3	-	-
– 227	SL-LSCL	9.1		-	43.5	42.0	10.1	5.1	2.7	100	0.004												
– 270	SL	9.5		-	42.7	40.6	10.1	3.5	0.8	130	0.005												
– 390	SL	10.1		2.3	48.5	35.2	10.1	5.1	1.7	360	0.026			1.9	21	3.8	43	0.5	6	2.7	30	-	-
Murray Sand Shallow Phase: Profile 21 – Soil Map Sheet 8 Unit A																							
0 – 15	LS	7.4	2.0	-	55.4	39.8	2.0	2.0	0.9	40	0.004	0.023	0.32	1.6	42	0.4	11	0.3	8	0.1	3	1.3	35
– 40	LS	8.4	3.0	-	54.6	36.7	2.0	5.0	1.4	100	0.004	0.023	0.29	3.9	74	0.8	15	0.5	9	0.1	2	-	-
– 90	LS	8.9	3.0	-	50.9	38.7	2.0	6.0	1.8	80	0.004			4.4	80	0.7	13	0.3	5	0.1	2	-	-
– 145	SL	9.1	4.0	-	45.2	35.7	1.0	6.5	10.2	100	0.004			3.9	70	1.3	23	0.3	5	0.1	2	-	-
– 170	LSCL	9.2		-	44.5	36.0	2.0	5.5	11.5	130	0.004			2.5	48	2.3	44	0.3	6	0.1	2	-	-
– 195	SCL	8.9		-	44.8	39.5	1.0	9.1	6.5	140	0.005			1.9	37	2.7	52	0.5	10	0.1	2	-	-
– 235	SCL	8.9		-	36.8	40.0	10.1	7.1	9.0	140	0.014			5.7	41	7.3	53	0.8	6	0.1	1	-	-
– 270	LSCL	9.0		-	49.4	33.7	10.1	5.1	5.7	140	0.008												
Nangiloc Sandy Loam: Profile 40 – Soil Map Sheet 8 Unit B																							
0 – 15	SL	8.2	3.8	-	42.2	40.7	4.3	10.6	0.7	80	0.004	0.048	0.69	4.3	40	1.6	15	1.2	11	2.7	25	0.9	8
– 30	SL-LSCL	8.1	3.6	-	42.1	41.1	6.1	9.6	0.6	50	0.005	0.043	0.59	4.3	54	1.5	19	0.7	9	0.3	4	1.2	15
– 45	SC	9.2	7.9	-	41.6	27.6	4.3	2.4	1.3	180	0.005			6.7	51	3.8	29	0.5	4	1.6	12	0.6	5
– 72	SC	10.0	6.2	8.8						370	0.026			2.5	32	2.0	26	0.4	5	2.8	36	-	-
– 100	SC	10.1	5.3	-	43.4	30.1	3.3	12.6	10.7	420	0.035												
– 132	SC	10.2		11.4	47.3	23.8	2.8	12.6	10.8	610	0.053			0.7	10	1.1	16	0.4	6	4.6	68	-	-
– 160	SC	10.0		19.3	41.2	25.4	3.0	10.6	14.7	690	0.090			0.5	8	1.0	16	0.3	5	4.3	70	-	-
– 170	SC	10.0		47.6	39.5	35.5	2.3	10.6	11.5	700	0.089												
– 190	SC	9.8		-	61.7	22.7	3.3	11.1	0.5	540	0.095												
– 207	SC	9.6		-	33.4	47.6	3.9	13.7	0.9	640	0.119												
– 237	HC	9.5		-	15.3	36.4	16.8	31.9	0.9	900	0.169												

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%
Nangiloc Sandy Clay Loam: Profile 41 – Soil Map Sheet 8 Unit B																							
0 – 10	LSCL	7.9	2.8	-	47.2	39.4	5.1	7.6	0.7	50	0.009	0.050	062	3.7	66	0.8	14	0.8	14	0.3	5	-	-
– 20	SCL	8.3	3.3	-	30.4	51.9	6.6	9.1	0.8	50	0.003	0.040	0.44										
– 47	MC	9.1	12.3	-	21.1	36.7	6.6	33.8	1.3	860	0.199			3.9	51	1.1	14	0.7	9	0.6	8	1.3	17
– 82	MC	9.2	21.1	-	15.4	23.8	3.7	48.7	8.7	2130	0.469			4.5	25	4.1	23	1.2	7	7.2	41	0.7	4
– 132	MC	9.3		-	12.6	13.7	9.0	51.3	9.9	2220	0.462			3.1	11	5.3	19	1.4	5	18.5	65	-	-
– 152	MC	9.4		-	9.0	16.6	15.8	41.2	11.8	2020	0.409			2.3	9	4.6	19	1.1	4	16.8	68	-	-
– 180	MC-HC	9.6		-	11.3	17.0	18.7	38.4	11.1	1710	0.352			2.2	9	3.4	13	0.9	4	14.0	55	5.0	20
– 190	MC-HC	9.5		-						1960	0.425			1.4	7	2.2	11	0.8	4	14.9	76	0.3	2
Nangiloc Sandy Clay Loam: Profile 33 – Soil Map Sheet 8 Unit B																							
0 – 15	SCL	8.8	7.2	1.6	33.0	36.1	7.1	17.4	5.7	150	0.006	0.08	0.86	8.6	66	2.7	21	1.6	12	0.2	1	-	-
– 35	SCL	9.0	8.2	8.0	38.0	27.08.	6.9	18.4	11.29	130	0.007	0.06	0.68	8.5	62	3.8	28	0.8	6	0.5	4	-	-
– 72	SC-MC	9.6	11.2	32.9		03				250	0.008			4.3	32	6.1	45	0.8	6	2.4	18	-	-
– 102	MC	10.0	17.0	23.6	27.1	23.9	9.8	30.3	13.4	520	0.022			1.9	17	5.1	45	1.0	9	3.4	30	-	-
– 127	MC	9.9	16.7	-	28.3	34.5	7.2	28.8	2.3	470	0.021												
– 155	MC	9.9		1.4	26.3	35.6	10.2	25.1	4.7	400	0.023												
– 170	MC	9.5		-	17.7	42.6	13.8	26.6	0.5	260	0.024			2.1	16	4.1	31	0.7	5	6.1	46	0.3	2
– 180	MC	9.1		-	12.6	34.5	22.5	30.2	1.5	390	0.028			2.3	15	4.1	27	0.6	4	7.0	46	1.3	8
Nangiloc Sandy Clay Loam, Shallow Phase: Profile 14 – Soil Map Sheet 8 Unit B																							
0 – 15	LSCL	8.6	5.0	4.0	34.8	47.4	3.8	12.7	0.7	100	0.004	0.06	0.56	6.2	60	2.1	20	0.9	9	0.3	3	0.9	9
– 25	LC	8.8	15.0	-	19.1	34.5	4.5	43.0	2.3	140	0.006	0.06	0.39	10.9	42	8.8	34	1.5	6	2.6	10	2.1	8
– 40	MC	9.5	20.4	5.5	16.5	31.4	5.6	47.5	3.3	310	0.014			9.6	34	11.4	41	1.2	4	5.6	20	0.2	1
– 50	MC	9.7	28.0	8.2	11.6	26.8	3.7	52.5	8.8	460	0.018			7.5	23	13.0	40	1.3	4	10.4	32	-	-
– 75	MC	9.8	27.0	6.5	11.1	23.0	3.2	50.8	17.3	540	0.021			6.1	20	12.0	38	1.2	4	11.9	38	-	-
– 97	HC	10.0	19.0	19.2	13.7	23.6	4.1	32.6	28.3	500	0.010			3.8	18	7.3	3.5	0.7	3	9.3	44	-	-
– 125	MC	10.0	15.0	7.6	18.7	32.7	4.4	28.9	16.8	490	0.014			3.5	19	5.9	32	0.6	3	8.3	45	-	-
– 150	MC	10.1	14.0	56.5	18.5	36.6	4.9	28.8	16.8	490	0.020			3.0	18	5.6	33	0.6	3	7.9	46	-	-
– 170	MC	10.0	15.0	18.5	16.4	42.6	7.2	30.4	6.0	520	0.025			2.6	15	5.9	33	0.6	3	8.4	47	0.2	4
– 210	LC	9.7	15.0	5.4	7.7	48.0	17.0	30.3	1.3	810	0.104			2.5	14	5.6	32	0.5	3	8.5	48	0.6	3

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%
Nangiloc Sandy Clay Loam, Shallow Phase: Profile 35 – Soil Map Sheet 8 Unit B																							
0 – 22	SCL	9.2		-	30.3	45.3	3.6	13.7	5.3	140	0.005	0.06	0.74	8.4	68	2.5	20	0.6	5	0.9	7	-	-
– 30	SCL-SC	9.5	6.4	6.6	26.7	45.4	4.6	13.2	8.1	190	0.004	0.04	0.53	12.1	53	6.6	29	0.7	3	3.5	15	-	-
– 45	SC	9.8	7.0	86.7	32.5	35.4	5.1	11.7	13.02	300	0.015			7.3	33	8.7	39	0.7	3	5.5	25	-	-
– 77	SC	10.1	7.8	56.5	30.9	23.7	3.0	26.3	15.02	390	0.020			2.4	24	3.4	34	0.4	4	3.8	38	-	-
– 92	MC	10.1	10.5	43.0	26.3	22.6	17.3	17.8	13.6	470	0.080			1.3	13	3.1	31	0.4	4	5.1	51	-	-
– 112	MC	10.0		11.9	15.9	32.0	7.7	32.3	9.2	570	0.037												
– 120	MC	9.9		-	14.4	35.2	8.8	40.8	1.6	520	0.032												
– 132	MC-HC	9.6		-	14.4	35.9	9.8	38.8	1.5	320	0.039			9.3	32	5.6	20	0.9	3	12.2	43	0.7	2
– 147	HC	9.4		-	8.8	36.0	16.5	40.3	0.8	340	0.037												
– 180	HC	9.0		-	7.1	40.2	18.0	36.0	0.5	320	0.035			6.8	24	4.0	14	6.1	21	11.5	40	0.4	1
Nangiloc Sandy Clay: Profile 29 – Soil Map Sheet 2 Unit B																							
0 – 15	SCL	8.2	3.9	-	28.6	52.8	6.7	12.8	0.8	50	0.004	0.04	0.40	5.3	62	0.9	10	0.9	10	0.3	3	1.2	14
– 30	LC	8.8	8.9	-	24.7	40.7	6.0	27.2	1.1	50	0.010	0.04	0.28	6.4	46	2.7	19	1.0	7	2.0	14	1.9	14
– 60	LC	9.5	17.0	-	17.1	24.7	5.8	51.5	3.4	320	0.010			8.9	39	6.0	26	1.8	8	6.1	27	-	-
– 80	SC-MC	9.5	13.9	18.3	28.6	19.4	3.4	35.1	6.9	530	0.031			5.8	33	4.4	25	1.4	8	5.7	33	-	-
– 92	SC-MC	9.3	12.2	5.2	27.3	24.6	3.4	29.8	6.0	650	0.048			5.7	34	4.3	26	1.4	8	5.4	32	-	-
– 115	SC-MC	8.8	10.5	6.8	26.4	23.3	4.6	24.1	12.3	800	0.060			5.5	38	4.6	31	1.0	7	3.5	24	-	-
– 132	SC-MC	8.3		9.0	26.8	23.8	4.9	23.6	12.7	1520	0.078												
– 155	MC	8.6		-	29.1	25.7	4.4	26.7	9.4	1290	0.111												
– 172	SC	8.2		2.6	34.8	26.8	3.4	20.6	9.4	2610	0.120			4.1	31	4.3	33	1.0	8	3.7	28	-	-
– 192	SC	8.1		-	46.2	27.5	3.4	21.1	3.0	2330	0.124												
– 202	SC	8.3		-	44.8	23.8	2.9	24.7	0.8	1060	0.184			3.0	20	5.3	35	1.2	8	4.7	31	1.1	7
– 227	SC	8.3		-	47.1	24.2	3.6	23.6	0.4	1030	0.189			2.4	18	4.9	36	1.0	7	4.3	32	0.9	7
Nangiloc Sandy Clay: Profile 34– Soil Map Sheet 8 Unit B																							
0 – 15	SC	8.9	7.8	-	23.4	41.0	10.2	23.6	1.4	150	0.007	0.07	0.63	10.4	67	2.7	17	1.4	9	1.0	6	0.1	1
– 32	FSC	8.9	9.8	-	20.6	40.3	8.2	27.3	3.5	160	0.010	0.04	0.42	11.0	66	3.8	23	0.9	5	0.9	5	-	-
– 50	LC	9.0	10.3	13.9	20.4	33.7	5.7	24.6	12.7	150	0.008			9.5	63	4.5	30	0.4	3	0.7	5	-	-
– 65	MC	9.4	9.9	67.9	25.0	29.9	10.2	19.9	14.26	180	0.009			6.1	49	4.6	37	0.4	3	1.4	11	-	-
– 77	MC	10.0	13.6	47.3	24.5	25.4	15.7	17.3	14.42	340	0.014			2.8	27	3.8	37	0.3	29	3.4	33	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
														m.e. % - Milliequivalents per 100 g of soil % - Percentage of cation exchange capacity									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Nangiloc Sandy Clay: Profile 34 – Soil Map Sheet 8 (Cont'd) Unit B																							
0 – 92	MC	10.1	22.3	17.1	15.2	30.6	25.7	25.5	6.22	520	0.023			1.7	13	4.0	30	0.4	3	7.3	54	-	-
– 97	MC-HC	10.1		3.3	10.8	36.3	24.6	27.6	3.7	580	0.030			1.2	8	3.8	26	0.6	4	8.8	61	-	-
– 112	LC-MC	10.1		8.1	10.4	36.8	23.6	30.8	2.2	600	0.036			1.2	8	3.9	25	0.6	4	9.8	63	-	-
– 147	MC	9.9			9.0	32.3	17.0	43.3	1.7	690	0.054			1.2	6	5.0	26	0.8	4	12.5	64	-	-
Nowingi Sand: Profile 11 – Soil Map Sheet 10 Unit A																							
0 – 50	S	7.7		-	51.9	44.6	1.0	1.7	0.6	30	0.002	0.03	0.37	1.9	61	0.2	6	0.2	6	0.1	3	0.7	23
– 82	S	8.8		-	52.5	42.9	0.3	2.2	0.8	50	0.002			1.3	65	0.1	5	0.1	5	0.1	5	0.4	20
– 110	S	9.0		-	49.2	45.8	0.0	2.7	0.7	60	0.002			1.2	57	0.3	14	0.1	5	0.1	5	0.4	19
– 167	S	9.0		-	53.7	41.9	0.8	2.2	0.5	60	0.002			0.9	50	0.2	11	0.1	6	0.2	11	0.4	22
Nowingi Sand, Heavy Profile: Profile 6 – Soil Map Sheet 10 Unit A																							
0 – 20	S	8.2		-	67.2	26.0	0.5	4.5	0.1	80	0.005	0.04	0.72	3.0	67	0.5	11	0.3	7	0.1	2	0.6	13
– 60	S	8.7		-	65.7	27.9	0.2	5.0	0.6	70	0.004			1.5	68	0.4	18	0.2	9	0.1	4	-	-
– 90	SL	9.4		-	45.5	45.8	0.5	7.0	0.4	70	0.012			1.2	54	0.7	32	0.2	9	0.1	4	-	-
Winkie Sand, Deep Phase: Profile 30 – Soil Map Sheet 5 Unit A																							
0 – 17	S-LS	8.6	2.3	-	37.5	54.0	1.0	5.5	3.5	80	0.007	0.03	0.26	3.6	64	0.9	16	0.4	7	0.2	4	0.5	9
– 60	S	8.9	2.7	-	32.3	58.5	1.8	5.0	3.8	80	0.004			3.6	69	1.0	19	0.3	6	0.1	2	0.2	4
– 85	LS	9.0		-	37.9	52.1	1.5	6.1	3.7	80	0.005												
– 150	LS	9.1		-	30.7	56.6	0.0	8.1	4.4	90	0.004			2.4	52	1.8	39	0.3	6	0.1	2	-	-
– 180	SL	9.1		-	27.6	45.8	0.3	9.1	14.9	110	0.004												
– 200	SL	8.9		-	29.9	44.9	1.3	7.1	15.5	190	0.004			4.0	67	1.7	28	0.2	3	0.1	2	-	-
– 270	SL	8.6		-	33.1	54.1	1.8	5.5	6.1	410	0.006			4.1	78	0.9	16	0.2	4	0.1	2	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
														m.e. % - Milliequivalents per 100 g of soil % - Percentage of cation exchange capacity									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						Ca		Mg		K		Na		H	
														m.e.	%	m.e.	%	m.e.	%	m.e.	%	m.e.	%
Winkie Sand, Deep Phase: Profile 7 – Soil Map Sheet 10 Unit A																							
0 – 17	S	7.9		-	56.7	38.0	0.0	3.0	0.4	40	0.002	0.03	0.43	2.2	54	0.5	12	0.2	5	0.1	2	1.1	27
– 50	S	8.7		-	50.9	44.3	0.0	2.5	0.8	60	0.001			1.7	68	0.1	4	0.2	8	0.1	4	0.4	16
– 90	S	9.1		-	54.7	40.6	0.0	3.0	0.9	60	0.002			1.1	65	0.2	12	0.1	6	0.1	6	0.2	12
– 180	S	9.1		-	62.7	33.3	0.0	3.5	0.6	60	0.001			1.1	58	0.3	16	0.2	11	0.1	5	0.2	11
– 255	S	9.2		-	76.4	20.6	0.0	2.0	0.5	60				1.3	68	0.3	16	0.2	11	0.1	5	-	-
– 330	S	9.1		-	72.9	24.2	1.2	2.0	0.4					1.4	70	0.3	15	0.2	10	0.1	5	-	-
Winkie Sand, Deep Phase: Profile 12 – Soil Map Sheet 10 Unit A																							
0 – 65	S	9.0		-	64.5	32.2	0.0	2.7	0.6	50	0.002	0.01	0.11	0.8	50	0.1	6	0.2	13	0.1	6	0.4	25
– 135	S	9.1		-	51.4	43.3	0.0	3.0	1.0	60	0.003			1.1	55	0.3	15	0.1	5	0.1	5	0.4	20
– 210	S	9.2		-	68.1	27.6	0.0	3.5	0.9	60	0.002			1.0	45	0.3	23	0.2	9	0.1	5	0.4	18
– 265	S	9.1		-	58.1	38.0	0.0	3.0	0.7	60	0.002			0.8	42	0.6	31	0.3	11	0.1	5	0.2	11
Winkie Sand: Profile 18 – Soil Map Sheet 8 Unit A																							
0 – 20	S	7.3	2.1	-	48.1	45.0	0.3	0.5	0.2	100	0.004	0.04	0.52	2.5	52	0.5	10	0.5	10	0.04	1	1.3	27
– 50	S	8.3	2.3	-	53.8	39.0	0.3	6.5	0.4	90	0.004			3.6	74	0.8	17	0.3	6	0.04	1	0.1	2
– 102	S-LS	8.8	2.6	-	44.3	46.8	0.0	7.6	0.7	100	0.005			4.4	77	1.0	18	0.2	4	0.1	2	-	-
– 140	LS-SL	8.9	3.6	-	40.9	45.0	0.0	8.6	6.0	140	0.004			4.0	67	1.6	27	0.2	3	0.2	3	-	-
– 180	SL	9.2	3.3	-	41.2	46.1	0.0	8.6	4.9	100	0.004			3.5	57	2.3	38	0.2	3	0.1	2	-	-
– 210	LS	9.0	3.4	-	46.1	43.1	0.0	8.6	2.8	90	0.004			2.8	50	2.4	43	0.3	5	0.1	2	-	-
Type d_1: Profile 20 – Soil Map Sheet 6 Unit B																							
0 – 15	SL	8.8	7.1	1.9	41.3	27.8	5.9	20.0	7.1	120	0.004	0.05	0.50	9.4	65	1.7	12	2.8	19	0.6	4	-	-
0 – 30	FSCL	9.5	8.9	2.2	20.4	37.4	5.9	24.1	15.2	200	0.013	0.04	0.38	10.4	63	3.1	19	0.9	5	2.1	13	-	-
0 – 40	FSC	9.6	10.0	7.6	18.5	34.6	4.1	22.9	15.8	600	0.113			6.4	42	4.5	30	0.7	5	3.6	24	-	-
0 – 70	SC	9.2	10.0	4.2	16.9	39.8	4.1	22.6	13.05	1400	0.347			5.5	35	5.7	36	0.7	4	3.9	25	-	-
0 – 90	SC	9.1		3.4	17.3	40.8	3.6	29.9	12.0	1580	0.365			5.6	31	6.8	37	0.8	4	5.1	28	-	-
0 – 100	SC	9.1		-	37.9	16.9	5.2	33.6	8.1	1670	0.379			6.0	29	8.1	39	0.9	4	5.8	28	-	-
0 – 120	FSC	8.9		1.8	14.9	27.8	4.7	37.8	14.9	1970	0.452			6.5	28	9.1	40	1.1	5	6.2	27	-	-
0 – 142	FSC	8.8		6.2	12.2	21.8	3.6	41.6	17.2	2210	0.489			6.3	26	9.8	41	1.2	5	6.6	28	-	-
0 – 180	FSC	8.7		6.6	10.9	24.1	5.3	51.6	8.6	2520	0.545			6.9	24	12.0	42	1.5	5	8.3	29	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%
Type d_3: Profile 19 – Soil Map Sheet 6 Unit B																							
0 – 10	SCL	8.6	7.4	-	22.6	46.3	9.2	24.0	1.6	100	0.008	0.05	0.80	8.5	62	2.2	16	1.9	14	0.4	3	0.8	6
– 27	LC	9.1	17.0	-	10.7	29.8	8.7	55.7	1.6	240	0.027	0.06	0.45	13.7	47	8.3	28	1.6	5	4.1	14	1.4	5
– 40	MC	9.2	21.1	-	7.4	25.4	7.9	61.3	5.7	610	0.096			11.6	34	11.5	34	1.5	4	6.3	19	2.9	9
– 60	MC	9.2	20.5	8.8	9.6	27.4	8.4	54.7	9.7	920	0.171			9.4	32	11.0	38	1.2	4	7.3	25	-	-
– 100	MC	9.3	20.5	16.6	8.4	29.1	9.9	44.8	10.6	880	0.137			7.5	31	8.3	34	0.9	4	7.4	31	-	-
– 142	HC	9.2	18.3	39.7	4.8	22.3	19.8	51.1	9.6	1110	0.157			7.6	30	8.1	32	0.9	3	8.9	35	-	-
– 167	HC	9.0	20.1	82.2	3.7	23.7	20.2	52.4	6.2	1400	0.187			7.2	26	9.3	33	0.9	3	10.7	38	-	-
– 180	HC	8.6	16.6	30.8	2.5	26.1	19.0	54.3	3.0	2050	0.203			7.6	25	10.4	34	0.9	3	11.7	38	-	-
Type 4: Profile 9 – Soil Map Sheet 10 Unit B																							
0 – 17	S	8.1		-	50.2	43.9	0.5	3.5	0.5	30	0.003	0.05	0.58	2.5	73	0.5	15	0.3	9	0.1	3	-	-
– 52	S	9.1		-	48.2	45.1	0.8	3.0	0.9	70	0.002			2.3	77	0.5	17	0.1	3	0.1	3	-	-
– 80	S	9.3		-	47.8	47.4	0.0	3.0	0.4	70	0.002			1.4	64	0.6	27	0.1	5	0.1	5	-	-
– 105	SL	9.3		-	44.6	46.7	0.5	6.5	0.4	70	0.003			1.9	51	1.5	41	0.2	5	0.1	3	-	-
– 115	SCL	9.6		-	37.3	50.2	0.5	11.1	0.8	120	0.006			1.8	33	1.3	43	0.3	6	1.0	19	-	-
– 135	SCL	9.7		-	41.9	41.1	0.5	15.0	1.7	220	0.011			2.3	31	3.3	45	0.5	7	1.3	18	-	-
– 152	SCL	9.6		-	46.1	41.4	1.3	10.1	0.7	140	0.012			1.6	31	2.2	62	0.3	6	1.1	21	-	-
– 172	SCL	9.4		-	48.1	38.2	0.0	12.1	0.8	170	0.019			1.8	32	2.4	42	0.3	5	1.2	21	-	-
– 185	SCL	9.3		-	41.3	44.1	0.0	14.2	0.2	150	0.025			1.9	30	2.7	43	0.3	5	1.4	22	-	-
– 230	SCL	9.4		-	35.2	45.2	0.8	16.0	1.0	250	0.033			2.0	26	3.3	43	0.4	5	2.0	26	-	-
– 255	SCL	9.5		-	39.3	45.4	0.0	13.6	0.8	260	0.025			1.4	21	2.9	44	0.4	6	1.9	29	-	-
– 270	SCL	9.0		-	50.9	33.8	0.3	13.2	0.6	240	0.066			1.2	17	3.2	45	0.4	6	2.3	32	-	-
– 292	MC-HC	9.6		-	13.0	24.2	9.2	45.8	6.1	700	0.087			2.9	15	8.1	42	1.1	6	7.0	37	-	-
Type 8: Profile 8 – Soil Map Sheet 10 Unit B																							
0 – 10	SL	7.9		-	48.3	35.5	3.5	10.6	0.6	30	0.003	0.03	0.40	3.5	47	1.4	19	0.5	7	0.1	1	2.0	2.7
– 25	SL	8.0		-	40.5	48.4	3.3	8.1	0.6	20	0.004	0.02	0.24	2.8	45	1.3	21	0.4	6	0.1	2	1.6	2.6
– 42	SCL	9.2		-	36.6	38.6	2.5	21.4	1.2	150	0.006			5.4	44	3.9	32	0.5	4	1.2	10	1.2	10
– 60	SC	9.6		2.0	44.3	31.2	0.8	19.8	4.3	180	0.004			4.5	42	4.1	39	0.5	5	1.5	14	-	-
– 77	SCL	9.8		0.1	36.0	43.1	1.3	15.2	2.4	240	0.007			2.5	29	3.8	44	0.4	5	2.0	23	-	-
– 90	SCL	10.2		-	20.7	51.1	1.5	19.9	4.9	370	0.007			1.8	16	4.9	44	0.5	4	4.0	36	-	-

Depth (cm)	Field Texture	pH	% Moisture (15 Atmosphere)	% Gravel	Particle Size				% Loss on Acid Treatment	E.C. u S/cm	% Sodium Chloride (Cl x 1.65)	% Nitrogen	% Organic Carbon	Exchangeable Cations									
					% Coarse Sand	% Fine Sand	% Silt	% Clay						m.e. % - Milliequivalents per 100 g of soil . % - Percentage of cation exchange capacity									
														Ca		Mg		K		Na		H	
														m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%	m.e. %	%
Type 8: Profile 8 – Soil Map Sheet 10 (Cont'd) Unit B																							
0 – 137	HC	10.1		1.8	6.7	34.4	8.0	43.0	8.4	570	0.018			1.8	10	9.6	53	0.5	3	6.2	34	-	-
– 180	HC	8.8		-	5.2	28.3	11.8	49.8	3.0	850	0.113			1.0	5	11.1	55	1.1	5	7.0	35	-	-
Type 12: Profile 10 – Soil Map Sheet 10 Unit B																							
0 – 30	SL	6.5		-	37.5	46.0	2.8	10.6	1.1	670	0.001	0.04	0.48	6.9	75	0.6	7	0.6	7	0.1	1	1.0	11
– 37	SCL	7.4		-	32.0	40.2	5.9	21.3	0.9	230	0.002	0.03	0.27	7.0	57	3.0	25	1.0	8	0.1	1	1.1	9
– 52	SC	8.3		-	30.0	32.9	3.9	32.5	1.8	390	0.004			6.2	43	6.3	43	1.3	9	0.4	3	0.3	2
– 62	MC	8.7		0.4	25.9	32.4	2.0	35.0	3.2	330	0.005			10.1	53	7.3	38	1.0	5	0.7	4	-	-
– 87	MC	9.3		21.8	29.1	39.3	1.8	25.2	3.1	230	0.006			5.6	41	5.4	40	1.0	7	1.6	12	-	-
– 120	SC-SCL	9.9		8.5	39.5	39.4	1.0	17.3	2.9	300	0.007			2.4	26	3.3	36	0.8	9	2.7	29	-	-
– 152	SCL-SC	10.2		5.2	38.5	41.3	0.5	16.7	2.3	390	0.009			1.3	14	2.6	28	1.4	15	3.9	42	-	-
– 162	SCL-SC	10.2		1.8	34.2	42.5	3.9	16.9	2.1	420	0.014			0.8	8	2.4	24	1.4	14	5.2	53	-	-
– 170	MC	10.1		-	19.7	37.4	14.8	28.4	1.4	390	0.020			0.8	9	3.5	37	0.8	9	4.3	46	-	-
– 180	MC	10.1		17.0	12.5	32.7	13.4	35.7	6.6	600	0.026			1.3	8	4.3	26	1.2	7	9.8	59	-	-
– 200	MC	9.9		6.4	7.3	35.1	16.5	36.1	3.5	570	0.041			0.9	5	4.0	24	1.0	6	10.6	64	-	-
– 210	SLC	9.8		2.9	2.2	28.6	25.1	36.1	2.1	520	0.046			0.9	5	3.8	23	0.9	5	11.2	67	-	-
Type 14: Profile 3 – Soil Map Sheet 10 Unit C																							
0 – 17	MC	8.4		0.4	8.1	29.9	11.8	49.0	2.4		0.005	0.10	1.00	13.9	50	8.3	30	1.8	6	1.4	5	2.5	9
– 50	HC	9.1		1.2	5.7	25.4	12.4	55.1	2.2		0.035			11.0	40	10.8	39	1.4	5	4.5	16	-	-
– 70	MC	9.4		1.0	5.9	20.6	11.0	60.5	3.3		0.054			8.4	28	12.0	39	1.5	5	8.5	28	-	-
– 95	MC	9.5		1.5	3.4	20.5	12.1	58.4	3.8		0.068			7.1	22	12.5	38	1.5	5	10.7	33	-	-
– 117	MC	9.4		1.1	4.8	17.2	12.6	63.1	2.6		0.076			5.9	19	12.4	40	1.5	5	11.3	36	-	-
– 125	MC	9.4		2.3	3.2	17.8	14.7	61.8	3.2		0.090			5.6	18	12.1	39	1.5	5	11.8	38	-	-
– 140	MC	9.3		5.2	2.3	16.4	23.8	54.9	4.2		0.110			4.6	18	10.0	38	1.4	5	10.0	39	-	-
– 152	MC	9.3		10.7	1.8	8.8	35.8	49.3	4.9		0.124			4.3	19	8.7	38	1.1	5	8.7	38	-	-
– 177	MC	9.3		7.5	1.1	13.2	36.0	45.5	4.9		0.133			3.6	17	9.3	43	0.9	4	7.8	61	-	-
– 210	MC	9.1		2.1	0.9	17.1	27.8	40.7	4.2		0.262			3.5	15	9.1	39	0.9	4	7.9	34	-	-

APPENDIX III - Analytical Methods

Ultimate Particle (Mechanical) Analysis

The method used was that of Mikhail and Briner, 1978, see References.

Electrical Conductivity (E.C.), pH and Chloride

A 1:5 soil-water suspension was used to determine electrical conductivity, using a conductivity cell, and to determine pH using a glass electrode. Chloride was determined by argentometric titration using the electrometric method of Best (1929).

Organic carbon

The wet oxidation method of Walkley (1947) was used.

Exchangeable Cations

After the removal of soluble salts by washing with a 10 percent solution of ethanediol in methylated spirit, exchangeable cations were leached from the soils using a 1M ammonium chloride solution adjusted to pH 8.5. In the leachate, calcium and magnesium were determined by atomic absorption spectrophotometry and sodium and potassium using an EEL flame photometer. The individual cations have been expressed as milligram equivalents per 100 g of soil and also as a percentage of the total cation exchange capacity.

Exchangeable Hydrogen

This was determined by Mehlich's barium chloride – triethanolamine method (reference point pH 8.0) using the modification of Peech et al (1962).

Cation Exchange Capacity

This is expressed as the sum of exchangeable calcium, magnesium, potassium, sodium and hydrogen.