

LAND MANAGEMENT MANUAL WAGGAMBA SHIRE

PART B FIELD MANUAL



QUEENSLAND DEPARTMENT
OF PRIMARY INDUSTRIES



Queensland Government Technical Report

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LAND MANAGEMENT MANUAL
WAGGAMBA SHIRE

PART B
FIELD MANUAL

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SUMMARY

This section of the manual (Part B - Field Manual) is designed as the primary reference section for the Land Resource Areas, soils and management recommendations. It comprises maps, keys and summary data for the land resources and their management. Guidelines are provided on how this section is best used.

Succinct soil identification and characterisation data are presented on waterproof cards with colour photos for ease of visual identification. These cards, and the accompanying land management information cards, are designed to be detachable from the manual and can be used separately and restored to the manual when required.

The Land Resource Area map, in the back pocket, is the major starting point for land resource identification and description. It, and the accompanying soil and management information, make a reference unit in themselves. More detailed information and interpretation are provided in Part A of the manual.

INTRODUCTION

The challenge for today's landholders and land use planners is to achieve optimum production from the land while still maintaining the stability of the nation's soil.

The identification of specific soils, together with their particular management requirements for sustainable production, is an integral part of meeting this challenge. Such information should be presented in a suitable format for use by landholders and land use planners and needs to be regularly reviewed to keep pace with changes in technology.

Information of this nature is required for the maintenance of long term agricultural and pastoral productivity in Waggamba Shire.

This manual is one of a series detailing the land resources and recommended land management practices for the major cropping and pastoral areas of Queensland. The program was started in late 1979 and has as its objectives:

- The provision of a land resource base for farm planning purposes by defining the major agricultural soils for each district;
- The provision of recommendations and specifications for soil conservation measures, agronomic practices and conservation management for those soils;
- The documentation of this information in Land Management Field Manuals; and
- The periodic review of the land resource base information and management recommendations and specifications.

The program involves cooperation between officers of Land Resources, Land Conservation, Agriculture and other Branches of the Queensland Department of Primary Industries, as well as other agricultural organisations.

This report (Part B of two parts), complements Part A and presents a summary of information on the Land Resource Areas (LRAs) for Waggamba Shire as well as the soils that occur in each LRA. It also presents easy to use methods for identifying these land resource areas and agricultural management units together with colour photos and soil profile descriptions.

The limitations for crop and pastoral use, together with summaries on land use and land management requirements for sustainable production, are provided for each soil. Suitability for soil conservation structures and limitations to land use are also included.

The use of this information by landholders, people with the responsibility for land use planning decisions, and research and extension personnel providing technical advice to land users, will lead to the sustainable productivity of the shire's land resources.

HOW TO USE THE LAND MANAGEMENT MANUAL

Land resource information is essential for determining land use potential and recommending management practices which achieve and sustain that potential.

A summary of the land use potential and land management information for Waggamba Shire is presented in this part of the manual. To use this information it is first necessary to determine the soil group for which the information is required. As knowledge of the land resources is gained it will be possible to identify both the Land Resource Area (LRA) and the soil using only the summary information from Part B. This summary information includes the LRA map and LRA key, as well as the soils key, representative soil photographs and a summary description of each soil.

Until experience is gained with the land resources of the district, the soil may be determined by the following method:

Step 1 Refer to LRA Map in Part B. Locate the site that you are interested in and note the LRAs at and surrounding the site on the map.

Step 2 Compare the field site with the description given for the LRA on the reverse of the map and in Chapter 7 of Part A of the manual. If -

- (a) description matches* - go to Step 4;
- (b) description does NOT match - go to Step 3.

Step 3 Use the LRA key in Part B, determine the LRA and repeat Step 2.

(Note: The LRA map shows a generalised distribution of the LRAs only, due to the mapping scale of 1:250 000. Small areas of any of the 15 defined LRAs could occur on the property being planned without being delineated on the map).

Step 4 Having determined the correct LRA, check the LRA map reference to see which soils occur in that LRA.

Step 5 Dig a hole, use the soil descriptions (Chapter 7 in Part A, and the photo cards in Part B) and the accompanying key in Part B to determine the soil. Check with the colour photograph of the representative soil profile in Part B to see that the soil appearance matches. If site -

- (a) matches soil description + soil photograph - go to Step 7;
- (b) does NOT match soil description + soil photograph - go to Step 6.

Step 6 If the site does not match the soil description and soil photo, try the LRA map reference and key again. If the site still does not match any of the described soils, record this site and contact the nearest Department of Primary Industries office with either a Land Conservation Officer or Land Resources Officer.

Step 7 Refer to the summary cards and tables of Part B of the manual for all soil, land use information and management recommendations for the soil.

* Matching does not imply they must be 'identical' but rather that they should be similar in most respects.

THE LAND RESOURCE AREAS AND SOILS

Introduction

The land resources of an area should be first documented in order to define its agronomic, land management and erosion control requirements. The land resources of Waggamba Shire have been delineated at two levels:

- **Land Resource Area (LRA)** - a land resource area consists of a pattern of soils, vegetation and landform developed on common or related geological units.
- **Soils** - Each soil defined represents a broad group of soils with similar agricultural and soil conservation management requirements. These soils have been defined on the basis of the soil associations of Isbell (1959) and recent field assessment of the major soils used for cropping in Waggamba Shire. An LRA may contain one or more of the defined soils.

The land resource areas

Fifteen LRAs are delineated in Waggamba Shire. Their distribution is shown on the accompanying map. The distinguishing features of the LRAs are given in the legend on the reverse of the map and in Chapter 7 of Part A of the manual. The key to the LRAs is also presented in Table B2 of this part.

Soils

Twenty-nine soils are recognised in Waggamba Shire and their distinguishing morphological features are given in Chapter 7 and Tables II.1 and II.2 in Appendix II of Part A of the manual. A key to the soils is presented as Table B3 in this part. Photographs of these soils together with landscape and profile descriptions and the soils' major properties are presented in the summary cards of this manual.

Table B1. Concepts of each of the soils in Waggamba Shire

Soil (No.)	Concept
Keetah (1)	Brown alluvial soil on narrow, fine sandy levees and lower terraces adjacent to major rivers
Bengalla (2)	Silty, impermeable, duplex soil on extensive, high terraces adjacent to major rivers
Undabri (3)	Hard setting, dark or grey cracking clay with tussock grassland or coolibah woodland on flood prone alluvial plains
Kalanga (4)	Self-mulching, dark or grey cracking clays with belah - coolibah woodland or myall shrubland on flood prone alluvial plains
Murra Cul Cul (5)	Dark or brown duplex soil, with poplar box woodland on narrow, alluvial plains of major creeks in the east
Yambocully (6)	Loamy, duplex soil with poplar box woodland on higher areas within alluvial plains
Oonavale (7)	Sandy, duplex soil with poplar box woodland on higher areas within alluvial plains
Jindabyne (8)	Red-brown, duplex soil with poplar box woodland on narrow alluvial plains of major creeks in the west
Wondoogle (9)	Soft, brown, deep sands on low, broad rises within alluvial plains
Wai Wai (10)	Loose, red, deep sands on low, elongated ridges within alluvial plains
Marella (11)	Sandy, duplex soil with cypress pine - poplar box forest, on relict alluvial plains
Bendidee (12)	Sandy, impermeable, duplex soil with cypress pine - ironbark - rusty gum forest, on sloping lowlands in the east
Yelarbon (13)	Eroded, silty, impermeable duplex soil with stunted vegetation on relict alluvial plains
Wondalli (14)	Self-mulching, dark or grey cracking clay on melonholed, brigalow - belah plains in the east
Calingunee (15)	Self-mulching, dark or grey cracking clay on sloping, melonholed, brigalow - belah lowlands in the north-east
Kurumbul (16)	Friable, dark or brown, duplex soil on belah plains in the east
Mt. Carmel (17)	Friable, dark or brown duplex soil on sloping belah lowlands in the east
Moruya (18)	Hard setting, red-brown or brown duplex soil on sloping, belah lowlands in the east
Wynhari (19)	Dark or brown, (non-cracking) clay on sloping belah lowlands in the east
Tandewanna (20)	Red or brown (non-cracking) clay or friable, duplex soil on belah plains in the west
Arden (21)	Self-mulching, red or brown cracking clay on sloping brigalow - belah lowlands, in the west
Tarewinnabar (22)	Self-mulching, dark cracking clay on lower slopes and valley flats within open downs
Tarewinnabar shallow (23)	Shallow, hard setting, red or brown cracking clay with ironbark - box woodland on crests within open downs
Weengallon (24)	Red, duplex soil or structured earth with poplar box woodland, in the west
Flinton (25)	Red, massive earth with ironbark - poplar box woodland, in the west
Uranilla (26)	Loamy, impermeable duplex soil with bull oak - ironbark - rusty gum - poplar box forest, in the east
Westmar (27)	Sandy, impermeable, duplex soil with ironbark - poplar box - cypress pine woodland
Flinton shallow (28)	Very shallow, red, gravelly soil on the jumpups
Karbullah (29)	Very shallow, dark or brown, stony soil on the jumpups in the east

Table B2. Key to the Land Resource Areas

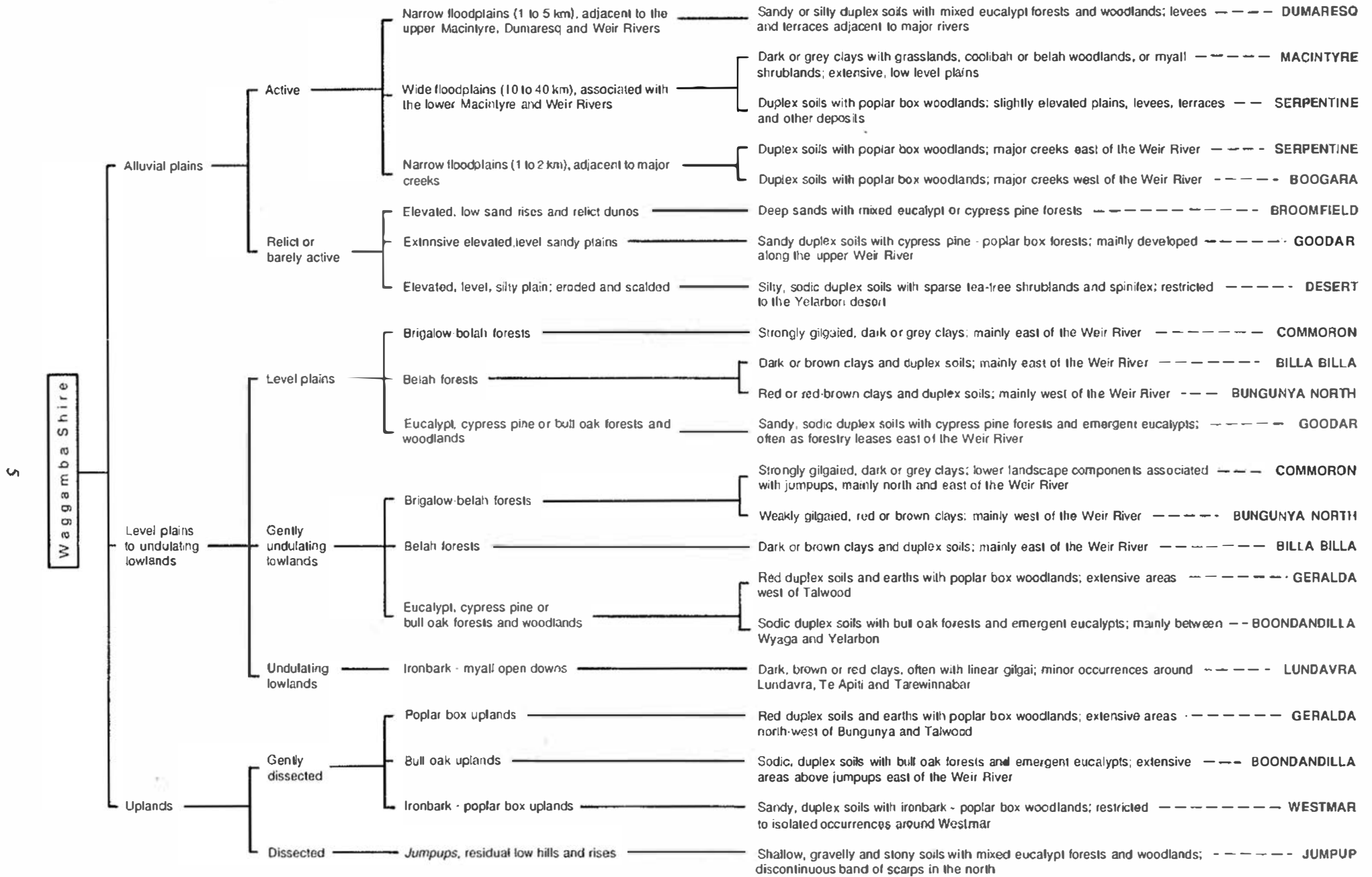


Table B3. Key to the soils of Waggamba Shire

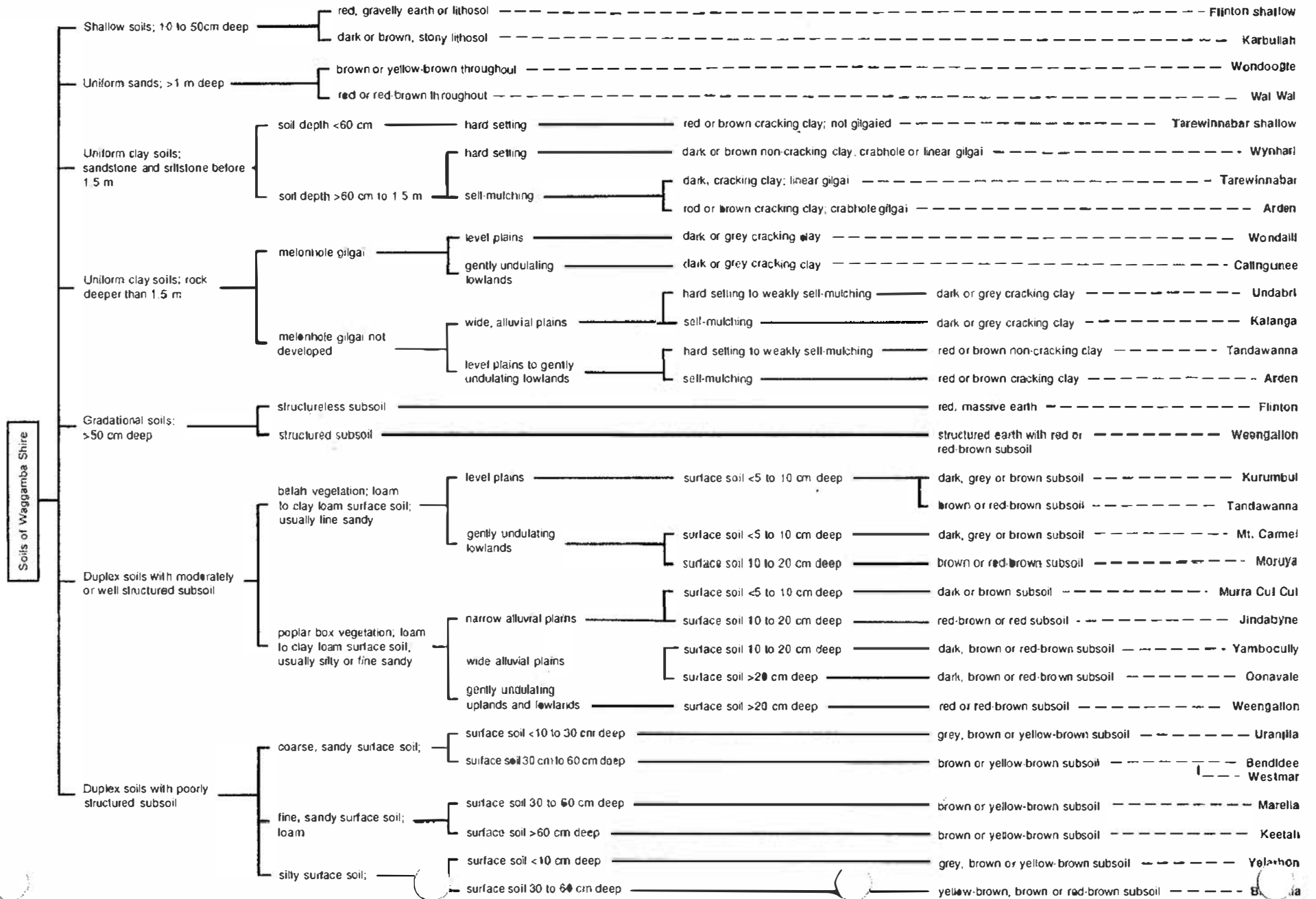


Table B4. Soil suitability for irrigated agriculture

Soil (No.)	Irrigation system			
	Flood	Spray	Trickle	
Undabri (3) Kalanga (4) Kurumbul (16) Tandawanna (20)	S			flood irrigation soils (cropping only)
Yambocully (6) Oonavale (7) Jindabyne (8)	S			spray irrigation soils (cropping); flood or spray irrigation soils (pastures)
Wondalli (14) Keetah (1) Marella (11)	M	S		spray irrigation soils (cropping and pastures)
Wondoogle (9) Wai Wai (10) Bengalla (2)	U	M	S	trickle irrigation soils (cropping)

S: suitable; the benefits from the land use outweigh required inputs to initiate and maintain production

M: marginal; the benefits from the land use are cancelled out by the required inputs to initiate and maintain production; long-term suitability is doubtful

U: unsuitable; the benefits from the land use do not justify the required inputs to initiate and maintain production; limitations are too severe

Table B5. Soil suitability for dryland agriculture

Soil (No.)	Dryland cropping	Annual forage	Perennial forage	Sown pasture	Native pasture
Kurumbul (16) Tandawanna (20) Arden (21) Wynhari (19) Mt. Carmel (17) Tarewinnabar (22) Kalanga (4) Undabri (3) Wondali (14) Calingunae (15)			S		long-term dryland cropping soils
Moruya (18) Murra Cul Cul (5) Yambocully (6) Oonavale (7)			S		short-term dryland cropping soils
Tarewinnabar (23) shallow Jindabyne (8) Weengallon (24) Flinton (25) Keetah (1)		M		S	sown pasture soils
Bengalla (2) Marella (11) Wondoogle (9) Wai Wai (10) Bendidee (12) Uranilla (26) Westmar (27) Flinton shallow (28) Karbullah (29) Yelarbon (13)			U		native pasture soils; unsuitable for development

S: suitable M: marginal U: unsuitable; definitions as with Table B4

Table B6. Soil - crop suitability for irrigated and dryland cropping

	Cotton	Grain sorghum	Soybean	Winter forages	Summer forages
Keetah (1)	Ir	-	Ir	Ir	-
Bengalla (2)	Ir	-	-	Ir	-
Undabri (3)	I/D	I/D	Ir	I/D	I/D
Kalanga (4)	I/D	I/D	Ir	I/D	I/D
Murra Cul Cul (5)	-	-	-	D	D
Yambocully (6)	Ir	Ir	Ir	I/D	I/D
Oonavale (7)	Ir	Ir	Ir	D	D
Jindabyne (8)	Ir	Ir	Ir	Ir	-
Wondoogle (9)	Ir	-	-	-	-
Wai Wai (10)	Ir	-	-	-	-
Marella (11)	Ir	-	Ir	Ir	-
Bendidee (12)	-	-	-	-	-
Yelarbon (13)	-	-	-	-	-
Wondalli (14)	Ir	D	Ir	I/D	D
Calingunee (15)	D	D	-	D	D
Kurumbul (16)	Ir	I/D	Ir	I/D	I/D
Mt. Carmel (17)	D	D	-	-	-
Moruya (18)	-	D	-	-	-
Wynhari (19)	D	D	-	-	-
Tandewanna (20)	I/D	I/D	Ir	I/D	I/D
Arden (21)	D	D	-	-	-
Tarewinnabar (22)	D	D	-	-	-
Tarewinnabar shallow (23)	-	-	-	-	-
Weengallon (24)	-	-	-	-	-
Flinton (25)	-	-	-	-	-
Uranilla (26)	-	-	-	-	-
Westmar (27)	-	-	-	-	-
Flinton shallow (28)	-	-	-	-	-
Karbullah (29)	-	-	-	-	-

Ir = Suitable for irrigated cropping only

D = Suitable for dryland cropping only

I/D = Suitable for both irrigated and dryland cropping

Table B7. Soil - crop suitability for dryland cropping only

	Winter cereals ¹	Grain millet	Grain legumes	Oilseed crops
Keetah (1)	-	-	-	-
Bengalla (2)	-	-	-	-
Undabri (3)	W	S	W/S	W/S
Kalanga (4)	W	S	W	-
Murra Cul Cul (5)	W	-	-	-
Yambocully (6)	W	-	-	-
Oonavale (7)	W	-	-	-
Jindabyne (8)	-	-	-	-
Wondoogle (9)	-	-	-	-
Wai Wai (10)	-	-	-	-
Marella (11)	-	-	-	-
Bendidee (12)	-	-	-	-
Yelarbon (13)	-	-	-	-
Wondalli (14)	W	S	W/S	W/S
Calingunee (15)	W	S	W/S	W/S
Kurumbul (16)	W	S	W/S	W/S
Mt. Carmel (17)	W	S	W/S	W/S
Moruya (18)	W	-	-	-
Wynhari (19)	W	S	W	-
Tandewanna (20)	W	S	W	-
Arden (21)	W	S	W	-
Tarewinnabar (22)	W	S	W	-
Tarewinnabar shallow (23)	-	-	-	-
Weengallon (24)	-	-	-	-
Flinton (25)	-	-	-	-
Uranilla (26)	-	-	-	-
Westmar (27)	-	-	-	-
Flinton shallow (28)	-	-	-	-
Karbullah (29)	-	-	-	-

¹ Wheat; Barley; Triticale

W = Suitable for winter crops

S = Suitable for summer crops

W/S = Suitable for both winter and summer crops

SOIL SUMMARY CARDS

The following cards provide summary information about each soil and its associated land use suitability and management. Any technical or specific terms used are defined in the Glossary.

1. SOIL INFORMATION - laminated photo cards

The laminated cards provide photographic description of the landscapes and the profile for each soil. This is accompanied by summary information on the soil's characteristics and properties.

Site description: summarises the environmental characteristics that relate to the soil. The landscape photograph shows the most typical example of the soil landscape in as close to its natural state as possible.

Soil description: comprises the classification and the description of the main features of the soil profile. The classification is in two forms (i) the Great Soil Group (Stace *et al.* 1968), and (ii) the Factual Key notation of Northcote (1979).

The soil description is simplified from the profile descriptions contained in Appendix I of Part A but is detailed enough to identify the soil. Soil colour, structure and types of inclusions are defined in the Glossary. For the purposes of this description the structure terms are defined as follows:

- soils with any grade of columnar structure or a weak grade of any other structure are described as *poorly structured*
- soils with a moderate grade of any structure other than columnar are described as *moderately structured*
- soils with a strong grade of any structure other than columnar are described as *well structured*

Distinguishing soil properties: brief summaries of the chemical and physical attributes of the soil which are relevant to land use.

Chemical

- N, P, K statements are the level of nitrogen, phosphorus and potassium, respectively, in the top 10 cm of the soil;
- comment is made on the copper and zinc status of the surface soil if it deviates from an acceptable moderate level; and
- acidity is recorded as a pH value for *surface soil* (A horizon), usually a 0 to 10 cm sample; *upper subsoil* (top of the B horizon), usually a 20 to 30 cm and a 50 to 60 cm sample; *lower subsoil* (bottom of the B horizon), usually a 80 to 90 cm sample and a 100 to 120 cm sample. Further explanation is given in the Glossary.

Comment is also made about the depth to acid clay subsoil, where it exists.

- The level of sodicity at various depths in the profile is given in general terms relating to ESP (exchangeable sodium percentage).

For further information, including the sodicity classes, refer to the Glossary.

- Profile salinity, that is the amount of soluble salts within the profile is indicated by electrical conductivity (EC) value (see Glossary).

For further information refer to Table II.3 in Appendix II of Part A.

Physical

- Soil surface condition is expressed both as:
 - a surface condition in the natural, uncultivated state; and
 - a seedbed condition in the cultivated state following tillage.
- A range is given for effective rooting depth (ERD) which is usually the depth to an impeding layer, for example, weathered rock or depth to the maximum profile salt level (see Glossary).
- Plant available water capacity (PAWC) is given as a range of millimetres of water. This then correlates with rainfall measurement.
- Drainage classes are:
 - poorly drained
 - imperfectly drained
 - moderately well drained
 - well drained
 - rapidly drained
- The level of dispersion (see Glossary) at various depths in the profile is expressed in terms of the dispersivity ratio.

For further information refer to Tables II.2 and II.5 in Appendix II of Part A.

2. LAND USE INFORMATION - unlaminated cards

- **Recommended land use** is defined as that which is most suitable to achieve optimal production with minimal land degradation. It is based on the properties and limitations of the soil only.
- **Land use suitability** lists the specific crops and pastures for the recommended agricultural systems for the soil.

Annual and perennial forages are separated by a ● within a single agricultural system grouping.

Crops and pasture types mentioned in brackets are of marginal suitability for the soil because of climate, soil PAWC, soil nutrition or length of growing season. They can still be grown profitably with careful, suitable management. For example:

- Dryland cotton, grain legumes and grain millets are recommended for climatic zone A (Map 2) on dryland cotton soils but may be only marginally suitable for climatic zone B because of declining rainfall. The same is true for annual forages.
- Oilseed crops and triticale may be marginally suitable on dryland cropping soils in climatic zone A but are not recommended in climatic zone B because of declining rainfall or because of their longer growing season.
- Land use limitations are important to management of the soil. These are the moderate and severe limitations from the suitability evaluation in Chapter 8 of Part A.
- Land conservation aspects include statements on water erosion hazard for the surface soil, and surface runoff potential based on surface soil characteristics. Classes for both are *low, moderate or high*.

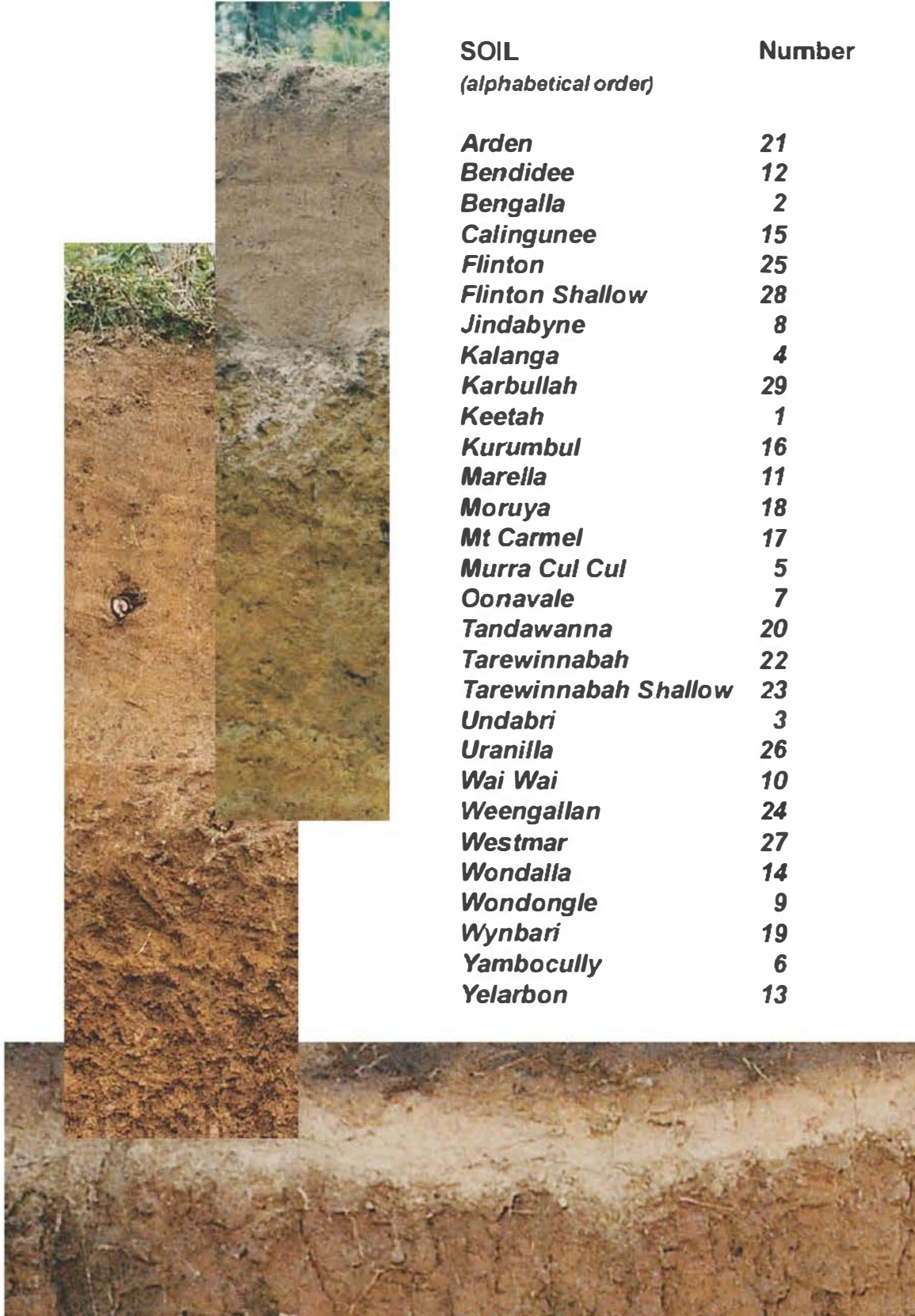
Conservation structures and dams are specified as *suitable, of limited suitability, or unsuitable* depending on soil characteristics. They are otherwise classed as not applicable (*n.a.*) where the site or landscape does not warrant it.

- Stocking rates for sheep (DSE - dry sheep equivalent) and cattle (AE - adult equivalent) are *estimates* only given for native pastures in both cleared and uncleared states, as well as sown pastures. Quoted rates are conservative for both native and sown pastures. The rates for sown pastures are for dryland pastures at constant stocking. There will be a substantial variation in native pasture rates both between soils and within soils. This is owing to many factors such as fire history, pasture-forbs-browse proportions, creek frontage, and suckering compared to seedling regrowth densities. Sown pasture rates will also vary according to pasture type and management system as well as state of rundown of the pasture. For these reasons there may well be considerable variation from the commonly proposed 8:1 AE to DSE conversion ratio. These estimates are the best figures that can be provided on a general basis from current knowledge. They are, therefore, tentative and graziers should seek advice concerning stocking in specific areas.

Stocking rates are explained further in Chapter 10 of Part A.

- Management recommendations refer to conservation management practices that are recommended for the soil under typical conditions. Reference is sometimes made to sown pastures that may be suitable for the soil type whilst developing the land only. It is *not* to be implied from this that sown pastures are a suitable land use.

Soil Summary Cards



SOIL <i>(alphabetical order)</i>	Number
Arden	21
Bendidee	12
Bengalla	2
Calingunee	15
Flinton	25
Flinton Shallow	28
Jindabyne	8
Kalanga	4
Karbullah	29
Keetah	1
Kurumbul	16
Marella	11
Moruya	18
Mt Carmel	17
Murra Cul Cul	5
Oonavale	7
Tandawanna	20
Tarewinnabah	22
Tarewinnabah Shallow	23
Undabri	3
Uranilla	26
Wai Wai	10
Weengallan	24
Westmar	27
Wondalla	14
Wondongle	9
Wynbari	19
Yambocully	6
Yelarbon	13

Optimal land use: Spray irrigated cropping and pastures; sown pastures

Land use suitability

Suitable for: spray irrigated cropping	- soybean; (cotton)
spray irrigated forages	- oats; ryegrass; lucerne; forage sorghum
trickle irrigated cropping	- cotton; horticultural crops
spray irrigated pastures	- medic; clovers; temperate grasses; creeping bluegrass; Premier digit grass; Pioneer rhodes grass
sown pastures	- creeping bluegrass; Premier digit grass (buffel grass; Pioneer rhodes grass; barrel medic; serradellas)
native pastures	- refer to Appendix IV in Part A
dryland forages (while developing) and renovating land)	- oats; snail medic; forage sorghum • lucerne; Silk sorghum

Land use limitation

- low PAWC
- adverse seedbed conditions
- regular flooding in lower lying areas

Land conservation

Water erosion hazard: moderate to high	Contour banks: n.a.
Surface runoff: low to moderate	Waterways: n. a.
	Diversion Banks: n.a.
	Dams: limited suitability

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.2	5.6
Cleared native pasture:	0.4	4
Sown pasture:	0.2	2.5

Management recommendations

- Plant forage crops while developing country for irrigation or pastures
- Undertake a short-term farming phase every 8 to 10 years to renovate sown pastures and to control woody weed regrowth
- Use minimum tillage on irrigated land, and rotate crops with pastures
- Avoid planting forage legumes and pasture legumes in areas prone to waterlogging and flooding

LRA: *Dumaresq*

Concept: *Brown alluvial soil on narrow, fine sandy levees and lower terraces adjacent to major rivers*

SITE DESCRIPTION

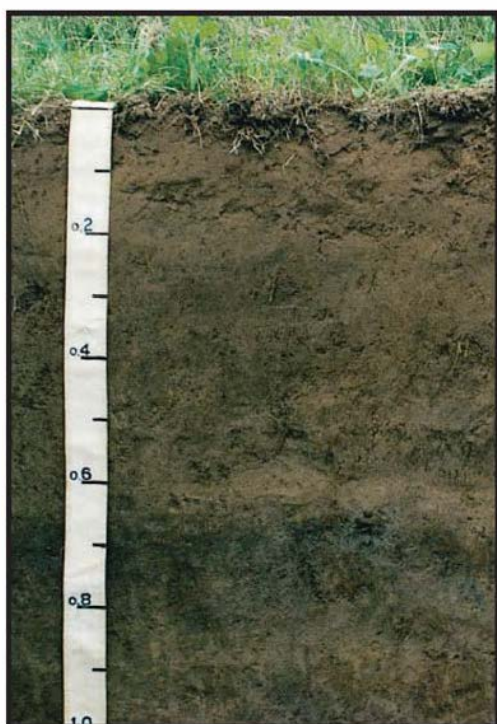
Landform: Narrow, gently undulating, alluvial plains: mainly levees and low terraces of the upper Macintyre, Dumaresq and Weir Rivers. Local relief is less than 9 m with most slopes between 1 and 3%.

Substrate: Fine sandy alluvium

Vegetation: Tall, open forest of river red gum, poplar box and silver leaved ironbark with occasional carbeen or coolibah. Understorey is usually absent.



Remnant river red gum forest on cleared lower terrace



SOIL DESCRIPTION

Classification: Alluvial soil (Uc3.21)

Depth (cm)	Description
0 to 40	Brown loamy sand; structureless. Gradual change to:
40 to 70	Yellow-brown sandy loam with slight bleaching; structureless. Abrupt change to:
70 to 110	Brown, slightly mottled, light clay; poorly structured. Gradual change to:
110 to 150	Brown, slightly mottled, sandy clay loam; moderately structured.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - high; K - high
- surface pH 6.5 to 7, upper subsoil pH 8, lower subsoil pH 8.5
- slightly sodic below 70 cm
- low to very low salinity throughout

Physical

- hardsetting, structureless surface
- fine sandy seedbed; pulverises readily with tillage; seals and sets hard if organic matter decreases; dries rapidly
- ERD range: 40 to 100 cm
- PAWC range: 70 to 120 mm
- imperfectly to moderately well drained
- moderate to high dispersion below 70 cm

Optimal land use: Trickle irrigated cropping, spray irrigated pastures; native pastures

Land use suitability

Suitable for	spray irrigated forages	- <i>oats; ryegrass; lucerne</i>
	trickle irrigated cropping	- <i>cotton</i>
	spray irrigated pastures	- <i>temperate grasses; medics; clovers</i>
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *adverse seedbed conditions*
- *surface soil impermeability and poor subsoil drainage*
- *adverse lower subsoil conditions*
- *high wind erosion risk*

Land conservation

Water erosion hazard: *low*
Surface runoff: *low*

Contour Banks: *n.a.*
Waterways: *n.a.*
Diversion Banks: *n.a.*
Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.6	7
Cleared native pasture:	0.6	5.6
Sown pasture:	0.3	2.5

Management recommendations

- Selectively clear timber for increased native pasture production
- Use sown pastures for rehabilitating cleared land or as a ley pasture on irrigated land.
Pioneer rhodes grass, serradellas
- Use minimum tillage on irrigated land

LRA: *Dumaresq*

Concept: *Silty, impermeable, duplex soil on extensive, high terraces adjacent to major rivers*

SITE DESCRIPTION

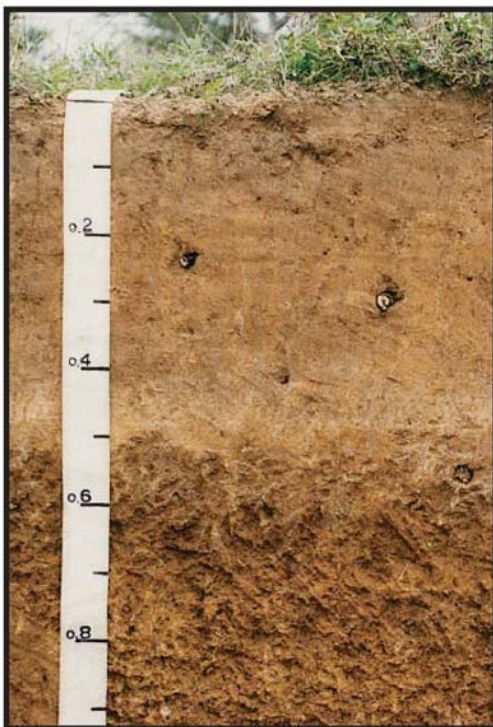
Landform: Narrow, level alluvial plains; mainly high terraces of the upper Macintyre and Dumaresq rivers. Occasionally includes narrow-ridged levees adjacent to main channels. Local relief less than 9 m with most slopes below 1%.

Substrate: Silty alluvium

Vegetation: Tall woodland of silver leaved ironbark and poplar box with occasional roughbark apple. Understorey is usually absent.



Tall silver leaved ironbark - poplar box woodland with minor regrowth



SOIL DESCRIPTION

Classification: Solodized solonetz (Dr2.42)

Depth (cm)	Description
0 to 15	Brown loam; structureless. Clear change to:
15 to 50	Brown clay loam; strong bleaching between 40 to 50 cm; structureless. Abrupt change to:
50 to 95	Red-brown medium clay; poorly structured. Gradual change to:
95 to 150	Red-brown light clay; moderately structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - medium to high; K - medium to high
- surface pH 5.5 to 6, upper subsoil pH 6.5, lower subsoil pH 7 to 7.5
- sodic to strongly sodic below 50 cm
- medium salinity below 80 cm

Physical

- hardsetting, structureless surface
- silty seedbed; pulverises very easily with tillage; severe surface sealing and crusting, wind erodible
- ERD range: 40 to 60 cm
- PAWC range: 70 to 90 mm
- poorly drained
- high to very high dispersion below 50 cm

Optimal land use: Flood irrigated cropping and pastures; long-term dryland cropping

Land use suitability

Suitable for

flood irrigated cropping	- cotton; soybean; grain sorghum
spray irrigated cropping	- soybean; grain sorghum; cotton
trickle irrigated cropping	- cotton
flood or spray irrigated forages	- oats, ryegrass, forage sorghum, lucerne
flood or spray irrigated pastures	- <i>Bambatsi panic</i> , purple pigeon grass, medics, clovers, temperate grasses
dryland cropping	- wheat; barley; grain sorghum; cotton, chickpea; (mungbean; grain millet; canola; safflower; triticale; sunflower; canary)
dryland forages	- oats; snail medic; forage sorghum; lab lab; cowpea; (forage millet) • lucerne; Silk sorghum
sown pastures	- <i>Banthatsz panic</i> ; purple pigeon grass; snail and barrel medics
native pastures	- refer to Appendix IV Part A

Land use limitation

- *adverse seedbed conditions (coarse)*
- *adverse lower subsoil conditions*
- *waterlogging and restricted trafficability associated with flooding in lower lying areas*

Land conservation

Water erosion hazard: *low*

Surface runoff: *low*

Contour Banks: *n a*

Waterways: *n a*

Diversion Banks: *n a*

Dams: *Suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	0.4	3.7 to 4.7
Cleared native pasture :	n.a.	n.a.
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and legumes
- Rotate using legumes or apply nitrogen fertiliser for high protein grain
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on dryland crop fallows using zero or minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels (or rollers) to assist establishment of crops, forages and pastures
- Avoid planting grain forage and pasture legumes in areas prone to waterlogging and flooding

LRA: *Macintyre*

Concept: *Hardsetting, dark or grey cracking clay with tussock grassland or coolibah woodland on flood prone alluvial plains*

SITE DESCRIPTION

Landform: Wide, level, alluvial plains of the lower Macintyre and Weir rivers. Extensive, open, clay plains which are low lying and flood prone, with complex drainage. Local relief is less than 9 m with most slopes below 1%.

Substrate: Clay alluvium

Vegetation: Variable associations; mainly tussock grasslands of curly Mitchell grass and Queensland blue grass with occasional coolibah or mid-high, open woodland of coolibah.



Open alluvial plains with tussock grassland and coolibah



SOIL DESCRIPTION

Classification: Grey clay (Ug5.16)

Depth (cm)	Description
0 to 10	Dark heavy clay; well structured. Clear change to:
10 to 70	Grey heavy clay; moderately structured. Clear change to:
70 to 105	Grey heavy clay; moderately structured. A few soft carbonate segregations. Gradual change to:
105 to 150	Brown heavy clay; moderately structured; a few soft carbonate segregations.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - low to very high, generally high; K - very high
- low zinc
- surface pH 7.5, upper and lower subsoil pH 8.5
- slightly sodic to sodic below 70 cm
- medium to low salinity below 70 cm

Physical

- periodic cracking; hardsetting or weakly self-mulching; forms a weak surface flake after rain
- coarse, friable seedbed; stable with tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 145 mm
- imperfectly drained
- moderate dispersion below 70 cm

Optimal land use: Flood irrigated cropping and pastures; long-term dryland cropping

Land use suitability

Suitable for: flood irrigated cropping	- cotton; soybean; grain sorghum
spray irrigated cropping	- soybean; grain sorghum; cotton
trickle irrigated cropping	- cotton
flood or spray irrigated forages	- oats; rye grass; forage sorghum; lucerne
flood or spray irrigated pastures	- <i>Bambatsi panic</i> ; purple pigeon grass; medics, clovers; temperate grasses
dryland cropping	- wheat; barley; grain sorghum; chickpea; (cotton; grain millet)
dryland forages	- oats; snail medic; forage sorghum; (lab lab, cowpea; <i>Echinochloa millet</i>) • lucerne; Silk sorghum
sown pastures	- <i>Bambatsi panic</i> ; snail and barrel medics; purple pigeon grass
native pastures	- refer to Appendix iv m Part A

Land use limitation

- *adverse lower subsoil conditions*
- *waterlogging, and restricted trafficability in lower lying areas*
- *woody weed invasion associated with flooding in lower lying areas*

Land conservation

Water erosion hazard: *low*

Surface runoff: *low*

Contour Banks: *na*

Waterways: *na*

Diversion Banks: *na*

Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (haJAE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.4	3.7
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate using legumes or apply nitrogen fertiliser for consistent production of high proteingrain
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on dryland crop fallows using zero or minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels (or rollers) to assist establishment of crops, forages and pastures
- Avoid planting grain forage and pasture legumes in areas prone to waterlogging and flooding

LRA: *Macintyre*

Concept: *Self-mulching, dark or grey cracking clay with belah - coolibah woodland or myall shrubland on flood prone alluvial plains.*

SITE DESCRIPTION

Landform: Wide, level, alluvial plains of the lower Macintyre and Weir rivers. Extensive, open, clay plains which are low lying and flood prone, with complex drainage. Local relief is less than 9 m with most slopes below 1 %.

Substrate: Clay alluvium

Vegetation: Either mid-high to tall woodland of belah with myall and coolibah, or low to mid-high shrubland of myall and boonaree.



Mixed belah - coolibah regrowth on a flood prone alluvial plain



SOIL DESCRIPTION

Classification: Grey clay (Ug5.24)

Depth (cm)	Description
0 to 2	Dark medium clay; well structured. Clear change to :
2 to 20	Grey heavy clay; moderately structured. Clear change to:
20 to 80	Grey heavy clay; well structured. Gradual change to:
80 to 140	Grey heavy clay; well structured; some carbonate nodules.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - low to very high, generally high; K - very high
- low to very low zinc
- surface pH 8 to 9, upper subsoil pH 9, lower subsoil pH 8.5
- slightly sodic or sodic 20 to 80 cm; strongly sodic below 80 cm
- high to very high salinity below 80 cm

Physical

- periodic cracking; self-mulching; forms a weak surface flake after rain
- fine, friable seedbed; stable with tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 140 cm
- imperfectly drained
- moderate dispersion below 50 cm

Optimal land use: Short-term dryland cropping

Land use suitability

Suitable for	dryland cropping	- wheat; barley
	dryland forages	- oats; (snail medic; forage sorghum; lab lab; cowpea) • (lucerne; Silk sorghum)
	sown pastures	- Katambora; rhodes grass; barrel medic; (purple pigeon grass; Banthatsi panic)
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- moderate PAWC
- adverse seedbed conditions (cloddy, crusting)
- adverse subsoil conditions

Land conservation

Water erosion hazard: *low to moderate*
Surface runoff: *low to moderate*

Contour Banks: *suitable: NB type*
Waterways: *suitable: type B; replace topsoil, do not excavate >0.3m, grass with rhodes grass or African star grass*
Diversion Banks: *suitable*
Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.4	9 to 14
Cleared native pasture:	0.6	5.6
Sown pasture:	0.25	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with 3 to 5 year ley pasture sequences following land development
- Retain stubble on crop fallows using minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertilizer with crops and annual forages at planting

LRA: *Serpentine*

Concept: *Dark to brown duplex soil, with poplar box woodland on narrow, alluvial plains of major creeks in the east*

SITE DESCRIPTION

Landform: Level or gently undulating, narrow, alluvial plains and drainage floors of the major creeks, east of the Weir River. Local relief is less than 9 m with most slopes 1 to 3%.

Substrate: Fine sandy and clay alluvia

Vegetation: Tall, open woodland of poplar box with occasional belah or myall. Understorey of false sandalwood and wilga.



Tall poplar box woodland with false sandalwood understorey



SOIL DESCRIPTION

Classification: Solodic soil (Dd1.43)

Depth (cm)	Description
0 to 5	Brown sandy clay loam; structureless; a little gravel. Abrupt change to:
5 to 10	Grey sandy clay loam with strong bleaching; structureless. Sharp change to:
10 to 25	Dark heavy clay; moderately structured. Clear change to:
25 to 85	Brown heavy clay; moderately structured; a little gravel; a few soft carbonate segregations and nodules; some gypsum crystals and slight mottling below 60 cm. Clear change to:
85 to 150	Yellow-brown, strongly mottled, medium clay; moderately structured; a little gravel.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - low; K - high
- surface pH 7, upper subsoil pH 8 to 8.5, lower subsoil pH 7.5 to 5
- acid below 100 cm
- strongly sodic below 20 cm
- high to extreme salinity 20 to 60 cm; variable below 60 cm

Physical

- hardsetting, structureless surface
- where A horizon less than 10 cm: coarse, clay seedbed after tillage; severe crusting; but where A horizon greater than 10 cm: loamy seedbed; cloddy but pulverises with tillage; seals and sets hard after rain.
- ERD range: 40 to 80 cm
- PAWC range: 75 to 125 mm
- imperfectly drained
- moderate dispersion 20 to 90 cm; very high below 90 cm

Optimal land use: Spray irrigated cropping, flood and spray irrigated pastures; short-term dryland cropping

Land use suitability

Suitable for:	flood irrigated cropping	- cotton; soybean; (grain sorghum)
	spray irrigated cropping	- soybean; horticultural crops; (grain sorghum; cotton)
	trickle irrigated cropping	- cotton
	flood or spray irrigated forages	- oats; ryegrass; (forage sorghum)
	flood or spray irrigated pastures	- purple pigeon grass; Katambora rhodes grass; ryegrass; lucerne; medic; clovers; temperate grasses; (Bambatsi panic)
	dryland cropping	- wheat; barley
	dryland forages	- oats; snail medic; forage sorghum; (lab lab, cowpea) • lucerne, Silk sorghum
	sown pastures	- Katambora rhodes grass, barrel medic; (purple pigeon grass)
	native pastures	- refer to Appendix IV m Part A

Land use limitation

- moderate PAWC
- adverse seedbed conditions (cloddy)
- adverse subsoil conditions

Land conservation

Water erosion hazard: *low*
Surface runoff: *low*

Contour Banks: *n a.*
Waterways: *suitable*
Diversion Banks: *n a.*
Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.4	7
Cleared native pasture:	0.6	5.6
Sown pasture:	0.25	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with 3 to 5 year ley pasture sequences following land development
- Retain stubble on dryland crop fallows using minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels to assist establishment of crops, forages and pastures

LRA: *Serpentine*

Concept: *Loamy, duplex soil with poplar box woodland on higher areas within alluvial plains*

SITE DESCRIPTION

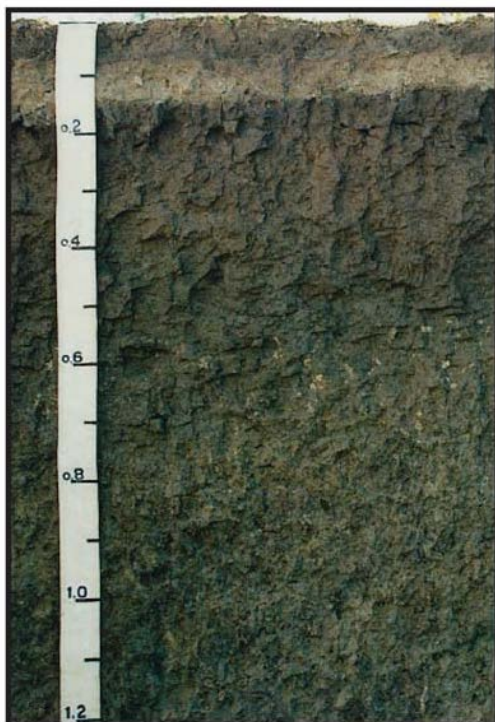
Landform: Elevated, level landforms within the wide, alluvial plains of the lower Macintyre and Weir Rivers. Local relief is less than 9 m with most slopes below 1 %.

Substrate: Fine sandy and clay alluvia

Vegetation: Tall, open woodland of poplar box with occasional belah or supplejack. Shrub understorey of false sandalwood, wilga and boonaree.



Tall poplar box woodland with false sandalwood and wilga understorey



SOIL DESCRIPTION

Classification: Solodic Soil (Db1.43)

Depth (cm)	Description
0 to 10	Brown clay loam; poorly structured. Abrupt change to:
10 to 15	Brown clay loam with strong bleaching; structureless. Sharp change to:
15 to 25	Red-brown heavy clay; well structured. Clear change to:
25 to 85	Brown medium clay; well structured; a few soft carbonate segregations and nodules. Clear change to:
85 to 150	Yellow-brown light clay; well structured; a few soft carbonate segregations

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - high; K - very high
- surface pH 7, upper subsoil pH 8, lower subsoil pH 8.5
- slightly sodic to sodic below 50 cm
- very high salinity below 50 cm

Physical

- hardsetting, structureless surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain; crusts; wind erodible
- ERD range: 60 to 100 cm
- PAWC range: 95 to 130 mm
- moderately well drained
- low to moderate dispersion between 20 and 50 cm; low below 50 cm

Optimal land use: Spray irrigated cropping, flood and spray irrigated pastures; short-term dryland cropping

Land use suitability

Suitable for:	flood irrigated cropping	- cotton, soybean; (grain sorghum)
	spray irrigated cropping	- soybean; horticultural crops; (grain sorghum; cotton)
	trickle irrigated cropping	- cotton
	flood or spray irrigated forages	- oats; (rye grass; forage sorghum)
	flood or spray irrigated pastures	- purple pigeon grass; Katambora rhodes grass; ryegrass; lucerne, medics; clovers; temperate grasses; (forage sorghum; Banthatsi panic)
	dryland cropping	- wheat; barley
	dryland forages	- oats; snail medic; forage sorghum; (lab lab; cowpea) • lucerne; Silk sorghum
	sown pastures	- Katambora rhodes grass; barrel medic; (purple pigeon grass)
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- moderate PAWC
- adverse seedbed conditions (cloddy)
- adverse subsoil conditions

Land conservation

Water erosion hazard: *low*
Surface runoff: *low*

Contour Banks: *na*
Waterways: *statable*
Diversion Banks: *na*
Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.4	7
Cleared native pasture:	0.6	5.6
Sown pasture:	0.25	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with 3 to 5 year ley pasture sequences following land development
- Retain stubble on dryland crop fallows using minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels to assist establishment of crops, forages and pastures

LRA: *Serpentine*

Concept: *Sandy, duplex soil with poplar box woodland on higher areas within alluvial plains*

SITE DESCRIPTION

Landform: Elevated, level landforms within the wide alluvial plains of the lower Macintyre and Weir Rivers. Local relief is less than 9 m with most slopes below 1%.

Substrate: Fine sandy and clay alluvia

Vegetation: Tall woodland or tall, open woodland of poplar box with occasional cypress pine and silver leaved ironbark. Understorey of wilga, false sandalwood and boonaree.



Selectively cleared, tall poplar box woodland with cypress pine



SOIL DESCRIPTION

Classification: Solodic soil (Db1.43)

Depth (cm)	Description
0 to 20	Brown sandy loam; structureless. Clear change to:
20 to 35	Brown loamy sand with strong bleaching; structureless. Abrupt change to:
35 to 55	Brown, slightly mottled, sandy clay; well structured. Clear change to:
55 to 140	Brown sandy clay loam; poorly structured, becoming structureless below 85 cm; a few soft carbonate segregations and nodules

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - high; K - high
- low copper and zinc
- surface pH 6 to 6.5, upper subsoil pH 8.5 to 9, lower subsoil pH 9 to 10
- strongly to very strongly sodic below 50 cm
- very high salinity below 80cm

Physical

- hardsetting, structureless surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain
- ERD range: 60 to 100 cm
- PAWC: 125 mm
- moderately well drained
- moderate to high dispersion below 35 cm

Optimal land use: Spray irrigated cropping, flood and spray irrigated pastures; sown pastures

Land use suitability

Suitable for: flood irrigated cropping	- cotton; soybean
spray irrigated cropping	- soybean; horticultural crops; (grain sorghum; cotton)
trickle irrigated cropping	- cotton
spray irrigated forages	- oats; ryegrass; lucerne
flood or spray irrigated pastures	- purple pigeon grass; Silk sorghum; Bambatsi panic; medics
sown pastures	buffel grass; barrel medic
native pastures	- refer to Appendix 1 V in Part A
dryland forages (while developing and renovating land)	- oats; medics • Silk sorghum

Land use limitation

- low PAWC
- adverse seedbed conditions (cloddy)
- adverse subsoil conditions

Land conservation

Water erosion hazard: *low to moderate*
 Surface runoff: *low to moderate*

Contour Banks: *suitable: NB type*
 Waterways: *suitable type B; grass with rhodes or buffel grass*
 Diversion Banks: *suitable*
 Dams: *suitable*

Stocking rates

	Sheep (haJDSE)	Cattle (ha/AE)
Uncleared native pasture:	2.4	11
Cleared native pasture:	0.6	5.6
Sown pasture:	0.3	2.5

Management recommendations

- Plant forage crops while developing country for pastures
- Undertake a short-term farming phase every 8 to 10 years to renovate pastures and to control woody weed regrowth
- Use minimum tillage on irrigated land

LRA: *Boogara*

Concept: *Red-brown, duplex soil with poplar box woodland on narrow alluvial plains of major creeks in the west*

SITE DESCRIPTION

Landform: Level or gently undulating, narrow, alluvial plains and drainage floors of the major creeks, west of the Weir River. Local relief is less than 9 m with most slopes between 1 and 3%.

Substrate: Fine sandy and clay alluvia

Vegetation: Tall, open woodland of poplar box with occasional belah or brigalow. Understorey of false sandalwood, wilga and limebush.



Tall poplar box woodland with belah, wilga and false sandalwood



SOIL DESCRIPTION

Classification: Red brown earth (Dr2.43)

Depth (cm)	Description
0 to 12	Red-brown sandy clay loam; structureless. Sharp change to:
12 to 13	Red-brown loam with strong bleaching; structureless. Sharp change to:
13 to 30	Red heavy clay; well structured. Clear change to:
30 to 95	Red-brown medium clay; moderately structured; some soft carbonate segregations and nodules. Diffuse change to:
95 to 150	Red-brown medium clay; moderately structured; a few carbonate nodules

DISTINGUISHING SOIL PROPERTIES

Chemical

- N- low; P - medium to low; K - very high
- surface pH 6.5, upper and lower subsoil pH 9
- strongly sodic below 15 cm
- high to very high salinity below 30 cm

Physical

- hardsetting, structureless surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain
- ERD range: 50 to 70 cm
- PAWC range: 85 to 110 mm
- imperfectly drained
- high dispersion below 15 cm

Optimal land use: Trickle irrigated cropping; unsuitable for dryland development; light grazing only

Land use suitability

Suitable for: trickle irrigated cropping - *horticultural crops; vine or tree crops*
light grazing - refer to Appendix IV m Part A

Land use limitation

- *low PAWC*
- *low fertility*
- *adverse seedbed conditions*
- *high wind erosion risk*

Land conservation

Water erosion hazard: *moderate*
Surface runoff: *low*

Contour Banks: *n.a.*
Waterways: *n.a.*
Diversion Banks: *n.a.*
Dams: *not suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.6	9 to 12
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop for dryland crops and pastures
- Use sown pastures for rehabilitating cleared land or as a ley pasture on irrigated land:
buffel grass; creeping bluegrass, Premier digit grass

LRA: *Broomfield*

Concept: *Soft, brown, deep sands on low, broad rises within alluvial plains*

SITE DESCRIPTION

Landform: Very low, broad sand rises within the wide, alluvial plains of the lower Macintyre and Weir rivers. Local relief is less than 5 m with most slopes less than 1 %.

Substrate: Sand, mainly overlying clay alluvium

Vegetation: Tall woodland or tall, open forest of tumbledown gum, river red gum and carbeen with occasional poplar box, cypress pine, iron wood or long fruited bloodwood. Understorey is usually absent.



Open forest of river red gum, carbeen and long fruited bloodwood



SOIL DESCRIPTION

Classification: Siliceous sand (Ucl.23)

Depth (cm)	Description
0 to 5	Dark loamy sand; structureless. Abrupt change to:
5 to 85	Brown loamy sand; structureless. Diffuse change to:
85 to 150	Yellow-brown, slightly mottled, sand; structureless; many large soft clay segregations

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - very low; P - medium; K - medium
- medium to low zinc and copper
- surface pH 7, upper and lower subsoil pH 7.5
- non sodic throughout
- very low salinity throughout

Physical

- loose or soft, structureless surface
- coarse, sandy seedbed; loose; dries rapidly; abrasive
- ERD: 100 cm
- PAWC: 105 mm
- well drained

Optimal land use: Trickle irrigated cropping; unsuitable for dryland development; light grazing only

Land use suitability

Suitable for: trickle irrigated cropping
light grazing

- *horticultural crops; vine or tree crops*
- refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *extreme wind erosion risk*

Land conservation

Water erosion hazard: *moderate to high*
Surface runoff: *low*

Contour Banks: *n.a.*
Waterways: *n.a.*
Diversion Banks: *n.a.*
Dams: *not suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.6	9 to 12
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop for dryland crops and pastures
- Use sown pastures for rehabilitating cleared land or as a ley pasture on irrigated land:
buffel grass; creeping bluegrass; Premier digit grass

LRA: *Broomfield*

Concept: *Loose, red, deep sands on low, elongated ridges within alluvial plains*

SITE DESCRIPTION

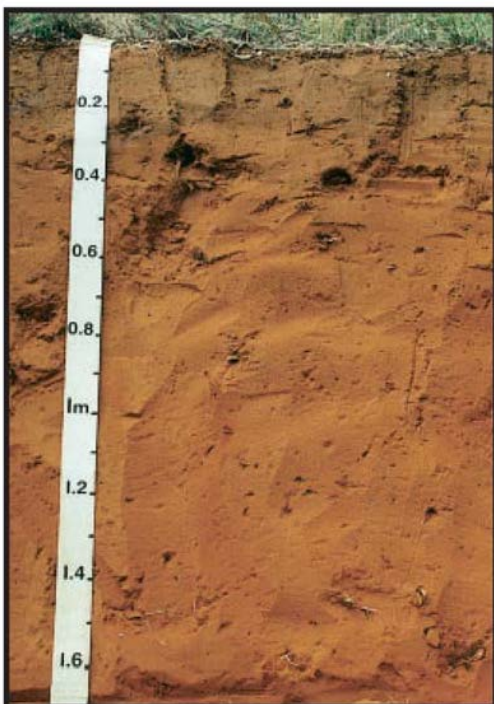
Landform: Low, elongated, dune-like, sand ridges within the wide, alluvial plains of the lower Macintyre and Weir rivers. Local relief is 5 to 9 m with most slopes between 1 and 3%.

Substrate: Sand, mainly overlying clay alluvium

Vegetation: Tall, open forest of cypress pine with occasional pink bloodwood and supplejack. Understorey of river wattle, wilga and bitter bark.



Wondoogle Landscape - Wai Wai is similar to this landscape



Chinchilla Soil - Wai Wai soil is similar to this soil

SOIL DESCRIPTION

Classification: Siliceous sand (Uc4.21)

Depth (cm)	Description
0 to 10	Dark sand; structureless and single grained. Gradual change to:
10 to 40	Dark sand; structureless. Gradual change to:
40 to 150	Red-brown sand; structureless

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - very low; P - low; K- medium
- low to very low copper and zinc
- surface pH 6.5, upper subsoil pH 5.5 to 6, lower subsoil pH 6
- non sodic throughout
- very low salinity throughout

Physical

- loose, structureless surface
- coarse sandy seedbed; very loose; dries rapidly; abrasive
- ERD: 100 cm
- PAWC: 100 mm
- rapidly drained

Optimal land use: Spray irrigated cropping and pastures; native pastures; native forestry

Land use suitability

Suitable for:	spray irrigated cropping	- soybean; horticultural crops
	trickle irrigated cropping	- cotton; horticultural crops; vine or tree crops
	spray irrigated forages	- oats; ryegrass; lucerne
	spray irrigated pastures	- temperate grasses; medics; clovers; creeping bluegrass
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- low PAWC
- low fertility
- adverse seedbed conditions
- woody weed regrowth

Land conservation

Water erosion hazard: *low*
Surface runoff: *low*

Contour Banks: *limited suitability; NB type*
Waterways: *limited suitability; type B; replace topsoil; grass with rhodes grass*
Diversion Banks: *limited suitability*
Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.5	9 to 12
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop for dryland crops and pastures
- Use sown pastures for rehabilitating cleared land or as a ley pasture on irrigated land: *buffel grass; Pioneer rhodes grass; creeping bluegrass; Premier digit grass; serradellas*
- Use minimum tillage on irrigated land

LRA: *Goodar*

Concept: *Sandy, duplex soil with cypress pine - poplar box forest, on relict alluvial plains*

SITE DESCRIPTION

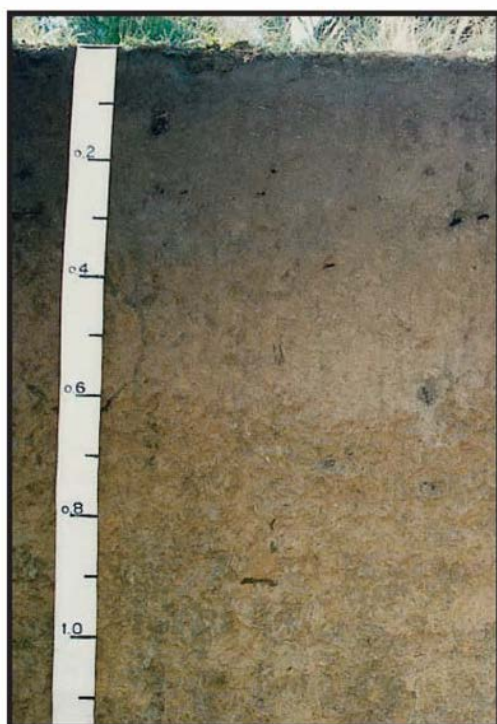
Landform: Elevated, level, relict, alluvial plains of the upper Weir River. Local relief is less than 9 m with most slopes below 1%.

Substrate: Fine sandy alluvium and other transported material (relict alluvia)

Vegetation: Tall, open forest of cypress pine and poplar box with occasional silver leaved ironbark and roughbark apple. Understorey of cypress pine regrowth with occasional wilga, false sandalwood and wattles.



Tall, open forest of cypress pine - poplar box



SOIL DESCRIPTION

Classification: Solodic soil (Db3.33)

Depth (cm)	Description
0 to 35	Dark sandy loam; structureless. Clear change to:
35 to 55	Brown sandy loam with slight bleaching; structureless. Abrupt change to;
55 to 85	Brown sandy clay; moderately structured. Abrupt change to:
85 to 150	Brown sandy clay loam; moderately structured; a few soft carbonate segregations at depth

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - high; K - high
- medium to low copper and zinc
- surface pH 7.5, upper subsoil pH 8 to 8.5, lower subsoil pH 9
- slightly sodic to sodic 35 to 80 cm; non sodic below 80 cm
- medium to low salinity below 100 cm

Physical

- soft or firm, structureless surface
- fine sandy seedbed; pulverises readily with tillage; seals and sets hard if organic matter removed; wind erodible
- ERD range: 60 to 100 cm
- PAWC range: 105 to 120 mm
- moderately well drained

Optimal land use: Unsuitable for development; native forestry and light grazing only

Land use suitability

Suitable for: native forestry
light grazing

- refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *adverse subsoil conditions (drainage)*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *high*
Surface runoff: *low to moderate*

Contour Banks: *na*
Waterways: *na*
Diversion Banks: *na*
Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	4.2	18 to 23
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop
- Use sown pastures for rehabilitating cleared land: *buffel grass; Pioneer rhodes grass; creeping bluegrass; Premier digit grass*

LRA: *Goodar*

Concept: *Sandy, impermeable, duplex soil with cypress pine - ironbark - rusty gum forest, on sloping lowlands in the east.*

SITE DESCRIPTION

Landform: Elevated, level or gently undulating, sandy plains of the lowlands in the extreme east. Local relief is less than 9 m with most slopes between 1 and 3%.

Substrate: Quartzose and deeply weathered sedimentary rocks; less commonly transported material (relict alluvia)

Vegetation: Tall, open forest of cypress pine, narrow leaved ironbark and rusty gum with occasional tumbledown gum. Understorey of bull oak and wattles.



Cypress pine forest with narrow leaved ironbark and rusty gum



SOIL DESCRIPTION

Classification: Solodized Solonetz (Dy5.43)

Depth (cm)	Description
0 to 40	Brown loamy sand; structureless. Clear change to:
40 to 45	Brown loamy sand with strong bleaching; structureless; a little quartz and ironstone gravel. Sharp change to:
45 to 100	Yellow-brown, strongly mottled, decreasing with depth; medium clay; poorly structured; a few soft carbonate segregations. Abrupt change to:
100 to 102	Yellow-brown sandy clay loam with strong bleaching; structureless. Abrupt change to:
102 to 150	Yellow, slightly mottled, sandy clay; poorly structured; a few soft carbonate segregations.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low to very low; P - very low; K - very low
- low to very low copper and zinc
- surface pH 5.5, upper subsoil pH 6 to 8, lower subsoil pH 8.5
- strongly sodic below 50 cm
- medium to high salinity below 50 cm

Physical

- soft or firm, structureless surface
- coarse sandy seedbed, loose; dries rapidly; abrasive
- ERD range: 30 to 60 cm
- PAWC range: 50 to 90 mm
- poorly drained
- very high dispersion below 50 cm

Optimal land use: Unsuitable for development; light grazing only

Land use suitability

Suitable for: light grazing - refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *surface soil impermeability*
- *adverse subsoil conditions (drainage)*
- *extreme wind erosion risk; scalding*
- *irregular flooding*

Land conservation

Water erosion hazard: *low*
Surface runoff: *low*

Contour Banks: *n.a.*
Waterways: *n.a.*
Diversion Banks: *n.a.*
Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.5	9 to 12
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop

LRA: *Desert*

Concept: *Eroded, silty, impermeable duplex soil with stunted vegetation on relict alluvial plains*

SITE DESCRIPTION

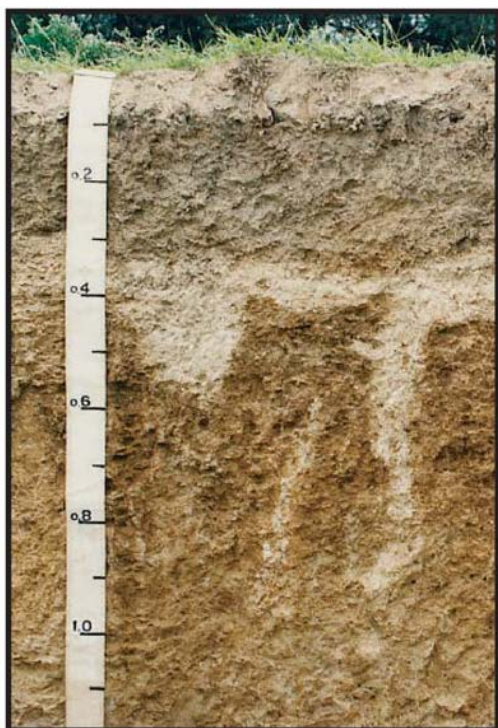
Landform: Elevated, level, relict alluvial plain at the junction of Macintyre Brook and Dumaresq River. Local relief is less than 9 m with most slopes below 1%.

Substrate: Transported material (relict alluvia)

Vegetation: Stunted tea-tree and isolated bull oak, gumtopped box, poplar box and false sandalwood. Sparse spinifex and roly-poly ground cover. Large, bare, scalded areas.



Typically eroded and scalded landscape with stunted tea-tree and gum-topped box.



SOIL DESCRIPTION

Classification: Solonetz (Dy2.43)

Depth (cm)	Description
0 to 5	Grey silty clay loam with strong bleaching; structureless. Abrupt change to:
5 to 30	Grey medium clay; moderately structured; a few soft carbonate segregations. Clear change to:
30 to 40	Yellow-brown light clay with strong bleaching; poorly structured; a few soft carbonate segregations. Clear change to:
40 to 90	Brown light clay; well structured; a few soft carbonate segregations. Gradual change to:
90 to 150	Yellow-brown sandy loam; poorly structured; a few carbonate nodules. Changes to structureless; yellow loamy sand below 120 cm

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low to very low; P - very low; K - medium to low
- low to very low zinc
- surface pH 9.5, upper subsoil pH 10, lower subsoil pH 10 to 11
- strongly to very strongly sodic throughout
- high to very high salinity 70 to 100 cm

Physical

- hardsetting, structureless surface
- silty seedbed; pulverises very easily; extreme surface sealing, crusting and scalding; wind erodible
- ERD range: 10 to 40 cm
- PAWC range: 20 to 75 mm
- poorly drained
- high to very high dispersion to 40 cm; low below 40 cm

Optimal land use: Spray irrigated cropping and pastures; long-term dryland cropping

Land use suitability

Suitable for:	spray irrigated cropping	- soybean; (grain sorghum; cotton)
	trickle irrigated cropping	- cotton
	spray irrigated forages	oats; ryegrass; lucerne; forage sorghum
	spray irrigated pastures	- medics; clovers; temperate grasses; Bambatsi panic; purple pigeon grass
	dryland cropping	- wheat; barley; grain sorghum; cotton; chickpea; mungbean; grain millet; canola; (safflower; triticale; sunflower; canary)
	dryland forages	- oats; snail medic; forage sorghum; lab lab; cowpea; Echinochloa millet; (Pennisetum millet) • lucerne; Silk sorghum
	sown pastures	- Bambatsi panic; purple pigeon grass; snail and barrel medics; (Katambora rhodes grass; green panic)
	native pastures	refer to Appendix IV in Part A

Land use limitation

- *melonhole microrelief*: ponding and waterlogging, restricted trafficability and tillage
- *adverse subsoil conditions*; exposure after levelling
- *woody weed regrowth*

Land conservation

Water erosion hazard: *low*

Surface runoff: *low*

Contour Banks: *suitable*

Waterways: *suitable*: type A, B or C; with rhodes grass or African star grass

Diversion Banks: *suitable*

Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.4	3.7
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on dryland fallows using zero or minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting
- Levelling of melonholes may be required before production of dryland cotton and grain legumes; test subsoils

LRA: *Commoron*

Concept: *Self-mulching, dark or grey cracking clay on melonholed, brigalow-belah plains in the east*

SITE DESCRIPTION

Landform: Elevated, level or occasionally gently undulating plains in the east. Local relief is less than 9 m with most slopes below 1%. Melonhole gilgai present.

Substrate: Transported material (clay sheets)

Vegetation: Tall, open forest of brigalow with belah and occasional poplar box or gum-topped box. Understorey of wilga and false sandalwood.



Tall brigalow - belah forest with wilga and false sandalwood understorey



SOIL DESCRIPTION

Classification: Grey clay (Ug5.24)

Depth (cm)	Description
0 to 5	Grey brown medium clay; well structured; a few carbonate nodules. Abrupt change to:
5 to 45	Grey heavy clay; moderately structured; a few carbonate nodules and some soft gypsum. Clear change to:
45 to 70	Grey heavy clay; well structured; a few carbonate nodules and some soft gypsum. Gradual change to:
70 to 150	Grey heavy clay; well structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium to low; P - medium to low; K - very high
- low zinc
- surface pH 8 to 9, upper subsoil pH 9, lower subsoil pH 8 to 6
- acid below 120 cm
- strongly sodic below 20 cm; below 40 cm in depressions
- very high to extreme salinity below 40 cm; below 70 cm in depressions

Physical

- gilgai; periodic cracking; self-mulching; forms a weak surface flake after rain; hardsetting in depressions
- fine, friable seedbed; stable with tillage
- ERD range: 80 to 100 cm
- PAWC range: 120 to 140 mm
- mounds imperfectly drained; depressions poorly drained
- high to very high dispersion below 20 cm; deeper in depressions

Optimal land use: Long-term dryland cropping

Land use suitability

Suitable for: dryland cropping	- <i>wheat; barley; grain sorghum; cotton; chickpea; grain millets; (mungbean; canola; safflower; triticale; canary; sunflower)</i>
dryland forages	- <i>oats; snail medic; forage sorghum; Echinochloa millet; lab lab; cowpea; (Pennisetum millet) • lucerne; Silk sorghum</i>
sown pastures	- <i>Bambatsi panic; purple pigeon grass; snail and barrel medics; (Katambora rhodes grass; green panic)</i>
native pastures	- refer to Appendix IV in Part A

Land use limitation

- *melonhole microrelief; ponding and waterlogging; restricted trafficability and tillage*
- *adverse subsoil conditions; exposure after levelling*
- *woody weed regrowth*

Land conservation

Water erosion hazard: <i>moderate to high</i>	Contour Banks: <i>suitable oversize NB type; BB on slopes over 5%</i>
Surface runoff: <i>low to high</i>	Waterways: <i>suitable type B; grass with rhodes grass or African star grass</i>
	Diversion Banks: <i>suitable</i>
	Dams: <i>suitable</i>

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.4	3.7
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on dryland crop fallows using zero or minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting
- Levelling of melonholes may be required before production of dryland cotton and grain legumes, test subsoils

LRA: *Commonon*

Concept: *Self-mulching, dark or grey cracking clay on sloping, melonholed, brigalow - belah lowland in the north-east*

SITE DESCRIPTION

Landform: Gently undulating rises, scarp footslopes and broad valleys of the lowlands associated with the *jumpups*; occasionally undulating. Local relief is mostly less than 30 m (occasionally 50 m) with most slopes between 1 and 3% (occasionally up to 8%) . Melonhole gilgai present.

Substrate: Labile sedimentary rocks

Vegetation: Tall, open forest of brigalow with belah and occasional poplar box. Understorey of wilga and false sandalwood.



Tall brigalow - belah forest with the understorey mostly absent



SOIL DESCRIPTION

Classification: Grey clay (Ug5.16)

Depth (cm)	Description
0 to 5	Dark medium clay; well structured. Abrupt change to:
5 to 20	Dark heavy clay; well structured; a little quartz gravel. Clear change to:
20 to 60	Grey heavy clay; well structured; a little quartz gravel; some soft carbonate segregations. Diffuse change to:
60 to 150	Brown heavy clay; moderately structured; a little quartz gravel.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium; P - low; K - high
- surface pH 7 to 7.5, upper subsoil pH 9, lower subsoil pH 5.5 to 5
- acid below 60 cm; deeper in depressions
- strongly sodic below 40 cm; deeper in depressions
- high to very high salinity below 60 cm; deeper in depressions

Physical

- gilgai; periodic cracking; firm or self-mulching; forms a weak surface flake after rain
- fine friable seedbed; stable with tillage
- ERD range: 80 to 100 cm; deeper in depressions
- PAWC range: 120 to 140 mm
- mounds imperfectly drained; depressions poorly drained
- high dispersion below 40 cm

Optimal land use: Flood irrigated cropping and pastures; long-term dryland cropping

Land use suitability

Suitable for:	flood irrigated cropping	- cotton; soybean; grain sorghum
	spray irrigated cropping	- soybean; grain sorghum; cotton
	trickle irrigated cropping	- cotton
	flood or spray irrigated forages	- oats; rye grass; forage sorghum; lucerne
	flood or spray irrigated pastures	- Bambatsi panic; purple pigeon grass; medics; clovers; temperate grasses
	dryland cropping	- wheat; barley; grain sorghum; cotton; chickpea; grain millets; (mungbean; canola; safflower; triticale; sunflower; canary)
	dryland forages	- oats; snail medic; forage sorghum; Echinochloa millet; lab lab; cowpea; (Pennisetum millet); lucerne; Silk sorghum
	sown pastures	- buffel grass; Bainbatsi panic; purple pigeon grass; snail and barrel medics; (Katambora rhodes grass; green panic)
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- *adverse subsoil conditions*

Land conservation

Water erosion hazard: *low*

Surface runoff: *low*

Contour Banks: *suitable*

Waterways: *suitable: type A, B or C; grass with rhodes grass or African star grass*

Diversion Banks: *suitable*

Dams: *suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.6	5.6
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and legumes
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on dryland fallows using zero or minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Billa Billa*

Concept: *Friable, dark or brown, duplex soil on belah plains in the east*

SITE DESCRIPTION

Landform: Elevated, level plains in the east. Local relief is less than 9 m with most slopes below 1%.

Substrate: Transported material (clay sheets)

Vegetation: Tall, open forest of belah with occasional brigalow, poplar box or gum-topped box. Understorey of wilga and false sandalwood.



SOIL DESCRIPTION

Classification: Solodic soil (Dy2.33)

Depth (cm)	Description
0 to 5	Brown clay loam; poorly structured; a little quartz gravel. Sharp change to:
5 to 7	As above but with slight bleaching
7 to 15	Dark heavy clay; moderately structured; a little quartz gravel. Abrupt change to:
15 to 85	Grey heavy clay; well structured; a little quartz gravel; a few soft carbonate segregations, and some gypsum crystals between 60 to 85 cm. Abrupt change to:
85 to 150	Grey heavy clay; moderately structured; a little quartz gravel; a few gypsum crystals

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium to low; P - low; K - very high
- low zinc
- surface pH 7; upper subsoil pH 9; lower subsoil pH 8 to 8.5
- acid below 90 cm
- sodic 15 to 30 cm; strongly sodic below 30 cm
- high salinity 30 to 60 cm; extreme salinity below 60 cm

Physical

- some periodic cracking; hardsetting; poorly structured surface
- friable seedbed after tillage; seals but does not set hard after rain; may crust after deep tillage
- ERD range: 60 to 100 cm
- PAWC range: 95 to 120 mm
- imperfectly drained
- moderate dispersion 15 to 30 cm; high below 30 cm

Optimal land use: Long-term dryland cropping

Land use suitability

Suitable for: dryland cropping	- wheat; barley; grain sorghum; cotton; chickpea; grain millet; (mungbean; canola; safflower; triticale; sunflower; canary)
dryland forages	- oats; snail medic; forage sorghum; Echinochloa millet; lab lab; cowpea; (Pennisetum millet); • lucerne, Silk sorghum
sown pastures	- buffel grass; Bambatsi panic; purple pigeon grass; snail and barrel medics; (Katambora rhodes grass; green panic)
native pastures	- refer to Appendix IV in Part A

Land use limitation

- adverse subsoil conditions

Land conservation

Water erosion hazard: moderate	Contour Banks: suitable NB and BB types
Surface runoff: moderate	Waterways: suitable: type B; grass with rhodes grass
	Diversion Banks: suitable
	Dams: suitable

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.6	5.6
Sown pasture:	0.3	2.4

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on crop fallows using zero or minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Billa Billa*

Concept: *Friable, dark or brown duplex soil on belah plains in the east*

SITE DESCRIPTION

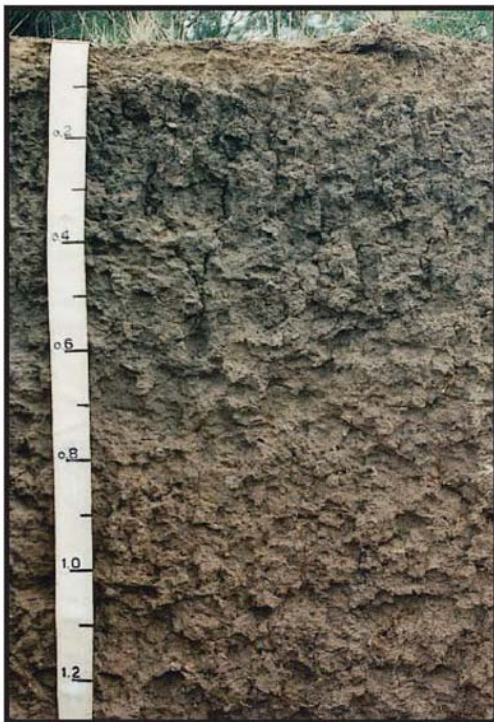
Landform: Gently undulating rises of the lowlands in the east. Local relief is less than 30 m with most slopes between 1 and 3%

Substrate: Labile sedimentary rocks

Vegetation: Tall, open forest of belah with occasional brigalow. Understorey of wilga and false sandalwood.



Tall belah forest with wilga and false sandalwood



SOIL DESCRIPTION

Classification: Solodic soil (Dd 1.33)

Depth (cm)	Description
0 to 5	Brown clay loam; poorly structured. Abrupt change to:
5 to 7	Dark sandy clay loam with slight bleaching; structureless. Abrupt change to:
7 to 35	Dark heavy clay; well structured; some soft carbonate segregations. Gradual change to:
35 to 55	Grey heavy clay; moderately structured; a little quartz gravel. Diffuse change to:
55 to 150	Yellow brown heavy clay; moderately structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium to low; P - very low; K - high
- very low zinc
- surface pH 7 to 7.5, upper subsoil pH 8.5, lower subsoil pH 7 to 5
- acid below 55 cm
- slightly sodic 10 to 20 cm; strongly sodic below 20 cm
- high salinity below 20 cm

Physical

- some periodic cracking; soft or hardsetting structureless or poorly structured surface
- friable seedbed after tillage; seals but does not set hard after rain; may crust after deep tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 140 mm
- imperfectly to moderately well drained
- moderate to very high dispersion below 20 cm

Optimal land use: Short-term dryland cropping

Land use suitability

Suitable for: dryland cropping	- wheat; barley
dryland forages	- oats; snail medic; (forage sorghum; lab lab; cowpea) • lucerne; Silk sorghum
sown pastures	- buffel grass; barrel medic; (purple pigeon grass; Katambora rhodes grass)
native pastures	- refer to Appendix IV in Part A

Land use limitation

- moderate PAWC
- adverse seedbed conditions (cloddy)
- adverse lower subsoil conditions

Land conservation

Water erosion hazard: moderate to high
Surface runoff: moderate

Contour Banks: suitable: NB type
Waterways: suitable: type B: grass with rhodes grass, African Star grass
Diversion Banks: suitable
Dams: suitable

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.8	7.5
Sown pasture:	0.4	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with 3 to 5 year ley pasture sequences following land development
- Retain stubble on crop fallows using minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Billa Billa*

Concept: *Hard setting, red-brown or brown duplex soil on sloping, belah lowlands in the east*

SITE DESCRIPTION

Landform: Gently undulating rises of the lowlands in the east. Local relief is less than 30 m with most slopes between 1 and 3%.

Substrate: Labile sedimentary rocks

Vegetation: Tall open forest of belah with occasional brigalow. Understorey of wilga and false sandalwood.



SOIL DESCRIPTION

Classification: Red brown earth (Dr2.43)

Depth (cm)	Description
0 to 10	Brown loam; structureless. Abrupt change to:
10 to 15	Red-brown clay loam with strong bleaching; structureless. Sharp change to:
15 to 80	Red-brown, medium clay; well structured some soft carbonate segregations and nodules mainly between 50 cm and 80 cm. Clear change to:
80 to 150	Brown, slightly mottled, medium clay; moderately structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - high
- low zinc
- surface pH 7.5 to 8, upper subsoil pH 9 to 9.5, lower subsoil pH 5.5
- acid below 100 cm
- strongly to very strongly sodic below 50 cm
- medium salinity 50 to 100 cm; high to very high below 100 cm

Physical

- hardsetting; structureless or poorly structured surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain
- ERD range: 60 to 100 cm
- PAWC range: 95 to 135 mm
- moderately well drained
- high to very high dispersion below 50 cm

Optimal land use: Long-term dryland cropping

Land use suitability

Suitable for: dryland cropping	- <i>wheat; barley; grain sorghum; cotton; chickpea; (grain millet; mungbean; canola; safflower; triticale; sunflower; canary)</i>
dryland forages	- <i>oats; snail medic; forage sorghum; (lab lab; cowpea; Echinochloa millet) • lucerne; Silk sorghum</i>
sown pastures	- <i>buffel grass; Bambatsi panic; snail and barrel medics; purple pigeon grass; (Katainbora rhodes grass)</i>
native pastures	- refer to Appendix IV in Part A

Land use limitation

- *adverse subsoil conditions*

Land conservation

Water erosion hazard: <i>moderate</i>	Contour Banks: <i>suitable: NB and BB types</i>
Surface runoff: <i>moderate</i>	Waterways: <i>suitable: type B; grass with rhodes grass, African star grass</i>
	Diversion Banks: <i>suitable</i>
	Dams: <i>suitable, but rock usually by 2 to 4 m</i>

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture	2.8	18 to 23
Cleared native pasture	0.6	5.6
Sown pasture	0.3	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on crop fallows using zero or minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Billa Billa*

Concept: *Dark or brown, (non-cracking) clay on sloping belah lowlands in the east*

SITE DESCRIPTION

Landform: Gently undulating rises of the lowlands in the east. Local relief is less than 30 m with most slopes between 1 and 3%.

Substrate: Labile sedimentary rocks

Vegetation: Tall, open forest of belah with occasional brigalow. Understorey of wilga and false sandalwood.



Tall belah forest with false sandalwood and wilga in a partially cleared shade line



SOIL DESCRIPTION

Classification: Brown clay (Ug5.32)

Depth (cm)	Description
0 to 5	Brown light clay; moderately structured. Abrupt change to:
5 to 35	Brown medium clay; well structured; a few carbonate nodules. Clear change to:
35 to 100	Yellow-brown, slightly mottled, heavy clay; well structured; many soft carbonate segregations and nodules. Abrupt change to:
100 +	Weathering sandstone and siltstone

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - high
- low to very low zinc
- surface pH 8.5, upper subsoil pH 9, lower subsoil pH 8.5
- strongly sodic below 20 cm
- medium salinity 20 to 50 cm; high to very high below 50 cm

Physical

- some periodic cracking; firm or self-mulching on mounds; hardsetting in depressions
- friable seedbed after tillage; seals but does not set hard after rain; may crust after deep tillage
- ERD range: 80 to 100 cm
- PAWC range: 100 to 140 mm
- imperfectly to moderately well drained
- moderate to high dispersion below 20 cm

Optimal land use: Flood irrigated cropping and pastures; long-term dryland cropping

Land use suitability

Suitable for:	flood irrigated cropping	- cotton; soybean; grain sorghum
	spray irrigated cropping	- soybean; (cotton; grain sorghum)
	trickle irrigated cropping	- cotton
	flood or spray irrigated forages	- oats; rye grass; forage sorghum; lucerne
	flood or spray irrigated pastures	- Bambatsi panic; purple pigeon grass; medics; clovers; temperate grasses
	dryland cropping	- wheat; barley; chickpea; (grain sorghum; cotton, grain millet)
	dryland forages	- oats; snail medic; forage sorghum • lucerne; Silk sorghum; (lab lab; cowpea; Echinochloa millet)
	sown pastures	- buffel grass; Bambatsi panic; snail and barrel medics; (purple pigeon grass)
	native pastures	- refer to Appendix IV in Part A

Land use limitation

- *adverse subsoil conditions*

Land conservation

Water erosion hazard: *low*
 Surface runoff: *low*

Contour Banks: *suitable: NB type*
 Waterways: *suitable: type B; build from the inside, replace topsoil; grass with rhodes grass*
 Diversion Banks: *suitable*
 Dams: *suitable*

Stocking rates

	Sheep (haJDSE)	Cattle (haJAE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.6	5.6
Sown pasture:	0.3	2.4

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on crop fallows using zero or minimum tillage
- Use minimum tillage on irrigated land
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Bungunya North*

Concept: *Red or brown (non-cracking) clay or friable, duplex soil on belah plains in the west*

SITE DESCRIPTION

Landform: Elevated, level or occasionally gently undulating plains in the west. Local relief is less than 9 m with most slopes below 1%.

Substrate: Clay alluvium and other transported material (clay sheets)

Vegetation: Tall, open forest of belah with occasional brigalow. Understorey of wilga and false sandalwood.



SOIL DESCRIPTION

Classification: Affinities with solodic soils (Dr2.33)

Depth (cm)	Description
0 to 5	Red-brown light clay; moderately structured. Sharp change to: A very thin bleached layer. Sharp change to:
5 to 70	Red-brown heavy clay; well structured. Abrupt change to:
70 to 80	Red-brown, strongly mottled, heavy clay; moderately structured; a few carbonate nodules. Clear change to:
80 to 150	Red-brown, strongly mottled, heavy clay; moderately structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium to low; P - medium; K - very high
- surface pH 7 to 8, upper subsoil pH 8 to 8.5, lower subsoil pH 5.5 to 5
- acid below 80 cm
- strongly sodic below 20 cm
- medium salinity 20 to 50 cm; high to very high below 50 cm

Physical

- some periodic cracking; firm or weakly self-mulching on mounds; hardsetting in depressions
- friable seedbed after tillage; seals but does not set hard after rain; may crust after deep tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 140 mm
- imperfectly drained
- high dispersion below 20 cm

Optimal land use: Long-term dryland cropping

Land use suitability

Suitable for: dryland cropping	-wheat; barley; grain sorghum; chickpea; (cotton; grain millet)
dryland forages	-oats, lucerne; snail medic; forage sorghum; Silk sorghum; (lab lab; cowpea; Echinochloa millet)
sown pastures	-buffel grass; Bambatsi panic; snail and barrel medics; (purple pigeon grass)
native pastures	-refer to Appendix IV in Part A

Land use limitation

- *adverse subsoil conditions*

Land conservation

Water erosion hazard: <i>moderate</i>	Contour Banks: <i>suitable: BB or oversize NB types</i>
Surface runoff: <i>moderate</i>	Waterways: <i>suitable: type B, grass with rhodes grass</i>
	Diversion Banks: <i>suitable</i>
	Dams: <i>suitable, but rock usually by 2 to 4 m</i>

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	18 to 23
Cleared native pasture:	0.4	3.7
Sown pasture:	0.2	2.5

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 years of continuous farming
- Retain stubble on crop fallows using zero or minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures
- Apply phosphorus fertiliser with crops and annual forages at planting

LRA: *Bungunya North*

Concept: *Self-mulching, red or brown cracking clay on sloping brigalow - belah plains, in the west*

SITE DESCRIPTION

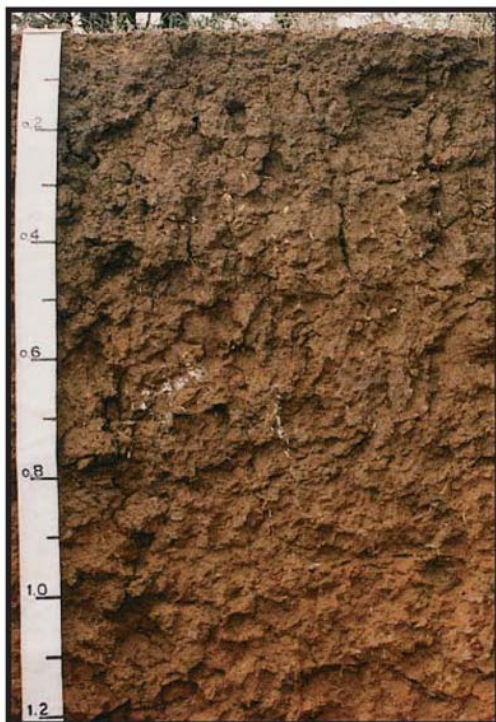
Landform: Gently undulating plains and rises of the lowlands in the west. Local relief is less than 30 m with most slopes between 1 and 3% (occasionally up to 5%).

Substrate: Labile sedimentary rocks and transported material (clay sheets)

Vegetation: Tall, open forest of brigalow with belah and occasional poplar box or yapunyah. Understorey of wilga and false sandalwood.



Shadeline of dense brigalow regrowth with some original trees



SOIL DESCRIPTION

Classification: Red clay (Ug5.38)

Depth (cm)	Description
0 to 5	Brown medium clay; well structured; a few carbonate nodules. Abrupt change to:
5 to 70	Red-brown heavy clay; well structured; a little gravel; a few soft carbonate segregations and nodules below 30 cm. Clear to change to:
70 to 90	Red-brown heavy clay; moderately structured; a few carbonate nodules and gypsum crystals. Gradual change to:
90 to 150	Red-brown heavy clay; well structured

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium; P - low; K - very high
- surface pH 7.5, upper subsoil pH 8.5, lower subsoil pH 5.5 to 4.5
- acid below 70 cm
- slightly sodic to sodic 10 to 30 cm; strongly sodic below 30 cm
- medium salinity 10 to 30 cm; extreme below 30 cm

Physical

- periodic cracking; self-mulching; forms a weak surface flake after rain
- fine, friable clay seedbed; stable with tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 140 mm
- imperfectly to moderately well drained
- moderate dispersion below 90 cm

Optimal land use: Long-term dryland cropping

Land use suitability

Suitable for: dryland cropping	- wheat; barley; grain sorghum; cotton; chickpea; (grain millet; mungbean; canola)
dryland forages	- oats; forage sorghum; snail medic; (lab lab, cowpea; Echinochloa millet) • lucerne; Silk sorghum
sown pastures	- Bambatsi panic; snail and barrel medics; purple pigeon grass
native pastures	- refer to Appendix IV in Part A

Land use limitation

- no significant limitations

Land conservation

Water erosion hazard: moderate	Contour Banks: suitable: BB type
Surface runoff: moderate	Waterways: suitable: type B; grass with rhodes grass or African star grass
	Diversion Banks: suitable
	Dams: suitable, but rock usually by 1 to 2 m

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	0.5	9 to 14
Cleared native pasture:	0.4	3.7
Sown pasture:	0.2	2.4

Management recommendations

- Rotate crops with alternative crops and forages
- Rotate crops and forages with ley pastures after 30 to 40 years of continuous farming
- Retain stubble on crop fallows using zero or minimum tillage
- Use press-wheels to assist establishment of crops, forages and pastures

LRA: *Lundavra*

Concept: *Self-mulching, dark cracking clay on lower slopes and valley flats within open downs*

SITE DESCRIPTION

Landform: Undulating rises of the lowlands in the east; lower slopes and valley flats around Tarewinnabar, Te Apiti and Lundavra. Local relief is less than 30 m (occasionally to 50 m) with most slopes between 1 and 5%. Linear gilgai.

Substrate: Labile sedimentary rocks

Vegetation: Tussock grassland of Queensland blue grass; mid-high, open woodland of myall and coolibah in drainage areas



SOIL DESCRIPTION

Classification: Black earth (Ug5.12)

Depth (cm)	Description
0 to 2	Dark heavy clay; well structured. Abrupt change to:
2 to 5	Dark heavy clay; moderately structured. Clear change to:
5 to 45	Dark heavy clay; well structured; a few carbonate nodules. Gradual change to:
45 to 90	Dark heavy clay; well structured; some carbonate nodules. Gradual change to:
90 to 100	Weathered sandstone and siltstone

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - high
- low to very low zinc
- surface pH 7.5 to 8, upper and lower subsoil pH 8.5
- non sodic throughout
- very low salinity throughout

Physical

- gilgai; periodic cracking; self-mulching; forms a weak surface flake after rain
- fine, friable clay seedbed, stable with tillage
- ERD range: 60 to 100 cm
- PAWC range: 100 to 150 mm
- imperfectly drained
- low dispersion throughout

Optimal land use: Sown pastures

Land use suitability

Suitable for: sown pastures
native pastures
dryland forages (while
developing and renovating
land)

- *buffel grass; barrel medic*
- refer to Appendix IV in Part A
- *oats; snail medic • Silk sorghum*

Land use limitation

- *low PAWC*
- *low fertility*
- *shallow soil depth*
- *adverse seedbed conditions (coarse)*

Land conservation

Water erosion hazard: *moderate to high*
Surface runoff: *moderate to high*

Contour Banks: *n.a.*
Waterways: *suitable type B; replace topsoil;
grass with rhodes grass or African star grass*
Diversion Banks: *suitable*
Dams: *suitable, but rock usually by 1 m*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	1.2	9 to 14
Cleared native pasture:	0.8	7
Sown pasture:	0.35	4

Management recommendations

- Plant forage crops while developing country for pastures
- Undertake a short-term farming phase every 8 to 10 years to renovate sown pastures

TAREWINNABAR SHALLOW SOIL 23

LRA: *Lundavra*

Concept: *Shallow, hardsetting, red or brown cracking clay with ironbark - box woodland on crests within open downs*

SITE DESCRIPTION

Landform: Undulating rises of lowlands in the east; crests and upper slopes around Tarewinnabar, Te Apiti and Lundavra. Local relief is less than 30 m (occasionally to 50 m) with most slopes between 1 and 5%

Substrate: Labile sedimentary rocks

Vegetation: Tall, open woodland of silver leaved ironbark and poplar box. Understorey absent.



Tall silver leaved ironbark woodland on a crest



SOIL DESCRIPTION

Classification: Red Clay (ug5.37)

Depth (cm)	Description
0 to 10	Brown light clay; moderately structured. Clear change to:
10 to 35	Red-brown medium clay; well structured. Clear change to:
35 to 60	Brown medium clay; well structured; some carbonate nodules. Clear change to:
60+	Weathered sandstone and siltstone

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium to low; P - very low; K - high
- low to very low zinc
- surface pH 7, upper subsoil pH 7.5, lower subsoil pH 8
- non sodic throughout
- very low salinity throughout

Physical

- periodic cracking, hardsetting, structured surface
- coarse, friable clay seedbed; seals after rain
- ERD range; 30 to 60 cm
- PAWC range; 60 to 100 mm
- moderately well drained
- low dispersion throughout

Optimal land use: Sown pastures

Land use suitability

Suitable for: sown pastures	- <i>buffel grass; barrel medic</i>
native pastures	- refer to Appendix IV in Part A
dryland forages (while developing and renovating land)	- <i>oats; snail medic • Silk sorghum</i>

Land use limitation

- *low PAWC*
- *low fertility*
- *adverse seedbed conditions (cloddy)*
- *woody weed regrowth*

Land conservation

Water erosion hazard: <i>high</i>	Contour Banks: <i>n.a.</i>
Surface runoff: <i>moderate</i>	Waterways: <i>suitable: type D; build from the outside; grass with buffel or rhodes grass</i>
	Diversion Banks: <i>suitable</i>
	Dams: <i>suitable</i>

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	2.8	14 to 18
Cleared native pasture:	0.8	7.4
Sown pasture:	0.35	4

Management recommendations

- Plant forage crops while developing country for pastures
- Undertake a short-term farming phase every 8 to 10 years to renovate sown pastures and to control woody weed regrowth

LRA: *Geralda*

Concept: *Red, duplex soil or structured earth with poplar box woodland, in the west*

SITE DESCRIPTION

Landform: Gently undulating plains and rises of the lowlands and gently dissected uplands in the west. Local relief is less than 30 m with most slopes between 1 and 3%.

Substrate: Transported material and deeply weathered sedimentary rocks

Vegetation: Tall woodland or open woodland of poplar box with occasional silver leaved ironbark, belah or kurrajong. Understorey of false sandalwood and wilga.



Tall poplar box woodland with false sandalwood



SOIL DESCRIPTION

Classification: Solodic soil (Dr2.13)

Depth (cm)	Description
0 to 5	Red-brown clay loam; structureless; a little gravel. Abrupt change to:
5 to 25	Red clay loam; structureless; some gravel. Clear change to:
25 to 45	Red light clay; moderately structured; multi-layered gravels. Clear change to:
45 to 85	Red medium clay; moderately structured; some gravel. Gradual change to:
85 to 130	Brown, slightly mottled, medium clay; moderately structured; some soft carbonate segregations and nodules and gravel. Clear change to:
130 to 140	Brown, strongly mottled, medium clay; moderately structured; some gravel

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - medium; P - very low; K - very high
- surface pH 6.5 to 7, upper subsoil pH 6.5 to 7.5, lower subsoil pH 8 to 8.5
- slightly sodic below 80 cm
- low to medium salinity below 80 cm

Physical

- hardsetting, structureless surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain; dries rapidly
- ERD range: 50 to 100 cm
- PAWC range: 85 to 135 mm
- moderately well drained

Optimal land use: Sown pastures

Land use suitability

Suitable for: sown pastures - *buffel grass; (barrel medic)*
 native pastures - refer to Appendix IV in Part A
 dryland forages (while - *oats; medics*
 developing and renovating land)

Land use limitation

- *low PAWC*
- *low fertility*
- *adverse seedbed conditions (cloddy)*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *high to very high*
 Surface runoff: *moderate to high*
 Contour Banks: *na*
 Waterways: *suitable: type D; build from the outside; grass with buffel or rhodes grass*
 Diversion Banks: *suitable*
 Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	3.2	16 to 21
Cleared native pasture:	1.2	10.7
Sown pasture:	0.45	4.5

Management recommendations

- Plant forage crops while developing country for pastures
- Undertake a short-term farming phase every 8 to 10 years to renovate sown pastures and to control woody weed regrowth

LRA: *Geralda*

Concept: *Red, massive earth with ironbark - poplar box woodland, in the west*

SITE DESCRIPTION

Landform: Undulating rises and occasional low hills of the gently dissected uplands in the west. Local relief is 20 to 50 m with most slopes between 2 and 5% (occasionally up to 8%)

Substrate: Deeply weathered sedimentary rocks

Vegetation: Tall woodland or open woodland of silver leaved ironbark and poplar box with occasional cypress pine, mulga and kurrajong. Understorey mainly false sandalwood and wilga.



Tall silver leaved ironbark - poplar box woodland with mulga and shrubs



SOIL DESCRIPTION

Classification: Red earth (Gn2.11)

Depth (cm)	Description
0 to 10	Red - brown loam; structureless. Clear change to :
10 to 45	Red clay loam; structureless; a little gravel. Gradual change to:
45 to 105	Red clay loam; structureless; much gravel. Diffuse change to:
105 to 125	Grey-brown, strongly mottled, sandy clay; well structured; a few large, platy rock fragments

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - high
- low zinc
- surface pH 5.5, upper subsoil pH 4.5, lower subsoil pH 4.5 to 5
- non sodic throughout
- very low salinity throughout

Physical

- hardsetting, structureless surface
- loamy seedbed; cloddy but pulverises with excessive tillage; seals and sets hard after rain; dries rapidly
- ERD range: 50 to 100 cm
- PAWC range: 80 to 125 mm
- well drained
- low dispersion throughout

Optimal land use: Unsuitable for development; native forestry and light grazing only

Land use suitability

Suitable for: native forestry
light grazing

- refer to Appendix IV of Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *adverse subsoil conditions (drainage)*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *high*
Surface runoff; *moderate*

Contour Banks: *n.a.*
Waterways: *n.a.*
Diversion Banks: *n.a.*
Dams: *not suitable*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	6.2	23 to 28
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop
- Use sown pastures for rehabilitating cleared land: *creeping bluegrass; Premier digit grass*

LRA: *Boondandilla*

Concept: *Loamy, impermeable duplex soil with bull oak - ironbark - rusty gum - poplar box forest, in the east*

SITE DESCRIPTION

Landform: Gently undulating plains and rises of the lowlands and gently dissected uplands in the east. Local relief is less than 30 m with most slopes between 1 and 3%, (occasionally up to 5%).

Substrate: Deeply weathered sedimentary rocks

Vegetation: Mid-high, open forest of bull oak with cypress pine and tall poplar box, narrow leaved ironbark, gum-topped box and rusty gum. Understorey of wattles regrowth.



SOIL DESCRIPTION

Classification: Solodized solonetz (Dy2.43)

Depth (cm)	Description
0 to 10	Brown sandy loam; structureless; a little gravel. Clear change to
10 to 20	Red-brown loamy sand with strong bleaching; structureless; much gravel. Sharp change to:
20 to 50	Brown medium clay; poorly structured; a little gravel. Gradual change to:
50 to 130	Brown, slightly mottled, medium clay becoming grey with depth; moderately structured; a little gravel

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low to very low; P - very low; K- very low
- low to very low copper and zinc
- surface and upper subsoil pH 5.5, lower subsoil pH 6.5 to 8
- strongly sodic below 20 cm
- medium to high salinity below 50 cm

Physical

- hardsetting, structureless surface
- loamy seedbed; pulverises readily with tillage; seals and sets hard after rain; dries rapidly; gravelly
- ERD range: 10 to 60 cm
- PAWC range: 25 to 95 mm
- poorly drained
- high to very high dispersion below 20 cm

Optimal land use: Unsuitable for development; native forestry and light grazing only
Land use suitability

Suitable for: native forestry
 light grazing

- refer to Appendix IV m Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *adverse subsoil conditions*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *high to very high*
 Surface runoff: *moderate to high*

Contour Banks: *n a*
 Waterways: *n a*
 Diversion Banks: *n a*
 Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	6.2	23 to 28
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop
- Use sown pastures for rehabilitating cleared land: *buffel grass; Pioneer rhodes grass; creeping bluegrass; Premier digit grass*

LRA: *Westmar*

Concept: *Sandy, impermeable, duplex soil with ironbark - poplar box - cypress pine woodland*

SITE DESCRIPTION

Landform: Gently undulating plains and rises interspersed with undulating low hills around Westmar. Local relief is less than 30 m (occasionally up to 50 m) with most slopes between 1 and 5 %.

Substrate: Quartzose sedimentary rocks and locally transported material

Vegetation: Tall woodland of silver leaved ironbark with poplar box and cypress pine. Understorey of wilga, wattles and quinine bush.



Bendidee Landscape - Westmar Landscape is similar to this landscape.



Bendidee Soil - Westmar Soil is similar to this soil

SOIL DESCRIPTION

Classification: Solodic soil (Dy5.43)

Depth (cm)	Description
0 to 40	Brown loamy sand; structureless. Gradual change to:
40 to 45	Grey sand with strong bleaching; structureless. Sharp change to:
45 to 65	Grey, slightly mottled, medium clay; poorly structured; a little gravel. Gradual change to:
65 to 90	Yellow-brown medium clay; poorly structured; a little gravel. Gradual change to:
90 to 130	Yellow-brown, strongly mottled, sandy clay; structureless; a little gravel.

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - low; K - *n.a.*
- copper and zinc *n.a.*
- surface pH 5.5, upper subsoil pH 7.5 to 8.5, lower subsoil pH 8.5
- strongly sodic below 40 cm
- moderate to low salinity below 70 cm

Physical

- soft or hardsetting, structureless surface
- coarse sandy seedbed; loose; dries rapidly; abrasive
- ERD range: 30 to 60 cm
- PAWC range: *n.a.*
- poorly drained
- high dispersion below 40 cm

Optimal land use: Unsuitable for development; light grazing only

Land use suitability

Suitable for: light grazing

- refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *shallow soil depth; usually very gravelly*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *very high*

Surface runoff: *high*

Contour Banks: *n.a.*

Waterways: *n.a.*

Diversion Banks: *n.a.*

Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	6.2	23 to 28
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop

LRA: *Jumpup*

Concept: *Very shallow, red, gravelly soil on the jumpups*

SITE DESCRIPTION

Landform: Undulating or rolling rises and low hills of the dissected uplands in the north (jumpups), often as continuous scarps. Local relief is 30 to 50 m with most slopes between 5 and 25%.

Substrate: Deeply weathered sedimentary rocks: pale and mottled clay, and ironstone gravel

Vegetation: Tall woodland of silver leaved ironbark, narrow leaved ironbark, poplar box and cypress pine. Understorey of wattle in the east or wilga, false sandalwood, mulga, bende and cassias in the west. Scarp slopes: brigalow, belah, gum-topped box and yapunyah.



Flinton Soil - Flinton Shallow Soil is similar to this soil but shallower and very gravelly

SOIL DESCRIPTION

Classification: Lithosol (Uc or Um)

Depth (cm)	Description
0 to 10	Red brown loam; structureless; some gravel. Clear change to:
10 to 50	Red clay loam; structureless; a few large rock fragments; much gravel. Clear change to:
50+	Weathered rock, pale or mottled kaolin clay, or dense ironstone gravel

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - high
- low zinc
- surface pH 5.5 to 6, subsoil pH 5 to 6
- non sodic throughout
- very low salinity throughout

Physical

- hardsetting, structureless surface
- shallow, gravelly seedbed; pulverises readily with tillage; seals and sets hard after rain; dries rapidly
- ERD range: 10 to 50 cm
- PAWC range: 25 to 80 mm
- well drained to rapidly drained
- low dispersion throughout

Optimal land use: Unsuitable for development; light grazing only

Land use suitability

Suitable for: light grazing - refer to Appendix IV in Part A

Land use limitation

- *very low PAWC*
- *very low fertility*
- *adverse seedbed conditions*
- *shallow soil depth*
- *very stony*
- *woody weed regrowth*

Land conservation

Water erosion hazard: *very high*
 Surface runoff: *high*

Contour Banks: *n.a.*
 Waterways: *n.a.*
 Diversion Banks: *n.a.*
 Dams: *limited suitability*

Stocking rates

	Sheep (ha/DSE)	Cattle (ha/AE)
Uncleared native pasture:	4.2	18 to 23
Cleared native pasture:	-	-
Sown pasture:	-	-

Management recommendations

- Do not develop

LRA: *Jumpup*

Concept: *Very shallow, dark or brown, stony soil on the jumpups in the east*

SITE DESCRIPTION

Landform: Undulating or rolling rises and low hills of the dissected upland (jumpups), often as continuous scarps, or flat-topped hills. Local relief is 30 to 50 m with most slopes between 5 and 25%.

Substrate: Deeply weathered sedimentary rocks: silicified sandstone and siltstone

Vegetation: Tall woodland of silver leaved ironbark, narrow leaved ironbark, poplar box and cypress pine. Shrub understorey of wattle, wilga and false sandalwood. Scarp slopes: brigalow, belah and gum-topped box.



Typical jumpup landscape representative of both Flinton Shallow and Karbullah Soils



SOIL DESCRIPTION

Classification: Lithosol (Ucl.24)

Depth (cm)	Description
0 to 10	Dark sandy loam; structureless; many sandstone rocks. Clear change to:
10 to 35	Dark loamy sand; structureless; many sandstone rocks. Abrupt change to:
35 to 45	Weathered sandstone and siltstone

DISTINGUISHING SOIL PROPERTIES

Chemical

- N - low; P - very low; K - medium
- surface pH 6 to 6.5, subsoil pH 6.5
- non sodic throughout
- very low salinity throughout

Physical

- firm or hardsetting, structureless surface
- shallow, stony seedbed; dries rapidly
- ERD range: 10 to 50 cm
- PAWC range: 25 to 75 mm
- well drained to rapidly drained
- low dispersion throughout

Table B8. List of species found in Waggamba Shire and their common names

<i>Acacia aneura</i>	mulga
<i>Acacia catenulata</i>	bendøe
<i>Acacia excelsa</i>	ironwood
<i>Acacia harpophylla</i>	brigalow
<i>Acacia pendula</i>	myall
<i>Acacia sparsiflora</i>	lancewood
<i>Acacia spectabilis</i>	kogan wattle
<i>Alphitonia excelsa</i>	red ash
<i>Alstonia constricta</i>	bitter bark
<i>Angophora costata</i>	rusty gum
<i>Angophora intermedia</i>	roughbark apple
<i>Anthobolus leptomerioides</i>	-
<i>Aristida latifolia</i>	feathertop wiregrass
<i>Aristida</i> spp.	wiregrasses
<i>Astrebla elymoides</i>	hoop mitchell grass
<i>Astrebla lappacea</i>	curly mitchell grass
<i>Atalaya hemiglauca</i>	whitewood
<i>Atriplex semihaccata</i>	creeping saltbush
<i>Bothriochloa bladhii</i>	forest bluegrass
<i>Bothriochloa decipiens</i>	pitted bluegrass
<i>Bothriochloa intermedia</i>	forest bluegrass
<i>Brachychiton populneus</i>	kurrajong
<i>Callitris columellaris</i>	cypress pine
<i>Capparis lasiantha</i>	nipan
<i>Capparis mitchellii</i>	wild orange
<i>Carex</i> spp.	sedges
<i>Carissa ovata</i>	currant bush
<i>Carissa</i> spp.	currant bushes
<i>Cassia nemophila</i>	birdseye cassia
<i>Casuarina cristata</i>	belab
<i>Casuarina leuhmannii</i>	bull oak
<i>Chenopodium trigonon</i>	fishweed
<i>Chloris acicularis</i>	curly windmill grass
<i>Chloris divaricata</i>	slender chloris
<i>Chloris truncata</i>	windmill grass
<i>Chloris</i> spp.	windmill grasses
<i>Cypress biflex</i>	downs nutgrass
<i>Dactyloctenium radicans</i>	button grass
<i>Dichanthium sericeum</i>	Queensland bluegrass
<i>Diplachne parviflora</i>	beetle grass
<i>Dodonea attenuata</i>	hob bush
<i>Enteropogon acicularis</i>	spider grass
<i>Eragrostis leptostachya</i>	paddock lovegrass
<i>Eragrostis parviflora</i>	weeping lovegrass
<i>Eremocitrus glauca</i>	limebush
<i>Eremophila mitchellii</i>	false sandalwood
<i>Erenophila</i> spp.	fuchsias
<i>Eriochloa pseuolarotricha</i>	early spring grass
<i>Eucalyptus camaldulensis</i>	river red gum
<i>Eucalyptus crebra</i>	narrow leaved ironbark
<i>Eucalyptus dealbata</i>	tumbledown gum
<i>Eucalyptus melanophloia</i>	silver leaved ironbark
<i>Eucalyptus microtheca</i>	coolibah

Table B8. Cont.

<i>Eucalyptus pilligaensis</i>	gum-topped box or mallee box
<i>Eucalyptus polycarpa</i>	long fruited bloodwood
<i>Eucalyptus populnea</i>	poplar box
<i>Eucalyptus tessellaris</i>	carbeen
<i>Eucalyptus thozetiana</i>	yapunyah
<i>Eulalia fulva</i>	brown top
<i>Exocarpus aphyllus</i>	-
<i>Flindersia maculosa</i>	leopard wood
<i>Geijera parviflora</i>	wilga
<i>Heterodendrum oleifolium</i>	boonaree
<i>Iseilema membranaceum</i>	small flinders grass
<i>Leptochloa digitata</i>	canegrass
<i>Maireana microphylla</i>	cottonbush
<i>Marsilea drummondii</i>	nardoo
<i>Melaleuca adnata</i>	-
<i>Melaleuca bracteata</i>	black tea-tree
<i>Neurachne</i> spp.	mulga grasses
<i>Panicum decompositum</i>	native millet
<i>Paspalidium caespitosum</i>	brigalow grass
<i>Paspalidium globoideum</i>	shot grass
<i>Paspalidium gracile</i>	slender panic
<i>Petalostigma pubescens</i>	native quinine bush
<i>Rhagodia spinescens</i>	berry saltbush
<i>Salsola kali</i>	soft roly-poly
<i>Sclerolaena muricata</i>	prickly roly-poly
<i>Sclerolaena tetracuspis</i>	brigalow burr
<i>Sporobulus caroli</i>	fairy grass
<i>Stipa verticillata</i>	slender bamboo grass
<i>Triodia irritans</i>	spinifex
<i>Ventilago viminalis</i>	supplejack

spp. = species, where more than one species of a genus is indicated

Source for common names: Stanley and Ross (1983)

GLOSSARY

Acid clay	Clay subsoils of low pH that occur particularly under brigalow-belah vegetation.												
Alluvial plain	A plain formed by the accumulation of alluvium over a considerable period of time; this accumulation may be still occurring at present (recent alluvium) or may have ceased (relict alluvium).												
Alluvium (pl. alluvia)	Deposits of gravel, sand, silt, clay or other debris, moved by streams from higher to lower ground.												
Bleach	Subsurface soil that is white, near white or much paler than adjacent soil layers. It occurs in varying proportions.												
C material	Layers below the B horizon which may be weathered parent material little affected by soil forming processes.												
Clays	Soils with a uniform clay texture throughout the surface soil and subsoil.												
- cracking	Clay soils that develop vertical cracks when dry.												
- non-cracking	Clay soils that do not develop vertical cracks when dry.												
Colluvium (pl. colluvia)	Slope deposits of soil and rock material.												
Colour	see <i>Soil colour</i> .												
Cracking clays	see <i>Clays, cracking</i> .												
Deep weathering	The process by which earthy or rocky materials are slowly broken down into finer particles and soil by chemical and physical processes to a substantial extent.												
Dispersion (dispersivity)	The capacity of a soil to break down or separate soil aggregates into their constituent particles. This is often associated with soils which are highly sodic or saline. This process greatly aids erosion. Dispersivity is measured as a clay dispersion ratio (x:1). Dispersibility ratings come from D. Baker (Agricultural Chemistry Branch, QDPI, Brisbane, personal communication). The classes are: <table border="0" style="margin-left: 20px;"> <tr> <td style="padding-right: 20px;">low</td> <td style="padding-right: 20px;">-</td> <td>less than 0.6</td> </tr> <tr> <td style="padding-right: 20px;">moderate</td> <td style="padding-right: 20px;">-</td> <td>between 0.6 and 0.8</td> </tr> <tr> <td style="padding-right: 20px;">high</td> <td style="padding-right: 20px;">-</td> <td>between 0.8 and 0.95</td> </tr> <tr> <td style="padding-right: 20px;">very high</td> <td style="padding-right: 20px;">-</td> <td>greater than 0.95</td> </tr> </table>	low	-	less than 0.6	moderate	-	between 0.6 and 0.8	high	-	between 0.8 and 0.95	very high	-	greater than 0.95
low	-	less than 0.6											
moderate	-	between 0.6 and 0.8											
high	-	between 0.8 and 0.95											
very high	-	greater than 0.95											
Dissection	The process of streams or erosion cutting the land into hill, ridges and flat areas.												

Duplex soil	A soil in which there is a sharp change in soil texture between the A and B horizons over a distance of 10cm or less.
Duricrust	A cemented layer at or near the surface resulting from concentration of breakdown products of rock weathering.
Earths	Soils with a sandy to loamy (including clay loam) surface soil gradually increasing to a loamy to light clay subsoil.
- massive	Earths in which the subsoil is not arranged into natural soil aggregates and appears as a coherent, or solid mass.
- structured	Earths in which the subsoil is arranged into natural soil aggregates which can be clearly seen.
Effective rooting depth (ERD)	Depth to which most plant feeder roots will penetrate. This is taken here to be the depth to which salts have been leached and have therefore accumulated. This represents the long-term depth of wetting. The quoted ERD is adjusted to horizon boundaries.
Ferruginisation	Breakdown of iron-rich minerals under intense weathering to produce iron oxides (the equivalent of rust). See also <i>Laterite</i> .
Horizon	see <i>Soil horizon</i> , also <i>Soil horizon boundary</i> .
Kaolinisation	Breakdown of minerals (particularly feldspars) under intense weathering to form kaolinite clay (china clay). See also <i>Laterite</i> .
Labile	see <i>Sedimentary rocks</i> .
Laterite	A profile formed by intense weathering. Many deeply weathered profiles termed 'lateritic' exhibit a distinct series of layers including a surface duricrust, a ferruginised zone and mottled and pallid (kaolinised) zones. See also <i>Duricrust</i> , <i>Ferruginisation</i> , <i>Kaolinisation</i> .
Lithology	The use of characteristics such as colour, mineral composition and grain size to describe rocks.
Local relief	The altitude difference between the base and crest of slopes in undulating or hilly areas.
Loams	Soils with a uniform loam (including clay loam) texture throughout the surface soil and subsoil. See also <i>Texture</i> .
Loose surface	The surface soil is easily disturbed by pressure of the forefinger as it consists of an incoherent mass of individual particles or aggregates.
Massive earths	see <i>Earths, massive</i> .
Massive structure	see <i>Soil structure, apedal</i> .
Nodules (in soil)	Small, hard, rounded masses of mineral compounds accumulated and concentrated in the soil by chemical action with water. They vary in size, shape and colour. (compare with <i>Segregations</i>).

The capacity for transmission under pressure (mainly gravity) of a fluid through a porous rock, sediments or soil.

Field water capacity (WC)

The quantity of water held in a soil that can be extracted by plant roots; the capacity is usually expressed as depth of water in millimetres.

A measure of the acidity or alkalinity of the soil on a scale of 1 to 14. The pH of a soil is a measure of its hydrogen activity. Acid soils have a high level of active hydrogen, while alkaline soils do not. Soil pH may be acid (3.0 to 6.5), neutral (6.5 to 7.5) or alkaline (7.5 to 10.0+). Each unit change in pH represents a 10-fold change in either the acidity or alkalinity of the soil. For example, a pH of 5.0 is 10 times more acid than a pH of 6.0.

The presence of soluble salts (mainly sodium chloride but also sodium carbonate, sodium nitrate, potassium carbonate, sodium nitrate and potassium nitrate) in the soil profile as solution or as accumulated crystalline salts. High salinity adversely affects root growth if it occurs within the rooting zone. It is expressed as a level of electrical conductivity (EC). EC units are deciSiemens per metre (dSm^{-1}).

The classes are defined as follows:

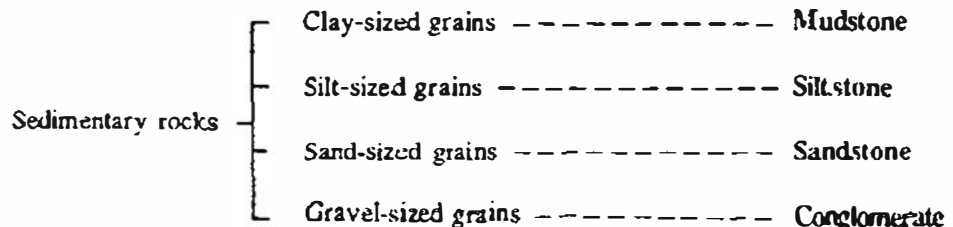
very low	-	less than 0.5
low	-	0.15 to 0.30
medium	-	0.30 to 0.70
high	-	0.70 to 1.20
very high	-	1.20 to 1.90
extreme	-	more than 1.90

Soils with a uniform sand (including sandy loam) texture throughout the surface soil and subsoil.

rocks

Rocks formed from the accumulation of material which has been weathered and eroded from pre-existing rocks, then transported and deposited as sediment by wind or water.

Sedimentary rocks have been classified according to grain size and constituent minerals:



Sandstone is further subdivided on the basis of the dominated minerals making up the clasts (solid inclusions) or the matrix which cements the clasts together:

Sandstone { 90% or more of grains are quartz: **Quartzose sandstone**
 less than 75% of grains are quartz: **Labile sandstone**

Labile sandstone may be dominated by rock fragments and is therefore called **lithic sandstone**.

Segregations (in soil)

Soft, finely divided mineral compounds accumulated in the soil through chemical action with water. They are not easily separated as discrete bodies (compare with *Nodules*).

Self-mulching

A condition of the surface soil, notably of clays, in which the aggregates fall apart naturally as the soil dries to form a loose surface mulch.

Silicification

Impregnation of rocks with silica during weathering.

Sodicity

A characteristic of soils (usually subsoils) containing exchangeable sodium to the extent of adversely affecting soil stability. It is measured as an exchangeable sodium percentage (ESP) of the cation exchange capacity (CEC) of the soil.

The classes are defined as follows:

non-sodic	-	less than 6%
slightly sodic	-	between 6 and 10%
sodic	-	between 10 and 15%
strongly sodic	-	between 15 and 35%
very strongly sodic	-	more than 35%

Soil colour

The colour of soil material is determined by comparison with a standard Munsell soil colour chart. The colour classes used for soil description in this manual is as follows:

Value/Chroma rating*:	1	2a	2b	4	5
Hue					
10R	dark	red-grey	red-brown	red	red
2.5YR	dark	grey-brown	red-brown	red	red
5 YR	dark	grey-brown	brown	red-brown	red-brown
7.5YR	dark	grey-brown	brown	yellow-brown	brown
10YR	dark	grey	yellow-brown	yellow	brown
2.5Y	dark	grey	yellow-grey	yellow	olive-brown
5Y	dark	grey	yellow-grey	yellow	olive

* Value/chroma rating is that defined by Northcote (1979)

Soil depth

The terms used in this manual for soil depths are governed by sampling methods.

Surface depth represents the A horizons (A1, A2), usually a 0 to 10 cm sample. It may include 20 to 30 cm and occasionally 50 to

60 cm samples where A horizons are deep; for example, Keetah, Bengalla, Marella, Bendidee, Oonavale.

Upper subsoil depth represents the top of the B horizon; usually a 20 to 30 cm and, or a 50 to 60 cm sample. It may include a 80 to 90 cm sample where A horizons are deep; for example, Keetah.

Lower subsoil depth represents the bottom of the B horizon; usually a 80 to 90 cm and, or 110 to 120 cm sample. It may include a 50 to 60 cm sample where soils are shallow; for example, Tarewinnabar shallow.

Soil horizon

A layer of soil material within the *soil profile* with distinct characteristics and properties produced by soil processes, and which are different from those of the layers above and/or below. The three main horizons are: A (topsoil); B (subsoil) C (see *C material*).

Soil horizon boundary

Boundaries between horizons take many forms. The terms used in the Soil Descriptions of Part B are:

Sharp - less than 5 mm wide; Abrupt - 5 to 20 mm wide; Clear 20 to 50 mm wide; Gradual - 50 to 100 mm wide; Diffuse - more than 100 mm wide.

Soil profile

A vertical cross-sectional exposure of a soil, from the surface to the parent material or *substrate*.

Soil structure

The arrangement of natural soil aggregates that occur in soil; structure includes the distinctness, size and shape of these aggregates.

- apedal

There are no observable natural soil aggregates; the soil may be either a coherent mass (*massive*) or a loose, incoherent mass of individual particles such as sand grains (*single grain*).

- blocky

The natural soil aggregates have the approximate shape of cubes with flat and slightly rounded sides.

- prismatic

The natural soil aggregates have the approximate shape of elongated blocks.

- columnar

The natural soil aggregates are like those of *prismatic* but have domed tops.

- polyhedral

The natural soil aggregates are irregular, many sided and multi-angled.

- lenticular

The natural soil aggregates are like large vertical lens shapes with curved cracks between the aggregates.

- coarse

The natural soil aggregates are relatively large; an average size of 20 mm or more is coarse for the purposes of this manual.

- medium The average size of the natural soil aggregates is between fine and coarse.
- fine The natural soil aggregates are relatively small; an average size of 5 mm or less is fine for the purposes of this manual.
- strong The natural soil aggregates are quite distinct in undisplaced soil; when displaced more than two-thirds of the soil material consists of aggregates.
- moderate Natural soil aggregates are well formed and evident but not distinct in undisplaced soil; when displaced more than one-third of the soil material consists of aggregates.
- weak The natural soil aggregates are indistinct and barely observable in undisplaced soil; when displaced up to one-third of the soil material consists of soil aggregates.

Soil texture

The coarseness or fineness of soil material as it affects the behaviour of a moist ball of soil when pressed between the thumb and forefinger. Texture classes used in this manual are defined primarily by the total clay content:

	Group	Clay content (%)
Coarse	Sand	less than 5
	Loamy sand	5 to 10
	Sandy loam	10 to 20
Medium	Loam	~ 25
	Sandy clay loam	20 to 30 + sand
	Clay loam	30 to 35
Fine	Sandy clay	35 to 40 + sand
	Light clay	35 to 40
	Medium clay	40 to 50
	Heavy clay	more than 50

Structured earths

see *Earths, structured.*

Subsoil

Soil layers below the surface with one of the following attributes:
 - a larger content of clay, iron, aluminium, organic material (or several of these) than the surface and subsurface soil;
 - stronger colours than those of the surface and subsurface soil above, or the *substrate* below.

Substrate

The material below the soil profile which may be the parent material or may be unlike the material from which the soil has formed; substrate which is not parent material for the soil above may be layers of older alluvium, rock strata unrelated to the soil or the buried surface of a former landscape.

Subsurface soil	Soil layers immediately under the surface soil which usually have less organic matter, paler colours and may have less clay than the surface soil.
Surface soil	The soil layer extending from the soil surface down which has some organic matter accumulation and is darker in colour than the underlying soil layers.
Terrace	Any long, relatively level or gently sloping surface, generally narrower than a plain and bounded by a steeper ascending slope on one edge and a steeper descending slope on the other. Often associated along the margin and above the level of a body of water eg. stream or lagoon.
Texture	<i>see Soil texture.</i>
Uniform clays	<i>see Clays.</i>
Uniform loams	<i>see Loams.</i>
Uniform sands and sandy loams	<i>see Sands.</i>
Waterlogged	An area in which water stands near, at or above the land surface, so that the roots of all plants except those with extreme water tolerance are drowned and the plants die.

