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Department of **Agriculture and Food**



Technical Bulletin

Land Systems of the Kimberley Region, Western Australia

No. 98



Alan Payne
Noel Schoknecht

Land systems of the Kimberley Region, Western Australia

Alan Payne and Noel Schoknecht

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Front cover: Ragged Range, an impressive expression of Weaber land system,
East Kimberley.
Photo: Noel Schoknecht, DAFWA

The authors

Alan Payne, retired, formerly Senior Advisor, Rangeland Survey, Department of Agriculture and Food, Western Australia (DAFWA) and Noel Schoknecht, Senior Research Officer, Land Resource Assessment and Monitoring, Department of Agriculture and Food, Western Australia.

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The authors also acknowledge the significant contribution from the authors of the source land system publications upon which much of the text is based.

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Acknowledgments for photographs are provided in the text.

Aerial photography provided by and with the permission of the Western Australian Land Information Authority trading as Landgate.

Digital data disclaimer

This mapping has been conducted at a regional scale. If using the digital linework (available from DAFWA), especially at larger scales (e.g. greater than 1:50,000), map boundaries may not exactly coincide with features on the ground. For some specific applications boundaries may require further revision.

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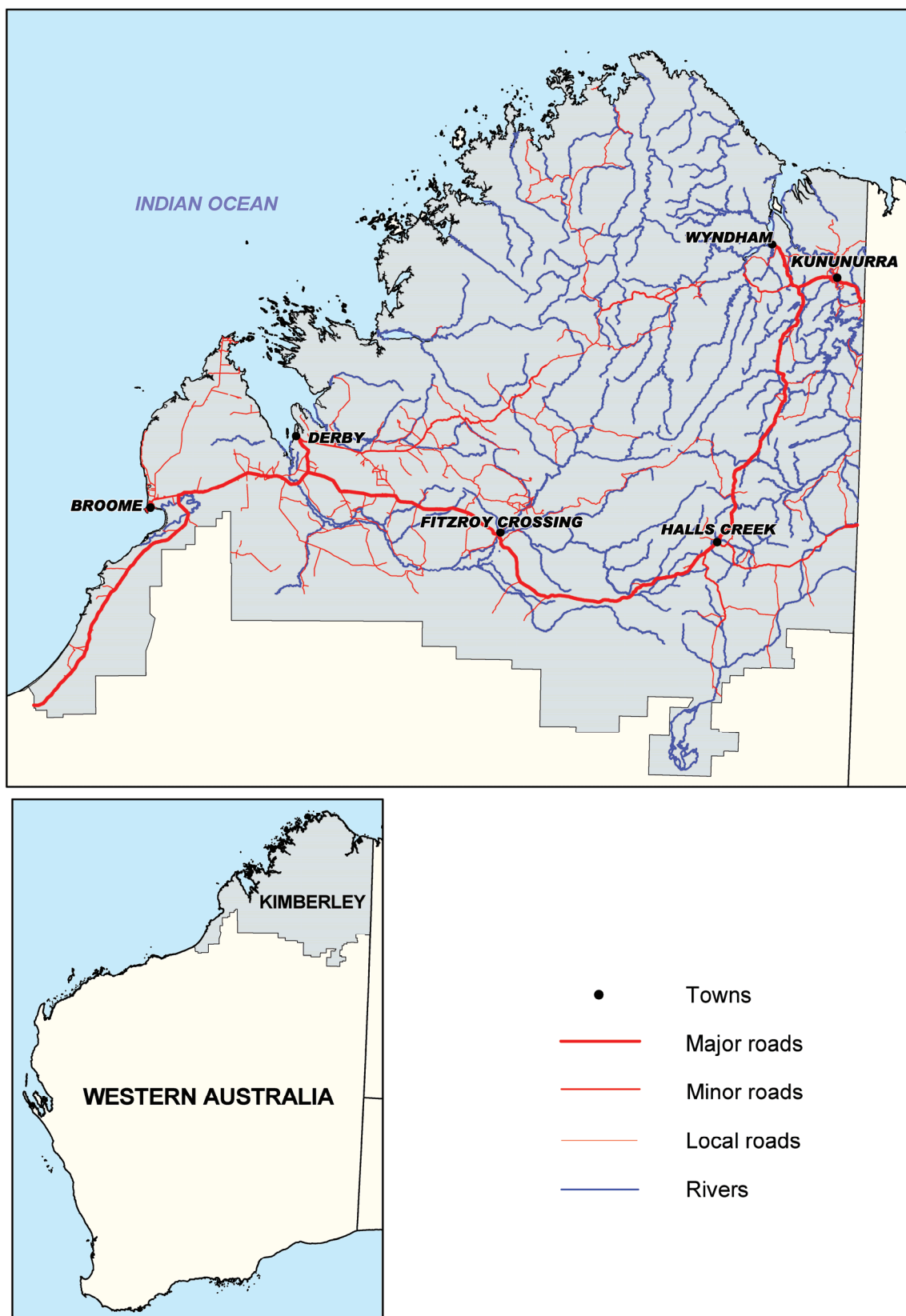


Figure 1 Location map showing coverage of land system mapping in the Kimberley Region

Purpose

The main purpose of this report is to consolidate descriptions of the landscapes, soils and vegetation of the Kimberley Region of Western Australia from a succession of surveys carried out by different organisations since the 1940s. Reports of some of the surveys are unpublished or out of print.

The purpose is achieved by listing and describing the 111 land systems which have been mapped in the region and by providing a joint land system and land type map. The Kimberley Region as defined in this report covers 330,070 km² and its extent is shown in Figure 1. Lake Argyle, with a nominal area of 1021 km², is included in the total area but unlike the source survey (Ord-Victoria) is not covered by land system mapping in this report and accompanying map.

Eighty-eight of the land systems have been previously described in three reports prepared as a result of major land resource surveys undertaken by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 1949 and the 1950s. The remaining 23 land systems have been described as a result of subsequent surveys undertaken jointly by the Western Australian Department of Agriculture (now Department of Agriculture and Food - DAFWA) and the Department of Lands and Survey (now Landgate), jointly by the DAFWA and the Department of Environment and Conservation, or solely by DAFWA.

This publication presents all systems for the first time arranged alphabetically in a standardised format.

History of land system surveys

Broadscale land resource surveys covering the Kimberley Region of Western Australia commenced in 1949 by the CSIRO. Three major surveys (see Figure 2) described and mapped the area at the land system level.

Field work for the first of these surveys (Ord-Victoria area) was undertaken in 1949 and 1952 but the report was not published until 1970 (Stewart et al. 1970). Field work for the other two surveys (North Kimberley and West Kimberley) was undertaken in 1954 and 1959 respectively with reports published by Speck et al. (1960, 1964).

These surveys adopted the land system approach developed by Christian and Stewart (1953). A land system was defined as 'an area or group of areas through which there is a recurring pattern of topography, soils and vegetation'. These patterns can be readily seen and delineated by stereoscopic examination of aerial photographs. The interpreted land system boundaries are then verified by limited ground validation during field work.

In the 1960s the Department of Lands and Surveys commenced a program of rangeland surveys in the Kimberley and Pilbara. These surveys classified the land into broad pasture types, mainly for the purpose of estimating paddock and station carrying capacities (Pringle 1991). Maps showing general landscape and vegetation attributes, but no accompanying reports, were produced during this program.

The land system approach to resource mapping has stood the test of time. It was continued by CSIRO and the Department of Agriculture/Department of Lands and Surveys in numerous subsequent surveys in other rangeland regions of Western Australia. Nearly all WA rangelands where pastoralism is the primary land use are now described and mapped at the land system level.

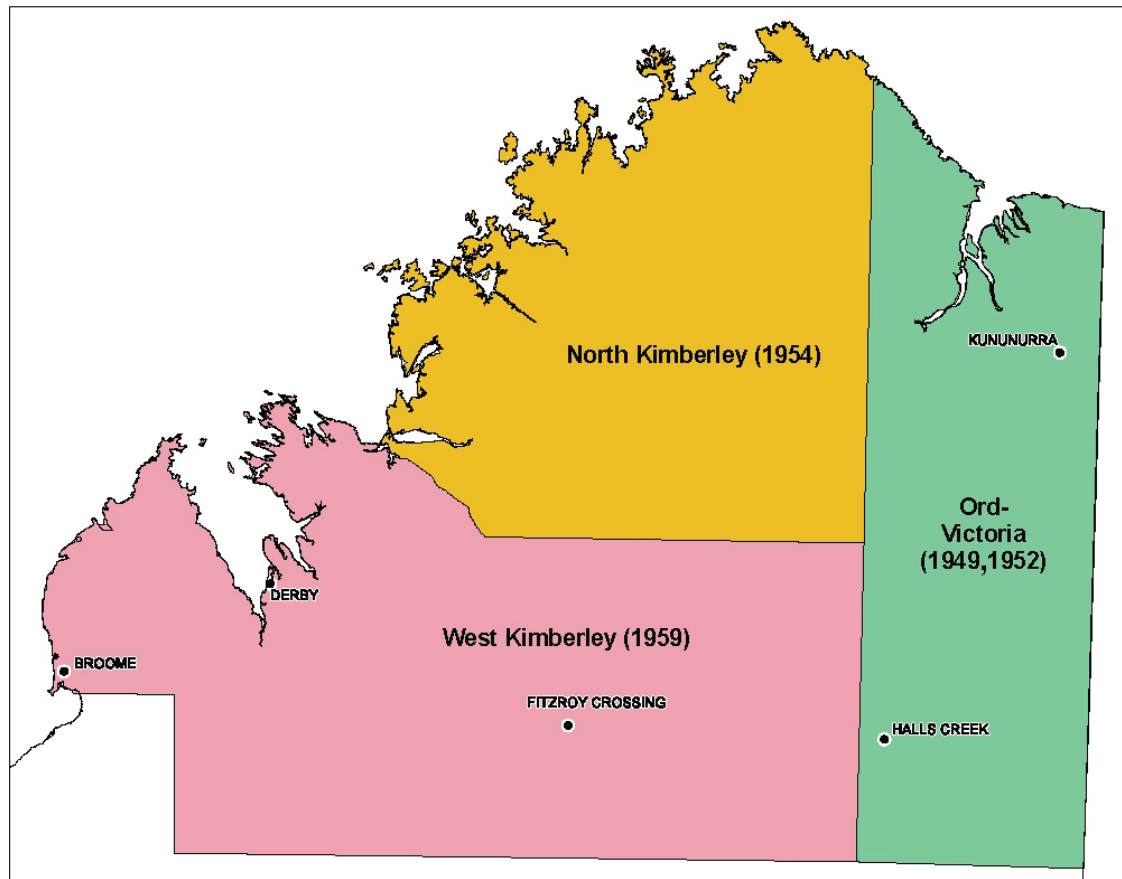


Figure 2 CSIRO broadscale land resource surveys in Kimberley showing dates of field work

Publications

Ord-Victoria (Stewart et al. 1970). Note: The area shown in Figure 1 is only the WA portion of the survey – the original survey included adjacent parts of the Northern Territory

North Kimberley (Speck et al. 1960)

West Kimberley (Speck et al. 1964)

Scanned copies of these reports are now available online at www.publish.csiro.au/nid/289.htm

Several more recent rangeland resource field surveys and a desktop exercise without ground validation have been undertaken in the Kimberley since the early CSIRO work (see Figure 3). Two surveys were jointly carried out by the Department of Agriculture and the Department of Lands and Surveys and three by the Department of Agriculture alone. Five reports have been published (Kubicki and Beer 1975; Payne et al. 1979; Ryan 1981; De Salis 1993; Cotching 2005). The desktop exercise (for the South Kimberley) was undertaken by the Department of Agriculture (Payne unpublished).

As part of the Ord-Bonaparte Program in the early 2000s, the Department of Agriculture and Food conducted land unit mapping on several stations within the Ord River catchment (Carlton Hill, Ivanhoe, Bow River and Violet Valley) plus several small “training” areas throughout the catchment, and incorporated soil mapping from the Ord River Irrigation area. This work is detailed by Tille (in prep.). Following the methodology of this work, further land unit mapping by DAFWA and Department of Environment and Conservation (DEC) (Handasyde et al. 2009) included Texas Downs, Mabel Downs and Osmond Valley stations and the Osmond Ranges plus vegetation/land unit mapping in the Lower Ord Ramsar Sites.

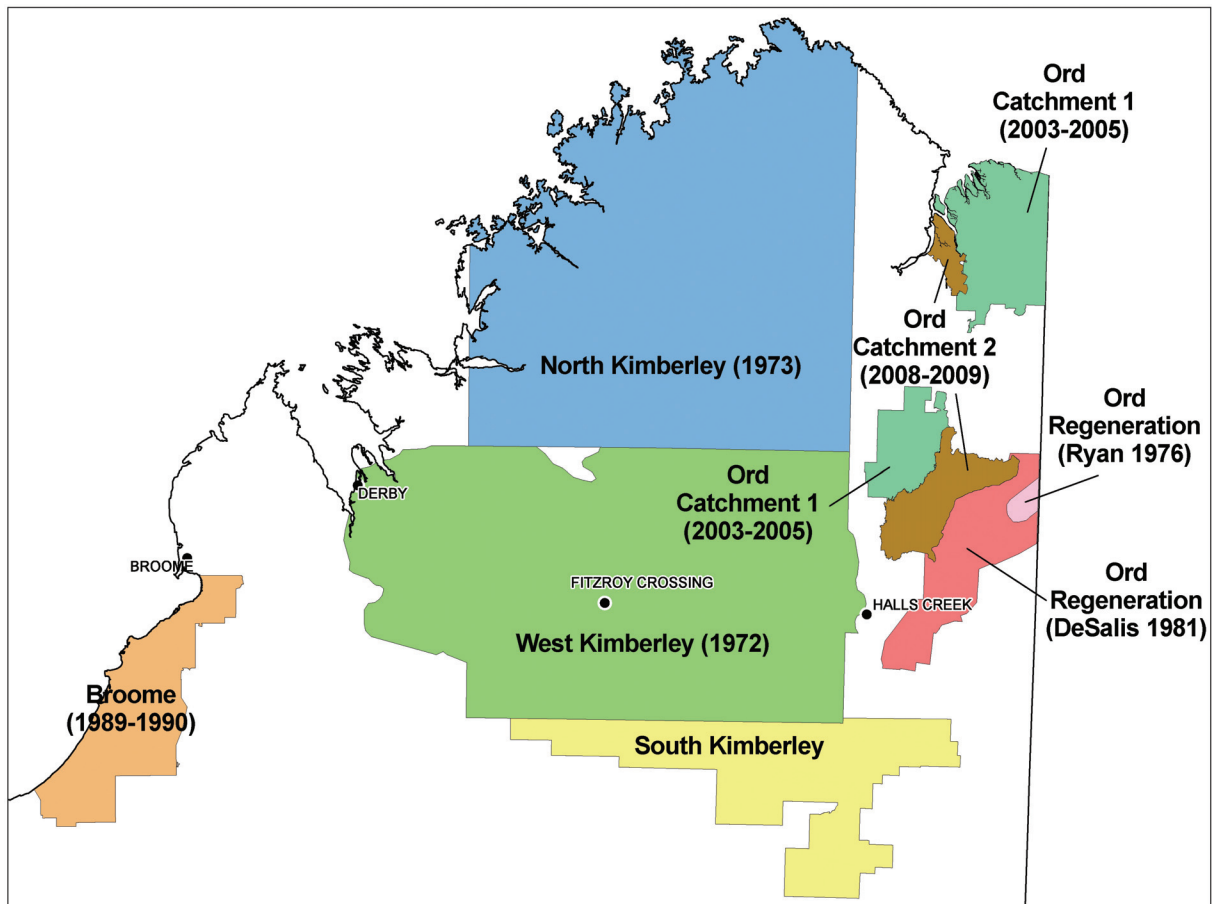


Figure 3 Department of Agriculture and Department of Lands and Surveys rangeland resource surveys in Kimberley showing dates of field work

Publications

- Broome (Cotching 2005)
- West Kimberley (Payne et al. 1979)
- North Kimberley (Kubicki and Beer 1975)
- Ord Regeneration 1 (Ryan 1981)
- Ord Regeneration 2 (De Salis 1993)
- South Kimberley (Payne unpublished)
- Ord Catchment 1: Bow River, Violet Valley, Carlton Hill & Ivanhoe stations (Schoknecht et al. 2004/05 unpublished)
- Ord Catchment 2: Mabel & Texas Downs, Osmond Valley stations, Osmond Ranges & Lower Ord (Handasyde 2009)

These surveys had various purposes (such as condition assessment of soils and vegetation, assessment of suitability for exotic pastures) but all adopted the land system as the basic mapping unit. Opportunities to re-interpret and modify existing land system boundaries were taken in some instances and in two surveys (West Kimberley and Broome) new systems were described and mapped.

Limitations of early surveys

The reports of the three CSIRO surveys were prepared many years apart and correlation between surveys was not always successful. There were many examples of mismatched boundaries at survey edges. There were also problems correlating land system names. For example, the Buldiva, Pinkerton and Precipice land systems from the North Kimberley (Speck et al. 1960), Ord-Victoria (Stewart et al. 1970) and the West Kimberley (Speck et al. 1964) surveys respectively edge-match to a large extent and are all essentially the same, all being associated with dissected sandstone plateaux and ranges.

Problems of misregistration of the land system boundaries when drafting maps of the original surveys were common in some areas. Some examples of simple misinterpretation probably due to poor quality base maps or geological information (and limited ground validation) were also found.

Mapping improvements

One of the earliest attempts to check and modify boundaries of land systems to improve the quality of the mapping was by Kubicki and Beer (1975). They investigated the suitability of land in the North Kimberley for the legume Townsville stylo and undertook considerable re-interpretation of the aerial photos, redrawing land system boundaries. This work was continued by Alan Payne who, in 1985, prepared a land system map showing the pastoral potential of the entire Kimberley Region. Where possible, he edge-matched boundaries from the three different CSIRO surveys and correlated the land systems.

During the West Kimberley range condition survey (Payne et al. 1979) a small number of amendments were made to CSIRO land system boundaries and two new systems (Bulka and Landrigan) were described and mapped.

Work in the Ord Regeneration area (Ryan 1981, De Salis 1993) remapped existing land systems down to the land unit scale and resulted in improved accuracy.

The previously unmapped Broome coastal area was surveyed by Cotching in 1989 and 1990 where he mapped and described eight new land systems (Cotching 2005).

Land system mapping in South Kimberley areas was undertaken as an *ad hoc* desktop exercise in the late 1990s and early 2000s by Alan Payne (unpublished). A number of new land systems were identified and tentatively described. These descriptions and maps are only provisional in that there was no ground validation.

In 2007 and 2008 most land system boundaries in the Kimberley were checked and redrawn by Alan Payne, Noel Schoknecht and Phil Goulding. The interactive use of up-to-date digital geological, contour, terrain model and cadastre maps as well as LANDSAT imagery and Google Earth considerably increased the efficiency of amending boundaries. Misregistration errors have been largely removed.

A report by Tille (in prep.) outlines the history of all Kimberley surveys in more detail and explains the methodology used in the recent preparation of improved maps.

Source of land system descriptions

All land system descriptions are taken from previous reports except for 12 land system descriptions which are published for the first time. The original source of the descriptions is acknowledged as a code in the heading line for each of the land systems. Where the land system has not been previously published the source code is UNP with a link to a footnote describing the unpublished source for the description.

Publication source codes and survey names:

BRM	Broome survey (Cotching 2005)
NKY	North Kimberley survey (Speck et al. 1960)
OVC	Ord-Victoria survey (Stewart et al. 1970)
PRP	Pilbara ranges survey (Van Vreeswyk et al. 2004)
UNP	Unpublished
WKC	West Kimberley range condition survey (Payne et al. 1979)
WKY	West Kimberley survey (Speck et al. 1964)

Where necessary, the CSIRO descriptions have been updated by converting all measurements from imperial to metric units and by modernising the plant names. Layout of the descriptions has been amended and standardised as much as possible. No text has been altered other than consigning approximate area percentages to land units for each system where previous descriptors such as 'large', 'medium', 'very small', etc. were used.

Each of the original CSIRO land system descriptions have had two additional headings added; namely **State land type** (see Appendix 3) and **Land management**. Vulnerabilities of the land system and management requirements for sustainable use are briefly described under the land management heading.

In the case of the CSIRO North Kimberley report the original pasture description in each land system description has been deleted.

In the case of the CSIRO North Kimberley and West Kimberley reports numbers in brackets in Soils and Vegetation sections refer to soil families and vegetation alliances/communities (numbers in bold type indicate dominants) in the original publications which should be referred to for further detail.

All land system tables have had a **pasture** column added using Kimberley pasture type descriptions from Payne and Schoknecht (2004, unpublished) and Ryan et al. (2009).

Previously unpublished descriptions are presented for 12 land systems (Bannerman, Betty, Billiluna, Cornish, Gilgie, Lake Gregory, Mulan, Snap, Spincrete, Sturt Creek, Texas and Wolfe), of which all except Texas occur in the South Kimberley. Descriptions for the 11 new land systems of the South Kimberley which were prepared by Alan Payne or officers of the Kununurra office of DAFWA are provisional as there has only been limited ground validation. The description for Texas is based on field work conducted as part of a land unit mapping exercise in the Ord River catchment (Handasyde et al. 2009).

State mapping hierarchy

The land system maps covering the Kimberley and other rangeland areas were completed as part of a survey programme separate from the land resource mapping undertaken in the Agricultural Area in the South-west of Western Australia (Schoknecht et al. 2004). Over the years these two programmes developed their own sets of standards, conventions and procedures.

The desirability of a single dataset covering the entire state and capable of feeding into Australian Soil Resource Information System (ASRIS) led to reconciliation between the outputs of these two programmes. This included placing the rangeland land systems into DAFWA's soil-landscape mapping hierarchy (Tille 2006).

This soil-landscape hierarchy comprises six nested levels of mapping. Each level is a subdivision of the preceding one, with decreasing internal complexity of the map unit as the scale becomes more detailed (Schoknecht et al. 2004).

The highest level of the hierarchy - **Regions** - is subdivided into **Provinces**. Both are aligned to the ASRIS national framework based on the mapping of Jennings and Mabbutt (1977), but their boundaries are derived from more detailed mapping in the lower levels of the hierarchy.

The Provinces are sub-divided in **Zones**, and the zones into **Systems** (equivalent to **Land Systems** in rangeland mapping). The map units described in this report are

placed at the **System** level of the hierarchy. Below the systems are **Subsystems** (equivalent to **Land Units** in rangeland mapping) and **Phases** (equivalent to **Land Unit Phases** in rangeland mapping).

Land unit mapping of Mabel Downs, Osmond Valley and Texas Downs stations (Handasyde et al. 2009) includes mapping to the **land unit** and **land unit phase** level.

1. Region

Broad subdivisions of the Australian continent

e.g. **Kimberley Region**
(3)

2. Province

Provides a broad overview of the whole state

e.g. **Southern Kimberley Ranges Province**
(31)

3. Zone

Area defined on geomorphological or geological criteria – suitable for regional perspectives

e.g. **Halls Creek Ridges Zone**
(314)

4. Land system (System)

Areas with recurring patterns of landforms, soils and vegetation – suitable for regional and pastoral property mapping

e.g. **Wickham land system**
(314Wk)

5. Land unit (Subsystem)

Classified according to position in landscape and further described by vegetation and soils – suitable for pastoral property and paddock scale mapping

e.g. **Wickham drainage floor land unit**
(314Wk_8)

6. Land unit phase (Phase)

Further division of land unit based on vegetation association, soil type or other specific interest

e.g. **Wickham drainage floor wet phase**
(314Wk_8150) – in this instance '1' signifies alluvium and '50' has been assigned to represent the wet phase

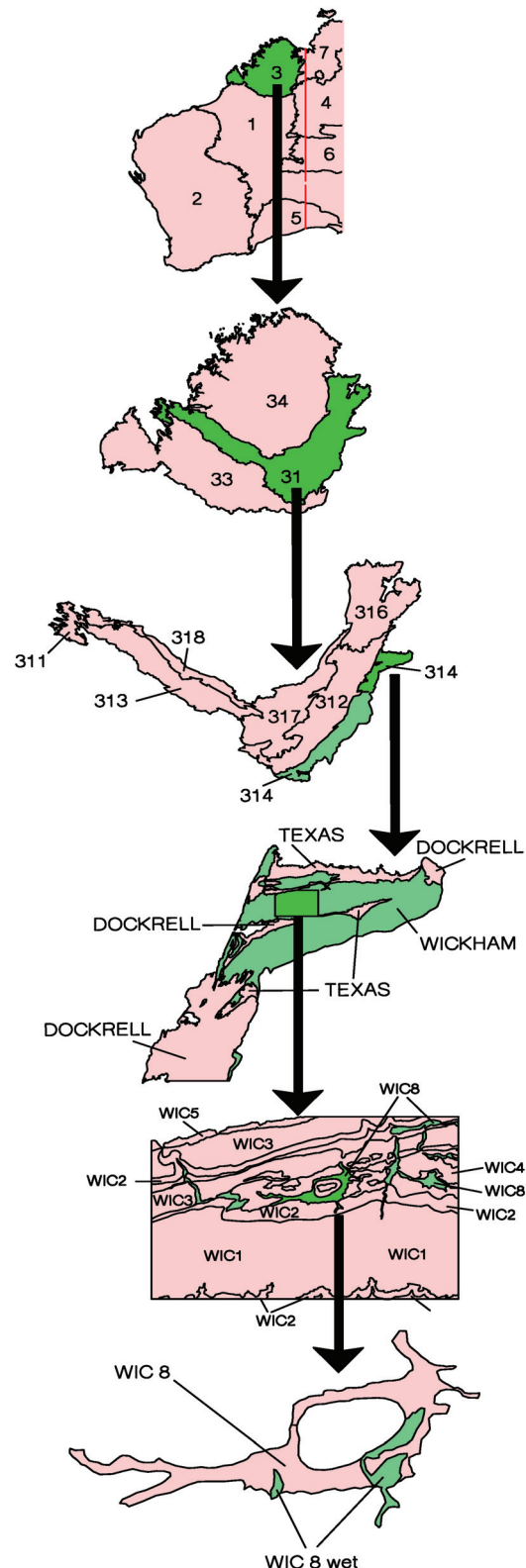


Figure 4 Example of the Wickham land system (Wic) placed in the soil-landscape mapping hierarchy

Each map unit is assigned a symbol that is unique across the entire State. The place of the map unit in the hierarchy is implicit in the symbol: the first character of the label signifying the region; the 2nd the province; the 3rd the zone; the 4th and 5th the system; the 6th and 7th the subsystem; and the remainder (up to 12 characters) the phase.

Figure 4 demonstrates the position of the **Wickham** land system in the soil-landscape hierarchy. The standard three letter rangeland land system code (**Wic**) has been replaced by the six character soil-landscape system code (**314Wic**).

Pasture types

A standard set of pasture types for the entire Kimberley was created by Payne and Schoknecht in 2004 (unpublished) and is published for the first time in this report (see Appendix 1). This is an expansion of the pasture types of the West Kimberley described by Payne et al. (1974) and has similarities with some of the Pilbara pasture types described in the Pasture Condition Guides for the Pilbara (Payne and Mitchell 2002). Ryan et al. (2009) published pasture condition guides for the Ord River catchment of the most common Kimberley pasture types.

In the Pilbara inventory and condition survey report (Van Vreeswyk et al. 2004) pasture types are referred to as site types. Some of the land system descriptions in this publication are derived from the Pilbara report, and in these instances either the site types from the Pilbara report are used where there is no Kimberley pasture type equivalent, or a Kimberley pasture type is used where the site type and pasture type are equivalent.

There is also one new Kimberley pasture type derived from the Broome survey report (Cotching 2005).

Up to four pasture types have been allocated proportionally (%) to each land unit of each land system. These proportions are estimates based on the original land system descriptions plus more recent traverse data. The proportions, and even the mix of pasture types, may vary within individual occurrences of each land unit.

A summary of pasture types for the Kimberley is presented on the following page. Detailed pasture type descriptions are provided in Appendix 1.

A guide to the grazing potential for each pasture type is provided in Appendix 2.

Pasture types of the Kimberley Region – summary, listed alphabetically by code

Pasture type code	Pasture type	Source
APXG	Alluvial Plain Mixed Grass Pastures	Pilbara Survey - Site Types*
ASGP	Arid Short Grass Pastures	Pasture types of the Kimberley region**
ASHP	Annual Sorghum Hill Pastures	Pasture types of the Kimberley region**
BGAP	Bluegrass Alluvial Plain Pastures	Pasture types of the Kimberley region**
BSGP	Black Speargrass Pastures	Pasture types of the Kimberley region**
BUGP	Buffel Grass Pastures	Pasture types of the Kimberley region**
CAHP	Curly Spinifex Annual Sorghum Hill Pastures	Pasture types of the Kimberley region**
CASG	Calcrete Spinifex Pastures	Pilbara Survey - Site Types*
CDBG	Coastal Dune Buffel Grass Pastures	Pilbara Survey - Site Types*
CDSG	Coastal Dune Soft Spinifex Pastures	Pilbara Survey - Site Types*
COGP	Cockatoo Grass Pastures	Pasture types of the Kimberley region**
CSPP	Curly Spinifex Plain Pastures	Pasture types of the Kimberley region**
CTGP	Coastal Tall Grass Pastures	Pasture types of the Kimberley region**
DEAW	Drainage Eucalypt and Acacia Woodland/Shrubland Pastures	Pilbara Survey - Site Types*
DMES	Drainage Melaleuca Shrubland Pastures	Pilbara Survey - Site Types*
FRGP	Frontage Grass Pastures	Pasture types of the Kimberley region**
FRIP	Fringing Pastures	Pasture types of the Kimberley region**
HSHP	Hard Spinifex Hill Pastures	Pasture types of the Kimberley region**
HSPP	Hard Spinifex Plain Pastures	Pasture types of the Kimberley region**
LCSP	Lowland Curly Spinifex Annual Sorghum Pastures	Pasture types of the Kimberley region**
LGAP	Lovegrass Alluvial Plain Pastures	Pasture types of the Kimberley region**
LITP	Littoral Pastures	Pasture types of the Kimberley region**
MACP	Marine Couch Pastures	Pasture types of the Kimberley region**
MGAP	Mitchell Grass Alluvial Plain Pastures	Pasture types of the Kimberley region**
MGUP	Mitchell Grass Upland Pastures	Pasture types of the Kimberley region**
OERG	Oat-eared Spinifex/Ribbon Grass Pastures	Broome Coastal Survey Pasture Types***
OTHP	Other Pastures	Pasture types of the Kimberley region**
PINP	Pindan Pastures	Pasture types of the Kimberley region**
PLSP	Plume Sorghum Pastures	Pasture types of the Kimberley region**
RAPP	Ribbon Grass Alluvial Plain Pastures	Pasture types of the Kimberley region**
RGRP	Ribbon Grass Pastures	Pasture types of the Kimberley region**
SHSG	Sandplain Hard Spinifex Pastures	Pilbara Survey - Site Types*
SMPP	Samphire Pastures	Pasture types of the Kimberley region**
SSPP	Soft Spinifex Pastures	Pasture types of the Kimberley region**
SSSG	Sandplain Soft Spinifex Pastures	Pilbara Survey - Site Types*
TAPP	Threeawn Plain Pastures	Pasture types of the Kimberley region**
TTGP	Tippera Tall Grass Plain Pastures	Pasture types of the Kimberley region**
WGBP	White Grass Bundle-Bundle Pastures	Pasture types of the Kimberley region**
XXNP	No Pastures	Pasture types of the Kimberley region**

* Van Vreeswyk et al. (2004). Note that Site Types in the Pilbara Survey are equivalent to Pasture Types in this report.

** Payne and Schoknecht (2004).

*** Cotching (2005).

Land systems

(listed alphabetically)

Land system	Code
Alexander	(Ale)
Amy	(Amy)
Angallari	(Agl)
Anna	(Ann)
Antrim	(Ant)
Argyle	(Arg)
Bannerman	(Bnm)
Barry	(Bar)
Barton	(Bat)
Betty	(Bet)
Billiluna	(Bll)
Bohemia	(Boh)
Buchanan	(Bch)
Buldiva	(Bul)
Bulka	(Buk)
Burramundi	(Bur)
Calwynyardah	(Clw)
Camelgooda	(Cml)
Carpentaria	(Cap)
Chestnut	(Cht)
Clifton	(Clf)
Cockatoo	(Coc)
Cockburn	(Cok)
Coolindie	(Cld)
Coonangoody	(Con)
Cornish	(Crn)
Cowendyne	(Cow)
Dinnabung	(Dbg)
Djada	(Dja)
Dockrell	(Dok)
Duffer	(Duf)
Egan	(Egn)
Eighty Mile	(Eig)
Elder	(Edr)
Fork	(Fok)
Forrest	(Frt)
Fossil 2	(Fsl)
Foster	(Fos)
Franklin	(Frk)
Fraser	(Fra)
Frayne	(Fry)
Geebee	(Gbe)
Gidgia	(Gia)
Gilgie	(Gig)
Gladstone	(Gls)
Glenroy	(Gny)
Gogo	(Gog)
Gordon	(Gor)
Gourdon	(Gdn)
Great Sandy	(Gts)
Headley	(Hea)
Inverway	(Inv)
Isdell	(Isd)
Ivanhoe	(Iva)
Karunjie	(Kri)
Kennedy 2	(Kny)

Land system	Code
Koongie	(Kog)
Lake Gregory	(Lgr)
Landrigan	(Lan)
Legune	(Leg)
Leopold	(Lep)
Little Sandy	(Lsa)
Looingnin	(Log)
Lowangan	(Low)
Lubbock	(Lub)
Lucas	(Luc)
Luluigui	(Lui)
MacPhee	(Mcp)
Mamilu	(Mam)
Mandeville	(Mnv)
Mandora	(Mda)
Mannerie	(Mnr)
Margaret	(Mrg)
Mulan	(Mln)
Myroodah	(Myr)
Napier	(Nap)
Neillabubica	(Nei)
Nelson	(Nel)
Nita	(Nit)
O'Donnell	(Odl)
Oscar	(Osc)
Pago	(Pag)
Parada	(Pda)
Phire	(Phr)
Pigeon	(Pig)
Pinkerton	(Pin)
Pompey	(Pom)
Precipice	(Pre)
Reeves	(Rev)
Richenda	(Ric)
Roebuck	(Roe)
Rose	(Ros)
Ruby 2	(Rub)
Sisters	(Sis)
Snap	(Snp)
Spincrite	(Spi)
St George	(Stg)
Sturt Creek	(Stc)
Tableland	(Tld)
Tanmurra	(Tan)
Tarraji	(Tar)
Texas	(Tex)
Wanganut	(Wan)
Wave Hill	(Wav)
Weaber	(Wbr)
Wickham	(Wic)
Willeroo	(Wio)
Windjana	(Wij)
Winnecke	(Wnk)
Wolfe	(Wof)
Yeeda	(Yed)

ALEXANDER LAND SYSTEM (Ale)

1050 km²

Source: WKY

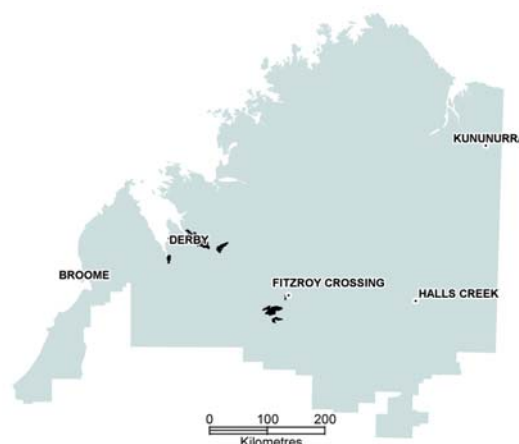
Stable, old floodplains with cracking clay soils supporting Mitchell grass and ribbon grass-bluegrass grasslands with sparse trees and shrubs.

State land type: Alluvial plains with tussock grasslands.

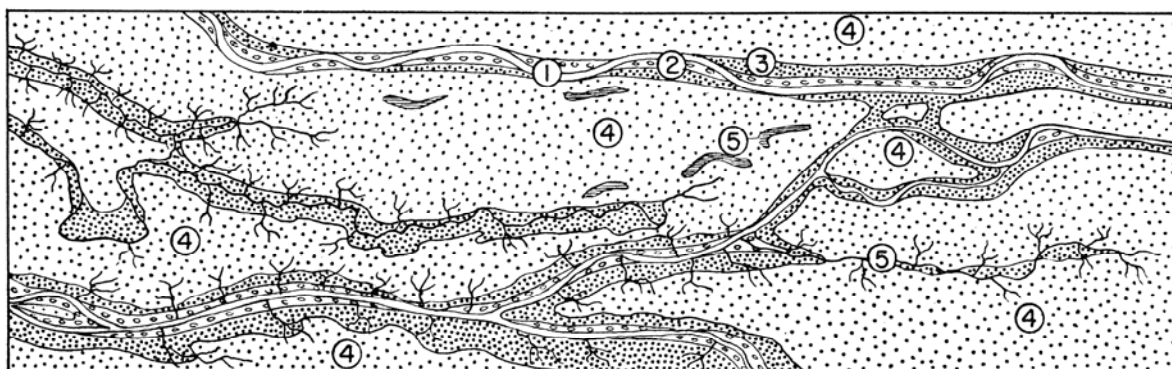
Geology: Quaternary alluvium.

Geomorphology: Alluvial plains-stable floodplains: extensive plains of dark cracking clays with shallow marginal dissection adjacent to restricted active levee zones; meandering, anastomosing channels; gradients 1 in 2000 to 1 in 4000.

Land management: Parts of this system are subject to fairly regular flooding and as a consequence are inaccessible for some periods. Much of the vegetation is highly attractive to grazing animals and is prone to degradation if grazing is uncontrolled. Levee crests and levee bank slopes (units 2 and 3) are moderately to highly susceptible to erosion if vegetative cover is lost. Controlled stocking is essential.



*Productive tussock grass pastures are characteristic of the cracking clay plains of the Alexander and many other land systems.
Photo: DAFWA*



Stylised plan showing location of land units

ALEXANDER LAND SYSTEM (Ale) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	2	Main channels: up to 460 m wide, and 18 m deep distributaries up to 90 m wide and 6 m deep; locally incised in bedrock.	Channels, no soil, banks, brownish loamy alluvial soil: Robinson family (21).	Fringing forests and woodlands, <i>Eucalyptus camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (42).	FRIP
2	5	Levee crests: up to 1 m high and less than 440 m wide; river banks dissected up to 6 m.	Clayey, micaceous alluvial soils: Fitzroy family (22).	Open grassy woodland with scattered or patchy shrubs, moderately dense, tall to medium-height grass layer and patches of short annual grasses. Forbs seasonal. <i>Corymbia bella</i> alliances (22a, 22b).	FRGP
3	16	Levee backslopes: up to 1% and 800 m long; hummocky, scalded surfaces.	Brownish juvenile cracking clays (16).	Similar to unit 2 but more open, grasses sparser, scalding common. Communities 22a, 22b; locally 20a.	FRGP
4	73	Plains: almost flat plains up to 24 km in extent with marginal slopes about 0-2%; sealed hummocky surfaces, and gilgais up to 1 m deep locally.	Dark self-mulching heavy clays: Cununurra family (12).	Grassland communities with scattered trees and shrubs. <i>Astrebla</i> spp. (47), <i>Chrysopogon</i> spp.- <i>Dichanthium fecundum</i> (48) and locally 20b.	MGAP 50% RAPP 50%
5	4	Minor channels and billabongs: channels to 180 m wide and 4.5 m deep, billabongs typically about 90 m wide and less than 800 m long.	Brownish, silty to heavy clays: billabong floor soils (30).	Open coolibah woodland fringing communities. <i>E. microtheca</i> alliance (20a, 20c).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

AMY LAND SYSTEM (Amy)

1417 km²

Source: WKY

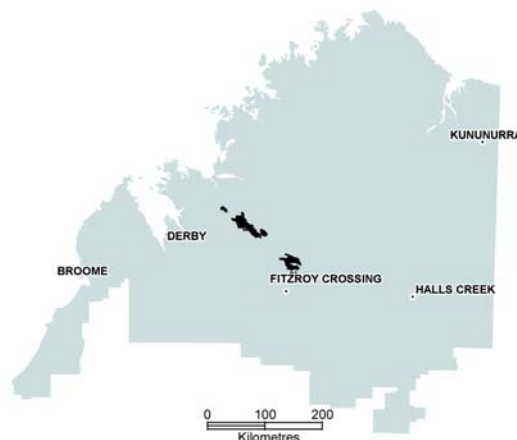
Granite domes with scattered spinifex and low trees, and intervening alluvial flats with open grassy woodlands.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

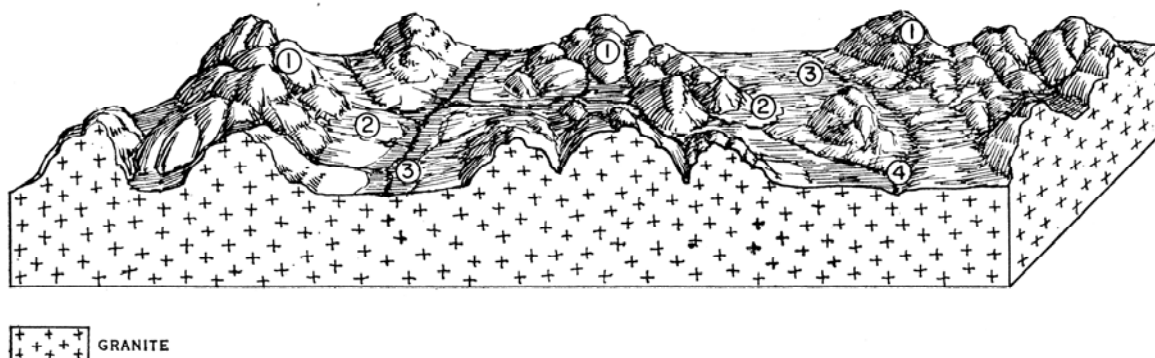
Geology: Lower Proterozoic or Archaeozoic granite.

Geomorphology: Mountain and hill ranges eroded below the Kimberley surface: strike belts up to 19 km wide, with granite domes and broad, alluvial drainage floors; moderately dense rectangular pattern of strike-controlled drainage; relief up to 150 m.

Land management: Granite domes (unit 1) are poorly accessible; lower slopes and alluvial drainage floors (units 2 and 3) with texture contrast (duplex) soils are highly susceptible to erosion if vegetative cover is depleted; controlled stocking essential on these units.



*The granite domes (unit 1) of Amy land system make an impressive sight.
Photo:
Tricia Handasyde,
DEC*



Stylised block diagram showing location of land units

AMY LAND SYSTEM (Amy) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	41	Domes: up to 150 m high; rounded crests, commonly with joint block cappings, and convex slopes up to 80%.	Rock outcrop with very limited pockets of sandy skeletal soils (24).	Much bare rock, vegetated only in cracks, crevices, and pockets of soil. Scattered trees and shrubs with tussocks of <i>Triodia bynoei</i> and other grasses. <i>Adansonia gregorii</i> alliance (32).	XXNP 60% CAHP 40%
2	16	Lower slopes: typically less than 2% and 400 m long; colluvial mantles and local outcrop.	Deep brown sands: Kalyeeda family (9).	Very open woodland with scattered tussocks of <i>Chrysopogon</i> spp. and <i>Triodia bitextura</i> . <i>Eucalyptus tectifica</i> and <i>E. argillacea</i> alliances (14b, 14c, 18); also 9b.	RGRP 75% CSPP 25%
3	37	Alluvial drainage floors: up to 1.6 km wide, gradients 1 in 100 to 1 in 500; scalded, sandy surfaces.	Mainly greyish to brownish sands and loams over tough domed clays; Jurgurra family (19). Some deep brown sands: Kalyeeda family (9).	Very open woodland with <i>Sehima nervosum</i> - <i>Sorghum</i> spp. and <i>Enneapogon</i> spp. ground storeys. <i>E. brevifolia</i> and <i>E. tectifica</i> alliances (1f, 14a); Also 36 and 49.	ASGP 40% RGRP 30% WGBP 30%
4	6	Channels: to 30 m wide and 4.5 m deep.	Bed-load deep coarse sand and gravel.	Fringing forests and woodlands, <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (41, 42); and 33 on smaller channels.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



Alluvial drainage floors between granite hills and domes of the Amy land system are vulnerable to preferential overgrazing and erosion.
Photo: DAFWA 1972

ANGALLARI LAND SYSTEM (Agl)

1552 km²

Source: OVC

Many small areas of timbered gently sloping alluvial plains with benched yellowish loamy or sandy soils scattered through the northern part of the Ord-Victoria survey area.

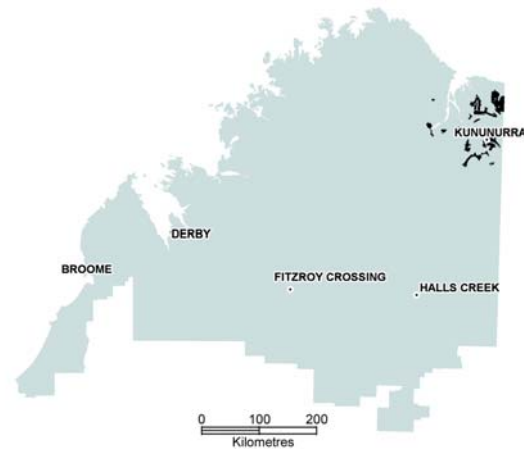
State land type: Alluvial plains with mixed woodlands/shrublands and mixed grasses.

Geology: Quaternary alluvia.

Geomorphology: Coarse-textured fluvial plains.

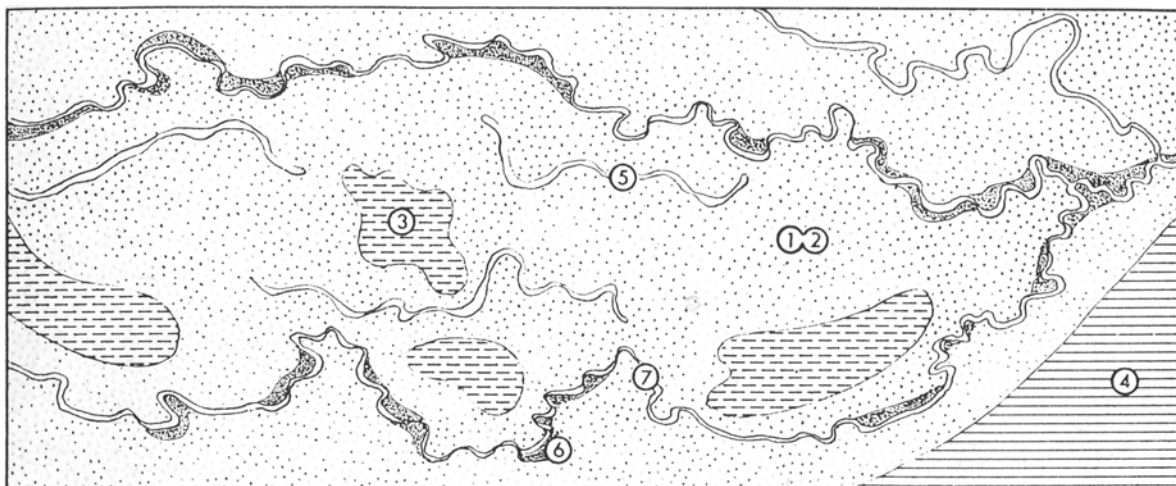
Drainage: Generally insequent channels of moderate intensity, some areas have intensive patterns of braided stream channels; the slight depressions are probably flooded for short periods each wet season.

Land management: Although fires may temporarily alter botanical composition and density of vegetation most of the system is not prone to degradation and has low susceptibility to erosion. Controlled stocking and fire management programs are desirable.



Alluvial plains and very gentle slopes of the Angallari land system with sandy loam soils supporting eucalypt woodlands and, in this case, boab trees (Adansonia gregorii), over annual sorghum (Sorghum stipoideum) and occasional perennial grasses. The distinctive spiral stem of snakevine (Tinospora smilacina) is winding up the small tree in the left foreground.

Photo : Noel Schoknecht, DAFWA



Stylised plan diagram showing arrangement of land units

ANGALLARI LAND SYSTEM (Agl) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	50	Very gentle slopes	Elliott and Batten grey sandy loam over mottled yellow clay.	Northern box-bloodwood woodland (<i>Eucalyptus tectifica</i> , <i>Corymbia foelscheana</i>) and silver-leaved box sparse low woodland (<i>E. pruinosa</i>) with Tippera tall grass (<i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>); paperbark low woodland (<i>Melaleuca</i> spp.) with upland tall grass (<i>Sorghum stipoideum</i> , <i>Triodia bitextura</i>).	TTGP 60% LCSP 40%
2	20	Gentle slopes	Cullen - deep sands with mottled yellow subsoil.	Northern box-bloodwood woodland (<i>C. grandifolia</i>) with upland tall grass (<i>Sorghum stipoideum</i>).	LCSP
3	10	Shallow depressions of the back plains	Marrakai - loam over mottled clay; Card - deep sandy light grey soil with rusty mottling.	Marrakai mid-height grass (<i>Eriachne</i> spp., <i>Themeda triandra</i>).	OTHP
4	10	Gentle slopes, generally at base of sandstone hills	Pago - deep yellow sands; and Chunuma - deep brown sands.	Frontage woodland (<i>Corymbia polycarpa</i> , <i>C. bella</i> , <i>E. apodophylla</i>) with upland tall grass (<i>Sorghum stipoideum</i> , <i>Aristida browniana</i>).	LCSP
5	3	Nearly flat or slight depressions, commonly associated with abandoned stream channels	Hooper - sand surface over tough clay subsoil.	Saline soil short grass (<i>Xerochloa imberbis</i>).	OTHP
6	3	Levees associated with active streams	Manbulloo and Katherine - brown sand or sandy loam over permeable reddish brown subsoil.	Frontage woodland (<i>C. bella</i> , <i>E. tectifica</i>) with Tippera tall grass (<i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Heteropogon contortus</i> , <i>Aristida hygrometrica</i>).	TTGP
7	4	Stream channels, 4.5-18 m wide, sinuous with steep banks		Fringing communities	FRIP

⁺ Pasture types described in Appendix 1.

ANNA LAND SYSTEM (Ann)

1037 km²

Source*: PRP, BRM

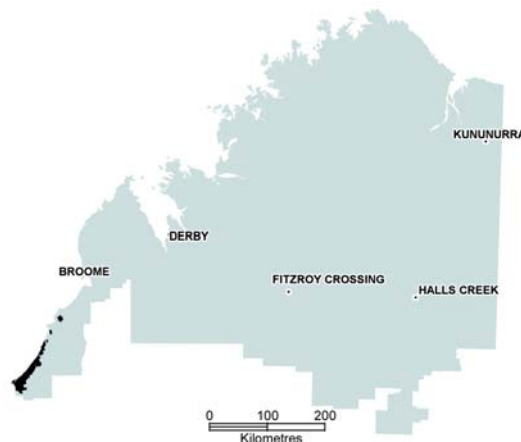
Paleo-tidal coastal plain with saline soils supporting tussock grasslands and minor halophytic low shrublands

State land type: Alluvial plains with tussock grasslands.

Geology: Quaternary supratidal littoral deposits and old alluvium; clay silt and sand.

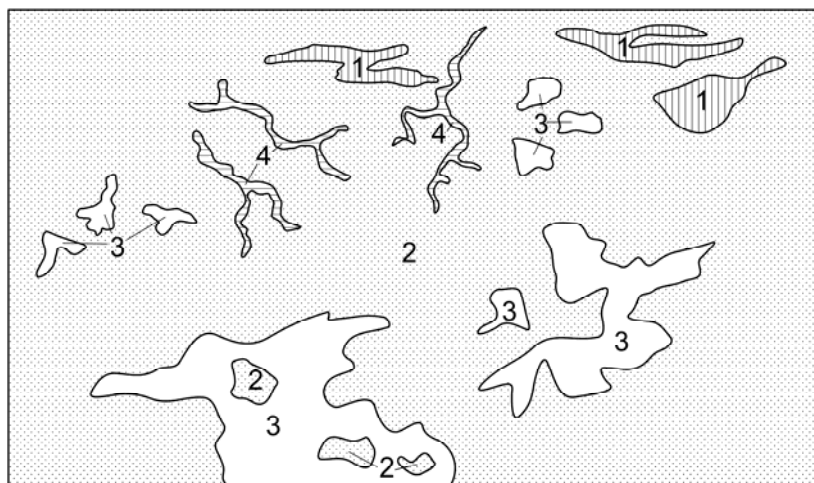
Geomorphology: Depositional surfaces; broad coastal supratidal plains on saline and calcareous littoral and alluvial deposits, minor sand sheets and sandy banks, a few narrow sluggish internal drainage depressions but no organised drainage features.

Land management: Grasslands of the system are highly preferred by grazing animals but are resilient under grazing unless grazing pressure is grossly excessive. Grassy halophytic shrublands are more prone to degradation and have slight susceptibility to wind erosion when degraded. The system is subject to inundation: waterlogging for prolonged periods can adversely affect vegetation and prevent access.



*Treeless coastal plains of the Anna land system supporting tussock grasslands frequently dominated by introduced buffel grass (*Cenchrus ciliaris*).*

Photo: DAFWA



Stylised plan diagram showing arrangement of land units

* This land system is described in the Pilbara Ranges Report (Van Vreeswyk et al. 2004) and the Broome Shire report (Cotching 2005). The descriptions differ, and the Pilbara Ranges Report description is presented here as it is more representative of the entire occurrence of this land system.

ANNA LAND SYSTEM (Ann) – land units

Unit	Approx. area (%)	Landforms	Soils ⁺	Vegetation	Pasture type ⁺
1	2	Sand sheets and banks: isolated level sand sheets to 1.5 km in extent or linear banks up to 600 m long by 100 m wide, raised to a few metres above adjacent plains (units 2 and 3).	Calcareous deep sands (442)	Tussock or hummock grasslands of <i>Cenchrus ciliaris</i> (buffel grass) or <i>Triodia pungens</i> (soft spinifex) with isolated to very scattered shrubs	CDBG 50% SSSG 50%
2	70	Coastal plains: level plains up to 10 km in extent or as smaller areas as a mosaic with saline plains (unit 3).	Grey deep loamy duplex (509), calcareous loamy earths (542), red deep sandy duplex (405) and some red/brown non-cracking clay (662).	Tussock grasslands of <i>Cenchrus ciliaris</i> or other grasses such as <i>Eulalia aurea</i> (silky brown top), <i>Chrysopogon fallax</i> (ribbon grass), <i>Eriachne benthamii</i> (swamp grass), <i>Eragrostis xerophila</i> (Roebourne Plains grass) and <i>Sporobolus virginicus</i> (salt water couch).	BUGP** 70% APXG 20% MACP*** 10%
3	26	Saline plains: level plains up to 5–6 km in extent but also as much smaller mosaics within coastal plains (unit 2).	Calcareous loamy earths (542).	Scattered low shrublands of <i>Tecticornia</i> spp. (samphire), <i>Frankenia</i> sp. (frankenian) and occasional taller shrubs of <i>Melaleuca lasiandra</i> and patchy grasses including <i>Sporobolus virginicus</i> . Also patchy tussock grasslands with <i>S. virginicus</i> , <i>Eragrostis falcata</i> (sickle lovegrass) and <i>Cenchrus ciliaris</i> .	SMPP**** 70% MACP*** 10% APXG 10% BUGP** 10%
4	2	Drainage lines: sinuous poorly defined internal drainage lines and depressions, mostly < 100 m wide, no sharp incision.	Grey deep loamy duplex (509) soils and some grey non-cracking clays (621).	Mixed grasslands with <i>Sporobolus virginicus</i> , <i>Eriachne benthamii</i> , <i>Eulalia aurea</i> or grassy low shrublands with <i>Tecticornia</i> and <i>Frankenia</i> spp.	SMPP**** 50% APXG 30% MACP*** 10% BUGP** 10%

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

** BUGP is equivalent to APBG in the Pilbara report (Van Vreeswyk et al. 2004).

*** MACP is equivalent to SPSP in the Pilbara report (Van Vreeswyk et al. 2004).

****SMPP is equivalent to PPS in the Pilbara report (Van Vreeswyk et al. 2004).

ANTRIM LAND SYSTEM (Ant)

4541 km²

Source: OVC

Hilly country associated with intermediate and basic igneous rocks, spread widely throughout the southern half of the Ord-Victoria survey area.

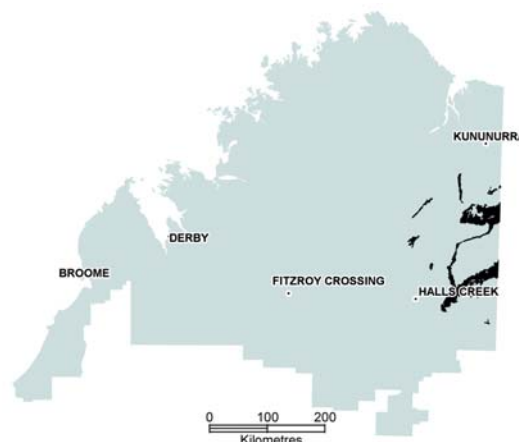
State land type: Hills and lowlands with eucalypt woodlands and tussock grasses.

Geology: Basalt, agglomerate, and tuff; Lower Cambrian (Antrium Plateau Volcanics). Some Carpentarian dolerite.

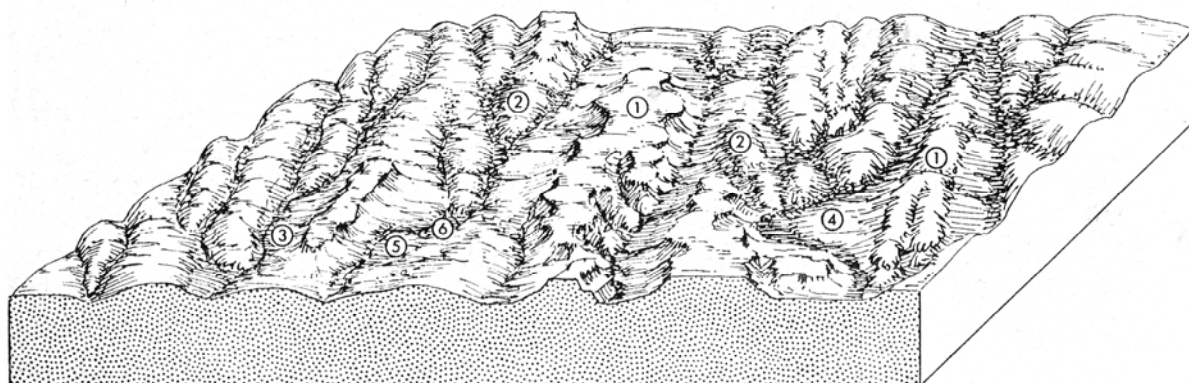
Geomorphology: Volcanic mesas and buttes, and volcanic structural benches; minor ancient igneous masses.

Drainage: Fairly intense angular or rectangular drainage patterns.

Land management: Much of the system is stony and not susceptible to erosion. Minor units 4 & 5 which support pastures attractive to cattle are prone to preferential over-grazing and degradation if grazing is uncontrolled.



*Basaltic uplands of the Antrim land system support tussock grasses as in this photograph, or hard spinifex.
Photo: Noel Schoknecht, DAFWA*



Stylised block diagram showing location of land units

ANTRIM LAND SYSTEM (Ant) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	50	Mesas and buttes with steeply sloping margins	Mostly rock outcrops with basalt boulders and pockets of red clayey soils.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i>) with arid short grass (<i>Enneapogon</i> spp.) or upland tall grass (<i>Sorghum stipoides</i>); snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with hard spinifex (<i>Triodia wiseana</i> , <i>T. inutulis</i> , <i>T. intermedia</i>) or arid short grass (<i>Enneapogon</i> spp.).	ASHP 40% HSHP 40% ASGP 20%
2	40	Crests and slopes of rounded hills		As for unit 1. Also tussock grasses such as <i>Sehima nervosum</i> .	HSHP 50% WGBP 30% ASGP 20%
3	5	Moderate to gentle slopes	Frayne - brown loam merging into dark red clay, generally stony on surface.	Bloodwood-southern box sparse low woodland (<i>C. opaca</i> , <i>E. limitaris</i> , <i>E. tephrodes</i>), silver-leaved box sparse low woodland (<i>E. pruinosa</i>), or snappy gum sparse low woodland (<i>E. brevifolia</i>), all with arid short grass (<i>Enneapogon</i> spp.).	ASGP
4	2	Gentle lower slopes and flat areas	Cununurra, Argyle, Barkly - grey and brown cracking heavy clays.	Mitchell and other mid-height grasses (<i>Astrelia pectinata</i> , <i>Aristida latifolia</i>).	MGUP
5	2	Flats bordering drainage lines	Variable light to medium textured alluvial soils.	Frontage woodland (<i>C. opaca</i> , <i>C. bella</i>) with arid short grass (<i>Enneapogon</i> spp.) or frontage tall grasses.	ASGP 50% FRGP 50%
6	1	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1



*Stony and bouldery slopes characteristic of units 2 and 3 in Antrim land system.
Photo: Noel Schoknecht, DAFWA*

ARGYLE LAND SYSTEM (Arg)

836 km²

Source: OVC

Several medium and small areas of gently undulating 'black soil' plain in the north-central part of the Ord-Victoria survey area.

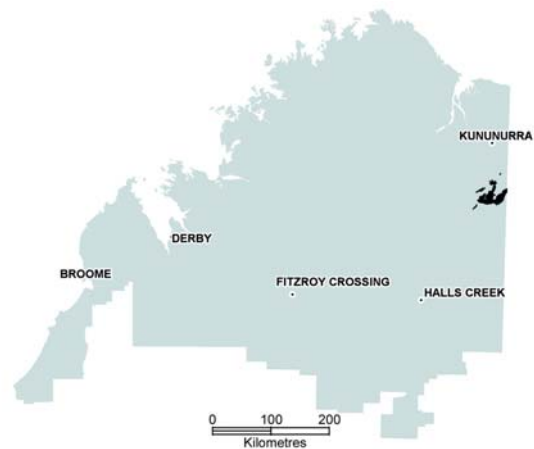
State land type: Alluvial plains with tussock grasslands.

Geology: Calcareous, dolomitic, and shale sediments of Middle Cambrian and Adelaidean age.

Geomorphology: Coastal erosional plains.

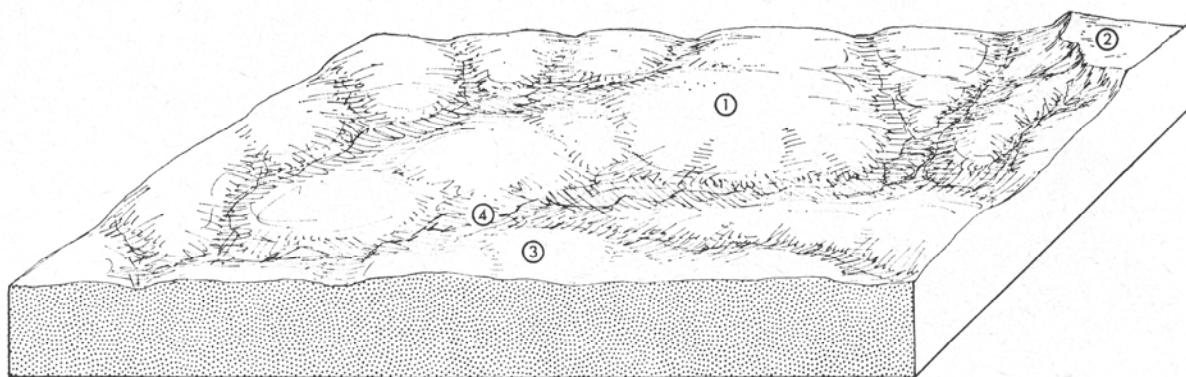
Geomorphology: Widely spaced dendritic stream pattern; the lower slopes near drain lines may be waterlogged or flooded for short periods after heavy rain.

Land management: The system supports valuable pastures which are highly attractive to cattle; although relatively resilient under grazing the pastures need controlled stocking to prevent degradation. Lack of slope and heavy soils means the system is not generally susceptible to erosion.



A significant area of the Argyle land system was permanently inundated by Lake Argyle when the the Ord River dam was built in 1971.

Photo: DAFWA



Stylised block diagram showing location of land units

ARGYLE LAND SYSTEM (Arg) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	80	Very gentle slopes	Argyle, Cununurra - brown and grey cracking clays.	Mitchell and other mid-height grasses (<i>Astrebla pectinata</i> , <i>Aristida latifolia</i>).	MGAP
2	10	Low limestone rises	Limestone outcrops, with pockets of shallow loamy soil.	Deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Bauhinia cunninghamii</i> , <i>Cochlospermum fraseri</i>) with upland tall grass (<i>Sorghum stipoides</i>), hard spinifex (<i>Triodia</i> sp.), or arid short grass (<i>Enneapogon</i> spp.).	ASHP 40% HSHP 40% ASGP 20%
3	8	Gentle slopes	Negri - brown calcareous loamy soils on soft shales.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i>) with arid short grass (<i>Enneapogon</i> spp.).	ASGP
4	2	Streamlines		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



The very gentle slopes of Argyle land system at the southern end of Lake Argyle have brown and grey cracking clays and are highly valued for grazing but may be seasonally inundated by the lake waters.

Photo: ccferg (Flickr.com)

BANNERMAN LAND SYSTEM (Bnm)

54 km²

Source: UNP*

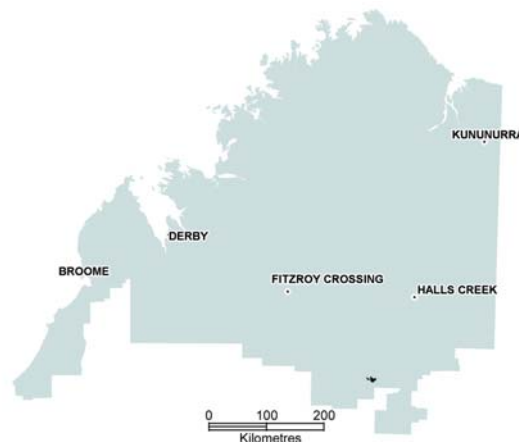
Alluvial plains and flood out areas with occasional dunes supporting shrubby grasslands and soft spinifex grasslands.

State land type: Alluvial plains with tussock grasslands.

Geology: Quaternary alluvium and aeolian sand.

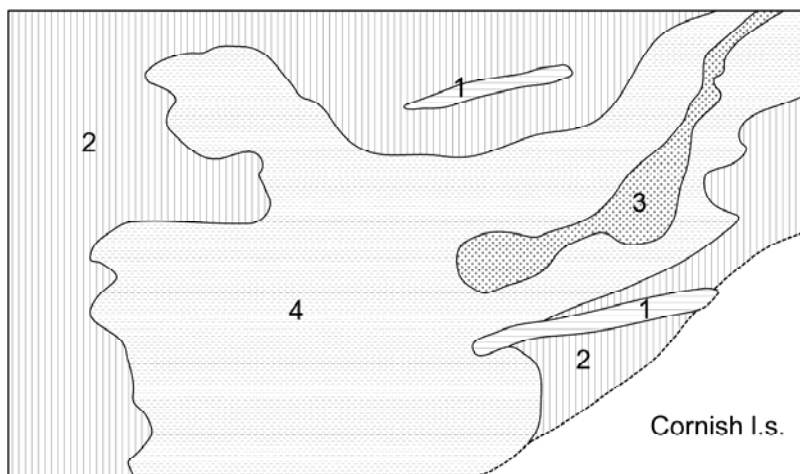
Geomorphology: Depositional surfaces subject to seasonal inundation and slightly more elevated sandplain not subject to flooding.

Land management: Recently burnt dunes and sand plain areas (units 1 & 2) have minor susceptibility to wind erosion but stabilise rapidly after rain. Alluvial plains (unit 4) support grass pastures which are moderately attractive to cattle. Controlled grazing and fire management programs desirable.



Alluvial plains (unit 4) of the Bannerman land system showing banded or groved patterns of vegetation arranged approximately at right angles to sheet flow. Width of this image is about 4.5 km

Image: Google Earth



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described (without land units) in *Carranya Station Rangeland Condition Report* (2005) DAWA, unpublished.

BANNERMAN LAND SYSTEM (Bnm) – land units

Unit	Approx. area (%)	Landforms	Soils [*]	Vegetation	Pasture type ⁺
1	2	Linear dunes	Red deep sands (445).	Hummock grasslands of <i>Triodia pungens</i> .	SSPP
2	35	Sandplains	Red deep sands (445).	Hummock grasslands of <i>Triodia pungens</i> .	SSPP
3	5	Swampy depressions, drainage foci and occasional channels	Sandy duplexes (400) and non-cracking clays (620).	Grassy eucalypt woodlands.	RGRP
4	58	Alluvial plains: level plains subject to inundation	Sandy earths (460) and sandy duplexes (400).	Grasslands of <i>Chrysopogon fallax</i> and <i>Triodia pungens</i> .	RGRP 80% SSPP 20%

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

BARRY LAND SYSTEM (Bar)

4893 km²

Source: OVC

Two medium-sized areas, in the south-east and south-west corners of the Ord-Victoria survey area, of gently undulating red soil 'desert' with shrub vegetation.

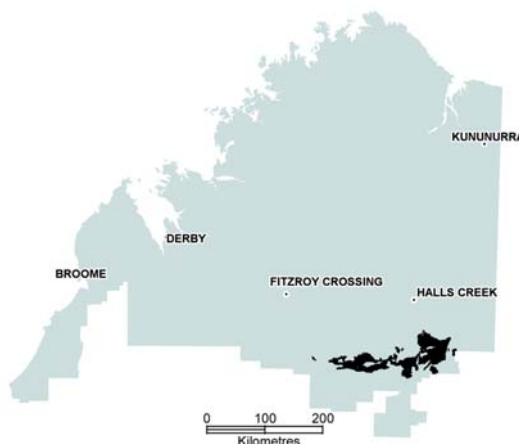
State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Tertiary laterite and associated soils, over Adelaidean dolomitic rocks.

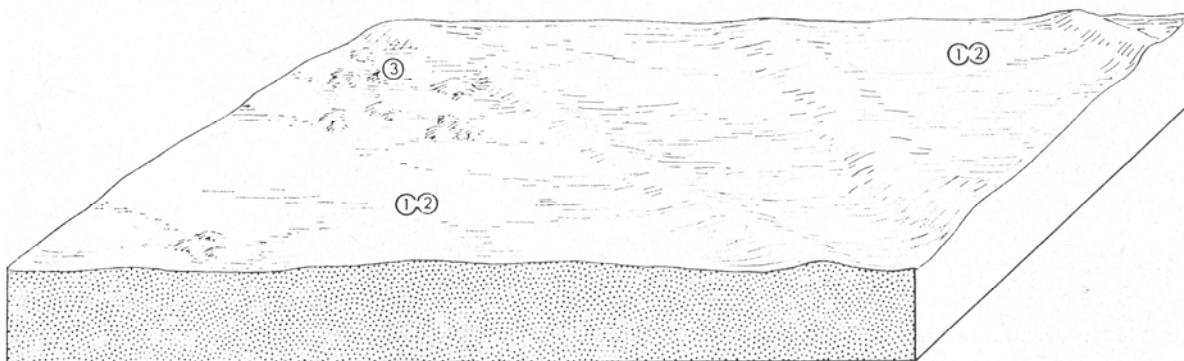
Geomorphology: Elevated non-lateritic plain (red earth and yellow earth soils).

Drainage: No surface drainage.

Land management: Supports soft spinifex pastures which are moderately attractive to cattle for a few years following fire. Not prone to erosion; control of grazing pressure and frequency of burning is desirable.



*This mature stand of soft spinifex on very gentle slopes of the Barry land system has not been burnt for some years. It is of low pastoral value.
Photo: DAFWA*



Stylised block diagram showing location of land units

BARRY LAND SYSTEM (Bar) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type+
1	70	Very gentle slopes with some poorly defined low WNW-ESE dunes	Camil-brown sandy loam merging into dark red clay, sandier on low dunes.	Desert shrubland with soft spinifex (<i>Triodia pungens</i>).	SSPP
2	20	Very gentle slopes	Argada-grey sandy loam merging into hard mottled yellow clay.	Desert sparse low woodland (<i>Eucalyptus microtheca</i>) with soft spinifex (<i>Triodia pungens</i>).	SSPP
3	10	Outcrops on gentle slopes	Limestone outcrops and shallow soils.	Bloodwood - southern box sparse low woodland (<i>Corymbia opaca</i>) with arid short grass (<i>Enneapogon</i> spp.).	ASGP

+ Pasture types described in Appendix 1



A view from the rim of Wolfe Creek Crater looking north-west over Barry land system. A low dune, a minor component of unit 1, is in the mid-ground. The green treed band in the mid-background is the crater's namesake, Wolfe Creek (Wolfe land system).

Photo: Andre du Plessis (Panoramio.com)

BARTON LAND SYSTEM (Bat)

4414 km²

Source: NKY

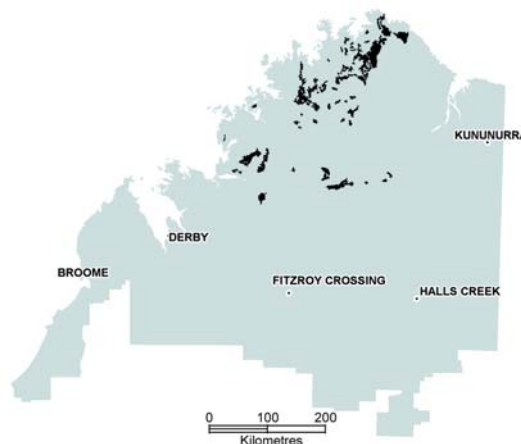
Gently undulating volcanic country with grassy woodland vegetation and shallow or leached soils.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology and geomorphology: Part of the erosional plains on volcanic rocks, mostly on Mornington volcanics, with some small areas on Hart basalt and younger volcanics in the south-east.

Drainage: Flooding during the wet season restricted to narrow river flats. Subrectangular drainage of sparse intensity.

Land management: The system provides useful grazing for cattle and is stable under controlled stocking. It mostly has low susceptibility to erosion.



Eucalypt woodlands with mixed tussock grasses on igneous red earths are characteristic on plains of the Barton land system.

Photo: DAFWA 1997



Stylised block diagram showing location of land units

BARTON LAND SYSTEM (Bat) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type+
1	80	Gentle slopes	Mostly igneous red earths and skeletal red earths; smaller areas of fine-textured yellow podzolics.	Woodlands: <i>Eucalyptus tectifica</i> , <i>Corymbia grandifolia</i> (1, 2, 10, 13, 14, 15) alliance.	WGBP 50% PLSP 25% TTGP 25%
2	6	Low rocky hills and medium slopes	Predominantly skeletal red earths with some igneous red earths.	Woodlands: <i>E. tectifica</i> , <i>C. grandifolia</i> alliance (1, 2, 8).	ASHP 80% PLSP 20%
3	2	Shallow depressions	Grey soils of heavy texture.	Grassland with variable small trees: <i>Terminalia</i> sp., <i>Dichanthium fecundum</i> alliance (69 , 70).	BGAP
4	6	Flats	Mixed lateritic podzolics and coarse and fine-textured yellow podzolics.	Woodlands: <i>E. latifolia</i> alliance (48 , 49 , 50, 51).	WGBP
5	6	Streamlines and levee	Mostly red levee soils but with some igneous red earths.	Fringing community and woodlands: <i>Terminalia</i> , <i>Ficus</i> . and <i>Melaleuca</i> spp. community; <i>C. bella</i> (53, 54, 55, 56, 57) and <i>E. tectifica</i> , <i>C. grandifolia</i> (1, 3) alliances and <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. (75) community.	FRIP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



Annual sorghum (Sorghum spp.) on the slopes of Barton land system buffeted by an approaching wet season storm. Photo: Peter Ewing

BETTY LAND SYSTEM (Bet)

566 km²

Source: UNP*

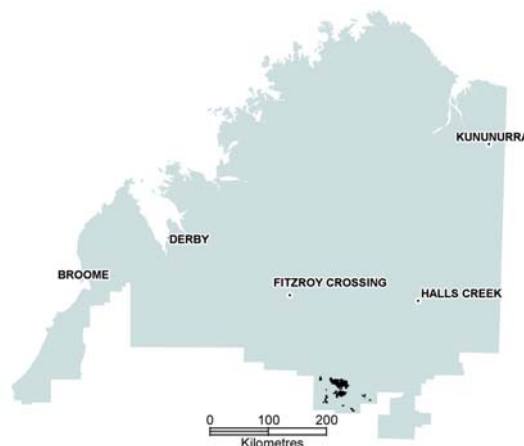
Lakes (mostly bare) with fringing alluvial plains, gravelly plains, occasional low stony ridges and breakaways and minor dunes. Patchy hummock grasslands and halophytic shrublands.

State land type: Salt lakes and fringing alluvial plains with halophytic shrublands or grasslands.

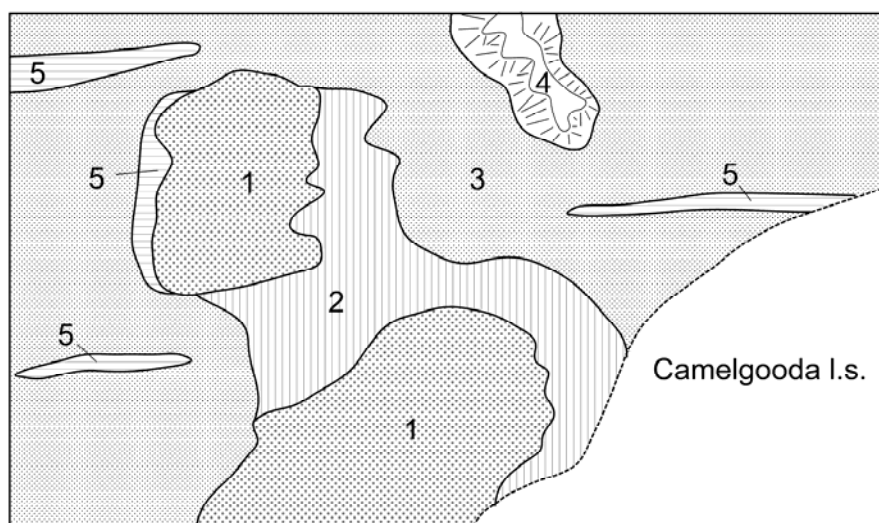
Geology: Quaternary alluvium and aeolian sand, Tertiary ferricrete and Triassic shale and siltstone.

Geomorphology: Lake beds subject to regular inundation, fringing alluvial plains subject to less regular flooding, slightly elevated gravelly plains and minor stony ridges and dunes.

Land management: An isolated system not likely to be under much grazing pressure. Alluvial plains (unit 2) likely to be susceptible to erosion if vegetative cover lost. Land system poorly known but may be an important wetland refuge area.



Betty land system showing lake bed, mostly unvegetated, and fringing sandy lunettes supporting recently burnt spinifex. Photo: Dave Hadden, DAFWA



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in *Madigan Station Rangeland Condition Assessment* (2004) DAWA, unpublished.

BETTY LAND SYSTEM (Bet) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	25	Lake beds	Salt lake soil (102).	Mostly unvegetated.	XXNP
2	20	Fringing alluvial plains	Saline wet soils (101) and sandy duplexes (400).	Shrubby tussock grasslands and (?) chenopod shrublands.	RGRP 70% OTHP 30%
3	40	Gravelly plains with surface mantles of shaly fragments	Shallow red and brown sandy or loamy duplexes (406, 408, 507, 508).	Mixed hummock and tussock grasslands.	HSPP 60% SSPP 20% RGRP 20%
4	10	Low stony ridges and breakaways with lateritic gravel	Stony and gravelly soils (203, 300).	Hard and soft spinifex hummock grasslands.	HSPP 80% SSPP 20%
5	5	Dunes and lunettes	Red deep sands (445).	Soft spinifex hummock grasslands.	SSPP

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

+ Pasture types described in Appendix 1.



Satellite image clearly showing highly reflective bare lake bed (unit 1) and fringing alluvial plains to south and east of the lake. The sandplain to the west of the lake is in Billiluna land system, and the parallel dunes to the north-east are part of Cornish land system. Width of image is about 5.5 km. Image Google Earth 2011.

BILLILUNA LAND SYSTEM (BII)

180 km²

Source: UNP*

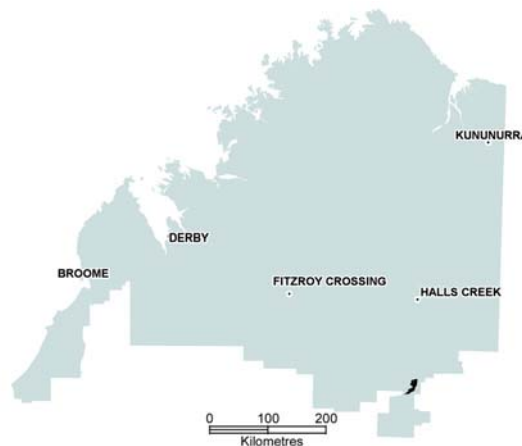
Gently undulating red sandplains supporting mainly open eucalypt and acacia shrubland with soft spinifex

State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Quaternary aeolian quartzose sand, minor Tertiary calcrete, silcrete and ferricrete and minor Triassic shale and siltstone.

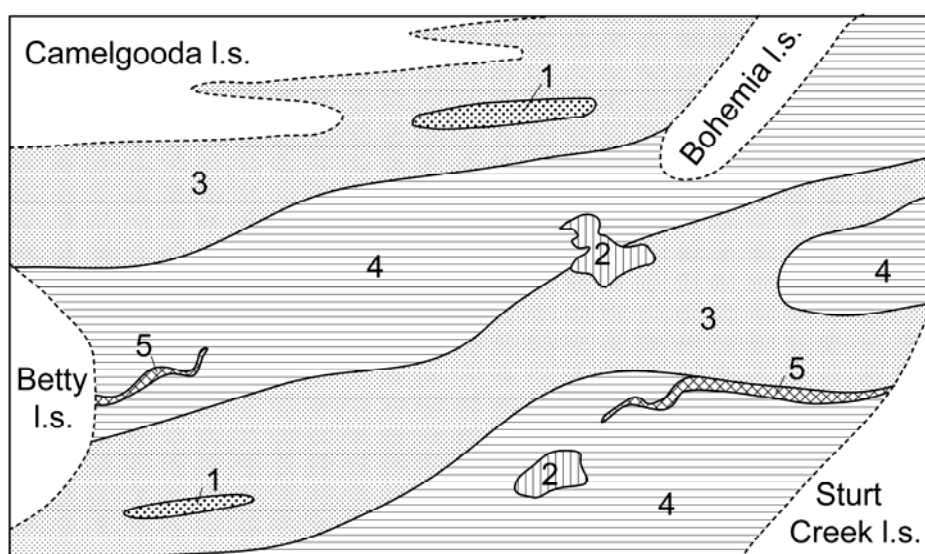
Geomorphology: Very gently undulating sandplain with little organised drainage, minor stony plains and occasional dunes.

Land management: Subject to limited grazing and fairly regular burning; generally resilient and stable.



*Red sandy plains of the Billiluna land system supporting soft spinifex (*Triodia pungens*) and other grasses with small gum trees.*

Photo: Francis Yan Leung (Panoramio.com)



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in *Billiluna Resource Survey Report* (1993) DAWA, unpublished.

BILLILUNA LAND SYSTEM (BII) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	2	Linear dunes	Red deep sands (445).	Probably hummock grasslands of <i>Triodia pungens</i> .	SSPP
2	3	Stony plains	Stony soils (203).	Hard spinifex grasslands.	HSPP
3	46	Gently or very gently sloping sandy low rises and broad crests	Red sandy earths (463). Red deep sands (445).	Open shrublands of <i>Acacia stipuligera</i> , <i>A. cowleana</i> , <i>A. hilliiana</i> , <i>Hakea suberea</i> , <i>Grevillea wickhamii</i> , and <i>Corymbia greeniana</i> with understorey of <i>Triodia pungens</i> .	SSPP
4	48	Near level flats between rises	Red lateritic loamy sands.	As for unit 3.	SSPP
5	1	Drainage tracts, mostly unchannelled	Variable. Probably sandy duplexes (400).	Probably tussock grasslands of <i>Chrysopogon fallax</i> and hummock grasslands of <i>Triodia pungens</i> .	RGRP

+ Pasture types described in Appendix 1.

- Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).



The red colour of the dominant sandy soils in Billiluna land system is reflected in the termite mounds.

Photo:
Michael Keller
(alias Kellony,
Panoramio.com)

BOHEMIA LAND SYSTEM (Boh)

2975 km²

Source: WKY

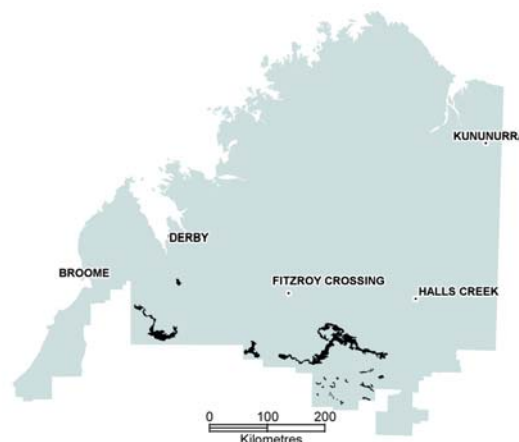
Lateritic plateaux and hilly sandstone country with sandy and gravelly soils, spinifex with scattered trees and shrubs.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Laterised or relatively unweathered subhorizontal or gently dipping sandstone, conglomerate, tillite, and shale of Permian and Jurassic age.

Geomorphology: Formed by dissection of the Kimberley surface - hill lands: strike tracts up to 19 km wide, with intact and stripped summit remnants, rocky plateaux and hillslopes, dissected hill-footslopes, and restricted valley floors; dense branching pattern of incised valleys with strike-controlled, through-going trunk drainage; relief up to 150 m.

Land management: Most units stable except valley floor slopes and drainage floors (units 6 & 7) which are susceptible to degradation and erosion if vegetation is removed by preferential overgrazing or other disturbance.

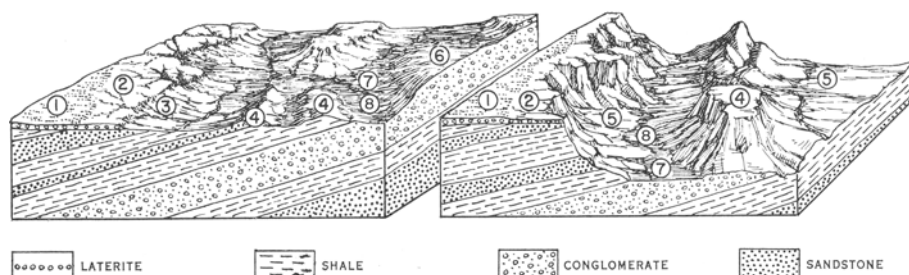


Highly dissected country of the Bohemia land system cutting into the sandy plains and dunes of the Camelgooda land system to the south. Width of this 2007 aerial photograph is about 5.5 km.
Photo: Landgate



Aerial oblique photograph showing the summit remnants, breakaways, slopes below breakaways and valley floors.

Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)



Stylised block diagram showing location of land units

Unit 8, missing from original, has been added

BOHEMIA LAND SYSTEM (Boh) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	9	Summit remnants: up to 800 m wide; pebble-strewn sandy slopes, less than 1%.	Red sands of variable depth on laterite: Cockatoo family (7).	Spinifex grassland and very open woodland. <i>Triodia intermedia</i> community (57) and <i>Eucalyptus brevifolia</i> alliance (1a, 2).	HSPP
2	17	Stripped surfaces and marginal breakaways: up to 1.6 km wide, stony slopes up to 5%, with frequent laterite exposures and with marginal breakaways up to 6 m high.	Laterite and pallid-zone remnants, some outcrops of bedrock and some deep red sands: Cockatoo family (7).	As for unit 1.	HSHP
3	7	Slopes below breakaways: concave, up to 5% and up to 800 m long; dissected up to 6 m into narrow rounded spurs with marginal slopes attaining 10%; colluvial mantles.	Much outcrop with some shallow reddish sands high in laterite fragments: Yabbagoddy family (1).	Much bare ground. Low open woodland with <i>Triodia intermedia</i> . <i>E. brevifolia</i> alliance (1a, 2); locally 1c.	HSHP
4	28	Rocky plateaux and hills: flat or gently sloping plateaux to 150 m high, with steep escarpments; hills to 90 m high with slopes up to 70%, and basal scree slopes up to 45%.	Much sandstone outcrop with some reddish gravelly skeletal soils (24).	Open spinifex with scattered stunted trees, much bare rock. <i>Triodia intermedia</i> community (57).	HSHP
5	17	Hill-footslopes: concave up to 10% and up to 1.6 km long; dissected up to 9 m into narrow spurs with marginal slopes up to 60%; colluvial mantles.	Much outcrop with some yellowish stony skeletal soils (24).	As for unit 4.	HSHP
6	8	Valley floor slopes: mainly less than 2% and up to 1.6 km long; dissected up to 3 m with local slopes to 10%; sealed, scalded surfaces.	Probably brownish stony sands and loams over red clay: Moonah family (17).	Mixed open grassy woodland communities (1f, 38c, locally 15).	ASGP
7	3	Drainage floors: up to 400 m wide, gradients 1 in 100 to 1 in 500.	Brownish loamy alluvial soil: Robinson family (21)	Low woodland with <i>Triodia bitextura</i> . <i>Bauhinia cunninghamii</i> alliance (38a).	SSPP
8	11	Channels: up to 30 m wide and 4.5 m deep, gradients ranging from 1 to 30 in hillslope channels to 1 in 500 in main channels.	Bed-loads mainly sand and pebbles.	Fringing communities (40, 41).	FRIP 60% FRGP 40%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

BUCHANAN LAND SYSTEM (Bch)

1057 km²

Source: OVC

Gently undulating sandy country in the central-western part of the Ord-Victoria survey area.

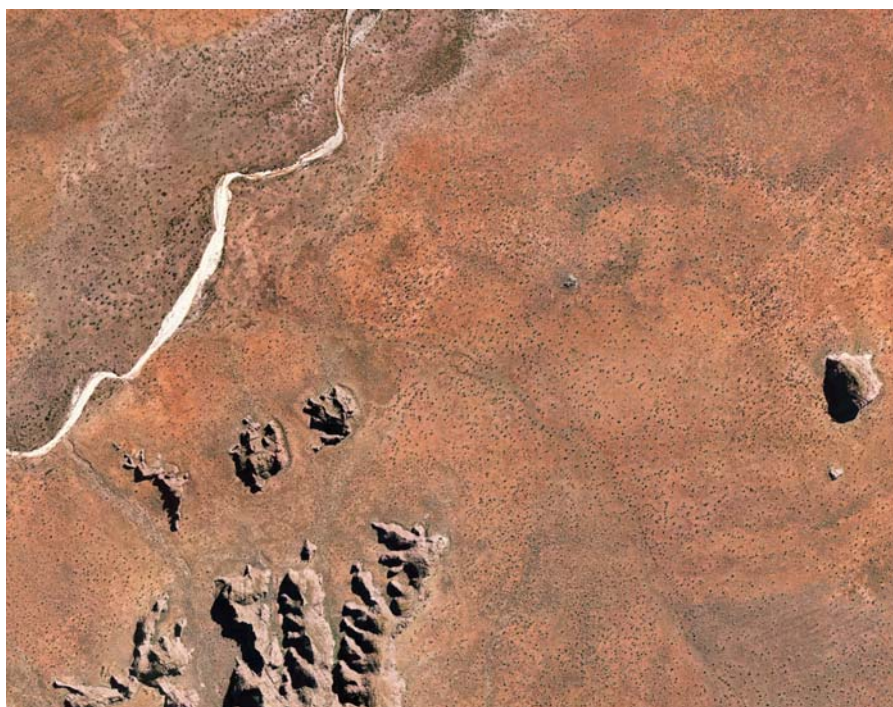
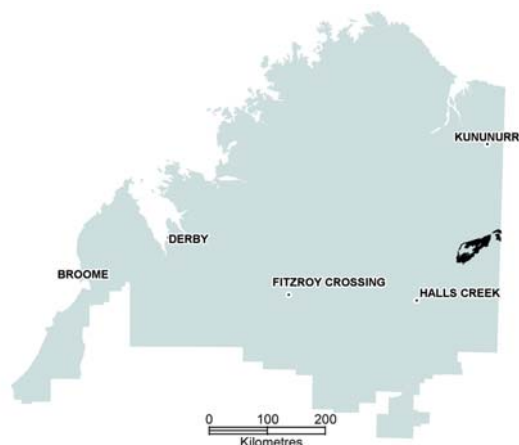
State land type: Sandplains with eucalypt woodlands and spinifex/tussock grasses.

Geology: Sandstone. Middle Cambrian (Elder Sandstone).

Geomorphology: Sandstone structural bench (asymmetric basin) and sandstone-shale cuestas (asymmetric basin).

Drainage: Sparse.

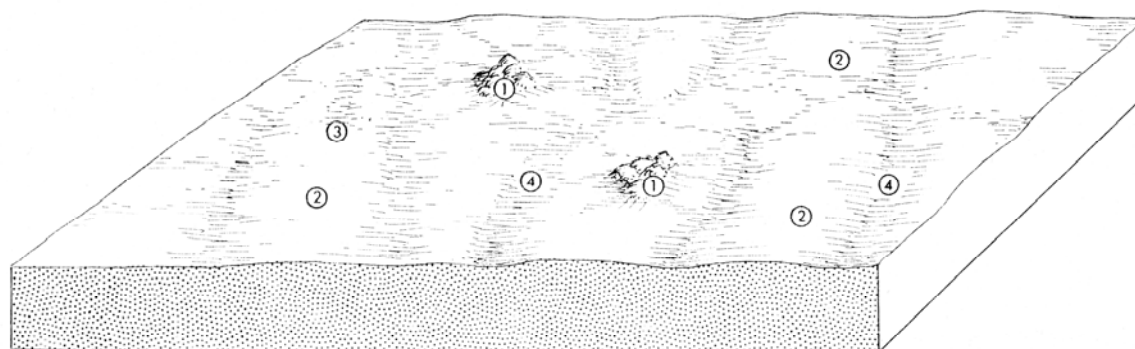
Land management: System is in the Ord River Regeneration Project area and Purnululu National Park. Well vegetated, ungrazed by livestock and stable. Fire management important.



The Buchanan land system consists of gently undulating sandy plains with isolated low sandstone hills. The large hills in the south of the picture are part of the Bungle Bungles (Elder land system).

The width of this 2004 aerial photograph is about 6 km.

Photo: Landgate



Stylised block diagram showing location of land units

BUCHANAN LAND SYSTEM (Bch) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	10	Very bouldery low hills	Sandstone boulders with pockets of sandy soil.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with soft spinifex (<i>Triodia pungens</i>), or silver-leaved box sparse low woodland (<i>E. pruinosa</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	SSPP 50% TAPP 50%
2	70	Gentle slopes and crests of gently undulating landscape	Cockatoo - deep red sand; minor Pago - deep yellow sand.	Silver-leaved box sparse low woodland (<i>E. pruinosa</i> , <i>Corymbia grandifolia</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	TAPP
3	10	Small isolated areas in gently undulating landscape	Tippera - brown sandy loam merging into dark clay.	Bloodwood-southern box sparse low woodland (<i>C. opaca</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	TAPP
4	10	Shallow linear drainage floors, in some cases with shallow sandy stream channels	Pago-deep yellow sand; some Cullen - greyish sand merging into mottled yellow sand.	Silver-leaved box sparse low woodland (<i>E. pruinosa</i> , <i>C. grandifolia</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	TAPP

+ Pasture types described in Appendix 1.



The contrast between the gently undulating plains of Buchanan land system and the “beehive-shaped” sandstone hills of the Bungle Bungles (Elder land system) provides numerous photo opportunities for tourists.
Photo: Steve Markham Photos (alias S & S Markham, Panoramio.com)

BULDIVA LAND SYSTEM (Bul)*

45,841 km²

Source: NKY

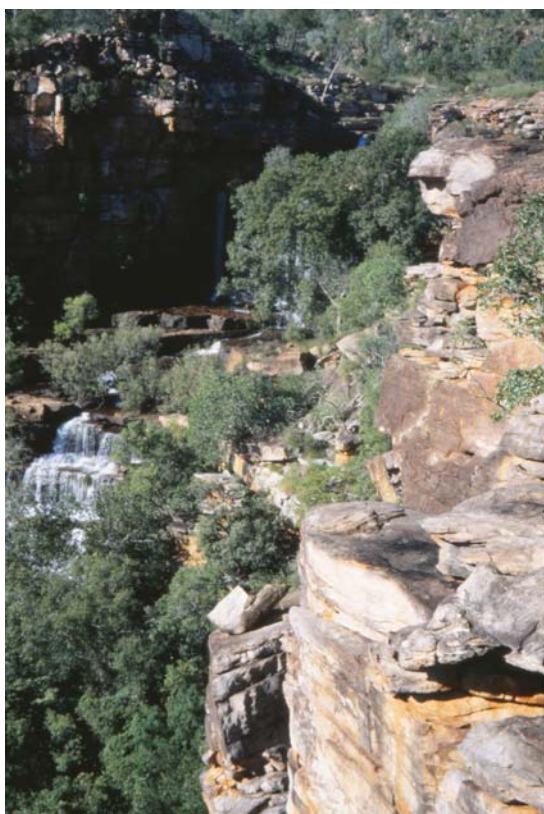
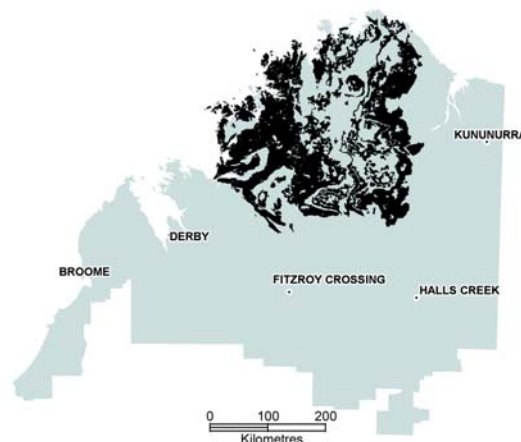
Rugged sandstone country with open forest vegetation on sandy soils with rock outcrops.

State land type: Hills, ranges and plateaux with eucalypt woodlands and tall grasses.

Geology and geomorphology: The more rugged parts of maturely dissected sandstone plateaux and of the cuestas and structural plateaux; King Leopold, Warton, and Mt House beds and Walsh tillite.

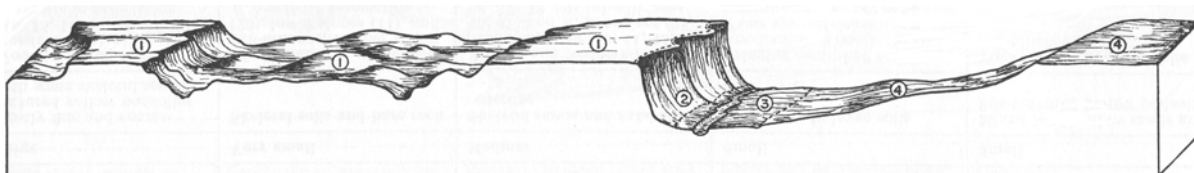
Drainage: Angular; moderate. No flooded areas during the wet season.

Land management: Very rugged system, mostly unsuitable for pastoralism, high scenic amenity and conservation value.



*Above: Plateau tops and slopes of the rugged Buldiva land system have dense rocky pavements of sandstone with pockets of shallow soils.
Photo: DAFWA 1973*

*Left: The rugged sandstone ranges of Buldiva land system host some of the Kimberley's most spectacular scenery.
Photo: Noel Schoknecht, DAFWA*



Stylised block diagram showing location of land units

* Buldiva land system is essentially equivalent to Precipice (WKY), Pinkerton (OVC) and Wickham (OVC) land systems. The different names are a result of surveys being undertaken at different times combined with rainfall differences which are reflected in the vegetation.

BULDIVA LAND SYSTEM (Bul) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	80	Rugged, very steep slopes, much bare rock	Skeletal sands, much bare rock.	Forests and woodlands: <i>Eucalyptus tetrodonta</i> - <i>Corymbia opaca</i> alliance (37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 73).	ASHP 50% CAHP 50%
2	5	Steep-sided gorges and scarps	Skeletal soils and bare rock.	Woodlands: <i>Brachychiton</i> spp.- <i>Terminalia</i> spp. - <i>C. confertiflora</i> community (73).	ASHP
3	5	Streamlines and seepage areas	Sandy levee soils with patches of deep light grey sands.	Fringing community and woodland: <i>C. bella</i> (53) and <i>C. polycarpa</i> - <i>E. apodophylla</i> (61, 62, 63, 64, 66, 67, 68, 69, 71) alliances; and <i>C. grandifolia</i> sub-alliance and <i>E. camaldulensis</i> - <i>Melaleuca</i> spp. (75) community.	TAPP
4	10	Stepped moderate slopes and flat tops	Mostly deep yellow sands, smaller areas of medium red sands.	Forest: <i>E. tetrodonta</i> - <i>C. opaca</i> alliance (24, 25, 26, 30, 34, 35, 36, 37, 38, 39, 40).	CAHP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



The coastline of the North Kimberley has a profusion of rocky headlands, inlets and islands. On Bigge Island the massive sandstone of Buldiva land system meets the turquoise waters of the Timor Sea. The large tidal range is evident on the rocks. Photo: Axel Schmidt (alias Axelino, Panoramio.com)

BULKA LAND SYSTEM (Buk)

907 km² Source: WKC, BRM

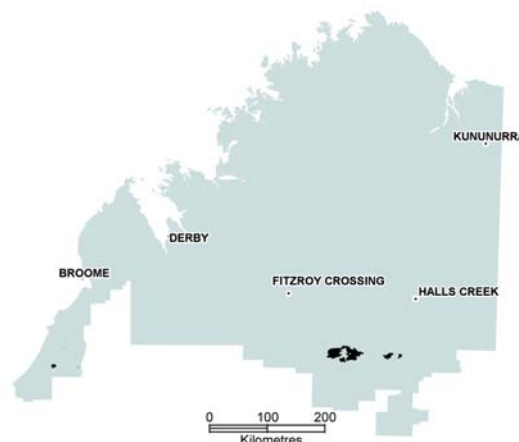
Gently undulating plains with occasional low scattered hills supporting lobed spinifex grassland.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Mudstone, siltstone and minor sandstone of Upper Proterozoic or Mesozoic age, laterite and minor Quaternary aeolian sand deposits.

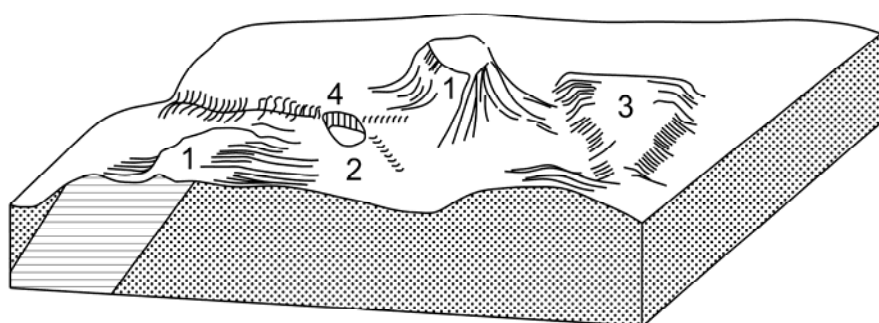
Geomorphology: Plains and low residuals formed by erosion of the Kimberley surface; flat-topped mesas with laterite ring plains.

Land management: Little used system, vegetation unattractive to livestock, stable, very low susceptibility to erosion; controlled burning may be desirable.



Gently undulating plains (unit 2) of the Bulka land system show lines of parent rock material beneath shallow soils. Vegetation is mostly lobed (hard) spinifex (Triodia intermedia) grasslands. Width of this 2004 aerial photograph is about 4 km. Photo: Landgate

- Sandstone
- Siltstone



Stylised block diagram showing location of land units

BULKA LAND SYSTEM (Buk) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	10	Hills and low rises: up to 15 m high; flat or gently sloping rocky crests up to 0.8 km wide.	Lithosols; outcrops of mudstone and sandstone.	Grassland of <i>Triodia intermedia</i> with very scattered <i>Acacia</i> spp. shrubs.	HSHP
2	60	Undulating plains: with laterised shale strew and occasional outcrop of laterite, laterised shale strew.	Lithosols; shallow reddish brown coarse sandy loams over laterite and mudstone.	Grasslands dominated by <i>Triodia intermedia</i> with very scattered <i>Acacia translucens</i> and <i>Eremophila bignoniiflora</i> , patches <i>Triodia pungens</i> and <i>Eucalyptus pruinosa</i> .	HSPP 90% SSPP 10%
3	25	Sandplain islands: up to 1.6 km wide.	Deep red sands with patches of thin laterite strew.	Open grassy shrublands of <i>Triodia bitextura</i> , <i>Acacia tumida</i> and <i>Grevillea wickhamii</i> .	CSPP
4	5	Pans and drainage depressions: less than 0.8 km wide; depressions less than 0.3 m deep.	Grey tough alluvial clays and depressions of sandy loam soils.	Low fringing woodlands and grasslands of <i>Triodia bitextura</i> , <i>Triodia pungens</i> and <i>Eucalyptus pruinosa</i> .	CSPP 50% SSPP 50%

+ Pasture types described in Appendix 1.



Lobed (hard) spinifex (*Triodia intermedia*) is the dominant grass of the hills, low rises and stony undulating plains in Bulka land system.

Photo: Simon Eyres, DAFWA 2008

BURRAMUNDI LAND SYSTEM (Bur)

895 km²

Source: WKY

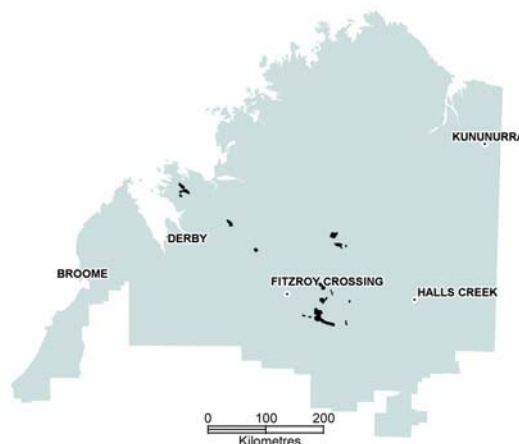
Rocky rounded hills and undulating terrain, skeletal soils, spinifex and scattered low trees.

State land type: Hills and ranges with spinifex grasslands.

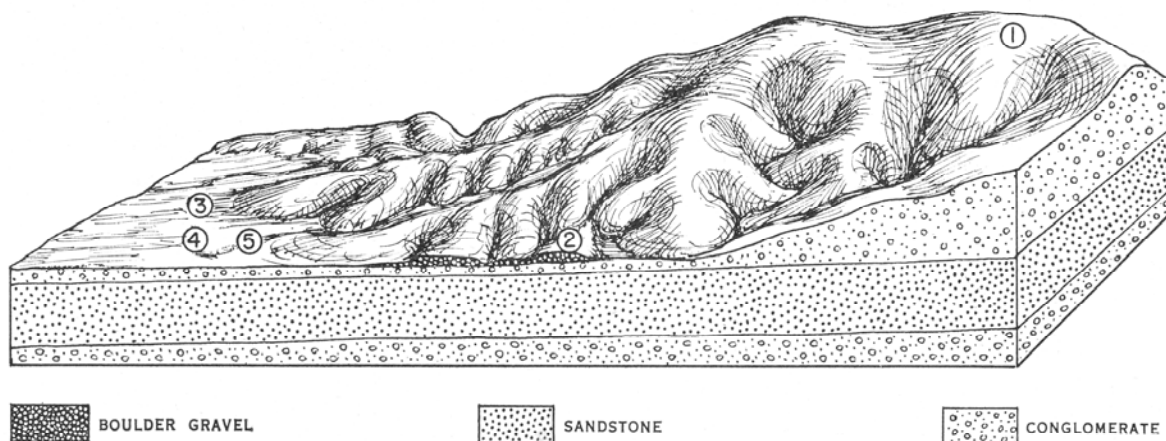
Geology: Flat-bedded or gently dipping Devonian conglomerate and sandstone, or Upper Proterozoic tillite.

Geomorphology: Formed by dissection of the Kimberley surface - hill lands: secondary divides up to 20 km wide consisting of hills with gently rounded or bevelled crests up to 800 m wide, and marginal alluvial aprons; moderately dense, radial pattern of incised drainage with restricted alluvial drainage floors in the lowest sectors; relief up to 150 m.

Land management: Most of the system supports hard spinifex pastures of very low pastoral value. Alluvial aprons and drainage floors (units 3 & 4) support more attractive pastures and have minor susceptibility to erosion.



*Rounded hills and hill spurs with hard spinifex grasslands are a feature of the Burramundi land system.
Photo: DAFWA 1972*



Stylised block diagram showing location of land units

BURRAMUNDI LAND SYSTEM (Bur) - land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	68	Hillslopes: boulder- and cobble-strewn up to 40%, with lower slopes dissected up to 15 m into rounded spurs, up to 800 m wide, with marginal slopes up to 25%.	Outcrop of reddish bouldery coarse-textured soils (24).	Open spinifex with scattered small trees and low open woodlands with <i>Triodia intermedia</i> , <i>Eucalyptus brevifolia</i> alliance (1a) and 57. Communities 1d and 54 in higher-rainfall parts.	HSHP
2	2	Boulder fans and aprons: up to 1200 m long, slopes less than 10%, with upper talus fans to 25%; dissected up to 9 m at head and 1.5 m distally.	Bouldery coarse-textured skeletal soils (24).	Very open woodlands with <i>Triodia bitextura</i> . <i>E. brevifolia</i> alliance (1d).	CAHP
3	20	Alluvial aprons: up to 2.4 km long, gradients 1 in 80 to 1 in 200; sealed surfaces with pebble patches.	Shallow, reddish and yellowish sandy soils; Yabbagoddy (1) and Tableland (5) families.	Open woodland with <i>Chrysopogon</i> spp. and scattered short annual grasses. <i>Corymbia dichromophloia</i> alliance (9b).	RGRP
4	5	Alluvial drainage floors: up to 275 m wide, gradients 1 in 100 to 1 in 300.	Brownish loamy alluvial soils: Robinson family (21).	Very open woodlands with clumps of <i>Triodia bitextura</i> , <i>C. dichromophloia</i> alliance (8c).	CSPP
5	5	Channels: up to 30 m wide and 1.8 m deep.	Bed-loads range from sand to boulders	Open fringing woodland with mixed tall frontage grasses. <i>Bauhinia cunninghamii</i> and <i>Adansonia gregorii</i> alliances (39, 33).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



The rounded hill spurs characteristic of Burramundi land system show clearly in this 2005 aerial photograph. Photo width is about 3.7 km. Photo: Landgate

CALWYNYARDAH LAND SYSTEM (Clw) 1736 km² Source: WKY

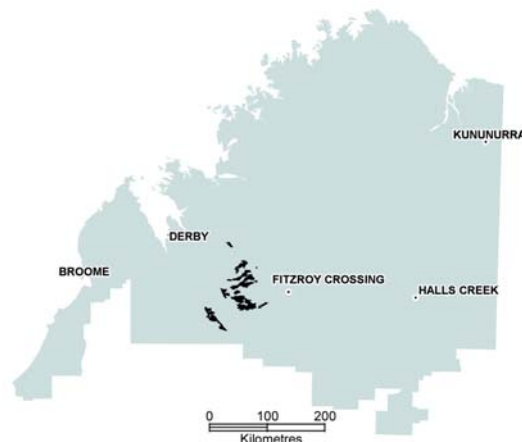
Alluvial plains downslope from lateritic remnants, yellowish loamy soils, beefwood grassy woodlands.

State land type: Alluvial plains with mixed woodlands/shrublands and mixed grasses.

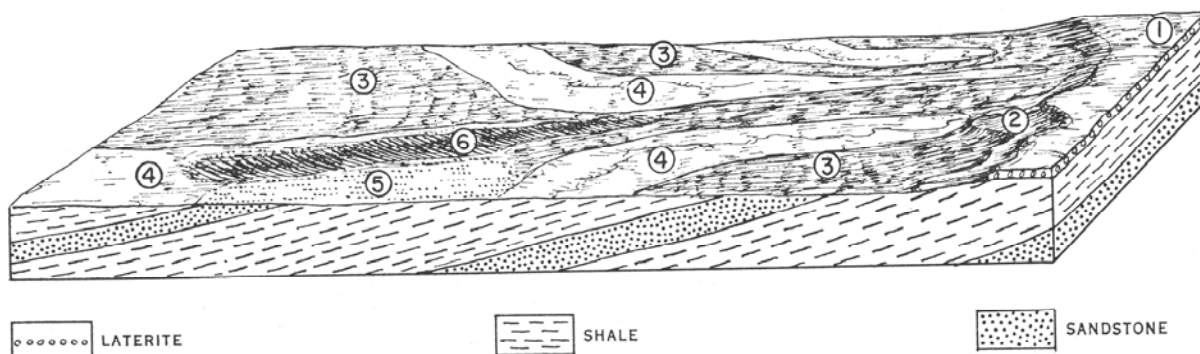
Geology: Quaternary alluvium; weathered gently folded sandstone and shale of Permian and Triassic age.

Geomorphology: Alluvial plains - tributary alluvial plains: up to 19 km in extent, comprising loamy alluvial plains with extensive scalded areas and minor sandplain islands, occurring downslope from restricted laterised summit remnants; sparse pattern of sub-parallel alluvial drainage floors.

Land management: Scalded tracts and drainage floors (units 4 & 6) of the system have moderate to high susceptibility to erosion if vegetation cover is lost; control of grazing pressure is essential.



Alluvial plains supporting grassy woodlands of beefwood (*Grevillea striata*) and acacias. Photo: DAFWA



Stylised block diagram showing location of land units

CALWYN YARDAH LAND SYSTEM (Clw) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	8	Summit remnants: up to 15 m high; sandy slopes less than 0.3%, but up to 7% adjacent to breakaways, with local exposures of laterite and weathered rock; delimited by breakaways up to 12 m high or by stony slopes up to 2%.	Reddish loamy soils: Tippera family (2). Laterite exposures in and marginal to breakaways.	Mainly spinifex grassland with scattered trees and shrubs. <i>Triodia intermedia</i> community (57); locally 54 and 16.	HSPP
2	4	Lower slopes: concave up to 3% and less than 1.6 km long, forming gently rounded spurs up to 1.5 m high and 400 m wide with marginal slopes less than 1%; colluvial mantles and local outcrop.	Complex association of reddish sandy and loamy soils; Tippera family (2); and brownish loams over red clay: Moonah family (17).	Spinifex grassland and low beefwood woodland. <i>Triodia intermedia</i> community (57) and <i>Grevillea striata</i> alliance (34b and 34c).	HSPP
3	44	Alluvial plains: up to 3.2 km in extent with gradients 1 in 200 to 2 in 500; lightly sealed sandy surfaces with pebble patches.	Yellowish sandy soils with laterite gravel horizon: Tableland family (5).	Low beefwood woodland with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp., and <i>Triodia pungens</i> . <i>Grevillea striata</i> alliance (34a, 34b, 34c).	CSPP 40% RGRP 40% SSPP 20%
4	36	Scalded tracts: extending up to 6.4 km downslope, gradients 1 in 150; lightly sealed sandy surfaces with pebble patches.	Association of greyish to brownish sands and loams over tough domed clays: Jurgurra family (19) with yellowish sandy to loamy soils: Elliott family (6).	Much bare ground; patches of beefwood and <i>Bauhinia</i> woodlands with <i>Triodia bitextura</i> , <i>Grevillea striata</i> alliance (34b and 34c).	CSPP 50% RGRP 50%
5	4	Sandplain islands: up to 1.6 km wide with slopes up to 2%.	Deep red sands: Cockatoo family (7).	Woodland with prominent <i>Acacia</i> tall shrub layer and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storey. <i>Corymbia dichromophloia</i> alliance (10, 11) and 56.	CSPP
6	4	Drainage floors: up to 400 m wide, gradients 1 in 100 to 1 in 500; locally with channels up to 6 m wide and 1.2 m deep.	Brownish sands and loams over red clay: Moonah family (17). Minor occurrence of reddish sandy soils: Yabbagoddy family (1).	Fringing communities (20c, 33).	SSPP 50% FRGP 50%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

CAMELGOODA LAND SYSTEM (Cml)

17,826 km²

Source: WKY

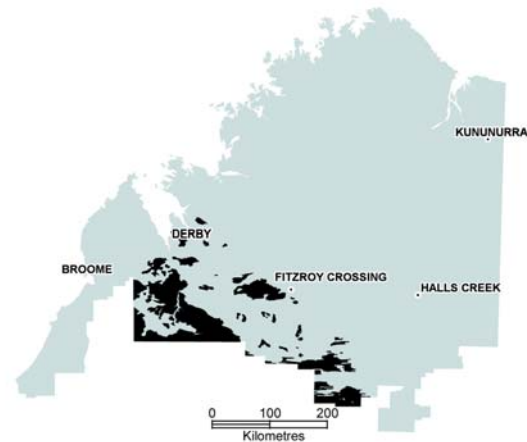
Extensive dunefields, pindan and other low woodlands.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

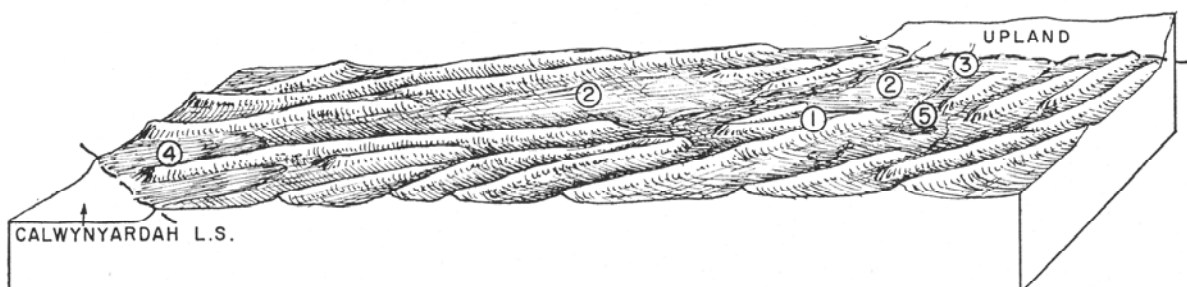
Geology: Quaternary aeolian sands.

Geomorphology: Sandplains and dunefields, with little organised drainage: stable dunefields with swales opening locally into sandplain; restricted marginal plains with thin sand cover occur adjacent to dissected tracts and there are minor, isolated hills up to 60 m high; limited surface drainage mainly as sheet-flow in tracts downslope from uplands and extending for short distances into dunefields; relief up to 12 m.

Land management: System is not generally prone to degradation or erosion although recently burnt areas have minor susceptibility to wind erosion but stabilise rapidly after rain. Control of grazing pressure and frequency of burning is desirable.



Linear dunes and fire patterns in the spinifex vegetation of the Camelgooda land system. Width of this 2007 aerial photo is about 3 km. Photo: Landgate



Stylised block diagram showing location of land units

CAMELGOODA LAND SYSTEM (Cml) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	26	Dunes: linear, up to 12 m high and 32 km long, with narrow uneven crests; flanks slope 3-15% on north side and up to 20% on south.	Deep red sands: Cockatoo family (7).	Low woodland of bloodwood and/or <i>Bauhinia</i> with prominent tall shrub layer characterised by <i>Acacia</i> spp. and <i>Triodia bitextura</i> , <i>Triodia pungens</i> , and <i>T. bitextura</i> - <i>Chrysopogon</i> spp. ground storeys. <i>Corymbia dichromophloia</i> and <i>Bauhinia cunninghamii</i> alliances (10, 38a, 38b); crests 38c, locally 55.	PINP 80% SSPP 20%
2	66	Swales and sandplain: swales to 1.6 km wide with flat floors and concave marginal slopes up to 2%; locally opening into sandplain up to 3.2 km.	Reddish sandy soils: Yabbagoddy family (1).	Low scrubby woodland with prominent tall shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp., ground storeys, <i>C. dichromophloia</i> and <i>Grevillea striata</i> alliance(10, 8c, 12, 34a); locally 34b, 37b, 57.	PINP 80% CSPP 20%
3	3	Tracts receiving run-on: up to 1.6 km wide and extending downslope for up to 4.8 km; slopes less than 0.5%.	Mottled yellowish sandy soils: Tableland family (5).	Similar to unit 2 but with patches of paperbark trees (36).	SSPP
4	2	Plains with thin sand cover: up to 1.6 km wide; lightly firmed slopes up to 5% with linear scalds and local outcrop.	Mainly reddish sandy soils; Yabbagoddy family (1), with some laterite and rock outcrop.	Complex of spinifex grasslands, with scattered trees and low open woodlands, <i>Triodia bitextura</i> and <i>Triodia pungens</i> communities (54, 55); <i>Bauhinia cunninghamii</i> alliance (38a, 38b).	CSPP
5	3	Pans and depressions: up to 3.2 km wide; depressions very shallow with firmed sandy surfaces; pans up to 2 m deep, with heavily cracking surfaces and marginal slopes up to 1%.	Depressions mainly greyish, mottled, sandy to loamy soils over tough, mottled clayey subsoils: Hooper family (20). Pans brownish, massive, intractable silty to heavy clays: Billabong floor soils (30).	Commonly <i>Chrysopogon</i> spp. grassland (49). Fringes of <i>Melaleuca</i> spp. (36) and 21.	RGRP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



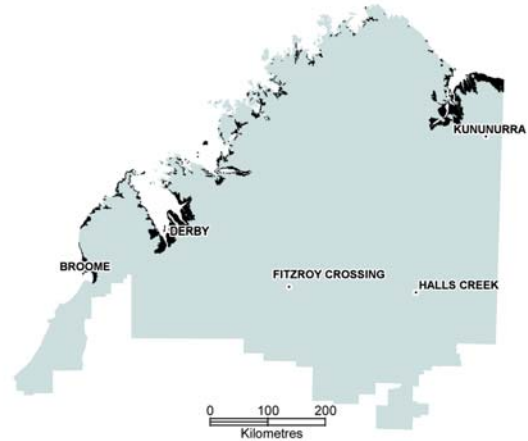
The Kimberley is a place of great beauty, and many surprises – in this case a boab (Adansonia gregorii) growing out of seemingly solid rock. Dinnabung land system. Photo: Noel Schoknecht, DAFWA

CARPENTARIA LAND SYSTEM (Cap) Total area across surveys 6601 km²

Source: NKY, OVC, WKY

Carpentaria was described in three CSIRO land system reports: North Kimberley, Ord-Victoria and West Kimberley.

The general description of the land systems, and in particular the land units, was significantly different in each survey, and in this report no attempt has been made to merge them. The table below correlates the land units between surveys, and subsequent pages present the individual land system and land unit descriptions from each survey.



North Kimberley	Ord-Victoria	West Kimberley
	1 Higher plains mainly along the inland margin of land system - medium	1 Inner slope 8%
3 Small streamline - small		2 Drainage mouths 2%
		3 Samphire flats 19%
1 Wet salt flat - medium	2 Nearly flat plains – large	4 Mud flats 40%
2 Moist salt flat - medium		
4 Dry salt flat – medium		
	5 Sand dunes, isolated areas near coast - very small	5 Dunes 2%
	3 Slopes and flats adjacent to channels and the coast, submerged at high tide - small	6 Slopes at lower margin of mud flats 18%
		7 Outer flats 11%
	4 Salt water channels - small	

A small area of Carpentaria land system (46 km²) was mapped along the east shore of Roebuck Bay near Broome in the Broome (BRM) survey however a detailed land system description was not included in the report. The West Kimberley (WKY) survey land system description should be used for this area.

In addition Carpentaria land system in the West Kimberley and Ord-Victoria surveys has been subdivided based on pastoral productivity into Carpentaria High (Cph) - those areas with grassy pastures and low to moderate pastoral grazing potential, and Carpentaria Low (Cpl) - those areas with bare unproductive mudflats and mangroves of no pastoral grazing potential. These subdivisions are not described in detail in the text of this report but are shown on the land system map. Further information can be obtained from DAFWA. For enquiries see contact details page (i).

CARPENTARIA LAND SYSTEM (Cap)

888 km²

Source: NKY

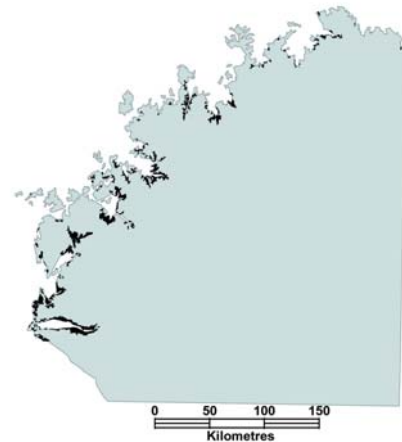
Estuarine flats with mangrove vegetation and saline soils, sparsely distributed near the mouths of the main rivers.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

Geology and geomorphology: Depositional plains consisting of saline muds liable to tidal inundation.

Drainage: Dendritic, centrifugal; of variable intensity.

Land management: The system consists largely of unvegetated saline mud flats except for unique fringing mangrove thickets which have high conservation value.



Tidal creeks, bare and vegetated saline mudflats of the Carpentaria land system at Walcott Inlet.

Photo: Noel Schoknecht, DAFWA



Stylised block diagram showing location of land units

CARPENTARIA LAND SYSTEM (Cap) – land units, NKY survey area

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	30	Wet salt flat	Saline muds	Mangroves along sides of estuaries	XXNP
2	30	Moist salt flat	Saline muds	Bare	XXNP
3	10	Small streamline	Saline muds	Mangroves	XXNP
4	30	Dry salt flat	Saline muds	Bare	XXNP

+ Pasture types described in Appendix 1.



In the North Kimberley many areas of Carpentaria land system are narrow and controlled by the jointing pattern of the massive sandstone hills of Buldiva land system. Width of this 2004 aerial photograph taken near the mouth of the Roe River in Prince Frederick Harbour is about 14 km. Photo: Landgate

CARPENTARIA LAND SYSTEM (Cap)

2577 km²

Source: OVC

A discontinuous strip of saline country, with some sand dunes, along the coastline.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

Geology: Quaternary alluvia.

Geomorphology: Coastline plains and estuarine-deltaic plains.

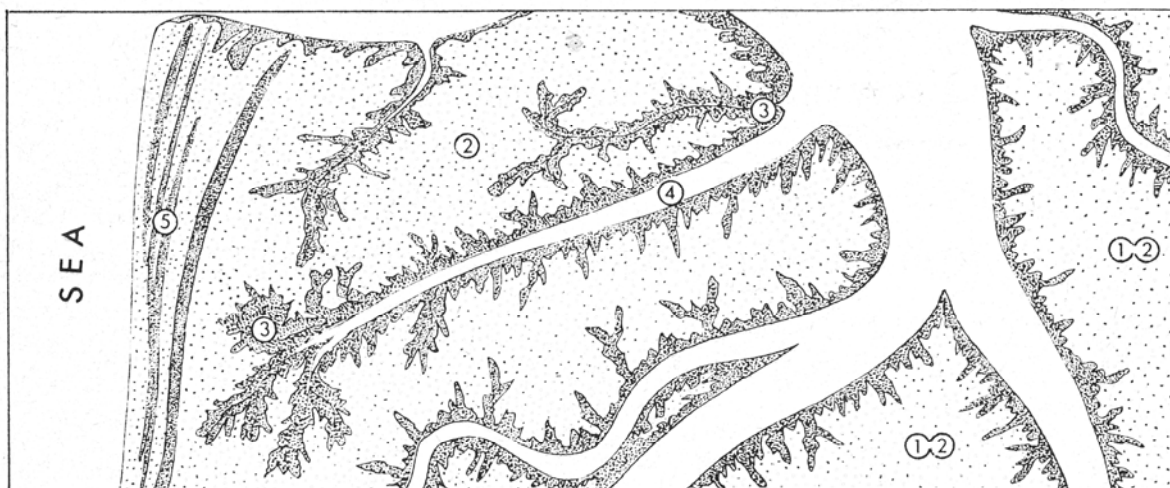
Drainage: Dendritic tidal channels and small streamlines of very variable intensity, some large meandering estuaries; unit 3 is regularly flooded by tidal waters, unit 2 only by highest tides, and unit 1 only by combinations of peak floods and high tides.

Land management: More than 50% of this system consists of unvegetated highly saline plains and flats. About a quarter of the system (unit 1) supports useful littoral pastures of saltwater couch, rice grass and other perennial grasses which are resilient under grazing except in extreme situations where cover is lost and powdery soil surfaces are prone to wind erosion. Mangrove communities have high conservation value.



Saline mudflats with mangrove fringes on the margins to the West Arm of Cambridge Gulf, viewed from the Five Rivers Lookout near Wyndham.

Photo: Noel Schoknecht, DAFWA



Stylised plan diagram showing arrangement of land units

CARPENTARIA LAND SYSTEM (Cap) – land units, OVC survey area

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	27	Higher plains mainly along the inland margin of the land system	Mainly Flapper - grey sandy loam over mottled clay; some Legune - grey cracking clay.	Saline soil short grass (<i>Xerochloa imberbis</i> , <i>Sporobolus virginicus</i>).	LITP
2	50	Nearly flat plains	Carpentaria - highly saline clays.	Bare mud or samphire.	XXNP 90% SMPP 10%
3	10	Slopes and flats adjacent to channels and coast, submerged at high tide	Carpentaria - highly saline clays.	Mangroves	XXNP
4	10	Salt-water channels			XXNP
5	3	Sand dunes , isolated small areas near the coast	Coastal sand dunes Carpentaria - deep yellow-grey sands.	Sand-dune vegetation.	OTHP

+ Pasture types described in Appendix 1.



Overlooking the tidal flats of Carpentaria land system to an impressive expression of Weaber land system called "The Needles". Cape Dommert in the north-east Kimberley.

Photo: Noel Schoknecht, DAFWA

CARPENTARIA LAND SYSTEM (Cap)

2490 km²

Source: WKY

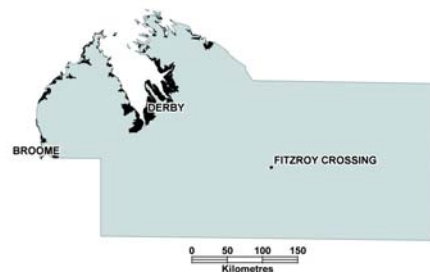
Coastal country, bare mud flats and saline soils with halophytic vegetation types.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation.

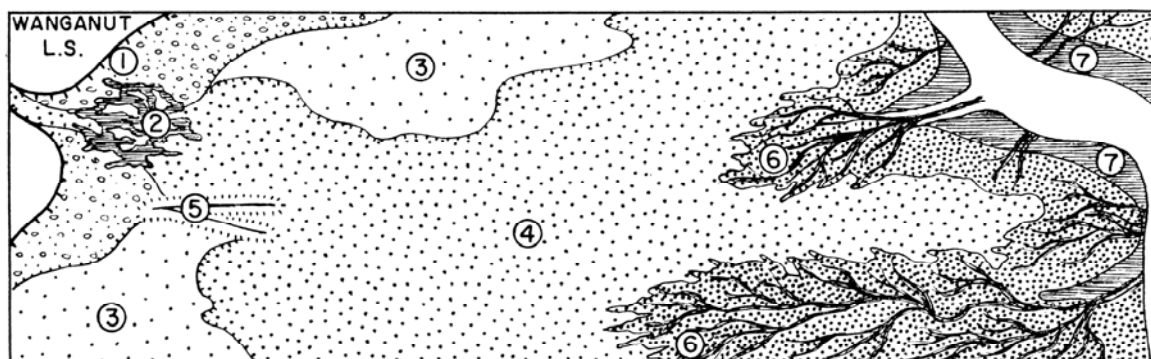
Geology: Quaternary estuarine and littoral calcareous mud and silty sand; aeolian sand.

Geomorphology: Saline coastal flats: saline estuarine and littoral flats with extensive bare mud surfaces and slightly higher samphire flats; mangrove fringes occur along the seaward margin, and short sandy slopes, with outlying low sandy rises, occur at the landward margin; minor fixed dunes; dense, intricately branching pattern of shallow tidal inlets; slopes mainly less than 0.3%.

Land management: Parts of the system support variable littoral pastures which are moderately favoured by stock. Controlled stocking required to prevent vegetation degradation and soil scalding. Mangrove communities have high conservation value.



Tidal mudflats and mangrove lined creeks of the Carpentaria land system surrounding Derby townsite. The width of this 2007 aerial photograph is about 12 km. Photo: Landgate



Stylised plan diagram showing arrangement of land units

CARPENTARIA LAND SYSTEM (Cap) – land units, WKY survey area

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	8	Inner slopes: concave, up to 1% and 230 m long; lightly firmed sandy surfaces.	Yellowish sandy soils, commonly mottled and showing saline influence: Tableland family (5).	Thickets of <i>Melaleuca</i> spp. with variable ground storeys. <i>Melaleuca alsophila</i> alliance (35a, 35b).	RAPP 50% LITP 50%
2	2	Drainage mouths: up to 3.2 km wide, traversed by numerous runnels and channels 1–50 m wide and up to 1 m deep; vegetated sandy rises up to 0.6 m high with intervening bare sealed surfaces.	Variable soil complex mainly yellowish, sandy soils: Tableland family (5); and loamy alluvial soils: Robinson family (21). Both exhibiting local saline influence.	As for unit 1.	RAPP 50% LITP 50%
3	19	Samphire flats: up to 4.8 km in extent, with slopes less than 0.3%; margins up to 0.2 m above mud flats.	Brownish and greyish, calcareous, saline loams (26).	Halophytic shrubland. Samphire community (66).	SMPP 60% LITP 40%
4	40	Mud flats: up to 6.4 km wide with slopes less than 0.3%; sealed, cracking surfaces with microrelief.	Dark saline muds (28).	Bare mud.	XXNP
5	2	Dunes: linear, up to 3.2 km long and 6 m high, with narrow, irregular crests; flanks slope up to 5%.	Sandy commonly calcareous beach dunes (29).	<i>Spinifex longifolius</i> and other perennial tussock grasses and forbs with an open shrub layer (<i>Acacia</i> spp.) and scattered trees. Beach-dune community (67).	OTHP
6	18	Slopes at lower margin of mud flats: up to 0.3% and 400 m long.	Dark saline muds (28).	Low open mangrove community (46).	XXNP
7	11	Outer flats: up to 3.2 km in extent; in shallow water or exposed at low tide.	Dark saline muds (28).	Dense mangrove communities, Medium-height (2 – 3 m) mangrove community (45) occupies the inner part of this zone and a taller community 3 – 8 m high (44) occupies the outer or seawards margin.	XXNP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

CHESTNUT LAND SYSTEM (Cht)

520 km²

Source: WKY

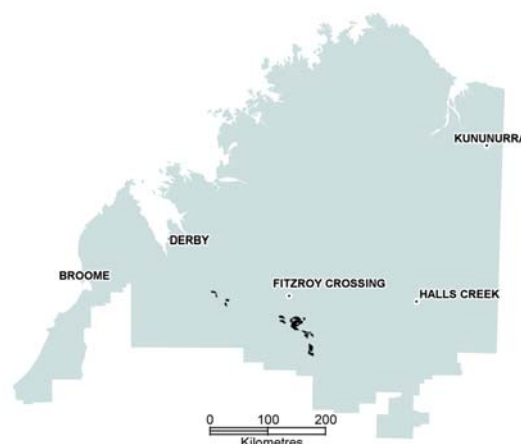
Restricted stable floodplains above the level of the active floodplains, sandy to loamy reddish soils with soft spinifex grasslands with scattered trees.

State land type: Alluvial and sandy plains with soft spinifex grasslands.

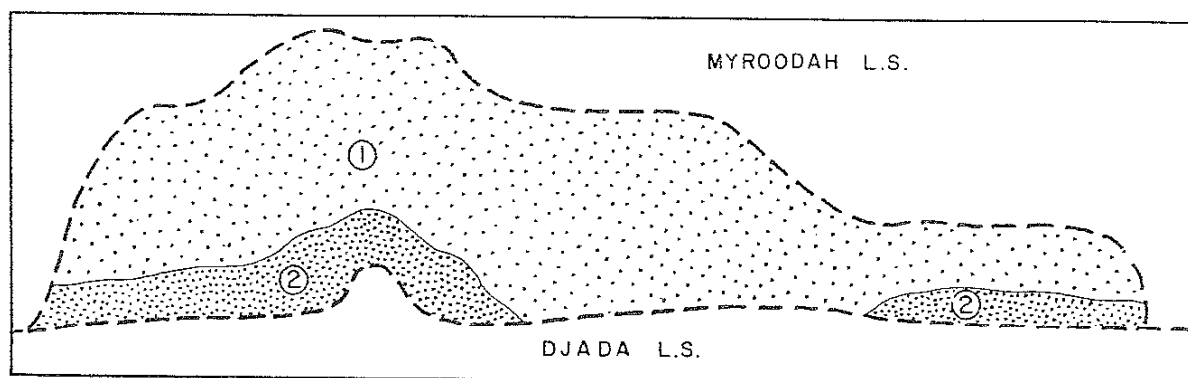
Geology: Quaternary alluvium.

Geomorphology: Alluvial plains - stable floodplains: plains up to 9 m above active floodplains; with marginal, stony erosional slopes; surface drainage absent except for minor ill-defined floors with shallow channels.

Land management: Soft spinifex pastures are moderately attractive to cattle for a few years following fire; old stands are unattractive. Generally low susceptibility to erosion; control of grazing pressure and frequency of burning desirable.



Broad plains with soft spinifex (*Triodia pungens*) grasslands and numerous termite mounds are characteristic of the Chestnut land system.
Photo: Andrew McLaughlin
DAFWA 1998



Stylised plan diagram showing arrangement of land units

CHESTNUT LAND SYSTEM (Cht) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	88	Plains: up to 16 km in extent locally with drainage floors up to 90 m wide: lightly firmed sandy surfaces with pebble patches; gradients less than 1 in 200.	Mainly reddish loamy soils: Tippera family (2). Some reddish sandy soils: Yabbagoddy family (1).	Soft spinifex grassland and very open woodlands with <i>Triodia pungens</i> and <i>T. bitextura</i> . Communities 55, 8b, 8c and locally 34b, 20.	SSPP
2	12	Erosional slopes: pebble-strewn concave slopes, up to 2%; minor structural benches.	Mainly reddish sandy soils: Yabbagoddy family (1). Some reddish skeletal soil and outcrop (24).	Spinifex grassland with very scattered, stunted trees and shrubs. <i>Triodia intermedia</i> community (57).	HSPP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



Soft Spinifex Pastures (SSPP) dominated by soft spinifex (Triodia pungens) [above] and less commonly curly spinifex (Triodia bitextura) [left] is the main pasture type on Chestnut land system.

Photos: Bob McCartney (above) and Simon Eyres (left), DAFWA

CLIFTON LAND SYSTEM (Cif)

606 km²

Source: WKY

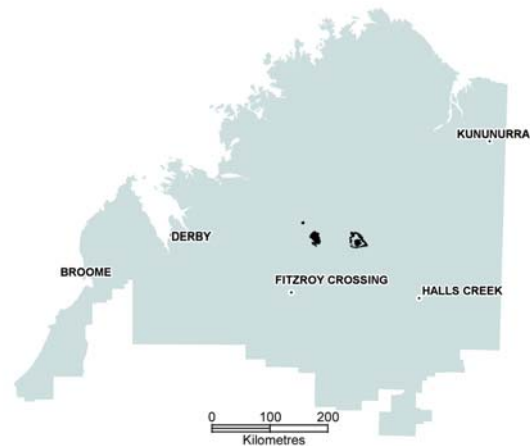
Sandstone plateaux with deep valleys, low open woodlands with curly spinifex.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

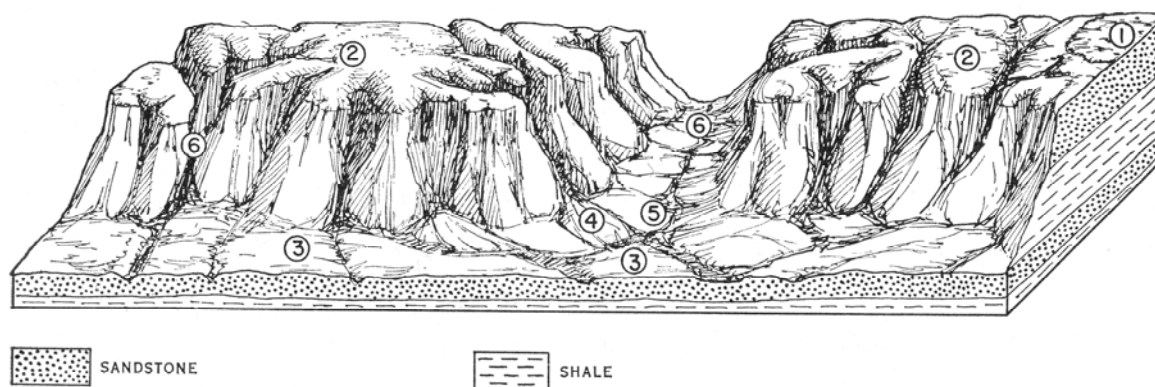
Geology: Subhorizontal sandstone and shale of Upper Proterozoic age.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: rocky plateaux up to 22.5 km in extent, with high escarpments and restricted lower slopes; moderately dense, branching pattern of narrow, incised valleys; relief up to 305 m.

Land management: A rugged and inaccessible system of no value for pastoralism, inherently resistant to erosion, high scenic amenity.



*Mount House, an isolated range and plateau of the Clifton land system, standing above surrounding plains of the Glenroy land system.
Photo: DAFWA*



Stylised block diagram showing location of land units

CLIFTON LAND SYSTEM (Clf) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	7	Summit remnants: up to 4.8 km in extent; sandy slopes less than 1% with laterite exposures locally.	Mainly deep red sands: Cockatoo family (7). Some deep brown sands; Kalyeeda family (9) and minor laterite	Open woodland with scattered shrubs and <i>Triodia bitextura</i> (4, 6). Locally 3 and 28.	CAHP
2	70	Rocky plateaux: gently sloping or undulating, with relief up to 15 m and slopes up to 5%; indented escarpments to 305 m with vertical upper walls and steep slopes and with basal scree slopes up to 45%.	Mainly outcrop with some reddish loamy skeletal soil (24).	As for unit 1.	CAHP
3	9	Lower slopes: concave up to 5% and up to 1.6 km long; dissected up to 9 m into spurs with flat or gently sloping crests up to 180 m wide and marginal slopes up to 60%; mantled with colluvium.	Reddish loamy and clayey lithic soils: Yabbagoddy (1, 23) and Tippera (2, 23) families.	Open woodland with scattered shrubs and <i>Triodia bitextura</i> , <i>Eucalyptus brevifolia</i> , <i>Corymbia cadophora</i> community (3).	CSPP
4	2	Boulder fans: up to 270 m long, slopes up to 30%.	Bouldery, medium-textured skeletal soils (24).	Soft spinifex grassland with scattered trees and shrubs, <i>Triodia bitextura</i> community (54).	CAHP
5	4	Alluvial drainage floors: up to 550 m wide, gradients 1 in 200 to 1 in 300; marginal slopes up to 25%.	Gravels, with locally developed greyish sands over tough loamy subsoils: Tarraji family (18).	Open woodland with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storeys. <i>Adansonia gregorii</i> alliance (31).	CSPP 50% RGRP 50%
6	8	Channels: up to 30 m wide and 4.5 m deep.	Bed-loads range from sand to boulders.	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



An aerial oblique photo of a main occurrence of Clifton land system showing the indented plateau landform bounded by escarpments. Photo: Geerten van Gelder (alias Geerten, Panoramio.com)

COCKATOO LAND SYSTEM (Coc)

2378 km²

Source: OVC

Gently undulating timbered sandy country in the north-western part of the Ord-Victoria survey area.

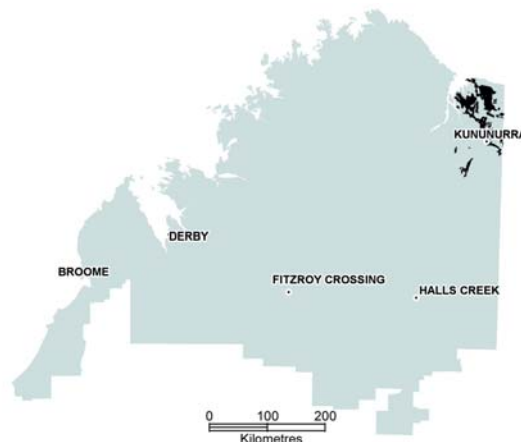
State land type: Sandplains with eucalypt woodlands and spinifex/tussock grasses.

Geology: Sandstone, calcareous sandstone, calcareous conglomerate, and minor limestone; Permian, Lower Carboniferous, Upper Devonian, and Ordovician-Cambrian (Carlton Group).

Geomorphology: Coastal erosional plains.

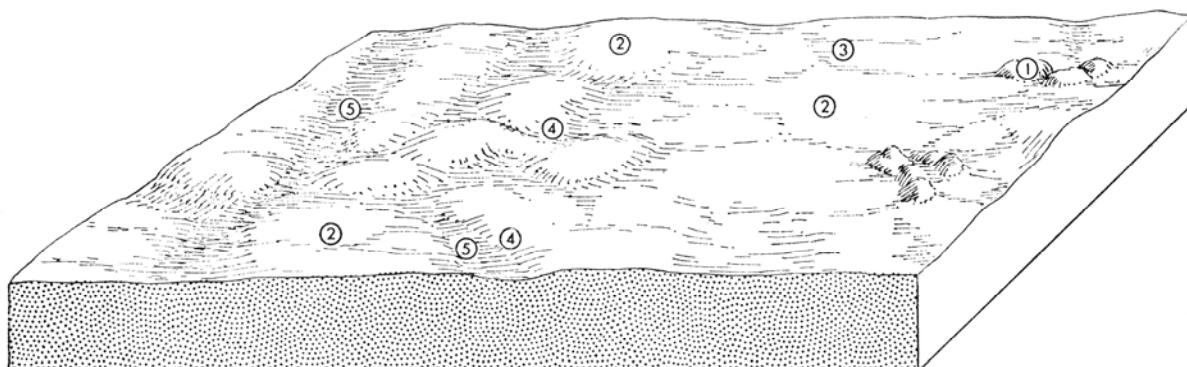
Drainage: Widely spaced insequent stream pattern, shallow depressions may be waterlogged or flooded for short periods.

Land management: System supports pastures which are only moderately favoured by livestock and are generally stable with low susceptibility to erosion. Fire management programs desirable; in the Kununurra area unit 2 has potential for horticultural use.



Gently undulating sandplains which are the major unit (unit 2) of the Cockatoo land system have deep red sandy soils and support eucalypt woodlands.

*Photo:
Henry Smolinski
DAFWA*



Stylised block diagram showing location of land units

COCKATOO LAND SYSTEM (Coc) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	5	Very bouldery low hills	Sandstone boulders with pockets of sandy soils.	Stringybark - bloodwood woodland (<i>Eucalyptus tetrodonta</i> , <i>Corymbia dichromophloia</i> , <i>E. miniata</i> , <i>C. ferruginea</i> , <i>E. aspera</i>) or deciduous sparse low woodland (<i>Xanthostemon paradoxus</i> , <i>Owenia vernicosa</i> , <i>Terminalia</i> spp.), both with upland tall grass (<i>Sorghum stipoideum</i> , <i>Triodia bitextura</i> , <i>Triodia stenostachya</i>).	ASHP
2	80	Gentle slopes and crests of gently undulating landscape	Cockatoo - deep red sand; and Pago - deep yellow sand; small areas of Cullen - greyish sand merging into mottled yellow sand.	Stringybark - bloodwood woodland <i>E. tetrodonta</i> , <i>E. miniata</i> , <i>C. dichromophloia</i>) with upland tall grass (<i>Sorghum stipoideum</i> , <i>Triodia bitextura</i>).	LCSP
3	5	Small isolated areas in gently undulating landscape	Tippera - brown sandy loam merging into dark red clay.	Northern box - bloodwood woodland (<i>E. tectifera</i> , <i>C. foelscheana</i> , <i>C. confertiflora</i>) with upland tall grass (<i>Sorghum stipoideum</i>).	LCSP
4	5	Lower slopes and shallow drainage floors	Pago - deep yellow sand; and Cullen - greyish sand merging into mottled yellow sand.	Stringybark - bloodwood woodland <i>E. tetrodonta</i> , <i>E. miniata</i> , <i>C. dichromophloia</i>) with upland tall grass (<i>Sorghum stipoideum</i> , <i>Triodia bitextura</i>).	LCSP
5	5	Shallow linear depression lines	Hooper - greyish surface over mottled hard clay.	Marrakai mid-height grass (<i>Eriachne</i> spp., <i>Themeda triandra</i>).	OTHP

+ Pasture types described in Appendix 1.



Sorghum species and *Triodia bitextura* are common species in the grassy understorey of Cockatoo land system.
Photo: DAFWA

COCKBURN LAND SYSTEM (Cok)

2308 km²

Source: OVC

Several small patches of undulating to low shaly country with sparse shrub vegetation scattered throughout the Ord-Victoria survey area.

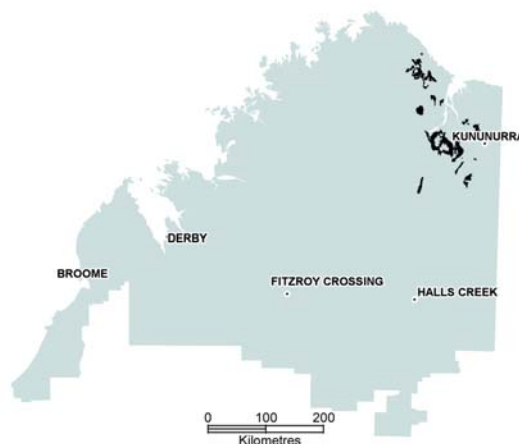
State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Mainly shales and siltstones; Adelaidean and Carpentarian sediments.

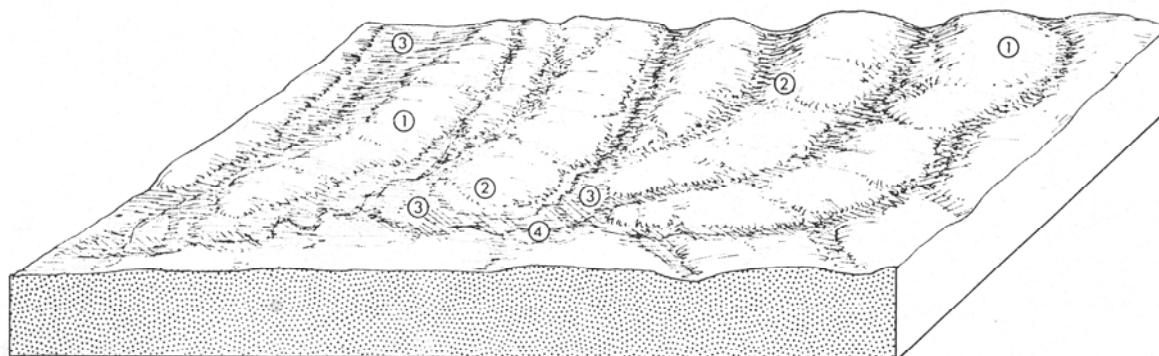
Geomorphology: Coastal erosional plains.

Drainage: Rectangular and angular stream pattern of moderate intensity; unit 3 may be flooded for short periods after heavy rains.

Land management: Supports curly spinifex pastures which, when young, are moderately attractive to cattle; mature stands are unattractive. Land system not usually prone to degradation or erosion but control of grazing pressure and frequency of burning is desirable.



*Small paperbark trees (*Melaleuca* spp.) and curly spinifex (*Triodia bitextura*) are common on shaly slopes (units 1 & 2) of the Cockburn land system.
Photo:
Andrew Craig
DAFWA*



Stylised block diagram showing location of land units

COCKBURN LAND SYSTEM (Cok) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Moderate to gentle slopes	Rock outcrops and shallow, very gravelly, skeletal soils.	Trees absent, or paperbark sparse low woodland (<i>Melaleuca</i> spp.) with spinifex (<i>Triodia bitextura</i>).	CAHP 50% CSPP 50%
2	15	Gentle lower slopes on shale	Elliott - shallow grey sandy loam merging into mottled yellow clay.	Paperbark sparse low woodland (<i>Melaleuca</i> spp. with upland tall grass (<i>Sorghum stipoides</i> , <i>Triodia bitextura</i>).	CSPP
3	13	Alluvial depressions or flats fringing streamlines	Elliott - deep grey sandy loam merging into mottled yellow clay.	As for unit 2 also <i>Chrysopogon fallax</i> .	CSPP 50% RGRP 50%
4	2	Small stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



Gentle slopes of Cockburn land system flank the spectacular Cockburn Ranges (Pinkerton land system) near Wyndham.

Photo: David Ribbans (Flickr.com)

COOLINDIE LAND SYSTEM (Cld)

2535 km²

Source: OVC

Areas of gently undulating red sandy “desert” with shrub vegetation along the southern edge of the Ord-Victoria survey area.

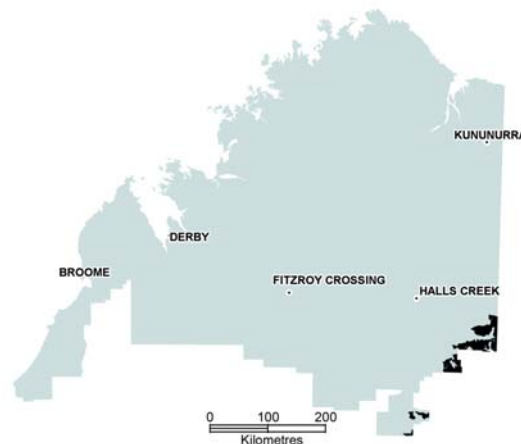
State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Lateritized arenaceous sediments; Carpentarian sandstones (Gardiner Beds).

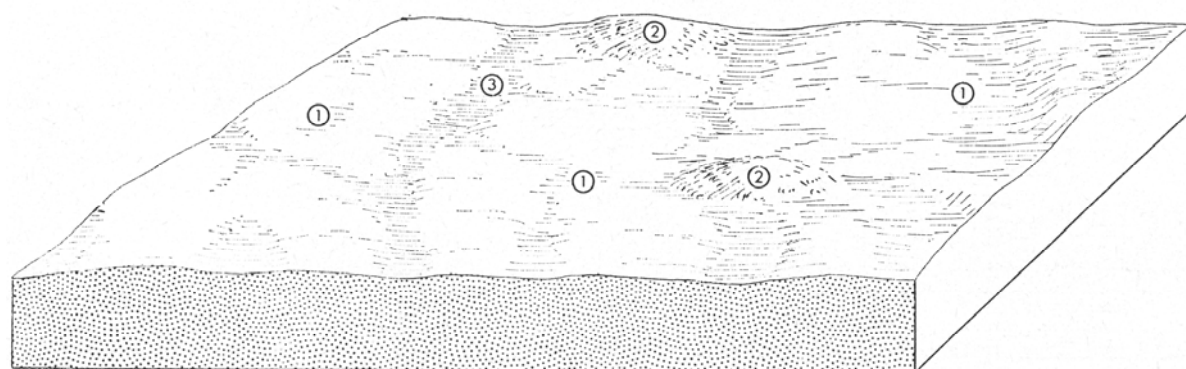
Geomorphology: Elevated lateritic plain (sandy red earth surface horizon).

Drainage: Very widely spaced shallow insequent drainage lines.

Land management: A spinifex system subject to fairly regular burning but stable with low or very low susceptibility to erosion.



*The major unit of the Coolindie land system (unit 1) is gently sloping plains with deep red sands supporting soft spinifex (*Triodia pungens*) grasslands with scattered trees and shrubs.
Photo: DAFWA*



Stylised block diagram showing location of land units

COOLINDIE LAND SYSTEM (Cld) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	80	Gently sloping plains	Cockatoo - deep red sand and some Pago - deep yellow sands.	Trees absent or desert shrubland (<i>Acacia</i> spp., <i>Eucalyptus</i> spp.) with soft spinifex (<i>Triodia pungens</i>).	SSPP
2	15	Low gravelly rises	Chunuma, shallow phase-shallow sands with laterite gravel.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with soft spinifex (<i>Triodia pungens</i>).	SSPP
3	5	Broad shallow linear drainage floors	Argada - greyish loam merging into hard mottled yellow clay.	Desert sparse low woodland (<i>E. microtheca</i>) with soft spinifex (<i>Triodia pungens</i>).	SSPP

+ Pasture types described in Appendix 1.

COONANGOODY LAND SYSTEM (Con) 1777 km² Source: WKY

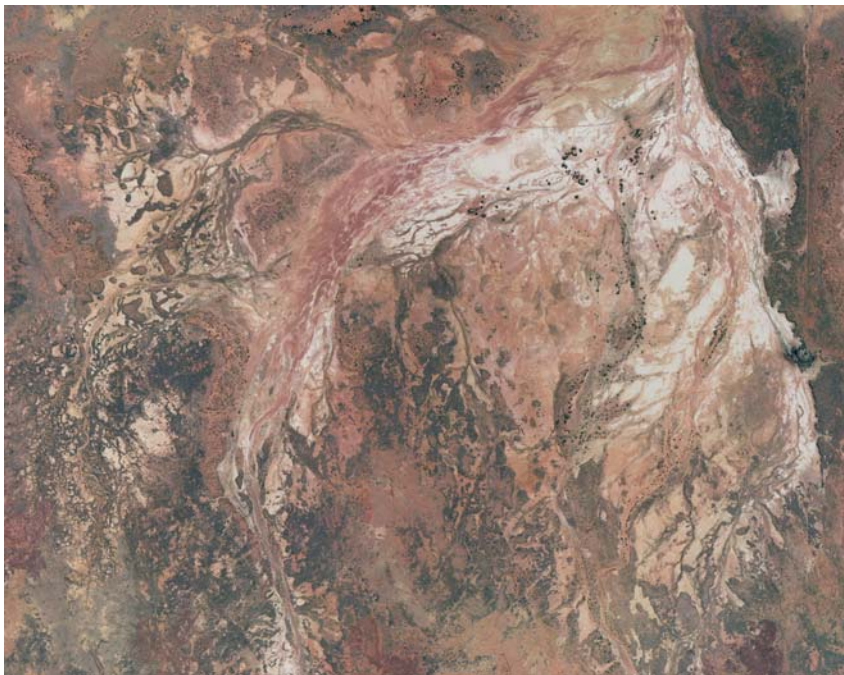
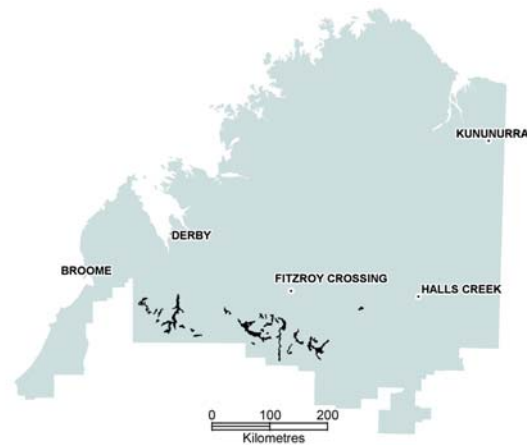
Sandy alluvial plains with broad through-going drainage floors, low grassy woodlands.

State land type: Alluvial plains with mixed woodlands/shrublands and mixed grasses.

Geology: Quaternary alluvium derived mainly from sandstone and shale; aeolian sands.

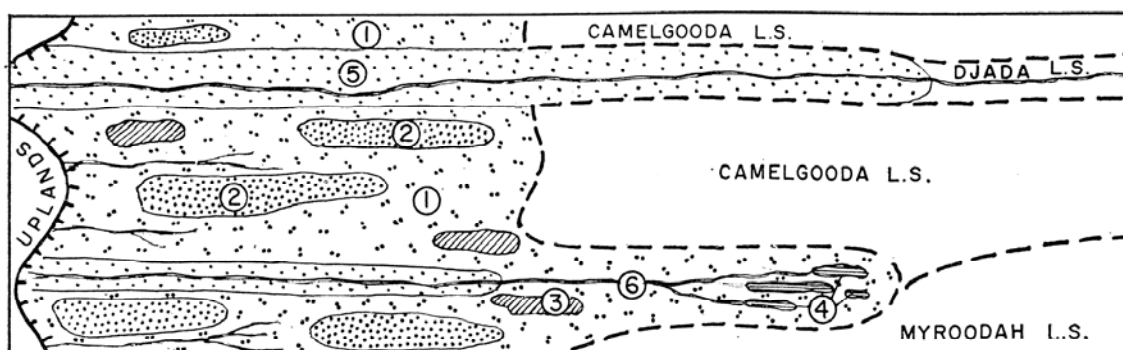
Geomorphology: Alluvial plains - tributary alluvial plains: sandy plains extending up to 4.8 km downslope, with low interfluvies formed by sandplain and minor outcrop plains; trunk drainage floors with anastomosing channels and broad linear drainage depressions in the lowest parts, elsewhere broad tracts receiving diffuse run-on from adjacent uplands; gradients mainly between 1 in 500 and 1 in 100.

Land management: The system supports pastures which are favoured by stock and are prone to degradation. Units 1, 3 and 5 are moderately to highly susceptible to erosion; control of grazing pressure is essential.



Highly reflective degraded alluvial plains and drainage floors of the Coonangooddy land system form complex patterns.

*Width of this 2007 aerial photograph is about 4 km.
Photo: Landgate*



Stylised plan diagram showing arrangement of land units

COONANGOODY LAND SYSTEM (Con) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	52	Alluvial plains: gradients mainly less than 1 in 500 but attaining 1 in 150 at upper margins; degraded soil surfaces.	Yellowish sandy soils with local alluvial or solonchic tendencies: Tableland family (5).	Very open, low grassy woodland with short grasses and patches of <i>Chrysopogon</i> spp. <i>Bauhinia cunninghamii</i> - <i>Ventilago viminalis</i> community (38c); also 1f [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common in parts].	RGRP 80% BUGP 20%
2	23	Sandplain islands: up to 3.2 km across: uniformly sloping or gently undulating, with relief up to 2 m and slopes up to 3%.	Mainly deep red sands: Cockatoo family (7). With deep yellow sands: Pago family (8) in shallow depressions.	Open stunted woodland with patchy shrub layer and <i>Triodia pungens</i> , <i>Chrysopogon</i> spp., and <i>Aristida browniana</i> . <i>Grevillea striata</i> and <i>Bauhinia cunninghamii</i> alliances (34b, 37b, 38c).	SSPP 80% RGRP 20%
3	8	Outcrop plains: stony surfaces up to 3.2 km across, slopes less than 1%, marginally dissected up to 9 m; thin patchy cover of sand and grit and much outcrop	Variable soil cover depending on lithology. Mainly reddish skeletal soil (24), high in rock fragments with 90% strew cover. Minor amounts of shallow, dark brown and reddish brown, loamy to clayey, calcareous soils: Oscar family (11)	Much bare ground; patches of grass-lands. Communities 57, 55, 54; and 58 on calcareous soils.	CSPP 40% SSPP 30% HSPP 30%
4	3	Linear drainage depressions: up to 800 m wide and 4.8 km long: firmed surfaces locally with pans up to 200 m across.	Yellowish sandy soils commonly with lateritic gravels and hard subsoils: Tableland family (5). Brownish, massive, intractable, silty to heavy clay in pans (30).	Low beefwood woodland with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> community (34a).	RGRP
5	11	Drainage floors: up to 3.2 km wide, gradients mainly between 1 in 200 and 1 in 500; lightly firmed hummocky surfaces with scalds up to 800 m across; levees up to 800 m wide; loose sand rises up to 2 m high at outer margins.	Grey to brownish sands and loams over tough loamy sub-soils or tough, domed clays: Tarraji (18) and Jurgurra (19) families.	Low beefwood woodland with <i>Triodia pungens</i> . <i>Grevillea striata</i> community (34b).	SSPP 60% RGRP 40%
6	3	Channels: up to 150 m wide and 6 m deep.	Bed-loads of deep sand	Fringing woodland with <i>Chrysopogon</i> spp. Community 20a.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

CORNISH LAND SYSTEM (Crn)

3108 km²

Source: UNP*

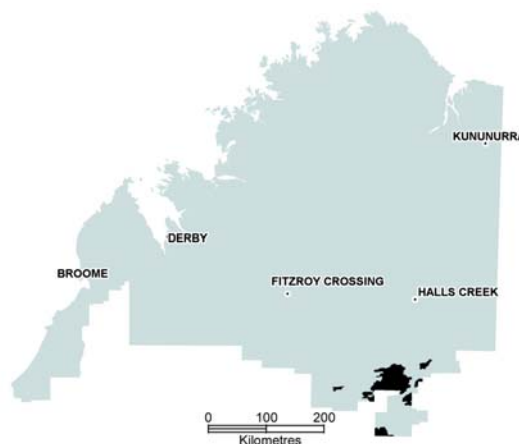
Gently undulating red sandplains with regular parallel E-W trending dunes supporting mainly Acacia, Grevillea and Melaleuca shrubland with soft spinifex.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

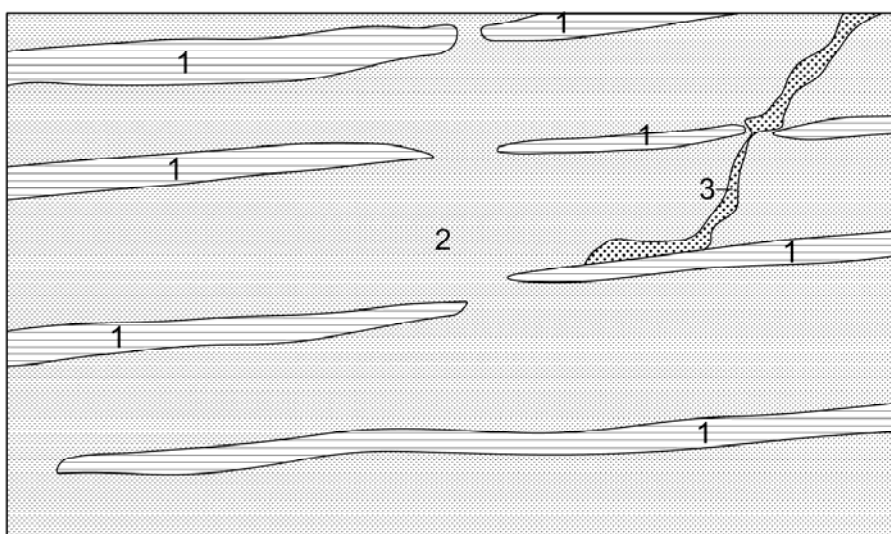
Geology: Quaternary aeolian sands and minor alluvium.

Geomorphology: Sandplains and dunefields with very few drainage features.

Land management: Supports soft spinifex pastures which are not highly preferred by cattle but do supply reasonable feed in dry times if maintained in young condition by appropriate fire management. Dunes (unit 1) have minor susceptibility to wind erosion for short periods after burning.



This sandplain (unit 2) with deep red sands supporting shubby soft spinifex (Triodia pungens) grasslands is a major unit of the Cornish and many other sandplain land systems which differ from Cornish in the proportion of other units such as gravelly plains and sand dunes. Photo: DAFWA



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in *Billiluna Station Resource Survey Report* (1993) DAWA, unpublished.

CORNISH LAND SYSTEM (Crn) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	18	Linear dunes: up to 10 km long with relief up to 10 m	Red deep sands (445).	Sparse shrublands of lemonwood (<i>Dolichandrone heterophylla</i>), <i>Stylobasium spathulatum</i> , and <i>Hakea suberea</i> over mainly soft spinifex (<i>Triodia pungens</i>), with areas of <i>Cullen martinii</i> .	SSPP
2	80	Near level interdunal flats	Red deep sands (445).	Shrublands of <i>Acacia ancistrocarpa</i> , <i>A. coriacea</i> , <i>Grevillea striata</i> , <i>Hakea</i> sp., <i>Melaleuca lasiandra</i> and lemonwood (<i>Dolichandrone heterophylla</i>) over mainly soft spinifex (<i>Triodia pungens</i>). Occasional trees of <i>Corymbia greeniana</i> .	SSPP
3	2	Swampy depressions, drainage foci and occasional channels	Sandy duplexes (400) and non-cracking clays (620).	As for unit 2.	SSPP

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

+ Pasture types described in Appendix 1.

COWENDYNE LAND SYSTEM (Cow)

1626 km²

Source: WKY

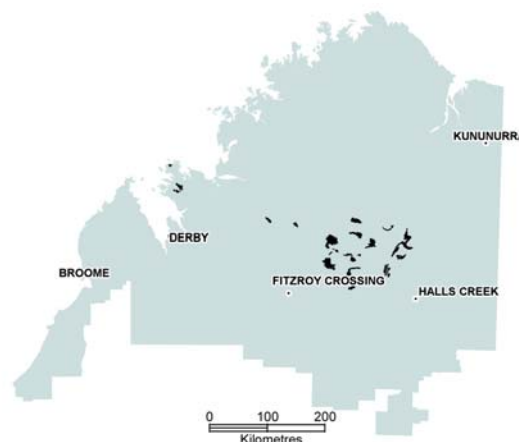
Stony, undulating basalt country with red earths and grassy woodlands, also extensive cracking clay plains with grasslands.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

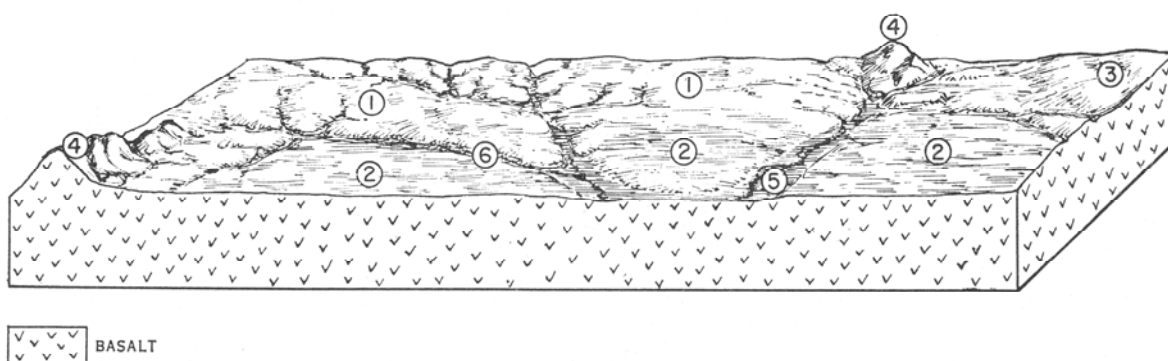
Geology: Basalt and dolerite of Upper Proterozoic or Lower Cambrian age.

Geomorphology: Formed by partial dissection of the Fitzroy surface - plains: stony interfluvies and cracking clay plains, with low rises in headwater areas and scattered hills; moderately dense branching drainage pattern in upper parts with sparse pattern of trunk drainage in lower parts; relief mainly less than 6 m.

Land management: Controlled grazing is necessary as the system supports pastures which are preferentially grazed by cattle; generally low susceptibility to erosion.



*Somewhat elevated cracking clay plains (unit 2) make up about half of the Cowendyne land system. This site is in poor condition. The ranges in the background are in Precipice land system.
Photo: DAFWA*



Stylised block diagram showing location of land units

COWENDYNE LAND SYSTEM (Cow) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	36	Stony interfluves: flat or gently rounded crests up to 1.6 km wide, with marginal slopes less than 5% but attaining 7% locally; colluvial mantles with local outcrop.	Deep red basaltic soil: Frayne family (3).	Open grassy woodland. On hills and rocky slopes: <i>Eucalyptus tectifica</i> with <i>Sehima nervosum</i> ; <i>Sorghum</i> spp. (14a). On lower slopes: <i>E. tectifica</i> - <i>Corymbia dichromophloia</i> with <i>Sehima nervosum</i> - <i>Dichanthium fecundum</i> ground storey.	WGBP
2	46	Cracking clay plains: up to 6.4 km wide with slopes less than 1%; marginally dissected up to 3 m into rounded spurs up to 400 m wide with slopes up to 3%; hummocky surfaces.	Dark self-mulching clays: Cununurra family (12).	Grassland of <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> (48); with scattered trees and shrubs.	RAPP 40% BGAP 40% MGAP 20%
3	7	Low rises: up to 4.8 km wide; pebble-strewn slopes less than 1%.	Deep red basaltic soils: Frayne family (3).	Open grassy woodland as in unit 1.	WGBP
4	2	Hills: mainly less than 30 m high, but up to 60 m; rounded, rocky crests and benched slopes up to 60% with boulder mantles.	Mainly outcrop with shallow red basaltic soils: Walsh family (4).	Low open grassy woodland, scattered shrubs with <i>Sehima nervosum</i> - <i>Sorghum</i> spp. ground storey. <i>E. tectifica</i> alliance (14a).	ASHP
5	3	Drainage floors: up to 800 m wide, gradients 1 in 200 m and 1 in 500; central channelled tracts up to 90 m wide.	Limited areas of soils. Reddish clayey alluvial soils: Fitzroy family (22).	Low, open grassy woodland with scattered shrubs and <i>Sehima nervosum</i> - <i>Sorghum</i> spp. ground storey. Community 14a.	WGBP
6	6	Channels: up to 30 m wide and 3 m deep.	Bed-loads range from fine sand to cobbles.	Fringing forest or woodland. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (41, 42); and 33 on smaller channels.	FRIP

Comparable to a combination of Isdell, Barton, and Kennedy land systems. North Kimberley (NKY) area.

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

DINNABUNG LAND SYSTEM (Dbg)

1049 km²

Source: OVC

Many small areas of timbered gently undulating limestone country scattered throughout the northern part of the OVC survey area.

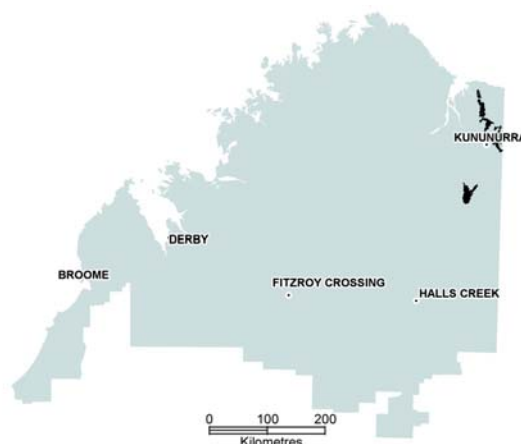
State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology: Limestone and shale. Calcareous and dolomitic sediments of Permian, Upper Devonian, Middle Cambrian, and Adelaidean age.

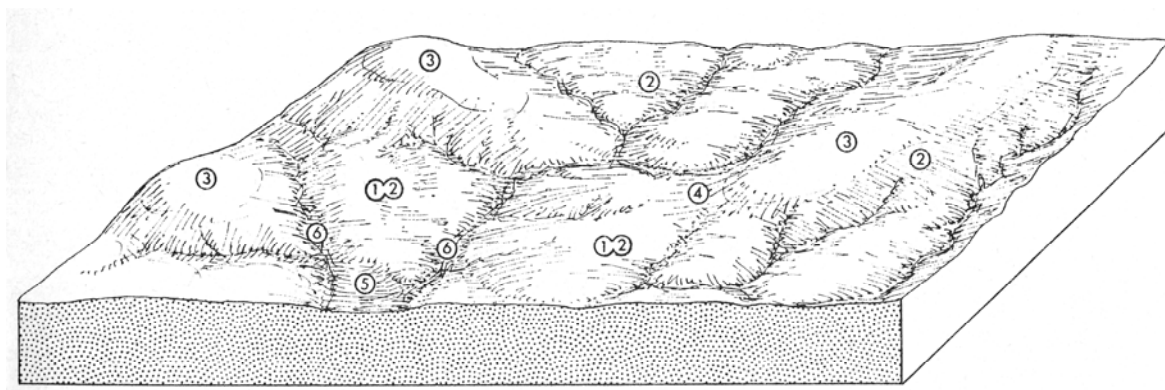
Geomorphology: Coastal erosional plains and limestone structural benches.

Drainage: Moderately spaced angular, rectangular, and dendritic drainage patterns; the shallow depressions flooded for very short periods.

Land management: This system supports useful and preferred pastures for grazing. Low susceptibility to erosion; control of grazing pressures and appropriate fire management needed.



*Plains and gentle slopes of the Dinnabung land system often have shallow soils with frequent limestone outcrop and support low eucalypt woodlands.
Photo: DAFWA*



Stylised block diagram showing location of land units

DINNABUNG LAND SYSTEM (Dbg) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	20	Gentle slopes	Tippera - brown sandy loam over permeable red clay, with scattered limestone outcrops	Northern box - bloodwood woodland (<i>Eucalyptus tectifica</i> , <i>Corymbia confertiflora</i> , <i>C. foelscheana</i> , <i>E. argillacea</i> form C) with Tippera tall grass (<i>Themeda triandra</i> , <i>Sorghum plumosum</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>).	TTGP
2	50	Gentle slopes	Elliott - grey sandy loam over mottled yellow clay, with scattered limestone outcrops.	As unit 1. Smaller areas silver-leaved box, sparse low woodland (<i>E. pruinosa</i>) with Tippera tall grass.	TTGP
3	20	Crests and low rises	Limestone outcrops with pocket of Tippera in north and of Tobermorey in south.	As unit 1. Very stony areas deciduous sparse low woodland with upland tall grass.	CAHP
4	3	Gentle slopes or slight depressions	Springvale - shallow dark grey clay loam over soft limestone.	Bloodwood-southern box low woodland (<i>C. opaca</i> , <i>C. confertiflora</i>) with Tippera tall grass.	TTGP
5	5	Lower gentle slopes of depressions	Cununurra - grey cracking clay.	Trees absent on downs sparse low woodland (<i>Bauhinia cunninghamii</i>) with bluegrass tall grass (<i>Dichanthium</i> spp., <i>Sorghum plumosum</i>).	FRIP
6	2	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



Dinnabung land system frequently occurs as broad expanses of gentle slopes between the limestone hills of Tanmurra land system (foreground and background)

Photo: Noel Schoknecht, DAFWA

DJADA LAND SYSTEM (Dja)

4437 km²

Source: WKY

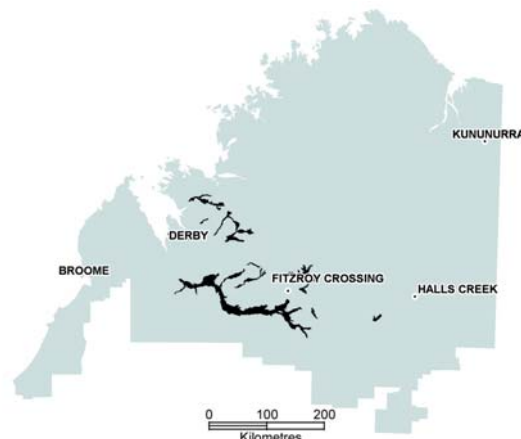
Active floodplains with extensive back plains of cracking clays, grasslands and grassy woodlands.

State land type: River plains with grassy woodlands and tussock grasslands.

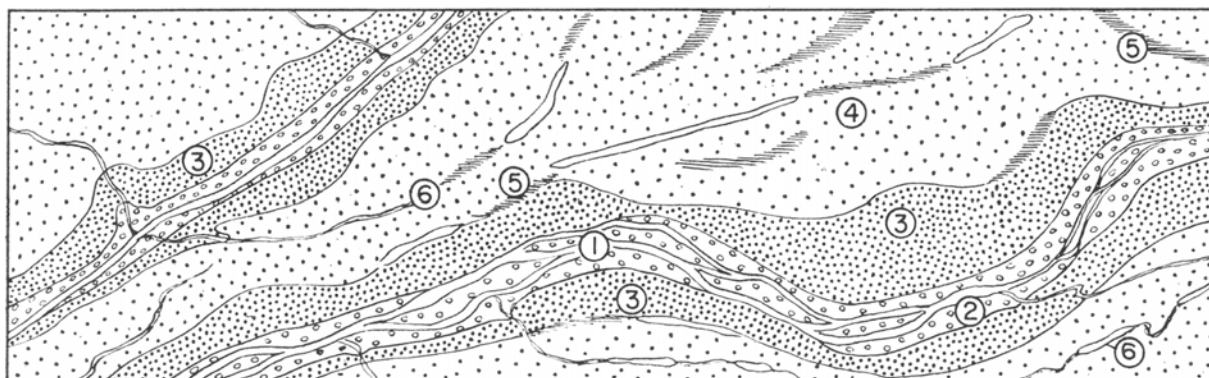
Geology: Quaternary alluvium.

Geomorphology: Alluvial plains - active floodplains: extensive back plains of dark cracking clays with shallow linear depressions and deeper billabongs, traversed by minor channels; scalded, levee zones flanking meandering and anastomosing channels; main gradients between 1 in 2000 and 1 in 4000 but up to 1 in 400 on tributary floodplains.

Land management: Substantial parts of the system are subject to regular flooding which restricts access. Pastures are highly preferred by cattle and are prone to overuse and degradation. Levee crests and levee back slopes (units 2 & 3) are highly susceptible to erosion; control of grazing pressure is essential.



Levee backslopes of the Djada land system are subject to fairly regular flooding and support productive grassy woodlands with coolibah (*Eucalyptus microtheca*) and ghost gum (*Corymbia bella*).
Photo: DAFWA



Stylised plan diagram showing arrangement of land units

DJADA LAND SYSTEM (Dja) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type*
1	5	Main channels: up to 800 m wide and 12 m deep.	Channels no soils. Banks brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (42, 43).	XXNP 80% FRIP 20%
2	8	Levee crests: mainly up to 1.5 m high and 400 m wide, but attaining 800 m inside meanders; bank slopes up to 1%.	Mainly clayey alluvial soils: Fitzroy family (22).	Open grassy woodland with scattered or patchy shrubs moderately dense, tall to medium-height grass layer, and patches of short annual grasses. <i>Corymbia bella</i> alliance (22a); locally 22b. Forbs seasonal. [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common].	FRGP 80% BUGP 20%
3	24	Levee backslopes: up to 0.5% and 800 m long, locally up to 3.4 km long; broadly undulating with low rises up to 610 m across and local slopes up to 1%: hummocky, scalded surfaces.	Brownish juvenile cracking clays (16).	Very open grassy woodland or grassland. Subject to degradation and scalding. Patchy, tall to medium-height grasses, short annual grasses, and forbs in season. <i>Corymbia bella</i> , <i>E. microtheca</i> , and <i>Bauhinia cunninghamii</i> alliances (20a, 20b, 21, 22a, 37a, 38c); and locally 48. Highest-rainfall parts also include 23, 24. [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common].	FRGP 90% BUGP 10%
4	46	Back plains: almost flat plains up 8 km wide with marginal slopes up to 0.2%, including rises up to 1 m high and 1.6 km across with slopes up to 0.4%; sealed, hummocky surfaces with microrelief, and gilgais up to 1 m deep locally.	Mainly dark self-mulching clays with some dark brown self-mulching clays: Cununurra (12) and Wonardo (14) families.	Grasslands with scattered trees arid shrubs. <i>Astrelba</i> spp, and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48); locally 20b, 37b, 55. Also areas of annual grasses and forbs.	MGAP 80% RAPP 20%
5	7	Depressions: up to 800 m wide and 1 m deep; hummocky, sealed surfaces.	Grey crusty heavy clays Myroodah family (13).	Variable, but commonly tall to medium-height perennial grasses. <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> and <i>Chrysopogon</i> spp. communities (48, 49). Locally annual grasses or forbs.	RAPP
6	10	Minor channels and billabongs: channels up 60 m wide and 4.5 m deep, occurring singly or in zones up to 2.5 km wide; billabongs up to 25 m wide and 3.2 km long, often linked in series.	Brownish, massive, intractable, silty to heavy clay in (30).	Fringing woodlands (20a, 20c, 21).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

DOCKRELL LAND SYSTEM (Dok)

6038 km²

Source: WKY, OVC

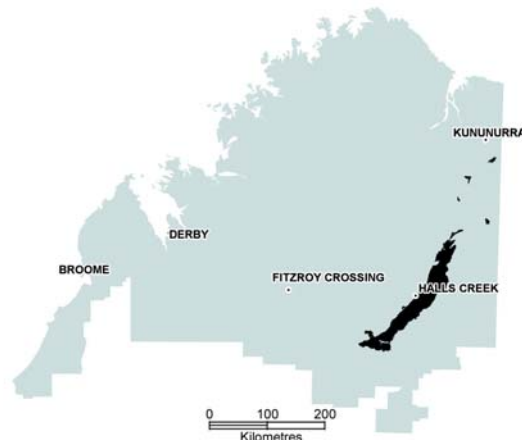
Rocky, mountain ridges on metamorphic rocks, skeletal soils, open stunted woodlands with spinifex.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

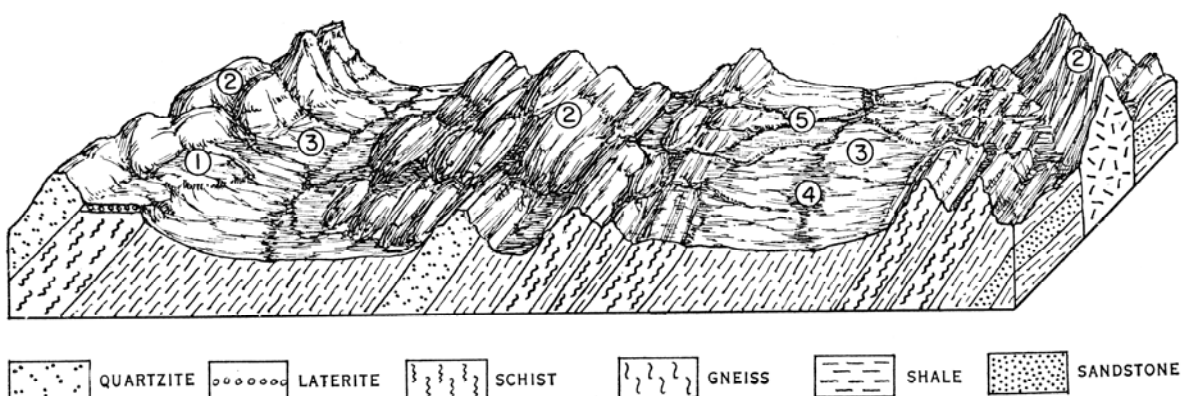
Geology: Strongly metamorphosed quartzite, schist, sandstone, slate, and shale, with quartz veins and dolerite intrusions.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: mountain ranges in strike belts up to 22.5 km wide, with closely-spaced strike ridges above the level of, or produced by dissection of, restricted lateritized remnants, and with strike-aligned valley plains; dense rectangular pattern of incised drainage with strike-controlled trunk drainage; relief up to 150 m.

Land management: A rough hill system with hard spinifex vegetation; very low pastoral value, stable, very low susceptibility to erosion.



Low parallel ridges on metamorphic rocks of the Dockrell land system support hard spinifex (*Triodia* spp.) and isolated small trees of snappy gum (*Eucalyptus brevifolia*). Photo: David Hadden, DAFWA



Stylised block diagram showing location of land units

DOCKRELL LAND SYSTEM (Dok) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type+
1	2	Stable remnants: up to 3.2 km in extent; sandy slopes mainly less than 1% but with marginal slopes up to 5%; laterite exposures locally.	Reddish sandy soils with laterite horizon: Yabbagoddy family (1).	Woodland with patches of dense <i>Acacia</i> shrubs and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> community (1d).	CSPP
2	47	Ridges: up to 150 m high and 4.8 km long; narrow, rocky crests and benched slopes up to 70%, locally vertical with basal scree slopes up to 35%; concave lower slopes up to 10% and 800 m long, colluvial mantles and local outcrop.	Much outcrop with shallow, micaceous sandy skeletal soils (24).	Open woodland of small, stunted trees, moderately dense to sparse shrub layer and <i>Triodia intermedia</i> and <i>T. inutilis</i> , <i>E. brevifolia</i> alliance (1a, 1b).	HSHP
3	33	Valley plains: up to 4.8 km wide and 16 km long, cobble-strewn slopes mainly less than 0.5%; dissected up to 9 m with local slopes up to 10%.	Shallow brownish sands and loams over red clay commonly high in rock fragments: Moonah family (17).	As for unit 2.	HSPP
4	8	Alluvial drainage floors: up to 400 m wide, gradients 1 in 100 to 1 in 500.	Locally developed, commonly scalded areas of greyish to brownish sands and loams over tough clays: Hooper family (20).	Open spinifex grassland with scattered low trees and shrubs. <i>Triodia intermedia</i> commonly (57).	HSPP
5	10	Channels: up to 30 m wide and 4.5 m deep, ranging from hillslope channels, gradients up to 1 in 30 to main channels with gradients as low as 1 in 500.	Channels bed-loads range from sand to boulders. Banks, probably brownish sandy and loamy alluvial soils: Robinson family (21).	Small streams fringed by low trees and spinifex of adjacent community. <i>E. brevifolia</i> commonly (1a). Larger streams with fringing woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (40).	HSPP 50% FRIP 50%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

DUFFER LAND SYSTEM (Duf)

667 km²

Source: WKY

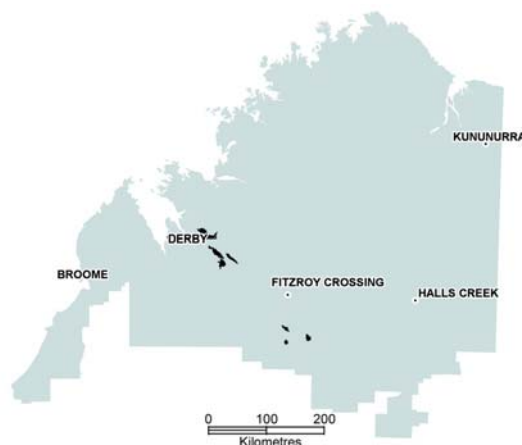
Cracking clay plains with grasslands and scattered trees and shrubs.

State land type: Alluvial plains with tussock grasslands.

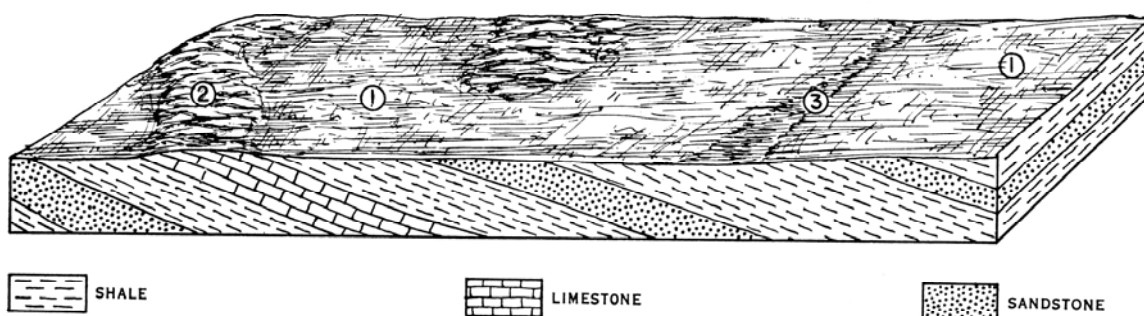
Geology: Gently folded Permian shale, siltstone, limestone, and sandstone; Triassic shale.

Geomorphology: Formed by partial dissection of the Fitzroy surface - plains: strike tracts up to 32 km long and 16 km wide, comprising almost flat cracking clay plains and restricted outcrop plains; sparse ill-defined pattern of strike-controlled drainage; relief less than 3 m.

Land management: Pastures on the system are preferred by cattle and control of grazing pressure is needed to prevent decline in condition; generally low susceptibility to erosion.



*The Duffer land system consists largely of plains with cracking clay soils developed in situ on shales and siltstones. It supports productive Mitchell grass (*Astrebla* spp.) and ribbon grass (*Chrysopogon fallax*) grasslands.
Photo: DAFWA*



Stylised block diagram showing location of land units

DUFFER LAND SYSTEM (Duf) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	86	Cracking clay plains: up to 16 km wide with slopes less than 0.2%; sealed cracking surfaces with gilgais locally.	Dark grey and brown self-mulching heavy clays: Cununurra (12) and Wonardo (14) families.	Grasslands with scattered trees and shrubs. <i>Astrebla</i> spp. and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48); locally 37a.	MGAP 60% RAPP 40%
2	10	Outcrop plains: up to 1.6 km wide; cobble-strewn slopes up to 2% with local outcrop.	Yellowish sandy soils of variable depth: Tableland family (5). Some outcrop.	Open grassy woodland with <i>Chrysopogon</i> spp. <i>Corymbia dichromophloia</i> - <i>C. grandifolia</i> community (12).	RGRP
3	4	Drainage floors: up to 275 m wide with numerous shallow channels; gradients 1 in 200 to 1 in 500.	Clayey alluvial soils: Fitzroy family (22) and juvenile cracking clays (16).	Open coolabah and <i>Bauhinia</i> fringing communities. <i>Eucalyptus microtheca</i> and <i>Bauhinia cunninghamii</i> alliances (20a, 20c, 39).	RAPP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



Impressive lightning displays are common sights associated with wet season storms – this example over the plains west of Duffer land system near Christmas Creek Station, south-east of Fitzroy Crossing.

Photo: Kane Lyons (Panoramio.com)

EGAN LAND SYSTEM (Egn)

1621 km²

Source: WKY

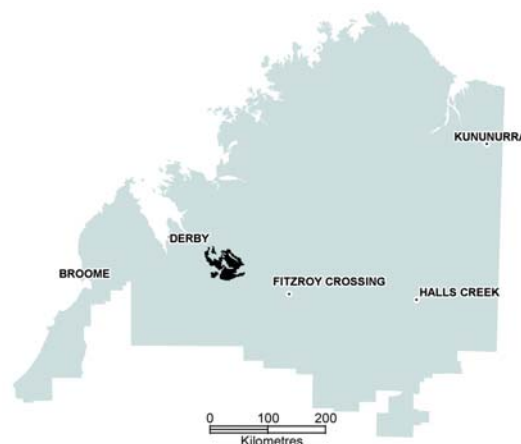
Outcrop plains with low lateritic rises, grassy woodlands and spinifex. Restricted cracking clay plains.

State land type: Plains with low woodlands and spinifex/tussock grasslands.

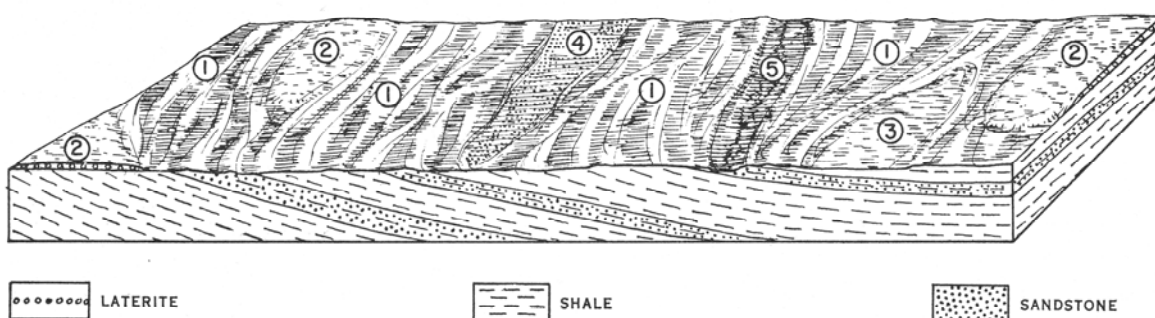
Geology: Weathered gently folded silty sandstone and shale of Permian and Triassic age; Quaternary aeolian sands.

Geomorphology: Formed by partial dissection of the Fitzroy surface - plains: plains up to 12.8 km wide, extending along the strike up to 38.6 km, with low, lightly stripped lateritic rises, restricted black earth plains, and minor sandplain tracts; sparse, ill-defined drainage pattern locally with alluvial floors; relief less than 3 m.

Land management: Most of the system supports pastures which are attractive to cattle and are prone to degradation where grazing is uncontrolled; the major plains and drainage floors (units 1 & 5) are moderately susceptible to erosion in the form of surface sealing and scalding; controlled stocking required.



Near level plains of the Egan land system support low grassy woodlands on gravelly loam soils and often feature numerous yellowish termite mounds. Photo: DAWFA



●●●●●● LATERITE

▨ SHALE

▨ SANDSTONE

Stylised block diagram showing location of land units

EGAN LAND SYSTEM (Egn) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	70	Plains: slopes mainly less than 0.5%, but attaining 1% locally; bevelled outcrop evident in linear rises less than 0.3 m high and up to 180 m wide; extensively scalded sandy surfaces with pisolith detritus.	Yellowish loamy soils, commonly with lateritic gravels: Elliott family (6).	Low grassy woodland with variable shrub layers and ground storeys. <i>Corymbia dichromophloia</i> , <i>Grevillea striata</i> , and <i>Bauhinia cunninghamii</i> alliances (11, 34a, 37a, 38c); also locally 8d, 10, 49 55.	RGRP
2	15	Lightly stripped rises: less than 3 m high and up to 1.6 km wide; sandy surfaces with lateritic detritus.	Reddish sandy and loamy soils, commonly with rock fragments and/or lateritic gravels: Yabbagoddy (1) and Tippera 2) families.	Open spinifex. <i>Triodia intermedia</i> community (57); with patches of 10 and 16.	HSPP
3	8	Cracking clay plains: up to 1.6 km wide and extending along the strike for up to 4.8 km; gilgais and scalds locally, with cobble patches.	Light olive brown self-mulching clays: Wonardo family (14).	Mitchell grass and ribbon grass-bluegrass grasslands. <i>Astrebla</i> spp. and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48).	MGAP 50% RAPP 50%
4	5	Sandplain: up to 800 m wide, with slopes less than 1%.	Deep red sands: Cockatoo family (7).	Low woodland (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. ground storey. <i>C. dichromophloia</i> - <i>C. zygophylla</i> - <i>Acacia</i> spp. community (10).	PINP
5	2	Drainage floors: up to 400 m wide, gradients 1 in 200 to 1 in 500; sealed, scalded surfaces with numerous runnels and locally with channels up to 9 m wide and 1.2 m deep; bed-loads of deep sand.	Probably brownish sand and loams over red clay: Moonah family (17). Minor reddish loamy soils: Tippera family (2).	Grassy woodland with <i>Chrysopogon</i> spp. and frontage grasses. <i>C. dichromophloia</i> and <i>Adansonia gregorii</i> alliances (12, 33).	FRGP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

EIGHTY MILE LAND SYSTEM (Eig)

160 km²

Source*: PRP, BRM

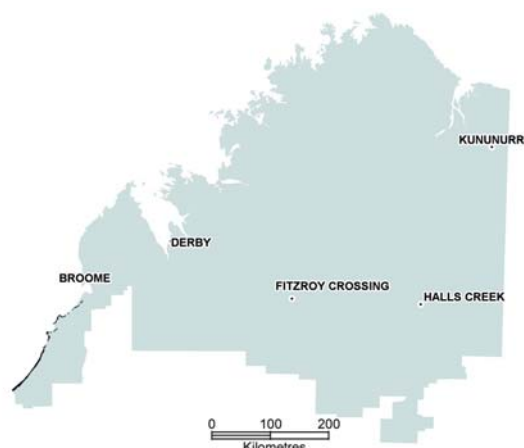
Beach foredunes, coastal dunes and sandy plains supporting buffel grass grasslands and soft spinifex grasslands.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

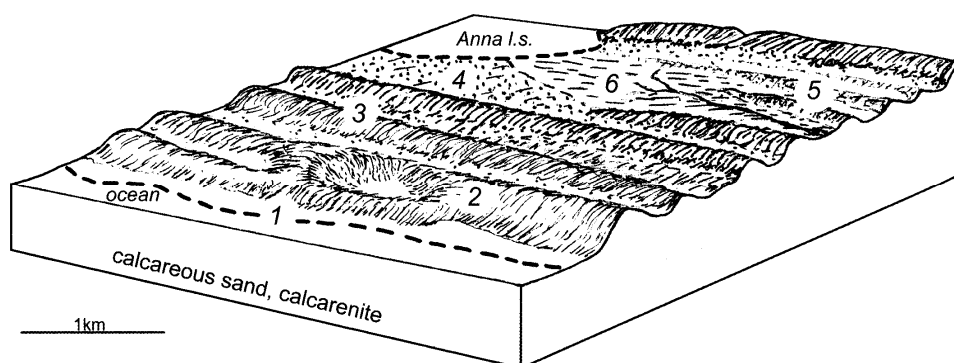
Geology: Quaternary aeolian calcareous sand, quartzose calcarenite, minor clay and silt.

Geomorphology: Depositional surfaces; beaches, unconsolidated (but largely stabilised) foredunes and unconsolidated to partly consolidated hind dunes mostly parallel but also reticulate; narrow sandy swales and broader sandy plains, minor interdunal corridors with more saline soils, narrow limestone ridges; no organised drainage. Relief up to 15 m.

Land management: Dunes stable when heavily vegetated but highly susceptible to wind erosion if vegetation is lost by overgrazing, fire or other disturbance and can result in large blow-outs and sand drifts.



*Eighty Mile land system showing foredunes and hind dunes parallel to the coast. White patches are minor blowouts. The width of this 2004 aerial photograph is about 1.5 km.
Photo: Landgate*



Stylised block diagram showing location of land units

* This land system is described in the Pilbara Ranges Report (Van Vreeswyk et al. 2004) and the Broome Shire report (Cotching 2005). The descriptions differ, and the Pilbara Ranges Report description is presented here as it is more representative of the entire occurrence of this land system.

EIGHTY MILE LAND SYSTEM (Eig) – land units

Unit	Approx. area (%)	Landforms	Soils ⁺⁺	Vegetation	Pasture type ⁺
1	1	Beaches: narrow shelly sand beaches on seaward side of foredunes.	Calcareous deep sands (442).	No vegetation.	XXNP
2	5	Foredunes: unconsolidated dunes extending up to 150 m inland from beaches with gently to moderately inclined slopes and uneven, hummocky crests; relief up to 15 m.	Calcareous deep sands (442).	Hummock grasslands with <i>Spinifex longifolius</i> (coastal spinifex), <i>Whiteochloa airoides</i> (dune tussock grass), <i>Triodia pungens</i> and <i>T. epactia</i> (soft spinifex).	CDSG
3	42	Hind dunes and swales: parallel and reticulate hind dunes and old beach ridges with gently to moderately inclined slopes and narrow (25-200 m wide) level swales between crests; relief up to 15 m.	Calcareous deep sands (442).	Tussock grasslands of <i>Cenchrus ciliaris</i> (buffel grass), some other perennial grasses such as <i>Dichanthium</i> , <i>Triodia</i> and <i>Sporobolus</i> spp.	CDBG 80% CDSG 20%
4	30	Sandy plains: level or very gently inclined plains extending for 1-2 km between other units or as plains adjacent to the Anna land system.	Calcareous deep sands (442).	Tussock grasslands of <i>Cenchrus ciliaris</i> with isolated shrubs. Less frequently hummock grasslands of <i>T. pungens</i> , <i>T. epactia</i> with isolated shrubs.	BUGP** 60% SSSG 40%
5	10	Limestone ridges: narrow (usually < 100 m wide) ridges up to 4 km long with gently inclined slopes, abundant outcrop of rough limestone with solution holes and sink holes.	Red shallow sands (423).	Hummock grasslands of <i>T. epactia</i> , <i>T. pungens</i> with very scattered shrubs.	CASG
6	12	Saline plains: level plains with saline alluvium occurring as inclusions up to 500 m in extent with sandy plains (unit 4) or as narrow corridors between dunes of unit 3.	Grey calcareous loamy earths (542) and grey deep loamy duplex soils (509).	Grasslands and low grassy shrublands with <i>Sporobolus virginicus</i> (salt water couch), <i>Eragrostis falcata</i> (sickle lovegrass), <i>Tecticornia</i> spp. (samphire) and <i>Frankenia</i> spp. (frankenian)	MACP*** 60% SMPP**** 40%

+ Pasture types described in Appendix 1.

++ Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

** BUGP is equivalent to APBG in Pilbara report (Van Vreeswyk et al. 2004).

*** MACP is equivalent to SPSP in the Pilbara report (Van Vreeswyk et al. 2004).

**** SMPP is equivalent to PSPS in the Pilbara report (Van Vreeswyk et al. 2004).

ELDER LAND SYSTEM (Edr)

1249 km²

Source: OVC

Rugged sandstone hills in the central-western part of the Ord Victoria survey area.

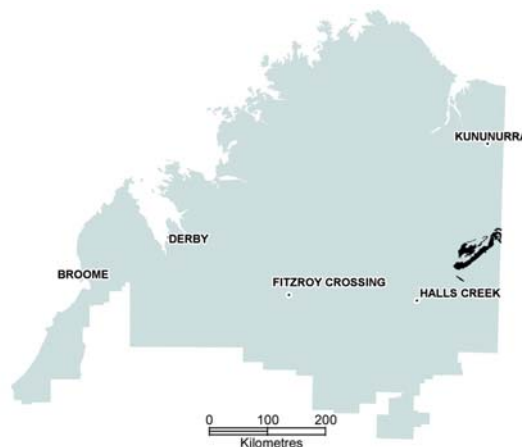
State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

Geology: Sandstone. Upper Devonian (Elder Sandstone).

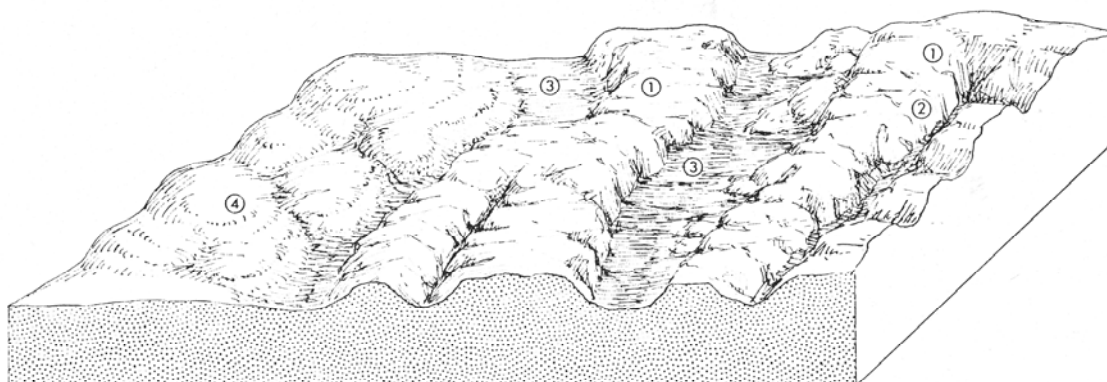
Geomorphology: Sandstone structural plateaux (asymmetric basin) and sandstone-shale cuestas (asymmetric basin).

Drainage: Angular and rectangular patterns of moderate to high intensity.

Land management: Most of the system falls within the Purnululu National Park or the Ord River Regeneration project area and is not grazed by cattle. It is inherently stable and not prone to erosion; controlled burning programs needed to minimise risk of wildfires.



*The most spectacular expressions of the Elder land system are the unique sandstone beehives of the Bungle Bungles (Purnululu National Park).
Photo: Noel Schoknecht, DAFWA*

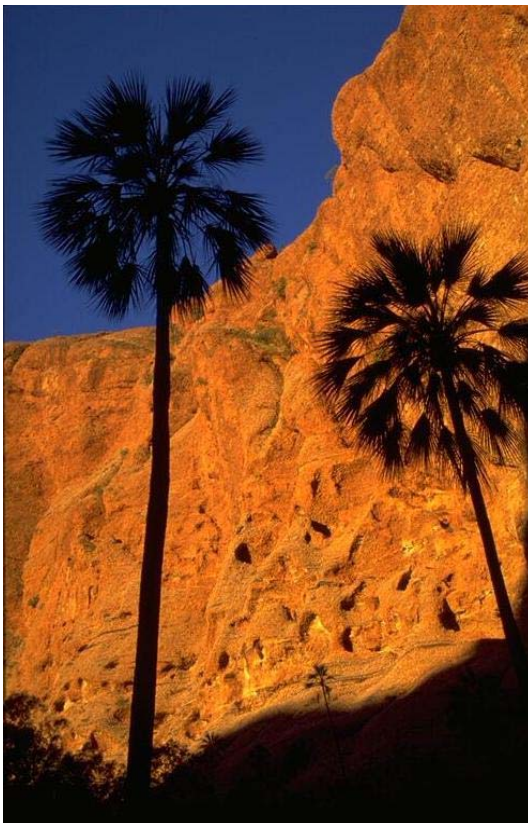


Stylised block diagram showing location of land units

ELDER LAND SYSTEM (Edr) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	60	Very rugged hills	Sandstone outcrops.	Snappy gum (<i>Eucalyptus brevifolia</i>) or silver-leaved box (<i>E. pruinosa</i>) sparse low woodlands with soft or hard spinifex.	HSHP 60% SSPP 40%
2	5	Moderate to steep slopes within unit 1	Outcrops with patches of skeletal soils and shallow red and yellow soils.	As for unit 1.	HSHP 60% SSPP 40%
3	10	Gently sloping sandplains and valley floors	Cockatoo - deep red sand.	Silver-leaved box sparse low woodland (<i>E. pruinosa</i> - <i>Corymbia grandifolia</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	TAPP
4	25	Undulating to low hilly country	Alternating outcrop and sandy soils. Cockatoo - deep red sand; minor Tippera.	Snappy gum (<i>E. brevifolia</i>) or silver-leaved box (<i>E. pruinosa</i>) sparse low woodlands with soft or hard spinifex on outcrop areas and threeawn mid-height grass on areas with soils.	HSHP 60% SSPP 20% TAPP 20%

+ Pasture types described in Appendix 1.



Sunsets in the Bungle Bungle Range are an impressive sight.

Above: The northern end of the western escarpment of the Bungles Massif.

Left: *Livistona* palms guarding the entrance to *Echidna* chasm.

Photos: Noel Schoknecht, DAFWA

FORK LAND SYSTEM (Fok)

1057 km²

Source: WKY

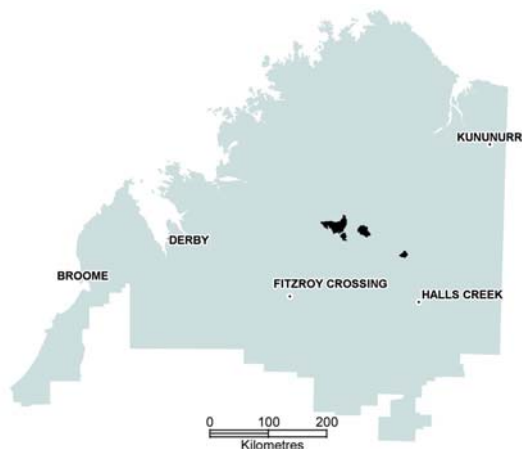
Upland plains and rocky undulating country, sandy and skeletal soils, low open woodlands with shrubs and curly spinifex.

State land type: Undulating plains and uplands with eucalypt woodlands and spinifex.

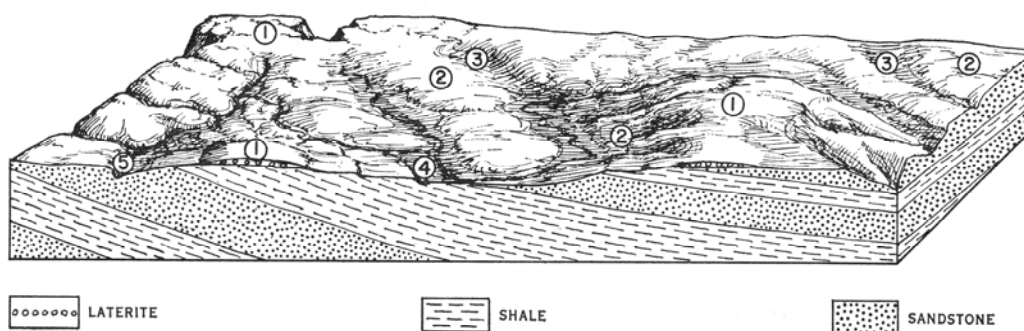
Geology: Lateritized or relatively unweathered, gently dipping sandstone and shale of Upper Proterozoic age.

Geomorphology: Formed by dissection of the Kimberley surface - undulating terrain: rocky surfaces, comprising rounded hills less than 30 m high, and cuestas up to 15 m high, with upland plains and gently rounded interfluve crests; moderately dense branching pattern of incised valleys with shallow unchannelled floors in upper parts; relief less than 30 m, but marginal escarpments up to 90 m high.

Land management: A rocky system little used for grazing; although (like most systems) it is subjected to regular burning it is inherently resilient with very low susceptibility to erosion.



Underlying sandstone and shale geology create distinctive patterns on the Fork land system. Shallow gorges and seepage zones show as green areas. Width of this 2008 aerial photograph is about 7 km. Photo: Landgate



Stylised block diagram showing location of land units

FORK LAND SYSTEM (Fok) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	13	Plains and interfluvial crests: plains up to 3.2 km wide and interfluvial crests up to 1.6 km wide; sandy slopes less than 1% with pebble patches.	Mainly yellowish sandy soils high in laterite gravels: Table-land family (5). Some yellowish loamy soils, high in laterite gravels and slate fragments: Elliott family (6).	Low woodland with moderately dense to dense shrub layers and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> and <i>E. phoenicea</i> alliances (5, 7). Locally, <i>Melaleuca</i> thickets (36).	CSPP
2	65	Rocky surfaces: up to 4.8 km in extent; benched hillslopes up to 70% and cuesta dip slopes up to 5%; boulder mantles and laterite exposure locally.	Much rock outcrop with yellowish and reddish gravelly skeletal soils and some laterite remnants (24).	Low woodlands with moderately dense shrub layer and <i>Triodia bitextura</i> . <i>E. phoenicea</i> - <i>Corymbia ferruginea</i> alliance (7); locally 1a and 36.	CAHP
3	11	Headwater valley floors: up to 800 m wide; sandy slopes up to 2%; with lightly sealed surfaces and pebble patches.	Yellowish loamy soils, commonly with moderate amounts of rock fragments: Elliott family (6).	Grassy woodlands characterised by <i>Aristida hygrometrica</i> . <i>C. polycarpa</i> commonly (25), locally 36.	TAPP
4	4	Drainage floors: up to 400 m wide, gradients 1 in 100 to 1 in 300.	Limited areas of clayey alluvial soils: Fitzroy family (22).	As for unit 3.	CSPP
5	7	Channels: up to 30 m wide and 1.8 m deep, incised in bedrock.	Channels, bed-loads range from sand to boulders. Banks brownish stony alluvial soils. Robinson family (21).	Fringing woodlands. <i>E. camaldulensis</i> - <i>Melaleuca</i> spp. fringing community (41).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

FORREST LAND SYSTEM (Fr1)

2347 km²

Source: WKY

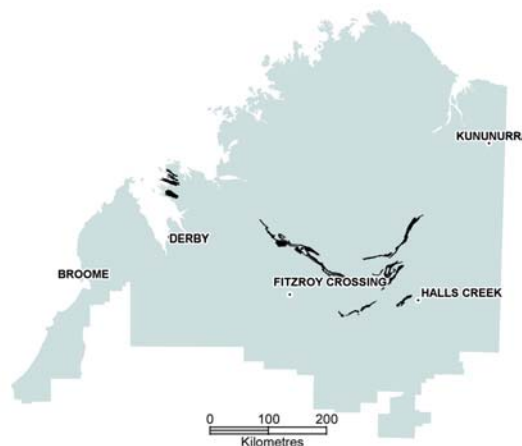
Mountainous country with quartzite ridges and hilly basalt vales, sandy soils and red earths, low open woodlands with spinifex and grassy woodlands.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

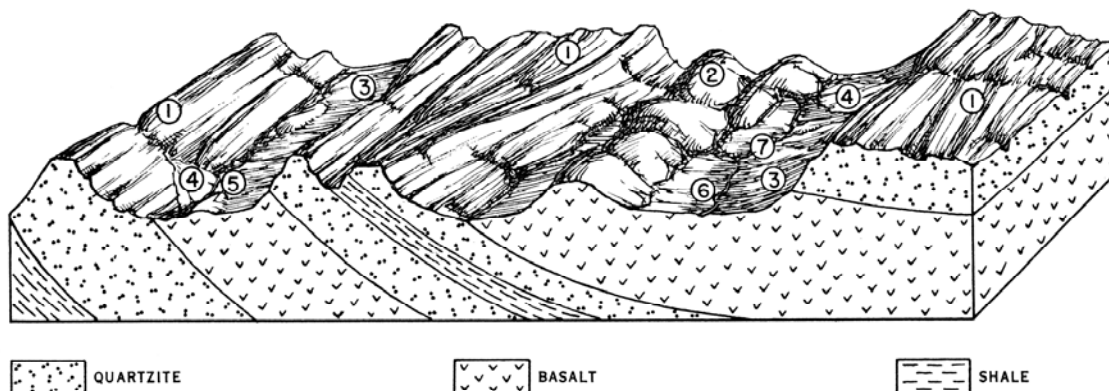
Geology: Folded Upper Proterozoic quartzite, sandstone, and shale, with basalt and dolerite flows of Upper Proterozoic or Lower Cambrian age.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: extensive quartzite ridges, rounded basalt hills, and narrow basalt floors, in strike belts up to 9.6 km and 80 km long; moderately dense, rectangular pattern of incised valleys, comprising strike-controlled trunk drainage and short, steep tributaries.

Land management: Restricted lower parts of this rugged system support pastures which are moderately favoured by cattle but the majority is poorly accessible; controlled grazing is desirable but difficult in this terrain. Low or very low susceptibility to erosion, high scenic amenity.



*This oblique aerial photograph of Dimond Gorge on the Fitzroy River shows a massive sandstone ridge of the Precipice land system (left) and the complex of basaltic low hills (dark) and low quartzite ridges (pale) of the Forrest land system.
Photo: DAFWA*



Stylised block diagram showing location of land units

FORREST LAND SYSTEM (Frt) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	50	Quartzite ridges: up to 150 m high and 32 km long; narrow, rocky crests and benched slopes exceeding 100%; locally with boulder fans up to 275 m long, slopes up to 20%.	Mainly outcrop with areas of shallow, sandy skeletal soil (24), with bouldery yellowish sandy soils on aprons: Tableland family (5).	Open woodland, with scattered shrubs and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> and <i>Corymbia dichromophloia</i> alliances (1d, 3, 6, 8c).	CAHP
2	18	Basalt hills and ridges: 6-60m high, locally up to 4.8 km long; benched rocky slopes up to 60% with basal scree slopes up to 20%.	Mainly outcrop with shallow red basaltic soil: Walsh family (4).	Open box woodland, scattered shrubs and <i>Sehima nervosum</i> - <i>Sorghum</i> spp. ground storey. <i>E. tectifera</i> alliance (15).	CAHP 50% WGBP 50%
3	14	Lower slopes: concave up to 5%, and up to 800 m long; extensively masked with colluvium.	Deep red basaltic soil: Frayne family (3).	Grassy woodland with scattered shrubs and <i>Sehima nervosum</i> - <i>Dichanthium fecundum</i> ground storey. <i>E. tectifera</i> alliance (15).	WGBP
4	5	Alluvial fans: up to 550 m long, gradients between 1 in 20 and 1 in 60; gullies eroded to 3 m.	Yellowish sandy soils high in quartz fragments: Tableland family (5).	Grassy woodlands with scattered shrubs and <i>Triodia bitextura</i> . <i>E. brevifolia</i> and <i>E. tectifera</i> alliances (1d, 14c).	CSPP
5	3	Stony rises: up to 9 m high, gently rounded crests up to 180 m wide, marginal slopes less than 5%.	Dark, weakly self-mulching heavy clays: Cununurra family (12), with fine strew cover.	Very open, low woodlands with <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> and <i>Aristida browniana</i> ground storeys, <i>Bauhinia cunninghamii</i> alliance (37a), 38c).	RAPP
6	2	Drainage floors: up to 275 m wide, gradients 1 in 200 to 1 in 500.	Locally developed reddish and brownish stony, clayey alluvial soils: Fitzroy family (22).	Grassy woodlands with scattered shrubs, fringing grasses, and <i>Aristida hygrometrica</i> . <i>C. bella</i> alliance (22a, 22b).	FRGP
7	8	Channels: up to 90 m wide and 3 m deep, ranging from hillslope channels, gradients up to 1 in 6, to main channels with gradients as low as 1 in 500.	Channels, bed-loads range from sand to boulders. Banks, brownish loamy alluvial soil: Robinson family (21).	Fringing woodland. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (41, 42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

FOSSIL 2 LAND SYSTEM (FsI)*

2606 km²

Source: WKY

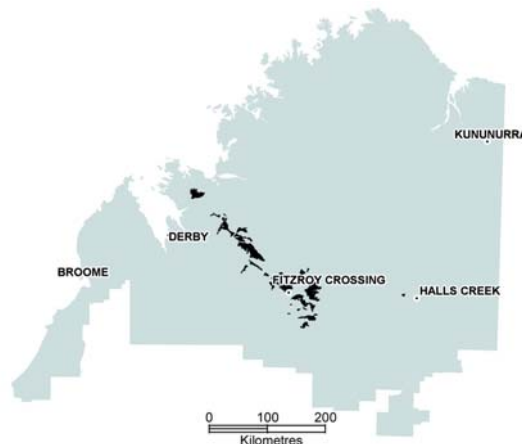
Extensive dark cracking clay plains formed on limestone deposits with grasslands.

State land type: Alluvial plains with tussock grasslands.

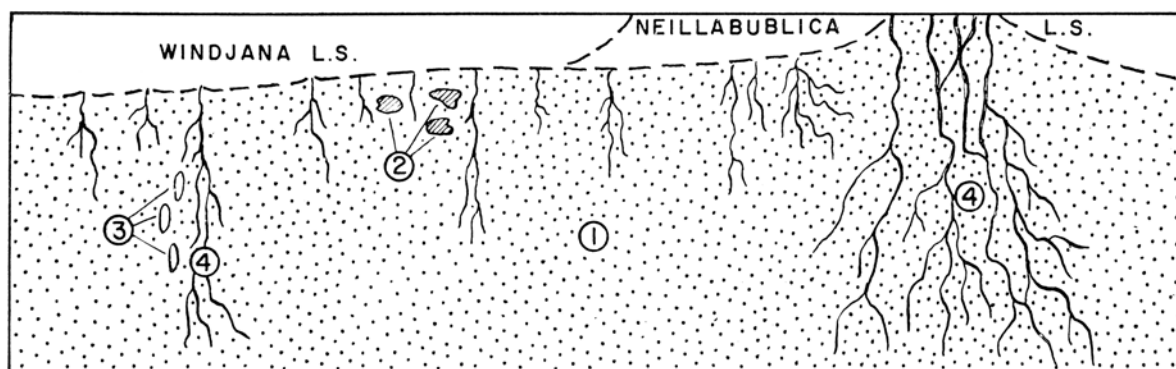
Geology: Quaternary calcareous alluvium; outcrops of Devonian limestone locally.

Geomorphology: Alluvial plains - tributary alluvial plains: strike belts up to 48 km long and 16 km wide at the foot of limestone ranges, comprising cracking clay plains with minor outcrop rises up to 6 m high and restricted, low, linear sandy rises; sparse subparallel pattern of short drainage zones at upper margin, and moderately dense pattern of subparallel anastomosing distributary drainage in belts up to 9.6 km wide in lowest sectors.

Land management: Mitchell and other grass pastures are of very high pastoral value. They are resilient and not prone to degradation unless grazing levels are excessive. Generally low susceptibility to erosion; controlled stocking essential.



*Productive Mitchell grass pastures (Astrebla spp.) - in this instance barley Mitchell grass (Astrebla pectinata) - pastures on cracking clay plains are characteristic of Fossil 2 and numerous other land systems.
Photo: DAFWA*



Stylised plan diagram showing arrangement of land units

* The name Fossil has been applied to two different land systems in Western Australia. Fossil 1 occurs in the Gascoyne and Carnarvon Basin survey areas.

FOSSIL 2 LAND SYSTEM (Fsl) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	83	Cracking clay plains: gradients mainly less than 1 in 500 but up to 1 in 100; locally with marginal dissection up to 6 m; hummocky surfaces with gilgais.	Dark grey and brown, strongly self-mulching heavy clay: Cununurra (12). Wonardo (14) families. Commonly with gilgais.	Mitchell grass, ribbon grass-bluegrass, and ribbon grass grasslands and very open grassy woodlands. <i>Astrelia</i> spp. <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> , and <i>Chrysopogon</i> spp. communities (47, 48, 49) and <i>Bauhinia cunninghamii</i> alliance (37a, 38c); locally 20b.	MGAP 80% RAPP 10% BGAP 10%
2	4	Outcrop slopes: less than 400 m in extent; cobble-strewn slopes up to 10%.	Outcrop with shallow, dark brown and grey, loamy to clayey calcareous soils: Oscar family (11).	Spinifex with scattered trees and shrubs, and open woodlands. <i>Triodia wiseana</i> community (58) and <i>Corymbia dichromophloia</i> alliance (8a, 8b).	HSPP
3	1	Sandy rises: up to 0.6 m high and less than 90 m long, flanked by narrow linear depressions up to 0.3 m deep.	Yellowish sandy soils: Tableland family (5).	Open grassy woodland with <i>Chrysopogon</i> spp. <i>C. dichromophloia</i> - <i>E. argillacea</i> community (9b).	RGRP
4	12	Drainage zone: up to 800 m wide, with numerous channels up to 18 m wide and 4.5 m deep; gradients 1 in 200 to 1 in 2000.	Dark grey and brown, strongly self-mulching heavy cracking clay: Cununurra (12) and Wonardo (14) families.	Open grassy woodland with <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> , frontage grasses, and <i>Chrysopogon</i> spp. ground storeys. <i>Bauhinia cunninghamii</i> alliance (37a, 37b, 39); locally 43.	RAPP 50% BGAP 50%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

FOSTER LAND SYSTEM (Fos)

3309 km²

Source: NKY

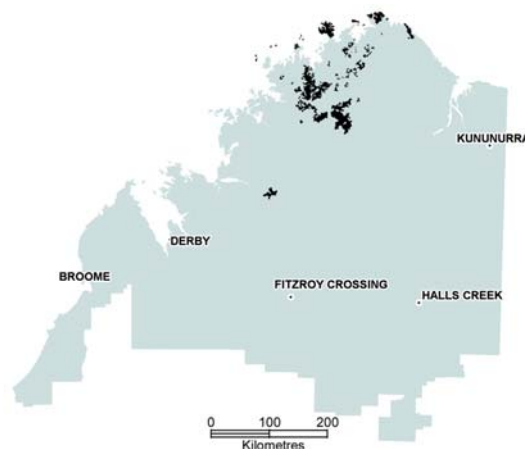
Laterite-capped volcanic mesa and plateau country with open forest vegetation and gravelly soils.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

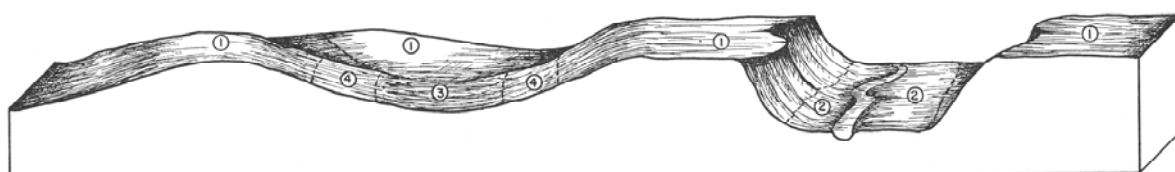
Geology and Geomorphology: Immaturely dissected lateritic plateaux on volcanic rocks, formed on Mornington and younger volcanics. The laterite cappings of the higher parts appear to be remnants of a Tertiary land surface.

Drainage: Sparse, limited to small streamlines between mesas, and widely spaced streamlines of dendritic pattern on uplands.

Land management: Large parts of the system fall within unallocated crown land or conservation reserves and are little grazed. It is generally stable and not prone to erosion. It includes very large deposits of bauxite.



Eucalypt woodlands and forests with a distinctive understorey of fan palms (Livistona sp.) frame the track in this undulating area of Foster land system on the Mitchell Plateau, North Kimberley. Photo: Michal Synowiec (Panoramio.com)



Stylised block diagram showing location of land units

FOSTER LAND SYSTEM (Fos) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	60	Tops of mesas and upland parts of undulating areas	Skeletal laterite.	Woodlands and forests: <i>Eucalyptus tetrodonta</i> (24 , 25 , 28, 29) and <i>Corymbia dichromophloia</i> (40) sub-alliances.	CAHP
2	10	Slopes, flats and stream-lines between mesas	Mixed red levee soils, igneous red earths, and skeletal red earths.	Woodlands: <i>E. tectifica</i> - <i>C. grandifolia</i> (1 , 3) and <i>C. bella</i> (53, 54) alliances.	PLSP 60% TTGP 20% BSGP 20%
3	25	Flats between the laterite uplands	Find-textured yellow podzolics.	Woodlands: <i>C. latifolia</i> alliance (48 , 50) (<i>Livistona</i> sp. forms well-developed understorey).	RGRP 80% CSPP 20%
4	5	Lower portions of the gentle slopes	Lateritic podzolics.	Woodlands: <i>E. tectifica</i> sub-alliance (1).	CSPP 60% RGRP 40%

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



The laterite-capped volcanic rocks of Foster land system are very evident in this aerial oblique photograph of Cape Bougainville jutting out into the Timor Sea in the far North Kimberley. Photo: Robert Wanless (alias R Wanless, Panoramio.com)

FRANKLIN LAND SYSTEM (Frk)

548 km²

Source: OVC

Many small areas of mesas and dissection scarps capped with lateritic material, scattered throughout the southern half of the Ord-Victoria survey area.

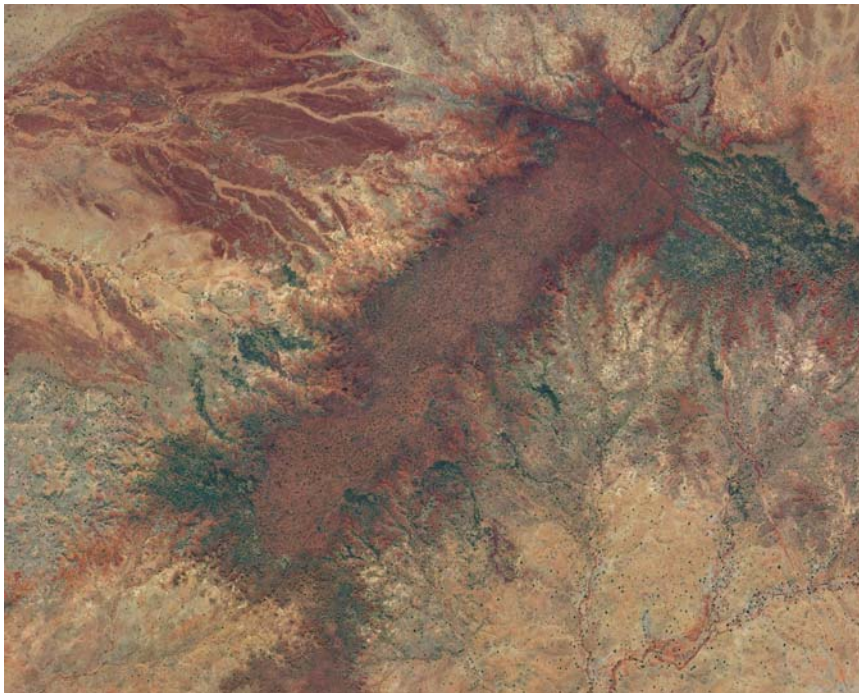
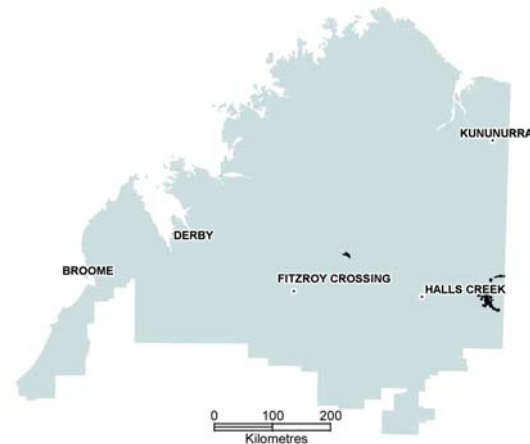
State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Lateritized sediments and volcanics; Lower Cambrian volcanics and Adelaidean sediments.

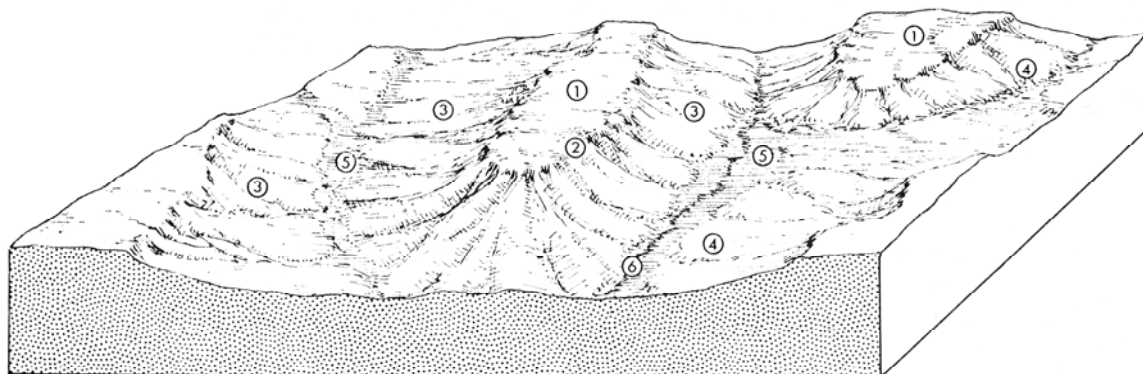
Geomorphology: Dissected elevated lateritic plain.

Drainage: Moderately intense dendritic pattern of both coastal and inland draining streams.

Land management: Lower slopes and valley floors (units 4 & 5) support tussock grass pastures which are attractive to livestock and require controlled stocking to prevent degradation.



This aerial photograph shows a flat mesa top (dark brown in centre) surrounded by highly dissected colluvial slopes of the Franklin land system. The width of this 2005 image is about 3 km. Photo: Landgate



Stylised block diagram showing location of land units

FRANKLIN LAND SYSTEM (Frk) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	10	Gentle slopes above scarps	Wonorah shallow phase - red-brown clay loam with many ferruginous concretions.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) or stringybark - bloodwood woodland (<i>Corymbia dichromophloia</i>), both with soft spinifex (<i>Triodia pungens</i>).	SSPP
2	2	Steep scarps and upper slopes	Outcrops of ferruginous, mottled, and pallid zones with pockets of skeletal soils.	Snappy gum sparse low woodland (<i>E. brevifolia</i>) with soft spinifex (<i>Triodia pungens</i>) or lancewood forest with bare ground.	SSPP
3	50	Moderate colluvial slopes with many small gullies	Shallow reddish soils with much ferruginous gravel.	Snappy gum sparse low woodland (<i>E. brevifolia</i>) with soft spinifex (<i>Triodia pungens</i>) or upland tall grass (<i>Sorghum timorense</i>).	SSPP
4	25	Moderate to gentle lower slopes	Frayne - brown loam merging into dark red clay; some Argyle - brown cracking clay.	Bloodwood - southern box woodland (<i>Corymbia terminalis</i>) with Tippera tall grass (<i>Themeda triandra</i>).	TTGP
5	10	Valley floors	Cununurra - grey cracking clay.	Mitchell and other mid-height grasses (<i>Astrebla pectinata</i> , <i>Aristida latifolia</i>).	MGAP
6	3	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.

FRASER LAND SYSTEM (Fra)

728 km²

Source: WKY

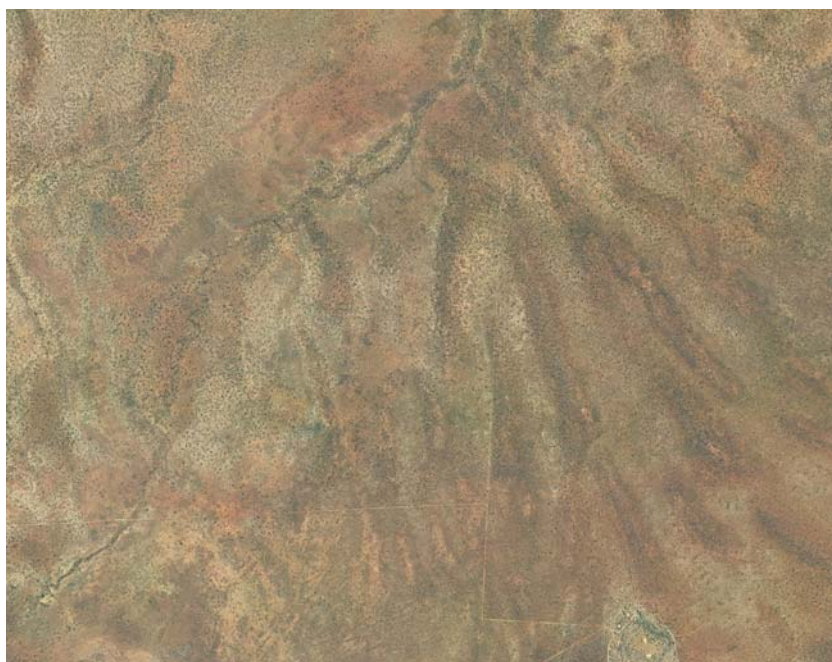
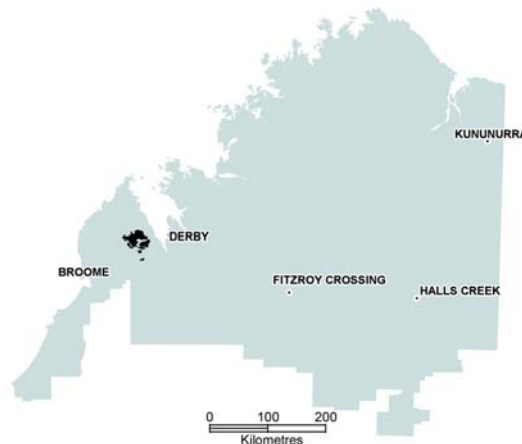
Sandplain with irregular dunes and local stony surfaces, pindan and low grassy woodlands.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

Geology: Quaternary aeolian sand; minor outcrops of gently dipping Cretaceous sandstone.

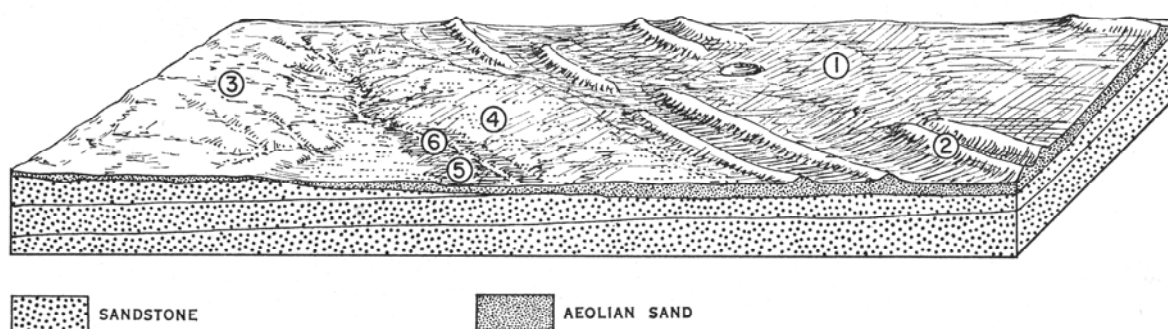
Geomorphology: Sandplain and dunefields with through-going drainage: sandplain with irregular linear dunes, plains with thin sand cover and local outcrop, and low-lying sandplain flanking drainage floors; sparse through-going trunk drainage with branching, locally incised tributaries; relief less than 9 m.

Land management: System is generally stable with low susceptibility to erosion except for sand dunes (unit 2) which have moderate susceptibility immediately after fire but stabilise rapidly after rain. Fire history affects composition and density of pindan vegetation which is resilient under controlled grazing.



Patterns of the Fraser land system result from a mixture of land units such as sandplains, sand dunes, outcrop plains with thin sand cover and drainage floors.

*Width of this 2007 aerial photograph is about 6 km.
Photo: Landgate*



Stylised block diagram showing location of land units

FRASER LAND SYSTEM (Fra) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	36	Sandplains: up to 4.8 km in extent with slopes less than 1%; pans up to 1.2 km wide and 1.5 m deep locally, with bare cracking floors.	Reddish sandy soils: Yabbagoddy family (1). With brownish massive heavy clays in pans (30).	Low woodland (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. ground storey. <i>Corymbia dichromophloia</i> - <i>C. zygomphyla</i> - <i>Acacia</i> spp. community (10).	PINP
2	13	Sand dunes: up to 6.4 km long and 9 m high; flanks slope up to 15%.	Deep red sands: Cockatoo family (7).	Variable. Woodlands as in unit 1. Also more open woodlands with <i>Triodia pungens</i> and <i>Aristida browniana</i> . <i>Bauhinia cunninghamii</i> alliance (38b, 38c).	PINP 70% SSPP 30%
3	16	Sandplains with outcrop: up to 3.2 km in extent with slopes less than 0.5%, marginally dissected up to 9 m into narrow spurs with slopes up to 5%, discontinuous sand mantles and local outcrop.	Shallow, gravelly, reddish skeletal soil (24). Some reddish sandy soils: Yabbagoddy family (1). Some outcrop.	Open woodlands and patches of pindan with <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. ground storey. <i>Adansonia gregorii</i> and <i>C. dichromophloia</i> alliances (31, 10); locally 57 and 54.	PINP
4	27	Low-lying sandplains: up to 1.6 km wide; slopes less than 0.3% but attaining 1% locally.	Yellowish, mottled, sandy soils: Tableland family (5).	Complex of grassy woodlands and pindan vegetation with <i>Chrysopogon</i> spp., and <i>Triodia bitextura</i> . <i>Bauhinia cunninghamii</i> and <i>C. dichromophloia</i> alliances (10, 12, 37b, 38a); locally 34a and 38c.	RGRP 50% PINP 50%
5	4	Drainage floors: up to 275 m wide, gradients 1 in 200 to 1 in 500: sealed, scalded surfaces with sand hummocks.	Probably yellowish, mottled loamy soils: Elliott family (6).	Low grassy woodland with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> and <i>Bauhinia cunninghamii</i> alliances (34a, 37b).	RGRP
6	4	Channels: up to 30 m wide and 3 m deep.	Channels, bed-loads of deep sand. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing woodlands and forests. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (41, 42, 43); also 39.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

FRAYNE LAND SYSTEM (Fry)

1099 km²

Source: OVC

Many small patches scattered throughout the Ord-Victoria survey area of undulating to low hilly basalt country with predominantly red soils.

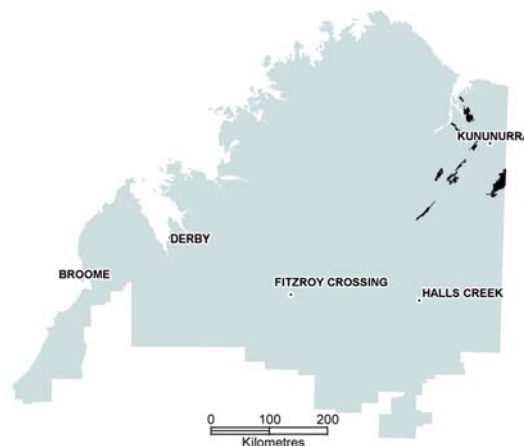
State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology: Basalt agglomerate, and tuff, Lower Cambrian (Antrim Plateau Volcanics); small areas of Carpentarian dolerite.

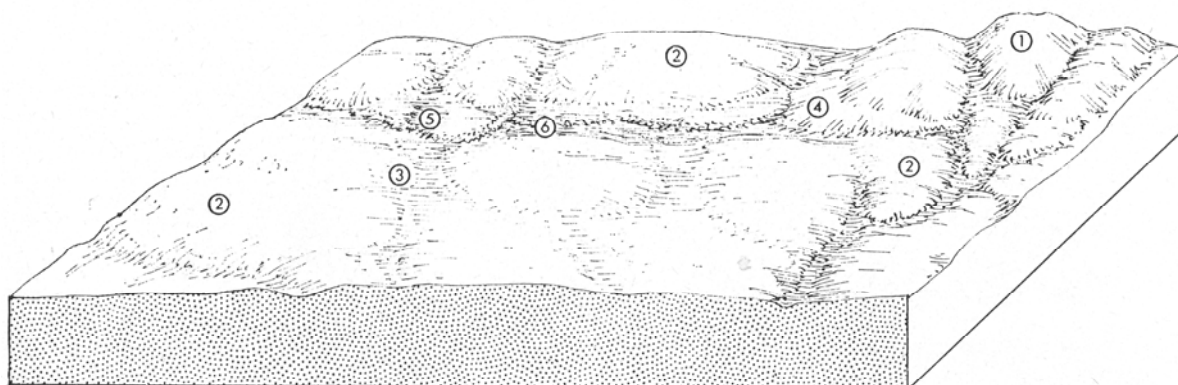
Geomorphology: Volcanic structural benches, and coastal and inland erosional plains.

Drainage: Moderately intense angular or rectangular drainage on the benches and mostly moderately intense dendritic on the inland and coastal plains.

Land management: This accessible system supports pastures which are preferred by cattle; most parts have low susceptibility to erosion except unit 4 which has moderate susceptibility when degraded. Controlled stocking is required.



*Moderate to gentle slopes on basalt are a major part (unit 2) of the Frayne land system, here supporting inland bloodwood (*Corymbia opaca*), annual sorghum (*Sorghum* spp.) and tussock grasses.
Photo: Noel Schoknecht, DAFWA*



Stylised block diagram showing location of land units

FRAYNE LAND SYSTEM (Fry) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	10	Rounded hills or structural benches in the east; bouldery rugged hills in the west	Mostly rock outcrops and basalt boulders, with pockets of skeletal soil.	Deciduous sparse low woodland with upland tall grass. Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) or trees absent with soft spinifex (<i>Triodia pungens</i>).	ASHP
2	65	Moderate to gentle slopes	Mostly Frayne - brown loam merging into dark red clay; some brown clay skeletal soils and small areas of Elliott.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i> , <i>E. limitaris</i> and <i>E. tephrodes</i>) or silver leaved box sparse low woodland (<i>E. pruinosa</i>) with Tippera tall grass (<i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>).	TTGP
3	10	Gentle slopes	Cununurra and Barkly - grey and brown cracking heavy clay.	Downs sparse low woodland (<i>Terminalia arostrata</i> , <i>T. volucris</i>), or trees absent with bluegrass tall grass (<i>Dichanthium</i> spp., <i>Astrelba squarrosa</i>) or Mitchell and other mid-height grasses (<i>A. pectinata</i> , <i>Dichanthium fecundum</i> , <i>Panicum</i> spp., <i>Aristida latifolia</i>).	BGAP MGAP
4	10	Moderate to gentle slopes adjacent to alluvial floors	Tobermorey - shallow grey to yellow-brown calcareous loamy soils.	Bloodwood-southern box sparse low woodland (<i>C. opaca</i>) with arid short grass (<i>Enneapogon</i> spp., <i>Tragus australianus</i>).	ASGP
5	3	Alluvial floors along streamlines	Variable light – to medium-textured alluvial soils.	Frontage woodland (<i>C. opaca</i>) with frontage grass (<i>Themeda triandra</i>).	FRGP
6	2	Steam channels		Fringing communities.	FRIP

Comparable with Barton land system of the North Kimberley survey (NKY) area.

+ Pastures types described in Appendix 1.

GEEBEE LAND SYSTEM (Gbe)

2642 km²

Source: OVC

Many small and large areas of gently undulating gravelly red 'deserts' with shrub or woodland vegetation scattered throughout the southern half of the Ord-Victoria survey area.

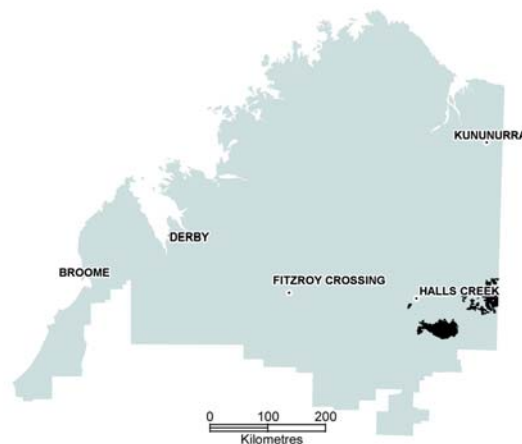
State land type: Undulating plains and uplands with eucalypt woodlands and spinifex.

Geology: Tertiary laterite and associated soils overlie Lower Cambrian volcanics, Adelaidean sediments, and Lower Proterozoic granite, gabbro, and metamorphic rocks.

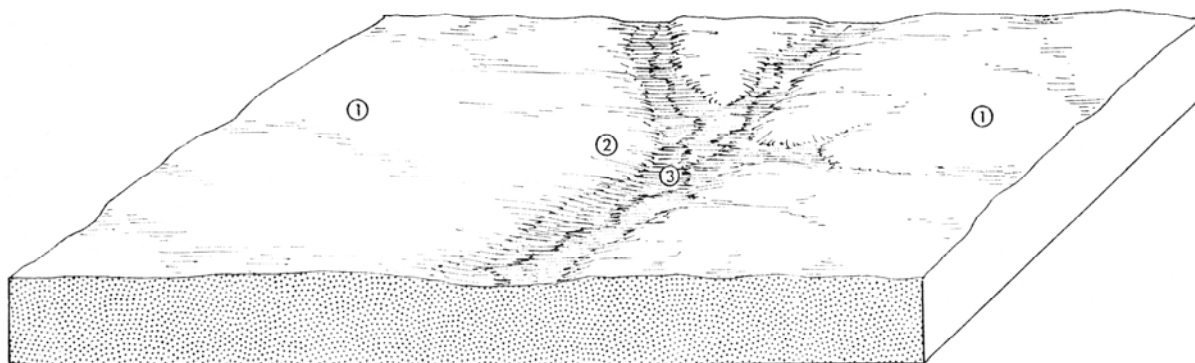
Geomorphology: Elevated lateritic plain (lateritic red earth and lateritic podzolic surface horizon).

Drainage: Widely spaced insequent headwater tributaries of both coastal rivers and the inland-draining Hooker and Sturt Creeks.

Land management: Soft spinifex pastures generally resilient under appropriate management of fire regime and grazing pressure; low or very low susceptibility to erosion.



*Gently undulating, very gravelly slopes and plains with snappy gum (*Eucalyptus brevifolia*) and soft spinifex (*Triodia pungens*) are characteristic of the Geebee land system. Photo: DAFWA*



Stylised block diagram showing location of land units

GEEBEE LAND SYSTEM (Gbe) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	80	Upper slopes and crests	Wonorah, shallow phase - red-brown clay loam with much ferruginous gravel.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) or stringybark-bloodwood woodland (<i>Corymbia dichromophloia</i>) with soft spinifex (<i>Triodia pungens</i>).	SSPP 60% HSPP 40%
2	10	Gently lower slopes	Wonorah - brown sandy loam merging into dark red clay over laterites.	Silver-leaved box sparse low woodland (<i>E. pruinosa</i>), or bloodwood-southern box sparse low woodland (<i>E. limitaris</i> or <i>E. tephrodes</i>) with threeawn mid-height grass (<i>Aristida pruinosa</i>).	HSPP 50% TAPP 50%
3	10	Shallow linear depressions with narrow shallow streamlines	Elliott - grey sandy loam merging into mottled yellow clay.	As for unit 2.	RGRP

+ Pasture types described in Appendix 1.

GIDGIA LAND SYSTEM (Gia)

306 km²

Source: WKY

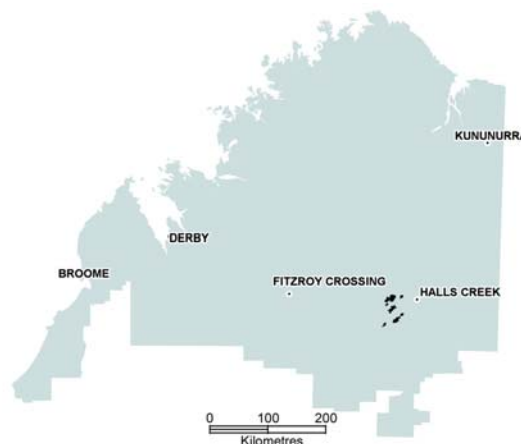
Plains on deeply weathered granitic rocks, red sandy to loamy soils, woodlands with shrubs and spinifex.

State land type: Plains with low woodlands and spinifex/tussock grasslands.

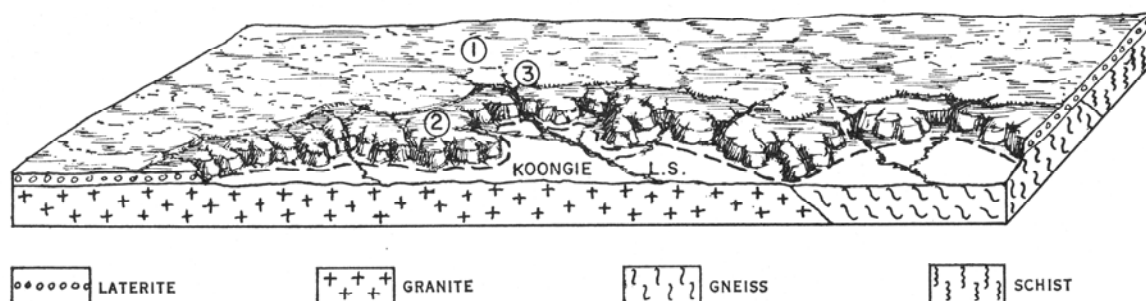
Geology: Lateritized granite, gneiss, and schist of lower Proterozoic and (?)Archeozoic age.

Geomorphology: Part of the Kimberley surface: gently sloping lateritized plains forming divides up to 19 km in extent; surface drainage absent except for moderately dense branching pattern of incised channels on marginal stripped surfaces.

Land management: Spinifex pastures not very attractive to livestock; system is stable and not prone to erosion.



Nearly level gravelly plains (unit 1) with low woodlands of snappy gum (*Eucalyptus brevifolia*) are a major part of Gidgia land system. Curly spinifex (*Triodia bitextura*) is usually the dominant grass, although soft spinifex (*T. pungens*) is dominant in this photo. The unit is common to other land systems such as Geebee but Gidgia differs in that it has stripped margins and low breakaways which are absent in Geebee. Photo: DAFWA



Stylised block diagram showing location of land units

GIDGIA LAND SYSTEM (Gia) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	85	Stable plains: slopes less than 1%; sandy surfaces sparsely strewn with ironstone gravel.	Reddish, sandy to loamy soils, with variable amounts of lateritic gravels: Tippera family (2).	Woodlands with dense patches of <i>Acacia</i> shrubs and <i>Triodia bitextura</i> <i>Eucalyptus brevifolia</i> alliance (1d); lowest-rainfall areas 1a.	CSPP 60% HSPP 40%
2	14	Stripped margins: up to 800 m wide with slopes up to 5% and marginal breakaways up to 12 m high; cobble-strewn rocky surfaces with exposures of laterite and weathered rock.	Mainly exposed laterite with minor pockets of reddish sandy soils: Yabbagoddy family (1).	Very open woodland with scattered shrubs and <i>Triodia intermedia</i> and <i>T. inutulis</i> . <i>E. brevifolia</i> alliance (1a, 1b); also 57.	HSPP
3	1	Channels: up to 4.5 m wide and 1.8 m deep; gradients above 1 in 200.	Channels, bed-loads of sand and cobbles on bedrock. Banks, brownish sandy and loamy alluvial soils: Fitzroy family (21).	Open woodlands with frontage grasses, <i>E. brevifolia</i> community (1g).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

GILGIE LAND SYSTEM (Gig)

253 km²

Source: UNP*

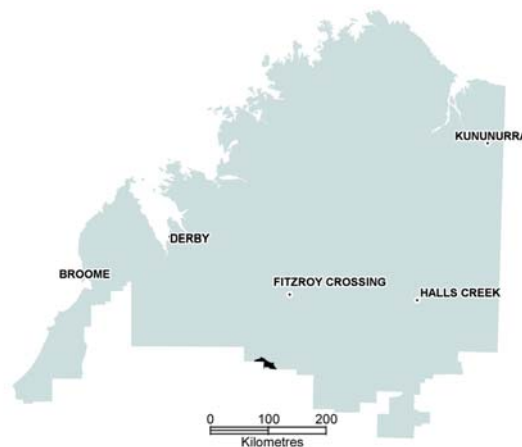
Sandplains supporting shrubby spinifex grasslands.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Quaternary aeolian sand and minor alluvium and also minor Tertiary ferricrete.

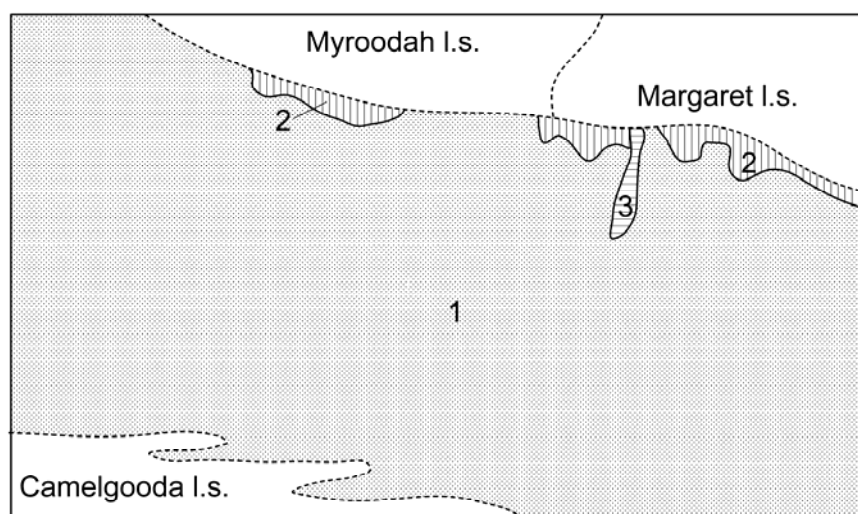
Geomorphology: Sandplain with negligible drainage features.

Land management: A minor sandplain land system supporting soft spinifex pastures which are moderately attractive to livestock for a few years following fire; stable, very low susceptibility to erosion. Control of grazing pressure and frequency of burning is desirable.



*Most of the Gilgie land system consists of featureless near level sandplains, as shown in this image. It supports shrubby soft spinifex (*Triodia pungens*) grasslands. Width of this 2010 image is about 1.7 km.*

Image: Google Earth



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in Bulka and Larrawi Resource Survey Reports (1988) DAWA, unpublished.

GILGIE LAND SYSTEM (Gig) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	90	Sandplain	Red deep sands (445).	Shrubby hummock grasslands of <i>Triodia pungens</i> and other <i>Triodia</i> species.	SSPP 80% HSPP 20%
2	9	Gently sloping surfaces with frequent exposures of laterite	Shallow gravels (304), sandy. Deep sandy gravels (301).	Shrubby hummock grasslands of hard spinifex (<i>Triodia</i> spp.).	HSPP
3	1	Drainage tracts: ill-defined unchannelled tracts receiving occasional through flow	Red deep sands (445) and Red sandy duplexes (405, 406).	Shrubby hummock grasslands of <i>Triodia pungens</i> .	SSPP

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

+ Pasture types described in Appendix 1.



*Sandplain with shrubby grasslands dominated by soft spinifex (*Triodia pungens*) occupies 90% of the Gilgie land system.
Photo: DAFWA 1988*

GLADSTONE LAND SYSTEM (Gls)

123 km²

Source: WKY

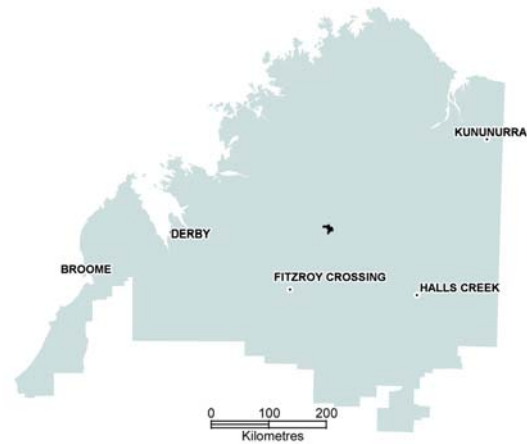
Cracking clay plains and broad loamy rises, grasslands and grassy woodlands.

State land type: Alluvial plains with tussock grasslands.

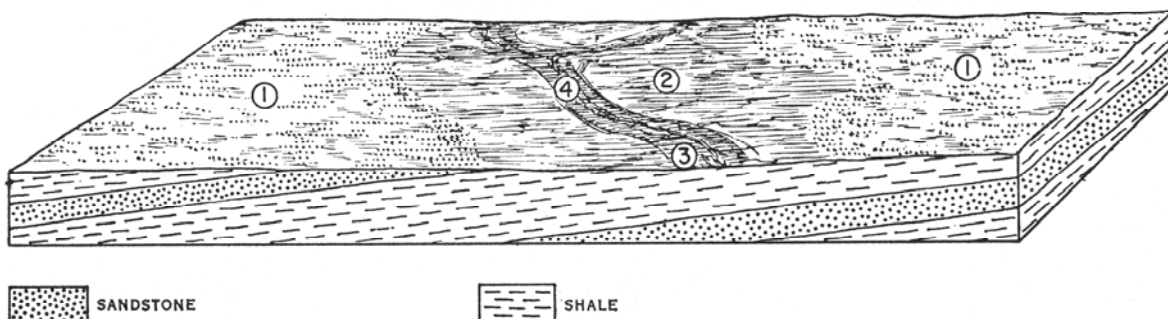
Geology: Subhorizontal or gently dipping sandstone and shale of Upper Proterozoic age.

Geomorphology: Formed by dissection of the Kimberley surface - plains; broad, gently sloping interfluvies and lower plains; sparse branching pattern of ill-defined drainage floors; relief less than 3 m.

Land management: The system supports tussock grasses which are preferentially grazed by cattle; controlled stocking is essential to prevent degradation. Low susceptibility to erosion.



*These clay plains (unit 2) of Gladstone land system are derived from shale and support curly bluegrass (*Dichanthium fecundum*). Photo: DAFWA*



Stylised block diagram showing location of land units

GLADSTONE LAND SYSTEM (Gls) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	55	Interfluves: up to 4.8 km wide with slopes up to 1%; sealed surfaces with pebble patches and local outcrop.	Yellowish loamy soils: Elliott family (6), commonly high in shale fragments with depth.	Open, grassy, snappy gum woodland with <i>Chrysopogon</i> spp. <i>Eucalyptus brevifolia</i> community (1e).	RGRP
2	39	Plains: hummocky surfaces up to 4.8 km across with slopes less than 0.5%.	Dark self-mulching heavy clays with linear gilgai: Wonardo family (14), minor Cununurra family (12).	Mitchell grass, ribbon grass grassland, and very open woodlands. <i>Astrelba</i> spp. and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48); also <i>Bauhinia cunninghamii</i> community (37a).	MGAP 40% BGAP 30% RAPP 30%
3	3	Drainage floors: mainly up to 180 m wide but attaining 360 m in lowest sectors; gradients 1 in 200 to 1 in 500.	Only very local soil development.	Open grassy woodland. <i>Adansonia gregorii</i> and <i>Bauhinia cunninghamii</i> alliances (33, 39).	FRGP
4	3	Channels: up to 12 m wide and 1.5 m deep.	Bed-loads of sand and pebbles.	Open grassy woodland. <i>Adansonia gregorii</i> and <i>Bauhinia cunninghamii</i> alliances (33, 39).	FRGP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

GLENROY LAND SYSTEM (Gny)

1536 km²

Source: WKY

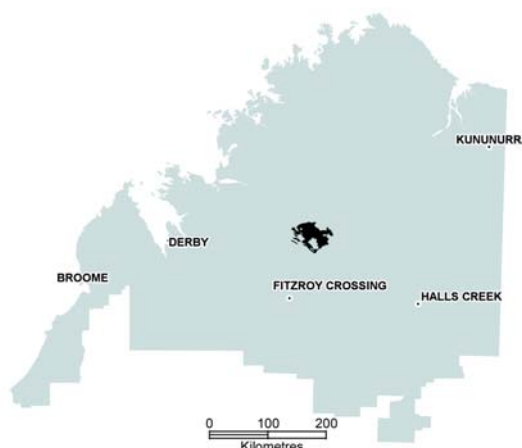
Stony undulating shale country with broad alluvial drainage floors, yellowish fine-textured skeletal soils, open woodlands with curly spinifex and grassy woodlands.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

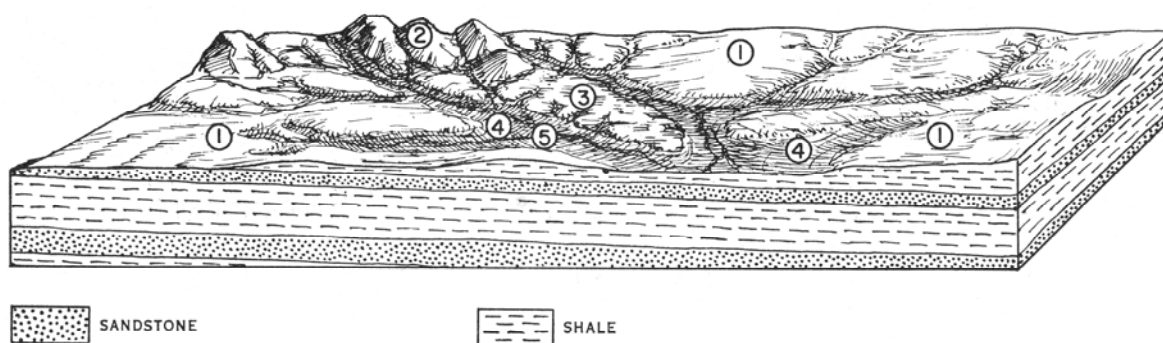
Geology: Subhorizontal and gently dipping sandstone and shale of Upper Proterozoic age.

Geomorphology: Formed by partial dissection of the Fitzroy surface - undulating terrain: broad, gently rounded interfluvial plains with scattered low hills and minor cracking clay plains; dense branching pattern of tributary drainage in upper parts and through-going alluvial trunk drainage; relief typically less than 9 m with infrequent hills up to 30 m.


Land management: Most pastures are moderately to highly preferred by cattle and prone to degradation. Interfluvial and alluvial drainage floors (units 1 & 4) are moderately to highly susceptible to erosion. Control of grazing pressure is essential.



Broad interfluvial and plains on shale supporting curly spinifex (Triodia bitextura) occupy about half of the Glenroy land system. Hills and plateaus in background are Clifton land system. Photo: DAFWA



 SANDSTONE

 SHALE

Stylised block diagram showing location of land units

GLENROY LAND SYSTEM (Gny) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	50	Interfluves: up to 3.2 km wide and less than 10 m high with slopes up to 2%; locally with 'stepped' slopes comprising steeper facets, up to 1.5%, separating gently sloping facets, less than 0.5%; locally dissected up to 6 m into spurs with flat or gently sloping crests up to 800 m wide and marginal slopes up to 25%; cobble mantles and local outcrop.	Yellowish, fine-textured skeletal soils (24).	Open woodland with moderately dense scrub layers and <i>Triodia bitextura</i> and <i>Chrysopogon</i> spp. <i>Eucalyptus brevifolia</i> alliance (1d, 1e); also 54.	CSPP
2	7	Hills: up to 30 m high; bevelled rocky crests up to 800 m wide and hillslopes up to 60%.	Outcrop and yellowish skeletal soils high in rock fragments (24).	Open woodlands with moderately dense shrub layers and <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d).	CAHP
3	3	Cracking clay plains: up to 4 km in extent with slopes less than 0.5%; marginally dissected up to 3 m with slopes up to 5%; hummocky surfaces.	Olive brown moderately mulching weakly cracking heavy clays; Wonardo family (14).	Ribbon grass-bluegrass grasslands with scattered trees and shrubs. <i>Chrysopogon</i> spp.- <i>Dichanthium fecundum</i> community (48).	RAPP
4	25	Alluvial drainage floors: sealed surfaces up to 1.2 km wide with levees up to 1 m high and 275 m wide; gradients 1 in 200 to 1 in 500.	Mainly yellowish sandy to loamy soils of variable depth: Elliott family (6). Some local areas of clayey alluvial soils: Fitzroy family (22).	Grassy woodland with frontage grasses. <i>Corymbia bella</i> community (22a); also 19, 27.	FRGP
5	15	Channels: up to 30 m wide and 6 m deep, locally incised in bedrock.	Channels, bed-loads range from sands to cobbles. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (40, 42, 43).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

GOGO LAND SYSTEM (Gog)

1966 km²

Source: WKY

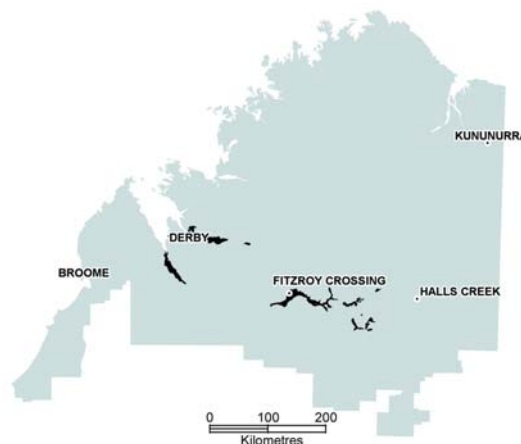
Active floodplains with broad levee zones and moderately extensive back plains of cracking clays with grasslands and grassy woodlands.

State land type: River plains with grassy woodlands and tussock grasslands.

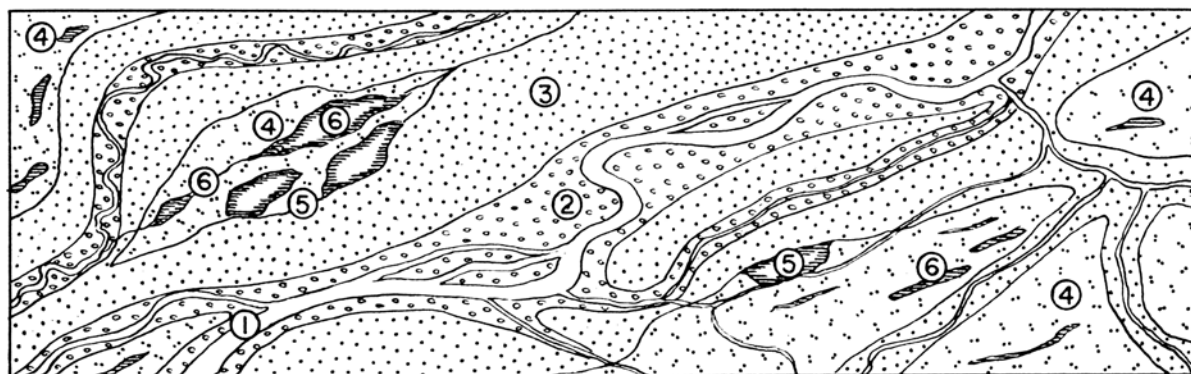
Geology: Quaternary alluvium.

Geomorphology: alluvial plains - active floodplains: extensive levee zones, locally flanked by broad flat-bottomed depressions; restricted back plains with billabongs, traversed by minor channels; meandering anastomosing channels; gradients 1 in 2000 to 1 in 4000.

Land management: Parts are subject to regular flooding and consequent poor accessibility. A high value system for pastoralism supporting pastures which are highly attractive to cattle; levee crests and backslopes (units 2 & 3) are moderately to highly susceptible to erosion if vegetative cover is lost. Controlled stocking is essential.



*Previously degraded levees and levee backslopes of the Gogo land system have been colonised by the introduced buffel grass (*Cenchrus ciliaris*) since the original CSIRO survey. These new pastures are favoured grazing for cattle. Photo: DAFWA*



Stylised plan diagram showing arrangement of land units

GOGO LAND SYSTEM (Gog) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	6	Main channels: up to 800 m wide and 12 m deep.	Channels, no soil. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests of several layers. <i>Eucalyptus camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (42).	XXNP 80% FRIP 20%
2	20	Levee crests: up to 2.4 m high and 800 m wide; bank slopes up to 1%.	Mainly clayey, micaceous alluvial soils: Fitzroy family (22). Some loamy alluvial soils: Robinson family (21).	Open grassy woodland with scattered or patchy shrubs, moderately dense tall to medium-height frontage grasses, patches of short annual grasses. Forbs seasonal. <i>Corymbia bella</i> alliance (22a, 22b); also 8d. [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common].	FRGP 70% BUGP 30%
3	47	Levee backslopes: up to 0.5%, but attaining 1% locally, and up to 1.6 km long; hummocky, scalded surfaces.	Brownish juvenile cracking clays (16).	Grassy woodlands more open than in unit 2, with bare scalded areas. <i>C. bella</i> and <i>E. microtheca</i> alliances (20a, 21, 22b); also locally 48. Highest-rainfall parts also 24. [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common].	FRGP 70% BUGP 30%
4	11	Back plains: up to 1.6 km wide, with slopes less than 0.1% but attaining 0.5% at margins; with linear depressions up to 400 m wide and 1 m deep; hummocky sealed surfaces with gilgais locally.	Mainly dark self-mulching heavy clays: Cununurra family (12). With dark brown self-mulching clays: Wonardo family (14). Gilgais common.	Mitchell grass and ribbon grass-bluegrass grassland with scattered trees and shrubs; also large areas of annual grasses and forbs. <i>Astrebla</i> spp. and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48); locally 37b.	MGAP 50% RAPP 50%
5	6	Depression: up to 1.2 km wide and 1 m deep; short marginal slopes up to 1%.	Dark grey crusty heavy clay: Myroodah family (13), commonly showing recent alluvial influences.	Tall to medium perennial grassland, or annual grasses and forbs, varying according to conditions of flooding. <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> and <i>Chrysopogon</i> spp. (48, 49).	RAPP
6	10	Minor channels and billabongs: channels up to 3 m deep and 275 m wide; billabongs up to 3.2 km long, often in linked series.	Brownish, massive, intractable, silty to heavy clays (30).	Grassy woodland fringing communities, varying according to conditions of flooding. <i>E. microtheca</i> alliance (20a, 20c, 21).	FRGP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

GORDON LAND SYSTEM (Gor)

1012 km²

Source: OVC

Low hilly to undulating limestone country scattered throughout the southern half of the Ord-Victoria survey area.

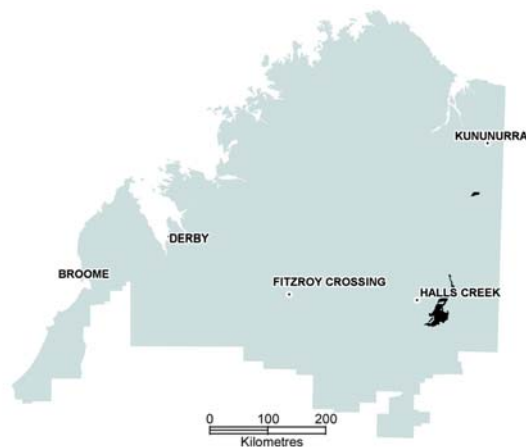
State land type: Undulating plains with tussock grasslands.

Geology: Calcareous and dolomitic sediments of Adelaidean age.

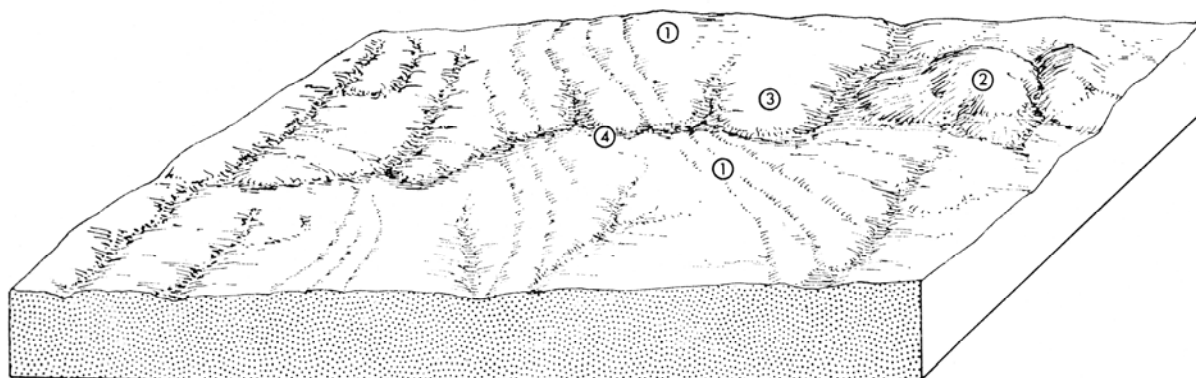
Geomorphology: Inland and coastal erosional plains.

Drainage: Moderately intense dendritic pattern.

Land management: Pastures are highly preferred by cattle and prone to degradation if grazing is uncontrolled. Parts of gently undulating uplands (unit 1) are moderately to highly susceptible to erosion if vegetative cover is lost.



*The Gordon land system consists largely of gently undulating upland plains (unit 1) with calcareous soils which support palatable pastures based on limestone grass (*Enneapogon polyphyllus*).
Photo: DAFWA*

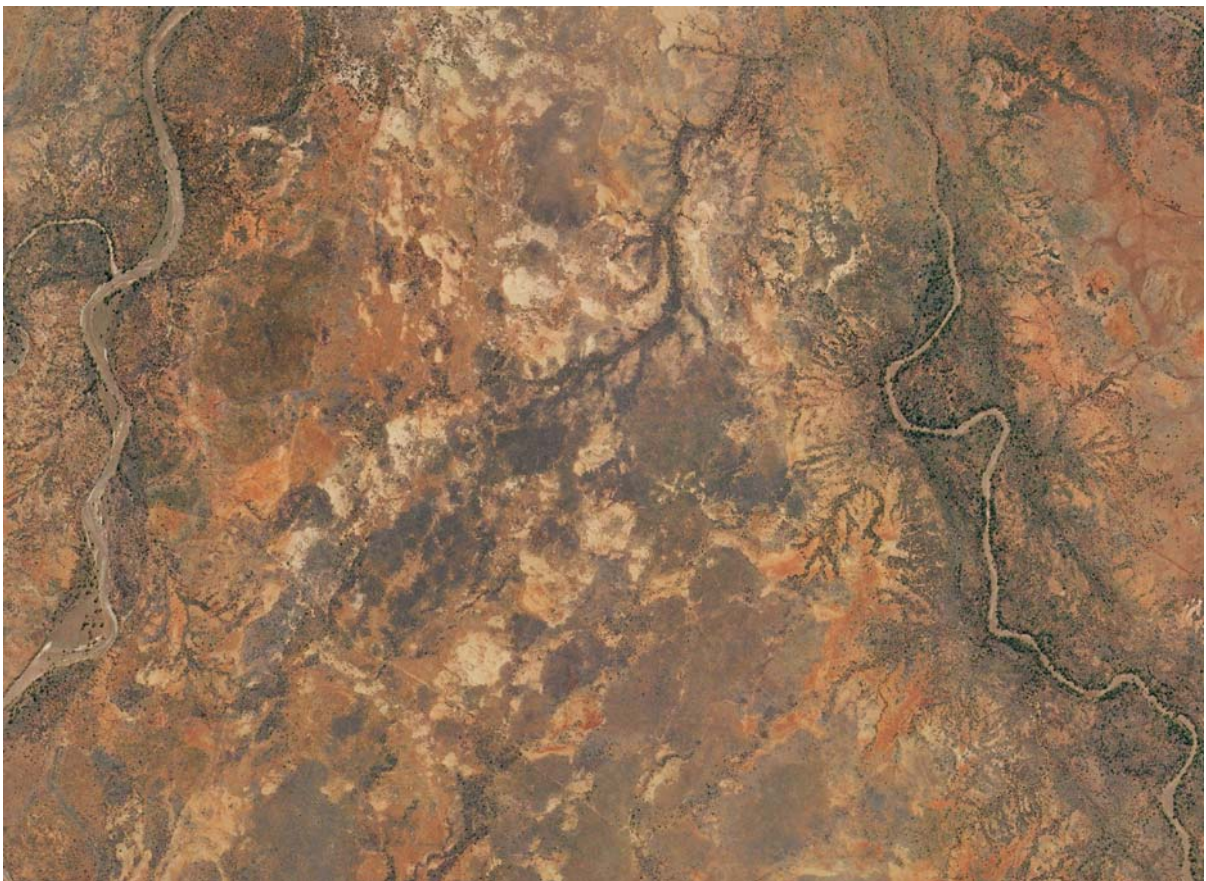


Stylised block diagram showing location of land units

GORDON LAND SYSTEM (Gor) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	80	Gently undulating uplands	Tobermorey - shallow grey to yellow-brown calcareous loamy soils; scattered outcrops and boulders of limestone.	Bloodwood - southern box sparse low woodland (<i>Corymbia opaca</i>) with arid short grass (<i>Enneapogon</i> spp.).	ASGP
2	3	Low hills	Limestone outcrops with pockets of loamy skeletal soil.	Deciduous sparse low woodland with arid short grass.	ASGP
3	15	Gentle lower slopes	Cununurra, Barkly, and Argyle - grey and brown cracking clays.	Barley Mitchell mid-height grass (<i>Astrebla pectinata</i>).	MGAP
4	2	Streamlines		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



The Gordon land system is a complex of well-vegetated “black soil” plains and creeklines interspersed with scalded plains and slopes supporting sparse limestone grass pastures. For additional information about the units of this land system see De Salis (1993). Width of this 2005 aerial photo is about 4.6 km. Photo: Landgate

GOURDON LAND SYSTEM (Gdn)

65 km²

Source: BRM

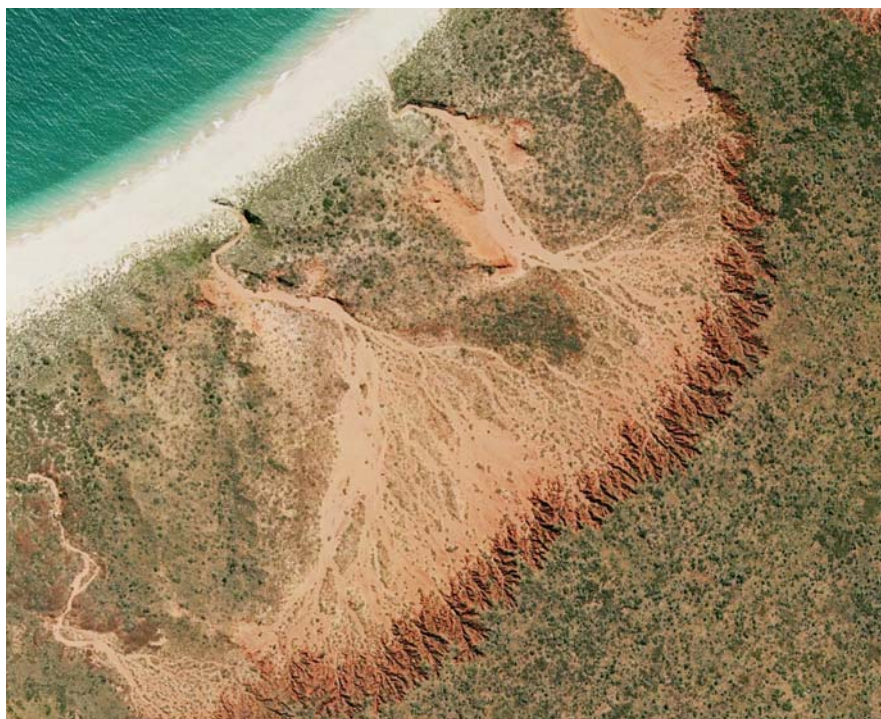
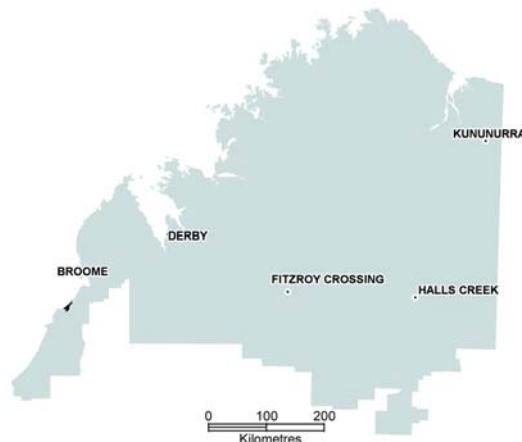
Sandplain and undulating lateritic country with steep coastal gullies supporting spinifex grasslands with scattered trees.

State land type: Sandplains and occasional dunes with shrubby spinifex grasslands.

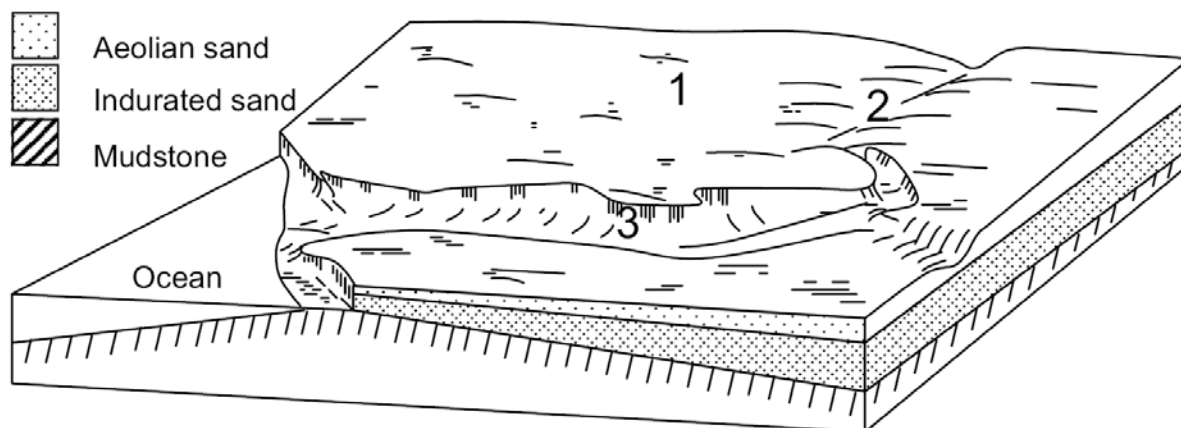
Geology: Quaternary aeolian sands overlying Cretaceous sandstone and some mudstone.

Geomorphology: Depositional sandplain adjacent to erosional surface of undulating laterite country with gullies draining to steep deeply incised coastal gullies and cliffs.

Land management: Sandplains with spinifex vegetation (unit 1) are inherently resilient and stable; gullies and cliffs (unit 3) are unstable, high scenic amenity; protection from grazing and other disturbance is desirable on unit 3.



Highly dissected, seaward facing, red cliffs on the edges of sandplain are a characteristic component of the Gourdon land system. The width of this 2004 aerial photograph is about 900 m. Photo: Landgate



Stylised block diagram showing location of land units

GOURDON LAND SYSTEM (Gdn) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Sandplains: up to 7 km in extent and gently dipping to the west.	Earthy sands; dark red loamy sand topsoil over red loamy sand to coarse sandy loam subsoil.	Sparse low-tree steppe dominated by <i>Triodia pungens</i> with minor <i>Triodia bitextura</i> and <i>Chrysopogon fallax</i> . Trees dominated by <i>Corymbia setosa</i> and <i>Grevillea pyramidalis</i> and <i>Acacia</i> spp. shrubs.	SSPP
2	16	Lateritic interfluves: up to 1 km wide undulating interfluves and gullies with laterite and sandstone outcrop common.	Lithosols; lateritic gravels and rock outcrop with patchy thin sand cover.	Steppe grassland dominated by <i>Triodia pungens</i> with a few <i>Grevillea</i> sp. aff. <i>angulata</i> shrubs.	SSPP
3	14	Gullies and cliffs: up to 2.5 km long with steep sided gullies and cliffs opening westward onto coast; saline gully floors with tidal influence.	Lithosols and Solonchak; sandstone outcrop with consolidated Quaternary sands.	Little vegetation with some <i>Triodia pungens</i> on gully sides, and <i>Tecticornia</i> spp. <i>Sporobolus virginicus</i> and <i>Melaleuca acacioides</i> on gully floors.	XXNP 50% SMPP 25% MACP* 25%

+ Pasture types described in Appendix 1.

* MACP is equivalent to SPSG in the Pilbara report (Van Vreeswyk et al. 2004).

GREAT SANDY LAND SYSTEM (Gts)

2094 km²

Source: BRM

(Modified from McKenzie 1985.)

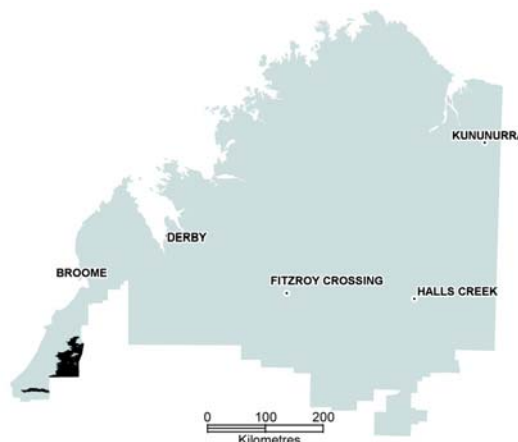
Extensive dunefields of linear dunes supporting spinifex grasslands with scattered shrubs and trees.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Quaternary aeolian sands.

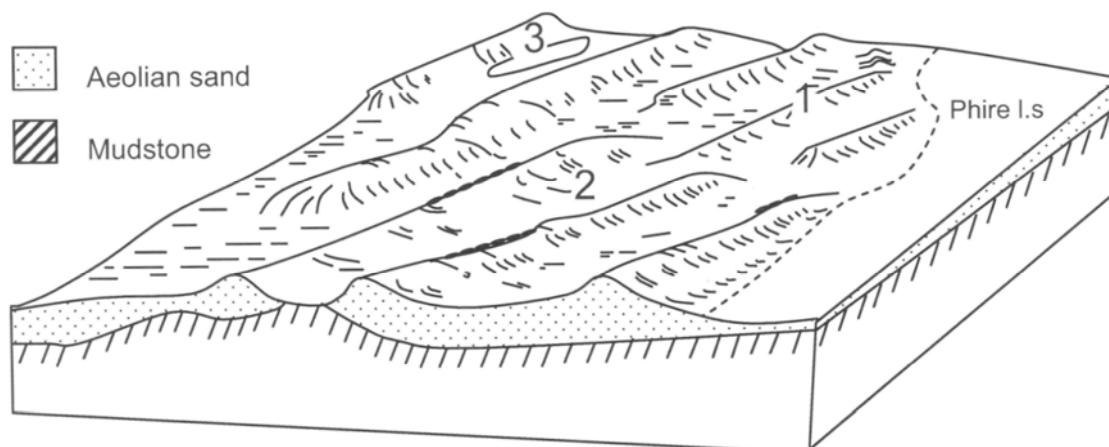
Geomorphology: Depositional surface; stable dunefields of longitudinal or seif dunes with swales opening locally onto sandplain or laterite outcrop plain; minor depressions receiving drainage with salt pans; relief up to 12 m.

Land management: Fires recur fairly regularly in spinifex vegetation; swales (unit 2) show some susceptibility to wind erosion immediately after burning but stabilise rapidly after rain. Dune crests and flanks (unit 1) are moderately to highly susceptible to erosion after any disturbance that removes vegetation.



Parallel and occasionally reticulate sand dunes extending for many kilometres are characteristic of the Great Sandy land system.

The width of this 2004 aerial photograph is about 10 km.
Photo: Landgate



Stylised block diagram showing location of land units

GREAT SANDY LAND SYSTEM (Gts) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	30	Dunes: longitudinal ridges up to 12 m high and 40 km long with narrow crests and many small blowouts on the crests; flank slopes 25 - 45%.	Siliceous sands; red loose sand; Uc 1.23, Uc 1.22.	Sparse tree steppe dominated by <i>Triodia pungens</i> and <i>Triodia</i> sp. (feathertop spinifex) grasses; trees are dominated by <i>Corymbia</i> sp. and <i>Gardenia</i> sp.a with <i>Grevillea</i> and <i>Acacia</i> spp. shrubs.	SSPP
2	68	Swales: from 0.5 to 1.0 km wide with flat floors and marginal slopes to 3%. Opening at western ends on to sandplain or laterite outcrop plains. Minor inclusions of laterite outcrop.	Earthy sands; dark reddish brown sand surface horizons overlying red loamy sand subsoils; Uc 5.21.	Sparse tree steppe dominated by <i>Triodia pungens</i> and <i>Triodia</i> sp. (feathertop spinifex) grasses; trees are dominated by <i>Corymbia</i> sp. and <i>Owenia reticulata</i> with <i>Acacia</i> spp. and <i>Grevillea</i> spp. shrubs.	SSPP
3	2	Depressions receiving run-on with pans: salt pans with run-on areas extending up to 5 km either side; pans mostly 1 - 2 km in length but up to 4 km.	Earthy sands; brown silty clay surface horizon on brown sandy loam; surrounding soils are dark brown sandy loams overlying red to strong brown sandy loams to sands; Uc 5.22.	Pans bare: margins dominated by <i>Melaleuca acacioides</i> . <i>Acacia</i> and <i>Tecticornia</i> spp. shrubs plus <i>Xerochloa</i> spp. grasses; isolated <i>Eucalyptus</i> sp. (white gum).	XXNP 80% SMPP 20%

+ Pasture types described in Appendix 1.



Spinifex, as it ages, forms characteristic rings and provides good habitat for native animals such as marsupial mice and reptiles in the red sandy swales of the Little and Great Sandy deserts.

HEADLEY LAND SYSTEM (Hea)

1250 km²

Source: OVC

Dissected limestone hills in the south-western part of the Ord-Victoria survey area.

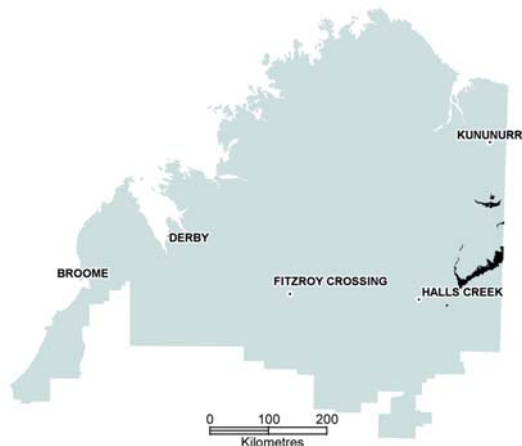
State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Limestone, minor shale, Middle Cambrian (Negri Group).

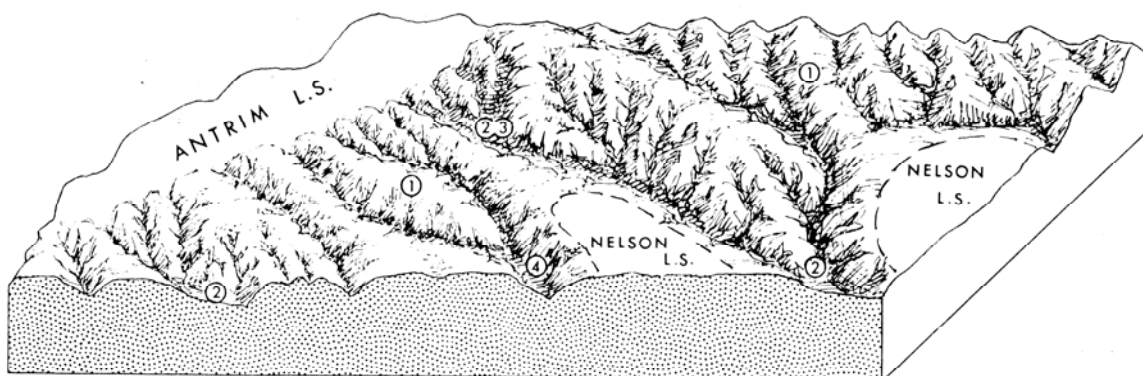
Geomorphology: Limestone cuestas (asymmetric basin).

Drainage: Intense pattern of insequent stream channels in unit 1, widely spaced insequent channels in unit 2.

Land management: About 70% of the system consists of steep low hills (unit 1) supporting hard spinifex pastures of very low pastoral value, subject to fairly frequent fires but stable and with very low susceptibility to erosion. Units 2 and 3 support short grass and other grass pastures which are highly preferred by cattle and prone to degradation with moderate susceptibility to erosion; control of grazing pressure is required.



Most of the Headley land system consists of steep, dissected low hills of limestone (pale on image) with limestone spinifex (*Triodia wiseana*). The width of this 2004 aerial photograph is about 2.5 km. Photo: Landgate



Stylised block diagram showing location of land units

HEADLEY LAND SYSTEM (Hea) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Steep low hills separated by many deeply incised stream channels	Limestone outcrops with pockets of shallow skeletal soils.	Deciduous sparse low woodland with limestone spinifex (<i>Triodia wiseana</i>)	HSHP
2	20	Gentle lower slopes at foot of hills	Tobermorey - shallow grey to yellow-brown calcareous loamy soils on limestone; many limestone boulders and outcrops.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i>) with arid short grass (<i>Enneapogon</i> spp.) or limestone spinifex (<i>Triodia wiseana</i>).	HSPP 60% ASGP 40%
3	5	Gentle slopes associated with unit 2	Negri - brown calcareous loamy soil on shales.	Bare ground or sparse arid short grasses and low trees.	ASGP
4	5	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



Sparsely vegetated dissected low hills characteristic of unit 1 in Headley land system. The pale surface is due to an abundant mantle of stones and rocks of grey limestone.

Gregory National Park, Northern Territory

Photo: Peter Brocklehurst, Northern Territory Department of Natural Resources, Environment, The Arts and Sport

INVERWAY LAND SYSTEM (Inv)

3360 km²

Source: OVC

Nearly treeless high-level 'black soil' plains scattered throughout the southern part of the Ord-Victoria survey area.

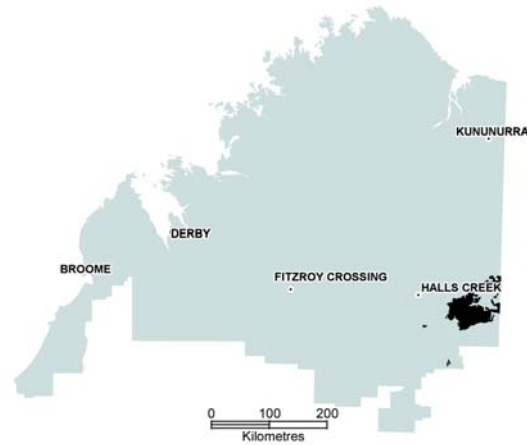
State land type: Alluvial plains with tussock grasslands.

Geology: Tertiary swamp, lake, and river deposits.

Geomorphology: Elevated non-lateritic plain (grey soils of heavy texture), interior fluvial plains, and interior swamp plains.

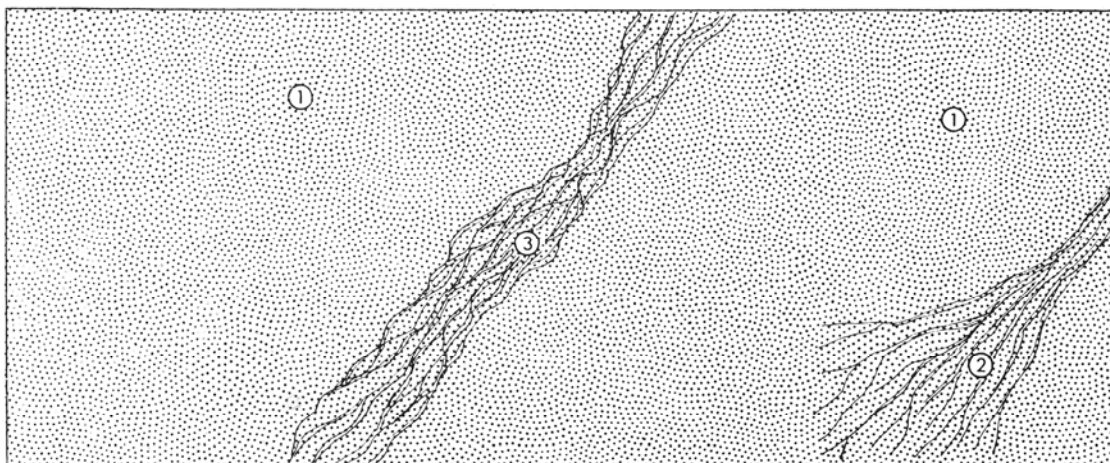
Drainage: Largely drained by insequent streamlines of the internally draining streams; the distributary systems are flooded for prolonged periods after heavy rain, the braided streams for short periods, and the nearly flat plains may be waterlogged, but not flooded, for short periods.

Land management: A system with high pastoral value; pastures preferentially grazed by cattle, control of grazing pressure is essential. Low susceptibility to erosion due to clay soils and level topography.



Near level, treeless plains with dense tussock grasses on cracking clay soils of the Inverway land system.

Photo: Andrew Craig, DAFWA



Stylised plan diagram showing arrangement of land units

INVERWAY LAND SYSTEM (Inv) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	90	Nearly flat broad plains	Cununurra - grey cracking clays; and Argyle - brown cracking clays.	Barley Mitchell mid-height grass (<i>Astrebla pectinata</i>).	MGAP
2	5	Low lying distributory areas with low linear rises and depressions	Cununurra - grey cracking clays.	Bluebush shrubland (<i>Chenopodium auricomum</i> , <i>Muehlenbeckia florulenta</i>).	OTHP
3	5	Linear tracts up to 800 m wide with intense braided pattern of small stream channels	Cununurra - grey cracking clays.	Fringing low woodland (<i>Eucalyptus microtheca</i> , <i>Acacia stenophylla</i>) with bluegrass tall grass (<i>Dichanthium fecundum</i> , <i>Themeda avenacea</i> , <i>Eulalia aurea</i>).	BGAP

Unmappable inclusion: Geebee. Comparable with Barkly land system of the Barkly region.

+ Pasture types described in Appendix 1.



The grey and brown clays (Vertosols) characteristic of unit 1 in Inverway land system shrink and crack in the dry season. The surface often spontaneously forms crumb-sized soil aggregates on drying - this surface condition is termed "self-mulching".

Self-mulching cracking clays are common in many land systems with gentle slopes and plains derived from basaltic or limestone parent material, including Argyle, Alexander, Fossil 2, Gogo, Isdell, Ivanhoe, Oscar, Wave Hill and other land systems.

Although these clays are usually grey or brown in colour they are collectively called "black soils" in the Kimberley.

Photo: Noel Schoknecht, DAFWA

ISDELL LAND SYSTEM (Isd)

642 km²

Source: NKY

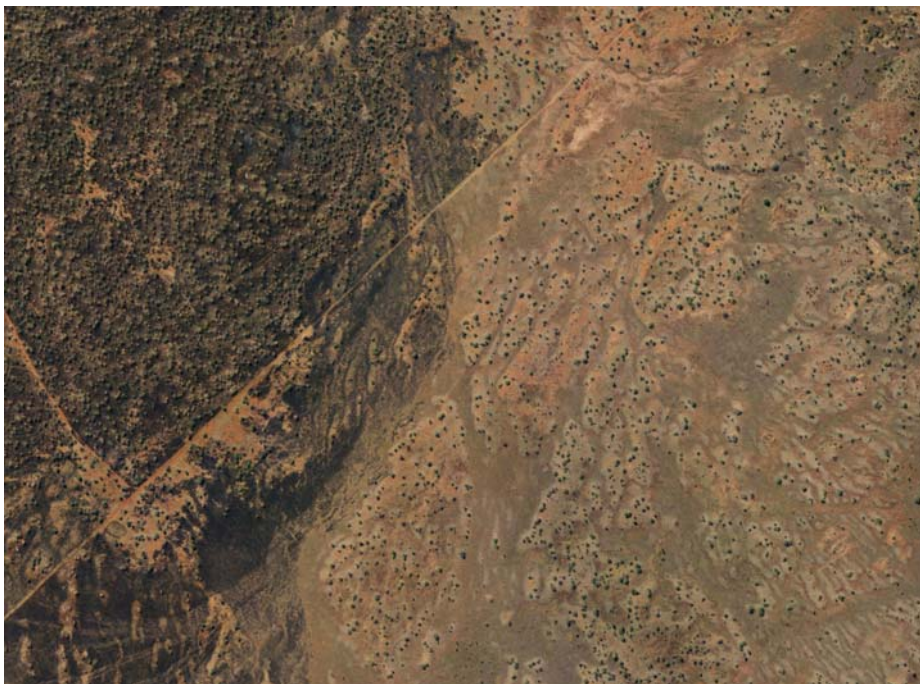
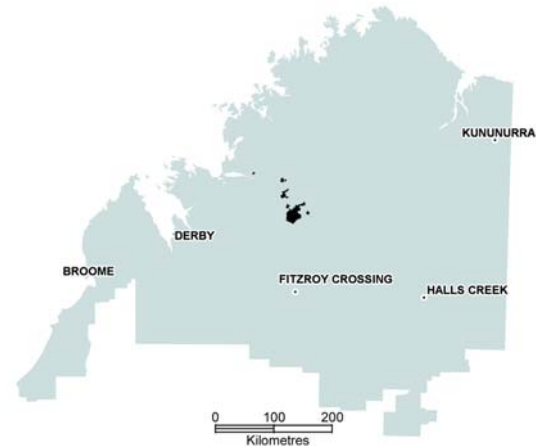
Gently undulating volcanic country with cracking clay soils carries grassland and grassy woodlands.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology and geomorphology: Part of the erosional plains on volcanic rocks formed mostly on Mornington volcanics with small areas on younger volcanics in the south-west.

Drainage: Flooding during wet season restricted to narrow river flats. Sub-rectangular drainage of moderate intensity.

Land management: Supports pastures which are attractive to cattle; controlled stocking needed to prevent degradation. Generally low susceptibility to erosion.



Gilgai (right) and fire patterns (left) show clearly on cracking clay plains of the Isdell land system. Width of this 2008 aerial photograph is about 1.5 km. Photo: Landgate



Stylised block diagram showing location of land units

ISDELL LAND SYSTEM (Isd) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	65	Flats or very gentle slopes	Grey soils of heavy texture.	Grasslands with sparse trees: <i>Terminalia</i> sp. - <i>Dichanthium fecundum</i> alliance (70).	BGAP
2	20	Gentle slopes undulating	Mostly igneous red earths and skeletal red earths, smaller areas of fine-textured yellow podzolics.	Woodlands: <i>Eucalyptus tectifica</i> - <i>Corymbia grandifolia</i> alliance (1, 2, 5, 10, 13, 14, 15).	WGBP 70% TTGP 15% BSGP 15%
3	12	Streamlines and levees	Mostly red levee soils, but with some igneous red earths .	Fringing community and woodlands: <i>Terminalia</i> spp. - <i>Ficus</i> spp. - <i>Melaleuca</i> spp. community; <i>C. bella</i> alliance (53, 54, 55, 56, 57); <i>E. tectifica</i> - <i>C. grandifolia</i> alliance (1, 3). Woodlands: <i>E. tectifica</i> - <i>C. grandifolia</i> alliance (1, 2, 8).	PLSP 70% TTGP 30%
4	3	Low rocky hills and moderate slopes	Predominantly skeletal red earths with some igneous red earths.		PLSP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



The cracking clays of unit 1 in Isdell land system support very productive pastures dominated by bluegrass (*Dichanthium* spp.).
Photo: DAFWA

IVANHOE LAND SYSTEM (Iva)

1239 km²

Source: OVC

Many small to medium areas of gently sloping alluvial 'black soil' plains with some timbered 'red' soil in the central and northern parts of the Ord-Victoria survey area.

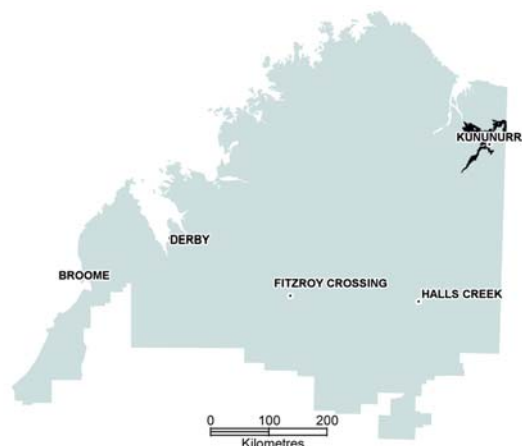
State land type: Alluvial plains with tussock grasslands.

Geology: Quaternary alluvia.

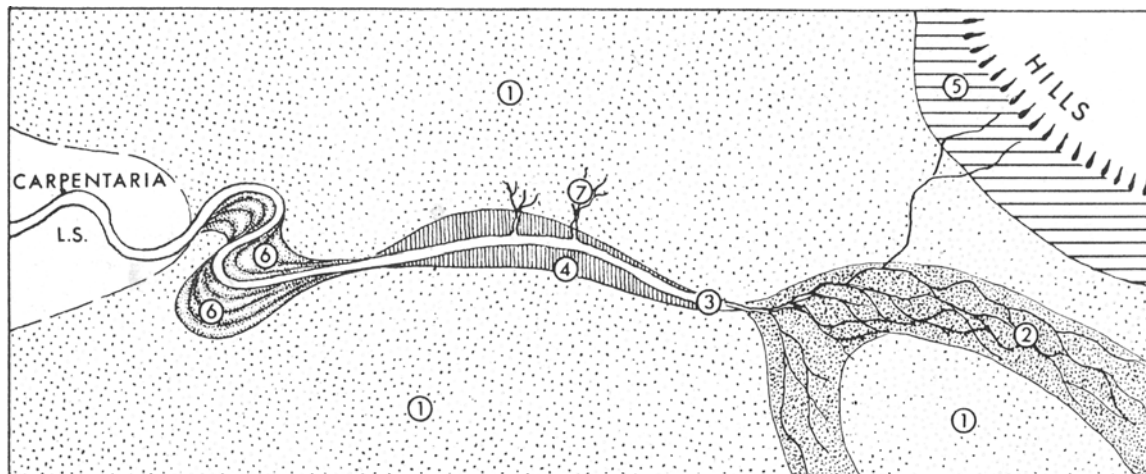
Geomorphology: Fine-textured fluvial plain.

Drainage: The floodplains of the Ord and Victoria Rivers are characterised by deep broadly meandering channels, and the floodplains of the upper Baines and Armstrong rivers have an intense pattern of braided stream channels.

Land management: Minor parts may be flooded and inaccessible for periods. High pastoral value with pastures attractive to cattle; control of grazing pressure is essential. Most of the system has low susceptibility to erosion except for levees (unit 4) which have moderate susceptibility. Parts of the system are used for irrigated agriculture.



The fertile "black soil" (grey and brown cracking clays) plains of the Ivanhoe land system adjacent to the Ord River at Kununurra are favoured for irrigated agriculture.
Photo: DAFWA



Stylised plan diagram showing arrangement of land units

IVANHOE LAND SYSTEM (Iva) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Nearly flat plains	Cununurra - grey cracking clays with small areas of Argyle - brown cracking clays.	Bluegrass tall grass (<i>Dichanthium</i> spp. <i>Astrebula squarrosa</i> , <i>Sorghum stipoideum</i> , <i>Ophiuros exaltatus</i> , <i>Aristida latifolia</i>) with fringing forest and fringing tall grasses near streamlines.	BGAP
2	15	Valley floors up to 3.2 km with intense braided pattern of small channels	Cununurra - grey cracking clays with small areas of Argyle - brown cracking clays.	Bluegrass tall grass (<i>Dichanthium</i> spp. <i>Astrebula squarrosa</i> , <i>Sorghum stipoideum</i> , <i>Ophiuros exaltatus</i> , <i>Aristida latifolia</i>) with fringing forest and fringing tall grasses near streamlines.	BGAP
3	3	Major stream channel: 400–1200 m wide and up to 18 m deep		Fringing communities.	XXNP 80% FRIP 20%
4	3	Levees associated with major stream channels	Mostly Manbulloo and Katherine - brown sand or sandy loam over permeable reddish brown subsoil along Ord River and its major tributaries.	Frontage woodland (<i>Corymbia bella</i> , <i>Eucalyptus tectifica</i> , <i>Corymbia opaca</i>) with frontage tall grass (<i>Sorghum stipoideum</i> , <i>Chrysopogon latifolius</i> , <i>Panicum</i> sp., <i>Aristida</i> spp.). [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common].	FRGP 50% BUGP 50%
5	3	Plains adjacent to sandstone hills, in upper part of West Baines River valley	Manbulloo and Katherine.	Northern box-bloodwood woodland (<i>C. grandifolia</i> , <i>C. latifolia</i>) or silver-leaved box sparse low woodland (<i>E. pruinosa</i>) with threeawn mid-height grass (<i>Aristida</i> spp., <i>Chrysopogon fallax</i>).	TAPP
6	3	Scroll plains with alternating low levee ridges and swales; adjacent to and inland from Carpentaria land system	Brown alluvial soils with stratified sediments at shallow depth.	Frontage woodland (<i>C. bella</i> , <i>C. opaca</i> , <i>E. terminalis</i>) with frontage tall grass (<i>Sorghum stipoideum</i> , <i>Chrysopogon latifolius</i> , <i>Panicum</i> sp., <i>Aristida</i> spp.).	FRGP
7	3	Moderately to steeply sloping gully systems up to 18 m deep	Various undefined loamy and clayey soils, commonly with carbonate concretions at the surface.	Scattered trees and sparse grass.	FRGP

+ Pasture types described in Appendix 1.

KARUNJIE LAND SYSTEM (Krj)

5890 km²

Source: NKY

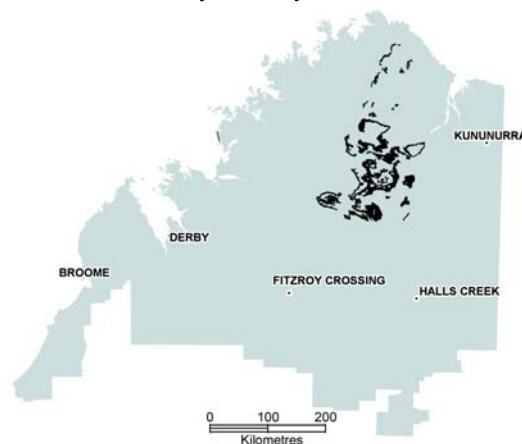
This gently sloping and undulating shale country with sandstone-capped scarps is confined mainly to the south-eastern and eastern parts of the North Kimberley survey area. It has grassy woodlands and shrubby forests with leached or stony soils.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology and geomorphology: Parts of the cuesta and structural plateaux formed on shales of the Warton beds and Mt House beds.

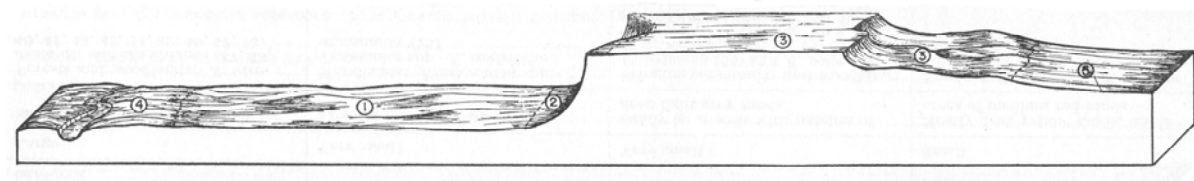
Drainage: Irregular, moderate. Small low-lying areas adjacent to the rivers may experience flooding during wet season.

Land management: Parts (units 2 & 3) are rugged, poorly accessible and unsuitable for pastoralism, high scenic amenity; lower parts support low or moderate value pastures. Low susceptibility to erosion.



Low eucalyptus woodlands over curly spinifex on slopes of the Karunjie land system.

Photo: Andrew Craig, DAFWA



Stylised block diagram showing location of land units

KARUNJIE LAND SYSTEM (Krij) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	60	Flat to gentle slopes often at foot of shale scarps	Mostly fine and coarse textured yellow podzolics with some skeletal sands.	Woodlands and forests: <i>Corymbia grandifolia</i> sub-alliance (13, 14a , 15 , 16 , 17, 18, 19, 21; <i>Eucalyptus brevifolia</i> association (71); <i>Melaleuca</i> spp. alliance (72).	LCSP
2	2	Steep slopes of scarps	Skeletal soils and bare rock.	Woodlands: <i>C. grandifolia</i> sub-alliance, steeper slopes (23), lower slopes (11), and <i>E. brevifolia</i> association (71).	CAHP
3	30	Flat tops and rugged dissected country	Skeletal sands and sandstone outcrops.	Forests and woodlands: <i>C. dichromophloia</i> (40, 41 , 45, 46, 47) and <i>E. phoenicea</i> (35, 36, 37 , 38 , 39) sub-alliances.	CAHP
4	3	Steamlines and levees	Varied sandy levee soils.	Fringing community and woodlands: <i>Terminalia</i> spp., <i>Ficus</i> spp., <i>Melaleuca</i> spp. community; <i>C. bella</i> alliance (55); <i>C. grandifolia</i> sub-alliance (11 , 12); <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. community (75).	FRIP
5	5	Elevated gentle slopes	Mixed hard yellow sands and fine-textured yellow podzolics.	Woodlands: <i>C. grandifolia</i> sub-alliance (21).	CSPP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



The flat to gentle slopes (unit 1) of Karunjie land system below nearby (but not visible in this photo) hills of Buldiva land system. The attractive pale barked eucalypt, *Corymbia grandifolia*, is a characteristic feature of this unit.

Photo: Uki Deane (Panoramio.com)

KENNEDY 2 LAND SYSTEM (Kny)*

3369 km²

Source: NKY

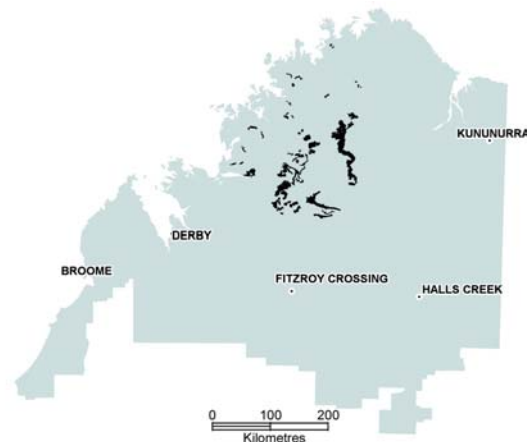
Gently undulating volcanic country with mostly open forest vegetation and shallow sandy or leached soils, confined mostly to the central and southern parts of the North Kimberley survey area.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology and geomorphology: Part of the erosional plains on volcanic rocks, almost entirely on Mornington volcanics. In many places there is only a thin veneer of volcanics and the soils are partly formed on the underlying sandstones.

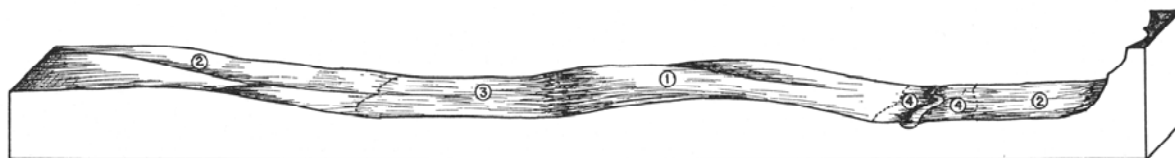
Drainage: Sub-angular or sub-parallel; sparse. Flooding limited to narrow river flats and depressions.

Land management: Pastures are moderately attractive to cattle and prone to degradation if stocking is uncontrolled; generally low susceptibility to erosion. Controlled stocking and fire management systems desirable.



Like most Kimberley land systems the Kennedy 2 system is subject to frequent fires. Perennial tussock grasses in eucalypt woodlands produce considerable biomass much of which is lost after fire. (left 2000 - unburnt; right 2009 – burnt).

Photos: DAFWA



Stylised block diagram showing location of land units

* The name Kennedy has been applied to two different land systems in Western Australia. Kennedy 1 occurs in the Carnarvon Basin survey area.

KENNEDY 2 LAND SYSTEM (Kny) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	60	Gentle slopes or undulating plains	Mostly igneous red earths and skeletal red earths, with smaller areas of fine-textured yellow podzolics.	Woodlands and forests: <i>Eucalyptus tectifica</i> , <i>Corymbia grandifolia</i> alliance (1 , 2 , 5 , 6 , 10, 13, 14, 15); <i>E. tetradonta</i> sub-alliance.	WGBB 40% RGRP 40% TTGP 20%
2	25	Gentle slopes or undulating plains	Predominantly deep yellow sands, patches medium red sands, skeletal sands and small ridges of skeletal laterite.	Forests: <i>E. tetradonta</i> (24 , 25 , 26, 31) and <i>C. dichromophloia</i> (40) sub-alliances.	RGRP 60% CSPP 40%
3	10	Flats	Mixed lateritic podzolics, coarse and fine-textured yellow podzolics.	Woodlands: <i>C. latifolia</i> alliance (48 , 49 , 50, 51).	RGPP 60% CSPP 40%
4	5	Streamlines and levees	Mixed red levee soils and sandy levee soils.	Fringing community and woodlands: <i>Terminalia</i> spp., <i>Ficus</i> spp., <i>Melaleuca</i> spp. community; <i>C. polycarpa</i> , <i>E. apodophylla</i> (61, 65, 67 , 68, 69); <i>C. bella</i> (53, 54, 55, 56, 57) alliances; <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. (75) community.	FRIP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1



The gentle slopes (units 1 and 2) of Kennedy 2 land system in the foreground are overshadowed by the Caroline Range in Buldiva land system. This area marks the headwaters of the Prince Regent River which flows north-west into Saint George Basin and the Timor Sea.
Photo:
Wayne Parker
(Panoramio.com)

KOONGIE LAND SYSTEM (Kog)

3236 km² Source: WKY, OVC

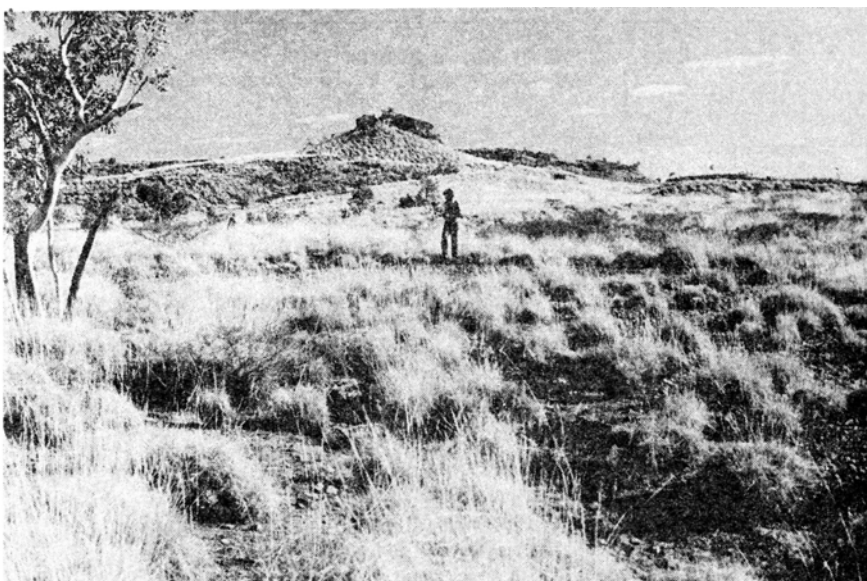
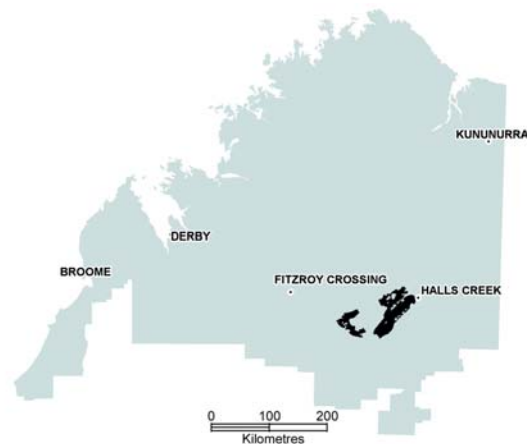
Low laterite plateaux and scattered hills, reddish loamy gravelly soils, low open woodlands and spinifex.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Lateritized or relatively unweathered granite and schist - gneiss complexes of Lower Proterozoic and (?)Archaean age.

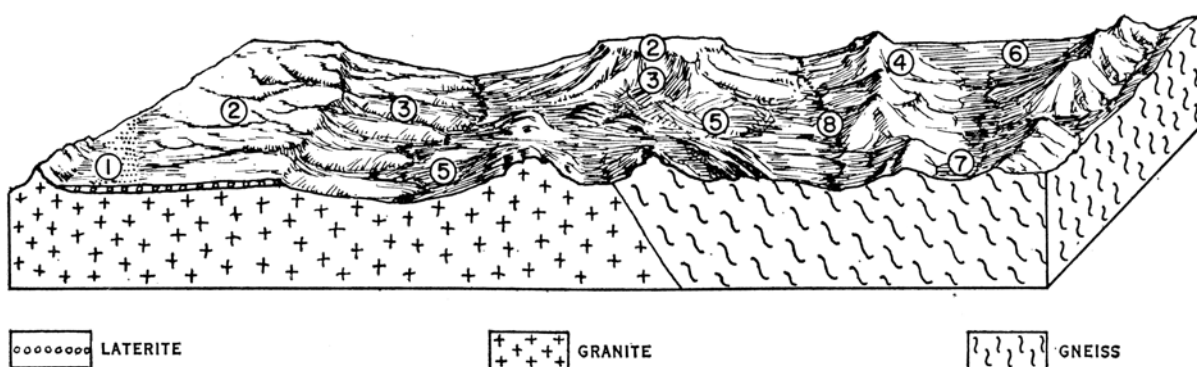
Geomorphology: Formed by dissection of the Kimberley surface - hill lands: strike belts up to 40 km wide, with low lateritic plateaux, scattered gneiss hills, narrow schist ridges, and granite domes; restricted cracking clay plains; dense to moderately dense branching pattern of incised valleys with through-going trunk drainage; relief up to 30 m.

Land management: Much of the system supports hard spinifex vegetation which is unattractive to cattle and little grazed; other parts (units 3, 6 & 7) support attractive pastures which degrade if stocking is uncontrolled. Low susceptibility to erosion except for units 3 & 7 which have moderate to high susceptibility.



Slopes below breakaways (unit 3) of the Koongie land system, like many other units of the system, have stony soils supporting lobed (hard) spinifex (mostly Triodia intermedia).

Photo: DAFWA 1972



Stylised block diagram showing location of land units

KOONGIE LAND SYSTEM (Kog) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	3	Summit remnants: sandy slopes less than 1% and up to 3.2 km in extent; minor upstanding rocky ridges up to 15 m high with slopes up to 50%.	Reddish, sandy to loamy soils: Tippera family (2) with minor outcrop.	Woodlands with patches of dense <i>Acacia</i> shrubs and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> community (1d); also 17, and locally 1a.	CSPP
2	25	Stripped surfaces: up to 4.8 km in extent; rocky slopes up to 5%, with laterite exposures and with marginal breakaways up to 12 m high.	Mainly exposed laterite surface with pockets of reddish sandy soils: Yabbagoddy family (1).	Very open woodland of small trees and <i>Triodia intermedia</i> . <i>E. brevifolia</i> community (1a); also 57.	HSPP
3	14	Slopes below breakaways: concave, up to 5%, dissected up to 6 m into rounded spurs up to 400 m wide, with marginal slopes up to 10%; laterite scree and outcrops of weathered rock in upper parts, colluvial mantles in lower sectors.	Shallow reddish, loamy and sandy soils community high in laterite gravel: Yabbagoddy family (1, 23). Local, minor areas of brownish sands over red clay: Moonah family (17).	Much bare ground or with sparse cover of annual grasses; local patches of <i>Triodia intermedia</i> and low open woodlands. <i>E. brevifolia</i> alliance (1a); also 8d, 12, 57.	HSPP 50% ASGP 50%
4	25	Rocky hillslopes: benched slopes on gneiss and schist, up to 70%, with basal scree slopes up to 35%; smooth convex slopes on granite, up to 80%, locally with joint-block cappings.	Mainly outcrop with some areas of reddish, sandy skeletal soil (24).	Much bare rock. Pockets of <i>Triodia intermedia</i> , <i>T. inutilis</i> , and <i>Enneapogon</i> spp. and low open woodlands. <i>E. brevifolia</i> alliance (1a, 1b, 1f).	HSPP 60% ASGP 40%
5	16	Hill–footslopes: concave, up to 5% and up to 3.2 km long; colluvial mantles with pebble patches and local outcrop.	Shallow reddish sandy and loamy soils: Tippera family (2, 23). Some reddish sands and loams over red clay: Moonah family (17).	Spinifex grasslands and very open woodlands with <i>Triodia intermedia</i> and <i>Chrysopogon</i> spp. <i>E. brevifolia</i> alliance (1a, 1e); also 57.	HSPP
6	6	Cracking clay plains: hummocky slopes less than 0.5% and less than 3.2 km in extent.	Dark brown self-mulching clays: Wonardo family (14).	Mitchell grass and ribbon grass-bluegrass grasslands with scattered trees and shrubs. <i>Astrelba</i> spp. and <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> communities (47, 48).	MGAP 50% RAPP 50%
7	5	Alluvial drainage floors: up to 800 m wide, gradients 1 in 80 to 1 in 500; marginal slopes up to 0.5%.	Brownish sands and loams over red clay: Moonah family (17).	Open woodlands with <i>Chrysopogon</i> spp., locally short annual grasses. <i>E. brevifolia</i> community (1e).	RAPP 80% ASGP 20%
8	6	Channels: up to 90 m wide and 9 m deep.	Channels, bed-loads mainly deep sands with pebble gravels. Banks, brownish loamy alluvial soils: Robinson family (21).	Small streams with open fringing communities (1a, 1g). Large streams, fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (41, 42, 43).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

LAKE GREGORY LAND SYSTEM (Lgr)

672 km²

Source: UNP*

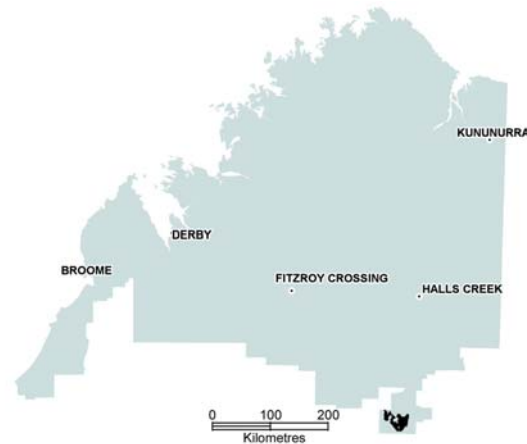
Lakes and surrounding floodplains supporting tussock grasslands of lovegrass and buffel grass and hummock grasslands of soft spinifex with scattered shrubs and trees.

State land type: Alluvial plains with tussock grasslands.

Geology: Quaternary sand, silt and clay deposits of alluvial and aeolian origin, minor halite and gypsum deposits.

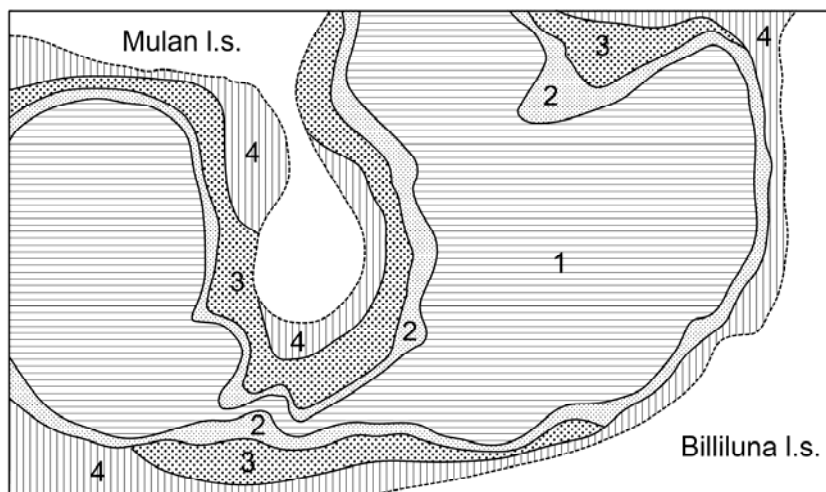
Geomorphology: Lake beds and fringing alluvial plains and slightly more elevated sandy plains all subject to seasonal inundation for variable periods.

Land management: A unique system which is a significant bird refuge and wetland area with high conservation value. About 30% of the system (the seasonally inundated lake margins, units 2, 3 & 4) support pastures which are moderately to highly preferred by grazing animals and are prone to degradation and erosion; control of grazing pressure is essential. Parts or all of the system should be considered for complete protection from grazing by livestock and feral animals.



Lake Gregory after good rains.

*Photo:
Philip Greatbatch
Dec 2008
(alias batchee,
Panoramio.com)*



*Stylised plan diagram
showing arrangement of
land units*

* Provisional description, not previously published. Originally described in *Lake Gregory Station Range Condition Report* (2000) DAWA, unpublished.

LAKE GREGORY LAND SYSTEM (Lgr) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Lake beds: level lake floors up to 20 km in extent, subject to regular inundation.	Salt lake soil.	No vegetation.	XXNP
2	5	Lake margins: level to very gently inclined alluvial plains and occasional gypsiferous dunes (up to 100-200 m from late dry season water level), subject to seasonal inundation.	Grey clay loam.	Succulents and short grasses. Most common species are <i>Myriophyllum verrucosum</i> , <i>Tecticornia</i> spp., and <i>Eragrostis dielsii</i> .	SMPP
3	10	Loamy alluvial plains: near level plains (from 100 m – 1 km from late dry season water levels), subject to seasonal inundation.	Orange to grey loamy sands.	Mainly grasslands with scattered trees. The most abundant tree is an <i>acacia</i> species. Pastures are mainly <i>Eragrostis dielsii</i> , buffel grass (<i>Cenchrus ciliaris</i>), soft spinifex (<i>Triodia pungens</i>), feathertop (<i>Aristida inaequiglumis</i>) and <i>Senna notabilis</i> .	LGAP 60% BUGP 20% SSPP 20%
4	15	Sandy alluvial plains: floodout areas (from 200 m up to 4 km from late dry season water levels) slightly elevated above units 2 and 3 but still subject to occasional inundation.	Orange sands.	Mainly grasslands and low shrublands. Most abundant trees and shrubs are <i>Eucalyptus victrix</i> , <i>E. pachyphylla</i> , <i>Acacia coriacea</i> , <i>A. stipuligera</i> , <i>A. bivenosa</i> , <i>Dicrastylis exsuccosa</i> and <i>Hakea lorea</i> . Grasses and forbs are mainly <i>Eragrostis eriopoda</i> , buffel grass (<i>Cenchrus ciliaris</i>), <i>Eriachne aristidea</i> , soft spinifex (<i>Triodia pungens</i>), <i>Aristida inaequiglumis</i> and <i>Pluchea tetranthera</i> .	LGAP 60% BUGP 20% SSPP 20%

+ Pasture types described in Appendix 1.



This photo shows a flooded Lake Gregory land system in the background fed by the anastomosing channels of Sturt Creek land system in foreground. Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)

LANDRIGAN LAND SYSTEM (Lan)

1831 km²

Source: WKC

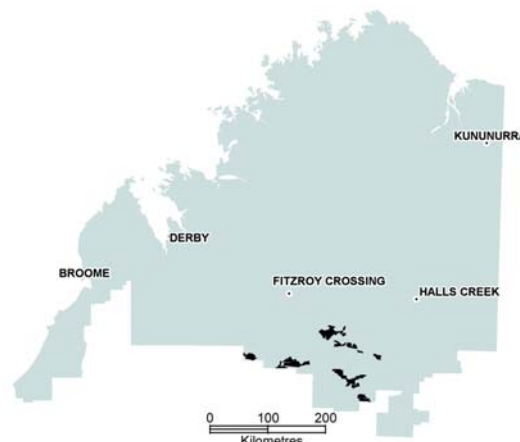
Undulating plains and sandplains, brown sandy soil over laterite, spinifex grassland and very open shrubland.

State land type: Sandplains and occasional dunes with shrubby spinifex grasslands.

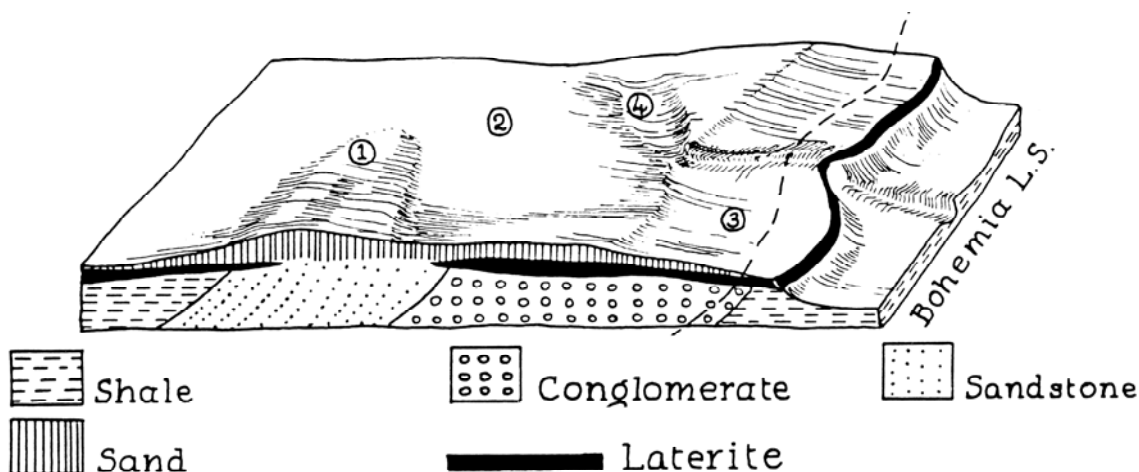
Geology: Lateritized gently dipping sandstone, conglomerate and shale of Permian and Jurassic age. Quaternary aeolian sand plain islands.

Geomorphology: Part of the Kimberley surface. Gently sloping plains up to 10 km in extent. Surface drainage absent except for occasional shallow drainage depressions.

Land management: Predominantly hard spinifex pastures of very low pastoral value; some soft and curly spinifex which is moderately attractive and useful for cattle for a few years after fire. Generally not prone to degradation or erosion but control of grazing pressure and frequency of burning is desirable.



*Landrigan land system showing sandy surfaced plain over laterite and gravel supporting spinifex grasslands (*Triodia bitextura* and/or *T. pungens*) and sparse shrubs. Photo: Andrew Craig, DAFWA*



Stylised block diagram showing location of land units

LANDRIGAN LAND SYSTEM (Lan) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	11	Sandplain islands: up to 4.8 km in extent; flat.	Deep red sands, commonly with some laterite.	Spinifex grassland and very open shrubland of <i>Triodia bitextura</i> , <i>Triodia pungens</i> and <i>Acacia</i> spp.	CSPP 50% SSPP 50%
2	54	Plains: up to 9.6 km in extent, sandy surface, sparsely strewn with laterite gravel, slopes less than 1%.	Shallow skeletal sands over laterite, patches of sandy loams over laterite.	Spinifex grasslands and very open shrublands of <i>Triodia intermedia</i> , <i>Triodia bitextura</i> and <i>Acacia</i> spp.	HSSP 50% CSPP 50%
3	32	Stripped margins: up to 3.2 km wide, stony slopes with frequent exposure of laterite.	Shallow red or brown loamy sands over laterite. Frequent laterite exposure.	Open shrublands of <i>Acacia</i> spp. and <i>Triodia intermedia</i> .	HSSP
4	3	Shallow depressions: up to 400 m wide and 3.2 km long.	Mostly firmed sandy surface over brown sandy loam.	Grasslands of <i>Triodia pungens</i> and <i>T. bitextura</i> .	SSPP

+ Pasture types described in Appendix 1.



Another example of the characteristic spinifex grasslands of the Landrigan land system – in this case dominated by soft spinifex (*Triodia pungens*).
Photo: DAFWA

LEGUNE LAND SYSTEM (Leg)

78 km²

Source: OVC

Nearly flat grasslands behind the littoral fringe at the mouth of the Keep and Victoria Rivers.

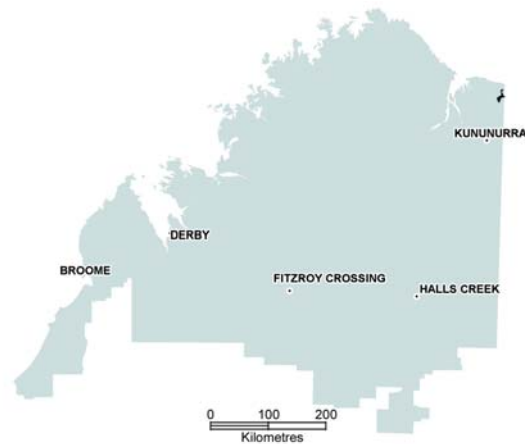
State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

Geology: Quaternary alluvia.

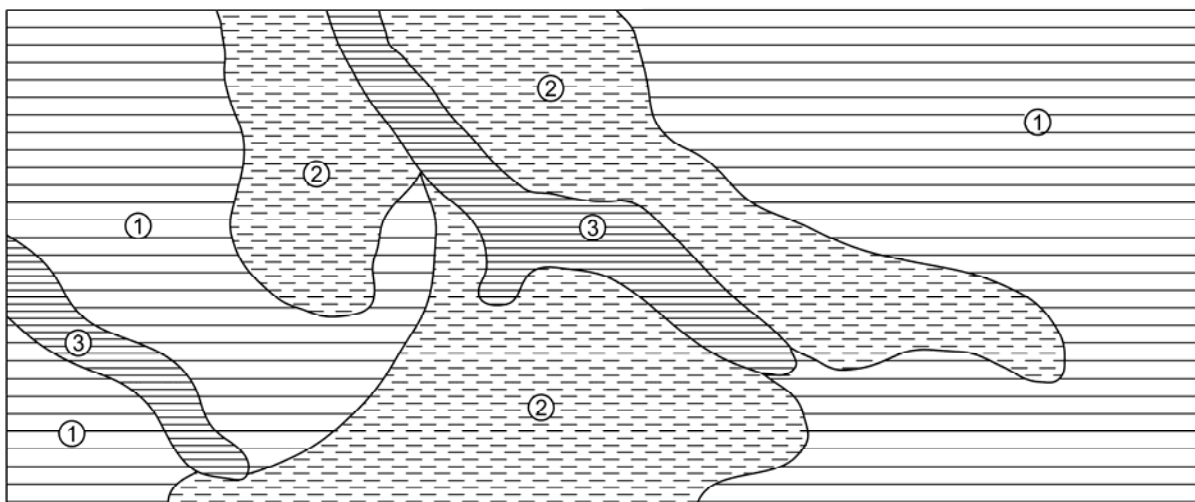
Geomorphology: Estuarine - deltaic plain.

Drainage: Widely spaced shallow meandering streamlines; liable to fresh water flooding in wet years.

Land management: Subject to flooding and consequent poor accessibility during and immediately after wet season. Variable pastures which are moderately attractive to cattle, control of grazing pressure required; mostly low susceptibility to erosion.



*Grassy coastal plains of the Legune land system that are subject to fresh water inundation during the wet season extend onto bare tidal mudflats of the Carpentaria land system. Width of 2005 aerial photograph is about 5 km.
Photo: Landgate*



Stylised plan diagram showing arrangement of land units

LEGUNE LAND SYSTEM (Leg) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	60	Nearly flat plain with gilgai	Complex of Flapper - grey sandy loam over mottled heavy clay - and Legume, shallow phase - grey cracking clay over stratified alluvium; minor Carpentaria.	Mostly saline soil short grass (<i>Xerochloa imberbis</i>), patches of bluegrass tall grass (<i>Dichanthium</i> spp., <i>Eulalia aurea</i> , <i>Ophiuros exaltatus</i>).	LITP 50% CTGP 50%
2	30	Nearly flat plain	Mainly Legume - grey cracking clay; minor Flapper.	Mainly bluegrass tall grass (<i>Ophiuros exaltatus</i> , <i>Dichanthium</i> spp.) and lowland tall grassland (<i>Imperata cylindrica</i>).	CTGP
3	10	Shallow linear depressions	Mainly Carpentaria - highly saline clay.	Bare mud or sparse samphire.	XXNP 50% SMPP 50%

+ Pasture types described in Appendix 1.

LEOPOLD LAND SYSTEM (Lep)

399 km²

Source: WKY

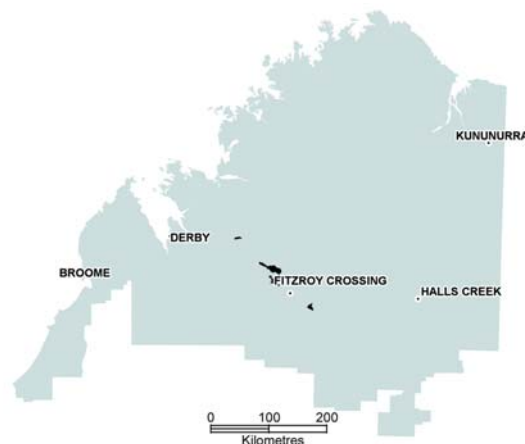
Cracking clay plains and marginal outcrop plains, grasslands and very open grassy woodlands.

State land type: Alluvial plains with tussock grasslands.

Geology: Gently dipping limestone, calcareous sandstone, and shale of Devonian age.

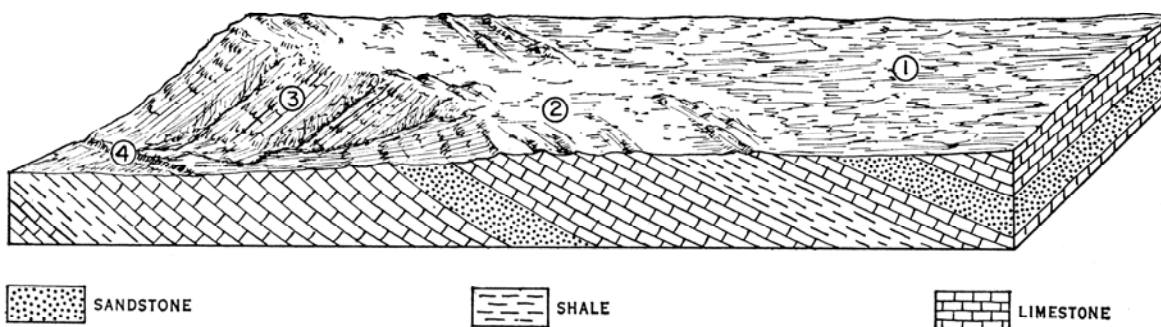
Geomorphology: Formed by dissection of the Kimberley surface - plains: strike belts up to 9.6 km wide and 40 km long, comprising cracking clay plains with marginal outcrop plains, and lower outcrop plains occurring in entrenched valleys; sparse, strike-controlled pattern of incised drainage; relief less than 30 m.

Land management: A high pastoral value system supporting tussock grass pastures preferred by cattle; control of grazing pressure is essential to prevent degradation. Not prone to erosion.



*Cracking clay plains with numerous limestone floaters are common in Leopold land system. It supports barley Mitchell grass (*Astrebla pectinata*) and bluegrass (*Dichanthium fecundum*) pastures which, in this image, have been recently burnt.*

Photo: DAFWA



Stylised block diagram showing location of land units

LEOPOLD LAND SYSTEM (Lep) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	49	Cracking clay plains: up to 1.6 km wide; hummocky slopes less than 0.5%, with local outcrop.	Dark grey self-mulching cracking clay with structure-controlled linear gilgai: Cununurra family (12).	Mitchell grass and ribbon grass - bluegrass grasslands and open woodlands with <i>Astrebla</i> spp. and <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> ground storeys. Communities 47, 48, 37a.	MGAP 80% RAPP 20%
2	36	Outcrop plains: up to 3.2 km wide; boulder-strewn slopes up to 1% with much outcrop.	Dark grey strongly self-mulching heavy clay with some outcrop and commonly flat limestone 'floaters'. Cununurra family (12).	Grasslands and very open woodlands with <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> ground storey. <i>Bauhinia cunninghamii</i> community (37a) and 48.	RAPP 50% MGAP 50%
3	9	Valley sides: concave, up to 10%; benches up to 3 m high with outcrop and boulder strew.	Complex of limestone outcrop and shallow dark brown to dark grey, loamy to clayey calcareous soils: Oscar family (11). With dark grey self-mulching heavy clays; Cununurra family (12), showing structure-controlled gilgais.	Complex grasslands and open woodlands as in unit 2, also <i>Triodia wiseana</i> with scattered trees on rock outcrops. <i>Corymbia dichromophloia</i> alliance (8a) and 48.	RGRP 60% HSPP 40%
4	6	Channels: up to 60 m wide and 1.8 m deep, gradients 1 in 100 to 1 in 500; incised in bedrock.	Channels, bed-loads range from cobbles to boulders. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylia</i> fringing communities (42, 43).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

LITTLE SANDY LAND SYSTEM (Lsa)

259 km²

Source: PRP

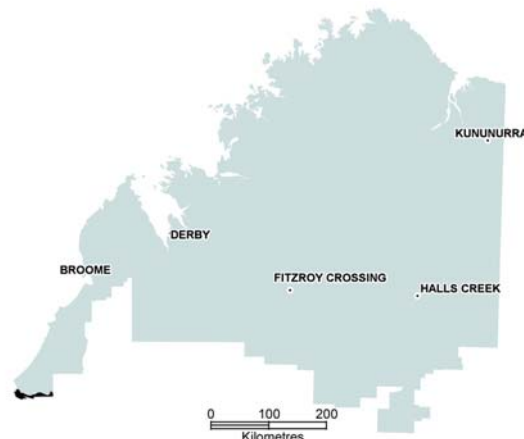
Sandplains with linear and reticulate dunes supporting shrubby hard and soft spinifex grasslands.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

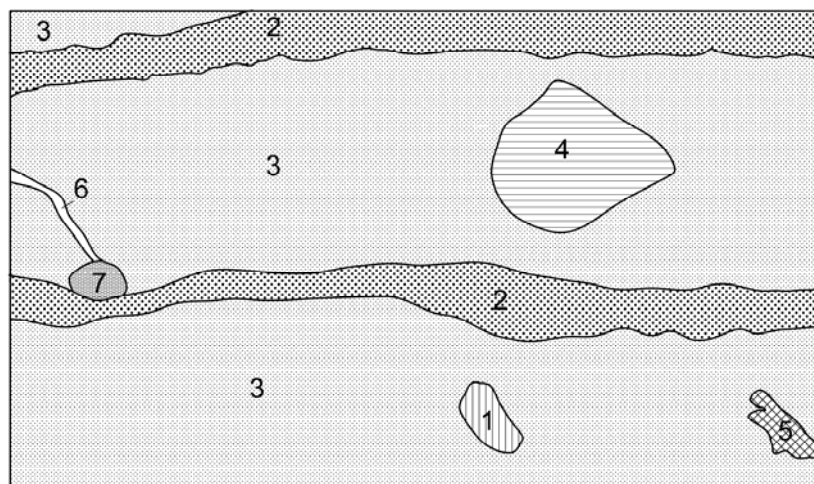
Geology: Quaternary eolian sand.

Geomorphology: Depositional surfaces; sand plains and dunefields formed by wind action; linear and reticulate dunes trending generally west-north west to east-south east, sandplains and swales as corridors between dunes, minor gravelly plains and plains with thin sand cover over calcrete and isolated low hills; no organised drainage features but some low lying tracts receiving through flow. Dune relief is up to 30 m.

Land management: Fires occur fairly regularly in spinifex vegetation; dunes (unit 2) and sandplains and swales (unit 3) show some susceptibility to wind erosion immediately after burning but rapid stabilisation occurs after rain. Dune flanks and crests are moderately to highly susceptible to erosion after any disturbance which removes vegetation.



Little Sandy land system is similar to Great Sandy land system except that it has fewer linear dunes and much more extensive sandplains and swales. The width of this 2004 aerial photograph is about 10 km. Photo: Landgate



Stylised plan diagram showing arrangement of land units

LITTLE SANDY LAND SYSTEM (Lsa) – land units

Unit	Approx. area (%)	Landforms	Soils ⁺⁺	Vegetation	Pasture type ⁺
1	< 1	Low hills: isolated hills with gently inclined to steep slopes, up to 500 m in extent and 50 m relief, occurring within unit 3; surface mantles of abundant cobbles, stones and boulders of granitic or sedimentary rocks and outcrop.	Red shallow sands (423).	Patchy hummock grasses <i>Triodia pungens</i> (soft spinifex) or <i>T. spp.</i> (hard spinifex) with very scattered shrubs.	SSPP ^{**}
2	8	Linear sand dunes: linear and reticulate dunes extending for up to at least 40 km with moderately inclined slopes, loose, uneven crest surfaces; relief up to 30 m.	Red deep sands (445).	Hummock grasslands with <i>Triodia schinzii</i> , <i>T. melvillei</i> (soft or hard spinifex) with scattered shrubs including <i>Grevillea</i> and <i>Acacia</i> spp., occasional trees of <i>Corymbia chippendalei</i> (sand dune bloodwood).	SSSG 50% SHSG 50%
3	78	Sandplains and swales: level plains extending for up to 5 km or as corridors 0.5–2 km wide between dunes.	Red deep sands (445) with some red sandy earths (463) in swales.	Hummock grasslands with <i>Triodia basedowii</i> , <i>T. spp.</i> (hard spinifex) with very scattered to scattered shrubs and trees <i>Grevillea</i> , <i>Acacia</i> spp., <i>Allocasuarina decaisneana</i> (desert oak) and many other species. Less frequently <i>Triodia schinzii</i> (soft spinifex) understorey.	SHSG 70% SSSG 30%
4	8	Gravelly plains: level to gently undulating plains extending for up to 2 km, sandy surfaces with mantles of common to abundant ironstone gravels.	Shallow gravel soils (304).	Hummock grasslands of <i>Triodia lanigera</i> and other <i>T. spp.</i> (hard spinifex) with very scattered shrubs.	HSPP [*]
5	3	Plains with thin sand cover over calcrete: level plains up to 1.5 km in extent occurring within sandplains and swales (unit 3).	Red shallow sands on calcrete (423).	Shrubby hummock grasslands with <i>Triodia wiseana</i> (hard spinifex).	CASG
6	1	Drainage tracts: level tracts up to 500 m wide occurring as low areas within sandplains and swales (unit 3) and receiving occasional through flow, usually unchannelled.	Red deep sands (445) and some sandy red earths (463).	Scattered to moderately close shrublands of <i>Melaleuca</i> spp. with patchy <i>Triodia</i> spp. understorey.	DMES
7	< 1	Drainage foci: isolated swampy depressions up to 1 km in extent.	Deep red/brown non-cracking clays (622).	Scattered woodlands of <i>Eucalyptus victrix</i> (coolibah) and very sparse tussock grasses.	DEAW

+ Pasture types described in Appendix 1.

++ Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

* HSPP is equivalent to PHSG in Pilbara report (Van Vreeswyk et al. 2004).

** SSPP is equivalent to HSPG in Pilbara report (Van Vreeswyk et al. 2004).

LOOINGNIN LAND SYSTEM (Log)

4728 km²

Source: WKY

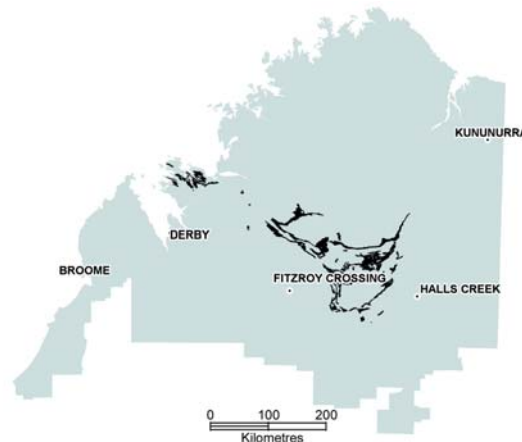
Basalt mountains and hills, shallow stony red earths, and grassy grey box woodlands.

State land type: Hills, ranges and plateaux with eucalypt woodlands and tall grasses.

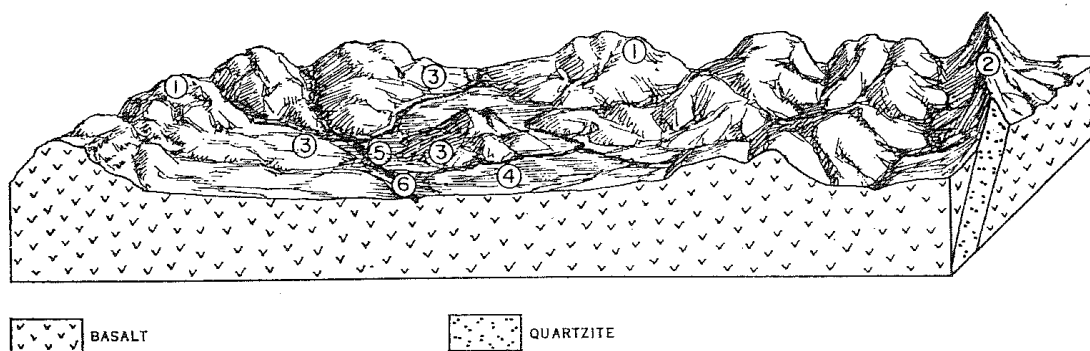
Geology: Basalt and dolerite of Upper Proterozoic or Lower Cambrian age; minor Upper Proterozoic quartzite and sandstone.

Geomorphology: Mountain and hill ranges eroded below the Kimberley surface: basalt hills and ridges, restricted lower slopes, and minor quartzite ridges, in strike belts up to 128 km long and 26 km wide; moderately dense rectangular pattern of incised valleys; relief up to 90 m.

Land management: Much of system is poorly accessible. Lower parts (units 3, 4 & 5) support pastures which are moderately attractive to cattle and not generally prone to degradation and erosion unless grazing pressure is excessive. Controlled stocking is desirable but difficult in this terrain.



*This basaltic hillslope supporting annual sorghum (*Sorghum* spp.) and white grass (*Sehima nervosum*) is part of the Looingnin land system. It is also a common unit of many other basaltic land systems such as Napier and Antrim.
Photo: DAFWA 1972*



Stylised block diagram showing location of land units

LOOINGNIN LAND SYSTEM (Log) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	58	Basalt hills and ridges: up to 60 m high and 4.8 km long; benched slopes up to 60% with basal scree slopes up to 20%.	Mainly outcrop with locally developed shallow red basaltic soil: Walsh family (4).	Low, very open grassy woodland with scattered shrubs and <i>Sehima nervosum</i> , <i>Sorghum</i> spp. ground storey. <i>Eucalyptus tectifica</i> alliance (14a); locally 14b and 1e.	WGBP
2	5	Quartzite ridges: up to 90 m high and 6.4 km long; narrow, rocky crests and steep benched slopes with boulder mantles.	Mainly outcrop with very limited soil development.	Low open woodland with <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d).	CSPP
3	26	Lower slopes: concave up to 7%, and up to 800 m long; dissected into interfluvies up to 4.5 m high and 400 m wide; patchy cobble mantles.	Mainly shallow red basaltic soil: Walsh family (4). Locally developed dark self-mulching heavy clays: Cununurra family (12).	Open grassy woodland with <i>Sehima nervosum</i> , <i>Dichanthium fecundum</i> ground storey. <i>E. tectifica</i> alliance (15); also 14a and 1e.	WGBB
4	2	Plains: hummocky surfaces up to 1.6 km wide with slopes less than 1%; patchy cobble mantles and local outcrop.	Dark, self-mulching heavy clays: Cununurra family (12).	Ribbon grass-bluegrass grassland with scattered trees. <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> community (48); also 49.	RAPP
5	2	Drainage floors: up to 400 m with channelled tracts up to 90 m wide; gradients 1 in 200 to 1 in 500.	Predominantly reddish sandy to loamy soils: Tippera family (2). Minor yellowish loamy soils: Elliott family (6). Minor greyish, mottled, loamy soils over tough mottled clayey subsoils: Hooper family (20).	Open grassy woodland with frontage grasses and <i>Sehima nervosum</i> , <i>Dichanthium fecundum</i> ground storeys. <i>E. tectifica</i> and <i>Corymbia bella</i> alliances (15, 22a).	WGBP
6	7	Channels: up to 15 m wide and 4.5 m deep, incised in bedrock; ranging from hillslope channels, gradients up to 1 in 10, to main channels with gradients as low as 1 in 500.	Channels, bed-loads range from sand to boulders. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing woodland. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (41, 43).	FRIP

Comparable with Napier land system, North Kimberley area.

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

LOWANGAN LAND SYSTEM (Low)

108 km²

Source: WKY

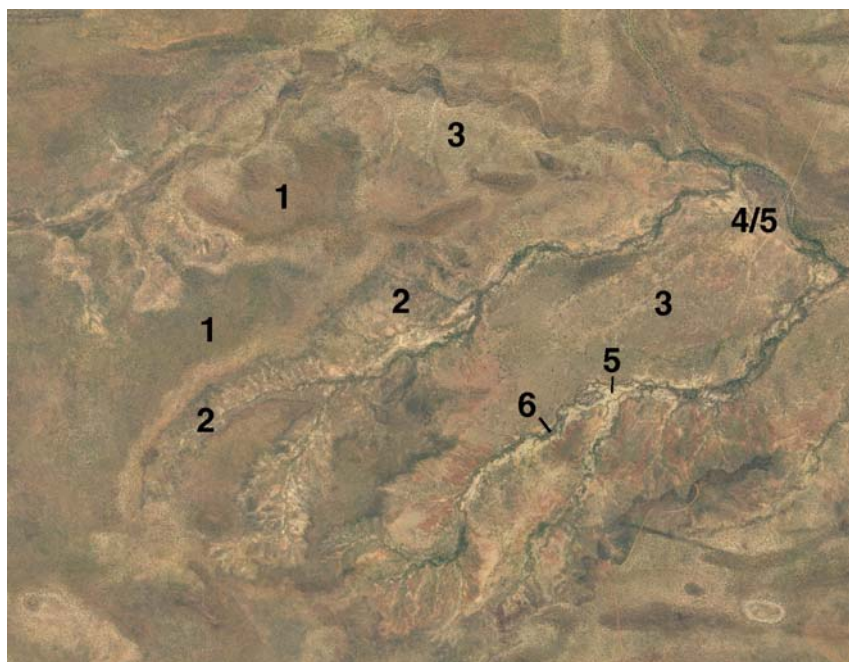
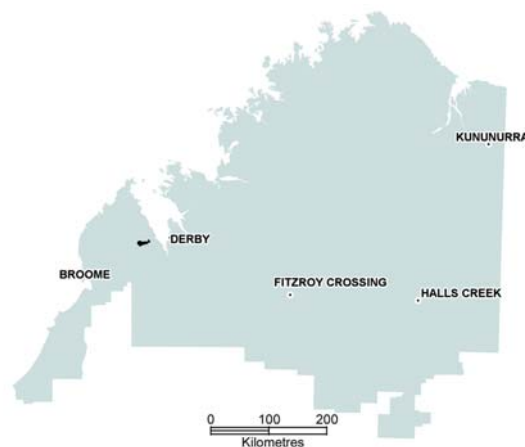
Sandy interfluvies and lower sandplain, grassy woodlands and pindan.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

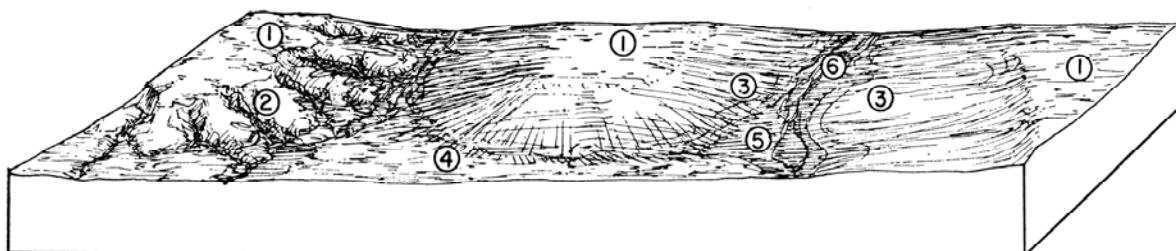
Geology: Quaternary aeolian sand; weathered rock and silicified nodular limestone of Jurassic age.

Geomorphology: Sandplain and dunefields with through-going drainage: gently sloping sandy interfluvial crests with dissected lower slopes; lower sandplain and restricted alluvial plains; moderately dense drainage pattern of branching tributaries and through-going alluvial floors; relief less than 15 m.

Land management: Pindan and ribbon grass pastures are moderately to highly attractive to cattle. Moderately resilient but controlled stocking required. Low or very low susceptibility to erosion except for alluvial plains and drainage tracts (units 4 & 5) which have moderate susceptibility.



This aerial photograph from 2004 shows all the land units that comprise Lowangan land system. For details refer to table. Photo: Landgate



Stylised block diagram showing location of land units

LOWANGAN LAND SYSTEM (Low) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	21	Interfluve crests: up to 1.6 km in extent, sandy slopes mainly less than 0.5%, up to 1% locally; delimited by sandy slopes up to 5% and by outcrop slopes up to 25%.	Probably mainly outcrop with minor areas of reddish skeletal soil (24).	Probably low open beefwood woodlands with <i>Chrysopogon</i> spp. Locally dense <i>Acacia</i> thickets on laterite exposures. <i>Grevillea striata</i> community (34a); also 17.	RGRP
2	15	Lower slopes: concave up to 5%, and 1.6 km long; shallowly dissected into spurs less than 275 m wide; colluvial mantles.	Reddish sandy soils of variable depth: Yabbagoddy family (1).	Open spinifex grassland with scattered shrubs. <i>Triodia intermedia</i> community (57).	HSPP
3	33	Sandplains: up to 1.6 km in extent, slopes less than 1% but attaining 2% locally.	Mainly deep sandy soils: Cockatoo family (7).	Low open woodland (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. and <i>Triodia bitextura</i> ground storey. Locally <i>Acacia</i> , dominated thickets. <i>Corymbia dichromophloia</i> and <i>E. tectifera</i> alliances (10, 16); higher-rainfall parts 28.	PINP
4	11	Alluvial plains: up to 3.2 km wide, gradients below 1 in 200; scalded surfaces locally.	Probably yellowish, loamy soils: Elliott family (6).	Probably low beefwood woodland with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> community (34a).	RGRP
5	13	Drainage floors: up to 400 m wide with extensive scalded tracts; gradients 1 in 100 to 1 in 500.	Complex of yellowish sandy soils: Tableland family (5). With scalded tracts of greyish to brownish sands and loams over tough domed clays: Jurgurra family (19).	Probably low open beefwood woodland with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> community (34a).	RGRP
6	7	Channels: up to 60 m wide and 4.5 m deep.	Channels, bed-loads of deep sand. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (40, 41); also 39.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

LUBBOCK LAND SYSTEM (Lub)

4989 km²

Source: WKY

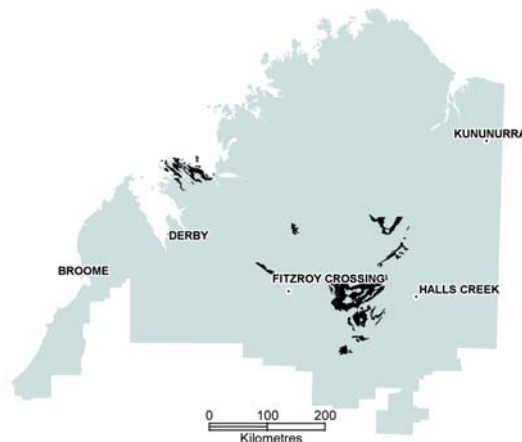
Rugged sandstone cuestas, ridges, and plateaux; low open woodlands and curly spinifex.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

Geology: Gently dipping or folded quartzite, sandstone, and shales of Upper Proterozoic age.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: strike belts up to 26 km wide and with extensive rocky surfaces comprising dissected cuestas, steep-sided ridges, and plateaux; short lower slopes with fans and aprons locally; dense rectangular or branching pattern of incised valleys with strike-controlled trunk drainage; relief up to 150 m.

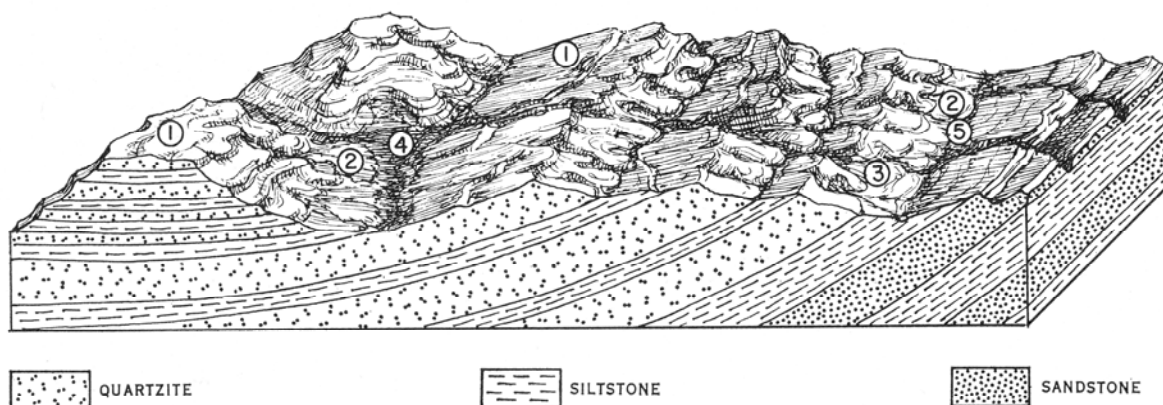
Land management: Rugged, poorly accessible system of little use for pastoralism; low or very low susceptibility to erosion, generally stable and not prone to degradation although fires may temporarily alter botanical composition and density.



This aerial photograph shows the characteristic patterns produced by the sandstone cuestas, backslopes, ridges and plateaus of the Lubbock land system.

Width of this 2005 aerial photograph is about 6 km.

Photo: Landgate



Stylised block diagram showing location of land units

LUBBOCK LAND SYSTEM (Lub) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	72	Rocky surfaces: dip slopes up to 10% and 4.8 km long, plateau surfaces less than 2% and up to 3.2 km wide; benched hillslopes up to 70%, locally vertical, and mantled with boulders.	Outcrop with variable, gravelly, sandy skeletal soils (24).	Open woodland, patchy shrub layer, and <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d). Lowest-rainfall parts 1a.	CAHP 50% CSPP 50%
2	16	Lower slopes: concave, up to 5%, and up to 800 m long; dissected up to 9 m into narrow spurs with benched marginal slopes; cobble mantles and outcrop in upper parts, masked with colluvium in lower sectors.	Bouldery, coarse-textured skeletal soils (24) with some outcrop.	Open woodland, patchy shrub layer, and <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d). Lowest-rainfall parts 1a.	CAHP 50% CSPP 50%
3	2	Fans and aprons: up to 800 m long with gradients 1 in 20 to 1 in 60 and gullied up to 3 m.	Mainly yellowish sandy soils: Tableland family (5).	Woodlands with moderately dense shrub layer and <i>Triodia bitextura</i> . <i>Corymbia collina</i> , <i>Corymbia dichromophloia</i> community (6). Lower-rainfall parts 1a.	CSPP
4	2	Drainage floors: up to 400 m wide, gradients 1 in 100 to 1 in 800; marginal slopes up to 1%.	Mainly reddish sandy soils: Yabbagoddy family (1). Minor occurrences of brownish sands over red clay: Moonah family (17).	Woodlands with <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d). Lowest-rainfall parts 1a.	CSPP
5	8	Channels: up to 30 m wide and 4.5 m deep; ranging from hillslope channels with gradients up to 1 in 6, to main channels with gradients as low as 1 in 800.	Channels, bed-loads range from sand to boulders, Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (42, 43).	FRIP

Comparable with the rocky cuestas of Buldiva land system, North Kimberley area.

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

LUCAS LAND SYSTEM (Luc)

112 km²

Source: UNP*

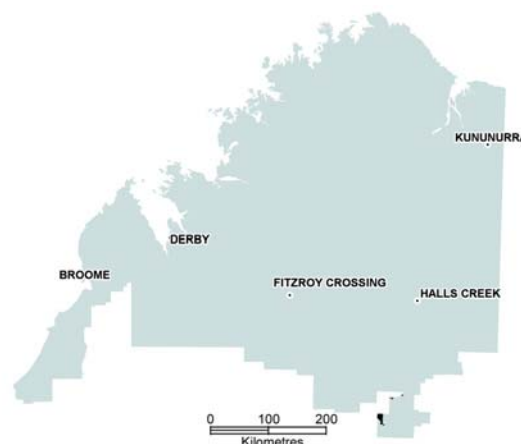
Gently undulating plains with sandy rises and dunes. Vegetation mainly soft spinifex, with desert oak, low acacia species, and lemonwood occurring on rises and dunes.

State land type: Sandplains and dunes with acacia shrublands and spinifex

Geology: Quaternary aeolian quartzose sand.

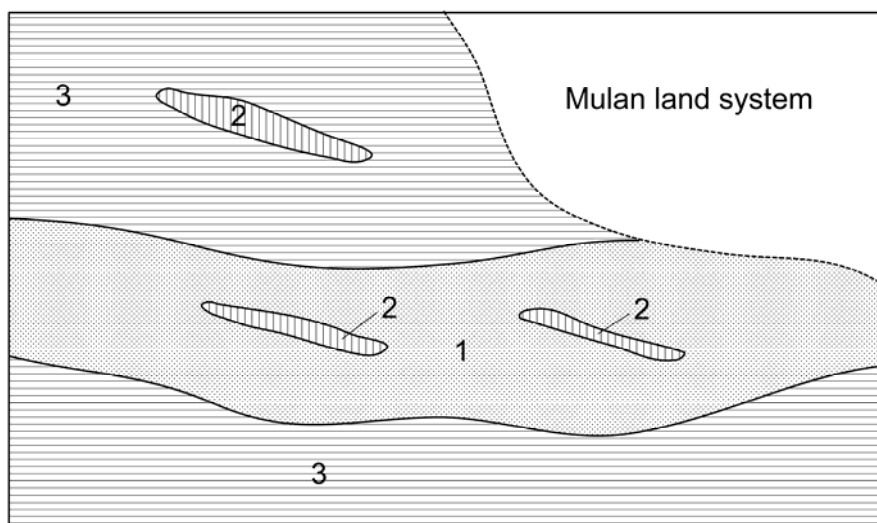
Geomorphology: Sandy plains and minor dunes with no organised drainage.

Land management: Soft spinifex pastures which are moderately attractive to cattle for a few years following fire. Dunes (unit 2) have some susceptibility to wind erosion after burning but stabilise rapidly after rain; control of grazing pressure and frequency of burning is desirable.



Desert oaks (*Allocasuarina decaisneana*) over soft spinifex (*Triodia pungens*) provide park-like scenery on large areas of Lucas land system.

Photo: Andrew Craig, DAFWA



Stylised plan diagram showing arrangement of land units

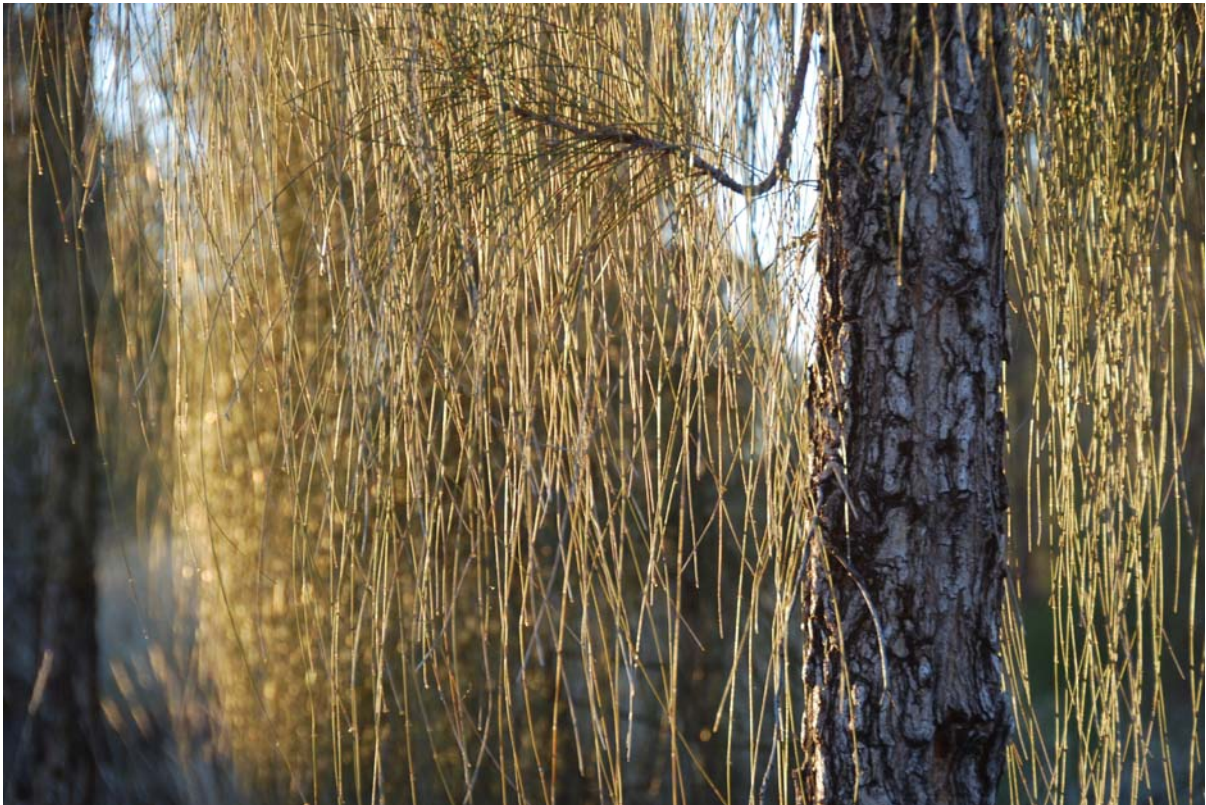
* Provisional description, not previously published. Originally described in *Billiluna Station Resource Survey Report* (1993) DAWA, unpublished.

LUCAS LAND SYSTEM (Luc) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	30	Low sandy rises	Red deep sands (445)	<i>Allocasuarina decaisneana</i> (desert oak) open woodland with a shrub layer of <i>Acacia bivenosa</i> , <i>A. tumida</i> and <i>Dolichandrone heterophylla</i> (lemonwood). Pastures mainly <i>Triodia pungens</i> .	SSPP
2	10	Sand dunes	Red deep sands (445)	As above.	SSPP
3	60	Plains	Red sandy earths (463)	Hummock grasslands of <i>Triodia pungens</i> .	SSPP 90% RGRP 10%

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

+ Pasture types described in Appendix 1.



The delicate, weeping foliage of the desert oak (Allocasuarina decaisneana) creates a characteristic and hauntingly beautiful whistling sound in the wind.

Photo: Ken Leighton, Landgate

LULUIGUI LAND SYSTEM (Lui)

1797 km²

Source: WKY

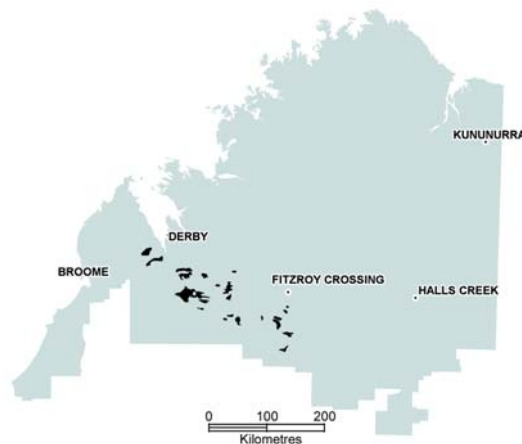
Sandplain and dunefields with stony surfaces and scalded plains, spinifex and low open grassy woodlands.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

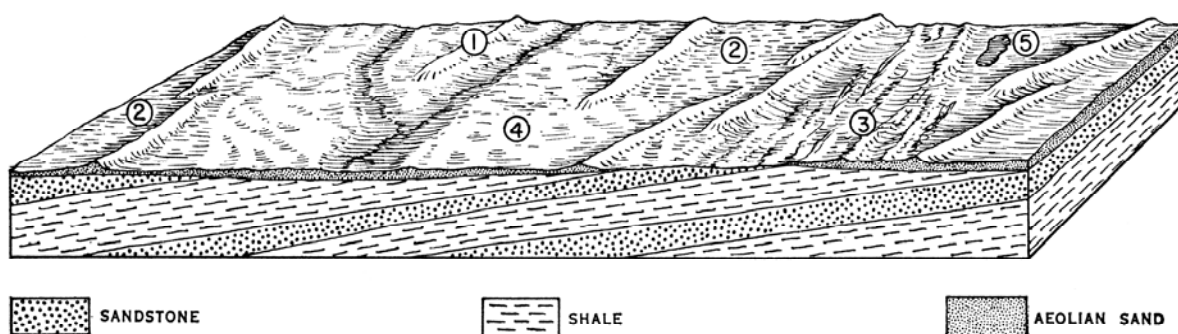
Geology: Quaternary aeolian sands; gently folded Permian sandstone, shale, minor sandy limestone.

Geomorphology: sandplain and dunefields with little organised drainage: stable dunefields with pans and shallow drainage depressions, with limited surface drainage mainly as sheet-flow; soil-covered plains traversed by channelled drainage floors; minor stony outcrop plains; relief mainly less than 9 m but locally attaining 21 m.


Land management: Dunes and sandplains (units 1 and 2) support dense wattle scrub with pindan pastures subject to fairly frequent fires which induce short term changes in botanical composition, density and structure. Unit 4 supports pastures more attractive to cattle and prone to degradation with moderate susceptibility to erosion. Control of grazing pressure and frequency of burning is required.



Soil covered plains (unit 4) of Luluigui land system supporting beefwood trees (*Grevillea striata*) over spinifex (*Triodia* spp.), wire grass (*Eriachne obtusa*) and other grasses.
Photo: DAFWA



 SANDSTONE

 SHALE

 AEOLIAN SAND

Stylised block diagram showing location of land units

LULUIGUI LAND SYSTEM (Lui) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	16	Dunes: linear, up to 9 m high and 11 km long with uneven crests; flanks slope up to 15% on north side and up to 20% on south.	Deep red sands: Cockatoo family (7).	Low open woodlands (pindan), sparse to moderately dense <i>Acacia</i> spp. shrub layer with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp., <i>Triodia pungens</i> , and <i>Aristida browniana</i> ground storeys. <i>Corymbia dichromophloia</i> , <i>Grevillea striata</i> , and <i>Bauhinia cunninghamii</i> alliances (10, 34b, 38c); locally 55.	PINP
2	40	Swales and sandplain: swales up to 1.6 km wide with flat floors and marginal slopes less than 2%; opening into sandplain up to 8 km in extent, with slopes less than 1%.	Reddish sandy soils: Yabbagoddy family (1).	Low open woodland (pindan) with prominent <i>Acacia</i> spp. shrub and small tree layers and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp., and <i>Triodia pungens</i> . <i>Corymbia dichromophloia</i> , <i>Grevillea striata</i> , and <i>Bauhinia cunninghamii</i> alliances (10, 12, 34a, 34b, 37b).	PINP 80% RGRP 20%
3	14	Stony outcrop plains: strike belts, up to 1.6 km wide and up to 8 km long; with slopes generally less than 0.5%; localised escarpments up to 21 m high with slopes up to 60%.	Ferruginised outcrop and strew with loamy and clayey skeletal soils (24).	Spinifex grassland and open boabab woodlands with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storey. <i>Triodia intermedia</i> community (57) and <i>Adansonia gregorii</i> , <i>Corymbia cadophora</i> community (31).	CSPP 50% HSPP 50%
4	25	Soil-covered plains: strike belts 4.8 km wide and up to 13 km long; extending in tongues up to 800 m wide between dunes; traversed by drainage floors up to 800 m wide, gradients between 1 in 200 and 1 in 600, with channels up to 30 m wide and 1.8 m deep; extensively scalded soil surfaces.	Mainly brownish sands and loams over red clay: Moonah family (17). Some reddish loamy soils with variable strew cover: Tippera family (2).	Much bare ground with patches of low, open beefwood or bloodwood woodland with <i>Chrysopogon</i> spp. or <i>Triodia pungens</i> . <i>Grevillea striata</i> and <i>C. dichromophloia</i> alliances (34a, 34b 8b).	RGRP
5	5	Pans and drainage depressions: up to 3.2 km wide; depressions less than 0.3 m deep with firmed sandy surfaces, pans up to 1.5 m deep with bare, crackling surfaces.	Yellowish sandy and loamy soils with tough subsoil: Elliott family (6).	Fringing woodlands of coolibah with <i>Triodia pungens</i> . <i>E. microtheca</i> alliance (20c).	SSPP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

MACPHEE LAND SYSTEM (Mcp)

1106 km²

Source: OVC

Several small patches of undulating sandy granite country in the north-western portion of the Ord-Victoria survey area.

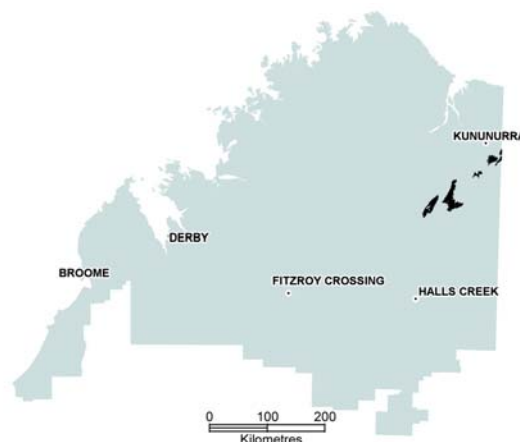
State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology: Lower Proterozoic granite (Lamboo Complex).

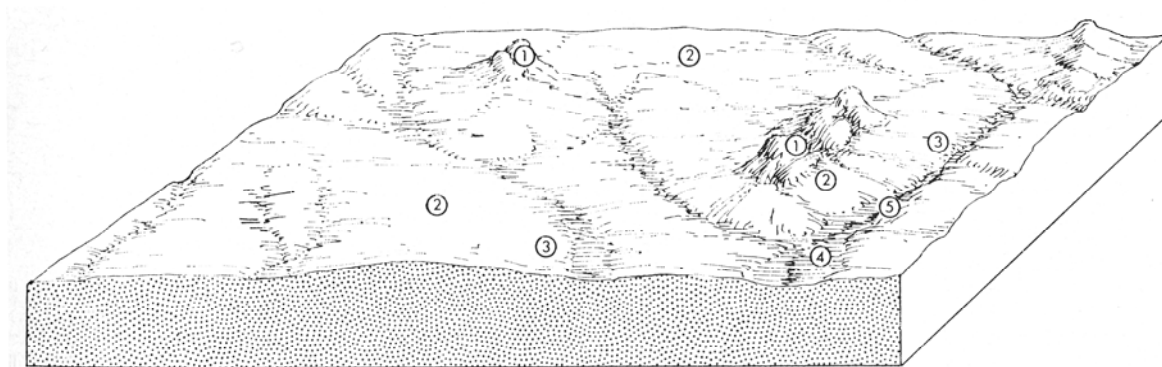
Geomorphology: Coastal and inland erosional plains.

Drainage: Dendritic and subangular drainage of moderate intensity.

Land management: Pastures low to moderately attractive to cattle, require controlled stocking; slopes have some susceptibility to gully erosion if vegetative cover is removed. Fire management programs desirable.



Gently to moderately sloping plains based on granite are the major components of the Macphee land system. The system also has a few steep granitic hills (foreground). The hills in the background are the Richenda land system. Photo: DAFWA



Stylised block diagram showing location of land units

MACPHEE LAND SYSTEM (Mcp) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	10	Steep bouldery hills	Mostly boulders of granite.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with hard spinifex (<i>Triodia inutulis</i>).	HSHP 50% XXNP 50%
2	70	Moderate slopes	Pago - very gritty yellow sands, with scattered outcrops of granite.	Northern box-bloodwood (<i>Corymbia grandifolia</i> , <i>C. foelscheana</i> , <i>C. latifolia</i>) with upland tall grass (<i>Sorghum timorense</i> , <i>S. stipoideum</i> , <i>Eriachne obtusa</i> , <i>Triodia bitextura</i>). Southern parts stringybark woodland (<i>C. dichromophloia</i>) with upland tall grass.	CAHP
3	15	Lower gentle slopes	Cullen - grey sand merging into mottled yellow sand.	As for unit 2	LCSP
4	3	Narrow depressions on flats adjacent to streamlines	Hooper - greyish sandy surfaces over mottled hard clay.	Trees absent with Marrakai mid-height grass. Small areas paperbark low woodland (<i>Melaleuca minutifolia</i>) with upland tall grass (<i>Sorghum timorense</i> , <i>S. stipoideum</i> , <i>Eriachne obtusa</i>).	OTHP
5	2	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.

MAMILU LAND SYSTEM (Mam)

652 km²

Source: WKY

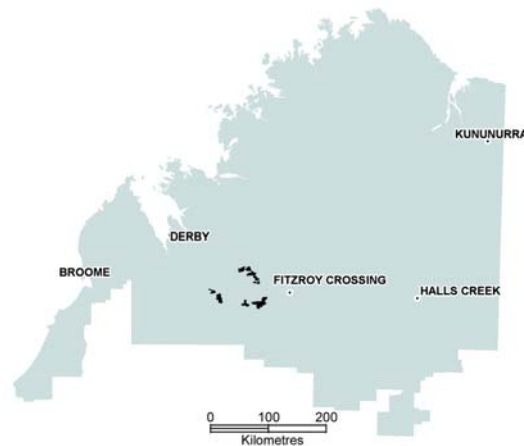
Plains and sandplains, deep red sands and yellowish loamy soils, pindan and grassy woodlands.

State land type: Plains with low woodlands and spinifex/tussock grasslands.

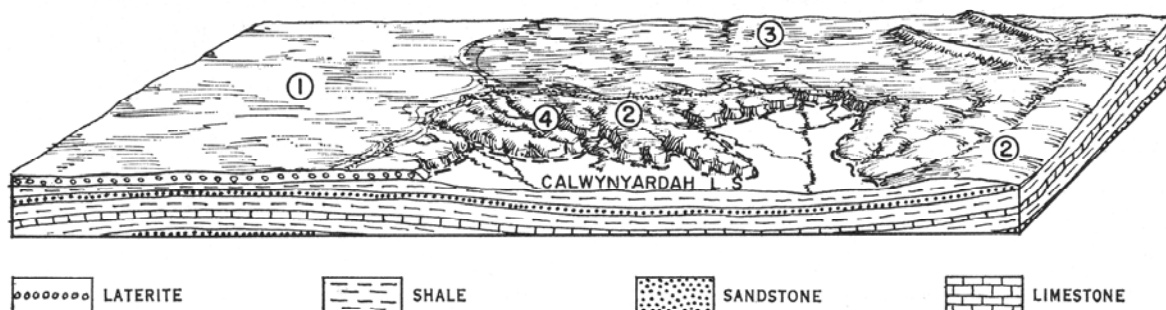
Geology: Lateritized gently folded sandstone, shale, and sandy limestone of Permian age; Quaternary aeolian sands.

Geomorphology: Part of the Kimberley surface: gently sloping lateritized plains, up to 22 km in extent with sandplain tracts; surface drainage absent except for moderately dense branching pattern of incised channels on marginal stripped surface.

Land management: Pindan and ribbon grass pastures of low to moderate value for pastoralism, generally resilient under controlled grazing, not prone to erosion. Fire management programs desirable.



*Dissected stripped margins are a minor but distinctive unit of the Mamilu land system. The major units of the system, stable plains and sandplains, are in the top half of the image. Width of this 2007 aerial photograph is about 1.4 km.
Photo: Landgate*



Stylised block diagram showing location of land units

MAMILU LAND SYSTEM (Mam) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	43	Stable plains: slopes less than 1%; sandy surfaces sparsely strewn with ironstone gravel.	Yellowish sandy and loamy soils with laterite gravels; Elliot family (6).	Low woodlands with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> and <i>Bauhinia cunninghamii</i> alliances (34a, 37b).	RGRP
2	12	Stripped margins: up to 4.8 km wide with slopes less than 1%; delimited by breakaways up to 9 m high or marginally dissected up to 9 m into gently rounded spurs with slopes up to 5%; cobble-strewn rocky surfaces with exposures of laterite and weathered rock.	Laterite exposure, with some reddish loamy skeletal soils (24). Some reddish loamy soils: Tippera family (2).	Low shrub woodlands. Communities 8b, 16, 31, 34b, 57.	HSPP 50% CSPP 25% SSPP 25%
3	44	Sandplains: up to 3.2 km wide, slopes less than 1%, locally with linear dunes up to 9 m high and 1.6 km long, flanks slope up to 15%.	Deep red sands: Cockatoo family (7).	Low shrubby woodland (pindan) with prominent <i>Acacia</i> shrub layer with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storeys. <i>Corymbia dichromophloia</i> , <i>C. zygophylla</i> , <i>Acacia</i> spp. community (10).	PINP
4	1	Channels: up to 4.5 m wide and 1.8 m deep; gradients 1 in 200 to 1 in 300.	Bed-loads of sand and cobbles on outcrop.	Fringing woodland. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (40, 41).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

MANDEVILLE LAND SYSTEM (Mnv)

242 km²

Source: WKY

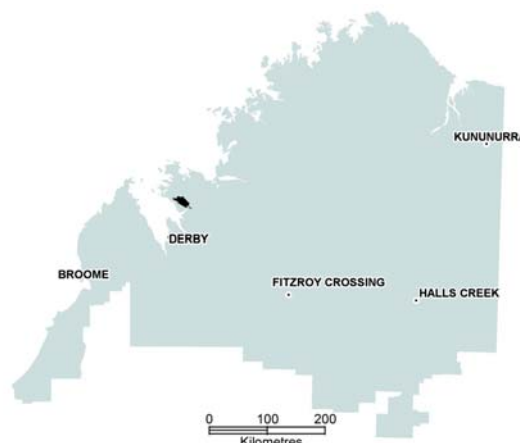
Broad rocky ridges with low open woodlands and curly spinifex and sandy lowlands with tall woodlands.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Dipping quartzite and sandstone of Upper Proterozoic age, and lateritized basaltic rocks of Upper Proterozoic or Lower Cambrian age; Quaternary aeolian sands.

Geomorphology: Land system formed by dissection of the Kimberley surface - plateaux and mountain ranges: broad, rocky ridges up to 1.6 km wide and extending along the strike for up to 10 km; lower, gently sloping sandy interfluvies, and valley floors with restricted ill-drained depressions; moderately dense rectangular pattern of strike-controlled drainage; relief up to 150 m.

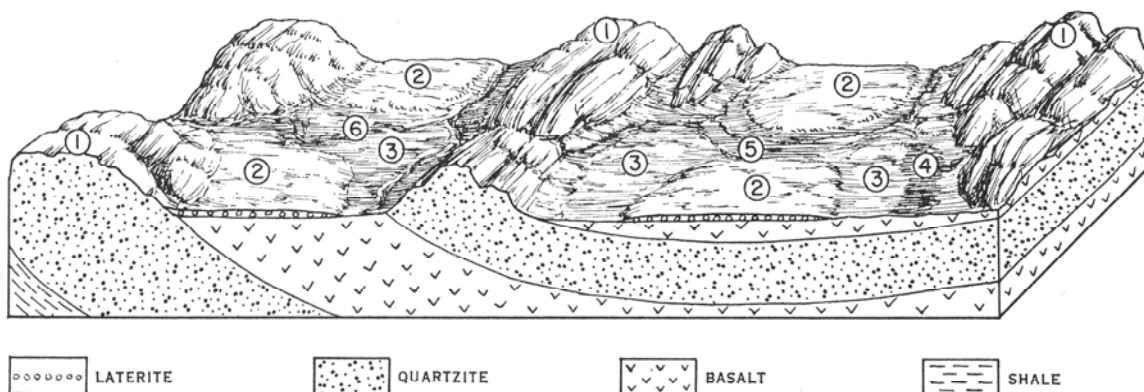
Land management: Rocky ridges (unit 1) poorly accessible, other parts support ribbon grass and curly spinifex pastures which are moderately favoured by cattle; resilient under controlled stocking and not prone to erosion except for some valley floors with duplex soils which are moderately susceptible. Currently this area is not under an active grazing lease.



The distinctive pattern of the Mandeville land system is derived from linear quartzite ridges interspersed by sandy interfluvies and valley floors.

Width of this 2004 aerial photograph is about 10 km.

Photo: Landgate



Stylised block diagram showing location of land units

MANDEVILLE LAND SYSTEM (Mnv) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	24	Ridges: up to 150 m high; rounded rocky crests and boulder-strewn slopes up to 50%.	Mainly outcrop.	Low depauperate woodland with moderately dense shrubs and <i>Triodia bynoei</i> . <i>Corymbia cadophora</i> , <i>Adansonia gregorii</i> , <i>C. dichromophloia</i> community (32).	CAHP 80% XXNP 20%
2	40	Interfluves: up to 12 m high and 3.2 km wide, extending along the strike for up to 8 km; sandy crest slopes less than 1%, and marginal slopes up to 25%, with low, discontinuous, laterite breakaways.	Deep yellow sands on laterite: Pago family (8).	Tall grassy woodland with smaller tree layer, abundant shrubs and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp., and <i>Chrysopogon</i> spp. ground storey. <i>Eucalyptus miniata</i> alliance (20a).	CSPP 50% RGRP 50%
3	20	Valley floors: up to 1.6 km wide; sandy slopes mainly less than 0.2%, locally up to 1%, strewn with pisoliths.	Mainly mottled yellowish loamy soils: Elliott family (6). Greyish to brownish sands and loams over tough clays: Hooper family (20).	Open grassy woodland of coolibah trees with <i>Chrysopogon</i> spp. <i>E. microtheca</i> alliance (20a).	RGRP
4	7	Ill-drained depressions: linear, up to 800 m wide and 3.2 km long; flat, hummocky floors and short marginal slopes up to 1%.	Mottled yellowish sandy soils: Tableland family (5). With brownish, mottled powdery sandy soils over tough mottled loamy subsoils: Tarraji family (18).	Fringing woodlands and paperbark thickets. Communities 26, 36.	CSPP
5	2	Alluvial drainage floors: up to 400 m wide, gradients 1 in 200 to 1 in 500.	Clayey alluvial soils: Fitzroy family (22).	Open grassy woodland with frontage grass. <i>Corymbia bella</i> community (22a).	FRGP
6	7	Channels: up to 60 m wide and 4.5 m deep.	Channels, bed-loads of deep sand, Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

MANDORA LAND SYSTEM (Mda)

238 km²

Source: UNP*

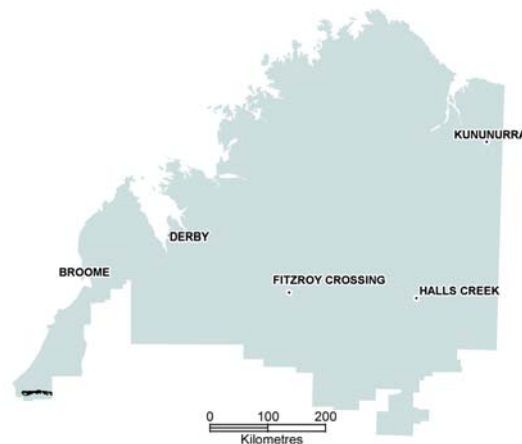
Bare salt pans and highly saline alluvial plains subject to regular inundation supporting low shrublands of samphire and melaleuca.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

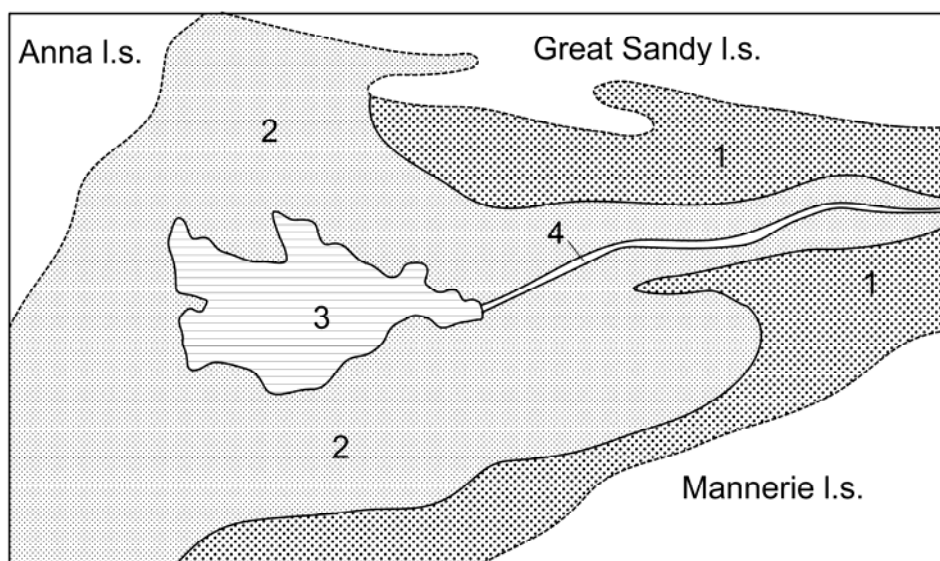
Geology: Quaternary alluvial and lacustrine deposits – sand, silt, clay and minor gypsum.

Geomorphology: Depositional surfaces; saline paleo-drainage plains and minor channels terminating in Lake Mandora.

Land management: Unique alluvial system subject to regular flooding, mixed vegetation melaleuca and samphire shrublands, spinifex and mangroves, also unvegetated saline lake flats; low pastoral value. Likely to have high conservation value as wetlands.



The distinctive patterns of the Mandora land system are a complex of alluvial plains, saline plains, bare salt lakes, channels and pools. Width of this 2004 aerial photograph is about 12 km. Photo: Landgate



Stylised plan diagram showing arrangement of land units

* Mapped by Cotching (2005), but not described in report. Originally described by McKenzie (1985) and reported in *Anna Plains Station Rangelands Resource Survey Report* (1985) DAWA, unpublished.

MANDORA LAND SYSTEM (Mda) – land units

Unit	Approx. area (%)	Landforms	Soils [*]	Vegetation	Pasture type ⁺
1	25	Alluvial plains: subject to occasional flooding	Probably sandy duplexes (400) and sandy earths (460).	Shrublands of <i>Melaleuca lasiandra</i> and <i>M. glomerata</i> , <i>Acacia bivenosa</i> , <i>Hakea microneura</i> and <i>Santalum acuminatum</i> with understorey of <i>Triodia pungens</i> and <i>T. basedowii</i> .	SSPP 50% HSPP 50%
2	45	Saline plains: subject to regular flooding	Saline wet soil (101).	Low shrublands of <i>Tecticornia halocnemoides</i> , <i>T. indica</i> and <i>Sesuvium portulacastrum</i> and a few grasses.	SMPP
3	25	Bare areas, salt lakes: inundated for extended periods	Salt lake soil (102), Saline wet soil (101).	No vegetation or occasionally very scattered samphire shrubs.	XXNP
4	5	Channels and pools	Unknown.	Nil or fringing vegetation of mangroves and/or melaleucas.	XXNP

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

MANNERIE LAND SYSTEM (Mnr)

433 km² Source*: PRP, BRM

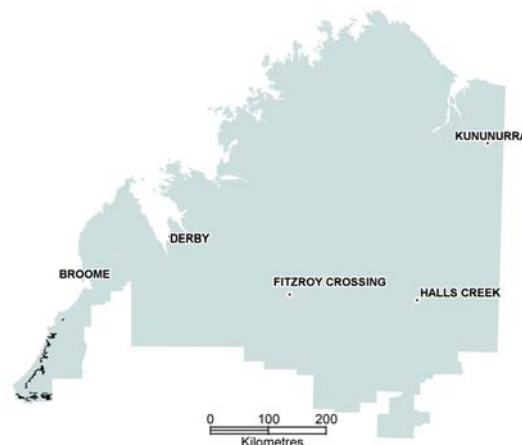
Seepage areas on inland margins of paleo-tidal plains supporting melaleuca thickets and halophytic shrublands.

State land type: Alluvial plains with mixed woodlands/shrublands and mixed grasses.

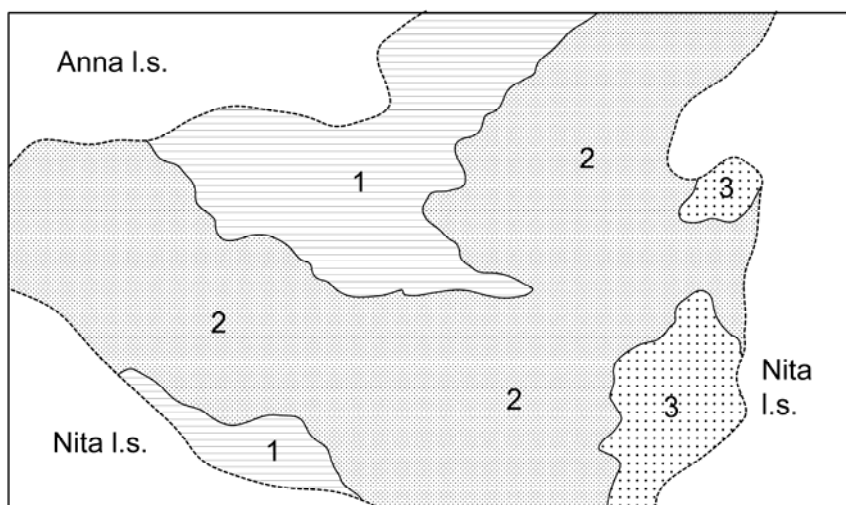
Geology: Quaternary supratidal mudflat deposits: clay, silt and sand.

Geomorphology: Depositional surfaces; level plains with seepage areas and swamps on saline alluvium, minor sandy banks; no organised drainage features.

Land management: The system is subject to inundation and waterlogging and supports very dense shrublands making access difficult.



The main unit of the Mannerie land system consists of dense thickets (green) of paperbark (Melaleuca lasiandra) on seepage areas flanking the seaward margins of the sandplains of Yeeda or Nita land systems. Width of this 2004 aerial photograph is about 2.5 km. Photo: Landgate 2004



Stylised plan diagram showing arrangement of land units

* This land system is described in the Pilbara Ranges Report (Van Vreeswyk et al. 2004) and the Broome Shire report (Cotching 2005). The descriptions differ, and the Pilbara Ranges Report description is presented here as it is more representative of the entire occurrence of this land system.

MANNERIE LAND SYSTEM (Mnr) – land units

Unit	Approx. area (%)	Landforms	Soils ⁺⁺	Vegetation	Pasture type ⁺
1	25	Saline plains: level plains up to 3 km in extent or as smaller patches within seepage zones (unit 2), surfaces often with saline or carbonate encrustations.	Grey calcareous loamy earths (542).	Scattered to moderately close low or mid height shrublands of <i>Tecticornia</i> spp. (samphire), <i>Frankenia</i> spp. (frankenian), <i>Trianthema turgidifolia</i> with occasional taller shrubs <i>Acacia ampliceps</i> (black wattle), <i>Melaleuca lasiandra</i> and grass <i>Sporobolus virginicus</i> (salt water couch). Occasionally mixed grasslands.	SMPP**** 80% APXG 10% MACP*** 10%
2	60	Seepage zones and swamps: level tracts up to 6 km in extent, subject to inundation and with water table very close to surface.	Grey calcareous shallow loams (542) and grey deep loamy duplex soils (509).	Moderately close to closed tall shrublands or low woodlands of <i>Melaleuca lasiandra</i> or <i>Acacia ampliceps</i> , understoreys absent or very sparse, occasional patches of grass <i>Sporobolus virginicus</i> .	DMES 80% MACP*** 20%
3	15	Sand sheets and banks: level plains and sandy banks as patches up to 1 km in extent or as plains up to 500 m wide on outer landward margins of the system, hummocky surfaces elevated up to 1 m above saline plains and seepage zones (units 1 and 2).	Red deep sands (445) with some red sandy earths (463).	Scattered to moderately close shrublands of <i>Acacia</i> and <i>Melaleuca</i> spp., other shrubs and prominent ground layer of <i>Triodia pungens</i> (soft spinifex) and occasionally <i>Cenchrus ciliaris</i> (buffel grass).	SSSG 80% BUGP** 20%

+ Pasture types described in Appendix 1.

++ Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

** BUGP is equivalent to APBG in Pilbara report (Van Vreeswyk et al. 2004).

*** MACP is equivalent to SPSP in the Pilbara report (Van Vreeswyk et al. 2004).

**** SMPP is equivalent to PPS in the Pilbara report (Van Vreeswyk et al. 2004).

MARGARET LAND SYSTEM (Mrg)

1702 km²

Source: WKY

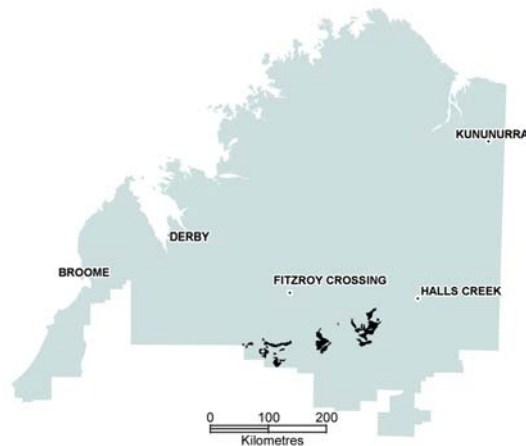
Rocky plateaux and ridges and lower slopes, spinifex and stunted open woodlands.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

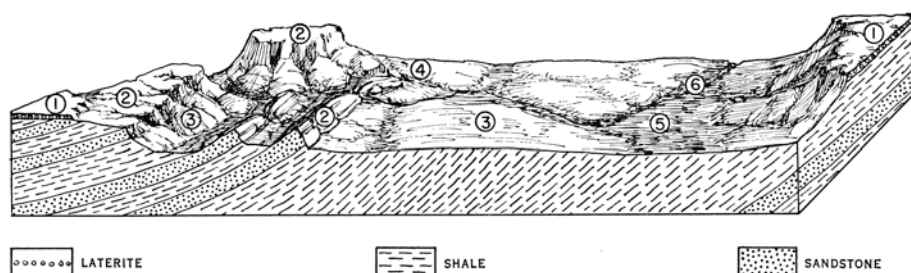
Geology: Laterised or relatively unweathered subhorizontal or gently dipping quartzite, sandstone, and shale of Upper Proterozoic age.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: rocky plateaux and ridges with lateritized summit remnants forming narrow drainage divides, and extensive lower slopes and interfluvies on sandstone or shale; dense branching or rectangular pattern of incised tributary drainage with through-going trunk drainage flanked by narrow alluvial plains in lower parts; relief up to 106 m.

Land management: Lobed (hard) spinifex vegetation of very low pastoral value except for the small alluvial plains unit (unit 5) which supports better quality pastures which are preferentially grazed by cattle and prone to degradation and erosion; control of grazing pressure is essential.



*The Margaret land system consists of remnant lateritic cappings, ridges, stony slopes and plains supporting lobed (hard) spinifex (*Triodia intermedia*). The alluvial plains in the foreground of the above photo (unit 5) support annual short grass pastures (*Enneapogon* spp.) and some ribbon grass (*Chrysopogon fallax*).
Photos: Bob McCartney, DAFWA*



Stylised block diagram showing location of land units

MARGARET LAND SYSTEM (Mrg) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	11	Lateritic summits: remnant cappings up to 4.8 km in extent, slopes mainly less than 3%; marginal breakaways up to 12 m high; boulder or cobble strewn surfaces with exposures of laterite and weathered rock.	Rock outcrop, laterite exposure, and reddish sandy skeletal soils (24).	Depauperate snappy gum woodland with scattered shrubs and <i>Triodia intermedia</i> , grading into spinifex grassland, <i>Eucalyptus brevifolia</i> community (1a); also 57.	HSHP
2	16	Stripped plateaux and ridges: up to 106 m high; gently sloping; plateaux up to 3.2 km in extent, and dissected ridges up to 9.6 km long, with dip slopes up to 20% and benched scarps up to 70%, rocky, boulder-strewn surfaces.	Mainly outcrop with some reddish loamy to clayey skeletal soils (24).	Depauperate snappy gum woodland with scattered shrubs and <i>Triodia intermedia</i> , grading into spinifex grassland, <i>E. brevifolia</i> community (1a); also 57.	HSHP
3	36	Lower slopes and interfluves on shale: concave lower slopes, up to 10% and 4.8 km long, dissected up to 12 m into spurs with flat or gently sloping crests up to 730 m wide and marginal slopes up to 40%; interfluves up to 7.5 m high and 3.2 km wide, slopes less than 2%; patchy cobble-strewn surfaces with local outcrop.	Shallow reddish loamy soils: Tippera family (2). With shallow brownish loams over red clay: Moonah family (17). Both soils high in shale fragments.	Depauperate woodland with scattered shrubs and <i>Triodia intermedia</i> , grading into spinifex grassland. <i>E. brevifolia</i> alliance (1a, 1); also 57.	HSHP
4	20	Lower slopes on sandstone: concave, up to 10%, and up to 3.2 km long, dissected up to 9 m into spurs less than 400 m wide with marginal slopes up to 60%, mantled with colluvium.	Probably deep yellow sands: Pago family (8). Locally stony.	Similar to units 1 and 2.	HSHP
5	9	Alluvial plains: up to 1.6 km wide and traversed by drainage floors up to 400 m wide; sealed, scalded surfaces with pebble patches; gradients 1 in 100 to 1 in 500.	Reddish clayey alluvial soils: Fitzroy family (22). Some scalded brownish sands over red clays: Moonah family (17).	Much bare ground. Patches of short annual grasses (61). Patches of very open woodlands. <i>Grevillea striata</i> and <i>Bauhinia cunninghamii</i> alliances (34c, 38b). [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common in parts].	ASGP 40% RGRP 30% BUGP 30%
6	8	Channels: up to 92 m wide and 6 m deep, ranging from hillslope channels, gradients 1 in 20, to main channels with gradients as low as 1 in 500.	Channels bed-loads range from sand to boulders. Banks, brownish alluvial soils: Robinson family (21).	Fringing woodlands, <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing community (42); also 39.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

MULAN LAND SYSTEM (MIn)

4439 km²

Source: UNP*

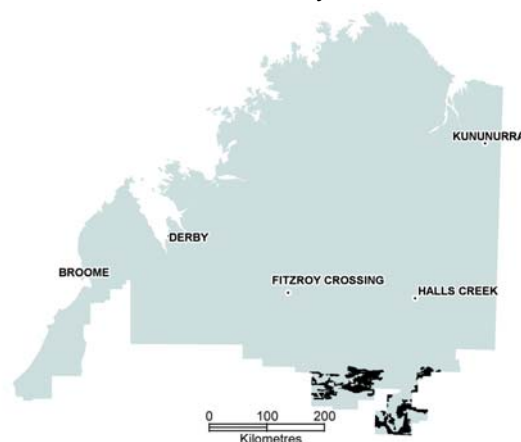
Gently undulating red sandplains with sandy rises, pans and depressions and linear dunes, supporting mainly stunted eucalyptus and acacia shrublands with understorey of soft spinifex.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

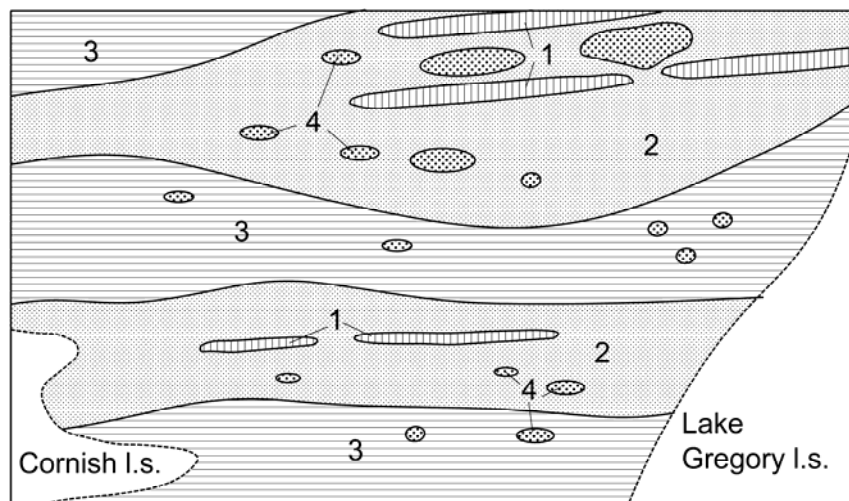
Geology: Quaternary aeolian quartzose sand with sand, silt and gravel of alluvial origin.

Geomorphology: Sandplains with little organised drainage; sandplains up to 10 km in extent, numerous small drainage foci or pans and linear dunes.

Land management: Mostly soft spinifex pastures which, when in young condition, provide useful grazing for cattle. Dunes and some sandy rises (units 1 & 2) have low to moderate susceptibility to wind erosion immediately after fire but stabilise rapidly after rain. Control of grazing pressure and frequency of burning is desirable.



Sandy plain of the Mulan land system supporting soft spinifex (*Triodia pungens*) and stunted eucalypt regrowth a few years after fire.
Photo: DAFWA



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in *Billiluna Station Resource Survey Report* (1993) DAWA, unpublished.

MULAN LAND SYSTEM (Mln) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	15	Dunes: linear dunes up to 2 km long with relief up to about 10 m.	Red deep sands (445).	Stunted shrubland of <i>Eucalyptus victrix</i> , <i>E. pachyphylla</i> , <i>Melaleuca lasiandra</i> , and lemonwood (<i>Dolichandrone heterophylla</i>). Pastures mainly soft spinifex (<i>Triodia pungens</i>).	SSPP
2	30	Sandy rises: gently undulating plains and low rises.	Red deep sands (445).	As above	SSPP
3	45	Flats: near level flats between rises and dunes.	Red sandy and loamy earths (463, 544).	Shrubland of <i>E. aspera</i> , <i>Corymbia greeniana</i> , <i>Hakea</i> sp., <i>H. lorea</i> , <i>Acacia victoriae</i> and <i>Acacia ancistrocarpa</i> . Pastures mainly soft spinifex (<i>Triodia pungens</i>).	SSPP
4	10	Drainage foci and pans: level pans, circular or oval up to 250 m in extent.	Saline wet soil (101).	Prostrate succulent halophytes.	SMPP

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

+ Pasture types described in Appendix 1.



Soft spinifex pastures and abundant termite mounds of unit 3, Mulan land system, near Mulan settlement.

Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)

MYROODAH LAND SYSTEM (Myr)

7101 km²

Source: WKY

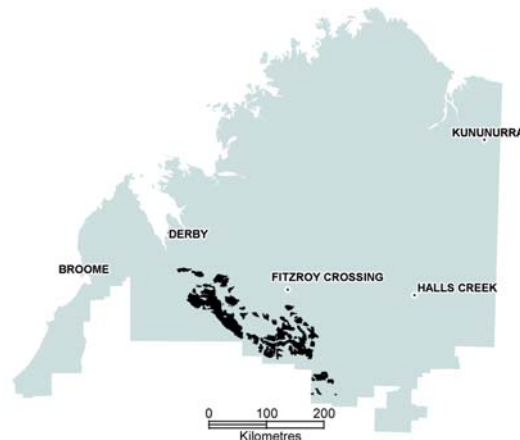
Outcrop plains, with extensive scalded surfaces, spinifex and low very open woodlands.

State land type: Stony plains with spinifex grasslands.

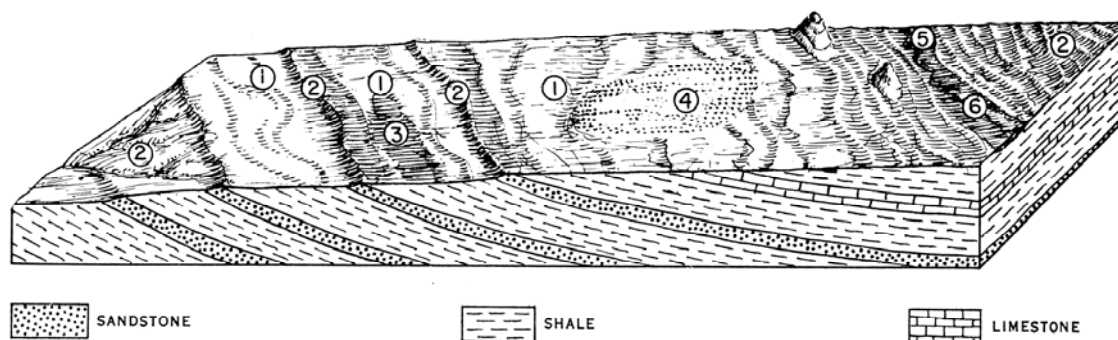
Geology: Gently folded Permian sandstone, shale, and sandy limestone; Jurassic lamproite; Quaternary aeolian sands.

Geomorphology: Formed by partial dissection of the Fitzroy surface – plains up to 112 km in extent; soil-covered areas, consisting of strike-aligned flats with degraded soils and low rises with relatively stable soil surfaces; stony surfaces comprising outcrop plains and low cuestas; ill-drained linear depressions and sandplain islands; sparse, through-going, channelled drainage floors with strike-aligned, generally unchannelled, tributary floors; relief mainly less than 9 m.

Land management: Supports a mixture of pastures which are unattractive (hard spinifex) and attractive (ribbon grass, soft spinifex) to cattle resulting in preferential use and degradation of the latter if grazing is uncontrolled. Soil surfaces without stony mantles (parts of unit 1) or duplex soils on drainage floors (unit 5) are moderately to highly prone to erosion. Controlled grazing pressure essential.



Soil covered plains (unit 1) are the major part of the Myroodah land system and support a somewhat banded mosaic of lobed (hard) spinifex (*Triodia intermedia*) and ribbon grass (*Chrysopogon fallax*) grasslands. The banding is due to the underlying bedrock features being expressed at the surface.
Photo: DAFWA



Stylised block diagram showing location of land units

MYROODAH LAND SYSTEM (Myr) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	66	Soil-covered plains: regional slopes generally less than 0.3%; pebble-strewn flats with sealed, scalded soil surfaces; strike rises up to 0.3 m high and 375 m wide on steeper slope facets up to 1% with loose sandy surfaces.	Mainly brownish sands and loams over red clay: Moonah family (17). Some reddish loamy soils with variable strew cover: Tippera family (2).	Much bare ground. Extensive <i>Triodia intermedia</i> grasslands (57). Groves of low depauperate woodlands: <i>Grevillea striata</i> and <i>Bauhinia cunninghamii</i> alliances (34a, 34b, 34c, 37b) and 8b.	HSPP 60% RGRP 40%
2	18	Stony surfaces: plains sloping less than 0.5%, in strike belts up to 3.2 km wide and up to 16 km long; cuestas with scarp slopes up to 10% and 9 m high; concave slopes up to 2% and up to 1.6 km long, marginal to main rivers outside land system.	Ferruginised outcrop and strew with reddish loamy skeletal soils (24).	Spinifex grassland with very scattered low trees and shrubs and local groves of depauperate woodland. <i>Triodia intermedia</i> grassland (57) and <i>Adansonia gregorii</i> woodland (31).	HSPP
3	5	Ill-drained strike depressions: up to 1.6 km wide and 3.2 km long, slopes less than 0.3%; alternate scalded flats and sandy steeper facets, up to 1% and 90 m wide.	Probably reddish brown crusty heavy clays: Cherrabun family (15).	Fringing woodlands of coolibah and <i>Triodia pungens</i> . <i>Eucalyptus microtheca</i> community (20c).	SSPP
4	4	Sandplain islands: up to 4.8 km in extent, slopes less than 1%.	Deep red sands, commonly with some lateritic gravels: Cockatoo family (7).	Pindan and depauperate beefwood woodlands. <i>Corymbia dichromophloia</i> and <i>Grevillea striata</i> alliances (10, 34b); also 54.	PINP 70% CSPP 20% SSPP 10%
5	6	Drainage floors: up to 800 m wide and 0.3 m deep; gradients 1 in 200 to 1 in 600, sealed surfaces with sand hummocks.	Complex of brownish sands and loams over red clays: Moonah family (17). With reddish sandy and loamy soils: Tippera family (2). Both commonly scalded and sealed.	Low beefwood woodland with <i>Chrysopogon</i> spp. <i>Grevillea striata</i> alliance (33); locally 34a, 48.	RGRP
6	1	Channels: up to 30 m wide and 3 m deep.	Channels, bed-loads of deep sand. Banks, brownish loamy alluvial soil: Robinson family (21).	Fringing woodland. <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. community (41).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

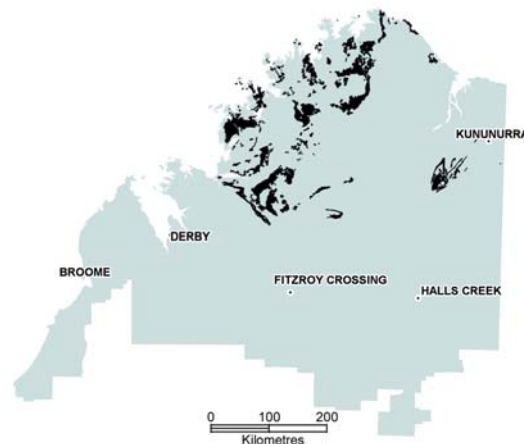
NAPIER LAND SYSTEM (Nap)

Total area across surveys 10,538 km²

Source: NKY, OVC

Napier land system was described in two CSIRO land system reports: North Kimberley and Ord-Victoria.

As the general description of the land system, and in particular the land units, was different in each survey both descriptions are presented in this report and no attempt has been made to merge them.



NAPIER LAND SYSTEM (Nap)

Area 9630 km²

Source: NKY

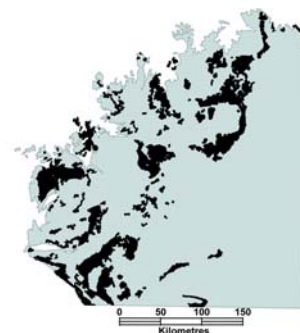
Hilly volcanic country, with grassy woodland vegetation and shallow stony soils.

State land type: Hills and lowlands with eucalypt woodlands and tussock grasses.

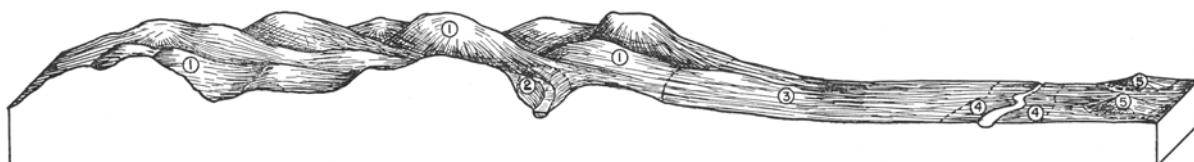
Geology and geomorphology: Maturely dissected plateaux on volcanic rocks, formed mostly on Mornington volcanics, but also on Hart basalt.

Drainage: Moderate, sub-angular; no areas subject to flooding during wet season.

Land management: Much of the system consists of poorly accessible low hills; lower parts support tussock grasses which are moderately preferred by cattle and have minor susceptibility to erosion. Control of grazing pressure and frequency of burning is desirable.



*The Napier land system consist mainly of low hills and footslopes on basalt, but restricted lower parts of it, as shown here, support eucalypt woodlands and useful perennial grass pastures.
Photo: DAFWA*



Stylised block diagram showing location of land units

NAPIER LAND SYSTEM (Nap) – land units, NKY survey

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	60	Rugged hills with steep to moderate slopes	Mostly skeletal red earths: patches of igneous red earths.	Woodlands: <i>Eucalyptus tectifica</i> sub-alliance (1, 2, 8).	ASHP 80% WGBP 20%
2	3	Small rocky streamlines	Mostly skeletal red earths with very small pockets of grey soils of heavy texture.	Woodlands: <i>E. tectifica</i> sub-alliance (2).	PLSP 50% WGBP 50%
3	26	Moderate slopes with occasional depressions	Mixed skeletal red earths and igneous red earths, patches of fine-textured yellow podzolics.	Woodlands: <i>E. tectifica</i> sub-alliance (1, 2 , 10)	WGBP 40% PLSP 30% TTGP 30%
4	8	Streamlines and associated levees	Mostly red levee soils, some igneous red earths.	Fringing community and woodlands: <i>Terminalia</i> spp., <i>Ficus</i> spp., <i>Melaleuca</i> spp. community; <i>Corymbia bella</i> (53, 56, 57, 65) alliance; <i>E. tectifica</i> (1, 3 , 4 , 10) sub-alliance and <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. (75) community.	FRIP
5	3	Low rocky rises	Skeletal soils with cherty rock fragments.	Forests: <i>E. tectifica</i> sub-alliance (7).	CAHP

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

+ Pasture types described in Appendix 1.



A scenic view from St Andrews Island, Saint George Basin, North Kimberley, showing the basaltic slopes of Napier land system flanking the flat-topped sandstone caps of Buldiva land system. Mt Trafalgar in the distance is a prominent example of this combination of land systems. Photo: Tricia Handasyde, DEC.

NAPIER LAND SYSTEM (Nap)

Area 908 km²

Source: OVC

Hilly volcanic country in the northern half of the Ord-Victoria survey area.

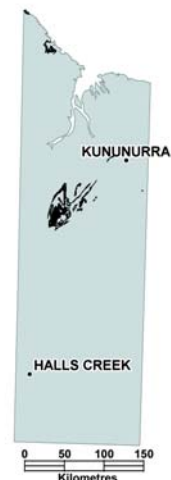
State land type: Hills and lowlands with eucalypt woodlands and tussock grasses.

Geology: Basalt, agglomerate, and tuff. Lower Cambrian (Antrim Plateau Volcanics), some Carpentarian dolerite.

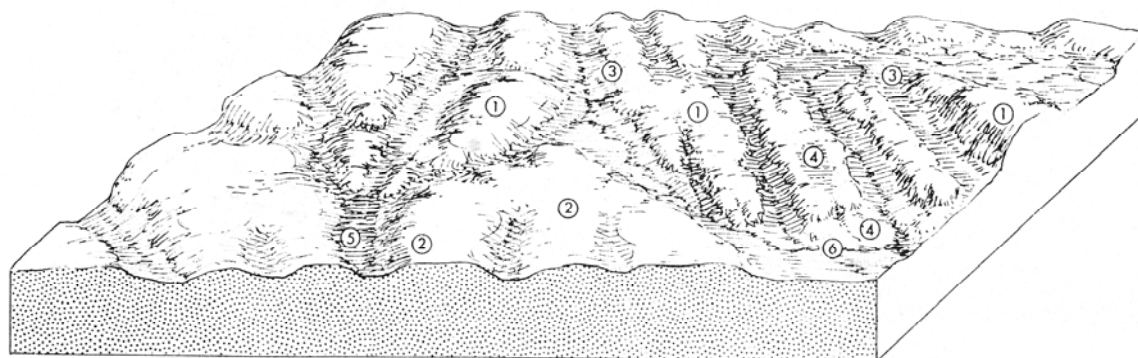
Geomorphology: Volcanic mesas and buttes.

Drainage: Fairly intense angular or rectangular pattern.

Land management: Much of the system consists of poorly accessible mesas and low hills; lower parts support tussock grasses which are moderately preferred by cattle and have minor susceptibility to erosion. Control of grazing pressure and frequency of burning is desirable.



*This photo shows the low basaltic hills and gentle lower footslopes typical of the Napier land system.
Photo: Noel Schoknecht, DAFWA*



Stylised block diagram showing location of land units

NAPIER LAND SYSTEM (Nap) – land units, OVC survey

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	40	Mesa and buttes with steeply sloping margins	Mostly rock outcrops with basalt boulders and pockets of red clayey soils.	Northern box-bloodwood woodland (<i>Eucalyptus tectifica</i>) or deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Cochlospermum fraseri</i>) both with upland tall grass (<i>Sorghum timorense</i> and <i>S. stipoideum</i> , <i>Triodia stenostachya</i>).	ASHP 50% CAHP 50%
2	40	Crests and slopes of rounded hills	Mostly rock outcrops with basalt boulders and pockets of red clayey soils.	Northern box-bloodwood woodland (<i>E. tectifica</i>) or deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Cochlospermum fraseri</i>) both with upland tall grass (<i>Sorghum australiense</i> , <i>Triodia stenostachya</i>).	ASHP 50% CAHP 50%
3	10	Moderate to gentle slopes	Frayne - stony brown loam merging into dark red clay.	Silver-leaved box sparse low woodland (<i>E. pruinosa</i>) with Tippera tall grass (<i>Sehima nervosum</i> , <i>Themeda triandra</i>).	TTGP
4	4	Gentle lower slopes and flat area	Cununurra, Argyle, Barkly - grey and brown cracking clays.	Bluegrass tall grass (<i>Dichanthium</i> spp. <i>Eulalia aurea</i> , <i>Ophiuros exaltatus</i>).	BGAP
5	3	Flats bordering streamline	Variable light and medium-textured alluvial soils.	Frontage woodland (<i>E. tectifica</i> , <i>Corymbia foelscheana</i>) with frontage tall grass.	FRGP
6	3	Stream channels		Fringing communities.	FRIP

Comparable with Napier land system of the North Kimberley area and Looingnin land system of the West Kimberley area.

+ Pasture types described in Appendix 1.

NEILLABUBLICA LAND SYSTEM (Nei)

2494 km²

Source: WKY

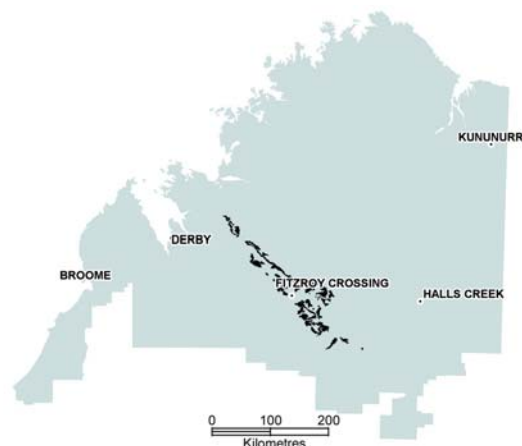
Undulating limestone country with scattered low hills and cracking clay plains. Open grassy woodlands, grasslands, and spinifex.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

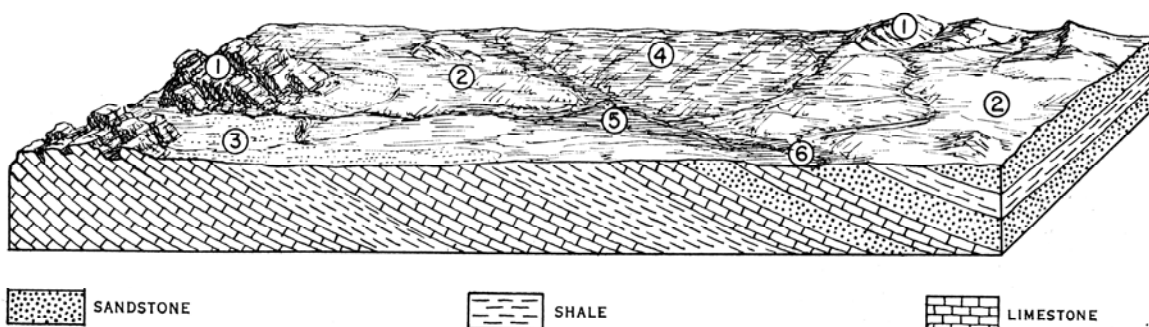
Geology: Dipping or gently folded limestone, calcareous sandstone and shale of Devonian age.

Geomorphology: Formed by partial dissection of the Fitzroy surfaces - undulating terrain: undulating plains in strike belts up to 6.4 m wide and 80 km long, with low interfluvies and rocky surfaces, comprising plateaux, rounded hills, and cuestas, up to 30 m high; sandy or calcareous alluvial plains in the lowest parts; moderately dense rectangular pattern of strike-controlled drainage; relief mainly less than 9 m.

Land management: System is a mixture of stable, rocky surfaces (unit 1 and parts of 2) supporting hard spinifex and interfluvies, plains and drainage floors (units 2, 3, 4 & 5) supporting attractive, preferentially grazed pastures. Generally not prone to erosion but controlled grazing is essential to prevent deterioration of preferred pastures.



*This interfluve (unit 2) of the Neillabublica land system is supporting arid short grass (*Enneapogon* spp.) pastures and limestone (hard) spinifex (*Triodia wiseana*). The rounded hills in the background are the Burramundi land system.
Photo: DAFWA*



Stylised block diagram showing location of land units

NEILLABUBLICA LAND SYSTEM (Nei) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	13	Rocky surfaces: up to 1.6 km in extent; plateaux and hill crests sloping less than 2%, dip slopes up to 5%; scarp and hillslopes comprise vertical upper walls rising above boulder-strewn slopes up to 50%.	Mainly outcrop with very limited shallow soil formation.	Very open baobab and bloodwood woodlands with <i>Triodia wiseana</i> , <i>Corymbia dichromophloia</i> and <i>Adansonia gregorii</i> alliances (8a, 30).	HSPP
2	51	Interfluves: up to 4.8 km wide; pebble-strewn slopes typically less than 2%, with local outcrop; marginally dissected up to 6 m.	Shallow dark brown and reddish brown to dark grey, loamy to clayey, calcareous soils: Oscar family (11).	Spinifex steppe and open woodlands with <i>Triodia wiseana</i> and <i>Chrysopogon</i> spp. <i>C. dichromophloia</i> alliance (8a, 8d); locally 1c, 9a, 9b, 58.	HSPP 70% RGRP 30%
3	10	Sandy alluvial aprons and plains: aprons up to 800 m long, gradients 1 in 2 to 1 in 60, and plains up to 8 km wide with gradients less than 1 in 200; traversed by shallow flood channels.	Dark brown to dark grey loamy to clayey calcareous soils: Neillabublica family (10). Minor areas of reddish sandy soils: Yabbagoddy family (1).	Grassy bloodwood and box woodlands with <i>Chrysopogon</i> spp. <i>C. dichromophloia</i> , <i>Eucalyptus argillacea</i> community (9b).	RGRP
4	20	Cracking clay plains: up to 1.6 km in extent with slopes less than 0.5%; hummocky surfaces.	Dark strongly self-mulching heavy clays: Cununurra family (12).	Mitchell grass and ribbon grass-bluegrass grasslands with scattered trees and shrubs. <i>Astrelia</i> spp. and <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> communities (47, 48); locally 37a.	MGAP 80% RAPP 20%
5	2	Drainage floors: up to 275 m wide, gradients 1 in 100 to 1 in 500.	Clayey alluvial soils: Fitzroy family (22).	Grassy woodlands with frontage grasses. <i>C. bella</i> community (22a).	FRGP
6	4	Channels: up to 45 m wide and 3 m deep.	Bed-loads range from sand to boulders on bedrock.	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> community (42); small streams 39.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

NELSON LAND SYSTEM (Nel)

1692 km²

Source: OVC

One area of undulating sparsely timbered country with powdery calcareous soil in the southern-central part of the Ord-Victoria survey area; many parts have suffered severe wind and gully erosion.

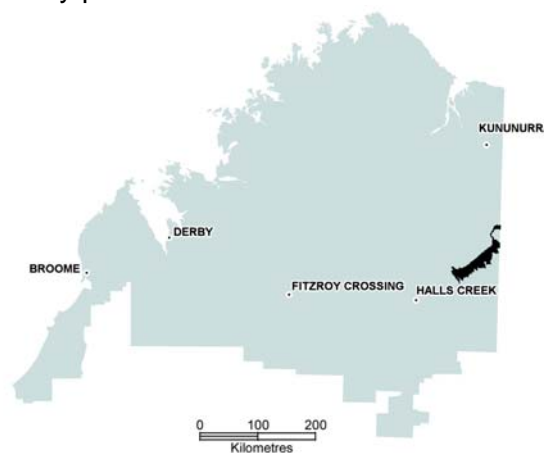
State land type: Undulating plains with tussock grasslands.

Geology: Shale and limestone. Middle Cambrian (Negri Group).

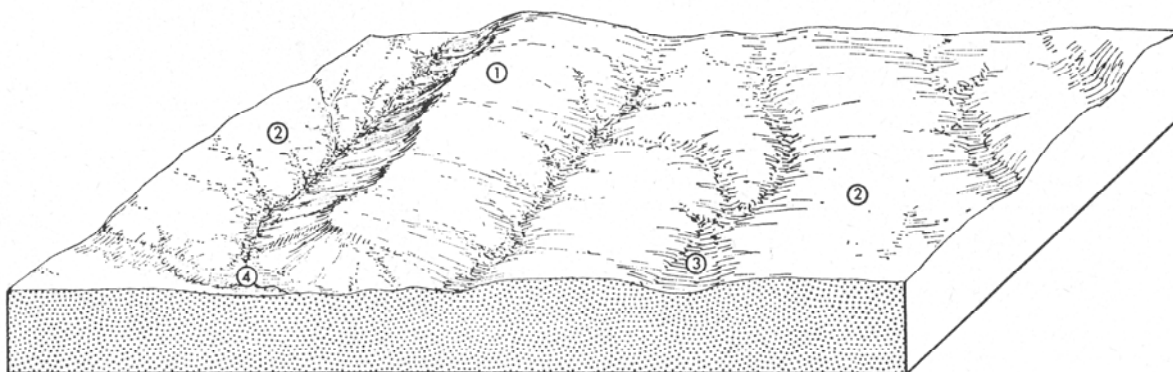
Geomorphology: Inland erosional plains.

Drainage: Subparallel to dendritic patterns of moderate intensity; gully erosion active in small headwater tributaries; also considerable sheet erosion on drainage divides of unit 2.

Land management: All of the system falls within the Ord River Regeneration Reserve or the Purnululu National Park and is not grazed by livestock. It previously supported pastures highly favoured by cattle and was highly degraded with unit 2 severely eroded. Vegetation has recovered and grass biomass can be high; fire management programs to minimise the risk of wildfires are essential.



Spectacular recovery in the Ord River Regeneration Reserve on slopes (unit 2) of the Nelson land system – 1963 (l) to 2002 (r). Photo: DAFWA



Stylised block diagram showing location of land units

NELSON LAND SYSTEM (Nel) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	15	Crests or low scarps	Limestone outcrops and Tobermorey - shallow calcareous loams.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i>) with hard spinifex (<i>Triodia wiseana</i>) or arid short grass (<i>Enneapogon</i> spp.). [Introduced buffel and Birdwood grasses (<i>Cenchrus ciliaris</i> , <i>C. setiger</i>) now common.]	HSPP 50% BUGP 50%
2	79	Moderate slopes, many areas severely gullied	Negri - brown powdery calcareous loams over deep clay loams.	Arid short grass (<i>Enneapogon</i> spp.) [Introduced buffel and Birdwood grasses (<i>Cenchrus ciliaris</i> , <i>C. setiger</i>) now dominant.]	BUGP 80% ASGP 20%
3	5	Gentle lower slopes or shallow depressions	Argyle - brown cracking clays.	Mitchell and other mid-height grasses (<i>Astrebla pectinata</i> , <i>Aristida latifolia</i>).	MGAP
4	1	Stream channels		Fringing communities.	BUGP

+ Pasture types described in Appendix 1.



Although now largely stabilised by buffel grass (*Cenchrus ciliaris*), gully erosion is still evident in susceptible parts of unit 2 in Nelson land system within the Ord River Regeneration Reserve. Photo: DAFWA

NITA LAND SYSTEM (Nit)

2803 km² Source*: PRP, BRM

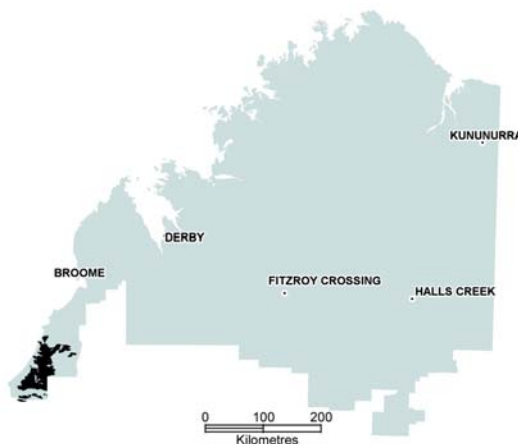
Sandplains supporting shrubby soft spinifex grasslands with occasional trees.

State land type: Sandplains and dunes with acacia shrublands and spinifex.

Geology: Quaternary aeolian sand.

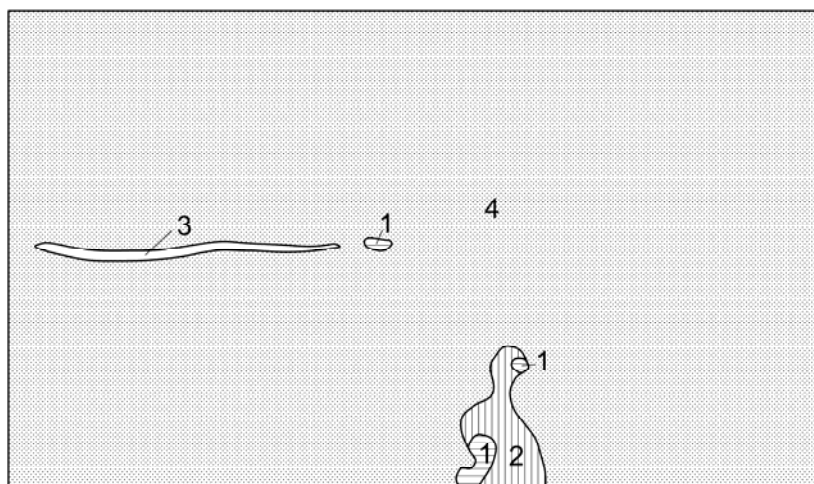
Geomorphology: Depositional surfaces: level eolian sand plains and occasional linear dunes, isolated low hills and occasional stony or gravelly rises; no organised drainage features. Relief up to 15 m.

Land management: Spinifex hummock grasslands on this system are subject to frequent fires which induce short-term changes in botanical composition and structure. Wind erosion may occur after fire, however, stabilisation is usually rapid following rain and consequent regeneration of vegetation. Young soft spinifex (2 or 3 years after fire) is moderately preferred by grazing animals but mature stands are unattractive. Control of grazing pressure and frequency of burning is desirable.



*Near level sandplains with deep red sand soils, as shown here, occupy most of the the Nita land system. They support soft spinifex (*Triodia pungens*) hummock grasslands with scattered shrubs.*

Photo: DAFWA



Stylised plan diagram showing arrangement of land units

* This land system is described in the Pilbara Ranges Report (Van Vreeswyk et al. 2004) and the Broome Shire report (Cotching 2005). The descriptions differ, and the Pilbara Ranges Report description is presented here as it is more representative of the entire occurrence of this land system.

NITA LAND SYSTEM (Nit) – land units

Unit	Approx. area (%)	Landforms	Soils ⁺⁺	Vegetation	Pasture type ⁺
1	< 1	Low hills: occasional isolated low hills of sandstone or ferruginised sandstone up to 500 m in extent, surface mantles of abundant pebbles, cobbles and stones. Relief up to 15 m.	Red shallow sands (423) and stony soils (203).	Hummock grasslands of <i>Triodia</i> spp. (hard or soft spinifex).	SSPP* 50% HSHP 50%
2	2	Stony or gravelly plains: level or very gently inclined plains up to 1 km in extent, surface mantles of many to abundant pebbles and cobbles of sandstone or ferruginised sandstone or lateritic gravels.	Red shallow sands (423) and shallow gravel soils (304).	Hummock grasslands of <i>Triodia epactia</i> or <i>T. pungens</i> (soft spinifex) with isolated shrubs.	SSPP**
3	1	Dunes: linear and occasionally reticulate sand dunes up to 3 km long with gently to moderately inclined slopes, uneven hummocky crest surfaces; relief up to 8 m.	Red deep sands (445).	Hummock grasslands of <i>Triodia epactia</i> or <i>T. pungens</i> with scattered mixed shrubs.	SSSG
4	96	Sandplains: level sand sheets extending for many kilometres.	Red deep sands (445).	Scattered to moderately close shrublands with acacias including <i>Acacia ancistrocarpa</i> (shiny leaf wattle), <i>A. stellaticeps</i> (poverty bush), <i>A. eriopoda</i> (Broome wattle), <i>A. monticola</i> , occasional trees such as <i>Bauhinia cunninghamii</i> (bauhinia), <i>Corymbia zygophylla</i> (Broome bloodwood) with prominent hummock grass <i>Triodia epactia</i> , <i>T. schinzii</i> , <i>T. pungens</i> (soft spinifex) ground layer. Also hummock grassland of <i>T. epactia</i> , <i>T. schinzii</i> , and <i>T. pungens</i> with isolated or very scattered shrubs. Sandplains near the westward margin of the system (adjacent to Mannerie and Anna land systems) often support shrubby tussock grasslands of <i>Cenchrus ciliaris</i> (buffel grass).	SSSG 75% PINP 20% BUGP 5%

+ Pasture types described in Appendix 1.

++ Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

* This occurrence of SSPP is equivalent to HSPG in Pilbara report (Van Vreeswyk et al. 2004).

** This occurrence of SSPP is equivalent to PSSG in Pilbara report (Van Vreeswyk et al. 2004).

O'DONNELL LAND SYSTEM (Odl)

3729 km²

Source: WKY, OVC

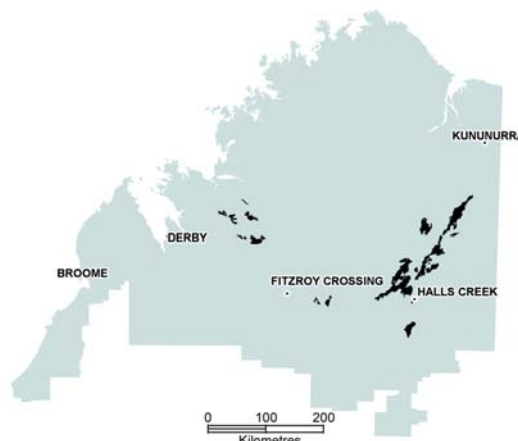
Stony undulating country with scattered hills, loamy skeletal soils, open woodlands with short grasses and restricted cracking clay plains.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

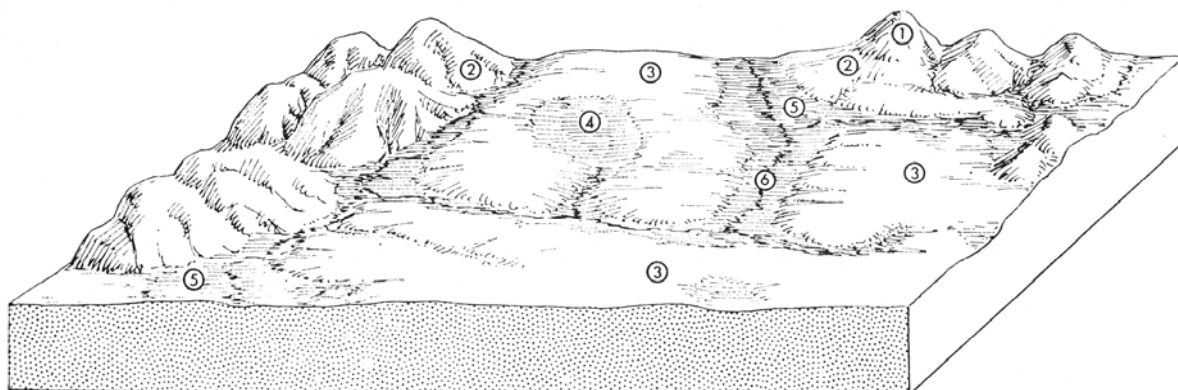
Geology: Gneiss, granite, and schist of Lower Proterozoic or Archaeozoic age.

Geomorphology: Formed by partial dissection of the Fitzroy surface - undulating terrain: gently sloping low interfluvial, scattered, rocky hills and ridges with restricted hill-foot slopes, and local cracking clay plains; moderately dense rectangular pattern of incised drainage; relief mainly less than 9 m.

Land management: The system supports grass pastures which are highly preferred by cattle and prone to degradation; interfluvial and drainage floors (units 3 and 5) have moderate susceptibility to erosion. Control of grazing pressure is essential.



Major units of O'Donnell land system are interfluvial with reddish sandy and loamy soils supporting open grassy woodlands with arid short grasses (*Enneapogon* spp.) and some perennial grasses. The low granite hill in the background is a minor unit.
Photo: DAFWA



Stylised block diagram showing location of land units

O'DONNELL LAND SYSTEM (Odl) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	12	Hills and ridges: less than 60 m high; benched slopes up to 70%, locally vertical, and basal scree slopes up to 35%.	Outcrop with limited areas of reddish, shallow, gravelly skeletal soil (24).	Open snappy gum woodland with <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> community (1d).	CAHP
2	12	Hill-footslopes: concave, up to 10%, and less than 400 m long; outcrop and cobble debris in upper parts, colluvial mantles in lower parts.	Outcrop, with reddish skeletal soil (24). some shallow red sands: Cockatoo family (7).	Mixed grasslands with scattered trees and shrubs. Local bare patches. <i>Chrysopogon fallax</i> , <i>Dichanthium fecundum</i> and <i>Triodia intermedia</i> ground storey (48, 49, 57).	RGRP 50% HSHP 40% CSPP 10%
3	51	Interfluves: flat or gently sloping crests up to 1% and 1.6 km wide, with marginal slopes up to 2%; cobble mantles and local outcrop.	Outcrop, with reddish sandy and loamy skeletal soils (24) with shallow brownish sands and loams over red clay: Moonah family (17).	Very open grassy woodland with <i>Chrysopogon fallax</i> and other perennial and short grass ground storey (48, 49, 57). <i>E. brevifolia</i> community (1f).	RGRP 70% HSHP 15% CSPP 10% ASGP 5%
4	6	Cracking clay plains: less than 1% and 3.2 km wide; hummocky surfaces.	Dark brown self-mulching clays: Wonardo family (14).	Mitchell grass and ribbon grass-bluegrass grasslands with sparse trees and shrubs. <i>Astrelba</i> spp. and <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> and <i>Chrysopogon</i> spp. communities (47, 48, 49).	MGUP 50% RAPP 50%
5	10	Alluvial drainage floors: up to 400 m wide with gradients 1 in 100 to 1 in 400; sandy surfaces with pebble patches.	Complex of greyish to brownish sands and loams over tough domed clays: Jurgurra family (19). Mottled yellowish sandy to loamy soils: Elliott family (6). Clayey alluvial soils: Fitzroy family (22).	Mixed grasslands as in unit 2.	RGRP 80% CSPP 10% HSPP 10%
6	9	Channels: up to 90 m wide and 4.5 m deep.	Channels, bed-loads range from deep sand to cobbles. Banks, brownish loamy alluvial soils: Robinson family (21).	Open woodland fringing community with patches of frontage grasses. <i>E. camaldulensis</i> community (40).	FRIP 50% FRGP 50%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

The composition of pastures types within O'Donnell land system was reviewed in 2015 by Matthew Fletcher (DAFWA), Dave Hadden (DAFWA) and Phil Thomas (DAFWA) using recent land system ratings data. As a result of this review the pasture types and their proportions have been changed. The changes are reflected in this table.

Note: Proportions and occurrence of pasture types within land units are subject to change over time due to invasion by native and introduced species, seasonal conditions, fire frequency and grazing management.

OSCAR LAND SYSTEM (Osc)

224 km²

Source: WKY

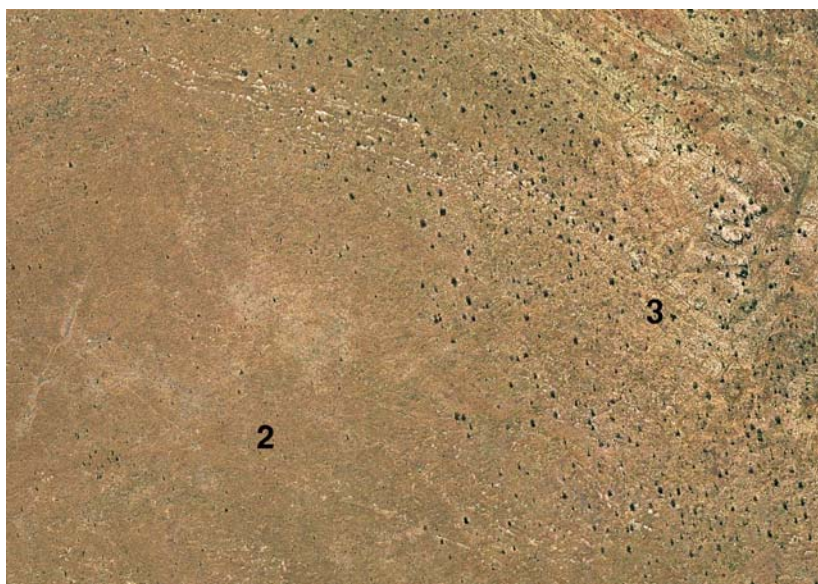
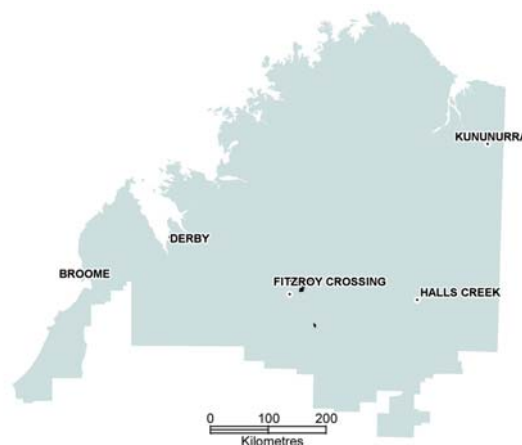
Cracking clay plains and limestone outcrop plains, grasslands, spinifex, and open woodlands.

State land type: Alluvial plains with tussock grasslands.

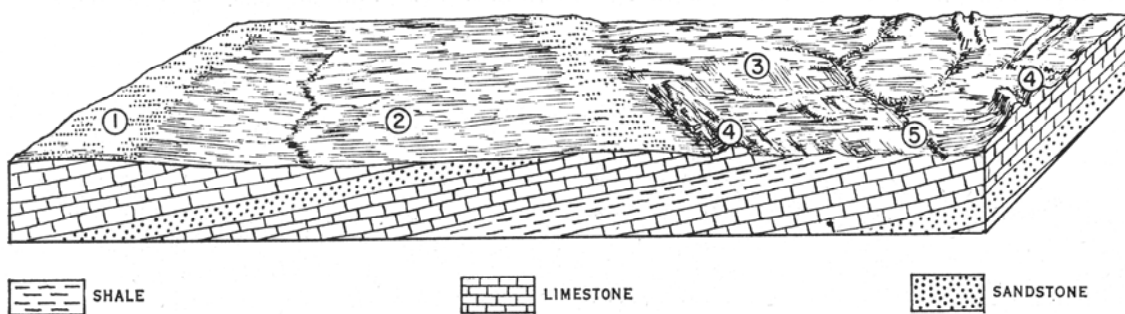
Geology: Dipping or gently folded limestone, calcareous sandstone, and siltstone of Devonian age.

Geomorphology: Formed by dissection of the Kimberley surface - plains: upland plains up to 6.4 km wide with low rises, slightly lower cracking clay plains, and outcrop plains with scattered low hills; sparse rectangular drainage pattern; relief less than 12 m.

Land management: A mixture of non-preferred and highly preferred pastures for cattle; generally resilient and not prone to erosion but control of grazing pressure is essential in order to maintain preferred Mitchell grass and ribbon grass pastures.



*This photo shows two of the major units of the Oscar land system, cracking clay plains (unit 2) and limestone outcrop plains (unit 3). Unit 2 supports Mitchell grass (*Astrebla* spp.) and ribbon grass (*Chrysopogon fallax*) grasslands; unit 3 has very shallow soils with much limestone outcrop and supports limestone (hard) spinifex (*Triodia wiseana*). Width of this 2007 aerial photograph is about 1.3 km. Photo: Landgate*



Stylised block diagram showing location of land units

OSCAR LAND SYSTEM (Osc) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	11	Low rises: up to 3.2 km wide; sandy slopes less than 0.5%; with pebble patches.	Limestone outcrop with shallow dark brown and reddish brown to dark grey, loamy to clayey calcareous soils: Oscar family (11). Local minor patches of dark, self-mulching heavy clays: Cununurra family (12) in depressions.	Grasslands and open woodlands. <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> . <i>Chrysopogon</i> spp. communities (48, 49); <i>Corymbia dichromophloia</i> community (8a).	HSPP 50% RAPP 25% RGRP 25%
2	42	Cracking clay plains: up to 3.2 km in extent; hummocky slopes less than 15.	Dark self-mulching strongly cracking heavy clays: Cununurra family (12) commonly shallow with structure-controlled gilgais. Minor amounts of shallow, dark brown clayey calcareous soils: Oscar family (11) on crests.	Mitchell grass and ribbon grass-bluegrass grasslands with scattered trees and shrubs. <i>Astrebla</i> spp. and <i>Chrysopogon</i> spp., <i>Dichanthium fecundum</i> communities (47, 48); locally 37a, 37b.	MGAP 50% RAPP 50%
3	35	Outcrop plains: up to 4.8 km wide; cobble-strewn slopes up to 5%, and frequent outcrop.	Limestone outcrop with shallow dark brown to dark grey, loamy to clayey, calcareous soils: Oscar family (11). Minor local patches of dark grey self-mulching heavy clays: Cununurra family (12).	Spinfex grassland and very open woodland with <i>Triodia wiseana</i> . <i>C. dichromophloia</i> community (8a) and 58.	HSPP 80% RAPP 20%
4	7	Hills: up to 9 m high; narrow, rocky crests and boulder-strewn slopes up to 50%, locally vertical.	Mainly limestone outcrop with minor areas of shallow dark brown to dark grey, loamy, calcareous soils: Oscar family (11).	Very open woodlands with scattered <i>Triodia wiseana</i> . Much bare rock. <i>C. dichromophloia</i> and <i>Adansonia gregorii</i> alliances (8a, 30).	HSPP
5	5	Channels: up to 15 m wide and 1.8 m deep; incised in bedrock.	Channels, bed-loads range from sand to cobbles. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>Eucalyptus camaldulensis</i> - <i>Terminalia platyphylla</i> community (42); small streams (39).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

PAGO LAND SYSTEM (Pag)

16,072 km²

Source: NKY

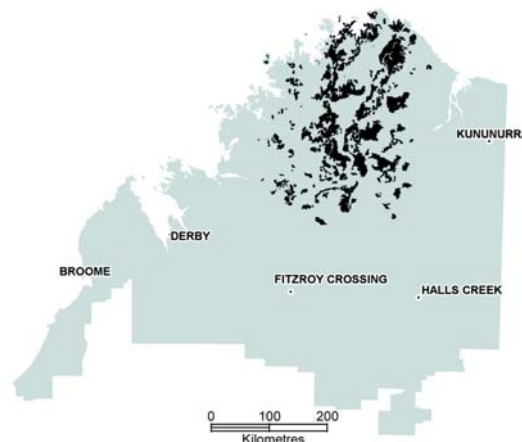
Gently undulating sandstone country with open forest vegetation and deep sandy soils.

State land type: Undulating plains and uplands with eucalypt woodlands and spinifex.

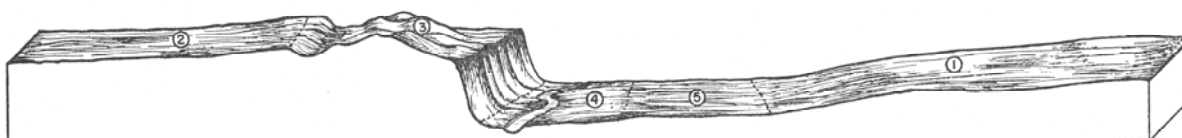
Geology and geomorphology: This land system consist of the undissected plateaux and erosional plains of the dissected sandstone plateaux (King Leopold beds) together with the flatter parts of the cuestas and structural plateaux on sandstone of the Warton beds and Mt House beds that have deep sandy soils.

Drainage: Angular, rectangular, sparse. Flooding during wet season limited to small flat areas adjacent to streamlines.

Land management: Mostly accessible sandy country supporting grass pastures of predominantly low pastoral value. Low or very low susceptibility to erosion but subject to frequent fires which induce short term changes in botanical composition, density and structure. Control of grazing pressure and frequency of burning is desirable.



The major characteristic of the Pago system is fairly large areas of gently undulating country with deep yellow sand soils. These areas, as shown here, support eucalypt woodlands (Eucalyptus and Corymbia spp.) over curly spinifex (Triodia bitextura) and annual sorghum (Sorghum stipoides). Photo: DAFWA



Stylised block diagram showing location of land units

PAGO LAND SYSTEM (Pag) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation*	Pasture type ⁺
1	60	Gentle slopes sometimes separated by scarps	Predominantly deep yellow sands, with smaller areas of red medium sands, and patches of skeletal sands.	Forests: <i>Eucalyptus tetradonta</i> , <i>E. miniata</i> alliances (24 , 25 , 25a, 26, 34, 35 , 37 , 38 , 39 , 40).	LCSP
2	25	Gentle slopes, generally on elevated flat-tops	Mostly lateritic podzolics with small areas of skeletal laterite.	Forests and woodlands: <i>E. tetradonta</i> (27) and <i>Corymbia dichromophloia</i> (40) sub-alliances; <i>C. latifolia</i> (48) alliances.	LCSP 50% ASHP 50%
3	5	Moderate to steep slopes with sandstone outcrops or scarps	Skeletal sands and considerable bare rock.	Woodlands and forest: <i>E. tetradonta</i> , <i>E. miniata</i> (40 , 41 , 42 , 43, 44, 45, 46 , 47 , 37 , 38) alliances; <i>Brachychiton</i> spp., <i>Terminalia</i> spp., <i>C. confertiflora</i> (73) community.	CAHP 50% ASHP 40% COGP 10%
4	5	Levees and depressions along streamlines	Sandy levee soils and some deep light grey sands.	Fringing communities and woodlands: <i>Terminalia</i> , <i>Ficus</i> , <i>Melaleuca</i> spp. community; <i>C. bella</i> (53) and <i>C. polycarpa</i> , <i>E. apodophylla</i> (61, 66 , 67 , 68, 69, 71) alliances; <i>E. camaldulensis</i> , <i>Melaleuca</i> spp. (75) community.	OTHP** 80% COGP 20%
5	5	Small flats	Deep light grey sands.	Woodlands: <i>C. polycarpa</i> , <i>E. apodophylla</i> (61 , 62, 63, 64, 66) alliance.	OTHP** 80% COGP 20%

+ Pasture types described in Appendix 1.

* Numbers refer to vegetation communities/alliances listed in 'Lands and Pastoral Resources of the North Kimberley area, WA' (Speck et al. 1960). Numbers in bold type indicate dominants.

** OTHP = Annual sorghum and kerosene grass (*Aristida hygrometrica*) pastures (Speck et al. 1960).



Fire is an integral part of the Kimberley landscape, although control of fire frequency is important for ecosystem health. Pago land system near Kalumburu in the North Kimberley. Photo: Chelli (Panoramio.com)

PARDA LAND SYSTEM (Pda)

153 km²

Source: BRM

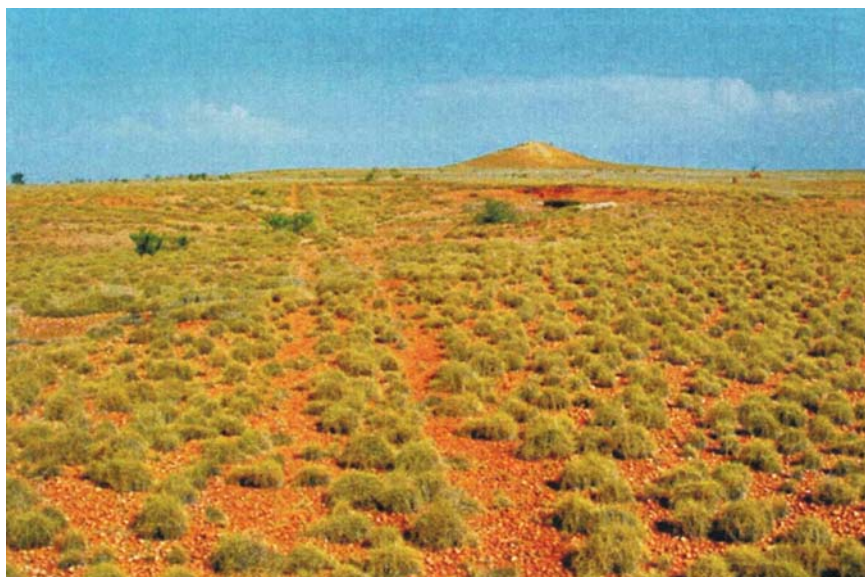
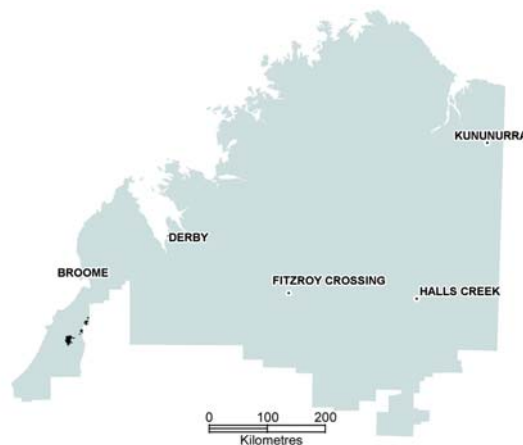
Conical hills, stony ring plains, alluvial plains and shallow valleys supporting spinifex grassland with sparse shrubs and trees.

State land type: Stony plains with spinifex grasslands.

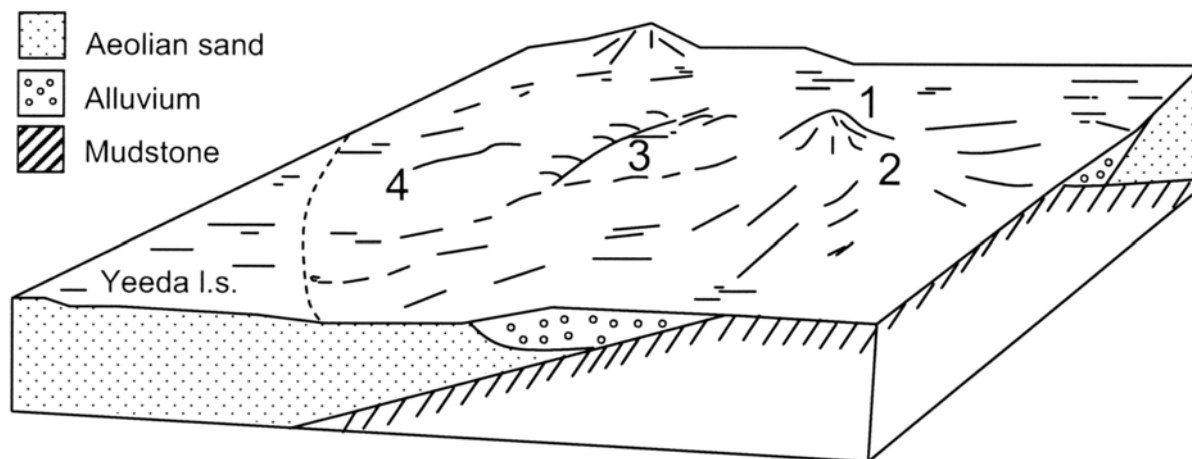
Geology: Mudstone of late Cretaceous age, shale or deeply weathered mudstone with sandstone cap rock; Quaternary sand, silt and minor gravel of alluvial origin.

Geomorphology: Erosion remnant conical hills surrounded by stony surfaced ring plain with minor radial gullying; surrounded by alluvial floors and marginal sandplain. Relief up to 47 m.

Land management: Hard spinifex vegetation of very low pastoral value subject to frequent burning which induces short term changes to botanical composition, density and structure but generally stable and not prone to erosion.



*Lobed spinifex (Triodia intermedia) hummock grasslands on stony ring plains (unit 2) of the Parda land system. A conical hill (unit 1) of the system is in the background.
Photo: DAFWA*



Stylised block diagram showing location of land units

PARDA LAND SYSTEM (Pda) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	1	Conical hills: up to 30 m high with moderately inclined slopes and stony surfaces.	Red clays; red clay with stony surface mantle on mudstone; Uf 1.43.	Steppe grassland dominated by <i>Triodia intermedia</i> with scattered <i>Eucalyptus brevifolia</i> .	HSPP
2	32	Ring plains: up to 6 km wide gently inclined plains with sandstone or shale stones as strewn.	Lithosols and red clays; reddish sandy loam or clay topsoil on red clay or gravels with stony surface mantle; Dr 2.32, Uf 1.43.	Steppe grassland dominated by <i>Triodia intermedia</i> with scattered <i>Eucalyptus brevifolia</i> .	HSPP
3	36	Alluvial plains: up to 3 km wide flat to very gently inclined plains.	Alluvial soils; dark reddish or yellowish brown loamy topsoil over a brown or red loam to clay B horizon on laterite gravel; Um 5.51, Dr 2.32.	Pindan shrubland dominated by <i>Triodia pungens</i> , <i>Triodia schinzii</i> and <i>Chrysopogon fallax</i> with <i>Acacia eriopoda</i> .	OERG 40% SSPP 30% HSPP 30%
4	31	Shallow valleys: up to 1 km wide very shallow valleys on margin with surrounding sandplains.	Earthy sands; dark reddish brown sandy loam topsoil on red sandy loam subsoils; Um 5.52.	Tree savanna dominated by <i>Corymbia dichromophloia</i> with <i>Triodia pungens</i> and <i>T. schinzii</i> .	SSPP 50% OERG 50%

+ Pasture types described in Appendix 1.

PHIRE LAND SYSTEM (Phr)

593 km²

Source: BRM

(modified from McKenzie 1985)

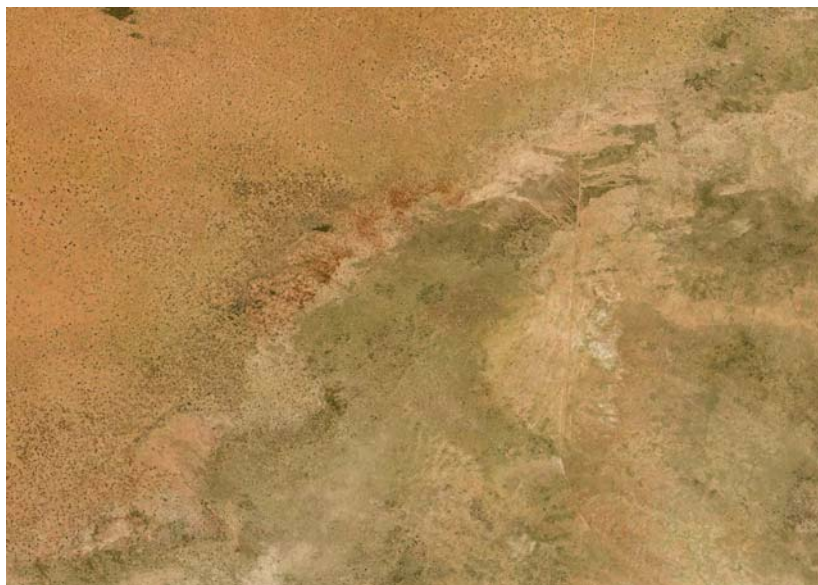
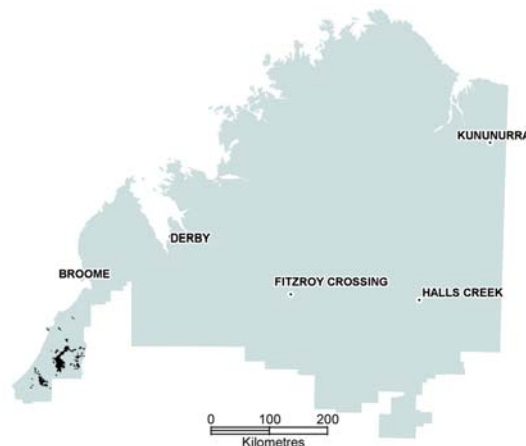
Outcrop plains with laterite gravels and low ridges supporting spinifex grasslands.

State land type: Stony plains with spinifex grasslands.

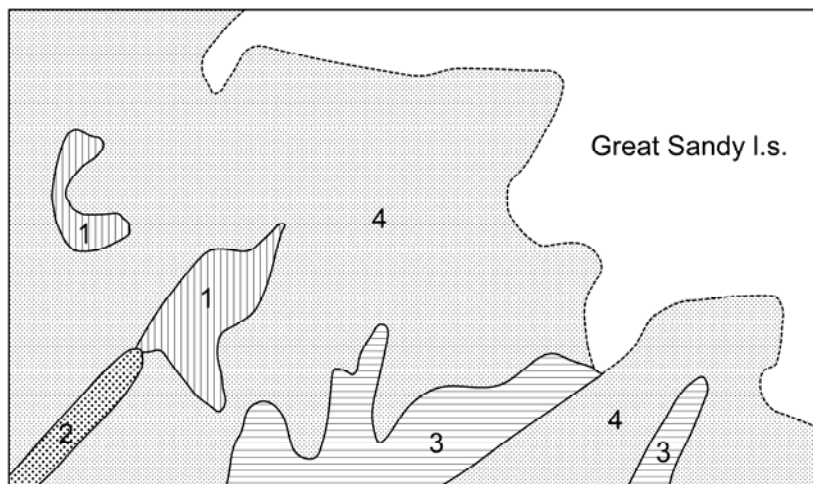
Geology: Minor sand and silt of mixed alluvial and aeolian origin over laterite on mudstone of late Cretaceous age.

Geomorphology: Erosional surface of flat to gently undulating plains up to 10 km in extent. Organised surface drainage absent on flat plains with shallow depressions in undulating areas.

Land management: Spinifex grasslands subject to frequent fires which induce short term changes in botanical composition, density and structure. Young soft spinifex pastures (up to 2 or 3 years after fire) are moderately preferred by cattle but mature stands are unattractive. Control of grazing pressure and frequency of burning is desirable.



The sandpains of Nita land system (top left) abruptly change to the lateritic plains with thin sand cover and stony surfaces of Phire land system. It supports mostly soft spinifex (*Triodia pungens*). Width of this 2004 aerial photograph is about 3.6 km
Photo: Landgate



Stylised plan diagram showing arrangement of land units

PHIRE LAND SYSTEM (Phr) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	8	Stony surfaces: up to 1 km wide and 9 km long, laterite outcrop on plains or low rises.	Lithosols; thin layer of laterite gravels over laterite; KS-Uc 5.21.	Steppe grassland dominated by <i>Triodia intermedia</i> and minor <i>T. pungens</i> with isolated <i>Acacia translucens</i> , <i>A. victoriae</i> and <i>Grevillea pyramidalis</i> .	HSP 80% SSPP 20%
2	1	Breakaways: laterite or shale outcrop on mudstone base; up to 4 m relief, and up to 0.5 km wide and 2 km long.	Lithosols.	Bare rock with some <i>Triodia intermedia</i> .	HSP
3	15	Broad drainage floors: gently sloping run-on areas adjacent to sandplain.	Earthy sands; brown sand with laterite gravels below 70 cm, KS-Uc 5.22.	Sparse pindan shrubland dominated by <i>Triodia pungens</i> , <i>Acacia eriopoda</i> , <i>A. colei</i> and <i>Eucalyptus</i> and <i>Corymbia</i> spp.	SSPP
4	76	Lateritic plains with thin sand cover: flat plains up to 10 km in extent.	Lithosols; less than 20 cm dark reddish brown sand on laterite gravels; KS-Uc 5.21.	Steppe grassland dominated by <i>Triodia pungens</i> with scattered <i>Acacia translucens</i> , <i>A. orthocarpa</i> and <i>Grevillea</i> spp.	SSPP

+ Pasture types described in Appendix 1.

PIGEON LAND SYSTEM (Pig)

3136 km²

Source: WKY

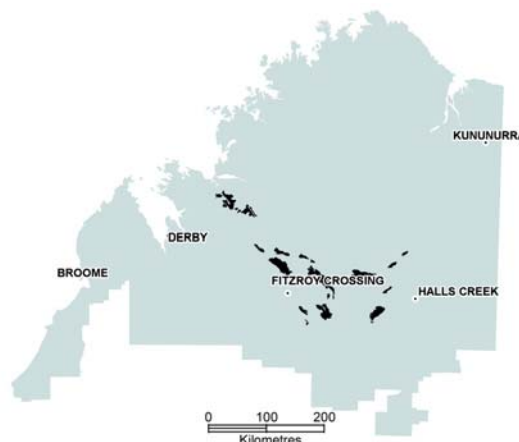
Stony undulating country with scattered rocky hills, sandy shallow soils, grassy woodlands and curly spinifex.

State land type: Undulating plains with eucalypt woodlands and mixed grasses.

Geology: Gneiss, schist, minor granite, and minor quartz reefs of Lower Proterozoic or Archaeozoic age.

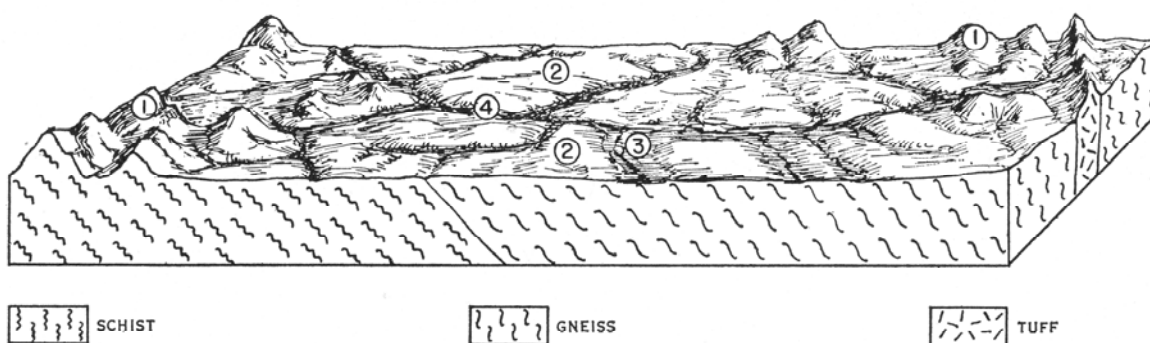
Geomorphology: Formed by partial dissection of the Fitzroy surface - undulating terrain: strike belts up to 16 km wide and 48 km long, comprising broad interfluvies and hill-footslopes with relief up to 9 m, scattered gneiss hills, schist ridges, and minor quartz reef ridges, mainly less than 30 m high but locally attaining 90 m; dense rectangular or branching pattern of incised tributary drainage, with through-going alluvial trunk floors.

Land management: Hills poorly accessible; curly spinifex and other grass pastures on lower units of system are moderately attractive to cattle. Most of system has low vulnerability to erosion except for drainage floors (unit 3) which are moderately susceptible; control of grazing pressure is required.



*The Pigeon land system is similar to the O'Donnell system except that the soils are more sandy and there is a higher proportion of curly spinifex (*Triodia bitextura*) under the scattered eucalypts.*

Photo: DAFWA 1972



Stylised block diagram showing location of land units

PIGEON LAND SYSTEM (Pig) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	24	Rocky hillslopes: benched up to 70%, locally vertical, with basal scree slopes up to 35%.	Predominantly outcrop.	Very open woodlands with <i>Triodia bitextura</i> , <i>Eucalyptus brevifolia</i> community (3); also 16, 54.	CAHP
2	55	Lower slopes and interfluvies: concave lower slopes, up to 10% and less than 1.6 km long; interfluvies up to 4.8 km in extent and 3 m high, with slopes less than 5%; locally dissected up to 9 m into spurs with gently sloping crests and marginal slopes up to 25%; colluvial mantles with cobble patches and local outcrop.	Sandy and loamy, gravelly skeletal soils (24) with some outcrop.	Very open grassy woodland with <i>Triodia bitextura</i> and <i>Enneapogon</i> spp., <i>Triodia bitextura</i> and <i>Corymbia dichromophloia</i> alliances (1f, 3, 8c, 11); locally 8a.	CSPP 50% ASGP 50%
3	11	Drainage floors: up to 1.6 km with marginal slopes up to 2% and gradients 1 in 200 to 1 in 800; pebble-strewn scalded surfaces.	Brownish sands and loams over red clay: Moonah family (17), lithic in nature on marginal slopes.	Grassy woodland with <i>Chrysopogon</i> spp. and frontage grasses. <i>C. dichromophloia</i> and <i>C. bella</i> alliances (8d, 22a).	RGRP
4	10	Channels: up to 60 m wide and 3 m deep, incised in bedrock; ranging from head-water channels, gradients up to 1 in 30, to main channels with gradients as low as 1 in 800.	Channels, bed-loads range from sand to cobbles. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (42, 43); smaller streams 33.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



The very gentle slopes of the drainage floors (unit 3) are dominated by ribbon grass/golden beard grass (*Chrysopogon fallax*) - in this case in association with northern wanderrie grass (*Eriachne obtusa*). The site was burnt in 2004. The mid-ground tree is Darwin box (*Eucalyptus tectifica*). Photo: DAFWA 2007

PINKERTON LAND SYSTEM (Pin)*

15,325 km²

Source: OVC

Rugged stony country on sedimentary rocks in the northern part of the Ord-Victoria survey area.

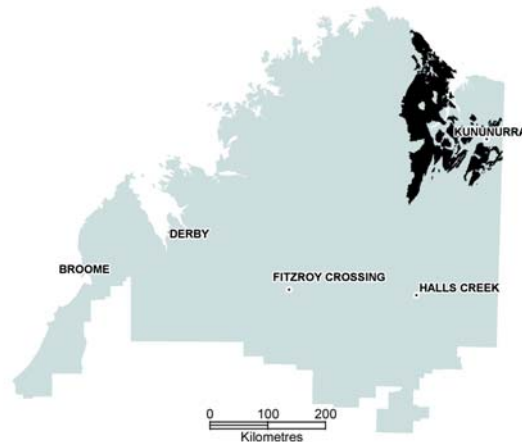
State land type: Hills, ranges and plateaux with eucalypt woodlands and tall grasses.

Geology: Sandstone, shale, and some dolomite; Adelaidean, Carpentarian, and Lower Proterozoic.

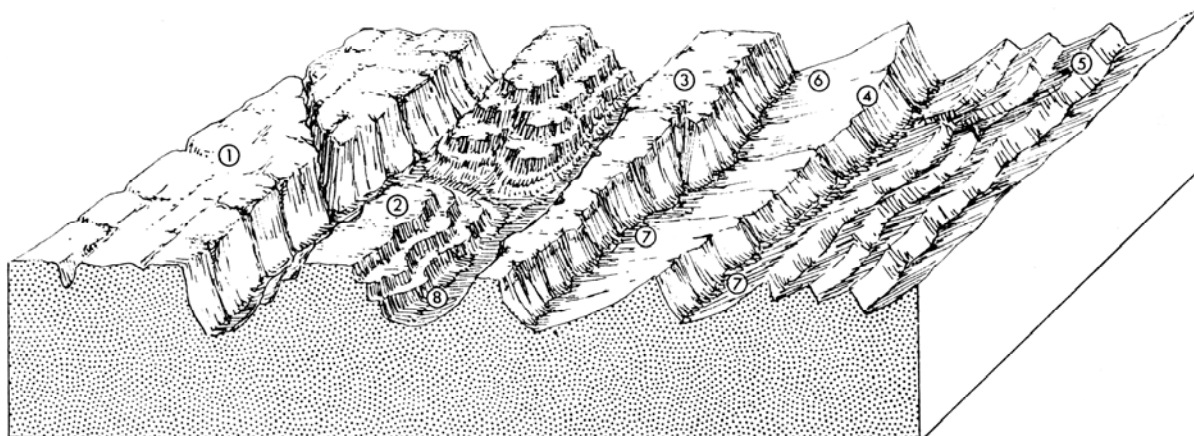
Geomorphology: Ridges, hogbacks, cuestas, and structural plateaux.

Drainage: Angular and rectangular patterns of moderate to high density. Gentle slopes adjacent to streamlines may be subject to flash floods.

Land management: Very rugged and poorly accessible system, high scenic amenity and conservation value, unsuitable for pastoralism.



*The massive flat-topped mountains of the Cockburn range, East Kimberley, are a classic example of the Pinkerton land system. The gentle slopes surrounding the ranges are in Cockburn land system.
Photo: Noel Schoknecht*



Stylised block diagram showing location of land units

* Pinkerton land system is essentially equivalent to Wickham (OVC), Buldiva (NKY) and Precipice (WKY) land systems. The different names are a result of surveys being undertaken at different times combined with rainfall differences which are reflected in the vegetation.

PINKERTON LAND SYSTEM (Pin) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	20	Structural plateaux of sandstone or quartzite with deep V-shaped gorges	Rock outcrop and skeletal soils.	Stringybark-bloodwood woodland (<i>Eucalyptus tetrodonta</i> , <i>Corymbia dichromophloia</i> , <i>E. miniata</i> , <i>E. phoenicea</i>) with upland tall grass (<i>Sorghum stripoideum</i> , <i>Triodia bitextura</i>).	CAHP
2	20	Structural plateaux with benches, formed on interbedded limestone, shale, and sandstone	As for unit 1	As for unit 1	CAHP
3	10	Mesas capped by hard sandstone overlying shales	As for unit 1	As for unit 1	CAHP
4	20	Cuestas formed on interbedded hard sandstones and shales	As for unit 1	As for unit 1	CAHP
5	20	Hogbacks and ridges	As for unit 1	As for unit 1	CAHP
6	4	Gentle lower slopes	Tippera, Elliott - loamy surface soils merging into subsoils of red and yellow clay respectively.	Northern box-bloodwood woodland (<i>E. tectifica</i> , <i>C. foelscheana</i> , <i>C. latifolia</i> , <i>C. confertiflora</i> , <i>E. limitaris</i> and/or <i>E. tephrodes</i> with Tippera tall grass <i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>) or upland tall grass (<i>Sorghum stipoides</i>).	TTGP
7	3	Gentle slopes adjacent to streamlines	Elliott and miscellaneous alluvial soils.	As per unit 6	TTGP
8	3	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



The Ord River cuts a green and blue swathe through the Carr-Boyd Ranges between Kununurra and Lake Argyle. Pinkerton land system. Photo: Tricia Handasyde, DEC

POMPEY LAND SYSTEM (Pom)

1648 km²

Source: OVC

Rugged granite country with some sandy soils occurring as a number of small areas in the north-western part of the Ord-Victoria survey area.

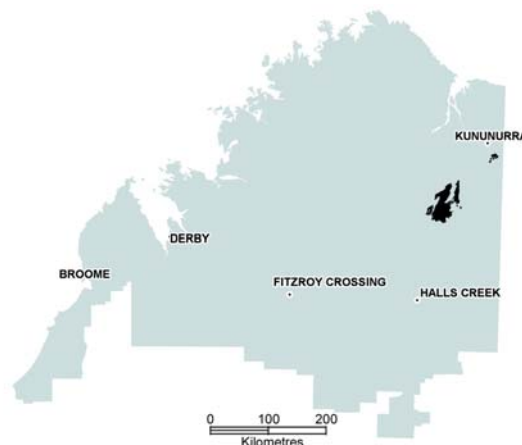
State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

Geology: Granitic rocks, high-grade metamorphic, gabbro, acid volcanic; Lower Proterozoic.

Geomorphology: Ancient igneous masses.

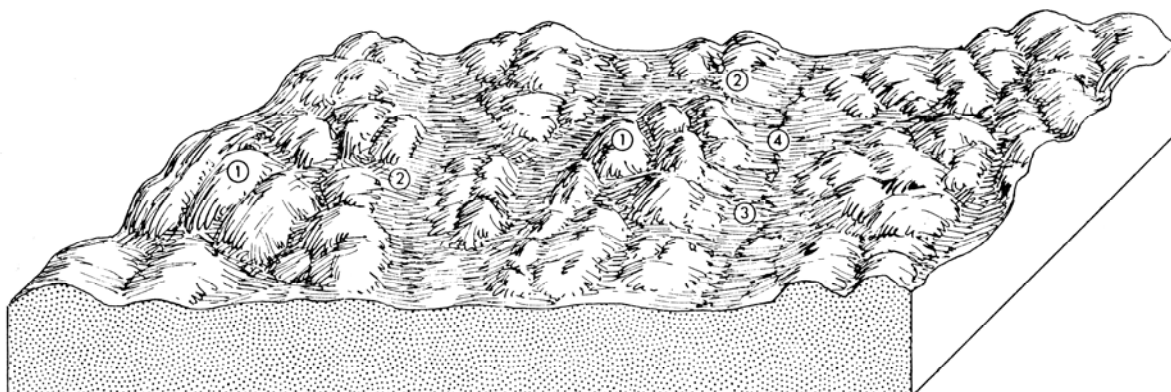
Drainage: Angular and rectangular pattern of moderate intensity in the steeply sloping parts, becoming dendritic in the broader valleys.

Land management: About 70% of system consists of poorly accessible rough bouldery hills and tor heaps, lower parts support poor quality pastures not highly preferred by cattle; system generally stable and not prone to erosion.



The most distinctive features of the Pompey land system are bouldery hills, domes and tor heaps of granite.

Photos: DAWFA



Stylised block diagram showing location of land units

POMPEY LAND SYSTEM (Pom) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	70	Rugged bouldery hills	Mostly boulders of granite.	Trees absent or deciduous, sparse low woodlands with upland tall grass (<i>Triodia cunninghamii</i> , <i>T. bitextura</i> , <i>Sorghum australiense</i>), or snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) over hard spinifex (<i>Triodia inutulis</i>) or upland tall grass (<i>Sorghum australiense</i> , <i>T. bitextura</i> , <i>Eriachne obtusa</i>).	CAHP 60% HSHP 20% XXNP 20%
2	20	Moderate slopes	Pago - very gritty yellow sands, with boulders of granite.	Snappy gum sparse low woodland (<i>E. brevifolia</i>) with hard spinifex (<i>Triodia inutulis</i>).	HSHP
3	5	Narrow depressions or flats adjacent to streamlines	Hooper -shallow sand or sandy loam over tough clay.	Trees absent with Marrakai mid-height grass (<i>Eriachne</i> spp., <i>Themeda triandra</i>).	OTHP
4	5	Steam channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



A Pompey panorama

Photo: Noel Schoknecht, DAFWA

PRECIPICE LAND SYSTEM (Pre)*

7530 km²

Source: WKY

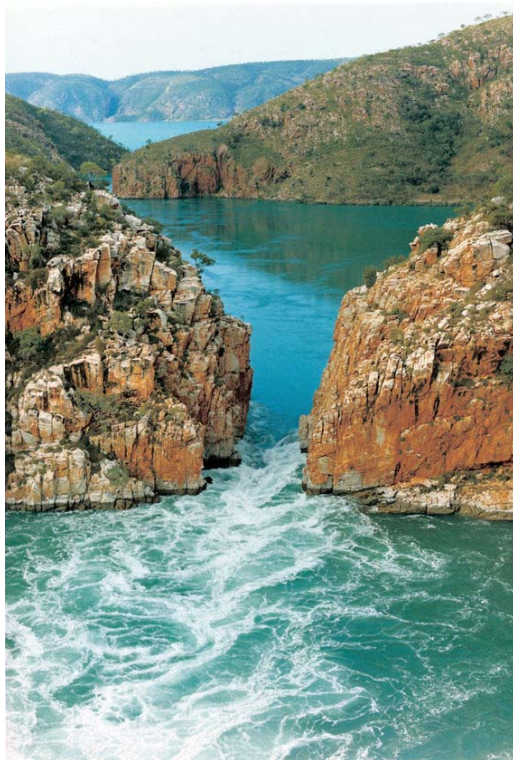
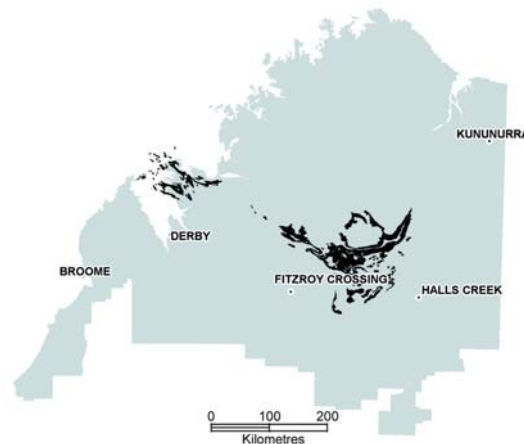
Rocky mountainous sandstone country with narrow or restricted basalt valleys, low open woodlands with curly spinifex.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex.

Geology: - Upper Proterozoic, gently dipping and folded quartzite, sandstone, and shale, with basalt and dolerite flows and intrusions of Upper Proterozoic or Lower Cambrian age.

Geomorphology: - Formed by dissection of the Kimberley surface - plateaux and mountain ranges: extensive, high plateaux, cuestas, and upstanding mountain summits in strike belts up to 40 km wide, with steep escarpments and upper slopes and restricted lower slopes; basalt and dolerite hills in valley floors; moderately dense, rectangular pattern of narrow, incised valleys; relief up to 530 m.

Land management: Very rugged poorly accessible system mostly unsuitable for pastoralism; high scenic amenity and conservation value.

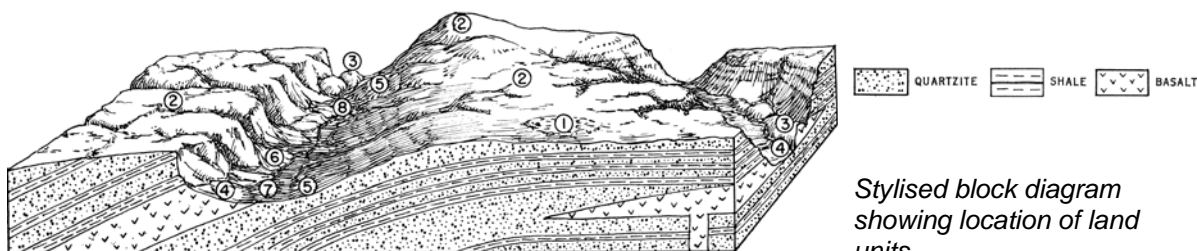


Above: Dimond Gorge is an impressive feature where the Fitzroy River cuts through the quartzite and sandstone ridges of Precipice land system.

Photo: Wayne Parker (Panoramio.com)

Left: The spectacular horizontal falls in the West Kimberley where tidal flows pass through narrow gaps in quartzite ridges of Precipice land system.

Photo: Tourism WA



Stylised block diagram showing location of land units

* Precipice land system is essentially equivalent to Buldiva (NKY), Pinkerton (OVC) and Wickham (OVC) land systems. The different names are a result of surveys being undertaken at different times combined with rainfall differences which are reflected in the vegetation.

PRECIPICE LAND SYSTEM (Pre) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	2	Summit remnants: up to 3.2 km in extent; pebble-strewn slopes mainly less than 1%.	Yellowish sandy soils high in laterite gravels: Tableland family (5).	Low open woodland with scattered shrubs and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> , <i>Corymbia collina</i> and <i>C. dichromophloia</i> communities (4, 6).	CAHP
2	74	Quartzite plateaux and mountain summits: plateaux and dip slopes typically less than 5%, with indented escarpments up to 305 m high comprising vertical upper walls and benched steep slopes; mountain slopes up to 50%; basal screes and boulder fans sloping up to 35%.	Mainly outcrop with some sandy skeletal soil (24).	Low, very open woodland, scattered or patchy shrubs and <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d).	CAHP
3	5	Basalt and dolerite hills: up to 76 m high; rounded crests up to 90 m wide and benched slopes up to 60%, with boulder mantles.	Outcrop with red basaltic soil: Walsh family (4).	Very open, grassy woodland, with scattered shrubs and ground storeys of combinations of <i>Sehima nervosum</i> , <i>Sorghum</i> spp., <i>Dichanthium fecundum</i> and <i>Triodia bitextura</i> . <i>E. tectifera</i> alliance (14a, 14c, 15).	WGBP
4	4	Lower slopes on basalt and dolerite: concave, up to 5%, and up to 800 m long, colluvial mantles and local outcrop.	Moderate to deep, reddish sandy to loamy basaltic soils: Frayne family (3).	Similar to unit 2.	WGBP
5	4	Lower slopes on quartzite: concave, up to 10%, and up to 800 m long; colluvial mantles and local outcrop.	Some outcrop with yellowish sandy soils of variable depth: Tableland family (5).	Open woodland with moderately dense shrub layer and <i>Triodia bitextura</i> . <i>E. brevifolia</i> community (1d); locally 28.	CAHP
6	2	Colluvial aprons and fans: up to 460 m long with gradients 1 in 20 to 1 in 60 and gullied up to 3 m.	Mainly yellowish sandy soils: Tableland family (5).	Spinifex with scattered trees and shrubs and patches of open woodland. <i>Triodia bitextura</i> grassland (54) and <i>Corymbia collina</i> , <i>C. dichromophloia</i> community (6).	CSPP
7	4	Drainage floors: up to 800 m wide, gradients 1 in 200 to 1 in 500; marginal slopes up to 1%.	Variable soils but mainly greyish sands over tough loamy subsoils: Tarraji family (18), commonly mottled.	Grassy woodland, sparse to moderate shrubs and <i>Aristida hygrometrica</i> . <i>C. bella</i> community (22b); also 25.	TAPP
8	5	Channels: up to 90 m wide and 9 m deep.	Channels, bed-loams range from sand to boulders. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

REEVES LAND SYSTEM (Rev)

428 km²

Source: WKY

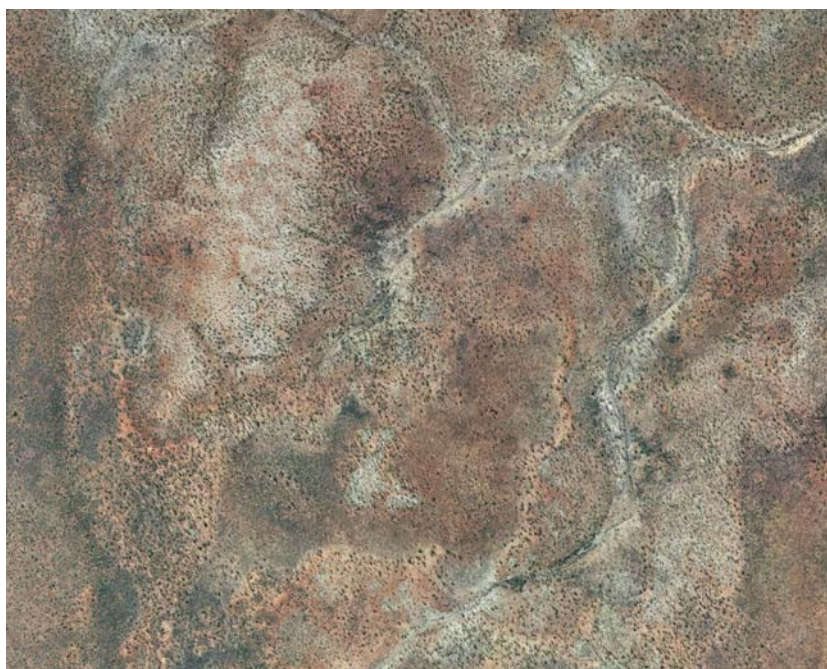
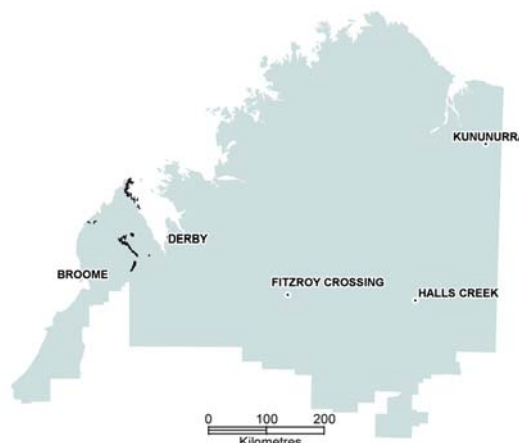
Sandplain with scattered hills and minor plateaux, reddish sandy soils, pindan.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

Geology: Subhorizontal or gently dipping sandstone, sandy siltstone, and silicified quartz sandstone of Cretaceous age; Quaternary aeolian sand.

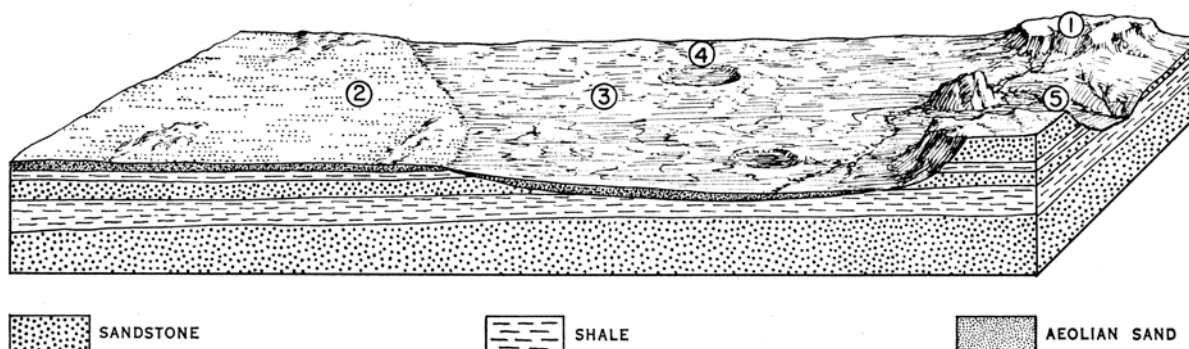
Geomorphology: Formed by dissection of the Kimberley surface - hill lands: strike belts up to 4.8 km wide, with scattered hills, dip slopes with thin sand cover and local outcrop, and sandplain; sparse, branching drainage pattern; relief up to 60 m.

Land management: Pindan vegetation subject to fairly frequent fires which induce short term changes in botanical composition, density and structure; low to moderate pastoral value for a few years after fire. Sandplains (unit 3) have minor susceptibility to wind erosion immediately after fire but stabilise rapidly after rain; control of grazing pressure and frequency of burning is desirable.



This mosaic of patterns is typical of Reeves land system – a complex of sandplains, stony plains with thin sand cover, minor hills, pans, depressions and channels. Width of this 2005 aerial photograph is about 3.7 km.

Photo: Landgate



Stylised block diagram showing location of land units

REEVES LAND SYSTEM (Rev) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	11	Hills: up to 60 m high; flat or gently sloping rocky crests up to 800 m wide, with marginal escarpments up to 70%, locally vertical, and basal scree slopes up to 45%.	Mainly outcrop with scree slopes.	Depauperate woodland and spinifex grassland with scattered trees and scrubs. <i>Corymbia confertiflora</i> community (13).	CAHP
2	29	Sandy surfaces with local outcrop: up to 1.6 km in extent, sandy slopes up to 1% with frequent outcrop.	Outcrop with reddish sandy soils of variable depth: Yabbagoddy family (1).	Low woodland (pindan) with prominent <i>Acacia</i> tall shrub layer and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storey. <i>C. dichromophloia</i> , <i>C. zygophylla</i> , <i>Acacia</i> spp. community (10).	PINP
3	52	Sandplains: up to 2.4 km wide with slopes up to 2%.	Reddish sandy soils: Yabbagoddy family (1).	Low woodland (pindan) with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storey; <i>Adansonia gregorii</i> and <i>C. dichromophloia</i> alliances (31, 10).	PINP
4	7	Pans and depressions: up to 800 m wide; shallow depressions with firmed sandy surfaces, and pans up to 1.5 m deep with bare cracking surfaces and with short marginal slopes up to 1%.	Mottled yellowish sandy soils: Tableland family (5) on slopes. Greyish massive, intractable, silty to heavy clays (30) in pans.	Mostly bare, with paperbark fringing communities. <i>Melaleuca</i> spp. communities (36).	XXNP 70% CSPP 30%
5	1	Channels: up to 9 m wide and 1.5 m deep; gradients 1 in 100 to 1 in 500.	Channels, bed-loads range from deep sand to cobbles. Banks, limited narrow areas of brownish loamy alluvial soils (21).	Fringing woodlands. <i>E. camaldulensis</i> and <i>Melaleuca</i> spp. communities (40, 41).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

RICHENDA LAND SYSTEM (Ric)

11,199 km² Source: WKY, OVC

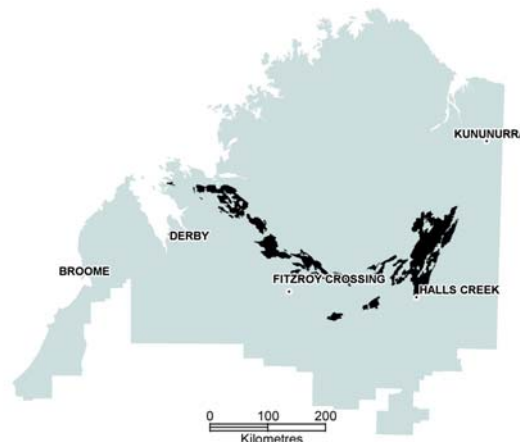
Inaccessible mountainous country, open stunted woodlands with curly spinifex, and grassy woodlands.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

Geology: Granite, gneiss, and schist of Lower Proterozoic or Archaeozoic age.

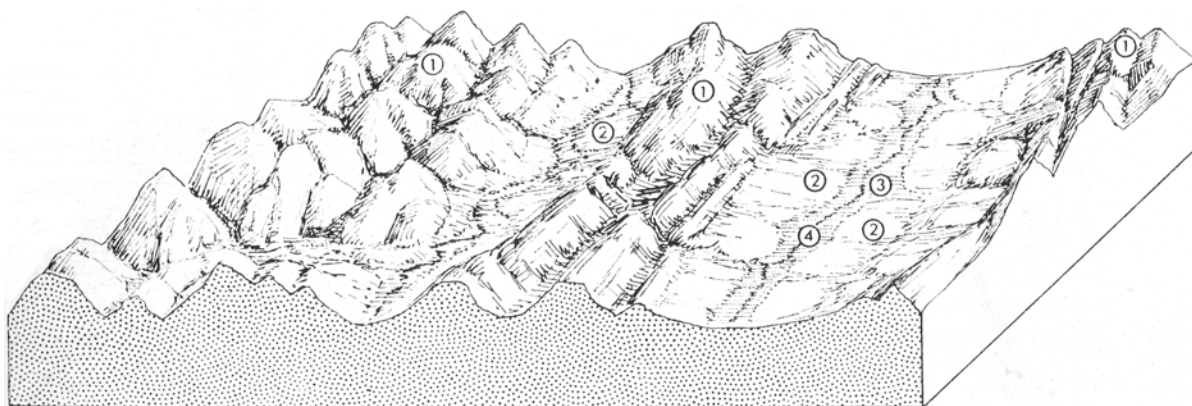
Geomorphology: Mountain and hill ranges eroded below the Kimberley surface: mountain ranges in strike belts up to 26 km wide; with elongated gneiss hills, narrow schist ridges, and granite domes; dense rectangular pattern of incised tributary drainage and through-going strike-aligned alluvial floors; relief up to 150 m.

Land management: Much of the system consists of poorly accessible hills and steep slopes (unit 1). Lower slopes and drainage floors (units 2 & 3) support tussock grass pastures which are moderately preferred by cattle; drainage floors and some lower slopes are moderately to highly susceptible to erosion; control of grazing pressure is essential.



Most of the Richenda land system is poorly accessible rough hills, but a few drainage floors and lower slopes support preferentially grazed perennial tussock grasses under scattered eucalypts.

Photos: Noel Schoknecht, DAFWA



Stylised block diagram showing location of land units

RICHENDA LAND SYSTEM (Ric) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	66	Rocky hillslopes: benched slopes on gneiss and schist, up to 70%, locally vertical, with basal scree slopes up to 35%; convex rocky slopes on granite, up to 80%, locally with joint-block cappings.	Mainly outcrop with limited areas of shallow, reddish, sandy skeletal soils (24).	Low open woodland. Communities 3, 8a, 14a, 16, 32.	CAHP 80% HSHP 20%
2	24	Lower slopes: concave, up to 10%, mainly less than 400 m long but up to 1.6 km long; outcrop and cobble mantles in upper parts, colluvial mantles in lower sectors.	Mainly outcrop with shallow, sandy skeletal soils (24). Minor occurrences of greyish to brownish sands and loams over tough clays: Jurgurra family (19).	Open grassy woodlands with <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp., and <i>Sehima nervosum</i> - <i>Sorghum</i> spp. ground storeys. <i>Eucalyptus tectifica</i> alliance (14a, 14b, 14c).	CAHP 50% WGBP 50%
3	3	Drainage floors: up to 365 m wide, gradients 1 in 100 to 1 in 400 with transverse slopes up to 1%; locally with central unchannelled drainage zones up to 90 m wide and 15 cm deep; sandy surfaces with pebble patches.	Loamy alluvial soils: Robinson family (21).	Very open grassy woodland with sparse shrubs, and <i>Sehima nervosum</i> - <i>Sorghum</i> spp., <i>Sehima nervosum</i> - <i>Dichanthium</i> ground storeys. <i>E. tectifica</i> alliance (14a, 15); also 48, 36.	WGBP
4	7	Channels: up to 90 m wide and 4.5 m deep, ranging from hillslope channels, gradients up to 1 in 10, to main channels with gradients as low as 1 in 400.	Channels, bedloads range from deep sand to cobbles on bedrock. Banks, brownish stony alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (40, 41, 42); small streams 33.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.



The attractive boulder-strewn hilly landscape of Richenda land system.

Photo: Bob McCartney, DAFWA

ROEBUCK LAND SYSTEM (Roe)

804 km²

Source: WKY

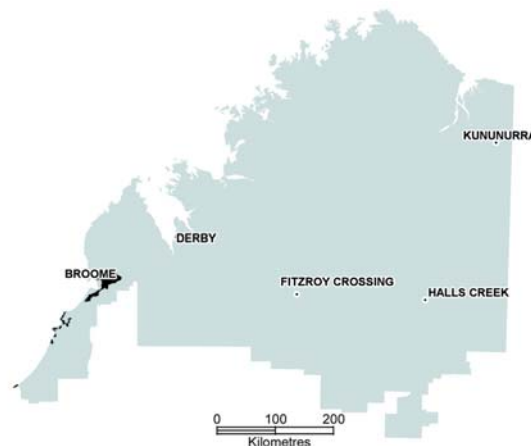
Saline coastal flats with broad plains of salt water couch grasslands, samphire, and bare mud flats.

State land type: Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types.

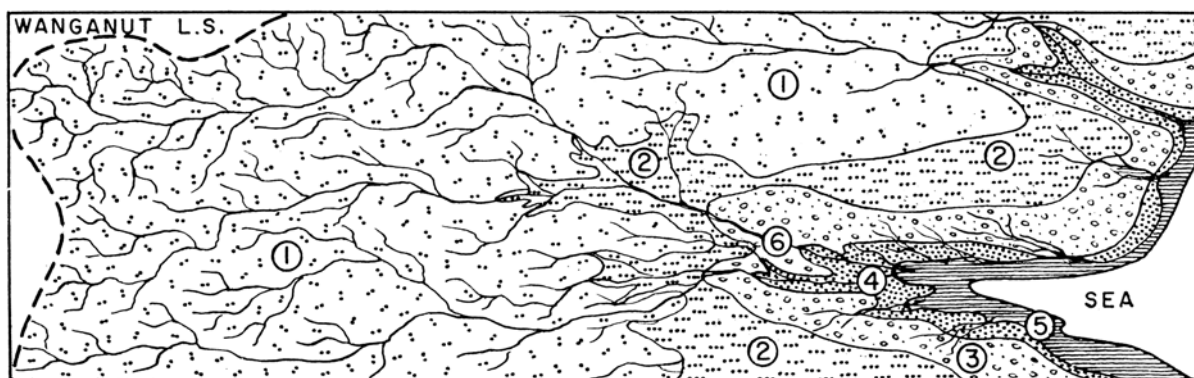
Geology: Quaternary estuarine and littoral calcareous mud and silty sand.

Geomorphology: Saline coastal flats: estuarine and littoral flats comprising grassy plains above high tides, traversed by a close network of channels, and bare tidal mud flats; intervening samphire flats; mangrove fringe along the seaward margins; dense, intricately branching pattern of shallow tidal inlets in lower sectors.

Land management: Saltwater couch pastures are attractive to cattle and generally resilient with low susceptibility to erosion; however control of grazing pressure is required.



About 60% of the Roebuck land system consists of saline plains (unit 1), as shown here, which support salt water couch (*Sporobolus virginicus*) grasslands with occasional low shrubs of samphire (*Tecticornia* spp.).
Photo: DAFWA



Stylised plan diagram showing arrangement of land units

ROEBUCK LAND SYSTEM (Roe) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	56	Plains: up to 26 km in extent; sandy, shell-strewn slopes, less than 0.1% but attaining 0.5% at lower margin and 1% at landward margin.	Salt flat soils (25).	Salt water couch grassland, locally degraded. <i>Sporobolus virginicus</i> community (64).	MACP
2	13	Samphire flats: up to 3.2 km in extent with slopes less than 0.3%; margins up to 20 cm above mud flats.	Brownish and greyish, calcareous, saline loams and clays (26, 27).	Halophytic shrubland. Samphire community (66).	SMPP
3	5	Mud flats: up to 1.6 km wide with slopes less than 0.3%; sealed, cracking surfaces with micro relief.	Dark saline muds (28).	Mostly bare mud.	XXNP
4	4	Slopes at lower margins of mud flats: up to 0.3% and 275 m long.	Dark saline muds (28).	Low mangrove community (46).	XXNP
5	4	Outer flats: up to 400 m wide; in shallow water or exposed at low tide.	Dark saline muds (28).	Medium-height and tall mangrove communities (44, 45).	XXNP
6	18	Channels: up to 90 m wide and 1 m deep, bed-loads of deep sand.	Mainly salt flat soils (25).	Grasslands. <i>Sporobolus virginicus</i> community (64).	MACP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.



A menacing storm cloud brewing over Roebuck land system east of Broome
 Photo:
 Ben Grummels
 (alias Aitutaki,
 Panoramio.com)

ROSE LAND SYSTEM (Ros)

525 km²

Source: WKY

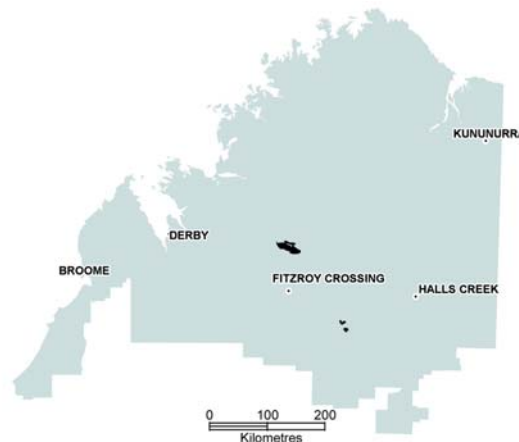
Granite domes with lateritic summit remnants, shallow soils and outcrop, spinifex and low open woodlands.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

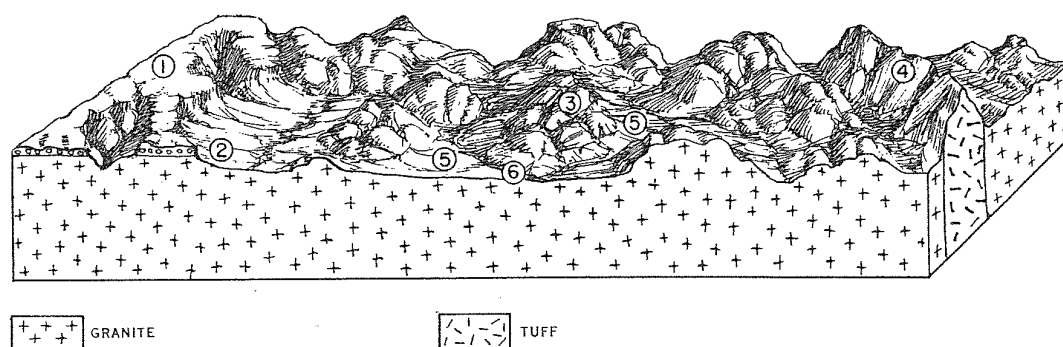
Geology: Lateritised or relatively unweathered granite of Lower Proterozoic or Archaeozoic age; minor quartz reefs.

Geomorphology: Formed by dissection of the Kimberley surface - hill lands: closely-spaced granite domes, short lower slopes, restricted lateritised summit remnants, and minor quartz reef ridges; dense to moderately dense rectangular pattern of incised valleys with subparallel, through-going trunk drainage; relief mainly less than 90 m, but attaining 180 m locally.

Land management: Much of the system consists of poorly accessible hills and bare domes of granite; lower slopes and drainage lines (units 5 & 6) support curly spinifex and annual short grass pastures which are moderately attractive to cattle. System has mostly low susceptibility to erosion but control of grazing pressure is desirable.



Granite domes and bouldery hills of the rugged Rose land system. Width of this 2007 aerial photograph is about 1.7 km. Photo: Landgate



Stylised block diagram showing location of land units

ROSE LAND SYSTEM (Ros) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	12	Summit remnants: less than 1.6 km in extent; sandy slopes less than 1%, and marginal rocky slopes up to 5%; delimiting laterite breakaways up to 12 m high.	Reddish sandy to loamy soils commonly high in lateritic gravels: Tippera family (2), with laterite outcrop near breakaways.	Open woodland with <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> community (1d); locally 1a.	CAHP
2	7	Slopes below breakaways: concave, up to 5% and less than 400 m long; colluvial mantles with local outcrop.	Reddish loamy and clayey lithic soils: Yabbagoddy family (1, 23); commonly high in lateritic gravels.	Much bare ground. Very open, low woodland with <i>Enneapogon</i> spp. and other short grasses. <i>E. brevifolia</i> community (1f).	ASGP
3	42	Domes: up to 150 m high; rounded crests, locally with joint-block cappings, and convex, rocky slopes up to 80%.	Outcrop with very limited pockets of sandy skeletal soils (24).	Much bare rock, vegetated only in cracks, crevices, and pockets of soil. Scattered trees and shrubs and tussocks of <i>Triodia bitextura</i> and other grasses. <i>Adansonia gregorii</i> alliance (32).	CAHP 60% XXNP 40%
4	2	Ridges: up to 60 m high and 2 km long; narrow rocky crests and benched slopes up to 70%, with basal scree slopes up to 35%.	Rock outcrop.	Open depauperate woodland with scattered <i>Triodia bitextura</i> . <i>E. brevifolia</i> and <i>E. tectifera</i> alliances (1d, 14c).	CAHP
5	29	Lower slopes: concave, up to 10% and 400 m long; cobble mantles and local outcrop.	Mainly brownish sands and loams over tough loamy sub-soils: Tarraji family (18). Minor deep brown sands: Kalyeeda family (9).	Grassy woodland with <i>Enneapogon</i> spp., <i>Triodia bitextura</i> , and <i>Aristida hygrometrica</i> ground storeys. <i>E. brevifolia</i> and <i>E. tectifera</i> alliances (1f, 14c, 14d).	CSPP 50% ASGP 50%
6	8	Channels: up to 90 m wide and 4.5 m deep, locally flanked by alluvial floors up to 275 m wide with marginal slopes up to 1%; gradients 1 in 100 to 1 in 400.	Channels, bed-loads range from deep sand to cobbles. Banks, areas of loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> , <i>Terminalia platyphylla</i> fringing communities (41, 42) and 33.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

RUBY 2 LAND SYSTEM (Rub)*

1179 km²

Source: WKY

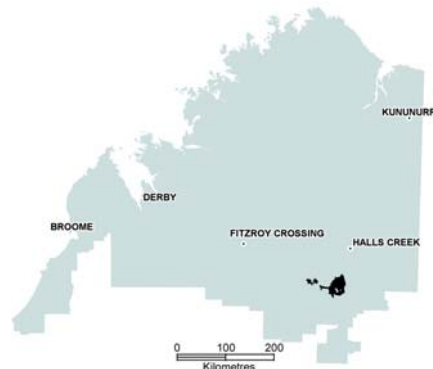
Undulating country with extensive lateritic remnants and sandplain, low woodlands with spinifex.

State land type: Hills and lowlands with eucalypt woodlands and spinifex.

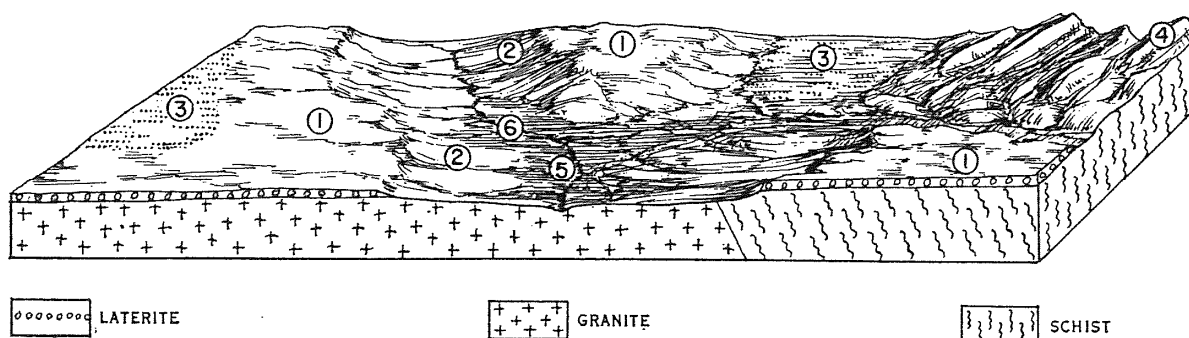
Geology: Laterised granitic and metamorphic rocks of Lower Proterozoic and (?)Archaeozoic age; Quaternary aeolian sands.

Geomorphology: Formed by dissection of the Kimberley surface - undulating terrain: summit remnants forming low divides, stony lower slopes, sandplain islands, and scattered ridges; moderately dense branching pattern of incised headwater drainage, and sparse pattern of trunk drainage; relief mainly less than 9 m.

Land management: System supports numerous pasture types some of which are of very low pastoral value (e.g. hard spinifex), others of moderately high value (e.g. ribbon grass and annual short grass); low or very low susceptibility to erosion except for drainage floors (unit 5) which are moderately susceptible if vegetative cover is lost. System is relatively resilient but control of grazing pressure and frequency of burning is desirable.



Spinifex and termite mounds – characteristic of many land systems in the Kimberley – in this instance on unit 1 of the Ruby 2 land system. Photo: David Hadden, DAFWA



Stylised block diagram showing location of land units

* The name Ruby has been applied to two different land systems in Western Australia. Ruby 1 occurs in the Ashburton survey area.

RUBY 2 LAND SYSTEM (Rub) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	52	Summit remnants: up to 6.4 km wide, with slopes mainly less than 1% but attaining 5% locally, and with marginal breakaways up to 9 m high; sandy surfaces with pebble patches and laterite exposures locally.	Reddish sandy to loamy soils of variable depth, commonly high in laterite gravels: Tippera family (2).	Probably woodland with patches of dense <i>Acacia</i> shrubs and <i>Triodia intermedia</i> and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> alliance (1a, or 1d).	HSPP 70% CSPP 30%
2	19	Lower slopes: concave, up to 5%, and up to 1 mile long; locally dissected up to 6 m into rounded spurs up to 275 m wide, with marginal slopes up to 10%; colluvial mantles and local outcrop.	Reddish, loamy and clayey skeletal soils with laterite gravels and some outcrop (24). Local minor occurrences of brownish sands and loams over red clay: Moonah family (17).	Much bare ground, sparse cover of short annual grasses with patches of <i>Chrysopogon</i> spp. and <i>Triodia intermedia</i> . Probably <i>E. brevifolia</i> and <i>Corymbia dichromophloia</i> alliances (1a, 2, 8d, 12) and 57.	ASGP 40% HSPP 30% RGRP 30%
3	16	Sandplain: slopes less than 1% and up to 2.4 km in extent.	Deep red sands: Cockatoo family (7).	Probably woodland (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp., <i>Triodia pungens</i> . <i>C. dichromophloia</i> alliance (10, 8b).	SSPP 80% PINP 20%
4	4	Ridges: up to 60 m high and 800 m long; narrow, rocky crests and benched slopes to 70%, with basal scree slopes up to 35%.	Mainly outcrop.	Probably open woodland with <i>Triodia intermedia</i> and patches of short annual grasses. Much bare ground, <i>E. brevifolia</i> community (1a); also 57.	HSHP
5	5	Drainage floors: up to 800 m wide, gradients 1 in 100 to 1 in 500; sealed, scalded surfaces with sand hummocks.	Probably greyish sands over tough loamy subsoils: Tarraji family (18). Some loamy alluvial soils: Robinson family (21)	Probably very open woodland with <i>Triodia intermedia</i> , other tall to medium-height grasses, patches of short annual grasses, and much bare ground. <i>E. brevifolia</i> alliance (1a, 1e, 1f); also 61.	HSPP 60% RGRP 20% ASGP 20%
6	4	Channels: up to 12 m wide and 15 m deep.	Channels, bed-loads range from deep sand to cobbles. Banks, brownish loamy alluvial soils: Robinson family (21)	Open fringing woodland. <i>E. camaldulensis</i> fringing community (40); smaller streams 1a.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970).

+ Pasture types described in Appendix 1.

SISTERS LAND SYSTEM (Sis)

3346 km²

Source: WKY

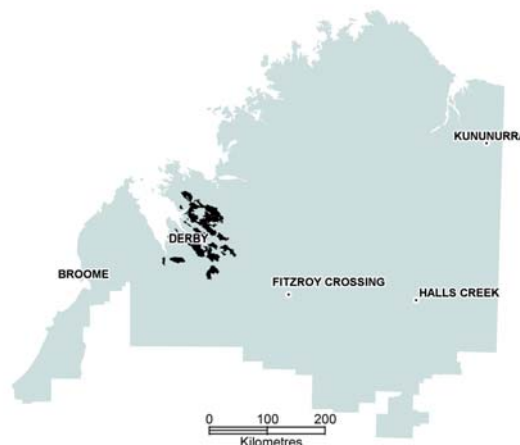
Low sandy plateaux and sandplain with through-going drainage, deep red sands and yellow loamy soils, pindan and tall woodlands.

State land type: Plains with low woodlands and spinifex/tussock grasslands

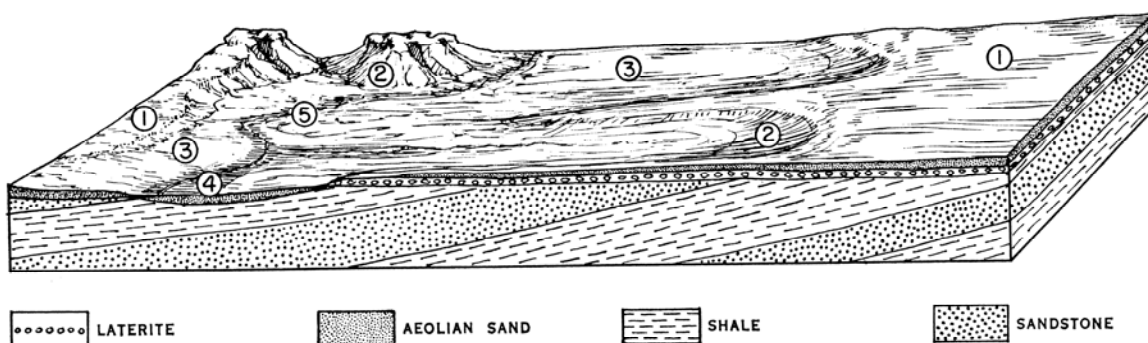
Geology: Quaternary aeolian sand on weathered, gently folded, or subhorizontal Permian, Triassic, and Jurassic sandstone and shale.

Geomorphology: Sandplain and dunefields with through-going drainage: sandplain crest surface, with laterite exposures and rocky marginal slopes, restricted lower slopes, and extensive sandy valley plains; moderately dense to sparse branching drainage pattern; relief mainly up to 12 m, locally attaining 60 m.

Land management: About 60% of system supports pindan and similar pastures which are not highly preferred by cattle but provide moderate grazing for a few years following fire; valley plains and drainage floors (units 3 & 4) support better quality ribbon grass and frontage grass pastures but have moderate to high susceptibility to erosion if vegetative cover is lost. Control of grazing pressure and frequency of burning is required.



*Minor, but spectacular units of the Sisters land system are the mesas and breakaways of the Erskine Ranges locally attaining 60 m above the extensive plains of the system.
Width of this 2007 aerial photograph is about 3 km.
Photo: Landgate*



Stylised block diagram showing location of land units

SISTERS LAND SYSTEM (Sis) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	49	Crest surfaces: up to 8 km in extent, with slopes less than 0.5%, attaining 1% marginally; delimited by sandy slopes up to 5% and 12 m high, or by slopes up to 25% and 9 m high, with low discontinuous breakaway and outcrops of laterite and weathered rock; stripped rocky surfaces up to 3.2 km in extent behind breakaways, or forming outlying plateaux up to 60 m high with benched escarpments up to 80% and with basal scree slopes up to 35%.	Deep red sands, high in lateritic gravels on laterite, on crest surfaces, Cockatoo family (7); with mainly laterite and minor occurrences of reddish sandy soils, Yabbagoddy family (1) on breakaways.	High-rainfall: tall woodland with smaller tree layer, abundant tall shrubs, and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. ground storey. <i>Eucalyptus miniata</i> alliance (28); also 26 and 29. Lower-rainfall: open woodland, patches of dense <i>Acacia</i> shrubs with <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. ground storey. <i>Corymbia dichromophloia</i> alliance (10, 11) and 17.	PINP 80% CSPP 20%
2	13	Lower slopes: up to 5% and 2.4 km long, traversed by shallow runnels; colluvial mantles.	Much outcrop. Some deep red sands with lateritic gravels: Cockatoo family (7)	High-rainfall: similar to unit 1. Lower-rainfall: open woodland with patchy shrub thickets and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. and <i>Triodia bitextura</i> ground storeys. <i>Adansonia gregorii</i> and <i>E. brevifolia</i> alliances (3, 31).	CSPP 50% PINP 50%
3	32	Valley plains: up to 8 km wide; grit and pisolith-strewn slopes mainly less than 0.2% but locally attaining 1%; linear scalds up to 15 cm deep, 180 m wide, and 1.6 km long locally.	Mainly yellowish sandy to loamy soils: Elliott family (6). Areas of scalded greyish to brownish sands and loams over tough clays: Hooper family (20).	High-rainfall: grassy woodland with <i>Chrysopogon</i> spp. ground storey, <i>E. microtheca</i> community (20a); also 14b. Lower-rainfall: low beefwood woodland with <i>Chrysopogon</i> spp. and <i>Triodia bitextura</i> . <i>Grevillea striata</i> and <i>Adansonia gregorii</i> alliances (34a, 34c) and 14b, 37b.	RGRP
4	2	Drainage floors: up to 800 m wide, gradients 1 in 200 to 1 in 500, with marginal slopes up to 0.5%; hummocky, scalded surfaces.	Mainly yellowish sandy soils, with greyish sands over tough loamy subsoils - usually stripped: Tableland (5) and Tarraji (18) families.	Grassy woodland with frontage grasses and <i>Aristida hygrometrica</i> . <i>C. bella</i> alliance (22a, 22b, 23, 24).	FRGP
5	4	Channels: up to 60 m wide and 4.5 m deep.	Channels, bed-loads of deep sand, Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodland. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

SNAP LAND SYSTEM (Snp)

9 km²

Source: UNP*

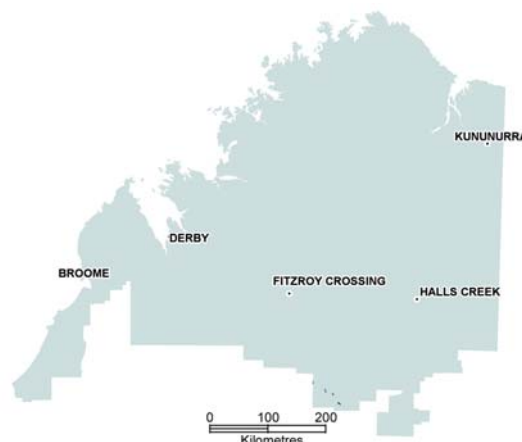
Pans, swampy depressions, fringing sand plains and occasional lunettes; pans bare, swamps with grassy eucalypt woodlands and sandy margins with hummock grasslands.

State land type: Salt lakes and fringing alluvial plains with halophytic shrublands or grasslands

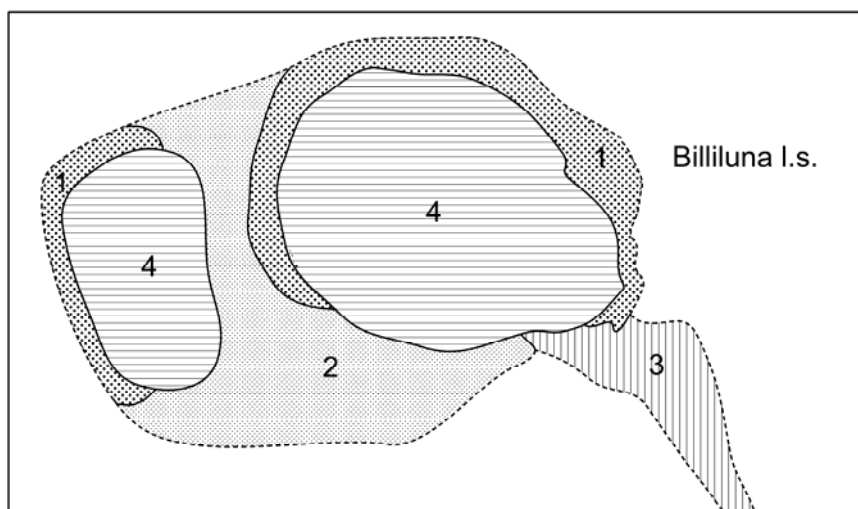
Geology: Quaternary alluvium and aeolian sand.

Geomorphology: Very gently undulating sandplain internally drained into numerous pans and playa lakes, minor lunettes and occasional dunes.

Land management: This isolated, very small, poorly known system is unlikely to be subjected to much grazing pressure; almost 60% consists of mostly unvegetated lake beds and pans, other parts probably support useful soft spinifex and ribbon grass pastures; subject to fairly frequent fires, not prone to erosion.



*Unvegetated lake bed (unit 4) of the Snap land system.
Photo: DAFWA*



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published.

SNAP LAND SYSTEM (Snp) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	10	Fringing sandplains and lunettes: gently sloping sandy margins.	Red deep sands (445), Red sandy earths (463).	Hummock grasslands of <i>Triodia pungens</i> .	SSPP
2	20	Swampy depressions and plains: subject to occasional flooding.	Probably sandy duplexes (400) and sandy earths (460).	Woodlands of <i>Eucalyptus victrix</i> with tussock grasses such as <i>Chrysopogon fallax</i> and hummock grasses such as <i>Triodia pungens</i> .	RGRP 70% SSPP 30%
3	10	Drainage tracts with minor channels	Probably sandy duplexes (400) with minor non-cracking clays (620).	Scattered <i>E. victrix</i> with tussock grasses such as <i>Chrysopogon fallax</i> and hummock grasses such as <i>Triodia pungens</i> .	RGRP 60% SSPP 40%
4	60	Lake beds and pans: subject to occasional inundation.	Various wet soils, including Saline wet soils (101) and Salt lake soil (102).	No vegetation.	XXNP

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).



Satellite image of Snap land system clearing showing the lake beds and pans (unit 4), and fringing plains and lunettes (units 1 and 2). The linear dunes of Camelgooda land system are visible to the north and south-west of the lakes. Width of this image is about 3 km. Image: Google Earth

SPINCRETE LAND SYSTEM (Spi)

257 km²

Source: UNP*

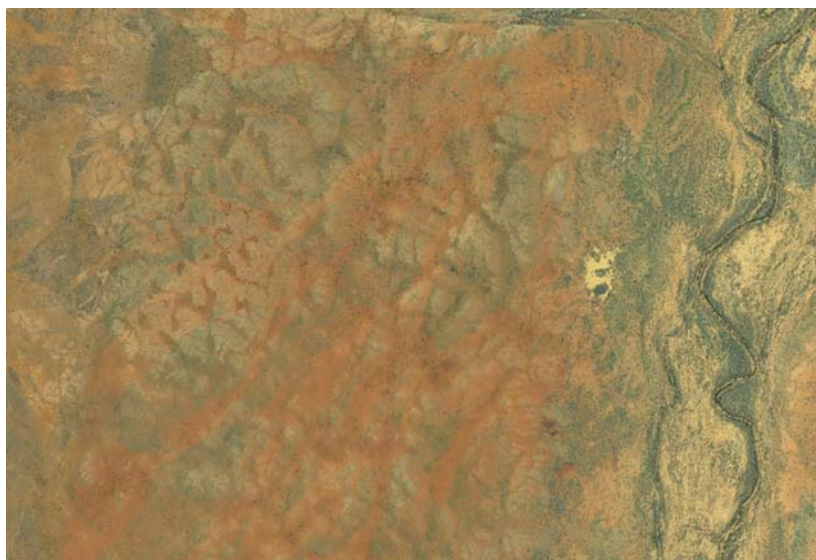
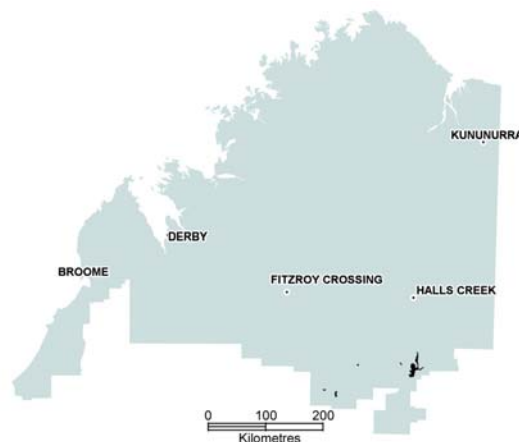
Gently undulating plains with thin sand cover over calcrete supporting hummock grasslands and scattered shrubs.

State land type: Calcrete plains with spinifex grasslands

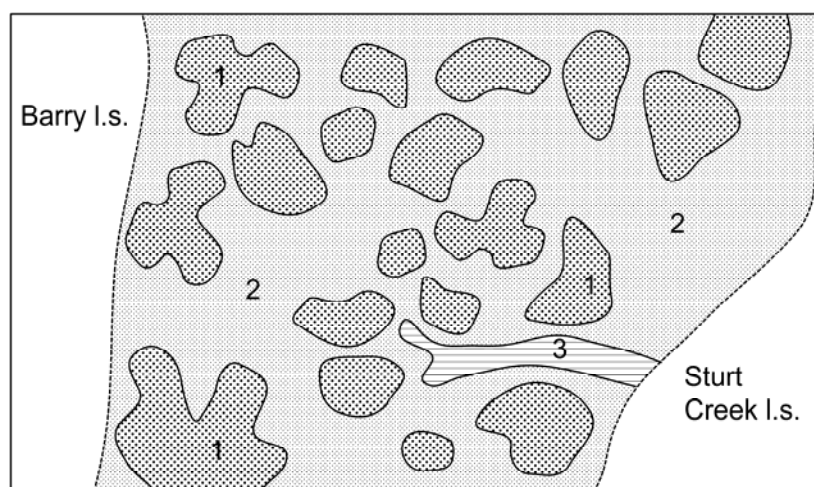
Geology: Tertiary calcrete, minor Quaternary alluvium and aeolian deposits.

Geomorphology: Depositional surfaces, level to very gently undulating plains of calcreted valley full deposits variously overlain by aeolian sand sheets; no organised drainage.

Land management: Predominantly limestone (hard) spinifex pastures unattractive to cattle and of very low pastoral value; more useful soft spinifex pastures provide moderate grazing for a number of years after burning; mostly stable and not prone to erosion but control of grazing pressure and frequency of burning is desirable.



Calcrete platforms with thin sandy soils (unit 1 of Spincrete land system) show clearly as greyish patches on this image. The drainage system to the right is the Sturt Creek land system. Image: Google Earth



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described (without land units) in *Carranya Station Rangeland Condition Report* (2005) DAWA, unpublished.

SPINCRETE LAND SYSTEM (Spi) – land units

Unit	Approx. area (%)	Landforms	Soils [*]	Vegetation	Pasture type ⁺
1	60	Calcrete platforms: near level surfaces slightly raised above surrounding sandplain.	Shallow sands, often calcareous, Calcareous shallow loams (521).	Shrubby grasslands of <i>Triodia wiseana</i> .	HSPP
2	35	Sandy plains: near level plains between calcrete platforms.	Red deep sands (445) of variable depth.	Shrubby grasslands of <i>Triodia pungens</i> .	SSPP
3	5	Drainage tracts: shallow unchannelled zones.	Unknown – possibly Calcareous loamy earths (542).	Shrubby grasslands of <i>Triodia pungens</i> .	SSPP

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).



Shrubby grasslands of Spincrete land system viewed from the Tanami track north of Billiluna
 Photo: Sylvain P Labartette (alias SL & LS, Panoramio.com)

ST GEORGE LAND SYSTEM (Stg)

1870 km²

Source: WKY

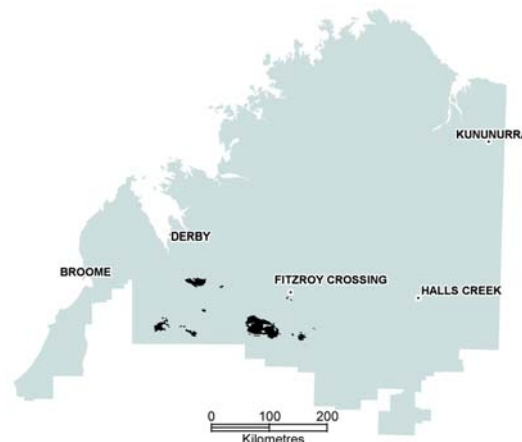
Sandstone plateau and hill lands with open spinifex and stunted trees, and pindan on the intervening sandplain.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex

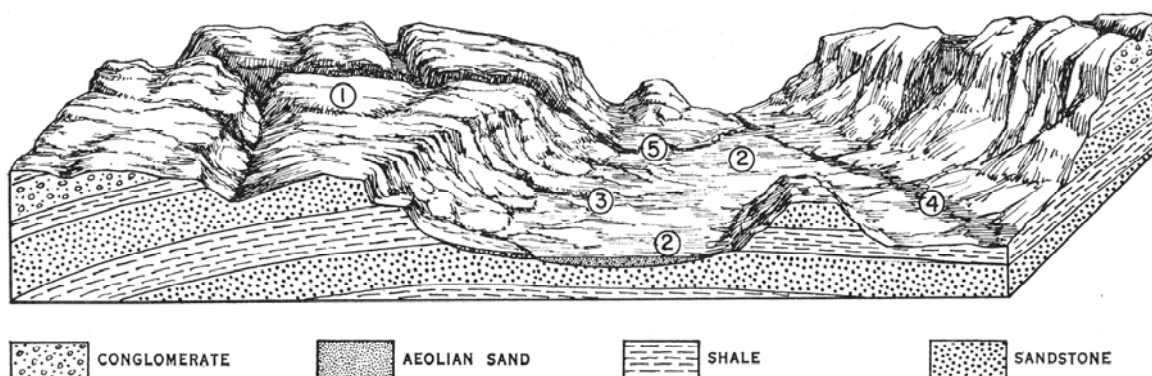
Geology: Gently dipping sandstone, conglomerate, and shale of Permian and Jurassic age; Quaternary aeolian sands.

Geomorphology: Formed by dissection of the Kimberley surface - plateaux and mountain ranges: bevelled plateaux and narrow elongated hills with extensive lower slopes; sandplain occurs in the lowest parts; dense rectangular pattern of incised valleys with narrow alluvial drainage floors; relief up to 150 m.

Land management: A large part (unit 1) of the system consists of rugged inaccessible plateaux, hills and scarps unsuitable for pastoralism, high scenic value. Lower parts (units 2, 3 & 4) are accessible and support pindan and other pastures which are moderately attractive to cattle when in young condition for a few years after fire. Not susceptible to erosion, controlled grazing and burning desirable.



*Much of the St George land system consists of poorly accessible hills and plateaux (unit 1), as shown in background. Surrounding sandplains (unit 2) are minor parts of the system.
Photo: DAFWA*



Stylised block diagram showing location of land units

ST GEORGE LAND SYSTEM (Stg) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	58	Rocky plateaux and hillslopes: boulder-strewn plateau surfaces with benched escarpments and hillslopes up to 80%, and with basal scree slopes up to 45%, lower hillslopes to 10% and 1.6 m long, dissected up to 9 m, with laterite exposures locally.	Mainly rock outcrop with some laterite.	Open spinifex with scattered stunted trees grading into open woodlands. <i>Triodia intermedia</i> and <i>T. pungens</i> communities (55, 57) and <i>Corymbia dichromophloia</i> and <i>Adansonia gregorii</i> alliances (11, 31); also 17.	HSHP 50% SSPP 50%
2	19	Sandplains: up to 1.6 m in extent, slopes less than 1%, attaining 2% locally.	Probably red sands of variable depth: Cockatoo family (7).	Woodlands (pindan) with prominent <i>Acacia</i> tall shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. <i>C. dichromophloia</i> - <i>Adansonia gregorii</i> alliances (10, 31).	PINP
3	14	Sandplains with run-on: up to 1.6 km wide and extending downslope for up to 3.2 km; slopes less than 0.5%.	Mainly mottled yellowish sandy soils: Tableland family (5).	Ribbon grass grassland with scattered trees and shrubs. <i>Chrysopogon</i> spp. community (49).	RGRP
4	5	Drainage floors: up to 800 m wide, gradients 1 in 100 to 1 in 500; marginal slopes up to 2%; scalded, hummocky surfaces.	Mainly greyish to brownish sands and loams over tough clays: Hooper family (20). Commonly scalded and degraded.	Mixed woodlands with <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. and <i>Triodia pungens</i> ground storeys. <i>Adansonia gregorii</i> and <i>Bauhinia cunninghamii</i> alliances (31, 38b).	CSPP 50% SSPP 50%
5	4	Channels: up to 75 m wide and 4.5 m deep.	Channels, bed-loads range from sand to boulders. Banks, brownish stony alluvial soils: Robinson family (21).	Fringing woodlands. <i>Eucalyptus camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (40, 42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

STURT CREEK LAND SYSTEM (Stc)

1502 km²

Source: UNP*

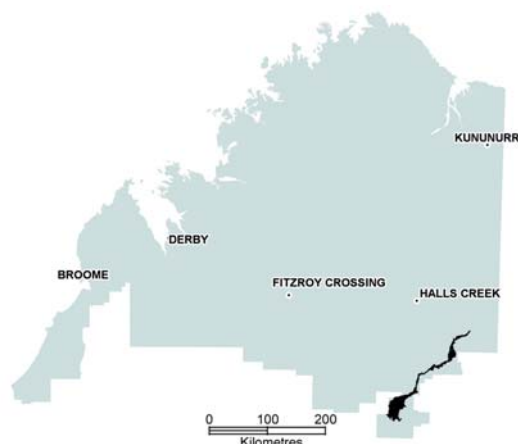
Drainage lines, depressions, alluvial plains and sand rises associated with the Sturt Creek drainage system. Vegetation mainly *Eucalyptus*, *Melaleuca*, *Eremophila* and *Acacia* shrublands with understoreys of lovegrass and ribbon grass.

State land type: Alluvial plains with mixed woodlands/shrublands and mixed grasses

Geology: Quaternary sand, silt and clay of alluvial and aeolian origin.

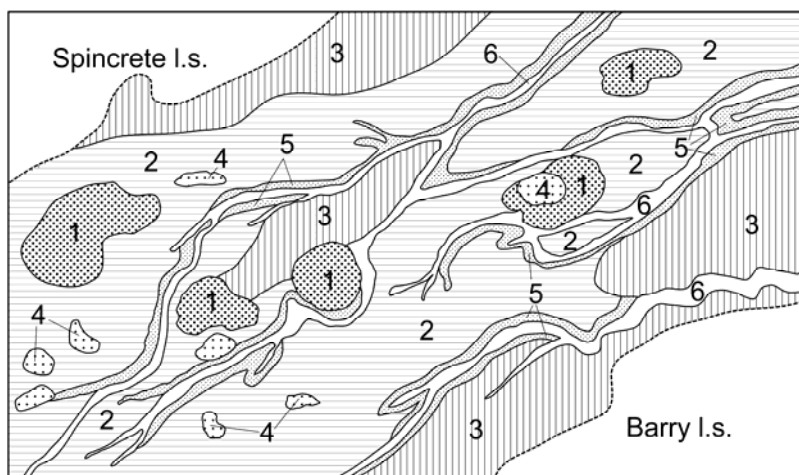
Geomorphology: Level depositional surfaces subject to regular flooding and slightly more elevated sandy surfaces not generally flooded.

Land management: Subject to fairly regular flooding and consequent difficult access; various pastures, some well preferred by grazing animals and prone to degradation; some parts likely to have moderate susceptibility to erosion. Control of grazing pressure and frequency of burning is required.



A north looking aerial view along Sturt Creek from just south of the Tanami track crossing (mid photo). Sturt Creek land system describes the complex channelled area. Billiluna land system is the plain to the left and Cornish land system is the plain to the right. The barely visible low linear dunes of Cornish land system are at right angles to the creek.

Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described in *Billiluna Station Resource Survey Report* (1993) DAWA, unpublished.

STURT CREEK LAND SYSTEM (Stc) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	20	Sand rises: sandy surfaces elevated up to a few metres above adjacent units.	Orange loamy sands, Red deep sands (445).	Shrublands of <i>Acacia bivenosa</i> , <i>Melaleuca glomerata</i> , and <i>M. lasiandra</i> with understorey mainly soft spinifex (<i>Triodia pungens</i>).	SSPP
2	35	Depressions, floodplains, swamps and drainage foci: tracts subject to regular inundation.	Grey sandy loams, probably Brown loamy earths (541).	<i>Eucalyptus victrix</i> woodlands. Pastures mainly <i>Eragrostis</i> spp., <i>Fimbristylis phaeoleuca</i> and ribbon grass (<i>Chrysopogon fallax</i>).	LGAP 50% RAPP 50%
3	25	Clay plains: level flats.	Grey sandy loams, probably Grey non-cracking clays (621) and Grey shallow sandy duplexes (404).	Shrublands of <i>Eremophila longifolia</i> , and <i>Acacia pachycarpa</i> . Pastures mainly <i>Eragrostis</i> spp., soft spinifex (<i>Triodia pungens</i>), ribbon grass (<i>Chrysopogon fallax</i>), <i>Fimbristylis phaeoleuca</i> and <i>Aristida browniana</i> .	LGAP 40% RAPP 30% SSPP 30%
4	10	Salt pans	Saline wet soils (101) and Salt lake soils (102).	Open low shrublands of samphire (<i>Tecticornia</i> spp.).	SMPP
5	7	Banks and levees associated with active streams: fringing unit 1.	Grey to brown sandy loams, probably Brown sandy earths (462) and Brown deep sands (441).	Woodlands of <i>Eucalyptus camaldulensis</i> and <i>E. victrix</i> with a shrub layer of <i>Melaleuca glomerata</i> , <i>Acacia dictyophleba</i> , <i>A. holosericea</i> , and <i>A. ampliceps</i> . Pastures mainly <i>Eragrostis</i> spp., ribbon grass (<i>Chrysopogon fallax</i>), soft spinifex (<i>Triodia pungens</i>) and buffel grass (<i>Cenchrus ciliaris</i>).	LGAP 60% FRIP 40%
6	3	Stream channels	Sand and gravel bed load deposits.	No vegetation.	XXNP

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).



A billabong lined by *Eucalyptus victrix* and/or *E. camaldulensis* on one of many stream channels in Sturt Creek land system about 50 km north of Lake Gregory.
Photo:
Francis Yan Leung
(Panoramio.com)

TABLELAND LAND SYSTEM (Tid)

1864 km²

Source: WKY

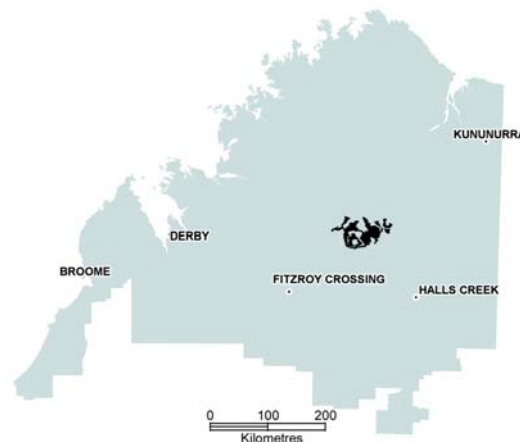
Undulating shale country with yellowish gravelly soils, open woodlands with curly spinifex.

State land type: Undulating plains and uplands with eucalypt woodlands and spinifex

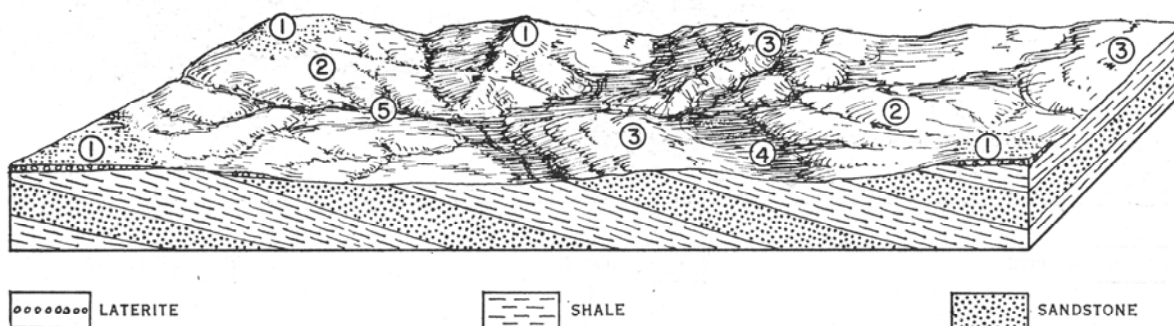
Geology: Laterised or relatively unweathered, gently dipping Upper Proterozoic shale and sandstone.

Geomorphology: Formed by dissection of the Kimberley surface - undulating terrain: strike tracts up to 32 km wide, with rocky surfaces comprising interfluvial up to 9 m high and rounded hills and cuestas up to 15 km high; stripped gently sloping lateritized surfaces with intact remnants forming upland plains or gently rounded interfluvial crests; moderately dense rectangular pattern of incised drainage, with unchannelled tributary valley floors.

Land management: Supports open woodlands with curly spinifex pastures, subject to frequent burning which induces short term changes in botanical composition and density; young curly spinifex pastures are moderately attractive to grazing animals; generally not prone to degradation or erosion but control of both grazing and burning is desirable.



Snappy gum
(*Eucalyptus brevifolia*)
over curly spinifex
(*Triodia bitextura*) on a
stony interfluvial (unit 3)
of the Tableland land
system.
Photo: DAFWA



Stylised block diagram showing location of land units

TABLELAND LAND SYSTEM (Tld) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	5	Plains and interfluvial crests: up to 3.2 km in extent; sandy slopes less than 1%; with pebble patches.	Mainly yellowish sandy to loamy soils, high in laterite gravels and shale fragments: Elliott (6) and Tableland (5) families.	Open woodland with moderately dense shrub layer and <i>Triodia bitextura</i> . <i>Eucalyptus brevifolia</i> alliance (1d, 5).	CSPP
2	30	Stripped surfaces: up to 3.2 km in extent; pebble-strewn slopes up to 5%, with frequent laterite exposures.	Shallow, red sands high in lateritic gravels on laterite: Cockatoo family (7, 23); some laterite outcrop.	Open woodland with moderately dense shrub layer and <i>Triodia bitextura</i> , <i>E. phoenicea</i> - <i>Corymbia ferruginea</i> community (7).	CSPP
3	48	Rocky surfaces: interfluvial crests up to 1% and 1.6 km wide with marginal slopes up to 10%; hill and scarp slopes up to 35%; cobble-strewn surfaces with much outcrop.	Much outcrop with shallow, yellowish gravelly soils: Tableland family (5, 23).	Open woodland with moderately dense shrub layer and <i>Triodia bitextura</i> and <i>Aristida hygrometrica</i> . <i>E. brevifolia</i> and <i>E. tectifica</i> alliances (1d, 14d); also 36.	CAHP
4	9	Unchannelled valley floors: up to 400 m wide, gradients 1 in 80 to 1 in 200; sealed surfaces with sand and pebble patches.	Mainly yellowish sandy to loamy soils: Elliott family (6), With dark brown self-mulching heavy clays: Wonardo family (14) on black soil plain element.	Grassy woodland with patches of paperbarks, with <i>Chrysopogon</i> spp., <i>Aristida hygrometrica</i> , and fringing grasses. <i>E. brevifolia</i> and <i>C. polycarpa</i> alliances (1e, 25, 27).	RGRP 50% FRGP 50%
5	8	Channels: up to 30 m wide and 1.8 m deep, and locally flanked by alluvial floors up to 400 m wide; gradients 1 in 100 to 1 in 500.	Probably brownish loamy alluvial soils: Robinson family (21).	Open woodland fringing community with fringing grasses and <i>Aristida hygrometrica</i> . <i>Adansonia gregorii</i> and <i>C. polycarpa</i> alliances (25, 33).	FRGP 60% FRIP 40%

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

TANMURRA LAND SYSTEM (Tan)

111 km²

Source: OVC

Hilly dolomite and limestone country in the northern half of the Ord-Victoria survey area.

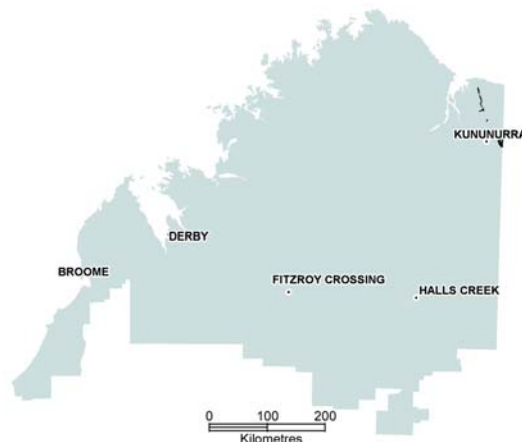
State land type: Hills and lowlands with eucalypt woodlands and tussock grasses

Geology: Adelaidean dolomitic rocks, some sandstone; Lower Carboniferous and Upper Devonian limestones.

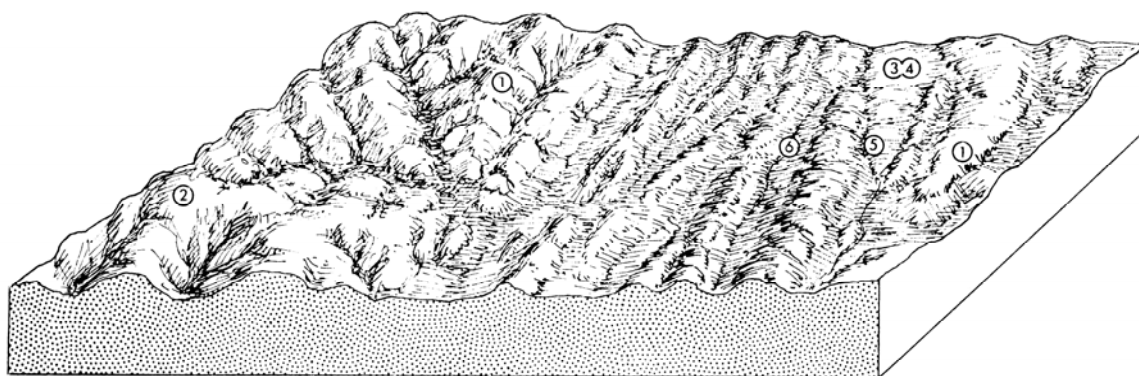
Geomorphology: Limestone ridges, hogbacks, cuervas, and structural plateaux.

Drainage: Dendritic, angular, and radial patterns of moderate intensity.

Land management: Bouldery limestone hills (unit 1) are poorly accessible but other units support pastures which are moderately or highly preferred by cattle and will degrade unless grazing pressure is controlled.



*The distinctive grey limestone hills of unit 1 in Tanmurra land system.
Photo: Noel Schoknecht, DAFWA*



Stylised block diagram showing location of land units

TANMURRA LAND SYSTEM (Tan) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	60	Very bouldery limestone hills	Limestone outcrops or boulders.	Deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Bauhinia cunninghamii</i> , <i>Cochlospermum fraseri</i>) with upland tall grass (<i>Sorghum stipoides</i>).	ASHP
2	15	Gently sloping limestone boulder areas of short steep strike scarps	Shallow soils with limestone outcrops or boulders.	As for unit 1	ASHP
3	15	Gentle slopes	Tippera - brown loam merging into red clay; some areas of Elliott - grey sandy loam merging into mottled yellow clay; minor Tobermorey - shallow grey to yellow-brown calcareous loamy soil on limestone.	Northern box-bloodwood woodland (<i>Eucalyptus tectifica</i> , <i>Corymbia foelscheana</i> , <i>C. latifolia</i>) and Tippera tall grass (<i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>).	TTGP
4	4	Lower gentle slopes	Cununurra - grey cracking heavy clays.	Bluegrass tall grass (<i>Dichanthium</i> spp., <i>Sorghum</i> spp., <i>Ophiuros exaltatus</i>).	BGAP
5	4	Gentle slopes near streamlines	Variable light to medium-textured alluvial soils.	Northern box-bloodwood woodland (<i>E. tectifica</i> , <i>C. foelscheana</i> , <i>C. grandifolia</i>) with frontage tall grass (<i>Chrysopogon latifolius</i> , <i>Panicum</i> spp., <i>Sorghum</i> spp.)	RGRP
6	2	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.

TARRAJI LAND SYSTEM (Tar)

571 km²

Source: WKY

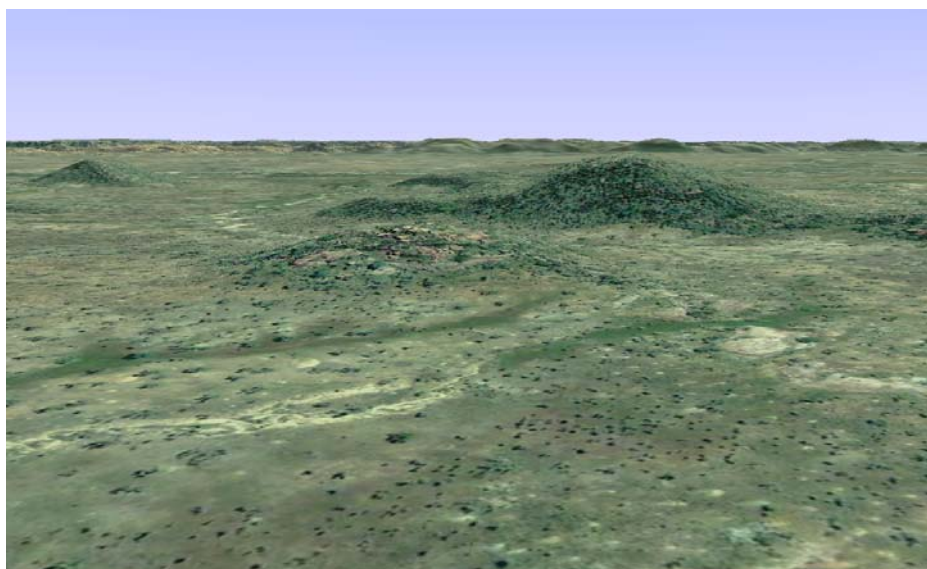
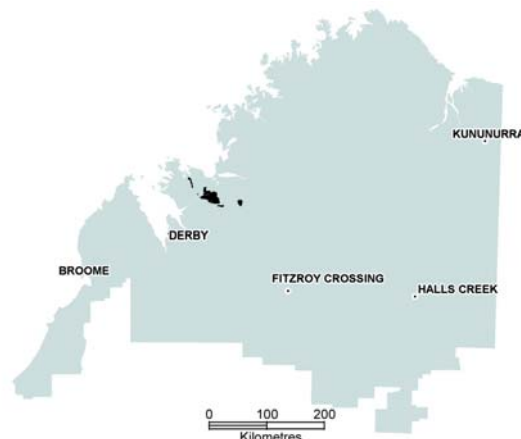
Gently undulating country with grassy woodlands, scattered granite domes with sparse spinifex and low trees and shrubs.

State land type: Undulating plains with eucalypt woodlands and mixed grasses

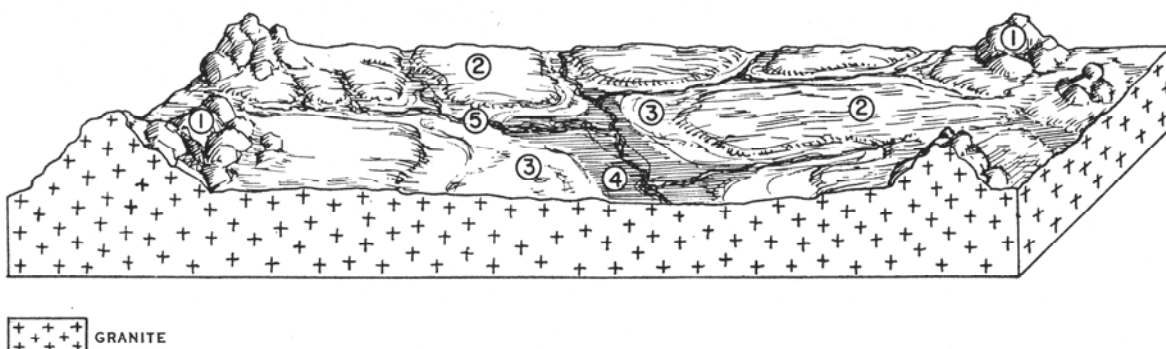
Geology: Lower Proterozoic or Archaeozoic granite.

Geomorphology: Formed by partial dissection of the Fitzroy surface - undulating terrain: gently sloping interfluvies, and restricted valley plains, with scattered granite domes up to 120 m high; dense to moderately dense rectangular pattern of incised drainage; relief mainly less than 9 m.

Land management: Hills and granite domes (unit 1) are poorly accessible; other parts support ribbon grass, curly spinifex and frontage grasses which are attractive to cattle; units 3 and 4 have moderate susceptibility to erosion if vegetative cover is depleted or lost. Control of both grazing and burning is required.



*Gently undulating interfluvies based on granite and isolated domes and bouldery hills comprise the Tarraji land system as shown in this 2010 aerial oblique image.
Image: Google Earth*



Stylised block diagram showing location of land units

TARRAJI LAND SYSTEM (Tar) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	18	Domes: smooth, convex, outcrop slopes, up to 80%, with joint-block cappings.	Predominantly outcrop.	Much bare rock. Vegetated only in cracks, crevices, and pockets of soil. Very open woodlands with sparse ground storey of tussocks of <i>Triodia bynoei</i> and other grasses. <i>Corymbia cadophora</i> - <i>Adansonia gregorii</i> - <i>C. dichromophloia</i> community (32).	CAHP 60% XXNP 40%
2	58	Interfluves: up to 1.6 km wide with slopes less than 0.5%, attaining 3% adjacent to domes; marginally dissected up to 9 m with slopes up to 20% and local outcrop; sandy, pebble-strewn surfaces.	Greyish sands over tough loamy subsoils: Tarraji family (18). With deep brown sands: Katyeeda family (9).	Open woodlands with patches of paper-bark trees, scattered shrubs with <i>Triodia bitextura</i> , short grasses, and, <i>Chrysopogon</i> spp. <i>Eucalyptus brevifolia</i> , <i>C. dichromophloia</i> , and <i>E. tectifica</i> alliances (1d, 1f, 8d, 14b).	RGRP 40% CSPP 30% ASGP 30%
3	8	Valley plains: up to 4.8 km in extent with slopes less than 0.2%; lightly firmed, locally scalded surfaces with grit patches.	Weakly mottled yellowish loamy soils: Elliott family (6).	Grassy woodland with <i>Chrysopogon</i> spp. <i>E. tectifica</i> community (14b).	RGRP
4	8	Drainage floors: up to 1.6 km wide, gradients 1 in 100 to 1 in 500.	Clayey alluvial soils with loose subsoils: Fitzroy family (22).	Grassy woodland with frontage grasses. <i>C. bella</i> - <i>E. alba</i> community (23).	FRGP
5	8	Channels: up to 60 m wide and 6 m deep.	Channels, bed-loads of deep sand and pebbles. Banks, brownish loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

TEXAS LAND SYSTEM (Tex)

265 km²

Source: UNP*

Low rises and stony plains on fine and coarse-grained sedimentary rocks and colluvium from basalt supporting spinifex and tussock grasslands.

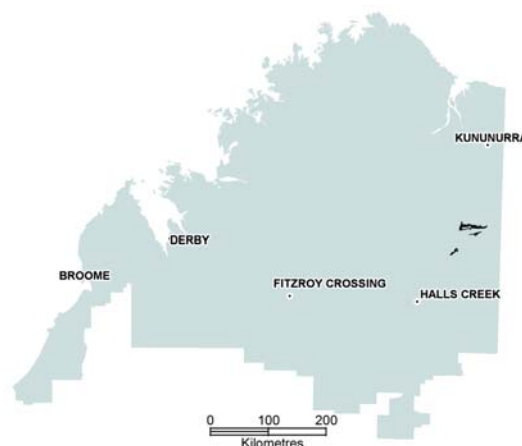
State land type: Undulating plains and uplands with eucalypt woodlands and spinifex

Geology: Proterozoic siltstone, sandstone, dolomite and tillite, Quaternary colluvium and minor alluvium.

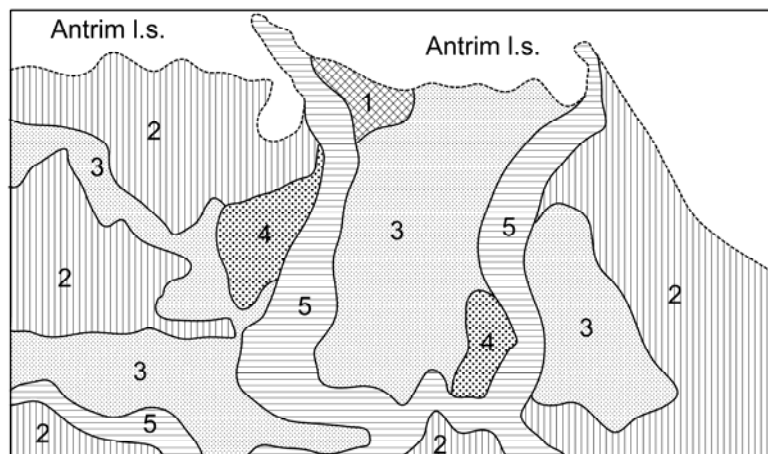
Geomorphology: Erosional and depositional surfaces: rises, pediments and lower plains; relief mostly less than 15 m.

Drainage: Moderately spaced more or less parallel drainage arising in adjacent uplands and converging in valley floors.

Land management: Overall the system has moderate pastoral value but supports pastures which vary from unattractive to cattle (e.g. hard spinifex) to highly preferred (ribbon grass and bluegrass); units 3 & 5 are prone to erosion. Control of grazing pressure is essential in order to prevent degradation of the most highly preferred pastures.



This stony gently undulating rise on the sedimentary rocks (unit 2) of the Texas land system supports small eucalypts and curly spinifex (Triodia bitextura). Photo: DAFWA



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published.

TEXAS LAND SYSTEM (Tex) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	2	Undulating to steep low hills on sedimentary rocks	Red and brown stony soils (203).	Very sparse woodland of <i>Corymbia opaca</i> , <i>Eucalyptus brevifolia</i> (occasionally <i>E. pruinosa</i>) with understorey of <i>Triodia bitextura</i> or <i>Triodia</i> spp. (hard spinifex).	HSHP
2	48	Gently undulating to rolling rises on sedimentary rocks	Stony red and brown sandy and loamy duplexes (400, 500), minor red shallow loams (522), brown cracking clays (600) and stony soils (203).	Very sparse woodland of <i>C. opaca</i> , <i>E. brevifolia</i> (occasionally <i>E. pruinosa</i>) with understorey of <i>Triodia bitextura</i> or <i>Triodia</i> spp. (hard spinifex).	CSPP 70% HSHP 30%
3	30	Level to undulating colluvial plains	Stony red and brown sandy and loamy duplexes (400, 500), minor red shallow loams (522), brown cracking clays (600) and stony soils (203).	Very sparse woodland of <i>E. pruinosa</i> , <i>C. opaca</i> or <i>E. brevifolia</i> ; or isolated to mid-dense <i>Acacia</i> spp. or <i>Carissa lanceolata</i> shrubland; with understorey dominated by <i>Triodia bitextura</i> , <i>Triodia</i> spp. (hard spinifex), <i>Dichanthium fecundum</i> or <i>Chrysopogon fallax</i> .	CSPP 80% HSPP 10% RGRP 10%
4	6	Level to undulating gilgai plains	Hard or self-mulching cracking clays (600), usually brown or grey and sometimes with a stony surface. Minor inclusions of red or brown loamy duplex soils (505, 506, 507, 508).	Grasslands of <i>Chrysopogon fallax</i> , <i>Dichanthium fecundum</i> , <i>Aristida latifolia</i> , <i>Astrebla elymoides</i> and the perennial herb <i>Flemingia pauciflora</i> . Isolated trees and shrubs.	RAPP 50% BGAP 30% MGUP 20%
5	14	Drainage floors and channels	Variable alluvial soils including brown sandy or loamy earths (462, 541), often stony. Stony soils (203) in and adjacent to channels.	Fringing trees of <i>Lophostemon grandiflorus</i> , <i>Terminalia platyphylla</i> , <i>Adansonia gregorii</i> and <i>E. camaldulensis</i> over <i>Eriachne festuacea</i> .	FRIP 70% RAPP 30%

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).

WANGANUT LAND SYSTEM (Wan)

6973 km²

Source: WKY

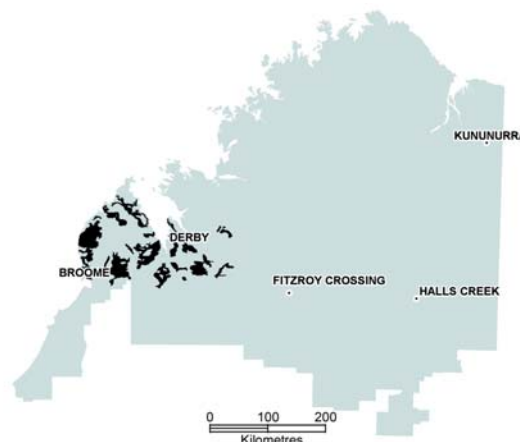
Low-lying sandplain and dunefields with through-going drainage, pindan.

State land type: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands

Geology: Quaternary aeolian sands.

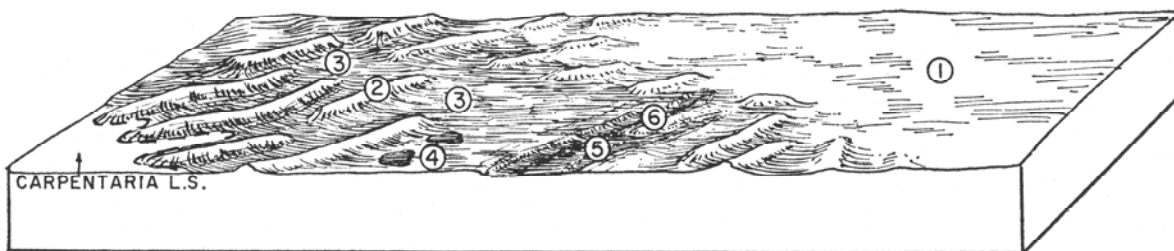
Geomorphology: Sandplain and dunefields with through-going drainage: sandplain, mainly in the upper parts, with stable dunefields, low-lying sandplain, and scattered pans and depressions; sparse to moderately dense branching drainage pattern; relief up to 9 m.

Land management: System supports dense wattle scrub with pindan pastures and is subject to fairly frequent fires which induce short term changes in botanical composition, density and structure. Pindan pastures, depending on time since last fire, are poorly to moderately attractive and useful to cattle. Generally not prone to degradation or erosion but control of grazing pressure and frequency of burning is desirable.



*Sandplains (unit 1) of the Wanganut land system support characteristic pindan vegetation on red sandy soils. Pindan consists of trees such as variable barked bloodwood (*Corymbia dichromophloia*) and other eucalypts over a dense tall acacia shrub layer with a ground storey of curly spinifex (*Triodia bitextura*) and ribbon grass (*Chrysopogon fallax*).*

Photo: DAFWA



Stylised block diagram showing location of land units

WANGANUT LAND SYSTEM (Wan) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	37	Sandplain: up to 4.8 km in extent; broadly undulating, with relief up to 1.2 m and slopes up to 2%, or gently sloping, less than 1%.	Deep red sands: Cockatoo family (7)	Woodlands (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. <i>Corymbia dichromophloia</i> alliance (10). High-rainfall parts: <i>Eucalyptus miniata</i> alliance (28, 29); also l4c.	PINP
2	11	Linear dunes: up to 9 m high and 19 km long, with flank slopes up to 15%.	Mainly deep red sands: Cockatoo family (7). Pindan dunes with reddish sandy soils: Yabbagoddy family (l) common.	Low woodland (pindan) with patches of dense <i>Acacia</i> shrubs and <i>Triodia bitextura</i> - <i>Chrysopogon</i> spp. and <i>Aristida</i> spp. ground storeys. <i>C. dichromophloia</i> and <i>Bauhinia cunninghamii</i> alliances (10, 38c). High-rainfall parts: <i>E. miniata</i> community (28).	PINP
3	43	Dune swales and low-lying sandplain: swales up to 1.6 km wide with concave marginal slopes up to 5%, rapidly decreasing to less than 1%; low-lying sandplain up to 16 km extent with slopes less than 0.3%, attaining 1% locally.	Mainly yellowish sandy soils: Tableland family (5). Minor amounts of reddish sandy soils: Yabbagoddy family (1).	Grassy woodlands with patchy <i>Acacia</i> shrub layer, <i>Triodia bitextura</i> and <i>T. bitextura</i> - <i>Chrysopogon</i> spp. ground storeys. <i>C. dichromophloia</i> , <i>E. tectifera</i> and <i>E. microtheca</i> alliances (10, l4c, 21). [Introduced buffel grass (<i>Cenchrus ciliaris</i>) now common in parts].	PINP 90% BUGP 10%
4	5	Pans and depressions: linear, up to 800 m wide and 4.8 km long, commonly in linked series; depressions shallow with lightly firmed sandy surfaces, and pans up to 1.5 m deep with heavily cracking surfaces and microrelief; short marginal slopes to 1%.	Yellowish, strongly mottled loamy soils: Elliott family (6) on depressions. Brownish, massive, intractable heavy clays (30) in pans.	Ribbon grass grasslands with patches of <i>Triodia bitextura</i> and fringing paperbark and bloodwood woodlands. <i>C. polycarpa</i> , <i>E. microtheca</i> , and <i>Melaleuca</i> spp. alliances (21, 26, 36).	RGRP
5	2	Drainage floors: mainly less than 800 m wide but up to 1.6 km locally, with marginal slopes about 0.5% hummocky, extensively scalded surfaces.	Complex of yellowish sandy soils: Tableland family (5); and scalded greyish and brownish sands and loams over tough clays: Hooper family (20).	Complex of ribbon grass and paperbark trees. <i>Melaleuca</i> spp. community (36) and <i>Chrysopogon</i> spp. community (49).	RGRP
6	2	Channels: up to 30 m wide and 4.5 m deep.	Channels, bed-loads of deep sand. Banks, brownish sandy and loamy alluvial soils: Robinson family (21).	Fringing forests and woodlands. <i>E. camaldulensis</i> - <i>Terminalia platyphylla</i> fringing community (42).	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.

WAVE HILL LAND SYSTEM (Wav)

1238 km²

Source: OVC

Gently undulating basalt 'black soil' country, occurring in one large area near Wave Hill and many small areas scattered throughout the southern half of the Ord-Victoria survey area.

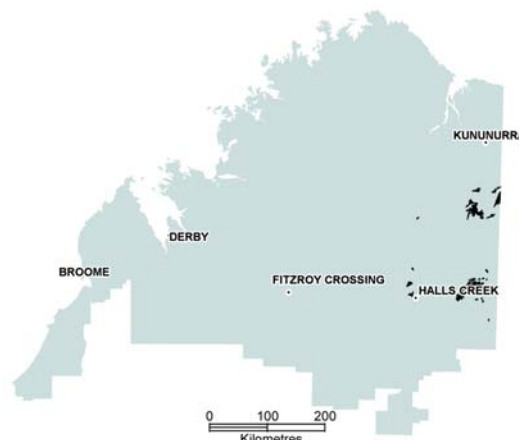
State land type: Undulating stony plains with cracking clay soils and tussock grasslands

Geology: Basalt, minor agglomerate, tuff of Lower Cambrian volcanics, some Lower Proterozoic gabbro.

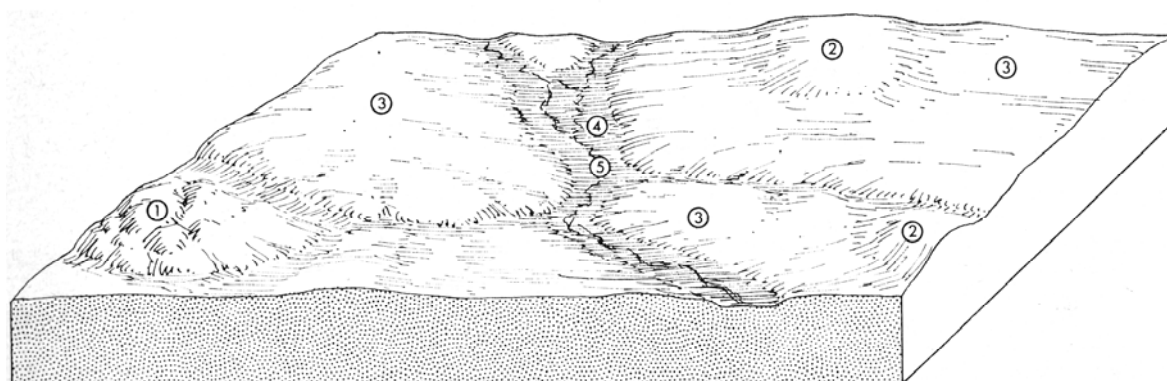
Geomorphology: Volcanic structural benches, inland and coastal erosional plains.

Drainage: Rectangular, angular, and dendritic drainage patterns of moderate intensity; the Camfield River in the Northern Territory has a braided system of channels; the braided river systems and flats adjacent to streamlines may be flooded for short periods.

Land management: Much of the system supports Mitchell grass and bluegrass pastures which are highly preferred by cattle; the system is relatively resilient and stable under grazing but pastures degrade with sustained overuse. Control of grazing pressure is essential.



Gently sloping plains (unit 3) with cracking clay soils and basalt stones of Wave Hill land system. At this site perennial grass pastures of barley Mitchell grass (*Astrebla pectinata*) and curly bluegrass/bundle-bundle (*Dichanthium fecundum*) have been degraded to feathertop wiregrass (*Aristida latifolia*) and annuals.
Photo: DAFWA



Stylised block diagram showing location of land units

WAVE HILL LAND SYSTEM (Wav) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	5	Low stony rises	Mostly basalt boulders and rock outcrops with pockets of red clayey soils.	Deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Bauhinia cunninghamii</i> , <i>Cochlospermum fraseri</i>) with upland tall grass (<i>Sorghum stipoides</i>); snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with soft spinifex (<i>Triodia pungens</i>).	ASHP 50% SSPP 50%
2	10	Steep to gentle slopes	Shallow stony red clay soils, some Frayne - brown loam merging into dark red clay.	Bloodwood-southern box sparse low woodland (<i>Corymbia opaca</i> , <i>E. limitaris</i> , <i>E. tephrodes</i>) with arid short grass (<i>Enneapogon</i> spp.) or threeawn mid-height grass (<i>Aristida pruinosa</i> , <i>Chrysopogon fallax</i>).	ASGP 60% TAPP 40%
3	70	Moderate to gentle slopes, may be stony	Cununurra, Barkly and Argyle - grey and brown cracking clays.	Mitchell and other mid-height grasses (<i>Astrelba pectinata</i> , <i>Dichanthium fecundum</i> , <i>Panicum</i> spp.).	MGUP
4	5	Lower slopes near drainage lines	Tobermorey - shallow grey to yellow-brown calcareous loamy soils.	Bloodwood-southern box sparse low woodland (<i>C. opaca</i>), with arid short grass (<i>Enneapogon</i> spp.)	ASGP
5	5	Flats adjacent to drain lines	Cununurra - grey cracking clay.	Bluegrass tall grass (<i>Dichanthium</i> spp., <i>Aristida latifolia</i> , <i>Eulalia aurea</i>).	BGAP
6	5	Stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.

WEABER LAND SYSTEM (Wbr)

851 km²

Source: OVC

Scattered small areas of rugged sandstone hills with some gentle lower slopes in the north-western part of the Ord-Victoria survey area.

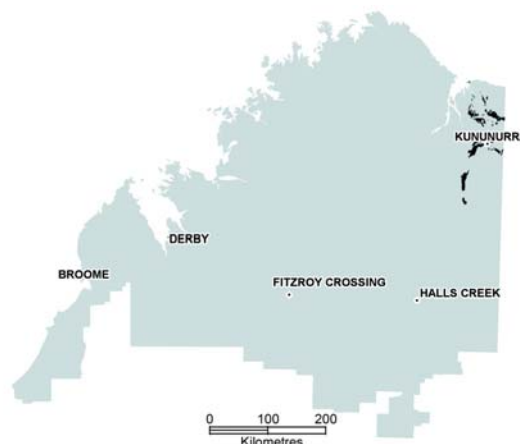
State land type: Hills, ranges and plateaux with eucalypt woodlands and tall grasses

Geology: Sandstone, calcareous sandstone, conglomerate, and minor limestone; Permian, Devonian–Carboniferous, and Cambrian–Ordovician.

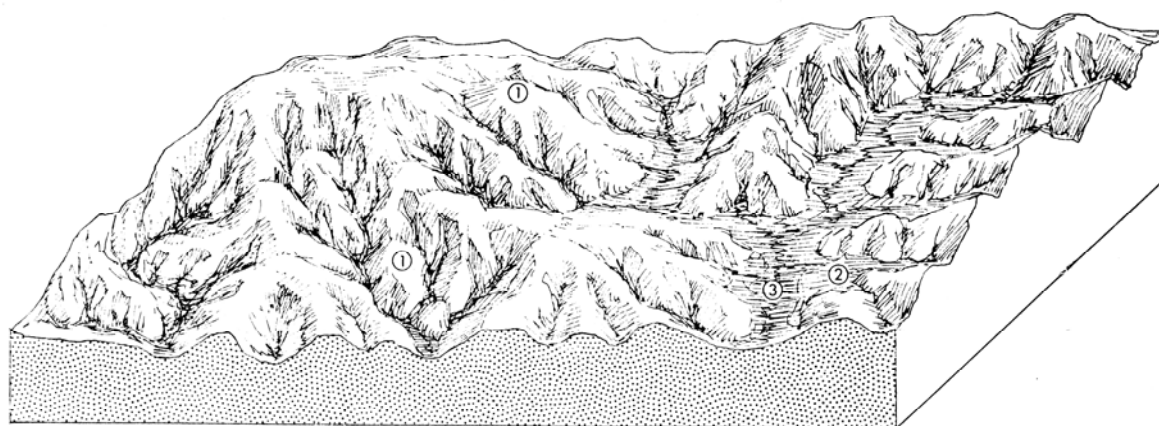
Geomorphology: Ridges, hogbacks, cuestas, and structural plateaux.

Drainage: Angular and rectangular patterns of moderate to high intensity.

Land management: Rugged sandstone hills which are poorly accessible; subject to regular fires but generally stable and not prone to erosion; mostly unsuitable for pastoralism; high scenic amenity.



Watching the sunset from Kelly's Knob, an outlier of Weaber land system near the centre of Kununurra, is a popular pastime with tourists and locals alike. A larger expression of Weaber land system is in the background. The irrigated 'black soil' plains of Ivanhoe land system are in the mid-ground. Photo: H P Meul (Panoramio.com)



Stylised block diagram showing location of land units

WEABER LAND SYSTEM (Wbr) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	80	Very rugged hills	Sandstone outcrops with patches of skeletal soils and shallow red and yellow soils.	Stringybark bloodwood woodland (<i>Eucalyptus tetrodonta</i> , <i>Corymbia dichromophloia</i> , <i>C. ferruginea</i> , <i>C. aspera</i>) or deciduous sparse low woodland (<i>Xanthostemon paradoxus</i> , <i>Owenia vernicosa</i> , <i>Terminalia</i> spp.), both with upland tall grass (<i>Sorghum stipoides</i> , <i>Triodia bitextura</i> , <i>Triodia stenostachya</i>).	ASHP 50% CAHP 50%
2	15	Gentle lower slopes	Cockatoo - deep red sand; Pago - deep yellow sands.	Stringybark - bloodwood woodland (<i>E. tetrodonta</i> , <i>E. miniata</i> , <i>C. dichromophloia</i>) or frontage woodlands (<i>C. polycarpa</i> , <i>C. bella</i> , <i>E. apodophylla</i>), both with upland tall grass (<i>Sorghum stipoides</i> , <i>Triodia bitextura</i> , <i>Aristida</i> spp.).	LCSP
3	5	Small stream channels		Fringing communities.	FRIP

+ Pasture types described in Appendix 1.



Hidden Valley National Park, a popular tourist destination just east of Kununurra, provides an impressive example of the rugged sandstone hills of Weaber land system.

Photo: Paul Müller (alias Peter Mueller, Panoramio.com)

WICKHAM LAND SYSTEM (Wic)*

5200 km²

Source: OVC

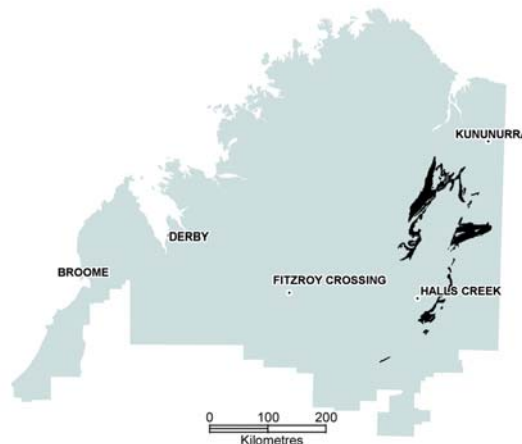
Rugged stony country formed on sedimentary rocks widespread in the southern half of the Ord-Victoria survey area.

State land type: Hills, ranges and plateaux with eucalypt woodlands and spinifex

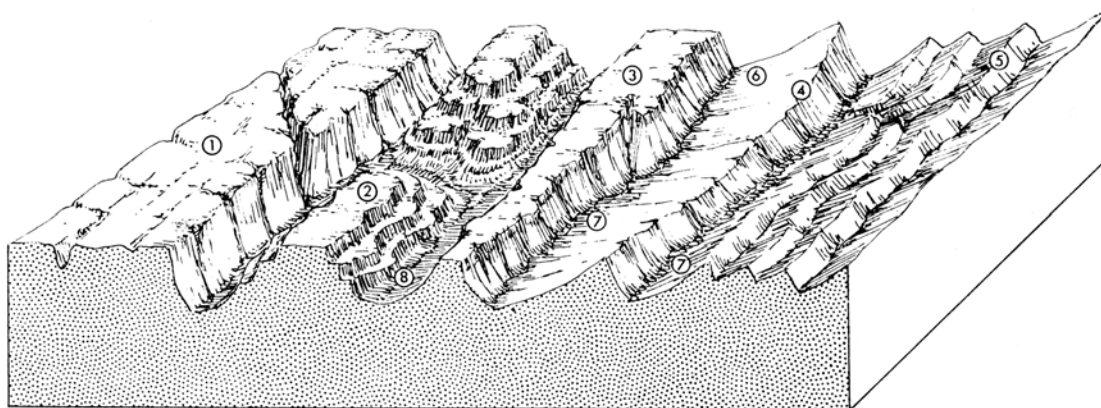
Geology: Sandstone, shale, and some dolomite; Adelaidean and Carpentarian.

Geomorphology: Ridges, hogbacks, cuestas, and structural plateaux. Angular and rectangular patterns of moderate to high intensity.

Land management: Very rugged and poor accessible system, high scenic amenity and conservation value; unsuitable for pastoralism.



Rugged sandstone ranges, escarpments and gorges characteristic of Wickham land system, Osmond Ranges, East Kimberley. Photo: Noel Schoknecht, DAFWA



Stylised block diagram showing location of land units

* Wickham land system is essentially equivalent to Pinkerton (OVC), Buldiva (NKY) and Precipice (WKY) land systems. The different names are a result of surveys being undertaken at different times combined with rainfall differences which are reflected in the vegetation.

WICKHAM LAND SYSTEM (Wic) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	20	Structural plateaux of sandstone or quartzite with deep V-shaped gorges	Rock outcrop and shallow sandy skeletal soil.	Snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i>) with soft spinifex (<i>Triodia pungens</i> , <i>T. bitextura</i>).	CAHP 90% HSHP 10%
2	20	Structural plateaux with benches, formed on interbedded limestone, shale, and sandstone	As for unit 1	As for unit 1	CAHP 90% HSHP 10%
3	10	Mesas, capped by hard sandstone overlying soft shales	As for unit 1	As for unit 1	CAHP 90% HSHP 10%
4	20	Cuestas formed on interbedded hard sandstone over shales	As for unit 1	As for unit 1	CAHP 90% HSHP 10%
5	20	Hogbacks and ridges	As for unit 1	As for unit 1	CAHP 90% HSHP 10%
6	4	Lower gentle slopes	Elliott - grey loam merging into yellow clay; some Tobermorey - shallow calcareous loamy soils.	Bloodwood - southern box sparse low woodland (<i>Corymbia opaca</i> , <i>E. limitaris</i> , <i>E. tephrodes</i> , <i>C. confertiflora</i>) or silver-leaved box (<i>E. pruinosa</i>) sparse low woodland, both with threeawn mid-height grass (<i>Aristida pruinosa</i> , <i>A. browniana</i> , <i>Chrysopogon fallax</i>) or arid short grass (<i>Enneapogon</i> spp., <i>Aristida</i> spp.).	TAPP 50% CSPP 50%
7	3	Gentle slopes adjacent to streamlines	Elliott and miscellaneous alluvial soils.	As for unit 6	TAPP 50% CSPP 50%
8	3	Stream channels		Fringing communities	FRIP

+ Pasture types described in Appendix 1. The pasture types are based on more comprehensive vegetation descriptions from recent land unit mapping (Handasyde *et al.* 2009)



Mount John, in the Osmond Ranges of the East Kimberley, has a distinctive conical shape with a flat-topped protective cap of sandstone. Wickham land system. Photo: Noel Schoknecht, DAFWA

WILLEROO LAND SYSTEM (Wio)

240 km²

Source: OVC

Numerous small areas of basalt 'black soil' plains with tall pastures, mostly in the north-eastern part of the Ord-Victoria survey area.

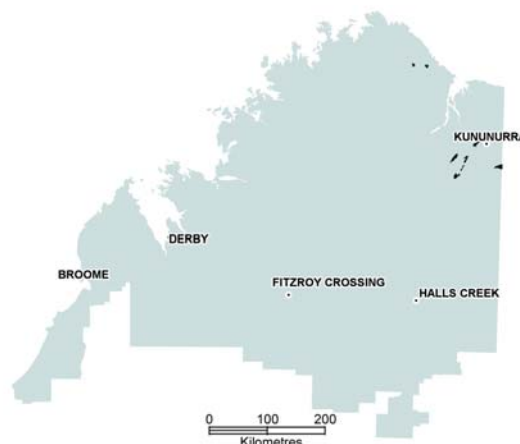
State land type: Undulating stony plains with cracking clay soils and tussock grasslands

Geology: Basalt, agglomerate, and tuff; Lower Cambrian (Antrim Plateau Volcanics), some Carpentarian dolerite.

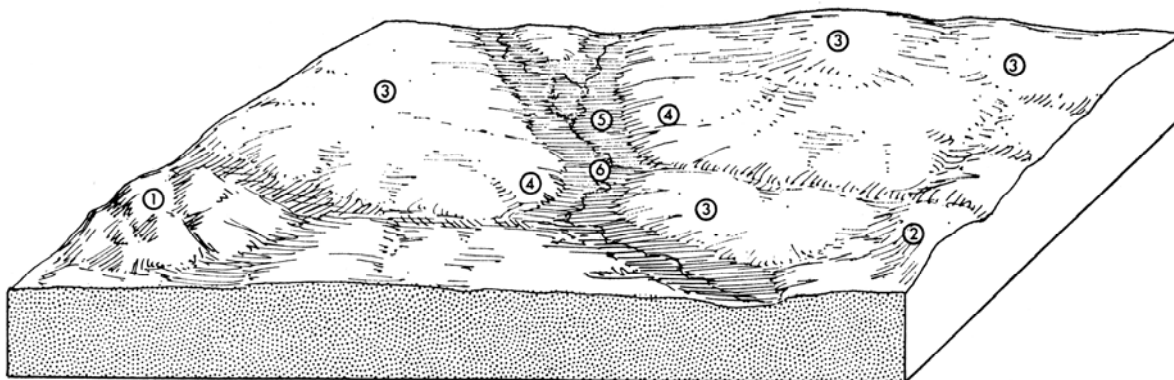
Geomorphology: Volcanic structural benches and coastal erosional plains.

Drainage: Generally rectangular, angular, and dendritic drainage patterns of moderate intensity but some large streams are braided; the braided river systems and flats adjacent to streamlines may be flooded for short periods.

Land management: Land system supports tall grass, bluegrass and other tussock grass pastures which are highly preferred by cattle. Relatively resilient and stable under grazing but pastures degrade with preferential overuse; control of grazing pressure is essential.



*Basaltic cracking clay plains of the Willeroo land system supporting productive curly bluegrass/ bundle-bundle (*Dichanthium fecundum*) tussock grass pastures. Photo: DAFWA*



Stylised block diagram showing location of land units

WILLEROO LAND SYSTEM (Wio) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	3	Low stony rises	Mostly rock outcrops with basalt boulders and pockets of red clayey soil.	Northern box-bloodwood woodland (<i>Eucalyptus tectifica</i> , <i>Corymbia foelscheana</i>) or deciduous sparse low woodland (<i>Terminalia</i> spp., <i>Bauhinia cunninghamii</i> , <i>Cochlospermum fraseri</i>) both with upland tall grass (<i>Sorghum stipoides</i>).	ASHP
2	8	Steep to gentle slopes	Shallow stony red clay soils and Frayne - brown loam merging into dark red clay; minor Elliott.	Northern box-bloodwood woodland (<i>E. tectifica</i>), or silver-leaved box sparse low woodland (<i>E. pruinosa</i>), both with Tippera tall grass (<i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i>).	TTGP
3	70	Moderate to gentle slopes	Cununurra and Argyle - grey and brown cracking clays.	Bluegrass tall grass (<i>Dichanthium</i> spp., <i>Sorghum</i> spp., <i>Eulalia aurea</i> , <i>Ophiuros exaltatus</i>).	BGAP
4	8	Flats adjacent to drainage floors	Cununurra - grey cracking clays.	As for unit 3	BGAP
5	8	Drainage floors	Not described	Frontage grass communities	FRGP
6	3	Stream channels	Not described	Fringing communities	FRIP

+ Pasture types described in Appendix 1.

WINDJANA LAND SYSTEM (Wij)

1382 km²

Source: WKY

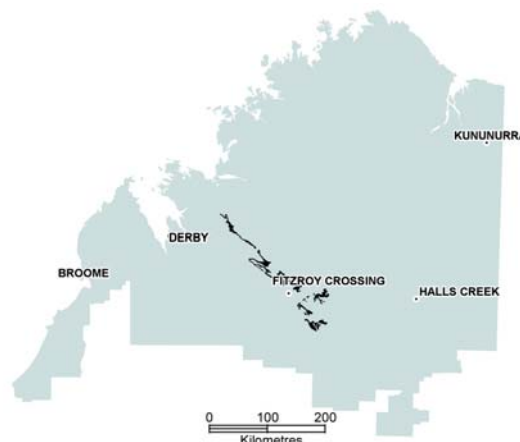
Rocky limestone hill ranges, outcrop and shallow calcareous earths, spinifex and scattered trees. Local grasslands on cracking clay soils.

State land type: Hills and lowlands with eucalypt woodlands and spinifex

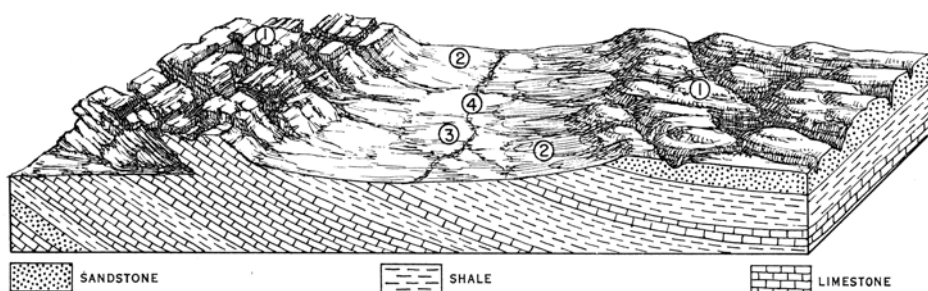
Geology: Dipping or gently folded limestone, calcareous sandstone, and shale of Devonian age.

Geomorphology: Formed by dissection of the Kimberley surface - hill lands: strike belts up to 6.4 km wide and 80 km long, comprising hill ranges, plateaux and cuestas, with narrow bevelled crests and with short lower slopes; restricted cracking clay plains in the lowest parts; sparse to moderately dense rectangular or branching pattern of incised valleys with strike-directed trunk drainage; relief up to 75 m.

Land management: Hills, plateaux and cuestas (unit 1) are poorly accessible, high scenic amenity; lower slopes (unit 2) support hard spinifex pastures of very low pastoral value; minor cracking clay plains (unit 3) support useful Mitchell grass and ribbon grass pastures which are preferentially overgrazed unless stocking is controlled. Very low susceptibility to erosion.



*Rocky limestone hills (unit 1) and surrounding lower slopes and plains (units 2 & 3) of the Windjana land system.
Photo: Tricia Handasyde, DEC*



Stylised block diagram showing location of land units

WINDJANA LAND SYSTEM (Wij) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	68	Rocky hills plateaux, and cuestas: bevelled hill and plateau crests up to 800 m wide with slopes less than 2%; cuestas up to 1.6 km wide with dip slopes up to 5%; boulder-covered hill and scarp slopes up to 50% with vertical upper walls; pitted, fluted outcrop surfaces.	Mainly limestone outcrop with limited areas of shallow dark grey, loamy to clayey calcareous soils: Oscar family (11).	Very open woodlands, scattered shrubs and <i>Triodia wiseana</i> , <i>Corymbia dichromophloia</i> and <i>Adansonia gregorii</i> alliances (8a, 30).	HSHP
2	23	Lower slopes: concave, up to 5% and less than 800 m long; locally with alluvial fans, gradients 1 in 20 to 1 in 30; pebble-strewn surfaces with local outcrop.	Limestone outcrop with shallow dark brown to dark grey, loamy to clayey calcareous soils: Oscar family (11).	Open woodlands, very scattered shrubs and ground storey of <i>Triodia wiseana</i> . <i>C. dichromophloia</i> alliances (8a, 9a).	HSHP
3	5	Cracking clay plains: up to 800 m wide, with slopes less than 0.5%; hummocky surfaces.	Dark, strongly self-mulching heavy clays: Cununurra family (12), with minor gilgai formation.	Mitchell grass and ribbon grass-bluegrass grasslands with scattered trees and shrubs, <i>Astrelba</i> spp. and <i>Chrysopogon</i> spp. - <i>Dichanthium fecundum</i> communities (47, 48); also 37a.	MGAP 50% RAPP 50%
4	4	Channels: up to 30 m wide and 3 m deep, gradients 1 in 100 to 1 in 500.	Channels, bed-loads range from sand to boulders on bedrock. Banks, outcrop with local areas of shallow brownish loamy alluvial soils: Robinson family (21).	Fringing woodland <i>Eucalyptus camaldulensis</i> - <i>Terminalia platyphylla</i> fringing communities (42, 43); smaller streams 38b.	FRIP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.



Geikie Gorge is an often visited expression of the Windjana land system.
Photo: DAFWA

WINNECKE LAND SYSTEM (Wnk)

3451 km²

Source: OVC

A number of irregular areas or linear bands of stony hills associated with the red sandy 'deserts' in the southern part of the Ord-Victoria survey area.

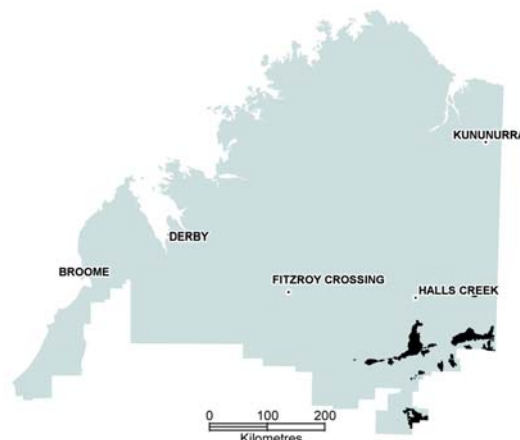
State land type: Hills and lowlands with eucalypt woodlands and spinifex

Geology: Mainly sandstone, some conglomerate and dolomite; Gardiner Beds of Carpentarian age.

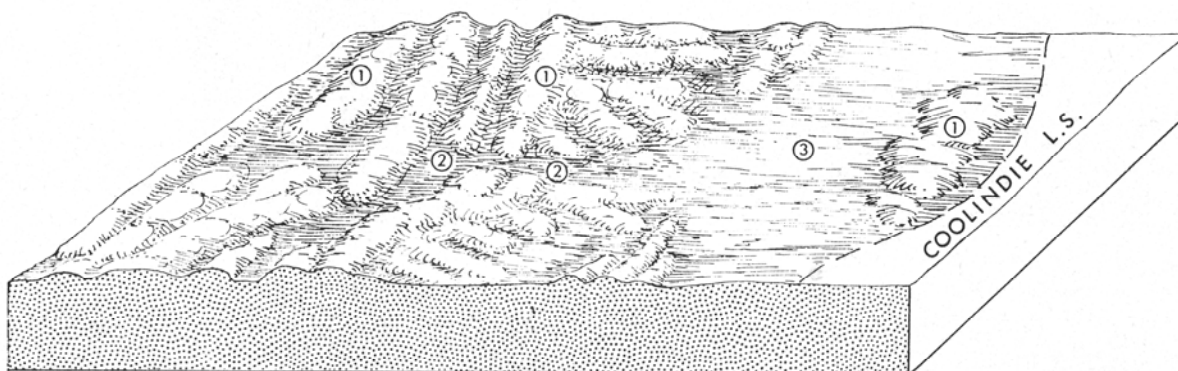
Geomorphology: Ancient monadnocks.

Drainage: Intensive parallel drainage on the first unit, widely spaced angular drainage on other units, generally terminating in deep sands at the base of hills.

Land management: System supports soft spinifex grasslands which are subject to frequent fires; these induce short term changes in botanical composition, density and structure. Young soft spinifex is moderately attractive to cattle; system generally has low or very low susceptibility to erosion except for some drainage floors which have moderate susceptibility. Controlled grazing desirable.



The description of the Winnecke land system in the text is inadequate to show the full complexity of land units seen in this image. Width of this 2005 aerial photograph is about 5.5 km. Photo: Landgate



Stylised block diagram showing location of land units

WINNECKE LAND SYSTEM (Wnk) – land units

Unit	Approx. area (%)	Landforms	Soils	Vegetation	Pasture type ⁺
1	65	Low linear or rounded hills	Outcrops of sandstone.	Trees absent or snappy gum sparse low woodland (<i>Eucalyptus brevifolia</i> , <i>E. aspera</i>) with soft spinifex (<i>Triodia pungens</i> , <i>T. spicata</i>).	SSPP
2	10	Gently sloping valley floors, mainly unchannelled	Cockatoo - deep red sandy soil, minor Elliott.	Desert shrubland (<i>Acacia</i> spp., <i>Eucalyptus</i> spp.) with soft spinifex (<i>Triodia pungens</i>).	SSPP 50% RGRP 50%
3	25	Gently sloping sandplain	Cockatoo - deep red sandy soil.	Desert shrubland (<i>Acacia</i> spp., <i>Eucalyptus</i> spp.) with soft spinifex (<i>Triodia pungens</i>).	SSPP

+ Pasture types described in Appendix 1.



Low rounded hills (unit 1) and gently sloping valley floors (unit 2) near Gumbo Point west of Balgo. Winnecke land system.

Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)

WOLFE LAND SYSTEM (Wof)

59 km²

Source: UNP*

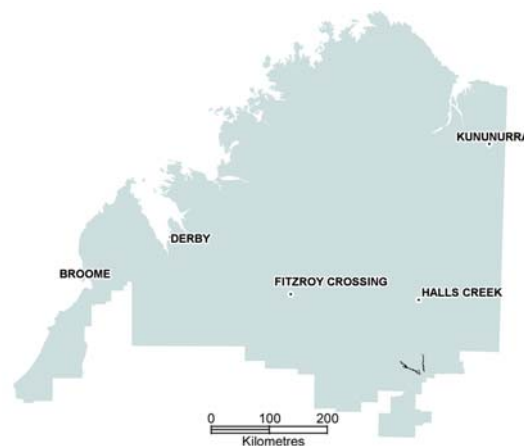
Alluvial drainage tracts and channels supporting open eucalypt woodlands and tussock and hummock grasslands.

State land type: River plains with grassy woodlands and tussock grasslands

Geology: Quaternary alluvium.

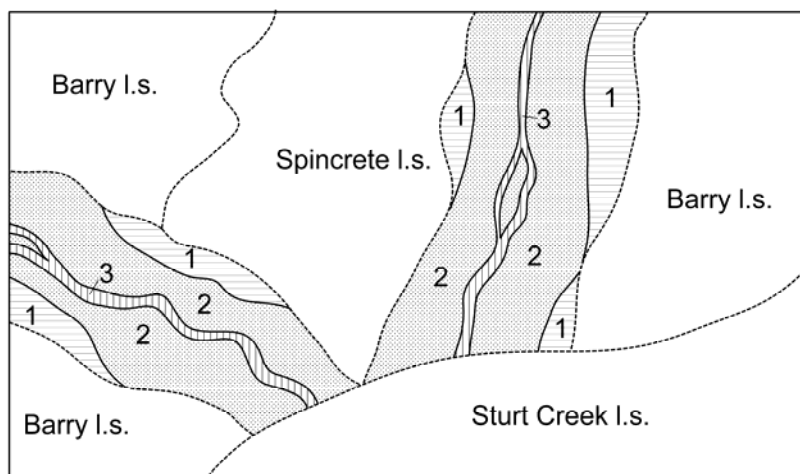
Geomorphology: Near level depositional surfaces subject to regular sheet and channelled throughflow.

Land management: Subject to flooding during wet season. Pastures of lovegrass, ribbon grass and soft spinifex are moderately attractive to cattle and prone to preferential overuse. Alluvial plains (unit 1) are likely to have moderate susceptibility to erosion if vegetative cover is depleted.



The major channel (unit 3) of Wolfe land system.

*Photo:
Andre du Plessis
(Panoramio.com)*



Stylised plan diagram showing arrangement of land units

* Provisional description, not previously published. Originally described (without land units) in *Carranya Station Rangeland Condition Report* (2005) DAWA, unpublished.

WOLFE LAND SYSTEM (Wof) – land units

Unit	Approx area (%)	Landforms	Soils*	Vegetation	Pasture type ⁺
1	25	Alluvial plains: plains on outer margin of system subject to less regular flooding.	Probably brown sandy and loamy earths (462, 541) and sandy duplex soils (400).	Grasslands of lovegrass (<i>Eragrostis</i> spp.), ribbon grass (<i>Chrysopogon fallax</i>) and soft spinifex (<i>Triodia pungens</i>) with occasional trees.	LGAP 30% SSPP 70%
2	70	Floodplains: floodplains and minor levees subject to regular overbank flooding.	Probably brown sandy and loamy earths (462, 541).	Woodlands of <i>Eucalyptus victrix</i> with understorey grasses of lovegrass (<i>Eragrostis</i> spp.), ribbon grass (<i>Chrysopogon fallax</i>), soft spinifex (<i>Triodia pungens</i>) and buffel grass (<i>Cenchrus ciliaris</i>).	LGAP 60% SSPP 40%
3	5	Stream channels and banks	Channels (50%): Sand and gravel bed-load deposits. Banks (50%): Brown sandy earths (462).	Channels, no vegetation. Banks fringing woodlands of <i>E. camaldulensis</i> and <i>E. victrix</i> .	XXNP 50% FRIP 50%

+ Pasture types described in Appendix 1.

* Numbers refer to Soil Groups of Western Australia (Schoknecht 2002).



Panorama photo (above):
Matt Shumack
(Panoramio.com)

Wolfe Creek Meteorite Crater, although not actually in Wolfe land system, is a notable nearby feature within Barry land system.

Photo (left): Andre du Plessis
(Panoramio.com)

YEEDA LAND SYSTEM (Yed)

21,308 km²

Source: WKY

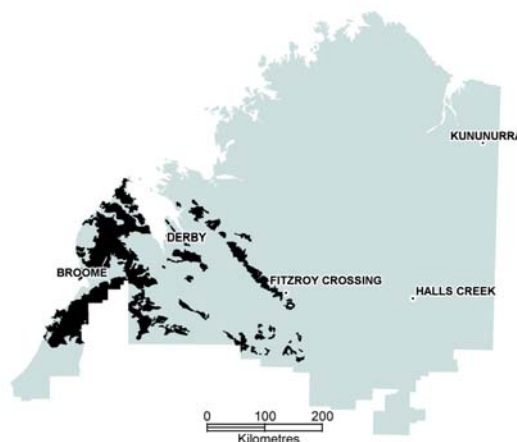
Sandplain, deep red and yellow sands, pindan and tall woodlands.

State land type: Sandplains and occasional dunes with shrubby spinifex grasslands or pindan woodlands

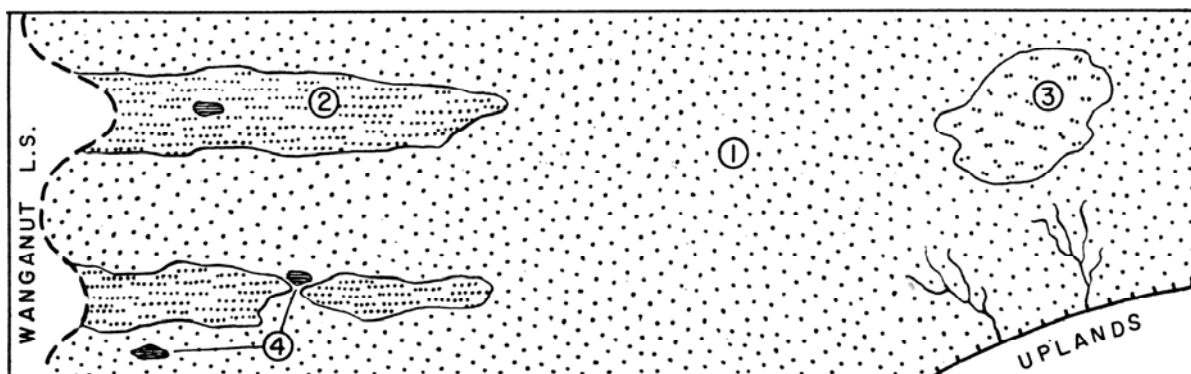
Geology: Quaternary aeolian sands.

Geomorphology: Sandplain and dunefields with little organised drainage; sandplain up to 16 km in extent, with shallow valleys, plains with thin sand cover, and scattered pans; limited surface drainage in zones of sheet-flow up to 3.2 km wide and extending up to 8 km downslope from adjacent uplands.

Land management: Supports woodlands and dense wattle scrub with pindan pastures, subject to fairly frequent fires which induce short term changes in botanical composition, density and structure. Pindan pastures, depending on time since last fire, are poorly to moderately attractive and useful to cattle. Generally not prone to degradation or erosion but control of grazing pressure and frequency of burning is required.



Yeeda sandplain with pindan wattle (*Acacia tumida*) over mixed grasses woollybutt grass (*Eragrostis eriopoda*), erect kerosene grass (*Aristida holathera*), curly spinifex (*Triodia bitextura*) and ribbon grass (*Chrysopogon fallax*).
Photo: DAFWA



Stylised plan diagram showing arrangement of land units

YEEDA LAND SYSTEM (Yed) – land units

Unit	Approx. area (%)	Landforms	Soils*	Vegetation*	Pasture type ⁺
1	82	Sandplain: up to 16 km in extent: slopes mainly less than 1% but up to 2% locally; infrequent rocky hills less than 30 m high with boulder strewn slopes up to 60%.	Deep red sands: Cockatoo family (7).	Woodland (pindan) with prominent <i>Acacia</i> shrub layer and <i>Triodia bitextura</i> , <i>Chrysopogon</i> spp. ground storey. <i>Corymbia dichromophloia</i> alliance (10, 11), Higher rainfall parts: <i>Eucalyptus miniata</i> alliance (28, 29); also 14c.	PINP
2	14	Shallow valleys: up to 4.8 km wide; gently undulating floors, with slopes up to 3%.	Reddish sandy soils: Yabbagoddy family (1). Deep yellow sands: Pago family (8) in higher-rainfall areas.	Grassy woodlands with patchy <i>Acacia</i> shrub layer and <i>Chrysopogon</i> spp. <i>E. tectifera</i> and <i>E. argillacea</i> (14b, 18): also 31. Higher rainfall parts: <i>E. miniata</i> alliance (28, 29).	RGRP 70% PINP 30%
3	3	Plains with thin sand cover: up to 3.2 km wide, with slopes less than 0.5%; strike-aligned, scalded flats with intervening rises up to 230 m wide and 0.3 m high; discontinuous sand mantles with pebble patches and outcrop locally.	Probably yellowish sandy soils: Tableland family (5). Scalded areas of greyish sands over tough loamy subsoils: Tarraji family (18).	Open patchy woodland with <i>Chrysopogon</i> spp. and <i>Triodia bitextura</i> , patches of paperbark trees. <i>Grevillea striata</i> , <i>Bauhinia cunninghamii</i> and <i>Melaleuca</i> spp. alliances (34a, 34c, 37b, 36).	RGRP
4	1	Pans: less than 800 m wide and 1.5 m deep, with short marginal slopes up to 1%; sealed, cracking surfaces.	Brownish, massive, intractable, silty to heavy clays (30).	Various tall grasses (48) with fringes of bloodwood and paperbark woodlands. <i>C. polycarpa</i> and <i>Melaleuca</i> spp. alliances (26, 36).	RAPP

* Numbers in brackets refer to soil family or vegetation community/alliance in 'General report on lands of the West Kimberley area, WA' (Speck et al. 1970)

+ Pasture types described in Appendix 1.



Fire is a common occurrence in the pindan vegetation of Yeeda land system. Beagle Bay turnoff on Cape Leveque Road. Photo: Berkeley Fitzhardinge (alias Yaruman5, Flickr.com)

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Most of these reports are available online at
www.publish.csiro.au/nid/289.htm (CSIRO reports) or
www.agric.wa.gov.au (DAFWA under publications section)

Appendix 1: Pasture types of the Kimberley Region

Detail, listed alphabetically by name

Pasture type	Code	Pasture type summary definition
Alluvial Plain Mixed Grass Pastures	APXG	Alluvial Plain Mixed Grass Pastures are tussock grasslands on floodplains, alluvial plains and drainage tracts associated with major rivers. The plains and drainage tracts are frequently gilgaied. Soils are most often cracking clays and occasionally loamy earths and clays. It consists of communities of mixed tussock grass species, with the tussock grass layer often dominated by single species such as Mitchell grass (<i>Astrebla</i> spp.), ribbon grass (<i>Chrysopogon fallax</i>), neverfail (<i>Eragrostis setifolia</i>), swamp grass (<i>Eriachne benthamii</i>), silky browntop (<i>Eulalia aurea</i>) or kangaroo grass (<i>Themeda triandra</i>). Shrubs and trees are generally isolated to very scattered. Found on Anna land system.
Annual Sorghum Hill Pastures	ASHP	Annual Sorghum Hill Pastures are found in open eucalypt and terminalia (<i>Terminalia</i> spp.) woodlands on hillslopes and crests of basalt, sandstone and other rocks. Soils are shallow and stony sands and loams. The dominant grass is annual sorghum (<i>Sorghum</i> spp.) while some plume sorghum (<i>Sorghum plumosum</i>) and white grass (<i>Sehima nervosum</i>) may also be found. Frequent burning induces annual sorghum pastures. Found on Buldiva, Cowendyne, Forrest, Looingnin, Pinkerton, Precipice and other hilly land systems.
Arid Short Grass Pastures	ASGP	Arid Short Grass Pastures are grasslands dominated by short-lived perennial or annual grasses with scattered eucalypt trees. They occur on level to undulating plains. Soils are variable depth loams (+/- calcareous) and may have some stony mantle. Dominant grass is usually limestone grass/leafy nineawn (<i>Enneapogon polyphyllus</i>), other annuals are wind grass/bunched kerosene grass (<i>Aristida contorta</i>), kerosene grass (<i>Aristida</i> spp.), Kimberley couch/spider grass (<i>Brachyachne convergens</i>) and rice grass (<i>Xerachloa laniflora</i>). Small patches of perennial grasses such as ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), black speargrass/bunch speargrass (<i>Heteropogon contortus</i>) and curly spinifex (<i>Triodia bitextura</i>) may be present but not dominant. Found on Gordon, Koongie, Nelson, O'Donnell, Pigeon and a few other land systems.
Black Speargrass Pastures	BSGP	Black (bunch) Speargrass Pastures are dominated by black speargrass/bunch speargrass (<i>Heteropogon contortus</i>) and usually occur in open eucalypt woodlands on plains and footslopes with sandy to loamy soils. Other grasses include ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), feathertop (<i>Aristida</i> spp.) and annual grasses. Found on O'Donnell, Kennedy, Buldiva and Napier and as small patches on many other land systems.
Bluegrass Alluvial Plain Pastures	BGAP	Bluegrass Alluvial Plain Pastures are perennial grasslands with variable tree cover. They occur on level plains with grey and brown cracking clay soils. The dominant grasses are bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>) and Queensland bluegrass (<i>Dichanthium sericeum</i>) with ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), plume sorghum (<i>Sorghum plumosum</i>) and native millet (<i>Panicum decompositum</i>) often present. Found on Barton, Dinnabung, Frayne, Isdell, Ivanhoe, Legune, Willeroo and numerous other land systems.
Buffel Grass Pastures	BUGP	Buffel Grass Pastures are tussock grasslands or grassy shrublands/woodlands with the grass layer dominated by introduced buffel grass (<i>Cenchrus ciliaris</i>) or a mixture of buffel grass and Birdwood grass (<i>C. setiger</i>). They occur on coastal plains, alluvial plains, levees, drainage tracts and river banks. Soils are commonly well drained sandy and loamy earths, sandy and loamy duplexes, juvenile soils (associated with levees and drainage tracts) and deep sands. It is rare on clay soils. Trees and shrubs may be absent or isolated to scattered <i>Corymbia</i> , <i>Eucalyptus</i> and <i>Acacia</i> spp. and others. Found on Anna, Coonangoody, Djada, Eighty Mile, Gordon, Gogo, Mannerie, Nelson and occasionally in other land systems.

Pasture type	Code	Pasture type summary definition
Calcrete Spinifex Pastures	CASG	Calcrete Spinifex Pastures are hummock grasslands with isolated to scattered shrubs occurring on calcrete or limestone platforms, plains, footslopes and hills. Soils are calcareous shallow loams with calcrete fragments on the surface and outcropping of calcrete or limestone is common. The dominant grass is limestone spinifex (<i>Triodia wiseana</i>) with <i>T. plurinervata</i> or <i>T. pungens</i> occasionally present. The dominant shrubs are <i>Acacia</i> and <i>Senna</i> species. Occurs on limestone ridges in Eighty Mile land system.
Coastal Dune Buffel Grass Pastures	CDBG	Coastal Dune Buffel Grass Pastures are tussock grasslands that occur on coastal dunes, swales and narrow sandplains. Soils are calcareous deep sands and deep sands that may have shell fragments through the profile and on the surface. The dominant grass is buffel (<i>Cenchrus ciliaris</i>). Isolated shrubs may occur. Common on Eighty Mile land system and occasionally found on Anna land system.
Coastal Dune Soft Spinifex Pastures	CDSG	Coastal Dune Soft Spinifex Pastures are hummock grasslands that occur on coastal dunes, limestone ridges, swales and narrow sandplains. Soils are calcareous deep sands and deep sands that may have shell fragments through the profile and on the surface. The dominant grasses are soft spinifex (<i>Triodia pungens</i>) or <i>T. epactia</i> with occasional shrubs such as coastal jam (<i>Acacia coriacea</i>) or green bird flower (<i>Crotalaria cunninghamii</i>). Minor occurrences on Eighty Mile land system.
Coastal Tall Grass Pastures	CTGP	Coastal Tall Grass Pastures are characterised by dense stands of tall grasses and sedges. They are restricted to treeless areas on coastal plains subject to annual flooding. Refer to p118 of 'Lands of the Ord-Victoria Area', CSIRO, 1970 (under Lowland Tall Grass) for species list. A minor pasture type found on Legune and a few other coastal land systems
Cockatoo Grass Pastures	COGP	Cockatoo Grass Pastures are isolated grasslands with trees found in the wetter (northern) areas of the Kimberley on broad depressions with coarse sandy soils. Apart from cockatoo grass (<i>Alloteropsis semialata</i>), other species include <i>Panicum</i> spp., curly spinifex (<i>Triodia bitextura</i>), sedges (<i>Cyperus</i> , <i>Fimbristylis</i> spp.) and forbs. A minor pasture type found on Buldiva, Pago and a few other land systems.
Curly Spinifex Annual Sorghum Hill Pastures	CAHP	Curly Spinifex Annual Sorghum Hill Pastures are widespread on stony uplands and hills of the north and east Kimberley. Soils are shallow and stony. Overstorey is a eucalypt, cotton tree/kapok bush (<i>Cochlospermum fraseri</i>) or terminalia (<i>Terminalia</i> spp.) woodland. Curly spinifex (<i>Triodia bitextura</i>) is dominant or co-dominant with annual sorghum (<i>Sorghum</i> spp.); other perennial grasses are extremely sparse. Found on Buldiva, Clifton, Cockburn, Pinkerton, Precipice, Richenda and many other hilly land systems.
Curly Spinifex Plain Pastures	CSPP	Curly Spinifex Plain Pastures are widespread on level to gently undulating plains and can occur in woodlands in the north or tree-less hummock grasslands in the drier southern areas. This pasture is found on a range of sandy or stony soils. Curly spinifex (<i>Triodia bitextura</i>) is the dominant grass, however variable amounts of other perennial and annual grasses occur. Found on Camelgooda, Glenroy, Gidgia, Sisters, Wanganut, Yeeda and numerous other land systems.
Drainage Eucalypt and Acacia Pastures	DEAW	Drainage Eucalypt and Acacia Pastures are eucalypt and/or acacia woodlands or tall shrublands that occur on near level drainage tracts and floors and level drainage foci (such as claypans and swamps) which are subject to fairly regular inundation. Soils are sandy and loamy earths and clays. The dominant eucalypt is often coolibah (<i>E. victrix</i>) and the dominant acacia is often mulga (<i>Acacia aneura</i>). There is generally a low shrub layer but no perennial grass layer. It is a minor component of Little Sandy land system.

Pasture type	Code	Pasture type summary definition
Drainage Melaleuca Shrubland Pastures	DMES	Drainage Melaleuca Shrubland Pastures are scattered to closed tall melaleuca shrublands occurring on level drainage features such as narrow drainage floors, drainage foci and swamps, alluvial plains and floodplains that are poorly drained or inundated. Soils are loamy earths and loamy duplexes. The dominant shrub is usually <i>Melaleuca alsophila</i> or <i>M. lasiandra</i> . There is generally a mid shrub layer dominated by melaleuca or black wattle (<i>Acacia ampliceps</i>) but no low shrub layer. The grass layer is often very patchy and poorly developed. It is common in Mannerie land system and a minor component of the Little Sandy land system.
Fringing Pastures	FRIP	Fringing Pastures occur in dense eucalypt, melaleuca and terminalia woodlands as very narrow strips (typically < 50 m) adjacent to creeks, rivers and lagoons. In northern areas, perennial grasses include tall coarse types such as reed grass (<i>Mnesithea rottboellioides</i>), canegrass (<i>Ophiuros exaltatus</i>), as well as ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>), sedges (<i>Cyperus</i> , <i>Fimbristylis</i> spp.) and numerous annuals. In drier areas, grasses are typically mid-height, commonly ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), white grass (<i>Sehima nervosum</i>) and feathertop (<i>Aristida</i> spp.) and buffel grass (<i>Cenchrus ciliaris</i>). Minor but widespread in many land systems.
Frontage Grass Pastures	FRGP	Frontage Grass Pastures occur in open eucalypt woodlands on levees, levee backslopes and narrow alluvial plains associated with major rivers and watercourses. Soils are sands, loams and clays, often silty. Co-dominant perennial grasses include bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>), ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), white grass (<i>Sehima nervosum</i>), feathertop (<i>Aristida</i> spp.), native millet (<i>Panicum decompositum</i>) and buffel grass (<i>Cenchrus ciliaris</i>). Annual grasses include button grass (<i>Dactyloctenium radulans</i>), annual sorghum (<i>Sorghum</i> spp.), and Kimberley couch/spider grass (<i>Brachyachne convergens</i>). Found on Djada, Gogo, Ivanhoe, Alexander and other land systems that front major rivers.
Hard Spinifex Hill Pastures	HSHP	Hard Spinifex Hill Pastures occur in the drier areas on hills, ranges and footslopes in low open woodlands (e.g. snappy gum, <i>Eucalyptus brevifolia</i>) or as hummock grasslands with scattered trees and shrubs. Soils are shallow and rocky. Dominant species are limestone spinifex (<i>Triodia wiseana</i>), lobed spinifex (<i>Triodia intermedia</i>) and other hard spinifexes (<i>Triodia</i> spp.). Found on Barramundi, Dockrell, Headley, Lubbock, Wickham and other hilly land systems.
Hard Spinifex Plain Pastures	HSPP	Hard Spinifex Plain Pastures occur on level to undulating plains and low rises in the drier areas as hummock grasslands or shrubby hummock grasslands with occasional trees. Soils are variable, including loams, calcareous loams, sandy earths, loamy earths and clays. Soils depth is variable (frequently shallow) with a variable cover of rocks. Dominant species are limestone spinifex (<i>Triodia wiseana</i>), lobed spinifex (<i>Triodia intermedia</i>) and other hard spinifexes (<i>Triodia</i> spp.). Found on Bulka, Landrigan, Little Sandy, Myroodah, Neillabubica, Oscar and some other land systems.
Littoral Pastures	LITP	Littoral Pastures occur as grasslands on level coastal plains with loamy and clayey saline soils. The dominant perennial grass is usually rice grass (<i>Xerochloa imberbis</i> or <i>X. barbata</i>) with patches of other grasses such as marine couch (<i>Sporobolus virginicus</i>), wire grass (<i>Eriachne</i> spp.), beetle grass (<i>Leptochloa fusca</i>) and umbrella canegrass (<i>Leptochloa neesii</i>). There may be occasional bare patches and a few samphire (<i>Tecticornia</i> spp.) plants. Found on Carpentaria and Roebuck land systems.
Lovegrass Alluvial Plain Pastures	LGAP	Lovegrass Alluvial Plain Pastures occur as grasslands with variable tree cover in the drier areas of the Kimberley, on alluvial plains with loamy to clayey soils. The dominant pasture species is lovegrass (<i>Eragrostis</i> spp.), however other perennials including ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), feathertop (<i>Aristida</i> spp.) and buffel grass (<i>Cenchrus ciliaris</i>) occur in varying proportions. Found on Sturt Creek, Lake Gregory and possibly a few other land systems.

Pasture type	Code	Pasture type summary definition
Lowland Curly Spinifex Annual Sorghum Pastures	LCSP	Lowland Curly Spinifex Annual Sorghum Pastures occur in open eucalypt woodlands on level to gently sloping alluvial plains and sandy plains, mostly in the higher rainfall areas. Soils are coarse sands or loamy sands which may vary from well drained to somewhat poorly drained. Curly spinifex (<i>Triodia bitextura</i>) and annual sorghum (<i>Sorghum</i> spp.) are the dominant grasses, but plume sorghum (<i>S. plumosum</i>) and wire grass (<i>Eriachne</i> spp.) may also be fairly common. Found on Angallari, Cockatoo, Pago and other land systems.
Marine Couch Pastures	MACP	Marine Couch Pastures are perennial rhizomatous grasslands which occur on level coastal plains and some drainage foci with sandy, loamy and clayey slightly saline soils. Marine couch (<i>Sporobolus virginicus</i>) is the dominant grass and forms a thick vegetative mat, often to the virtual exclusion of other plants. Ratstail couch (<i>Sporobolus mitchellii</i>) and a few other grasses may also occur. Trees and shrubs usually absent but occasionally form prominent layers with paperbarks (<i>Melaleuca</i> spp.), wattle (<i>Acacia ampliceps</i>), false lignum (<i>Muellerolimon salicornaceum</i>), lignum (<i>Muehlenbeckia cunninghamii</i>) or samphires (<i>Tecticornia</i> spp.). Found on Anna, Carpentaria, Eighty Mile and Roebuck land systems.
Mitchell Grass Alluvial Plain Pastures	MGAP	Mitchell Grass Alluvial Plain Pastures are grasslands, sometimes with scattered trees, on level alluvial and lacustrine plains with grey and brown cracking clay soils. Perennial Mitchell grasses – barley Mitchell grass (<i>Astrebla pectinata</i>), weeping Mitchell grass (<i>A. elymoides</i>) and bull Mitchell grass (<i>A. squarrosa</i>) are dominant or co-dominant. Other perennial and annual grasses include bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>), Queensland bluegrass (<i>Dichanthium sericeum</i>), native millet (<i>Panicum decompositum</i>), feathertop (<i>Aristida</i> spp.), ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), Flinders grass (<i>Iseilema</i> spp.) and annual sorghum (<i>Sorghum</i> spp.). Found on Alexander, Argyle, Fossil 2, Gogo, Inverway, Ivanhoe and other land systems.
Mitchell Grass Upland Pastures	MGUP	<p>Mitchell Grass Upland Pastures are grasslands, sometimes with scattered trees, on elevated plains and uplands with often stony grey and brown cracking clay soils formed <i>in situ</i> on basalt, shale or limestone. Perennial Mitchell grasses - barley Mitchell grass (<i>Astrebla pectinata</i>), weeping Mitchell grass (<i>A. elymoides</i>) and bull Mitchell grass (<i>A. squarrosa</i>) are dominant or co-dominant. Other perennial and annual grasses include bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>), Queensland bluegrass (<i>Dichanthium sericeum</i>), native millet (<i>Panicum decompositum</i>), feathertop (<i>Aristida</i> spp.), ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), Flinders grass (<i>Iseilema</i> spp.) and annual sorghum (<i>Sorghum</i> spp.). Found on Antrim, Duffer, Leopold, Napier, Oscar and Wave Hill land systems.</p> <p>Note: this is similar to Mitchell Grass Alluvial Plain Pastures (MGAP) but is rather more elevated and xeric, usually much stonier and not quite as productive for pastoralism.</p>
No Pastures	XXNP	No Pastures: bare ground or non-pasture species (e.g. mangroves).
Oat-eared Spinifex/Ribbon Grass Pastures	OERG	Spinifex/Ribbon Grass Pastures are characterised by Oat-eared spinifex (<i>Triodia schinzii</i>) with ribbon grass (<i>Chrysopogon fallax</i>) occurring in limited amounts, usually around the base of trees. Other perennials commonly present include soft spinifex (<i>Triodia pungens</i>), perennial sorghum (<i>Sorghum plumosum</i>), wiregrass (<i>Eriachne obtusa</i>), feathertop threeawn (<i>Aristida inaequiglumis</i>) and erect kerosene grass (<i>Aristida holathera</i>). Common on Yeeda land system, with smaller areas on alluvial plains of Parda land system.
Other Pastures	OTHP	Other (undescribed or unknown) pastures.

Pasture type	Code	Pasture type summary definition
Pindan Pastures	PINP	<p>Pindan Pastures are characterised by a dense acacia shrub layer (although this may be suppressed for some years following hot fire), often with emergent eucalypt trees. They occur on level plains with red deep sandy soils. Curly spinifex (<i>Triodia bitextura</i>) is the dominant perennial grass, with some ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), wire grass (<i>Eriachne</i> spp.) and annual grasses. When the shrub layer is dense the grass layer is frequently sparse. Found in the West Kimberley on Camelgooda, Sisters, Wanganut, Yeeda and a few other land systems.</p> <p>Note: this is essentially equivalent to Curly Spinifex-Ribbon Grass of Range Condition Guides for West Kimberley (Payne <i>et al.</i> 1974, p38).</p>
Plume Sorghum Pastures	PLSP	<p>Plume Sorghum Pastures generally occur in open eucalypt woodlands in the wetter north on plains and some hill footslopes. Soils are variable-depth rocky red loams on basalts and other volcanics and sandy loams. These pastures are dominated by plume sorghum (<i>Sorghum plumosum</i>) with a few other perennials such as ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>) and a mixture of annual grasses also present. Found on Angallari, Barton, Kennedy, Napier and other land systems.</p> <p>Note: this is similar to Tippera Tall Grass Plain Pastures (TTGP), however plume sorghum (<i>Sorghum plumosum</i>) is dominant whereas in TTGP kangaroo grass (<i>Themeda triandra</i>) is dominant.</p>
Ribbon Grass Alluvial Plain Pastures	RAPP	<p>Ribbon Grass Alluvial Plain Pastures occur on level alluvial plains as grasslands with a variable tree cover of eucalypts and bauhinia (<i>Bauhinia cunninghamii</i>), etc. Soils are deep grey or brown cracking clays. Ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>) is either dominant or co-dominant in these pastures and other co-dominants can be plume sorghum (<i>Sorghum plumosum</i>) or bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>). Found on Alexander, Djada, Gogo, Ivanhoe and other cracking clay plain land systems.</p>
Ribbon Grass Pastures	RGRP	<p>Ribbon Grass Pastures occur on level to gently sloping plains as grasslands or grassy woodlands of eucalypts or bauhinia (<i>Bauhinia cunninghamii</i>) and may include characteristic groves of beefwood (<i>Grevillea striata</i>). Ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>) is either dominant or co-dominant and other co-dominants can be white grass (<i>Sehima nervosum</i>) and plume sorghum (<i>Sorghum plumosum</i>) in the higher rainfall areas or soft spinifex (<i>Triodia pungens</i>) and curly spinifex (<i>T. bitextura</i>) in the lower rainfall areas. Soils are sands, loams and occasionally clays. Occurs on Calwynyardah, Coonangoody, Egan, Franklin, Gladstone, Luluigui, Mamilu, Myroodah, Richenda, Sisters and other land systems.</p>
Samphire Pastures	SMPP	<p>Samphire Pastures are patchy low shrublands or grassy shrublands on level plains in coastal areas with highly saline and calcareous soils. Samphire (<i>Tecticornia</i> spp.) is the dominant shrub and there may be small patches of perennial grasses such as marine couch (<i>Sporobolus virginicus</i>) and rice grass (<i>Xerochloa imberbis</i> or <i>X. barbata</i>) and/or small areas of bare ground. Found on Anna, Carpentaria, Eighty Mile, Mannerie and Roebuck land systems.</p>
Sandplain Hard Spinifex Pastures	SHSG	<p>Sandplain Hard Spinifex Pastures occur as hummock grasslands with variable shrub layers on sandplains, gravelly sandplains and dunes. Soils are usually deep red sands, sometimes with a gravelly mantle. The dominant grass is spinifex (<i>Triodia lanigera</i> or <i>T. sp. weeping Indee</i>). The projected foliage cover of the spinifex ranges from 0 to 60%, depending largely on the time elapsed since the last fire, but is generally in the range 10-40%. There may be tree and/or shrub layers, which range in density from isolated to moderately close. Common on Little Sandy land system.</p>

Pasture type	Code	Pasture type summary definition
Sandplain Soft Spinifex Pastures	SSSG	Sandplain Soft Spinifex Pastures occur as hummock grasslands on sandplain and dunes. Soils are red deep sands and sandy earths. Dominant grasses include soft spinifex (<i>Triodia pungens</i>), <i>T. epactia</i> or <i>T. schinzii</i> , with variable shrubs and occasional trees. There may be a patchy tree layer of eucalypts or occasionally desert walnut (<i>Owenia reticulata</i>) or bauhinia (<i>Bauhinia cunninghamii</i>). There may be tall, mid or low shrub layers, mostly of acacias or grevilleas, but not all layers are always present or may be poorly developed. Common on Nita and Little Sandy land systems
Soft Spinifex Pastures	SSPP	Soft Spinifex Pastures are hummock grasslands with scattered trees and acacia shrubs that occur on level to gently undulating plains and occasionally hills. Soils are usually well drained sands and loams, sometimes rocky. The dominant grass is soft spinifex (<i>Triodia pungens</i>) with minor components of other perennials such as ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), curly spinifex (<i>Triodia bitextura</i>), and woollybutt grass (<i>Eragrostis eriopoda</i>) and annual grasses. Found on Barry, Chestnut, Coonangoody, Cornish, Geebee, Gourdon, Landrigan, Mulan, Nita and other land systems.
Threeawn Plain Pastures	TAPP	<p>Threeawn Plain Pastures occur as open eucalypt and other woodland on level to gently undulating plains with variable depth sand and loam soils. The dominant perennial grasses include gulf feathertop wiregrass (<i>Aristida pruinosa</i>), feathertop threeawn (<i>A. inaequiglumis</i>) and other feathertop species (<i>Aristida</i> spp.). Other perennial grasses such as ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>), white grass (<i>Sehima nervosum</i>) and black spear grass are occasionally present. Annuals include northern kerosene grass (<i>Aristida hygrometrica</i>). Found on Buchanan, Elders, Karunjie and other land systems.</p> <p>Note: this pasture type seems to be seldom encountered. More commonly, dominance by feathertop species (<i>Aristida</i> spp.) has been interpreted as indicating severe disturbance by grazing or fire.</p>
Tippera Tall Grass Plain Pastures	TTGP	<p>Tippera Tall Grass Plain Pastures occur as eucalypt woodlands on level to gently undulating plains. Soils, of variable depth, are red or yellow sandy and loamy earths. Kangaroo grass (<i>Themeda triandra</i>) is dominant, or co-dominant with either plume sorghum (<i>Sorghum plumosum</i>), white grass (<i>Sehima nervosum</i>) or ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>). Found on Angallari, Dinnabung, Frayne and other land systems, mainly in higher rainfall areas.</p> <p>Note: this is similar to Plume Sorghum Pastures (PLSP) however kangaroo grass (<i>Themeda triandra</i>) is dominant whereas in PLSP plume sorghum (<i>Sorghum plumosum</i>) is dominant.</p>
White Grass Bundle-Bundle Pastures	WGBP	White Grass Bundle-Bundle Pastures occur as grasslands or grassy eucalypt and bauhinia (<i>Bauhinia cunninghamii</i>) woodlands on gently sloping plains, interfluvies and lower hillslopes on basalt and other rocks. Soils are shallow to deep red loamy earths, often with stony mantles. The dominant grass is white grass (<i>Sehima nervosum</i>), commonly with bundle-bundle/curly bluegrass (<i>Dichanthium fecundum</i>). Other grasses include ribbon grass/golden beard grass (<i>Chrysopogon fallax</i>) and annual sorghum (<i>Sorghum</i> spp.). Found on Barton, Cowendyne, Forrest, Headley, Kennedy, Looingnin, Napier and other land systems.

Notes:

Scientific names as per Florabase¹, WA Herbarium, April 2011.

Common names as per Florabase¹, WA Herbarium, April 2011. Where a second common name is in local usage, this name precedes the Florabase¹ name.

¹ florabase.dec.wa.gov.au/

Appendix 2: Pasture type grazing potential of the Kimberley Region

Pasture type	Code	Pasture potential class
Alluvial Plain Mixed Grass Pastures	APXG	High
Annual Sorghum Hill Pastures	ASHP	Very low
Arid Short Grass Pastures	ASGP	Moderate
Black Speargrass Pastures	BSGP	Moderate
Bluegrass Alluvial Plain Pastures	BGAP	High
Buffel Grass Pastures	BUGP	High
Calcrete Spinifex Pastures	CASG	Very low
Coastal Dune Buffel Grass Pastures	CDBG	High
Coastal Dune Soft Spinifex Pastures	CDSG	Very low
Coastal Tall Grass Pastures	CTGP	Moderate
Cockatoo Grass Pastures	COGP	Low
Curly Spinifex Annual Sorghum Hill Pastures	CAHP	Low
Curly Spinifex Plain Pastures	CSPP	Low
Drainage Eucalypt and Acacia Pastures	DEAW	Very low
Drainage Melaleuca Shrubland Pastures	DMES	Very low
Fringing Pastures	FRIP	Moderate
Frontage Grass Pastures	FRGP	High
Hard Spinifex Hill Pastures	HSHP	Very low
Hard Spinifex Plain Pastures	HSPP	Very low
Littoral Pastures	LITP	Moderate
Lovegrass Alluvial Plain Pastures	LGAP	Moderate
Lowland Curly Spinifex Annual Sorghum Pastures	LCSP	Low
Marine Couch Pastures	MACP	High
Mitchell Grass Alluvial Plain Pastures	MGAP	High
Mitchell Grass Upland Pastures	MGUP	High
No Pastures	XXNP	Nil
Oat-eared Spinifex/Ribbon Grass Pastures	OERG	Low
Other Pastures	OTHP	Variable – mostly Low
Pindan Pastures	PINP	Low
Plume Sorghum Pastures	PLSP	Low
Ribbon Grass Alluvial Plain Pastures	RAPP	Moderate
Ribbon Grass Pastures	RGRP	Moderate
Samphire Pastures	SMPP	Very low
Sandplain Hard Spinifex Pastures	SHSG	Very low
Sandplain Soft Spinifex Pastures	SSSG	Low
Soft Spinifex Pastures	SSPP	Low
Threeawn Plain Pastures	TAPP	Very low
Tippera Tall Grass Plain Pastures	TTGP	High
White Grass Bundle-Bundle Pastures	WGBP	Moderate

Notes on pasture potential classes

The ratings assume that the pasture type is in good condition.

High more than 8 cu/km²

Moderate 4 to 8 cu/km²

Low 2.5 to 4 cu/km²

Very low less than 2.5 cu/km²

cu = cattle unit (mature dry cow or bullock, 450kg liveweight)

Pasture potential classes based on Western Australian Department of Agriculture report: *Maps showing pastoral potential in the Kimberley Region, Western Australia* (Rangeland Management Branch, 1985).

Appendix 3: State land types

State land types are very broad scale descriptions of landform and vegetation and are used for mapping and describing country at the state or regional scale. These have not been previously published. Currently there are 47 state land types covering the rangelands of Western Australia of which 22 occur in the Kimberley region.

Land types are made up of a number of land systems. The land systems which comprise each land type all have broadly similar characteristics of geology, landform, soils and vegetation.

State land types of the Kimberley Region and their component land systems.

Description	Land system/s
Hills and ranges with spinifex grasslands	Burramundi
Hills, ranges and plateaux with eucalypt woodlands and tall grasses	Buldiva, Looingnin, Pinkerton, Weaber
Hills, ranges and plateaux with eucalypt woodlands and spinifex	Clifton, Dockrell, Elder, Forrest, Lubbock, Pompey, Precipice, St George, Wickham
Hills and lowlands with eucalypt woodlands and spinifex	Amy, Bohemia, Cockburn, Foster, Franklin, Headley, Karunjie, Koongie, Mandeville, Margaret, Richenda, Rose, Ruby 2, Windjana, Winnecke
Hills and lowlands with eucalypt woodlands and tussock grasses	Antrim, Napier, Tanmurra
Undulating plains and uplands with eucalypt woodlands and spinifex	Fork, Geebee, Pago, Tableland, Texas
Undulating plains with eucalypt woodlands and mixed grasses	Barton, Cowendyne, Dinnabung, Frayne, Glenroy, Isdell, Kennedy 2, MacPhee, Neillabublica, O'Donnell, Pigeon, Tarraji
Undulating plains with tussock grasslands	Gordon, Nelson
Undulating stony plains with cracking clay soils and tussock grasslands	Wave Hill, Willeroo
Stony plains with spinifex grasslands	Myroodah, Parda, Phire
Plains with low woodlands and spinifex/tussock grasslands	Egan, Gidgia, Mamilu, Sisters
Sandplains and dunes with acacia shrublands and spinifex	Barry, Billiluna, Bulka, Coolindie, Cornish, Gilgie, Great Sandy, Little Sandy, Lucas, Mulan, Nita
Sandplains with eucalypt woodlands and spinifex/tussock grasses	Buchanan, Cockatoo
Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands	Camelgooda, Fraser, Lowangan, Luluigui, Reeves, Wanganut
Sandplains and occasional dunes with shrubby spinifex grasslands or pindan woodlands	Gourdon, Landrigan, Yeeda
Alluvial plains with mixed woodlands/shrublands and mixed grasses	Angallari, Calwynyardah, Coonangoody, Mannerie, Sturt Creek
Alluvial and sandy plains with soft spinifex grasslands	Chestnut
Alluvial plains with tussock grasslands	Alexander, Anna, Argyle, Bannerman, Duffer, Fossil 2, Gladstone, Inverway, Ivanhoe, Lake Gregory, Leopold, Oscar
Calcrete plains with spinifex grasslands	Spincrete
River plains with grassy woodlands and tussock grasslands	Djada, Gogo, Wolfe
Salt lakes and fringing alluvial plains with halophytic shrublands or grasslands	Betty, Snap
Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation types	Carpentaria (on map subdivided into Carpentaria high and low), Eighty Mile, Legune, Mandora, Roebuck

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