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# Assessment of the suitability for horticulture of the Packsaddle infill area, Kununurra

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Department of Agriculture  
Government of Western Australia



**Assessment of the suitability for  
agriculture of the  
North-west Packsaddle area,  
Kununurra**

*by Noel Schoknecht*



*March 1996*



**RESOURCE MANAGEMENT  
TECHNICAL REPORT 156**



## Summary

A brief assessment of the suitability for agriculture of about 260 ha in the North-west Packsaddle area was conducted in early September 1993.

Nine map units based on soil and landform were identified, and their suitability for broadscale flood irrigated agriculture and spray or trickle irrigated horticulture assessed. The map units are based on field observations and extrapolation from existing surveys. The map was prepared at a scale of 1:20,000 and is only accurate at that scale.

For **broadscale flood irrigated agriculture**, 41 ha were assessed as suitable, 62 ha marginally suitable and 157 ha unsuitable.

For **spray or trickle irrigated horticulture**, 103 ha were assessed as suitable, 57 ha marginally suitable and 100 ha unsuitable.

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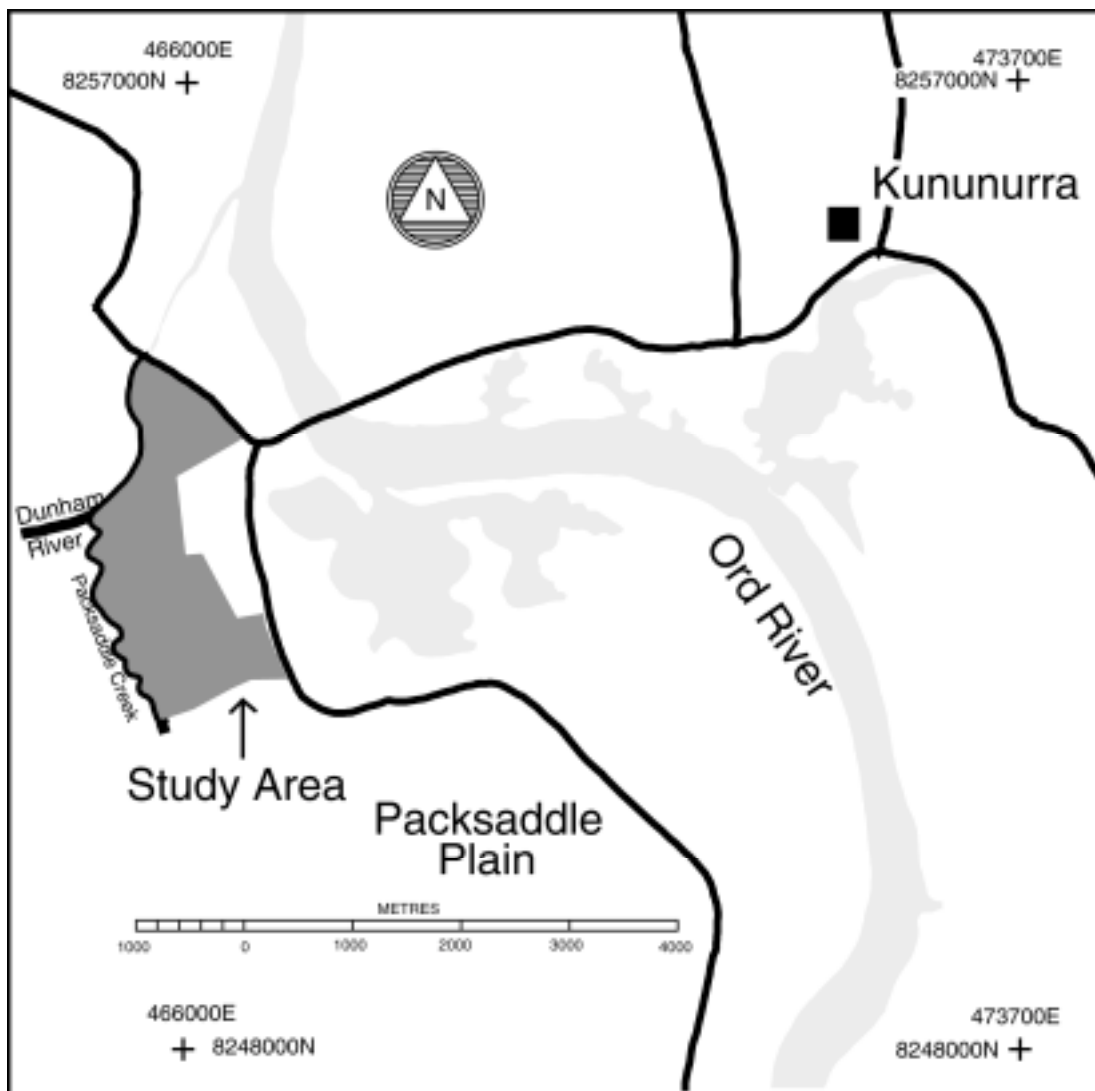
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# 1. Introduction

Land suitable for agriculture, and in particular horticulture, is keenly sought in the Kununurra area. Interest has been expressed by local land holders in the North-west Packsaddle area being available for agriculture. Subsequently the Ord Development Council (ODC) requested the Department of Agriculture (now Agriculture Western Australia) to conduct a survey to identify the main soil and land types and their suitability for agriculture.

The broad objective of the survey was to provide soil and land resource information that would facilitate sound planning decisions on future land use in the area. The study area covers 260 ha of Crown Land about 6 km south-west of Kununurra near the junction of the Victoria Highway and Packsaddle Road.

A sandstone ridge, running east-west through the area, plus a buffer of 100 m on each side, was not mapped because of the significance of the ridge to the local community.



*Location of the North-west Packsaddle area.*

## 2. Land use

The area is Crown Land and has not been used for agriculture, although it has been grazed by cattle since European settlement.

## 3. Climate

The area is semi-arid with summer monsoonal rains. Average rainfall for Kununurra is 778 mm, most of which falls in the four months December to March, with the rest of the year a virtual drought. The mean maximum temperatures range from 30.5°C in July to 38.8°C in November and mean minima range from 14.2°C in July to 24.8°C in December. The area is virtually frost-free (Delane 1987).

## 4. Geology and physiography

Most of the area is of alluvial origin, with a low sandstone ridge running roughly east-west through the centre.

*Erosion is extensive close to the Ord River. The extent of the lower terrace is apparent by the exposure of the tree roots.*



## 5. Native vegetation

The area is typically open woodland, with a variety of eucalypts present, the most common being *Eucalyptus tectifera* (grey box) and *E. confertiflora*\* (roughleaf cabbage gum). There is a grassy understorey including *Aristida latifolia* (feathertop wiregrass), *Heteropogon contortus* (black speargrass), *Themeda triandra* (kangaroo grass) and *Astrebla squarrosa* (bull Mitchell grass). Small areas of black soil plain carry scattered low trees, mainly *Lysiphyllum cunninghamii* (bauhinia), with a grassy understorey dominated by *Iseilema vaginiflorum* (red Flinders grass). Scattered *Adansonia gregorii* (boab) grow on the levee soils.

\* identification not confirmed

*The flat upper areas with Cununurra cracking clays are almost treeless; red Flinders grass is common with only scattered bauhinia (Lysiphyllum cunninghamii).*



## 6. Survey methods

### ***Previous surveys***

The first survey of the area was a reconnaissance of about 300,000 ha between Wyndham and the Western Australian border in 1944 (Burvill 1991). This survey was conducted to identify areas with potential for irrigated agriculture. The Packsaddle Plain was identified as an area of potential, but no soils information was gathered.

A semi-detailed soil survey of the Packsaddle Plain was conducted by Trevor Stoneman in 1972. Two soil landscapes were described for the North-west Packsaddle area, coded C for Cununurra clay and E for eroded soils near Packsaddle Creek (Stoneman 1980).

### ***Current survey***

Fieldwork was conducted during early September 1993. Preliminary map units were marked on 1:20,000 colour photographs (taken July 1989), and examined in the field considering features such as soil, landform, microrelief and vegetation.

Nineteen complete profiles were described. These were obtained by pushing a 50 mm steel tube down to about 80 cm with a Gemco drill rig, and then augering to 150 cm with an open auger bit. Each profile was examined for a minimum of texture, colour, structure, depth of horizons, pH and electrical conductivity (EC).

On the basis of the profile descriptions, general observations, information from previous surveys and discussions with local Department of Agriculture staff, soils were described, map units delineated and assessments made.

## 7. Map units

Nine map units based on soil and landform were identified, and their suitability for flood irrigated broadscale agriculture and spray or trickle irrigated horticulture assessed. Time constraints did not allow the development of a soils map, and the map units are based on some field observations and extrapolation from existing surveys. They are a combination of soil type and landform, and other factors such as period of inundation. They may contain one soil or an association of several soils. The map units are used as the basis for assessment of land suitability.

The map was prepared at a scale of 1:20,000 and is only accurate at that scale.

Total mapped area of study is approximately 260 ha. About 30 ha, incorporating a low sandstone ridge with a plain on each side, occurs within the study area but was not mapped because of its significance to the local community. This 30 ha is not included in the 260 ha total. Map unit areas are approximate.

### 1 Brown cracking clay plain

An upper level plain of cracking brown clays (Cununurra clays) occurs in the south-east of the study area. This is almost treeless, with scattered *Lysiphyllum cunninghamii* (bauhinia) and *Iseilema vaginiflorum* (red Flinders grass).

### 2 Slopes with reddish soils

Packsaddle sandy loams predominate. They are variously eroded, ranging from relatively intact in unit 2a, to eroded or dissected in 2c.

#### **2a gently sloping, not eroded**

Loamy topsoil over the red clay subsoil is relatively intact and the terrain is flat to very gently sloping.

#### **2b sloping with varying degrees of erosion**

The loamy topsoil of the Packsaddle sandy loams has been largely removed by erosion bringing the clayey subsoils near, or to, the surface.

#### **2c eroded/dissected slopes**

The unit includes the sloping terrain with dissected Packsaddle loamy soils, as some minor eroded or sloping areas of Ord sandy loams. They are not suitable for irrigated agriculture. Minor reddish stony soils over sandstone are included.

### **3 Lower terrace adjacent to Packsaddle Creek; brown structured clays**

This lower terrace is dissected, and in some areas the topsoil has been removed exposing an inhospitable saline and calcareous subsoil. Some erosion can be attributed to inappropriate land management since European settlement. This unit is divided into three on the degree of erosion or dissection.

#### **3a *relatively non-eroded terrace***

Brown structured clays predominate. The soils may be overlain by wash from erosion of the higher red soil slopes. Depth to the calcareous and saline subsoil varies.

#### **3b *eroded/scalded areas with subsoil exposed***

In some areas the brown structured clay has been eroded exposing an alkaline and saline clayey subsoil which is not suitable for agriculture.

#### **3c *dissected drainage lines into terrace***

This unit describes areas with clearly defined dissection of the terrace. The soils are variable and not described, and the unit is not suitable for irrigated agriculture.

### **4 Levee**

Gently sloping levee with reddish brown sandy loam soils (Ord sandy loams). The levee slopes gently away from the river, and the subsoil textures gradually become heavier with increasing distance from the river. Subsoil textures range from sandy loams on the crest of the levee, to light clay on the lower slopes. Surface textures are typically sandy loams.

### **5 Poorly drained depression**

This is a small poorly drained depression with undescribed grey clays. Not suitable for irrigated agriculture.

## Correlation of map units with common map key

A common map key, instigated by Aldrick (1990), covers the major surveys in the Ord Irrigation Area. The latest version of the map key is published by Schoknecht and Grose 1996. This common map key includes the following surveys:

- Ivanhoe Plain
- Ivanhoe West Bank
- Weaber Plain
- Lower Weaber-Keep Plain
- Knox Creek Plain.

The map units in this survey can be correlated to the common map key as shown in Table 1.

**Table 1. Correlation of survey map units with common map key.**

Map unit	Area (ha)	Equivalent in common map key
1	41	1
2a	40	Unit 2 group - no exact equivalent
2b	54	Unit 2 group - no exact equivalent
2c	38	2g
3a	30	No equivalent
3b	23	No equivalent
3c	11	No equivalent
4	22	7c
5	1	Sw
<b>Total</b>	<b>260</b>	

## 8. Soils

Where possible the soil names of Riley *et al.* (1993) have been used, with modifications or additions to suit the range of soils on the study area.

The main soils occurring in the study area are:

### ***Ord sandy loam (levee soil)***

This brown loamy soil is fertile, permeable and well drained. The loamy textures indicate a relatively high water-holding capacity. It is well suited to spray or trickle irrigated agriculture, especially horticulture.

#### **Typical profile (site NWP15)**

Horizon	Depth (cm)	Description
A11	0-30	Dark brown (7.5YR 3/2) fine sandy loam; apedal and earthy; pH 7.0; gradual boundary.
A12	30-60	Dark brown (7.5YR 3/4) fine sandy loam; apedal and earthy; pH 6.6; diffuse boundary.
AC	60-150+	Dark reddish brown (5YR 3/3) fine sandy clay loam; apedal and earthy; pH 6.7.

Heavier variants of this soil occur on lower slopes of the levee away from the river. In this situation subsoil textures are finer, ranging from clay loams to light clays.

### ***Cununurra clay (brown cracking clay)***

Extensive areas of this soil occur throughout the Ord River Irrigation Area. Aldrick (1990) described several phases, but the main one in this area is the normal phase. It occurs on a high level plain adjacent to Packsaddle Road in the south-east of the study area.

#### **Typical profile (site NWP1)**

Horizon	Depth (cm)	Description
A11	0-10	Dark greyish-brown (10YR 4/2) medium clay; self-mulching subangular blocky structure beneath a thin crust; pH 7.0; moderate surface cracking; gradual boundary.
A12	10-35	Very dark greyish brown (10YR 3/2) heavy clay; moderate subangular blocky structure; pH 7.4; gradual boundary.
A13	35-120	Very dark greyish brown (10YR 3/2) heavy clay; coarse blocky structure; pH 8.6; few fine carbonate concretions; diffuse boundary.
AC	120-150+	Dark brown (7.5YR 3/2) heavy clay; few carbonate and manganese concretions.

The Cununurra clays have been widely used in the Ord River Irrigation Area for broadscale flood-irrigated crops.

## Packsaddle sandy loam (red clay soil)

Reddish gradational soils, which have loamy surface textures and structured red clay subsoils are common in the Packsaddle area. These soils are suitable for horticulture using flood, spray or trickle irrigation.

### Typical profile (site PIN10)

Horizon	Depth (cm)	Description
A1	0-7	Dark brown (7.5YR 3/3) clay loam; pH 7.2; weak subangular blocky structure; gradual boundary.
B21	7-50	Dark reddish brown (5YR 3/3) medium clay; pH 7.1; moderate subangular blocky structure; gradual boundary.
B22	50-135	Dark reddish brown (5YR 3/4) light clay; pH 6.9; weak subangular blocky structure; diffuse boundary.
BC	135-150+	Dark reddish brown (5YR 3/3) light clay; slightly micaceous; weak structure; pH 8.2; many fine carbonate concretions.

The soil may be underlain by lighter textured micaceous alluvium.

These soils are frequently eroded, especially in areas with significant slope (>1%), and the loamy surface horizons may be absent, exposing the clayey subsoil (**eroded phase**). The exposure of the subsoil in the more eroded variants can result in a hardsetting surface and infiltration problems. Where these soils have been severely eroded a calcareous and sometimes saline subsoil occurs near or at, the surface. The less eroded soils can be improved with good management.

### ***Brown structured clays***

Brown structured non-cracking clays occur on the lower terrace near Packsaddle Creek. These soils are variously eroded, occasionally exposing an inhospitable calcareous and saline subsoil. Occasionally eroded material from higher areas forms a layer over the soil. The soils may have a thin, lighter textured surface.

These soils have not been studied enough to describe a typical profile. Their calcareous (often pH >9.5) and extremely saline subsoils preclude them from irrigated agriculture.

## 9. Land use interpretation

### Suitability of soils and map units for agriculture

Two categories of land use are considered:

- Broadscale agriculture which is flood irrigated, for crops such as sugar cane, sorghum, maize, leucaena and sunflowers, and some dry season horticultural crops.
- Horticulture using spray or trickle irrigation for crops such as bananas, mangoes and vegetables.

#### Land suitability ratings (and relationship to FAO five class system)

Suitable	High to very high suitability (classes I and II in five class system)
Marginally suitable	Fair suitability (class III in five class system)
Unsuitable	Low to very low suitability (class IV and V in five class system)

**Table 2. Suitability for broadscale agriculture - flood irrigation.**

Map unit	Suitability class	Approx. area (ha)	Limiting factors
1	Suitable	41	Surface crust, waterlogging and access in wet season, heavy cracking clays.
2a	Marginally suitable	40	Very gentle slopes require terracing. Terracing may expose subsoil clays.
2b	Unsuitable	54	Topsoil largely lost through erosion. Gentle slopes 1-5% require terracing which would expose inhospitable subsoil.
2c	Unsuitable	38	Moderate slopes, exposed subsoil through erosion, proximity to creek/river.
3a	Unsuitable	30	Soils of variable depth over calcareous and saline subsoil. Frequent high pH and moderate to high salt levels.
3b	Unsuitable	23	Highly calcareous and saline subsoil exposed.
3c	Unsuitable	11	Steep slopes of dissected minor drainage lines, calcareous and saline soils may be exposed.
4	Marginally suitable	22	Highly permeable soils make even water application difficult, slopes >1%.
5	Unsuitable	1	Seasonal inundation, heavy clay soils
<b>TOTAL</b>		<b>260</b>	

**Table 3. Suitability for horticulture - spray or trickle irrigation.**

Map unit	Suitability class	Approx. area (ha)	Limiting factors
1	Suitable <sup>+</sup>	41	Seasonal waterlogging, access in wet season, heavy cracking clays.
2a	Suitable	40	Very gentle slopes may require terracing, control of run-off necessary.
2b	Marginally suitable	54	Gentle slopes require control of run-off, in more eroded areas subsoil may be at or near surface with associated infiltration problems and a calcareous and sometimes saline subsoil.
2c	Unsuitable	38	Moderate slopes, eroded soils, calcareous and saline subsoil or alluvia sometimes exposed.
3a	Unsuitable	30	Soils of variable depth over calcareous and saline subsoil. High pH and moderate to high salt levels.
3b	Unsuitable	23	Calcareous and extremely saline subsoil clays exposed.
3c	Unsuitable	11	Incised drainage lines.
4	Suitable	22	Few limitations apart from proximity to river/creek.
5	Unsuitable	1	Seasonal inundation, heavy clays.
<b>TOTAL</b>		<b>260</b>	

<sup>+</sup> Suitable for dry season horticultural crops, and possibly perennials such as mango. Not suited to horticultural crops in the wet season.

**Table 4. Suitability summary for irrigation.\***

Rating	Broadscale agriculture		Horticulture	
	Area	%	Area (ha)	%
Suitable	41	16	103**	40
Marginally suitable	62	24	57	22
Unsuitable	157	60	100	38
<b>TOTAL</b>	<b>260</b>	<b>100</b>	<b>260</b>	<b>100</b>

\* See Appendix 3 for definition of summary suitability classes

\*\* 41 ha suitable with qualifications: dry season horticultural crops, and possibly perennials such as mango.



## ***Discussion of map units***

All areas stated for map units and suitability classes are approximate only. They have been derived from a brief field survey and analysis of aerial photographs and must only be taken as an indication of the areas available. Mapping has been drawn from 1:20,000 photographs and is only accurate at that scale.

### ***Map unit 1***

This is part of the existing black soil (Cununurra clay) plain used for flood irrigation in the Packsaddle Plain. The edge of the plain is very gently sloping which could cause problems with flood irrigation. The heavy cracking soils which are untrafficable at times, limit their year-round suitability for horticulture. These soils are suitable for some dry season horticultural crops and limited perennial crops e.g. mango, and for these purposes are rated as suitable with qualifications.

### ***Map unit 2a***

These very gently sloping areas are largely uneroded and suited to horticulture, but have limited potential for broadscale agriculture because of their slope (0 to 2%) and small areas.

### ***Map unit 2b***

The gentle slopes and variously eroded red clays of unit 2b are unsuitable for flood irrigation without terracing. This could expose calcareous and partly saline subsoils and is not recommended. The unit is marginally suitable for horticulture. The gentle slopes and eroded soils could be used very cautiously, with spray or trickle irrigation.

### ***Map unit 2c***

This includes actively eroding red clays, areas of greater dissection and steeper sloping and eroded parts of unit 4 adjacent to the Dunham River is not suitable for agriculture.

### ***Map units 3a, b & c***

The soils of these areas are often high in soluble salts, especially where the subsoils are exposed or near the surface. Salinity hazard in these areas is high to extreme. In addition the subsoils have a high pH, between pH 8.7 and 9.7. In the eroded map unit 3b a subsoil with a very high pH of 10.3 was recorded. The high pH would contribute to nutrient availability and toxicity problems, and the high salt levels would severely restrict plant growth. These areas are not suitable for agriculture and should be rehabilitated.

### ***Map unit 4***

The levee soils are highly suited to horticulture. Limitations include proximity to the Dunham River and associated nutrient pollution problems, and the gentle slopes which may present erosion problems from run-off. This unit is only marginally suitable for flood irrigation because of the slope, high permeability of the soils, and inaccessibility.

***Map unit 5***

This seasonally wet area is not suitable for agriculture.

## Acknowledgments

This assistance of Lincoln Heading and Joe Sherrard from Kununurra office with field work, and John Bessell-Browne, South Perth, with the digitising of the maps is gratefully acknowledged.

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## Appendix 1. Site locations

Site no.	Easting (m)	Northing (m)
NWP1	466617	8252070
NWP2	466613	8251791
NWP3	466672	8251579
NWP4	466330	8251525
NWP5	466162	8251622
NWP6	465960	8251617
NWP7	466177	8251821
NWP8	465903	8252155
NWP9	465772	8252221
NWP10	465712	8252109
NWP11	465865	8252451
NWP12	465869	8252814
NWP13	465734	8253727
NWP14	465797	8254234
NWP15	465801	8254185
NWP16	465871	8254074
NWP17	465955	8253992
NWP18	466101	8253847
NWP19	466250	8253604

Detailed site information is available from the Natural Resources Assessment Group, Agriculture Western Australia, South Perth.

## Appendix 2. pH and salinity ratings

Site	Depth (cm)	pH (1:5 water)	EC (1:5)	Salinity rating
NWP1	0-10	7.0	15	Negligible
	10-35	7.4	7	Negligible
	35-120	8.6	19	Negligible
NWP2	0-5	6.9	9	Negligible
	5-35	6.3	9	Negligible
	35-150	7.8	7	Negligible
NWP3	0-5	7.8	10	Negligible
	5-25	8.3	9	Negligible
	25-120	8.4	n.a.	
	120-150+	8.4	n.a.	
NWP4	0-5	6.7	6	Negligible
	5-60	6.9	48	Slight
	60-120			
	120-150+	9.1	64	Moderate
NWP5	0-20	7.4	9	Negligible
	20-120	6.8	19	Slight
	120-150+	8.2	42	Moderate
NWP6	0-10	7.4	9	Negligible
	10-60	8.2	390	Ex treme
	60-120	8.5	250	Ex treme
	120-150	n.a.	180	High
NWP7	0-10	6.9	5	Negligible
	10-60	6.8	7	Negligible
	60-120	7.8	3	Negligible
	120-150+	8.9	11	Negligible
NWP8	0-2	7.8	41	Moderate
	2-30	9.1	79	Moderate
	30-75	9.5	82	Moderate
	75-150+	9.7	126	High
NWP9	0	8.9	480	Ex treme
	40	8.4	1030	Ex treme
	80	9.3	390	Ex treme
	150	10.3	80	Moderate
NWP10	0-2	7.5	6	Negligible
	2-10	n.a.	n.a.	n.a.
	10-60	8.2	2	Negligible
	60-150+	9.2	136	High
NWP11	0-10	5.9	4	Negligible
	10-60	6.1	6	Negligible
	60-120	7.4	4	Negligible
	120-150+	7.6	6	Negligible
NWP12	0-10	6.9	10	Negligible
	10-40	8.2	12	Negligible
	40-120	8.2	12	Negligible
	120-150+	8.7	15	Negligible



Site	Depth (cm)	pH (1:5 water)	EC (1:5)	Salinity rating
NWP13	0-15	6.0	5	Negligible
	15-80	6.7	5	Negligible
	80-150+	7.4	4	Negligible
NWP14	0-10	6.1	8	Negligible
	10-70	6.5	0	Negligible
	70-110	6.8	1	Negligible
	110-150+	7.5	2	Negligible
NWP15	0-30	7.0	3	Negligible
	30-60	6.6	1	Negligible
	60-150+	6.7	1	Negligible
NWP16	0-20	6.8	1	Negligible
	20-40	6.5	1	Negligible
	40-100	6.7	1	Negligible
	100-150+	7.5	2	Negligible
NWP17	0-5	6.9	2	Negligible
	5-35	7.3	1	Negligible
	35-45	8.3	5	Negligible
	45-150+	8.0	11	Negligible
NWP18	0-5	7.1	5	Negligible
	5-70	6.9	1	Negligible
	70-130	6.8	1	Negligible
	130-150+	7.1	5	Negligible
NWP19	0-10	6.9	1	Negligible
	10-25	n.a.	n.a.	
	25-80	7.4	1	Negligible
	80-150+	6.7	2	Negligible

n.a. - not available

Salinity ratings determined by EC (1:5 water) and texture

### Appendix 3. Definition of suitability classes

Class	Description
Suitable	High to very high suitability for the proposed land use. There may be minor soil or landscape limitations which affect productive land use or land degradation, but these can be overcome by careful planning and management.
Marginally suitable	Fair suitability for the proposed land use. Limitations will affect productive land use or land degradation. They may be overcome by careful planning or management, but the cost of the additional measures required will influence the economics of the proposed land use.
Unsuitable	Low to very low suitability for the proposed land use. High to severe soil or landscape limitations which will affect productive land use or land degradation. Limitations may be overcome by specialised planning and management, although these measures are usually prohibitive in terms of either development costs or the associated risks of land degradation.



## ***Recent Resource Management Technical Reports***

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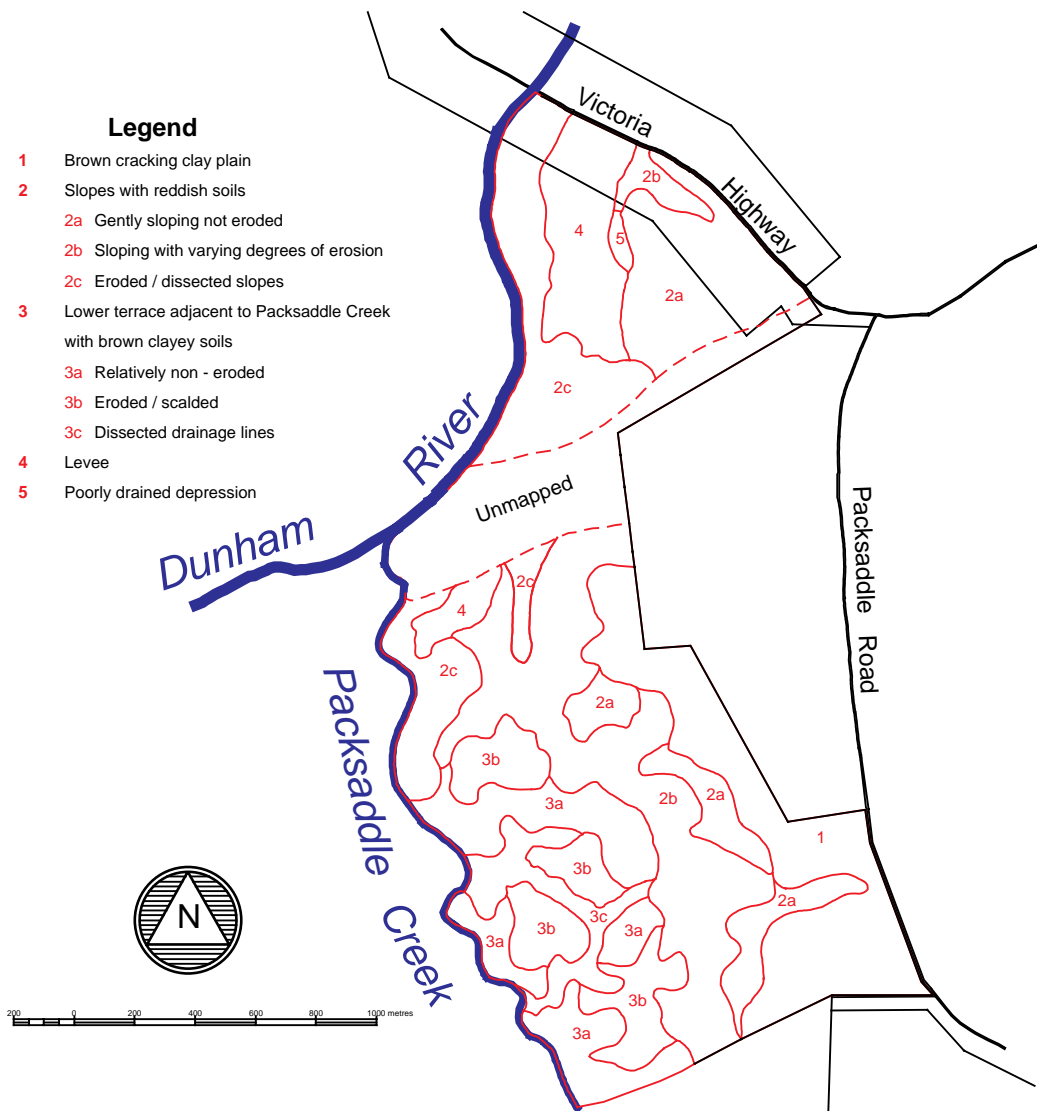


# Map 1 : Map Units

## North West Packsaddle Area

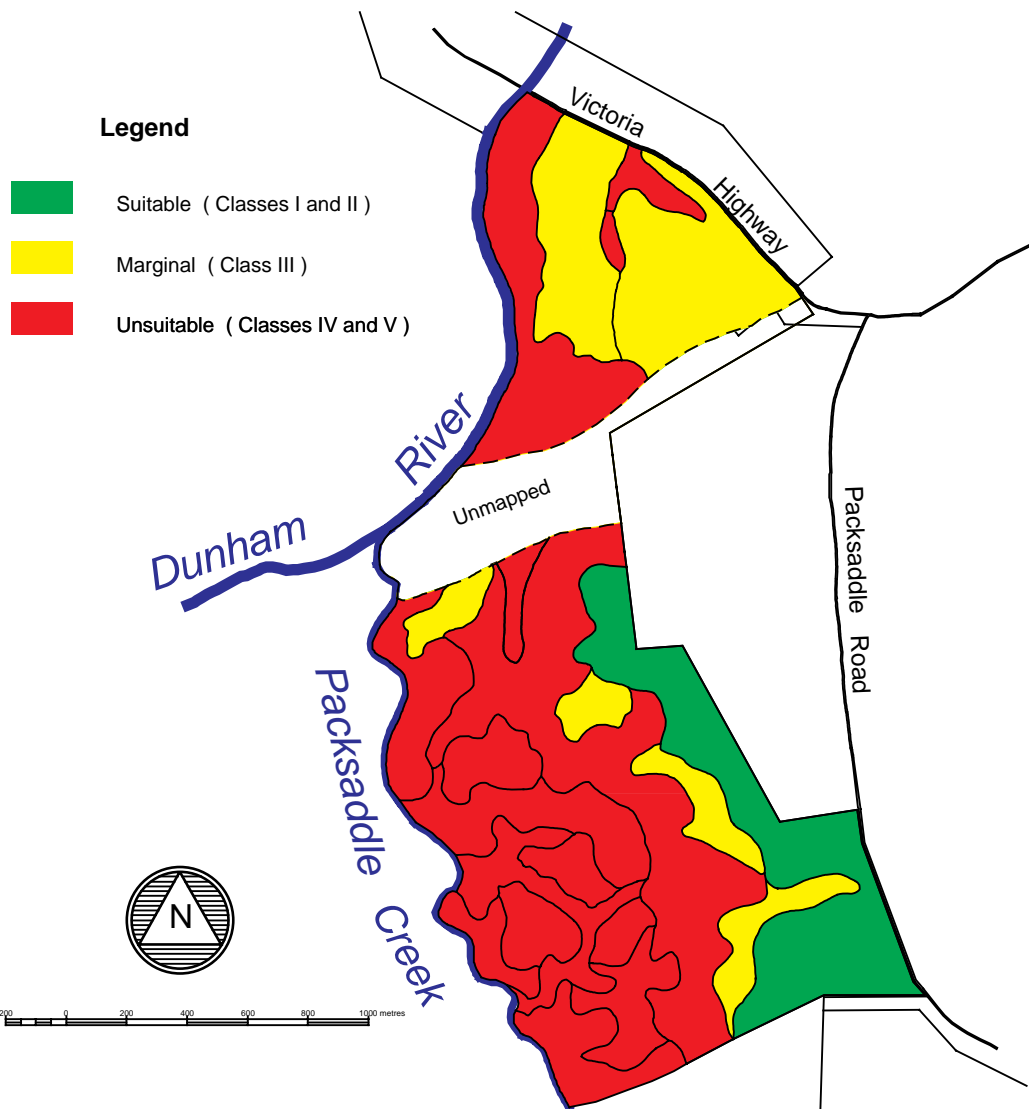
### Legend

- 1 Brown cracking clay plain
- 2 Slopes with reddish soils
  - 2a Gently sloping not eroded
  - 2b Sloping with varying degrees of erosion
  - 2c Eroded / dissected slopes
- 3 Lower terrace adjacent to Packsaddle Creek with brown clayey soils
  - 3a Relatively non - eroded
  - 3b Eroded / scalded
  - 3c Dissected drainage lines
- 4 Levee
- 5 Poorly drained depression



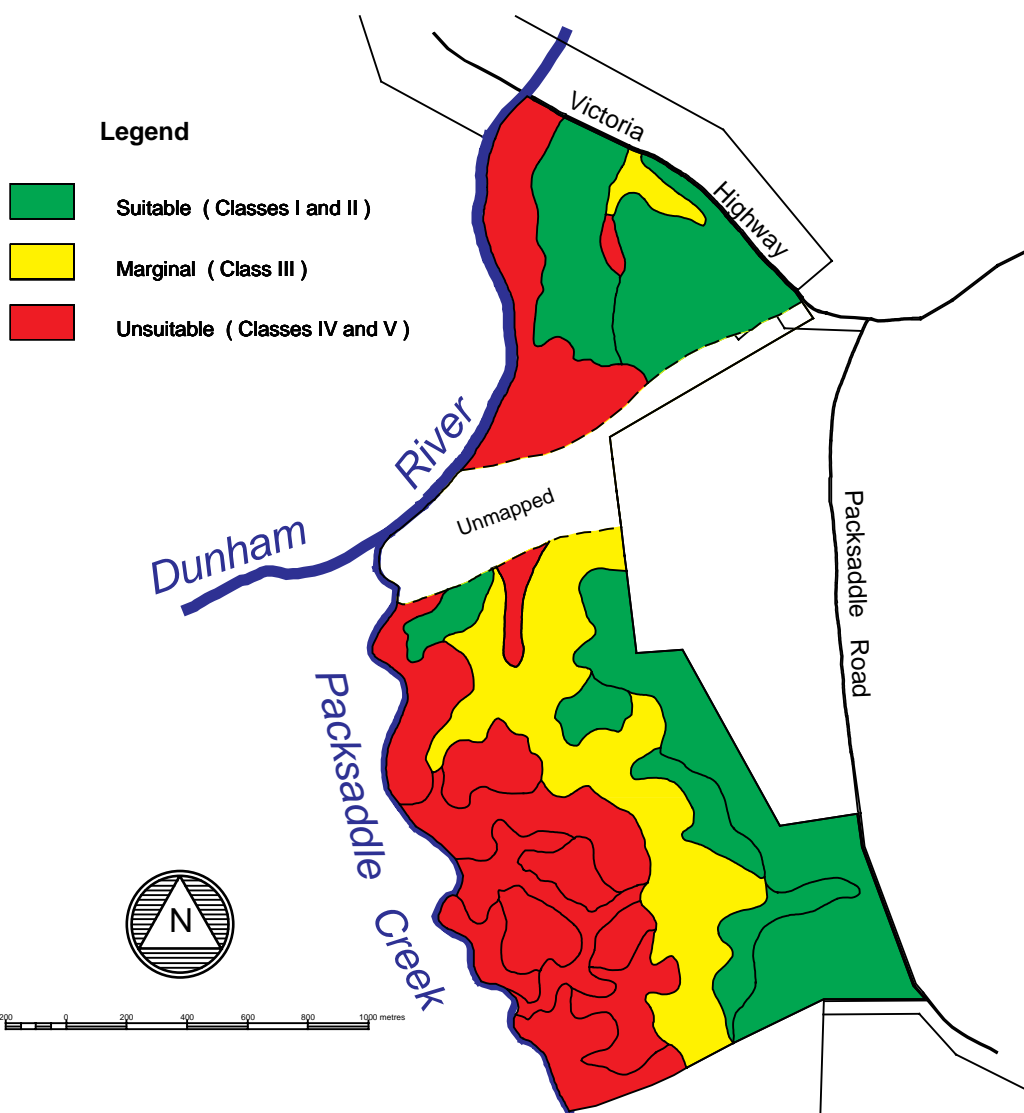
N. Schoknecht, Natural Resources Assessment Group  
Agriculture Western Australia, 1996

## Map 2 : Land Suitability for Flood Irrigated Broad-acre Agriculture North West Packsaddle Area



N. Schoknecht, Natural Resources Assessment Group  
Agriculture Western Australia, 1996

### Map 3 : Land Suitability for Spray or Trickle Irrigated Horticulture North West Packsaddle Area



N. Schoknecht, Natural Resources Assessment Group  
Agriculture Western Australia, 1996