Land resources of the Kellerberrin region

William Morrison McArthur

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LAND RESOURCES OF THE KELLERBERRIN REGION

W.M. McArthur

In collaboration with:
Officers of the Land Assessment Group
Western Australian Department of Agriculture
South Perth, Western Australia 6151
1992

TECHNICAL REPORT 134
DIVISION OF RESOURCE MANAGEMENT
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W.M. McArthur, 9 Davy St, Alfred Cove, WA 6154

The landforms and associated soils in the Kellerberrin area (Figure 1) were mapped using a combination of air photo interpretation (1:50,000 black and white, 1984 photography) and ground traverses along roads and tracks. Mapping units used are similar to those described by Bettenay and Hingston (1961; 1964) and Hingston and Bettenay (1961) for the Merredin district. The present survey may be seen as a western extension of the Merredin survey; it adjoins the work of Lantzke (in prep) on the west.

The study area, of 2,688 km², is covered by the Yorkrakine, Kodj Kodjin, Doodlakine and Kellerberrin 1:50,000 sheets (Western Australian Department of Land Administration), and forms parts of the Wyalkatchem, Trayning, Tammin, Nungarin and Kellerberrin Shires. It is part of the Great Plateau of Western Australia which here consists of a basement of various Archaean granites, gneisses and migmatites and possibly with basic volcanics (greenstones) extending into the north–eastern corner (Anon. 1975). The regional strike of these rocks is about north–west. The basement is commonly intruded by mafic dykes, possibly of Proterozoic age, having a general east–northeast lineation. The area is drained by tributaries of the Mortlock and Avon River systems; elevations range from 250 to 350 m above sea level.

The distribution of landforms and soils conforms to the pattern in the central wheatbelt as described by Bettenay and Hingston (1961; 1964). The principle involved is that an ancient plateau of very low relief, mantled by a sandy and gravely surface over weathered mottled and pallid zones, has been differentially eroded. As erosion proceeded the plateau was reduced to isolated remnants (Ulva unit) and a range of red or yellow duplex soils formed on the exposed mottled and pallid zone materials (Booraan and Colgar units). In places, generally lower landscape positions, the underlying granitic rocks are exposed and shallow gritty soils have developed (Danberrin unit). Erosion products have accumulated in broad valleys (Merredin and Belka units) which, in turn, enter the trunk valleys (Baandee unit) consisting of discontinuous salt lakes and swamps. Calcareous and saline materials have been blown from the lake beds over adjacent landscapes (Nangeenan unit). The arrangement of units are shown diagrammatically in Figure 2.

Details of nine soil profiles, to represent the map units, are given in the Appendix. These profiles, numbered KELL 1 to KELL 9, and included as Western Australian Reference Soil Sites (McArthur, in press), were selected mainly in the Durokopin Nature Reserve where most of the units are represented. The Reserve is marked with a 200 x 100 m grid of pegs and sampling sites are identified by co–ordinates measured from the south–west corner. Where possible profiles are referred to the soil types as defined by Bettenay and Hingston (1961). Each profile is classified according to The Great Soil Group Concept (Stace et al. 1968) and the Factual Key (Northcote 1979).
Figure 2: Section showing arrangement of soil landscape units in relation to topography; elevation difference between Ulva and Baandee units is about 90m.

<table>
<thead>
<tr>
<th>Danberrin</th>
<th>Nangeenan</th>
<th>Baandee</th>
<th>Nangeenan</th>
<th>Merredin</th>
<th>Collgar</th>
<th>Booraan</th>
<th>Ulva</th>
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<tr>
<td>Low rocky hills</td>
<td>Low dunes</td>
<td>Salt lakes and playas</td>
<td>Low dunes</td>
<td>Flat plain</td>
<td>Gently sloping terrain</td>
<td>Pediment</td>
<td>Undulating sandplain</td>
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<tr>
<td>Red or yellow duplex soils</td>
<td>Calcaceous earths</td>
<td>Solodic soils</td>
<td>Calcaceous earths</td>
<td>Red or yellow duplex soils</td>
<td>Yellow duplex soils</td>
<td>Red duplex soils</td>
<td>Yellow earths</td>
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</tbody>
</table>

Modified from Bettanay and Hingston (1964)
Descriptions of the Mapping Units

**Ulva (U)** consists of flat or gently sloping remnants of the lateritic sandplain; commonly the remnants form divides but also they occur in all landscape positions right down to the valley floor. In the original state the unit has about 2 m of yellow sand or sandy loam, often with gravel in the lower horizons, overlying a gravelly mottled sandy clay. However the profile is often modified by erosion and so the depth of sand is variable and may be entirely lacking; at the edges of the unit the surface often consists of gravelly clay. In some instances the unit includes a broad shallow valley and in the lowest topographic position the sand may be grey and is very deep due to accumulation of erosion products.

Profiles KELL 1 and KELL 2 represent the depositional and erosional phases respectively of the Ulva unit. KELL 1 is typical of the yellow sandplain of the wheatbelt. It is slightly acid throughout, has extremely low concentrations of plant nutrients, and negligible salts. Clay content is low in the surface and gradually rises with depth; kaolinite is the main clay mineral. KELL 2 represents the tammar scrub soils which are dominated by ferruginous gravel in the surface horizons. This soil also has very low concentrations of plant nutrients, especially when the whole soil, consisting mainly of gravel, is considered. Bettenay and Hingston (1961) report that this soil type, sampled at Merredin had kaolinite as the main clay mineral.

The sandplain vegetation is renowned for its endemism and species richness and these have often been discussed. There are usually three structural layers, the composition of which may vary over short distances. The upper layer of small trees, mallee and shrubs is 2.5 to 3.5 m high and consists of Leptospermum erubescens, Eucalyptus burracoppinensis, Acacia fragilis, Allocasuarina acutivalvis, A. huegeliana, Xylomelum angustifolium, Hakea scoparia, H. oriea, Santalum acuminatum, and S. murrayanum. The second layer, at 0.5 to 1 m, is often very dense and consists of the shrubs Beaufortia bracteosa, Isopogon scabriusculus, Melaleuca conothamnoides, M. seriata, other Melaleuca spp., Persoonia quinquenervis, Andersonia caerulea, Astroloma serratifolium, Verticordia spp. Acacia spp., and Grevillia spp. The sedges Ecdieocolea monostachya, Lepidosperma angustatum, and Mesemelaena preissii occur in more open situations. Ground cover consists of Borya nitida, Loxocarya spp. and Lyginia spp., mat plants and many lichen encrustations. In those areas where sand has been removed and the surface is gravelly, often on the fringes of the sandplain, the vegetation is dense heath, at about 2 m, dominated by Allocasuarina campestris.

The Booraaan unit (B) is developed on the upper slopes of dissections in the lateritic sandplain landscape; often the boundary between the two is marked by a low scarp. The Booraaan unit is typically formed from weathered granitic materials and the soils are generally duplex forms. In upper slope positions the profile is shallow, often with weathered granite outcropping, and becomes deeper down slope. As mapped the unit may contain small areas of gravelly soils.

Profile KELL 3 was sampled on a pediment at the foot of a low scarp marking the edge of the Ulva unit. It is a yellow duplex soil which shows properties consistent with its pre–weathered parent material. Nutrients are mainly associated with surface organic matter but decline rapidly with depth; there is a significant increase in salt concentration in the clay sub–soil. This profile is acid throughout but others described by Hingston and Bettenay (1961) are alkaline with lime. The vegetation is typically a woodland with scattered Eucalyptus salmonophloia and E. wandoos, 15–20 m tall, scattered Callitris canescens trees, and a dense shrub layer, at about 1.5 m, dominated by Melaleuca uncinata but also with other Melaleuca spp., Allocasuarina campestris, Olearea muelleri, Beaufortia bracteosa, Acacia hemiteles and Templetonia sulcata.

The Collgar unit (C) occurs on very gentle slopes of dissections, often down–slope from the Booraaan unit, and extending to the valley floors. Profile KELL 5 is representative of this unit. It consists of a brown sandy surface, a bleached and indurated sub–surface, and a structured mottled clay sub–soil. The clay has a slight accumulation of salts and a predominance of exchangeable sodium and magnesium on the exchange complex. The indurated horizon often acts as a barrier to water and root penetration.
The vegetation is mallee scrub 4–6 m tall, with the main species being *Eucalyptus transcontinentalis*, *E. cylindriflora*, *E. wando*, *E. erythronema*, and *E. foecunda*. The shrub layer is sparse and includes *Melaleuca uncinata*, *Acacia hemiteles*, *Westringia cephalantha* and *Petrophile seminuda*; locally, there may be dense thickets of *Melaleuca cardiophylla*.

The Merredin (M) and Belka (Be) units are broad, flat, alluvial landscapes which are either fringed by or occur downstream from the Collgar unit. The surface is typically marked by many shallow prior stream channels. For the Merredin unit the soils have a brown loamy surface and a red clay subsoil; these are the so-called 'heavy' soils of the wheatbelt. The Belka unit has paler and more sandy soils; the surface is light grey–brown sand or sandy loam over mottled yellow and brown clay.

Profiles KELL 7 and KELL 7A, sampled at Baandee, represent some of the variation in this unit. These profiles were only 200 m apart and, while they are similar in most properties, there is a marked difference in colour. Both profiles show an increase in salts and pH with depth and large amounts of soft lime and lime nodules in the subsoil. Many of these soils are underlain by a strongly acidic horizon as shown in profile P348, described by Hingston and Bettanay (1961) on the Merredin Research Station.

The vegetation is woodland with *Eucalyptus salmonophloia*, *E. salubris* and *E. wando*, which is at least 20 m tall, and a shrub layer which appears to vary from place to place. In some cases there is a sparse heath, at 1.5 m, including *Melaleuca* spp., *Acacia hemiteles* and other *Acacia* spp. with some ground cover of *Loxocarya* and *Borya nitida*. In other cases there is a dense layer of halophytic plants, at 0.5–1 m, consisting of *Atriplex paludosa*, *Maireana carnosa*, *M. appressa*, *Enchyelaena tomentosa* and *Mesembryantherum crystallinum*. This difference probably relates to soil conditions with the halophytic plants associated with highly calcareous soils. In some cases the Belka unit appears to have less vigorous trees than Merredin and in places mallee vegetation replaces *Eucalyptus salmonophloia* – *E. salubris* woodland. Thus, on both soils and vegetation, the transition from Belka to Collgar is often very difficult to determine.

The Baandee (Ba) unit represents the ancient drainage zones which have become filled with detritus and, with very low gradients, have ceased to function as drainage lines. These zones are now occupied by lakes, swamps and playas, usually with lunettes around the south–eastern margins. The whole landscape is dominated by salts which have accumulated over a very long period. Each year drainage water (containing salts) entered the lakes and swamps while, during summer, it evaporated leaving behind the salts which, together with sand from the lake floor, were blown out to form lunettes. The soils are thus very saline and sometimes gypseous or calcareous and the vegetation is mainly halophytic. The most saline areas have Samphire communities while less saline parts have *Atriplex* spp., *Maireana* spp. and *Enchyelaena*. The lunettes may also have a woodland of *Callitris canescens*, *Casuarina obesa* and *Melaleuca* spp. Ground cover consists of succulent plants such as *Mesembryantherum crystallinum*, *Enchyelaena* spp., *Suaeda* spp. and *Portulaca* spp.

The Nangeenan (N) unit occurs as a veneer of salt lake materials – clay, gypsum, calcium carbonate and salts – blown over the adjacent landscapes. Thus it is most common on the alluvial terrain or the lower gentle slopes; it is not well represented in the study area. The soils are generally fine textured, highly calcareous, and are prone to develop saline patches when cleared. The surface often shows gilgai microlrelief. The vegetation is a woodland with *Eucalyptus salmonophloia*, *E. salubris* and *E. longicornis*, at least 20 m tall, and a dense shrub layer, 0.5 m high, of halophytes including *Atriplex paludosa*, *Maireana carnosa*, *M. appressa*, *Mesembryantherum crystallinum*, and *Suaeda* spp.

Profile KELL 9, sampled at Doodlakine, is typical of soils which are generally known as "morrell soils" in the wheatbelt. The surface is loose and powdery when dry and forms a surface seal when wet. The profile has distinctive chemical properties with relatively high concentrations of salts, phosphorus, potassium, and exchangeable cations. It is calcareous throughout and, as expected, is strongly alkaline.
The Danberrin (D) unit consists of irregular low hills and gentle slopes, occurring in all topographic positions, but most commonly at lower levels adjacent to drainage lines. This unit represents the maximum degree of erosion with all of the pre-weathered mottled and pallid zone materials removed. The soils are very variable and include shallow gritty sandy loams even granite, red or yellow duplex soils, and red fine-textured soils on mafic dykes.

Profiles KELL 4, KELL 6 and KELL 8 represent some of the variation in the Danberrin unit. KELL 4 was sampled downslope from a large granite outcrop and is apparently developed in coarse colluvial detritus. It has a clay substrate but this is likely to be an unrelated horizon. The profile is very young as shown by the presence of unweathered feldspar crystals and the lack of differentiation. KELL 8 represents more mature conditions where the soil is strongly differentiated and with lime in the subsoil. There is a marked building-up of salts in the subsoil. In the surface horizons exchangeable calcium is the main cation but, with depth, exchangeable magnesium and sodium become dominant. KELL 6 is in strong contrast to most other soils in the area. It is a red soil, developed on dolerite, tending to the self-mulching in the surface and with a high grade of structure throughout. Chemical properties are consistent with the mafic parent material with high values for salts, extractable potassium, and exchange capacity; exchangeable magnesium and sodium are dominant in the lower horizons. Clay minerals are mainly kaolinite, illite, and smectite.

Rock outcrop or areas dominated by rock outcrop (R) are generally associated with the Danberrin unit. Most soils are similar to those already described but there may also be shallow coarse textured soils formed from weathering granite detritus around the edges of large outcrops. Run-off from these areas is high and, when concentrated on steeper slopes, results in erosion gullies which are commonly 2–3 m deep.

The vegetation of the Danberrin unit is generally Eucalyptus laxonchleba–Acacia acuminata woodland but there may also be dense Allocasuarina huegeliana fringing rock outcrops. The sparse ground cover consists of Lepidosperma gracile, Stypandra imbricata, Waitzia acuminata and Borya nitida. Rock surfaces have almost complete cover of lichens with mosses, liverworts and Borya nitida in shallow depressions. The ferns Adiantum aethiopicum and Cheilanthes australis grow in clefts in the rocks.
References


Lantzke, N. and Fulton, I. The Land Resources of the Northern Region. WADA Land Resources Series (in prep.).


LEGEND

Landforms, Soils and Vegetation

Ulva soil landscape unit:  (U)
Gently undulating lateritic uplands; yellow sands or sandy loams; some grey sands; some gravelly soils along fringes; scattered *Grevillea pritzelii*, *Leptospermum erubescens* and *Eucalyptus burracoppinensis*; dense shrub layer including *Astroloma serratifolium*, and *Xylomelum angustifolium*, *Allocasuarina* spp. *Acacia* spp. *Santalum spicatum*.

Booraan soil landscape unit:  (B)
Gently sloping terrain flanking the lateritic uplands; shallow sandy surface over mottled yellow and brown clay; some weathered granite outcrop; Scattered *Eucalyptus wando, E. salmonophloia*, and *E. salubris*, with a shrub layer (2 m) of *Melaleuca uncinata*, *Melaleuca* spp. *Olearia revoluta* and *Callitris canescens*.

Collgar soil landscape unit:  (C)
Very gentle lower slopes fringing alluvial plains and in heads of drainage lines; sandy surface over mottled yellow and grey clay; Mallee including *Eucalyptus cylindrificolia, E. transcontinentalis, E. foecunda, E. loxophleba, E. eremaphila* and *E. erythronema*; sparse shrub layer.

Danberrin soil landscape unit:  (D)
Hilly terrain with irregular surface; some rock outcrop; shallow brown gritty loams and sandy loams; some red or yellow duplex soils; *Acacia acuminata* and *Eucalyptus loxophleba* woodland; sparse shrub layer.

Rock Outcrop soil landscape unit:  (R)
Areas of bare rock or dominated by granite or dolerite outcrop or boulders; some shallow brown gritty loamy soils; *Acacia acuminata* and *Allocasuarina huegeliana* on deeper soils; rocks have scattered *Borya nitida*. *Stypandra imbricata* and *Lepidosperma gracilis*; mosses and lichens are common.

Belka soil landscape unit:  (Be)
Broad flat trunk valleys with many braided prior to drainage lines; sandy surface over yellow and brown mottled clay; some lime nodules; Open forest of *Eucalyptus wando, E. salmonophloia* and *E. salubris* with a shrub layer of *Santalum spicatum*.

Merredin soil landscape unit:  (M)
Broad, flat, trunk valleys with many braided prior stream channels; brown loam over red clay; lime nodules below; *Eucalyptus salmonophloia* and *E. salubris* open forest with shrub layer of *Atriplex* spp. *Suaeda* spp.

Baandee soil landscape unit:  (Ba)
Broad, flat, saline, trunk valleys with a pattern of lakes and playas and with associated lunettes; calcareous and gypaceous loams; Halophytic vegetation including samphire, *Suaeda* spp., *Atriplex* spp. and *Maireana* spp.

Nangeenan soil landscape unit:  (N)
Flat or gently sloping land adjacent to saline drainage lines, grey calcareous clays, often with lime nodules below; gilgai microrelief; Open forest of *Eucalyptus salmonophloia, E. salubris, E. longicornis* and a shrub layer of *Atriplex* spp. and *Maireana* spp.
APPENDIX
Details of nine soil profiles

Profile no.: KELL 1  
Classification:  (1) Siliceous Sand  (2) Uc 5.22
Location: Lat. 31° 23' 30" S. Long. 117° 46' 30" E.  
Durkoppen Nature Reserve (Conservation and Land Management)  
27 km north of Kellerberin on the Traimming Road.  
Durkoppen co-ordinates 1800/1640
Landform/topography: Gently sloping (2%) sandplain remnant.
Parent material: Precambrian granitic rocks & dolerite dykes.
Drainage: Internal—excessive, highly permeable.  
External—nil.
Climate: Rainfall—Kellerberin 339 mm, 72 wet days.  
Evaporation—Merridie 2110 mm.  
Temperatures—Kellerberin Jan. 17-34°C, July 6-16°C.
Native vegetation: Trees: Xylopium angustifolium, Grenville eristachya, 3-4 m (2%).
Shrubs: 1.3-2.5 m; (3%). Allocassarium compestre, Acacia acuminata, Grenvillea integrifolia.
Shrub: 0.5-1 m; (30%). Melaleuca conothamnoides, Dasiesia decurrens, D. haloides, Verticordia chrysanth, Astroloma serratifolium, Baecke crassiflora, Hibbertia spp.
Ground: (2%). Erodium monostachya, Borya nitida, Neurachne alopecuroidea, Stipa elegantisima, Isopogon sp. Wastia acuminata, Mesembryanthemum stygium.

Morphological description

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<th>Sample no.</th>
<th>Horizon</th>
<th>Depth (cm)</th>
<th>Description</th>
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<td>1</td>
<td>A1</td>
<td>0-6</td>
<td>Brown (10YR 5/3) loamy sand*, slightly coherent (1 D); thin algal crust on surface; sandy fabric, clear, regular to</td>
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<td>B1</td>
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<td>3</td>
<td>B2</td>
<td>13-40</td>
<td>Yellowish brown (10YR 5/6) loamy sand to sandy loam; weak coherence (2 D); sandy fabric; gradual change to</td>
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<td>4</td>
<td>B31</td>
<td>40-65</td>
<td>Yellowish brown (10YR 5/8) sandy loam; weak coherence (2 D); sandy fabric; porous; gradual change to</td>
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<td>5</td>
<td>B32</td>
<td>65-90</td>
<td>Brownish yellow (10YR 6/8) sandy loam; weak coherence (2 D); massive; sandy fabric; porous; gradual change to</td>
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<td></td>
<td>90-110</td>
<td>Brownish yellow (10YR 6/8) sandy loam; firm (3 D); massive; porous.</td>
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*Some sand grains rounded.

Chemical and physical analysis

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mg/kg, cmol(+)/kg.
Profile no.: KELL 2  
Classification: (1) Yellow Earth  (2) Cn 2.21  
Location:  
Lat. 31° 23' 30" S; Long. 117° 46' 30" E;  
Durokopinn Nature Reserve (Conservation and Land Management);  
27km north of Kellerberrin on the Trayning Road  
Durokopinn co-ordinates 1500/1635.  
Landform/topography:  
Gently undulating lateitic sandplain remnant, slightly dissected.  
Parent material:  
Precambrian granite rocks and dolerite dykes.  
Drainage:  
Internal—moderately permeable.  
External—well drained.  
Climate:  
Rainfall—Kellerberrin 339mm; 74 wet days.  
Evaporation—Merredin 2110mm.  
Temperatures—Kellerberrin Jan. 17-34°C; July 6-16°C.  
Native vegetation:  
Shrubs: 1.5-2.5 m, (30%). Allocasuarina campestris.  
Shrubs: 0.5-1 m, (5%). Melaleuca coonothamnoides, Astroloma serratifolium, Baukeas crispifrons, Hakea scoposa, Castaldothium obcordatum, Verticordia chrysantha. Persoonia quinquenervis, Bauforia myrtiflora.  

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-8</td>
<td>Yellowish brown (10YR 5/4) loamy sand; thin crust on surface; single grain, loose; 61% ferruginous gravel, clear, regular to</td>
</tr>
<tr>
<td>2</td>
<td>A12</td>
<td>8-15</td>
<td>Brown (7.5YR 5/4) sandy loam; sandy fabric; slightly coherent (1 D); 58% ferruginous gravel; gradual change to</td>
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<tr>
<td>3</td>
<td>B1</td>
<td>15-35</td>
<td>Yellowish brown (10YR 5/8) sandy loam; massive; very firm (4D); 34% ferruginous gravel, few red-brown mottles; gradual to</td>
</tr>
<tr>
<td>4</td>
<td>B21</td>
<td>35-50</td>
<td>Brownish yellow (10YR 6/8) sandy clay loam; massive; dense; very firm (4D); 18% gravel, tending to platy horizontal laminations; clear to</td>
</tr>
<tr>
<td>5</td>
<td>B22</td>
<td>50-70</td>
<td>Yellowish brown (10YR 5/8) and yellowish red (5YR 5/8) mottled sandy clay loam; massive; dense, very firm (4D); gradual to</td>
</tr>
</tbody>
</table>
| 6          | B23    | 70-90      | Yellowish brown (10YR 5/8) with few 5YR 5/8 mottles sandy clay loam; massive, earthy, porous, very firm (4D); 4% gravel.  
*Some sand grains rounded, occasional water-worn quartz pebble on surface.*  

Chemical and physical analysis  
< 2 mm fraction

| Sample no. | pH H2O | pH 0.01 M CaCl2 | Electric Cond. mS/m | Org. C per cent | Total C per cent | C5 per cent | Particle size C5 | Si per cent | C per cent | Extractable Fe/Al | Total P mg/kg | Ext. P mg/kg | Ext. K mg/kg | CEC cmol+ | Ca mg/kg | Mg mg/kg | K mg/kg | Na mg/kg |
|------------|--------|----------------|---------------------|-----------------|-----------------|-------------|----------------|-------------|------------|-----------------|--------------|--------------|--------------|-----------|----------|---------|---------|---------|---------|
| 1          | 5.9    | 5.1            | 2                   | 0.72            | 0.03            | 63          | 27             | 3           | 7          | 130             | <2           | 33           | 2            | 0.7       | 0.3     | 0.1     | <0.1    |         |
| 2          | 5.5    | 4.5            | 1                   | 0.56            | 0.03            | 55          | 30             | 5           | 10         | 160             | <2           | 36           | 2            | 0.5       | 0.4     | 0.2     | <0.1    |         |
| 3          | 5.5    | 4.5            | 2                   | 0               | 0.03            | 55          | 30             | 5           | 10         | <2              | 47           | 2            | 2            | 0.4       | 1.6     | <0.1    | 0.1     |         |
| 4          | 5.5    | 4.5            | 4                   | 0               | 0.03            | 55          | 30             | 5           | 10         | <2              | 47           | 2            | 2            | 0.4       | 1.6     | <0.1    | 0.1     |         |
| 5          | 5.0    | 4.4            | 5                   | 0               | 0.03            | 32          | 25             | 9           | 34         | <2              | 47           | 2            | 2            | 0.4       | 1.6     | <0.1    | 0.1     |         |
| 6          | 5.2    | 4.7            | 4                   | 0               | 0.03            | 32          | 25             | 9           | 34         | <2              | 47           | 2            | 2            | 0.4       | 1.6     | <0.1    | 0.1     |         |
Profile no.: KELL 3

Classification: (1) Yellow duplex soil (2) Dy. 3:4:1.


Location: Lat. 31° 23' 30" S; Long. 117° 46' 30".
Durokopin Nature Reserve (Conservation and Land Management).
27km north of Kellerberrin on the Trayning Road.
Durokopin co-ordinates 1480/3030.

Landform/topography: Sloping pediment (5% to south) near low scarp at edge of laterite remnant.

Parent material: Precambrian granitic rocks with dolerite dykes.

Drainage: Internal—restricted by clay subsoil.
External—very good.

Climate: Rainfall—Kellerberrin 339mm; 74 wet days.
Evaporation—Merredin 2110mm.
Temperatures—Kellerberrin Jan. 17.34°C; July 6.16°C.

Native vegetation: Trees: Wandoor: 10-16m, 3-40cm dbh; 25%.
Shrubs: 0.5-1 m: (17%) Cleistes azillaris, Dianella spinosa, wandoor regeneration.
Ground: (5%): Boronia nuda, Lerpaca cinerea, Dianella revoluta, Acacia acuminata seedlings, Waitzia acuminata, Lomandra sp., Chamaescilla spiralis.

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horizon</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-4</td>
<td>Dark greyish brown (10YR 4/2) gritty loamy sand; non wetting; massive; sandy fabric; slightly coherent (2D); hard-setting; 4% gravel; clear, regular to</td>
</tr>
<tr>
<td>2</td>
<td>A12</td>
<td>4-10</td>
<td>Brown (10YR 3/3) gritty loamy sand; massive; porous; very firm (4D); 9% gravel; gradual change to</td>
</tr>
<tr>
<td>3</td>
<td>A21</td>
<td>10-18</td>
<td>Light yellowish brown (10YR 6/4) gritty loamy sand; massive; porous; very firm (4D); 16% quartz gravel; gradual to</td>
</tr>
<tr>
<td>4</td>
<td>A22</td>
<td>18-25</td>
<td>Bleach. Very pale brown (10YR 7/3 dry; 6/3 moist) gritty sandy loam; massive; porous; very firm (4D); 12% gravel; very sharp break to</td>
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<td>5</td>
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<td>25-60</td>
<td>Brown (10YR 5/3) and strong brown (7.5YR 5/8) mottled gritty medium clay; massive; dense; very firm (4D); 16% gravel; gradual to</td>
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<td>6</td>
<td>B12</td>
<td>60-85</td>
<td>Yellowish brown (10YR 5/4) and strong brown (7.5YR 5/8) mottled gritty sandy clay loam; tending to horizontal laminar; extremely firm (2D); 11% gravel.</td>
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Chemical and physical analysis

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<tr>
<th>Sample no.</th>
<th>pH</th>
<th>H₂O</th>
<th>0.01M CaCl₂</th>
<th>Elect. Cond.</th>
<th>Total C</th>
<th>N</th>
<th>Org. C</th>
<th>Total N</th>
<th>C : N</th>
<th>CS</th>
<th>FS</th>
<th>Si</th>
<th>C</th>
<th>Particle size</th>
<th>Extractable Fe/Al</th>
<th>Total Ext.</th>
<th>Ext. P</th>
<th>Ext. K</th>
<th>Exch. Cations</th>
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</table>
Profile no.: KELL 4  
Classification: (1) Red duplex soil  (2) Dr 4 82  
Reference: Jura; Bettany and Huntington (1961).  
Landform/topography: Gently sloping (6% to south-east) terrain associated with granite outcrop.  
Parent material: Precambrian granite rocks.  
Drainage: Internal—excessive; highly permeable. External—well drained.  
Climate: Rainfall—Kellerberrin 339 mm; 74 wet days. Evaporation—Merredin 2110 mm. Temperatures—Kellerberrin Jan. 17-34°C, July 6-16°C.  
Native vegetation: Trees: Allocasuarina huegeliana, Acacia acuminata 4-6 m; 5-15 cm (15%). Shrubs: 0.5-1 m; (2%); Acacia acuminata seedlings, Dodonea viscosa, Melaleuca ramulosa, Xanthorrhoea preissii. Ground: (70%); Glossochrysum australe, Lepidosperma sp. Chamaecrista spiralis, Neurachne alpina, Conostylis sp., Boronia nitrata, Laxmannia grandiflora, Christieaa austrotergula.  

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-6</td>
<td>Dark brown (7.5YR 3/3) gritty loamy sand; very weak granular structure; sandy fabric; slightly coherent (1D); 9% quartz gravel; clear, regular to</td>
</tr>
<tr>
<td>2</td>
<td>A12</td>
<td>6-16</td>
<td>Dark brown (7.5YR 4/4) gritty loamy sand; sandy fabric; slightly coherent (1D); 11% quartz gravel; gradual to</td>
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<tr>
<td>3</td>
<td>A13</td>
<td>16-45</td>
<td>Reddish brown (5YR 4/4) gritty loamy sand; sandy fabric; slightly coherent (1D); 7% quartz gravel; gradual to</td>
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<tr>
<td>4</td>
<td>A21</td>
<td>45-70</td>
<td>Brown (7.5YR 5/3) gritty loamy sand; sandy fabric; slightly coherent (1D); 7% quartz gravel; very sharp break to</td>
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<tr>
<td>5</td>
<td>A22</td>
<td>70-80</td>
<td>Bleach pinkish grey (7.5YR 7/2) gritty loamy sand; massive; porous; firm (4D); 9% quartz gravel; very sharp break to</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>80-95</td>
<td>Red (2.5YR 4/6) gritty light clay; massive; porous; firm (3D); 10% quartz gravel; very sharp break to</td>
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<td></td>
<td></td>
<td>95</td>
<td>Weathering granite.</td>
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</tbody>
</table>

Chemical and physical analysis

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>pH H2O</th>
<th>pH 0.01M CaCl2</th>
<th>Elect. Cond.</th>
<th>Org. C</th>
<th>Total N</th>
<th>Total C</th>
<th>Particle size (CS)</th>
<th>Particle size (F5, S5, C)</th>
<th>Extractable Fe/Al</th>
<th>Total P</th>
<th>Ext. P</th>
<th>Ext. K</th>
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<th>CEC Ca</th>
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</table>
Profile no.: KELL 5

Classification: (1) Yellow duplex soil (2) Dy 3.41

Reference:
Colgar, Bettonay and Hingston (1961).

Location:
Lat. 31° 23' S; Long. 117° 47' E.
Durkoppin Reserve (Conservation and Land Management).
27km north of Kellerberrin on the Trayning Road.
Durkoppin co-ordinates 0290/0040.

Landform/topography:
Long gentle slope (3% to south).

Parent material:
Alluvium-colluvium from weathered Precambrian granitic rocks.

Drainage:
Internal—restricted by clay subsoil.
External—well drained.

Climate:
Rainfall—Kellerberrin 339 mm; 74 wet days.
Evaporation—Merredin 2110 mm.
Temperatures—Kellerberrin Jan. 17-34°C; July 6-16°C.

Native vegetation:
Trees: Acacia acuminata, 4-10 m (15%).
Mallees: Eucalyptus erythronema, E. radiata 3-5 m; 4-5 cm (5%).
Shrubs: 1.5-2.5 m; (30%). Melaleuca acuminata, M. lateriflora, M. adnata. Acacia acuminata seedlings; wandoo regeneration.
Shrubs: <0.5 m; (1%). Acacia australis, Dodonaea bursarifolia, Westringia dampieri.
Ground: (80%), Borga nitida, Dasthonia sp., Loxostigma cinnerea, Wartzia acuminata, Neurachne alopecuroidea, Enchylaena tomentosa, Danella revoluta, many seedlings (undeterminate).

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0-10</td>
<td>Dark brown (7.5YR 4/4) loamy sand, very weak granular structure; very weak coherence (1D); clear and regular boundary to</td>
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<tr>
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<td>A12</td>
<td>10-20</td>
<td>Brown (7.5YR 4/5) loamy sand—sandy loam; porous; slightly coherent (2D); 1% quartz grit; clear, regular boundary to</td>
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<tr>
<td>3</td>
<td>A2</td>
<td>20-25</td>
<td>Bleach; Pinkish grey (7.5YR 7/2 dry; 6/4 moist) loamy sand; massive; very porous; very firm (4D); 7% quartz grit; sharp change to</td>
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<tr>
<td>4</td>
<td>B1</td>
<td>25-35</td>
<td>Brown (7.5YR 5/3) gritty sandy clay loam; coarse polyhedral structure (20-40mm); very hard (4D); 10% quartz grit; some cutans; clear change to</td>
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<td>5</td>
<td>B21</td>
<td>35-50</td>
<td>Yellowish brown (10YR 5/4) medium clay; few faint brown mottles; moderate polyhedral structure (5-15mm); cutans; very firm (4D); 3% quartz grit; gradual to</td>
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<td>6</td>
<td>B22</td>
<td>50-70</td>
<td>Pale brown (10YR 6/3) medium clay; few faint brown mottles; very firm (4D); moderate polyhedral structure with cutans; 3% rock fragments; gradual to</td>
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<td>7</td>
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<td>70-100</td>
<td>Pale brown (10YR 6/3) and yellowish brown (10YR 5/6) mottled medium clay; polyhedral structure (10-20mm); very firm (4D); cutans; 2% rock fragments;</td>
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Chemical and physical analysis

< 2 mm fraction

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<th>Fe₃⁺/Al₄⁺</th>
<th>Al₃⁺</th>
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<th>Ext. K</th>
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<th>Mg</th>
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<td>38 &lt;2</td>
<td>33</td>
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</tbody>
</table>
Profile no.: KELL 6

Classification: (1) Red Clay (2) Ugg 5.37

Location:
Lat. 31° 23'S; Long. 117° 46'E.
Durokoppin Reserve (Conservation and Land Management). 27 km north of Kellerrabin on the Trayning Road.
Durokoppin co-ordinates 0000/1650.

Landform/topography:
Moderate slope (10% to west) on flanks of minor valley.

Parent material:
Precambrian dolerite.

Drainage:
Internal—moderately permeable.
External—well drained.

Climate:
Rainfall—Kellerrabin 339 mm; 74 wet days.
Evaporation—Merredin 2110 mm.
Temperatures—Kellerrabin Jan. 17.3°C; July 6-16°C.

Native vegetation:
Trees: Salmon Gum: 15-20 m; 30-70 cm dbh (20%).
Shrubs: 1-1.5 m; (1%); Pittosporum phyllaenosides, Rhododendron caucasa, Acacia humilis;
<0.5 m 15%; Atriplex palaesia, Olarion muesleri, Acacia erinacea, Eucalyptus tintonosa.
Ground: 20%; Stipa elegantissima, S. seriabilda, Wiliorum humilis, Durokoppin sp.

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A1</td>
<td>0-5</td>
<td>Dark reddish brown (SYR 3/2) light clay; granular structure tending to be shallow-mulching; porous; firm (3 D); 3% gravel; clear, regular to</td>
</tr>
<tr>
<td>2</td>
<td>B1</td>
<td>5-17</td>
<td>Dark red (2SYR 3/5 nearly) light clay; very strong polyhedral structure (20-30 mm); some cutans; very firm (4 D); 4% soft lime; gradual change to</td>
</tr>
<tr>
<td>3</td>
<td>B2</td>
<td>17-32</td>
<td>Red (SYR 4/6) light clay; very strong structure (15-30 mm); firm (3 D); 11% soft lime and few lime nodules; gradual to</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>32-60</td>
<td>Red (SYR 4/6) medium clay; strong polyhedral (10-20 mm); cutans; firm (3 D); 24% soft lime; 5% lime nodules; gradual to</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>60-75</td>
<td>Red (2SYR 3/6-4/6) medium clay; strong structure; 24% ferruginous gravel; 8% soft lime; sharp change to</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>75-92</td>
<td>Dark red (2SYR 3/6) and brown (7SYR 3/6) mottled light clay; massive; dense; few cutans; 3% gravel; 3% soft lime; sharp break to</td>
</tr>
<tr>
<td>92</td>
<td></td>
<td></td>
<td>Weathering dolerite.</td>
</tr>
</tbody>
</table>

Chemical and physical analysis
< 2 mm fraction

| Sample no. | pH H₂O | 0.01M CaCl₂ | Elect Cond. | Org C | Total N | CS | FS | St | C | Particle size | Extractable Fe/Al | Total Ext. P | Ext. P | Ext. K | CEC Ca | Mg | K | Na |
|------------|--------|-------------|-------------|-------|---------|----|----|----|----|---------------|-------------------|--------------|-------|-------|-------|-------|----|----|----|
| 1          | 7.2    | 6.0         | 8            | 1.7   | 0.10    | 38 | 27 | 23 | 12 |               |                   |              |       |       |       |       |    |    |    |
| 2          | 9.1    | 9.0         | 38           | 38    | 0.08    | 19 | 15 | 17 | 49 |               |                   |              |       |       |       |       |    |    |    |
| 3          | 9.4    | 8.6         | 300          | 300   | 2       | 2   | >300| 2  | >300|               |                   |              |       |       |       |       |    |    |    |
| 4          | 9.1    | 8.6         | 370          | 370   | 2       | 2   | >300| 2  | >300|               |                   |              |       |       |       |       |    |    |    |
| 5          | 9.4    | 8.6         | 370          | 370   | 2       | 2   | >300| 2  | >300|               |                   |              |       |       |       |       |    |    |    |
| 6          | 9.2    | 8.5         | 310          | 310   | 2       | 2   | >300| 2  | >300|               |                   |              |       |       |       |       |    |    |    |

Mineralogical analysis of clay fraction

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>K₂O %</th>
<th>Fe₂O₃ %</th>
<th>CEC cmol (+)/kg</th>
<th>Illite Kt Illite Si(n)</th>
<th>Chlortile Mica</th>
<th>Vitreous Qtz Mica</th>
<th>H₂O/Go Fd Gb An Dt Mt</th>
<th>per cent range</th>
</tr>
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<tbody>
<tr>
<td>4</td>
<td>15</td>
<td>15</td>
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<td>15</td>
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</tr>
</tbody>
</table>
Profile no.: KELL 7, 7A
Classification: 7 (1) Yellow duplex soil (2) Dy 2.63
7A (1) Red duplex soil (2) Dy 2.83

Reference: Merredin; Bettaney and Hingston (1961).

Location: Lat. 31° 23' 5; Long. 117° 52' 30" E.
Baandee North Reserves (Shire of Kellerberrin);
37 km north-east of Kellerberrin Townsite.
KELL 7 is 120 m south from the northern boundary of Reserve 14498
and 40 m west of Baandee North Road.
KELL 7A is 120 m south from the northern boundary of Reserve 12182
and 160 m east of Baandee North Road.

Landform/topography: Flat alluvial plain; 286 m elevation.

Parent material: Alluvium from weathering of granite and dolerite (Precambrian).

Drainage: Internal—restricted by clay horizon.
External—restricted by low gradient.

Climate: Rainfall—Baandee North 310 mm; 64 wet days.
Evaporation—Merredin 2110 mm.
Temperatures—Kellerberrin Jan. 17-34°C; July 6-16°C.

Native vegetation: Trees: Salmon gum: 25-30 m; 3%. Gimlet: 15-25 m; 2%.
Salmon gum—gimlet regrowth 8-10 m; 15%.
Shrubs: 1.5-2 m; 30%. Santalum acuminatum, Acacia hamiltoris, A. collettioides, A. saccionioides, Nitraria hispidissima, Eremophila lehmanniana.
Shrubs: 0.5 m; 2%. Osaria Muelleri, Grevillea acacia, Templotonia sultana, Acacia mercillii.
Ground: (2%). Stipa elegantissima, S. variabilis, Encocharna tomentosa, seedlings (Astraceae)

KELL 7

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-6</td>
<td>Dark reddish brown (SYR 3/3 nearly) gritty sandy loam; massive; earthy, porous; hard-setting, firm (3 D); surface algal crust (2 mm); regular, clear boundary to</td>
</tr>
<tr>
<td>2</td>
<td>A12</td>
<td>6-16/18</td>
<td>Brown (7.5YR 4/5) gritty sandy loam; massive; porous; firm (3 D); clear and irregular boundary to</td>
</tr>
<tr>
<td>3</td>
<td>A2</td>
<td>16/18-20/22</td>
<td>Light brown (7.5YR 6/4 dry; 5/5 moist) gritty sandy loam, massive, porous, very firm (4 D); sharp irregular break to</td>
</tr>
<tr>
<td>4</td>
<td>B11</td>
<td>20/22-50</td>
<td>Strong brown (7.5YR 4/6 nearly) gritty light clay; massive; porous; tending to platy structure with some cutans; sharp break to</td>
</tr>
<tr>
<td>5</td>
<td>B12</td>
<td>50-85</td>
<td>Strong brown (7.5YR 5/5) gritty medium clay; mainly massive, but with some horizontal structure with cutans; very firm (4 D); sharp break to</td>
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<tr>
<td>6</td>
<td>B2</td>
<td>85-105</td>
<td>Yellowish brown (10YR 5/4) gritty medium clay; massive; porous; firm (4 D); 16% soft lime and lime nodules.</td>
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KELL 7

Chemical and physical analysis

<table>
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<th>Sample no.</th>
<th>pH</th>
<th>0.01M CaCl₂</th>
<th>Elect. Cond.</th>
<th>Org. Total</th>
<th>Particle size</th>
<th>Extractable Fe/Al</th>
<th>Total Ext.</th>
<th>Exch. cations</th>
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<td>0.03</td>
<td>64</td>
<td>19</td>
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<td>8</td>
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< 2 mm fraction

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<th>Org. Total</th>
<th>Particle size</th>
<th>Extractable Fe/Al</th>
<th>Total Ext.</th>
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<td>0.03</td>
<td>64</td>
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**KELL 7A**

**Morphological description**

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<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-6</td>
<td>Yellowish red (SYR 4/6) sandy loam +; weak granular structure; earthy and porous, slightly coherent (2 D); regular and clear boundary to</td>
</tr>
<tr>
<td>2</td>
<td>A12</td>
<td>6-17</td>
<td>Yellowish red (SYR 4/7) loam with sand; weak granular structure; slightly coherent (2 D); earthy and porous; very sharp break to</td>
</tr>
<tr>
<td>3</td>
<td>A2</td>
<td>17-20</td>
<td>Bleach, light reddish brown (SYR 6/3 dry, 5/4 moist) sandy clay loam; massive, earthy, porous, very firm (4 D); regular clear boundary to</td>
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<td>4</td>
<td>B1</td>
<td>20-40</td>
<td>Yellowish red (SYR 4/8) medium clay; massive, earthy, porous; very firm (4 D); 3% gravel; abrupt change to</td>
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<td>40-60</td>
<td>Brown (7 SYR 4/6) medium clay; massive, earthy; firm (3 D); 3% soft lime; 9% lime nodules, sharp to</td>
</tr>
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<td>60</td>
<td>Impenetrable horizon of lime nodules.</td>
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**Chemical and physical analysis**

<table>
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<th>pH H₂O</th>
<th>Elect. Cond.</th>
<th>Org. C</th>
<th>Total N</th>
<th>Particle size Cs F₅ Si C</th>
<th>Extractable Fe/Al Fe₅ Al₅ Al₆</th>
<th>Total P</th>
<th>Ext. P</th>
<th>Ext. K</th>
<th>CEC</th>
<th>Ca</th>
<th>Mg</th>
<th>K</th>
<th>Na</th>
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<td>55</td>
<td>22</td>
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<td>17</td>
<td>86</td>
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<tr>
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<td>7.6</td>
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<td>&lt;2</td>
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<td>&lt;2</td>
<td>200</td>
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</table>
Profile no.: KELL 8

Classification: (1) Yellow duplex soil (2) Dy 2.13

Reference: Jura, Bitterley and Hingston (1961)

Location: Lat. 31° 23' 00" S; Long. 117° 46' 00" E. Durokoppi Nature Reserve (Conservation and Land Management). 27 km north of Kellerberrin on the Trayning Road. Durokoppi co-ordinates 2000/3170. Soil is very variable in colours, textures, depths, lime contents probably due to presence of dolerite dykes.

Landform/topography: Dissected slope; very irregular; much outcrop; upper landscape position.

Parent material: Precambrian granitic rocks and dolerite dykes.

Drainage: Internal—restricted by clay subsoil. External—well drained.

Climate: Rainfall—Kellerberrin 339 mm; 74 wet days. Evaporation—Merredin 2110 mm. Temperatures—Kellerberrin Jan. 17-34°C, July 6-16°C.

Native vegetation: Trees: York gum; 6.8 m; 10-30 cm (25%).
Acacia acuminata 3-5 m (10%).
Shrubs: 1-2 m; 2%. Acacia acuaria, A. acuminata seedlings, A. triphylla.
<1 m; 15%. Acacia erinacea, Olearia muelleri, Dodonea bursarifolia, Eremopila lehmanniana.
Ground: 2%. Amphipogon sp., Stipa versatilis, Bore ya nitida, Enchyelyne tomentosa.

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A11</td>
<td>0-4</td>
<td>Dark brown (10YR 3/3) gritty sandy loam; non-wetting; massive; porous, slightly coherent (2 D); 8% gravel; regular and clear boundary to</td>
</tr>
<tr>
<td>2</td>
<td>A2</td>
<td>4-10</td>
<td>Dark brown (10YR 4/3) gritty sandy loam; massive; porous; slightly coherent (2 D); non-wetting; much fungal hyphae; 7% gravel; gradual change to</td>
</tr>
<tr>
<td>3</td>
<td>B11</td>
<td>10-25</td>
<td>Dark yellowish brown (10YR 4/4) gritty light clay; weak polyhedral structure (20-30 mm); porous; firm (3 D); trace of soft lime; 11% gravel; gradual to</td>
</tr>
<tr>
<td>4</td>
<td>B12</td>
<td>25-45</td>
<td>Brown (10YR 5/3) light clay; moderate polyhedral structure (20-30 mm); firm (3 D); some cutans, 14% soft lime; few nodules; 9% gravel; gradual to</td>
</tr>
<tr>
<td>5</td>
<td>B21</td>
<td>45-70</td>
<td>Yellowish brown (10YR 5/4) light clay; moderate polyhedral structure (20-30 mm); firm (3 M); 22% soft lime; few nodules; 13% gravel; gradual change to</td>
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<td>6</td>
<td>B22</td>
<td>70-85</td>
<td>Yellowish brown (10YR 5/5) light clay; firm (3 M); 25% soft lime; 16% lime nodules; gradual change to</td>
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<td>7</td>
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<td>85-100</td>
<td>Strong brown (7.5YR 5/8) light clay; firm (3 M); 11% soft lime; few cutans visible; 12% lime nodules.</td>
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</table>

Chemical and physical analysis

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<th>Sample no.</th>
<th>pH H2O</th>
<th>0.01M CaCl2</th>
<th>Electron Cond.</th>
<th>Org. C</th>
<th>Org. N</th>
<th>Total C</th>
<th>CS per cent</th>
<th>CS F5</th>
<th>CS Si</th>
<th>CS C</th>
<th>Particle size per cent</th>
<th>Extractable Fe/Al</th>
<th>Total P (mg/kg)</th>
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<th>Ext. K</th>
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- <2 mm fraction

- Exch. cations: Ca, Mg, K, Na
- CEC: cmol (+)/kg
Profile no.: KELL 9  
Classification:  (1) Brown Calcareous soil  (2) Gc 1.12
Location: Lat. 31° 37' S, Long. 117° 52' 30" E, Doodlakine Town Reserve (Shire of Kellerberrin) 16 km east of Kellerberrin on the Great Eastern Highway. 80 m from the Bruce Rock Road. 100 m from the southern boundary.
Landform/topography: Nearly level plain; gilgai microrelief 25 cm. Elevation 250 m.
Parent material: Calcareous clay blown from adjacent salt lakes.
Climate: Rainfall—Doodlakine 314 mm; 65 wet days. Evaporation—Merredin 2110 mm. Temperatures—Kellerberrin Jan. 17.34°C; July 6.16°C.
Native vegetation: Trees: Eucalyptus longicorns (red morrell) 10-14 m; 20-40 cm (20%). Shrubs: 2-2.5 m; (15%). Melaleuca pyriforma, Eremophila lehmanniana, Santalum araucinatum, Escorpius amygdaloids, Acacia harrimans. Shrubs: <1 m; (1%). Atriplex paludos, Acacia colletoides, Enchylaena tomentosa. Ground; (10%). Stipa elegantissima, S. torrabilia, Maireana sp.

Morphological description

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Horiz.</th>
<th>Depth (cm)</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>A11</td>
<td>0-8</td>
<td>Dark brown (7.5YR 3/3 nearly) loam; very fine granular structure; loose; powdery; very weak coherence (1 D); 3% soft lime. Clear; regular.</td>
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<td>2</td>
<td>A12</td>
<td>8-18</td>
<td>Dark brown (7.5YR 3/4) loam; very weak granular structure; weak (2 D); 4% soft lime. Abrupt to</td>
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<td>18-30</td>
<td>Brown (7.5YR 4/4) loam; massive; porous; firm (3 D); 8% soft lime. Gradual to</td>
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<td>4</td>
<td>B2</td>
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<td>Strong brown (7.5YR 4/6) sandy clay loam; massive; porous; firm (3 D); 9% soft lime. Gradual to</td>
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<td>B3</td>
<td>50-75</td>
<td>Yellowish red (5YR 5/6) light clay; massive; porous; firm (3 D); 12% soft lime; few lime nodules. Abrupt to</td>
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<td>75-100</td>
<td>Yellowish red (5YR 5/6) light clay; massive; 19% soft lime; 3% lime nodules.</td>
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Chemical and physical analysis

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<th>Particle size</th>
<th>Extractable Fe/Al</th>
<th>Total P</th>
<th>Ext. P</th>
<th>Ext. K</th>
<th>CEC</th>
<th>Exch. cations cmol (+)/kg</th>
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Mineralogical analysis of clay fraction

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<th>St</th>
<th>Vm</th>
<th>Qz</th>
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<td>D.G. WILCOX, E.A. MCKINNON</td>
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<td>J. RICHES</td>
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<td>M. WELLS, P. HESP</td>
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<td>&quot;DRAINS&quot; A METHOD OF FINANCIALLY ASSESSING DRAINS USED TO MITIGATE WATERLOGGING IN SOUTH-WESTERN AUSTRALIA</td>
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<td>H. BORG</td>
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<td>72. THE CONCEPT OF PRIME AGRICULTURAL LAND - A WESTERN AUSTRALIAN PERSPECTIVE</td>
<td>V.T. READ</td>
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<td>P. A. FINDLATER, P. MULLER</td>
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<td>S. HEARN</td>
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<td>T.C. STONEMAN</td>
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<td>83. THE RELATIONSHIP BETWEEN THE CONCENTRATION OF TOTAL SOLUBLE SALTS AND OSMOTIC POTENTIAL IN SOIL, GROUND AND SURFACE WATER FOR Several regions in Western Australia</td>
<td>H. BORG</td>
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<td>C.J. HENSCHKE</td>
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