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Native Vegetation Handbook for the Shire of Pingelly

Rod Safstrom

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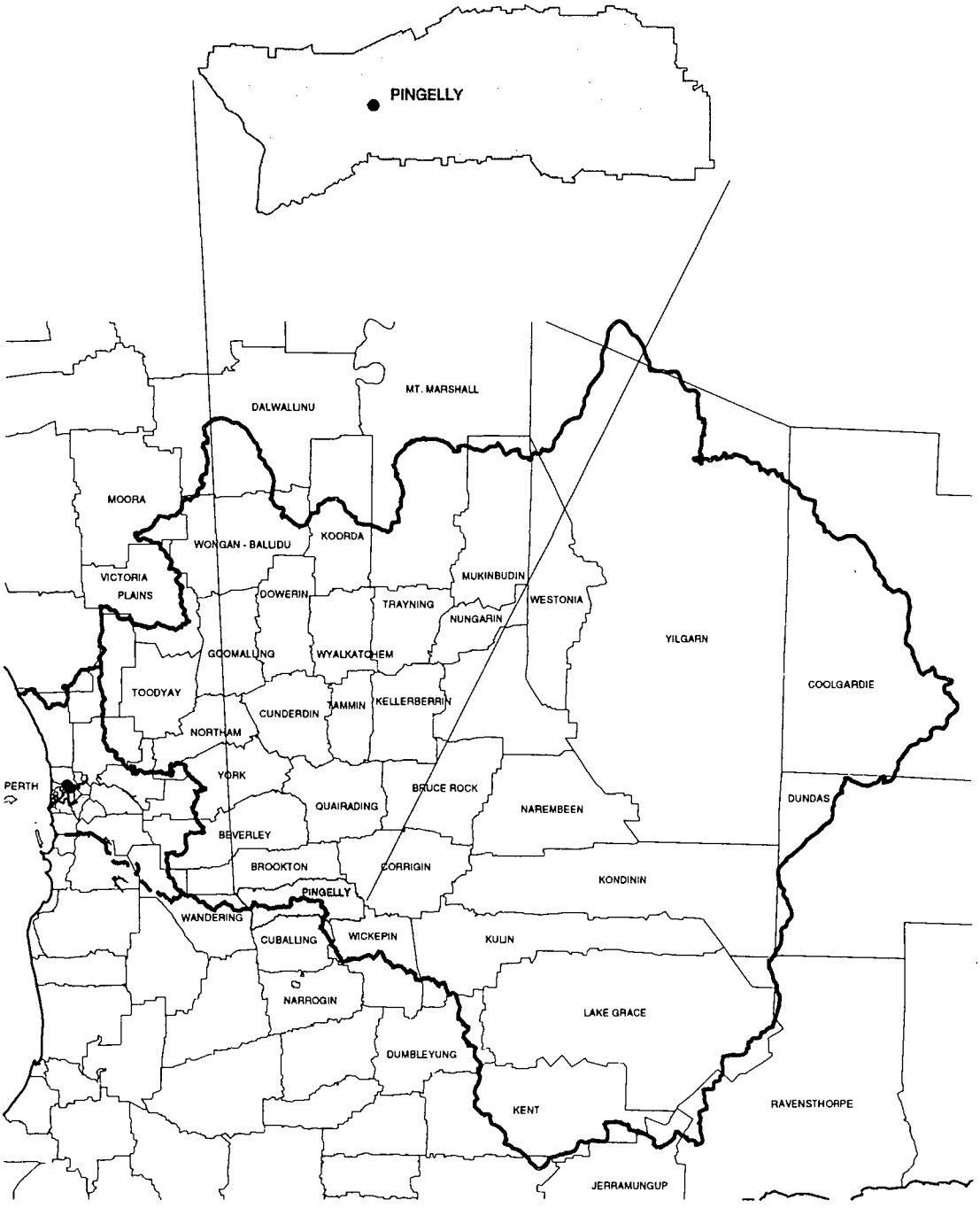

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Copies of the Native Vegetation Handbook for the Shire of Pingelly are available by contacting:

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Cover: The Shire of Pingelly in relation to the Avon River Catchment (indicated by a bold line) and the Swan River Catchment (indicated by a dotted line)

NATIVE VEGETATION HANDBOOK FOR THE SHIRE OF PINGELLY

Rod Safstrom

Spatial Resources Information Group
Division of Regional Operations
Agriculture Western Australia

July 1997

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Introduction

Purpose of this Handbook

The purpose of this Handbook is to bring to people in the Shire of Pingelly, particularly farmers, land managers, the Land Conservation District Committee, catchment groups and local government, information to assist in revegetation and in the management of remnant native vegetation within agricultural systems.

This Handbook is one of a series covering the agricultural region of Western Australia. The Handbook aims to assist the development of sustainable farming systems which combine agricultural production and nature conservation as depicted in Figure 1. Information is provided on the natural resources of the Shire of Pingelly, including the existing vegetation, drainage systems and soils. Problems in managing these resources are described and community initiatives to tackle the problems are summarised.

It is hoped that this Handbook will contribute to the long term viability of the agricultural landscape and the conservation of native vegetation within the Shire.

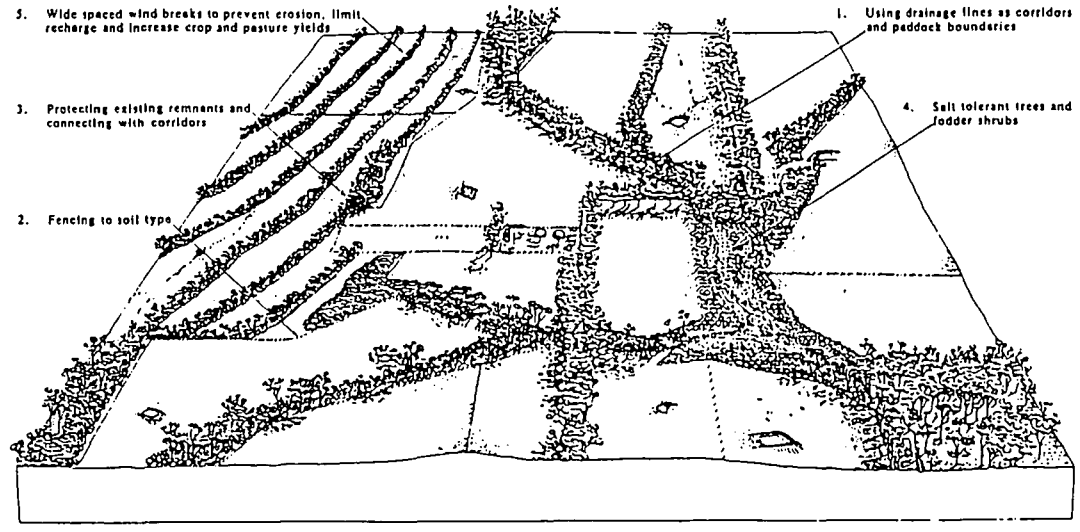


Figure 1. A stylised representation of a central wheatbelt farm illustrating a mosaic of agricultural, natural and semi natural systems. Key elements are:

1. Reinstated drainage lines used as conservation corridors and field boundaries.
2. Coincidence between soil types and management unit.
3. Protection of existing remnants in vegetation corridors.
4. Productive revegetation of land effected by secondary salinity.
5. Alley farming; a network of wide spaced shelterbelts (10 15 x their height apart) to prevent wind erosion, limit recharge of groundwater, increase crop and pasture yield and act as conservation corridors.

Source: Lefroy and Hobbs (1991).

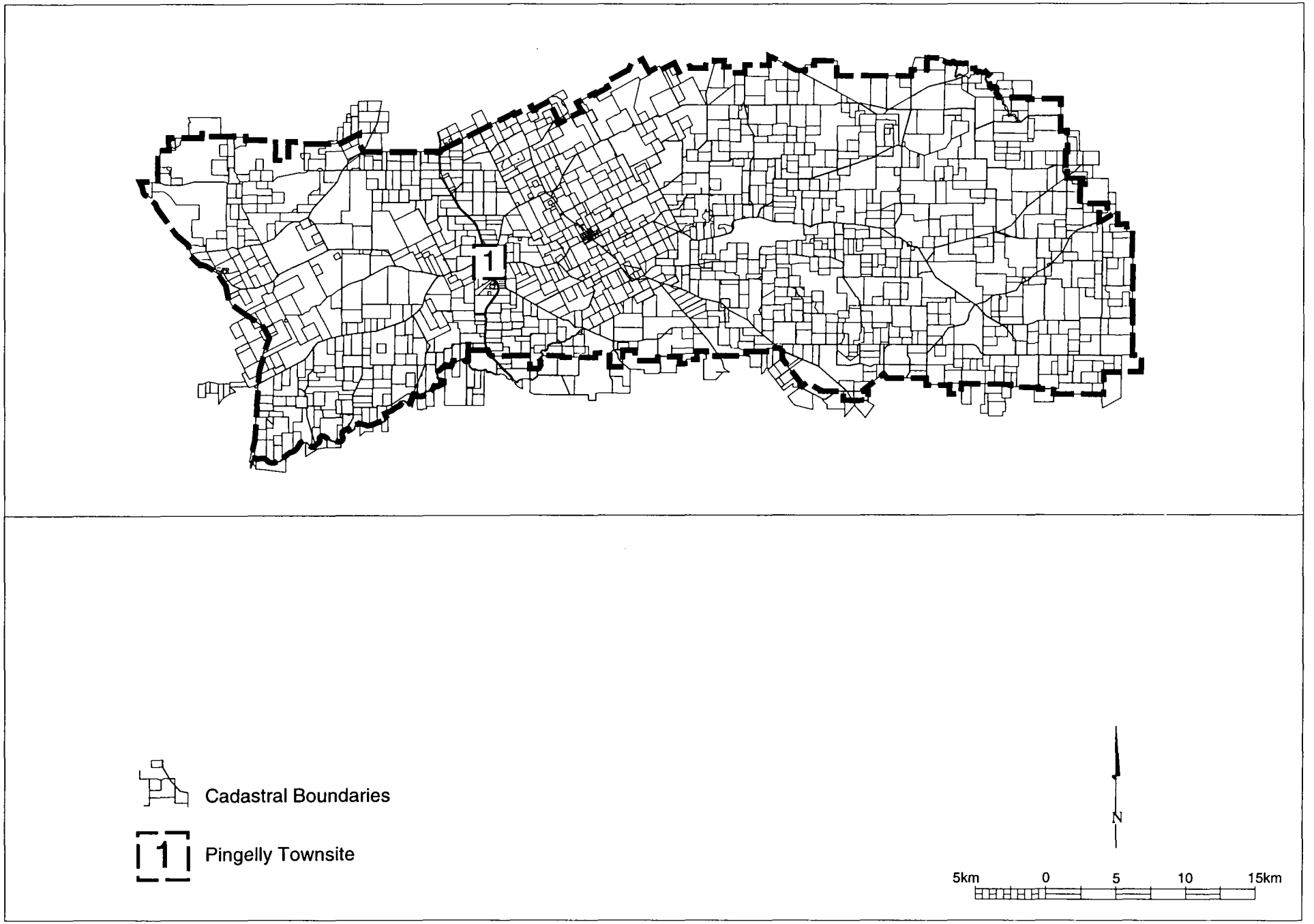


Figure 2: Cadastral Boundaries and townsites in the Shire of Pingelly .

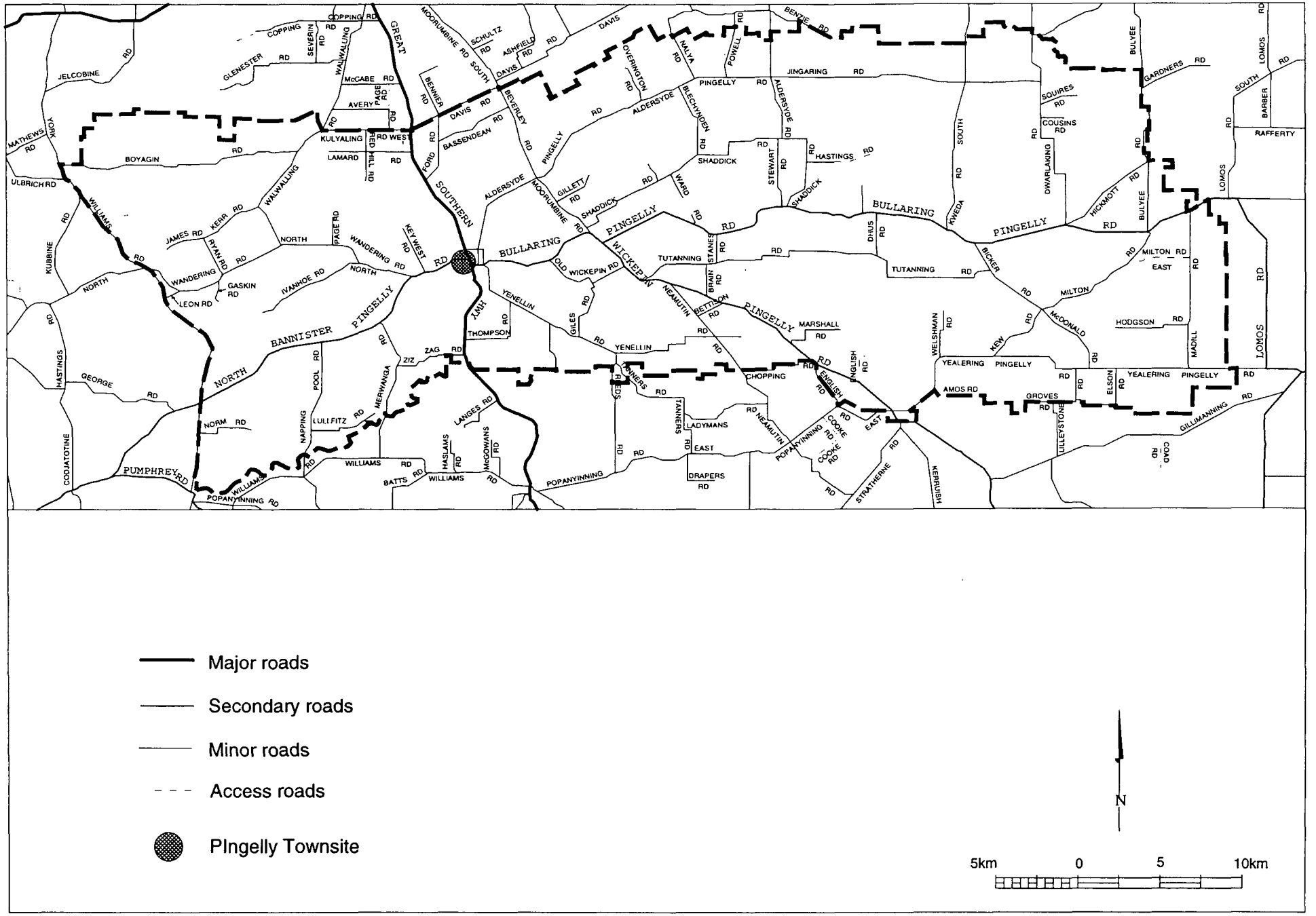


Figure 3: Major, Secondary, Minor and Access Roads in the Shire of Pingelly .

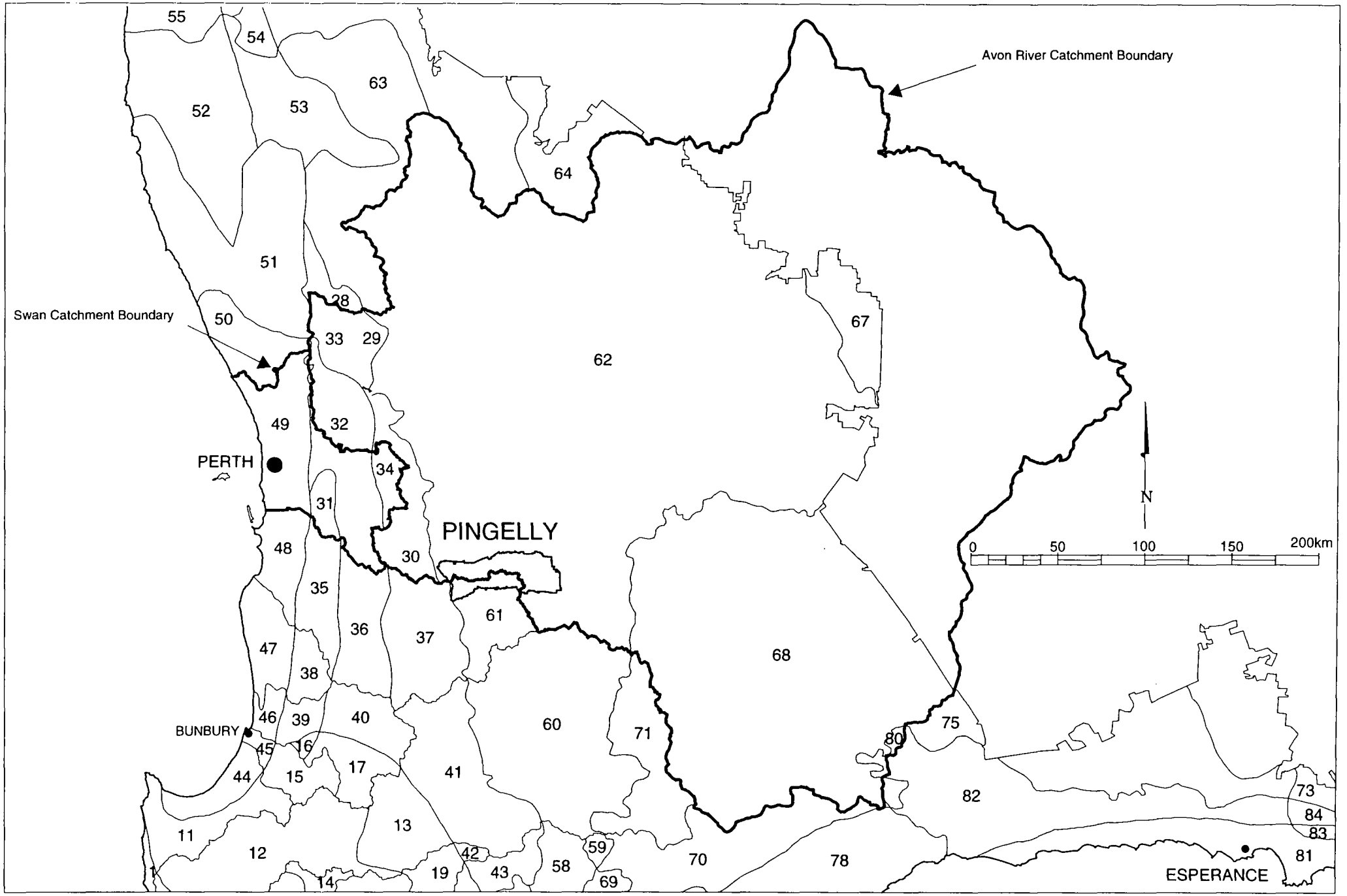


Figure 4: Shire of Pingelly in relation to Natural Resource Zones of the south-west land division of Western Australia

The Shire of Pingelly

The Shire of Pingelly, a long narrow Shire running from east to west, covers an area of 128,552 hectares. It includes parts of the Avon and Hotham River catchments, (see cover map), the divide running through the western and central parts of the Shire. Thus, the Shire includes some of the headwaters of the Avon and Hotham Rivers. The Hotham River also forms part of the southern boundary of the Shire.

Cadastral boundaries in the Shire are shown in Figure 2, while all 561 kilometres of road network in the Shire are shown in Figure 3. The only major townsite in the Shire is Pingelly. The population of the Shire was 1,213 at June 1994 (W.A. Municipal Directory, 1995/96).

Climate

The Shire's climate is regarded as Mediterranean, with cool, moist winters and hot, dry summers. Pingelly receives on average, 455mm rainfall per annum. Average maximum temperatures range from 31.7°C in January to 15.2°C in July, while average minimum temperatures range from 16.0°C in February to 5.6°C in August.

Agricultural production and revegetation

Agricultural land use in the Shire is predominantly crops and sheep. In 1993/94, a total of 39,860 hectares of the Shire was sown with crops, 58,822 hectares with sown pasture and 8,734 hectares of native pastures (ABS, 1994/5). In 1994/95, there were at least 81,802 trees planted from seedlings and 12 hectares revegetated with seed (ABS, 1994/95).

Natural Resource Zones

The south-west of Western Australian has been divided into districts (called Natural Resource Zones) on the basis of their natural resources ie vegetation type, drainage/catchment system and rainfall (Allison *et. al.*, 1993). The Shire of Pingelly contains parts of two Natural Resource Zones [numbers 61 and 62] (Figure 4) making it a mosaic of the Wheatbelt (Avon) Botanical District and the Avon and Murray catchments within an area receiving less than 500mm rainfall.

Land Conservation District Committee and Catchment Groups

The Pingelly Land Conservation District Committee (LCDC) was formed in 1989 and is based on the Shire's boundary. There are three catchment groups in the eastern part of the Shire, East Hotham, Woodebulling and Dartling Creek.

Natural Resources of the Shire of Pingelly- Past and Present

Forming the landscape and soils

The original vegetation in the Shire of Pingelly developed over millions of years as the climate changed and soils formed and eroded. It is helpful to reflect on this history when looking at the current vegetation. Information source: Lantzke (1993).

"During the Tertiary period (60-10 million years ago) Western Australia had a moist temperate tropical climate which led to the formation of deep soils with accumulations of iron, aluminium and quartz in their upper parts and several distinct zones (Figure 5).

In the Pleistocene period (2-10 million years ago) the sea level dropped and/or uplift of the south west of Western Australia occurred. This resulted in erosion of the lateritic mantle to varying degrees exposing the lateritic profile and in places, the bedrock below.

The extent of the dissection of this lateritic profile can be used to explain the development of the landform, soils and the vegetation. Where little or no erosion of the lateritic profile has occurred, fossil soils have been preserved as sandplain or as 'buckshot gravels' above breakaway hills. Where the laterite profile has been dissected to reveal the pallid zone, loamy sand and sandy loam over clay soils have developed. Where removal of the laterite profile has been complete the soils are shallow, gritty soils on granite or red loams on dolerite."

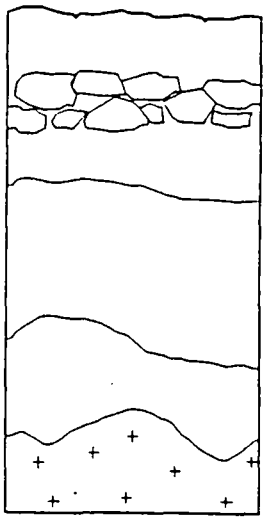


Figure 5. The lateritic profile (above) formed in the Tertiary period during a moist temperate tropical climate has since been eroded to varying degrees
Source: Lantzke (1993)

The vegetation and landscape in the Shire of Pingelly reflects the topography and soils and the rainfall as it declines from west to east. A broad landscape picture is presented in the following section and descriptions of the original and current plant communities.

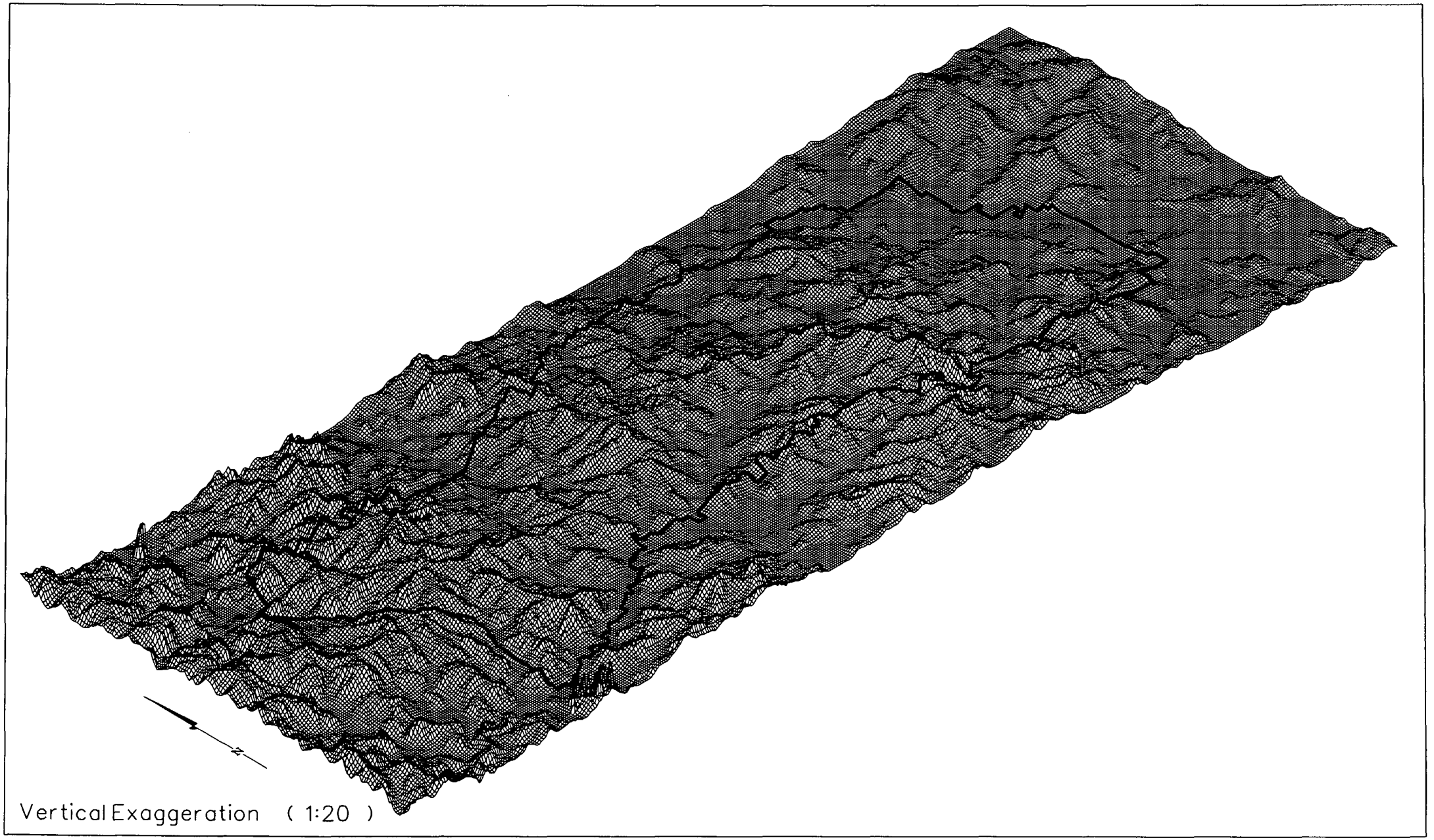


Figure 6: Topographical View of the Shire of Pingelly

Landscape

Pingelly Shire has an agricultural landscape featuring extensive paddocks, occasional Nature Reserves and very scattered remnant vegetation.

In the west and central parts, the valley systems have distinctly dissected the landscape. Flooded gum (*Eucalyptus rudis*) is common along the creeklines in the west. York gum (*Eucalyptus loxophleba*) with rough grey bark is often mixed with the low, bushy jam tree (*Acacia acuminata*) on the lower slopes, and features along the drainage lines and roadsides or as scattered clumps. Wandoo (*Eucalyptus wandoo*), with its pale silver grey or mottled creamy yellow bark, mainly occurs on the middle to lower slopes. Larger areas of native vegetation often indicate outcroppings of granite such as Boyagin Rock or breakaways - terracotta coloured hills of lateritic gravel with powder-bark wandoo (*Eucalyptus accedens*) and brown mallet (*Eucalyptus astringens*).

Moving further east beyond Pingelly there are occasional breakaways and sweeping views over the wide shallow channels of the ancient drainage lines and distant low cresting hills. Wandoo predominates as the main component of remnant vegetation with occasional stands of salmon gum *(Eucalyptus salmonophloia)* and red morrel *(Eucalyptus longicornis)* on flats with heavy soils.

Landscape descriptions have been adapted from Reading the Remote, *Landscape Characters of Western Australia*, CALM (1994). Figure 6 shows a Digital Elevation map of the Shire of Pingelly.

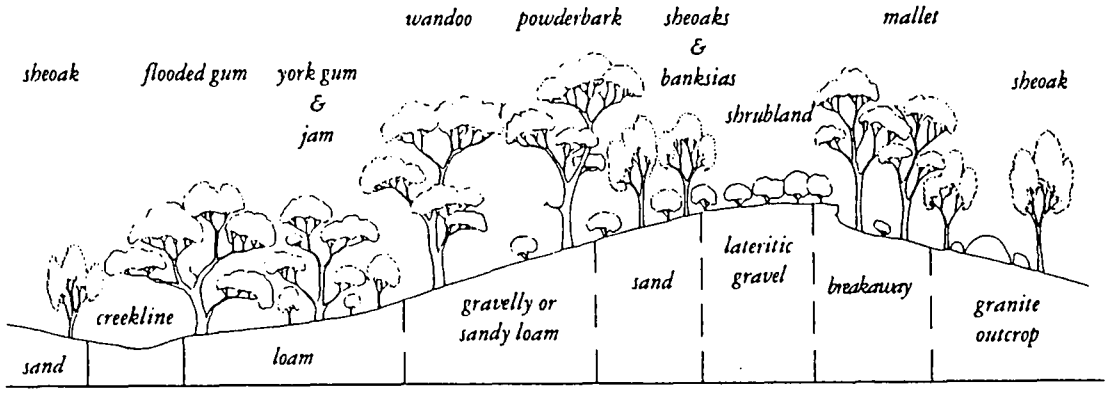
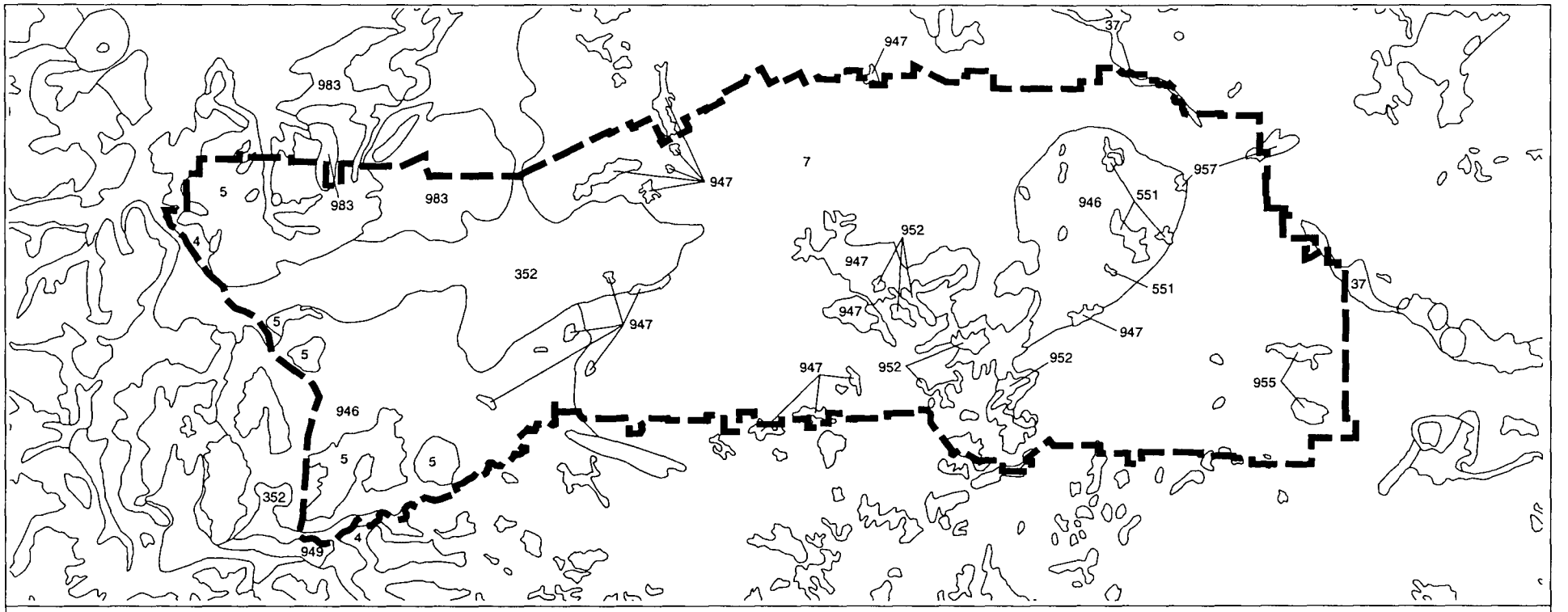


Figure 7. A typical landscape sequence in the Shire of Pingelly showing the relationship of vegetation and soils. Source: Bamford (1995).



4	Medium Woodland; marri - wandoo
5	Medium Woodland; wandoo - powderbark
7	Medium Woodland; York gum - wandoo
37	Shrublands; teatree thicket
352	Medium Woodland; York gum
551	Shrublands; *Allocasuarina campestris* thicket
946	Medium Woodland; wandoo
947	Medium Woodland; powderbark & mallet
952	Shrublands; dryandra heath
955	Shrublands; scrub-heath / Shrublands; *Allocasuarina campestris* thicket
957	Succulent Steppe; saltbush & scattered Yorkgum
983	Shublands; *Melaleuca thyoides* thicket, scattered York gum
⬭	Rock outcrops

N

5km 0 5 10 15km

Figure 8: Vegetation Systems and Major Vegetation Types in the Shire of Pingelly .

Original plant communities

The following descriptions of plant communities are based on plant distribution studies by J. S. Beard who described the vegetation which may have existed if European settlement and clearing had not occurred. Further detail can be obtained from Beard J. S., (1979) and Beard J. S., (1980). An estimation of the original distribution of the dominant vegetation types based on the work by Beard is shown in Figure 8 (Hopkins *et al.*, 1996). Appendix 1 lists plant species commonly found in each plant community.

Jarrah - Marri - Wandoo - Powderbark Wandoo - Brown Mallet Woodlands

To the west of the Shire of Pingelly there is the jarrah (*Eucalyptus marginata*) forest of the Darling Range and as rainfall declines woodlands of jarrah and marri (*Corymbia calophylla*). There are only small outliers of the jarrah and marri woodlands in the Shire of Pingelly, these being replaced by woodland of powderbark wandoo and brown mallet on laterite plateaus, woodlands of wandoo and powderbark wandoo on upper slopes with gravel wash below the breakaways. Scattered shrubs and woodlands of rock sheoak (*Allocasuarina huegeliana*) are associated with the granite outcrops.

In the most eastern parts of the Shire, powderbark wandoo and brown mallet are at the limit of their range and occur on moister lower slopes with heath occurring on the plateaus. Stands of powderbark wandoo become lower and more open.

A good example of wandoo woodland is protected in Noombling Nature Reserve (reserve 26150). The wandoo are 16-24 metres tall, with only 2-10% cover, the understorey consists mainly of thick leaved poison (*Gastrolobium crassifolium*) at 1 metre tall with a ground layer of limestone grass (*Enneapogon caerulescens*), pincushions (*Borya sphaerocephala*) and *Loxocarya pubescens*. In another part of the same reserve, wandoo is mixed with rock sheoak (4-5 metres tall) and some jam. Here, grass trees (*Xanthorrhoea* sp.) are more abundant and the ground cover is almost entirely pincushions.

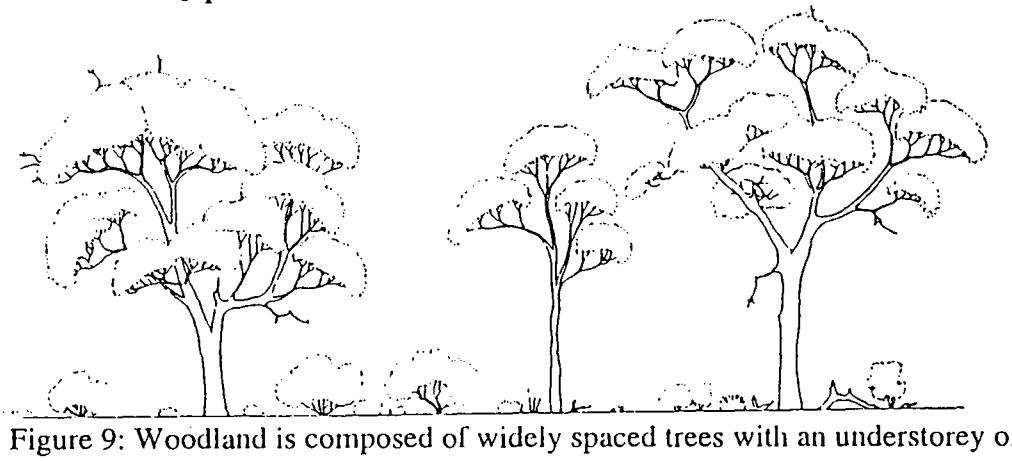


Figure 9: Woodland is composed of widely spaced trees with an understorey of shrubs. Source: Bamford, 1995.

York Gum Woodland

As rainfall reduces in the east of the Shire, the bulk of the country below the brown mallet and powderbark woodland of the breakaways is covered by woodland of York gum (Figure 10) and wandoo. York gum and wandoo are usually in mixture but often with wandoo on the upper slopes and York gum on the red soils of the lower slopes. York gum is often mixed with jam *(Acacia acuminata),* with rock sheoak and needle tree *(Hakea preissii)* as small tree associates. Salmon gum and red morrel sometimes occur on heavier red soils (Figure 11). Swamp sheoak (*Casuarina obesa*) occurs on saline drainage lines.

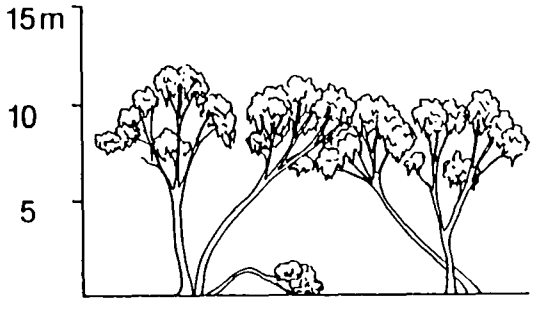


Figure 10. Example of height and form of York gum woodland
Source: Beard (1981)

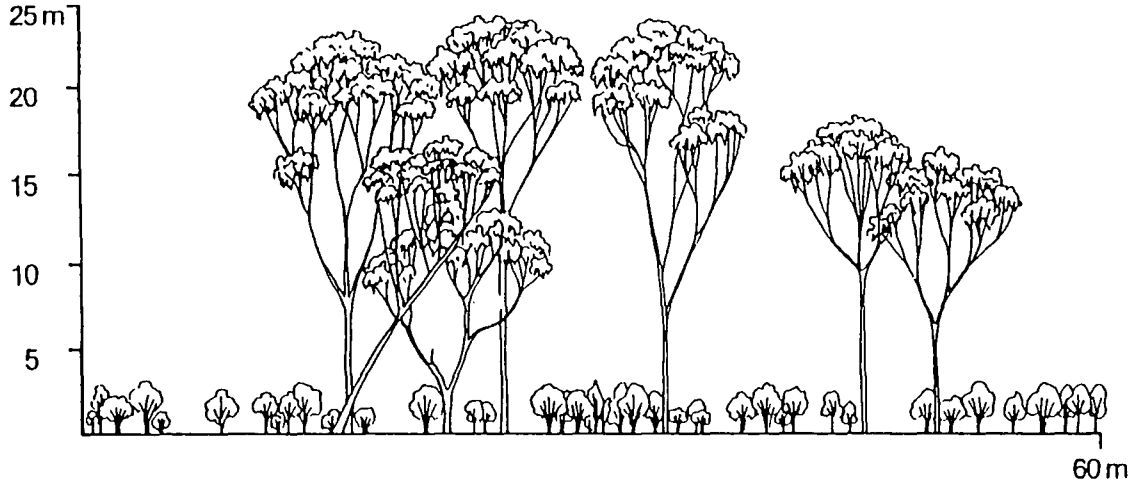


Figure 11. Salmon gum woodlands, often with a succulent understorey, sometimes occur on heavy red soils low in the landscape
Source: Beard (1981)

Heath and thicket

Heath vegetation takes over from the brown mallet and powderbark woodlands on the laterite plateaus as rainfall decreases in the east. The soils can be gravelly or sandy overlaying the laterite, determining the vegetation type.

Banksia low woodland

Banksia woodlands (Figure 12) can occur on transported sand sheets on lower ground which may contain swampy pockets of tea tree and reeds. They can range from scrub heaths but if long unburnt the structure can improve to low woodland.

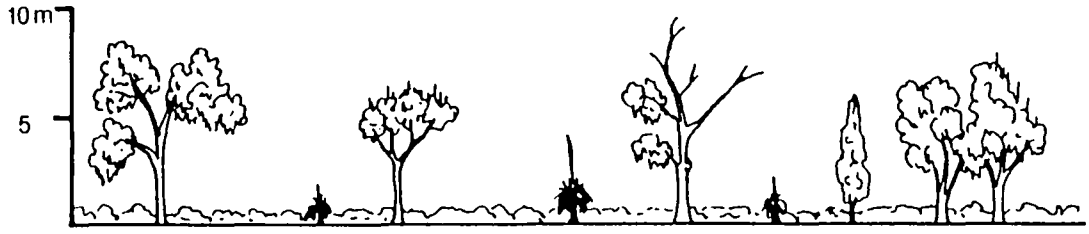


Figure 12. Profile of Banksia low woodland
Source: Beard (1981)

Salt flats

Salt flats may be bare or vegetated with samphires. There are often low sandy dunes in the vicinity with scattered York gum and shrubs including broom bush (*Melaleuca uncinata)* and a range of other Melaleucas.

Tutanning Nature Reserve - an example of the sequence of plant communities in the Shire of Pingelly

The Tutanning Nature Reserve represents most of the vegetation types in the Shire of Pingelly. Salmon gum woodland occurs on heavy red loam flats, wandoo woodland on sandy loam flats, York gum woodland close to drainage lines, brown mallet woodland on pediments below breakaways, powder-bark wandoo open low woodland mainly on shallow granitic soils, manna wattle (*Acacia microbotrya*) low forest on wetter drainage areas, rock sheoak low forest on shallow sand peripheral to granite outcrops. There are three types of heath: (1) with *Dryandra* spp. dominant on the lateritic plateau, (2) mixed heath on sand overlying laterite, (3) mixed heath on shallow duplex soils with poor drainage. The reserve also contains a patch of jarrah on grey sand, the second most easterly occurrence (Beard, 1980).

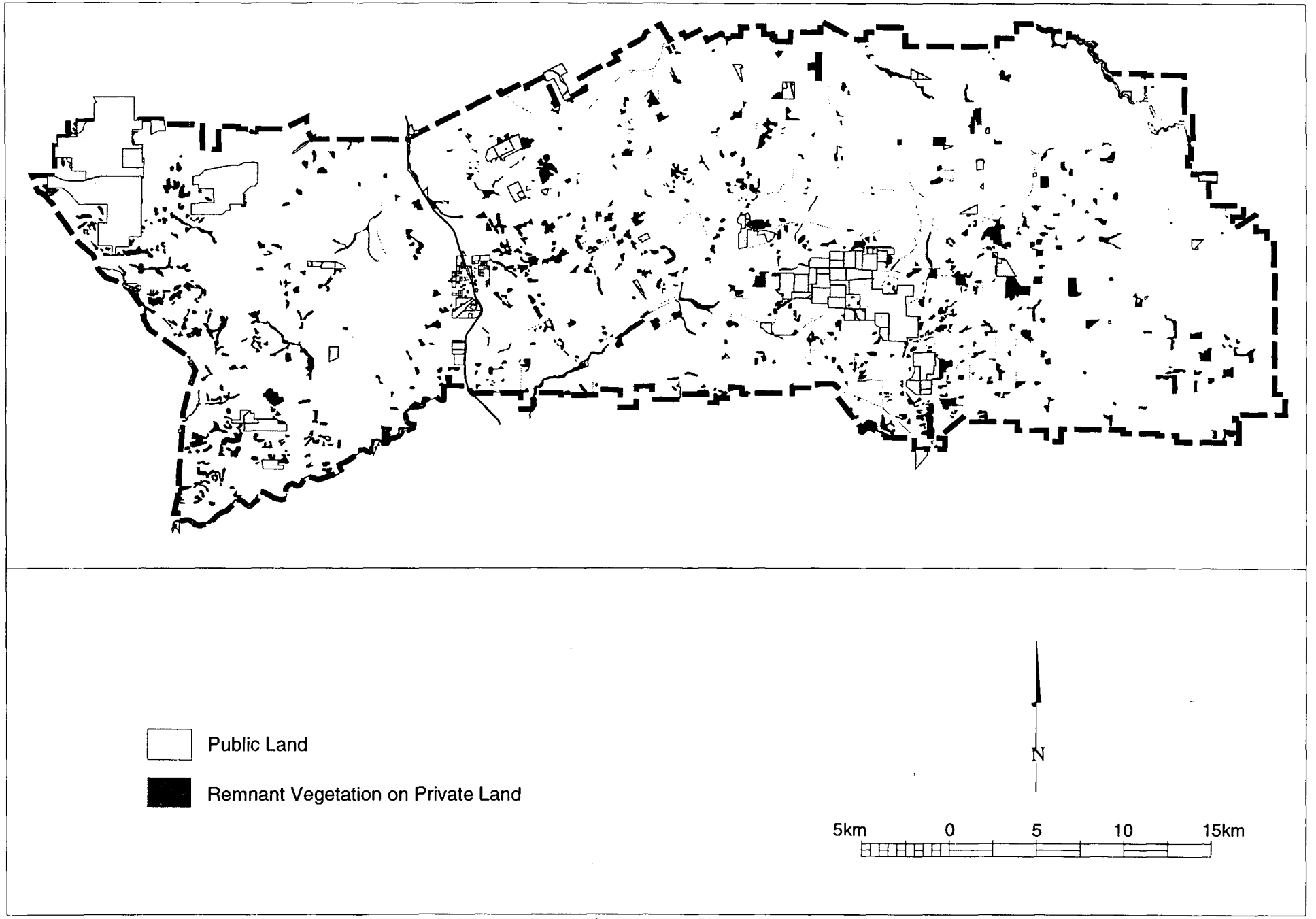


Figure 13: Existing Native Vegetation Cover on Public and Private Land in the Shire of Pingelly .

Current vegetation

Native vegetation in the Shire of Pingelly has been significantly cleared for agricultural purposes. The district was first settled in the middle 1800's and the best country for agriculture, the woodlands on heavy soils in the valleys, was cleared by hand. Much of the sand plain was cleared post 1950, with the advent of bulldozers and trace elements. Remnant areas were often cleared in the early days, as they were seen to harbour rabbits. The remaining areas of native vegetation are mostly the areas unsuitable for agriculture: the granite outcrops, breakaway country and saline areas. Woodlands and sandplain country are very poorly represented in reserves and much of the woodlands that do remain on private land have been degraded by grazing and weed invasion. The laterite hills have mostly been resistant to weed invasion and represent wonderful examples of some of the original diversity of the native vegetation within the Shire.

Approximately 10.6% of the Shire of Pingelly remains covered by native vegetation, 4.8% (6,166 hectares) of which is found on private land. The remaining 5.8% (7,461.3 hectares) exists as public reserves, water reserves, crown land, gravel pits etc, not all of which has a cover of native vegetation (Figure 13).

In the Shire of Pingelly, aerial photo interpretation indicates that there are 560 bush remnants (excluding scattered trees), of which 348 (62%) are regarded as being "remnant vegetation" (closely resembling the original vegetation), and 212 (38%) as being "modified vegetation" (vegetation with a degraded understorey, disturbed, salt affected or narrow lines of vegetation). More than 85% of all bush remnants in the Shire are less than 20 hectares in area (Beeston *et al.*, 1994).

In 1992, Ted Griffin and Frans Mollemans undertook a botanical survey of the Shire of Pingelly (Griffin, 1995). Copies of the findings of this survey are available by contacting the Spatial Resource Information Group, Agriculture Western Australia (08) 9368 3732. A total of 208 bush remnants in the Shire were surveyed briefly and one (number 03006) was surveyed in detail (Griffin, 1995). The study found that 3% of all the bush areas surveyed were fenced and two of the three areas classified as remnant vegetation were fenced. The results of the detailed survey are in Appendix 2.

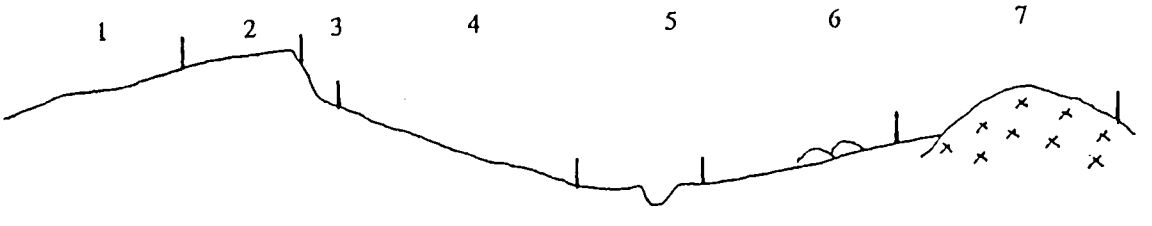
Nature Reserves

The central wheatbelt, which includes the Shire of Pingelly, was intensively settled over 100 years ago with vast areas of the bush opened up in post war years. At that time little priority was given to setting aside land for non agricultural purposes. By the late 1950's, only scattered and often small remnants of the original bush remained. Many of the remnants were unsuitable for agriculture or were set aside as reserves for mallet or supported dense stands of poison bush. As a result, Nature Reserves occupy only about 1.5 % of the land area. The reserves are typically small (median size 125 hectares), often poorly shaped and not representative of the variety of landforms. The Shire of Pingelly is fortunate to have two outstanding Nature Reserves, Boyagin and Tutanning, which are described below.

There are 18 Nature Reserves in the Shire of Pingelly which are vested in the National Parks and Nature Conservation Authority (NPNCA) for the conservation of flora and fauna. They are managed by the Department of Conservation and Land Management (CALM) on behalf of the NPNCA. Some of these reserves are described below from information gathered from CALM at Narrogin. In addition, there are a number of vested reserves under the control of the Shire and other authorities.

Boyagin Nature Reserve

Boyagin Nature Reserve (4844.5 hectares), covers parts of the Shires of Brookton and Pingelly. The reserve represents upland country with seven distinct land types (Figure 14) and has a rich animal fauna.



1. Gravel (laterite) slopes, deep sand hollows.
2. Ironstone (laterite) caps. Gravel sands and loams with ironstone.
3. Breakaway faces. Loams, sandy loams often with gravel.
4. Gravel slopes.
5. Valley flats and major drainage lines.
6. Slopes with sandy loams, red-brown loams, granite bosses.
7. Areas with sheet granite, granite monoliths

Figure 14. Land types at Boyagin Nature Reserve. Source : CALM Narrogin

Vegetation of Boyagin Nature Reserve
The following vegetation descriptions are derived from Dames and Moore International (1985), *The Vegetation of Boyagin Nature Reserve.*

The principal plant communities in the reserve are forests, low forests, woodlands, low woodlands, kwongan (heaths and shrublands) and herbaceous plant communities. Some of the tree dominated communities also occur as tall shrublands and grade into kwongan. The vegetation is generally a continuum that can be broken down into units only arbitrarily.

420 plant species have so far been recorded for the reserve including two Declared Rare Flora species. *Eucalyptus caesia* is found in several small populations on granite rock and also occurs on other granite outcrops in the wheatbelt. Yorrel *(Eucalyptus gracilis)* has only been recorded from Boyagin Nature Reserve and two other localities. The following non gazetted rare and geographically restricted species have been recorded: *Acacia deflexa, Boronia capita* spp. *clavata* or *capita, Calothamnus planifolius, C. Rupestris* (mouse ears), *Dryandra cyaroides, Gastrolobium stipulare, Hakea loranthifolia, Hemigenia saligna, Thomasia montana* (hill thomasia).

Tree communities
The most widespread association in the reserve is woodland or low woodland dominated by powderbark wandoo, often with wandoo or mallet and often as an overstorey or emergent in Drummond's mallee (*Eucalyptus drummondii*) heathland (kwongan). Lateritic soils on the plateaus and pockets of sand overlying lateritic soils support woodlands and low woodlands of powderbark wandoo, intergrading, on the poorer sites, with kwongan vegetation characterised by two small trees or mallees, Drummond's mallee and *Eucalyptus exilis*. On the more favourable sites, wandoo and marri are more common. Jarrah also occurs on some plateaus, as scattered individuals or small populations. Pediment slopes below the laterite breakaways generally support powderbark wandoo woodlands but on some laterite or, particularly, clayey soils, mallet woodlands or patches of forest replace them.

Marri and wandoo occur with powderbark wandoo, or in place of it, on mid-slopes with loamy soils. On sandier upper slopes and on sandy loamy soils on lower slopes, powderbark wandoo often shares dominance with wandoo or is replaced by it. Rock sheoak trees are common in this woodland and sometimes occur as the dominant species on coarse sandy soils.

In many of the broad valleys and shallow slopes bordering them, generally on sandy loamy soils, wandoo is the dominant tree. Rock sheoak is commonly an understorey tree in wandoo woodland. Jam is less common, sometimes occurring with the rock sheoak in the understorey and sometimes without it. The two poisons, prickly poison *(Gastrolobium spinosum)* and box poison *(Oxylobium parviflorum)*, form dense shrub understoreys to over 2 m tall under wandoo canopies. In some areas the two poisons, particularly prickly poison, form thickets without an overstorey.

York gum and wandoo woodland originally covered most of the lowland area surrounding the reserve. Most of it has since been cleared and now occurs in the reserve only as small mixed populations on the periphery. Jam is a small tree that is sub-dominant in parts of the stand.

Rock sheoak forms monospecific stands of open low forest on lower slopes and drainage floors and on granite rocks and soils around them. Stands of rock sheoak often have canopy densities in excess of 30% and form catenas with thickets of prickly poison, box poison, parrot bush *(Dryandra sessilis)* and wilyurwur *(Acacia lasiocalyx)* in some places. Where the rock sheoak trees are mature and openly spaced the two poisons often occur as an understorey.

Two wattles, Jam and wilyurwur, form low forests and open low forests that on some sites might be better described as shrub communities. Communities dominated by jam are uncommon in the reserve, but dense wilyurwur communities form mosaics with rock sheoak low forests around many of the granite outcrops. In some areas, *Allocasuarina campestris* forms dense thickets.

Kwongan communities (heaths and shrublands)
The kwongan communities in the reserve can be grouped into four types on the basis of structure and floristic composition.

1. Denser Dryandra - Petrophile shrublands that are 2-3 metres tall when mature and generally confined to duricrust.
2. Diverse, mixed shrublands less than 2 metres tall, with a high proportion of species belonging to the families *Proteaceae, Myrtaceae* and *Leguminosae* and occurring commonly on lateritic duricrust and on sandy soils in depressions in the lateritic plateaus and on spillway deposits in lower parts of the landscape.
3. Shrubland with Drummond's mallee or *Eucalyptus exilis* as an overstorey or emergent, often with types 1 or 2 above as an understorey and usually on sandy and gravelly soils on laterite plateaus, or on Boyagin Rock with gungurru *(Eucalyptus caesia)* dominant.
4. Sclerophyllous shrubland with grass tree and emergent slender banksia *(Banksia attenuata),* acorn banksia *(Banksia prionotes),* bull banksia *(Banksia grandis)* and fan hakea *(Hakea baxteri)* on white, sandy soils.

Herbaceous plant communities
Where there is shallow soil development on granite outcrops, there is often a low meadow of resurrection plants and small, ephemeral annuals.

Fauna of Boyagin Nature Reserve
Boyagin reserve has been a refuge for some fauna which has all but disappeared from the wheatbelt and is a good habitat for fauna re-introductions when combined with fox control. The fauna of Boyagin include: quenda or southern brown bandicoot *(Isooden obseslus fucsiventer),* numbat *(Myrmecobius fasciatus),* red tailed phascogale *(Phascogale calura),* brushtail possum *(Trichosurus vulpecula)* and pygmy possum *(Cercartetus concinnus).* Notes on some of these animals can be found in the Fauna section of this report.

Tutanning Nature Reserve
Sources: Hopkins A. *et al.* (1985), Friend G. (1990)

Tutanning Nature Reserve has been acclaimed as one of the richest and most important conservation areas in Western Australia. It is a haven for several of the State's rarest mammals including the tammar wallaby *(Macropus eugenii)*, woylie *(Bettongia penicillata)* and red-tailed phascogale and is a refuge for the rare malleefowl (*Leipoa ocellata*). It harbours some 35 species of reptiles, seven species of frogs and 10 species of native mammals. It boasts some of the richest flora sites in the world with recent studies in the heathland (kwongan) having recorded 315 plant species from 11 sites and totalling only 64 hectares. In total, 630 plant species have been collected. Rare and restricted species recorded include the smooth-lipped spider orchid *(Caladenia integra),* Tutanning triggerplant *(Stylidium expeditionis), Hakea loranthifolia,* king dryandra *(Dryandra proteoides)* and the Tutanning pomaderris *(Pomoderris bilocularis)*. It is an outstanding remnant of the original ecosystem.

Tutanning Reserve crystalised the concept of conservation reserve when it was vested in the Fauna Protection Advisory Committee in 1960. The key players, Mr. J. P. Marshall, a farmer who owned land south of the area, Professor A. R. Main and Mr. R. D. Royce of the Fauna Protection Advisory Committee could see that little would remain of the rich and varied beauty of Tutanning's bush and wildlife and urged that the land previously set aside in 1929 for timber be assessed as a potential fauna reserve.

Tutanning Nature Reserve now has an area of 2078 hectares of which some 315 hectares is in a block to the south-east separated from the main body of the reserve by 700 m of cleared farmland. Over the past 25 years, extra land has been consolidated into the reserve; this has come about by inclusion of other timber reserves, road reserves and through the purchase of intervening blocks of farmland.

Tutanning Nature Reserve encompasses an extremely diverse cross section of the landscape (Figure 15). The Reserve includes the Dutarning Range and nearby lateritic plateau remnants to 440 m in elevation and a variety of lower numbers of the landform sequence to an elevation of 340 m. At the top of the landform sequence is a complex of lateritic residuals and associated sediments with pools of sand, gravelly sand duplex yellow soils and duricrust (fused laterite). In the middle of sequence, the lateritic materials have been stripped away to produce gentle slopes with sandy loams, yellow duplex soils and exposures of doleritic or granitic country rock. The slopes run into a valley floor which is composed mainly of coarse textured soils.

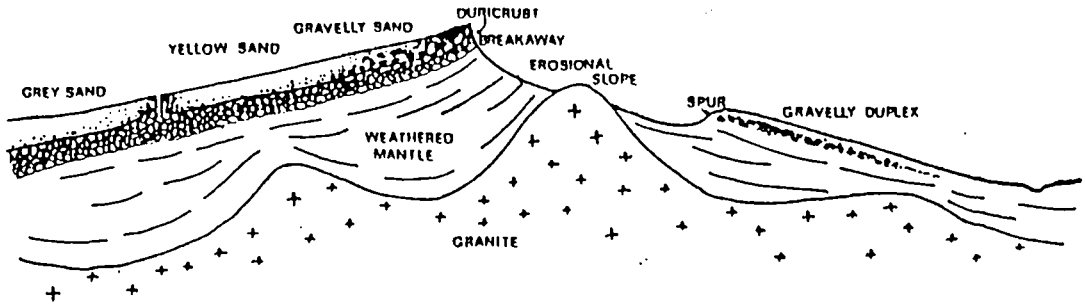


Figure 15: Cross section of the Tutanning landscape showing landform and major soil types. Source: Hopkins *et al.*, (1985)

The vegetation in Tutanning is a mosaic with some relationships between soils and vegetation. The lateritic soils together with the pockets of overlying sands support low woodlands of powderbark wandoo, Drummond's mallee and *E. pachyloma* together with shrublands dominated by prickly dryandra *(Dryandra armata),* golden dryandra *(Dryandra nobilis), Dryandra ferruginea, Dryandra seneciifolia* (on laterite) and roadside teatree *(Leptospermum erubescens), Eremaea pauciflora,* round-fruit banksia *(Banksia sphaerocarpa),* common smokebush (*Conospermum stoechadis), Davesia* spp. and *Hakea* spp. (on sand). Pediment slopes below the lateritic breakaways support woodlands of brown mallet, powderbark wandoo with some wandoo and rock sheoak and shrublands with king dryandra *(Dryandra proteoides).* In the mid to lower slope areas below the heavy clay upper slopes, soils are predominantly sandy to sandy loam with occasional outcrops of granite and dolerite. Woodlands and low forests of wandoo, York gum, rock sheoak, jam and wilyurwur occur, often with box poison in the understorey. One small area of salmon gum is located at the western end of the Reserve. Sandy loams on the lower slopes and the drainage floor soils support woodlands of wandoo, rock sheoak, wilyurwur and orange wattle *(Acacia saligna).*

Tutanning Nature Reserve became Western Australia's first biological research station in 1964 and has since been the site of major ecological studies. There is a permanently marked sampling grid with 316 sampling points for monitoring, development of a detailed geographical information system including soils, vegetation, fire history and topography, detailed ecological studies, and studies on fire effects, rehabilitation of abandoned farmland, ecology of the tammar and woylie, fire fuel accumulation and litter invertebrates.

Murnanyine Nature Reserve 30298
Source: CALM Narrogin

This 28.7 hectare reserve is in reasonable condition but with weed invasion particularly at the edges and north east corner. Some timber cutting has occurred. Nest hollows are available but some have been lost through timber cutting. The reserve comprises the following vegetation communities:

- Open wandoo woodland with some stands of low rock sheoak forest.
- Low woodland of wandoo and rock sheoak
- Open low scrub with box poison dominant
- Open herbs including weeds.

Boyermucking reserve 12098
Source: B. G. Muir (1979)

This 35.6 hectare reserve was originally set aside for "Water" in 1909 and made an A class reserve in 1956. The reserve has been heavily disturbed with timber removal, grazing and rubbish dumping. Weed encroachment has taken place over a very high percentage of the reserve. There are abundant nest hollows in the wandoo. The reserve is a valuable patch of bush for birds and animals that use the long corridor of the Avon River.

The vegetation associations include:

- Jam-York gum low woodland with mixed shrub understorey. Other species include: rock sheoak, red morrel, *Dampiera spicigera, Enneapogon caerulescens,* scented matrush *(Lomandra effusa), Olearia revoluta,* cluster-leaved blindgrass *(Stypandra imbricata)* and orange immortelle *(Waitzia acuminata).*
- Wandoo open woodland over jam and rock sheoak low woodland. Other species include: *Borya sphaerocephala, Calytrix* affin *fraseri, Harperia lateriflora,* scented matrush, feather speargrass *(Stipa elegantissima)* and cluster-leaved blindgrass,
- Creek and creek margins with aquatics, samphire flat and marginal trees and shrubs. Species of the creek margin include flooded gum, *Arthrocnemum bidens*, lesser bottlebrush *(Callistemon phoeniceus)*, swamp sheoak and *Melaleuca hamulosa.*

Other Eucalypts recorded are salmon gum and red morrel.

Jingaring Nature Reserve 13797
Source: B. G. Muir (1979)

This 36 hectare reserve was originally set aside for "Water and Camping" in 1911 and became "Conservation of Flora" in 1950.

The vegetation comprises wandoo woodland with little understorey and a floristically very rich mixed heath. Fifty one plant species have been recorded

North Woyerling Nature Reserve 20066
Source: B. G. Muir (1979)

This 23 hectare reserve which is in excellent condition was originally set aside for "Timber (Mallet)" in 1929 and changed to "Conservation of Flora and Fauna" in 1967.

Wandoo woodland covers the whole reserve with addition of rock sheoak and other trees. The understorey is fairly rich in species with 46 species recorded.

Petercaring Nature Reserve 20095
Source: B. G. Muir (1979)

This 39 hectare reserve was originally set aside for "Timber (Mallet)" in 1929 and changed to "Conservation of Flora and Fauna" in 1975. A fire in the early 1970's has provided a large area of woodland in an early seral stage. The vegetation comprises:

- Fire regrowth of brown mallet low forest over *Gastrolobium* spp. heath
- Rock sheoak dense low forest.
- Unburnt rock sheoak dense low forest with numerous plant species.

22 plant species have been recorded.

The red-tailed phascogale has been recorded in the reserve in 1991/92.

Noombling Nature Reserve 26150
Source: B. G. Muir (1979)

This 46 hectare reserve was set aside for "Conservation of Flora" in 1961. The vegetation is wandoo woodland over Gastrolobium dwarf scrub over a grass and sedge ground cover. Some areas have abundant rock sheoak. 27 native plant species were recorded. The reserve has been burnt frequently.

Datenning Nature Reserve 28656
Source: B. G. Muir (1979)

This 23 hectare reserve was first set aside for "Conservation of Flora" in 1967. The reserve is valuable for conservation but timber has been removed and much of the reserve disturbed by human activities, with gravel pits and parts cleared. The vegetation comprises wandoo, jam and flooded gum low woodland and York gum woodland. A creek runs the length of the reserve with couch grass and an orange wattle thicket. Weeds are abundant throughout the reserve.

Napping Nature Reserve 21286
Source: CALM Narrogin

This 61 hectare reserve was originally set aside for mallet but is floristically very interesting. There is a small grove of York gum and jam which merges into jam and salmon gum in the north east corner. The major portion of the reserve is typical laterite plateau with Drummond's mallee, golden dryandra, pingle and various *Hakea* spp. and *Petrophile* spp.

To the west there is a fringe of brown mallet, a pure stand of powderbark wandoo and a pure stand of hook-leaved mallee *(Eucalyptus uncinata)*. Further west, wandoo predominates on the stony gravelly clay loam flat.

Pingelly Nature Reserve 29182
Source: CALM Narrogin

The vegetation associations on this 5 hectare reserve comprise:

- Harsh hakea *(Hakea prostrata)* thicket over introduced groundcover with emergent rock sheoak and *Acacia* spp.
- Wandoo woodland over *Oxylobium/Gastrolobium* spp. over introduced groundcover - upland areas
- Brown mallet and wandoo woodland over *Oxylobium/Gastrolobium* spp. low scrub
- Rock sheoak low woodland

Noonabin Nature Reserve 11320
Source: CALM Narrogin

This 3.5 hectare reserve, although small, appears to be valuable as a transient refuge for birds. The vegetation is rock sheoak and jam with scattered wandoo over open low scrub of box poison over introduced weeds. The grass tree and red morrel occur.

Nature Reserve 27223
Source: CALM Narrogin

The vegetation associations in this 6.9 hectare reserve include:

- Thicket of *Allocasuarina campestris* with scattered powderbark wandoo over open herbs
- Open woodland of powderbark wandoo over jam over open herbs, with a small area of low heath
- Open low woodland of powderbark wandoo with some red morrel over rock sheoak Scrub with some jam over open herbs.

Mockerdungulling Nature Reserve 2023
Source: CALM Narrogin

32.6 hectares of York gum jam woodland with rock sheoak, wandoo and flooded gum.

Horne Nature Reserve 21827

The vegetation associations in this 166.7 hectare reserve include:

- Low open woodland of wandoo over heath over herbs
- Scrub mallee of black marlock *(Eucalyptus subangusta)* over herbs
- Low heath of round-fruit banksia and prickly dryandra over tall sedges
- Low woodland of powderbark wandoo and wandoo over heath of white myrtle *(Hypocalymma angustifolia).*
- Low forest of brown mallet over very sparse herbs and shrubs
- Open woodland of powderbark wandoo over scrub of *Petrophile divaricata,* grass leaf hakea *(Hakea multilineata)* and golden dryandra over dwarf scrub of *Melaleuca* species and *Petrophile divaricata* over low sedges.

Moorumbine Nature Reserve 6798
Source: CALM Narrogin

Tree species noted for this 18.7 hectare reserve include: Jam, rock sheoak, wandoo and York gum.

Goodenough Nature Reserve 6799 and 28599

This reserve of almost 71 hectares is in reasonable condition but with weed invasion on lowland areas, watercourse and perimeters. The following plant formations occur:

- York gum woodland with jam, rock sheoak and an understorey of weeds plus sedges
- York gum woodland with jam, rock sheoak and *Acacia microbotrya* over weed invaded understorey plus climbing lignum *(Muehlenbeckia adpressa)*
- York gum and wandoo woodland over *Acacia microbotrya* and jam over disturbed understorey
- Wandoo woodland over box poison, panjang *(Acacia lasiocarpa)*, blueberry lily *(Dianella revoluta)* and grass tree over weed invaded understorey in lowland areas and *Borya sphaerocephala* herbs on upland areas
- Rock sheoak woodland over box poison, *Gastrolobium spinescens*, some wandoo and jam over *Borya sphaerocephala* with *Cheilanthes tenuifolia*. This vegetation type supports a rich orchid population
- Jam with some wandoo and rock sheoak.

Woyerling Nature Reserve 9714 and 10142 and Landscape Hill 39174
Source: CALM Narrogin

This 93.4 hectare reserve contains the following vegetation associations:

- Dense rock sheoak and jam with scattered wandoo and York gum over low *Borya* herb-field, low sedges and in places dense introduced grasses.
- York gum woodland over dense introduced grasses with wandoo upslope with open shrubs of prickly poison, parrot bush and *Leptospermum* sp.
- Scattered thickets of rock sheoak and jam over *Borya* sp. and other low growing herbs
- Open wandoo woodland with scattered jam and rock sheoak over very open low shrubs and *Borya* sp.
- Small areas of species rich sandplain.

The red-tailed phascogale has been located on private property south of these reserves in wandoo woodland over low forest of rock sheoak over low scrub of mixed species.

Wetlands and rivers

The divide between the Avon and Hotham River systems runs through the south central part of the Shire of Pingelly and the Hotham river forms part of the southern boundary of the Shire. Being at the headwaters is an important responsibility for any community as the results of local actions affect the rivers and their environments on the long path to the sea

The Avon River system

The Avon River system drains 120,000 square kilometres of land mass. It is comprised of four main river systems: the Avon, the North Mortlock, the East Mortlock and the Dale. Many of the tributaries of the Avon River begin in the Shire of Pingelly, some being: Woodebulling Creek, Woyerling Creek, Sandplain Creek, Petercarring Brook, Avon River South and the Dale River South (Figure 16). Four topographical divisions of the Avon River System are shown in Figure 17.

Most of the wetlands in the upper Avon River catchment were fresh or near fresh until the mid 1930's. Lake Yealering on the border of Pingelly and Corrigin Shires is reported to have become saline between 1936 and 1940 (Sanders, 1991). Originally, the wetlands were covered by sheoak, paperbark and tea tree, forming a dense canopy with low scrub below. Animal life in the area of the Avon was varied and quite different to that which occurs today.

There has been a rise of saline ground water as a result of the clearing of native vegetation throughout the agricultural region with salinity increasing in the Avon River catchment much earlier than other wheatbelt regions which were cleared later. The wetlands of the wheatbelt have suffered enormous changes as a result of these salinisation processes, run off, siltation and eutrophication.

Increasing river salinity was quickly followed by the death of vegetation fringing lakes and wetlands in the catchment. The freshwater aquatic weed, *Marsillea* sp. (nardoo) found in the Avon River began to disappear as a result of these changes and the appearance and increase of ribbonweed *(Ruppia maritima)* was recorded. This is a salt tolerant species (Sanders, 1991). Animal species are also good indicators of increased salinity. Kim Mills, of Brookton Shire, reports that "the last gilgies were observed in the river around 1960, fresh water crays 1955-60, shrimps 1965-70. A dry salty crust now appears where pools have dried in summer. The biggest flood was in 1935 with another major flood in 1955".

The Avon River was characterised by long, deep pools separated by braided sections where the river ran in numerous channels between islands of vegetation. The pools were important refuges and breeding sites for a range of water fowl and fauna. Flooding was a regular feature of river flow with the occasional high flood levels inundating large areas adjacent to the river. Early settlers often built close to the river and flooding became a concern with low lying settlements being subject to high flood levels in later years.

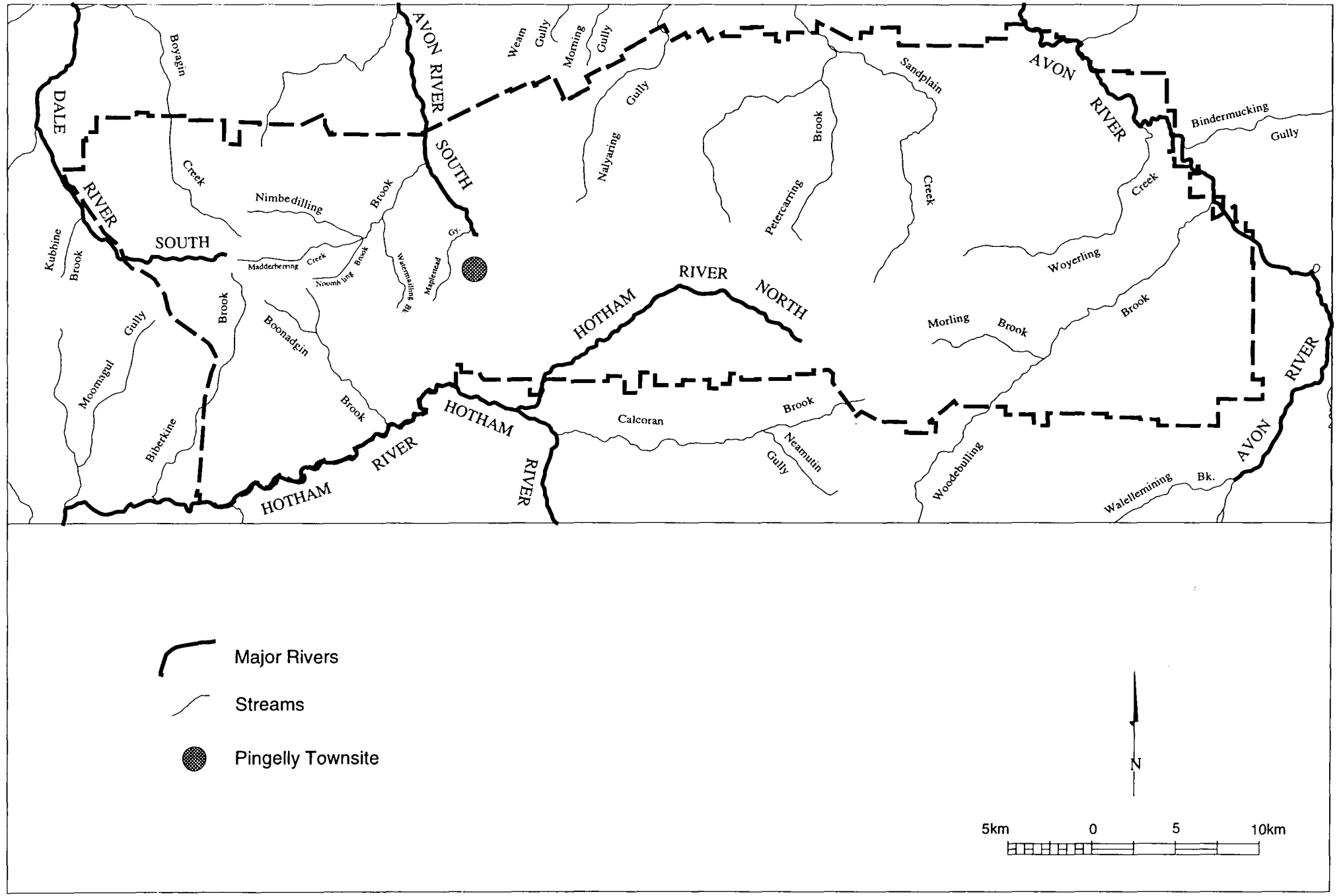
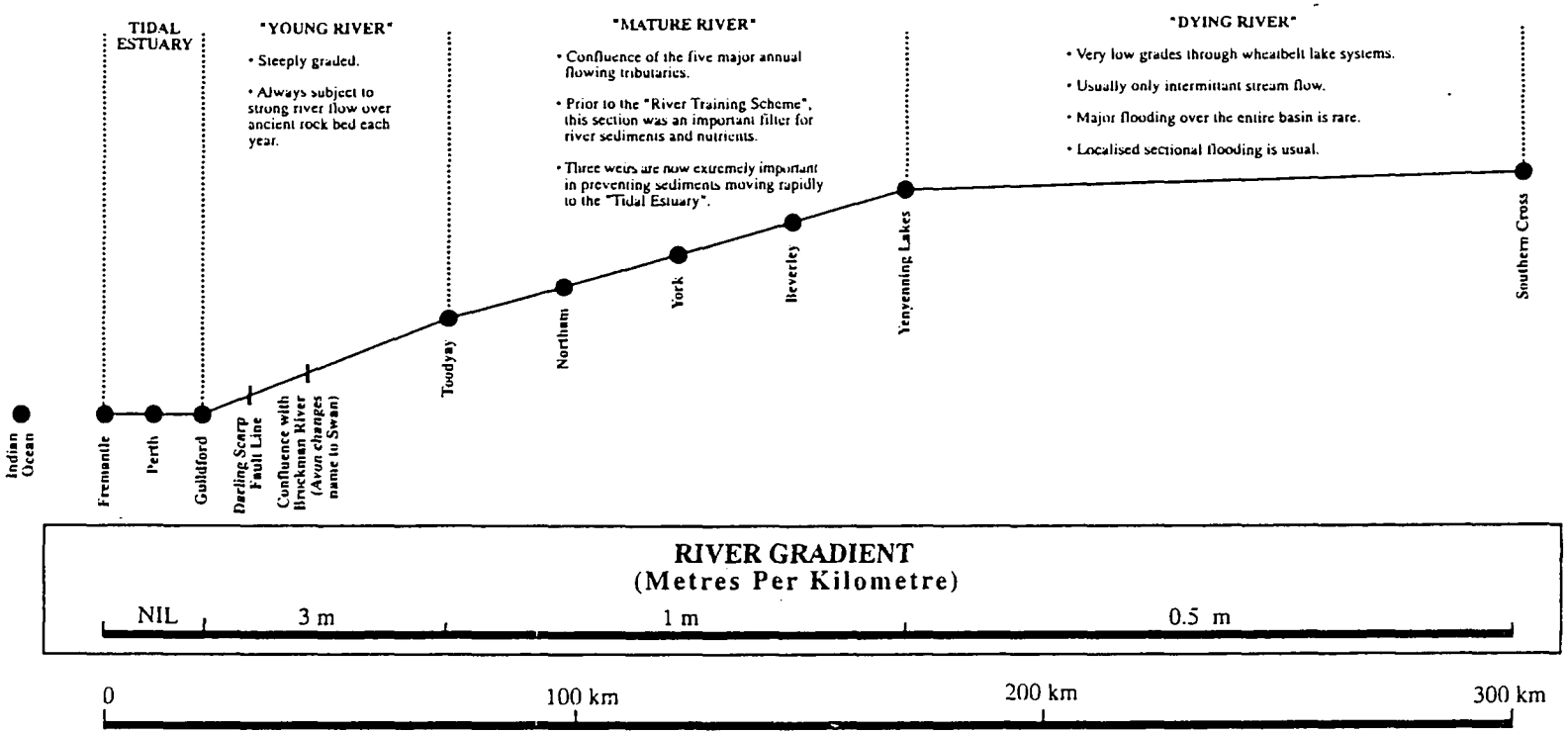


Figure 16: Major Drainage Systems in the Shire of Pingelly.



Four topographical divisons of the Swan/Avon River System

The Avon Management Committee was set up in 1984 to tackle some of the problems of the Avon River system and to bring together local government representatives from each Shire along the river. One element of the management strategy was the establishment of the Avon River Management Authority (ARMA) in 1992 (under the Waterways Conservation Act, 1976-1982). Although Pingelly Shire is not included in the Avon River management area (Figure 18), there will be positive benefits from the management strategy. The role of the Authority is to coordinate and advise on research, management and monitoring of the area with the help of a range of organisations including Agriculture Western Australia, the Department of Conservation and Land Management, the Department of Environmental Protection, the Water Authority of WA, the Waterways Commission and a number of community organisations such as the Land Conservation District Committees and the River Conservation Society.

The Authority is addressing some of the problems of the river with foreshore vegetation protection and revegetation projects have been initiated along the length of the Avon River, fencing off areas and stock restrictions, also the control of fire, weeds and feral animals. Much of the foreshore is privately owned which might cause problems but this is being overcome with management agreements between the ARMA and landowners.

The main purpose of the recommendations put forward by the Authority are that the river remain "biologically alive" and that it can be enjoyed as a source of recreation. These issues, amongst others, will be tackled over the coming years.

The pamphlet, *Principles of River Management,* Masters (1996), details the following principles:

1. Understand the nature of the river being protected.
2. Maintain the river's energy balance.
3. Base management on long term observations.
4. Protect natural resources throughout the catchment.
5. Respect the forces of nature.

Further information is available from Agriculture Western Australia (Northam).

The Hotham River

The upper reaches of the Hotham River in the Shire of Pingelly mirror the Avon River in terms of salinity. The catchment has deteriorated significantly since development and now the headwaters of the Hotham River are a major contributor of salinity to the Hotham River and further downstream the Murray River.

Further information

Information on managing wetlands on private land can be found in: Oates, N. (1994). *Managing Your Wetland. A practical guide for landholders.* Victorian Wetlands Trust and Department of Conservation and Natural Resources, Victoria.

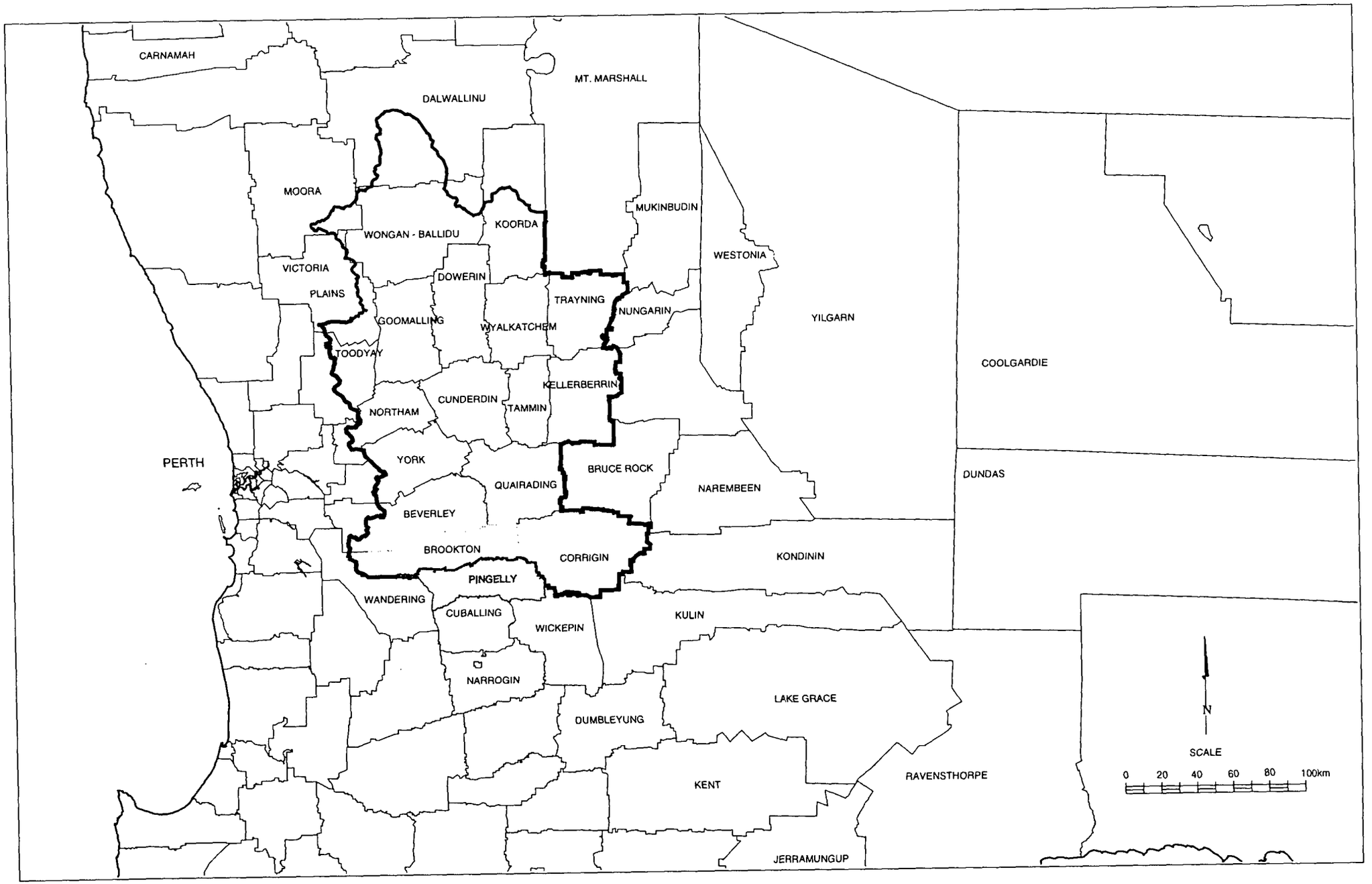


Figure 18: The Avon River Management Authority Area.

Fauna

The fauna of the wheatbelt was once extremely rich but has been reduced greatly since European settlement. For example, of the 44 mammal species originally recorded for the region, 4 are probably extinct, a further 11 are mainly confined to offshore islands and the survival of an additional 10 species is in doubt. Tutanning and Boyagin Nature Reserves are very important refuges for some species and have been the location for some successful re-introductions combined with fox control.

In 1906, G. C. Shortridge camped at Woyerling Spring, 5 kilometres east of Tutanning Nature Reserve, and collected specimens for the British Museum of Natural History. He reported an amazing tally of mammals, some 270 specimens had been collected. This collection comprised many species that are now very rare or extinct on the mainland eg. crescent nailtail wallaby *(Onychogalea lunata)*, banded hare-wallaby *(Lagostrophus fasciatus)*, burrowing bettong *(Bettongia lesueur)*and bilby *(Macrotis lagrotis)* or have considerably reduced distributions eg. numbat, chuditch *(Dasyurus geoffroii)* and Mitchell's hopping mouse *(Notomys mitchellii)* (Friend, 1990).

At that time, the Pingelly district probably supported about 26 species of native mammals, and introduced species such as rabbits and foxes had not then gained a strong foothold. By the time Tutanning Nature Reserve was proclaimed in 1960, clearing and burning for agricultural development, combined with the impact of the now common introduced species, had eliminated about ten of these native mammal species (Friend, G., 1990).

Birds such as whistlers and fairy wrens have not coped well and are generally declining in numbers. Species such as Carnaby's cockatoo (*Calyptorhynchus funereus latirostris*) have undergone a significant reduction through loss of habitat (Saunders and Ingram 1987). The effects on populations after environmental change may be a slow process and so continued loss of these bird species dependent on native vegetation can be expected. Further degradation and fragmentation of remnant vegetation will render many species more vulnerable.

The future

Sadly, the decline of animal species typical of small isolated remnants of bush, has not yet been halted, even at larger reserves like Tutanning. In the last decade numbats, quendas and western ringtail possums seem to have disappeared from Tutanning, and it only contains about 40% of the mammal species that were present when Shortridge collected in the district in 1906 (Friend, 1990).

There is, however, new hope. Researchers have recently found evidence of the positive effects of fox control on native animal populations. Control of foxes in a number of reserves in the region including Boyagin Nature Reserve have shown increases in populations of small mammals including the numbat, chuditch and red-tailed phascogale. This coupled with captive breeding and reintroduction programs have added to the security of some of these species.

The quenda, numbat and red-tailed phascogale have all benefited from fox control programs. The following notes have been derived from Tony Friend, CALM, Woodvale (personal communication) and from Strahan, R. (1995), *The Mammals of Australia.*

The quenda or southern brown bandicoot prefer sandy soil with scrubby vegetation and a mosaic of vegetation, particularly the early stages of regeneration after fire. They are nocturnal and omnivorous, searching the ground and digging for insects, roots, small invertebrates, larvae and termites.

Numbats were reintroduced into Boyagin Nature Reserve in 1985. Numbats feed on termites, require woodland habitat and standing dead timber with tree hollows up to 5 metres above the ground for nesting and shelter.

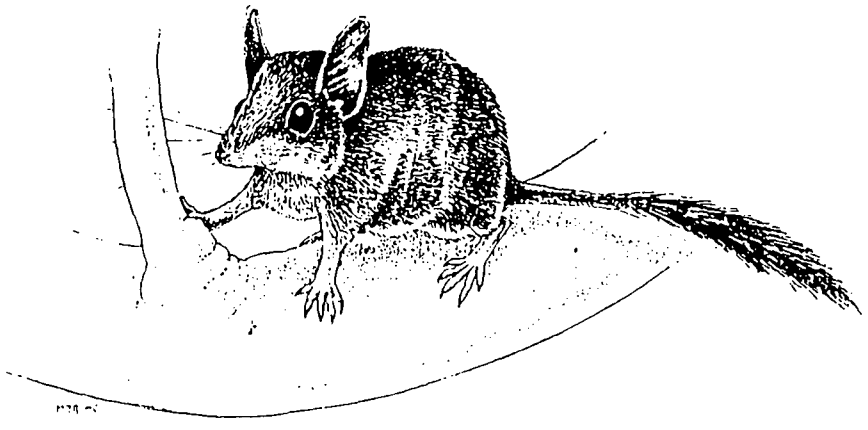


Figure 19. Red-tailed phascogale Source: Bamford (1995)

The red-tailed phascogale is arboreal, prefers large dense stands of rock sheoak and nests in hollows in dead blackboys, logs, dead and live wandoo or sheoak. It is an opportunistic feeder, taking a wide variety of insects and spiders, small birds and small mammals. Red-tailed phascogales are threatened by frequent fire (less than 20 years), foxes and cats. They can live in reserves as small as 65 hectares.

Common animals

Animals commonly seen in the Shire of Pingelly include the western grey kangaroo (*Macropus fuliginosus*), the western brush wallaby (*Macropus irma*) and the echidna (*Tachyglossus aculeatus*) and reptiles including the bobtail (*Tiliqua ragosa*), the blue tongue lizard (*Tiliqua occipitalis*), the dugite (*Pseudonaja affinis*), the mulga snake (*Notechis australis*) and a variety of geckos. Some species such as galahs (*Cacatua roseicapilla*), ravens (*Corvus coronoides*), crested pigeons (*Ocyphaps lophotes*), magpies (*Gymnorhina dorsalis*) and the Port Lincoln parrot (*Barnardius zonarius*) have adapted to and favour the increased agricultural development and are increasing in numbers. Further information on woodland habitats and woodland species of insects, birds reptiles and mammals is available in M. Bamford (1995). *Exploring Wheatbelt Woodlands*. CALM.

Threatened and Priority Fauna

Threatened and Priority Fauna are afforded special protection under Wildlife Conservation Act, 1950 which is administered by the Department of Conservation and Land Management (CALM). CALM has two categories of specially protected fauna:

- Threatened fauna are fauna which is rare, likely to become extinct or extinct.
- Priority Fauna are declared to be fauna that is in need of special protection.

The following Threatened and Priority Fauna are found in the Shire of Pingelly:

Threatened Fauna

Red-tailed phascogale	*Phascogale calura*
Numbat	*Myrmecobius fasciatus*
Tammar wallaby	*Macropus eugenii*
Carpet python	*Morelia spilota imbricata*

Priority Fauna

Western brush wallaby	*Macropus irma*
Native bee (no common name)	*Hyaleus globuliferus*

Declared Rare and Priority Flora

Declared Rare Flora are taxa which have been adequately searched for and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild, and have been gazetted as such. The descriptions have been derived from *Western Australia's Endangered Flora* (Hopper *et al.*, 1990).

The following Declared Rare Flora have been reported in the Shire of Pingelly (lists supplied by the Department of Conservation and Land Management).

Hill thomasia ***Thomasia montana***
An upright shrub to 1m high with pale lilac flowers in September to October. Found on lateritic red clay-loam soils in open low woodland.

Shy feather flower ***Verticordia fimbrilepis*** **subsp.** ***fimbrilepis.***
An erect small shrub to 60cm high with slender branches and clusters of attractive purplish pink flowers in November to December. Grows in shallow sand over gravel amongst mixed heath.

Verticordia fimbrilepis **subsp.** ***australis***
Differs from *Verticordia fimbrilepsis* subsp. *fibrilepsis* in its long peduncles (5-15 mm long). Grows in granitic soil in low open heath. Flowering period: late October-November.

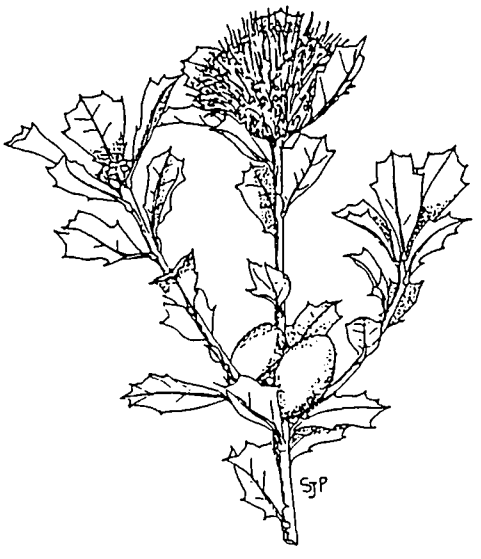


Figure 20. The matchstick banksia *(Banksia cuneata)* is Declared Rare Flora in the Avon Catchment

Priority flora

The Department of Conservation and Land Management also lists Priority Flora. These are rare and poorly known, some under threat but they have not been gazetted as Declared Rare Flora. The following plants have been listed for the Shire of Pingelly:

Acacia anarthros
Acacia campylophylla
Acacia cuneifolia (ms)
Acacia gemina (ms)
Acacia insolita subsp. *efoliolata* (ms)
Andersonia carinata
Anigozanthos bicolor subsp. *exstans*
Beaufortia sp. column (JS Beard 8119)
[aff. *heterophylla*]
Boronia capitata subsp. *capitata*
Caladenia integra
(Smooth-lipped spider orchid)
Caladenia triangularis x (Shy spider orchid)
Calothamnus brevifolius
Calothamnus rupestris (Mouse ears)
Chamelaucium croxfordiae (ms)
Chorizandra multiarticulata exilis
Dryandra columnaris
Dryandra cyrnaroides
Dryandra ferruginea subsp. *tutanningensis*
Dryandra subpinnatifida
Eucalyptus caesia subsp *caesia*
Eucalyptus latens (Narrow-leaved red mallee)
Eucalyptus aff. *latens*
Eucalyptus marginata x pachyloma
Hemigenia glabrescens
Hemigenia rigida
Jacksonia epiphyllum (ms)
Nemcia stipularis
Persoonia hakeiformis
Pomaderris bilocularis (Tutanning pomaderris)
Stylidium coatesianum in the wild
Stylidium expeditionis (Tutanning triggerplant)
Stylidium tenuicarpum
Synaphea flabelliformis
Tetratheca retrorsa
Thysanotus tenuis
Trachymene moorei subsp. Tutanning
Verticordia bifimbriata
Verticordia huegelii var. *tridens*

Land Resources

Geology

Source: Lantzke N. and Fulton I. (1993) and Chin R. J. (1986).

Most of the agricultural region of Western Australia including the Shire of Pingelly is underlain by gneiss, granite and migmatite rocks. This has been a relatively stable part of the earth's crust for 2400 million years (Geological Survey, 1990).

Gneisses are hard crystalline banded rocks which were affected by high pressures and temperatures (that is metamorphosed) when they were several kilometres below the earth's surface. The minerals present are commonly quartz and felspars.

Granites are hard crystalline rocks dominated by quartz and felspars, have very few dark minerals and are not banded. Granites form when very large masses of molten rock ('magma') are pushed up ('intruded') into the earth's crust. Here the magma cools and crystallises.

Earth movements over hundreds of millions of years have uplifted the basement rocks and weathering has led to soil formation.

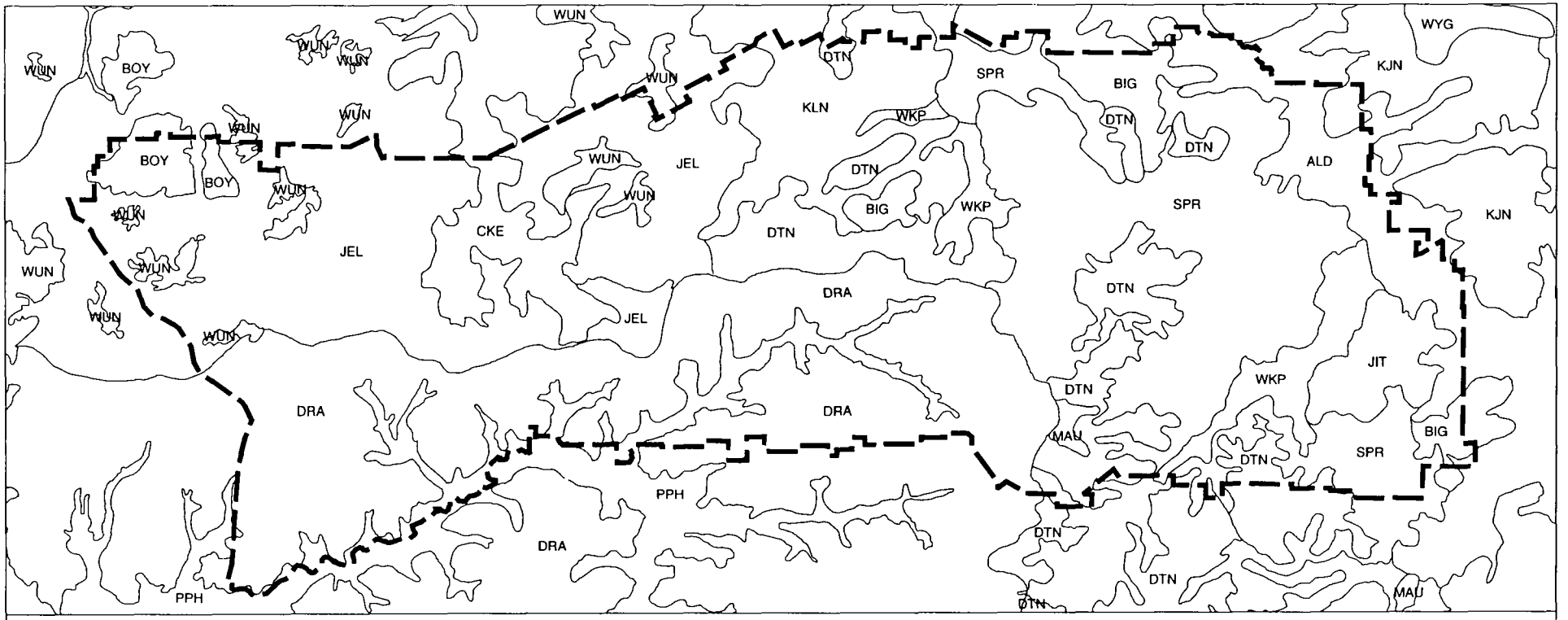
Suites of basic and quartz dykes have intruded into the gneisses, granites and migmatites. Dykes form when molten material is forced upwards into fractures within the basement rocks and cools to form a feature which is often vertical and may be from millimetres to tens of metres wide and several kilometres long. The most common rock type is dolerite which is a dark rock with a high proportion of iron and magnesium minerals. Quartz dykes are a prominent feature in some areas.

Soils

The distribution of the soil landscape systems of the Shire of Pingelly is shown on Figure 21 within two physiographic regions:

The **Zone of Rejuvenated Drainage** is characterised by greater dissection of the landscape forming steeper, narrower valleys which contain rivers and creeklines that flow in Winter. Small remnants of sandplain occur, often bordered by a scarp or breakaway. Large areas of sandy surfaced over yellowish clay soils occur in the area. Where the lateritic profile has been completely removed there area extensive areas of rocky red and greyish soils. The valley floors contain alluvial clays, loams and sand.

The **Zone of Ancient Drainage** consists of gently undulating plateau with wide divides, long gentle slopes and broad valleys that contain salt lakes. Large areas of yellow sandplain and gravelly soils occur on the upland areas. Dissection of the lateritic profile on the slope has resulted in the formation of hardsetting grey duplex soils with some loose, sandy surfaced duplex soils on the lower slopes (Lantzke and Fulton, 1993).



SOIL - LANDSCAPE SYSTEMS

ALD	Alderside	JEL	Jelcobine	PPH	Pumphreys Bridge
BIG	Bilgening	JIT	Jitarning	SPR	Springfield
BOY	Boyagin	KLN	Kulin	WUN	Wundowie
CKE	Cooke	KJN	Kunjin	WKP	Wickepin
DTN	Dattening	MAU	Maublaring	WYG	Walyuring
DRA	Dryandra				

N

5km 0 5 10km

Figure 21: Soil - Landscape Systems within the Shire of Pingelly.

The soil landscape systems are described below (Verboom and Galloway, unpublished) and further information is available from the Natural Resource Assessment Group, Agriculture Western Australia, South Perth:

Alderside System (ALD) Differentiated old alluvium and colluvium derived from the adjacent sandplain. Occurring in major low gradient valleys of the Zone of Ancient Drainage. Casuarina and tea tree thicket with scattered wandoo on heavy duplex soils comprises the major vegetation.

Bilgering System (BIG) Undulating low hills of lateritic plateau largely stripped by erosion, in the southern areas of the Zone of Ancient Drainage. Gravelly and shallow duplex soils are the major soils. The principal vegetation types are scrub heath and casuarina thicket on old surface, wandoo and gimlet on new surface.

Boyagin System (BOY): Major rock outcrop with duricrust remnants in the Zone of Rejuvenated Drainage. Bare rock and stony or gravelly soils predominate. Vegetation consists of casuarina woodland, jarrah-marri and wandoo forest with parrotbush understorey. There is mallet and powderbark on scarp faces.

Dattening System (DTG) Undulating to rolling low granite hills in the western Zone of Ancient Drainage. Grey shallow and deep sandy duplexes are the main soils. Major vegetation consists of York gum-jam, casuarina and wandoo woodlands.

Jelcobine System (JEL) Isolated steep low hills with undulating low granite hills and isolated lateritic remnants in the Zone of Rejuvenated Drainage. Principal soils are gravels and grey shallow to deep sandy duplexes. Wandoo, York gum, jam and casuarina woodland predominate.

Jitarning System (JIT) Undulating low hills of the stripped old lateritic plateau in the Zone of Ancient Drainage. Main soils are alkaline grey shallow to deep sandy or loamy duplexes and gravels. Major vegetation types include scrub heath-casuarina thicket on sandplain, wandoo, gimlet and mallee elsewhere.

Kulin System (KUL) Gently undulating rises of partly intact old lateritic surface with few breakaways in the Zone of Ancient Drainage. Principal soil types are yellow sandy earths, gravels and alkaline grey shallow or deep sandy duplexes. Tamma scrub and sandplain heath predominate.

Maublaring System (MAU) Undulating low hills of old lateritic plateau. Main soil types are shallow and moderately deep sandy gravels. Principal vegetation found in this system is scrub heath and casuarina thicket on old surface, wandoo and gimlet on new surface.

Springfield System (SPR) Undulating low hills in southern areas of the Zone of Ancient Drainage. Sandy gravels, sandy duplexes and shallow sands predominate. Main vegetation types include wandoo, gimlet, black marlock and mallee scrub, scrub heath and casuarina on sandplain remnants

Wallambin System (WAL) Salt lake chains in the central Zone of Ancient Drainage with salt lake soil and calcareous loamy earth. Mallee, morrel woodland and saltbush-bluebush-samphire flats predominate.

Wickepin System (WKP) Found in major valleys in the Zone of Rejuvenated Drainage and secondary valleys in the Zone of Ancient Drainage. Predominant soils are grey shallow to deep sandy duplexes. Principal vegetation is wandoo, York gum, jam and casuarina woodlands.

Wundowie System (WUN) Lateritic plateau with deep sandy gravels. Jarrah-marri forest and woodland predominates.

Walyuring System (WYG) Undulating low hills of largely intact lateritic surface in the Zones of Ancient and Rejuvenated Drainage. Main soils are shallow to deep sandy gravels and deep pale sands. Major vegetation types include Christmas tree, banksia and casuarina with sandplain heath.

Yelbeni System (YLB) Gently undulating sandplain plain in the central Zone of Ancient Drainage with yellow sandy earth (occasionally acid), yellow deep sand, gravel and pale deep sand. Heath, shrubland and mallee scrub predominate.

Pumphreys Bridge System (PPH) Valley floors in the central Zone of Rejuvenated Drainage with deep sandy duplex, pale deep sand and wet soil (often saline).

Dryandra System (DRA): Gently undulating granitic terrain in the central Zone of Rejuvenated Drainage with deep sandy duplex, loamy duplex and brown loamy earth.

Kunjin System (KJN): Gently undulating rises of partly intact lateritic surface in the Zone of Ancient Drainage. Yellow sandy earths, gravels and alkaline grey shallow or deep sandy duplexes are the main soil types. The principal vegetation types are tammar scrub and sandplain heath, wandoo, York gum, jam and gimlet.

Cooke System (CKE): Low granitic hills in the north of the Western Darling Range with rock outcrop, stony soil, grey deep sandy duplex, loamy earth and gravel. The major vegetation types include jarrah-marri woodland, heath and lichens.

Land Management and Land Degradation Issues

History

The first European farmers settled in the Avon valley in 1831 and established themselves as pastoralists, grazing sheep on the native herbage and cropping small areas of the better soil types.

For the next fifty years, the region developed at a steady rate as new areas of land were released, settled and cleared. In the second half of 1880, the railway came to the Avon Valley reducing the isolation of farmers. Large advances in agriculture were made in the early 1900's. Superphosphate came into general use, together with the seed drill, the stripper harvester and large horse teams. The jam and York gum soils were found to produce excellent crops when superphosphate was applied.

The most notable farming developments in the study area in the 1920's were the introduction of the farm tractor and the first attempts to introduce subterranean clover. In 1936, the first sidings for bulk wheat handling were built. The years following the second world war saw a rapid increase in the area established to improved pasture.

Advances in soil nutrition in the 1950's allowed trace element deficiencies on sandplain soils to be corrected thus opening up large areas of land. In the 1970's, a range of herbicides became available for weed control allowing the development of reduced tillage systems.

Current land uses

The dominant land use in the Shire of Pingelly is agricultural production. The type of production practised changes in a gradual trend from sheep grazing on subterranean clover based pastures and some cropping where rainfall is higher in the west to broadscale cropping and sheep grazing on subterranean clover and medic based pastures in the east.

An increasing proportion of rural land in the west of the Shire is being used for rural residential and hobby farm development.

Land degradation

European settlement in the south-west of Western Australia and the subsequent clearing of native vegetation and replacement with crops and pastures have given rise to problems of land degradation, the loss of agricultural production and loss of conservation values of the area. The most obvious problems are associated with changes in hydrology, for example, the rising water table with salinity and waterlogging.

The State's south-west agricultural region produces agricultural goods worth over $4.5 billion annually on around 18 million hectares of cleared land. Already about 1.8

million hectares of formerly productive land, or about 10% of Western Australia's farmed areas, are affected by salinity. Production from this land has either been lost or reduced. It is estimated that the total of this loss is in the order of $1445 million. If the current rate of salinity expansion continues, there will be a resulting annual loss to agriculture of $64 million each year. In the past, farmers largely adapted to the cost of salinity and land degradation by increasing production on unaffected land and developing uncleared land. This will be increasingly difficult in the future as the resource base continues to deteriorate (Western Australia Salinity Action Plan, 1996).

Within the Shire of Pingelly, the most prevalent land degradation problems are ones of waterlogging, salinity and salt scalding, wind and water erosion and top and sub-soil acidification. A brief summary of these problems is provided below.

Rising water tables and salinity

The principal cause for increased soil surface salinisation in much of the wheatbelt has been the removal of native deep-rooted perennial vegetation and its replacement with annual shallow-rooted crops and pasture. Less water is transpired (given off via leaves) by these shallow-rooted plants resulting in the rise of groundwater, and the rise of soluble salts to the plant roots or soil surface. Quite often the effects of salinity are not seen for 15-20 years following the removal of native vegetation.

The Shire of Pingelly had 3 058 hectares of land affected by salinity in 1979 and 5938 hectares (5.29% of arable land) affected in 1989 representing a 1.9% increase in ten years (George, 1990).

Drainage and pumping methods can be used to drain limited areas of land but drainage water can be detrimental to land further down the catchment. Biological solutions include planting perennial, deep-rooted vegetation and adopting farming practises that utilise more water. Revegetation low in the landscape areas has been recommended (Schofield and Scott, 1991) but it is suggested that initial plantings be kept well back from saline areas with the expectation of moving into the saline areas as water tables are lowered.

Waterlogging

A soil is waterlogged when it is completely saturated by water due to poor internal and surface drainage, low permeability of the subsoil and the inability of the soil to store much water. This is exacerbated by the removal of deep-rooted vegetation, rising water tables, cultivation and soil compaction from stock trampling and use of heavy farm machinery. It reduces plant growth, particularly where soils are salt-affected.

Waterlogging is most prevalent in areas of above 400mm annual rainfall and particularly on duplex and clay soils in plains and valley floors with a high risk of inundation.

Harry Whittington, a farmer from Brookton Shire, has over many years of practical observation and experimentation formulated an understanding of the deteriorating soil health of our farming landscape. He believes that water logging and salinity can be

controlled by taking measures to retain rainfall where it falls rather than allow it to move to lower slopes. He has pioneered the construction of a system of interceptor banks on the upper slopes of the landscape and believes that where these have been constructed there is good evidence of improved productivity on the upper and lower slopes (H.S. Whittington, personal communication). Mr Whittington has had a big role in establishing the WISALTS group and "Whittington Banks" are now a feature of many landscapes in the wheatbelt. Many of these banks are now being planted with trees to provide shelter and to increase water use.

The scientific community has been at odds with the WISALTS group as it is considered that seepage from level banks can increase salinity (McFarlane *et al.*, 1990) resulting in lively debate in the community over landcare issues. Agriculture Western Australia recommends contour banks in some circumstances provided safe disposal of water can be achieved (Figure 22).

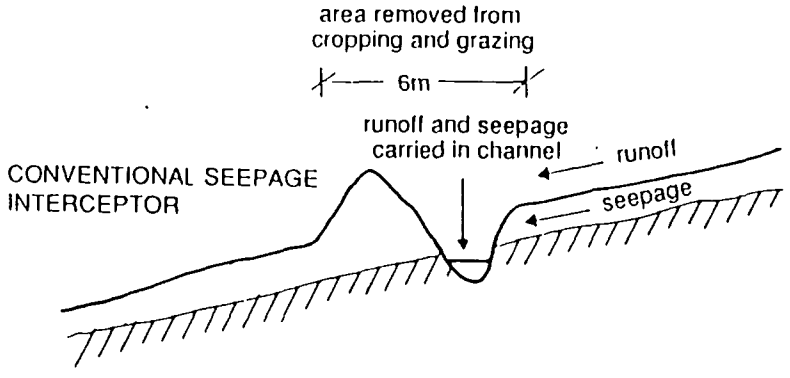


Figure 22. Cross section of a conventional seepage interceptor drain
Source: Hunt and Gilkes (1992)

Wind erosion

Wind erosion is the removal of topsoil by the wind from bare soil surfaces, redepositing it elsewhere. The loose, sandy soils of Western Australia are prone to wind erosion particularly following cultivation and overgrazing and in times of sustained droughts. The three major processes of wind erosion, saltation, surface creep and suspension, are shown in Figure 23.

The Shire of Pingelly, being largely comprised of sandy surfaced soils, is considered to be highly susceptible to wind erosion. Wind erosion can occur on all soil types if cover is removed, the soil is detached (loosened) and strong enough winds occur.

Appropriate grazing management, farming to soil type, modifying tillage and direct seeding into stubble and the establishment of wind breaks can reduce wind erosion. Windbreaks should be several rows wide and consist of trees and understorey at right angles to the most damaging winds. Windbreaks, if appropriately designed can also serve as effective wildlife corridors linking areas of existing vegetation.

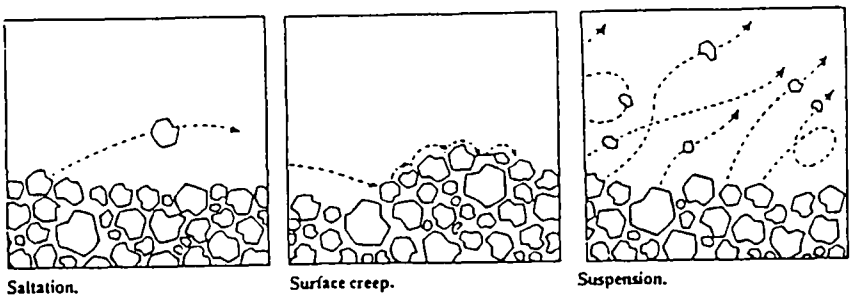


Figure 23. The three major processes of wind erosion
Source: Hunt and Gilkes (1992)

Water erosion

Water erosion results in a loss in soil fertility, reduced crop yield and siltation of waterways. The water repellent sandy soils of Western Australian are particularly susceptible to water erosion made worse by over-cultivation, overgrazing and stock trampling. This erosion is of most concern on steep slopes, dispersive and shallow duplex soils. The three main forms of water erosion are sheet, gully and rill (Figure 24).

Water erosion is thought to be a significant factor in the siltation of the Avon River and its tributaries. Bank erosion along the tributaries, the main feeder creeks and streams of the Avon River, mainly caused by stock damage, has been a serious problem. Revegetation and fencing along the tributaries streams and feeder creeks is suggested (C. Howell, personal communication).

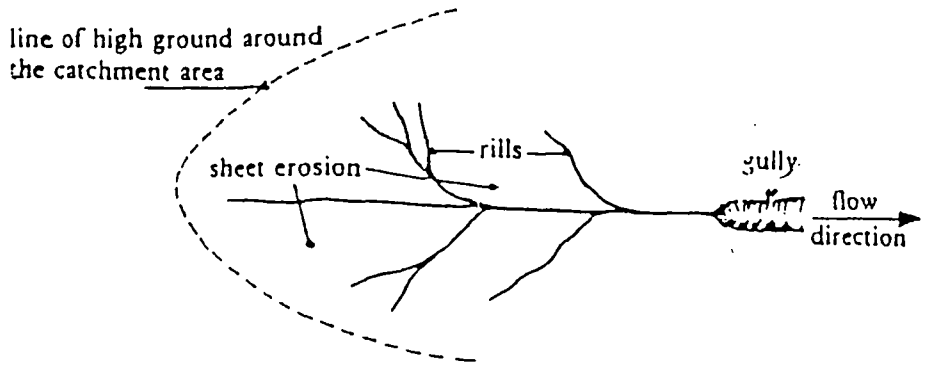


Figure 24. The three major forms of water erosion
Source: Hunt and Gilkes (1992)

Acidity

Many soils in the Agricultural Zone of Western Australia are becoming more acid because of farming practices. This includes the use of ammonium-based fertilisers and clover pastures. Acidification can inhibit the growth of plant roots of both native and pasture species and render soils more susceptible to degradation by wind and water erosion (*State of the Environment Report*, 1992).

In the Shire of Pingelly, most soils appear to have some risk of acidification, with lighter soils having a high risk of developing this problem.

Solutions to ameliorating soil acidity include the rotation of legume-based pastures with non-legume based pastures, reduction in the use of chemical fertilisers and it is found that acidification is less under deep rooted perennial vegetation. The only realistic treatment is liming

Soil compaction

Soil compaction by stock and heavy farm machinery is a major degradation problem experienced by many wheatbelt shires including Pingelly. Stock and heavy machinery compact the soil and prevent infiltration of both water and air that reduces root development. This results in reduced plant growth and an increase in wind and water erosion. Rectification is possible by deep ripping and using lighter farm machinery and restricting machinery traffic on the land through using minimum or zero tillage to establish crops. Fencing remnant vegetation will prevent stock causing soil compaction within the bush.

Clearing

The Shire of Pingelly was one of the earlier shires to be settled in the Avon Valley and has been extensively cleared. The Avon district is recognised as the worst affected area in the wheatbelt for loss of native vegetation. In the early days, when nature conservation was not considered important, the government set aside areas of native vegetation as crown reserves for townsites, water catchments and for gravel extraction. Many of these patches of vegetation have nature conservation values and some have since been designated as Nature Reserves.

Current clearing guidelines recommend that for an area receiving 500 mm per annum rainfall or less (eg. most of agricultural areas in the Shire of Pingelly), 20% of the catchment should remain under perennial vegetation to prevent land degradation (Clark, 1992). Currently, the Shire has 12.3% remnant native vegetation cover. This includes the State forest and reserves, masking the true extent of clearing over the rest of the Shire where only 3% of the original native vegetation remains.

Action to prevent clearing of native vegetation is being taken by the State Government. Land clearing is controlled under the Soil and Land Conservation Act requiring all landowners to give notice to the Commissioner for Soil and Land Conservation of intent to clear land greater than one hectare in area. Landscape and soils are assessed within a set of guidelines directed at protecting remnant vegetation for land degradation purposes (Select Committee into Land Conservation, 1992). The Department of Environmental Protection and Agriculture Western Australia are currently developing nature conservation criteria when assessing clearing applications.

Revegetation

Planting of trees and shrubs is being undertaken in some areas as part of the solution to land degradation and loss of water quality. A barrier to replanting has been a lack of information about revegetation methods and what to plant. Many people are now focussing on local native plants for the following reasons:

- local species provide regional identity
- a big species choice to enables matching of plants to sites and revegetation goals
- introduced plants may become weeds
- natural combinations of local plants maintain biodiversity, provide natural habitat values and are probably best for local fauna
- local species are proving to be robust in the long term

It is hoped that this Handbook, with its lists of species for different landscape types and references to other sources of information will encourage the use of local plants and that these will be increasingly demanded from and grown by plant nurseries.

Sources of information include:

The Revegetation Guide to the Central Wheatbelt (Lefroy *et al.*, 1991). This excellent resource book attempts to address land degradation problems by providing an understanding of soils and matching plants to soils. Colour photos of many of the recommended plants and revegetation hints make the book particularly useful.

Toolibin Catchment Revegetation Manual. This folder is a resource for any community with similar soils and issues to the Toolibin Catchment. Case studies give real life examples of revegetation options for different soil types and purposes whether for commercial production or nature conservation. An appendix provides comprehensive lists of plants for different soil types with information on origin, usefulness in saline and waterlogged situations, size and form and uses. The manual provides information, examples and inspiration towards achieving a balanced and healthy environment in which revegetation plays a significant role.

REX'96. Revegetation Expert software, uses modern software (CD-ROM or disc) to make choosing plants easier and more efficient, while giving comprehensive information on almost 2500 plants from right across Australia. REX'96 is an encyclopedia on particular plants (many with colour photographs) which allows sorting to choose the right plants for particular situations. In addition there are articles on revegetation and conservation issues. REX'96 is available from CALM Narrogin and from Greening Western Australia (08) 9481 2144. Cost is less than $100.

Managing existing vegetation

Protecting remnants of the original vegetation communities in all their complexity is considered to be a greater priority than revegetation. These remnants of natural systems will be the building blocks for future revegetation and it is considered impossible to reconstruct all the elements of natural systems.

Survival of existing vegetation, which is often in small, fragmented patches, requires more than just fencing out stock. Active management is often required where natural processes such as fire are not possible or where weeds have invaded through disturbance or increased nutrients from past grazing and fertiliser drift.

Specific recommendations on how to manage existing bush are provided in *Managing Your Bushland: A Guide for Western Australian Landowners* Hussey and Wallace, 1993. The book *Managing Perth's Bushlands* Scheltema, M. and Harris, J. (eds) (1995) provides much useful management information.

Landcare progress

There has been significant progress in landcare in the Shire of Pingelly. There are three catchment groups in the eastern part of the Shire, East Hotham, Woodebulling and Dartling Creek. A western catchment group was formed in 1996. A number of challenging projects have been initiated including a herbarium and seed orchard (see below). Fencing and revegetation of corridors and waterways and fencing of remnant vegetation have also been important projects.

The goals and activities for the Pingelly LCDC for 1966 illustrate the positive direction landcare activities are taking. They are set out in Appendix 4

The Pingelly seed orchard project
(Information supplied by Dawn Box, Secretary of the Pingelly Land Conservation District Committee LCDC)

The object of the Pingelly seed orchard project is to build up a seed orchard of local genetic species, for revegetation of degraded sites and enrich remnant vegetation within the Pingelly Shire. By maintaining the local genetic basis, it can help protect and maintain local individuality.

This project was an initiative of Greening Western Australia and Pingelly LCDC in 1993. It was suggested that disused gravel pits made satisfactory seed orchard sites and Pingelly LCDC chose the disused gravel pit in the Station Street Reserve, 5 kms south of Pingelly on the Great Southern Highway. Greening Western Australia provided encouragement and ideas through Joanna Seabrook and Dorothy Redreau and approval was given in 1994.

During the summer of 1994/95, LCDC members and children collected seed from at least 4 different sites for each species within an area of 50 kms radius from Pingelly town to maintain the local genetic bases.

In early May 1995, the seed orchard site was ripped, prepared and sown on 11 May. There were mixed results, some species giving an excellent result while two of the most common did not germinate. A visit by rabbits, and some damage to healthy plants by parrots decreased the original results, however, it was generally regarded as successful.

It is planned to expand the seed orchard, however, the late break in the 1996 season made it impossible to direct seed but three new species were hand planted. The discovery of many noxious weeds growing in the pit, ie. sour sob, cape tulip and oxalis to name a few has created a weed control problem.

Pingelly seed orchard species

Glowing wattle	*Acacia celastrifolia*	Two leaf hakea	*Hakea trifurcata*
Prickly moses	*Acacia pulchella*	Pincushion cone flower	*Isopogon dubius*
Dwarf sheoak	*Allocasuarina humilis*	Nodding coneflower	*Isopogon teretifolius*
Round fruit Banksia	*Banksia sphaerocarpa*	Spreading coneflower	*Isopogon divergens*
Lesser bottlebrush	*Callistemon phoeniceus*	Roadside tea tree	*Leptospermum erubescens*
	Calothamnus dwarf species	Rough honeymyrtle	*Melaleuca scabra*
One sided bottlebrush	*Calothamnus quadrifidus*	Mohan	*Melaleuca viminea*
Golden Dryandra	*Dryandra nobilis*	Broom bush	*Melaleuca uncinata*
Pingle	*Dryandra squarossa*	Swamp tea tree	*Pericalymma ellipticum*
Marble hakea	*Hakea incrassata*	Variable leaved cone-bush	*Petrophile heterophylla*
Grass leaf hakea	*Hakea multilineata*		*Petrophile media*

The Pingelly herbarium project

The object of the Pingelly Herbarium project is to protect vegetation for the future. If it is not known accurately what is there and where it is, it cannot be satisfactorily protected so that future generations are able to enjoy all local species. The herbarium will also provide the basis for choosing local species for revegetation.

Early 1995, Greening Western Australia called for expressions of interest from groups interested in setting up an herbarium in their area with kits sponsored by Alcoa Australia valued at $1500. Pingelly LCDC had found it necessary to keep very good records of seed collection, and pressed specimens of species grown in the seed orchard and it seemed natural to progress into the herbarium business. An application was successful and in June 1995, the Pingelly LCDC were given a herbarium kit. June Page and Dawn Box attended a workshop at Greening Western Australia sponsored by Alcoa on how to record, collect, press and mount herbarium specimens.

Approximately 200 specimens have now been collected, recorded and mounted. Most have been entered on a computer data base and a label printed incorporating full details, following official identification by the Western Australian Herbarium.

The Pingelly herbarium is set up in the Community Craft Shop which is the display centre for the LCDC. Volunteers willing to join in collecting and completing the necessary data are welcomed. The plan is to allocate areas within the Shire to different people, so that the entire Shire can, over the next few years, have all flora listed and a specimen mounted in the Pingelly display. The High School is being involved and plant identification workshops are planned.

A grant from the Gordon Reid Foundation for Conservation in 1996, provided valuable equipment such as microscopes for plant identification, a chest freezer to sterilise specimens, signs and materials for landcare display, a display board and brochure stand, and funds to assist with adding a photographic collection.

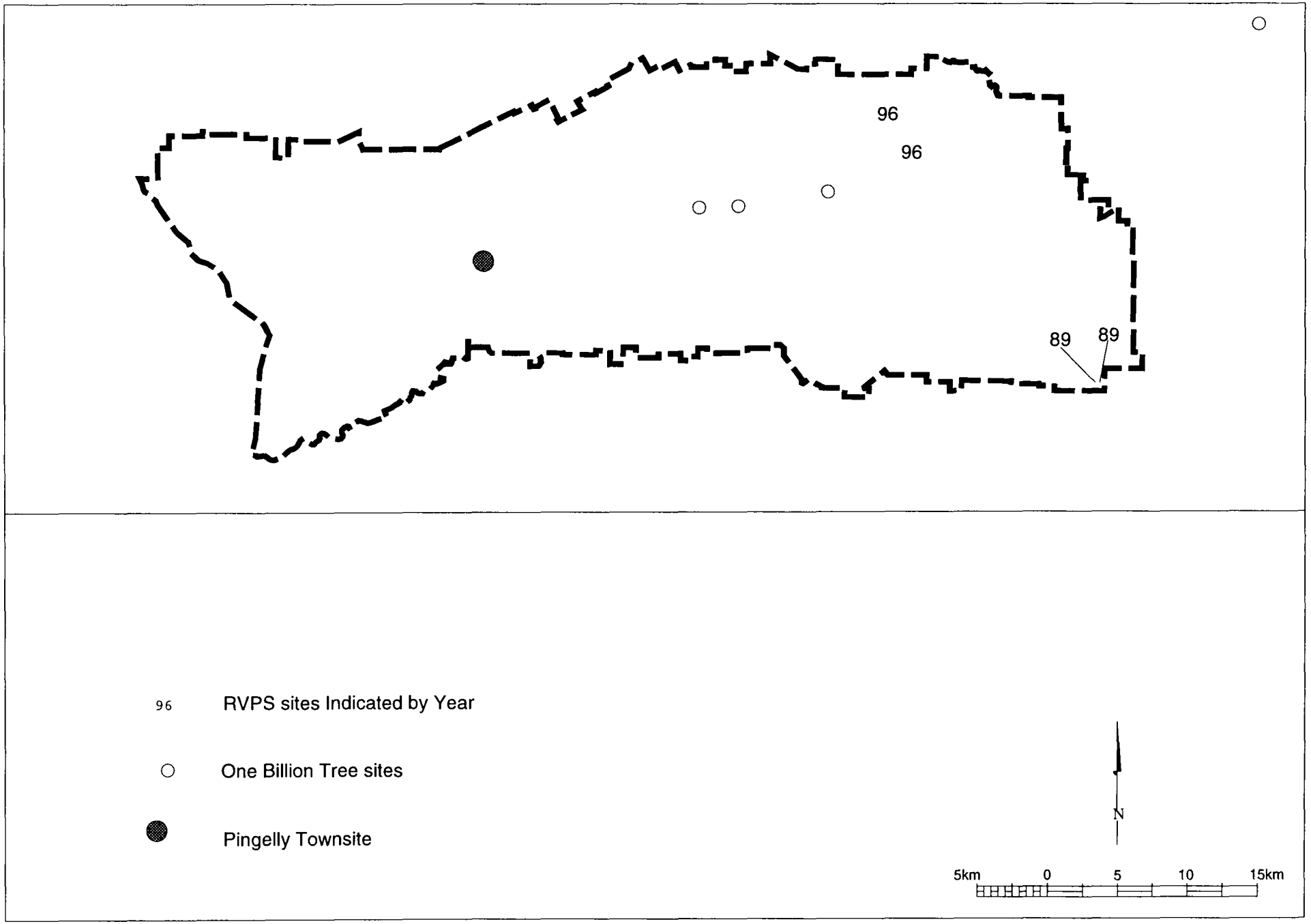


Figure 25: One Billion Trees, and Remnant Vegetation Protection Scheme sites in the Shire of Pingelly.

Landcare support

The Pingelly Land Conservation District Committee (LCDC), together with the three catchment groups in the east and one to be in the west, are the focus for improving land management for both agricultural sustainability and nature conservation in the Shire of Pingelly. Their work has been described in the sections Landcare progress and Revegetation.

There are a number of other groups and funding bodies working constructively towards a sustainable future.

The Avon Catchment Landcare Program was established in 1990 and initiated by Alcoa and Agriculture Western Australia as part of the National Decade of Landcare. The program provides financial, human and technical resources to undertake catchment planning, farm planning and demonstration of rehabilitation techniques to tackle soil and water degradation problems.

The Remnant Vegetation Protection Scheme (RVPS) was developed by the State Government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. Figure 25 indicates the locations of RVPS and One Billion Trees grants to assist in the fencing of native vegetation on farm land. The aim is that these remnants will not be grazed and that the nature conservation values will gradually improve.

The National Landcare Program (NLP) has primarily had the role of providing funding to the One Billion Trees and Save the Bush programs which have provided: extension services, coordinators, demonstration projects, workshops and training.

The Gordon Reid Foundation for Conservation, a funding arm of the Lotteries Commission, has supported the Pingelly LCDC with a number of small grants totalling $28,409 between 1994 and 1996. Supported projects include: fencing and revegetation of corridors, equipment for herbarium and fencing remnant vegetation and waterways.

A list of programs of funding aimed at land and nature conservation together with contacts is found in Appendix 5.

Future directions

The future is likely to see innovative measures to create sustainable farming systems integrated with nature conservation to sustain viable native flora and fauna populations.

Protection and management of existing areas of native vegetation will be very important. These areas are the museums of the original plant communities, habitat for our native fauna and are a rich resource for future revegetation. These areas will need to be managed as many are steadily declining due to weed proliferation and rising water tables.

Using smoke to aid regeneration of native species is an exciting initiative. It has been found that the seed of many species responds to smoke rather than heat from a fire as the trigger for germination. Smoke can be applied when dissolved in water and could assist the regeneration of many areas where the use of fire is difficult. Further information is available from Kings Park and Botanic Garden (see Local Contacts).

Planting native trees and shrubs can remedy some land degradation problems but is a relatively expensive practice.

The high cost of planting seedlings is recognised as a constraint to revegetation. Direct seeding produces a more natural distribution of plants and in some areas has proved successful as a cost efficient way of establishing native vegetation. Unfortunately, direct seeding is constrained by lack of information on successful techniques and by lack of seed. The Pingelly LCDC's seed orchard is helping to address this concern but it is anticipated that many more seed orchards will be required and that native plant seed supply will become a commercial opportunity.

Deep rooted perennial vegetation is being used in some areas to increase water use and to provide farmers with an additional source of income. Many farmers are looking at use of natural fertilisers, alley farming is increasingly changing the landscape, tagasaste is a possibility particularly on sandy soils. Olives, tea tree oil and eucalyptus oil industries are being trialed or developed. Tannins from acacia and eucalypt species; cut wildflowers and wildflower seeds; and value-added wood products are all possibilities. Care must be taken that such species do not become environmental weeds.

The Salinity Action Plan states that the Government will ensure:

- another three million hectares of trees and shrubs are planted across the agricultural area;
- other commercially viable water management practices complement these plantings to maximise water use and economic benefits;
- remnant vegetation is protected and managed to maintain it in perpetuity.

Local Contacts

Pingelly Land Conservation District Committee
Secretary - Mrs Dawn Box, PO Box 143, Pingelly 6308.
Phone and fax (08) 98871 242.

Catchment Group Coordinators

East Hotham	Michael Page	(08) 98879 052
	Les Marshall	(08) 98879 014
	Kevin O'Brien	(08) 98871 384
Woodebulling	Chris Walton	(08) 98887 048
Dartling Creek	Greg Ward	(08) 98879 024
	Michael Page	(08) 98879 052
Biberkine Brook	David Freebairn	(08) 98877 088
	Peter Bostock	(08) 98877 043

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Appendix 1. Local plants for Shire of Pingelly landscapes

This appendix lists the major vegetation types and some of the plants in the Shire of Pingelly (Source: Vegetation community descriptions from CALM Narrogin for Nature Reserves in the Shires of Pingelly and Brookton). Additional local species and species from other areas which may be suitable for revegetation for many of the soil types in the Shire of Pingelly, together with detailed site and use classifications, can be sourced in the Toolibin Catchment Revegetation Manual, Baxter, A. (1996), available for $10.00 plus postage from Lake Toolibin Catchment Committee, Catchment Co-ordinator. PO Box 36 Wickepin WA 6370.

Jam - York Gum Woodland

Botanical name	Common name (if known)	Notes
Acacia acuminata	jam	Small tree
Acacia microbotrya		
Acacia saligna	orange wattle	Understorey
Allocasuarina campestris		
Allocasuarina huegeliana	rock sheoak	Small tree
Dampiera spicigera		Understorey
Dianella revoluta		Understorey
Dryandra sessilis		Understorey
Enneapogon caerulescens		Understorey
Eucalypyus calophylla	marri	Medium tree
Eucalypts longicornis	red morrel	Tall tree
Eucalyptus loxophleba	York gum	Medium tree
Eucalyptus wandoo	wandoo	Tall tree
Gastrolobium spinosum		Understorey
Hakea prostrata		Understorey
Lepidosperma effusum		Sedge
Lomandra effusa		Understorey
Muehlenbeckia adpressa		
Olearia revoluta		Understorey
Oxylobium parviflorum		Understorey
Stypandra imbricata	cluster leaved blindgrass	Understorey
Waitzia acuminata		Understorey
Xanthorrhoea preissii		Understorey

Wandoo Woodland

Botanical name	Common name (if known)	Notes
Acacia acuminata	jam	Small tree
Acacia lasiocarpa	panjang	Understorey
Acacia pulchella	prickly moses	Understorey
Allocasuarina huegeliana	rock sheoak	Small tree
Allocasuarina humilis	dwarf sheok	Low understorey
Allocasuarina microstachya		
Astroloma pallidum	kickbush	
Astroloma serratifolium	kondrung	
Borya sphaecelata	pincushions	Groundcover
Bossiaea eriocarpa	common brown pea	Low understorey

Wandoo woodland	**(continued)**	
Calothamnus quadrifidus	one sided bottlebrush	Understorey
Calytrix affin *fraseri*	pink summer calytrix	Understorey
Allocasuarina microstachya		
Caustis dioica	Chinese puzzle	
Choretrum glomeratum	common sour bush	
Comesperma scoparia	broom milkwort	Understorey
Dampiera affin *coronata*	wedge-leaved dampiera	
Dampiera juncea	rush-like dampiera	Understorey
Daviesia brevifolia		
Daviesia cardiophylla		
Dianella revoluta	blueberry lily	Understorey
Diuris corymbosa)	common donkey orchid	Understorey
Dodonaea bursariifolia		
Dryandra cirsioides		
Dryandra fraseri		Understorey
Dryandra nivea	couch honeypot	Understorey
Dryandra sessilis	parrot bush	Understorey
Eucalyptus accedens	powderbark wandoo	Medium tree
Eucalyptus astringens	brown mallet	Medium tree
Eucalyptus falcata	silver mallet	
Corymbia calophylla	marri	Tall tree, western parts
Eucalyptus longicornis	red morrel	Tall tree
Eucalyptus subangusta	black morlock	
Eucalyptus wandoo	wandoo	Tall tree
Gastrolobium crassifolium	thickleaf poison	Understorey
Gastrolobium hookeri		
Gastrolobium spinescens		Understorey
Gastrolobium spinosum	prickly poison	Understorey
Glischrocaryon flavescens		
Hakea lissocarpha	honeybush	Understorey
Hakea petiolaris	sea urchin hakea	
Hakea prostrata	harsh hakea	Understorey
Harperia lateriflora		Understorey
Hibbertia pungens		
Isopogon formosus	rose coneflower	
Lepidosperma tenue		
Loxocarya fasciculata		
Lechenaultia formosa	red leschenaultia	Understorey
Lomandra effusa	scented matrush	Understorey
Olearia revoluta		Understorey
Oxolobium parviflorum	box poison	Understorey
Persoonia striata	kauberry	
Ptilotus manglesii	pom poms	Understorey
Schoenus compressus		
Sollya heterophylla	australian bluebell	
Stipa elegantissima	feather speargrass	Grass
Stypandra imbricata	cluster leaved blindgrass	Understorey
Thelymitra antennifera	vanilla orchid	Understorey
Westringia cephalantha		
Westringia rigida	stiff westringia	
Xanthorrhoea drummondii		Understorey
Xanthorrhoea preissii	grass tree	Understorey

Brown Mallet Woodland

Botanical name	Common name (if known)	Notes
Acacia acuminata	jam	
Acacia colletioides		
Allocasuarina huegeliana	rock sheoak	Small tree
Astroloma pallidum	kickbush	
Casuarina huegelina		
Eucalyptus astringens	brown mallet	Medium tree
Eucalyptus salmonophloia	salmon gum	Tall tree
Eucalyptus falcata	silver mallet	
Gastrolobium crassifolium	thickleaf poison	
Gastrolobium spinosum	prickly poison	Understorey
Oxylobium parviflorum		Understorey
Dodonaea bursariifolia		Understorey

Powderbark Wandoo Woodland

Botanical name	Common name (if known)	Notes
Acacia acuminata	jam	Tall shrub
Allocasuarina campestris		
Allocasuarina huegeliana	rock sheoak	Tall shrub
Allocasuarina humilis	dwarf sheoak	Low understorey
Beaufortia incana		Low understorey
Bossiaea eriocarpa		Low understorey
Calothamnus planifolius		Understorey
Dryandra nivea	couch honeypot	Low understorey
Dryandra nobilis		Understorey
Dryandra sessilis	parrot bush	Understorey
Eucalyptus accedens	powderbark wandoo	Medium tree
Eucalyptus astringens	brown mallet	Medium tree
Corymbia calophylla	marri	Medium tree western parts
Eucalyptus longicornis	red morrel	Tall tree
Eucalyptus marginata	jarrah	Tall tree western parts
Eucalyptus wandoo	wandoo	Tall tree
Gastrolobium spinosum	prickly poison	Understorey
Hakea multilineata		Understorey
Hakea trifurcata	two-leaf hakea	Understorey
Hypocalymma angustifolium	white myrtle	Understorey
Leptospermum erubescens	roadside tea tree	Understorey
Gastrolobium parvifolium	box poison	Understorey
Petrophile divaricata		Understorey
Verticordia eriocephylla		Understorey

Allocasuarina Woodland

Botanical name	Common name (if known)	Notes
Acacia acuminata	jam	Small tree
Acacia celastrifolia	glowing wattle	
Acacia pulchella	prickly moses	
Allocasuarina campestris		
Allocasuarina huegeliana	rock sheoak	Small tree
Allocasuarina microstachya		Understorey
Astroloma pallidum	kickbush	
Borya sphaerocephala	pincushions	Groundcover
Cheilanthes tenuifolia	rockfern	
Cryptandra glabriflora		Understorey
Daviesia cardiophylla		Understorey
Dianella revoluta	Dianella	Understorey
Dillwynia cinerascens	grey parrot-pea	
Dryandra cuneata	wedge-leaved dryandra	
Dryandra sessilis	parrot bush	Understorey
Gastrolobium crassifolium	thickleaf poison	
Gastrolobium spinescens		Understorey
Gastrolobium spinosum	prickly poison	Understorey
Gastrolobium trilobium	bullock poison	
Eucalyptus accedens	powderbark wandoo	Medium tree
Eucalyptus loxophleba	jam	Medium tree
Eucalyptus wandoo	wandoo	Tall tree
Hakea lissocarpha	honeybush	Understorey
Hakea prostrata	harsh hakea	Understorey
Hakea trifurcata	two-leaf hakea	Understorey
Goodenia pinifolia	fine leaved goodenia	
Grevillea pulchella	beautiful grevillea	
Hakea petiolaris	sea urchin hakea	
Hibbertia enervia		
Hibbertia rupicola		
Hovea chorizemifolia	holly-leaved hovea	
Lepidosperma drummondii		
Lepidosperma tenue		
Leptospermum erubescens	roadside tea tree	Understorey
Macrozamia riedlei	zamia	Understorey
Gastrolobium parviflorum	box poison	Understorey
Santalum acuminatum	sandalwood	Understorey
Sollya heterophylla	australian bluebell	Understorey

Heath on sand

Botanical name	Common name (if known)	Notes
Adenanthos argyraea		
Allocasuarina campestris		
Allocasuarina huegeliana	rock sheoak	
Alloasuarina microstachya		
Andersonia lehmanniana		
Acacia filifolia		
Acacia lasiocarpa	panjang	
Acacia pulchella	prickly moses	
Acacia saligna	orange wattle	
Acacia stenoptera	narrow winged wattle	
Anigozanthos humilis	catspaw	
Banksia sphaerocarpa	round fruit banksia	
Boronia coerulescens		
Calectasia cyanea	blue tinsel lily	
Calothamnus quadrifidus	one sided bottlebrush	
Calothamnus sanguineus		
Cassytha glabella	tangled dodder laurel	
Comesperma scoparia	broom milkwort	
Conostylis setigera	bristly cottonhead	
Cryptandra myriantha		
Daviesia brevifolia		
Daviesia cardiophylla		
Dryandra cirsioides		
Dryandra fraseri		
Dryandra hewardiana		
Dryandra nivea	couch honeypot	
Gastrolobium hookeri		
Goodenia pinifolia	fine-leaved goodenia	
Grevillea pilulifera	woolly-flowered grevillea	
Hakea baxteri	fan hakea	
Hakea crassifolia	thick leaved hakea	
Hakea lissocarpa	honeybush	
Hakea subsulcata		
Hakea varia	variable-leaved hakea	
Harperia lateriflora		
Isopogon drummondii		
Isopogon polycephalus	clustered coneflower	
Lomandra effusa	scented matrush	
Loxocarya fasciculata		
Lysinema ciliatum	curry flower	
Melaleuca subtrigona		
Mesomelaena uncinata		
Persoonia striata	kauberry	
Petrophile squamata		
Santalum acuminatum	quandong	
Schoenus compressus		
Santalum spicatum	sandalwood	
Synaphnea petiolaris	synaphnea	
Synaphnea polymorpha	albany snaphnea	
Trichocline spathulata	native gerbera	
Verrauxia reinwardtii	common verreauxia	
Verticordia eriocephala	bush cauliflower	
Xanthorrhoea preissii	grass tree	

Heath on gravel/laterite

Botanical name	Common name (if known)	Notes
Dryandra nobilis	golden dryandra	
Dryandra stuposa		
Hakea gilbertii		
Hakea trifurcata	two-leaf hakea	
Leptospermum spinescens		
Petrophile heterophylla	variable-leaved conebush	
Stirlingia tenuifolia		

Creek and creek margins

Botanical name	Common name (if known)	Notes
Allocasuarina huegeliana	rock sheoak	Small tree
Halosarcia sp.	samphire	Understorey
Callistemenon phoeniceus		Understorey
Casuarina obesa	swamp sheoak	Small tree along streams
Eucalyptus loxophleba	York gum	Medium tree
Eucalyptus rudis	flooded gum	Tall tree
Eucalyptus salmonophloia	salmon gum	Tall tree
Melaleuca hamulosa		Understorey
Santalum spicatum	sandalwood	Understorey

Salt flats

Botanical name	Common name (if known)	Notes
Halosarcia sp.	samphire	
Halosarcia halocnemoides	samphire	
Callistemon phoeniceus	inland bottlebrush	Medium to large shrub
Casuarina obesa	swamp sheoak	Small tree, adjacent salt flats
Melaleuca hamulosa		Medium to large shrub
Melaleuca lateriflora	gorada	Medium to large shrub
Melaleuca thyoides		Medium to large shrub
Melaleucca uncinata	broombush	Medium shrub
Melaleuca viminea	mohan	Large shrub

Appendix 2. Detailed botanical information for one bush remnant

Information from sites surveyed in detail during the study: E.A. Griffin (1995). *Distribution and Ecological Significance of On-Farm Bush Remnants in the Southern Wheatbelt Region of Western Australia- Phase II.* Refer Figure 15 for location.

Survey of site PIN03006

Pingelly Shire [PIN03] Corrigin SI50-03 1:250 000.

Surveyed 01.10.92
Location: 8 km NNE of Pingelly, 14.5 km SE of Brookton and 19.5 km WSW of Alderside; 32^28'00"S, 117^06'23"E; 350 m.

- Powder-bark wandoo (*Eucalyptus accedens*) woodland to 7-12 m over 2 m shrubland (*Petrophile divaricata* ± grass tree) over 80 cm mixed sclerophyll scrub (includes shallow slope areas).
- Brown mallet woodland over ± open ground layer with *Gastrolobium* (3-spine poison).
- White gum woodland over mixed shrubland over mixed herbage (Similar character to Dryandra Forest).

PIN03006 Species List

Scientific Name	Common Name
Acacia ?uncinella	
Daviesia cordata	Bookleaf
Dillwynia aff. acerosa	
Dryandra sp.	
Gastrolobium parvifolium	Berry poison
Grevillea monticola	
Hibbertia enervia	
Melaleuca scabra (gp)	
Millotia tenuifolia	Soft millotia
Monotaxis grandiflora	Diamond of the desert
Nemcia dilatata	
Rhodanthe leavis	
Schoenus aff. pleiostemoneus	
Trachymene pilosa	Native parsnip

Appendix 3. Some fauna in Boyagin Nature Reserve

Source: CALM Narrogin

Birds

Common Name	Scientific Name
Golden Whistler	*Pachycephala pectoralis*
Rufous Whisler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Grey Fantail	*Rhipidura fuliginosa*
Willie Wagtail	*Rhipidura leucophrys*
Chestnut Quail-thrush	*Cinclosoma castanotum*
White-browed Babbler	*Pomatostomus superciliosus*
Rufous Songlark	*Cincloramphus mathewsi*
Splendid Fairy-wren	*Malurus splendens*
Blue-breasted Fairy-wren	*Malurus pulcherrimus*
Red-winged Fairy-wren	*Malurus elegans*
White-browed Scrubwren	*Sericornis frontalis*
Weebill	*Gerygone brevirostris*
Western Gerygone	*Gerygone fusca*
Inland Thornbill	*Acanthiza apicalis*
Western Thornbill	*Acanthiza inornata*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Varied Sittella	*Daphoenositta chrysoptera*
Rufous Treecreeper	*Climacteris rufa*
Red Wattlebird	*Anthochaera carunculata*
Little Wattlebird	*Anthochaera chrysoptera*
Singing Honeyeater	*Lichenostomus virescens*
White-eared Honeyeater	*Lichenostomus leucotis*
Yellow-plumed Honeyeater	*Lichenostomus ornata*
Brown-headed Honeyeater	*Melithreptus brevirostris*
White-naped Honeyeater	*Melithreptus lunatus*
Brown Honeyeater	*Lichmera indistincta*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
White-cheeked Honeyeater	*Phylidonyris albifrons*
Tawny-crowned Honeyeater	*Phylidonyris melanops*
Western Spinebill	*Acanthorhynchus superciliosus*
White-fronted Chat	*Ephthianura albifrons*
Mistletoebird	*Dicaeum hirundinaceum*
Spotted Pardalote	*Pardalotus punctatus*
Striated Pardalote	*Pardalotus striatus*
Silvereye	*Zosterops lateralis*
Magpie-Lark	*Grallina cyanoleuca*
Black-faced Woodswallow	*Artamus cinereus*
Dusky Woodswallow	*Artamus cyanopterus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Gymnorhina tibicen*

Reptiles

Gehyra variegata	Tree Dtella
Oedura reticulatra	Reticulated Velvet Gecko
Crenodactylus ocellatus	Clawless Gecko
Phyllodactylus marmoratus	Marbled Gecko
Phyllurus milii	
Underwoodisauris millii	Thick tailed Gecko
Delma fraseri	
Lialis burtonis	Burton's Snake Lizard
Amphibolurus minimus	Western Bearded Dragon
Amphibolurus ornatus	Ornate Dragon
Moloch horridus	Mountain Devil
Varanus gouldii	Goulds Goanna or Sand Monitor
Varanus tristis	
Ctenotus labillardiera	
Egernia kingii	Kings Skink
Egernia multiscutata	
Menetia greyi	
Morathia butleri (?)	
Cryptoblepharus plagiocephalus	
Trachydosaurus rogosus	Shingle-back
Sphenomorphus richarsonii	Broad Banded Sand Swimmer
Morethia obscura	
Ctenotus schomburgkii	
Morelia spilotes	Carpet or Diamond Python
Pseudonaja affinis	Dugite
Pseudechis australis	Mulga/King Brown Snake

Appendix 4. Goals and activities for the Pingelly LCDC for 1966

Remnant vegetation

Goals

- All remnant vegetation fenced, protected and enhanced to use more water/intercept more water.
- To record native vegetation within Shire in order to manage and protect it successfully.
- Support Shire in better road verge management.

Activities

- Continue both seed orchard and herbarium projects.

Revegetation

Goals

- Creeklines and waterways revegetated.
- To keep increasing revegetation of the Shire.
- Encourage the younger generations of farmers in revegetation.
- To encourage the retention of species biodiversity in revegetation projects.

Activities

- Encourage commercial possibilities to encourage widescale revegetation.
- Balga tree planting project (annual).

Salinity

Goals

- Stop water table from rising further.
- Lower water table.
- Investigate salinity issues by looking at all promising ideas/projects.
- Attack salinity by group co-ordination and implementation.

Activities

- Supporting catchment revegetation projects.

Awareness/involvement by community

Goals

- Greater community involvement (people on the land and in towns).
- For communities to be more aware of environmental problems and to understand and implement solutions.
- Promoting group participation and co-ordination in landcare issues.

Activities

- Advertise locally when grants, field days etc come up.
- A community display with participation from surrounding catchments to make a feature at Pingelly Alternatives (formerly Pingelly Show).
- Set up displays of Pingelly catchment projects and display.
- Aerial photography of catchment projects.

- Collection of local photos for display and records, especially before and after.

Productivity

Goals
- Greater production on farms through a better farm plan. (Crops suited to soil types and better water use. Sheep and cattle the same).
- Maximise water use by harvesting rainfall run off and high water use cropping programs.
- Give equal status to increasing productivity issues and conservation issues - so farmers can make more money to do more conservation.
- Emphasise role of liming and fertilising (trace elements) in cropping and pastures.

Activities
- Whopper Crop bus tour and competition.
- Continue to part-fund surveying of banks.

Funding

Goals
- Maintain the momentum of grant applications for all aspects of the landcare movement ie. GWA, GRF, NLP, SRS.
- Earthworks to be included in funding applications.

Activities
- Summarise grants received locally by farmers.
- Support any major push for landcare tax deductions/rebates/credits/$:$grants.

Catchment Activities

Goals
- Support all catchment group activities.
- Establish groups in all catchment areas.

Activities
- Increased catchment activity in East Hotham and Woodebulling.
- Dartling Creek catchment project.
- Complete fencing of the Hotham River and tributaries in Pingelly Shire.
- Initiate a project in western end of Shire.

Vermin

Goals
- Rabbits controlled.
- Other vermin controlled, such as parrots and foxes.

Activities
- Keep up to date on Calici virus release and spread for rabbit control.
- Invite new APB officer onto LCDC.

Soils

Goals

- To manage surface and subsurface water.
- To preserve soil in a healthy state.

Activities

- Monitor and maintain pH levels, plant windbreaks to save topsoil, construct earthworks to save/store water. To encourage use of CLTs for water control works.

Appendix 5. Programs of Funding Aimed at Land and Nature Conservation

Remnant Vegetation Protection Scheme

The Remnant Vegetation Protection Scheme (RVPS) was developed by the Western Australian State Government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. The scheme (which is jointly administered by CALM and Agriculture Western Australian (AgWA), with AgWA as the lead agency) provides a 50% subsidy towards the cost of protective fencing of native vegetation on farms, with landowners giving an undertaking by covenant on title that the fenced vegetation will be managed for nature conservation for a period of at least thirty years.

To be granted a subsidy, the area of vegetation to be fenced must be five hectares or more, and must be in good condition or able to be rehabilitated to good condition. Regular botanical surveys of RVPS fenced areas are undertaken to monitor the condition of the vegetation. This provides an objective measure of the longer term success of the Scheme and also an opportunity for land owners to improve their management practices by providing them with a measure of the impact of their management actions.

Since 1989, the Shire of Pingelly has received 4 RVPS grants to fence 60 hectares of remnant vegetation. According to the Australian Bureau of Statistics, Agricultural census (1993/94), landholders reported a further 2,001 hectares of native vegetation which was fenced or inaccessible to stock.

Applications: RVPS Coordinator, Locked Bag No. 3 South Perth WA 6151.
Further information and forms: Phone (08) 9368 3573 and all offices of Agriculture Western Australia or the Department of CALM.

The National Heritage Trust

The National Heritage Trust (NHT), established in 1996, aims to take an integrated, long-term approach to the conservation and sustainable management of land, water and biodiversity. It will seek to foster cooperation between Commonwealth, State, Territory and the community. Community groups and individuals will be able to apply for funding with one application form and the source of funding will then be decided at the administrative level.

Assistance through the NHT will be delivered at a number of levels:

- Community groups
- Regional strategies
- National partnerships eg. The Endangered Species Program
- Commonwealth

The Community groups component is made up of five programs: the National Vegetation Initiative, National Landcare Program, Murray-Darling 2001, National Rivercare Initiative and the National Wetlands Program.

The National Vegetation Initiative

The National Vegetation Initiative (NVI) is one of five components of the National Heritage Trust, and aims to address Australia's land and water degradation problems. The primary objective of NVI is to reverse the long term decline in the extent and quality of Australia's native vegetation through:

- the conservation of remnant vegetation
- the conservation of Australia's biodiversity
- the restoration, through revegetation, of the environmental values and productive capacities of Australia's degraded land and water.

The National Vegetation Initiative builds on the work of former vegetation programs including One Billion Trees and Save the Bush, details of which follow. The National Landcare Initiative commenced in 1997. **Details will be available through Agriculture Western Australia offices, The Department of Conservation and Land Management and from Anne Brandenburg, Greening Western Australia.**

National Landcare Program

The National Soil Conservation Program (NSCP) was established by the Federal Government in 1983 with the aim of developing and implementing a national strategy for the rehabilitation and sustainable use of the nation's land and water resources. The program provided funds to government, education institutions, research institutions, landcare and other community groups for soil conservation projects. There was particular emphasis given to fostering co-operation and co-ordination amongst government agencies and those in the local community working on land degradation problems.

In 1991 the NSCP changed to the National Landcare Program (NLP). In 1992/93, the NLP, the One Billion Trees Program (OBT) and the Save the Bush Program (STB) were incorporated into a One-Stop-Shop for Community Grants under the National Landcare Program. The NLP aim was to encourage community groups to responsibly manage and conserve land, water, biological diversity and cultural heritage in their area.

The National Landcare Program is now a component of the National Heritage Trust and incorporates the former programs, Land and Water and the community grants. The aim of the program is still to encourage cooperative implementation of projects which contribute to the ecologically sustainable development of land, water and vegetation resources.

Contact and further information:

National Heritage Trust Coordinator, Agriculture Western Australia. Telephone (08) 9368 3333

Anne Brandenburg, Greening Western Australia. Telephone (08) 9481 2144

Ken Atkins, Department of Conservation and Land Management. Telephone (08) 9334 0333

One Billion Trees
The One Billion Trees (OBT) program was initiated in 1989 by the Federal Government with the aim of catalysing revegetation. It was administered in Western Australia by Greening Western Australia. The program provided grants for revegetation projects through the One-Stop-Shop for Community Grants under the National Landcare Program. It has now become part of the National Vegetation Initiative.

Contact and information on past projects: Anne Brandenburg, Greening Western Australia. Telephone (08) 9481 2144

Save the Bush
The Save the Bush Program (STB) was established by the Federal Government in 1989 to assist with the preservation of biological diversity by the protection and management of remnant vegetation. It was administered by the Australian Nature Conservation Agency (ANCA), now called Environment Australia and by CALM in Western Australia. Grants from this scheme aimed to encourage, facilitate and support programs, actions and activities associated with the protection, management and investigation of remnant bush. The program is now a part of the National Vegetation Initiative.

Contact and further information: Ken Atkins, Department of Conservation and Land Management. Telephone (08) 9334 0333.

State Landcare Program
The State Government introduced the State Landcare Program in 1987 to support Land Conservation District Committees and catchment groups in combating land degradation problems in rural areas. Financial support is provided to LCDCs to undertake projects in catchment planning, demonstrate conservation practices and for communications and training.

Contact and further information: Marnie Lebourne, Soil and Land Conservation Council, PO Box 483 Northam 6401. Phone (08) 96226 100. Fax (08) 96221 902.

The Roadside Conservation Committee
The Roadside Conservation Committee (RCC) was set up by the Western Australian Government in 1985 to coordinate and promote conservation and the effective management of rail and roadside vegetation. The program is administered by the Department of Conservation and Land Management (CALM) and relevant data is administered by the Main Roads Department. In 1989, the Roadside Conservation Committee (RCC) organised an assessment of roadside vegetation involving community volunteers on a shire basis, using a proforma designed by the RCC (Hussey, 1991).

Contact and information: David Lamont (Executive Officer), Department of Conservation and Land Management, Locked Bag No. 104, Bentley Delivery Centre 6983

Ribbons of Green
Ribbons of Green is a community based Greening Western Australia project sponsored by Alcoa which started in 1989 with the aim of replanting and regenerating cleared strips of land with native plants and trees. The 'ribbons' are corridors along roads, rail reserves, waterways or linking patches of bush. These 'ribbons' are important for the conservation of wildlife, by providing bush corridors. The details of what, where and when to plant, are developed by the local community in consultation with Greening Western Australia, government departments (AgWA, CALM), local government authorities, consultants and community groups.

Contact and further information: Dorothy Redreau, Greening Western Australia. Telephone (08) 9481 2144.

Trees and Seeds for Diversity (Formally, Plants for Conservation)
Plants for Conservation was managed by Greening Western Australia and sponsored by ALCOA Australia and the Hamel Nursery. The aim of the project was to support groups and individuals undertaking revegetation projects, by providing more than 300,000 seedlings each year. Participating groups and individuals provide additional seedlings, tools and labour towards the project. It is now called Trees and Seeds for Diversity which has developed as a program to develop partnerships involving the use of local provenance seedlings and direct seeding in revegetation. The program is managed by Greening Western Australia and sponsored by Alcoa of Australia through their Marrinup Nursery. Related to this project are the **Understorey Seed Farms.**

Contact and further information: Dorothy Redreau, Greening Western Australia. Telephone (08) 9481 2144.

Gordon Reid Foundation for Conservation
The Gordon Reid Foundation for Conservation aims to provide funds or other support for the purposes of enhancing community involvement in conservation within Western Australia. Funds are provided for:

- the conservation of the Western Australian environment with emphasis on native flora and fauna;
- the identification and conservation of critical habitats and ecosystems;
- the conservation of rare, threatened and endangered species in WA;
- public education and awareness of environmental issues within WA;
- and research or other studies into other matters related to any of the above.

Contact and further information: Michael Crouch, Executive Officer, Gordon Reid Foundation for Conservation. PO Box 6725 East Perth WA 6892. Phone/Fax (08) 9322 1850.

Australian Trust for Conservation Volunteers (ATCV)
ATCV is a national, non profit, non political, community based organisation which seeks to assist landholders with practical conservation projects. ATCV supplies teams of up to ten volunteers with an ATCV team leader to co-ordinate and supervise volunteers and liaise with project managers. A vehicle, basic tools and camping equipment and first aid equipment are available. A fee is charged to cover administrative costs and the land manager is responsible for project planning, preparation including materials and specialised tools and basic accommodation. Teams are available on a daily, weekly or weekend basis. Projects include fencing,

tree planting, seed collection, flora and fauna surveys, walking track construction and historic building restoration.

Contact and further information: ATCV Box 1092 South Perth 6151. Phone (08) 9474 3445. Fax. (08) 9368 2160.

Land for Wildlife

Land for Wildlife is a voluntary scheme that aims to encourage and assist private landholders in Western Australia to provide habitats for wildlife on their property. Land for Wildlife is free, there are no legal binds and there is no limitation on property size or use for registration.

Land for Wildlife offers:

- on site advice to each landholder who applies for Land for Wildlife registration
- information about other forms of assistance and incentives
- contact with like minded landholders
- regular newsletters and more detailed publications
- help to create healthy ecosystems

On full registration, the landholder receives a sign to put up on his/her property showing a numbat, knob-tailed gecko and pink rainbow plant.

Contact and further information: Land for Wildlife Coordinator (Ms Penny Hussey), Wildlife Branch, Department of Conservation and Land Management, Locked Bag 104, Bentley Delivery Centre, WA 6983. Phone (08) 9334 0530. Fax (08) 9334 0278.